

From planet Earth to society: a new dynamic in Portugal concerning geoscience education and outreach activities

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Abstract: Since the United Nations declared 2008 as the International Year of Planet Earth (IYPE) (during the triennium of 2007–2009), under the motto ‘Earth Sciences for Society’, many impacts and changes were generated in Portuguese society. Particular attention was given to educational activities concerning geosciences and these were promoted by several entities in Portugal. The Portuguese National Commission for United Nations Educational, Scientific and Cultural Organization (UNESCO) has assumed an increasing role in the science sector with the promotion of initiatives and the creation of several scientific committees acting as national branches of UNESCO scientific programmes. This is the case of the National Committee for the International Geosciences Programme (NC–IGCP), which has been responsible for multiple initiatives that have been promoted and implemented in the area of geosciences and that contribute to the improvement of scientific literacy. The work developed by NC–IGCP has contributed to developing new ways of promoting geosciences and to creating awareness about the role of geoscientists for a better world based in a sustainable development guided by ethical principles. The use of tools such as itinerant exhibitions, educational training courses, school contests and information available on the website have allowed closer support and visibility to the development of fundamental science projects and outreach activities in Earth sciences.

Since the United Nations General Assembly declared 2008 as the International Year of Planet Earth (IYPE), during the triennium of 2007–2009, under the motto ‘Earth Sciences for Society’, many impacts and changes were generated in Portuguese society. The renewed dynamic, created since then, within the Portuguese community of geoscientists, with an increasing focus on public knowledge of the results of the research completed and the scientific advances in this area of knowledge, has made geosciences increasingly recognized socially. In this sense, particular attention should be given to educational activities concerning geosciences that have been streamlined by several entities such as universities, geoparks, biosphere reserves, the National Agency for Scientific Culture and Technology and a growing number of municipalities.

Acting mostly as a facilitator for this new awareness, the Portuguese National Commission for United Nations Educational, Scientific and Cultural Organization (UNESCO) (NatCom) has assumed an increasing role in the science sector with the promotion of initiatives and the creation of several scientific committees acting as national branches of the scientific programmes of UNESCO, such as the Portuguese National Committee for the International Geoscience Programme (NC–IGCP), the Portuguese National Committee for Mathematics of Planet Earth and the Portuguese National Forum of Geoparks. All of these entities, coordinated by Portuguese NatCom, as a whole and in an integrated manner, have been promoting and implementing multiple initiatives in education and in the dissemination of geoscience information in Portugal in a more comprehensive way. In this work, we intend to highlight the reality of this new dynamic in education and public awareness of geosciences in Portugal.

Geosciences in Portugal and IYPE

In April 2007, Portuguese NatCom, in the framework of the United Nations Decade of Education for Sustainable Development (2005–2014), created the Portuguese National Committee for IYPE (NC–IYPE). With this initiative, Portuguese NatCom tried to highlight the role of Earth scientists as key players in building a sustainable world. At the same time, the initiative was to show to society at large how Earth sciences can help future generations meet the challenge of ensuring a safer and more prosperous world. To achieve this, it is important to promote a wise and sustainable use of Earth's materials, to encourage better planning and management to reduce the risks for the world's inhabitants (Mulder *et al.* 2006; Brilha 2007; Silva & Henriques 2009; Marques 2012) and to conduct this work based on ethical principles that should guide the geoscientists. In this sense, NC–IYPE was created to promote, during the triennium 2007–2009, the application of a scientific programme and an outreach programme. The scientific programme emphasized relevant cooperation between Earth scientists from the Community of Portuguese-speaking Countries, under the guidance of their national committees (Angola, Brazil, Cape Verde and Mozambique). This cooperation has been promoted by the publication in Portuguese of 12 IYPE brochures, that are also available online, and by the organization of the First International Conference on the Development of Geosciences in the Community of Portuguese-speaking Countries, which was held in Coimbra, Portugal in October 2008 (Silva & Henriques 2009; Henriques *et al.* 2010; Marques 2012). Regarding the outreach programme, NC–IYPE sponsored 420 events throughout the country. The implementation of the outreach programme was based on the production of leaflets containing general information about IYPE, as well as an exhibition about the themes of IYPE (which was presented throughout the country, starting at the Portuguese Parliament and then in schools, museums, municipalities, geoparks, etc.). Posters, DVDs and books were also produced. Concerning the latter, two books especially for children, entitled *Tales of Ms Earth and Big Mess among the Rubbish*, including Braille versions, were published (Henriques *et al.* 2010; Marques 2012). An important acknowledgement is also due to other material, such as special stamps, first day postmarks and postcards and a special edition port wine bottle with the IYPE label. The events promoted by NC–IYPE have also been presented on TV and radio programmes and in articles in local and national newspapers. The outreach programme also included the promotion of international student contests, the organization of conferences, workshops, the participation of artists and ballet dancers in a special ballet dedicated to IYPE, etc. (Silva & Henriques 2009; Henriques *et al.* 2010; Marques 2012). By the end of 2009, it was possible to evaluate that, due to the initiatives carried out by NC–IYPE, Earth sciences achieved great

visibility within the national educational system. This was demonstrated both by the increase in students who selected geosciences and by the increase in the number of master's and doctorate programmes in geosciences in Portuguese universities. However, the major achievement in the implementation of IYPE in Portugal was the experiences of good practices shared between all members and participant entities of NC–IYPE (370 members belonging to different sectors). This provided greater visibility for other initiatives within the scope of the United Nations Decade for Sustainable Development and for the promotion of geoethics among students and the public based on the main IYPE issues (Henriques 2008; Silva & Henriques 2009; Henriques *et al.* 2010; Marques 2012).

The Portuguese National Committee for the International Programme of Geosciences

After 2009, Portuguese NatCom created the Portuguese National Committee for the International Programme of Geosciences (IGCP) (NC–IGCP) with the main goal of continuing the work carried out by NC–IYPE. This new national committee emerged as the natural heir of NC–IYPE and was established as a formal association under Portuguese law in May 2012. The main goals of NC–IGCP are (a) coordinating its own initiatives related to geosciences and supporting others promoted by partners; (b) promoting and following up on scientific research projects in the area of Earth sciences that can be submitted to the IGCP programme; (c) disseminating the International Geosciences Programme IGCP–UNESCO, nationally and internationally, using various communication tools (website, newsletter, newspaper, magazines, etc.); (d) promoting close cooperation with other IGCP national committees; (e) promoting close contact and collaboration between national institutions engaged, directly or indirectly, in the field of Earth sciences, including entities that fund scientific research and dissemination; (f) encouraging the creation of national committees in African countries whose official language is Portuguese; (g) translating into Portuguese IGCP and UNESCO's documentation, considered relevant to geosciences, for dissemination to the public and throughout the scientific community and the Community of Portuguese-speaking Countries; (h) collaborating with the Portuguese Geopark Forum and the Portuguese Network of Biosphere Reserves of UNESCO, promoting education in geosciences and geoethics; (i) working with the International Union of Geological Sciences (IUGS), in particular with the Commission on Geoscience Education, Training and Technology Transfer (COGE) and also with the International Association for the Promotion of Geoethics and (j) maintaining regular contact with the Secretariat of the IGCP–UNESCO by sending annual activity reports and participating in the meetings of the scientific council at UNESCO headquarters.

With these goals, since its foundation, NC–IGCP has had an active participation in national and international conferences, congresses and workshops on geosciences. It is also co-responsible for the organization and implementation of school competitions/ contests, of an informal nature, in partnership with different institutions like municipalities, geoparks, biosphere reserves or regional boards of education and is responsible for the management and coordination of itinerant exhibitions (e.g. 'Once upon a time Earth ...', 'Chemistry between Us' and 'Journey to Palaeozoic'). To achieve the aim that all these initiatives (Fig. 1) have a real impact on society and thus comply with the motto 'Earth Sciences for Society', a big bet has also been made in the promotion and dissemination of educational projects, training courses and capacity building activities. At the same time, NC–IGCP has supported the accomplishment of scientific activities and outreach activities in geosciences, especially conferences, workshops and outreach programmes on television and through other national media.

Recently, it was established as the basis for close cooperation with the Brazilian National Committee for IGCP. This initiative aims at developing an effective exchange of experiences between these two active national committees and at the strengthening of cooperation in the field of geosciences in the Community of Portuguese-speaking Countries, especially in Africa. This is a new stage in the effort of NC–IGCP in order to increase the education and outreach activities of geosciences and geoethics, which is expected to have tangible results before the end of this decade.

Educational training courses and capacity building

In the framework of the main goals of the United Nations Decade of Education for Sustainable Development, Portuguese NatCom, in collaboration with NC–IGCP and National Public Television (RTP), organized an educational training course. This activity was created to reach journalists and was targeted at giving them more information, related to Earth's dynamics and mainly to natural hazards and climate change.

It is essential that society knows its degree of vulnerability to the occurrence of extreme natural phenomena, which are the basis of natural catastrophes, with serious social and economic consequences. Thus, the development of a culture of prevention and precaution, which hinges on correct information, based in scientific knowledge on causes and consequences of extreme natural phenomena, is crucial. At the same time, it is necessary to implement mitigation and adaptation measures, based on the analysis and the cartography of risks, and an effective monitoring process. During these workshops, particular emphasis was given to the need to inform and educate society in general, and students in particular, to the reality of living on a dynamic planet. Particular importance was given to natural hazards, such as those resulting from earthquakes, landslides, floods, droughts, heat and cold waves and storms, which are the ones with the greatest potential for danger in Portugal. An informed society is a society which, based on its intrinsic resilience, can live and deal with the inherent risk of natural disasters.

In this sense, the first training course was aiming directly at capturing the attention of the Portuguese journalists to these issues. The format was a very innovative one, based on interviews of scientists conducted by well-known journalists. The purpose of these interviews was to prove that natural disasters that have occurred in several regions of Portugal, due to extraordinary natural phenomena (e.g. tornados), could be a consequence of climate change. However, from a scientist's point of view, these phenomena had a scientific explanation, and it was not possible to answer simply 'yes' or 'no'. This situation created a very stressed conversation between the journalist and the scientist. Through humour, it was possible to understand the problem of communication existing between these two elements. Based in this video, the training course aimed to lead the journalists to other scientific areas of knowledge and to provide skills and tools to improve the interviews and allow them to be based on accurate scientific knowledge and on pertinent data, regarding these themes. The first training course took place in 2011, in the Environmental Centre of Serra da Estrela, and 30 journalists, from public and private television channels, national and local radios as well newspapers and magazines, participated. The invited scientists talked about different themes, such as education for sustainable development, climate change, natural disasters and biodiversity. Due to the success of this first training course, the organizers were encouraged to promote other annual editions, for not only journalists, but also for teachers, staff from municipalities, geoparks and biosphere reserves, tour guides, scouts and decision-makers, among others. During the second edition of this training course, it

was possible to gather 56 participants, from different regions of Portugal and from different areas of work with the support of the Secretary of State for Forests, and the media covered the training course. Since 2013, NC–IGCP created the educational programme ‘GEA – Mother Earth’ into which this training course was integrated and started to promote it in schools, twice a year.



Fig. 1. Examples of initiatives undertaken by the Portuguese National Committee for the International Programme of Geosciences (NC–IGCP). (a) Exhibition about Geoparks in the Portuguese Parliament; (b) tribute of national gratitude to Professor Emeritus Galopim de Carvalho, for his work in favour of geosciences; (c) ceremony awards to students participating in the school contest ‘Water that unites us’ in the Arouca Global Geopark; (d) winning work produced under the school contest ‘Water that unites us’ on the Biosphere Reserve of Principe Island (STP); (e) educational training course ‘Information in Context’ in the Araripe Global Geopark (Brazil); (f) official logos of the educational programme ‘GEA – Mother Earth’ (left) and school contest ‘The water that unites us’ (right).

Educational programme ‘GEA: Mother Earth’

The educational programme ‘GEA – Mother Earth’, developed by Portuguese NatCom and NC–IGCP, is intended to foster themes in the area of geosciences for schools in the Community of Portuguese-speaking Countries. This programme is based on the overall goals of IGCP–UNESCO. The dynamics of this initiative is based on the following objectives of the celebrations proclaimed by the United Nations and streamlined by UNESCO: (a) the United Nations Decade of Education for Sustainable Development (2005–2014); (b) the United Nations Decade on Biodiversity (2011–2020); (c) the International Decade of Action ‘Water for Life’ (2005–2015) and (d) the International Year of Water Cooperation (2013/2014).

‘GEA – Mother Earth’ is based on the promotion of school contests, including ‘Water that unites us’ and ‘Chemistry between us’, and every year a new theme is selected and this theme is in accordance with the framework of the main goals of the scientific programmes of UNESCO, such as IGCP, the International Hydrological Programme (IHP), the Program ‘Man and Biosphere’ (MAB) or the Program of Fundamental Sciences. This educational programme was also extended to the UNESCO Network of Associated Schools (ASPNet) and to the geoparks under the auspices of UNESCO. In addition, this programme also aims at promoting training activities for teachers, educators and other staff working in those territories.

For the school years 2013–2015, the selected theme was related to water, mainly the availability of safe drinking water. It is focused on the promotion of greater public awareness at the national and international level of the importance of the sustainable use of water and the chemical issues related with this subject, with particular emphasis on the inhabitants living in the territories of geoparks and biosphere reserves.

In this context, this educational programme aims to articulate the goals of the celebrations proclaimed by UNESCO mentioned above, in order to encourage the discussion of issues related to water, taking into account also the objectives of the United Nations Millennium Development Goals (MDGs). In order to streamline this programme within school communities, including the schools associated with UNESCO located in territories where it has been developed, it was divided into four components:

- (a) Training courses for teachers, educators, librarians, representatives of geoparks and biosphere reserves and journalists. These courses address topics such as water, desertification, climate change, natural disasters, biodiversity, sustainable development and geoethics. These courses are organized by members of NC–IGCP, who are also the trainers, and usually other experts are invited to talk about specific themes.
- (b) Organization of the school contest ‘Water that unites us’, to encourage school communities to reflect on this issue. In this sense, students and teachers are encouraged to investigate, analyse and discuss the amount of freshwater resources that exist in their territories. At the same time, they are encouraged to collect information about the processes of recharge, flow and discharge of freshwater systems and their role in ecosystems; to reflect on concrete measures to mitigating the environmental impacts that arise from the extraction and degradation of groundwater, rivers or lakes and to protect the affected wetlands; to create campaigns to alert and to prevent the deterioration of drinking water in terms of quantity and quality; to reflect on the value of water in different environments and to implement strategies to conserve and protect water resources.

(c) Organization of the school contest 'Chemistry between Us', sponsored by Bayer-Portugal, whose main objective is to demonstrate that through chemistry it is possible to promote sustainability and improve the well-being of communities. At the same time, it contributes to the reflection on the usefulness of and the solutions given by chemistry for the well-being of society. Thus, it is intended to raise awareness and increase the understanding of the importance of chemistry in the search for solutions to improve the environment we live in and to build bridges to solidify the aspects that relate to the importance and management of forests, the water cycle, climate change and solutions that promote the production of more sustainable and energy efficient materials.

(d) Production and supply of educational tools:

(i) Coordination of the itinerant exhibitions 'Once upon a time Earth ...' and 'Chemistry between Us'. These exhibitions are managed locally by the responsible teacher-librarian and they are exhibited in each of the headquarters of the cluster of schools who participate in the contest.

(ii) Educational kits, which include videos, documents, links and other materials.

The Portuguese geoparks (Naturtejo Global Geopark, Arouca Global Geopark, Azores Global Geopark and the Aspiring Geopark of Terras de Cavaleiros), the Portuguese Biosphere Reserves of Santana (Madeira Island) and three biosphere reserves located in Azores archipelago (Graciosa, Corvo and Flores) are already involved at a national level in this educational programme. At an international level, this programme was extended to Araripe Global Geopark (Brazil) and to the Biosphere Reserve of Prince Island in S. Tomé and Príncipe archipelago in Africa. In Portugal as in Brazil, it was decided to hold at the end of each school year (July in Portugal and November in Brazil), an event in which students together with teachers involved in this educational programme present the results of their work in a conference format. The proceedings of this event will be preserved for future memory, like a kind of manifest of the young people of today for future generations, as a set of solutions for a more sustainable and enduring reality of humanity. Since 2012, more than 80 000 students as well as 2000 teachers from more than 200 schools of these territories are already involved in this educational programme. The extension of this educational programme to Brazil and S. Tomé and Príncipe shows already the effectiveness of the goals of cooperation, in which the communication facilitated by the common language allows us to think in the long term and to reach into the future of over 350 million people.

Conclusions

The activities developed by the national committees for geosciences created under the aegis of Portuguese NatCom aim to contribute to changing attitudes, not only in interpersonal relationships, but also in relation to Earth and towards improving scientific literacy in Portugal. In this sense, some of these activities have highlighted the role of geoscientists in society and the responsibilities that they have to assume as scholars of Earth and as experts of the territory, in accordance with what was stated by Peppoloni & Di Capua (2012). Thus, there is a concern to demonstrate that geoethics cannot exist without a real awareness among geoscientists of the cultural value of Earth sciences. Following these guidelines, the work and initiatives

developed firstly by NC–IYPE and later by NC–IGCP changed the way geosciences were promoted in Portugal, and new ways of promoting UN activities related to sciences among the Portuguese society were developed.

The process of streamlining geosciences in Portugal is currently focused on the educational programme ‘GEA – Mother Earth’, which aims at involving an increasing number of partners, with particular emphasis on schools, municipalities, geoparks and biosphere reserves. Within this programme, the training courses also aim to capture the attention of the media and, in addition, the attention of teachers and educators. An additional aim is to create synergies between different partnerships, one of the objectives of the Decade of Education for Sustainable Development. The success of these initiatives is due to the support of sponsors such as Bayer-Portugal, which have facilitated numerous activities of NC–IGCP.

The fact that NC–IGCP is based on a bottom-up paradigm for the geosciences outreach process has allowed enhancing the capacity utilization of all those involved. Thus, the promotion of geosciences has encouraged reflection on several issues related to the dynamics of Earth among society, in accordance with the following actions: understand the interconnections, that is, know the causes to understand the consequences and find solutions; disseminate information in context; understand the processes of production and changes in scientific knowledge and make them accessible; share and communicate knowledge; work in a team/network (platform) and evaluate and monitor the communication process. In this sense, the use of tools such as itinerant exhibitions (already visited by more than 60 000 people since 2011), the training courses and the information available on the website (http://www.igcp.org.pt/IGCP_Pt) have allowed closer support and visibility to the development of fundamental science projects and outreach programmes in Earth sciences. Thus, it is intended to contribute to the increasing awareness of society, to train and actively face the reality of the ongoing dynamic of Earth and to find the balance that humanity must seek for its own existence.

References

- Brilha, J. 2007. Ano Internacional do Planeta Terra: uma abordagem em contexto educativo. *In*: Vasconcelos, C., Ribeiro, M. A., Martins, H. & Noronha, F. (eds) XXVII Curso de actualização de Professores de Geociências: Comunicações – Itinerários – Trabalhos Práticos, *Memória do Departamento de Geologia da Faculdade de Ciências da Universidade do Porto*, Universidade de Porto, Porto, 11, 15–18.
- Henriques, M. H. 2008. Ano Internacional do Planeta Terra e Educação para a Sustentabilidade. *In*: Vieira, R. M., Pedrosa, M. A. F., Martins, I., Caamaño, A., Vilches, A. & Martín Diaz, M. J. (eds) (Coords.), *Ciência – Tecnologia – Sociedade no Ensino das Ciências – Educação Científica e Desenvolvimento Sustentável*, Aveiro, Universidade de Aveiro, Aveiro, 110–116.
- Henriques, M. H., Guimarães, F. A., Sá, A., Silva, E. & Brilha, J. 2010. The International Year of Planet Earth in Portugal: past activities and further developments. *Episodes*, 33, 33–37.
- Marques, E. M. R. S. 2012. *Geologia e Sociedade – O Ano Internacional do Planeta Terra. Impacto e mudanças em Portugal*. MSc thesis, Universidade Aberta.
- Mulder, E., Nield, T. & Derbyshire, E. 2006. The International Year of Planet Earth (2007–2009): Earth Sciences for Society. *Episodes*, 29, 82–86.

Peppoloni, S. & Di Capua, G. 2012. Geoethics and geological culture. *Reflections from the Geoitalia Conference 2011, Annals of Geophysics*, Bologna, 55, 3.

Silva, E. & Henriques, M. H. 2009. Implementation of the International Year of Planet Earth (2007–2009) in Portugal, in the framework of the United Nations Decade of Education for Sustainable Development. *In: Carvalho, C. N. & Rodrigues, J. (eds) New Challenges with Geotourism. Proceedings of the VIII European Geoparks Conference*. Naturtejo E.I.M, Idanha-a-Nova, 131–134.