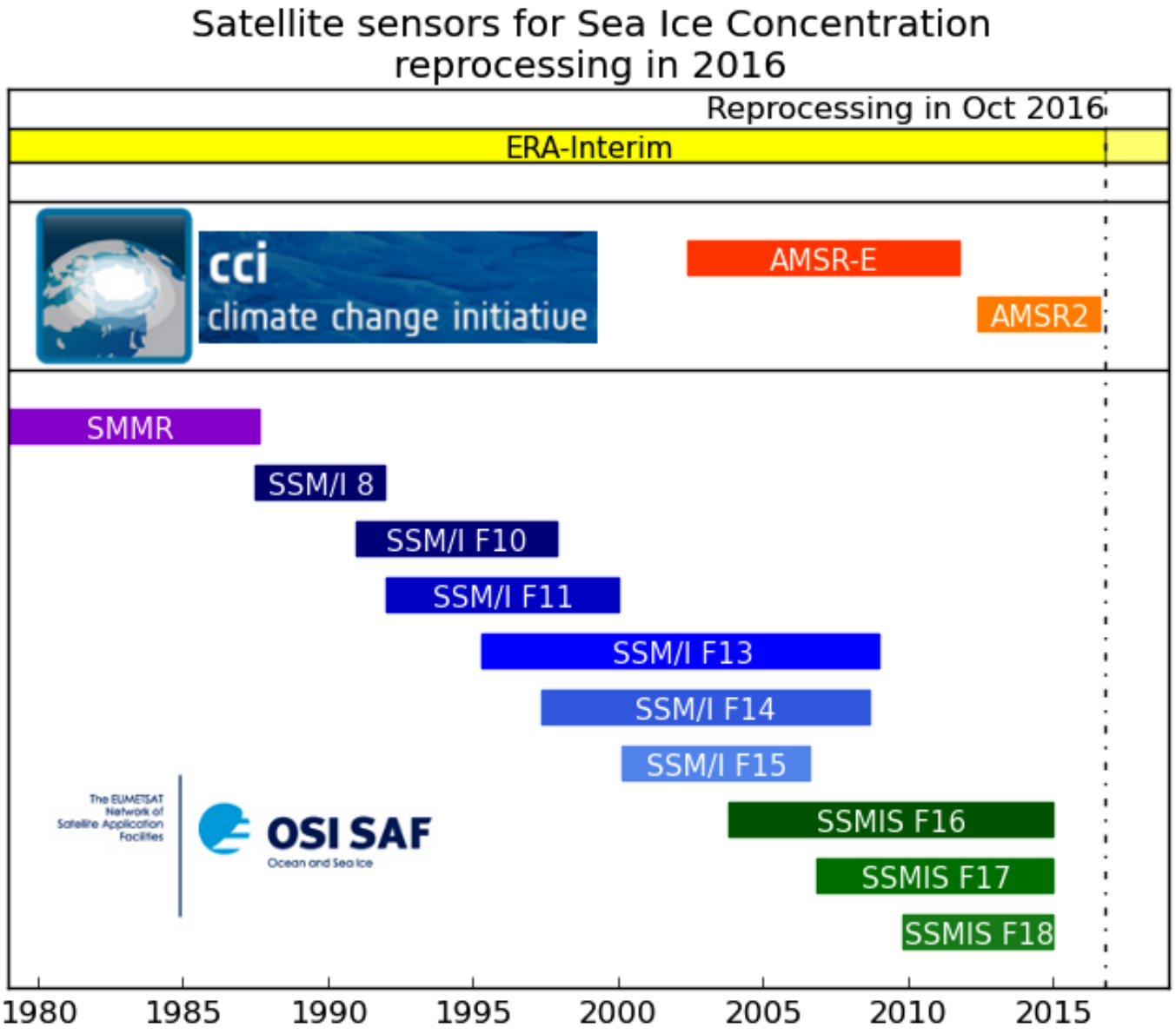
CCI Sea Ice project status

CMUG meeting

13-14 Feb 2017

Sea ice concentration CDR datasets



Three CDR data sets from ESA CCI:
AMSR-E 2002-2010
+
AMSR2 2012-2015

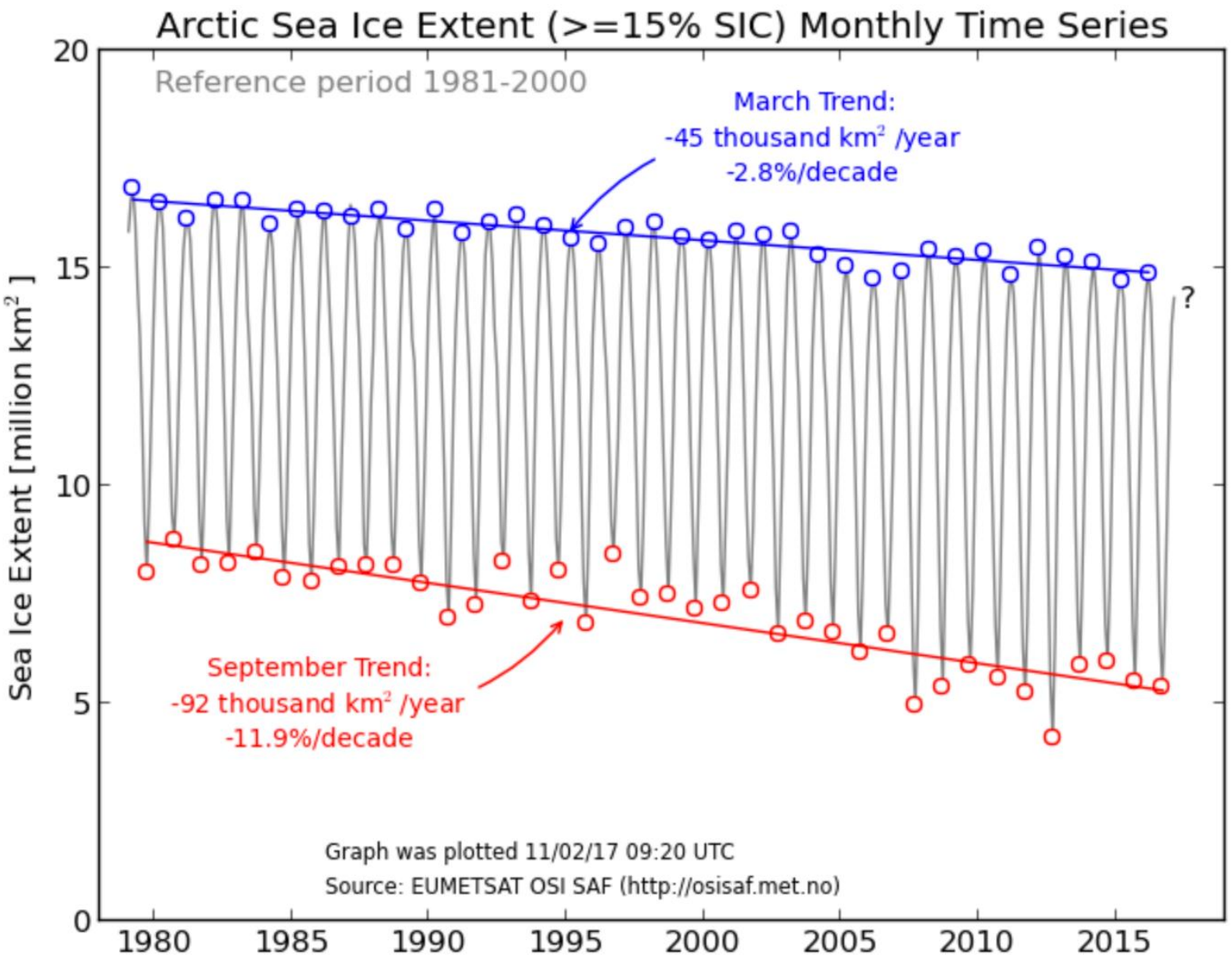
One CDR data set from OSI SAF based on merged data from SMMR, SSM/I and SSMIS 1979-2015

Sea ice concentration from 4 CDRs,
including merged time series from SMMR, SSM/I and SSMIS

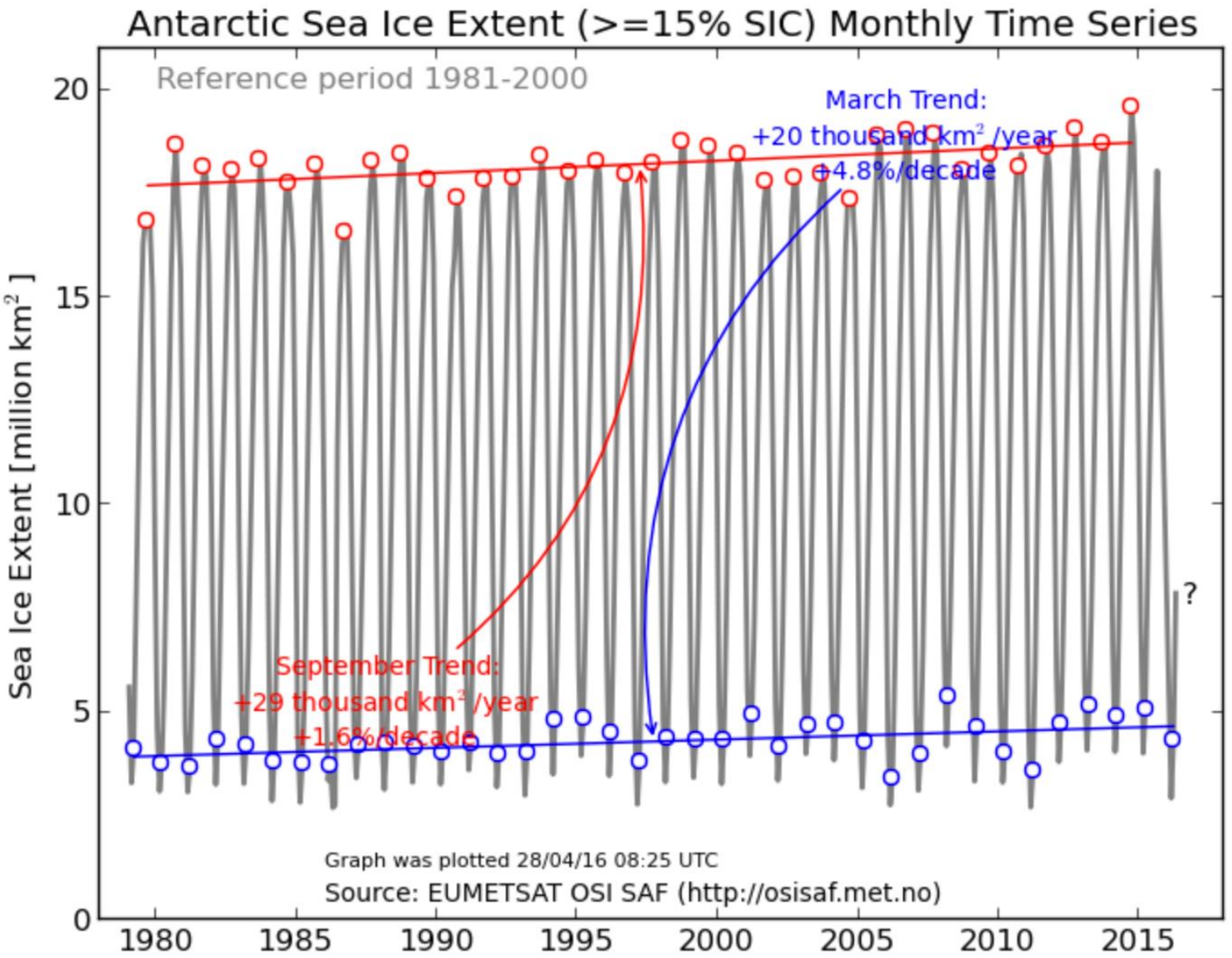
CDR	Algorithm / Channels	Instruments	Period	Grid resolution	Project
OSI-450	(19v,37v,37h)	SMMR SSM/I SSMIS	1979-2015	25x25 km	OSI SAF
SICCI2 25.0km	(18v,36v,36h)	AMSR-E AMSR2	2002-2011 2012-2015	25x25 km	sea ice cci
SICCI2 50.0km	(06v,36v,36h)	AMSR-E AMSR2	2002-2011 2012-2015	50x50 km	sea ice cci
SICCI2 12.5km	(18v,89v,89h)	AMSR-E AMSR2	2002-2011 2012-2015	12.5x12.5 km	sea ice cci

Processing plan for **4 new SIC CDRs** using the dynamic algorithms (developped in ESA CCI project) and taking advantage of «all» instruments and channels. All CDRs are global.

Arctic sea ice extent 1979 - present



Antarctic sea ice extent 1979 - present



Sea Ice Concentration from 3 CDRs
based on AMSR-E and AMSR2

- In Phase 2, the SICCI project worked on **three** SIC CDRs, all based on AMSR-E (2002-2010) and AMSR2 (2012-today) data:
  - The CCI SIC 50.0km CDR;
  - The CCI SIC 25.0km CDR;

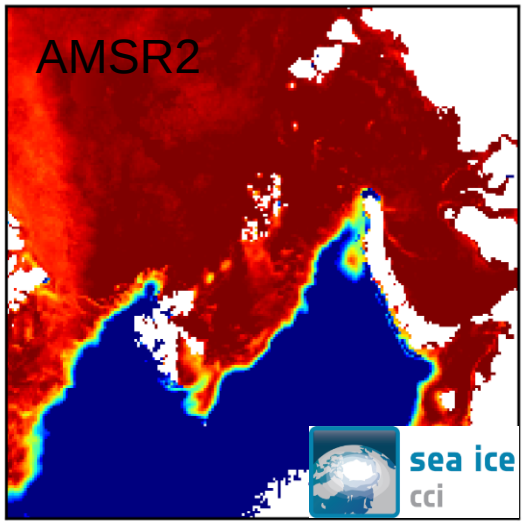
  } Release Feb 2017

  - The CCI SIC 12.5km CDR. → Requires more assessment

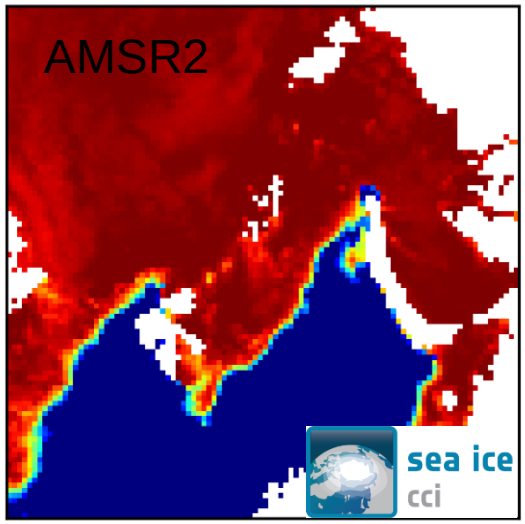
- The three are global, with new algorithms, with maps of uncertainties.
- Each use different imaging channels of the AMSR sensors
- The production is coordinated with OSISAF.

Simultaneous snapshots of 4 SIC products

CCI 12.5km



CCI 25.0km



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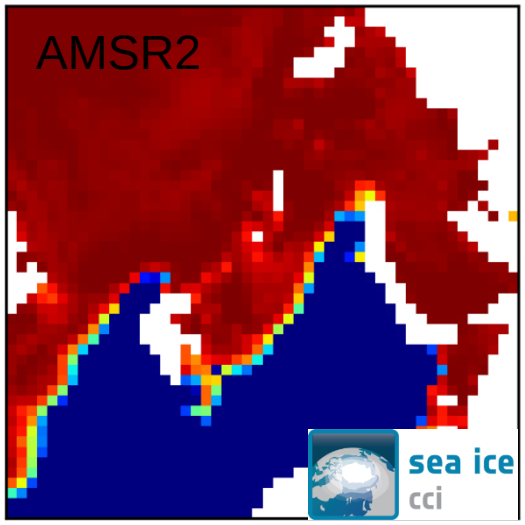
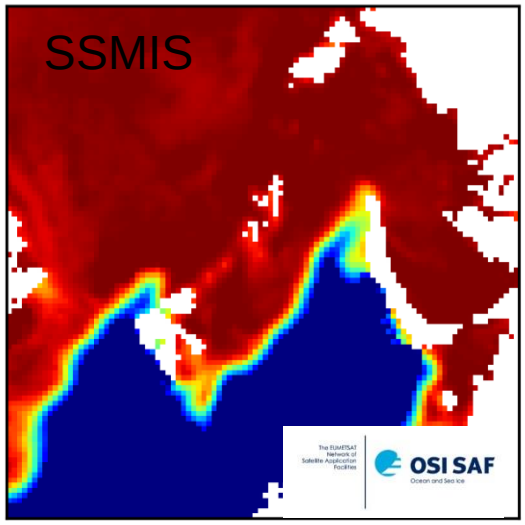
CCI 50.0km



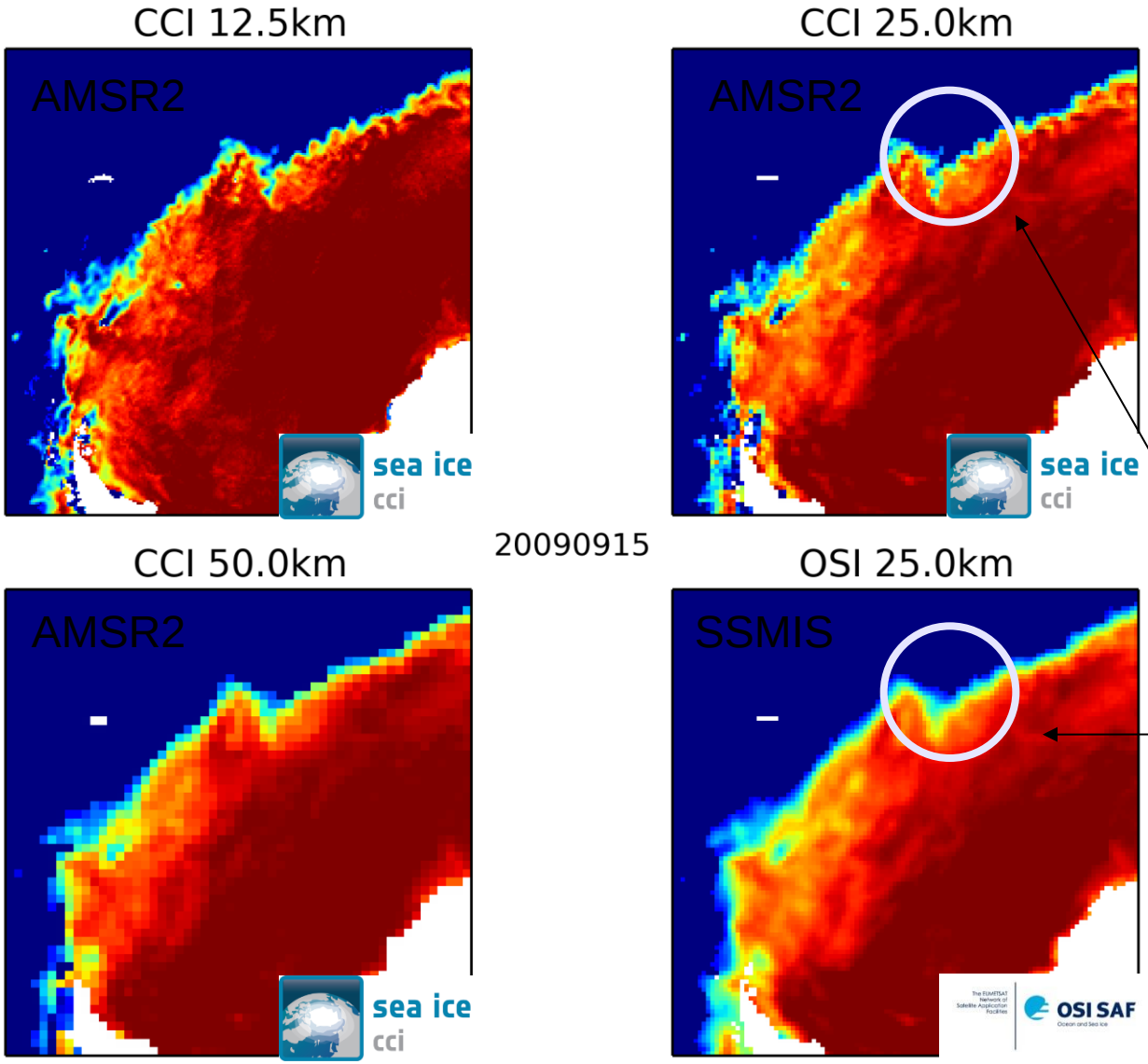
OSI 25.0km



Example maps from the 3 AMSR2 (CCI) and the SSMIS (OSI) CDRs on 15th March 2013.

The maps from AMSR2 exhibit more details along the ice edge, except that at 50km using 6 GHz.

Simultaneous snapshots from MIZ in Sept

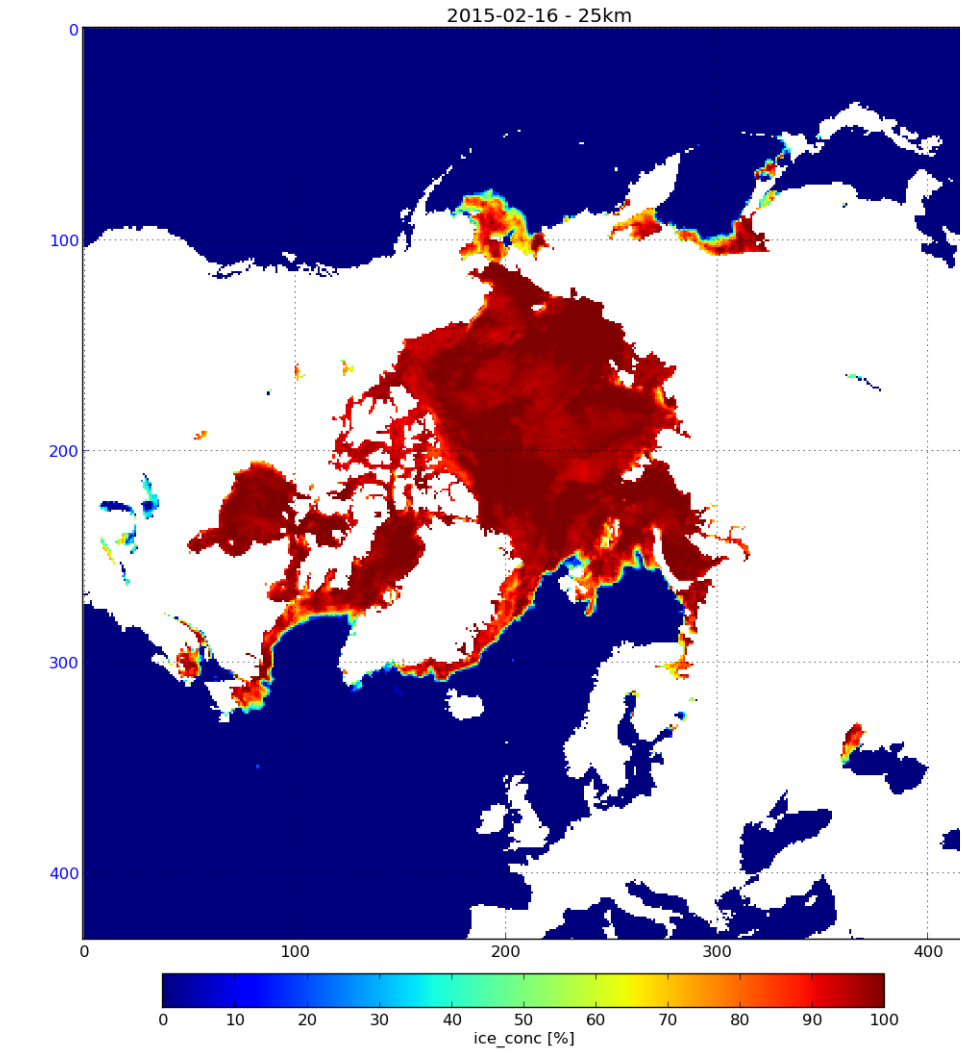


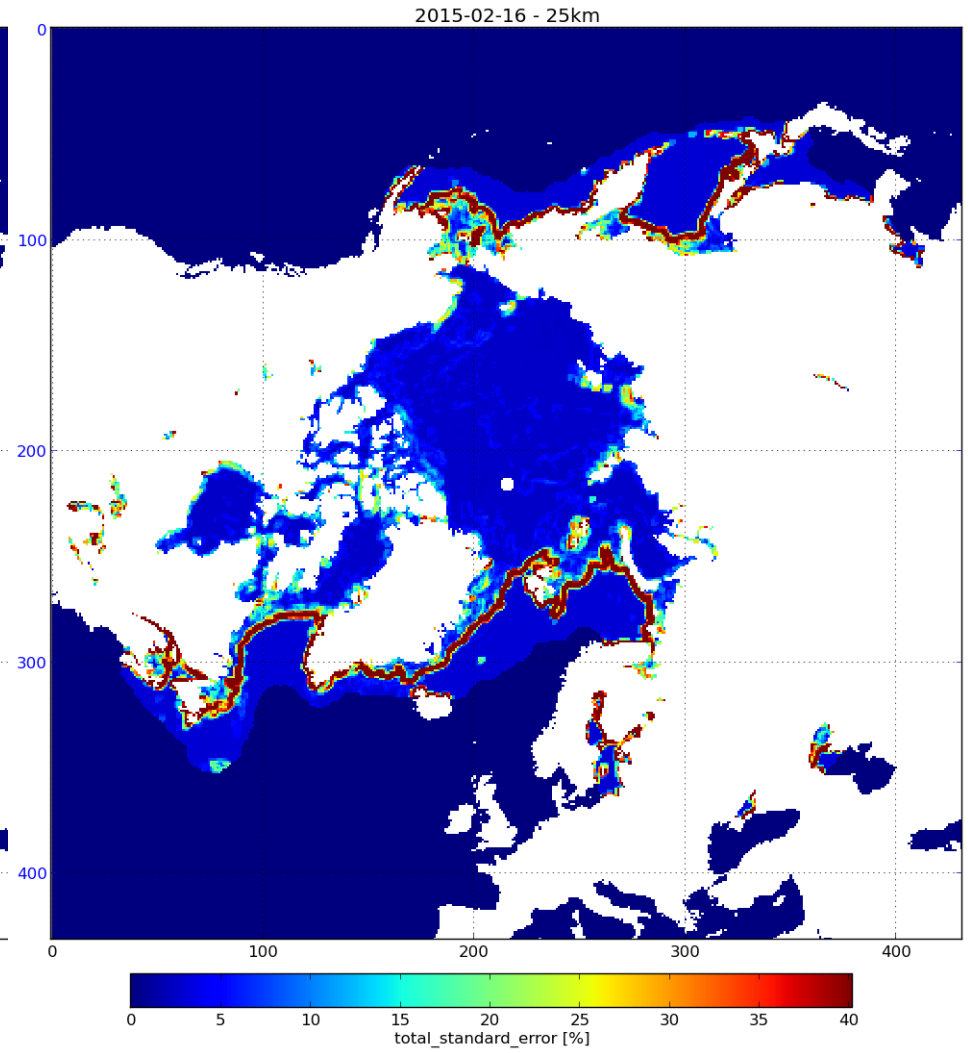
Example maps from the 3 AMSRE (CCI) and the SSM/I (OSI) CDRs on 15th Sept 2009.

The maps from AMSRE exhibit more details along the ice edge, except that at 50km using 6 GHz.

Much finer Marginal Ice Zone details with CCI data.

Uncertainty estimate for each pixel





Strengths of CCI SIC CDRs in Phase2

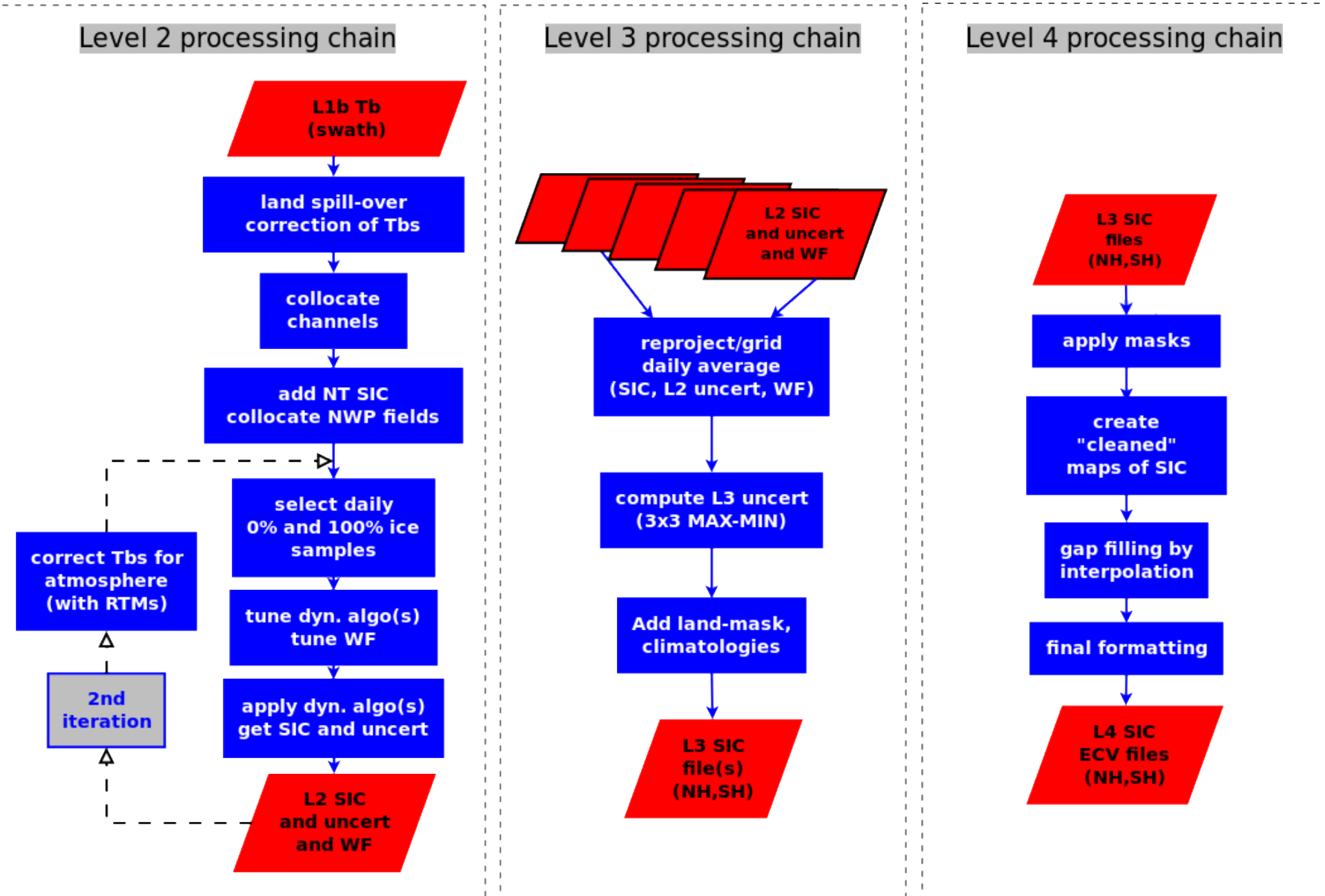
- Exploit the AMSR-E and AMSR2 capabilities : low noise, higher spatial resolution, 9+2,5 years (potentially extending to present day).
- New R&D from Phase 1 and 2 (new SIC algorithms, new filters, better uncertainties,...);
- Coordinated with OSISAF (1979-2015) data record: same algorithm, same grid/projection, same land-mask, same file format,...
- Holds both a “clean” filtered SIC, and possibility to un-apply some filters for advanced users.

First evaluation results

CDR	Open Water (SIC=0%)			Sea Ice (SIC=100%)		
	Accuracy	Precision	Error	Accuracy	Precision	Error
SICCI2 25.0km NH	0.1%	1.7%	2.4%	-3.4%	5.2%	3.9%
SICCI2 50.0km NH	0.0%	1.3%	1.7%	-1.8%	4.1%	3.2%
SICCI2 25.0km SH	0.0%	1.3%	2.1%	-1.3%	4.1%	3.8%
SICCI2 50.0km SH	-0.2%	1.1%	1.6%	-0.5%	2.7%	3.3%

- Evaluation covers ALL SEASONS & entire period (2002-2015)
- Above figures INCLUDE melt season

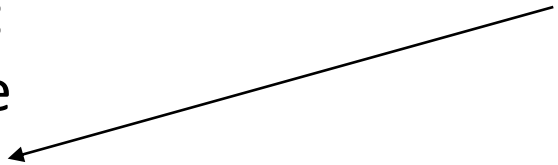
Processing chain for SIC



File format for all SIC CDRs

- netCDF4 / CF-1.6 / ACDD-1.3

- Inside the files:
  - lat/lon/time
  - ice_conc
  - raw_ice_conc_values
  - total_standard_error
  - smearing_standard_error
  - algorithm_standard_error
  - status_flag

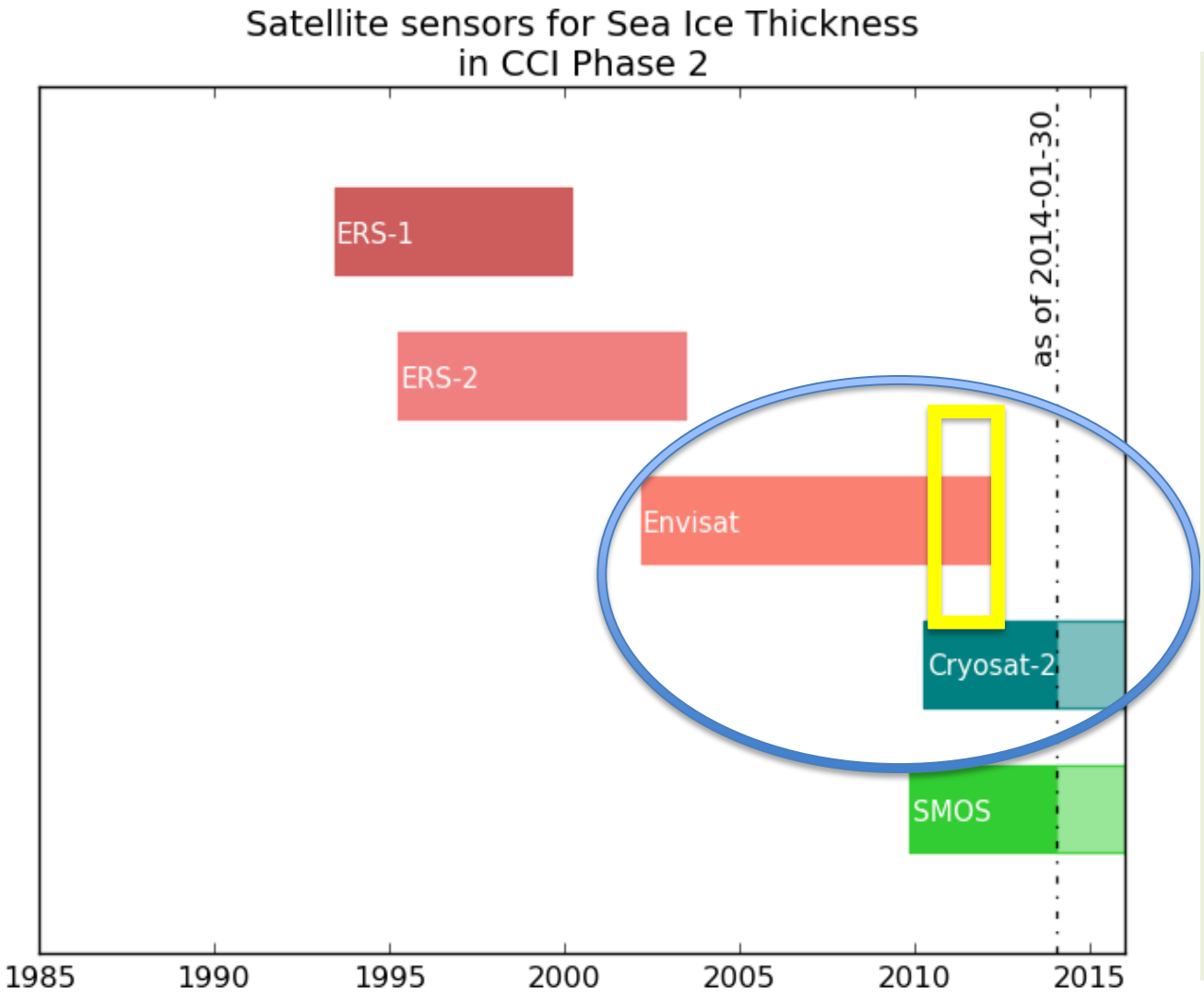


«clean» maps, with all filters applied

the original values, prior to filtering

Maps of uncertainties (total and its components)

Sea ice thickness CDR datasets



Goal:
Provide consistent data sets of (a) freeboard and (b) thickness from ENVISAT and CryoSat2

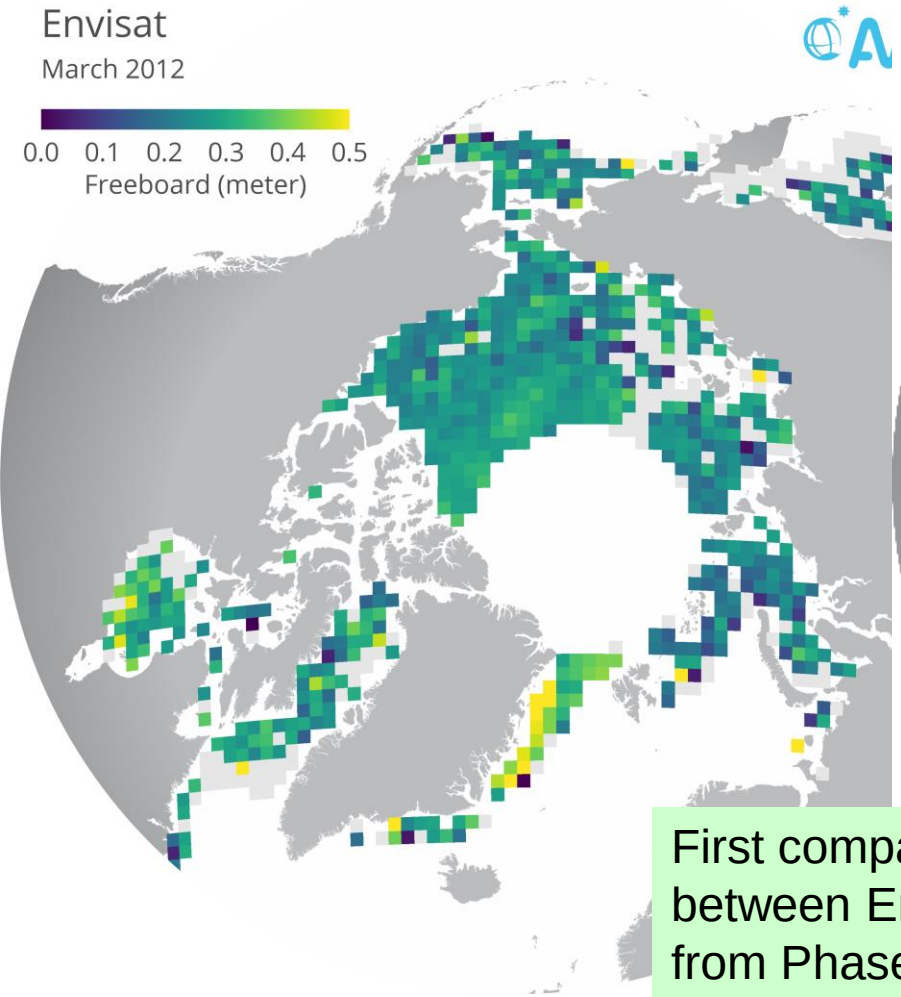
Key task:
Use the overlap period to develop consistency

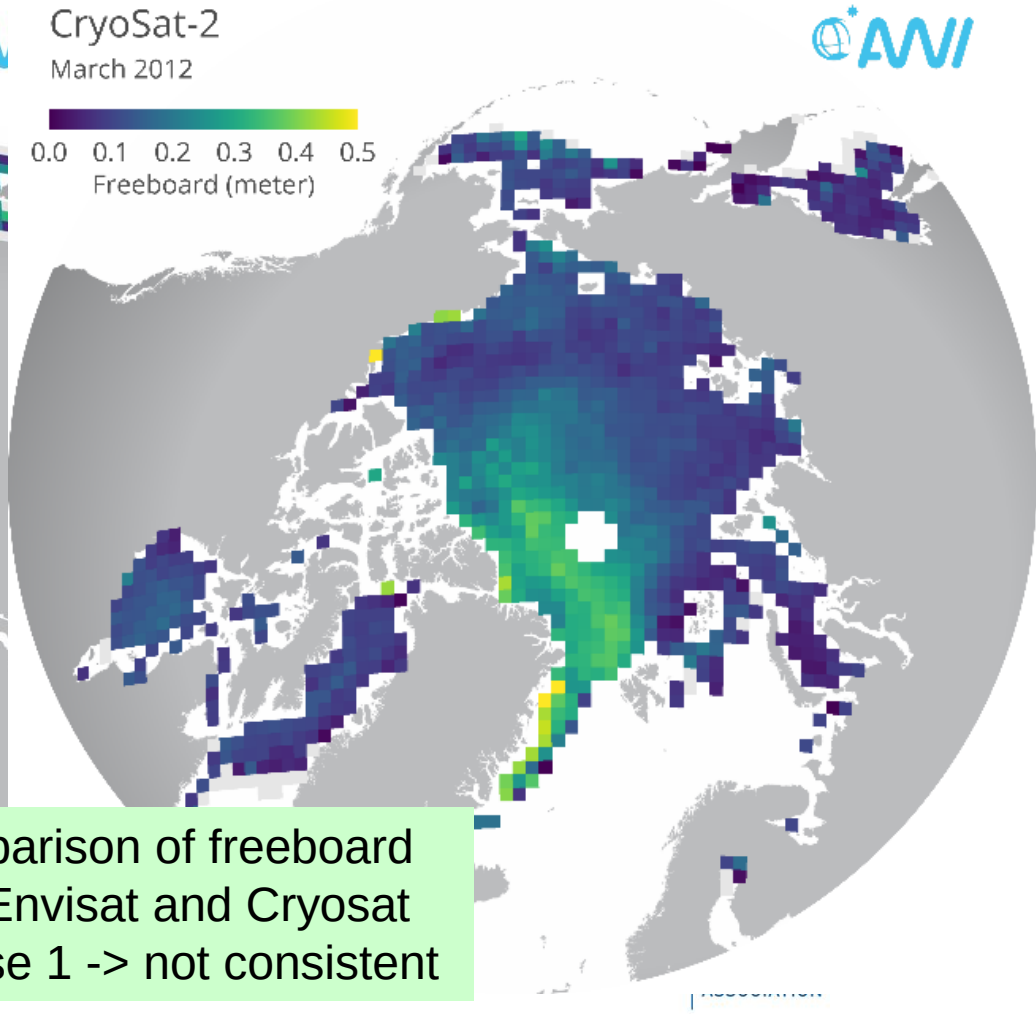
Develop a common processor for ENVISAT, ERS, Cryosat-2 (and other satellites

Still issues with ERS data

Freeboard from ENVISAT and Cryosat-2 in March 2012

ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG





First comparison of freeboard between Envisat and Cryosat from Phase 1 -> not consistent

Valid waveform fraction from ENVISAT and Cryosat-2

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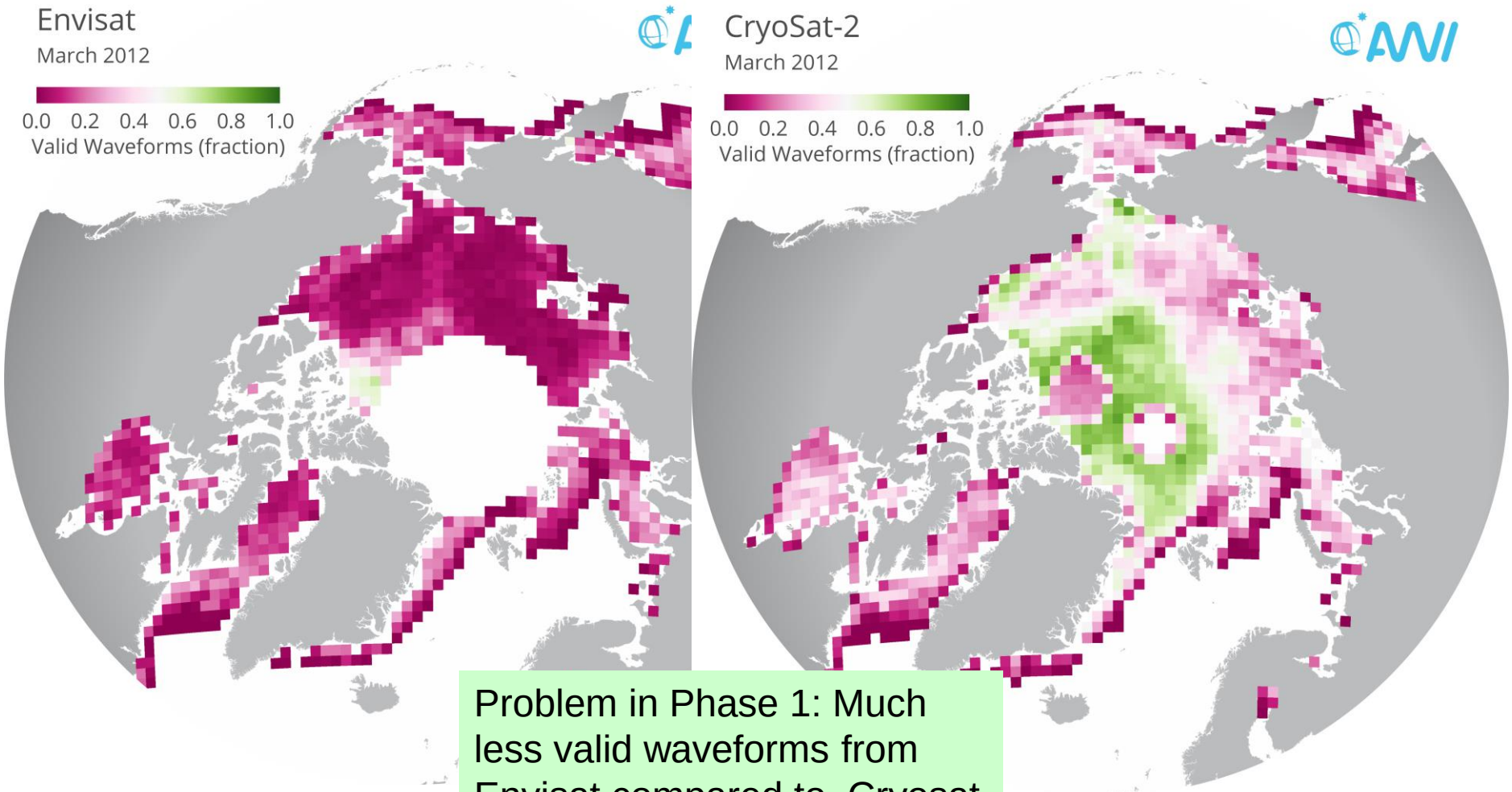
HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG



Problem in Phase 1: Much less valid waveforms from Envisat compared to Cryosat

Implementation of a unified ice freebaord and thickness processor

SIT production systems in Phase 1

Separate processing chains for CryoSat-2 (AWI IDL-based cs2awi) and Envisat (FMI python based SICCI1)

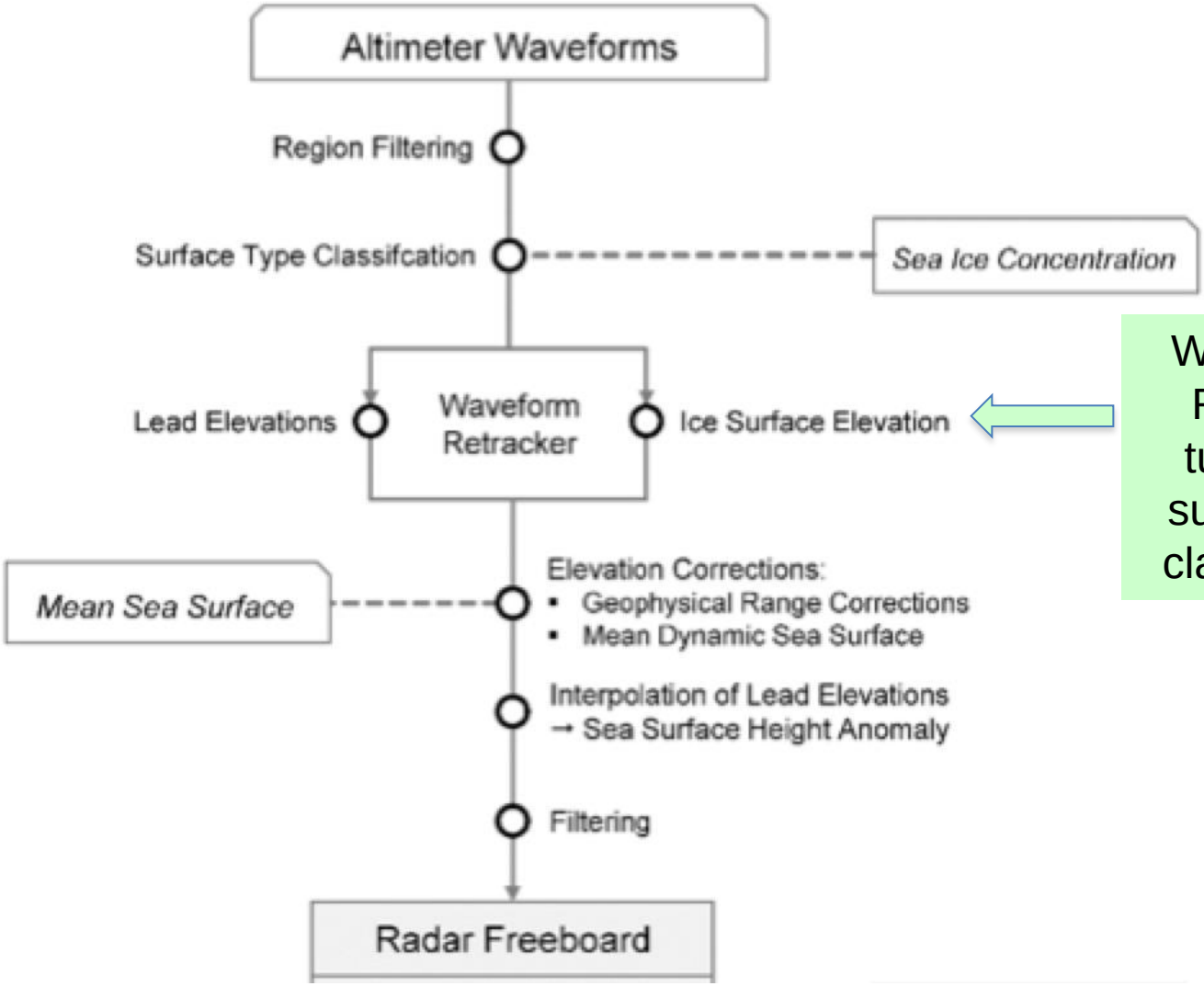
SIT production system for SICCI-2

Unified code base (python) for processing of all radar altimeter data.

Required a complete re-implementation of cs2awi / SICCI1

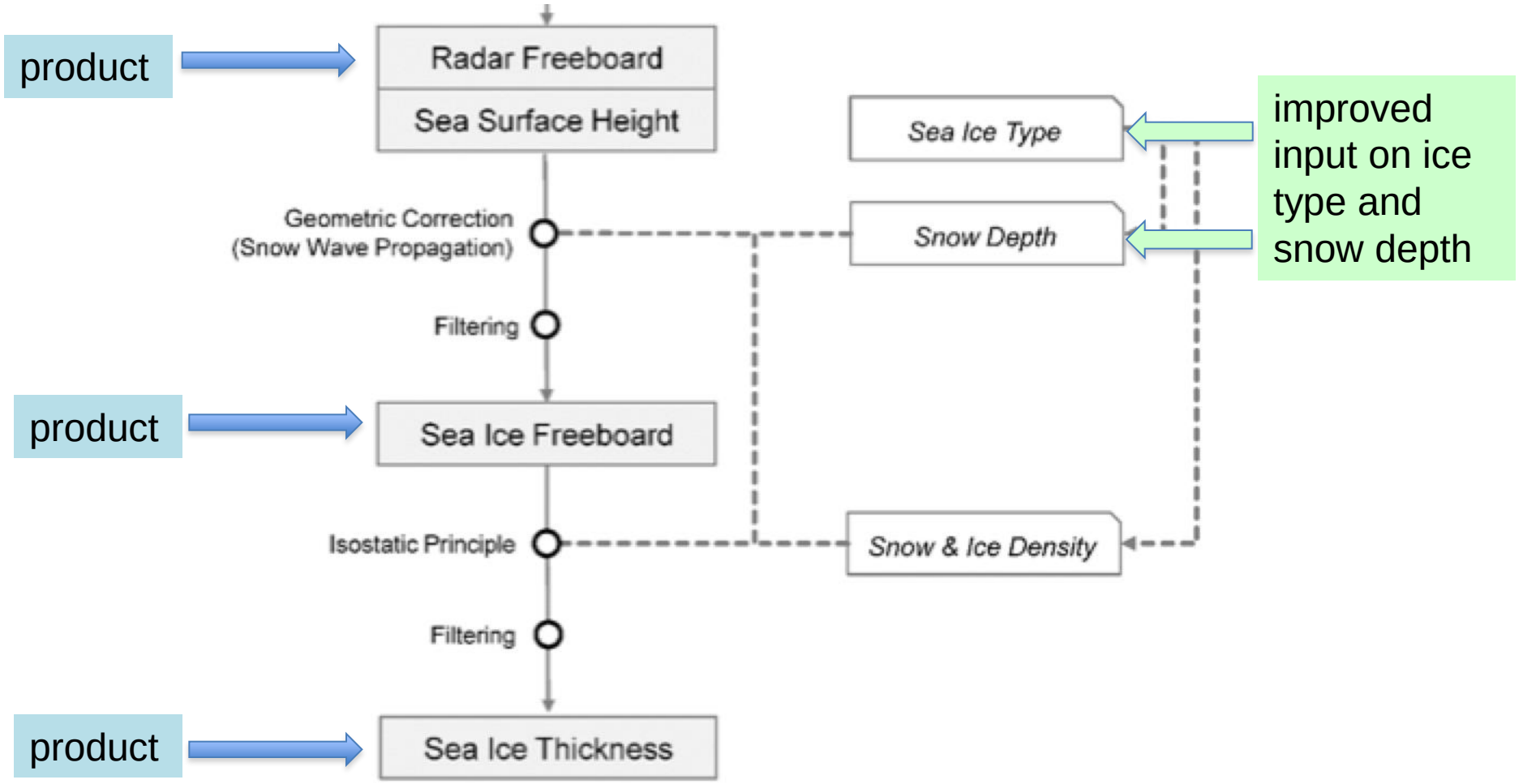
- ***pysiral -*** **PY**thon **S**ea **I**ce **R**adar **AL**timetry software library

The algorithm – part 1: from waveform to radar freeboard



Work focus: Retracker tuning and surface type classification

The algorithm – part 2: from radar freeboard sea ice freeboard and thickness



New Arctic MYI Concentrations

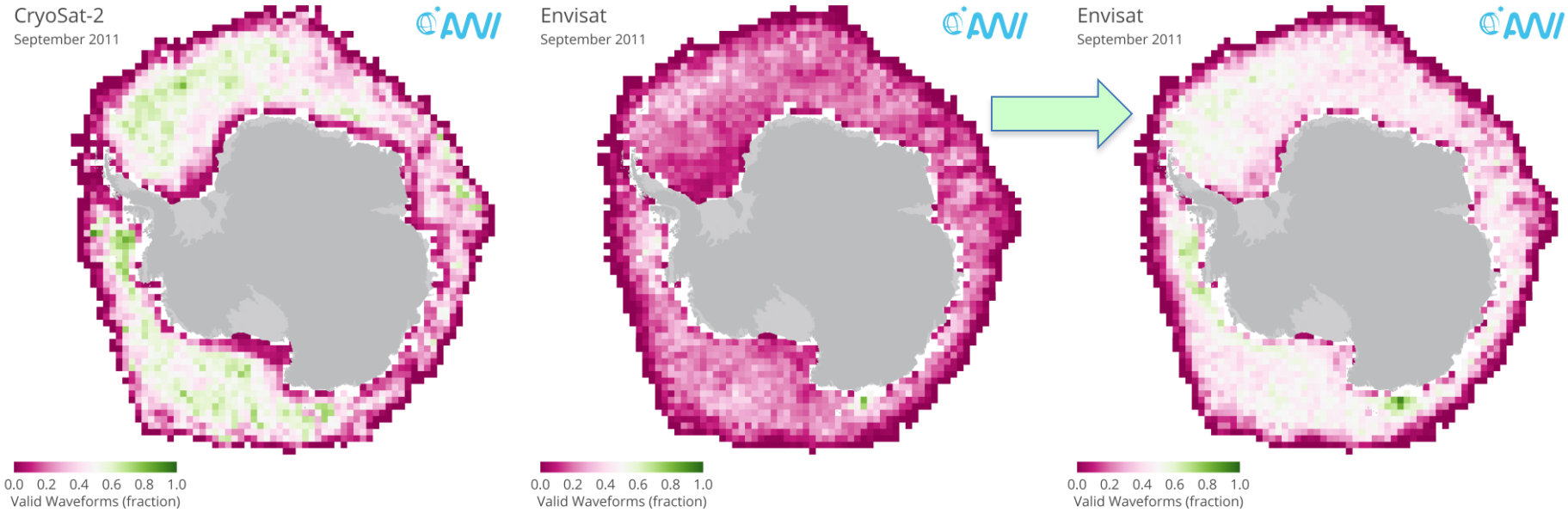
Improved MYI concentration includes improved snow climatology

Provided by S. Kern

Improved Surface Type Classification

- While optimized for the Arctic, this also improved the Antarctic results:

Valid waveform fraction for ENVISAT has been increased



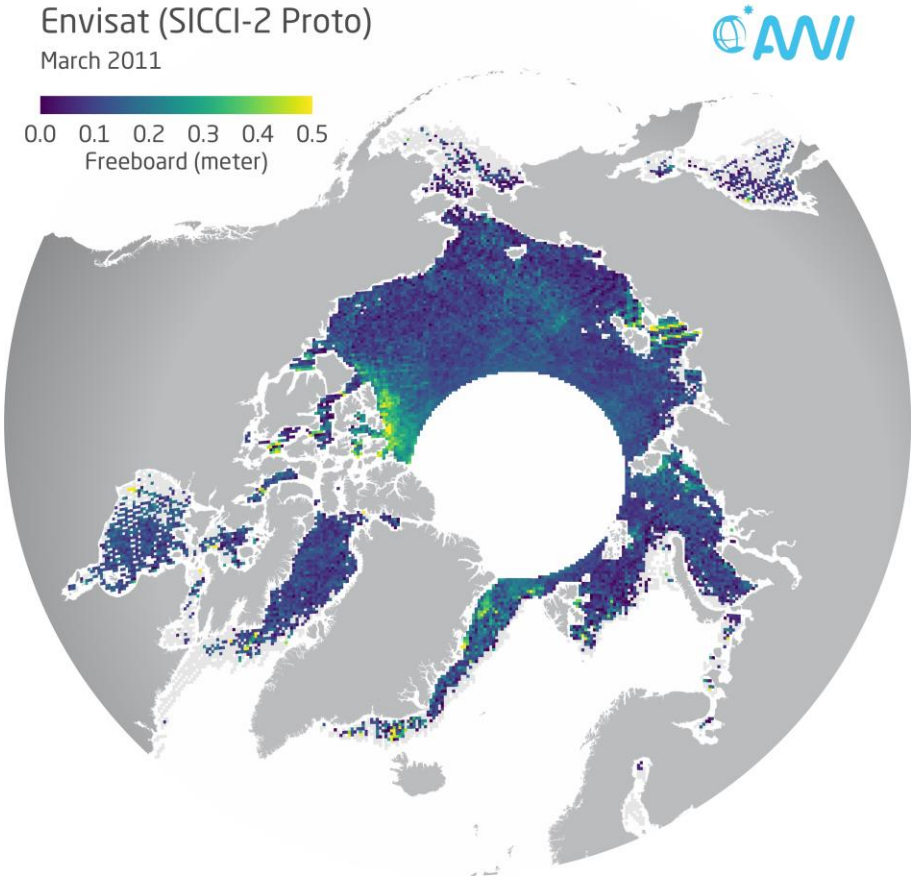
Cryosat-2 Reference

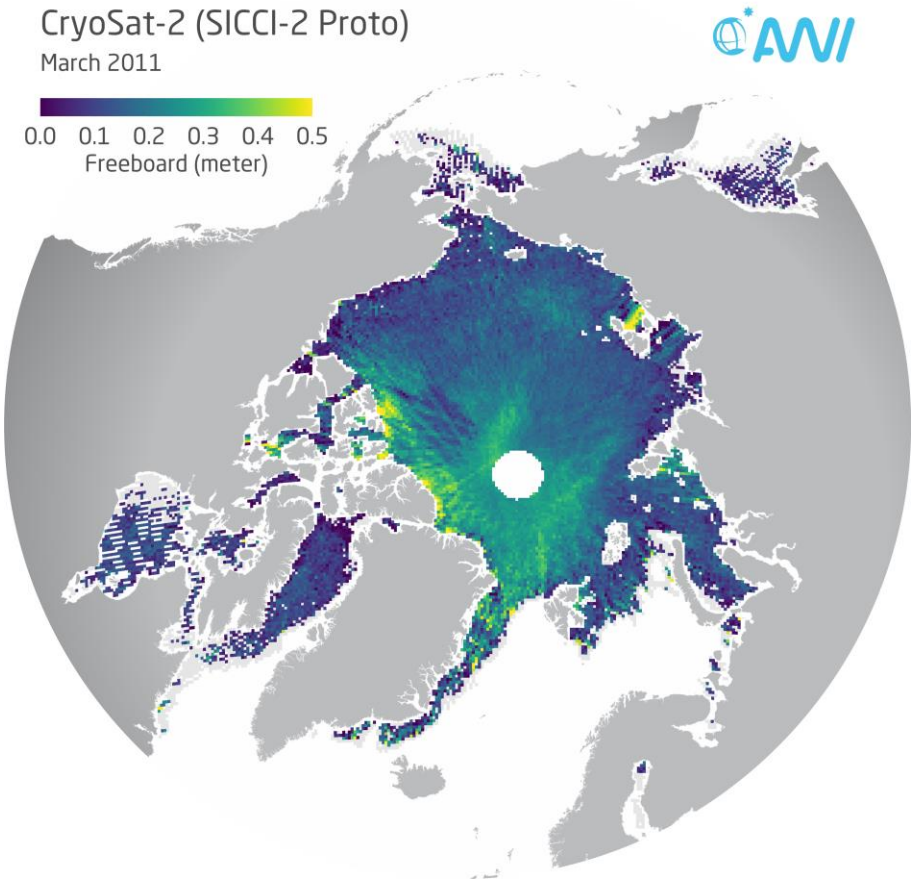
ENVISAT SICCI1

ENVISAT SICCI2

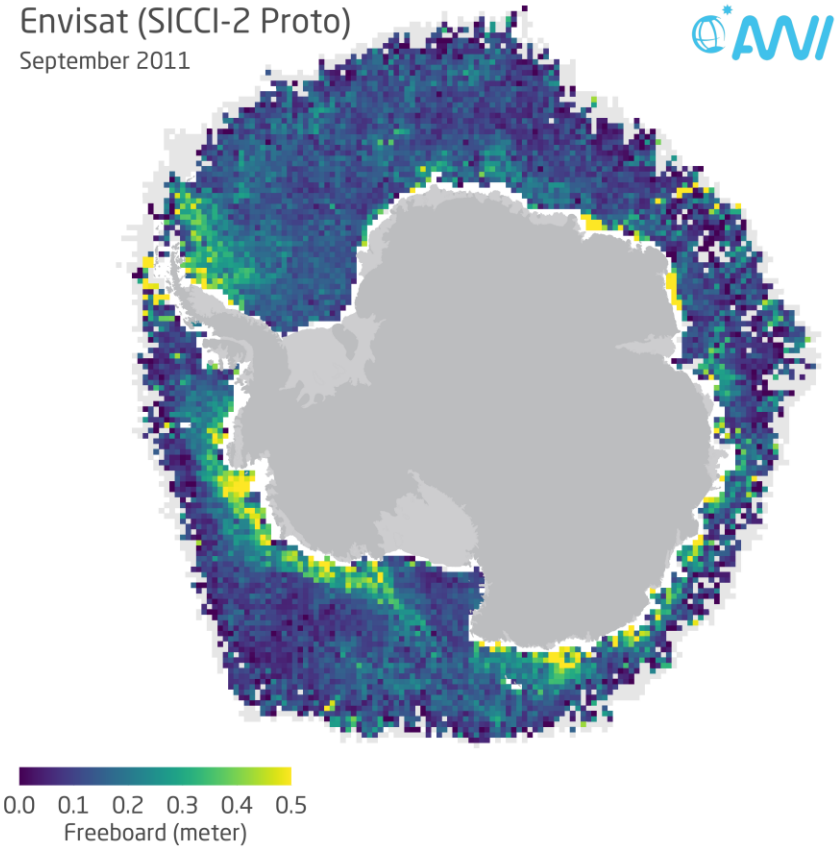
HELMHOLTZ ASSOCIATION

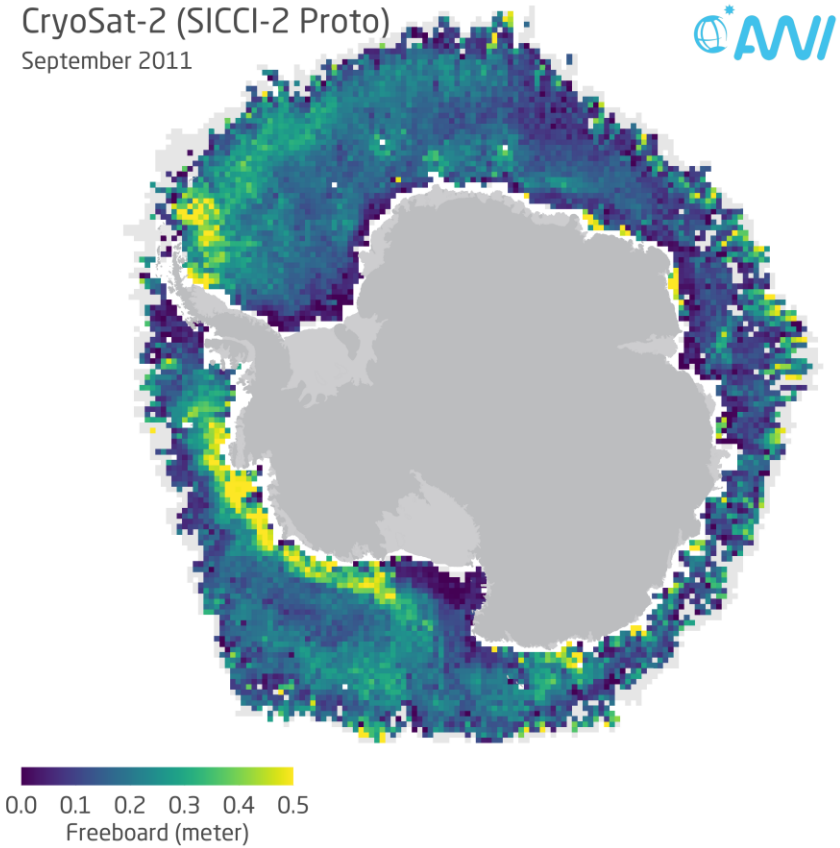
Consistent freeboard in the Arctic



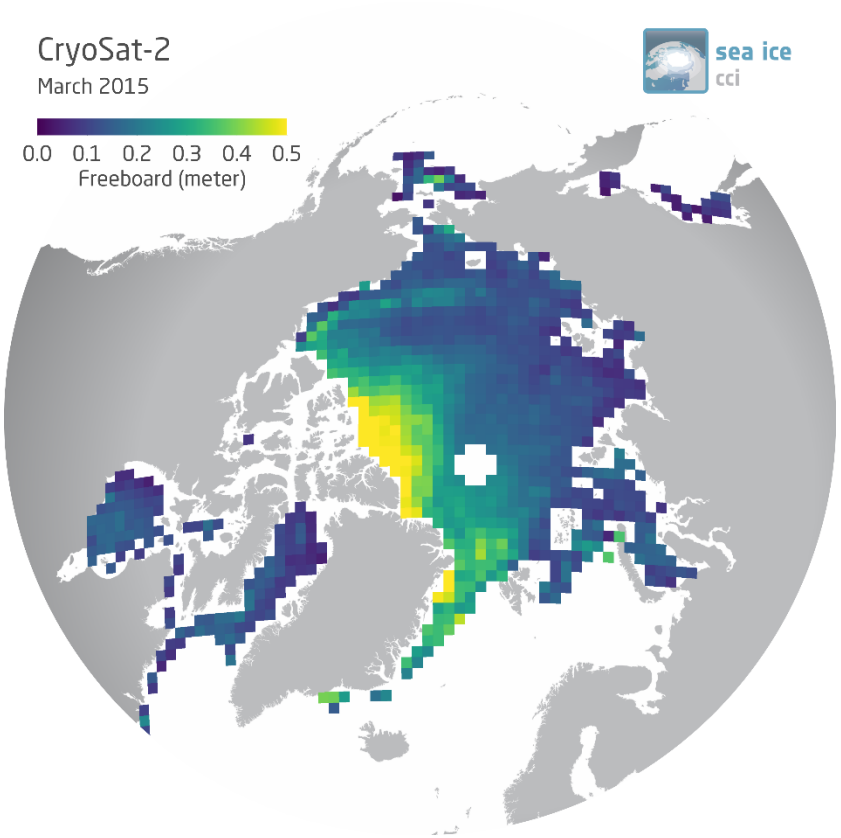


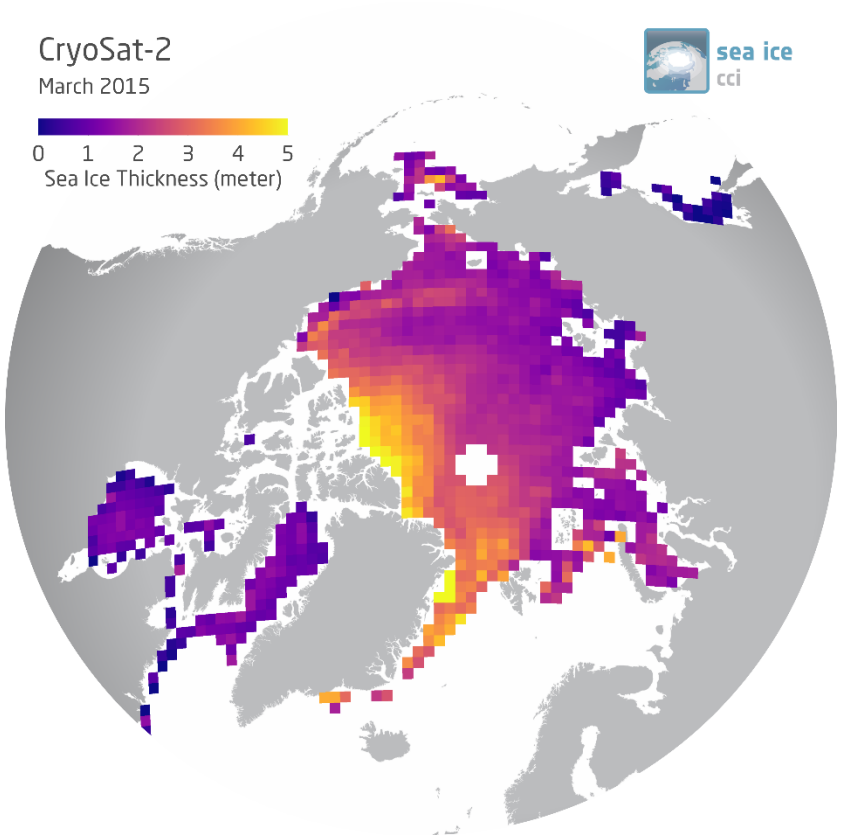
Freeboard Antrctic





Last step: from freeboard to thickness





Status of the processing system

L1B Pre-Processing	ERS-1/2	Envisat	CryoSat-2	Sentinel-3A
L2-Processing	ERS-1/2	Envisat	CryoSat-2	Sentinel-3A
L3 Processing	ERS-1/2	Envisat	CryoSat-2	Sentinel-3A
L2 Parameter	Freeboard(s)	Thickness	MSS/SSA	Snow Depth
	SIC	MYI Fraction	Surface Type	Elevation
	Densities			
L3 Parameter	L2 Parameter	Grid Cell Statistics		
Retracker	TFMRA	OCOG	Giles07	
SIC	OSI-SAF	Ifremer	SICCI SIC	
SIType (MYI Fraction)	OSI-SAF	MYI Default	SICCI MYI Fraction	
Surface Type Class.	cs2awi	SICCI-1		
Snow Depth	Warren99	Fixed	UIP Passive MW	
Snow & Ice Densities	Warren99 (Snow)	Fixed (FYI/MYI)		
MSS	DTU10-15			
SSH Interpolation	cs2awi			
Geometric Correction	Snow Wavespeed			
Freeboard to Thickness	Sea Ice Freeboard	Penetr. Corr ?		
Uncertainties	SICCI-2			
Filter	Valid Freeboard	Valid Thickness		
Output	L1b (pre)	L2i	L2p	L3s
System Tests	L1b Pre Processing	L2 Processing	L3 Processing	Tools