

FREEZING CONTAMINATION : AIRCRAFT ICING

PUTTING THE FORECASTS IN PLACE

A transmission chain of adapted information

SIGMET, AIRMET, GAMET, SIGWX charts

PIREPS

Awareness of the icing phenomena

A few points on where to go with research and development

A few bibliography resources

List of key words

Forecasting icing conditions falls in the common framework of the routine anticipation of significant weather for the aviation world on the same levels as for instance the forecast of atmospheric turbulence.

In any case, regional or local climatology sometimes gives more importance to this forecast:

- More impact outside the tropical regions
- More impact in wintry conditions in the temperate latitudes.

Each Meteorological Service has to adapt its efforts (*) to the local situation and needs expressed by the users of the forecasts.

The quality of the rendered service depends for a large part upon the means available for the forecast.

Beforehand :

- Observational systems (mesoscale and aerological scale), in particular multispectral satellite images and radar images but also conventional surface and upper air observations.

Afterwards:

- Adapted numerical models (mesoscale) with explicit schemes to produce prognostic icing parameters or an icing index
- A way of combining all targeted observational data
- Local expertise (*)
- Fast systems to transmit the information.

A transmission chain of adapted information: alphanumeric formats (1)

Aeronautical messages SIGMET and AIRMET (*) are the regulated formats.

They are produced by the meteorologists in charge of the Meteorological Watch Offices (MWO) for the flight information regions (FIR and UIR) and are regulated by ICAO.

A SIGMET message can describe forecast or observed severe icing outside convective clouds by using the code SEV ICE. (FZRA) is added when the phenomenon is caused by freezing rain.

Example :



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LFBB SIGMET 3 VALID 070500/070900 LFBD-  
LFBB BORDEAUX FIR SEV ICE (FZRA) OBS FCST BTN GND AND  
FL060 LINED AHEAD WARM FRONT W OF LFBB FIR 75 NM WIDTH  
MOV E 15KT NC
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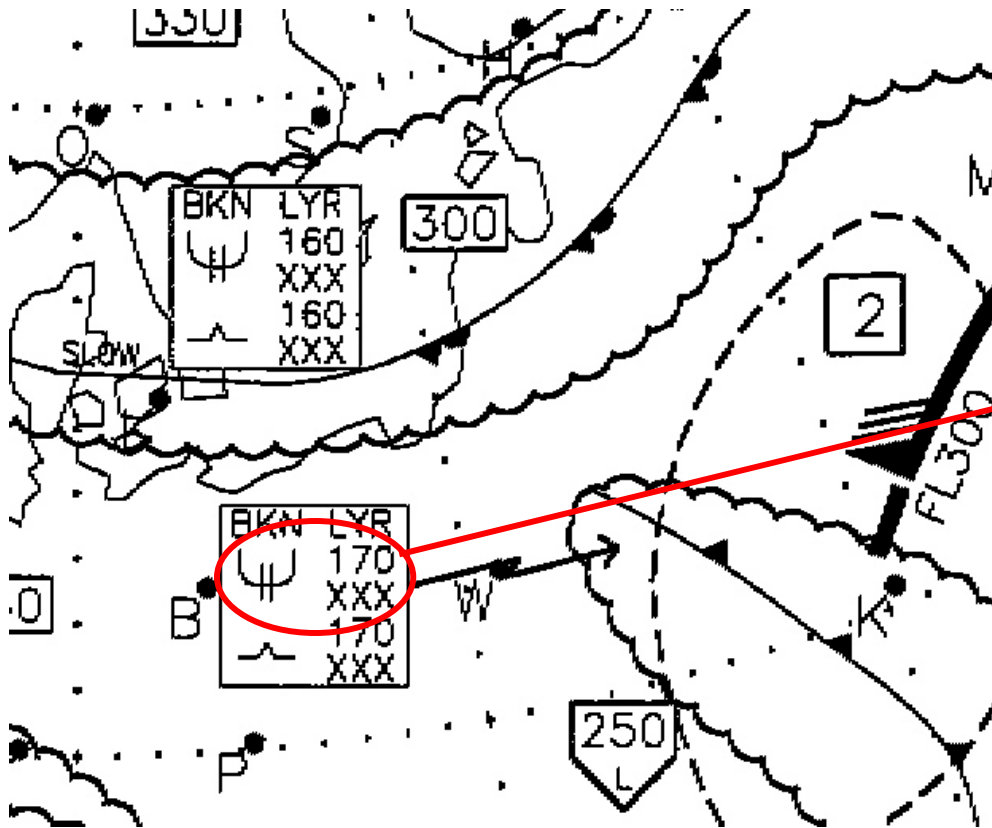
An AIRMET message can describe (in the same format as a SIGMET) observed or forecast moderate icing (which has not been mentioned in the SIGMET) in the lower levels (*) outside convective clouds by using the code MOD ICE.

A GAMET (**) has the possibility to indicate moderate icing outside convective clouds in section 1 for the lower levels.

It is recommended the aerodrome warnings also include following phenomena which imply a risk of contamination by ice: snow, freezing precipitation, hoar frost, clear ice, rime ice, frost.

A transmission chain of adapted information: graphical formats (3)

Significant weather charts (SIGWX) explicitly indicate the moderate  or severe  icing potential (*) (**)



Example in chart format
SIGWX EUR
WAFC LONDON

Moderate icing potential in clouds between, level XXX (here FL100 the first to be described in this chart) and FL170.

In-flight observations of aircraft can include information on observed ice accretion (*).

Collected by the meteorological watch office, they can be centralised in the form of PIREPs in order to validate the forecasts.

For safety reasons, it is highly desirable that in the situations with severe icing, the feedback of information by the MWO, is fast and up to date (**).

In order to perform a quality control on the forecasts, it is desirable to set up a light, regional level, procedure for collecting observational data (***)).

These are a few attitudes (*) which could degrade our work:

On the meteorologist side,

- a routine approach to the forecast
- little knowledge of the aeronautical world
- being isolated from the users

On the user of the forecast side,

- simplification of the phenomena
- loss of vigilance at the start of the winter season or because the phenomenon is rare
- little knowledge of the meteorological world and the limits of icing forecasts
- too much or too little confidence in the forecasts
- not transmitting systematically observations of the phenomenon on a routine basis.

These are a few attitudes that can improve or work:

On the meteorologist side,

- recognise the marginal situations (on the edge of...) that are often forgotten and which can lead to « booby trap » situations
- be reactive to observations of severe icing (*)
- inform and mobilise the users on the progress in concepts and the evolution in forecasting techniques of the phenomenon (**).

On the user of the forecast side,

- use the ability to observe the phenomenon and transmit the obtained information (***)
- inform yourself regularly on the progress of the concepts and the evolution in forecasting techniques for predicting icing.

A few points on where to go with research and development.

- Towards a better understanding of physical processes in cloudy environments.
- Sophistication of the cloud schemes: explicit representation of the physical processes in the mesoscale modelling.
- In-flight observation campaigns in order to sample the regional situation.
- Objective and active standardization of the response of aircraft to the icing conditions. (*)

Common international training standards :

- WMO No 49, Technical regulations vol II, Meteorological Service for International Air Navigation
- WMO No 258, Guidelines for the education and training of personnel in meteorology and operational hydrology
- WMO No 732, Guide to practices for meteorological offices serving aviation
- ICAO Annex 3, Meteorological Service for International Air Navigation

In English :

A small complete book : Aircraft Icing Handbook
GAP booklet, Safety Education and Publishing Unit
Civil Aviation Authority
P O Box 31 441, Lower Hutt, New Zealand

In French :

Un ouvrage plus général : Météorologie Aéronautique
Ecole Nationale de l'Aviation Civile
7 Avenue Edouard Belin B.P. 4005
31055 Toulouse Cedex 4, France

List of key words (*)

- Contamination, contaminant, ice
- Accretion (of ice), hoar frost, rime ice, clear ice, mixed ice
- Icing (light, moderate, severe)
- Icing conditions; icing levels
- Icing potential (light, moderate, severe)
- Carburettor icing
- De-icing, anti-icing
- Temperature, 0°C-isotherm
- Liquid Water Content (supercooled)
- Large droplets (SLD)
- Vertical wind shear
- Freezing fog
- Satellite observation (near infrared, middle, thermal)
- Radar observation, bright band
- Icing indices
- SIGMET, AIRMET, GAMET, SIGWX charts, PIREP

Notes for teachers