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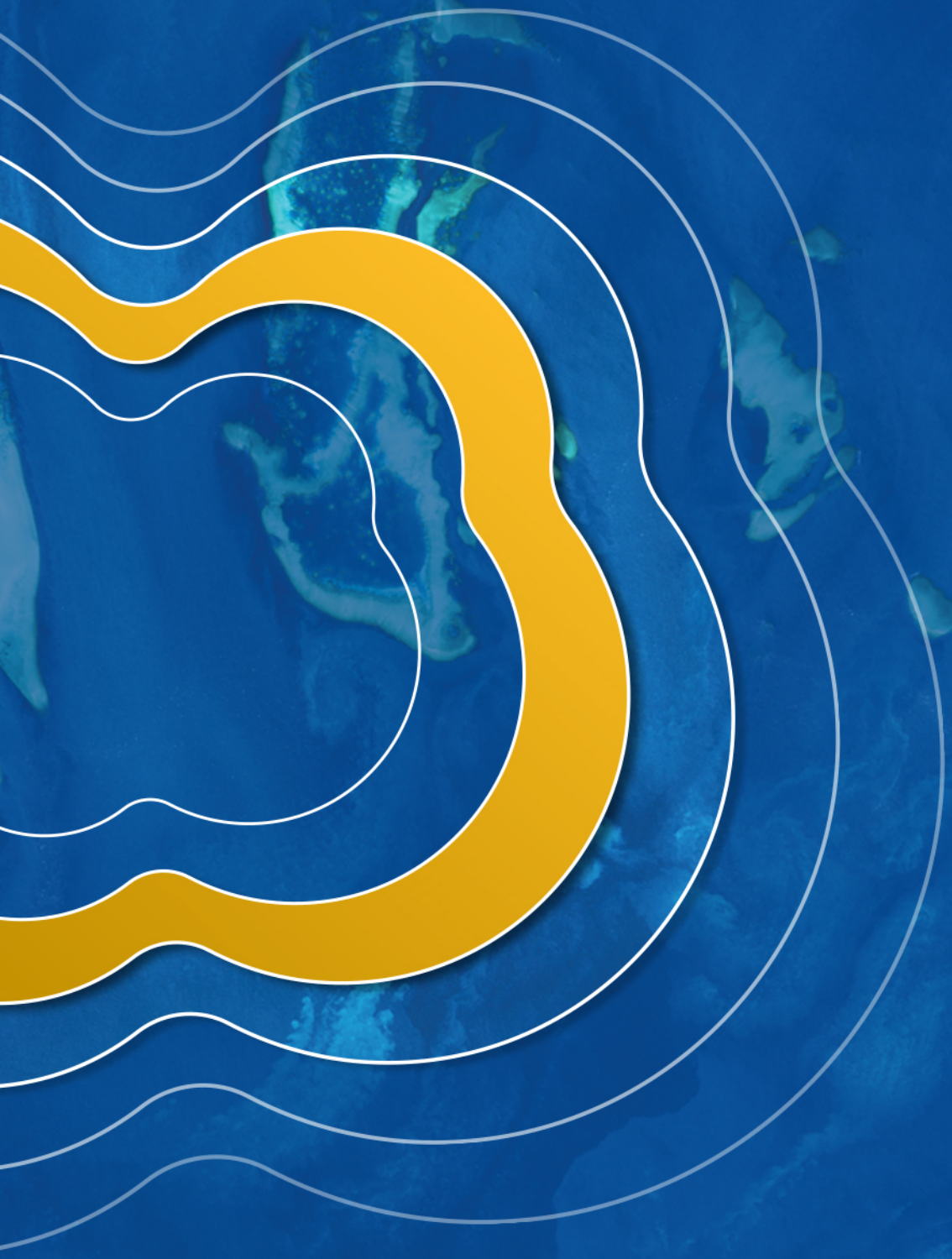

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Sea ice concentration in Arctic summer estimated from AMSR2 and NWP data based on machine learning approaches

A2.09: Sea-Ice Poster Session
화요일, 5월 14, 2019
5:20 오후 - 7:00 오후
South Hall - Floor 0
Poster Presentation

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Hide Abstract

Arctic sea ice concentration (SIC) is a primary information for the prediction of climate change and the development of sea route in polar oceans. Passive microwave (PM) sensors such as Advanced Microwave Scanning Radiometer-2 (AMSR2) have observed microwave radiation properties of sea ice and open water and provided the SIC by using various algorithms since the 1970s. However, the SIC retrieval algorithms adopted for the PM observations show low accuracy in the Arctic summer. This is because the algorithms only use the PM observation data that could not reflect the unique microwave radiation characteristics of sea ice and open water in summer due to the effects of atmospheric water contents and ice surface melting by high temperature. In this study, SIC estimation models for the Arctic summer considering the atmospheric effects on the PM observations were developed by using the AMSR2 brightness temperatures, numerical weather prediction (NWP) data from the European Centre for Medium-Range Weather Forecasts (ECMWF) ERA-Interim reanalysis and Korea Multi-Purpose Satellite-5 (KOMPSAT-5) synthetic aperture radar (SAR) images. Four machine learning approaches—Decision Tree (DT), Random Forest (RF), Multi Layer Perceptron (MLP), and Convolution Neural Network (CNN)— were adopted for the development of the SIC estimation models. A total of 339 KOMPSAT-5 Enhanced Wide-swath SAR images in HH-polarization were acquired in the Pacific Arctic Ocean (East Siberian Sea, Chukchi Sea and Beaufort Sea) during the summer (July to September) from 2015 to 2017. We discriminated sea ice from open water in the KOMPSAT-5 SAR images and computed 42,480 values (samples) of SIC within 10 km × 10 km window. Eighty percent of the KOMPSAT-5 SIC values were used as training dataset for the SIC estimation models and the remaining values were used as test dataset. The brightness temperatures measured at each channel of AMSR2 and their combinations and the atmospheric parameters (atmospheric water vapor, wind speed, sea level pressure, 2-m temperature, and 925 hPa-temperature) predicted by the ERA-Interim reanalysis were used as input variables for the SIC estimation. The SICs estimated from the machine learning approaches showed the value of bias less than 1% and the value of root mean square error (RMSE) less than 9% compared to the KOMPSAT-5 SAR SIC values. The values of bias and RMSE from the machine learning models are much smaller than those from the existing SIC retrieval algorithms for the AMSR2 such as Bootstrap algorithm (bias of 8.8% and RMSE of 21.7%) and ARTIST Sea Ice algorithm (bias of 6.7% and RMSE of 20.3%).

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Sea ice concentration in Arctic summer estimated from AMSR2 and NWP data based on machine learning approaches

Arctic sea ice concentration (SIC) is a primary information for the prediction of climate change and the development of sea route in polar oceans. Passive microwave (PM) sensors such as Advanced Microwave Scanning Radiometer-2 (AMSR2) have observed microwave radiation properties of sea ice and open water and provided the SIC by using various algorithms since the 1970s. However, the SIC retrieval algorithms adopted for the PM observations show low accuracy in the Arctic summer. This is because the algorithms only use the PM observation data that could not reflect the unique microwave radiation characteristics of sea ice and open water in summer due to the effects of atmospheric water contents and ice surface melting by high temperature. In this study, SIC estimation models for the Arctic summer considering the atmospheric effects on the PM observations were developed by using the AMSR2 brightness temperatures, numerical weather prediction (NWP) data from the European Centre for Medium-Range Weather Forecasts (ECMWF) ERA-Interim reanalysis and Korea Multi-Purpose Satellite-5 (KOMPSAT-5) synthetic aperture radar (SAR) images. Four machine learning approaches—Decision Tree (DT), Random Forest (RF), Multi Layer Perceptron (MLP), and Convolution Neural Network (CNN)— were adopted for the development of the SIC estimation models. A total of 339 KOMPSAT-5 Enhanced Wide-swath SAR images in HH-polarization were acquired in the Pacific Arctic Ocean (East Siberian Sea, Chukchi Sea and Beaufort Sea) during the summer (July to September) from 2015 to 2017. We discriminated sea ice from open water in the KOMPSAT-5 SAR images and computed 42,480 values (samples) of SIC within 10 km × 10 km window. Eighty percent of the KOMPSAT-5 SIC values were used as training dataset for the SIC estimation models and the remaining values were used as test dataset. The brightness temperatures measured at each channel of AMSR2 and their combinations and the atmospheric parameters (atmospheric water vapor, wind speed, sea level pressure, 2-m temperature, and 925 hPa-temperature) predicted by the ERA-Interim reanalysis were used as input variables for the SIC estimation. The SICs estimated from the machine learning approaches showed the value of bias less than 1% and the value of root mean square error (RMSE) less than 9% compared to the KOMPSAT-5 SAR SIC values. The values of bias and RMSE from the machine learning models are much smaller than those from the existing SIC retrieval algorithms for the AMSR2 such as Bootstrap algorithm (bias of 8.8% and RMSE of 21.7%) and ARTIST Sea Ice algorithm (bias of 6.7% and RMSE of 20.3%).

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