Customers at the centre: Linking observations, science and models for decision making

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Australian Government
Bureau of Meteorology

Outline

- The Bureau's strategy
- Customers at the centre
- The Pipeline Concept – It's context within the Bureau
- Understanding customer needs
- Our R&D plan
- Billions and billions of observations
- Modelling
- Products and services
- Challenges and opportunities

Bureau of Meteorology strategy

Customer needs are at the centre of all we do

Our vision

To be an organisation of global standing, that is highly valued by the community for our pivotal role in enabling a safe, prosperous, secure and healthy Australia.

Our mission

To provide trusted, reliable and responsive weather, water, climate and ocean services for Australia—all day, every day.

2018–19 **Snapshot**

EYE ON THE **ENVIRONMENT**

62
weather surveillance radars

32
field offices

~6600
rainfall stations

700
automatic weather stations

13
wind profilers

13
solar observatories and terrestrial radiation monitors

30
wave buoys

46
sea level stations

19
satellites operated by international partners

over 5000
volunteer observers

5300+
hydrological monitoring stations operated by the Bureau and its partners

WHAT WE **DELIVERED**

over 700 000
public forecast services

182 000
marine forecasts and warnings

16 504
weather and ocean warnings

1468
flood watches and warnings

685
fire weather warnings

1.9 million
aviation forecast products

225
critical event briefings to the Australian Government Crisis Coordination Centre

500 000+
climate graphs and charts

150
scientific journal articles and research reports published

250+
climate briefings

210
locations in the seasonal streamflow forecasts service

THE REACH OF **OUR SERVICES**

over 85%
of website visitors returned the following month

805 716
Facebook followers

544 196
Twitter followers

16 764
subscribers to the Bureau's YouTube channel

348 million
BOM Weather app sessions

21%
increase in Climate Data Online downloads

16 500+
responses to media enquires

~97%
of the population covered by a Bureau radar

~92%
of the population within 20 km of a Bureau automatic weather station

11
bilateral agreements with overseas counterparts

$93.197 million
in own source income

OUR SERVICE **HIGHLIGHTS**

92.8%
of routine forecast products delivered on schedule

98.7%
uptime of automatic weather stations

97.2%
uptime of real-time radars

97.3%
uptime of wind profilers

100%
uptime of internet services

99.9%
uptime of the Australis supercomputer

Top 5
performance of ACCESS in global forecasting models

75%
of community customers' needs exceeded by the Bureau's forecast services

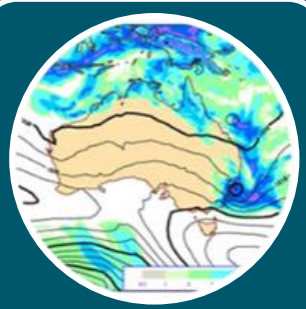
15 minutes
average time from earthquake to tsunami bulletin

+51
Net Promoter Score for community customers

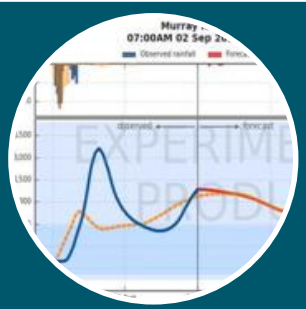
+70
Net Promoter Score for emergency management customers and partners

Dimensions of our service role

Observe



Analyse



Forecast

Inform

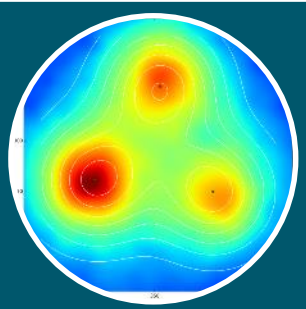
Warn

Information from environmental data and models to inform decisions

Dimensions of our model pipeline

Need

Develop



Refine

Deliver

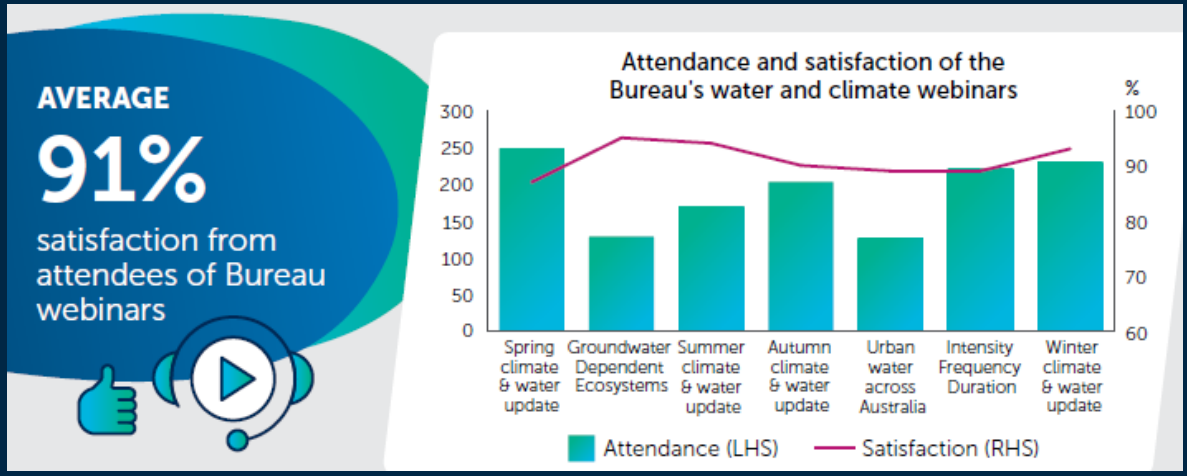
Operate

Research and innovation delivering reliable operational services

Understanding customer needs

- Dedicated customer relationships capability

- Elements
  - Listening
  - History
  - Feedback and surveys
  - Investment
  - UC/UX design
  - Customer discovery



Building a new weather webservice that our customers will love

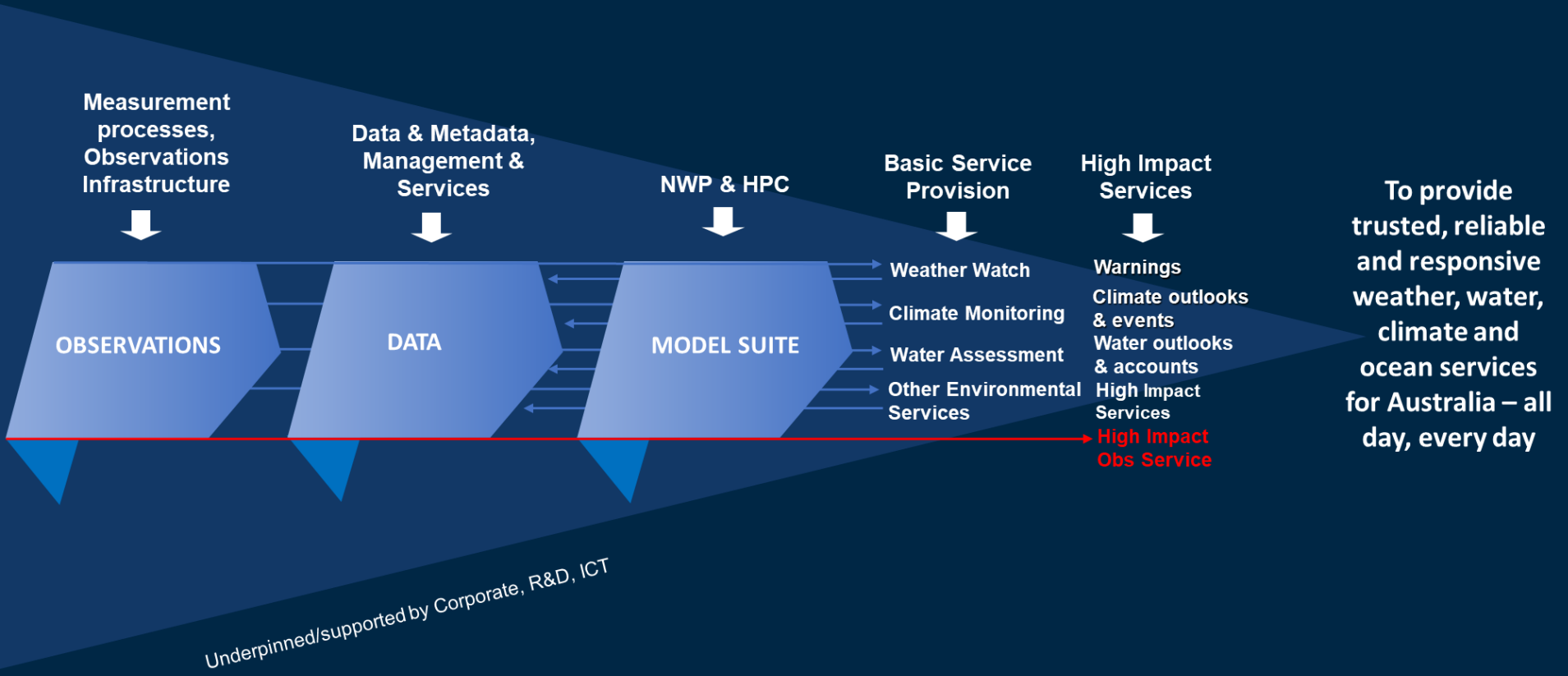
The Bureau R&D plan

- Objective 1: Customised impact-based forecasts and warnings when and where it counts: more localised and timely information from cities and regions
- Objective 2: Reliable and trusted forecasts: Enhanced assimilation of observations for precise accurate predictions
- Objective 3: An Earth system capability: Fully integrated atmosphere, ocean, sea-ice and hydrology models
- Objective 4: Seamless weather, climate and water insights: From historical observations to outlooks from weeks to decades

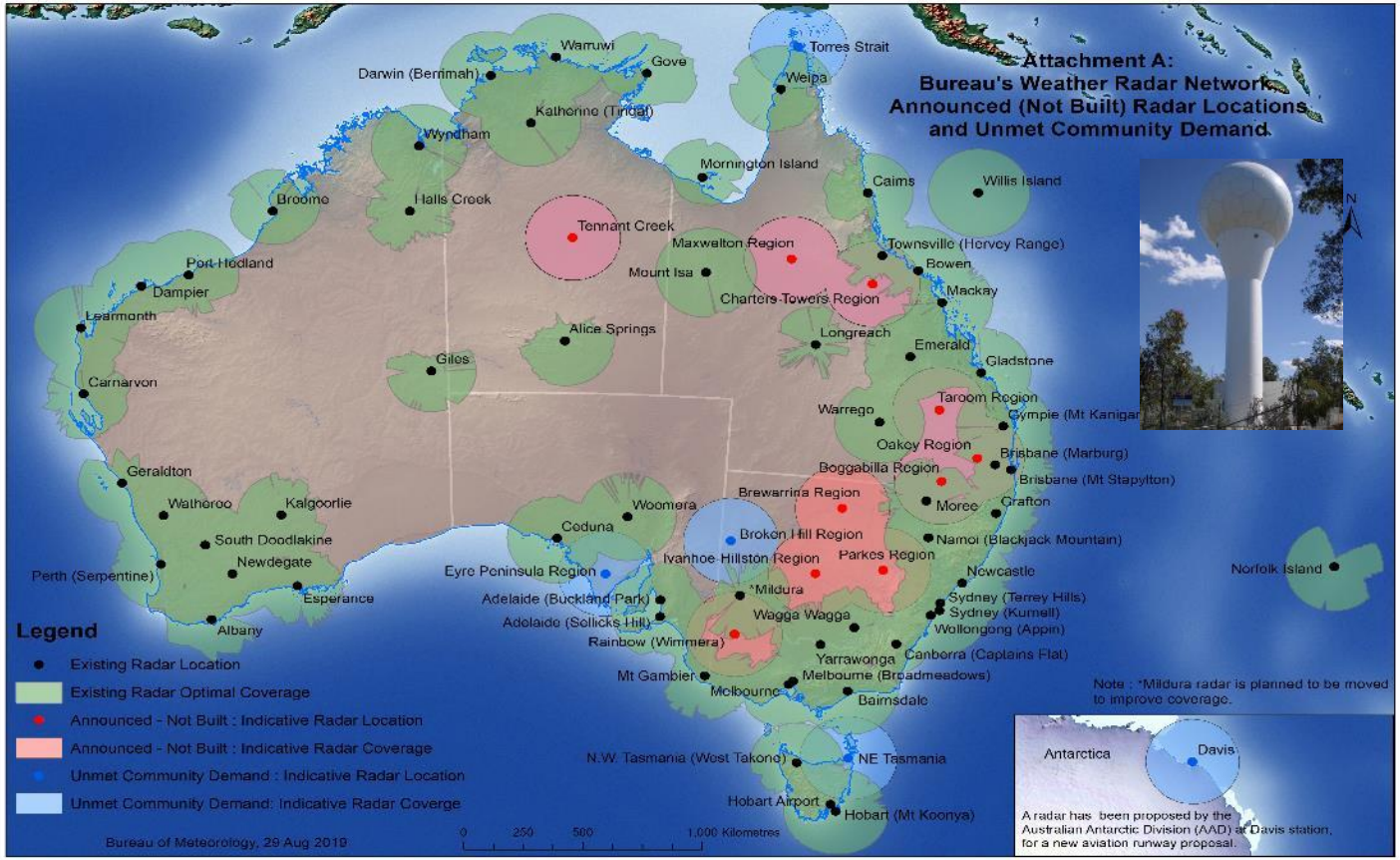
- Our national and international R&D partnerships are a core component of our success

Observations: The foundation of the Bureau's value chain

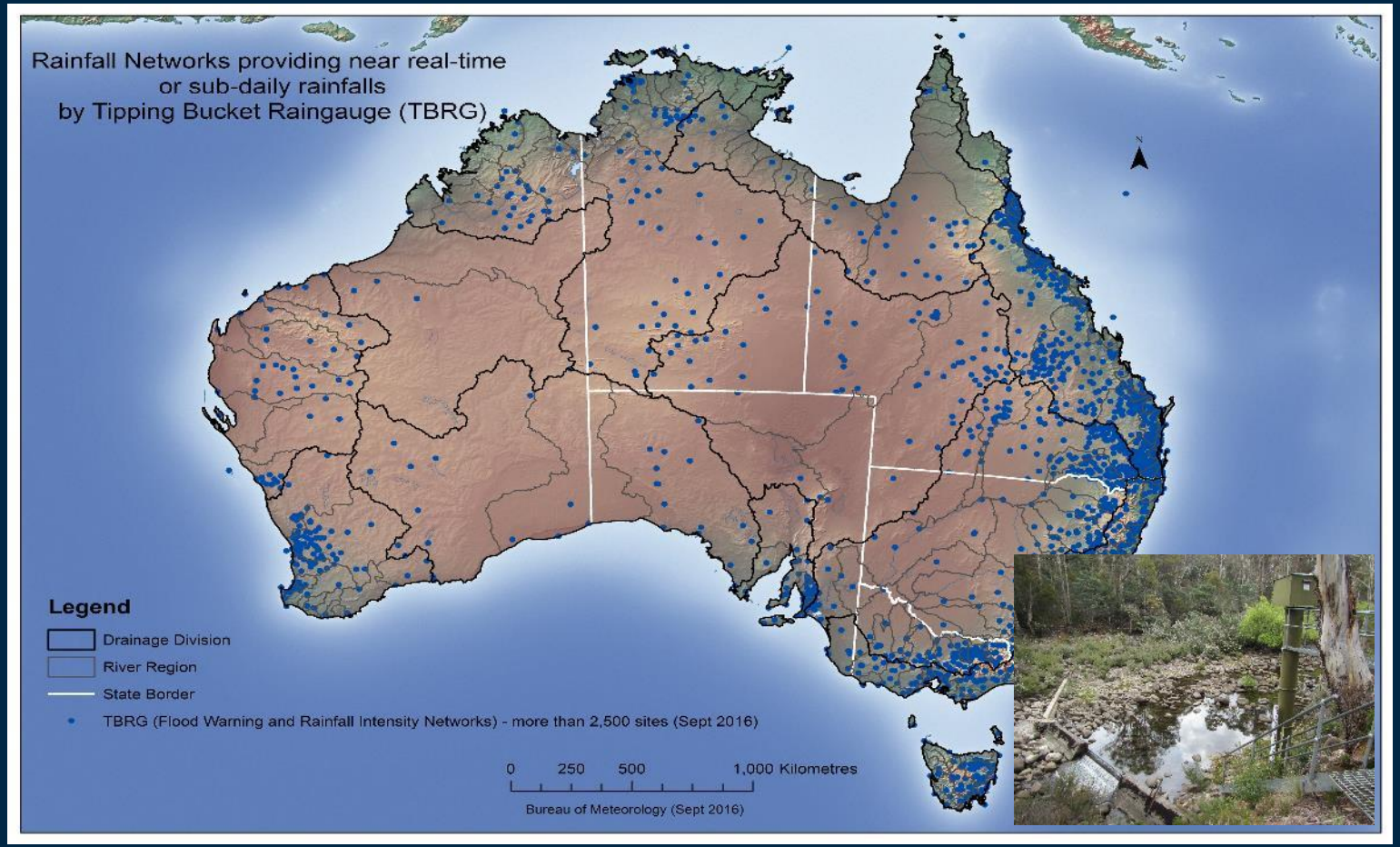
A data-centric view of the Bureau services pipeline



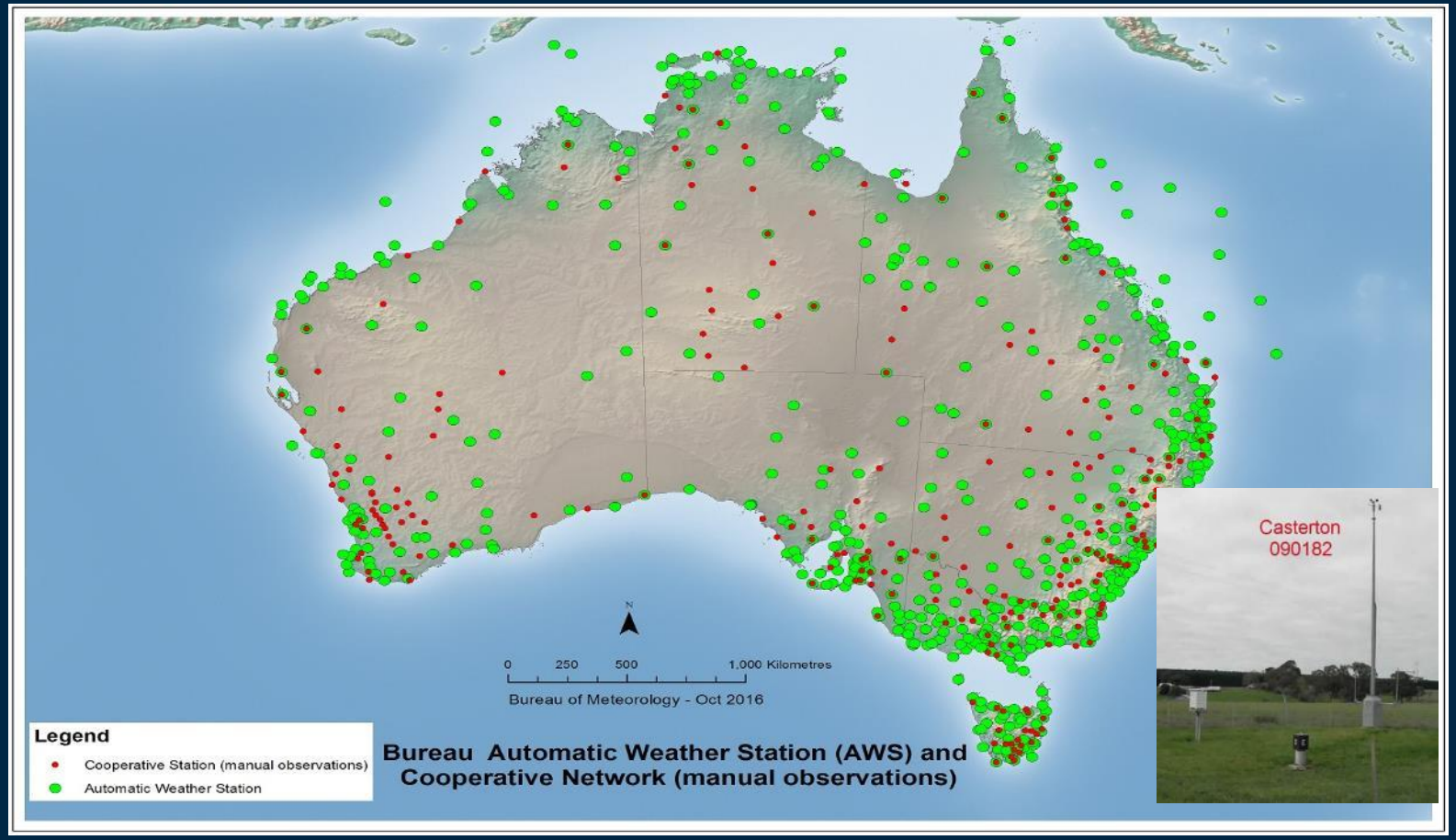
System 1 Radars



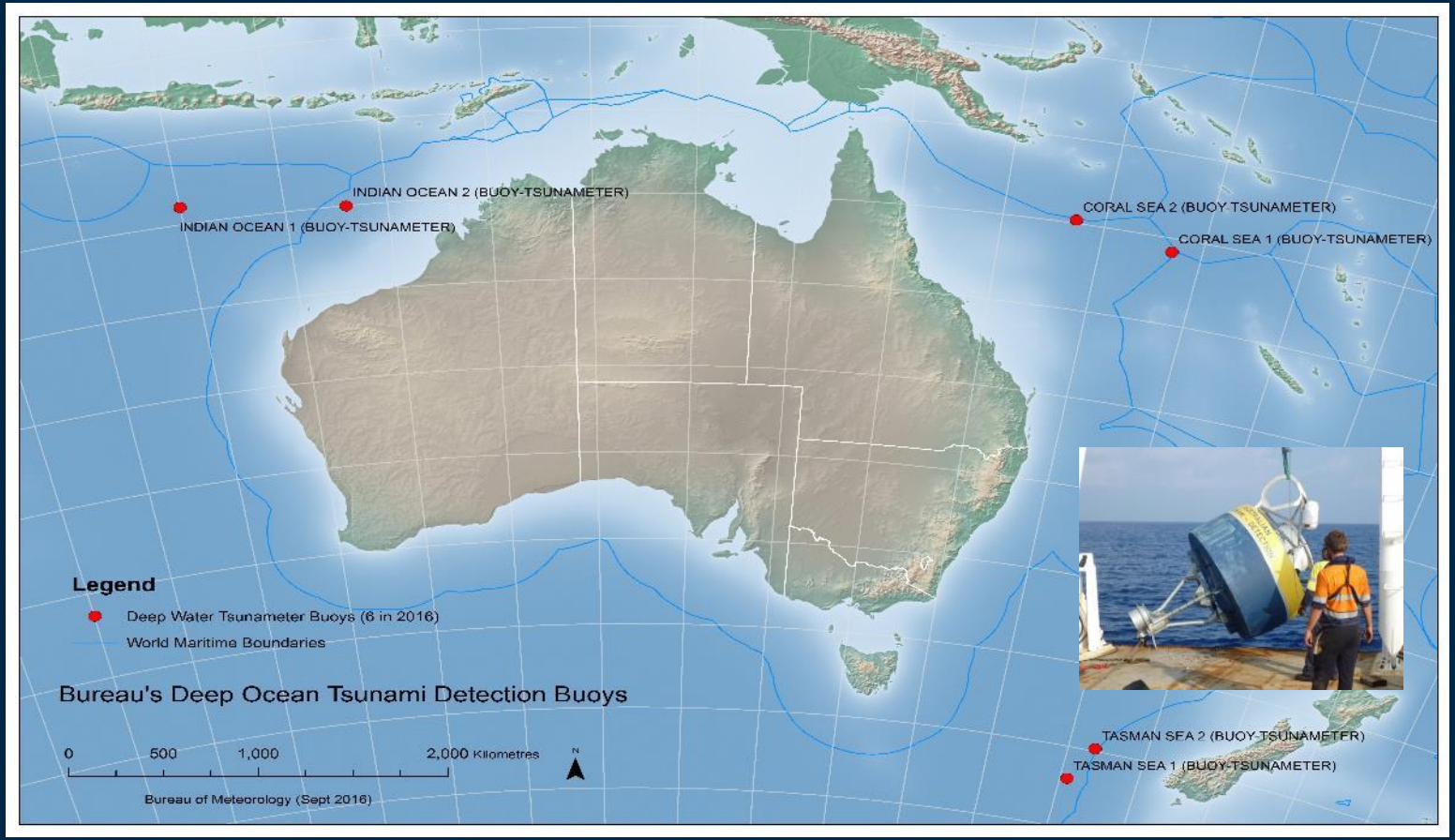
System 2 – Flood and Rain



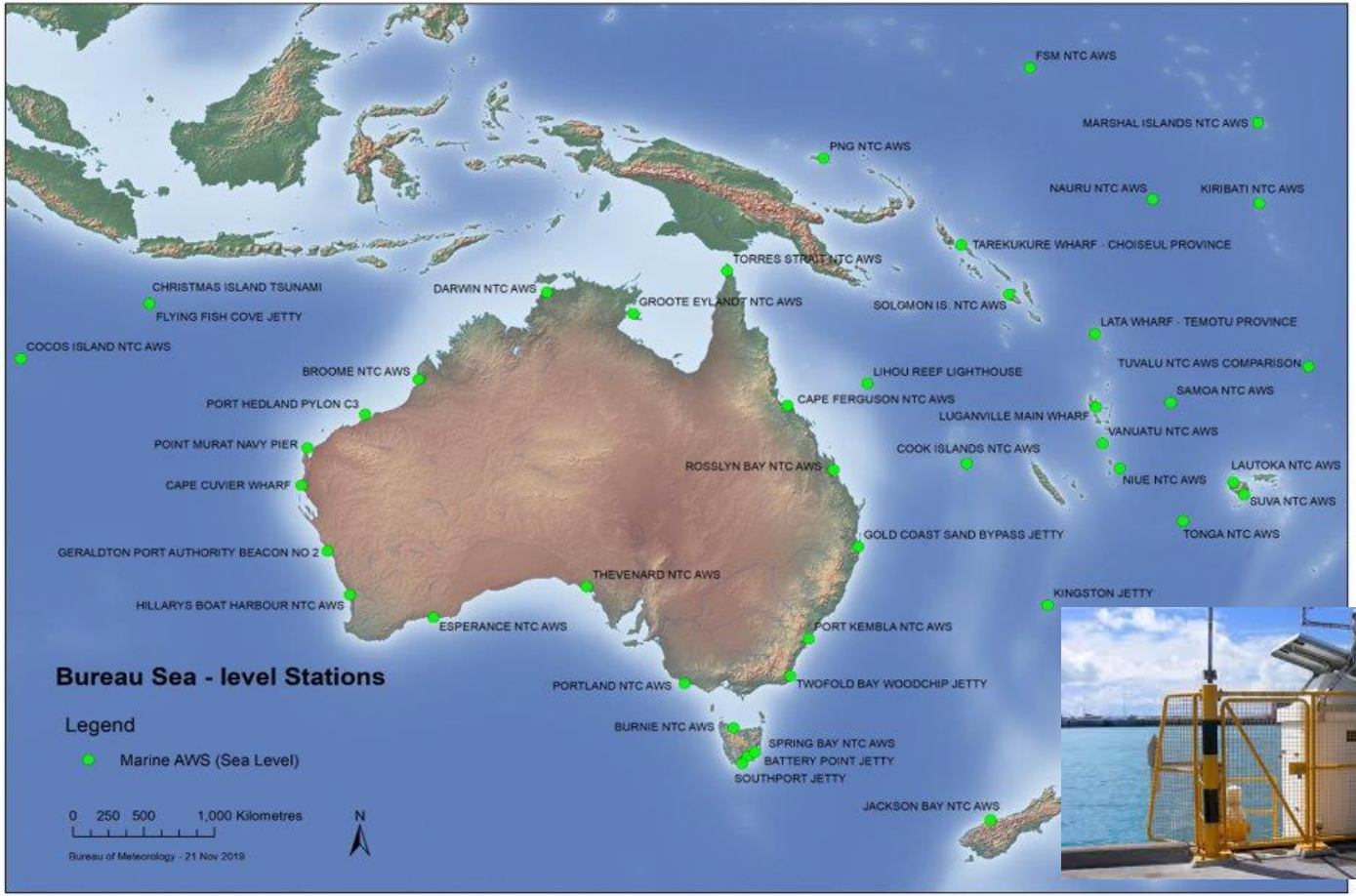
System 3 - Surface Network (AWS and Co-ops)



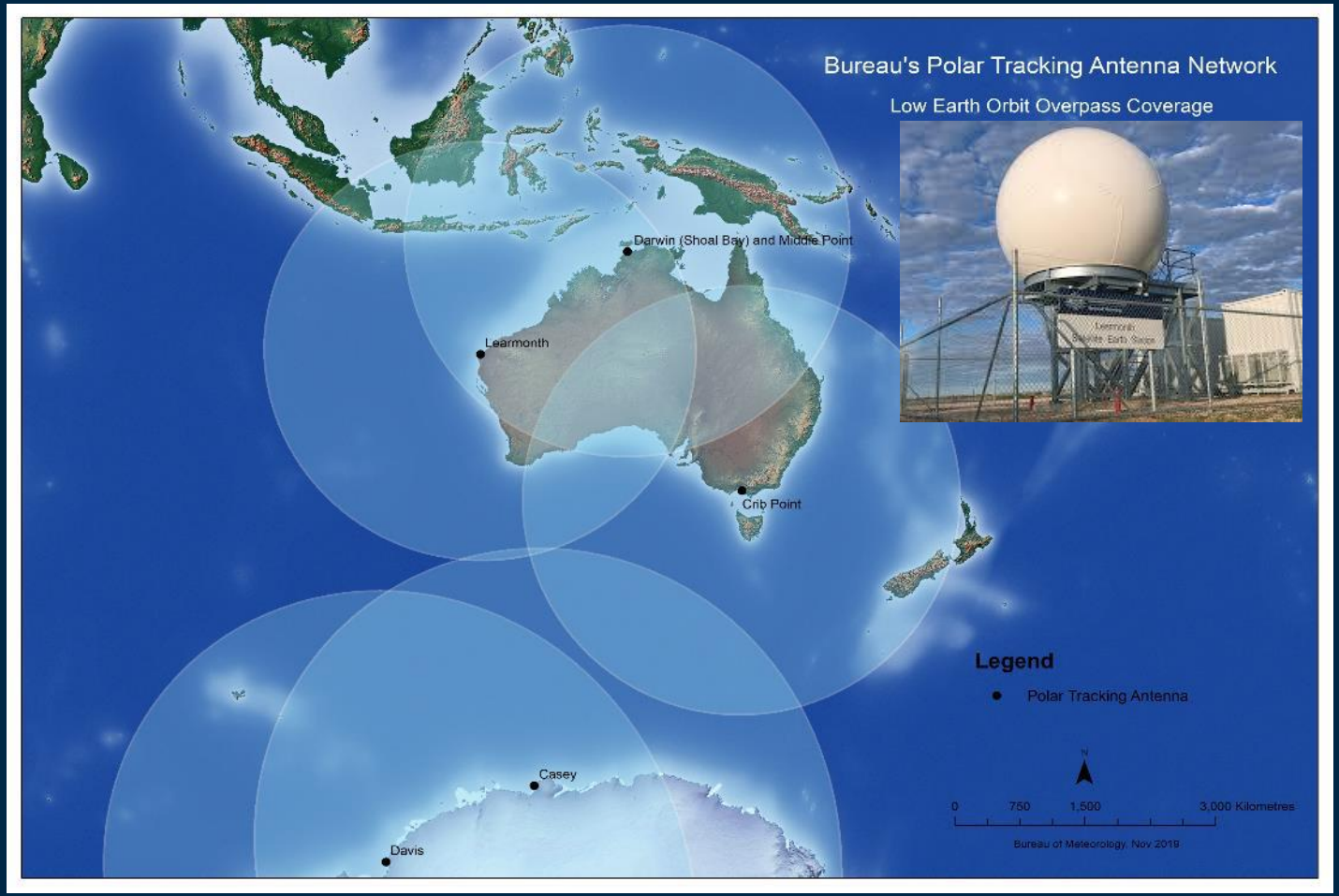
System 4 Tsunami Part A



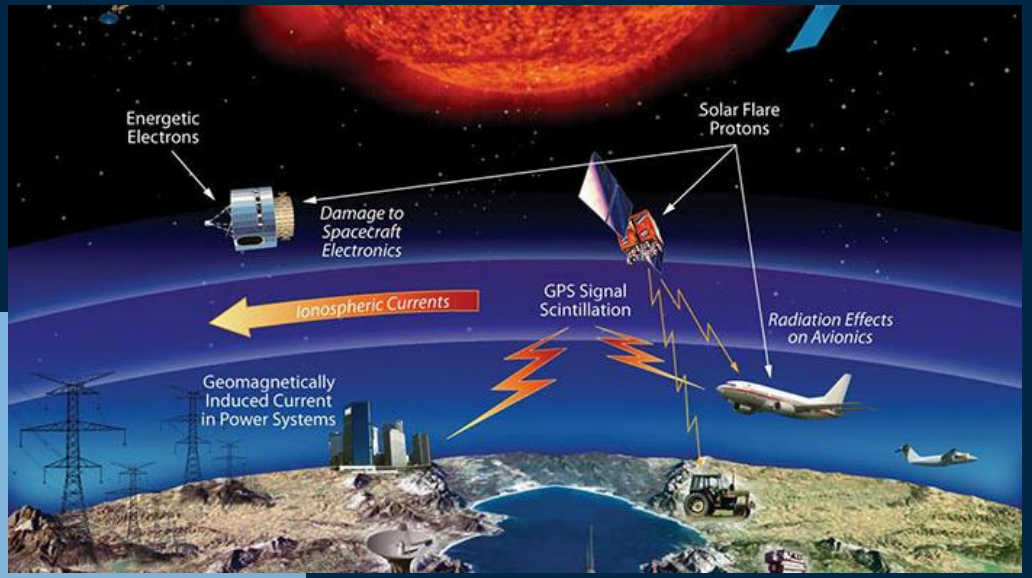
System 4 - Tsunami Part B Sea Level



System 5 - Satellite



System 6
Space Network and Observatory

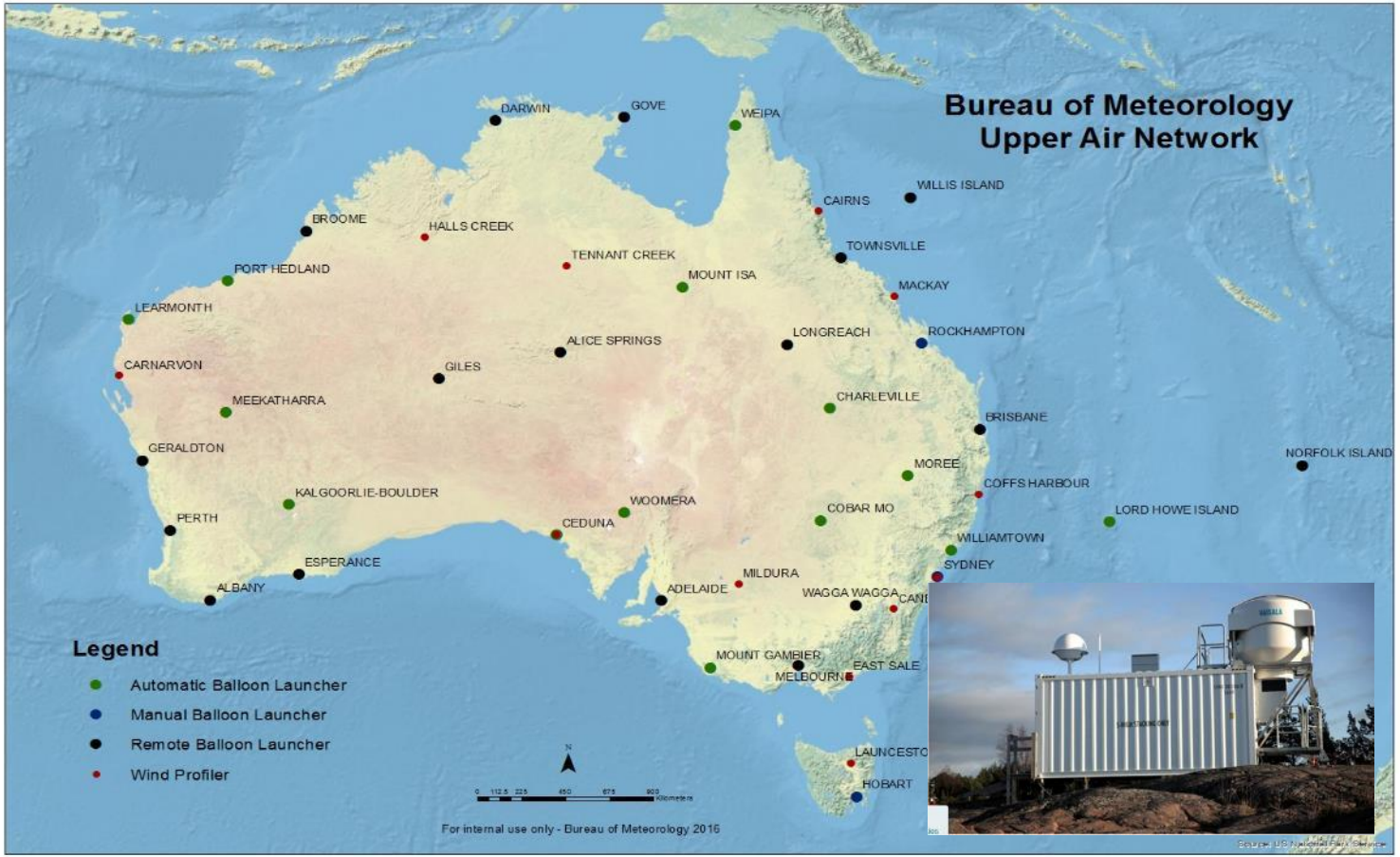


Shared USAF Facility

System 7 Atmosphere Watch and Observatory

System 8 Marine

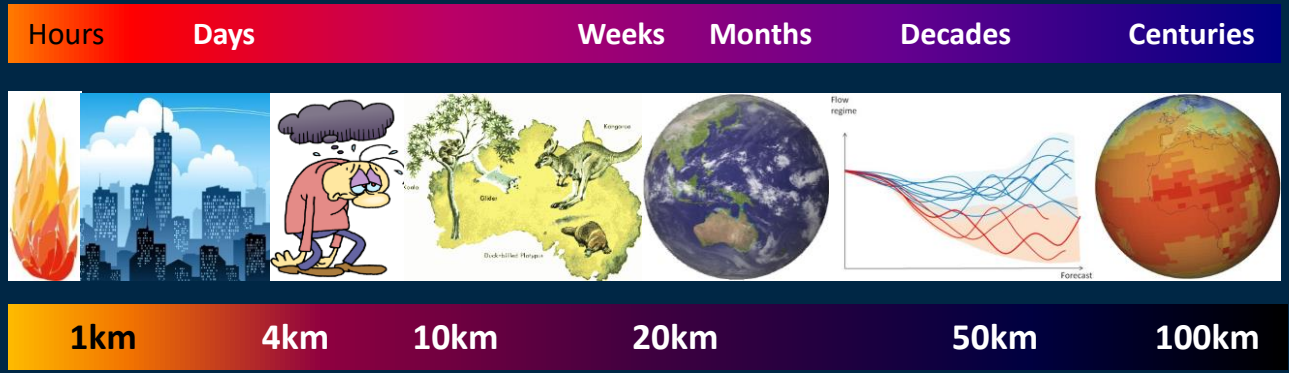
System 9 Upper Air



System 10 Staffed Sites

Modelling coverage

ACCESS: seamless weather and climate modelling



- Different configurations of the ACCESS model are used across time and space scales; from very high resolution fire modelling to lower resolution climate prediction
- The atmosphere and land Surface are fully coupled in all configurations of ACCESS

THIS IS REALLY
BIG DATA

NEARLY 100 METEOROLOGICAL PARAMETERS

12 KM GRID
COVERING AUSTRALIA, NEW ZEALAND AND SURROUNDS

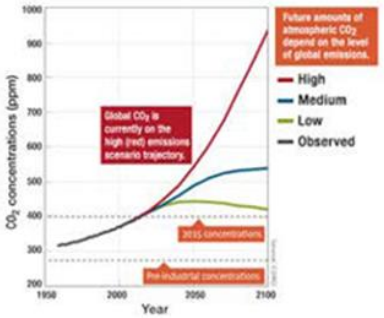
4 x 1.5 KM SUB-DOMAINS
CENTRED OVER SYDNEY, HOBART ADELAIDE AND PERTH

70 LEVELS
IN THE ATMOSPHERE
(THE TOP LEVEL IS AT 80 KM)

ANALYSED HOURLY EVERYDAY
OVER 29 YEARS 1990–2018

Modelling hydrological responses to future climate

Future GHG Concentrations

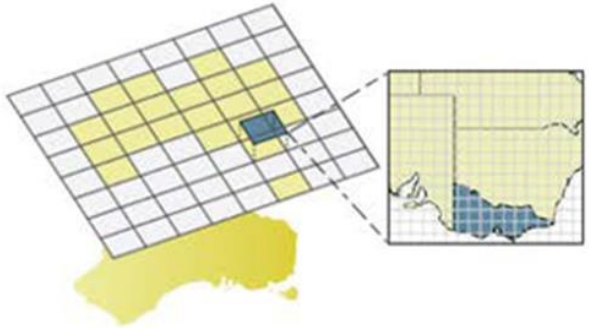


Representative Concentration Pathways

Changes in Global Climate

Global Climate Modelling

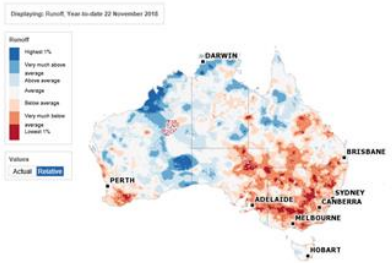
Changes in Regional Climate



Regional climate modelling or statistical downscaling

Bias-Correction

Changes in Regional Hydrology

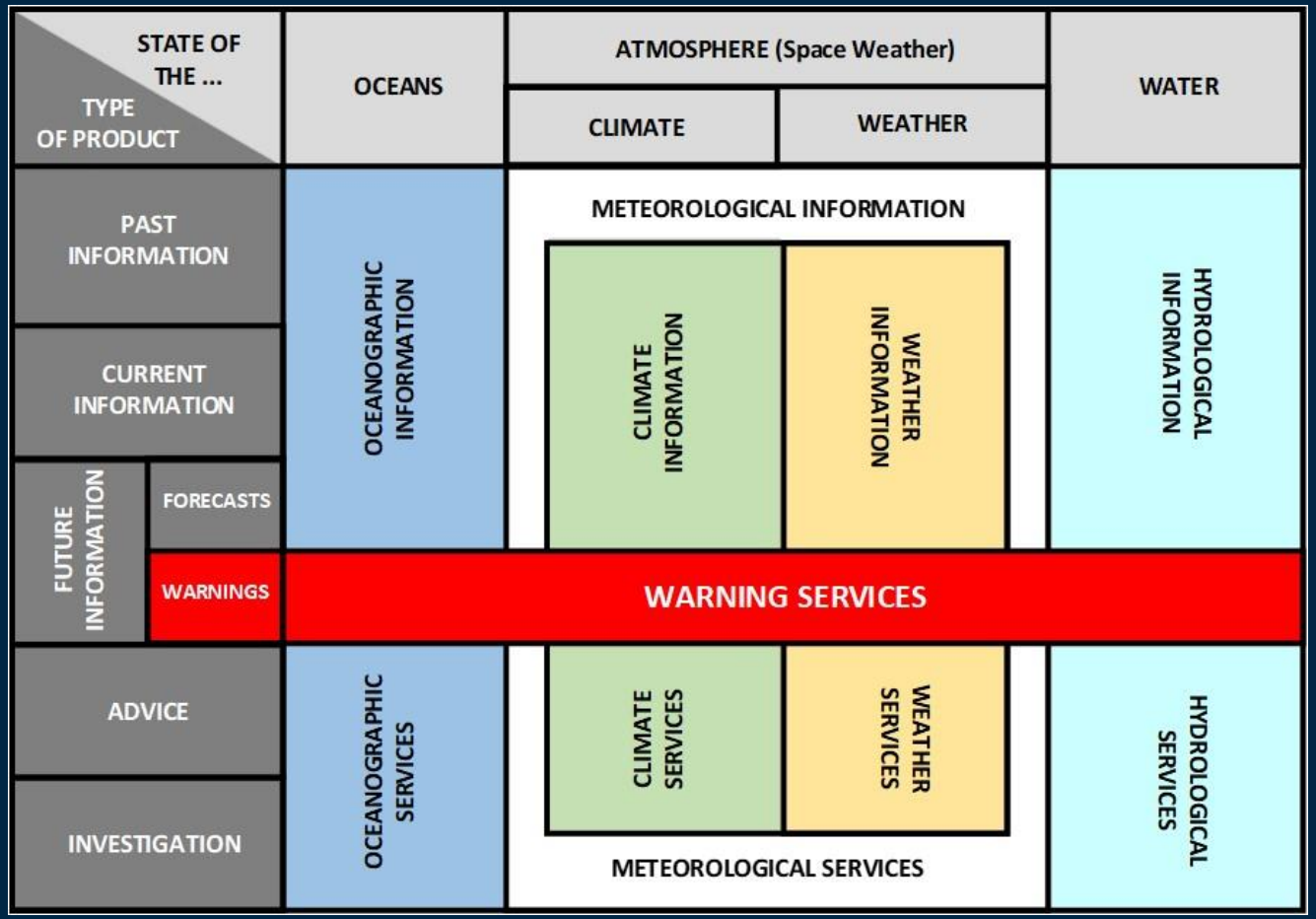


Hydrological Modelling

"Downstream" products and services – A summary….

Agriculture Advice
Agriculture Forecast
Agriculture Warning
Air Alert
Air Observation
Aviation Advisory
Aviation Alert
Aviation Analysis
Aviation Application
Aviation Briefing
Aviation Bulletin
Aviation Bundle
Aviation Chart
Aviation Forecast
Aviation Image
Aviation Information
Aviation Observation
Aviation Warning
Climate Advice
Climate Analysis
Climate Briefing
Climate Bundle
Climate Calendar
Climate Data File
Climate Forecast
Climate Information
Climate Interview
Climate Map
Climate Observation
Climate Outlook
Climate Publications
Climate Report
Climate Service
Embedded Service
Fire Weather Briefing
Fire Weather Bulletin
Fire Weather Bundle
Fire Weather Data File
Fire Weather Forecast
Fire Weather Image
Fire Weather Information
Fire Weather Map
Fire Weather Observation
Fire Weather Outlook
Fire Weather Service
Fire Weather Warning
Flood Advisory
Flood Alert
Flood Analysis
Flood Application
Flood Briefing
Flood Bundle
Flood Data File
Flood File
Flood Forecast
Flood Image
Flood Information
Flood Map
Flood Observation
Flood Outlook
Flood Service
Flood Warning
Grid Bundle
Grid File
Grid Forecast
Heavy Rainfall Bulletin
Media Conferences
Media Interview
Media Publications
Media Release
Media Service
Model Chart
Model File
Model Forecast
Model Grid Bundle
Model Grid File
Ocean / Water Advisory
Ocean / Water Analysis
Ocean / Water Application
Ocean / Water Bundle
Ocean / Water Chart
Ocean / Water Data File
Ocean / Water File
Ocean / Water Forecast
Ocean / Water Image
Ocean / Water Information
Ocean / Water Map
Ocean / Water Obser'vn
Ocean / Water Publicn's
Ocean / Water Report
Ocean / Water Service
Ocean / Water Temp.
Ocean / Water Warning
Radar Bundle
Radar Image
Radar information
Radar Metadata
Radar Report
Radar Service
Rainfall Alert
Rainfall Analysis
Rainfall Bulletin
Rainfall Bundle
Rainfall Data File
Rainfall File
Rainfall Forecast
Rainfall Grid File
Rainfall Information
Rainfall List
Rainfall Map
Rainfall Observation
Rainfall Outlook
Rainfall Service
Rainfall Temperature
Rainfall Velocity
Satellite Application
Satellite Bundle
Satellite Data File
Satellite Image
Satellite Publications
Solar Alert
Solar Data File
Solar Grid File
Solar Report
Solar Service
Space Weather Application
Space Weather Data File
Space Weather Forecast
Space Weather Information
Space Weather Observation
Space Weather Publications
Thunderstorm Advice
Thunderstorm Application
Thunderstorm Observation
Thunderstorm Service
Thunderstorm Warning
Tropical Cyclone Advice
Tropical Cyclone Advisory
Tropical Cyclone Alert
Tropical Cyclone Analysis
Tropical Cyclone Application
Tropical Cyclone Bulletin
Tropical Cyclone Bundle
Tropical Cyclone Data File
Tropical Cyclone Forecast
Tropical Cyclone Image
Tropical Cyclone Information
Tropical Cyclone Map
Tropical Cyclone Outlook
Tropical Cyclone Warning
Tsunami Analysis
Tsunami Bulletin
Tsunami Information
Tsunami Service
Utilities Service
Volcanic Ash Advisory
Volcanic Ash Information
Weather Analysis
Weather Application
Weather Bulletin
Weather Forecast
Weather Grid File
Weather Image
Weather Information
Weather Observation
Weather Publications
Weather Service
Wind Analysis
Wind Chart
Wind Forecast
Wind Observation
Wind Warning

Categorisation of meteorological-related services



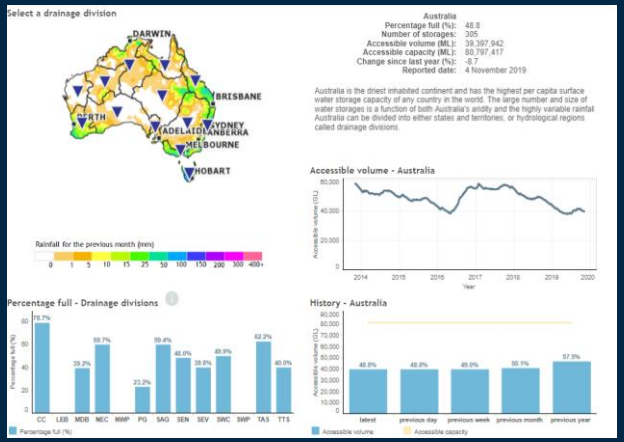
Water information key products

Access to over 4 billion observations

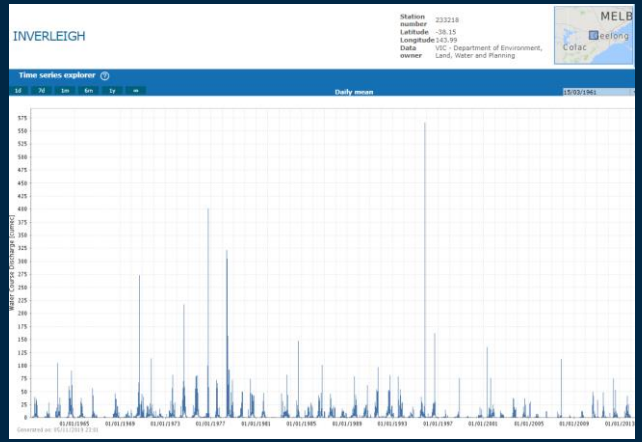
Awareness

- Storages, Markets
- Water Data Online
- Groundwater Explorer, GDE Atlas

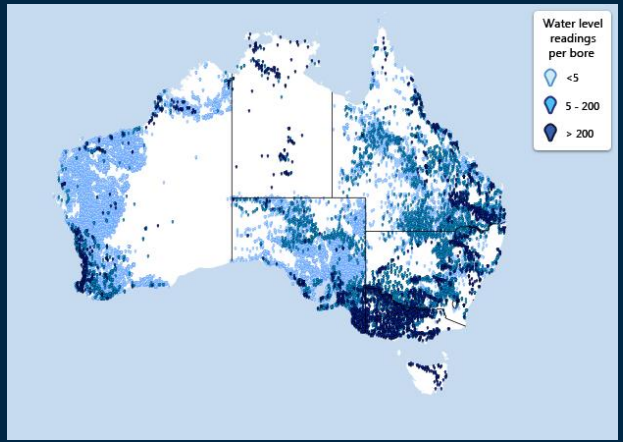
- ✓ Daily tracking of >97% of water capacity
- ✓ Comprehensive archive, instant analysis
- ✓ Water levels, stratigraphy, ecosystems



310 public storages



>6200 monitoring stations



>850,000 bores

Water information key products

Access to over 4 billion observations

Perspective

National landscape & river model

National Water Account

Water Resource Assessments

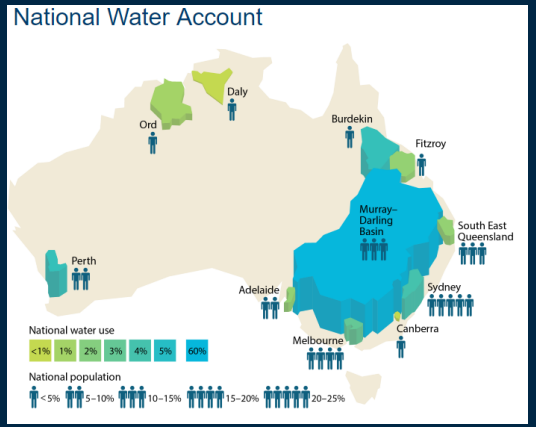
Intensity-Frequency-Duration

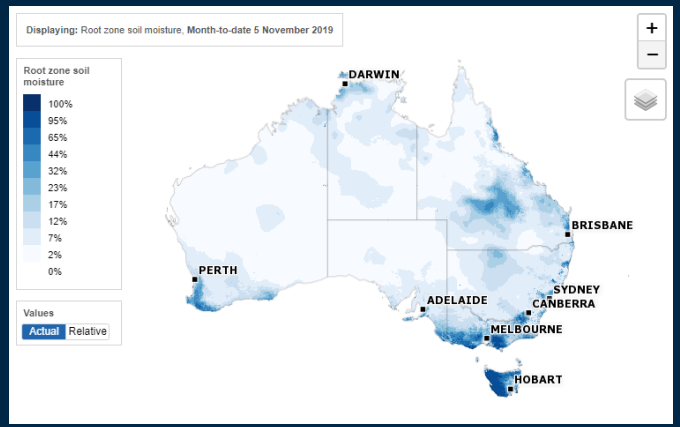
✓ Daily modelled soil moisture, stock & flows

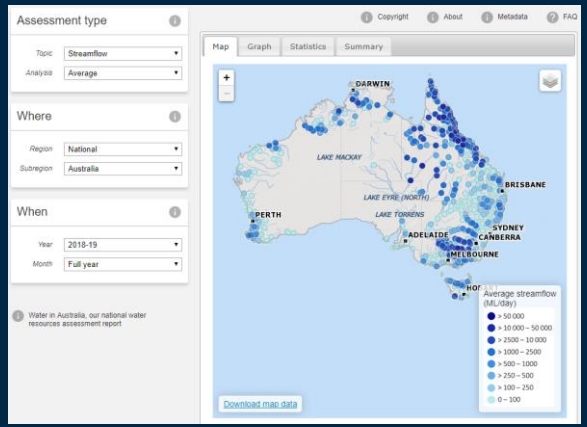
✓ Authoritative, annual stocktake

✓ National context, consistent methodology

✓ Reduced flood risk, efficient use of capital







80% water usage

5km continental grid

2,300+ data over 30 years

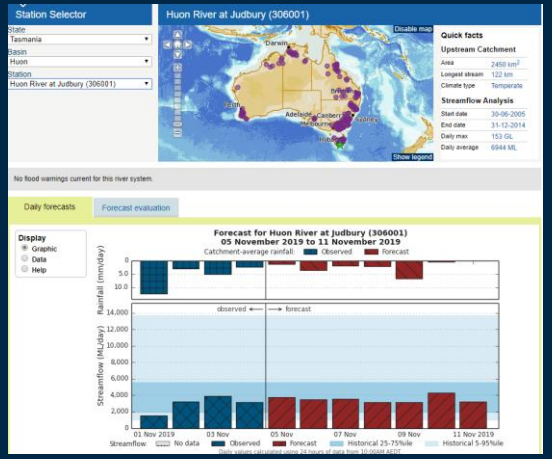
Water information key products

Access to over 4 billion observations

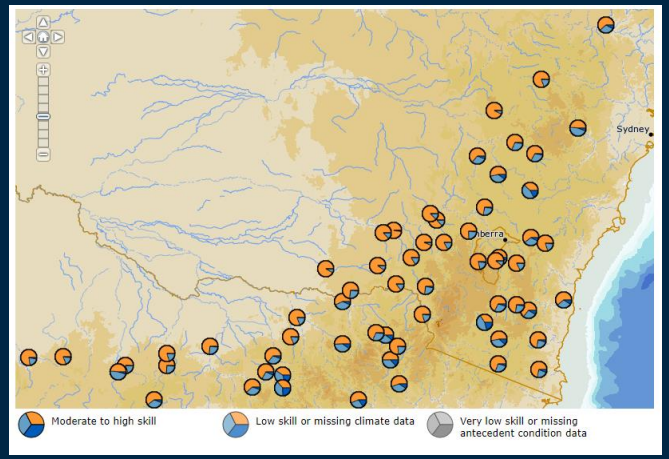
Foresight

- Flood, 7-day streamflow forecasts
- Seasonal streamflow forecasts
- Hydrologic Reference Stations

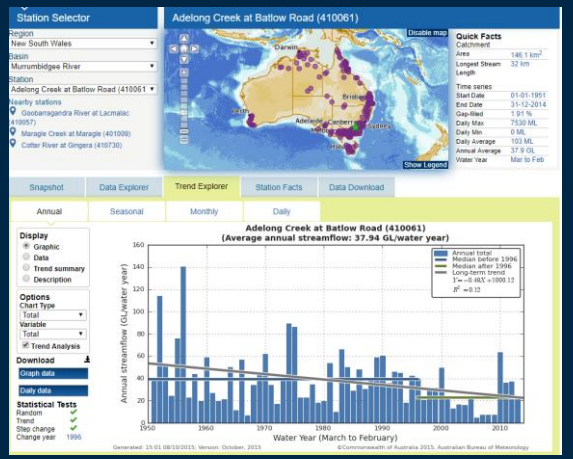
- ✓ Daily forecasts: emergencies to irrigation
- ✓ Enhanced agribusiness worth $1 billion
- ✓ Long-term term trend analysis



168 locations



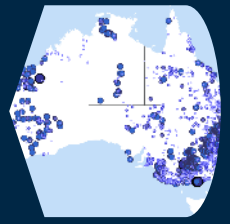
215 locations



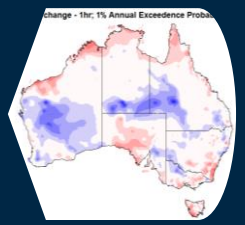
222 stations

An Example – Hydro Services Pipeline

Weather Prediction



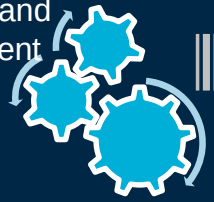
Groundwater



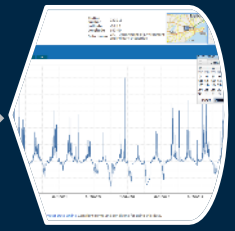
Design Rainfall

Flood

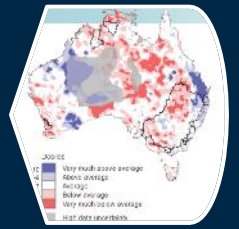
Research and Development



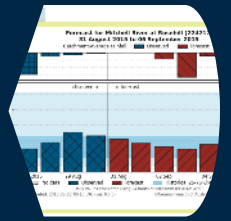
Hydrologic models



Streamflow



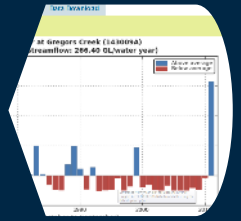
Assessments



7-day stream

Data warehouse

Water storage



Reference streamflow

Seasonal Forecasts

Making it work for our customers!

- Research function
  - Long term investigation and innovation; delivery focus
- Research to Operations function
  - Effective, efficient end-to-end workflow
  - Verifying and communicating uncertainty
- Customer facing teams
  - Understand the customer environment
  - Contribute feedback and new customer needs

- Connecting model outputs to decisions
  - Close links to application
  - Customer involvement from the research end of the pipeline
- Cycling from operations back to research
  - Bring emerging knowledge and technology together with understanding of current and future needs

Challenges and opportunities

- Disruption and competition
- Increasing frequency and severity of natural hazards
- Speed to market
- Global and national trends
- Bureaucracy and red tape
- Unmanaged dependencies

- Our people – doing higher value work
- Partnering and collaboration
- Technology and innovation
- Moving our offerings/market
- Large, government initiatives
- Networks and leveraging

Thank you

Questions?

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Australian Government
Bureau of Meteorology