In-flight aircraft trajectory optimization within corridors defined by ensemble weather forecasts

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Abstract— Today, each flight is filed as a static route not later than one hour before departure. From there on, changes of the lateral route initiated by the pilot are only possible for safety reasons. Thus, the initially optimized trajectory of the flight plan is flown, although the optimization may already base upon outdated weather data at take-off. Global weather data as those modeled by the Global Forecast System does, however, contain hints on forecast uncertainties itself, which is quantified by considering so-called ensemble forecast data. In this study, the variability in these weather parameter uncertainties is analyzed, before the trajectory optimization model TOMATO is applied to single trajectories considering the previously quantified uncertainties. TOMATO generates, based on the set of input data as provided by the ensembles, a 3D corridor encasing all resulting optimized trajectories. Assuming that this corridor is filed in addition to the initial flight plan, the optimum trajectory can be updated even during flight, as soon as updated weather forecasts are available. In return, flights would have to stay within the corridor the corridor to provide planning stability for Air Traffic Management. Although the corridor restricts the re-optimized trajectory, fuel savings of up to 1.1 %, compared to the initially filed flight, could be shown.