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Quantifying model uncertainty in seasonal Arctic sea-ice forecasts

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Dynamical model forecasts in the Sea Ice Outlook (SIO) of September Arctic sea-ice extent over the last decade have shown lower skill than that found in both idealized model experiments and hindcasts of previous decades. Additionally, it is unclear how different model physics, initial conditions or post-processing techniques contribute to SIO forecast uncertainty. In this work, we have produced a seasonal forecast of 2015 Arctic summer sea ice using SIO dynamical models initialized with identical sea-ice thickness in the central Arctic. Our goals are to calculate the relative contribution of model uncertainty and irreducible error growth to forecast uncertainty and assess the importance of post-processing, and to contrast pan-Arctic forecast uncertainty with regional forecast uncertainty. We find that prior to forecast post-processing, model uncertainty is the main contributor to forecast uncertainty, whereas after forecast post-processing forecast uncertainty is reduced overall, model uncertainty is reduced by an order of magnitude, and irreducible error growth becomes the main contributor to forecast uncertainty. While all models generally agree in their post-processed forecasts of September sea-ice volume and extent, this is not the case for sea-ice concentration. Additionally, forecast uncertainty of sea-ice thickness grows at a much higher rate along Arctic coastlines relative to the central Arctic ocean. Potential ways of offering spatial forecast information based on the timescale over which the forecast signal beats the noise are also explored.