Author comments

Ensemble design for seasonal climate predictions: Studying extreme Arctic sea ice lows with a rare event algorithm

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Figures for replies to reviewer #2

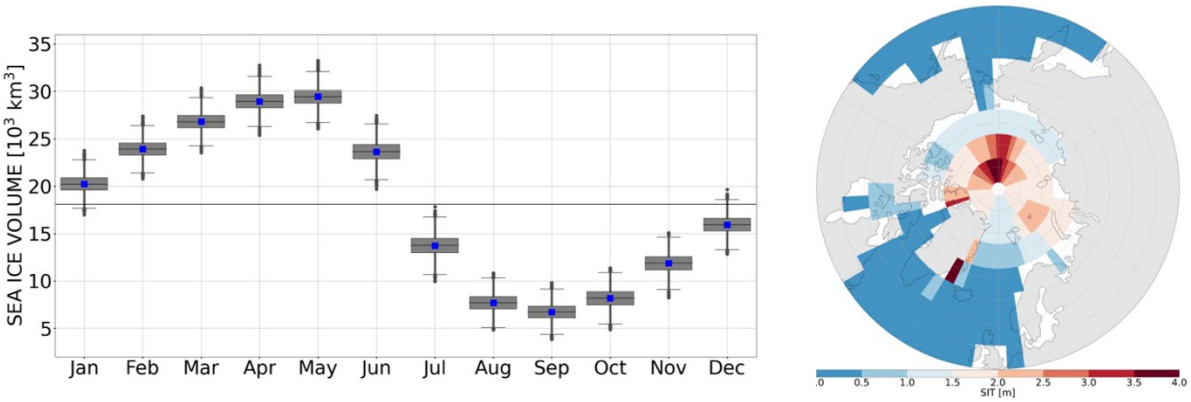

Figure R1: *Model years 501-3500 of PlaSim-LSG control run [Sauer et al. 2024]]: (a) Distributions of monthly mean pan-Arctic sea ice volume [10^3 km^3] with respect to the 3000 control run model years. The averages and medians are given by the blue squares and the horizontal lines in the boxes. The boxes denote interquartile ranges and the maximum whisker length is defined as 1.5 times the interquartile range. The horizontal gray line shows the annual mean pan-Arctic sea ice volume. (b) Annual mean sea ice thickness [m].*

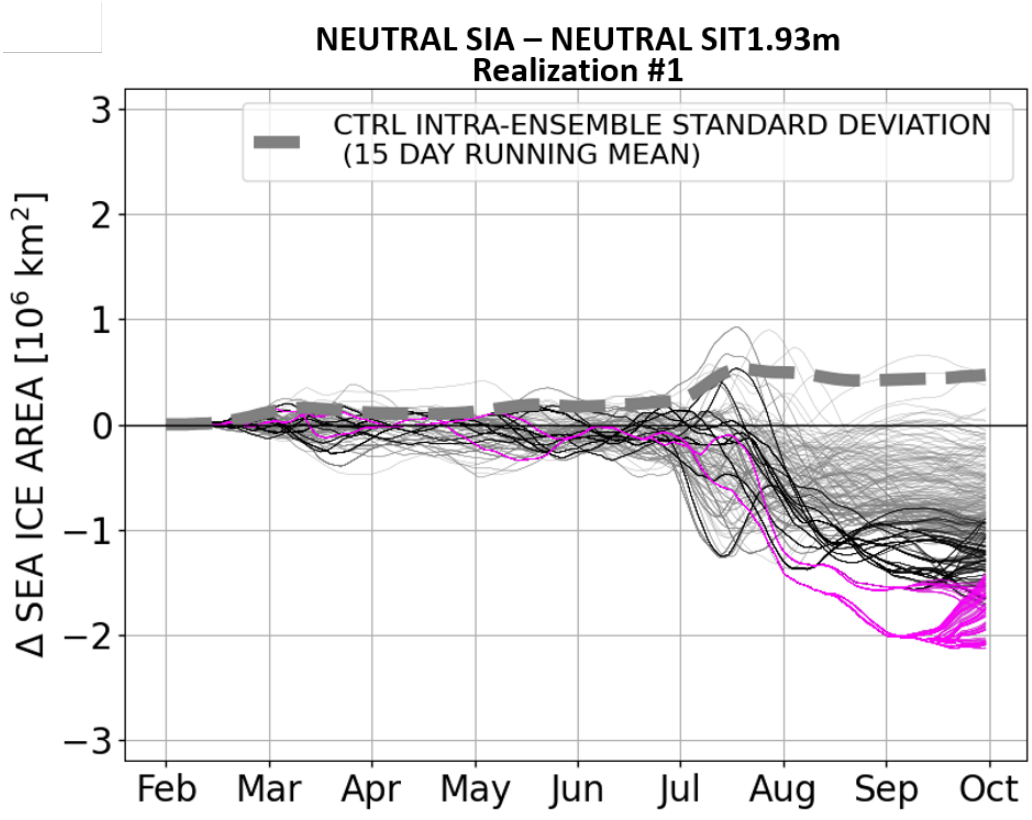

Figure R2: *Rare event ensemble simulations initialized on 01 February 1930 of the control run. 15-day running mean of daily pan-Arctic sea ice area anomalies [10^6 km^2] relative to the control ensemble mean. The magenta lines show trajectories leading to the lower peak of the bimodal distribution of Figure 2(e) of the main manuscript and the dark black lines the trajectories leading to August-September mean sea ice area anomalies below -2.5 control ensemble standard deviations excluding the lowest peak. The gray dashed line shows the 15-day running mean of the intra-ensemble standard deviation.*

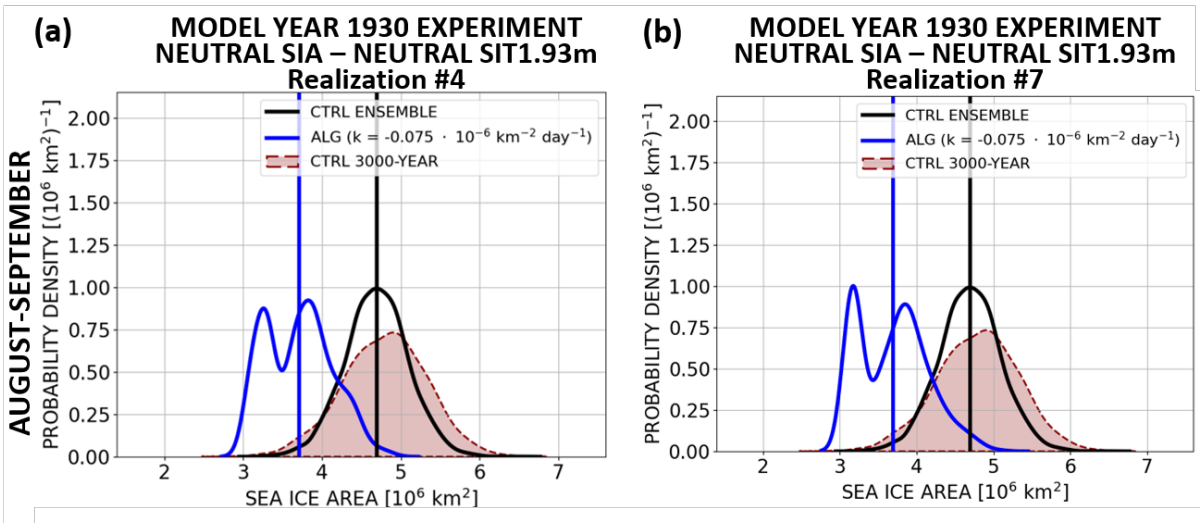

Figure R3: *Ensemble simulations initialized on 01 February 1930 of the control run. August-September mean pan-Arctic sea ice area for (blue) the rare event simulation, (black) the control ensembles (N=6000 trajectories) and (red) the 3000-year control run for (a) rare event simulation realization #4 and (b) rare event simulation realization #7. The vertical lines show the mean of the distributions. The black and blue values indicate the smallest August-September mean sea ice area value in the control and rare event ensemble simulations respectively.*

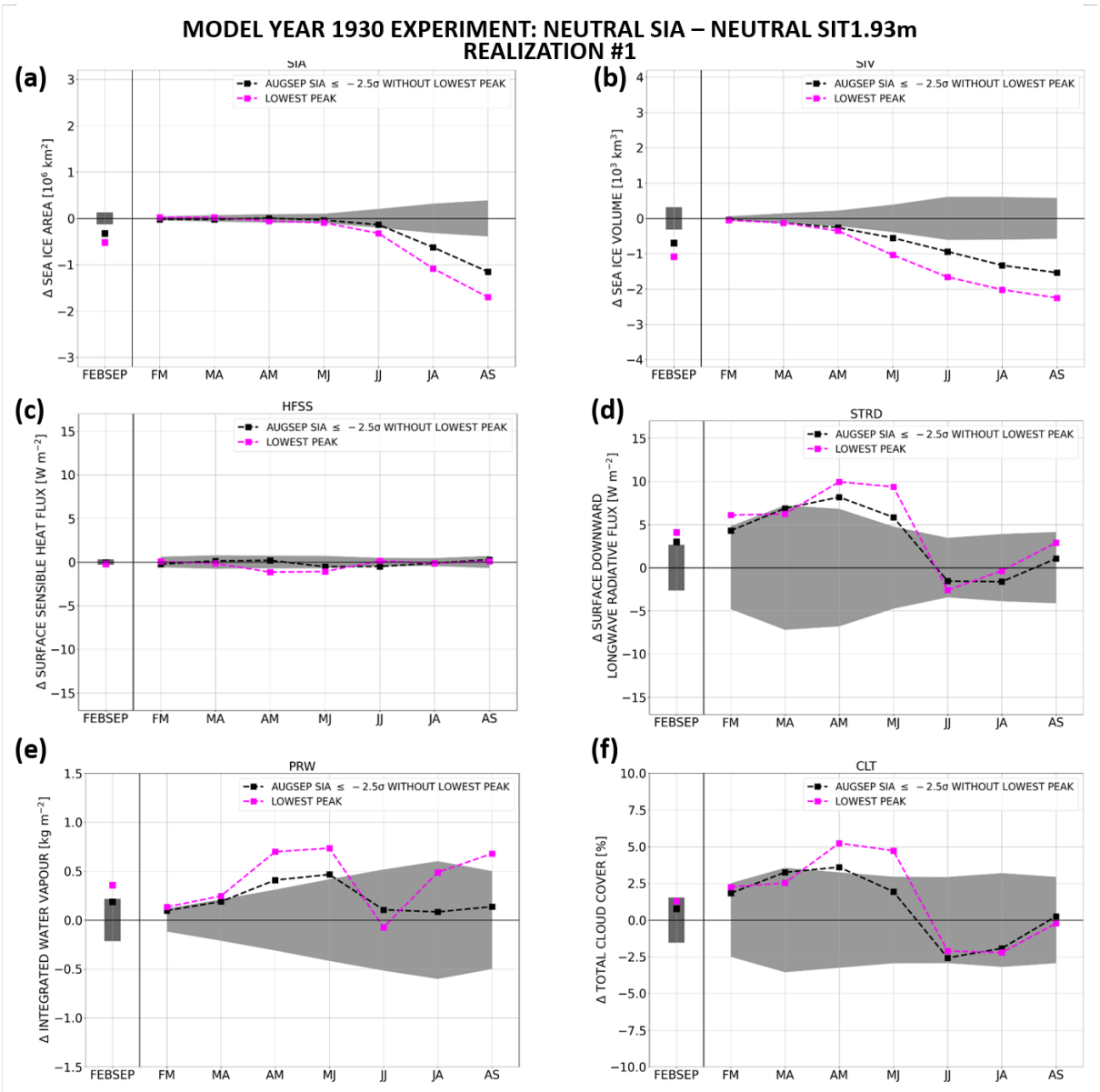

Figure R4: *Rare event simulation realization #1 starting from a neutral winter initial condition. Composite mean anomalies of different quantities for all trajectories leading to an August-September mean sea ice area value belonging to (magenta) the "lower peak" of the rare event algorithm probability distribution function of Figure 2(e) and (black) for all trajectories leading to an August-September mean sea ice area anomaly equal or smaller than -2.5 standard deviations of the control ensemble excluding the magenta trajectories (see Figure S4 for the selected trajectories). The composites are computed using the estimator in Equation (3) of the main manuscript (see Sauer et al. [2024] for details about the computation of composites with the output of the algorithm). (a-b) Pan-Arctic sea ice (a) area and (b) volume. (c-d) Spatially averaged composite mean anomalies over all ocean grid boxes northern of 70° N. (c) Surface sensible heat flux and ([W m^{-2}]; positive upwards) (d) downward longwave radiative flux anomalies [W m^{-2}] (Direction-independent absolute values of the downward and upward fluxes are considered, i.e., a positive (negative) anomaly indicates a radiative flux that is stronger (weaker) in magnitude than the climatology). (e) Integrated water vapour [kg m-2] and (f) total cloud cover [%] anomalies. (a-f) Shading indicates the intra-ensemble standard deviation of the control ensemble and anomalies are computed with respect to the climatology of the control ensemble.*

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