2.5 Topic 5: Infrastructure

Responsible: centre managements
Contributing Centres: AWI, GKSS

Mission
To provide optimal tools for field and laboratory studies as well as computational facilities

2.5.1 Challenges

In order to stay at the forefront in research scientists must be able to rely on the smooth running of excellent and state of the art laboratory and computational facilities. The centres are faced with the challenge to provide these tools within existing budgetary and personnel constraints and to effectively distribute and balance this load according to the specific research requirements

2.5.2 Contents and goals

Effective research in Ocean, Coastal and Polar Sciences requires an efficient and specialized suite of research platforms and infrastructure. This includes ice breaking research vessels, year round stations, both in the Arctic and Antarctic, with attached observatories, aircraft and vehicles specially adapted for the polar environment and also medium sized and small research vessels capable for multidisciplinary research in shelf seas and coastal regions. These instruments for field research must be matched by appropriate laboratory facilities, ranging from cutting edge analytical tools to labs for controlled experiments simulating natural conditions. Increasingly important are the availability of high performance computational facilities and knowledge base information systems. Reaching the goals of this programme with its inherent long-term engagement requires the continuing availability of this research infrastructure including its continuous modernisation and upgrading.
In line with this there is also the necessity of financial contributions to large international programs such as IODP, ANDRILL, IPICS all of which require substantial financial resources for their respective infrastructure and which will not only be used to reach some of the goals of this programme but also by our partners in universities and other research institutes.

Specific infrastructure necessary and available for achieving the goals of the programme topics encompasses a broad range of facilities. They serve all programme topics, but are also shared with the wider scientific community where appropriate. Examples are cold room laboratories for ice core processing and analysis, a seawater circulation system, polar condition aquaria, and ice and sediment core storage and curating facilities. Analytical laboratories are well equipped and instruments range from NMR-systems for in vivo experiments through mass spectrometers, electron microscopes to general analytical instruments. For sea going research AWI additionally operates a number of smaller research vessels and motor boats, adapted for work in coastal areas and which serve as daily workhouses: “Uthörn”, “Mya”, “Aade” and “Diker”. GKSS operates the “Ludwig Prandtl” as platform for research and monitoring purposes mainly in the German bight.
In addition this programme operates a marine geophysical instrumentation pool DEPAS, which consists of 80 broadband ocean bottom seismometers, which can be deployed and record for up to 2 years. This pool is available for all interested parties and is overseen by an outside

expert advisory panel, which next to deciding on instrument distribution also ensures close connections to the respective land based systems operated by GFZ.
At present instrumentation of an AUV is being developed in order to allow safe navigation even in ice covered regions and to have a suite of sensors available, which will be of use to the research goals of this programme such as high resolution swath bathymetry, optical and chemical sensors.
In addition it is planned to augment the marine instrumentation pool by a modern ROV system to be developed together with IFREMER and a system of autonomous observation platforms and floats to be deployed in the ice covered regions of the polar oceans, which will be essential components of sustained ocean observation systems in the Arctic, and the Southern Oceans.

Computing/Information facilities
The services provided by the AWI Computer Centre cover a broad range of items: from basic user support and network interconnections between AWI locations to high performance scientific computing facilities used in climate as well as seismic or radar studies. The scientific databases and information systems maintained by the Computer Centre form the core of the AWI Information Resource Centre. Preserving scientific data and information on a long-term basis is essential for the discovery of long-term changes in nature and for interdisciplinary scientific cooperation. The Computer Centre maintains central facilities for data management and gives support to the scientific community of the AWI. In addition to technical support, the computing Centre also provides guidance for the scientific use of these tools, facilitating interdisciplinary research.

Another key element in the support of scientists working with numerical models comes from the Scientific Computing Group of the Computer Centre, which is mainly concerned, with the growing need of high performance computer systems and efficient numerical algorithms. The group members work in close connection with several research groups at the AWI and lead efficient numerical solvers for diverse problems in modelling. Ocean and sea-ice models, often used at AWI, are parallelized for the use on the massively parallel computer NEC SX8 at the Computer Centre.

In addition we operate seismic processing packages (Disco, Focus, Landmark) on a multiprocessor computer (SUN).

The information system PANGAEA - Network for Geological and Environmental Data is aimed at archiving, publishing and distributing georeferenced data from research on climate variability, solid earth, and the marine environment. Data is stored with meta-information in a relational database, which is accessible through the Internet (http://www.pangaea.de). The system is used by the World Data Centre for Marine Environmental Sciences (WDC-MARE) to archive and distribute data from publications and projects.
The challenge of managing the heterogenic and dynamic data of environmental and geological research was met through a flexible data model, which reflects a strictly generalized 'world' of scientific data.
The system can be used by any scientific project related to geological or environmental science to collect and share data, to make the data available to the community via the Internet and to store data in a long-term operated archive. The institutes AWI & MARUM are responsible for the operation of the system and give support for the members and data curators of the projects. Organization of data management includes quality control and publication of data and the dissemination of metadata according to international standards. For the visualization of data freeware tools are provided, which can be used either with a direct link to the system or as standalone applications.

The German Climate Computing Center (Deutsches Klimarechenzentrum; DKRZ) is a joint effort of the Max-Planck Society, the City of Hamburg and the two HGF centres AWI and GKSS The former holds 6/11 shares, Hamburg 3/11 and AWI and GKSS each 1/11. In repeated

independent reviews, with competent experts from other scientific computing centers, the operation of a dedicated computing centre for climate research has been recognized.
The key features of the DKRZ are suitable compute facilities and - the equally important - large storing resources; the series of community models, dealing with different compartments of the regional and global Earth system; the „Konsortialrechnungen“ with extensive (and expensive) multi-purpose climate simulations used by significant segments of the scientific community.
The hardware investments of DKRZ are covered by the Federal Ministry of Research and Education (BMBF), while the operation is paid for by the four shareholders. 50% of the total computing time is managed as a „BMBF account“, which is distributed among applicants from universities and other scientific institutions. Only recently it has been decided to install new computing power (33 Mio EUR by BMBF) and to provide a new building (26 Mio EUR by the City of Hamburg) resulting in one of the most powerful computers in the world. From 2010 DKRZ will be operated within the Helmholtz structures.

2.5.3 Expected results, milestones

Excellent scientific returns can be expected from all marine observing systems as they are constantly upgraded and kept in good condition. Various long-term deployments of ocean bottom seismometers will contribute to resolving deep crustal and mantle structure at continental margins or the oceanic realm. The AUV and ROV Systems will open new vistas on benthic life as well as help to understand processes and material flow at the sediment-water interface. The HAFOS system will lead to a detailed picture of ocean water mass distributions and change in the polar oceans and hence to new boundary conditions for the coupled ocean-sea ice-atmosphere models. The engagement as strong partner and later operator of the DKRZ will enable an easier integration of the regional and process oriented modelling expertise specific to this program into the large Earth System Models.
Several of the specialized labs which operate at the forefront of present analytical precision are important not only for achieving the scientific goals of the programme but also form a solid base for international collaboration and for the participation within EU funded projects.

The specific results will become evident in the progress within the different Topics and milestones will be the successful operation on a year to year basis