Australian Government
Bureau of Meteorology

Rainfields rainfall estimates and forecasts

User guide

Product Description

Rainfields produces real-time quality controlled, rainfall estimates and forecasts using radar, rain gauges and numerical weather prediction models.

It generates:

- **Calibrated radar rainfall** which uses bias corrected radar reflectivity from real-time rain gauge observations.
- **Merged rain gauge and radar rainfall** which blends real-time rain gauge observations with calibrated radar rainfall.
- **Rainfall forecasts** incorporating ensembles and probabilistic information:
    - Short-term, high-resolution forecasts for limited radar domains;
    - Longer-term forecasts which use automated radar nowcasting blended with high-resolution rainfall forecasts from the Bureau's Numerical Weather Prediction model (ACCESS-C) for mosaic domains.

Product types

Data types described above are available for a variety of accumulation periods.

File name suffix shown in brackets – see file naming convention below.

Calibrated rainfall (QPE) available for all domains, updating every five minutes:

- Calibrated rainfall – 5 minute accumulation (AR)
- Calibrated rainfall – 60 minute accumulation (A1)
- Calibrated rainfall – daily (updates 9am only) (AD)
- Calibrated rainfall – since 9am (A9)

Merged rainfall (QPE) available for all domains, updating every fifteen minutes:

- Merged rainfall – 15 minute accumulation (MQ)
- Merged rainfall – 30 minute accumulation (M)
- Merged rainfall – 60 minute accumulation (M1)
- Merged rainfall – 180 minute accumulation (M3)
- Merged rainfall – daily (updates 9am only) (MD)
- Merged rainfall – since 9am (M9)

Two hour rainfall forecasts (QPF) available for limited radar domains, updating every five minutes, 500m spatial resolution, 5min temporal resolution, 30 ensemble members:

- Rainfall forecast – 30-member ensemble (E)
- Rainfall forecast – ensemble mean forecast, 30/60/90min ensemble mean accumulations (FA)
- Rainfall forecast – probability of 60-minute rainfall exceeding 0.2, 0.4, 0.6, 1, 2, 5, 10, 20, 30, 50mm (P)

Twelve hour rainfall forecasts (QPF) available for mosaic domains, updating every ten minutes, 1000m spatial resolution, 10min temporal resolution, 10 ensemble members:

- Rainfall forecast – 10-member ensemble (EN)
- Rainfall forecast – ensemble mean forecast, 30/60/90min ensemble mean accumulations (EA)
- Rainfall forecast – probability of 60-minute rainfall exceeding 0.2, 0.4, 0.6, 1, 2, 5, 10, 20, 30, 50mm (PA)

File naming convention

Files are named:

IDR*nnxx*.RF3.*yyyymmddhhmm*.nc

Where: *nn(n)* is the radar ID (see below – note: radar domains are two digits; mosaic domains three digits);

xx refers to the product type (see list above):

yyyymmddhhmm refers to the date and time in UTC.

Radar status reports take the following filenames:

IDR999*nn*.html

Where *nn* is the radar ID (see below). Radar status reports are not available for mosaic domains.

Formats

- NetCDF4
- Radar status reports: HTML

Available domains

Radar domains are a 256x256km grid centred at the radar with 500m spatial resolution. Rainfall estimate products are available for all radar domains; rainfall forecast products are only available for limited radar domains (see below).

Regional mosaic domains vary in extent and have 1km spatial resolution. All rainfall estimate and forecast products are available for these domains.

The national mosaic domain has a spatial resolution of 2km. Only rainfall estimate products are available for the national domain.

Radar domains available for Rainfields data are as follows. Radars with forecast data available are denoted with an asterisk.

01 – Broadmeadows (Melbourne), Vic
02 – Melbourne (Laverton), Vic*
03 – Wollongong (Appin), NSW
04 – Newcastle, NSW
05 – Carnarvon, WA
06 – Geraldton, WA
08 – Gympie (Mt Kanigan), Qld
09 – Gove, NT
14 – Mount Gambier, SA
15 – Dampier, WA
16 – Port Hedland, WA
17 – Broome, WA
19 – Cairns, Qld
22 – Mackay, Qld
23 – Gladstone, Qld
24 – Bowen, Qld
25 – Alice Springs, NT
27 – Woomera, SA
28 – Grafton, NSW
29 – Learmonth, WA
30 – Mildura, Vic
31 – Albany, WA
32 – Esperance, WA
33 – Ceduna, SA
36 – Mornington Island (Gulf of Carpentaria), Qld
38 – Newdegate, WA
40 – Canberra (Captains Flat), NSW
41 – Willis Island, Qld
42 – Katherine (Tindal), NT
44 – Giles, WA
46 – Adelaide (Sellick's Hill), SA
48 – Kalgoorlie, WA
49 – Yarrawonga, Vic
50 – Brisbane (Marburg), Qld
52 – Northwest Tasmania (West Takone), Tas
53 – Moree, NSW
54 – Sydney (Kurnell), NSW
55 – Wagga Wagga, NSW
56 – Longreach, Qld
58 – South Doodlakine, WA
63 – Darwin (Berrimah), NT
64 – Adelaide (Buckland Park), SA*
66 – Brisbane (Mount Stapylton), Qld*
67 – Warrego, Qld
68 – Bairnsdale, Vic
69 – Namoi, NSW
70 – Perth, WA
71 – Sydney (Terrey Hills), NSW*
72 – Emerald, Qld
73 – Townsville, Qld
75 – Mount Isa, Qld
76 – Hobart (Mount Koonya), Tas
77 – Warruwi, NT
78 – Weipa, Qld (previously 18)
79 – Watheroo, WA

Mosaic domains are:

310 – Australia
311 – New South Wales
312 – Victoria
313 – Queensland
314 – South Australia
315 – Northern Territory
317 – Western Australia
318 – Tasmania

Metadata

RAINFIELDS products are stored in netCDF format, an international standardised file format widely used in the scientific community. More information regarding and netCDF and the CF-1.7 metadata convention used by RAINFIELDS is available in the netCDF specification (Eaton et al. 2011).

```
netcdf file:/2_20190207_050000.prcp-m30.nc {
  dimensions:
    n2 = 2;
    y = 512;
    x = 512;
  variables:
    long start_time;
      :units = "seconds since 1970-01-01 00:00:00 UTC";
      :long_name = "Accumulation start time";
    long valid_time;
      :standard_name = "time";
      :units = "seconds since 1970-01-01 00:00:00 UTC";
      :long_name = "Accumulation end time";
      :calendar = "gregorian";

    byte proj;
      :grid_mapping_name = "albers_conical_equal_area";
      :standard_parallel = -36.3, -39.4; // double
      :longitude_of_central_meridian = 144.752; // double
      :latitude_of_projection_origin = -37.852; // double
      :false_easting = 0.0; // double
      :false_northing = 0.0; // double
      :semi_major_axis = 6378137.0; // double
      :semi_minor_axis = 6356752.31414; // double
      :_CoordinateTransformType = "Projection";
      :_CoordinateAxisTypes = "GeoX GeoY";

    double y_bounds(y=512, n2=2);

    double x_bounds(x=512, n2=2);

    double precipitation(y=512, x=512);
      :grid_mapping = "proj";
      :fraction_missing = 0.0; // double
      :long_name = "Accumulated precipitation";
      :standard_name = "precipitation_amount";
      :units = "kg m-2";
      :scale_factor = 0.05; // double
      :add_offset = 0.0; // double
      :_ChunkSizes = 512U, 512U; // uint

    double y(y=512);
      :standard_name = "projection_y_coordinate";
      :units = "km";
      :bounds = "y_bounds";
      :_CoordinateAxisType = "GeoY";

    double x(x=512);
      :standard_name = "projection_x_coordinate";
      :units = "km";
      :bounds = "x_bounds";
      :_CoordinateAxisType = "GeoX";
  // global attributes:
```

Dimensions

Time Period

Projection

Precipitation units

Coordinates

```
  :licence = "http://www.bom.gov.au/other/copyright.shtml";
  :source = "rainfields 3.1.6 ho-rainfields 2018-12-03";
  :station_id = 2; // int
  :title = "Merged Gauge/Radar Accumulation (30 min)";
  :Conventions = "CF-1.7";
  :institution = "Commonwealth of Australia, Bureau of Meteorology (ABN 92 637 533
532)";
  :station_name = "Melb";
  :_CoordSysBuilder = "ucar.nc2.dataset.conv.CF1Convention";
}
```

The different attributes of the metadata dump file for QPE 30-minute merged accumulation above are explained in the following sections.

Dimensions

QPE files have:

- Two spatial dimensions: x, and y, defining the location of the centre of the data pixel;
- Two temporal variables, start_time, which corresponds to the time when the accumulation commences and valid_time, which corresponds to the time when the accumulation ends;
- A data variable, 'precipitation', which corresponds to the actual precipitation accumulation values.

QPF *ensemble* files have:

- Two spatial dimensions: x, and y;
- The time: valid_time corresponding to the number of time steps;
- The number of ensemble members.

```
dimensions:
    y = 512;
    x = 512;
    member = 10;
    valid_time = 74;
    n2 = 2;
```

QPF *ensemble mean* and *probabilistic* data sets do not have the member dimension.

Variables x_bounds and y_bounds are required in both QPE and QPF files by netcdf standards and indicate the extension of each pixel, and n2 indicates they extend into two directions, toward the positive and negative x and y axes respectively.

Coordinates

The variables x and y define the grid location in space. The y dimension represents the north-south coordinate, centred on the mid-point with values across the range -255, -254, ... , 0, ..., 255, 256. The x dimension represents the east-west coordinate with values
from -256, -255, ..., 0, ... , 254, 255. Each grid is 1 km, and the 0, 0 coordinate is the location of the radar for individual radars, or the centre point of the mosaic for multiple radars.

Coordinates x = 0 and y = 0 represent the centre of the grid (and location of the radar if it is a single radar grid and not a mosaic). The coordinates of the centre of the grid are provided in the variable proj. The latitude and longitude of the other grid cells are calculated based on the projection information described further in the *Projection* section below.

Further information on the netCDF coordinate system may be found in Eaton et al., (2011), see Coordinate Types and Coordinate Systems; and Appendix F: Grid Mappings, particularly Albers Equal Area and Table F.1. Grid Mapping Attributes.

Precipitation units

Variable "precipitation"

```
short precipitation(member=30, valid_time=24, y=512, x=512);
  :standard_name = "precipitation_amount";
  :long_name = "Accumulated precipitation";
  :units = "kg m-2";
  :_FillValue = -1S; // short
  :scale_factor = 0.05f; // float
  :add_offset = 0.0f; // float
  :grid_mapping = "proj";
  :_ChunkSizes = 1U, 1U, 512U, 512U; // uint
```

Precipitation is encoded in fixed point, e.g. multiples of 0.05. Accumulated precipitation values are calculated by the relationship:

precipitation = grid value * scale_factor + add_offset

The scale_factor and add_offset attributes are constant for the entire grid and provided in the precipitation variable in the metadata. In **Error! Reference source not found.** they are equal to 0.05 and 0.0 respectively. Other typical values of precipitation are shown below:

- a grid value of 1 becomes precipitation of 1 * 0.05 + 0.0 = 0.05 mm
- a grid value of 20 becomes precipitation of 20 * 0.05 + 0.0 = 1.00 mm.

This representation loads the accumulated precipitation variable grid and reduces the data file size, see Eaton et al., (2011), Reduction of Dataset Size and Packed Data for information.

Fill value

Missing values in the precipitation variable are usually encoded with a negative _FillValue. In **Error! Reference source not found.**, _FillValue is equal to -32768. Refer to see Eaton et al., (2011) Variables: Missing Data for more information.

Projection

The grid_mapping_name defines the projection and longitude_of_central_meridian and latitude_of_projection_origin variables correspond to the centre of the grid.

RAINFIELDS netCDF files store precipitation data in an Albers Conical Equal Area projection. Transforming Albers longitude and latitude coordinates into cartesian coordinates (and vice versa) may be completed using 3rd party software such as PROJ4 (see http://proj4.org/apps/index.html; https://racw.githubusercontent.com/OSGeo/proj.4/gh-pages/proj4.pdf.

Some hydrological modelling frameworks such as Delft-*FEWS* readily import Albers projected netCDF files.