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Long-term changes of atmospheric blocking and their contribution to recent large-scale trends

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An atmospheric blocking event can be characterised by a disruption of the prevailing westerly circumpolar flow in the extra-tropics due to a persistent quasi-stationary high pressure system. Since blocking exhibits a preferred spatial distribution, a significant and sustained trend in its amplitude and/or location could impact upon the large-scale signature of climate change. Here a systematic trend analysis is undertaken using a recently developed dynamically-based blocking indicator, based upon quasi-stationary, potential vorticity anomalies at tropopause level. The investigation is conducted over the whole ERA-40 ECMWF-reanalysis period (1958 - 2001) on the Northern Hemisphere. The basis for the blocking trend analysis is the long-term blocking climatology. Seasonal composites generally agree with already published blocking climatologies but give in addition the possibility to capture dynamically relevant blocking characteristics. Using this blocking climatology linear trends for the entire ERA-40 period are calculated on a monthly basis at every grid point separately. The results point to significant negative blocking trends over Greenland (North Pacific) during the boreal winter (spring) season. Evidence is shown that the detected blocking trends can be related to changes in the number of blocking events rather than changes in their final life time. In addition the strong negative blocking trends over Greenland correspond to trends of various meteorological variables (e.g. tropopause height, geopotential height, sea level pressure). In particular wintertime tropopause height trends are associated with an opposed trend pattern situated south of the trend pattern around Greenland. Our results suggest that atmospheric blocking contributes seminally to establish the tropopause height trend. Furthermore it is indicated that trends of high-frequency anomalies (synoptic scale) are linked to the neighbouring tropopause trend signal to the south.