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Does the Arctic Amplification peak this decade?

Torge Martin (1) and Thomas W. N. Haine (2)

(1) GEOMAR Helmholtz Centre for Ocean Research Kiel, Kiel, Germany, (2) Earth & Planetary Sciences, The Johns Hopkins University, Baltimore, MD, USA

Temperatures rise faster in the Arctic than on global average, a phenomenon known as Arctic Amplification. While this is well established from observations and model simulations, projections of future climate (here: RCP8.5) with models of the Coupled Model Intercomparison Project phase 5 (CMIP5) also indicate that the Arctic Amplification has a maximum. We show this by means of an Arctic Amplification factor (AAF), which we define as the ratio of Arctic mean to global mean surface air temperature (SAT) anomalies. The SAT anomalies are referenced to the period 1960-1980 and smoothed by a 30-year running mean. For October, the multi-model ensemble-mean AAF reaches a maximum in 2017. The maximum moves however to later years as Arctic winter progresses: for the autumn mean SAT (September to November) the maximum AAF is found in 2028 and for winter (December to February) in 2060.

Arctic Amplification is driven, amongst others, by the ice-albedo feedback (IAF) as part of the more general surface albedo feedback (involving clouds, snow cover, vegetation changes) and temperature effects (Planck and lapse-rate feedbacks). We note that sea ice retreat and the associated warming of the summer Arctic Ocean are not only an integral part of the IAF but are also involved in the other drivers. In the CMIP5 simulations, the timing of the AAF maximum coincides with the period of fastest ice retreat for the respective month. Presence of at least some sea ice is crucial for the IAF to be effective because of the contrast in surface albedo between ice and open water and the need to turn ocean warming into ice melt. Once large areas of the Arctic Ocean are ice-free, the IAF should be less effective. We thus hypothesize that the ice retreat significantly affects AAF variability and forces a decline of its magnitude after at least half of the Arctic Ocean is ice-free and the ice cover becomes basically seasonal.