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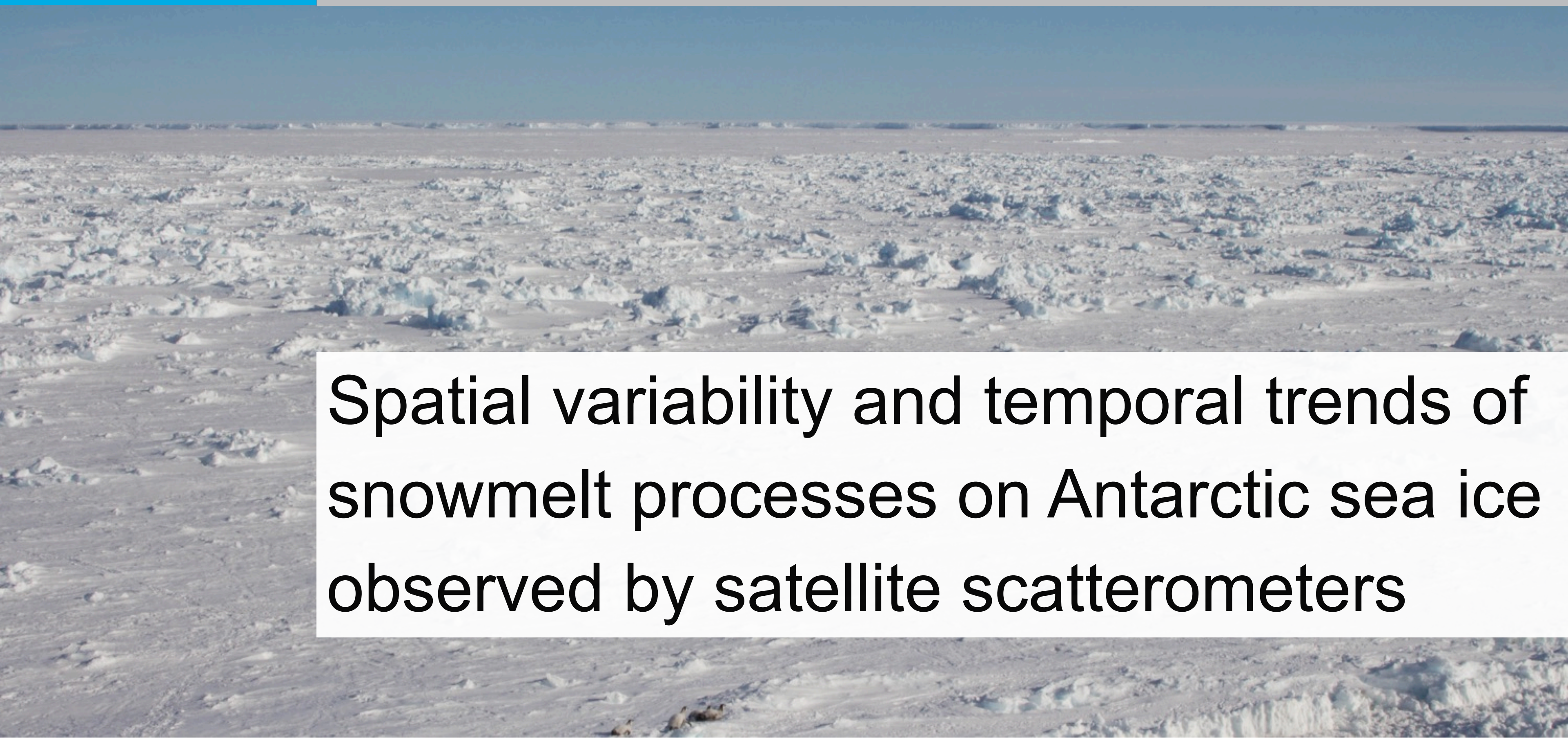

Spatial variability and temporal trends of snowmelt processes on Antarctic sea ice observed by satellite scatterometers

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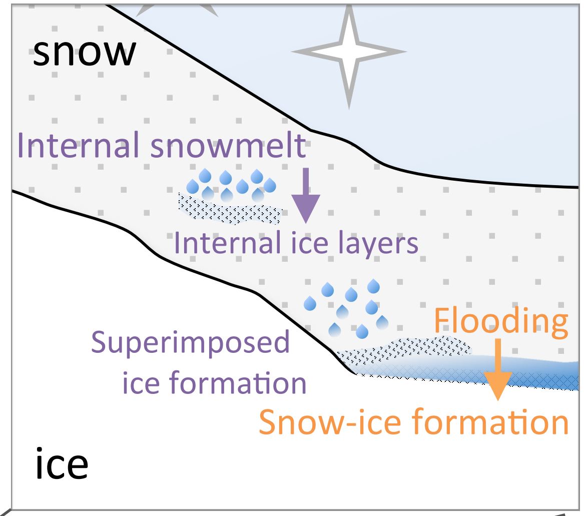
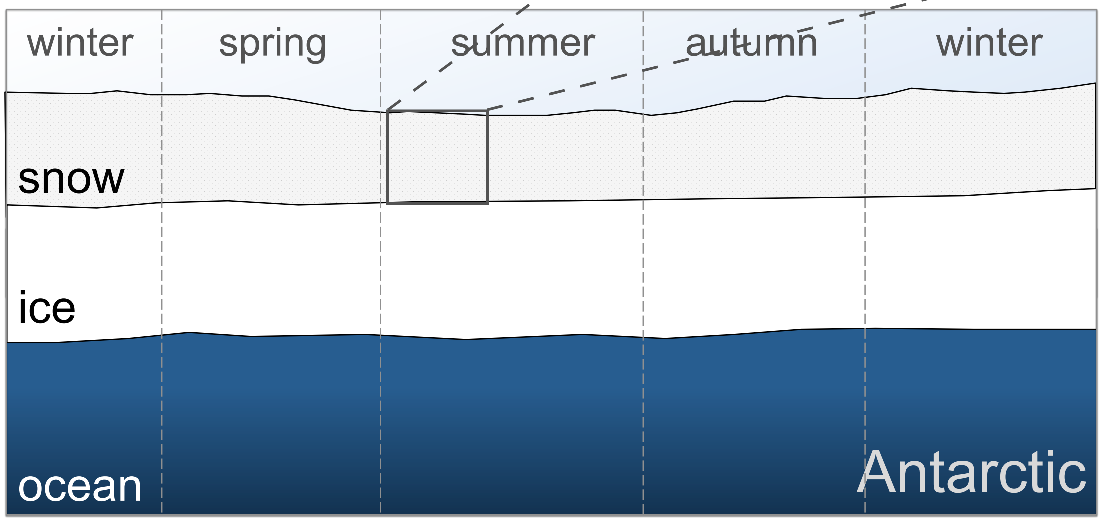
Temporal evolution of surface properties





Year-round snow cover

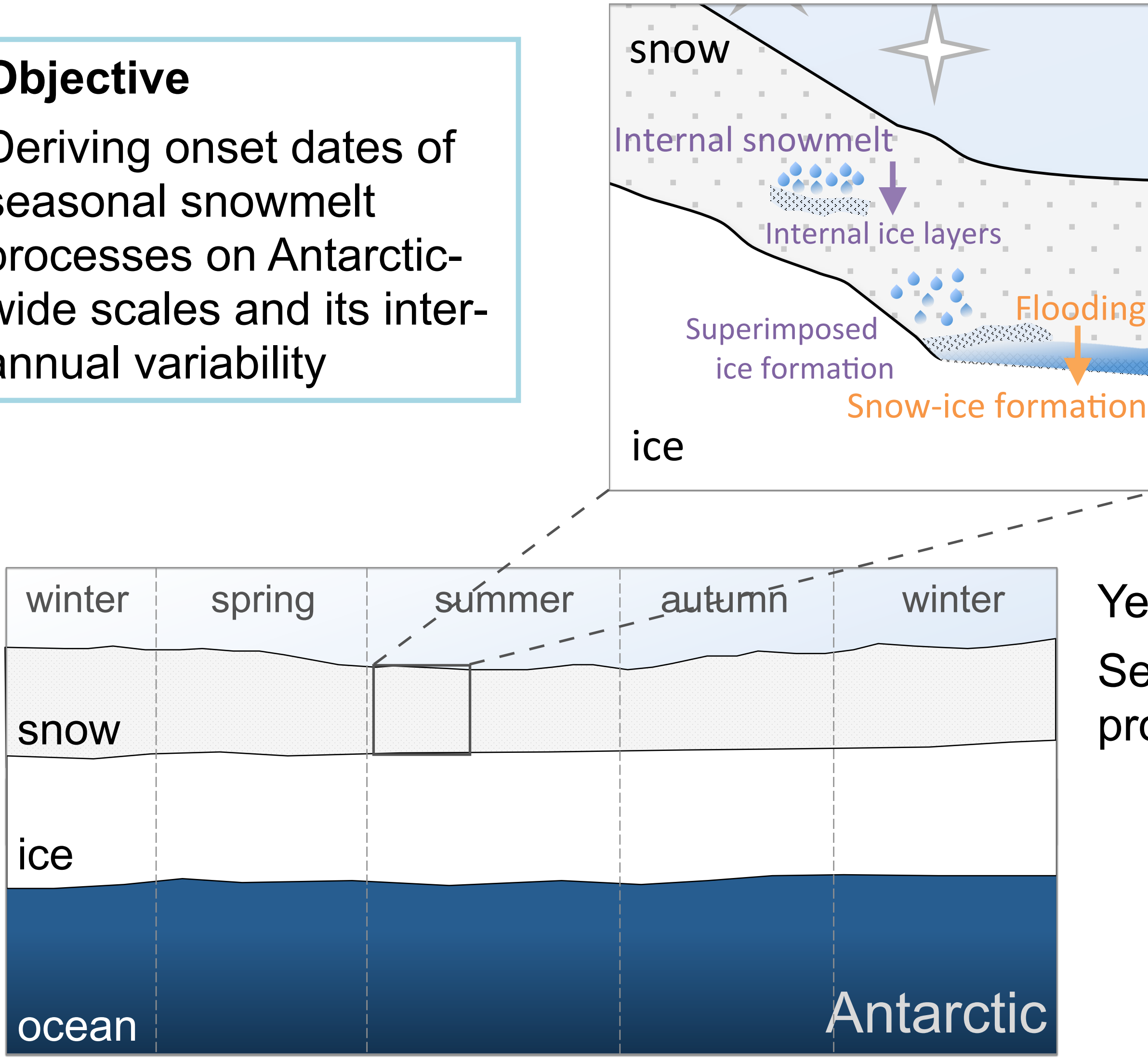
Seasonal changes in snow properties dominated by

- Diurnal thawing and refreezing
- Internal snowmelt

Temporal evolution of surface properties

Objective

Deriving onset dates of seasonal snowmelt processes on Antarctic-wide scales and its inter-annual variability



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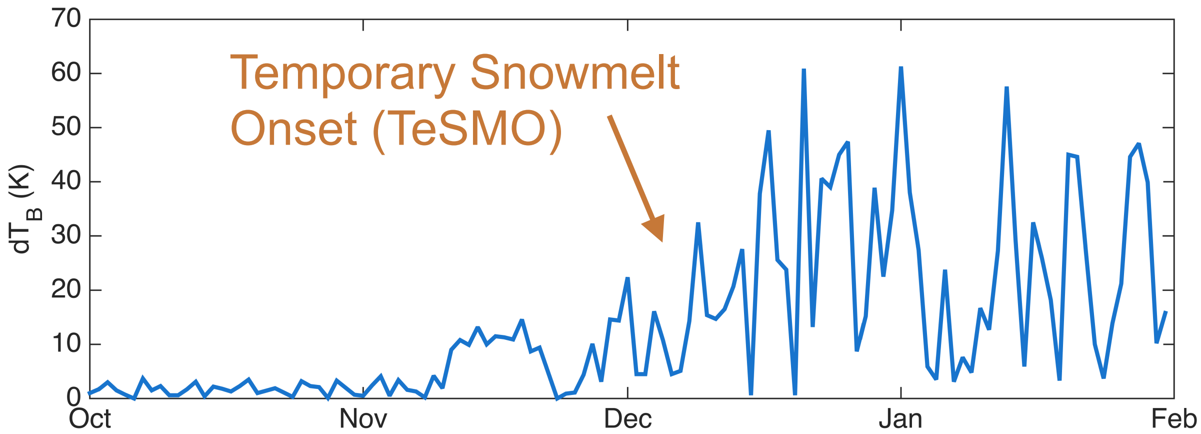
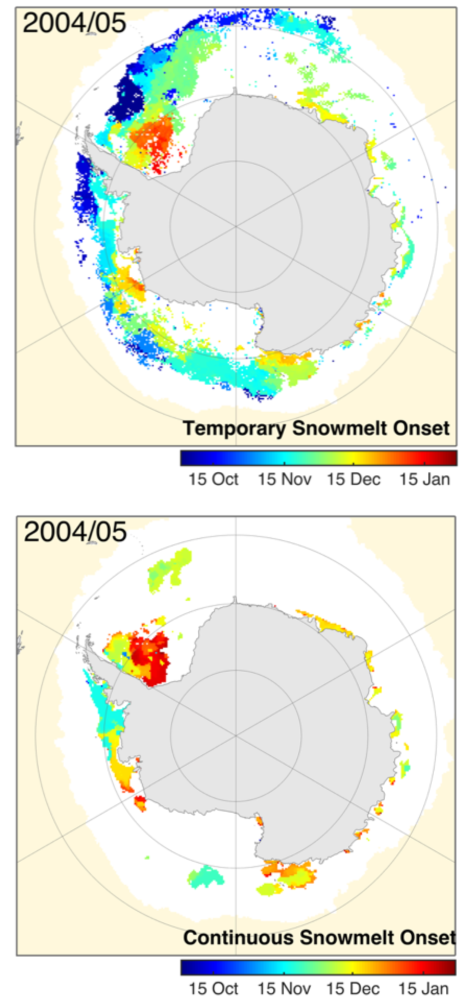
Snowmelt patterns from passive microwave observations

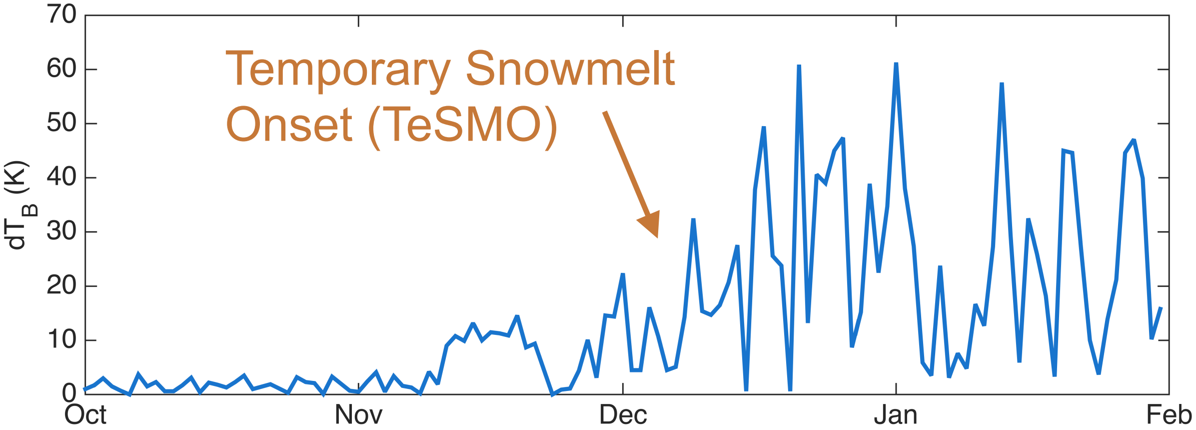


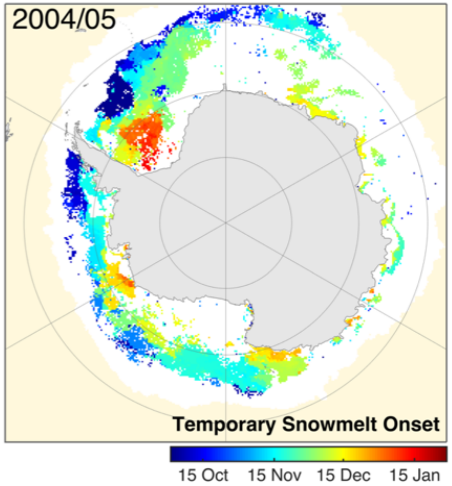
Method: Analysis of diurnal variations in brightness temperature (passive microwave, 37 GHz, vert. pol.)



Arndt et al., 2016 (JGR)

Snowmelt patterns from passive microwave observations





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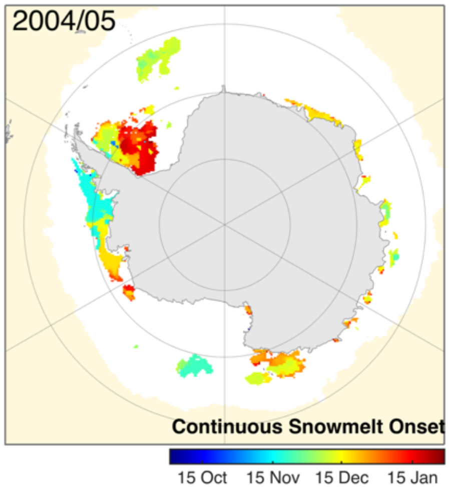


Key points

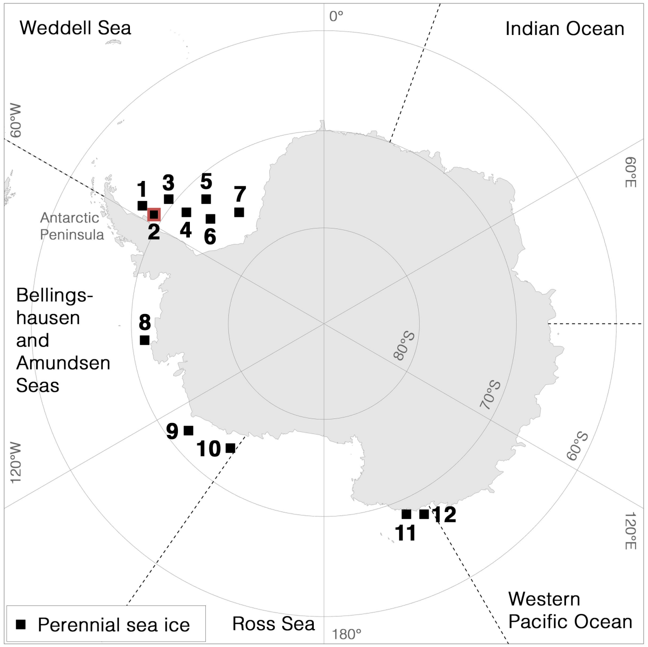
Temporary snowmelt shows a **latitudinal dependence**

Continuous snowmelt is usually 17 days after temporary snowmelt onset observed

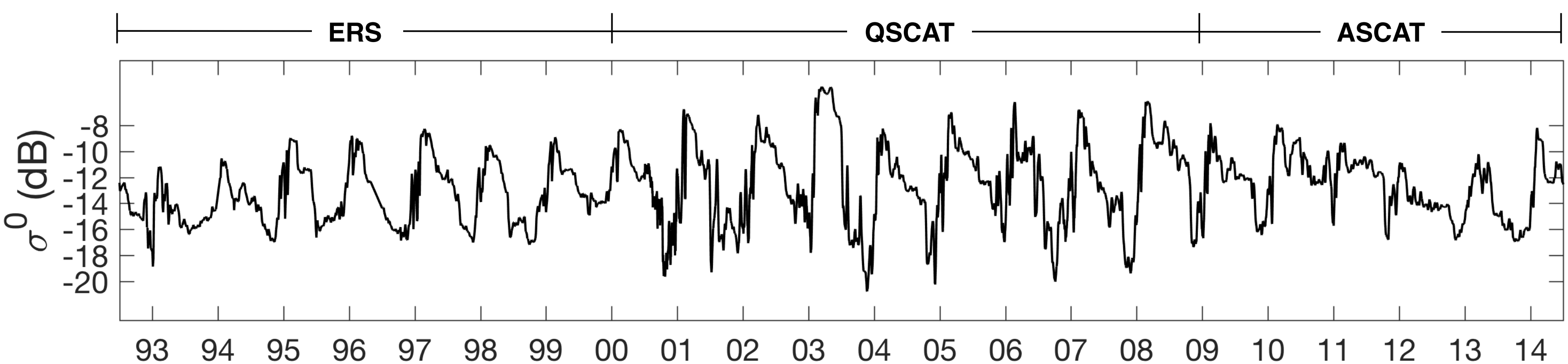
Results indicate **four characteristic melt types**

Arndt et al., 2016 (JGR)

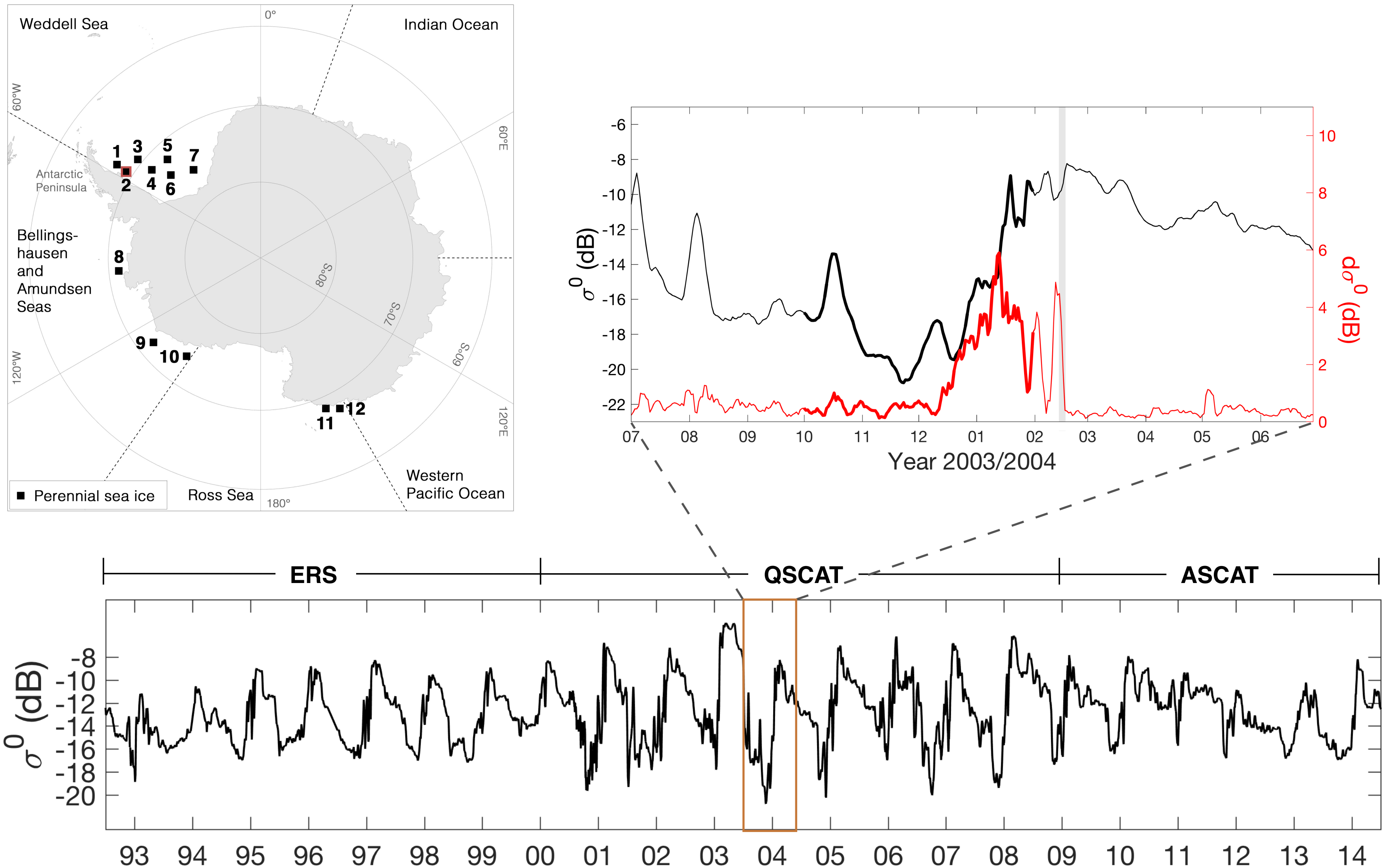
Temporal evolution of radar backscatter



Based on **Haas, 2001**



Temporal evolution of radar backscatter



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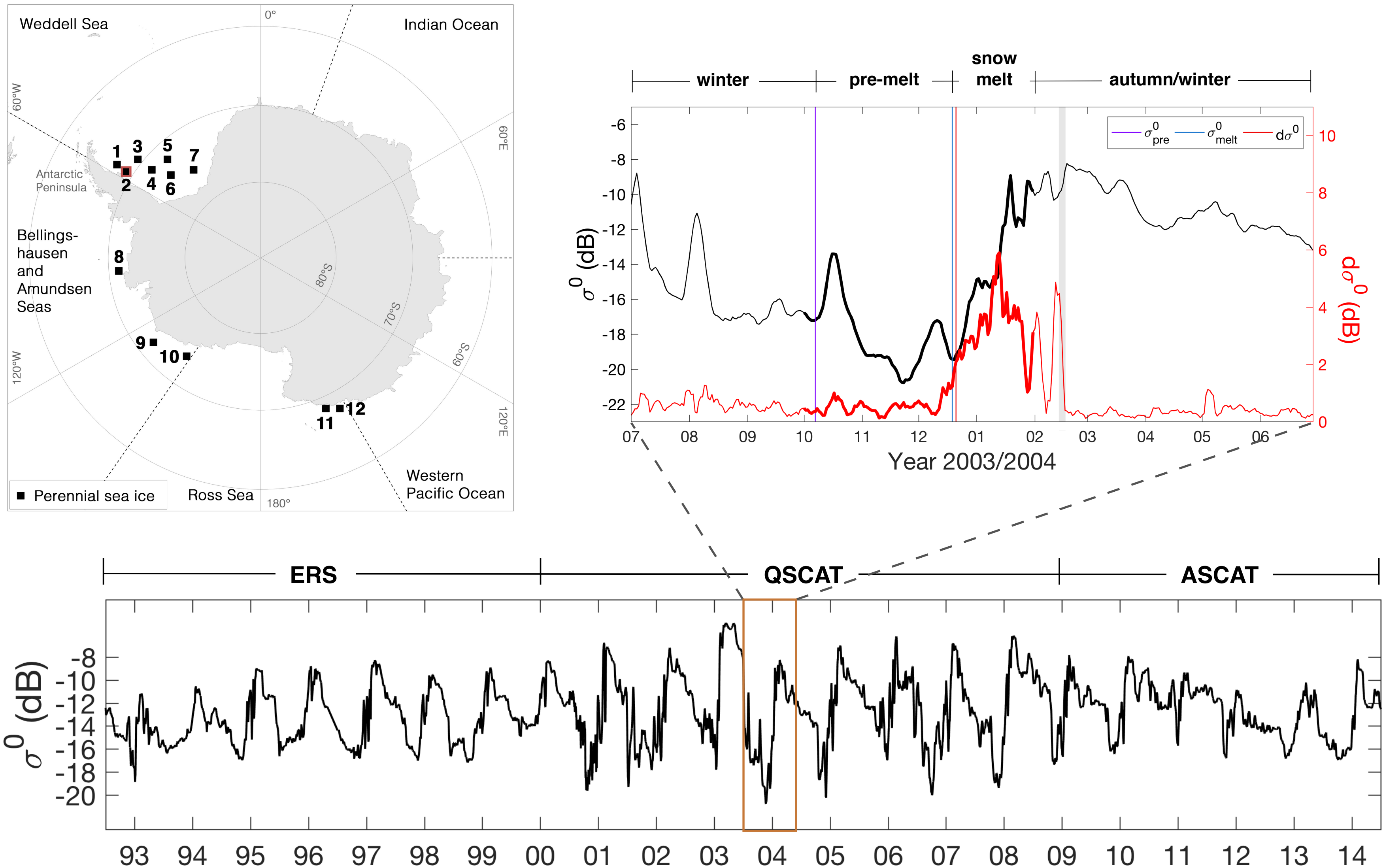
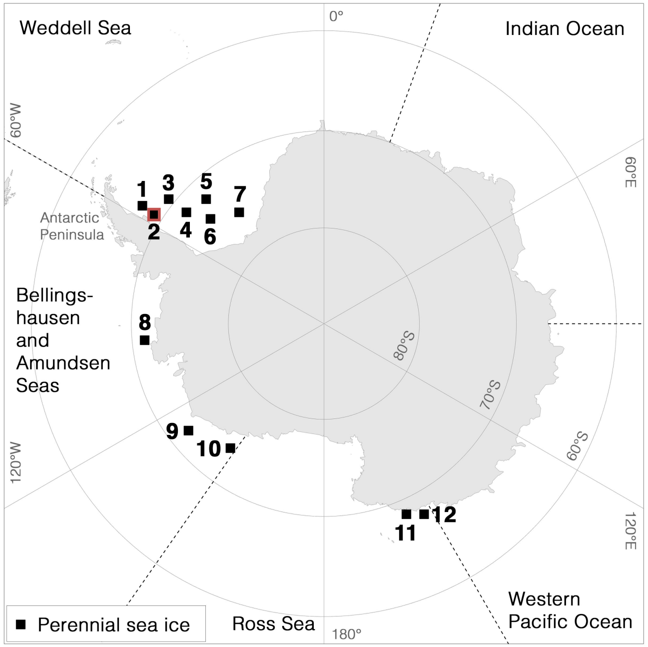
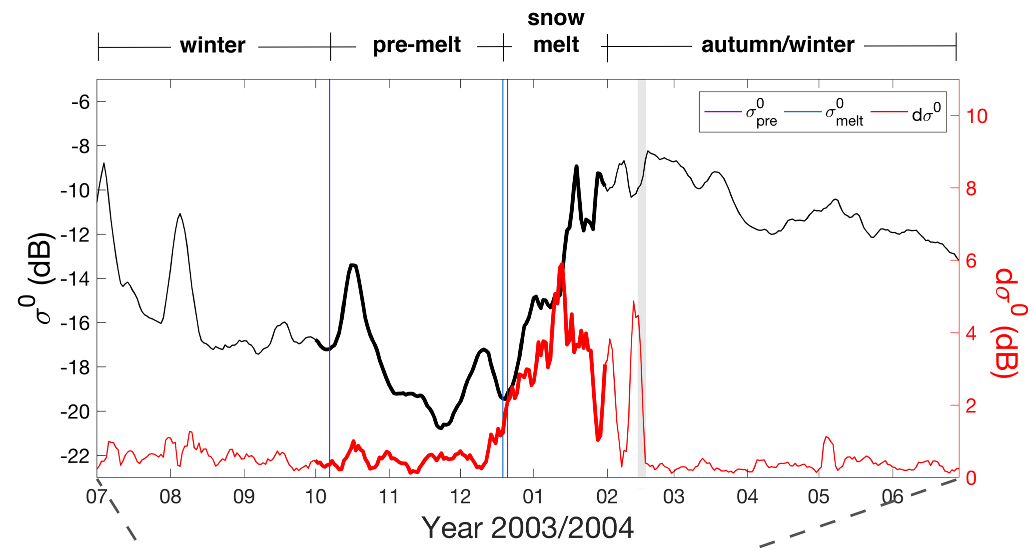
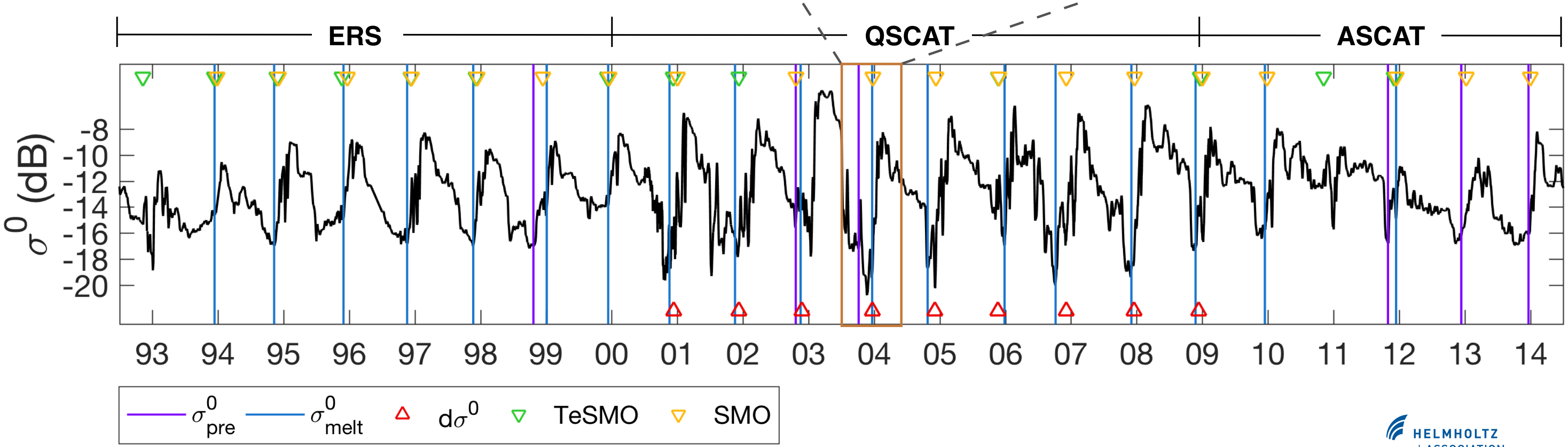


Temporal evolution of radar backscatter







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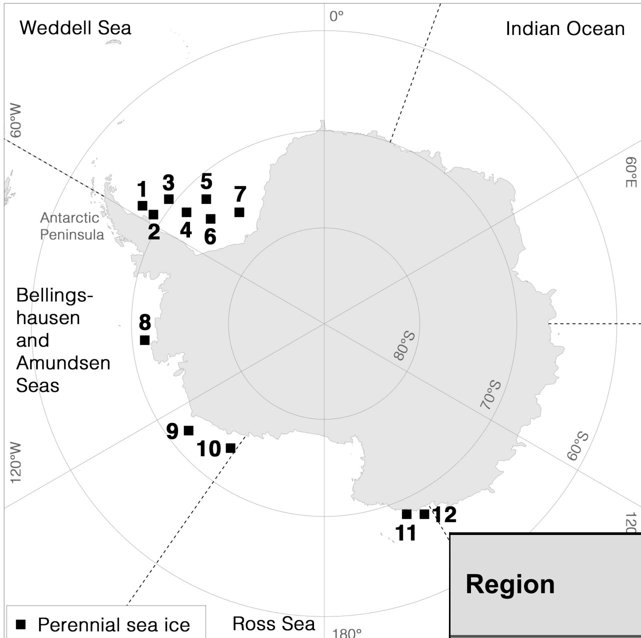
Spatial variability of snowmelt onset dates



Mean snowmelt onset dates.

Latitudinal gradient in snowmelt onset dates

- *North:* warm-air advection
- *South:* diminished warm-air advection and stronger heat loss at the snow surface

	From scatterometer data			From passive microwave observations
Region	**Pre-melt Onset**	**Snowmelt Onset**	**Diurnal thawing-refreezing Onset**	**Temporary Snowmelt Onset (TeSMO)**
Southern Weddell Sea	27 Nov ± 25 days	16 Dec ± 19 days	19 Dec ± 13 days	21 Dec ± 11 days
Northern Weddell Sea	24 Nov ± 16 days	06 Dec ± 16 days	09 Dec ± 9 days	13 Dec ± 11 days
Bellingshausen Sea	01 Dec ± 29 days	04 Dec ± 27 days	19 Oct ± 20 days	19 Oct ± 28 days
Amundsen Sea	24 Nov ± 23 days	06 Dec ± 18 days	02 Dec ± 10 days	05 Dec ± 16 days
Ross Sea	11 Dec ± 18 days	15 Dec ± 17 days	13 Dec ± 8 days	16 Dec ± 10 days
All regions	29 Nov ± 10 days	10 Dec ± 12 days	09 Dec ± 5 days	12 Dec ± 8 days

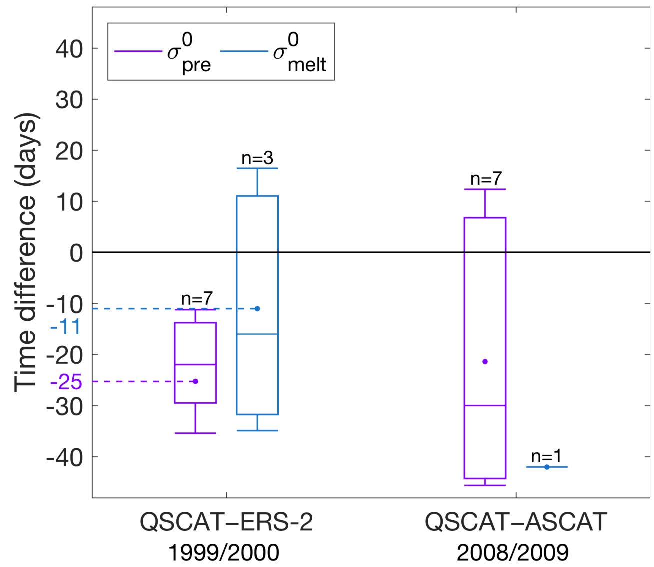
Differences between Ku- and C-band

C-band:

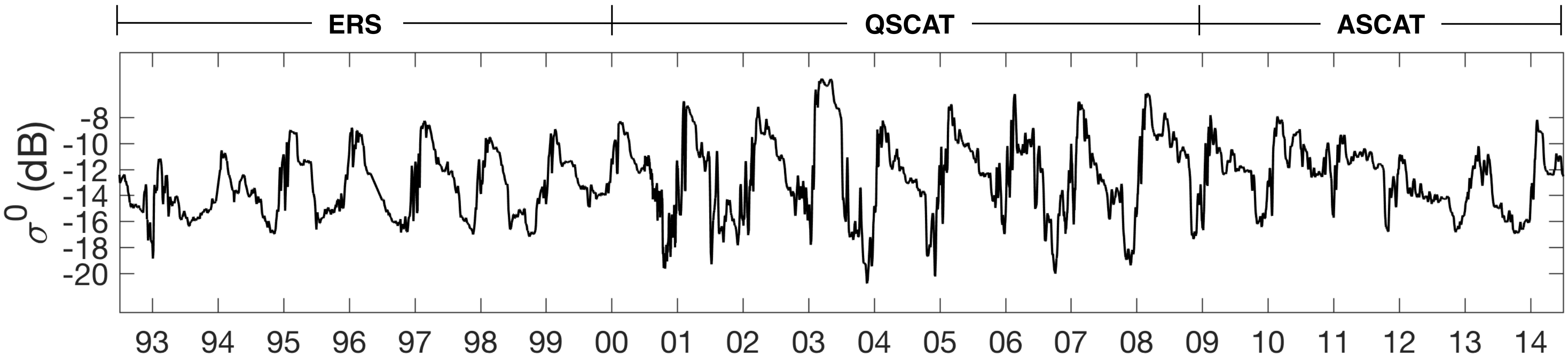
- ERS and ASCAT scatterometers
- Frequency: 5.6 GHz

Ku-band:

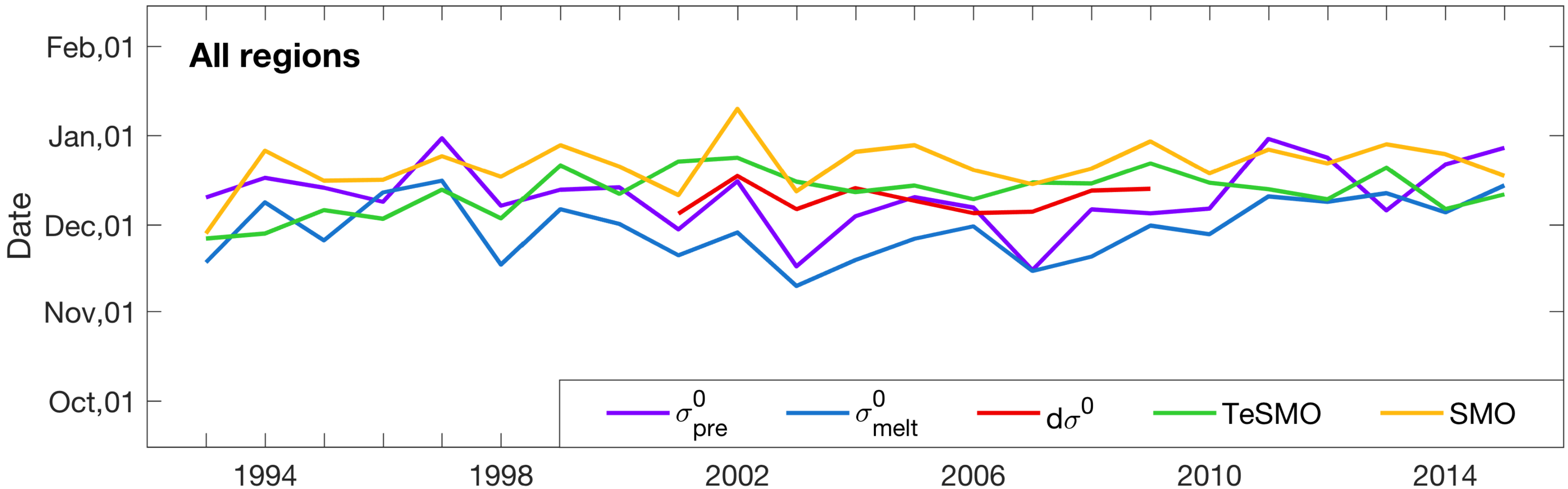
- QSCAT scatterometer
- Frequency: 13.4 GHz



Ku-band derived pre-melt and snowmelt onset dates are earlier by 25 and 11 days



Time series of snowmelt onset dates



No significant trend in snowmelt onset dates but large inter-annual variability

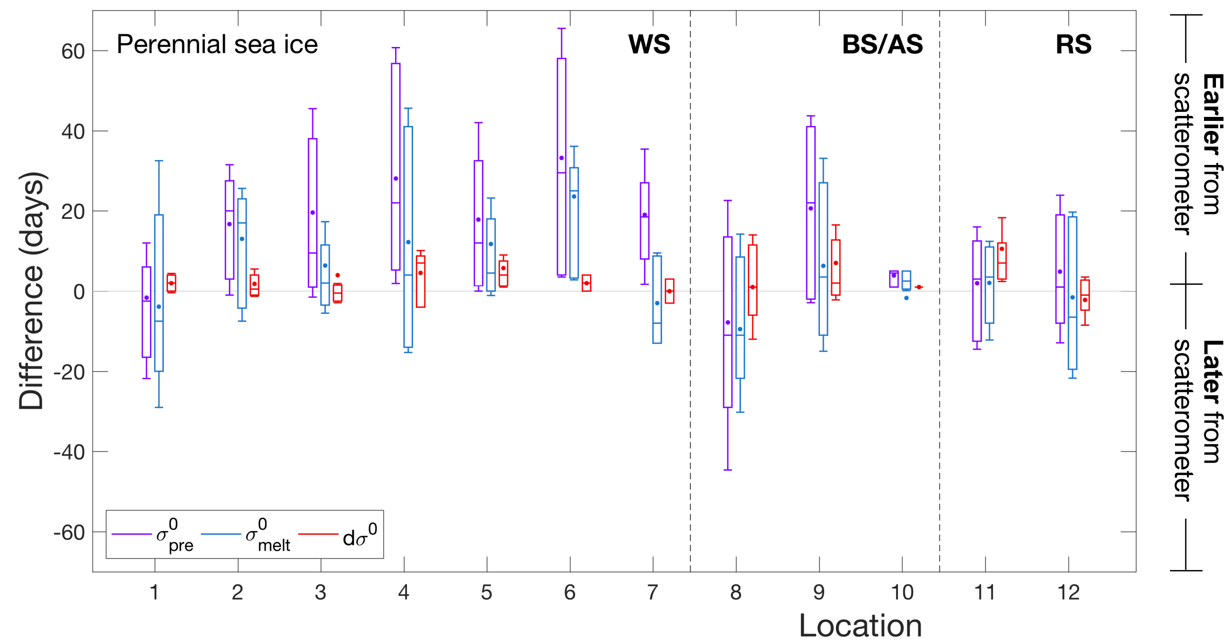
Onset dates from different sensors

Scatterometer observations:

- Frequency: 5.6 and 13.4 GHz
- higher penetration depth

Passive microwave observations:

- Frequency: 37 GHz
- smaller penetration depth



Snowmelt onset dates from scatterometers are earlier by 13 and 5 days than those from passive microwave observations

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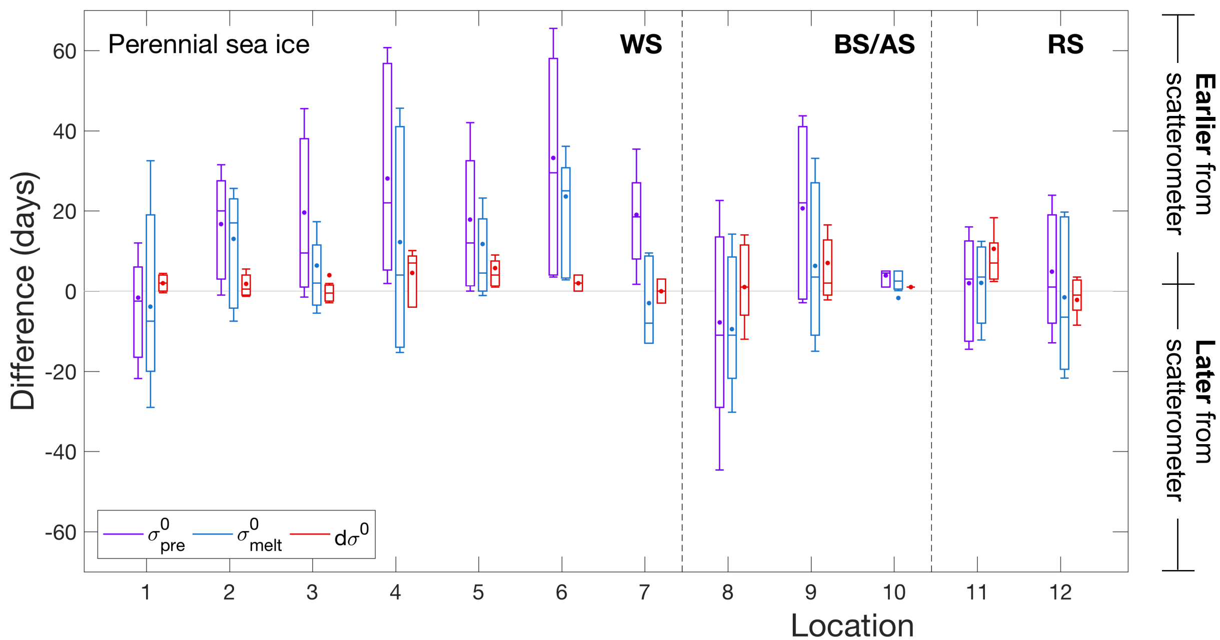

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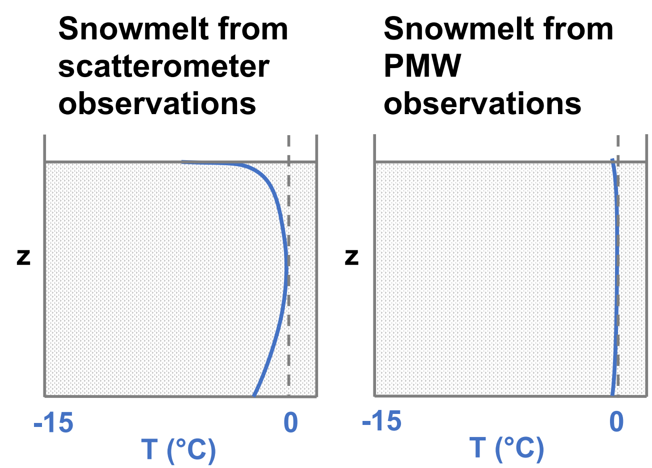
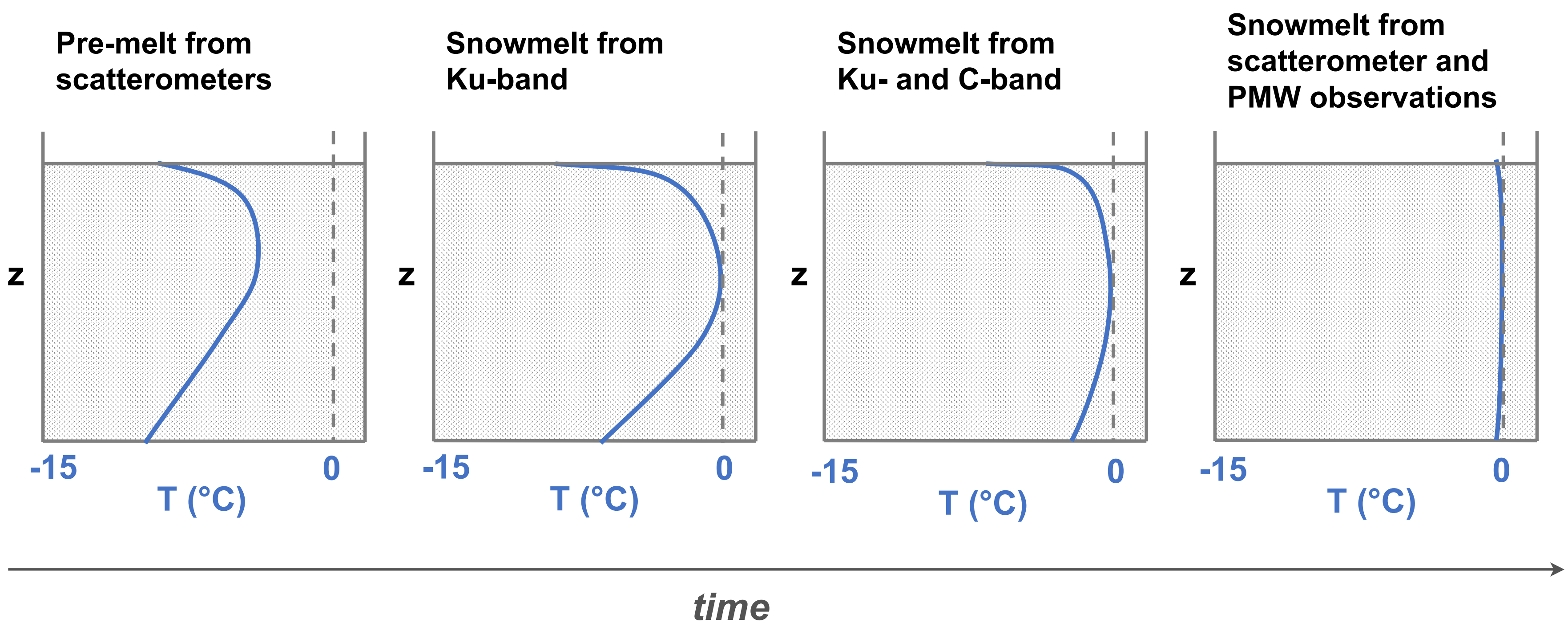


Onset dates from different sensors

Hypothesis:
Different sensors respond to snow melt processes in different depths within the snow cover



Summary

➡ Retrieved snowmelt onset dates show a latitudinal dependence

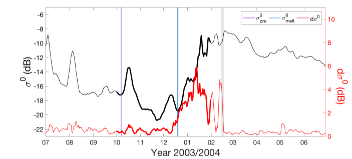
➡ Correcting for sensor differences between Ku- and C-band scatterometers allows to compile a backscatter time series

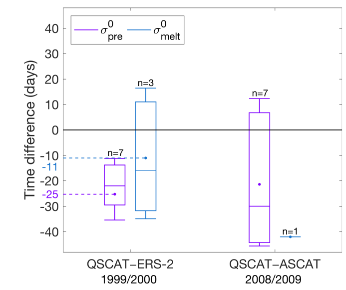
➡ Snowmelt onset dates show no significant trend but a large inter-annual variability for the study period

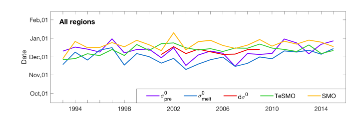
➡ Using satellite remote sensing sensors with different signal frequencies might allow to describe snowmelt processes in different snow layers

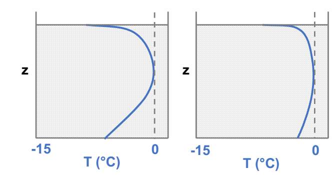
  ➡ Improvement of energy and mass budget calculations for the ice-covered Southern Ocean

  ➡ Knowledge gain on uncertainties and spatial variability of space-borne retrievals of sea-ice concentration, sea-ice thickness and snow depth









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