

Globales Gewitternowcasting in Echtzeit basierend auf Satellitendaten

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ÖGM/DMG Fortbildungstag 25.11.2016 in Hall in Tirol

Knowledge for Tomorrow



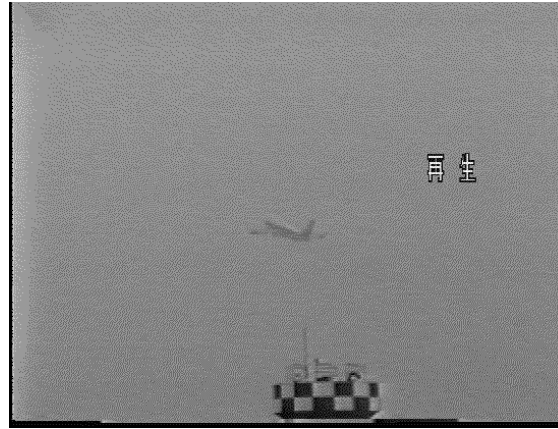
Überblick

- Gewitterinformation für Piloten
- DLR Verfahren Cb-global
- Anwendungsbeispiele
- Globale Abdeckung
- Nutzen für die Luftfahrt





Vereisung



Blitzschlag



Hagel

Consequences:

- **Injuries or fatalities:** tenths of \$million
- **Delays:** in Europe, € 900 million weather-related costs, one third due to thunderstorms. A one hour delay for an air carrier ranges from \$1.400 to \$4.500 (FAA 2015).
- **Image loss**

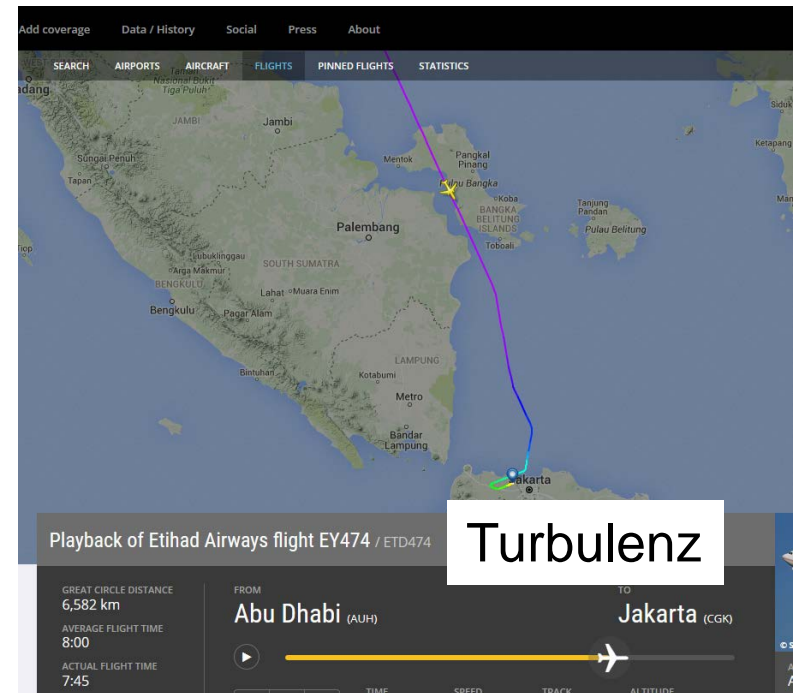




Foto: Steffen Gemsa, DLR



FMS1
25.9nm
ELOPE

158

15

12

S

21

24

LX

ELOPE

MNS
RW10
EG3
EG367
UB309

LUSUK

SAT	-62
TAS	423
GS	406

WX
T-1.5°

5→
17↓

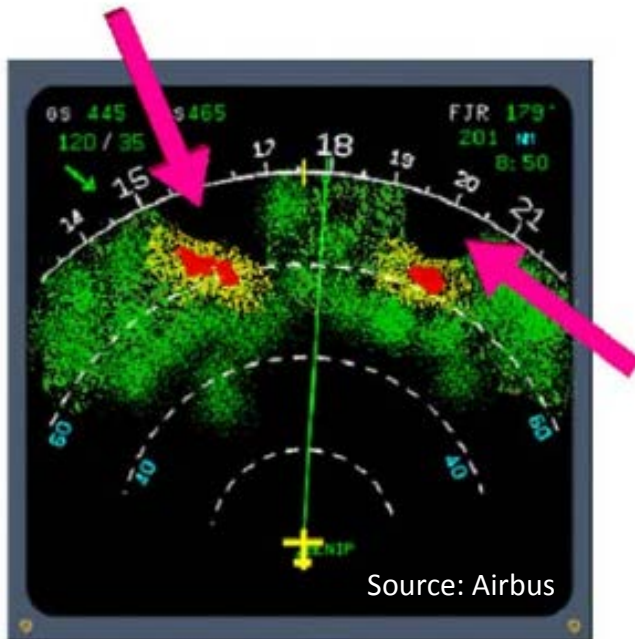
C 50

LUSUK

EG



The Problem of Today's Thunderstorm Information for Pilots



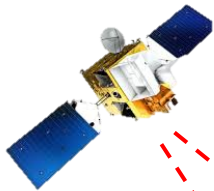
Attenuation of onboard radar signals behind two thunderstorm cells

- Onboard radar
 - has limited reach
 - can only see a limited sector
 - cannot „see behind“ (attenuation)
- Weather charts based on forecast models are outdated when used in the cockpit
- Forecast models cannot forecast location and time of thunderstorm cells

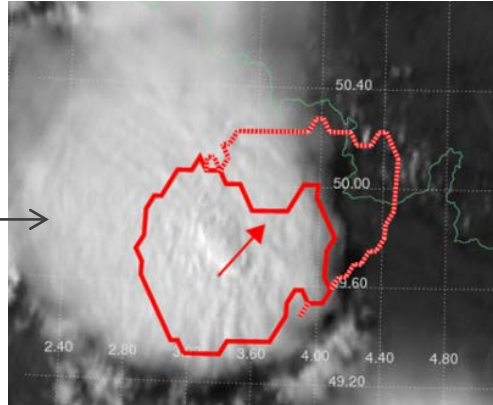
Piloten haben nicht den vollen Überblick über die Gewittersituation

The Solution:

Thunderstorm Detection and Nowcasting Based on Satellite Data



Cb-global



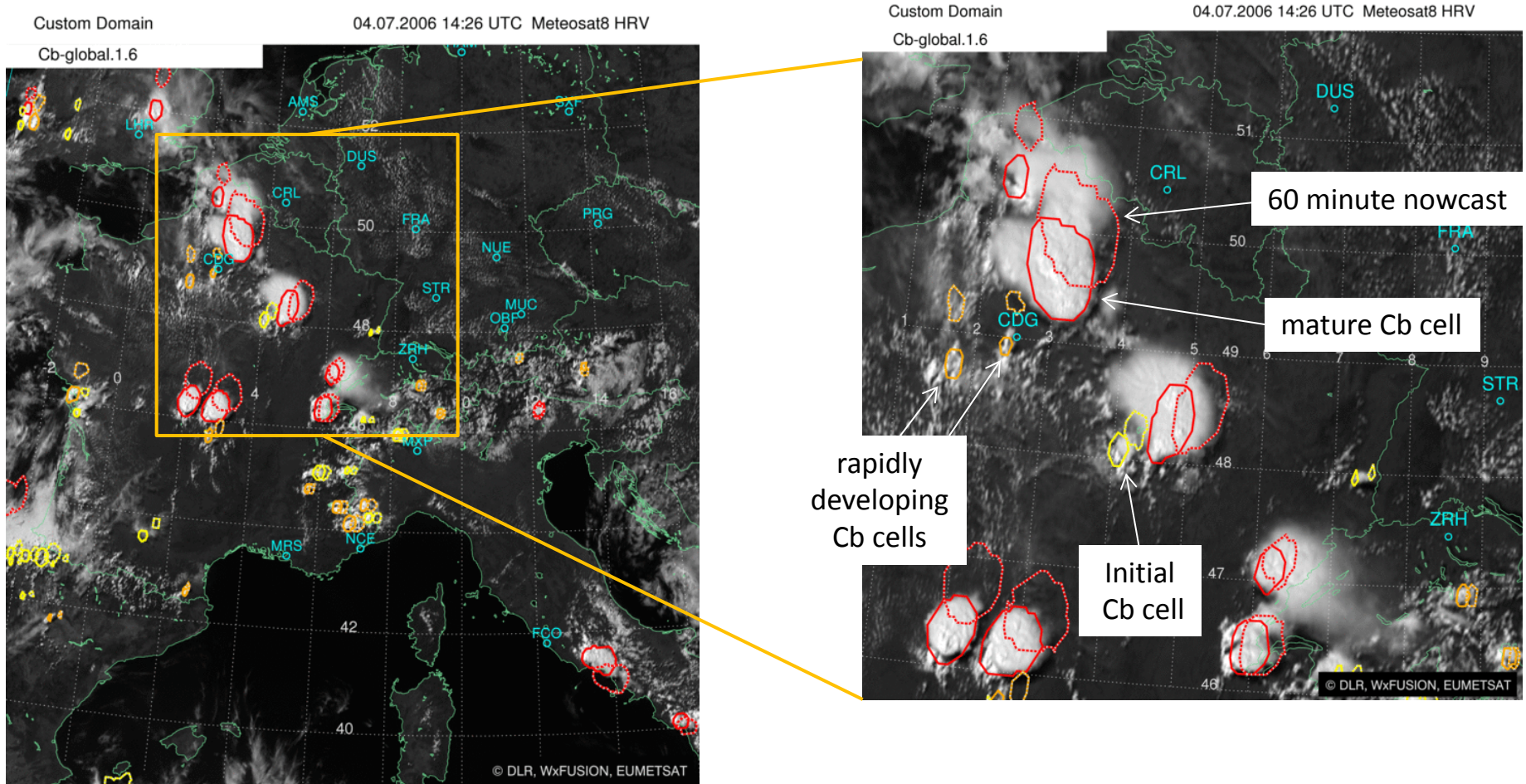
Reducing nature's complexity to meet the specific needs of aviation stakeholders:

- Hazard areas clearly marked
- Near real-time data delivery
- For take-off, en route, and landing
- Updates every 10 –15 minutes
- Nowcasts up to one hour ahead of time



Cb-global – Cb detection and nowcasting based on satellite data

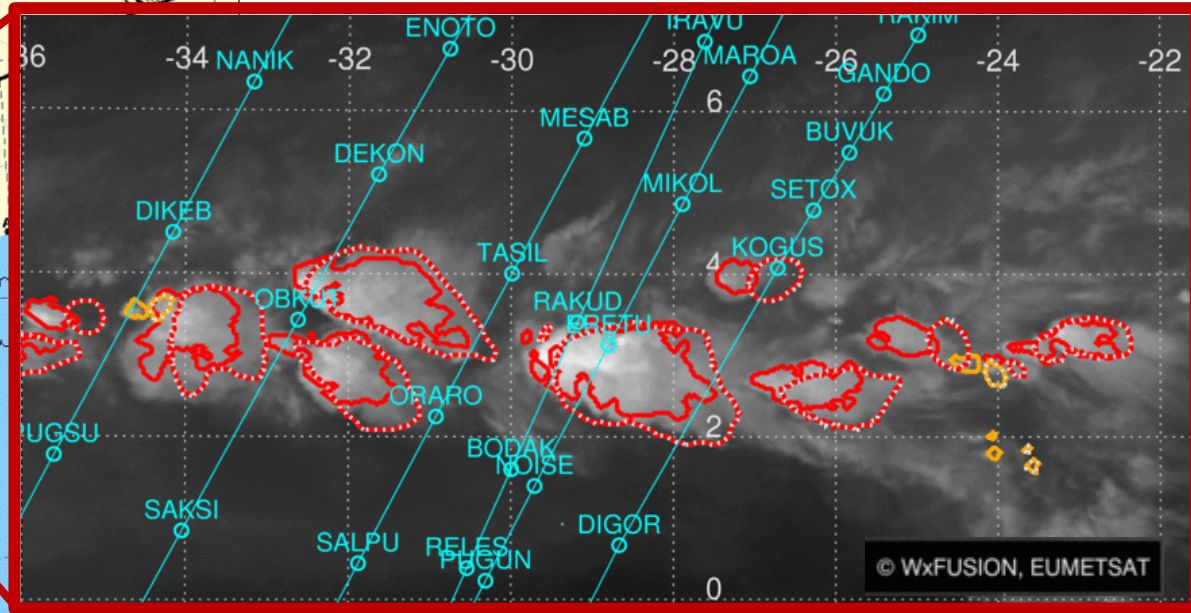
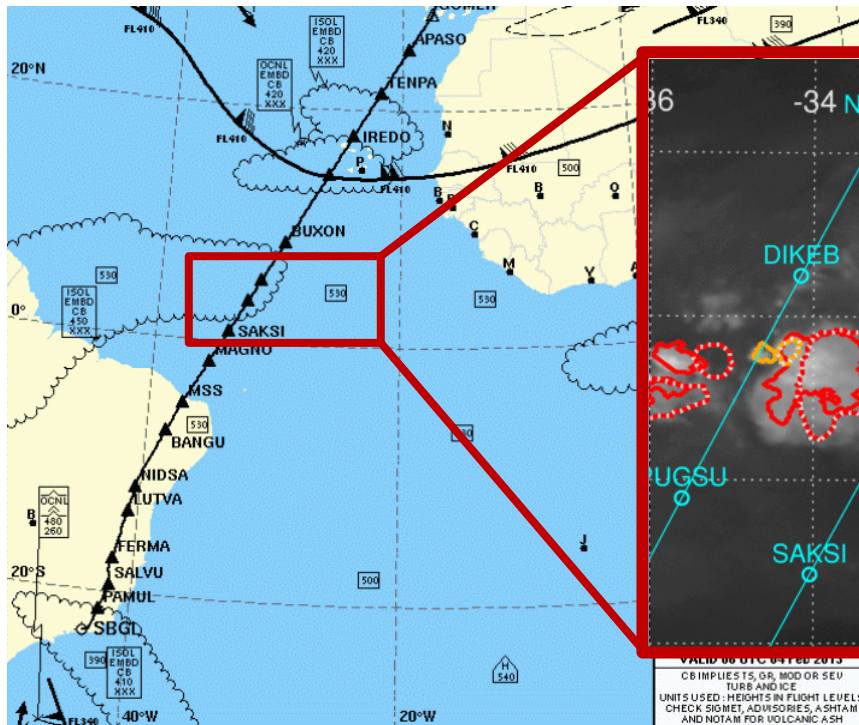
- Combination of four spectral channels (HRV, IR10.8 μ m, IR12.0 μ m, WV6.2 μ m)
- Detection of three different development stages
- Tracking and nowcasting by pyramidal image matching



Cb-global – Cb detection and nowcasting based on satellite data

SigWx 4. Feb. 2013 06 UTC

Cb activity detected+nowcast
4. Feb 2013 06 UTC

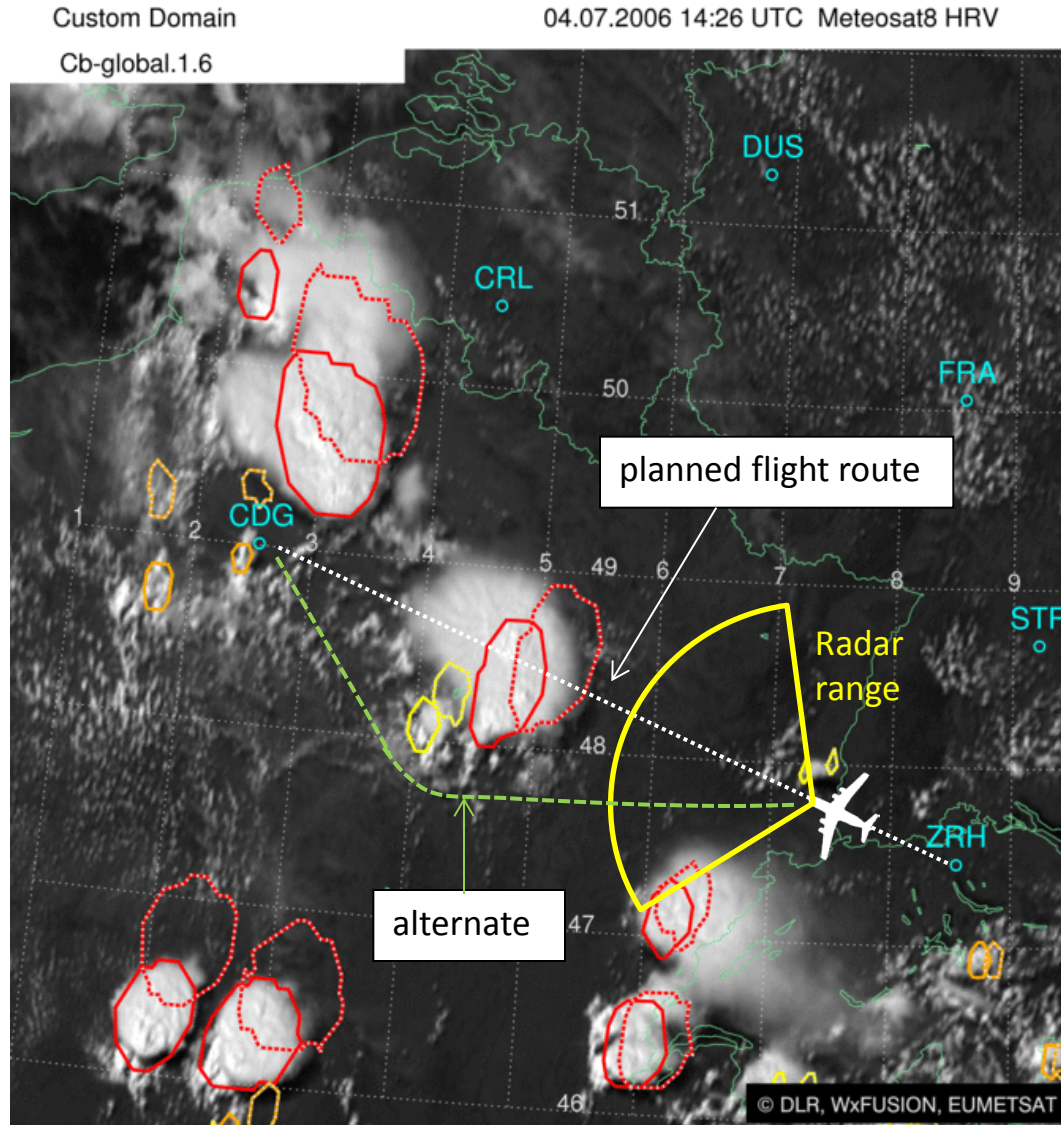


VALID 06 UTC 04 FEB 2013
CB IMPLIES TS, GR, MOD OR SEV
TURB AND ICE
UNITS USED: HEIGHTS IN FLIGHT LEVELS
CHECK SIGMET, ADVISORIES, A-SHTAM
AND NOTAM FOR VOLCANIC ASH

© WxFUSION, EUMETSAT

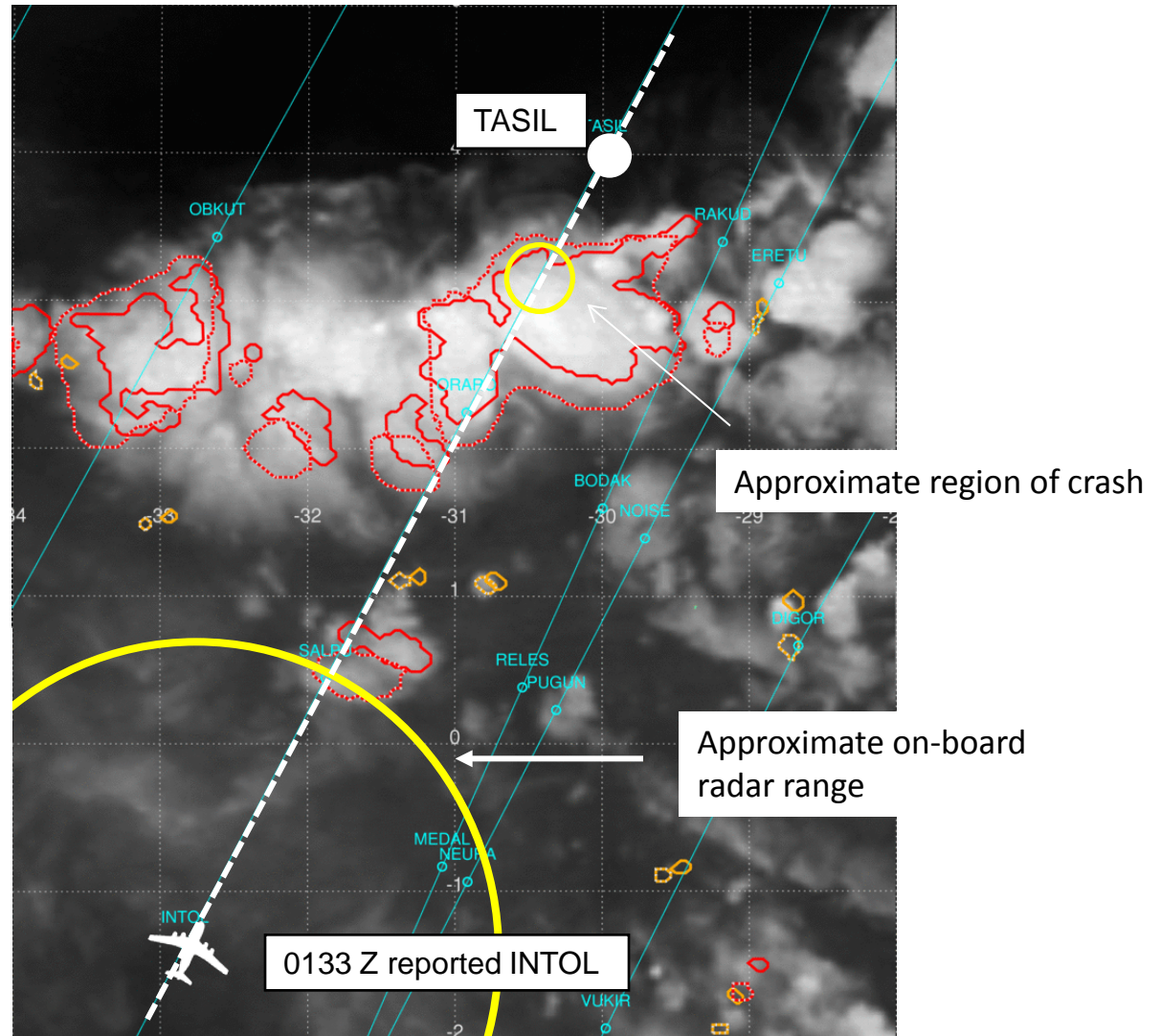


Cb-global enables strategic flight route planning

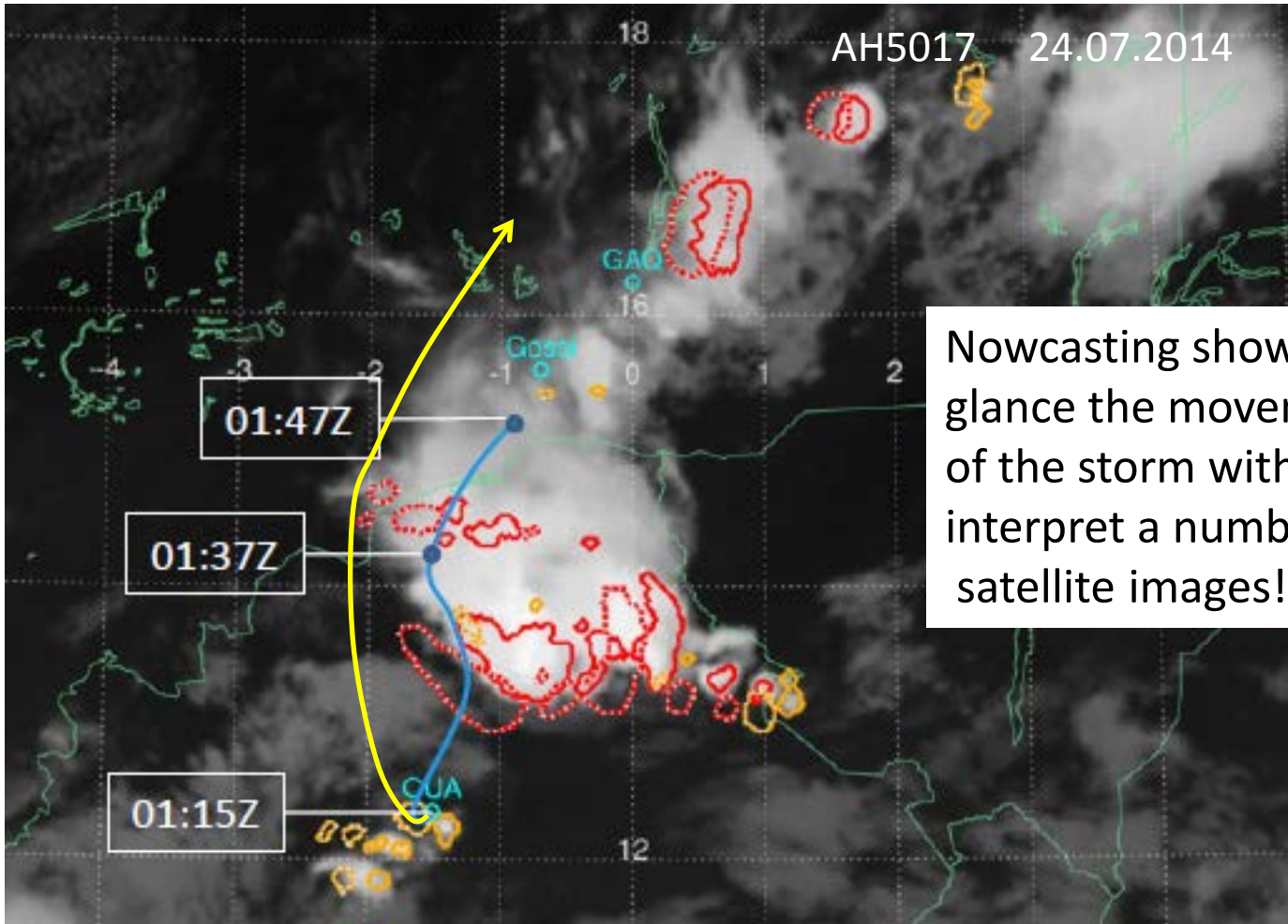


Cb-global analysis for aircraft crash on 1 June 2009

Meteosat IR image at 01:30 UTC on 1 June 2009 overlaid with mature convective cells (red) from Cb-global analysis. 1-hr nowcast plotted with dashed contours.



Cb-global analysis for AH-5017 crash over Mali, July 2014

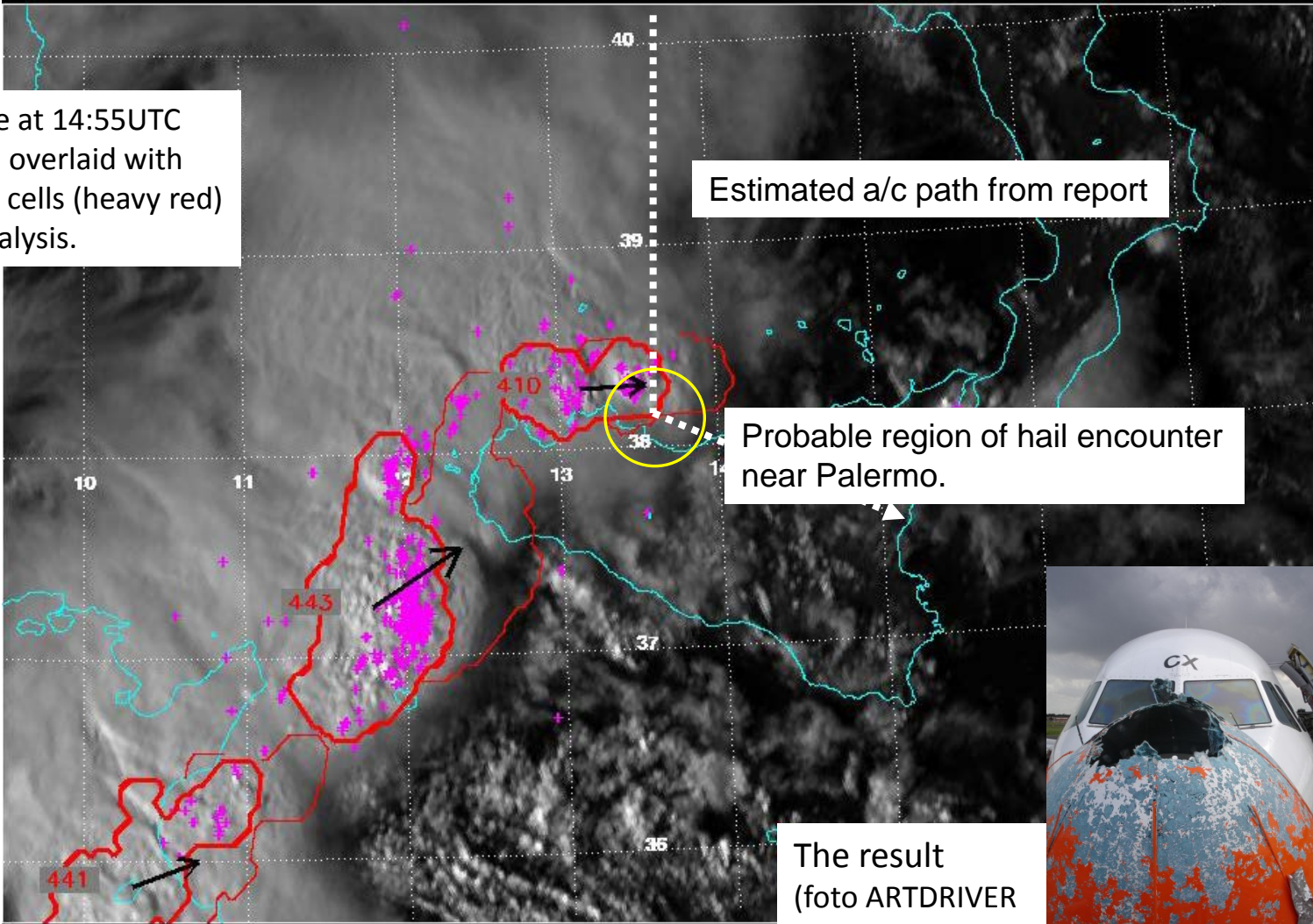


Nowcasting shows the pilot at one glance the movement and intensity of the storm without having to interpret a number of consecuting satellite images!

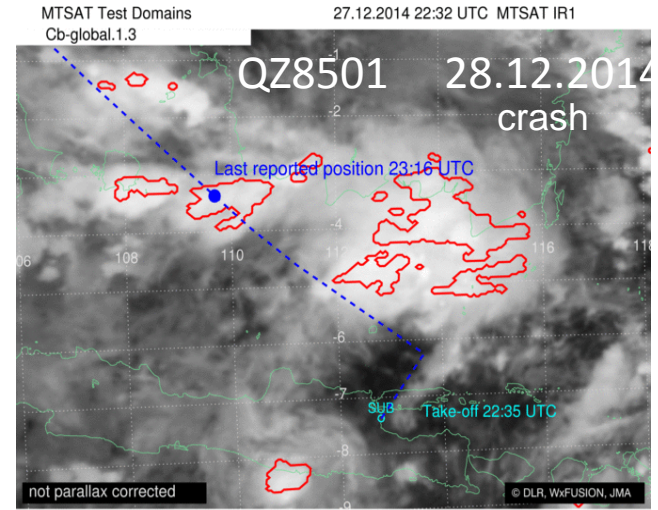
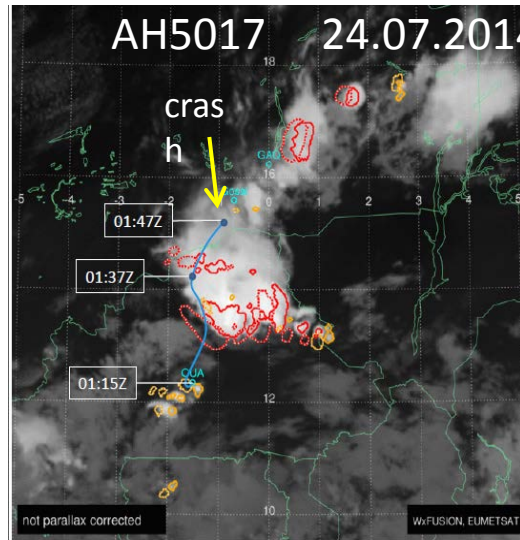
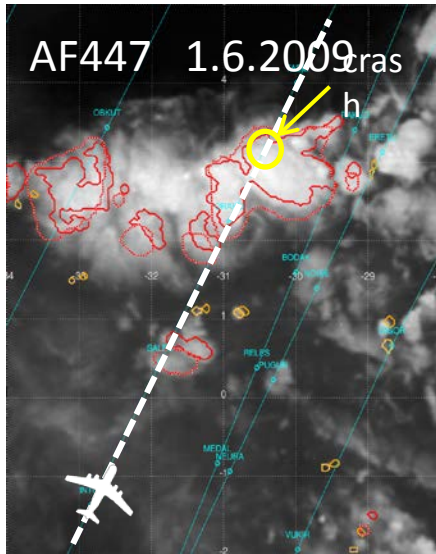


Hail encounter during missed approach to Palermo on 1 October 2009 (EIEDM)

Meteosat IR image at 14:55UTC on 1 October 2009 overlaid with mature convective cells (heavy red) from Cb-global analysis.

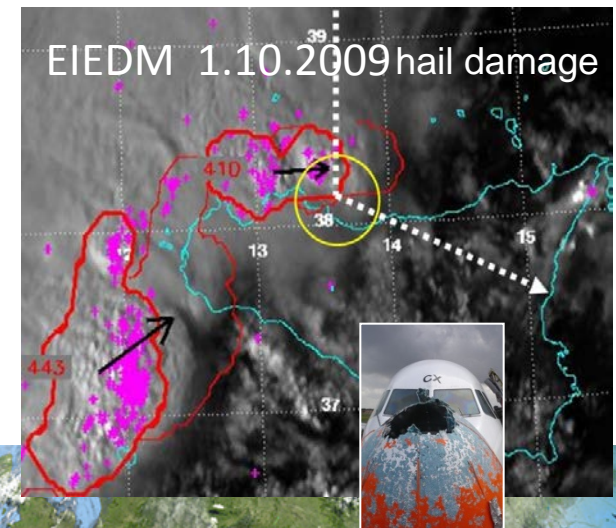
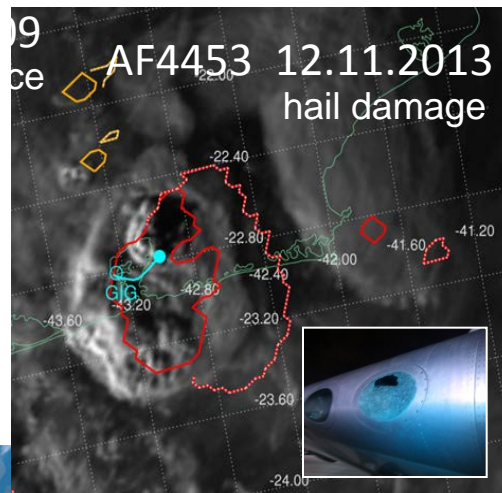
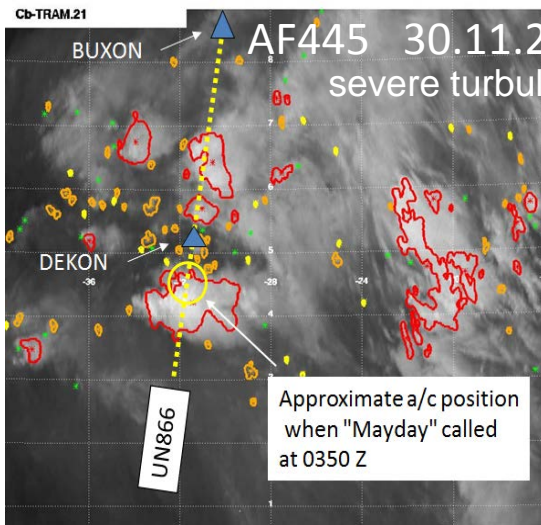


Analyses of accidents/incidents



EXPERIMENTAL PRODUCT - NOT FOR OPERATIONAL USE

Safety! The Cb-hazard information would have been available at least 30 minutes in advance!



Übertragung der Information in das Cockpit

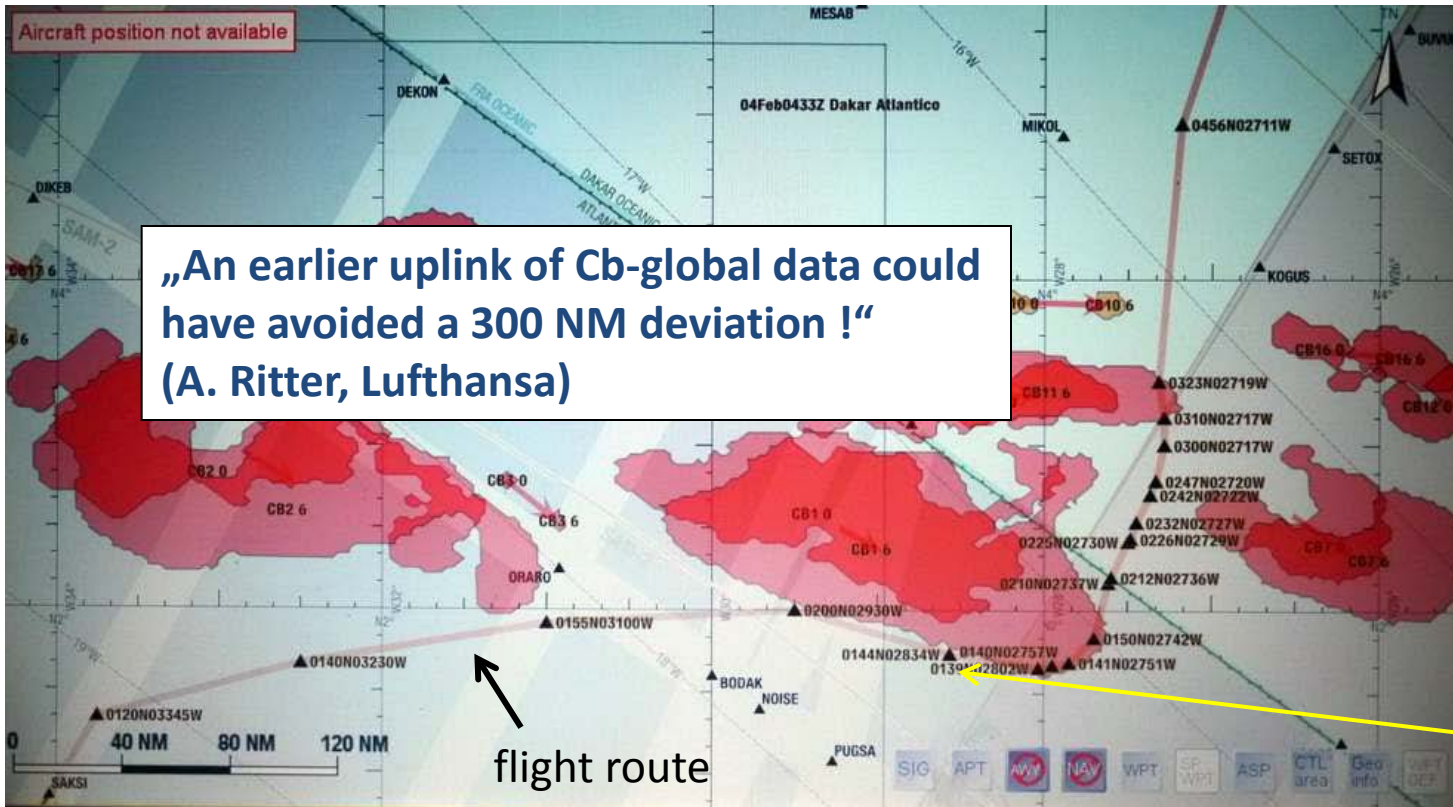
Cb-global in Echtzeit auf dem EFB-Display direkt beim Piloten



Fotos:
Capt. Andreas Borengässer (Lufthansa Cityline)
Capt. Andreas Ritter (Deutsche Lufthansa)



Cb-global Data Link into LH Cockpit EFB Test Flight: Rio to Frankfurt, Febr 2013



Courtesy: Andreas Ritter, Lufthansa





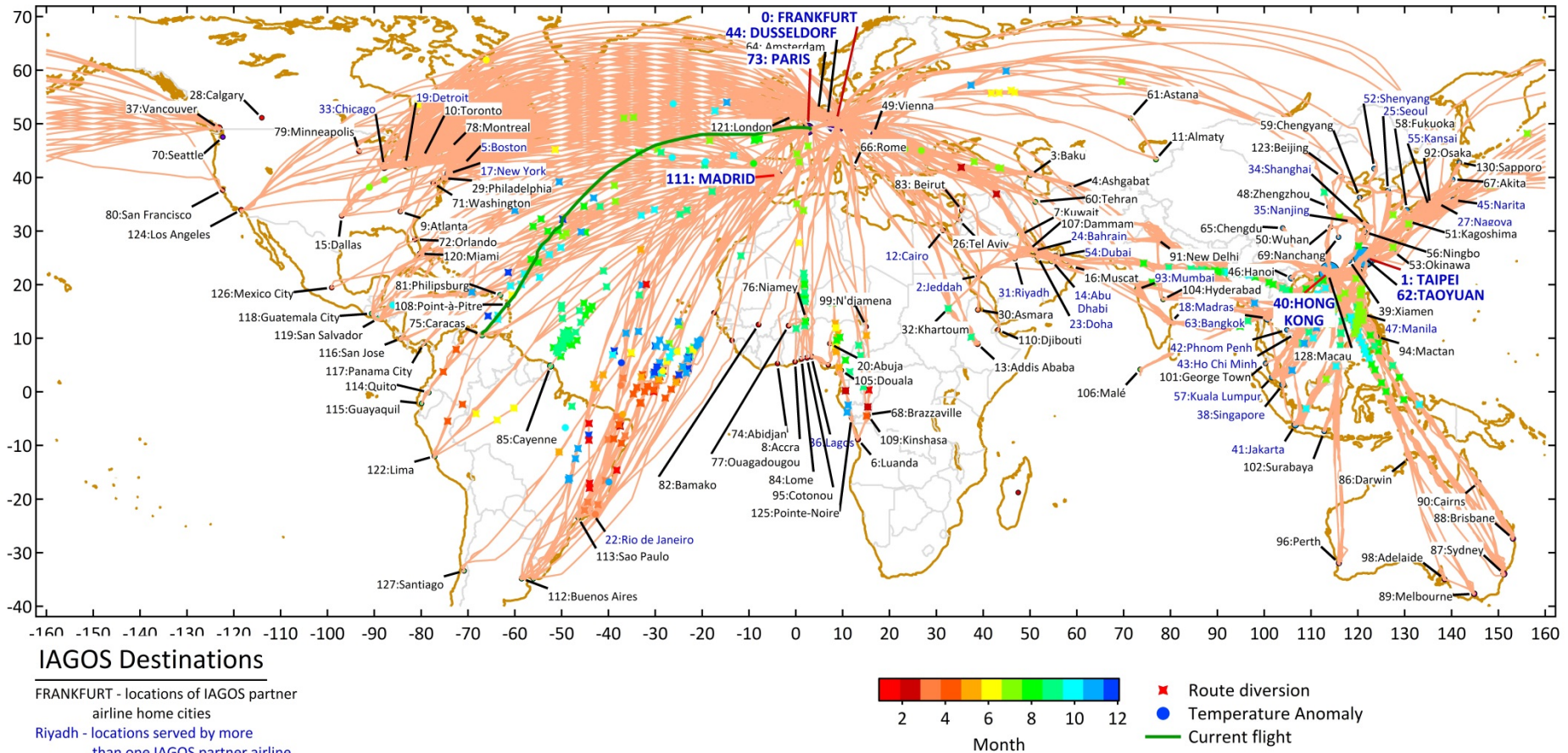
In-service Aircraft for a Global Observing System - European Research Infrastructure

LH D-AIGT IAGOS No. 1



Window for Backscatter Cloud Probe (BCP)



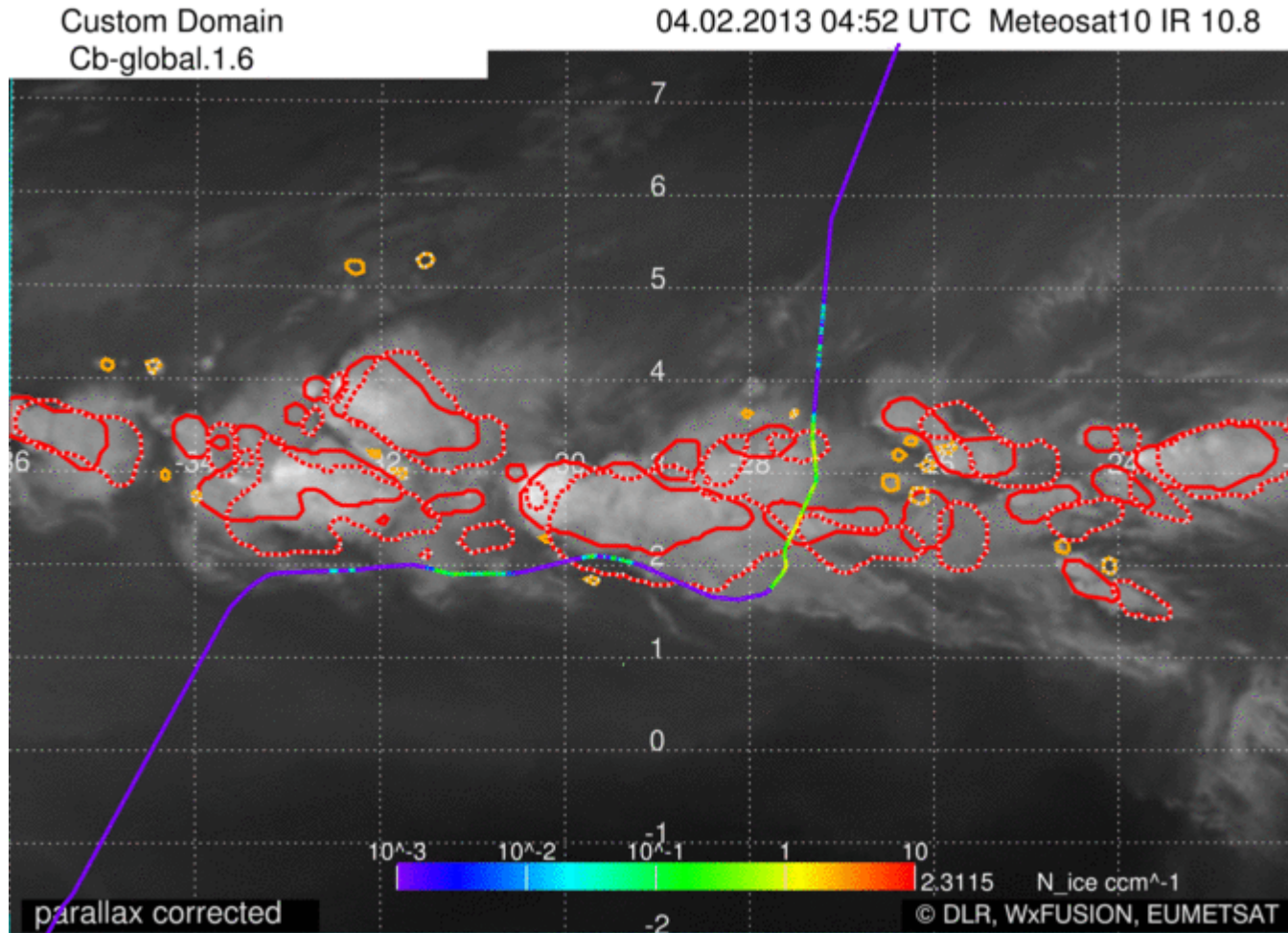


- Over 600 events with avoidance manoeuvres identified
- 55 events (out of 600) with flight tracks and BCP measurements currently available for Cb-global validation
- Cb-global validation with IAGOS data performed for 31 events (out of 55)



Test Flight: Rio to Frankfurt, Febr 2013

IAGOS Ice Particle Number Concentrations N_{ice}

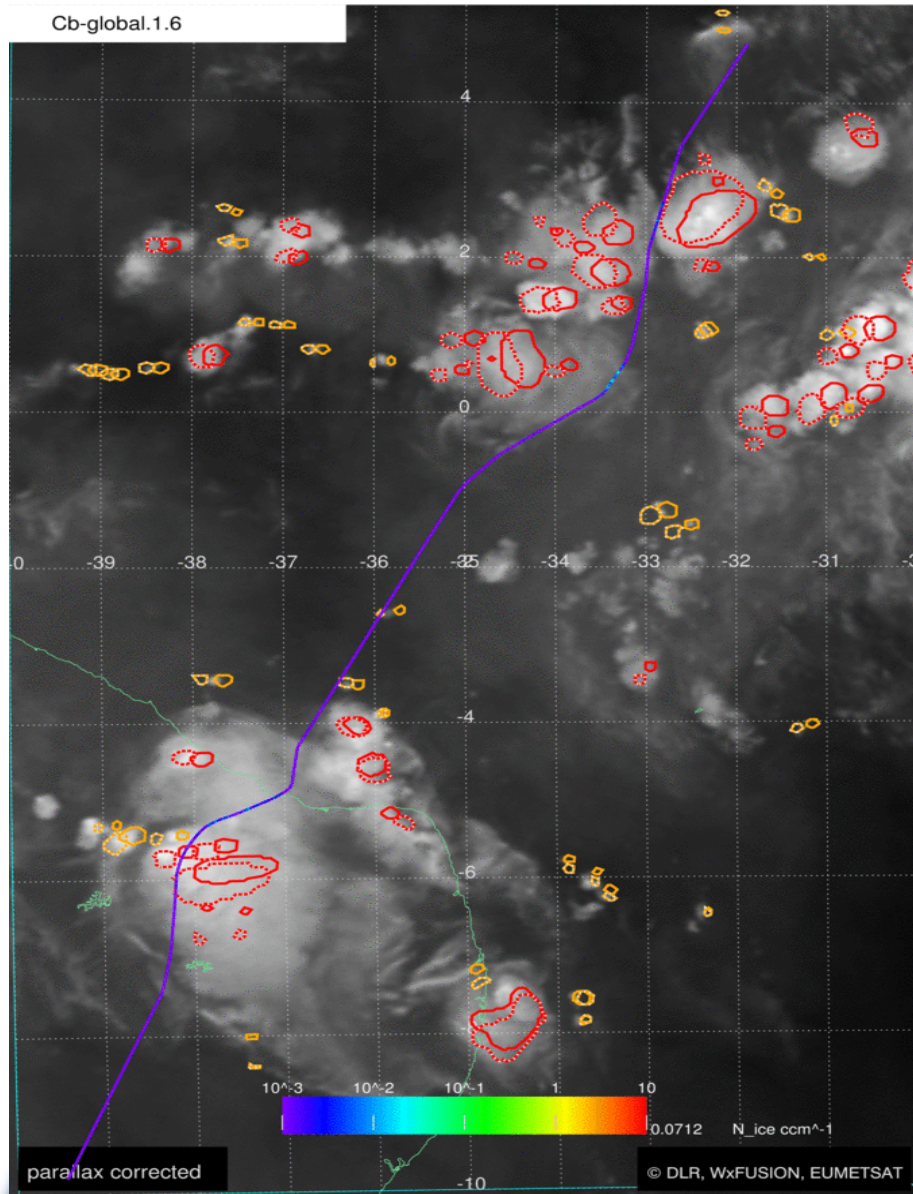


Example: Flight from Sao Paulo to Madrid

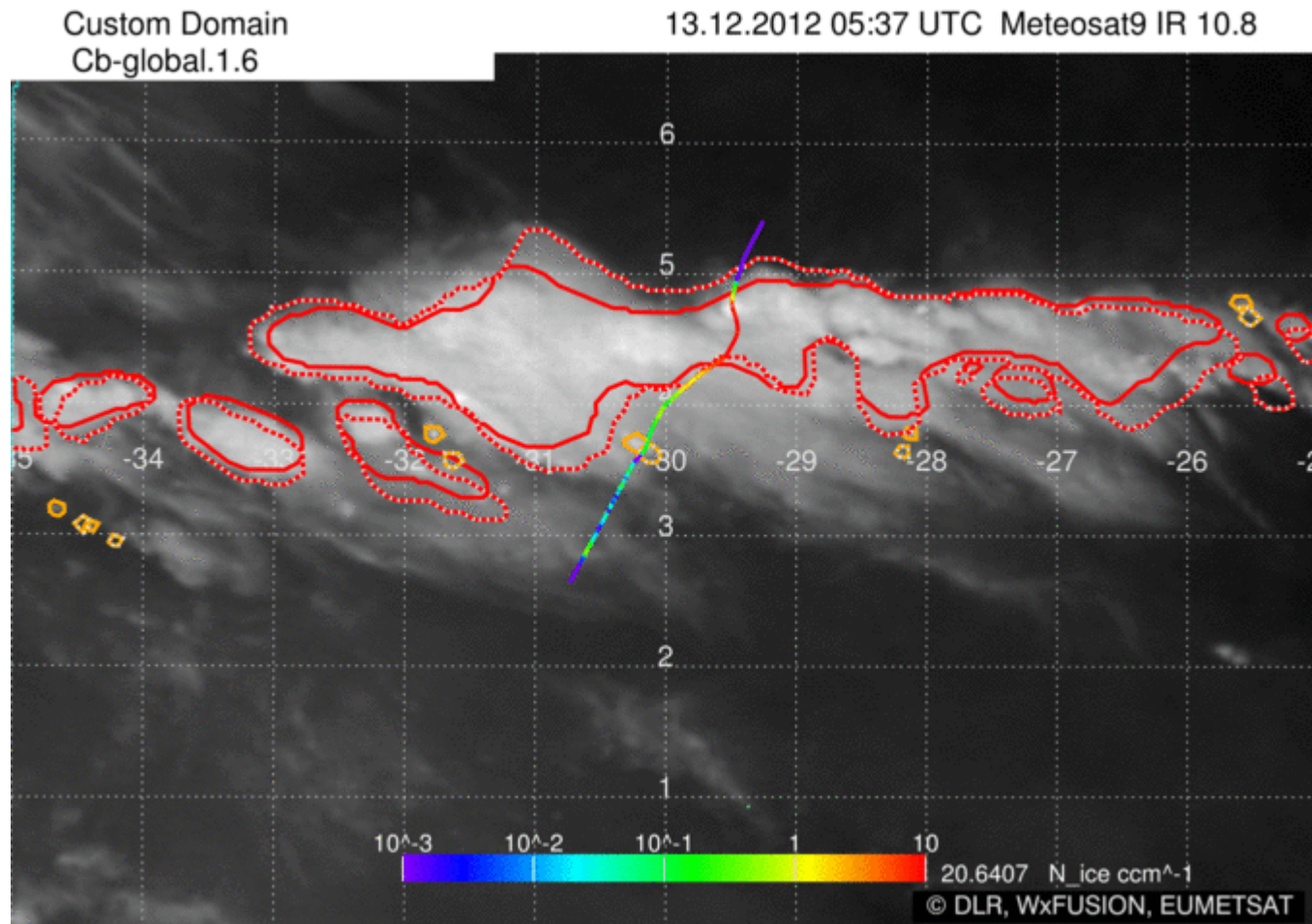
Custom Domain

29.04.2014 02:37 UTC Meteosat10 IR 10.8

Cb-global.1.6



Example: Flight from Frankfurt to Rio de Janeiro



FL 360 T=248 K



Cb-global validation with IAGOS data

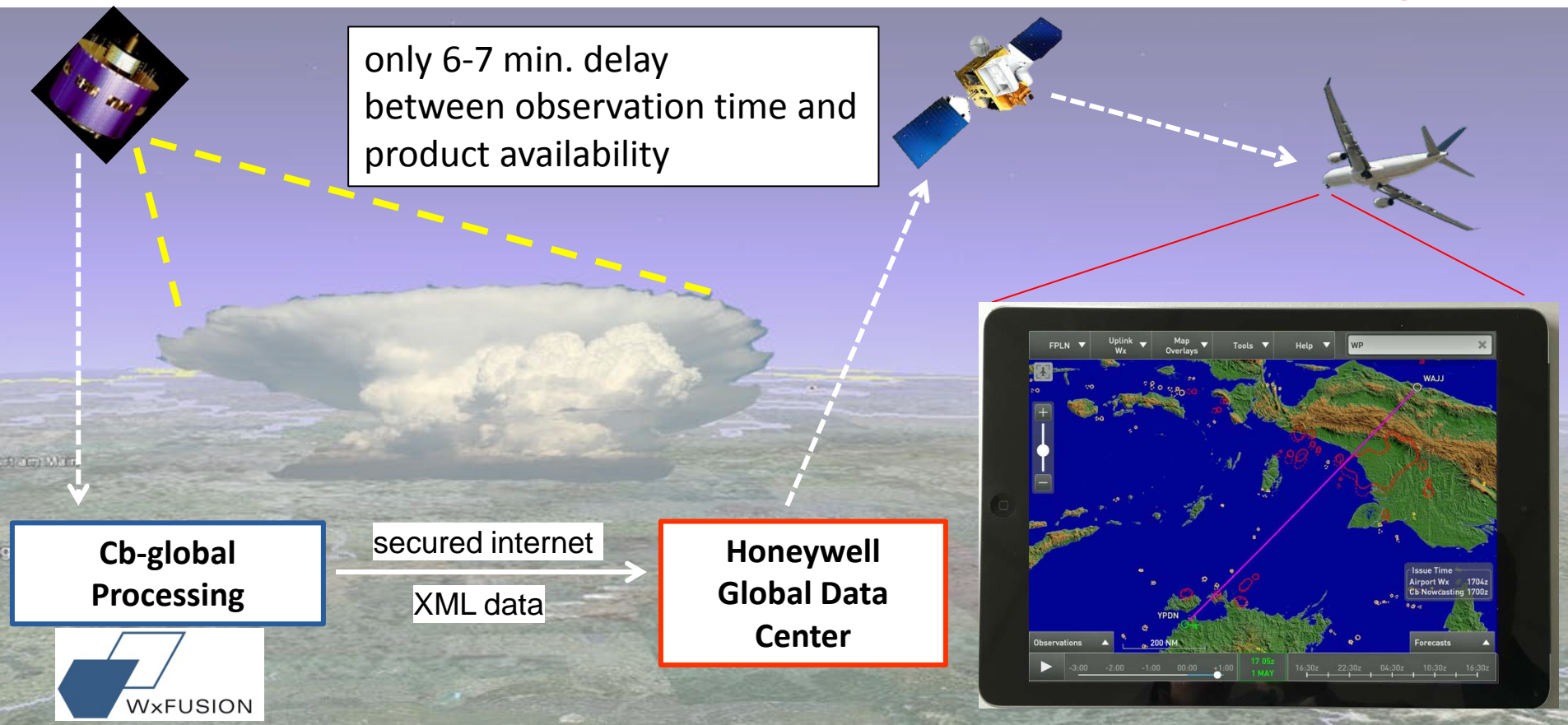
- Obviously, the on-board radar picture is in accord with Cb-global
- Ice particle number concentrations along the flight routes that avoid the Cb-global hazard regions show low values;
- The few cases where the flight route leads through Cb-global hazard regions show high ice particle number concentrations within these regions

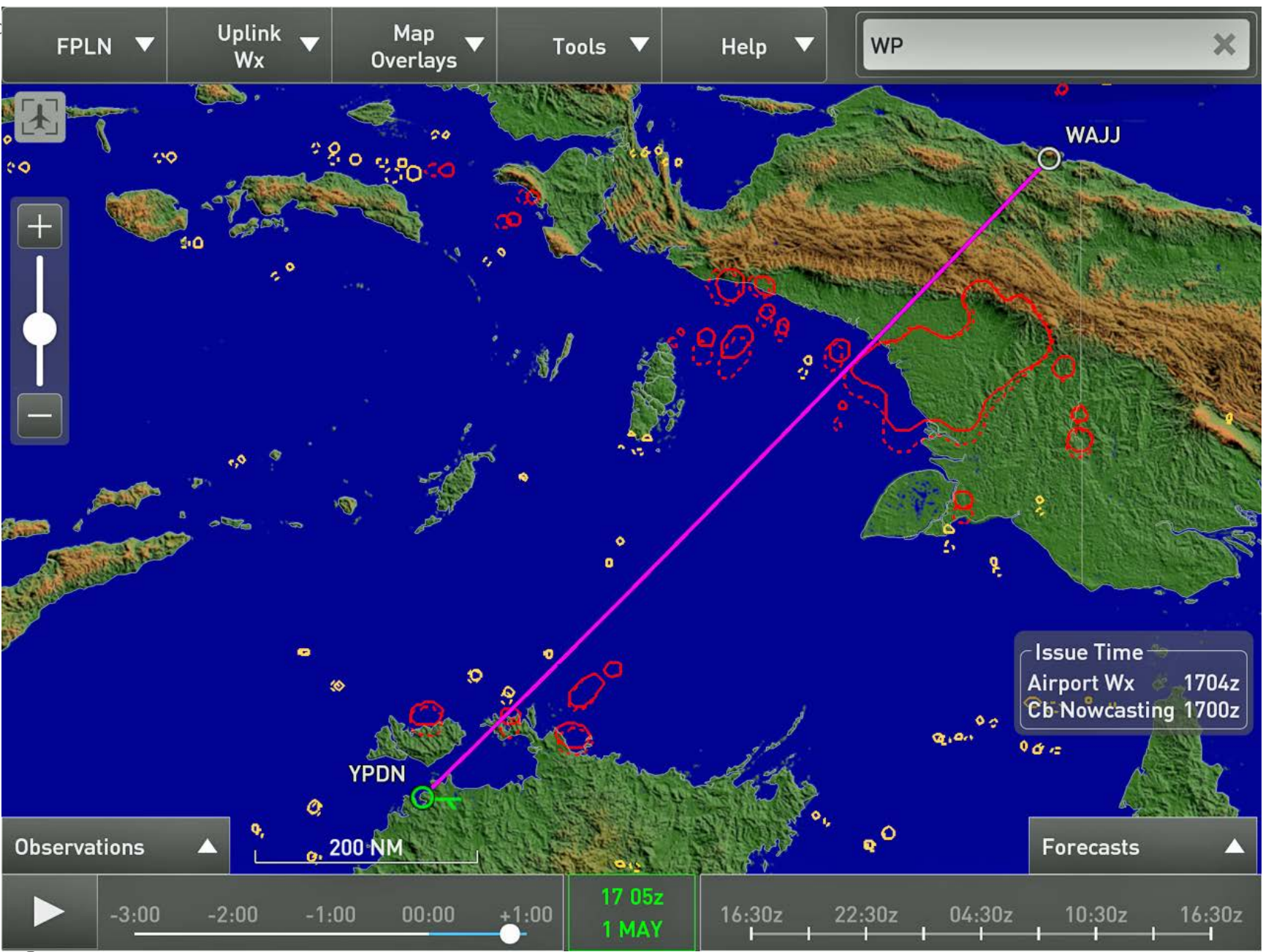
Conclusion: Cb-global can be used for flight route planning



Trial Experience

Cb-global Data Link into Honeywell WIS Application



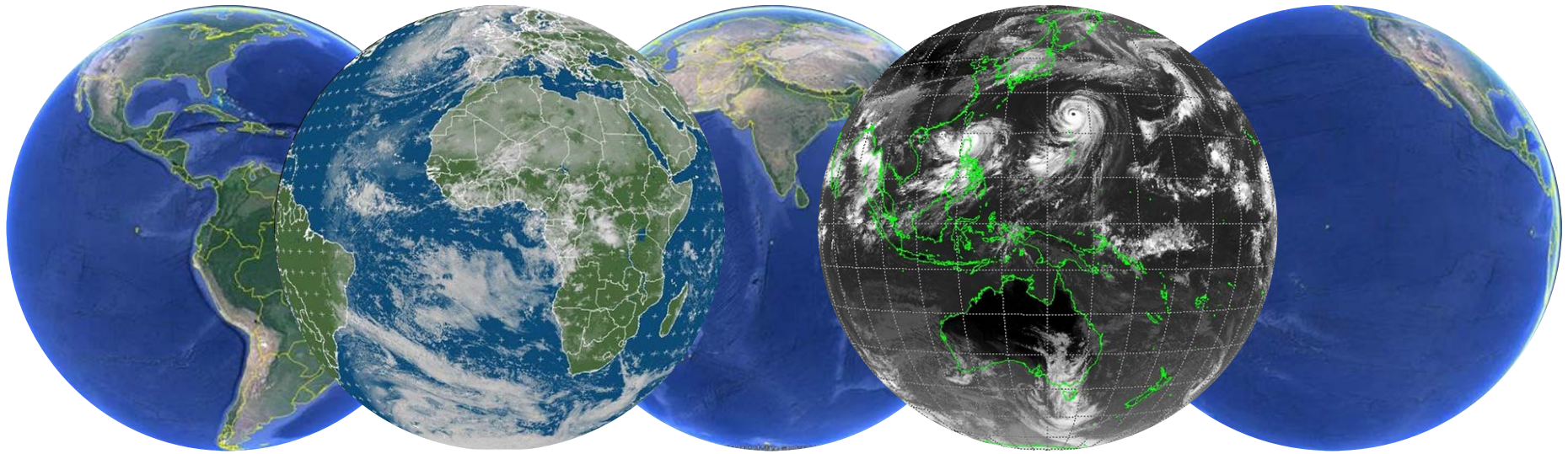


Global Coverage

2017



2018



GOES-R

Meteosat 10

Meteosat 8

Himawari 8

GOES-S

5/10 min

5/10 min

15 min

10 min

5/10 min

1 / 2 km

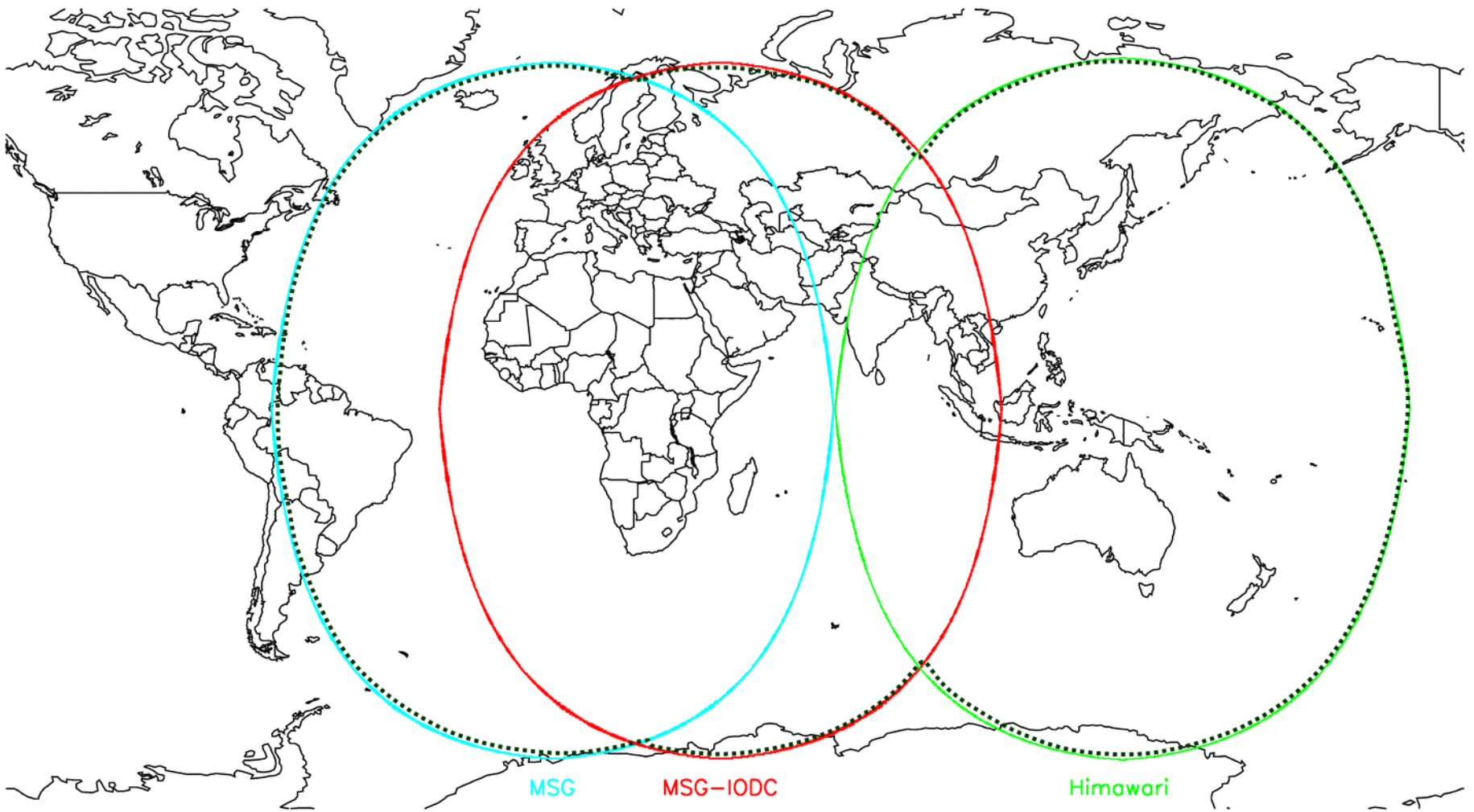
2 / 4 km

2 / 4 km

0,5 / 2 km

1 / 2 km





Zusammenfassung

- Satellitendaten über den ganzen Globus in hoher Auflösung verfügbar
- DLR Verfahren Cb-global kann hohe Datenmengen in Echtzeit verarbeiten
- Entwicklung und Installation von Cockpit Electronic Flight Bags
- Ausstattung der Flugzeuge mit Datenlink und Verbindung im Cockpit

Das bedeutet für die am Flugverkehr Beteiligten:

- Besserer Überblick über die Situation
- Strategische Planung der Route an Stelle von taktischem Manövrieren
- Weniger Stress, weniger Unfälle, weniger Verletzungen und Schäden
- Weniger Treibstoffverbrauch

