The Python-ARM Radar Toolkit (Py-ART), an open source package for weather radar.

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Abstract

With the acquisition of a number of X- and C-band scanning precipitation radars, the Atmospheric Radiation Measurement (ARM) facility now routinely deals with large amounts of complex data from these instruments. The measured parameters from these radars as well as value-added products (VAPs) derived from these data are made available to the radar, cloud, and climate modeling communities. Preparing these data for dissemination requires extensive use of computational resources and algorithms, which are not well addressed by current software packages. To address these needs we have developed the Python-ARM Radar Toolkit (Py-ART), an open source package for working with weather radar data.

Py-ART offers a powerful interpreted environment for ingesting radar data from a number of formats, correcting for aliasing and attenuation, mapping radar coordinate data from a single or multiple radars to a Cartesian grid, and performing a number of geophysical retrievals on the data. The package is capable of creating Climate and Forecast (CF) standard NetCDF files as well as files in the emerging CF-Radial format for antenna coordinate data. Py-ART is written in the Python programming language, taking advantage of the powerful scientific libraries NumPy, SciPy, and matplotlib, available to the language, as well as interfacing with legacy C and FORTRAN radar data. The package is available freely under a BSD license and can be downloaded from https://github.com/ARM-DOE/pyart.

Ingest and Writing

Py-ART has the ability to natively ingest (read) radar data from MDV, Sigmet, NEXRAD Level 2, and CF-Radial, as well as other NetCDF based formats. Using a Python interface, file formats supported by the NASA TRMM Radar Software Library (UF, Lassen) can also be ingested and used by Py-ART. Field data and instrument metadata are stored in memory as a Radar object with which the routines in Py-ART can interact. Data can be written out to Climate and Forecast (CF) standard NetCDF files which conform to the the CF-Radial standard.

Mapping and Gridding

Radar data is collected in antenna coordinates (similar to radial coordinates). For many purposes, it is useful to map these data to a Cartesian grid. Py-ART includes routines to perform this gridding on moments from one or multiple radars using a nearest neighbor lookup. The resulting gridded data and metadata is stored in a Grid object.

Plotting

Py-ART can quickly create high quality plots of radar moments. Support for creating plan position indicator (PPI) and range-height indicator (RHI) plots as well as plotting individual rays is included. More elaborate plots can be created using the functionality provided by Py-ART and the matplotlib plotting package.

Antenna coordinate moment corrections

Py-ART includes implementations of many algorithms which can be used to correct and analyze radar moments in antenna coordinates.

Z-PHI based attenuation correction

Phase correction using an linear programming (LP) algorithm

Univ. Washington 4D Velocity Dealiasing

Additional information and Acknowledgements

Py-ART is an open source project which is distributed under a BSD license. The source code is hosted at GitHub. We welcome forks, contributions, bug-reports and suggestions. For additional information or questions about the package, please contact the lead developer, Jonathan Helmus (jhelmus@anl.gov).

Documentation and examples are available online at: http://arm-doe.github.io/pyart

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Py-ART would not be possible without the hard work of many other open source Scientific Python packages such as NumPy, SciPy, matplotlib, Cython, and python-netcdf4.

https://github.com/ARM-DOE/pyart