Metadata report: Arcturus atmospheric greenhouse gas monitoring

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David Etheridge1, Zoe Loh1, Ivan Schroder2, Henry Berko2, Tehani Kuske2, Colin Allison1, Rebecca Gregory1, Darren Spencer1, Ray Langenfelds1, Steve Zegelin3, Mark Hibberd1 and Andrew Feitz2.



1. CSIRO Marine and Atmospheric Research, Aspendale, 3191 Victoria
2. Geoscience Australia, Canberra, 2601, ACT
3. CSIRO Marine and Atmospheric Research, Black Mountain, Canberra, 2601, ACT

Department of Industry

Minister for Industry: The Hon Ian Macfarlane MP  
Parliamentary Secretary: The Hon Bob Baldwin MP  
Secretary: Ms Glenys Beauchamp PSM

Geoscience Australia

Chief Executive Officer: Dr Chris Pigram  
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Introduction

The Arcturus greenhouse gas (GHG) monitoring station began operation in July 2010 50 km southeast of Emerald, Queensland. The station was part of a collaborative project between Geoscience Australia (GA) and CSIRO Marine and Atmospheric Research (CMAR) to establish and operate a high precision atmospheric monitoring facility for measurement of baseline greenhouse gases in a geological carbon dioxide capture and storage (CCS) region. The primary purpose of the station was to establish newly developed greenhouse gas monitoring technology and demonstrate best practice for regional baseline atmospheric monitoring appropriate for geological storage of carbon dioxide. The GHG records were to be used as a reference for monitoring of the atmosphere at a CO2 storage project (see for example Leuning et al., 2008 and Etheridge et al., 2011), providing a baseline to quantify typical variations in the area and a background against which any anomalies in the immediate vicinity of the storage might be detected.

Site selection was based on the recommendations of the Carbon Storage Taskforce’s National Carbon Mapping and Infrastructure Plan, regional assessments of prospective basins, regional atmospheric modelling, and consultation with key stakeholders (Berko et al., 2012). During early 2010, the ZeroGen CCS project had an active exploration program for geological storage and the atmospheric station was therefore eventually located approximately 8 km upwind from the boundary of ZeroGen’s most prospective storage area in the northern Denison Trough, part of the larger Bowen Basin.

The Arcturus site and environs is representative of the activities and ecology of Queensland Central Highlands and the GHG signals are likely to be influenced by cropping, pasture, cattle production, and gas and coal activities. The site is secure, can be accessed via an existing road, is not often subject to flooding, and has easy access to electricity supply.

The station comprises a modified air conditioned shipping container equipped with gas monitoring instruments, meteorological sensors and a 10 metre fibre-glass mast with air inlets (Berko et al., 2012). Wavelength scanned cavity ring down spectroscopy (WS-CRDS) was adopted for gas measurements. Two Picarro gas analysers (wavelength scanned cavity ring down spectrometers) continuously monitor greenhouse gases and CO2 isotopes. One unit measures isotopic ratios of carbon in CO2 (12C and 13C) and water vapour while the other measures the concentrations of CH4, CO2 and water vapour. Atmospheric composition is also occasionally measured on air samples collected with flask sampling equipment. An automated weather station measures wind speed, wind direction, temperature, humidity and rainfall. A solar powered eddy covariance flux tower was also installed at the site, some 250 m south of the main station. The flux tower comprises a LI-7500A LI-COR open-path eddy covariance gas instrument that measures atmospheric CO2 and H2O. Wind speed and direction are measured in 3 dimensions using a CSAT3 sonic anemometer (Campbell Scientific Inc). A wireless network connects the flux tower to the main station, although the flux tower can also be accessed independently via a modem should power in the main station fail. Communication for remote access to the instruments in the station is provided via a router/modem fitted with a mobile phone SIM card and an external antenna. Any authorised PC running GoToMyPC software can access and control the PC in the container via the internet over the NextG network.

In June 2010, on the basis of a pre-feasibility study of the ZeroGen project, it was found that the geology of the north Denison Trough was not viable for large scale CO2 storage (Greig, 2012). This meant that Arcturus was no longer providing atmospheric baseline measurements for an active geological storage region. Nevertheless, the stakeholders agreed that there is a clear benefit to continuing the project as there was no alternative onshore exploration program in Australia, and many of the project objectives could still be realised. This includes field-testing and evaluating a new generation of greenhouse gas monitoring technology in remote environments; understanding a complex greenhouse gas baseline; and developing methods for leak detection and quantification (Wilson, 2013). Preliminary results demonstrate that significant methane anomalies are being detected that can be attributed to coal mine emissions in the area. The station also generates data that could be used for the purposes of estimating regional and national greenhouse gas budgets (Ziehn et al., submitted).

Citation notice

Calibrated, averaged concentration data should be considered an interim product. CMAR may update records to improve quality, internal consistency or alignment to a calibration scale as new or improved information becomes available. The water vapour correction and in particular the calibration requirements of the Picarro cavity ring down instrument for CO2 isotopes are under active investigation by CMAR staff, the instrument manufacturers and other users of the instruments (Allison et al., submitted).

Please contact the relevant staff member (as listed for each variable in the tables below) via telephone or e-mail addresses if any clarification of the meaning or limitations of the data is required. If users wish to send us preprints of any publications using the data, we would be happy to check that the data are being used within their limitations.

It is recommended that in addition to the required attribution for use of this data, that the version of the data (as specified by release date) be explicitly stated (e.g. Data supplied by CSIRO and Geoscience Australia (2014) version 31.03.2014.).

Central repository for atmospheric data from Arcturus

Most composition data reside both on CMAR’s servers (gl-as, dagage1) and on the local PC belonging to the staff member responsible for work-up of that data stream. Flask data can be accessed through the GASLAB database (Squall: http://squall-as/gaslab/index.php). Access is presently available on request to the relevant CSIRO staff member.

Meteorological data are held on GA’s server (\\nas\energy\ccs\Atmospheric monitoring facility\Arcturus site\ Met\_Data\archived), and accessible by request to the relevant GA staff member.

The raw and processed eddy covariance data (covariances, met data and soil data) are held on GA’s server (\\nas\energy\ccs\Atmospheric monitoring facility\Arcturus site\ Eddy covariance tower\Fully\_Processed\_Data), and accessible by request to the relevant GA staff member. The raw data are also held on CSIRO’s server (fsact01-cdc\csiro\cmar\Enterprise1\flux\arcturus). Processed eddy covariance data are also publically accessible from the OzFlux Data Portal (accessible from http://www.tern.org.au).

Calibration scales for concentration measurements

CMAR’s GASLAB has a multi-decade history of maintaining close links with a number of global atmospheric trace gas sampling networks. These include the National Oceanographic and Atmospheric Administration’s (NOAA, USA) global sampling network; the Advanced Global Atmospheric Gases Experiment (AGAGE), and the World Meteorological Organization’s Global Atmosphere Watch (WMO GAW) program.

In order to merge data with these global networks, laboratories are required to maintain their measurements on internationally recognised mole fraction scales. These scales are typically defined by a set of primary standards, produced either manometrically or gravimetrically and held at a nominated central calibration facility. Participating laboratories hold one or more suites of their own calibration standards that are measured and defined against the scale in the central calibration laboratory. Linkage to a given international scale may be maintained in a number of ways, including regular exchanges of high-pressure cylinder standards and more frequent flask-air-sharing comparisons.

# METADATA: Ambient atmospheric composition – in situ measurements

Atmospheric composition is measured by two Picarro gas analysers located within the shipping container, which sample continuously from aspirated inlets at 10 m on the fibre-glass mast.

All composition data is logged onto the Picarro instruments and written to daily files, which are compressed and copied to the Arcturus PC workstation. These daily files are downloaded from the workstation via the internet weekly to CSIRO, where quality control and processing of the data is performed, producing average minute and hourly summary files.

The analysers automatically measure their reference standard daily. Calibration runs, which are initiated remotely every 4-6 weeks, comprise repeatedly measuring each of the calibration standards (as a set of pyramids; low, ambient, high, reference, high, ambient, low), to tie measurements back to internationally recognised mole fraction scales.

## CO2

|  |  |
| --- | --- |
| Location | Arcturus station  23.85872° S, 148.4746° E, 175 masl inlet at 10 m above ground level. |
| Instrument | Picarro continuous wave cavity ring down spectrometer. The initial unit, Picarro G1301 Analyser (CFADS63), was replaced by a Picarro G2301 Analyser (CFADS2324) on 22 Oct 2013. |
| Period of record | July 2010 – June 2014 |
| Frequency of measurement/ effective averaging time | Continuous measurement with data averaged to minute and hourly means. |
| Forms of data | Raw output and diagnostics.  Quality controlled, corrected for water vapour, calibrated, minute and hourly means. |
| Corrections | Water vapour correction for volumetric dilution and spectroscopic pressure broadening as per Chen et al., 2010. |
| Calibration scale | Linked to the WMOx2007 CO2 mole fraction scale.  Maintained by a reference standard measured for 30 minutes every day and three calibration standards measured several times each month. |
| Accuracy | Better than ±0.1 ppm |
| Network | Australian Greenhouse Gas monitoring network, WMO GAW (site code ARA) |
| Primary data storage of record | CSIRO:  \\gl-as\Picarro\CFADS63\arcturus and  \dagage1\arcturus-picarro\DataLog\_User  Hour and minute averages (calibrated):  \\gl-as\GOLD\Data\Arcturus and  \dagage1\arcturus-picarro\export |
| Other locations | External CSIRO back-up |

|  |  |
| --- | --- |
| Organisation and primary contact | CSIRO Marine and Atmospheric Research  Zoe Loh  [zoe.loh@csiro.au](mailto:zoe.loh@csiro.au)  03 9239 4518 |

## CH4

|  |  |
| --- | --- |
| Location | Arcturus station  23.85872° S, 148.4746° E, 175 masl inlet at 10 m above ground level. |
| Instrument | Picarro continuous wave cavity ring down spectrometer. The initial unit, Picarro G1301 Analyser (CFADS63), was replaced by a Picarro G2301 Analyser (CFADS2324) on 22 Oct 2013. |
| Period of record | July 2010 – June 2014 |
| Frequency of measurement/ effective averaging time | Continuous measurement with data averaged to minute and hourly means. |
| Forms of data | Raw output and diagnostics  Quality controlled, corrected for water vapour, calibrated, minute and hourly means. |
| Corrections | Water vapour correction for volumetric dilution and spectroscopic pressure broadening as per Chen et al., 2010. |
| Calibration scale | NOAA04 CH4 mole fraction scale (Dlugokencky et al., 2005).  Maintained by a reference standard measured for 30 minutes every day and three calibration standards measured four times each month. |
| Accuracy | Better than ±1 ppb |
| Network | Australian Greenhouse Gas monitoring network, WMO GAW (site code ARA) |
| Primary data storage of calibrated record | CSIRO:  \\gl-as\Picarro\CFADS63\arcturus and  \dagage1\arcturus-picarro\DataLog\_User  Hour and minute averages (calibrated):  \\gl-as\GOLD\Data\Arcturus and  \dagage1\arcturus-picarro\export |
| Other locations | External CSIRO back-up |
| Organisation and primary contact | CSIRO Marine and Atmospheric Research  Zoe Loh  [zoe.loh@csiro.au](mailto:zoe.loh@csiro.au)  03 9239 4518 |

## H2O

|  |  |
| --- | --- |
| Location | Arcturus station  23.85872° S, 148.4746° E, 175 masl inlet at 10 m above ground level. |
| Instrument | Picarro continuous wave cavity ring down spectrometer. The initial unit, Picarro G1301 Analyser (CFADS63), was replaced by a Picarro G2301 Analyser (CFADS2324) on 22 Oct 2013. |
| Period of record | July 2010 – June 2014 |
|  |  |

|  |  |
| --- | --- |
| Frequency of measurement/ effective averaging time | Continuous measurement with data averaged to minute and hourly means. |
| Forms of data | Raw output and diagnostics  Minute and hourly means |
| Corrections | Nil – these data are used to provide the volumetric dilution and spectroscopic pressure broadening correction to the CO2 and CH4 records. |
| Calibration scale | Uncalibrated. However, data from both instruments are cross-referenced to check for drift that might compromise the water vapour correction to the trace gas records. |
| Accuracy | ±100 ppm |
| Network | Australian Greenhouse Gas monitoring network, WMO GAW (site code ARA) |
| Primary data storage of calibrated record | CSIRO:  \\gl-as\Picarro\CFADS63\arcturus and  \dagage1\arcturus-picarro\DataLog\_User  Hour and minute averages:  \\gl-as\GOLD\Data\Arcturus and  \dagage1\arcturus-picarro\export |
| Other locations | External CSIRO back-up |
| Organisation and primary contact | CSIRO Marine and Atmospheric Research  Zoe Loh  [zoe.loh@csiro.au](mailto:zoe.loh@csiro.au)  03 9239 4518 |

## 12CO2

|  |  |
| --- | --- |
| Location | Arcturus station  23.85872° S, 148.4746° E, 175 masl inlet at 10 m above ground level. |
| Instrument | Picarro G1101-i Analyser (CBDS36) continuous wave cavity ring down spectrometer. It was returned to manufacturer for rebuild on 19 Jul 2011. Reinstalled at ARA as CFFDS36 on 17 Jul 2012. |
| Period of record | July 2010 – June 2014, with breaks given above |
| Frequency of measurement/ effective averaging time | Continuous measurement with data averaged to minute and hourly means. |
| Forms of data | Raw output and diagnostics  Minute and hourly means |
| Corrections | Water vapour correction for volumetric dilution and spectroscopic pressure broadening as per Chen et al., 2010. Note that this instrument is under active investigation and highly subject to change (Allison et al., submitted). |
| Calibration scale | Linked to the WMOx2007 CO2 mole fraction scale.  Maintained by a reference standard measured for 2 hours every day and three calibration standards (measured four times every month). |
| Accuracy | ±0.5 ppm |
| Network | Australian Greenhouse Gas monitoring network, WMO GAW (site code ARA) |
| Primary data storage of calibrated record | CSIRO:  \\gl-as\Picarro\CFFDS36\Arcturus  Hour averages:  \\gl-as\GOLD\Data\Arcturus |

|  |  |
| --- | --- |
| Other locations | External CSIRO back-up |
| Organisation and primary contact | CSIRO Marine and Atmospheric Research  Zoe Loh  [zoe.loh@csiro.au](mailto:zoe.loh@csiro.au)  03 9239 4518 |

## 13CO2

|  |  |
| --- | --- |
| Location | Arcturus station  23.85872° S, 148.4746° E, 175 masl inlet at 10 m above ground level. |
| Instrument | Picarro G1101-i Analyser (CBDS36) continuous wave cavity ring down spectrometer. It was returned to manufacturer for rebuild on 19 Jul 2011. Reinstalled at ARA as CFFDS36 on 17 Jul 2012. |
| Period of record | July 2010 – June 2014, with breaks given above |
| Frequency of measurement/ effective averaging time | Continuous measurement with data averaged to minute and hourly means. |
| Forms of data | Raw output and diagnostics  Minute and hourly means |
| Corrections | Water vapour correction for volumetric dilution and spectroscopic pressure broadening as per Chen et al., 2010. Note that this instrument is under active investigation and highly subject to change (Allison et al, submitted). |
| Calibration scale | Linked to the WMOx2007 CO2 mole fraction scale. Maintained by a reference standard measured for 2 hours every day and three calibration standards (measured four times every month). |
| Accuracy | ±0.02 ppm |
| Network | Australian Greenhouse Gas monitoring network, WMO GAW (site code ARA) |
| Primary data storage of calibrated record | CSIRO:  \\gl-as\Picarro\CFFDS36\Arcturus  Hour averages:  \\gl-as\GOLD\Data\Arcturus |
| Other locations | External CSIRO back-up |
| Organisation and primary contact | CSIRO Marine and Atmospheric Research  Zoe Loh  [zoe.loh@csiro.au](mailto:zoe.loh@csiro.au)  03 9239 4518 |

## 13C of CO2

|  |  |
| --- | --- |
| Location | Arcturus station  23.85872° S, 148.4746° E, 175 masl inlet at 10 m above ground level. |
| Instrument | Picarro G1101-i Analyser (CBDS36) continuous wave cavity ring down spectrometer. It was returned to manufacturer for rebuild on 19 Jul 2011. Reinstalled at ARA as CFFDS36 on 17 Jul 2012. |
| Period of record | July 2010 – June 2014, with breaks given above |
| Frequency of measurement/ effective averaging time | Continuous measurement with data averaged to minute and hourly means. |
| Forms of data | Raw output and diagnostics  Minute and hourly means |
| Corrections | Water vapour correction for volumetric dilution and spectroscopic pressure broadening as per Chen et al., 2010. Note that this instrument is under active investigation and highly subject to change (Allison et al, submitted). |
| Calibration scale | Linked to the VPDB-CO2 scale.  Maintained by a reference standard measured for 2 hours every day and three calibration standards measured several times every month. |
| Accuracy | Estimated ±0.5 ‰ |
| Network | Australian Greenhouse Gas monitoring network, WMO GAW (site code ARA) |
| Primary data storage of calibrated record | CSIRO:  \\gl-as\Picarro\CFFDS36\Arcturus  Hour averages:  \\gl-as\GOLD\Data\Arcturus |
| Other locations | External CSIRO back-up |
| Organisation and primary contact | CSIRO Marine and Atmospheric Research  Zoe Loh  [zoe.loh@csiro.au](mailto:zoe.loh@csiro.au)  03 9239 4518 |

# METADATA: Ambient atmospheric composition – G050 (0.5 L glass) flask measurements

Air samples were collected through the 10 metre tower inlet, pressurised into 0.5 litre glass flasks using a CSIRO flask pump unit and drying (using magnesium perchlorate) and measured in CSIRO GASLAB in Aspendale, Victoria. Flask samples were typically filled in pairs. Being a manual process, samples were filled only during visits to the site, typically during well mixed daytime conditions. The flask sampling and measurements were consistent with the protocols of CSIRO’s Greenhouse Gas Network (Francey et al., 2003).

## CO2

|  |  |
| --- | --- |
| Location | Arcturus station  23.85872° S, 148.4746° E, 175 masl inlet at 10 m above ground level. |
| Instrument | Carle-3: gas chromatograph with flame ionisation detection after methanization of CO2 to CH4. |
| Period of record | May 2010 – June 2014 |
| Frequency of measurement/ effective averaging time | Flask samples, pre-dried, obtained in pairs, several times per year.  Effective averaging time ~1 minute |
| Forms of data | Dry air mole fraction value |
| Corrections | Nil |
| Calibration scale | WMOx2007 CO2 mole fraction scale |
| Accuracy | ±0.1 ppm |
| Network | Australian Greenhouse Gas monitoring network, WMO GAW (site code ARA) |
| Primary data storage of calibrated record | CSIRO:  \\gl-as\GOLD\Data\CSIRO\co2 |
| Other locations | External CSIRO back-up |
| Organisation and primary contact | CSIRO Marine and Atmospheric Research  Rebecca Gregory  [rebecca.gregory@csiro.au](mailto:rebecca.gregory@csiro.au)  03 9239 4656 |

## CH4

|  |  |
| --- | --- |
| Location | Arcturus station  23.85872° S, 148.4746° E, 175 masl inlet at 10 m above ground level. |
| Instrument | Carle-3: gas chromatograph with flame ionisation detection. |
| Period of record | May 2010 – June 2014 |
| Frequency of measurement/ effective averaging time | Flask samples, pre-dried, obtained in pairs, several times per year.  Effective averaging time ~1 minute |
| Forms of data | Dry air mole fraction value |
| Corrections | Nil |
| Calibration scale | NOAA04 CH4 mole fraction scale |
| Accuracy | ±2.4 ppb |
| Network | Australian Greenhouse Gas monitoring network, WMO GAW (site code ARA) |
| Primary data storage of calibrated record | CSIRO:  \\gl-as\GOLD\Data\CSIRO\ch4 |
| Other locations | External CSIRO back-up |
| Organisation and primary contact | CSIRO Marine and Atmospheric Research  Rebecca Gregory  [rebecca.gregory@csiro.au](mailto:rebecca.gregory@csiro.au)  03 9239 4656 |

## CO

|  |  |
| --- | --- |
| Location | Arcturus station  23.85872° S, 148.4746° E, 175 masl inlet at 10 m above ground level. |
| Instrument | RGA3-1: gas chromatograph with a mercuric oxide reduction gas detector. |
| Period of record | May 2010 – June 2014 |
| Frequency of measurement/ effective averaging time | Flask samples, pre-dried, obtained in pairs, several times per year.  Effective averaging time ~1 minute |
| Forms of data | Dry air mole fraction value |
| Corrections | Nil |
| Calibration scale | Linked to NOAA’s gravimetrically-derived CO mole fraction scale (Novelli et al., 1991) and augmented by CSIRO dilution standards for concentrations below 196 ppb. |
| Accuracy | ± 1 ppb |
| Network | Australian Greenhouse Gas monitoring network, WMO GAW (site code ARA) |
| Primary data storage of calibrated record | CSIRO:  \\gl-as\GOLD\Data\CSIRO\co |
| Other locations | External CSIRO back-up |
| Organisation and primary contact | CSIRO Marine and Atmospheric Research  Rebecca Gregory  [rebecca.gregory@csiro.au](mailto:rebecca.gregory@csiro.au)  03 9239 4656 |

## H2

|  |  |
| --- | --- |
| Location | Arcturus station  23.85872° S, 148.4746° E, 175 masl inlet at 10 m above ground level. |
| Instrument | RGA3-1: gas chromatograph with a mercuric oxide reduction gas detector. |
| Period of record | May 2010 – June 2014 |
| Frequency of measurement/ effective averaging time | Flask samples, pre-dried, obtained in pairs, several times per year.  Effective averaging time ~1 minute |
| Forms of data | Dry air mole fraction value |
| Corrections | Nil |
| Calibration scale | MPI 2009 (Max Planck Institute, Jena, Germany) H2 mole fraction scale |
| Accuracy | ± 2 ppb |
| Network | Australian Greenhouse Gas monitoring network, WMO GAW (site code ARA) |
| Primary data storage of calibrated record | CSIRO:  \\gl-as\GOLD\Data\CSIRO\h2 |
| Other locations | External CSIRO back-up |
| Organisation and primary contact | CSIRO Marine and Atmospheric Research  Rebecca Gregory  [rebecca.gregory@csiro.au](mailto:rebecca.gregory@csiro.au)  03 9239 4656 |

## N2O

|  |  |
| --- | --- |
| Location | Arcturus station  23.85872° S, 148.4746° E, 175 masl inlet at 10 m above ground level. |
| Instrument | Shimadzu-1: gas chromatograph with electron capture detection. |
| Period of record | May 2010 – June 2014 |
| Frequency of measurement/ effective averaging time | Flask samples, pre-dried, obtained in pairs, several times per year.  Effective averaging time ~ 1 minute |
| Forms of data | Dry air mole fraction value |
| Corrections | Nil |
| Calibration scale | NOAA 2006a N2O mole fraction scale |
| Accuracy | ± 0.3 ppb |
| Network | Australian Greenhouse Gas monitoring network, WMO GAW (site code ARA) |
| Primary data storage of calibrated record | CSIRO:  \\gl-as\GOLD\Data\CSIRO\n2o |
| Other locations | External CSIRO back-up |
| Organisation and primary contact | CSIRO Marine and Atmospheric Research  Rebecca Gregory  [rebecca.gregory@csiro.au](mailto:rebecca.gregory@csiro.au)  03 9239 4656 |

## 13C of CO2

|  |  |
| --- | --- |
| Location | Arcturus station  23.85872° S, 148.4746° E, 175 masl inlet at 10 m above ground level. |
| Instrument | Finnigan MAT252 stable isotope ratio mass spectrometer. |
| Period of record | May 2010 – June 2014 |
| Frequency of measurement/ effective averaging time | Flask samples, pre-dried, obtained in pairs, several times per year.  Effective averaging time ~1 minute |
| Forms of data | Delta (difference) measurement of the ratio of 13C16O2/12C16O2 in sample from the ratio in the international reference material. |
| Corrections | Isobaric interference from N2O |
| Calibration scale | The international VPDB-CO2 scale, via a precisely maintained internal scale designated CSIRO2005:CO2-in-air (Allison and Francey, 2007; Coplen, 1995). |
| Accuracy | ±0.03 ‰ |
| Network | Australian Greenhouse Gas monitoring network, WMO GAW (site code ARA) |
| Primary data storage of calibrated record | CSIRO:  \\gl-as\GOLD\Data\CSIRO\co2c13 |
| Other locations | External CSIRO back-up |
| Organisation and primary contact | CSIRO Marine and Atmospheric Research  David Etheridge  [david.etheridge@csiro.au](mailto:david.etheridge@csiro.au)  03 9239 4590 |

## 18O of CO2

|  |  |
| --- | --- |
| Location | Arcturus station  23.85872° S, 148.4746° E, 175 masl inlet at 10 m above ground level. |
| Instrument | Finnigan MAT252 stable isotope ratio mass spectrometer. |
| Period of record | May 2010 – June 2014 |
| Frequency of measurement/ effective averaging time | Flask samples, pre-dried, obtained in pairs, several times per year.  Effective averaging time ~1 minute |
| Forms of data | Delta (difference) measurement of the ratio of 12C16O18O/12C16O16O in sample from the ratio in the international reference material. |
| Corrections | Isobaric interference from N2O |
| Calibration scale | The international VPDB-CO2 scale, via a precisely maintained internal scale designated CSIRO2005:CO2-in-air (Allison and Francey, 2007; Coplen, 1995). |
| Accuracy | ±0.05 ‰ |
| Network | Australian Greenhouse Gas monitoring network, WMO GAW (site code ARA) |
| Primary data storage of calibrated record | CSIRO:  \\gl-as\GOLD\Data\CSIRO\co2o18 |
| Other locations | External CSIRO back-up |
| Organisation and primary contact | CSIRO Marine and Atmospheric Research  David Etheridge  [david.etheridge@csiro.au](mailto:david.etheridge@csiro.au)  03 9239 4590 |

# METADATA: Meteorological data

All data from the instruments located on the fibre-glass mast and on the rooftop of the station are logged onto a Campbell Scientific Instruments (CSI) logger (CR1000) located in the Arcturus station. Data are transferred daily, automatically, from the CR1000 logger to the Arcturus PC workstation. Periodically, 15-minutes, 24-hour and 60-minutes average data are downloaded from the workstation via the Internet to GA, where quality control and filtering of the data are performed.

Processed and filtered data are placed on GA’s server, \\nas\energy\ccs\Atmospheric monitoring facility\Arcturus site\Met\_Data\archived in the following files:

“CR1000\_Min15” and “CR1000\_Daily24” have 15-minutes and 24-hour data respectively from 07/07/2010 to 03/06/2011

“ARA\_Met\_CR1000\_Min15”; “ARA\_Met\_CR1000\_Min60” and “ARA\_Met\_CR1000\_Daily24” have   
15-minutes, 60-minutes and 24-hour data respectively from 03/06/2011 to 21/03/2014

## Wind Speed

|  |  |
| --- | --- |
| Location | Fibre-glass mast  23.85872°S, 148.4746°E, 175 masl, 10 m above ground level. |
| Instrument | RM Young Wind Sentry cup anemometer |
| Period of record | July 2010 – June 2014 |
| Frequency of measurement/ effective averaging time | Measurements taken every minute. Used to prepare 15 minute, hourly and daily averages. |
| Forms of data | Raw data, quality controlled |
| Corrections | Nil |
| Calibration scale | N/A |
| Accuracy | ±0.5 ms-1 |
| Network | N/A |
| Primary data storage of calibrated record | GA:  \\nas\energy\ccs\Atmospheric monitoring facility\Arcturus site\Met\_Data\archived |
| Other locations | Arcturus Station PC |
| Organisation and primary contact | Geoscience Australia  Andrew Feitz  [andrew.feitz@ga.gov.au](mailto:andrew.feitz@ga.gov.au)  02 6249 9781 |

## Wind Direction

|  |  |
| --- | --- |
| Location | Fibre-glass mast  23.85872°S, 148.4746°E, 175 masl, 10 m above ground level. |
| Instrument | RM Young Wind Sentry wind vane |
| Period of record | July 2010 – June 2014 |
| Frequency of measurement/ effective averaging time | Measurements taken every minute. Used to prepare 15 minute, hourly and daily averages. |
| Forms of data | Raw data, quality controlled |
| Corrections | Nil |
| Calibration scale | N/A |
| Accuracy | ±5° |
| Network | N/A |
| Primary data storage of calibrated record | GA:  \\nas\energy\ccs\Atmospheric monitoring facility\Arcturus site\Met\_Data\archived |
| Other locations | Arcturus Station PC |
| Organisation and primary contact | Geoscience Australia  Andrew Feitz  [andrew.feitz@ga.gov.au](mailto:andrew.feitz@ga.gov.au)  02 6249 9781 |

## Solar Radiation

|  |  |
| --- | --- |
| Location | Station rooftop  23.85872°S, 148.4746°E, 175 masl, 3 m above ground level. |
| Instrument | Licor LI200x Pyranometer |
| Period of record | July 2010 – June 2014 |
| Frequency of measurement/ effective averaging time | Measurements taken every minute. Used to prepare 15 minute, hourly and daily averages. |
| Forms of data | Raw data, quality controlled; total and average solar radiation |
| Corrections | Nil |
| Calibration scale | N/A |
| Accuracy | ±3% |
| Network | N/A |
| Primary data storage of calibrated record | GA:  \\nas\energy\ccs\Atmospheric monitoring facility\Arcturus site\Met\_Data\archived |
| Other locations | Arcturus Station PC |
| Organisation and primary contact | Geoscience Australia  Andrew Feitz  [andrew.feitz@ga.gov.au](mailto:andrew.feitz@ga.gov.au)  02 6249 9781 |

## Relative Humidity

|  |  |
| --- | --- |
| Location | Fibre-glass mast  23.85872°S, 148.4746°E, 175 masl, 10 m above ground level. |
| Instrument | Vaisala HMP50 temperature and relative humidity sensor |
| Period of record | July 2010 – June 2014 |
| Frequency of measurement/ effective averaging time | Measurements taken every minute. Used to prepare 15 minute, hourly and daily averages. |
| Forms of data | Raw data, quality controlled |
| Corrections | Nil |
| Calibration scale | N/A |
| Accuracy | ±5% |
| Network | N/A |
| Primary data storage of calibrated record | GA:  \\nas\energy\ccs\Atmospheric monitoring facility\Arcturus site\Met\_Data\archived |
| Other locations | Arcturus Station PC |
| Organisation and primary contact | Geoscience Australia  Andrew Feitz  [andrew.feitz@ga.gov.au](mailto:andrew.feitz@ga.gov.au)  02 6249 9781 |

## Temperature

|  |  |
| --- | --- |
| Location | Fibre-glass mast  23.85872°S, 148.4746°E, 175 masl, 10 m above ground level. |
| Instrument | Vaisala HMP50 temperature and relative humidity sensor |
| Period of record | July 2010 – June 2014 |
| Frequency of measurement/ effective averaging time | Measurements taken every minute. Used to prepare 15 minute, hourly and daily averages. |
| Forms of data | Raw data, quality controlled |
| Corrections | Nil |
| Calibration scale | N/A |
| Accuracy | ±0.6°C |
| Network | N/A |
| Primary data storage of calibrated record | GA:  \\nas\energy\ccs\Atmospheric monitoring facility\Arcturus site\Met\_Data\archived |
| Other locations | Arcturus Station PC |
| Organisation and primary contact | Geoscience Australia  Andrew Feitz  [andrew.feitz@ga.gov.au](mailto:andrew.feitz@ga.gov.au)  02 6249 9781 |

## Pressure

|  |  |
| --- | --- |
| Location | Inside station  23.85872°S, 148.4746°E, 175 masl. |
| Instrument | Vaisala barometer PTB110 |
| Period of record | July 2010 – June 2014 |
| Frequency of measurement/ effective averaging time | Measurements taken every minute. Used to prepare 15 minute, hourly and daily averages. |
| Forms of data | Raw data, quality controlled |
| Corrections | Nil |
| Calibration scale | N/A |
| Accuracy | ±1.5 mbar |
| Network | N/A |
| Primary data storage of calibrated record | GA:  \\nas\energy\ccs\Atmospheric monitoring facility\Arcturus site\Met\_Data\archived |
| Other locations | Arcturus Station PC |
| Organisation and primary contact | Geoscience Australia  Andrew Feitz  [andrew.feitz@ga.gov.au](mailto:andrew.feitz@ga.gov.au)  02 6249 9781 |

## Rainfall

|  |  |
| --- | --- |
| Location | Station rooftop  23.85872°S, 148.4746°E, 175 masl, 3 m above ground level. |
| Instrument | Hydrological Services tipping bucket rain gauge (TB4) |
| Period of record | July 2010 – June 2014 |
| Frequency of measurement/ effective averaging time | Measurements taken every minute. Used to prepare 15 minute, hourly and daily averages. |
| Forms of data | Raw data, quality controlled; total and average rainfall |
| Corrections | Nil |
| Calibration scale | N/A |
| Accuracy | ±2% |
| Network | N/A |
| Primary data storage of calibrated record | GA:  \\nas\energy\ccs\Atmospheric monitoring facility\Arcturus site\Met\_Data\archived |
| Other locations | Arcturus Station PC |
| Organisation and primary contact | Geoscience Australia  Andrew Feitz  [andrew.feitz@ga.gov.au](mailto:andrew.feitz@ga.gov.au)  02 6249 9781 |

# METADATA: Flux data

All data from the flux tower instruments are stored on a Campbell Scientific CR3000 and transferred to a PC located in the Arcturus station via WiFi every half hour. At the end of each hour the fast data are processed to produce 30 minute averages and estimate fluxes of CO2 and H2O for the previous two half hour periods, using modified Campbell Scientific software. Processed data are saved within three worksheets (slow\_flux, slow\_met, slow\_rad) and automatically transferred to a CSIRO FTP site on a daily basis via the internet where initial QC is done. Data are then fully processed from Level 1 to Level 3 (quality control, filtering and corrections) every few months by staff from GA.

Fully processed and filtered data are placed on GA’s server at: \\nas\energy\ccs\Atmospheric monitoring facility\Arcturus site\Eddy covariance tower\Fully\_Processed\_Data

## Wind Speed and Direction

### Primary 3D wind speed and direction

|  |  |
| --- | --- |
| Location | Flux tower  23.85872°S, 148.4746°E, 175 masl, 6.7 m above ground level. |
| Instrument | Campbell Scientific CSAT3 3D sonic anemometer |
| L1 Output | Wind direction (WD\_CSAT\_Compass), wind speed (WS\_CSAT), orthogonal wind components (Ux\_CSAT, Uy\_CSAT, Uz\_CSAT) (slow\_met) |
| Period of record | 10 June 2011 – 31 December 2013 |
| Frequency of measurement/ effective averaging time | 10 Hz, used to process 30 minute averages and fluxes. |
| Forms of data | 30 minute data, quality controlled and filtered |
| Corrections | WD\_CSAT\_Compass:  2011-06-10 00:30 to 2012-09-18 22:00, adjusted clockwise 236°  2012-09-19 17:00 to 2012-09-24 22:00, adjusted clockwise 21°  2013-03-13 14:30 to 2013-03-18 10:00, adjusted clockwise 21° |
| Calibration scale | N/A |
| Accuracy | Wind speed < 30 ms-1; azimuth angles between ±170°.  Offset Error:  ux, uy: < ±8 cms-1  uz: < ±4 cms-1  Gain Error:  Wind vector within ±5° of horizontal < ±2%  Wind vector within ±10° of horizontal < ±3%  Wind vector within ±20° of horizontal < ±6% |
| Network | OzFlux |
| Primary data storage of calibrated record | GA:  \\nas\energy\ccs\Atmospheric monitoring facility\Arcturus site\Eddy covariance tower\Fully\_Processed\_Data |

|  |  |
| --- | --- |
| Other locations | Raw and 10 Hz files on CSIRO server (fsact01-cdc\csiro\cmar\Enterprise1\flux\arcturus). Backed up and processed at GA, Canberra. |
| Organisation and primary contact | Geoscience Australia  Andrew Feitz  [andrew.feitz@ga.gov.au](mailto:andrew.feitz@ga.gov.au)  02 6249 9781 |

### Secondary 2D wind speed and direction

|  |  |
| --- | --- |
| Location | Flux tower  23.85872°S, 148.4746°E, 175 masl 7.0 m above ground level. |
| Instrument | Gill WindSonic4 2D sonic anemometer |
| L1 Output | Wind direction (WD\_WS4), wind speed (WS\_WS4) (slow\_met) |
| Period of record | 10 June 2011 – 31 December 2013 |
| Frequency of measurement/ effective averaging time | 10 Hz, used to process 30 minute averages. |
| Forms of data | 30 minute data, quality controlled and filtered |
| Corrections | WD\_WS4:  2011-06-10 00:30 to 2013-03-12 13:30, adjusted clockwise 177°  2013-03-12 14:00 to 2012-03-13 14:00 adjusted clockwise 7°  2013-03-13:14:30 to 2013-03-18 10:00 adjusted clockwise 177°  2013-03-18 10:30 to 2014-01-01 00:00 adjusted clockwise 7° |
| Calibration scale | N/A |
| Accuracy | Wind direction: ± 3° with no dead band,  Wind speed: <60 ms-1, ± 2% at 12 ms-1 |
| Network | OzFlux |
| Primary data storage of calibrated record | GA:  \\nas\energy\ccs\Atmospheric monitoring facility\Arcturus site\Eddy covariance tower\Fully\_Processed\_Data on GA server |
| Other locations | Raw and 10 Hz files on CSIRO server (fsact01-cdc\csiro\cmar\Enterprise1\flux\arcturus). Backed up and processed at GA, Canberra. |
| Organisation and primary contact | Geoscience Australia  Andrew Feitz  [andrew.feitz@ga.gov.au](mailto:andrew.feitz@ga.gov.au)  02 6249 9781 |

## Temperature

### Primary air temperature

|  |  |
| --- | --- |
| Location | Flux tower  23.85872°S, 148.4746°E, 175 masl, 5.6 m above ground level. |
| Instrument | Vaisala HMP45 temperature and relative humidity probe |
| L1 Output | Air temperature (Ta) (slow\_met) |
| Period of record | 10 June 2011 – 31 December 2013 |
| Frequency of measurement/ effective averaging time | 10 Hz, used to process 30 minute averages and fluxes. |
| Forms of data | 30 minute data, quality controlled and filtered |
| Corrections | Nil |
| Calibration scale | N/A |
| Accuracy | ± 0.3°C |
| Network | OzFlux |
| Primary data storage of calibrated record | GA:  \\nas\energy\ccs\Atmospheric monitoring facility\Arcturus site\Eddy covariance tower\Fully\_Processed\_Data on GA server |
| Other locations | Raw and 10 Hz files on CSIRO server (fsact01-cdc\csiro\cmar\Enterprise1\flux\arcturus). Backed up and processed at GA, Canberra. |
| Organisation and primary contact | Geoscience Australia  Andrew Feitz  [andrew.feitz@ga.gov.au](mailto:andrew.feitz@ga.gov.au)  02 6249 9781 |

### Virtual air temperature

|  |  |
| --- | --- |
| Location | Flux tower  23.85872°S, 148.4746°E, 175 masl, 6.7 m above ground level. |
| Instrument | Campbell Scientific CSAT3 3D sonic anemometer |
| L1 Output | Virtual air temperature (Tv) (slow\_met) |
| Period of record | 10 June 2011 – 31 December 2013 |
| Frequency of measurement/ effective averaging time | 10 Hz, used to process 30 minute fluxes |
| Forms of data | 30 minute data, quality controlled and filtered |
| Corrections | Nil |
| Calibration scale | N/A |
| Accuracy |  |
| Network | OzFlux |

|  |  |
| --- | --- |
| Primary data storage of calibrated record | GA:  \\nas\energy\ccs\Atmospheric monitoring facility\Arcturus site\Eddy covariance tower\Fully\_Processed\_Data |
| Other locations | Raw and 10 Hz files on CSIRO server (fsact01-cdc\csiro\cmar\Enterprise1\flux\arcturus). Backed up and processed at GA, Canberra. |
| Organisation and primary contact | Geoscience Australia  Andrew Feitz  [andrew.feitz@ga.gov.au](mailto:andrew.feitz@ga.gov.au)  02 6249 9781 |

### Soil temperature

|  |  |
| --- | --- |
| Location | Flux tower  23.85872°S, 148.4746°E, 175 masl, located at 2 cm, 5 cm and 15 cm below ground level. |
| Instrument | 3x Campbell Scientific thermocouple temperature probe (TCAV) |
| L1 Output | Soil temperature (Ts\_01 = 15 cm, Ts\_02 = 5 cm, Ts\_03 = 2 cm) (slow\_met) |
| Period of record | 10 June 2011 – 31 December 2013 |
| Frequency of measurement/ effective averaging time | 10 Hz, used to process 30 minute CO2 and H2O fluxes |
| Forms of data | 30 minute data, quality controlled and filtered |
| Corrections | Nil |
| Calibration scale | N/A |
| Accuracy | ± 0.3°C |
| Network | OzFlux |
| Primary data storage of calibrated record | GA:  \\nas\energy \ccs\Atmospheric monitoring facility\Arcturus site\Eddy covariance tower\Fully\_Processed\_Data |
| Other locations | Raw and 10 Hz files on CSIRO server (fsact01-cdc\csiro\cmar\Enterprise1\flux\arcturus). Backed up and processed at GA, Canberra. |
| Organisation and primary contact | Geoscience Australia  Andrew Feitz  [andrew.feitz@ga.gov.au](mailto:andrew.feitz@ga.gov.au)  02 6249 9781 |

## Soil Heat Flux

|  |  |
| --- | --- |
| Location | Flux tower  23.85872°S, 148.4746°E, 175 masl, located at 5 cm and 10 cm below ground level. |
| Instrument | 3x Middleton CN3 thermopile heat flux plates |
| L1 Output | Ground heat flux (Fg\_01 = 5 cm, Fg\_02 = 10 cm,Fg\_03 = 10 cm) (slow\_flux) |
| Period of record | 10 June 2011 – 31 December 2013 |

|  |  |
| --- | --- |
| Frequency of measurement/ effective averaging time | 10 Hz, used to process 30 minute averages |
| Forms of data | 30 minute data, quality controlled and filtered |
| Corrections | Nil |
| Calibration scale | N/A |
| Accuracy | ± 5% |
| Network | OzFlux |
| Primary data storage of calibrated record | GA:  \\nas\energy\ccs\Atmospheric monitoring facility\Arcturus site\Eddy covariance tower\Fully\_Processed\_Data |
| Other locations | Raw and 10 Hz files on CSIRO server (fsact01-cdc\csiro\cmar\Enterprise1\flux\arcturus). Backed up and processed at GA, Canberra. |
| Organisation and primary contact | Geoscience Australia  Andrew Feitz  [andrew.feitz@ga.gov.au](mailto:andrew.feitz@ga.gov.au)  02 6249 9781 |

## Soil Moisture

|  |  |
| --- | --- |
| Location | Flux tower  23.85872°S, 148.4746°E, 175 masl, located at 5 cm, 15 cm, 22.5 cm and 30 cm below ground level. |
| Instrument | 16x Campbell Scientific CS616 water content reflectometer |
| Output | Volumetric water content (Sws\_13-16 = 5 cm, Sws\_09-12 = 15 cm, Sws\_05-08 = 22.5 cm, Sws\_01-04 = 30 cm) (slow\_met) |
| Period of record | 10 June 2011 – 31 December 2013 |
| Frequency of measurement/ effective averaging time | 10 Hz, used to process 30 minute averages |
| Forms of data | 30 minute data, quality controlled and filtered |
| Corrections | Nil |
| Calibration scale | N/A |
| Accuracy | ± 2.5%  Precision < 0.1% |
| Network | OzFlux |
| Primary data storage of calibrated record | GA:  \\nas\energy\ccs\Atmospheric monitoring facility\Arcturus site\Eddy covariance tower\Fully\_Processed\_Data |
| Other locations | Raw and 10 Hz files on CSIRO server (fsact01-cdc\csiro\cmar\Enterprise1\flux\arcturus). Backed up and processed at GA, Canberra. |
| Organisation and primary contact | Geoscience Australia  Andrew Feitz  [andrew.feitz@ga.gov.au](mailto:andrew.feitz@ga.gov.au)  02 6249 9781 |

## CO2 Concentration

|  |  |
| --- | --- |
| Location | Flux tower  23.85872°S, 148.4746°E, 175 masl, 6.7 m above ground level. |
| Instrument | Licor 7500A open path infrared gas analyser (Li7500A), replaced with the Licor 7500 (Li7500) open path infrared gas analyser from 13 December 2011 to 17 July 2012 and 12 March 2013 to 20 August 2013 |
| L1 Output | CO2 concentration (Cc\_7500) (slow\_met) |
| Period of record | 10 June 2011 – 31 December 2013 |
| Frequency of measurement/ effective averaging time | 10 Hz, used to process 30 minute averages |
| Forms of data | 30 minute data, quality controlled and filtered |
| Corrections | Nil |
| Calibration scale | Zero and Span calibrations |
| Accuracy | ± 1%  Zero drift: ± 0.3 ppm per °C  Gain drift: ± 0.1% per °C at 370 ppm |
| Network | OzFlux |
| Primary data storage of calibrated record | GA:  \\nas\energy\ccs\Atmospheric monitoring facility\Arcturus site\Eddy covariance tower\Fully\_Processed\_Data |
| Other locations | Raw and 10 Hz files on CSIRO server (fsact01-cdc\csiro\cmar\Enterprise1\flux\arcturus). Backed up and processed at GA, Canberra. |
| Organisation and primary contact | Geoscience Australia  Andrew Feitz  [andrew.feitz@ga.gov.au](mailto:andrew.feitz@ga.gov.au)  02 6249 9781 |

## CO2 and H2O Flux

|  |  |
| --- | --- |
| Location | Flux tower  23.85872°S, 148.4746°E, 175 masl, 6.7 m above ground level. |
| Instruments | Licor 7500A open path infrared gas analyser (Li7500A), replaced with the Licor 7500 (Li7500) open path infrared gas analyser from 13 December 2011 to 17 July 2012 and 12 March 2013 to 20 August 2013.  Campbell Scientific CSAT3 3D sonic anemometer |
| L1 Output | CO2 covariances (covUxCc, covUyCc, covUzCc), provisional CO2 flux (Fc) (slow\_flux)  H2O covariances (covUxAh, covUyAh, covUzAh), provisional H2O flux (Fe) (slow\_flux) |
| Period of record | 10 June 2011 – 31 December 2013 |
| Frequency of measurement/ effective averaging time | 10 Hz, used to process 30 minute averages and fluxes. |
| Forms of data | 30 minute data, quality controlled and filtered |

|  |  |
| --- | --- |
| Corrections | Sensor separation:  CSAT3🡪Li7500 = 210 mm at 320° |
| Calibration scale | Zero and Span calibrations |
| Accuracy | N/A |
| Network | OzFlux |
| Primary data storage of calibrated record | GA:  \\nas\energy\ccs\Atmospheric monitoring facility\Arcturus site\Eddy covariance tower\Fully\_Processed\_Data |
| Other locations | Raw and 10 Hz files on CSIRO server (fsact01-cdc\csiro\cmar\Enterprise1\flux\arcturus). Backed up and processed at GA, Canberra. |
| Organisation and primary contact | Geoscience Australia  Andrew Feitz  [andrew.feitz@ga.gov.au](mailto:andrew.feitz@ga.gov.au)  02 6249 9781 |

## H2O

### Primary absolute humidity and relative humidity

|  |  |
| --- | --- |
| Location | Flux tower  23.85872°S, 148.4746°E, 175 masl, 5.6 m above ground level. |
| Instrument | Vaisala HMP45 temperature and relative humidity probe |
| Output | Absolute humidity (Ah\_HMP), relative humidity (RH\_HMP) (slow\_met) |
| Period of record | 10 June 2011 – 31 December 2013 |
| Frequency of measurement/ effective averaging time | 10 Hz, used to process 30 minute averages |
| Forms of data | 30 minute data, quality controlled and filtered |
| Corrections | Nil |
| Calibration scale | N/A |
| Accuracy | ±2% RH (0 to 90% RH)  ±3% RH (90 to 100% RH) |
| Network | OzFlux |
| Primary data storage of calibrated record | GA:  \\nas\energy\ccs\Atmospheric monitoring facility\Arcturus site\Eddy covariance tower\Fully\_Processed\_Data |
| Other locations | Raw and 10 Hz files on CSIRO server (fsact01-cdc\csiro\cmar\Enterprise1\flux\arcturus). Backed up and processed at GA, Canberra. |
| Organisation and primary contact | Geoscience Australia  Andrew Feitz  [andrew.feitz@ga.gov.au](mailto:andrew.feitz@ga.gov.au)  02 6249 9781 |

### Secondary absolute humidity

|  |  |
| --- | --- |
| Location | Flux tower  23.85872°S, 148.4746°E, 175 masl, 6.7 m above ground level. |
| Instrument | Licor 7500A open path infrared gas analyser (Li7500A), replaced with the Licor 7500 (Li7500) open path infrared gas analyser from 13 December 2011 to 17 July 2012 and 12 March 2013 to 20 August 2013. |
| Output | Absolute humidity (Ah\_LI7500) (slow\_met) |
| Period of record | 10 June 2011 – 31 December 2013 |
| Frequency of measurement/ effective averaging time | 10 Hz, used to process 30 minute averages. |
| Forms of data | 30 minute data, quality controlled and filtered |
| Corrections | Nil |
| Calibration scale | Zero and Span calibrations |
| Accuracy | ± 1%  Zero drift: ± 0.05 mmol/mol per °C  Gain drift: ± 0.3% per °C at 20 mmol/mol |
| Network | OzFlux |
| Primary data storage of calibrated record | GA:  \\nas\energy\ccs\Atmospheric monitoring facility\Arcturus site\Eddy covariance tower\Fully\_Processed\_Data |
| Other locations | Raw and 10 Hz files on CSIRO server (fsact01-cdc\csiro\cmar\Enterprise1\flux\arcturus). Backed up and processed at GA, Canberra. |
| Organisation and primary contact | Geoscience Australia  Andrew Feitz  [andrew.feitz@ga.gov.au](mailto:andrew.feitz@ga.gov.au)  02 6249 9781 |

## Radiation

|  |  |
| --- | --- |
| Location | Flux tower  23.85872°S, 148.4746°E, 175 masl, 6.7 m above ground level. |
| Instrument | Kipp & Zonen CNR4 net radiometer |
| Output | Net radiation (Fn), shortwave down radiation (Fsd), shortwave up radiation (Fsu), longwave down radiation (Fld), longwave up radiation (Flu (slow\_rad) |
| Period of record | 10 June 2011 – 31 December 2013 |
| Frequency of measurement/ effective averaging time | 10 Hz, used to process 30 minute averages. |
| Forms of data | 30 minute data, quality controlled and filtered |
| Corrections | Nil |
| Calibration scale | N/A |
| Accuracy | ± 10% |
| Network | OzFlux |

|  |  |
| --- | --- |
| Primary data storage of calibrated record | GA:  \\nas\energy\ccs\Atmospheric monitoring facility\Arcturus site\Eddy covariance tower\Fully\_Processed\_Data |
| Other locations | Raw and 10 Hz files on CSIRO server (fsact01-cdc\csiro\cmar\Enterprise1\flux\arcturus). Backed up and processed at GA, Canberra. |
| Organisation and primary contact | Geoscience Australia  Andrew Feitz  [andrew.feitz@ga.gov.au](mailto:andrew.feitz@ga.gov.au)  02 6249 9781 |

## Pressure

|  |  |
| --- | --- |
| Location | Flux tower  23.85872°S, 148.4746°E, 175 masl, 6.7 m above ground level. |
| Instrument | Licor 7500A open path infrared gas analyser (Li7500A), replaced with the Licor 7500 (Li7500) open path infrared gas analyser from 13 December 2011 to 17 July 2012 and 12 March 2013 to 20 August 2013. |
| Output | Atmospheric pressure (ps\_7500) (slow\_met) |
| Period of record | 10 June 2011 – 31 December 2013 |
| Frequency of measurement/ effective averaging time | 10 Hz, used to process 30 minute averages. |
| Forms of data | 30 minute data, quality controlled and filtered |
| Corrections | Nil |
| Calibration scale | Zero and Span calibrations |
| Accuracy | ± 1% |
| Network | OzFlux |
| Primary data storage of calibrated record | GA:  \\nas\energy\ccs\Atmospheric monitoring facility\Arcturus site\Eddy covariance tower\Fully\_Processed\_Data |
| Other locations | Raw and 10 Hz files on CSIRO server (fsact01-cdc\csiro\cmar\Enterprise1\flux\arcturus). Backed up and processed at GA, Canberra. |
| Organisation and primary contact | Geoscience Australia  Andrew Feitz  [andrew.feitz@ga.gov.au](mailto:andrew.feitz@ga.gov.au)  02 6249 9781 |

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