The BOU tethered balloon:
a low-cost profiling system for monitoring the lower ABL over complex terrain.

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Introduction

- What is the BOU?

- Intercomparison with a surface station

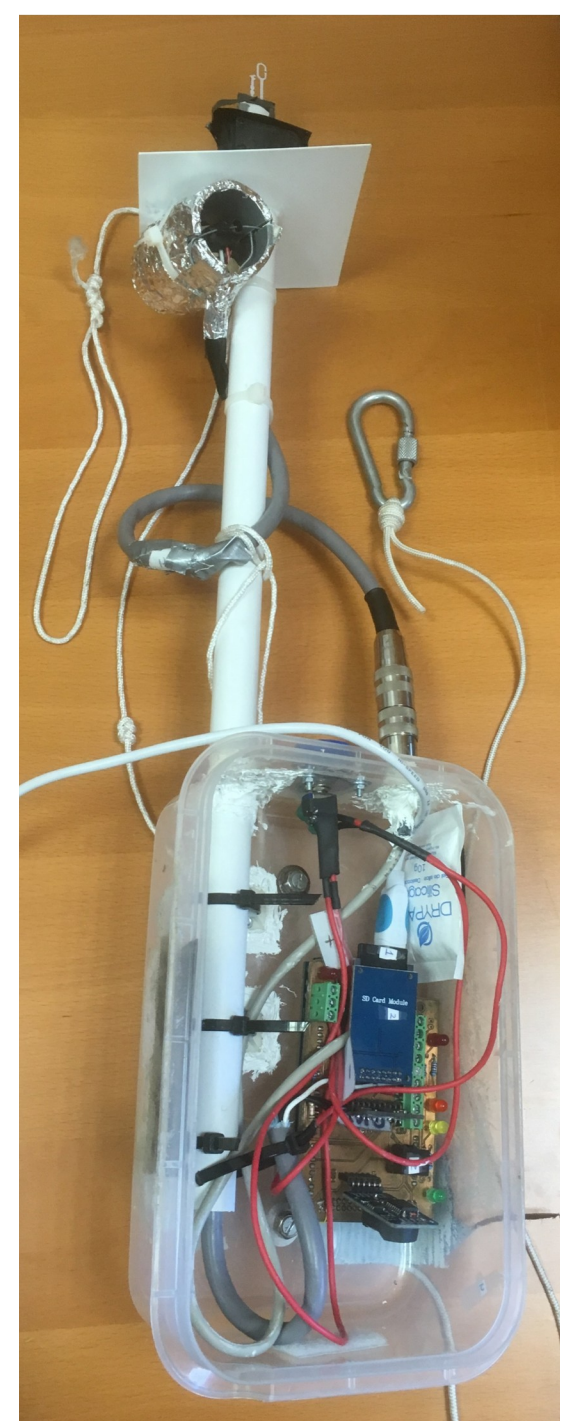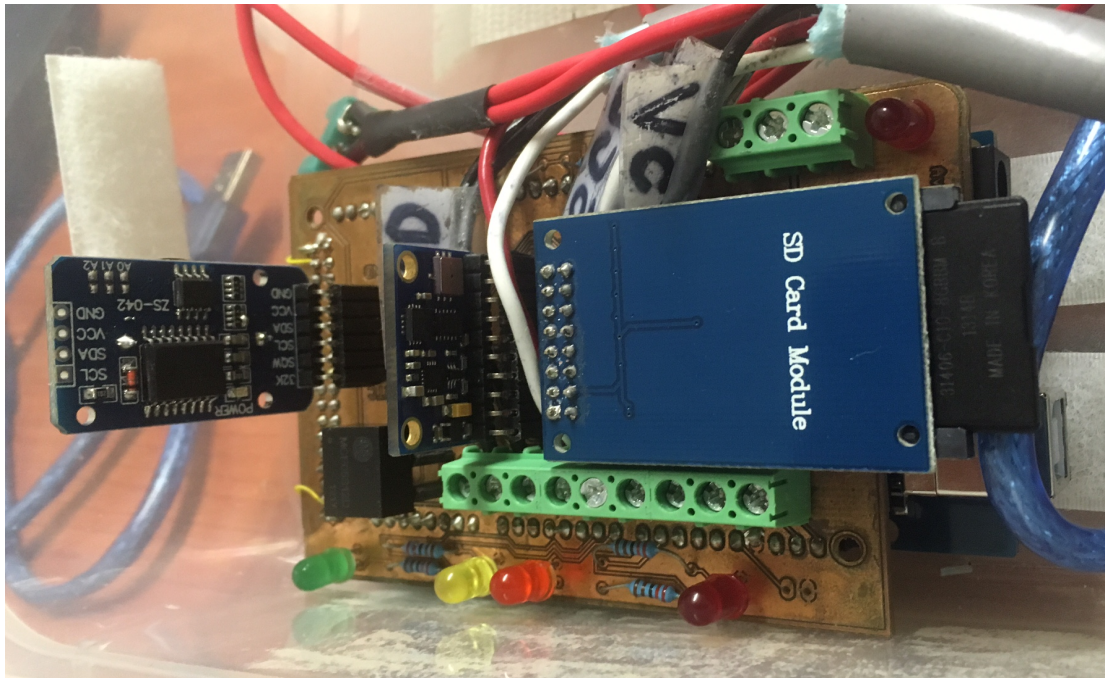- CCP17 measurements validation

- Conclusions

What is the BOU?

-Arduino controlled acquisition system

-Custom made connection shield

Sensors:

T and RH (hyt)
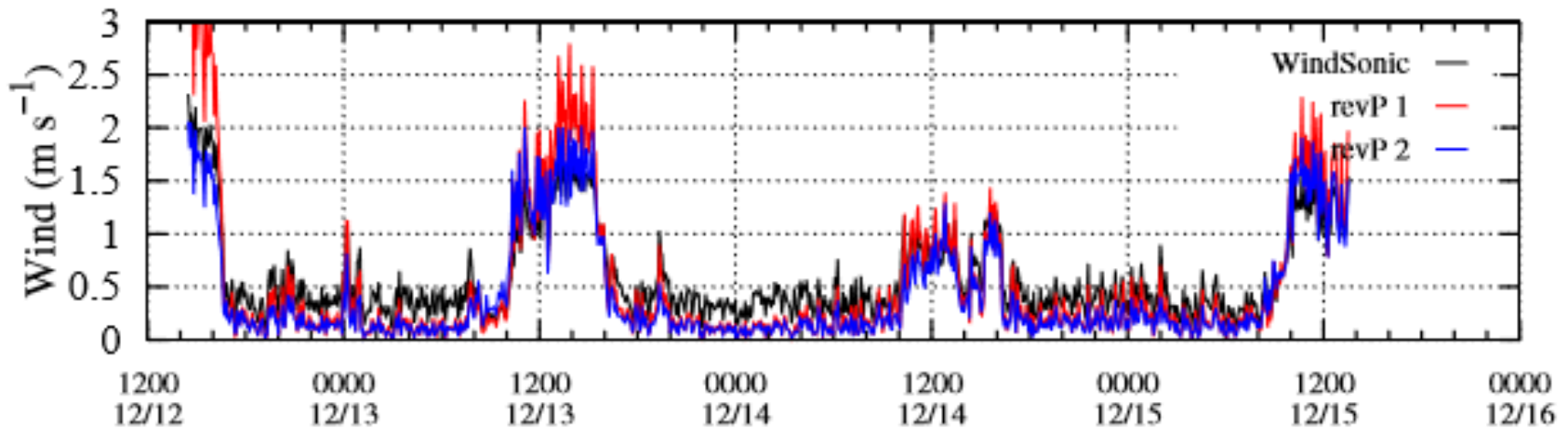
wind and T (rev.P)   P, T and IMU (Gy-80)
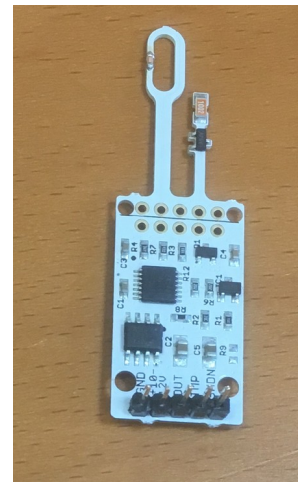
Intercomparison with a surface station

-Surface balance micrometeorological station(ECUIB) is situated at the UIB Campus

-The ECUIB sensors are used to compare the BOU sensors and improve its measurements
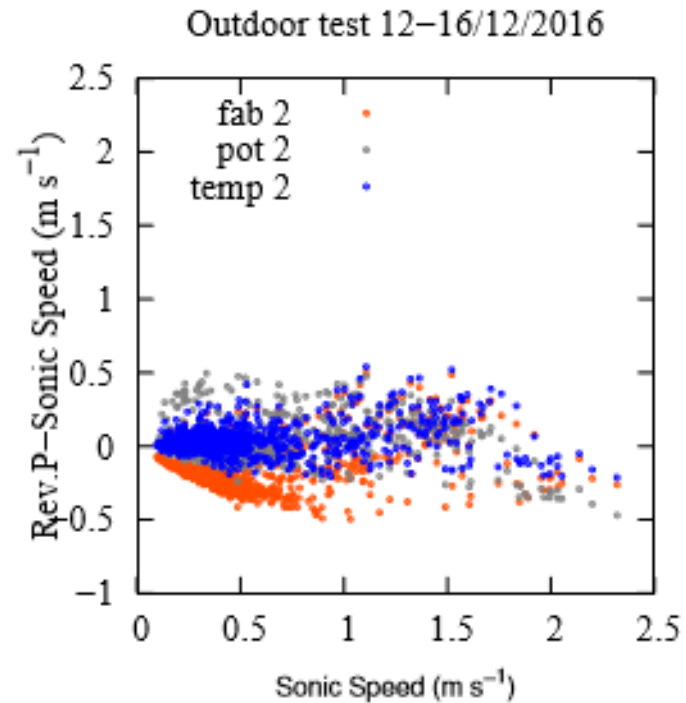
Intercomparison with surface station: wind

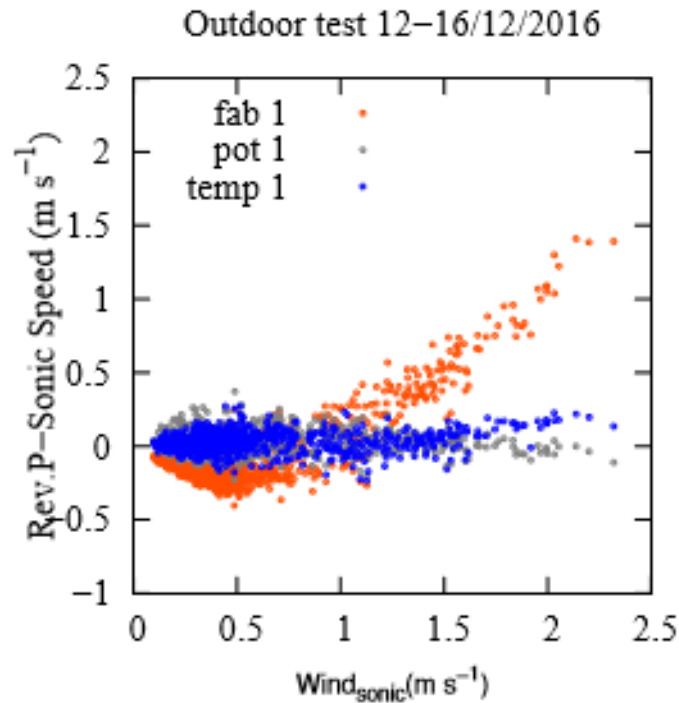- Rev.P comparison against 2D windsonic   (5min avg series)

- Winds of 0.5m/s are underestimated

- Winds greater than 1m/s are not well represented

☐The general calibration curve provided by the manufacturer can be further improved


Rev.P sensor

Intercomparison with surface station: wind

Outdoor test 12−16/12/2016

$$V = a + b * T + c * w^d$$

A new power fit using the intercomparison data reduces the differences significantly

	ME	RMSE	SDD	COR
fab 1	-0.06	0.28	0.27	0.98
pot 1	0.02	0.08	0.08	0.98
temp 1	0.03	0.07	0.07	0.99
fab 2	-0.16	0.23	0.16	0.95
pot 2	0.02	0.14	0.13	0.95
temp 2	0.04	0.11	0.10	0.97

Intercomparison with superficial station: Temperature and humidity

BOU2−ECUIB temperature comparison

BOU2−ECUIB humidity comparison
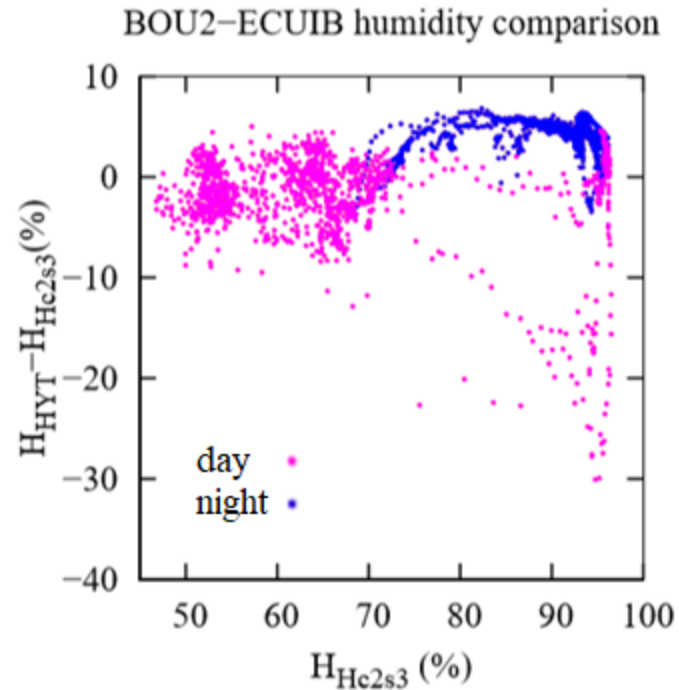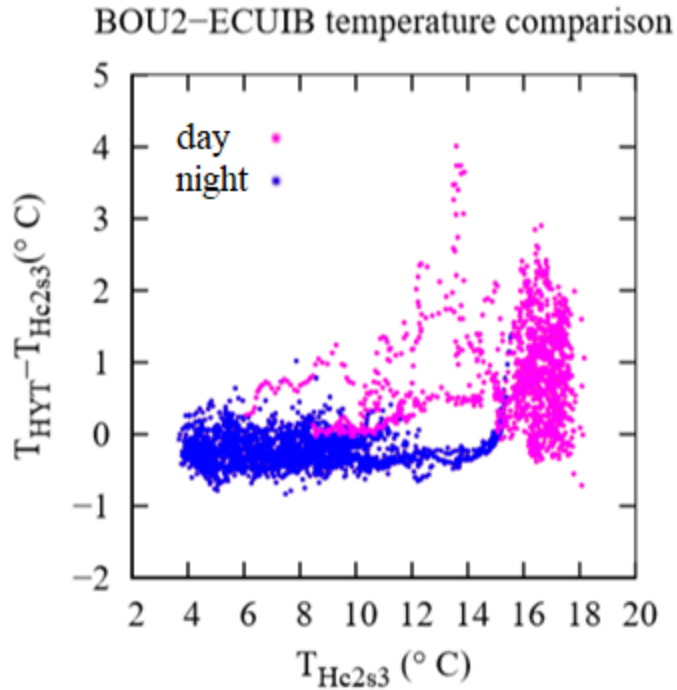
- Despite direct radiation protection, diurnal measurements are affected

HYT	SDD	RMSE	COR
T 16-8 UTC	0.2	0.3	0.99
T 8-16 UTC	0.7	1.1	0.97

HYT	SDD	RMSE	COR
RH 16-8 UTC	1.3	4.7	0.97
RH 8-16 UTC	4.7	5.0	0.96

Cerdanya Cold Pool Experiment CC

Several campaigns developed in la Cerdanya
-2011
-2015
-2017 □109

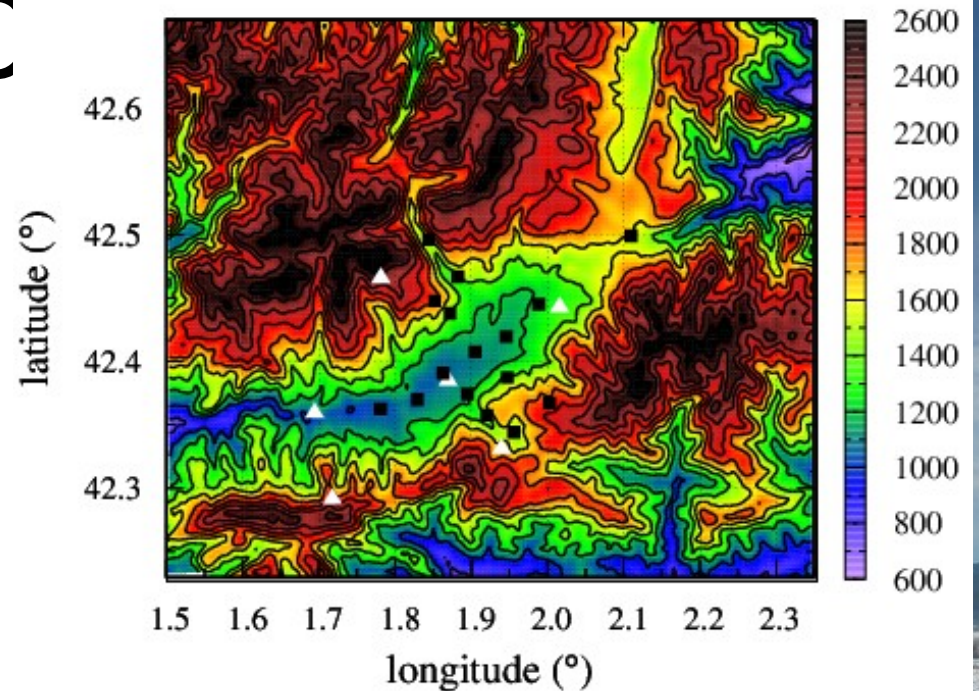Several measurements taken
-Windrass
-Balance station
-Tethered balloon soundings
-Radiosoundings
-Multicopter
-Local station (EMA)
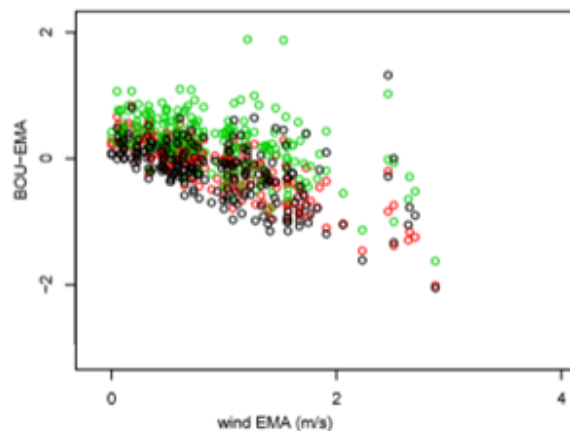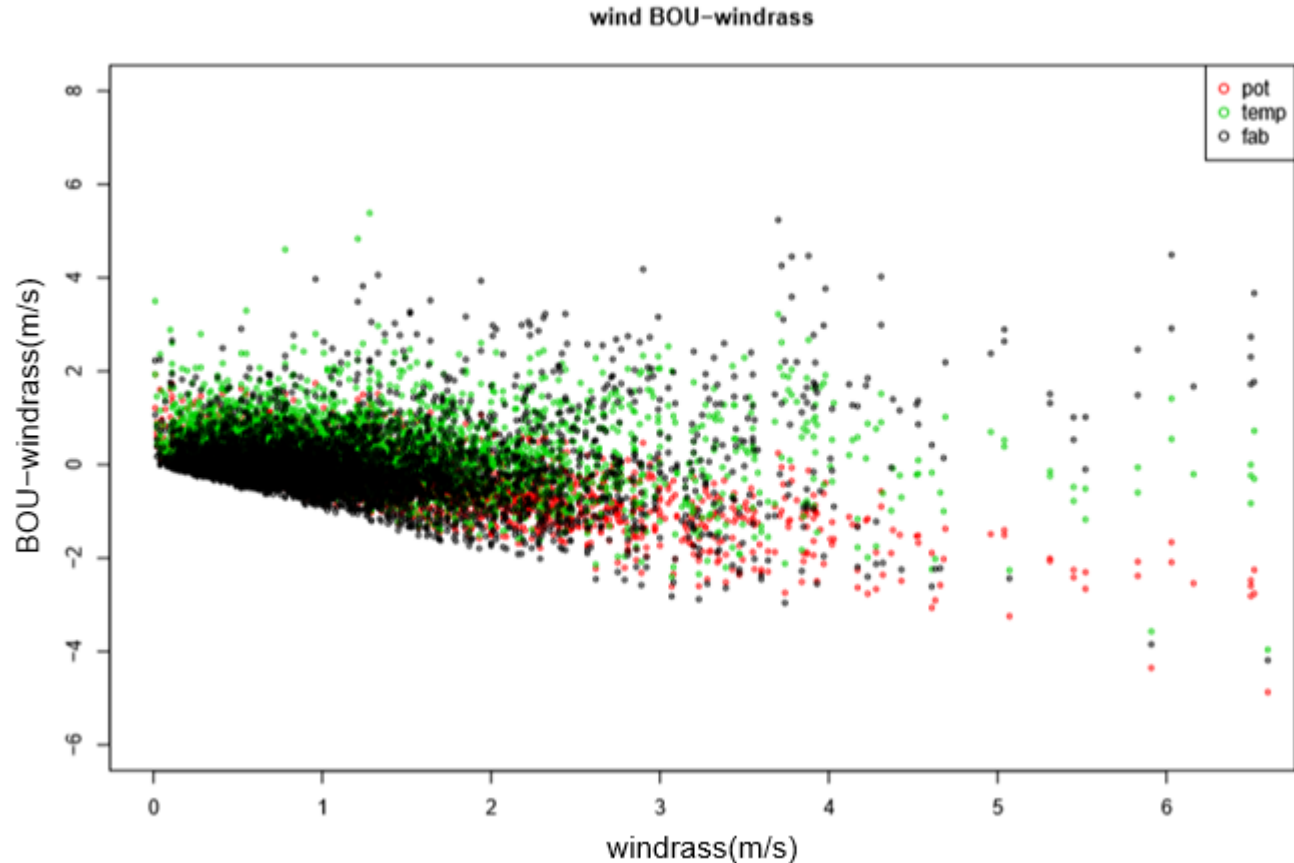-...

CCP17 measurement validation: wind

-Windrass

    15 minute average sodar measurements of wind

    10 meter resolution

-Local station (EMA)

    10m wind

	SDD	ME	MAE	RMSE	COR
pot-windrass	0.57	-0.14	0.41	0.58	0.56
temp-windrass	0.60	0.27	0.49	0.66	0.56
fab-windrass	0.73	-0.04	0.49	0.73	0.56

wind BOU−windrass
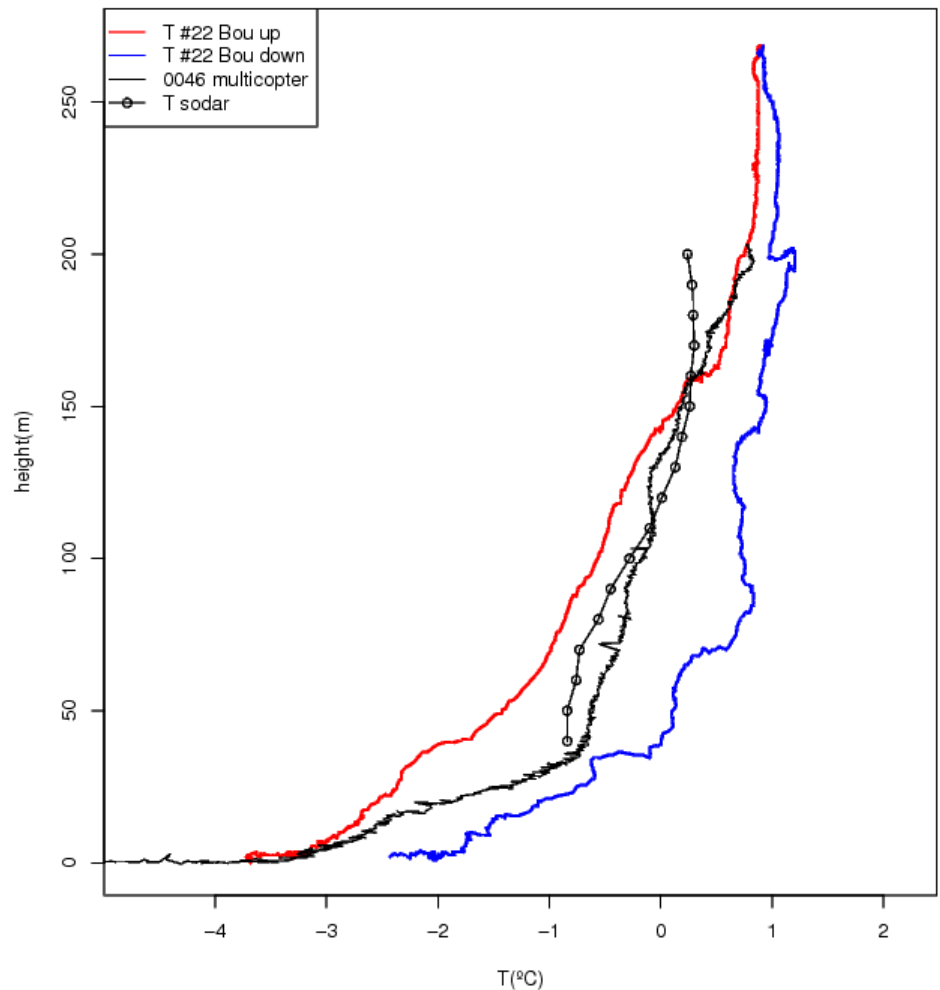
CCP17 measurement validation: Temperature

-Windrass

     15 minute average
sodar measurements of T
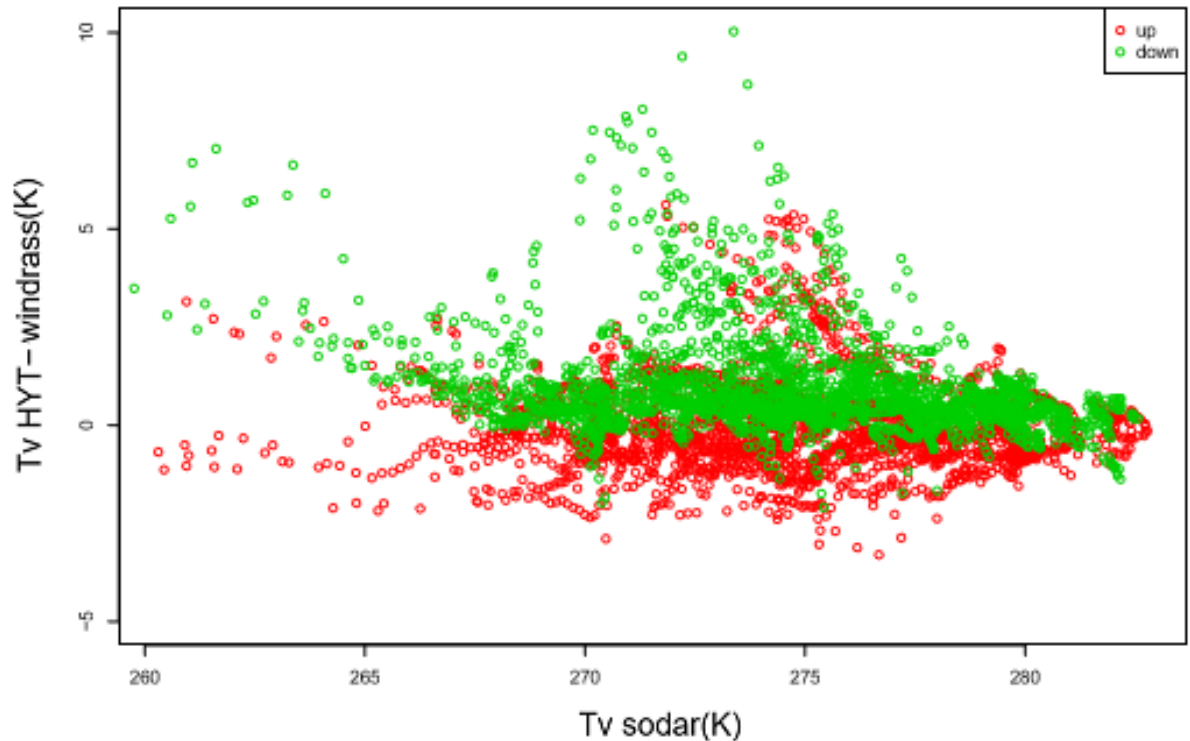
     10 meter resolution

-Local station (EMA)

     1,5m Temperature
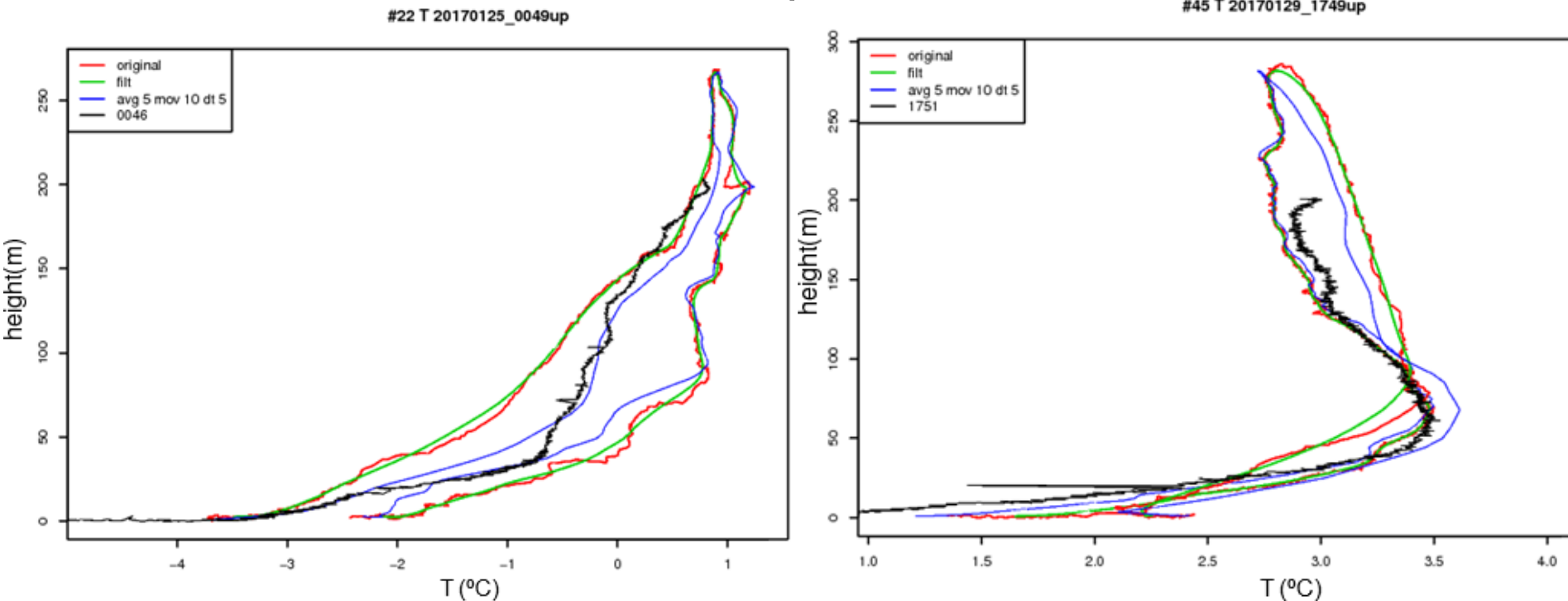and Humidity

-Multicopter

#22 T 20170125_0049

CCP17 measurement validation: Temperature

-Upward and downward temperature profiles against the windrass show a bias
-It is partly attributed to the time response of the sensor

CCP17 measurement validation: Temperature

-We check the time lag correction with the multicopter profiles that are simultaneous

-To prevent unnecessary alteration of the physics of the profiles we will modify only the upwards profiles.

Conclusions

- A robust system for profiling has been developed
- The wind sensor (rev.P) needs calibration before campaign use
- After calibration rev.P's error in static is of 0.1m/s
- The power fit with temperature correction prevents overestimation of wind.
- The HYT performs differently during daylight. An error of 0.2K at night and during the day an error of 0.7 is considered the worst case scenario.
- The difference between upwards and downwards profiles in temperature due to sensor response time is greatly corrected by only modifying the upwards profile.
- Operation is recommended at constant velocity under 0.5m/s, of 0,3m/s if possible
- An investment in higher priced sensors with a faster response time may be advisable

Further work

- The humidity analysis of the profiles is under analysis
- Finding a temperature and humidity sensor with faster response time
- Analyse the IMU data to estimate wind direction
- Adding a gps to the BOU for estimating direction of the wind

Acknowledgments

Thank you

Questions?