



The use and potential of radar satellite data as input for ecosystem modelling in boreal and sub-arctic environments

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Radar signals are strongly dependent on hydrological conditions in addition to surface roughness and vegetation structure. Thus, from one side, multi-temporal approaches allow the detection of environmental processes that are important for the functioning of terrestrial biota, in particular inundation dynamics, soil moisture and freeze-thaw changes. From another side, above-ground phytomass (AGPh) measured by radar is of high accuracy if thresholds are chosen correctly. Radar satellite data supports important applications for modelling biochemical cycles in boreal and sub-arctic environments through: 1) detection of permanent and seasonal inundation patterns; 2) identification of wetlands; 3) observation of seasonal transition from frozen to non-frozen conditions; and 4) estimation of AGPh that in combination with landscape characteristics and regularities presents valuable numerical information for delineation of land cover classes and estimation of rapid changes in ecosystems.

Methane production and carbon storage are important wetland functions. Vast peatlands are located in the transition zone of permafrost in the boreal biome, which undergo changes due to variations in climate. The relatively short growing season within high latitudes is significantly impacted by inter-annual variability in the onset of freeze and thaw and, within the boreal forest, directly influences atmospheric carbon sequestration in terms of CO₂ exchange.

Instruments such as the Seawinds QuikScat and ENVISAT ASAR provide data with a high temporal resolution; which is a basic requirement in order to analyse the diurnal to seasonal processes of interest. Seawinds is a Ku-band scatterometer with a 25 km

footprint and completes several revisits per day in high latitudes. The ASAR instrument is a ScanSAR system working in C-Band. It provides data with a pixel spacing of 75 m (in wide swath mode) and has revisit intervals of three to five days. Based either on a synergy of the scatterometer and ScanSAR data, or directly from each data set, parameters for ecosystem modelling can be derived.

The Siberia II project deals with multi-sensor concepts for Greenhouse Gas (GHG) accounting and within this framework both spatial datasets of freeze-thaw transition and inundation patterns have been developed. Examples of these products covering 3,100,000 km² of the boreal and sub-arctic biomes in central Siberia are presented. It is shown that the further integration of these new data sets as thematic layers into a polygon based GIS GHG accounting system provides for substantial synergism and results in decreasing uncertainties of both inventory-based and process-based approaches of the terrestrial biota full GHG account.