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SWEAT: Snow Water Equivalent with AlTimetry

Dries Agten, Harm-Jan Benninga, Carlos Diaz Schümmer, Julia Donnerer, Georg Fischer, Marie Henriksen, Alexandre Hippert Ferrer, Maryam Jamali, Stefano Marinaci, Toby JD Mould, Liam Phelan, Stephanie Rosker, Caroline Schrenker, Kerstin Schulze, and Jorge Emanuel Telo Bordalo Monteiro

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To study how the water cycle changes over time, satellite and airborne remote sensing missions are typically employed. Over the last 40 years of satellite missions, the measurement of true water inventories stored in sea and land ice within the cryosphere have been significantly hindered by uncertainties introduced by snow cover. Being able to determine the thickness of this snow cover would act to reduce such error, improving current estimations of hydrological and climate models, Earth's energy balance (albedo) calculations and flood predictions.
Therefore, the target of the SWEAT (Snow Water Equivalent with AlTimetry) mission is to directly measure the surface Snow Water Equivalent (SWE) on sea and land ice within the polar regions above 60°and below -60° latitude. There are no other satellite missions currently capable of directly measuring SWE. In order to achieve this, the proposed mission will implement a novel combination of Ka- and Ku-band radioaltimeters (active microwave sensors), capable of penetrating into the snow microstructure.
The Ka-band altimeter ($\lambda \approx 0.8$ cm) provides a low maximum snow pack penetration depth of up to 20 cm for dry snow at 37 GHz, since the volume scattering of snow dominates over the scattering caused by the underlying ice surface. In contrast, the Ku-band altimeter ($\lambda \approx 2$ 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 a factor of 55. The combined difference in Ka- and Ku-band signal penetration results will provide more accurate and direct determination of SWE. Therefore, the SWEAT mission aims to improve estimations of global SWE interpreted from passive microwave products, and improve the reliability of numerical snow and climate models.