IEEE International Geoscience And Remote Sensing Symposium

July 23-27 2012, Munich.

A conference report focussing on talks particularly relevant to the marine renewable energy sector

Introduction

The Annual IGARSS conference covered a broad range of remote sensing topics over five days in 16 parallel sessions, in which just under half comprised invited papers only, with two substantial poster sessions over two days each.

The majority of talks and posters involved the satellite remote sensing community and users with both land and ocean applications, although there were a significant number of sessions devoted to airborne and ground based techniques.

Remote Sensing of Winds

A number of talks detailed the advances being made with satellite remote sensing of winds over the ocean, including methods of extending these measurements from the 10m level up to those of more interest to the wind industry, which could potentially be applied to estimates of offshore wind resource and interannual variability.

Li & Lehner showed a sample of wind vectors derived from TERRASAR-X data at the FiNO 1 research platform at the Alpha Ventus wind farm in the North Sea, and showing a reduction in wind speed downwind of the wind farm. Badger et al showed how data from SAR wind fields could be 'lifted' to a height 100m above sea level closer to wind turbine elevations. Nicolas et al demonstrated how data from Soil Moisture and Ocean Salinity (SMOS) data could also be used as an all weather wind sensor with a large swath and hence quick revisit time. They monitored Hurricane Igor in 2010 and were able to reproduce realistic hurricane strength winds that matched well with other measurements and models.

Li & Perrie showed how the Alpha Ventus wind farm can be discriminated from the surrounding sea surface roughness by isolating the relative phase of the SAR data. This distinguished the wind turbines from the sea surface roughness and the area of increased roughness of the turbine wakes. The associated paper included an interesting SAR picture clearly showing the roughness wakes from the turbines.

Lido et al demonstrated the results of several approaches to obtaining wind vectors from sea surface roughness streaks in marine radar data, showing good agreement with conventional instruments. This technique was developed partly to measure wind vectors from ships without the flow distortion from the ship superstructure felt by conventional instruments.

SEA SURFACE WIND FIELD RETRIEVAL FROM TERRASAR-X AND ITS APPLICATIONS TO COASTAL AREAS
Xiaoming Li, Susanne Lehner, German Aerospace Center (DLR), Germany

BRINGING OCEAN WINDS FROM 10 M TO HIGHER LEVELS
Merete Badger, Alfredo Peña, Technical University of Denmark, Denmark; Ad Stoffelen, Tilly Driesenaar, Royal Netherlands Meteorological Institute (KNMI), Netherlands; Erik Berge, Rolv Bredesen, Kjeller Vindteknikk, Norway

THE SMOS SENSOR: A NEW CAPABILITY TO ESTIMATE OCEAN SURFACE HIGH WINDS AND TO MONITOR OCEANIC RESPONSE UNDER TROPICAL CYCLONES
Reul Nicolas, Institut Français de Recherche pour l'Exploitation de la Mer, France; Tenerelli Joseph, Collecte Localisation Satellites (CLS), France; Chapron Bertrand, Quilfen Yves, Institut Français de Recherche pour l'Exploitation de la Mer, France; Vialard Jerome, Vincent Emanuel, LOCEAN-IPSL-CNRS, France; Vandemark Doug, UNH, United States

DETECTION OF WIND FARM USING THE RELATIVE PHASE OF COMPACT POLARIMETRY SAR
Haiyan Li, Key Laboratory of Computational Geodynamics, CAS / Graduate University, CAS / Bedford Institute of Oceanography, Canada; William Perrie, Bedford Institute of Oceanography, Canada

RETRIEVAL OF OCEAN SURFACE WIND FIELDS FROM MARINE RADAR IMAGE SEQUENCES
Cristina Lido, Ruben Carrasco, Jochen Horstmann, NATO Undersea Research Center, Italy

Remote Sensing of Currents

A session on "Applications of Infrared Imaging of Air-Water Interfaces" detailed the use of thermal image sequences to track turbulent structures across the water surface and hence derive high resolution current vector maps using Particle Image Velocimetry style techniques. The various methods of deploying the thermal cameras enabled a variety of scales to be observed from very small scales of a few centimeters with a camera close to the water surface, river scale at ~1m resolution using a helium balloon to mount cameras tens of metres above the surface (Chickadel et al). Smith & Marmorino also showed high resolution thermal imagery taken from an aircraft of submesoscale eddies with diameters of the order of 100-500m and showing the detail of the finer structures making up these larger features. All of these were of areas where there was sufficient thermal stratification to provide a contrast for the mixing of water of different temperatures to be detected and visualized by the thermal imagers.

Romeiser illustrated his talk in the **"Don Thompson memorial session"** with some high resolution TERRASAR-X and also TanDEM-X derived current data of the Pentland Firth and Orkney waters demonstrating how such systems might collect wide area, high resolution current data that could have applications in model validation and current resource assessment.

In one of the final sessions of the conference in the **"Radar Remote Sensing of the Ocean at Grazing Incidence"**, Hessner & Nieto Borge presented comparisons of a high resolution current and bathymetry mapping package for use with ground based marine X-band radar systems. This showed good correlations with in-situ current and wave measurement systems and spatial maps of currents and water depth to ranges of around 4km. Bell et al demonstrated the first results from a marine radar at the tidal test site of the European Marine Energy Centre in Orkney. The currents derived from wave inversions of marine radar image sequences showed realistic current patterns for the area and the presentation included plots of current speeds approaching 5m/s in places.

RIVER SURFACE FLOW AND TURBULENCE FROM THERMAL IMAGING
Chris Chickadel, Alexander Horner-Devine, University of Washington, United States; Stefan Talke, Portland State University, United States; Andrew Jessup, University of Washington, United States

FROM SUBMESOSCALE OCEAN EDDIES TO LABORATORY-SCALE TURBULENCE
Geoffrey Smith, George Marmorino, Naval Research Laboratory, United States

25 YEARS OF OCEAN CURRENT MEASUREMENTS BY ALONG-TRACK INSAR
Roland Romeiser, University of Miami, United States

HIGH RESOLUTION CURRENT AND BATHYMETRY DETERMINED BY NAUTICAL X-BAND RADAR
Katrin Hessner, OceanWaveS GmbH, Germany; José Nieto Borge, University of Alcalá, Spain

DETERMINING CURRENTS FROM MARINE RADAR DATA IN AN EXTREME CURRENT ENVIRONMENT AT A TIDAL ENERGY TEST SITE
Paul Bell, National Oceanography Centre, United Kingdom; John Lawrence, Jennifer Norris, The European Marine Energy Centre Ltd., United Kingdom

Remote Sensing of Waves & Storm Surges

Pleskachevskey et al gave a fascinating presentation on the origin of extreme waves (significantly larger than the estimated sea state should have been able to support) that have been recorded and caused damage at platforms in the North Sea, showing how coherent and long lived wind cells propagating at speeds close to those of the waves could build highly localised wave groups of the type that conventional wind inputs to wave models cannot reproduce. The key factor in reproducing similar conditions in the simulation was driving the wave model with a realistic wind pattern of sufficient resolution to include these circular wind cells.

Lehner et al and Bruck & Lehner showed how high resolution SAR imagery from the TERRASAR-X satellite can be used to infer the varying wind and sea states found in coastal regions as a result of sheltering by the coast.

Cipollini & Benveniste revealed how re-analysis of 20 years of satellite altimeter data with new algorithms was allowing sea levels close to the coast to be reliably determined, when they were previously flagged as unusable due to contamination by the land signatures, and how this data might be used to study the spatial characteristics of storm surges.

Senet et al showed comparisons of a range of sea state measurement systems including radar level gauges and marine radar compared with in-situ instruments. The radar level gauges were clearly excellent point measurements, and the marine radar performed well provided the minimum significant waveheight was above 0.5-1m - this low waveheight cutoff for the marine radar is a known issue related to the lack of scatterers on the sea surface in calm conditions, and common with many radar and satellite measurements.

STORM OBSERVATIONS BY REMOTE SENSING AND INFLUENCES OF ORGANIZED GUSTS ON OCEAN SURFACE WAVES
Andrey Pleskachevsky, Susanne Lehner, German Aerospace Center (DLR), Germany; Wolfgang Rosenthal, GAUSS, Germany

SEA STATE VARIABILITY AND COASTAL INTERACTION PROCESSES OBSERVED BY HIGH RESOLUTION TERRASAR-X
SATELLITE RADAR IMAGES
Susanne Lehner, Andrey Pleskachevsky, Miguel Bruck, German Aerospace Center (DLR), Germany

SEA STATE MEASUREMENTS USING TERRASAR-X DATA
Miguel Bruck, Susanne Lehner, German Aerospace Center (DLR), Germany

COASTAL ALTIMETRY: RECENT PROGRESS AND APPLICATION TO STORM SURGE RESEARCH
Paolo Cipollini, National Oceanography Centre, United Kingdom; Jérôme Benveniste, European Space Agency ESRIN, Italy; Craig Donlon, European Space Agency, Netherlands

REMOTE SENSING AND IN SITU SEA STATE INSTRUMENT COMPARISONS AT THE RESEARCH PLATFORM FINO 1 IN THE GERMAN BIGHT
Christian Senet, Jens Fischer, Olaf Outzen, Kai Herklotz, Holger Klein, Federal Maritime and Hydrographic Agency, Germany

Remote Sensing of Bathymetry

Brusch et al showed on their poster how underwater topography could be estimated over wide areas from clear swell wave patterns visible on Synthetic Aperture Radar (SAR) single images, with optical data used to infer very shallow waters close to the coast.

Li & Heygster's poster demonstrated the mapping of the intertidal areas of the Wadden Sea using waterline mapping technique coupled with a water level model. Several successive years of data were processed to yield yearly topographic maps of the intertidal areas that could be used in future for studying the morphological evolution of the area.

Hessner & Nieto Borge demonstrated the output of a high resolution marine radar bathymetry and current mapping algorithm at the Port Phillip near Melbourne in Australia, resolving shipping channels and the strong tidal currents in them.

SYNERGY AND FUSION OF OPTICAL AND SYNTHETIC APERTURE RADAR SATELLITE DATA FOR UNDERWATER TOPOGRAPHY ESTIMATION IN COASTAL AREAS
Stephan Brusch, Andrey Pleskachevsky, Susanne Lehner, German Aerospace Center (DLR), Germany; Thomas Heege, EOMAP, Germany

TOPOGRAPHIC MAPPING OF WADDEN SEA, WITH SAR IMAGES AND WATERLEVEL MODEL DATA
Zhen Li, Georg Heygster, Justus Notholt, University of Bremen, Germany

HIGH RESOLUTION CURRENT AND BATHYMETRY DETERMINED BY NAUTICAL X-BAND RADAR
Katrin Hessner, OceanWaveS GmbH, Germany; José Nieto Borge, University of Alcalá, Spain

Paul Bell, NOC

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