Title: Trajectory-derived convective influence for ACCLIP airborne in situ observations
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1 Dataset Description

This dataset provides the location and time scales of most recent convective influence for the air masses sampled by aircraft during the Asian summer monsoon Chemical and Climate Impact Project (ACCLIP; https://www2.acom.ucar.edu/acclip). These statistics are derived using a suite of backward trajectories which are initiated from the flight tracks of both research aircraft (NSF/NCAR GV and NASA WB-57) during ACCLIP. The trajectories are traced backward in time to their most recent "encounter" with a convective cloud.

2 Data Collection and Processing

Backward trajectory clusters are launched from the aircraft locations at an interval of 60s of flight time for aircraft pressure values less than 500 hPa. Each trajectory cluster features 75 trajectories arranged in a 5 x 5 x 3 grid of latitude x longitude x pressure, with a total dimension of 0.1 degrees latitude x 0.1 degrees longitude x 0.2 hPa, and centered on the aircraft's location. Cluster information is included in the dataset's netCDF (.nc) files to allow for uncertainty and sensitivity of the convective influence data product to be characterized. The median values from each cluster are included with the dataset's ICARTT (.ict) files for ease and simplicity.

We use the TRAJ3D model, which is a three-dimensional Lagrangian trajectory model developed at Texas A&M (Bowman, 1993; Bowman and Carrie, 2002). We configure TRAJ3D to use the zonal, meridional, and kinematic vertical (pressure tendency $\omega, hPa\ s^{-1}$) velocity fields from the ERA5 reanalysis (Hersbach et al., 2020). Missing values indicate that convective influence did not occur within the previous 30 days. A satellite-derived spatiotemporal database of convective cloud top altitude (described by Pfister et al., 2022) is used to determine each backward trajectory's most recent convective encounter.

3 Data Format

The file naming convention is: ACCLIP_Convective-Influence_AAA_YYYYMMDD_R1_XXZZ
Where AAA is the aircraft name (either "GV" or "WB57"), XX is the flight type identifier (either "TEST", "TF" for transit flight, or "RF" for research flight), and ZZ gives the two-digit flight number.

The files contain information about the aircraft location at the time of trajectory launch, as well as information about the trajectory-derived convective influence associated with each such trajectory launch. These variables are described below:
Conv_Encounter_Lon: Longitude of most recent convective influence (°E)
Conv_Encounter_Lat: Latitude of most recent convective influence (°N)
Conv_Encounter_Prs: Pressure of most recent convective influence (hPa)
Conv_Encounter_Temp: Temperature of most recent convective influence (K)
Conv_Encounter_Time: Time since most recent convective influence (d)

There are two types of file formats in this dataset, which are described below.

3.1 NetCDF Files

In the netCDF (.nc) files, data fields are all two-dimensional, with one dimension corresponding to the time along the flight track (with size equal to the total number of trajectory clusters launched in a given flight), and the other corresponding to information for all the trajectories within each cluster (with size 75, see Section 2).

3.2 ICARTT Files

In the ICARTT (.ict) files, information from each individual cluster is represented by its median. Representing a cluster by single values is required for ICARTT format to be used, otherwise there would be 75 convective influence solutions valid at each aircraft measurement location and time. Additional information about the ICARTT format can be found at:
https://www.earthdata.nasa.gov/esdis/esco/standards-and-practices/icartt-file-format

The authors find that the median statistics are reasonably representative of the spatiotemporal variability of the statistics for a large sample size (not shown). Representing each cluster by its median inherently discards the uncertainty information, of which none is provided. The authors simply note it is likely that uncertainty within a given cluster is related to the median convective influence time, with shorter (longer) convective influence times indicative of lower (higher) uncertainty.

4 References

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