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Analysis of turbulence from EDR reports and ERA5 in the UTLS over the North Atlantic during winter in a tropopause-relative framework

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The tropopause is often conceived as a quasi-two-dimensional surface which marks the border between the troposphere to the stratosphere. The transition of chemical trace gas characteristics along with the ambiguity of different tropopause definitions however gives rise to a perception of the tropopause as a three-dimensional transition layer. The transition of the chemical composition is associated with the occurrence of distinct dynamical processes at the interface between troposphere and stratosphere. These processes foster cross-tropopause exchange and mixing around the tropopause which in turn is thought to create the chemical transition across the tropopause. A variety of diabatic processes have been proposed and analysed in this context, i.e., convective overshooting and injection of tropospheric air into the stratosphere, radiatively induced potential vorticity modification along with a modulation of the tropopause altitude and stratosphere-troposphere-exchange, and the occurrence of flow instabilities and turbulence. The overall significance of individual processes concerning the formation and maintenance of the all year existing and chemically defined extratropical transition layer remains an open research question.

This study aims to shed new light onto this question. For this an analysis is presented over the time period of two winter seasons. The goal is to obtain a tropopause relative vertical distribution of turbulence across the tropopause over the North Atlantic. A total of 1.5 million automated EDR reports from commercial aircrafts have been analysed to identify the occurrence of turbulence in the UTLS. This data is complemented by ERA5 reanalysis data to put the EDR reports into the tropopause relative coordinate system. From ERA5 several other turbulence indicators and diagnostics are calculated and will be presented to ultimately explain the vertical extent of the transition layer around the tropopause.