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
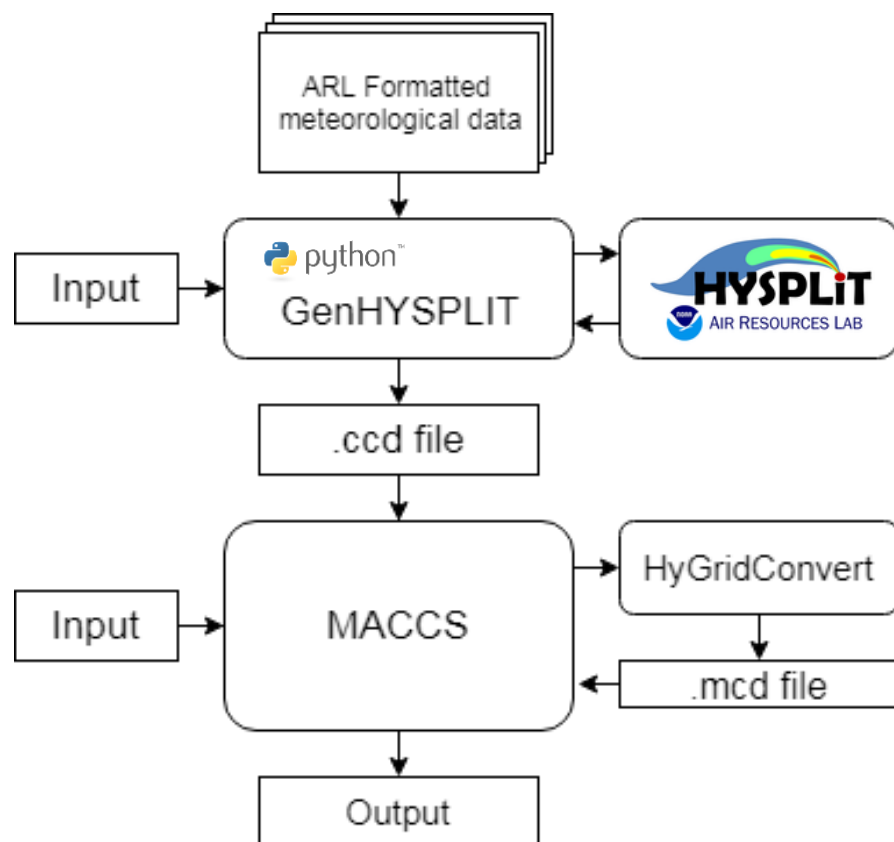
1. Installation of software

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
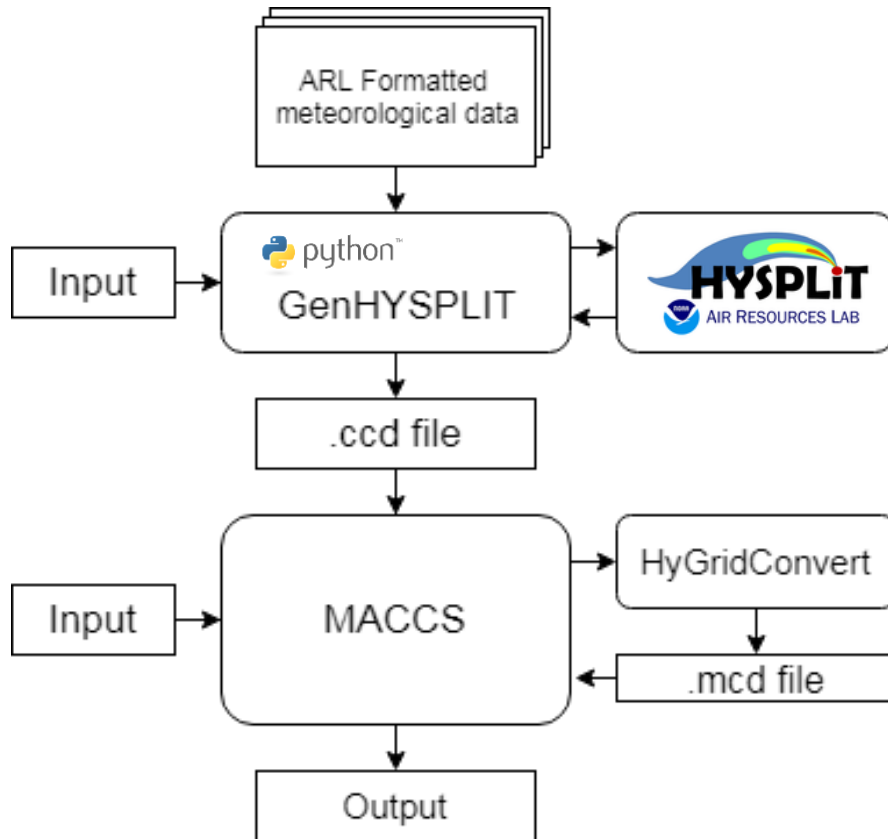
GenHYSPLIT (pre-generated)

- ✓ 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

https://www.ready.noaa.gov/archives.php

- HYSPLIT requires meteorological data to be in <u>ARL format</u>
- 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 ->

https://www.ready.noaa.gov/documents/ppts/Cheat_Sheet_2018.pdf

3. Run GenHYSPLIT
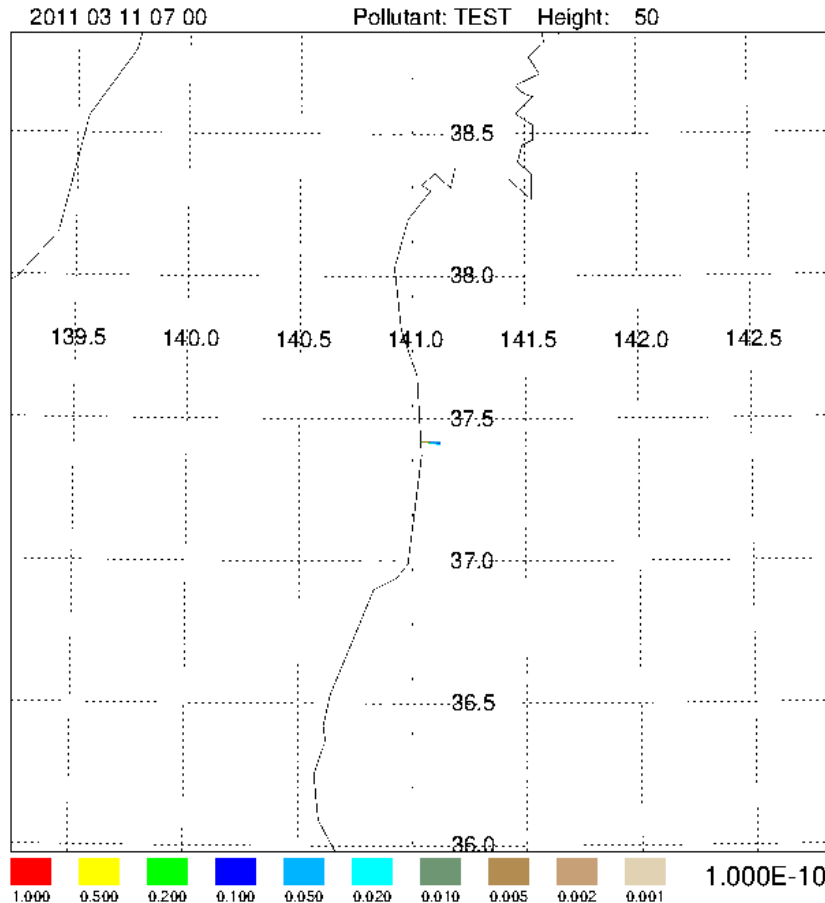
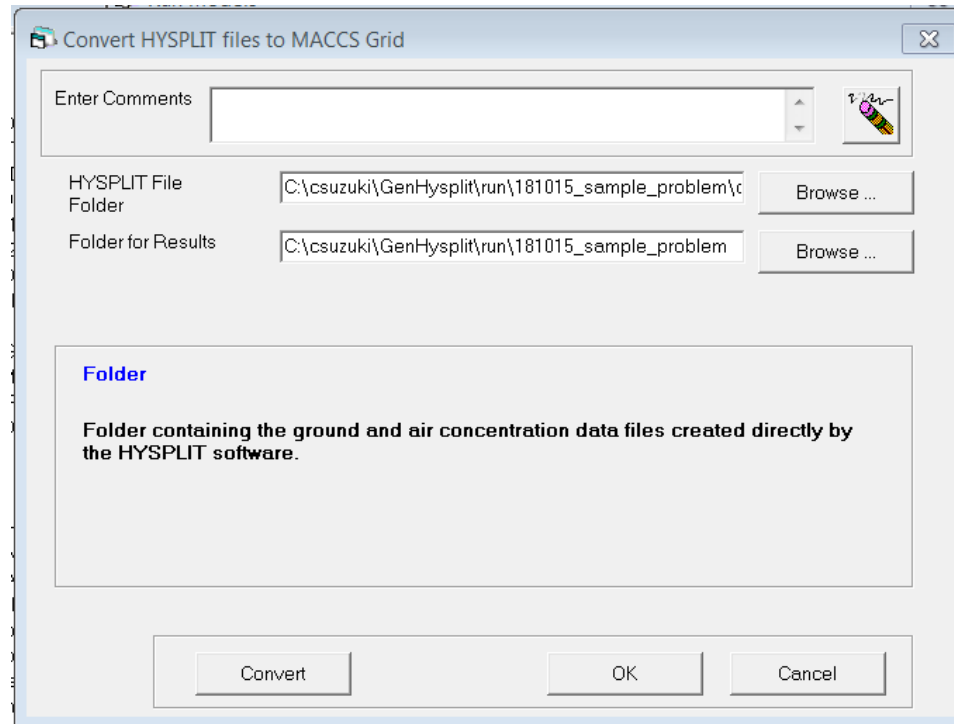**Specify in input file:**
- Weather days of interest
- Release location
  - latitude, longitude, height
- Grid size and spacing
- Aerosol properties
  - size, density, deposition velocity
- Other modeling options

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
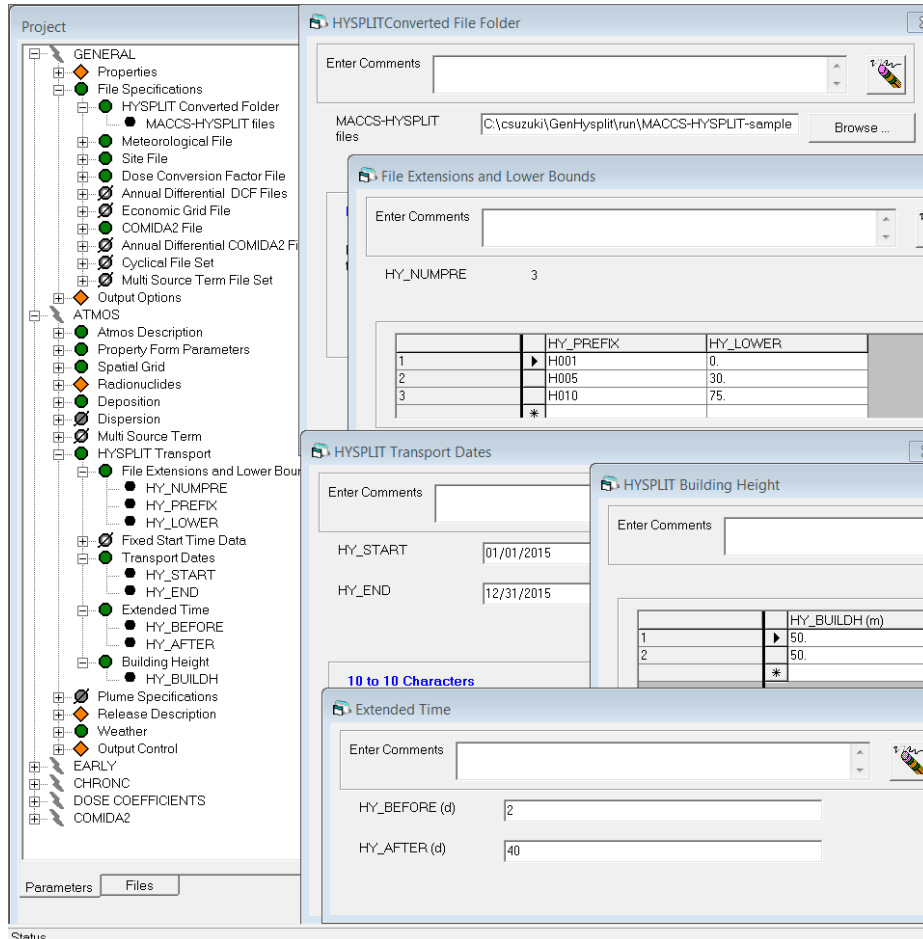
4. Run HyGridConvert

5. Run MACCS

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.