

Wave measurements from drifters PP-WMD



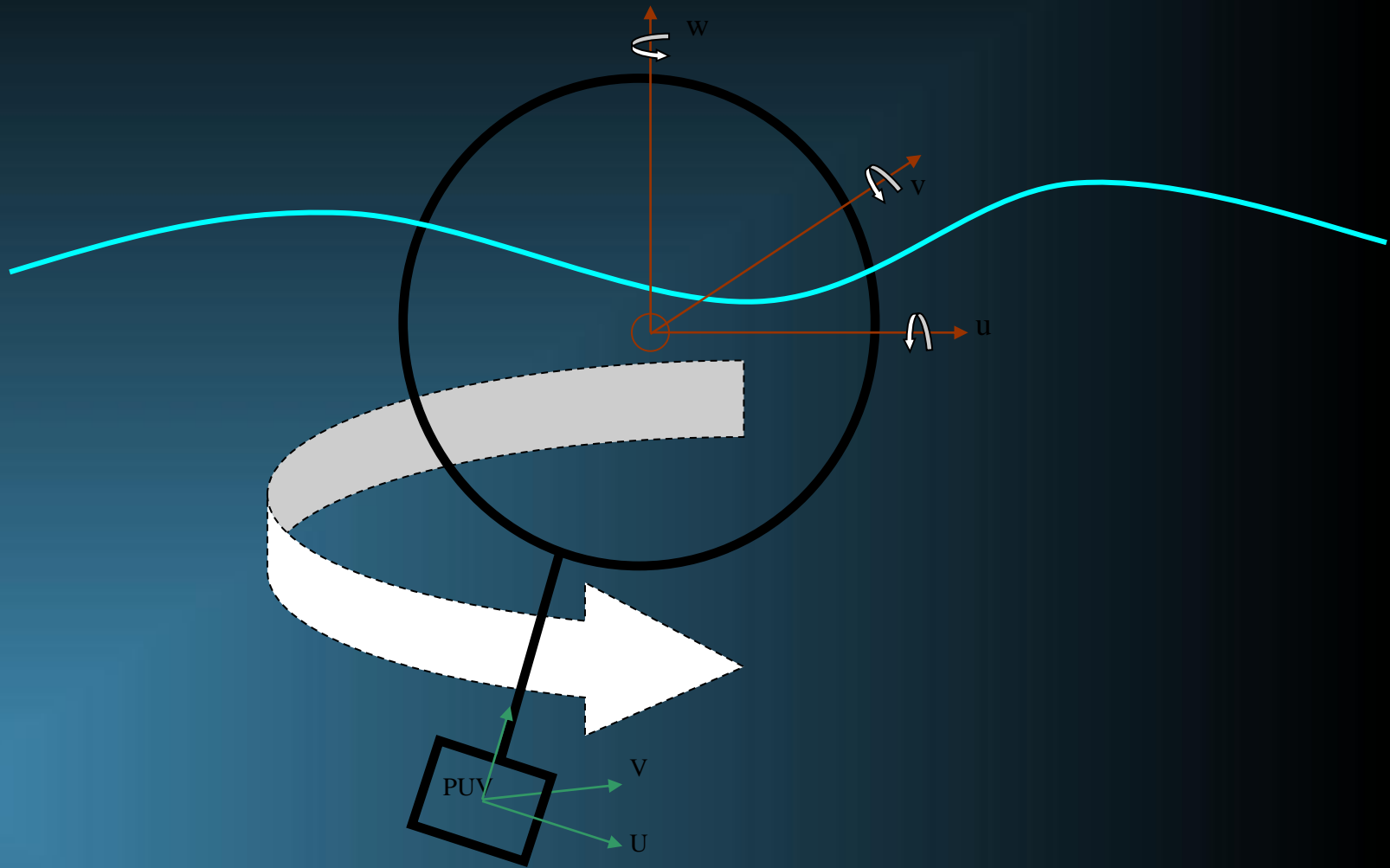
JCOMM Technical Workshop on Wave Measurements from Buoys

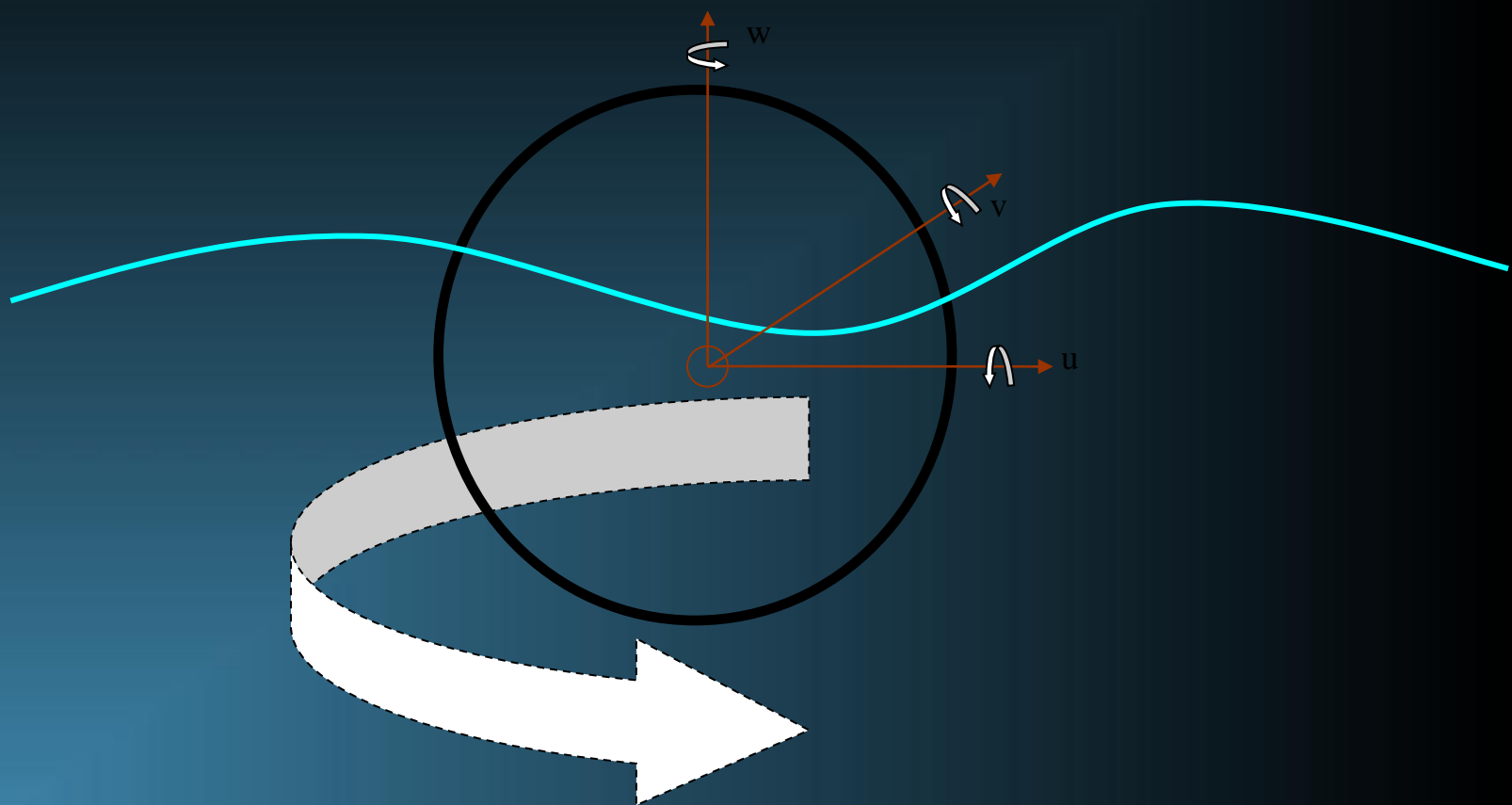


- Deep ocean wave measurements needed for
 - Validation of models
 - Validation of satellite observations
 - Process studies (e.g. for hurricanes and other extreme events)
- An undrogued drifter is a good wave follower and might carry
 - Upwards-looking ADCP
 - Attitude sensor, e.g. GPS, pitch-roll package
- Presentation of 'First 5' as minimum reporting standard
 - Energy spectrum + first four spectral moments
 - See http://www.act-us.info/download/workshop_reports/ACT_WR07-03_Wave_Sensor.pdf
- Need for careful evaluation of wave drifters
- Proposal for DBCP Pilot Projects

Wave measurements – the ‘Big 3’

- Three time series needed
 - in x, y and z or their derivatives
- No buoy is a perfect wave follower
- Need to compensate for buoy ‘inertia’
 - Buoy motion + PUV or ADCP
- Can we assume that a drifter is a good wave follower?
 - Only if undrogued





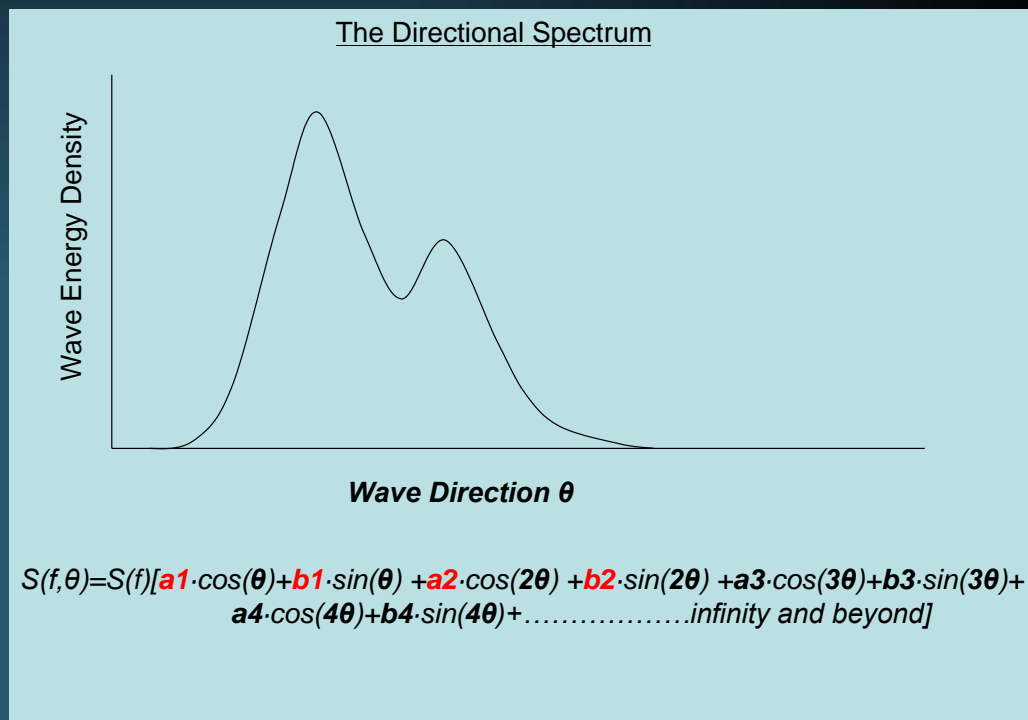
Low cost technologies to measure the Big 3



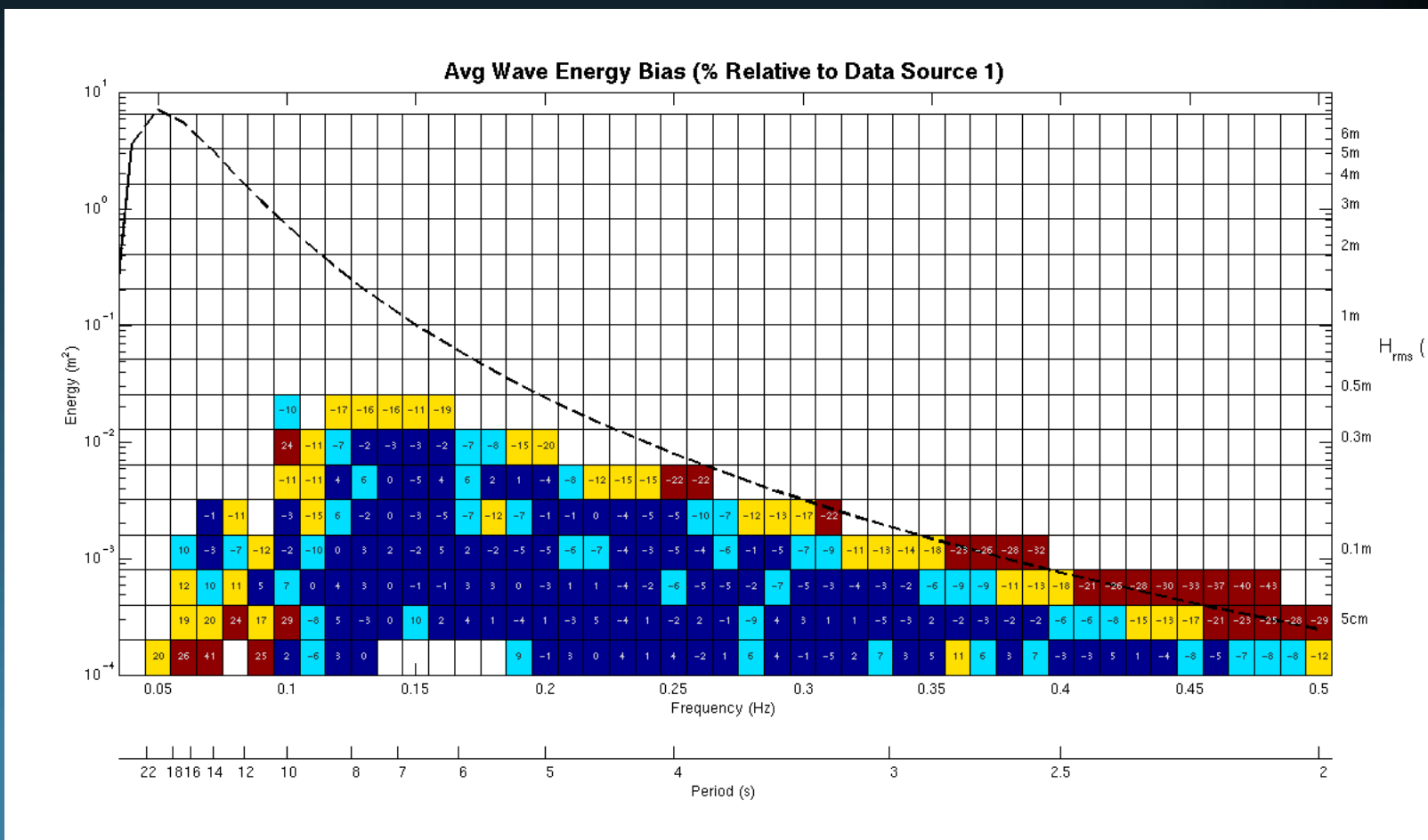
- Not always low cost!
- Energy hungry
 - Sensor itself
 - In situ processing
 - Communications

What data do we need to report?

- 'First 5'
 - Power spectrum: coefficients as a function of frequency band ($S(f)$)
 - Directional spectrum: first two pairs of coefficients of spectral moments (a_1, b_1, a_2, b_2)
- Work by O'Reilly (Scripps), Jensen (USACE) and at NDBC
 - Development of IOOS



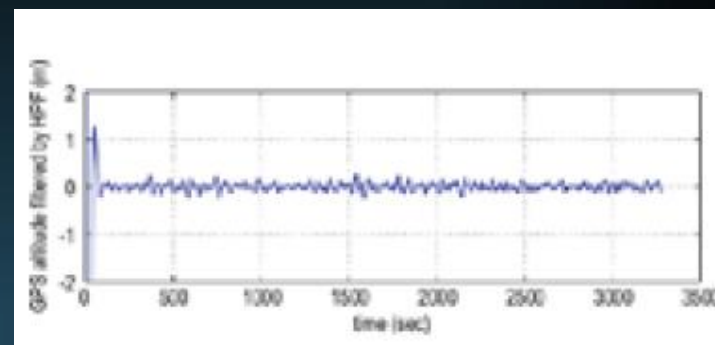
Need for careful intercomparison



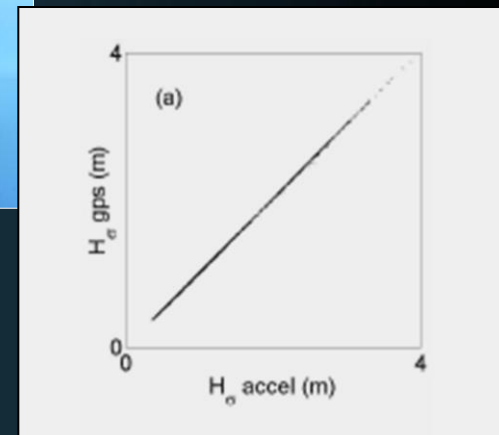
Sources of User Equivalent Range Errors (UERE)		
Source	Effect	Time constant
Ionospheric effects	± 5 m	10 min
Ephemeris errors	± 2.5 m	1 hour
Satellite clock errors	± 2 m	5 min
Multipath distortion	± 1 m	100 sec
Tropospheric effects	± 0.5 m	10 min
Numerical errors	± 1 m	White noise

Power spectrum of most errors lies well below ocean wave power spectrum

- JMA/JAXA prototype wave buoy
 - GPS World, May 2005
 - HP filter to separate out wave signal
 - Claimed accuracy of a few cm
 - US Patent 6847326



- Datawell wave buoy DWR-G
 - Sea Technology, Dec 2003
 - Probably similar technique



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



- Objectives
 - Evaluate feasibility of wave measurement from drifters
 - Explore in particular use of GPS as the cost-effective means of yielding 2-dimensional wave spectra
 - Prove the technology by measurements and intercomparison with existing trusted wave measurement technologies
 - Deploy up to 50 wave measurement drifters within the framework of the pilot project
 - Establish confidence in user community in the validity of wave measurements from drifters
- Approved by DBCP XXIV
 - Up to 3 years
 - Up to \$30k 'seedcorn' funding

Objectives of Scripps SC meetings

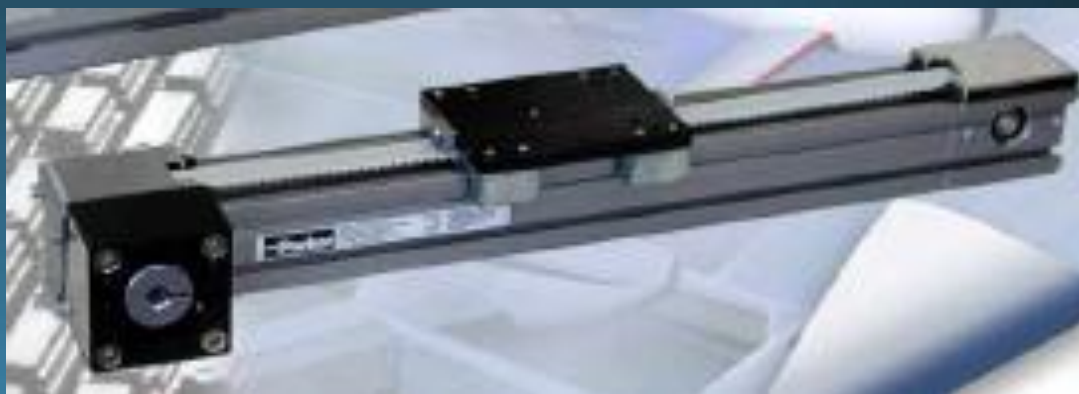
- Report to DBCP XXV
- Action Plan
- Named individuals!



Outcomes since Scripps meeting

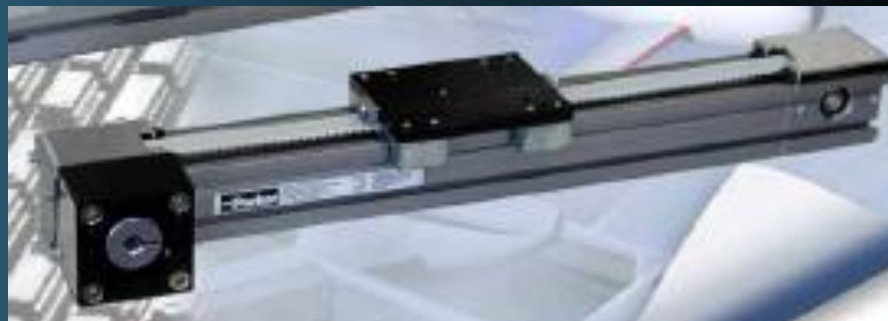
- Additional SC members (Ball, Young, Greenslade)
- Adoption 'of first 5' spectral representation
- 'Town meeting' at Ocean Science, Portland, Feb 2010
- Approach to ESA for inclusion in Climate Change Initiative
- Optimistic response re Iridium bulk rates ('DISA' rates)
- Idea for test rig using linear actuators

- Up to 5m long
- Up to 2g acceleration
- Arbitrary waveform, not just sinusoidal (cf Scripps)



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- Approach to ESA for inclusion in Climate Change Initiative
- Optimistic response re Iridium bulk rates ('DISA' rates)
- Idea for test rig using linear actuators
- Marlin-Yug proposal – please study
- To do:
 - Practical trials
 - Funding proposals
 - Data formats/issues





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