Unsupervised Machine Learning for GNSS Reflectometry Inland Water Body Detection

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Keywords *GNSS-R, Machine Learning, CYGNSS, Inland water body*

Abstract

Inland water bodies, wetlands and their dynamics play an essential role in a variety of scientific, economic, and social applications. They are significant in identifying climate change, water resource management, agricultural productivity, and the modeling of land-atmosphere exchange. The changes in water bodys' extent and position are crucial to the ecosystems.

Mapping water bodies at the global scale presents a challenge due to the global variety of terrains and water surface. However, the sensitivity of spaceborne Global Navigation Satellite System Reflectometry (GNSS-R) to different land surface properties offers the potential to detect and monitor inland water bodies. The extensive data available by the Cyclone Global Navigation Satellite System (CYGNSS), launched in December 2016, is used in our investigation. Standing water leads to a coherent reflection with a power substantially stronger than that of the diffuse scattering coming from surrounding land and oceans. Both bistatic radar cross section (BRCS) and signal-to-noise ratio (SNR) can be used to detect, identify, and map the changes in the position and extent of inland waterbodies. Moreover, SNR can be used to detect, and map inundated surfaces. The aim of the current research is to exploit the potential of unsupervised machine learning algorithms, more specifically clustering methods such as K-Means, Agglomerative and Density-based Spatial Clustering of Applications with Noise (DBSCAN), for the detection of inland waterbodies. The results demonstrate that CYGNNS data processed using unsupervised machine learning techniques can identify and monitor the inland waterbodies and their small tributaries.