

Advisory Committee of the IDL institute

Meeting: 23 – 24 July 2009

Members of the Committee: Sierd Cloetingh (Netherlands Research Centre for Integrated Solid Earth Sciences), Michael Bevis (Ohio State University, USA).

1. Short Description of the Review Procedure

The Committee received the following documentation:

- IDL Annual Report for 2008
- IDL Science Report, 2003 - 2008
- Copies of published scientific papers, PhD and MSc theses (for consultation)

The Committee visited 23 and 24 July 2009. The following presentations were given:

Day 1, Cloetingh and Bevis attended presentations by the director of IDL and the 10 research group leaders. A large fraction of the IDL community was present. The formal presentations were followed by an open discussion.

Day 1. After lunch, the committee met with a large group of M.Sc. and Ph.D. students.

Day 1. Subsequently the committee visited the laboratories of eight of the ten research groups, for in-depth discussions of their recent activities and future plans.

Day 2: In the morning, Cloetingh and Bevis visited the two remaining research groups.

Day 2. The committee then met with the IDL community as a whole to summarize their main findings and to indicate some of the recommendations to be made in writing.

The Committee expressed its satisfaction with the procedures and the organization efforts made by IDL staff, enabling effective review procedures.

2. General Observations

The research area covered by IDL addresses a broad spectrum of system Earth science issues relating to climate change, hazards, natural resources, and energy. These are areas of rapidly growing impact in Europe and worldwide, and there is a growing need for young researchers with expertise in these fields. In a number of European countries large projects have been formed, and a large proportion of established centres of excellence in a number of European countries are centred around integrated earth sciences and climate change.

The Committee is pleased to see that the merger of LATTEX and CGUL has been largely achieved, and that geologists are now in more frequent and direct contact with geophysicists and atmospheric scientists. The committee recognizes a strong potential to intensify the links between the various IDL groups, and in sharing expertise and research facilities. It is important that this general thrust progresses with a sense of urgency, and that associated funding is directed appropriately.

The committee noted that there are no currently active full professors in IDL, and this seems rather unfair given the burdens and responsibilities imposed on the senior members of the projects. It also undermines the position of these organizations within the university, and might hurt their funding prospects.

The committee noticed that IDL has made a great effort to implement the previous recommendation at the level of institutional reforms and reorganization. But we note that our more technical or scientific recommendations, made for specific groups or combinations of groups, have been implemented less widely, in some cases because the necessary funding was lacking. In a few cases we remain convinced that unimplemented recommendations still apply, as addressed in section 4.

3. IDL

3.1 Mission

IDL is a research centre that studies, in quantitative fashion, most of the important components of the Earth System. It combines analytical studies, data analysis, observational activities and modelling. The targets correspond to a wide range of processes going from the structure of the deep Earth, surface processes, atmospheric processes and natural hazards at or near the Earth surface. IDL aims to be a national nucleus of scientific activities and an educational platform of high-level research and teaching, thereby attracting the brightest students in the field, and providing a stable base for European partnership in major research initiatives in these areas.

3.2 Past performance

IDL successfully realized several of its key objectives in 2008. Most importantly it realized the merger of CGUL and LATTEX and brought about the necessary restructuring of the organization. It has successfully attracted new talent to the organization, including eight young researchers of very high quality, some of whom bring perspectives gained in other countries, as well as new classes of expertise. That such talent can be attracted to IDL, despite the limited level of resources that IDL receives, and its modest salaries, provides an indication of an attractive, exciting and competitive research environment. This is no mean achievement given the rising demand for earth scientists in academic research and in industry.

The committee noted with pleasure that IDL has been very effective in attracting third-party funding, as manifested by a 50% increase in total research funding between 2007 and 2008. This is a remarkable achievement considering the disruption attending a major institutional reorganization, and the dismal state of the global economy through much of 2008. The director of IDL, and the various group leaders, and the entire body of researchers deserve credit for this success.

The Committee observes some fears among the IDL scientists regarding the continuity of the science policy as regards tenure track positions at Universities or State Laboratories.

The focus of the research in the areas of meteorology and climate science is largely based on numerical modelling of atmospheric processes and analysis of large data sets provided by satellite agencies, international research institutions (e.g. ECMWF, IPCC, etc) and through participation in European programmes.

The focus of the solid Earth science is on monitoring of solid Earth processes and imaging of Earth's structure. IDL has a strong position in terms of its equipment as for example a pool of land-based seismometers and OBS (ocean bottom seismometers), allowing it to actively participate in new research programmes such as TOPO-EUROPE and TOPO-IBERIA.

The committee was pleased to see a significant increase in number of publications in international peer-reviewed journals.

3.3 Forward Look

The Committee noted that IDL is committed to further strengthening the connection between its three main disciplinary components, providing a base for further integration of fundamental and societal relevant activities. The present structure of IDL is a good first approximation, but it is likely that some fine tuning of group names, their research lines, and their membership will be required.

At the same time IDL is dedicated to make an effort to integrate further its research on the connection between solid Earth and atmospheric processes, both fundamentally (e.g. geophysical fluid dynamics) and in terms of methodologies, instrumentation (e.g. multiple use of GPS networks, shared numerical methods).

It also appears that the organization will further intensify the link between data acquisition and modelling and will pursue further investment, particularly in scientific instrumentation.

It is obvious to the Committee that the emerging environmental, water resource and energy crises ask for a integrated Earth system approach, for both the job market in the private sector and as a solid knowledge base for policy making.

3.4 SWOT Analysis of IDL

The committee made the following SWOT analysis:

3.4.1 Strengths of IDL include:

- Strong International cooperation
- Strong involvement in European Projects
- Publications in high level international peer-reviewed journals
- High quality motivated researchers
- Strong involvement of young researchers
- Strong connection between fundamental research and societal needs
- Well selected unique natural laboratories (Iberian Margin, Iberian Peninsula, Azores, Europe) on which the thematic research is centred; some of these natural laboratories are unique on the European scale; this makes IDL an attractive partner in European research initiatives, such as ESF, EUROCORES, TOPO-EUROPE, GMES, ECMWF, EUMETSAT.
- Attracted and employed several young researchers from abroad.

3.4.2 Weaknesses of IDL include:

- Incomplete integration of geology, geophysics and atmospheric science. (Mostly this is a matter of time).
- Irregular Funding
- Uneven distribution of funding across the disciplines
- The administrative structure is still evolving
- Near absence of surface hydrology and river system studies.
- In both main areas of research (meteorology/climate and solid earth science) of IDL, there is a limited balance between observational and modelling thrusts. In meteorology/climate, IDL is strong in modelling, while in geology and geophysics it is strong in observational aspects, but the balance in each of the two components is rather limited.
- Some sub-groups of IDL do not publish sufficiently in the peer-reviewed literature, although the overall publication output is fine and has increased in the last years.

3.4.3 Opportunities emerging for IDL:

- Further strengthening interaction between its different research components so as to realize a total system approach to Earth science
- Further strengthening of European position
- Excellent basis for expanding interaction between solid Earth and climate processes
- Further strengthening the integration of geology and geophysics
- Creation of a centre of excellence in Portugal as a node in a European future centre of excellence in integrated Earth Sciences
- Expanding the initiatives for joint field studies in geology and geophysics
- The theoretical and numerical tools associated with atmospheric science and geophysics could be utilized by the geologists and their students, to almost everyone benefit.

3.4.4 Threats for IDL:

- Poor career prospects for young researchers; this means a threat for building up the critical mass of expertise and know how that is required to address fundamental issues in energy and environmental aspects of Portuguese policy.
- Uneven efforts of research groups to secure stable funding from external sources.
- The lack of investment in laboratory and field equipment threatens the active involvement of IDL researchers in both established and emerging areas of research.

3.5 Specific Observations for Individual Research Groups

RG1 Climatology and Climate Change. This group has been highly productive both in terms of its research and publications, and in attracting strong PhD students, often jointly with other research groups in IDL and elsewhere. It is intensifying its interaction with the Land Use Climate and the Atmospheric Modeling groups. It is digitizing of unique and important historical data sets from Portugal and its former colonies, to the benefit of the international research community. Its applications include weather driven hazards such as wildfires and landslides.

RG2 Applied and Environmental Geophysics. This young and energetic research group has developed some interesting and useful software, and is actively engaged in industrial partnerships. Although they are primarily a shallow geophysics group, we note the potential to develop some deep sounding methods (e.g. magnetotellurics) that could help them promote joint research with the seismology and volcanology groups. The shallow exploration techniques might drive a synergy with the paleoseismology researchers. They are developing the tools and the experience that they need to pursue their stated ambitions and goals. The committee recommends that their list of research topics might be revised so as to generate a more coherent statement of their vision and expertise.

RG3 Geohazards and Warning Systems. This group has focused on tsunami research and operational monitoring activities, including the deployment of a deep seafloor observatory. They also incorporate a small but active coastal dynamics and environmental change group. Both activities are of great societal relevance. We noted, with pleasure, the productive and harmonious relationship between this group and RG4, and the advantages that accrued to both sides when they combined their resources and expertise in complementary fashion. The committee notices new research opportunities in the field of geophysical oceanography – the use of seismic methods for imaging of the water column.

RG4 Seismology and Earth Tomography. This small but very productive group has a research portfolio focused on the deep structure of the crust and upper mantle below the Azores, Cape Verde and Iberia/Gulf of Cadiz. The group is actively involved in probing plumes in superb natural laboratories, and in developing novel approaches to seismic anisotropy. The committee was impressed by the OBS deployment in the Gulf of Cadiz, and the results that were extracted from this unique data set. We believe that the volcanic island studies have considerable promise too. The group plays a significant role in the ESF-EUROCORES TOPO-EUROPE program.

RG5 Dynamics of Geological Processes. This group has been highly productive in terms of scientific publications in international, peer-reviewed journals. Recently, three young scientists have joined this group. The committee noticed that no PhD students presently reside within this group. The group has recently completed the TEAMINT project on the Variscan arc system. It is using magnetic methods to investigate flow patterns in dikes, and has obtained some remarkable results. It's cooperation with the ETH structural geology/tectonics group is particularly strong, and has resulted in some interesting links between rock deformation studies and analog tectonics experiments. The group is hosting the International Geomod2010 conference in Lisbon.

RG6 Atmospheric and Climate Modeling. This is a high quality and highly motivated research team with 6 Ph.D. students. These students have all been exposed to research environments in other countries, often in very prestigious institutions. The group actively cooperates with RG10 and RG1, and is playing a very valuable role in European initiatives and consortia. The committee noticed a high level of self-organization and the proactive roles of its Ph.D. students, which we feel might serve as a role model for many of the other groups within IDL. The committee is pleased with the prospects for cooperation between this group and the newly established activity in geophysical fluid dynamics, driving a useful and highly link between the atmospheric and solid earth research areas within IDL. The committee feels that RG6 has responded forcefully to their previous recommendations.

RG7 Earth Observation and Space Geodesy. The committee was pleased to see the unification of what was once two rather disparate geodesy groups. The partition of responsibilities between InSAR and GPS activities seems to us to be well thought out. The group is routinely processing the data being collected by the new national CGPS network, and this promise to generate useful atmospheric products immediately, and useful measurements of crustal strain in two or three years from now. The collaboration with RG6, in which the WRF model is used to generate delay corrections for InSAR data, is encouraging in and of itself, but also because it represents an interdisciplinarity activity of the kind that IDL needs to develop. We are disappointed that the group is not more active in exploiting survey GPS to study crustal strain accumulation in southern Portugal, and thereby build links to IDL's onshore and offshore studies in neotectonics. We hope that their survey GPS activities will expand, and their collaboration with the volcanologists and geologists of GR8 will expand both in terms of fieldwork, including site selection, and in terms of the interpretation of the results obtained by RG7. We endorse their activities in landslide monitoring and urban subsidence. Given the size of this group, we think they are correct to emphasize space geodesy over their activities in physical geodesy and remote sensing. We believe that this group would benefit from more computing power, and if it could acquire several sets of survey GPS equipment (and ancillaries) for use in survey or campaign mode measurements.

RG8 Seismic and Volcanic Hazards. This group incorporates considerable expertise in neotectonic and volcanic fieldwork and mapping, and it operates in some world-class natural laboratories. As such the group represents a very important

component of IDL's expertise and experience in natural hazard systems. They have obtained funding in paleoseismology, and have initiated a valuable digital geodatabase. The committee believes that considerable potential exists for synergies between this group and RG2, RG3, RG4, RG5, RG7 and RG9. Perhaps a series of meetings between RG8 and each of these other groups could be organized in an attempt to initiate new links or deepen existing ones. The synergy that might exist between surface geological studies and seismic studies of plumes is particularly obvious. The potential that volcanic islands have for tsunamigenesis within the Atlantic Ocean suggests that this group might joint in some of the international projects forming to address this deadly natural hazard. The group needs better computational facilities and software, and needs the resources necessary to complete its suspended activity in GIS. They might lend a helping hand to RG7 by helping them set up survey GPS stations in uninhabited volcanic islands, since they already travel to these remote locations, and often spending considerable periods of time one site, and because they are probably better suited to picking the measurement sites. They could also provide a deeper interpretation of the geodetic results obtained than could the geodesists if they are working alone.

RG9 Sedimentary Basins. This young group is generating considerable momentum at the interface between geology and geophysics. A research focus exists on rifted continental margins, with a strong link between mantle and surface processes. The group is actively involved in new data acquisitions, through, for example, wide angle reflection/refraction studies, and is pursuing numerical and analog tectonic modeling. The research output, although limited in 2008, is steeply increasing in 2009. Prospects for cooperative projects with the oil industry are particularly promising. The group is well positioned for participation in major European and broader international research projects, exemplified by its participation in the TOPO-EUROPE and NEAREST programs. Further investments in the analog laboratory are crucial for the further success of this group.

RG10 Land – Climate Interactions. This is a highly productive and innovative group working in an area of great societal relevance. It has an effective cooperation with IDL's atmospheric modeling group. Its activities include fire modeling and vegetation recovery studies. Efforts to incorporate more hydrological modelling have not been materialized due intense market competition for hydrologists. The group is disadvantaged by a lack of computational capacity for necessary reprocessing of satellite data. The committee notes considerable potential for joint projects with Brazilian researchers focused on the Amazon Basin.

3.6 Observations on the Research Lines of IDL

The division of research activities within IDL is grouped into the following four research lines:

Global Change and Societal Risks

Geophysics and Tectonophysics

Earth Observation and Geodynamics

Meteorology and Climate Research

The committee feels that the separation of 'Geophysics and Tectonophysics' and 'Earth Observation and Geodynamics' is neither necessary nor helpful. In the aftermath of a major institutional reform, the implications of which are still being recognized, we believe that a minor tuning of the research groups and the research lines is required. In particular, the Earth Observation and Geodynamics line is dominated by geodetic and geodynamics research, which would be better incorporated with Geophysics and Tectonophysics, in our opinion.

This minor fine tuning should probably be driven from the bottom up rather than the top down.

4. RECOMMENDATIONS

- Extend and deepen interdisciplinary activity through joint research, shared field areas, multiple use instrumentation and datasets, shared tools, etc.
- Develop courses, in areas like numerical modelling, which are framed so as to make them relevant to students from as many research groups as possible.
- Implementation of a common library, databases, computers and other scientific facilities that strengthen interaction between students from different research groups.
- Increase the number of scientific journals that are available on-line to IDL students and researchers.
- Organize regular group meetings within *all* IDL research groups
- Promotion of regular scientific seminars and cross-cutting meetings among complementary IDL groups.
- Organization of an annual workshop in which IDL research groups can update each other, and members of collaborating institutes, etc., on their research activities and emerging interests. It might be a good idea for a second workshop to be organized by and for the students themselves.
- Connect the above activities to an annual self-assessment of IDL and its activities and opportunities, and, when timely, to any external review process.
- Creation of an Association of Research Students within IDL.
- Maintain web pages associated with individual researchers and research students within (below) each Research Group website, to allow optimal self-expression by the students.
- It is highly beneficial to encourage the sharing of data acquisition and processing facilities (a plotter for printing posters, high resolution large-format scanners, etc.)
- The rock magnetism lab is presently a minimal facility and needs to be upgraded if it is to drive new research opportunities.

- The analog tectonic laboratory needs upgrading, especially if it is to be used to address a wider range of tectonic systems and problems, particularly if this group hopes to obtain industrial funding for its research in basin studies and orogenic inversion.
- Develop a course or workshop for students that focuses on scientific communications, including powerpoint presentations, scientific papers and proposals.
- Permit and promote a greater degree of self-organization at all levels (IDL, research groups, students, research lines, etc).
- Develop and encourage a forward-looking approach that directs the evolution of the organization so that it can take maximum advantage of emerging opportunities
- Expand the practice of joint or dual PhD programs with foreign institutions.
- Develop a culture in which research groups assist each other, and each others students, even when the advantage is not mutually beneficial in the short term.
- We restate our previous recommendations concerning the acquisition of tripod and airborne LIDAR systems, and the construction of a dense survey GPS network within southern Portugal.
- A strategy should be developed for rock dating (geochronology) so as to better quantify the *rates* of geological processes, especially active processes.
- Develop some seminars or workshops that focus on areas such as rheology in which physics meets chemistry and geology meets geophysics. In this context particular attention should be given to linking seismological, magnetotelluric, thermal and petrological aspects of crustal and upper mantle structure and evolution.
- Consider possible synergies between the shallow geophysical exploration group and the neotectonics and paleoseismology group.
- Consider a synergy between seismological, magnetotelluric and GPS studies of plumes and volcanic structures in those islands in which IDL geologists have developed a great deal of knowledge based on their analyses of structures, petrology, stratigraphy and geomorphology.
- Develop a stronger connection between offshore and onshore studies of neotectonics and paleoseismology. The committee believe that a suitable geodetic efforts can promote such a connection.
- Foster a closer link between deep earth and surface process studies.
- Patiently pursue and develop further links between IDL and industry.
- Continue to stress IDL's participation in European and other international consortia and programs.
- Improve IDLs visibility by a construction of a superior and regularly updated website, and by making IDL data and data products available on-line.