WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

Improving Access to Aircraft-derived MET Data

Sharon Lau
Hong Kong, China

CAeM-16
23 to 27 July 2018
Exeter, United Kingdom

WMO OMM
World Meteorological Organization
Organisation météorologique mondiale

Need from Aviation User's

- Worldwide cost of turbulence = 2 billion $ per year
  - Injuries
  - Enroute FL change
  - maintenance

16 July 2014
SA Airways 286

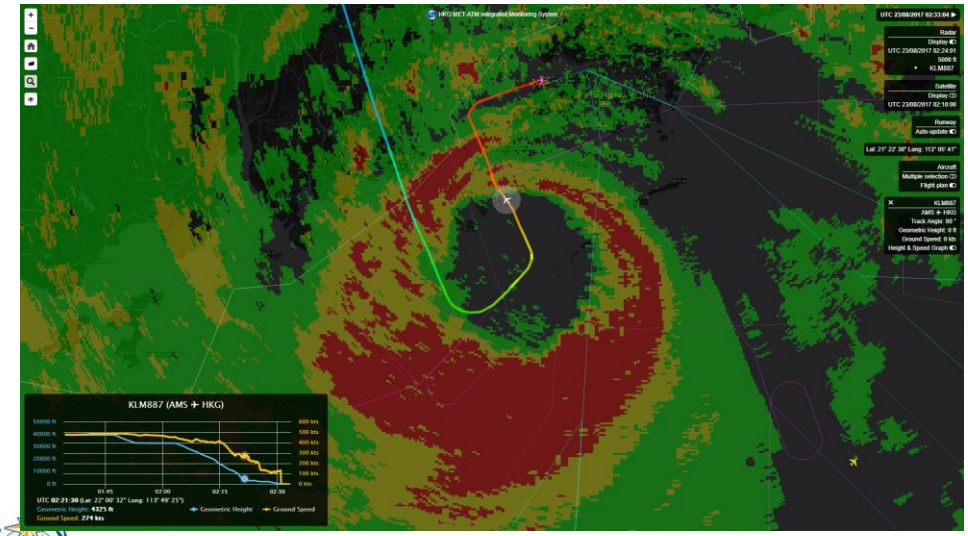
SEV CAT

WMO OMM

Outline

- Why?
- Where?
- What?
- How?
- Other aircraft data?

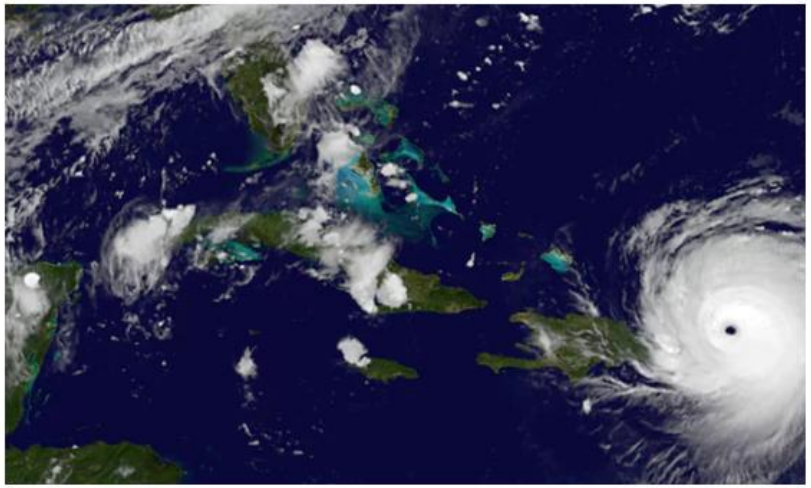
Increasing demand for MET Support



Delta Airlines plane flies straight into Hurricane Irma - and out again

Flight records show plane landing in Puerto Rico as storm hit and departing with 170 people on board 40 minutes later

Live coverage: massive damage across Caribbean as death toll rises



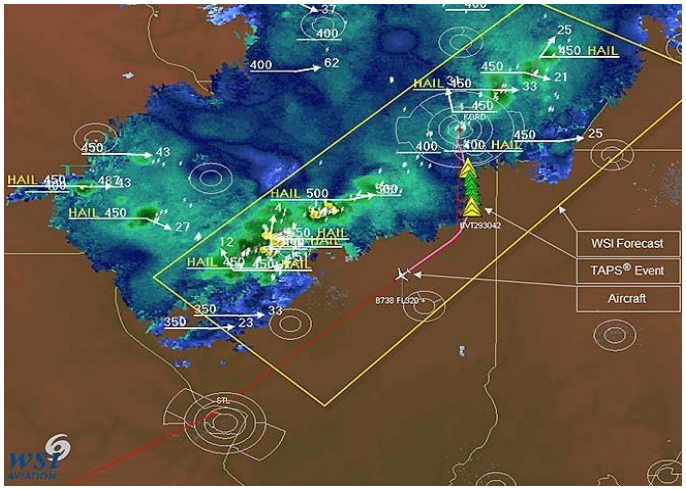
▲ A satellite image released by Nasa shows Hurricane Irma over Puerto Rico. Photograph: AP

As Hurricane Irma threatened to make landfall in Puerto Rico, most pilots were avoiding the area. Understandably so, perhaps.

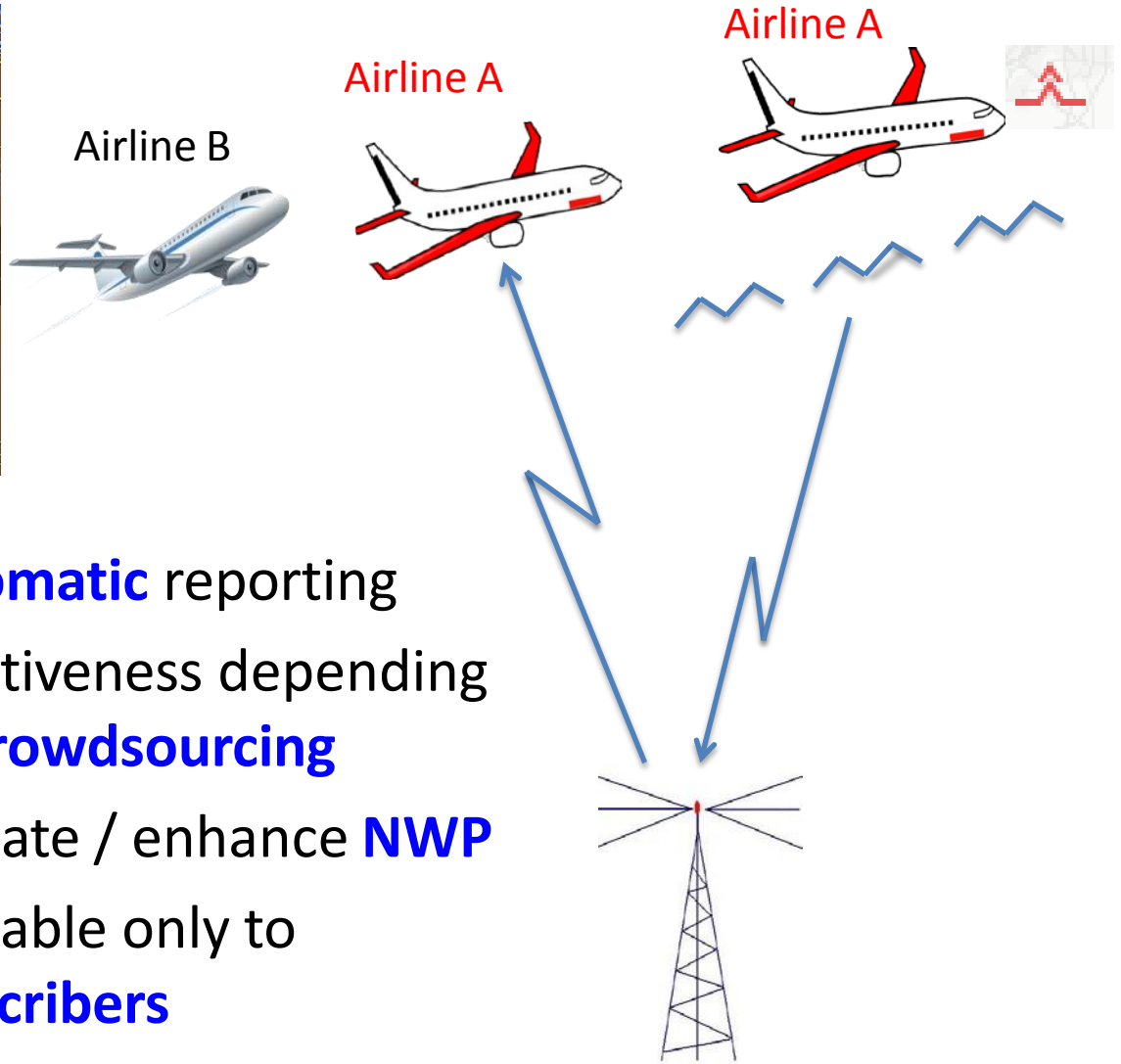
One Delta Airlines plane, however, headed straight toward the storm. The pilot landed on the island as it was engulfed and got away again within an hour, taking more than 170 people out of the path of the most powerful

WMO OMM

Commercial Turbulence Reports



TAPS (WSI)

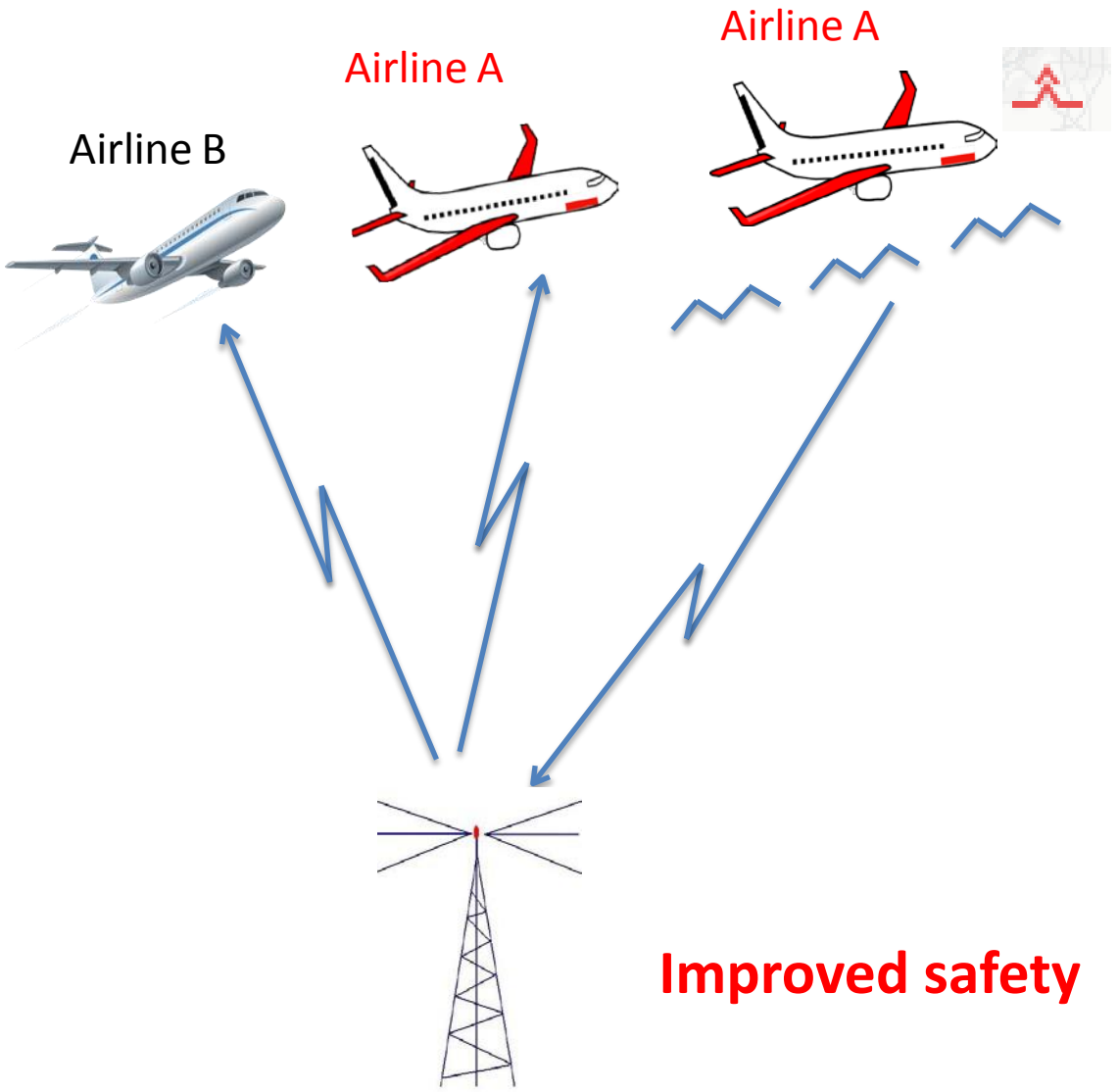


- **Automatic** reporting
- Effectiveness depending on **crowdsourcing**
- Validate / enhance **NWP**
- Available only to **subscribers**
- **Proprietary** information

WMO OMM

WMO AMDAR Programme

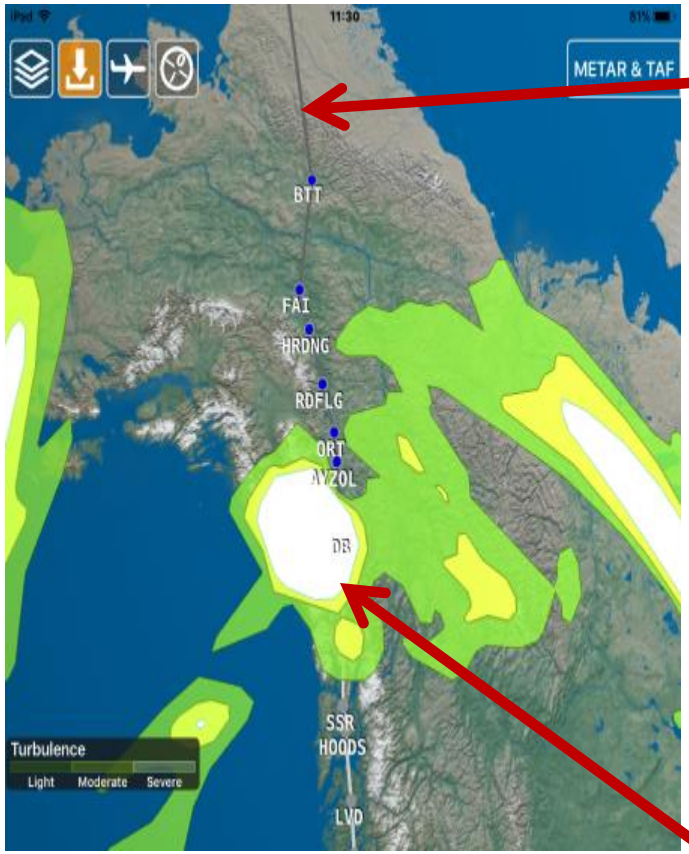
- Enable turbulence reporting
- Data shared within MET community
- **Idea:** Global/regional database for sharing both AMDAR and commercial reports (PPP) – Win-Win-Win
- Crowdsourcing – Big data



Improved safety

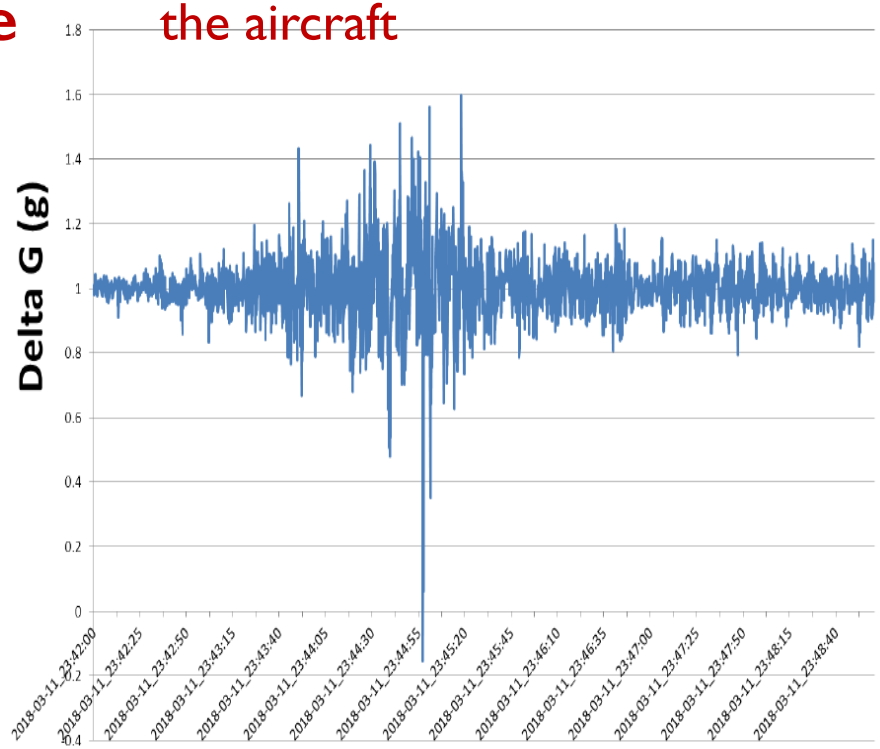
WMO OMM

Blending with NWP Model Guidance and verification



Flight route

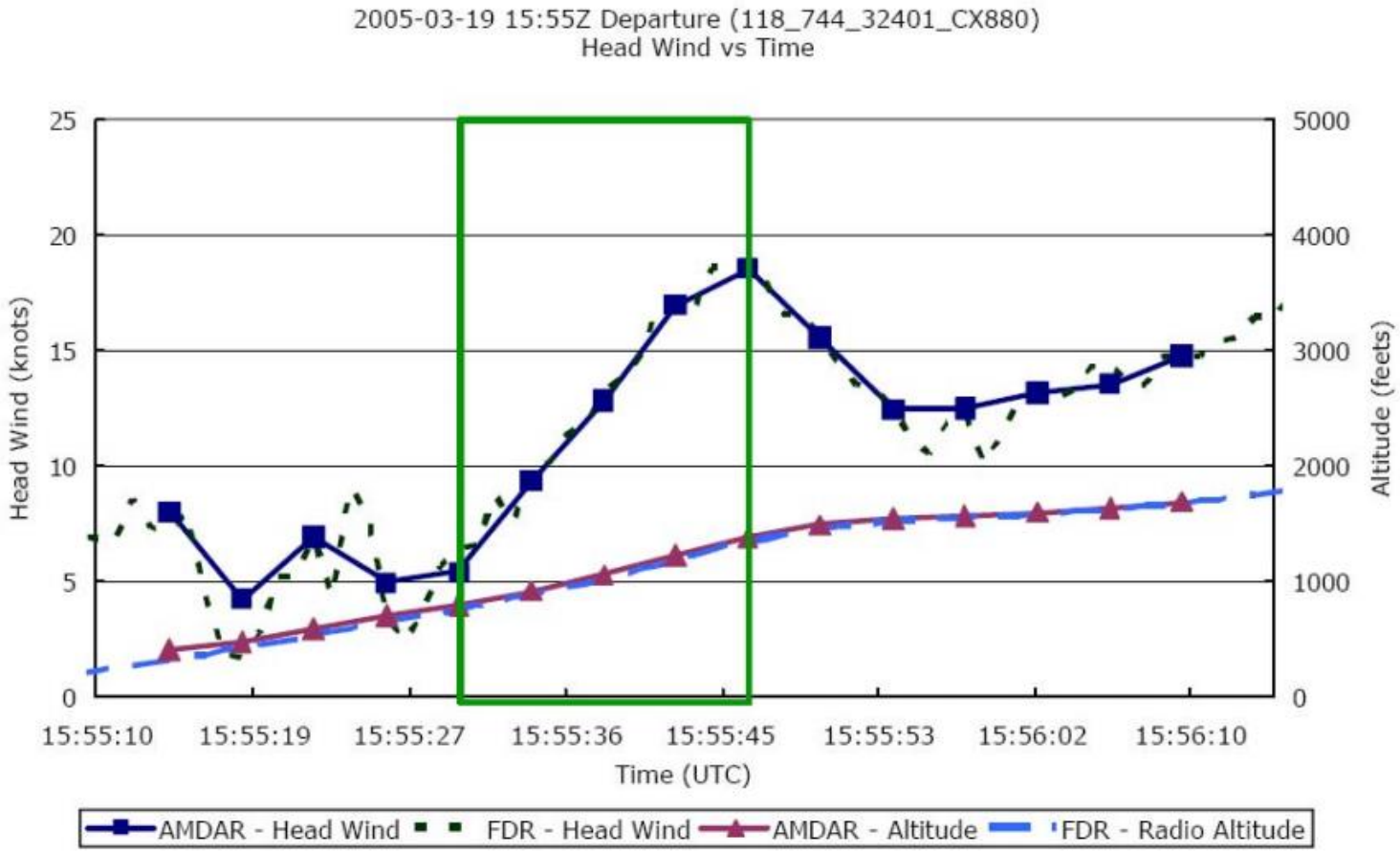
Actual Delta G measured by the aircraft



Forecast area of severe turbulence

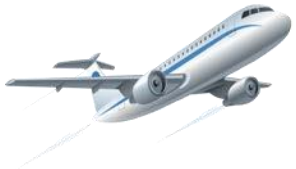
WMO OMM

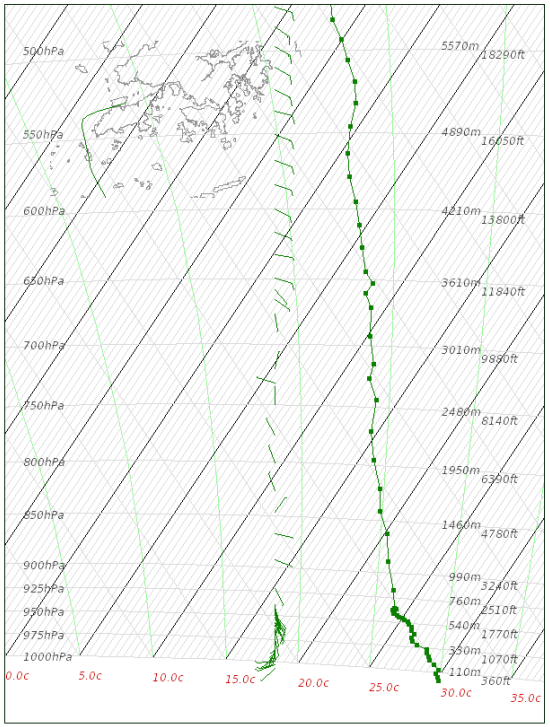
Windshear detection



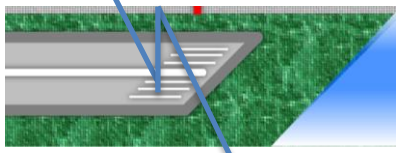
WMO OMM

Support to ATM and airlines





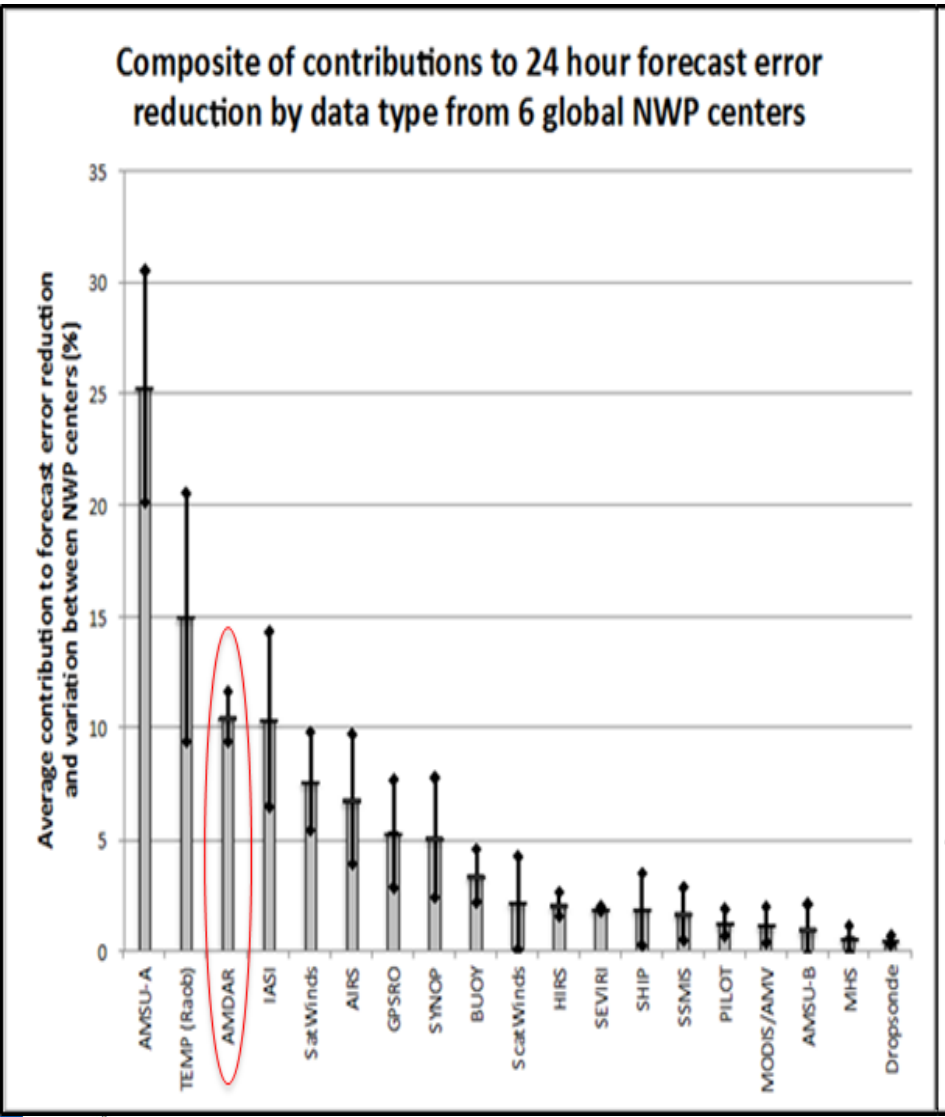
Flight path

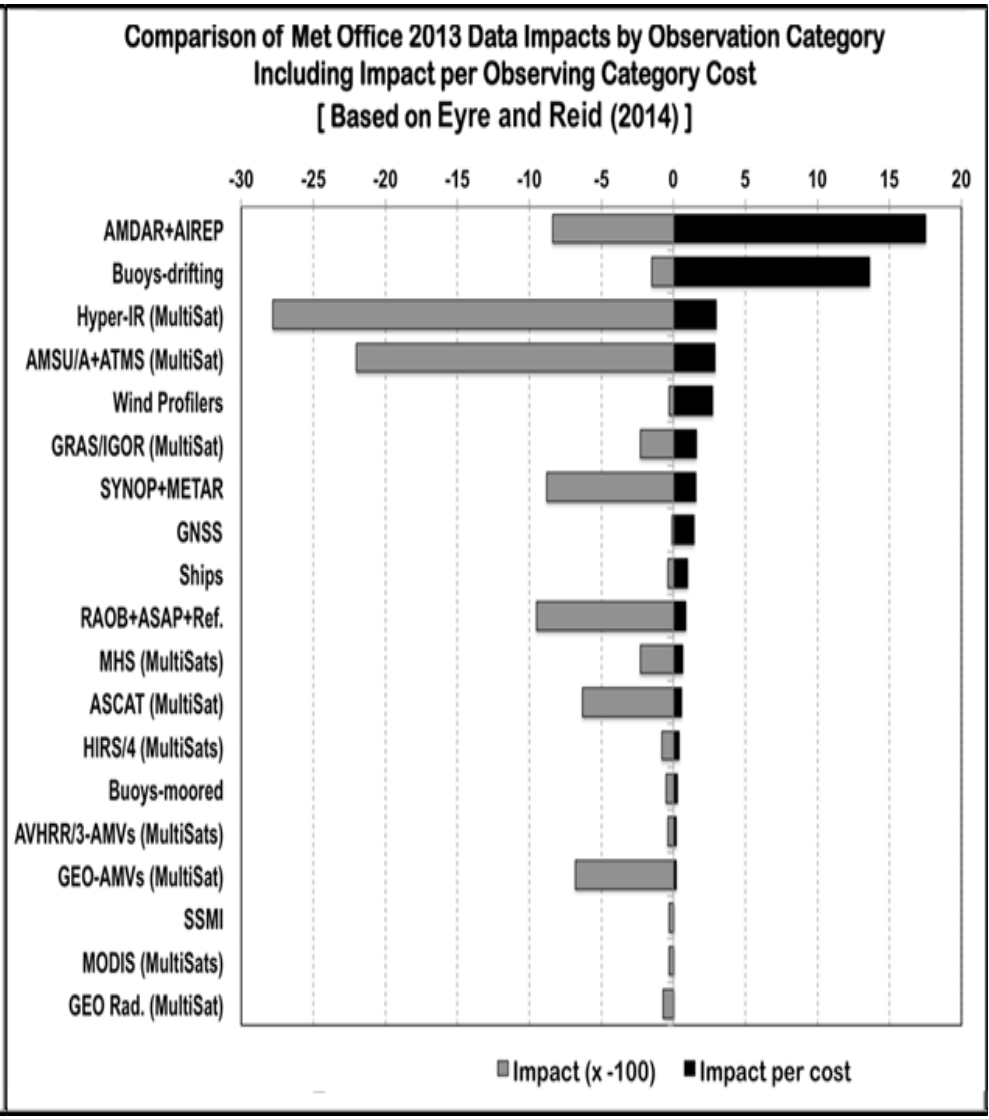


Arrival metering & continuous descent operations – **reduce cost**

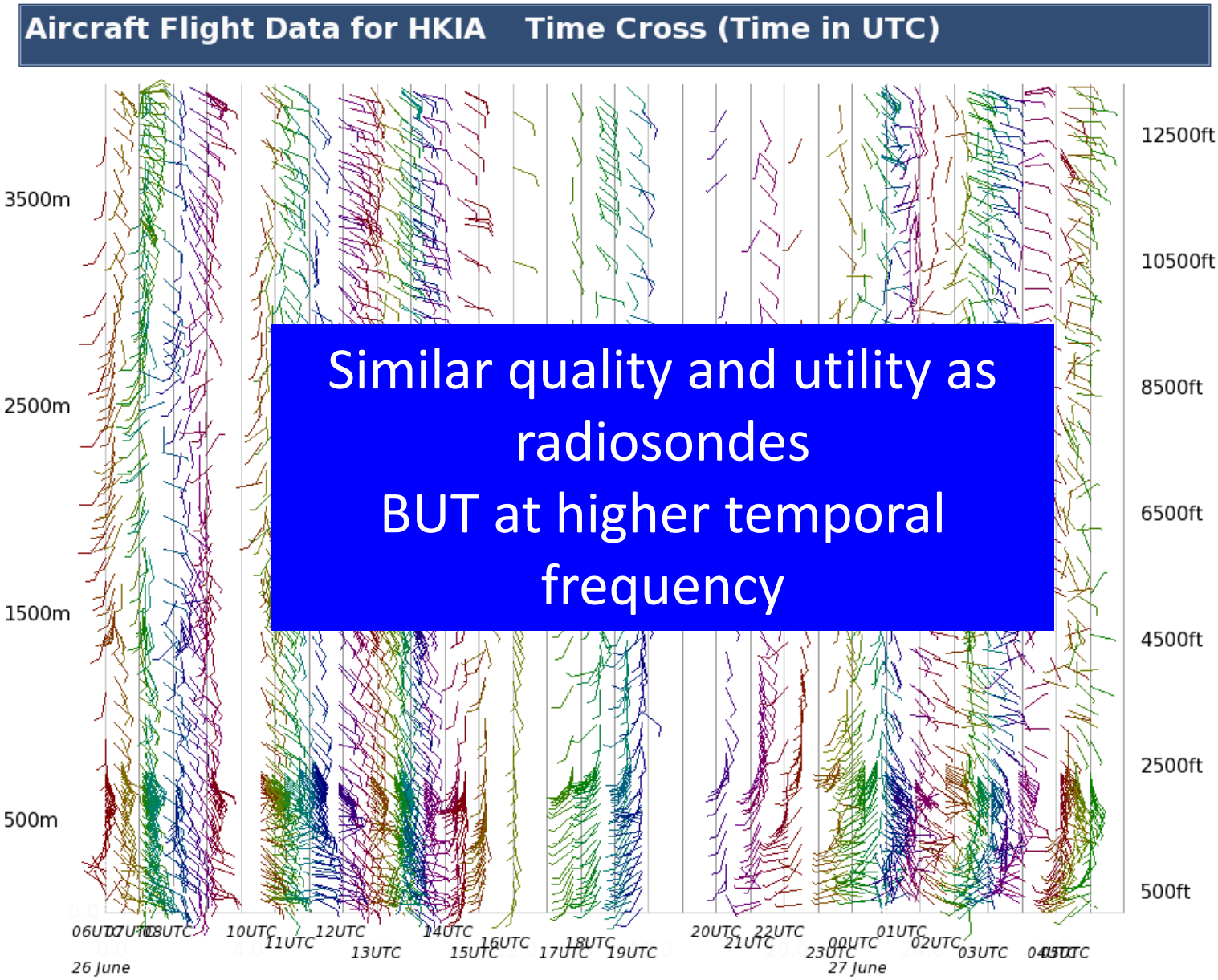
WMO OMM

Benefits of AMDAR to NWP





What it meant to NMHS – more profiles at less cost!



Benefits to BOTH partners - PPP

To Meteorology

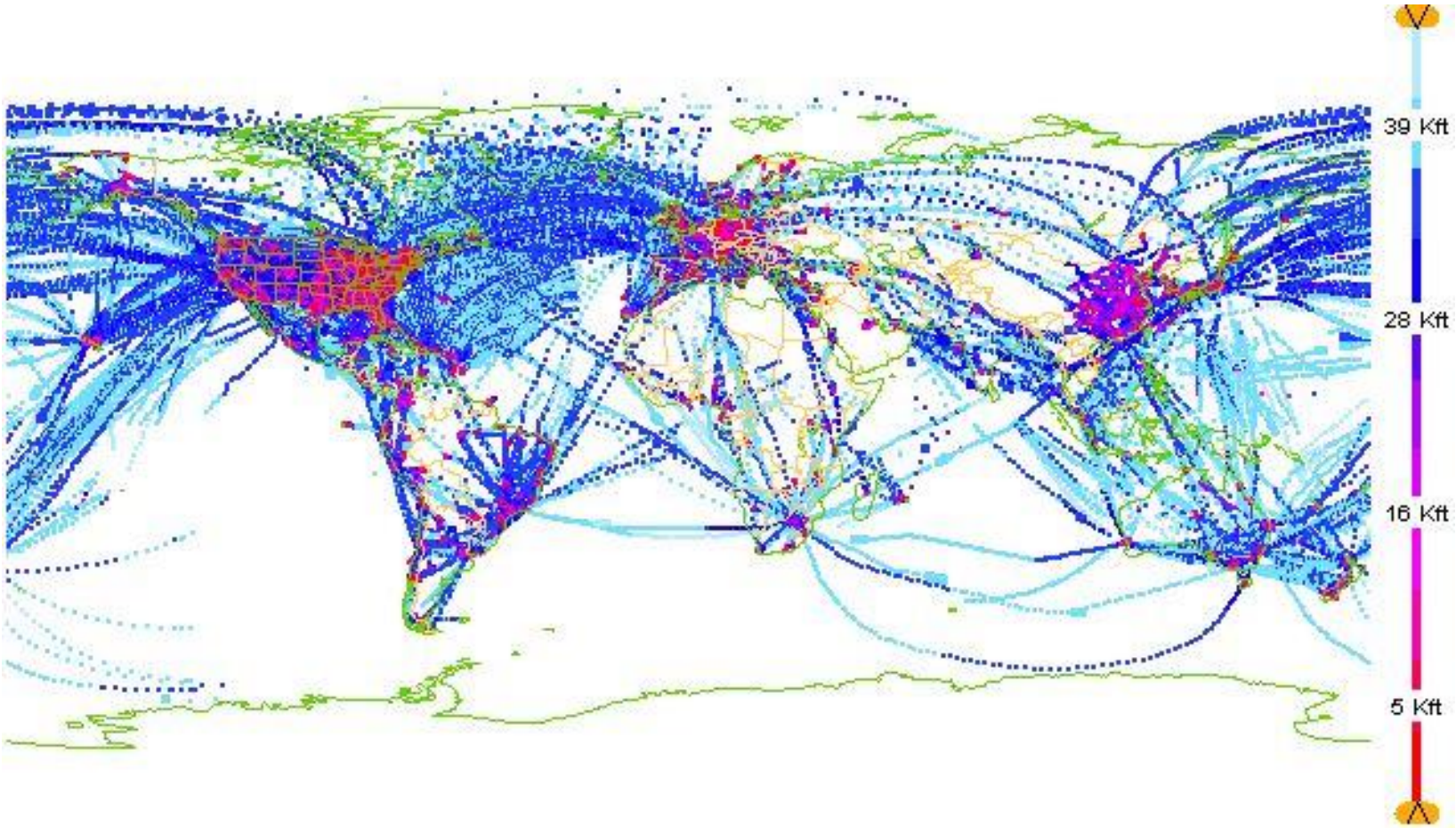
- Efficient source of high quality upper air data
- Observing system operated under PPP
- Higher temporal frequency reporting of vertical profiles
- Improved forecasting of high impact weather phenomena
- Significant impact and improvement to NWP systems
- Improved forecast skill to all weather & climate applications areas

To Airlines & Aviation

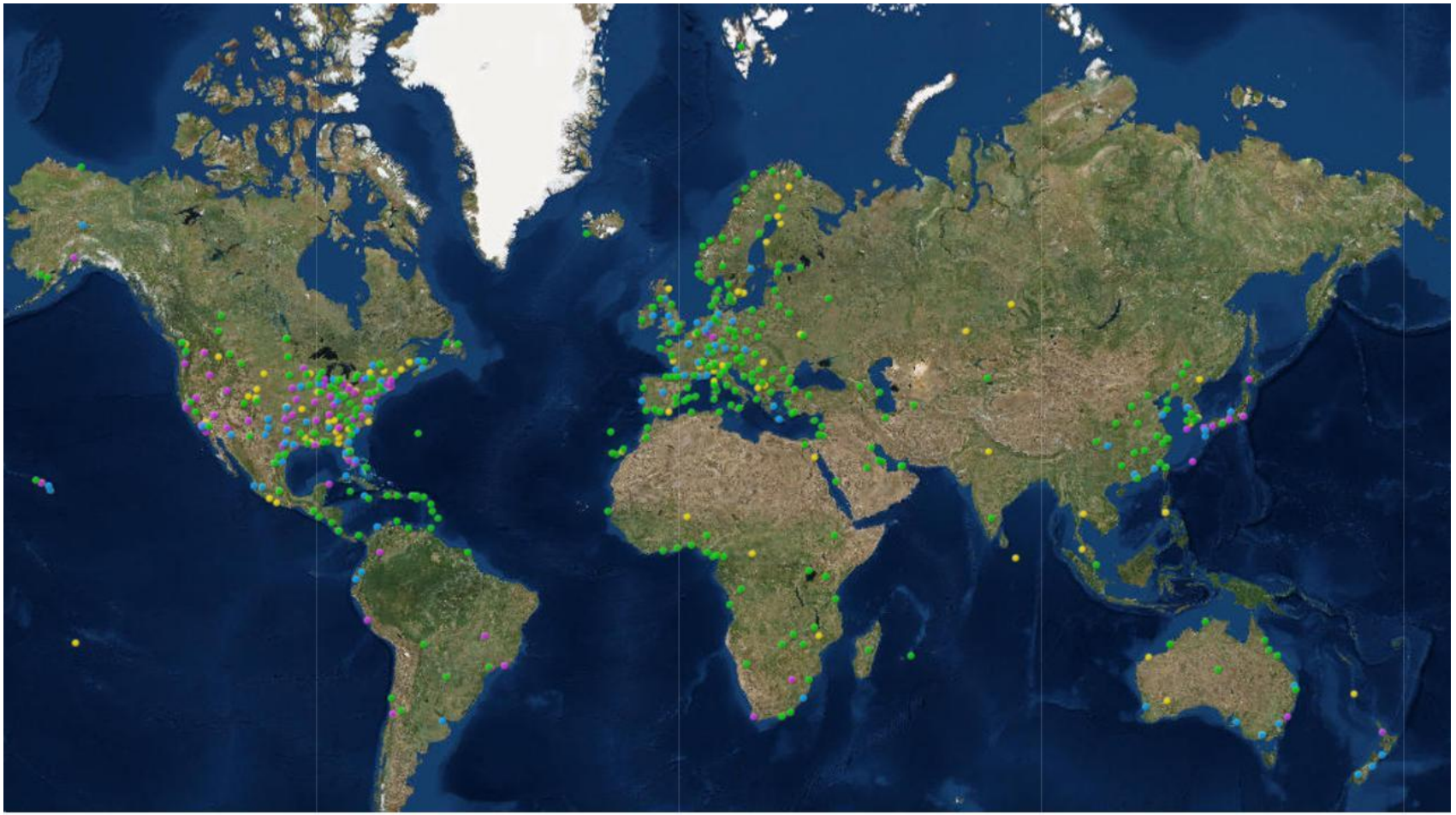
- Improved terminal forecasts leading to less delays
- Better forecast of inflight phenomena – improved safety of passengers
- Better turbulence forecasts – reduced costs for maintenance
- Better forecast of enroute winds – reduced costs for fuel efficiency
- Less impact on environment – better perception with public

Air Traffic Flow Chart

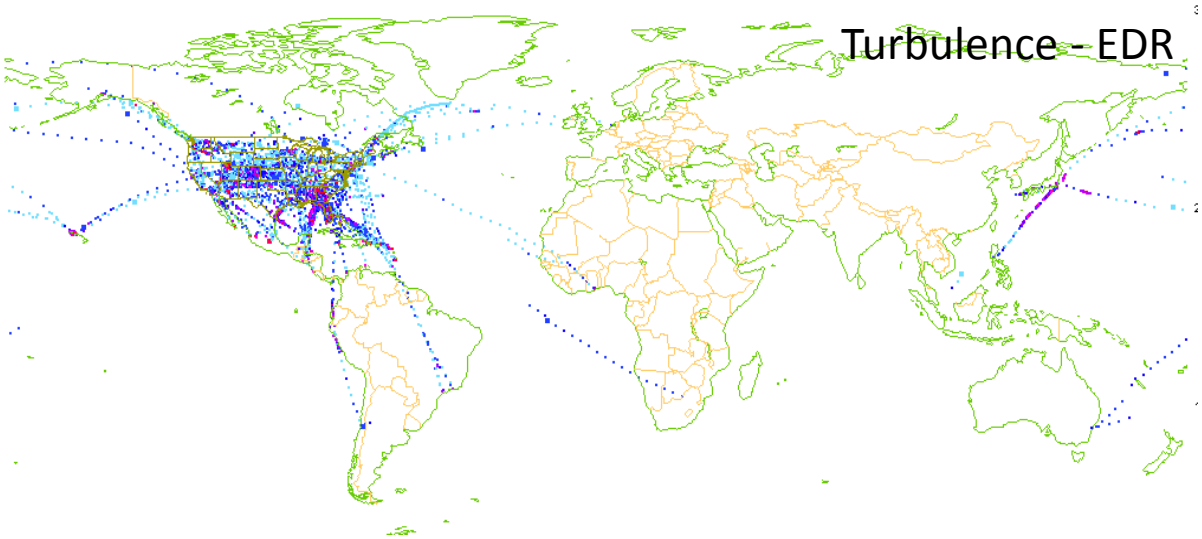
Where?


39 Kft
28 Kft
16 Kft
5 Kft
31-Mar-2018 00:00:00 -- 31-Mar-2018 23:59:59 (862938 obs loaded, 747643 in range, 34500 shown)
NOAA / ESRL / GSD Altitude: -1000 ft. to 45000 ft.
Good w and T

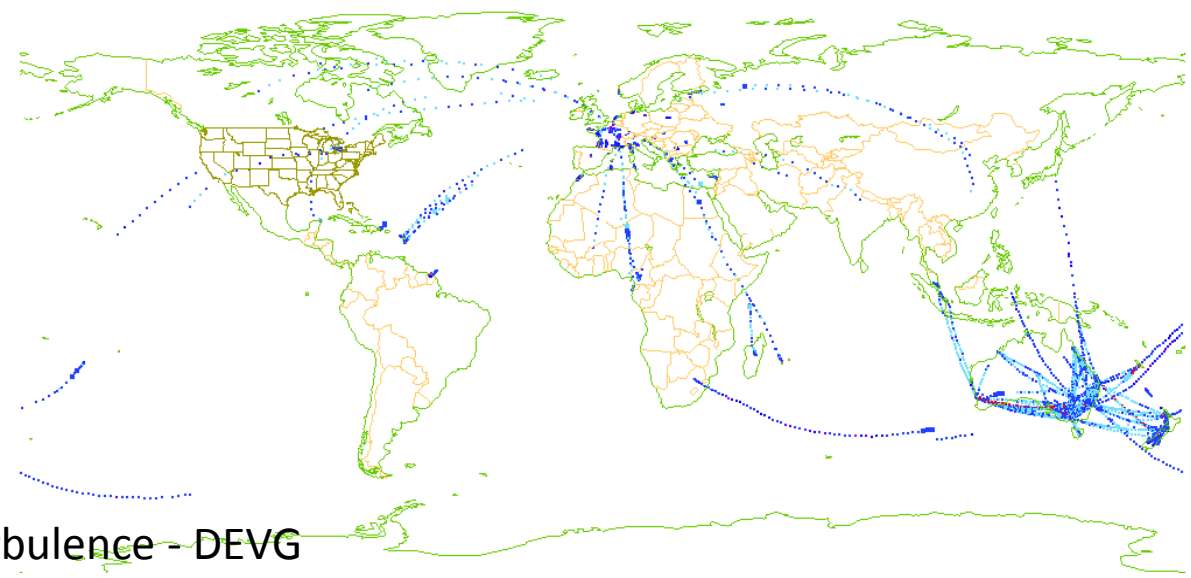
Where? – Good potential for growth!



Again Room for Improvement!



Turbulence - EDR



Turbulence - DEVG

WMO OMM

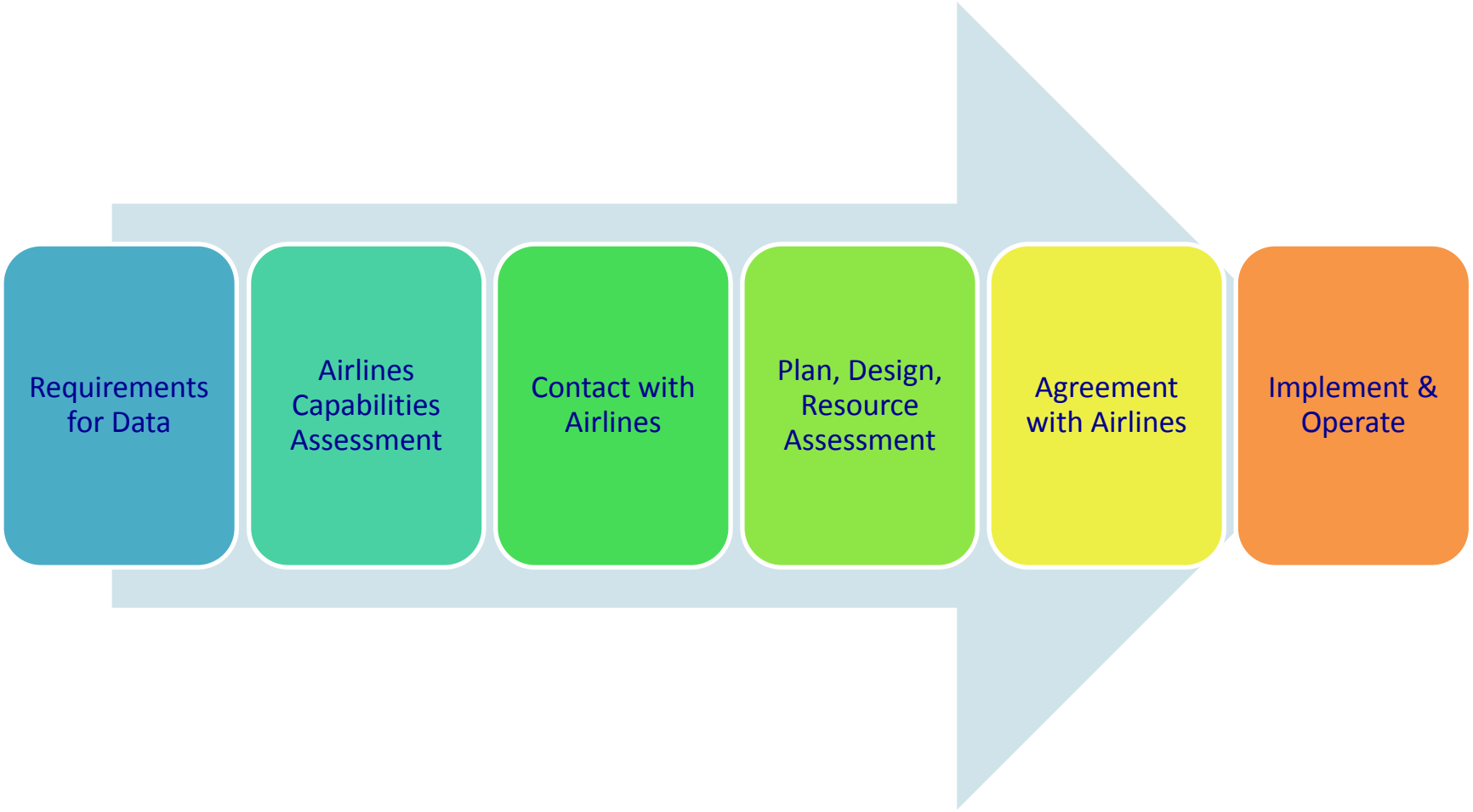
What is AMDAR?

AMDAR is:

1. An automated aircraft-based observing system
2. Component of WIGOS and WMO GOS
3. PPP - Operated by WMO Member NMHSs with partner national airlines
4. Operated based on meteorological (WMO) requirements for provision of data
5. A system that:
   i. provides meteorological data in near-real-time on the WMO GTS
   ii. Predominantly uses existing aircraft sensors and communications

How?

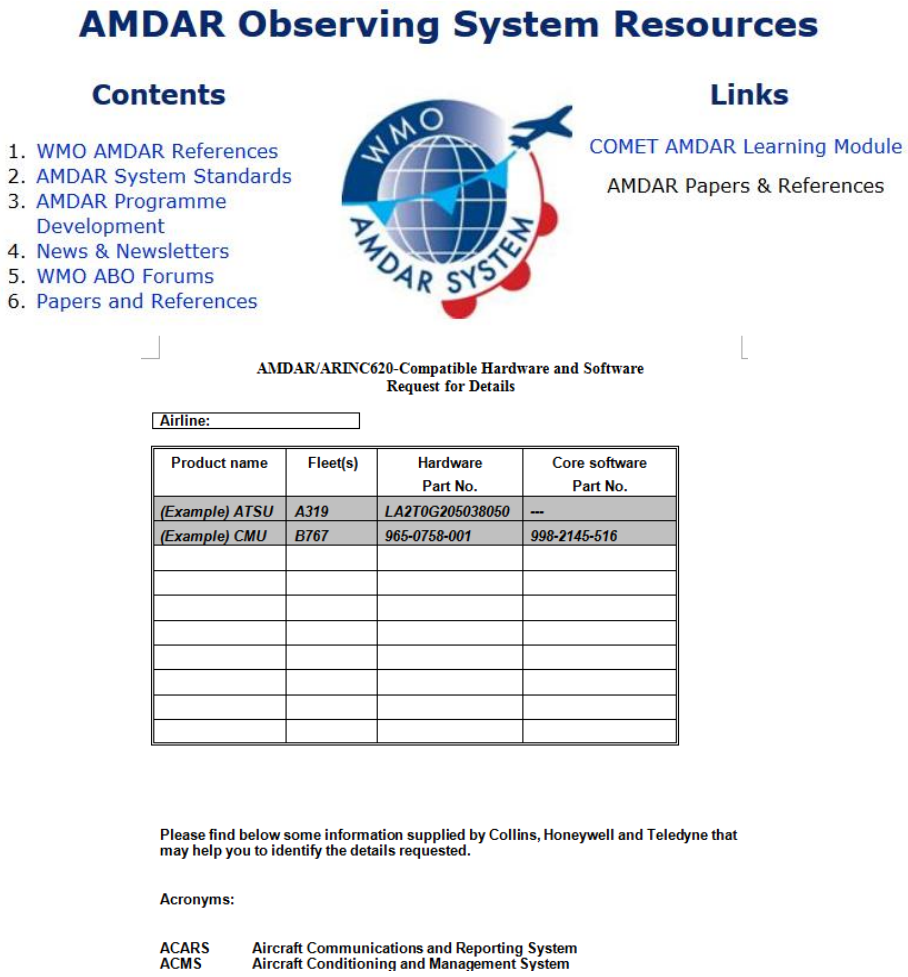
AMDAR Program Development Process



WMO OMM

Assessment of national airlines capabilities and coverage

- Which aircraft types are operated by the airline?
- Which destinations (domestic and international) does each aircraft type routinely fly to?
- What is the age of fleets?
- Do aircraft have ACARS communications?
- How many vertical profiles per day are likely to be obtained at each airport?
- Is software development required? No. of fleets?
- With airline complete avionics survey.



AMDAR Observing System Resources

Contents

1. WMO AMDAR References
2. AMDAR System Standards
3. AMDAR Programme Development
4. News & Newsletters
5. WMO ABO Forums
6. Papers and References

Links

COMET AMDAR Learning Module

AMDAR Papers & References

AMDAR/ARINC620-Compatible Hardware and Software Request for Details

Airline:

Product name	Fleet(s)	Hardware Part No.	Core software Part No.
(Example) ATSU	*A319*	*LA2T0G205038050*	*---*
(Example) CMU	*B767*	*965-0758-001*	*998-2145-516*

Please find below some information supplied by Collins, Honeywell and Teledyne that may help you to identify the details requested.

Acronyms:

ACARS Aircraft Communications and Reporting System
ACMS Aircraft Conditioning and Management System

Contact with Airlines

Position	Role/Relation to AMDAR
Airline CEO or other Executive Officer	Understands the impact of weather on airline operations. May provide initial decision on airline involvement.
Senior Pilot	Representative of pilots to airline executive and influential in decision-making, will understand the impact of weather on airline operations.
Flight Operations Manager	Manager of all aspects of aircraft operations. Often the contact that liaises with NMHSs for weather services, will understand the impact of weather on airline operations.
Avionics and Maintenance Engineering	Will be involved in determining avionics capabilities and responsible for AMDAR software integration.

WMO works with air transport industry on data gathering system

Tags: Partnership

7 Published 7 July 2017

IATA-WMO Collaboration

IATA

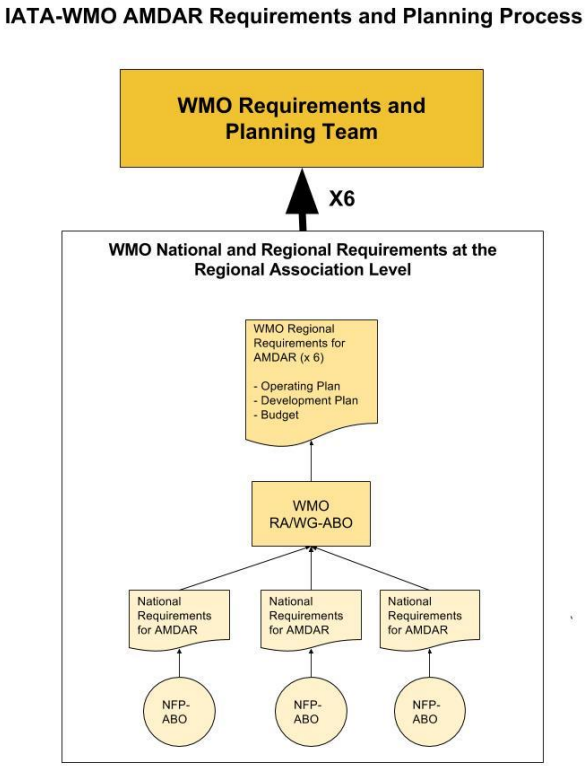
- Promote AMDAR to it's member
- Educate airlines on program benefits
- Close the historical NMHS / Airline "gap"
- set up a **global turbulence database** with real-time data transmission to airlines
- Facilitate discussion amongst MET and aviation stakeholders

WMO

- Promote AMDAR to it's members
- Increase access to sky truth - Essential data for unrestricted exchange under Resolution 40
- Establishment and provision of AMDAR requirements
- Establishment of Regional framework

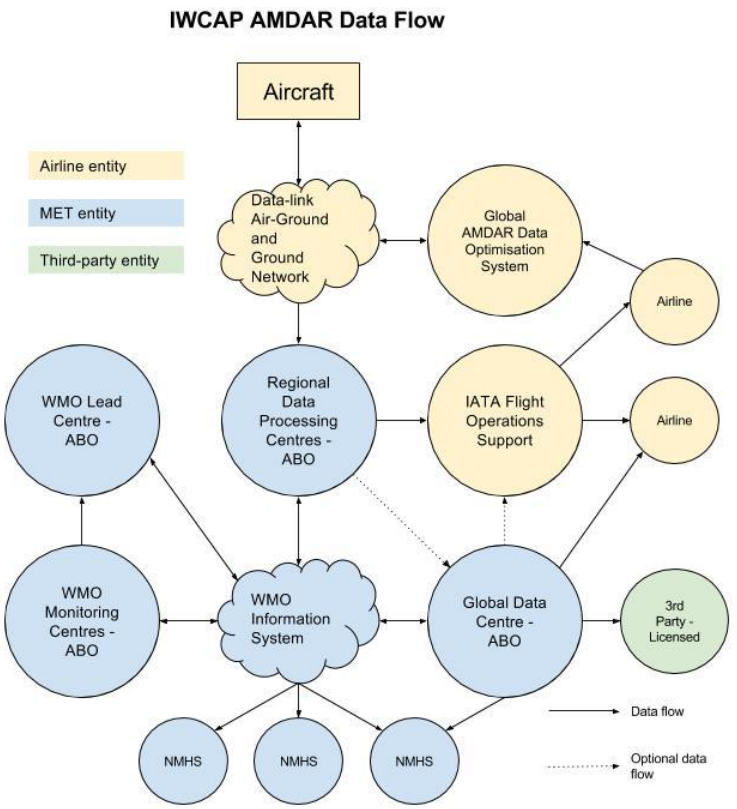
Establishment and provision of requirements

- Requirements for AMDAR established by each WMO region (6)
- National requirements -> consolidated regional plan
- -> consolidated global plan
- Annual cycle with 3-5 year forward planning

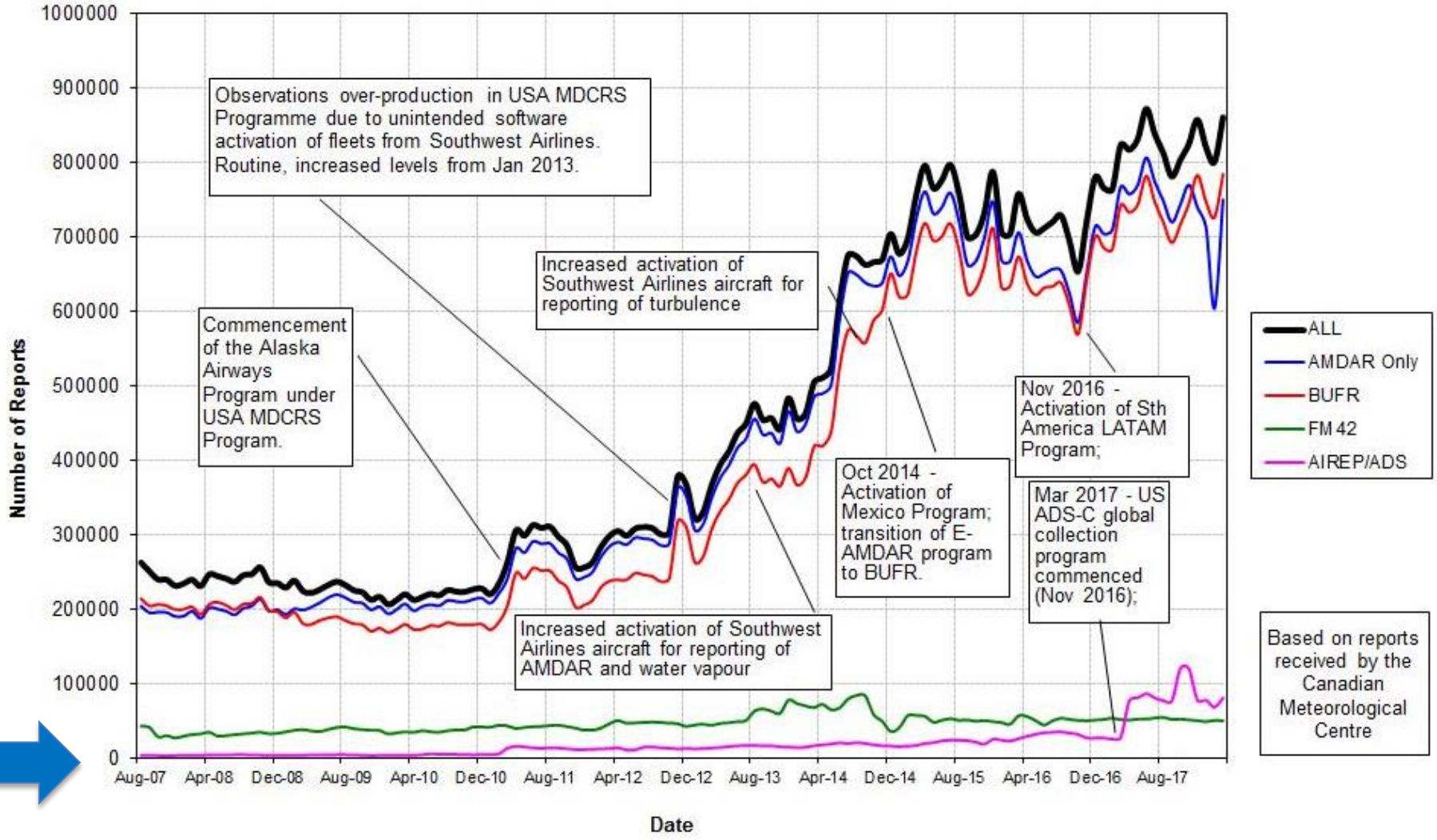


AMDAR data ownership and management practices

- Introduce Regional Data Processing Centres for data distribution on WIS
- Members licensed to use data for mandated met. purposes
- Data archived in GDC
- IATA responsible for 3rd party commercialisation of data

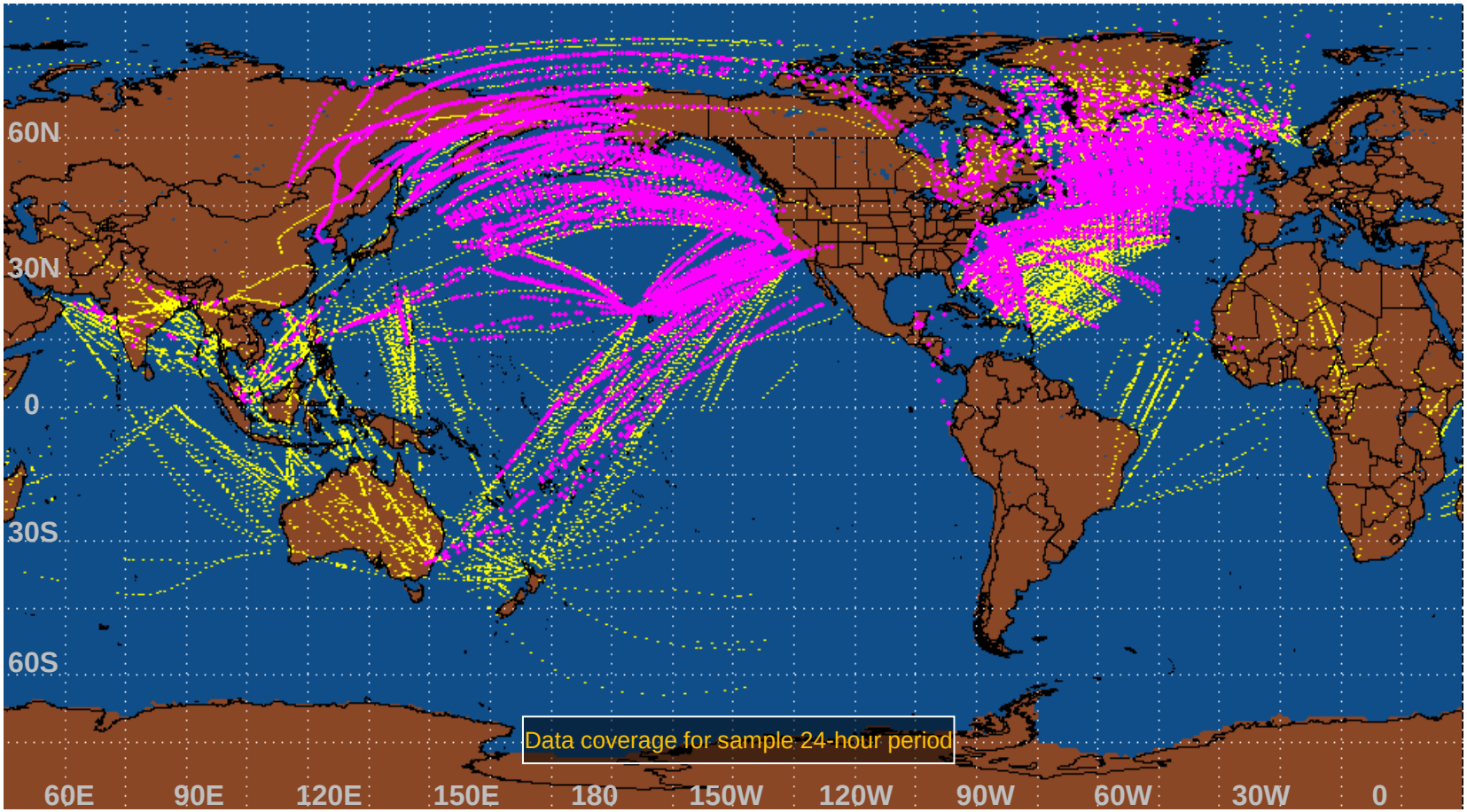


What others?



WMO OMM

ADS-C

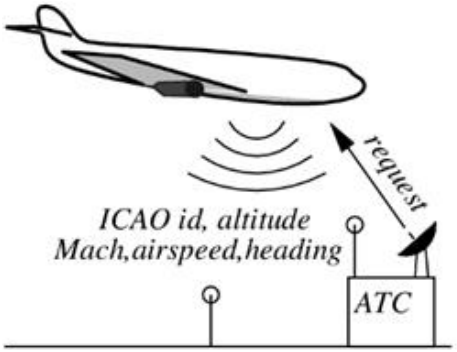


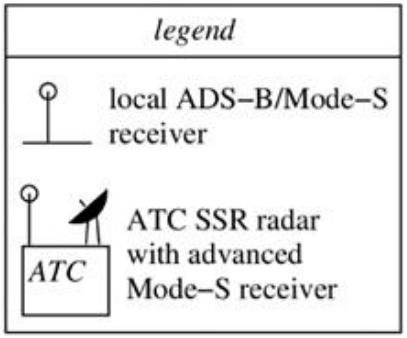
ADS-C data originating from U.S. commercial carrier aircraft

ADS-C data originating from non-U.S. commercial carrier aircraft

WMO OMM

Mode S implementation





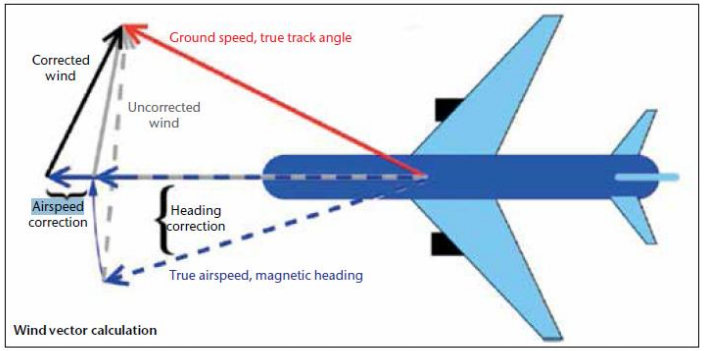
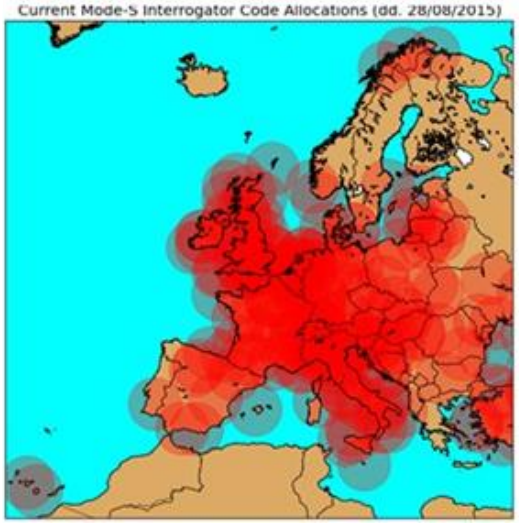
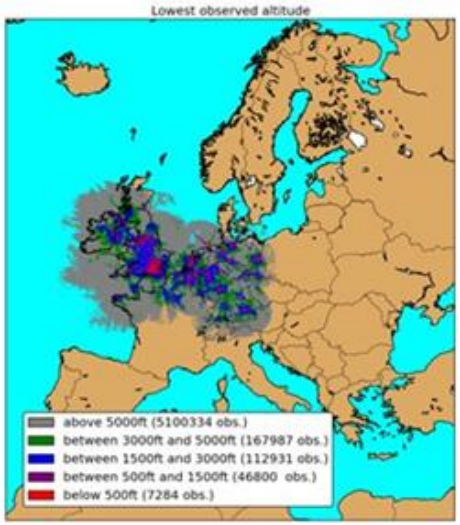


Figure 2.4. Wind vector calculated from aircraft carrying Mode S EHS





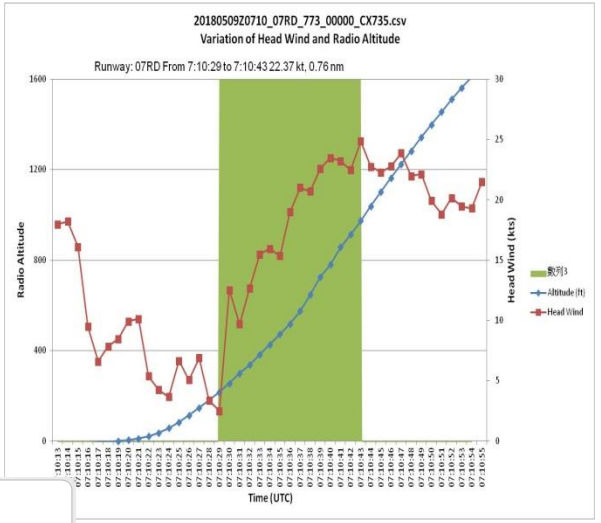
- additional navigational data (air speed, mach number, magnetic heading, etc) interrogated via Mode S* could also be received by ADS-B receivers.
- The additional data can be used to calculate upper winds and temperatures. Approximately ten million “Mode S observations” per day are being received over northern Europe

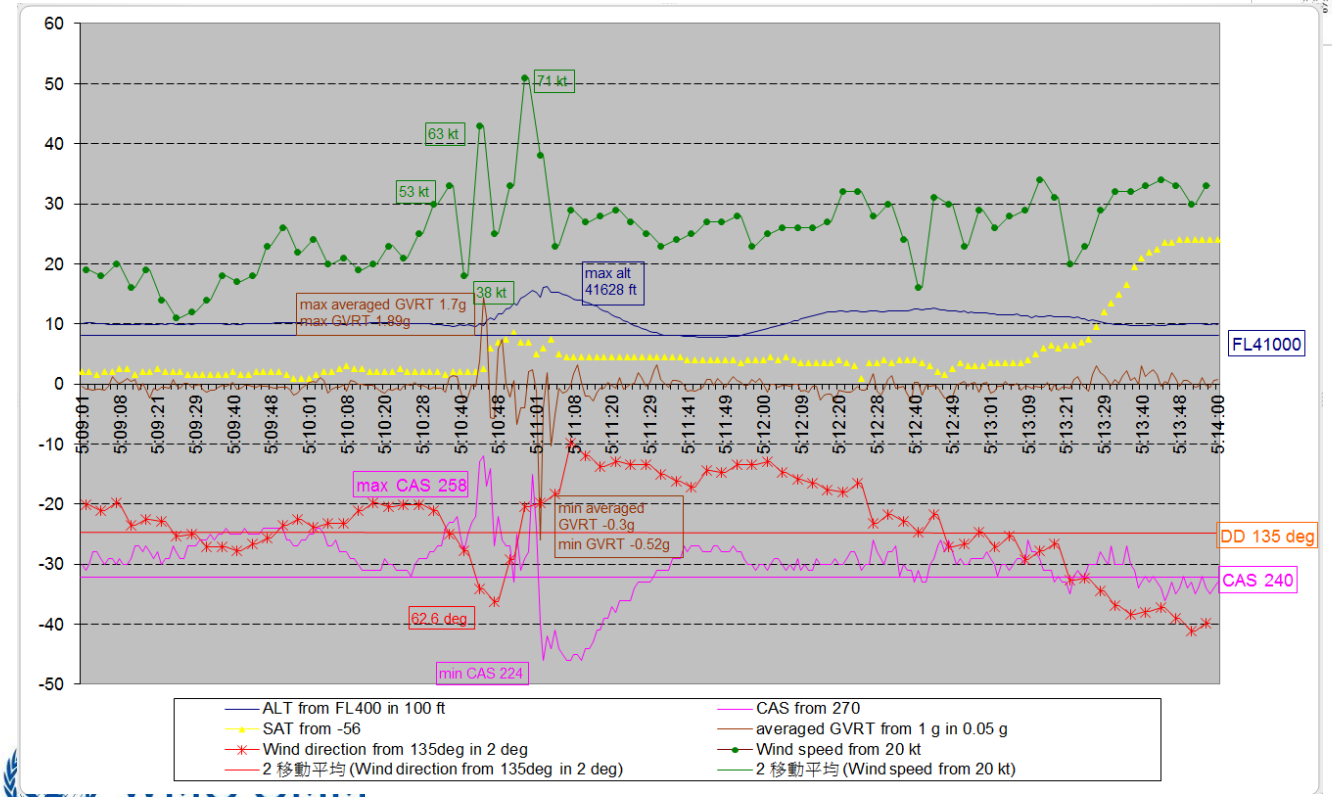
WMO OMM

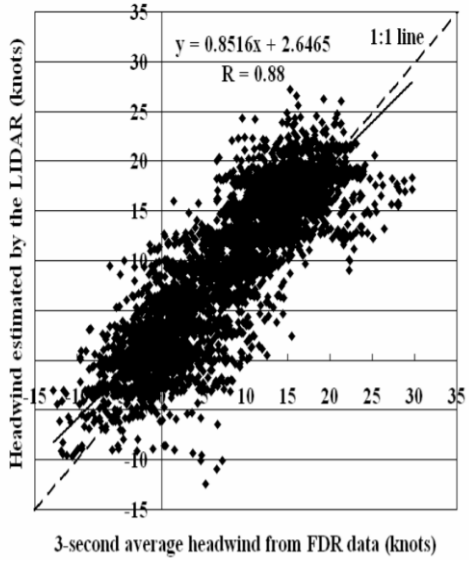
* See Asia/Pacific Seamless ATM Plan v2.0

QAR data

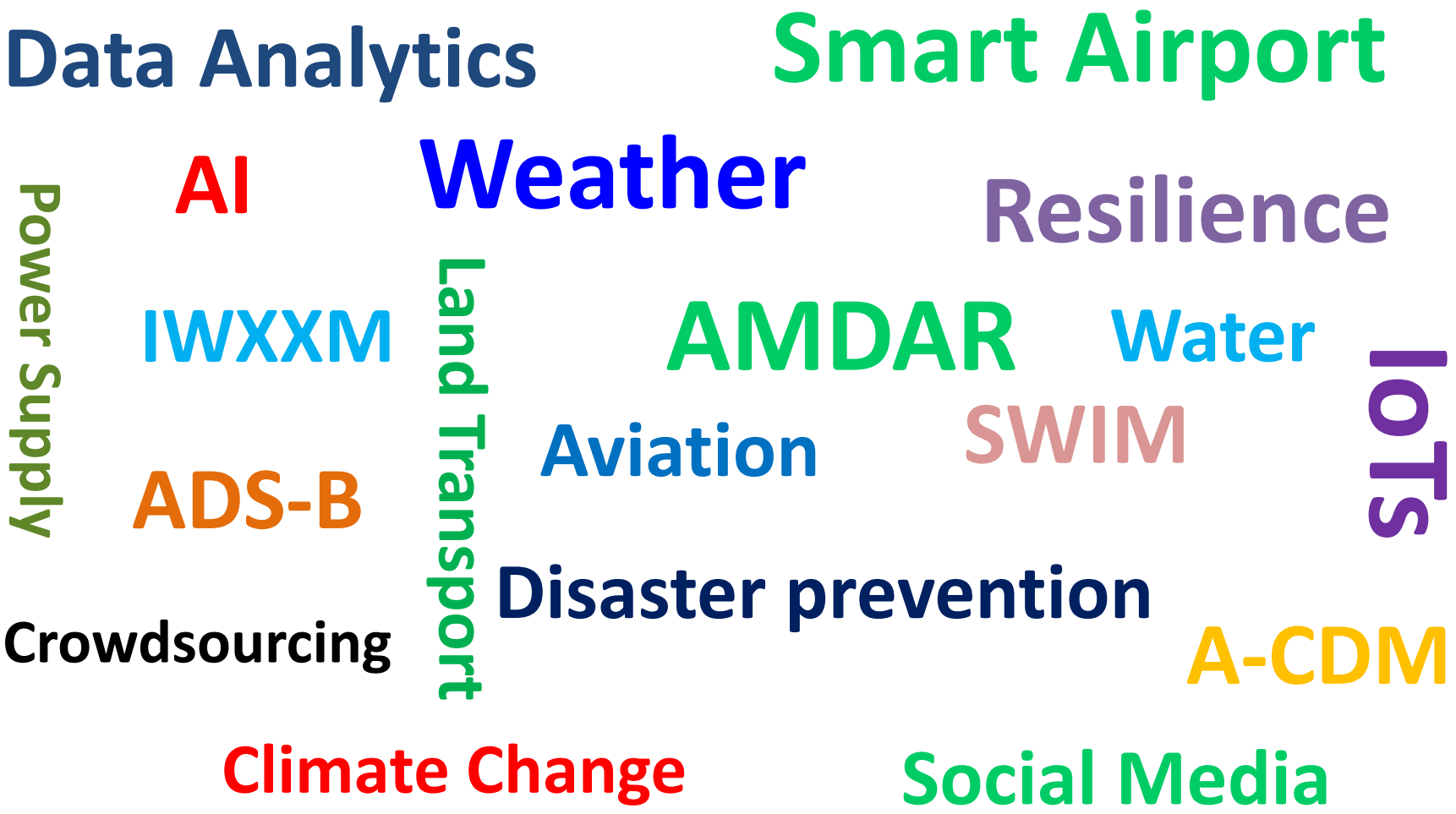
- For case studies to improve forecasting skill
- For verification of remote sensing equipment
- For verification of forecast and alerting systems







Big Data Era – are your data ready?



WMO OMM

WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

Thank you
Merci

WMO OMM

World Meteorological Organization
Organisation météorologique mondiale

AMDAR Program Estimated Costs

Item	Implementation Cost	Ongoing Cost (per annum)	Potential Savings
AMDAR Software	< 100K USD	nil/small (budget for 10% per annum)	• AOS already onboard • AOS already available • Functionality
AOS Rollout	< 1K USD per aircraft	nil/small	• No charge by airline
NMHS Data Processing System	• Comms (DSP): 5K USD • Ground proc. infra.: 25K USD • Ground proc. dev.: 50K USD	8K USD (10%)	• Service provision by DSP • GTS Encoding software avail. • Existing comms infrastructure. • Off-shelf software. • Regional collaboration.
Optimisation System	• 1M USD (new dev.) • 50K USD (exist., e.g. E-AMDAR)	100K USD	• Not required (< 50 aircraft) • Existing system
Data Communications		< 0.07 USD per observation, e.g. 30 aircraft: 130K	• Lower comms cost • AOS Config. • Optimisation System

Coming Soon:

- Increased functionality of Lead and Monitoring Centre for ABO – daily monitoring and reporting; monitoring of data availability; online tools for monitoring
- Global Data Centre for Aircraft-Based Observations
  - Operated by NOAA/MADIS
  - Access to archived ABO/AMDAR data
  - Display system
  - Operational in 2018