

A Golden Era for Hydrology from Space

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Program: FY22 R&TD Strategic Initiative

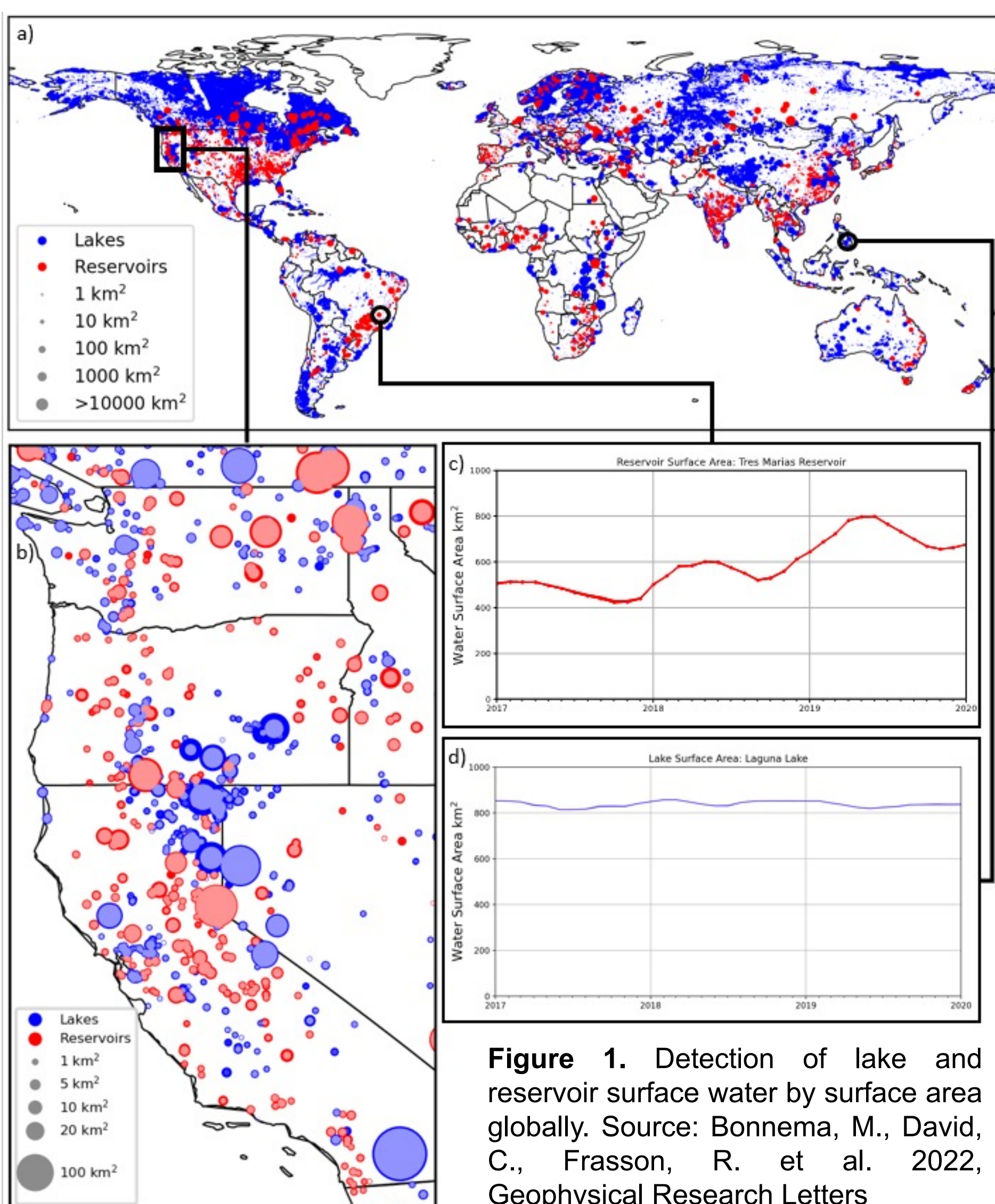
Strategic Focus Area: A Golden Era for Hydrology from Space - Strategic Initiative Leader: Susan E Owen

Objectives:

The overarching goal of this initiative is to strengthen JPL's capabilities for scientific discovery in hydrology and water resources in the upcoming era of satellite remote sensing. A) Ensure success of upcoming JPL hydro missions by confirming readiness, asserting scientific leadership, and fostering discoveries resulting from the Laboratory's engineering efforts. B) Strengthen JPL's response to 2017 Decadal Survey from a hydrology perspective in support of SDSWE, SBG, and/or MC. Science question: what key Earth System processes drive the joint variability of the water, energy, and carbon cycles? C) Remain at the forefront of the space-scape by ensuring capabilities for justifying transformative concepts for the next decadal survey.

Background:

"Understanding our water cycle and monitoring our freshwater availability" is one of five Earth Science and Applications Strategic Themes in JPL's 2018 Strategic Implementation Plan, and therefore a critical priority for JPL's Earth Science and Technology Directorate.

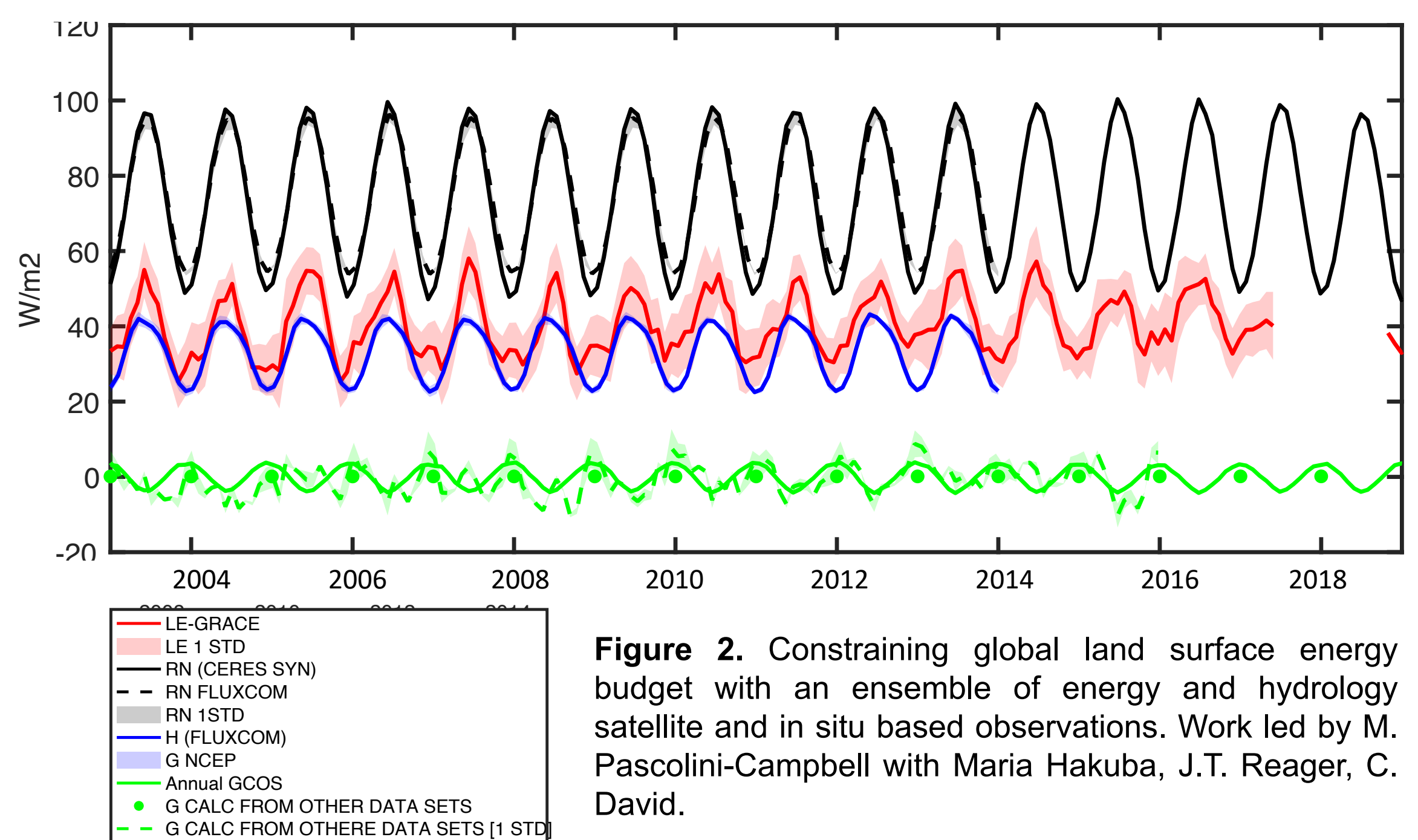


Approach and Results:

- Advancing Uncertainty Quantification for SWOT discharge algorithms. This activity lays the groundwork for robust uncertainty estimation of upcoming SWOT measurements. *Result:* Paper submitted to Journal of Hydrometeorology.
- Evaluate state-of-the-art observations for monitoring open water bodies. Involved monitoring of over 150,000 individual bodies of water via cloud computing. *Result:* Paper published in Geophysical Research Letters, 2022. **(Figure 1)**
- Multi-mission synergy for flood observation. This activity involves multi-sensor fusion to monitor flood events. *Result:* Paper to be submitted.
- Vegetation-driven changes to water cycle variability. Characterization of changes in water storage residence based on GRACE/GRACE-FO, and, 2) identifying relation to land cover change via satellite vegetation. *Result:* Paper to be drafted
- Water and Energy Cycle Interaction: Multi-mission exploration of variability between water and energy cycles using hydrology missions (GRACE, GRACE/FO) and energy missions (CERES). **(Figure 2)**

Significance of Results/Benefits to JPL:

R. Frasson has advanced uncertainty quantification for SWOT (Frasson et al., 2021), and identifying discharge performance bottle necks (submitted 2022). He has mentored two postdocs, resulting in a paper (Bonnema, et al, 2022), with another in preparation. R. Frasson also selected for funding by NASA Water Resources Applications Program as PI. M. Pascolini-Campbell has led regular meetings on lab across groups (329F, 329G, 329H), for research into water/carbon/energy cycle interactions. Core of activities involve building a research program/team and scientific exploration. She is actively recruiting a postdoc (inviting for interviews) to explore water/energy cycle interaction.



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Publications:

- Bonnema, M., David, C. H., Frasson, R. P. et al. (2022). The Global Surface Area Variations of Lakes and Reservoirs as Seen from Satellite Remote Sensing Geophysical Research Letters, n/a(n/a), e2022GL098987. doi:https://doi.org/10.1029/2022GL098987
- Frasson, R. et al. (2021). Exploring the factors controlling the error characteristics of the Surface Water and Ocean Topography mission discharge estimates Water Resources Research, 57(6), e2020WR028519. https://doi:10.1029/2020WR028519
- Frasson, R. P et al. Estimating the relative impact of measurement, parameter, and flow law errors on discharge from the Surface Water and Ocean Topography mission Submitted to Journal of Hydrometeorology
- Munasinghe, D., et al. Evaluating the Potential of a Multi-sensor approach for increased Temporal Sampling of Floods To be submitted to Nature Communications.
- Pascolini-Campbell, M., et al. Multi-sensor observation of changes in water storage fraction, Draft in preparation

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