

# Rain Rates Measured Acoustically in the Central Equatorial Pacific Using STS/PAL Drifters



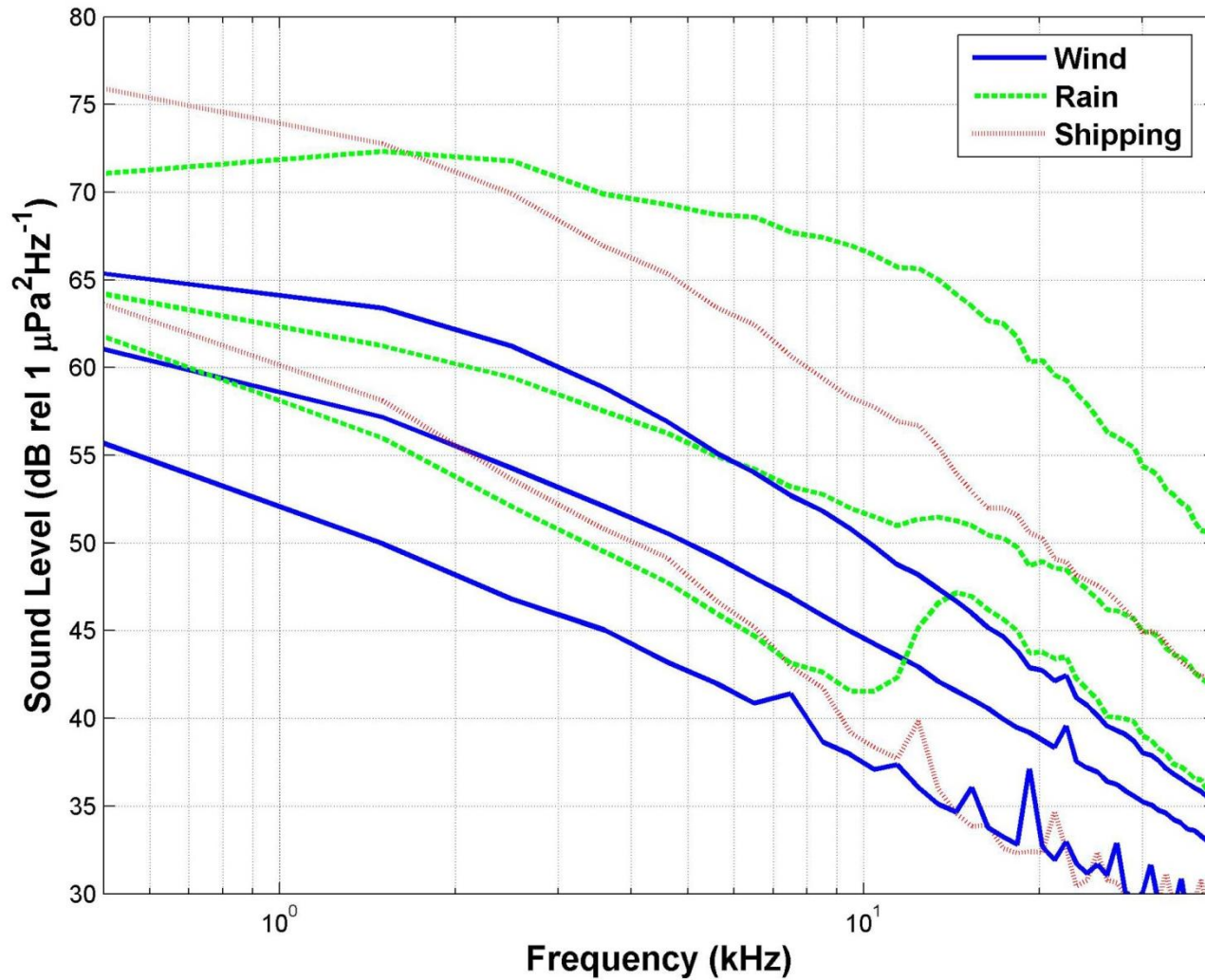
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Applied Physics Laboratory, University of Washington

Eighth Aquarius/SAC-D Science Team Meeting

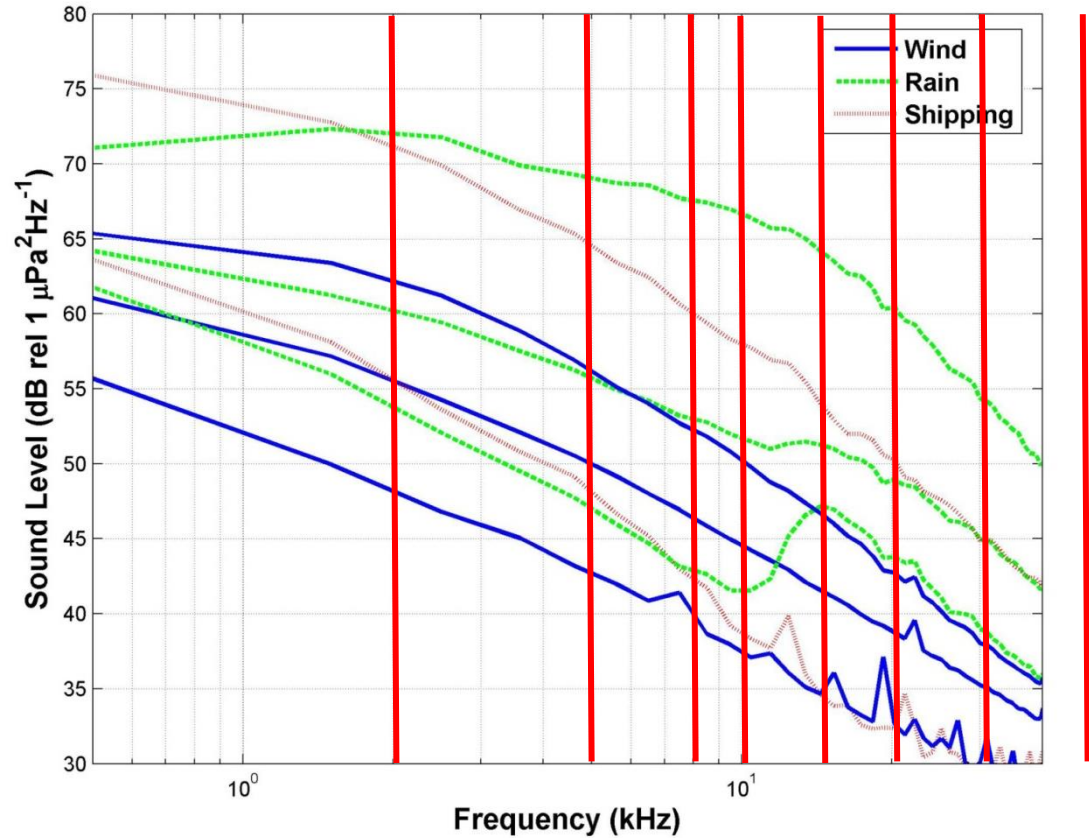
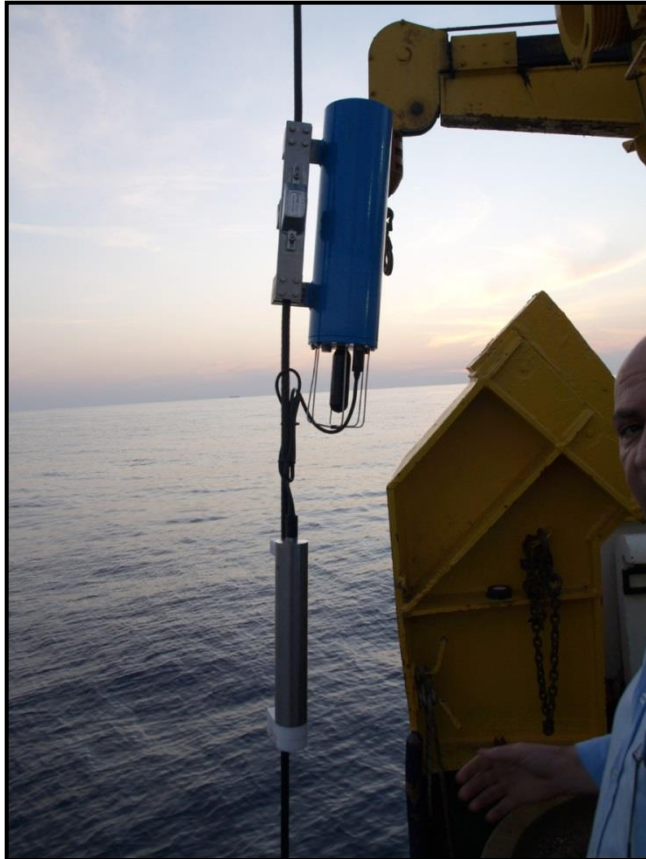
Project funded by NASA under the Aquarius Mission

# Underwater acoustics: The basics\*



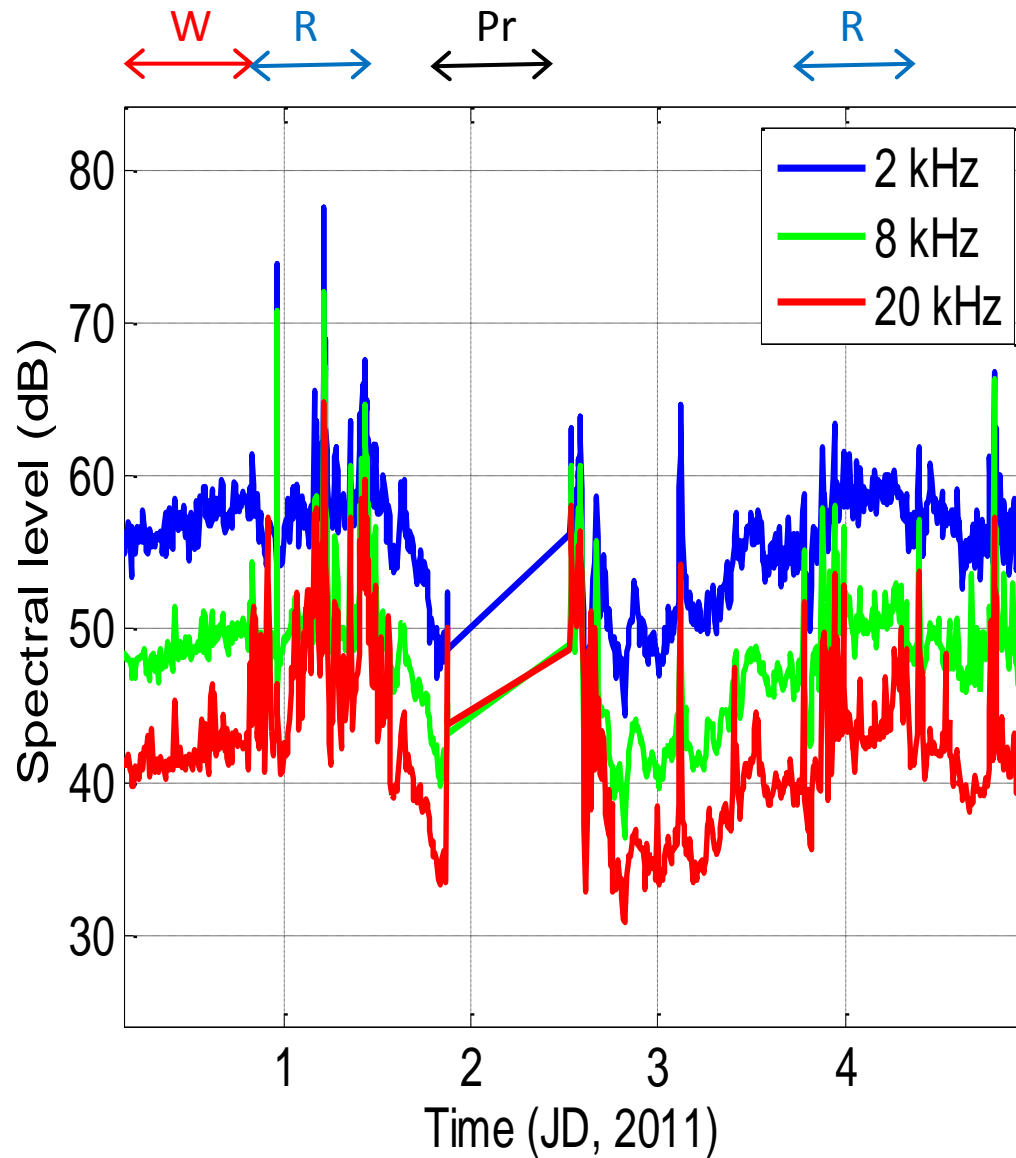
\*As related by someone who doesn't know any underwater acoustics

# The Passive Aquatic Listener (PAL) instrument

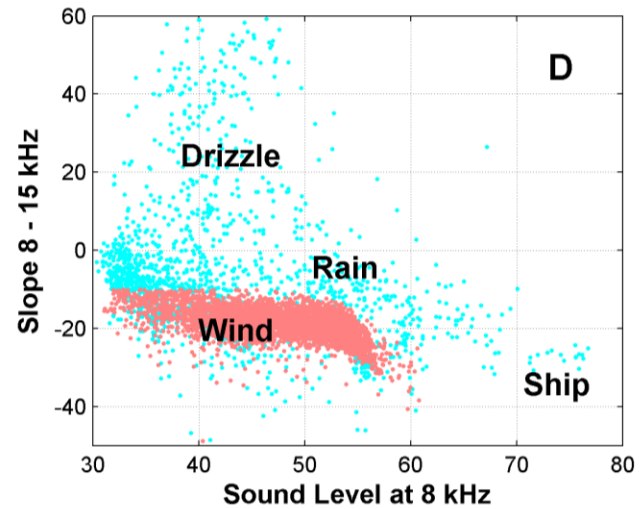
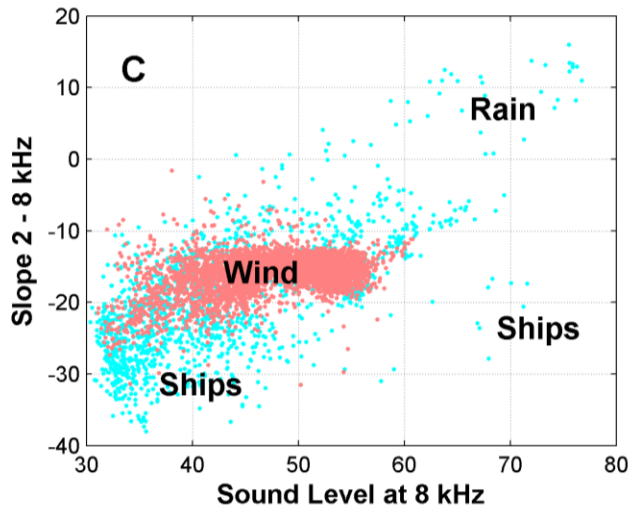
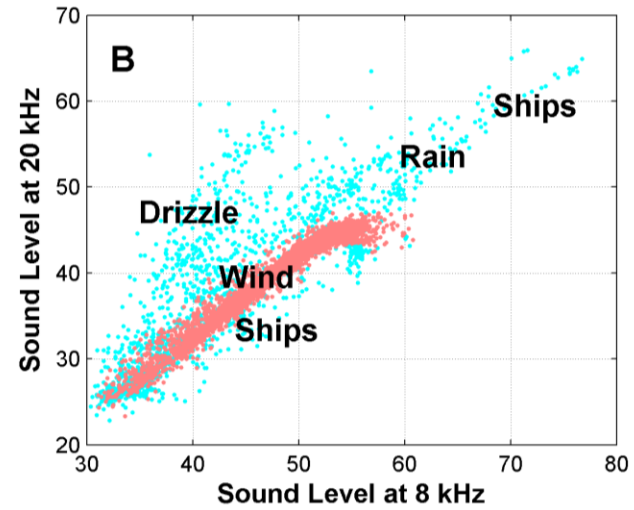
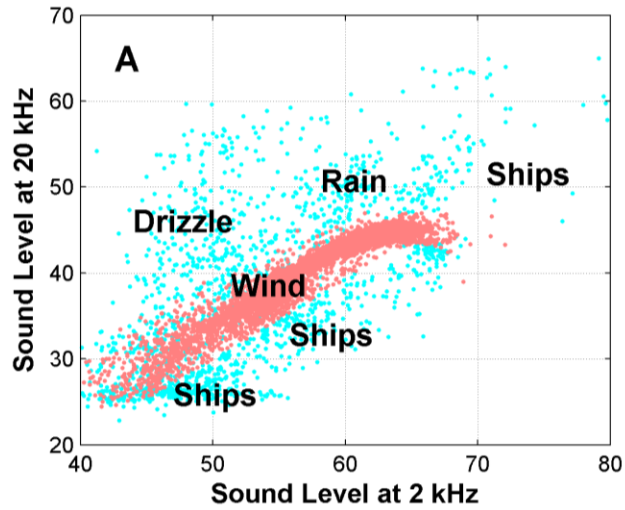


STS-PAL Profiling floats sample sound at 8 discrete frequencies  
Record sampled spectra while float is parked at 1000 m

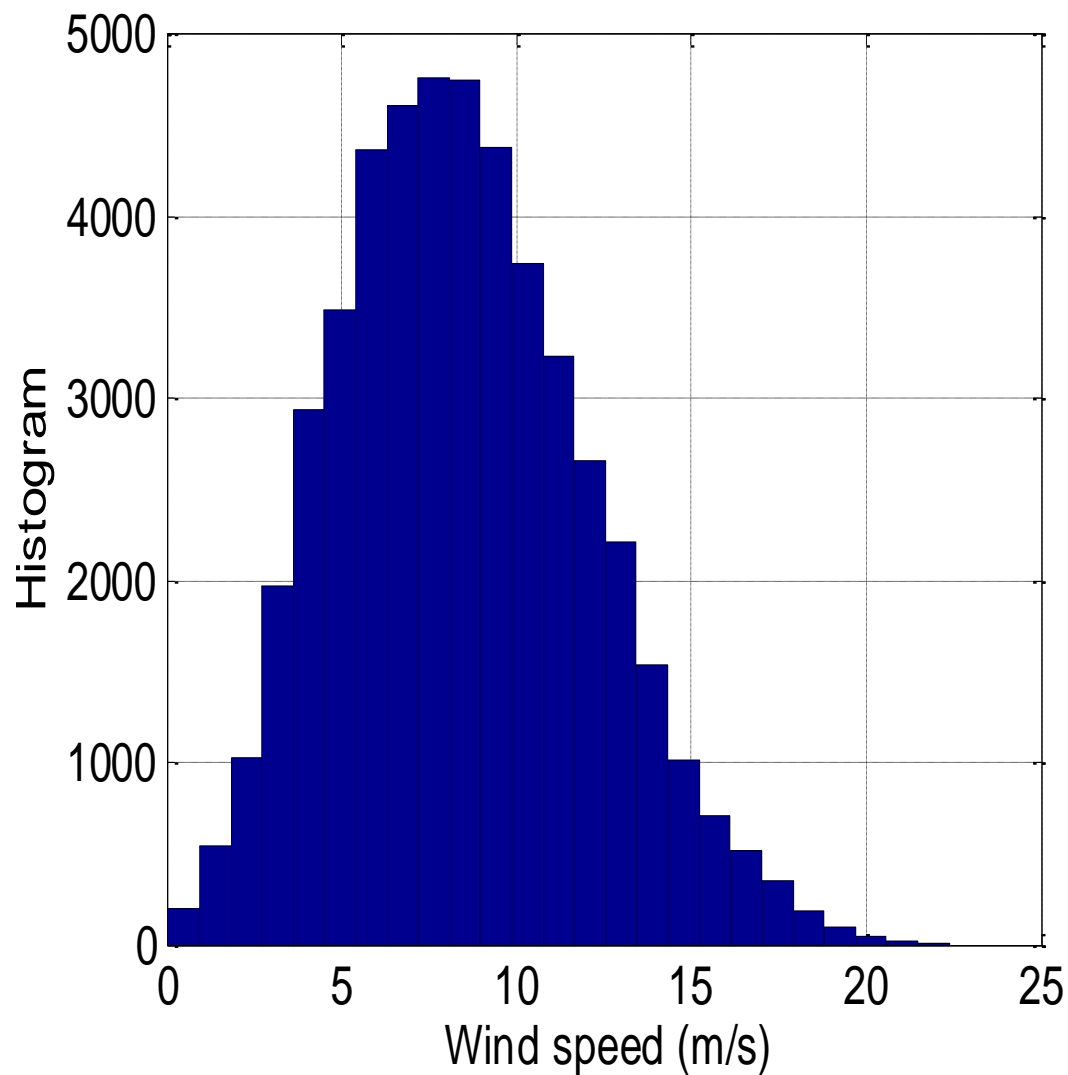
# PAL data: A short illustrative time series



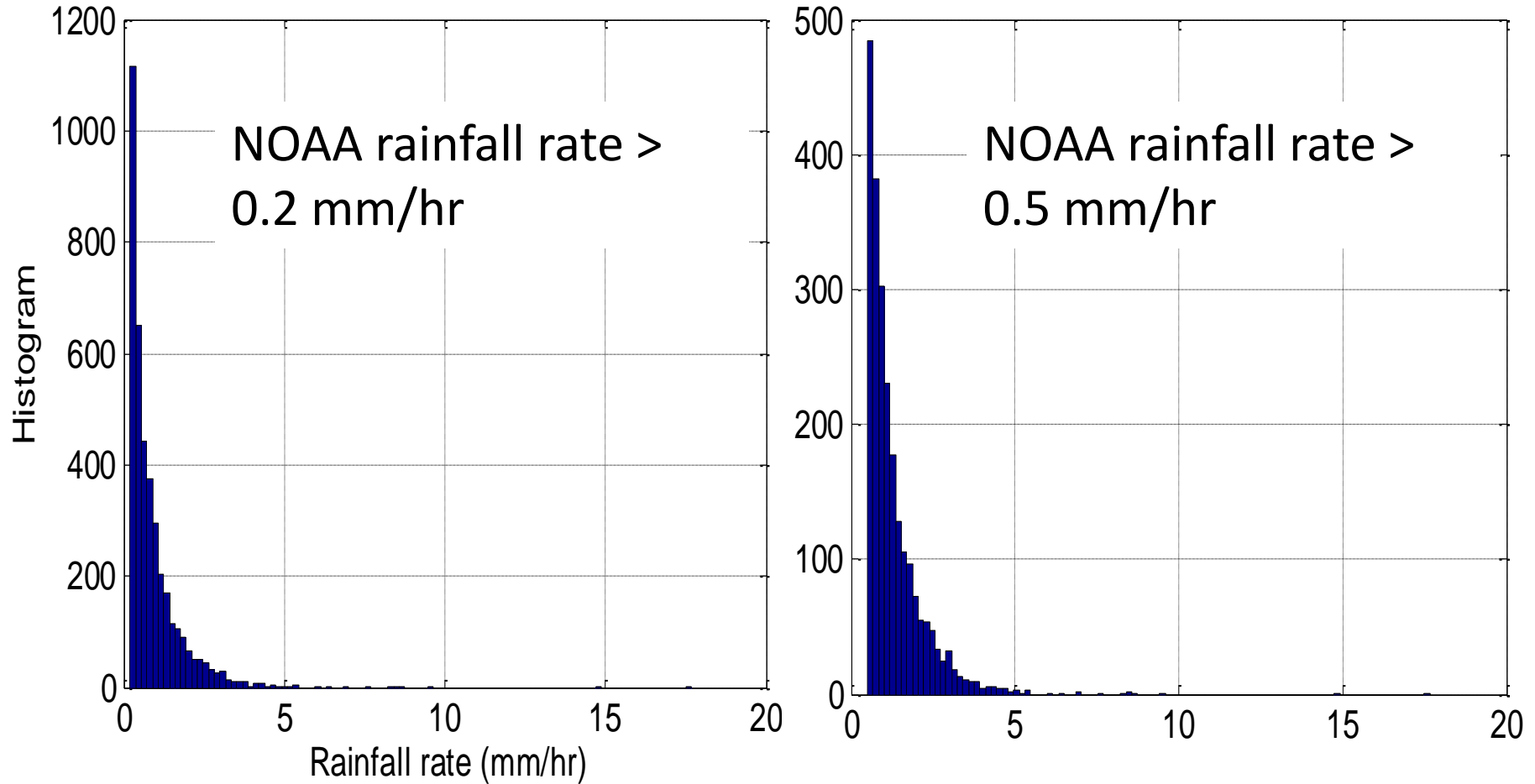
# PAL data classification: Separating noise sources



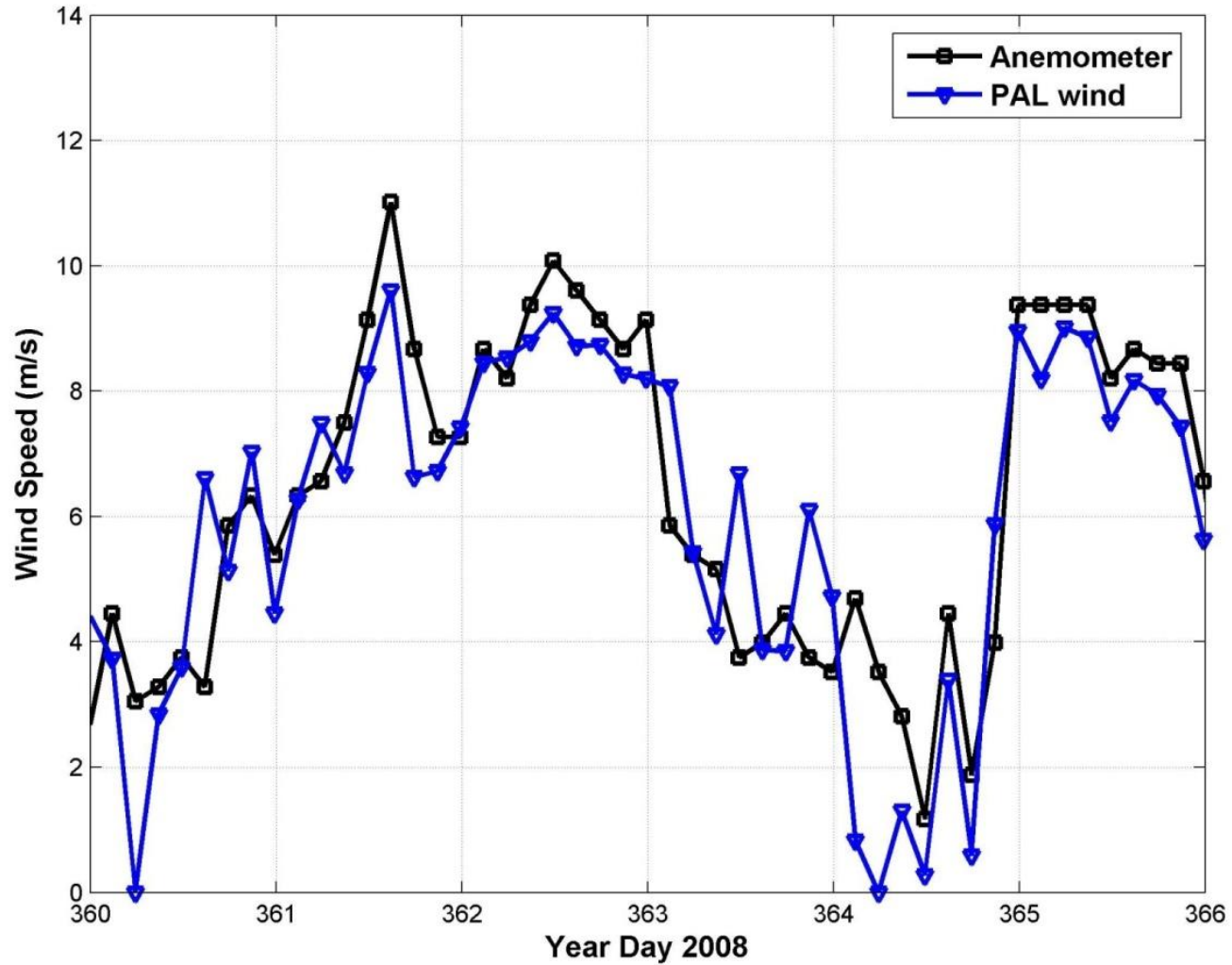
# Histogram of buoy wind speed for PAPA data 07–08



# Histogram of buoy rain rate for PAPA data 07–08

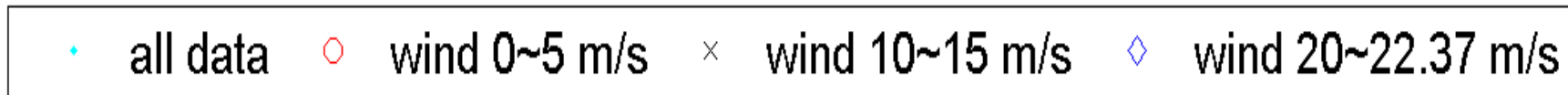
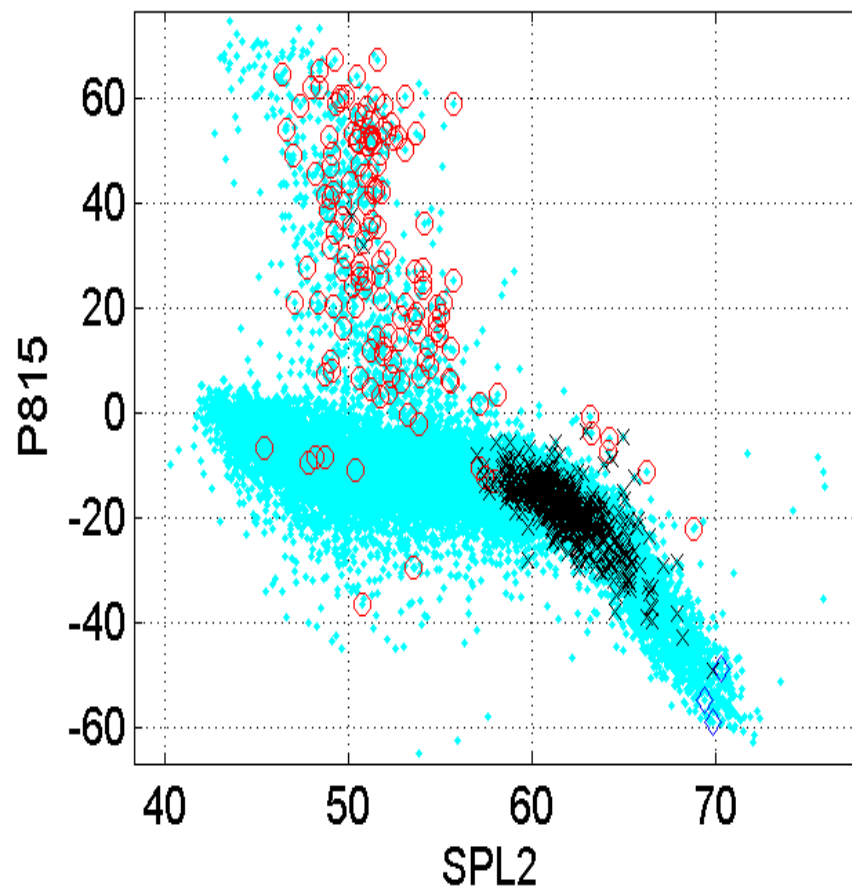
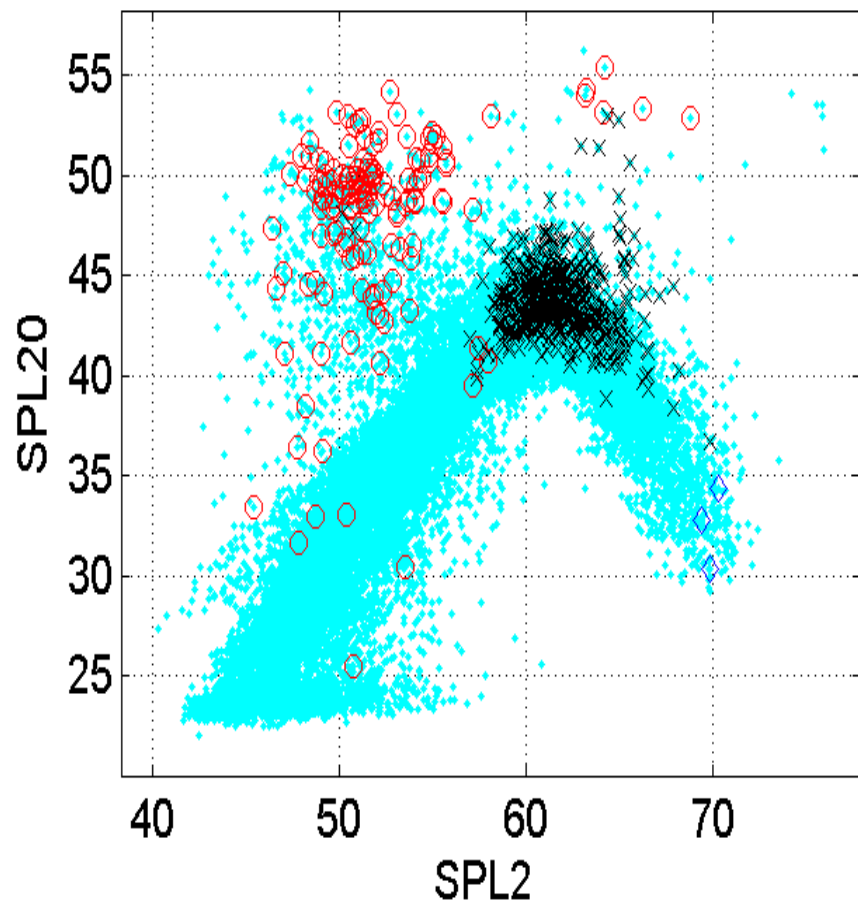


# PAL wind speed measurement

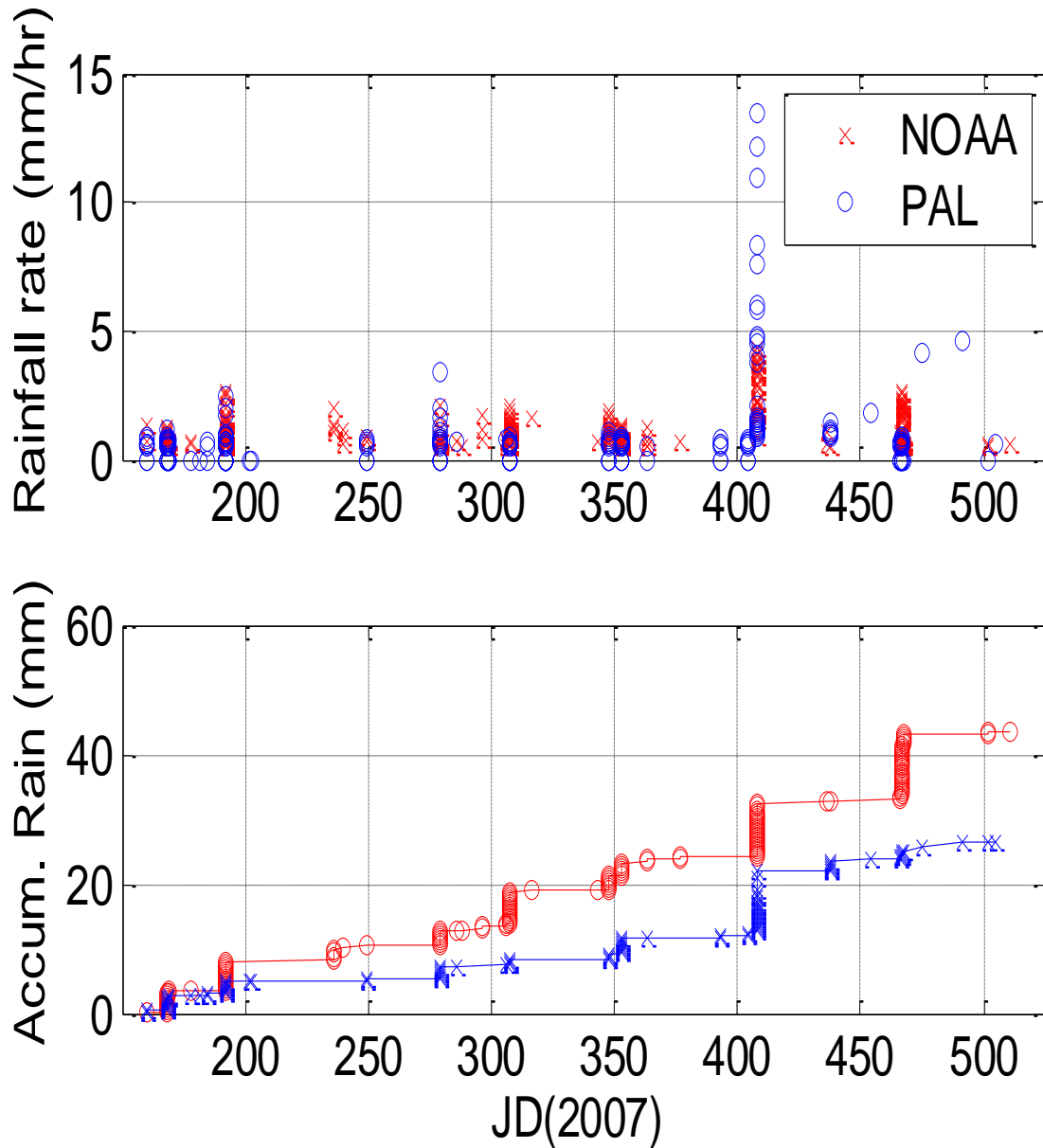




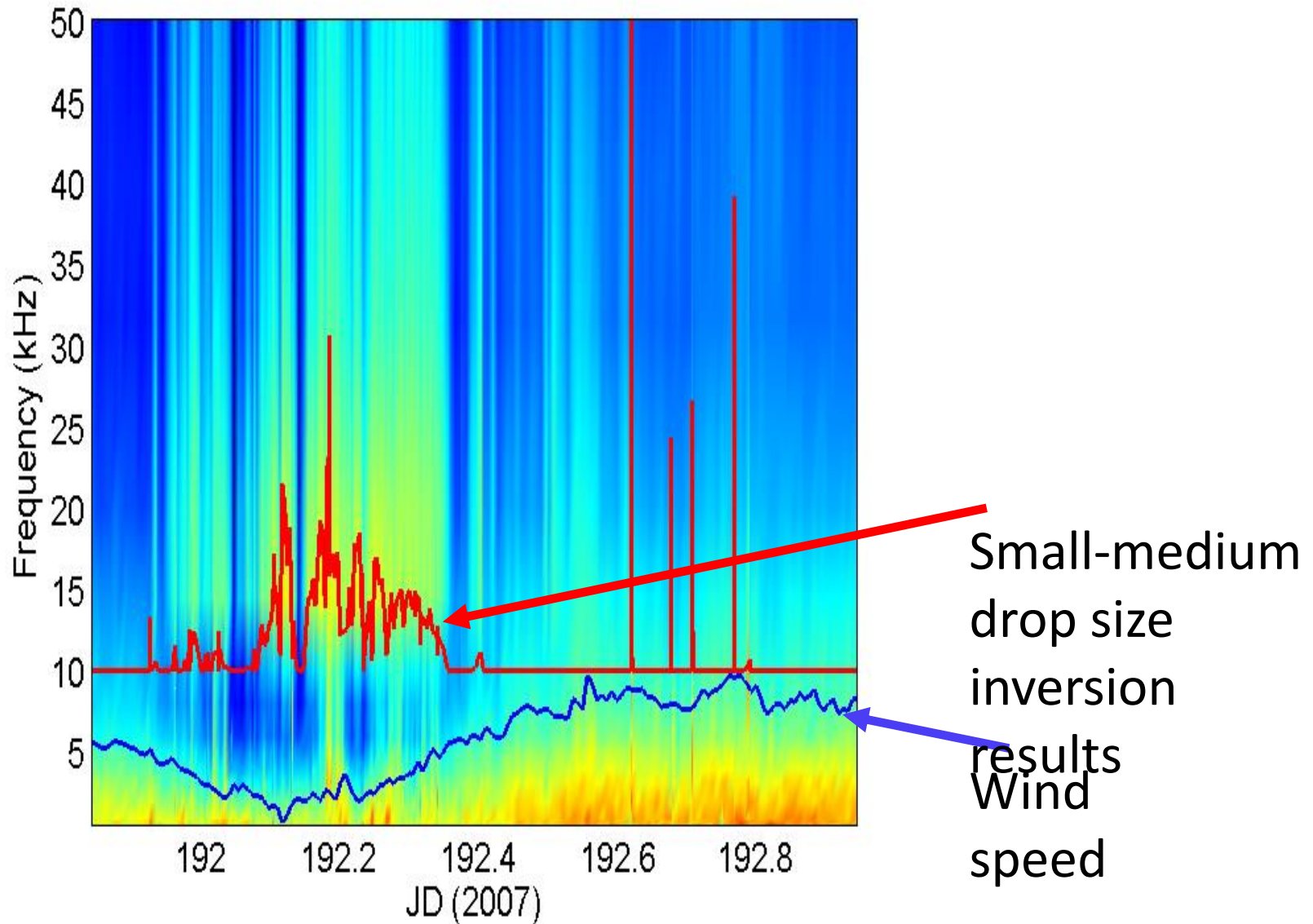
# PAL rain rate measurement



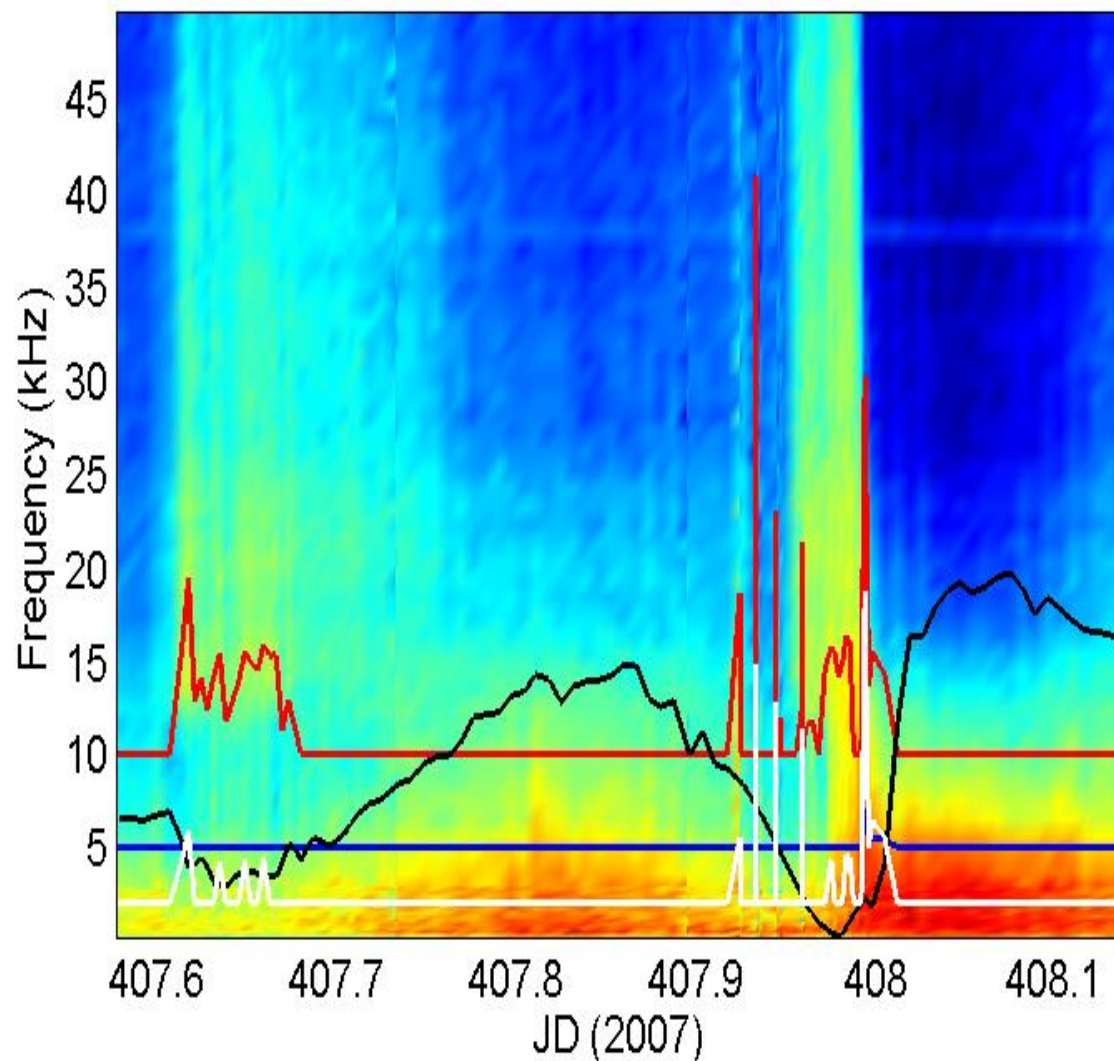
# PAL vs. Buoy: $U < 10$ m/s rain rate



# Drop size distribution inversion on Event 192



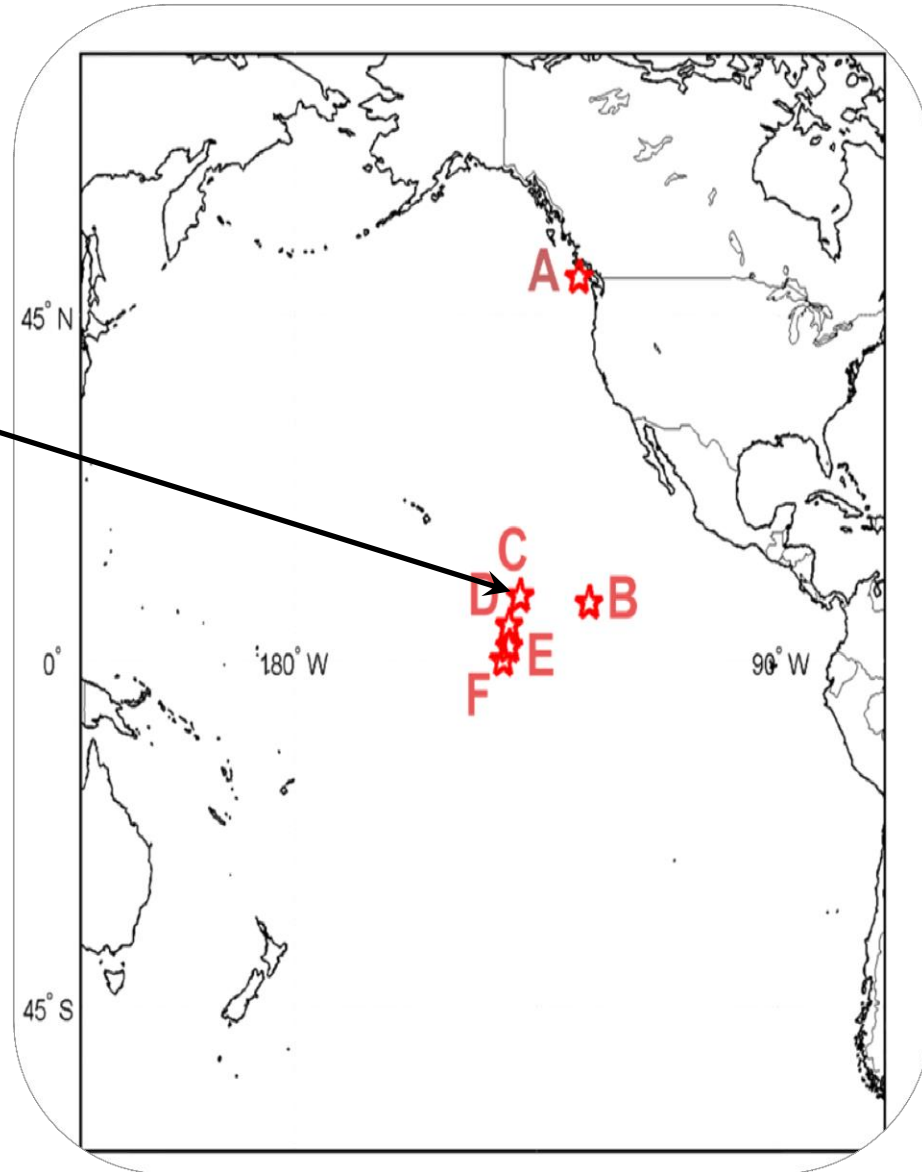
# Drop size distribution inversion on Event 407



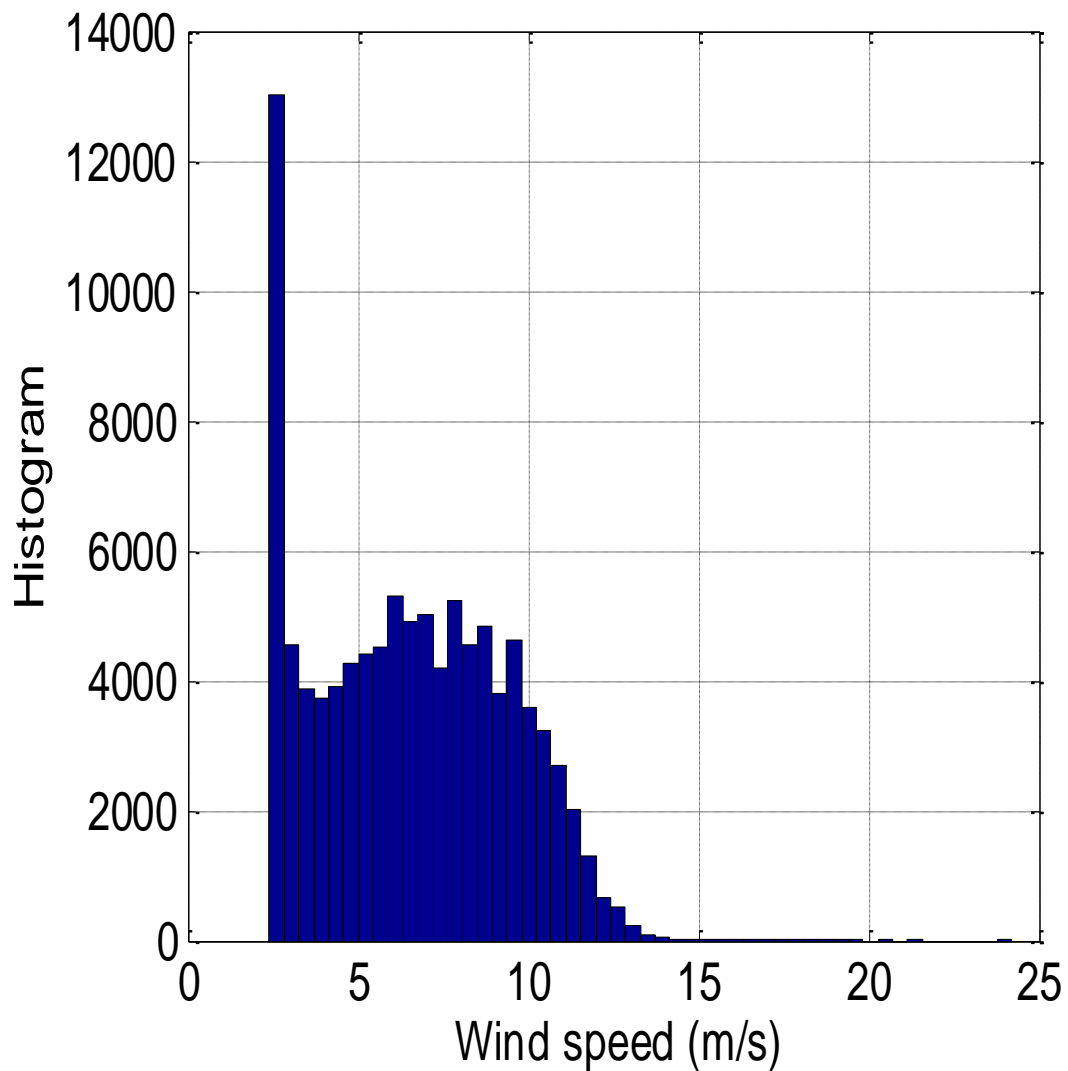
# STS/PAL Float # 6917: Central Pacific Ocean



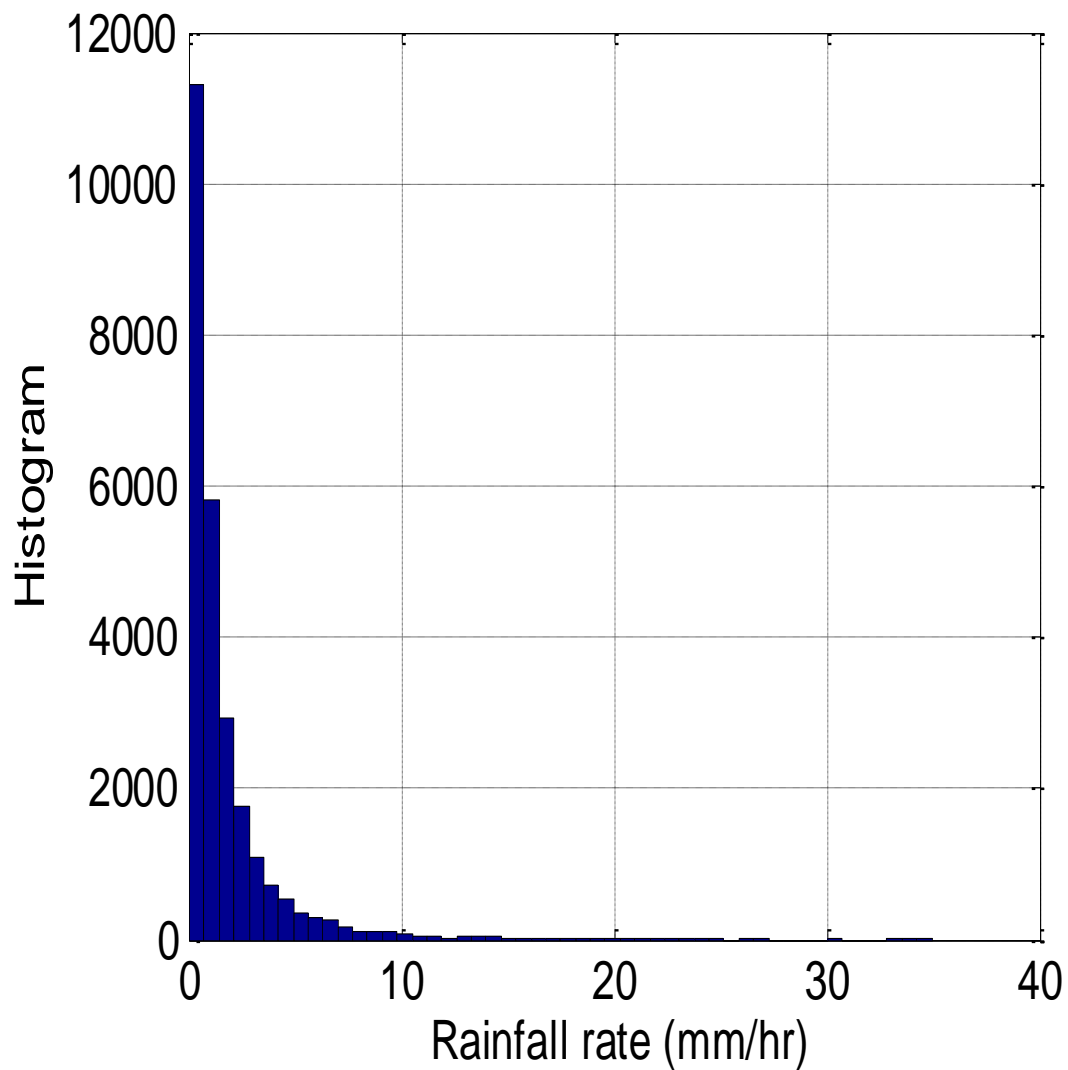
STS/PAL 6917



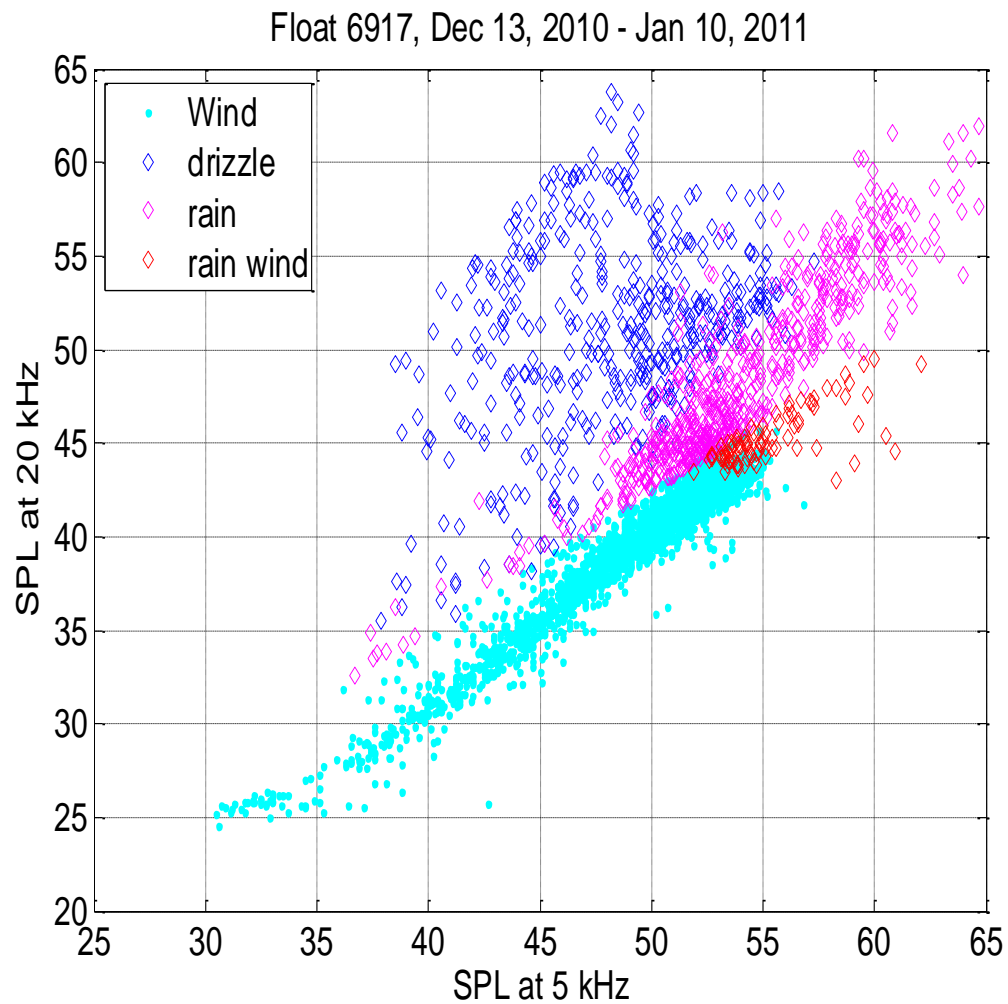
# Float # 6917: Wind speed distribution for 2011



# Float # 6917: Rain rate distribution for 2011

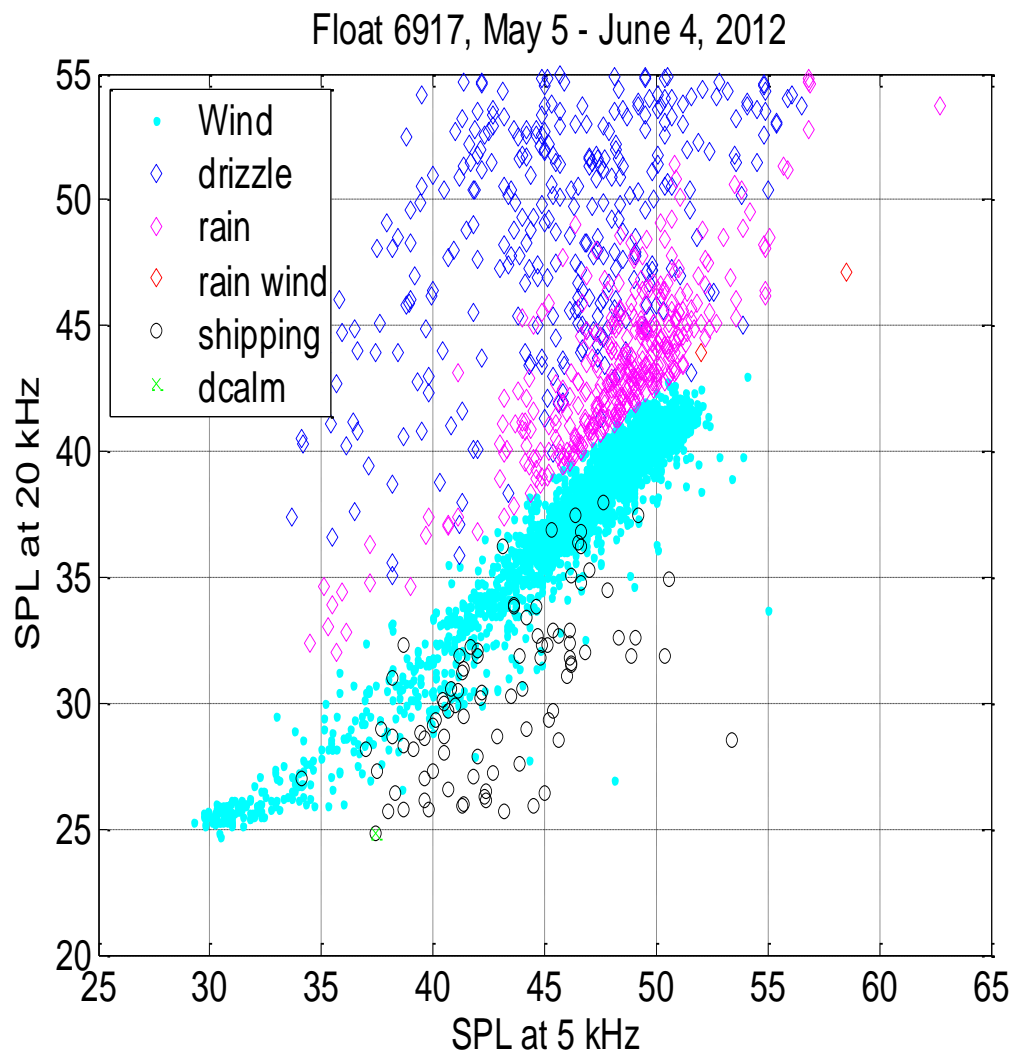


# Float # 6917: Classification Dec. 2010/Jan. 2011

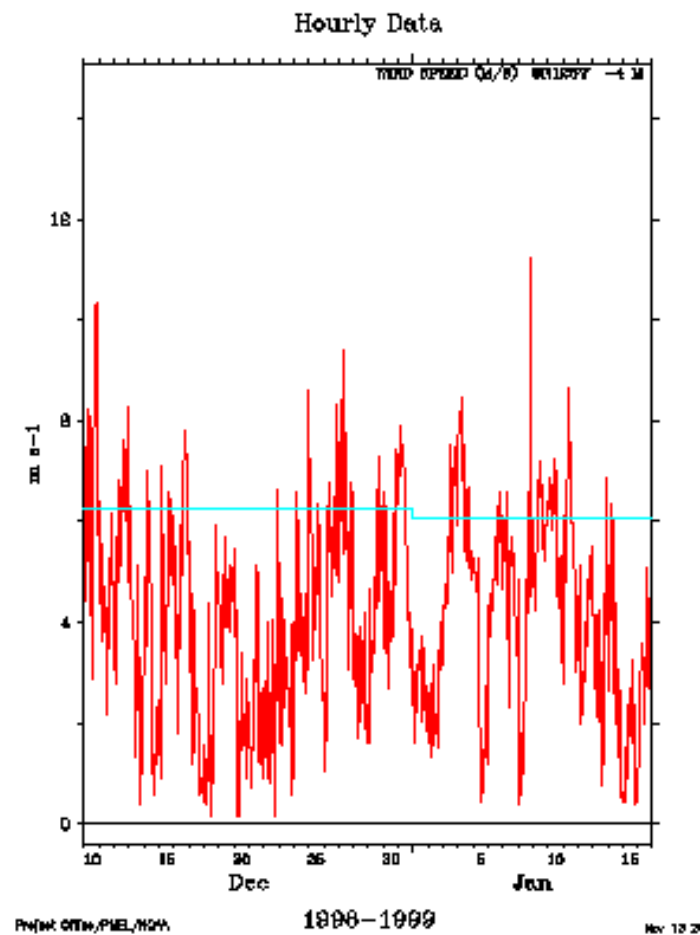
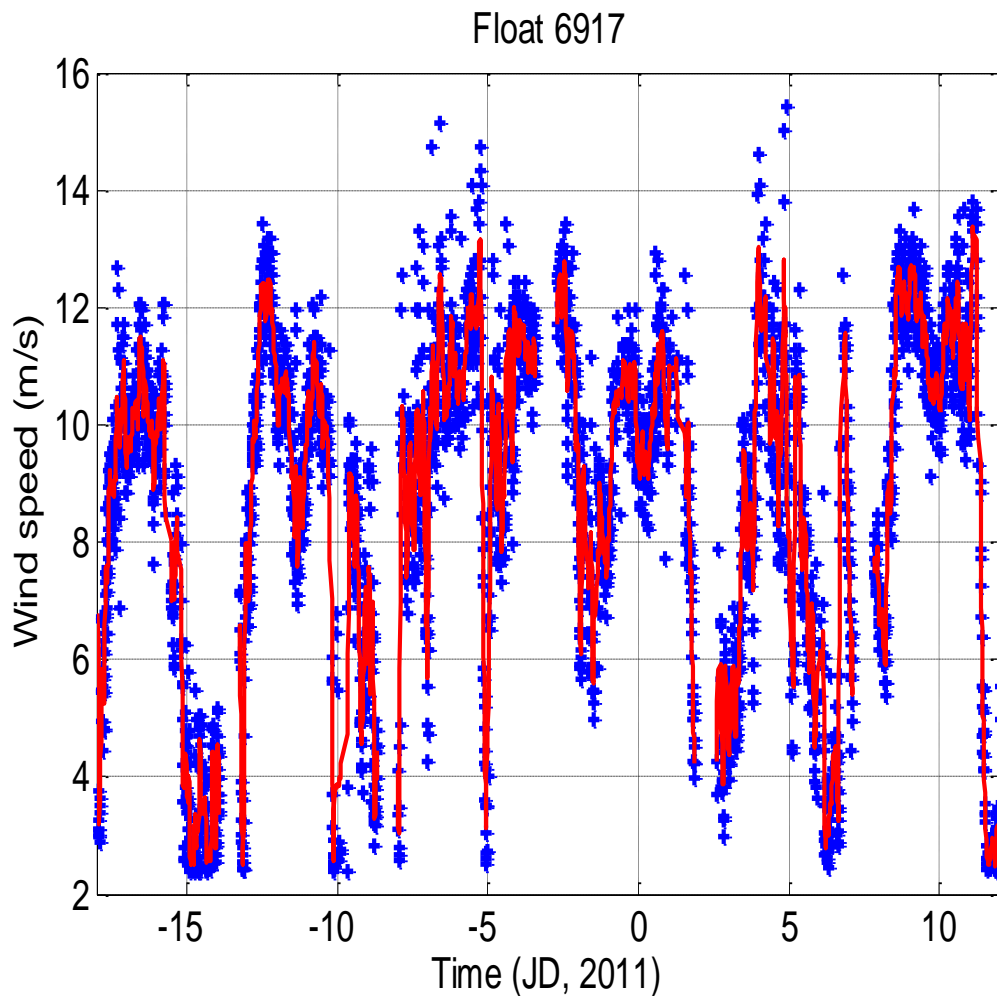




# Float # 6917: Classification May /Jun 2011

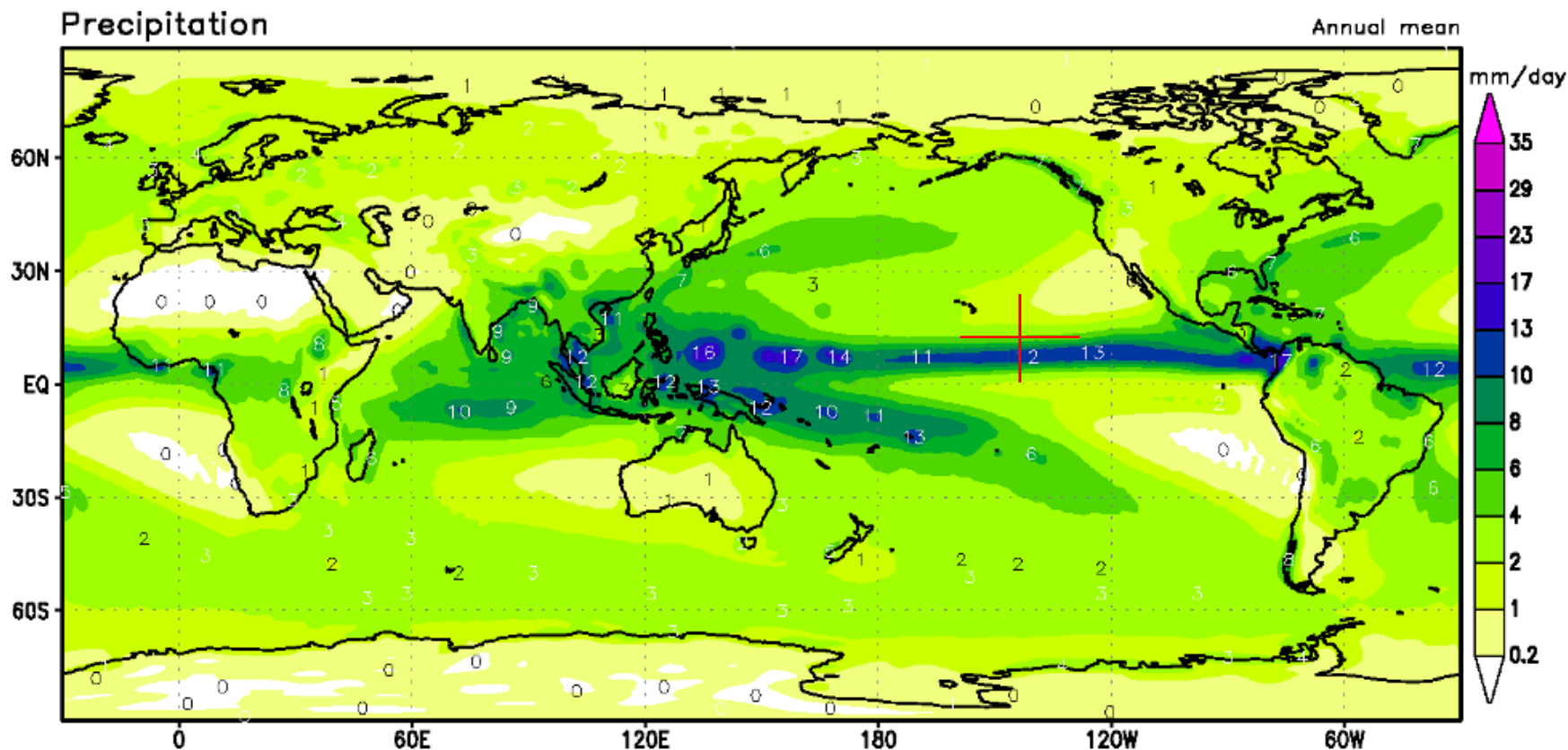


# STS/PAL Float # 6917: Wind speed Dec/Jan 2011



<http://www.pmel.noaa.gov/tao>

# STS/PAL Float # 6917: Accumulated rainfall



[http://oceanworld.tamu.edu/resources/oceanography-book/Images/rain\\_ANN.png](http://oceanworld.tamu.edu/resources/oceanography-book/Images/rain_ANN.png)

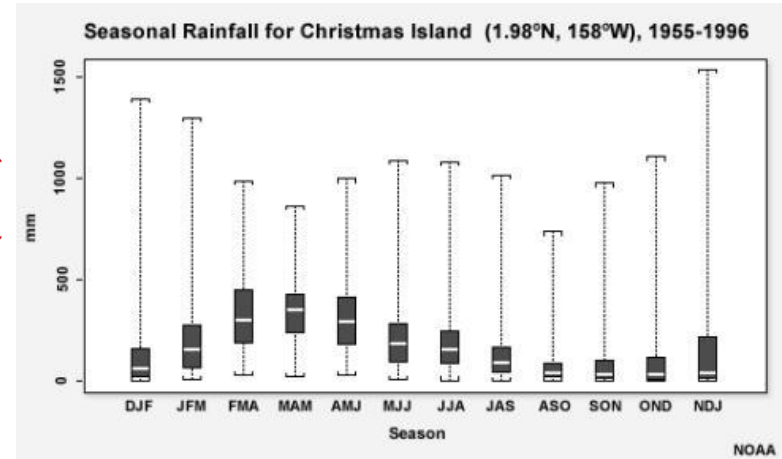
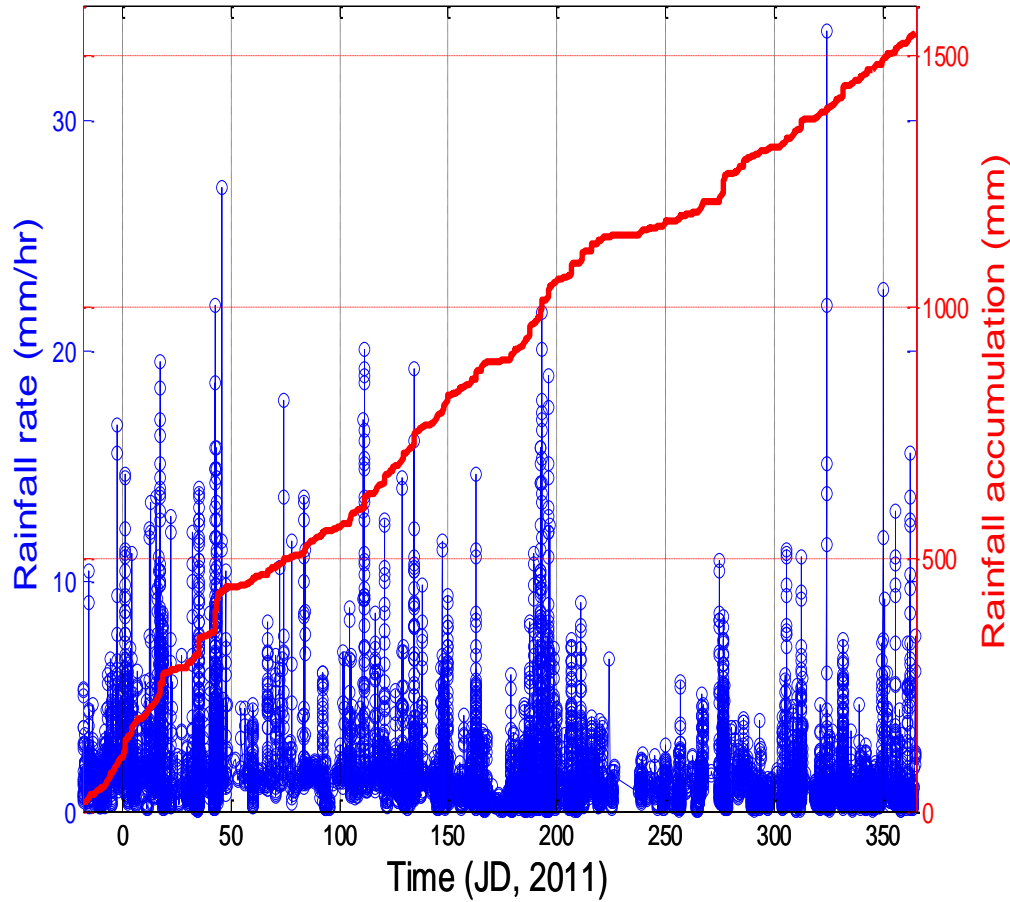
Monthly Accumulation: 150 mm – 300 mm

Yearly Accumulation: 2000 mm – 3600 mm

# STS/PAL Float # 6917: Accumulated rainfall



Float 6917



[http://www.meted.ucar.edu/tropical/textbook\\_2nd\\_edition/media/graphics/chri\\_season\\_rain\\_cpc.jpg](http://www.meted.ucar.edu/tropical/textbook_2nd_edition/media/graphics/chri_season_rain_cpc.jpg)

# Summary



- Passive acoustic monitoring of the ocean can provide measurements of wind speed and rainfall rate
- Acoustic classification is improved using mooring data (NOAA surface truth) from Ocean Station PAPA
- Passive acoustic monitoring technology has been deployed on STS/PAL floats
- Initial results from STS/PAL #6917 (8°N, 125°W, Equatorial Pacific) are very encouraging
- Development of the classification system to deal with raindrop size issue and wind/rain effect is ongoing