Use of ECMWF IFS forecast for the provision of flight specific turbulence forecast

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Abstract

This presentation shows:

1) The use of ECMWF IFS data to provide turbulence forecast according to the flight route specified in the flight plans of the commercial flights;
2) The display of the flight specific forecast to the user and collection of user feedback; and
3) The verification of the turbulence forecast against the in-situ measurement recorded by the quick access recorder (QAR) on board the commercial aircraft.

Data processing for the forecast

Turbulence indices are derived from ECMWF IFS global forecast in a horizontal resolution of 0.125°, at 9 vertical levels from FL140 to FL610, with a forecast interval of 3 hours. A total of 17 turbulence indices are generated including TI2, TI3, CP and DTF3. Some of these indices are used in the Graphical Turbulence Guidance [1].

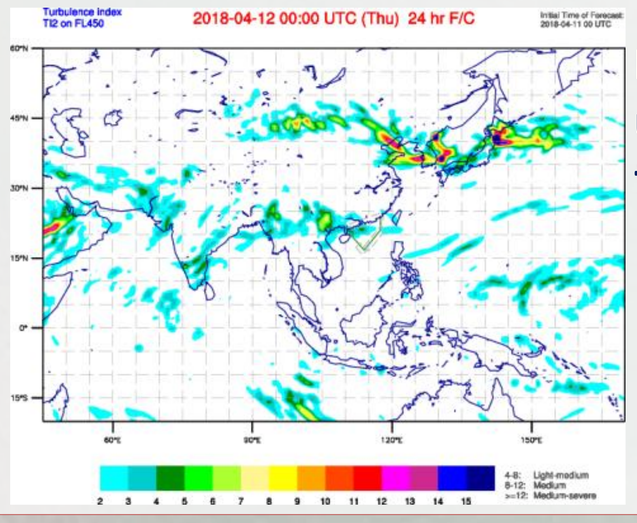

Fig. 1 TI2 generated using ECMWF IFS forecast for FL450.

Product display and User feedback

The flight specific turbulence forecast is displayed on "MyFlightWx", an electronic flight bag weather application to provide fight crew with the latest weather information, in the form of horizontal and vertical cross-section (Fig. 2). Two alternative scenarios in which the departure time is advanced or delayed by 3 hours are also available. Feedback from users is collected through social networking platform Fig. 3.

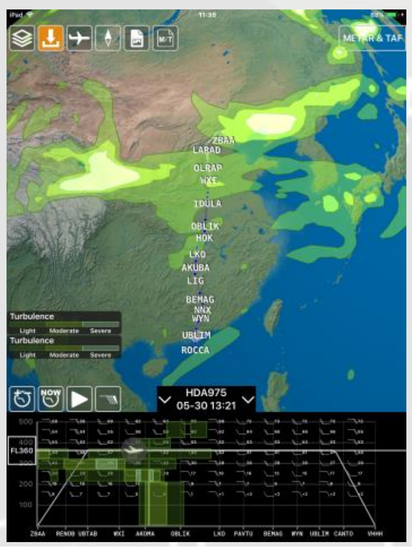

Fig. 2 Display of flight specific forecast

Fig. 3 Collection of user feedback through social networking platform

Forecast verification

The flight route specific turbulence forecast is verified against the QAR data. More than 170 selected flight between mid-2015 and late 2016 with turbulence related incidents reported are used for the verification. Only data recorded above FL100 are included in the verification. Eddy-dissipation rate (EDR) is estimated from the QAR data using a wind-based algorithm [2]. Events of turbulence are classified based on the value of EDR. Based on this limited data set, two indices, namely Colson-Panofsky index (CP) and DTF3, show significant skills in forecasting moderate turbulence (EDR > 0.4), Fig. 6.

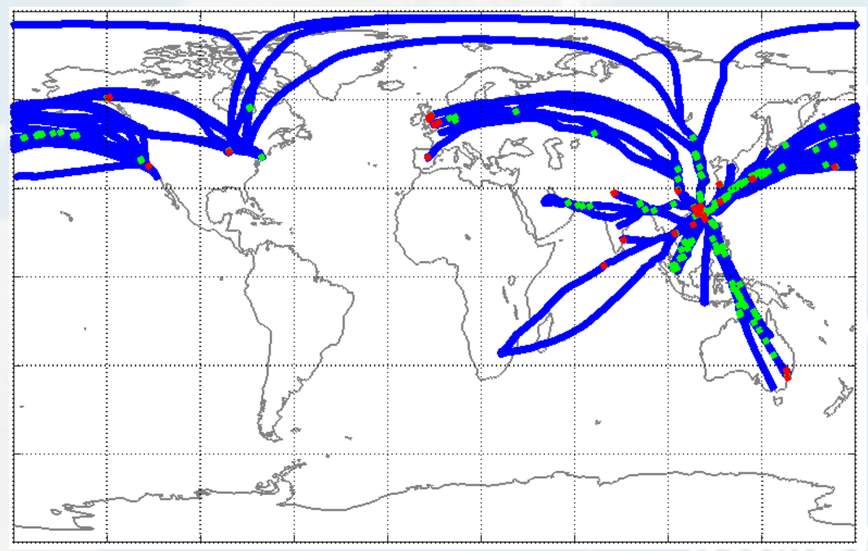

Fig. 4 Distribution of QAR data (Blue for EDR ≤ 0.1, Green for 0.1 < EDR ≤ 0.4, Red for EDR > 0.4)

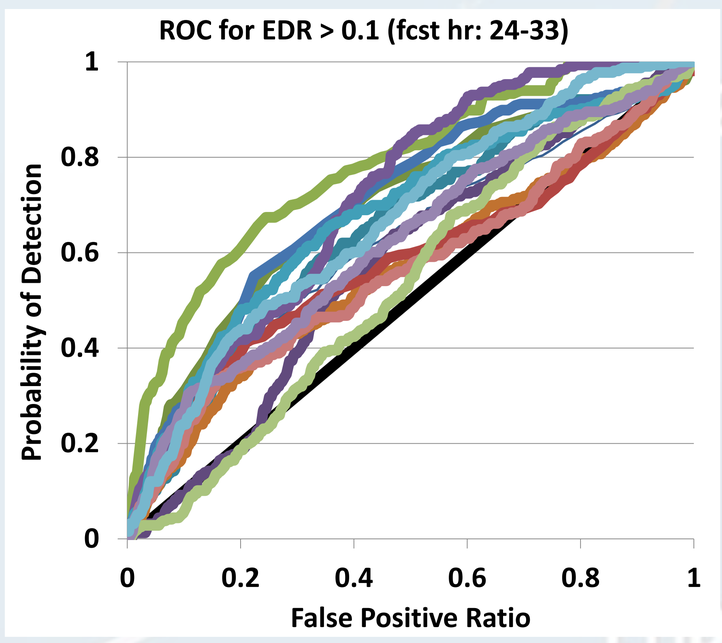

Fig. 5 ROC curve for the turbulence indices verified against QAR data for EDR > 0.1

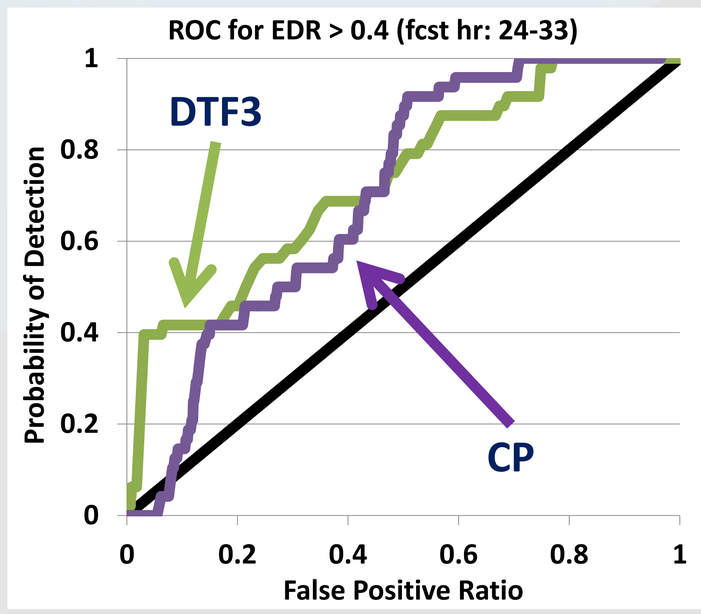

Fig. 6 ROC curve for two turbulence indices that shown significant skills when verified against QAR for EDR > 0.4

Reference

[1] R. Sharman, C. Tebaldi, G. Wiener and J. Wolff, 2006: An Integrated Approach to Mid- and Upper-Level Turbulence Forecasting, Weather and Forecasting, Volume 21, 268-286

[2] H. Haverdings and P. W. Chan, 2010: Quick Access Recorder (QAR) data analysis software for windshear and turbulence studies, Journal of Aircraft, Volume 47, No. 4, p.1443-1447, July-August 2010