

# SPICE III



## Science for the Protection of Indonesian Coastal Marine Ecosystems

**zmt** Leibniz Center  
for Tropical Marine  
Ecology



### TOPIC 6 Potentials of ocean renewable energy in the Indonesian Seas

About 80% of the global energy consumption is supplied by fossil fuels. In the face of the climate change, sea level rise and the ongoing depletion of the mineral resources much effort is made worldwide to use renewable resources of energies. The conversion of wave power and tidal current power is recently growing up to a crucial sector of renewable ocean energy. Particularly the use of tidal power which is based on the relative motion and gravitational fields of earth, moon and sun is attractive to be used as its availability is predictable.

Topic 6 aims to identify marine environments in the Indonesian Archipelago, which are suitable for the efficient generation of electric power by converter facilities. The converters shall be driven by tidal currents and waves.

For the preliminary selection of suitable areas in Indonesia the German radar system SAR of the TerraSAR-X satellite is applied to detect and classify wind fields, currents and waves. In addition to hydrographic data provided by international organizations in situ field measurements of currents, waves, sediment transport and bed evolution will be carried out in the promising sites in Indonesia.

Research sponsored by



Photos:  
Ferse, Jennerjahn, Rixen, Reuter (ZMT); Mayerle (FTZ)

### TOPIC 5 Climate versus anthropogenic forcing of Late Holocene environmental change affecting Indonesian marine, coastal, and terrestrial ecosystems

Over historical times the effects of natural climate on environmental variability have been "modified" by an increasing impact of human activities. Thus, discerning past natural climate forcing and the impacts of agricultural activities, forestry and pollution etc. on environmental variability in Indonesia could support a better estimation of future environmental variability in times of accelerating global change.

Consequently, topic 5 aims to study both, the natural environmental variability and the effects of increasing land-use (and other factors) by humans during the last 4,000 years.

Surface sediments from the Java Sea will be utilized to assess the present-day state of marine sedimentary proxies indicative for various terrestrial and marine environmental variables. Based on this "calibration" sediments accumulating offshore two rivers from Kalimantan that are largely unbiased by human interference, and two rivers from Java that are strongly affected by land-use and irrigation will be analyzed in order to untangle natural and anthropogenic induced environmental changes during the past 4,000 years.



For more information  
please visit the SPICE III website:

<http://spice.zmt-bremen.com>



## Participating Institutions

### GERMANY

- Albrecht-von-Haller-Institute for Plant Sciences, Department of Palynology and Climate Dynamics, University of Göttingen
- Alfred-Wegener-Institute for Polar and Marine Research (AWI), Wadden Sea Station Sylt
- Center for Environmental Research and Sustainable Technology (UFT), University of Bremen
- Center for Marine Environmental Sciences (MARUM), University of Bremen
- German Aerospace Centre (DLR), Oberpfaffenhofen
- Institute of Animal Sciences and Technology (NTT), Faculty of Agricultural and Environmental Sciences, University of Rostock
- Institute of Geology and Geochemistry of Petroleum and Coal (LEK), RWTH Aachen University
- Institute of Oceanography, Centre for Marine and Atmospheric Sciences (ZMAW), University of Hamburg
- Institute of Soil Science, University of Hannover (LUH)
- Leibniz Center for Tropical Marine Ecology (ZMT), Bremen
- Leibniz Institute for Baltic Sea Research (IOW), Rostock-Warnemünde
- Leibniz Institute for Natural Product Research and Infection Biology (HKI), Jena
- Research Center for Sustainability Studies (artec), University of Bremen
- Research and Technology Centre Westcoast (FTZ), University of Kiel (CAU)

### INDONESIA

- Agency for the Assessment and Application of Technology (BPPT), Jakarta
- Bandung Institute of Technology (ITB)
- Bogor Agricultural University (IPB)
- Gadjah Mada University (UGM), Yogyakarta
- Hasanuddin University (UNHAS), Makassar
- Indonesian Institute of Science (LIPI), Bandung
- Jenderal Soedirman University (UNSOED), Purwokerto
- Ministry of Energy and Mineral Resources (ESDM), Jakarta
- Ministry of Fisheries and Marine Affairs (KKP), Jakarta
- Riau University (UNRI), Pekanbaru
- Syah Kuala University (UNSYIAH), Banda Aceh
- Udayana University (UNUD), Badung Bali

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### Indonesia

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**Background**

The Indonesian Archipelago consists of about 17,500 islands and has a coastline of 81,000 km. The region is a center of biodiversity with highly productive ecosystems such as coral reefs, mangroves and sea grass meadows. Indonesia's rich marine resources are an important source of livelihoods for the more than 250 million inhabitants, of which 60% live within 100 km of the coast. Local, regional and global factors such as overfishing, habitat degradation, rising sea temperatures and ocean acidification seriously undermine the resilience of the coastal ecosystems as well as their capacity to sustain local livelihoods by providing crucial ecosystem services such as coastal protection and provision of food.

The SPICE initiative was developed under the agreement on scientific and technological cooperation between Indonesia and Germany. The national guiding institutions are the State Ministry of Research and Technology (RISTEK), the Ministry of Fisheries and Marine Affairs (KKP) and the Federal Ministry of Education and Research (BMBF).

SPICE addresses scientific, social and economic issues as they affect Indonesian coastal and marine systems and attempts to strengthen the existing scientific data base on coastal ecosystems which are crucial for formulating policies towards the sustainable use of coastal and ocean resources. Natural and social scientists from German and Indonesian universities and research institutions participate in the SPICE Program. The overall coordination is with the Leibniz Center for Tropical Marine Ecology (ZMT) in Bremen which is involved in several research projects.



**Capacity Building**

The SPICE Program has created a bilateral team of scientists contributing to implement national marine research and development as well as higher education priorities in Germany and Indonesia. The scientific activities are accompanied by actions towards building capacity and infrastructure for marine research and development. Scientists and students from both countries participate in the research projects to pursue graduate and postgraduate degrees in marine science. Trainings, seminars and workshops are organized as an accompanying measure within the program.

**Development and Implementation**

The SPICE Program was initiated in 2003 with the first phase carried out until 2007. SPICE I provided significant information on the structure and functioning of coastal ecosystems and on their alterations due to human interventions. Based on the information and experience gained in the first phase, the focus on natural sciences was complemented by social sciences during the second phase (2007-2010), aiming to better understand the social dimension of coastal ecosystem changes and to improve the links between research and decision making. Following two phases of successful bilateral cooperation the research program has been continued in 2012. For the third SPICE phase six interdisciplinary research topics were jointly agreed by the German and Indonesian research team as follows:

**TOPIC 1 Impacts of marine pollution on biodiversity and coastal livelihoods**

Pollution severely impacts natural habitats and marine biodiversity, with serious consequences for food security and the sustainable use of coastal ecosystems, and thus the livelihoods of coastal communities.

Topic 1 projects explore and quantify negative effects of anthropogenic pollution on coastal and marine resources, identify organisms affecting food quality, and assess the use and importance of marine living resources for local communities and international markets.

The interdisciplinary approach aims at improving the knowledge on pollutant transport and dispersal, contaminant burden, bacteria and parasites, spatial variability in aquatic resources, physiological responses of economically important species to different stressors, food security and seafood use by local communities. While it focuses on Jakarta Bay, an area heavily influenced by a large metropolitan area with over 20 million inhabitants, comparative assessments are carried out at locations in central and eastern Indonesia (e.g., Sulawesi and Bali).



**TOPIC 2 Carbon sequestration in the Indonesian Seas and its global significances: Generation of scientific knowledge for formulating strategies for adaptation to climate change**

The aim of topic 2 is to quantify and to value the carbon storage in and the CO<sub>2</sub> emission from the Indonesian Seas caused by declining coastal ecosystems for the development of sustainable mitigation strategies in the framework of compensation-based institutional approaches to reduce CO<sub>2</sub> emissions. Therefore a budget for the organic and the inorganic carbon cycle will be established by determining long-term organic and inorganic carbon accumulation rates as well as carbon exports from coastal ecosystems into the ocean and the atmosphere. In order to account for the different succession of ecosystems in peat and non-peat dominated coastal regions, three main working areas were bilateral agreed and selected: the peat-dominated eastern coast of Sumatra, the coral reef-dominated carbonate platform in the Spermonde Archipelago and the Banten Bay close to Jakarta.



**TOPIC 3 Understanding and managing the resilience of coral reefs and associated social systems**

Topic 3 aims to analyze sources and drivers of resilience and vulnerability, potential conditions for phase-shifts in coral reefs and the possible long-term social-ecological trajectories associated with different management schemes in the context of environmental and social change. The project goal is to support the development of a governance framework and of management strategies for Indonesian coral reefs that are feasible, adaptive and sustainable.

Holistic interdisciplinary investigations of coral reef dynamics under a range of environmental constraints and scenarios of anthropogenic exploitation and pollution will be carried out.

The integration of diverse forms of knowledge is of crucial importance for the topic. A novel modelling framework will be developed as a tool to link knowledge and data from the fields of ecology, genetics, and environmental sociology. Within the research regions (Spermonde Archipelago, Sulawesi and Savu Sea) specific marine research sites will be investigated jointly.



**TOPIC 4 Terrestrial influences on mangrove ecology and sustainability of their resources**

Mangrove forests provide important ecosystem functions and services, as feeding and nursery ground, as coastal protection, as carbon sink, and as food and income source both for local communities and national economies.

The overarching goals are to understand how interactions between humans and the environment affect ecosystem integrity and natural resource availability in mangroves and their watersheds and to develop and to assess governance options for a sustainable use of resources. It shall be achieved with a multidisciplinary approach across the natural and social sciences. Topic 4 builds on knowledge and infrastructure built during former SPICE phases. It will be conducted in Segara Anakan and other mangrove ecosystems.

