# Changes of sea ice drift and deformation in the Weddell Sea

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FESOM
Finite-Element Sea-ice Ocean Model

AWI

Universität Bremen

ESSReS

# Outline

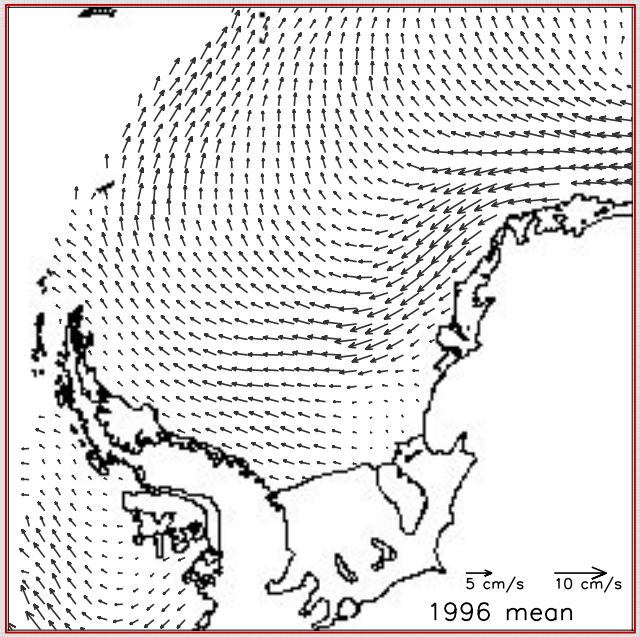
Introduction

Sea ice drift
Sea ice growth

Conclusion
Further needs

# Introduction

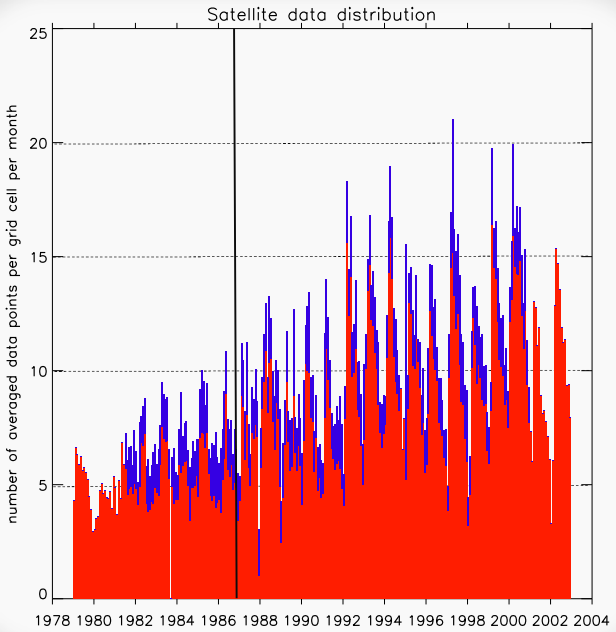
- Polar Pathfinder sea ice motion vectors
- 25 km x 25 km grid
- Cross correlation method
- Interpolation onto grid cell with SIC ≥ 50%
- Monthly mean when ≥ 20 OI vectors available

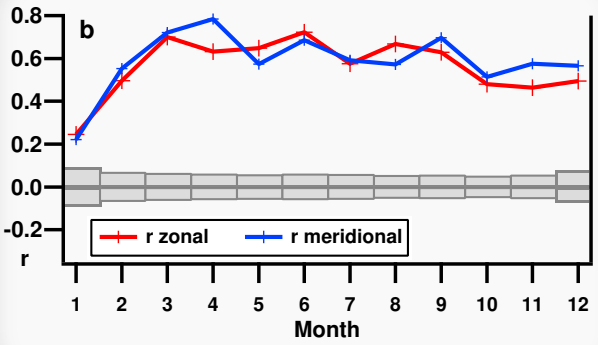



| Sensor | Operation time | Temporal coverage |
|---|---|---|
| Scanning Multi-channel Microwave Radiometer (SMMR) | Oct 1978 – Aug 1987 | every other day |
| Special Sensor Microwave/Imager (SSM/I) | Jul 1987 – Dec 2006 | every day |
| Advanced Very High Resolution Radiometer (AVHRR) | Jul 1981 – Dec 2000 | 4 satellite passages each day |

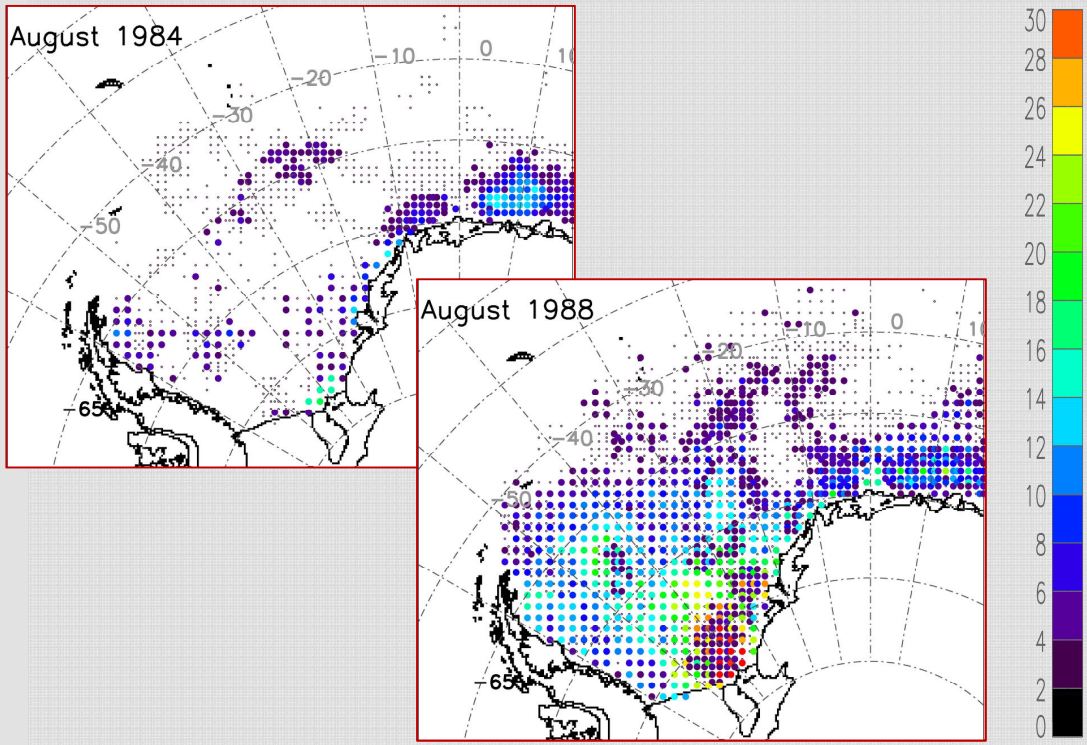
Fowler (2003), Data from NSIDC

# Accuracy of drift data



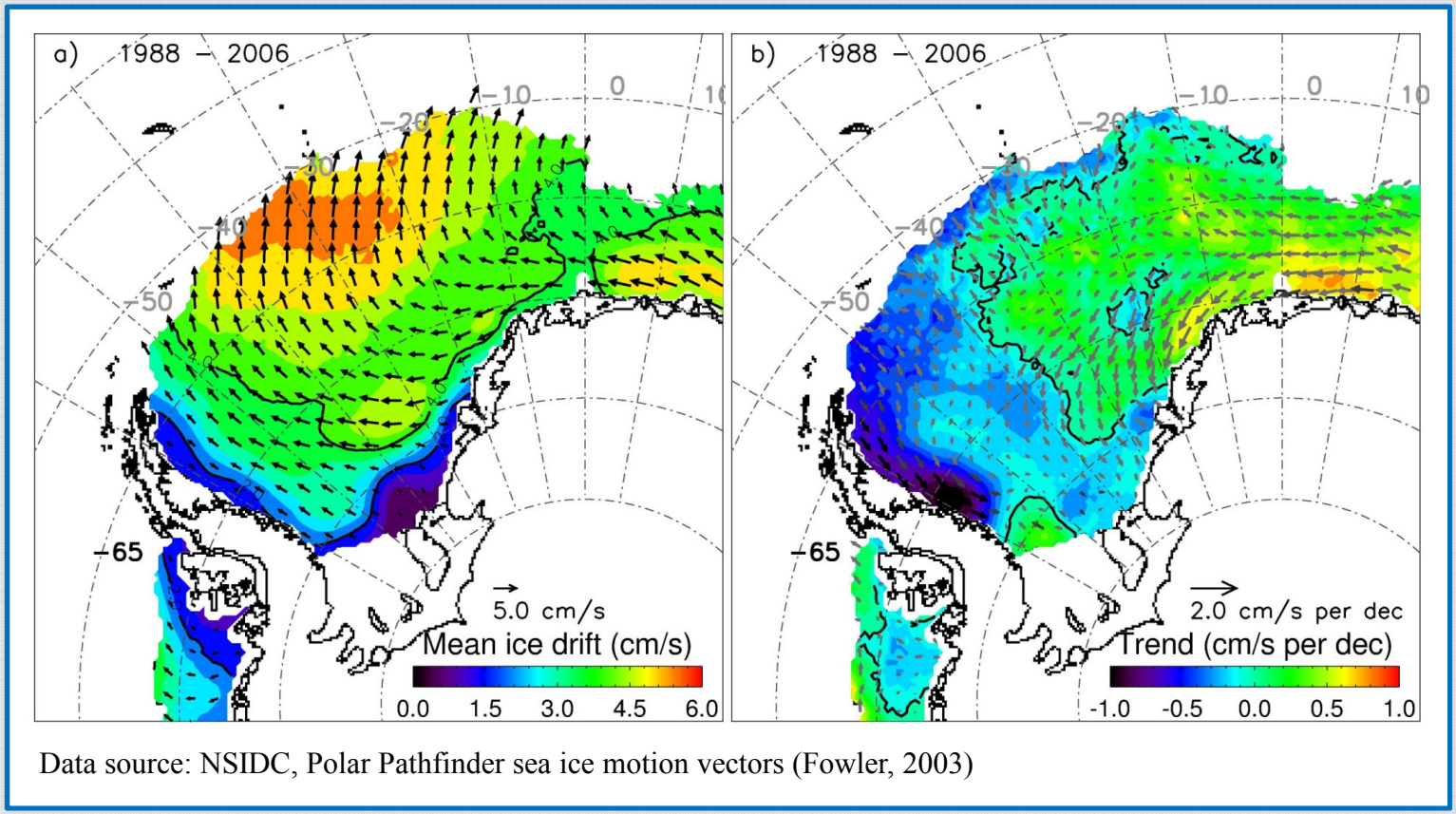




Adapted from Schwegmann et al. (2011)




- **High data coverage since 1987**
- **Satellite and *in situ* data correlate well**
- **Summer months: lower data coverage/ correlation**

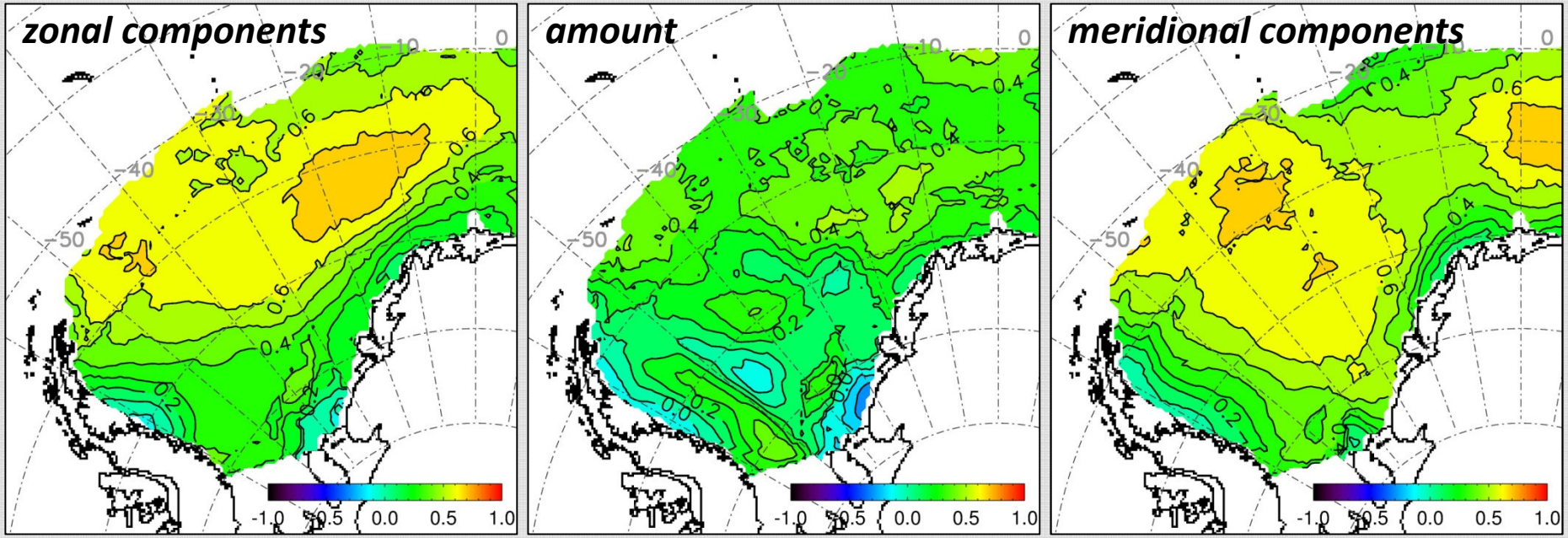
# Sea ice drift variability




Data source: NSIDC, Polar Pathfinder sea ice motion vectors (Fowler, 2003)

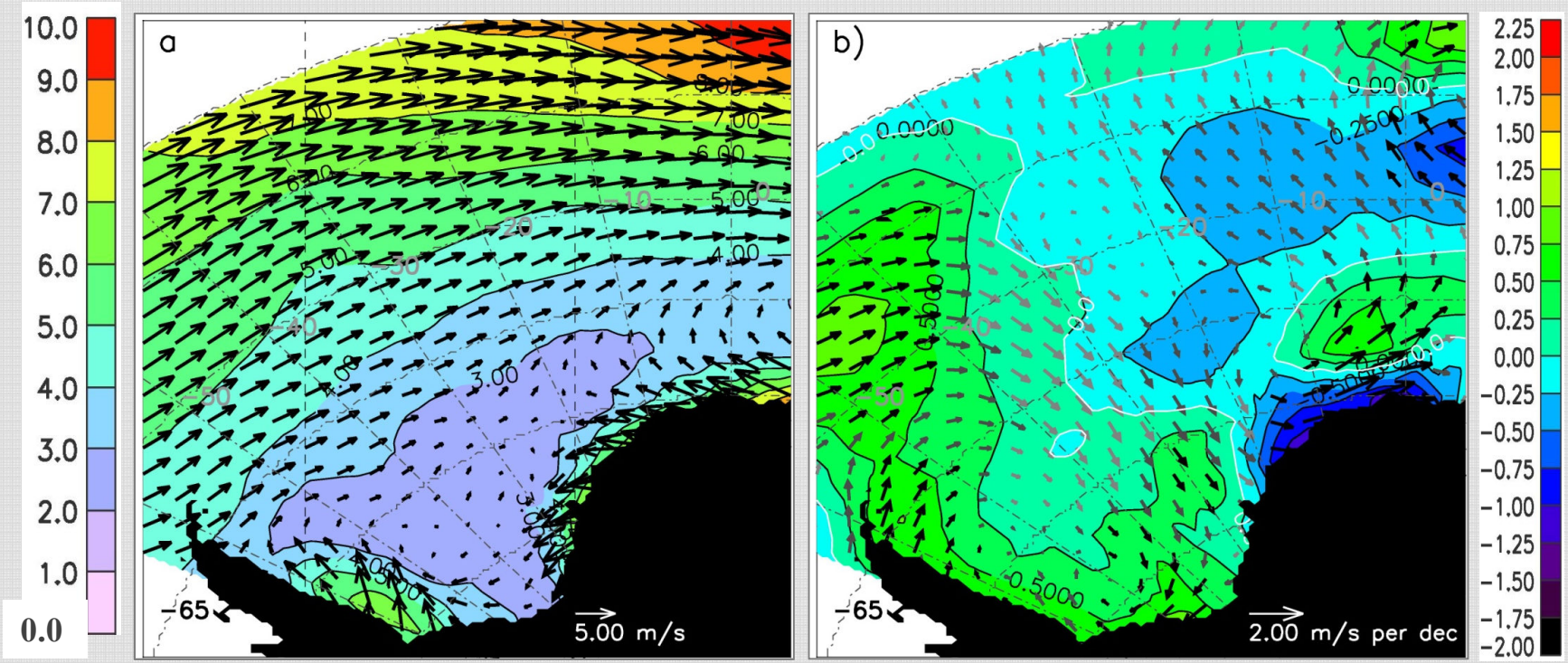
- **Decrease in sea ice drift velocities in the western Weddell Sea**
- **Increased sea ice drift in the eastern Weddell Sea**

# Correlation wind/drift




- **Correlation coefficients of up to 0.7 in the central and marginal sea ice zone for zonal and meridional components**
- **Correlation of magnitudes does not exceed coefficients of 0.5**
- **Generally low correlation near the coasts**

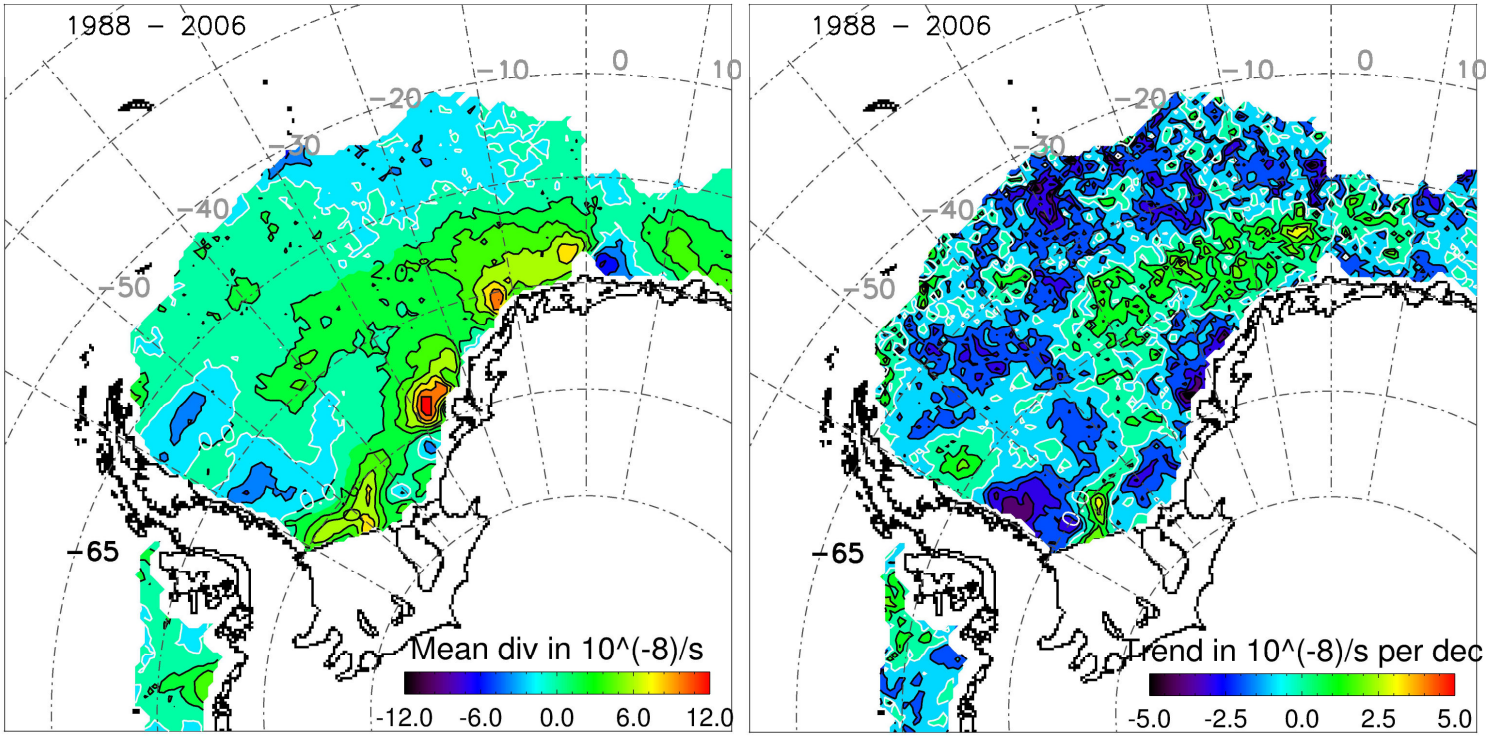
# Wind variability




Data source: NCEP Reanalysis (Kalnay, 1996)

- **Western Weddell Sea exhibits**
  - ➢ **increasing westerlies in the north**
  - ➢ **increasing offshore winds**
- **Trends in wind field are opposed to trends in sea ice drift**

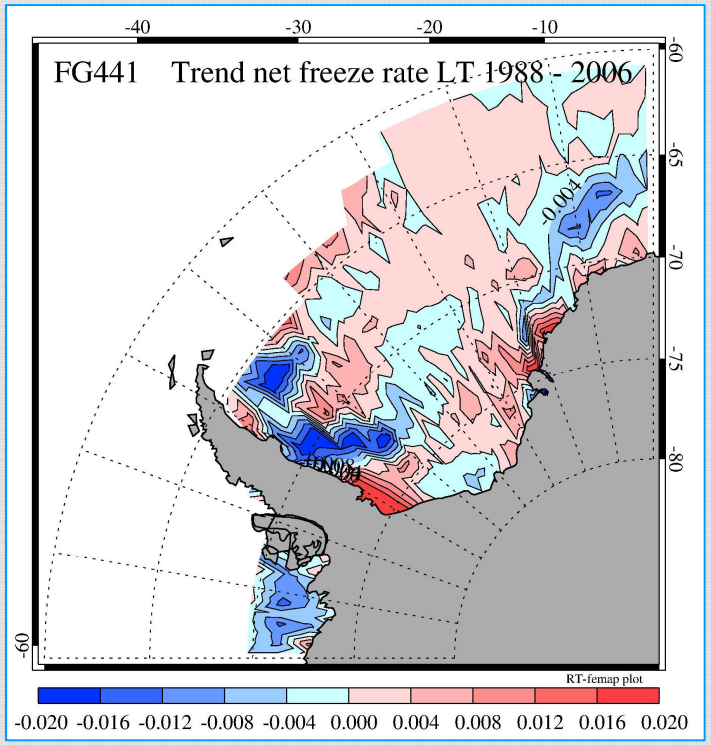
# Divergence



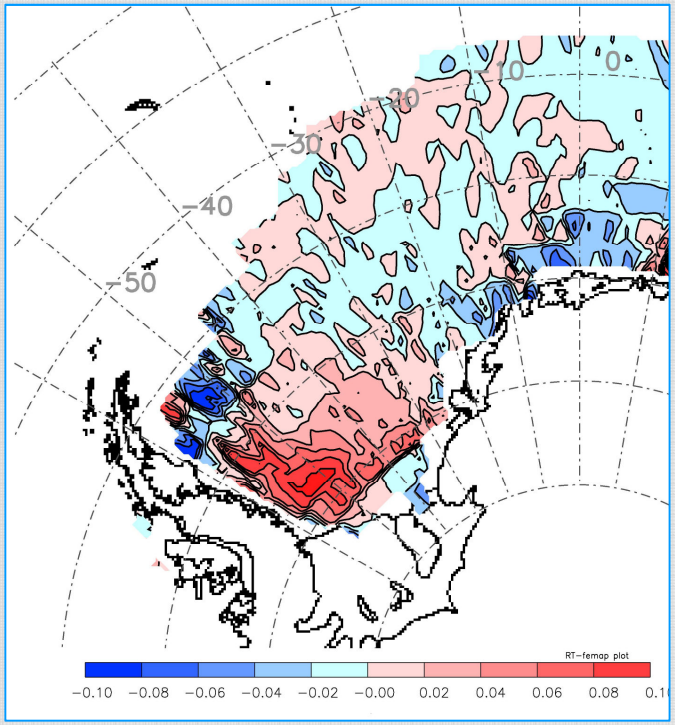

Data source: NSIDC, Polar Pathfinder sea ice motion vectors (Fowler, 2003)

- **Tendency to reduced divergence in most parts of the Weddell Sea**
- **Redistribution of sea ice from the west to the east**

# Sea ice volume




- **Thermodynamical sea ice growth**
  - ➢ **increases in Ronne polynya**
  - ➢ **decreases in north-western Weddell Sea**




- **Dynamical sea ice growth**
  - ➢ **increases in the south-western Weddell Sea**

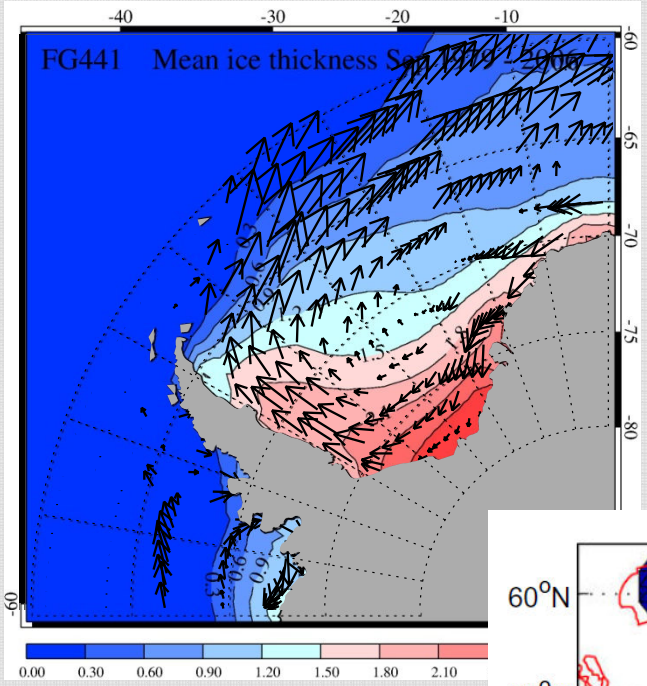
# Conclusions

- **Reasonable data quality since 1988**
  - **before 1988: low data coverage**
  - **since 1988: validation with buoy data possible**
- **Decrease of sea ice drift in the west certainly by increased deformation**
- **Higher ice production in Ronne polynya consistent with**
  - **increased off-shore wind**
  - **increased sea ice drift**

# Needs

- **Sea ice thickness measurements**
  - **frequent large-scale measurements from e.g. satellites**
  - ***in situ* measurements for validation and case studies**
- **Updated large-scale sea ice drift product**
- **Ongoing *in situ* sea ice drift data, especially in arrays of at least 3 buoys**

# The Finite Element Sea ice-Ocean Model



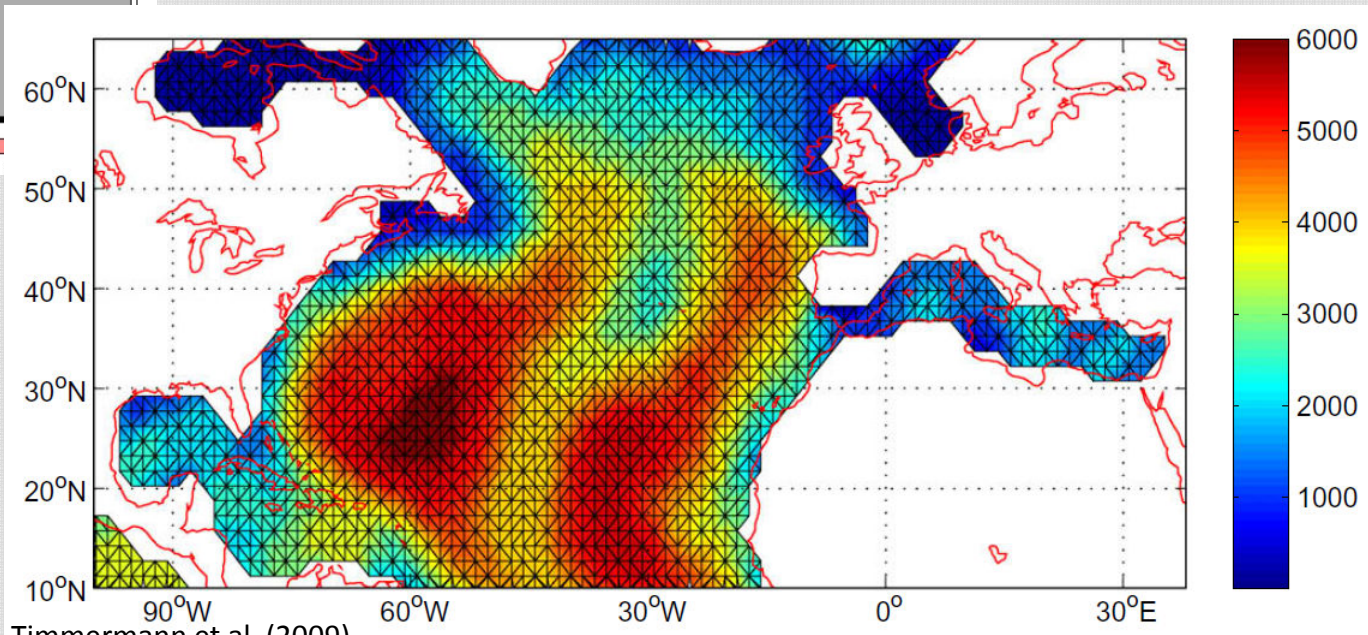

**Mean September sea ice thickness and sea ice drift vectors (1979 – 2006)**

**Global resolution: 1.5° x 1.5°**

**Prognostic variables:**

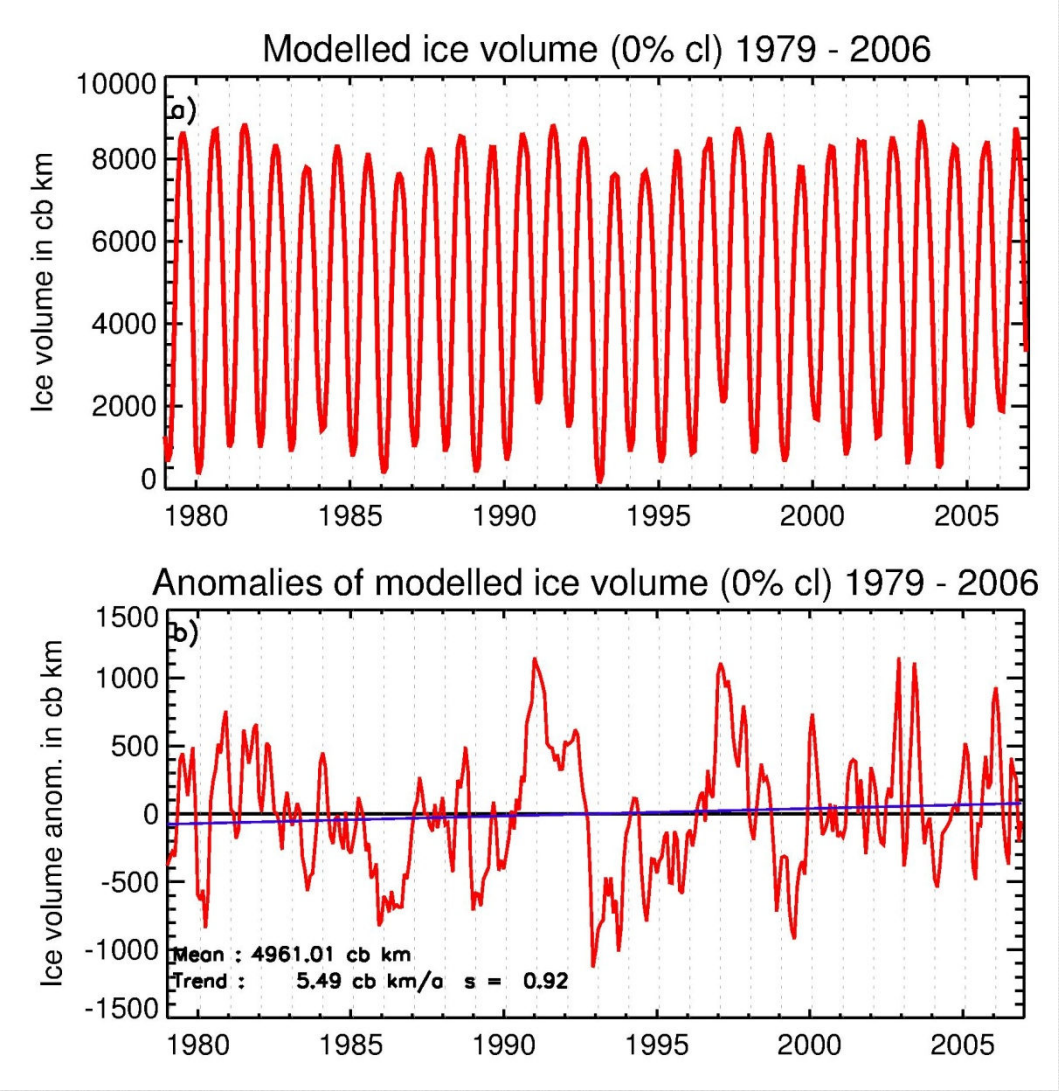
**ice concentration, ice drift, mean ice and snow thickness**

**Forcing: NCEP wind, temperature, specific humidity, cloud cover and precipitation**




Timmermann et al. (2009)

# Sea ice volume




- **Increase of modeled sea ice thickness by few cm per decade**
- **Overall increasing sea ice volume**
- **Highest trends occur in summer and fall**
- **High interannual variability**