French contribution to NAWDIC: SAFIRE ATR42 aircraft & ground-based deployment

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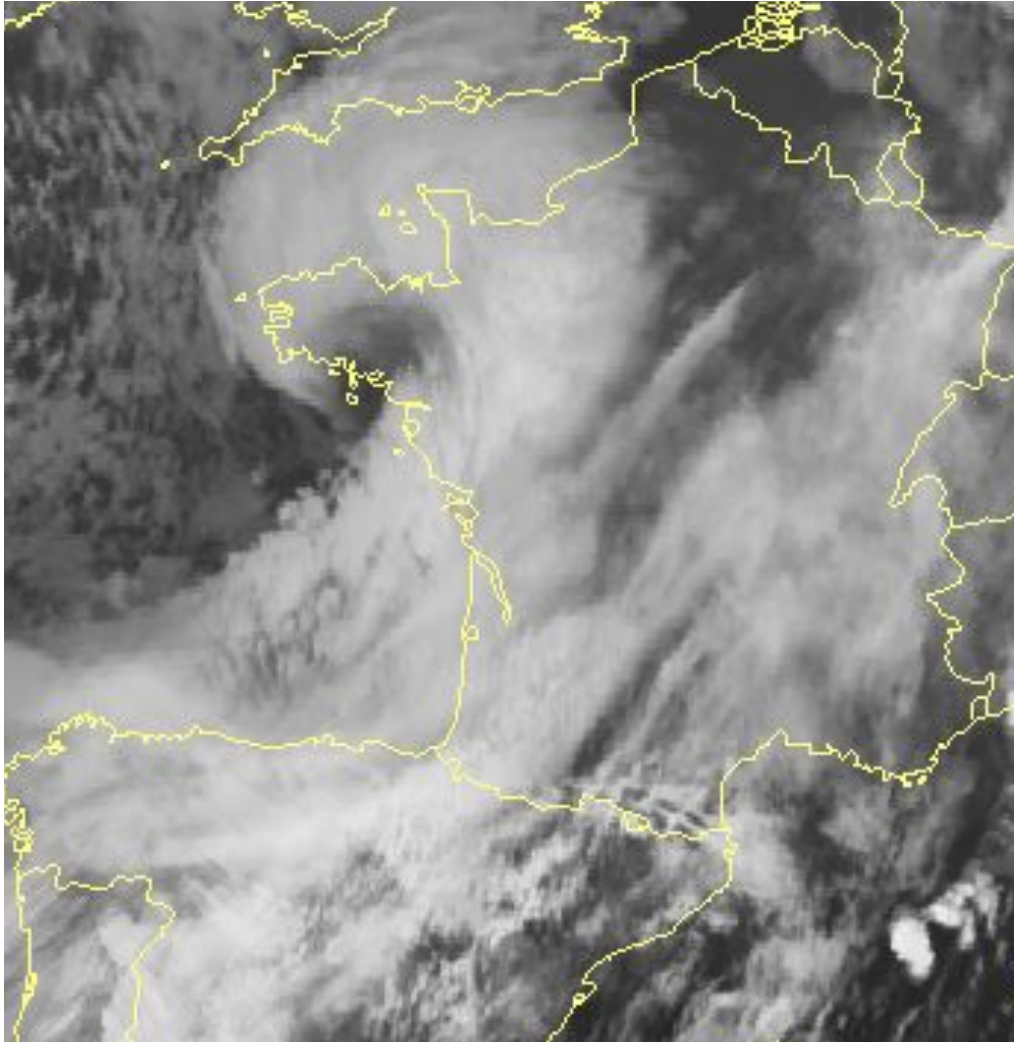
[1] LMD, ENS, Paris, France
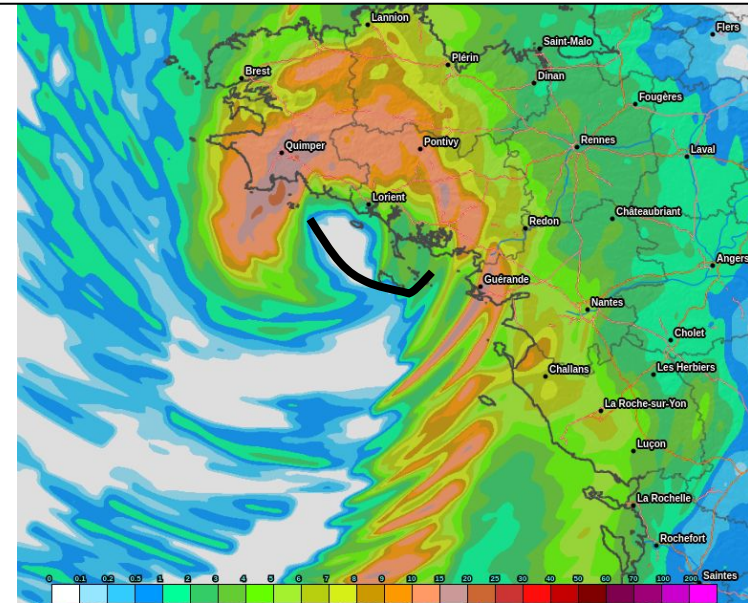[2] LATMOS, UVSQ, Guyancourt, France
[3] LAERO, Toulouse, France
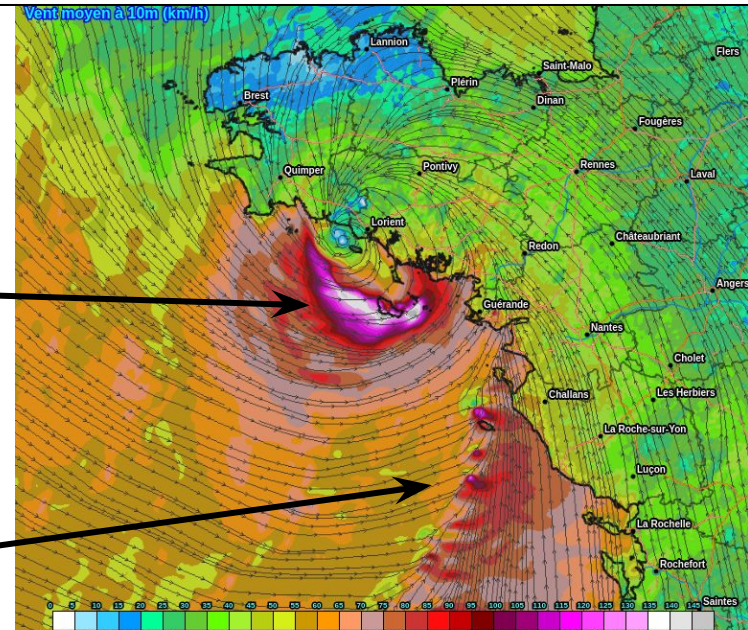[4] CNRM, Météo-France, Toulouse, France

Motivation

IR satellite image Storm Alex (1-3 Oct 2020)

4-hr AROME forecast precip (mm/hr)

4-hr AROME forecast: 10-m wind speed (m/s)

Strong winds due to a Sting-jet?

Strong winds due to cold front

Scientific objectives

- <u>Topic:</u> Formation of near-surface strong winds in winter storms (ahead of the bent-back warm front, vicinity of cold fronts)
- <u>Low-tropospheric and boundary layer processes</u>
  - ☐ formation of low-level jets / downward transport of momentum

turbulence   Convective rolls   Evaporative cooling

- <u>Types of observations needed:</u>
  - ☐ dynamics (3D components of the winds)
  - ☐ thermodynamics (temperature, humidity)
  - ☐ cloud microphysics and hydrometeors
  - ☐ turbulent fluxes
  - ☐ surface properties (SST, roughness)

Strong link with NAWDIC goals:
- DI-PBL interactions
- Precursors of HIW events

Airborne platform: ATR42

ATR42 operated by SAFIRE (http://www.safire.fr/).
Speed 100 m/s (min 70m/s max 134 m/s)
Typical endurance during a field campaign: 3h30, max 6 h
Typical maximal range: 1 500 km, max 3 000 km
Ceiling 5 000 m, maximal 7 500 m
Scientific payload: 2500 kg

What observation region can be accessed ? Mainly low to mid troposphere
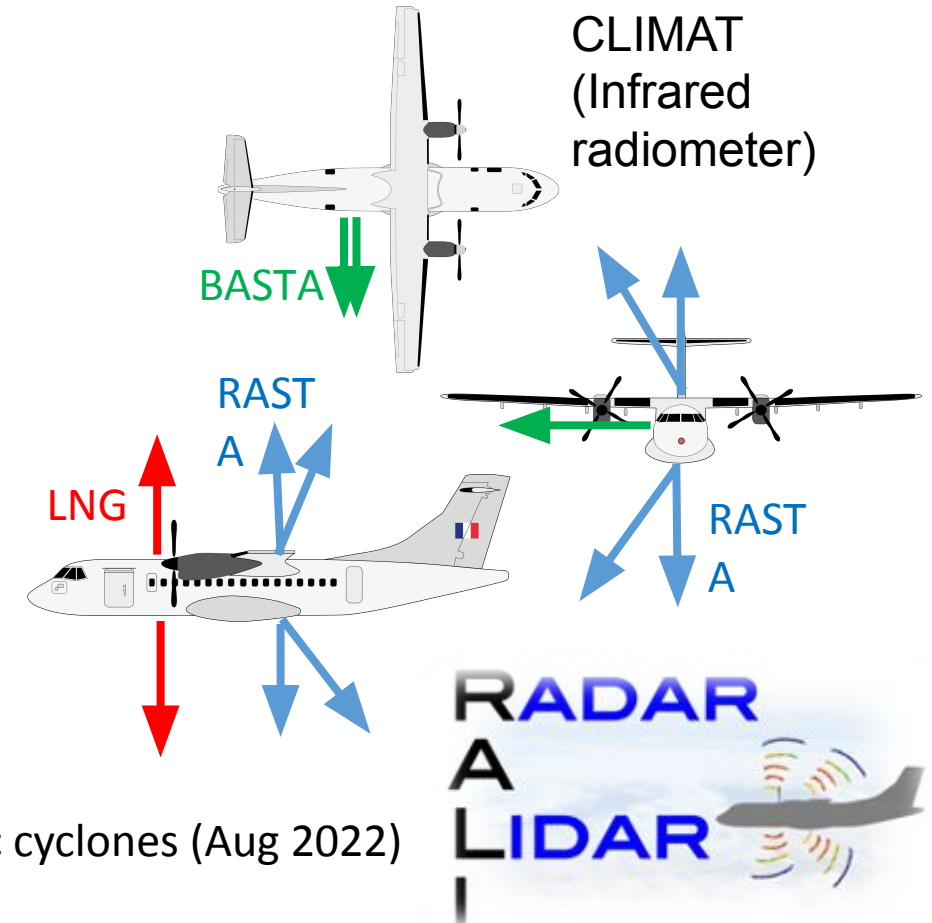
ATR42 possible payload

In-situ

To be discussed with LaMP scientists

| Name	Outputs
Cloud Droplet Probe (CDP-2)	DSD, 3 - 50 µm, res. 2/4 µm - LWC
2D-Stereo (2D-S)	PSD, 10 µm -1.28 mm - B&W images, res. 10 µm
Cloud Imaging Probe (CIP)	PSD, 10 µm -1.28 mm, B&W images, res. 25 µm
Precipitation Imaging Probe (PIP)	PSD, 100 µm – 6.4 mm, B&W images, res. 100 µm
High Volume Precipitation Spectrometer (HVPS)	PSD, 150 µm – 1.92 cm, B&W images, res. 150 µm,
High Speed Imager (HIS)	Grey-scale images, res. 5 µm, 2048 x 896 pix, Detailed morphological properties
Counterflow Virtual Impactor (CVI-Snow),	IWC
ROBUST WC-3000 probe	TWC (= IWC + LWC)

Remote-sensing

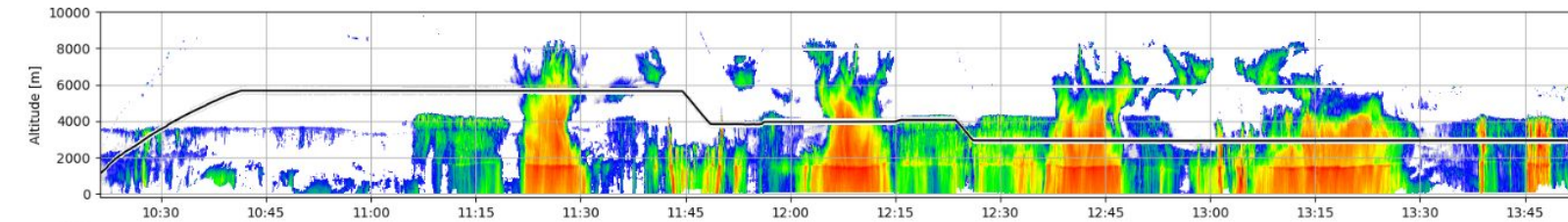
CLIMAT (Infrared radiometer)

BASTA
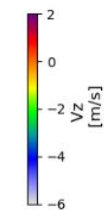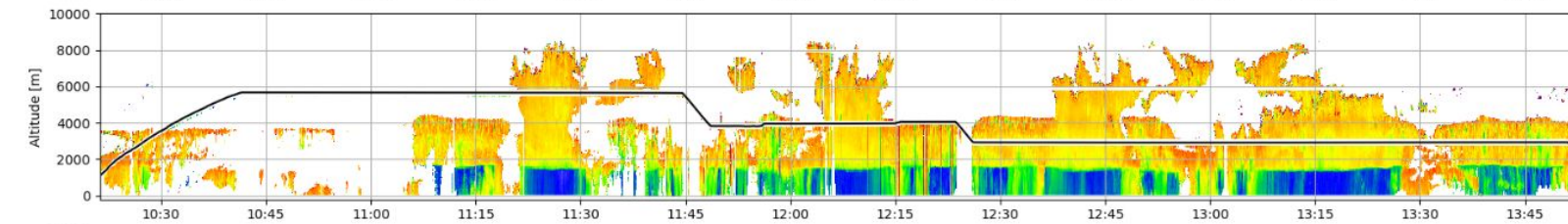
RAST A

LNG

RAST A

RADAR RALI LIDAR

Previous campaign with similar payload: RALI-THINICE focused on Arctic cyclones (Aug 2022)

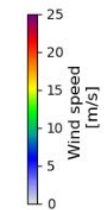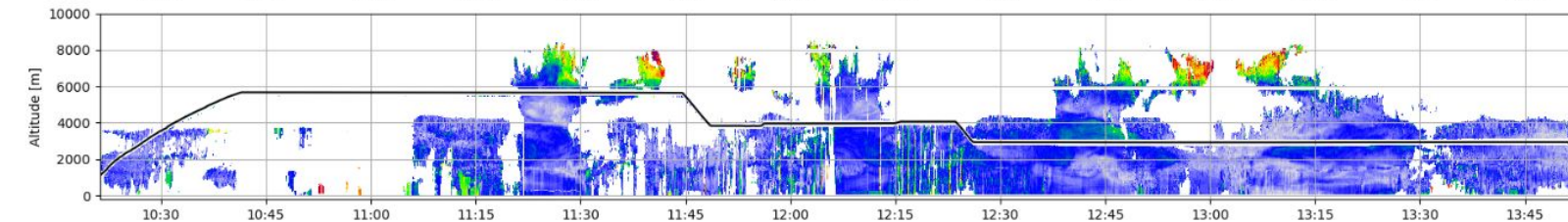# Illustration of RALI products from one flight during RALI-THINICE
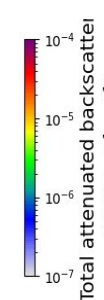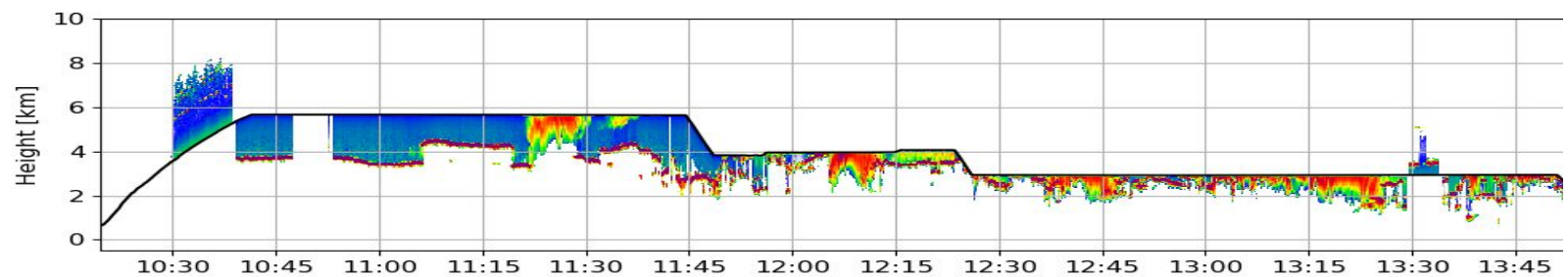

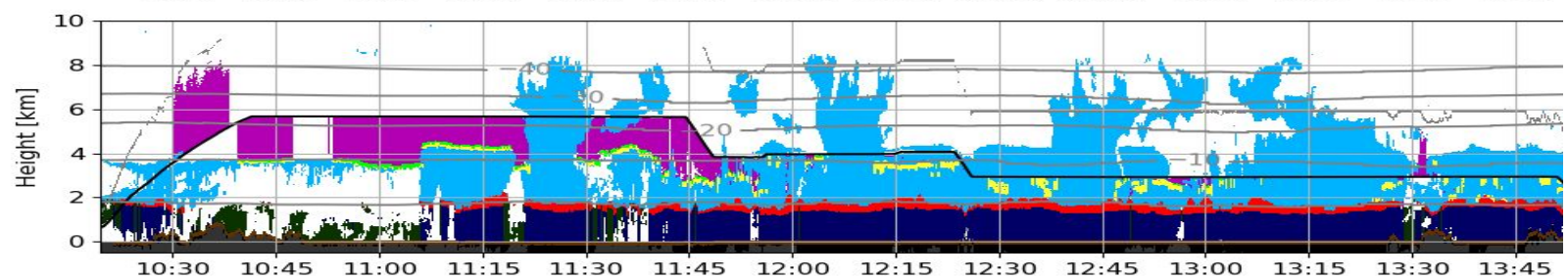THINICE 20220806 F40
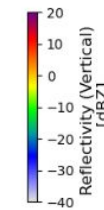
Vertical reflectivity from RASTA

Vertical velocity from RASTA (3 antennas)

Horizontal wind intensity from RASTA (3 antennas)
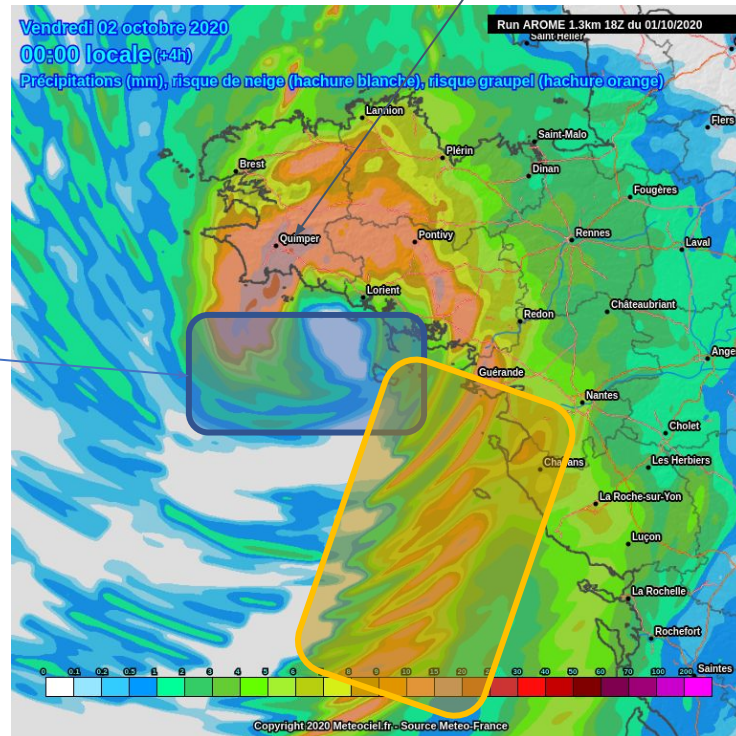
Particulate backscatter @532nm
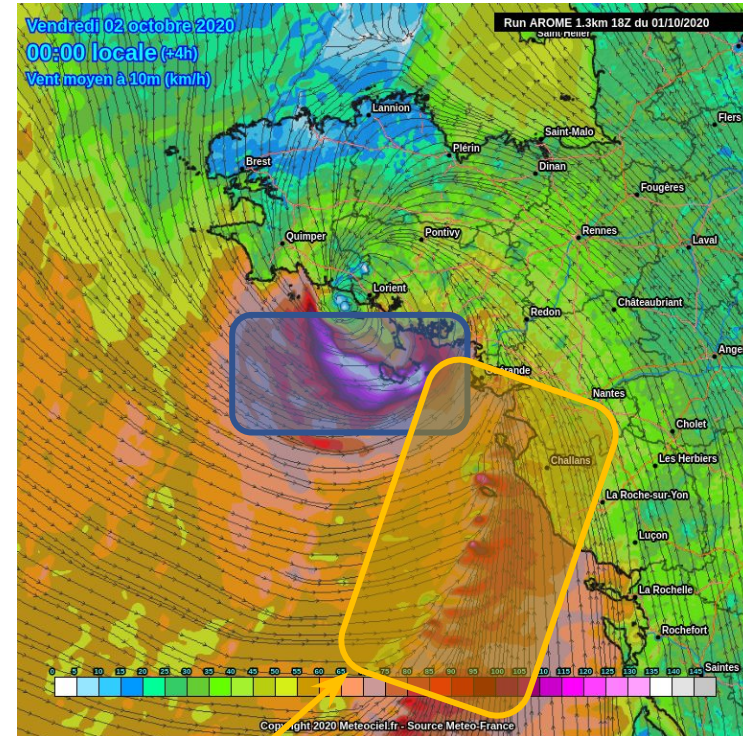
Cloud properties categorization

Potential regions of operation / flight strategy

Off the coast of France (but depends on the operation of international partners)
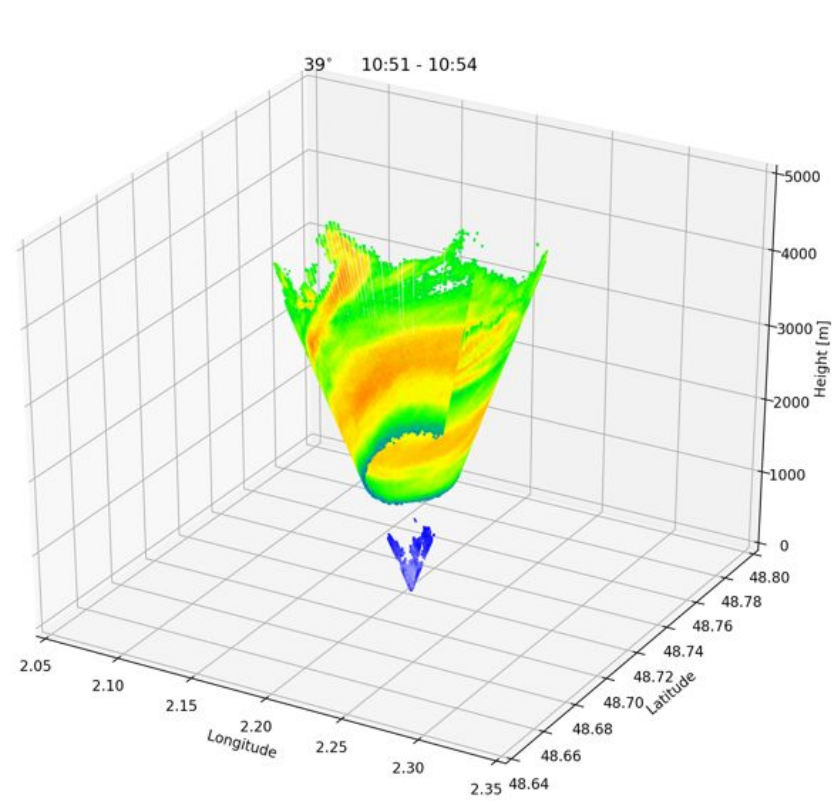
Potential airport in Brittany (e.g., Quimper)

-Along and cross jet sections
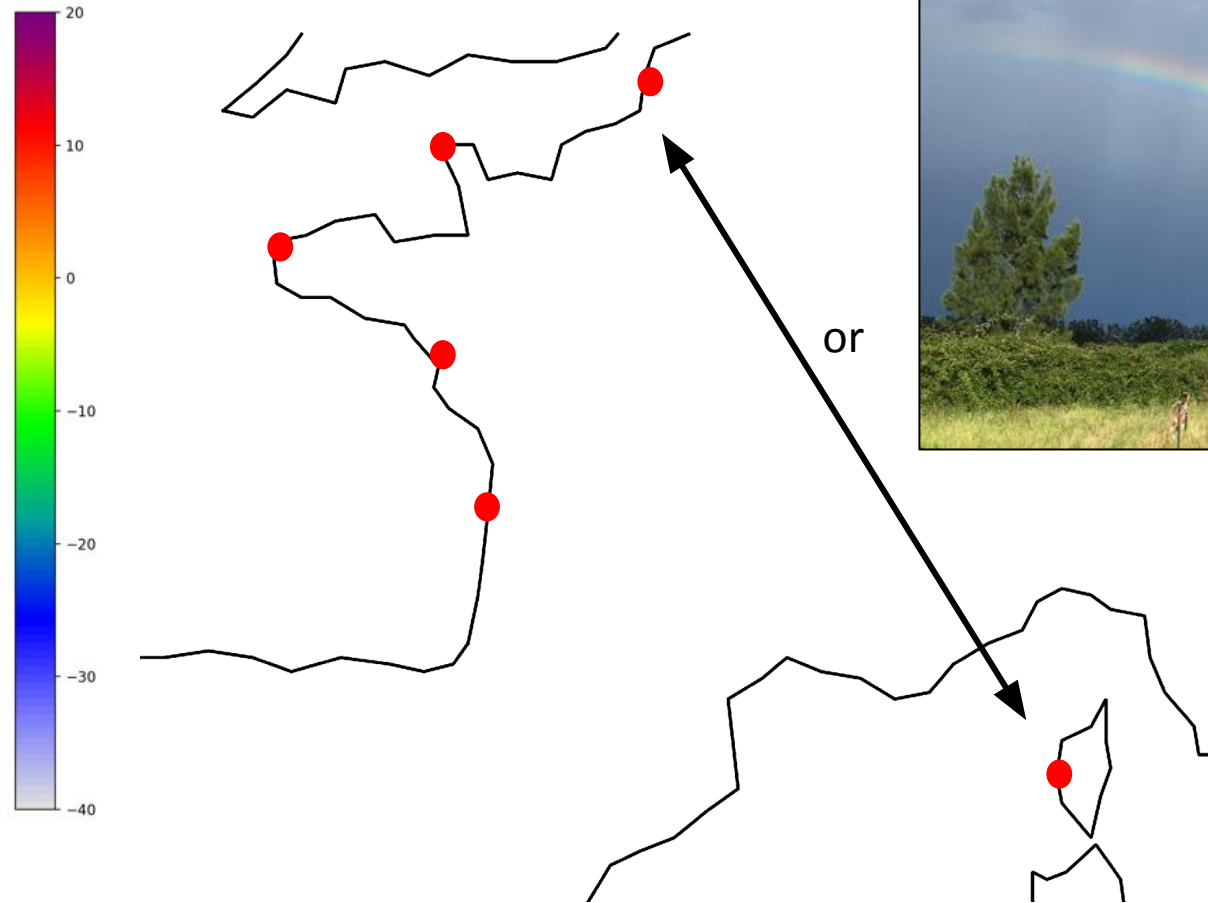- at the frontiers of precip areas

Along the cold front and perpendicular to bands of wind maxima

Possible deployment of ground-based Doppler cloud radars

- We could deploy up to 5 cloud radars BASTA (one with scanning mode)
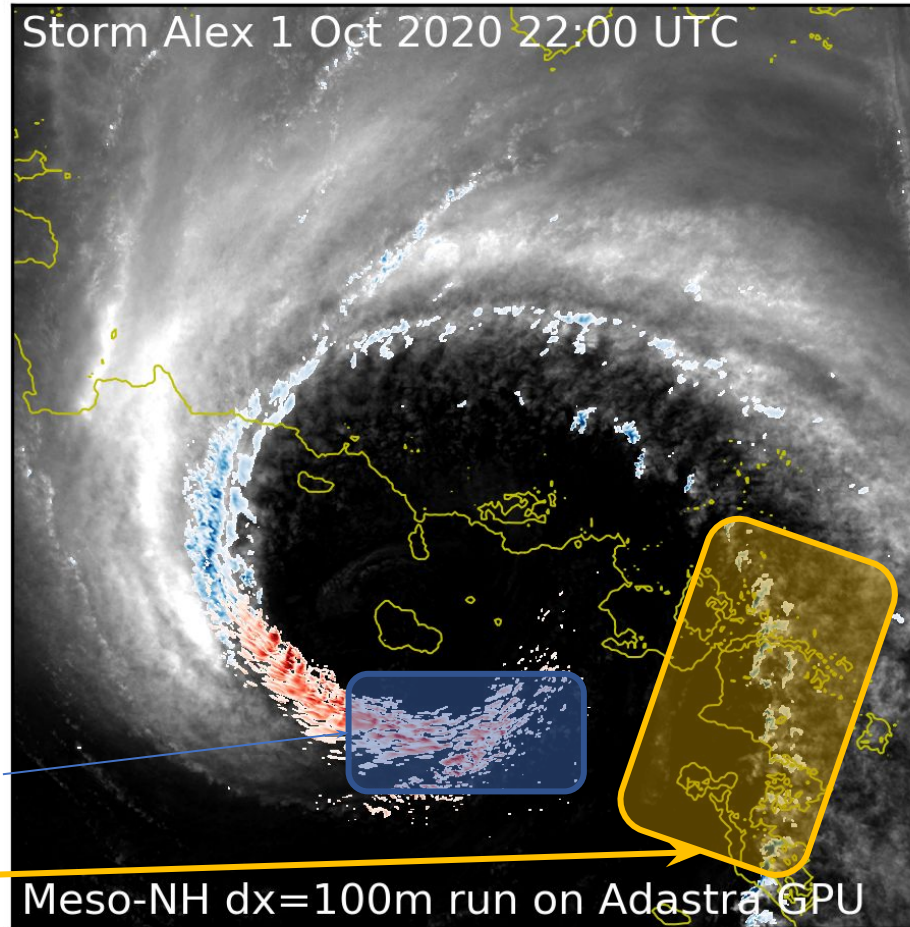

Reflectivity + Wind speed

or

Preparation of the measurement strategy

Ongoing modelling studies based on high-resolution simulations (postdoc starting in September 2023)

Strong winds due to Sting-jet?

Strong winds due to cold front!

Planned work / funding / timeline

- **Availability of observational plaforms**:
  - → ATR42 aircraft available in Feb 2026 (annual maintenance in Jan)
  - → BASTA ground-based radars: at least 2 available, but up to 5
- **Potentially interested French scientists** :
  - ⬜ Atmosphere dynamicists (LMD in Paris, LAERO in Toulouse)
  - ⬜ Air-sea interactions (LOPS at Brest)
  - ⬜ Cloud microphysics (LaMP at Clermont-Ferrand, LATMOS in Paris)
  - ⬜ Weather forecasts (CNRM, Météo-France, Toulouse)
- **Funding opportunities:**
  - → ANR-DFG project (International collaborative project) ?
  - → ERC ?