

Review of IDL by the Internal Advisory Committee (IAC) Meeting of September 14-15, 2015

IAC Committee Members:

Sierd Cloetingh (Netherlands Research Center for Integrated Solid Earth Science)

Christoph Schär (ETH Zürich, Switzerland)

Montserrat Torne (ICTJA-CSIC, Barcelona, Spain)

Proceedings

The committee received the following documents prior to the evaluation:

- IDL Interim Report for 2015
- IDL Highlights 2015
- List of publications (2013-2015)
- IDL presentation to external review 2014
- FCT Consensus report from external Panel
- Comments on the FCT Consensus

In addition, the IAC received documents related to the EARTHSYSTEMS PhD programme.

The review was conducted together with the EARTHSYSTEMS review.

The review committee attended the presentation by the Director of IDL, who reviewed past performance, current structure and a forward look with options for the future. Subsequently, five presentations were provided by the coordinators of the newly formed research groups. The panel also attended the presentations of the new director of EARTHSYSTEMS on teaching, and oral and poster presentations by PhD students on their projects.

These presentations were followed by an open discussion. The meeting was well attended. In addition to senior staff, many young researchers attended. The committee met informally with individual researchers. During this, the committee explicitly addressed issues related to the synergies between research groups, opportunities for the generation of added value, the optimal use of existing resources, and the need for new initiatives to attract funding.

The committee noted with pleasure that most of its previous recommendations had been partially or fully implemented with the encouragement of IDL's leadership. The committee noticed an overall consensus in the IDL scientific community to strive for further integration in earth system research and its applications for societally relevant issues related to climate change, forecasting of atmospheric extreme events, natural geohazards, as well as scarcity of georesources and energy. All these issues require an integrated approach linking fundamental process understanding to state of the art monitoring, observation systems, field studies and laboratory experiments, as well as numerical and analogue modeling. This also provides an attractive research and training environment for young researchers and students.

The current evaluation centers on the future structure of IDL and the plans offered by the IDL leadership to the committee for a critical assessment of and advise on potential, added value and feasibility. In doing so, the committee has attributed great importance to past and current performance of IDL and its research groups in terms of scientific excellence, societal relevance, and viability. In this context, the committee paid particular attention to the FCT consensus report (14-FCT-317) and the response by the IDL director

Mission and structure of IDL

The scientific mission of IDL is centered on its three thematic lines:

- 1) Climate Change: this research line focuses on Earth-system integrated approach, innovations in data analysis and process studies, integrations of national and regional priorities in the global agenda.
- 2) Solid-Earth Dynamics: This include integration across time and spatial scales, study of the coupled deep Earth and surface processes and their implications for georesources and natural hazards assessment, with the Iberian-Atlantic region as a prime natural laboratory;
- 3) Energy and Earth Resources: This includes resources and technologies in the transition towards a sustainable energy and Earth resource systems.

This mission is timely and particularly relevant for a country with significant natural geohazards, extreme events, water stress, and a great potential for georesources and energy in its territory, both onshore and offshore. All these domains require geoscience expertise on the highest possible levels, also in view of the international research agenda and the priorities formulated in the EU Horizon 2020.

The structure of IDL derives from its mission: Excellent science providing a know-how base for addressing grand societal challenges.

The committee feels that IDL has made progress in consolidating and self-organizing in the aftermath of a major and sometimes stressful restructuring. The presentations provided to the committee were of high to outstanding quality. The PhD and post-doctoral students are well integrated into the overall program.

The director and his management team have fulfilled their positions with great commitment, adequately supported by the high-level administrative capabilities of Mrs. Celia Lee.

The internal organization and structure of IDL is currently being optimized and adjusted, also taking into account the recommendations by the FCT external review and in response to account for new opportunities and challenges. Mobility of researchers is an important factor in this very competitive research domain with strong demands on international level for high-quality expertise. IDL researchers have gained important positions abroad, and a strong need exists to replace them with new talents, filling in the gaps. Crucial in this respect is to build out IDL as a top institute with a creative research environment attractive to future ERC grantees and other recipients of major prestigious external funding schemes, including Marie Curie and similar networks.

To this aim, an open and dynamic structure with ample opportunities for bottom-up initiatives and stimulating integration is a prerequisite. As regards the current structuring into a smaller number of research groups, following the recommendations of

the SAC, the IDL leadership strives for highest quality, critical mass, and compatibility with the overarching research mission of IDL. An optimization of the current IDL structure is now very timely and also urgent in view of new funding opportunities. To be effective at the highest international level, IDL must build on its strengths in a limited number of high-priority areas where it can excel and be of maximum societal benefit.

The committee supports the restructuring of IDL into 5 research groups:

RG1: Atmosphere, Ocean and Climate. This group is composed by members of the former research groups WG1 (Atmosphere-Ocean Processes and Climate Modelling) and WG2 (Climate Change, Variability and the Extremes). This new group has 34 members and has attracted 1615 kEURO of external funding. They currently host 18 PhD students and have published 171 papers in high impact journals for the period 2013-15.

RG2: Coast, Water and Surface Processes. This group, formerly referred to as WG3, consists of 13 members has attracted 320 kEURO and is hosting 20 PhD students. The group has published 57 papers and has a high societal impact.

RG3: Marine Geology and Geophysics. This group has 19 members, has attracted 1149 kEURO external funding and is hosting 11 PhD students. The group, formerly WG4, has published 65 papers and provides an important science base for responding to Portugal's marine strategy in the years to come.

RG4: Continents, Islands and the underlying Mantle. This group is mostly incorporating the former members from the former WG5 (Earthquakes, Volcanism and Lithospheric Processes), WG6 (Sedimentary Basins) and WG7 (Chemical Geodynamics and Multidisciplinary Research on Geological Resources). The group consists of 27 members, has attracted 1953 kEURO external funding, hosts 11 PhD students and has published 136 papers.

RG5: Renewable Energy. This group consists of 7 members, has attracted 1358 kEURO and published 43 papers and is hosting 12 PhD students. RG5, formerly WG8, has joined IDL two years ago. In spite of its relatively modest size, the presence of this group is serving the profile of IDL in both the research lines on Energy and Georesources as well as Climate Change.

Research groups 1 to 4 have all critical mass, and they all have at least 10 PhD students, differences occur in the level of attracted external funding and scientific output. The SAC recommendations at the end of this report contain a number of specific actions to be taken to enhance and optimize the research performance, earning power and further integration within and between the five RGs. In the view of the SAC, the new structure with five RG's contributing to three thematic research lines is robust and resilient, making IDL also internationally competitive in the long term.

The main overarching accomplishments of IDL

The current IDL yielded an output of 472 papers in the period 2013-2015 in ISI-ranked journals. The committee noted that about 50% of the scientific output is published in high-impact international journals. A substantial number (65%) of these publications are with international partners, demonstrating that IDL scientists are viewed by their colleagues as attractive collaborators.

IDL has also shown a strong capability in attracting external funding from different sources, including FCT, EU funding and industry. The total external funding amounts to 6.4M€ in project grants in the period 2013-2015 to which it should be added the 1.5M€ in the Associated Laboratory contracts in the same period.

A particularly important achievement of IDL has been its central role in bringing together scientists from different backgrounds and institutions. In this context, the linkage between FCUL (with primary missions in the areas of research and education) and IPMA (with many responsibilities in the areas of operational monitoring and forecasting) is an asset to mutual benefit of both organizations and vital for the functioning of research efforts and optimal use of research infrastructure in this area. This kind of linkage exists in most European countries and it appears to work particularly well in the current IDL.

The new initiatives for the future IDL are logical next steps in this process towards strengthening the Portuguese know-how base in this domain. It is obvious that Lisbon with its strong concentration of university and non-university research institutes should play a leading role in this process.

Thematic research lines and participating research groups

IDL gathers expertise in a broad range of Earth System science, incorporating Atmospheric, Oceanic, Solid Earth Geophysicists, Geochemists, Geologists, and Physicists.

The IDL organization in research groups builds on established expertise in a number of disciplines and research topics. Synergies between participating groups are crucial for IDL success.

The committee subscribes to the research mission formulated by the IDL leadership to advance earth-process understanding in three thematic research lines, each at the forefront of modern integrated earth-system science.

In each of the three thematic research lines, the committee recognizes adequate critical mass, high level expertise, attractive research opportunities, and funding potential. Each of them offers a platform for the necessary integration of IDL research groups. A special effort should be made to connect advances in individual research groups and the thematic research lines to reinforce the profile and mission of IDL at large.

1) Climate change

In this research line strong expertise exists in the following topics:

- climate change, variability and extremes
- atmosphere, ocean and climate modeling
- coastal processes
- remote sensing

The RG1 group conducts studies about the links between climate variability and atmospheric circulation, analysis of extreme events, ocean modeling using the ROMS model, global climate modeling using the EC-Earth model, as well as regional climate modeling using the WRF model. The group has a high international visibility and the committee identified a number of significant scientific advances made. The committee is

also pleased with the successful integration of oceanographic expertise in this research line.

The research group on coastal processes (RG2) is an important partner in this research line, both in terms of high research quality and added value. This applies in particular to their know-how base in urban hydrogeology, coastal processes in general and sea-level rise, all directly connected to past and present climate change.

We also recommend that the links between RG1 and RG2 in this research line will be further intensified, in order to optimally exploit their great potential and quality.

2) Solid Earth Dynamics

In this research line, strong expertise exists in the following topics:

- marine and continental margin research
- seismology, volcanology and (neo)tectonics
- applied geodesy and geophysics
- geochemistry and geological resources

The committee noticed that the marine and continental margin research community has also very valuable expertise in the domain of sedimentary basin formation and evolution, as well as in analogue modeling of tectonic processes. This group has a strong and successful collaboration with IPMA. The committee is pleased with the successful integration of geophysical and geological aspects including active field studies. The focus on coupled deep-earth and surface processes as well as strong efforts in marine earth sciences provides a very fruitful base from the solid-earth perspective towards an effective interface with research on climate, ocean and atmospheric processes.

The expertise on sedimentary geology including basin stratigraphy and clastic and carbonate sedimentology, backed up by a strong embedding in field studies is a very valuable contribution to the IDL research base in sedimentary basin systems, complementary to the existing expertise on tectonics and crustal-lithosphere aspects of basins residing in the realm of marine and continental margin research. The committee notices potential for strong synergy towards industrial partners.

In this research line there is also considerable expertise in geochemistry, natural resources on land and in the deep sea, with strong efforts in deep-sea resources, hydrothermal fields and environmental geochemistry.

3) Energy and Earth Resources.

The present society is facing a very challenging energy transition in the decades to come. The research portfolio of the existing IDL groups is strong in a number of geoenergy resources, crucial for this transition. These include knowledge on the formation of deep-water basins and continental margins, which are sites of active hydrocarbon exploration. In addition, high-level expertise exists at IDL on renewable energy sources, including geothermal energy, hydroelectric dams and water resources, as well as climatological information on wind power and solar energy.

The research carried out in research lines 1 and 2 with their primary focus on scientific excellence and novel process understanding have direct bearing for building up the scientific knowledge base in the domain of geoenergy and georesources.

Synergy between the three thematic research lines

The IDL leadership should make a special effort to develop strong interfaces between its three thematic research lines.

IDL is probably one of the first organizations of its kind where research efforts connecting natural hazards, climate change and georesources are pursued in an integrated fashion. This is a prerequisite for future policy decisions on cost benefits of different scenarios figuring in the energy and climate transitions facing mankind in the coming decades.

Scientific infrastructure

IDL is hosting a significant research infrastructure, including an advanced computing facility, analytical laboratories for Solid Earth studies, geophysics and geological field equipment, a geomagnetic laboratory, and a number of applied physics laboratories. This infrastructure is in many ways unique in Portugal and of great potential for the Portuguese participation in the European plate observing system (EPOS), selected for the EU-ESFRI road map for large-scale European research infrastructure. With the increasing role of numerical modeling studies, high-performance computing hardware and expertise will increasingly become important. The well-established connection between IDL and IPMA, provides easy access for IDL researchers to cost-intensive equipment, including research vessels and networks of geo-monitoring equipment, as well as access to unique meteorological and climate data sets through IPMA's partner institutions (e.g. ECMWF).

The ongoing reshaping of IDL is accompanied by changes of the IDL coordination system and of its governance. Those changes intend to guarantee a transparent decision system, offering an appropriate and open environment for a large group of researchers in the process of building long-term working relationships, and to enhance the scientific productivity of current and prospective IDL team members, and to attract the best scientists in their fields.

Recommendations

Based on the above assessment, the committee is of the opinion that IDL has a high level of internationally acknowledged expertise and excellence in many key scientific areas relevant to the challenges of the next decades. Significant progress over the last years is well evident, despite the need to integrate additional research groups (CeGUL, CREMINER, and a group on renewable energy). While the integration of these groups has resulted in a heavy workload for the IDL leadership, the committee believes that integrating these groups is of critical importance for the Portuguese research environment.

In addition, IDL has provided leadership in providing education and research opportunities to young PhD and post-doctoral researchers. This contribution is of crucial importance to the Portuguese society in light of the increasing importance of highly qualified individuals in a number of scientific and industrial areas.

The committee recommends:

- 1) The committee supports implementing the new structure with 5 research groups centered on core expertise of IDL. The committee notes that two out of the five research group coordinators are early career scientists. They should be fully backed up by formally nominated senior faculty staff. It is also recommended to secure stability in the leadership of the research groups through permanent positions for these early-career scientists.

- 2) Profiling the research mission around the three thematic research lines of IDL. To this aim, a task force should be set up to shape and implement a robust and convincing strategy and effective collaboration between research groups participating in the respective research lines. Regular meetings between the scientists from different groups participating in these research lines are important for prioritization of common research objectives and identification of key scientific questions and funding opportunities.
- 3) IDL needs a long-term strategy for funding and human resources.
- 4) In view of the ambition of IDL to be a center of excellence, selection of its members should be based on scientific requirements going beyond the minimum requirements set by FCT. It is recommended to bring the number of IDL members more in balance with the scientific productivity. At the same, it is recommended that researchers, who otherwise contribute to the IDL mission, are involved as collaborators.
- 5) Building-up a strategy with other international groups to secure future EU funding, taking the example of the successful efforts made for EPOS (European Plate-Observing System) with full Portuguese participation and listed on the national road map for large-scale scientific infrastructure.
- 6) Fostering a pro-active attitude and bottom-up spirit of the whole IDL community. The SAC also recommends holding an annual meeting and to publish a yearly report centered on the three thematic research lines and the scientific breakthroughs.
- 7) The newly formed groups 3 and 4 need more common coordination in their joint thematic research line. The SAC supports the newly suggested names of the two groups that secure optimal profiling of each of them.
- 8) Group 5 on renewable energy has a great potential to be made more visible in the thematic energy and earth resources research line. The committee notices that research group 5 has already realized an effective link with thematic research line climate change.
- 9) We recommend that research group 2 needs to focus its research portfolio more sharply around their scientific strengths, at the same time the committee recognizes the pro-active role of this research group in addressing research issues of great societal relevance.
- 10) IDL should continue with its efforts to attract a significant number of excellent PhD students and post docs. The committee is confident that EARTHSYSTEMS is an important instrument to secure this goal. Previous PhD students and post docs of IDL have shown to be highly competitive in key international research centers and universities.
- 11) The committee recommends that IDL shares with other institutions a responsibility to engage in the public debate on the detection and attribution of climate change and seismic and volcanic hazards. The committee noticed a strong motivation in the IDL community to contribute to this activity.