Fourth Meeting of the North American, Central American and Caribbean Working Group (NACC(WG)
Implementation of Aeronautical Meteorology (MET) Task Force (METTF04)
Mexico City, Mexico, 28 to 31 July 2026
Item agenda 9

WMO Aircraft-based Observations Programme contribution and regional needs

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Daniel Vila / WMO RAM – INF Technical Coordinator

30 July 2026

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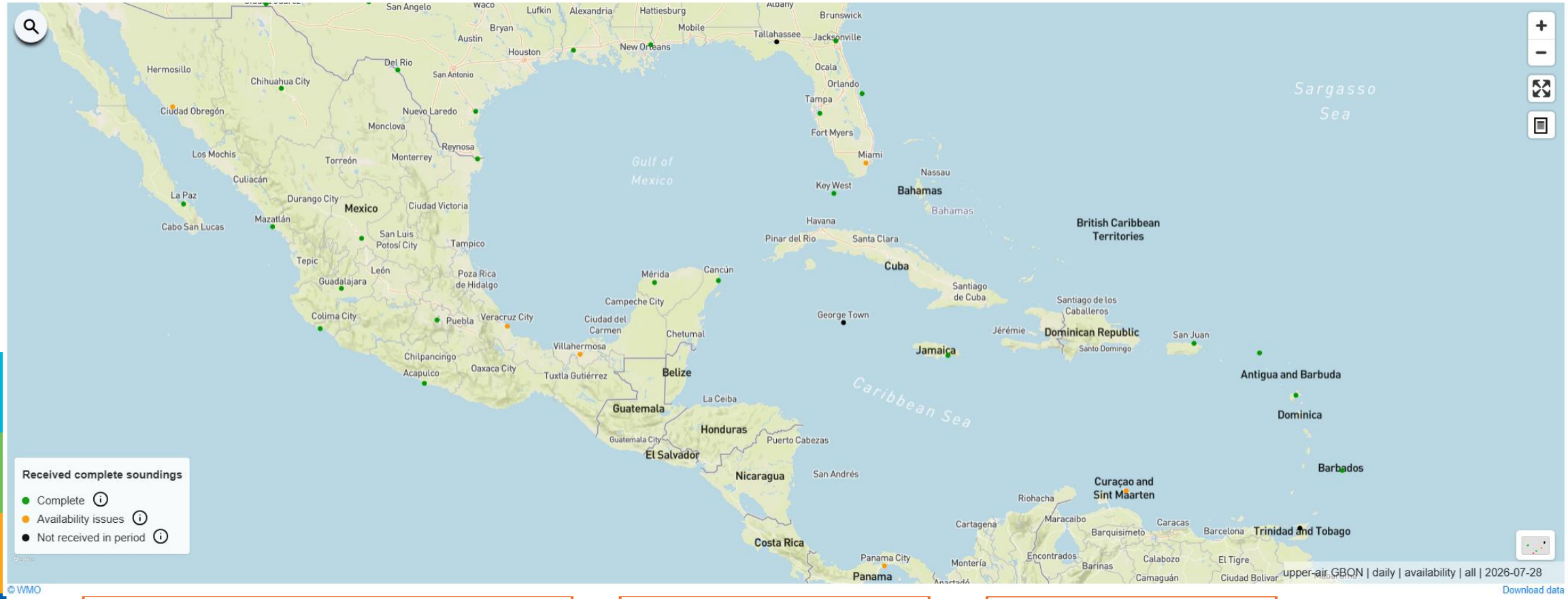
Content

1. Status of upper air observation in the region
2. Review of WMO Aircraft-based Observations Programme
3. Status of ABO in the WMO Region IV (ICAO NAM/CAR)
4. Recommendations and requests raised from ABO Community

Why is so important ABO?

There is a gap in upper-air measurements, which reduces NWP capabilities in the region.

Availability of upper-air land observations (GBON)



Because **lack of upper-air observations:** there are very few places where they are releasing radiosoundings ballon in time (green dots)

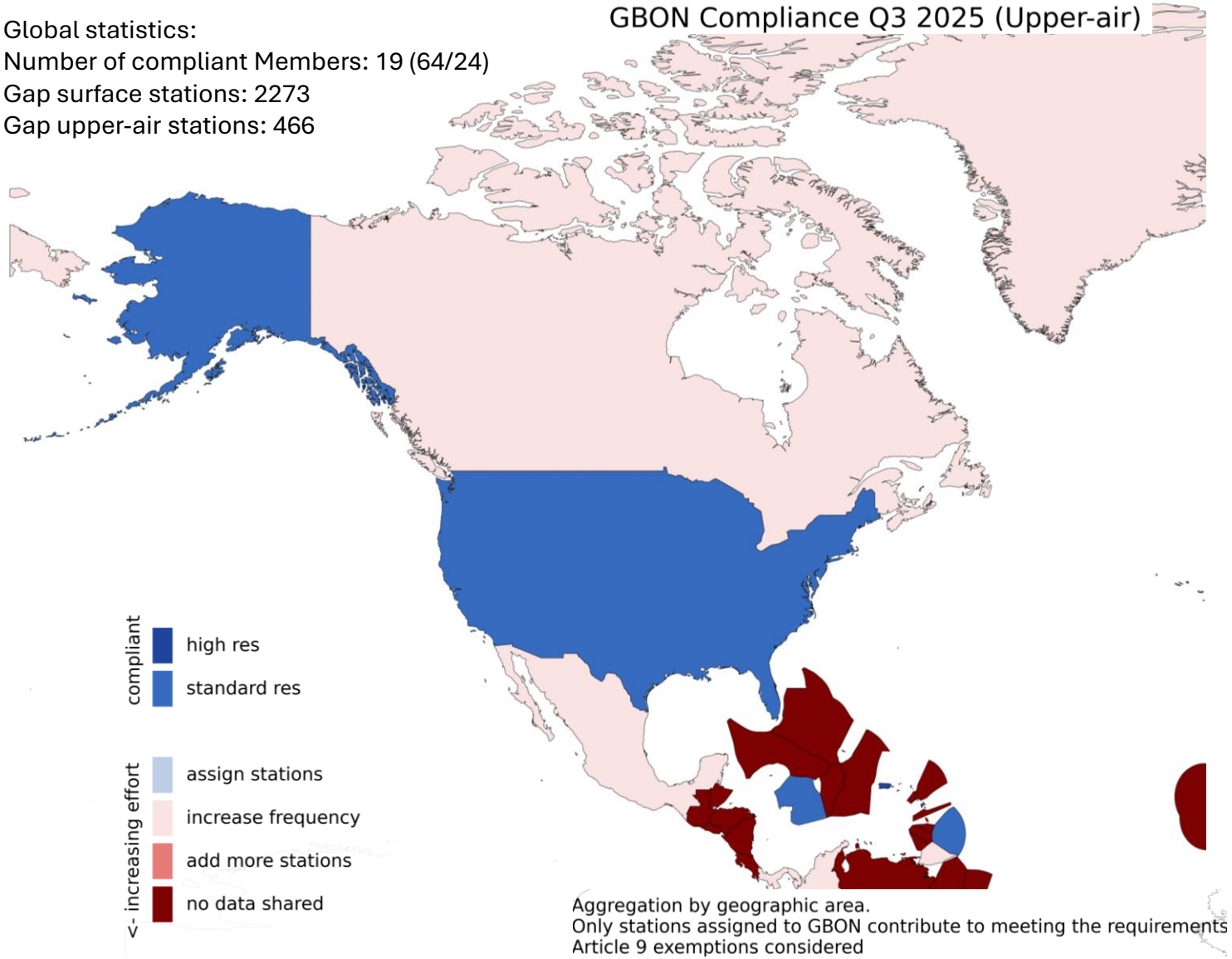
Because **the impact of ABO is well known due to the big amount of** data

Because it is cheap and helps aviation and general communities

Because it **is not necessary install any additional hardware** into the aircraft

Global Basic Observing Network Compliance for upper-air data

Global statistics:
Number of compliant Members: 19 (64/24)
Gap surface stations: 2273
Gap upper-air stations: 466



Most of the countries are not compliant on GBON (UA) and some of them are showing a decrease of radiosounding stations

https://gbon-compliance.wmo.int/

More details available in the document: ***Status report on Global Basic Observing Network (GBON) Implementation and Member-level Compliance Assessment***

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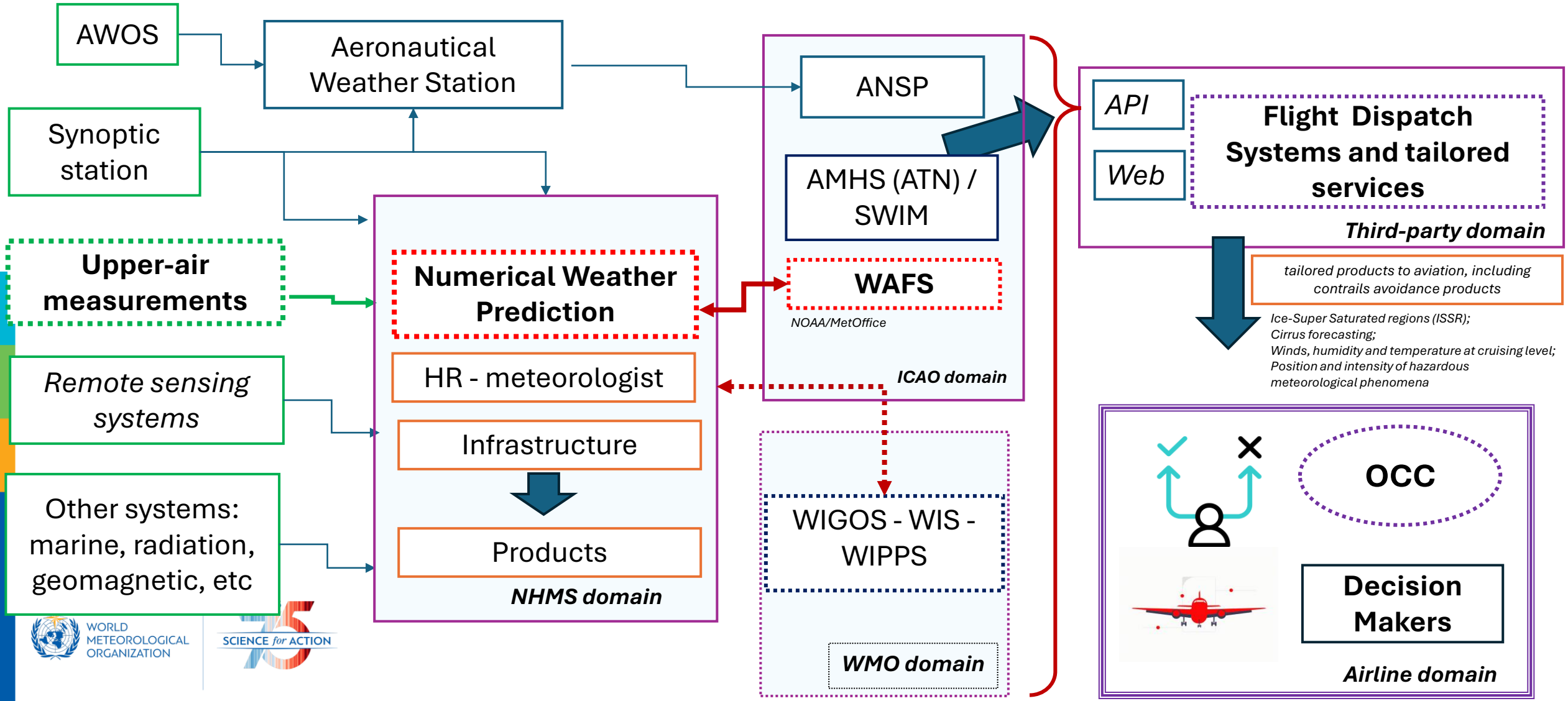
1950-2025 SCIENCE for ACTION

Why is so important Aircraft-based Observation for aviation?

The importance of NMHS to the aviation industry



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SCIENCE for ACTION

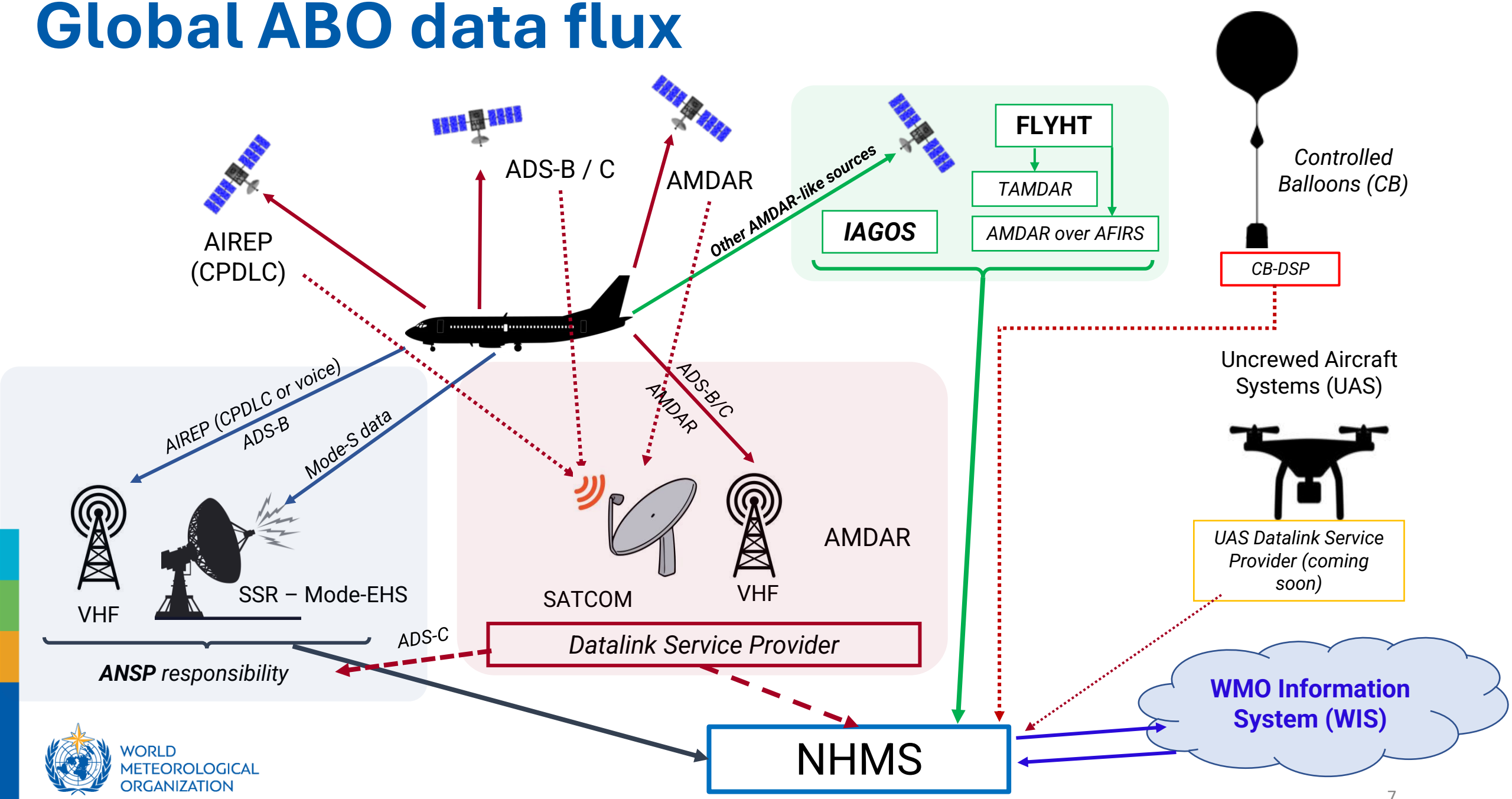
Review of Sources of Aircraft-Based Observations

ABO Source	*System/ type*	*Regulator/ provider*	*Auto/ manual*	*Sensors*	*Communications*	*Meteorological information*	*Air–ground format*	*Responsible for ground reception*	*Responsible for meteorological processing and WIS provision*	*Preferred WIS format*
WMO ABO	AMDAR	WMO	Auto	Innate to aircraft[a]	ACARS	Always	AMDAR (WMO)	NMHS	NMHS	BUFR
ICAO ABO	AIREP	ICAO	Auto and manual	Innate & pilot (from cockpit display and subjective)	ACARS	Always	AIREP (ICAO Annex 3)	ANSP	Currently NMHS	BUFR
ICAO ABO	PIREP	FAA	Manual	Innate & pilot (from cockpit display and subjective)	VHF radio/ACARS	Always	PIREP (FAA)	NCAA	Currently NMHS	BUFR
ICAO ABO	ADS-C	ICAO	Auto	Innate to aircraft	ACARS	Optional	ICAO aircraft report	ANSP	Currently NMHS	BUFR[h]
ICAO ABO (ADD)	Mode-S	ICAO	Auto	Innate to aircraft	L-Band (SSR)	Derived	ICAO aircraft report	ANSP/EMADDC	EMADDC	NetCDF
Other ABO	TAMDAR	FLYHT Inc.	Auto	Additional	Satellite	Always	TAMDAR	FLYHT/FTG	NMHS	BUFR
Other ABO	UAS	CAA/NMHS	Auto	Innate and additional	VHF/Satellite	Always	Custom by DSP	UAS-DSP	NMHS	UAS-NetCDF
Other ABO	Controlled Balloons	WMO	Auto	Additional	Satellite	Always	Custom by DSP	CB-DSP	NMHS	BUFR/NetCDF

Adapted from WMO N°1200 – Guide to Aircraft-based Observations (*in red, the inclusions will be proposed for WMO INFCOM V*)

WMO INFCOM/SC-ON/**ET-ABO** leads all ABO activities

Global ABO data flux



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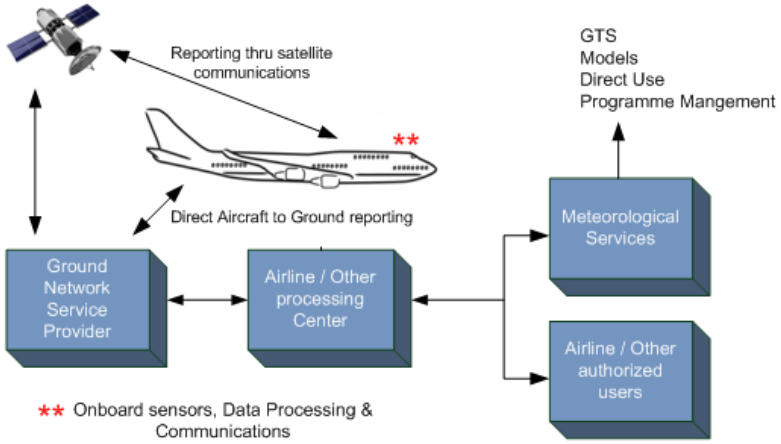
Adapted from S. Stringer, 2017 – Modified by N. Rivaben, 2026

Aircraft Meteorological Data Relay - AMDAR

- It uses installed sensors (pitot probe, static port, accelerometer) or additional sensors (WVSS-II)
- AMDAR **is supported by ACARS-type telecommunication protocols** (ARINC 620). It requires an AMDAR Onboard Software (AOS) installed in the aircraft. Other systems such as AFIRS (FTG/FLYHT) can relay AMDAR messages
- It is managed by the **Airline participant, DSP and the NMHS**
- Restricted data policy in some cases
- Data should be **disseminated into WIS** (preferable WIS2) through FM94 BUFR bulletins.
- Data should be **processed and consisted into the DA of G-NWP** systems



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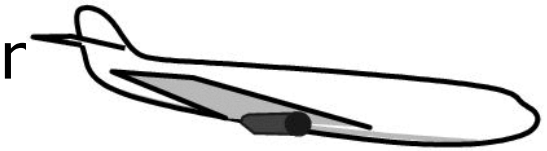
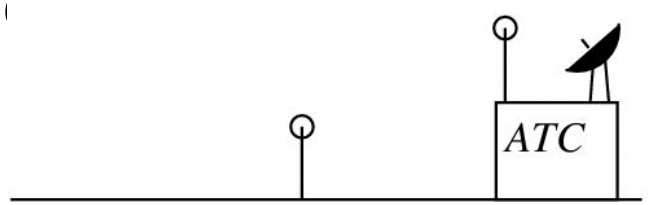
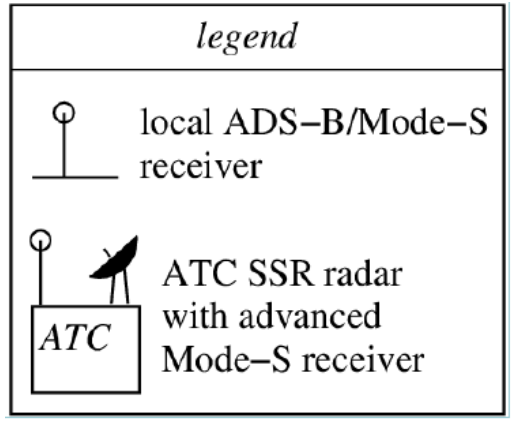
SSR Mode S and ADS-C/B

- **SSR-Mode** : ANSP uses SSR to interrogate aircraft at 1030/1050Mhz bandwidth. Meteorological information can get by:
  - **Using innate instruments** (called as Mode-S Meteorological Routine Air Report – **MRAR**): Quality is very similar to AMDAR and RAOB. Unfortunately, 5% or less of the aircraft have a transponder with BDS 4.4 register and very few ATC radar interrogate this BDS;
  - **Deriving from aeronautical variables** such as Mach Number, heading, true airspeed, ground speed, altitude and ICAO id, among others.
- **ADS-C data use airborne instruments data like AMDAR** and no derivation is required.







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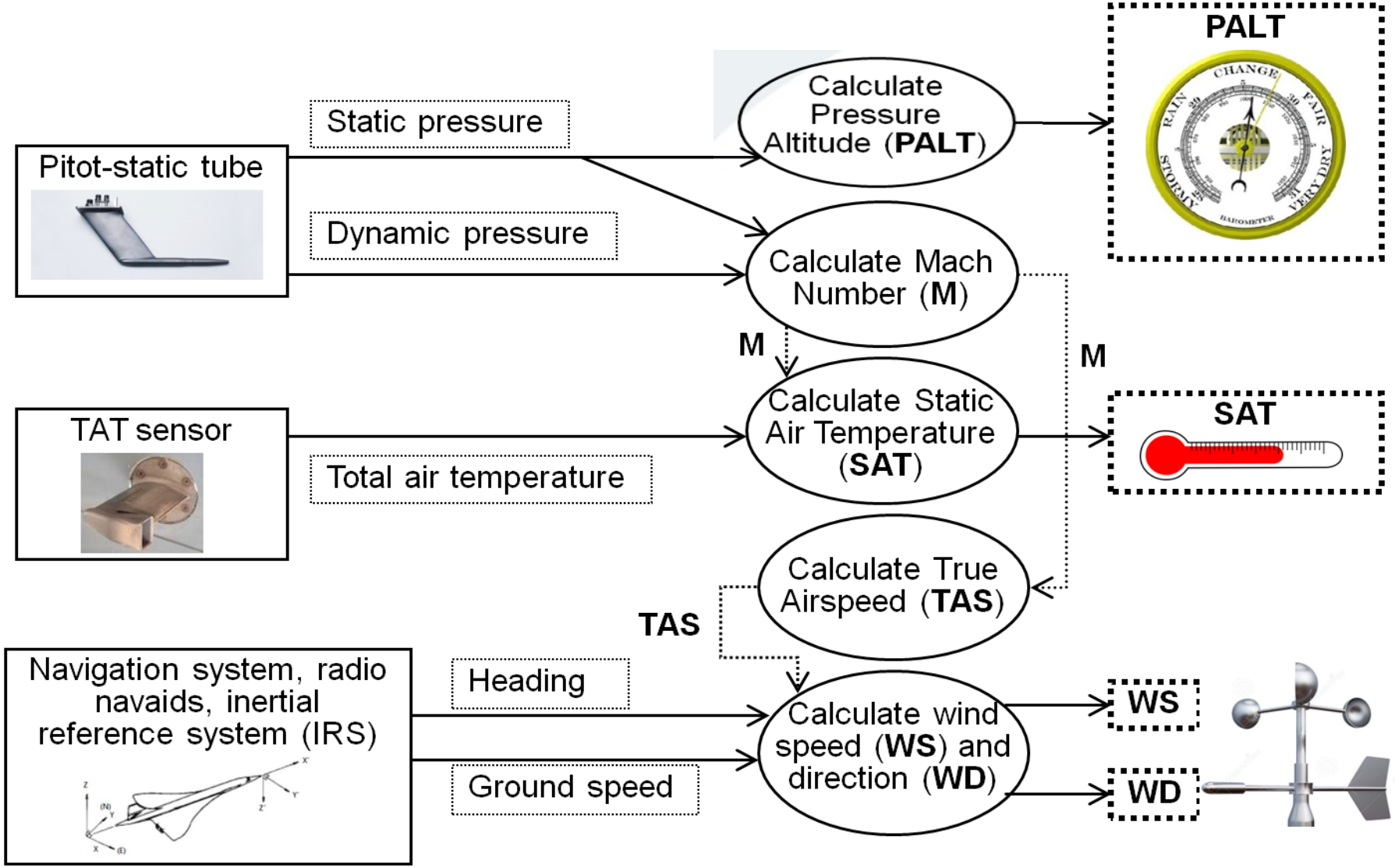
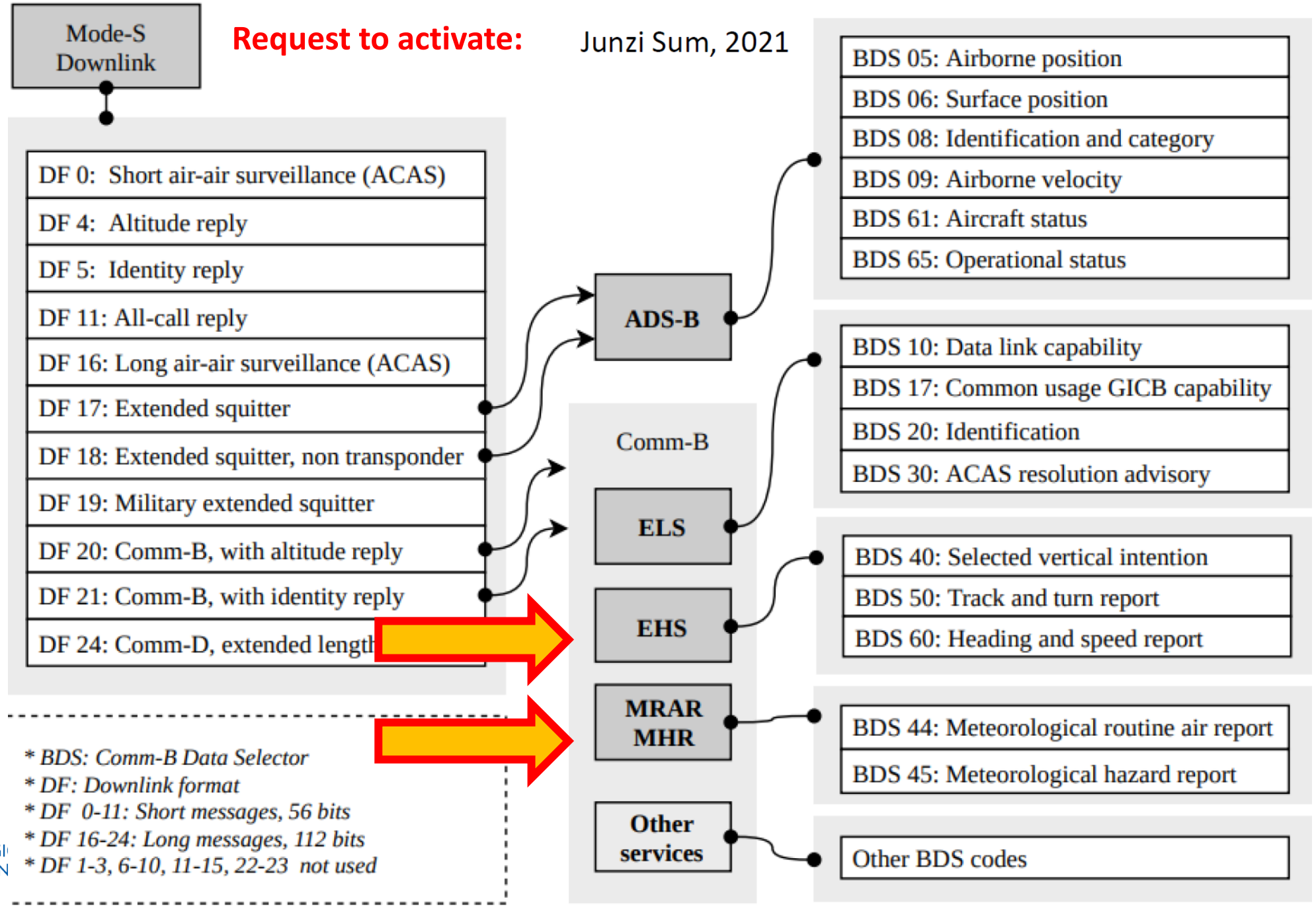
How is the process of deriving meteorological data from aeronautical parameters?





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Global ADS-C Coverage

ADS-C: Non MET reporting FIRs

ANSPs that are not enabling the MET group in periodic ADS-C contracts (based on analysis of several weeks in 2019)

ICAO code	FIR/ANSP	RA	ICAO code	FIR/ANSP	RA
DAAA	Algeria	I	FIMM	Mauritius	I
FNAN	Angola	I	VIDF	New_Delli	II
ENOB	Bodo	VI	DNKN	Nigeria	I
GCCC	Canary_Islands	I	SPIM	Peru	III
GMAC	Casablanca	I	LPPO	Portugal/Santa Maria	VI
ZLLL	China_West	II	GVSC	Sal	I
ZWWW	China_West	II	SCEZ	Santiago	III
MHTG	Cocesna/Central America	IV	FSSS	Seychelles	I
CZEG	Edmonton	IV	HCSM	Somalia	I
RJJJ	Fukuoka	II	VCCF	Sri_Lanka	II
DGAC	Ghana	I	VVTS	Tan_Son_Nhat	II
WIFF	Jakarta		TTZP	Trinidad/Piarco	IV
WMFC	KUALA_		CZVR	Vancouver	IV
VRMF	Maldives/Male				

...ve Stringer, based on data provided by Collins Aerospace, WMO Workshop on ADD, 2022.

We need enable MET ADS-C in all Oceanic FIRs to enhance Global NWP in those areas

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Summary ADD

Focus primarily on Mode-S EHS data and Mode-S Meteorological Routine Air Report (MRAR).
ADS-C over oceanic airspaces.

Type	Sub-type	Direct meteorological information	Derived meteorological information	Remarks
Automatic Dependent Surveillance (ADS)	ADS-B	✗	✓	- Only wind - Small number - Poor quality
	ADS-B ES	✗	✓	- Small number - Poor quality
	ADS-C	✓	✓	- Only small portion of messages - Good quality - Data only via ATC or airlines - Data communication costs
Secondary Surveillance Radar (SSR) Mode-S	Mode-S ELS	✗	✗	-
	Mode-S EHS	✗	✓	- Specific dynamic aircraft corrections and quality control required - Good quality wind - Lower quality of temperature - Exceptionally large amounts of observations - Data distribution costs still to be negotiated with ATM community
	Mode-S MRAR	✓	✗	- Small number - Good quality
	Mode-S MET Hazard Report	✗	✗	-

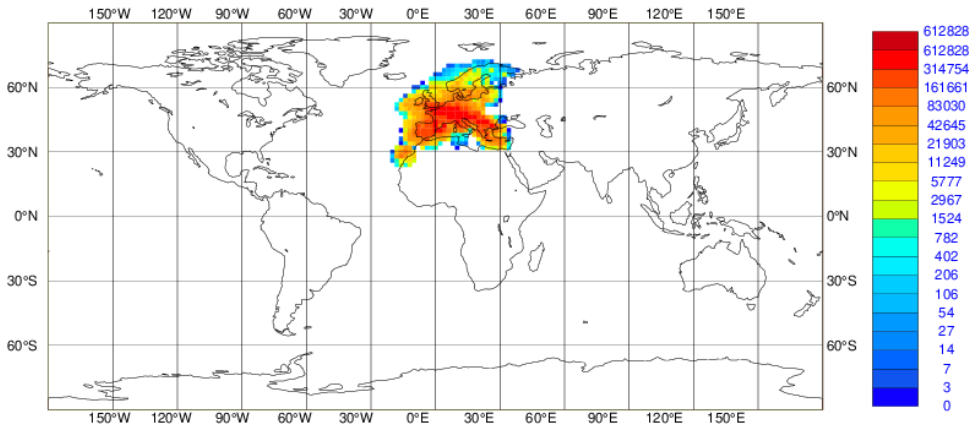
Steve Stringer, WMO ADD Workshop 2022

Current operational Mode-S data: EMADDC

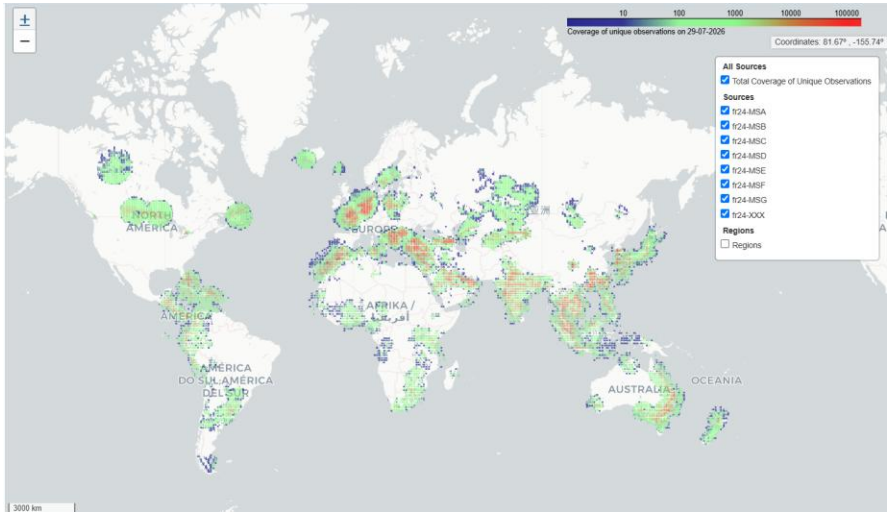
European Meteorological Aircraft Derived Data Centre - EMADDC - is an operational center under development to provide quality-controlled wind and temperature observations that are based on aircraft data.

EMADDC is a SESAR deployment project and co-funded by the EU (INEA):

- KNMI process **ASTERIX CAT48 format** to derive MET data**.**
- MetOffice collects SSR Mode S (EHS) available through FlightRadar24 and shares to KNMI.
- **Absolute quality estimated:**
  - Wind speed: 1-1,5m/s
  - Wind direction: 5 – 10 degrees
  - Temperature: 0,5 – 2°K
- Format available: WMO BUFR, NetCDF and ASCII



Original network using SSR Mode S (Asterix CAT048) for MUAC airspace – Jan de Sondij (EMADDC) WMO ADD Workshop 2022



SSR Mode S Global Coverage provided by FR24 and supported by MetOffice to EMADDC – 29 July 2026. Source: EMADDC

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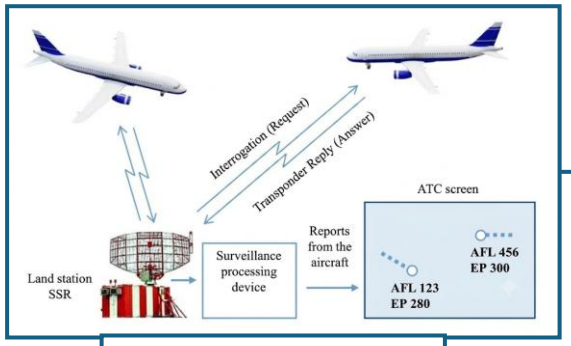
Global SSR-Mode S Data Flux – Two scenarios for ANSP' constribution



ANSP

Provides SSR mode S data (EHS) in Asterix CAT048 format part 4

Royal Netherlands Meteorological Institute
Ministry of Infrastructure and Water Management

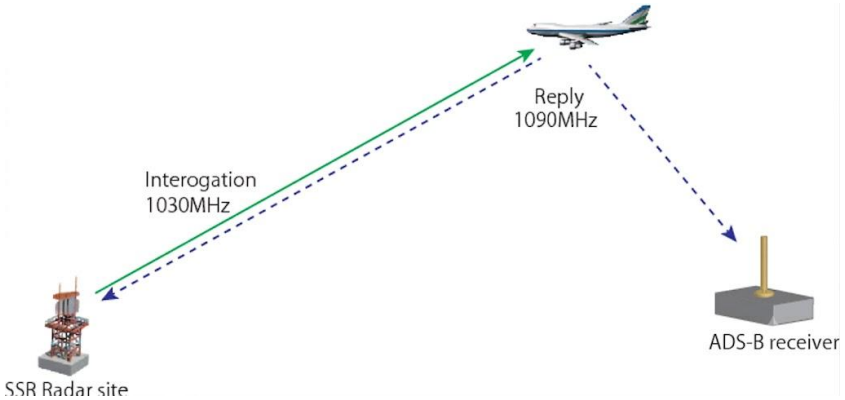
EUMETNET

EMADDC

Derive MET information from raw data and put it into WIS and G-NWP (ECMWF)

Scenario 1

Scenario 2



ANSP

Operates SSR Mode S EHS antennas

FlightRadar 24

Receives data from transponders

Collects and send pre-processed data

Met Office

Royal Netherlands Meteorological Institute
Ministry of Infrastructure and Water Management

EUMETNET

EMADDC

Derive MET information from raw data and put it into WIS and G-NWP (ECMWF)

Weather Unmanned Aerial Systems (wx-UAS)

- **Small weather-sensing UAS (WxUAS):**
- **are nearly 100% reusable** - as opposed to radiosondes of which only 20% are recovered and a smaller fraction reused;
- can **rapidly sample the lower atmosphere**; hence they improve the short-term **prediction of radiation fog events** (Leuenberger et al. 2020); and they **can improve the skill of mesoscale weather predictions** (e.g., Jonassen et al. 2012; Flagg et al. 2018; Chilson et al. 2019; Jensen et al. 2021);
- **are extremely adaptable**; capable of flying targeted missions or performing routine systematic profiling (Elston et al. 2015);
- It can be automated or operated remotely

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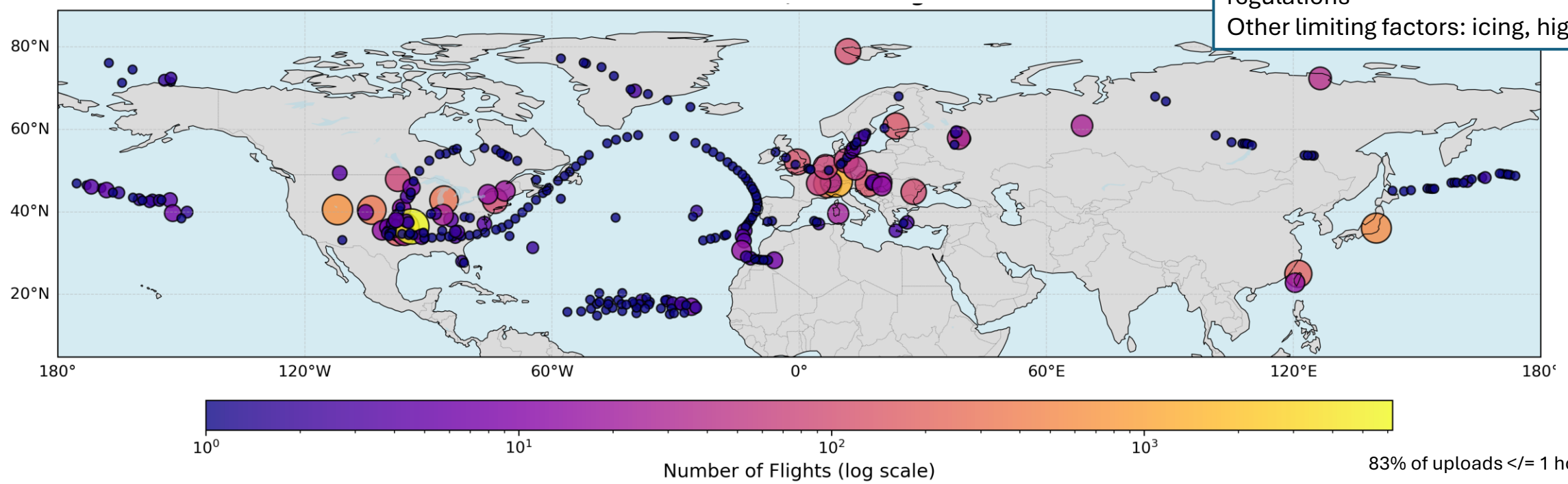
2024 WMO UAS Demonstration Campaign Summary

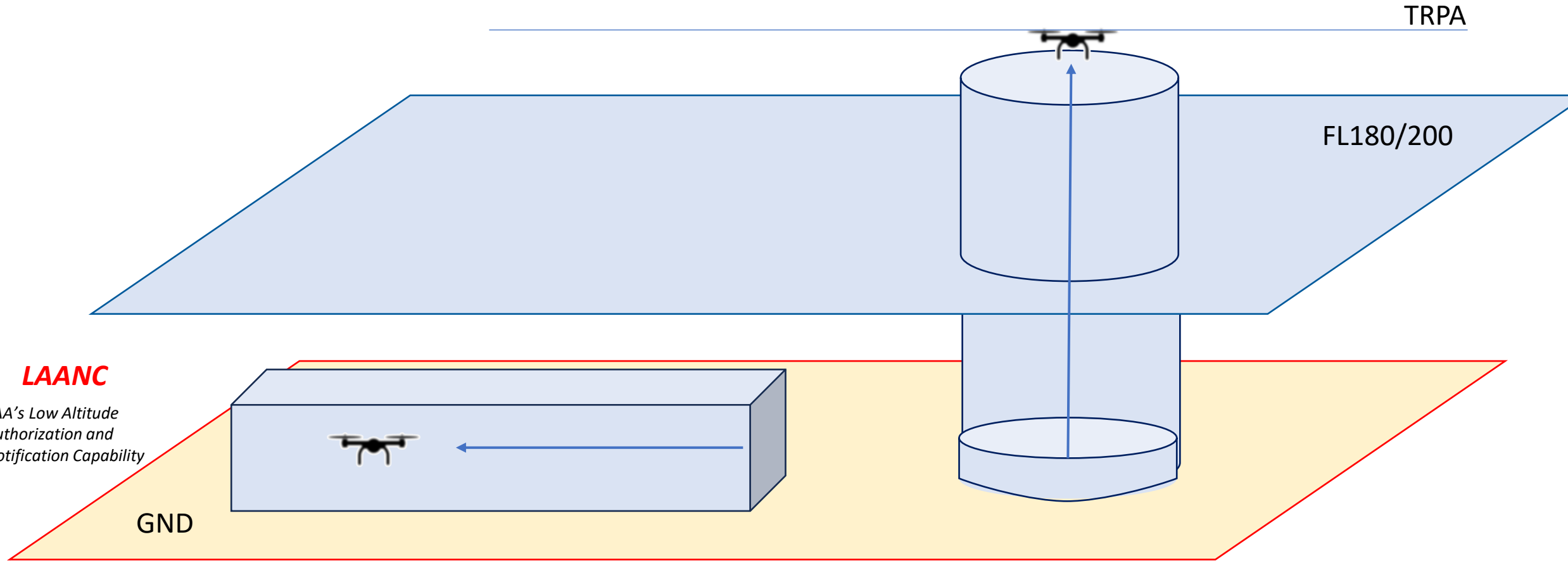
- **Goal :** Accelerate and Demonstrate Operational Readiness for inclusion in WMO Integrated Global Observing System (WIGOS)
- **Dates :** March – Sept 2024
- **Coverage :** Global (31 cities from 12 countries)
- **Operators :** 44
- Profiles collected as of 21 Sep 2024 : **over 12000**
- **Data format :** CF compliant netCDF & BUFR
- NWP Center Participation: ECMWF, DWD, MeteoSwiss, NOAA GSL.

Max altitude mostly limited by regulations
Other limiting factors: icing, high winds



83% of uploads </= 1 hour

WMO UAS DC: discussion about UAS airspace management and procedures for MET observations



Limited airspace fixed by NOTAM. Ceiling: FL004 or G/E-class airspace. Only VLOS. NOT USEFUL for regular MET observations

Airspace fixed by AIP ENR 5.1 with a 2-5 NM radius. Ceiling: FL400. BVLOS. USEFUL for regular MET observations

Status of WMO ABO Programme at regional level

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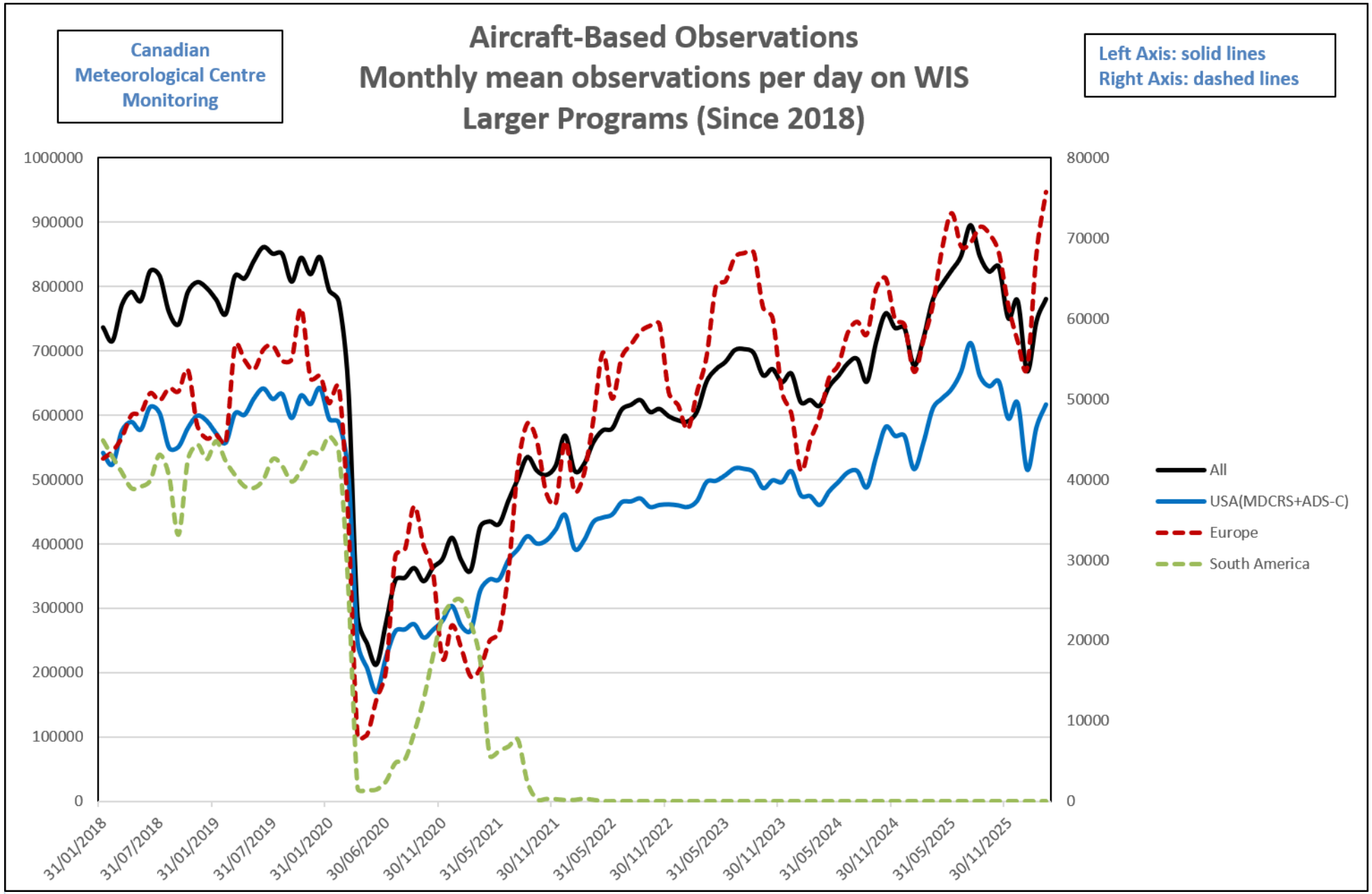

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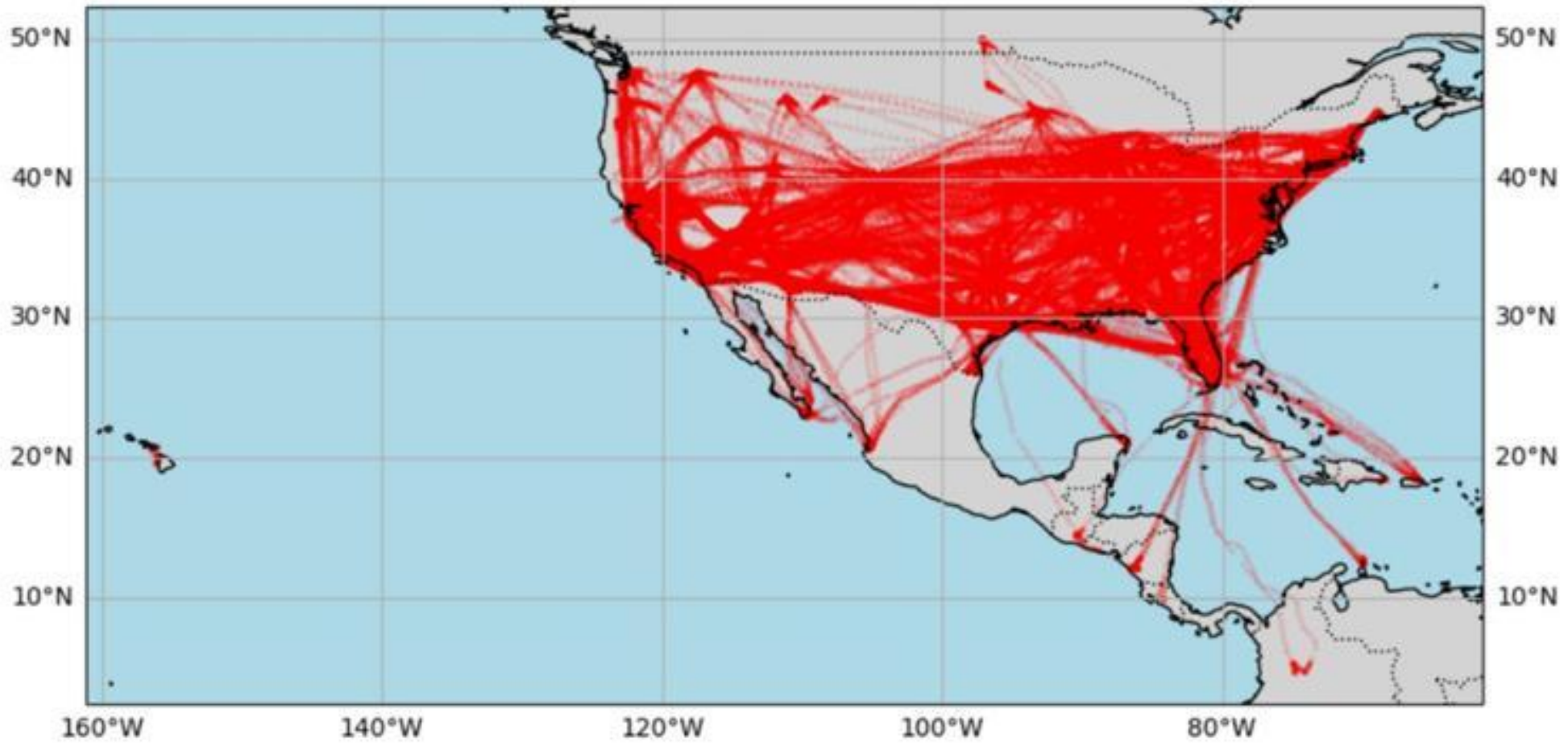
ABO Dataset available for RA IV: WVM



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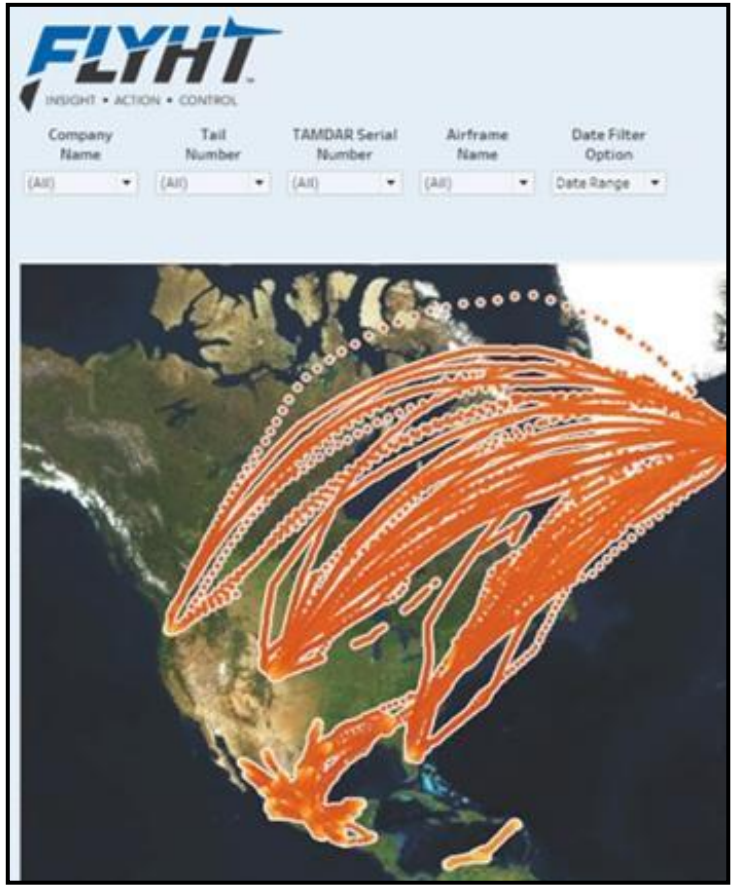
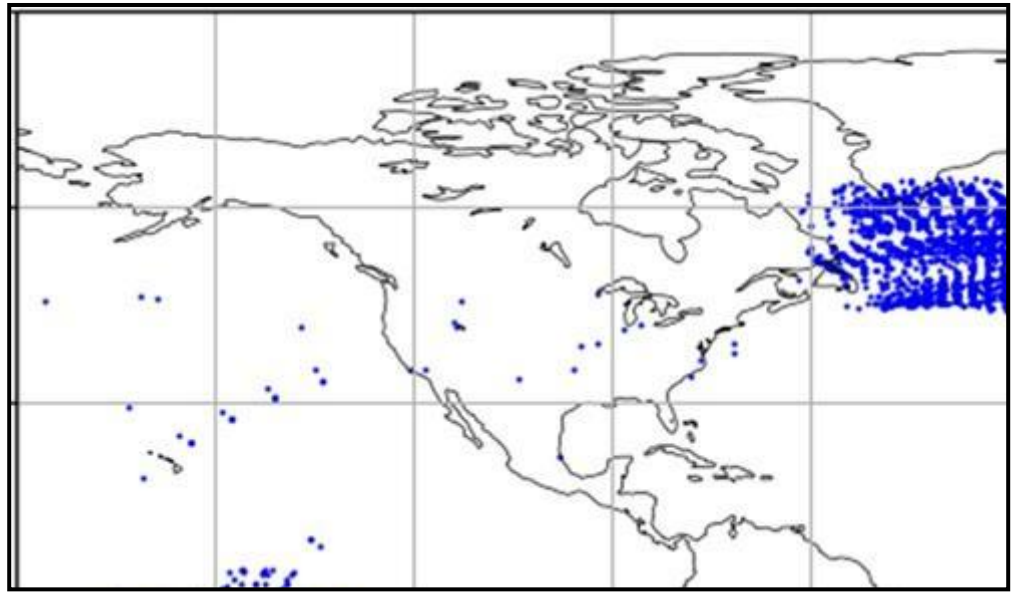
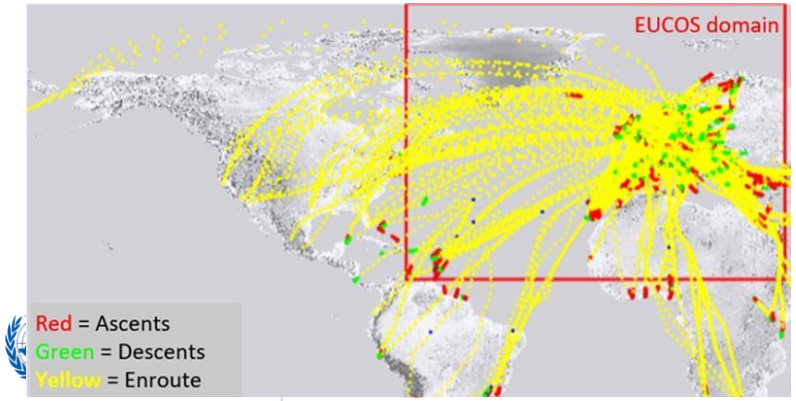
WVSS-II measurements from the North American AMDAR program from 06-12 October 2025 (source: NOAA)



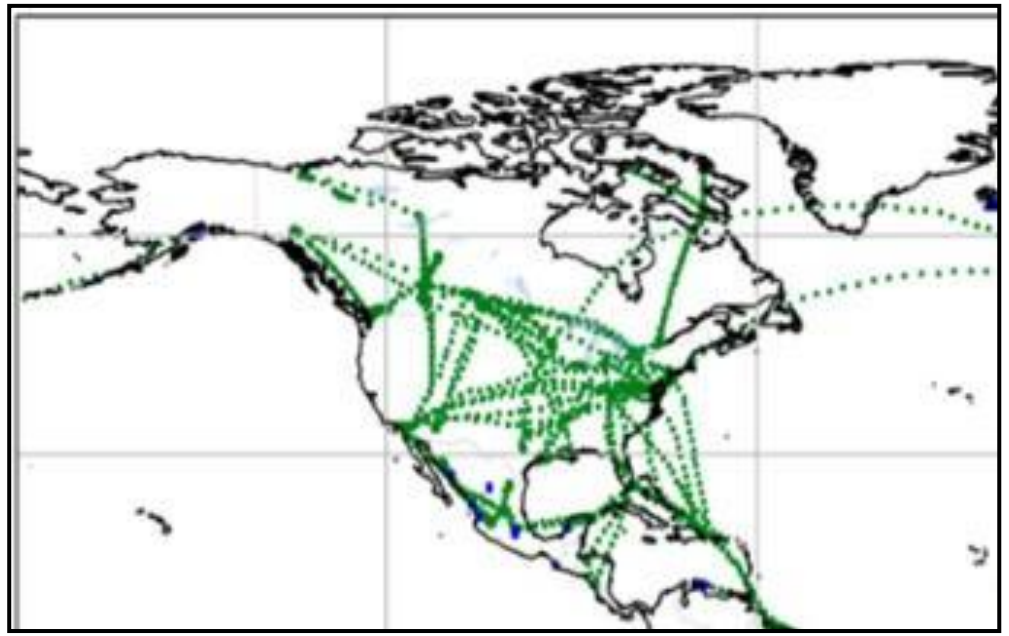
TAMDAR (FLYHT) coverage (Dec 2025)



AIREP coverage (Dec 2025)



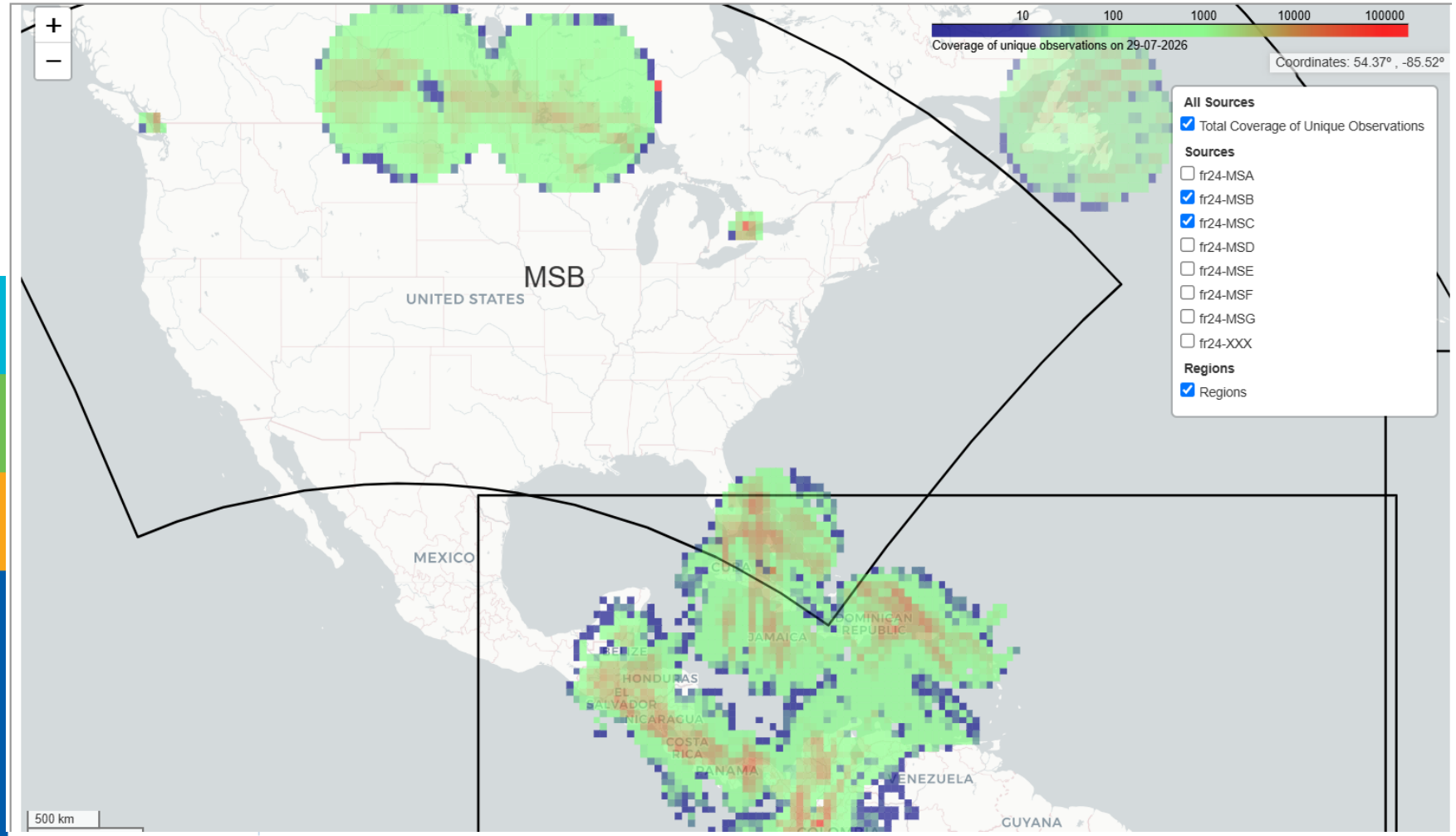
EUMETNET coverage (Dec 2025)



AFIRS coverage (Dec 2025)

ABO Dataset available for RA IV

- EMADDC/MetOffice/FlighRadar24 data set:



- SSR Mode S EHS is not available in the BNATCS/US. Mexico also is not providing SSR Mode S EHS data,
- Caribbean region is well covered.

ANSPs over RAIV should enable SSR Mode EHS capabilities!

ABO Dataset available for WMO RA IV - ICAO NAM/CAR

- **ACARS-based systems** (US AMDAR) and **ACARS-like systems:** AFIRS/TAMDAR (FLYHT/FTG).
- WIS/GTS messages: **IUAX92 KWBC** bulletins by NOAA (FM94 BUFR)
- MET ADS-C data (US/Canada Airspace) : Coverage over FIRs: CZQX, KZNY.
- Wx-UAS (experimental) in NOAA (US)
- SSR Mode S (MIT-experimental): PADWOS

Data availability:

- US/NOAA MADIS Site: amdar.noaa.gov → Graphical Displays → Public or Restricted
- NOAA/NCEP/MADIS variables: https://madis.ncep.noaa.gov/acars_variable_list.shtml

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Regional Coordination mechanisms

- Currently US is operating the core **Meteorological Data Collection Reporting System** (MCDRS) with: American Airlines, Delta Air Lines, Federal Express (FedEx), Southwest Airlines, United Airlines. United Parcel Service (UPS) y Northwest Airlines (now under Delta).
- **US Water Vapour Programme is composed by 130 B737** with WVSS-ii sensors and 25 within FLYHT/TAMDAR Programme.
- **US NOAA collected in the past data from AeroMexico** (2011-2014) with the participation of CONAGUA.
- US NOAA is looking for resuming data provision from **LATAM Airlines Airlines by mid 2026**. No significant progress with COPA, Avianca, and Caribbean Airlines.

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Recomendations from ABO Community

- **To solve the problem of lack of funding for ACARS-based systems** (AMDAR):
  - AMDAR Onboard Software (development cost)
  - Communication cost (operative costs)
  - Collaboration from targeted airlines
- **To solve the lack of coordination between NMHS and METP/ANSPs/CAAs**
- **ANSP:**
  - to enable SSR Mode EHS (enhanced)
  - to enable ‘MET’ component of ADS-C messages, specially over oceanic areas
  - to encourage large adoption of ADS-B V3 ‘Wx’.
- **CAAs:**
  - To issue operations **BVLOS** certification for wx-UAS
  - To allocate a dedicated airspace for wx-UAS and /or establish SARs for their ops.

More details are available at: **Final report of the WMO Regional Workshop on ABO for the America (Dec 2024)** and the **Final report of the WMO Global Aviation Stakeholders on ABO Meeting**

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Thank you!

Muchas gracias!

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