



WORKSHOP REPORT

# Climate challenges for water resources management in Western Australia

July 2018

Earth Systems and Climate Change Hub Report No. 6

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## Background

This workshop builds on a series of engagements in 2016 between the WA Department of Water and other key stakeholders in WA, CSIRO, Bureau of Meteorology and the National Environmental Science Programme (NESP) Earth Systems and Climate Change (ESCC) Hub. These engagements have facilitated a preliminary exchange of information relevant to climate challenges for WA, especially for the water sector. Topics covered have included:

- Learnings from the Indian Ocean Climate Initiative (IOCI), which ran from 1998–2012
- Scope of post-IOCI climate research with relevance to WA
- How climate research is being used
- What still needs to be done in terms of innovative research and linking research to stakeholder needs.

Based on engagements during 2016, the needs can be summarised as:

- Information about causes of climate trends and extreme weather over recent decades in south-west WA, and formal attribution of climate trends and extreme events
- Better understanding of large-scale climate drivers that influence sustained wet or dry periods
- Better reliability of seasonal (1–3 month) climate forecasts
- Forecasts for six months to two years, especially dry periods, frosts and hot spells
- Forecasts for multi-year to decadal timeframes (2–10 years)
- Consistent application of multi-decadal projections (including downscaling) from 2030–2100
- Better communication of climate projections, confidence, uncertainties, and variability vs. change, especially information about climate variability and change in the near-term (2030)
- An inter-agency document to articulate the climate science being used by each agency
- WA State of the Climate report every two years;
- Input to new WA Museum exhibition materials showcasing the story of WA climate
- Understanding how continued rainfall decline affects streamflow and groundwater recharge
- Impact of climate change on water demand
- Impact of climate change on extreme weather (e.g. heatwaves, bushfires, storms, strong winds, tropical cyclones, floods and lightning)
- More detailed climate change risk and vulnerability assessments
- Case studies that demonstrate uptake of science on a path to impact.

## Workshop objectives

The workshop program and participants can be found in the appendix of this report. ESCC Hub Leader Kevin Hennessy opened the workshop by acknowledging discussions held during 2016, then outlined the objectives of the March 2017 workshop:

- Identify and build a shared understanding of immediate (3–5 year) climate research and communication needs and opportunities, and associated priorities for water management in south-west WA
- Build a shared understanding of the ESCC Hub research projects most relevant for south-west WA
- Identify opportunities for tailoring and adding value to projects to address climate-related water management needs for the south west of WA
- Establish an ongoing process of engagement and development (and support for best-practice use of tailored climate products) across relevant stakeholders.

## Workshop presentations

The workshop began with a presentation from the WA Department of Water (Greg Claydon, Jacqui Durrant and Susan Worley). This showed how climate science has been used in outreach activities, communication products, a future climate planning tool (for future rainfall, surface water and ground water), and water resource management (supply and demand). They highlighted possible synergies with ESCC Hub projects 2.2, 2.6 and 2.7:

- 2.2 Communication products for south-west WA
- 2.6 Updates to the Department of Water's climate tool;
- 2.6 Useful data at spatial and temporal scales to use in modelling to make water resource decisions
- 2.7 Hydroclimate metrics at the regional scale.

There were a number of presentations from CSIRO and BoM, outlining research on climate variability, climate change and water resources:

- Kevin Hennessy presented an overview of the ESCC Hub, the goal of which is to ensure that Australia's policy and management decisions are effectively informed by Earth systems and climate change science, now and into the future. The Hub has seven case studies and 11 projects addressing five outcome areas (water, food and NRM, extremes, coasts and carbon). One case study has produced a prototype animation of rainfall variability and change in south-west WA from 1940–2015, which will be further developed during 2017. Three projects have greatest relevance to WA, so these were covered in more detail by other speakers.
- Pandora Hope leads Project 2.2: Enhancing Australia's capacity to manage climate variability and extremes in a changing climate. The focus is on historical heatwaves, floods, drought, cyclones and east-coast lows. Part of the research addresses the causes of extreme events (attribution), including the October 2015 Australian heatwave, the spring 2015 drought in Tasmania, the mangrove deaths in the Gulf of Carpentaria in late 2015, and the September 2016 frosts in the WA grain belt.
- Michael Grose leads Project 2.6: Regional climate projections, information and services. The focus is on enhancing the uptake of climate projections, refining confidence ratings and constraining uncertainties, and preparing for the next generation of climate projections. There is a strong emphasis on stakeholder engagement and better communication of climate variability and change.
- Dewi Kirono leads Project 2.7: Refining Australia's water futures. The focus is on understanding user needs, defining a relevant set of surface water metrics, then generating regional projections on a 5-km grid. Case studies are being developed.
- Steve Charles described CSIRO/BoM experiences in bridging the science–management gap in the water/NRM sector. He summarised recent water resources assessments for key regions of Australia, including the Pilbara Water Resource Assessment, the Northern Australia Sustainable Yields project and the Southwest WA Sustainable Yields project. The SA Climate Ready portal was presented as an example of how downscaled climate data can be accessed and used in water management case studies.
- Glenn Cook (BoM) described the State of the Climate 2016 report, expansion of WA weather observations networks, a rainfall data analysis upgrade, a climate reanalysis project providing hourly data on a 12-km grid over 25 years, an enhanced/free climate data explorer and improvements to seasonal forecasts at finer spatial and temporal resolution.

## Discussion

The aim of this session was to identify research undertaken by the ESCC Hub that is relevant to WA water resources management, along with opportunities for tailoring information or adding value to meet stakeholder needs.

The WA Department of Water indicated a preference that:

- All ESCC Hub project communications and reporting recognise how/if the work applies to south-west WA, so that the local situation isn't lost in more general statements that apply to most of Australia
- Projects 2.2, 2.6, 2.7 (which appear to be most relevant to south-west WA) incorporate statements or findings that help to inform our messages or management
- Communication tools or products consider utility for south-west WA.

A number of possible options emerged, some of which might be undertaken within existing ESCC Hub resources while others would require additional investment. These options are summarised in the following table (in no particular order of importance).

| Option   | Action  |
|--|---|
| 1. <i>Research on causes of extreme climate events (attribution studies) through ESCC Hub Project 2.2</i> –This would provide information about the key climatic processes, including natural modes of variability (e.g. El Niño Southern Oscillation, Indian Ocean Dipole and Southern Annular Mode), as well as human influence (e.g. increasing greenhouse gases, aerosols and ozone depletion). Current examples include spring frosts in southwest WA in 2016 (relevant to Dept. Ag) and the hot/dry spring of 2015 (relevant to the WA Dept of Water and WA Water Corporation). It was felt that this information could be used in communication activities. | Leader of Project 2.2 (Pandora Hope) and Michael Grose to liaise with WA Dept of Agriculture, WA Dept of Water and WA Water Corp to ensure planned research is fit for purpose (within existing ESCC Hub resources). Could investigate if there is an increase in the odds of a pattern of wetter summers being followed by later/drier winters in south-west WA, and if so, what the main drivers are. Creating one or more case studies in collaboration with stakeholders would require co-investment in 2018. |
| 2. <i>Research on near-term climate (next 10–15 years) variability and change</i> – Brian O'Brien expressed a strong desire to see climate projections for the year 2030 highlighted in communication products to raise awareness about climate variability and change. This could draw upon existing information about south-west WA projections for 2030 published by CSIRO and BoM <sup>1</sup> which include both climate  | Leader of Project 2.6 (Michael Grose) to liaise with Brian O'Brien, WA Dept of Water and WA Water Corp to determine what types of communication products are required and how this research might be funded. A brochure on climate projections for south-west WA in 2030 would be relatively cheap (less than \$10K). The benefit to the Dept of Water will be communication products that reinforce their messages and management, with a focus on   |

<sup>1</sup> CSIRO and the Bureau of Meteorology (2015) Climate Change in Australia. Available at [www.climatechangeinaustralia.gov.au](http://www.climatechangeinaustralia.gov.au)

| Option   | Action   |
|--|--|
| <p>variability and climate change<sup>2</sup> (see Appendix 2). It could also be part of a much larger research initiative focused on improved understanding of the drivers of climate variability and change in southwest WA, along the lines of IOCI.</p>  | <p>southwest WA. A better understanding of uncertainties will also assist planning and management. A larger research initiative like IOCI would require significant effort and funding from a number of interested parties.</p>  |
| <p>3. <i>Update of South-west WA Sustainable Water Yield projections published in 2008</i> – Use the latest CMIP5 climate model projections and IPCC emission scenarios, extend the projections beyond 2030 to provide transient projections, and include a broader range water resource metrics.</p>  | <p>Leader of ESCC Project 2.7 (Dewi Kirono) to liaise with WA Dept of Water and WA Water Corp to determine what research is already being undertaken for southwest WA (within existing ESCC Hub resources) and what would need additional investment. However, the Dept of Water feels that updating the Sustainable Yields research would not be of much value since they already have a tool to suit their needs (see item 4).</p> |
| <p>4. <i>Update Dept of Water climate tool and report on ‘Selection of future climate projections for WA’</i> – Assess what value an update may add (e.g. would updating from old CMIP3 to new CMIP5 climate models produce different conclusions or add credibility?) Should the tool/report include any other planning cases (e.g. a drier dry case, a less dry wet case)? What baseline period should be used, and how sensitive are the results to the choice of baseline?</p> | <p>The Dept of Water would appreciate feedback from any of the ESCC projects that suggests they need to change their projections for south west WA, especially if it impacts on water management. Further understanding of ‘climate change in Australia’ website might assist in this comparison (see item 5).</p>   |
| <p>5. <i>Webinars on how to use data tools available at <a href="http://www.climatechangeinaustralia.gov.au">www.climatechangeinaustralia.gov.au</a></i> – The Dept of Water would get a lot of value from this. If these data tools we can be used more effectively, it may replace the need for the Dept to maintain their climate tool.</p>   | <p>Leader of ESCC Project 2.6 (Michael Grose) to liaise with WA Dept of Water. Webinars could be provided within existing ESCC Hub resources.</p>  |
| <p>6. <i>Case study of science to management</i> – Given the excellent use of existing climate science in WA water resource management, there is an opportunity to raise the profile of this exemplar in a case study. This would be useful for WA water managers as well as the ESCC Hub.</p>   | <p>Leaders of ESCC Projects 2.6 and 2.7 (Michael Grose and Dewi Kirono) to liaise with WA Dept of Water and WA Water Corp to determine the scope of work and whether this could be an ESCC-funded case study in 2018. The Dept would like case studies for their communication activities and their website.</p>   |

<sup>2</sup> Whetton PH, Grose MR, Hennessy KJ (2016) A short history of the future: Australian climate projections 1987–2015. *Climate Services*, (2–3), 1–14, doi:10.1016/j.cliser.2016.06.001

| Option  | Action  |
|---|---|
| 7. <i>Develop and publish an inter-agency document to articulate the climate science being used by each agency</i> – The Dept of Water is happy to share drafts of this document as it evolves.   | Leaders of ESCC Projects 2.2, 2.6 and 2.7 (Pandora Hope, Michael Grose and Dewi Kirono), Steve Charles and relevant universities to liaise with WA government agencies to determine the scope of work and funding.  |
| 8. <i>Develop and publish a WA State of the Climate report with input from CSIRO, BoM, relevant universities and WA Museum</i> – The Dept of Water is interested in this, especially to assist communications and community understanding. Why is southwest WA special, why is it the ‘canary in the coalmine’ and being affected by climate change before almost anywhere else in terms of rainfall? | Leaders of ESCC Projects 2.2, 2.6 and 2.7 (Pandora Hope, Michael Grose and Dewi Kirono) and Steve Charles to liaise with WA government agencies and WA Museum to determine the scope of work and funding.   |
| 9. <i>Produce a video animation of 1940–2016 patterns of rainfall variability and change over south-west WA</i> – Build on the existing video from 1940-2010 and include projected rainfall changes during the 21st century for low and high emission scenarios.  | ESCC Hub Leader and Leaders of ESCC Projects 2.2 and 2.6 (Pandora Hope, Michael Grose) to liaise with WA Dept of Water, WA Water Corp WA Museum and Brian O’Brien to determine the scope, format and communication plan for the video (an approved case study funded by the ESCC Hub).                    |
| 10. <i>Groundwater and recharge</i> – Identify and communicate critical thresholds (supply and also environmental), provide information about multi-year dry/wet sequences, and information to assist identifying what management is possible   | Olga Barron/Steve Charles to liaise with WA Dept of Water and WA Water Corp to determine what research is needed. Harry Hendon and Hanh Nguyen (via Pandora Hope) can provide a BoM perspective.  |
| 11. <i>Modelling water demand, accounting for demographic change and climate change</i> – The Dept of Water is interested in the near term as well as to 2030 and to 2050. Demand from the IWSS related to weather would have considerable data for analysis and may inform future climate scenarios and planning. Irrigation demands will also be of interest  | Steve Charles (CSIRO) and Pandora Hope (BoM) to liaise with Dept of Water.  |
| 12. <i>Climate variability at a range of scales – further science, and evaluation of models</i> – Extreme events projections at a finer temporal or spatial scale is of value to the Dept of Water, especially for south-west WA. Integrating multi-year and multi-decadal projections are also of interest.  | Leader of ESCC Project 2.6 (Michael Grose) to liaise with Andrew Dowdy (ESCC Project 2.8: Extreme weather projections), Dept of Water and Dept of Agriculture. Multi-year projections are not operational at this stage, but CSIRO and BoM are developing systems that may eventually become operational. |

| Option   | Action   |
|--|--|
| 13. <i>Projected changes in mean and variability of water supply</i> – Further research and communication products on climate variability, extremes and reliability of water supply in a changing climate. Flash flooding and runs of dry years are of interest. | Leader of ESCC Project 2.7 (Dewi Kirono) to liaise with WA Dept of Water and WA Water Corp to determine what research is already being undertaken for south-west WA (within existing ESCC Hub resources) and what would need additional investment. ESCC Project 2.7 will consider developing projections for a metric known to affect south-west WA water supply (e.g. Susan Worley mentioned that the spring 2015 water crisis in south-west WA was preceded by three consecutive years of low flow) |
| 14. <i>Communicating climate science to government</i> – A small consultancy with selected scientists.   | WA Dept of Water to specify how CSIRO and BoM could help.  |

### Other notes

- Interest from several people in participating in the ESCC Project 2.6 user panel. Please register your interest with [michael.grose@csiro.au](mailto:michael.grose@csiro.au).
- Certain aspects, including extremes such as floods and fires, are relevant to other government departments and would require wider engagement.

The next step from this discussion is to prioritise these options. We seek feedback on:

- Activities that can be undertaken immediately within ESCC Hub projects using existing resources
- Other opportunities that could be proposed as case studies for 2018 in the ESCC Hub
- Other small projects that could be undertaken with additional funding.

## Appendix: Workshop participants and agenda

### Participants

#### **Western Australian Government**

WA Dept of Water: Greg Claydon, Susan Worley, Jacqui Durrant, Clare Meredith, Peta Kelsey

WA Water Corporation: Charles Jeevaraj, Deanne McDonald

WA Dept of Agriculture and Food: Ian Foster

WA Dept of Environment and Regulation: James Duggie

WA Office of Science: Simon McGarvie

#### **Other WA stakeholders:**

Brian O'Brien

Ian Thilthorpe (WA Museum)

Kevin Goss (Kevin Goss Consulting)

#### **NESP ESCC Hub:**

(in Perth) Kevin Hennessy (CSIRO), Pandora Hope (BoM), Michael Grose (CSIRO)

(via video) Geoff Gooley (CSIRO), Dewi Kirono (CSIRO), Aurel Moise (BoM)

#### **CSIRO:**

Steve Charles, Olga Barron, Guobin Fu, Justine Lacey (Floreat)

(Apologies: Bryson Bates, Francis Chiew)

#### **Bureau of Meteorology**

Glenn Cook (Perth Office)

## Workshop agenda

|                  |   |              |                  |
|------------------|---|--------------|------------------|
| <b>Date/Time</b> | 16 March 2017<br>9.30am-1pm (AWST)/12.30-4pm (AEDT) | <b>Venue</b> | CSIRO Floreat    |
| <b>Chair</b>     | Kevin Hennessy, NESP ESCC Hub                       | <b>Video</b> | Details provided |

| Item | Description  | Responsible              | Start    |
|------|--|--------------------------|----------|
| 1.   | Welcome & Introductions<br>Objectives of the workshop  | Kevin                    | 9.30 am  |
| 2.   | Water resource management and response to drying climate in the south-west of WA<br>DoW overview of <ul style="list-style-type: none"> <li>how the existing science has been used for water allocation and water supply planning and decision-making</li> <li>communicating about drying climate and management adaptation to water stakeholders</li> </ul>  | Greg/Jacqui/<br>Susan    | 9.45 am  |
| 3.   | Science perspective <ul style="list-style-type: none"> <li>Overview (Kevin)</li> <li>Hub project profile (emphasis on key projects) &amp; south-west WA rainfall video case study <ul style="list-style-type: none"> <li>Project 2.2 (climate variability), 2.6 (regional climate projections) and 2.7 (water and climate)</li> <li>problem being addressed, scope of work, outputs &amp; outcomes</li> <li>relevance to south-west WA &amp; scope for added value in south-west WA</li> <li>CSIRO/BoM experiences bridging the science-policy/management gap in the water/NRM sector</li> </ul> </li> </ul> | ESCC Hub<br>CSIRO<br>BoM | 10.45 am |
| 4.   | Open Forum and Synthesis – facilitated discussion addressing workshop objectives <ul style="list-style-type: none"> <li>prioritise immediate (3-5 year) climate research and associated communication needs and opportunities and associated priorities for WA stakeholders</li> <li>identify relevant research undertaken by the NESP ESCC Hub and opportunities for tailoring/value-adding to address WA needs</li> <li>potential case studies</li> <li>identify other relevant collaborative research initiatives and communications opportunities</li> </ul>   | Kevin/All                | 11.45 am |
| 5.   | Summary/concluding comments: <ul style="list-style-type: none"> <li>Actions arising</li> <li>Way forward</li> </ul>  | Kevin/all                | 12.45 am |
| 6.   | Close & light lunch  |                          | 1.00 pm  |



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