### Sea ice variability and trends in the Weddell Sea for 1979 - 2006

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# Outline



#### Background

Changes in sea ice extent & Sea ice concentration



Ice-atmosphere interactions

Temperature Wind



Drift and deformation Volume changes



Summary and Outlook

Summary of interactions Outlook on further needs





## Sea ice extent changes



**GEMEINSCHAFT** 

## The Weddell Sea





Sea ice extent anomalies in the Weddell Sea.

Seasonal trends in % per decade.

NSIDC bootstrap sea ice concentration data (Comiso, 1999) vs. FESOM model simulation.

- Largest sea ice extent in the Southern Ocean
- Special sea ice drift regime due to the Antarctic Peninsula
- Occurrence of second year ice
- Areas of potential deep and bottom water formation
- High data coverage



# Sea ice concentration, 1979-2006



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#### Mean SIC





Data from NSIDC (Comiso, 1999).

# Sea ice concentration, 1979-2006



#### **Mean SIC**













Data from NSIDC (Comiso, 1999).

# Monthly sea ice concentration trends



Trends in % per decade. Period: 1979 to 2006. Data source: NSIDC (Comiso, 1999)

#### Sea ice concentration (SIC)

- decreases near the Antarctic Peninsula
- increases in the central and eastern marginal sea ice zone





- Connection between air temperature/ wind forcing and sea ice concentration variability and trends
- Do sea ice drift and deformation changes support connections?
- Impact on sea ice growth changes
- Impact on sea ice volume



# SIC correlated with SAT





Monthly correlation between detrended anomalies of bootstrap sea ice concentrations (SIC) and surface air temperatures (SAT) from NCEP, from 1979 to 2006.



## SAT trends





SAT trends in  $\degree~$  C per decade. Period: 1979 to 2006. Data source: NCEP Reanalysis Data



# Wind speeds







# Wind speed trends





Trend of wind speed (in m/s per decade). Black arrows: statistically significant trends at the 95% level.







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



### Sea ice divergence





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



## Dynamical sea ice growth





- Sea ice thicknesses influenced by deformation at the Antarctic Peninsula
- Trends indicate increased sea ice growth by deformation in this region



#### Freeze rates from FESOM





- Reduced freeze rates in the north-western Weddell Sea
- Enhanced freezing in the south-western Weddell Sea



## 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



# Summary





# Outlook



- Sea ice thickness measurements are needed
  - In different seasons
  - In different regions
  - Continuation of ULS measurements in the central Weddell Sea
  - Planned sea ice thickness surveys in winter 2013

#### • Refinements of grid resolution in FESOM simulations

Deformation processes might be better resolved

#### Comparison with model runs forced by ECMWF data

Higher resolution of atmospheric forcing

