

# 2016 National Research Infrastructure Roadmap Capability Issues Paper

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Our **views represent a combined position, having consulted widely within each institution.** We highlight an issue of critical importance to research infrastructure for weather and climate sciences. While Earth observation requirements are well-recognised in the existing Australian research infrastructure system, no effective nationally coordinated and funded approach supports integrated infrastructure for research into *modelling* of future weather and climate. This submission makes the case for improved governance and funding for ACCESS, Australia's weather and climate modelling system.

## **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 welcome the identification of ACCESS as a research infrastructure capability under *Environment and Natural Resource Management* in the NRIR Capability Issues Paper. Our rationale and community vision has ACCESS at its core, creating a platform to deliver world-class research and state-of-the-art weather, climate and environmental predictions, and delivering national benefit through enhanced national and international research collaboration.

**Economic Rationale:** Australia's economic sensitivity to weather and climate is estimated at \$65B, or 4% of GDP<sup>i</sup>. Natural disasters, mostly weather or climate related, cost \$6.3B annually, and this is projected to increase to \$23B by 2050<sup>ii</sup>. Improved national weather and climate simulation capability has numerous benefits:

- Improved weather predictions will deliver more accurate forecasts of natural hazards (e.g., floods, fires and cyclones) and significantly reduce the avoidable cost and risk to human life.
- The potential value of improving seasonal predictions for Australia is estimated to be \$1.6B per annum for the agricultural sector and \$0.4B per annum for other industries.<sup>iii</sup>
- More credible simulations of future climate scenarios are our only means to enable national preparedness through effective adaptation and mitigation strategies.

Building our resilience to climate change impacts requires a prediction capability that is global in scope but tailored to Australia's unique environment and accessible to our research community.

**The Vision:** Over the last decade Australia's research community (CSIRO, Bureau of Meteorology and universities, with international partners) collaborated to build ACCESS, an advanced weather and

climate simulation system. ACCESS significantly improves forecasting skill and is benchmarked in the top five global climate models. The ACCESS framework provides a clear research pathway to impact by direct contribution to operational weather and climate prediction tools. While the ACCESS infrastructure has driven effective research collaboration (the Earth Systems and Climate Change Hub being one example), the focus has been on operationally robust systems, rather than on applications designed to support research. Our research community is poised to transform this investment into a nationally significant platform that drives deep and effective research collaboration, independent of the operational agencies.

ACCESS is arguably the single most important piece of infrastructure underpinning future weather and climate prediction in Australia. Providing the ACCESS infrastructure as a national weather, climate and environmental research platform, located at a national high-performance computing centre, will have significant immediate and long-term benefits for Australia. It will:

- 1) Ensure highest international standards of software engineering and provide scientists with a world-class, globally-benchmarked, modelling infrastructure;
- 2) Further enhance research collaboration for effective continuous model system improvement;
- 3) Significantly enhance Australia's preparedness and resilience to a changing climate;
- 4) Ensure efficient use of HPC infrastructure where ACCESS is implemented (currently NCI);
- 5) Create a more skilled workforce, trained in the development and operation of complex Earth System models such as ACCESS (noting such skills are highly useful outside our domain); and
- 6) Develop Australia as a regional hub for weather and climate prediction research.

A weather, climate and environmental research platform comprises: i) High Performance Computing (HPC) to run model simulations; ii) High Performance Data management systems (HPD) to curate and analyse and make available the large volumes of output data; and iii) the software code comprising the ACCESS system itself. The ACCESS model framework encompasses a range of sub-models which each represent key parts of the Earth system (atmosphere and ocean; land surface and cryosphere; biogeochemistry and hydrology). This framework integrates over capability elements and is seen as a future emerging trend in the NRIR Issues Paper. However, the interdisciplinary nature of the Earth System components results in extraordinarily complex underlying software architecture. ACCESS comprises over 2 million lines of code, representing a level of complexity rivalling physical infrastructure. Yet, Australian investment in its maintenance, efficiency and agile deployment are far below that of comparable nations.

The potential national benefits of ACCESS depend on a network of Australian institutions and international partners, each with specific interests and priorities guiding investment. This research into Australian weather and climate depends so critically upon ACCESS, that the support of its associated infrastructure necessitates arrangements that minimise vulnerability to limited and short-term funding cycles. Instead, it requires a long-term and national commitment to fund expert operators who can maintain and serve the ACCESS infrastructure to the research community.

#### **Recommendations:**

1. That there be a formal NCRIS facility for a national research platform in weather and climate research, with ACCESS at its core;

2. That ACCESS is hosted at a national HPC centre, supported by a team of software engineers to maintain and serve the infrastructure to the research community;
3. That ACCESS adopt a governance structure to ensure accessibility to the Australian research community, supporting collaboration and leveraging national benefit outcomes sought by the investment.

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<sup>i</sup> CAWCR technical report CTR 075. Next Generation Australian Community Climate and Earth-System Simulator (NG- ACCESS) – A Roadmap 2014-2019. Bureau of Meteorology.

<sup>ii</sup> Building our nation's resilience to natural disasters. A report of the Australian Business Roundtable for Disaster Resilience and Safer Communities. <http://australianbusinessroundtable.com.au/our-papers/white-paper>

<sup>iii</sup> Improved Seasonal Forecasts. Managing Climate Variability R&D Program. <http://www.managingclimate.gov.au/research/current-projects/climate-forecasting-research-2/improved-seasonal-climate-forecasts-the-benefits-for-agriculture/>