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Plans for an polar ice and snow topography mission.

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This paper describes plans for a potential operational mission with the aims to continue and enhance measurements obtained from the CryoSat mission.
The primary high level objectives of the proposed mission are:
1. Monitor critical climate signals: ice sheet, ice cap melting and sea level. In order to understand the contribution of ice sheet and ice cap melting to global sea level rise and circulation, one needs to monitor mass balance of the major ice sheets and ice caps. Monitoring instabilities in the grounded ice sheet margins and floating ice shelves is also required to understand where and why mass loss is accelerated.
For ice sheets, glaciers/ice caps and permafrost regions, monitoring the surface elevation and its temporal change is required. The change of glacier mass over time (typically over annual intervals) is the basis for determining the mass balance of the ice bodies and compiling the contributions to sea level rise. Precise, regularly updated DEMs are required as essential auxiliary data for deriving ice velocity maps from displacements in repeat-pass satellite imagery, for retrieving calving fluxes and ice discharge, for estimating iceberg freeboard, thickness and mass. In particular:
• High spatial resolution surface elevation (typically between 50 and 100 m sampling) and regular repeat observations for regions where major changes in surface elevation occur (typically $\sim 5^\circ$), such as, outlet glaciers, boundaries of ice sheets and caps, mountain glaciers, zones that are subject to permafrost erosion, icebergs.
• Low to moderate spatial resolution and an acquisition interval of a few months to get coverage: typically 1 km spacing, for low slope terrain (typically $<0.2^\circ$) in the interior of ice sheets, for example, Antarctica.
2. Monitor variability of Arctic and Southern Ocean sea-ice and its snow-loading. The seasonal sea ice cycles are hugely important for both human activities and biological habitats. Monitoring the inter-annual variability of sea ice volume, extent and thickness not only offers one of the most sensitive climate signals, it is also essential for long term planning of any kind of activity in the Polar Regions. This requires an improved knowledge of snow loading on sea ice. On shorter timescales, maps of sea ice thickness and types are essential to support increasing marine operations in those regions.
Secondary objectives are:
3. Support applications related to coastal and inland waters. Observation of water level at the (Arctic) coast as well as rivers and lakes is a key quantity in hydrological research. Rivers and lakes not only supply freshwater for human use including agriculture but also maintain natural processes and ecosystems. The monitoring of global river discharge and its long-term trend contributes to the evaluation of global freshwater flux critical for understanding the mechanism of global climate change.
4. Contribute to the observation of ocean topography. Contribute to the observation system for global observation of mean sea level, mesoscale and sub-mesoscale currents, wind speed and significant wave height as a critical input to operational oceanography and marine forecasting services as well as ice thickness retrieval in the Arctic.