

Sea Ice

State-of-the-art and challenges: Sea ice monitoring is important for documenting climate change and validating models. Sea ice concentration and extent is perhaps the best-observed climate variable in the Arctic with four decades of systematic monitoring (Breivik et al., 2009, Ivanova et al, 2015). However, there is a significant uncertainty in retrieval of quantitative data on sea ice concentration from microwave satellite data due to melt-ponds. The challenge is to improve and validate the ice concentration retrieval algorithms in the summer season. Satellite radar altimeter data (e.g. CryoSat2) has delivered promising results to measure changes in Arctic sea ice thickness since 2010 (Laxon, 2013, Kwok, 2015). Ice thickness data are also obtained from several in situ and airborne observing systems (Lindsay and Schweiger, 2015). Retrieval of sea-ice thickness from freeboard data observed with radar altimeter is a challenge due to uncertainties caused by penetration depth of the radar signal, as well as the varying snow cover and snow-ice density. Ice drift and discrimination between first-year ice and multiyear ice are derived products from satellite data used operationally.

In the ESA CCI programme, algorithms for sea-ice concentration, thickness, and drift are studied and validated in order to produce time series data for climate research. The Sentinels will increase the amount of sea ice data significantly in the coming years and new derived products such as ice drift and ice classification will be produced and made available for users. The main challenge is to collect relevant *in situ* measurements for validation of the satellite product.

Expected progress beyond state-of-the-art:

- Improved satellite-based ice concentration, ice thickness and ice drift products using new Sentinel data, passive microwave and optical data.
- Obtain year round in situ measurements from ITP and ice mass balance buoys of snow and ice thickness, and ice drift for validation of satellite products and models.
- Provide access to sea-ice data products developed and disseminated from various European and international programmes.