

a. Shipboard Instruments

The R/V Ronald H. Brown (RB) is outfitted with sensors for air temperature (Ta), relative humidity (RH), barometric pressure (P), sea surface temperature (SST), and wind speed/direction (U, DIR). Ta and RH are from a Rotronic MP-101A mounted at 14 m ASL on the ship bow mast. Pressure is a Vaisala PTB330 mounted in the bridge at a height of 15.24 m ASL. Wind speed and direction are from an RM Young 05103 prop-vane mounted at 14.2 m ASL on the bow mast. SST and salinity are from an SBE45 micro-TSG drawing seawater from the ship's clean intake at 5m depth. The location of the SBE45 is not confirmed at this time, but ship's SST is elevated compared to the PSD seasnake and STRATUS buoys, so the plumbing lines may be subject to heating. Longwave and shortwave downwelling radiative flux are from WHOI ASIMET sensors mounted on the forward 02 deck railing, in close proximity to the PSD radiometers. RB underway data are normally available from the SAMOS site, but measurements for the period of this cruise seem to be missing from the SAMOS database. Ship data presented in this report were recorded from a serial feed to the PSD data acquisition system during the cruise.

b. ESRL/PSD flux system

The ESRL/PSD/BLO collected surface meteorology and sea surface temperature data during the cruise. The PSD met system deployed for STRATUS 2017 consists of eleven components:

1. Vaisala WXT520 weather station for U, T, RH, P and rain rate @ 17 m ASL on the bow mast.
2. Eppley PSP and PIR solar and infrared radiometers (2 each) on the forward 02 deck railing.
3. Vaisala HMT330 T/RH sensor in a ventilated shield @ 16.5 m ASL on the bow mast.
4. Vaisala PTB220 digital barometer @ 16 m on the bow mast.
5. Differential GPS unit measuring 2 Hz SOG, COG, heading and roll angle from the forward 02 deck.
6. Floating sea surface temperature measurement (YSI 46040 thermistor, sea snake).
7. Gill Windmaster-Pro 3-D sonic anemometer @ 18.16 m ASL on the bow mast.
8. 10-Hz motion system (Systron Donner MotionPak) @ 17.6 m ASL on the bow mast.
9. Licor LI-7500 fast CO₂/water vapor sensor @ 17 m on the bow mast.
10. OCI ORG-815 optical rain gauge @ 14.5 m on the bow mast.
11. A fast pressure sensor @ 16.5 m on the bow mast.

The sea snake SST sensor drags ~5 cm below the surface and was deployed from a davit-boom off the port bow, several meters forward of an engineering water discharge point on the ship's hull. These were all logged on a NOAA/PSD acquisition system to hourly files for the duration of the cruise.

Bulk fluxes are computed from ‘best’ met measurements on 10-min and hourly timescales using COARE 3.5. For STRATUS-2017, ‘best’ values for bulk variables are defined as:

- 1) Wind speed and direction: PSD Gill sonic with flow distortion correction
- 2) Air temperature: PSD Vaisala HMT330
- 3) RH: PSD WXT520
- 4) SST: PSD seasnake
- 5) Longwave radiation: mean of both PSD PIRs
- 6) Solar radiation: mean of both PSD PSPs
- 7) Pressure: PSD WXT520
- 8) Rain: PSD ORG-815

c. Comparisons with STRATUS-15 and -16

Tables 1 and 2 show the mean, median and standard deviation in measurement bias for ship and buoy systems relative to the PSD measurements. Pressures are adjusted to sea level ($z = 0$) for all systems. For the PSD-ship comparison, U, T and RH variables are unadjusted for measurement height. PSD wind speed is adjusted for mean flow distortion effects at the ship’s bow: U is increased by 5% and V decreased by 15%. For the comparison with buoy systems, PSD data (U, Ta, RH) are adjusted to $z = 3\text{m}$ with COARE 3.5. Comparison statistics for U, Ta and RH are limited to hours when the relative wind direction at the ship is within $\pm 60^\circ$ from the bow.

STRATUS-15 (S15) data are 1-min from data loggers 1 and 2, averaged to 1 hour.

STRATUS-16 (S16) data are 1-hr averages transmitted from loggers 1 and 2 following deployment.

Table 1 shows a comparison over the entire period at the STRATUS site (DOY 132.2–136.8).

Table 2 limits the comparison with each buoy to the time when the ship was near the mooring. Comparison times are DOY 134.1–135.9 for S15 and DOY 136.1–136.9 for S16. Map plots show hourly positions near each mooring corresponding to valid comparison data (red markers).

Time series and correlation plots for each variable are shown on following pages and available as separate files in .png format. Time series plots show all measurements, unfiltered for relative wind direction or location. Correlation plots show only valid intercomparison measurements.

d. Additional notes

Two additional plots are included for longwave radiation, illustrating a difference between the ship’s ASIMET and PSD IR radiometers. The PSD measurement is the mean of both PIRs deployed for the project, which are in generally good agreement.

The difference (SCS – PSD) is close to zero at night but shows a positive bias of 5-10 W/m^2 during the day (red trace in upper plot on p.13, blue trace shows solar radiation to indicate daytime periods). Bin averaged by hour of day for the whole cruise, the daytime difference is very clear in the SCS-PSD trace and may also be present in the buoy measurements, but the relationships are noisy due to limited data.

The cause for this difference is unknown at this time but may be due to: 1) a difference in the dome temperature correction factor or other error in PSD or SCS processing code or 2) slightly greater solar radiation contamination in the ASIMET sensors. PSD uses a coefficient value of 4 in the dome temperature correction term of the Albrecht-Cox equation:

$$Rl (W/m^2) = \frac{mV}{C} + \sigma_{sb}T_c^4 - 4\sigma_{sb}(T_d^4 - T_c^4)$$

Table 1: Bulk met measurement bias relative to NOAA/PSD for the entire period of time at the STRATUS site.

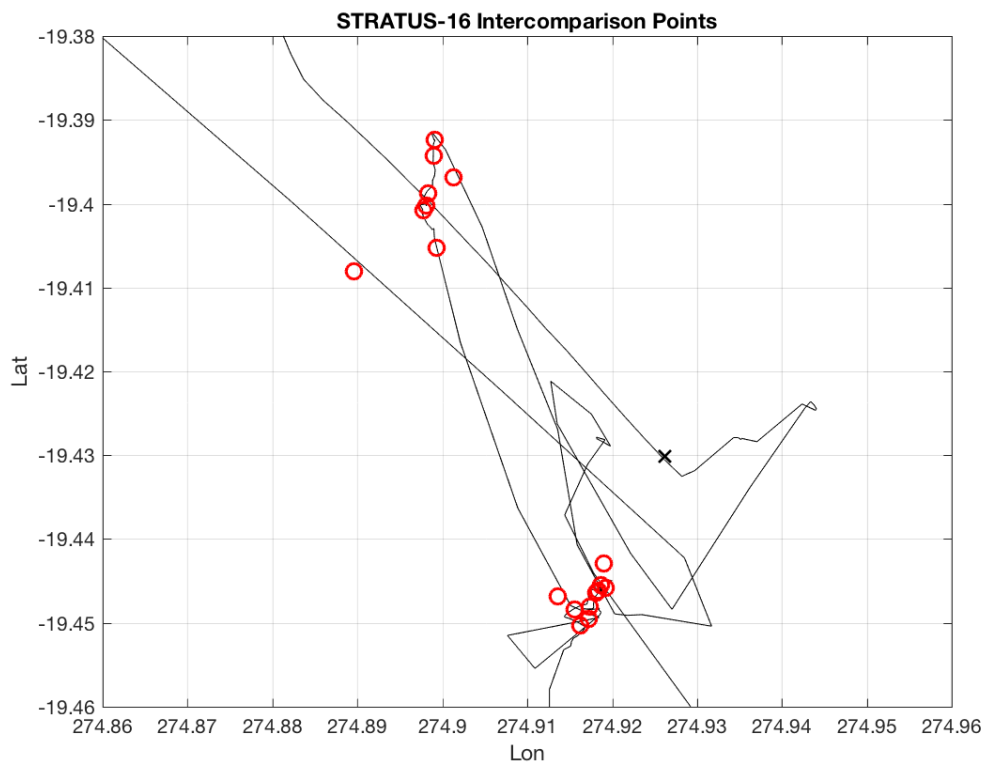
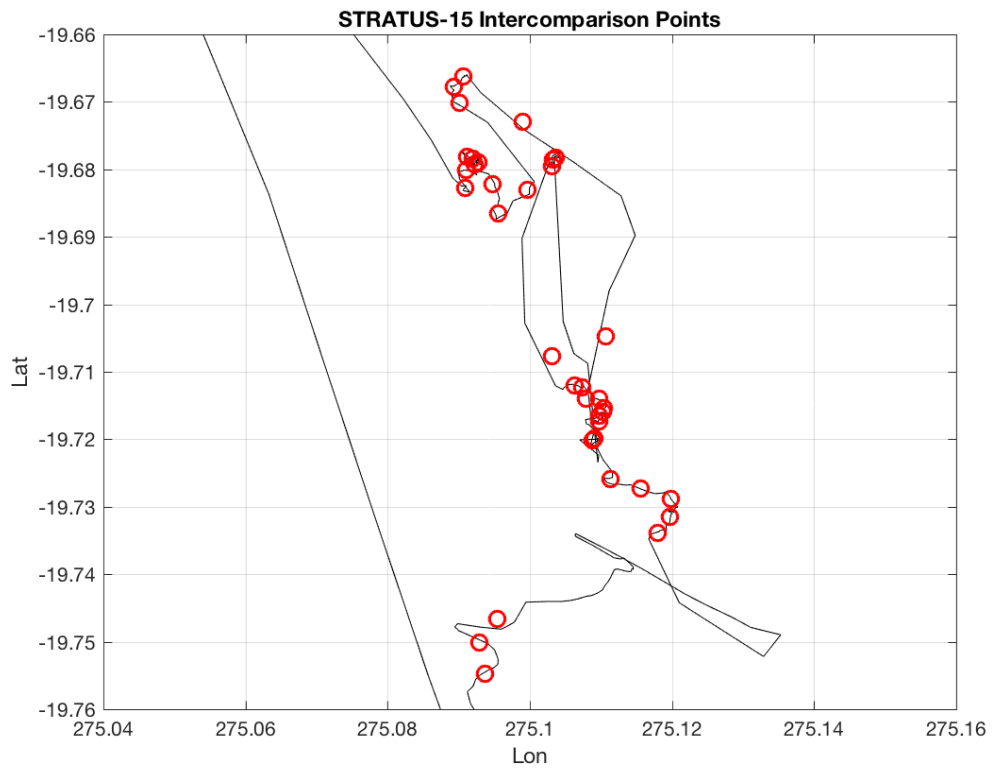
Bias	Ta C	RH %	SST C	U m/s	dir deg	Rs W/m2	RI W/m2	P mb
psd – ship								
mean	0.12	2.02	-0.49	-0.43	-9.03	-0.96	-1.81	0.04
median	0.11	1.98	-0.49	-0.44	-8.87	0.42	-1.09	0.04
std	0.06	0.31	0.16	0.30	2.02	11.95	2.83	0.05
psd – S15-1								
mean	-0.14	-0.79	0.10	0.53	-2.41	-8.39	-1.74	0.18
median	-0.15	-0.91	0.10	0.54	-2.10	-4.80	-1.40	0.19
std	0.16	1.68	0.04	0.53	5.31	59.06	16.22	0.13
psd – S15-2								
mean	-0.15	-2.76	0.10	0.60	0.67	-5.86	1.37	0.07
median	-0.17	-2.79	0.10	0.60	1.48	-1.69	1.28	0.07
std	0.18	1.78	0.04	0.53	5.29	57.54	16.56	0.10
psd – S16-1								
mean	-0.22	-3.14	0.04	0.76	-6.44	-3.25	-1.83	0.56
median	-0.19	-3.14	0.03	0.74	-6.75	-2.63	-0.93	0.56
std	0.25	2.71	0.04	0.78	6.61	59.93	18.06	0.29
psd – S16-2								
mean	-0.16	-3.49	0.04	0.69	-0.88	-4.79	-0.40	0.61
median	-0.13	-3.53	0.03	0.67	-0.94	-4.49	0.93	0.64
std	0.26	2.67	0.04	0.76	6.39	59.99	17.69	0.31

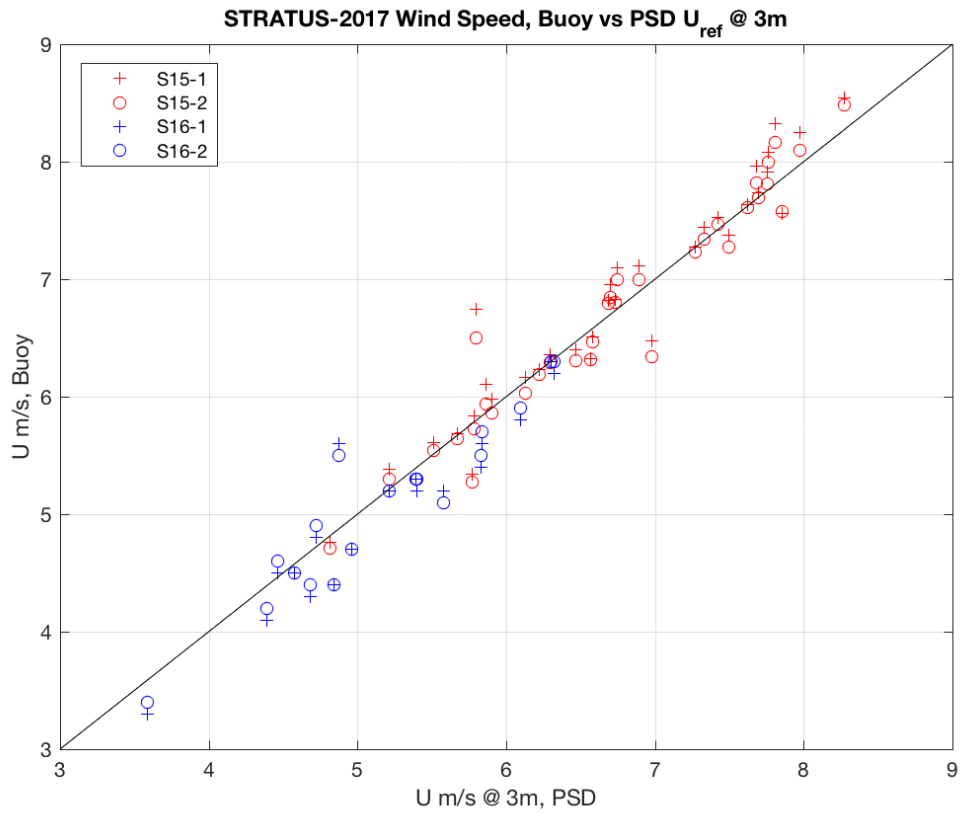
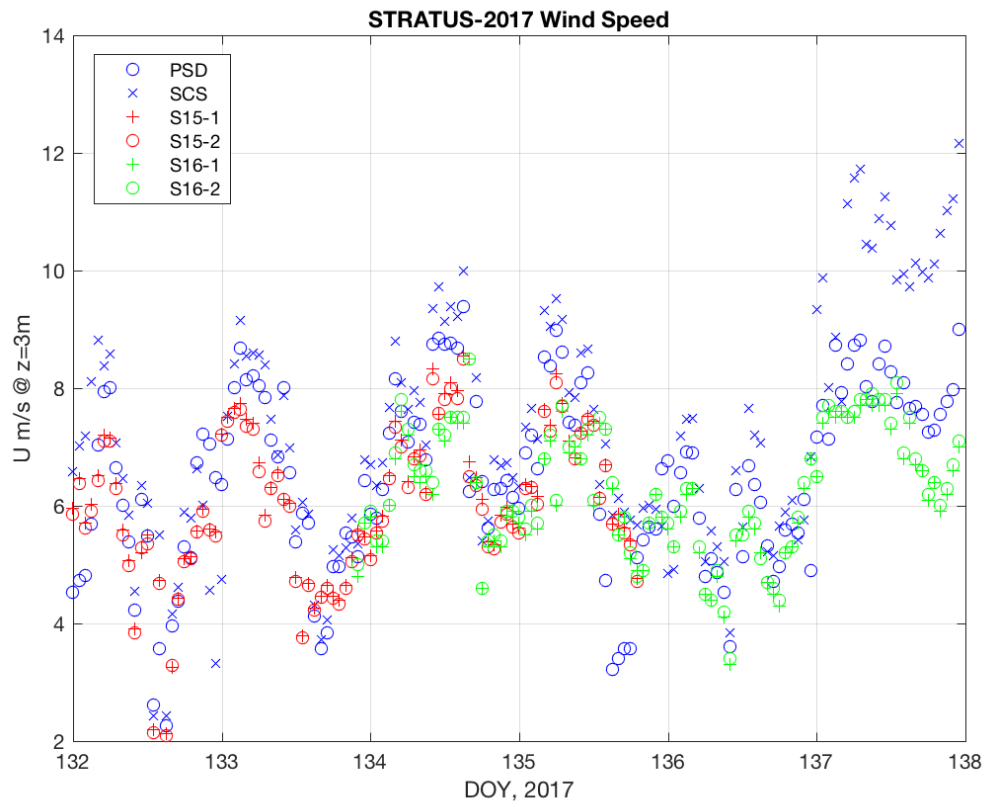
Table 2: Bulk met measurement bias relative to NOAA/PSD measurements for buoy intercomparison periods

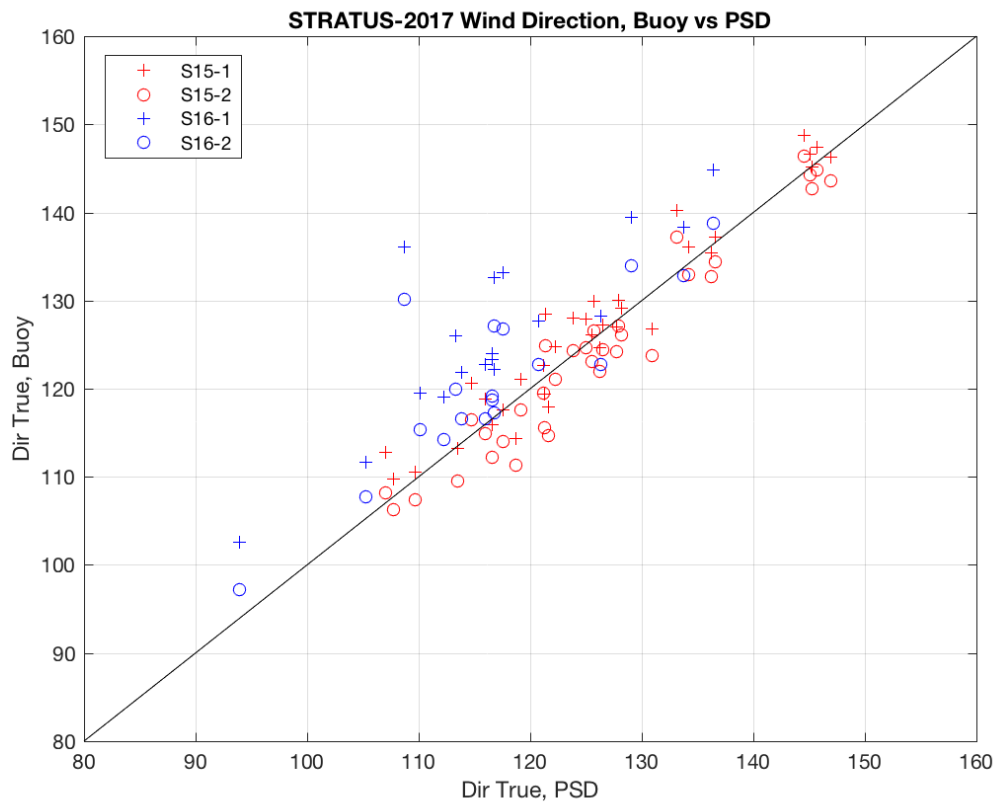
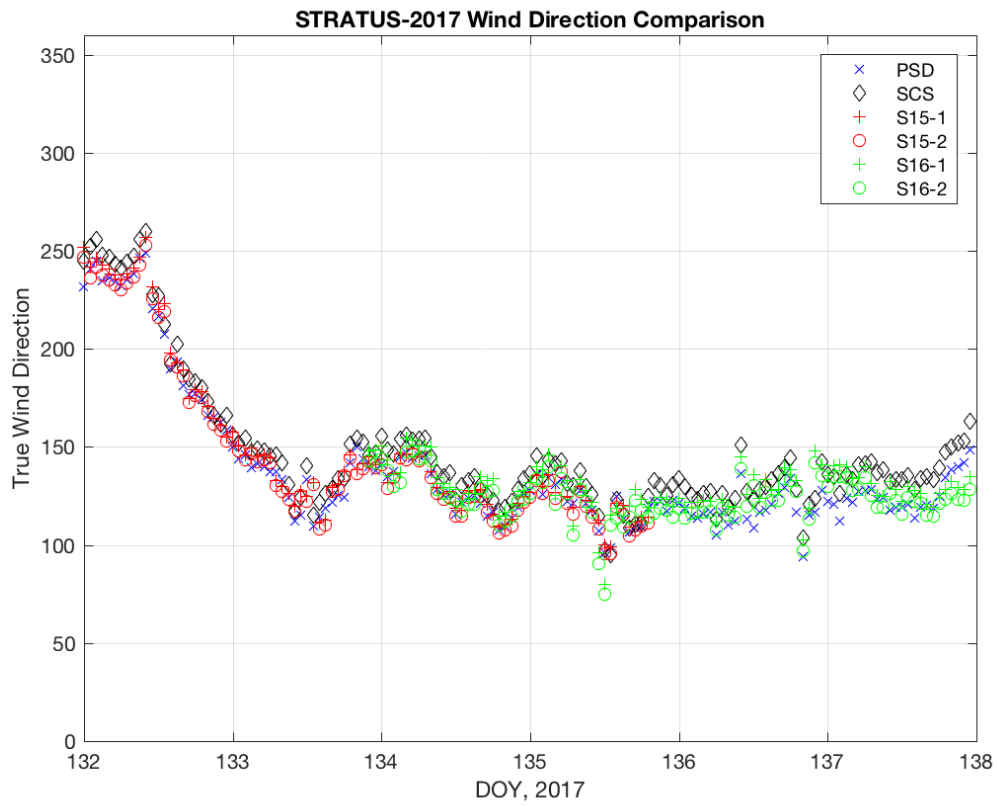
Bias	Ta C	RH %	SST C	U m/s	dir deg	Rs W/m ²	RI W/m ²	P mb
psd – S15-1								
mean	-0.17	-1.05	0.08	0.62	-1.29	-1.97	-3.33	0.22
median	-0.16	-0.99	0.08	0.64	-1.22	-4.61	-1.26	0.23
std	0.11	1.04	0.02	0.33	2.87	40.14	5.72	0.13
psd – S15-2								
mean	-0.20	-3.05	0.08	0.71	1.91	0.01	-0.25	0.10
median	-0.19	-2.91	0.08	0.70	1.91	-1.42	1.20	0.11
std	0.11	1.10	0.02	0.30	2.74	38.19	4.37	0.11
psd – S16-1								
mean	-0.19	-2.05	0.08	0.49	-9.39	-3.11	-0.79	0.41
median	-0.17	-2.20	0.07	0.59	-7.74	-2.94	-0.54	0.36
std	0.12	1.40	0.05	0.34	5.71	21.15	5.69	0.27
psd – S16-2								
mean	-0.10	-2.61	0.08	0.45	-4.09	-3.69	0.32	0.46
median	-0.10	-2.60	0.07	0.53	-2.51	-4.55	0.85	0.37
std	0.16	1.38	0.05	0.33	5.45	21.11	5.78	0.30

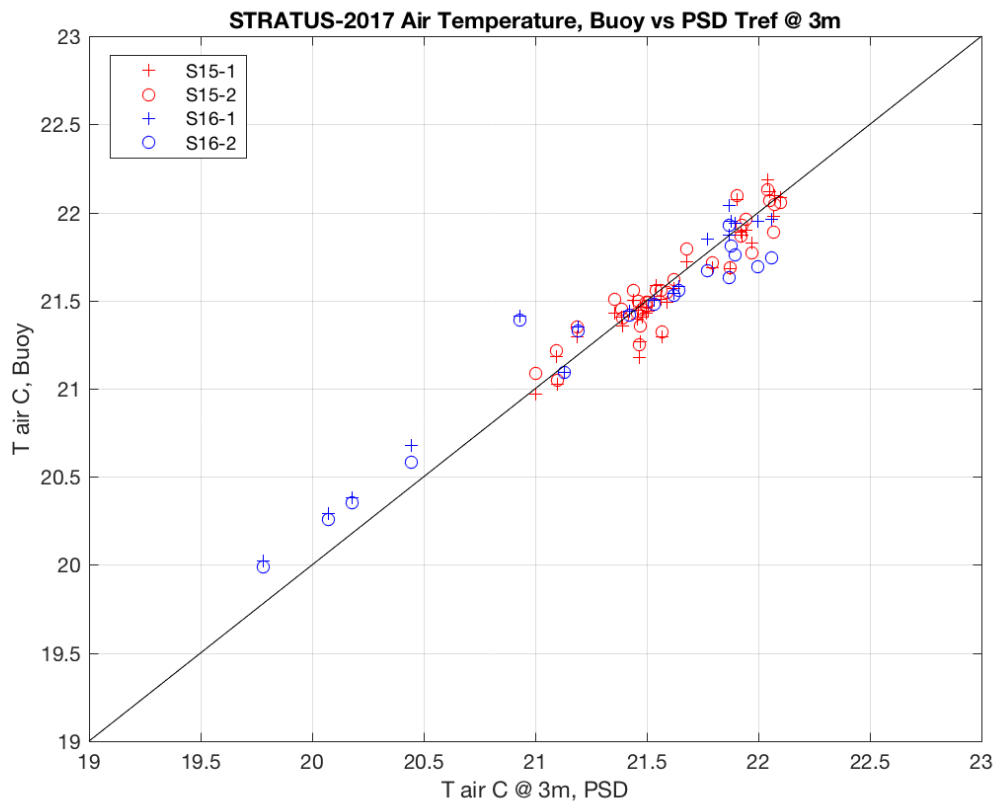
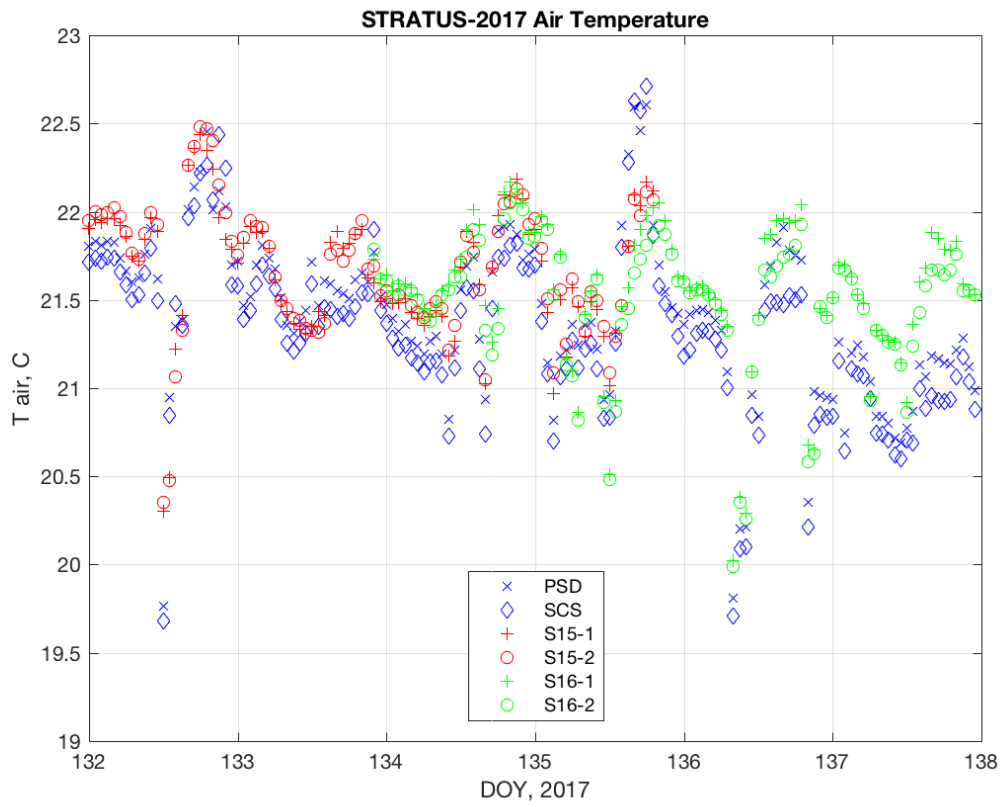
TABLE 3: Flux system components and calibration information

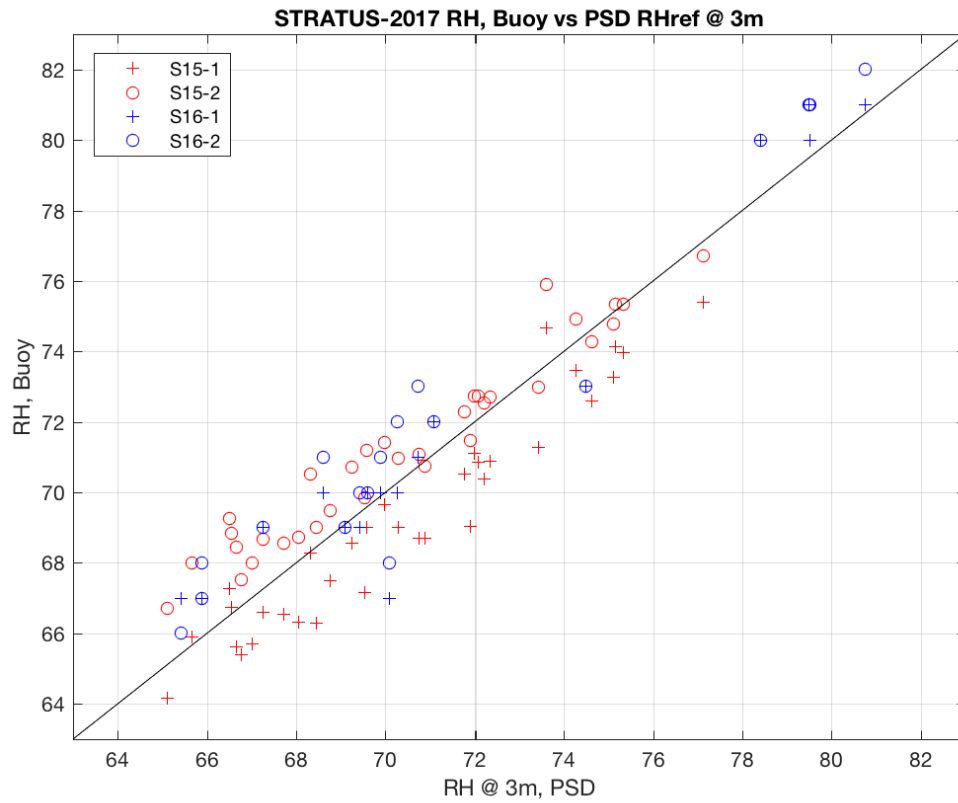
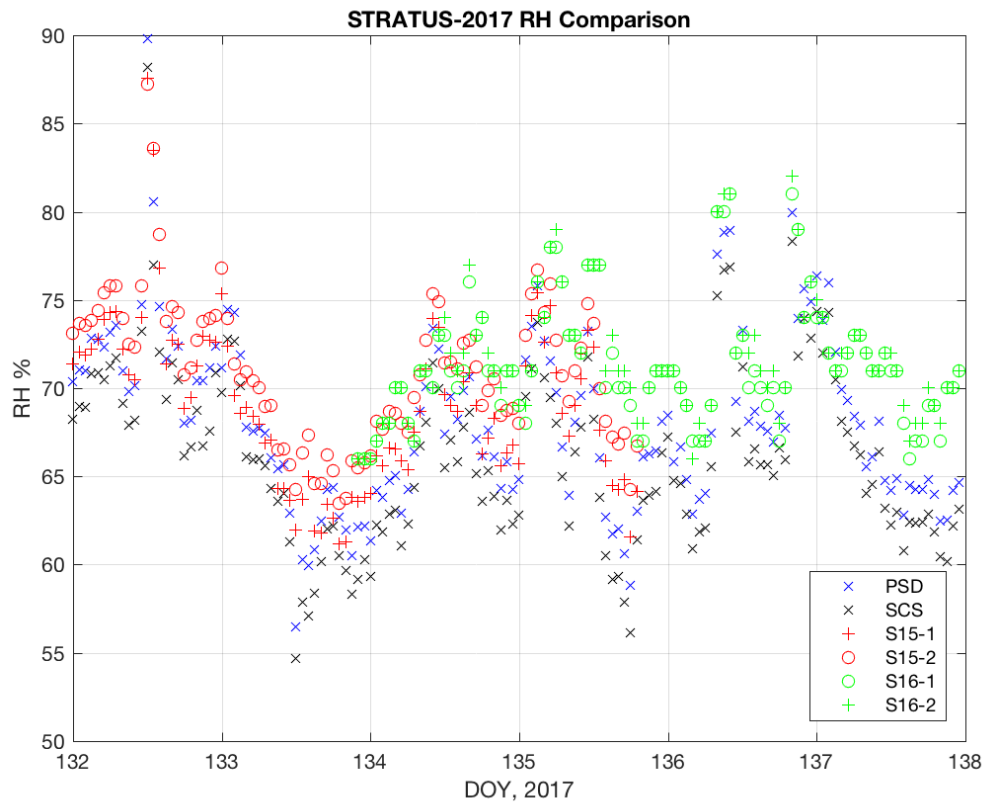
Sensor	Calibration coefficient	Make / Model	Serial Number	Date of calibration
Precision Spectral Pyranometer	0.00865	Eppley / PSP 1	30593F3	April, 2016
Precision Spectral Pyranometer	0.00847	Eppley / PSP 2	30434F3	April, 2016
Precision Infrared Radiometer	0.00392	Eppley / PIR 1	34302F3	April, 2016
Precision Infrared Radiometer	0.00431	Eppley / PIR 2	30432F3	April, 2016
Rain Gauge	Offset=0.058mV	OSI/ORG815DA	8060281	Dec, 2013 Tested April, 2017
Motion Pak		Systron &Donner	681	June 22, 2015
Angular Rate x-axis y-axis z-axis	24.924mV/deg/s 24.917mV/deg/s 24.912mV/deg/s			
Linear Acc x-axis y-axis z-axis	3.744 V/g 3.746 V/g 3.748 V/g			
Wind Sensor	n/a	Gill /Wind Master Pro 1561-PK-20	1004002	
Sea Snake thermistor 0C to 40C	C4=0.001399937 C5=0.00237854 C6=0.000000097	YSI 46040 series	n/a	
Temp / Humidity	n/a	Vaisala/HMT335	C1110008	
Class A Barometer	n/a	Vaisala/ PTB220	A2710002	
CO2/H2O Analyzer	Available	Licor / LI-7500 In use	75H-1749	Zeroed Jul 19,2013 CO2 Zero=0.9190 H2O Zero=0.9023
Vaisala Weather Transmitter		WXT-520	L4720496	
Riegl Laser Distance Sensor	n/a	LD90-3100VHS-FLP	9994271	

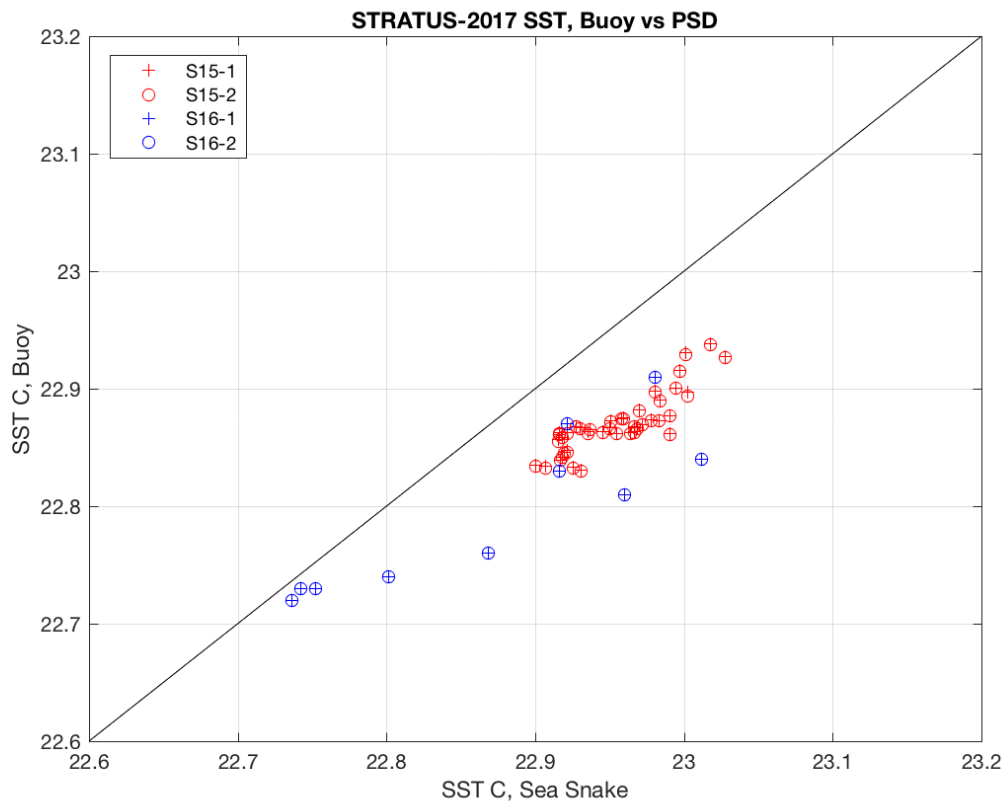
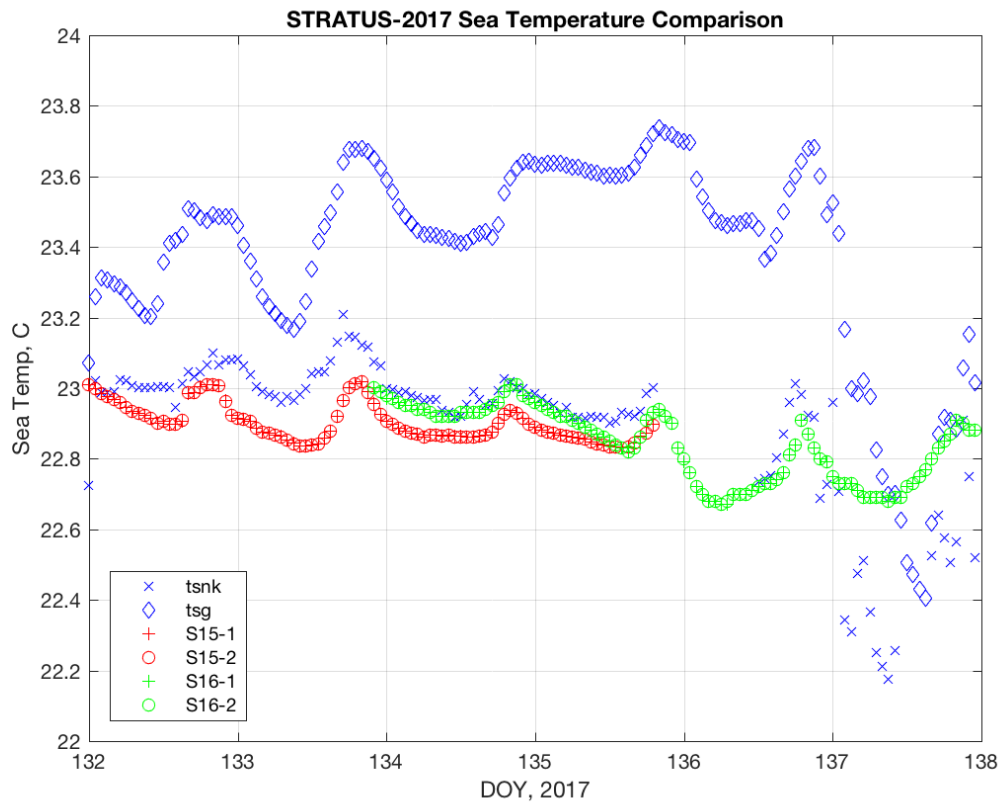


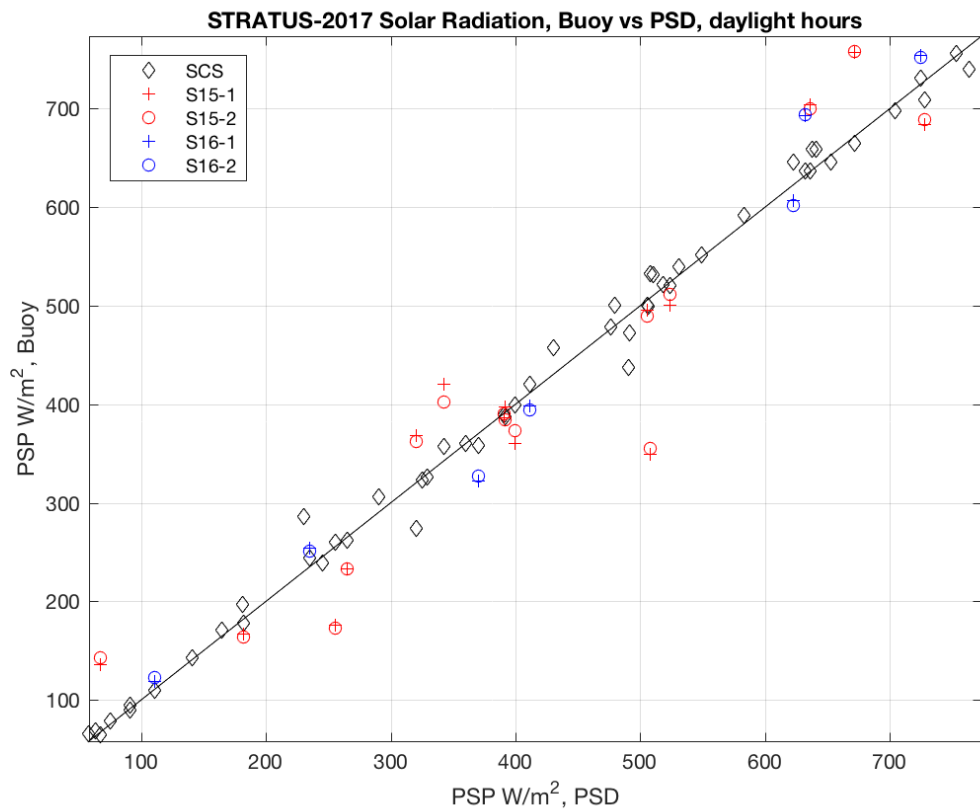
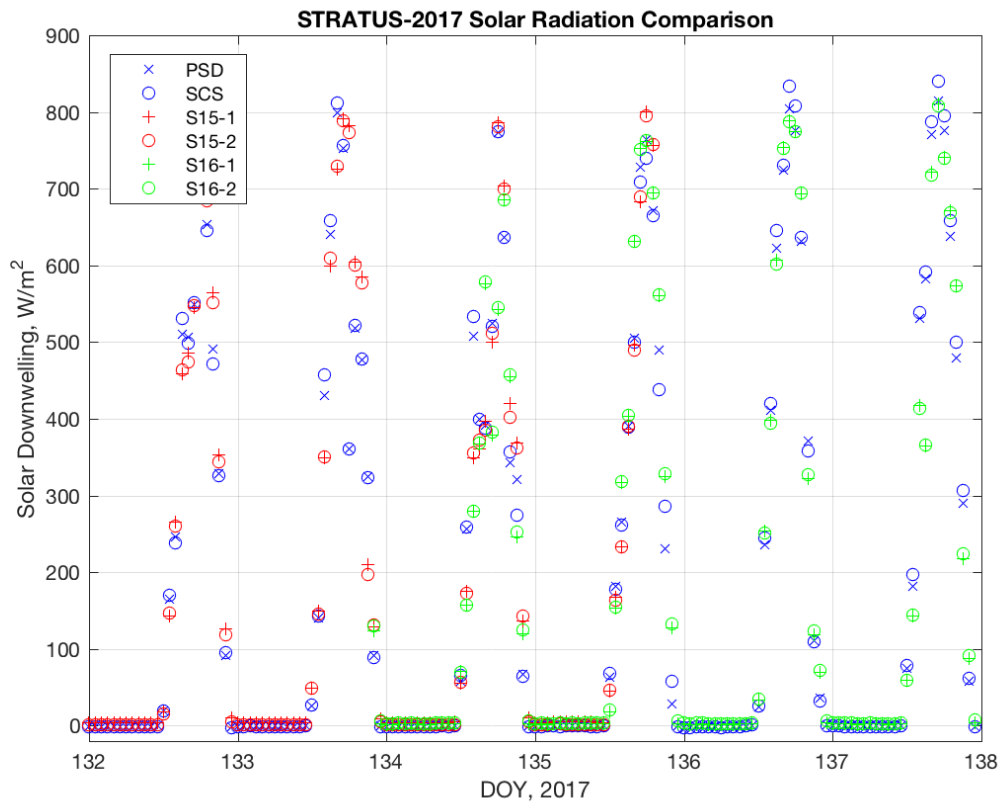


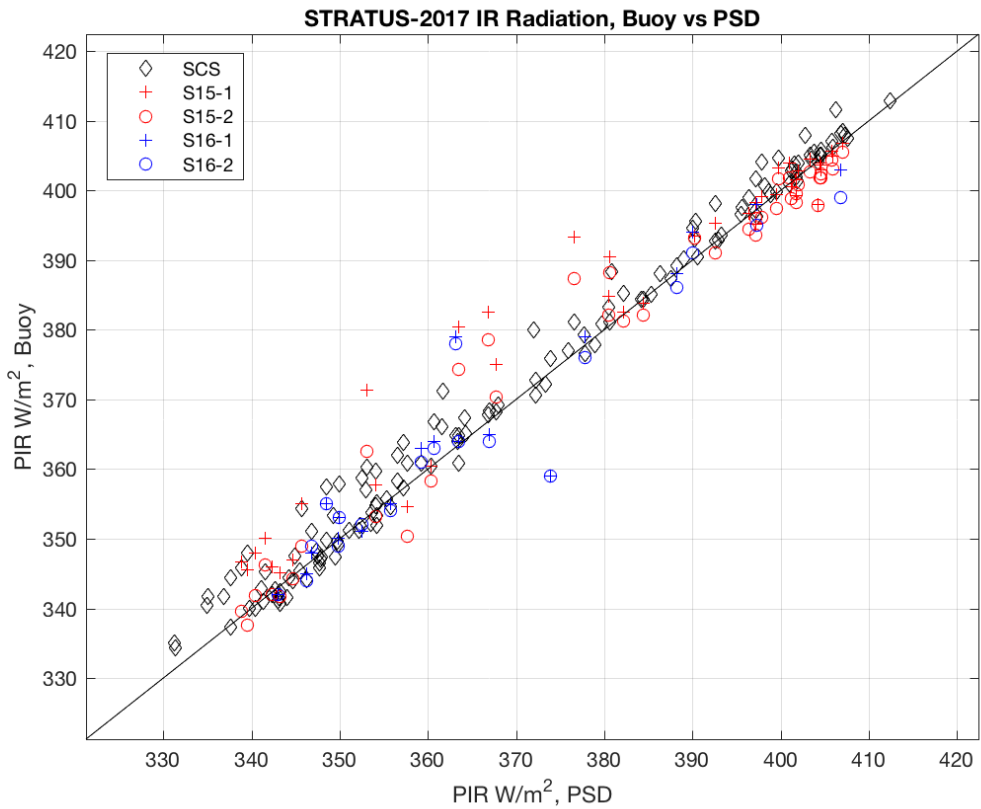
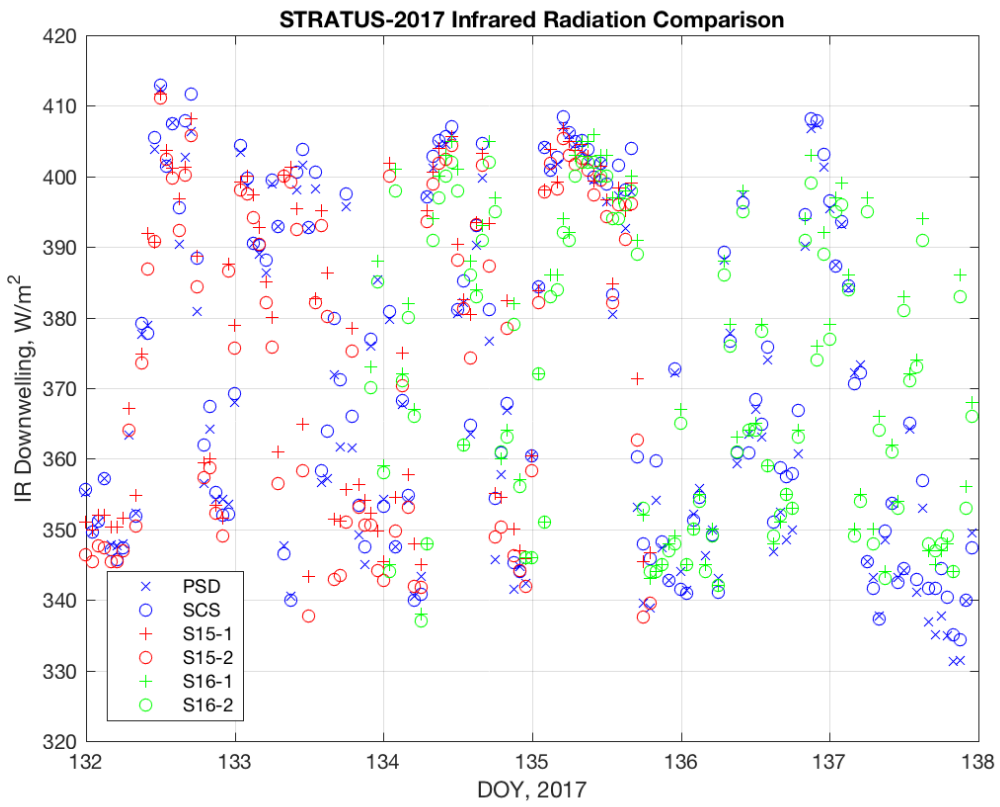


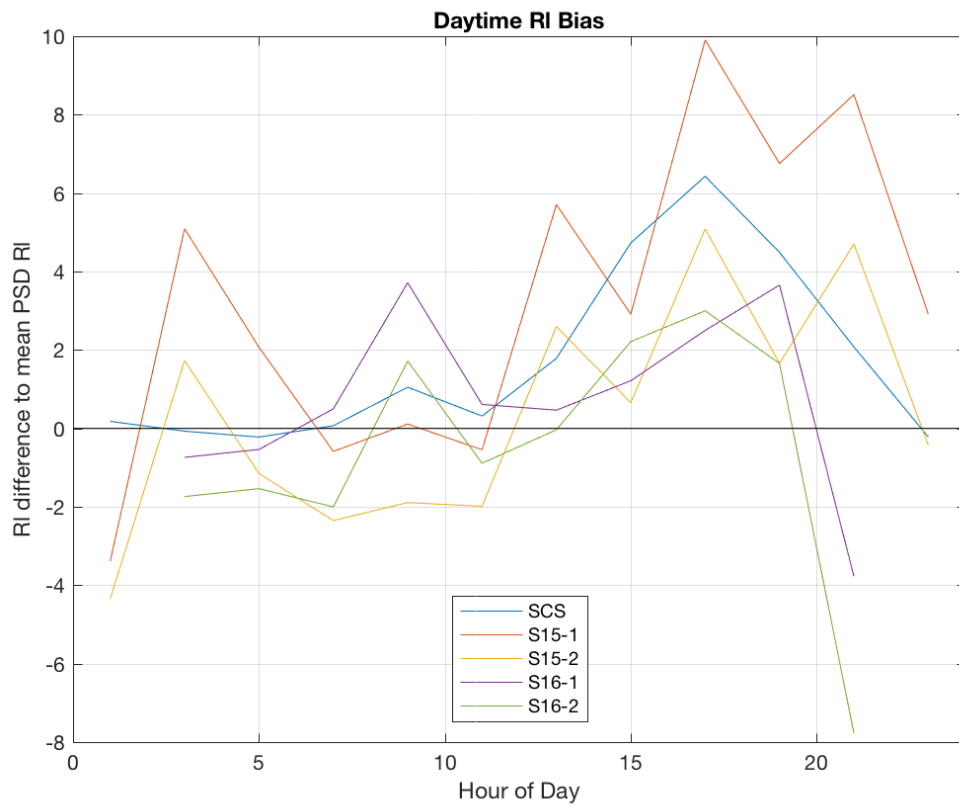
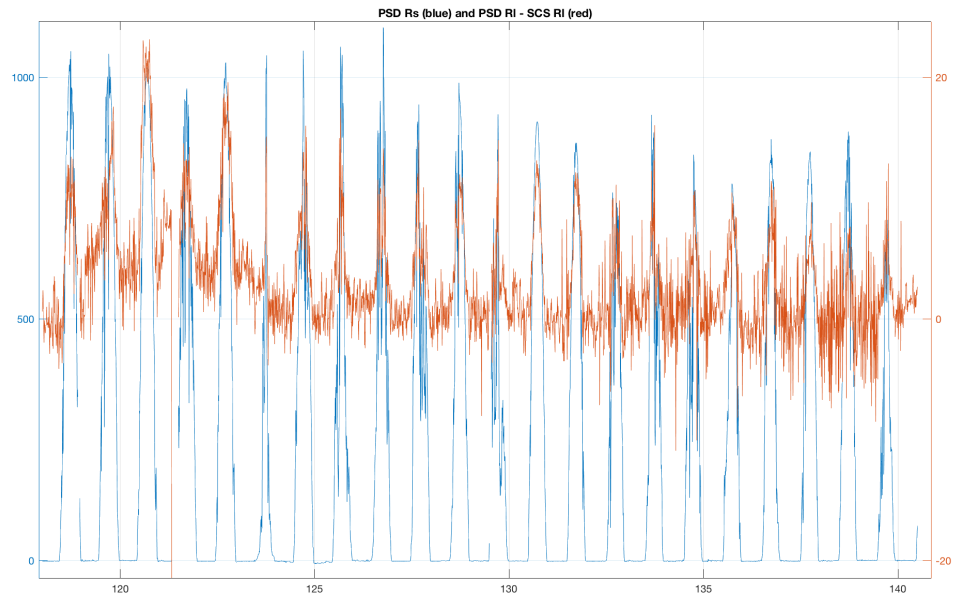




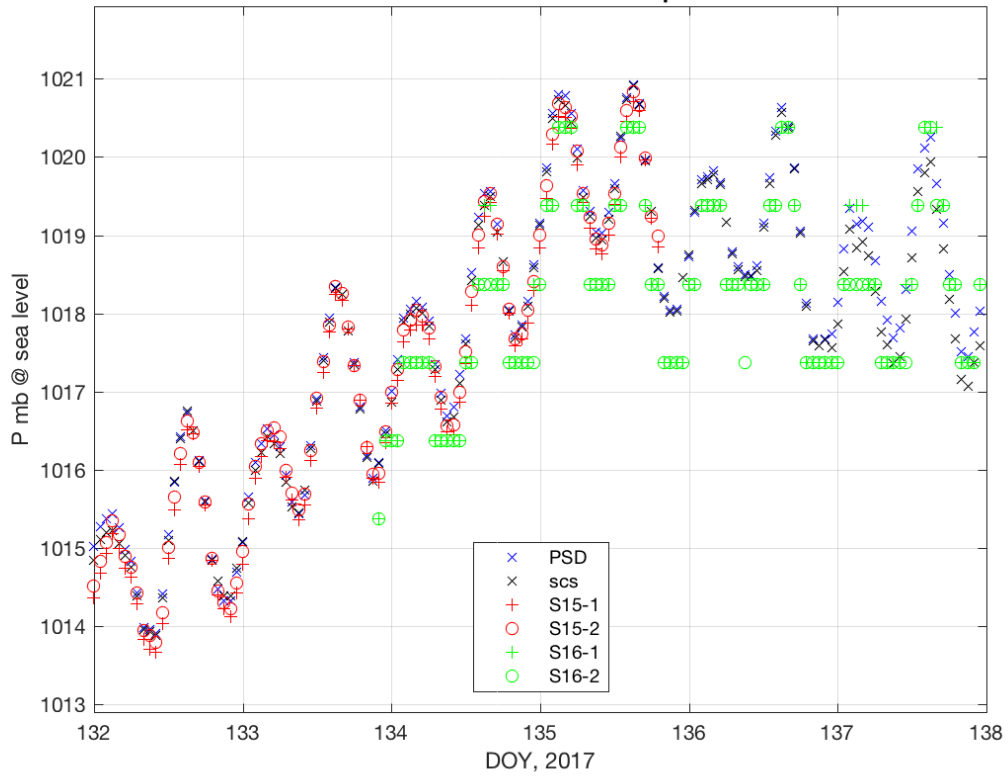








STRATUS-2017 Pressure Comparison



STRATUS-2017 Sea Level Pressure, Buoy vs PSD

