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# Lead orientation from satellite observations compared to sea-ice deformation

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Leads are linear, crack-like openings in the sea-ice cover. Leads consist of open water or young ice or a mixture of both. An interaction between leads and sea-ice dynamics has been hypothesized but is not well understood. The aims of this study are to provide a climatology of sea-ice lead orientation and to investigate possible links between sea-ice lead orientation and sea-ice dynamics. So far, only a sparse observational data record of leads and their orientation exists from satellite observations. One reason for the sparse observational record is that the lead orientation is often obtained manually, which is time-consuming and depends on human perception.

We introduce a method to infer lead orientations automatically. The method is based on an image analysis technique applied to lead concentration maps, which are calculated from daily advanced microwave scanning radiometer measurements. An evaluation of the method reveals that 55% of the manually derived leads are derived automatically with a root mean square deviation for the orientation of 8.5°.

We calculate daily maps of lead orientation from November to April for the years 2002 to 2011. Regional time series of monthly averaged lead orientation vary from month to month. Each monthly multi-year mean of lead orientation maps shows a spatially coherent pattern. The mean lead orientation of the whole period shows a prevailing spatial pattern in many regions of the Arctic, especially in the Fram Strait. In the Beaufort Sea, lead orientations are bimodally distributed.

As a first approach to explain the spatially coherent mean pattern over the whole period we compare the lead orientation to deformation parameters derived from sea-ice drift. Furthermore, we compare weekly averaged lead orientation to weekly averaged sea-ice deformation estimated by RADARSAT Geophysical Processor System. The comparison shows that the orientation of the derived leads is similar to the orientation of the large kinematic features visible in the high-resolution divergence fields.