ATSC595 Air Pollution Modelling
HYSPLIT Model Quick Guide- OSX, Linux

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The NOAA Air research lab HYSPLIT model comes both in executable form, as well as source code form depending on the Operating System. This guide will cover installation of HYSPLIT on Mac using precompiled files, and on Linux using source code. Obtaining the HYSPLIT air pollution model requires registration with NOAA ARL. This usually takes a business day but can extend to a week. Please follow the procedures for registration on the ARL website promptly before installing HYSPLIT (For those who desire to compile through UNIX source code, please mention that in your registration email).

Each method has its pros and cons, please refer to the graphic below to find out the method that best suits your needs.

Install Option	Compatible with	Requires Admin Rights	WRF Input Compatible
PC	PC	Y?	N*
Mac Precompiled	Mac	N	N
UNIX Source	Linux	Y	Y

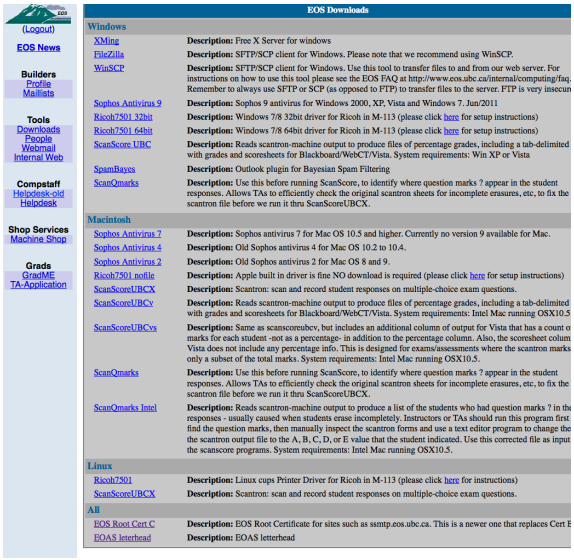
Contents

1. Download & ARL Registration (all)

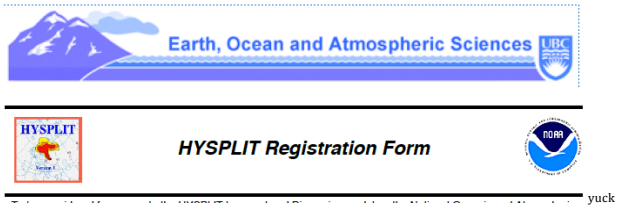
Downloads for Windows PC Hysplit does not require an ARL account, but for OSX and linux binary file download, registration is needed. Since we are using Hysplit for educational purposes, the only 'credentials' needed is a EOAS letterhead, and a referral from a person who already has an account.

i. Register for an NOAA ARL account at http://ready.arl.noaa.gov/HYSPLIT_register.php
After a read through of the documents, you will be prompted to fill and email a form to the webmaster.

ii. The form requires an attachment of a letterhead of the affiliated institution. For those who have an myeos account, the EOAS letterhead could be downloaded under "Tools -> Downloads" and at the bottom, "EOAS letterhead".



iii. If a scanner is accessible, by all means print, fill and scan the form. This is probably the most logical way because the form also required a signature. The form could also be filled with any pdf viewer. Adobe reader is probably the easiest way of filling the texts in the form, however when I tried doing that on the WFRT iMacs, adobe reader seems to distort the letterhead, not that it is too big of an issue.



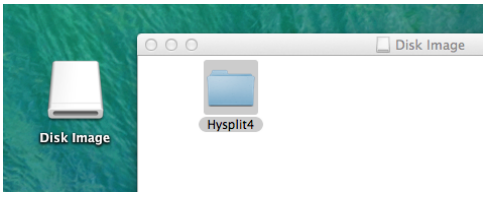
yuck

Fire off the email the arl.webmaster@noaa.gov and you will receive an account confirmation in a few days. (For those who want source code, please mention that you require the “UNIX source code instructions

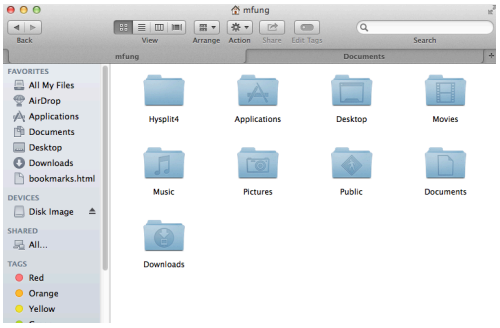
2a i. Mac Download & Installation

i. Once account is granted, go to ARL, Apple-based HYSPLIT, and download "Apple disk image File".

ii. Once disk image HYSPLIT_mac.dmg is downloaded, double click and open the .dmg. There should be a drive popping up on your desktop containing the Hysplit files.



iii. After inspecting the folder, copy Hysplit4 to home directory.
This could be done by either copy-pasting through finder. To access home directory, go to any folder and click cmd+up until you hit home
Ω



Or, to do the same thing in terminal, run:

" cp –r /Volumes/Disk\ image/Hysplit4 ~/ "

iv. One last thing recommended in the hysplit tutorials is to copy the gui link to the a folder in hysplit4. Take a look in the Hysplit4 directory, go to /Hysplit4/working:

If you do not see "hysplit4.tcl", you need to create a symlink
Do this by going to terminal and typing:

"cd ~/Hysplit4/working"
" ln –s ~/Hysplit4/guicode/hysplit4.tcl hysplit4.tcl"
(This assumes you've put Hysplit4 into your home directory).

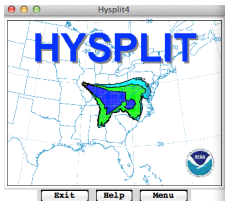
To confirm, type:

"ls ~/Hysplit4/working "
And you should see hysplit4.tcl* in your /working/ directory.

```
mfunga23-175:~$ ls ~/Hysplit4/working
ASCDATA.CFG          default_conc        icon63.png          redball.png
CONTROL              default_exec        oct1618.BIN         sample_conc
MESSAGE              default_ftp         oct1718.BIN         sample_traj
Readme_working.txt   default_traj        particle.png        tdump
TRAJ.CFG             greenball.png       particlelegend.png  trajplot.ps
blueball.png         hysplit4.tcl@       plants.txt
mfunga23-175:~$
```

v. Execute the gui with the following command

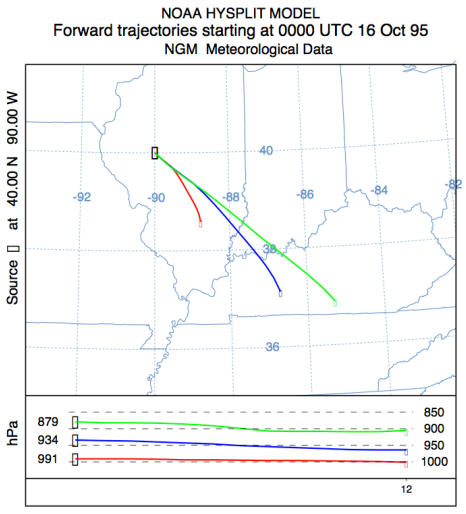
"(cd ~/Hysplit4/working && ./hysplit4.tcl)"

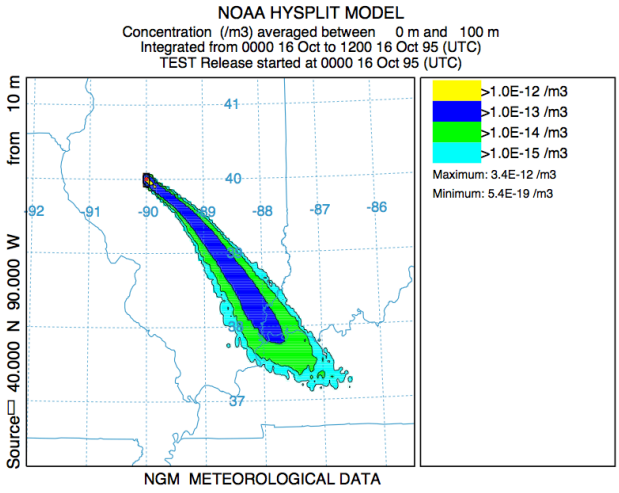


When I click on the window, the buttons become dim/unreadable, but just click at a browser window other than the hysplit window, and the buttons should become readable again.

vi. Simple test:

In the menus interface, click "Trajectory -> QuickStart ->Run Example" "Concentration-> QuickStart -> Run Example"





2a ii. Using Manson Server to Convert WRF input files

i. WRF input is formally not supported for Mac and PC versions of HYSPLIT. That said, since the "manson.eos.ubc.ca" class server runs on Linux, we can first convert the WRF files on manson, then run HYSPLIT on our local computers

> For information on access to manson, please refer to "Manson User Guide"
> For information on accessing UBC WRF data, refer to "WFRT WRF data Guide"

ii. *Filetype Primer:*
WRF runs output files of type "netCDF"
The UBC forecasts produce hourly netCDF data files. The netCDF files should be available under /scratch/data directory.

HYSPLIT meteorology input uses .BIN binary as its file type.
In order to convert netCDF files into .BIN files, there are two executable files in Manson, "prepARW.py, and arw2arl" located in /scratch/models/hysplit/exec

iii. *Prepare Directory*
Connect to manson.eos.ubc.ca
"ssh [username]@manson.eos.ubc.ca"

Create a directory to store WRF files
Ex. "mkdir ~/hysplit "

Copy a set of WRF data to your directory
"cp –r /scratch/data/wrf_sample ~/hysplit/."

Run Executables on the folder
"cd ~/hysplit/wrf_sample && python /scratch/models/hysplit/exec/prepARW.py "

"cd ~/hysplit/wrf_sample && /scratch/models/hysplit/exec/arw2arl wrfout.nc"

This produces a .BIN file named ARLDATA.BIN, which you can input to HYSPLIT

iv. *Transfer files to local computer*
Bring your terminal back to the local computer, cd to the folder which you want to copy the .BIN file.
"cd /path/to/folder"

Secure copy the file by typing
"scp [user]@manson.eos.ubc.ca:hysplit/wrf_sample/ARLDATA.BIN . "

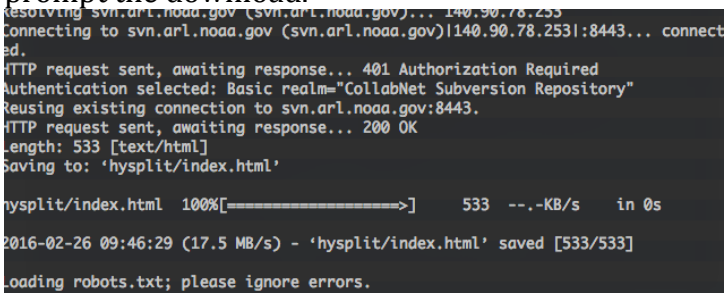
2b. Download and Installation from Source Code

i. Upon registering with ARL, you should receive an email with the necessary instructions to download the source code either through 'svn' or 'wget', something like:

"wget -r --reject "index.html" -nH --cut-dirs=1 --secure-protocol=auto --no-parent --no-check-certificate –user=XXXXX --password=XXXXX https://svn.arl.noaa.gov:8443/svn/hysplit/"

ii. Open terminal, change directory to the folder of your choice:
"cd ~/path/to/folder"

iii. Input the 'wget' command with the given username and password. This will prompt the download.



Inspect the file by typing 'ls' on the terminal.
You should see a new folder called "hysplit"

iv. Checking Dependencies

This part is rather important for the installation process. Please refer to the following graphs and make sure that your dependencies are installed.

For the following guide, I will be using Macports or Homebrew as Mac package manager, and pip as python packager. Here is the list of dependencies for those who are comfortable in checking/downloading dependencies through other means.

Compilation (for WRF input support):
-netcdf library (cxx, fortran)
\-nco (netcdf operator)
-python nco package

b. Check if XCode and Macport is installed (OSX only)
"xcode-select"
"port"
If nothing pops up on either command, please refer to the *XCode & gfortran installation guide on ATSC595 website*

c. Verify Python is installed by typing
"python --version"
The current scripts support python 2.7 and python3 (tested with 3.5)

Checksif you have pip (python module manager) installed.

"pip --version"

If not, refer to your python version found. If you have python 2.7, type:

"port install py27-pip"

Similiarly, python 3.4 pip would be 'py34-pip'

d. Verify that netCDF libraries are installed:

On Mac, type:

"port installed | grep netCDF"

If you see "*netcdf, netcdf-cxx4, netcdf-fortran*" listed on your terminal, you do not need to install additional packages. Otherwise, install any missing package by typing:

"port install [name of missing package]"

On Ubuntu Linux, type:

"aptitude search "~i" | grep netcdf"

If you see "*libnetcdf-dev"* installed, you are good to go.
Otherwise, type the following in terminal to install the packages needed.

"sudo apt-get install libnetcdf-dev"

e. Verify that nco library is installed:

"ncatted"

If command is not found, please install nco by typing:

"port install nco" (Mac)

"sudo apt-get install nco" (Linux)

f. Finally, verify python nco package is installed by typing:

"pip list | grep nco"

If not, install nco module by typing:

"sudo pip install nco" *

(might not need sudo in front depending on the folder permissions on your machine)

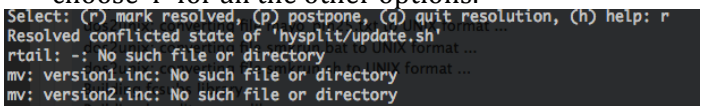
Summary:

Package name	Check if installed, type in terminal:	Should see:	Install Command:
macports (Mac only)	port --version	version text	see gcc macport setup
xcode (Mac only)	xcode --version	version text	see gcc macport setup
pip	pip --version	version text	port install py[version]-pip (eg. "py27-pip")
netcdf (mac)	port installed | grep netcdf	netcdf netcdf-cxx4 netcdf-fortran	port install [package name]
netcdf (linux)	aptitude search "~i" | grep netcdf	libnetcdf-dev ...	sudo apt-get install libnetcdf-dev
nco	ncatted	function info	port install nco (nco is available in hombrew/science)
python nco	pip list | grep nco	nco (version)	sudo pip install nco

v. Compiling HYSPLIT source code:

a. Update source code

Run update.sh by typing:
"sh update.sh"
select "server", "checkout"
choose 'r' for all the other options.



b. Check version & library locations

In order to compile the source code, you need to know the following information:

- name of the fortran compiler used
- location of netcdf libraries (installed earlier)

I. You should know the former if you have had installed models before (eg. AERMOD)

Type "gfortran --version"
"g95 --version"
"pg95 --version"
In terminal and note the first one that does not give a "command not found"
If all of them are not found, please refer to "gcc Macports OSX setup guide"

II. In order to find the location of the netCDF library please do the following.

If you have installed netcdf through macports, type:
"port contents netcdf"
For Linux, type
"dpkg –L netcdf"

Please note the locations of the following files:
"netcdf.inc"
"libnetcdf.a or libnetcdff.a"
(Also take note which .a file your machine has. [1 f or 2 f's (or both)] It will be important later on)

vi. Compilation process

Again, with finder or terminal, open the newly downloaded 'hysplit' directory.
We will need to make changes to three compilation files.

a) In /hysplit/trunk/compile.sh
Open compile.sh with the text editor of your choice.

In line 139, look for:

```
cd ${DIR}/data2arl/arw2arl
  export NETLIB=/usr/local/lib
  export NETINC=/usr/local/include
#  export NETLIB=/usr/local/netCDF4/lib
#  export NETINC=/usr/local/netCDF4/include
#  export NETLIB=/usr/local/netcdf/netcdf363/lib
#  export NETINC=/usr/local/netcdf/netcdf363/include
```

Change NETLIB to the location where "libnetcdf.a or libnetcdff.a" is located (default for macport is /opt/local/lib)
Change NETINC to the location where "netcdf.inc" is located (default for macport is /opt/local/include)

```
cd ${DIR}/data2arl/arw2arl
  export NETLIB=/opt/local/lib
  export NETINC=/opt/local/include
#  export NETLIB=/usr/local/lib
#  export NETINC=/usr/local/include
#  export NETLIB=/usr/local/netCDF4/lib
#  export NETINC=/usr/local/netCDF4/include
#  export NETLIB=/usr/local/netcdf/netcdf363/lib
#  export NETINC=/usr/local/netcdf/netcdf363/include
```

Exit the text editor upon completion

b) In /trunk/data2arl/arw2arl/Makefile
Open compile.sh with the text editor of your choice.

Go to line 20

```
# library name for netCDF3=netcdf and for netCDF4=netcdff
  LINKS = -L$(NETLIB) -lnetcdf  -L../../library -lhysplit
# LINKS = -L$(NETLIB) -lnetcdff -L../../library -lhysplit
```

If previously, you have "libnetcdf.a", or both of the two, make no change
However, if you have "libnetcdff.a", comment the first one and uncomment the second one.

```
# library name for netCDF3=netcdf and for netCDF4=netcdff
  LINKS = -L$(NETLIB) -lnetcdf  -L../../library -lhysplit
# LINKS = -L$(NETLIB) -lnetcdff -L../../library -lhysplit
```

(if you have libnetcdff.a)

c) Make the same changes in /trunk/cmaq/Makefile line 23

```
# library name for netCDF3=netcdf and for netCDF4=netcdff
  LINKS = -L$(NETLIB) -lnetcdf  -L../library -lhysplit
# LINKS = -L$(NETLIB) -lnetcdff -L../library -lhysplit
```

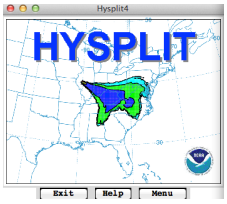
vii.

To actually compile the code, you have an option to 'compile', or 'install'.
Install creates a separate folder with the program while compile creates the program in the downloaded directory.
(if you're not short in space, I'd suggest install)

To install, cd to /path/to/hysplit/, type in terminal:
"sh install.sh"
create a new folder, "../hysp_new" is okay
say "yes" to update
say "yes" to Update Version Number
say "no" to softlink
say "yes" to hardlink

To install, cd to /path/to/hysplit/trunk, type in terminal:
"sh compile.sh"

vii. viii. Execute the gui with the following command
"(cd ~/Hysplit4/working && ./hysplit4.tcl)"



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viii. Simple test:
In the menus interface, click

"Trajectory -> QuickStart ->Run Example"
"Concentration-> QuickStart -> Run Example"