GRENE-Arctic

Interannual change of sea-ice motion in the Arctic

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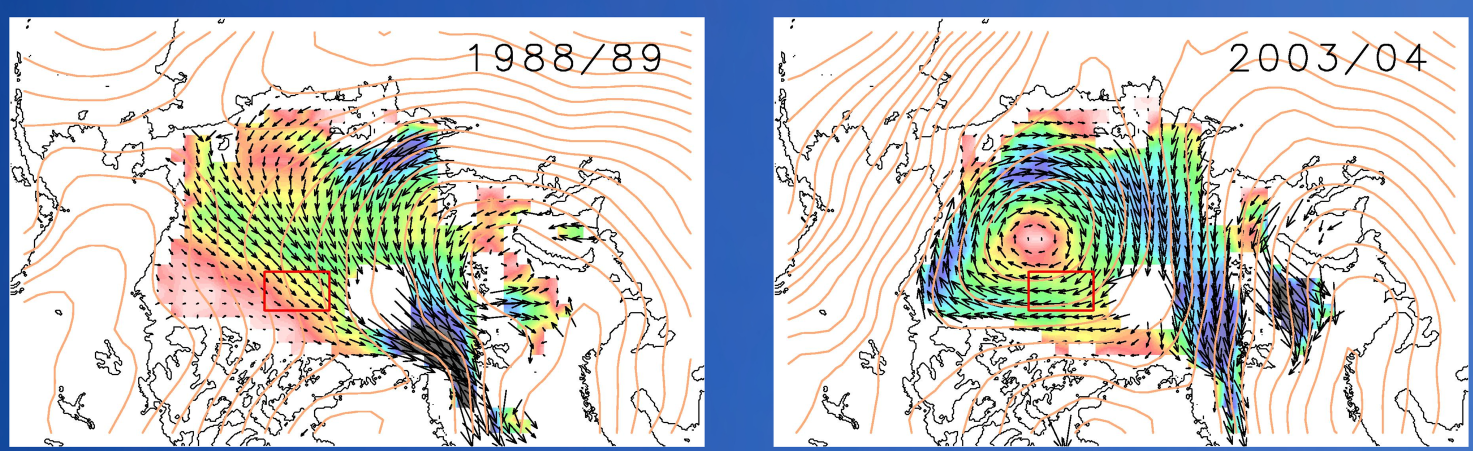
Objective

The Arctic ice motion changes drastically day-by-day and year-by-year. It is mostly controlled by the change of wind field (Kimura and Wakatsuchi, GRL, 2000).

This study aims to reveal the interannual variability of the Arctic sea ice motion in winter, especially on its relation with wind field. We also examine the relationship between the winter ice convergence/divergence and summer ice cover, and predict the summer ice cover based on the relation.



Mean ice motion field for 1988/89 and 2003/04 winters (December-March). Contour lines show mean sea-level pressure for the same period.

Data

Ice velocity

Calculated by maximum cross-correlation method from the data of satellite microwave sensors (Kimura and Wakatsuchi, GRL, 2000).

period	data from	grid size	frequency
2003-2014	AMSR-E , AMSR2 36GHz	60 x 60 km	1 day

Ice concentration

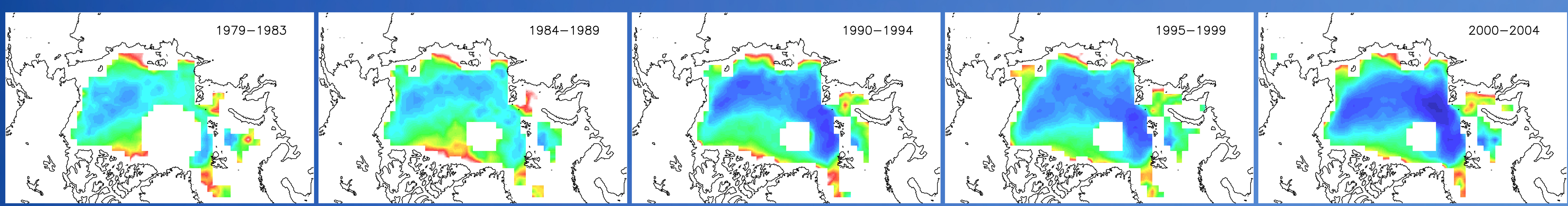
Daily 10 km-grid data calculated from AMSR-E and AMSR2 images processed by JAXA.

Ice thickness

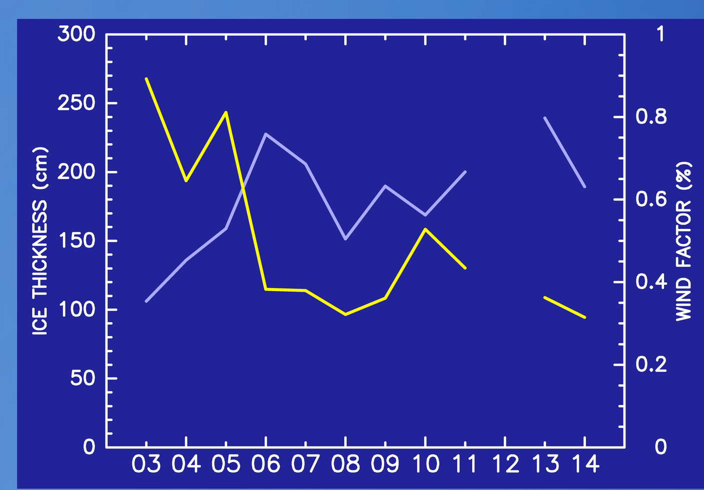
Daily 10 km-grid data calculated from AMSR-E and AMSR2 images using the algorithm by Dr. Tateyama (Krishfield et al., JGR, 2014).

Relationship between ice motion and wind field

Using derived daily ice velocity and wind speed, correlation coefficient between them, wind factor, turning angle, ocean current are calculated. We can find the long term increase of wind factor in this several decades and a relation between the wind factor and ice thickness.



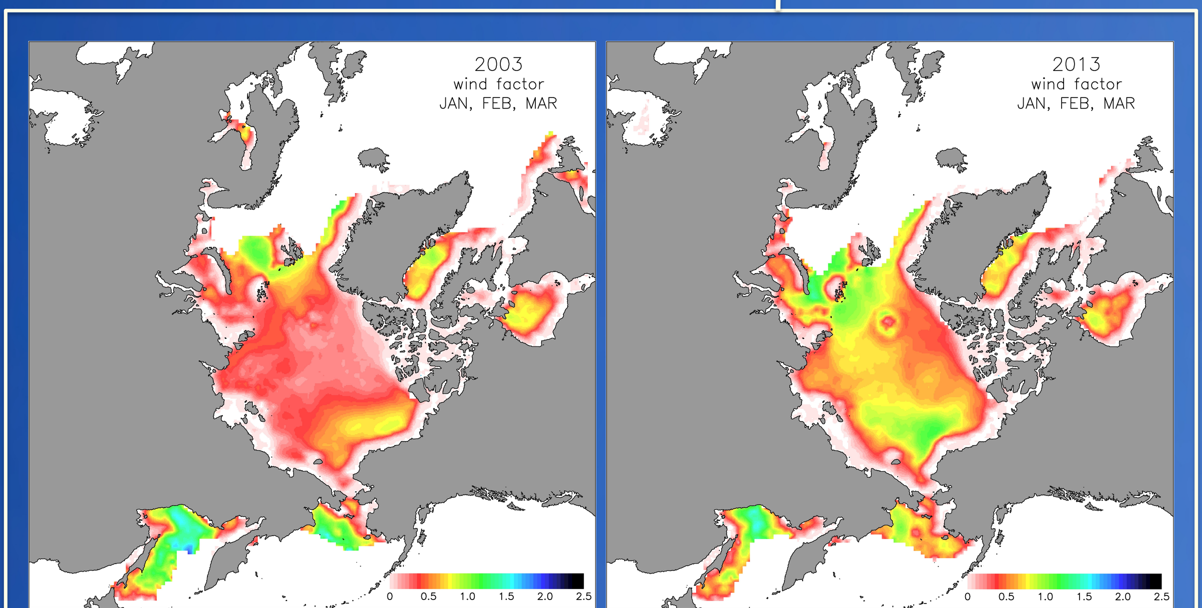
Long-term change in the wind factor in winter (December-March). It becomes larger gradually.



Interannual change of the wind factor (blue line) and ice thickness (yellow line) in the blue rectangle.

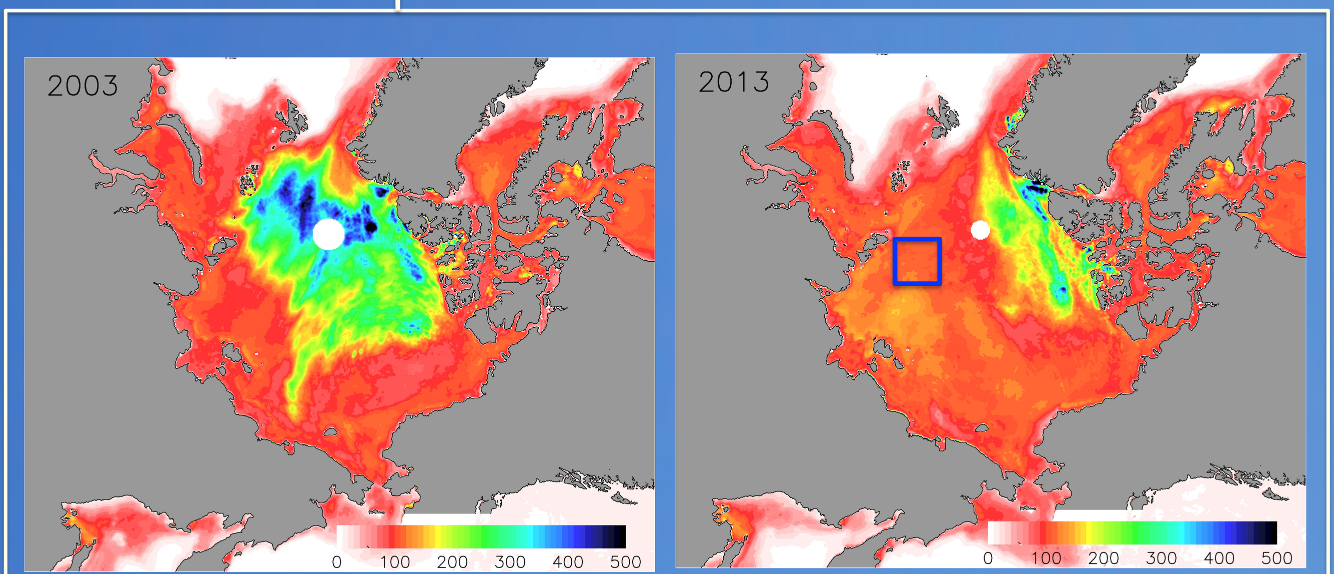
Relation

Wind factor

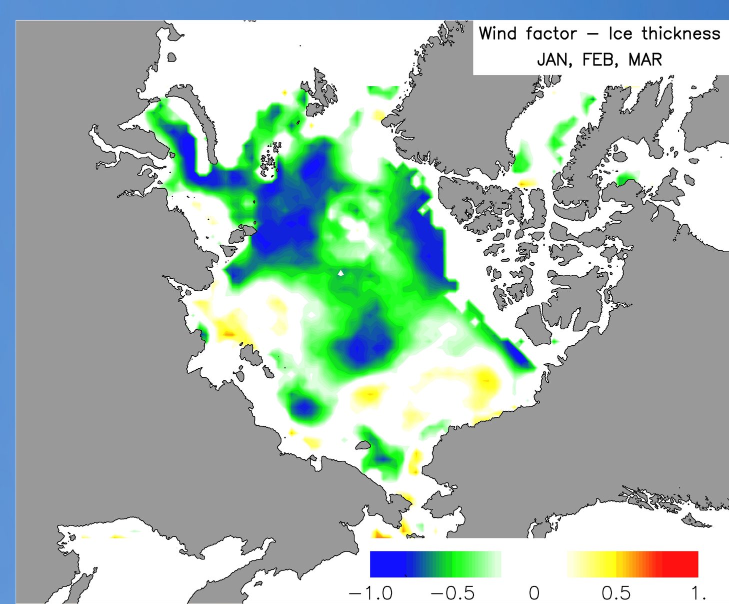


Wind factor for 2003 and 2013 winters (January-March).

Ice thickness



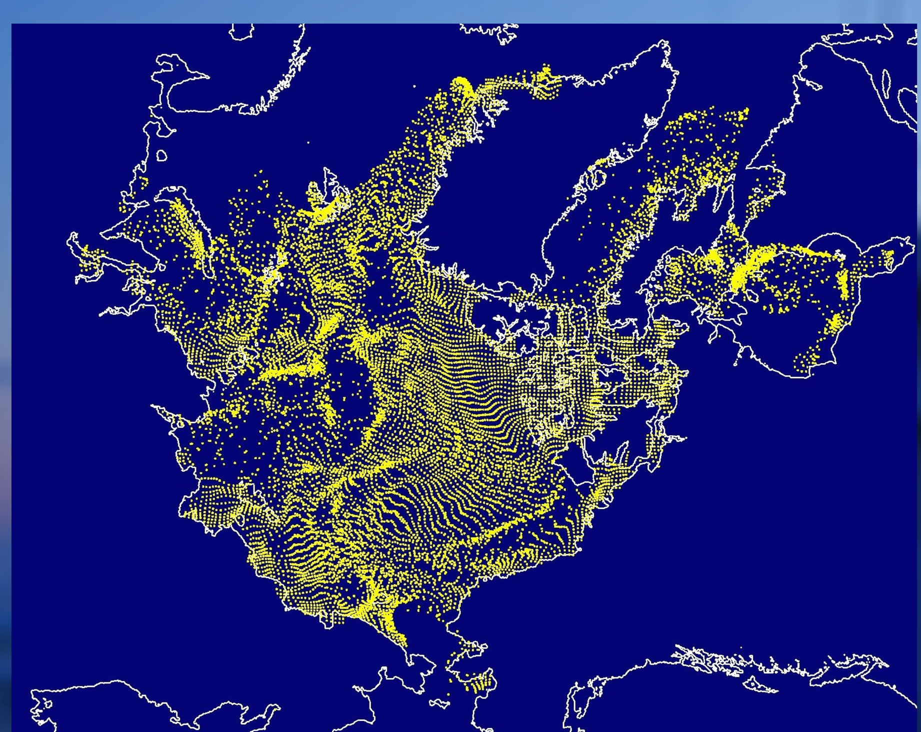
Mean ice thickness for 2003 and 2013 winters (January-March).



Correlation coefficient between the winter wind factor and ice thickness.

Winter ice motion and summer ice cover

The winter ice divergence/convergence is strongly related to the summer ice cover in some regions; the correlation coefficient between the winter ice convergence and summer ice area ranges between 0.5 and 0.9 in areas with high interannual variability (Kimura et al., Polar Research, 2013). Based on this relation, we predicted the summer ice area (http://www.1.k.u-tokyo.ac.jp/YKWP/2014arctic_e.html).



Distribution of particles on April 30 2014, which are first arrayed over the ice-covered area on December 1 2013 and are moved based on our ice velocity dataset.

Winter ice motion

↓ Divergence : become thinner
Convergence : become thicker

Spring ice thickness

↓ Thin ice : easy to melt
Thick ice : hard to melt

Summer ice cover