EGU2020-18804
https://doi.org/10.5194/egusphere-egu2020-18804
EGU General Assembly 2020

Synergy between optical imaging radiometry and radar altimetry for inland waters: an experience with Sentinel-3 on the Nasser Lake

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It is currently well known that a combination of stressors, such as climate change, human activities and new infrastructures might influence the storage capacity of strategic surface water reservoirs at a global level.

The Nasser Lake is the biggest and most important lake in Egypt, located in the southern part of the Nile River in Upper Egypt. The expected impact of the Grand Ethiopian Renaissance Dam (GERD) on the future availability of the Nile water, together with the significant and rapid water level variations and sedimentation processes, make the Nasser Lake a particularly challenging place to be monitored in the next years.

This work describes a preliminary study on the possible usage of the imaging radiometer SLSTR (Sea and Land Surface Temperature Radiometer) onboard Sentinel-3 for estimating water coverage extent in inland water contexts, in synergy with radar altimetry measurements provided by the SRAL (Synthetic aperture Radar ALtimeter) instrument. In particular, this work wants to exploit the simultaneous acquisition offered by SRAL and SLSTR instruments hosted by the Sentinel-3A/B platform.

We introduce an alternative technique to the classical calculation of the whole water extent based on high-resolution imagery, essentially intended for the application to wide-swath short-revisit sensors. The proposed approach starts from the hypothesis that a much-reduced subset of pixels may carry enough information for assessing the status of the observed water body by estimating the water coverage percent within each single pixel. Such an assumption can rely only on the radiometric performance of the instrument, SLSTR in this case.

The timeseries of water levels by the SRAL instrument were obtained by using the 20 Hz product generated by the SARvatore processor run on the ESA GPOD (Grid Processing On Demand) platform. A timeseries derived from SLSTR measurements has been generated by a simple feature extraction technique, based on the selection of pixels exhibiting the highest variability of the collected radiance. As expected, this subset essentially identifies particular spots on the coastlines

of the target, as a consequence of its morphological characteristics.

Preliminary results show a promising relationship between the timeseries generated by the two independent measurements and between the available in situ data as well. Under the hypothesis of a time-invariant system (i.e., characterised by no significant morphological changes), once an area-level-volume relationship is identified, volume estimations can be inferred by either altimetric or radiometric measurements per se.

Thus, the simultaneous observation by the two instruments represents a relevant opportunity for cross-validating the acquired data. Moreover, the approximation experimented in this work gives the perspective of a very light computational process for expedite water storage estimations in large surface reservoirs, provided that the natural system is fully identified on the basis of ground-truth data.