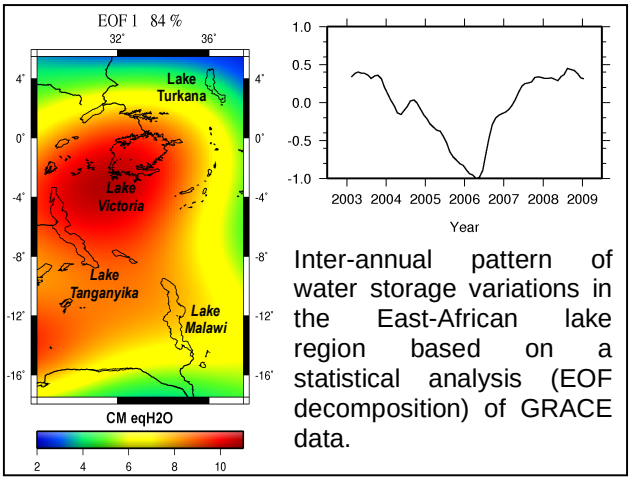
GRACE Reveals Variability of Water Resources in Eastern Africa

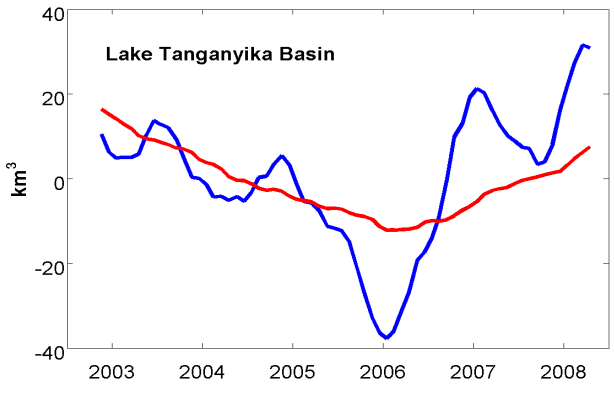
Water Resources and Climate Variability in Eastern Africa: The large lakes in the East African Rift Valley are of outstanding economic and ecological importance for freshwater supply, agriculture, aquiculture, tourism and as a means of transportation. The region provides water resources for a large population both in the lake surroundings and further downstream, such as in the Nile river basin. However, droughts are a regular feature of the regional climate. The impact of climate variability and anthropogenic effects on water resources remains poorly known because in-situ measurements are very sparse. Furthermore, future adaptations in response to climate change and rapid population growth are expected to intensify dependence upon water in Africa. In recent years, remote sensing observations, such as satellite altimetry and gravimetry, have been used to study water resources variations in major river basins.

The **Gravity Recovery And Climate Experiment (GRACE)** satellite mission, in orbit since 2002, has demonstrated its *unique* capability to monitor spatial and temporal variations of vertically-integrated water storage (snow, surface water, soil moisture and groundwater) over the continents. GRACE can resolve the mass variations associated to water storage change by measuring the time-variable gravity field of the Earth. Satellite gravimetry by GRACE is the only technology able to observe total water storage variations above and below the Earth's surface in an integrative way for large areas.

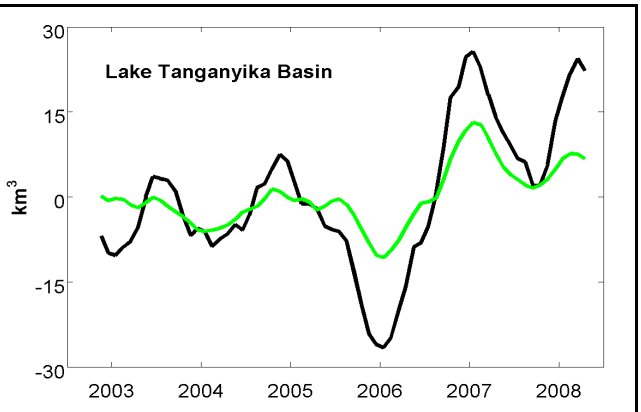


Inter-annual pattern of water storage variations in the East-African lake region based on a statistical analysis (EOF decomposition) of GRACE data.

GRACE revealed the inter-annual variability of water storage in East Africa. The GRACE data show a dramatic decrease of water storage due to drought conditions until 2006 and a later gradual recovery in the surroundings of Lake Victoria. These variations are correlated with regional rainfall, related to West Indian Ocean temperature, and with water level variations in the lakes. Besides surface water, GRACE allows quantifying subsurface water storage variations in the soil and groundwater. This contribution is shown to further aggravate drought impacts on total water availability in some regions.



Total water storage from GRACE for the catchment of Lake Tanganyika (blue) and lake water storage from altimetry (red).



GRACE-based subsurface water storage in black (lake storage removed) (black) and simulation results of the global hydrological model WGHM (green).

Reference: Becker M., Llovel W., Cazenave A., Güntner A. and Crétaux J.F. (2009), submitted to Comptes Rendus Geosciences.