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Temporal and spatial variability of elevated inversions over Europe based on ERA-Interim reanalysis

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Tropospheric temperature inversions are thought to be an important feature of climate as well as a significant factor affecting air quality and low-level cloud formation. The aim of this study is to investigate the temporal and spatial variability of tropospheric temperature inversions, in particular so-called elevated inversions, over Europe. This is based on data derived from ERA-Interim reanalysis for the period 1981-2015. They consist of air temperature, geopotential height, and relative humidity from the entire vertical cross-section of the troposphere, i.e. from 1,000 to 100 hPa. The study examines the temporal (intra- and inter-annual) and spatial variability of the temperature inversions based on their frequency, depth, and strength. The analysis conducted revealed that the temperature inversions are a common phenomenon occurring in the lower troposphere, i.e. up to 750 hPa. Their temporal and spatial variability is, however, determined by the inversion type. Surface-based inversions (SBI) indicate a clear diurnal cycle, while the temporal variability of elevated inversions (EI) is far less pronounced. Two main regions of the most frequent EI occurrence may be distinguished. These are: (i) a marine area west of the Iberian Peninsula, and (ii) Eastern Europe. Both of them are located in areas which are under the influence of extensive high-pressure systems – the permanent Azores High and semipermanent Siberian High, respectively. Hence, EI development should be attributed mainly to large-scale subsidence and adiabatic heating of air parcels. They are also quite common over the other parts of the Atlantic Ocean, which is closely linked to the persistence of marine inversions. Generally, EI are supposed to be weaker than SBI – mean seasonal inversion strength is usually substantially higher for SBI. On the other hand, EI reach higher values of mean seasonal inversion depth as compared with SBI.