Proposed numerical definition of persistent cold air pools over the Carpathian Basin

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The persistent cold air pool (PCAP) is a winter-time, anticyclone-related weather event over a relatively large basin. During this time the air is colder near the surface than aloft. This inversion near the surface can last for many days or even weeks. As the cold air cools down, relative humidity increases and fog forms. PCAP usually appears when an anticyclone builds up after a cold front passed over a particular basin, and it is usually destructed by a coming strong cold front of another midlatitude cyclone. PCAP may result in different socio-economic hazards: (1) Temperature inversion in the surface layers together with weak wind may lead to severe air pollution causing health problems for many people, especially, elderly and children. (2) The fog and/or smog during chilly weather conditions often results in freezing rain. Both fog and freezing rain can distract transportation and electricity supply.

Unfortunately, numerical weather prediction models have difficulties in predicting PCAP formation and destruction. One of the reasons is that PCAP is not defined objectively with a simple formula, which could easily be applied to the numerical output data. However, according to some recommendations from the synoptic literature, the shallow convective potential energy (SCPE) can be used to mathematically describe PCAP.

In this study, radiosonde measurements and ERA-Interim reanalysis are used to analyze PCAPs in detail. The ultimate goal of this research is to propose a precise numerical definition of PCAPs using radiosonde data. The main criteria of the definition include the duration of the inversion, the thickness of the inversion layer, the wind speed of different atmospheric layers, the SCPE and the spatial extent.