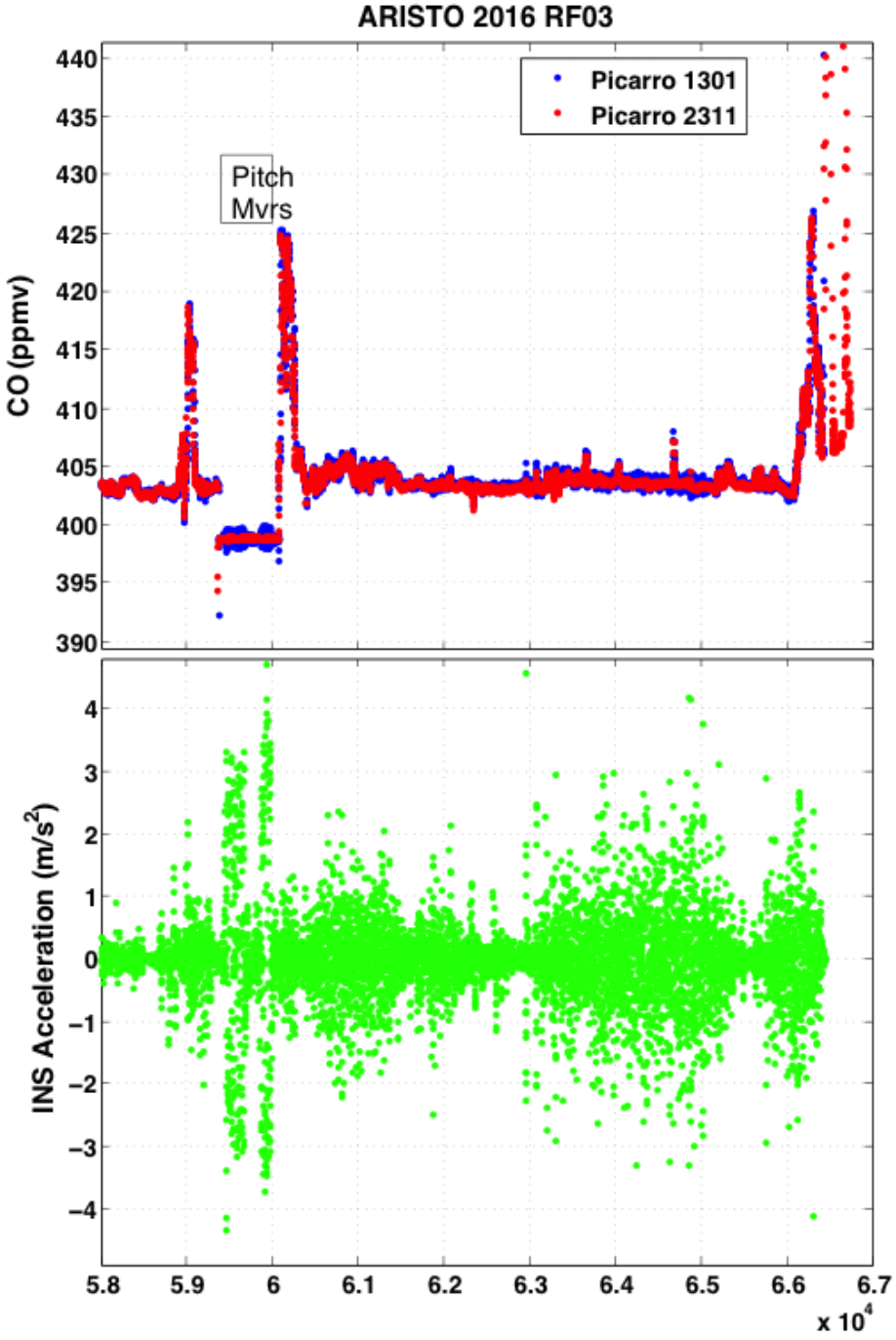
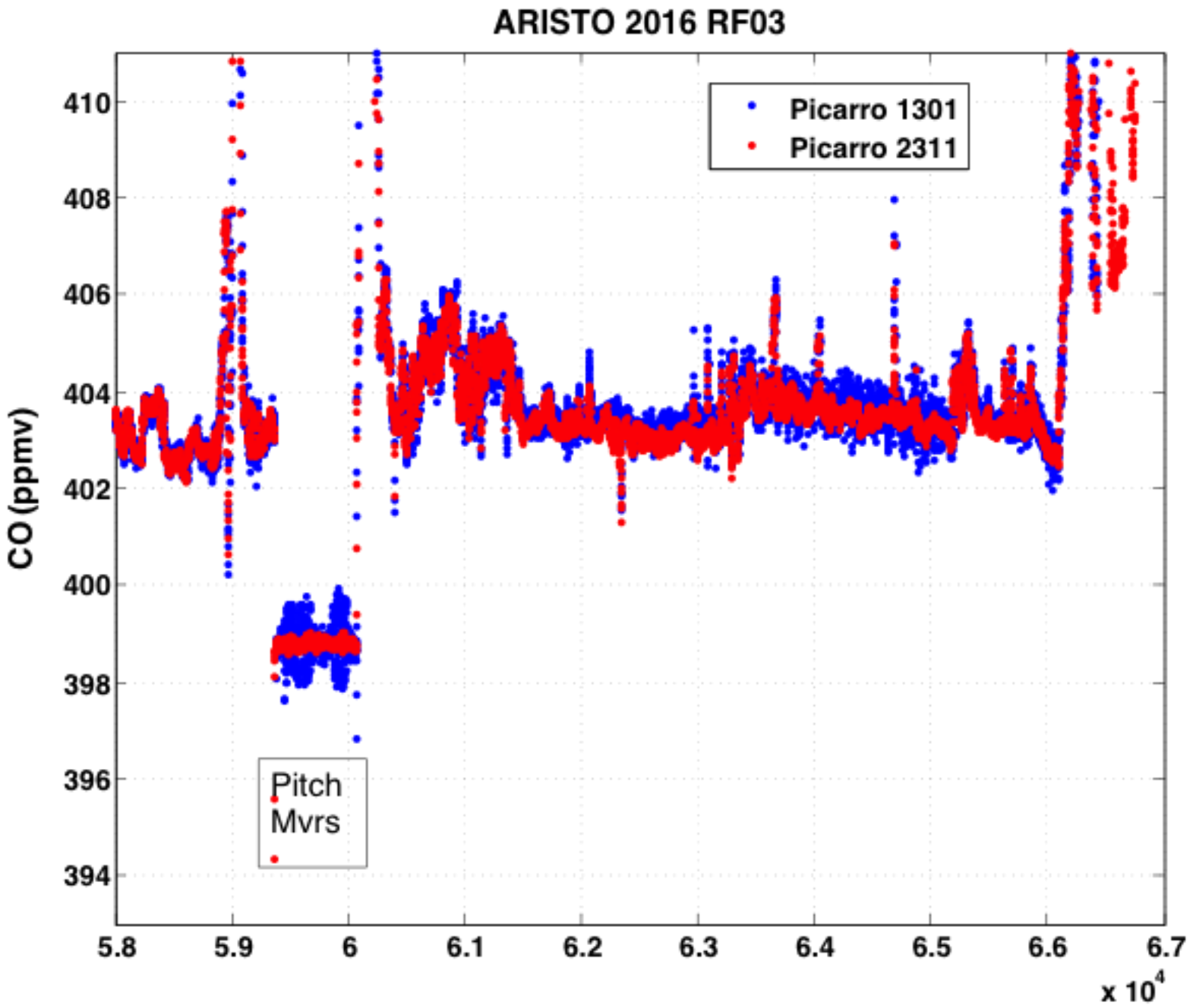
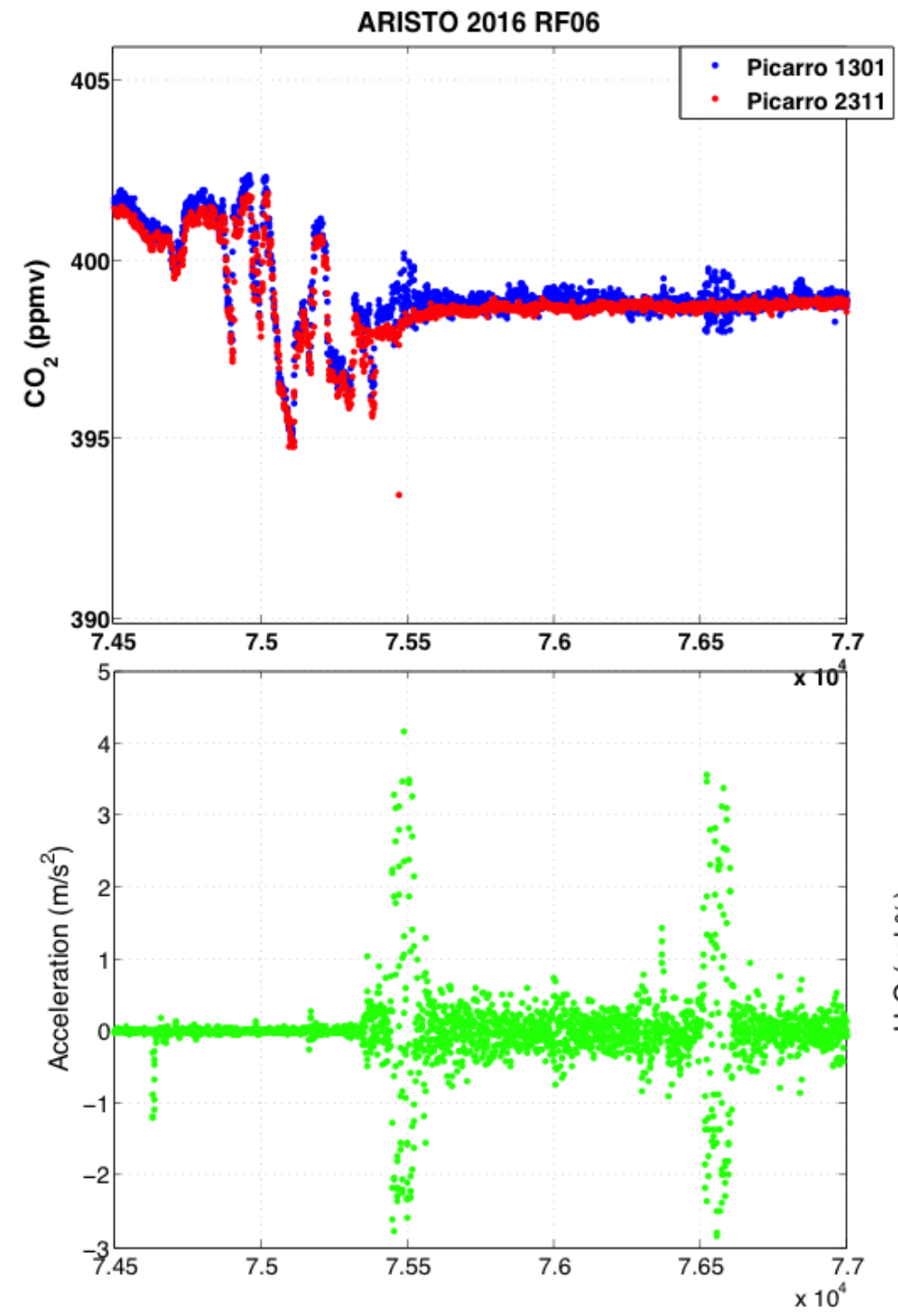
Picarro CO_2 Measurement Accuracy and Stability: A First Look at Preliminary Results from ARISTO-2016

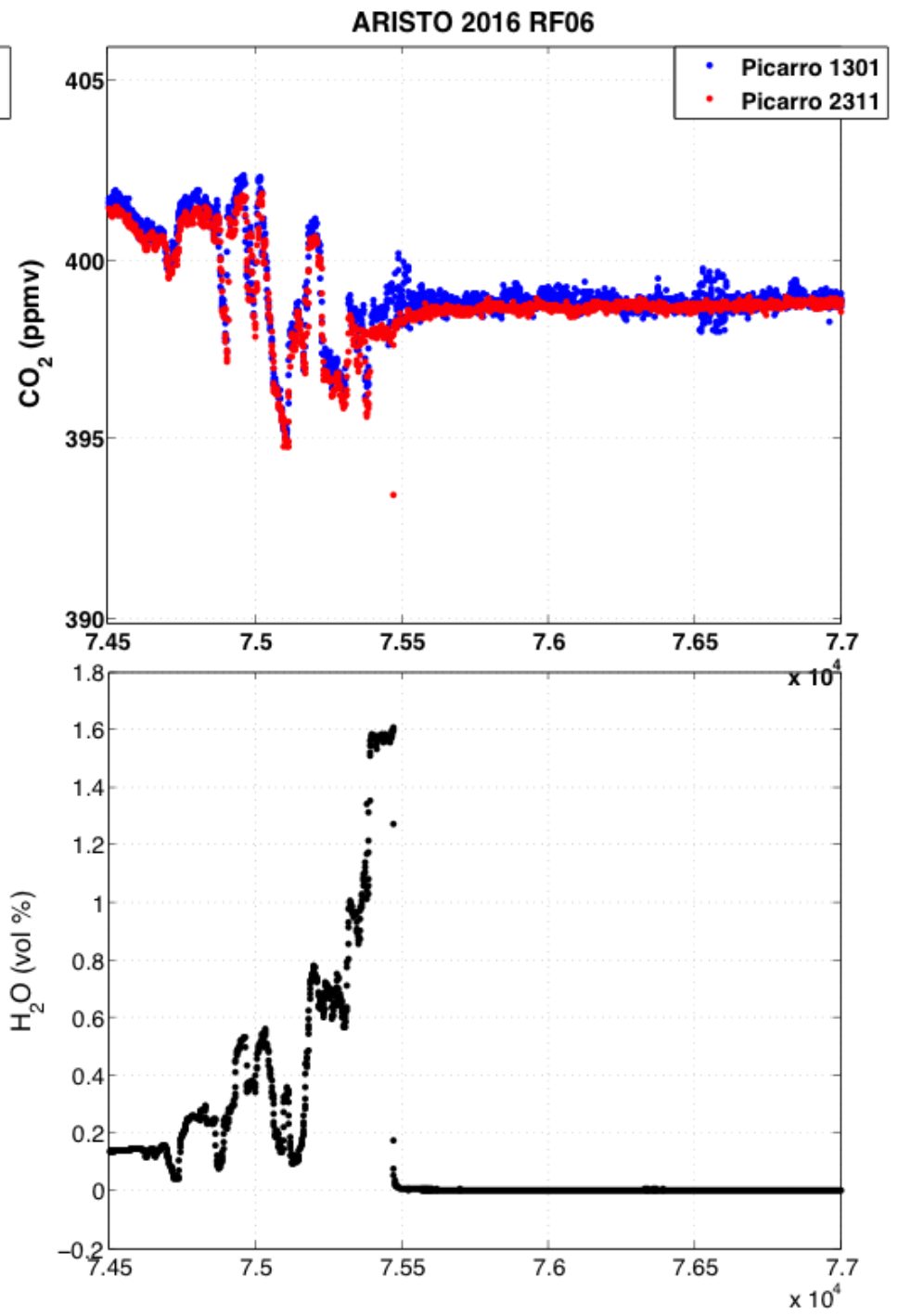
Objectives: Characterization of Picarro CO_2 and CH_4 instrumentation
1) temporal, flight environment, and cabin pressure impacts on humidity correction factor; and
2) aircraft acceleration impacts on signal variance while sampling calibration gas during maneuvers

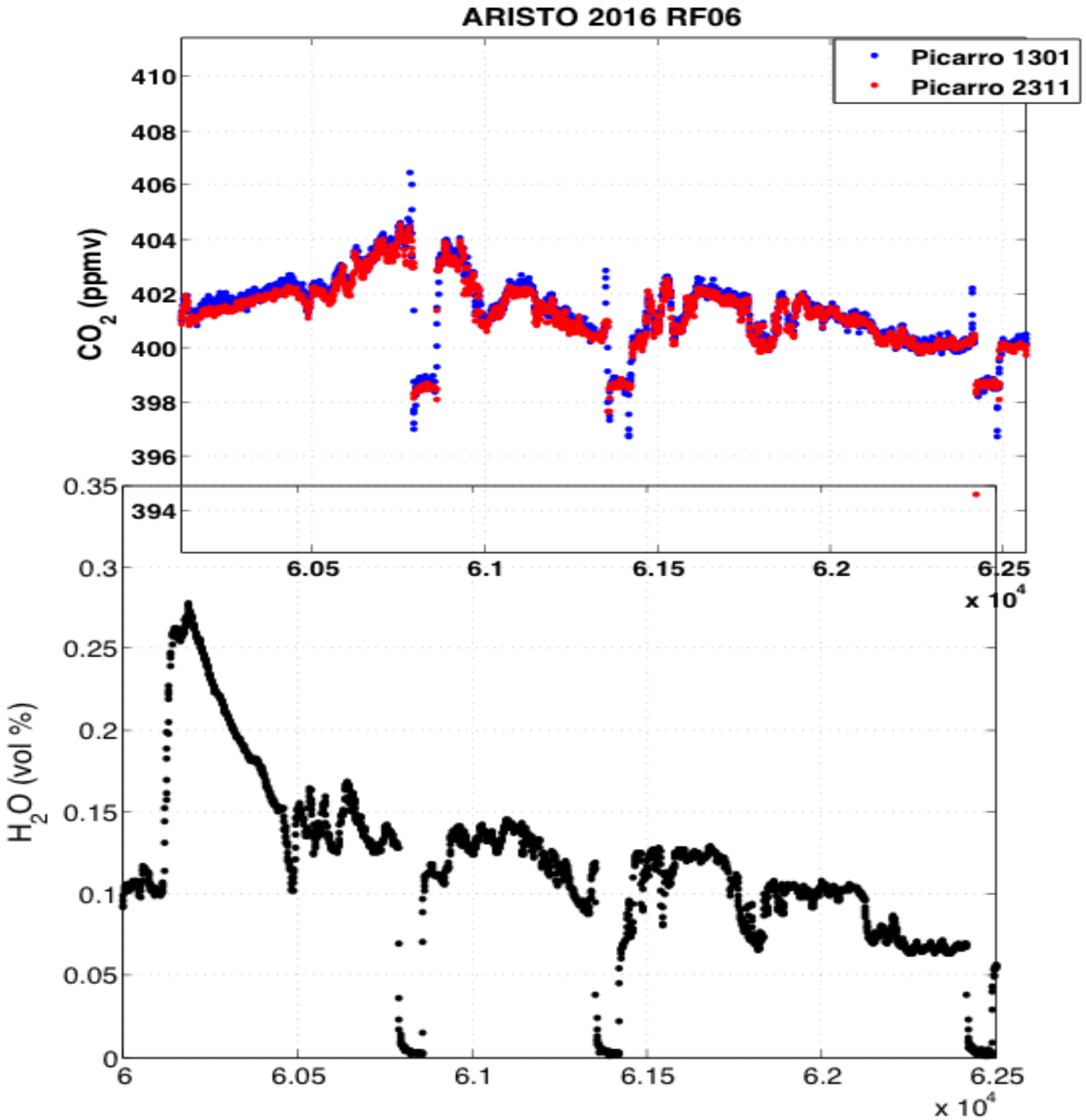
Flight/Expt	Configuration	
ARISTO-16; RF03; clear sky	Water removed from both Pics; multiple cal checks	Air motion artifact quantified; drying time; confirm accurate dry mole fraction measurement
ARISTO-16; RF06; cloud sampling, MBL	Water removed from G1301 only (2-ch); multiple cal checks	Air motion artifact quantified; Cryotrap ahead of 1301 used to evaluate 2311 water correction algorithm
ARISTO-16; RF04; clear sky	No drying for either instrument; multiple cal checks	Infer upper limit of 1301 water correction algorithm uncertainty
CONTRAST and ARISTO-16	2311 water correction algorithm compared to updated 2016 correction algorithm measurements	Evaluate temporal stability of water correction algorithm (lab and flight)


ARISTO 2016 RF03
Picarro 1301
Picarro 2311
Pitch
Mvrs
CO (ppmv)
440
435
430
425
420
415
410
405
400
395
390
INS Acceleration (m/s^2)
4
3
2
1
0
−1
−2
−3
−4
5.8
5.9
6
6.1
6.2
6.3
6.4
6.5
6.6
6.7
x 10^4


ARISTO 2016 RF03
Picarro 1301
Picarro 2311
Pitch
Mvrs
CO (ppmv)
410
408
406
404
402
400
398
396
394
5.8
5.9
6
6.1
6.2
6.3
6.4
6.5
6.6
6.7
x 10^4


ARISTO 2016 RF06
Picarro 1301
Picarro 2311
CO2 (ppmv)
405
400
395
390
7.45
7.5
7.55
7.6
7.65
7.7
x 10^4
Acceleration (m/s^2)
5
4
3
2
1
0
−1
−2
−3


ARISTO 2016 RF06
Picarro 1301
Picarro 2311
CO2 (ppmv)
405
400
395
390
7.45
7.5
7.55
7.6
7.65
7.7
x 10^4
H2O (vol %)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
−0.2


ARISTO 2016 RF06
Picarro 1301
Picarro 2311
CO2 (ppmv)
H2O (vol %)
x 10^4
x 10^4

Preliminary conclusions:

We were successful at acquiring data to meet our objectives
The G1301 model suffers from significant air motion sensitivity, and the 2311 model seems much smaller and perhaps insignificant.

Remaining Steps

Quantify the RMS added uncertainty due to WV correction for both 2311 and 1301 Picarro instruments.

Quantify the added uncertainty due to vertical acceleration, especially for the 1301.
Evaluate the suitability of the 2311 for vertical flux measurements by eddy correlation method.

Quantify the temporal stability of the Picarro humidity correction factors:

- 2311: CONTRAST 2014 and ARISTO-2016
- 1301: NOMADSS 2013 and ARISTO-2016

Evaluate the time response of each using spectral analysis of ambient sampling in the boundary layer. Compare.