

Using satellite products to evaluate Arctic sea ice in the ECMWF ocean reanalysis

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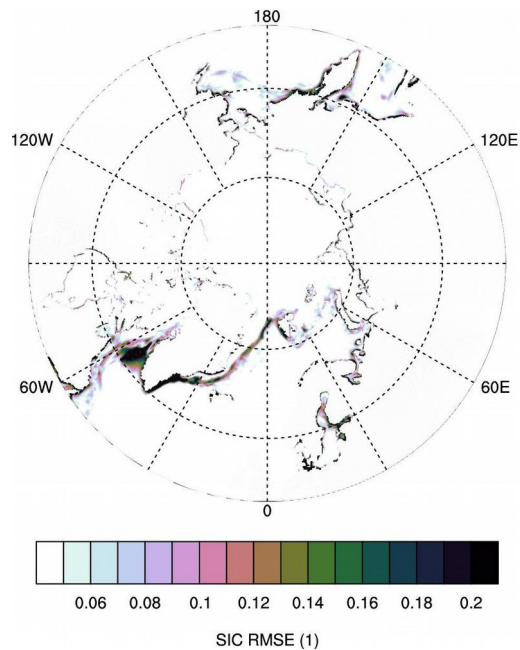
APVE II Workshop, Norkopping, 28 October 2015

The ECMWF ocean reanalysis ORAP5

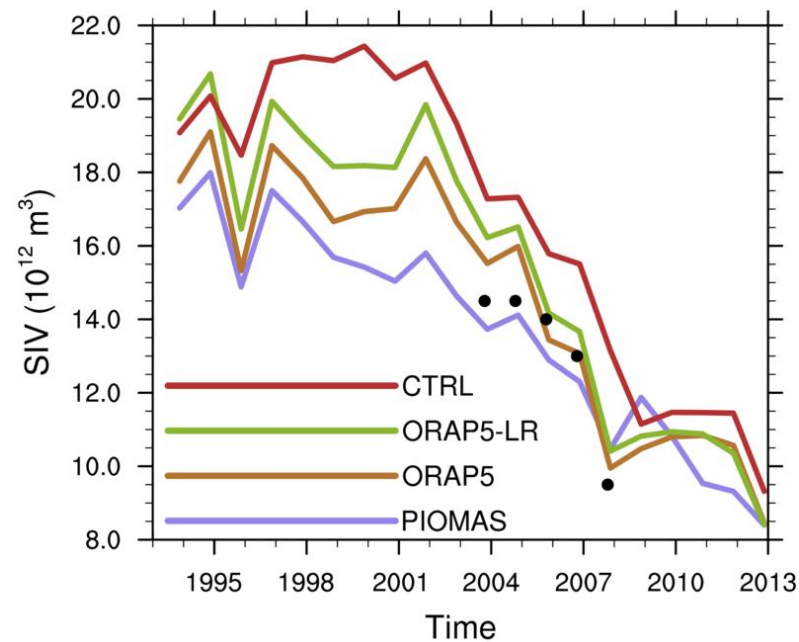
- Reconstruction of global ocean and sea ice state 1979 – 2013
 - initial conditions for weather and climate predictions
 - climate monitoring
- NEMO ocean model with $\frac{1}{4}$ deg spatial resolution
- LIM2 sea ice model
- Assimilates observations of
 - Ocean temperature & salinity (in-situ)
 - Sea surface height (satellite)
 - Sea ice concentration (satellite)

Arctic sea ice in ORAP5

March ice concentration error



November ice volume



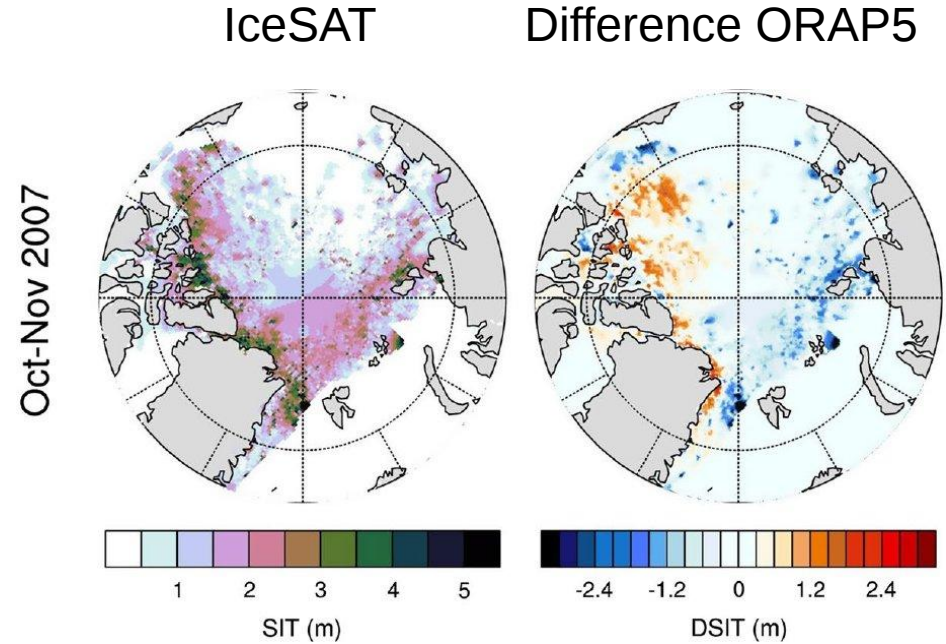
Tietsche et al., Clim. Dyn. (2015)

Overall successful assimilation of ice concentration, with benefit for ice volume

Sea ice thickness observations from altimeters

Thickness derived from freeboard

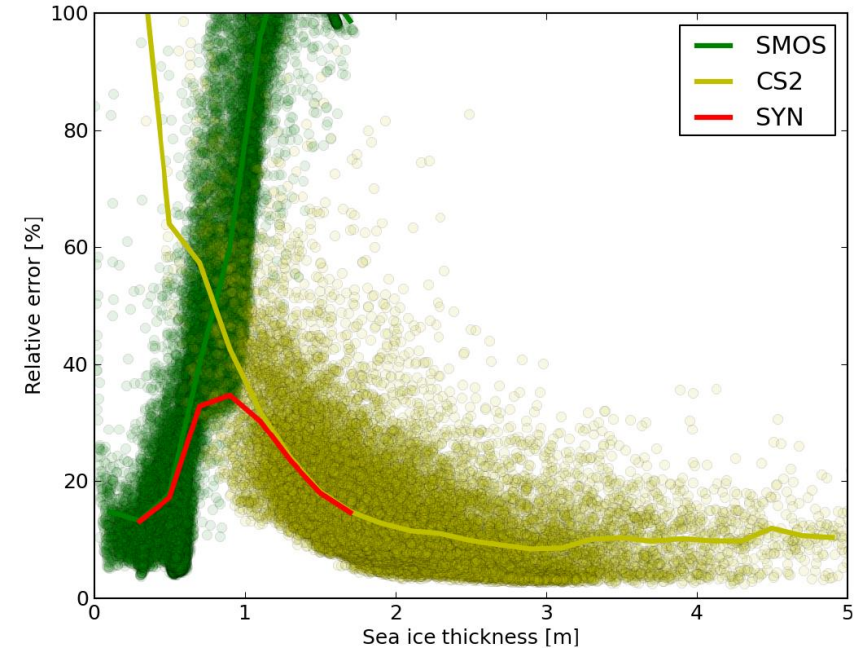
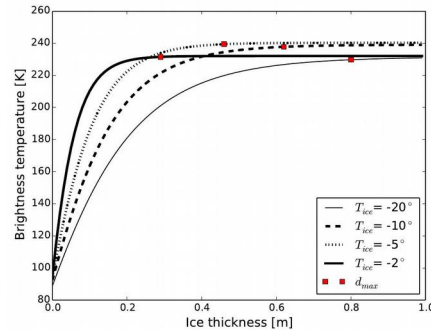
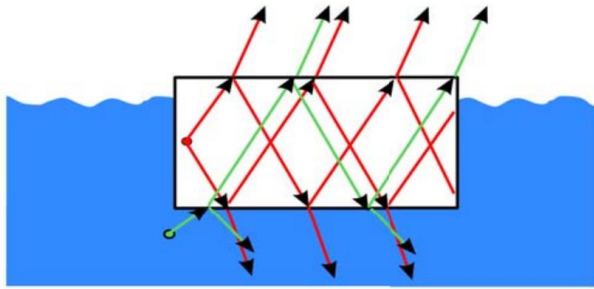
- IceSAT 2003 – 2008
- CryoSat 2010 – present
- IceSAT2 from 2017



Zuo et al., Clim. Dyn. (2015)

Tietsche et al., Clim. Dyn.(2015)

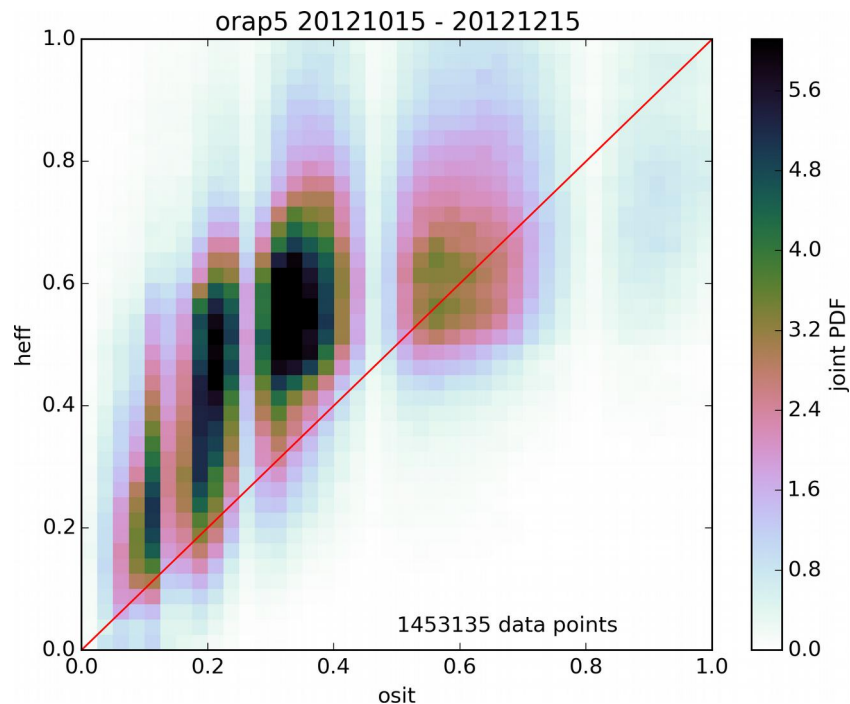
SMOSIce – sea ice thickness from L-band MW



- Complex and large errors
- Only feasible for **thin** sea ice
→ complements altimeter measurements
of **thick** sea ice

Kaleschke et al., GRL (2012)
Maass, PhD thesis (2013)
Tian-Kunze et al., Cryosph. (2014)

Model–observations comparison of thin sea ice



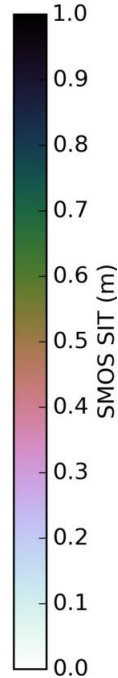
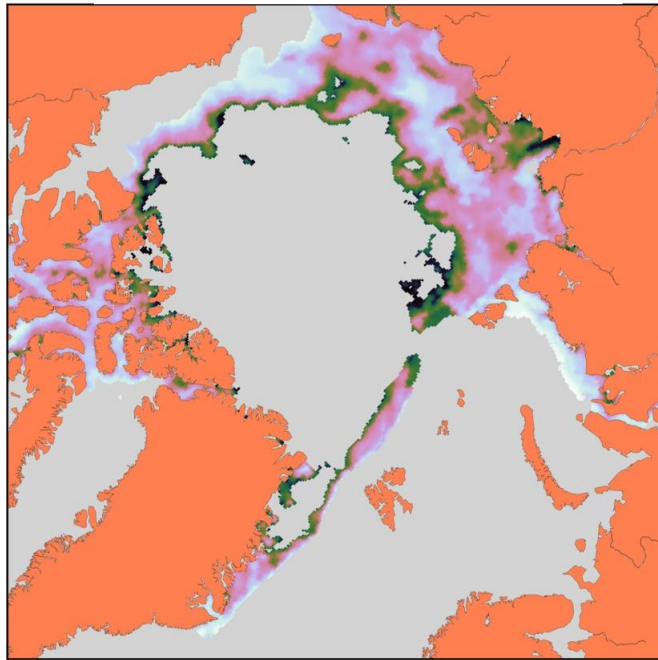
Promising first results, but lots of work needs to be done:

- Model: overestimates thickness, overly simplistic for thin sea ice
- SMOSIce: relies on uncertain ancillary fields, has artifacts

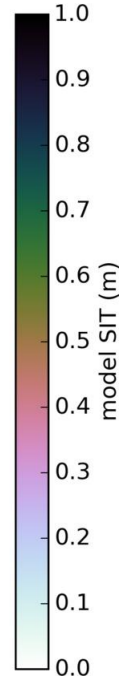
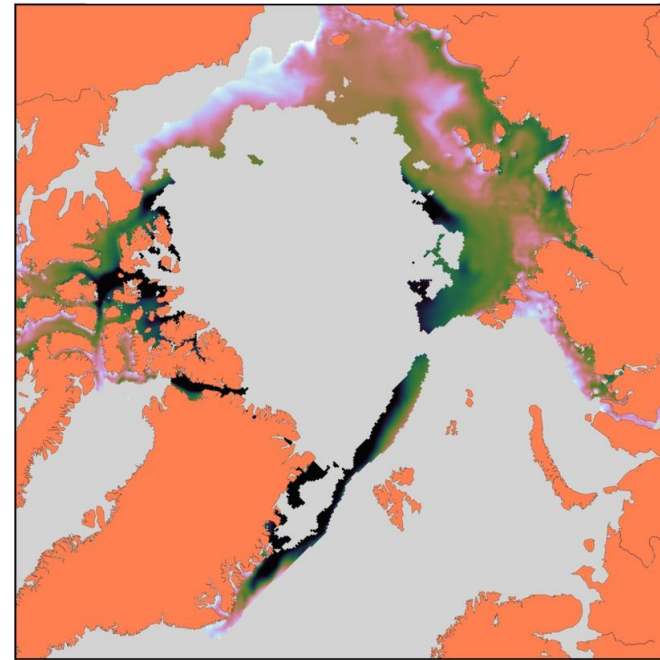
Maps of thin sea ice during freeze-up

11 Nov 2012

SMOSIce observations



ORAP5 ocean reanalysis

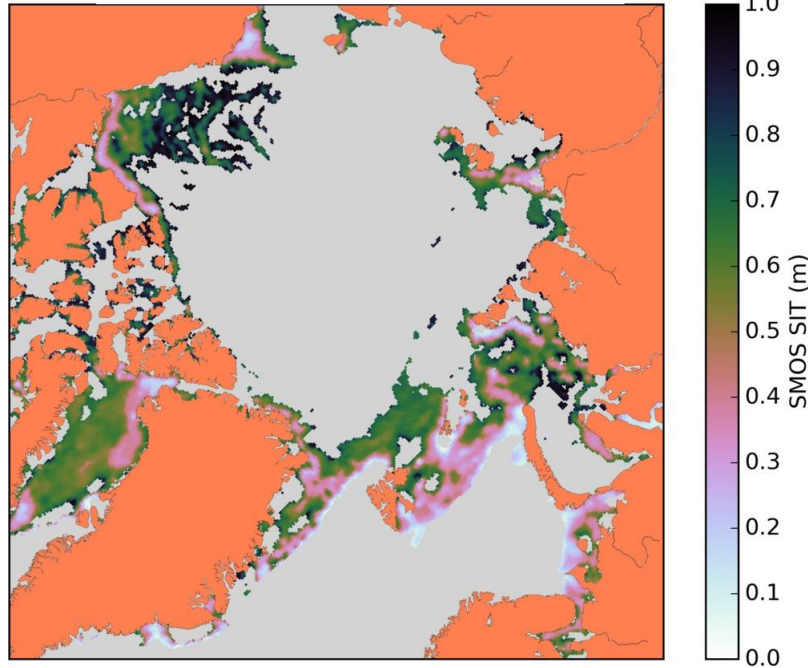


Thin new ice reliably detected, reasonably well simulated

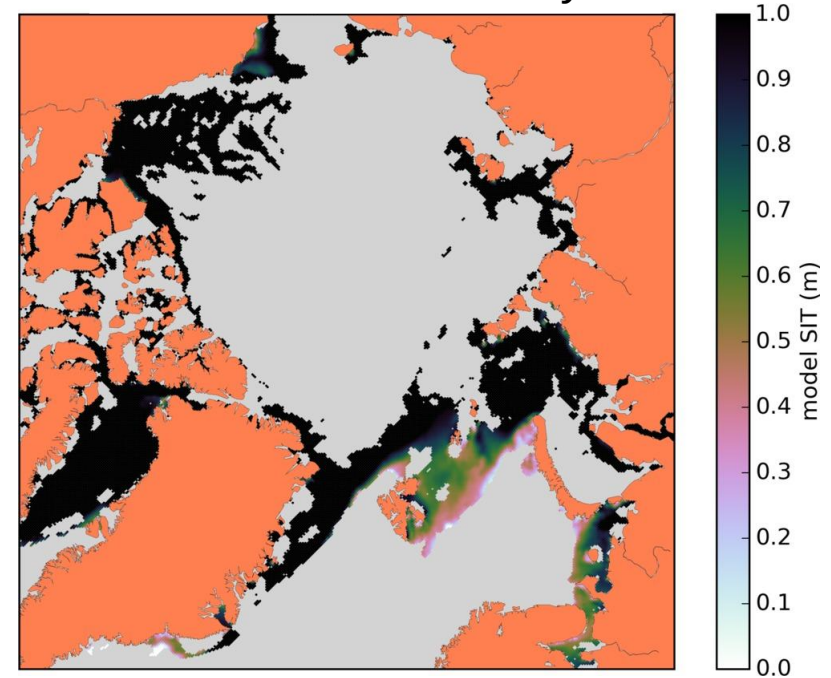
Maps of thin sea ice during late winter

22 Mar 2013

SMOSIce observations



ORAP5 ocean reanalysis



Modelled thickness much larger than SMOSIce (polynyas, uncertain snow cover, ...)

Summary and Conclusions

- Sea ice state important for weather and climate predictions
- ECMWF plans to invest in sea-ice modelling and satellite data
→ “Earth System” approach, not just atmosphere any more
- Sea ice concentration products established for data assimilation
- New sea ice thickness products (altimeters for thick ice, SMOS for thin ice): First results promising, but much work to be done