Sea Ice CCI project Phase 2

2015-2017

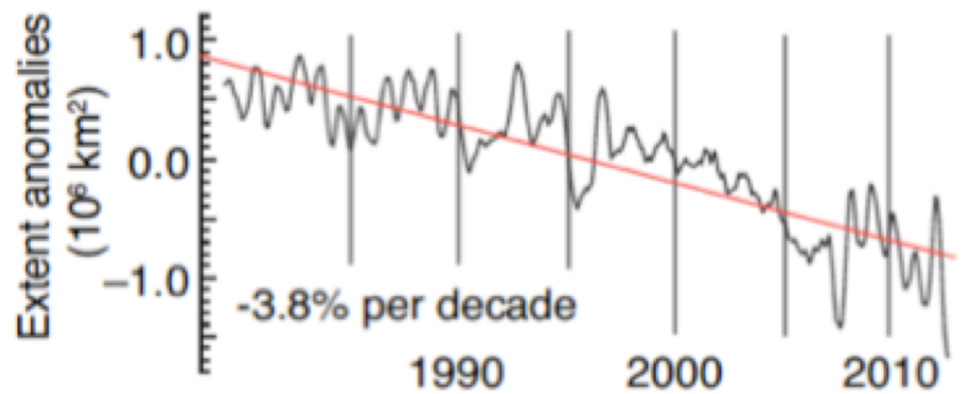
Improvements in Phase 2 with regards to GCOS Requirements

Sea Ice Concentration	GCOS requirements (2011 update)	CCI Phase 1	CCI Phase 2
Spatial Resolution	10-15 km	25 km	25 km
Temporal Resolution	Weekly	Daily	Daily
Period		1992-2008	1979-2015
Accuracy	5% ice area fraction	3-4 % (interior)	improved
Stability	5% per decade	*assessed: stable*	

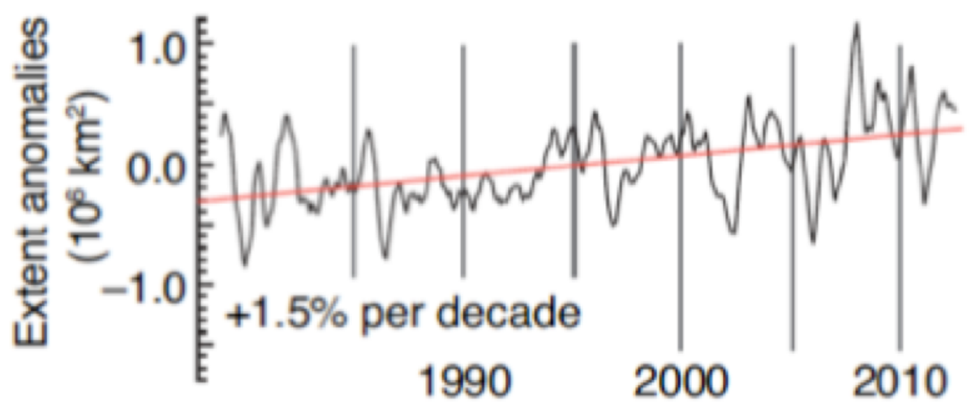
Sea Ice Thickness	GCOS requirements (2011 update)	CCI Phase 1	CCI Phase 2
Spatial Resolution	25 km	100 km	100 km
Temporal Resolution	Monthly	Monthly (winter)	Monthly (winter)
Period		2002-2012	1993-2015
Accuracy	0.1 m	0.5 m (target)	?
Stability	unspecified	*not assessed*	To be assessed

Arctic ice extent decreases,
Antarctic ice extent increases

Arctic



Antarctic

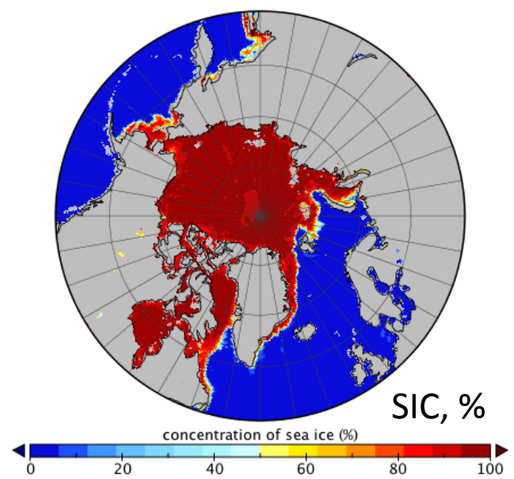


IPCC AR5, 2013

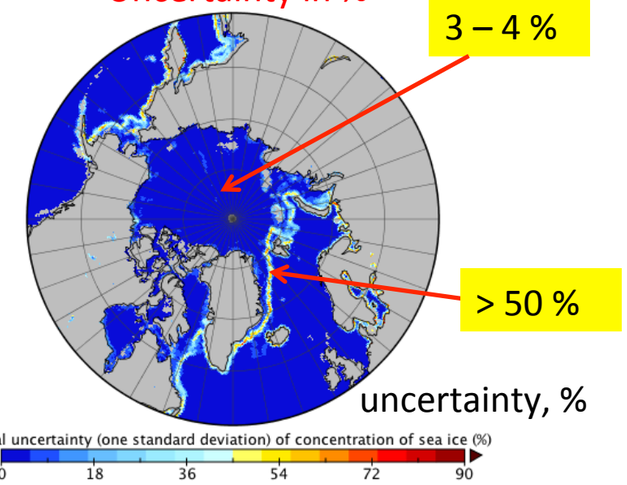
Arctic and Antarctic ice concentration

AMSR-E
25 km EASE
20080103

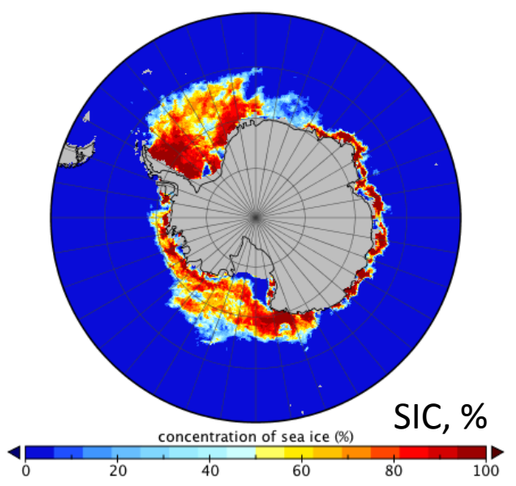
Ice concentration in %

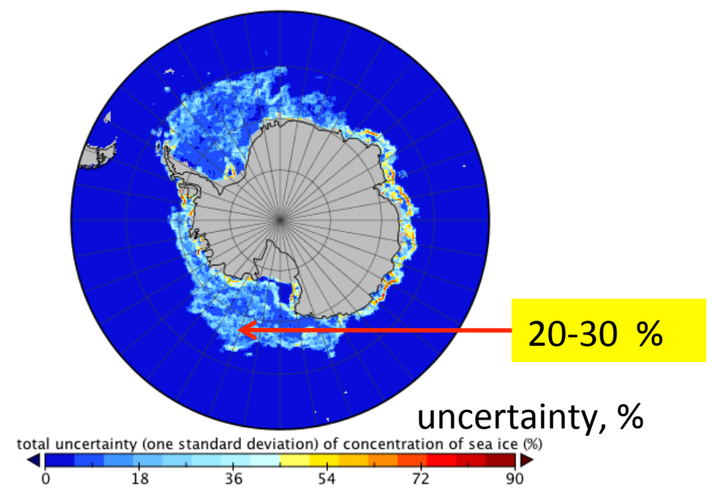


Uncertainty in %

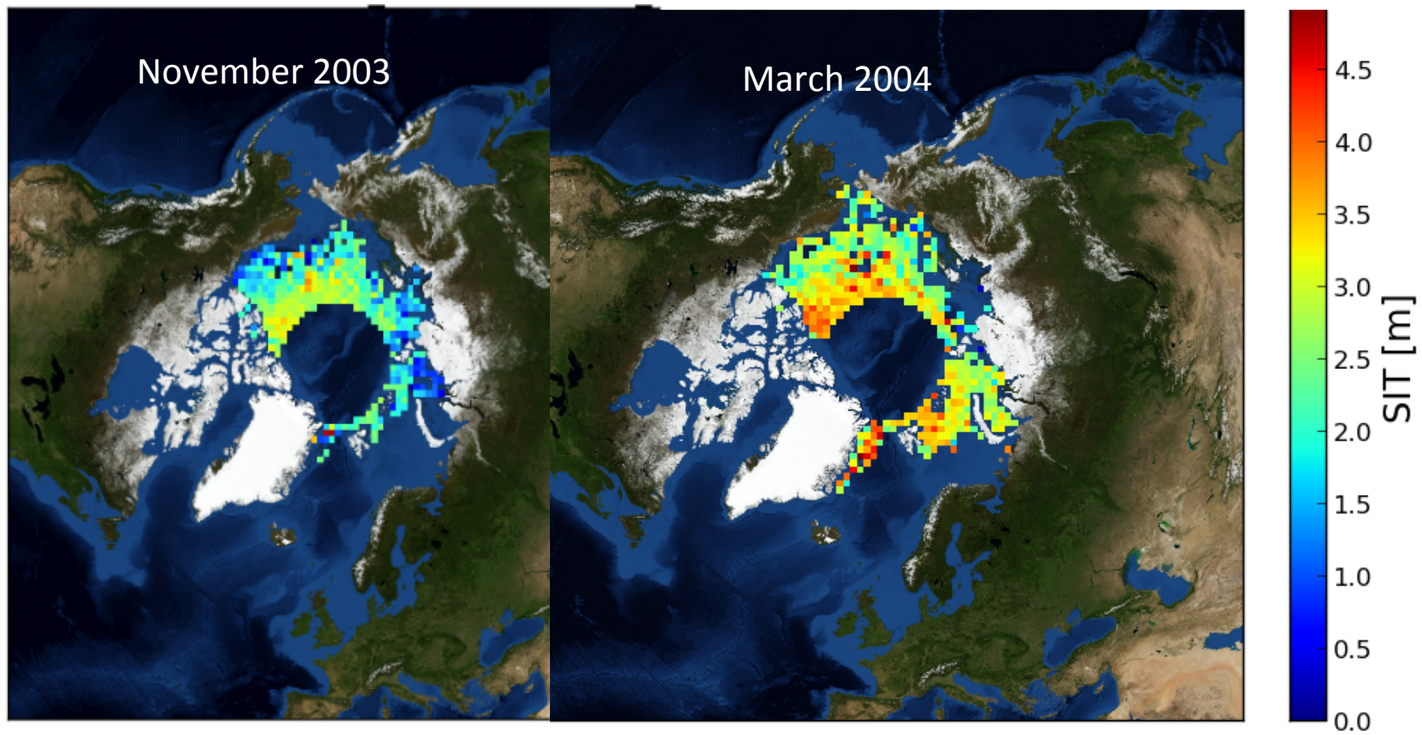


Uncertainty =
tiepoint +
smearing +
daily variability
with a grid cell



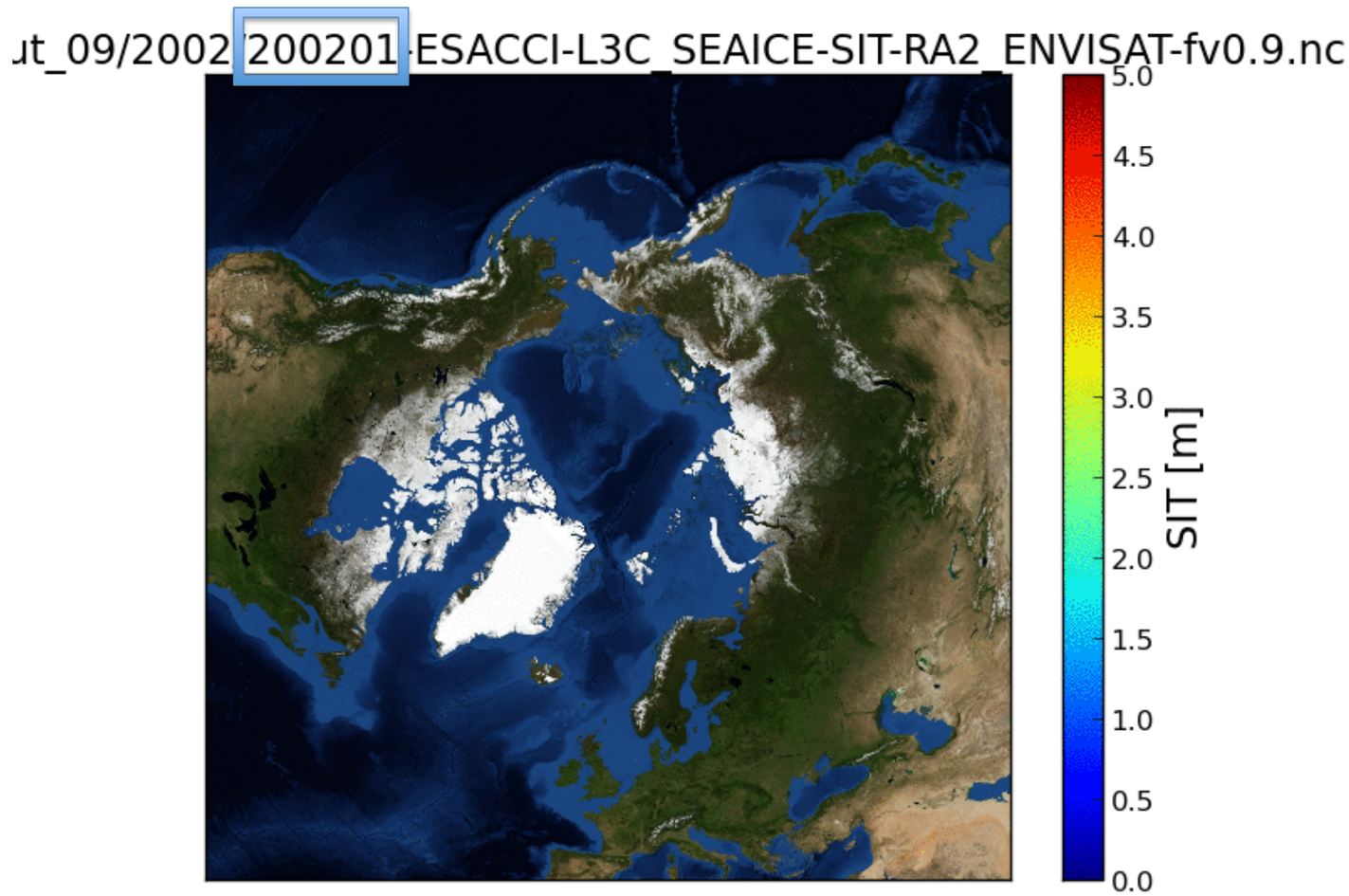


Ice thickness product from ENVISAT radar altimeter

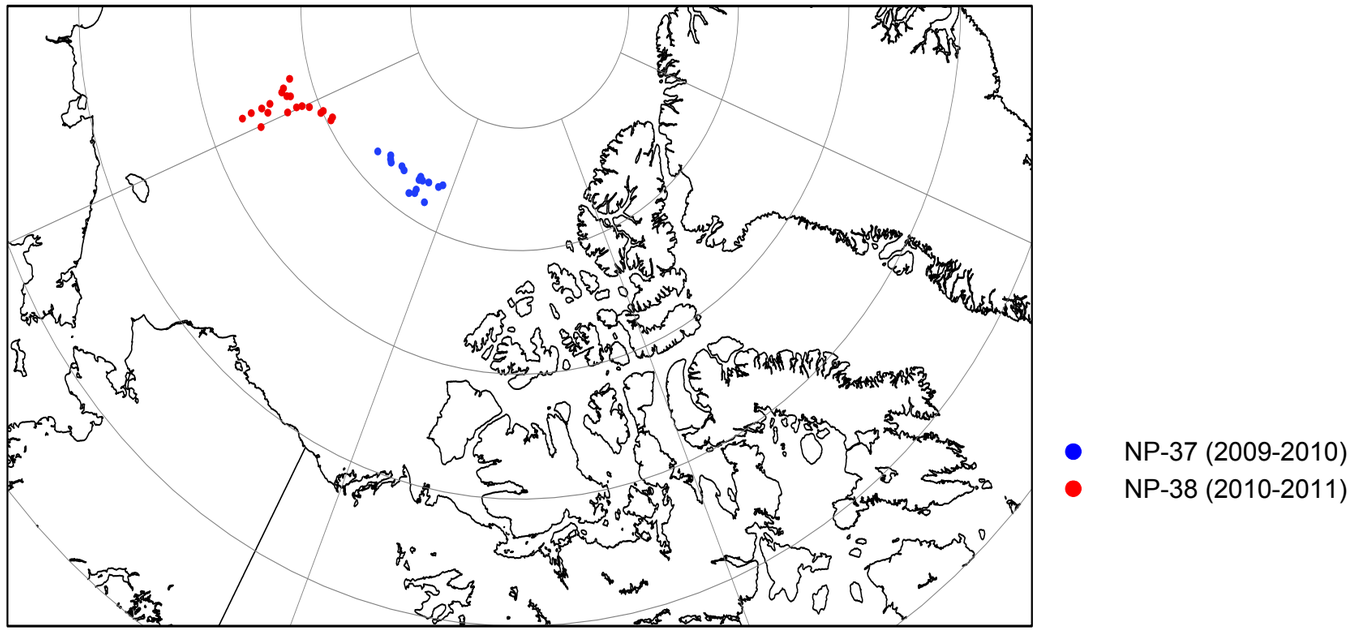


Monthly maps of FB and SIT (winter months)
100 km grid
Arctic coverage (< 82N due to satellite orbit)

Ice thickness from ENVISAT RA 2002-2012

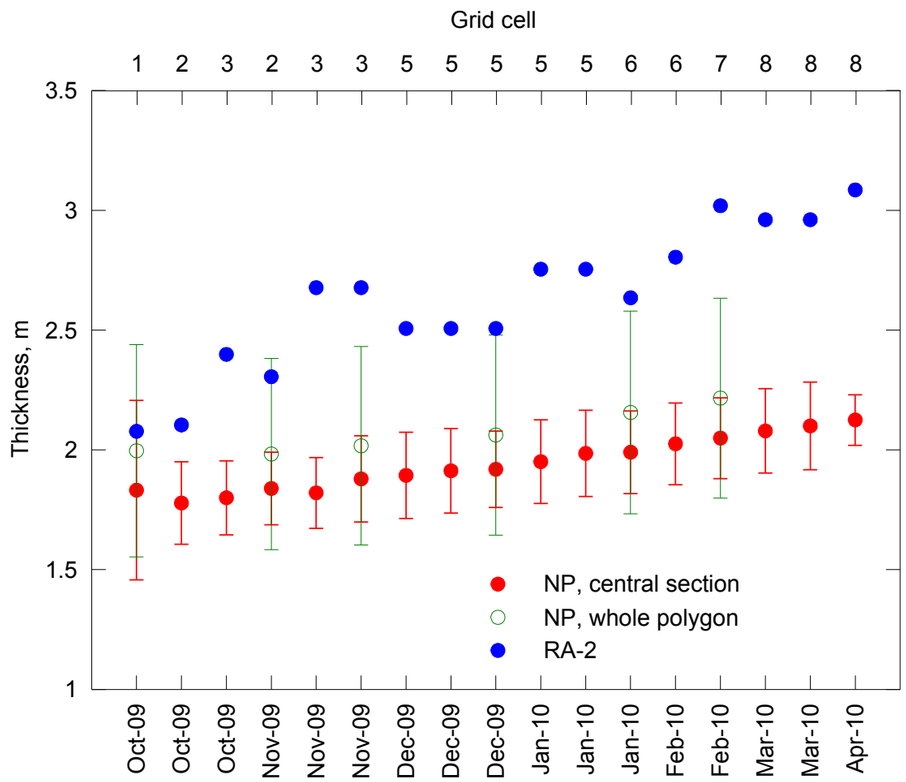


Ice thickness validation using in situ data from North Pole drifting stations



- Collocated in situ and Envisat data
- Every 10 days measurements
- 100 m × 100 m polygon

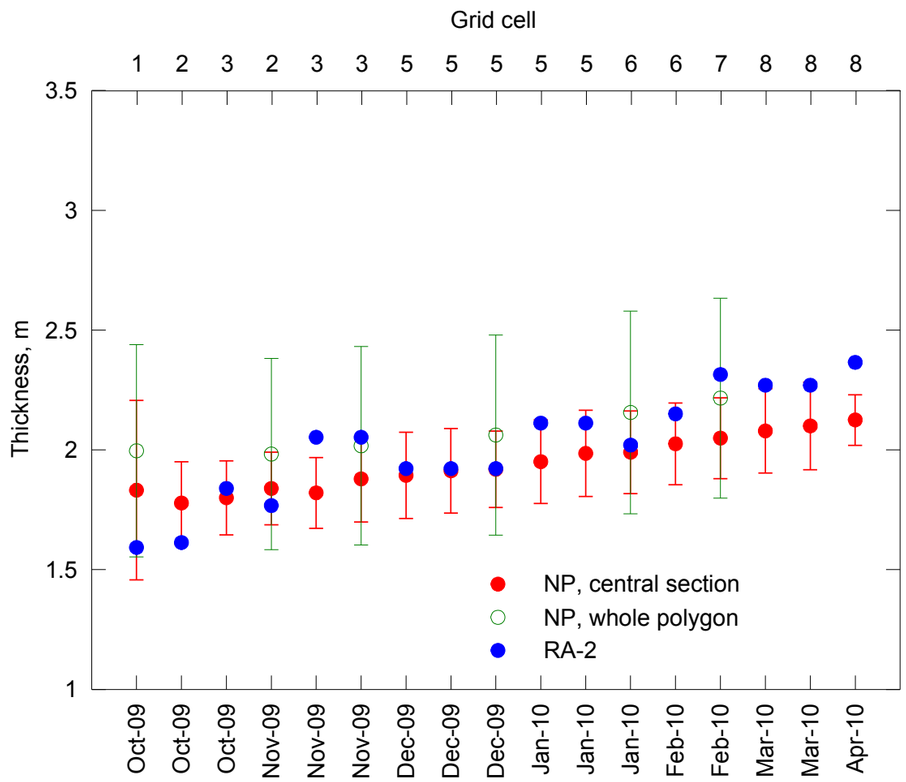
Seasonal ice thickness evolution from collocated NP-37 and Envisat RA-2(100-km grids) data (1)



ρ_{ice} = 915.1 kg/m^3
Snow : Warren climatology

Mean (S.D.) diff: 0.69 (0.21) m
(Mean (S.D.) diff: 0.46 (0.25) m)

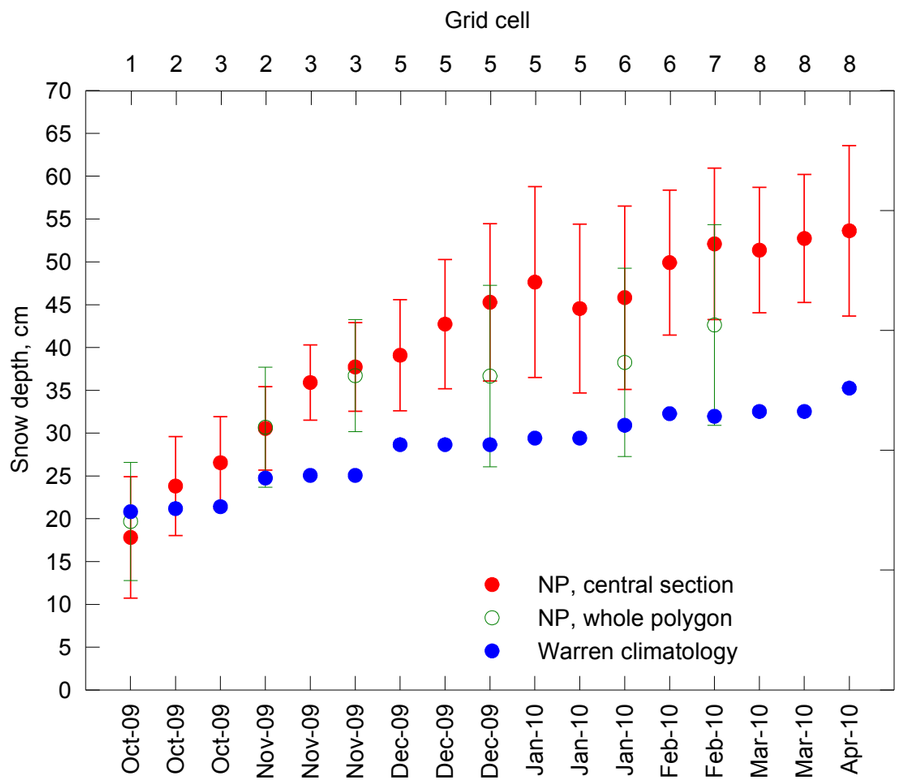
Seasonal ice thickness evolution from collocated NP-37 and Envisat RA-2 (100-km grids) data (2)



ρ_{ice} = 882 kg/m^3
Snow : Warren climatology

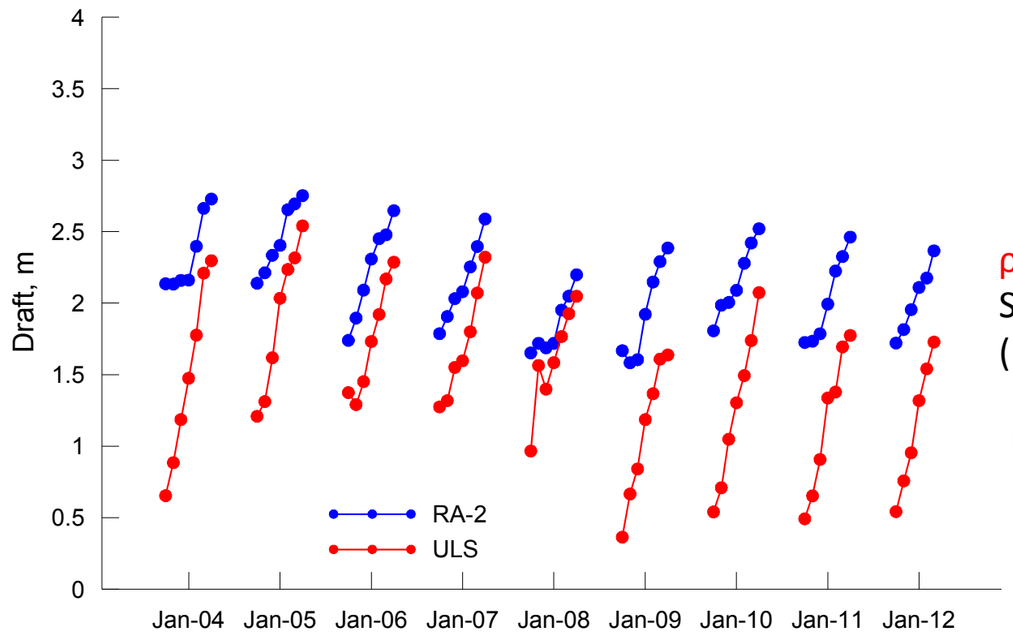
Mean (S.D.) diff: 0.08 (0.14) m
(Mean (S.D.) diff: -0.13 (0.18) m)

Seasonal evolution of snow depth from NP-37 and Warren climatology over RA-2 100-km grids



Mean (S.D.) diff: -12.9 (6.7) cm
(Mean (S.D.) diff: -7.1 (4.6) cm)

Winter month ice draft from mean ULS and Envisat RA-2 data in the Beaufort Sea (2004-2012)



ρ_{ice} = 900 kg/m^3
Snow : Warren climatology
(12 by 30 deg. lat/lon sector)

Mean (S.D.) diff: 0.67 (0.33) m

Sea ice freeboard from airborne data

Available data from Operation Ice Bridge

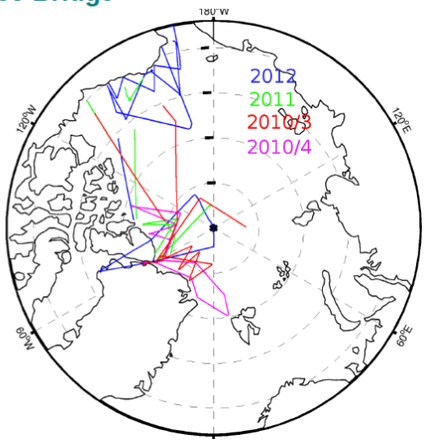
March 2010
April 2010

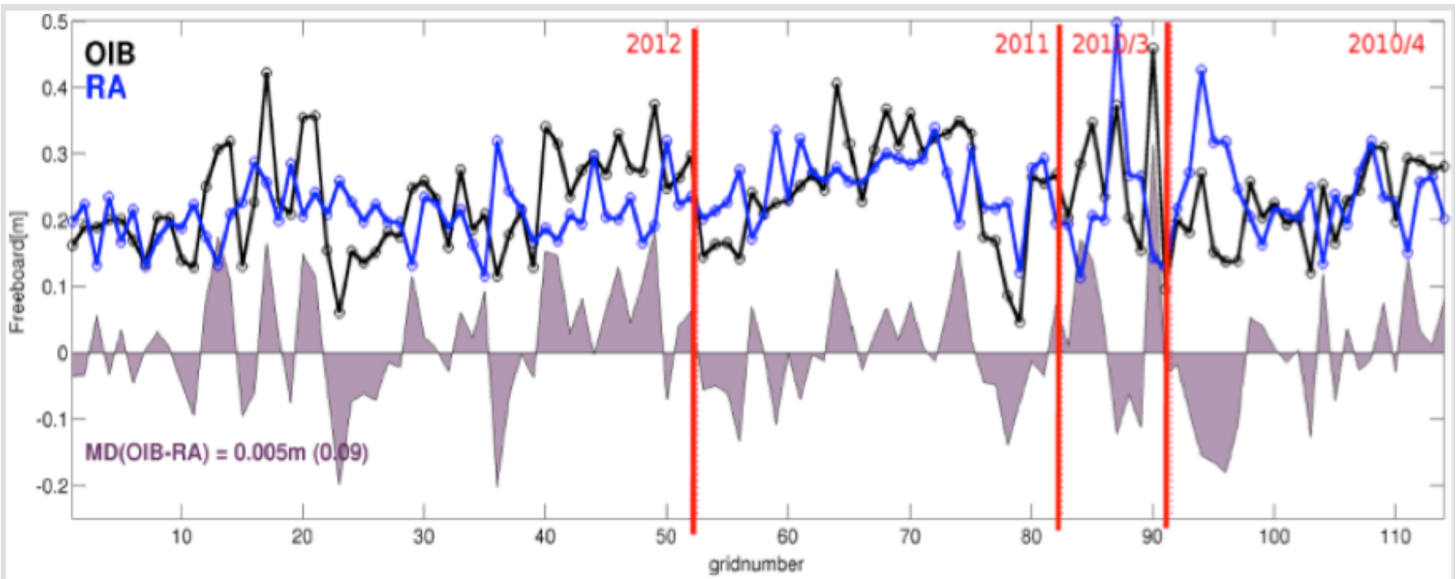
March 2011

March 2012

Contains:
snow-ice freeboard (laser)
snow depth (snow radar)

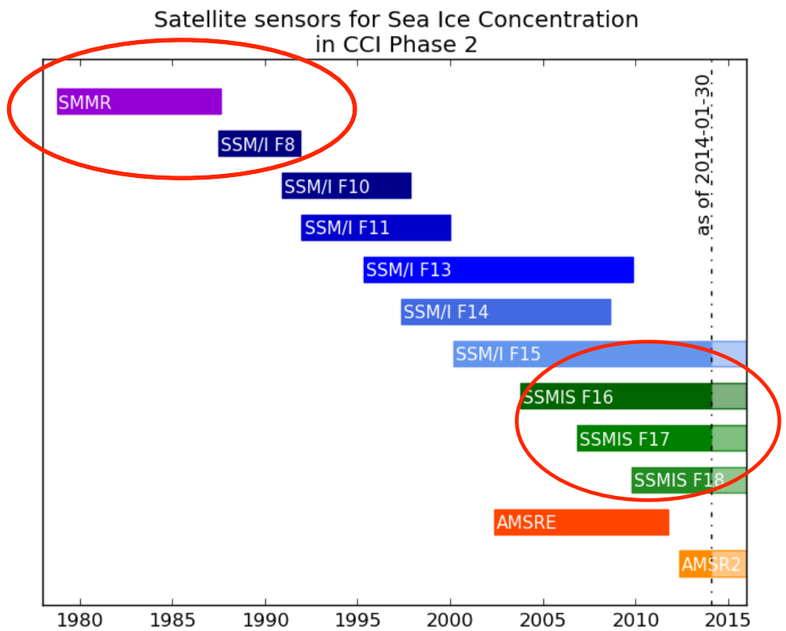
→ sea ice freeboard
→ sea ice thickness





Extending the ECV timeseries in phase 2

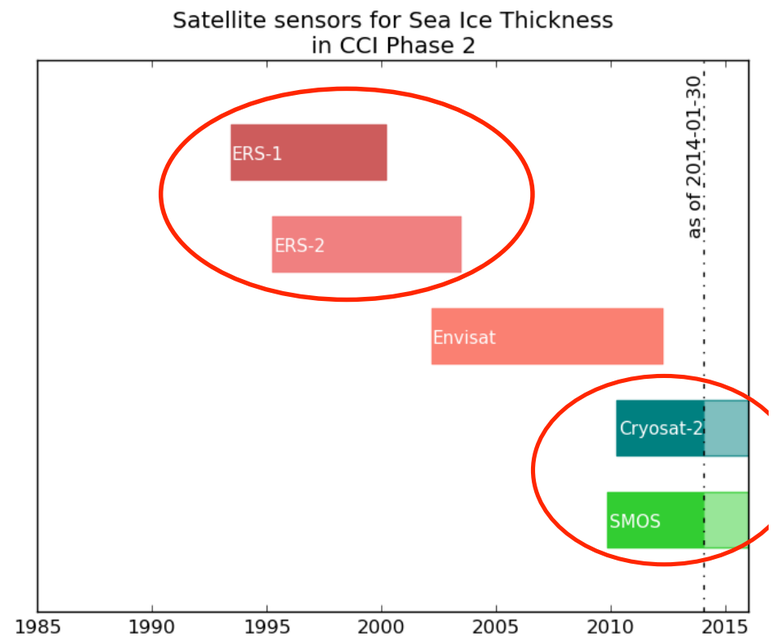
Sea ice concentration



Phase 1

Phase 2

Sea ice thickness



Phase 1

Phase 2

Ice concentration tasks

- reduction of uncertainties
- improved quantization of uncertainties
- improvements to the spatial resolution
- extension of the time series (1978-2015)

Specific issues:

- melt season
- thin ice
- snow cover

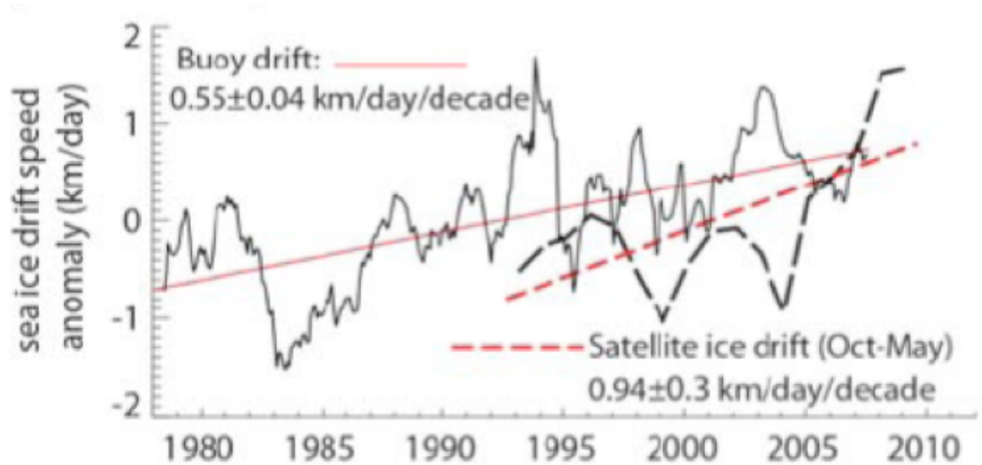
Ice thickness tasks

- extension of the Envisat RA-2 SIT time series by ERS-1/2 and CryoSat-2
- development of a consistent multi-mission sea-ice freeboard processor
- optimization of freeboard-to-thickness conversion
- development of an Antarctic SIT product
- development of an operational system for SIT ECV production

Issues: bridging different altimeters, penetration depth, snow cover, melt season,

Sea ice drift as ECV

- obtain analyze user requirements
- intercompare algorithms in a Round-Robin exercise, and document the best of these for future ice drift ECV
- estimate uncertainties for the selected algorithm;
- to prepare for upcoming satellite and sensors;



Ref. IPCC AR5, 2013

Scientific climate topics in the Polar regions

- Changing sea ice (reduced extent and thickness) has impact on climate at lower latitudes
- Why is the Antarctic sea ice extent increasing ?
- Interaction between marine terminating glaciers and sea ice: less sea ice leads to more calving ?
- Dynamic topography in the Arctic Ocean- > effect on ocean circulation and sea ice motion
- Radiation (cloud cover) effect on melting/freezing
- Marine ecosystems dependency on sea ice
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