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Verification of FLYSAFE Clear Air Turbulence (CAT) objects against aircraft turbulence measurements

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Prediction of gridded CAT fields
The main causes of CAT are
(a) Vertical wind shear [U+0096] low Richardson Number
(b) Mountain waves
(c) Convection.
All three causes contribute roughly equally to CAT occurrences, globally
Prediction of shear induced CAT
The predictions of shear induced CAT has a longer history than either mountain-wave induced CAT or convectively induced CAT. Both Global Aviation Forecasting Centres are currently using the Ellrod TI1 algorithm (Ellrod and Knapp, 1992). This predictor is the scalar product of deformation [akm1]and vertical wind shear. More sophisticated algorithms can amplify errors in non-linear, differentiated quantities so it is very likely that Ellrod will out-perform other algorithms when verified globally.

Prediction of mountain wave CAT
The Global Aviation Forecasting Centre in the UK has been generating automated forecasts of mountain wave CAT since the late 1990s, based on the diagnosis of gravity wave drag.

Generation of CAT objects
In the FLYSAFE project it was decided at an early stage that short range forecasts of meteorological hazards, i.e. icing, Clear Air Turbulence, Cumulonimbus Clouds, should be represented as weather objects, that is, descriptions of individual hazardous volumes of airspace. For CAT, the forecast information on which the weather objects were based was gridded, that comprised a representation of a hazard level for all points in a pre-defined 3-D grid, for a range of forecast times. A [U+0093]grid-to-objects[U+0094] capability was generated. This is discussed further in Mirza and Drouin (this conference).

Verification of CAT forecasts

Verification was performed using digital accelerometer data from aircraft in the British Airways Boeing 747 fleet. A preliminary processing of the aircraft data were performed to generate a truth field on a scale similar to that used to provide gridded forecasts to airlines. This truth field was binary, i.e. each flight segment was characterised as being either [U+0093]turbulent[U+0094] or [U+0093]benign[U+0094].

A gridded forecast field is a continuously changing variable. In contrast, a simple weather object must be characterised by a specific threshold. For a gridded forecast and a binary truth measure it is possible to generate Relative Operating Characteristic (ROC) curves. For weather objects, a single point in the hit-rate/false-alarm-rate space can be generated. If this point is plotted on a ROC curve graph then the skill of the forecast using weather objects can be compared with the skill of the gridded forecast.