Greenland and Antarctic Ice Sheets #1
Highlights and Recommendations

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Highlights/Recommandations

Keep CryoSat-2 working for as long as possible, aiming for an overlap with CRISTAL!!!!

- long term time series are important to understand annual/decadal variations of elevation change and also to understand and observe spatial-patterns of mass change, seasonal melting and snowfall variability or mission specific patterns (e.g. cross over differences, due to polarimetric effects in East Antarctica)
- Overlapping missions is **the key** to get multi-decadal time series and to contribute to society demands by observing the evolution of ice sheet in a warming climate - Radar altimetry provides a 30 year record
- Coverage of areas > +/-81.5° important to observe changing SMB in East Antarctica for years to come
- Very important for mass balance estimation to have a reliable mass balance from satellite radar altimetry, and to compare to independent estimates from gravimetry, mass budget method and laser altimetry, this will also help constrain projections of future sea level rise

Meteorological and firn processes dominate GRE MB

- using CryoSat-2, increased runoff for the last decade as well as a higher year to year variability of SMB has been estimated correlating well with regional climate models
- firn induced elevation change (firn densification -FD) as well as the complex nature of Ku-Band penetration is important to understand and correct for to derive reliable elevation/volume mass change estimates. Especially in peripheral areas of Greenland, where warm summer temperatures speed up firn compaction leading to percolation of melt water into the snow pack but also in the interior (melt event).
- —> ?ideas for new Explorer mission to estimate FD? or operational FD models to be incorporated in climate services

Highlights/Recommendations

Radar KU-Band penetration

- We still need a better understanding of the Ku-Band penetration to minimize errors over the vast East Antarctic plateau as well as the interior of Greenland
- use the opportunity of Cryo2ice as well as SARAL/Altika to compare Ku/Ka radar and laser data to better identify the scattering horizon of CryoSat-2 and better understand fluctuations in penetration depth
- it will also be very useful to look at sampling differences between radar/laser sensors which may also cause the differences we see
- waveform information to gain meteorological variables to be used in assimilation in climate models is of particular importance

Swath capability

- opens new research field and enables to observe changes in steep complex and rough terrain which was not able before (lake drainage, glacier surge, small ice caps, Antarctic Peninsula)

→ does ESA need a better control on the antenna mis-pointing prior launch, rigidity of antenna frame and exact measure of antenna baseline - might be even more important for Ka-interferometry) - to enable high quality of swath processing

Highlights/Recommendations

Switching from LRM to SAR in the ice sheet interior:

- explore potential impacts (if any) on the long-term record of switching from pulse-limited to SAR only in the ice sheet interiors with CRISTAL: possible change in the scattering horizon?
- will SAR mode benefit of being less sensitive to changes in scattering properties than LRM which could improve our retrieval of meteorological info in the interior?
- Additionally providing PLRM over ice sheets is important to allow a continuity of the long-term dh/dt time series as well as to identify differences of SAR and LRM

Concurrent missions and Validation using data from Ground/Airborne campaigns are key to multiply our knowledge and understanding

(e.g. CryoVEX, ICEBRIDGE, Sentinels1-3+ICESat-2+SARAL/AltiKa+TanDEM-X,TSX)

- only by combining different missions (SAR Imaging, Optical, …) as well as Airborne/Ground truthing with satellite altimetry will enable to increase our understanding of processes, allow a validation of products and improve spatial/temporal sampling of processes (like lake drainage, grounding line migration, lake depth/volumes) or provide data sets needed for L3 products (e.g. basal melt rate need velocity divergence over shelves)