GLOBAL WETLAND INUNDATION DYNAMICS DERIVED FROM PASSIVE AND ACTIVE MICROWAVE REMOTE SENSING

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Earth's natural wetland complexes are a major source of atmospheric methane which is an important greenhouse gas. Because wetlands and associated methane production are highly dependent on the climate, changes in atmospheric methane concentration may be due to changes in precipitation, temperature or available plant material. Hence characterizing the global extent and distribution of wetlands is crucial in understanding the effect of climate change on wetlands and associated effects on the carbon and hydrological cycles, weather and biodiversity. Remote sensing techniques combined with methane modeling are essential tools for observing wetlands and characterizing methane cycling, with useful predictions on the future climate.

Here, we present a satellite data approach that employs both passive and active microwave data from AMSR-E and QuikSCAT along with topographic information to track changes in wetland extent globally during the period from 2002 until present. Our remote sensing technique consists of 3 major working steps: 1) Screening for AMSR-E C-Band Radio-Frequency-Interference (RFI), snow and frozen ground, 2) application of a multivariate iterative clustering, and 3) computation of inundation fraction using backscatter measurements derived from QuikSCAT scatterometer data.

Before iteration can be successfully applied, AMSR-E C-Band Brightness Temperature measurements are carefully screened for snow cover area, for frozen ground conditions, and for RFI to which passive microwave measurements are particularly susceptible. We use mean and standard deviation of AMSR-E brightness temperature spectral differences to indentify strong RFI, while weaker RFI signals are identified using a threshold on the AMSR-E C-Band Brightness Temperature Polarization Ratio. Frozen ground and snow cover are obtained from multi-band AMSR-E measurements using a decision tree to separate snow cover scattering from other sources of microwave scattering. Water vapor and cloud absorption/emission are negligible for AMSR-E C-Band and QuickSCAT land observations. However, the low spatial resolution of both satellites (25 km) makes a correction for water contamination along coastal areas necessary. Hence a coastal mask has also been employed.

After the microwave signals have been screened, the spatiotemporal behavior of C-Band AMSR-E brightness temperature differences, their horizontal and vertical polarizations and topographic information are exploited to track changes in surface water extent using iterative multivariate clustering. The detection of surface water relies primarily on the passive microwave land-surface emissivity and polarization difference. C-Band measurements are used because of their capability to penetrate through vegetation typical for wetland complexes. Other factors such as surface temperature and roughness are also influencing the brightness temperature and are, in this analysis, used to assist in separating inundated land from other land cover units, as deserts, mountains and vegetation. Deserts often show high surface temperatures while mountains do not. Large and productive wetlands are typically found close to sea level characterized by small topographic gradients and productive vegetation.

Because the response to inundation is modulated by the surface temperature and vegetation density, C-Band AMSR-E polarization ratios along with QuikSCAT backscatter values are computed to determine inundation fraction. Polarization ratios account for the effect of surface temperature variations whereas the QuikSCAT scatterometer data provide information on vegetation density. Changes in vegetation density and changes in inundation fraction are then used to compute inundation fraction using a linear mixture model.

Initial results demonstrate that this method can be applied globally and without tuning of the input data. Our results are compared with high resolution wetlands and open water maps derived from Synthetic Aperture Radar and MODIS flood water maps.

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