Weekly Report – January 5, 2024

Cooperative Institute for Satellite Earth System Studies (CISESS)

NOAA/NESDIS/STAR

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PUBLICATIONS

Quantifying Uncertainty for AI using GEO Observations to Simulate LEO Passive Microwave Radiances

Citation: Ortiz, Pedro; Eleanor Casas, Marko Orescanin, Scott W. Powell, **Veljko Petković**, and Micky Hall, 2023: Uncertainty calibration of passive microwave brightness temperatures predicted by Bayesian deep learning models. *Artif. Intell. Earth Syst.*, **2**(4), e220056, https://doi.org/10.1175/AIES-D-22-0056.1.

Summary: CISESS Scientist Veljko Petković has a new article out in the AMS journal *Artificial Intelligence for the Earth Systems,* which discusses artificial intelligence (AI) uncertainty. One of the primary problems limiting the application of AI and machine learning models in Earth system sciences is their inability to provide a measure of uncertainty for their products. This study is based on a Bayesian deep learning system using the Geosynchronous Earth-Orbiting (GEO) Advanced Baseline Imager (ABI) observations to simulate the Low Earth-Orbiting (LEO) Global Precipitation Measurement (GPM) Microwave Imager (GMI) data. The goal of this AI model is to extend the spatial and temporal coverage of passive microwave data (see figure (a) & (b) below). For the uncertainty analysis, they first used deterministic residual networks to preset a mean absolute error of 1.72 K into simulated data. Then they used three different Bayesian residual network models set with a comparable amount of error to produce previously unavailable predictive variance (i.e., uncertainty) for each synthetic data point (see figure (c) below). They found this additional information was also useful for post-production quality control.

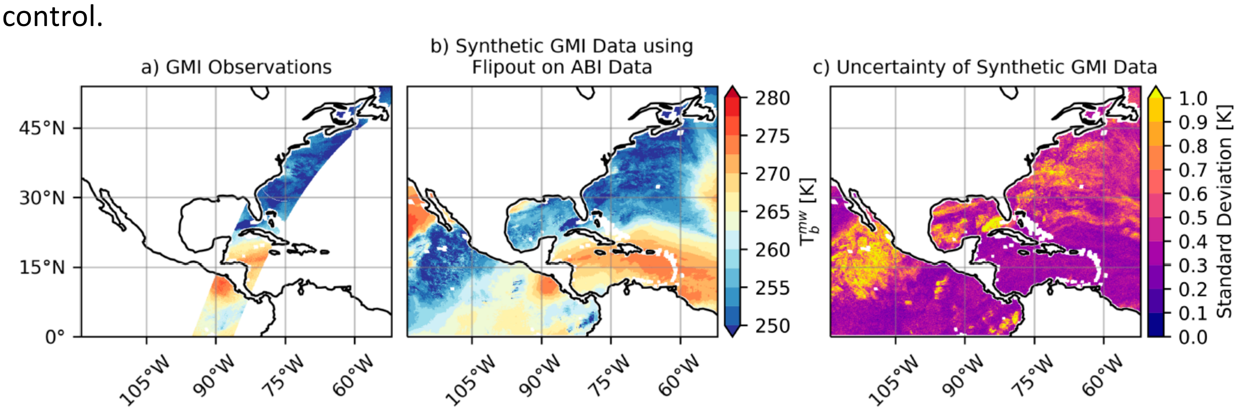

Figure: The microwave brightness temperatures at 1440 UTC 1 Feb 2020 from (a) LEO observations and (b) simulated data from GEO observations; (c) Its predictive standard deviation for each simulated data point.

(Veljko Petković, CISESS, veljko@umd.edu; Funding: JSTAR GCOM, METOP-SG, HPCC)

Retrieval and Applications of Precipitation Estimation from LEO SatelliteCitation: Gorooh, Vesta Afzali; Kuolin Hsu, Ralph Ferraro, Joe Turk, Huan Meng, **Phu Nguyen**, Claudia Jimenez Arellano, Satya Kalluri, and **Soroosh Sorooshian**, 2023b: Advances in precipitation retrieval and applications from low-earth-orbiting satellite information. *Bull. Amer. Meteor. Soc.*, **104**(10), E1764–E1771, https://doi.org/10.1175/BAMS-D-23-0229.1..

Summary: CISESS Consortium Scientist Kuolin Hsu (UCI) has published a meeting summary in *BAMS* for the NOAA Workshop on "Precipitation Estimation from LEO Satellites: Retrieval and Applications," held virtually on March 1–2, 2023. This workshop was funded by JPSS PGRR through CISESS. The meeting had four themes:

1. NOAA and the international communities' future plans for Low Earth-Orbiting (LEO) satellites (see figure below);
2. Estimation of precipitation from LEO satellites as single or blended products and satellite retrieval algorithms;
3. Uncertainty quantification for LEO precipitation estimation; and
4. Users of LEO precipitation products and applications for LEO observations.

One of several recommendations of the workshop participants was for LEO products to incorporate location-specific error and uncertainty for regional variability, time frames, precipitation events, and application domains. A 57-page NOAA Technical Report on the workshop is available from the NOAA Repository: https://repository.library.noaa.gov/view/noaa/55547.

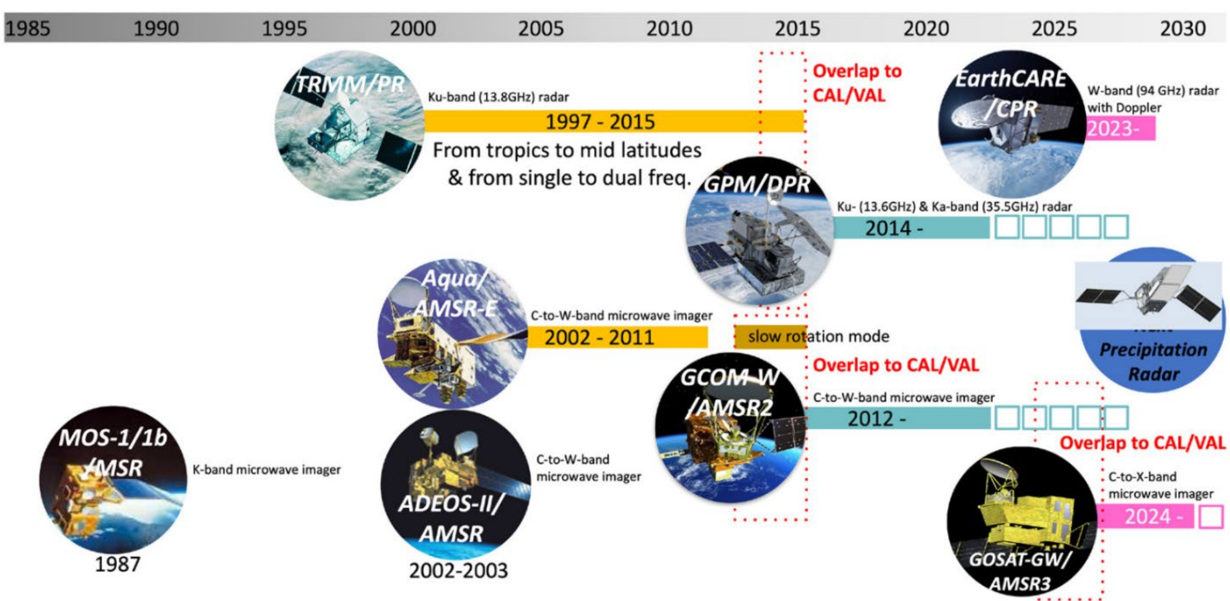

Figure: Precipitation-related missions in Japan (source: Misako Kachi and Takuji Kubota presentations at the Workshop on Precipitation Estimation from LEO Satellites*).*
(Kuolin Hsu, CISESS & UCI, kuolinh@uci.edu; Funding: JPSS PGRR)

How to Report and Share Data from Ocean Alkalinity Enhancement Research
Citation: Jiang, Liqing; Adam V. Subhas, Daniela Basso, Katja Fennel, and Jean-Pierre Gattuso, 2023: Chapter 13: Data reporting and sharing for ocean alkalinity enhancement research, in *Guide to Best Practices in Ocean Alkalinity Enhancement Research* (Oschlies, A., Stevenson, A., Bach, L. T., Fennel, K., Rickaby, R., Satterfield, T., Webb, R., and Gattuso, J.-P. , Eds.). Copernicus Publications, State of the Planet series, 2-oae2023, https://doi.org/10.5194/sp-2-oae2023.
Summary: CISESS Scientist Liqing Jiang, who leads the CISESS task on the NOAA Ocean Carbon and Acidification Data System (OCADS), has a chapter on data reporting and sharing in a new book on best practices for ocean alkalinity enhancement research. Ocean alkalinity enhancement (OAE) is an experimental approach to removing carbon from the atmosphere by adding alkaline substances to the ocean to increase its ability absorb carbon dioxide [Oschlies et al. (2023) *Glossary of Terms*, p.4]. See the figure below.

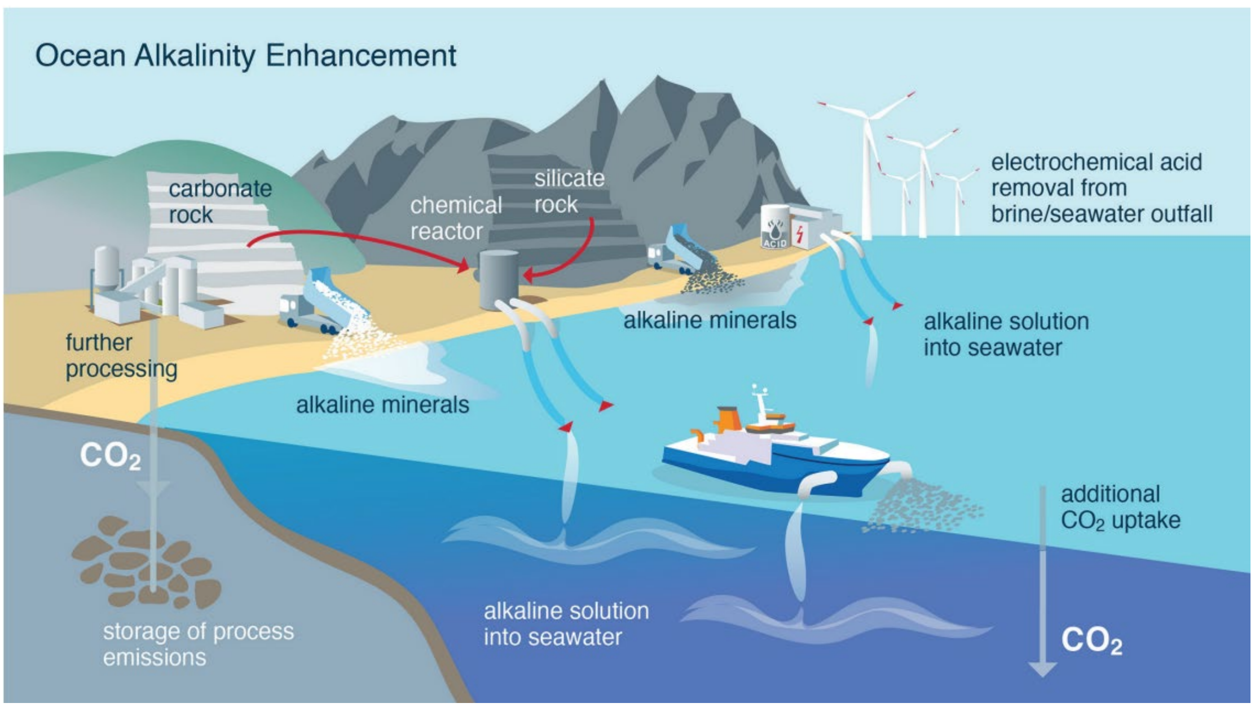

Figure: Schematic of ocean alkalinity enhancement. From: Oschlies et al. (2023) Chapter 1, p. 5, Fig. 2

For his Chapter, Jiang and his co-authors update existing data standards to accommodate OAE research needs and introduce a new physiological response data standard. A metadata template is provided along with controlled vocabularies, including types of OAE studies, source materials for alkalinization, platforms, and instruments.
(Liqing Jiang, CISESS, liqing.jiang@noaa.gov; Funding: NCEI & OCADS)