

5 Earth System Modelling (ESM)

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5.1 Overview

Australia is particularly vulnerable to the risks of climate change and year-to-year climate variability. Australians already live with a highly variable climate and climate change will result in even greater challenges. Mitigating and adapting to climate change is therefore a priority for Australia. Accordingly, the National Framework for Australian Climate Change Science¹⁹ identified climate prediction at all time scales (daily, seasonal, decadal and centennial) as one of the highest research priorities for Australia's climate change science. This capability, combined with the addition of social and economic systems to climate model systems, is essential to underpin Australia's mitigation and adaptation responses to climate change.

The Earth System Modelling (ESM) program is addressing this high priority need by building a national capability in climate and earth system simulation for the Australian community. The ESM Program is part of CMAR's joint operation with the Australian Bureau of Meteorology (Bureau), the Centre for Australian Weather and Climate Research (CAWCR), and is developing the Australian Community Climate and Earth System Simulator (ACCESS) with significant involvement from Australia's universities and international agencies, especially the UK MetOffice.

ACCESS will be Australia's next generation climate model: it is already the Bureau's operational weather forecasting model and by 2013 it will underpin the Bureau's seasonal climate prediction service. ACCESS will be internationally competitive and world class, so that it provides the best possible simulation capability and science needed: i) for climate impact and adaptation studies; ii) to underpin Australia's basic weather services; iii) to enable Australia to contribute to future Intergovernmental Panel on Climate Change (IPCC) assessments and participate in international model intercomparisons; and iv) for better understanding and prediction of the drivers that affect Australia's climate (such as El Niño) in order to better manage Australia's climate-sensitive natural resource systems (rainfall, soil water, vegetation) in the coming decades.

ESM's science and team leaders are a mix of both Bureau and CSIRO staff, have strong track records in developing and implementing world class coupled climate models and numerical weather prediction systems. For example, Drs' Tony Hirst and Martin Dix led the participation of the CSIRO Mk 3.5 climate model in the IPCC Fourth Assessment report (IPCC AR 4) in 2007 and Dr Kamal Puri has led the development of the Bureau's global and regional Numerical Weather Prediction (NWP) systems for many years and was Chair of the World Meteorological Organisation's Working Group on Numerical Experimentation. Furthermore, the teams include scientists such as Drs' Hirst, John Finnigan, Yingping Wang, and Richard Matear who are leaders in their respective fields, with over 7000 career citations between them. The data assimilation, model system, and infrastructure teams are a mix of highly skilled and experienced scientists and software engineers that are the hallmark of any team tasked with building the current generation of highly complex climate and earth system models. This comprehensive biophysically-based capability is enhanced by the Complex System Science team, led by Dr John Finnigan, which is developing the Integrated Assessment Models (IAMs) and approaches required to bring social and economic systems into Australia's biophysical Earth System Models.

Developing an earth system and climate simulation capability cannot be done by the ESM Program alone. Building ACCESS requires skills in process understanding and observations of all elements of the climate system. Applying ACCESS will require the development of modules for regional scale modelling and environmental prediction. Close collaboration with all the Programs in CAWCR, (ALOA, WEP, CVC, OOAP) which provide specialist capability in complementary research areas is an essential element of the ESM Program's strategy for fulfilling its mission and achieving its goals.

¹⁹ Australian Climate Change Science: A National Framework (2009), Department of Climate Change. Commonwealth of Australia ISBN: 978-1-921298-57-8.