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Agency Report to CEOS WGCV-40
Australian Bureau of Meteorology

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Outline

- Overview of BoM and satellite applications
- Generic verification of satellite applications
- BoM observation networks

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OVERVIEW OF BOM AND SATELLITE APPLICATIONS

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The BoM provides Australians with environmental intelligence for safety, sustainability, well-being and prosperity

- Monitor and report on current environmental conditions.
- Analyse and explain trends in environmental data.
- Provide forecasts, warnings and long-term outlooks on environmental phenomena that affect the safety, prosperity and resilience of Australians.
- Foster greater public understanding and use of environmental intelligence.

- ~1500 staff
- Head Office in Melbourne, Regional centres around the nation
- Strong links with Asia-Pacific nations, national & international agencies

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National Observing Network

Point/Localised Data

- Automatic Weather Stations
- Rainfall Observations
- Upper Air Balloon Flights

Medium-area Coverage
(Hundreds of km)

- Radar
- Lightning Detectors

Wide-area Coverage
(Thousands of km)

- Polar-Orbiting Satellites
- Geostationary Satellites

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Observations & Infrastructure Division
Science & Engineering Section

S&E provides O&I with scientific expertise, predominantly in physics, meteorology and metrology, to support both ongoing activities and projects

Passive Remote Sensing subsection

- Terrestrial and Solar Radiation Network
- Ozone observations
- Satellite applications

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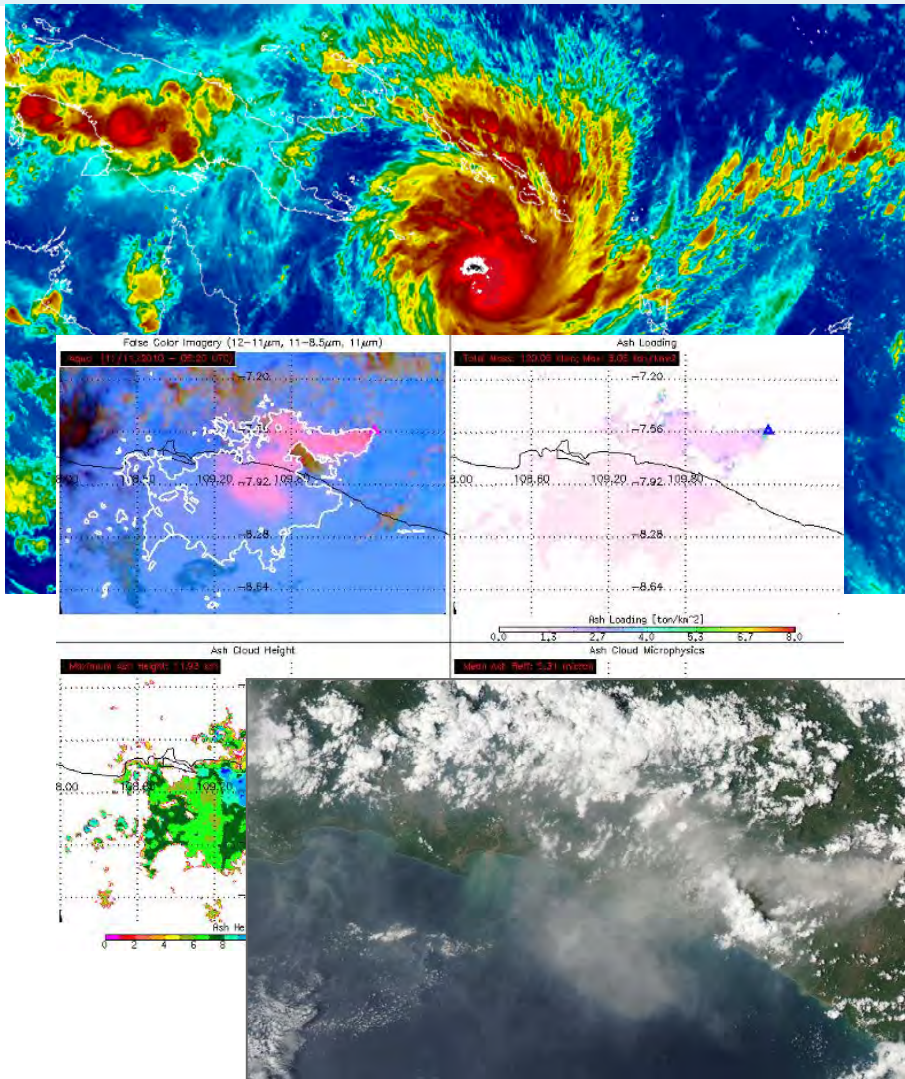
Satellite Applications

- Weather & Warnings
- Tropical Cyclone Warning Centres
- Volcanic Ash Advisory Centre
- NWP
  - Hyper-spectral sounders
  - Atmospheric motion vectors
- Ocean Modelling
  - Altimeters, Radiometers
- Climate
  - Ocean Temperatures, Clouds…
- Environmental Applications
  - Sea Surface Temperature, Solar Radiation, Vegetation Indices, Grassland Curing, …



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Weather Satellites Used in the Bureau

Polar-orbiting

NOAA series

Metop series

Aqua & Terra

Suomi-NPP

Fengyun-3

TRMM

Jason-2

SARAL

WindSat

GCOM-W1

Geostationary

MTSAT series

Fengyun-2 series

GOES series

METEOSAT

Himawari-8

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O&I Division – Passive Remote Sensing: Satellite-based products

External use

Solar Radiation
Grassland Curing
NDVI (vegetation greenness)
Sea Surface Temperature
Volcanic Ash
Fog / Low cloud
Aircraft Icing Potential
Public imagery

Internal use

Sounder radiances
Atmospheric Motion Vectors
Forecaster imagery

Future development

Cloud properties
Convective initiation
Precipitation
Advanced Dvorak analysis (TC)

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GENERIC SATELLITE APPLICATION VERIFICATION

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BoM Satellite Application Verification

BoM satellite applications are moving to generic systems

- Processing
  - GEOCAT framework from NOAA
  - Software management: version control, continuous integration
- Data standards
  - Products in netCDF4-CF
  - Standard metadata
- Validation
  - Matchup and intercomparison of arbitrary 1D, 2D, 3D datasets
  - Aim is continuous monitoring of data product quality

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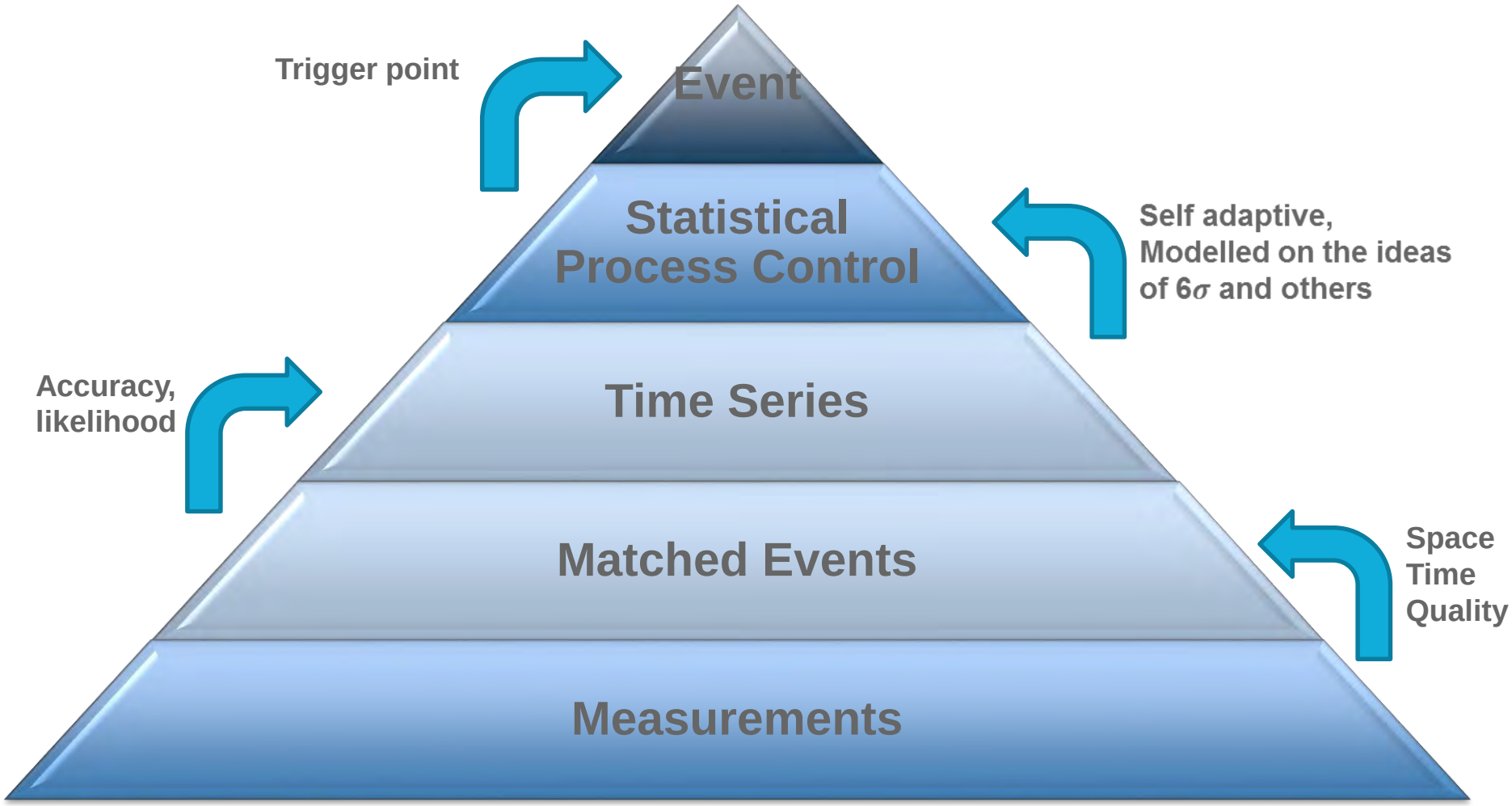
Developing a validation framework



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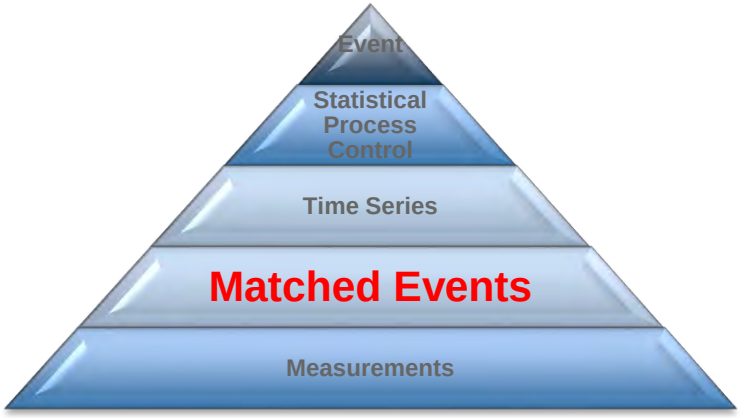
Basic Ideas

- Match in space and time results in a **"validation"** dataset
  - Primarily concerned with matches within limits (±x hours, ±y km)
  - Subsampling and thinning
    - Millions of **Target** and **Standard** observations
    - Can emphasise exceptional events
- Aggregate multiple target validation datasets to enable analysis of target performance over time/space



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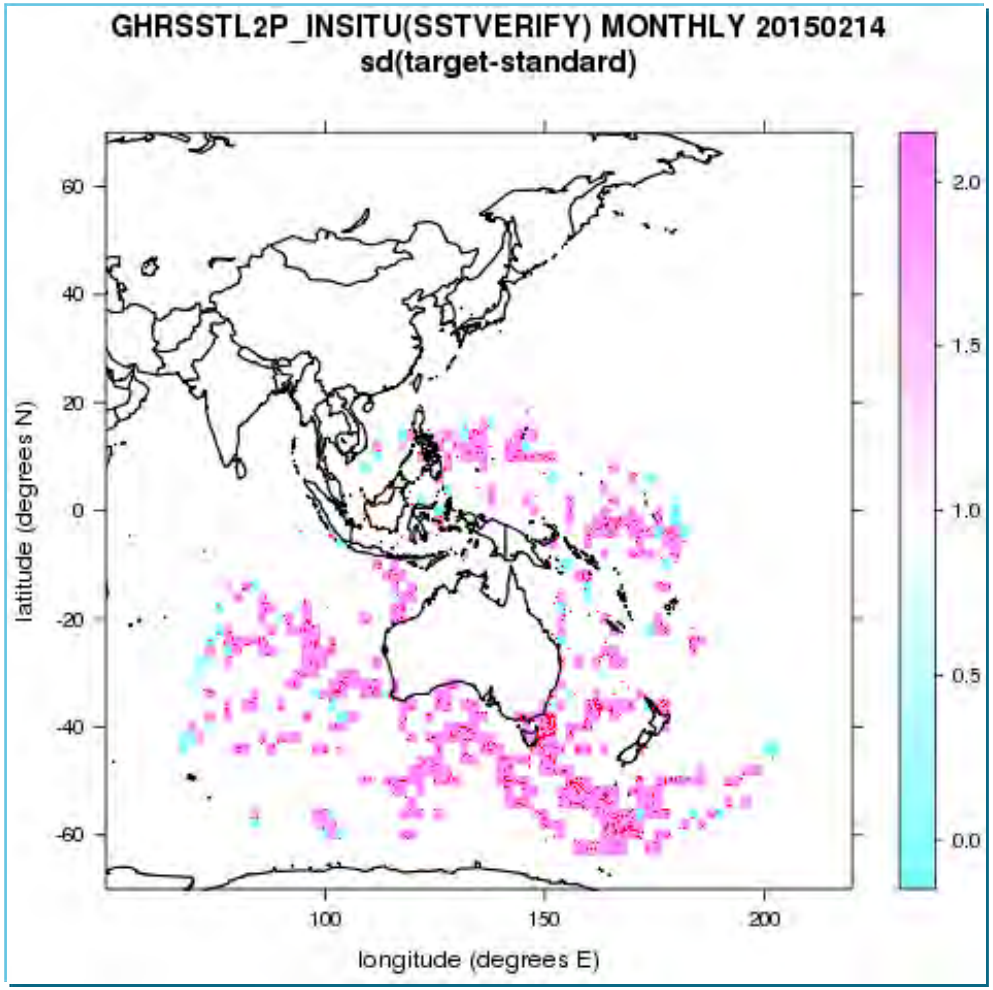
Matchup example

- **Target**: GHRSST L2P (NOAA-18 and -19)
- **Standard**: drifting buoys
- Criteria:
  - 15 Jan-14 Feb 2015
  - ±1 hour, ±5 km
  - All quality levels



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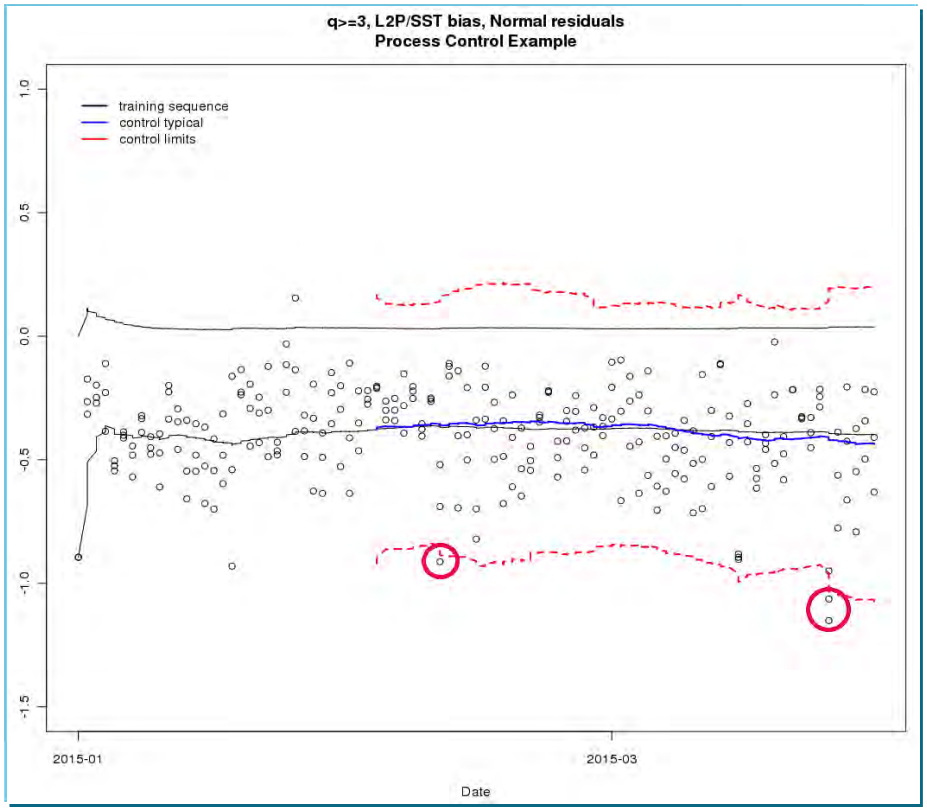
Process Control and Alarm example

- **Target**: GHRSST L2P (NOAA-18 and -19)
- **Standard**: drifting buoys
- Criteria:
  - 1 Jan-1 Apr 2015
  - ±1 hour, ±5 km
  - Good quality data
- With alarm events, training and control limits



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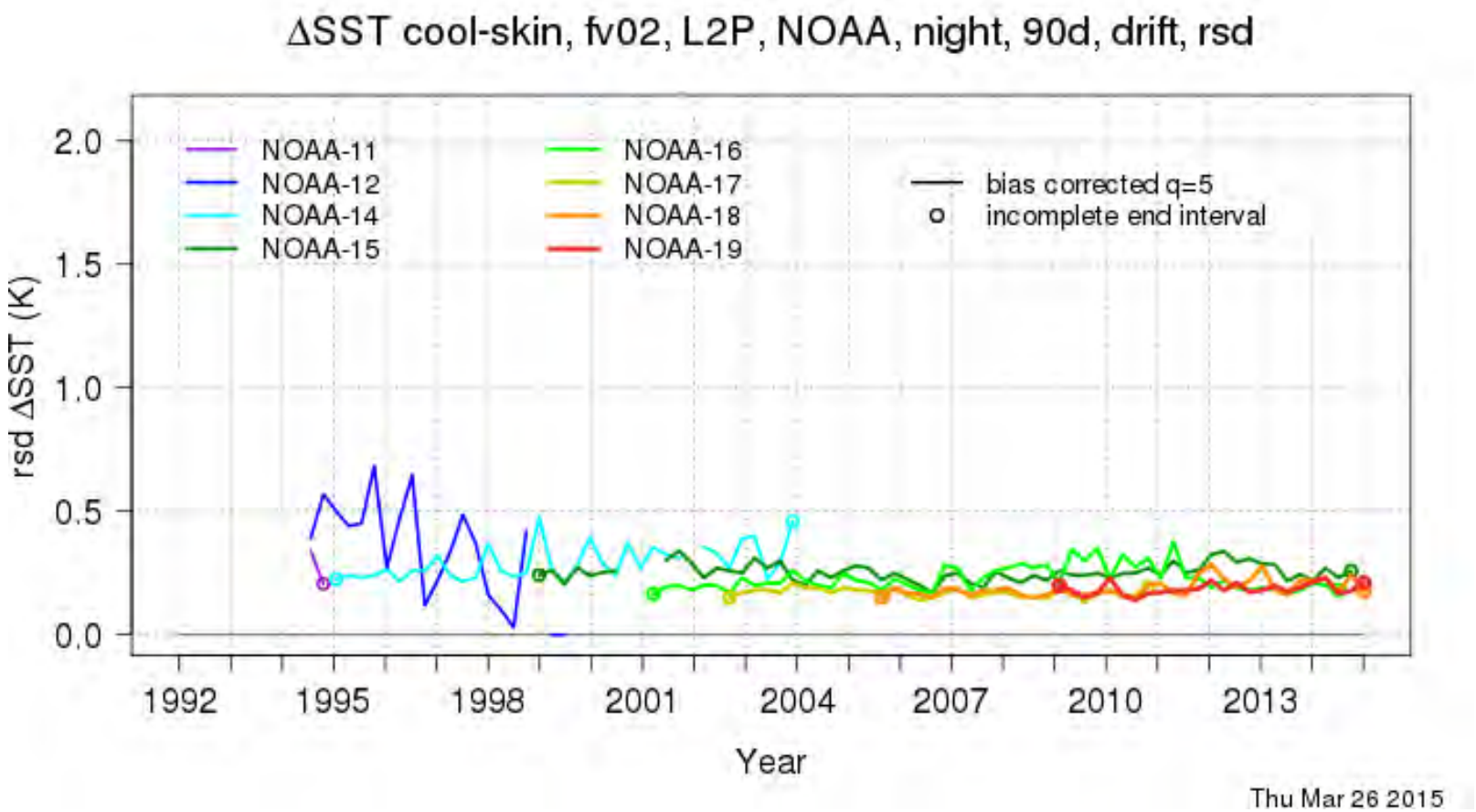
IMOS AVHRR SST on-line routine verification

http://opendap.bom.gov.au:8080/thredds/fileServer/abom_imos_ghrsst_archive/v02.0fv02/Validation/web/index.html

Robust Standard Deviation of SST from all NOAA satellites versus drifting buoys



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BOM OBSERVATION NETWORKS

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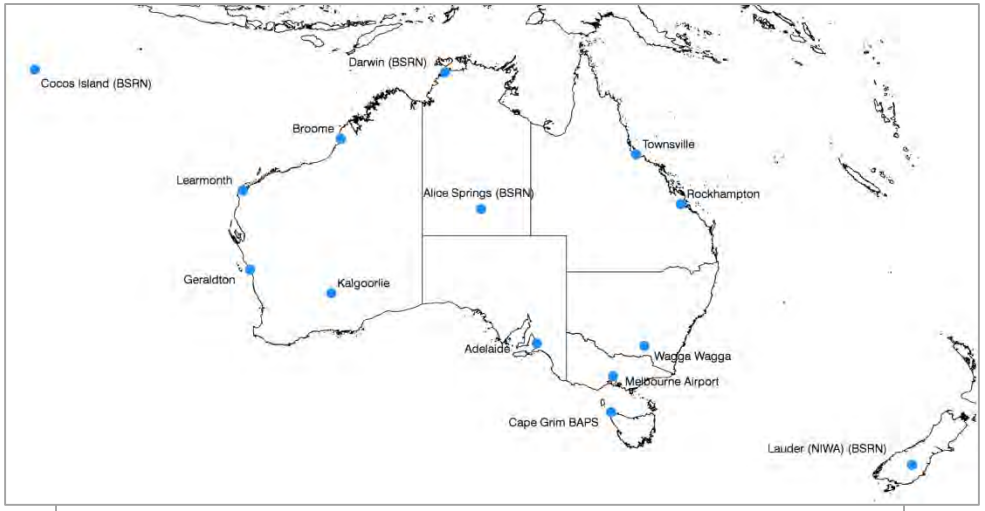
Bureau surface radiation network

- **Radiation**: 1 minute statistics of solar global, diffuse and direct components & downwelling IR
- Spectral transmission at 7 wavelengths
  → **Aerosol optical depth**
- 31 stations, 14 currently open
- 3 BSRN stations
- 240 station-years of data
- Solar measurements are traceable to the World Radiometric Reference



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Recently acquired new instrumentation

Prede POM-2 Skyradiometer

- Skynet

PMOD Precision Spectral Radiometer

- Absolute spectral irradiance measurements, 300 – 1020 nm resolution (1.5 - 6 nm)

Pandora

- 290-520 nm, resolution 0.6 nm
- Primary intention is for ozone but other retrievals possible

EnviMeS MAX-DOAS (UV/Vis)

- Two spectrometers, 300-340 nm and 450-590 nm
- To be used for column and tropospheric abundances of key species

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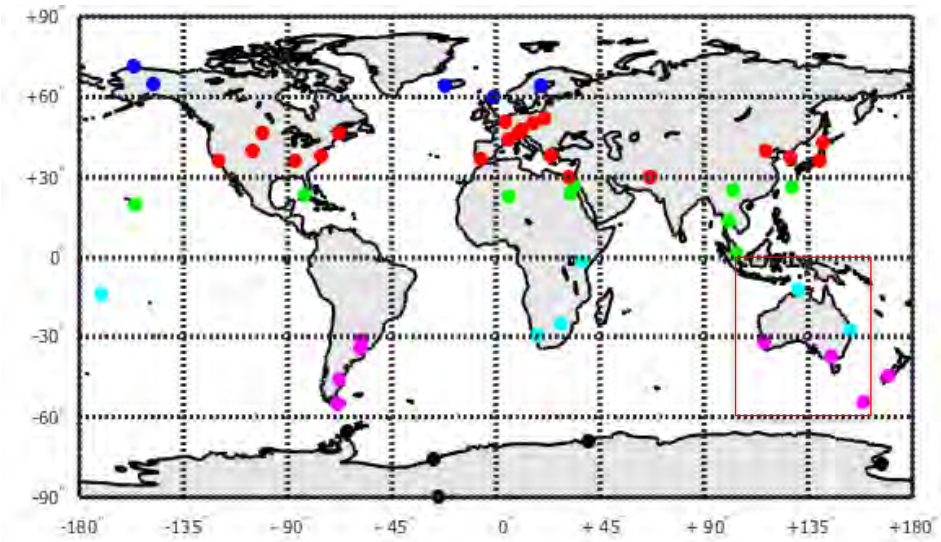
Dobson instrument network

Total Column Ozone

- Data available at World Ozone and Ultraviolet Radiation Data Centre (WOUDC, http://woudc.org)
- BoM sites contribute a large fraction of the data at southern latitudes



Map from Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2016-11, 2016

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Ozonesonde sites

Ozone profiles

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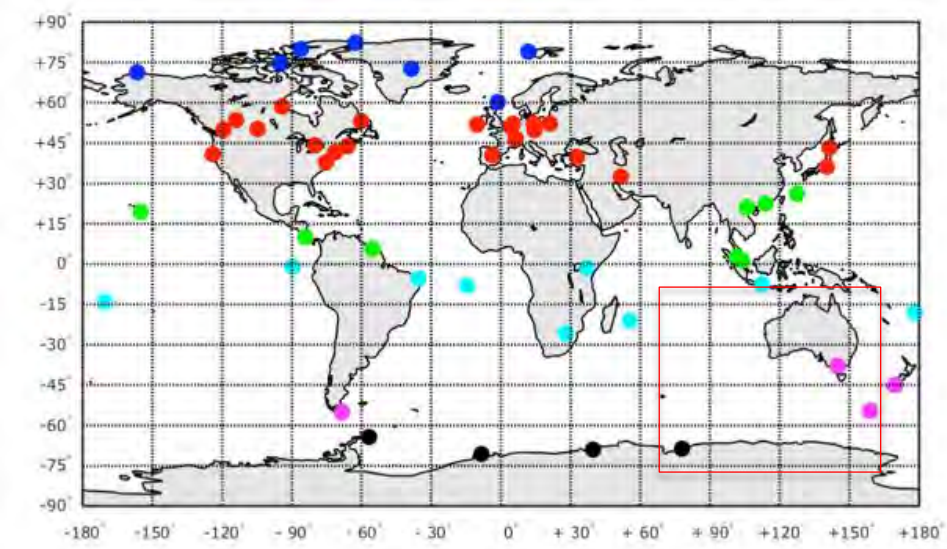

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Thank you…

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