Introduction

- The aim is to investigate the role of zonally asymmetric O3* in atmospheric circulation via the induced radiation perturbations with the focus on the impact on seasonal predictability of AO by NAM as function of altitude and leading times as well as the predicted period.
- Observed patterns of NAM and AO are diagnosed with ECMWF Reanalysis (ERA Interim 1979-2011, polar cap based > 65° N) on NCEP reanalysis (1958-2002, EOF1 based, taken from M. Baldwin homepage).
- 40-year-model runs with ECMWF were performed to reveal the one-way effects of prescribed O3* anomaly on the AO predictability by NAM from higher altitudes.

Methodology

1. Motivation:
   - Zonal Ozone Anomaly O3*
   - Impact on Poleward Rossby Wave Breaking (RWB-P2-index) Events

2. Variance of Low - and High Pass Filtered NAM (Polar Cap Based > 65° N)

3. Predictability of AO From NAM of Higher Altitudes

Results - Conclusion

- Pronounced influence of zonal asymmetries in ozone on poleward RWB events and on the appearance of SSW processes have been shown, in agreement with other studies, and are expected due to the higher induced atmospheric and tropospheric variability by stratospheric ozone anomaly in boreal extra-tropics.
- For the anomaly run we found a better agreement of the mean seasonal structure for low and high pass filtered NAM with the observation like ERA Interim.
- Insufficient model performance in describing the AO predictability skill, but for the anomaly run the predictability skill increases in midwinter in the middle stratosphere.
- We conclude that the consideration of the observed mean zonally asymmetric ozone structure in GCMs improves the model performance in describing the AO predictability by NAM of the middle stratosphere.

Control run [O3] - O3ZMO
Anomaly run O3ZOA driven by O3* (months)

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1960s
ERA-40
1990s

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More P2 RWB events over western Europe in GCM run with zonally asymmetric ozone

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\[ \text{AO minimum from mid-1980s causing weaker AO}^+ \text{and in connection weaker NAO}^+ \text{patterns} \]
\[ \text{+ significant more major SSWs for 1980-99 period} \]

\[ \text{+ comparable inter-annual variance structure between ECHAM5 model runs and ERA Interim observation} \]
\[ \text{+ significant changes and better agreement in the upper stratosphere for O3ZOA run in midwinter, green lines sign.} \]

\[ \text{+ less NAM predictability in ECHAM5 model runs in comparison to ERA Interim and NCEP reanalysis} \]
\[ \text{+ improvement by zonally asymmetric ozone O3* (anomaly run) in the middle stratosphere in midwinter} \]
\[ \text{+ significant increase as known from observation} \]

\[ \text{+ less NAM predictability for ERA Interim (1979-2011) than for NCEP reanalysis (1958-2002)} \]
\[ \text{+ similar significant Gaussian smoothed structure in the middle stratosphere} \]
\[ \text{+ weaker tropospheric predictability in midwinter} \]

Related references of our group:


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Annales Geophysicae
J. Climate
JASTP

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