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A signal and noise analysis of stratosphere-troposphere coupling in the S2S models

Charlton-Perez A(1)

University of Reading, UK

On sub-seasonal timescales, coupling between the stratosphere and troposphere represents a significant source of skill for northern mid and high-latitudes. Previous studies have examined this skill either on a case-by-case basis or from the perspective of the additional skill present during sudden stratospheric warming (SSW) or strong polar vortex events. Here we complement these approaches by fitting a simple statistical model to the full hindcast set available from the S2S database. The statistical model used enable us to separate the predictable signal and noise in the annular mode present in each hindcast set. While all models in the S2S database exhibit some degree of stratosphere-troposphere coupling in the annular mode, there are significant differences between them. In the middle and lower stratosphere, models have high skill out to week four, with large signal to noise ratio. In the troposphere, annular mode skill is weaker in weeks three and four. In the lower stratosphere, many models have low spread and are over-confident. In the troposphere, there is similar overconfidence, particularly in week 3. Models with the largest overconfidence in the lower stratosphere also exhibit the largest overconfidence in the troposphere. In the troposphere, the overconfidence is due to an over estimation of the size of the predictable signal in most models.

Correlation between the extracted signal in the lower stratosphere and surface varies significantly between models. Taken together with the over-estimation of the size of the predictable signal in the troposphere in these models suggests that some models have excessively strong stratosphere-troposphere coupling on sub-seasonal timescales.