

Implementation testing of the New MACCS/HYSPLIT ATD model on assignment to U.S.NRC

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Overview

Background

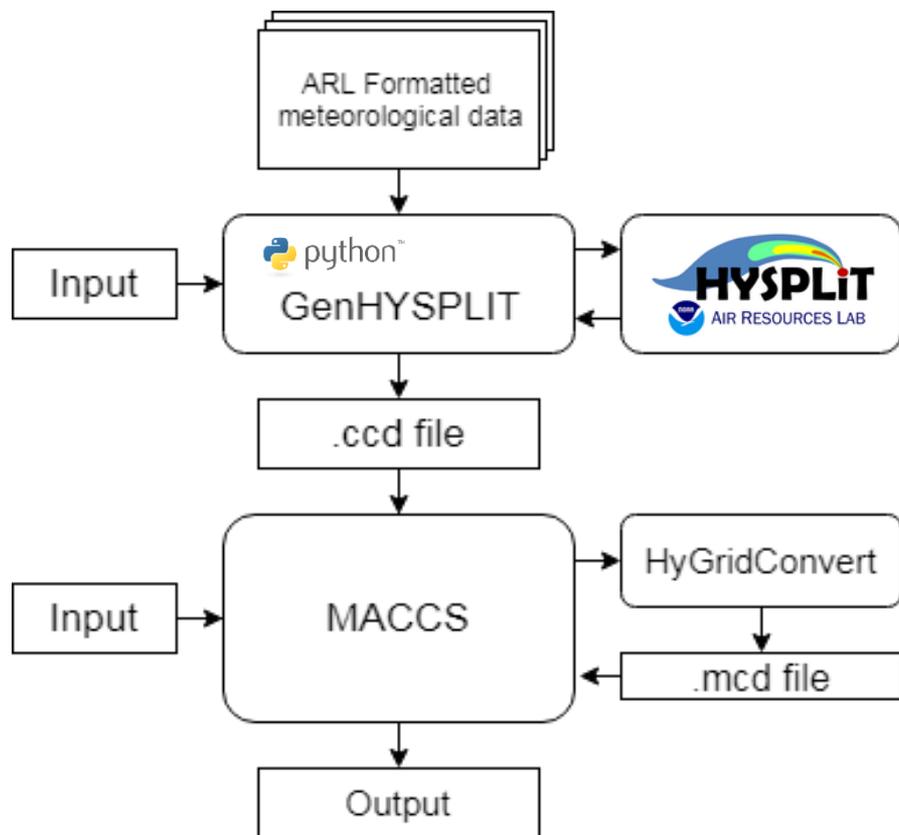
MACCS is being modified to integrate results from the US National Oceanographic and Atmospheric Administration (NOAA) HYSPLIT atmospheric transport model as an alternative to the traditional Gaussian plume segment model.



Assignment

Perform acceptance testing of the newly developed capability using the draft installation documents.

Steps



1. Installation of software
2. Obtain meteorological data
3. Run GenHYSPLIT
4. Run HyGridConvert
5. Run MACCS

Testing environment:

Windows 7 SP1 (64 bit)

Intel® Core™ i7 - 4800 MQ CPU @ 2.70 GHz

No Internet connection (Offline installation)

Sample problem

Sample problem 1: Fixed Start date

GenHYSPLIT

- ✓ Weather data: GDAS 0.5 degrees
- ✓ Weather data: 2011.03.11 to 2011.03.15 (5 days)
- ✓ Release height: 10 m
- ✓ Run time after release: 12 hour
- ✓ Grid size: 100 miles

MACCS

- ✓ Fixed start time: 2011.3.11 7hr
- ✓ 6 plumes, 2 cohorts

Sample problem 2: Weather Sampling

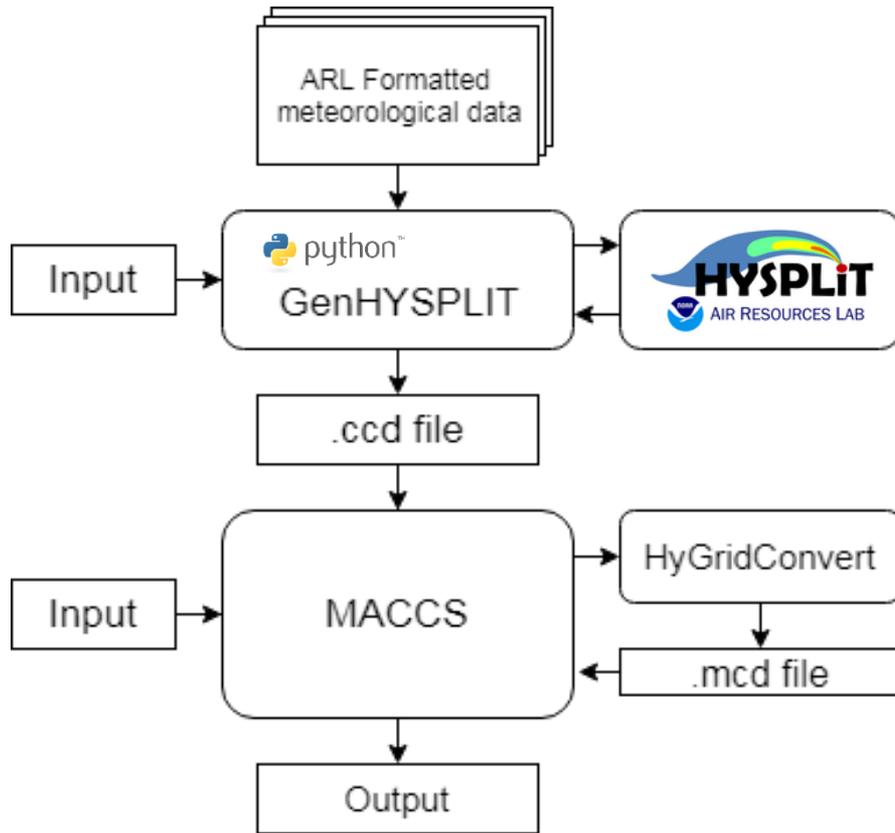
GenHYSPLIT (pre-generated)

- ✓ Weather days: 2014.12.29 to 2016.2.9 (1 year and 43 days)
- ✓ Release heights: 10, 50 and 100 m
- ✓ Run time after release: 12 hour
- ✓ Grid size: 100 miles

MACCS

- ✓ Nonuniform bin sampling (2015.1.1 to 2015.12.31)
- ✓ 2 plumes, 2 cohorts

1. Installation of software



1. Python 3
 - a. numpy
 - b. mpi4py
2. Microsoft MPI
3. HYSPLIT (non-registered)
Optional: Tcl*, Ghostscript, GSView, ImageMagick
4. WinMACCS (beta version)

*Latest .tcl version (v8.6, as of Oct. 2018) didn't work with HYSPLIT. Older version (v8.5) did.

- All software are available online with no charge
- Can be installed by an installer
 - Except for python packages

2. Obtaining meteorological data

NOAA Air Resources Laboratory
Advancing Atmospheric Science and Technology through Research

Gridded Meteorological Data Archives

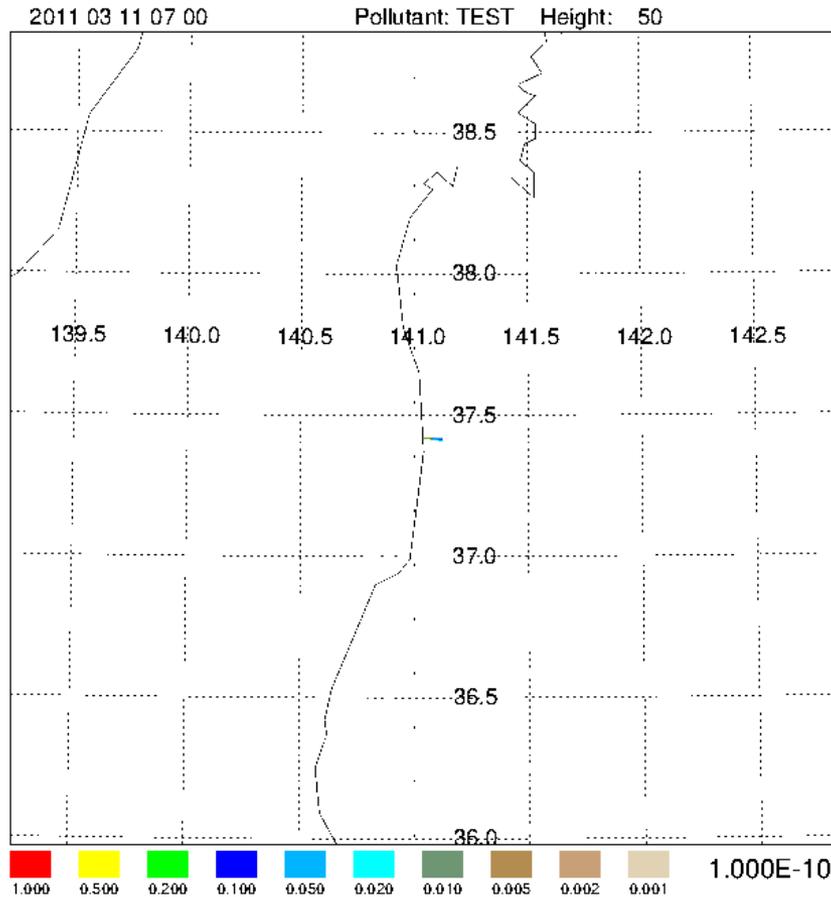
Overview
The National Weather Service's National Centers for Environmental Prediction (NCEP) runs a series of computer analyses and forecasts operationally. NOAA's Air Resources Laboratory (ARL) routinely uses NCEP model data for use in air quality transport and dispersion modeling calculations. In 1989 ARL began to archive some of these datasets for future research studies. ARL has in the past, or is presently archiving the following NCEP datasets, which can be retrieved via ftp by clicking on the name of the dataset.

For further information on model changes see the following web sites:
<http://www.nco.ncep.noaa.gov/bmb/>
<https://www.ready.noaa.gov/archives.php>

- HYSPLIT requires meteorological data to be in ARL format
- ARL formatted data can be found at the NOAA website (ftp)
 - Data size can be reduced by extracting data of the area of interest using NOAA's extraction tool.
- FORTRAN conversion tools prepared by NOAA can be used to convert some weather data for use in HYSPLIT
 - Conversion can be challenging.

	Dataset	Horizontal Resolution (km- approx.)	Full-grid dimensions	Temporal resolution (hrs)	Vertical Levels	Period of each file	Size of each file (GB)	Total size for one month of data (GB)	Availability
North American**	HRRR-3km	3	1799 x 1059	1	37	¼ day	3.2	390	June 2015 ->
	NAM-12km	12	614 x 428	3	27	1 day	0.395	12	May 2007 ->
	WRF-ARW-27km	27	216 x 174	1	35	1 day	0.210	6.4	1980-2016
	NARR-32km	32	309 x 237	3	24	1 month	2.8	2.8	1979 ->
	EDAS-40km	40	185 x 129	3	27	½ month	0.6	1.2	2004 ->
Global	GFS - 0.25°	27	1440 x 721	3	56	1 day	2.7	82	June 2016 ->
	GDAS - 0.5°	55	720 x 361	3	56	1 day	0.468	14	Sept 2007 ->
	GDAS - 1°	111	360 x 181	3	24	1 week	0.571	2.5	Dec 2004 ->
	Global Reanalysis - 2.5°	278	144 x 73	6	18	1 month	0.11	0.11	1948 ->

3. Run GenHYSPLIT



Specify in input file:

- Weather days of interest
- Release location
 - latitude, longitude, height
- Grid size and spacing
- Aerosol properties
 - size, density, deposition velocity
- Other modeling options



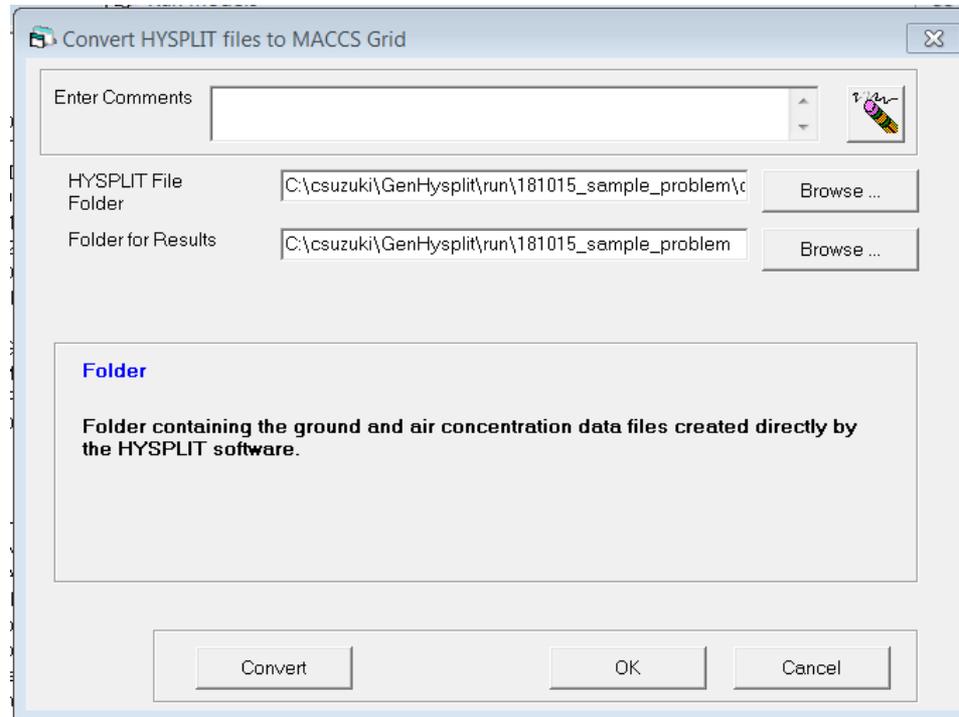
Run GenHYSPLIT



.ccd data set

- HYSPLIT tutorial on NOAA website was useful to learn the dispersion model
- Sample problem (Fixed start time) took approximately an hour to complete using 7 logical processors

4. Run HyGridConvert



Hit "Convert"



.mcd data set

5. Run MACCS

The screenshot displays the MACCS software interface with several configuration windows open. On the left is a project tree with categories like GENERAL, ATMOS, and EARLY. The main area shows the following windows:

- HYSPLITConverted File Folder:** Shows the MACCS-HYSPLIT files path as `C:\csuzuki\GenHysplit\run\MACCS-HYSPLIT-sample`. It includes a table for file extensions and lower bounds:

	HY_PREFIX	HY_LOWER
1	H001	0.
2	H005	30.
3	H010	75.
	*	

- HYSPLIT Transport Dates:** Shows HY_START as 01/01/2015 and HY_END as 12/31/2015.
- HYSPLIT Building Height:** Shows a table for building heights:

	HY_BUILDH (m)
1	50.
2	50.
	*

- Extended Time:** Shows HY_BEFORE (d) as 2 and HY_AFTER (d) as 40.

Specify in input file:

- Location of .mcd file folder
- Which weather file to use for each release height or energy
- Weather days (hours) of interest
- Building height
- All other MACCS parameters



Run MACCS

The results of the calculation matched the results of sample problems.

Summary

- I was able to install MACCS/HYSPLIT following installation instructions provided by SNL.
 - Comments were provided on installation notes on the installation procedure and additional findings
 - Suggested improvements on installation documents
 - Provided editorial comments
- I was able to run the sample problems and create outputs following instructions provided by SNL.
 - Comments were provided on instructions that did not describe the actual situation
- Data size may be an issue
 - Limiting area of interest reduces input weather data size
- Using meteorological data not on NOAA website may require additional effort.