Wx-UAS

A new standard for Atmospheric Observations for NMHS

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- Introduction - wx UAS
- WMO UAS Demonstration Campaign 2024
- Need from NMHS to CAAs and ANSPs

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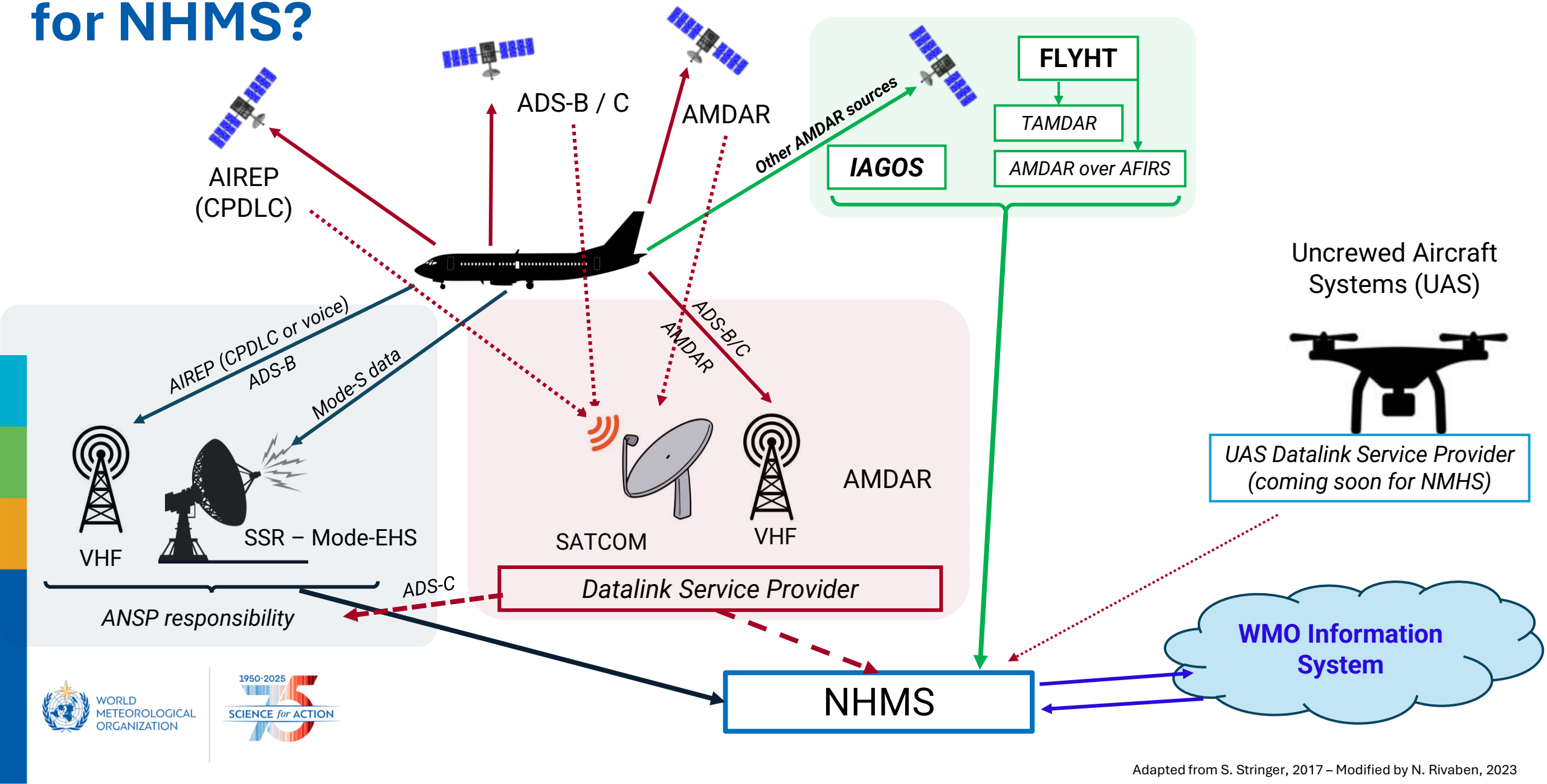
What kind of Aircraft-based Observations are available for NHMS?



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1950-2025 SCIENCE for ACTION

Adapted from S. Stringer, 2017 – Modified by N. Rivaben, 2023

Why WxUAS?

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) and general meteorologz (Pinto et al, 2024; Mudyek et Ladwig 2025);
- **are extremely adaptable**; capable of flying targeted missions or performing routine systematic profiling (Elston et al. 2015);
- **NMHS has the option of operating** them directly or through *third parties*, as set out in the DaaS agreement.

Meteorological instruments

- Winds can be obtained directly by **ultrasonic anemometer or using inertial instruments** of the drone.
- Temperature and relative humidity sensors **are similar** to radiosounding systems.
- Other sensors such as GHG, aerosols could be deployed for **research**

Key considerations for integrating sensors into UAS fuselages include the need to shield sensors from solar radiation, insulate them or aspirate them, to avoid heat generated by UASs from the motors and the batteries, or aerodynamic effects such as compressional warming from the propeller modified airstreams (Greene et al. 2018, 2019)

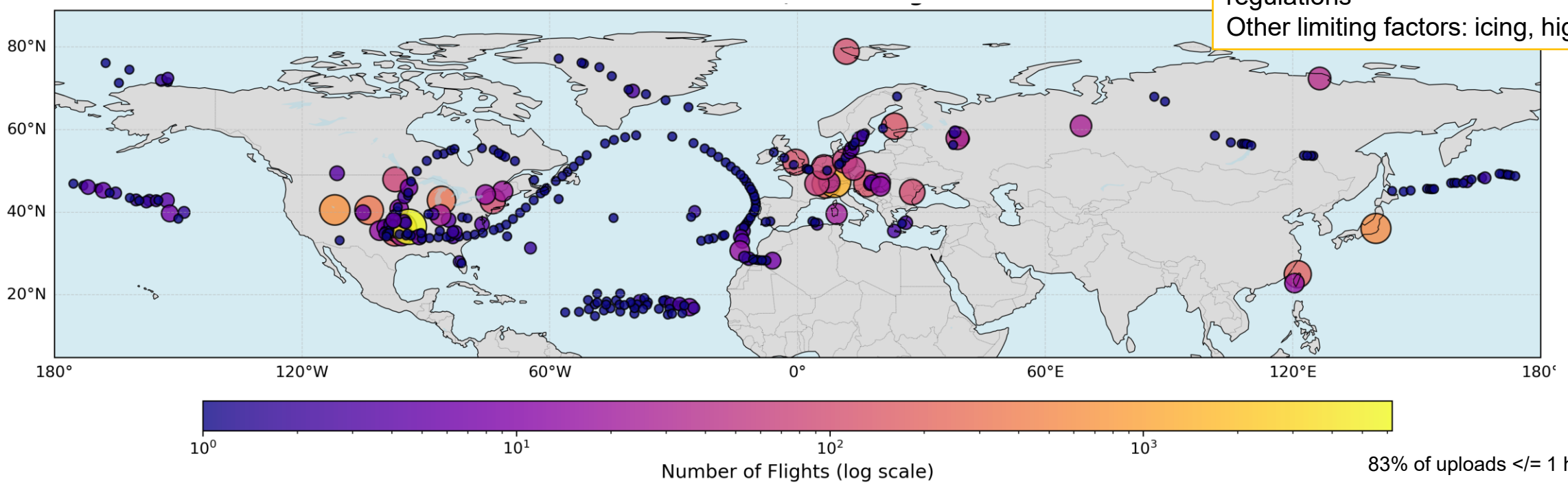
MetSprite wxUAS developed by Menapia Ltd

Meteomatics MeteoDrone MM-670 automatically recharging on the Meteobase

2024 WMO UAS Demonstration Campaign Summary

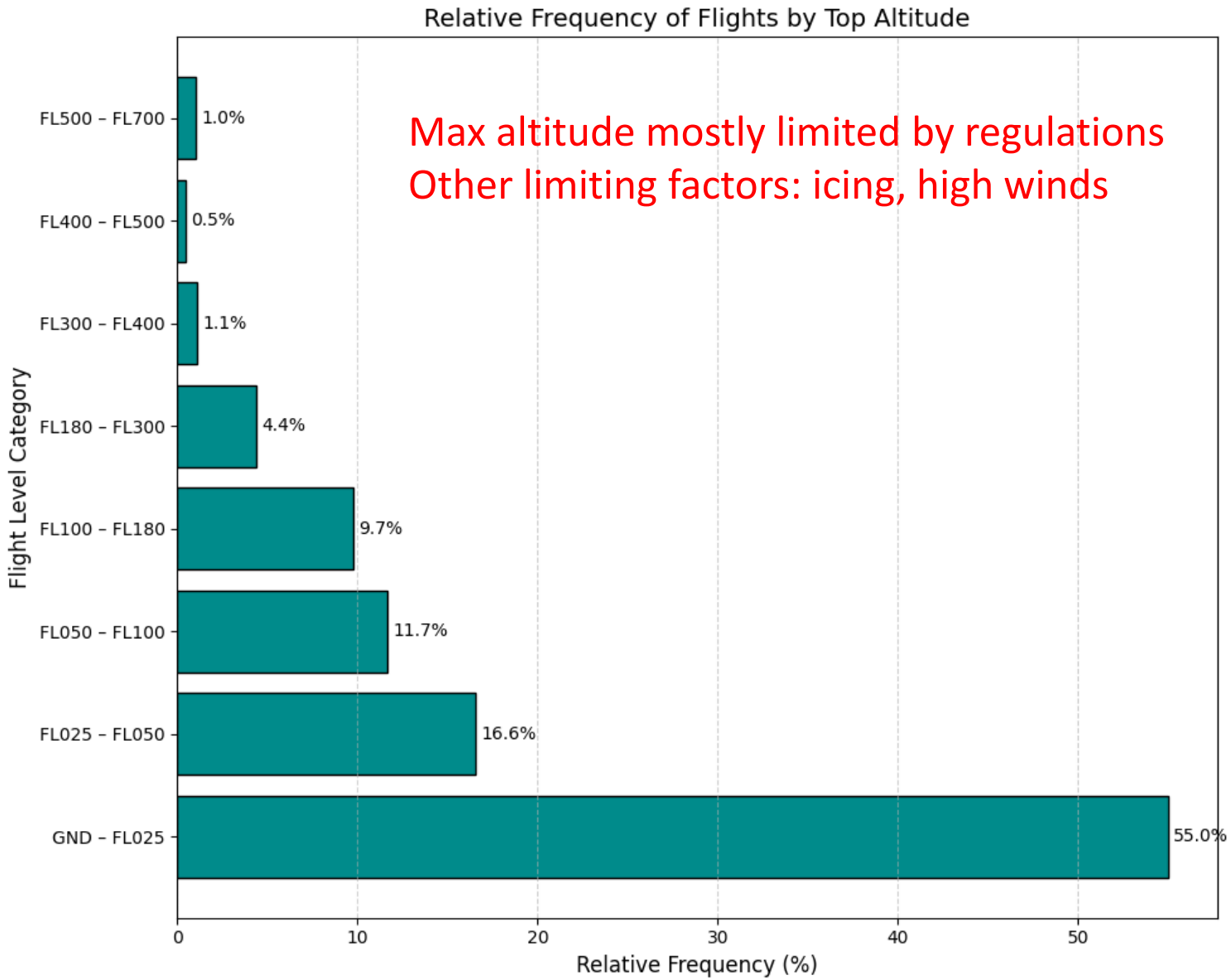
- **Goal :** Accelerate and Demonstrate Operational Readiness for inclusion in WMO Integrated Global Observing System (WIGOS)
- **Dates :** March – Sept 2024
- **Coverage :** Global (31 cities from 12 countries)
- **Operators :** 44
- Profiles collected as of 21 Sep 2024 : **over 12000**
- **Data format :** 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

Metrics of WMO UAS DC according to Post-campaign report



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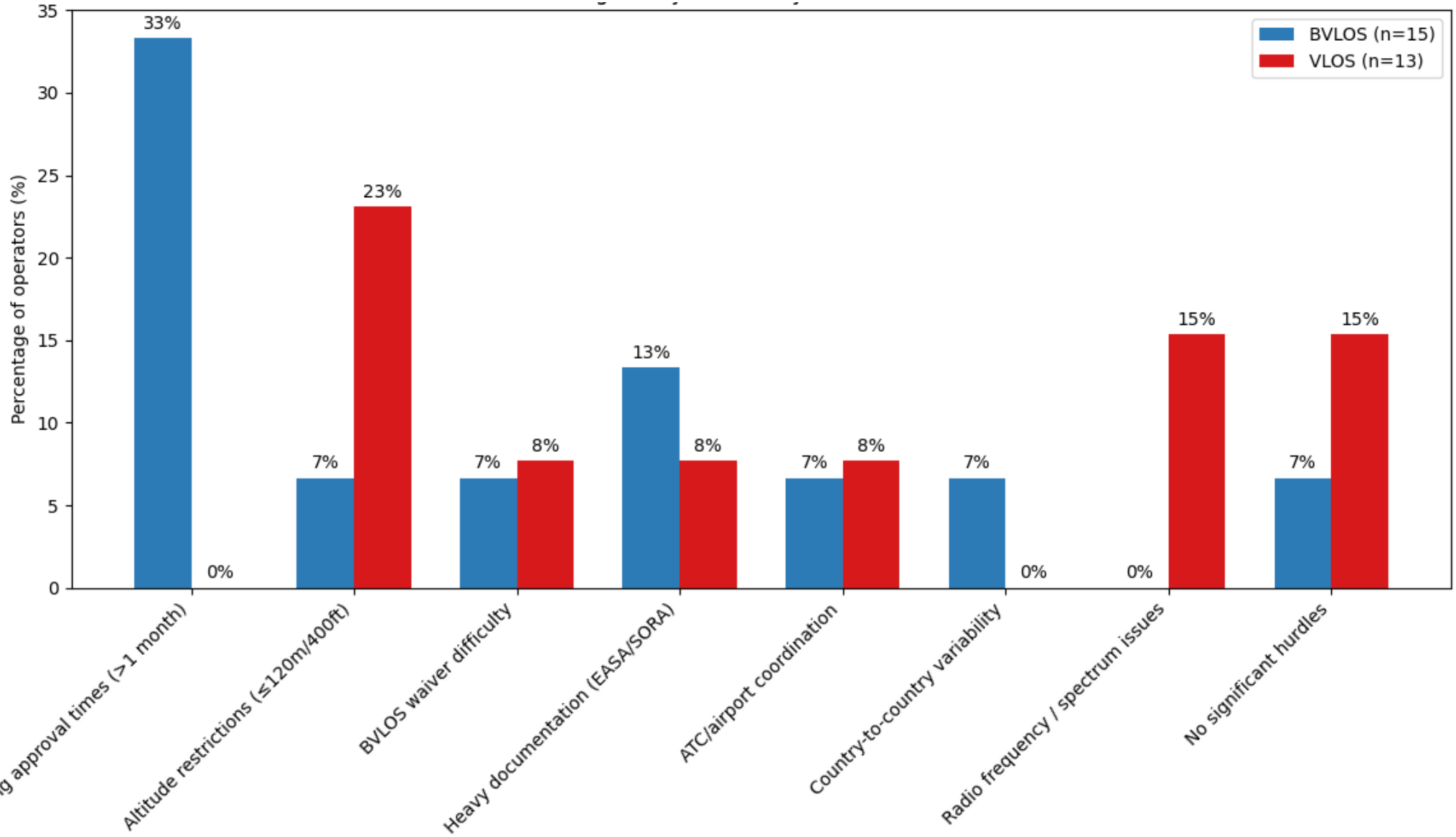

Discusion about airspace for Wx-UAS:

Two scenarios proposed:

- ***Flexible scheme*** – temporary NOTAMs + coordination with ATC.
- ***Fixed scheme*** – dedicated restricted airspace (e.g., 2 or 5 NM radius, up to FL400) published in the AIP – ENR 5.1.

In both case it should start with temporary NOTAMs (up to 3 months). If operations become permanent, then request AIP publication.

- **Identified risk:** In Performance-Based Navigation (PBN) routes, aircraft do not follow fixed airways
- Peruvian experience so far in Lima: Flights have been conducted inside Air Force bases or with Navy support – i.e., already segregated military airspace.

Example of best practice: Peru case

- SENAMHI acquired a Meteomatics MM-670 drone (capable of up to ~18,000 ft / 5,500 m) to obtain vertical profiles
- The initiative started in 2019, was delayed by the pandemic, and later faced regulatory hurdles. They made different test flights during 2024/45.
- They MM 670 flew in the forest and the desert. However, the maximum ceiling allowed was ~FL100 in low-populated areas.

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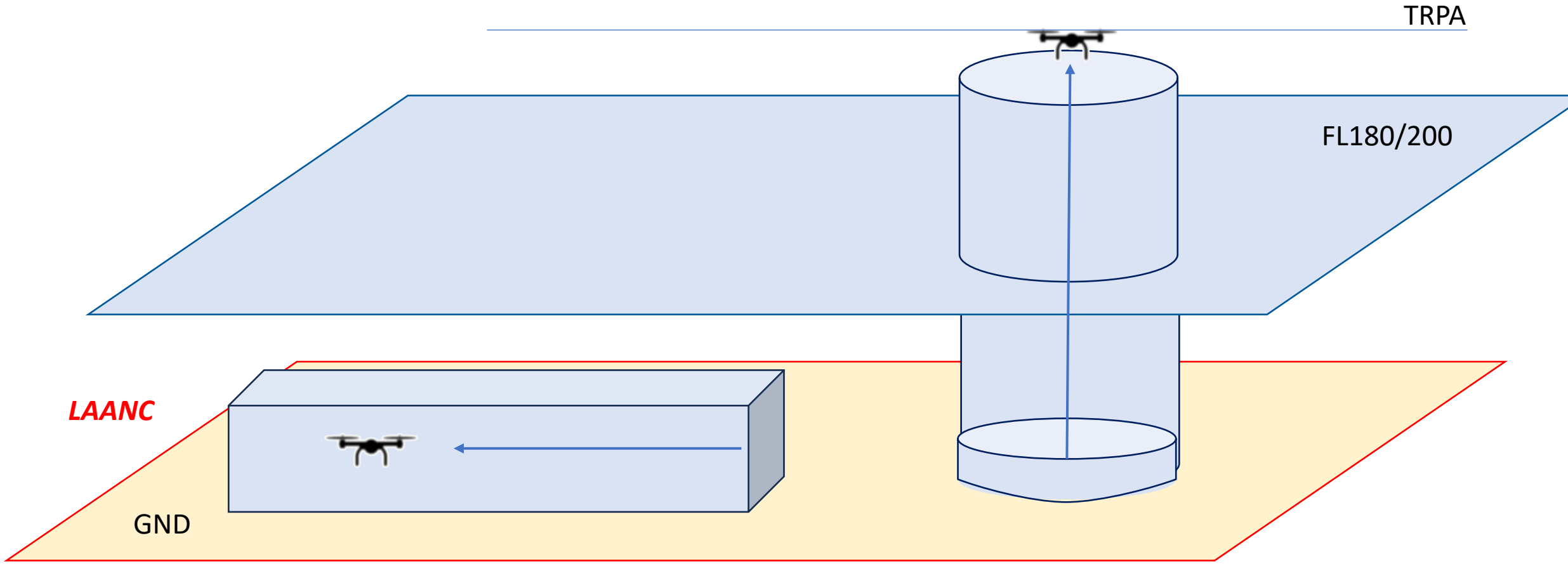
Discussion about UAS airspace management and procedures for MET observations



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

Key takeaways wx-UAS for CAAs/ANSPs

Airframe types	Quadcopter, hexacopter, fixed-wing with VTOL capability
Maximum take-off mass (MTOM)	500 g – **15 kg** (incl. parachute system)
Maximum operating altitude	Operational: up to ~**FL300** (30,000 ft AMSL) Research: up to ~**FL700** (70,000 ft AMSL)
Climb time to service ceiling	**20 – 40 minutes** (FL300-FL700)
Command & data link frequencies	433 MHz – 5.8 GHz (e.g., 433, 868/915 MHz, 2.4 GHz, 5.8 GHz)
Environmental tolerance	Sustained winds up to ~50–60 kt, icing conditions, moderate to severe turbulence
Airspace integration equipment	Some have **ADS-B/L** (EASA) transponder, detect-and-avoid (DAA) capability
Horizontal range	**2-5NM radius** horizontal extension. 10NM or higher for research
Airspace penetration	Can regularly penetrate **Class A** airspace (above FL180); research platforms may exceed FL600

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Final questions

- Should **MET Operators** apply the same process for standard RPAS operations?
- What is the best to **harmonize the approval of BVLOS** at CAAs?
- Is it possible to develop a '*Part 108-like*' initiative? *LAANC* for A-class airspace for wx-UAS?
- What is the best way to allow wx-UAS (research) ops from ANSPs perspective?
- Could ADS-L /Remote ID or just ADS-B *out* be the solution for UTM by ANSP?

Thank you!

Muchas gracias!

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