Korea LMA Level 2 File Documentation

The Korean LMA was a NASA system that was deployed near Seoul during May-October 2023 for a field campaign called Korea Precipitation Observation Program (KPOP): International collaborative experiments for Mesoscale convective system (MCS) in Seoul metropolitan area (KPOP-MS). The NASA Marshall Space Flight Center contacts for this dataset are Timothy Lang (timothy.j.lang@nasa.gov) and Matthew Wingo (matthew.t.wingo@nasa.gov). The lead for KPOP-MS was GyuWon Lee (gyuwon@knu.ac.kr) of Kyungpook National University.

Level 2 data were created using the lmatools Python package (https://github.com/deeplycloudy/lmatools). A minimum of 6 detecting stations is required to consider a VHF source as part of a flash. Maximum allowable distance and maximum allowable time between successive sources in a flash is 3000 m and 0.15 s, respectively. Maximum allowable flash duration is 3 s. See references below for more information about LMA data, processing, and each variable.

Each Korean LMA Level 2 file is an HDF5 architecture containing two overarching data tables: "events" and "flashes." Each of these houses a sub-table with the name "LMA_yymmdd_HHMMSS_600," where yymmdd is two-digit year, month, and day, and HHMMSS is two-digit UTC time stamp of the 10-minute file.

Inside each of these sub-tables are structured arrays containing the actual data. For example, in the KOREA_230709_032000_0600.dat.flash.h5 file, the event data are all contained in a structured array within events/LMA_230709_032000_600 and the flash data are all contained in a structured array within flashes/LMA_230709_032000_600.

The *events* structured array reproduces much of the input Level 1 VHF source location file but also adds *flash_id*, a unique tag that matches each relevant event to a particular flash. The columns in order are as follows:

- 'alt' (float, altitude in m above the WGS84 ellipsoid)
- 'charge' (int, charge identification - not used, always 0)
- 'chi2' (float, chisqr value for the VHF source)
- 'flash_id' (int, matches each relevant source to its parent flash in the "flashes" table - see below)
- 'lat' (float, decimal latitude)
- 'lon' (float, decimal longitude)
- 'mask' (str, hexadecimal mask)
- 'power' (float, VHF source power)
- 'stations' (int, number of stations contributing to source's location solution)
- 'time' (double, second of day)

The *flashes* structured array contains information about each flash identified in the dataset. The columns in order are as follows:

- 'area' (float, km^2)
- 'ctr_alt' (float, altitude of flash centroid in m above the WGS84 ellipsoid)
- 'ctr_lat' (float, decimal latitude of flash centroid)
- 'ctr_lon' (float, decimal longitude of flash centroid)
- 'duration' (float, duration of flash in seconds)
- 'flash_id' (int, unique identification number for each flash)
- 'init_alt' (float, altitude of flash initiation in m above the WGS84 ellipsoid)
- 'init_lat' (float, decimal latitude of flash initiation)
- 'init_lon' (float, decimal longitude of flash initiation)
- 'init_pts' (str, not used; always empty)
- 'n_points' (int, number of sources in flash)
- 'specific_energy' (float, J/kg)
- 'start' (double, second of day for first source in flash; note that flash data from the 2350 UTC file from each day end 1 second into the following day)
- 'total_energy' (float, J)
- 'volume' (float, km^3)

In Python, you can retrieve level 2 data into numpy structured arrays using the following example code snippet:

```
import numpy as np
import h5py
data = h5py.File('KOREA_230709_032000_0600.dat.flash.h5')
events = np.array(data['events']['LMA_230709_032000_600']
flashes = np.array(data['flashes']['LMA_230709_032000_600']
data.close()
```

References

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