CloudSat/CALIPSO/GOES-16 ABI Joint Dataset

Abstract:

This dataset consists of matched CloudSat radar and CALIPSO lidar cloud detection in pressure layers, GOES-16 ABI reflectance, and GFS relative humidity data for a time period from October 2018 through June 2019. It is intended to accompany a publication by the same authors (namely the *corresponding publication* provided below).

Corresponding publication:

Haynes, J. M., Y.-J. Noh, S. D. Miller, K. D. Haynes, I. Ebert-Uphoff, and A. Heidinger, 2021: Low cloud detection in multilayer scenes using satellite imagery with machine learning methods. *J. Atmos. Ocean. Technol.*, https://doi.org/10.1175/JTECH-D-21-0084.1.

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Dataset home / additional information:

https://doi.org/10.7910/DVN/LPXYBL

Data citation:

Haynes, John, 2022, "CloudSat/CALIPSO/GOES-16 ABI Joint Dataset", https://doi.org/10.7910/DVN/LPXYBL, Harvard Dataverse, V1.

Data format:

The data are in netCDF-4 format (https://www.unidata.ucar.edu/software/netcdf), which is commonly used in the atmospheric sciences. Viewers and read routines are widely available for a variety of platforms and languages.

File contents:

Two files are provided. 'training.nc' contains data used for training, as described in the *corresponding publication*. 'testing.nc' contains data used for testing and the relative humidity/cloud analysis in the *corresponding publication*. Note that only those data points where *ml_flag* is set to one are used for the machine learning portion of the analysis.

The variables contained in the file are listed in Table 1 at the end of this document, with additional information provide in Tables 2 and 3.

Date dataset was last modified:

Version 1: Created 2022/02/16

Acronyms:

ABI	Advanced Baseline Imager
CCL	Cloud cover layers
CIRA	Cooperative Institute for Research in the Atmosphere
CLAVR-x	Clouds from AVHRR Extended
ECMWF	European Centre for Medium-Range Weather Forecasts
GFS	Global Forecast System
GOES	Geostationary Operational Environmental Satellite
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration

Data sources:

- CloudSat and CALIPSO are NASA missions. Data were provided by the CloudSat Data Processing Center (https://www.cloudsat.cira.colostate.edu) and processed as described in the *corresponding publication*:
    - 2B-GEOPROF (version P1_R05)
    - 2B-GEOPROF-LIDAR (version P2_R05)
    - ECMWF-AUX (version P_R05)
- GOES ABI data were provided by NOAA and NASA
- CLAVR-x data were generated in-house at CIRA, based on a variety of inputs
    - Heidinger, A., and W. C. Straka III, 2013: Algorithm theoretical basis document: ABI cloud mask. NOAA/NESDIS Center for Satellite Applications and Research Tech. Rep., http://www.star.nesdis.noaa.gov/goesr/docs/ATBD/Cloud_Mask.pdf.
- GFS data were provided by NOAA

Other information:

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Table 1: Scientific data sets (SDS) stored in the netCDF file

Variable	Description	Dimensions	Units / Meaning
ccl_flag	CCL flag	n	0=clear or no retrieval, 1=L, 2=M, 3=L+M, 4=H, 5=H+L, 6=H+M, 7=H+M+L
cloud_present_prs	Flag indicating whether cloud is present in pressure bin (** see Table 2 below **)	n x n_prs	0=clear, 1=radar-only cloud, 2=lidar-only cloud, 3=radar+lidar cloud
cloud_type	CLAVR-x cloud type	n	0=clear, 1=probably clear, 2=fog, 3=water cloud, 4=supercooled water, 5=mixed phase, 6=opaque ice, 7=cirrus, 8=overlapping, 9=overshooting tops, 11=dust, 12=smoke, -128=missing
granule	CloudSat granule number	n	
icef_gfs	Surface ice fraction from GFS	n	
land_class	CLAVR-x land class	n	0=shallow_ocean, 1=land, 2=coastline, 3=shallow inland water, 4=ephemeral water, 5=deep inland water, 6=moderate ocean, 7=deep ocean, 128=missing
latitude	Latitude	n	degrees north
longitude	longitude	n	degrees east
ml_flag	Flag indicating whether data point was used for machine learning training/testing in the *corresponding publication*		0=not used 1=used
mslp_gfs	Mean sea-level pressure from GFS	n	hPa
profile	CloudSat profile number	n	
reflectance	ABI solar reflectance	n x n_vis	
rh_gfs	Relative humidity with respect to liquid water from GFS (** see Table 3 below **)	n x n_rh	percent
sensor_zenith_angle	Sensor zenith angle	n	degrees
snowd_gfs	Snow depth from GFS	n	cm
solar_zenith_angle	Solar zenith angle	n	degrees
tb	Brightness temperature	n x n_ir	K

Table 2: Limits of the n_prs=5 pressure bins used with variable *cloud_present_prs*.

Index	Pressure range (hPa)
0	> 700
1	> 631
2	700 to 350
3	631 to 350
4	< 350

Table 3: Level of the n_rh=8 relative humidity bins used with variable *rh_gfs*.

Index	Pressure range (hPa)
0	150
1	250
2	500
3	650
4	750
5	850
6	950
7	1000