

A NEW METHOD TO FORECAST AIRCRAFT ICING FROM HIGH-RESOLUTION NWP



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BACKGROUND

- Today's high resolution weather forecast models utilizes advanced microphysical parameterizations of different cloud processes.
- Give the possibility to produce highly detailed forecasts of icing conditions in the atmosphere.
- Icing growth on airframes is a complex process, simplification needed in an operational environment.
- Cloud forecasting is inherently uncertain, use of ensemble methods is preferred.
- This forecast method can also be used for icing climate studies using high resolution reanalysis data.

METHOD

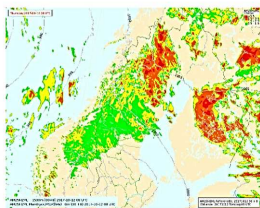
- Based on developments done for the wind energy sector.
- Rate of ice build-up on a cylinder is calculated using an ice accretion model.
- Icing rate is translated to aircraft icing severity.
- The accretion model uses as input temperature and all hydro-meteors (liquid cloud water, cloud ice, rain, snow and graupel).
- Cloud ice and snow contributes to the icing when mixed-phase clouds are present.
- 175 kt airspeed is assumed.

MODEL

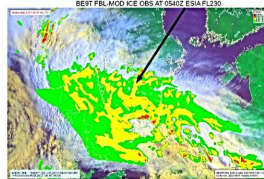
- HARMONIE-AROME version 40h1.1.
- 2.5 km horizontal resolution, 65 vertical levels.
- 3 hours cycling
- 66 hours forecast at 00, 06, 12 and 18 UTC
- Non-hydrostatic dynamics.
- ICE3 advanced microphysical parameterization..



Examples of forecasts



Icing forecast (TRC,LGT,MOD,SEV) at 1500 meters



Icing forecast 6000 meters, one verifying airp

MetCoOp EPS (MEPS)

- Cooperation on operational production of forecasts between Sweden, Norway and Finland.
- Using HPC-resources in all three countries.
- Running HARMONIE-AROME in an ensemble setup.
- 10 members, all with 2.5 km horizontal resolution.
- Will give the possibility to produce probabilistic forecasts of aircraft icing using this method.
- No probabilistic products ready yet.

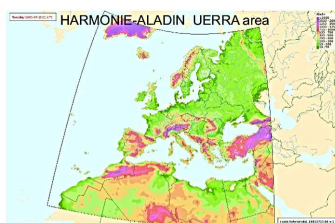
VERIFICATION

- No systematic verification has been done yet.
- The method was used operationally for the first time last winter during a helicopter certification campaign.
- The forecasters thought that the new icing product gave a valuable guidance for their briefings.

AIRCRAFT ICING CLIMATE FROM REGIONAL RE-ANALYSES

UERRA

- Uncertainties in Ensembles of Regional ReAnalysis.
- Three full upper air Regional European Reanalysis systems and two 2-dimensional ones.
- Observation rescue and quality control of historical observations.
- SMHI has been running HARMONIE-ALADIN at 11 km horizontal resolution for 55 years (1961-2015).
- Boundaries from ECMWF ERA40/ERA Interim.



UERRA ICING

- The icing calculation method can be applied to output from the UERRA reanalysis.
- It is possible to analyse a lot of climatic aspects of aircraft icing using this database.
- Below three maps that shows the number of hours of active icing at 850 hPa for three January months (1990, 2000, 2010) during the 55-year period.

