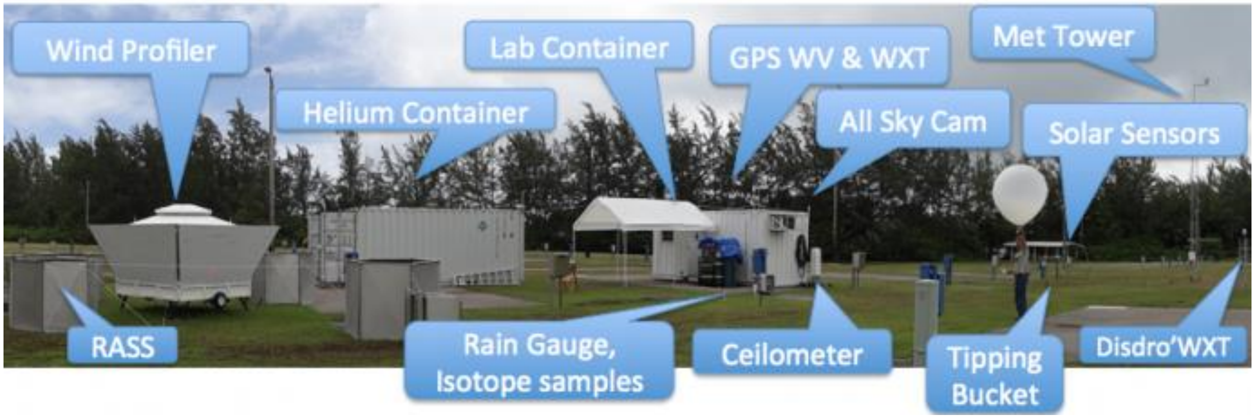
Diego Garcia ISS Surface Meteorology Data



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1. Data Set Overview:

NCAR / EOL deployed two Integrated Sounding Systems (ISS) for the DYNAMO field campaign in the Indian Ocean. The two ISS were deployed on the island on Diego Garcia and on-board the R/V Revelle in the central Indian Ocean from October 2011 to early 2012, along with much other instrumentation from many other groups. The ISS used wind profiler radars, radiosonde soundings, and other instrumentation to provide near continuous profiles of atmospheric motion and thermodynamics at two corners of a sounding array. (See https://www.eol.ucar.edu/content/dynamo-iss and https://www.eol.ucar.edu/observing_facilities/iss).

Time period: 25 September 2011 – 16 January 2012.

Physical location: Diego Garcia. 7° 14' 9.6" S, 72° 24' 5.39" E.

Data source: Standard measurements of temperature, pressure, humidity and wind, from a 10 meter meteorological tower.

2. Instrument Description

(From https://www.eol.ucar.edu/content/iss-specifications.)

ISS Surface Measurement Instrumentation Description

The ISS surface meteorological instrument installation includes several sensors mounted on two separate towers as well as a rain gauge mounted independently. An anemometer is mounted on the top of a ten-meter tower. Temperature and humidity sensors are mounted on the end of a one-meter boom attached to the ten-meter tower at two meters above the surface. The temperature and humidity sensors are aspirated and protected with a radiation shield. The pressure sensor is housed in the box containing the Campbell CR 10x datalogger. That box is mounted on the ten-meter tower at one meter above the surface and a "pressure port" is connected and mounted at 2 meters. The "pressure port" reduces noise in the pressure sensor do to the venturi effect of from the wind.

The radiation sensors are mounted on a one meter boom on the top of a separate one-meter tower. The standard ISS radiation sensors include an up-looking Eppley PSP solar radiation sensor, Eppley PIR sensor and a net radiation sensor. In situations which require more complete radiation measurements, additional sensors can be added.

The output from all the sensors is directed to the Campbell datalogger for processing. The Campbell datalogger, which is independently programmable, typically generates one-minute average data which are sent via RS-232 to the ISS Data Manager workstation. The data input to the Campbell datalogger are five-second sample data.

ISS Surface Measurement Instrumentation Specifications

Pressure Measurement

The surface pressure sensor used in the ISS installation is either a Vaisala PTA427 or PTA427A pressure sensor. The PTA427 sensor pressure range is 800 to 1060mb while the PTA427A sensor pressure range is 600 to 1060mb. These sensors have an accuracy of +/- 0.5mb and +/- 0.8mb respectively. They are both silicon capacitive pressure sensors patented by Vaisala. Both are temperature compensated and produce a linear voltage output over the full operating range. In order to interface with the Campbell datalogger, a 2:1 voltage divider is incorporated into the cable from the pressure sensor.

Temperature and Humidity Measurement

The temperature and humidity sensors are contained in a Vaisala 50Y humitter which has been carefully calibrated with a curve fit. The actual sensors are a PRT and a Vaisala "humicap" capacitive relative humidity sensor. The temperature sensor accuracy is +/- 0.4 degrees C over the range -33 to +48 degrees C. The accuracy of the humidity sensor against field references is approximately +/- 2% with a long term stability of better than 1% RH per year. These specifications for accuracy are achieved by internal calibration at EOL and data curve fitting in real time. The 50Y humitter sensor probe is protected and ventilated by an RM Young aspirated radiation shield model number 43-408 and external high flow aspiration fan.

Wind Measurement

Wind speed and direction are measured with an R.M. Young 05103 Wind Monitor. The monitor is a propeller wind vane with a 0.9 m/s threshold for wind speed and a 60 m/s maximum. Wind direction is measured using a 360 degree mechanical precision conductive potentiometer. Direction measurements have a threshold of 1.0 m/s at a 10 degree displacement and 1.5 m/s at a 5 degree displacement. The potentiometer is 10 K-ohm, with a life expectancy of 50 million revolutions and has a 0.25% linearity through the entire range.

Radiation Measurements

The standard ISS radiation measurements are incoming solar radiation and net radiation. The incoming solar radiation measurement is made with a Eppley PSP precision pyranometer. The infrared measurements are made with an up looking Eppley PIR precision PIR pyrgeometer. The net radiation sensor is a Radiation and Energy Balance Systems, Inc. Fritschen net radiometer. The net radiation sensor is a single sensor with up-looking and down-looking hemispheric sensors mounted back-to-back at the end of a 0.5 meter boom.

The Eppley Precision Spectral Pyranometer (PSP) comprises a circular multi-junction wire-wound Eppley thermopile which has the ability to withstand severe mechanical vibration and shock. Its receiver is coated with Parson's black lacquer (non-wavelength selective absorption). This instrument is supplied with a pair of removable precision ground and polished hemispheres of Schott optical glass. Both hemispheres are made of clear WG295 glass which is uniformly transparent to energy between 0.285 to 2.8µm. Please refer to http://www.eppleylab.com/ for specifications.

The PIR comprises a circular multi-junction wire-wound Eppley thermopile which has the ability to withstand severe mechanical vibration and shock. Its receiver is coated with Parson's black

lacquer (non-wavelength selective absorption). Isolation of long-wave radiation from solar short-wave radiation in daytime is accomplished by using a silicone dome. The inner surface of this hemisphere has a vacuum-deposited interference filter with a transmission range of approximately 3.5 to 50 µm. Refer to http://www.eppleylab.com/ for specifications.

The Radiation and Energy Balance Systems, Inc. Fritschen net radiometer, measures the sum of all incoming radiation (direct solar, diffuse solar, longwave skylight) minus the sum of all outgoing radiation (reflected radiation and terrestrial longwave radiation). A single data stream, the difference of incoming and outgoing radiation, is recorded from the Radiation and Energy Balance Systems, Inc. Fritschen net radiometer. The wavelength range of this instrument covers both the shortwave and longwave bands.

When more precise radiation measurements are required, three separate radiation measurements can be made in the surface meteorological installation, shortwave, longwave, and net radiation. Both the shortwave and longwave radiation measurements are then made with pairs of Eppley radiometers, one up-looking and one down-looking radiometer in each pair. The net radiation measurement is again made with the Radiation and Energy Balance Systems, Inc. Fritschen net radiometer.

The shortwave radiation measurements are made with Eppley PSP pyranometers. The wavelength range of these instruments is 0.285 to 2.8 um. Separate data streams are recorded from both the up-looking and down-looking pyranometers. The longwave radiation measurements are made with Eppley pyrgeometers. The wavelength range of these instruments is 3.5 to 50.0 um. As with the pyranometers, separate data streams are recorded from both the up-looking and down-looking pyrgeometers.

Rain Measurement

A Texas Electronics TE525 tipping bucket rain gauge is used at all land based ISS sites for measurement of rainfall. The rain gauge resolution is 0.254 mm. The gauge is typically positioned 1.5 meters above the ground about 7 or 8 meters from the ten-meter tower. Shipboard rain measurements can be made with a Scientific Technology Inc. optical rain gauge, STI ORG-100. These STI rain gauges are currently not available as standard ISS furnished equipment. At present they would have to be purchased by the project. They may become available as standard equipment at a later time as funding permits.

3. Data Collection and Processing

The NetCDF format data were obtained from the EOL data access portal, and no modifications have been made.

4. Data Format

File name convention is **surface_met.YYYYMMDD.nc** where YYYY is the year, MM is the month, and DD is the day of the month. The data are in CF compliant NetCDF format, as indicated below.

```
dimensions:
        time = UNLIMITED ; // (1440 currently)
variables:
        double time(time) ;
                time:long_name = "Time" ;
                time:units = "seconds since 2011-11-09 23:56:03 0:00" ;
        int base_time ;
                base_time:string = "9-Nov-2011,23:56:03 GMT" ;
                base_time:long_name = "Base time in Epoch" ;
                base_time:units = "seconds since 1970-1-1 0:00:00 0:00" ;
        float pres(time) ;
                pres:long_name = "Pressure" ;
                pres:units = "hPa" ;
                pres:field_type = "P" ;
                pres:missing_value = -99999.f ;
        float tdry(time) ;
```

```
        tdry:long_name = "Surface Temperature" ;
        tdry:units = "degC" ;
        tdry:field_type = "T" ;
        tdry:missing_value = -99999.f ;
float rh(time) ;
        rh:long_name = "Relative Humidity" ;
        rh:units = "%" ;
        rh:field_type = "rh" ;
        rh:missing_value = -99999.f ;
float wspd(time) ;
        wspd:long_name = "Wind Speed" ;
        wspd:units = "meters second-1" ;
        wspd:field_type = "wspd" ;
        wspd:missing_value = -99999.f ;
float wdir(time) ;
        wdir:long_name = "Wind Direction" ;
        wdir:units = "degrees" ;
        wdir:field_type = "wdir" ;
        wdir:missing_value = -99999.f ;
float year(time) ;
        year:long_name = "" ;
        year:units = "" ;
        year:field_type = "" ;
        year:missing_value = -99999.f ;
float jd(time) ;
        jd:long_name = "" ;
        jd:units = "" ;
        jd:field_type = "" ;
        jd:missing_value = -99999.f ;
float hhmm(time) ;
        hhmm:long_name = "" ;
        hhmm:units = "" ;
        hhmm:field_type = "" ;
        hhmm:missing_value = -99999.f ;
float secs(time) ;
        secs:long_name = "" ;
        secs:units = "" ;
        secs:field_type = "" ;
        secs:missing_value = -99999.f ;
float vwspd(time) ;
        vwspd:long_name = "" ;
        vwspd:units = "" ;
        vwspd:field_type = "" ;
        vwspd:missing_value = -99999.f ;
float wdev(time) ;
        wdev:long_name = "" ;
        wdev:units = "" ;
        wdev:field_type = "" ;
        wdev:missing_value = -99999.f ;
float vis(time) ;
        vis:long_name = "Total Incoming Visible Radiation" ;
        vis:units = "Watts meters-2" ;
        vis:field_type = "" ;
        vis:missing_value = -99999.f ;
float netrad(time) ;
        netrad:long_name = "Net Radiation" ;
        netrad:units = "watts meters-2" ;
        netrad:field_type = "" ;
        netrad:missing_value = -99999.f ;
float ir(time) ;
        ir:long_name = "Infrared Radiation" ;
        ir:units = "Watts meters-2" ;
        ir:field_type = "" ;
```

```
                ir:missing_value = -99999.f ;
        float rain(time) ;
                rain:long_name = "Rainfall Rate" ;
                rain:units = "mm/min" ;
                rain:field_type = "" ;
                rain:missing_value = -99999.f ;
        float batt(time) ;
                batt:long_name = "Battery Charge" ;
                batt:units = "volts" ;
                batt:field_type = "" ;
                batt:missing_value = -99999.f ;
        float tbox(time) ;
                tbox:long_name = "Campbell Box Temperature" ;
                tbox:units = "degC" ;
                tbox:field_type = "T" ;
                tbox:missing_value = -99999.f ;
        float lat ;
                lat:long_name = "north latitude" ;
                lat:units = "degrees" ;
                lat:valid_range = -90.f, 90.f ;
                lat:missing_value = -99999.f ;
        float lon ;
                lon:long_name = "east longitude" ;
                lon:units = "degrees" ;
                lon:valid_range = -180.f, 180.f ;
                lon:missing_value = -99999.f ;
        float alt ;
                alt:long_name = "Altitude (meters above Mean Sea Level)" ;
                alt:units = "meters" ;
                alt:missing_value = -99999.f ;

// global attributes:
                :missing_value = -99999.f ;
                :zebra_platform = "surface_met" ;
                :history = "Thu Nov 17 16:47:37 2011: ncrcat -O -d time,237.0,86636.0
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/h/eol/iss/project/dynamo/data/iss3/surface_met/surface_met.20111110.232603.nc
/h/eol/iss/project/dynamo/data/iss3/surface_met/surface_met.20111110.235603.nc
surface_met.daily/surface_met.20111110.nc\n",
                        "Created by the Zebra DataStore library, 9-Nov-2011,23:57:13,
$RCSfile: DFA_NetCDF.c,v $ $Revision: 3.90 $\n",
                        "" ;
                :nco_openmp_thread_number = 1 ;
}
```

5. Data Remarks

The data can be accessed using the myriad of software that is able to interact with NetCDF format files, including ncdump, ncview, Matlab, Python, IDL, and NCL.

6. References

UCAR/NCAR - Earth Observing Laboratory. (1997). NCAR Integrated Sounding System (ISS). UCAR/NCAR - Earth Observing Laboratory. https://doi.org/10.5065/D6348HF9 Retrieved February 17, 2017

Parsons D, Dabberdt W, Cole H, Hock T, Martin C, Barrett AL, Miller E, Spowart M, Howard M, Ecklund W, Carter D, 1994: The integrated sounding system: Description and preliminary observations from TOGA COARE. *Bulletin of the American Meteorological Society.* **75(4),** 553-567.