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Bimodality, regime shifts, and decadal variability in the QBO and the NH stratospheric winter vortex as seen in the CMIP5 ensemble

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The stratospheric Northern Hemisphere (NH) winter mean vortex alternates between a strong and a weak state which is manifested in a statistically significant bimodal distribution. In the end of the 1970s a regime change took place increasing the probability of the strong phase relative to the weak phase (Christiansen 2003). Christiansen (2010) found a strong coincidence between strong (weak) vortex winters and the westerly (easterly) QBO phase. This work also demonstrated that the change of the vortex in the late 1970s can be related to a change in the QBO. However, this change in the QBO can be random process simply related to the annual sampling of the QBO.

In this paper we investigate the connection between the decadal variability of the vortex and the QBO in historical CMIP5 experiments. The CMIP5 archive contains both models with and without a spontaneously generated QBO. Furthermore, the spontaneously generated QBO's have different (quasi-) periodicities making the CMIP5 archive well suited for a study of the influence of the QBO on the low-frequency variability.

Preliminary results indicate that the QBO shows a pronounced decadal variability related to an intermittent (partly) phase-locking to the annual cycle. This decadal variability is transferred to the vortex so that a phase-locked/non-phase-locked QBO corresponds to weak/strong vortex variability. We will also investigate how the decadal variability of the QBO and the vortex impacts the circulation at the surface (NAO, AO).

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