Addressing the observational gap over heterogeneous land surfaces in the lower atmospheric boundary layer by multi-copter temperature and humidity profile measurements

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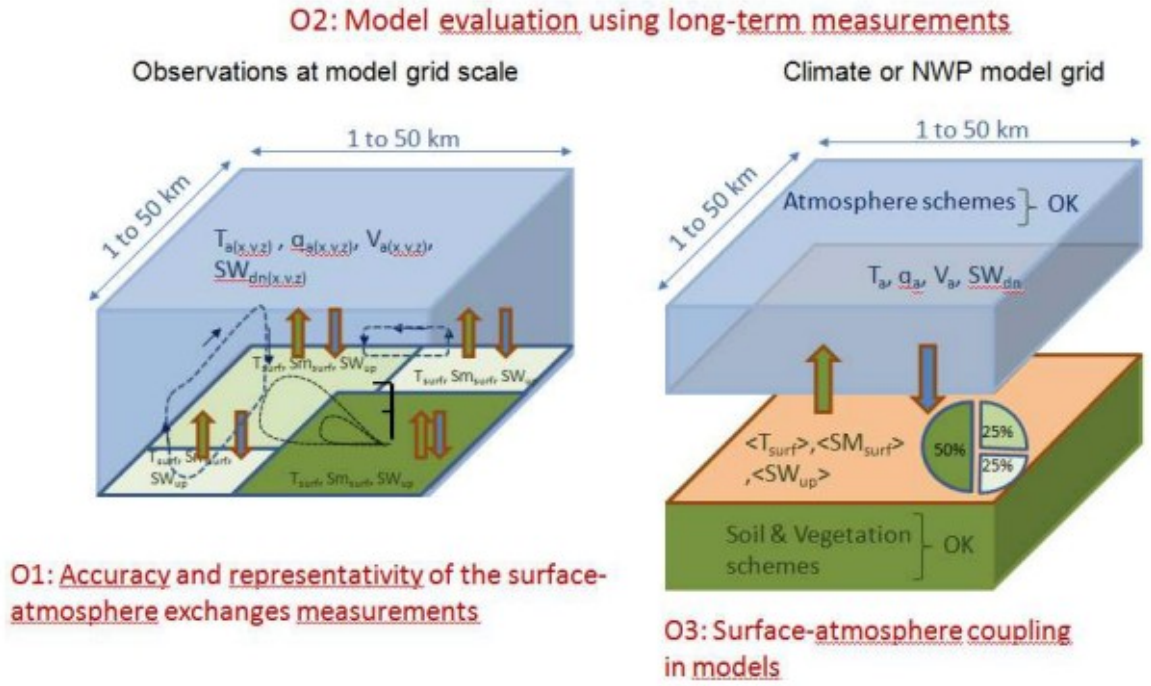
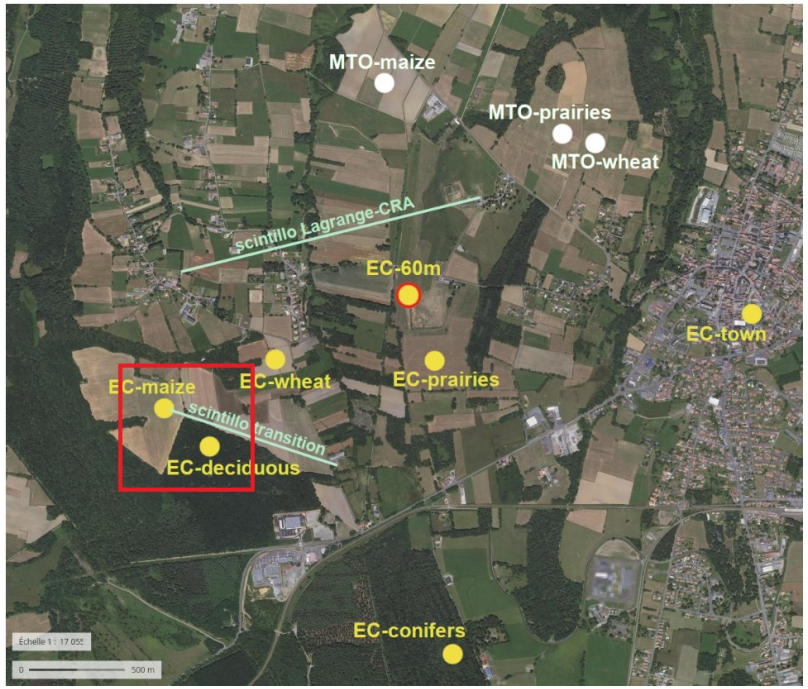
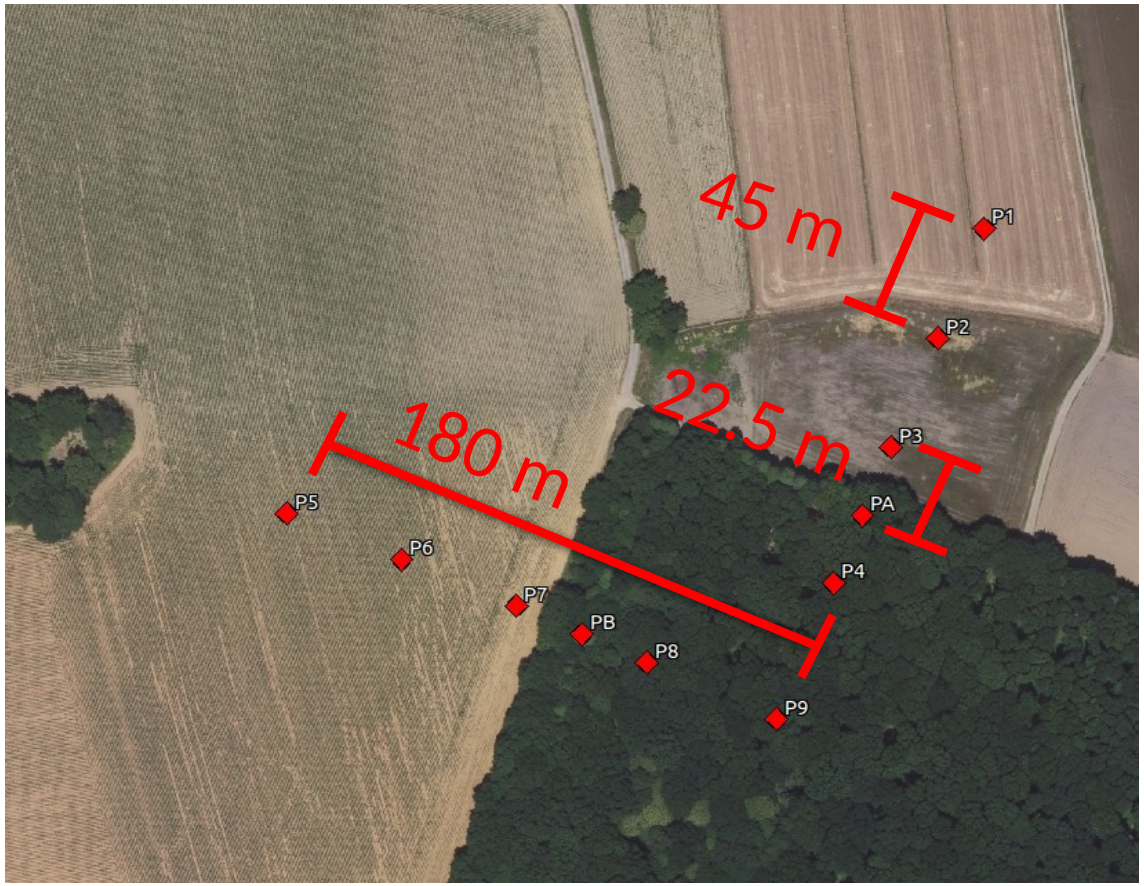
Goals and Motivation

- Point measurements between varying sfcs has an observational gap
- Can this gap be collected near & across the transitional boundary with a small drone?



Field Site & Plan of Attack

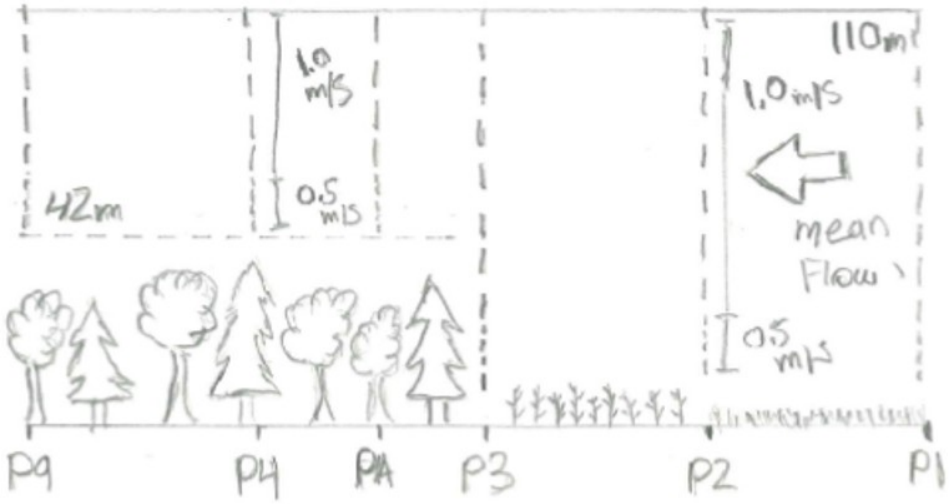




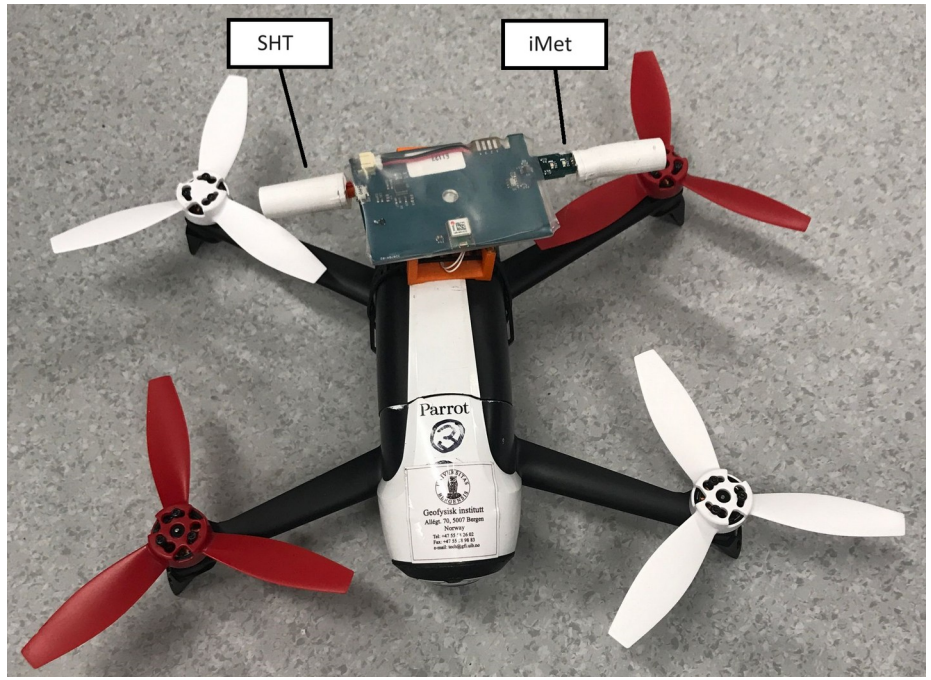
- Two flight plans for prevailing wind direction
- Five positions 45 m apart (180 m total length)
- Position A/B added Aug 19th (22.5 m)

Field Site & PoA cont.

- Smooth to rough
- Grass - Corn – Forest
- Corn - Forest
- Approx. perpendicular to transition
- Swapping with change of flow



Bebop2Met & Instrumentation



- iMet: T, p, RH; 1 Hz
- SHT: T, p, RH; 4 Hz
- GNSS: Pos., lat, lon, alt; 4 Hz
- IMU: Attitude angles; 4 Hz

Profile Flight Distribution

2023	Profiles	Total
SOP April		56
19th	34	
20th	22	
SOP August		251
15th	24	
17th	38	
19th	52	
20th	57	
22nd	41	
23rd	39	
SOP December		136
6th	40	
9th	29	
11th	41	
14th	26	
Total MOSAI		443

Only iMet

= Golden Days by group

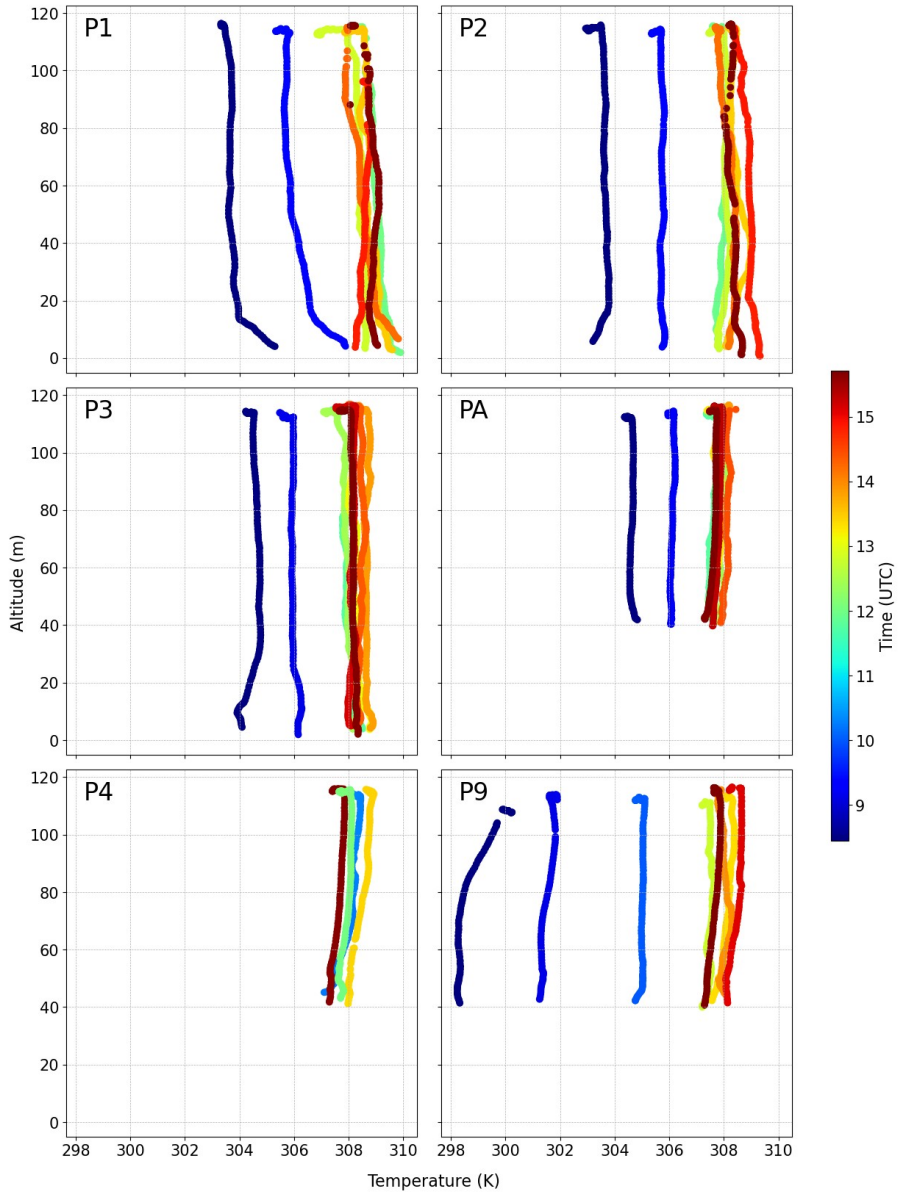
Bebop2Met cont.

KML Files for August SOP

- Visual from Google Earth
- Example from August 20th and cumulative August SOP
- Launch sites vary
- 2-3 profiles per battery
- Some WiFi & Paparazzi issues

Okay, so what do we have?

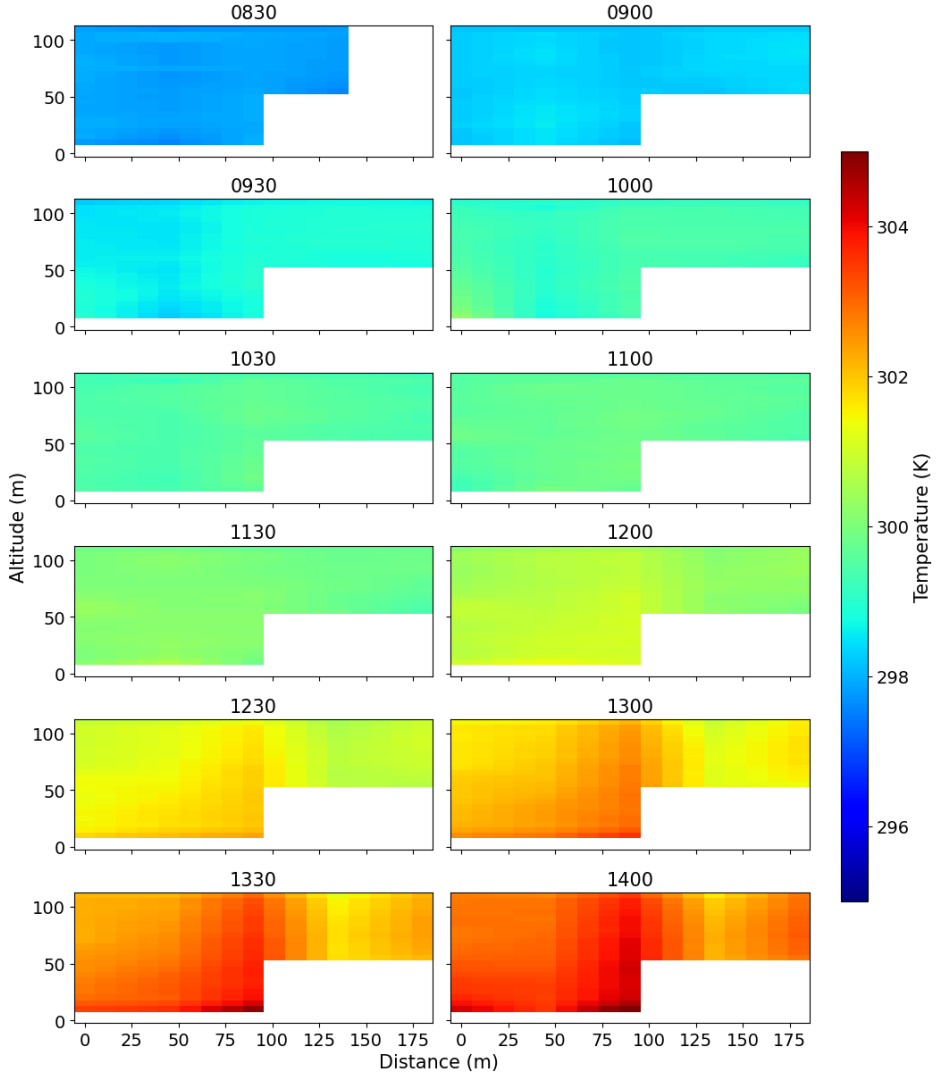
- Discard descending profiles
- Focus on SHT (for now)
- How to best visually show the data?
- Many combinations possible

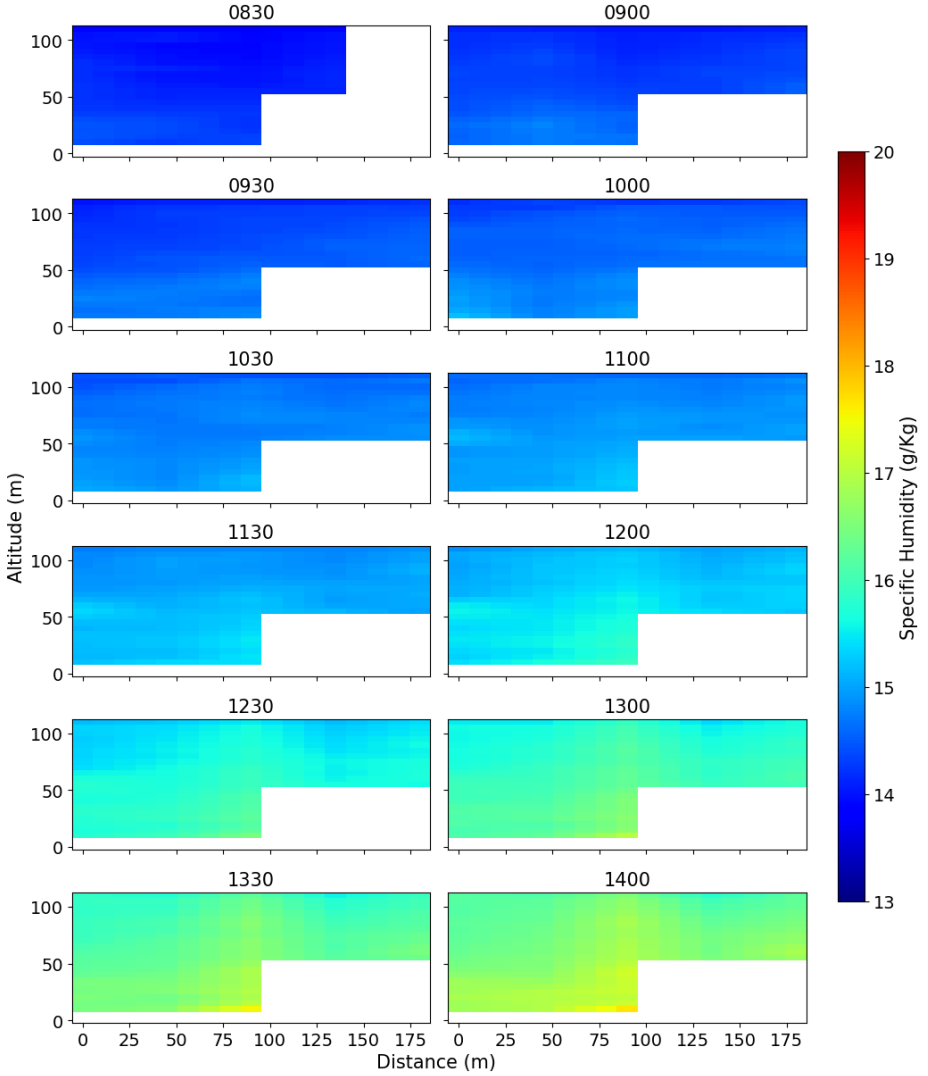


August 17th Interpolation

All time UTC

- T: 18-24
- ws: 0.5-2.0 m/s
- wd: NE-E
- Fog layer, 30m 0630-0830
- Partly cloudy most of the day

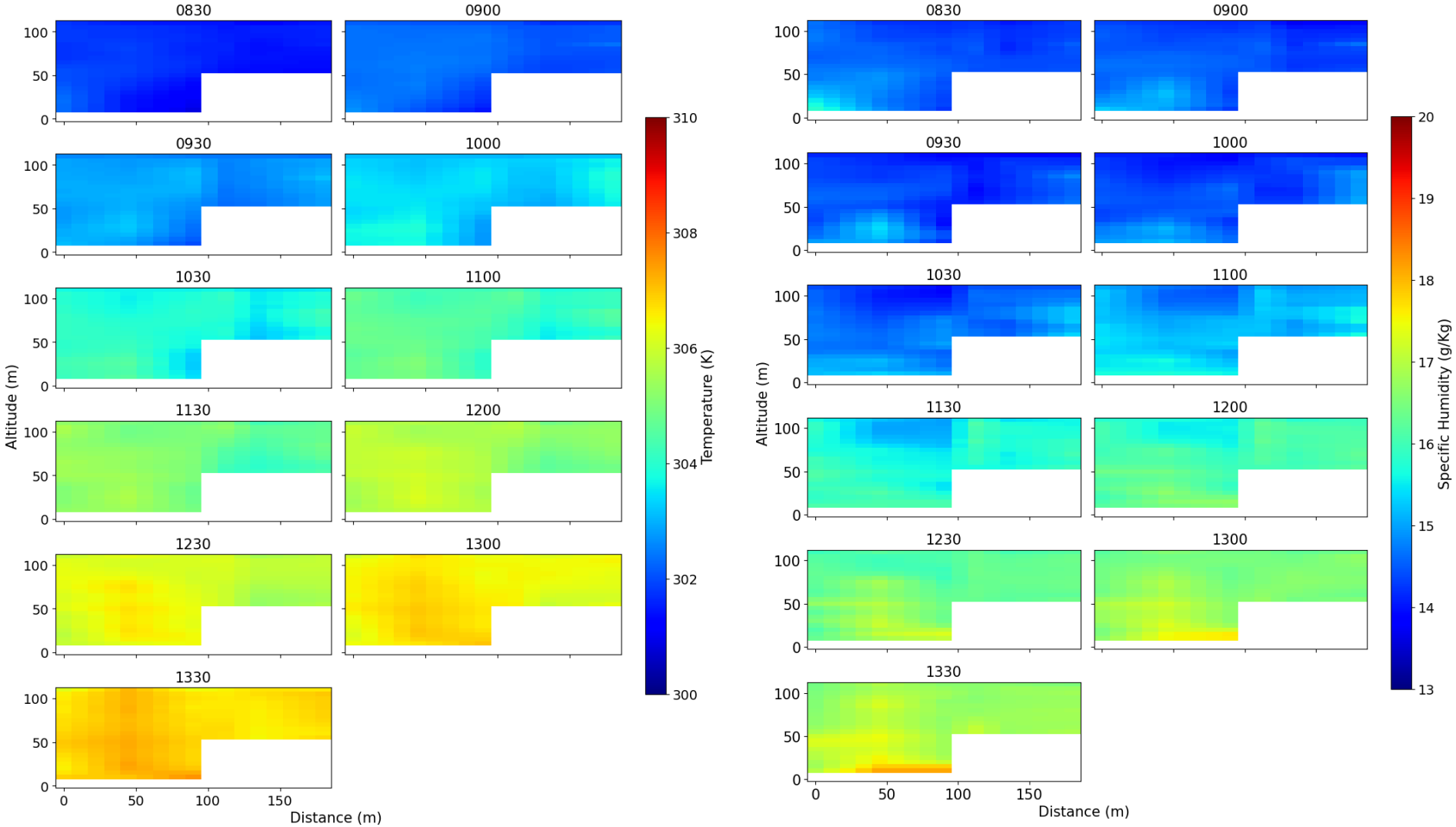




August 17th cont.-

August 19th Interpolation

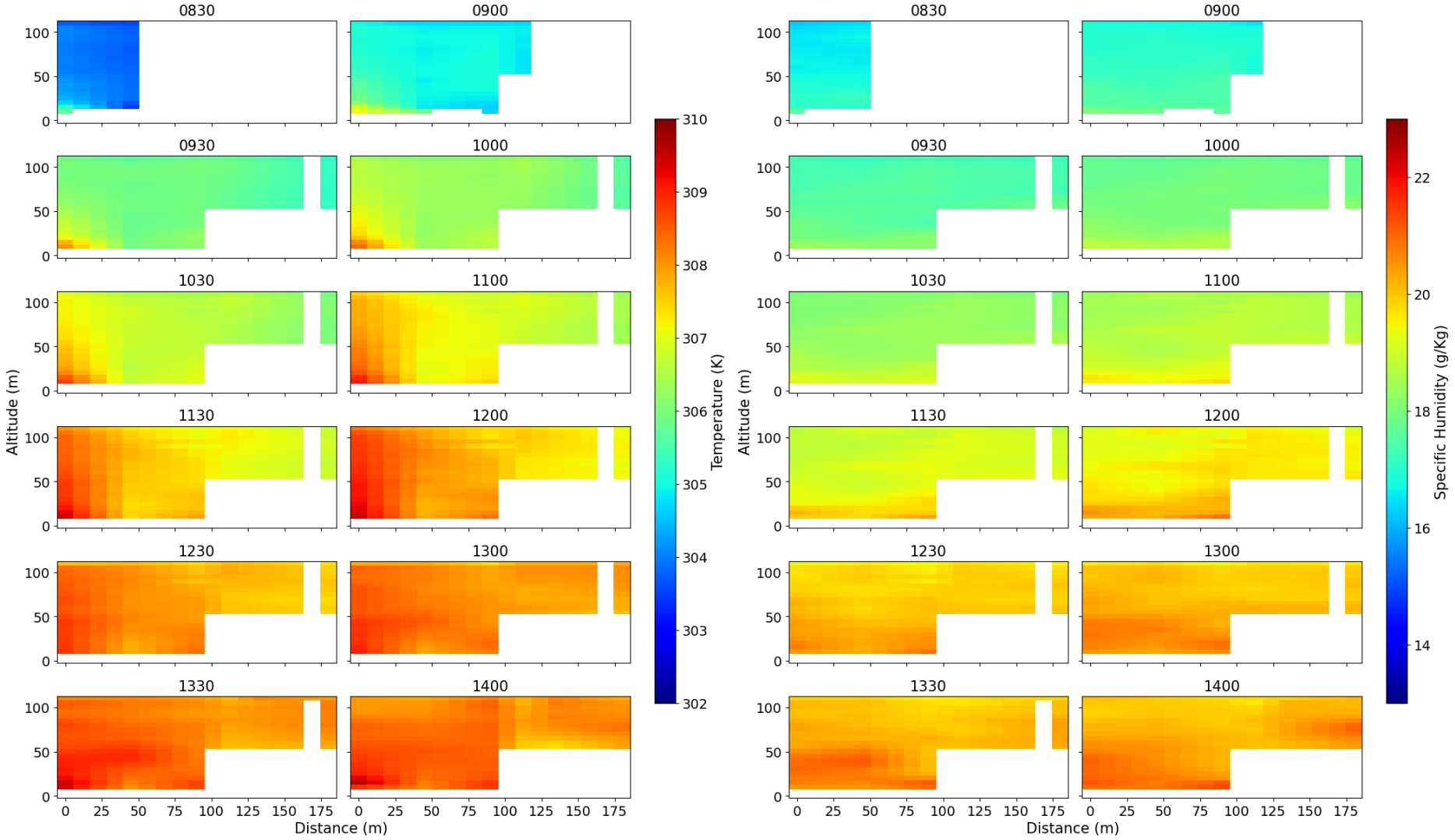
- T: 22-28 C
- ws: 3-1.5 to 2.0
- wd: SW to NW
- No cloud cover
- No fog layer



August 19th cont.

August 20th Interpolation

- T: 20-26 before 1000, 29 by 1400
- ws: 0.5-2.0/2.5
- wd: NE to N to NW
- 0630 fog 70m
- Slight cloud cover early

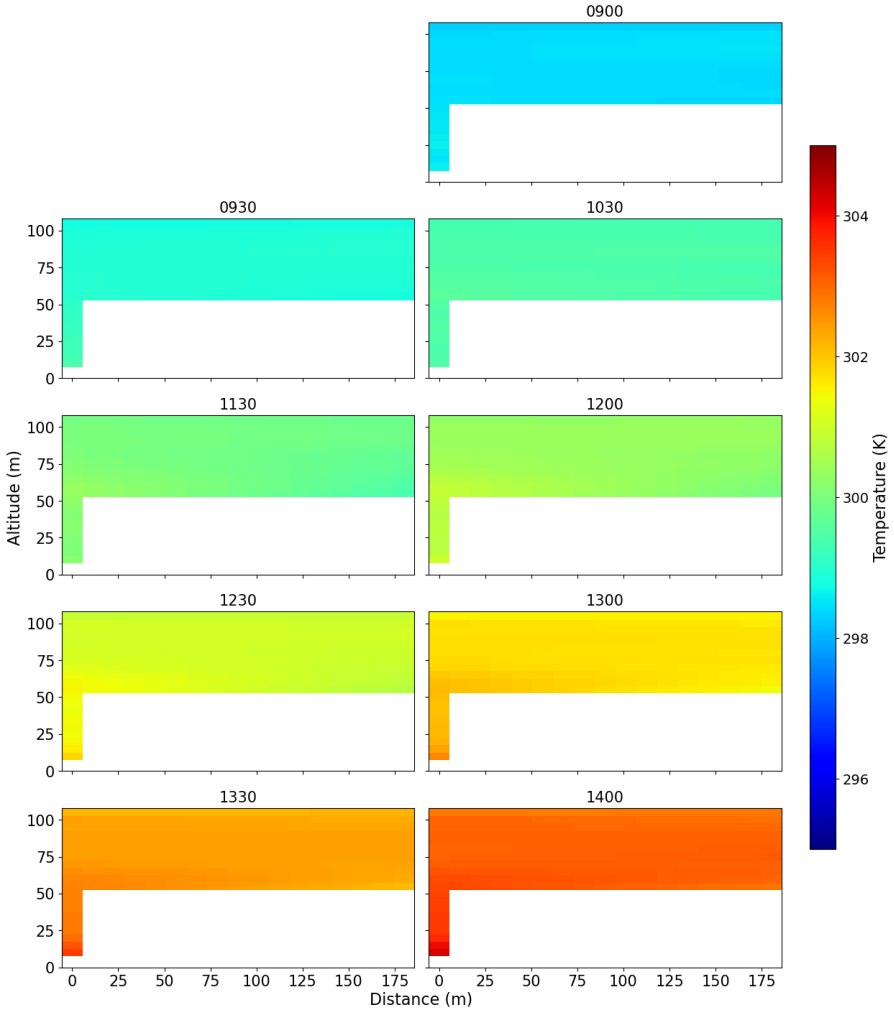


August 20th cont.

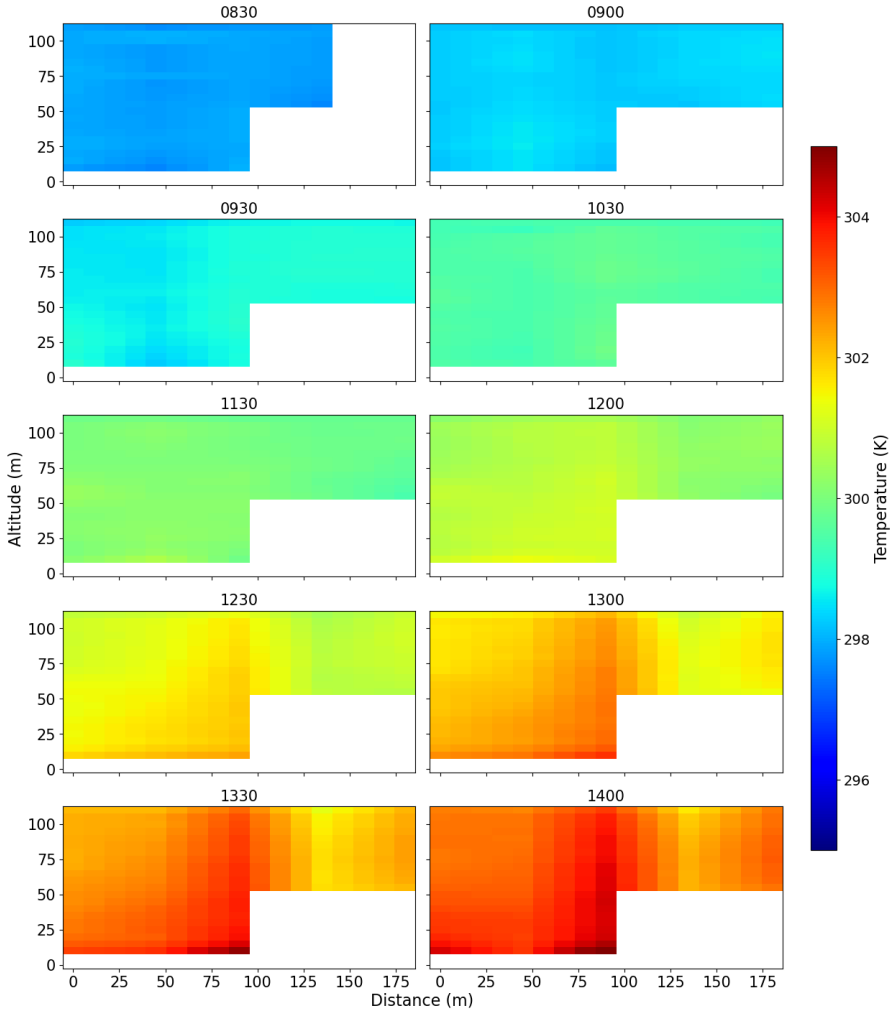
Comparison

- Ex: Aug 17th
- P1 to P9 only
- What is lost with only two points?

2 positions

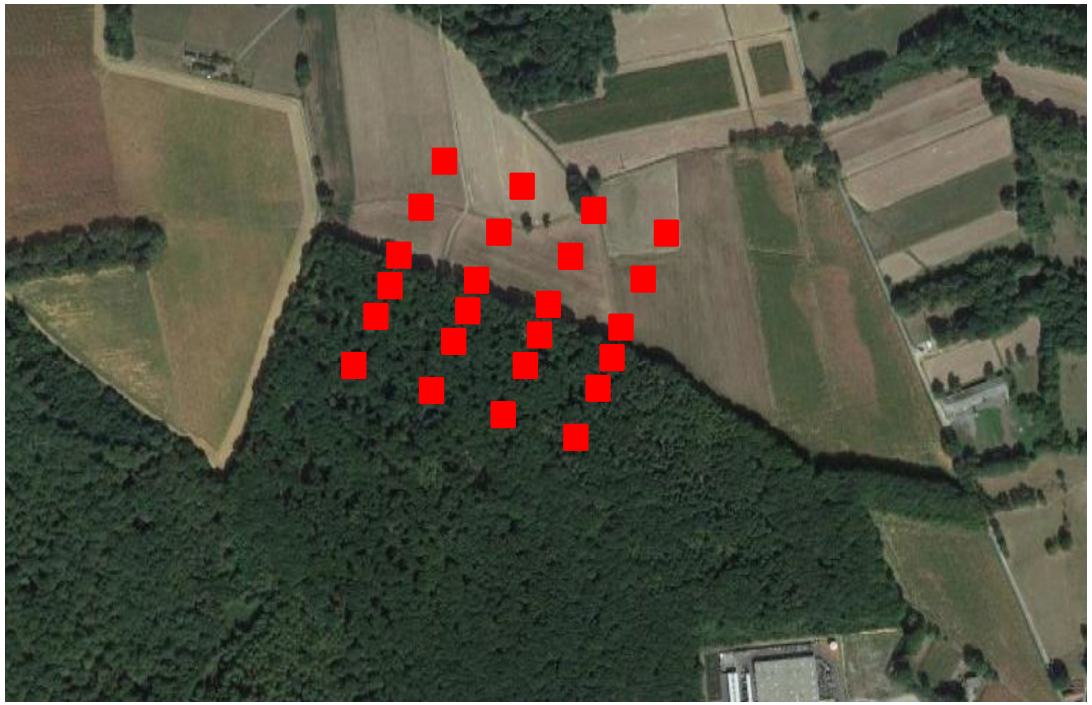


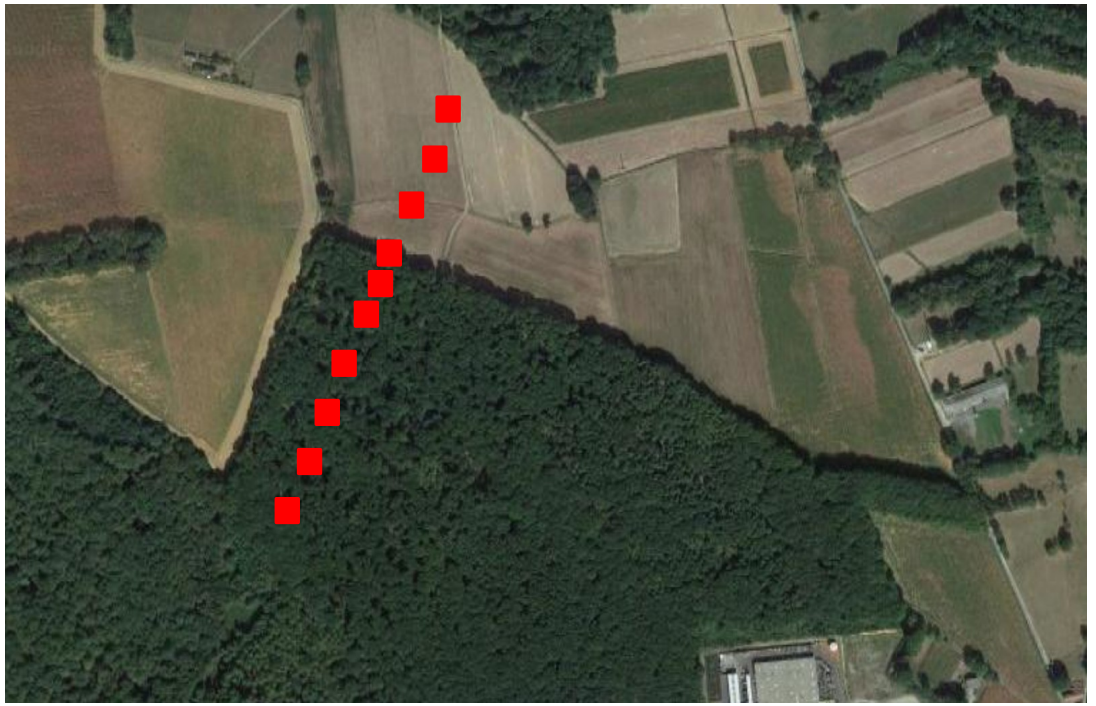
6 positions



Possible Flight Plan Improvements

- Scheduled & more uniform flight times
- Swarm – Reduce time lag
- Swarm – Add dimension(s)





- Replace WiFi system for more forest penetration (VLOS issues then)
- Higher alt (Regulations issue)?

First Conclusions and Outlook

Possible to measure these temperature and humidity measurements with a small drone with basic meteorological payload

Many possible improvements to time lag, spatial coverage, organization

Simple approach remains incredibly complex

More to analyze and (try to) interpret even with a single drone (Apr.? Dec. & continuing with Aug.)