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Uncertainty and sensitivity analysis of the retrieved essential climate variables from remotely sensed observations

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The sensitivity of weather and climate system to sea ice thickness (SIT), Sea Ice Draft (SID) and Snow Depth (SD) in the Arctic is recognized from various studies. Decrease in SIT will affect atmospheric circulation, temperature, precipitation and wind speed in the Arctic and beyond. Ice thermodynamics and dynamic properties depend strongly on sea Ice Density (ID) and SD. SIT, SID, ID and SD are sensitive to environmental changes in the Polar region and impact the climate system. For accurate forecast of climate change, sea ice mass balance, ocean circulation and sea- atmosphere interactions it is required to have long term records of SIT, SID, SD and ID with errors and uncertainty analyses.
The SID, SIT, ID and freeboard (F) have been retrieved from Radar Altimeter (RA) (on board ENVISAT) and IceBridge Laser Altimeter (LA) and validated, using over 10 years -collocated observations of SID and SD in the Arctic, provided from the European Space Agency (ESA CCI sea ice ECV project).
Improved algorithms to retrieve SIT from LA and RA have been derived, applying statistical analysis. The snow depth is obtained from AMSR-E/Aqua and NASA IceBridge Snow Depth radar. The sea ice properties of pancake ice have been retrieved from ENVISAT/Synthetic Aperture Radar (ASAR). The uncertainties of the retrieved climate variables have been analysed and the impact of snow depth and sea ice density on retrieved SIT has been estimated. The sensitivity analysis illustrates the impact of uncertainties of input climate variables (ID and SD) on accuracy of the retrieved output variables (SIT and SID).
The developed methodology of uncertainty and sensitivity analysis is essential for assessment of the impact of environmental variables on climate change and better understanding of the relationship between input and output variables. The uncertainty analysis quantifies the uncertainties of the model results and the sensitivity analysis evaluates the contribution of each input variable to output uncertainty. This demonstrates that uncertainty and sensitivity analysis are essential steps in model building and quality assurance for this domain.