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Wetlands and floods dynamics using the Topex-Poseidon dual-frequency radar altimeter: an application over the Boreal Regions.

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Monitoring wetland and flood dynamics and their climate-sensitive processes is crucial to better understand their influence on future climate through their role in the global carbon cycle, as well as their role in the prediction of inter-annual and longer-term climate variations or their role in local or regional hydrological studies. In that context, satellite observations provide a unique means of monitoring wetlands and their dynamics at global and regional scales over long time periods.

Initially launched to operate over the ocean satellite radar altimeter exhibited soon a high potential for the study of continental surfaces, especially to accurately estimate the topography of ice-covered regions such as Antarctica or Greenland or to monitor large continental water surfaces and measure their stage elevation for hydrological applications. Recently, the altimetric response was investigated over land surfaces using dual-frequency backscattering coefficients from the French-American Topex-Poseidon satellite or the new ESA ENVISAT satellite, demonstrating new capabilities to characterize and monitor vegetated areas, deserts, semi-arid, or boreal regions at global scale. The Topex-Poseidon altimeter was also successfully used to retrieve snow depth evolution over the Northern Great Plains.

This study presents a first attempt to quantify extend and seasonality of northern wetlands using radar altimeter satellite observations, as a new complementary technique to the ones previously developed for that purpose, such as passive microwave observations. We propose to analyze the altimetric observations from the CNES/NASA Topex-Poseidon (T-P) launched in August 1992. The NASA Radar Altimeter (NRA) on board this satellite is the first dual-frequency active microwave sensor, with nadir

measurements at Ku (13.6 GHz) and C (5.4 GHz) bands.

The sensibility of Topex-Poseidon dual-frequency radar altimeter to detect inundation is firstly investigated including a comparison of passive and active microwave satellite measurements along with land surfaces in-situ database. The C band backscatter altimeter signal is clearly in accordance with passive microwave emissivity observations above wetlands and is thus more able to detect small local flooded areas. Because of the nadir looking angle, the radar altimeter shows also more capability to detect wetlands than C band scatterometer. Monthly flooded areas are then calculated by estimating pixel fractional coverage of flooding using the altimeter C band backscatter magnitude and a linear model with dual-frequency altimeter backscatters difference C-Ku to account for vegetation cover. Because of Topex-Poseidon satellite cover, the results are given for northern hemisphere wetlands from 40° to 66° of latitude that represent more than 30% of world's global inundated surfaces during the summer period. Radar altimetry estimations, comprising natural wetlands and river/lakes, indicate a maximum inundated area for July 1993 and 1994 with $1.86*10^6$ km^2 to be compared with $1.31*10^6$ km^2 from passive microwave technique and $\sim 2.10*10^6$ km^2 from independent dataset. Wetlands seasonal variability from altimeter or passive microwave technique is clearly in accordance. These promising results needs now to be confirm with the Topex-Poseidon 10-year span dataset and the use of the ENVISAT dual-frequency radar altimeter which better spatial cover will allow to survey world's global inundated surfaces.