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SNOW WATER EQUIVALENT ALTIMETRY MISSION: ENABLING DIRECT MEASUREMENT OF SWE ON SEA ICE AND LAND IN THE CRYOSPHERE

Abstract

To study the temporal and spatial dynamics of the global water cycle, satellite and airborne remote sensing missions are essential for discovering specific patterns within the cryosphere over an extensive area within short time periods. However, measurements of true water inventories stored in sea, lake and land ice have been significantly hindered by uncertainties introduced by snow cover for the last 40 years of satellite missions. Current estimations of hydrological and climate models, Earth's energy balance (albedo) calculations and flood predictions suffer from inaccuracies due to an inability to accurately determine the water content of snow cover.

The Snow Water Equivalent Altimetry mission concept has been developed to address this fundamental issue, enabling direct measurement of surface Snow Water Equivalent (SWE) on sea ice and land at latitudes above 60 degrees and below -60 degrees. In order to achieve this, the proposed mission will

implement a novel combination of Ka- and Ku-band radar altimeters (active microwave sensors), capable of penetrating into the snow microstructure. There are no other satellite missions currently capable of directly measuring SWE.

The Ka-band altimeter (wavelength 0.8 cm) provides a low maximum snow pack penetration depth of up to 20 cm for dry snow, since the volume scattering of snow dominates over the scattering caused by the underlying ice or land surface. In contrast, the Ku-band altimeter (wavelength 2 cm) provides a high maximum snowpack penetration depth of up to 15 m in high latitudes regions with dry snow, as volume scattering is decreased by more than one order of magnitude compared to Ka-band. The combined difference in Ka- and Ku-band signal penetration results will provide a direct and more accurate determination of SWE. As a result, global SWE estimations interpreted from passive microwave products and the reliability of numerical snow and climate models will be advanced.

The spacecraft would be launched into a 90 degree polar orbit with a 3 days revisit time in order to fulfill the priority scientific requirement of having the highest temporal resolution in the polar regions. This will enable a detailed study of these remote areas by providing a 3 day maximum revisit time. The spacecraft would be of about 850 kg and could be transported by the Vega Launcher into a 761 km orbit allowing the sharing of the launch price.