Quantifying the impact of aerosols on the predictive skill of subseasonal global atmospheric simulations

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Subseasonal forecasts have been fundamental in bridging the gap between numerical weather predictions and seasonal forecasts, offering a wide range of products and services, particularly within the intraseasonal timescale. Despite the unprecedented opportunities to provide relevant information on key climate characteristics within the Subseasonal to Seasonal (S2S) timescale, there remains room for improvement in the predictive skill of S2S forecasts.

One potential avenue for enhancement is the numerical representation of two-way aerosol-climate interactions. Atmospheric aerosols play a crucial role as climate forcing due to their interactions with radiation (direct effect) and influences on cloud life cycle and precipitation (indirect effect).

Recognizing the significance of atmospheric composition in enhancing weather and climate prediction capabilities for the global climate system, the World Climate Research Programme Core Project Earth System Modeling and Observations-Working Group on Numerical Experimentation (WGNE), the WCRP and World Weather Research Programme (WWRP) S2S Steering Group (S2S-SG) and the Global Atmosphere Watch Programme Scientific Advisory Group on Applications (SAG APPs) have collaboratively led the WGNE Aerosol Project. This initiative aims to gain a deeper understanding of the role of aerosols in the predictive skill of models within the S2S timescale.

The WGNE Aerosol Project involves operational meteorological centers worldwide, contributing their state-of-the-art climate-chemistry-aerosol-cloud-radiation coupled modeling systems. Modeling groups participants contributed with an ensemble of retrospective predictions (hindcasts) considering distinct model configurations, taking into account the feedback between radiation/microphysics parametrization and aerosols. No-feedback between radiation/microphysics and aerosols experiments were considered as reference experiments. These reference experiments serve as a baseline to evaluate and understand the impact of incorporating feedback mechanisms in the modeling systems.

We propose to assess the performance of the WGNE Aerosol project modeling contributions, specifically focusing on the global domain within the S2S timescale. This work will present the
results of the assessment, focusing on the main atmospheric variables near the surface, and aerosol optical depth from both deterministic and probabilistic perspectives, using common statistical metrics.

The WGNE Aerosol Project offers an opportunity to comprehend the feedback represented in current climate-chemistry-aerosol-cloud-radiation coupled systems and their impact on predicting climate variability, air quality, and extreme meteorological events within the S2S timescale. Moreover, it aims to identify the uncertainties associated with model predictions of feedback, providing insights for future developments and addressing the complexities of coupled modeling systems that impact predictive skill within the S2S timescale.