Measurements from the NOAA P-3 during ATOMIC

Robert Pincus, Chris W. Fairall, Adriana Bailey, Haonan Chen, Patrick Y. Chuang, Gijs de Boer, Graham Feingold, Dean Henze, Quinn T. Kalen, Jan Kazil, Mason Leandro, Ashley Lundry, Ken Moran, Dana A. Naeher, David Noone, Akshar J. Patel, Sergio Pezoa, Ivan PopStefanija, Elizabeth J. Thompson, James Warnecke, and Paquita Zuidema

See also https://doi.org/10.5194/essd-2021-11


NOAA
N43RF

Instrumentation

ATOMIC aimed to illuminate the role of mesoscale circulations in the ocean and atmosphere as they influence the coupling between the two. To this end the aircraft carried a wide complement of sensors and expendables

In situ measurements:

- Temperature, humidity*, winds… up, down, and side-looking IR
- Cloud and aerosol size distributions
- Water vapor isotopic composition (NCAR)

Expendables

- Dropsondes
- AXBTs (oceanic temperature profiles)

Remote sensing instruments

- PSL W-band cloud radar (clouds and rain)
- Stepped-frequency microwave radiometer (10-m wind speed, rain rate)
- Wide swath radar altimeter: ocean surface wave state (also rain)

Strategy

The P-3 has long (8-9 hour) endurance and is capable of flying for extended periods anywhere between the surface and ~7.5 km. Each flight contained a mix of sampling strategies:

High-altitude, 220 km radius circles for deploying dropsondes and deriving large-scale budgets, often centered on the Ron Brown

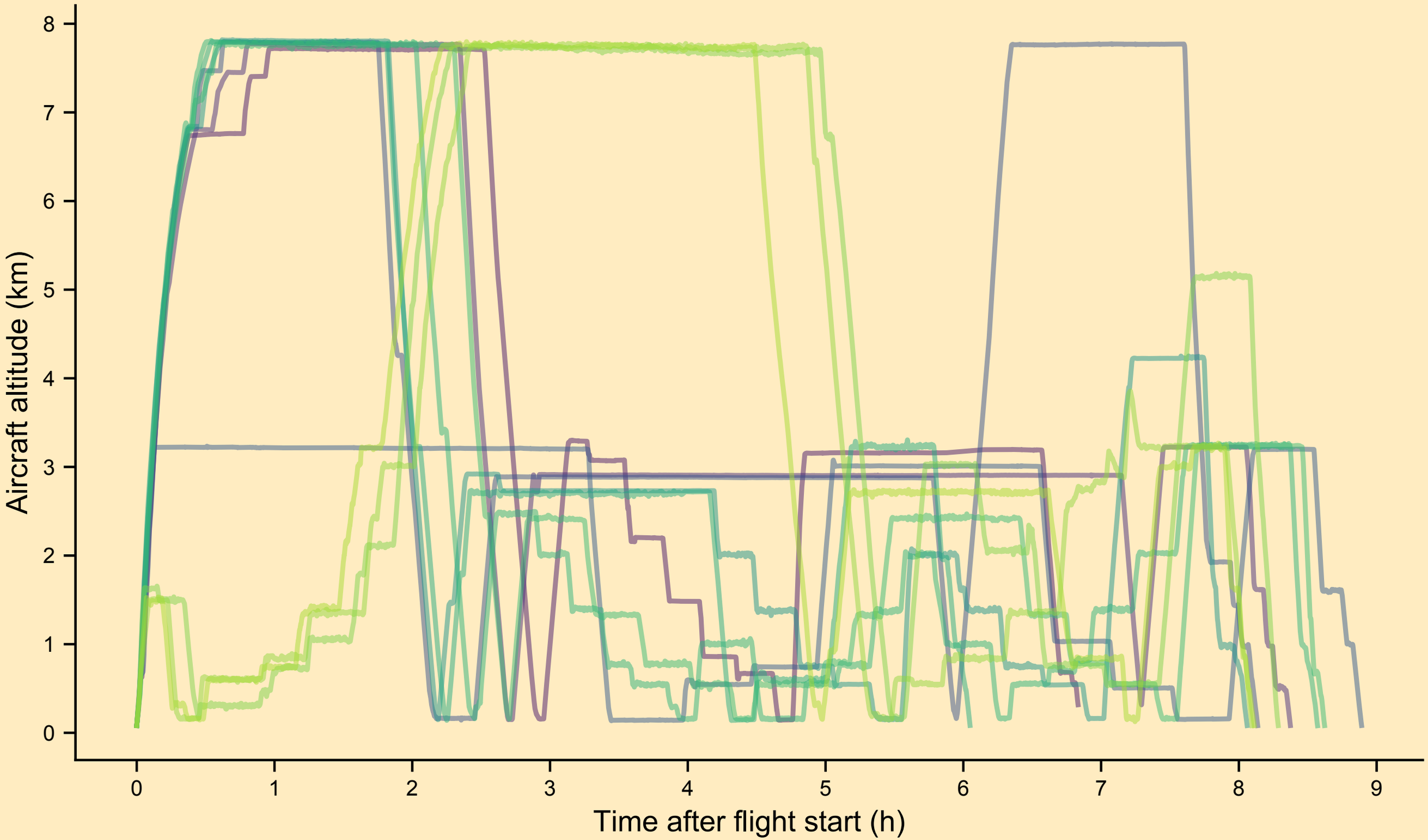
Slow profiles to sample isotopic composition

In situ sampling of clouds, aerosols, and thermodynamic fluxes, based on stacked legs from near the surface to just above the cloud layer

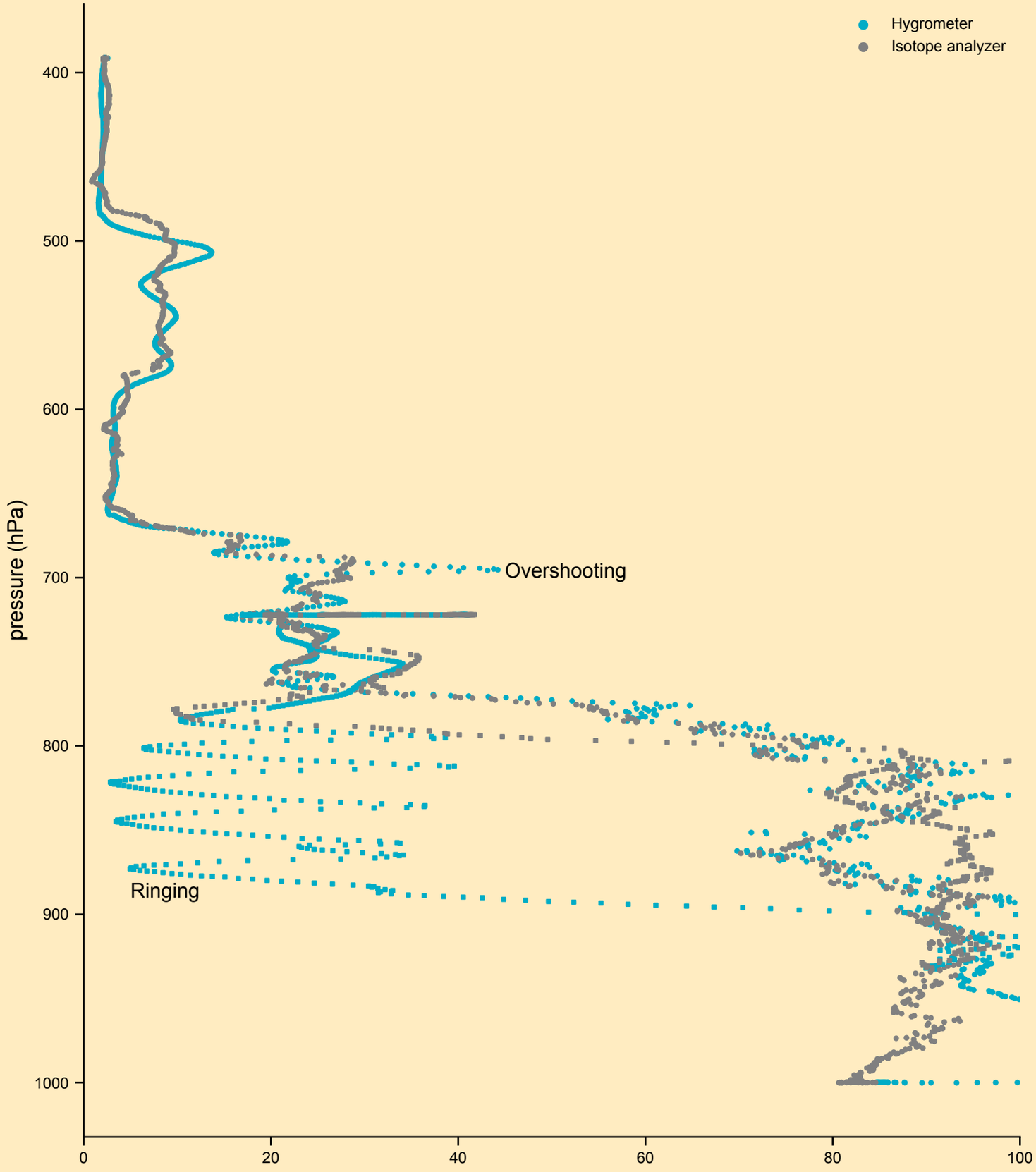
Lawnmower patterns at 2.5-ish km for deploying AXBTs and remote sensing of clouds and the ocean surface

Eleven flights in all. Most took off ~9 am LT; the last three were overnight (9-11:30 pm LT) timed for full moon conditions

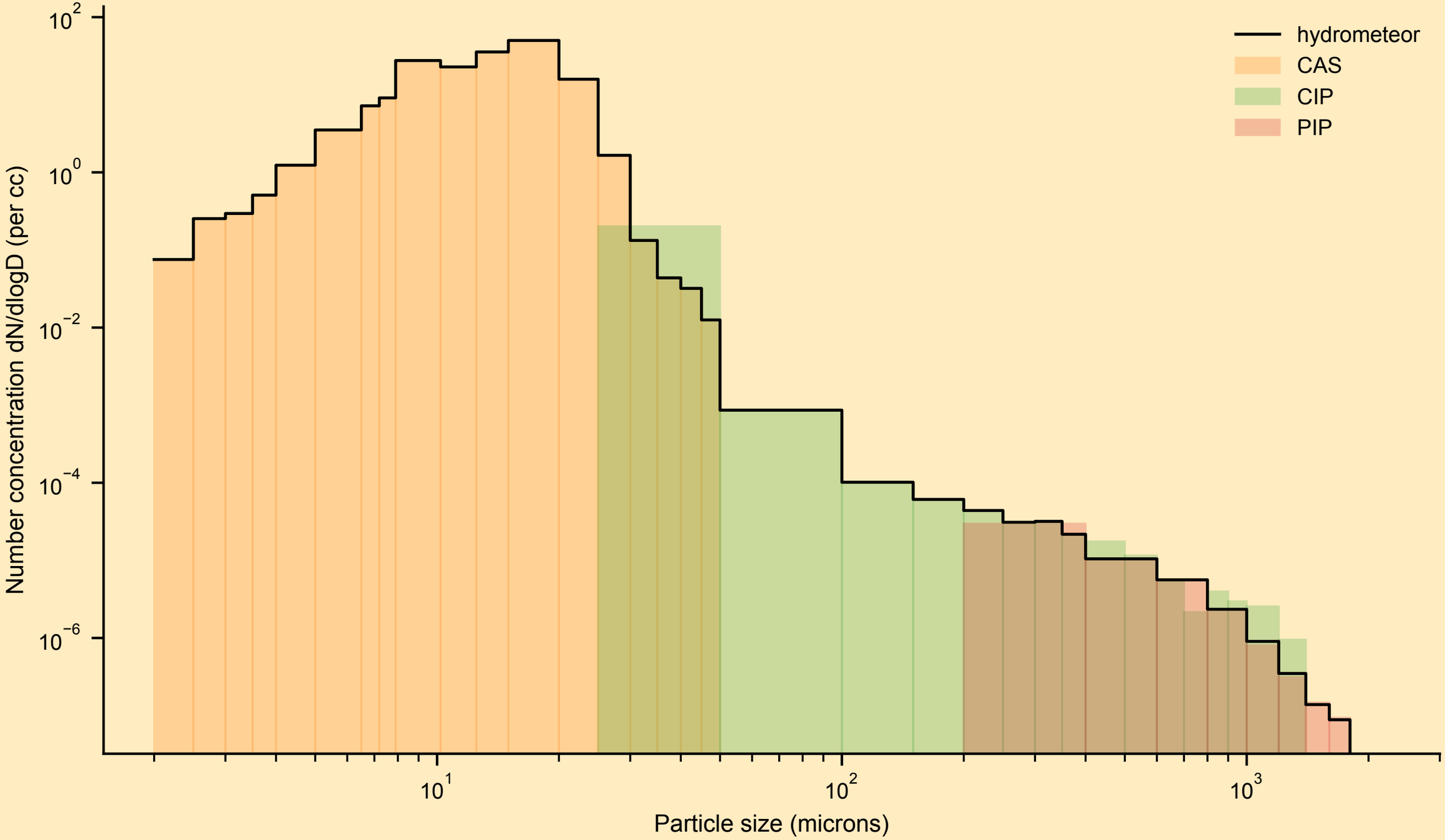
60°W
57.5°W
55°W
52.5°W
50°W
15°N
12.5°N
Flight date (MM-DD-2020)
01-17
01-19
01-23
01-24
01-31
02-03
02-04
02-05
02-09
02-10
02-11


Aircraft altitude (km)
0
1
2
3
4
5
6
7
8
Time after flight start (h)
0
1
2
3
4
5
6
7
8
9

Use the isotope-analyzer water vapor if you can

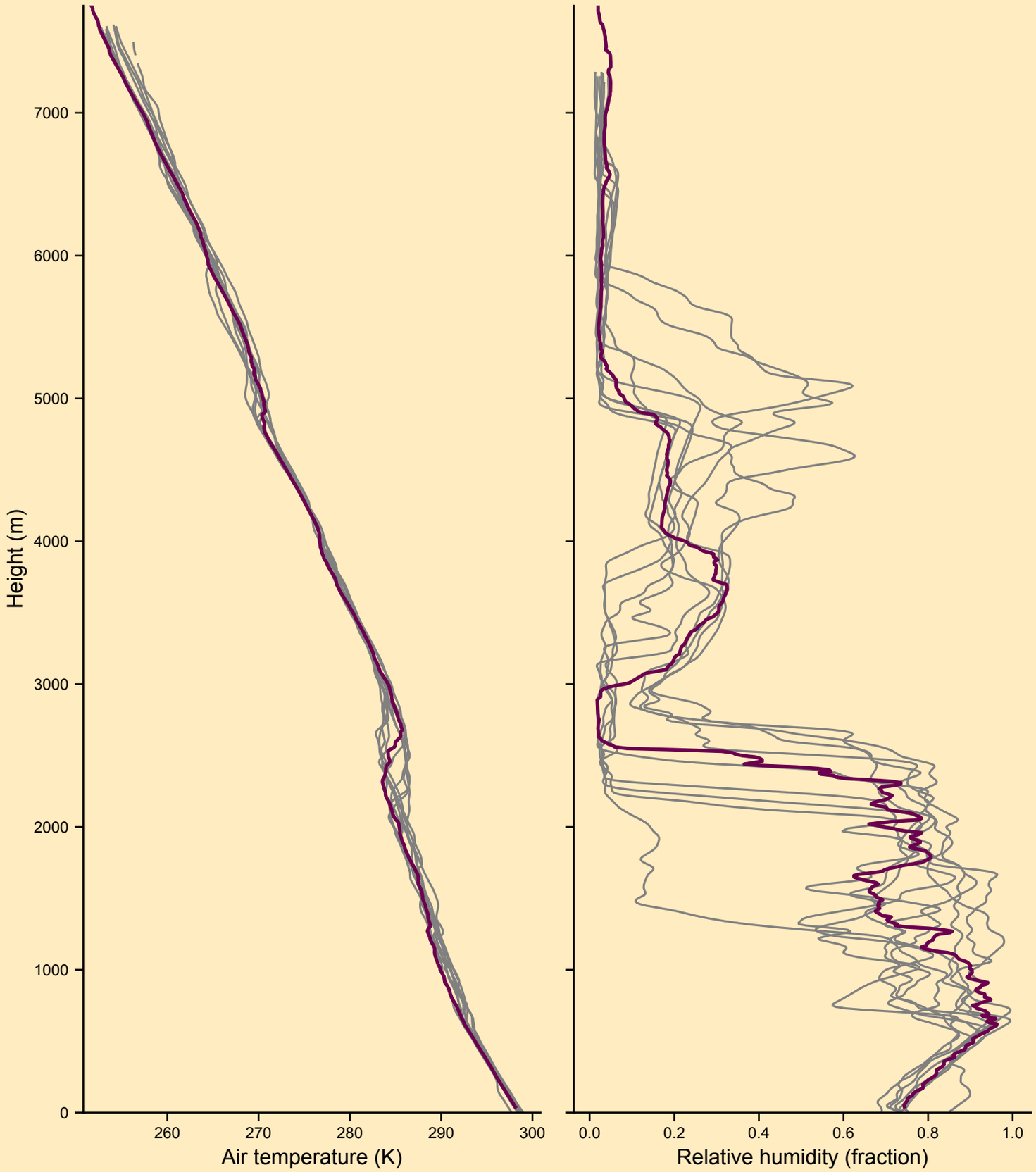


UCSC gave the in situ microphysics some love, when it worked



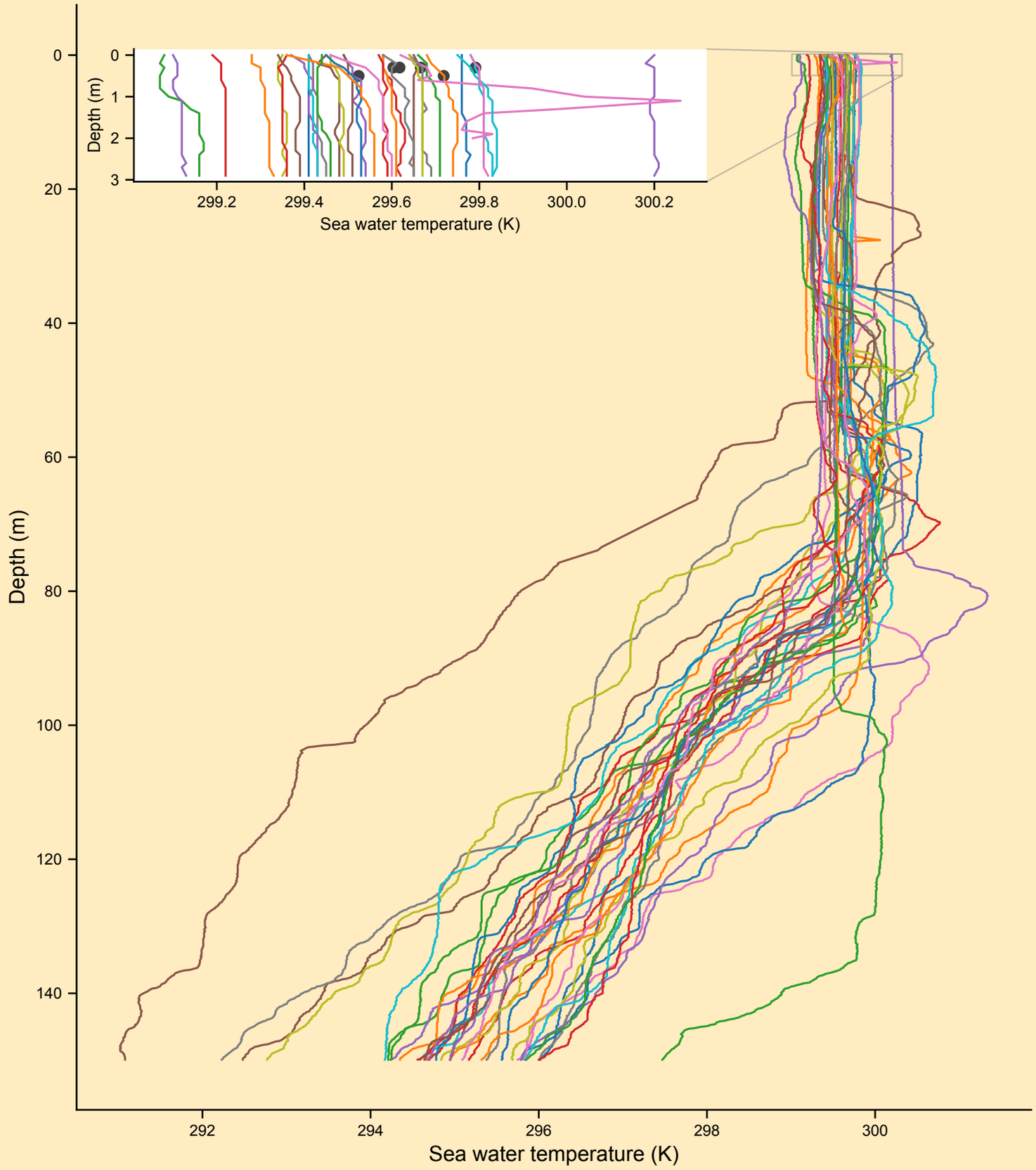
60°W
57.5°W
55°W
52.5°W
50°W
15°N
12.5°N
Flight date (MM-DD-2020)
01-17
01-19
01-23
01-24
01-31
02-03
02-04
02-05
02-09
02-10
02-11

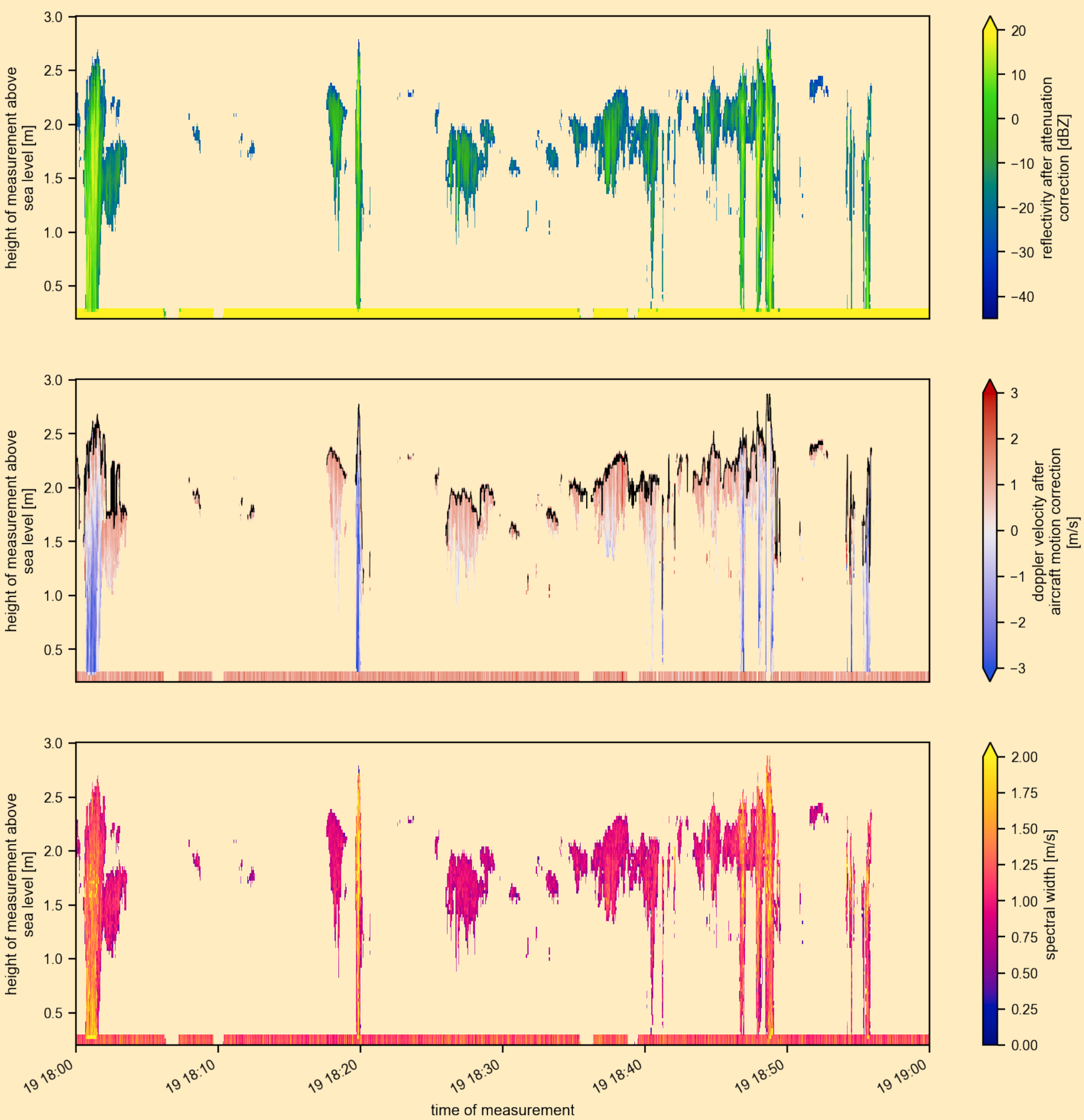
Dropsondes are in a rich context; JOANNE adds value

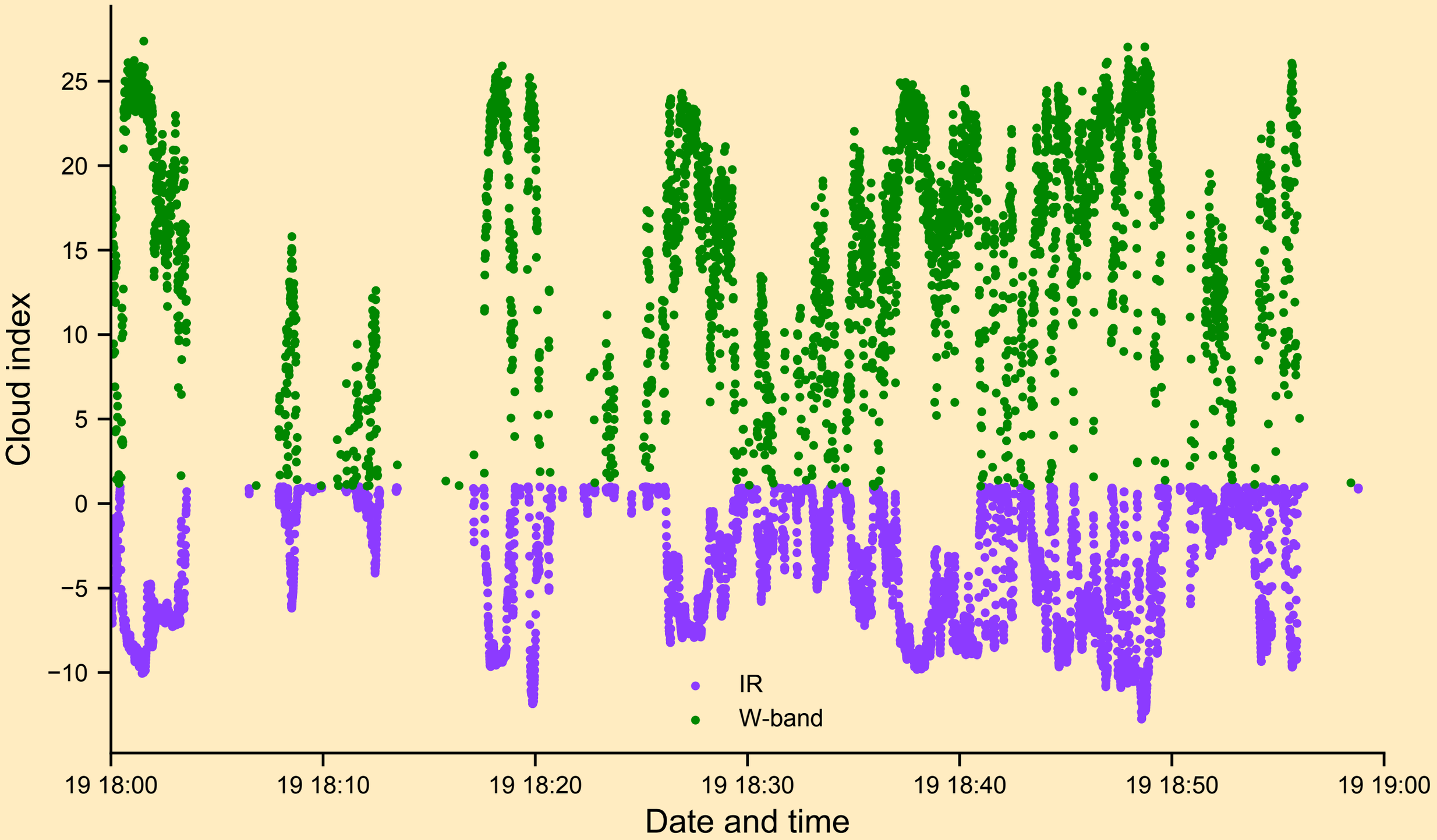


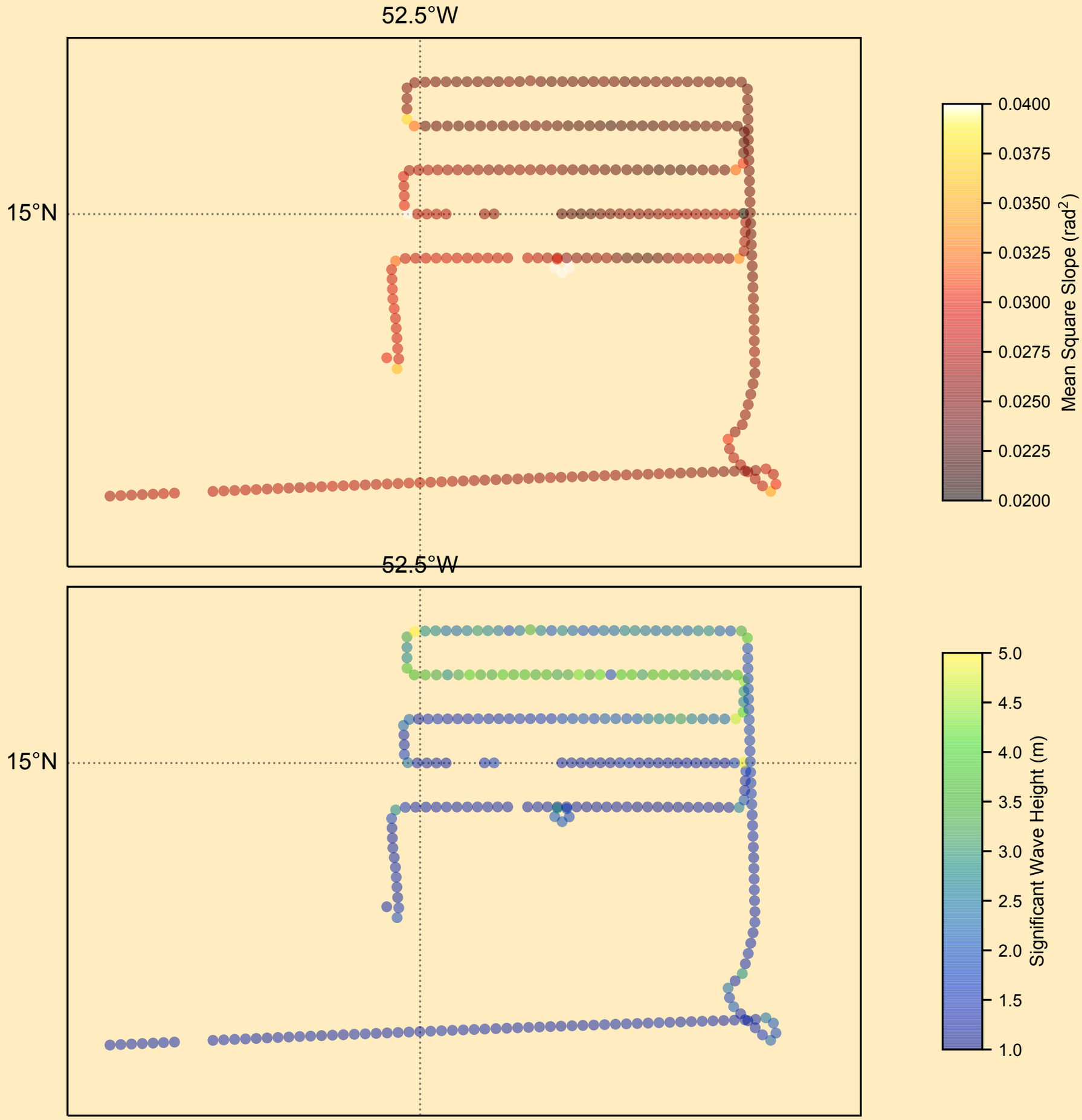
60°W
57.5°W
55°W
52.5°W
50°W
15°N
12.5°N
Flight date (MM-DD-2020)
01-19
01-23
02-03
02-04
02-05
02-09
02-11

AXBTs are also in a rich context




height of measurement above sea level [m]
3.0
2.5
2.0
1.5
1.0
0.5
reflectivity after attenuation correction [dBZ]
20
10
0
−10
−20
−30
−40
doppler velocity after aircraft motion correction [m/s]
3
2
1
0
−1
−2
−3
spectral width [m/s]
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
19 18:00
19 18:10
19 18:20
19 18:30
19 18:40
19 18:50
19 19:00
time of measurement


Cloud index
25
20
15
10
5
0
−5
−10
IR
W-band
19 18:00
19 18:10
19 18:20
19 18:30
19 18:40
19 18:50
19 19:00
Date and time


52.5°W
15°N
52.5°W
0.0400
0.0375
0.0350
0.0325
0.0300
0.0275
0.0250
0.0225
0.0200
Mean Square Slope (rad^2)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
Significant Wave Height (m)

For further information…

Quinn, P. K. et al., 2021: Measurements from the RV Ronald H. Brown and related platforms as part of the Atlantic Tradewind Ocean-Atmosphere Mesoscale Interaction Campaign (ATOMIC) Earth Syst. Sci. Data, 13, 1759–1790, doi:10.5194/essd-13-1759-2021.

Pincus, R. et al., 2021: Observations from the NOAA P-3 aircraft during ATOMIC. To appear in Earth Syst. Sci. Data., see doi:10.5194/essd-2021-11

George, G. et al., 2021: JOANNE : Joint dropsonde Observations of the Atmosphere in tropical North atlaNtic meso-scale Environments. Under open review at *Earth Syst. Sci. Data.*, doi:10.5194/essd-2021-162

Stevens, B., S. Bony, D. Farrell et al., 2021: EUREC^{4}A. To appear in Earth Syst. Sci. Data., see doi:10.5194/essd-2021-18

Albright, A. L. et al., 2021: Atmospheric Radiative Profiles during EUREC^{4}A. *Earth Syst. Sci. Data*, **13**, 617–630, doi:10.5194/essd-13-617-2021

https://howto.eurec4a.eu/