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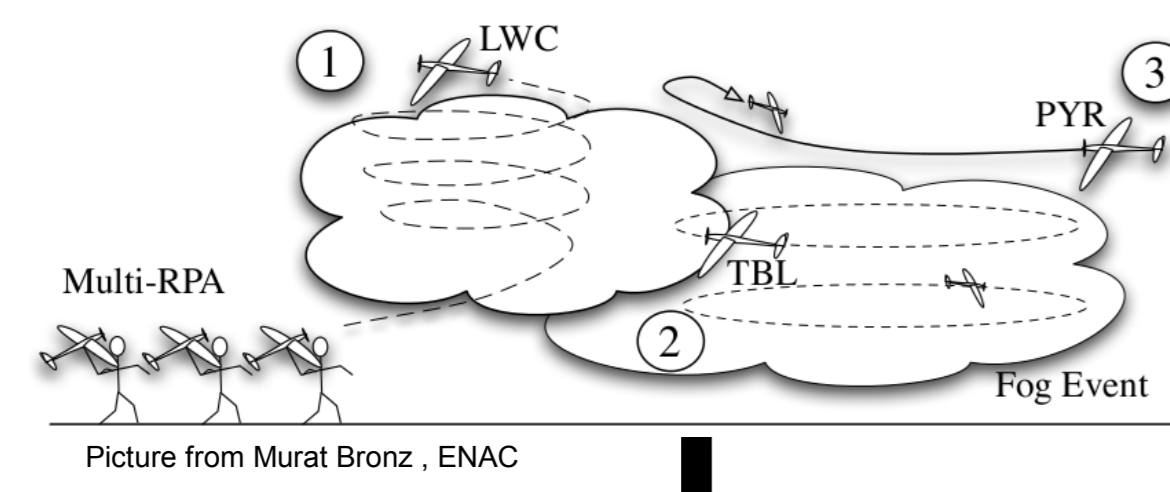
Active teaching and learning of the use of RPA in meteorology

Grégoire Cayez (1,2), Gautier Hattenberger(3), Michel Gorraz(3), Alexandre Bustico(3) and Greg Roberts (2,4)

(1) METEO FRANCE, ENM, Toulouse, France, (2) METEO FRANCE, CNRM, Toulouse, France, (3) École Nationale de l'Aviation Civile, Toulouse, France, (4) Scripps Institution of Oceanography, La Jolla, California, USA.

2012-2015

VOLTIGE project : Probing the atmosphere with multi-RPA

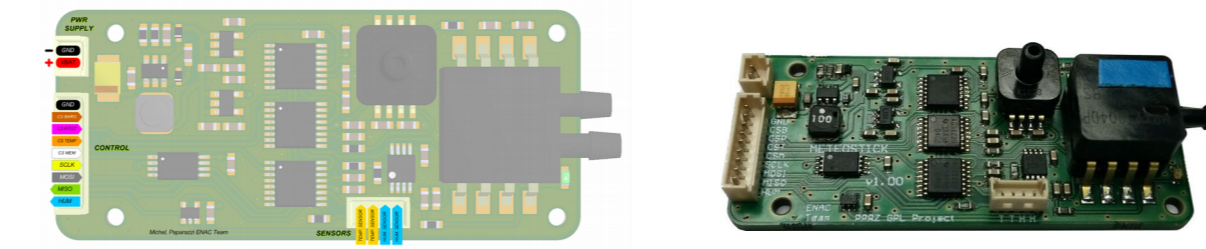


The French National School of Meteorology (INP-ENM) develops **active teaching and learning** of the use of **RPA in meteorology**.

Students internship projects

- > **instrumentation,**
- > **website development,**
- > **data analysis,**
- > **participation in field campaigns**

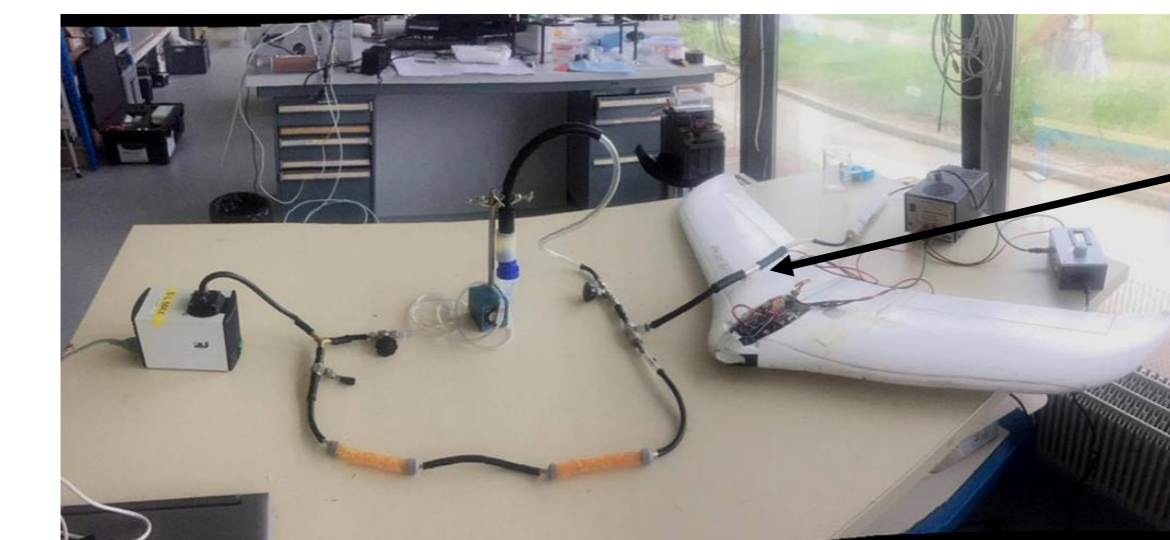
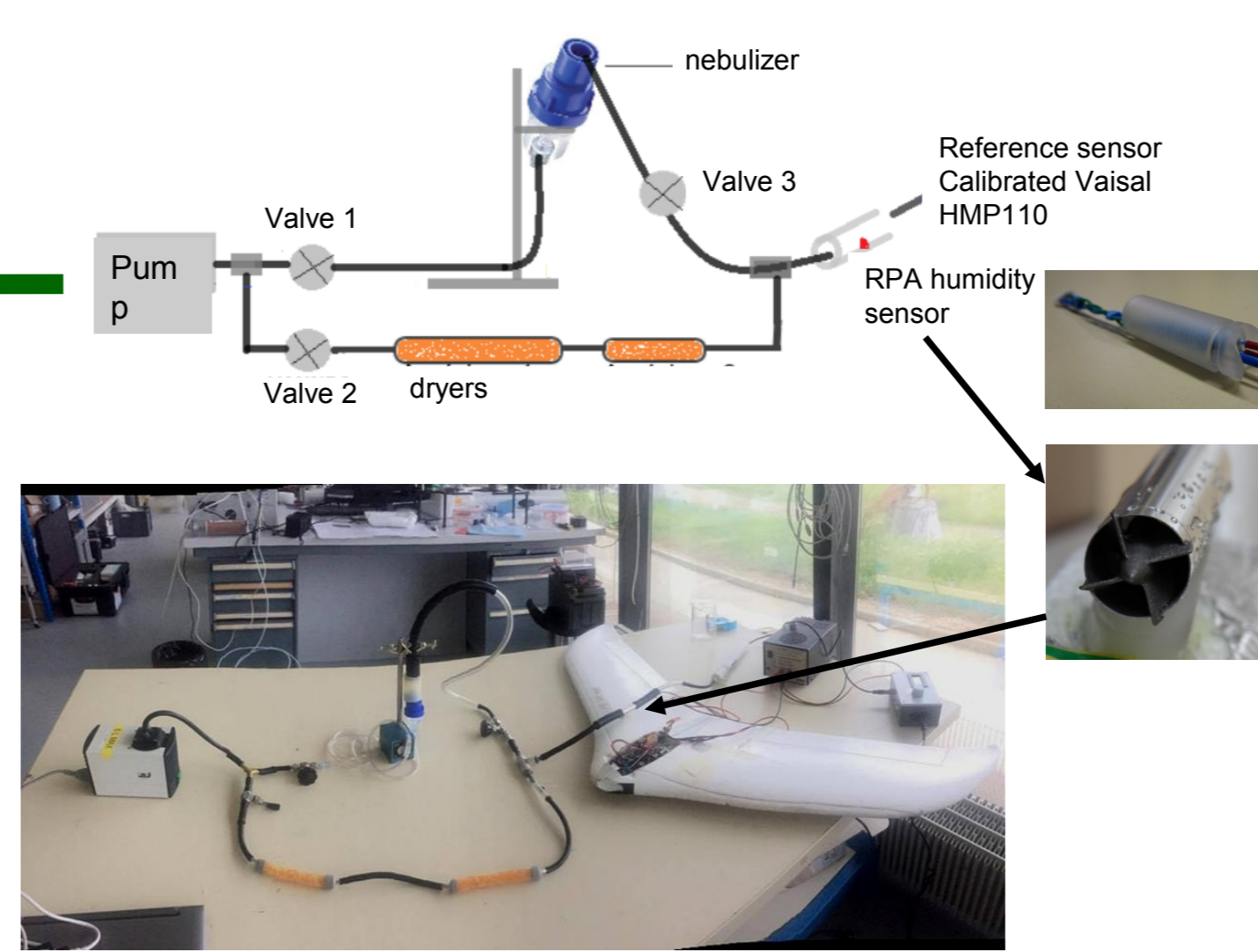
Calibration coefficients stored in Meteostick Precision measurement board (ENAC Paparazzi) T, R.H., absolute and differential P



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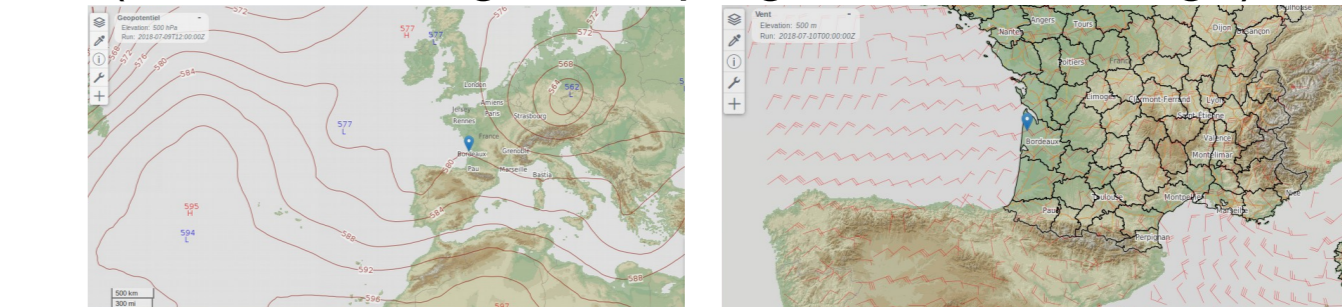
Humidity calibration system for lab and field



Website development



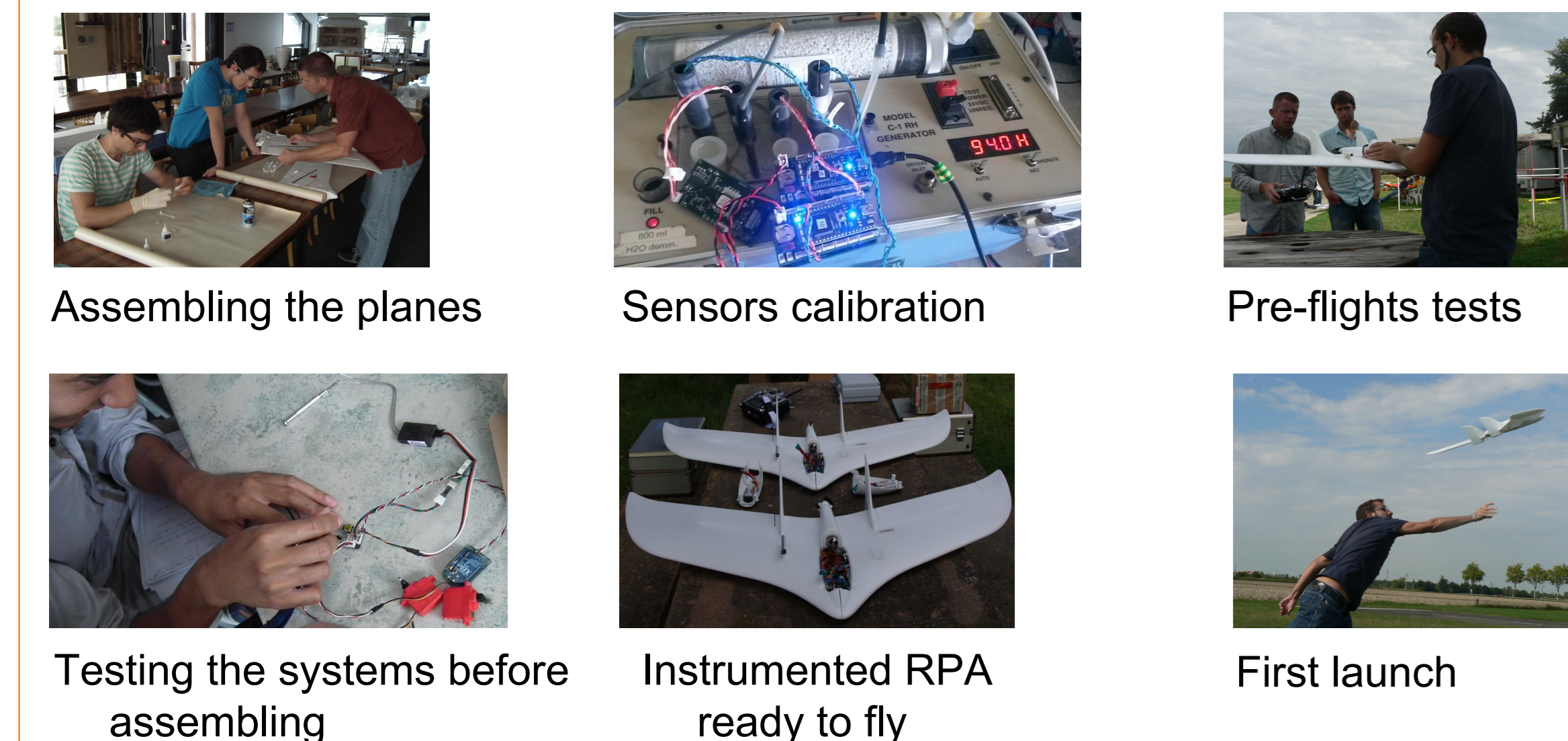
Meteorological conditions for RPA flights: students use their knowledge in meteorology (ISARRA16 flight campaign meteo briefings)



2012 brainstorming of research topics particularly suited for RPA in atmospheric measurements,
2013 VOLTIGE field campaign data analysis
2014-2015-2016 => construction of 6 instrumented RPAS

2017 => pedagogical field campaign and data exploitation

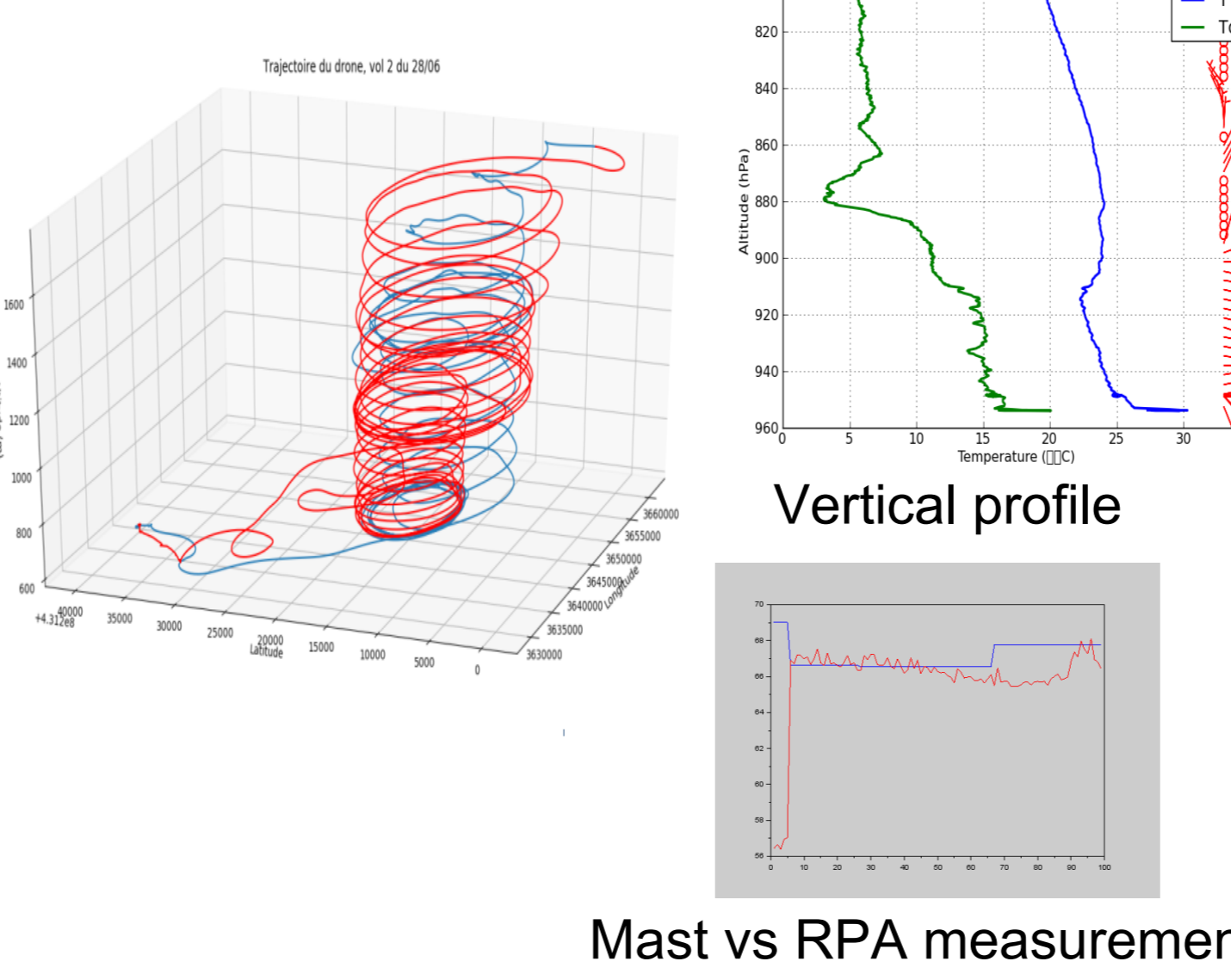
Engineering class preparing the RPA, the ground station and the sensors



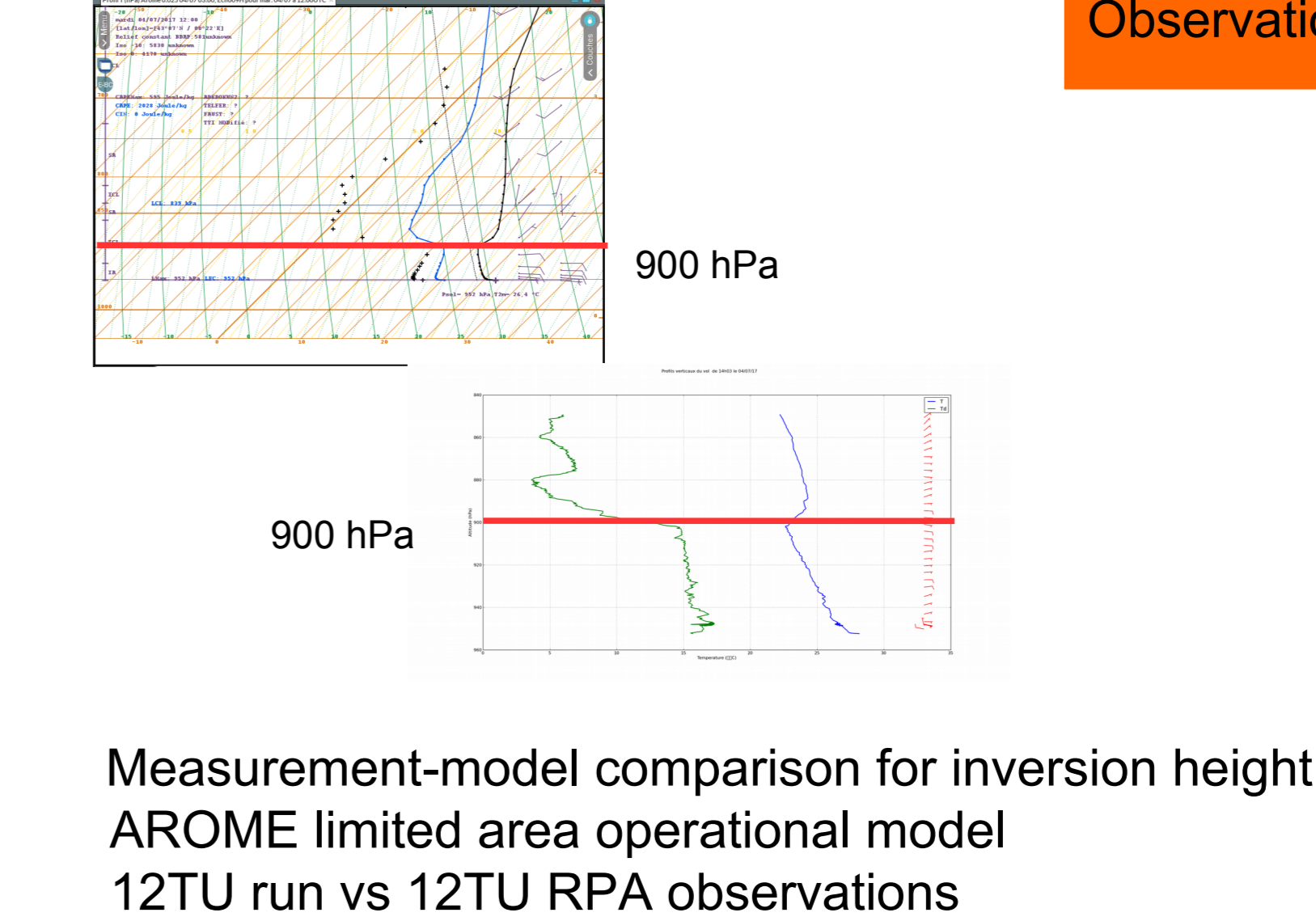
In the field (P20A Lannemezan) to make the measurements



Data analysis



Autumn 2018
 > pedagogical field campaign and
 > comparison to LES 1D
 Observation and model activities



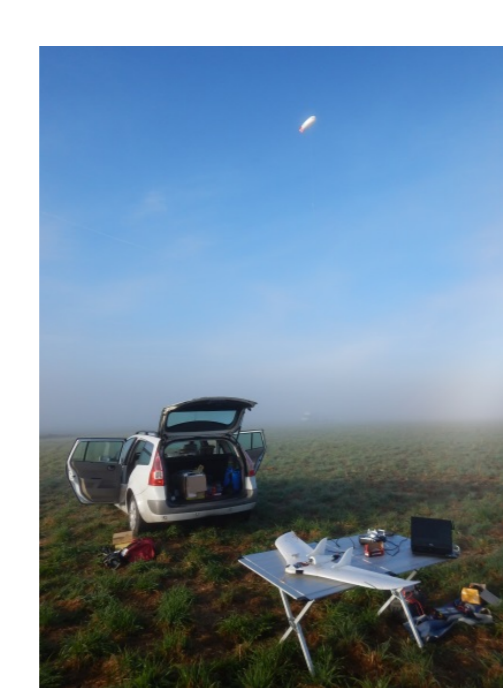
Since 2015
Using the systems assembled and tested with students for field campaigns

2015 BACC+ : STABLE BOUNDARY LAYER

- > Long term measurements in Landes for boundary layer and fog studies => step toward operational activities
- > Boundary layer evolution
- > Around 100 flights by the end of 2017
- > Single operator + car

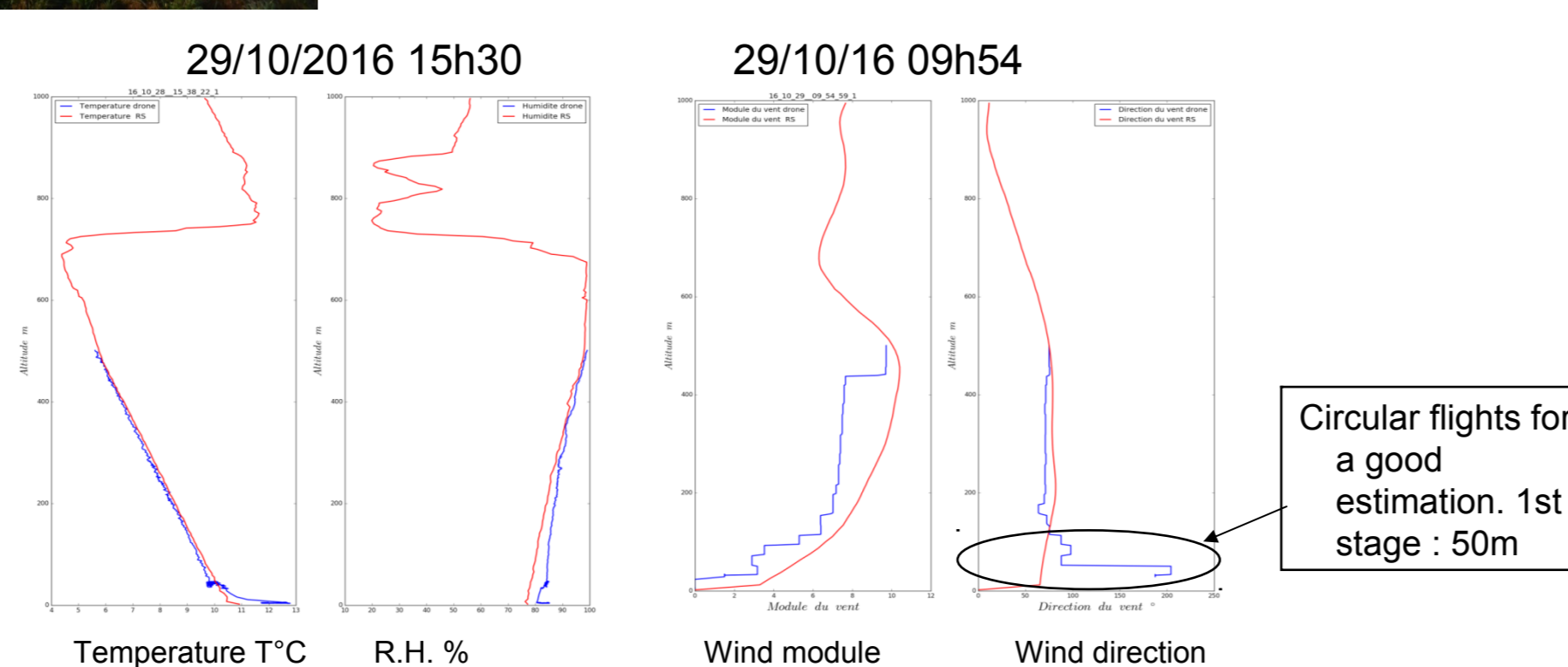


Acknowledgements: S. Defloy



2016 BURE : FOG CAMPAIGN

- > Single operator + car
- > 2 to 3 soundings per hour
- > T and RH measurement, wind estimation during spirals ascents
- > Radio sounding comparison within 0.5°C and 6% RH

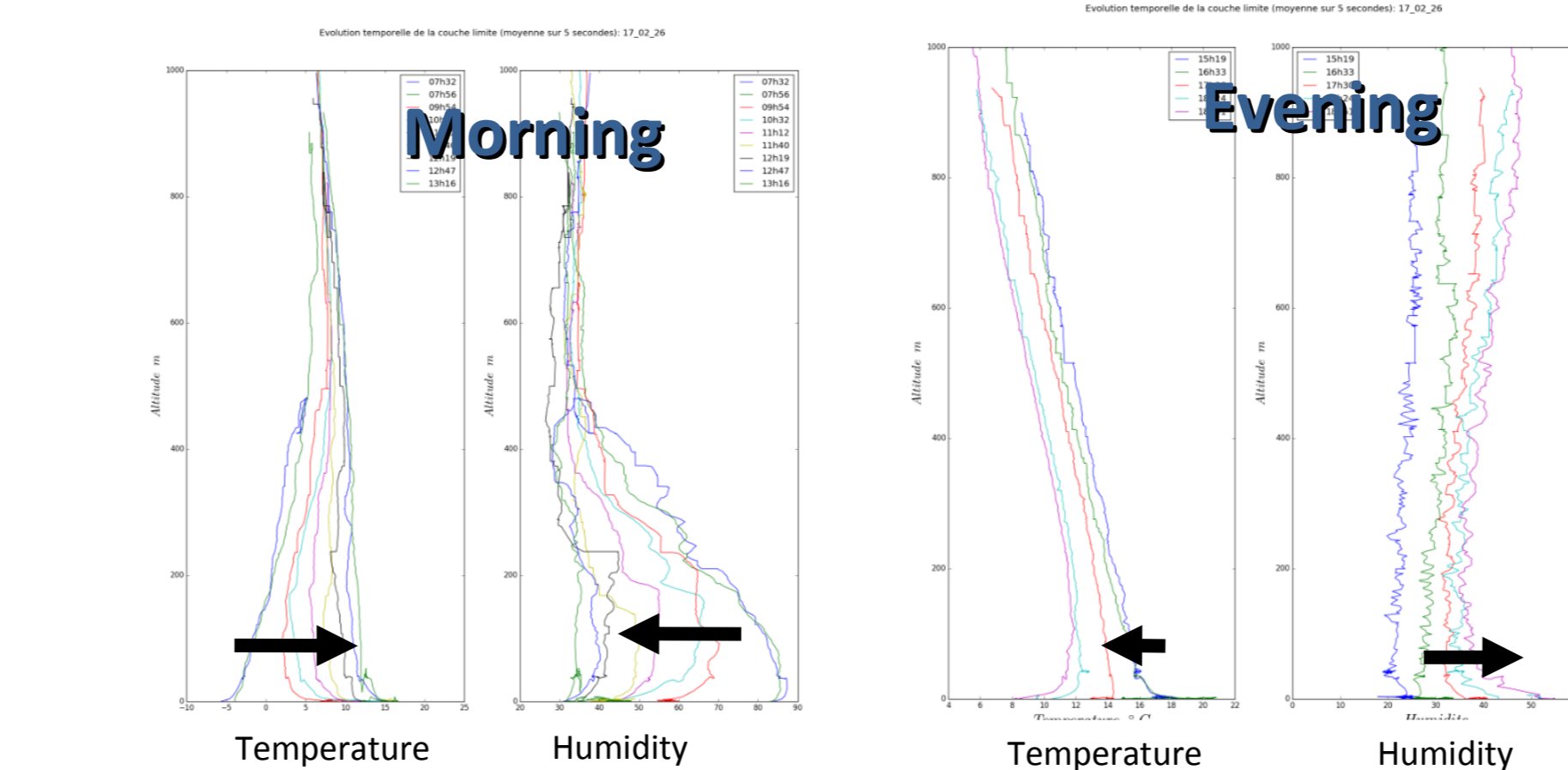


Circular flights for a good estimation, 1st stage : 50m



2017 Cerdanya : STABLE BOUNDARY LAYER

- > Flights up to 1000 m AGL (every 20 min)
- > Boundary layer evolution



Engagement of students

Benefits for the research lab :

- > add educational component
- > outreach via university newsletters
- > link research and operational meteorology
- > unlock creativity, add interesting new vision and motivation to the projects.

Benefits for the university :

- > develops active learning experience
- > creates motivation and encourage team building