

## Background and History

### *What is the Indian Ocean Climate Initiative?*

The Indian Ocean Climate Initiative (IOCI) is a strategic program of research and information transfer to support government decision-making. IOCI's vision: empowering the State of Western Australia by providing the best available scientific knowledge to facilitate adaptation to climate variability and change. IOCI is a research partnership between the Western Australian government, CSIRO and the Bureau of Meteorology.

### *About the logo*

Developed in 2009, the most recent IOCI logo reflects the Western Australian continent (brown area on the right) and the Indian Ocean to its west. The weather systems that impact southern WA from the west are signified by the large whorl of the 'O'. There is also a tropical cyclone weather symbol embedded in the 'O', emphasising the Initiative's new focus on the state's north.

### *About the name*

The Pacific Ocean strongly influences Australia's climate. To distinguish IOCI's focus on WA, the Indian Ocean was included in the title. It was also thought, at the outset of IOCI's first stage, that the Indian Ocean might play a strong role in driving WA's climate.

### *Who are the research partners?*

- Bureau of Meteorology
- CSIRO



### *Indian Ocean Climate Initiative*



The former IOCI logo emphasised the focus on Western Australia and the Indian Ocean.

*What were the timelines, funding and partners for each stage?*

**IOCI1: 5 years: January 1998 – December 2002**

- \$300,000 per year, matched by research partners.
- Contributors: Department of Commerce and Trade, Water and Rivers Commission, Department of Agriculture, Water Corporation, Department of Conservation and Land Management, Department of Environmental Protection, Fire and Emergency Services Authority, Bureau of Meteorology Regional Office.

**IOCI2: 3 years: July 2003 – June 2006**

- \$500,000 per year, matched by research partners.
- Partners: Department of Premier and Cabinet, Department of Environment, Department of Agriculture, Water Corporation (Department of Water), Department of Conservation and Land Management, Fire and Emergency Services Authority, Forest Products Commission, Department of Fisheries, Department of Planning and Infrastructure, Bureau of Meteorology Regional Office.

**IOCI3: 4 years: January 2008 – July 2012**

- \$4,000,000 over 4 years, matched by research partners.
- Funding is centrally managed through the Climate Change Unit, Department of Environment and Conservation, for all WA State Government stakeholders.

## IOCI Goals, Scope and Results

### *What was the initial impetus for IOCI?*

During the late 1960s, early winter rainfall in south-west WA began to decline, as did its year-to-year variability. Surface water supplies also declined as a consequence of this climatic change. The reasons were unknown, and it was also unclear whether this was a temporary, cyclical or long-term phenomenon.

### *What have been the major research questions?*

#### **IOCI1**

IOCI1 sought to pursue the overlapping research and development interests of several WA economic sectors. It aimed to better define and understand how the climate varied across years and decades.

This was achieved by:

- Understanding the rainfall decline in the late 1960s through:
  - improved datasets
  - 'detecting' change – how unusual is this rainfall decline?
  - understanding behaviour of extremes throughout the rainfall decline
- Understanding climate variability in the Indian Ocean.

IOCI1 also aimed to make it possible to provide outlooks for subsequent seasons that were accurate enough to permit effective decision making.

#### **IOCI2**

IOCI2 sought to discover the causes for the climatic changes IOCI1 had detected. It asked: "What drove the late 1960s rainfall decline in south-west WA?"

Was it:

- anthropogenic climate change,
- land clearing,
- multi-decadal natural variability,
- or changes to Antarctic sea-ice extent?

It also asked, "What is the best rainfall baseline to use for management decisions?"

Other related questions posed by IOCI2 were answered through collaborative work on topics including: historical climate, river flows, groundwater, salinity, sea temperature, sea level, and the Leeuwin current.

#### **IOCI3**

The scope of IOCI3 extends beyond the original basic research question posed back in 1998 (that is, to explain the on-going south-west WA rainfall decline). IOCI3 seeks to analyse both rainfall and temperature variability and change across the whole state.

In addition, Stage 3 seeks further understanding of north-west WA climate systems. Mining and energy companies are strongly investing in this region yet relatively little is known about north-west WA's climate. Even basic weather data are much more sparse than in the south-west. IOCI3 is also analysing tropical cyclone behaviour and trends in the region.

### *What has been discovered and produced?*

Dozens of widely-cited publications

- IOCI staff have produced 152 research outputs, including journal articles, book chapters, reports, conference papers and other publications.
- Eighty-three of these research outputs are peer-reviewed book chapters, reports and other publications.
- As of May 2011, IOCI's published work had been cited 741 times by papers published worldwide.

### **New, accessible high-quality datasets**

- New high-quality rainfall, temperature, and cloud datasets.
- New high-resolution temperature, rainfall and water availability data.
- Web-based access to these products.

### **South-west WA rainfall decline explained**

- The late 1960s rainfall decline for south-west WA occurred in early winter, primarily on the west coast.
- Rainfall declines are now evident across all of the south-west. A further rainfall downturn appeared to take place in the late 1990s.
- The large-scale circulation and local weather patterns match this rainfall decline. July storms are less common due to fewer low-pressure systems and more high-pressure systems.
- These observed circulation changes are also reflected in climate model projections.
- Turning to causes, increasing levels of greenhouse gases in the atmosphere are likely to have contributed to the rainfall decline. Land clearing may also have a role.

**Projections:** IOCI work has improved confidence in understanding of how south-west WA's rainfall and temperature will change under different greenhouse gas emissions scenarios. Thanks to new, faster climate models that can provide more fine-grained analyses, likely changes to rainfall can be determined.

- These models indicate that the number of winter rain days will decrease 17% by 2030, compared to the 1960-1990 baseline.
- Catchments across south-west WA can expect runoff decreases of 5-40% compared to 1990 levels.
- Models indicate that temperatures will rise in all seasons by 2030.

### **Extremes:**

- In this area of ongoing investigation for IOCI, work has so far shown that observed trends in rainfall and temperature extremes vary, depending on the location in WA.
- Nevertheless, the trends in extremes generally follow the same direction as the means. These trends for extremes are often greater than the corresponding trends in the averages. And the 'most extreme' extremes are also changing more rapidly.

### **Improved understanding of north-west WA rainfall**

Our knowledge of the causes of rainfall variability in the north-west has improved during IOCI3, along with our tools (climate models) to explore this. However, much work remains to be done in this area.

### **Tropical cyclone forecasting and future trends**

Researchers have developed two-week lead time forecasts for tropical cyclones.

Research suggests that the number of tropical cyclones will be fewer in future, however, they are likely to be more intense.

## IOCI Perception and Influence

### *How do IOCI stakeholders and others regard its research?*

The IOCI produces high quality, independent, objective research:

- The high quality of IOCI science is universally confirmed by stakeholders, according to an independent 2011 consultant's report.
- IOCI research is also applauded for its independence and objectivity. This benefits policymakers, by allowing them to implement rational policy initiatives in response to climatic changes.
- IOCI work also fed into International Panel on Climate Change (IPCC) work; this eventually led to Bryson Bates, one of IOCI's chief researchers, sharing the Nobel Peace Prize awarded to the IPCC.

### *How has IOCI influenced activities in WA and nationally?*

- The science undertaken by the IOCI has been mentioned more than 50 times in the state parliament, according to a search of Hansard.
- IOCI success in building knowledge for a state-based, needs-driven climate program has been demonstrated by imitation. The South-Eastern Australian Climate Initiative, established in 2006 following years of Murray-Darling Basin drought, closely resembles the IOCI in its structure and focus. In addition, the recently established Goyder Institute – which seeks to examine the climate of South Australia – also has themes and research questions that are similar to those of the IOCI.
- IOCI results have been crucial to water-related and agricultural policy (see below).

## Contributions to Western Australian policy making

### *How has the IOCI influenced decisions related to water supply?*

- From the 1980s, south-west WA's drying trend led Perth to examine the need to secure alternative water sources. IOCI 1 and 2 crucially contributed to the debate by showing that the drying was not temporary or cyclical – hastening and strengthening the case for a desalination plant.
- The Department of Water uses IOCI data extensively when de-rating water sources based upon rainfall projections for south-west WA.
- More recently, the Department of Water is using IOCI data to make recommendations on some aspects of forestry related to catchment management (i.e., how dense forest cover should be on lands rehabilitated after mining activities).

### *How does IOCI work inform agricultural decisions?*

- IOCI has assisted the Department of Agriculture and Food to understand, under future climate scenarios, which land uses would best suit different parts of WA. The Department passes this advice onto farmers to inform their investment decisions.
- IOCI information suggests that some areas in south-west WA will, in future, no longer be too wet for crops. Knowing that these areas will be just dry enough in future has been a factor behind the Department of Agriculture and Food's research on crops that can be sustained in relatively wet areas.

### *How does it inform decision making on mines and petroleum?*

- IOCI information is used by the Department of Mines and Petroleum to inform mine safety and environmental regulation.
- This Department has been involved with the IOCI since its first stage. However, IOCI's ongoing Stage 3 work in north-west WA, the location of major mining and energy infrastructure, will be especially important.
- For example, local rainfall information helps determine the best location for mine tailings dams, by helping to gauge whether they could be breached (and thereby release pollutants).
- Rainfall information also informs the Department whether mines themselves would have enough drainage, and whether infrastructure for power, water, gas and transport (roads, rail and ports) may withstand likely weather scenarios.

### *How does IOCI work inform health and safety related policy?*

The Department of Health needs to know how future temperature and rainfall changes may influence public health through the rise of new disease vectors (e.g., Ross River virus); or by causing bushfires or other emergencies to become more frequent. Along with the Fire and Emergency Services Authority of Western Australia, this Department relies on IOCI climate scenarios to allow it to develop appropriate strategies and policies for the future.

For example, baseline climate information from the IOCI underpinned the development of the Department's 2007 publication *Health Impacts from Climate Change*.

### *How does it inform local government work?*

Local governments also use IOCI information to understand local effects of climate change and inform their adaptation strategies.

As IOCI information becomes more fine-grained, and as local governments become more aware of the needs for climate change adaptation strategies, this use of IOCI information is likely to become more important.