



Evaluation of the possible improvements of NWP products with the integration of observational data from dropsondes released from stratospheric platforms.

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**University of
Reading**

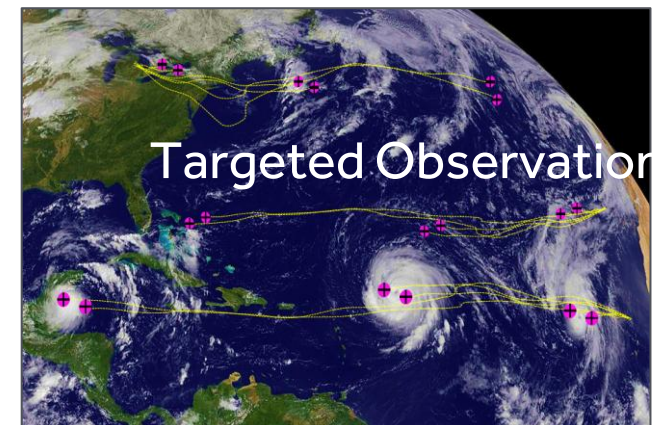
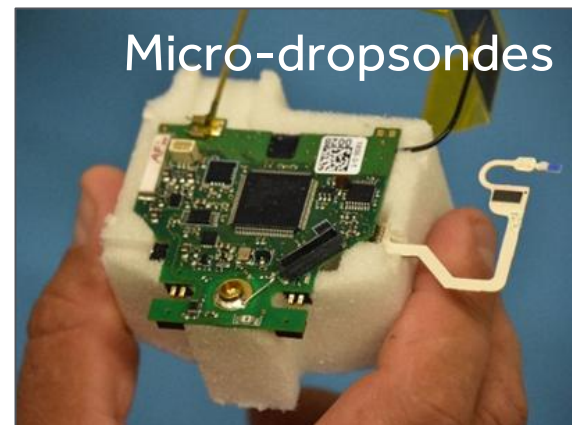
Voltitude Ltd.

Main objective:

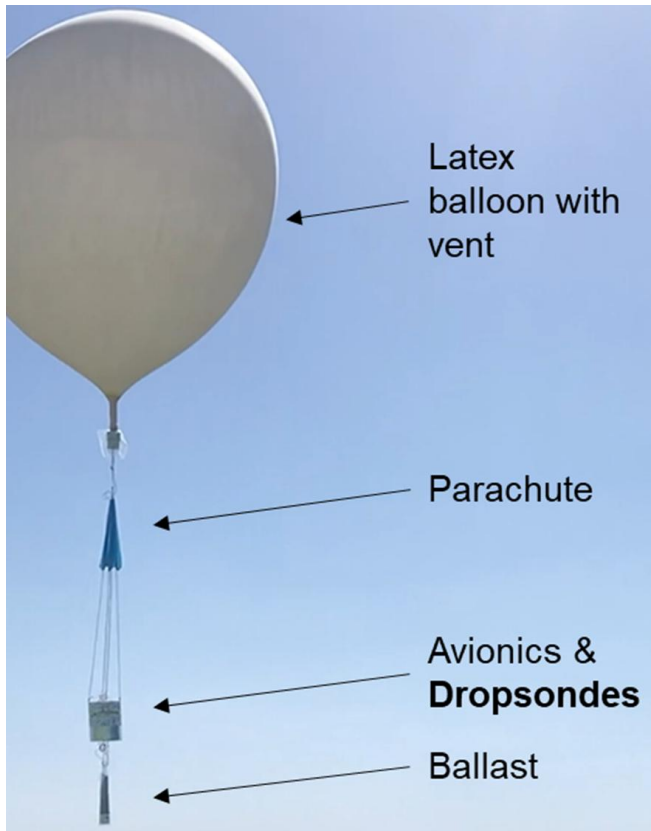
- **Unlock the Stratosphere[®]** using fixed wing High Altitude Pseudo Satellites (HAPS) and micro-High-Altitude Balloons (mHAB).

Primary Missions:

1. Obtain targeted meteorological observations over remote regions of the globe.
2. Remote sensing from the stratosphere.
3. Defense ISR and Connectivity



StratoSonde[®] mHAB and the Voltitude *microdropsonde*

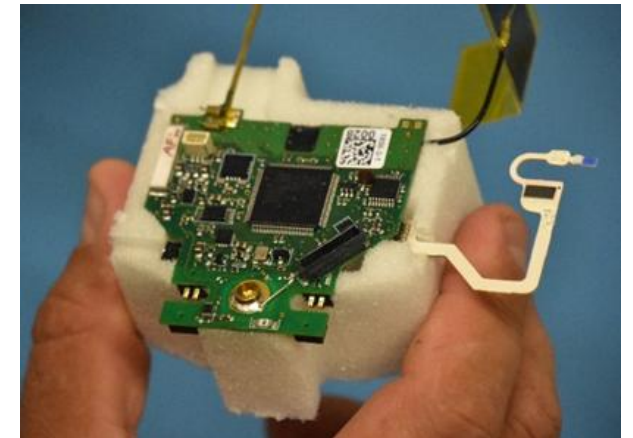


mHAB:

- In flight for 3 – 5 days
- Altitude controlling
- Carry up to 32 dropsondes
- Controlled remotely

Microdropsondes:

- 25 g
- ~ 20 minutes to drop
- ~1200 data points per drop

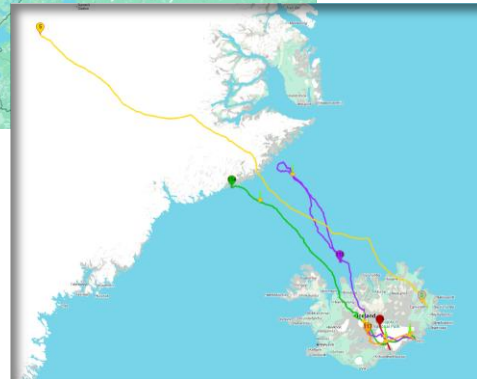


Campaigns using mHAB

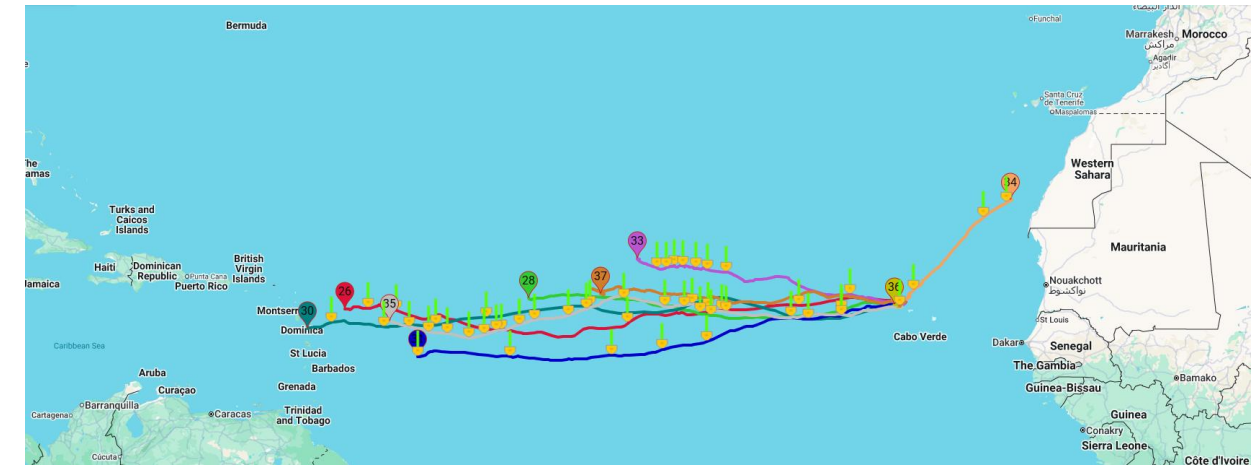


ICELAND: 2025 AND 2026

Gather data from Arctic region



CABO VERDE: 2024 AND 2025



Future campaigns (mHAB)

Planned missions using the mHAB system include:

1. Continue gathering data from Cabo Verde for Hurricane research, targeting full hurricane season presence.
2. Autumn and winter launches from the east coast of Canada for observations of the autumn/winter storms crossing the high north Atlantic and polar regions.
3. West Pacific dropsondes campaigns in collaboration with KIOST.

StratoSat[®] HAPS

StratoSat HAPS can take-off and land over a much wider operating envelope, overcoming the main barrier to commercial services from the stratosphere and reducing operating costs

- ✓ <25 kg Take-off mass
- ✓ 12.5 m wingspan
- ✓ Payload: 4 kg and 100 W peak power
- ✓ Starlink 5 Mbps.
- ✓ **Class II drone**
- ✓ 24 km ceiling
- ✓ 20 km cruise altitude
- ✓ Speed range 45-70 knots (at 20 km)
- ✓ Anti-collision lights, transponder ADS-B in and out



Future campaigns (HAPS)

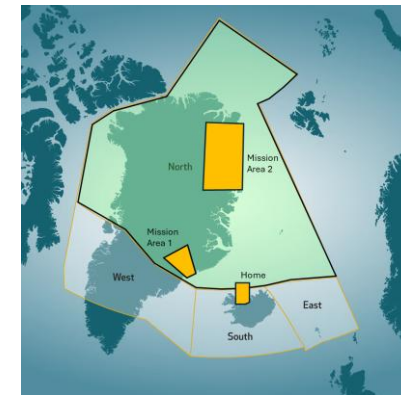
Currently, we are test flying in UK under “open category” at low altitude.
 Areas where Voltitude has permission or is in the process of obtaining permission for future HAPS flights and dropsonde release missions:

1. ARCTIC:

I. Iceland 2027/2028

- **CryoWatch** mission in collaboration with ARIA
 - Detail observation of the Greenland icesheets

Target 2027-28



2. TROPICAL ATLANTIC:

- I. Cabo Verde 2028/2029
- II. Barbados 2029/2029
- III. Caribbean 2030/2031

Target 2028-29



Target 2029-30



Target 2030-31



Using dropsonde data to improve weather forecast

The *StratoSonde's* ability to reach remote areas has provided an opportunity to obtain valuable observational data from regions with little-to-no observations:

- Obtain sounding data over Tropical and Arctic oceans
 - Sounding data from regions without radiosonde data
 - Provides atmospheric observations above tropopause
- ❖ These data sets can be used to improve accuracy of NWP models through data assimilation

Proposed workplan

Objective:

Quantify the improvement of forecast accuracy from the assimilation the Voltitude dropsonde data

Methodology:

Use the Ensemble Sensitivity Analysis (ESA) method to quantify observation impact on forecasts (Ancell and Hakim, 2007; Hakin and Torn, 2008; Torn and Hakim, 2008).

- ❖ Focus on the impact on *forecast uncertainty*
 - Measures the change in the variance of a metric of forecast skill due to the assimilation of a new set of observations
- ❖ No need to set up nature run

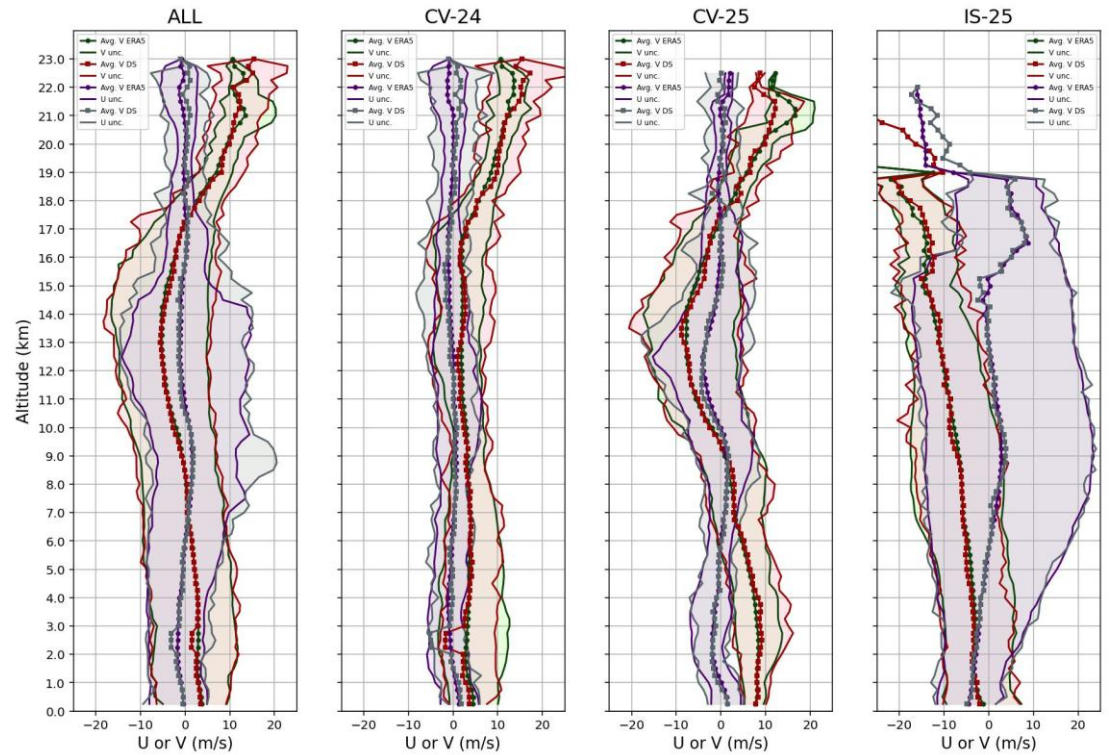
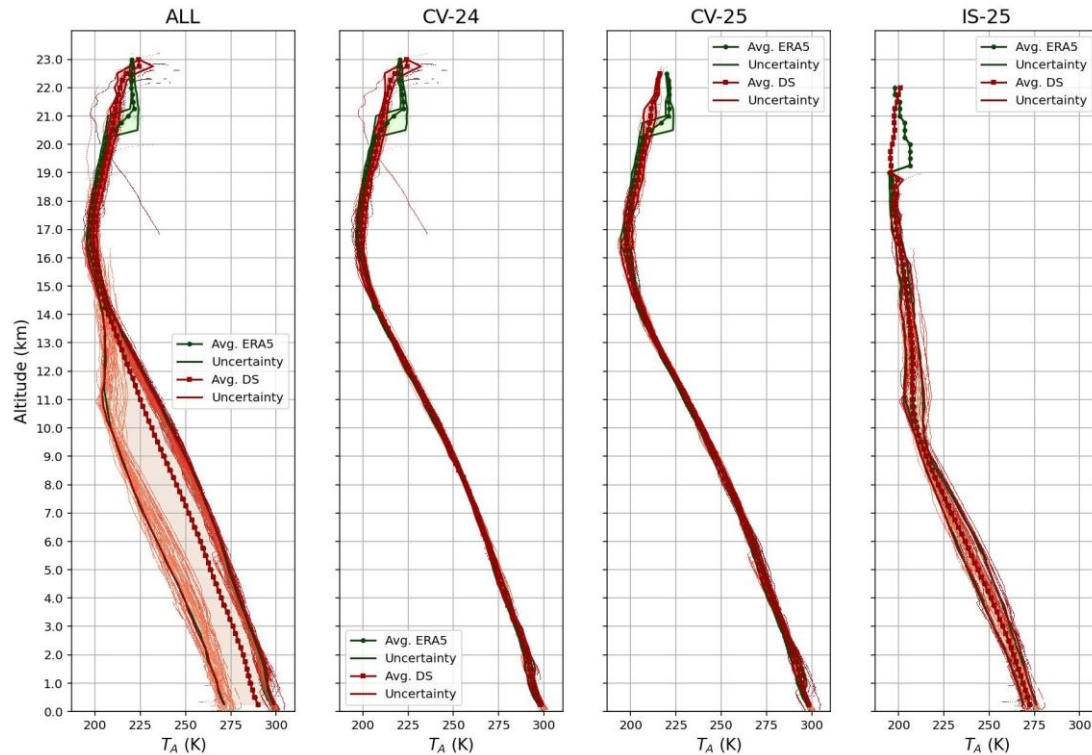
Steps to take:

1. Ensemble data will be obtained from TIGGE database to quantify the uncertainty before the new observations are assimilated
2. Quantify the potential observation impact from proposed observation strategies. 9

Initial dropsonde data evaluation

Observation analysis of the raw dropsonde data with ERA5 data.

- Cabo Verde 2024 and 2025 and Iceland 2025 campaigns
- Results were positive: temperature, pressure (not shown) and wind data had good accuracy.



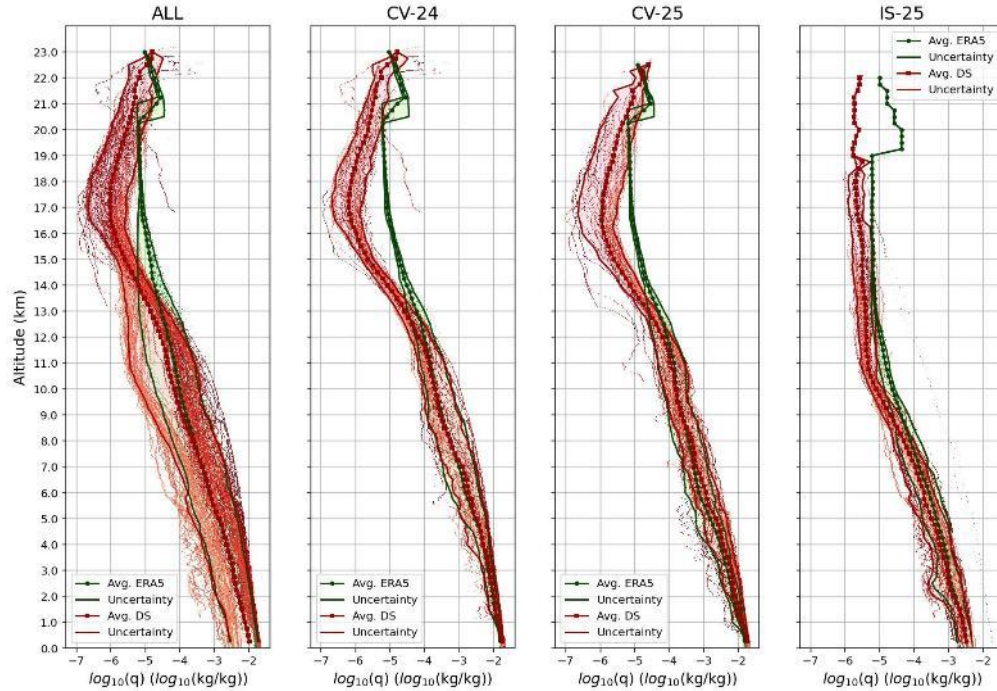
Vertical profile of air temperature with average and uncertainty:

Green – ERA5 data
Red – Dropsonde data

Vertical profile of wind components (U and V) with average and uncertainty:

Green – ERA5 (U) data
Gray – ERA5 (V) data
Purple – Dropsonde (V) data
Red – Dropsonde (U) data

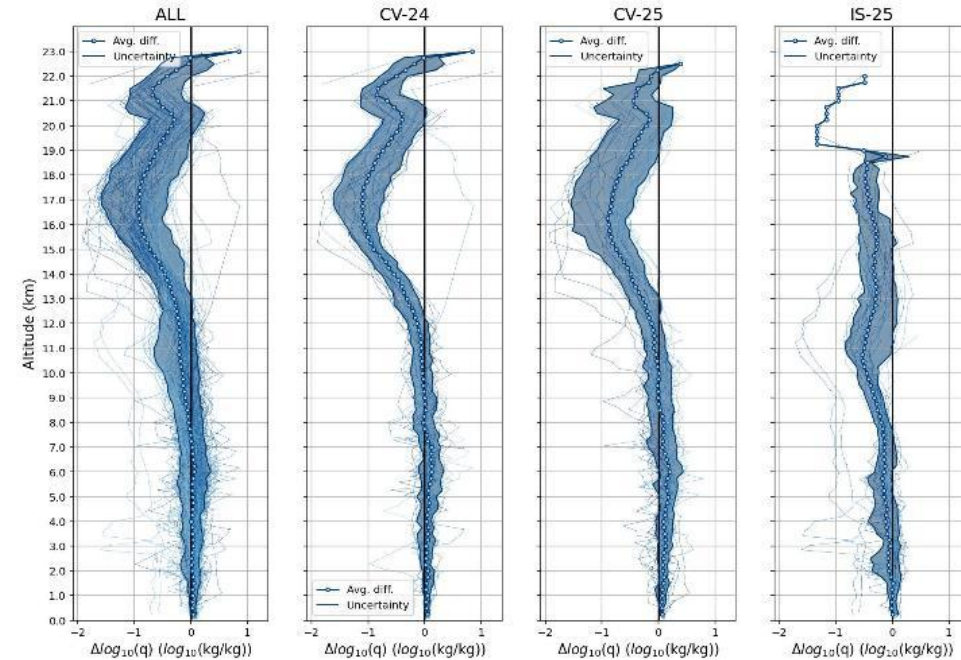
Initial dropsonde data evaluation



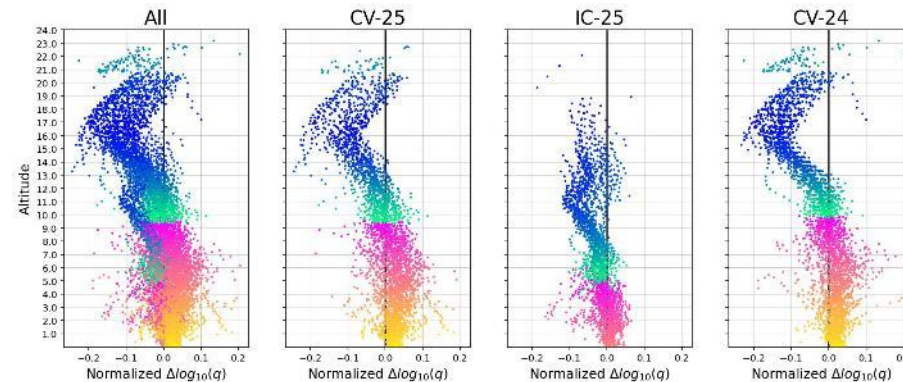
Vertical profiles of $\log_{10}(q)$ with average and uncertainty:

Green – ERA 5 data
Red – Dropsonde data

- Humidity (specific humidity shown here) data was less accurate
 - lower than expected humidity values when temperatures are below -25°C .
- The sensor's response time is too big!!!



Vertical profile of normalized difference of $\log_{10}(q)$ with average and uncertainty



Vertical profile of normalized difference of $\log_{10}(q)$ coloured according to air temperature measured

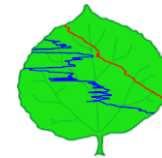


Currently: data quality control

- Right now, we are working towards establishing a quality control procedure to ensure the best value and to assure the correct parameters/variables are implemented in the ESA methodology:

1. ASPEN (NCAR EOL; Martin and Suhr, 2026)

NCAR | EARTH OBSERVING
LABORATORY



2. Time lag compensation algorithm being developed by the NPL

NPL 
National Physical Laboratory



Questions?

References

1. Ancell, B., and G. J. Hakim, 2007: Comparing Adjoint- and Ensemble-Sensitivity Analysis with Applications to Observation Targeting. *Mon. Wea. Rev.*, 135, 4117–4134, <https://doi.org/10.1175/2007MWR1904.1>.
2. Hakim, G.J. and Torn, R.D. 2008: Ensemble Synoptic Analysis. *Meteorological Monographs*, 33, 147–162, <https://doi.org/10.1175/0065-9401-33.55.147>
3. Martin, C. and Suhr, I. (2026). NCAR/EOL Atmospheric Sounding Processing ENvironment (ASPEN) software version 4.0.6. <https://doi.org/10.26023/3MXP-4C54>, 2026.
4. Torn, R. D., and G. J. Hakim, 2008: Ensemble-Based Sensitivity Analysis. *Mon. Wea. Rev.*, 136, 663–677, <https://doi.org/10.1175/2007MWR2132.1>.