



Joint WMO-IOC Technical Commission
for Oceanography and Marine Meteorology

DBCPC-ETWS Joint Pilot Project on Wave Measurement Evaluation and Testing

Val Swail¹, Robert Jensen² and Boram Lee³

¹Chair, JCOMM Expert Team on Wind Waves and Storm Surges

²Co-Chair, Pilot Project on Wave measurement Evaluation and Test

³World Meteorological Organization, Marine Meteorology and Oceanography Programme



WMO



IOC/UNESCO



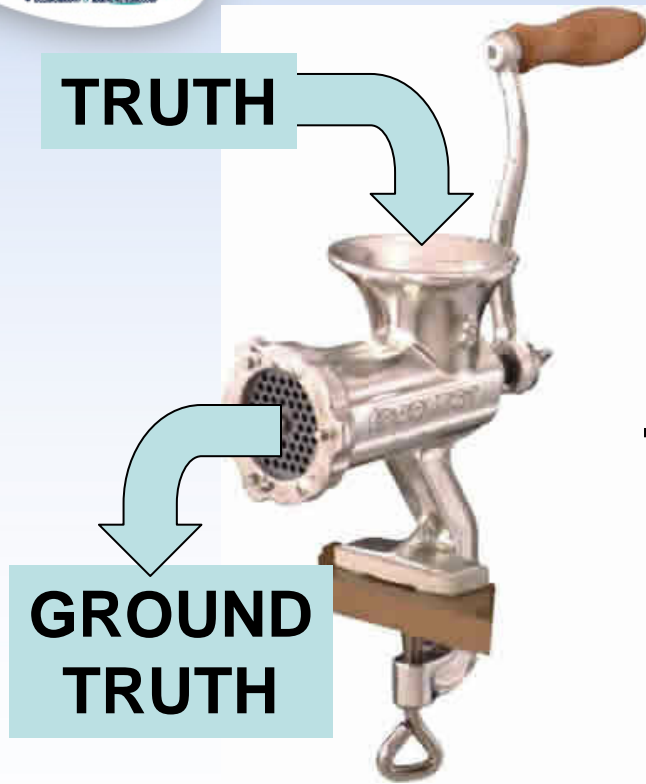
How is your wave measurement?



Courtesy C-C Teng

“Continuous testing and evaluation of operational and pre-operational measurement systems is an essential component of a global wave observing system, equal in importance to the deployment of new assets”

Swail et al., *Wave Measurements, Needs And Developments For The Next Decade*. OceanObs09 publication.



**New System for
obtaining
“ground truth”
for wave measurements**

Or

**What about an
independent group
of assessors??**

PP-WET Steering Team membership

- Val Swail, Co-Chair (ETWS, EC)
- Bob Jensen, Co-Chair (USACE)
- David Meldrum (DBCP, SAMS)
- Jean Bidlot (ECMWF)
- Kwang-Chang Lim (KHOA)
- Bill Burnett (NOAA/NDBC)
- Julie Thomas (UCSD)
- Hans Graber (U. Miami)
- Diana Greenslade (Australian Bureau of Meteorology)
- Venkatesan (India)
- Bill O'Reilly (UCSD)
- Jon Turton (Met Office)
- Christian Meinig (NOAA/PMEL)
- Anne Karin Magnusson (met.no)
- Kevin Ewans (Shell)
- George Forristall (ForOcean)
- Colin Grant (OGP Metocean)
- DBCP Technical Coordinator
- Secretariat support will be provided by WMO and IOC.
- Boram Lee (WMO)
- Etienne Charpentier (WMO)

PP-WET: Objectives

- Develop the basis for an international framework for the continuous testing and evaluation of existing and planned wave buoy measurements
- Coordinate buoy inter-comparison activities.
- Develop technical documentation of differences due to hull, payload, mooring, sampling frequency and period, processing (e.g. frequency bands & cutoff), precision, transmission
- Develop training material to educate users about how to deploy and operate wave sensors appropriately.
- Contribute appropriate material to the JCOMM Standards and Best Practice Guide
- Establish confidence in the user community of the validity of wave measurements from the various moored buoy systems

Project Building Activities during the Year

- **Alliance for Coastal Technologies Workshop** – St. Petersburg FL - February 2011 – US contribution to PP-WET and vice versa; draft report and US plan in review
- **OGP Metocean Committee** - London UK – April 2011
- **National Oceanography Centre** Southampton, UK – April 2011 - Seminar
- **JCOMM Workshop on Advances in Marine Climatology** – Frascati Italy - May 2011 – marine climate community concerned with wave climate biases, wave climate summaries, trends; satellite community with calibration
- **RMIC Asia Pacific Workshop** – Tianjin China - July 2011 workshop noted that RMIC can play a role in the Pilot Project by calibrating instruments, providing technical advice do data analysis on behalf of PP participants; workshop supported long term need for instrument evaluations
- **12th Waves Workshop** - Special Session on Wave Measurement Evaluation – Kona Hawaii - November 2011
- ***DBCP XXVII Session and Technical Workshop - Geneva***

Status of Intercomparison Activities during the Year

Canada

- Contract continued with to CDIP/SIO to
 - Maintain intercomparison web site
 - Provide intercomparison software to partners – new PC version
 - Advise on use of intercomparison methodology and web site - Appendix
 - Advise on intercomparison technical issues
 - Conduct individual intercomparison analyses for participants
- Intercomparison activities – 3 co-deployments
 - Hecate Strait: 3D vs DWR – 3D vs TriAxys when data retrieved
 - Burgeo: 6N vs DWR; TriAxys vs DWR
 - Halifax: 3D vs DWR; 3D vs TriAxys when data retrieved
 - Hecate Strait DWR to be relocated to La Perouse 3D November' 11
 - See Technical Workshop presentation and following slides for results

Status of Intercomparison Activities during the Year

United States

1. Analysis of historical NDBC multiple sensor packages on
 - 44014 (Virginia Beach-Atlantic Ocean offshore of the FRF)
 - 46029 (Columbia River, Oregon Pacific Ocean)
 - 46042 (Monterey, California)**
 - 51001 (Hawaii NorthWest, was operating but not any more)

2. **NDBC Buoy Farm to be located near 46042 Monterey Canyon
 - 3D multiple sensor (46042)
 - 2.4D new buoy with 3DM sensor
 - Datawell Directional Waverider (to be deployed at the end of the month).
 -

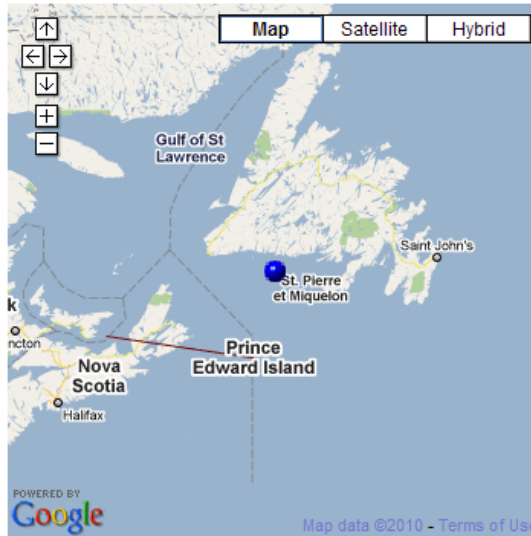
3. Alliance for Coastal Technologies Report under review. Consensus of all manufacturers is to use a Datawell Mark III or IV as reference to evaluate buoys. The FRF Duck to be the shallow water site to evaluate to the FRF linear array as relative reference.

Status of Intercomparison Activities during the Year

- **Korea** – multiple co-locations at leodo platform. Data to be retrieved at end September for analysis
 - **India** – co-location offshore India in 20m water depth with DWR. Data to be retrieved at end September for submission to CDIP for analysis
 - **Norway** – Ekofisk platform wave historical data being assembled for submission to CDIP for analysis – LASAR, waverider, MIROS. Coordination with Conoco regarding deployment of DWR
 - **UK** – purchased DWR for research; plan to evaluate K-series buoys
 - **ECMWF** – compared co-located Canadian buoys to operational wave model output
 - **OGP** – sensitivity analysis of buoy hull size to wave measurement bias (Woodside); interest in providing co-located measurements to CDIP for analysis; Ekofisk logistics
 - **Interest but no definite plans at the moment:** ESURFMAR, Australia, China, Japan
- **Other participants are encouraged to join the WET activity by contacting the co-chairs or Secretariat.**

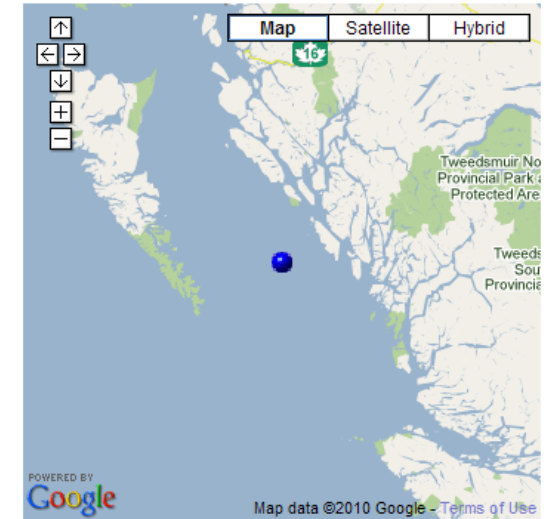
Canadian Co-deployment locations

- Current status: **operational**
- Most recent location: **47 15.91 N 57 20.49 W (47.2652 -57.3415)**
- Instrument description: **Datawell directional buoy**
- Most recent water depth (MLLW): **177 m (581 ft, 97 fm)**
- Measured parameters: **wave energy, wave direction, sea temperature**
- NDBC/WMO identifier: **44235**



170 - Station Map

- Current status: **operational**
- Most recent location: **52 26.20 N 129 47.70 W (52.4367 -129.7950)**
- Instrument description: **Datawell directional buoy**
- Most recent water depth (MLLW): **230 m (755 ft, 126 fm)**
- Measured parameters: **wave energy, wave direction, sea temperature**
- NDBC/WMO identifier: **46138**

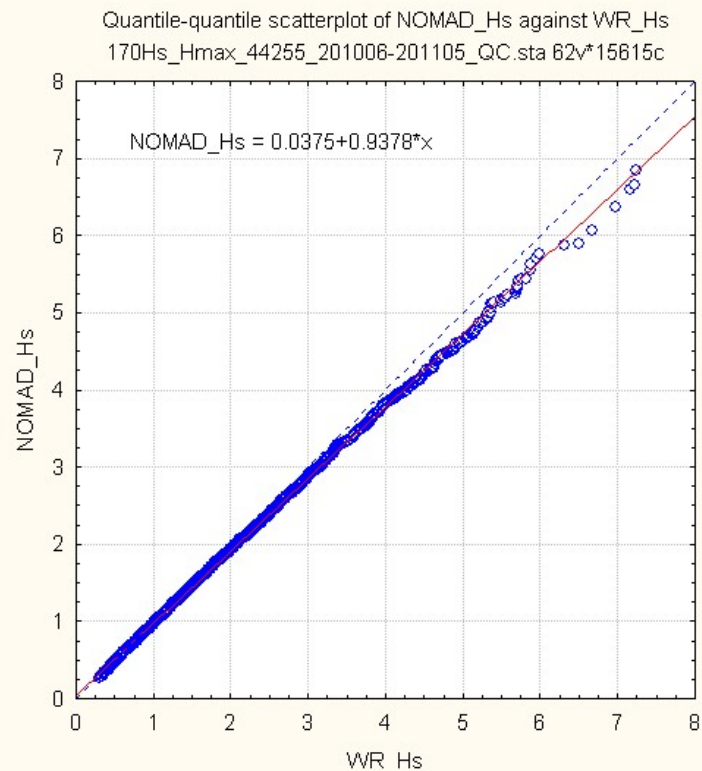
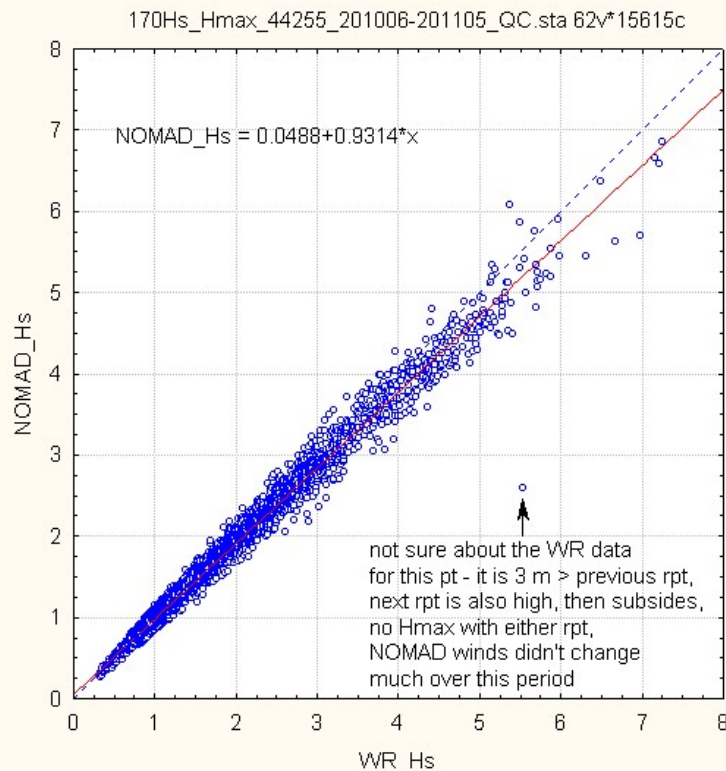


174 - Station Map

- 170 co-located with operational 6m NOMAD 44255 plus TriAxys sensor
- 174 co-located with operational 3m discus 46185 plus TriAxys sensor
- 170 now co-located with 3m plus TriAxys sensor at Halifax Harbour
- 174 to be moved with 3m plus TriAxys sensor to La Perouse

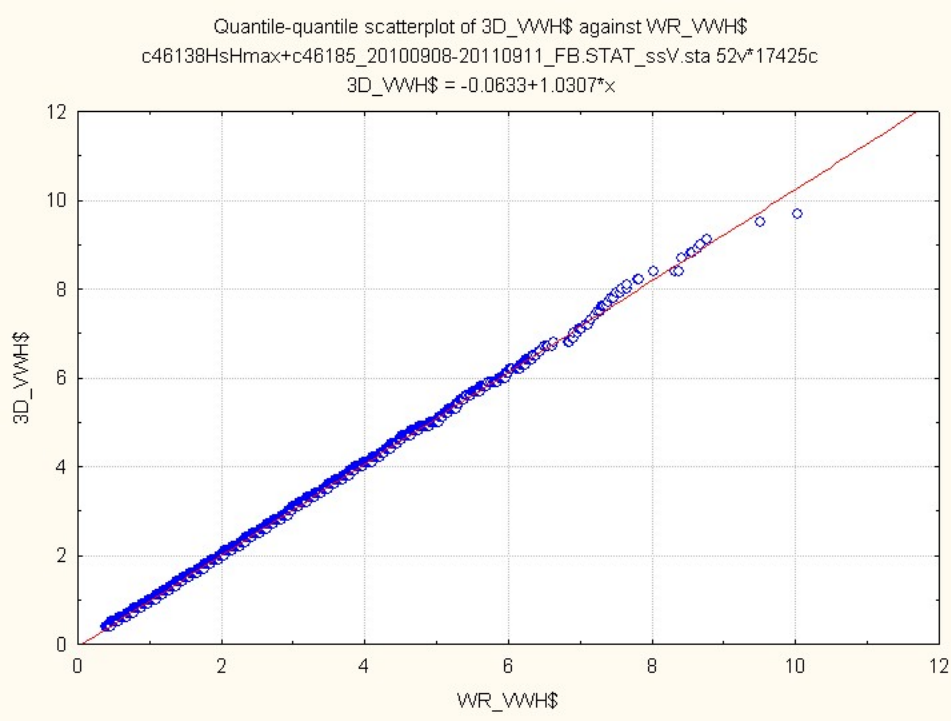
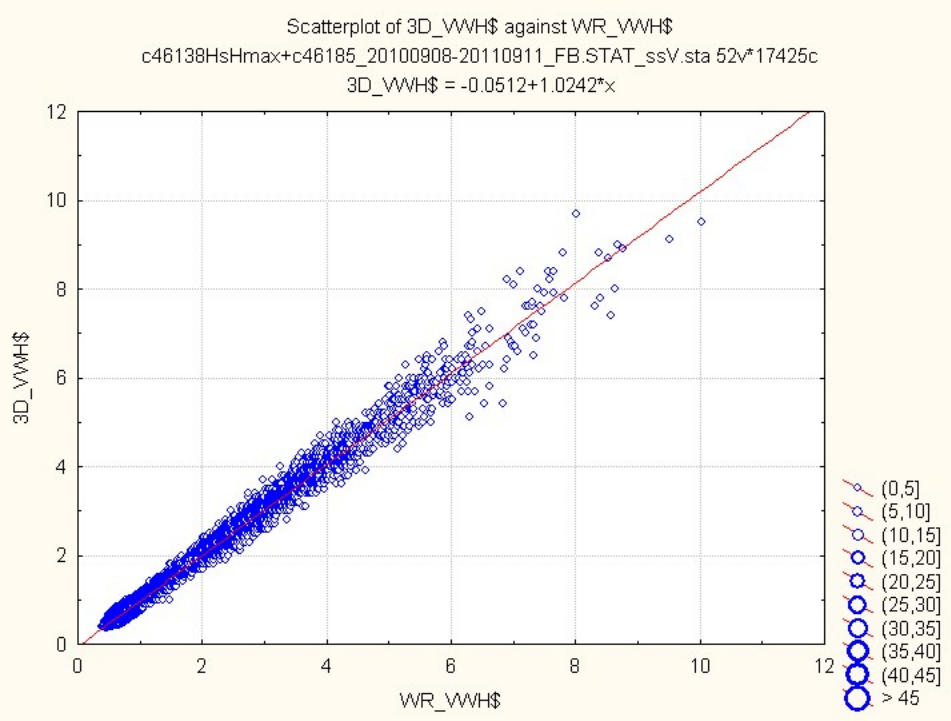
NOMAD - DWR H_s Comparison

- NOMAD H_s ~ 7% low compared to WR H_s over range of data (up to ~ 7 m)
- Treat results with caution! – not First-5.



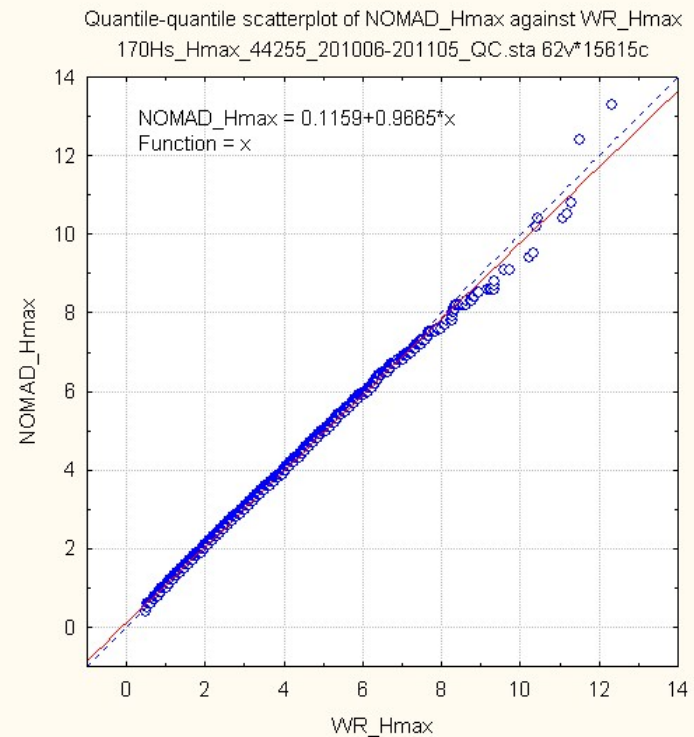
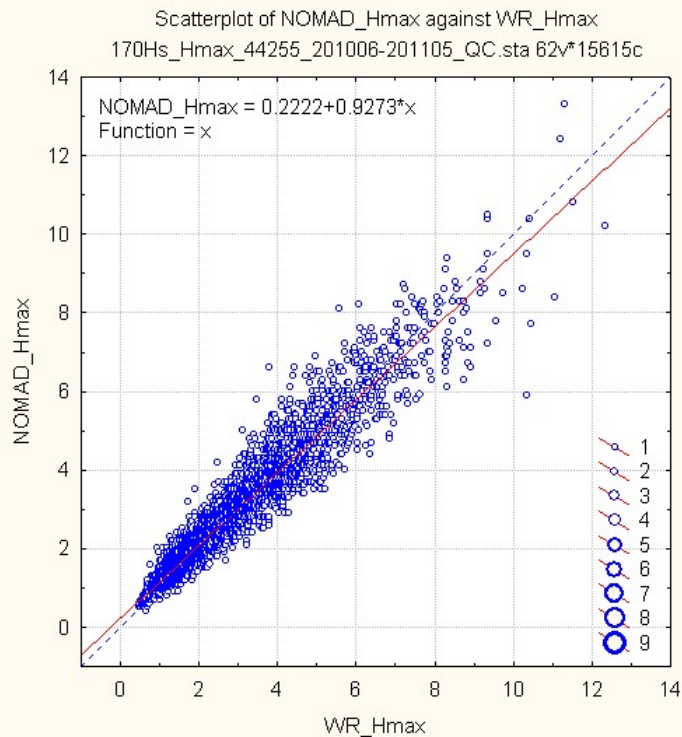
Comparison of Hs: 3D - DWR

- 3D Hs ~ 3% > WR Hs
- Treat results with caution!



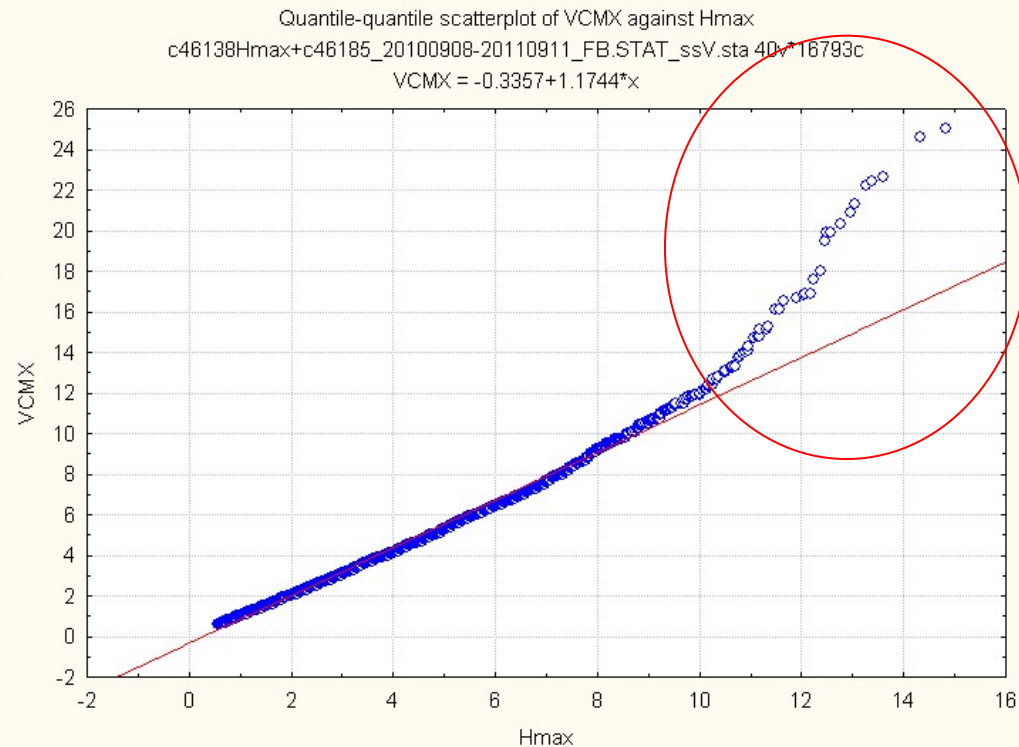
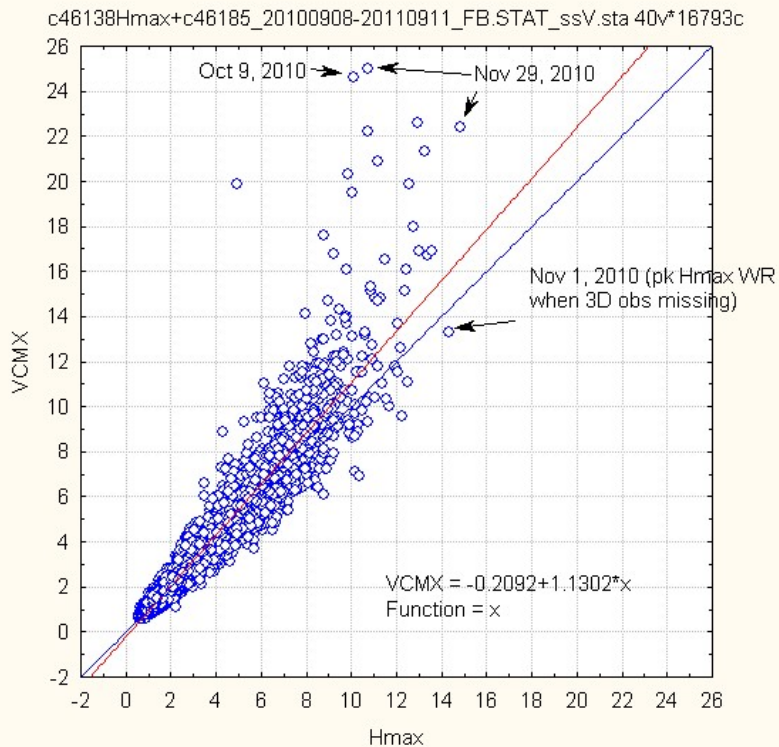
NOMAD - DWR H_{\max} Comparison,

- $\text{NOMAD_Hmax} = 0.12 + 0.97 * \text{WR_Hmax}$
- Fairly good agreement in H_{\max} up to 11 m, a few higher outliers ($\text{NOMAD_Hmax} > \text{WR_Hmax}$)

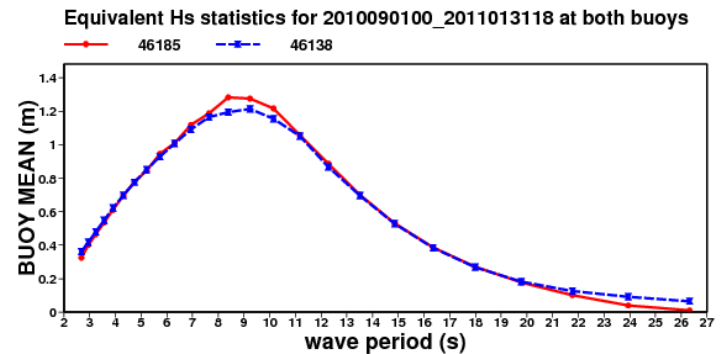
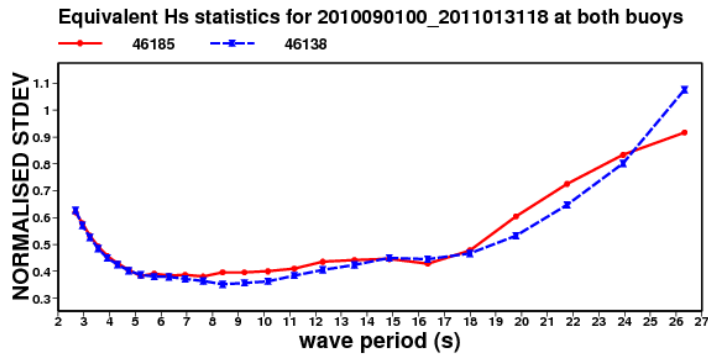
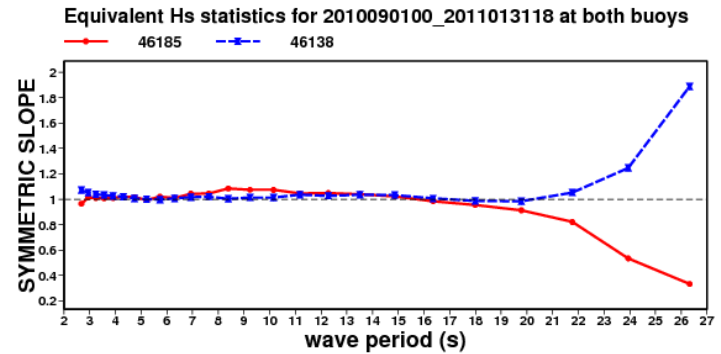
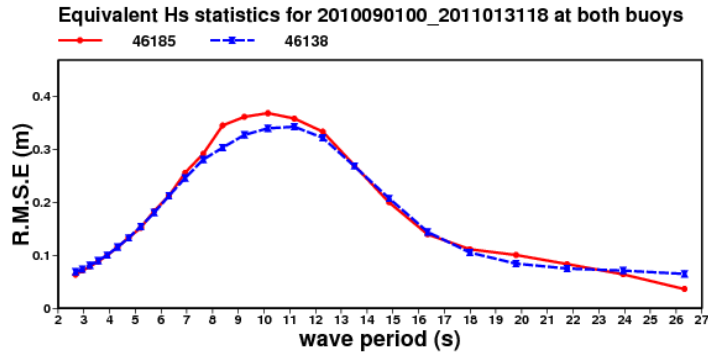
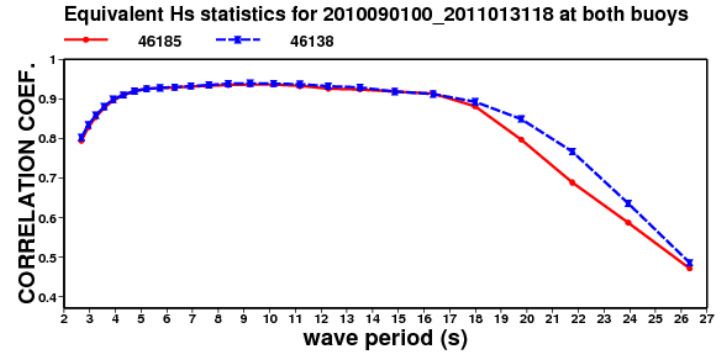
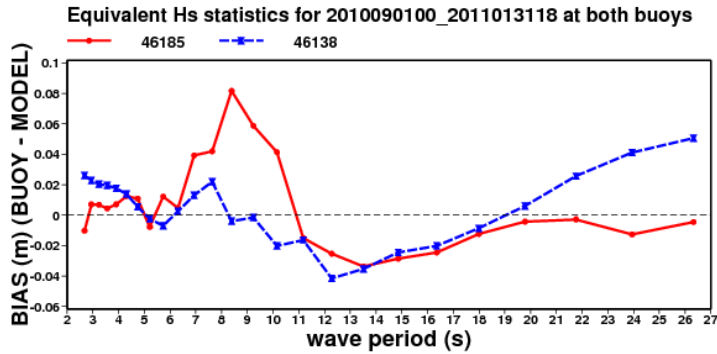


Comparison of H_{max} : 3D to DWR

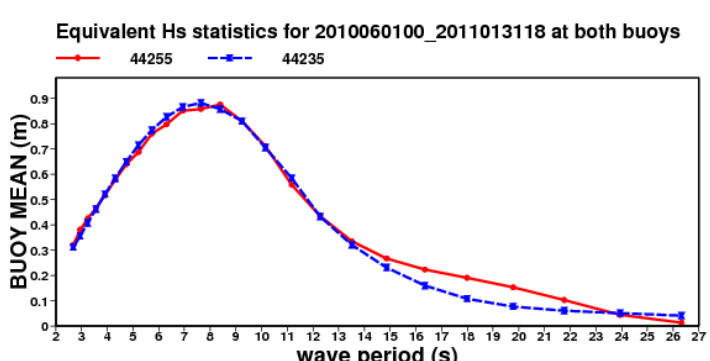
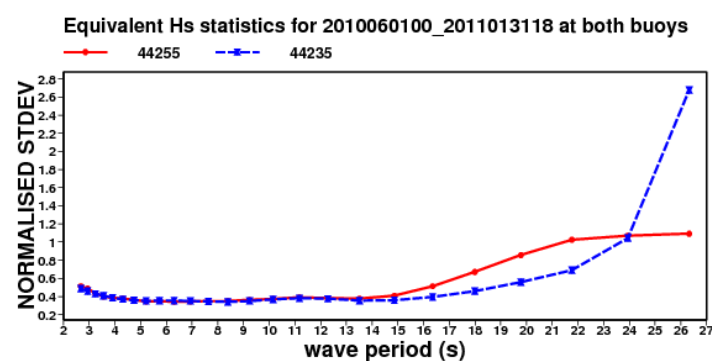
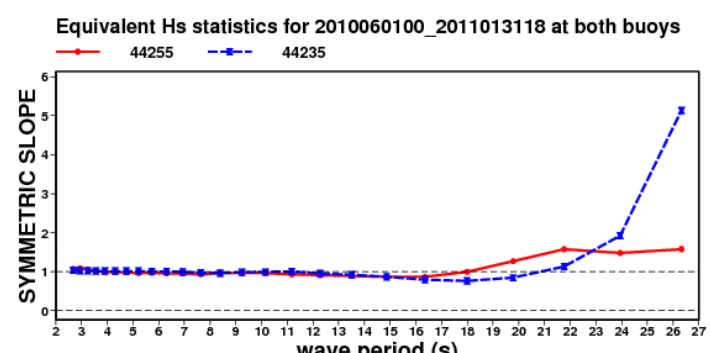
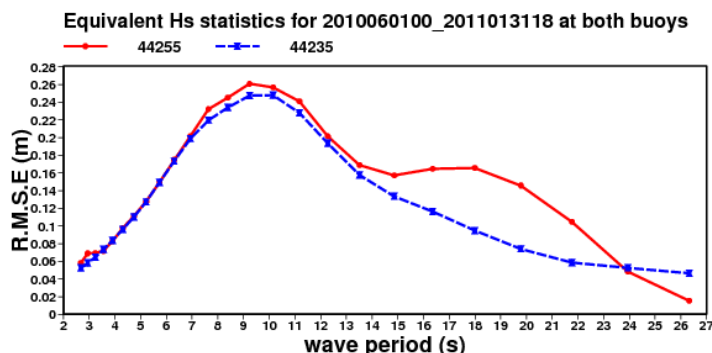
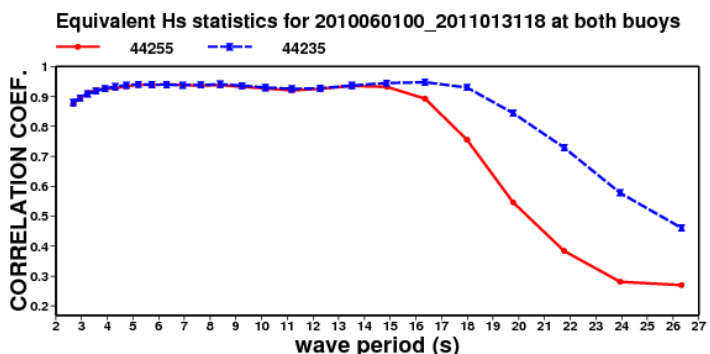
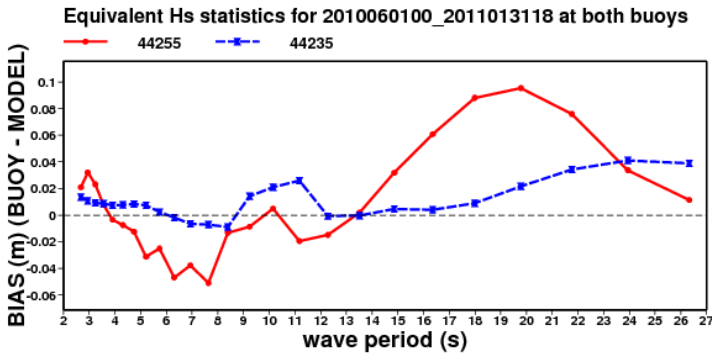
- 3D (VCMX) shows spuriously high values of H_{max} compared to WR H_{max} , above H_{max} 9 m
- 3D H_{max} is also $>$ WR H_{max} below 9 m



CA Hecate (46185 red) vs DW Hecate (46138 blue)

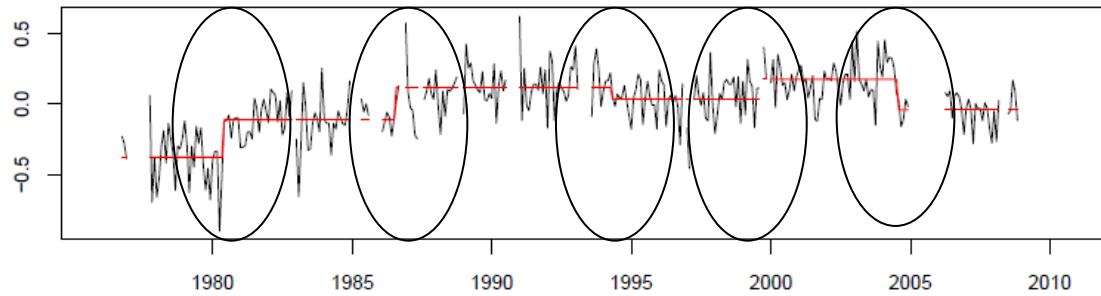


CA NE Burgeo (44255 red) vs DW Ramea (44235 blue)

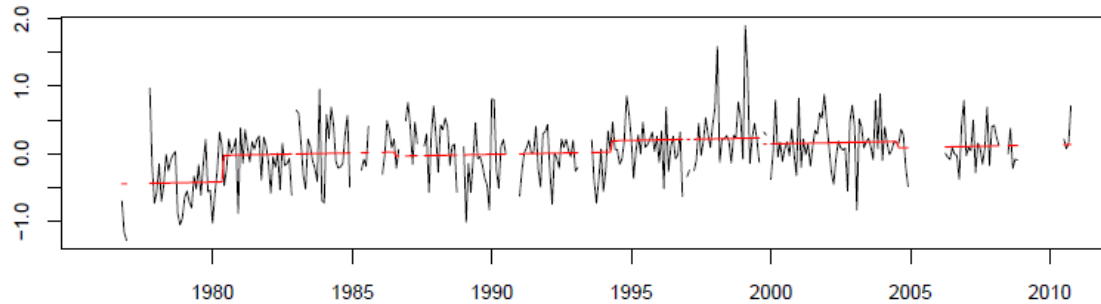


46005 - Washington

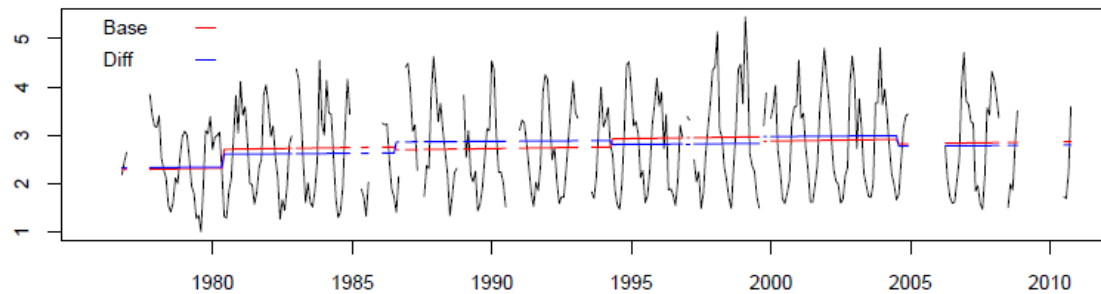
a. Base-minus-reference series



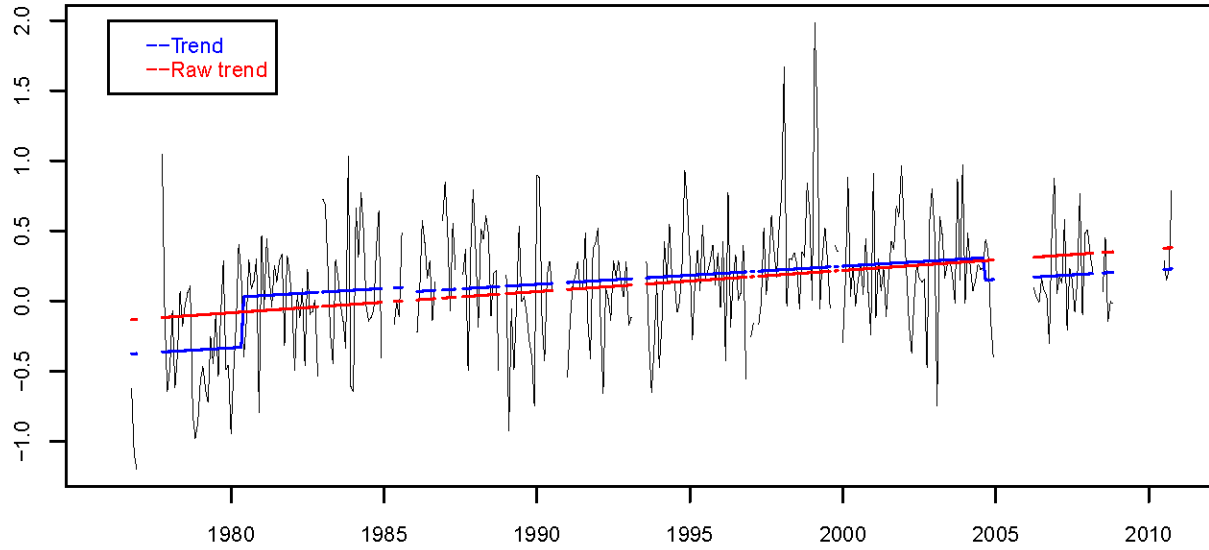
b. De-seasonalized base series



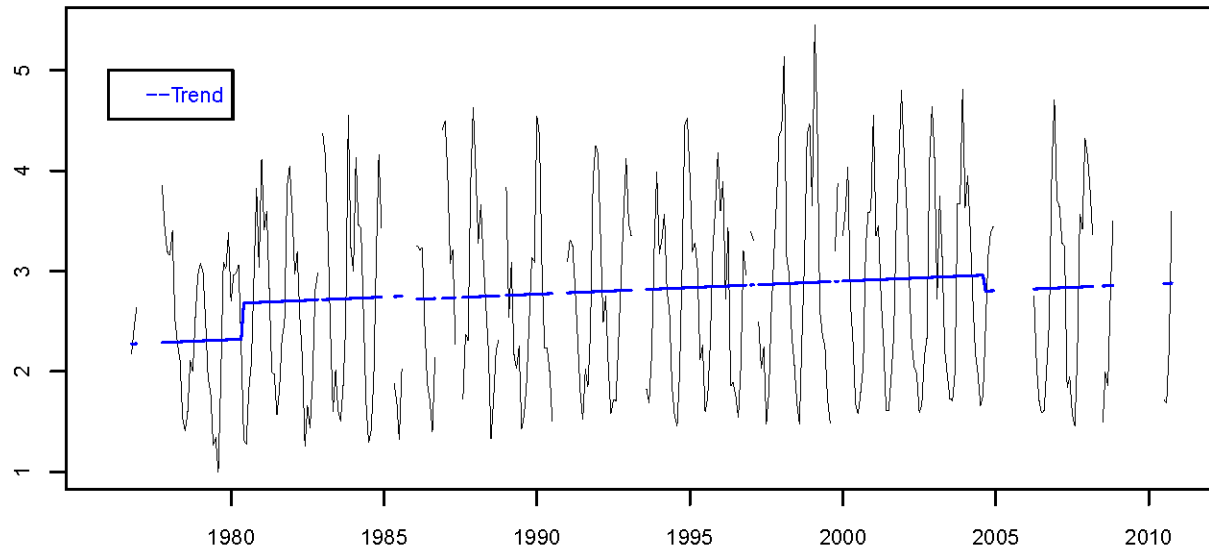
c. Base series



De-seasonalized buoy series



Original buoy series



Recommendations for PP-WET

- Encourage additional agencies/countries to carry out intercomparisons
- **In particular as a matter of priority undertake the following:**
 - NDBC 6N versus DWR
 - UK K-series buoy versus DWR
 - DWR versus LASAR array at Ekofisk
 - First-5 evaluation of GPS drifter versus DWR
- More directional spectral intercomparisons
- Continue the Pilot Project for another year
- Encourage RMIC RA-IV (and other RMICs with wave component) to play a role in the Pilot Project

Proposed Plans PP-WET Work Plan - Year 4

- 3rd Steering Committee Meeting– November 2011
- Coordinate intercomparisons of wave measurements from different platforms, on an opportunistic basis
 - Assist participants where appropriate
- Develop a plan for a continuous testing and evaluation program
- Contribute, as appropriate, to the JCOMM Standards and Best Practice Guides
- Present results to DBCP-XXVIII and other scientific fora

Thank you.



PP-WET Work Plan - Year 3

☒ 3rd Steering Committee Meeting– Spring 2011

- ✓ Coordinate intercomparisons of wave measurements from different platforms, on an opportunistic basis
 - ✓ Assist participants where appropriate
- ➡ Develop a plan for a continuous testing and evaluation program
- ➡ Contribute, as appropriate, to the JCOMM Standards and Best Practice Guides
- ✓ Present results to DBCP-XXVII and other scientific fora, e.g. MARCDAT-III, 12th Waves Workshop