Australian Government

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Nuclear-based science benefiting all Australians

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Secretary
Standing Committee on Industry, Science and Innovation
House of Representatives
PO Box 6021
Parliament House
Canberra ACT 2600

To Whom It May Concern

Please find attached a submission from the Australian Nuclear Science and Technology Organisation to the Committee's inquiry into long-term meteorological forecasting in Australia. The submission concentrates on the first of the terms of reference of the inquiry. ANSTO would be happy to provide further information to the Committee if that would be helpful.

Yours sincerely

Dr Adi Paterson

Current climate modelling methods and techniques and long-term meteorological prediction systems can be validated by being tested against past changes in climate. ANSTO's capabilities in nuclear science provide a unique insight into changes in climate and atmospheric composition in Australia and elsewhere.

Use of cosmogenic isotopes researching older climates and environmental systems and translating them into long-term prognosis

ANSTO uses cosmogenic isotopes to research older climate changes and environmental systems and translates the findings into understanding the main forcing patterns that drive change. The study of Earth's climate system of the past is archived in corals, tree-rings, glacial deposits, ocean sediments, cave formations and ice cores, reveals a complex scale of variations ranging from major glacial cycles (100,000 years), to millennial time scales (1,000 years) and even decadal changes (e.g. El Nino). That research has revealed, for example, rainfall patterns in the Perth area dating back 450 years, and how this is influenced by the Indian and Southern Oceans.

Currently, 'global patterns' of climate change are inferred principally from Northern Hemisphere records and modelling approaches. Critical questions are now being asked about the intensity, timing and mode of abrupt climate transition patterns across Earth's hemispheres. However, with a scarcity of Southern Hemisphere studies, answers are not readily available. Using isotopes such as radiocarbon and uranium series, ANSTO carries out field studies in Australia and Antarctica. We have been focusing on select Southern Hemisphere archives to enhance our knowledge of past climate variability in Australasia and Antarctica in order to better predict future change in our region and to study landscape evolution processes and past environmental conditions.

Use of naturally occurring atmospheric radionuclides and stable isotopes to evaluate and advance model predictions of climate-related gases and pollution

ANSTO has a major research commitment aimed at understanding atmospheric processes and aerosol (pollution) characterisation using nuclear techniques and natural isotope tracers. The measurement-based experimental research of ANSTO's atmospheric group is designed to ultimately feed into improved weather and climate model forecasts on a range of scales, through both process studies (which lead to better understandings of physical processes represented in models) and long-term monitoring (which can be used to evaluate model transport predictions and to constrain pollutant source functions). Our measurements and empirical understanding thus provide both an improved physical basis and a means of validation for meteorological forecasts.

ANSTO focuses upon key atmospheric issues for which the application of nuclear-based technologies and expertise have the potential to progress our understanding in ways that are unavailable to conventional techniques. With strong national links to the Australian Bureau of Meteorology and CSIRO, and international involvement in the World Meteorological Organisation's Global Atmosphere Watch Program, the European and North American Carbon Programs, and the Global Energy and Water Cycle Experiment (GEWEX) modelling community, ANSTO enjoys a unique position worldwide, having at its disposal in one place multiple established and tested environmental nuclear technologies, including:

- High-precision measurements of naturally occurring radioactive isotopes in air, for tracing of transport and mixing processes in the atmosphere;
- Accelerator-based Ion Beam Analysis for determination of the detailed elemental composition of airborne fine particle samples;
- High-resolution stable isotope measurements, for the partitioning of complex intrinsic processes in natural exchange cycles in the atmosphere.

ANSTO's atmospheric science program contributes to high-priority Australian and international scientific research by advancing knowledge and representations of the movement of key climate-related gases and pollutants in the atmosphere. Results from our research are enabling practical, science-based improvements to the management of pollution (and thereby human health) in our cities, and alleviation of the effects of climate change.

In particular:

- ***Mixing and exchange in the lower atmosphere.*** ANSTO research is providing crucial observational underpinning for Australian and international efforts to advance scientific understanding of atmospheric mixing and exchange processes that affect weather and climate, and to improve their representations in numerical prediction models.
- ***Regional sources and transport of pollution and climate-active species.*** ANSTO research is providing advanced nuclear-based tools for characterisation of patterns of pollution and greenhouse gas emissions in Australia and elsewhere, in particular for several of our Asian neighbours...