4th International Conference of
UNESCO IGCP programme 481 Dating Caspian Sea Level Change
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Caspian Sea level change is a stunning phenomenon. While people along coasts elsewhere in the world are anxious about one metre of sea-level rise in the course of this century, Caspian coastal dwellers have experienced three metres of sea level rise in just twenty years at the end of the past century. And we still do not understand the causes enough to make sound predictions on future sea-level change.

In the first place this is a formidable environmental challenge for the people themselves. Along all Caspian shores the effects of this dramatic episodes can be seen: drowned villages in the Volga delta, drowned holiday resorts in Dagestan, drowned oil fields in Azerbaijan, drowned mosques along the southern Caspian coast in Iran. In Kazakhstan the giant offshore Kashagan oil field is being developed in only three metres of water depth in the extremely shallow Northern Caspian Sea: whether sea level will go down or up is of crucial importance for both industry and environment.

Caspian Sea level change is forced by influx of water from the Volga river on the input side, and by evaporation at the sea surface at the output side. Therefore, global and regional climate patterns are of paramanount importance for Caspian sea-level, but on the other hand past Caspian sea-level can help us to better understand global climate change

This is the second reason why it is important to study Caspian sea-level change.

In the third place, as the Caspian may rise a hundred times as afst as the global oceans, the Caspian is a natural laboratory for coastal response to global sea level rise. Data from the Caspian have been used to better predict the behaviour of the coast in the Netherlands, also situated below sea level.

And in the fourth place, many oil deposits, especially in the South Caspian Basin, have been formed in sediments deposited under earlier phases of rapid Caspian Sea level change, so understanding modern sedimentation in the Caspian helps us to produce hydrocarbons in a more efficient and sustainable way.

All these reasons have induced us to start an IGCP (International Geoscience Programme) sponsored by UNESCO and IUGS to study causes and effects of Caspian Sea level change. The IGCP 481 programme consists of a series of meetings, which started in 2003 in Moscow and Astrakhan (Russia), and continued in Baku (Azerbaijan) in 2004, and in Rasht (Islamic Republic of Iran) in 2005. The latter conference was a combined one with IGCP 490 Environmental Catastrophes in the Holocene, and the ICSU programme Dark Nature. The present conference in Aktau, Kazakhstan is the fourth in row, and the first along the extremely dry eastern coast of the Caspian, so we have almost finished our tour around the Caspian. The final conference is foreseen for 2007. The conference is hosted in the University of Aktau.

The goal of the conference is to bring together scientists from the different countries interested in the Caspian Sea and its potential for global change studies, and to formulate joint research programmes in order to make better predictions for the future.

We are extremely grateful to Farida Akiyanova, Vice Director of the Institute of Geography of the Academy of Sciences and her staff, for organising the conference in

such an excellent way. We are also thankful to the rector of the University of Aktau, to the Governor of Mangistau district and to all Kazakh friends for their warm hospitality.

This abstracts book unites the contribution of almost 50 scientists from all Caspian countries and several western countries, and we hope it will continue to serve as a reference text for a long time after the conference.

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THE DEVELOPMENT OF GORGAN BAY USING REMOTE SENSING DATA

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The development of Gorgan bay is directly related to the dynamics of the Caspian Sea. During sea level rise Gorgan bay is separated to several parts and appears as several islands. During sea level fall, Gorgan bay appears as a peninsula. The continuous fall of sea level would result in expanding morphological features along the shoreline. Rapid sea level fluctuation provides an opportunity for the study of coastal processes in terms of their response to sea level changes. Gorgan bay presents a wonderful small laboratory for a study of rapid sea level change. It is influenced by both land and water systems, but its evolution is directly related to sea level change. It covered 531 km^2 in March 2004. During sea level fall the dynamics of fluvial system was encroaching in Gorgan bay at the rate of 1.5km yr^{-1} and, based on satellite data, its surface decreased from more than 600 km^2 in the last shoreline to 323 km^2 in 1975. When the Caspian Sea was rising from 1977 to 2000, its surface was extended, but not to the former sea level rise. This paper aims at showing the rapid sea level fluctuation and the development of Gorgan bay using remote sensing data. The results of remote sensing data show several phases of fluctuation of the Caspian Sea by at least three high stands. Remote sensing data have been used widely in studying coastal area to detect rapid sea level change. Shoreline changes and dynamics can be investigated in details using remote sensing data. By using RSD (1955-2004), including aerial photography and satellite imagery (MSS, TM, ETM, IRS, ASTER, ASTER DEM and SRTM DATA), the coastal regions along Iranian shoreline were targeted to show rapid sea level changes and the development of Gorgan bay. All remote sensing data and topographic maps were georeferenced using both Aster images and topographic maps with a scale 1/50000 at project system TM (transverse mercator). Then, three years of satellite imagery (1975, 1987, 2004) and the old shorelines were overlaid to show the evolution of Gorgan bay.

TYPES OF COAST OF THE KAZAKHSTAN PART OF CASPIAN SEA IN CONDITIONS OF MODERN TRANSGRESSION.

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Study of types of sea coast demands a complex approach. Complexity of it increases, as coast are exposed to anthropogenous influence, intensive economic development. Research and development of hydrocarbon raw materials, region has a mediocre relation to sea coast. Development of navigation demands creation of new ports, especially, starting from the moment of large oil and gas fields evolvement. At the moment, port Aktau and port Bautino is actively maintained, construction of port " Kuryk " is conducted. In the meantime, various industrial enterprises are placed on sea coast, as shipping on water remains the cheapest way of transportation.

The coast is a strip of terrestrial surface adjoining to a coastal line, which is periodically drained or filled in and constantly experiencing the influence of changing upswash at the given sea level, inflow – falling tide and wind effected processes.

The majority of the dynamic factors, effectuated at a coastal zone, are various kinds of water movements. The most important factors for the water surface of Caspian sea are wind-driven waves and deriving from that hydrological phenomena: a ripple, upswash, wave currents. Apart from that, hydrodynamical factors such as wind effected phenomena including both short-term changes of a sea level and the currents connected to them, discharge currents, dispersion of energy of constant currents on shorelines, discharge currents of the rivers are of great value. Standing waves (seiches) and upcoming – falling tide phenomena are rarely seen on Caspian sea. At the Kazakhstan coast from delta of Volga up to Karabogaz Bay (2300км) there are several types if accumulative and abrasion coast.

A shift from regressive mode to transgression influences changes of signs of the processes occurring in a coastal zone: accumulation prevailing during regression was replaced by differently shown processes of washout, that often results in changes of morfodinamic types of coast.

On coast of low pri-Caspian from the total of 1100 km/h (including coast of gulf Komsomolec, but excluding Mertvyi Kultuk), the greatest extent has the "drained" coast of about 800 km. In 30-70 years, during falling level of Caspian sea, a gain of dry land on such coast totaled to tens of meters per year. The surface of dry lands was periodically levelled under influence of wind indused surge and wind effected waves, but in process of the further deviation of the sea, started to be processed by subaerial processes of eolion and erosive lines, and also anthropogenous way (agrotechnical actions, various construction, transport ways). Today, on most shallow coast (slope of about 0,0001) there is the passive flooding of territory, accompanied by flooding of adjoining land due to rise of a mirror of subsoil waters. Flooding, in most cases, does not cause redistribution of friable ground adjournment because of their small stock. Substantial washout of eolion tubercle, which has turned to archipelagoes of small islands, occurs only in Volgo - Uralsk interstream area, where some places of sandy file are flood. The structure of a coastal zone is not reconstructed under abrasion influence either. At aerovisual observations, channels, dams and the earth roads, which appear on shallow bottom, but have not lost their outlines through several years may be visible.

At increase in slopes, reorganization of the coastal zone becomes morphology expressed. An example of that is a clear surface of coastal bar at the east coast of Bozashy peninsula, where slopes reach 0,0015. Nowadays, it reaches a height of 0,3-1,2 m above autumn water edge (about -27 м) and is extended almost to 6 km. Width of a surface part of a bar from the first meters up to 30 m. It cuts off a lagoon that also meridionally extended, width of which lasts up to hundreds of meters. The fine-grained material goes downwards on a frontier slope, which has a steepness of 5-7º. The slope inverted to a lagoon is more abrupt, up to 30º, as the bar continues to grow on and approaches a lagoon. The lagoon grows with reeds which did not exist there 10 years ago. With the approach of the sea, gulfs including as large as Mertvyi Kultuk and Kaidak come to life again. The zone subject to wind – indused surge phenomena shifts to the deeper territories of coast. Direction and force of winds, slope of a coastal zone, and a relief of coast are factors that influence them. According to the height of a maximal wind – indused surge, Kazakhstan coast is divided into 15 areas. On some, mainly from a mouth Emba river up to Komsomolec gulf, the abnormal height of wind-indused surge can reach 2,5 m. Wind – indused surge in height up to 1 m, caused by winds with a speed of 10-15 km/h and duration from 0,5 till 2 day, is quite ordinary phenomena. Wind – indused surge waters of the sea flood significant areas, bringing material damage to the economy of a region.

There is a much more active reorganization of deltoid coastal zones. Recently r. Volga and Ural, due to the big weight of clastic material, formed the forward deltas. Mouth bars, spits, shallows at falling level turned to islands, and avandelta left following the receding sea. Kazakhstan part of Volga river delta (channel Kigach, etc.) accrued with a speed of 100-250 m / year, and Ural river delta put forward on 30-40 km during the period of 1929-78. Naturally, the newformed territories have been quickly accustomed to. As a result of rise in a background sea level, washout of the Caspian deltas began, strengthened by influence of hydraulic engineering actions in valleys. Flooding of low deltoid coast, abrasion of delta islands has begun. In the east of delta of Volga river such islands - "oseredki" have disappeared or considerably decreased in sizes. In a mouth of Ural river a circuit of islands Peshnye, which in the peak of regression turned to peninsula, were separated again and there was practically one island above water. Underwater and surface bars – “shalygi" are intensively washed away.

A reorganization of a coast on the area of Emba river is slightly different. Its delta was essentially continental and only small channels of part-time water-currents reached the sea. The sea of a modern background level once again approaches the advanced edge of deltoid plain, and during time of spring wind – indused surge appears a back water, which adds to areal accumulation of alluvial-deltoid adjournment. On steep sites of Mangyshlak coast, shift from regressive mode to transgression substantially influenced the development of abrasion coast. In process of growth of a sea level, cliffs come to life, there is a destruction of beaches, of low modern terraces, of coastal shaft and of lagoon bars. Abrasion coast with the earlier dead cliff, become actively exposed to abrasion again at northern and southern coast of Tubkaragan peninsula, at coast of the Kazakh gulf and on the majority of sites, adjoining to forward capes in the sea. Abrasion - accumulative and even accumulative beach coast where terrace surfaces of 40s were flooded, experience reorganization of a underwater slope. There is a frontier washout of coastal accumulative forms with the creation of new bars and coastal shafts due to uphill shift of a material.

APPLICATION OF GIS-TECHNOLOGIES IN STUDY OF EXOGENOUS

RELIEF FORMATION PROCESSES

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The problem of mapping of exogenous relief forming processes, considered to be one of the most important tasks of modern geomorphology. Along with the traditional methods of mapping study, in the last decade there is a new GIS-technologies method have been developed. Possessing the broadest opportunities of generating, storage, structural organization, visualization, updating of data, in the meantime, it, along with the natural observations and laboratory definitions, is the most perspective method in study of exogenous processes.

Area of research is Kazakhstan coast and shallow shelf of the Caspian sea. The study of the area distribution and estimation of degree of development of exogenous processes in that area was carried out with the application of programs like: ArcView 3.2a., WinChips and some of the modules of ArcInfo 8.2a.

In projections of Gauss-Kruger and UTM binding of topographical basis of different scales (1000000, 500000, 200 000, 100 000) on all Kazakhstan coast and shallow shelf of Caspian Sea were made.

The geographical binding of pictures taken from the space was made in ArcView 3.2a., WinChips. Further by the method of trained classification automatic decoding of digital multi-channel space pictures occurring at different time was carried out: “Landsat 7” (1982; April, May 2000, August 2000.), “Resource” (July 1998., August 1999.), “Aster” (26 pictures year 2000 and 2001.).

Automatic decoding was supplemented and corrected by the method of visual decoding on the background of raster and vector layers of a topographical basis, geomorphology, geological and hydro-geological maps. Furthermore, the analysis of the received data occurring at different time was made, which at overlapping allowed to determine dynamics of development of a particular exogenous processes.

However, the study and mapping was conducted not only on general nature-anthropogenous processes which form a modern shape of the basic types of a relief, but also, locally shown processes representing certain risk for the population and economic objects. The processes of flooding, abrasion, karst, mud-flow, landslips, collapses and others which develop in areas of settlement, economic development and may result in destruction and human victims.

For the regional analysis in the research of influence of substances of oil-gas branch on exogenous relief forming processes and pollution of natural environment of Caspian Sea region most significant were digital summer pictures “Landsat” and “Resource”, for the local research multi-channel digital pictures “Landsat” and “Aster” were used. The presence of digital pictures occurring at different time on territory of Kazakhstan of Caspian Sea shore, automatic decoding of them and application of a package “Image Analyst” and “Spatial Analyst” of ArcView 3.2a., has allowed to carry out the comparative analysis of changes in areas of development of the basic types of a relief, hence, apply it to the processes of relief forming.

For example, now in the field of low Caspian Sea shore the longest extent have “soil drainage” of a coast (slope 0.0005). During last regressive cycle (1929-

1977) gain in dry on summed up to tens meters per year. Levelling of a surface soil drainage wind-induced surge by the phenomena, processing eolian and erosive processes and anthropogenous development has changed an external shape of this territory. Since 1978 there is a return process-flooding “soil drainage” of coast. On adjacent areas at increase of a mirror of earth waters the processes backwater, silting and salty soils develop. Aerial observations testify that passivity of transformation of a relief in zones of a shallow flooding. Only on Volga-Ural interstream areas occurs appreciable having washed away eolian of the forms transformed into archipelagoes of small islands.

There is a reorganization of delta cost more actively. In last regressive period Kazakhstan part of delta of Volga (r. Kigath and to the east) accrues up to 100-250 meters per year, delta of Ural in the period of 1929-1978 was up to 30-40 kilometers[1]. In connection with background rise of a sea level flooding of low sites of deltas o Volga and Ural, abrasion delting of islands and intensive having washed away bars. The sea has approached to advanced front of delta r. Emba, former before continental.

Processing and analysis of a new cartographical materials and interpretation of space pictures occurring at different time have allowed to discover changes in development of the basic types of a relief and dated to them exogenous processes in view of character and degree of anthropogenous intervention, and also influence modern transgression of the Caspian Sea.

The most significant transformation for the last 25 years have tested low sea accumulative of plain Northern Caspian Sea. It mainly flat, in some places half-divided plains advanced from a modern coastal line (a sea level –27m) on the average up to absolute marks in 50m[2]. The whole area of their development starting from 1982 has decreased by 33.6% by 1998.

Exogenous processes of coast are closely connected to wind effected phenomena. The maximum importance of phenomena (up to 2.5m) are observed at east low coast. At them being flooded a strip of plains of width up to 15-30 km. This phenomena raise a level of earth waters and essentially influence the development of a relief of shallow coasts [3]. The comparative analysis of space pictures for spring (April 27) and summer (August 1) period 2000 has shown, that there are rather significant changes in a coastal zone of delta of Ural region. Especially, they concern gulfs at low sea coast, where in time of wind induced surge the sea on significant distances take over lad, and during the opposite acts inversely. On a map it is clearly visible, that in April the sea takes root on 4.3 km deep into of land in area Gogol of channel (east boarder of delta of Ural), and in August- being flooded western boarder in area of a mouth Black river. And the flooding is accompanied floating, i.e., the areas of grounds with risk of degradation under influence of these processes are increased.

Modern transgression has rendered appreciable influence on abrasion and abrasion-accumulative types of shores of Mangyshlak, testing reorganization in a coastal and underwater part of a slope. The formation new accumulative of the forms is observed having washed away bars, beaches, coastal shaft and modern low sea terraces. On northern and southern coast of a peninsula Tupkaragan, coast of the Kazakh gulf dead cliffs relives earlier. For last 10 years extent of abrasion areas in Aktau-Ozen of a site has increased from 8 up to 13%.

The erosive processes as a whole are made active during a spring high water. In valleys of the rivers of Volga, Ural, Emba, Sagiza the processes of lateral erosion amplify, there is an accumulation of deposits on flood-plain and deltas of the rivers.

Within the limits of temporary waterstreams of a peninsula Mangyshlak there is a growth and deepening of gulch net, and increase of volumes of spread of cones. The linear erosion is shown and on the flat areas, where even the rather small roughnesses can result in formation of a network temporary waterstreams. The local bases of erosion with the small areas of water collecting can have karst-suffosion or deflation an origin. The traces of mechanical transport promote amplification of linear erosion which coinciding with yk-bosoms of a surface, after some years turn into a gully.

On slopes, steepness more than 30-35^{o} , the processes of water erosion proceed together with gravitational. On slopes, steepness till 12-15 Ë, at presence of the certain hydro-geological conditions, alongside with water erosion, develop landslide processes. On sites, where on limestone adjournment neogen, there is no layer quarter of adjournment, the water erosion promotes development of processes carst Within the limits of slopes large sor of downturn, is especial on east slopes Karagie, in places of outputs with water of horizons, the development carst-erosian of valleys is observed.

The territories of sea plains, sandy sea and river coastal shaft, ground of easy mechanical structure on accumulation alluvial-delta plains, plump solonchaks are subject to process deflation. But the greatest areas deflation are connected to anthropogenous influence, by which first of all it is necessary to attribute the thrown grounds, territories of the occupied items and transport highways. The analysis of the diagram of the areas testifies also to it as development of processes on which as a whole deflation 20,6 % of territory Aktau-Ozen of a site, it in the basic surface of denudation plains, eolian files and territories of anthropogenous influence is subject.

The essential influence on activization of processes backwater, salty soils, development of gully is rendered with economic activity. Technogenic loading in limits oil-gas of deposits creates changed and technogenic-formed breeds and forms of a relief. In limits of oil and gas deposits observe of slow immersing a surface with development new solonchaks, urgent there is a question of the induced seismic activity. As a result of development of oil and gas deposits on a shelf Northeast Caspian Sea there are sites new, technogenic of a relief as berms and artificial islands, which can essentially affect of exogenous relief forming processes. At active development of stocks on deposits of a shelf Northern Caspian Sea here will be construction archipelago of islands, that can result at the end in transformation of a relief and possible risk of development of dangerous processes. The application of GIS-modeling will help considerably to lower the specified risks.

Thus application of modern geoinformation systems allows to lift on a qualitatively new level study and mapping of exogenous relief forming processes. With the help of GIS-technologies the development of scientific bases and decision of applied tasks of sciences on the Earth in global, regional and local levels is possible.

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HOW CHANGING OF THE CASPIAN SEA LEVEL MAKES INFLUENCE ON BIODIVERSITY OF FISHES AND FREE-LIVING AQUATIC INVERTEBRATES

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Famous Russian scientist Acad. A. Alimov put forward hypothesis that lake's biodiversity should reflect changes in level and surface area (Alimov, 2006). We decided to check his hypotesis using available data for the Caspian Sea at its present stage and in its paleo-history. We analyzed the following periods: Balakhan (5 millions years B.P., 144000 km2), Akchagyl (3 millions years B.P., 968900 km2), Post-Akchagyl (more than 2 millions years B.P., 246000 km2), Apsheron (2 millions years B.P., 835000 km2), Tjurkian (up to 2 millions years B.P., 208000 km2), Bakuvian (1.7 millions years B.P., 750000 km2), Venedian (500 thousands years B.P., 336000 km2), Low Hazarian (400 thousands years B.P., 788000 km2), Upper Hazarian (200 thousands years B.P., 710000 km2), Atelian (more than 50 thousands years B.P., 282500 km2), Low Hvalynian (50 thousands years B.P., 872000 km2), Enotaevsk time (22 thousands years B.P., 288000 km2), Mangyshlak time (7.5 thousands years B.P., 358000 km2), New-Caspian (5 thousands years B.P., 437000 km2) and recent (371000 km2). Our analysis showed that during transgressions number of fishes and free-living aquatic invertebrates are going higher, while during regressions its number is going lower. Salinity change throughout Caspian Sea paleo-history also is studied by us. For paleo-salinity reconstructions we used data based on mussels (Starobogatov, 1994) and ostracods (Aladin, Plotnikov, 2000). Some other issues related to biodiversity of the Caspian Sea and its level change are discussed.

CLIMATIC CONTROL FOR THE SEDIMENTATION IN CLOSED BASINS (FROM THE EXAMPLE OF PLIOCENE CASPIAN SEA SUCCESSION)

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A 7 km thick Lower Pliocene sedimentary succession (Productive Series) consisting of rhythmically bedded fluvial- deltaic sediments of several large river systems was deposited in the land-locked South Caspian basin as a result of interaction between fluvial and lake processes. The main goal of this research was to evaluate the effects of climatic controls on rapid Pliocene Caspian Sea level fluctuations and depositional environments.

Detailed sedimentary analyses in the Kirmaki Valley (Absheron peninsula, Azerbaijan) pipeline trench and high resolution time series geochemical analyses of carbon and oxygen isotopes and elemental ratios (Mg/Ca and Sr/Ca) in ostracodes, sulfur isotopes in sedimentary gypsum deposits, along with radiometric, palynological and bulk sediment trace elements determinations demonstrated a close correlation between climatic variations in Lower Pliocene and Productive Series facies variability. These integrated efforts provided a quantitative understanding of sedimentary processes in isolated basins under climatically-induced sea level fluctuations. A detailed sedimentological and gamma log analyses of a new pipeline trench in the Kirmaki Valley targeted on recognized shifts in depositional environments was accompanied by a high resolution stratigraphic sampling and biostratigraphic, palynological analyses. Carbon and oxygen isotope and microprobe analyses were performed on ~50-100 microgram samples of the ostracode shells isolated from the succession as well sulfur isotope analysis was performed on disseminated and bed evaporates. The ostracods shells for isotopes determination were selected after elemental abundance and the rejection of contaminated specimens. For comparison, we have additionally analyzed modern ostracodes (Cyprideis littoralis) separated from recent sediments in the Kura River delta in the South Caspian Sea. These shells are characterized by precisely detected environmental parameters as salinity, depth of the sea water, temperature, and have been used as typical end members in our interpretations.

The study of recent Caspian Sea ostracodes (Cyprideis littoralis) supports the view that there is a correlation between temperature and oxygen isotopes, Ca/Mg and Sr/Ca ratios. These relationships underpin the use of Ca/Mg and/or Sr/Ca thermometry with O isotopes measurements for past temperature calibrations. Our experience also shows that Sr/Ca compositional differences of the different ostracodes is quite sensitive to the salinity changes, and is accepted as a reliable proxy for paleosalinity reconstructions. The low numbers of microfauna typical of this fluvial - lacustrine succession suggests a highly stressed ecological system, which is consistent with the general lack of ichnofossils in Productive Series. Nonetheless, we recognize a good correlation between depositional environment and microfaunal growth. For example, large, well-developed shells (from the same species of ostracodes), but in low numbers not exceeding 1-3 valves per sample, were found in sediments accumulated in fluvial channels. Shale horizons considered to be deposited in flood plain/delta plain setting are characterized by limited numbers of stressed ostracodes. These are small in size and thin-walled. The most well developed ostracodes within Productive Series are confined to deltaic deposits. Here ostracodes reach their peak in the number of genera and species, but size of shells is smaller than that of the shells separated from fluvial sands. The assemblage of ostracodes in the upper portion of the Productive Series differs from those in the lower portion. The assemblage changes again in the transition to the uppermost Surakhany suite, which is consistent with sedimentologic evidence for exposure. The extinction of foraminifera in the Surakhany suites is presumed to have been the result of progressive retrogradation of the paleoVolga River delta to the north, and establishment, in the Apsheron peninsula and adjacent area, of a vast brackish lake.

Results of geochemical analyses of Productive Series ostracodes reveal significant ranges and sample-to-sample variability. For example, oxygen isotope compositions of ostracode shells range from -2 to -12‰ while those of carbon isotopes range from -0.5 to -7.5‰. Instead the sample-to-sample variability might be interpreted as the result of cyclic changes in environment or to diagenetic alteration. Similar sample-to-sample variations are recorded in both Ca/Mg (ranging overall from 2 to 20) and Sr/Ca (ranging overall from 1 to 8). The end member **18O** compositions in Productive Series ostracodes (maximally 3‰ different) indicate that temperature variations between the warmest and coldest stages did not exceed 10oC. It is notable the small 13C variations (2,5 ‰ different for the most samples) that is, probably, an evidence for low salinity changes proved by C isotopes in the test modern Caspian shells varying in 1,6‰ limits on the background of relatively stable salinity. Salinity as an environmental stress during deposition of the lower Productive Series has previously been accepted as the primary factor, however we note that there are considerably fewer sulfates in this part of the Pliocene succession. The few gypsum samples from these beds are significantly less 34S enriched than samples from the open marine environment (ranging between +3 and +11‰). The most samples display isotopic characteristic similar to modern Volga river delta. A significant 34S enrichment is seen in the few available samples from the overlying NKG beds which is consistent with 34S of recent Caspian sediments. Gypsum is far more abundant in the Balakhany, Sabunchi, and Surakhany intervals suggesting considerably greater salinity in the depositional basin at this time. Measurements from these exposures reveal a progressive decrease in **34S** values, although the extremely depleted 34S compositions in the Surakhany samples may testifying to epigenetic genesis of sulphates from this interval. We do not have data indicated to hyperarid climate in NKG Suite and other intervals where desiccation cracks have been recorded. We assume that climate in these phases was close to recent climate in the investigated area That is also confirmed by data on chemical indexes and oxygen isotopes we got on other genera of ostracods- Leptocythere. The overall 13C depletion in the shells, probably, is also an evidence that stress could be caused by high content of gases (CO_2 and or CH_4) in the depositional basin related to increased mud volcanoes activity.

The overall variability of geochemical parameters in ostracode shells may be recording climatic and environmental variability in the Caspian Sea region during deposition of the Productive Series resulted in PalaeoCaspian Sea level fluctuations affecting temporal facies distribution and facial shifts in the range of fluvial-lake environment. The proximal setting dominated in the cool periods (Ca/Mg ratio is 35-40). Here we also recorded the lowest Sr/Ca ratios. The distal prodeltaic - lacustrine environment established in warm humid phases (average Ca/Mg is 95). We can report tens of climatically controlled short term depositional cycles occurred during Productive Series sedimentation. Consistently with these data we can assume that progradation of the PaleoVolga delta was caused by increased precipitation in the catchment area causing high water and sediment budget driving this river system, but the shifts to distal facies occurred because of the PaleoCaspian lake rise in warm humid stages, that could dominate over sediment supply control. We also suppose that tectonic control also played an important role. For the example, a sharp progradation of the PaleoVolga delta in the base of Pereriva Suite on the background of rising lake level in the uppers of underlying NKG Suite could reflect a rapid tectonically forced lake level drop.

MODERN ENVIRONMENTAL PROBLEMS OF THE CASPIAN POOL

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Caspian sea washes coasts of five independent states: Russia, Kazakhstan, Azerbaijan, Iran and Turkmenistan and also serves as a link between continents of Europe and Asia. The nature of Caspian sea has been attracting attention of many scientific travelers and statesmen for a long period of time. Development of resources of this water area had an important economic value to national economies of the Caspian states and surrounding countries.

Scientists of antiquity, ancient and middle ages have devoted their works to Caspian sea: Herodotus, Homer, Aristotle, Hekatey Miletskiy, Eratosthenes, Strabon, Al-Masudi, Ibn Fakikh, Istakhri, Ibn Rusta, Biruni, Marco Polo, Jenkinson. The most important data on Caspian sea has been received as a result of researches of Russian and Soviet scientists, starting with the time of Peter the Great: A.Bekovich-Cherkassky, I.V.Tokmacheva, M.I.Voinovich, N.N.Muravjeva, Charles Baire, G.S.Karelin, E.N.Alikhanova, A.H.Kasymov and many other researchers.

Caspian sea is a unique creation of nature, which brought us a relic flora and fauna, including world herd of sturgeon fishes that used to provide more than 80 percent of its trade extraction. Also, the sea is an important factor to climate formation of air in all Caspian region, as it considerably softens the climate.

However, because of the intensified actions of the person, Caspian sea became a hostage of the industry lately. The intensification of an oil and gas extraction both on continent and on shelf, enterprises of hard chemistry, manufacture of aluminium, and extraction of sulphur containing oil brought numbers of serious environmental problems to the region.

Caspian sea is a final pool of a drain for set of anthropogenous components. Annually, multi-ton rests of heavy metals, oil products, and biogenic dirt are thrown in deltas of the rivers of Volga, Ural, Terek, Sulak, and Kura. Today, Caspian sea is turning into the sewer receiver. Multi-million crude drains are being directed to the sea in the areas of Baku, Sumgait, Makhachkala, Astrakhan, Atyrau, Aktau, Tengiz. It consists of mercury, phenol, sulfur, heavy metals.

This phenomenon strongly influences the environment of the region, and negatively affects bioresources, ichthyofauna, and the sea. There has been an enormous amount of keys drilled during many years on the coastal zones, which are flooded and flooding, on the territory of Atyrau, Mangystau areas of Kazakhstan, Azerbaijan, Turkmenistan. Their exact number is unknown, but any of them may cause irreversible consequences: emission of crude oil, underground salty waters and brines in water area.

It is difficult to monitor environmental damage of Caspian sea, but taking into consideration huge territories, rich biological and a mineral raw material resources of Caspian sea, it is necessary to draw a conclusion; economic and environmental consequences of possible catastrophe will exceed the catastrophe of Aral sea by many times.

In later years, new problems have appeared, such as geopolitical- Caspian sea becomes a crisis zone. Expected large stocks of oil in the Caspian shelf become the reason of sharp contradiction between many countries. For example, uncertainty of the status of Caspian sea brings misbalance even during scientific integration - various states have various interests in defining the status of the sea. By now, scientists and politicians of Caspian area have gathered many times in order to put their efforts together in solving the Caspian problem. However, perhaps, they arrive sooner than the movement of this process of necessary unity of efforts. Although there is no doubt in necessity of creation of uniform coordination center- International institute of the Caspian pool.

The idea of a uniform interstate, institute of Caspian sea has been open for a long time, and it is quite probable that if all interested states found means to support it, there would not be problems with defining the direction of its work.

We recommend to unite scientific researches in a coherent plan on the Interstate basis. We hope that the idea of creation of the International institute of the Caspian pool and conducting teamwork will be supported by managers and scientists of the countries of Caspian Area, ecologists of the world headed by the United Nations Organization and UNESCO. Caspian sea should become the sea of our hopes, the sea of the consent, uniting people of this vast region.

FULL DEPOSITIONAL CYCLES AND FE/MN RATIO IN MARINE UPPER BAKU REGIOSTAGE SUCCESSION IN THE WESTERN FLANK OF THE SOUTH CASPIAN DEPRESSION

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The results of the field works on exposures of the Lower Pleistocene deposits located in the Western flank of the South Caspian depression (Shikhovo outcrop) demonstrated the high-frequency cyclicity in sedimentation accompanied by rapid lateral and vertical depositional environment change. It is possible to observe several full depositional sequences developed from high stand system tract to low stand system tract and transgressive system tract. Return to sedimentation under conditions of sea level high stand marks beginning of the next depositional cycle. The depositional setting during accumulation of this succession has changed within shore face-shelf environment.

On the background of these cycles, the depositional series of higher order containing sediments formed during very small-scale sea level fall and rise occur. Below I give the lithofacial characteristics of one full depositional cycle and our interpretation of depositional environment during its sedimentation.

Bedset I is subdivided into 10 interbeds with total thickness 2m70cm. Lithologically represented by alternation of sand, sandstone, sandy organogenic limestone, organogenic limestone and shelly sandstone. We consider these series as high stand system tract.

Bedset II is the massive and homogeneous, thickness 1m10cm. Lithologically represented by organogenic limestones. We consider these series as low stand system tract.

Bedset III is subdivided into 7 interbeds with total thickness 1m5cm. Lithologically represented by alternation of sand, sandstone, sandy organogenic limestone, organogenic limestone and shelly sandstone. We consider these series as high stand system tract.

Bedset IV is the massive and homogeneous, thickness 2m. Lithologically represented by organogenic limestones. We consider these series as low stand system tract.

Bedset V is subdivided into 13 interbeds with total thickness 4m30cm. Lithologically represented by alternation of sand, sandstone, sandy organogenic limestone and shelly sandstone. We consider these series as transgressive system tract.

Bedset VI is subdivided into 12 interbeds with total thickness 2m78cm. Lithologically represented by alternation of muddy sandstones sand, sandstone, sandy organogenic limestone and shelly sandstone. We consider these series as high stand system tract.

I also carried out the faunal analysis, which displays an insignificant presence of mollusk fauna mainly represented by Didacna and Dreissensia and mostly developed in the organogenic limestones. However our studies demonstrated the abundance of Ostracoda shells represented by genera Tracheleberis, Loxoconcha, Leptocythere, Cyprideis, Cythereis, Xestoleberis, Candona, Caspiocypris, Mediocytherideis, Caspiella and e.t.c.

The quantitative changes of ostracoda composition for each interbed depending on paleosalinity fluctuation, in detail point out the tendency of increasing and decreasing of Fe/Mn ratio in shells as indicator of paleosalinity. Carried out biogeochemical analyses also have shown, that amount of the studied elements, including Fe and Mn considerably vary in a section, which reflect the change in depositional setting during accumulation of sediments.

THE ARAL SEA LEVEL VARIABILITY FROM THE ATMOSPHERIC POINT OF VIEW

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The Aral Sea has recently undergone a large variability of its sea level. Since the middle of the last century a steady decrease has been observed. Most of this is assumed to be human made due to increased diversion of water from the rivers Amu-Darya and Syr-Darya for irrigation. Using observed precipitation data and model simulations it is shown that there were not any atmospheric changes which could have lead to this sea level drop. The year by year variability of the precipitation gets a large contribution from the summer precipitation. The observed variability of the precipitation is reproduced by simulations with the ECHAM4 atmospheric model, which is forced with observed sea surface temperatures. This suggests that the sea surface temperatures play an important role for the precipitation variability over the Aral Sea catchment area. It is further shown that far reaching teleconnections are closely connected to the variability of the river discharges, or better to the variability of the precipitation over the catchment areas of the rivers. When there is more precipitation over the catchment of the Aral Sea in summer then there is less precipitation south of the Hindukush, i.e. over the catchment of the Indus river. This is connected with an anomalous upper air cyclonic circulation in the upper troposphere, resulting in a reduced wind speed of the central subtropical jet and widening it to the south. With less precipitation the opposite can be found. There is also a very strong connection between the precipitation over the Aral Sea catchment area and the El Nino / southern oscillation (ENSO). When the tropical eastern Pacific is warmer, there is more precipitation over the Aral Sea catchment area.

Recently it has been shown that also the sea level changes of the Caspian Sea (or variations of the precipitation over the Volga River) have a significant influence from ENSO. However, the forcing factors for the Aral Sea are much easier and straight forward to show. Although both seas show impacts from ENSO there are hardly any relations between themselves.

Simulations with the ECHAM models show teleconnections like the ones observed. Especially the coupled atmosphere-ocean model, ECHAM5-OM, reproduces very well the connection with the Indian Monsoon and ENSO. Using this model for predicting the impacts of increased greenhouse gases on the climate, one finds no trend in the precipitation amount for the 21st century over the entire Aral Sea catchment area. Some reduction for the Amu-Darya in the later 21st century are found which are compensated by increases in other areas of the Aral Sea catchment area.

RAPID LANDSCAPE CHANGE AND IMPLICATIONS FOR SUSTAINABILITY: THE CASPIAN SEA AS GLOBAL MODEL

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Beneath the heavy human footprint of industry, agriculture, climate change and urbanization, natural processes continue to operate as they have throughout geological time. Around the globe, the morphology and physio-chemical composition of landscapes can change, for example channel switches in rivers, erosion and deposition along coastlines, slope failure in mountains, and dune migration in deserts. Such phenomena are familiar to local residents, for they can occur on a human time scale - decades, years, days, or less. The geoindicator approach to tracking rapid landscape change (www.geoindicator.org) is one way to group together abiotic changes to landscapes and to systematize them for use in assessing the condition of terrestrial environments. Geoindicators are being now used in managing national parks and protected areas, in tracking the environmental effects of mining and quarrying, and in state-of-the-environment reporting. The marked changes in the coastal areas of the Caspian Sea demonstrate clearly the social, medical, economic and ecosystem importance of rapid natural change. Variations in level and in the position of the shoreline must, presumably, be taken into account in determining management and legal regimes among the five bordering nations. Since landscapes such as the Caspian littoral, low-lying oceanic islands and circum-Polar regions are subject to significant changes from time to time, whether entirely natural or human-induced, it is hard to see how continuity of society and infrastructure can be maintained indefinitely. Recognizing the autonomy of natural processes challenges notions of sustainability, to the extent that this may turn out to be fundamentally unattainable.

TAXONOMY AND PHYLOGENY OF ENDEMIC CASPIAN FISHES OF THE GENUS BENTHOPHILUS THROUGH THE HISTORY OF EASTERN PARATETHYS

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Many groups of aquatic organisms including crustaceans, molluscs and fishes have radiated in the Ponto-Caspian biogeographical region. Among fishes, clupeids and gobiids are particularly diverse, with separate radiations of Clupeonella, Alosa (Caspialosa), neogobiins and benthophilins. The objective of the study was to revise the taxonomy of species of Ponto-Caspian genus Benthophilus (Gobiidae). A number of new characters are used along with the traditional ones. The data support the recognition of 20 species and one more still doubtful taxon which can be devided into four species groups. Species of the presumably ancestral group occur only in the Caspian Sea, with four species from five having comparatively limited geographical distribution in Central Caspian at depths up to 200 m (B. leptorhynchus, B. svetovidovi, B. grimmi, B. kessleri) with preferring water salinity of 10-13.5‰. The second group is the only one distributed now out of the Caspian Sea and adopted to highly freshened or pure fresh waters. Three Caspian species display undoubted phenotypic affinity to the species from the Pontic basin - B. mahmudbejovi and B. durrelli, B. аbdurahmanovi and B. magistri, B. leobergius and B. stellatus. Benthophilus nudus from the Black Sea is also close to the latter pair. Species of the third and fourth groups also include species only distributed in the Caspian Sea and clearly confined to deeper waters (30-300 m) of the Central and South Caspian. These data give reasons to examine two opposing models, the origin of species via late Miocene vicariance events for the Pontic/Caspian lineages vs. late Pliocene through Holocene dispersal events lineages for the Pontic basin. However both hypotheses suggest that the extant high diversity of endemic Caspian Benthophius species reflects the continuity of their fauna since late Miocene-Pliocene and a complex process of speciation to specific conditions of a "brackish water sea". The study is supported by a RFBR grant No 05-04-49218.

HISTORY AND SCIENTIFIC RESULTS OF THE CASPIAN EXPEDITION IN 1904 HEADED BY NIKOLAY M. KNIPOVICH

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Within the frames of a study on Eurasian freshwater fishes and preparing Identification Keys of the Caspian Sea fishes (the programme "Biological Resources" of Russian Academy of Sciences)it became evident that a revision of many historically important collections is needed especially with regard to nomenclature of the taxa. Materials of a number of expeditions are deposited in Zoological Institute, St. Petersburg, in particular, those from the Caspian Expedition organized and headed by N.M. Knopovich in 1904 which is sketched in this presentation. This expedition had a great influence upon investigations of the Caspian Sea dividing them into two periods, "before Knipovich and after him", according to Svetovidov. We specifically emphasize those achievements of the expedition that resulted from new methods used for collecting and for scientific analysis of materials and data collected. Discussed is the important contribution to the knowledge on the Caspian Sea biodiversity, in particular, discovered (and later described) new taxa. We show the specificity of activities and contribution endowment of each participant of the expedition. The itineraries analyzed in details with special regard to data on localities of all historically important findings. The taxonomic composition of the Caspian fish fauna is reviewed and the necessity of investigations of poorly known taxa is founded. Underlined is the continuity of all subsequent explorations of the Caspian Sea.

POLLEN DATA APPLIED TO PROGNOSTIC MODEL AIMED AT FUTURE ENVIRONMENTAL CHANGE PREDICTION IN THE CASPIAN REGION

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A search for palaeo-analogue of the modern interglacial stage and detailed reconstructions of changes in vegetation and climate during that interval constitute an essential part in development of prognostic model of future environmental changes in any chosen region.

In search of the closest palaeogeographic analogue of the modern interglacial, we compared floristic, phytocoenotic and climatic successions reconstructed from palynological data on the most comprehensive sections of Neopleistocene on the East European Plain.

By comparative analysis of paleoenvironmental reconstructions based on studies of the exceedingly complete geological sequence exposed in the section near the Otkaznoe Village (44 20 N and 43 50 E, middle reaches of the Kuma R., the modern grass steppe zone), two large cycles have been distinguished in the vegetation and climate changes during the Neopleistocene. Using the data obtained from of palynological, palaeopedologic, palaeofaunistic and palaeomagnetic studies of a 140-metre loess-palaeosol sequence of Pleistocene deposits, we reconstructed the climates and environments for all interglacials and cold periods of the Brunhes chronozone (Bolikhovskaya, 1995, 2005).

The detailed comparative analysis of the reconstructed climatic and palaeo-phytocoenotic successions has shown that every interglacial or glacial period within the interval between the Pokrovka cooling (MIS 20) to the Likhvin Interglacial has its younger analog (that is an epoch similar to it in all the essential palaeogeographic characteristics) within the interval from the Kaluga cooling (MIS 10) to the Holocene (MIS 1). The features of similarity include zonal belonging of the dominant vegetation; degree of climate aridization (or moistening) in comparison with of the cold or warm stages within the considered interval; expansion of ice sheets in the correlatable cold period, etc.

The modern interglacial (MIS 1) makes a distinct parallel to the Likhvin Interglacial which in turn correlates with marine isotope stage 11 (MIS 11). Both Likhvin and Holocene sediments were deposited here in environments dominated by of forest-steppe and steppe. It is in the Likhvin Interglacial only that a typical steppe phase dominated by grass steppe has been recorded in the Middle Kuma region. Such steppes constitute a characteristic element of Holocene landscapes, except that Likhvinian dendroflora found in the Otkaznoe section included some relict and thermophilic taxa (Picea sect. Omorica, Pinus sect. Strobus, Betula sect. Costatae, Juglans regia, Ostrya sp. etc.); those trees occurred presumably in small patches of forests.

The conclusion about the Likhvin (Holstein) interglacial being a palaeogeographic analogue of the Holocene is in good agreement with data obtained recently from other regions and natural objects. Many authors note a certain resemblance in orbital parameters, global climate, regional climatic regimes and other palaeogeographic characteristics of the two warm epochs corresponding to MIS 11 and MIS 1 (Bauch et al., 2000; Hodell et al., 2000; McManus and Jerry, 2004; etc.).

To determine age and duration of the reconstructed warm and cold stages, the author in collaboration with Prof. A.N.Molodkov (Lab. of Geochronology, Institute of Geology, Tallinn) made a comparison of palaeoclimatic events reconstructed in extra-glacial and glacial-periglacial zones on the East European Plain with warm climatic events based on ESR-dated skeletal remains of subfossil mollusks recovered from transgressive marine deposits of the palaeo-shelf zone of Northern Eurasia (Bolikhovskaya, Molodkov, 1999) and with oxygen isotope stages (Bassinot et al., 1994).

A comparison between cycles recognized in the climatic and floristic changes through the last million years on one hand and data on age and duration of the interglacial and glacial events on the other permits to estimate an individual cycle at about 450,000 years. Such was duration of the cycle spanning Pokrovka cooling → Likhvin Interglacial. The performed correlations lead us to the conclusion that the Holocene may be as long as its analogue – the Likhvin Interglacial, that is ~95 thousand years. The total length of the "Kaluga cooling → recent interglacial" cycle may be tentatively estimated at about 450 thousand years.

The detailed characteristic of vegetation and climate development during Likhvin interglacial will be considered in this paper as analog model of their changes in previous and future stages of the modern interglacial epoch.

EXTRAORDINARY RATE OF KHVALYN TRANSGRESSION: HUGE FLOODINGS, SEA LEVEL OSCILLATIONS, COASTLINE MIGRATION, INFLUENCE TO CIVILIZATION

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Khvalynean transgression appears to be not common Caspian Pleistocene transgression, but this hydrological event was exceptional in the Caspian history.

1. The exceptional high sea level +48 +50 m asl, the highest sea level among Pleistocene Caspian basins, which was reached 17-15 ka BP. This level was just 80 m higher than recent Caspian and just 200 m higher than previous Atelian basin level (-120-140 m asl).

2. Huge area of Khvalynean basin: it was the biggest Pleistocene basin in Caspian depression. Its water covered near 1 000 000 sq km: 3 times more than recent Caspian and 6 times more than previous Atelian basin. Total flooded terrestrial area of joined Aral and Caspian basin reached up to one million sq km.

3. Relatively short time of this basin existence (near 5-6 ka), taking in amount time span of this transgression from 16-17 ka to 10-11 ka.

4. Very quick sea level rising in the pick of transgression: during ~100 years sea level rose on 200 m with rate 2 meters a year. It is 10 times more than recent catastrophic Caspian level rise in the last 20 years of XX century.

5. Very fast sea level oscillations: 10 oscillations during 5-6 ka, so 500-600 years cyclicity. Rate of vertical sea level changes reached 50-60 m. This dynamics of Khvalynean basin will be demonstrate by multimedia animation.

6. Sea level oscillations caused great coastline migrations especially on the flat planes of the North Caspian lowland where coastline replaced northward 400-500 km with rate 4-5 km a year. Volga mouth replaced much more - 2000 km with rate 20 km a year (50 m a day)

7. Khvalynean sea oscillations have mainly climatic origin and related to deglaciation phase of Valday Ice Age, accompanied by 500-600 years cyclic climatic oscillations. This climatic changes can be correlated with the Khvalynean sea level oscillations.

8. So, quick sea level changes and large scale coast migrations provocated hazards for ancient people, but multiple repeating of these stress situations leaded to elaboration of human adaptation. For avoid of negative situations it was necessary to improve transport possibilities. Indicators of the first productive economy in Caspian Region are the oldest in the world horse domestication and the first sailing (rock paintings of ships in Gobustan). Some authors suggest relation of Khvalynean transgression to events of Noah's Flood (Leonov et al 2002, Chepalyga 2004-2005)

KARSTIC AND SUFFOSIVE PROCESSES OF MANGYSTAU PENINSULA COASTAL ZONE

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The karst of Mangyshlak and Ustyurt is relatively well-known as a result of number of publications and a special research of G.M.Potapova.

The following conditions are necessary for development of a karst: soluble rocks, their water penetration, presence of water, its dissolving ability, an opportunity of circulation and unloading of liquids and gases.

Practically everywhere in the field of raised coast, from northwest Ustyurt chinks up to ledges of Kendirly-Kayasan plateau, carbonate breeds have evolved, which to some extent are seized by processes of a karst. Mainly it is shelly and oolitic limestones Sarmatian, meotic and pontian circles of Neogen, strengthening surface of a plateau and in some places having total capacity up to 100м.

In coastal ledges of a plateau there are various karstic, karstic-abrasive and karstic-erosive forms. Formation of caves is connected to destructive activity of sea waves and an accompanying role of a karst, microforms of a karst on ceilings and walls of caves and also dripping and flowing down of water proves this idea. In a vertical arrangement of caves, canopies, niches and cells there appear to be two - three levels. The bottom level with a floor at a level of modern beaches was generated in current New-Caspian time, and top level several meters higher was accumulated during the period of Khvalyn transgressions. The most significant groups of coastal caves are at Aralda, Akshokur, Adamtash settlements, on capes Melovoy and Zhylandy. Larger caves length of which is 10-50 meters with width at an entrance of 1-20 m and height up to 10м, are located in the bottom level. In the top part of coastal ledges small caves length of which lasts up to 5-8 meters prevail. Probably, significant part of caves of these levels has disappeared in result of backward movement of abrasion coast for many millennia of Khvalyn time.

Other large formations on coastal ledges are karstic-erosive ravines, exceptionally large number of which is located on cape Segendy. Karstic cracks, extended in cross-section to a ledge from 0.5 up to 20 m, at width from 0.05 up to 1 m, are major factors in appearance of ravines. Traces of leaching on walls of cracks are distinctly visible. If the relief of pre-board part of a plateau promotes a drain of surface waters, cracks quickly expand in ravines with abrupt thalwegs and steep walls. Quite often trailing ravines, but the most advanced cut coastal ledges up to the basis, and in the top level separate and form water-gathering funnels, a diameter of which lasts for many kilometers.

Karstic-erosive poljes meet on a surface of a plateau, along the sea coast. These are downturns cut in surface of a plateau on 5-20 m, xtended submeridionally up to 49км (natural boundary Kyzyladyr), at width from 1 up to 6 kms. East slopes are abrupt (15-400) with exposures of limestones, western are downwearing (~100), soddy karst. At the poljes bottom there are funnels, small hollows with the diameter of hundreds meters and by depth up to 10м, and also flat top residual rock. In other cases, bottom is flat with a cover of deluvium lasting for meters, under which limestones - shell rocks appear. Poljes can be closed, or open to sea due to the growth and backward movement of the coast. Some karstic cavities have been used for cult character or for short-time habitation.

Karstic-erosive valleys of Tjub-Karagan peninsula, extending for tens of km, in the development of which other agents of denudation actively participate, represent significant threat to objects of a national economy and should be taken into account at realization of various building projects at coast.

Not only the mechanical carrying out of the fine particles of breed due to a filatration occurs in arid areas, where there is a high saltiness of the soil, clay and subsoil waters, but also chemical leaching a salt component. Thus, as well as in karstic process, chemical compound of salts of water and breed is of great value. It is known, that dissolving capacity of the water, which is not having common ions with dissolving substance repeatedly grows, as for example, in case of influence chloride-nitratite waters by sulfates and the carbonates of calcium contained in loams and sandy loams.

It is necessary to note, that suffosive downturns with diameter of tens of meters, at depth of the first meters, creating roughnesses add to a faster development of both linear and plane erosion and formation of a corresponding microrelief. Separate "small plates" become fine bases of erosion with a radial network of gullies and balka. Linearly co-ordinated suffosive downturns can give rise to rather large broad gullies.

On Mangyshlak coast, suffosive downturns meet more often and have impressive sizes in the south, in area Kendirli-Kayasan plateau, and also in the bottom of hollow Karakiya, as their capacity of eluvial loams reaches 2-4 m. In other cases, on the area naked or covered with low-power (up to 1м) eluvium limestones, typical karstic process prevails.

Rise of a level of Caspian sea, will, probably, raise activity of karstic processes on vaults of broken salty domes of northern coast. At east, top coast an increase, especially, chemical denudation will not occur. However, due to an abrasion cliffs come to life, volumes of cavities grow and karstic processes become more active on a shore line.

THE NATURAL REASONS OF FLUCTUATION OF A LEVEL OF CASPIAN SEA AND LONG-TERM FORECASTING

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One of unique features of Caspian sea, both geological, and the историко-archeologic data, inconstancy of his{its} level is fixed. The majority of researchers it speaks changes of climatic conditions on which factors of anthropogenous activity recently are imposed. Accordingly development of forecasts of a sea level is based on climatic (гелиофизических) and the вероятностно-statistical methods which are starting with стационарности processes, and done{made} by extrapolation of components of water balance of the sea. The last rather изменчивы, and these changes are non-uniform and разнопериодны. Many disputes arise around of the underground drain, seen evaporation, geological and anthropogenous factors in fluctuations of Caspian sea. Not putting under doubt existing methods of forecasting, we shall note them односторонность, resulted to occurrence of numerous forecasts about catastrophic decrease{reduction} in a level, to creation of projects of rescue of Caspian sea due to cutting off of a gulf Kara Bogas Gol (it is blocked in 1980, is open in 1993), переброски parts of a drain of northern rivers in pool of Volga, etc.

The intensive raising of a level of Caspian sea (since 1978 the increment has made almost 3 m with annual average speed 14 sm / year) has denied the majority of forecasts and has shown absence enough reliable methods of forecasting of expected changes of a level. The present{true} raising of a level of Caspian sea is regarded as abnormal during historical and tool supervision (with 1830) as it is not entered in the general{common} tendency of Caspian sea to a shallowing, will not be coordinated to a mode of superficial waters and an atmospheric precipitation, with the increased volumes of withdrawal of water from the rivers of the Caspian pool for economic needs and is record on duration and speed in comparison with four most significant episodes of rise of a sea level since 1830.

Last years a part климатологов (B.P.Borisenkov, O.A.Drozdov, M.I.Krivoshej, etc.) not only confirms presence of contradictions in calculations of water balance of Caspian sea, but also specifies disagreement of a present raising of a level with features of zone circulation of an atmosphere [1] that demands search of the additional reasons of modern rise of a sea level.

Well-known, that positions of a climatic hypothesis are completely fair only for small on amplitude and duration of changes of a sea level. As to significant fluctuations which are not stacked in hydroclimatic periodicity it is necessary to take into account and the tectonic factor, meaning an arrangement of Southern and Average Caspian sea in active seismic areas with an intense tectonic mode [2].

The analysis available геолого-geophysical, geomorphological, литологических, общеклиматических materials, the newest age definitions radiocarbon both термолюминесцентными methods and наблюденные the data allow to make a natural course of fluctuations of a level of Caspian sea for last 500 thousand years (fig. 1 J). In плейстоценовой histories of Caspian sea as one-serial are authentically established Baku, хазарская and хвалынская трансгрессивные the epoch divided{shared} by deep and less long periods of regress. These time intervals (accordingly 100M200, about{near} 250 and) are allocated with 10 thousand years as large трансгрессивные cycles (epoch) with presence powerful (100 m and more) a complex of deposits with a characteristic set of mineral organisms, the precise breaks separating sea adjournment from continental. Earlier accepted conformity of large transgressions of Caspian sea with congelations of Russian plain with the advent of new methods of datings specify absence between them to a direct communication [3] that proves to be true also changes of a climate for 100000 according to studying isotopes of oxygen in layers of ice of Greenland [4] where the period of last congelation coincides with ранне-and позднехвалынскими трансгрессивными epoch [5].

In view of amplitudes of the maximal and minimal standing the sea level reached{achieved} during a maximum хвалынской transgression of a mark of 50 m абс. Heights, and earlier снижавшегося up to a mark a minus 48M50 m, for a conditional reference point the mark 0 concerning which position and the tendency of development of Caspian sea are defined{determined} is accepted. In this connection it is represented obvious, that modern Caspian sea is the pool which is taking place in a deep regressive stage. It proves to be true a новокаспийско-modern complex дидакн, characteristic for a regressing reservoir.

Позднехвалынский the pool had basically a maximum level close to a zero mark, minimal - a minus of 22 m (шиховская a stage). The ambassador кумской трансгрессивной phases on the geomorphological data are allocated two террасовые surfaces (сарташская and the Dagestan stages) with marks accordingly M11 and M16 in m. This piece of fluctuations of a level of Caspian sea has average уровенный reference point M30 m - the lowest for all плейстоценовую a history of development of Caspian sea.

Not pressing in the detailed analysis of changes of level Новокаспийского of pool, we shall note, that the maximal height трансгрессивнной stages was a minus of 20 m, and Caspian sea in голоцене reached{achieved} this level twice. Новокаспийская the stage is connected to approach of the Atlantic period with a soft and damp climate to what testify споропыльцевые spectra новокаспийских adjournment and accumulation of a carbonate of calcium in ground adjournment.

THE NATURAL REASONS OF FLUCTUATION OF A LEVEL OF CASPIAN SEA AND LONG-TERM FORECASTING

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One of unique features of Caspian sea, both geological, and the историко-archeologic data, inconstancy of his{its} level is fixed. The majority of researchers it speaks changes of climatic conditions on which factors of anthropogenous activity recently are imposed. Accordingly development of forecasts of a sea level is based on climatic (гелиофизических) and the вероятностно-statistical methods which are starting with стационарности processes, and done{made} by extrapolation of components of water balance of the sea. The last rather изменчивы, and these changes are non-uniform and разнопериодны. Many disputes arise around of the underground drain, seen evaporation, geological and anthropogenous factors in fluctuations of Caspian sea. Not putting under doubt existing methods of forecasting, we shall note them односторонность, resulted to occurrence of numerous forecasts about catastrophic decrease{reduction} in a level, to creation of projects of rescue of Caspian sea due to cutting off of a gulf Kara Bogas Gol (it is blocked in 1980, is open in 1993), переброски parts of a drain of northern rivers in pool of Volga, etc.

The intensive raising of a level of Caspian sea (since 1978 the increment has made almost 3 m with annual average speed 14 sm / year) has denied the majority of forecasts and has shown absence enough reliable methods of forecasting of expected changes of a level. The present{true} raising of a level of Caspian sea is regarded as abnormal during historical and tool supervision (with 1830) as it is not entered in the general{common} tendency of Caspian sea to a shallowing, will not be coordinated to a mode of superficial waters and an atmospheric precipitation, with the increased volumes of withdrawal of water from the rivers of the Caspian pool for economic needs and is record on duration and speed in comparison with four most significant episodes of rise of a sea level since 1830.

Last years a part климатологов (B.P.Borisenkov, O.A.Drozdov, M.I.Krivoshej, etc.) not only confirms presence of contradictions in calculations of water balance of Caspian sea, but also specifies disagreement of a present raising of a level with features of zone circulation of an atmosphere [1] that demands search of the additional reasons of modern rise of a sea level.

Well-known, that positions of a climatic hypothesis are completely fair only for small on amplitude and duration of changes of a sea level. As to significant fluctuations which are not stacked in hydroclimatic periodicity it is necessary to take into account and the tectonic factor, meaning an arrangement of Southern and Average Caspian sea in active seismic areas with an intense tectonic mode [2].

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THE HYDROLOGICAL EFFECTS ON THE CASPIAN SEA FLUCTUATION BALANCE DUE TO KARSTIC AQUIFERS IN SOUTHERN CASPIAN

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In several parts of the southern Caspian a numerous sedimentary rocks dominantly limestone and dolomitic or chalky limestone could provide a large amount of underground waters which have been singled out as karstic aquifers as a predominant water bearing resources along the coastal zone. The age of these limestone facieses are attributed to Jurassic and the Cretaceous. During the geological time and gradually closing the Tethys ocean together with uplifting of Alborz mountains in Iranian territory the karstification have been occurred during as post tectonic movement. The catchments areas and the drainage systems evacuating a huge amount of waters about 6×10^9 m3 by surfacial rivers into Caspian Sea among which the so called Sefid Rud (white river) with almost 4×10^9 m3 is predominant, the 36 other rivers discharge are about 2×10 m3 per year. the average annual rainfall in the southern Caspian sea is about 800 to 1200 millimeters of which the maximum are attributed to Bandar Anzali with more than 2000 mm in Guilan province .The subsequent tectonic events or parallel to uplifting of the Alborz mountains gave rise an intensive faulted and fractured systems especially in limestone formations with subsequent dissolution especially in the region of Salman shahr (Motel Goo), Golestan, Shanderman, Masal .etc , which have a direct or indirect influence on the Sea water level. During the rain fall season, the sinkholes and polje together with ponors would drain the waters towards the Caspian Sea. Several submerged springs have been singled out along the coastal zone. A considerable amount of underground water due to hydraulic pressure would be drained along the faults and fractured systems which having a direct impact on the sea water fluctuation. The water discharge amount from karstic systems could be estimated around 0.5 to 1.5 billion m3 per year.

EFFECTS OF WATER LEVEL FLUCTUATIONS ON THE AQUATIC PLANTS IN THE ANZALI LAGOON, IRAN

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Caspian water level Fluctuations is a fundamental variable affecting those components of aquatic ecosystems that exist close to lake margins. Fluctuations in water level and the growth of the introduced exotic red water fern (Azolla filiculoides) and common reed (Phragmites australis) have significantly influenced the submerged and emergent vegetation of the Anzali lagoon, Iran over the period 1985-2000. The lagoon area is covered mainly by common reed and red water fern as the prevailing species. Fluctuations in water level appear to have increased the replacement of native species such as lotus (Nelumbo nucifera) and cattail (Typha latifolia) by common reed and red water fern. Water level fluctuations enhanced the fragmentation rates of red water fern and thus its dispersal and establishment. The exceptionally high plant density of common reed and red water fern showed significant effects on vegetation diversity, oxygen exchange in water depth, concentration and availability of nutrients and coastal wave protection of the Anzali lagoon.

THE IMPORTANCE OF ACOUSTIC STUDIES IN MARINE ENVIRONMENTS

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Advances in marine geosciences have been largely secondary to the development of tools dedicated to acoustic investigation. Depending on their structure and processing principles, these tools can either provide Sonar images of seafloor features or quantitatively access specific parameters about the seabed.

While not replacing the direct methods of seabed study made by geologists, which are based on the analysis of samples, acoustic systems provide a quasi-instantaneous wide observation of the differences in morphology between the water-seabed interface and sedimentary layers.

High-resolution mapping and monitoring of seabed is an essential component of under water acoustics. It is involved in marine geological and geophysical studies of the seabed, including stratigraphy, sedimentology, geomorphology, structural and gravity studies, geologic history, and many others.

At higher sound frequencies, the investigator may be interested in only the first few meters or tens of meters of sediments. At lower frequencies information must be provided on the whole sediment column and on properties of the underlying rocks.

Three types of acoustic systems are extensively used in marine geosciences: sidescan sonars, multibeam sounders and sediment profilers.

Description of these systems and their applications and importance in marine studies are the main subjects of this paper.

KIZIL-AGACHSKI ZAPOVEDNIK AS THE PLACE OF BIRDS' WINTERING IN THE SOUTH-WESTERN PART OF THE CASPIAN SEA

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During winter expedition of the Department of Biogeography (Moscow State University) to Azerbaijan we had several days of researches (30 January – 3 February 2005) in Kizil-Agachski Zapovednik which is well known as one of the greatest places of waterfowls' wintering at the Caspian Sea. Zapovednik is situated at the south-western coast of the Caspian Sea. It includes the coastal part of the land with crop fields at the north and two gulfs divided by narrow Sara peninsular from each other and by spit (Kurinskaja Kosa) from the Sea. The main biotops here are: water surface and land territory covered mainly by reed and rush swamps, and to a smaller extent by steppe. We investigated the birds from the land with the help of monocular (20x45), from the boats, at the standard tracks and with the help of nets.
Altogether 61 bird species of 11 orders were found.
Among waterfowls such species as Fulica atra, Phalacrocorax pygmaeus, Anser anser, Anser albifrons, Aythya ferina, Anas penelope, Anas acuta and Anas crecca are numerous. Zapovednik is the place of wintering for some rare and dangerous bird species. We had met such species as Anser erythropus, Aythya nyroca, Phoenicopterus roseus, Recurvirostra avosetta, Pelecanus crispus, Pelecanus onocrotalus, Francolinus francolinus, Porphyrio porphyrio and Otis tetrax.
Despite the fact that the level of the Caspian Sea had risen last years for several meters, Kizil-Agachski Zapovednik hasn't lost its role as one of the main places of concentration of wintering waterfowls, nesting at the Eastern and Western Siberia, Southern Ural, at the part of Russian Plain and Kazakh Steppe.
Some species, which were not previously mentioned for those places, were caught into the nets: Locustella naevia and Emberiza pusilla.

THE CASPIAN RAPID SEA LEVEL CHANGE AND COASTAL EROSION VULNERABILITY DEGREE ASSESSMENT WITH GIS MODELING

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At the present time, the protection of ocean and marine coastal regions is a vital plan in Coastal Management Program for sustainable development. Erosion processes have been developed with high population density and economic reservoir exploitation in these areas. The insufficient knowledge of coastal components and environmental forces (e.g., sea-level change and hydrodynamic impact) create serious problems for engineering applications to coastal management. The improper design of engineering protection structures in coastal areas and high costs of preventing the natural crisis are some of the most important problems along the southern coast of the Caspian Sea. Rapid Sea level change and hydrodynamic forces (waves & currents) also are most important agents for coastal processes changing and erosion advancing. Hydrodynamic activities and change of Caspian sea water level always caused serious damage and general changes along the coast. The two previous rises of the sea from 1978 till 1996 caused very hazardous conditions for socio- economic character of the region.

Caspian Sea as the largest lake in the world has different reaction to above factors. In this paper we are trying to present some facts about coastal erosion vulnerability degree in southern coasts of the Caspian Sea. In Fact the evaluation of beach sediments erosion instability and their hazardous degree assessment are the most important targets in this research which has been done in 6 selected stations each one including 6 depth points in the warm and cold period. Totally 72 sediment samples and beach geometry characteristics have been measured. After laboratory tests all experimental data have been analyzed in computer software in this research we have applied Universal Ranking System Model to measure instability characteristics. Finally by the help of overlaying method in GIS soft ware we come to the point of erosion and shore line changing by hydrodynamic process in varies from region to region in the Caspian Sea. Based on this result we can say that the Miankaleh area at the eastward of southern coasts of the Caspian Sea is the most stable area and Nashtaroud region at the west of Mazandaran province is the most instable coast on view of erosion processes (Fig1). On the other hand from Sea level rise and flooding statement point of view the east part of the southern coast of Caspian Sea is very vulnerable than other areas specially along the Gomishan till Miankaleh beach.

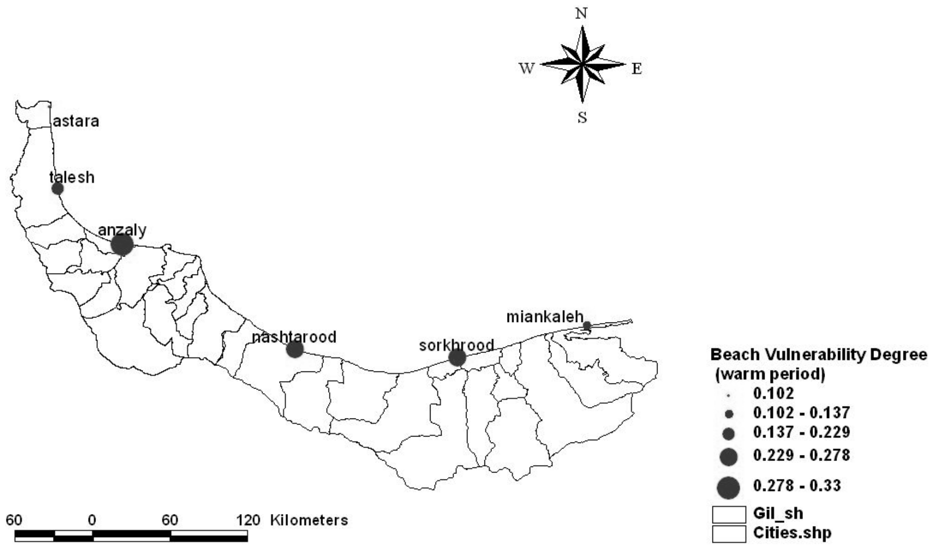

Fig 1- Beach sediments erosion vulnerability degree in the southern Coasts of the Caspian Sea

ORGANIC MATTER DISTRIBUTION IN THE KURA RIVER SEDIMENTS AS INDICATOR OF THE PALEOHYDRODYNAMIC ENVIRONMENT AND CASPIAN SEA LEVEL CHANGE

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The study of the distribution of organic carbon (Corg) in bottom sediments in marine basins allows a better picture of burial conditions and transformation of the organic matter (OM). Together with lithologic and biostratigraphic data enables reconstructing the paleogeographic and paleohydrodynamic depositional environment. This applies especially for the reconstruction of the evolution of recent river deltas. We investigated the distribution of Corg of the bottom sediments in the Caspian Sea which are accumulated in the area of active influence of the recent Kura delta. In total 300 samples were analysed to determine Corg, 216 from which are from piston cores and 84- from wells.

Analysis of the spatial distribution of Corg in 3 meters of sediments recovered from the piston cores shows a quite interesting regularity in arrangements of maximum and minimum of the contents. In the sediments from depths between 20-45 cm the minimum of Corg content is localized near the mouth of the active southern channel of the Kura River. This is a result of high turbulence of the water masses and a high amount of oxygen in the water that characterizes the offshore area near the river mouth. These factors are unfavorable for the accumulation, burial and fossilization of both marine and continental organic matter. Further southeastwards and eastwards Corg content increases. So, the areas with low Corg might be related to river mouth. In section 60-65 cm the area of minimum Corg is located at the north near the northeastern distributary's mouth that indicates to a high activity of this distributary channel at the time of deposition of this interval of the section. In interval 120-125 cm the minimum of Corg contents is confined to south-east continuation of the eastern distributary which is at present inactive and silted up. According to the paleogeographic reconstructions the Kura River flowed into the Caspian Sea through the eastern distributary due to Sea level fall and progradation of the delta. Thus, Corg minimum here corresponds to the eastern disributary channel mouth.. Later the main outlet migrated towards north and at present the main distributary has been displaced towards the south flank of the delta. However, this assumption might be applied under conditions of constant sedimentation rate.

Maximum Corg contents at depths 60-65 cm and 120-125 cm are located at the same place. This area is adjacent to the submarine mud volcano Kurinskaya and coincides with an E-W trending fault zone affecting this oil-gas anticlinal mud-volcanic structure. Therefore the maximum in sections 20-45 cm, 60-65 cm and 120-125 cm might be epigenetic and could have formed as a result of fluid injection of liquid bitumoids from underlying deposits into the bottom sediments.

Bottom sediments of studied area of the Caspian Sea are characterized by values of bitumen coefficient (β) for total CB+SBB from 0.1 to 0.7 %. A number of samples shows high contents of bitumoids both in sediments (up to 0.0225 %) and in OM (up to 3.1 %). This increases due to higher concentrations of chloroform part of bitumoids. As a whole the CB content for sediments is higher than SBB and this shows reduction nature of bitumoids. CB of all samples refers to type of oily bitumoid that can be characterized by high content of oils and low content of resins. In bottom sediments of marine basins organic matter can be both autochthonous caused by humification of marine OB, and allochthonous, supplied to the basin by the river. In our case the influence of allochthonous humic matters on OM composition may be stronger close to the mouth of the Kura River. Away from the coast humic matter content (humic and fulve acids) both in sediments and in OM decreases from 0.07-0.23 % to 0.04-0.09 % and from 10-27 % to 3-12 %. The same changes occur with contents of humic and fulve acids separately. This probably reflects a seawards decrease in the influx of allochthonous humic substances and an increased humic and fulvic acids production due to biochemical transformation of precipitated autochthonous OM. This situation is in harmony with the petrographical descriptions of organic matter of bottom sediments.

RESEARCHES AND OPERATIONAL FORECASTING OF THE SHORT-TERM FLUCTUATIONS OF THE CASPIAN SEA LEVEL IN KAZAKHSTAN

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The short-term fluctuations of water level at the northeastern part of the Caspian Sea depend on the following factors: relief, wind regime and background sea level position. During the period especially dangerous wind setup phenomena the sea level over the short period (a few hours) can rise up to 3.0 m at east most gently sloping seaside, therefore the low territories are flooded up to 30 km. Attention to the practical side of these problems is caused by the fact that coast flood by surges often has disastrous effect. Study of transformation of the surges and dynamics of wave setup represents both theoretical and applied interest.

Therefore, at designing and protection of hydraulic engineering and civil constructions the water level forecasts on basis of numerical modelling are put forward to one in the central places. The system of the hydrodynamic equations for shallow water is solved the bidimentional hydrodynamic module of the Mike 21 model developed in the Danish Hydraulic Institute. It has enabled to use model as a structural element of the technological line of the operative forecasting system of the storm surges with 120 hours lead time. The system allows to receive on the communication channels the meteorological information from the European Centre for Medium-Range Weather Forecasts (ECMWF, UK), hydrological - from the Kazakhstan stations by the Caspian sea, to process it and to make all necessary forecasts in the shortest possible time. Use of the meteorological forecasts permits to provide with anticipatory modeling of the probable consequences from the storm surges.

Adaptation of the HD module to the shallow conditions of the Northern Caspy was made by the authors over creation the bathymetric models of all sea (grid spacing 10 km) and its northern part (grid spacing 2.0 km), selection of the check-up factors: bed resistance, wind friction and others. System allows expecting hourly water level fluctuations in any point of the Caspian Sea. Initial sea level is defined according to network observation, acting by communicate channels. Water level forecasts are made for different regions of the Kazakhstan's coast of the Caspian Sea. Representation form of the forecast: text, water level fluctuations' graph, Warnings of the dangerous consequences (flooding, dams' destruction, deterioration of navigation conditions). Estimation of accuracy and efficiency of short-and-middle range forecasts of the Caspian Sea level has shown that the accuracy of automated method of 3-day forecast is on average 92%, 5-day forecast - 86%, therefore use of the method is expedient. Thus, in conditions of limited information the use of the mathematic modeling methods permit without major capital investments to realize a numeral experiments and to use model-made data for solving of practical tasks, which connected with the concrete marine basin.

SENSITIVE ZONES OF MANGISTAU COAST AREAS

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Change of a level - process natural, having long-term cyclic character. In the geological past his{its} amplitude reached{achieved} more than 30 m (мезолит), but during the modern period does not exceed - 27,0 m

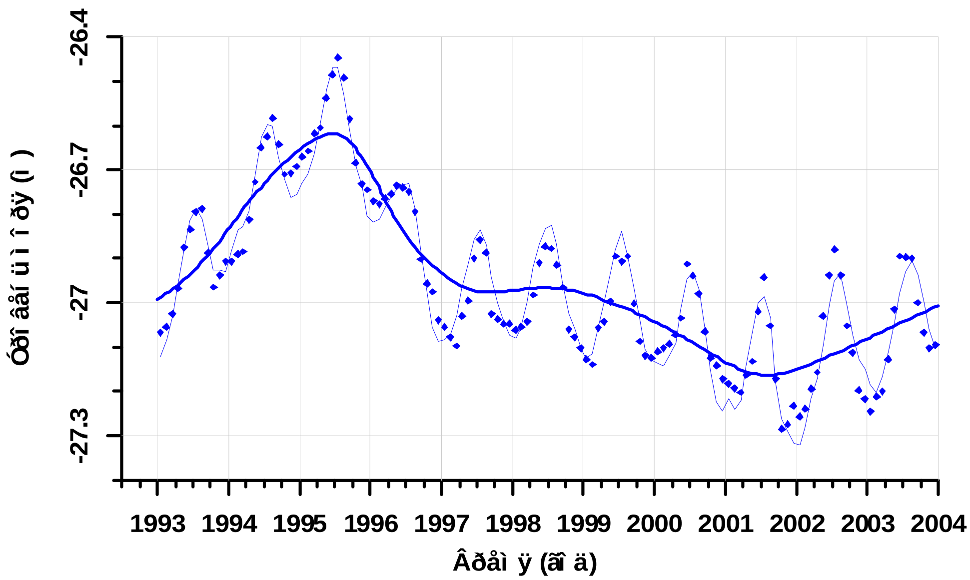
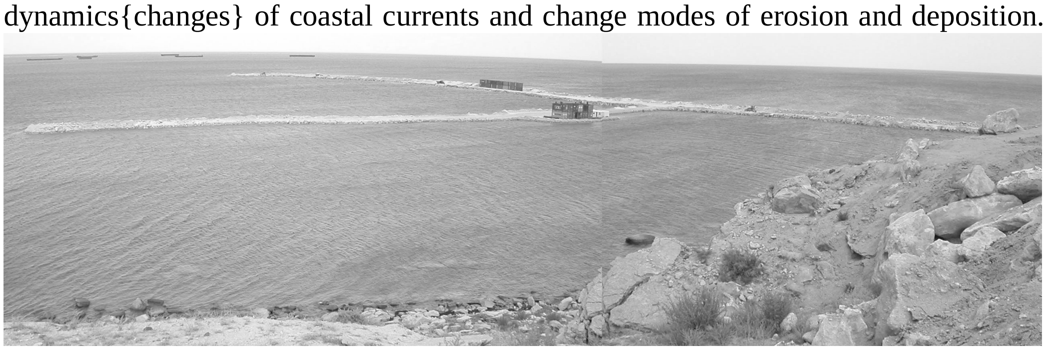


Рис 1. Колебания уровня Каспийского моря с 1993 по 2004 года.

Definition of sensitive zones of coast is necessary for definition приоритетности nature protection measures. The priority will be the sources rendering influence on zones of high sensitivity and the importance, such as artificial bay "КазТрансОйл", base Аджип КСО, deposits Каражанбас, Каламкас, Каратурын, Armand, Прорва.

Artificial bay of inhabited complex "КазТранОйл".

At average sensitivity of a coastal line, influence local, constant irreversible high (the Point 369). The potential of the given influence consists in creation of precedent of construction of artificial bays which, at their essential density can appreciablly lower dynamics{changes} of coastal currents and change modes of erosion and deposition.



. A consequence will be change of kinds ground беспозвоночных and vegetation so also a diet of the maximum{supreme} animals, that, in the sum with other forms of anthropogenous loading, can lower essentially survival rate so-called "проигрывающих" kinds, i.e. kinds which cannot adapt to changes of the natural environment caused by activity of the person and lose in a competition to kinds "winners" (for example, ravens, the seagull, some kinds of seaweed, etc.). In result a biological variety is appreciablly reduced and ceases to be natural. The similar construction as is present to sowing. To the east from item. Баутино (a point 45).

Base Аджип КСО.

The base of sea support Аджип КШО and industrial platforms of his{its} contractors are an essential constant and potential source of pollution of the sea. The greatest ecological influence can be attributed{related} to builded mooring Аджип КСО (a point 45). Influence from change of dynamics{changes} of coastal currents and mixing of water weights is described above. Here it is necessary to add such forms of constant influence on birds and seals, as increase in physical presence, noise from carrying out of explosive works and the subsequent work of transport and units, pollution околоводного a layer of air products выхлопа.

Deposit Каражанбас.

Deposit Каражанбас is located on peninsula Buzachi to the north from port Aktau. With a view of prevention of flooding of a deposit by the sea the bulk dam (about 16 kms) has been constructed.

In a flooded zone of a deposit (up to a dam) the important ecological value has reed thrickets and islands. At the moment of inspection all zone has been flooded. The basic sources of pollution of the sea in territory of a deposit are the deserted chinks and an old oil barn. The zone of flooding and flooding up to a dam limiting землеотвод deposits has been in details investigated. Known chinks are located in a zone of strong growth of a cane and at the moment of inspection were on depth of 0,5-1,5 m. Thereof the approach or an entrance by a boat to them appeared is strongly limited. Visual survey устьев known chinks has not revealed attributes of pollution. Besides in a zone of flooding 2 chinks are found out (№204, 961), the information about which was absent earlier. The chink 204 is in rather good condition, cement заглушка the whole without cracks and splittings. At the moment of inspection of a flank with traces of corrosion laid on the ground (from words of ecologists flanks fall camels). The chink 961 is working and is on balance КНМ. The condition satisfactory, outflow, corrosion is not revealed.

Фото 4.6 (77 05) Вид с нефтяного амбара у

Old oil barn at hard currency. 115 contains выветренную oil. On a surface of a fresh film was not, though the local population spoke about its{her} periodic occurrence. About it speaks also that the coast and a cane near to a barn is covered with oil (the Photo 77_05). Now the administration of a deposit develops the plan of liquidation of a barn.

Deposit Каламкас, Каратурын and Arman

All flooded territory at deposit Каламкас (the limited 3 m) at the moment of inspection has been flooded with a dam. As drilling outside a dam was not made, researches of a 500-meter zone of water area have been limited to visual survey. Traces of chinks of deposit Каратурын, the information about which has been given by the customer, it was revealed not though survey was carried out{was spent} within the limits of 2 kms to the West and 2 kms to the east from the given coordinates. The water table within the limits of the given area was as is in details examined with the help of the field-glass.

Survey of a coastal zone to the West from a dam of deposit Каламкас (territory of a deposit Armand) was carried out{was spent} in a zone of flooding without use of a boat owing to small depth and the big distance from a coastal line up to sources of pollution. Three chinks in a zone of flooding have been examined, about chink æ-2 sampling is made. Also 4 liquidated chinks have been found out, the information about which was absent.

At chink æ-2 tests as has been found out, presumably, a historical oil barn by the area about{near} 750м2. have been selected is distinctly visible корка выветренной oil. Proceeding from an arrangement of a barn, it is possible to assume, that it{he} is periodically flooded and подтопляется the sea that causes constant pollution of the sea environment.

Фото 4.7 Заброшенная скважина С-2 близ

On chink æ-9 outflow of oil has been found out. The chink is deserted, but traces not old attempt to reduce outflow are distinctly visible. The monthly volume of outflow has been approximately determined. Hour дебит (3 drops at one o'clock), it was multiplied on quantity{amount} of hours in a month and on volume of a drop. The volume of a drop was calculated in view of that the drop has the form of a sphere. The formula of volume of a sphere: V = 4/3πR3. The radius of a drop has made approximately 0,5см, volume - 0,524см3. Thus, average monthly дебит has made 11,32м3/month (0,524*3*24*30/100).

Depth of the stiffened flood was defined{determined} with the help of a shovel with gauging a structure within the limits of seen borders of pollution. Depth changes from 10 up to 30см in process of removal{distance} from a chink. Оконтуривание pollution was based on visual distinction of soil structures. On the average the area has made 500м2. The top layer of pollution (approximately 5см) represents выветренную oil that speaks about the big age of the given flood. There is a dense layer of dark substance with a weak smell of oil below. With the purpose of acknowledgement{confirmation} of that this oil pollution, from the given point tests for the analysis on oil hydrocarbons and гумус have been selected.

Oil pollution is the most dangerous on northern Caspian sea because of very low volume of water (0,94 % from total amount at 27,73 % from the area of the sea) at average depth of 6,2 m. Lethal concentration for many kinds of animals is reached{achieved} much faster. Northern Caspian sea is territory нагула fishes a forage reserve, "kindergarten" for many fishes, a site of duplication of seals, nestings of birds, etc.

The greatest influence renders deterioration of coastal waters on Caspian salmon, more often average in coastal waters average and southern Caspian sea, on depths of 20-50 m. Them улов it was reduced from 1500 tons one year up to 50 tons one year.
Size of influence of possible{probable} pollution from break of flooded chinks will be strong to vary seasonally, directions of a wind and physical presence of floating means at area of flood. As on northern Caspian sea at the moment there are no means of monitoring of floods, can pass many days while what be a vessel will not come across flood.

Deposit Прорва.

The flooded territory up to a dam limiting territory of a deposit (i.e. 15-20 kms from a usual coastal line) is a zone of the raised{increased} ecological sensitivity presence of thrickets of a reed and a congestion of birds of passage (the seagull, swans and the flamingo have been noticed at inspection). At the moment of inspection sea waters covered all flooded territory. In flooded territory there are some deserted chinks and the old chisel platform located by words маркшейдера of a deposit in 12 kms to the west of a dam Because of strong thrickets of a cane, shoalinesses and unsteadiness of the flooded ground to survey chinks and chisel it was not possible by a boat, on foot.

At supervision in the field-glass it was possible to find out two deserted chinks. Along coast congestions of the old trunks which frequently have scorched have been found out, or is simple the rests from them; on seen, them do not utilize, and simply store and in due course burn. The distance from the sea changes within the limits of 5-20 meters. The coastal zone To the south of a deposit Western Прорва, down to gulf Комсомолец, also is inaccessible to inspection in view of absence of roads and high нагона.

Фото 4.8 Несанкционированная свалка покрышек на месторождении Прорва.

In summary, it is necessary to tell, that 100 % of the forecast of the future changes of a level of Caspian sea to allow not probably. As a principal cause of change of a sea level is hydroclimatic factors, this it is similar to a problem{task} of the forecast of a climate.

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IFS MODEL OF CASPIAN SEA LEVEL DYNAMICS

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In previous investigations we have found that time series of Caspian Sea level (CSL) data demonstrates statistically selfsimilar or multifractal features[1]. Formally, the existence of such kind properties is confirmed by so called multifractal spectra. This in tern gives possibility to construct simple models of singular measures by means of Iterated Function System (IFS) known from theory of fractal[2]. In this work we discus an application of IFS to instrumental CSL data. First of all we apply Empirical Mode Decomposition (EMD) to monthly time series of CSL. The decomposition allows representation of the time series as a sum of trend and oscillation modes[3]. Then, to obtain empirical measure the methods of symbolic dynamics are used. After deleting the trend and season components we mark points of obtained time series with the help of binary alphabet words. An estimation of a measure is a frequency of occurrence of words of appropriate length on unit interval. Finally, using recurrence IFS we solve inverse problem to obtain model parameters[4]. The constructed Markov-process model can be apply for Caspian Sea level prediction.

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THE LEADING ROLE OF PRESENT-DAY GEODYNAMIC PROCESSES IN FORMATION OF ABNORMAL CHANGES OF THE CASPIAN SEA WATER LEVEL

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The Caspian region is characterized by a high degree of present-day geodynamic instability of the earth's crust, and Caspian Sea is classical model for studying a role of deformation processes in the water level changes within the limits of the closed sea. At discussion of the reasons (climatic, tectonic) abnormal change of a water level in Caspian Sea till now it is not produced a common opinion.

In the present report the geodynamic point of view on the given problem is offered. Historical periodic uplifts and downturns of the earth's crust within the Caspian See territory and continuing wave nature of present-day geodynamic processes are considered.

The examples of spatial-temporary connection of abnormal development of the present-day tectonic movements, having a wave nature including within the limits of the Caspian coast, and abnormal change of a water level in Caspian Sea are shown.

The mechanism of the Caspian See water level change in conditions of different geodynamic regimes (compression, a stretching) is offered.

Results of a quantitative estimation of a share of the contribution of the climatic and tectonic factors in fluctuations of the Caspian Sea level (where the share of the tectonic factor essentially prevails) are given.

Industrial breakdown susceptibility in the Caspian region (on oil-and-gas deposits in the sea and on land), connected with abnormal deformations of an earth's crust, occurs simultaneously on a background of development of abnormal changes of the Caspian See water level.

GEOMORPHOLOGY OF GREAT SEFIDROOD DELTA IN RELATION TO CASPIAN SEA LEVEL CHANGES (NORTH OF IRAN)

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The morphology of the Caspian Sea shore and its lateral territory in the Iranian coast is based on the shape of the mountain ranges and their side faults such as Talesh and Alborz fault. Sefidrood is the largest Iranian river of Caspian Sea. It pours into the Caspian Sea after making a delta the name of this delta is Sefidrood, too. The coastline of Sefidrood delta has two projections in old mouth of Sefidrood and Kiashahr small port that can be recognized even in Iran's maps which their scales are small. Only in the Sefidrood delta, the shoreline extends in to the sea, because of intense sedimentation of this river; the geometrical morphology of the coast is different from lateral faults. The Sefidrood river delta is one of the largest formed deltas and one of the three distinguished geomorphologic landforms in the southern Caspian Sea coast that dates back to the Pleistocene period. The morphology of the delta is asymmetrical. The maximum height of the delta is about 115 meter at around Emamzadeh Hashem .The main part of the delta from the topographic point of view is situated at the height of -26.5 – 100 meters. The zero counter line divides the delta into two northern and southern parts. The southern part which is between the top of the delta and zero counter line deltas back to Pleistocene and the northern part which is between the zero counter line and shore line was formed during Holocene period. About 80% of the Sefidrood delta is situated at the height of below zero.

In relation with Caspian Sea level change in quaternary, 5-shore line from Emamzade Hashem to present shoreline have recognized that progression of land in Caspian Sea was about 55 km. Also Sefidrood has changed its way six times. The replacement of the mouth from Kohne Sefidrood in Dastak village to Kiashahr happened about 500 years ago in Holocene period. This replacement (about 20km) was the biggest in the evolutional trend of Sefidrood delta and after replacement was smaller than 5 km.

HYDROGEOLOGICAL FACTORS OF FORMATION AND DEVELOPMENT OF NATURAL-TERRITORIAL COMPLEXES (THE CASPIAN EXAMPLE)

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The hydrosphere is submitted in a landscape by the extremely diverse forms and is in continuous **кру &#1075 ;о обор от&#1077**;, passing from one condition in another. The water factor plays the important role in formation of landscapes. V.I.Vernadsky considered{examined} natural waters as original minerals and even has developed their classification in view of a physical condition, concentration of salts, character of water reservoirs and a chemical compound of the dissolved substances.

A variety of natural waters is closely connected to a landscape. In each landscape the natural set of water congestions, and all their properties - a mode is observed. Intensity circlerevolution, the mineralization, a chemical compound, etc. - depend on a parity{ratio} of zone and azonal conditions and from an internal structure of the landscape, from structure of his{its} components and from morphological parts.

Features of a structure of a hydrographic network are appreciably caused by character of its{her} surface. The region Prikaspijsky is characterized by poorly advanced hydrographic network. The largest artery, to cut his{its} northern part, the river Ural is. Emba - second-largest and the economic importance the river only in abounding in water years reaches{achieves} the sea. The huge spaces located to the south r. Emba, including a plateau Ustyurt and Mangyshlak, are deprived constant water sources.

From the north and the West the region Prikaspijsky is washed by waters of Caspian sea - the largest in the world of the inland water pool having important landscapeformed the value and possessing rich natural resources. In structure of water chloride sodium and sulfursour magnesium prevails. A major factor of formation of salt balance of the sea, on given N.F.Glazovskogo/1/is unloading of underground waters.

The sea level substantially depends on quantity{amount} of an atmospheric precipitation and fast a drain. During last long period **усыхани&#1103**; the seas (with 1929 on 1977) his{its} level has gone down more than on 3 m that has led to **обсыхани&#1102**; a coastal strip in width of 30-40 kms. The shallow water area of northern and northeast coast where in 1941-1942 former gulfs Dead Cultuc and Caidac up to 5 thousand 2 km were separated by the general{common} area from the sea has especially strongly decreased and have turned in sor. Since 1978, the water level in the sea began to raise and by 1994 has made 2,4 m. In result the coastal territory, including working oil-and-gas deposits (Prorva, Caraarna and) is flooded. In a zone of flooding and flooding there are 32 deposits Atyrau and 11 - in Mangistau areas with the general{common} geological stocks of oil from above 5 billion ton./2/. Opening of a deep dam between Caspian sea and Karabogaz a gulf, carried out in 1992., Has allowed to dump{reset} in a gulf up to 2 km 2 waters monthly/3/.

Causes also the big danger pollution of water of Caspian sea due to an industrial - municipal drain and transportation of oil by sea way. On given to P.I.Buharitsyna/4/, annually within 198-1991 in the sea acted up to 150-170 thousand т. Oil and mineral oil, 1000-1500 t. phenol, 20-30 thousand t. Heavy metals. For last 15 years the average maintenance{contents} of copper in waters of Northern

Caspian sea has increased in 11,5 time, zinc - in 9,8 time, cadmium - in 4,9 and lead - in 5,6 times. During photochemical oxidation of harmful substances more toxic photooxidizers that has an adverse effect on bioefficiency of a shallow reserved zone are formed, conducts to disease and destruction of valuable breeds of a fish.

The region in the attitude{relation} formeding subsoil waters and their hydrochemical mode is characterized as a whole as бессточная area Waternose horizons here are dated to sand and sandy loams, as water-emphasises serve sea clay, as a rule, saliferous. A feed{meal} of subsoil waters is carried out due to a underground drain on the part of the General{Common} Syrt and Undenural a plateau, an atmospheric precipitation, condensation water **паров** and filtrations of freshet waters. Essential value in a feed{meal} of subsoil waters belongs to waters of hydrochloric domes. At a bias to the south **водо но сных** horizons there is to speed 1-3 mm / year/5/

The lowland concerns to soil - galogeochemical provinces chloride and sulfate-cloride saltcollect in ground and subsoil waters that is connected to receipt of salts from sea adjournment/6,7/. General salinity groundearth and subsoil waters in process of promotion to water area of Caspian sea increases with increase chloric accumulations. The maintenance{contents} in ground toxic chlorine and sodium in direct ratio degrees of a mineralization of subsoil waters.

In a northeast part of lowland Prikaspijskoj, in areas of petrocrafts (Culsary, Dossor, Baishonas and), subsoil waters everywhere stagnant, in seaside plain lie on depth of 0,5-1,5 m, on sandy and ridge-sor files - from 2-3 m in downturn of a relief up to 5-15 m and more on manes and bugre, and in valleys of the rivers - from 1 up to 5 m. Subsoil waters strongly - and it is very strong mineral (30-80g/l), chloride-sodium, in places close a loining to a surface cause formation{education} of saline soils.

Subsoil waters lie in area of Mangyshlak and Ustyurt deeply and do not take part in landscopeforming. On forge{bugle} Mangyshlak with crack Perm-Triassic waternose horizons connect stocks (about 130 ¼million 3) fresh{stale} underground waters, suitable for drink and **оази сного**; and irrigation/8/. In adjournment alb-senomana on depth of 100-300 m are open significant stocks of artesian waters, on quality fresh{stale} (up to 2,5g/l). The big stocks of fresh{stale} waters are found out in the central part of sandy files Sauskan, Tuesu, Bostankum. On them perfery on depth of 1-4 m lie saltish waters that causes occurrence here sandy saline complexes.

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VHR SEISMICS AND PALEOECOLOGY OF THE HOLOCENE VOLGA DELTA: PRELIMINARY RESULTS.

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Caspian highstands in the last millennia are now known to reflect the 2600BP and Little Ice Age solar-forced global cooling event. The 1000 BP Caspian lowstand coincides with the mediaeval warm period, and has led to a total desiccation of the North Caspian Sea and paleosol formation, which have been recognised in several borings in the Volga delta. A more dramatic lowstand occurred around 9000 BP, which led to a prominent desiccation horizon (sequence boundary) and incised valleys recognized as an important seismic reflector at 6-15 m depth in previous reconnaissance seismic profiles along the main Volga distributaries. This horizon forms the base of the Holocene sequence. The Volga delta is the only large delta in the world where such rapid sea-level changes can be traced, as all other deltas are affected only by eustatic fluctuations on much larger time scales.

We are now tracing in threedimensional detail the marine flooding surfaces and sequence boundaries since 9000 BP in this shallow sediment wedge by taking up to 400 km of very high-resolution marine seismic profiles (resolution down to 25 cm) along the myriad of shallow distributaries that characterise the delta front. We are applying the recently developed SEISTEC techniques and the INNOMAR parametric echosounder that enable acquisition of VHR seismic profiles in very shallow water (down to 1m depth). The dense network of seismic lines results in a virtually continuous 3-D data set. Shallow ramp deltas as the Volga delta have a very complex small-scale stratigraphy due to the extreme density of distributaries near the delta front, and this approach enables us to establish a 3-D geological model for such an environment in unprecedented detail. In this paper we will present the first preliminary data obatined during this survey.

In upcoming phases of the project we will characterise the highstands and lowstands recorded in the sediment wedge by augering and sampling at sites shown by the geophysics to be promising.. Sedimentological analysis, biostratigraphy, paleopedology, inorganic, organic and oxygen and strontium isotope geochemistry will be applied to reconstruct paleoenvironmental conditions of deposition. AMS ^{14}C and U-Th techniques will be applied on *in situ* double-valved molluscs and pedogenic carbonate to date the main events. The data will be assembled in a 3-D stochastic geological model, and matched with 3-D numerical simulation models of deltaic systems now under development by our teams. The results will not only lead to a better understanding of the impact of solar-forced sea-level changes on delta architecture, but also provide data that might help in predicting flooding patterns at future highstands and as such contribute to better coastal management. At last, the project will help to better understand the 3-D architecture of other deltaic bodies in the search for hydrocarbons.

SPACE SOUNDING AND MAPPING OF ECOLOGICAL SITUATIONS OF CASPIAN OIL FIELDS

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Before to carry out or even to plan those or other actions on protection of an environment and rational use of natural resources, it is necessary to know kinds, the sizes and character happening changes of ecological conditions and their distribution. These materials can be received only at carrying out of complex studying and mapping of a modern condition of an environment on the basis of various supervision including remote sounding.

The greatest practical value for the territorial characteristic of ecological conditions of region can have creation of special ecological cards on the basis of materials of remote researches/1, 2,3,4,5,6/.

Mapping by such method of ecological situations, revealing and estimation of the broken territories enable to receive evident highinformative the documents reflecting a modern condition of natural-territorial complexes, allowing most objectively to plan and supervise nature protection actions. Such already available specially made cards (at a local level) are necessary cartographical maintenance of the environmental problems which are having for an object protection and rational use of natural resources in scales not only one Near-Caspian region, but also republic as a whole. The analysis of literary and cartographical sources has shown, that the wildlife management made on the basis of the space information a lot of attention is given cards, however, till now still there is no completely developed and standard technique of their drawing up.

Certainly, the main advantage of space pictures - in an opportunity of revealing on them of large changes of the landscape, connected with an oil recovery, oil-field works, construction of pipelines and other linear constructions. On them it is possible not only chart oil development with various passing changes of a landscape, and among them such ecological dangerous, as pollution by the spread oil of ground, as a result - infringement and defeat of vegetation that is very characteristic for the given region but also to assess their dynamics and development.

On materials of remote sounding it is possible to fix also, as burning of natural gas in places of an oil recovery and gas. In the pictures executed from the American meteorological satellite, at night, fires from burning gas are visible. Mostly they are dated for oil deposits (for example, Tengiz, Karazhanbas, Kalamkas, etc.) and to a lesser degree - to gas (on an example, Karashiganak).

The supervision made from space allow to receive representation about morphological types of a relief and a complex modern relieftoform processes in oil fields. It enables to judge an orientation and intensity of movements of an earth's crust and geological structure of district that is exclusively important for platform areas of the Western Kazakhstan, covered powerful quaternary adjournment.

Ecologi-geomorphological mapping it is based on studying of morphology, genesis, age of a relief, and also dynamics and intensity of development modern ekzogen the processes caused by anthropogenous influence. And anthropogenous influence can be as single, giving only a push for the further development of process, and the repeated or constantly operating factor constantly strengthening and directing a natural course of process.

For ecologi-geomorphological researches by a basis ordering of ecological conditions of the reasons of desertification and development of an estimation of anthropogenous influence on an environment is. Thus anthropogenous infringements of natural-territorial complexes are considered at economic development and the infringements caused by the various reasons. So in the given region are allocated:

1) natural natural-territorial complexes (NTC), not used in a facilities (for example, in the given area - saline soils which borrow the most part of territory on the area) which infringement of an environment can be caused only casually and cannot be not so strong;

2) circumscribed used NTC where it is possible only weak or locally moderated disturbed natural components - a northeast part – peneplain;

3) extensively used territories to which deserts Near-Caspian Kara Kum and territories with a outrun facilities are carried, in this case infringements of an environment are caused with too high loading at operation of natural resources – rebite of livestock;

4) intensively used territories, are connected with extraction of oil-and-gas deposits, assumes formation of anthropogenous types of a relief.

Such conditional estimation of a degree of change of components of an environment is accepted proceeding from them modification, beginning from the most vulnerable vegetative cover before infringement most litogen bases of a relief/7/.

These conditional estimations give some representation about size anthropogenous modification ecological conditions in connection with character of development and use of the grounds. It has served for the further ordering kinds of anthropogenous change of ecological conditions and desertification which can be studied and displayed on cards and the help geomorphological photointerpretation the space information.

Considering opportunities of use of materials of remote sounding for its cartographical maintenance, it is necessary to note characteristic tendencies in this area:

1) the complex approach to all problem of ecology as a whole (consideration of anthropogenous influence on all components of the nature, the geomorphological approach to studying possible and existing anthropogenous changes));

2) use of ecologi-geomorphological methods of researches (studying and mapping on a geomorphological basis);

3) necessity of creation of series of ecological cards for maintenance of a problem as a whole;

4) expediency of use of remote materials for drawing up of cards of an environment, a modern condition and dynamics of an environment.

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RECONSTRUCTION OF LATE HOLOCENE CASPIAN SEA LEVEL CHANGE BASED ON ABSOLUTE DATING

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The Caspian Sea is characterized by strong changes in sea-level which is demonstrated trough it's sedimentary records. The reconstructed curves for the Caspian sea-level change, even for the Holocene time, in that sedimentary records are good preserved, are a matter of debate. We used sedimentary data, GPR images and isotope analysis recovered from five outcrops and one lagoonal core of the Iranian Coast to verify Caspian sea-level curve during the late Holocene. The results of carbon dating indicate that three highstands occurred during the last 2500 years in this area. The Caspian sea-level rised around 2400 Y BP reaching to a level about -24m.
The next rise in sea-level dated around 1000 and 400 years BP. According to carbon-oxygen stable isotope data retrieved from diagenetically unaltered bivalve shells with age of 2300-2500 years BP, seawater conditions (temperature and salinity) were similar as it could be seen today. Architecture of sand spits inferred from GPR images confirms the past two highstands. Further investigations of the coastal sedimentary records and denser sampling are needed for achieving better picture of the Caspian Sea-level curve during the Holocene.

A SIMULATION FOR PREDICTION OF CASPIAN SEA LEVEL FLUCTUATION EFFECTS ON SOUTHREN COAST .

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Regarding to intensive Caspian sea level fluctuation in recent times and their irregular trends coastal management issues is fronted with several problem. Therefore investigation of Caspian sea level fluctuation and their effects on coastal region like submergence and emergence is required for coastal management. Sea level change study from the view point of sustainable development such as recognition of geohazard zone, development of coastal town, protection of coastal environment and, establishment of industrial and marine structures is important to long term planning is necessary.

In this research, we used Aster satellite data(2000-2004) , digital elevation model (DEM) , statistic data for sea level fluctuation from 1880-2000 and their future predictions (frolov,2003).

The first satellite data was processed using Geomatica software then this data merged with DEM by ARC/GIS software and three dimensional images was created for coastal zone . with regarding to statistic data recent coastline was assumed in 27 meters (frolov,2003) highest Caspian sea level (-25.3) meters in 1880 and lowest(-29)meters in 1990 (florov,2003) and also on the basis of the latest report about prediction of Caspian sea level in 2020 (klige,1994) , these values was applied on satellite data of southern coast of Caspian sea . then their effects was estimated for this region.

As a result, more affected region from Sea level fluctuation are southeastern and southwestern coast of Caspian sea specially Bandar Turkmen , Bandar anzali and Chamkhaleh. While south coast of Caspian Sea such as Ramsar, Chalous, Noshahr will receive the least effects and will be the most appropriate places to long term development planning on south coast of Iran .

MODELLING THE CASPIAN SEA AND THE VOLGA RIVER BASINS HYDROLOGICAL REGIME USING PALEOCLIMATE DATA OF GEOLOGICAL EPOCHS

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Methods of paleogeography usually use the lakes water level and lake sediments as natural tools reflecting both short-term and long-term changes in natural resources and moisture regime for different epochs in the past. The changes in climate are likely caused by increasing carbon dioxide concentration in the atmosphere, and future climate in some features would resemble the Pleistocene and Neogene's warm epochs. Now we make the attempt to use the paleoclimatic data to predict the hydrological regime of the Caspian Sea for expected global changes.
The contemporary ideas about the Caspian Sea level fluctuations are based on the structure of the Sea water balance that is determined by the climate-related factors, as precipitation, evaporation and inflow. The main emphases have been made to the inflow by the Volga River, not only because the Volga River discharge amounts to almost 70% (some estimates suggest 82%) of the inflow to the Caspian Sea, but also as the Volga, the biggest river in Europe, is an epitome of the Russian culture, nature and identity. Almost 35% of the Russian population are living in the Volga catchment.
For the last 50 years the Volga River was under the anthropogenic pressure. 12 large reservoirs have been constructed in its catchment. The reservoirs are man-made water bodies, constructed mainly for the human needs: flood control, water supply and energetic; that's why only natural inflow to the reservoirs has been taken into consideration as a climate-related parameter.
In spite of the fact that reservoirs are water bodies with a regulated water level, catastrophic inflow to reservoirs or lack of inflow can cause serious economic and social after-effects. The observed increase of inflow to the Volga-Kama Reservoirs results in occurrence of situations when dams have not been able to regulate water storage carefully during last decades. So, in 1991, intensive spring snowmelt of significant snow resources caused the inflow to the Reservoirs Sheksninskoye, Rybinskoye, Gorkovskoye, Saratovskoye and Pavlovskoye equal to 1,8-2,2 of normal. The inflow to the Kamskoye Reservoir was 3 times higher than normal.
As a result, the inflow to reservoirs of the Volga-Kama cascade was 50 % higher than mean value (mean value is equal 66 cub. km, inflow in 1991 was 96,8 cub.km). The extremely high discharge through the Volgograd Hydropower Plant dam has caused the flood at the Low flow of the Volga River. The total economic losses have been equal to 552,5 million rubles (Taratunin, 2000).
The analyses of the inflow to the largest reservoirs of the European Russia show increase of inflow to the Volga River in its upper and middle parts and to the Kama River by about 30% for 1980-1999. During last decade, the inflow continued to rise. In 1999 the Volga and Oka Rivers' discharges were, respectively, 13% and 25% above the average long-term value (National report, 1999, 2001). At the same time in 1978-1995 there has been sharp raise of the Caspian Sea level for 2,45 m up to -26,5 m BS (Hydrometeorology and hydrochemistry of Seas, 1992; Frolov, 2003). This

raise of the CSL has lead to flooding and submerging of the Sea coasts and caused sufficient economic and ecologic losses. So, the local man-made factors should not recover modern environmental and climate changes.

To study forthcoming climate change both GSM and paleoclimatic scenarios for warm epoch of the past can be used. In this paper paleoclomatic reconstructions of air temperature and precipitation for three warm epochs are applied to modeling the hydrological regime with progress of global warming on 1, 2 and 3-4 C. These levels of the global warming correspond to the Holocene climatic optimum (5,3-6,2 KA BP), Last Interglacial-Eem (125 KA BP) and Pliocene climatic optimum (4.3-3.3 Myr B.P.).

A hydrological model has been developed to estimate the changes in the Volga River catchment parameters and to modeling the Caspian Sea level response to climate change. The model is based on the semi-empirical calculation method and on conceptual scenarios of nature and climate conditions for three geological epochs: Holocene climatic optimum, Last Interglacial –Eem and Pliocene climatic optimum .

The most dramatic changes were characteristic for the arid Caspian Sea zone during Last Interglasial-Eem and Pliocene climatic optimum. The significant growth both of temperature and precipitation initiates the increase of evaporation (70 mm/ year) and inflow to the Caspian Sea. The inflow was higher on 30-40% if compared with present climate.

These estimates should be considered from two points of view: (1) as reconstruction of the hydrological regime for the remote epochs of the past, which creates a new basis for improving Global Circulation Models; (2) as information for modeling natural resource responses to future global changes.

CASPIAN SEA SALINITIES DURING THE LATE PLEISTOCENE AND HOLOCENE BASED ON DINOFLAGELLATE CYSTS

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Dinoflagellate cysts have been analysed from a series of cores (2 to 10 m-long) taken in the south and central basins of the Caspian Sea. The chronology is based on radiocarbon dates, which for some depths have been corrected for detrital input and methane seepage. The dinocyst assemblages fluctuate between slightly brackish (Pyxidinopsis psilata and Spiniferites cruciformis) and more brackish (Impagidinium caspienense). The core tops often show a slight increase of eutrophisation illustrated by the presence of Lingulodinium machaerophorum. The sharp lithological change at 0.95 m depth in the south basin and 5.60 m depth in the central basin is dated at 10 ka radiocarbon ages and corresponds to an increase of salinity. This is linked to the loss of the meltwater inflow form the north and the temporary setting of an arid climate. In terms of local stratigraphy it is related to the transition between the Late Khvalynian transgression and the Mangyshlak regression. During the Holocene, similar important fluctuations are also observed, probably linked to flow modifications of the Uzboy River and the Amu Darya.

TECHNOGENOUS POLLUTION OF THE COAST AND THE SHELF OF NORTHEAST CASPIAN AREA

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In this article the basic pollution factors of natural environment components of northeast Caspian area are examined. A considerable part in pollution is represented by wind affected phenomena flooding oil fields, as a result, pollute the water pool. The complex of actions on prevention of pollution is necessary.

Today, the northeast part Kazakhstan Caspian area is a large region of an oil and gas extraction. Various chemistry and petrochemistry enterprises are concentrated here. The process of research of oil and gas fields on the territory continues.

Environmental condition around these objects is rather complex, but, except for Tengiz fields, monitoring of them is not carried out. Although Tengiz oil and gas complex takes nature protection actions, Terenuzek, Yeskene, Korsak fields almost do not pay any attention to the condition of the environment [1].

Pollution of atmospheric air is carried out by stationary (the industrial enterprises, especially oil and gas extraction and processing structure), and mobile sources (automobile and a railway transportation). However, due to the exceptional features of climatic conditions and a wind mode, it is difficult to examine correctly the areas and amount of accumulated polluting substances on a surface.

Dump of the crude industrial and economic - household sewage by the enterprises of the industrial targets located near coast within the limits of novocaspian sea plains is easier to observe. Together with wind affected phenomena, it may result in pollution of sea waters. Many oil and gas fields are located in the zone of flooding and influence of wind affected waters. They are surrounded by dams made of local clay, which is subject to flooding, abrasion and erosive processes. The problem of pollution of waters and soil by oil products is especially actual for the flooded fields of East Kokarna, Tajigali, Pribrejnoe, Pustinnoe, Morskoe. On fields of Kamyshitoviy and Terenuzek, during wind affected phenomena, sea waters frequently flood chinks and distribute pollution.

As a result of the latest increase in the level of Caspian sea, many other economic projects - settlements, seaside zones of industrial units, communications, oil fields of seaside territories are flooded also. Protection against an impact of the sea needed a construction of powerful, rather expensive dams. There was a threat of a transfer of some objects incurring enormous capital investments. Increase of a background sea level and wind affected phenomena have led to the rise in level of subsoil waters in a coastal strip, to capillary saturation and over-soaking of clay zones of aeration, to increase of aggressive salts in them, to formation of the new areas of the saline soils, salted and boggy territories. These processes extend the danger of destruction of the bases of buildings, corrosion of metal designs, flooding of basements. Pollution of sea water worsens environmental condition of coastal territories. Formation of an oil film on a water surface, besides deterioration of a gas mode and bioefficiency of a shallow part of Northern Caspian sea, have led to reduction in amount of evaporation from its surface and to change of water balance of a reservoir [2].

Clay and underground water pollution factors include passing waters dumped on fields of evaporation, which contain oil products, salts and heavy metals. Processes of becoming saltine of clay by waters of self-draining chinks are observed.

Petropollution of ground adjournment within the limits of a shallow shelf of northeast Caspian sea is highly probable. Mobility and rather friable condition of the top part of deposits strengthens transportation of polluted clay through currents subordinated to a relief of a bottom. Petropollution of a coastal zone is accumulated according to wind-waves mode, exceptional properties of clay, structures of a relief, presence and structure of vegetation.

Negative influence on coastal territories is performed by the disorder of transportation movement also, a lining of oil-and-gas route networks, a transport highway, ЛЭП, a various types of construction, quarries, sites of prospecting works, etc. Thus, the morphological structure of the soil collapses, its genetic properties change, occurs wind-blown carrying out fine-grained material, expanding environmental contamination.

From the environmental perspective, the territory is estimated by high internal danger. Rates and modern desertification of a soil - vegetative cover with low natural fertility are related to: 1. high degree of saltines and exposure to sun of soil 2. boric pollution of a residual sea origin of initial parent breeds of soil (the amount of a total pine forest in ground exceeds maximum concentration limit by 5-6 times, averages 45 mg / kg, mobile 8-17 mg / kg, exposed to sun and salty soil 8-10 times more); 3. pollution of soil by industrial emissions and sewage; 4. technogenous destruction of soil and vegetation by hydraulic engineering and human constructions, unsystematic roads.

From a summary it is visible, that in territory of northeast Caspian area there was the intense environmental condition, aggravated by additional pollution. Anthropogenous pressure on ecosystems may lead highly dangerous situation. Environmental well-being of northeast Caspian area depends on performance of the common actions coordinated by the state in order to control and care for environment of the region.

SATELLITE ALTIMETRY APPLIED TO CASPIAN SEA KARABOGAZ-GOL LAKE SYSTEM

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I. Introduction.

The Caspian sea is the largest inland sea of the world. It is consequently well covered by the different altimeter currently in orbit, and it offers the possibility of continuous and very high precision monitoring of the Caspian Sea Level (CSL), from 1993 (after the launch of Topex / Poseidon) until now. In fact the Caspian sea is an interesting target to evaluate the potential of altimetry in lake studies. It presents high level time and space variability, it has been monitored for more than 100 years by ground gauges, the reasons of CSL variations is still in debate, and the impacts on coastal zone are considerable.

Some different applications of satellite altimetry can be developed in the case of Caspian sea and Kara Bogaz Gol (KBG). They are described in the following section. This concerns three main components:

- Calculation of decadal Caspian Sea and KBG level variation and comparison with in-situ measurements.
- Estimation of water mass balance of each water bodies, based on coupled altimetry-climatological data
- Study of ice regime in the north of Caspian sea from combination of active (altimetry) and passive (radiometry) microwave data

II. Estimation of Caspian Sea and KBG level from the altimetry point of view, comparison with in-situ data

Due to its large area (375000 km^2) the Caspian sea is well covered by all satellite altimetry currently in orbit (Figure 1). 5 satellites can be used to compute the mean CSL variations.

Topex Poseidon launched on August 10, 1992, with an expected 5-year lifetime is still operating. It is a joined United States (National Aeronautics and Space Administration: NASA) - French (Centre National d'Etudes Spatiales: CNES) mission. The satellite carry two radar altimeters emitting on two frequencies (13.6 Ghz, Ku-Band, and 5.3 GHz, C Band), three frequencies Microwave radiometer (TMR: 18GHz, 21 GHz, and 37 GHz)) dedicated to the measurement of sea surface brightness temperature, needed for tropospheric correction and compute the surface wind spind, one laser reflector Array (LRA) and one radio positionning system (DORIS) both used to determined the precise orbit of the satellite. The orbit of Topex / Poseidon has been chosen in order to cover the maximum of ice free ocean without aliasing the tide, minimize the drag effect, and minimise the manoeuvre essential to maintain the orbit needed to reach the scientific requirements. The orbit of Topex / Poseidon is at an altitude of 1336 km, on a 10 days cycle repeat orbit, with equatorial cross-track separation of 315 km, and and inclination of 66°. The altimetry data and all geophysical and instrumental correction are distributed by two data center (AVISO and PO.DAAC) and are freely available to the scientific community.

The Jason satellite launched on December 7, 2001. It is the follow-on mission to the Topex / Poseidon mission. During the first 9 months of Jason's life (Calibration/Validation phase), both satellites were on the same orbit at 2 minutes of time interval. Since August 2002, Topex / Poseidon was put on an intermediate orbit in order to densify the coverage of both satellites (with equatorial cross-track separation between Jason and Topex / Poseidon of 160 km: see figure 1). The orbit of the satellite is determined with 3 positioning system, DORIS, GPS and Satellite Laser Ranging (SLR). The main requirement of Jason mission was to be at least as good as the Topex / Poseidon system.

The Envisat satellite has been launched on March 1, 2002 to monitor land, Ice caps and oceans with the main objective of addressing environmental and climatological issues. It carries many optic and radar instruments among them an altimeter, the RA-2. It is a nadir pointing instrument operating in a continuous mode around the whole Earth. It provides 18 range measurements per second. The satellite operates with a 35 day repeat cycle with an inclination of 98.5 degree, allowing an across track sampling of 80 km at the equator. It is particularly well adapted for lake monitoring as it increases by a factor 4 the spatial coverage of Topex / Poseidon of Jason satellites. The orbit is determined with the DORIS and SLR tracking systems. RA-2 has 2 channels of measurements (13.575 GHz: Ku band, and 3.2 GHz: S band) in order to correct for the ionospheric biais.

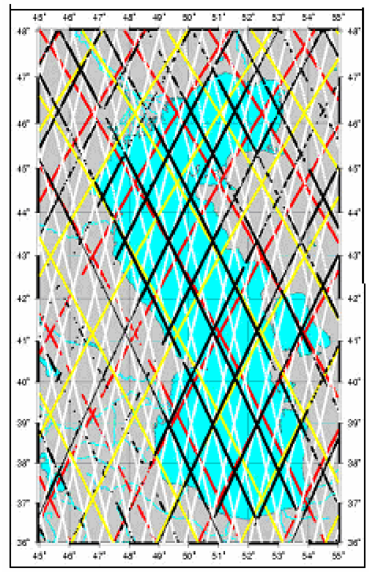

Figure 1: coverage of each of the current satellite altimeter. Jason (Red), Topex / Poseidon (Yellow), GFO (Black), and Envisat, ERS (White)

The Geosat Follow On (GFO) satellite has been launched on February 10, 1998 to maintain continuous ocean observatyion of the GEOSAT satellite. It has been put on a repeat cycle orbit of 17 days at an altitude of 800 km, and at 108° of elevation. Orbit is determined with Doppler Beacon. The radar altimeter operate in a single frequency mode: the Ku band at 13.5 GHz. Data are made available by the NOAA, but on the land surface a lot of altimetry data are missing. On Caspian Sea and Kara Bogaz Gol (KBG), a full coverage is available. The spatial distribution of the data, thanks to the specific orbit at 17 days repeat cycle, allow to complete the coverage of the 3 other altimetry system as one can see in Figure 1.

To compute the Caspian Sea and KBG lake level variations one thus can operate in a multisatellite mode. It is however necessary to first of all estimate biais between each satellite before computing the lake level in the multisatellite mode. Biais observed on Caspian Sea and KBG are in the range of 10 to 20 centimeters.

III. Water mass balance estimation

The water mass balance relate to variation of volume to climate or hydrological parameters. It is expressed by the water mass balance equation:

$$dV/dt = (P-E)S(t) + (Ri-Ro) + (Gi-Go) \qquad (1)$$

In which ***dV/dt*** represents the variation of volume of the lake in time. The inputs that tend to increase volume are ***P*** (Precipitation), **Ri** (river runoff to the lake) and **Gi** (underground water inflow), and the output which tend to decrease the volume are ***E*** (Evaporation), ***Ro*** (Runoff discharge from the lake) and ***Go*** (Underground losses). The water balance is a key element of analysis of impact of climate changes or human activities through water consumption in the surrounding catchment area, as lake will always tend to towards an equilibrium where ***dV/dt = 0***. If one of the components varies, the lake level will change in order to compensate and reach a new equilibrium. At seasonal time scale, the variation of evaporation and precipitation are the main drivers of lake level variation toward steady state. Indeed, the computation of water mass balance is a good indicator of climatic conditions, or inter-annual climate change.

Traditionally some of these parameters are easily measured (river runoff, precipitation), while for the others, their estimation impose the uses of hydrological or climatic modelling (evaporation, underground seepage).

For the Caspian Sea the water balance has been computed for the last century thanks to in-situ data based on the network of hydrometeorological stations homogeneously scattered along the coast and Islands of the Caspian Sea. The first measurement of sea level was made in Baku (Azerbaidjan's capital) in 1837, and this was followed by many other site measurements (Shiklomanov et al., 1995). Annual sea level variations from four stations (Baku, Makhashkala, port Shevchenko and Krasnovodsk) were averaged to provide an "official"Caspian Sea Level (CSL) as given in figure 2. Based on these data, the assessment of Caspian Sea water balance as published in numerous articles. The objective was to determine the uncertainty in the water balance (mainly the evaporation rate), with emphasis on explaining the level variations and predicting future evolution of the CSL (Kosarev and Yablonskaya 1994; Shiklomanov et al., 1995; Mamedov 2001; Panin, Mamedov, 2005).

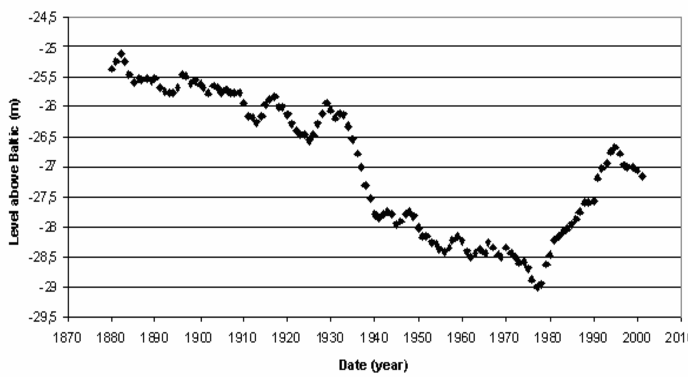

Figure 2: Caspian Sea level from in-situ data

The water balance of Caspian Sea is principally dictated by variations of Volga river and evaporation rate. There is a detailed description of all components of water balance in Shiklomanov et al., 1995: main features are the following:

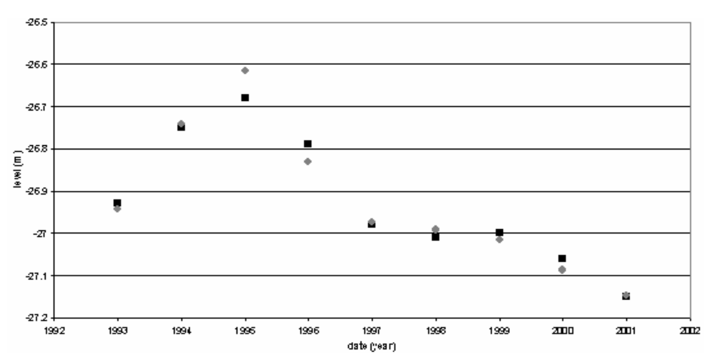

Figure 3: Caspian Sea level variation from altimetry (grey circle) and from in-situ

The Volga river provide more than 80% of the total inflow, and dictates interannual variability of the Caspian sea.

The approximate underground water inflow is about 3-5 km^3/yr and doesn't affect significantly water balance.

Precipitation rate is 250 mm/year in average and present high temporal variability.

Evaporation represents the main outflow component, (730 mm/year in average) without high temporal variability

Discharge to the Kara Bogaz bay in the East varied a lot in the past and depends on the difference level between the Caspian sea and the bay. It varied from 0 to 30 km^3/year.

Usually evaporation, which is difficult to measure directly, is computed as the residual term of the water balance.

The Caspian Sea is characterised by cyclic and high amplitude water level variations over historical time scales. For 2000 years the fluctuation were around 15 meters and for the last five centuries ~7

meters, noting extreme level oscillations of -23 m in the mid XVII century, and -29 in 1979 (Skadov et al., 1995). Caspian Sea level variation in the 19th and 20th centuries is given in figure 2. Between 1870 and 1929 the mean water level was -26m. Then it abruptly dropped ~2 meters in ten years. It continued to decrease reaching a minimum value in 1979, when the level started to rise again, the following 17 ears saw an increase of ~2 meters (figure 2).

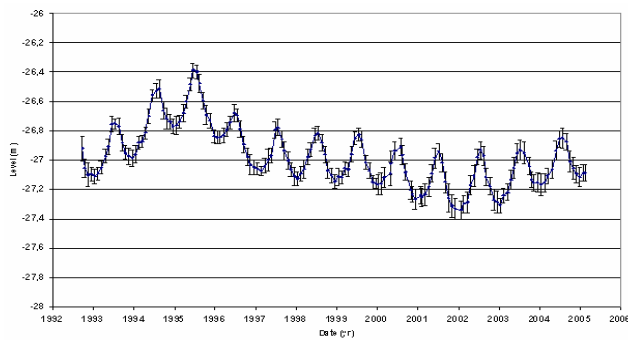

Figure 4: CSL variation deduced from altimetry measurements

Since 1993 with the help of radar altimetry, new water balance of the Caspian Sea can be estimated. Indeed altimetry could provide new light on the water balance variability of this big lake, connected to regional and global climate changes. First of all because since few years, many in situ data are not available, secondly because this can help to assess the quality of in-situ measurements when they exist. Comparisons of recent altimetry measurement and in situ gauges measurements are shown on figure 3 for annual term from 1993 to 2001. This figure demonstrates that the general trend of both time series are correlated (coefficient of correlation of: 0.98) but also that it remains some discrepancies in particular in 1995 which represent an amount of 7 cm of level, hence around 30 km^3 of water volume difference. After 2001 no in-situ data have been published for the level of Caspian Sea. Figure 4 show the Caspian Sea level from radar altimetry up to 2005: http://www.legos.obs-mip.fr/soa/hydrologie/hydroweb/

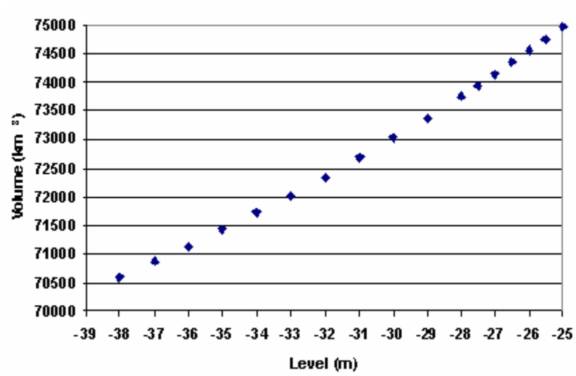

Figure 5: Hypsometry of Caspian

Figure 4 indicates first of all interannual variations, correlated with hydrological condition of the Caspian Sea basins. A slight decrease of the sea of around 60 centimetres in 7 years is observed after the highest level in 1995, followed by a rise again after 2002 currently continuing. It also indicates seasonal variations of sea level at around 15 centimetres, mainly driven by changes in river runoff, evaporation and precipitation. CSL determined by altimetry is then used to compute the evaporation over the same period, by inversion of equation of water mass balance (eq 2). In a first step the CSL is converted into Caspian Sea Volume variations (CSV) using hypsometric curves represented in figure 5.

The total river runoff, the precipitations and the discharge to Kara-Bogaz-Gol are given by in-situ measurements and shown on figure 6. Evaporation deduced from those data and inversion of eq (2) for the period 1993-2001 is given in figure 7. During the last decade altimetry show an increase of evaporation of around 22 mm of water per year (see figure 7). Models of evaporation indicate only an increase of evaporation of 17 mm/year during the same period. The difference in CSL in 1995 for altimetry and In-situ data (See figure 2) is the main reason which may explain this discrepancy

between rate of evaporation for the period considered. This highlight the interest of having very precise measurements of CSL.

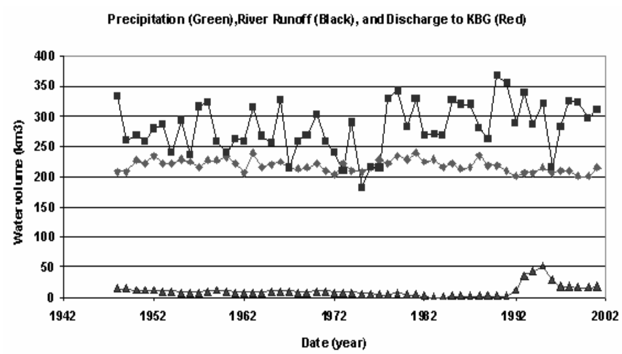

Figure 6: total river runoff, the precipitations and the discharge to Kara-Bogaz-Gol are given by in-situ measurements.

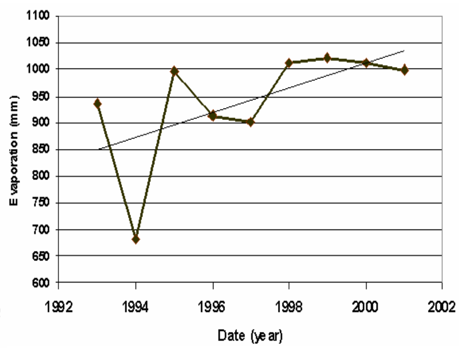

Figure 7: Evaporation Caspian Sea deduced from altimetry

IV. Impact of Volga river discharge on the CSL

From monthly data of Volga Runoff which represents more than 80% of the total runoff to the Caspian Sea, and altimetry monthly CSL variations one can estimate the time shift between maximum of discharge which occurs in Spring and maximum of the CSL which occurs two months later (Figure 8). Obviously not all the Caspian Sea volume variation can be explained by Volga Discharge: one should also take into account precipitation and evaporation seasonal fluctuations.

However, one could also be interested by spatial coverage of the CSL, which could explain in more detail the impact of Volga discharge on the CSL. On figure 8 and 9 is represented the amplitude (in cm) and phase (expressed as the day of the maximum of amplitude) for the CSL calculated

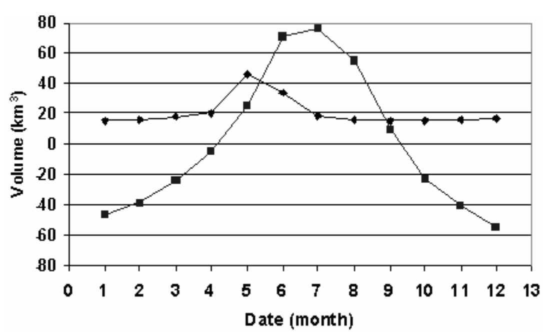

Figure8: Monthly CS volume/annual

along the Topex/Poseidon tracks. This results are very interesting for many reasons: this shows that amplitude of seasonal CSL variation is not a constant in terms of spatial distribution. There is a strong geographical pattern with more than 15 cm of annual amplitude in Central Caspian Sea, while in the NE or SE of the basin, annual amplitude does not exceed 10 cm. If we take a look on the distribution of the phase of the annual signal, there is also evident geographical patterns, with in particular a earlier pike of amplitude in the North East of the Sea, and later (by around 30-35 days) in the NW, SW or the central part of the sea. It is not evident whether this can be attributed to Volga river discharge behaviour. In fact few complementary and independent phenomenon could explain this: spatial inhomogeneous distribution of Evaporation minus Precipitation, snow melt process, and Volga and Ural river discharge under the wind stress which generate surface current in the whole sea.

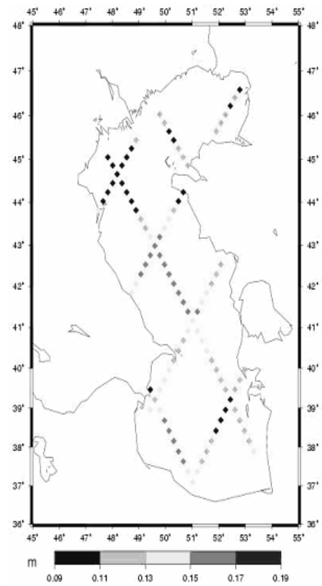

Figure 9: Caspian

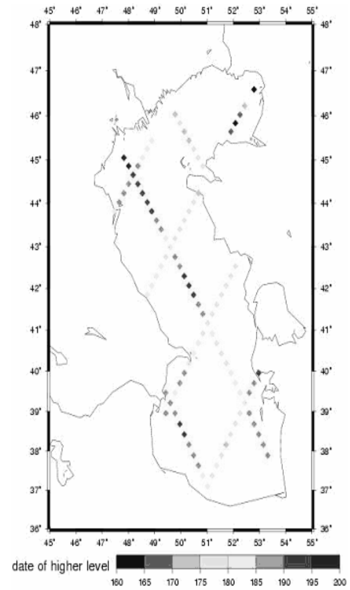

Figure 10: Caspian Sea

VI: Kara Bogaz Gol water mass balance

Connection with Kara Bogaz bay is also an interesting possibility of research, as altimetry provide also on this smaller lake very precise level variation as shown on figure 11.

Over the last decade, thanks to these altimetry and in situ hydrometeorological data one can also calculate the water mass balance of Kara Bogaz Gol, and in particular estimate the rate of evaporation as done for Caspian Sea. This is given in Figure 12.

Evaporation-Precipitation on KBG is much higher than on Caspian Sea. One can also remark

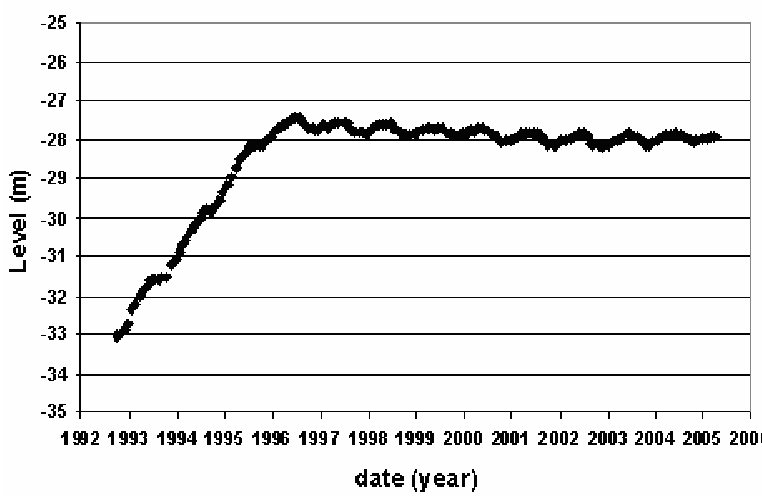

Figure 11: Kara Bogaz Goll level variation from multi-satellite analysis

than there is no increases trend of E-P for KBG as observed for Caspian Sea. Under the general increase of temperature associated to global warming this could be a surprising result. But E-P is also be controlled by precipitation temporal behaviour which in the case of the KBG is closely linked to the presence of Caspian Sea in the west, in particular under a general Eastward wind regime. It is generally known (Krapivin and Phillips 2001) that precipitations over the central Asian region, and in close area to Caspian Sea, like Aral Sea or KBG, are partially generated by water evaporated from Caspian sea. This indicates that an increase of evaporation over Caspian Sea can be followed by an increase of precipitation. If the E-P on KBG is mainly driven by variation of temperature, the 2 curves (on Caspian Sea and on KBG) should follow more or less the same trend. If precipitation is not negligible in the E-P ratio of KBG, then it is strongly influenced by those on Caspian Sea. This may occurred in 1993, and from 1996, to 2001. For this period when Evaporation rised in the Caspian Sea, it was attenuated or even revearsed on the KBG, which indicates more precipitation, while for the year when the E-P ratio diminish in the Caspian Sea it was either amplified on The KBG (decreasing of temperature is observed for both lakes, but KBG still receives some additional precipitation) either revearsed (which probably indicates that impact of lesser precipitation than the previous year prevails on the decreasing evaporation rates due to decreasing of temperature). A better assessment of water balance of KBG could be done with precise measurements of lake and air temperature and wind on the KBG and high spatio temporal resolution precipitation gridded data set. Altimetry data that give monthly based level of Caspian Sea and KBG can then be assimilated within a climatic model of the region, as control or even more as forcing data of the model.

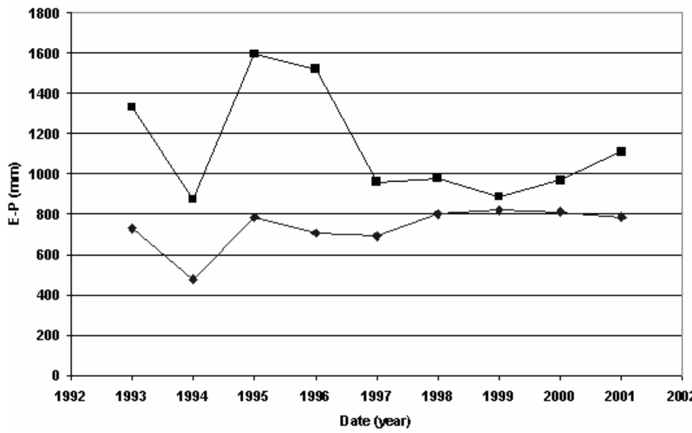

Figure 12: E-P on KBG (black) and Caspian Sea (red)

VI. Ice studies in the Caspian sea using satellite altimetry and radiometry.

Every winter the Caspian sea is covered by ice. The presence of ice negatively affects navigation, fisheries and other industrial activities. Of special concern is the impact of sea ice on industrial constructions located in the coastal zone, such as Russian and Kazakh prospecting oil rigs operating in the Northern Caspian shelf. Ice conditions make it necessary to maintain an ice-breaker fleet as well as to use oil drilling rigs of arctic-class in the Northern Caspian.

Ice processes in the Caspian sea have a significant temporal and spatial variability, influenced by meteorological conditions, wind fields and water currents, as well as by sea morphology. Caspian sea is located on the far southern boundary of sea ice cover development in the Northern Hemisphere. Due to this marginal location, data on ice variability may serve as an early indicator of the large-scale climate change. However, publicly available information on ice conditions in the Caspian sea is absent. Satellite remote sensing is able to fill this information gap and provide data for analysis of recent variability of ice cover using passive and active satellite microwave data since 1978 up to present.

Satellite microwave observations offer reliable, consistent, weather-independent, and easily accessible data on the ice cover. For many years, global sea ice cover has been studied using satellite observations, especially from instruments operating in the microwave range, such as passive radiometers, SAR, radar altimeters, etc. Numerous studies of ice cover variability have been conducted using passive microwave observations from SMMR and SSM/I instruments, providing global observations of ice extent with high temporal resolution. Most of these ice algorithms (such as NASA Team or Bootstrap algorithms) require good knowledge of radiometric properties of ice for each specific region. However, in many cases, such as for the Caspian sea, there are very few or no available in situ measurements of radiative properties of ice cover, and this fact significantly reduces applicability of these algorithms.

For these cases a promising novel satellite remote sensing technique for ice cover studies has been developed and tested. The method is based on the combination of simultaneous nadir-looking active and passive microwave measurements from satellite altimeters. [Kouraev et al., 2003a, 2004 a,b] and consists for the T/P in analysing data in the space of the backscatter coefficient at 13.6 GHz versus the average value between temperature brightness values at 18 and 37 GHz. T/P observations are processed and then further complemented by the passive microwave data from SMMR and SMM/I. The combination of specific advantages of both types of observations – such as wide spatial coverage and temporal resolution of SMMR-SSM/I and high radiometric sensitivity and along-track spatial resolution of T/P - allow to significantly enhance the capabilities of microwave measurement for ice studies.

Using satellite data, time series of (i) beginning and end dates of ice season, (ii) ice season duration and (iii) ice cover extent were computed. These results for the first time since mid-1980s provided continuous assessment of ice cover variability in the Caspian sea and indicate significant spatial and temporal variability of ice conditions, with a marked decrease of both duration of ice season and ice extent in

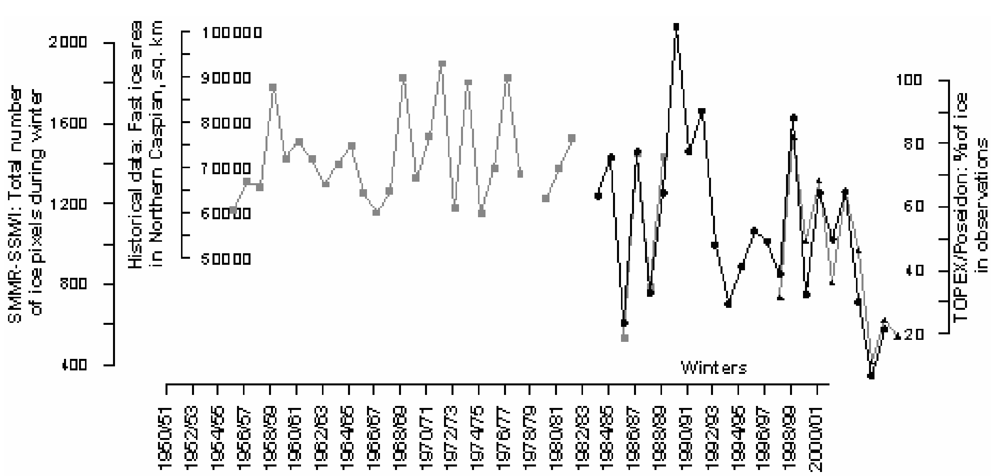

Figure 13. Ice cover extent in the Caspian and Aral seas from historical (bold grey line with rectangles) and satellite observations: SMMR and SSM/I (black line with black circles) and TOPEX/Poseidon data (bold grey line with black triangles) (Kouraev et al., 2004b)

recent time (winters 1998/99-2001/02).

The synergy of simultaneous data from nadir-looking active and passive sensors onboard the TOPEX/Poseidon satellite and passive microwave observations from SMMR and SSM/I represent a significant potential for the studies of sea ice cover and, for the first time, provide us with a continuous series of ice cover parameters for the Caspian sea since the mid-1980-s. Further validation and improvement of the ice algorithms using in situ and other types of satellite data will provide additional information on ice concentration, ice roughness and other parameters. Comparison of parameters of ice conditions in the Caspian and Aral sea with external climatic data will improve our understanding of the natural processes in these seas.

The combination of specific advantages of both types of observations – such as wide spatial coverage and temporal resolution of SMMR-SSM/I and high radiometric sensitivity and along-track spatial resolution of TOPEX/Poseidon - will significantly enhance the capabilities of microwave measurement for future ice studies.

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INTERPRETATION OF RECENT INCREASING OF CASPIAN SEA LEVEL

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The recent increasing of Caspian Sea level was interpreted by all other scientists in comparison with open sea as G.H.E, tectonic movement, and increasing of precipitation, without considering the evolution of closed basins such as Caspian sea, as pluvial lake in Quaternary about 2000000 years ago.

There was 6 glaciation and interglaciation periods in Quaternary. The last glaciation Wurm Ш achieved about 12000 years BC. We are actually in interglaciation period from Holocene in which, the increasing of temperature occurated the melting of polar ice in Antarctic and Arctic, accumulated during the precedent glaciation Wurm Ш in high latitude, increasing the open sea level, so, called G.H.E.

The Persian golf, the Manch, the Behring and others shallow regions are submerged. The Caspian Sea, as pluvial lake, did not follow the system. The bilan of input water (360km3/y) and output water (410km3/y) in interglaciation period is negative from Holocene to recent about 3cm/y with decreasing of sea level.

The convention between Iran and last U.R.SS in 1930 takes the sea level as -25.6m, we assist to continual decreasing sea level, with an important shoot from 1940 to 1950, related to dams construction and water using for agriculture and industry.

The northern part of Caspian Sea lies in Russian shield, with mean depth of 6m; the decreasing of sea level about 3m (to -28.5m in 1978)was a catastrophe for ecology, fishering and marine transport for U.R.SS, the oceanographic council of U.R.SS in 1972 recommend the maintenance of sea level, at -26 m imputing about 1200km3 water from Pechura and others northern rivers by 56km3/y for 20 years till 1998 with 13cm/y increasing the surface to avoid the catastrophic events in north shallow area of Caspian.

GEOMORPHOLOGY OF CASPIAN AND ARAL SEAS REGIONS

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The brief characteristic mainly flat relief of extensive region covering the Kazakhstan part of the East Europe platform and northern half Turan plate is given. Six integrated geomorphological areas with taking into account of an origin of a relief, its age, history of development, regularity of different forms distribution are considered. Region with determined oil and gas content, is incorporated by two largest reservoirs of arid zone and is exposed to natural – antropogeneous stress in connection with transgression of Caspian sea and disastrously shrink of Aral.

FEARS AND REGRETS OF CASPIAN SEA LEVEL CATASTROPHE AT -22 M IN 2050: RISK PERSPECTIVE IN GOLESTAN PROVINCE,IRAN

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In spite of critical uncertainties in current Caspian vagrant science and eustatic paradox, one of the long-term prediction is the Caspian Sea level rising up to -22 m datum in 2050.This high stand sea level that have been supposed as a safe and confidence datum by littoral countries since the 1980s, will threat by high risk all coastal zone management plans and projects as a pervasive catastrophe of Caspian hidden hazard and dark nature.

Caspian people had to cope with a sudden sea level rise of three meters in twenty years by continuous fearing and blessing and already experienced what scientists fear could happen to others in the near future elsewhere in the world as global warming and ocean level rising hazard. Doubtless, the imagination of increasing risk and perspective of sea level rising hazard to -22 m in the lifetime of current generation will go beyond the all emotivative thresholds of political, scientific, economical and technical decisions on national, regional and international scales and will cause to public fear for beneficial people and land users, and strategic regret for responsible leaders, scientists and decision makers.

Risk perspective of gradual or sudden transgression of sea water up to -22m in the Golestan province will be diverse and tremendous. Along more than 63 Km coastline and between -27 and -22 m datum in the coastal plain of province, different elements including cities, villages, farms, ranges, industries, fishery sites, seaports, railroads and other vital infrastructures with different vulnerability will be at severe risk and cause to a new geo-eco-disaster in the region like other Caspian coastal regions in five littoral countries.

We must try to understand specific spatial and temporal impact radius and decay time, remembering of risk as well as direct victims , and learn much more constructive lessons from each level rising catastrophe of dark sea to combating the threaten and hidden hazard and improving the ability of the people under pervasive fear and risk. Also, we must try to find modern solutions with politicians closely working with scientists and engineers, even their temporary mechanical unity for the radical solving of Caspian Sea level chronic problem and disaster.

Certainly, the only logical online way to prevention the probable catastrophe and end to fearing live with Caspian eustatic paradox lies on sea level stabilization strategy at suitable datum via " engineering solution" and by political motivation and support, and of course by sharing the multi-dimensional risk globally in the direction of human common future securing.

HEAVY METAL CONTAMINATION IN NEARSHORE SEDIMENTS ALONG THE IRANIAN COAST OF THE CASPIAN SEA

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This research examined the concentrations of heavy metals (Al, Cd, Cu, Pb, Ni, Zn) in the nearshore sediments in the alongshore direction of the Iranian coast of the Caspian Sea. Fourteen samples were collected and granulometric composition determined. The consideration of three grain size fractions (0.355 mm, 0.212 mm and 0.075 mm), plus fourteen bulk samples required analyzing 56 samples for the presence of heavy metals. Laboratory analysis utilized a cold acetic acid extraction procedure, followed by inductively coupled plasma optical emission spectroscopy. Box and Whisker plots demonstrated that metal concentrations were not homogeneously distributed, and there were large spatial variations in the median concentrations of heavy metals at each sample site. The statistical technique of discriminant analysis revealed that the six heavy metals had distinct and statistically significant concentrations at various locations along the coast. Concentrations reflected metal loadings from anthropogenic sources located at and in the vicinity of the sampling sites.

THE IMPACT OF SEA LEVEL CHANGE ON TRACE METALS IN CONTAMINATED SEDIMENTS ALONG THE IRANIAN COAST OF THE CASPIAN SEA

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Fifty six samples of total sediments and the separated size fractions were analysed employing aquaregia digestion followed by Inductively Coupled Plasma –Optical Emission Spectroscopy (ICP-OES) to evaluate the pollution level and the trends in samples collected along the Iranian coast of the Caspian sea in August 2005.
Selective partitioning of the studied contaminants in sediment fractions was observed, with a minimum content in the very fine sand fraction of grain size 0.075-0.125 mm. Anomalously high concentrations of trace metal content in the medium and coarse sediment fractions (0.212-0.250 mm and 0.355-0.500mm) was explained by the following:
1- As sea level change induced mixing in the shallow near shore waters winnows out the fine-grain material, pollutants discharged into this region are not likely to accumulate in the immediate vicinity and thus are exported. The finer sediments(silt/clay fractions) are comparatively highly polluted and are easily moved to the deeper waters. Remaining coarser particles better document anthropogenic inputs because of their limited transport and longer residence time at any particular site, often in shallow oxygenated areas and therefore may have more time to develop oxide coating and absorb more trace metals than smaller particles.(1)
2- Formation of large agglomerates (clusters), formed from smaller sediment fraction particles enriched by various contaminants kept on their large specific area by adsorption forces, have been also observed in medium and coarse sediment fractions. The formed agglomerates consist of small particles cemented either by dissolved organic matter or by sea salts present in the marine sediment.
3-Presence of heavy minerals or coarse fractions of lithogenic(terrigenous) origin also increase metal concentration in the coarser fractions.

The heavy metal data for different size fractions of the sediment samples collected along the Iranian coast of the Caspian sea suggest that the effects of grain size on the metal distribution in the sediments are uniform throughout the study area. Thus, control of grain size over metal distribution in sediments must be considered while dealing with the heavy metal data of the area under investigation.

Keywords: Caspian sea, Sea level change, Grain size, Heavy metals, Sediments, Iran.

EOLIAN PROCESSES IN SAND MASSIFS OF MANGISTAU PENINSULA

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Eolion processes of late-quarter and holocene time have generated a number of sandy files in the central zone of Mangistau peninsula, extended in a northwest direction: Sauskan, Baskuduk, Bostankum, Tyshkankum, Sengirkum, Tuyesu, and others.

Sandy files are dated to large denudation hollows and valley-shaped downturns. Formation of sandy files has taken place due to long movements of raw sand and sandstones of cretaceous system.

The mineralogical structure of sandy adjournments of the region is characterized by the insignificant contents of heavy fraction (up to 0.20 %) in which magnetite and ilmenit prevail (18 - 41 %). The prevailing simple fraction is represented by quartz (38 - 62 %) and field spats (32 - 35 %). On mechanical structure sand are well sorted, the fine-grained fraction (70 - 95 %) prevails. The resulted characteristics specify favorable development of deflationary processes.

Process of carrying out of sand directly depends on velocity of wind. The minimal (critical) velocity of wind at which sandy particles start to move, is equal to 5 - 6 km/s. In researched territory average long-term velocity of winds reach 5 - 7 km/s, i.e. fall in the active category, which favourably influences active development of a deflation. East and northwest directed winds are dominant during the year in Mangistau peninsula. At more than 12 km/s velocity of a wind, there is an appearance of sandy storms, which are observed here throughout the year repeatedly 5-6 times a month. 16 - 33 % of storms appear during cold period, 66 - 83 % - fall in warm, and their maximum is observed in July, reaching 19.6 % from the total annual amount. Hence, during activization of winds and development of sandy storms, there is frequently occurring coordinal changes of a relief within the limits of sandy files. Apart from that, the development of deflation process is influenced by deficiency of deposits, relative humidity of air and fluctuation of temperature. The amount of deposits in the given territory does not exceed 120 - 150 mm per year. The basic stocks of a moisture in ground are formed during the cold period (November - March). Relative humidity of air 54 - 61 %. Average temperature of July 29°C, and January a - 3,5°C.

The soil - vegetative cover also influences development of eolion processes. Deserted sandy ground of the given area is friable and unstructured, thus, is easily exposed to processes of a deflation because of weak fixation by vegetation, i.e. a vegetative cover is very rare; in particular places it is absent.

Sandy files of Mangystau peninsula have been used under pastures for a long period of time, the wood vegetation on many sites is cut down on fuel. Moreover, stale underground water fields of Tuyesu and Sauskan sandy files have been exploited for more than 30 years; they are used for water supply of Janaozen, Jetibay, Senek, Ushtogan cities and other settlements of area.

Therefore, the wind mode, insignificant amount of deposits and irrational economic activities create favorable conditions for development of eolion processes within the limits of territory of research. These conclusions prove to be true as a result of detailed researches of deflationary processes within the limits of Tuyesu sandy file. The most moving sands are located here, represented by separate and group barchans, barchans circuits. Most of the movement of barchans circuits occur during warm period of the year. Height of barchans circuits reaches 3 meters with length of more than 60 meters and with width of mid-barchans downturns of about 20 meters. Displacement of barchans circuits in a northwest direction on the average totals to about 15 meters per year. Sand covers motorways, engineering constructions and comes closer to Senek settlement.

In the meantime, Institute of geography of Ministry of Education and Science of Republic of Kazakhstan has developed and effectuated a project, directed on fastening of moving sand; authors of the given article also participate in the project.

AN INVESTIGATION ON WATER CHEMISTRY IN MEIANKALE AREA, SOUTH WEST OF CASPIAN SEA

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The recent water chemistry investigation in situation 713282.51 to 770343.89 and 4084974.74 to 4101473.08 in Caspian Sea, from 18 up to 50 meter of water depths was measured in 31 locations of water for pH, Do, TDS, EC, T, Salinity and Heavy metals such as Cr, Pb, V.
These measurements have been done in different levels of water (1, 10… 50m). In each location we have a sample near sea bed. All samples have been detected by sension146 and measurements have been done in situ.
The average salinity ranges from 14.80-17.40 ppt and the lowest value is in northern east of area that indicative fresh water run off into the area of study. pH ranges 8.24-8.47 that highest is in middle to south of area. Dissolve Oxygen ranges 1.8-9.8 mg/l, Temperature ranges 26.30-29.20 C that lowest is in south of area; So there is a strong effect of run off from southern east and northern east that is base of our investigation. We have also used cluster analysis to know about relationship among heavy metals.

MARINE HOLOCENE OF THE CASPIAN COAST OF IRAN

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Marine Holocene deposits of the Caspian coast of Iran are still poorly studied. Thanks to our colleagues from Iran and the organizers of the International Conference "Rapid Sea Level Change: a Caspian Perspective" held in Iran (Resht) in May 2005 we got a remarkable opportunity to visit and describe several sections of New Caspian sediments and to collect molluscan shells which were later identified and dated.

The sediment section in the inner part of the Holocene barrier beach separating the Anzali lake from the Caspian Sea consists of three sediment units. The upper and lower units are represented by coastal marine deposits. Faunal inclusions (predominantly Cerastoderma glaucum (Poir.) suggest the basin had a normal Caspian Sea salinity of 12-13‰. Marine beds are separated by lagoonal sediments which possess evidence of former episodes of freshening (co-occurrence of marine euryhaline, brackishwater and freshwater mollusks) and emergence (traces of hydromorphous soil formation).

The seaward part of the barrier beach is exposed in the quarry to the north from the described site. Here, the two series of coarse coastal deposits are assumed to be counterparts of the upper and lower marine units in the previous section, whereas lagoonal sediments are absent. Interestingly, sediments of the modern beach have a considerably more fine-grained composition than the pebbles from the quarry. They are largely represented by sorted fine sands with shells of Cerastoderma glaucum (Poir.) and rare fragrant valves of Adacna vitrea Eichw. and Ad. laeviuscula Eichw. These findings point to deeper and considerably more dynamically active near bottom environment during accumulation of the barrier beach sediments than now.

Sediments of the coastal lowland which is protected from the sea by the barrier beach consist of a 6-m-thick sequence of terrestrial aquatic deposits altered by soil formation processes. The investigated part of the section lacks marine deposits and channel alluvium facies, but it is possible to trace the tendency of a gradual replacement of marine (previously reported to be below the present water level) and lacustrine-lagoonal sediments by periodically accumulated alluvial deposits altered by soil formation. The section is characterized by high sedimentation rates reaching up to 0.5 cm/year.

Analysis of the studied sections allows distinguishing three types of Holocene sediment sequences in the area corresponding to different landforms: barrier beach, New Caspian terrace and coastal lowland. The sediments of the barrier beach separating the Anzali lake from the sea are represented by two marine layers divided by lagoonal layer in its inner part. The terrace separating the coastal lowland from the sea is comprised by marine sediments solely, while the lowland is covered by a layer of terrestrial aquatic sediments with the traces of hydromorphous soil formation. Marine Holocene sediment sequences of these two types are typical for other Caspian Sea coasts, especially for Dagestan coasts which have a similar geomorphological structure. The third type is represented by sediments of the marine terrace bordering the vast coastal lowland. These are formed by downslope sediment accumulations from the Elburs mountains and are unique for the Caspian coast of Iran.

The New Caspian molluscan assemblages differ from the correlative faunal assemblages from other Caspian Sea coasts by predominance of Cerastoderma glaucum, Didacna of crassa group and the presence of rare brackishwater species.

FEATURES OF DEVELOPMENT OF EROSION PROCESSES ON KAZAKHSTAN CASPIAN COAST IN CONDITIONS OF MODERN TRANSGRESSION.

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One of the key factors in modern relief formation of Caspian coast is water erosion. Plane washout, gully and river-bedded (ground and lateral) erosion have the widest distribution here.

Due to scarce liquid deposits, plane washout occurs on little inclined plain sites of denudative and accumulative plains, on slopes of Baer's mounds, between sors heights because of weak soil-covered surfaces on loamy and sandy breeds with high water penetration. Intensive snow melting, rare storm rains during the spring period cause maximal activity of the process, in particular at northeast coast where the relief is represented by numerous sors and low mid-sors heights extended between them. Sors serve as bases of erosion of plane washout.

Processes of deep erosion on the rivers of researched area do not perform the expressed intensity due to small longitudinal slopes of Zhajyk, Jem, Sagyz rivers. The expressed spring high water of these rivers, to which the maximal usage of water is corresponded, increases their erosive potential. During a high water, ground and lateral erosive processes become more active within the limits of the valley and channels through which a dump of a part of waters is conducted.

The high level of the Sagyz and Emba rivers falls in the time from the end of March up to the middle of April. Accumulation of deposits prevails, as a result of which channels break up, bifurcate and form meandering channels with some deepening.

Plane alignment along with the linear erosion connected to the activity of wind affected phenomena is typical for low sea coast. During wind affected phenomena small natural downturns sometimes become temporary channels.

Gully erosion is shown in research area at intensive snow melting, short-term, but strong downpours on badly fixed by vegetation slopes of a surface on friable, easy to wash away adjournments. The special role in activization of gully erosion belongs to human activities.

In Mangistau region, on slopes of Aktau, Karatau mountains, on downwearing chinks of Ustyurt, processes of linear erosion in terms of intensive gully formation and rills are well expressed. As a result, significant areas remain without a soil - vegetative cover.

Displays of process of linear erosion combined with landslips, landslides and activity of a wind are everywhere on Chinks of Ustyurt and Mangistau plateaus, and also on abrupt slopes of sors, abrasive ledges of sea terraces.

SOUTH-CASPIAN SEDIMENTS DATING USING 210PB TECHNIQUE

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Lake and estuarine sediments provide a basis for reconstructing many aspects of natural changes and man's impact on the environment, for estimating rates of change and for establishing a baseline in environmental monitoring programs. In such studies the establishment of accurate chronologies of sedimentation is of vital importance not only for dating events but for determining sediment accumulation rates.
210Pb is a naturally occurring radioactive isotope (half-life of 22.26 y) that has been used extensively to determine ages and sedimentation rates in various settings including lakes, continental shelves, and wetlands. This radionuclide is the decay product of soil-derived noble gas 222Rn. Soon after formation it becomes attached to the sub-micron aerosols in the atmosphere. 210Pb enters a lake or reservoir either directly by precipitation or indirectly in run-off from the catchment, which in turn is deposited at the mud/water interface by sedimentation and exchange processes and becomes incorporated into the sediment column.
With the recent increasing interest in Caspian studies especially the focus on sea level change, there is a need for more frequent application of chronological techniques. The 210Pb technique is a promising method for dating sediments spanning the last 100-150 years. A comprehensive collaborating program is now established in this respect to assist South Caspian sediment studies.
210Pb activities were measured by partial digestion of sediment samples using HNO3 and HCl acids to extract the granddaughter 210Po, which was then analyzed by SSB α-spectrometry system. The "supported" 210Pb were estimated by assaying 226Ra through γ-spectrometry using HPGe detectors. Primary results of the analysis carried out on sediment cores collected from locations near to the Sefidroud estuary and from Anzali Lagoon show sedimentation rates in the range of 5-11 mm y-1, which is slightly higher than the sedimentation rates estimated previously based on 14C dating of bivalve mollusk in southern Caspian.

DYNAMIC OF CASPIAN SEA BY USING REMOTE SENSING DATA

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The Caspian Sea is known as an excellent natural laboratory for study of coastal response patterns, because highly variable in its water level over decadal and secular time scale. Coastal morphology, especially the near-shore bottom slope, and the profile of coastal sedimentary bodies or erosion scarps, as well as the rate and amplitudes of sea-level change appear to be the most important factors in coastal response rate and patterns .The Caspian Sea, after being closed, has experienced many cycles in transgression and regression. It fell down 3 m between 1930 to 1975 from –26to -29and rose back again to –26 m. Although there is no any rigid reason for this fluctuation but the run off of Volga River plays an important agent. The Volga runoff accounts for around 78 percent of the annual gained by the sea. During sea level fall morphological features like Delta encroach in Caspian Sea and during sea level rise erosion processes are dominant form of coastal area. Due to rapid sea level, sedimentary processes can be investigated on a decadal scale, much faster than the oceanic coastal processes. Former delta outlines, former barrier-lagoon complexes and marine terraces are the most typical features indicating former high stands of the Caspian Sea. The south Caspian basin located along Alborz Mountain then tectonic deformation should be considered for study of sea level change. For this study Iranian shorelines at the east of Caspian Sea have been targeted to show rapid sea level rise and reaction of coastal processes against this fluctuation. By using remote sensing data including ASTER, TM, ETM, IRS data were used to interpret of shoreline and to show rapid sea level of Caspian Sea and also by using Dem data including SRTM and Astre dem morphological features were analyzed. Old shorelines and marine terraces were detected by using topographic map and Dem data as well as fieldwork observations. The boundaries of old delta and remained step-like terraces have been distinguished along coastal area.