

Stellungnahme zum Leibniz-Institut für Ostseeforschung Warnemünde (IOW)

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Vorbemerkung

Die Einrichtungen der Forschung und der wissenschaftlichen Infrastruktur, die sich in der Leibniz-Gemeinschaft zusammengeschlossen haben, werden von Bund und Ländern wegen ihrer überregionalen Bedeutung und eines gesamtstaatlichen wissenschaftspolitischen Interesses gemeinsam gefördert. Turnusmäßig, spätestens alle sieben Jahre, überprüfen Bund und Länder, ob die Voraussetzungen für die gemeinsame Förderung einer Leibniz-Einrichtung noch erfüllt sind.¹

Die wesentliche Grundlage für die Überprüfung in der Gemeinsamen Wissenschaftskonferenz ist regelmäßig eine unabhängige Evaluierung durch den Senat der Leibniz-Gemeinschaft. Die Stellungnahmen des Senats bereitet der Senatsausschuss Evaluierung vor. Für die Bewertung einer Einrichtung setzt der Ausschuss Bewertungsgruppen mit unabhängigen, fachlich einschlägigen Sachverständigen ein.

Vor diesem Hintergrund besuchte eine Bewertungsgruppe am 29. und 30. Oktober 2012 das Leibniz-Institut für Ostseeforschung (IOW) in Warnemünde. Ihr stand eine vom IOW erstellte Evaluierungsunterlage zur Verfügung. Die wesentlichen Aussagen dieser Unterlage sind in der Darstellung (Anlage A dieser Stellungnahme) zusammengefasst. Die Bewertungsgruppe erstellte im Anschluss an den Besuch den Bewertungsbericht (Anlage B). Das IOW nahm dazu Stellung (Anlage C). Der Senat der Leibniz-Gemeinschaft verabschiedete am 17. Juli 2013 auf dieser Grundlage die vorliegende Stellungnahme. Der Senat dankt den Mitgliedern der Bewertungsgruppe und des Senatsausschusses Evaluierung für ihre Arbeit.

1. Beurteilung und Empfehlungen

Der Senat schließt sich den Beurteilungen und den Empfehlungen der Bewertungsgruppe an.

Das IOW hat den **Auftrag**, interdisziplinäre Meeresforschung in Rand- und Schelfmeeren mit besonderem Fokus auf der Ostsee zu betreiben. Ziel ist es, Veränderungsprozesse in marinen Ökosystemen aufzuklären und dabei insbesondere zwischen anthropogenen und natürlichen Einflussfaktoren zu unterscheiden. Darüber hinaus werden mögliche Zukunftsszenarien entwickelt und Maßnahmen zur Erhaltung der ökologischen und ökonomischen Leistungsfähigkeit der Ostsee und anderer mariner Ökosysteme vorgeschlagen. Eine weitere wichtige Aufgabe besteht in der Durchführung regelmäßiger Ostsee-Monitoring-Programme.

Das IOW erfüllt seine Aufgaben überzeugend. Die Publikationsleistung konnte seit der letzten Evaluierung sowohl qualitativ als auch quantitativ deutlich gesteigert werden. Auch die Drittmittelwerbung hat nun ein sehr gutes Niveau erreicht, allerdings sollte das IOW in Zukunft den Anteil kompetitiv eingeworbener Drittmittel steigern. Hinsichtlich des Wissens- und Technologietransfers sollte das IOW sein Potenzial noch stärker zur Geltung bringen.

Das IOW verfügt über eine überzeugende Matrixstruktur. Vier disziplinäre Abteilungen werden durch drei interdisziplinäre Forschungsschwerpunkte verbunden. Die Leistungen in den Schwerpunkten „*Transport and Transformation Processes in the Sea*“ und „*Marine Communities and Matter Cycles*“ werden als „sehr gut“, die Leistung im Schwerpunkt „*Changing Marine Ecosystems*“ wird als „gut“ bewertet.

¹ Ausführungsvereinbarung zum GWK-Abkommen über die gemeinsame Förderung der Mitgliedseinrichtungen der Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz e. V.

Zum Zeitpunkt der Bewertung im Oktober 2012 war das IOW dabei, ein **neues Forschungsprogramm** für die Jahre 2013 bis 2023 auszuarbeiten, dessen Grundzüge überzeugen. Bei der Umsetzung sollten die folgenden Empfehlungen berücksichtigt werden:

Das Institut hat in jüngerer Zeit intensiv an systemübergreifenden Fragen gearbeitet. Daran anschließend werden nun weitere Forschungsdesiderata aufgegriffen, die weit über die Untersuchung der Ostsee hinaus von Interesse sind. So wird z. B. die Auswirkung des Klimawandels auf marine Ökosysteme erforscht. Für diese Arbeiten sollte das IOW seine Expertise in statistischer Analyse stärken. Die Modernisierung der Langzeitdatenerfassung in der Ostsee ist in diesem Zusammenhang ebenfalls wichtig. Sie sollte wie vom IOW und von den zuständigen Fachressorts geplant realisiert werden.

Die Betonung von systemübergreifenden und modellorientierten Forschungen sollte nicht dazu führen, dass eine umfassende Betrachtung der Ostsee als einzigartiger Naturraum in den Hintergrund tritt. Dieses wertvolle Alleinstellungsmerkmal ist weiterhin angemessen zu berücksichtigen. So sollte beispielsweise geprüft werden, Arbeiten zu Sediment- und Nährstoffeinträgen in die Ostsee stärker einzubeziehen. Auch kommt es einer spezifischen Betrachtung der Ostsee entgegen, das Thema *Coastal Seas and Society* stärker auszubauen. Die ersten Überlegungen hierzu werden begrüßt, sind aber noch wenig konkretisiert. Es wird empfohlen, zu diesem Thema eng mit Leibniz-Einrichtungen zu kooperieren, die wirtschafts- und sozialwissenschaftlich ausgewiesen sind.

Die **räumliche Ausstattung** des IOW konnte seit der letzten Evaluierung deutlich verbessert werden. Der Senat begrüßt, dass Mecklenburg-Vorpommern und der Bund zugesichert haben, die notwendige Renovierung eines älteren Gebäudes zügig umzusetzen.

Es ist sehr erfreulich, dass das IOW nun mit der ELISABETH MANN BORGESE über ein neues **Forschungsschiff** verfügt. Die Kosten für seinen laufenden Betrieb liegen allerdings erheblich über denen für das ausgemusterte Vorgängerschiff. Das Land Mecklenburg-Vorpommern hat für diesen Zweck bisher keine hinreichende finanzielle Vorsorge im Haushalt des IOW getroffen. Dies ist erforderlich, damit die Investition in die Beschaffung des Schiffs den erwarteten Nutzen erzielt.

Die Leitung des IOW wird gebeten, bis zum 31. Dezember 2015 zur Implementierung des Forschungsprogramms und zur Konsolidierung der Raum- und Finanzsituation einen Bericht vorzulegen.

Im Jahr 2011 kamen ein **neuer Direktor und eine neue Verwaltungsleiterin** ans IOW. Dieser Wechsel hat sich sehr positiv ausgewirkt. Unter anderem haben sich der wissenschaftliche Austausch und die Vernetzung innerhalb des Instituts deutlich verbessert.

Das IOW **kooperiert** intensiv mit benachbarten Hochschulen. Alle Wissenschaftlerinnen und Wissenschaftler in Leitungspositionen sind gemeinsam mit einer Universität berufen: sieben mit der Universität Rostock und zwei mit der Universität Greifswald. Die Mitwirkung des IOW beim Leibniz-WissenschaftsCampus *Rostocker Phosphorforschung* wird begrüßt. Auch die Zusammenarbeit mit anderen Leibniz-Einrichtungen funktioniert gut, beispielsweise im Rahmen einer Leibniz-Graduiertenschule und im *Leibniz-Verbund Biodiversität*. Mit anderen Forschungseinrichtungen in Deutschland ist das IOW ebenfalls gut vernetzt. Die internationalen Kontakte wurden in den vergangenen Jahren erweitert, sollten aber vor allem mit Einrichtungen in Ostsee-Anrainerstaaten intensiviert werden.

Der **wissenschaftliche Nachwuchs** wird am IOW gut ausgebildet. Die Postdoktorandinnen und Postdoktoranden am Institut sollten noch aktiver dabei unterstützt werden, beispielsweise

durch Konferenzteilnahmen professionelle Netzwerke aufzubauen und sich für Leitungsaufgaben zu qualifizieren.

Der Anteil von Frauen und Männern ist bei den Promovierenden etwa gleich hoch (53 % Frauen). Hingegen ist lediglich eine von neun wissenschaftlichen Leitungspositionen am IOW mit einer Frau besetzt. Es wird begrüßt, dass die Leitung die Notwendigkeit größerer Bemühungen zur **Steigerung des Frauenanteils in Führungspositionen** erkannt hat und entsprechend den GWK-Vorgaben das Kaskadenmodell der DFG umsetzen wird.

Das IOW hat sich, von Wissenschaftlichem Beirat und Kuratorium intensiv und konstruktiv begleitet, sehr gut entwickelt. Es erfüllt die Anforderungen, die an eine Einrichtung von überregionaler Bedeutung und gesamtstaatlichem wissenschaftspolitischen Interesse zu stellen sind. Die Erforschung langfristiger Entwicklungen in marinen Ökosystemen auf der Grundlage einer systematischen Integration verschiedener Disziplinen und die auf Dauer angelegten Monitoring-Aufgaben können in dieser Form nicht an einer Hochschule durchgeführt werden.

2. Zur Stellungnahme des IOW

Der Senat begrüßt, dass das Institut die Hinweise und Empfehlungen der Sachverständigen bei seiner weiteren Entwicklung berücksichtigen möchte.

3. Förderempfehlung

Der Senat der Leibniz-Gemeinschaft empfiehlt Bund und Ländern, das IOW als Einrichtung der Forschung und der wissenschaftlichen Infrastruktur auf der Grundlage der Ausführungsvereinbarung WGL weiter zu fördern.

Annex A: Status Report

Leibniz Institute for Baltic Sea Research *Leibniz-Institut für Ostseeforschung Warnemünde* (IOW)

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1. Structure, Tasks, and Institutional Environment

Development and funding

The first predecessor of the Leibniz Institute for Baltic Sea Research Warnemünde (*Leibniz-Institut für Ostseeforschung Warnemünde, IOW*), was established as an oceanographic agency in the former German Democratic Republic (GDR) in 1950. The Institute for Oceanography emerged from this agency and became a member of the Academy of Science of the GDR in 1960. After German reunification, the Institute for Oceanography was positively evaluated by the German Council of Science and Humanities (*Wissenschaftsrat*). It was consequently re-founded as the Baltic Sea Research Institute Warnemünde (IOW) and became one of the institutions on the “*Blaue Liste*”¹ in 1992. 50 % of IOW’s institutional funding is provided by the Federation (Bund) and 50 % by the *Länder*. The national importance of IOW was confirmed in external evaluations by the German Council of Science and Humanities in 1997 and by the Senate of the Leibniz Association in 2005.

Responsible department at Länder level:

Ministry for Education, Science and Culture of Mecklenburg-Vorpommern

Responsible department at federal level:

Federal Ministry of Education and Research (BMBF)

Legal form and organisation

Since March 2010, IOW has had the legal status of a foundation under public law. Its supervisory committee is the Board of Governors, which consists of up to eight members. The chair and one further member are appointed by the State Ministry for Science and Education; the deputy chair and one further member are appointed by the Federal Ministry of Education and Research (BMBF). The Board of Governors is responsible for endorsing the programme budget and confirming the annual accounts as well as for the appointment of the director, the head of administration, leading scientists, and the members of the Scientific Advisory Board.

IOW is led by the director, who represents the institute legally and externally, is in charge of staffing matters, and is responsible for designing and implementing the research programme. Responsibility for supervising the institute’s budget has been delegated to the head of administration.

To conduct IOW’s operational business there is a monthly meeting of the steering committee, which consists of the director, the four heads of department and their deputies, the head of administration, and the executive officer.

The Scientific Council advises IOW’s Board of Governors and especially the director on significant scientific matters relating to the institute. It is composed of the heads of department and one scientific representative from each department who is elected by IOW’s scientific staff for a period of three years. Its speaker is a regular guest at the Board of Governors’ meetings.

The other internal institutional bodies are the Staff Council, the Equal Rights Committee, two Equal Opportunities Officers, two Disabled Employees Officers, and an Ombudsman.

¹ The association of the members of the “Blaue Liste” subsequently developed into the Leibniz Association.

The Scientific Advisory Board (SAB) is composed of up to ten international scientists active in the marine sciences. It advises the institute's organisational bodies on scientific aspects of the research programme and its implementation. It meets at least once per year and is responsible for carrying out a regular audit between evaluations according to the guidelines issued by the Leibniz Association (cf. chapter 6 for more information on the SAB).

Mission and tasks

IOW conducts and supports interdisciplinary marine research oriented towards coastal and marginal seas with special emphasis on the Baltic Sea. By order of the Federal Maritime and Hydrographic Agency (*Bundesamt für Seeschifffahrt und Hydrographie*, BSH), it additionally carries out regular observations and monitoring programmes of the marine environment of the Baltic Sea in the framework of the Helsinki Convention, the so-called HELCOM monitoring.

Research focuses on observations and modelling of ecosystem changes and their underlying processes in marginal seas and shelf regions. The overall aim is to distinguish between natural variability and anthropogenically triggered changes, in order to properly assess the ecological status of marine environments and to identify suitable sustainability measures.

IOW also participates in technological developments and is involved in education and capacity building in close cooperation with the Universities of Rostock and Greifswald.

Research structure

The institute has four departments representing the main disciplines in marine research (cf. appendix 1: organisational chart): physical oceanography, marine chemistry, biological oceanography, and marine geology. An administration unit, an IT group, a library, an instrumentation group, a precision engineering workshop, and an analytical group are maintained as central units to support the scientific departments.

IOW's current research programme (2002–2012) is structured into three main research foci and three cross-cutting activities. The research foci are: (1) Transport and Transformation Processes in the Sea, (2) Marine Communities and Matter Cycles, and (3) Changing Marine Ecosystems: External Forcing and Internal Change. The three cross-cutting-activities are: (1) Coastal Seas and Society, (2) Modelling, and (3) Measuring Systems and Techniques.

This programme is implemented by interrelating the research foci with the disciplinary expertise of the departments in the form of a matrix structure. According to the institute, this interdisciplinary cooperation is the best approach for meeting the complex challenges of the long-term research programme.

In addition to the scientific departments, IOW has established project groups by recruiting personnel from all IOW's organisational units for up to five years. They are designed to promote specific scientific issues of importance to IOW's mission. In 2009, the project group "Upwelling" was established. The project group "Redoxcline" has been active since spring 2012.

Finally, IOW runs a monitoring programme for the Federal Maritime and Hydrographic Agency (BSH). It is made up of two components. The first consists of an observational monitoring programme in the German "Exclusive Economic Zone" in the Baltic Sea. The second covers the design, establishment, operation, and maintenance of a network of autonomous measuring stations in the Baltic Sea (Baltic MARNET) in addition to contributing to the HELCOM database.

National and international scientific environment

According to IOW, there are several other German marine research institutions; the larger ones are located (in alphabetic order) in

- Bremen: MARUM Center for Marine Environmental Sciences (combining a DFG Research Centre with the University of Bremen); Max Planck Institute for Marine Microbiology; Leibniz Center for Tropical Marine Ecology
- Bremerhaven: Alfred Wegener Institute for Polar and Marine Research
- Geesthacht: Helmholtz Centre Geesthacht for Material and Coastal Research
- Hamburg: University of Hamburg with the Center for Marine and Atmospheric Sciences, a cooperation between the university and the Max Planck Society
- Kiel: Helmholtz Centre for Ocean Research, GEOMAR
- Oldenburg: Institute for Chemistry and Biology of the Marine Environment at the University of Oldenburg
- Wilhelmshaven: Senckenberg Research Institute

Among these institutes, IOW claims to be unique in its comprehensive dedication to the Baltic Sea system, which includes the integration of all four basic marine disciplines. In addition, the institute emphasises the exceptional value of the long-term observational data of the Baltic Sea, collected and hosted at IOW, for the entire coastal sea research community, both nationally and internationally.

Among the research institutes involved in Baltic Sea research at international level, IOW sees itself playing an essential role due to its comprehensive observation programme, its ecosystem model, and its interdisciplinary systems approach, which is unique for the Baltic Sea region. Similar approaches are applied in Sopot at the Institute of Oceanology, a member of the Polish Academy of Science. The former Finnish Institute of Marine Research, which followed a comparable line, was closed down in 2009, and its oceanographic working groups were integrated separately into the Finnish Environmental Institute and the Finnish Meteorological Institute.

National interest and justification for funding as a non-university institution

According to IOW, knowledge of the mechanisms and processes that make coastal systems vulnerable to human impact and climate change is a prerequisite for sustainable action. Consequently, with its interdisciplinary systems approach and long-term observational data, IOW considers it its duty to provide a sound scientific foundation for the implementation of a marine strategy targeted toward sustainability, especially for the Baltic Sea.

Apart from that, operating large infrastructure such as research ships requires the broad-ranging capacity and financial flexibility of a non-university institute. Approximately 80 % of the institute's work necessitates sampling and measurement in the open sea, so that sufficient access to appropriately equipped research vessels is paramount.

The long-term data series from the Baltic Sea are considered to be a most important basis for detecting climate trends and investigating climate impact. Yet, the maintenance and continuation of these series can only be guaranteed by sufficient and continuing support as provided by IOW. According to the institute, the data set is the indispensable basis for reliable model projections on the future state of the Baltic Sea.

2. General Concept and Profile

Development of the institution since the last evaluation

IOW uses an integrated interdisciplinary research approach. Its objective is to build and interpret scenarios describing the reaction of the Baltic marine system to human impact against a background of climate change.

According to IOW, the general research strategy has not changed since the last evaluation, but there have been alterations such as the introduction of new interdisciplinary projects, infra-structural developments, and an increase in personnel.

The areas of microbial and molecular ecology, organic trace gases, biogeochemical processes at the benthic-pelagic boundary layer, and palaeo-oceanographic reconstruction have been expanded following the establishment of new professorships. In 2007, a Heisenberg group in biogeochemistry of marine particulate matter was established at IOW.

The establishment of new working groups accompanied a generational change in the scientific staff. Their work includes the investigation of sensitive trace metals in aquatic ecosystems, the introduction of modern microbial and molecular techniques for biodiversity studies, the development of new tools and sensors for specific long-term observations, the strengthening of expertise in regional oceanography by designing new methods for small and meso-scale process studies, and the expansion of the capabilities for biodiversity studies in benthic offshore regions.

During the last seven years, four interdisciplinary project groups were established: “Mineralisation of organic matter: dynamics of oxygen depletion” (2003–2007), “Nitrogen fixation in the Baltic Sea” (2004–2008), “Upwelling systems” (2009–ongoing), and “Redoxcline” (2012–2015).

Results

Research

According to IOW, since the last evaluation, all three research foci as well as the cross-cutting activities have resulted in major scientific achievements that have mostly been based on interdisciplinary efforts (for detailed results of the individual units, cf. chapter 3. Subdivisions of IOW). As indicators of IOW’s successful scientific activities, the institute mentions that the number of “project scientists” has increased by about 50 % and that the number of PhD students rose from 13 in 2004 to 43 in 2011. These increases were mainly achieved through a 200 % increase in research funding obtained from third parties in the last years, with a total of € 10 million in 2011.

With regard to publications, IOW stresses its strategy of preferably applying for joint research projects as these enhance the institute’s visibility. As a result, the institute’s participation in collaborative projects has increased, as has the number of publications in peer-reviewed journals, doubling from about 50 (2002–2004) to 100 (2009–2011) per year (cf. Appendix 2).

According to IOW, following the last evaluation, the choice of journals in which results are to be published became a major concern. Consequently, the institute offers monetary incentives for publications in high-ranking journals and provides funding for travel to international symposia based on the investigator’s publication record.

Scientific services, infrastructure, advice, and transfer

In terms of scientific services and infrastructural tasks, IOW offers two types of services: services for environmental authorities on the federal and state levels, in which the character of the service corresponds with the objectives and tasks of the institute's research programme, and community services such as the management of ship-time applications or the self-organisation of scientific quality management.

In terms of advice, IOW offers information on minimising negative impacts on the ecosystem and on the maintenance of major ecosystem services. The institute's activities in this respect are conducted under the umbrella of the cross-cutting activity "Coastal Seas and Society".

Technology or knowledge transfer at IOW can be described as a threefold activity: the goal of the IOW Instrumentation Group is to develop innovative, fully operative, and efficient measuring and sampling instrumentation in order to enhance IOW research. Furthermore, IOW scientists and engineers advise enterprises working on new marine research instrumentation in general. Finally, within the cross-cutting activity "Coastal Sea and Society", there are several applied projects in which IOW scientists cooperate with enterprises in order to develop new environmentally-friendly materials suitable for offshore application.

To strengthen technology transfer, IOW's directorate has acquired additional third-party funding in the framework of a programme offered by the Federal Ministry of Education and Research to professionalise technology transfer at Leibniz institutes (2011–2014). On this basis, a transfer officer is responsible for communication between IOW's technical development and an external consultancy service experienced in the transfer and utilisation business. Additionally, to foster communication with business and industry, IOW became a member of the German Association for Marine Technology.

Academic events and public relations

In 2009, IOW, together with colleagues from the Marine Biology Department at the University of Rostock, organised the Baltic Sea Science Conference in Rostock. In 2011, this conference was located in St. Petersburg and hosted by Russian scientists. Members of IOW participated in the scientific steering committees and acted as conference convenors for both meetings. In addition, IOW contributed to several other important scientific meetings in Germany and abroad.

As part of the institute's public relations concept, target groups have been identified that are provided with information on a regular basis. These groups include journalists, school students, the general public, enterprises, ministries, and other authorities responsible for the implementation of related environmental laws or legal directives.

Strategic work planning for the next few years

A new research concept has been developed recently and is due to be adopted by IOW's Board of Governors in November 2012. This concept addresses the sustainability of the ecological and economic potential of both marine ecosystems and their ecosystem services. According to IOW, generating knowledge that reduces uncertainties about ecosystem states under changing external forcing will be a main future task. Therefore, the planned research intends to address important scientific challenges for the years to come in order to contribute to solution-orientated research for sustainability. The objective is to ensure timely information as well as the participa-

tion of policy-makers, funders, academics, and other sectors of civil society in co-designing and co-producing research agendas and knowledge. IOW plans to increase capacity-building in science, technology, and innovation. Thus, the new IOW research programme addresses the emerging issues of the international Future Earth Initiative.

According to IOW, the resulting major changes in the new research concept affect the restructuring of the current research foci “Transport and Transformation Processes” and “Marine Communities and Matter Cycles”. By concentrating on the relevant scales, and with the aim of further promoting an interdisciplinary systems approach, they will be restructured as the new research focus 1, “Small- and Meso-Scale Processes”, and research focus 2, “Ecosystem Functioning”. Research focus 3, “System Changes”, will remain dedicated to observing long-term measurements, retrieving sedimentary records, and projecting future ecosystem scenarios through the construction of models. A substantial strengthening of the former cross-cutting activity “Coastal Sea and Society” will lead to a new, fourth research focus with the same title.

The new research programme will be based on long-term measurements and adopt a system-analytical approach, organised along ascending spatial and temporal scales for the first three research foci. Just as the scales interact, so do the research foci, thereby contributing to the fourth focus, in which proper links to end-users are ensured. All the foci will profit from the cross-cutting activities “Data”, “Tools”, and “Transfer”.

Appropriateness of funding, facilities, and equipment

In 2011, IOW’s total revenue was € 31.5 million, including € 16.6 million (53 %) institutional funding, € 9.2 million (29 %) revenue from project funding grants, € 800,000 (3 %) revenue from commissioned work (Fehmarn Belt Project), and € 4.9 million (15 %) from miscellaneous sources, mainly reserve funds (cf. appendix 3: revenue and expenditure).

On the infrastructure side, a new building jointly funded by the State of Mecklenburg-Vorpommern and the Federal Republic of Germany opened in 2007. It extended IOW’s capacities by providing modern laboratories for organic trace chemistry, microbiology, and marine geology. Offices for up to 30 people, a new library, and properly maintained rooms for computer servers were additional major improvements. As a result of this expanded space, a calibration laboratory and a pressure tank for the instrumentation group were established in the main building (constructed in the 1960s), where most of the standard laboratories and offices are located as well.

The third building at IOW’s disposal was built at the beginning of the 20th century and hosts offices for the modelling group and one of two seminar rooms. According to IOW, the entire “Villa” is in need of refurbishment, as main facilities are not up to modern safety standards. Renovation costs are estimated at about € 1.4 million, a sum that IOW cannot cover without extra funds.

In 2011, as recommended in the last evaluation report, the new research vessel ELISABETH MANN BORGESE replaced the former one. The institute has the means to run it for 300 days per year, of which 70 days are to be reserved for the previous owner, the German Navy. In addition, IOW can apply for further ship capacity from the German research fleet (about 50–100 days per year). Thus far, IOW researchers have organised six interdisciplinary expeditions aboard the MARIA S. MERIAN to study the entire Baltic Sea marine environment and other coastal and marginal seas like the shelf region off the Namibian coast.

According to IOW, the laboratory infrastructure and the research vessels have enabled IOW to increase its contributions to national and international interdisciplinary projects substantially.

In order to increase its budget permanently, in 2010, IOW announced an “extraordinary item of expenditure” (*Sondertatbestand*) referring to the urgent need for modernisation of its observation programme in the central Baltic Sea. Initially, the funding bodies agreed to this increase. In 2012, however, Mecklenburg-Vorpommern withdrew from this agreement. As a consequence, the original proposal was reduced by 50 %, and funding is only provided temporarily. According to IOW, this situation severely limits the institute’s plans for implementing emerging research topics.

3. Subdivisions of IOW

In the following, the three research foci as well as the cross-cutting activity “Coastal Seas and Society” are presented in detail as these units represent the thematic structure of the institute’s activities. The cross-cutting activities “Modelling” and “Measuring Systems and Techniques” support the research foci.

Research Focus 1: “Transport and Transformation Processes in the Sea”

In the context of this research focus, the processes that generate and sustain the physico-chemical gradients in the sea are quantified by resolving the nature and effects of external forcing as well as the internal dynamics of the system with respect to different time scales. Thus, the aim is to identify the biogeochemical and ecological responses to physical processes and variation in the gradients.

Results

The main results of research focus 1 comprise evidence about

- meso-scale processes including the dynamics of dense bottom currents, the Gotland Basin vertical mixing, small-scale processes and mixing in general, and the thermodynamics of seawater
- processes at boundary layers including emission of environmentally relevant volatiles, element transport and transformations across boundaries, basin-scale processes and water exchange, the role of Mn-Fe-P shuttle at the redoxcline, and atmospheric deposition of particles and its biogeochemical consequences
- salt and matter balances including the determination of biomass production and nitrogen fixation rates based on continuous pCO₂ measurement from a cargo ship as well as the determination of mineralisation rates, denitrification, and phosphate transformations by total CO₂ time series data

The project group “Upwelling” could determine that in the central Baltic Sea, episodic events constitute the most effective mechanism supplying the euphotic layer with nutrients from deeper layers.

Work planning

Due to re-structuring of the research programme (see above), research questions arising from results of this research focus will be addressed in those new research foci where they fit best.

IOW intends to continue the research on volatile emissions, mineral formation at pelagic redox-clines, element transport by benthic-pelagic coupling, eddy formation and filament dynamics, and dense bottom currents in the framework of the new research focus 1 (“Small- and Meso-Scale Processes”), using a combination of field studies with high-resolution observations and model experiments.

As part of the new research focus 2 (“Ecosystem Functioning”), IOW plans to continue the research on the control of salt water inflow and on the dynamics of the lateral structure of the halocline with a combination of numerical modelling and high-resolution observations, such as profiling moored probes and towed instruments. Model experiments will be used to better understand the underlying dynamics and to predict events of major salt water inflow. In addition, the impact of atmospheric particle supply on the marine environment will be investigated, with particular attention to volcanic ashes, iberulites, pollen, and anthropogenic particles.

Processes that connect large-scale driving motions with small-scale boundary mixing and allow communication of mixed boundary-layer fluid with the interior will be investigated in the framework of the new research focus 3 (“System Changes”).

Appropriateness of facilities

IOW considers the group of technicians in the instrumentation group to be well established and indispensable. Advanced instrumentation comprising ship-borne devices, towed instruments, and specific mooring equipment is available. Overall, the laboratories are considered to be well equipped and spacious.

In order to elucidate the chemical and mineralogical composition of all kinds of particles and to relate those to their sources, in situ measurements with modern analytical techniques are employed. In the near future, the newly acquired NanoSIMS will provide additional information e. g. about the formation of suspended particulate matter, both of natural and anthropogenic origin. Replacement and modernisation of older devices and instruments will become an important issue in the next few years.

Research Focus 2: “Marine Communities and Matter Cycles”

In this research focus, the qualitative and quantitative contribution of key species to biogeochemical turnover and the structural properties of the biodiversity found in coastal and marginal seas are assessed.

Results

The main results of research focus 2 comprise evidence about

- diversity and matter cycles including coastal nitrogen cycling and phosphorus as a trigger for blooms of diazotrophic cyanobacteria
- adaptation and stabilisation of the system including microbiology and biochemistry of pelagic redoxclines, macrozoobenthic diversity and ecological functioning along the salinity gradient, plankton communities in shelf sea areas, and the impact of global change on plankton communities

Work planning

Most research questions arising from results of this research focus will be addressed in the new research foci 1 (“Small- and Meso-Scale Processes”) and 2 (“Ecosystem Functioning”), but also in the new research focus 4 (“Coastal Seas and Society”).

To obtain a more comprehensive view of the importance of pelagic redoxclines and hypoxic water columns for changes in biodiversity and biogeochemical cycles, IOW plans to investigate the structure and function of microbial communities with increasing use of modern “omics” techniques. These analyses will be combined with studies on the chemical speciation of the reactants and the impact of physical forces.

To improve the understanding of the abiotic and biotic regulatory mechanisms in the major nutrient cycles, IOW will focus on the dynamics of specific less well-studied components and on processes in poorly understood compartments. Species-specific uptake and transformation rates in these cycles will be determined by the application of novel technologies such as HPLC-MS and NanoSims.

According to IOW, the broad salinity gradient of the Baltic Sea constitutes an ideal system to study how salinity-related changes in the composition of pelagic and benthic communities may translate into functional alterations. Long-term data and detailed information on the biodiversity of the different compartments and trophic levels will form the basis for experimental and modelling approaches that link biodiversity data to specific transport and transformation processes.

Appropriateness of facilities

For the analysis of microorganisms which are responsible for the majority of processes, a state-of-the-art molecular laboratory has been established. IOW sees the necessity to complement this facility by profound bioinformatics expertise, which at present is delivered by external collaborations only. For the rapid quantification of microorganisms in large numbers of samples, flow-cytometry is routinely used and has recently been complemented by an instrument that allows cell sorting for molecular analysis and activity measurements.

To assess transformations and sources within the nitrogen cycle using stable isotope techniques, IOW has on-site modern and regularly updated mass-spectrometry facilities. For investigations into other uptake processes and organismic activities, a new radioisotope laboratory has been built. Species-specific element uptake rates and element stoichiometries are among the many applications of the latest innovative tool, the NanoSims.

Research Focus 3: “Changing Marine Ecosystems: External Forcing and Internal Change”

In this research focus, the temporal variability in marine ecosystems of marginal and coastal seas on decadal to multicentennial time scales is investigated with the aim of explaining and modelling causal links between external forcing – such as long-term geological processes, climate-driven changes, and human impact – and chemical, biological, and sedimentary reactions in the ecosystem.

Results

The main results of research focus 3 comprise evidence about

- long-term coastline changes
- changes in biogeochemical matter cycles including long-term measurements as a backbone for research and political decision-making, recent stronger warming in the Baltic than globally, impact of climate change on the Baltic Sea ecosystem over the last 1000 years, projections for the future, and calibration of new (bio)geochemical proxies
- variability of the community of species including impact of climate variability on marine ecosystems and its potential predictability (using the example of small pelagic fish)

Work planning

In the coming years, IOW research under this focus will concentrate on high-resolution palaeo-environmental/palaeo-oceanographic multi-proxy reconstructions of the different sub-systems of the Baltic Sea. The spatial and temporal development of anoxic systems in response to climate dynamics, sea level changes, and regional glacio-isostatic rebound processes will be investigated. One major goal will be to link the sedimentary archive with long-term observations and instrumental time series. This will require highly detailed master-chronologies from key depositional areas. Such palaeo-environmental reconstructions will serve as a reference for numerical ecosystem model approaches by allocating and providing basic data for crucial periods in the historical record representative of natural, distinct environmental states of the ecosystem.

Modelling activities will further develop the systems approach for long-term simulations by coupling the Earth system model components with additional process modules to yield a marine ecosystem model. The main focus of this research is the response of the Baltic Sea ecosystem to external drivers and the relevant cause-effect relationships.

Appropriateness of facilities

Extraction of the critical physical, chemical, and biological parameters from sedimentary archives characterising past states of the ecosystem demands a wide spectrum of proxy methods. Consequently, the capabilities of the IOW laboratories in inorganic and organic geochemistry cover appropriate standard methods. For high-resolution down-core logging of sediment cores, various core scanner systems are available. Within the next few years, it is planned to extend these facilities by the acquisition of an ICP-MS device and a gamma counter for $^{210}\text{Pb}/\text{Cs}$ dating. As far as the long-term data are concerned, supercomputing facilities for ecosystem modelling are mainly provided by the North-German Supercomputing Alliance (HLRN).

Cross-cutting activity: “Coastal Seas and Society”

The concept of this cross-cutting activity is to summarise and pre-process prevailing knowledge from the three research foci as well as from modelling and methodical developments for potential non-scientific users, such as administrative and legislative bodies.

Results

The main results of this cross-cutting activity comprise

- a contribution to a marine and coastal policy in the EU: with support of IOW data and expertise, mainly gained on the basis of the long-term observation programme, important milestones in the implementation of a marine strategy in the German waters of the Baltic Sea were compiled. This work culminated in the publication of a set of draft reports by the German government to be discussed in public before the reports were sent to Brussels in July 2012 as requested in the *EU Marine Strategy Framework Directive*
- the uses of and measures in coastal and marine systems including the assessment of planned offshore constructions like the Fehmarn Belt Link. In the course of a Europe-wide call for tender, IOW and the Danish Hydraulic Institute (as project leaders) and other institutes were awarded the contract for comprehensive baseline studies, accompanying research, and the development and operation of a monitoring network in the Fehmarn Belt region. After three years (2009–2011), the results obtained were summarised in what is still a non-public report. According to IOW, this study has made the region into one of the best investigated sea regions in the world, and the scientific community will benefit enormously
- model simulations of regional climate change including analyses of its consequences for specific systems

Work planning

This cross-cutting activity will emerge as research focus 4, “Coastal Seas and Society”, in the future research programme. The implementation of the *Marine Strategy Framework Directive* will be of major importance, because it serves as an umbrella for European marine and coastal policy. Furthermore, as climate change and socio-economic transformation processes around and in the Baltic are ongoing, assessments as well as the development of adaption measures and strategies are required. Thus, new tools like geo-information systems and flexible models are needed. Improved coupled models will make it possible to analyse ecosystem services and cost-effectiveness. “Coastal Seas and Society” typically has a high percentage of external funding and requires thematic flexibility, fast responses to new challenges, and the exploration of new research themes. Therefore, intensified communication and cooperation with the actors concerned is envisaged.

Appropriateness of facilities

The three research foci contribute expertise and work to this activity; directly allocated resources are limited. In the future, it is intended that this cross-cutting activity should develop into a new research focus.

4. Collaboration and Networking

Collaboration with universities

The currently nine professorships at IOW are joint appointments with the Universities of Rostock (for Physical Oceanography [2], Marine Chemistry [2], Biological Oceanography [2] and Earth System Sciences[1]) and Greifswald (for Marine Geology [2]). Together with other IOW scientists, these professors regularly teach courses at the two universities.

At Rostock University, ten IOW professors and associate professors (“Privatdozenten”) have become active members of the Department of Maritime Systems in the Interdisciplinary Faculty (INF). They are engaged in joint interdisciplinary activities, such as the establishment of the INF research programme, concepts for joint projects and graduate schools, joint PhD programmes, and decisions related to jointly used infrastructures.

In 2008, the *International Leibniz Graduate School on Waves in the Atmosphere and the Ocean* was established jointly by IOW, the Leibniz Institute for Atmospheric Physics at Kühlungsborn (IAP), and the Chair of Fluid Mechanics at the University of Rostock. This project is funded by the Leibniz Association and was competitively acquired. It is now entering its second four-year phase, supporting a total of six PhD students and involving about 30 scientists from all three institutes.

IOW lecturers are involved in a number of national and international teaching programmes, such as the POMOR Master's Programme for Applied Marine and Polar Sciences, which is organised in close collaboration between universities in Northern Germany and St. Petersburg (Russia).

Very recently, IOW started to prepare an international Master's programme on coastal marine geosciences together with the University of Szczecin (Poland) and the University of Greifswald.

Collaboration with other institutions in Germany and abroad

At national level, IOW is involved in twelve “collaborative projects” (*Verbundprojekte*) run by the Federal Ministry of Education and Research (BMBF), many of which are national implementations of large international programmes. According to IOW, this has led to intense interaction with other institutes in the Leibniz Association as well as with institutes in the Max Planck Society and the Helmholtz Association. During the reporting period, four collaborative projects were of major importance in terms of national cooperation:

- Surface Ocean Processes in the Anthropocene (SOPRAN)
- Biological Impacts of Ocean Acidification (BIOACID)
- Research for an Integrated Coastal Zone Management in the German Oder Estuary Region (IKZM-Oder)
- Regional strategies for adaptations at the German Baltic Sea coast (RADOST)

Within the Leibniz Association, IOW successfully initiated a network of nine partner institutions devoted to analysing microbial response patterns to climate change. This was set up within the competitively acquired project ATKIM (Decomposition of Arctic Terrestrial Carbon in the Sea). In this context, the former Leibniz Institute for Marine Research in Kiel and the Leibniz Institute for Freshwater Ecology and Inland Fisheries in Berlin are IOW's partners.

Related to the international cooperation within the Baltic Sea research community, IOW has thus far participated in seven EU-funded BONUS+ projects (ERANET), for one of which (Assessment and Modelling of the Baltic Ecosystem Response, AMBER) it was responsible for coordination. IOW's partners in AMBER were research institutes and universities in Germany, Finland, Sweden, Lithuania, and Poland. In addition, IOW participated in twelve further Baltic projects with EU funding.

Beyond the borders of the European Union, IOW is involved in researching the Benguela upwelling system within the framework of several joint international projects including partners from Angola, Namibia, and South Africa.

A similar cooperative framework, coordinated by IOW, has been established with Chinese institutions on the basis of a collaborative project funded by the German Federal Ministry of Education and Research (2009–2012) in cooperation with the Leibniz Center for Marine Tropical Ecology in Bremen.

Based on two bilateral German-Ukrainian workshops (2010, 2011) held in Sevastopol and Warnemünde, IOW initiated a bilaterally funded interdisciplinary Black Sea project with two research institutes from Sevastopol, Ukraine.

In the framework of a project funded by the German Research Foundation, IOW's cooperation with the Vietnamese Institute of Oceanography in Nha Trang was intensified. Numerous visits and joint cruises were carried out between 2003 and 2008.

Other collaborations and networks

Scientists at IOW are involved in numerous networks, committees, and working groups at national and international level. They include

- the International Council for the Exploitation of the Seas (ICES)
- the Helsinki Commission (HELCOM)
- the European Network of Marine Research Institutes and Stations (MARS)
- the European marine network EUROCEAN
- the German Marine Research Consortium (Konsortium Deutsche Meeresforschung – KDM)
- the North-German Supercomputing Alliance (Norddeutscher Verbund für Hoch- und Höchstleistungsrechnen – HLRN)
- the German Climate Consortium (Deutsches Klimakonsortium – DKK)
- the German Association for Marine Technology (GMT)
- the Leibniz network on biodiversity research

Collaboration with the business sector, organisations, and public administrations

According to IOW, its most important non-scientific institutional partners at national level are the Federal Maritime and Hydrographic Agency (BSH) and the Federal Agency for Nature Conservation (BfN), which assigned IOW both the governmental tasks of the Baltic HELCOM monitoring in German national waters (BSH) and tasks within the framework of the EU Habitats Directive and the EU Water Framework Directive (BfN).

The Coastal & Marine Union is Europe's largest coastal non-governmental organisation. The office of the German branch "EUCC - Die Küsten Union Deutschland e. V." is located at IOW.

Important cross-border cooperation has been established with Femern A/S, a subsidiary company of the Danish, state-owned Sund & Bælt Holding A/S. It is responsible for designing and planning a fixed link between Denmark and Germany across the Fehmarn Belt. In order to provide the required environmental impact assessment, scientific studies were called for. IOW participated in a successful tender coordinated by the Danish Hydraulic Institute (DHI) in two consortia: Fehmarn Belt Hydrography (FEHY) and Fehmarn Belt Marine Animals (FEMA).

5. Staff Development and Promotion of Junior Researchers

Staff development and personnel structure

By the end of the year 2011, 206 people (178 full-time equivalents, FTE) were employed at IOW; 72 of them (67 FTE) were scientists actively working for the IOW research programme or the scientific service of the Federal Maritime and Hydrographic Agency, and 34 (20 FTE) were PhD students. They are supported by 13 persons (10 FTE) with scientific backgrounds who are responsible for scientific coordination, public relations, instrumentation, and IT support. Technical support (including the library) is provided by 66 members of staff (61 FTE). A team of 21 employees (19 FTE) is responsible for administration (cf. appendix 4: staff financing).

Among the 106 scientists (including the PhD students), 71 (67 %) held fixed-term contracts. The percentage of women in this group was 39 % (41 women), none of whom held a leadership position (cf. appendix 5: Temporary Employment Contracts and Proportion of Women on Academic Staff).

In 2010, a new head of the Marine Geology department assumed his duties on the basis of a joint appointment with the University of Greifswald where he holds the chair in Marine Geology.

In October 2011, a new director joined IOW. He was simultaneously appointed professor for Earth System Sciences at the University of Rostock.

The procedure to fill the position of the head of the IOW department of Biological Oceanography and professor for Biological Oceanography at the University of Rostock was successfully finalised in June 2012. The new professor is female and has started work in September 2012.

The procedure to fill the position of the head of the department of Physical Oceanography and Instrumentation has been initiated in August 2012. A joint selection commission of members from IOW and the University of Rostock has been established.

In order to ensure adequate flexibility in its scientific staff, fixed-term, three-year contracts are offered to new scientists. In parallel, tools are being developed to offer IOW's best qualified employees the opportunity to achieve a permanent position.

Promotion of gender equality

Since December 2010, IOW's directorate together with the two equal opportunities representatives have been working on a catalogue of measures to comply with the German Research Foundation's equal opportunities standards by 2013. Moreover, it was decided that IOW will strive for the "TOTAL E-QUALITY" certificate. To support this procedure, IOW engaged a consultant specialised in the field of family-work balance. An equal opportunities committee chaired by IOW's director was established in May 2011. It comprises representatives of all departments, the administration, and the work council. Further measures include:

- setting target percentages for female scientists as a binding commitment to the Leibniz Association
- establishing gender balance as a directorial task
- opening a special office exclusively dedicated to parents with short-term childcare issues
- adapting standard regulations for the procedure of filling vacancies to gender equality requirements
- a special support programme for young female scientists
- a fellowship programme supporting young female marine scientists who have interrupted their academic careers due to parental leave and childcare

Promotion of junior researchers

In 2008, funding for the *International Leibniz Graduate School on Waves in the Atmosphere and the Ocean* was competitively acquired in cooperation with the Leibniz Institute for Atmospheric Sciences at Kühlungsborn (IAP) and the Chair of Fluid Mechanics at the University of Rostock. Presently, it supports a total of six PhD students.

In the transitional area between research and teaching collaborations, IOW, along with the Alfred Wegener Institute for Polar and Marine Research (AWI) and the Helmholtz Centre Geesthacht (HZG), offers annual international summer school courses. Since summer 2002, these events have taken place at rotating venues and are attended by about 25 participants per year from all continents.

PhD students regularly receive a three-year contract with the option of a three-month extension. PhD candidates who make very promising progress are given an extension to encourage further publication output. The majority of PhD students finalise their theses during their fourth year. In 2011, the PhD contracts were brought in line with the regulations of the German Research Foundation that allow 75 % (instead of 50 %) positions.

IOW employs one postdoc per department on institutional funds. The young scientists are encouraged to apply for project grants to cover the costs of their positions after the duration of their contracts. Young scientists with excellent qualifications in key areas will benefit from a mentoring programme which will support guest stays at partner institutions abroad.

Professional qualification and training of non-academic staff

IOW staff benefits from the annual training courses in administration and management offered by the University of Applied Sciences for Public Administration in Güstrow. Technical staff and engineers visit international laboratories that use state-of-the-art technologies relevant to IOW research. On a regular basis, specialist personnel (i. e. radioactive safety officers, chemical safety officers, security managers) attend training courses to ensure they are familiar with the latest regulations.

During the last three years, IOW took on three trainees, one in the field of instrumentation (training completed in 2009), another as a chemical laboratory technician (training completed in 2011), and the third as an office administrator (training completed in 2009). In 2012, IOW announced three trainee positions in administration, chemistry, and the institute's workshop respectively. For 2013, three additional trainee positions are envisaged.

6. Quality Assurance

Internal quality management

The strategy for IOW quality management is based on an interlinking series of measures using incentives as major tools. The institute's foundation for sound scientific work is established in accordance with the respective DFG standards and implemented by IOW as an agreement between the directorate, the work council, and the scientific council (cf. chapter 1).

IOW has established a publication concept that puts special emphasis on applications for joint research projects in order to increase the institute's visibility. The institute seeks to improve the quality of its scientific publications and to place them in peer-reviewed international journals with a high impact factor. According to IOW, the choice of journals in which results are to be

published became a major concern. Monetary incentives for publications in high-ranking journals are offered, and additional funding for travel to international symposia based on the investigator's publication record is provided. In parallel, a new system has been implemented by which money is allocated to IOW research units based partially on scientific performance and partially on strategic relevance.

New projects of any kind are individually discussed in the steering committee. Larger projects are discussed beforehand by IOW's Scientific Council. Proposals for research time on the institute's ship are evaluated by the internal ship's advisory board before they are submitted to the steering committee. This committee also holds yearly discussions on the annual budget allocation to the research units as well as on any planned investments exceeding € 10,000. New, innovative, high-risk research projects can be established in "project groups" after being discussed by the Scientific Council and the steering committee. These project groups are subject to annual internal evaluation.

Quality management by the Scientific Advisory Board

According to IOW, the Scientific Advisory Board is the key consultative committee for determining the scientific orientation of the institute. It makes recommendations regarding the research programme and the implementation plans, and it states its position on the draft programme budget as well as on the annual scientific report. Finally, it assesses the scientific work of the institute in the framework of regular audits. The (up to ten) members of the Scientific Advisory Board are appointed by the IOW Board of Governors for a period of four years. They may be re-appointed for a second term of office only.

Implementation of recommendations from the last external evaluation

In order to meet the Senate's recommendations of November 2006 (in *italics*), IOW has implemented the following measures:

1. IOW should strive for greater international visibility of its results.

In this regard, IOW refers to a fourfold approach:

- Increase the percentage of papers published in international peer-reviewed journals with a high impact factor
- Present the results at highly regarded international conferences and symposia
- Strive for participation in international programmes and projects
- Participate in international scientific committees

2. Interdisciplinarity should be reflected to a higher degree by joint publications in peer-reviewed journals.

In the last years, the percentage of joint interdisciplinary articles at IOW has increased.

3. IOW has impressive modelling competence, which is yet not sufficiently exploited in all working areas.

Since the last evaluation, the evolution of the IOW model system has reached a level that allows many applications. Among others, it has been extensively applied to assess direct human impacts on marine ecosystems. A joint coupled coastal-ocean modelling system is scheduled to be

set up soon in cooperation with other coastal modelling groups. Moreover, IOW plans to enhance the modelling potential across the full spectrum of its research.

4. The number of publications still does not comply with international standards.

Both the number and the impact of IOW publications have increased significantly since the last evaluation.

5. Greater initiative and innovative spirit as well as a better strategic orientation are needed to reach global leadership.

According to IOW, its scientists are actively involved in designing new research programmes for the Baltic Sea; several examples are quoted.

6. Knowledge transfer should be strengthened. Results should regularly be presented to potential users and political and societal decision makers.

With reference to this recommendation, IOW cites a series of activities that document enhanced knowledge transfer. On the basis of its own measurements, for instance, IOW annually publishes reports on the hydrographic-hydrochemical and biological conditions of the Baltic Sea for ministries and other authorities responsible for the implementation of environmental laws or legal directives. These data and their interpretation are integrated into a larger data pool.

Another example are the HELCOM indicator fact sheets, of which IOW scientists are lead authors, and the “Baltic Sea Environment Proceedings”, also edited by HELCOM. The target groups of these publications are environmental managers and decision makers in the Baltic region.

7. The number of doctoral candidates and postdocs should be increased and their supervision intensified. Young scientists should be encouraged to publish their results in international journals before completing their theses. Together with the cooperating universities, a structured graduate programme should be developed.

IOW has significantly increased the number of doctoral fellows supervised by IOW scientists. PhD students are advised to pursue cumulative theses, thus allowing the early publication of their results. As a result, the majority of our doctoral candidates submit at least one paper before finishing their dissertation.

Since the last evaluation, two graduate programmes have been jointly developed by the University of Rostock and IOW. In addition, a new concept to improve PhD thesis committee work has been introduced. A soft-skill education and a mentoring programme are under development.

8. Quality management at IOW was not convincing. Greater integration of the Scientific Advisory Board in the regular reports on the institute's performance is recommended. The Board should become more critically involved in the institute and document audit results in greater detail. IOW's directorate shall report to the Board the development of performances in the research units on an annual basis.

The Scientific Advisory Board (SAB) meets once a year, and the director of IOW provides an annual, highly detailed report on the institute's performance. The chairperson of the SAB is a regular member of IOW's Board of Governors, to which she reports twice a year on the work and recommendations of the SAB.

9. An adequate system of incentives should be developed that will strengthen both the flexibility and the mobility of IOW's employees.

A quality management strategy for IOW has been implemented (cf. sub-chapters above)

10. The institute's budget should be increased by an amount of the personnel costs of six positions. IOW is asked to design a development strategy for future research that meets the changes in its financial framework.

IOW has managed to maintain long-term observations in the Baltic in spite of the cuts imposed by the Federal Maritime and Hydrographic Agency. The staff has been increased in accordance with the recommendation.

11. IOW needs a research vessel for flexible operations 220 days a year. A proper substitute for the research vessel Prof. A. Penck is mandatory.

The new research vessel ELISABETH MANN BORGESE was commissioned in June 2011, nine months after the decommissioning of the research vessel PROF. A. PENCK.

12. IOW should become legally independent.

IOW changed its legal status to a foundation under public law in March 2010.

Appendix 1

Organisational Chart and Matrix Structure

a) Organisational chart

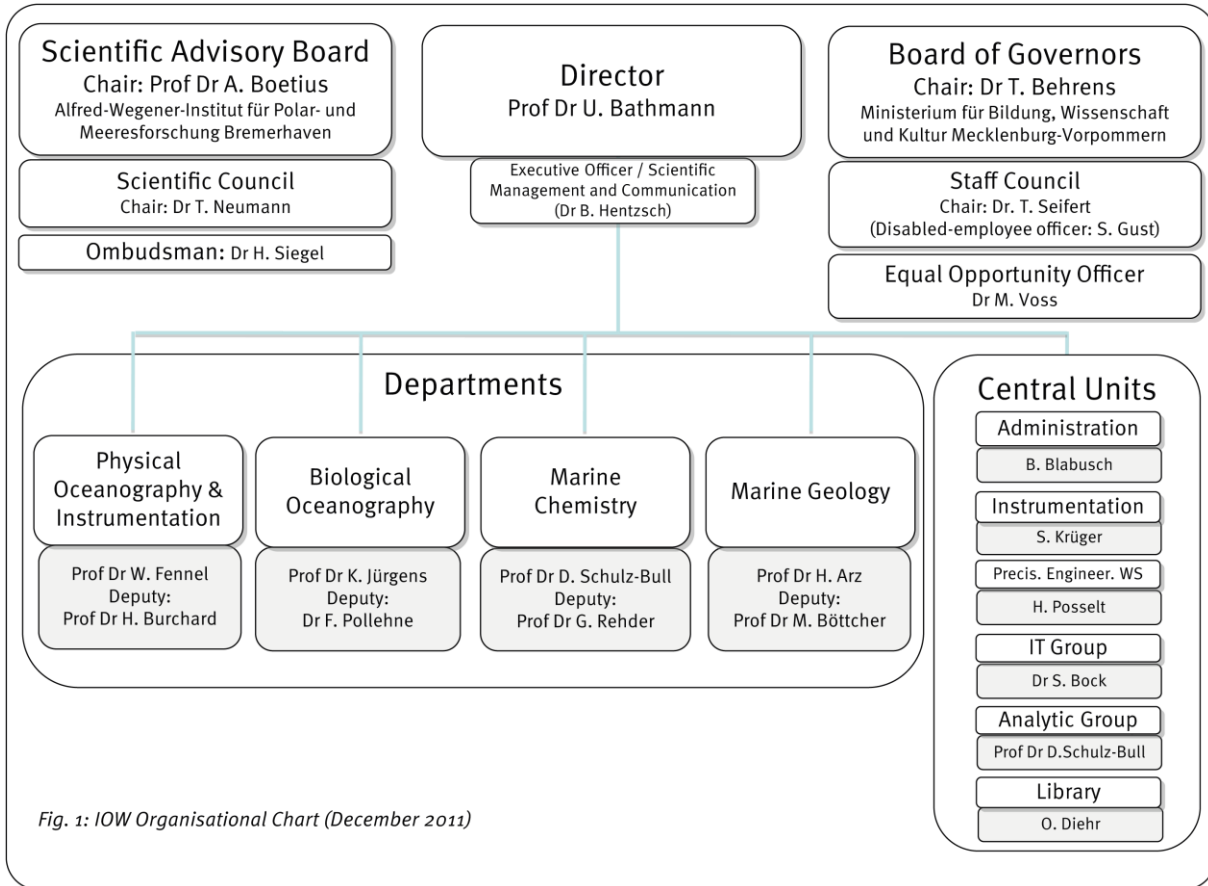
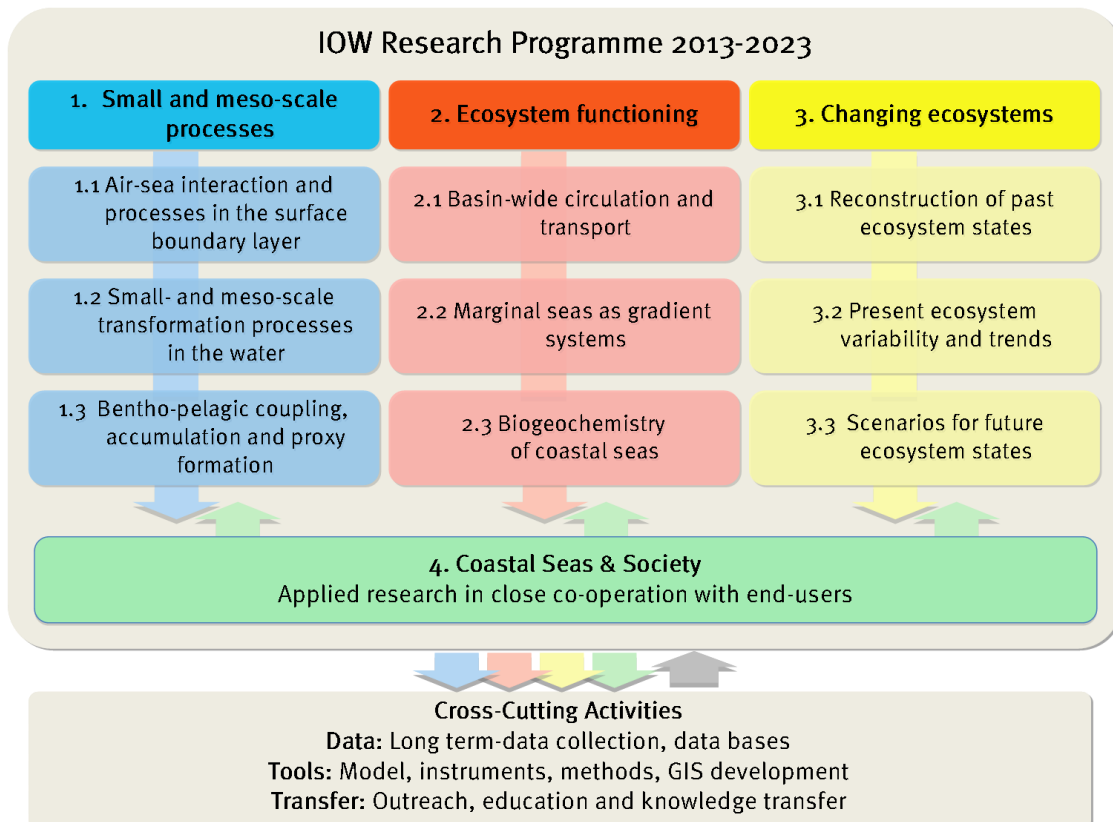
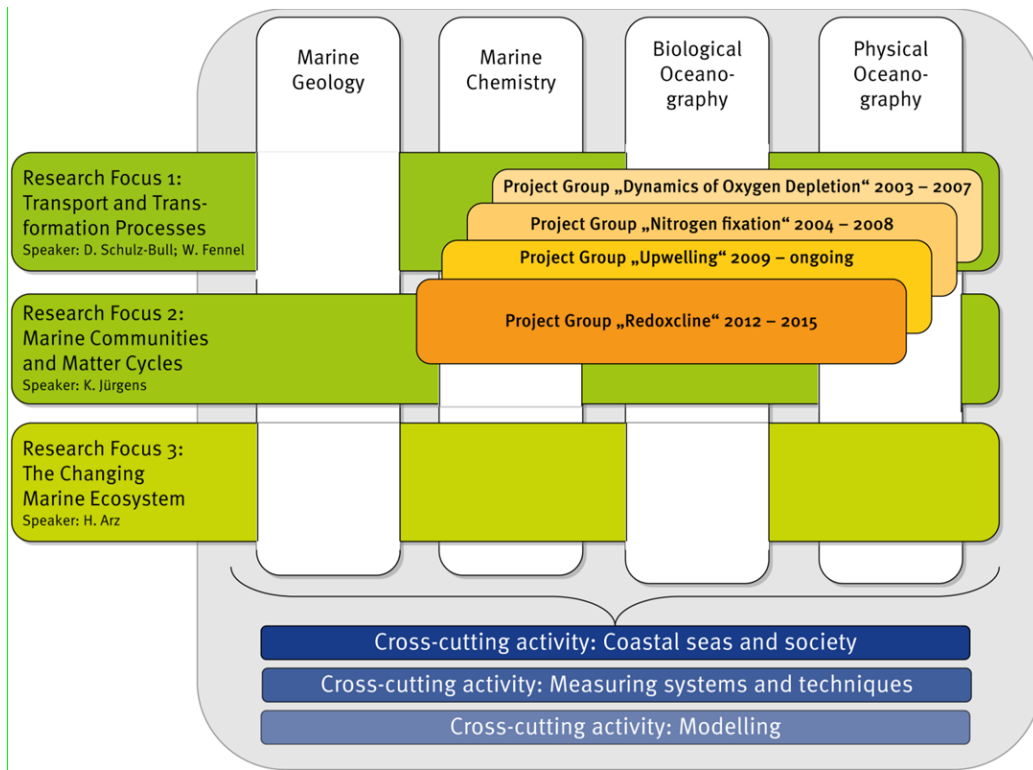


Fig. 1: IOW Organisational Chart (December 2011)

b) Present and forthcoming matrix structures of the research programme

Matrix Structure and Actual Project Groups of the IOW Research Programme (2002–2012)



Appendix 2

Publications and Patents

	Period		
	2009	2010	2011
Total number of publications	128	137	156*
Monographs	5	7	3
Individual contributions to edited volumes	12	9	31*
Articles in peer-reviewed journals	87	98	100*
Articles in other journals	14	11	13*
Working and discussion papers	7	8	7
Editorship of edited volumes	3	4	2
Number of publications per full-time equivalent (FTE) in 'research and scientific services' (not including doctoral candidates)	1.95	1.93	2.35

* including "online-first" publications

Industrial property rights (2009–2011)	Granted	Registered
Patents	0	0
Other industrial property rights	0	0
Exploitation rights/licences (number)	0	

Appendix 3

Revenue		2009			2010			2011 ¹⁾		
		T€	% ²⁾	% ³⁾	T€	% ²⁾	% ³⁾	T€	% ²⁾	% ³⁾
Total Revenue (amount I., II. and III.; excluding DFG fee)		23.221,2			24.889,3			31.531,2		
I.	Revenue (amount I.1., I.2. and I.3)	19.224,8	100,0		23.043,2	100,0		26.680,1	100,0	
1.	<u>Institutional funding (excluding construction operations and acquisition of property)</u>	11.991,9	62,4		11.065,3	48,0		16.644,2	62,4	
1.1	Institutional funding (excluding construction operations and acquisition of property) by the federal government and states according to AV-WGL	11.087,4			10.093,2			16.290,9		
1.1.1	of that: received on the basis of the Leibniz competitive scheme (SAW Scheme) ⁴⁾	174,8			169,6			29,0		
1.2	Institutional funding (excluding construction operations and acquisition of property), provided that it is not according to AV-WGL	904,5			972,1			353,3		
2.	<u>Revenue from project funding grants</u>	5.815,3	30,2	100,0	9.665,7	41,9	100,0	9.233,9	34,6	100,0
2.1	DFG	860,9		14,8	675,8		7,0	706,9		7,7
2.2	Leibniz Association (competitive scheme) ⁴⁾	0,0		0,0	0,0		0,0	276,2		3,0
2.3	Federal government, <i>Länder</i>	2.171,5		37,3	6.230,3		64,5	5.021,5		54,4
2.4	EU	213,1		3,7	207,3		2,1	630,0		6,8
2.5	Economy (further breakdown according to origin of source, if applicable)	15,0		0,2	0,0		0,0	0,0		0,0
2.6	Foundations (further breakdown according to origin of source, if applicable)	9,9		0,2	19,2		0,2	0,0		0,0
2.7	Other sponsors (thereof about 96,5% from Federal Maritime and Hydrographic Agency BSH for the monitoring programme)	2.544,9		43,8	2.533,1		26,2	2.599,3		28,1
3.	<u>Revenue from commissioned work (Fehmarn Belt project)</u>	1.417,6	7,4		2.312,2	10,1		802,0	3,0	
II. ⁵⁾	Miscellaneous revenue (e.g. reserve fund withdrawal, to a minor extent membership fees, donations, rent)	3.896,4			1.846,1			4.851,1		
III.	Revenue for construction operations (institutional funding by federal government and states, EU structure funds, etc.)	100,0			0,0			0,0		
Expenditures		T€			T€			T€		
Expenditures (excluding DFG fee)		22.944,0			24.551,7			31.278,9		
1.	Personnel	8.518,0			10.202,9			10.659,4		
2.	Material resources	5.153,3			5.002,9			5.425,4		
3.	Equipment investments and acquisitions	1.659,2			4.492,5			10.059,9		
4.	Construction operations, acquisition of property	689,1			161,3			0,0		
5.	"Reserves" (e.g. cash assets, expense carryovers)	6.924,4			4.692,1			5.134,2		
DFG fees (to the extent that they were paid for the institute – 2.5% of the revenue from institutional funding)		277,2			337,6			252,3		

¹ Preliminary data: yes

² Numerals I.1, I.2, and I.3 equate a total of 100 %. Thus, the percentage relationship between "institutional funding (excluding construction operations and acquisition of property)", "revenue from contributions for project funding", and "revenue from services" is asked for.

³ Numerals I.2.1 to I.2.7 amount to 100 %. Thus, the percentage relationship between the various origins of sources pertaining to "revenue from contributions for project funding" is asked for.

⁴ Leibniz Association's competitive scheme: resources from this process were awarded until December 31, 2010 within the scope of institutional funding. Since January 1, 2011, resources have been awarded by the Leibniz Association as contributions to project funding.

⁵ Fluctuations result from annual differences in the administration of IOW reserve funds at our account with the state of Mecklenburg-Vorpommern during the interim phase of our changing legal status.

Appendix 4

Staff Financing

Actual numbers in full-time equivalents and number of employees

Basic financing and third-party funding (as of: 31.12.2011)

	FULL-TIME EQUIVALENTS			PERSONS
	Total	Percentage of Third-Party Funding		Total
	Number	Number	Percent	Number
Research and Scientific Services	86.5	50.75	58,67	106
Research	80.5	44.75	55.6	101
Professors/directors (C4, W3)	3.35	0	0	4
Professors/directors (C3, W2, A16)	3.40	0	0	4
Academic staff with leadership functions	0.7	0	0	1 ¹
Acad. staff without leadership functions (A13, A14, E13, E14)	53.05	26.75	50.42	58 ²
PhD students (A13, E13, E13/2)	20	18	90	34
Scientific Services	6	6	100	5
Professors/directors (C4, W3)	0.20	0,20	100	0 ³
Acad. staff with leadership functions (E14, E15)	0.30	0,30	100	0 ³
Acad. staff without leadership functions (E13, E14)	5.50	5,50	100	5 ⁴
Service Areas	71.29	31.825	44.64	79
Scientific management/ public relation (acad. staff, E13, E15)	3.30	1.80	54.55	5
Instrumentation (application, develop., acad. staff, E 13, E 14)	4	2.50	62.5	4
Laboratory (E9 to E12, upper-mid-level service)	11.25	4.15	36.89	13
Laboratory (E5 to E8, mid-level service)	17.49	11.975	68.47	20
Workshops (E5 to E8, mid-level service)	2	0	0	2
Workshops (E9 to E12, upper-mid-level service)	1	0	0	1
Library (E9 to E12, upper-mid-level service)	1	0	0	1
Library (E5 to E8, mid-level service)	0.5	0	0	1
Information Technology - IT (E13 to E15, high-level service)	3	0.25	8.33	4 ⁵
Information Technology - IT (E9 to E12, upper-mid-level service)	2.75	1.25	45.45	3
Technology/equipment (large machines, service) (E9 to E12, upper-mid-level service)	17	6,9	40.59	17
Technology/equipment (large machines, service) (E5 to E8, mid-level service)	8	3	37.5	8
Administration	19.08	1	5.24	21
Administration management	1	0	0	1
Internal admin. (budget, personnel) (E9 to E12)	3	0	0	4 ⁵
Internal admin. (budget, personnel, office assistants in the departments) (E5 to E8 mid-level service)	13.08	1	7.65	14
Facility services	2	0	0	2
Student assistants	11	7.4	67.30	23
Research assistants	11	6.1	55.40	13
Apprentices	1	0	0	1
Scholarship holders at the institute	7	6	85.71	7
PhD students	5	4	80	5
Senior scientists	2	2	100	2

¹ This scientist is also engaged to a minor extent in scientific services; 15% of the work load of an IOW professor is devoted to teaching and is covered by the university.

² A total of 63 scientists work in this category, 45 of them full time, 13 with more than 50% of their capacity. 5 scientists, however, work mainly in scientific services and thus are listed there.

³ Scientists contribute with minor work load to this category.

⁴ A total of 16 scientists work in this category, 5 of them with more than 50% of their capacity. 11 scientists, however, work mainly in research and thus are listed there.

⁵ We filled one position some months before the actual retirement date of the precursor.

Appendix 5

Temporary Employment Contracts and Proportion of Women on Academic Staff¹

Actual number of employees; basic financing and third-party funding (as of 31.12.2011)

	Total staff members	on temporary contracts			Total staff members	proportion of women			Total of female employees	on temporary contracts	
	Number (100%)	Number	Percentage		Number (100%)	Number	Percentage		Number (100%)	Number	Percentage
Research and scientific services	106	71	67		106	41	39		41	37	90
Professors/directors (C4, W3 or equivalent)	4	0	0		4	0	0		0		
Professors/directors (C3, W2, A16 or equivalent)	4	0	0		4	0	0		0		
Academic staff in executive positions (E14, E15 or equivalent)	1	0	0		1	0	0		0		
Academic staff in non-executive positions (A13, A14, E13, E14 or equivalent)	63	37	59		63	23	37		23	19	83
Doctoral candidates (A13, E13, E13/2 or equivalent)	34	34	100		34	18	53		18	18	100
Scholarship recipients at the institution					7	5	71				
Doctoral candidates					5	4	80				
Post-doctoral candidates					0						
Senior scientists					2	1	50				

¹ Employment acc. to BAT, TVöD or classification according to other pay and wage tariff schemes (e. g. for medical staff) for persons who are financed from institutional resources (incl. vocational trainees and visiting scientists, provided that they are paid from basic institutional funding or from third-party funding, etc., but not incl. internships, diploma students, ancillary staff, scientists without payment, PhD students without payment, and persons under other contracts for work and services). In the case of joint appointments: persons whose salaries are reimbursed proportionately by the institute.

Annex B: Evaluation Report

Leibniz Institute for Baltic Sea Research *Leibniz-Institut für Ostseeforschung Warnemünde* (IOW)

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Appendix:

Members of review board and guests; representatives of collaborative partners

1. Summary and main recommendations

The Leibniz Institute for Baltic Sea Research Warnemünde (IOW) conducts research on the Baltic Sea as a unique natural area and model marine ecosystem. The aim is to elucidate ecosystem changes and the processes driving them. It differentiates between anthropogenically triggered and natural drivers. On the basis of scientific results and insights, future scenarios are developed and appropriate measures for conserving the ecological and economic capabilities of marine ecosystems are recommended. IOW also conducts regular observations of the Baltic Sea and relevant monitoring programmes on behalf of the Federal Maritime and Hydrographic Agency (Bundesamt für Seeschifffahrt und Hydrographie, BSH) in accordance with the Federal Republic's obligations in the framework of the Helsinki Convention. These scientific services and advisory activities are not only highly compatible with the research goals; they are also of considerable national importance. In general, IOW pursues its goals and carries out its tasks very successfully.

IOW's research section has a matrix structure combining four disciplinary departments (physical oceanography, marine geology, marine chemistry and biological oceanography) with three, and in the future four, thematically organised research foci (see Chapter 3). This interdisciplinary approach is very successful and, by comparison with the last evaluation, has led to much better networking between departments. The performance of the existing research foci is considered very good in two cases and good in the third one. Publication, outreach, educational and collaborative research activities have increased considerably, as has the volume of external, third-party funding.

In the last few years, a significant change has occurred at the leadership level, notably the arrival of a new director and a new head of administration in 2011. These changes have been well managed and they have helped formulate and solidify plans for the new research programme (2013-2023) as well as introduce the necessary measures for implementing these plans. Certain features of the new research programme were apparent at the time of the evaluation visit.

One important new direction is the proposed development of a fourth research focus on "Coastal Seas and Society". It is designed to strengthen the interfaces between politics, business and other non-scientific stakeholders. These plans are in line with the emphasis assigned to the transfer of scientific outcomes to society, and they are explicitly approved.

Overall, IOW is in a good position to take on the directions and tasks that have been proposed. It is well networked with other research institutions, particularly in Germany, and also maintains very good relations with political decision-makers, public authorities, associations, stakeholders and businesses.

Particular attention should be paid to the following recommendations in the evaluation report (highlighted in **boldface** in the text):

General concept and profile

1. The Baltic Sea provides IOW with a unique subject and focus for research and a valuable resource within the marine science community with enormous potential to generate basic and applied knowledge. In the future, IOW should exploit this potential more thoroughly and systematically.

Results

2. Since the last evaluation, IOW has produced a number of interesting, broad-ranging research results. The studies on structural and functional connections of the watersheds to the Baltic Sea proper, redoxcline and cyanobacterial blooms, for example, reflect both a high degree of quality and focus on contemporary issues that need to be resolved in order to gain a better understanding of how the Baltic Sea system functions and responds to environmental change. In the future, it is recommended that IOW expand its research scope and goals to couple terrestrial factors more closely, e. g. sediment and nutrient discharge from the catchment areas.
3. Publication activity has increased significantly, both in quantity and quality, since the last evaluation. This positive development should be continued. IOW's efforts to increase the number of high-impact publications are welcomed.
4. With regard to information and technology transfer opportunities, IOW has not yet made full use of its potential. It is recommended that the institute develop a corporate marketing strategy to optimise the exploitation of its transfer opportunities more effectively, both in scientific and, when possible, economic terms.

Strategic work planning for the coming years

5. The review board endorses IOW's intention to maintain the disciplinary expertise of the departments as the solid foundation of research, and it encourages the networking of these strengths in the form of interdisciplinary and multi-institutional collaborations.
6. Physical oceanography and process-level modelling are viewed as two of IOW's notable strengths. In the future, other disciplines should benefit more from these strengths, especially as larger-scale interdisciplinary, cross-boundary, long-term research efforts are undertaken. The institute should also be able to enhance the validity and applications of predictions derived from model simulations, especially as they apply to the effects of climatic and anthropogenically-driven change.
7. The proposed extension of studies by incorporating influences of climate change is in line with current research directions, and it is welcomed. The identification of impact factors and the differentiation between anthropogenically triggered and natural causes and changes poses a particular challenge. In order to be able to respond better to such issues in the future, IOW must improve its expertise in statistical analyses and applications.

Appropriateness of facilities, equipment, and staffing

8. External, third-party fund raising has increased considerably since the last evaluation and has now reached a desirable level. It is expected that this level will be maintained in the future. Efforts should focus on increasing the proportion of competitively raised funding (e. g. DFG and EU) within the third-party funding portfolio.

Future Research Focus

9. Plans to develop the cross-cutting activity "Coastal Seas and Society" into a new, fourth research focus are in line with the growing importance of the field, and they are welcomed. Currently however, there are no economists or sociologists working at the institute. In order to be able to address the proposed spheres of extended activity appropri-

ately, IOW must ensure that expertise at the interface of social, cultural and political science is present at the institute so that the necessary additional expertise can be incorporated through collaborations. In this context, the institute should make use of the Leibniz Association's expertise in these disciplinary areas. It is recommended that IOW define the goals and milestones for developing the new research focus clearly and that a road-map and timetable be created to help reach these goals and evaluate the progress.

Collaboration and networking

10. IOW should intensify its collaborative networking in the Baltic Sea region, particularly with Scandinavian and Finnish partners.

Promotion of gender equality

11. Women are significantly under-represented at IOW's leadership level. The institute is strongly encouraged to make great efforts to increase the proportion of women in leadership positions. It is acknowledged that IOW has taken first steps towards achieving this goal.

Promotion of junior researchers

12. It is welcomed that besides handing in a classical dissertation (monograph or comparable sizeable document), cumulative theses, comprised of a set of manuscripts, are an alternative. However, against the backdrop of a proposed three-year doctoral period, the current requirement for cumulative theses (three papers must be completed for a doctorate to be awarded, and two of them must have been published before the dissertation is submitted) is not realistic. The institute is recommended to appeal to the responsible universities to develop more flexible regulations. Efforts should also be made to ensure that the regulations on additional qualifying courses should be the same for all doctoral candidates at IOW.
13. It is recommended that IOW enhance active career-planning support for postdocs and to enable them to build up a professional network, particularly by participating in pertinent conferences and workshops. The junior research group strategy that has been introduced for promoting postdocs is welcomed and should be extended further.

2. General concept and profile

Employing an interdisciplinary approach, IOW conducts research on the Baltic Sea as a unique natural area and model marine ecosystem. It very successfully integrates new research directions and technical refinements/applications in the basic marine research disciplines – physical oceanography, marine geology, marine chemistry and biological oceanography. By combining empirical observations, experiments and modelling, changes in the ecosystems and the processes underlying them are elucidated. Particular emphasis is placed on identifying and distinguishing anthropogenically triggered and naturally-derived drivers of change. Furthermore, on this scientifically sound basis, models for predicting possible future ecosystem states are developed, and appropriate measures for conserving the ecological and economic capabilities of marine ecosystems are recommended.

IOW conducts research and monitoring programmes in the Baltic on behalf of the Federal Maritime and Hydrographic Agency (BSH) in accordance with the Federal Republic's obligations in

the framework of the Helsinki Convention. The data collected provide an extremely valuable basis for research at the institute and are used both for recording long-term trends and for modelling. In addition, IOW also develops and modifies measuring instruments for its own use.

IOW's research section comprises four departments, each of which bundles methodological expertise in one of the four marine science disciplines. The ten-year research plan, which ended in 2012, consisted of three research foci complemented by three cross-cutting activities (see Chapter 3). In these thematic units, the departments' technical expertise was combined and adapted to the relevant research issues. This matrix structure has proven to be an asset and has led to improved networking between departments.

The Baltic Sea provides IOW with a unique subject and focus for research and a valuable resource within the marine science community with enormous potential to generate basic and applied knowledge. In the future, IOW should exploit this potential more thoroughly and systematically. The institute should aim to investigate the Baltic Sea system with its unique, yet broadly applicable features even more comprehensively. In the medium term, additional relevant questions should be examined and translated into research projects. In the future, coastal and catchment areas should be included in the scope of research activities. Topics like the change in salinity gradients, the food web, sediment discharge and land-sea interaction as well as socio-economic issues should play a more important role. In the light of this recommendation, the proposed extension of the existing cross-cutting activity, "Coastal Seas and Society", into a research focus (see below) is endorsed.

Clearly, the characteristics and processes that are of particular relevance to the Baltic Sea are also of broad comparative scientific interest to international oceanographic and marine science communities. In many respects, the Baltic presents itself as a model marine ecosystem experiencing anthropogenic and climatically driven change. Hence the comparative and complementary studies IOW conducts in other marine ecosystems are, in principle, meaningful and scientifically productive.

Development of the institution since the last evaluation

Since the last evaluation, IOW has grown significantly in both its productivity and scope. Constructive discussions within the institute and with the Scientific Advisory Board have generated a number of new ideas and innovative projects in fields like microbial and molecular ecology, organic trace gases, biogeochemical processes at boundary layers and palaeo-oceanographic reconstruction. Innovative approaches have also been implemented through project groups: in 2009, the "Upwelling Systems" group was established; in 2012, the "Redoxcline" group. This has made it possible to extend the existing research programme and the breadth of thematic areas studied.

Results

Since the last evaluation, IOW has produced a number of interesting, broad-ranging research results. The studies on structural and functional connections of the watersheds to the Baltic Sea proper, redoxcline and cyanobacterial blooms, for example, reflect both a high degree of quality and focus on contemporary issues that need to be resolved in order to gain a better understanding of how the Baltic Sea system functions and responds to environmental change. In the future, it is recommended that IOW expand its research

scope and goals to couple terrestrial factors more closely, e. g. sediment and nutrient discharge from the catchment areas.

Publication activity has increased significantly, both in quantity and quality, since the last evaluation. This positive development should be continued. IOW's efforts to increase the number of high-impact publications are welcomed.

IOW conducts important scientific services and consultancy activities. The monitoring programme in the Baltic Sea and numerous services for environmental authorities and associations are of considerable national and international importance as well as being highly compatible with the goals and contents of the research programme. Public outreach is also increasing in a positive and productive manner: the institute's activities address various target groups from school students via interested laypersons and journalists to companies, ministries and public authorities.

With regard to information and technology transfer opportunities, IOW has not yet made full use of its great potential. Models like the General Ocean Turbulence Model (GOTM) that have been developed at IOW, for example, are made available to other researchers and institutes without sufficiently laying claim to the authorship. Excellent work is conducted at the institute in the development of scientific instruments and especially built or customised equipment. These results are of interest to domestic and international clientele. The high-value data sets that have been obtained as a result of deployment/application of this technology are also one of IOW's particular assets. **It is recommended that the institute develop a corporate marketing strategy to optimise the exploitation of its transfer opportunities more effectively, both in scientific and, when possible, economic terms.**

Strategic planning for future years

IOW plans to re-structure on the basis of the new research programme that is being implemented as of 2013, certain features of which were visible at the evaluation visit. The new research foci (RF) are supposed to be organised to a greater extent along various spatial scales. Parts of RF 1 and RF 2 will be absorbed in the new RF 1 and RF 2, "Small- and Meso-Scale Processes" and "Ecosystem Functioning". The new RF 3, "System Changes", will extensively continue the projects currently conducted in RF 3, "Changing Marine Ecosystems: External Forcing and Internal Change".

The review board endorses IOW's intention to maintain the disciplinary expertise of the departments as the solid foundation of research, and it encourages the networking of these strengths in the form of interdisciplinary and multi-institutional collaborations.

Physical oceanography and process-level modelling are viewed as two of IOW's notable strengths. In the future, other disciplines should benefit more from these strengths, especially as larger-scale interdisciplinary, cross-boundary, long-term research efforts are undertaken. The institute should also be able to enhance the validity and applications of predictions derived from model simulations, especially as they apply to the effects of climatic and anthropogenically-driven change.

The proposed extension of studies by incorporating influences of climate change is in line with current research desiderata, and it is welcomed. The identification of impact factors and the differentiation between anthropogenically triggered and natural causes and

changes poses a particular challenge. In order to be able to respond better to such issues in the future, IOW must improve its expertise in statistical analyses and applications.

The cross-cutting activity, “Coastal Seas and Society”, is to be turned into a fourth, fully-fledged research focus of the same name. The objective is to strengthen the interfaces with policy makers, business and other non-scientific stakeholders in order to be able to address current research issues ensuing from political or social demands at short notice and to provide stakeholders with tailored, forward-looking, research-based insights. These plans (see Chapter 3) are endorsed.

Appropriateness of facilities, equipment, and staffing

Since the last evaluation, IOW’s facilities have been vastly improved. As of 2007, the institute has had the use of an extension with approximately 1,000 square metres of additional laboratory space.

External, third-party fund raising has increased considerably since the last evaluation and has now reached a desirable level. It is expected that this level will be maintained in the future. Efforts should focus on increasing the proportion of competitively raised funding (e. g. DFG and EU) within the third-party funding portfolio.

It is pleasing to note that an appropriate successor, the ELISABETH MANN BORGESE, has replaced the decommissioned research vessel, PROFESSOR ALBRECHT PENCK. The “Villa”, one of IOW’s older buildings containing offices and seminar rooms, is in urgent need of major renovation, not least for ensuring safe conditions (fire safety, roof, electrics). It is welcomed that Mecklenburg-Vorpommern and the Federation intend to initiate the necessary renovations without delay.

3. Subdivisions of IOW

Research Focus 1: “Transport and Transformation Processes in the Sea”

The main objectives of this research focus are to quantify physical processes and biogeochemical transformations that play a role in the formation and sustenance of environmental gradients as well as to analyse the dynamics and consequences of mixing processes in the Baltic Sea. For this purpose, physical, chemical, biological and geological processes are examined, in some cases in great detail and depth. At the same time, in some projects various disciplines have been merged, with beneficial results. Knowledge on the physical state of the Baltic and the relevant transport mechanisms have been generated in such a way as to benefit other disciplines and extend, for example, knowledge about key biogeochemical processes (nutrient and carbon cycling). Yet more focussed merging of expertise from the various disciplines in this research focus could contribute to driving the research field in other areas, too, and generating new research questions.

One outstanding piece of work in this research focus was the development of a new international standard for the thermodynamics of seawater (TEOS-10). It describes the characteristics of seawater and sea ice and was endorsed by the Intergovernmental Oceanographic Commission in 2009, thus officially replacing the previous EOS-80 standard.

The project “Understanding small-scale processes and mixing in the Baltic Sea” focuses on examining mixing processes in a dynamic marine system. The aim is to improve existing and develop new simulation models, e. g. of rotating bottom gravity currents under frictional control or of

internal-wave mixing in deeper water layers, and thus acquire a deeper understanding of salt budgets or the distribution and variability of oxygen and carbon.

The project “Biogeochemical processes in upwelling-driven ecosystems” successfully integrates different disciplines, especially biological and physical oceanography. The objective is to characterise and simulate ecosystem responses to shifting physical impacts, with a focus on upwelling regions. It is sensible to employ a research approach that investigates not only the relevant areas in the Baltic but also oceanic regions that exhibit similar characteristics.

The project “Processes at the interface ocean-atmosphere” examines, amongst other things, the impact of external factors like the exchange of halogenated volatiles or the deposition of Sahara dust on the upper boundary layers. In this context, biological, chemical and physical topics are logically and successfully merged.

The project “Benthic-pelagic coupling in coastal seas and estuaries” focuses on themes relating to benthic-pelagic particle transfer, particularly the mechanisms underlying elementary exchange across the sediment-water interface and biogeochemical transformation processes. The impact of subsurface groundwater outflow in coastal areas is investigated with the aim of improving sediment transport modelling. These questions are highly relevant and will continue to play an important role in the future.

The project “CO₂ and CH₄ in the Baltic Sea: control by carbon transport and transformation” successfully examines the relevant biogeochemical carbon cycle processes in the Baltic. The objective is to elucidate the spatial and temporal distribution of climate-impacting greenhouse gases, especially carbon dioxide and methane.

Since the last evaluation, publication performance has been boosted and has now reached a very good level. This positive development should be continued. Collaborations with other research groups in the Baltic area, which have been mutually productive, should be intensified, and other international contacts should be developed. In summary, Research Focus 1 is rated as very good.

Research Focus 2: “Marine Communities and Matter Cycles”

In this research focus, significant progress has been made in linking biodiversity (especially amongst microbial and invertebrate taxa) to key processes determining biogeochemical cycling, trophic state and water quality of the Baltic Sea ecosystem.

Biological and geochemical research activities have been very successfully integrated to better understand processes at the redoxcline, for example, and new, meaningful biomarkers have been developed. These biomarkers should now be traced to the sediment to obtain palaeorecords. In order to uncover key microbial players, the proposed “omics” approach is in principle correct and worth supporting. However, to ensure that it can be followed up successfully, the necessary expertise in bioinformatics must be permanently available at the institute or guaranteed by appropriately qualified collaborations.

The projects addressing phosphorus cycling which are carried out in cooperation with the University of Rostock are novel and promising. IOW’s plans to set up a Science Campus on phosphorus – with the aim of closing the phosphorus budget and thus helping alleviate the impending phosphorus shortage in the future – are convincing, and they are endorsed.

The work thus far conducted has spawned a number of additional research questions on relevant themes such as dissolved oxygen and redox dynamics (i. e. on the redoxcline), material cy-

cling in benthic ecosystems, cyanobacterial bloom dynamics and their environmental control, the role of nitrogen fixation and the impact of ocean acidification and climate change on biodiversity and key nutrient cycles.

Overall, future research work planning is convincing. Some new tools are available which open up opportunities to extend research capacity and the thematic breadth of this research focus. NanoSIMS (a high-resolution secondary ion mass spectrometer), for example, will facilitate molecular characterisation of microorganisms that play an important role in carbon and nutrient cycling and production processes.

In general, the existing expertise in physical dynamics should be more systematically integrated in this research focus. For example, the influence of physical transport and exchange processes, such as at land-water and air-water interfaces, on the distribution and activity of nitrogen-fixing cyanobacteria, or generally on matter discharge, cycles and budgets, could be elucidated more precisely. The work on the impact of salt intrusions and salt balances on the distribution and activity of key biological players would also benefit from greater input of physical expertise, as would the very good projects on the response of cyanobacteria and other microbes to ocean acidification and warming.

There is a good chance that by applying the interdisciplinary, physical-chemical-biological approach to the analysis of ecosystem dynamics, combined with the relevant modelling techniques, it will be possible to carve out a meaningful link between the ecosystem's biotic structure and its function. This synthesis will lead to a more direct and quantitative understanding of physical vs. chemical (i. e. nutrient) control of primary production, algal bloom, hypoxia, and related water quality conditions in the Baltic Sea. The resultant more complete understanding of the system will be particularly relevant in view of the influence of climate change that will impact the Baltic in the future.

Altogether, very good publications have been produced. By comparison with the last evaluation, performance has been enhanced and, if the interdisciplinary approach is employed even more consistently, it should be possible to continue this trend. In summary, this research focus is rated as very good.

Research Focus 3: "Changing Marine Ecosystems: External Forcing and Internal Change"

Research in this research focus seeks to detect and explain the changes in marine ecosystems, particularly in the Baltic. For this purpose, expertise in marine sedimentology, ecology and geochemistry have been bundled successfully. Particular mention should be made of the very successful use of multi-proxy studies to address palaeoclimate questions on high-resolution sedimentary records in the Baltic.

Case studies using multi-proxy approaches have led to a greater understanding of the relationship between various external factors (such as influx of oxygen-rich North Sea water into the Baltic or temperature fluctuations) and the concomitant changes in biological activity caused by increasing cyanobacteria growth. It has also been possible to demonstrate how such processes are reflected in geochemical events such as manganese carbonate deposits.

Very good progress has been made in palaeoclimate changes and the related changes in the sedimentary regime and ecological conditions in the Baltic. The studies elucidating such regimes and conditions on a more recent time scale, by contrast, should be developed further. For example, regional differences and seasonal fluctuations should be investigated in more detail, examin-

ing how altered physical-oceanographic conditions in different parts of the Baltic affect sediment dynamics. The efforts to develop new geochemical, biological and sedimentological proxies, to calibrate them using large data sets and apply them to specific parts of both the past and current Baltic ecosystems are an important approach to this and should be pursued further.

It is welcomed that a start has been made on the systematic evaluation of existing long-term data sets. This has already generated a number of important insights. These analyses should be intensified and linked even more closely with (particularly physical) process studies.

Many projects in this research focus would benefit from more intensive and systematic involvement of physical-oceanographic expertise. This would, for example, facilitate the implementation of the palaeo-current estimation proxy “sortable silt” and open up better opportunities for gaining new insights, not least into changes in much earlier periods, using the instrumentally recorded data sets (current velocities, nutrient contents etc.).

IOW’s considerable expertise in modelling has been convincingly integrated into this research focus. However, so far, the focus has been on physical processes. It is recommended to extend the models and reduce the gap currently existing between physical process models and large-scale system models by integrating sedimentological, geochemical and biological components.

Altogether, studies in this research focus need to be embedded more in a joint strategic framework. On the basis of the existing methodological and technical expertise, the prospects are good for driving the research field as a whole by achieving a greater synthesis of the various research approaches and integrating the disciplines. The publication record is appropriate, but the potential of the research focus is so great that, in the future, an improvement in performance is expected. In summary, this research focus is rated as good.

Future Research Focus 4: “Coastal Seas and Society”

In this former cross-cutting activity, which is now being developed into a new research focus, applied research is conducted in close consultation with various stakeholders such as political decision-makers, public administrations, associations and businesses. This intensive exchange is very successful and makes it possible to build an important bridge between science and society. It facilitates formulating precise questions with relevance to the Baltic Sea on the basis of both scientific knowledge and social demands and finding scientifically supported answers to such questions.

Overall, the projects conducted and the publications and reports they have generated are impressive. The complex relationships and effects of measures like the construction of wind parks or agricultural production, for example, have been analysed and recommendations for various interest groups have been deduced from the outcomes.

Plans to develop this cross-cutting activity into a new, fourth research focus are in line with the growing importance of the field, and they are welcomed. Currently however, there are no economists or sociologists working at the institute. In order to be able to address the proposed spheres of extended activity appropriately, IOW must ensure that expertise at the interface of social, cultural and political science is present at the institute so that the necessary additional expertise can be incorporated through collaborations. In this context, the institute should make use of the Leibniz Association’s expertise in these disciplinary areas. It is recommended that IOW define the goals and milestones for devel-

oping the new research focus clearly and that a roadmap and timetable be created to help reach these goals and evaluate the progress.

IOW should also consider that the new research focus will only be successful in the long run if it is founded on very good, quality-assured research: study design and results must be verified scientifically. The primary goal of generating new knowledge should initially be to acquire visibility in the specialist community through publication in appropriate journals. Service and advisory activities building on this should only be developed as a second step. This procedure also means that the choice of research activities cannot primarily and exclusively be determined by externally-defined requirements. Rather, relevant questions should be identified and addressed in cooperation with non-scientific stakeholders under consideration of scientific perspectives. Regular, intensive communication should be fostered with these stakeholders.

With its existing good contacts to administrations, associations, interest groups and businesses, IOW is in a very good position to successfully implement the extension of its new research focus. During this development, IOW should also consider systematically which methods would be conducive to monitoring the quality and impact of advisory activities.

4. Collaboration and networking

Collaboration with universities

Academic cooperation with the University of Rostock functions very well. This is reflected, among other things, in seven jointly-appointed professorships and numerous IOW staff involved in teaching at the University of Rostock. It was gratifying to see that it was possible to establish the *International Leibniz Graduate School for Gravity Waves and Turbulence in the Atmosphere and Ocean* together with the University of Rostock in 2008. Currently, six doctoral candidates receive high calibre training and supervision there.

There are also two joint professorships with the University of Greifswald. Exchange in terms of teaching is good; efforts should be made, however, to intensify cooperation in research. IOW's request to the University of Greifswald to establish clear regulations for joint doctoral training, which should apply to all doctoral candidates supervised at IOW irrespective of discipline, is emphatically supported. In the future, the course load should be equal for all doctoral candidates at IOW.

IOW should initiate collaborations with additional universities at home and abroad involved in conducting Baltic Sea research.

Collaboration with other institutions in Germany and abroad

IOW cooperates very well with other Leibniz institutions. It is active, for instance, in the Leibniz Biodiversity Network. In the *International Leibniz Graduate School for Gravity Waves and Turbulence in the Atmosphere and Ocean*, which was acquired under the Leibniz Competition, it cooperates with the Leibniz Institute of Atmospheric Physics in Kühlungsborn. Proposals to set up a ScienceCampus on phosphorus are convincing, and are explicitly endorsed.

In Germany, IOW plays a central, important role in marine and coastal research. The longstanding cooperation with the Federal Maritime and Hydrographic Agency (Bundesamt für Seeschifffahrt und Hydrographie, BSH, see Chapter 2) is central in this context. Furthermore, the institute is represented on the Board of the German Marine Research Consortium (KDM) and is

also very well connected with other research institutions via other thematically-related research networks, such as the German Climate Consortium.

IOW's international contacts have been extended since the last evaluation. Collaborations have been established with Polish institutions in Sopot and Stettin, for example, and interesting projects are also conducted in Africa and Asia. This is explicitly welcomed.

IOW should intensify its collaborative networking in the Baltic Sea region, particularly with Scandinavian and Finnish partners. Given its expertise, particularly in modelling and physical oceanography, IOW is in a very good position to initiate joint projects in data evaluation or modelling with the aim of generating joint publications. For example, IOW provides a significant proportion of the data for a database that is jointly maintained with the Baltic Nest Institute in Stockholm and other Scandinavian institutes. On the basis of research results, these data make it possible to identify and quantify environmental protection targets and pave the way for achieving them.

The highly successful involvement in European Union research projects to date, like the BONUS Project, is welcomed. In the future, IOW should make efforts to head EU projects more regularly and thus cement its aspirations to adopt a leading role in coastal and marine research in the Baltic Sea Region.

5. Staff development and promotion of junior researchers

Staff development and personnel structure

The staffing and personnel structure of the institute are commensurate with its tasks, and the staff are highly motivated. The new director, who was appointed in October 2011, has noticeably increased the degree of scientific exchange within the institute.

It is greatly welcomed that everyone in a scientific leadership position holds a joint professorship with a university. In the last few years, some positions have been re-filled with very promising incumbents: apart from the professor for Earth System Sciences, who is also the director, the heads of the Geology Department (2010) and Biological Oceanography Department (2012). Appointment procedures for the position that is currently vacant (head of the Physical Oceanography Department) should now be completed as quickly as possible.

Technical staff are very well integrated in scientific projects. The number of technicians is relatively high, in accordance with IOW's mission as defined in its statutes.

Promotion of gender equality

Women are significantly under-represented at IOW's leadership level. The institute is strongly encouraged to make great efforts to increase the proportion of women in leadership positions. It is acknowledged that IOW has taken first steps towards achieving this goal. For example, in 2012, a woman was appointed head of the Biological Oceanography Department. Furthermore, IOW is striving to achieve the *Total E-Quality* certificate. A new appointments scheme has been developed which is geared to the DFG's cascade model. The new scheme also aims to achieve greater transparency and accountability in decision-making. Another meaningful measure was the introduction of an equal rights committee. IOW's equality objectives are supported and should continue to be pursued systematically.

The preconditions for combining work and family at IOW have also improved in the last few years. Financial support for doctoral candidates with children has been increased, and a working space for parents and children has been set up. These measures are expressly welcomed.

Promotion of junior researchers

Training and supervision of doctoral candidates is generally good. Recently, thesis committees were established which have already brought about noticeable improvements. **It is welcomed that besides handing in a classical dissertation (monograph or comparable sizeable document), cumulative theses, comprised of a set of manuscripts, are an alternative. However, against the backdrop of a proposed three-year doctoral period, the current requirement for cumulative theses (three papers must be completed for a doctorate to be awarded, and two of them must have been published before the dissertation is submitted) is not realistic. The institute is recommended to appeal to the responsible universities to develop more flexible regulations. Efforts should also be made to ensure that the regulations on additional qualifying courses should be the same for all doctoral candidates at IOW** (see Chapter 4). International scientific exchange should be promoted by recruiting more doctoral candidates from abroad, particularly from other Baltic Sea states.

The number of postdocs is low, particularly in comparison with the number of doctoral candidates. **It is recommended that IOW enhance active career-planning support for postdocs and to enable them to build up a professional network, particularly by participating in pertinent conferences and workshops. The junior research group strategy that has been introduced for promoting postdocs is welcomed and should be extended further.**

Vocational training for non-academic staff

Non-scientific staff are regularly given the opportunity to take part in continuing education measures or exchanges with other institutions. IOW currently offers three traineeships. The institute is encouraged to undertake further efforts to increase the number of trainees; plans to establish three additional traineeships are endorsed.

6. Quality assurance

Internal quality management

Quality assurance pertaining to IOW's research activities is conducted according to the DFG's principles of good scientific practice. In order to guarantee the high scientific quality of the research programme and projects, proposals are usually discussed by the Scientific Council and the Steering Committee. This procedure has proven worthwhile. It is welcomed that the Analytical Group has adopted a quality management system certified according to ISO.

Furthermore, since the appointment of the current scientific director a number of promising new management tools have been introduced, mainly based on performance incentives. In the context of performance-related funding allocation ("leistungsorientierte Mittelvergabe", LOM), scientists can, for example, be granted additional ship time or funding for auxiliary staff. Non-monetary and monetary incentives (for doctoral candidates) are also offered for publications in high-impact journals. These and other measures generally seem appropriate and expedient.

Cost-performance accounting has been established as an internal control element. Economic planning is based on the programme budget and ensures convincing dovetailing of scientific planning and resource management.

Quality management by the Scientific Advisory Board and Board of Governors

The Scientific Advisory Board monitors IOW's activities intensively and conscientiously. At the annual meetings constructive suggestions for developing the institute are drawn up. The Board of Governors also fulfils its tasks appropriately.

Implementation of recommendations from the last external evaluation

Altogether, the recommendations made by the Senate of the Leibniz Association in October 2006 (in *italics*) have been well implemented. The following individual points should be mentioned:

1. *IOW should strive for greater international visibility of its results.*

IOW has implemented this recommendation; the proportion of publications in international peer-reviewed journals, particularly with a high impact factor, has increased significantly.

2. *Interdisciplinarity should be reflected to a higher degree by joint publications in peer-reviewed journals.*

This recommendation has been implemented. The percentage of joint interdisciplinary articles at IOW has increased.

3. *IOW has impressive modelling competence, which is yet not sufficiently exploited in all working areas.*

IOW has developed its modelling expertise impressively and extended the spectrum of applications. One of its particular strengths is physical process modelling. By extending the models and integrating sedimentological, geochemical and biological components, the gap currently existing between physical process models and large-scale ecosystem models should be reduced.

4. *The number of publications still does not comply with international standards.*

The institute's publication record has improved appreciably.

5. *Greater initiative and innovative spirit as well as a better strategic orientation are needed to reach global leadership.*

IOW has not yet achieved this goal, but the main features of the new research programme point in the right direction.

6. *Knowledge transfer should be strengthened. Results should regularly be presented to potential users and political and societal decision makers.*

In this field IOW has clearly enhanced its performance (see Chapter 2).

7. *The number of doctoral candidates and postdocs should be increased and their supervision intensified. Young scientists should be encouraged to publish their results in international journals before completing their theses. Together with the cooperating universities, a structured graduate programme should be developed.*

This recommendation has been implemented. Cumulative doctorates allow candidates to publish research results earlier. A graduate school has been established with the University of Rostock (see Chapter 4).

8. *Quality management at IOW was not convincing. Greater integration of the Scientific Advisory Board in the regular reports on the institute's performance is recommended. The Board should become more critically involved in the institute and document audit results in greater detail. IOW's directorate shall report to the Board the development of performances in the research units on an annual basis.*
9. *An adequate system of incentives should be developed that will strengthen both the flexibility and the mobility of IOW's employees.*

These recommendations have been implemented (see Chapter 6).

10. *The institute's budget should be increased by an amount of the personnel costs of six positions. IOW is asked to design a development strategy for future research that meets the changes in its financial framework.*

The number of staff working on long-term observations in the Baltic was increased in accordance with the recommendation. Despite IOW's forward-looking, appropriate financial planning, a structural deficit has developed in the core budget due to increased vessel costs.

11. *IOW needs a research vessel for flexible operations 220 days a year. A proper substitute for the research vessel PROF. A. PENCK is mandatory.*

A new research vessel was commissioned in June 2011.

12. *IOW should become legally independent.*

IOW changed its legal status to that of a foundation under public law in March 2010.

Appendix

1. Review board

Chair (Member of the Senate Evaluation Committee)

Ursula **Gaedke** Institute of Biochemistry und Biology, University of Potsdam

Vice Chairman (Member of the Senate Evaluation Committee)

Manfred **Bayer** Experimental Physics 2, Dortmund University

External Experts

Icarus **Allen** Plymouth Marine Laboratory (UK)

Gerald **Ganssen** Department of Earth Sciences, VU University Amsterdam (NL)

Rüdiger **Henrich** Department of Sedimentology – Palaeoceanography, University of Bremen

Andrea **Koschinsky-Fritsche** Jacobs University Bremen

Hans W. **Paerl** Institute of Marine Sciences, University of North Carolina at Chapel Hill (USA)

Detlef **Stammer** University of Hamburg; Zentrum für Marine und Atmosphärische Wissenschaften; Institut für Meereskunde

Hans **von Storch** Institute for Coastal Research, Helmholtz-Zentrum Geesthacht – Zentrum für Material- und Küstenforschung

Angela **Wulff** Department of Biological and Environmental Sciences, University of Gothenburg (S)

An additional reviewer called off at short notice.

Federal Representative

Anke **Aretz** Federal Ministry of Education and Research, Bonn

Representative of the Länder (Member of the Senate Evaluation Committee)

Jörg **Geiger** State Ministry of Science and Art of the Land of Saxony, Dresden

2. Guests

Representative of the responsible Federal Government Department

Christian **Alecke**

Federal Ministry of Education and Research, Bonn

Representative of the responsible Länder Department

Woldemar **Venohr**

Mecklenburg-Western Pomerania's Ministry of Education, Science and Culture, Schwerin

Representative of the Office of the Joint Science Conference (GWK), Bonn

Rebekka **Kötting**

Representative of the Leibniz Association

Klement **Tockner**

Leibniz Institute of Freshwater Ecology and Inland Fisheries, Berlin

Chairman of the Scientific Advisory Board

Antje **Boetius**

Alfred Wegener Institute for Polar and Marine Research, Bremerhaven

3. Representatives of collaborative partners (one-hour interview)

Wolfgang **Schareck**

University of Rostock

Reinhard **Zölitz**

University of Greifswald, Institute for Geography and Geology

Monika **Breuch-Moritz**

Federal Maritime and Hydrographic Agency, Hamburg

Christoph **Humborg**

Baltic Nest Institute Sweden, Stockholm Resilience Centre, Stockholm University (S)

21 May 2013

Annex C: Statement of the Institution on the Evaluation Report

Leibniz Institute for Baltic Sea Research
Leibniz-Institut für Ostseeforschung Warnemünde
(IOW)

We thank the evaluation team for a comprehensive and fair analysis of our performance. We appreciate the recommendations, most of which confirm and strengthen the way we most recently started with the new research programme (2013 – 2023), new supportive actions for young scientists and a newly adopted gender balance plan.

We highly welcome the evaluation team's recommendations to exploit the scientific potential of the Baltic Sea system and share their appreciation of the comparative and special studies in other shelf seas that are indispensable for a lively international scientific exchange.

The recommendation to couple our research with related processes in the catchment area of the Baltic Sea reinforce those components of the new IOW research programme that focus on co-operation with distinguished national and international institutes known for their expertise in these fields. Combining our ecosystem models with related models from the catchment area will be a challenging task for the future but will provide obvious benefits.

We greatly appreciate the inspiring suggestions concerning the marketing potential of our results and products. Regarding the remarks on the Public Domain Open Source model system GOTM, we plan to organise regular GOTM user workshops and tutorials at the IOW. For other community models with substantial IOW involvement (such as ERGOM and GETM) we will follow similar procedures.

The reviewers expressed their appreciation for the work of our physical oceanography and process-level modelling. The proposed closer intertwining of these capacities with other disciplines has already been intensified, resulting in a recent publication in *Nature Climate Change*, and is in line with our plans under the umbrella of the new IOW research programme (2013 – 2023).

The valuable advice to obtain EU third party funding is in full alignment with our strategy of active participation in appropriate funding programmes. We will continue to actively participate in respective calls for proposals within the ERANET programme BONUS, which is the focus of the European financial support of Baltic Sea Research. However, as this is an ERANET initiative, funding is implemented by the member states, i. e. the Federal Ministry of Research and Education, even though the projects are truly European and the evaluation procedure is highly competitive. This was also the case with the previous call within the BONUS programme, in which seven projects with substantial IOW contributions were awarded funding (2009 – 2011).

The evaluation team placed special emphasis on the new Research Focus 4. We completely agree that a liaison officer is important to foster contact with social scientists and economists. For this reason we have employed a geographer with far-reaching and stable contacts to partners including regional ministries, federal authorities, social science and economic research institutions. The respective IOW group created a network especially aimed at reaching out to institutions able to provide us with the missing expertise in the social sciences and economics. We gladly accept the valuable advice of the evaluation experts to strengthen this direction and interface in the coming years.

In general, the recommendations validate our goal of further developing our international contacts and deepening our versatile partnerships with Scandinavian institutions.