A Comparison of Inundated Wetland and Open Water Distribution for Alaska Between High and Low Resolution Microwave Remote Sensing Data

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1. INTRODUCTION

In the northern high latitudes inundated vegetation and open water bodies are common features across the landscape and exert major impacts on hydrologic processes and surface-atmosphere carbon exchange. Their carbon dioxide and methane emissions can have a large impact on global climate. It is therefore of great importance to assess their spatial extent and temporal variations in order to improve upon carbon balance estimates. Despite their importance in the global cycling of carbon and water and climate forecasting, they remain poorly characterized and modeled, primarily because of the scarcity of suitable regional-to-global remote sensing data for characterizing wetlands distribution and dynamics. Spaceborne synthetic aperture radar (SAR) offers an effective tool for characterizing these ecosystems since it is particularly sensitive to surface water and to vegetation structure, and it allows monitoring large inaccessible areas on a temporal basis regardless of atmospheric conditions or solar illumination.

In this study we employ multi-temporal 100 meter L-band SAR data of Alaska from the Phase Array L-Band SAR (PALSAR) sensor mounted on the Advanced Land Observing Satellite (ALOS) to map open water across the state. We will also employ a wetland classification map of Alaska [1] at 100 meter resolution derived from SAR data from the Japanese Earth Resources (JERS-1) satellite. In concert with the open water products, we derive coarse resolution (~25 km) inundation products using high temporal repeat observations from combined AMSR-E and QuikSCAT data sets. A multi-scale analysis is then performed to compare the information content between the high and low resolution products.

This work supports science application development for the upcoming NASA Soil Moisture Active Passive (SMAP) mission, which will provide combined L-band radar and radiometer coverage globally with 3-day revisit for characterization of soil moisture and saturation extent. Also, this research supports efforts that are part of a NASA MEaSUREs project which is assembling a satellite-based global-scale Earth System Data Record (ESDR) of inundated wetlands to facilitate investigations of their role in ecosystem processes. Here, we present our efforts in validating results between the fine and coarse

resolution products of inundated vegetation and open water.

2. METHODOLOGY

Large-scale L-band SAR mosaics covering Alaska were assembled with JERS-1 SAR data collected during 1997 and 1998 under the Global Boreal Forest Mapping Project (GBFM) and with ALOS PALSAR data for the period 2006-2009. A vegetated wetland classification map was derived from the JERS-1 mosaics for the entire state of Alaska [1] and open water products were derived from the more recent PALSAR mosaics, both following a supervised decision tree-based approach utilizing Random Forests and ground measurements for training and validation [2]. The wetlands classification map is also partially assembled for Alaska using the recent PALSAR data [3]. The classification algorithm functions by generating a large number of decision trees based upon the training data, implementing the decision trees, and classifying each pixel according to the class selected by the most decision trees. Results are validated using ground data withheld from the training process. Supplementary layers such as a USGS digital elevation model (DEM), derived slope, texture, and day of acquisition for each pixel were input into the decision tree classifier. The high-resolution 100 m open water products and wetland classification were then aggregated to 25 km ease-grid cells containing percent open water and wetlands.

The coarse resolution landscape inundation products encompass the time frame of the PALSAR acquisitions and span the non-frozen seasons from spring through autumn. The 25 km inundation products were derived from time series C-Band AMSR-E brightness temperature and QuickSCAT backscatter to infer changes in surface inundation fraction, also accounting for snow and frozen ground. The AMSR-E data were screened to remove Radio Frequency Interference (RFI).

The 100 m resolution wetland classification and open water maps were aggregated to 25 km resolution and then compared to the 25 km resolution ASMR-E/QuikSCAT landscape inundation products.

3. PRELIMINARY RESULTS AND CONCLUSIONS

Preliminary results in the harmonization of the SAR-derived open water products and wetland classification map with the coarse resolution inundation mappings at high temporal resolution demonstrate high correlation between the two and the utility of the multiple-resolution datasets for characterizing inundation dynamics. The combined high spatial resolution and high temporal fidelity data sets to be provided by SMAP are therefore expected to provide enhanced characterization of wetland dynamics for assessment of land-atmosphere carbon fluxes.

This research was undertaken within the framework of the ALOS Kyoto & Carbon Initiative. The ALOS data were provided by JAXA EORC. This work was carried out in part at the Jet Propulsion Laboratory, California Institute of Technology under contract with the National Aeronautics and Space Administration.

4. References

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