On the Continuity of MODIS and VIIRS Based Global Reservoir Products

Huilin Gao[1], Shuai Zhang[1], Deep Shah[1], Gang Zhao[2], Sudipta Sarkar[3], Carol C Davidson[3],
Rui Zhang[4], Maosheng Zhao[3,5], and Sadashiva Devadiga[5]

1. Texas A&M University, 2. Carnegie Institution for Science, 3. Science Systems and Applications Inc, 4. Global Science & Technology Inc, 5.NASA GSFC

MOTIVATION

- **About 87%** of fresh surface water in liquid form is stored in global lakes and reservoirs.
- Lakes and reservoirs lose significant amounts of water through evaporation; however, **most currently available datasets do not account for lake evaporation**.
- Since VIIRS will be the future for the remote sensing of reservoirs, **understanding the continuity** of VIIRS with the MODIS is essential to combine and generate long-term data records.

DATA & OBJECTIVES

Input Data	Purpose
8-Day MODIS/VIIRS Surface Reflectance	Area
Area-Elevation (A-E) relationship from Li et al. (2020)	Elevation and Storage
8-day MODIS/VIIRS land surface temperature	Evaporation Rate
Meteorological Data from GLDAS	Evaporation Rate

- Evaluating the continuity between MODIS and VIIRS GWR products;
- Improving the modeling used for hydrological analysis, flood prediction, and weather forecasting;
- Supporting water management decisions—particularly during extreme events, and/or under climate change.

PRODUCT OVERVIEW

- The MODIS and VIIRS GWR products include time series of surface area, elevation, storage, evaporation rate, and volumetric evaporation loss for 151 large reservoirs and 13 regulated natural lakes.
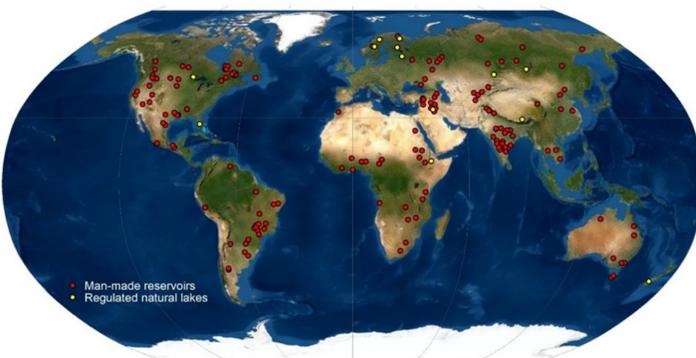
Figure 1. Locations of the 151 man-made reservoirs (in red) and 13 regulated natural lakes (in yellow) that are considered in these products (about 46% of global capacity).

8-DAY RESERVOIR PRODUCT

Data and Method

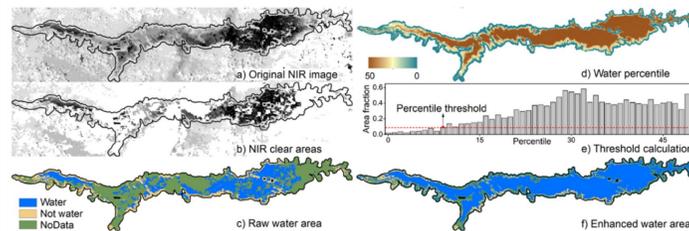**Figure 2.** Flowchart for developing VIIRS 8-day product components.

Figure 3. An example showing the enhancement algorithm for lake area.

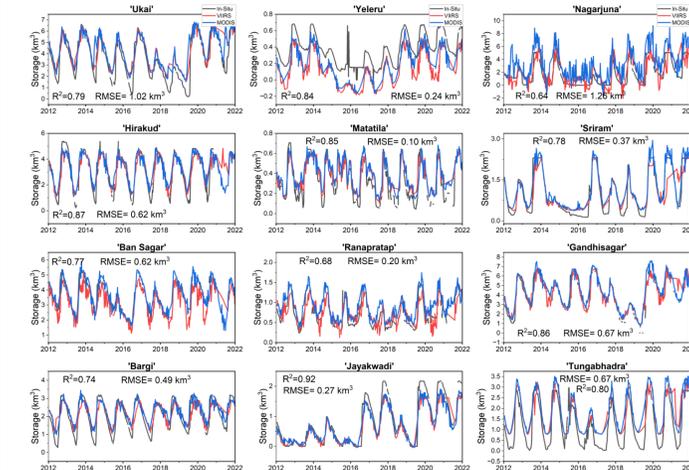### Continuity and Validation of the 8-day product

Figure 4. Comparison of the 8-day storage data from VIIRS (SNPP), MODIS (Terra), and in-situ observations over the twelve Indian reservoirs during 2012-2021.
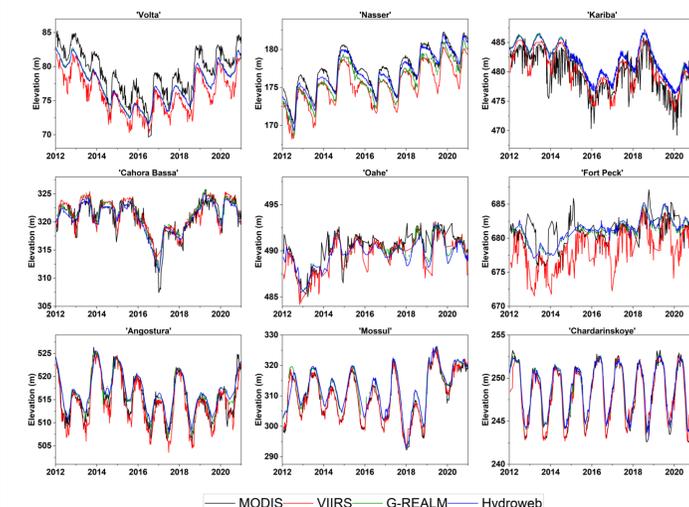
Figure 5. Validation of the 8-day elevation data from VIIRS (SNPP) and MODIS (Terra) with radar altimeter (G-REALM and Hydroweb) observations during 2012-2021.
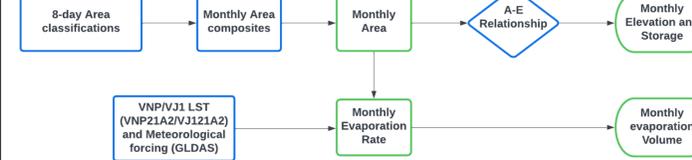
MONTHLY RESERVOIR PRODUCT

Data and Method

Figure 6. Flowchart for developing VIIRS monthly product components.
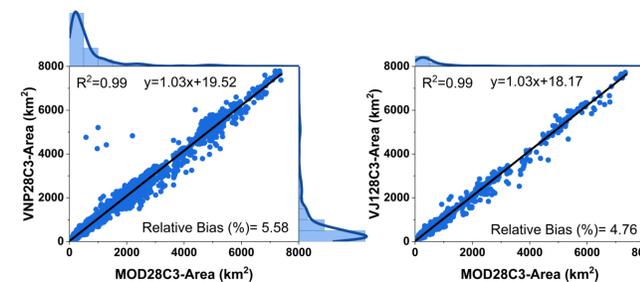
Comparison of monthly product

Figure 7. Comparison of monthly area between SNPP and MODIS (Terra) from 2012 to 2021 and JPSS and MODIS (Terra) from March 2020 to December 2021.
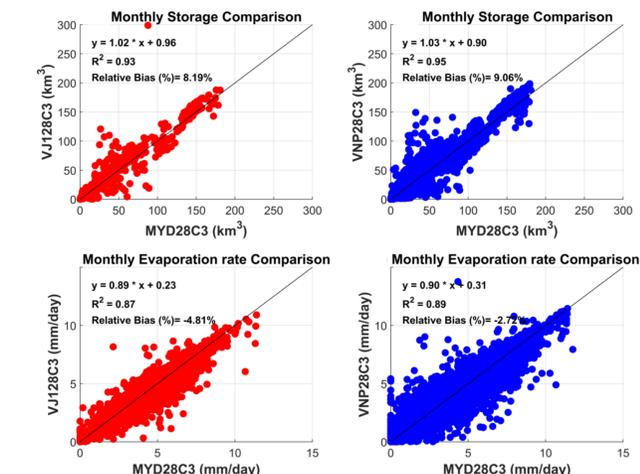
Figure 8. Comparison of the monthly storage and evaporate rate from SNPP and MODIS (Aqua) products during 2012 to 2021 and JPSS and MODIS (Aqua) during March 2020 to December 2021.
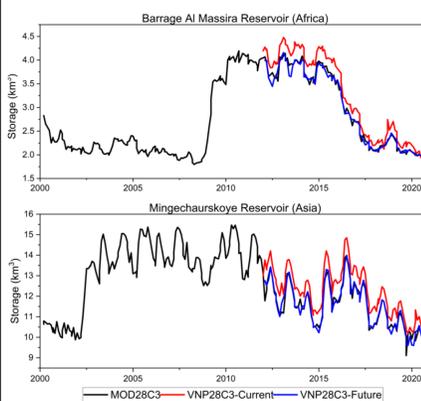
VIIRS-Future will include the following improvements:
(1) Addition of QA band
(2) Use of a terrain shadow mask
(3) Addition of the ice fraction and contamination fraction values
(4) Changes in estimation of the monthly composite lake area.

Figure 9. The critical role of VIIRS in maintaining the long-term trend with MODIS.

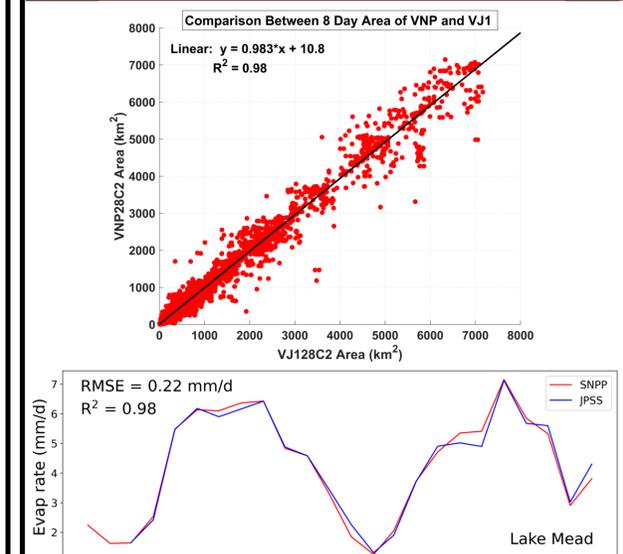## COMPARISONS OF SNPP AND JPSS1

Figure 10. Top: Continuity of 8-day area from March 2020 to May 2022; Bottom: Comparison of the monthly evaporation rate (at lake Mead) from March 2020 to December 2021.

CONCLUSIONS

- The VIIRS based GWR product has the unique advantage of continuing the MODIS legacy in monitoring global reservoirs from space.
- The global water reservoir product provides consistent estimates of elevation, area, storage, evaporation rate, and evaporation volume.
- The VIIRS based reservoir results have been validated comprehensively using in situ data. In addition, the JPSS and SNPP results have shown good agreement.
- Future work will focus on expanding the validations over more locations where in situ data are available, as well as cross validations against other satellite products (e.g., radar altimetry) at more locations.

REFERENCE

- Li, Y., Zhao, G., Shah, D., Zhao, M., Sarkar, S., Devadiga, S., Zhao, B., Zhang, S. and Gao, H., 2021. Nasa's modis/viirs global water reservoir product suite from moderate resolution remote sensing data. Remote Sensing, 13(4), p.565.

ACKNOWLEDGEMENT & CONTACT

Name: **Dr. Huilin Gao**
hgao@tamu.edu