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A model intercomparison analysing the link between column ozone and geopotential height anomalies in January

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Abstract. A statistical framework to evaluate the performance of chemistry-climate models with respect to the interaction between meteorology and column ozone during northern hemisphere mid-winter, in particularly January, is used. Different statistical diagnostics from four chemistry-climate models (E39C, ME4C, UMUCAM, ULAQ) are compared with the ERA-40 re-analysis. First, we analyse vertical coherence in geopotential height anomalies as described by linear correlations between two different pressure levels (30 and 200 hPa) of the atmosphere. In addition, linear correlations between column ozone and geopotential height anomalies at 200 hPa are discussed to motivate a simple picture of the meteorological impacts on column ozone on interannual timescales. Secondly, we discuss characteristic spatial structures in geopotential height and column ozone anomalies as given by their first two empirical orthogonal functions. Finally, we describe the covariance patterns between reconstructed anomalies of geopotential height and column ozone. In general we find good agreement between the models with higher horizontal resolution (E39C, ME4C, UMUCAM) and ERA-40. The Pacific-North American (PNA) pattern emerges as a useful qualitative benchmark for the model performance. Models with higher horizontal resolution and high upper boundary (ME4C and UMUCAM) show good agreement with the PNA tripole derived from ERA-40 data, including the column ozone modulation over the Pacfic sector. The model with lowest horizontal resolution does not show a classic PNA pattern (ULAQ), and the model with the lowest upper boundary (E39C) does not capture the PNA related column ozone variations over the Pacific sector. Those discrepancies have to be taken into account when providing confidence intervals for climate change integrations.

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