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Comparison of local sea ice motion at a polynia from SAR observations and model simulations

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Motivation

Coastal polynias are open regions in the sea ice cover. They are key regions for the interaction between atmosphere and ocean in the polar regions. Important processes are:

- formation of new ice on the ocean surface
- release of brine to the upper ocean layer
- increase of heat flux between ocean and atmosphere

Methodology

To study processes in the polynia, high spatial and temporal resolution is necessary. Here, the focus is on the comparison of polynia extent variation and drift patterns between:

- FESOM (A coupled sea ice ocean model, which allows studies at high resolutions) and its dependence on different atmospheric forcings.
- High resolution drift observations from Envisat ASAR WS based on a cascaded multiscale drift algorithm, first described by Thomas, 2008 and modified by Hollands and Dierking, 2011.

Drift velocities

The employed data set covered the Ronne Polynia in the Weddell Sea, Antarctica. It consisted of two time series of Envisat ASAR wide swath images (austral summer 2008 and late fall 2008).

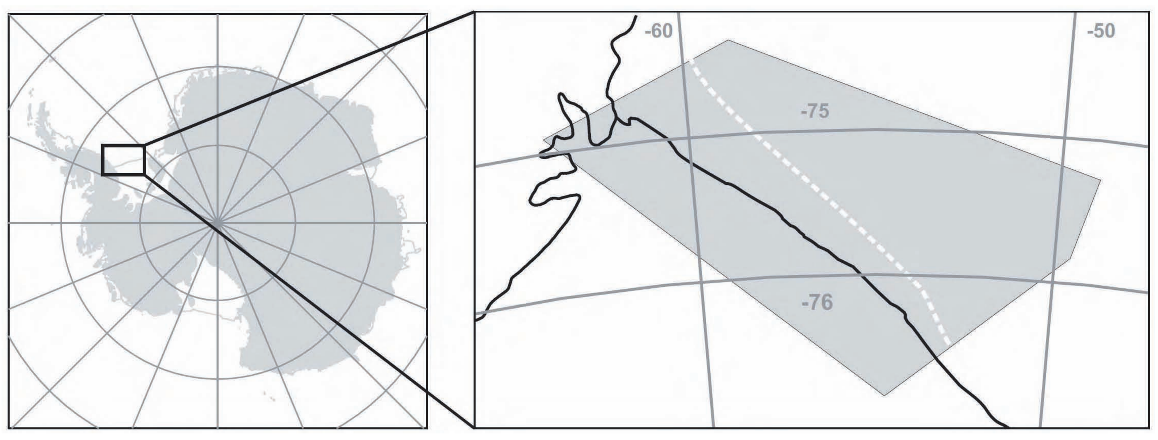

Figure 1: Area covered by the satellite data. The Figure shows the area of the Ronne polynia, adjacent to the Filchner-Ronne Ice Shelf.

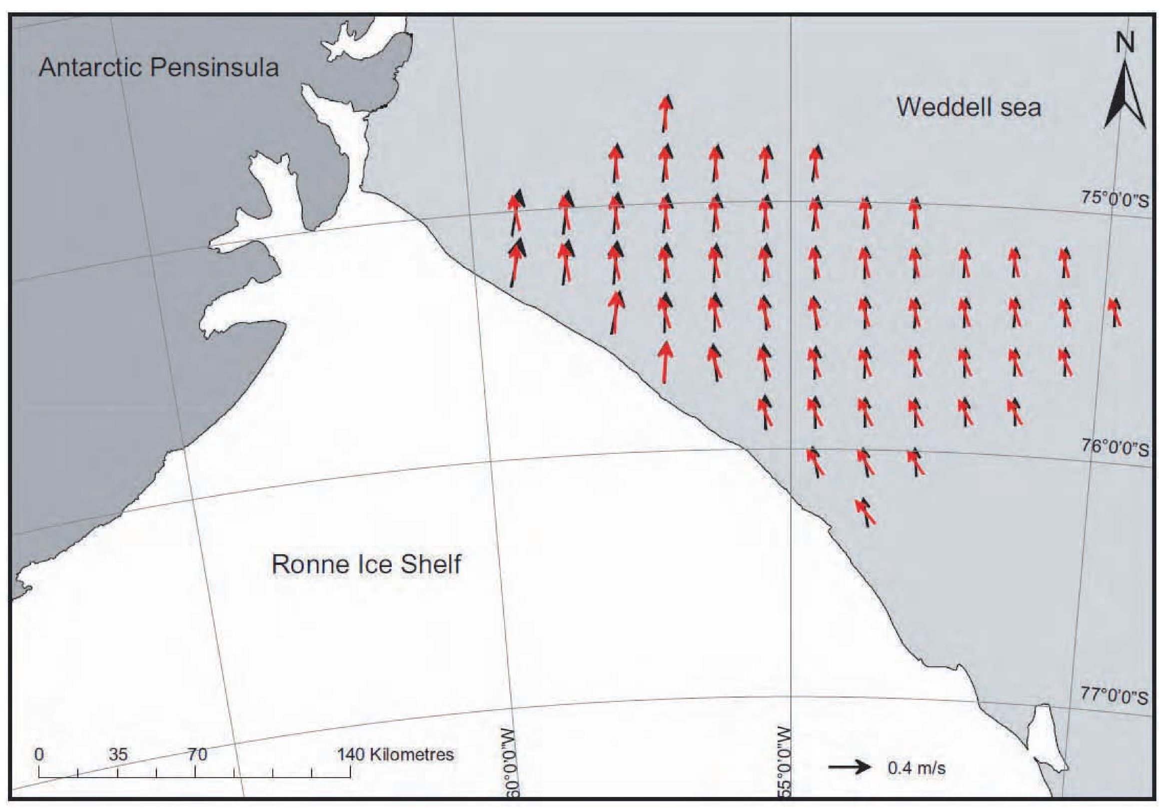

Figure 2: Drift vector field for observed drift (black) and modelled FESOM drift (red) forced with NCEP atmospheric data for the 30.5.2012

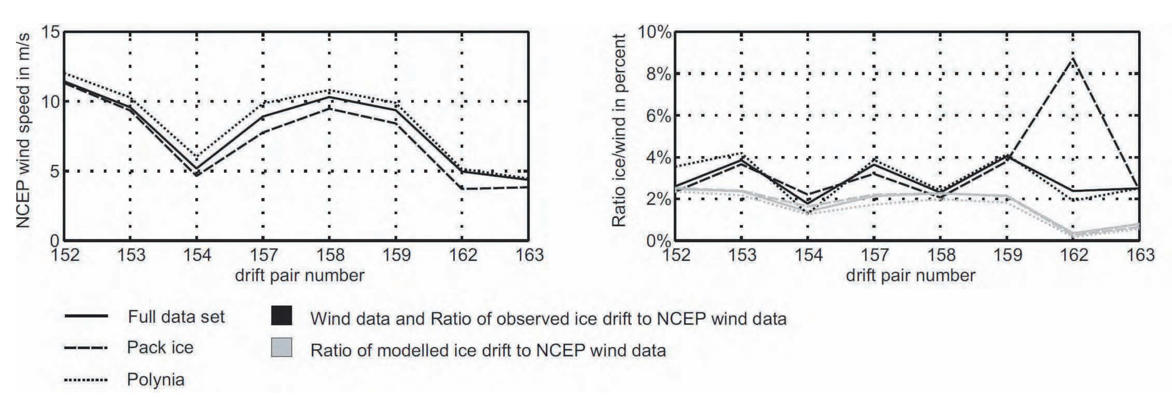

Figure 3: Wind speed and corresponding wind factors (ratio between drift velocity and wind speed) based on NCEP wind data.

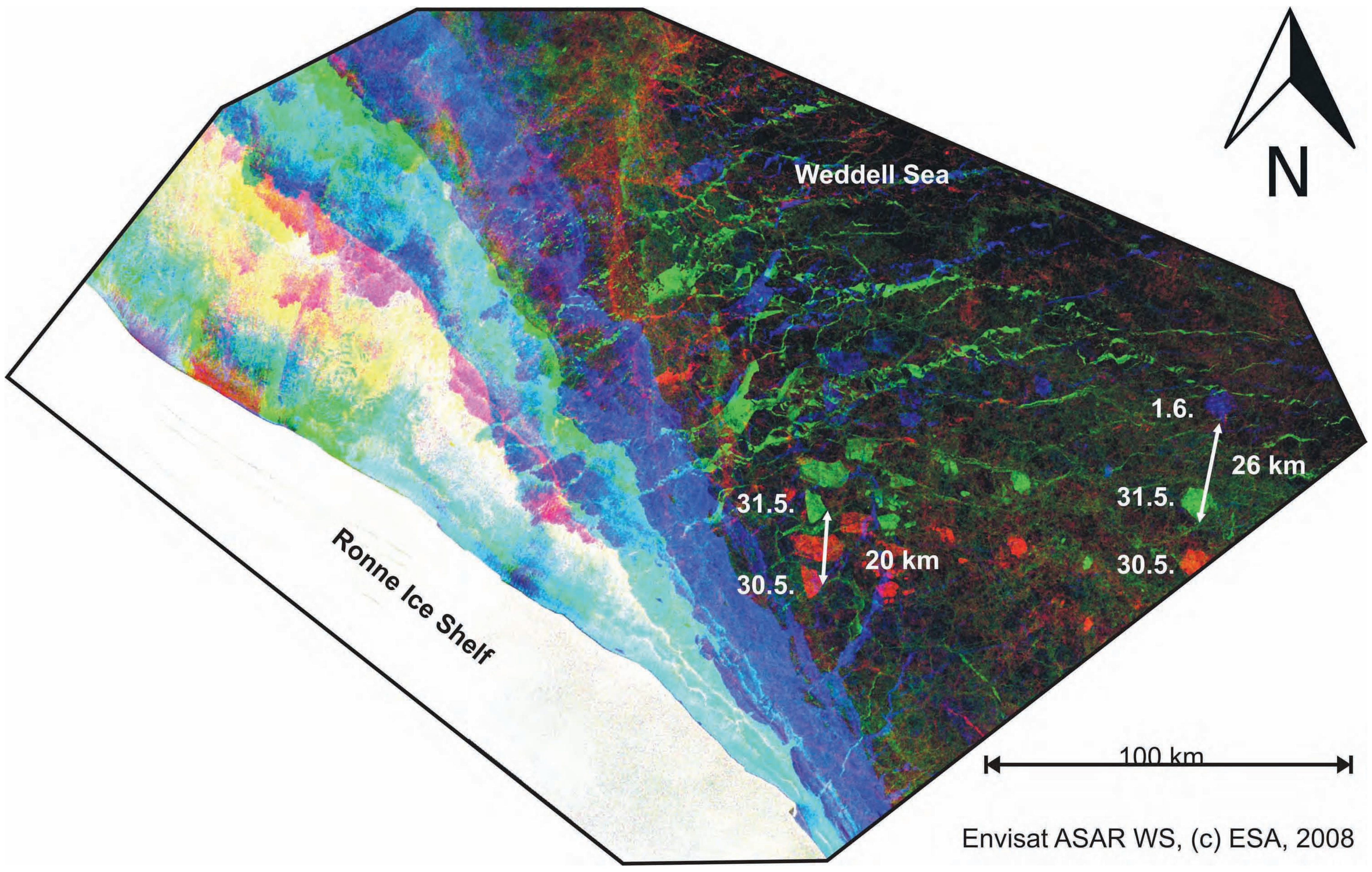

Figure 4: RGB composite of Envisat ASAR images over the Ronne Polynia, acquired at subsequent days. Red represents the patterns on 30.5.2008, green the patterns on 31.5.2008 and blue the patterns on 1.6.2008. The image illustrates the magnitudes of displacement during this period.

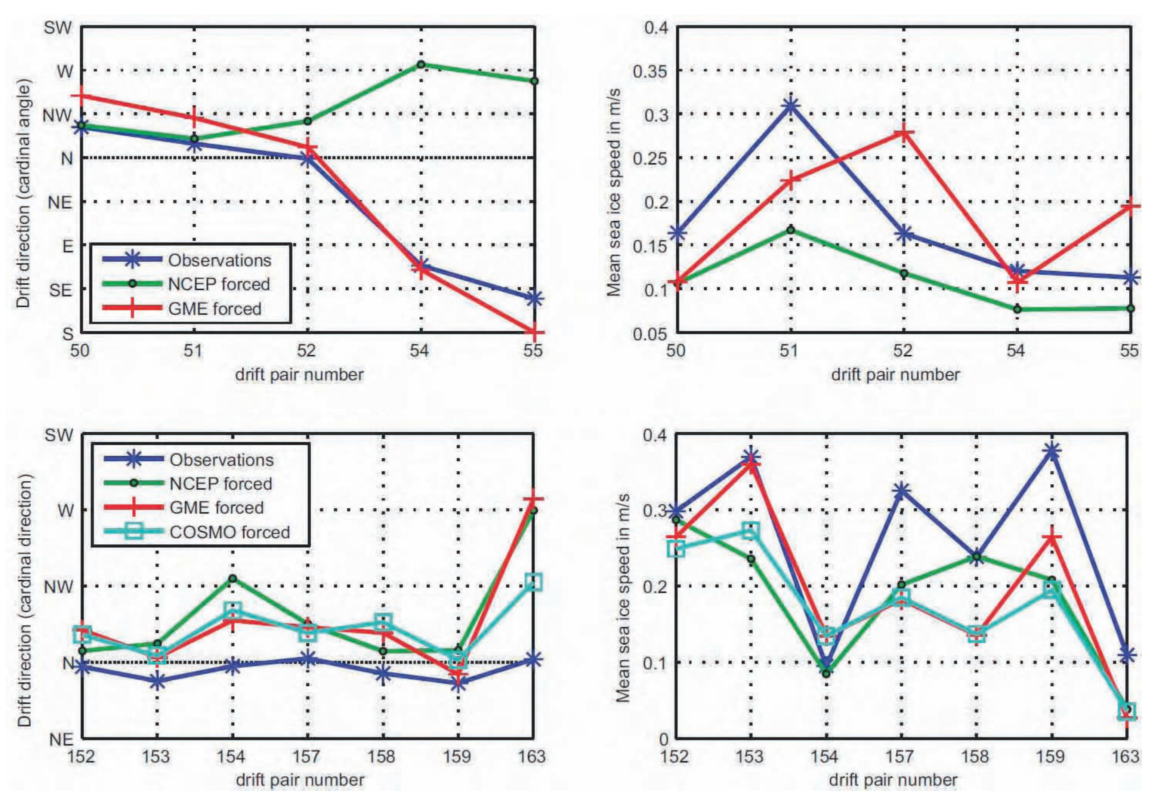

Figure 5: Observed and modelled mean magnitude and direction angle for ice drift.

Polynia extent

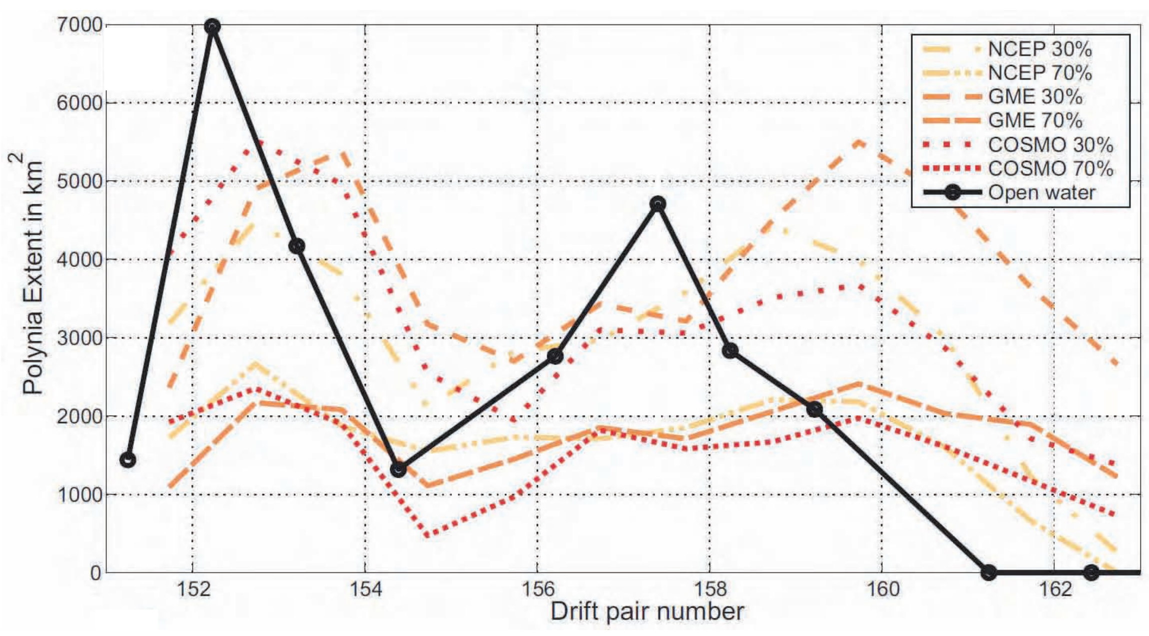

Figure 6: Observation and modelling of polynia extent for the June period. It shows the modelled results and the observed open water area.

Summary

The results of our study are:

- Modelled ice velocities were smaller and turning angles between wind direction and sea ice drift were larger.
- Atmospheric forcings seem to underestimate wind velocities.
- Simulations and observations of polynia extent compare.

The evolution of polynias can be realistically simulated with coupled sea ice models, provided that the modelling grid is dense (1-3 km) and the atmospheric forcing data are provided at high spatial resolution (<50 km).

References

Thomas, M. V., C. A. Geiger, and C. Kambhamettu (2008), *High resolution (400 m) motion characterization of sea ice using ERS-1 SAR imagery*, Cold Regions Science and Technology, 52 (2), 207-223.

Hollands, T., and W. Dierking (2011), *Performance of a multiscale correlation algorithm for the estimation of sea ice drift from sar images: initial results*, Annals of Glaciology, 52 (57), 311-317.

Hollands, Thomas, Verena Haid, Wolfgang Dierking, Ralph Timmermann and Lars Ebener (2012), *Sea ice motion at the Ronne Polynia, Antarctica: SAR observations vs. model results*, Journal of Geophysical Research [submitted]

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