“Principles of wave observations from drifters”

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With:

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Methodologies of wave measurements

- Measure wave height relative to a datum

  wave velocity by dynamical or statistical method

  - GPS sea level or acoustic travel time
  - Water pressure below surface

- Measure wave period velocity:

  wave height by dynamical or statistical method

  - Accelerometer, integrate once or twice
  - Current meter integrate once

Compact Sonar Deployment on a Profiling Float to measure Ocean Surface Waves

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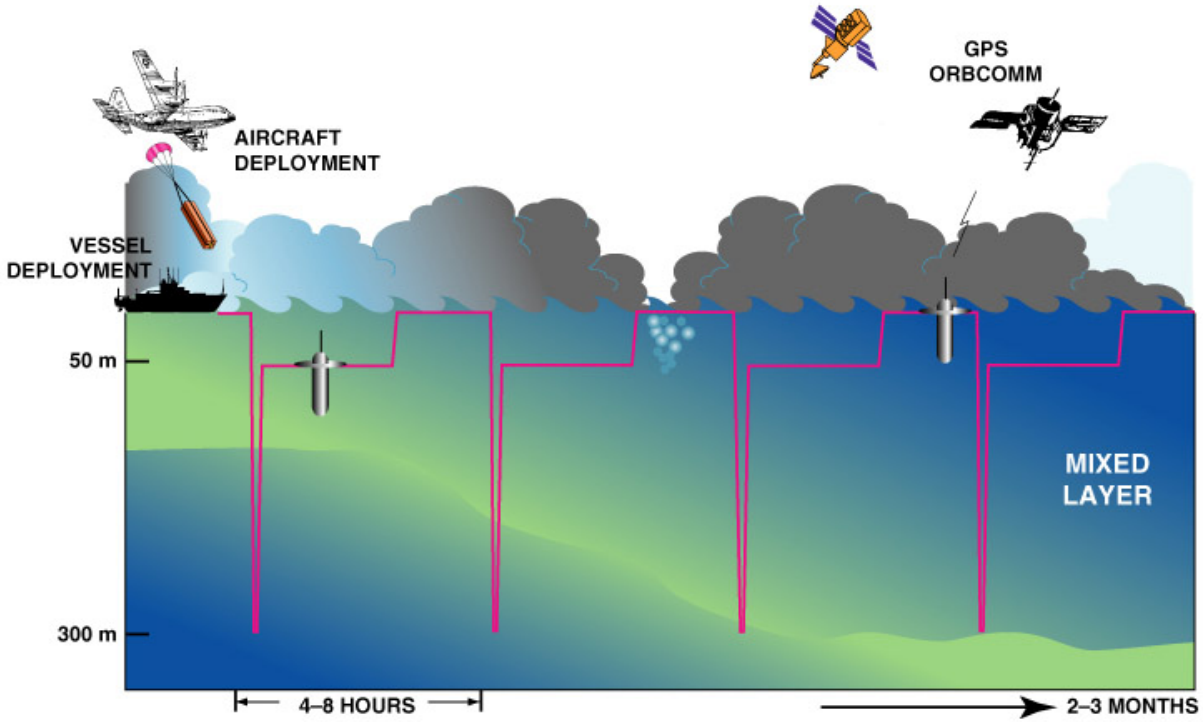
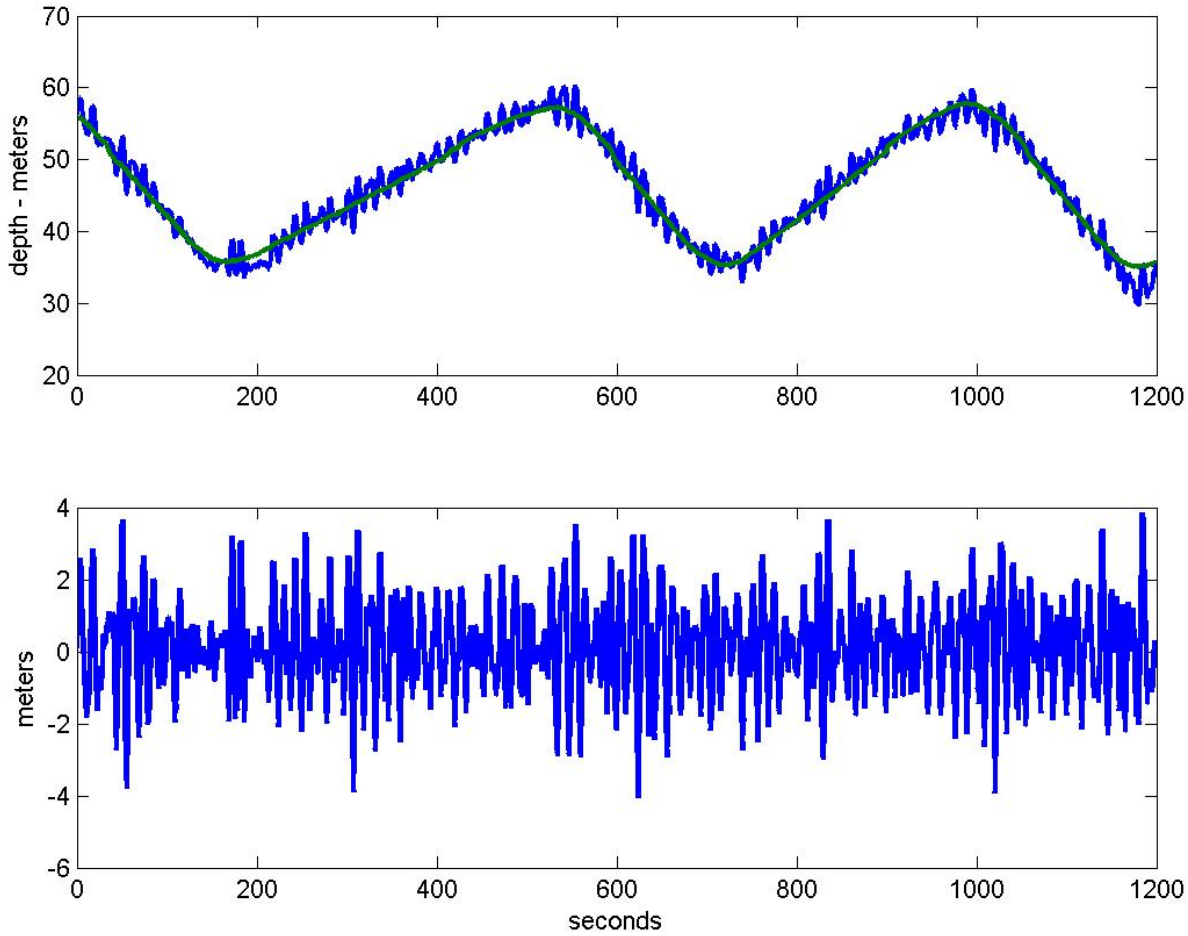
Capability developed as part of the ONR CBLAST Program.



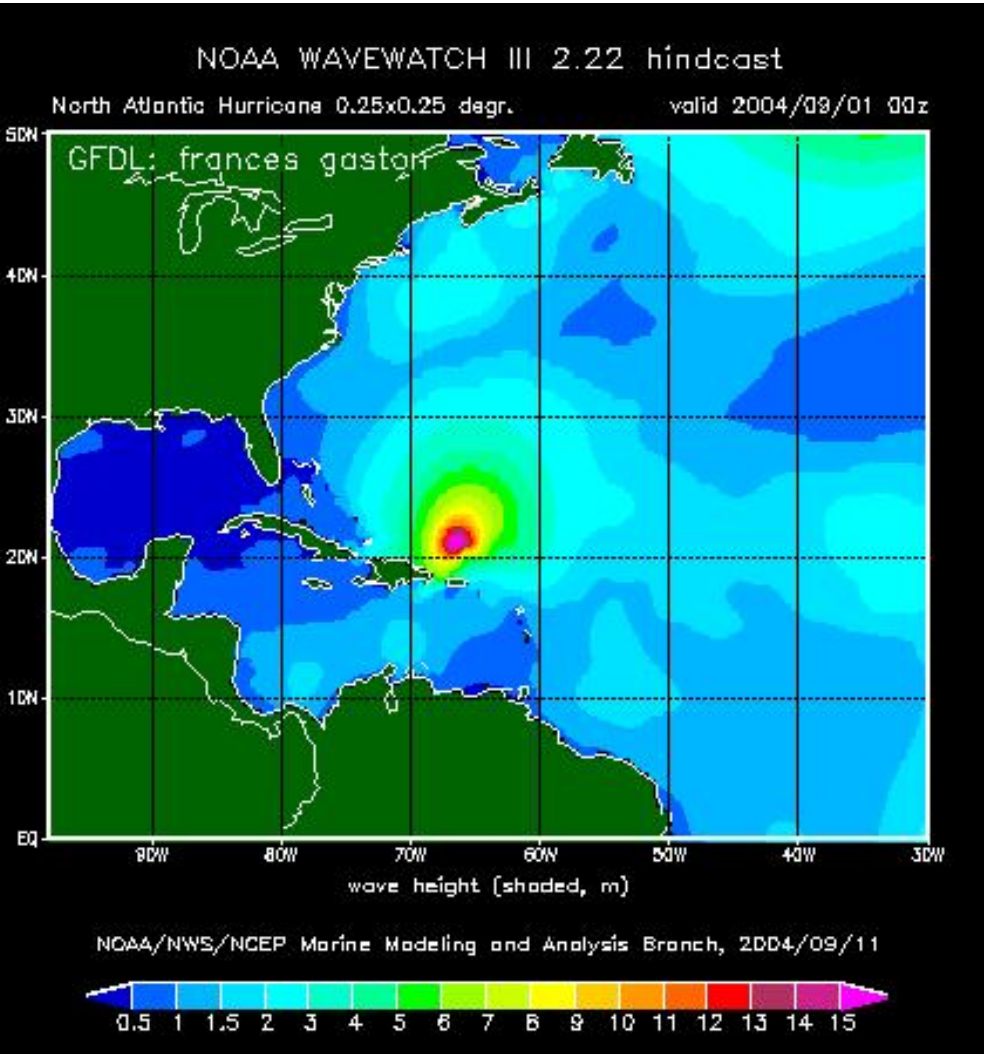
Modified SOLO floats (ARGO program) were programmed to sample upper ocean. Specialized sensors allowed measurement of waves and ambient sound field while in a hover mode.

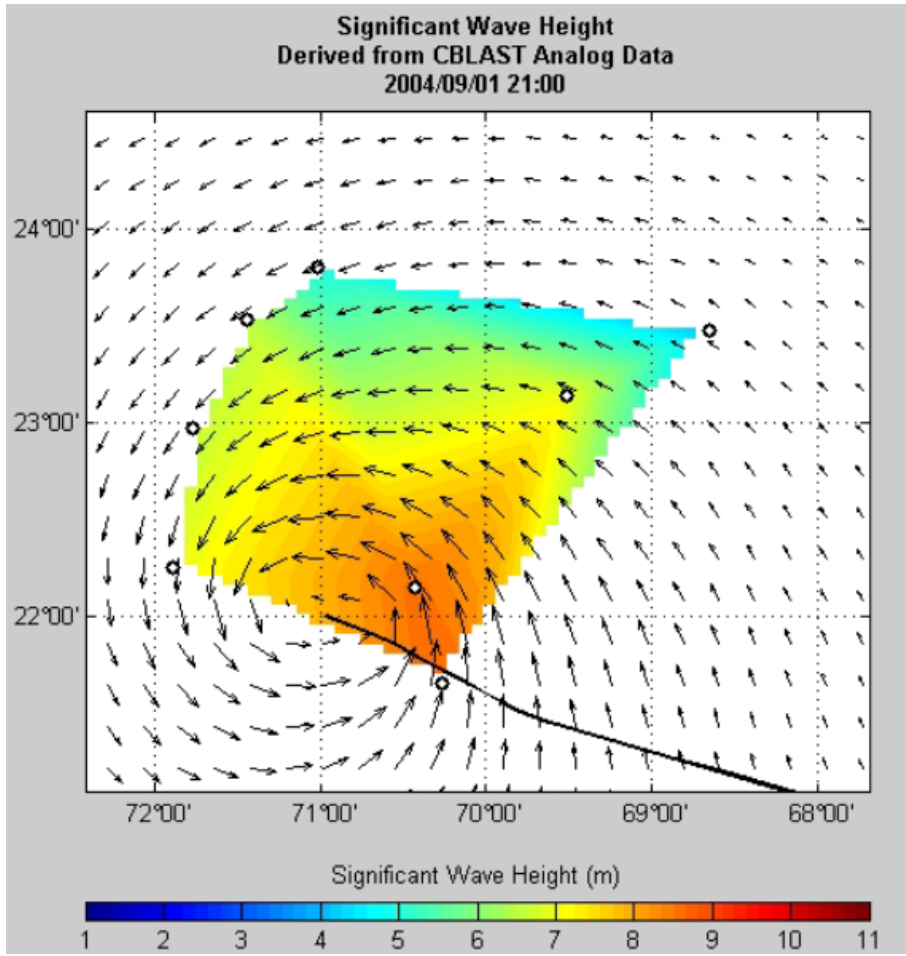
A compact, 200kHz sonar measured the distance of the free-surface at 1Hz. Beam angle of sonar resulted in a footprint of O(1-5) meters depending on depth. Data is sampled for 20 minutes every mission cycle and a 1-D spectrum is computed and telemetered via satellite.

SONAR integrated into SOLO endcap

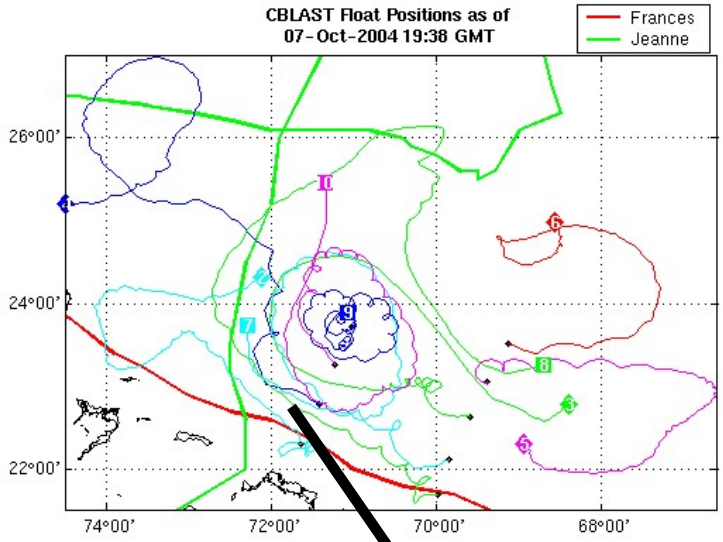


Wave Measurements
2004 Hurricane Frances
H=5.1m (16.7’)
T=12.8 seconds
U*=25m/sec from HWINDS



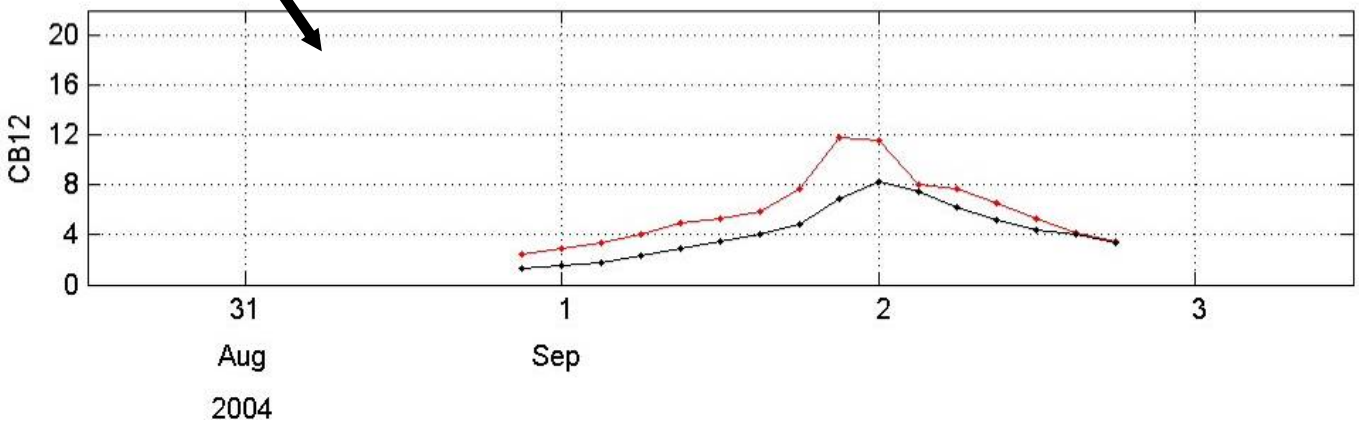


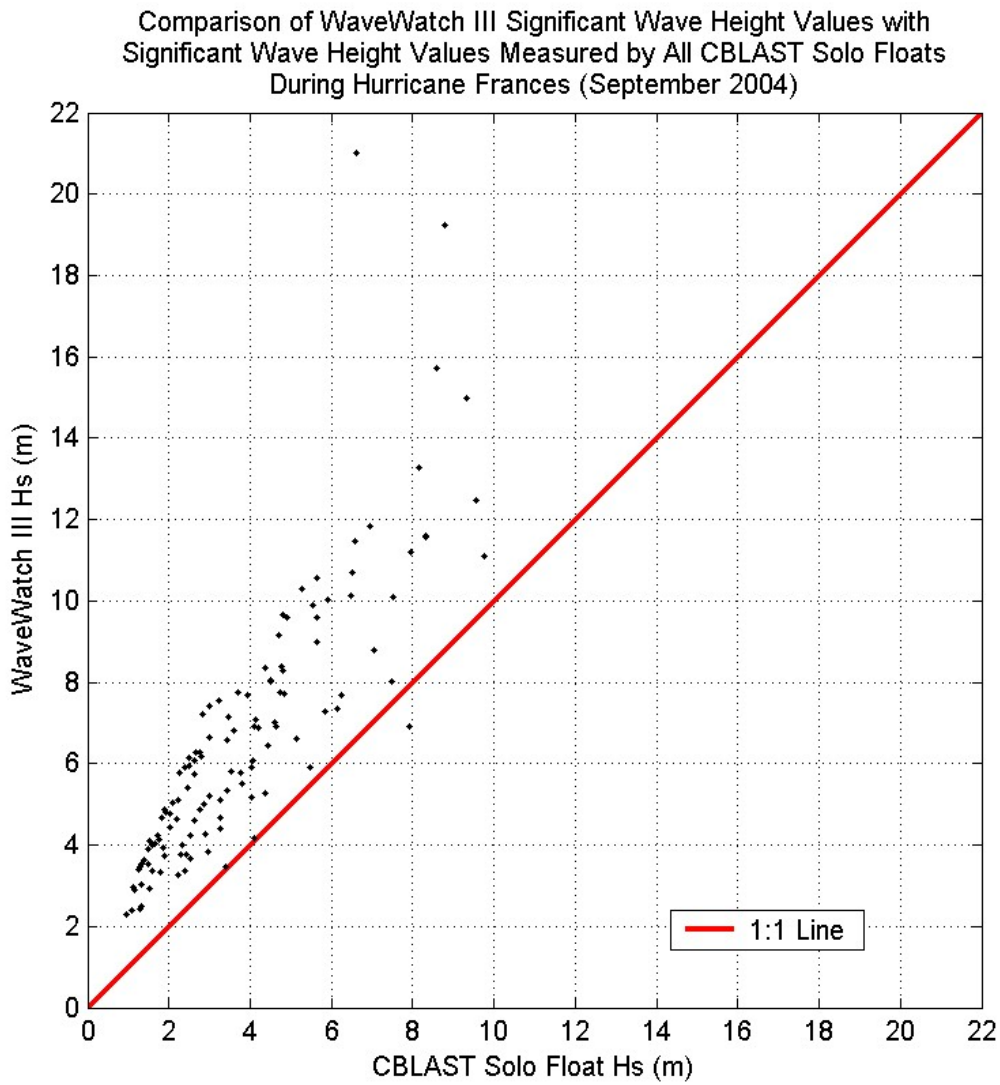
Comparison of operational Wavewatch iii model with in-situ float data



Significant wave height model-data comparison:

Wave-watch overestimated
Observed wave field




Comparison of WaveWatch III Significant Wave Height Values with
Significant Wave Height Values Measured by All CBLAST Solo Floats
During Hurricane Frances (September 2004)
WaveWatch III Hs (m)
CBLAST Solo Float Hs (m)
0
2
4
6
8
10
12
14
16
18
20
22
1:1 Line

SVP float does not follow surface wave motion - waves pass by producing horizontal water motion relative to the drifter float. The relative horizontal vector current can be converted to directional wave spectrum using statistical/dynamical model

QuickTime?and a
decompressor
are needed to see this picture.

SVP Drifter with ACM on bottom of float

Luca Centurioni

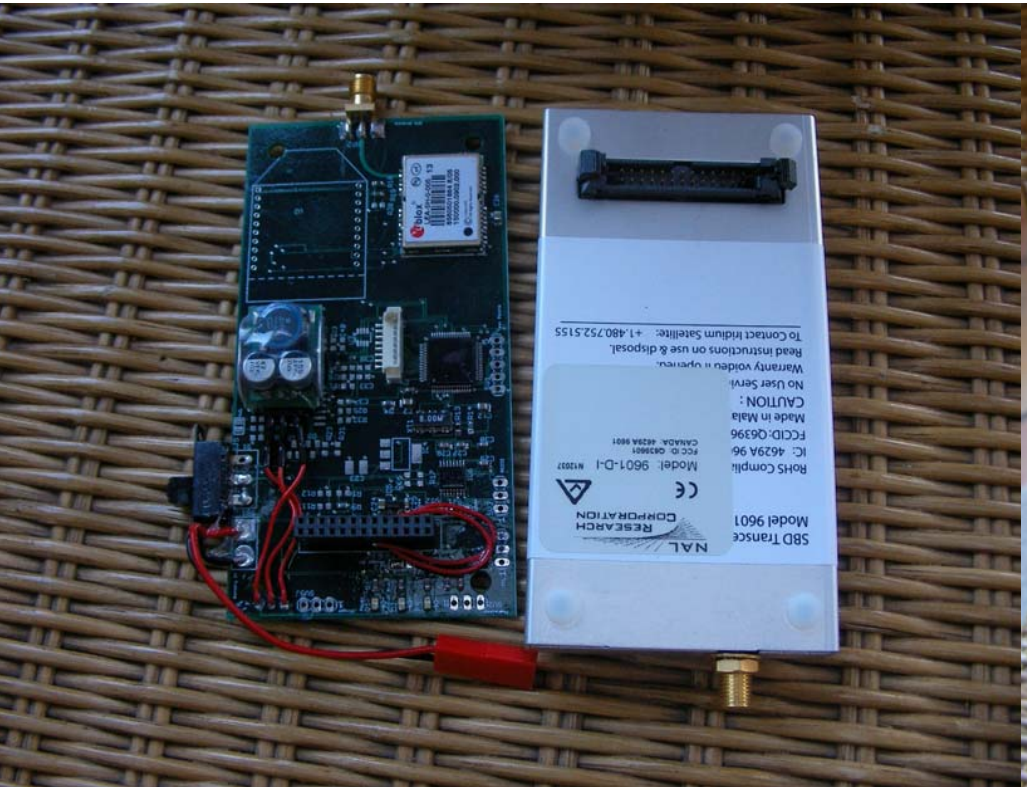
First at sea test of SVP drifter with ‘Nortek’ ACM below float sampling at 1hz. Drifter within 1km of NOAA wave sensor equipped Met buoy near Point Conception, CA

Summary of results for wave direction observations

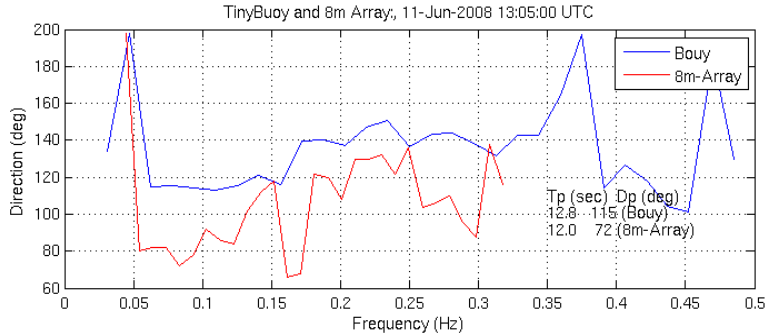
Time (UTC) of 8/12/08	Swell period (wave buoy)	Wind waves period (wave buoy)	Swell period (drifter)	Wind waves period (drifter)	Swell direction (drifter)	Wind waves direction (drifter)	Wind direction (buoy)
5 am	8.3	4.5	8.4	5.14	184T	264T	300 T
7 am	9.1	4.8	8.8	4.8	147T	275T	310 T

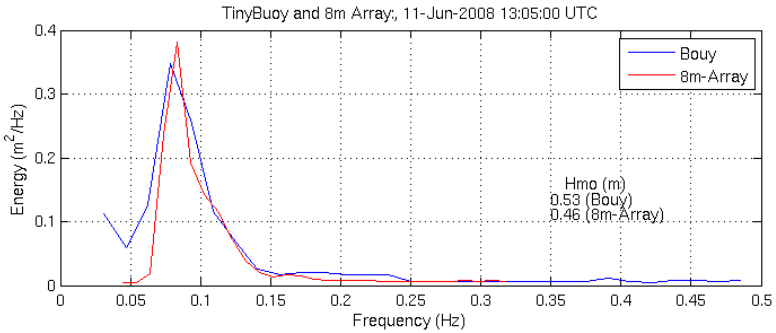
Continental Control Design, Inc.

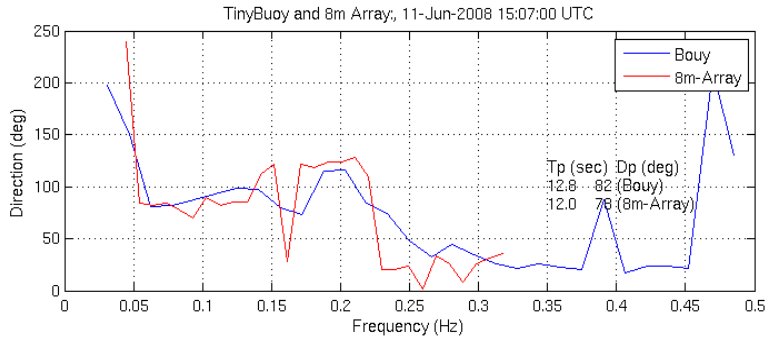
- Cell Phone GPS receiver 3D orbital velocities
- Microcontroller does the spectral analysis
- Iridium SBD modem ships data globally
- Hull is polycarbonate ice cream ball

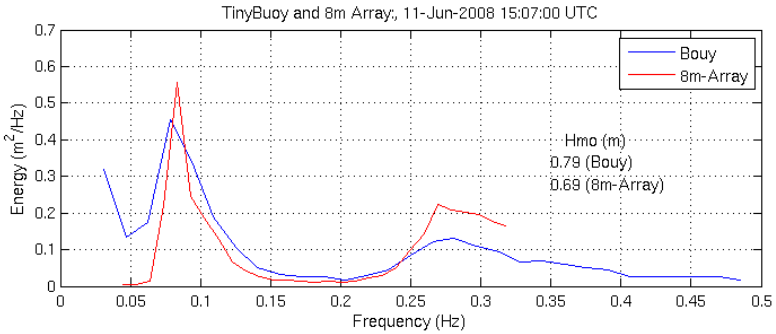


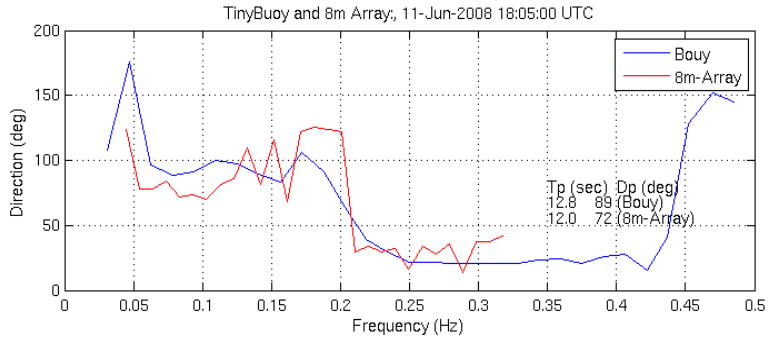
CCD comparison within DUCK wave array off North Carolina US

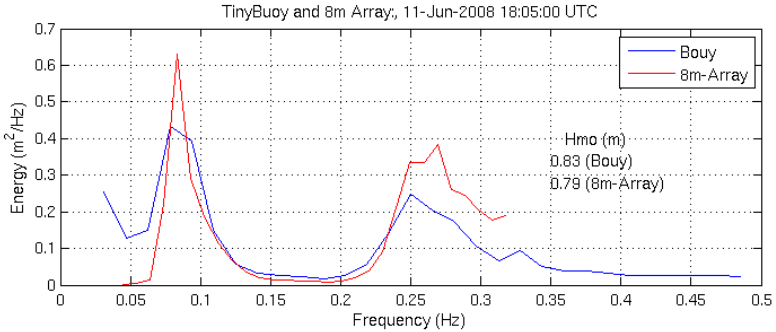




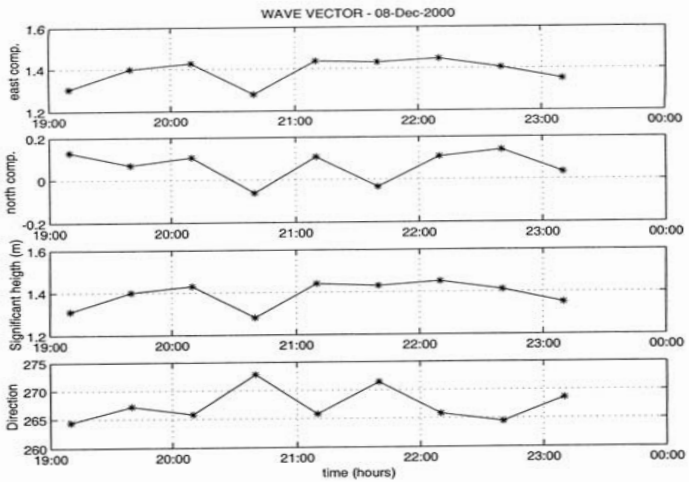








CODE-type Drifter with GPS vertical and horizontal record provides data for calculating wave height and direction (Pierre-Marie Poulain, Dec. .2000)



CODE-Type Drifter

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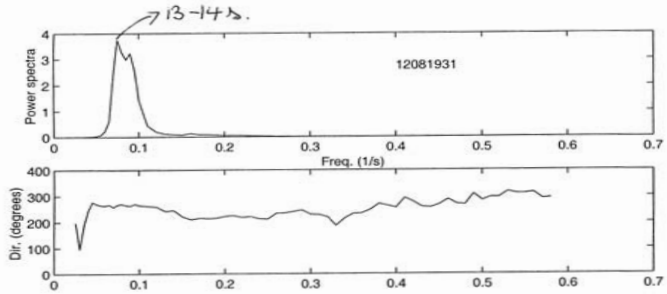

Observations near
wave-rider buoy
off Monterey CA

CONCLUSIONS

The Global Drifter Program array can provide 1200-1300 open ocean platforms for wave observations. SVP drifter float does not follow the free surface so wave sensor studies are needed.

Adaptations of GPS sensors to a variety of surface following platforms work well. Implementation is low cost and straight forward.

Adaptations of acoustic sensors on floats under Tropical Cyclones work well - high tech.