



Joint WMO-IOC Technical Commission
for Oceanography and Marine Meteorology

Field Laboratory for Ocean Sea State Investigation and Experimentation: FLOSSIE Intra-Measurement Evaluation

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Waves Workshop 14

9 November 2015

Key West, Florida

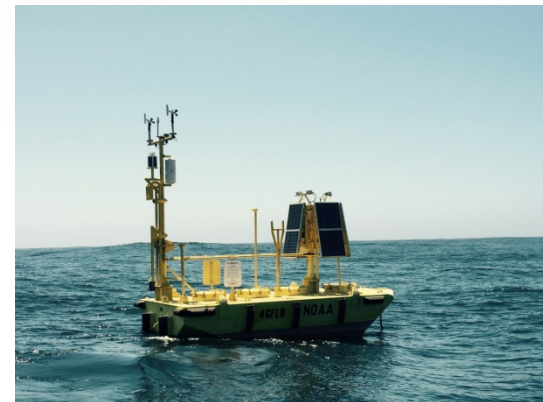


WMO



IOC/UNESCO

- Motivation: FLOSSIE / Buoy Farm
- FLOSSIE
 - Sensor / Payload Packages
 - Measurements Conducted
- Preliminary Results
- Summary / Future Testing
- Recommendations



Collaboration / Contributions

- USACE: Coordination (\$)
- NDBC:
 - Hull
 - Sensor/Payloads
 - Inclinator
 - HIPPY-Magnetometer
 - 3DMG
- USCG: Deployment
- AXYS
 - TRIAXYS Next Wave II DWS/WM
 - TBD:
 - TRIAXYS Next Wave II DWS/WM
 - TRIAXYS Buoy
- EC:
 - Strapped Down Accelerometer
 - AXYS-Watchman
 - MEDS-Data Archive



US Army Corps
of Engineers®



United States Coast Guard
U.S. Department of Homeland Security



- Test and Evaluate Platforms
 - Historical Configurations : NDBC 6N
 - 6N: NDBC vs EC
 - 6N: For quality directional estimates
 - NDBC 6N vs NDBC 3D
 - NDBC 3D : HIPPIY vs 3DMG
 - TBD: TRIAXYS Sensor vs NDBC 3D
 - TBD: TRIAXYS Buoy



Decommissioning

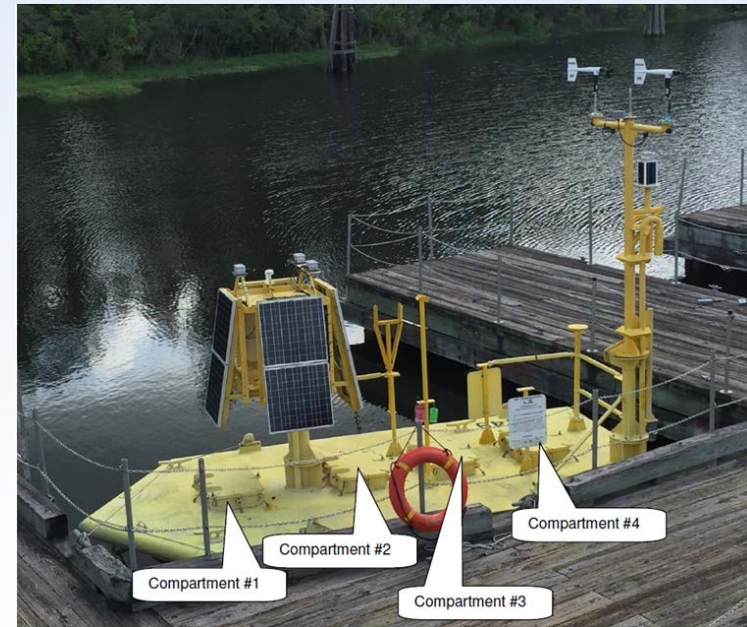


- Impact
 - **100's of Years of Wave Data (early 1970's)**
 - USACE: Wave Information Study
 - Wave model evaluation based on these platforms
 - Weather Prediction Center evaluation process
 - Integral wave parameters (H_{mo} , T_p , θ_{mean})
 - Discontinuities found in long-term measurements
 - Impacts to Trend Analysis
 - Altimeter Algorithms
 - Wave Model Improvements
 - Still relying on integral wave parameters
 - Tolerances: 0.25- to 0.50-m
 - Climate Variation
 - Specification of extreme storm events
 - Ability to measure directional characteristics

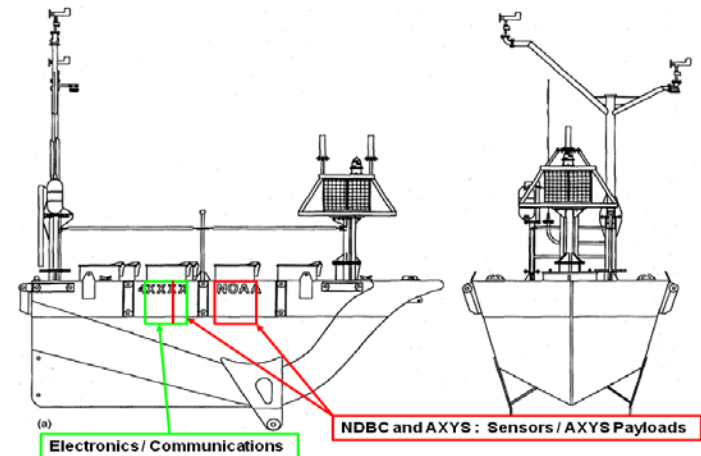


FLOSSIE Configuration

- Compartment 1
 - Empty: Cable Pass-through
- Compartment 2
 - NDBC HIPPY
 - AXYS: TRIAXYS
 - EC: SDA / AXYS: Watchman
 - Batteries / Internal Temperature Sensor
- Compartment 3
 - NDBC: 3DMG / Inclinator / Compass
 - NDBC: Payloads
 - DACT / ARES / DWPM / DDWM
 - Communications
- Compartment 4
 - Empty: Cable Pass-through

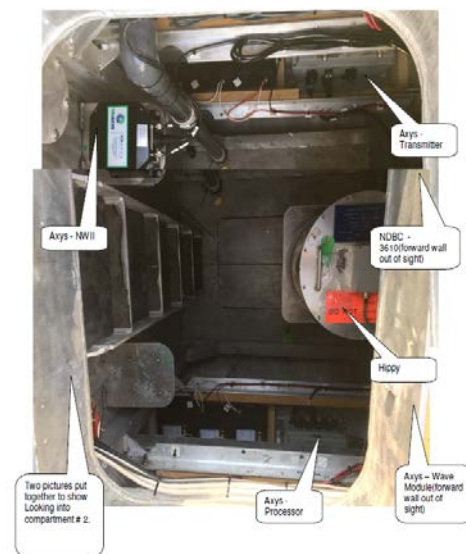
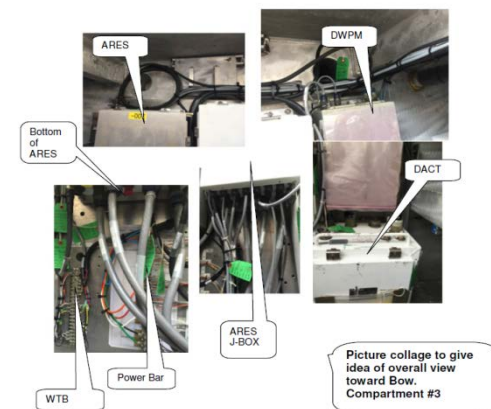


R. Riley & NDBC Techs



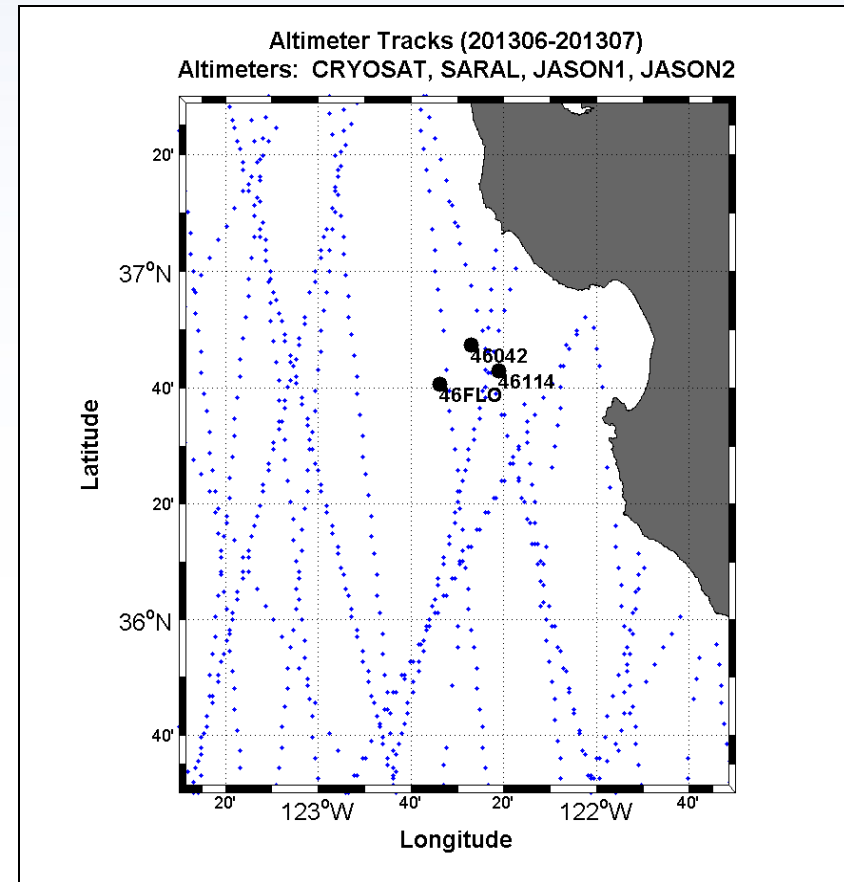
What FLOSSIE Will Measure

- Non-Directional Sensor / Payloads
 - NDBC: Inclinator
 - NDBC: HIPPY/Magnetometer
 - EC : SDA / AXYS: Watchman
- Directional Sensor / Payloads
 - NDBC: HIPPY / Magnetometer (DWPM)
 - NDBC: 3DMG (DDWM)
 - AXYS: TRIAXYS Next Wave II DWS-WM
- Complete Suite of Meteorological Sensors
- Data Transfer: IRIDIUM



Buoy Farm: Pacific / Monterey Canyon

- Buoy Farm
 - National Marine Sanctuaries
 - Water Depth 1500-2200m
 - Platforms
 - FLOSSIE
 - NDBC 3D (HIPPO/3DMG+)
 - Datawell Directional Waverider
 - Altimeter Tracks



Buoy Farm: Pacific / Monterey Canyon



Preliminary Evaluation: Potential Errors

• Sampling Interval

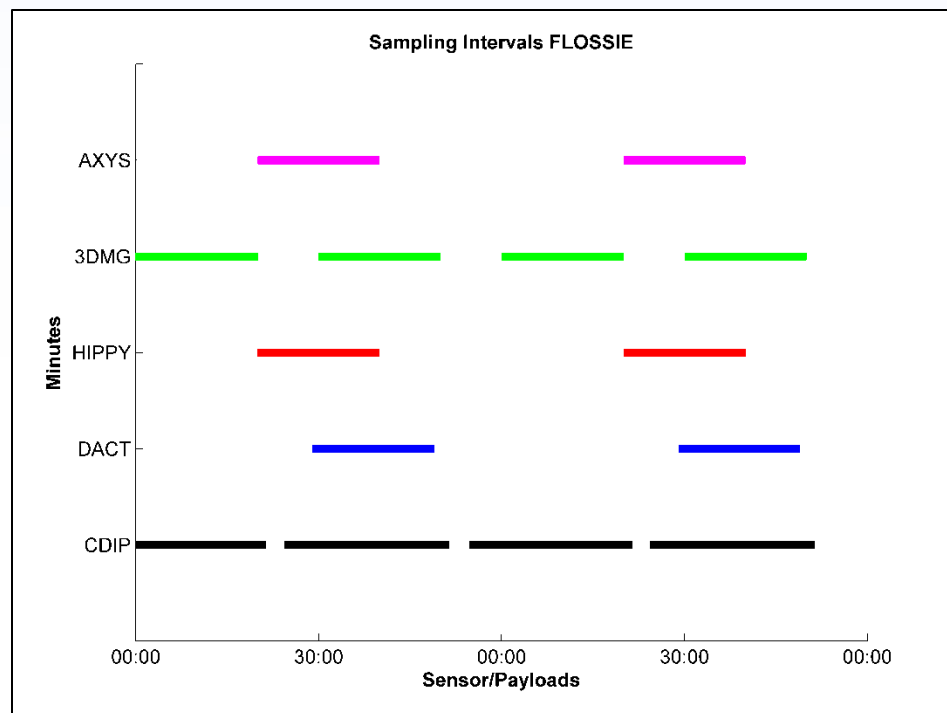
- CDIP: 30 min
- NDBC / Inclinator : 60-min
- NDBC / 3DMG: 30-min
- NDBC / HIPPY: 60-min
- AXYS/TRIAXYS: 60-min
- EC-SDA /AXYS Watchman 60-min

Sampling Interval
Overlap exists / Not perfect
May introduce some errors

• Distance Differences

- CDIP - FLOSSIE: 5-km
- FLOSSIE - 3D: 11-km
- CDIP - 3D: 8-km

Distance Differences
May introduce phase errors

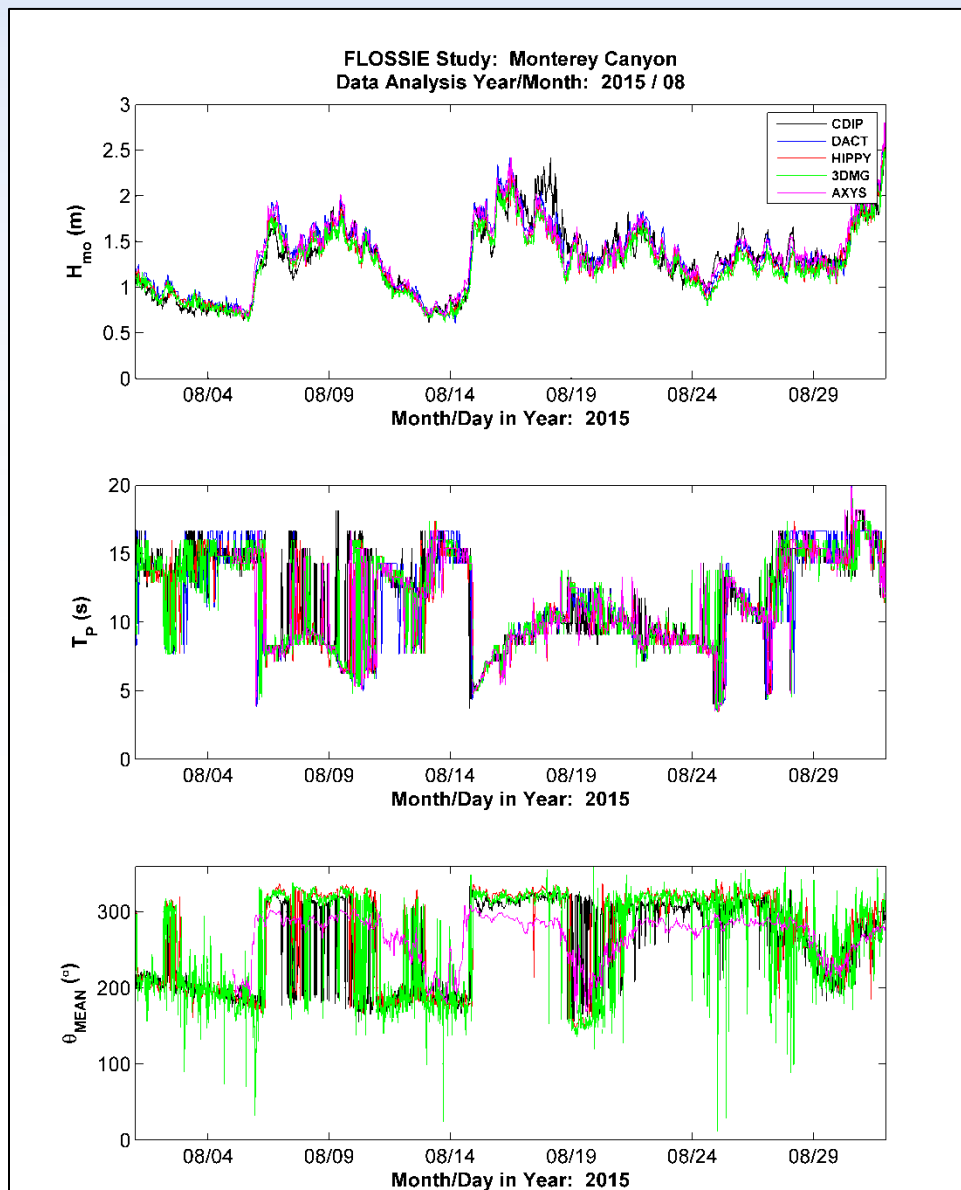


Preliminary Evaluation: August 2015

- August 2015

- Integral Wave Parameters: $H_{mo}, T_P, \bar{\theta}(f_m)$
 - Significant Wave Height
 - Peak Spectral Wave Period
 - Vector Mean Wave Direction at Spectral Peak
 - **AXYS/TRIAXYS Wave Direction DIFFERS**
 - **Vector Mean Wave Direction of the Spectrum**
- Data Return: ~100%
 - NDBC / Inclinator: DACT
 - NDBC / HIPPY (DWPM): HIPPY
 - NDBC / 3DMG (DDWM): 3DMG
 - AXYS / TRIAXYS AXYS
 - EC SDA / AXYS Watchman MEDS (Not Processed by MEDS)

Preliminary Evaluation: FLOSSIE Sensors



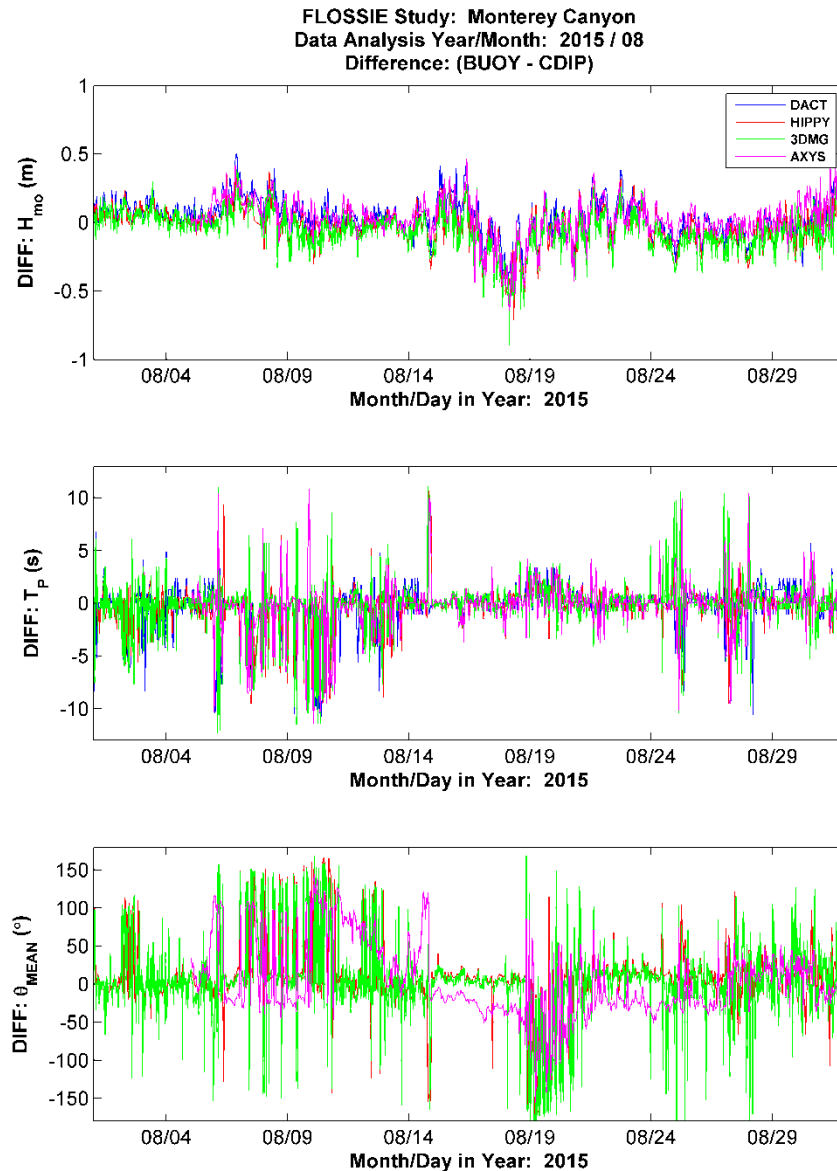
*Relative
Reference
CDIP
Diverges*

Indication of
Mixed
Wind-Sea / Swell

Difference in
AXYS
is the definition
of Wave
Direction

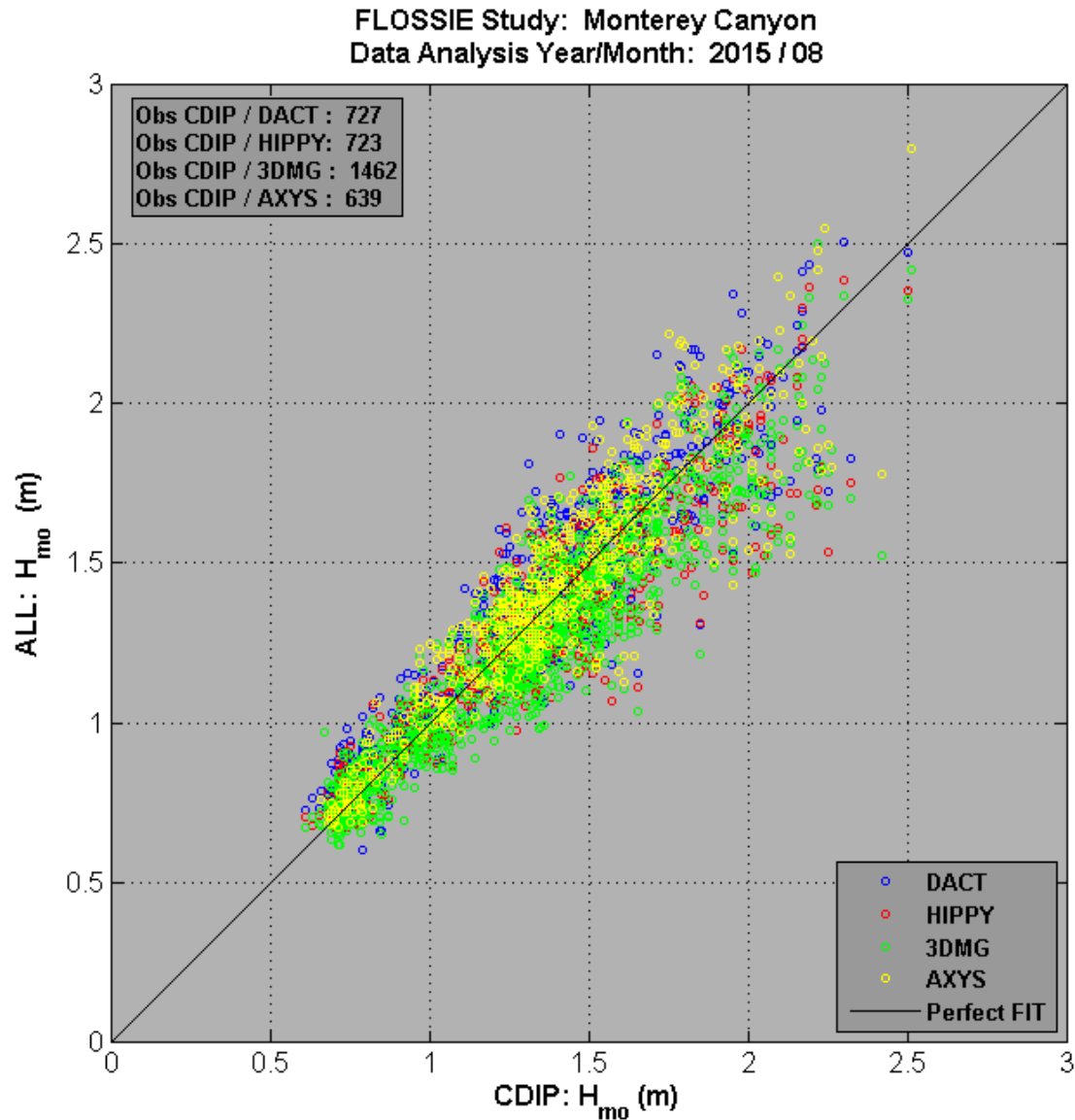
Preliminary Evaluation: FLOSSIE Sensors

Difference Plots TEST - CDIP



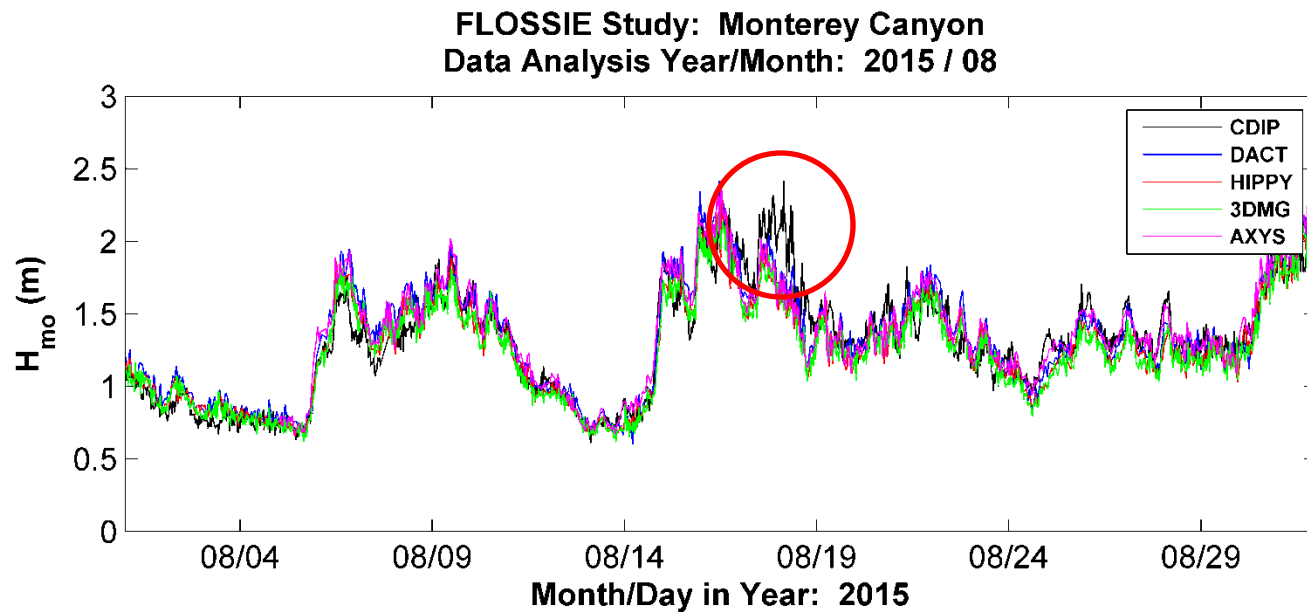
**Difference in
AXYS
is the definition
of Wave
Direction**

Preliminary Evaluation: FLOSSIE Sensors



Preliminary Evaluation: FLOSSIE Sensors

Relative Reference: Only Site Observing Secondary Peak Event ~30hr



Preliminary Evaluation: FLOSSIE Sensors

Relative Reference Evaluation: Harvest Platform (Pt. Conception)



Two Datawell Directional Waverider Buoys Deployed

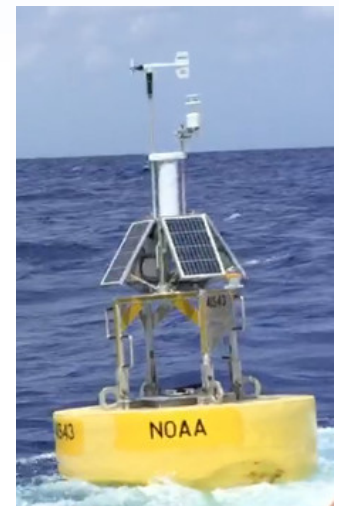
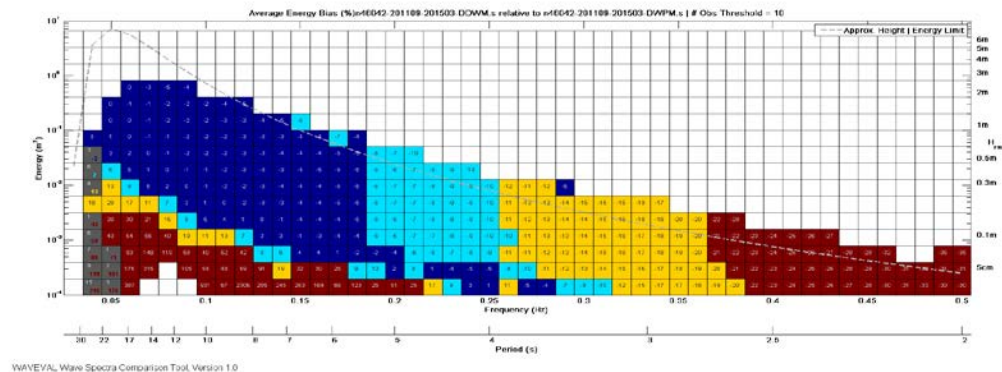
Evaluation Preliminary Conclusions

- FLOSSIE Transmitting Data
 - Data Return ~ 100% Five Sensor/Payloads
 - Preliminary Evaluation Based on Integral Wave Parameters
 - Mixed Wind-Sea / Swell (H_{mo} : ~2.5m)
 - Similarities / Differences Observed
 - *Relative Reference* (Datawell) Diverges: 0.25 - 0.5m (~30-hr)
- Identified Potential Errors
 - Sampling Interval
 - Location / Watch Radius
- Addressing Relative Reference (Harvest Platform)



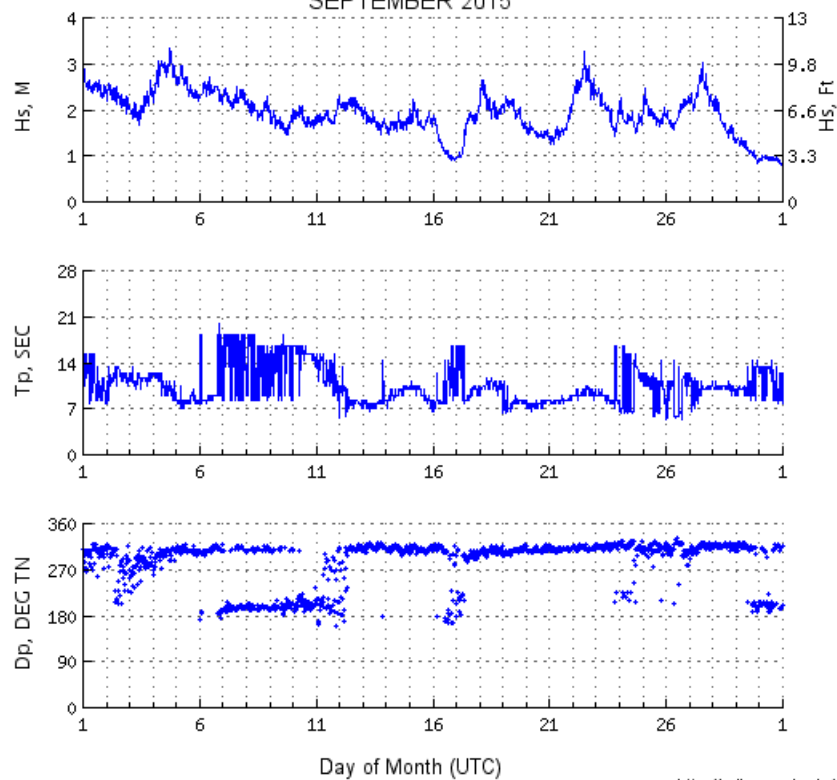
- Format Data for Consistency
 - AXYS / TRIAXYS Sensor/Payload
 - EC-SDS / AXYS Watchman: Process Data
- Analysis Continues
 - September (NDBC/AXYS-TRIAxYS/Datawell)
 - EC SDA / AXYS Watchman data not processed by MEDS
 - WaveEval Tools (~3 months of data)
 - Automate Procedures
- Analysis of *Relative Reference* (Harvest Platform)
- Primary Tests
 - NDBC Historical Assessment
 - NDBC / EC-SDA / AXYS-Watchman : Altimeter (Durrant, et al. 2008)
 - AXYS/TRIAxYS: Directional Evaluation

- Additional Sensor/Payload Deployments
 - TRIAXYS Buoy
 - TRIAXYS Sensor on 3D NDBC Buoy
 - GPS Sensor Packages (Drifter Program)
 - E. Terrill (SIO)
 - L. Centurioni and L. Braasch (SIO)
- NDBC SCOOP Buoy Evaluation
- NDBC New Motion Sensor Evaluation



185 MONTEREY BAY WEST, CA
(BUOY)

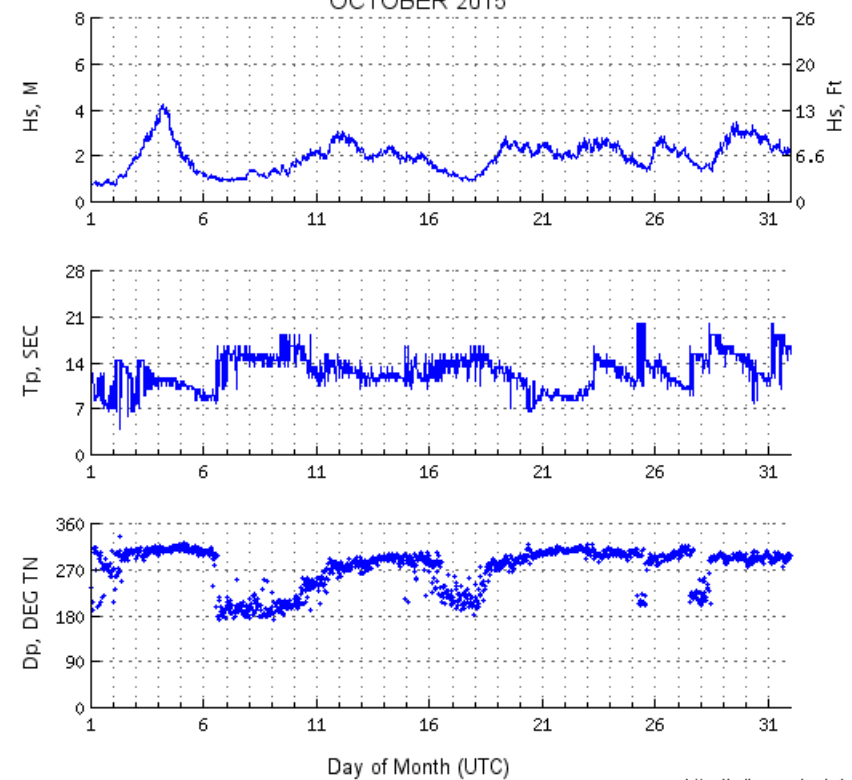
SEPTEMBER 2015



<http://cdip.ucsd.edu/>

185 MONTEREY BAY WEST, CA
(BUOY)

OCTOBER 2015



<http://cdip.ucsd.edu/>

CDIP 46114:Data: September / October 2015