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Arctic energy budget in relation to sea-ice variability on monthly to annual time scales

Folmer Krikken (1) and Wilco Hazeleger (2)

(1) University of Wageningen, Meteorology and Air Quality, Wageningen, Netherlands (folmer.krikken@wur.nl), (2) Royal Netherlands Meteorological Institution, De Bilt, Netherlands (wilco.hazeleger@knmi.nl)

The strong decrease in Arctic sea-ice in recent years has triggered a strong interest in Arctic sea-ice predictions on seasonal to decadal time scales. Hence, it is key to understand physical processes that provide enhanced predictability beyond persistence of sea ice anomalies. The authors report on an analysis of natural variability of Arctic sea-ice from an energy budget perspective, using 15 CMIP5 climate models, and comparing these results to atmospheric and oceanic reanalyses data. We quantify the persistence of sea ice anomalies and the cross-correlation with the surface and top energy budget components.
The Arctic energy balance components primarily indicate the important role of the seasonal sea-ice albedo feedback, in which sea-ice anomalies in the melt season reemerge in the growth season. This is a robust anomaly reemergence mechanism among all 15 climate models. The role of ocean lies mainly in storing heat content anomalies in spring, and releasing them in autumn. Ocean heat flux variations
only play a minor role.
The role of clouds is further investigated. We demonstrate that there is no direct atmospheric response of clouds to spring sea-ice anomalies, but a delayed response is evident in autumn. Hence, there is no cloud-ice feedback in late spring and summer, but there is a cloud-ice feedback in autumn, which strengthens the ice-albedo feedback. Anomalies in insolation are positively correlated with sea-ice
variability. This is primarily a result of reduced multiple-reflection of insolation due to an albedo decrease. This effect counteracts the sea-ice albedo effect up to 50%. ERA-Interim and ORAS4 confirm the main findings from the climate models.