THE ARAL SEA:
Water, climate, and environmental change in Central Asia

Michael H. Glantz and
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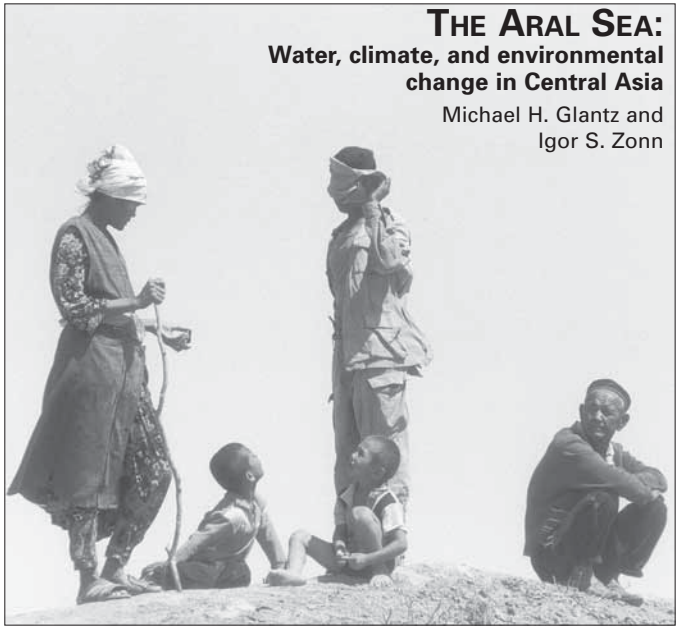

World Meteorological Organization
Weather • Climate • Water

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Cover photo: People standing near the Aral Sea, Muynak, Uzbekistan, 2001 (© M. Gattoni)

THE FLIP SIDE OF SCIENCE

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NOTE

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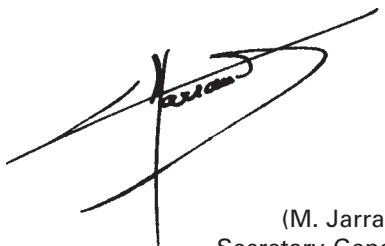
Foreword

The World Meteorological Organization (WMO) is well known for its scientific programmes on weather, climate and water, on natural hazards, on observations of the Earth's climate system from the surface and from space, and for communicating data and information on these subjects. Through the network of National Meteorological and Hydrological Services (NMHSs) in each of its 187 Member countries and territories, WMO also plays an increasingly vital role in the application of climate science to human progress, to sustainable socio-economic development, to poverty alleviation and to environmental protection. At the regional level, threats to human well-being and to the environment include the creeping environmental problems that have caused potentially irreversible damage to an inland sea, the Aral, which was once part of a thriving ecosystem.

This book is in two parts. It starts with the story of the Aral Sea followed by a set of maps, showing the Aral from 1960 to 2004. To use these maps, simply hold the book in your left hand and flip the pages with your right hand to see the sequence of changes to the region over this period. I sincerely hope that you will find the book, and the additional information to be found in the extensive list of resource materials, thought-provoking, educational and useful.

WMO will continue to play its part in monitoring the weather, climate and water of the region, in encouraging the open exchange of all relevant data and information, and in developing specialized climate services to governments and to the health, food, agriculture and water resources sectors through contributions to research on critical environmental issues such as that of the Aral Sea. I am grateful to the authors and contributors for their concerted efforts, and to all those who shepherded this project to completion.



(M. Jarraud)
Secretary-General
World Meteorological Organization

Introduction

The situation in and around the Aral Sea is known to be one of the worst human-made environmental crises of the twentieth century. Many people have now seen the satellite photos of the Aral Sea as it was a few decades ago and as it is today. In the 1960s, the Sea was full of water with ecologically diverse river deltas and functioning seaports: on the southern edge of the Sea is Muynak, and on the northern edge of the Sea is Aralsk. Now, the images show a dying Sea with, for example, the seaport of Muynak more than 150 kilometres from the shoreline.

Briefly, it was decided in the 1950s to double the amount of land devoted to cotton

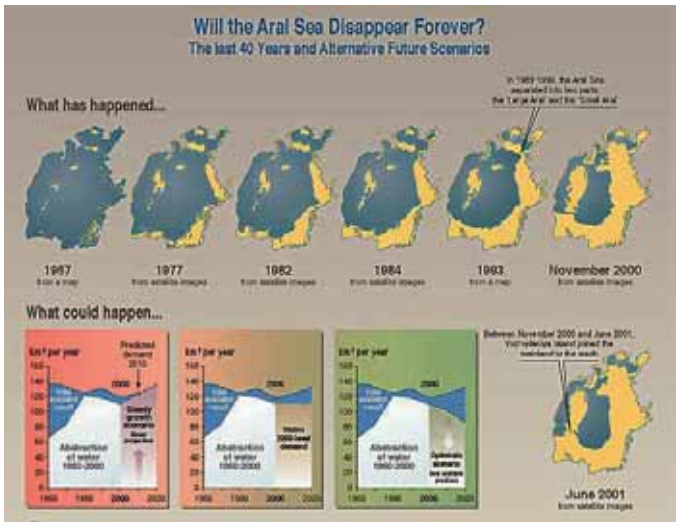
Map of the Aral Sea region as it was in 1853 (University of Texas).

production and to provide the necessary water for irrigation of the desert soils by diverting water from Central Asia's two major rivers that flowed into the Aral Sea. This resulted in eventually depriving the Sea of large amounts of fresh water. With time, evaporation from the Sea's surface greatly surpassed river inflow and the level of the Sea began to drop. The sea level,

Map of the Aral Sea region in 2004–2005 (UCAR).

which in 1960 was at 53 metres, had dropped to 31 metres by 2002. Also, the volume of the Sea has declined to less than one-third of its 1960 volume, and its surface area reduced by more than half of what it had been in 1960.

Thus, the Aral Sea crisis began over four decades ago. However, the deteriorating environmental conditions in the



Chronology of the Aral Sea (UNEP/Grid Arendal).

Areal Sea basin and the water crisis in the then Soviet Central Asia really only became known to the world in the mid-1980s. Almost immediately, the Aral Sea became a major environmental issue on the world stage.

It is not a global issue in the traditional sense, as it is neither global in cause, nor global in effect. It is, however, global in interest. It has been used by various interest groups to highlight how quickly human activities can destroy large parts of the Earth's surface in a relatively

Workers pondering their future in a dying industry in Nukus, Uzbekistan, 1995 (M.H. Glantz).

short time span, not in the order of centuries or millenniums, but of decades.

The Aral Sea crisis differs from other major environmental disasters like the quick-onset ones that occurred in Bhopal, India (the deadly 1984 accidental release of chemicals to the atmosphere) and in Chernobyl, former Soviet Union (the major nuclear accident in 1986). It has been and continues to be a slow-onset, creeping environmental problem, driven at first by political and economic decisions that favoured human activities over the constraints imposed by the natural environment.

A creeping environmental problem refers to a slow, incremental but cumulative environmental change. In other words, today's increase in air pollution is not much different from yesterday's; and tomorrow's air pollution level is not much different from that of today. Over a longer period of time, however, those seemingly unimportant incremental changes have added up to a real crisis situation.

There are many creeping environmental problems in progress around the globe, in rich countries as well as in poor ones: deforestation, desertification, water quality degradation, atmospheric pollution, ozone depletion, global warming, and so forth. It seems that most governments have difficulty dealing with slow-onset (creeping) environmental changes, because decision

makers are constantly being forced to decide about other competing, perhaps more urgent, socio-economic and political issues that usually capture their immediate attention.

History and geography of the Aral region

The Aral Sea in Central Asia is a terminal sea, which means that it has no connections to the open ocean. It is really a lake, although historically it has been called a sea. In 1960, the Aral Sea was the fourth-largest inland body of water in the world. It is located between two Central Asian deserts, the Karakum and the Kyzylkum. It had been entirely within the borders of the former Soviet Union until the early 1990s. With the breakup of the Soviet Union, the Sea was divided in ownership between the newly independent Central Asian Republics of Uzbekistan and Kazakhstan. The Central Asian Republics (Turkmenistan, Uzbekistan, Tajikistan, Kyrgystan, and Kazakhstan) found themselves without the assistance of the Russian Federation to help them cope with the Aral Sea crisis. By 2004, the level of the Sea had dropped by more than 20 metres and as a result, the original Sea became divided almost into three parts; a northern Sea (the Little Aral, *Maly Aral* in Russian), a western part (the Big Aral, *Bolshoi Aral* in Russian) and an eastern part. The eastern part is the shallowest part of the Sea and has all but disappeared.

The level of the Sea had been dependent on the streamflow of the Aral Sea basin's two major rivers, the Amudarya and the Syrdarya, which begin to form in the Pamir Mountains and the Tienshan Mountains, respectively. Along a portion of its watercourse, the Amudarya River (*dar'ya* means river in Kyrgyz, Uzbek, Turkmen, Uighur and Persian) forms the international border between Afghanistan and the Central Asian Republics of Tajikistan and Uzbekistan. The Amudarya River then flows through Turkmenistan and the length of Uzbekistan finally passing through Karakalpakstan, an autonomous region within Uzbekistan, before making its way to the Sea.

The Syrdarya River starts in the Tienshan Mountains and flows through Kyrgyzstan, and then through Uzbekistan and Kazakhstan. The Syrdarya River is about half the size of the Amudarya River and flows into the northern part, now called the Little Aral.

For millenniums, water from these two rivers has been used by settlements and civilizations in and around the region for a variety of life-sustaining purposes. The Sea has also been used for navigation and for commercial fishing purposes. The deltas of the Amudarya and the Syrdarya Rivers supported flora and fauna of commercial value. The level of the Aral Sea has fluctuated greatly over tens of thousands of years because of natural causes.

Today, it has become clear that the Sea has been rapidly drying out over a 40-year period. The increasing populations and activities in the region are exploiting the rivers to their fullest extent. Given the increasing demands for water all along the courses of the rivers, very little water reaches the Sea in amounts sufficient enough to replenish it. For all intents and purposes, the original Aral Sea no longer exists. In its place one can now find two, soon to become three, much smaller bodies of water.

Ecology collides with policy: dire consequences for the Sea

In the 1950s, cotton production in the arid, southern part of the Soviet Union was sharply increased. The Central Asian climate is perfect for cotton production: warm temperatures and abundant sunshine. At that time, the Soviet Union was already producing cotton on about four million hectares of irrigated land. The new goal was to increase irrigation activities in the desert area from four to more than seven million hectares. The cotton was to be used for a variety of purposes, but mainly by textile mills for domestic use and export. Such an expansion required a steady increase in water diversions to desert areas from the region's two major rivers.

Engineers had successfully begun to construct the Karakum Canal in 1954 to expand the amount of irrigated agricultural hectarage in Turkmenistan, one of the five Central Asian Republics of the former Soviet Union. Efforts to extend the length of the canal deeper into the Karakum Desert continued into the 1990s. This canal is over 1 200 kilometres long and is among the longest man-made rivers in the world. The canal now diverts into Turkmenistan an estimated 12–13 million cubic kilometres of water a year from the Amudarya River. The Karakum Canal is essentially Central Asia's third-largest river.

In the 1960s and 1970s, socio-economic development in the region centred around the notion of bringing water to a desert's dry but potentially fertile soils. By the late 1970s, cost-benefit analysis studies showed that the value of a unit of water placed on the land would be 100 times more valuable than if that same amount of water were to be used to keep some fish alive. No account was taken of the scientific warnings of the indirect effects that changes in the level of the Sea would have on regional climate conditions, on vegetation, and especially on the rivers' productive deltas.

The excessive amounts of water withdrawn from the rivers led to the stream flow of the Syrdarya River failing to reach the Sea by the late 1970s, and stream flow from the

Amudarya River failing to reach the Sea by the late 1980s. Since then, in some years water has reached the Sea but not enough to balance out the constant high demands of evaporation from the Sea. In the meantime, the level of the Sea, because of the widening imbalance between inflow to the Sea and outflow due to evaporative losses and all the diversions, dropped more than 20 metres (from 53 metres above sea level). In 1985–1986, when the level of the Aral Sea had dropped to about 41 metres, it divided into two parts — the Little Aral and the Big Aral.

In 1992, a sand barrier was created by local people around Aralsk to prevent a further drop in the level of the Little Aral. The level of the Big Aral, meanwhile, continued to drop. However, the barrier was breached by a natural rise in sea level in early 1993, and a new earthen barrier was put in place by the spring of 1997 to stop the flow of water from the northern Sea to the south. The new barrier was partially destroyed in the spring of 1999 because of an increase in the Syrdarya River flow. Today, there are plans to develop a concrete dam with a regulated waterspill in the Berg Strait in order to create a sustainable body of water by retaining the Syrdarya River water in the northern Sea, or the Little Aral.

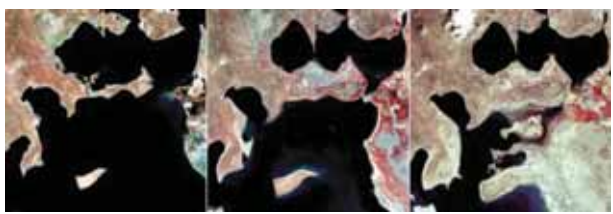
In 2003, Kazakhstan decided to preserve the Little Aral by allowing the Syrdarya River water to flow into it

permanently and to replace the earthen barrier with a 13-kilometre-long concrete barrier. The project is expected to be completed by 2007 and will help both to restore its ecological health and to bring back commercial fishing activities in the Little Aral.

Environmental impacts of the Aral crisis

Duststorms and toxic dust

As the Aral Sea seabed became increasingly exposed to the winds, large duststorms appeared, large enough so that Soviet cosmonauts in orbit in space were able to capture them on film in the mid-1970s. Since then, duststorms have apparently increased in number and frequency, with some people suggesting that there have



29 May 1973 19 August 1987 29 July 2000

Satellite images of the changes to the Aral Sea since 1992 (NASA).

been more than 50 such storms in some years. The dust from the exposed seabed is more than just particles of sand. It is a mix of sand and toxic chemicals that had been used in pesticides, herbicides and fertilizers and applied in excessive amounts to the cotton fields. These chemicals had returned to the rivers in water that had drained from the irrigated fields, ultimately making their way into the Sea. The toxic dust also contaminated croplands a few hundred kilometres downwind of the increasingly

Rusting remnant of a once healthy fishing industry (M.H. Glantz).

exposed desiccated seabed. Dust made its way to higher elevations in the mountain regions and has been blamed for an increase in glacial melting.

Toxic dust in the air has had adverse effects on human health conditions locally and at some distance downwind. Human health in the region, particularly around the Southern edge of the Sea, also deteriorated as a result of contaminated surface and ground water.

Fisheries

The Sea had once supported a thriving fishing industry with a fleet of vessels and fish processing and canning plants. At its peak (before 1970), this industry employed about 60 000 people. Today, few fish remain in the Sea, the salinity level of which now rivals that of the open ocean, a tenfold increase from 1960. Fishing boats became stranded in the desert and are now viewed as rusting monuments of, and tributes to, the once-vibrant Aral Sea.

Biodiversity

In ecological terms, parts of the Aral Sea basin have been transformed in a major way. The reduction in the size of the Sea has resulted, for example, in the creation of desert-like conditions (popularly referred to as desertification) of

hundreds of thousands of square kilometres. The exposed, desertified areas in the basin became known as Central Asia's newest desert, a human-made one, called the Aralkum. The loss of biodiversity in the lower reaches of the rivers and around the Sea itself has been catastrophic: more than 200 species of flora and fauna have disappeared.

Weather and climate

Regional climatic changes have also resulted directly from atmospheric and ecological changes in the Sea's basin.

Block of stamps issued on 3 May 1996 (M.H. Glantz).

These changes include a reduction in rainfall, and changes in regional wind flow patterns aloft and at ground level. A report from the Global Resource Information Database (GRID-Arendal) stated that "during the last 10–15 years, the drying out of the Aral Sea brought about noticeable changes in climate conditions". The reduced size of the sea surface meant that the Aral Sea was not able to moderate the harsh effects of the cold winds from Siberia or to reduce heat extremes in the summer time. Furthermore, the growing season was shortened, pasture productivity cut in half and precipitation along the seashore was reduced considerably. In other words, the summers got hotter and the winters colder; the regional climate, especially its seasonality, has become, in meteorological terms, more 'continental'.

Saving the Aral: is there hope?

In response to the drop of the Aral Sea level, which had been predicted by several geographers in the Soviet Union in the 1970s, studies were undertaken on the feasibility of redirecting water from the country's northward-flowing rivers. This controversial proposal would have led to diverting large volumes of water away from flowing into the Arctic Ocean towards the desert parts of Central Asia, but would not necessarily be used to refill the Sea.

The Central Asian Republics have, since independence, created several regional intergovernmental organizations related to improving the environmental, sanitation and economic conditions in the region. Several of the proposed activities centre directly or indirectly around the quantity, quality, as well as the allocation of the region's water resources. The Central Asian Republics created the International Fund for Saving the Aral Sea (IFAS) to overcome the Aral Sea crisis and improve the social and economic status of the population in the Aral Sea region. In 2002, they launched a new programme under IFAS on concrete actions for the improvement of the environmental and socio-economic situation in the Aral Sea basin for the period 2003–2010. The programme includes, among other things, combating desertification; improving human health and ecosystems; making water use more efficient; improving biodiversity; improving the wetlands in the two river deltas; strengthening inter-State organizations; and addressing regional social problems. It is highly likely that Afghanistan will, at some point, join IFAS, as it occupies a relatively large portion of the Amudarya River basin.

Despite desires and commitments to save the Aral Sea, few concerted attempts have been made to return the Sea to any of its previous levels or even to save much of what remains of it. It also appears that some of the inhabitants

A poster depicting the despair of the Aral peoples at the loss of the Sea (M.H. Glantz).

near the Sea have given up hope. Uzbek poems and plays, for example, that lament the total disappearance of the Sea, have begun to appear.

In the meantime, the economies of the Central Asian Republics are trying to diversify their agriculture in order to reduce their dependence on cotton production. Some of the reasons to diversify are related to the environment: fertilizers and pesticides are costly, cotton sales have to compete price-wise and quality-wise in the international marketplace, soils have become increasingly salinized leading to lower yields, cotton is a high-water use crop, and so on. To restore the Aral Sea by allowing enough river water to flow into it, very large volumes of water from the rivers would have to be allowed to reach the Sea each year for some decades, possibly crippling local and national economies. Although the Aral Sea may not be restored to its pre-1960s level, there is still interest in reclaiming some of the lands lost during the drying out of the Sea, especially the rivers' deltas.

A new country has entered into the Aral Sea basin picture — Afghanistan. While the Afghan territory covers about 17 per cent of the Aral Sea basin, it uses, as of 2005, about 1.5 cubic kilometres of water each year out of an estimated 70 cubic kilometres flowing in the Amudarya

River each year on average. Any future increase in water requirements in the region may put added pressures on the sharing of the river water.

In 1993, the United Nations Environment Programme completed a diagnostic study of the Aral Sea basin, which served to stimulate interest by the World Bank and other national, intergovernmental and non-governmental organizations. Various potential ways to improve the environmental quality of the region, especially water supply, as well as to implement sorely-needed human health initiatives have been proposed. In the mid-1990s, one of the proposals was to save the Amudarya River delta while choosing to sacrifice the Sea, using it as a receptacle for heavily contaminated irrigation drainage water. The deltas are important ecosystems, which, if improved, can once again become rich in flora and fauna and economically viable. Other proposals have been made to make the use of water more efficient in the basin, as well as to identify other crops to grow in place of water-consuming cotton and rice.

Since 1999, the World Meteorological Organization (WMO) has been working with the Central Asian Republics and potential donors on a concept called Aral-HYCOS. This builds on the ongoing hydrological activities being carried

out in the region, including those managed by the National Meteorological and Hydrological Services of the Central Asian Republics. Through this mechanism, WMO intends to provide for the collection and communication of the region's hydrological data to support research projects and hydrological services; to promote regional cooperation; and, inevitably to help improve management of the water resources of the region.

Very few countries have highlighted their environmental concerns by putting associated disasters on postage stamps. The former Soviet Union was one of those few countries producing stamps that commemorated a few human-induced disasters, such as the nuclear accident at Chernobyl and the drying out of the Aral Sea.

Russian postage stamp showing a ship trapped as the waters of the Aral Sea receded (M.H. Glantz).

The Aral Sea, as the world had come to know it up to the 1960s, is all but gone. The rivers and their deltas, however, while in need of intensive care, to use a medical analogy, are not yet past the point of no return. The rivers still support life directly and indirectly in the form of water resources for food, fiber, energy and natural ecosystems, and there appears to be a political will to save them. It will take regional actions, and considerable amounts of financial resources from the international community, to provide the way.

In this following section, myths about the Aral Sea are briefly discussed. These are statements that on the surface appear to be valid but they require more discussion than they usually receive. They are partial truths. Some suggested responses to the myths are presented.

Aral Sea myths

Myth 1: Technology is the answer

Many people consider the scarcity of the water supply to be the cause of the various environmental and social problems in the Aral Sea basin. These problems include, but are not limited to, desertification, water and air pollution, health conditions and regional climate changes. As a result of this view, many believe that the only response would be to increase the supply of water to the

region. While this would help address some of the problems related to the drastic drop in sea level faced by the inhabitants, ecosystems and decision makers in the region, it will not be the cure-all solution that everyone hopes for. Improving the water supply would be a benefit. However, it would only address part of the problem, as demand for water will surely continue to rise for domestic, agricultural and industrial uses. The sustained education of the public, decision makers and international partners about the importance of the efficient and effective use of such a scarce resource is almost as important as the water itself.

Myth 2: Siberian river diversions to Central Asia is a dead issue

A few decades ago, a planning process was initiated for the possible diversion of northward-flowing Siberian rivers to Central Asia, the arid southern part of the country. The diversions would enable more extensive irrigation of arid lands for cultivating cotton fields and rice paddies. The diversion scheme was proposed in the days when it was believed that the constraints imposed by the natural environment could be overcome by engineering expertise.

Considerable debate took place over the long-term implications of such a large-scale diversion. Many Soviet

geographers, soil scientists and writers, among others, opposed the diversions, citing the adverse direct and indirect environmental impacts that would likely ensue. Some observers have even suggested that diverting large amounts of fresh river water from following its course flowing naturally into the Arctic Ocean could ultimately lead to the melting of Arctic Sea ice by increasing the salinity of the Arctic Ocean, which would in turn lead to a change in global climate.

After an intense debate on this issue, the Siberian river diversion project was abandoned by the late 1980s. Or was it? It seems that river diversion ideas — plans to divert water from somewhere in Russia to somewhere in Central Asia — keep reappearing in one form or another. Perhaps the Siberian river diversion idea is still considered by some observers of the Aral Sea situation as the region's only route to sustainable economic development.

Myth 3: The Aral crisis is of recent origin

It is easy to see that the primary cause of the demise of the Aral Sea has been human activities. However, while the demise appears to have begun around 1960, the story of the fate of the (once) fourth-largest sea in the world really started in 1908. Then, Russian geographer and

climatologist A.I. Voeikov suggested that the water in the Sea was of little value to the Russian Empire if it was left to evaporate into the air without having been of use to human settlements. In 1927, another Russian scientist, D. Tzinzerling, took a different view. He warned the government about what might happen to the Sea if too much water was diverted from the two rivers to irrigate desert lands. His calculations showed how the sea level would drop in tandem with the increasing levels of stream flow diversions. His numbers corresponded to what actually happened.

Myth 4: Cotton is the problem

Increased cotton production had been the primary reason to expand the irrigated hectarage devoted to that crop. Cotton was to be used for textile manufacturing, ammunition and rocket fuel. As the salinity of the irrigated lands increases, increasing amounts of water are needed to flush the salts from the soil. Thus, cotton is seen as the culprit in Central Asia for the sharp decline of ecological and human health in the Aral Sea basin. But is cotton the culprit, or is it an innocent bystander?

A close look at the Aral Sea environmental situation will show that the large amounts of chemicals applied to the

Rings of vegetation show the receding of the Sea over time. The Aral Sea is becoming a memory, and there is little hope, now, of turning it back to its former health. With commitment and resources, perhaps there is still hope to keep the rivers and deltas from the same fate (M.H. Glantz).

fields were greatly in excess of that required for optimal cotton production. Unlined, open-ditch irrigation systems caused large amounts of water to be wasted because of infiltration and evaporation. Poorly designed drainage systems meant that increasing amounts of water would need to be diverted from the region's rivers in order to flush increasing amounts of salt buildup in the soil. Little consideration was given to the environmental costs associated with large-scale irrigation development in desert regions, even though numerous examples of negative impacts existed for similar arid and semi-arid parts of the globe.

In modern Uzbek culture, cotton has been symbolized everywhere as a life-saving crop. It has been referred to as "white gold." It appears in paintings, in murals on walls, on clothing, in jewelry, in carpets, in designs on eating utensils and even on postage stamps. Cotton is not the culprit in Central Asia with regard to the demise of the Aral Sea, but it has become the symbol of that demise.

Myth 5: Afghanistan does not have a role to play in the Aral Sea basin

A sizable part of the Aral Sea basin is within Afghanistan. It contains several of the headwaters that feed not only the Sea but also the populations that depend on the water of

the Amudarya and the Syrdarya Rivers. Over the last three decades, Afghanistan has not been greatly involved in deliberations about the Amudarya River water resources, nor on the future of the Aral Sea, being held by the five Central Asian Republics. However, future development activities of the upper basin States (Afghanistan, Kyrgyzstan and Tajikistan) can have major consequences for the quality and quantity of water in the rivers downstream, as the rivers pass through each of these States to the deltas and the Seas (*Maly* and *Bolshoi* Aral). The needs of these upper basin States will have to be taken into consideration by all concerned in order to ensure the well-being of a greater Central Asia, one that includes Afghanistan.

In Central Asia, *Voda – eto zhisn* (water is life). That is true, and the lack of water means morbidity, death or migration. The water crisis in the region is generated not just by the lack of water, but also by the inefficient use of it.

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The portfolio of Matilde Gattoni, photographer.

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Introduction to the maps

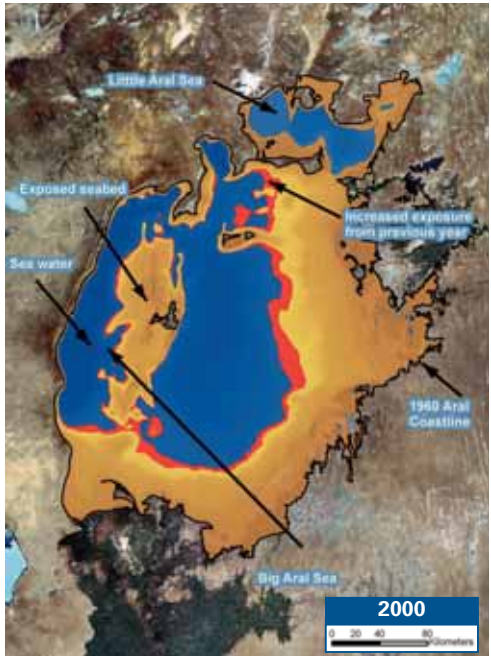
The Aral Sea is located in Central Asia. Once the fourth-largest inland sea on the globe, today it is well on its way to extinction as a mighty sea. Its demise has been the result of depriving the Sea of river water that was diverted instead to irrigate fertile but dry desert soils.

The series of maps that follow for the period 1960–2004 were developed from a baseline bathymetric map of the Aral Sea floor. If the Sea were to be emptied of all of its water, you would be able to see varying shades of tan that would relate to the different levels of elevation of the sea floor above mean sea level.

As shown in the map opposite, the red colour shows the change in the level of the Aral Sea (and in the surface area of the Sea) from the previous observation. The caption under each map that follows gives the level of the Aral Sea above mean sea level.

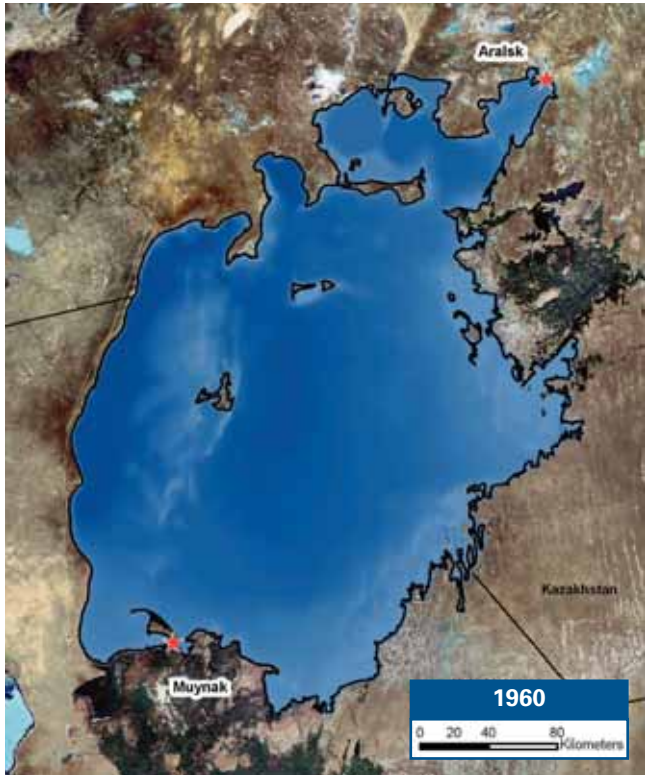
The black line surrounding the Sea is the shoreline of the Aral Sea as of 1960. The Sea was then filled with water up to its recorded level for 1960. That year is taken by most observers as the starting point for the negative human impacts on the level of the Aral Sea.

The last two maps in the series show what the Aral Sea would look like should the water level change by five metres from the 2002 level.

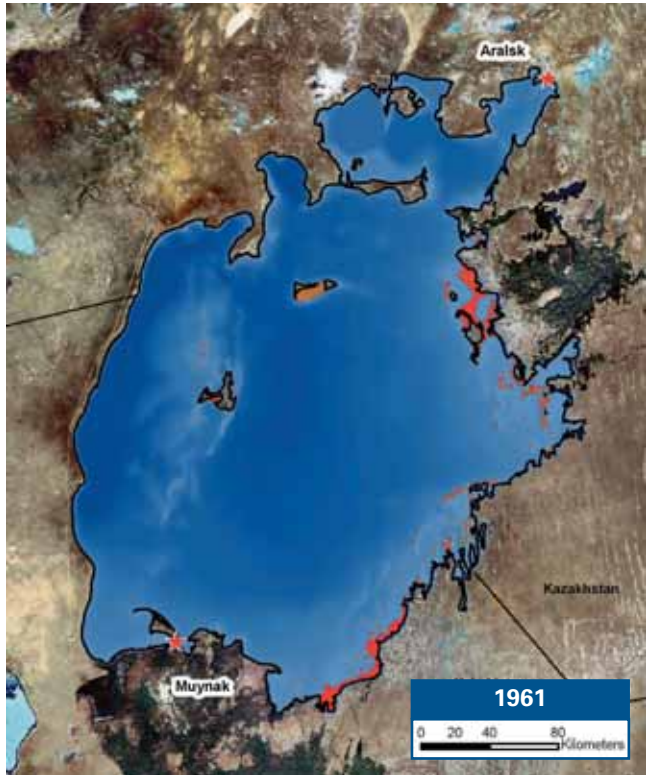


Exposed seabed (metres above mean sea level)

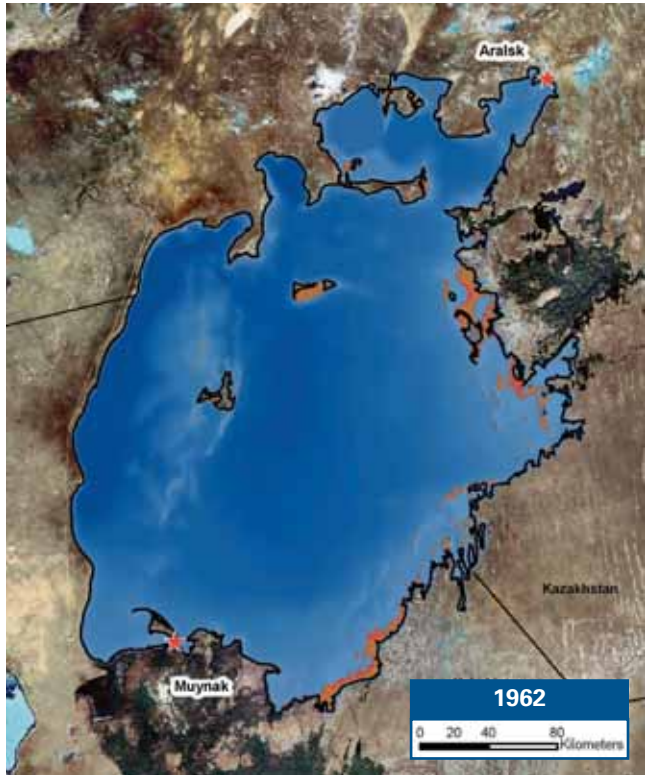
30–35	36–38	39–44	45–49	50–53



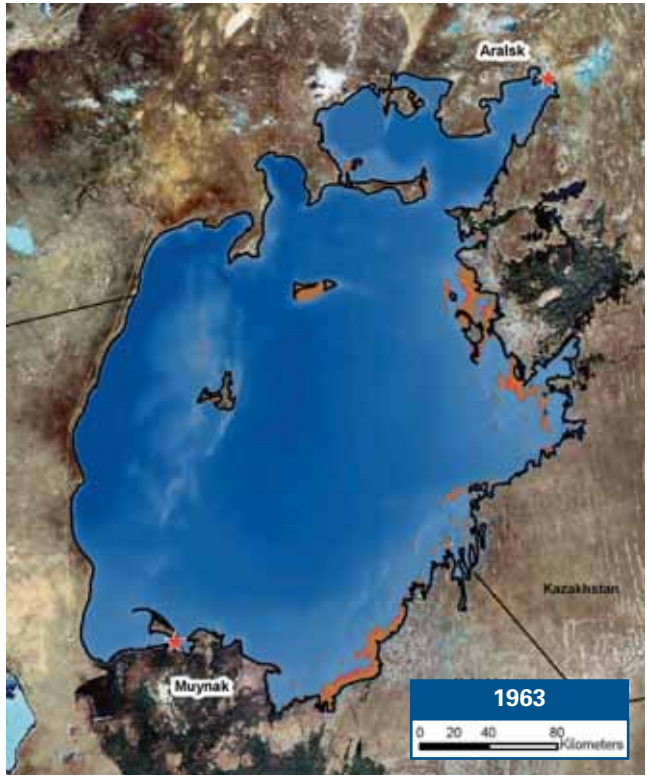
Sea level 53.29 m



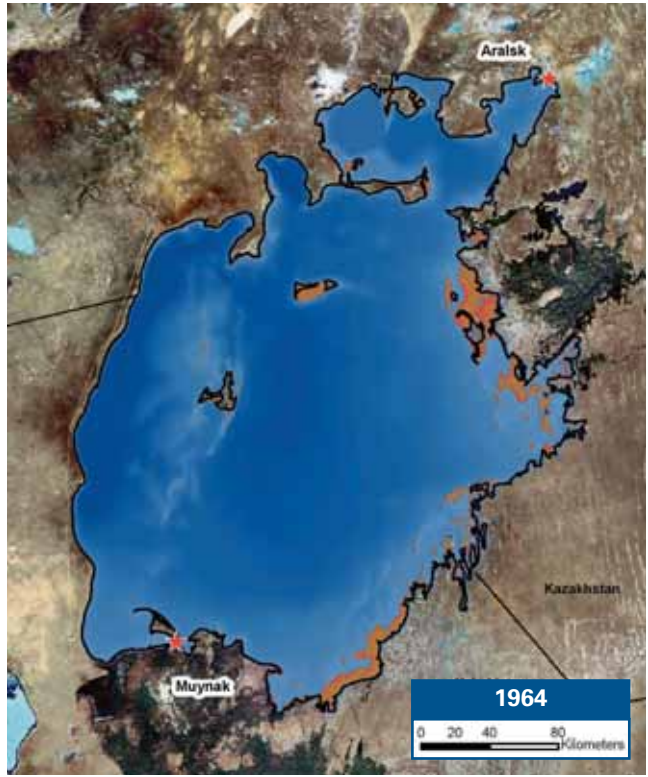
Sea level 52.97 m



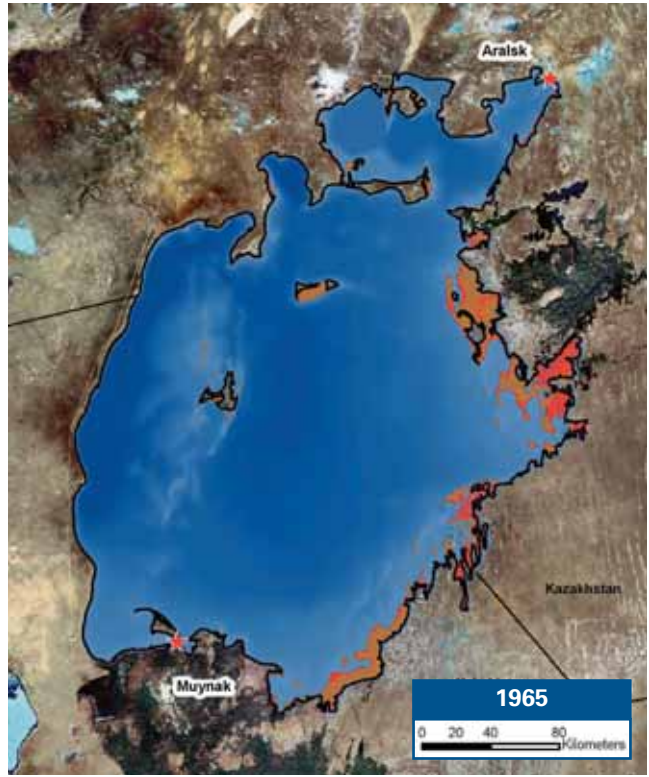
Sea level 52.61 m



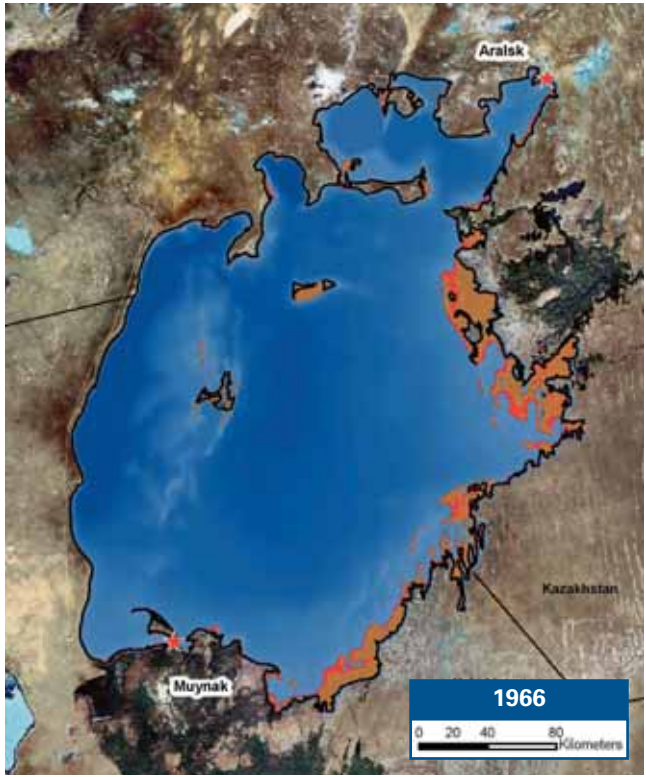
Sea level 52.61 m



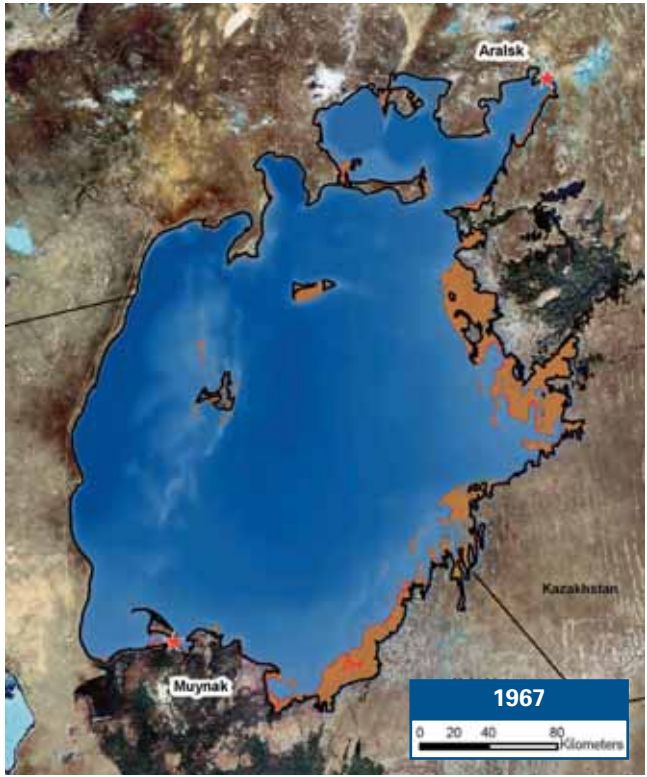
Sea level 52.49 m



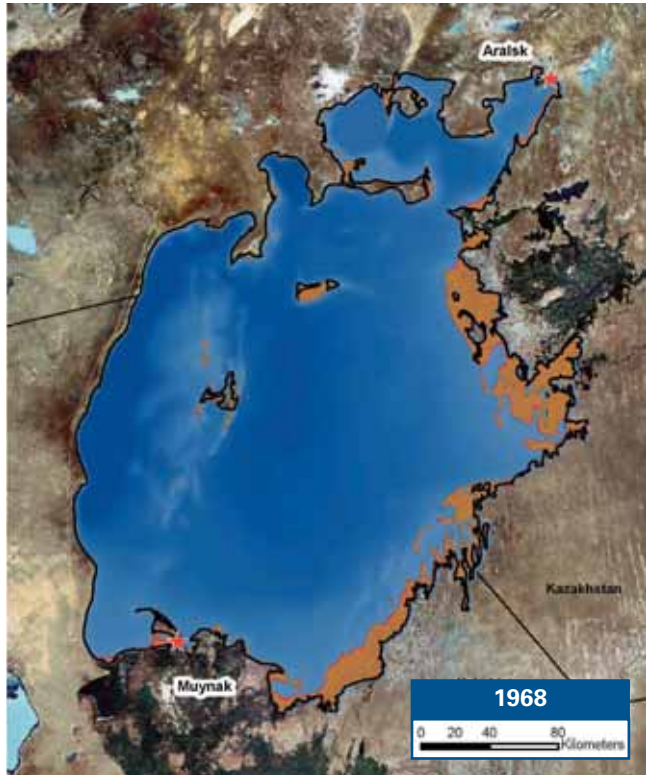
Sea level 52.31 m



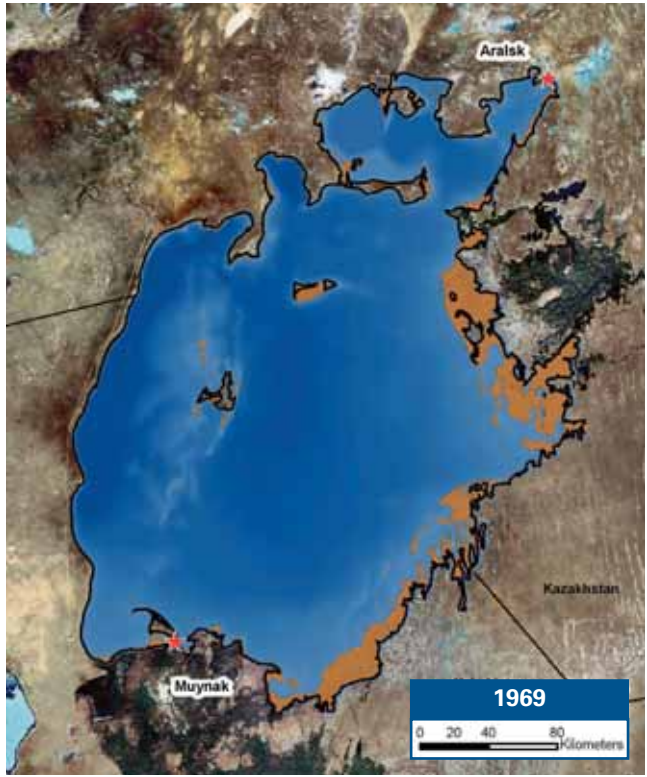
Sea level 51.89 m



Sea level 51.57 m



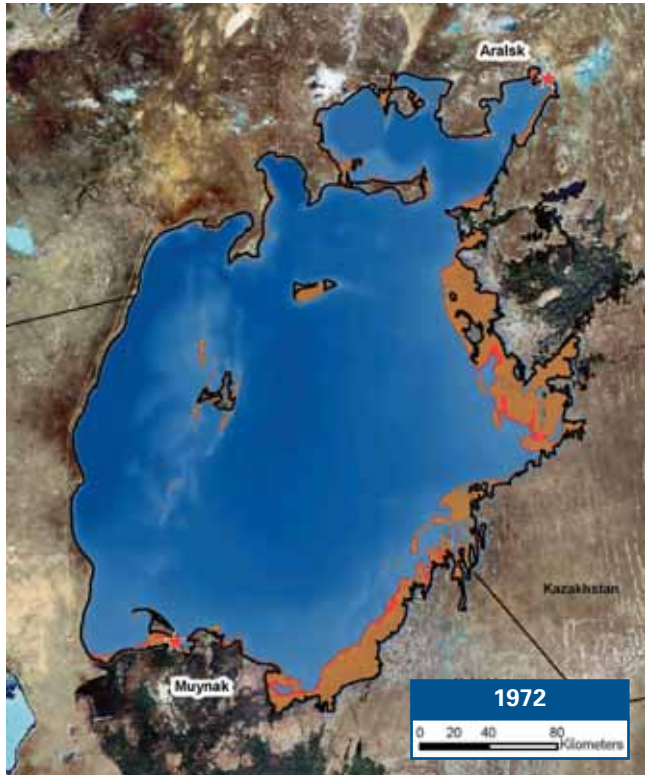
Sea level 51.24 m



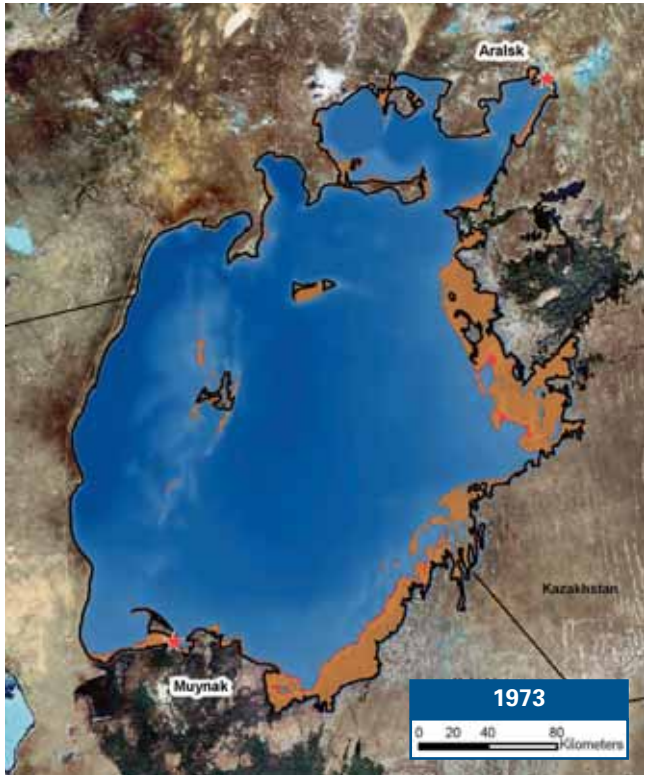
Sea level 51.29 m

Sea level 51.43 m

Sea level 51.06 m

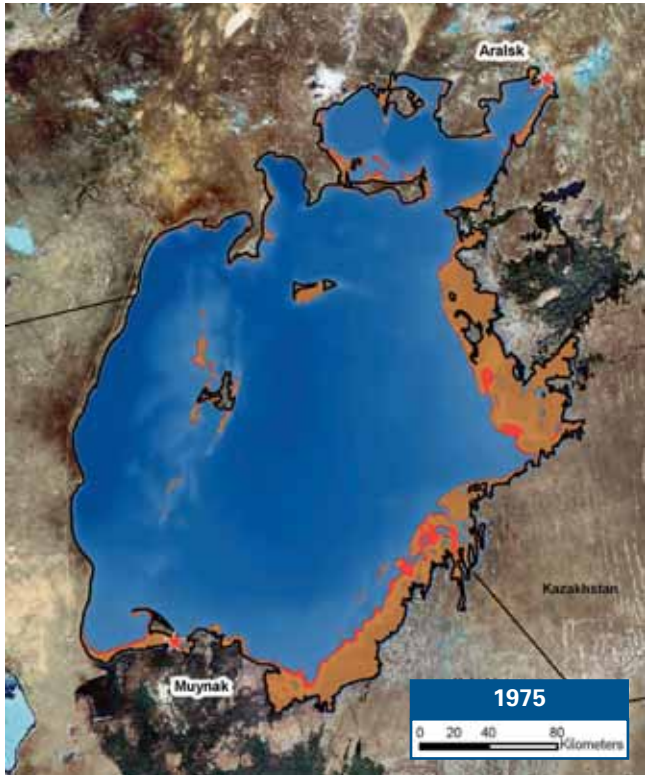


Sea level 50.54 m



Sea level 50.22 m

Sea level 49.85 m



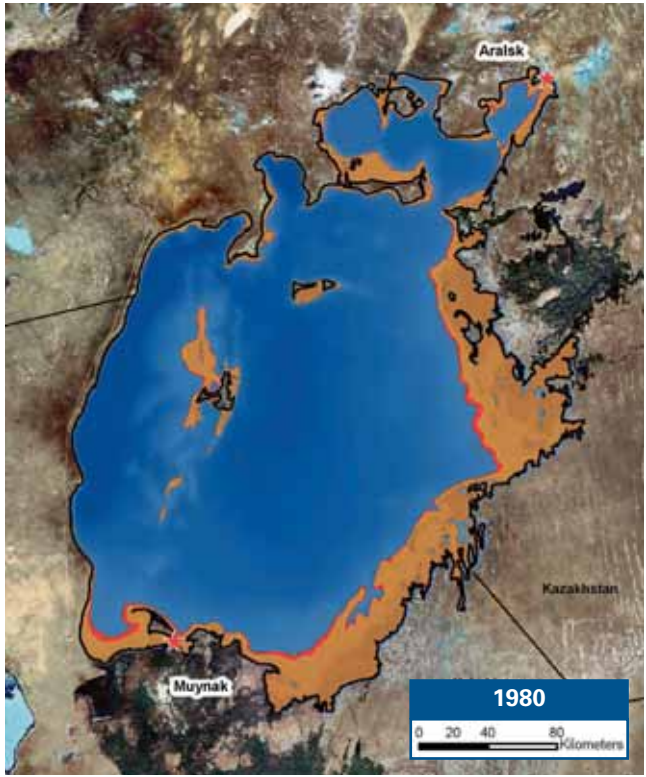
Sea level 49.01 m

Sea level 48.27 m

Sea level 47.63 m

Sea level 47.06 m

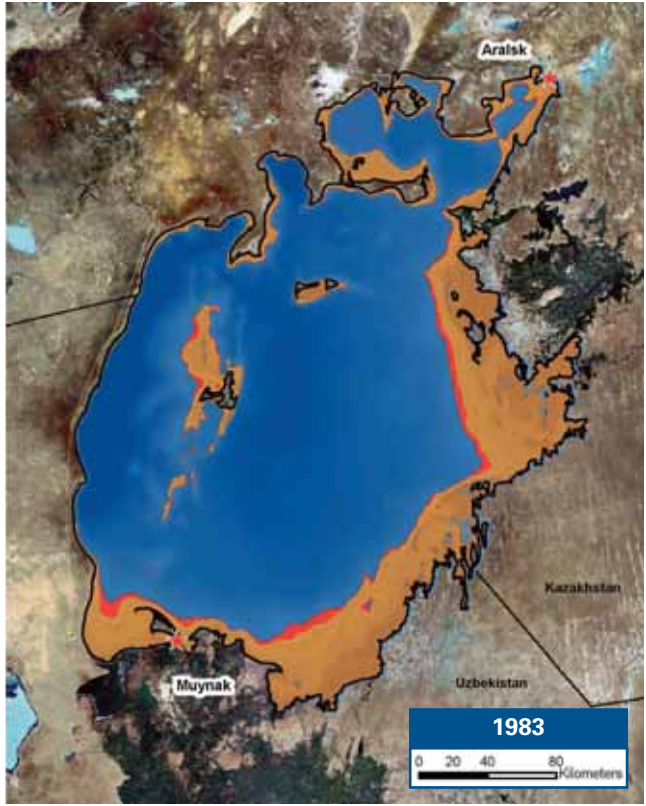
Sea level 46.45 m



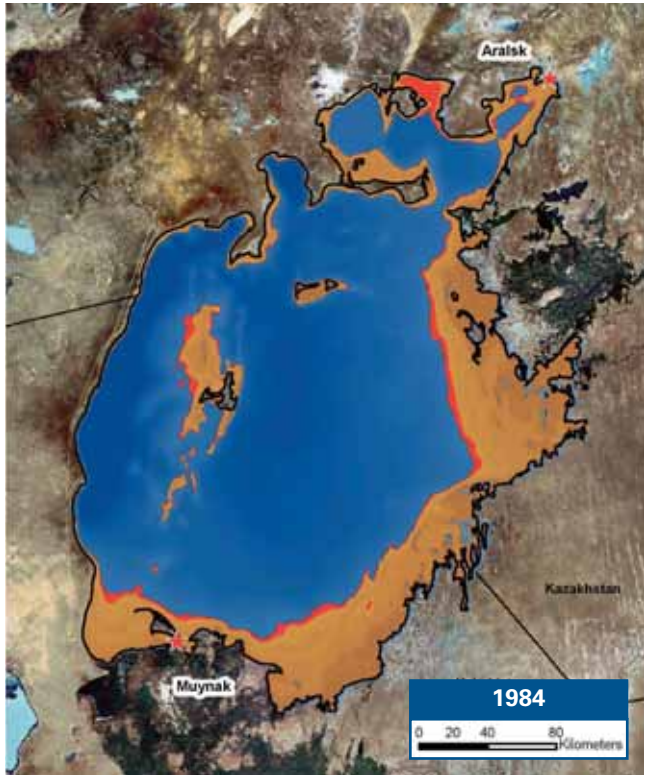
Sea level 45.75 m

Sea level 45.18 m

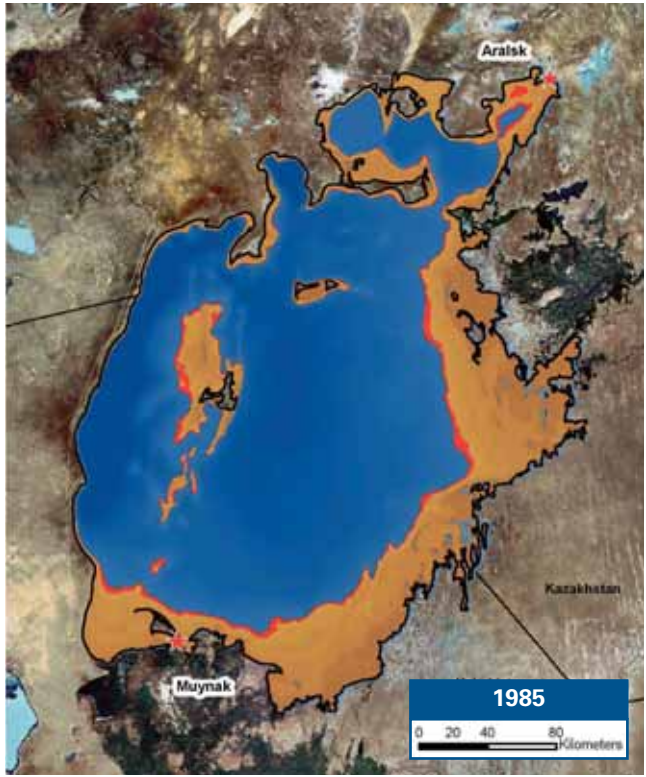
Sea level 44.39 m



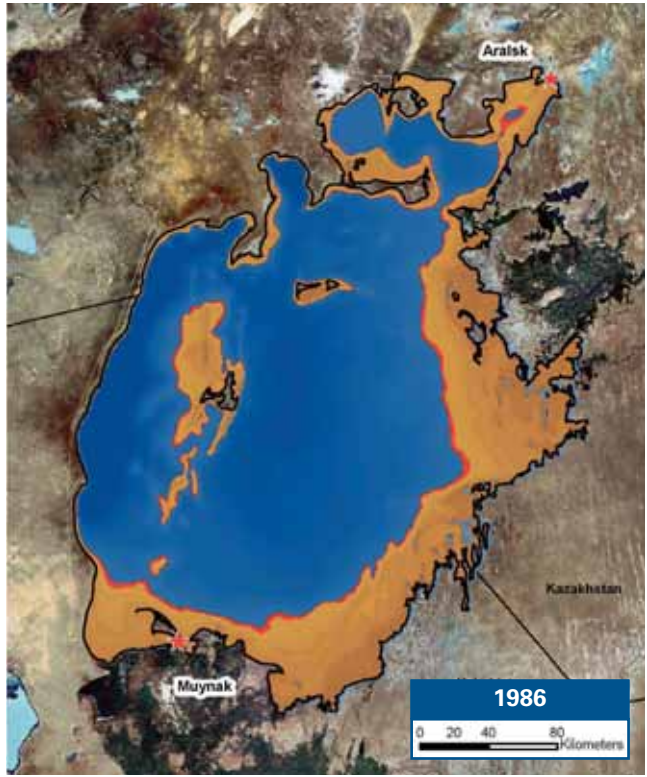
Sea level 43.55 m



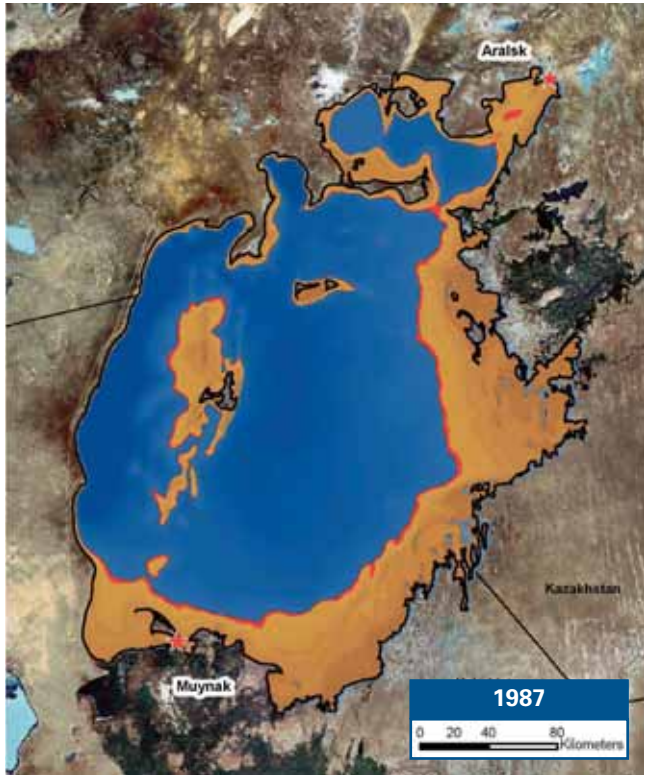
Sea level 42.75 m



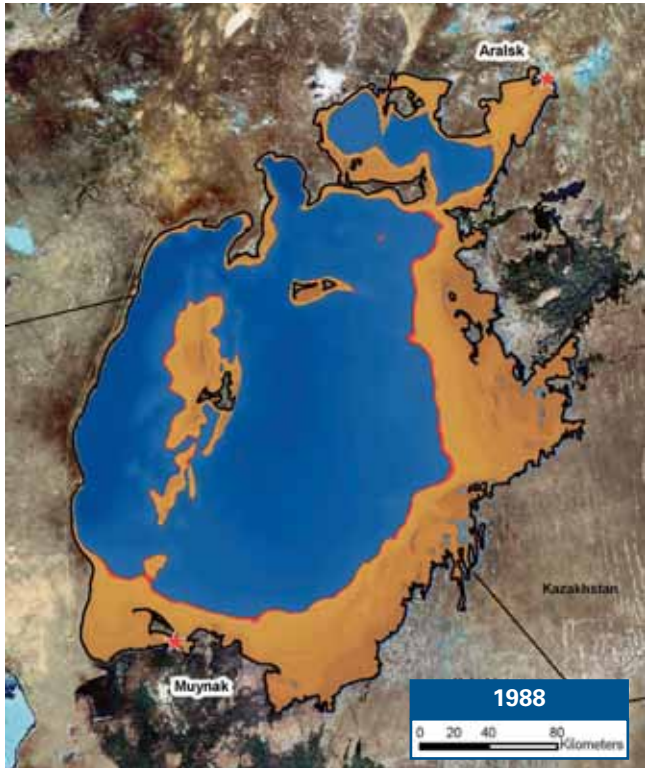
Sea level 41.94 m



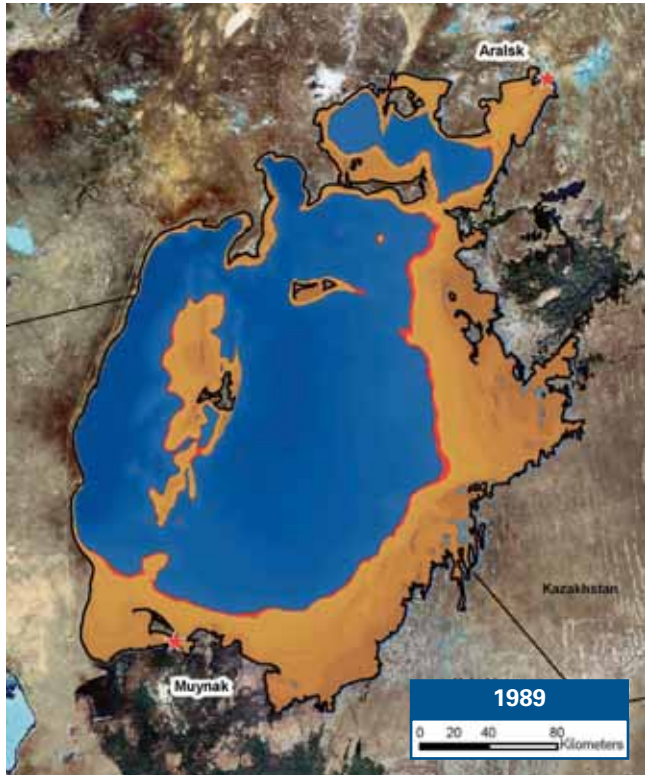
Sea level 41.10 m



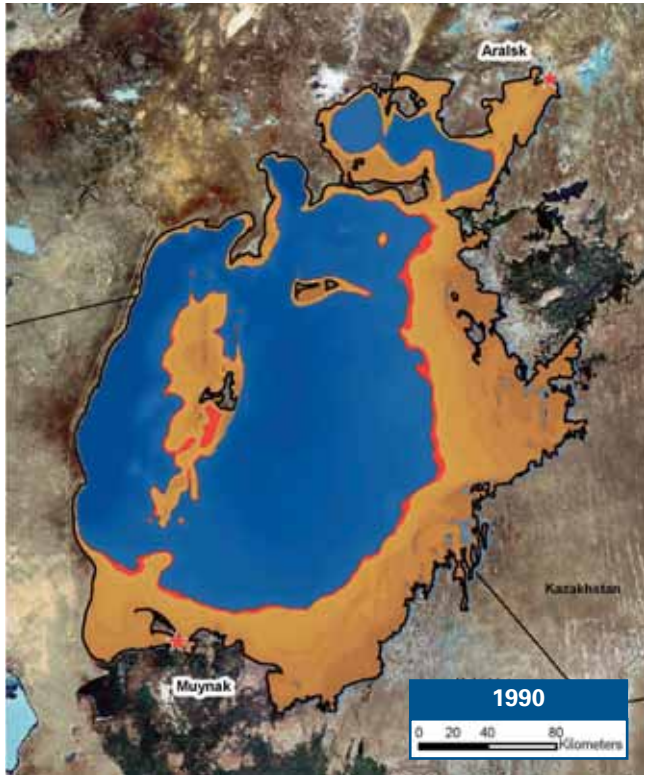
Sea level 40.29 m



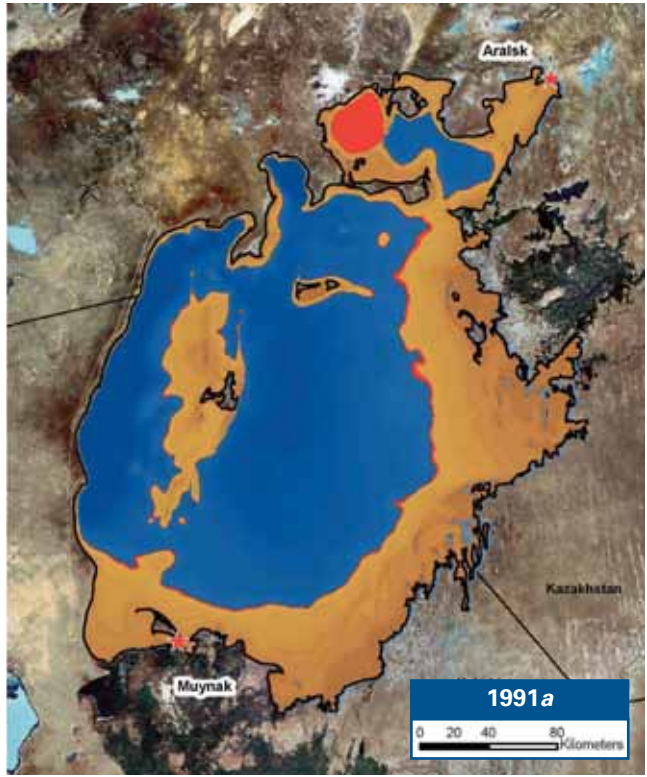
Sea level 39.75 m



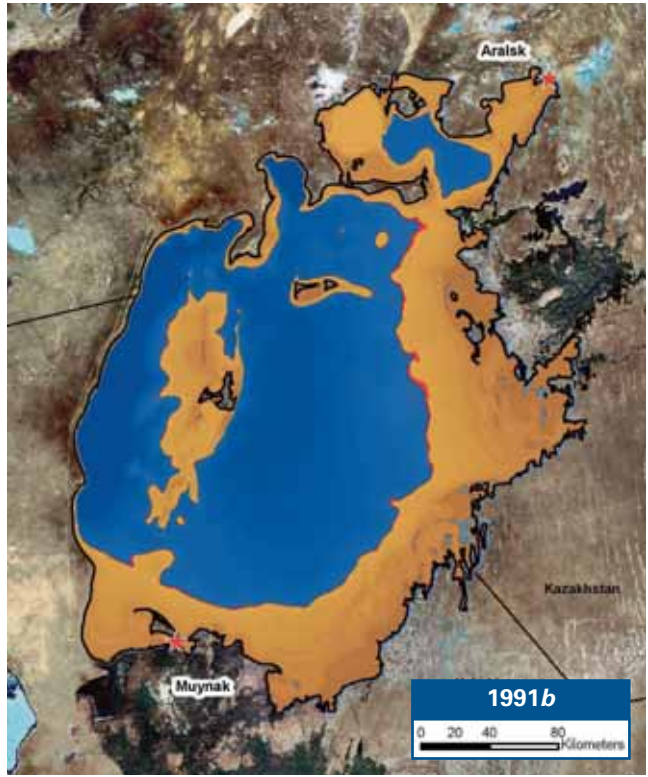
Sea level 39.08 m



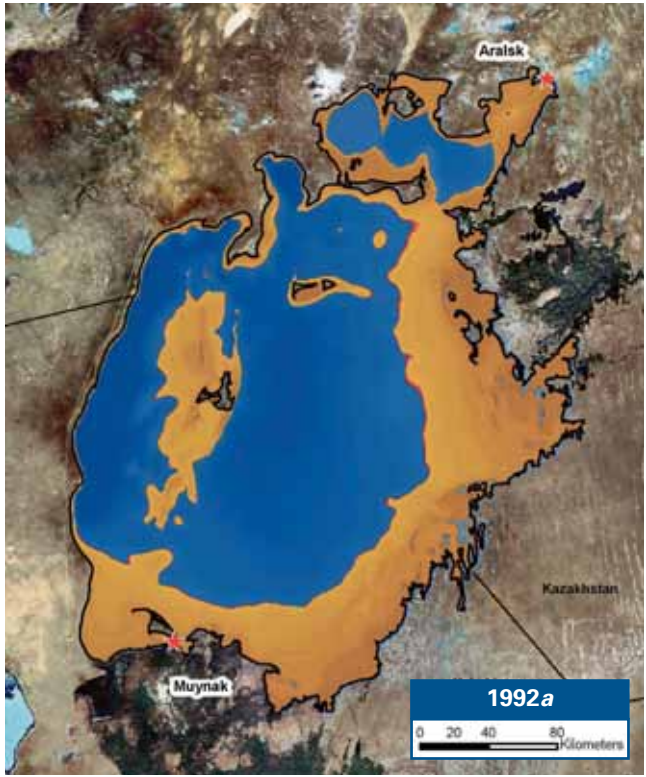
Sea level 38.24 m



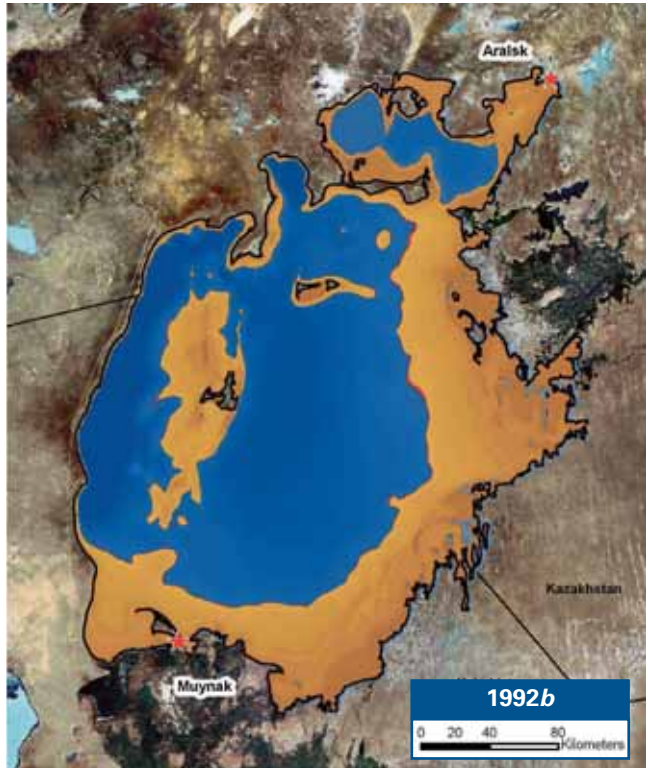
Sea level 37.56 m



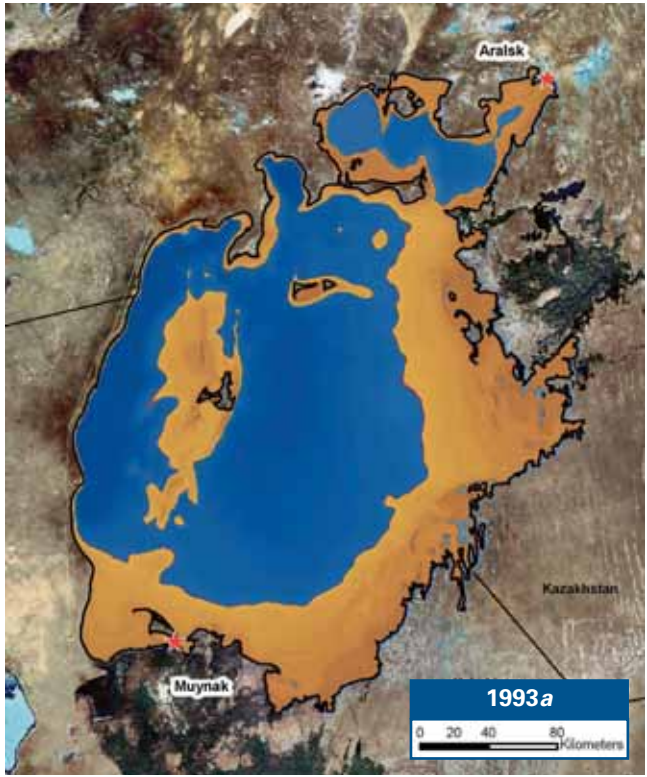
Sea level 37.56 m



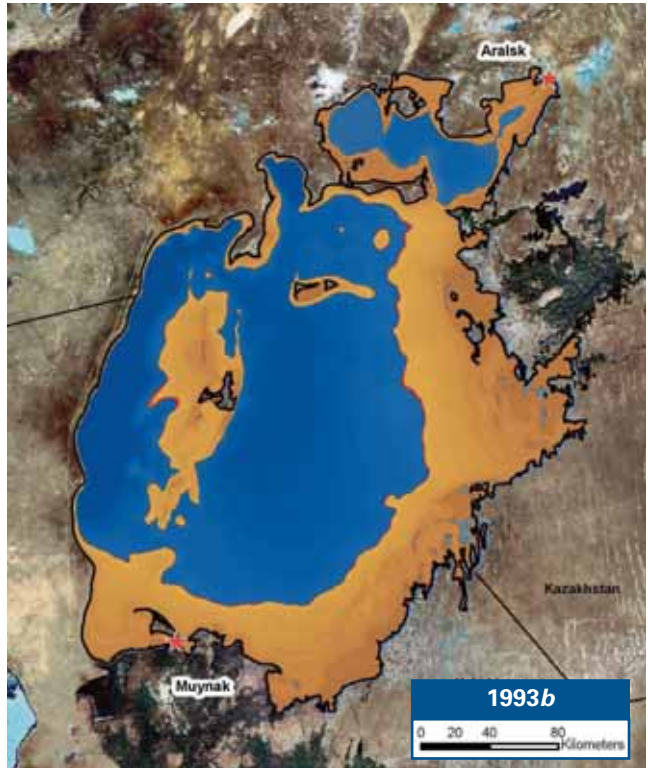
Big Aral sea level 37.20 m
Little Aral sea level 40.50 m



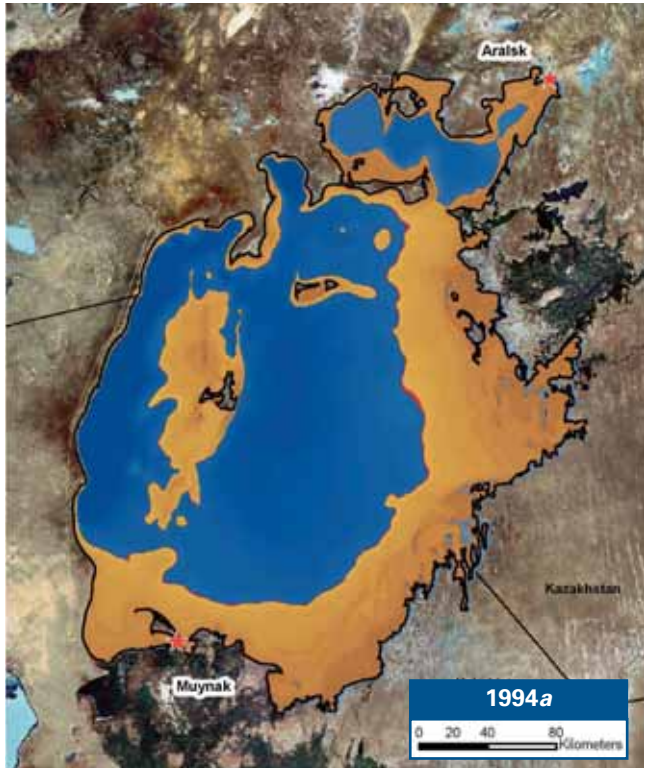
Big Aral sea level 37.20 m
Little Aral sea level 40.50 m



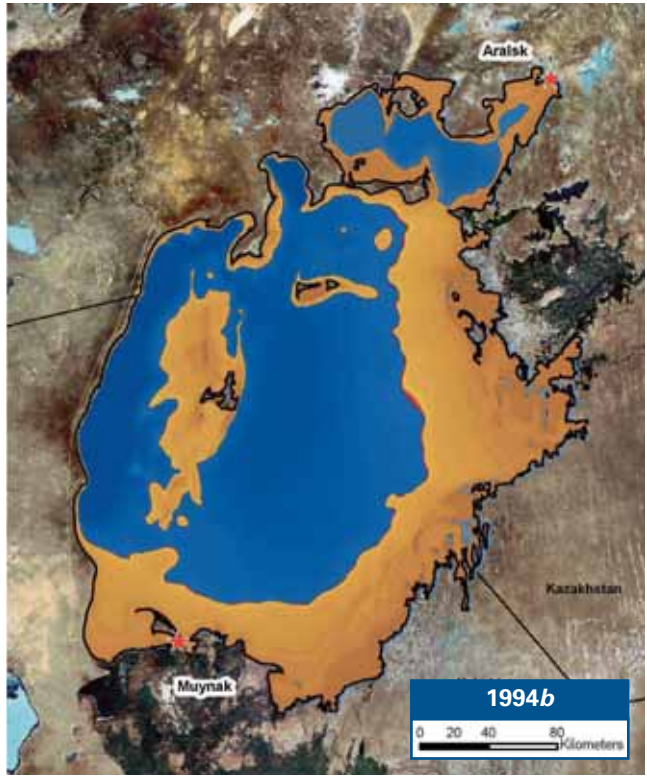
Big Aral sea level 36.93 m
Little Aral sea level 41.80 m



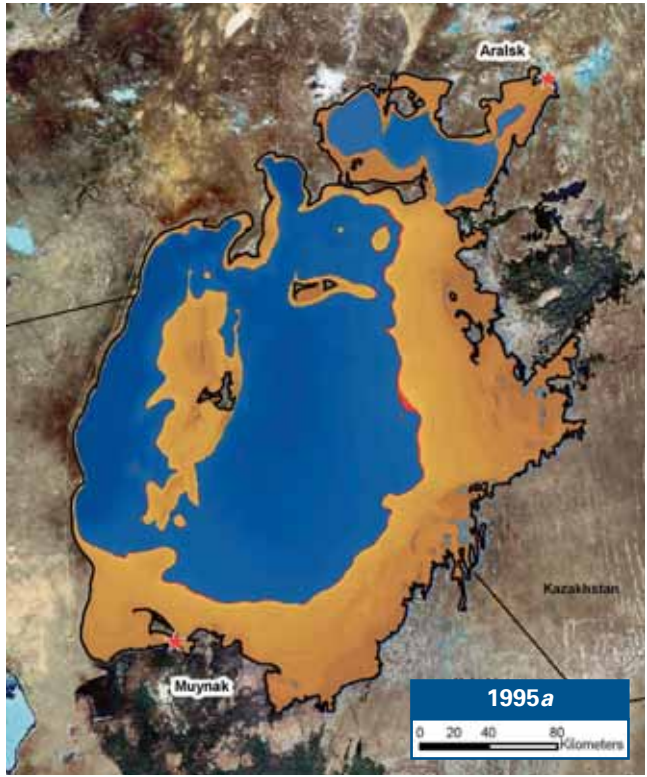
Big Aral sea level 36.93 m
Little Aral sea level 41.80 m



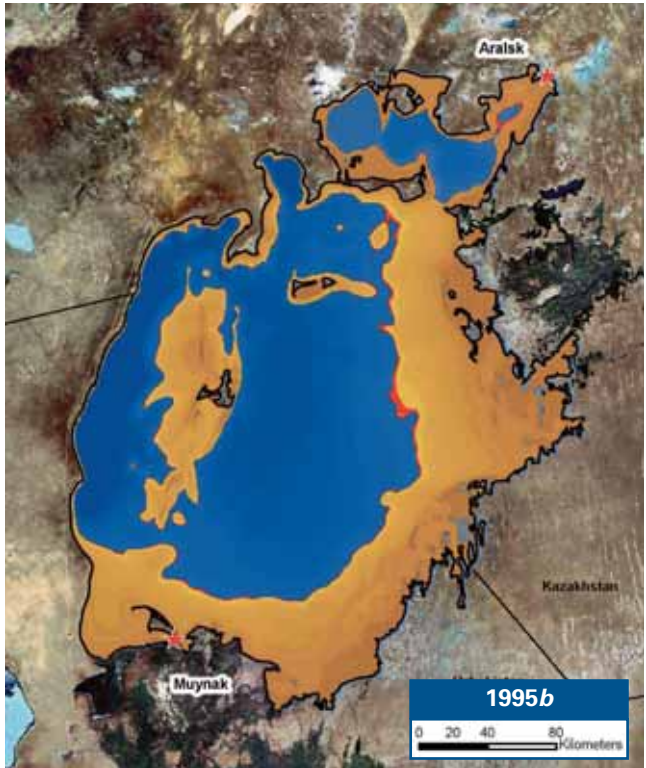
Big Aral sea level 36.60 m
Little Aral sea level 42.20 m



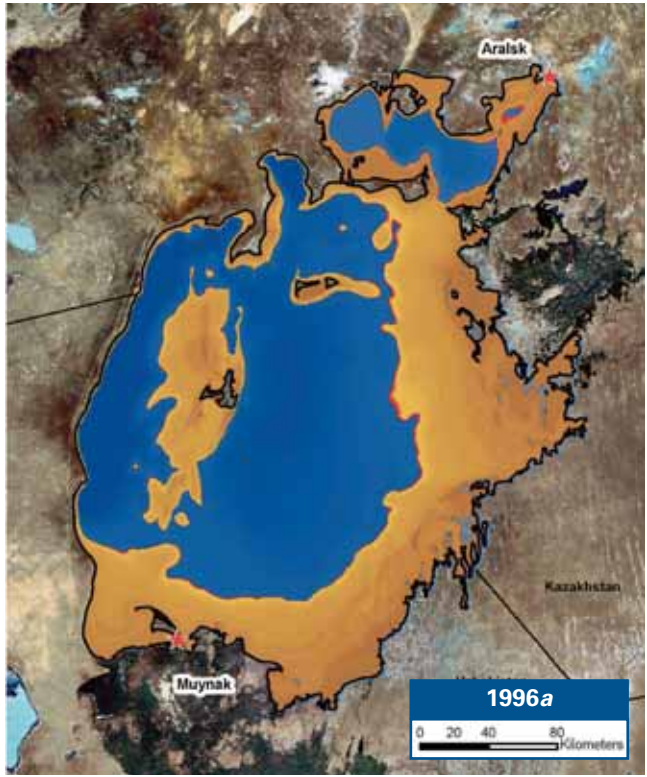
Big Aral sea level 36.60 m
Little Aral sea level 42.20 m



Big Aral sea level 36.11 m
Little Aral sea level 41.60 m

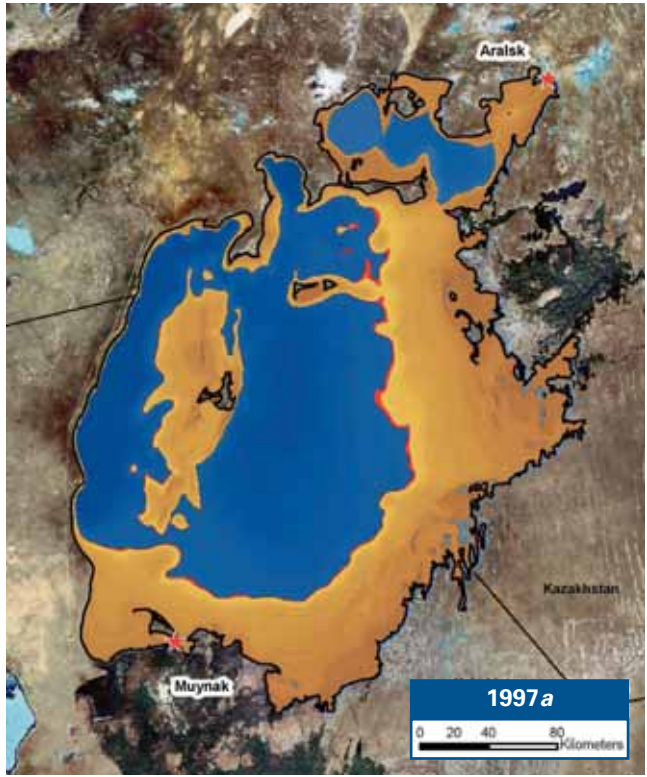


Big Aral sea level 36.11 m
Little Aral sea level 41.60 m

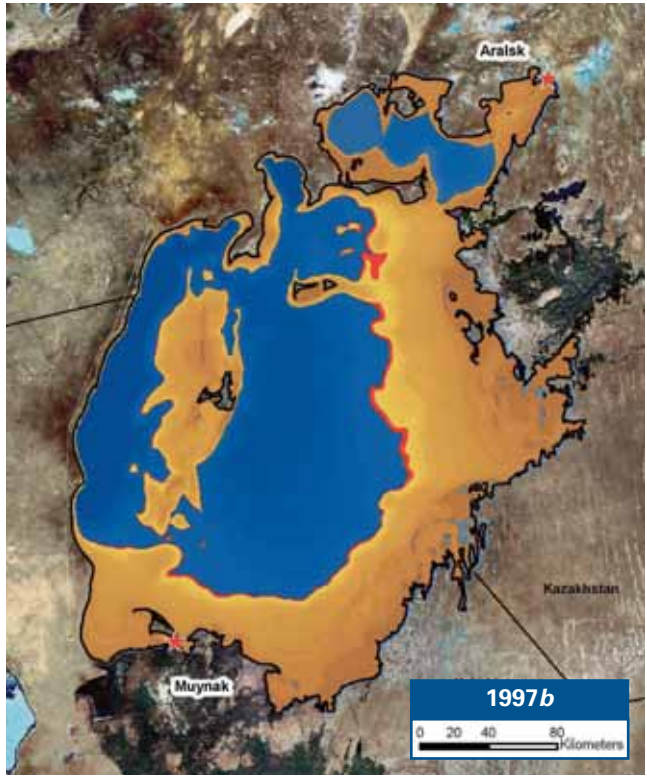


Big Aral sea level 35.48 m
Little Aral sea level 40.50 m

Big Aral sea level 35.48 m
Little Aral sea level 40.50 m

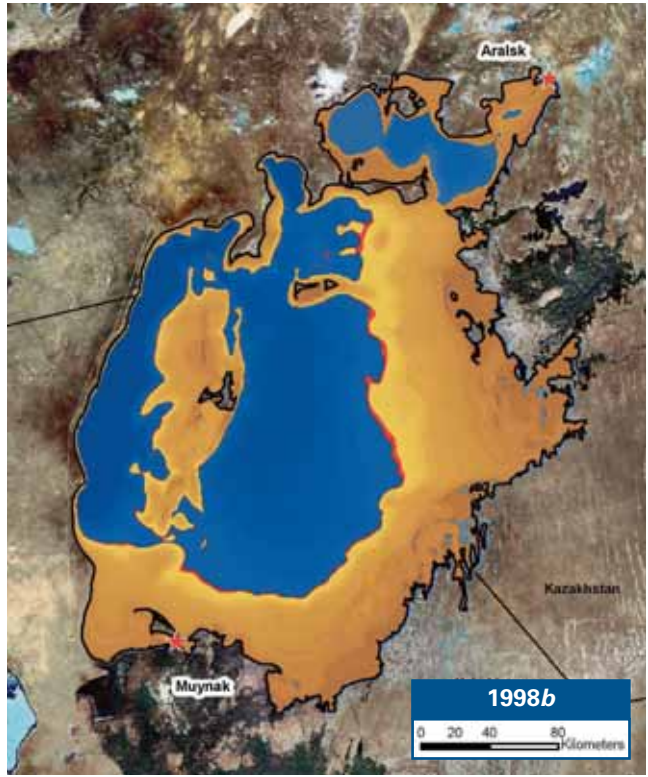


Big Aral sea level 34.80 m
Little Aral sea level 40.50 m



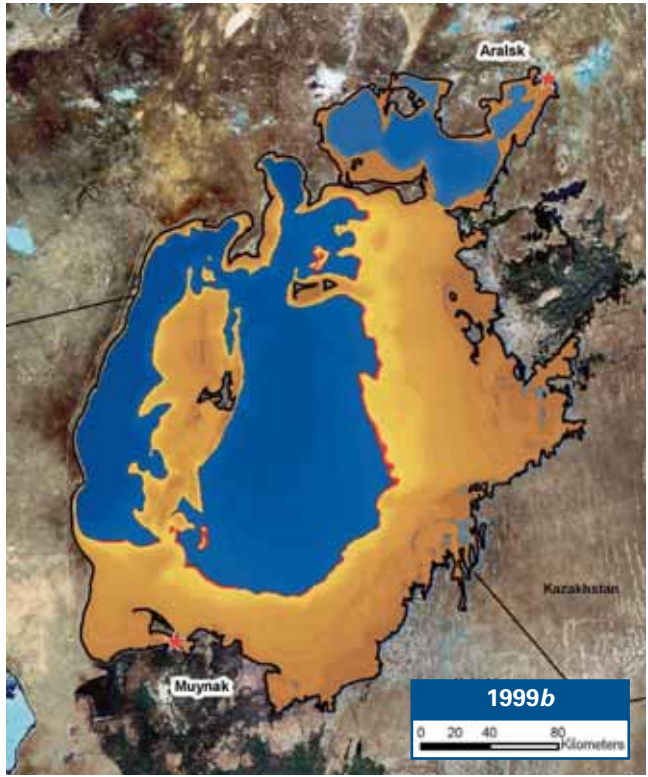
Big Aral sea level 34.80 m
Little Aral sea level 40.50 m

Big Aral sea level 34.24 m
Little Aral sea level 41.00 m

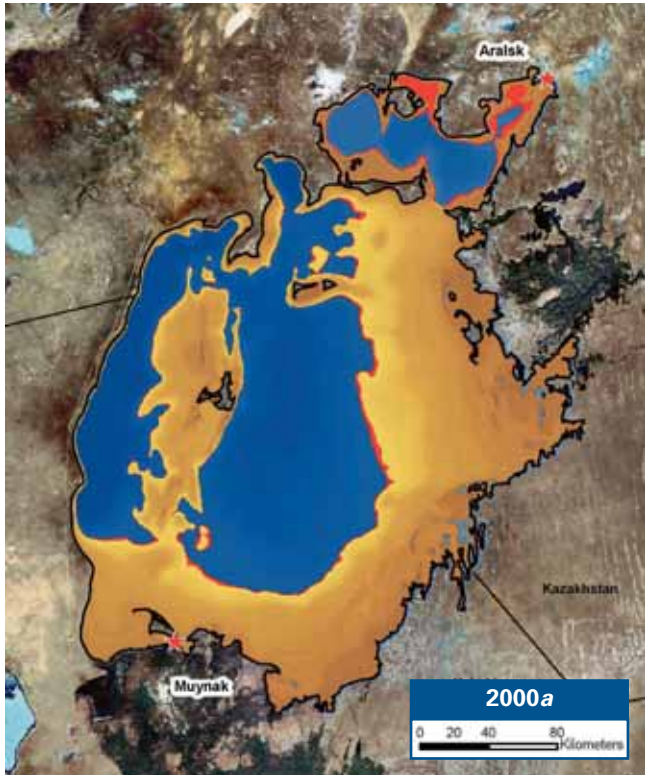


Big Aral sea level 34.24 m
Little Aral sea level 41.00 m

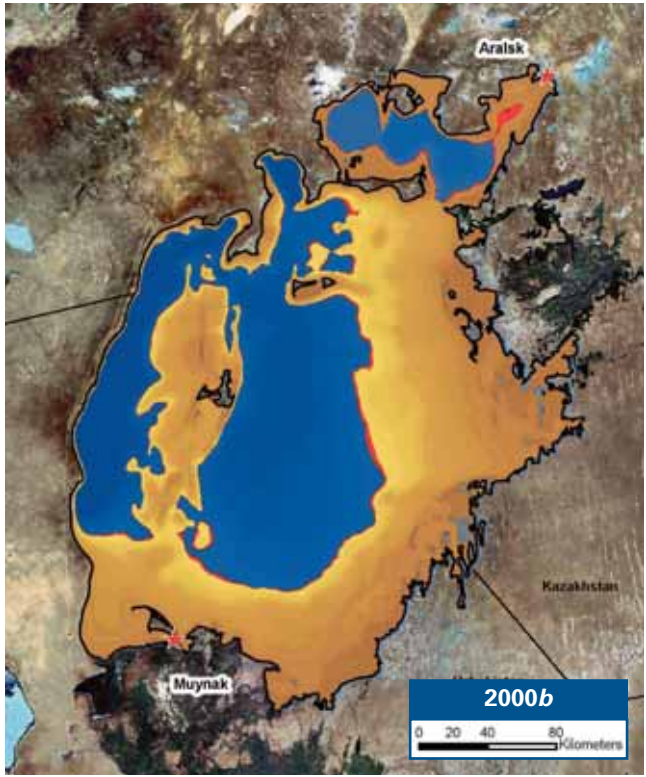
Big Aral sea level 33.80 m
Little Aral sea level 43.70 m



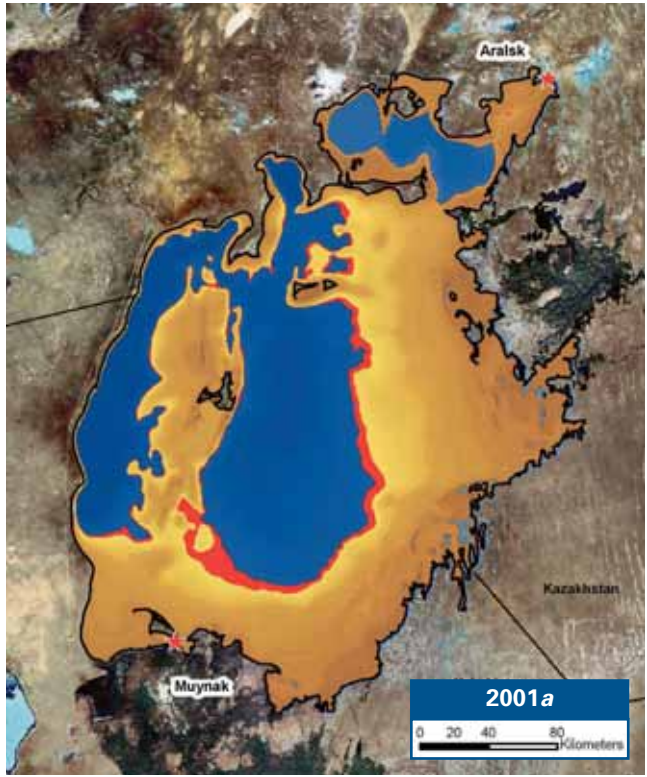
Big Aral sea level 33.80 m
Little Aral sea level 43.70 m



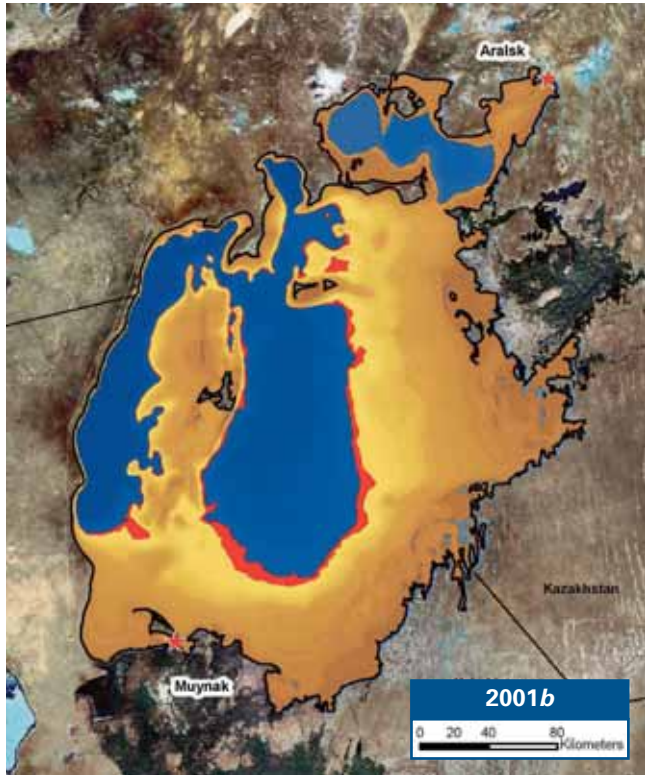
Big Aral sea level 33.30 m
Little Aral sea level 40.50 m



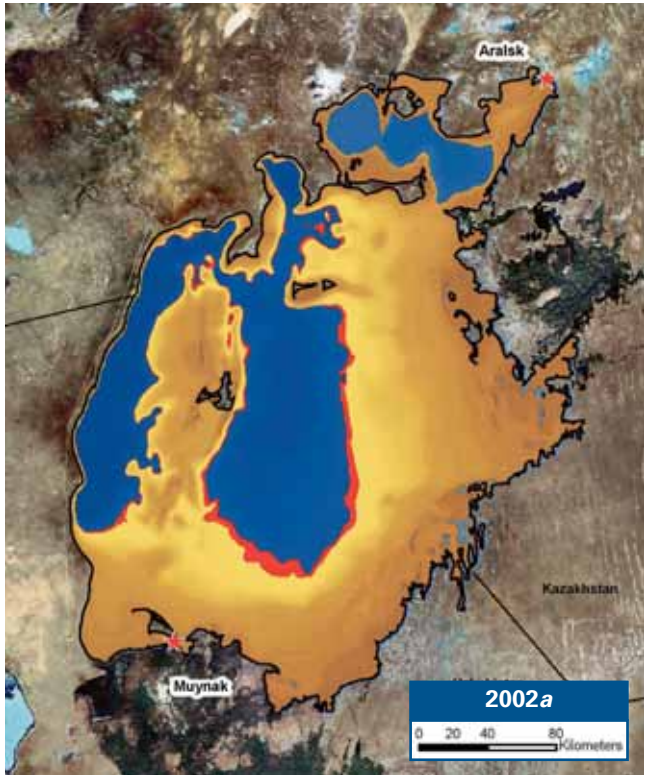
Big Aral sea level 33.30 m
Little Aral sea level 40.50 m



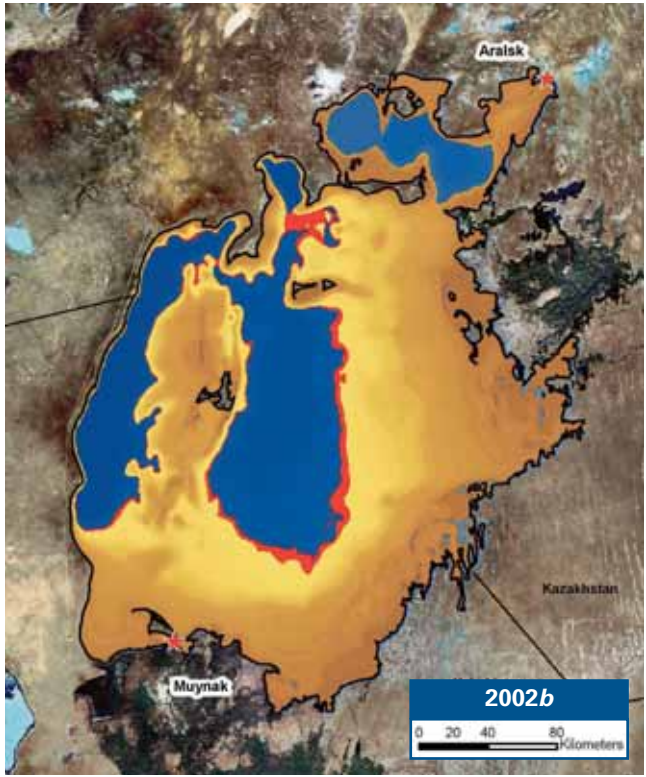
Big Aral sea level 32.16 m
Little Aral sea level 40.00 m



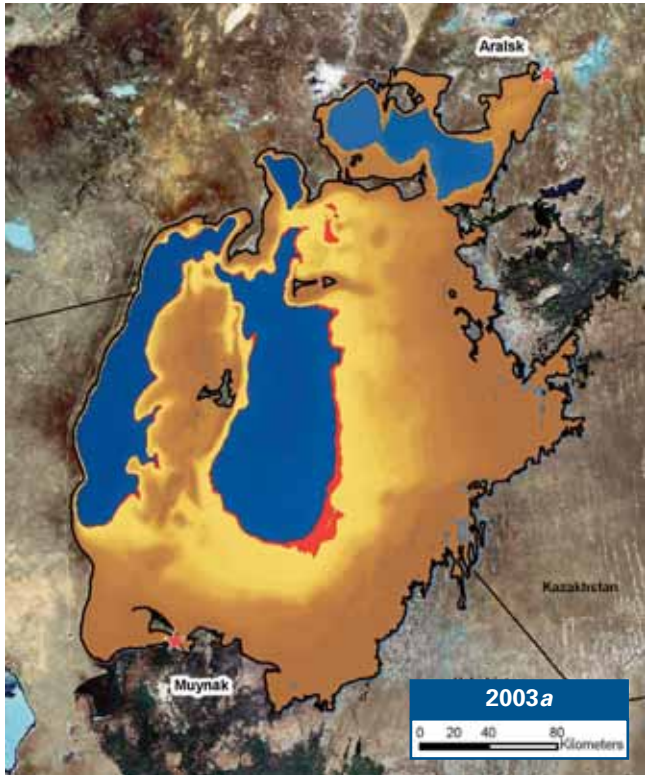
Big Aral sea level 32.16 m
Little Aral sea level 40.00 m



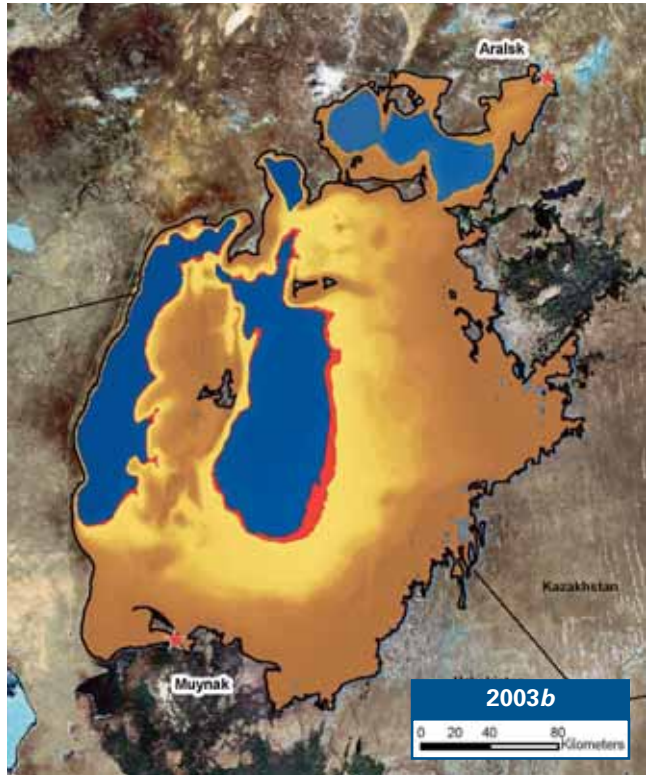
Big Aral sea level 30.90 m
Little Aral sea level 40.00 m



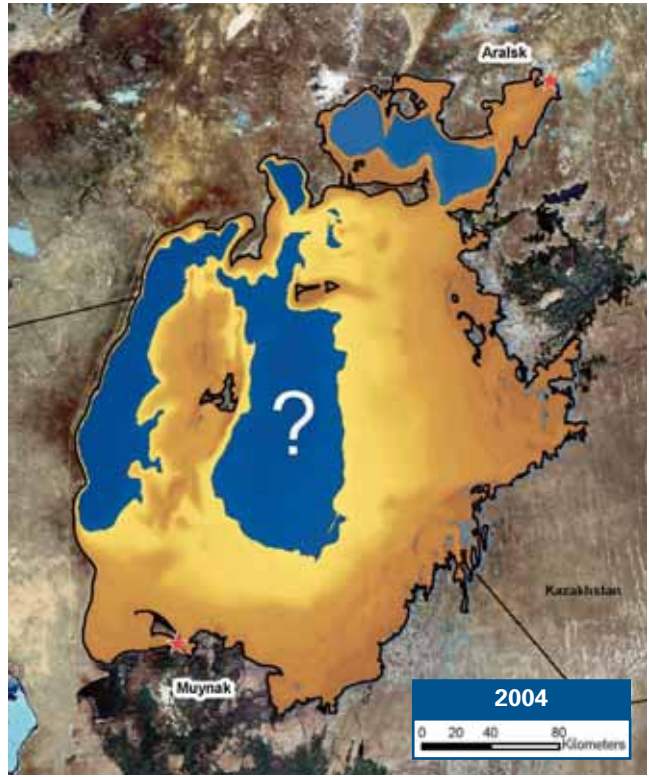
Big Aral sea level 30.90 m
Little Aral sea level 40.00 m



Big Aral sea level 29.85 m
Little Aral sea level 40.00 m



Big Aral sea level 29.85 m
Little Aral sea level 40.00 m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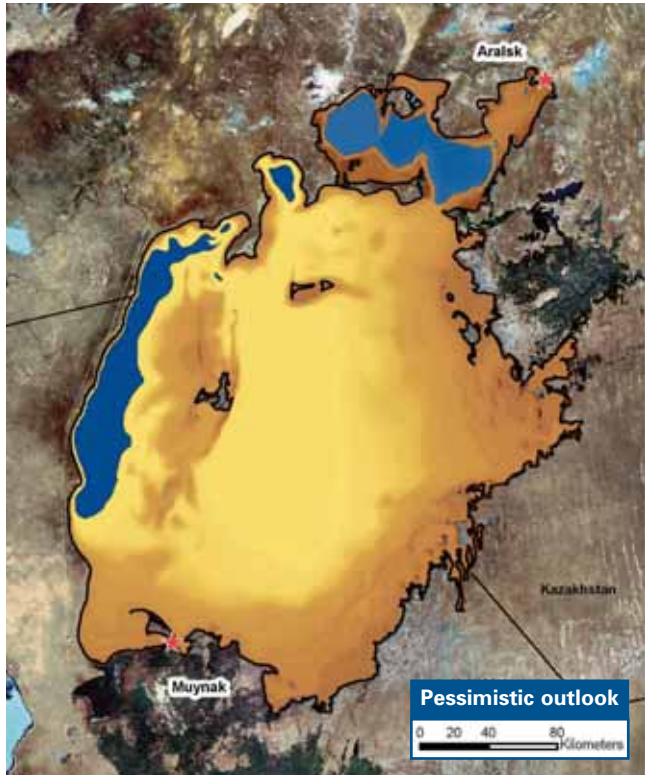
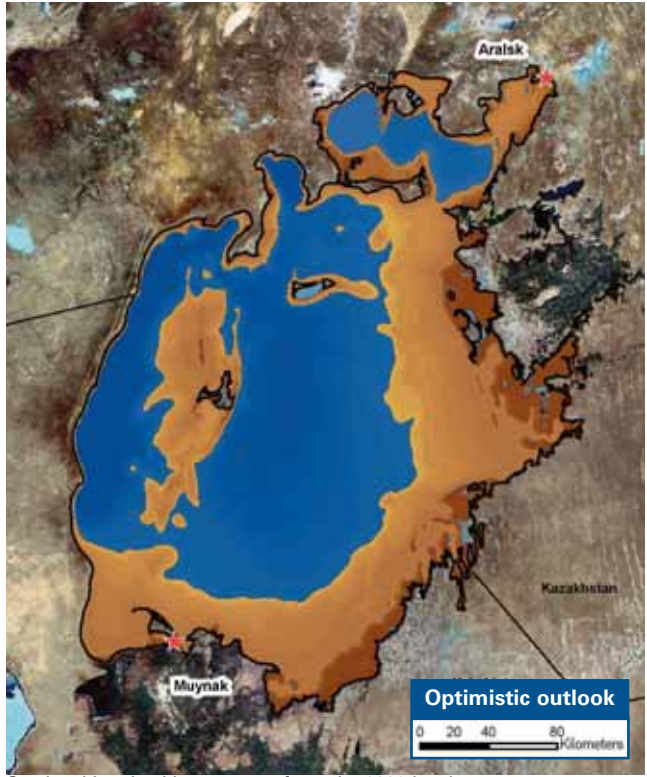


Sea level is lowered by 5 metres from the 2002 level.
Big Aral sea level 25.90 m



Sea level is raised by 5 metres from the 2002 level.
Big Aral sea level 35.90 m