

Climate scientists and the public: interactions and knowledge exchanges

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Introduction

Raising public awareness of climate change is crucial for transforming individual behaviours and amassing support to policy measures, which may threaten prosperity and comfort levels that came to be expected in affluent societies. Scientists are one of several agents involved in public communication of climate change and trust in these experts is of the utmost importance if citizens are to be persuaded of the severity of a problem that so far they cannot see nor feel.^[1]

However, other environmental risk and controversies have taught us that communication must be a two-way street and the public needs to be engaged rather than informed and 'enlightened'. Also, the public possesses its own experiential knowledge that can provide valuable contributions to the production of science.

This presentation aims to discuss these issues by drawing on the case of Portuguese scientists that work in the area of climate change (a wide-ranging field that spans such disparate subjects as meteorology, geophysics, biology, agriculture, health and even the social sciences). What has been their contribution to knowledge dissemination and improving awareness of climate change? How are they involved in public engagement activities? How are they responding to citizen's perceptions and experiences? And how does this vary by scientific discipline or research object?

This work is integrated in an on-going research project and it is based mainly on document analysis and in-depth interviews to Portuguese climate scientists, as well as observation in public events

Framework

Communicating the science of climate change to the public is essential. Unlike pollution or other environmental problems, climate change is invisible to the naked eye and its effects, though potentially catastrophic, are still hardly felt in daily life. Therefore, science is the only way of assessing that climate change is happening and that its impacts will be severe. In order to harness public support for mitigation and adaptation measures and to generate changes in individual behaviour and consumption (Tompkins and Adger 2005), citizens have to be understand and trust scientific information. Addressing the threat of climate change requires alliances between scientists and policy makers but also citizen participation, through networks that involve NGOs, business companies and communities (O’Riordan et al 1998; Gough and Shackley 2002).

According to McBean and Hegenveld (2002) the public obtains information on climate change through three main channels: the media, the internet and educators (scientists and teachers). Since the first two tend to allocate a disproportionate attention to conflicting views and climate sceptics,^[2] it falls on the educators to reaffirm the prevailing consensus: ‘the climate science community has an obligation to become more engaged in public service, particularly where there are clear indications of risks of danger to society.’ (2002: 20).

Hulme (2009) characterises climate change research as post-normal science, where ‘facts are uncertain, values in dispute, stakes high and decisions urgent’ (Funtowicz and Ravetz 1991), so scientists are forced to find ways to communicate uncertainty, to reflect on social impacts and values, to open up to public scrutiny and to acknowledge the plurality of expertise and the relevance of lay knowledge.

The deficit model of communication, based on the assumption that the public is ignorant and by providing information attitudes and behaviours are changed, has been proven to be flawed and unsuccessful (Hulme 2009; Heiskanen 2006; Neirlich, Koiteko and Brown 2010; Kellsted et al 2008). What social scientists have been calling for is the adoption of a deliberative model of communication that provides a better power balance between scientists and citizens, that embeds the dialogue in the experiences and values of participants and promotes real exchanges of information between participants (Hulme 2009; Neirlich, Koiteko and Brown 2010; Lorenzoni, Nicholson-Cole and Whitmarsh 2007).

McBean and Hegenveld (2002) also prescribe the principles that communication of climate change science should follow:

to communicate their findings to lay audiences in a manner that is effective and honest, scientists need to assimilate the information into integrated perspectives and move beyond the adversarial processes to focus on communicating the large body of science on which there is agreement (...) They also need to be more pro-active in presenting the information in the context of risks rather than uncertainties, and by appealing to the existing concepts, or cultural models, used by audiences in their daily practices of applying new information to their activities. Furthermore, scientists need to explain to these audiences the relationships between different environmental issues, the link-ages between human activities and environmental quality, and the co-benefits of risk management (McBean and Hegenveld 2002: 20)

They go on to affirm the need to train scientists in communication skills, to improve contact between scientists, the media and schools and also of more cooperation with social scientists: ‘physical scientists need to work more closely with social scientists in order to better relate science research results to societal concerns’ (McBean and Hegenveld 2002: 21).

But public involvement in climate change science should go beyond communication. Citizens and stakeholders can also be engaged in the production of scientific knowledge on climate change. R&D endeavours also would benefit from taking into consideration social needs and concerns, local knowledge and lay expertise; that is to say, to involve citizens in the definition of research questions, in the process of data collection or in the design and implementation of technical solutions (Heiskanen 2006; Lynn 2000; Green and Raygorodetsky 2010; see also the other articles of the special volume on indigenous knowledge and climate change of the journal *Climatic Change*, v 100, v 2, 2010).

Communication with the general public

Public understanding of science initiatives in Portugal have undergone a substantial growth in the past two decades (Gonçalves and Castro 2002, Felt et al 2003), in line with the development of the national scientific system. Science Alive, the national agency for promoting public understanding of science has been for the past 15 years the main actor in this area, funding and promoting a wide array of events, from exhibitions in a network of science centres (Delicado 2010) to projects for encouraging the use of experiments in science teaching at elementary and secondary schools (Costa et al 2005),

from science activities in the summer to short-term internships of youngsters in research centres. The involvement of scientists in these activities is quite strong (Miller et al 2002: 52-75).

However, climate change has been a somewhat neglected issue within these initiatives. So far, there has been no major exhibition on the issue on any of its science centres^[2] or a dedicated science awareness programme. Among the 4,026 projects for promoting experimental teaching funded between 1996 and 2006, only two concerned climate change. Since 2005 that the Biology in the Summer and Geology in the Summer include field trips and guided tours that broach the subject of climate change and their number and weight has tended to increase (Table 1).

Table 1 Events regarding climate change in Science in the Summer

		2005	2006	2007	2008	2009	2010	2011
Biology in Summer	Climate change	2	2	43	26	21	17	47
	% All events	0.5	0.4	6.5	3.7	2.9	2.4	5.4
Geology in Summer	Climate change	1	4	7	9	7	6	8
	% All events	0.2	0.9	1.1	1.5	1.2	1.2	1.6

Source: www.cienciaviva.pt

There was a café of science at the national Parliament dedicated to the issue in 2007. On the same year, the main science centre of the Science Alive Agency, Knowledge Pavilion, took part in the International Climate Change Conversation promoted by IGLO – International Action on Global Warming, a project of the Association of Science and Technology Centres. There have also been a handful of lectures and debates that dealt with climate change and it has also featured marginally in awareness programmes on other issues, such as Biodiversity, Oceans, Space.

The only initiative that featured climate change more prominently was called Latitude 60 and was part of the celebrations of the International Polar Year (2007/2008).^[3] It comprised a wide array of activities: exhibitions, lectures, films and theatre plays, a school competition (whose prize was a trip to Antarctica), a field internship for students

in the mountains, an international videoconference on climate change, phone conversations between students and scientists at the Antarctica research station. This project was coordinated by four Portuguese scientists specialising in polar research, with the support of the Science Alive Agency.

An interview with one of the leading scientists in this projects yielded information both on the motivations and conditions for launching it

With the International Polar Year, which started to be prepared in 2004, 2005, we started seeing that internationally there was a very big movement surrounding scientific dissemination. We, not just our group but the polar scientific community, we knew it was a great opportunity to take advantage of the International Polar Year and for Portugal to start having a polar programme. Thus, we could raise in society and also in politicians interest in polar regions. In the 2005 [research] campaign [in the Antarctica] I had a blog, which was a field diary, and there was this activity called 'ask a polar scientist' in which school kids could send me questions and I answered directly from Antarctica by email. RTP [TV broadcaster] interviewed me every week and broadcasted it, so there was a huge interest from society and I was also asked to go to schools. So we realised we could set up a project with Science Alive to frame all these activities (HU, researcher in geography and university lecturer)

and on its results

It was extremely positive. I think it couldn't have been better. To give you an example, we did a national competition for schools in all levels of education, we had 7 or 8 thousand students participating and we sent students to Antarctica on an expedition. (...) At the end of the project we held a polar weekend at the Knowledge Pavilion, it was our proposal, they lent us the space, they helped us organise it and we set a record for the number of entries. It was an amazing thing, interdisciplinary, there were school bands playing outside, lectures on polar science, it was a huge thing. (HU, researcher in geography and university lecturer)

One other significant initiative in raising awareness of climate change was the PROCLIRA project, also funded by the Science Alive Agency, led by the University of Evora and that run between 2006 and 2007. The project consisted of providing secondary schools with weather monitoring devices, training teachers and students on

how to read them and to send the results back to scientists, in order for them to feed a forecast model. There was also a website showing the monitoring results and supplying educational content on climate, atmosphere and meteorology.^[5] 19 schools took part in the project, although only 10 of those received the weather stations for registering meteorological observations. According to the scientist in charge of the project, its aim was:

We thought we could contribute in two ways, one as scientific education on this issue for teachers, and they would in turn transmit it to the students, and on the other way, we could contribute to this issue by monitoring. (...) our idea was that schools would send their observations to a central computer (...) and from them we would make a forecast based on a model we have, a meteorological model, a fine scale model that would then be disseminated to the schools. It was technical-scientific education not only on a conceptual level but also on a practical level. (...) It could only be on a conceptual aspect of climate change, because observations now are not observations in the future, but at least people were being educated with the correct ideas about the issue and started to practice by doing their own observations and seeing that these observations served a useful purpose (...) this project was very useful because it raised awareness of this issue (LQ, researcher in climatology and retired university professor)

However, the success of this initiative was somewhat marred by the lack of funding for continuing it. Although some keen teachers still use the equipment, most schools abandoned the observations and allocated the computers to other uses, data is no longer centralised to feed the model and the website lacks much of the educational resources it set out to provide. Nevertheless, the added value of this sort of projects that allow students to do their own scientific observations over traditional lectures in transmitting climate change information has been demonstrated by Pruneau et al (2003).

A group of scientists that have been doing communication of science via stand-up comedy since 2009, the “Stand Up Scientists”, have recently produced a short theatre play intituled “Enlightened Warming”, aimed at school audiences, in which climate change is addressed. The play is followed by a debate with a scientist.

Despite these examples, the majority of scientists working on climate change have a lower level of engagement in scientific dissemination activities, participating occasionally in conferences for the general public, lectures and debates in secondary schools, cooperating in school projects.

As a professor, I like to communicate and I believe that work is very important, I think that in this area and in others scientists should make an effort to communicate to the public, to reach other audiences besides their colleagues, their peers in scientific meetings and I have really been making an effort in this sense. Sometimes, in some secondary schools it's not very easy to maintain the students' attention, but in general it has been very gratifying and very positive this opportunity to communicate the current environmental challenges we face (GR, researcher in physics and university professor)

Some researchers have no involvement at all in public dissemination activities, both for lack of self-initiative and of external inducement

To be honest, I don't receive many invitations [for public dissemination activities]. Maybe the type of work I do isn't interesting to the general public. My colleagues that work with ecosystems or animals... that's more appealing, more interesting for the general public (BT, researcher in oceanography and university lecturer)

What can explain this lack of initiatives for promoting climate change awareness in Portugal? On the one hand, climate change scepticism is far from frequent in Portugal. Eurobarometer surveys (EC 2009) indicate that only 9% of Portuguese citizens do not believe that climate change is a serious problem^[6] and Ramos and Carvalho's research on representations in Portuguese newspapers shows that they 'tend to award little space to uncertainty and to the climate change "sceptics", promoting an image of solid scientific knowledge and a unified scientific community' (2008: 228).

Dissemination of results to stakeholders

Another level of knowledge exchange between scientists and the public concerns the dissemination of research results to stakeholders. Increasingly valued by funding agencies (for instance the EU Framework Programme, the Portuguese Foundation for Science and Technology) in the assessment of grant proposals, it aims both to increase public accountability and to maximise the opportunities for application of scientific results.

Although many of the research projects on climate change in Portugal still focus mainly on communication with peers (articles in specialised journals, papers at conferences),

which yields the symbolical capital indispensable for remaining and advancing in the scientific field, some examples can be found of projects that show a heightened concern with dissemination to stakeholders.

SIAM Climate change in Portugal: Scenarios, impacts and adaptation measures,^[2] the project that kick-started climate change research in Portugal, was carried out between 1999 and 2002 and it involved an extended team of 34 lead authors, 13 contributing authors and 15 reviewers, from 21 national institutions (universities, research centres, state laboratories, business companies) and 8 foreign ones. The project covered a wide range of issues: current climate and climate scenarios, water resources, coastal zones, agriculture, health, energy, forests and biodiversity, fisheries. The second stage of project (2002 – 2003) counted with a similarly large interdisciplinary and inter-institutional team and added to the analysis the issues of tourism and socioeconomic scenarios, but its main component was the dissemination of results to lay audiences. Seven outreach sessions were carried out throughout the country, with representatives of the public, private and non-profit sectors (universities, government offices, local authorities, trade unions, NGOs, business companies), totalling 112 participants (Forbes 2006). Each session was dedicated to a specific area of socio-economic impact (Fisheries, Agriculture, Forests and Biodiversity, Energy, Health) of special concern for the region in which it was held. After the presentation of research results, a debate was held ‘aimed at focusing the discussion on sectorial impacts and adaptation measures, asking for feedback on the on-going research’ (Forbes 2006: 499). These sessions allowed researchers to gather some local lay knowledge on these impacts, although it was recognised that some took place too late to be of use for research. It also allowed them to draw conclusions on the value of such dissemination and on the most efficient ways of communicating with non-scientific audiences (Forbes 2006: 505).

One of the scientists that took part in these sessions highlights the importance of this initiative

We had several meetings with stakeholders, in fishing areas with fishermen, in inland areas with mayors and people involved in regional planning, etc. I participated in a meeting in Gaia for the general public, ‘normal citizens’, so to say, and it was a very interesting and very comprehensive project, very well run from the point of view of participation. (...) (It’s important) to go outside, to leave the scientific community,

because this issue concerns us all. It's not just a scientific matter (LO, researcher in agricultural sciences, university professor)

but also acknowledges its limitations

[the interest of the regular citizen] is very weak, very weak. Due to the lack of scientific culture, of information, of misinformation. And this misinformation sometimes leads to scepticism. (...) There were groups in which it was very enriching, the interaction was very valuable. For instance, people connected with gardening and urban trees, some of these groups were very interested, but on the whole there was much scepticism. A scepticism that has to do with lack and information and misinformation, because our journalists, in the absence of critical thinking, use everything to make news (LO, researcher in agricultural sciences, university professor)

Despite this precedent, few other research projects on climate change have followed suit in awarding importance to the dissemination of results to stakeholders.

One such case was the research project *BioAridRisk - Space-Time Evaluation of the Risks of Climate Changes Based on an Aridity Index*, funded by the Foundation for Science and Technology and carried out between 2005 and 2007. It foresaw public dissemination as one of its tasks, and for that purpose a leaflet and a website^[8] were designed and seminars held in the regions covered by the study.

We set up this network of research centres that had these links, Évora is quite close to the left bank of the Guadiana which is the area that suffers more from desertification, so we did the whole 'dissemination circus', with stakeholders. It worked very well, except in Algarve. They were supposed to disseminate at a school, at that Science Alive thing, but they didn't. (...) [the stakeholders] were mainly public bodies, local authorities, the board of directors of the Regional Hydric Authority, in charge of hydric resources, the Regional Development Coordination Commission of Alentejo, all public entities. Private bodies that took part in this 'circus' was EDIA, the company that runs Alqueva (BT, researcher in geostatistics and university professor)

Considering the overwhelming impacts climate change is expected to have in economy and society and the need to harness support to mitigation and adaptation measures, as well as the general drive to make science more accountable and socially relevant, it was

to be expected that more attention would be paid to the dissemination of research results among stakeholders. And in Portugal this seems to happen only sporadically.

On the one hand, not all climate change research has direct stakeholders. Studies in paleoclimatology, atmospheric models or the vulnerability of particular species do not necessarily entail any social actors. Their results have potentially little interest outside the scientific community.

On the other hand, scientists are still fundamentally assessed by their scientific output (publication in peer review journals, patents), not by outreach activities or the application of their research, so there is little incentive to dedicate much time and effort to the latter. Additionally, the perception of lay public as ignorant and irrational may still be predominant among the scientific community (as seen in one of the quotations above).

Involving the public and stakeholders in research

The interaction between scientists and the public can also go beyond the communication of research results. Deeper and more useful knowledge exchanges can be generated by engaging citizens and stakeholders in the actual process of research.

The importance of taking into account local lay knowledge in scientific research, especially in environmental matters, has already been demonstrated in classical works in the social studies of science (see, for instance, Irwin 1995 or Wynne 1996), as well as in more recent case studies (see, for instance, the special issue of *Ecology and Society*, v 9, n 3, 2004):

It comes as no surprise that knowledge of resource and ecosystem dynamics and associated management practices exists among people of communities that, on a daily basis and over long periods of time, interact for their benefit and livelihood with ecosystems. The way such knowledge is being organized and culturally embedded, its relationship to institutionalized, professional science, and its role in catalyzing new ways of managing environmental resources have all become important subjects (Folke 2004)

Thus, the involvement of citizens in research benefits not just environmental literacy, but also the production of science (Heiskanen 2006).

This issue has already been taken up by European research policy, albeit with a strong business sector bias. The involvement of stakeholders is often referred to in strategy documents and many calls under FP7 already strongly encourage the participation of stakeholders, either formally as partners in consortiums (mandatory in the case of business companies in many programmes) or at least actively committed in the research process.

In Portugal, the level of formal participation in R&D endeavours by the private sector (profit and non-profit) is quite low. Out of the 77 participating institutions in the 67 FCT funded projects in collaboration in climate change between 2004 and 2009, just three were business companies, two associations and another a non-governmental organisation (an archaeology club). The weak involvement of business companies is explained not just by the less-applied nature of research in this field but also by the structure of the Portuguese scientific system (the business sector has low R&D funding and performing rates) and by the absence of funding rules that promote it.

As to the projects that include associations as research partners (both funded in 2009), one of them, *Short-term climate change mitigation strategies for Mediterranean vineyards (ClimVineSafe)*^[9], involves the participation of the federation of local wine producers, justified by the need to perform trials at commercial vineyards and to test for technical and commercial viability. The research team has already held a workshop for wine producers to present and discuss the results of the first stages of the project.

The other project involving an association is *Development of a Methodology to Integrate Climate Change Effects in Water Resources Management on a Portuguese River Basin* and it is being carried out by a consortium that includes also two Portuguese universities and the US federal agency National Oceanic and Atmospheric Administration (NOAA). It draws on the experience of an EU Framework project in which some members of the team participated and the project indicates the participation of stakeholders as one of its keywords. The participating association gathers together business associations, universities and government bodies working in the field of farming irrigation and owns agricultural land in which scientific experimentation is carried out.

Some research projects also involve the participation of stakeholders, although not as formal research partners. For example, the project *TRADWATER – Use of traditional*

knowledge to attain water sustainable management under different climate change scenarios carried out between 2005 and 2008, aimed to tap into lay knowledge, by studying ‘traditional irrigation systems and how they respond to unusual climate conditions in order to forecast problems and draw alleviation strategies’. The project included surveys, interviews and workshops with stakeholders, ‘where all the stakeholders will have an equal opportunity to express their views, interests and solutions. This will be the basis for the establishment of a participatory strategy to adapt and mitigate the negative impacts of global change.’^[10] A similar strategy was followed in the international project *AQUIMED Participatory design of adaptive groundwater management strategies and instruments in Mediterranean coastal water scarce areas as a response to climate change* (Bento et al 2009; Rinaudo et al 2012) and is being used in another social sciences project, *CHANGE Changing Climate, Changing Coasts, Changing Communities - Glocal Erosions, Risk Conceptions and Sustainable Solutions in Portugal*^[11].

In conclusion, involving the public and stakeholders in climate change research is still quite rare and seems entirely circumscribed to the area of agricultural research

Final remarks

In Portugal, if interactions between climate scientists and the public are fairly frequent, knowledge exchanges are still few and far between. There is some evidence of the persistence of a ‘deficit model’ of communication of climate science, insofar as scientists still seem to prefer one-way engagement with the public, via lectures, field trips, or theatre plays. However, a more in-depth analysis of these activities would be needed in order to assess the content of such communication. And yet, the fact that most activities are aimed at school children rather than adults or stakeholders with direct interests in these matters does give some clue as to the educational, rather than dialogical, purposes of this communication. Harnessing the power of local knowledge and integrating it in expert knowledge is also still a long way off. Portuguese climate scientists, especially in the ‘hard sciences’ have still to acknowledge that other world views can be pertinent for their work

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^[1] An earlier version of this article was presented at the 10th European Sociological Association conference (Geneva, 2011).

^[2] "Despite the highly regarded IPCC's consistent assertions that global warming is a serious problem with a "discernible" human component that must be addressed immediately, balanced reporting has allowed a small group of global warming skeptics to have their views amplified" (Boykoff and Boykoff, 2004: 126-127).

^[3] Unlike what has happened in other countries, such as the Atmosphere gallery at the Science Museum of London, several exhibitions at the Cité des Sciences in Paris (*Climax, L'atmosphère...le climat révélé par les glaces, Océan, climat et nous*), the exhibition *C'est notre Terre 2!* in Brussels.

^[4] <http://www.latitude60.blogspot.com/>

^[5] <http://www.proclira.uevora.pt/>

^[6] However, it should also be noted that 26% believe that its importance has been overstated and the rate of non-response (or "don't know") in these questions is higher in Portugal than in other countries.

^[7] <http://www.siam.fc.ul.pt/>

^[8] <http://cmrp.ist.utl.pt/BIOARIDRISK/index2.htm>

^[9] <http://www.cesam.ua.pt/index.php?menu=88&language=pt&tabela=projectosdetail&projectid=275>

^[10] <http://www.cesam.ua.pt/index.php?menu=82&tabela=projectosdetail&projectid=136&language=eng> ,

last accessed August 27 2011.

^[11]

<http://www.ics.ul.pt/instituto/?ln=e&mm=3&ctmid=1&mnid=1&doc=31818105387&linha=3&idpro=375>