EGU24-17205, updated on 19 May 2024
https://doi.org/10.5194/egusphere-egu24-17205
EGU General Assembly 2024

On the potential of monitoring small water structures with SWOT

Lionel Zawadzki, **Nicolas Gasnier**, Roger Fjortoft, Santiago Pena Luque, Damien Desroches, Nicolas Picot, and Thérèse Barroso
CNES, Toulouse, France

Launched in December 2022, the **SWOT satellit**e is a joint mission between NASA, CNES, UKSA, and CSA. It marks a significant breakthrough in the fields of oceanography and hydrology.

Historically, water quantity data derived from satellites relied on a combination of different types of imagery (such as SAR and optical) and nadir altimetry or bathymetry. However, these methods have several limitations, especially when it comes to accurately observing hydrology features without relying on data from Very-High Resolution commercial satellites.

As an example, Sentinel-2 imagery can detect water in optical images down to 10x10 m2 pixels [Pena-Luque et al, 2021]. As a result, Sentinel-2-derived land-water masks over rivers that are less than 20-m-wide often contain significant gaps. On the other hand, SAR imagery from Sentinel-1 can detect water surfaces larger than its 22 m resolution, but it's challenging to differentiate water from wet areas and roads [Pena-Luque et al, 2021]. Neither of these sensors can retrieve the water elevation. In contrast, conventional altimetry has limited spatial coverage and is generally considered difficult to use in obtaining accurate water surface elevations in rivers less than 100-m wide [Calmant et al, 2006, 2008, 2016]. However, recent algorithmic advances [Boy et al, 2021, Egido et al, 2016], on the latest generation of nadir sensors (Delay Doppler Altimeters or SAR-

altimeters) onboard Sentinel-3 and Sentinel-6 satellites showed that one can retrieve accurate water levels over small freshwater reservoirs.

SWOT observations offer a **novel approach to retrieve water quantity data from space**. It operates using a near-nadir Ka-band SAR Altimeter based on interferometry to measure the elevation of water pixels with a sampling of 10-60x22 m2. Although its revisit time is limited to at least twice per 21-day nominal cycle up to 78° latitude and its spatial resolution restricts its applicability for operational water management in irrigation and freshwater storage systems, SWOT presents new opportunities for understanding water management at the basin level. It can be used in combination with high-resolution imagery and real-time in situ measurements, and integrated into hydrological models for more effective water management.

Although the official mission specification designed SWOT for the retrieval of water surface elevation of 100-m wide rivers with 10-cm accuracy over 10-km reaches, a study by Gasnier et al, 2021, showed the **potential of SWOT to observe narrow rivers**. The first actual observations provided by SWOT in 2023 are publicly available on hydroweb.next and PO.DAAC websites. These **confirm its potential to observe small hydrological targets well beyond the mission requirements.**

In this study, we will present early results on human-made irrigation and freshwater storage systems, and discuss the current possibilities and limitations of SWOT satellite.