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Trends in Arctic sea ice speed and wind dpeed During 1992-2009

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During the last 20 years substantial changes of the Arctic sea ice cover have been observed. Although the most pronounced changes are the reduction in summer sea ice extent and thickness, an increase in sea ice speed has also been inferred from surface buoys and drift stations. The causes and spatial variability of sea ice speed trends, however, are not well understood. Sea ice movement depends on surface wind, ocean currents, and on the internal structure of the sea ice, e.g., strength, compactness, and drag. Here we study the observed trends in sea ice speed obtained from satellite measurements in combination with trends in 10 m wind speed obtained from four atmospheric reanalyses. Using data from the SSM/I 85V GHz channel, sea ice velocities can be retrieved on a daily basis during the winter months, October to May. Arctic sea ice speed during these months for the years 1992-2009 increased by 0.07±0.01 cm/s/year (+7%/decade). During the same time period no significant change in surface wind speed over sea ice can be found in any of the four atmospheric reanalyses JRA, ERAinterim, NCEP, or NCEP-2. Looking only at these mean trends one could draw the false conclusion that the increase in sea ice speed is not caused by winds but solely due to intrinsic changes of the sea ice (e.g., sea ice could be more often in free drifting conditions due to decreased ice compactness) or ocean currents changes. The spatial structure of the sea ice speed and wind speed trends, however, is very heterogeneous and both show a similar pattern. Positive trends are seen in the Central Arctic and to a lesser extent in the Western Beaufort Sea, the East Siberian Sea, and Kara Sea. The sea ice trend is positive almost everywhere in the Arctic Basin. The wind trend on the other hand shows negative trends in some parts of the Arctic e.g., the Greenland Sea, the Lincoln Sea, the Eastern Beaufort Sea plus Canadian Archipelago; nevertheless, the spatial correlation between the sea ice and wind speed trend pattern is about 0.5. Furthermore, in regions with positive wind speed trend the sea ice time series and wind speed time series are highly correlated (>0.6) while in regions with negative wind speed trends no or only very low correlations can be found. Many of the regions with negative wind speed trend like the Lincoln Sea are close to the coast and and have a thick and very compact ice cover. In these regions the sea ice is not in free drift condition and a change in wind speed is only causing small changes in sea ice speed. Many of these negative wind speed regions, however, show a positive ice speed trend. Here intrinsic sea ice changes, e.g., changes in compactness and strength, may play a dominant role for the sea ice speed increase. Overall we conclude that wind is one of the major contributors to the observed sea ice speed increase, despite the fact that no or only a very small Arctic-wide wind speed trend is found. In many places, however, local changes in wind speed correlate very well with the observed sea ice speed increase.