

RECENT DEVELOPMENTS IN CAL/VAL ACTIVITIES SUPPORTING SATELLITE ALTIMETRY IN THE CASPIAN SEA

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CONTEXT

The **Caspian Sea** is the **biggest enclosed body of water on Earth** which is also subject to significant water level fluctuations which have had serious consequences in the past.

PILOT STATION AT ABSHERON PORT BAKU (AZERBAIJAN)

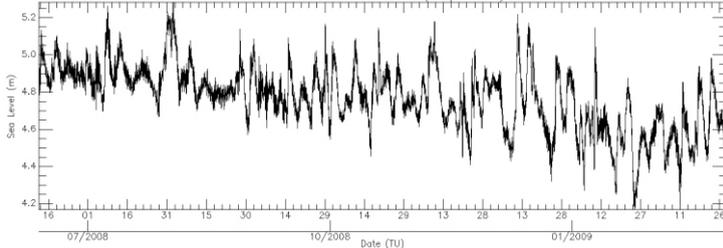
Bottom Pressure Location



No stations are maintained to GLOSS. **No transnational uniform geodetic leveling network** exists along coasts. Measurements at different sites are **not comparable**. The **quality and usability** of the altimeter-derived observations is dependent upon **good calibration** of the satellite sensors. **A modern station is operating since June 2008** to demonstrate the viability of a permanent cal/val site for satellite altimetry.

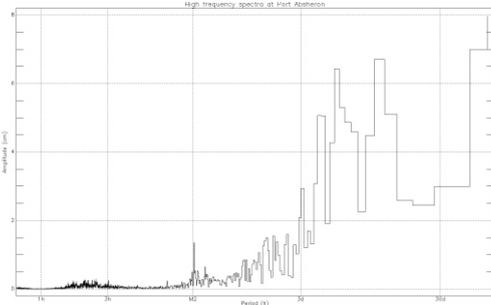
WHAT DATA COLLECTED TELL US

Sea Level at Port Absheron (Caspian Sea)



During the observational period, the sea level at Port Absheron exhibits **a large high frequency variability** (apparently more pronounced during summer time) with superimposed **other oscillations** that need careful investigation.

High frequency spectra at Port Absheron



The spectrum analysis shows **the existence of a little tidal contribution to the sea level**. The large contribution is observed in the **3-30 day band**, possibly linked to the meteorological forcing.

We expect with a longer record to better examine the effects of the various forcing mechanisms acting on the CSL, including **high frequency related to climate conditions** above the bottom pressure (e.g. wind, atmospheric pressure, water temperature variability, etc.) and **low frequency related to hydrological causes** (e.g., annual oscillations of river runoff at Volga and other rivers, big evaporation in summer time, rate of precipitation, etc.).

REASONS FOR CAL/VAL HERE

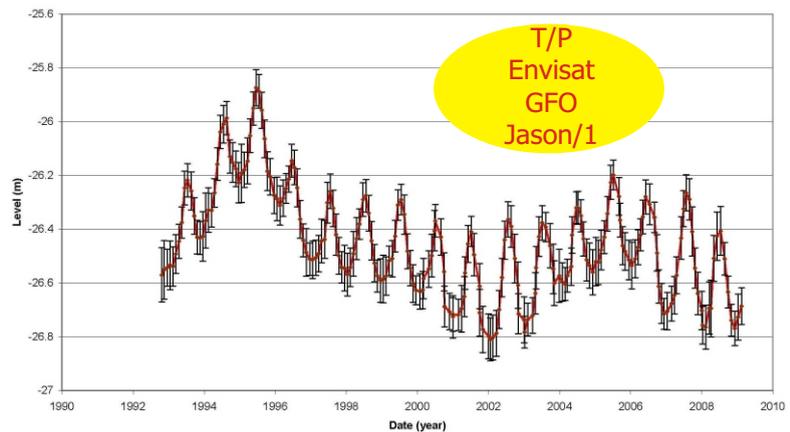
There is clear evidence that **the calibration of satellite altimetry over ocean does not apply to inland seas** (e.g., corrections, retracking, geographical effects).

It is acknowledged that **a regional Cal/Val site would supply invaluable data to formally establish the error budget of altimetry over continental water bodies**, in addition to the global mission biases and drift monitoring.

Calibration techniques over lakes are still immature even though important progresses are already achieved. **The Caspian Sea is currently the best natural target for calibration over continental water bodies** being a big lake with favorable location of satellite tracks and cross-over points. **No similar optimality of any existing cal/val site in Europe would satisfy these requirements.**

➡ We propose the Caspian Sea be used as a "laboratory" for developing a cal/val site for lakes

CASPIAN SEA LEVEL FROM MULTI-SATELLITE ALTIMETRY



Satellite altimetry can measure sea level variability in the whole basin beyond the political barriers.

The CSL variations are based on merged T/P, Jason-1, Envisat and GFO provided by ESA, NASA and CNES data centers. The altimeter range measurements used for CSL consist of 1h data. The water levels have been referred to Baltic Sea level reference frame

The most obvious benefit of a data set from multiple satellites is the improvement in spatial and temporal coverage.

Figure shows that **CSL variations present seasonal variations** due to climatological cycle (Evaporation, precipitation) and hydrological (river runoff, discharge to Kara bogaz Gol).

Inter-annual tendencies are also observed that should be interpreted in the light of decadal climate variability and amplification of irrigation in the Volga river basin. Long term changes may have several impacts on Caspian Sea shoreline.

FUTURE PLANS

- 1) Comparison of **altimeter-derived and observed sea level** time series and **analysis of the various met-ocean-hydro contributions**
- 2) Making the pilot station **GLOSS-compliant, including near real time transmission, permanent GPS Station** to control the vertical motion of the sea level sensor and **regular offshore leveling** along the altimetry ground tracks.

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