Completing the Forecast

Characterizing Forecast Uncertainty *and* Bridging Weather Predictions to User Applications

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Prediction of weather into the future remains a substantial challenge. But that's only part of the story. Making weather predictions useful to minimize weather impacts on human health and safety, transportation, utilities, agriculture, recreation, or infrastructure is another equally challenging part of the same story.

Understanding the vulnerability of a particular user, sector or infrastructure to weather is essential in order to maximize the utility of weather forecasts. Thus, assessing a forecast's quality requires not only evaluation of how well it did in terms of accurately depicting the weather into the future, but also how valuable that forecast was to a user of it. For all practical purposes, user-relevant information will have to be extracted from a weather forecast and placed into a situational context in order to estimate potential weather impacts. Only then a user may devise effective strategies to meaningfully mitigate potential weather impacts. Conversely, fully integrating weather into a user's decision-making process enables important feedback from the application side as to how accurate a forecast has to be in order to be valuable.

Completing the forecast, however, also requires information about prediction uncertainty. Today's trend in probabilistic weather forecasting is toward utilizing ensemble prediction systems. We have been exploring novel approaches of using high-resolution, ensemble-based numerical weather prediction model data for weather-related, probabilistic aviation impact forecasting. Examples will be discussed that represent a paradigm shift from "creating ensembles of weather information" (e.g., maps of predicted weather hazard intensity) to "developing ensembles of aviation-relevant information" (maps of potential throughput as measured by the available capacity), which entails a translation of weather forecasts into predictions of reduced airspace capacity. We have explored such ensemble-based concepts for strategic en-route traffic flow management as well as airport arrival and departure rate applications. Results thereof will be presented and discussed.