Met Office

Oasis Platform for Climate and Catastrophe Risk Assessment – Asia

Bangladesh Tropical Cyclone Event Set:
Data Description Documentation

Hamish Steptoe, Met Office

Supported by:

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based on a decision of the German Bundestag

Document Control		
	Role Title	**Name**
Document Owner	Project Manager	Claire Souch (Oasis)
Author	Project Scientist	Hamish Steptoe
Reviewer	Project Manager	Claire Souch (Oasis)
	Project Scientist	Kate Salmon
	Project Scientist	Bernd Becker

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Contents

Introduction

This document describes the data that forms the historical catalogue of Bangladesh tropical cyclones, part of the Oasis Platform for Climate and Catastrophe Risk Assessment – Asia, a project funded by the International Climate Initiative (IKI), supported by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, based on a decision of the German Bundestag

The catalogue contains the following tropical cyclones (landfall date): **BOB01** (30/04/1991 00:00), **BOB07** (25/11/1995 09:00), **TC01B** (19/05/1997 15:00), **Akash** (14/05/2007 18:00), **Sidr** (15/11/2007 18:00), **Rashmi** (26/10/2008 21:00), **Aila** (25/05/2009 06:00), **Viyaru** (16/05/2013 09:00), **Roanu** (21/05/2016 12:00), **Mora** (30/05/2017 03:00) and **Fani** (04/05/2019 06:00).

Each tropical cyclone comprises of a nine-member, 3-hourly time-lagged ensemble. Each ensemble member covers a period of 48 hours, once the initial 24-hour model spin is removed (see Figure 1 for a visual representation), at resolutions of 4.4km and 1.5km based on the Met Office Unified Model dynamically downscaling ECMWF ERA5 data. Note that there is no data assimilation process in these model runs.
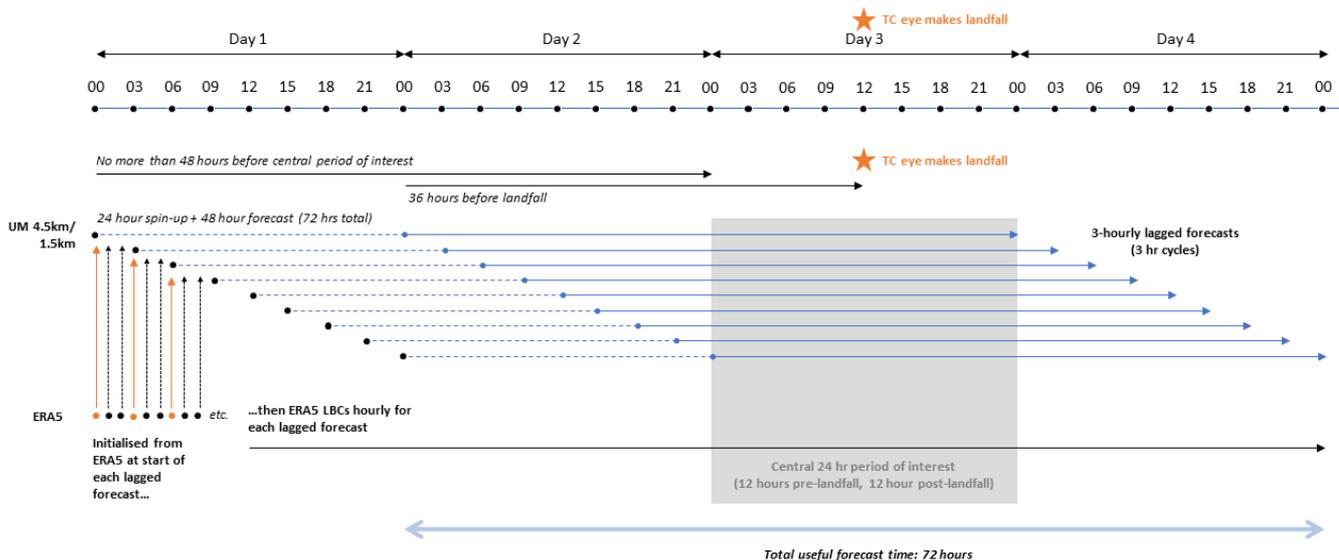
Figure 1 Ensemble configuration for the historical event set.

Data Categories

The data in this catalogue are grouped into the following categories:

Name	Identifier	Description
Time series ensemble	tsens	Time series data for each ensemble member. Dimensions are typically: forecast_period, forecast_reference_time, latitude and longitude.
Ensemble footprints	fpens	Time-aggregated data for each ensemble member. Dimensions are typically: forecast_reference_time, latitude and longitude.
Best footprint	fp	A single best estimate footprint with lower, median and upper bounds accounting for ensemble variation.

Note that some variables exist on multiple pressure levels. For these cases, an additional 'pressure' dimension may also be present.

See the Data Metadata section for additional description of the dimensions.

Additional details covering the production of the footprint (fp) files will be available in a separate document.

File Naming

Model output time-series (tsens) files are named according to the following convention:

VAR.TIMEMETHOD.UMRA2T.TIMEPERIOD.NAME.RES.nc

where:

VAR	A short variable identifier of the variable contained within the netCDF file. See full list of variables below.
TIMEMETHOD	The time method, specifying if the var is a mean, min, max or point and the period of time over which the mean, min, max or point measure is found. See below for a more detailed description.
UMRA2T	The Met Office regional model type. This is constant.
TIMEPERIOD	The time period that the data spans, in the form START_END formatted as YYYYMMDD.
NAME	The common name of the storm for the given time period.
RES	The resolution of the dataset. Either 4p4 = 4.4km or 1p5 = 1.5km grid size.
.nc	Indicates that this is a netCDF file.

Files relating to ensemble or best footprints have a simpler file naming structure:

fpens.VAR.TIMEMETHOD.NAME.RES.nc

or

fp.VAR.TIMEMETHOD.NAME.RES.nc

Variables

The full list of variables available, their shortened identifiers and their units are:

Variable	Identifier	Unit
net down surface sw flux corrected	rsnds	W/m^2
wet bulb potential temperature	wbpt	K
air pressure at sea level	psl	Pa
air temperature	tas	K
geopotential height	zg	m
relative humidity	hur	%
stratiform rainfall amount	prlst	kg/m^2
stratiform snowfall amount	prlssn	kg/m^2

surface downwelling shortwave flux in air	rsds	W/m^2
wind speed of gust	fg	m/s
x wind	ua	m/s
y wind	va	m/s

Note that where possible the variable names follow the CF Standard Names,
http://cfconventions.org/standard-names.html.

Time Methods

Time methods are defined by the sampling period of the data and the sampling type applied to this period. The sampling period (or sampling interval) is one of: hourly (T1H), 3-hourly (T3H) or 24-hourly (T24H).

The sampling type is one of max (maximum), min (minimum), mean or point. Point sampling is an instantaneous sample taken from the model time-step (which is typically much less than the sample period) and is the sampling type that is most closely comparable to observational data.

Together then, T1Hmax is interpreted as hourly maximum data; T3Hmean is interpreted a 3-hourly mean data, and T1Hpoint are instantaneous measurements taken every hour.

Data Metadata

Each netCDF file has metadata that describes the data file. The metadata should be considered the definitive source of file information. **For a full understanding of the netCDF metadata conventions, please refer to:**
http://cfconventions.org/cf-conventions/v1.6.0/cf-conventions.html.

What follows is a short description of the output from the UCAR Unidata ncdump utility, which prints this metadata to screen.

As an example:

```
$ ncdump -h psl.T1Hmin.UMRA2T.19910428_19910501.BOB01.1p5km.nc
```

returns:

```
netcdf psl.T1Hmin.UMRA2T.19910428_19910501.BOB01.1p5km {
dimensions:
     forecast_period = 48 ;
```

```
        forecast_reference_time = 9 ;
        latitude = 518 ;
        longitude = 400 ;
        bnds = 2 ;
variables:
        float air_pressure_at_sea_level(forecast_period, forecast_reference_time,
latitude, longitude) ;
                air_pressure_at_sea_level:standard_name = "air_pressure_at_sea_level" ;
                air_pressure_at_sea_level:units = "Pa" ;
                air_pressure_at_sea_level:um_stash_source = "m01s16i222" ;
                air_pressure_at_sea_level:cell_methods = "time: minimum (interval: 1
hour)" ;
                air_pressure_at_sea_level:grid_mapping = "latitude_longitude" ;
                air_pressure_at_sea_level:coordinates = "time" ;
        int latitude_longitude ;
                latitude_longitude:grid_mapping_name = "latitude_longitude" ;
                latitude_longitude:longitude_of_prime_meridian = 0. ;
                latitude_longitude:earth_radius = 6371229. ;
                latitude_longitude:proj4 = "+proj=longlat +ellps=WGS84 +datum=WGS84
+no_defs" ;
        double forecast_period(forecast_period) ;
                forecast_period:bounds = "forecast_period_bnds" ;
                forecast_period:units = "hours" ;
                forecast_period:standard_name = "forecast_period" ;
        double forecast_period_bnds(forecast_period, bnds) ;
        double forecast_reference_time(forecast_reference_time) ;
                forecast_reference_time:axis = "T" ;
                forecast_reference_time:units = "hours since 1970-01-01 00:00:00" ;
                forecast_reference_time:standard_name = "forecast_reference_time" ;
                forecast_reference_time:calendar = "gregorian" ;
        float latitude(latitude) ;
                latitude:axis = "Y" ;
                latitude:units = "degrees_north" ;
                latitude:standard_name = "latitude" ;
        float longitude(longitude) ;
                longitude:axis = "X" ;
                longitude:units = "degrees_east" ;
                longitude:standard_name = "longitude" ;
        double time(forecast_reference_time, forecast_period) ;
                time:bounds = "time_bnds" ;
                time:units = "hours since 1970-01-01 00:00:00" ;
                time:standard_name = "time" ;
                time:calendar = "gregorian" ;
        double time_bnds(forecast_reference_time, forecast_period, bnds) ;

// global attributes:
```

```
            :rim_removed = "13 point rim removed" ;
            :um_version = "11.1" ;
            :source = "Copernicus Climate Change Service Information (C3S) ECMWF ERA5
/ Met Office UM RA2T CON" ;
            :Conventions = "CF-1.7" ;
            :contact = "enquiries@metoffice.gov.uk" ;
            :comment = "Supported by the International Climate Initiative (IKI) and
the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety,
based on a decision of the Germany Bundestag" ;
            :data_type = "grid" ;
            :date_created = "20192730T15:27:10" ;
            :geospatial_lat_max = "27.483002" ;
            :geospatial_lat_min = "20.503502" ;
            :geospatial_lat_resolution = "0.01" ;
            :geospatial_lat_units = "degrees_north" ;
            :geospatial_lon_max = "92.942" ;
            :geospatial_lon_min = "87.5555" ;
            :geospatial_lon_resolution = "0.01" ;
            :geospatial_lon_units = "degrees_east" ;
            :history = "(1.0) Initial release" ;
            :id = "psl.T1Hmin.UMRA2T.19910428_19910501.BOB01.1p5km.nc" ;
            :institution = "Met Office, UK" ;
            :keywords = "Bangladesh, dynamical downscaling, RA2T, Met Office" ;
            :product_version = "v1.0" ;
            string :project = "Oasis Platform for Climate and Catastrophe Risk
Assessment – Asia" ;
            :references = "" ;
            :standard_name_vocabulary = "NetCDF Climate and Forecast (CF) Standard
Names version 51" ;
            :summary = "Tropical cyclone data over Bangladesh downscaled using Met
Office RA2T_CON initiated from ERA5" ;
            :title = "Downscaled Tropical Cyclone data over Bangladesh" ;
            :type = "float" ;
            :spatial_resolution = "4.4km" ;
            :licence = "Creative Commons Attribution 4.0 International (CC BY 4.0)" ;
}
```

Notice that this is split into several sections, and describes the data as follows:

Dimensions

```
dimensions:
    forecast_period = 48 ;
    forecast_reference_time = 9 ;
```

```
latitude = 518 ;
longitude = 400 ;
bnds = 2 ;
```

There are 5 dimensions used within this file:

- `forecast_period` - the time step of the data, in this case this dimension has length 48. This describes the time dimension of the data in hours relative to the forecast reference time.

- `forecast_reference_time` – the initialisation time of each model run. This dataset is made of 9 ensemble members, each of which are initialised at a different start time in units of 'hours since' a defined reference period (defined in the netCDF metadata), using the Gregorian calendar.

- `latitude` – The latitudinal position of each grid point relative to EPSG:4326 (WGS84)

- `longitude` - The latitudinal position of each grid point relative to EPSG:4326 (WGS84)

- `bnd` - the number of bounds the data has. In this case, two representing an upper and lower bound.

Additional dimensions that may be present in other files include:

- `pressure` – a vertical dimension, representing the pressure level at which the data exists, in units of hPa (hectopascals).

Variables

There is a long list of variables. Notice that each of these has a number of attributes associated with it, and information describing its dimensions. For example:

```
float air_pressure_at_sea_level(forecast_period, forecast_reference_time, latitude,
longitude) ;
        air_pressure_at_sea_level:standard_name = "air_pressure_at_sea_level" ;
        air_pressure_at_sea_level:units = "Pa" ;
        air_pressure_at_sea_level:um_stash_source = "m01s16i222" ;
        air_pressure_at_sea_level:cell_methods = "time: minimum (interval: 1 hour)" ;
        air_pressure_at_sea_level:grid_mapping = "latitude_longitude" ;
        air_pressure_at_sea_level:coordinates = "time" ;
```

Describes the variable `air_pressure_at_sea_level`, shows that the data is of type float, and is described using 4 of the 5 available dimensions (`forecast_period`, `forecast_reference_time`,

`latitude, longitude`). There follows additional metadata specific to this variable, such as the `units`, and `standard_name`.

Global Attributes

The global attributes contain additional meta data information applicable to the whole file. Note that this includes the data licence, product version number and project information.