



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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WMO



IOC/UNESCO

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



Collaboration / Contributions

- USACE: \$\$
- NDBC:
 - Hull
 - Sensor/Payloads
 - Inclinometer
 - 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



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



Decommissioning



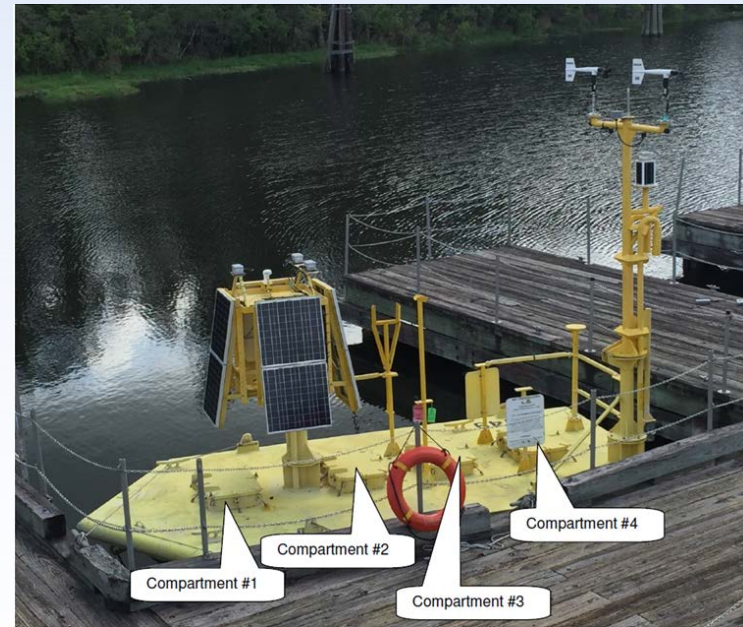
- Impact

- **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

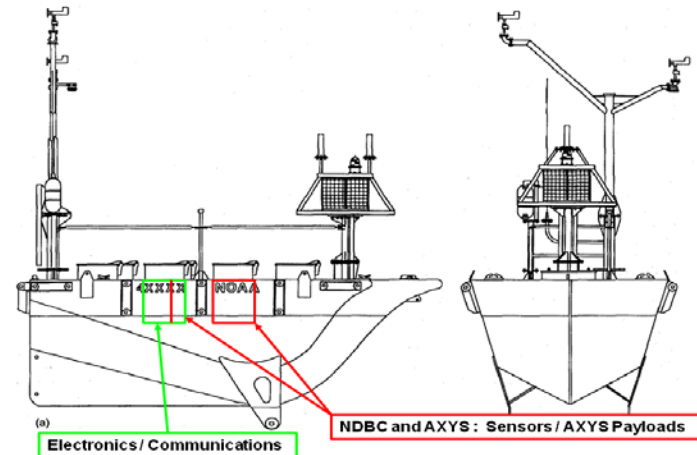


FLOSSIE Configuration

- **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

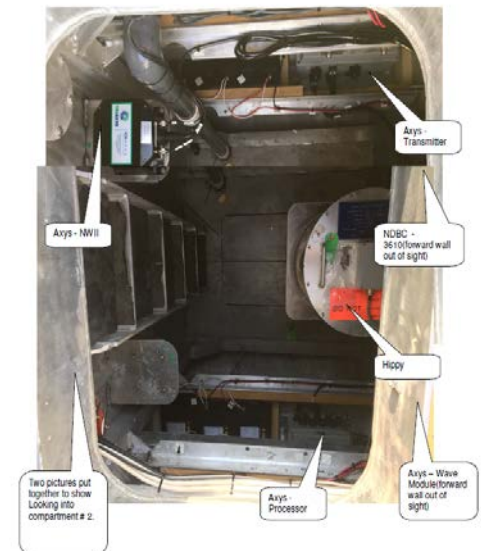
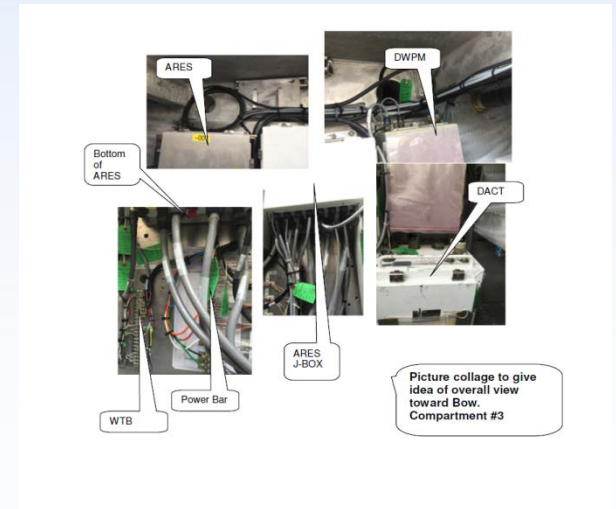


R. Riley & NDBC Techs



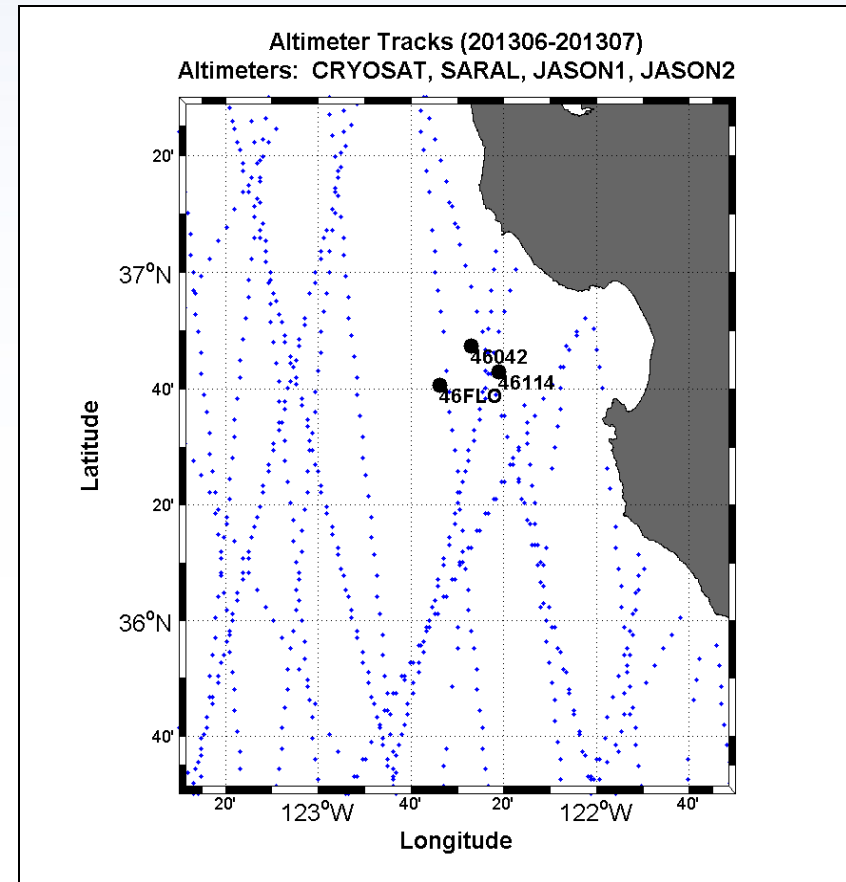
What FLOSSIE Will Measure

- Non-Directional Sensor / Payloads
 - NDBC: Inclinometer
 - 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

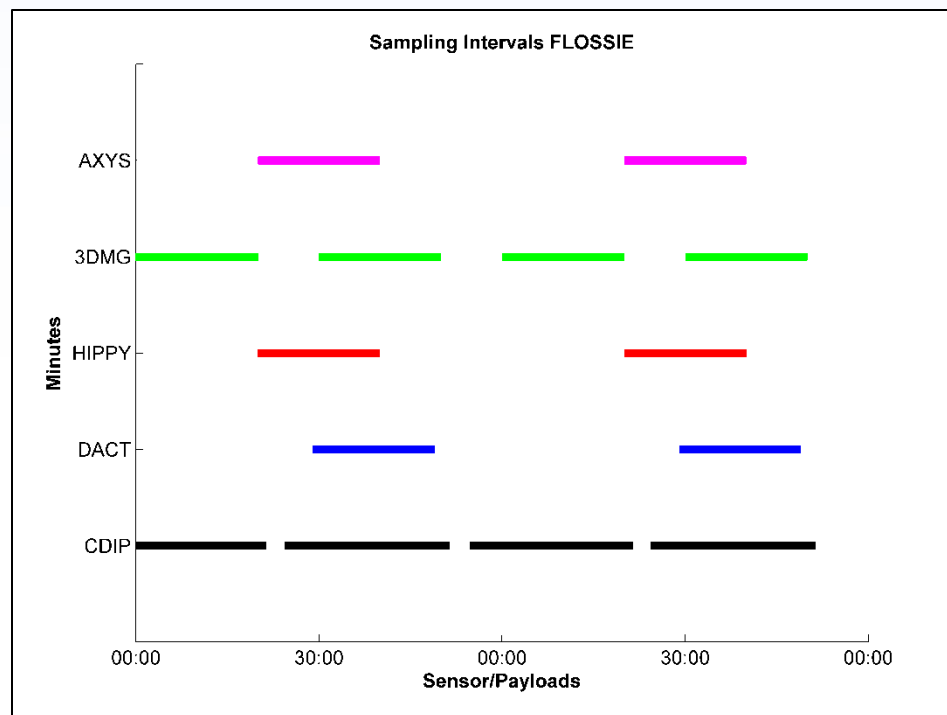
- CDIP: 30 min
- NDBC / Inclinter: 60-min
- NDBC / 3DMG: 30-min
- NDBC / HIPPY: 60-min
- AXYS/TRIAXYS: 60-min
- EC-SDA /AXYS Watchman 60-min

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

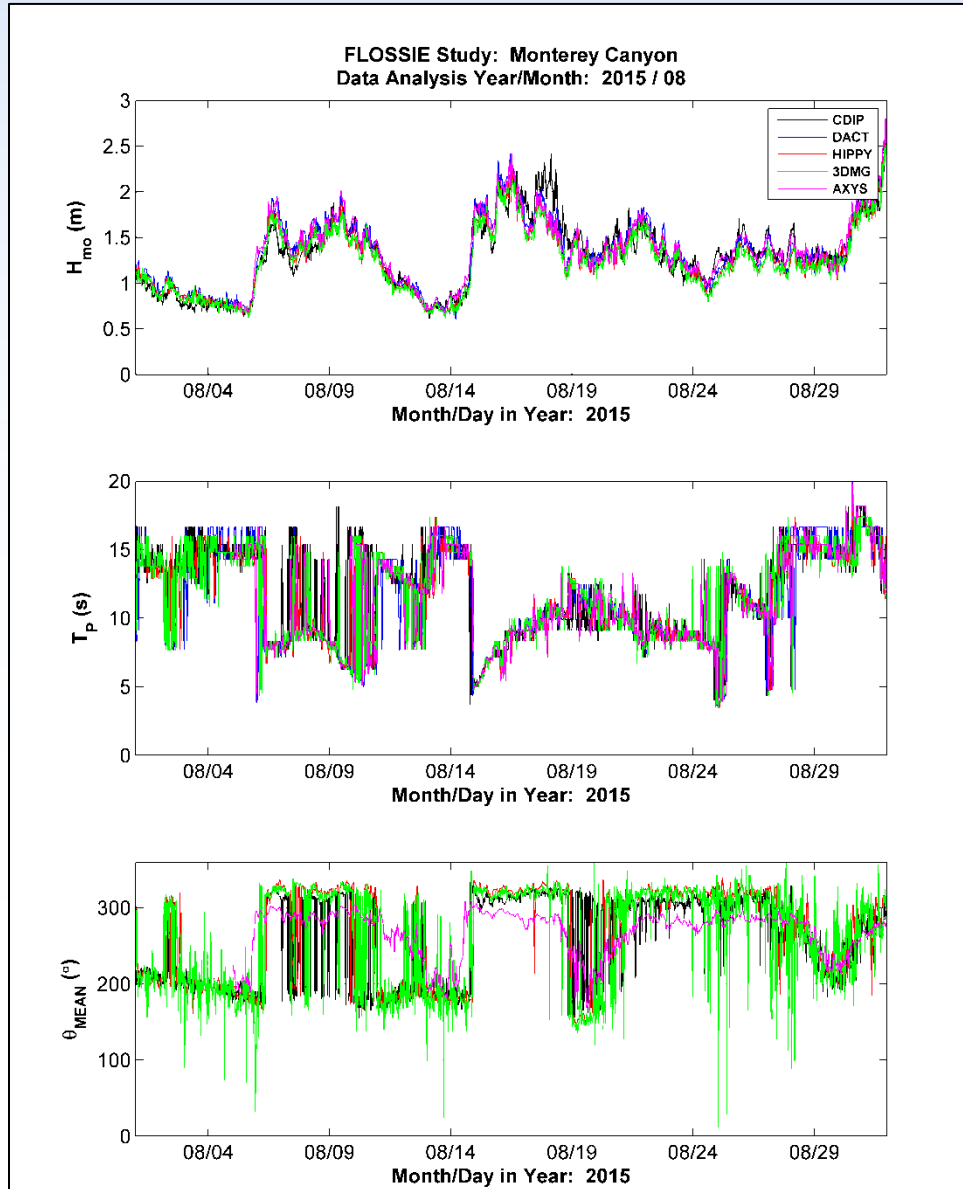
- Integral Wave Parameters: $H_{mo}, T_p, \bar{\theta}(f_m)$

- 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



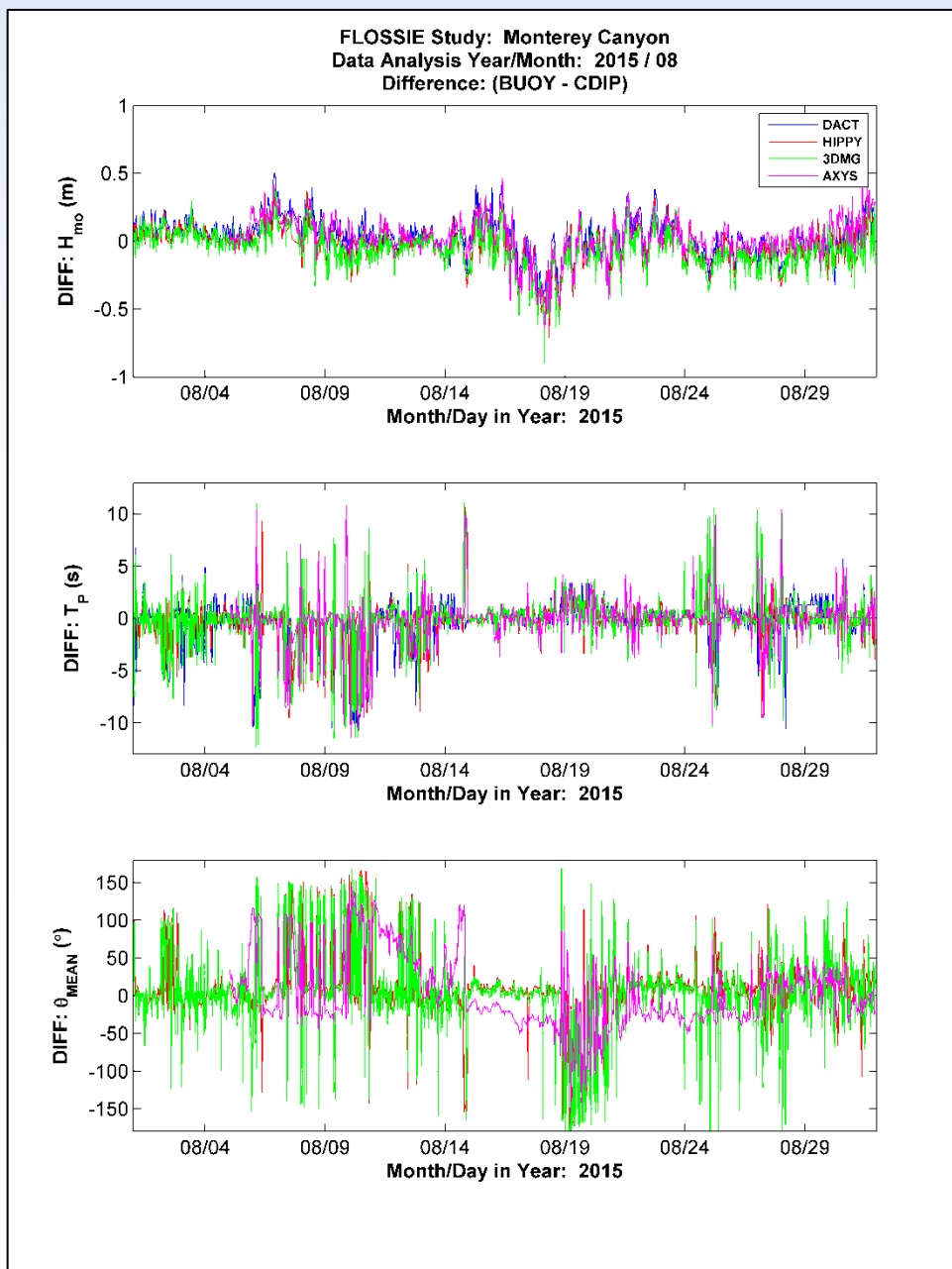
Relative Reference
CDIP Diverges

Indication of Mixed Wind-Sea / Swell

Difference in AXYS is the definition of Wave Direction

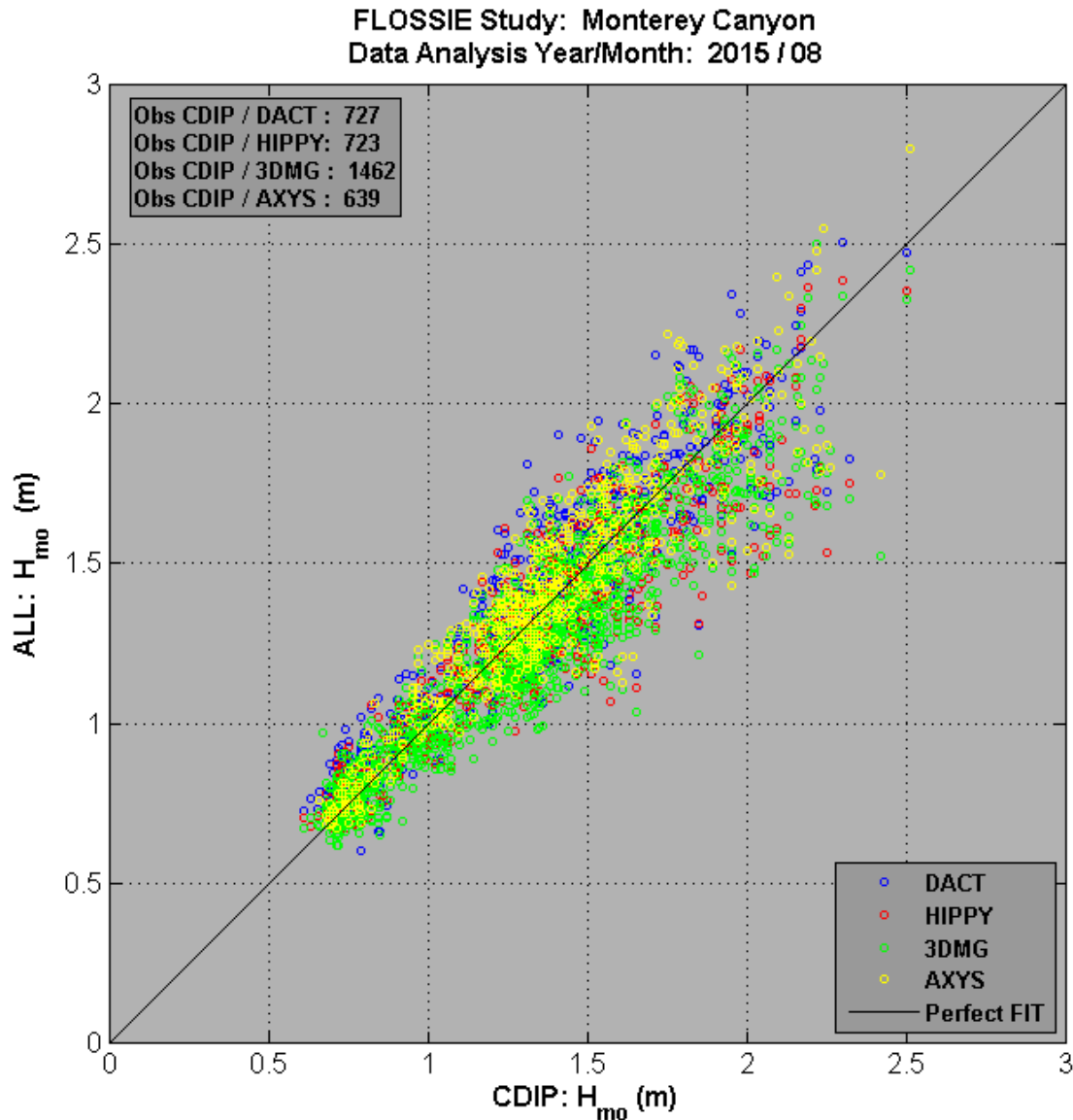
Preliminary Evaluation: FLOSSIE Sensors

**Difference Plots
TEST - CDIP**



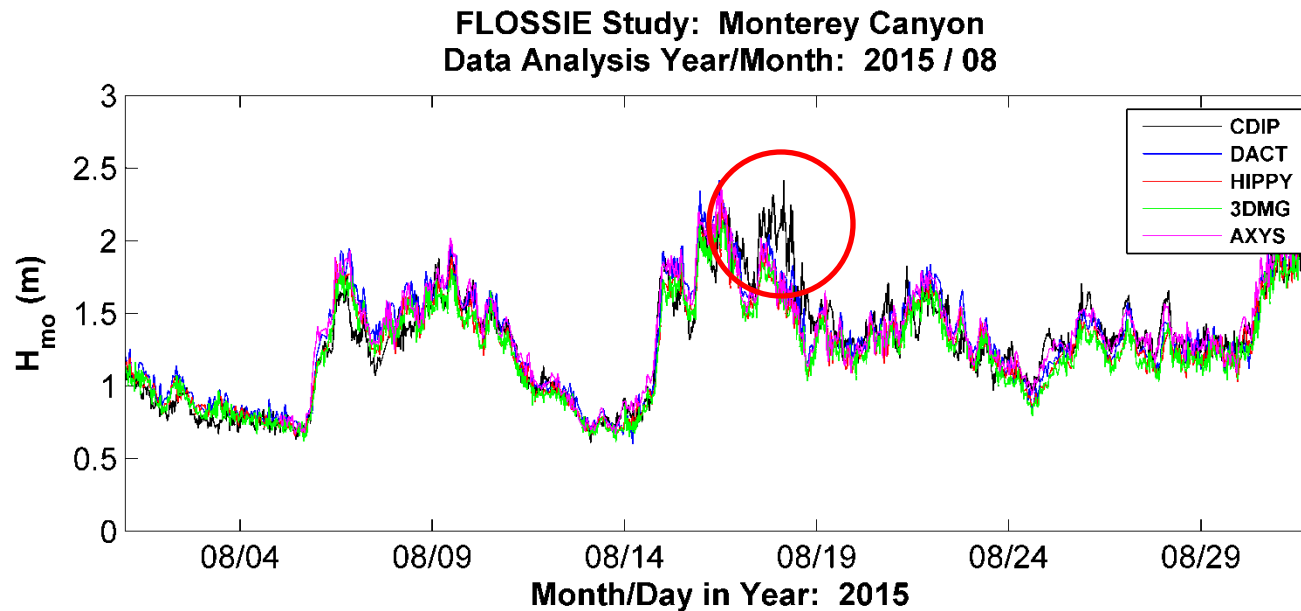
**Difference in
AXYS
is the definition
of Wave
Direction**

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

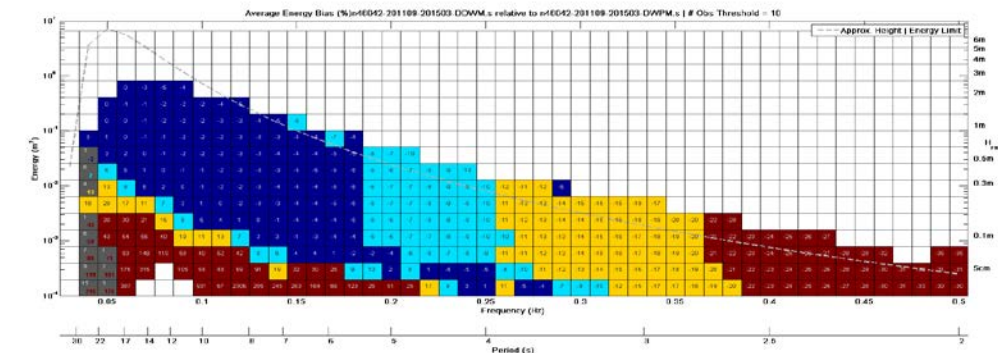
Evaluation Preliminary Conclusions

- 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)



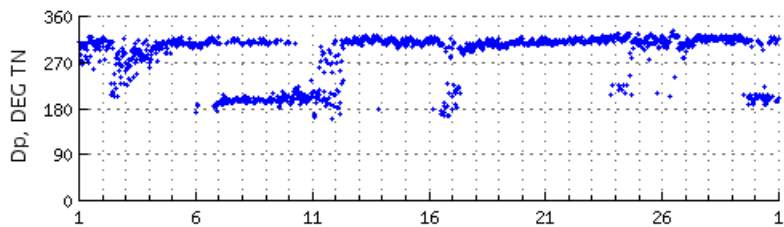
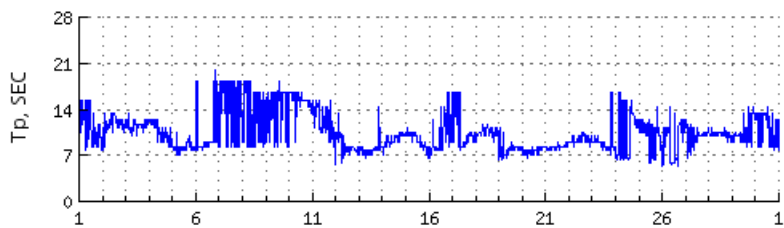
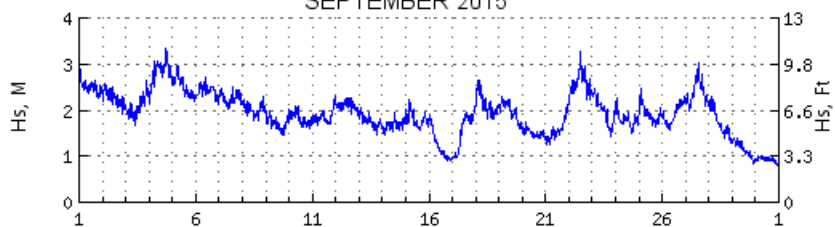
- Format Data for Consistency
 - AXYS / TRIAXYS Sensor/Payload
 - EC-SDS / AXYS Watchman: Process Data
- Analysis Continues
 - September (NDBC/AXYS-TRIAxYS/Datawell)
 - EC SDA / AXYS Watchman data not processed by MEDS
 - WaveEval Tools (~3 months of data)
 - Automate Procedures
- Analysis of *Relative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

- 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

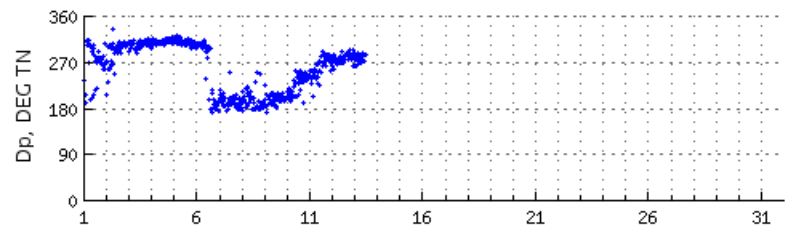
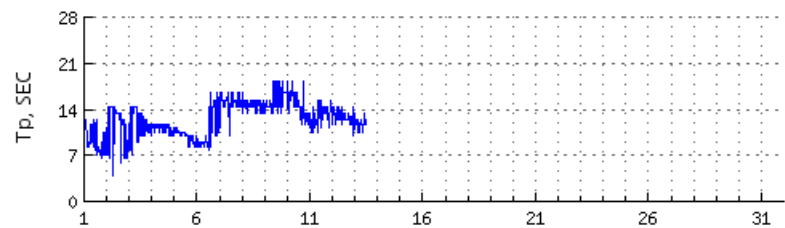


Day of Month (UTC)

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

185 MONTEREY BAY WEST, CA
(BUOY)

OCTOBER 2015



Day of Month (UTC)

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

Data: September / October 2015