Assessing Stability and Precision of Sea Ice Thickness Retrievals from Satellite Altimetry by a Cross-Over Analysis

Motivation

- While the **accuracy** is a measure of statistical bias, **precision** describes random errors (Figure 1).
- We evaluate the **precision** of satellite sea-ice thickness estimates, by an orbit crossover analysis, using trajectories along individual orbits.
- Sea ice thickness is derived from CryoSat-2 and Envisat radar altimeters in the framework of the ESA Climate Change Initiative Project.
- Moreover, differences in stability and precision between sea ice thickness retrievals from the northern and southern hemispheres are evaluated.

Data and methods

- Orbit crossovers are determined for each single daily trajectory for CryoSat-2 and Envisat.
- For each crossover location, a search radius of 12.5 km is used to collect SIT measurements in the vicinity of the crossover for each of the two crossing orbits (Figure 2).
- The sea ice thickness measurements within the radius are averaged, and the mean sea ice thickness of orbit 1 is subtracted from the averaged sea ice thickness of orbit 2, in order to retrieve the difference for each crossover.

**Figure 2** a) Scheme of the crossover analysis. Orbit 1 Sea Ice Thickness (SIT) and orbit 2 SIT are averaged within a radius of 12.5 km around the crossover. Then, orbit 1 mean SIT is subtracted from orbit 2 mean SIT.

Arctic vs. Antarctic

- Figure 4 shows histograms of the thickness differences between the sea ice thickness of orbit 2 and orbit 1 within the 12.5 km radius around the crossover for CryoSat-2 and Envisat over Arctic sea ice.
- 1. Crossovers were collected over the periods 2002-2012 (Envisat) and 2010-2017 (CryoSat-2).
- 2. Crossovers were collected during October-April (Arctic), and April-October (Antarctic) respectively.

Conclusions

- The mean absolute difference is 0.37 m for CryoSat-2 and 0.51 m for Envisat, implying that CryoSat-2 sea ice thickness retrievals exceed Envisat in precision.
- For both Envisat and CryoSat-2, the mean absolute difference slightly increases from the beginning of the winter season in October to the end of April in the northern hemisphere.
- The stability and precision in the Arctic is significantly higher than in the Antarctic. For CryoSat-2, the mean absolute difference between crossover orbits is 0.37 m in the Arctic, and 0.63 m in the Antarctic.