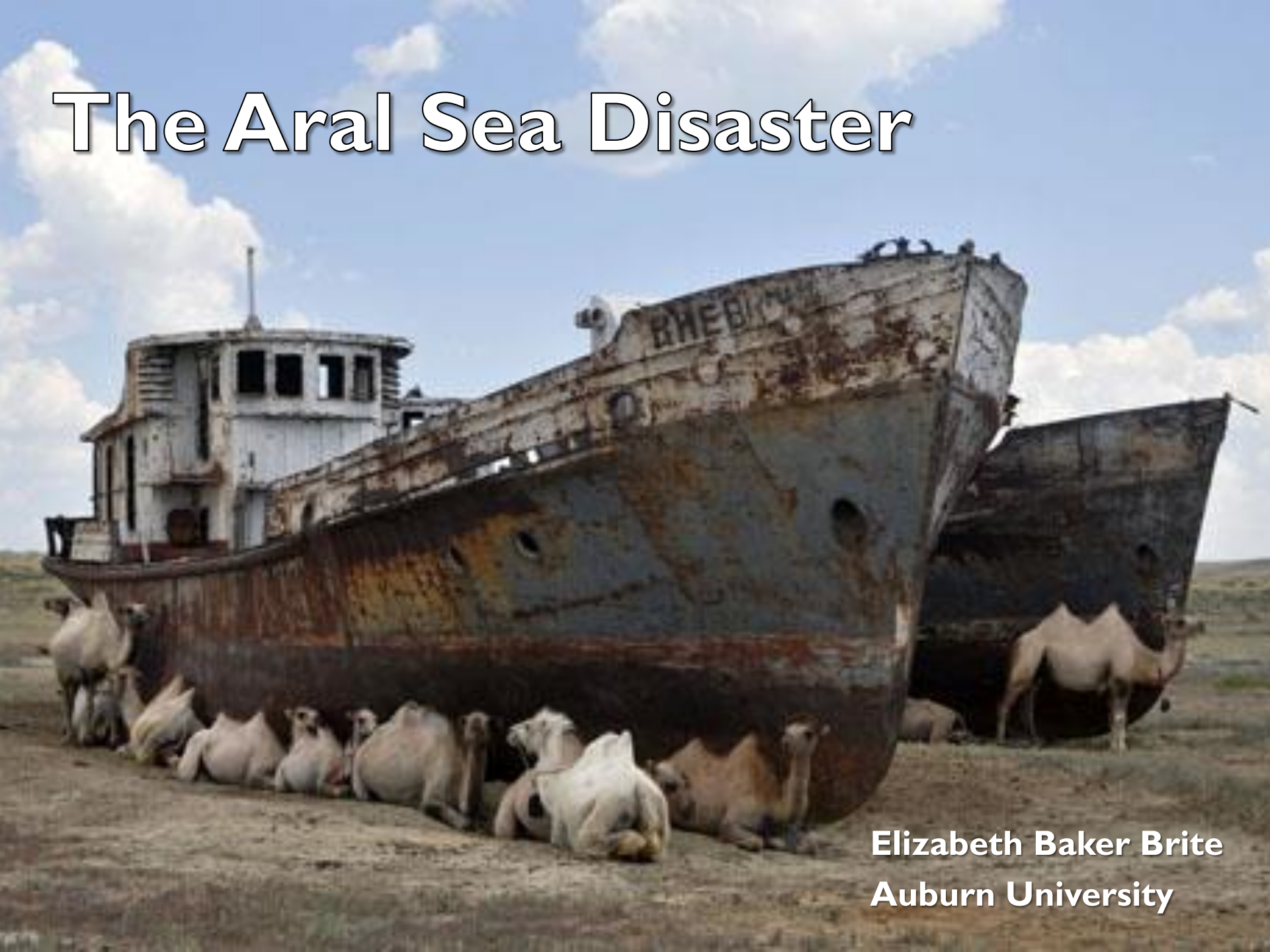
The Aral Sea Disaster



Elizabeth Baker Brite
Auburn University

Elizabeth Baker Brite

Postdoctoral Fellow, Auburn University

Ph.D. in Anthropology (UCLA 2011)
Archaeologist

Ancient Khorezm
(southern delta of the Aral Sea)

- Overview: the Aral Sea Disaster
- What happened?
- Effects
- *Why* did this happen?
- What is being done?

- **Overview: the Aral Sea Disaster**
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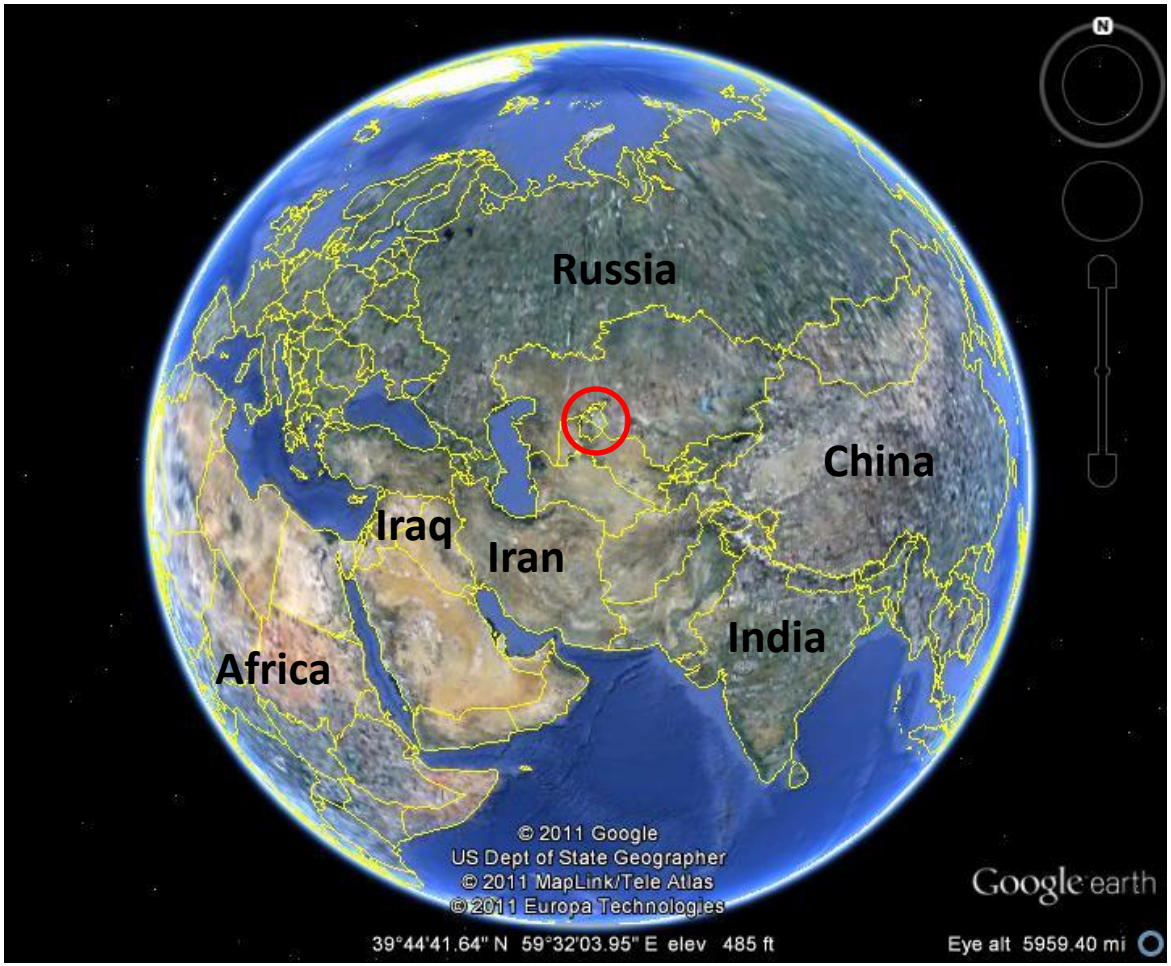
The Aral Sea


Russia
China
Iraq
Iran
India
Africa
© 2011 Google
US Dept of State Geographer
© 2011 MapLink/Tele Atlas
© 2011 Europa Technologies
Google earth
39°44'41.64" N 59°32'03.95" E elev 485 ft
Eye alt 5959.40 mi

The Aral Sea


Black Sea
TURKEY
SYRIA
IRAQ
IRAN
AFGHANISTAN
PAKISTAN
INDIA
CHINA
JORDAN
SAUDI ARABIA
Tehrān
Kabul
Baghdad
Tabrīz
Mosul
Aleppo
Trabzon
Kashi
Karamay
Scale 1:19,000,000
Lambert Conformal Conic Projection,
standard parallels 47°N and 62°N
300 Kilometers
300 Nautical Miles

Aral Sea

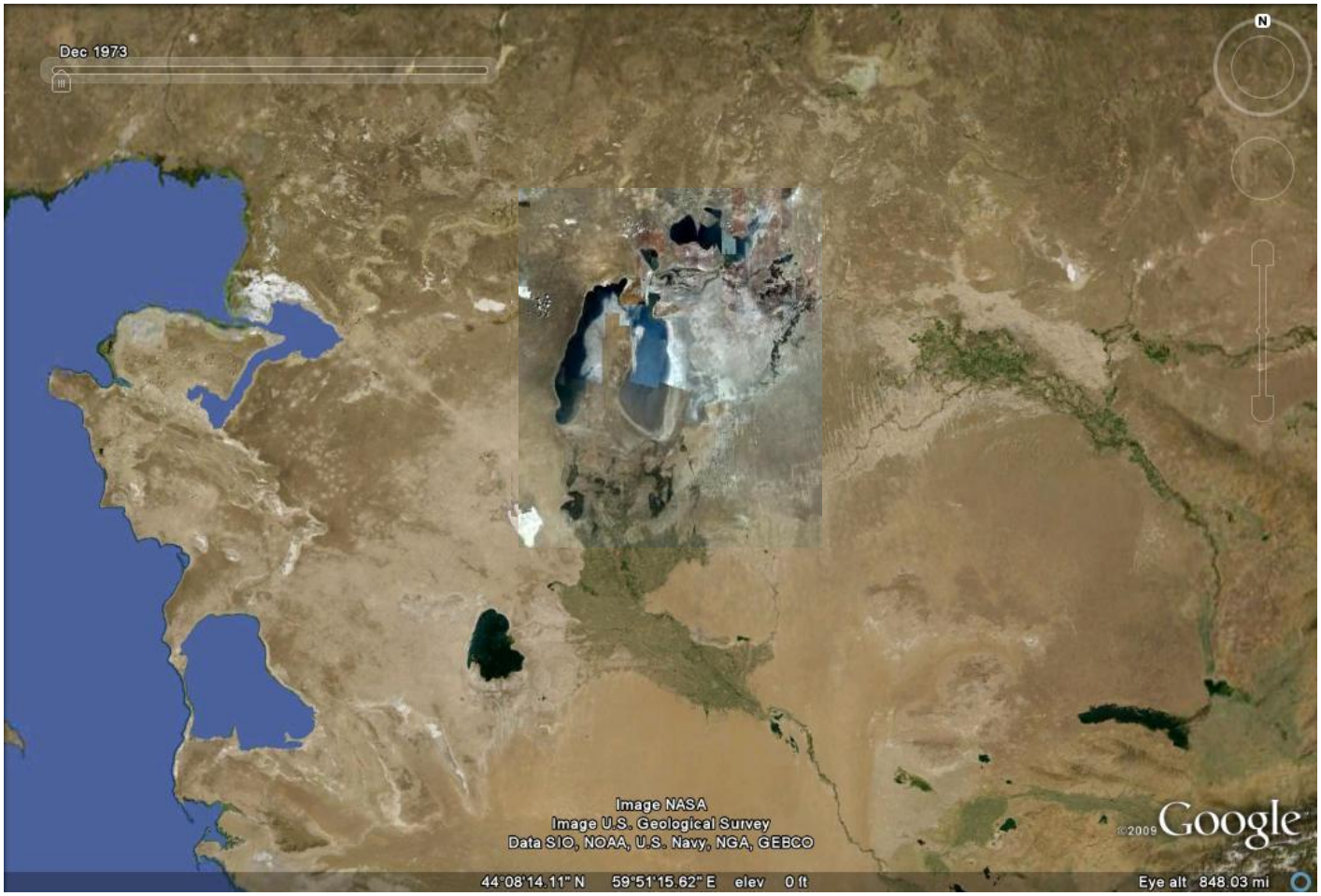
World's 4th Largest Lake

Not A Sea

Central Asia

Water in the Desert Steppe

Aral Sea


Dec 1973
N
Image NASA
Image U.S. Geological Survey
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
©2009 Google
44°08'14.11" N 59°51'15.62" E elev 0 ft
Eye alt 848.03 mi


DESPERATE MEASURES


SCIENCE PHOTO LIBRARY


PHOTO Denis LEGOURRIEREC 2005

"It is clearly one of the worst environmental disasters of the world…it is a vivid testament to what happens when we waste our common natural resources, when we neglect our environment, when we mismanage our environment."

-- Ban Ki-moon, United Nations Secretary-General, April 2010

Resources:

- Live Earth video, The Aral Sea
  - http://www.youtube.com/watch?v=NC5UIEx83fo&feature=player_embedded
- Al Jazeera report, The Aral Sea Reborn
  - http://www.aljazeera.com/programmes/earthrise/2012/07/201271912543306106.html

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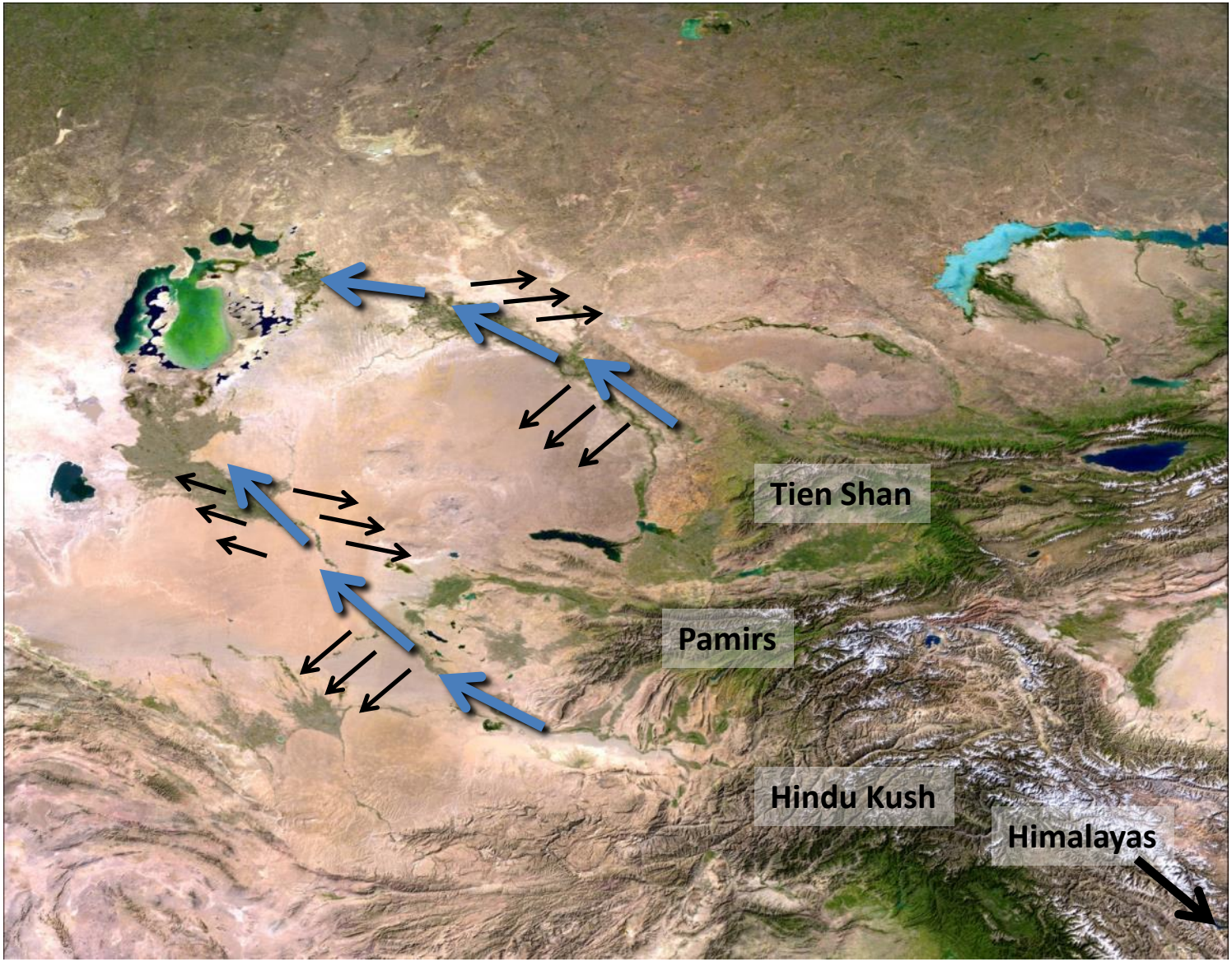
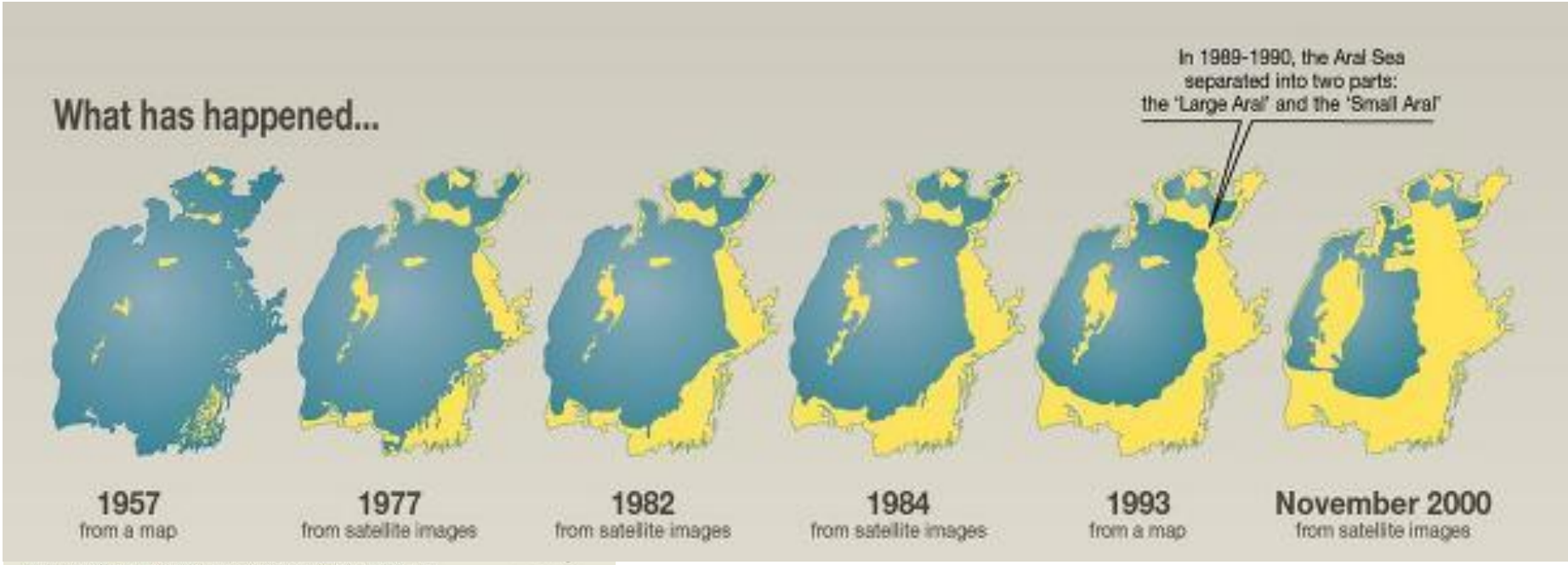
Why did the Aral Sea disappear?

1. Increases in irrigation agriculture throughout the 20th century used up all of the water before it could reach the sea

The Aral Sea

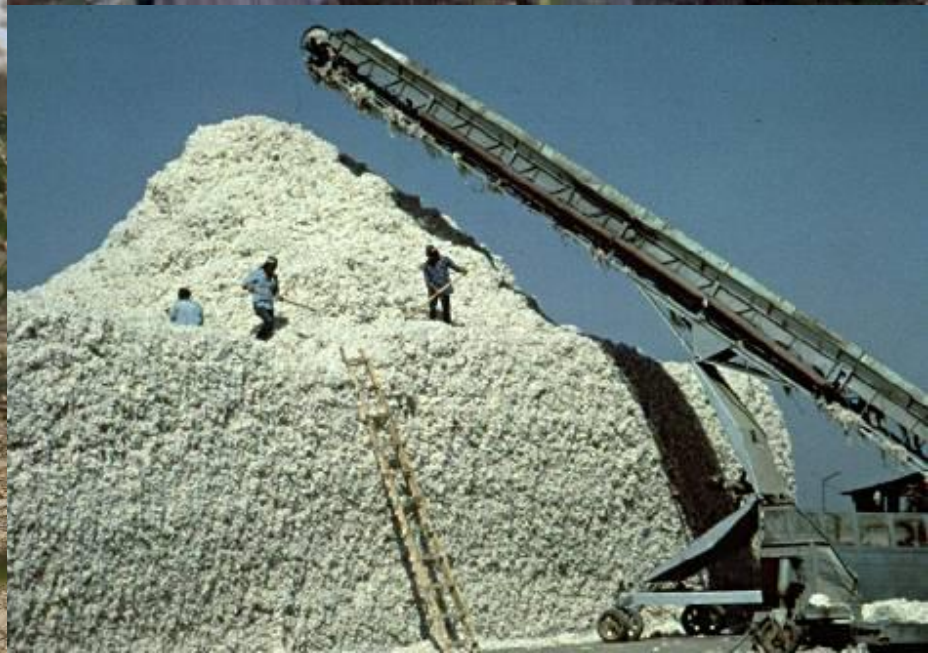




Sources: Nikolai Denisov, GRID-Arendal, Norway (especially for the graphics below); Scientific Information Center of International Coordination Water Commission (SIC ICWC); International Fund for Saving the Aral Sea (IFAS); The World Bank; National Astronautics and Space Administration (NASA); United States Geological Survey (USGS), *Earthshots : Satellite images of environmental change*, United States Department of the Interior, 2000.

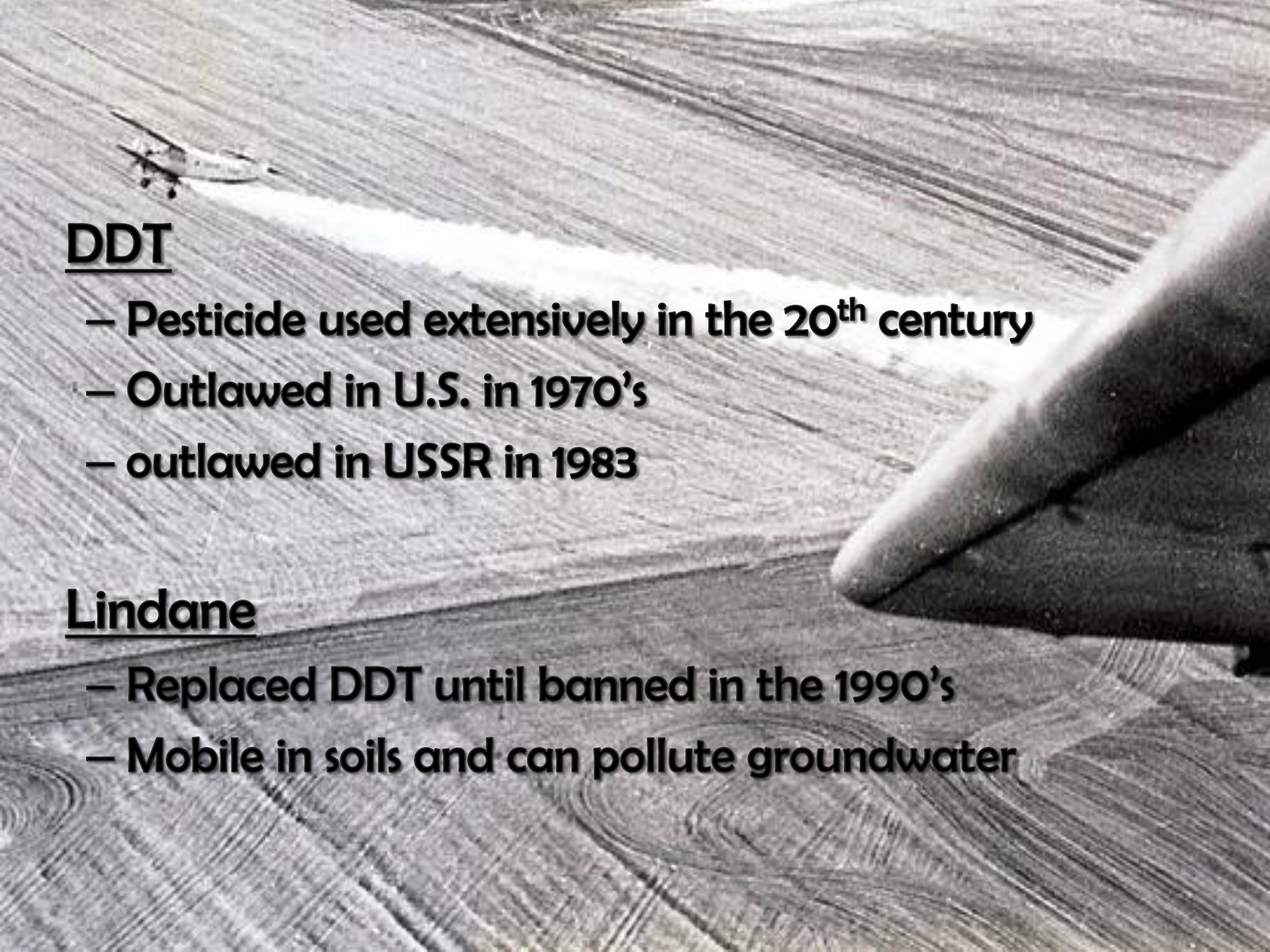
Why did the Aral Sea disappear?

1. Increases in irrigation agriculture throughout the 20th century used up all of the water before it could reach the sea
2. Farmers grew crops that required lots of water → cotton monoculture



Why did the Aral Sea disappear?

1. Increases in irrigation agriculture throughout the 20th century used up all of the water before it could reach the sea
2. Farmers grew crops that required lots of water → cotton monoculture
3. Excessive use of agricultural pesticides polluted the environment



DDT

- Pesticide used extensively in the 20th century
- Outlawed in U.S. in 1970's
- outlawed in USSR in 1983

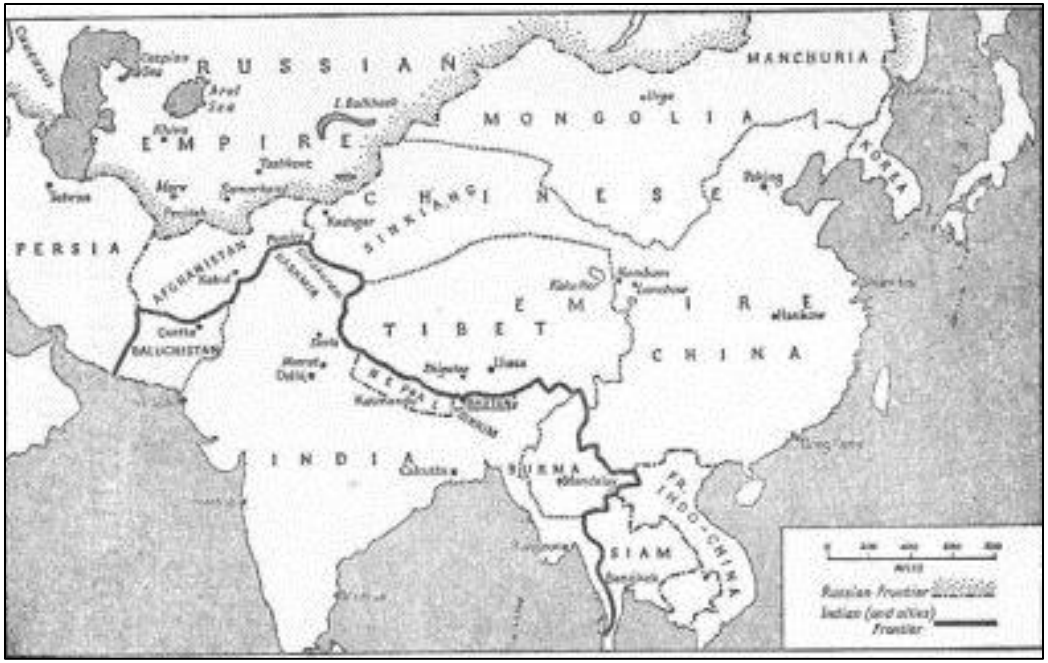
Lindane

- Replaced DDT until banned in the 1990's
- Mobile in soils and can pollute groundwater


KAZAKHSTAN
ELEVATION :
2 000 m
1 500 m
1 000 m
500 m
200 m
0
Dzhusaly
Kzyl-Orda
(Ak Mechet)
Syr-Dar'ya
KARAKALPAKIA
Turkestan
Dzhambul
Chimkent
Tashauz
Urgench
UZBEKISTAN
Tashkent
Namangan
Karadar'ya
Andizhan
Gulistan
Kokand
Amudar'ya
TURKMENISTAN
Bukhara
KYRGYZ
REPUBLIC
Samarkand
Ashkhabad
Chardzhou
Karshi
Dushanbe
Mary
IRAN
Kerki
TAJIKISTAN
Pyandzh
0
200
400 km
AFGHANISTAN
GRID-Arendal, 1998

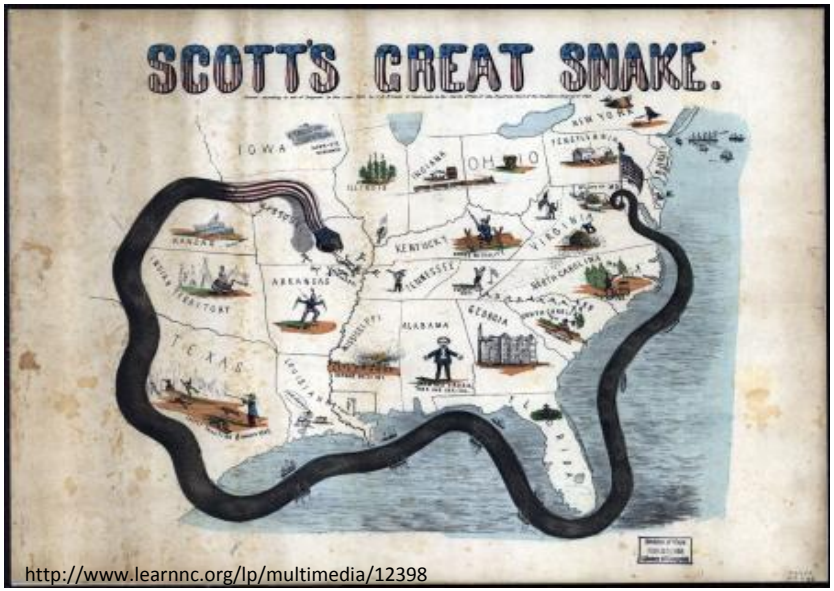
A Brief History of the Aral Sea Disaster

"The Great Game" – Colonial Conquest in Central Asia, 19th century



A Brief History of the Aral Sea Disaster

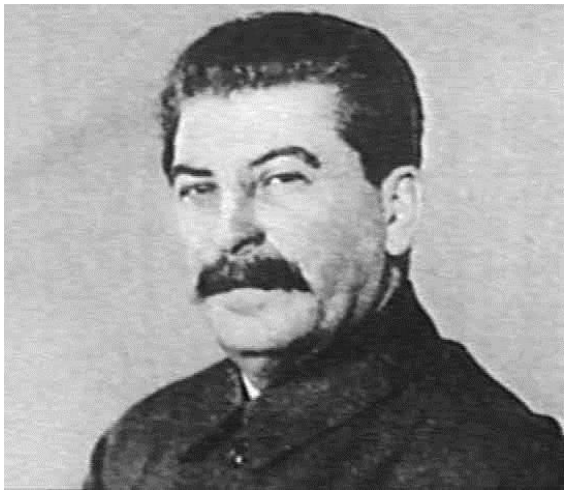
The Union Blockade, 1861



http://www.learnnc.org/lp/multimedia/12398

Soviet Agricultural Development

- The **USSR's Five-Year Plans** led to rapid industrialization of agriculture and other sectors
- Cotton became a major focus of the USSR's Central Asian economy



Joseph Stalin, 1941-1953

"Be like Stakhanov!" ca. 1936

"Grow vegetables!" ca. 1930

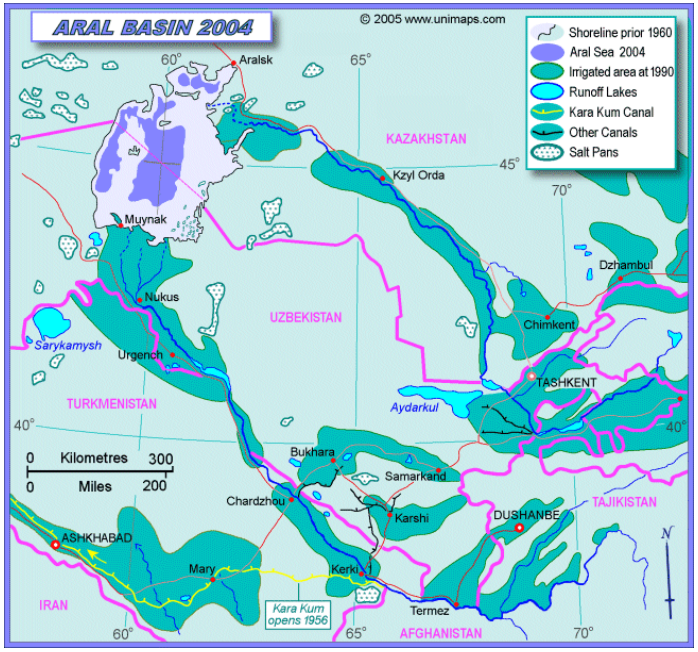
"Women, adhere to cooperation!" ca. 1917

"Our contribution to the world cause!" ca. 1951

Soviet Agricultural Development

- **Kara-Kum Canal** [ca. 1954] – one of the largest irrigation canals in the world
- Supports agriculture in Turkmenistan, supplies water to the capital, Ashgabat

Nikita Khrushchev, 1953 - 1964



1991 - The Break-up of the Soviet Union

Vozrozhdeniye Island

- USSR Biological Weapons development site
- Stores of **anthrax**, **smallpox**, **bubonic plague**, and other diseases
- Abandoned in 1992
- 2002 international emergency project decontaminated the island

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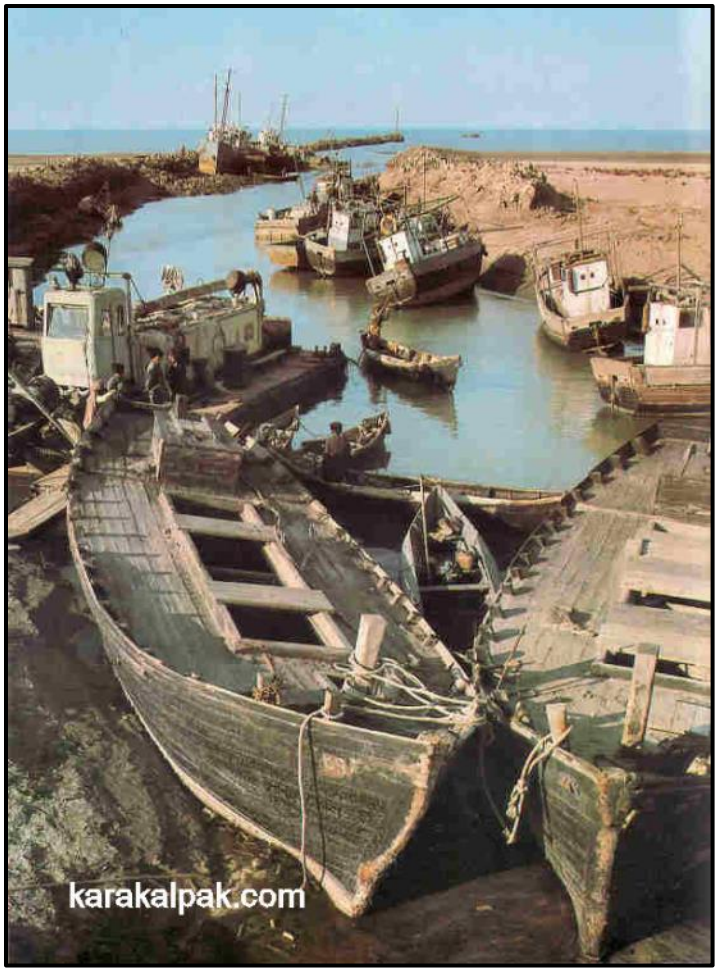
The Loss of the Aral Sea

- **Landscape and resource change**

Diminishing Resources

- Rising salinity kills off most commercial fish
- Fishing villages decimated
- Fishing and canning industries abandoned
- Cultural loss of traditional foods and economy



Receding waters, ca. 1980

Biodiversity Loss

✗ *Caspian Tiger*

ce Saiga Antelope

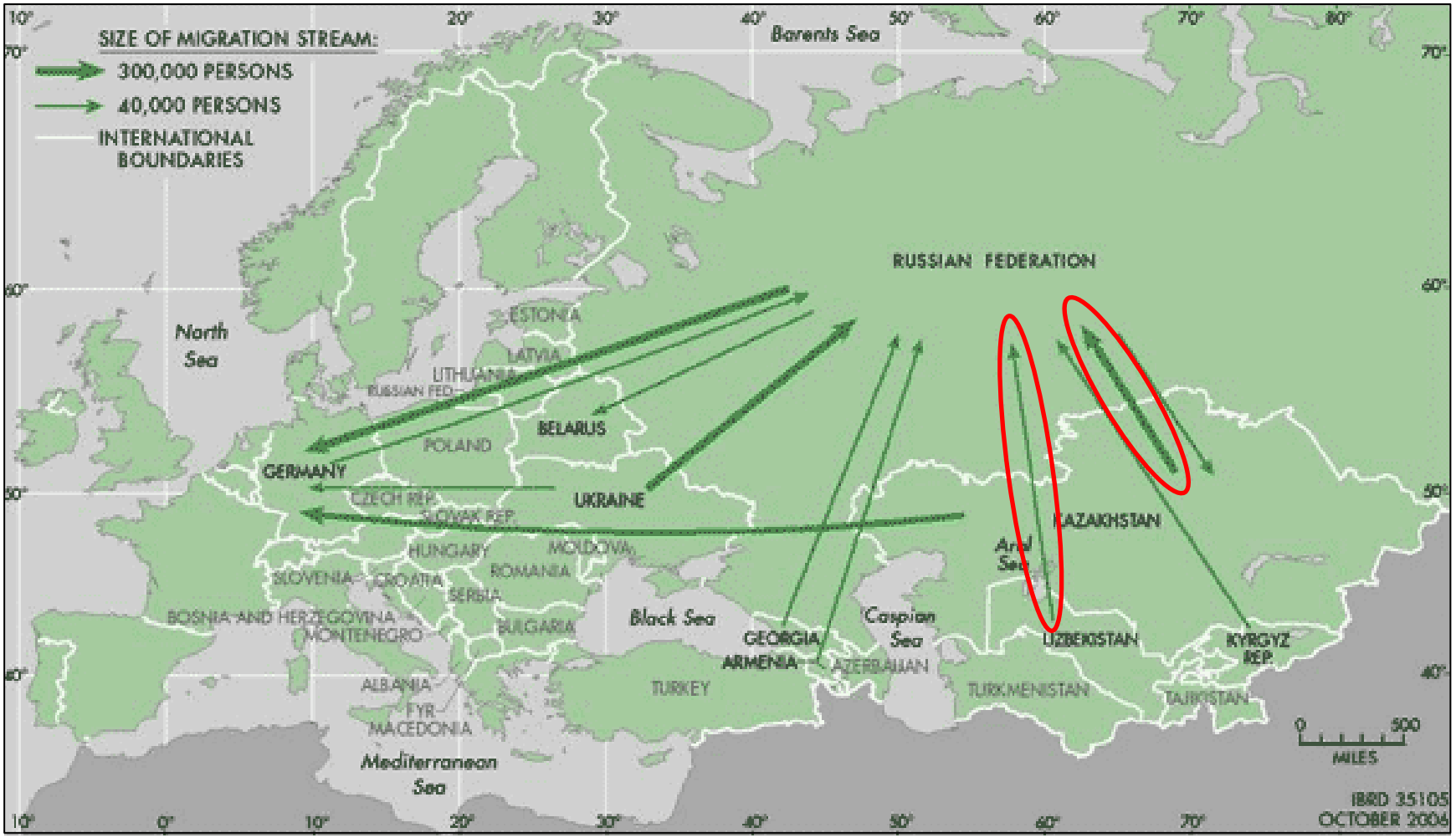
e Kulan (Asian Ass)

e Bukhara Deer

The Loss of the Aral Sea

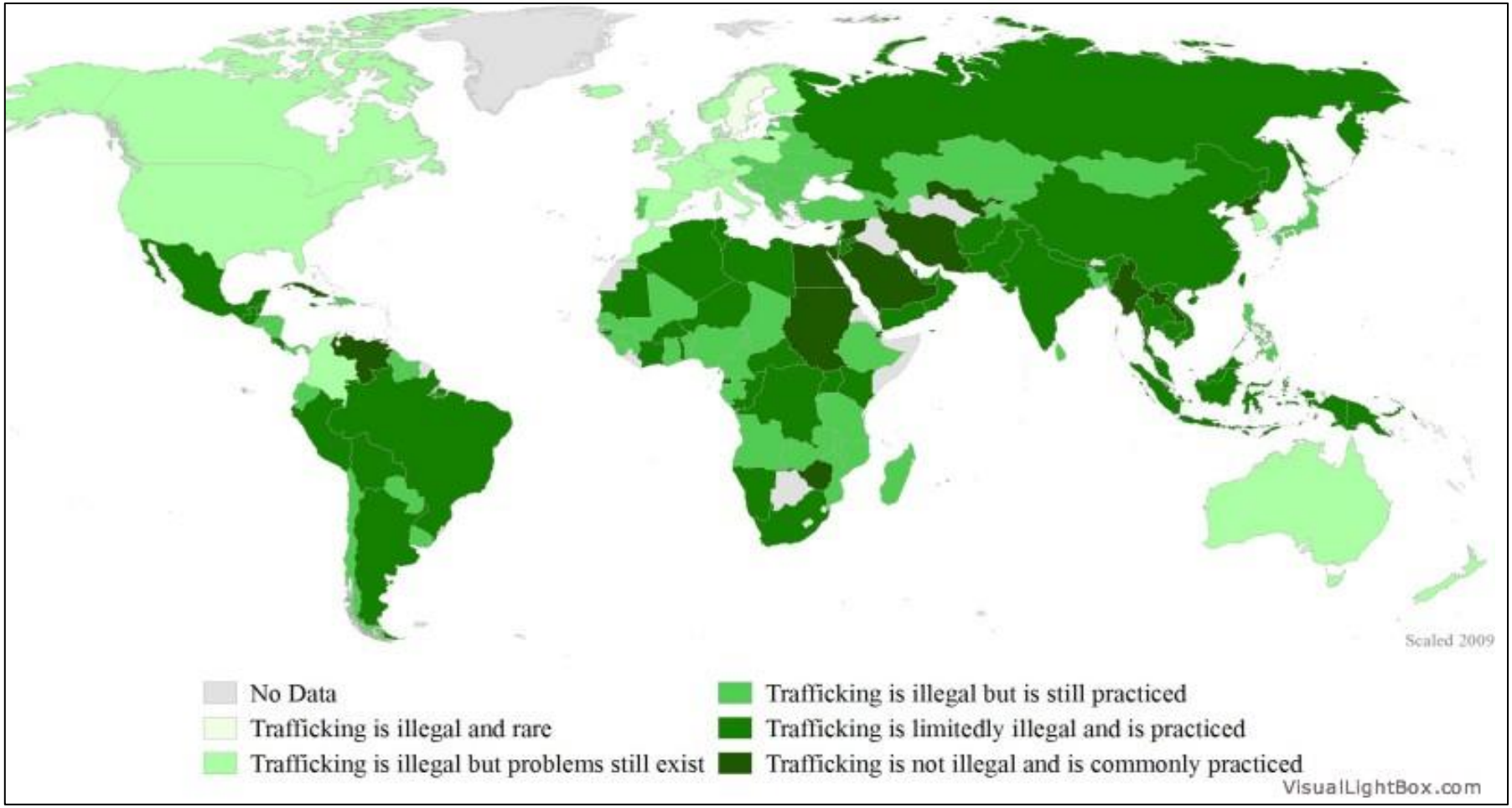
- **Landscape and resource change**
- **Migration issues**

Migration out of Central Asia



http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/ECAEXT/0,,contentMDK:22415020~pagePK:146736~piPK:146830~theSitePK:258599,00.html

Trafficking of Females



http://womanstats.org/data/images/map3.3trafficking_compressed.jpg

The Loss of the Aral Sea

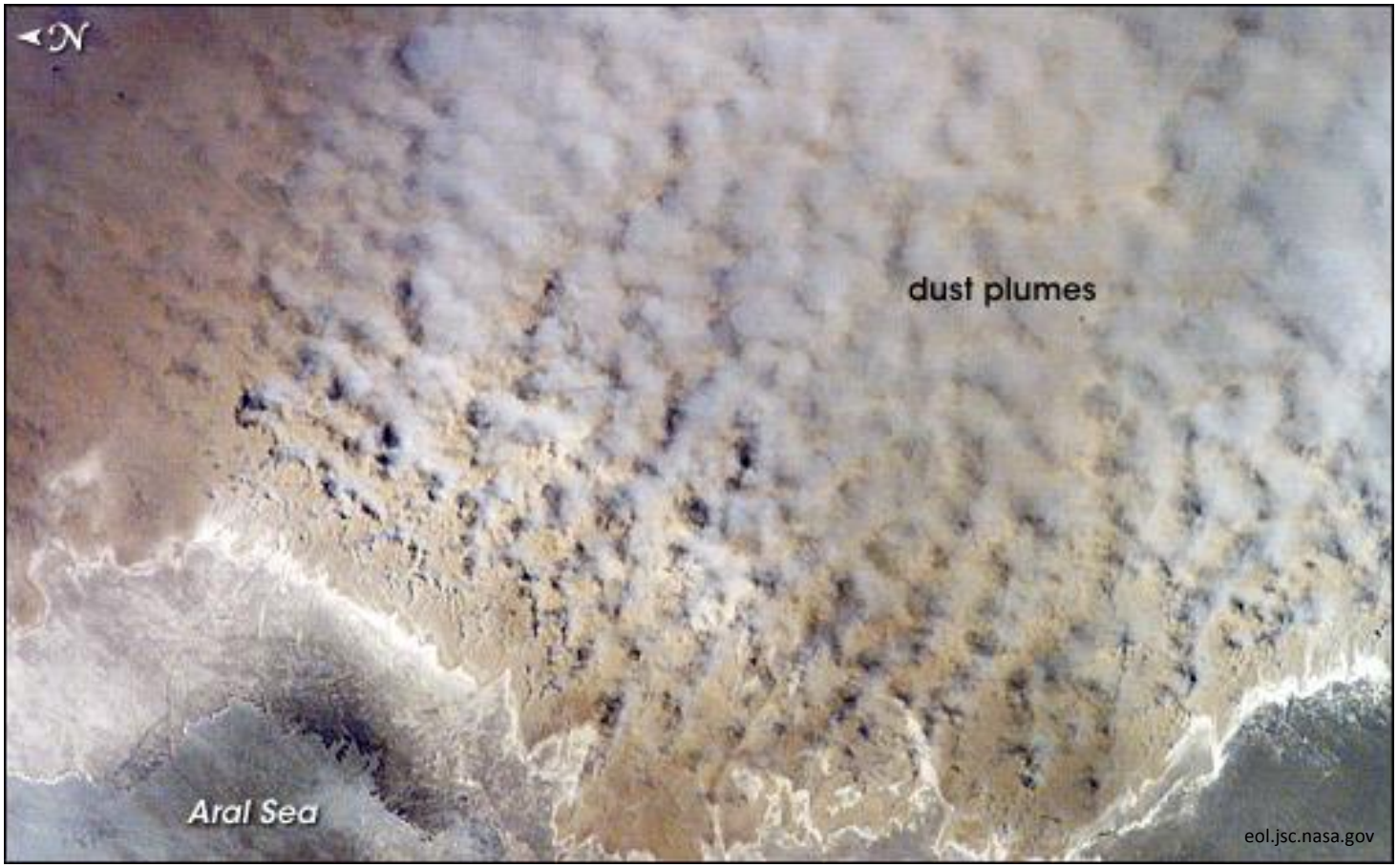
- **Landscape and resource change**
- **Migration issues**
- **Health problems**

Health Impacts

- As the sea dries up…
  - The sea bed is exposed to *aeolian* (wind) processes
  - Sediments are dispersed into the air
  - Along with these come **pollutants**, **toxins**, and **salt**, which are also present in the soil and water

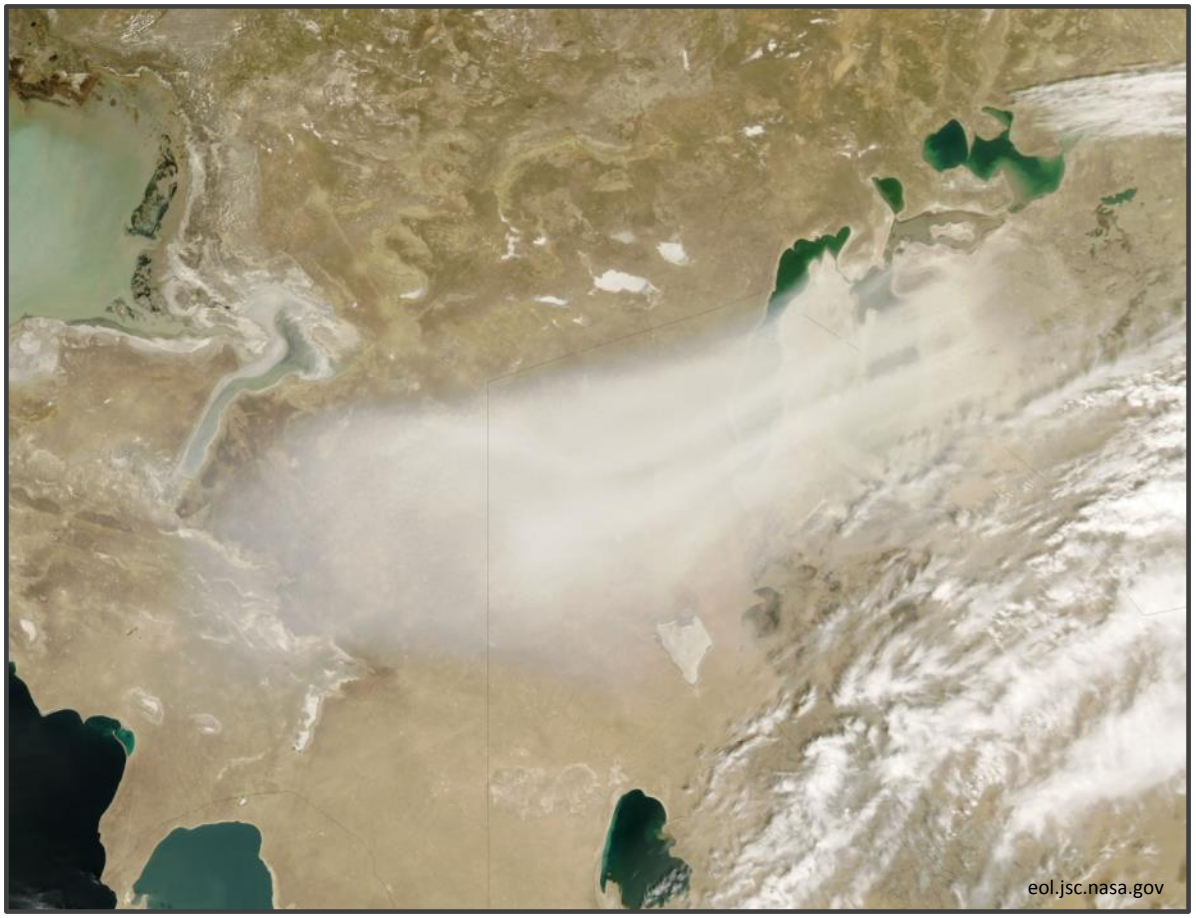
Health Impacts

Dust storms



Health Impacts

Dust storms



Health Impacts

- **Infants and Children are the most vulnerable**
  - Very high infant mortality rates
  - High incidences of respiratory illness in children

- **Adults suffer from:**
  - Respiratory illness, especially TB
  - Anemia
  - Kidney and liver diseases
  - Cancer
  - Lower life expectancy
  - Reproductive pathologies
    - infertility, miscarriages, complication in birth

All of these have increased significantly in the last 20-40 years

The Loss of the Aral Sea

- **Landscape and resource change**
- **Migration issues**
- **Health problems**
- **Climate change**

Climate Change

- **Sea Surface Temperature (SST)** changes
  - Previously, SST warmed the Siberian winds in winter, and cooled the region in the summer
- **Loss of the sea reduces SST effect**
  - As the sea looses volume, heat capacity is reduced
  - Warms up and cools off faster

→ Hotter summers, Colder winters

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The Aral Sea Disaster is a critical example of the environmental destruction wrought by humans

But human-environment interactions are complex!

*Ecosystems are ****dances***** between biological species and the physical world, and they are continuously evolving and changing. We join in the dance, but we do not control it.*

Proximate cause – immediate social or environmental factors that explain events

Ultimate cause – explanations that consider the larger context in which events take place; evolutionary forces

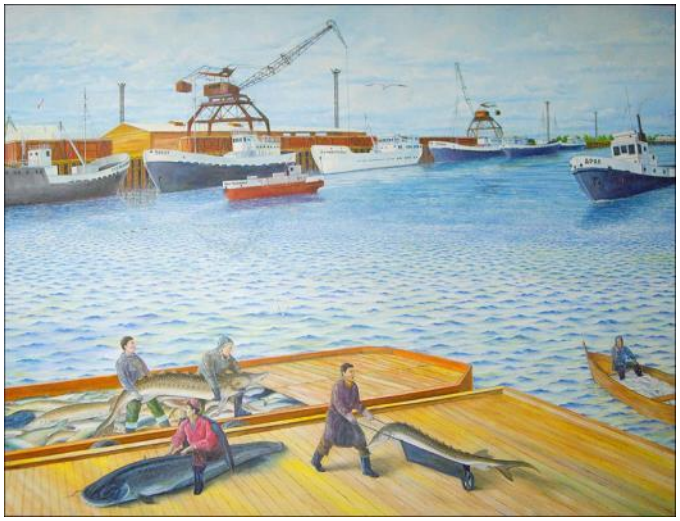
Why did the Aral Sea disappear?

- ✓ Explanation #1: Human Perception and Response

The Aral Sea disaster is a "**creeping**" environmental problem

Problems slowly accrue over time

The rate of change is so slow that people don't notice until it is too late



Like a frog in a pot….

Creeping vs. Sudden Disasters

Aral Sea

Chernobyl, Ukraine SSR, 1986

Creeping vs. Sudden Disasters

Aral Sea

Fukushima, Japan, 2011

Creeping Environmental Problems

Evolve slowly over time

Are hard to perceive, and therefore can go unnoticed for long periods of time

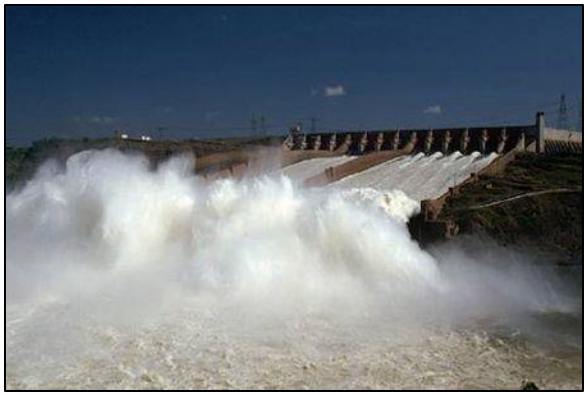
Result from the slow accumulation of human decisions over time

It is difficult to change the human systems that create the problem.

Food choices, agricultural strategies, infrastructure development, global trade, etc. all create the problem and perpetuate it.

Turkmenistan

Uzbekistan



Tajikistan

Why did the Aral Sea disappear?

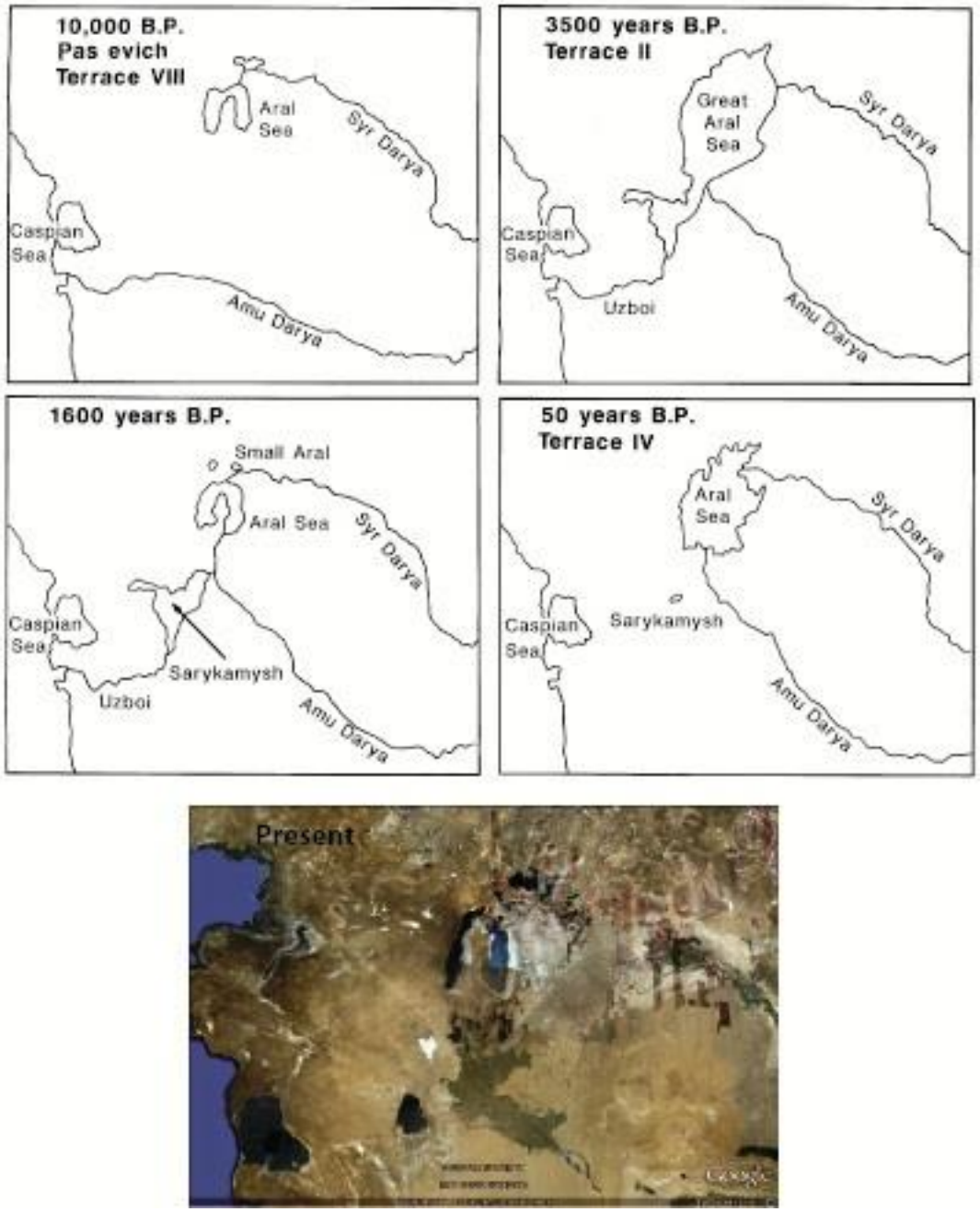
- ✓Explanation #1: Human Perception and Response
- ✓Explanation #2: Natural Processes

Natural Features of the Aral Sea

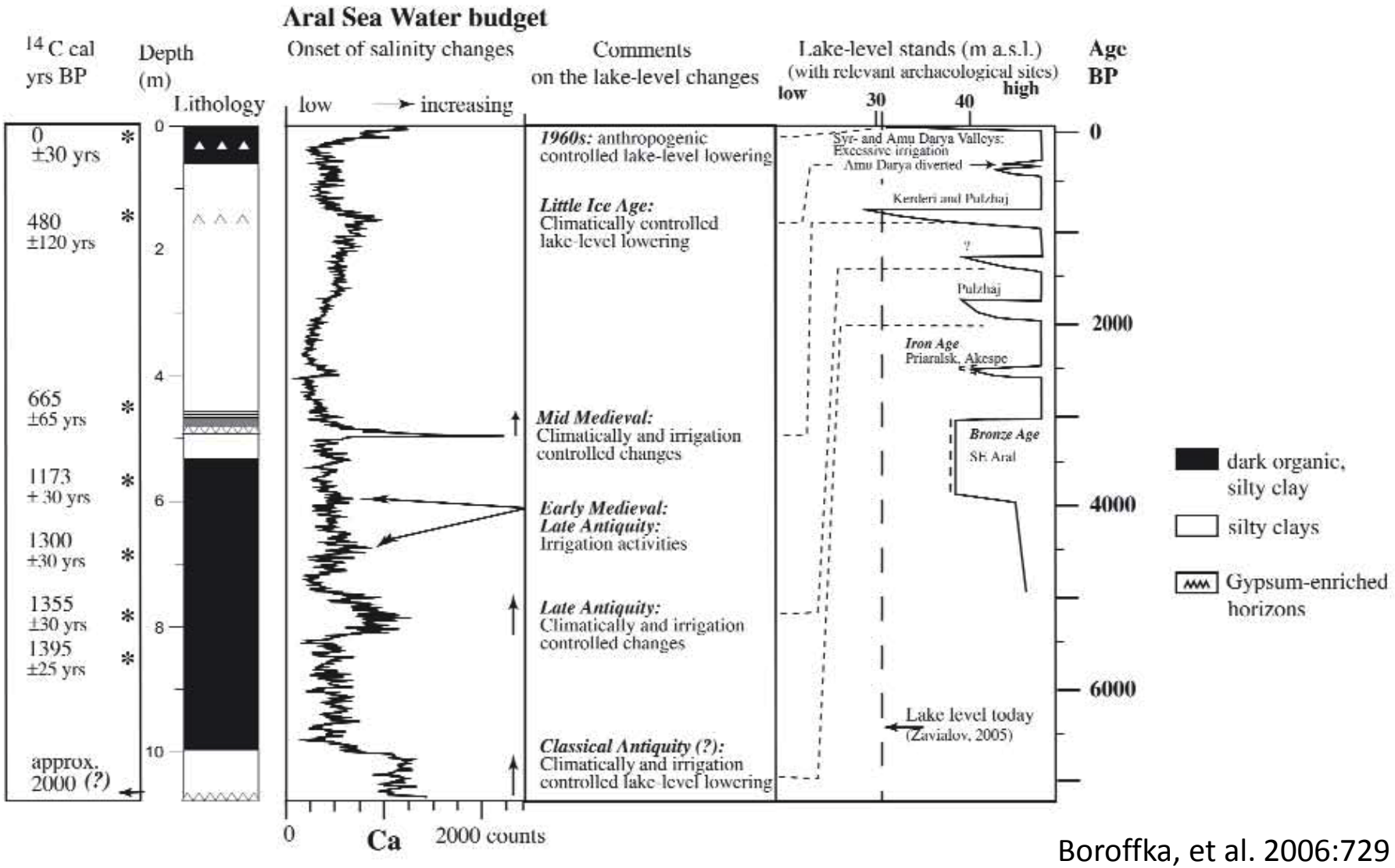
- **An *endorheic* basin**
  - internal drainage basin; “terminal” or “sink” lake

  = No outlet to the sea
- **Rivers deposit lots salts of sediments**
- **Very flat terrain**
- **Little rainfall**

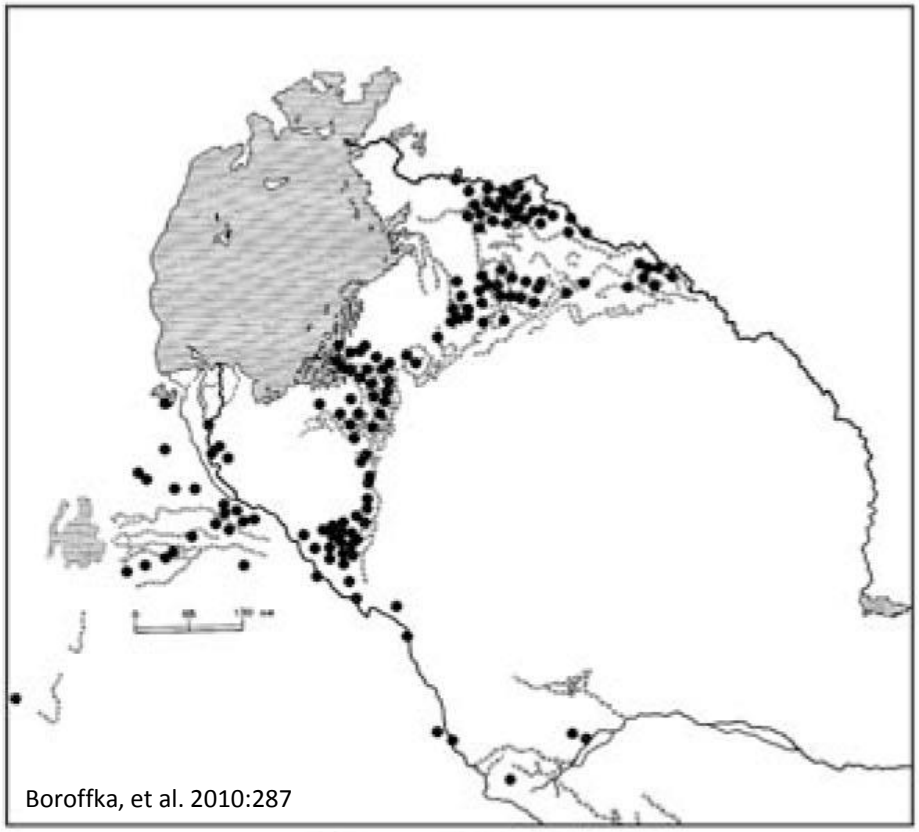
Like water in a bathtub…



Boomer, et al. 2000

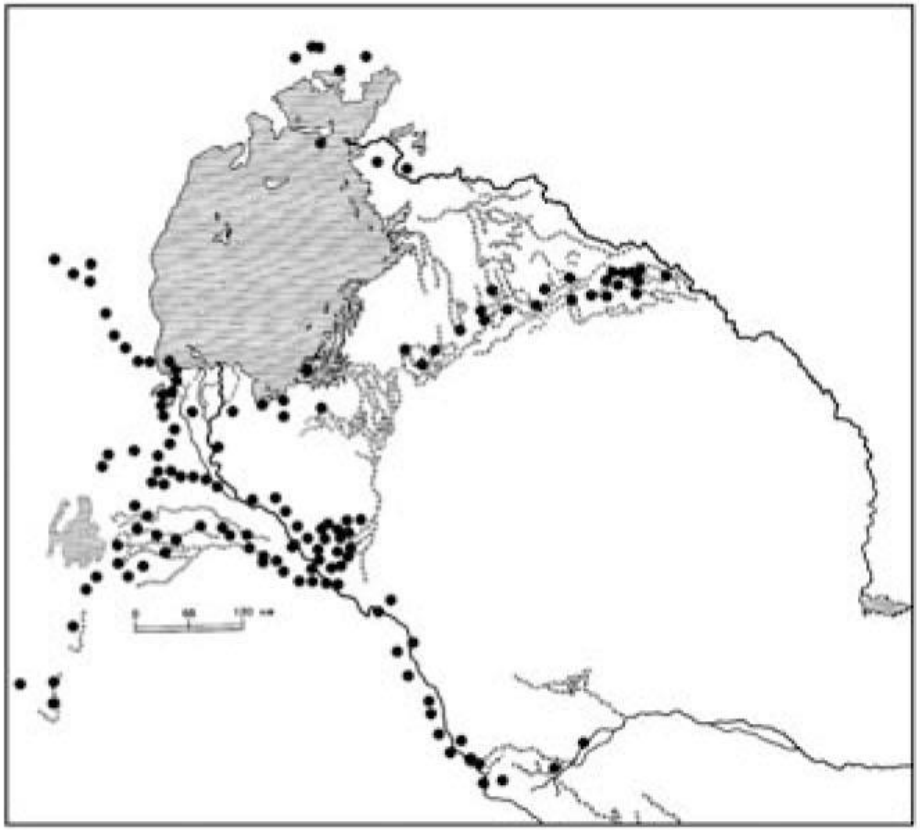


Boroffka, et al. 2006:729



Boroffka, et al. 2010:287

Antiquity
6th cen. B.C. – 3rd cen. A.D.
(Greeks and Romans)



Early Middle Ages
5th cen. A.D. – 8th cen. A.D.
(Dark Ages and Islam)

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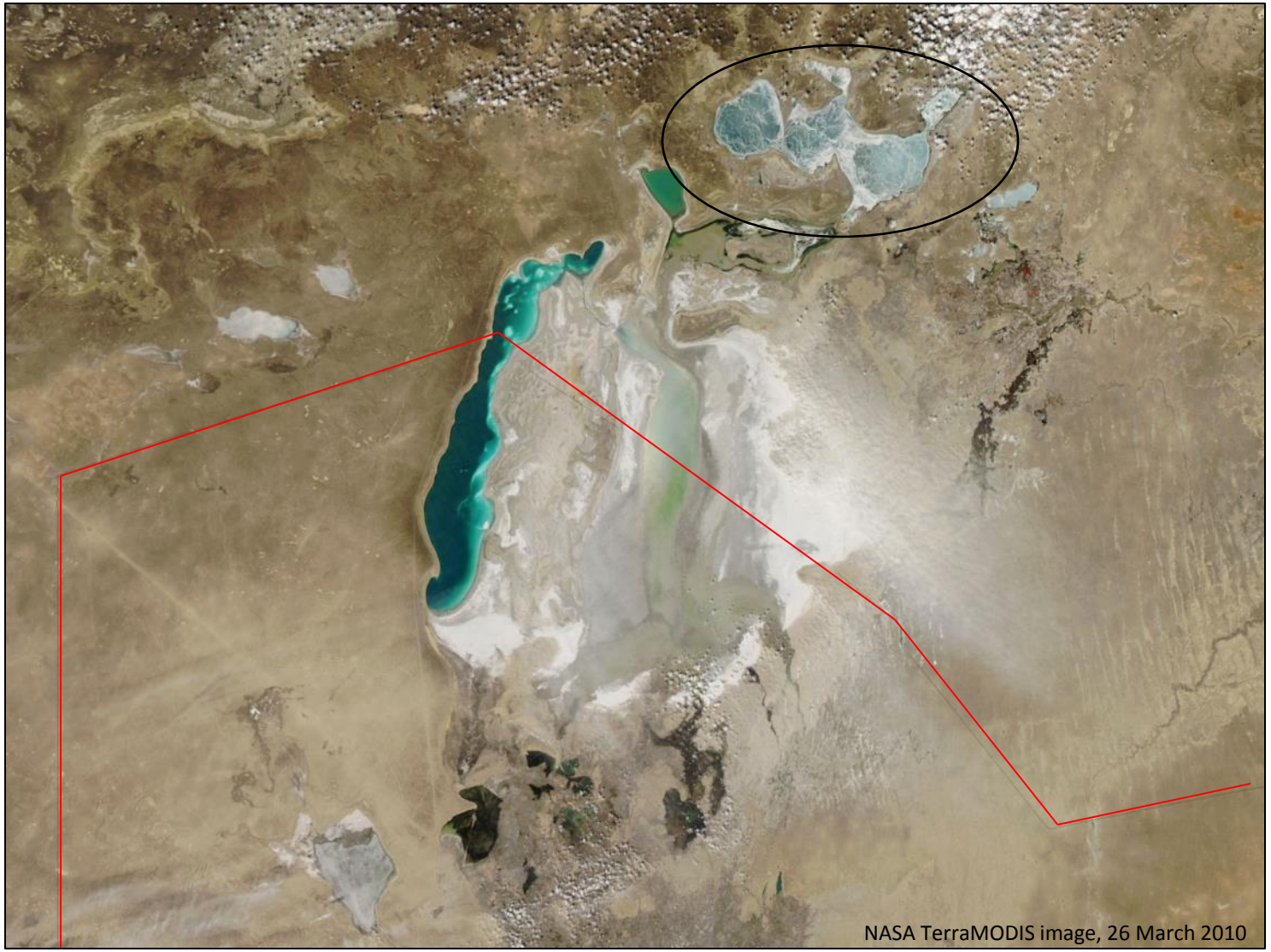
Restoration in the North Aral




NORTH ARAL 2006
© 2006 www.unimaps.com
61° 00'
N
Akespe
227m
324m
Aralsk
Mergensay
Ushkol
Zhalanash
Sarybasat
Akkuduk
179m
Ozek
Ushshoky
North Aral
46° 30'
Koktem
Approximate Shoreline August 2006
65m
Shoreline -prior 1960
Akbasty
Avan
Kokaral
163m
Bugun
Berg Strait (defunct)
Kyzylkair
Amanotkel'
Kyziljar
Karashalan
Syr Darya
Zhanakurylys
46° 00'
Karatereng
Imeni Shevchenko
Oktyabr
Zhanatalap
61° 00'
Aral Sea 2006
KAZAKHSTAN
UZBEKISTAN
Kokaral dam
Principal roads
Railway line
Diversion canal
Salt pan
Exposed seabed
Nth Aral at 2006
Township
65m
Local highpoint

April 9, 2006

April 8, 2005

- Since 2007, the annual catch in the North Aral has doubled
- As of 2009, all of the fish species in the South Aral are dead
- Fisheries are working to bring back native populations of carp and sturgeon

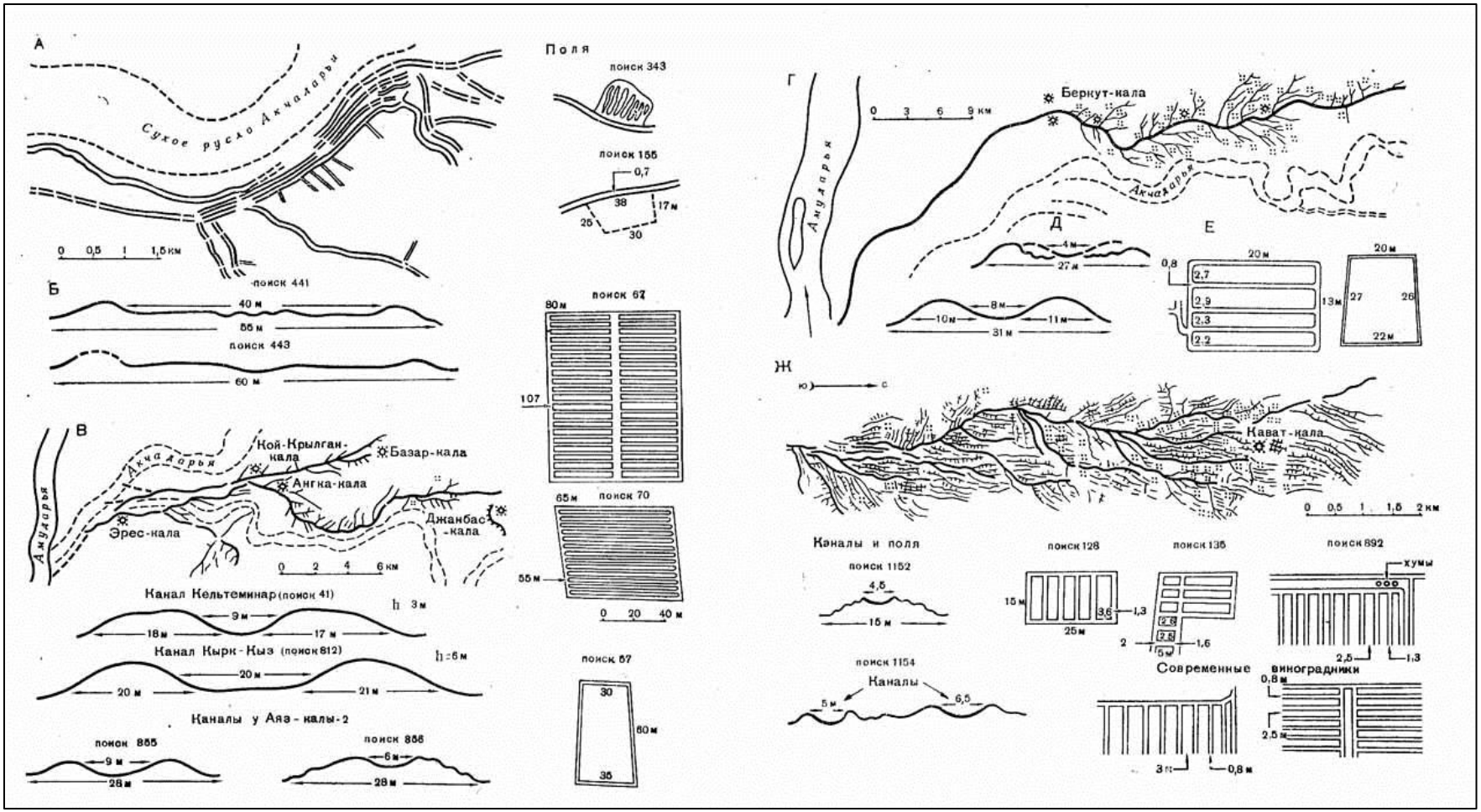
Phytomelioration in the "Aralkum"

Planting of saxaul, tamarix, and *Calligonum* to stabilize dunes, shelter villages, and combat desertification

Seedlings of *Calligonum*, Aralkum floor

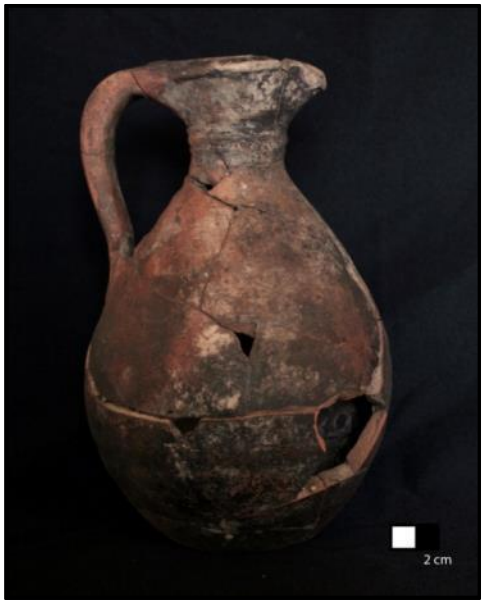
Black saxaul, planted in 2006

Archaeology and the Aral Sea



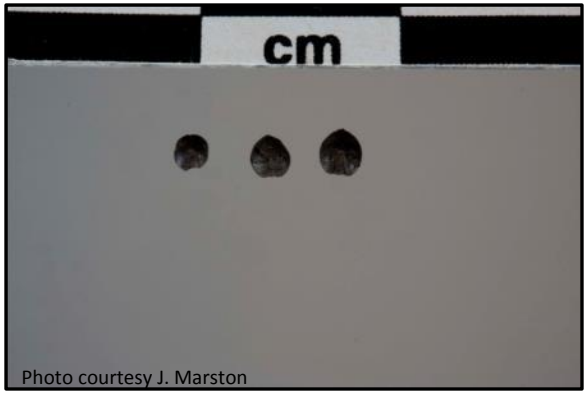
B.V. Andrianov, 1969

Archaeology and the Aral Sea



Archaeology and the Aral Sea

Cotton



Foxtail millet

Grape

Lessons from the Aral Sea

1. Humans can have significant impacts on the environment in relatively little time.

We can cause climate change!

Lessons from the Aral Sea

2. Monocultures and industrial agriculture can have significant consequences.

   The USSR and the U.S. have followed similar paths…..

Lessons from the Aral Sea

3. History and geopolitics impact the landscapes we inhabit.

Lessons from the Aral Sea

4. Environmental change has consequences for human health, equity, and demographics.

The changes we make to the environment change us.

Lessons from the Aral Sea

5. The interactions between human and natural systems are complex. Interactions are not always immediately perceptible and they are best understood in context.

Know your bioregion!