CloudSat-ETC

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Created by Catherine Naud July 2017.

For more information on the dataset and for citation purposes, refer to:
Naud, C.M., J.F. Booth, M. Lebsock, and M. Grecu, 2018: Observational constraint for precipitation in extratropical cyclones: Sensitivity to data sources. *J. Appl. Meteorol. Climatol.*, **57**, no. 4, 991-1009, doi:10.1175/JAMC-D-17-0289.1.

For each 6-hourly cyclone detection, we selected segments of CloudSat (Stephens et al., 2002) orbits that were found within $\pm$ 3 hours and in a 2500 km radius region centered on the low pressure center. The swath is only one pixel wide of approximate resolution 1 km x 2km. The files provided here include information on the cyclone and its track, along with the R04 2C-PRECIP-COLUMN file names (Haynes et al., 2009), and the surface precipitation rates and types (shallow, stratiform and convective) for each segment. The database uses the R04 version of the product, which can be extended to R05 using the filename information. It covers 2006-2016.

Each tar directory contains a year of matched cyclones/CloudSat PRECIP-COLUMN netcdf files, arranged in subdirectories per month.

The cyclones are detected and tracked using MCMS (Bauer et al., 2016) applied to 6-hourly ERA-interim SLPs. Each file corresponds to one of these 6-hourly detections, however the files also contain information on the overall track that the instantaneous cyclone snapshot belongs to.

For each of these cyclone locations, we searched the PRECIP-COLUMN database for orbits that were found within a circular region centered on the low of about 25° radius, within $\pm$3 hours. Then we extract portions of these orbits that are included in the cyclonic zone and save them in the ncdf files.

Filename convention
Cloudsat-ETC-frontid_yyyymmdd_tt_lat_long_surfacetype_trackID.ncdf
Where

- frontid is either cold, none, warm or both and for now is not of use.
- yyyymmdd is the date of the storm detection
- tt is the UT time of the detection (it can be 00, 06, 12, or 18)
- lat: is the latitude of the center of the storm (i.e. the location of the minimum SLP)
- long: is the longitude of the center
- surfacetype is either ocean or land and obtained by setting a 50% threshold on the MERRA2 land fraction file
- trackID is the unique identifier of the track this particular storm occurrence belongs to

The files contain the following:

- storminfo: a vector that contains some of the storm specific information, such as the longitude, the latitude, the SLP at the center, the land fraction and the SLP of the closed contour furthest from the center. This last parameter is used to evaluate the strength of the storm: based on the work of Polly and Rossow (2016), the difference in SLP between the outermost closed contour and the center is a good measure of the storm intensity (the largest the more powerful the storm).
- Trackinfo: this array contains the same information as above but for each instance along the track this storm is part of.
- Cloudsatfileslist: the list of PRECIP-COLUMN files that match the conditions highlighted above for proximity in time and space to the cyclone. The dimension is nbcloudsatfiles.

A selection of the data fields contained in the files is made, i.e. precipitation rate, type, phase, liquid fraction and surface type are extracted and saved in arrays of dimension nbcloudsatfiles x nblatlongmax (=maximum number of profiles included in the cyclone zone amongst the candidate files included in cloudsatfileslist):

- Cloudsatlatitude: latitudes of the profiles (-999. Is used to fill in the orbit chunks smaller that nblatlongmax)
- Cloudsatlongitude: longitudes of the profiles
- Cloudsatprecrate: surface precipitation rate
- Cloudsatprectype: shallow (=3), convective(=2) or stratiform(=1) rain type
- Cloudsatsurftype: surface type extracted from the files.
- Cloudsatliqfrac: precipitation melted fraction (0-1), i.e. the total mass fraction of liquid water contained in surface precipitation
- Cloudsatphaseflag: phase of surface precipitation (precip_flag in original files), =1, 2, 3 for rain, 4-5 for snow, 6-7 for mixed.
- Cloudsatdayflag: this is based on whether the orbit is ascending or descending, =1 for day and =0 for night.

Further Reading and Resources:

Bauer, M.P., G. Tselioudis, and W.B. Rossow, 2016: A new climatology for investigating storm influences in and on the extratropics. *J. Appl. Meteorol. Climatol.*, **55**, 1287-1303.

Haynes J. M., T. S. L'Ecuyer, G. L. Stephens, S. D. Miller, C. Mitrscu, N. B. Wood and S. Tanelli, 2009: Rainfall retrieval over the ocean with spaceborne W-band radar. *J. Geophys. Res.*, **114**, D00A22, doi:10.1029/2008JD009973.

Stephens G. L., D. G. Vane, R. J. Boain, G. G. Mace, K. Sassen, Z. Wang, A. J. Illingworth, E. J. O'Connor, W. B. Rossow, S. L. Durden, S. D. Miller, R. T. Austin, A. Benedetti, C. Mitrescu, and the CloudSat Science Team, 2002: The CloudSat mission and the A-TRAIN: A new dimension to space-based observations of clouds and precipitation. *Bull. Am. Meteorol. Soc*., **83**, 1771-1790.

If you want to learn more about or download CloudSat 2C-PRECIP-COLUMN:
http://www.cloudsat.cira.colostate.edu/data-products/level-2c/2c-precip-column?term=60

MCMS tracking software: https://gcss-dime.giss.nasa.gov/mcms/