The Near Real Time Global Reservoir and Lake Monitor

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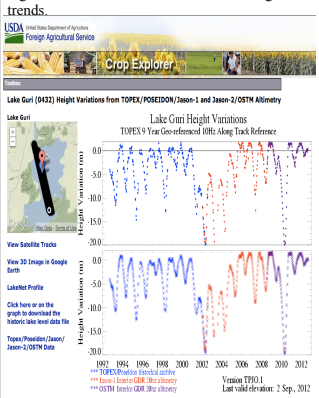
1. Introduction

A USDA/NASA funded program is performing near-real time altimetric monitoring of the largest lakes and reservoirs around the world. The near-real time stage measurements are derived from NASA/CNES Jason-2/OSTM mission IGDR data. Archived data from the NASA/CNES Topex/Poseidon and Jason-1 missions, and from the NRL GFO mission are also utilized to provide historical time series variations from 1992-2012. The program was recently expanded and enhanced by including part of the ESA ENVISAT archive data set (2002-2010) which allows the monitoring of several hundred additional lakes. Radar, lidar and ground-based data sets are all used for relative or absolute validation exercises. The USDA/FAS and other end-users utilize the products for assessing irrigation potential (and thus crop production estimates), and for general observation of high-water status, short-term drought, longer-term climatic trends, and anthropogenic effects. The performance of the Poseidon-3 radar altimeter, in terms of product quality and quantity and minimum target size is excellent. Upgrades to the merged Topex/Jason/OSTM products are underway, the system is being refined to allow for faster (daily) product updates, and data from the Cryosat-2 mission are being examined with a view to bridging the time series gap between ENVISAT and Sentinel-3/SARAL.

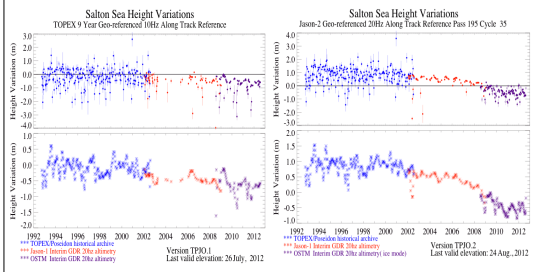
2. Jason-2/OSTM

Acquiring targets ~150km^2, ~800m wide, within 0.1-2.5secs of the coastlines, and with resulting time series accuracies 3-33cm rms. The GRLM is producing near real time products on a weekly basis. Roughly 4 weeks of products enter the USDA/FAS monthly lock-up process which estimates crop production statistics, and notes high and low-water current status and long-term trends.



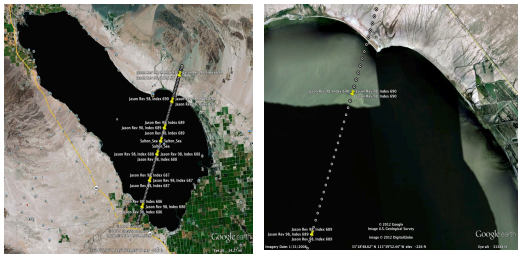
Example: Lake Guri, Venezuela, with water levels recharged sufficiently after the severe 2010 drought to resume full Hydro Electric Power generation.

3. New TPJO.2 products



TPJO.1 : T/P ***10hz*** 9-yr mean reference profile; Jason-2 ocean retracking

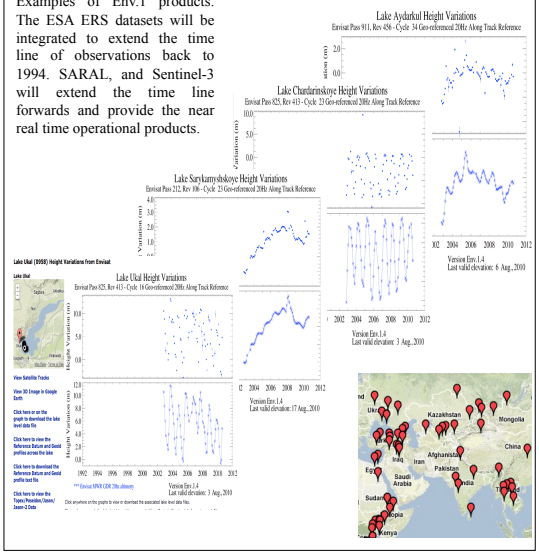
TPJO.2 : Jason-2 ***20hz*** mean reference pass profile; Jason-2 ice retracking



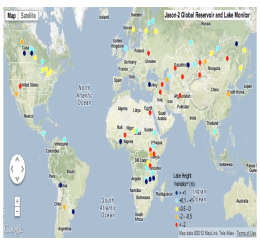
Currently TPJO.1 products are available from the NASA/CNES suite of altimeters. The water level variations are a relative height time series based on a mean datum derived for each lake and based on 9yrs of 10Hz T/P data. By switching to the OSTM 20Hz data set as the reference and using a single fly-over date as the reference pass, and having the ice-retracking mode option, the new TPJO.2 products show some improvement. Particularly, when the combined use of 20Hz and Google imagery allows for a better separation of land/water regions. The example shown here is the Salton Sea (USA). TPJO.2 products are due for release in November 2012.

4. ENVISAT products

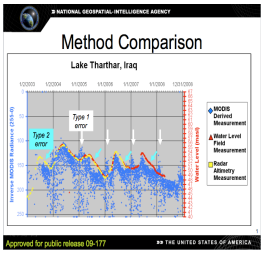
Examples of Env.1 products. The ESA ERS datasets will be integrated to extend the time line of observations back to 1994. SARAL, and Sentinel-3 will extend the time line forwards and provide the near real time operational products.



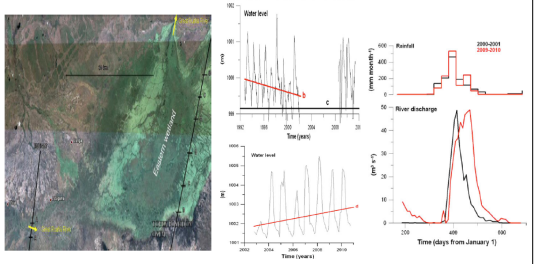
5. Applications



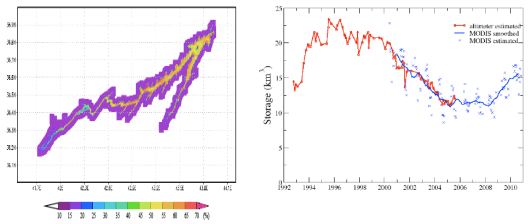
A) Lake levels as climatic indices. The map shows the current status of lakes compared to an average derived from 9yrs of the T/P GDR data. Roughly a third of these lakes have high water conditions, and one third drought conditions.



B) Monitoring drought: Comparison between gauge and altimetry (T/P) data and their combined use in validating inferred water levels derived from MODIS imagery. The MODIS data indicate an erroneous annual peak early in the year (white arrows), and the MODIS summer levels are underestimated (blue arrows).



C) The role of vegetation in the water budget of the Usangu wetlands, Tanzania. Combined imagery, altimetry, and precipitation being utilized to determine the hydrology of the region and the effects of overgrazing (cattle) within an important conservation, irrigation and HE-power region. The ENVISAT series of water variations (bottom) stems from the AA section of the western track. The T/P and OSTM series of water variations (top) stems from the BB section of the eastern track. Top far right shows monthly rainfall at Mbeya with altimetric-derived river discharge at N'Giriama for the 2001-2002 and 2009-2010 periods.



D) Determining global reservoir storage. Example for the Fort Peck Reservoir, Montana (USA). (left) Delineated mask derived from MODIS 16-day 250m vegetation index imagery showing percentiles for water class. Derived surface extent, together with altimetric water levels, allows for a combined estimation of reservoir storage (right, courtesy of Gao et al., 2012).

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