Paper ID: 68405
oral
student

IAF SYMPOSIUM ON INTEGRATED APPLICATIONS (B5)
Tools and Technology in Support of Integrated Applications (1)

Author: Mr. Albert Larson
The University of Rhode Island, United States, albertl@uri.edu

A CLEARER VIEW OF EARTH'S WATER CYCLE

Abstract

One tenet of NASA's Earth Observatory is to provide for scientists and engineers a global perspective of the water cycle as it occurs in solid, liquid, and gaseous phases. This principle manifests itself in satellite missions such as Aqua, Landsat, Soil Moisture Active Passive (SMAP) and the upcoming Surface Water and Ocean Topography (SWOT).

The focal point of this research is SMAP, which launched in 2015 with two different instruments onboard, a radiometer and a radar. Both instruments were designed to study soil moisture: the radiometer at a resolution of approximately 36km, well suited for hydroclimatological investigation; and the radar at a resolution of 3km, meant to measure higher fidelity meteorological signals. The SMAP mission produces an unprecedented three-day revisit time view of the water stored in the thin upper layer of the Earth's surface, something not possible with in-situ soil moisture monitoring.

Unfortunately, shortly upon placement of SMAP in orbit, the high fidelity radar instrument failed. Though SMAP's radar instrument failed, it did collect data for several months. The radiometer and radar instrument share the same wave reflector on the satellite, and acquired information about a similar spot on Earth at the same time. Knowing this and that the radiometer continues operating to this day, a machine learning framework based around neural networks and a novel deconvolution algorithm has been developed to predict the finer resolution radar from the coarser radiometer data. The research takes advantage of an oversampled radiometer, which

allows for the deconvolution of the footprint image and identification of the higher resolution observations.

To account for spatial variability, training and test data are segmented based on climate and location. Performance of the neural network is evaluated based on mean squared error and image quality. The algorithm trained with real data is compared against an algorithm trained with the North American Land Data Assimilation System (NLDAS) and other reputed soil moisture products. Once the algorithm is tuned and selected as best in breed, it is extended across the entire radiometer product to generate a higher resolution dataset. This is relevant in particular to NASA because it betters the output of the radiometer data, and is potentially scalable to other sensors, improving the ability to forecast weather, change climate, and agriculture, and extreme events.