Workshop: Stratospheric predictability and impact on the troposphere



Contribution ID: 23

Type: Oral presentation

The importance of stratospheric initial conditions for winter North Atlantic Oscillation predictability

Monday, 18 November 2019 16:00 (30 minutes)

This study investigates the influence of atmospheric initial conditions on winter seasonal forecasts of the North Atlantic Oscillation (NAO). Hindcast (or reforecast) experiments -which differ only in their initial conditions -are performed over the period 1960-2009, using prescribed sea surface temperature (SST) and sea-ice boundary conditions. The first experiment ("ERA-40/Int IC") is initialized using the ERA-40 and ERA-Interim reanalysis datasets, which assimilate upper-air, satellite and surface observations; the second experiment ("ERA-20C IC") is initialized using the ERA-20C reanalysis dataset, which assimilates only surface observations. The ensemble mean NAO skill is largest in ERA-40/Int IC (r = 0.54), which is initialized with the superior reanalysis data. Moreover, ERA-20C IC did not exhibit significantly more NAO hindcast skill (r = 0.38) than in a third experiment, which was initialized with incorrect (shuffled) initial conditions. The ERA-40/Interim and ERA-20C initial conditions differ substantially in the tropical stratosphere, where the quasi-biennial oscillation (QBO) of zonal winds is not present in ERA-20C. The QBO hindcasts are highly skilful in ERA-40/Int IC -albeit with a somewhat weaker equatorial zonal wind amplitude in the lower stratosphere -but are incorrect in ERA-20C IC, indicating that the QBO is responsible for the additional NAO hindcast skill; this is despite the model exhibiting a relatively weak teleconnection between the QBO and NAO. Whilst ERA-40/Int IC demonstrates a more skilful NAO hindcast, it appears to have a relatively weak predictable signal; this is the so-called "signal-to-noise paradox" identified in previous studies. Diagnostically amplifying the (weak) QBO-NAO teleconnection increases the ensemble-mean NAO signal with negligible impact on the NAO hindcast skill, after which the signal-to-noise problem seemingly disappears.

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Session Classification: Session 2 : Stratosphere-troposphere coupling in sub-seasonal to seasonal modes

Track Classification: Workshop: Stratospheric predictability and impact on the troposphere