File specification for the event-based precipitation dataset with life cycle evolution

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1. General descriptions

The dataset covers eastern Asia from 2016 to the present day. We identified initial rain clusters (RCs) from the Global Precipitation Measurement 2ADPR dataset and Mesoscale Convective Systems (MCSs) from the Himawari-8 Advanced Himawari Image gridded product. Based on the contours of the initial RCs and MCSs, we then carried out a series of resilient processes, including filtration, segmentation, and consolidation, to obtain the final RCs. The final RCs had a one-to-one correspondence with the relevant MCS. We extracted the RC area, central location, average radar reflectivity profile, average droplet size distribution profile and other precipitation information from the final RCs and retrieved the life cycle evolution of the MCS area, location, and cloud-top brightness temperature from the corresponding MCSs and tracking algorithms. This dataset facilitates studies of the life cycle evolution of precipitation and provides a good foundation for convection parameterizations in precipitation simulations.

We provided the dataset at a temporal range of April-June 2016-2020. The center of the rain cluster derived from the 2ADPR product is restricted to the spatial range (90–150 E, 10–50 N). We tracked the corresponding MCS from Himawari-8 AHI over a wider spatial range (80–170 E, 0–60 N) because the central area is in the region of subpolar westerlies with strong high-level westerly winds.

The files in the dataset were written in "NetCDF4" format using NCL language.

2. Dimension definitions

nrc	var	Number of rain cells
nray	176	Number of height levels. Bin interval is 125 m. 0 is at

the top.

nDSD	2	Number of DSD parameters. Parameters are dBNw and Dm (mm)
ntime	5	Number of time parameters. Parameters are Year, Month, Day, Hour, and Minute
npast	var	Number of maximum past life time of corresponding MCSs (hour)
nfuture	var	Number of maximum future life time of corresponding MCSs (hour)

3. Variable definitions

time (2-byte integer, array size: ntime):

Year, Month, Day, Hour, and Minute of the file, e.g., 2016, 04, 03, 12, 28.

s_rc (4-byte float, array size: nrc):

area of rain cell, units: km^2.

lat_rc (4-byte float, array size: nrc):

central latitude of rain cell, units: degree_N.

lon_rc (4-byte float, array size: nrc):

central longitude of rain cell, units: degree_E.

mrr_rc (4-byte float, array size: nrc):

average near-surface rain rate of rain cell, units: mm h^{-1}.

msth_rc (4-byte float, array size: nrc):

average storm top height of rain cell, units: m.

mz_rc (4-byte float, array size: nbin×nrc):

average Ku-band reflectivity profile of rain cell, units: dBZ.

mdsd_rc (4-byte float, array size: ndsd×nbin×nrc):

average drop size distribution profiles of rain cell. The first index is dBNw; the second index is Dm in mm.

live_past (4-byte integer, array size: nrc):

past life time of the corresponding MCSs, units: hour.

live_future (4-byte integer, array size: nrc):

future life time of the corresponding MCSs, units: hour.

lat_present (4-byte float, array size: nrc):

central latitude of corresponding MCS at present time, units: degree_N.

lon_present (4-byte float, array size: nrc):

central longitude of corresponding MCS at present time, units: degree_E.

area_present (4-byte float, array size: nrc):

area of corresponding MCS at present time, units: km^2.

tba_present (4-byte float, array size: nrc):

average Himawari-8 AHI 10.4 μm brightness temperature of corresponding MCS at present time, units: K.

tbm_present (4-byte float, array size: nrc):

minimum Himawari-8 AHI 10.4 μm brightness temperature of corresponding MCS at present time, units: K.

lat_past (4-byte float, array size: npast×nrc):

central latitude of corresponding MCS at past times, units: degree_N. The variable is not included if npast equals 0.

lon_past (4-byte float, array size: npast×nrc):

central longitude of corresponding MCS at past times, units: degree_E. The variable is not included if npast equals 0.

area_past (4-byte float, array size: npast×nrc):

area of corresponding MCS at past times, units: km^2. The variable is not included if npast equals 0.

tba_past (4-byte float, array size: npast×nrc):

average Himawari-8 AHI 10.4 μm brightness temperature of corresponding MCS at past times, units: K. The variable is not included if npast equals 0.

tbm_past (4-byte float, array size: npast×nrc):

minimum Himawari-8 AHI 10.4 μm brightness temperature of corresponding MCS at past times, units: K. The variable is not included if npast equals 0.

lat_future (4-byte float, array size: nfuture×nrc):

central latitude of corresponding MCS at future times, units: degree_N. The variable is not included if nfuture equals 0.

lon_ future (4-byte float, array size: nfuture×nrc):

central longitude of corresponding MCS at future times, units: degree_E. The variable is not included if nfuture equals 0.

area_ future (4-byte float, array size: nfuture×nrc):

area of corresponding MCS at future times, units: km^2. The variable is not included if nfuture equals 0.

tba_ future (4-byte float, array size: nfuture×nrc):

average Himawari-8 AHI 10.4 μm brightness temperature of corresponding MCS at future times, units: K. The variable is not included if nfuture equals 0.

tbm_ future (4-byte float, array size: nfuture×nrc):

minimum Himawari-8 AHI 10.4 μm brightness temperature of corresponding MCS at future times, units: K. The variable is not included if nfuture equals 0.