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Dynamics of summer tropopause folds over the eastern Mediterranean and the Middle East.

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Tropopause folds are atmospheric structures occurring in the subtropical and extratropical regions, while deep folds are a special category of tropopause folds, identified predominantly in the extratropics with their dynamics closely linked to those of midlatitude baroclinic waves. In the zonal mean, a distinct seasonal cycle is recognized featuring a summer minimum, especially for deep midlatitude folds, due to the weaker summer midlatitude baroclinicity. However, the investigation of the seasonal cycle of the vertical distribution of potential vorticity (PV) confirmed the findings of an earlier 1-year global climatolology that reported abundant summer folds over a sector ranging from the eastern Mediterranean to Afghanistan. This region lies at the western and northern flanks of the upper level South Asian Monsoon anticyclone. From late spring, it is gradually brought under the influence of the zonally asymmetric background state induced by the monsoon, which features an elevated tropopause and depression of isentropic surfaces. As areas of sharply sloping isentropes develop over the eastern Mediterranean and Iran-Afghanistan, which are exposed to the midlatitude westerlies, subsidence and tropopause fold formation are favored.

The present study aims at the further quantification of the above initial findings through the compilation of a comprehensive climatology of folds over the eastern Mediterranean and the Middle East. The methodology is based on an algorithm that detects folds as areas featuring multiple crossings of the dynamical tropopause. The analysis is based on the ERA-Interim data interpolated on a 1x1 regular grid, spanning the period 1979-2012.

The methodology allows the identification of geometrical features of tropopause folds and their classification into deep and shallow structures. This allows us the understanding of the distinct dynamical links with the monsoon on intra-seasonal timescales and the investigation of the evolution and vertical structure of tropopause folds on synoptic timescales, during periods of strong subsidence and northerly flow (Etesian outbreaks) over the region.