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Observation and Representativity Errors in historical Upper-Air Observations

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Upper-air observations are a fundamental data source for global atmospheric data products, but uncertainties, particularly in the early years, are not well known. Most of the early observations, which have now been digitized, are prone to a large variety of undocumented errors that need to be quantified e.g., for their assimilation in reanalysis projects.
Here we present a novel approach for systematically estimating observation and representativity errors in upper-air observations. The method is based on a buddy approach that is largely independent of metadata, making it applicable to a wide scope of observational datasets. We assume a linear dependency between the magnitude of the errors and station distance.
The method is applied to upper-air temperature, geopotential height and wind observations of the Comprehensive Historical Upper-Air Network (CHUAN; 1930 – 1966). The estimated mean non-systematic observation errors are 1.3 K for air temperature, 0.9 hPa for pressure, 3.4 ms^{-1} for wind speed, and 34 $^{\circ}$ for wind direction. All errors have physically meaningful vertical profiles and depend on both the geographical location as well as on time.
Next to its usefulness for future reanalysis products, the results are valuable for data homogenization efforts by highlighting suspicious observations.