Thunderstorm Nowcast and Forecast for Aviation Safety and Efficiency

Validation by IAGOS flights

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Innovative weather forecast system for aviation – why?

Example thunderstorms

- Adverse weather is responsible for 40-50% of all delays in Europe.
- Thunderstorm activity is the reason for up to 90% of all delays in the airspace over the USA during the summer months.
- Thunderstorms are the most dangerous weather phenomenon for aviation (survey with pilots).

Thunderstorm information for aviation is still rudimentary these days!

Goal: Help to increase safety and efficiency for air traffic during adverse weather situations.
Cb-TRAM - Cumulonimbus TRacking And Monitoring

satellite data analysis

en-route

Used MSG (rapidscan) data:

- WV 6.2
- IR 10.8
- IR 12.0
- HRV

potential development - yellow

rapid development - orange

mature thunderstorm - red
Cb-TRAM - Cumulonimbus TRacking And Monitoring

satellite data analysis

→ en-route

60 min nowcast

Cb-global object
Cb-TRAM - Application area Meteosat

Resolution 15 (5) minutes
1 / 4 km (VIS/IR)
first successful data link tests
cooperation DLR - DLH

Lufthansa GADCom project (Ground Air Data Link Communication):

Real time link of Rad-TRAM and Cb-TRAM data in 5 EFBs (Electronic Flight Bags) of Lufthansa Cityline aircraft via mobile network on the ground and later in 5 EFBs of Lufthansa aircraft via FlyNet during cruise-flight
The Test Flight: Rio de Janeiro to Frankfurt, February 2013

According to the charts: Business as usual at the ITCZ
Then, we uplinked the latest Cb-TRAMs to the eRM ...
Then, we uplinked the latest Cb-TRAMs to the eRM ... 
... planned the safest route with the eRM ... 
... and flew it tactically by looking at the weather radar
The result
If we would have uplinked the Cb-TRAM a few minutes earlier ....

... we would have seen the gap on the PUGSU DIKEB route

... or the gap on the ORARO-TASIL route

... and could have avoided a 300 NM deviation
The Test Flight: Rio de Janeiro to Frankfurt, February 2013

LH D-AIGT IAGOS No. 1

Window for Backscatter Cloud Probe
The Result as seen from IAGOS Aircraft

Regular occurrence of high ice crystal number concentrations on flights to or from Rio de Janeiro

Data from Backscatter Cloud Probe
The Result as seen from IAGOS Aircraft
The Result as seen from IAGOS Aircraft
The Result as seen from IAGOS Aircraft

Date 04.02.2013   Flight LH 501 Rio - Frankfurt

[Temperature graph]

[Concentration graph]

[Aerosol diameter graph]
The Result as seen from IAGOS Aircraft

Date: 04.02.2013
Flight LH 501 Rio - Frankfurt

-33 -32 -31 -30 -29 -28 -27 -26

0 2 4 6

Longitude
Latitude

max. 3000 L
preliminary data from 33h in the outflow of convective systems over Amazonia
M. Krämer and co-workers, Sept. 2014
The Result as seen from IAGOS Aircraft
Currently have 415 events, but only a fraction of the data have been checked.
Further IAGOS avoidance events in Cb-TRAM
Further IAGOS avoidance events in Cb-TRAM

Cb-TRAM detections are accurate, because:

- The avoidance actions by pilots generally follow the contours
  → No conflicts between on-board radar returns and Cb-TRAM detections
- Avoidance routes are safe: they basically show low ice crystal number concentrations. If not, in most cases Cb-TRAM detections are encountered.
  → Additional increase in safety by the use of Cb-TRAM

Conclusion: Cb-TRAM is qualified for strategic flight route planning!
Next Steps

- **DLR** runs Cb-TRAM for more identified avoidance maneuvers in the MSG Field of View;
- **Manchester** analyses BCP data for avoidance maneuvers;
- **FZ Jülich** analyses T, p, RH for avoidance maneuvers; identifies cirrus type encountered during avoidance maneuvers;
- **All (DLR lead)** combine information from Cb-TRAM & IAGOS cloud type classification and RH for an assessment of Cb-TRAM; publish results.
Summary

Severe storms are tracked by satellite data

On-board detection by IAGOS-BCP verifies cloud-free regions and cloud type during encounters and improves forecast system

Aircrew reroutes to avoid storms

Thank you for your attention!

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