REPORT

Science Briefing for Policy-Makers: Understanding Sea-Level Rise

Hosted by Chris Davies MEP at the European Parliament, Brussels

Wednesday 27th June 2012

Introduction

On Wednesday 27th June 2012, an audience from the European Parliament, European Commission and other interested parties met the world's leading researchers from the EU-funded FP7 programme ice2sea - a consortium research group that is improving global sea-level projections over the next 200 years.

Aim of the briefing

To provide an opportunity to find out what sea levels could mean for medium and long-term policy-making, and for participants to directly question senior researchers working at the forefront of sea-level science.

Project overview

Ice2sea is a European response to the uncertainty highlighted in the International Panel on Climate Change (IPCC) Fourth Assessment Report (2007), which identified ice sheets as the most significant remaining uncertainty in projections of sea-level rise. New sea-level projections from ice2sea will inform the Fifth Assessment Report from the IPCC, which will be delivered to EU policy-makers in September 2013.

For more information:
Contact Professor David Vaughan, ice2sea Programme Coordinator, British Antarctic Survey: ice2sea@bas.ac.uk
Visit: www.ice2sea.eu

Project aims

Using past records, observational measurements, and computer modelling techniques, ice2sea is developing an improved insight into the role of glaciers and polar ice-sheets in current and future sea-level change, and the tools to provide better projections.

Briefing programme

Three leading researchers presented an overview of factors affecting sea-level (including atmospheric and ocean change) and an insight into measurement of current sea-level rise, and how this could affect the risk of flooding on European coasts. This was followed by a discussion surrounding the role of sea-level projections in supporting policy development.

Professor David Vaughan, ice2sea Programme Coordinator, *British Antarctic Survey (BAS)*
David is a world-renowned scientist most notable for his contributions to the study of ice sheets in Antarctica. He leads the BAS 'IceSheets' science programme, and is Coordinating Lead Author of the Fifth Assessment of the IPCC, Working Group I (he was also Coordinating Lead Author of the Fourth Assessment of the IPCC, Working Group II). In 2004/05 David was the UK Principal Investigator and field-party leader for UK-US collaboration to complete airborne geophysical survey of the least visited part of West Antarctica. David is Programme Coordinator for ice2sea and also leads the management Work Package (1), which aims to facilitate the science and to maximise the researchers' ability to focus on scientific deliverables.

Professor Hartmut Hellmer, Physical Oceanographer, *Alfred Wegener Institute (AWI)*
Hartmut is a physical oceanographer at AWI studying the Southern Ocean, including ocean-ice shelf interactions, thermohaline circulation, climate change, and numerical ocean modelling. This year Hartmut and his team published a noteworthy Nature paper highlighting new discoveries about how future climate change will drive considerably greater quantities of warm water toward Antarctica, and increase the loss of ice from the continent. He is member of Member of CLIVAR / CliC / SCAR Southern Ocean Panel and this year (2012) was the UN nominated expert to assess and report the state of the marine environment. Hartmut leads ice2sea's Work Package 4, which aims to provide a range of surface climate change projections, ice surface (atmosphere) and ice shelf basal (ocean) mass fluxes for ice sheet models developed and applied in WP5 (projections of glacial change).

Professor Frank Pattyn, Glaciologist, *Université Libre de Bruxelles (ULB)*
Frank Pattyn is a glaciologist, the director of the Glaciology Department, and a visiting professor at the University of Ghent. He is responsible for teaching geomorphology and climatology courses in the Bachelor of Geography at ULB. On a scientific level, he took part in several expeditions to Antarctica and to glaciers of the Arctic, in order to study the interaction of glaciers and ice sheets with subglacial water and the ocean through the development of next-generation ice sheet models. He is president of the Belgian National Committee on Antarctic Research, , and a member of the steering committee of the NEEM project (deep ice core drilling in Greenland). Frank leads ice2sea's Work Package 2, which aims to address key uncertainties that currently limit the ability to understand the current changes seen occurring in glaciers and ice sheets, and thus the ability predict the future behaviour of continental ice.

The presentation given at the briefing is available to view at:
http://www.ice2sea.eu/wp-content/uploads/2012/07/ice2sea-MEP-briefing-public-version.pptx

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Sea-level rise: why does it matter?

Sea-level rise has been measured using tide gauges for the past 150 years, and using satellites for the last two decades. There is a strong consensus in the scientific community that global average sea-level is rising at approximately 3 mm per year, and that the rate of sea-level rise is increasing.

Worldwide, more than 10 million people each year are affected by coastal flooding. With expected growth in coastal cities this will rise to 30 million by 2080, but this number will increase dramatically if sea-level rise accelerates in future decades as predicted.

Economic projections suggest that by 2080 the annual bill for Europe alone would be around 25 billion Euros (figures from FP7 project ClimateCost).

Sea-level rise and policy-making decisions

The development of sound global and intergovernmental responses to climate change through the United Nations Framework Convention on Climate Change (UNFCCC) must be based on the most robust and reliable sea-level projections. The EU's long-term commitment to sea-level rise research is already shown in:

- The European Parliament's Integrated Coastal Zone Management strategy;
- The European Directive on Floods;
- The EU's national, regional, and local strategies, which include development of local sea-defence infrastructure.

Sea-level rise issues

Increased risk of flooding

The impact of sea-level rise is not as simple as might initially be imagined. The real impact occurs as the rise in sea-level progressively increases the frequency of damaging storm surges. Along many European coastlines, even moderate sea-level rise of a few tens of centimetres, could mean that storms we have grown used to seeing only perhaps once-per-century would come every few years.

"Sea-level rise isn't happening"

There is a proliferation of unverified anecdotal evidence on the Internet, along with specific local examples suggesting that global sea-level is not rising. Scientific consensus, based on a global network of in-situ measurements together with satellite data, shows that global average sea-level has risen throughout the 20th Century. Furthermore, in recent years the known contributions to sea-level change (such as glacier-retreat, thermal expansion of warming ocean water and ground-water extraction) have been measured with sufficient accuracy that measured global sea-level can be shown to be equal to the sum of the individual contributions.

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Misrepresentation of sea-level rise in the media

The 'poster child' of sea-level rise is a major misrepresentation of the actual risks to our growing coastal cities and unique coastal habitats, and damages the understanding of the changing risks associated with sea levels. Unfortunately, these provocative images often printed by the media alongside misleading headlines evoke a dramatic consequence of future sea-level rise projections. The role of ice2sea is to deliver clear and understandable information to policy-makers and the wider public on which to base opinions and future policies.

"Sea-level rise isn't equal all around the globe"

Although considerable emphasis is placed on global sea-level rise, sea level is not rising uniformly around the world; the highest rates of rise in recent years having been measured in the Pacific. However, Europe is currently seeing rates of sea-level rise that are close to average (~3mm/yr). In Europe, some areas of coastline are still "rebounding" (rising) after the loss of the weight of European ice sheets around 20,000 years ago; others are subsiding. Areas of rebound will be less affected by sea-level rise, while in areas that are subsiding, the effect of sea-level rise is magnified. Along some of the coastlines around the North Sea and Baltic, coastlines prone to erosion, long-term subsidence, and unusual storm surge characteristics make coastlines and coastal populations particularly vulnerable.

Next steps for ice2sea science and policy-makers

- End of July 2012: Submission of ice2sea scientific papers supporting IPCC AR5 (Working Group I);
- May 2013: Publication of the full report of sea-level change findings from ice2sea - available to policy makers;
- September 2013: Publication of IPCC AR5 (Working Group I) for policy-makers - Ice2sea consortium members available to comment and provide a deeper insight.

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Questions, comments, and responses

A range of questions were put to the panel (paraphrased below) – a synthesis of the answers provided by the presenters follows. If there are any additional questions please email ice2sea@bas.ac.uk and a member of the ice2sea consortium will respond.

Q1: *"Sea level rose dramatically at the beginning of the current interglacial period (10,000 years ago), when the ice melted. Since then, the rate of sea-level rise has dropped steadily and is now trivial. In particular, the example of the Polynesian island state of Tuvalu [a group of reef islands and atolls]" - Chris Davies, MEP*

Response from ice2sea: It is entirely true that sea levels have risen very fast in the past; for example, ice sheets retreated after the last glacial period between 20 and 10 thousand years ago, when the Earth was going though major climate change. There were small human populations around at that time, but they were relatively mobile and as sea-levels rose, they migrated inland. The current rates of sea-level rise, and those we predict for the future, are significantly lower than the geological record shows is possible, but now human populations and our infrastructure is so rooted in the coastal zone we are vulnerable even to small changes in sea levels. The rates of change we predict for the future may be less than we've seen in the geological past, but they will be sufficiently fast to require considerable planning and adaptation.

For the example of Tuvalu, there has been a lot of contrary discussion and reporting of incorrect information on this matter. Tuvalu is in an area of the high rates of recent sea-level rise, significantly higher than the global average (around 5 mm/yr, c.f. ~3mm/yr). The Proudman Oceanographic Laboratories is an international custodian for tide gauge data of this type. POL has the records from two stations on the main island, Funafuti. The Funafuti records going back to the 1980s are consistent with the rate of rise measured by satellites, but those underlying trends are contested because the records show very strong fluctuations on periods of a few years. These fluctuations have provided the opportunity, for those that would, to select segments of data that appear to show strong-rise/fall/no-change according to their preconceptions. The year-to-year fluctuations are driven by the El Nino/La Nina oscillations in the Pacific Oceans, which essentially represents a flipping from one state to another in the ocean temperature in the Pacific. They are related to climate change in the sense that more El Nino events may be occurring, but are not currently easy to forecast.

Coral atolls have the ability to grow to match the current level of the sea (or will be eroded if sea levels fall), and will likely do so over time. However, as above, it does not seem likely that the rate of growth will be sufficient in a state of accelerating rates of sea-level rise, to sustain the populations currently living on these islands.

Q2: *"Measurements of sea levels over the past century have been from tide gauge measurements, but could it not be the case that the gauges are falling due to land subsidence, rather than sea-levels rising? Also satellite measurements are adjusted with correction factors to make them match." - Chris Davies, MEP*

Response from ice2sea: Some individual tide gauges are indeed on land that is subsiding – others are on land that is rising. In our analysis of tide gauges, great care is take to allow for the vertical movement of each gauge, so that the sea-level change can be isolated. Similarly, corrections are required before satellite data can be relied on to give precise measurements of sea-level change. However, there are many sites on Earth, where satellite measurements can be properly verified, for example land-lock lakes, and salt-flats, and an such site provide a high degree of confidence that satellite measurements show a true picture of regional and global sea-level rise. The use of specific local records, or a focus on short-periods, can provide a highly misleading view, not representative of the general picture.

Q3: *"All the coverage of 'catastrophic sea-level rise' is based on predictions and projections and computer models, not on observation. And the IPCC has been busy reducing its estimates of sea level rise by 2100." – Chris Davies, MEP*

Response from ice2sea: We of course do not have observations of sea level heights in 2100, so computer simulations and projections must be used; they are all we have. Some models are based on an understanding of the physics involved, and others do use data observations for their basis. A common feature of our protocols for all climate projection is that before models can be used for prediction, they must be capable of reproducing recent and/or past changes. Testing model results against data is an important step in the process of developing any model and establishing the level of certainty we can ascribe to its projections.

Q4: *"Does the panel recognise that relative sea level rise and inundation in Bangladesh results from tectonic plate movement and the sinking of the Burma platelet, not from sea-level rise?" – Chris Davies, MEP*

Response from ice2sea: Yes, there are changes in land surface elevations in Bangladesh that are not climatic in origin. However rising sea levels will add to this to exacerbate the problems experienced by people living in Bangladesh, and this could be exacerbated even further by increases in the intensity of the monsoons.

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Q5: *"Is there too much of a focus on projections to 2100?" – Simon Wilson, AMAP*

Response from ice2sea: We are primarily concentrating on 2100 for our projections as this is the timescale chosen by the IPCC. We however believe it is important to consider further than this, which is why the majority of ice2sea's projections go up to 2200. Some governments already acknowledge that sea-level rise planning and adaptation strategies should address longer periods. For example, the Delta Commission in the Netherlands have developed sea-level projections to 2200, and the UK Environment Agency are looking to 2150 in their planning of London's sea defences. Projections need to cover the full lifetime of structures that are in the planning phase now – and many of these will have projected lifetimes of many decades – such as new power stations, commercial and residential developments, and the sea defences themselves. We should be ensuring that we allow for viable businesses and industry for our children's futures.

Q6: *"The European Commission's Impact Assessment Board wants to receive information in terms of Euros, not mm of sea-level rise. For example, if we reduce the uncertainty in sea-level rise by 25% will it reduce spending on adaptation by say 100MEuros/year?" - Iain Shepherd, European Commission*

Response from ice2sea: There is undoubtedly a monetary value of reducing uncertainty in sea-level rise, but calculating this would be a very difficult task, with strong dependence whether how policy-makers and individuals choose to invest early, or delay expenditure. However, for the role of ice2sea, and similar scientific programmes, is to provide robust projections so that costs can be saved and risks managed. The most economic sensible response may be early investment, but it may also be wise to delay investment until uncertainty in sea-level rise projections are reduced.

Q7: *"There are projects, e.g. the Millennium project that looked at the climate over the last 1000 years, including the "little ice age" of the 17th century, so climate variability can be seen in proxy data. Can we attribute sea-level rise to greenhouse gases, rather than natural variability of the Sun-Earth system?" – Andrea Tilche, European Commission*

Response from ice2sea: Sea-level change results from several different contributions, some of which are directly related to climate (e.g. thermal expansion of ocean water, and melting of mountain glaciers), and some which are not climate related (e.g. extraction of ground-water and construction of reservoirs). So, attribution of the 20th century rise in global sea-level to anthropogenic change is very difficult. However, sea-level and global temperature have been strongly linked throughout the geological record, and the projected rise is in global temperature will certainly add to current rises in sea-level, and the strongest influence on the temperature of the planet is the concentration of greenhouse gases in the atmosphere.

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Q8: *"What will the future be for modelling projections, and how will this fit with Horizon 2020?" – Paul Egerton, European Science Foundation*

Response from ice2sea: The funding for ice2sea came out of a call that was initiated by the statements made in the IPCC's AR4 report in 2007, and ice2sea will be contributing to the IPCC's upcoming report in the next few months. If science is to play its part in the wider debate, and properly serve policy-making, we need to set clear targets for ourselves and then work strategically to achieve towards those targets. For sea-level rise projection, it would be a reasonable goal to aim to reduce uncertainty in the 100-year projections by half every decade from now. For ice2sea, we have developed considerable momentum in the research and a community focussed on the same goal. The ice2sea partners will seek funding opportunities for continuation of this research within the last Work Programme of FP7, and in Horizon 2020 funding rounds.

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