Submission

2016 National Research Infrastructure Roadmap Capability Issues Paper

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Environment and Natural Resource Management

Question 18: Are the identified emerging directions and research infrastructure capabilities for Environment and Natural Resource Management right? Are there any missing or additional needed?

We feel that atmospheric measurements are somewhat under-represented in the current assessment. Improving the network of atmospheric greenhouse gas (GHG) concentration measurements to span the continent (including high density in urban and other high emissions areas) would provide a more rigorous dataset for ground based validation of satellite data and would allow high quality top-down estimates of GHG emissions to be made on local, through regional to continental scales. We believe these assessments will be increasingly important to meet the requirements of the Paris Agreement at COP21 and Australia needs to be investing in the infrastructure to deliver these assessments in the near future.

While we think many of the emerging directions and required infrastructure capabilities identified are right and are heartened to see that atmospheric observations are listed as "continu[ing] to be a high priority" (p. 22), we are concerned that there is a misunderstanding of what constitutes atmospheric observations. OzFlux (funded through TERN-NCRIS) is a network providing land-air exchange fluxes and does not provide greenhouse gas (GHG) concentrations. Rather, OzFlux products are complementary to the measurement of atmospheric trace gas concentrations.

We believe that enhancing atmospheric concentration measurement infrastructure would be synergistic with supporting OzFlux and other terrestrial observing platforms. Together, these data would provide more comprehensive information to drive and validate climate models such as ACCESS and their carbon cycle and chemistry modules. Unless ACCESS is underpinned by high quality observations spanning land, sea and air, it will ultimately fail in its goal of providing Australia with a tool to be climate change prepared (with all the environmental, social and economic benefits that preparedness will confer). We point to the work undertaken by the North American Carbon Program (NACP) and the Integrated Carbon Observation System (ICOS) – a European initiative, in which the physical infrastructure for observations along with data integration platforms are integrated at a high level across not only the terrestrial and marine environments, but also the atmosphere.

At present, Australia's research infrastructure capabilities around atmospheric observations are somewhat piecemeal. CSIRO plays a key role by running the Global Atmospheric Sampling Laboratory (GASLAB) in Aspendale (and its paleo counterpart ICELAB), which is crucial to providing the calibration links to World Meteorological Organisation (WMO) recognised mole fraction scales required for all atmospheric observation sites that report to WMO's Global Atmosphere Watch (GAW) programme.

The Cape Grim Baseline Air Pollution (in Tasmania) is operated by the Bureau of Meteorology (BoM) and the science program is jointly managed with CSIRO, along with contributions from the university

sector (principally the University of Wollongong) and the Australian Nuclear Science and Technology Organisation (ANSTO). The Cape Grim station is an integral piece of Australian scientific infrastructure (funded outside NCRIS) which provides an extensive set of atmospheric observations, including greenhouse and ozone depleting gases, reactive gases, aerosols and radon, with enormous scientific impact, through the WMO-GAW, along with the use of its data by the International Panel on Climate Change (IPCC), WMO/UNEP (United Nations Environment Programme) and similar.

Beyond Cape Grim, Australia's atmospheric composition observation infrastructure consists only of a handful of small, semi-permanent sites (mostly only measuring CO_2 and CH_4) largely attached to transitory projects that are not funded in the long term. This in situ ground based measurement network, termed the Australian Greenhouse Gas Observation Network (AGGON), is co-ordinated and run through CSIRO in collaboration with a range of partners including the BoM and Australian Antarctic Division (AAD). The University of Wollongong runs two Total Carbon Column Observing Network (TCCON) sites.

We note and applaud that the Issues paper identifies that terrestrial systems ought to expand to include desert, tropical and alpine regions. Similarly, we argue that atmospheric observations are also required in these crucial and under-represented zones. As a minimum, Australia should be investing in at least one 'Cape Grim twin' in the tropics. Our station at Gunn Point (near Darwin) has been an attempt to meet the unquestionable science need for high quality and extensive atmospheric observations in the tropics, but is at present largely unsupported.

A third node in an Australian atmospheric observation network should be situated centrally in Australia. We would then expand the network around these nodes with smaller facilities targeting specific needs such as monitoring GHG emissions from urban areas, from biomass burning events or as fugitives from carbon capture and storage or coal seam gas mining activities. The atmospheric network design (locations, compounds, measurement frequency) we are suggesting has been optimised with the use of atmospheric models across several scales (local to continental) to best facilitate the detection of GHG emissions trends with the deployment of any new infrastructure.

We see significant value in the capabilities of the CSIRO GASLAB and ICELAB infrastructure being accessible to a wide range of researchers and industries beyond the immediate interests of CSIRO. Analyses of atmospheric composition in air and ice cores are made for Australian agencies including BoM, Geoscience Australia, CO2CRC, Gas Industry Social and Environmental Research Alliance (GISERA), other CSIRO business units, the Universities of NSW, Melbourne, Wollongong and Tasmania, ANSTO and the AAD. Companies such as Origin Energy and Ecotech as well as overseas science organisations such as Scripps Institution of Oceanography (USA), Empa (Switzerland) and CNRS (France) also access the GASLAB/ICELAB capabilities. Calibration gases are produced and made available to these and many other groups and universities, enabling their measurements to be brought onto internationally recognised calibration scales, allowing the data to be integrated with both the CSIRO and international networks. These services significantly enhance the national effort in atmospheric monitoring but are only partly funded by users and would greatly benefit from stable support.

The CSIRO GASLAB and ICELAB facilities are advanced and mature capabilities that are highly regarded nationally and internationally. As such they are frequently depended upon for provision of measurements of the highest standards. These demands are growing as verification of emissions and validation of models increasingly require atmospheric observations. However, the funding and support for the facilities is exposed to organisational changes and economic variability. Stable funding and support are essential to meet these demands and to enhance new measurements

across a range of spatial and temporal scales, onto mobile platforms (ships, vehicles, UAVs) and to support major national programs (e.g. the Australian Antarctic Program's million year ice core).

Question 19: Are there any international research infrastructure collaborations or emerging projects that Australia should engage in over the next ten years and beyond?

Internationally, IG^{3}IS, the WMO's Integrated Global Greenhouse Gas Information System, is emerging, with the goal of combining atmospheric composition and socioeconomic activity data in partnership with the user community to:

- Quantify progress of emission reduction agreements, e.g., Nationally Determined Contributions (NDCs) pledged at the Paris Agreement,
- Reduce uncertainty of emission inventory reports, and
- Inform additional mitigation actions

The WMO now has Green Climate Fund accreditation for building greenhouse gas (GHG) observation infrastructure in developing countries with funding of $10-50M per proposal. Developed countries like Australia need to be contributing to this effort and leading the way by expanding our research infrastructure in GHG observations ahead of the game and developing the knowledge to operationalise these measurements in the medium term. We then expect that Australia would engage in capacity building activities with neighbouring developing countries to deliver on IG^{3}IS's goals.

The Million Year Ice Core is planned as a major international program by International Partnerships in Ice Core Sciences (IPICS), under The Scientific Committee on Antarctic Research (SCAR) and Future Earth/PAGES. The Australian Government has committed to leading the retrieval of this core through the Australian Antarctic Division, in a large international consortium. CSIRO is the sole Australian provider of the research into the trapped air in ice and will be expected to lead aspects of this science in the program. The analytical capabilities and modelling interpretation within CSIRO GASLAB and ICELAB are directly relevant and would be developed to apply to this significant and long term challenge.