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High-resolution maps of the sea-ice concentration from MODIS satellite data

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For realistic simulations with numerical weather prediction models in polar regions, the sea-ice concentration represents an essential boundary or initial field. For high-resolution process studies of atmosphere-sea-ice-ocean interactions, hence, maps of the sea-ice concentration are needed at up to one kilometer resolution.

For this purpose, a new algorithm was implemented that uses infrared satellite images taken by the Moderate Resolution Imaging Spectroradiometer (MODIS) on board NASA satellites Aqua and Terra to retrieve high-resolution data of the sea-ice concentration. This "MODIS potential open water algorithm" (MPA) first retrieves sea-ice concentration for each scene from the satellite-sensed surface temperature. Then, data from multiple satellite overpasses within one day are combined to a map. The remaining gaps (caused for example by clouds) are finally filled in by a scheme considering the brightness temperatures in gap areas.

Measurement from the field experiment "Atmospheric Boundary layer and Sea ice Interaction Study" (ABSIS) – conducted in April 2003 over the Fram Strait in the Arctic – are used to validate the results of MPA with in-situ measurements. The in-situ data comprise aircraft measurements of upwelling longwave radiation and helicopter-based measurements of the sea-ice thickness. The comparison yields that sea-ice concentration can be determined from MODIS data with approximately $\pm$ 10% error. The compilation of composite maps from multiple overpasses leads to an overall uncertainty of $\pm$ 11.5%. In a further comparison of MPA sea-ice concentration with the popular Special Sensor Microwave Imager (SSM/I) sea-ice concentration data, both data sets are found to agree within $\pm$ 7%.