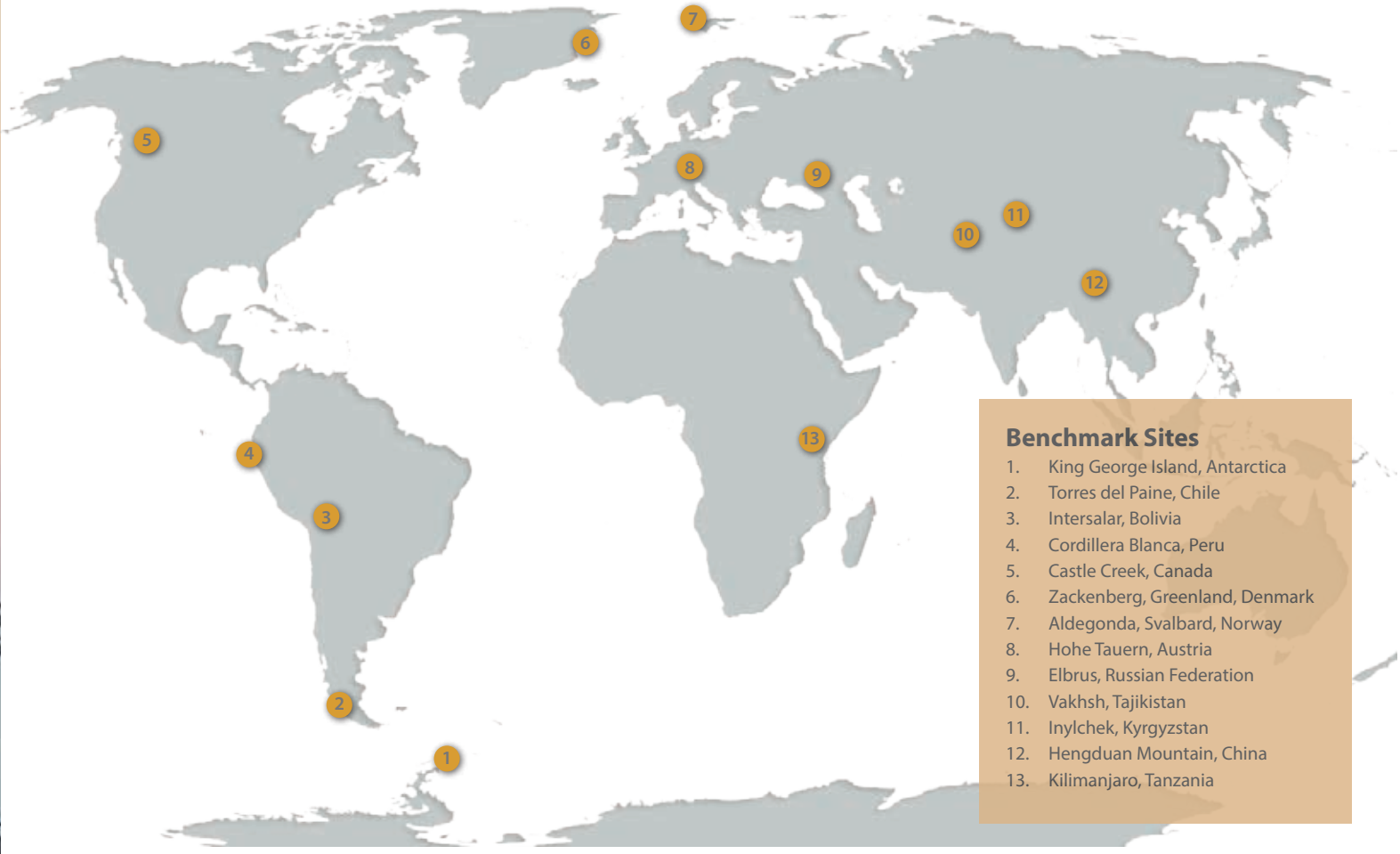
A changing world

Using nuclear techniques to investigate the impact of climate change on polar and mountainous regions

By Sasha Henriques



Nuclear techniques are being used in polar and mountainous regions to study climate change and its impact on the quality of land, water and ecosystems in order to better conserve and manage these resources.

Researchers from around the world will be using data from 13 benchmark sites to draw conclusions about the effects of the rapidly changing climate on the Arctic, mountains and the western part of Antarctica, which have alarmed communities, environmentalists, scientists and policy makers. Between July 2015 and July 2016 they will be using isotopic and nuclear techniques, as well as geochemical and biological analytical methods from other scientific disciplines. This will enable them to track soil and water, to monitor the movement of soil and sediment and to assess the effects of melting permafrost on the atmosphere, as well as on the land, water and fragile ecosystems of mountainous and polar regions. The measurements follow numerous on-site tests carried out since November 2014 to perfect the sampling technique.

Many fear that climate change will cause soils to become unstable, and that there will be less water available for communities living in mountainous areas. There is also concern that greenhouse gases locked away in the soils of these regions for millennia will now find their way into the atmosphere, causing further changes to the Earth's climate.

The IAEA has embarked upon a four-year (2014–2017) technical cooperation project involving 23 countries and six international organizations to assess whether or not these climate change concerns are justified, and to identify what can be done if they are.

Although the project will be undertaken in polar and mountainous regions the results, especially those relating to permafrost and carbon in the atmosphere, can have global implications.

Gerd Dercon, Head of the Soil and Water Management and Crop Nutrition Laboratory of the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, noted that the impact of climate change in mountainous and polar regions is "not always well understood. And that's why this project is so important. But also, this project is very significant in the context of looking at what happens when the cryosphere — that's snow cover, ice sheets, glaciers and

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permafrost — changes, and what happens in terms of greenhouse gas emissions, soil water availability, sediment and sedimentary distribution, slope stability, and coastal erosion."

Peering into the past with isotopes

According to Heitor Evangelista da Silva, a paleo-climatologist from the Universidade do Estado do Rio de Janeiro in Brazil, one of the project's key components is the use of nuclear techniques to understand past climate behaviour in order to predict the future.

Isotope and nuclear techniques allow scientists to read the history of the Earth preserved in nature's own archives. These archives are the ice in glaciers or polar ice caps. They are the soil and sediments in lakes and oceans and organic matter in the earth or in trees. Isotopes are different forms of a single element, which vary in the number of neutrons that they have.

By measuring isotope composition and ratios in layers of sediment and ice it is possible to reconstruct climate history and variations in greenhouse gas concentrations over extremely long time periods. The same techniques can be applied to soil to extract information about how climate change in polar and mountainous regions affects the movement and quality of soil, and the production of greenhouse gases.

Gaining insight into past climate change events and how the environment responded to those changes is an excellent way of understanding current and future changes in climate and developing appropriate responses.

Adaptation — the bigger question

In July 2015, IAEA will conduct a training course in Svalbard, Norway, for around 20 fellows from different benchmark sites, teaching them how to use the required testing

Researchers on their way to collect soil samples on King George Island, Antarctica.

Scientists travel through an ice cave to get to the best sampling locations.

methods. Later, experts will also be sent to the various locations to provide follow-up instruction as needed.

This approach will ensure cross-comparability of the sampling and results analysis, an important element in this multi-country project.

Sample collection and analysis of the data will take place from July 2015 to July 2016. "If this phase of the project goes well, we will have another phase where we will then look at how we can adapt to climate change. Because assessing the impact is one thing, but the bigger question is how we can use this information to help communities in mountain regions adapt," said Dercon.

Collaboration and policy change

"I think that the success of this project will trigger collaboration between countries from all continents and between scientific disciplines, helping us to better study and understand climate change in mountains and polar regions," said Bulat Mavlyudov, coordinator of the interregional project, and a glaciologist from the Russian Academy of Sciences' Institute of Geography. "The results will be put to good use in formulating recommendations for climate change adaptation policy being looked at by the Intergovernmental Panel on Climate Change."

Members of the scientific research team that went to King George Island, Antarctica.

(Photos: G. Dercon/IAEA and B. Mavlyudov/ Russian Academy of Sciences)

A small river bringing large amounts of sediment down from the higher altitudes.

Analysing the age and quality of organic matter in soil can tell scientists a great deal about future climate change.