DBCP-XXV 2009 Scientific and Technical Workshop – Program

WORKSHOP THEMES:

The Workshop requested abstracts that addressed the following themes*:*

Technological Demands and Developments – demands for enhanced observations collection technology; innovations or developments in related marine observation systems; developments in buoys/instruments (e.g. wave measurements).

Operational Practices and Enhancements – evaluation or analysis of operational performance or trials; data communications and data assimilation; performance and efficiency benchmarking; new systems and practices.

Applications of Collected Data – research and operational data applications; case studies.

Special Focus. In addition to the regular themes, this year's workshop will have a major focus on "Extended marine observing technologies and coastal risk management." Topics of interest are:

Wave measurements from buoys, and their intercomparisons – development and verification of wave observing technologies from buoys; need for in-situ observational data for the validation of wave models and satellite wave products, and for specific coastal applications; use of wave information (in-situ observations, satellite products, models) for shipping, port management and coastal risk management.

Tsunami observations – national experience with regard to deploying tsunameters in the open ocean and the use of the observations.

Presentation slots – 20 mins including 15 mins presentation + 5 mins questions / discussion (except where variation agreed)

MONDAY – 28 September 2009

	#	TIME	TOPIC	PRESENTER / AUTHOR
Technological Demands and Developments		09:00 – 09:10	Opening of DBCP XXV	David Meldrum, DBCP Chair
		0910 – 09:15	Technical Workshop Program (whole) 1st Session Organisation	Co-Chairs S&T Workshop
	1	09:15 – 09:35	Evaluation of SVP type drifters reporting through Iridium	Pierre Blouch and Jean Rolland (*Météo -France)*
	2	09:35 – 09:55	The results of new Marlin buoy prototypes evaluation	Sergey Motyzhev *(Marlin-Yug Ltd.)*
	3	09:55 – 10:15	Prototype Sonic Minimet Deployments Fall 2008, Spring 2009, Summer 2009	Andrew Sybrandy *(Pacific Gyre),* Peter Niiler *(Scripps) and* Jan Morzel *(Rosetta)*
	4	10:15 – 10:35	The Restrained ADOS-A: results from the 2009 experiment	Luca Centurioni and Peter Niiler (*Scripps*)
	5	10:35 – 10:55	Recent PMEL Climate Instrumentation Developments and Field Results	Christian Meinig and Paul Freitag *(NOAA/PMEL)*
	6	10:55 – 11:15	The Wave Glider, a mobile buoy concept for ocean science	Justin Manley and Tim Richardson (*Liquid Robotics Inc.*)
	7	11:15 – 11:35	Argos 3 and Drifting Buoy Applications	Gary Williams (*Clearwater Instrumentation, Inc.*)
	8	11:35 – 11:55	ARGOS-3: Just Do It!	Bill Woodward (*CLS America*), Michel Guigue and Christian Ortega (*CLS Toulouse*)
			Lunch	
Operational Practice and Enhancements	**#**	**TIME**	**TOPIC**	**PRESENTER / AUTHOR**
		13:00 – 13:05	Session Organisation / Introduction of Speakers	Chair – 2nd Session
	9	13:05 – 13:25	Global Drifter Program’s Drifter Data Center/Drifter Operations Center	Mayra Pazos and Erik Valdes *(NOAA/GDP)*
	10	13:25 – 13:45	Evaluation of sonic anemometry on the UK Met Office Buoy Network	Jon Turton *(UK Met Office)*
	11	13:45 – 14:05	Drifters surface temperature and salinity measurements	Reverdin, G., J. Boutin, N. Martin A. Lourenco, P. Bouruet-Aubertot, A. Lavin, J. Mader, P. Blouch, J. Rolland, J. Font

	#	TIME	TOPIC	PRESENTER / AUTHOR
	12	14:05– 14:25	Use of Drifting Buoy Reports of Sea-Surface Temperature in Remote Sensing	Christopher Merchant (*University of Edinburgh)* and Gary Corlett (*University of Leicester)*
	13	14:25 – 14:45	Buoy Vandalism Experienced by NOAA's National Data Buoy Center	C.C Teng, S. Cucullu, S. McArthur, C. Kohler, B. Burnett, and L. Bernard *(NOAA/NDBC)*
	14	14:45 – 15:05	Partnerships for New GEOSS Applications (PANGEA)	Sidney Thurston *(NOAA/CPO)*
	15	15:05 – 15:25	An innovative ocean platform for special observation campaign and fast deployment and maintenance of data buoys	Ugo Conti, Mark Gunderson, Isabella Conti (*Marine Advanced Research*) and K. Premkumar (*Win Marine Consultancy Services, India*)
		15:25 – 15:55	**Afternoon Break – 30 mins**	
Special Focus	**16**	15:55 – 16:15	On the need for wave buoy data for assessment of altimeter sea state measurements	Pierre Queffeulou (*IFREMER*)
	17	16:15 – 16:35	CANDHIS, the French National Centre for Archiving Coastal Swell Measurement	Xavier Kergadallan (*CETMEF*) Michel Benoit (*EDF LNHE*)
	18	16:35 – 16:55	MARK 1: Innovative buoy system for directional sea wave measurement	Daniele Calore (*Envirtech*)
	19	16:55 – 17:15	Surface gravity waves observation from SVP drifters	P.P. Niiler and L. R. Centurioni (*Scripps*)
	20	17:15 – 17:35	Subsurface AWAC Wave Measurements Compared to a Directional Waverider	Torstein Pedersen (*Nortek AS*)
	21	17:35 – 17:55	Wave Measurements Evaluation and Testing	R. Jensen, (*U.S. Army Corps of Engineers*), V. Swail (*Environment Canada*)and B. Lee (*IOC*)
	22	17:55 – 18:15	The Indonesian Tsunami Buoy Development Program and Its Regional Linkage	Wahyu Pandoe, Ridwan Djamaluddin, Djoko Hartoyo and Wira Yogantara *(BPPT, Jakarta, Indonesia)*
	23	18:15 – 18:35	NOAA/PMEL Tsunami Forecasts using Real-time DART data	Christian Meinig, Vasily Titov, Scott Stalin (*NOAA/PMEL*) and Ken Jarrott (*Australian Bureau of Meteorology*)
		18:35	**WORKSHOP CLOSE**	

PROVISIONAL AGENDA FOR
THE SCIENTIFIC AND TECHNICAL WORKSHOP
OF THE DATA BUOY COOPERATION PANEL (DBCP) XXV

VENUE: ***Intergovernmental Oceanographic Commission (IOC), Paris, France***
DATE : ***28 September 2009***

WORKSHOP CO-CHAIRS: Bill Burnett, *U.S. National Data Buoy Center*
Jean Rolland, *Météo-France*

PRESENTATION ABSTRACTS

1. Evaluation of SVP type drifters reporting through Iridium

Authors: Pierre Blouch and Jean Rolland *(Météo-France)*

Abstract: Meteo-France and E-SURFMAR have been actively participating in the DBCP drifter Iridium Pilot Project since its beginning. Fourteen SVP-B prototypes from three manufacturers – all fitted with a GPS – were first evaluated by Meteo-France. Then several batches of SVP-Bs, without GPS were ordered to one of them, for E-SURFMAR – 125 buoys at all. Out of them, 99 were deployed and 63 were in operation by mid-July 2009.

Globally, these buoys have excellent results in matter of availability and timeliness. The number of reports received from E-SURFMAR drifting buoys within 50 minutes increased significantly and their quality appeared the same than this of Argos buoys. The amount of buoys which ceased to work after emptying their batteries is now sufficiently high to measure mean lifetimes.

Meteo-France is also evaluating other kind of Iridium drifters: SVP-BS (salinity) and SVP-BTC (thermistor string), more especially. The raw Iridium data of all these buoys, plus a few ones from other organizations, are received and processed at Météo-France. They are coded into FM18-BUOY and FM94-BUFR messages and sent onto the GTS a few minutes after the observation. The presentation describes the results got from these drifters, including operations and performances.

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2. The results of new Marlin buoy prototypes evaluation

Authors: Kirichenko A., Lunev E., Motyzhev S., Tolstosheev A., Yachmenev V. (*Marine Hydrophysical Institute NASU/Marlin-Yug Ltd)*

Abstract: Marlin-Yug has participated in majority of the DBCP Pilot Projects (PP), which are carried out now. Four developments were completed for Iridium PP in 2008-2009 intersession period. The in-situ test of Iridium SVP-B and Iridium SVP-B mini first prototypes were successfully finished. Second prototype of Iridium SVP-B mini, equipped with RTC (Real Time

Clock) with GPS synchronization was tested. At last, the third prototype of Iridium SVP-B/GPS/RTC with a few novelties has been developed to keep in particular the advantages of drifter, equipped with RTC. The problem of second prototype of drifters, connected with fast fall asleep, because of wrong RTC operation, has been removed for this drifter. New generation of Iridium SVP-BTC/GPS/RTC temperature-profiling drifter has been developed and tested in situ. Moreover, the GPS equipped drifters, developed in this year, have the new GPS receiver, which has faster cold start as well as re-acquisition, when rough sea surface takes place. First prototype of Argos-3 SVP-B mini drifter was developed within Argos-3 PP. Two experimental buoys were built and sent to deploy them for evaluation of Argos-3 capabilities. Some job was completed to create SVP-B drifter, which can estimate the surface wave's parameters. This job is being performed to progress the PP Wave Measurements from Drifters. The conception of experimental SVP-B Wave drifter has been developed to be realized as a buoy prototype to be built and evaluated in-situ with aim of efficiency estimation of new technical decisions. Finally, the ice marker has been developed on basis of Argos SVP/GPS/RTC platform. The cluster of markers was built and deployed to study the ice movement near the Sakhalin Island.

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3. Prototype Sonic Minimet Deployments Fall 2008, Spring 2009, Summer 2009

Author: Andrew Sybrandy *(Pacific Gyre)*, Peter Niiler (*Scripps*) and Jan Mozel (*Rosetta Consulting*)

Abstract: Pacific Gyre, with Peter Niiler of SIO, continues to develop the Sonic Minimet drifter. This is a SVPBW drifter using a Gill sonic anemometer to measure wind velocity. Drifters were deployed in the fall of 2008, spring of 2009 and will be deployed in the summer of 2009. The fall 2008 deployments took place in the north Santa Barbara Channel to further refine the mechanical design of the drifter. The drifters were properly balanced and some low-wind speed wind velocities were collected near a NOAA buoy. Two drifters were then deployed just outside Monterey Bay in the spring of 2009, equipped with Iridium telemetry, and transmitting over 700 bytes of wind speed, wind direction, submergence, tilt, roll, and air pressure data. This data set helped determine the algorithms included in the two drifters to be deployed in late August 2009. The summer 2009 drifters are beta drifters configured with Argos II telemetry and first-pass firmware processing algorithms, and production surface float. Preliminary results from this deployment will also be presented.

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4. The Restrained ADOS-A: results from the 2009 experiment

Authors: L. R Centurioni and P. P. Niiler *(The Scripps Institution of Oceanography)*

Abstract: Five Restrained ADOS-A drifters, whose first prototype was described at the 24th DBCP meeting, were deployed in the East China Sea in August-September 2009. The deployments occurred on the continental shelf, at a depth of approximately 110 m. The scientific objectives of the experiments were to measure the internal tide, non-linear internal waves and the occurrence of Kuroshio water intrusions on the continental shelf.

The instruments used an improved self-deploying methodology that allows deployment from ships of opportunity or aircrafts. All data (pressure, temperature three dimensional currents profile and location) were transmitted in real time through the Iridium satellite system. The improved self-deploying package allowed us to deploy a significant payload, which included an

oversized ADCP battery canister and the ADCP communication module. The R-ADOS-A's were able to withstand relatively strong tidal currents (of the order of 1 m/s) without significant movement. Much stronger tidal flow, however, caused a considerable drift of the chains, of the order of a few km/day. The performances of the R-ADOS-A in such strong current regimes will be examined and the preliminary scientific results from the experiment will be presented.

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5. Recent PMEL Climate Instrumentation Developments and Field Results

Authors: Christian Meinig and Paul Freitag *(NOAA/PMEL)*

Abstract: PMEL is developing surface and subsurface instrumentation and platforms for long term ocean observations. Recent developments include field results from a vandal resistant TAO buoy in operation for >1 year in the Indian Ocean, where previous buoys had been vandalized. An additional development is a PICO (Platform and Instrumentation for Continuous Observations) buoy with an energy harvesting moored profiler that communicates data via inductive modem that was deployed for a 3 month test. For surface observations, a small self-contained data logger/transceiver is in the R&D stage. The instrument incorporates the Vaisala WXT-525, a magnetic compass and GPS and has had some promising intercomparisons with traditional MET sensors.

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6. The Wave Glider, a mobile buoy concept for ocean science

Authors: Justin Manley and Tim Richardson *(Liquid Robotics Inc.)*

Abstract: The Wave Glider autonomous sea-surface vehicle (ASV) represents a unique approach to persistent ocean presence. Wave Gliders harvest the abundant energy contained in ocean waves to provide essentially limitless propulsion while solar panels continuously replenish batteries that power the vehicle's control electronics, communications systems and payloads. Wave Gliders can serve many complementary functions to traditional ocean moorings and buoys.

Wave Glider is a hybrid sea-surface and underwater vehicle in that it is comprised of a submerged "glider" attached via a tether to a surface float. The vehicle is propelled by mechanical conversion of ocean wave energy into forward thrust, independent of wave direction. Directing this mobile system to a "hold station" results in a watch circle equalling or exceeding conventional moorings with greatly reduced capital and operation costs.

In this paper, we give an overview of the evolution of this unique platform and present results from the extensive engineering sea trials that we have conducted with several prototype generations of the vehicle. The vehicle's performance in a variety of ocean conditions – varying sea state, wind speed and surface currents – is discussed. The vehicle's robustness and capabilities for extended mission durations are also examined. In addition to the Wave Glider technology, we will present results from ongoing scientific demonstrations executed in collaboration with ocean scientists. We look forward to presenting the Wave Glider as a new option for ocean science.

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7. Argos 3 and Drifting Buoys Applications

Author: Gary Williams *(Clearwater Instrumentation, Inc)*

Abstract: Implementation of Argos 3 in drifting buoys extends the promise of returning higher quality data with lower power consumption. Argos 3 implements two-way communications between the satellite and PMT transceiver. This link allows satellite pass prediction through on-board computation and intelligent message management to raise message transfer rates toward 100%. We will report on the results of the first of use of Argos 3 for drifting buoys including SVP and SVPB configurations and Autonomous Drifting Observation Stations including temperature strings.

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8. ARGOS-3: Just Do It!

Authors: Bill Woodward *(CLS America)*, Michel Guigue and Christian Ortega *(CLS Toulouse)*

Abstract: The third generation of Argos offers the science community improved functionality while preserving the robust and reliable data collection and location features well known to the ocean-met community for the last 30 years. During 2008 and 2009, CLS has been implementing an aggressive campaign to promote the integration of the new Argos-3 hardware (PMT) and capabilities into contemporary ocean observing platforms to demonstrate how Argos-3 can improve their data collection capacity and efficiency. After a very brief statement of the new Argos-3 features, this presentation will describe the Argos-3 ocean-met application projects already completed, currently underway and scheduled for the future. Available test and evaluation results will also be presented. A snapshot of the features and capabilities of the Argos-4 system that is currently being developed will also be presented.

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9. Global Drifter Program's Drifter Data Center/Drifter Operations Center

Authors: Mayra Pazos and Erik Valdes *(NOAA Global Drifter Program' Drifter Data Center)*

Abstract: Each year, AOML's drifter centers evaluate transmitter, drogue and SST performance. Results from AOML's Data Buoy (ADB) comparison study of four manufacturers will be presented from data collected and processed after 18 months from the first deployment. Results show that even though some transmitters quit after a short life of 34 days, others are surpassing the 450 days' transmitter life expectancy. In some cases drogues are failing long before the transmitters quit, there are some that have exceeded the expected mark of 300 days.

In September 2008, a pilot study was conducted in the Bay of Biscay following the DBCP recommendation that drifter manufacturers implement tether strain for drogue detection. The three US manufacturers each had tether strain implemented in their drifters. A comparison between drogue submergence sensor and strain gauge sensor used for drogue detection will also

be presented. Results were mixed, indicating that challenges remain in detecting drogue presence and their ability to stay attached to the drifters for a longer period of time.

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10. Evaluation of Sonic Anemometry to the UK Met Office Moored Buoy Network

Author: Jon Turton *(UK Met Office)*

Abstract: Since the late 1980's, the Met Office has operated a network of moored buoys around the UK to provide early warning of severe weather conditions. The buoys are normally deployed for 2 years with a routine annual sensor change and mooring inspection. However, the cup and van anemometry system generally fails after 6-9 months. The paper will describe results from a trial of Gill WindSonic anemometers on a number of the moored buoys over the autumn, winter and spring months, comparing performance with a collocated Vector Instruments cup and vane system.

The results show the differences in wind speed and direction between the different systems are generally small, and for the most part consistent with the manufactures stated performance. Both wind speed and direction errors tend to increase with wind speed. However, the differences are not significantly different to those measured when using two Vector Instruments Systems on the same buoy. The results also show the wind speeds form the Vector Instruments system can degrade with time, so it cannot be regarded as being of climate quality, but there is no indication of deterioration with the WindSonics. As a result, it has been recommended that dual WindSonic systems are now deployed across the moored buoy network to improve overall reliability.

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11. Drifters surface temperature and salinity measurements

Author: G. Reverdin *(LOCEAN/IPSL)*, J. Boutin *(LOCEAN/IPSL)*, N. Martin *(LOCEAN/IPSL)*, A. Lourenco *(LOCEAN/IPSL)*, P. Bouruet-Aubertot *(LOCEAN/IPSL)*, A. Lavin *(IOE, Santander, Spain)*, J. Mader*(AZTI)*, P. Blouch *(CMM,CNRM)*, J. Rolland *(CMM,CNRM)*, and J. Font *(ICM-CSIC, Barcelona)*

Abstract: The accuracy of temperature measurements from drifters and the representative depth of its measurements is examined first from a set of (16) drifters (either from Metocean or Pacific Gyre) deployed with more than one temperature sensor in the tropical or North Altantic Ocean. One of these sensors is a Seabird probe associated with a conductivity cell, and which measurements are expected to be accurate usually to 0.01°C over at least a year, as was verified in a few opportunities. The other sensor is the classical thermistor installed since the mid-1980s on SVP drifters for SST measurements. We find (for 19 separate deployments) an average positive bias of the SST measurements in 17 out of 19 cases, exceeding in 5 instances the 0.1°C threshold accuracy reported by the constructor. The bias is often fairly constant in time, but in two instances a trend is found over a year (0.1 and -0.03°C/year), and in two other cases, there is an annual cycle of the trend, suggesting a dependency in temperature of the bias. We also examined 25 drifters from 4 manufacturers with just the SST sensor, but for which either a precise initial temperature value was available, or which were attached to a float with accurate

sensors (for a duration on the order of a month); This indicates often positive SST biases soon after deployments, but also during an intercomparison of 15 drifters in August 2008, that the biases of the Pacific Gyre drifters were on the order of 0.04°C higher than for Technocean or Clearwater drifters.

Accuracy of drifter salinity will be discussed based on comparisons at deployment or recovery of drifters mostly in the Bay of Biscay. These observations often suggest the presence of an initial bias after deployment that diminishes over the first day or couple of days, and then a progressive increase of the bias (typically 0.01 pss-78/month),, probably due to fouling. In the case of a drifter anchored in an upwelling site (Ilas Medes off Catalunya), this bias became very large after 9 months and visual observations of the drifter indicated intense fouling. There are however instances with no noticeable bias after 6 months or 1 year.

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12. Use of Drifting Buoy Reports of Sea-Surface Temperature in Remote Sensing

Authors: Christopher Merchant *(University of Edinburgh)* and Gary Corlett *(University of Leicester)*

Abstract: Drifting buoy reports of sea surface temperature (SST) are extensively used in operational and research mode by agencies and scientists involved in thermal remote sensing of the oceans. In this presentation, we review these present uses and outline the current trends in satellite SST. We hope to start a conversation about future possibilities for scientific and co-operative links between the drifting buoy and remote sensing communities.

Internationally, the production and dissemination of remotely sensed SST data are coordinated via the Group for High Resolution Sea Surface Temperature (GHRSST). GHRSST satellite data are produced to a common standard, known as L2P, which include standardized error estimates for the satellite SST. These error estimates are usually derived from the statistics of satellite-drifter SST comparisons, quasi-operationally. These error statistics are then used in SST analysis systems and data assimilation, so their representativeness is important to estimates of the overall state of the oceans.

More generally, comparison with drifting buoy SSTs is the most common approach to validation of satellite SSTs. The more sophisticated of such comparisons now account for variability due to the ocean thermal skin effect, skin-to-drifter-depth temperature difference under low-wind stratified conditions, and diurnal-cycle effects between the buoy and satellite observation times. For the best-quality observations systems (sensors plus estimation methods), satellite-drifter comparisons then yield standard deviations of 0.2 to 0.25 K. To interpret such results appropriately, the remote sensing community needs better understanding of contemporary drifting-buoy measurement characteristics. Looking forward, we will review a recent “wish-list” from GHRSST to the DBCP for changes to drifting buoy SST reports, and consider the perceived benefits the implementation would bring.

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13. Buoy Vandalism Experienced by NOAA's National Data Buoy Center

Authors: Chung-Chu Teng, Steve Cucullu, Shannon McArthur, Craig Kohler, Bill Burnett and Landry Bernard *(NOAA/NDBC)*

Abstract: U.S. National Oceanic and Atmospheric Administration's (NOAA) National Data Buoy Center (NDBC) has three major real-time ocean observing networks/programs: (1) Weather/Ocean Platform (WxOP) Program (with 113 moored buoys and 52 land-based C-MAN sites along U.S. coastal oceans and Great Lakes collecting meteorological and ocean data), (2) Tropical Atmosphere/Ocean (TAO) Program (with 55 buoys/moorings in the Tropical Pacific Ocean collecting ocean climatic data), and (3) Deep-ocean Assessment and Reporting of Tsunamis (DART) Program (with 39 buoys/moorings collecting and reporting water column height data). These buoys are located in robust biotic areas and can experience vandalism damage from fishing vessels and boaters.

Data collected by NDBC buoys contribute to saving lives, making marine operations safer, aiding commerce and transportation, and protecting the environments. Impacts of buoy vandalism are extremely significant from financial, scientific, marine prediction and warning, and marine operations standpoints. For example, between October 2007 and June 2008, the TAO program had eighteen (18) TAO buoys in the Tropical Pacific Ocean go off-station due to vandalism. The associated financial cost to the U.S. Government (NOAA) for this vandalism is nearly $1 million annually. Even worse, the damage has resulted in a 5 – 10 % loss of data. Since TAO buoys are critical in the monitoring and prediction of El Niño or La Niña phenomena, loss of TAO data will substantially impact climate prediction and studies, which affects important business variables like sales, revenues, and employment in a wide range of climate-sensitive industries and sectors, including commercial fishing. Damage to the WxOP and DART buoys due to vandalism results in the similar loss of critical information for weather and marine forecasts, at-sea rescue efforts from drift modeling, and most importantly, tsunami warnings – an event that could result in significant loss of life in coastal communities throughout the world.

A recent case of buoy vandalism occurred at an NDBC TAO buoy resulting in the total loss of the asset. On May 1, 2009, the TAO mooring located at 8^{o}N 95^{o}W showed signs of vandalism evidenced by the simultaneous failure of all surface and subsurface instruments. Initial indications were that the buoy had been pulled from its anchor and was adrift (the equipment's Argos transmitter was still working and was providing track information). By the next day it became obvious that the equipment was on a ship as it was travelling at a high rate of speed. It made landfall at Puntarenas, Costa Rica on May 14, 2009 shortly after midnight GMT. The position of the equipment was relayed to the Costa Rican Coast Guard via the U.S. State Department on May 14. On May 15, the Costa Rican Coast Guard searched the area for the missing equipment, but was unsuccessful. The equipment stopped transmitting its position later that day, indicating that it had been taken inside.

In this paper, we will present various vandalism incidents NDBC has experienced with examples encountered during the past 20+ years. The impacts of vandalism to NDBC (operations and data availability), to the scientific and marine communities, and to the U.S. Government will be discussed. Finally, some preventive measures NDBC, NOAA, and the U.S. State Department are taking will be discussed.

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14. Partnerships for New GEOSS Applications

Author: Sidney Thurston *(NOAA/CPO)*

Abstract: Partnerships for New GEOSS Applications (PANGEA) in the Indian Ocean Region are being established to help build sustainable capacity in maritime regions by convening in-country, practical, socio-economic applications training by U.S. experts for decision-makers, policy and budget administrators, scientists, end-users and other stakeholders. In exchange, Partners are providing ship time for the deployment of new in-situ ocean observations for IOGOOS/CLIVAR IndOOS Research Moored Array for African-Asian-Australian Monsoon Analysis and Prediction (RAMA) and other in-situ ocean-climate deployments. By building on and complementing existing capacity building programs, a sustainable capacity for the region is being achieved through the increases in both near real-time in-situ ocean observational data and information as well as demonstrating the more effective applications of, and access to, existing and new data. This presentation will provide an updated brief on recent NOAA agreements with India and Indonesia as well as future plans by the DBCP Capacity Building Task Team for the implementation of capacity building and ocean observations for the Western Indian Ocean Nations.

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15. An innovative ocean platform for special observation campaign and fast deployment and maintenance of data buoys

Authors: Ugo Conti, Mark Gundersen, Isabella Conti *(Marine Advanced Research, USA)* and K. Premkumar *(Win Marine Consultancy Services, India)*

Abstract: Dr. Ugo Conti, CTO of Marine Advanced Research, after 35 years of Engineering and Research work with Raytheon, University of California Berkeley, ElectroMagnetic Instruments and Schlumberger, decided to evolve the design of a completely novel craft. The craft’s design was inspired by the study of insects and spiders. Its articulation, springs and inflatable pontoons reduce considerably the rolling and pitching motions of tradional vessels. The geometry of this technology allows easy delivery and lifting of objects from the water surface in higher sea states than when using an overboard crane or A-frame.

Dr. Conti, along with Mark Gundersen of Marine Advanced Research, USA, has developed and produced an innovative fast moving ocean platform known as **W**ave **A**daptive **M**odular **V**essel (WAM-V®). Premkumar, known to DBCP forum for his design, development and operation of data buoys for India, got attracted to the WAM-V design and plans to adopt it as an ocean platform for special observation campaign in Indian seas for Climate Research, Satellite validation and data buoy deployment & maintenance activities.

WAM-V is built over two inflatable pontoons and flexibly connected through several components to a central structure. Springs, shock absorbers and ball joint articulate the vessel and mitigate stresses to structure, payload and crew. The engine pods are mechanically separate from the main hulls and can be switched to other pods with a different propulsion system. The vessel can work from a beach to deep sea. It has long endurance (from 2,000 to 5,000 miles) and excellent stability. The round and soft inflatable pontoons prevent digging of the catamaran hulls under waves. It provides a gentler ride with significantly reduced pitching or rolling sensation while sailing. The technology demonstrator named “Proteus” (a 100 feet WAM-V) underwent many sea trials and has validated the design concepts of Dr. Conti and his team.

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16. On the need for wave buoy data for assessment of altimeter sea state measurements

Author: Pierre Queffeulou *(IFREMER)*

Abstract: Since the launch of ERS-1, in 1991, satellite altimeters are measuring operationally the sea state significant wave height (*swh*). Furthermore, nowadays, Near Real Time swh data are provided by ERS-2, ENVISAT and Jason-1&2. These data are used as input to numerical wave models operated by meteorological institutes, for hindcast and forecast purposes. Accuracy of altimeter *swh* estimate is well established (with the exception for highest sea states) and is of the same order as (or even better than) the accuracy of buoy measurements. Nevertheless, wave measurements from operational buoy networks are essential for the altimeter wave height community. Some particular reasons for that are developed in this presentation. First, altimeters are different from one satellite to another one, and it is shown that each altimeter has to be validated and calibrated with respect to a common reference. Till now, wave buoy measurement has been a reference; yet, it is also shown that some differences were observed between buoy networks. Then, some *swh* related studies using only altimeters are complicated due to the particular time and space sampling scheme of satellite altimeters. This is illustrated in the case of estimation of long term *swh* statistics. A third argument is that altimeter provides only *swh*, and not the spectrum, though some studies showed that a mean period can be estimated from the altimeter measurements- note that these studies are based on wave buoy comparisons. Last, buoy wave spectrum are essential for development and validation of new algorithms for altimeters but also for new satellite sensors such as on board CFOSAT, CRYOSAT- 2, Wide Swath Ocean Altimeter (WSOA)... to be launched in a very near future.

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17. CANDHIS, the French National Centre for Archiving Coastal Swell Measurement

Authors: Xavier Kergadallan *(CETMEF, France)* and Michel Benoit *(EDF LNHE, France)*

Abstract: CETMEF (French national maritime and fluvial technical research centre) have responsibility of CANDHIS (French national centre for archiving coastal swell measurement).

CANDHIS refers both to the national network of coastal measurements of waves, database archiving measures and the website for diffusion of sea state parameters. The network includes about 30 waverider buoys all around French coast. Some specific data treatments have been developed to control quality of measurement and to compute sea state parameters. Real time data, monthly evolution of waves height, statistical data (histograms and correlograms) are available on CANDHIS website.

CETMEF with the national hydraulic l*aboratory* and environment of EDF work about evolution of CANDHIS website, with diffusion of new information for each point of measure (return period of extreme value, directional spectrum and identification of wave system, ...).That presentation is about all CANDHIS items, from way of measurement to diffusion of information. That includes policy of archive system, and description of data quality control.

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18. MARK 1: Innovative buoy system for directional sea wave measurement

Authors: Daniele Calore *(Envirtech)*

Abstract: In the latest years the inertial navigation systems (INS) to monitor attitude and positions of boats, vehicles, ships, etc, have had a significant spread in many applications. The main reason was the miniaturization of these devices that was made possible by the introduction of MEMS technology. Nowadays the market propose light, compact and low power consumption INS units integrating three accelerometers, three gyros and a heading sensor. Row data provided by these sensors can be processed with an extended Kalman filter to get in real time accurate measurement of attitude and displacement. The integration of these device in a buoy allows to measure the directional sea waves spectral that summarizes all the statistical information related to the sea waves dynamics.

The buoy MARK1 developed by Envirtech relies the sea waves measurement on this innovative technology. It is also equipped with meteorological sensors, CTD sensor, main radio link and satellite modem as back up communication system.

The same buoy can integrate a surface acoustic modem to interface underwater modules (UM). The main UM developed by Envirtech S.p.A. is the POSEIDON system to monitor tsunami waves from 100mwd to 6000mwd.

The presentation will be focused on the main innovative technological aspects of MARK1 buoy and UM POSEIDON and will illustrate samples of real acquired data in Mediterranean sea and in Indian Ocean.

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19. Surface gravity waves observation from SVP drifters

Authors: P.P. Niiler and L. R. Centurioni *(Scripps Institution of Oceanography)*

Abstract: SVP drifters fitted with a sideways looking ADCP and standard drogue centered at 15 m depth were used to measure the properties of surface gravity waves, such as period and direction, in two test deployments off the coast of Santa Barbara, in the proximity of a wave measuring NDBC buoy, in August and November 2008. The ADCP used for the experiment was a 1 Mhz Aquadopp by Nortek. The assembly of the wave sensing drifter, the test methodology, the algorithms used to infer the waves properties and results are discussed.

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20. Subsurface AWAC Wave Measurements Compared to a Directional Waverider

Authors: Torstein Pedersen *(Nortek AS)*

Abstract: Wave measurements from below the surface are most often conducted with a bottom mounted Doppler profiler. This approach has not only proved to provide high quality wave and current data, but it has allowed for good instrument survivability since the instrumentation is out of harms way. There is however a deficiency with bottom mounted deployments when the depth is significant (over 60 meters). Wave estimates suffer from an increasingly severe penalty as depths become greater. High frequency wave information is lost when depths are great and this lost information results in underestimating wave heights as well as loss of directional information for short waves.

The clever solution is to move the instrument closer to the surface by employing a subsurface buoy. This minimizes the risk of losing short wave information so that the complete wave spectrum is measured. The challenge with this type of deployments is that traditional wave array processing used by Doppler profilers (i.e. ADCPs) can not handle buoy motion such as rotation. Nortek has solved this problem by developing the SUV method. This is similar to the classic triplet measurement, but is modified by both correcting for the platforms attitude as it moves and employing a direct measure of sea surface position with the Acoustic Surface Tracking (AST). A more detailed discussion of the processing method, as well the possibilities and limitations of the SUV method, is presented.

Finally, results from a buoy mounted AWAC and a directional Waverider are compared. The instruments were deployed for a period of over two months, in close proximity to one another off the coast of Lysekil, Sweden. The total depth of the location was 120 meters. The AWAC's depth ranged between 30-50 meters as a result of mooring drawdown. Conditions included mean currents of 1 m/s and wave heights greater than 4 meters on at least four separate occasions.

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21. Wave Measurement Evaluation and Testing

Authors: Bob Jensen *(U.S. Army Corps of Engineers),* Val Swail (*Environmental Canada*) and Boram Lee *(IOC)*

Abstract: This presentation will describe the requirements for, and implementation of a continuous wave measurement testing and evaluation program for existing moored buoy networks and possibly extension to future in-situ and remotely sensed wave observation programs. We will describe the intercomparison methodology for evaluating co-located wave measurements, including details of the so-called "First-5" approach, the website and interface established to coordinate and document the various intercomparisons carried out by the project participants, the metadata requirements for intercomparisons and for operational networks, recommended quality control procedures for wave data, and protocols for field tests of wave measurement systems, including how the first set of system tests will be conducted, and how results will be presented. Examples of the first set of intercomparisons carried out will also be presented.

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22. The Indonesian Tsunami Buoy Development Program and its Regional Linkage

Authors: Wahyu Pandoe, Ridwan Djamaluddin and Djoko Hartoyo *(BPPT, Jakarta, Indonesia)*

Abstract: Indonesia has established the Indonesia Tsunami Early Warning System (InaTEWS) inaugurated on 11 November 2008. The system includes the array of 24 tsunami buoys, or well known as tsunameters, distributed in Indian Ocean along the west Sumatra, south Java and south Nusa Tenggara, in the eastern internal waters of Indonesia, and in Pacific Ocean north of Sulawesi, Halmahera and Irian. The 24 tsunameters consist of 10 Indonesian made tsunameters, 10 Germany, 3 USA and 1 Malaysian (Norwegian made). Fourteen of 24 tsunameters had been deployed until end of 2008, and the remaining are expected to be completed for operational by the end of 2009.

Most of the operational tsunameters work well performing the observational sea level (i.e. pressure data) and reporting to BPPT Read Down Station. The 'Krakatau' tsunameter was able to detect the occurrence of a minor tsunami during the Bengkulu Erathquake 12 September 2007. The 'Komodo' tsunamter also observed the periodic sea level and the event of Sumbawa earthquake in 7 August 2008. The DART-II Indian Ocean #53401 was also working well detecting a minor tsunami during the event of Sinabang Earthquake 20 Feb 2008.

The most recent earthquake are not only dominated by the subduction zone activity, but also generated by the faults system episodic events, which may generate the local tsunami. Therefore, the local tsunami warning issues become more prominent in near future.

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23. Recent NOAA/PMEL Tsunami Forecasts Using Real-time DART® Data

Authors: Christian Meinig, Vasily Titov, Scott Stalin *(NOAA/PMEL)* and Ken Jarrott *(Australian Bureau of Meteorology)*

Abstract: NOAA/PMEL has developed a tsunami forecast model that uses pre-computed models and real-time DART® (Deep Ocean Assessment and Reporting of Tsunamis) buoy data to make site specific forecasts. Recent advances in tsunami measurement and numerical modeling technology have been integrated to create an effective forecast system, neither technology can do the task alone. Over the past 2 years, 5 successful forecasts have been made when the model results are compared with independent tide gauges. DART®-II and DART®-ETD datasets from the August 10, 2009 Andaman Island and July 15, 2009 New Zealand tsunami and forecast results and comparisons will be presented.

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