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Uncovering physical processes responsible for the asymmetry of day-to-day temperature changes

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Day-to-day temperature changes, and especially those of minimum temperature in winter and maximum temperature in summer, are asymmetrical: in winter, large warmings occur more frequently than large coolings and small coolings occur more frequently than small warmings. In summer, the opposite is the case. We investigate causes of this asymmetry for Prague, Czech Republic. First, we relate strong temperature changes to passages of atmospheric fronts. More specifically, large warmings in winter are related with passages of warm fronts and large coolings in summer are related with passages of cold fronts. In particular, we test the hypothesis that the days with large temperature changes (changes exceeding 3°C or 5°C) are accompanied with passages of corresponding atmospheric fronts more frequently than other days. We prove statistical significance of such a relationship between front passages and large temperature changes by means of a two-sample Kolmogorov-Smirnov test. Second, we demonstrate that small temperature changes (by up to 2°C), namely, small warmings in summer and small coolings in winter, are tightly related to anticyclonic circulation conditions and, hence, occur due to radiative processes. This relationship is investigated by comparing frequencies of anticyclonic circulation types in selected classifications from the COST733 database between the days with small temperature changes and all other days. The relationship appears to be highly statistically significant.
Although the findings may seem a bit trivial, we are not aware of any study that would examine and prove the relationships between front passages and anticyclonic circulation conditions on one side, and the asymmetry of day-to-day temperature changes on the other side.