Near-Real Time Monitoring
of
Global Lakes and Reservoirs

A semi-automated system with global outlook, using the
Jason-1 and TOPEX/POSEIDON satellite radar altimeters

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ABSTRACT: . Satellite radar altimetry has the ability to monitor variations in surface water height (stage) for large lakes and reservoirs. A clear advantage is the provision of data where traditional gauges are lacking or where there is restricted access to ground-based measurements. As part of a USDA-funded program, near-real time altimetric monitoring of the largest lakes and reservoirs began in October, 2002. Data ingestion and manipulation closely follows the path of the NASA Ocean Altimeter Pathfinder Project with some modifications for inland water considerations. The program utilizes incoming data from the Jason-1 mission (near-real time, post 2002) and data from the TOPEX/POSEIDON archive (1992-2002). Focus was initially on the African continent but became more global with other reservoir targets in Turkey, Afghanistan, Pakistan, India, Kyrgyzstan, Iran and Iraq. The project began by utilizing the IGDR data with its expected <10cm orbit accuracy and delivery time of <4days after satellite overpass. The team produce graphic and text products, revealing the variation in lake height, within 7-14days after flyover. These are delivered to the Foreign Agricultural Service's, Precipitation Estimation and Crop Assessment Division for observation of flood/drought conditions, and for analysis of reservoir volume and irrigation potential.

Introduction

This project centers on the proven ability of satellite radar altimeters to monitor the variation of surface water height for large inland water bodies. It utilizes near-real time altimetric data from the Poseidon-2 instrument on-board the Jason-1 satellite to construct time series of surface water height variations.

A semi-automated data ingestion and analysis system has been constructed which outputs time series variation products which are directly delivered to the United States Department of Agriculture. The Foreign Agriculture Service utilizes the products for flood and drought applications, while the Precipitation Estimation Crop Assessment Division utilizes the data for the determination of reservoir storage and irrigation capacity. This project is unique, being the first of its kind to utilize near-real time altimeter data over inland water in an operational manner.
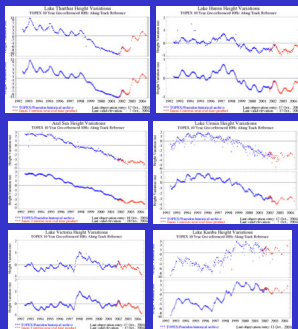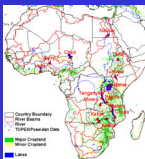
Targets

Initially the African continent was under consideration with focus on 4 major basins:

1) Nile Basin:
   Lakes Nasser, Tana, Victoria
2) Niger Basin:
   Lakes Chad, Kainji, Volta Reservoir
3) Rift Valley Basin:
   Turkana, Victoria, Tanganyika, Rukwa, Mweru
4) Zambezi Basin:
   Lakes Chiuta, Nyasa, Kariba, Cabora Bassa and Kafue

..but with further funding the project gained a more global outlook. The USDA finally selected 180 large lakes and reservoirs crossed by Jason and T/P for routine monitoring. With the near-real time requirement and in consideration of an acceptable height accuracy, the IGDR (Interim Geophysical Data Record) data stream is employed.

Jason-1

Jason Data

a) OSDR:
accuracy 30-40cm, 3hr data delivery delay
b) IGDR:
accuracy 10cm, 4day data delivery delay
c) GDR:
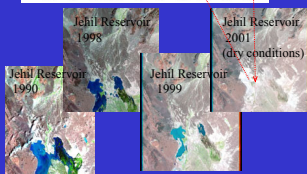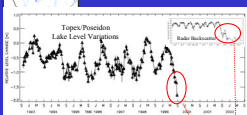accuracy 2-3cm, 1-2month data delivery delay

Deliverables

For each lake the deliverables consist simply of graphics plot and ASCII text file revealing the relative change in surface elevation as the Jason-1 mission progresses. Products are delivered to a dedicated server and public-accessible website within 7-14 after satellite overpass.

In the future, and where possible, elevations from multiple differing Jason-1 overpasses will be combined to form composite time series i.e. with potential ability to reduce the 10-day temporal resolution. In addition, new targets observed by T/P from its new ground-track location will be added. Consideration ia also being given to those lakes crossed by the NOAA/GFO and ESA ERS and ENVISAT missions.

Examples

To date, the database holds entries for 70 targets. Examples shown here depict those situated within drought stricken areas, or where irrigation has severely reduced inflows, or where levels are currently lower than then 10-year mean. Also shown are those lakes within regions that suffered high economic and financial losses during some of this decade's major flooding events. Observation of all reservoirs where water resources and agriculture are of prime importance, is a priority.