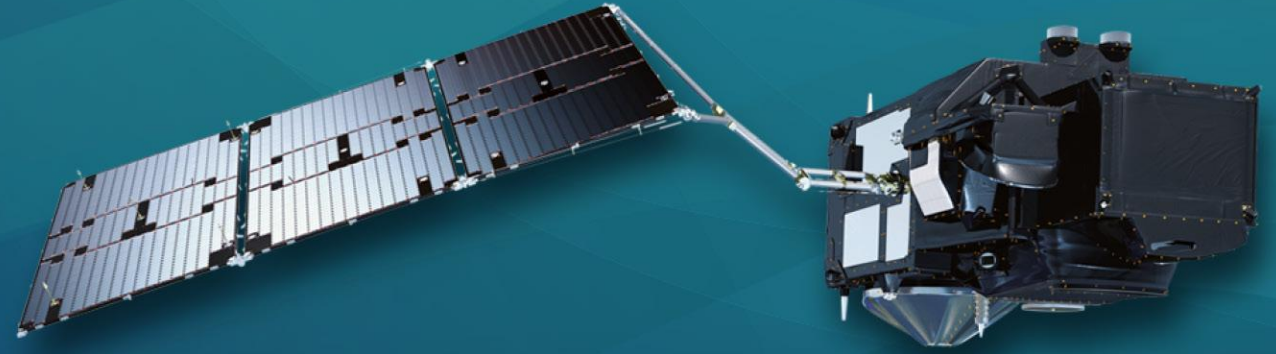




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# 9<sup>th</sup> Sentinel-3 Validation Team meeting 2026

30 March–01 April 2026 | ESA–ESRIN | Frascati (Rome), Italy

## Assessment of the new Sentinel-3 BC006.02: Part 2: polar ocean performance

*F. Nencioli<sup>1</sup>, L. Rinchuso<sup>1</sup>, C. Durand<sup>1</sup>, B. Lucas<sup>2</sup>, S. Dinardo<sup>2</sup> and C. Nogueira-Loddo<sup>2</sup>*

<sup>1</sup>*Collecte Localisation Satellites*

<sup>2</sup>*EUMETSAT*



## CalVal Analysis

- BC006.2 dataset from mid 2020 to mid 2022
- 20 Hz for open ocean
- Focus on key variables (Leads, SSHA)
- Comparison vs reference missions (CryoTEMPO and AltiKa)
- Comparison vs in-situ (not shown here!)

# 1. Leads



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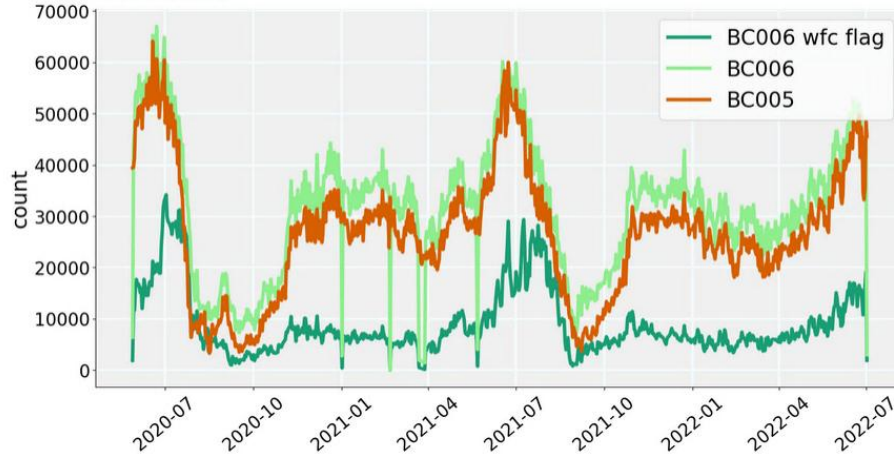


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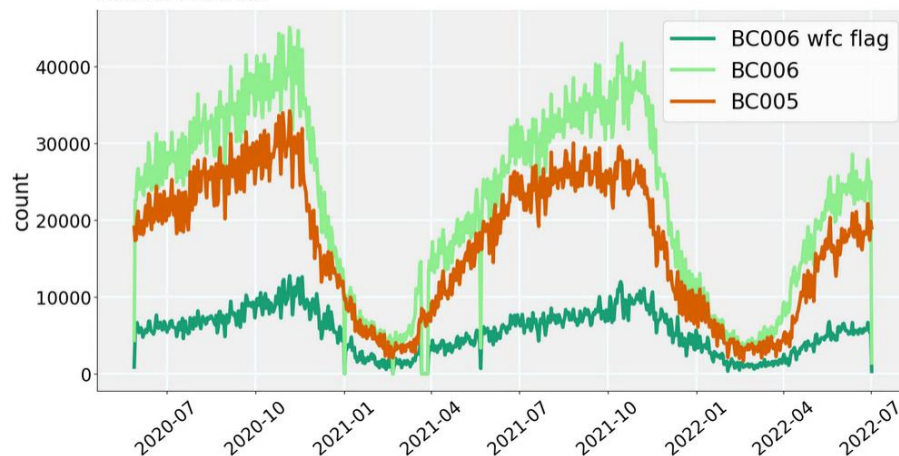
## S3A Daily number of leads observations

Arctic Ocean

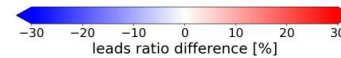
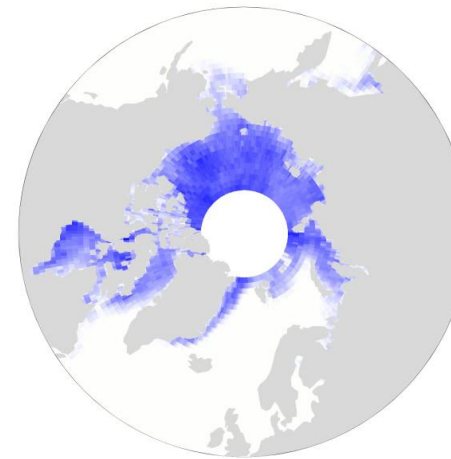


## S3A Daily number of leads observations

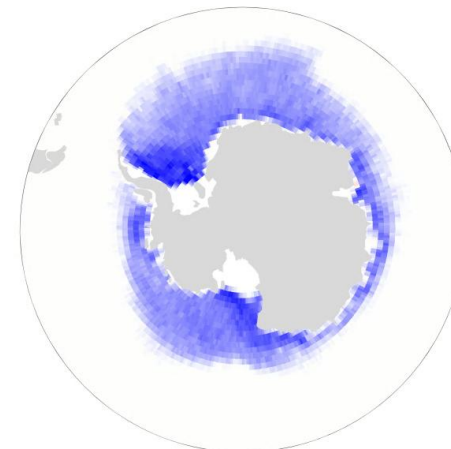
Southern Ocean



BC006 - BC005 mean leads ratio differences



BC006 - BC005 mean leads ratio differences



- Detection based on **Neural Network Waveform Classification**
- More conservative lead detection in BC006
- The periodic behavior is maintained
  
- About 20% less leads in new PB in the Arctic
- About 15% less leads in new PB in the Antarctic



## Surface Classification Flag

[copernicus.eumetsat.int](http://copernicus.eumetsat.int)

- Updated *recipe* with respect to preliminary TDS, based on internal EUM R&D activities
- Using outputs of Neural Network, but also using SIC and Peakiness and Sig0

Surface Type	Value	SIC	Sigma0	NN rank 1	NN rank 2	Peakiness
Ocean	0	[0,30]	$\forall$	$\in \{1,17\}$	$\forall$	$\forall$
Ocean, unsure	4	[0,30]	$\leq 28$	$\in \{5,6\}$	$\in \{1,17\}$	$\leq 8$
Leads	2	$> 30$	$\forall$	$\in \{2\}$	$\forall$	$\forall$
Leads, unsure	5	$> 30$	$> 45$	$\in \{4,7\}$	$\in \{2\}$	$> 45$
Sea ice	1	$> 30$	$\forall$	$\notin \{2,3,9,18\}$	$\forall$	$\forall$
Unclassified	3	Else				

# 1. Leads



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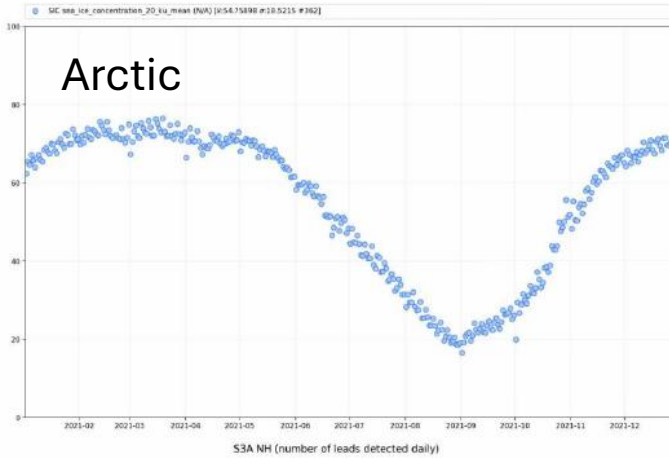
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## Number of leads detected

Daily mean SIC NH under S3A footprint - |lat| > 60



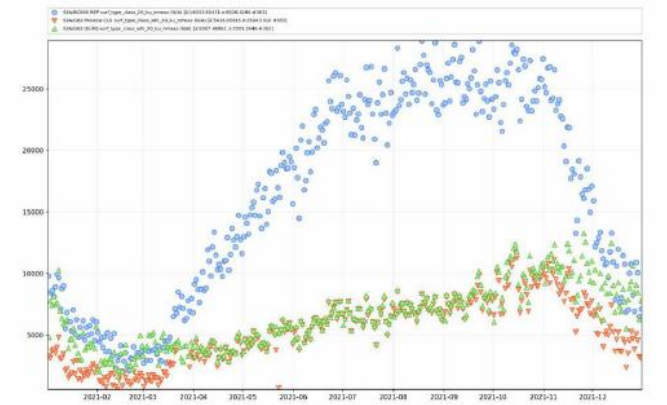
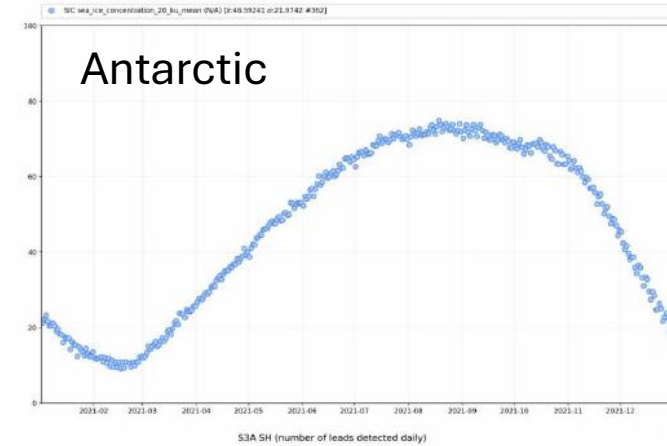
Higher number detected wrt to Preview TDS, but fundamentally the same behaviour

## Ice concentration

Differences between TDS flag and new flag as mostly linked to lower sea ice concentration periods. As the threshold is now lower.

copernicus.eumetsat.int

Daily mean SIC SH under S3A footprint - |lat| > 60



Important changes in BC006 that affect the SSHA:

- **0-padding** (expected to reduce variability)
- **Magic window** (for continuity between leads and open ocean)
- GDR-G (i.e. new MSS)

➤ **Specific SSHA variable for polar areas** in the products (used here for the CalVal)

Dedicated Corrections:

- `iono_cor_gim_20_ku` (instead of `iono_cor_alt_filtered_20_ku`)
- `gpd_wet_tropo_cor_20_ku` (or `mod_wet_tropo_cor_zero_latitude_20_ku` if it is unavailable)

## 2. SSHA: time series



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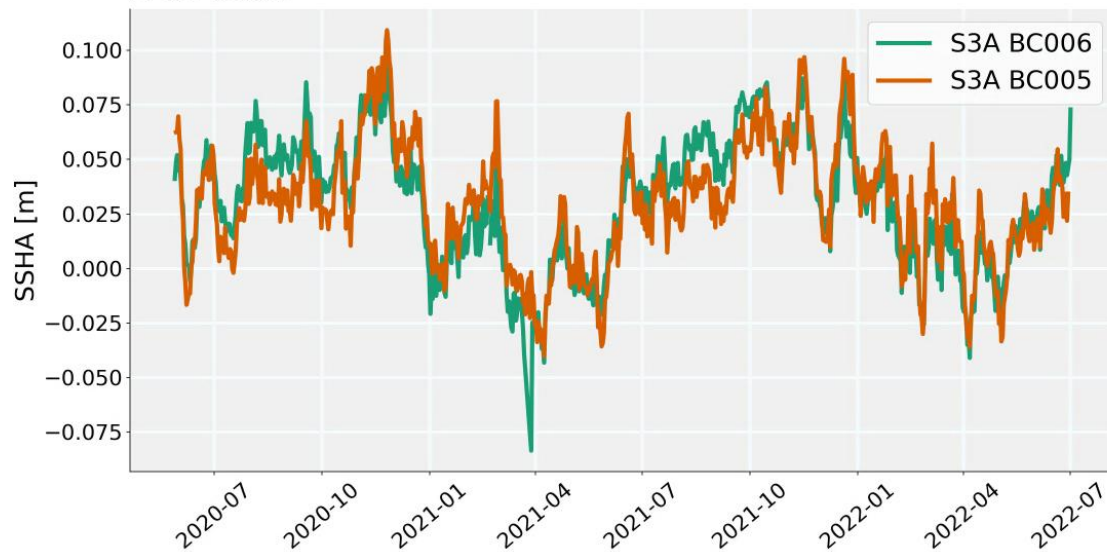
- Overall similar level of daily average SSHA (BC006 a bit lower in Southern Ocean)

BC006 mean: 3.12 cm  
BC005 mean: 3.01 cm

BC006 mean: 1.32 cm  
BC005 mean: 2.20 cm

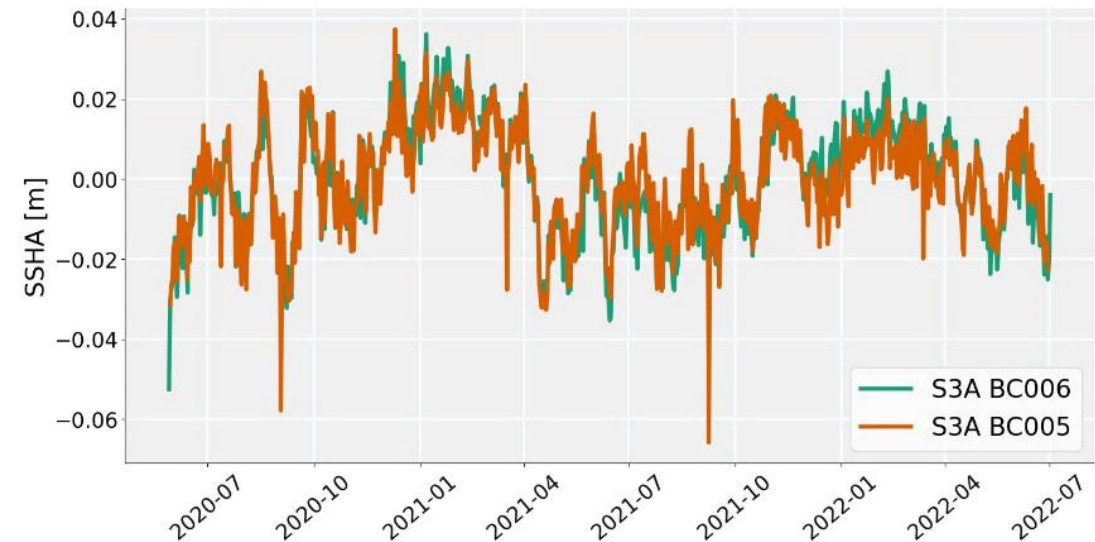
### Daily mean SSHA

Arctic Ocean



### Daily mean SSHA

Southern Ocean



## 2. SSHA: time series



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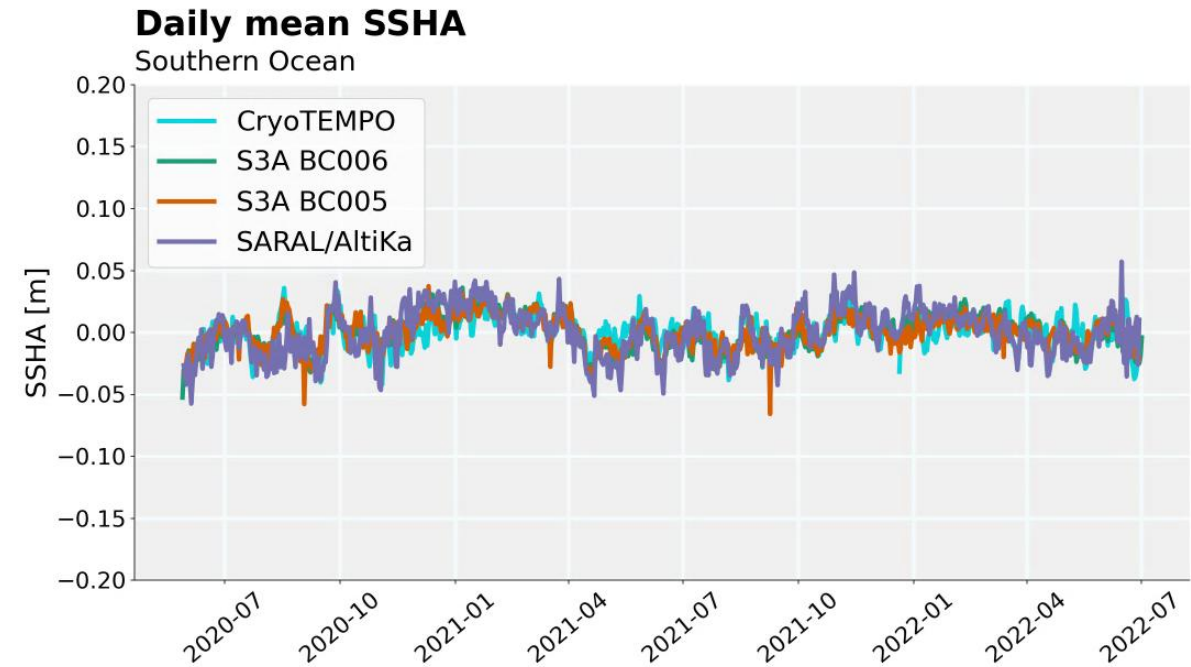
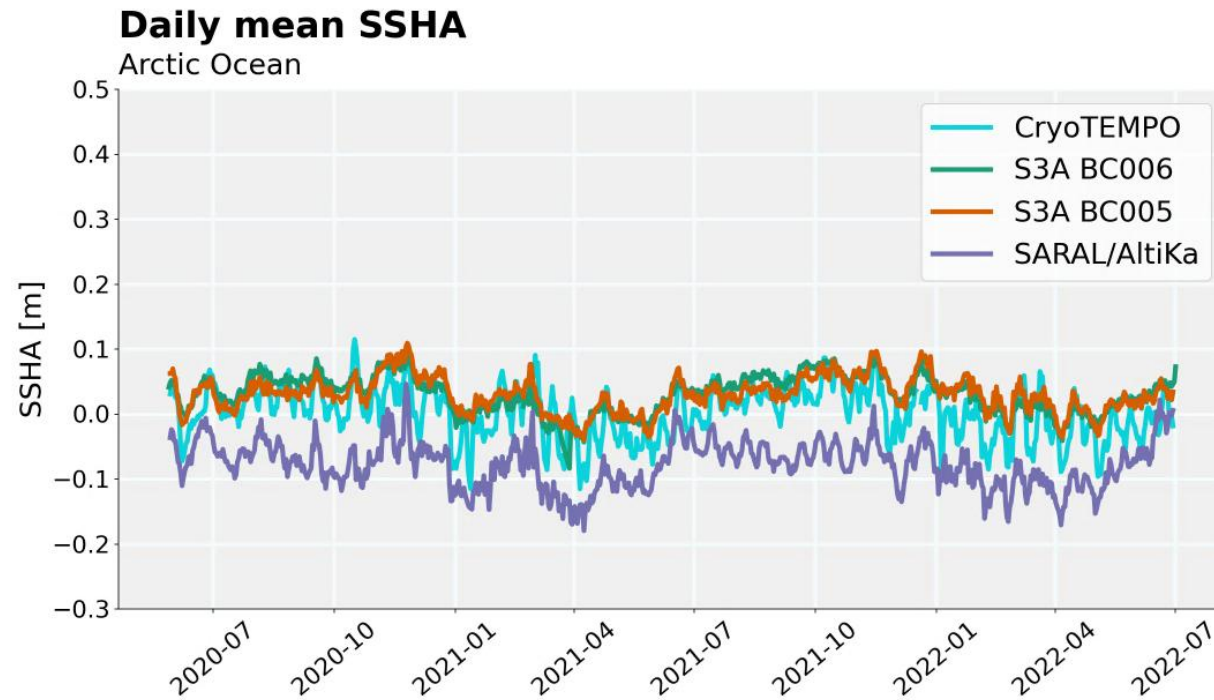


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- Overall similar level of daily average SSHA (BC006 a bit lower in Southern Ocean)
- SSHA aligned with CryoTEMPO (AL has an already known bias in the Arctic)



## 2. SSHA: box-stat maps



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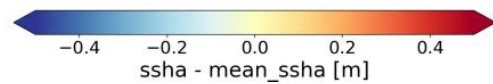
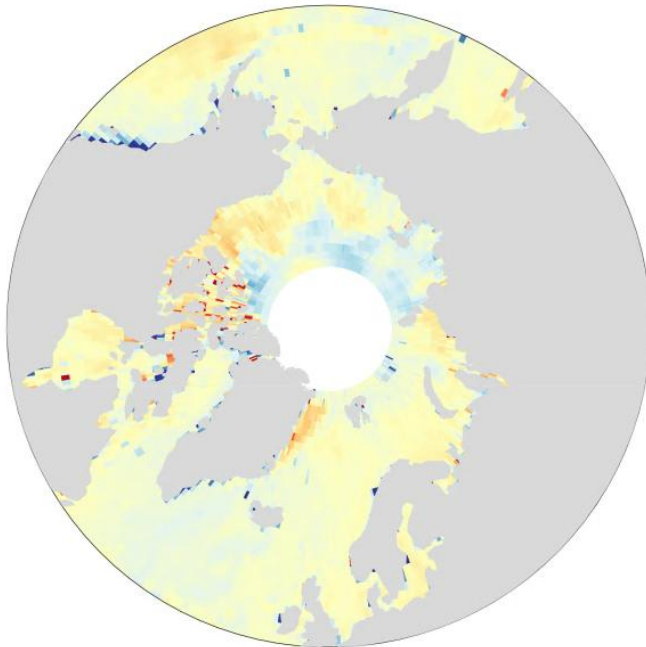
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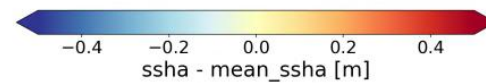
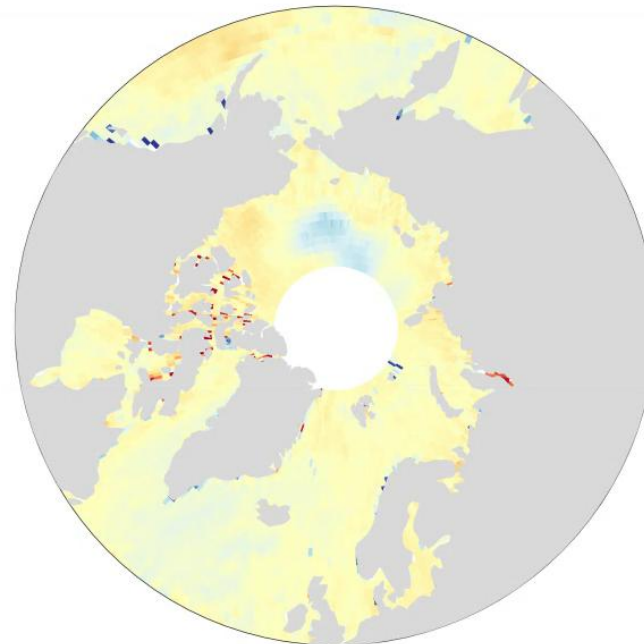


- Geographical patterns mitigated in BC006

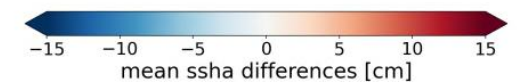
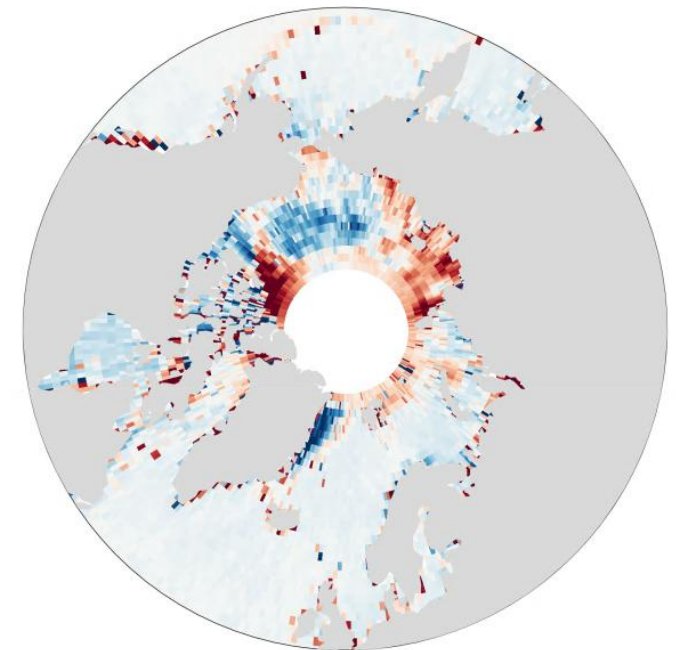
S3A BC005 ssha



S3A BC006 ssha



S3A BC006 - BC005 mean SSHA differences



## 2. SSHA: box-stat maps



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EUROPEAN UNION



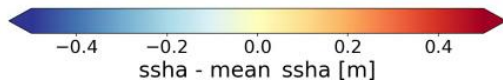
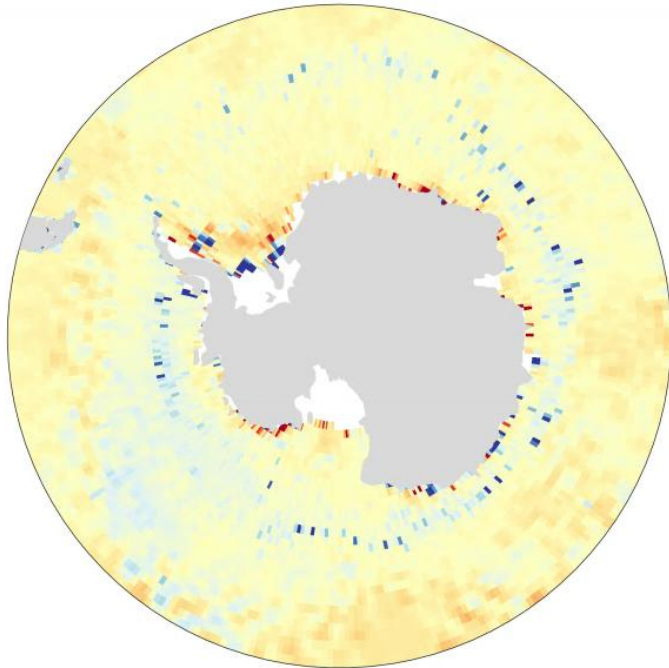
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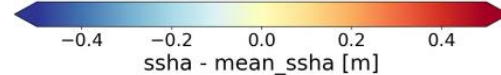
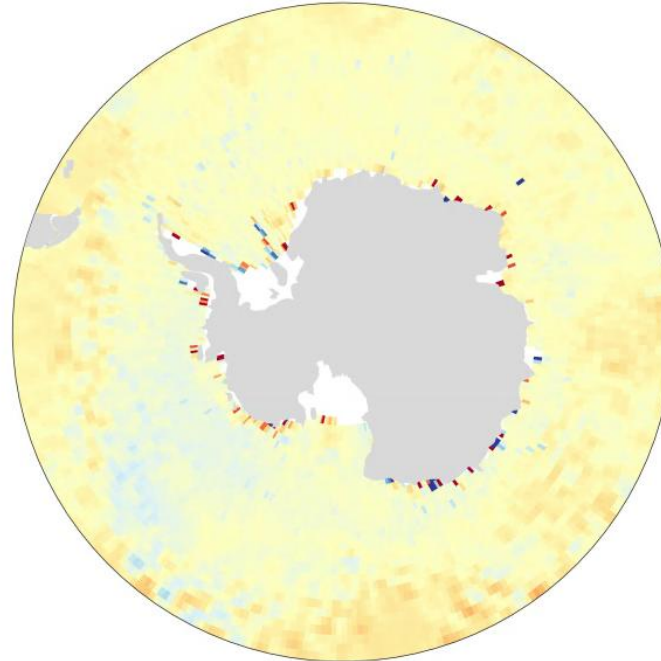


- Geographical patterns mitigated in BC006 near the coast and at the edge of the ice area

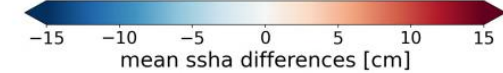
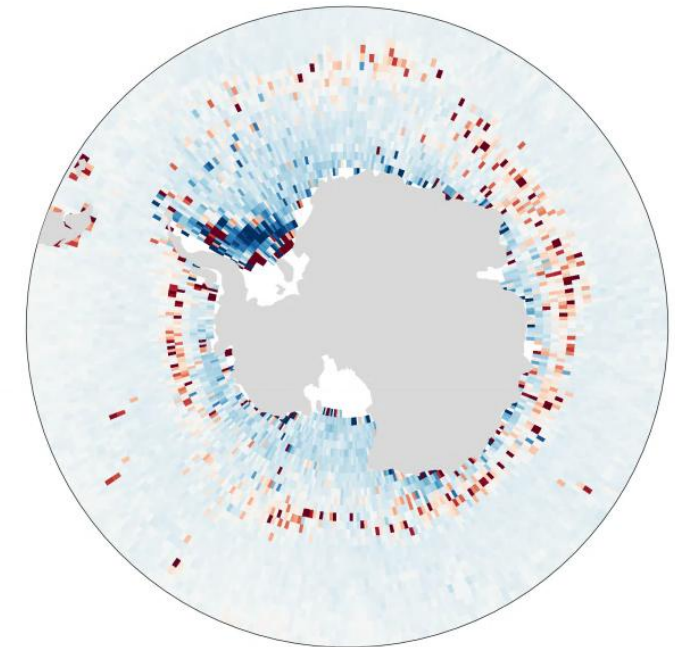
S3A BC005 ssha



S3A BC006 ssha



S3A BC006 - BC005 mean SSHA differences



## 2. SSHA: box-stat maps



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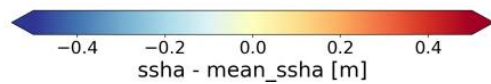
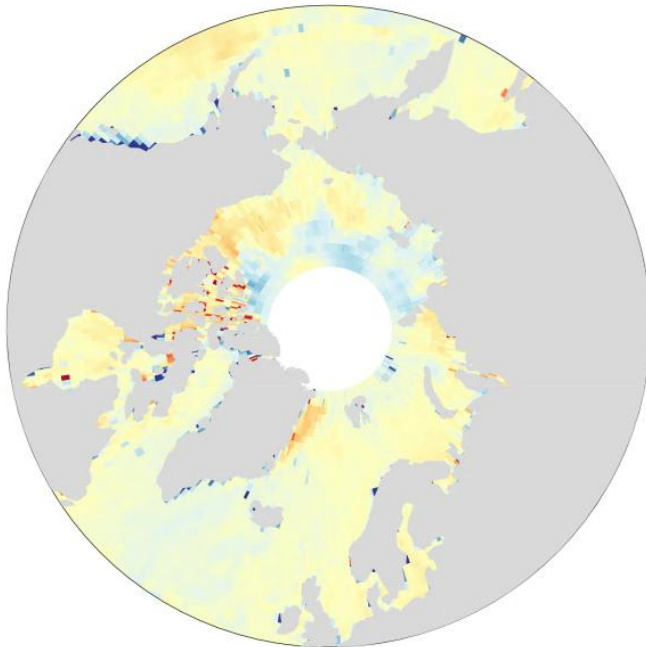
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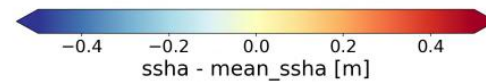
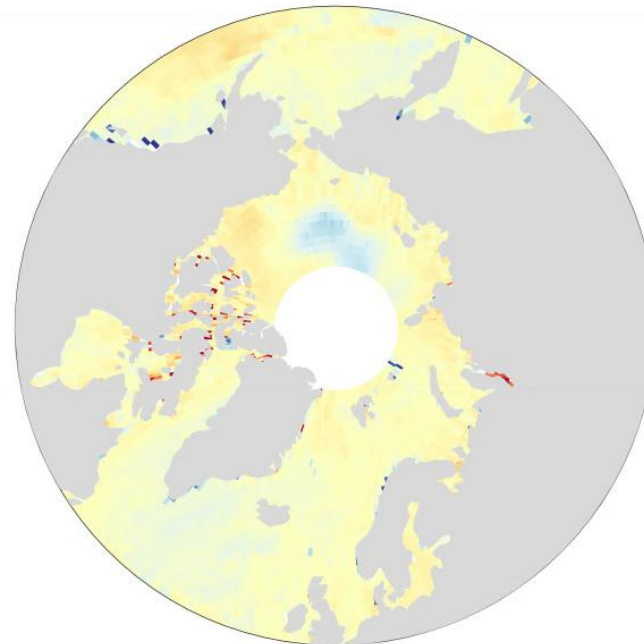


- BC006 shows more similar behavior to CryoTEMPO (and AltiKa – not shown)

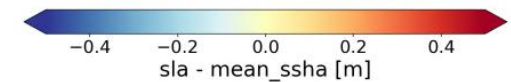
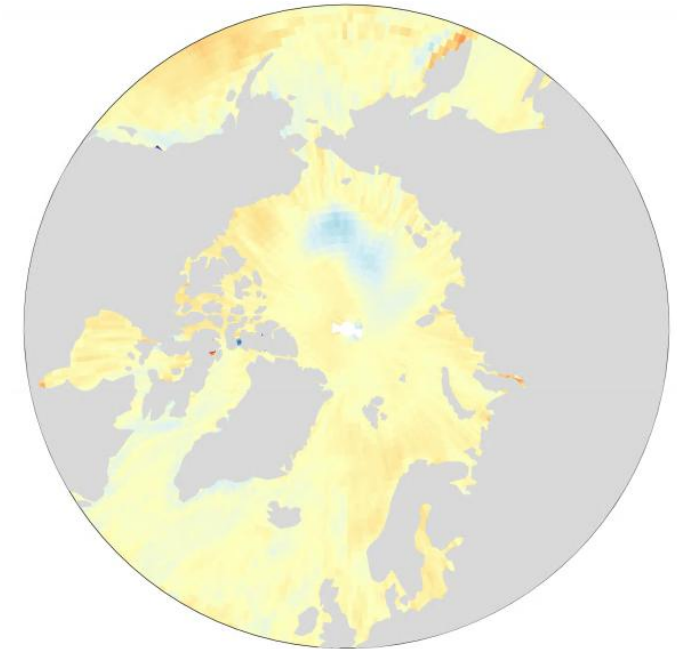
S3A BC005 ssha



S3A BC006 ssha



CryoTempo sla



## 2. SSHA: box-stat maps



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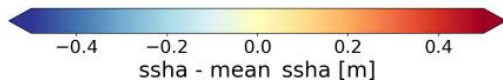
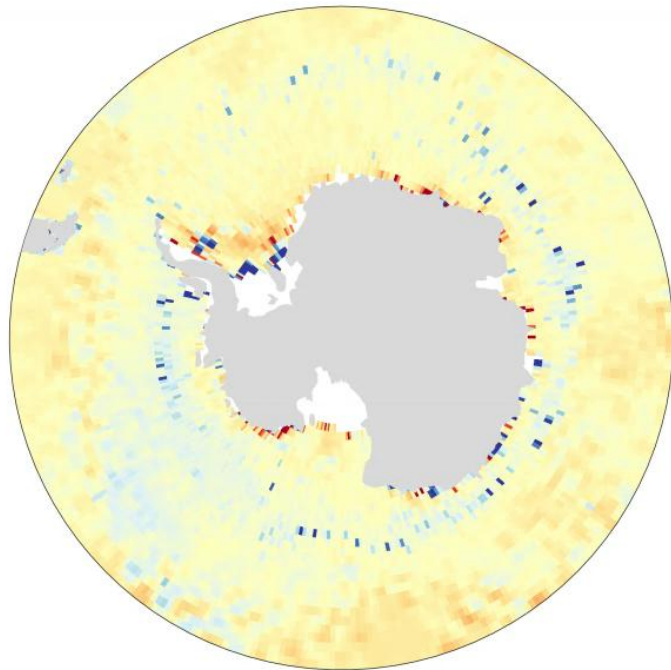
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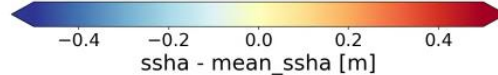
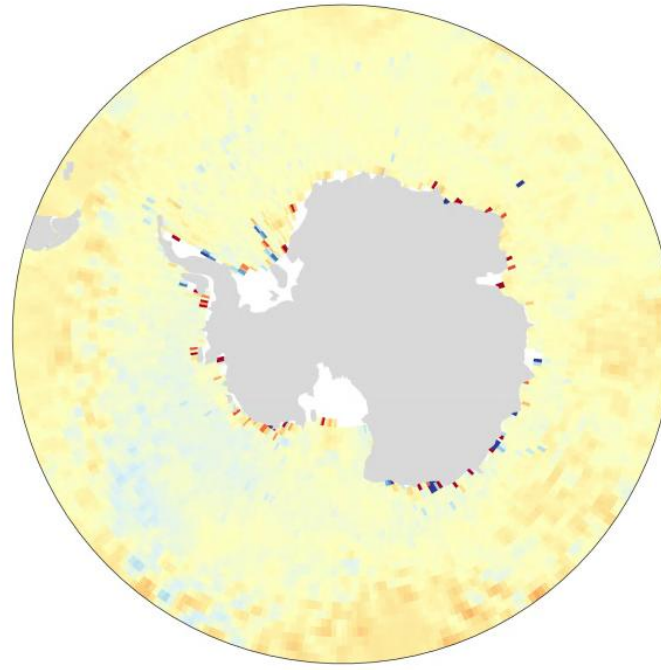


- BC006 shows more similar behavior to CryoTEMPO (and AltiKa – not shown)
- In Antarctic ocean removed the BC005 ring at the edge of the ice-covered area

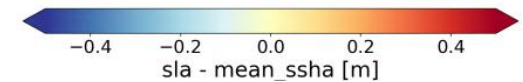
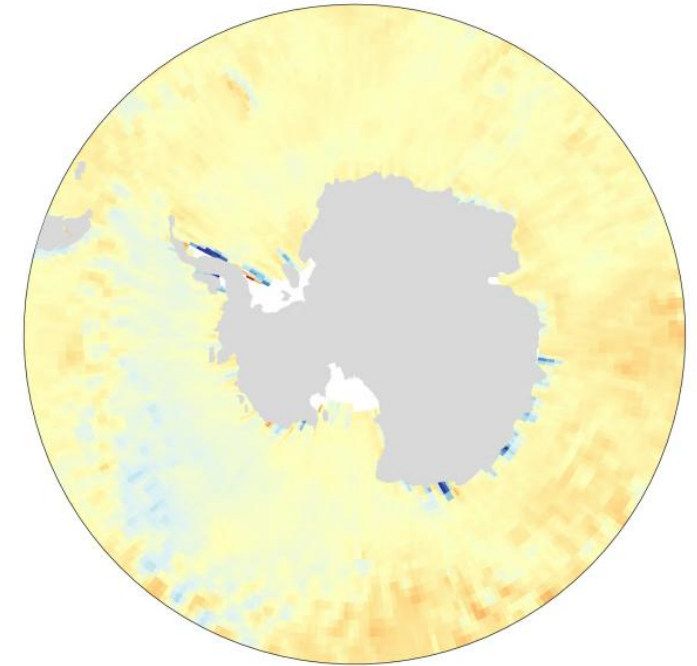
S3A BC005 ssha



S3A BC006 ssha



CryoTempo sla



## 2. SSHA: box-stat maps



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- BC006 variability smaller and more similar to CryoTEMPO (0-padding improvement)

S3A BC005 ssha stddev



S3A BC006 ssha stddev



## 2. SSHA: box-stat maps



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- BC006 variability smaller and more similar to CryoTEMPO (0-padding improvement)

S3A BC005 ssha stddev



S3A BC006 ssha stddev



CryoTempo sla stddev



## 2. SSHA: box-stat maps



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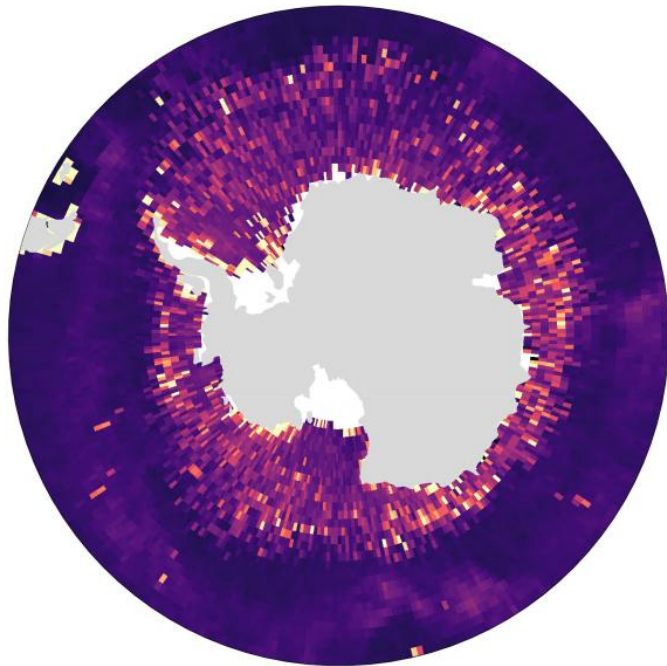
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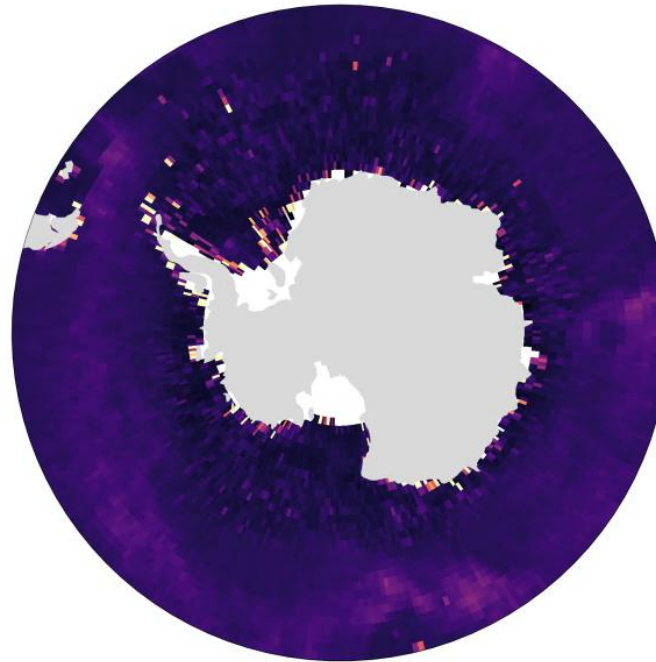


- BC006 variability smaller and more similar to CryoTEMPO (0-padding improvement)

S3A BC005 ssha stddev



S3A BC006 ssha stddev



## 2. SSHA: box-stat maps



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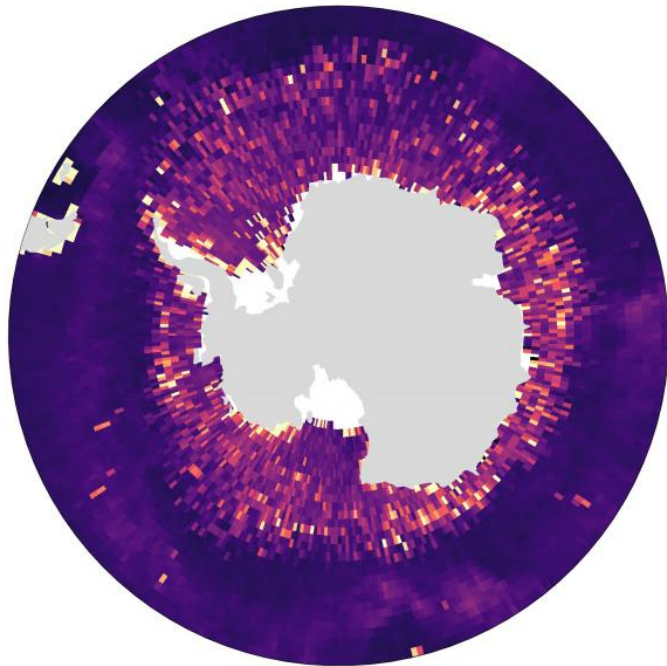
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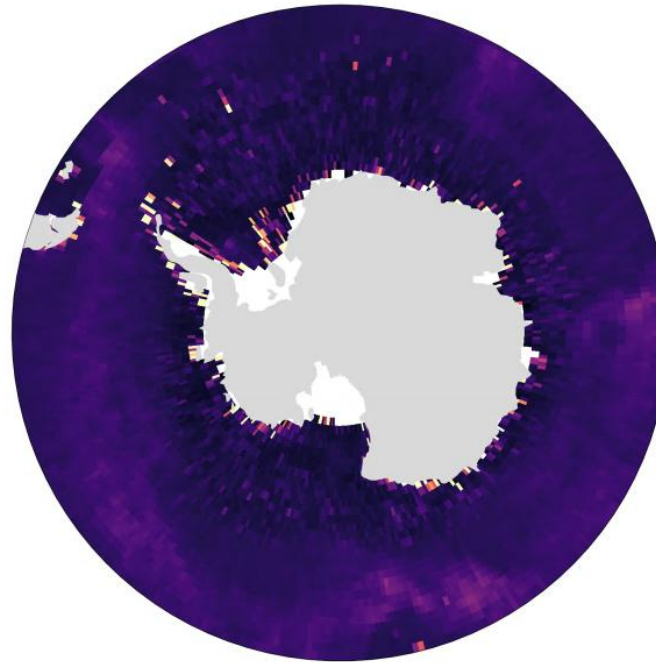


- BC006 variability smaller and more similar to CryoTEMPO (0-padding improvement)

S3A BC005 ssha stddev



S3A BC006 ssha stddev



CryoTempo sla stddev



## 2. SSHA: open-ocean/lead bias



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- The « magic window » introduced in BC006 is expected to improve continuity between open ocean and leads

To estimate bias between open-ocean and lead SSHA:

1. Open- ocean and ice-covered SSHA measurements gridded independently
2. Compute difference between both grids
3. Cells that have both open-ocean and ice-covered measurements provide one estimate of the bias

# 2. SSHA: open-ocean/lead bias



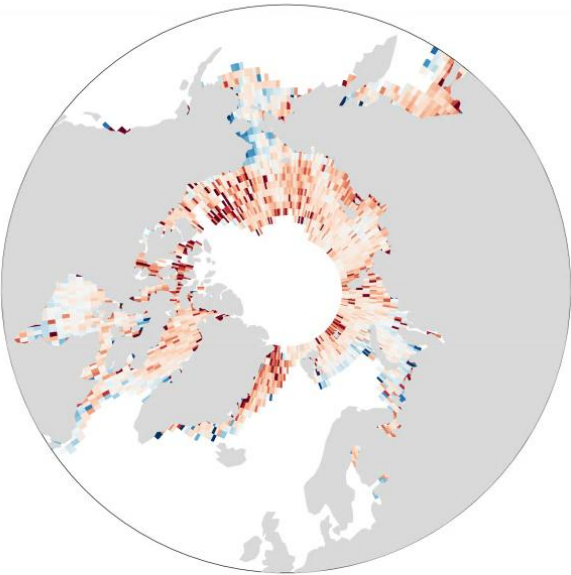
PROGRAMME OF THE EUROPEAN UNION



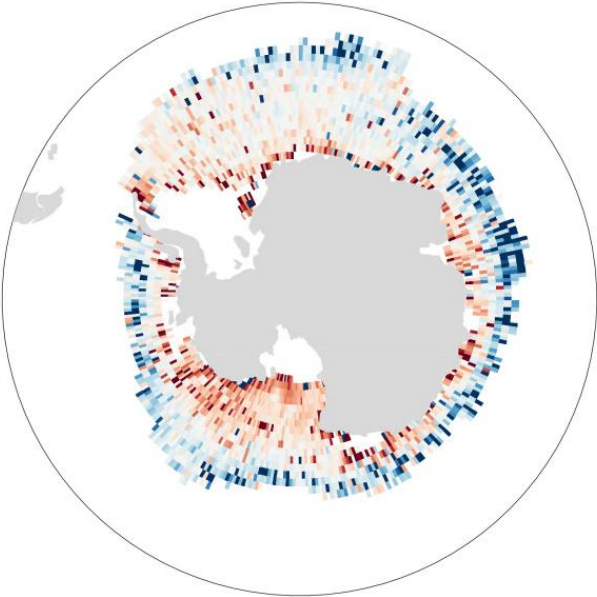
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S3A BC005 open-ocean/leads ssha bias



S3A BC005 open-ocean/leads ssha bias



## 2. SSHA: open-ocean/lead bias



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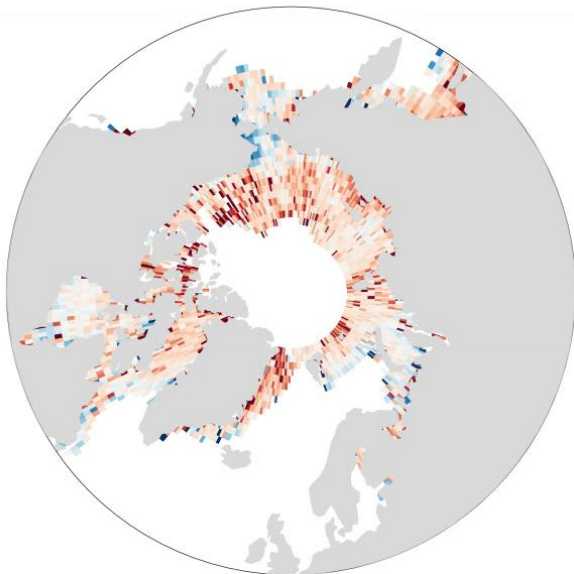
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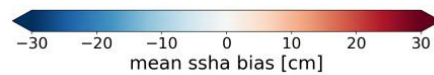
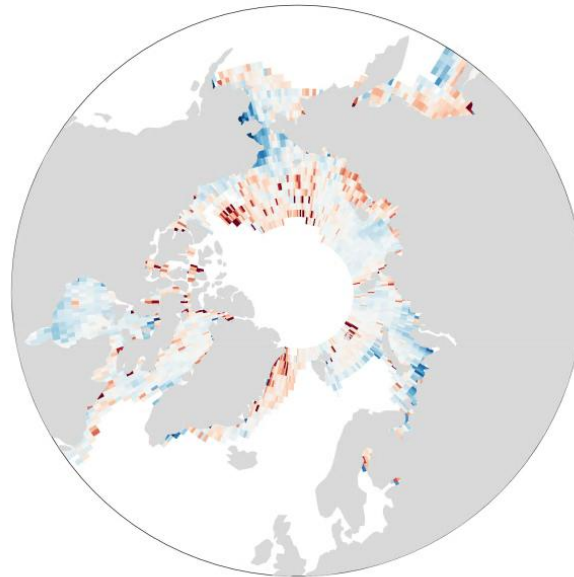


- Maps show a reduction of the open ocean/leads bias in BC006, especially in Southern Ocean

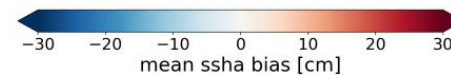
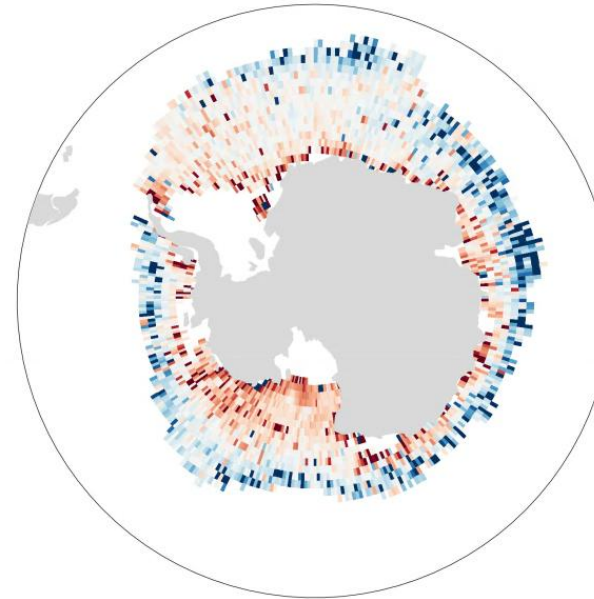
S3A BC005 open-ocean/leads ssha bias



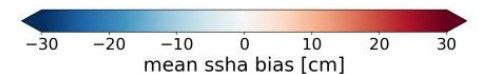
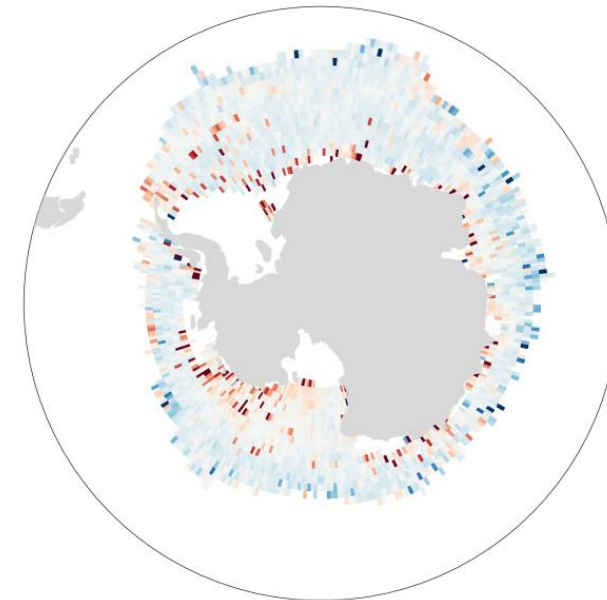
S3A BC006 open-ocean/leads ssha bias



S3A BC005 open-ocean/leads ssha bias



S3A BC006 open-ocean/leads ssha bias



## 2. SSHA: open-ocean/lead bias



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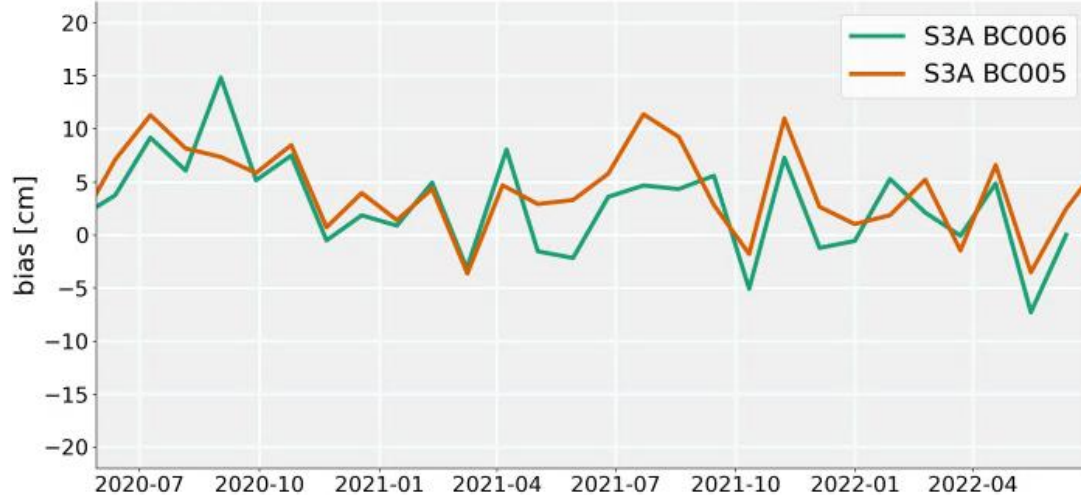
Time series:

- **Reduced open ocean/leads bias, especially in the Southern Ocean**
- Larger std in the Arctic for BC006

BC006: mean 2.81cm, std 4.56cm  
BC005: mean 3.96cm, std 3.96cm

### Open ocean/leads SSHA bias

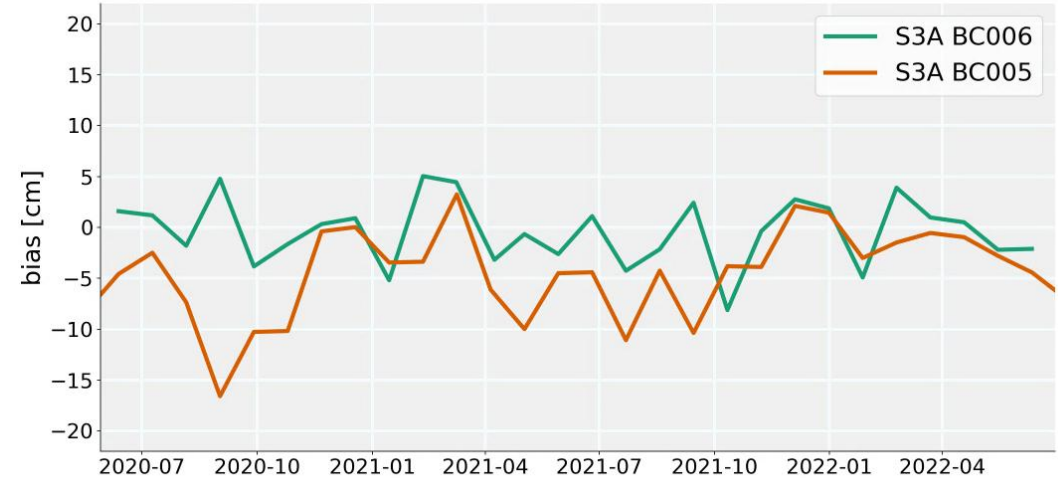
Arctic Ocean



BC006: mean -0.4cm, std 3.22cm  
BC005: mean -4.71cm, std 4.39cm

### Open ocean/leads SSHA bias

Southern Ocean



## 2. SSHA: open-ocean/lead bias



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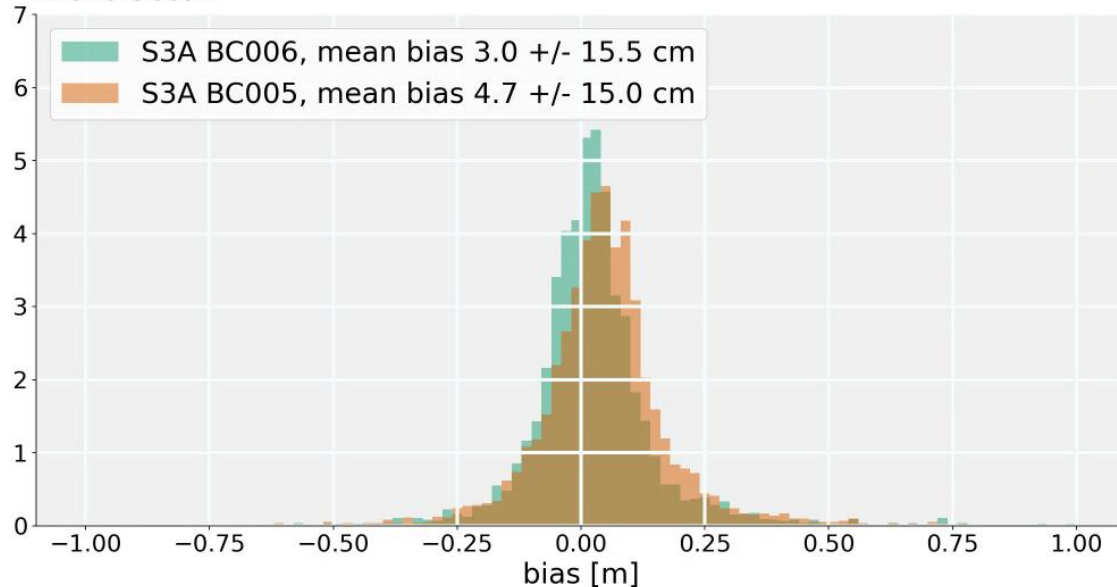


Histograms:

- **Open ocean/leads bias More centered around 0 for BC006 (especially in Southern Ocean)**
- BC006 histogram less skewed, but still large std

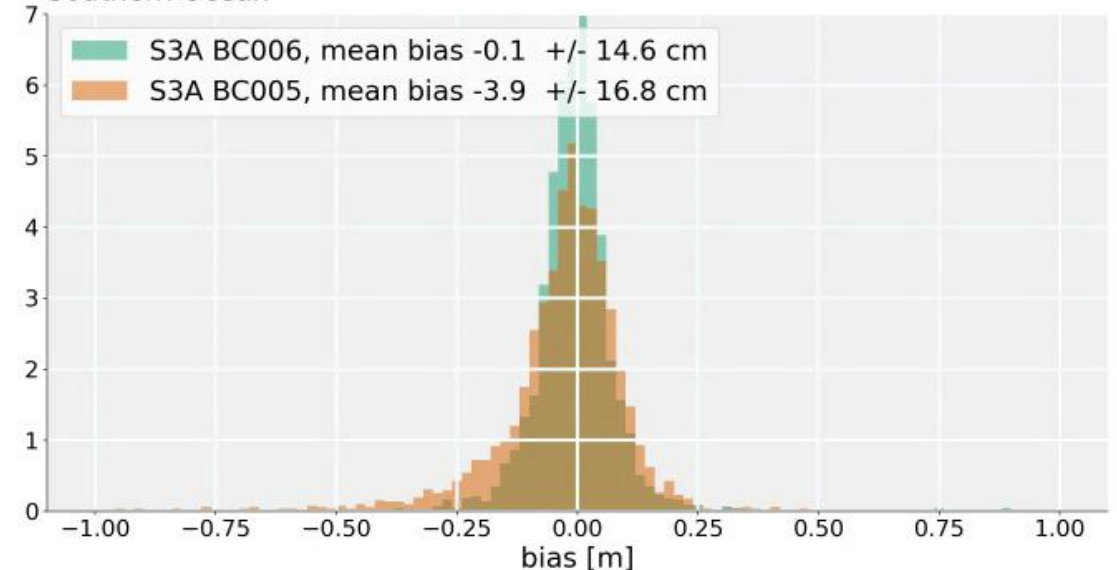
### Open ocean/leads SSHA bias distribution

Arctic Ocean



### Open ocean/leads SSHA bias distribution

Southern Ocean



- ❑ With the new lead flag less leads
  - More conservative waveform classification algorithm based on neural network
- ❑ Daily mean SSHA (both leads and open ocean) at similar levels for the two PBs
- ❑ The SSHA geographical patterns in BC006 are more coherent with CryoTEMPO (and AltiKa)
  - Reduced patterns near the coast and at the edge of the sea ice covered area in the Southern Ocean
- ❑ SSHA variability in BC006 is reduced and more consistent with CryoTEMPO
  - Improvement due to 0-padding introduced in BC006
- ❑ The bias between open ocean and leads is reduced, especially in the Southern Ocean
  - Improvement due to “Magic window” introduced in BC006

**BC006 improvements in polar regions aligned with CMEMS requirements**