Project title: PAMIP: Polar Amplification Model Intercomparison Project
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Allocation period: 01.01.2019 – 31.12.2019

Report on first ten months

In 2019 we have performed all planned PAMIP experiments in HR (see Table 1). Furthermore, we have carried out a thorough analysis of these experiments in terms of mean flow, waviness, and EP fluxes. Analysis was geared towards the question if the loss of Arctic sea ice has impacts on not only the mean mid-latitude climate but also on extreme events which could occur due to amplified meandering. However, the result is that while the mean flow is changed towards weaker westerlies which does affect the mean state of the mid-latitude climate, there seem to be only weak changes regarding waviness or meandering of the flow. Together with partners from the PAMIP consortium we are planning a joined paper.

Due to a large bias in the tropospheric mean flow in ECHAM 6.3 LR (subtropical jet up to 8 ms^{-1} stronger relative to 1979-2013 climatology from ERA Interim reanalysis) we decided not to pursue the LR simulations any further and restricted the experiments to HR simulations. For the HR simulations, Fig. 1 shows time series anomalies of the ensemble mean u component between 3 sets of experiments separating the influence of the SST and the influence of the Arctic sea ice. The stratosphere polar vortex weakens in response to sea-ice loss (middle panel). However, concomitant sea surface temperature changes may counteract the response to sea ice loss, as a stronger vortex in January is found when only SSTs are changed (bottom panel). Instead of further LR experiments we did additional experiments taking into account changes in the key region of Barents Sea / Kara Sea ice (experiment 3.2) and implemented at AWI Potsdam the fast stratospheric ozone chemistry module into ECHAM 6.3 (SWIFT). With this set-up we reran experiments 1.1 and 1.6 to study the importance of stratospheric ozone chemistry in the context of impacts of Arctic sea ice loss. Results are still being analyzed and a paper is planned on this topic. To make this possible with the limited computing time we also dedicated some of the AWI stakeholder share (ab0995) of computing time to the PAMIP simulations.

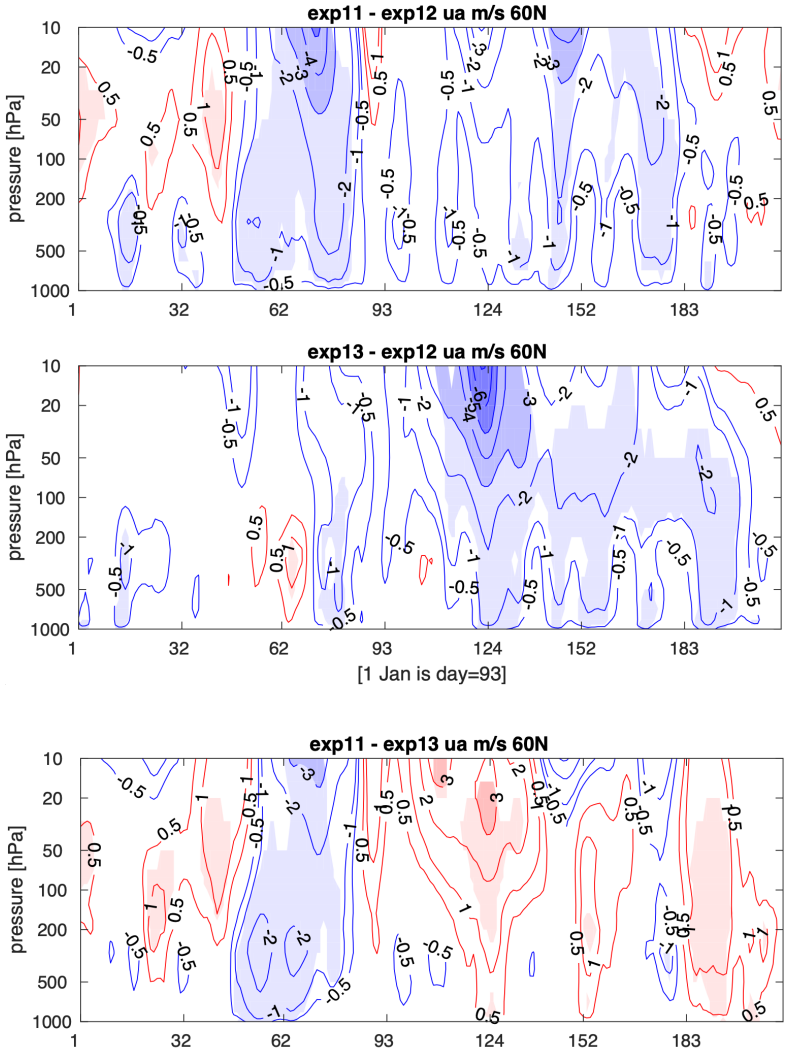

Figure 1: Time evolution from 1. October to 30 April (5-day smooth) of the ensemble (100-member) mean zonal mean zonal wind change at 60°N, PAMIP HR experiments for: (upper) present day minus pre-industrial SST and SIC, depicting the changes due to both sea surface temperatures and sea ice loss; (middle) present day minus pre-industrial SIC for pre-industrial SST, depicting the changes due to only sea ice loss; and (bottom) present day minus pre-industrial SST for present day SIC, depicting the changes due to only sea surface temperatures. Contours: ±0.5, ±1 and then every 1 ms^{-1}. Colors: blue / red for positive / negative changes, significant with $p < 0.10$

The work is part of the EU projects APPLICATE (coordinated by AWI) and Blue Action (co-led by MPI); in addition, PAMIP is endorsed by CMIP6. Therefore, results are gaining good visibility. It is the first time that polar amplification and its impacts on mid-latitudes is studied in an internationally coordinated way and we are among the first groups contributing data.

Results have been presented in 5 presentations in the PAMIP workshop taking place from the 24th to the 27th of June in Devon, UK. Subsequently, publications are planned as outlined above.