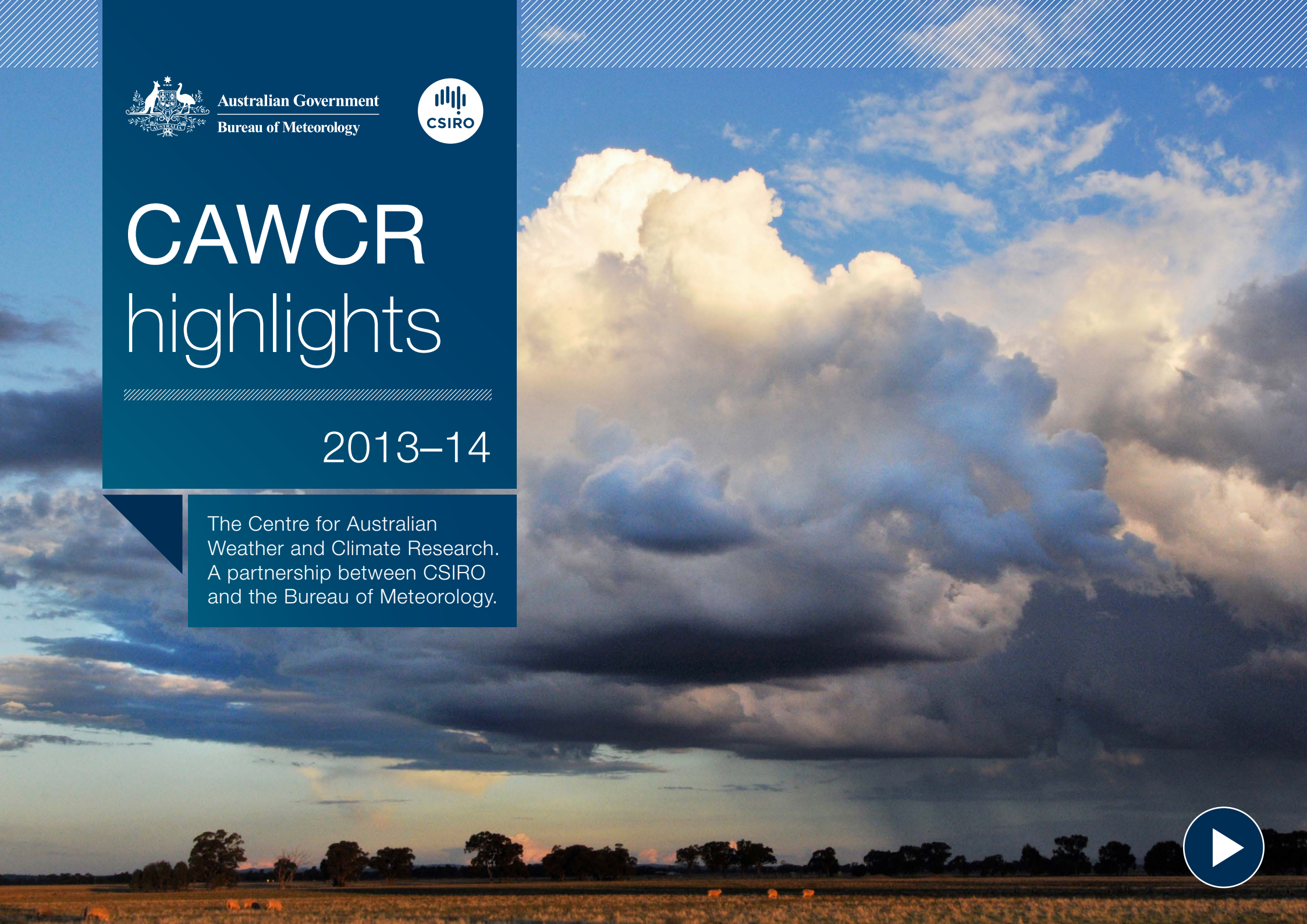
Australian Government
Bureau of Meteorology

CSIRO

CAWCR highlights

2013–14

The Centre for Australian Weather and Climate Research. A partnership between CSIRO and the Bureau of Meteorology.



CAWCR highlights 2013–14

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Cover photograph: Storm clouds near Logan, central Victoria. Photograph by Alison Pouliot.

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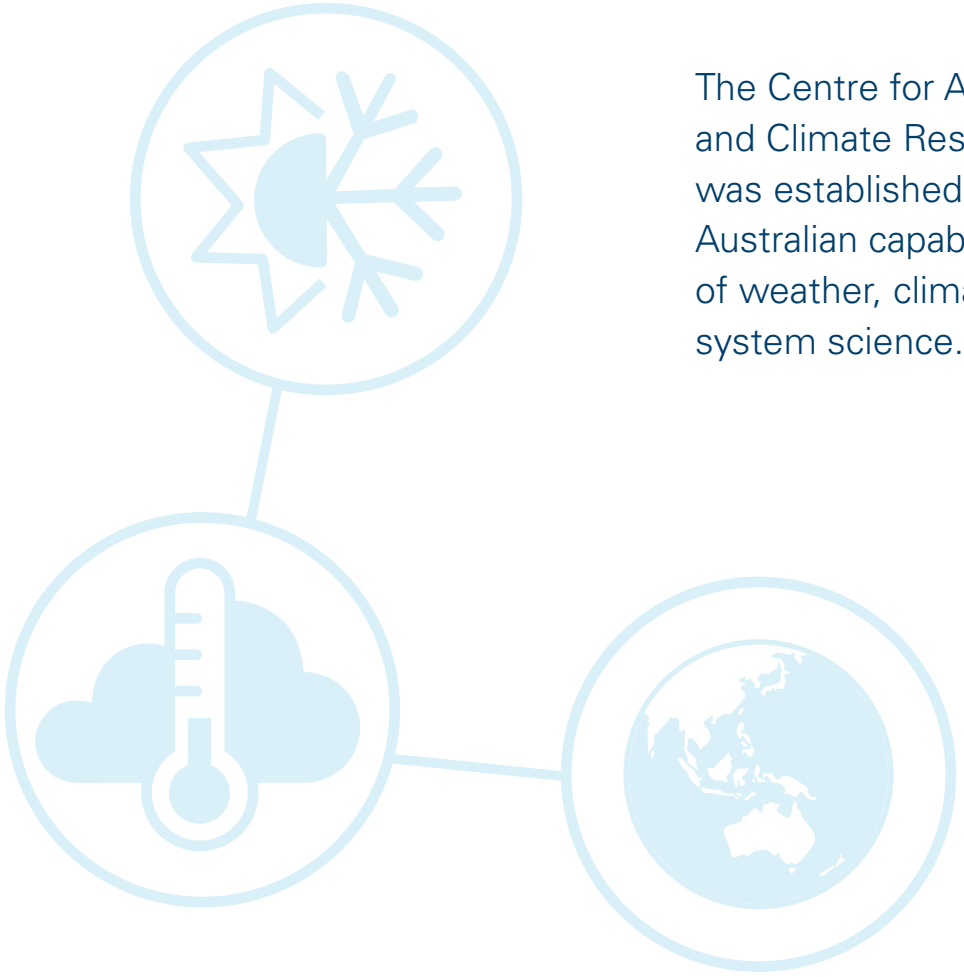

The Centre for Australian Weather and Climate Research (CAWCR) was established in 2007 to build Australian capability in the areas of weather, climate and earth system science.

It brings together the Commonwealth Scientific and Industrial Research Organisation's (CSIRO) Division of Marine and Atmospheric Research and the Bureau of Meteorology (the Bureau) in a joint research venture covering the fields of meteorology, climate, and earth system science.

The following examples provide an indication of the research that was conducted in CAWCR during 2013–14. The emphasis of these examples is on the practical outcomes of CAWCR activity.

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The significant impact of satellite data on numerical weather prediction

Experiments conducted in conjunction with the US Joint Centre for Satellite Data Assimilation have quantified the significant benefits of earth observations from space on southern hemisphere numerical weather prediction and the forecasting of extreme weather.

In the southern hemisphere, the accuracy of a 24-hour forecast without satellite data is the same, on average, as a 96-hour forecast with satellite data. That is, satellite data increase the forecast duration by a factor of four, for the same accuracy.

This gain in forecast skill results in significant societal benefits: improved warnings and more time to prepare for extreme weather such as tropical cyclones and heavy rainfall.

The high-ice water content/high-altitude ice crystal field campaign

Large concentrations of small ice crystals in high-altitude clouds are dangerous to aircraft because a build-up of ice in the engine can lead to engine failure.

Improved detection and prediction of high-ice water content will lead to more accurate aviation forecasting of these conditions. From January to March 2014, a high-ice water experiment was run out of Darwin, flying an aircraft fitted with microphysics and water-content sensors, and cloud radar. The aircraft flew 23 missions between Broome and Darwin, measuring ice conditions in convective clouds over the ocean. These data were combined with rapid-scan imagery, supplied specially from the Japanese MTSAT-1R satellite, surface radar data and lightning data. From the data, we hope to learn why high-altitude ice occurs, and how it might be predicted.

Numerical weather prediction

The numerical weather prediction system installed at the Bureau is called the Australian Prediction Suite (APS).

In October 2013, the original APS0 version was fully upgraded to APS1 with commissioning of high-resolution (4 km) forecasting for Australian cities. The next version of the APS (APS2) is in research implementation. APS2 includes an entirely new component, a global ensemble system, which enables multiple forecasts to be run, to test the statistical consistency of predictions.

APS is based on ACCESS (Australian Community Climate and Earth System Simulator), a modelling code being developed across the Bureau, CSIRO and the universities. The status of the ACCESS modelling framework as a community system was accelerated by moving to a new supercomputer at National Computational Infrastructure, and by the completion of the first phase of the development of the (virtual) Climate and Weather Science Laboratory, in conjunction with our partners through the National eResearch Collaboration Tools and Resources project. The virtual laboratory is designed to reduce the technical barriers to the use of ACCESS, and to enhance community collaboration in ACCESS development.

Coastal modelling and the Samoan Parliament

CAWCR scientists modelled storm surges in relation to tropical cyclones, sea-level rise and future climate change to establish where the new Samoan Parliament building could be located, to make sure that it is not at risk of flooding in the foreseeable future.

The project team provided estimates of sea-level height and currents for events with return periods of 50 and 100 years for different assumptions of sea-level rise and maps of inundation risk. These values are being considered by the engineers designing new structures.

Training the Pacific trainers

CAWCR is supporting the Climate and Oceans Support Program in the Pacific, funded by the Department of Foreign Affairs and Trade, to increase community capacity to respond to seasonal climate extremes.

As part of the project, techniques are being developed to incorporate traditional knowledge into the seasonal forecast products currently used by Pacific national meteorological services (NMS). Benefits to the local NMS include increased uptake of their seasonal products, while the community receives more accurate and relevant forecasts to help them make decisions and plan more effectively.

Carbon in the Southern Ocean

The Southern Ocean uptake of carbon dioxide is large compared to other ocean areas.

This uptake has been evaluated for the past 20 years from assembly of surface-ocean and full-ocean-depth hydrographic results, together with ocean and atmospheric models, as part of an international program— the Regional Carbon Cycle Analysis and Processes project.

Ocean models include the cycling of carbon through phytoplankton production. Measurements from ships and from moored sensors at the Southern Ocean Time Series Facility have revealed unexpectedly high levels of phytoplankton production in deep mixed layers in spring. The subantarctic Southern Ocean is a significant store for carbon in the earth system. These measurements change our perspective, and will lead to reformulation in the global carbon models.

MH370 Task Team

BLUElink has been a decade-long partnership between CAWCR and the Royal Australian Navy to develop a system for forecasting ocean currents out to several days in advance.

The system was deployed to assist the Australian Maritime Safety Authority in their search for Malaysian Airlines flight MH370, which disappeared in March 2014. Currents from OceanMAPS, the operational system at the Bureau, and OceanCurrent, a real-time data-interpretation system now installed on the Integrated Marine Observing System portal, were used to predict the possible drift of wreckage in the Indian Ocean. BLUElink's high-resolution relocatable model was also used in the search.

Enhanced storm-surge capability

Australia has a vast coastline, vulnerable to storm-surge events that often occur in conjunction with cyclones.

Damage caused by storm surges in recent years has highlighted the need to develop an enhanced operational storm-surge warning system. A probabilistic system is being developed, with an ocean model forced by an ensemble of tropical cyclones produced by the Bureau's numerical weather forecast. The system is intended for operational implementation at the Bureau by June 2017. It is being tested against data collected during the destructive category 5 tropical cyclone *Yasi*.

Detecting and predicting volcanic ash

Airborne volcanic ash is both disruptive and dangerous for aviation.

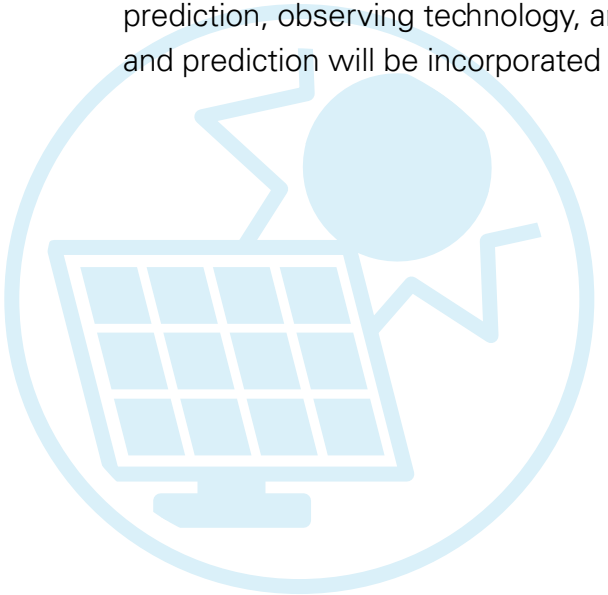
CAWCR tested advanced techniques for better detecting ash in multispectral satellite imagery from several volcanic eruptions in the Australasian region. Improved detection will be possible from mid-2015 with the availability of high-resolution observations from the new Japan Meteorological Agency satellite Himawari-8. The data interpretation is paired with improved modelling of volcanic ash dispersion to enhance the Bureau's warning service for this significant aviation hazard.

MENU

Forecasting solar energy

Accurate forecasts of supply and demand for solar energy will increase its commercial viability in Australia.

CAWCR delivered the Australian Solar Energy Forecasting System into the live market system at the Australian Energy Market Operator, covering timeframes from five minutes to two years. The system caters for large-scale photovoltaic and solar-thermal plants as well as distributed small-scale photovoltaic systems. New developments in numerical weather prediction, observing technology, and power conversion and prediction will be incorporated in the coming year.



Nowcasting floods

CAWCR, in collaboration with the Victorian Smart Water Fund, and the Sydney Catchment Authority, is developing a prototype web-based system to deliver nowcast (present conditions) data to aid in predicting floods.

The Bureau's nowcasting technology provides high-spatial-resolution rainfall estimates from radar and short-duration rainfall forecasts for the next 90 minutes to six hours. The Short Term Ensemble Forecast System (STEPS) rainfall forecasting software was developed jointly by the Bureau and the UK Meteorological Office.

Smoke predictions for improved health outcomes

Urban and rural populations are experiencing increased exposure to natural sources of air pollution from dust and smoke, with consequent negative health impacts.

CAWCR is leading a multidisciplinary project to develop a prototype smoke-management modelling framework that includes improved emission factors for key smoke constituents, estimation of fire intensity and regional smoke impacts. The framework will be able to predict and monitor smoke from hazard-reduction burns and bushfires. Support for this project comes from the Victorian Department of Primary Industries.

Intergovernmental Panel on Climate Change

The Intergovernmental Panel on Climate Change (IPCC) is the leading international body for assessing scientific research on climate change.

The IPCC reviews the most recent scientific, technical and socio-economic research produced worldwide, relevant to the understanding of climate change.

The IPCC Fifth Assessment Report *(Climate Change 2013: The Physical Science Basis—Working Group I contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change)* was published in January 2014. Two CAWCR scientists (Steve Rintoul and Nathan Bindoff) served as coordinating lead authors on the report and many others were contributing authors. More than 40 CAWCR papers are cited by the IPCC Working Group I.

The report finds there is strong evidence that the earth's climate system is changing, and stronger evidence than ever that human activities are the primary cause.

Awards

John Church and Neil White

Geophysical Research Letters Best Paper

A 20th century acceleration in global sea-level rise by John A. Church and Neil J. White was chosen as one of the 40 best papers ever published in Geophysical Research Letters and reprinted in the 40th anniversary issue. The paper was first published in January 2006.

Dr Steve Rintoul

Oceanography Award of the Society for Underwater Technology (London)

Steve's research has made a profound contribution to our scientific understanding of the Southern Ocean and of Antarctica's role in the global system. His research has provided new insights into the nature, causes and consequences of Southern Ocean change. His leadership has been critical to advancing coordinated international investigation of the Southern Ocean and to promoting long term Southern Ocean observing systems.

The SUT Oceanography Award recognises international contribution to the field of oceanography.

Dr Julie Arblaster

Anton Hales Medal of the Australian Academy of Science

Julie has been involved in, and initiated, distinguished research in the earth sciences. Her research focuses on many aspects of the workings of the global climate system and its sensitivity to changes. Much of her research pertains directly to the climate of the Australian region, particularly with respect to the ozone hole, El Niño, the monsoon, and Australian rainfall variability.

The Anton Hales Medal is award to encourage and recognise research work in earth sciences.

Awards

Dr Jeff Kepert

Bureau of Meteorology Australia Day Achievement Medallion

Jeff is recognised for his exemplary scientific research, leadership, and stakeholder-engagement skills. He has made profound contributions to our understanding of tropical cyclones, bushfire weather and data assimilation, enhancing the Bureau's international excellence in scientific research.

The Medallions are awarded under the auspices of the Australia Day Council to promote good citizenship and achievement, and acknowledge employee contributions on special projects that have made a significant contribution to the nation or outstanding performance of core duties in the year prior to which the award is made.

Dr Matthew Wheeler

Priestley Medal of the Australian Meteorological and Oceanographic Society

Matt was awarded the Priestly Medal in recognition of his outstanding research achievement as a mid-career scientist. He is recognised as an international leader in tropical meteorology, in particular as one of the worlds' leading experts on the Madden-Julian Oscillation and associated phenomena.

The Priestley Medal is awarded for outstanding research achievement by an early-to-mid career scientist.

CAWCR/CSIRO ACCESS Team

2013 CSIRO Medal for Science Excellence

Bureau and CSIRO scientists won the prestigious 2013 CSIRO Medal for Science Excellence for their development of the Australian Community Climate and Earth System Simulator (ACCESS). This has become a core component of the earth system science conducted at CAWCR. The award recognises the outstanding and sustained teamwork across CSIRO and the Bureau in building this world-class weather and climate simulation capability.

The CSIRO Medal for Science Excellence recognises exceptional research of CSIRO scientists or teams.

Awards

Dr Martin Cope

Werner Strauss Achievement Award

Martin was awarded the Werner Strauss Achievement Award for his outstanding contributions to improving air quality in Australian through his development of atmospheric chemical models, his inspiring science leadership and his effective collaborations with all Australian state and federal environmental agencies.

The Werner Strauss Achievement Award is awarded by the Clean Air Society of Australia and New Zealand.

NexGen Team

JK Berrie Award for Excellence (Asia–Pacific Spatial Excellence Awards)

CAWCR has provided much of the science, forecast process, guidance and text that underpins NexGenFWS (NexGen), which supplies the forecast data for MetEye. The project is a collaboration across Bureau branches including Information Systems and Services, Bureau of Meteorology Training Centre and CAWCR. Current CAWCR NexGen staff are Gary Weymouth, Tennessee Leeuwenburg, Michael Foley, Nathan Faggian, James Sofra, Ben Hu, Phil Riley, Tim Hume, Brianna Laugher, Deryn Griffiths and Ying Zhao. CAWCR was one of the major proponents of the NexGen Project.

NexGen and MetEye won both their category (Technical Excellence) and were the overall winner of all categories—the JK Berrie Award for Excellence—the most prestigious award APSEA offers.

The Asia–Pacific Spatial Excellence Awards (APSEA) recognise the innovation and activities of the spatial industry.

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