Data User Guide

Passive Microwave Hail Climatology Data Products

Introduction

The Passive Microwave Hail Climatology Data Products are gridded estimates of the annual frequency of severe hailstorm occurrence, as retrieved from satellite-borne passive microwave imagery. These data products can be useful for weather and climatological research related to storms, as well as applications involving risk management and emergency management. The dataset files are available in netCDF-3 format, as well as hail climatology maps in PNG format, from January 1, 1998 through March 31, 2022.

Citation

Cecil, Daniel J. and Sarah D. Bang. 2021. Passive Microwave Hail Climatology Data Products [indicate subset used]. Dataset available online from the NASA Global Hydrometeorology Resource Center DAAC, Huntsville, Alabama, U.S.A. doi: http://dx.doi.org/10.5067/MODEL/DATA101

Keywords

NASA, GHRC, passive microwave, hail, climatology, GPM, TRMM, GMI, TMI

Product Description

This is a gridded product of hail climatology using the multi-frequency (37 GHz and 19 GHz) passive microwave estimation of the probability of hail, accumulated over the TRMM and GPM domains and normalized for overpass counts (Bang and Cecil, 2019; Bang and Cecil, 2021)

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Data Characteristics

The Passive Microwave Hail Climatology Data Products are gridded estimates of the annual frequency of severe hailstorm occurrence. These data are available at a Level 4 processing level and stored in netCDF-3 format, as well as hail climatology maps in PNG format. More information about the NASA data processing levels is available on the EOSDIS Data Processing Levels webpage. The characteristics of this dataset are listed in Table 1 below.

Table 1: Data Characteristics

Characteristic	Description
Platform	GPM: Global Precipitation Mission satellite TRMM: Tropical Rainfall Measuring Mission satellite
Instrument	GMI: GPM Microwave Imager (passive microwave radiometer) TMI: TRMM Microwave Imager (passive microwave radiometer)
Spatial Coverage	N: 89.0, S: -89.0, E: 179.0, W: -179.0 (Global)
Spatial Resolution	2 degrees
Temporal Coverage	January 1, 1998 - March 31, 2021
Temporal Resolution	Annual Climatology
Sampling Frequency	Annually
Parameter	Hail climatology
Version	1
Processing Level	4

File Naming Convention

The Passive Microwave Hail Climatology Data Products dataset files are available in netCDF-3 format and named using the following convention:

Data files: <Type>_HailClimatology_BC2019_2deg.nc
Browse files: <Type>_HailClimatology.png

Table 2: File naming convention variables

Variable	Description
<Type>	COMBO: combined satellites (GPM and TRMM) GPM: Global Precipitation Mission TRMM: Tropical Rainfall Measuring Mission
.nc	netCDF-3 format

Data Format and Parameters

The Passive Microwave Hail Climatology Data Products files are stored in netCDF-3 format. The data fields included in each file are listed in Table 3 below.

Table 3: netCDF-3 Data Fields

Field Name	Description	Unit
latitude	The latitude at the center of each 2-degree box	Degrees North
longitude	The longitude at the center of each 2-degree box	Degrees East
norm_hail_density	Estimated number of severe hail storms per 10,000 km^2 per year	-

Algorithm

GPM or TRMM Polarization Corrected Temperature (PCT) features were paired with ground hail reports to train a hail retrieval algorithm to estimate the probability of hail. Probability of hail is calculated for each GPM (or TRMM) feature using the 37 GHz and 19 GHz PCT retrieval (Bang and Cecil, 2019). "Features" are contiguous areas larger than 1 GPM GMI (or TRMM TMI) pixel with 89 (or 85) GHz PCT < 200 K. Features must pass the surface artifact/deep convection screen (see Bang and Cecil, 2021) to be counted. Features with a minimum estimated probability of hail > 20% are counted in 2-degree boxes. The total of these individual hail probabilities is tallied for each box, and normalized for overpass counts and box area(See Bang and Cecil, 2019, Equation 5).

Between 39 degrees north and south latitudes, the climatology is from combining both the TRMM and GPM hail probabilities and overpass counts, normalized for orbit and sampling. Beyond 39 degrees, the climatology is solely from the GPM satellite. 37-GHz and 19-GHz PCT values from the two satellites are adjusted for internal consistency before computing and combining the hail probabilities. The PCT adjustment is described in the Appendix of Bang and Cecil (2021).

Quality Assessment

The effectiveness and regional bias of this hail retrieval was tested using well-known spaceborne radar-based hail proxies (such as reflectivity at −20°C) (Bang and Cecil, 2021). The hail retrieval exhibits little regional variability, even when examining regional

reflectivity profiles at a finescale. It shows improved performance in oceanic regimes (Bang and Cecil, 2021).

Software

These data products are in netCDF-3 format, so no special software is required to view these data; however, Panoply can be used to easily view these data products.

Known Issues or Missing Data

Missing data (where there is insufficient sampling by the satellites) are listed as -NaN.

References

Bang, S.D. and D.J. Cecil (2019). Constructing a multi-frequency passive microwave hail retrieval and climatology in the GPM domain. J. Appl. Meteor. Clim., 58, 1889-1904. doi: https://doi.org/10.1175/JAMC-D-19-0042.1.

Bang, S.D. and D.J. Cecil (2021). Testing passive microwave-based hail retrievals using GPM DPR Ku-band radar. J. Appl. Meteor. Clim., 60, 255-271. doi: https://doi.org/10.1175/JAMC-D-20-0129.1.

Contact Information

To order these data or for further information, please contact:

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