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The quantile score and its decomposition

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Forecast verification for probabilistic weather and climate predictions gain more and more importance due to the increasing number of ensemble prediction systems. The predictive performance of probabilistic forecasts is generally assessed using proper score functions, which are applied to a set of forecast-observation pairs. The propriety of a score guarantees honesty and prevents hedging. A variety of proper scores exist for different types of probabilistic forecasts. Moreover, proper scoring functions can be decomposed into the three parts reliability, resolution, and uncertainty, which describe main characteristics of a forecasting scheme. This decomposition is well known for the Brier score and the continuous ranked probability score.

This study expands the pool of verification methods for probabilistic forecasts by a decomposition of the quantile score (QS). Quantiles are suitable probabilistic measures especially for extreme forecast events, since they do not depend on an apriori defined threshold. The QS is a weighted absolute error between quantile forecasts and observations. We derive a decomposition of the QS in reliability, resolution, and uncertainty, and give a brief description of potential biases. A quantile reliability plot is presented. The quantile verification within this framework is illustrated on precipitation forecasts derived from the mesoscale ensemble prediction system COSMO-DE-EPS of the German Meteorological Service.