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Proposal	
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Information system for site selection and estimation of effective power yield from ocean renewable energy facilities in Indonesia

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Abstract: This paper summarizes results of the development and application of information systems for the selection of suitable sites and reliable estimates of the effective power yield from renewable energy installations in Indonesia. Emphasis is given to the investigation of the potentials of tidal stream power and wave power in Indonesia. The investigations have been carried out in the framework of the joint research project “Potentials of Ocean Renewable Energy in the Indonesian Seas - ORE-12” funded by the German and Indonesian governments from 2013 to 2016. The project aims at the identification of marine environments in the Indonesian Archipelago, which are suitable for the efficient generation of electric power by tidal in-stream energy conversion (TISEC) devices and wave converters. To enable reliable estimates in remote areas with scarce data, the effectiveness of advanced techniques for resource characterization was assessed. Emphasis was given to the integration of data from existing monitoring stations, state-of-the-art remote sensing techniques and high-resolution simulation models. Attention was also given to the improvement of rationale for site selection taking into account the impacts of the structures into the environment. The effectiveness of the techniques adopted was tested at the Strait of Larantuka in the Island of Flores and along the coast of Java in the Indian Ocean. Results of the application for selection of suitable sites and power yield at ten straits and the entire coast of Java were delivered.

Potentials of Ocean Renewable Energy in the Indonesian Seas: Study Cases for Larantuka Strait of Flores and Offshore Baron Beach of Jogjakarta

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Abstract

Limited informatin of the ocean renewable energy in Indonesian seas urges the selection of suitable sites and reliable estimates of the effective power yield from ocean renewable energy in Indonesia. The BPPT Technology Center for Marine Survey in collaboration with the Technology Centre Westcoast (FTZ) University of Kiel Germany through the program Science for the Protection of Indonesian Coastal Ecosystems (SPICE III), Topic 6 - Ocean Renewable Energy - Potentials of Ocean Renewable Energy in the Indonesian Seas has inverstigated potential energy of ocean renewable through tidal measurement in Larantuka Strait (eastern tip of Flores Island) and wave observation offshore Baron Beach (south coast of Jogjakarta, Central Java).

Tidal data measurement from tide gauge sensor was intalled in the old harbour of the oil company PERTAMINA south of Larantuka on May 2014. The sensors of the tidal gauge system provided good time series of tidal level variation, wind and air temperature. All recorded data were transmitted via GSM to the data center at BPPT in Jakarta, and a mirroring copy of the data was sent to Kiel University in Germany. In September 2014 after a recording period of 5 months, due to operational reason, the measurement campaign had to be removed to the Larantuka ferry harbor in about 4m water depth as a minimum substitute for the tidal gauge system. MIKE 21 Flow model flexible mesh (FM) uses a finite volume method used to determine the water level and current fields in Larantuka Channel in Flores Strait. Calculations of water levels performed good verifications between model result (in the bottle neck channel) and observation (in point red circle) in period 1 – 12 Jan 2015. Varying of current vectors in magnitude and directions controlled by tidal variations in the adjacent sea.

Waves data measurment in Baron – south coast of Central Java by installing wave rider buoy was deployed and moored about 2km offshore the village Baron at 08°08‘9,8‘‘S and 110°32’50,1‘‘E on the sea floor. Prior deployment, bathymetric measurements were conducted to verify the suitable water depth and the sea floor characteristics. The measured wave data were online sent to BPPT data center and FTZ – University of Kiel. For the model analysis data based on spectral wave model SWAN. The south coast of Java is exposed to a significant swell from Indian Ocean. Low pass filtering on spectral analysis was conducted to estimate the influence of low frequency wave variation occurring in this deployment site.

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Effectiveness of Synthetic Aperture Radar Satellites for Resource Characterization and Pre-selection of Potential Ocean Renewable Energy Sites in Indonesia

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Abstract

Ocean or offshore renewable energies (ORE) provide an opportunity to coastal regions to cost-efficiently cover their energy needs especially in countries that have only little fossil energy resources. To effectively exploit those energy sources, suitable locations have to be identified. Among others, coastal engineering aspects and estimates of the power potential need to be taken into account.

Spaceborne Earth observation methods can provide high spatial resolution and spatial coverage of large coastal areas and also cost-efficient long-term monitoring. SAR (Synthetic Aperture Radar) is a unique sensor that yields two dimensional information of the ocean surface. Due to its high resolution, independency of daylight or weather conditions, and global coverage, SAR is particularly suitable for many ocean and coastal observations. The new generation of SAR satellites like TerraSAR-X (TS-X), TanDEM-X (TD-X), RADARSAT-2, COSMO-Skymed or SENTINEL-1 acquire images of the sea surface with a high resolution up to 1m (for TS-X) and individual ocean waves with wavelengths as short as 30m are detectable. Based on the data, meteo-marine parameters like wind, wave and ocean currents can be derived. The spatial variability of the wave parameters, wave refraction, wave groupiness and wave breaking also contains additional information that can be used to estimate e.g. the ocean bottom topography.

Indonesia is a country with an extended coastline, tidal channels between the individual islands and very limited fossil fuel deposits and it can strongly benefit from sophisticated methods to identify promising ORE facility locations.

We evaluate the effectiveness of SAR remote sensing for the localization and characterization of ocean renewable energy resources within the site selection process for sustainable power generation facilities. In detail we investigate SAR-based local wind, wave and ocean current parameters as well as bathymetry estimates derived from ocean wave patterns.

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Investigation of the energy potential from tidal stream currents in Indonesia

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Abstract

In this study, results of an assessment of the current power potentials of tidal streams at several straits in Indonesia are presented. The investigations have been carried out in the framework of the joint research project “Potentials of Ocean Renewable Energy in the Indonesian Seas - ORE-12” funded by the German and Indonesian governments. The project aims at the identification of marine environments in the Indonesian Archipelago, which are suitable for the efficient generation of electric power by tidal in-stream energy conversion (TISEC) devices and wave converters. A stepwise methodology leading to the estimation of the effective tidal stream current power in the sites under investigation is adopted. It includes the modelling of the tidal steam currents, selection of suitable sites for the installation of the converters, resource assessment and estimation of the power potential. The methodology has been applied to eleven straits between Indian Ocean and inner Indonesian seas. For each site, annual tidal stream energy resource is estimated and spatial variation of the average exploitable electric power density with TISEC devices is determined. The results obtained showed that the straits under investigation have great potential for the production of renewable energy. Current velocities are up to 4m/s and the power density at some locations can exceed 6kw/m2. A decision support system is being set-up in the identification of suitable locations.

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Assessment of wave energy potential along the south coast of the Java, Indonesia

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Abstract: Scarce data remains the main constraint for the proper estimation of the wave energy power worldwide. In this study strategies integrating numerical models, data from global databases and large-scale models, field measurements and remote sensing techniques were adopted for the estimation of wave power energy in remote areas. Results of assessment of the effectiveness of the strategies are presented for the south coast of Java in Indonesia. As part of the east coast of Indian Ocean, this coastal stretch presents tremendous potential for wave energy. Annual median wave power is estimated to exceed about 20kw/m at several coastal stretches. Waves are simulated with the fully spectral model SWAN. A high resolution unstructured grid covering the coastal area and adjacent coastal sea was setup. The wave model is forced with wind and pressure fields from an improved atmospheric model and assimilation system from the ERA-Interim database. Results of successful model calibration and validation using remote sensing information and direct measurements are presented. Wave energy was estimated on the basis of model simulations covering a year period from November 2013 to October 2014. Suitable locations for installation of wave energy convertors were selected on the basis of the annual median wave power, water depth and distance from the coast. Two zones were identified as suitable for wave energy extraction. The relative importance of wave energy due to swells and local winds was investigated. Swells from the southwest turned out to be the major source of wave energy in this region. It was found that in some regions the monthly median wave power exceeds about 30kw/m.