



Satellite monitoring of the Aral Sea

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The Aral Sea disaster is one of the most significant examples of a man made ecological catastrophe caused by mismanagement of water resources. Uncontrolled water withdrawal lead to the Aral sea's level drop of up to 22 meters for the last 35 years. The sea separated in to two independent parts - Large Sea(Southern) and Small Sea (Northern), loosing more than 90% of its original water masses. When regular in situ investigations of the Aral sea were stopped after the collapse of the former Soviet Union, satellite retrieved data became the main source of information on this perishing system.

Regular observations from AVHRR, SeaWiFS, MODIS and ASTER satellite sensors were used for our investigations. Optical data of the AVHRR sensor and digital bottom map topography were used for sea level drop calculations. For the period 1989-2002 the sea level of the Large Sea dropped 9.2 meters. However in 2003 the sea level remained stable and in 2004 the sea level drop was 0.2m. This stabilisation was due to an increase of water output of the rivers Amu-Darya and Syr-Darya in 2003. High resolution ASTER data showed that the main amount of Syr-Darya waters is discharged into the Large Sea. The volume and surface variation of the Aral Sea was calculated for the years 1989-2004. The dried bottom area today covers more than 45 000 km²

On the base of AVHRR-SST data the temperature regime for different parts of the Aral Sea was calculated for the years 2002-2004. The annual amplitude of the SST variation reaches 37° C for the open waters. The observed maximum freezing point was -7° C due to very high salinity. Estimations from satellite retrieved freezing points show an increase of salinity up to 12% in the Eastern part of the Large Sea. It is almost paradox that on satellite images the ice appears warmer than the water. Strong variations of the

water temperature (up to 5° C) within a few days could be observed in April –August and could be related to wind induced mixing. NCEP wind data were used for this analysis.

SeaWiFS ocean colour data were used for the investigation of the optical properties of the water in different parts of the Aral Sea for the years 2002-2003. General variations and specific anomalies were observed for different areas of the sea. A significant relation of optical properties with wind and temperature was obtained. Strong changes of the thermal regimes of the Sea can cause variations in local climatic conditions: The analysis of AVHRR NDVI - data for the surrounding areas demonstrated a shift in annual vegetation cycle. Thermal and optical data were used for the detection of ground waters sources . Main sources of groundwater were found in the former bottom area between 18 and 21 meters level drop in the Eastern part of the Large Sea.

In addition phenomena like: “salt” storms, wind driven tides, eddies and frontal structures as well as ice coverage of the Aral Sea were demonstrated on satellite images.