# HYSPLIT 2024

UBC ATSC 595D

For Windows/Mac/Linux

- Bolded entries are individual commands to be placed on the command line; they should be written and entered as a single line in the terminal

- Italicized entries with > are graphical user interface (GUI) clicks and entries

- Main HYSPLIT site: https://www.ready.noaa.gov/HYSPLIT.php

- Full HYSPLIT user's guide: https://www.ready.noaa.gov/hysplitusersguide/

- HYSPLIT tutorial: https://www.ready.noaa.gov/documents/Tutorial/html/index.html

- If you need the Linux installation, or the registered Windows or Mac versions, you need to first register at: https://www.ready.noaa.gov/HYSPLIT_register.php
  - **Note: will need official UBC letterhead, and several days before response**

- Unregistered (trial) Windows and Mac installations do not require registration

Install + GUI HYSPLIT (Mac Unregistered, V5.2.1)

- NOTE: GUI workflow is the same across Windows/Mac/Linux...after you've installed HYSPLIT for your OS, you can just follow the instructions here to do the test runs
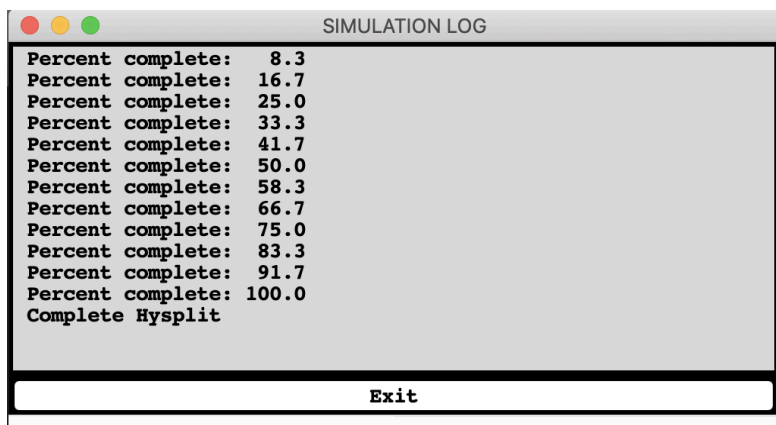
- ○ Your Mac's security settings may give you grief; you may need to keep open **System Preferences > Security and Privacy** throughout this tutorial

- Enter your email address at this link, and log in: https://www.ready.noaa.gov/HYSPLIT_machysplit.php

- Download and open the .dmg: hysplit_U_v5.2.1.dmg
    - ○ Latest version that "works" for Apple; v5.3.0 has a broken hycs_std utility (for running the concentration calculations)

- A finder window should show up; drag and drop the "hysplit" folder into your home directory (or you can also just run *install_hysplit.app*)
- In your finder, go into *home > hysplit > working*, and double-click hysplit.sh
    - ○ You may need to allow your system to recognize that it's safe
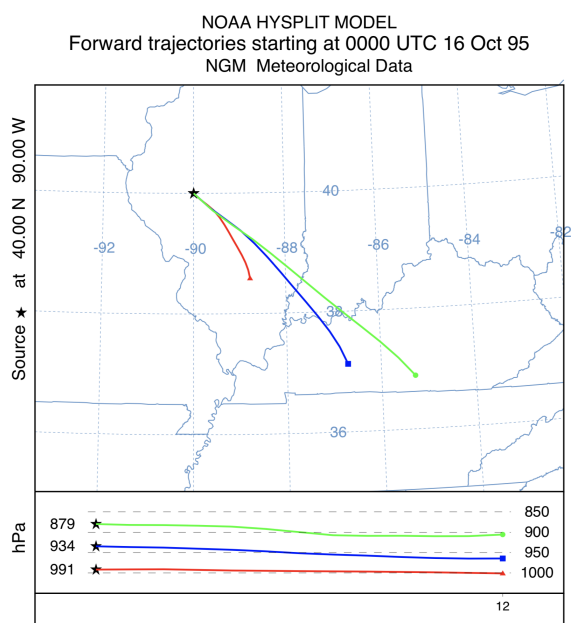   - ○ *System Preferences > Security & Privacy*, and *Open Anyway*
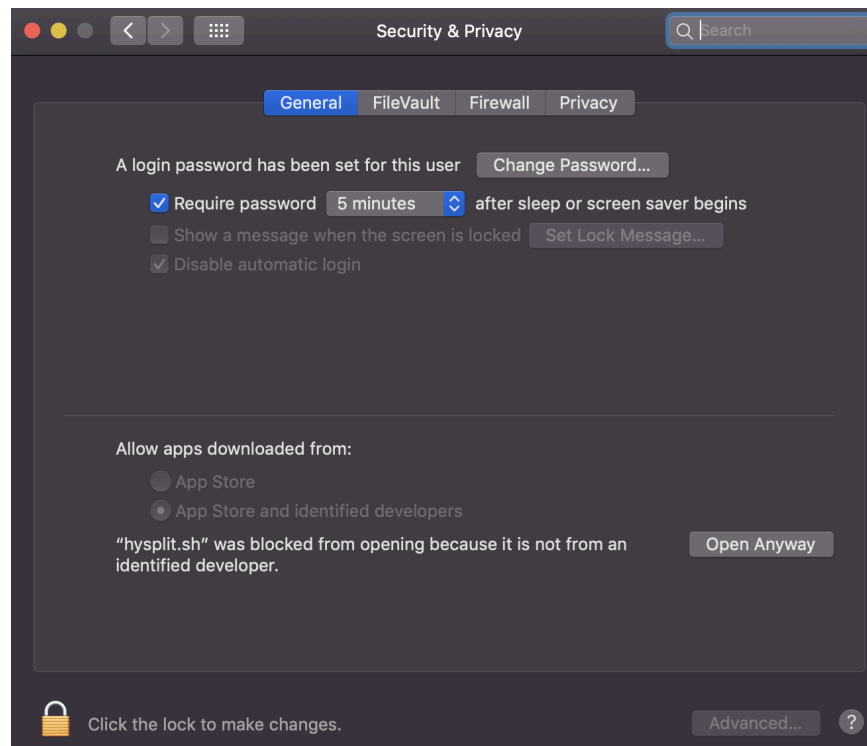
- If all is well, you should see the HYSPLIT Graphical User Interface (GUI) show up

- Click *Menu*
- You should see 4 main tabs
  - Meteorology: set up background meteorology
  - Trajectory: follow a single particle as it moves through the wind field (passive transport = wind field not affected by particle)
  - Concentration: integrate many particles, to create mean (trajectory) and turbulent (dispersive) components to compute concentrations
  - Advanced: Modelling setup; edits namelist file SETUP.CFG

- Model workflow
  - Setup Run: configures simulation; produces file "default_traj" or "default_conc"
  - Model Run: runs the model; copies the "default_" file above to a file named "CONTROL" which is read by the model executable (similar to aermod.inp for AERMOD)
  - Display: read model output and produce a Postscript graphics file

- Trajectory test
  - *Trajectory > Setup Run > Save*, to accept default configuration and set up the model
  - *Trajectory > Run Model*. The model will execute. You should see:

SIMULATION LOG

```
Percent complete:     8.3
Percent complete:    16.7
Percent complete:    25.0
Percent complete:    33.3
Percent complete:    41.7
Percent complete:    50.0
Percent complete:    58.3
Percent complete:    66.7
Percent complete:    75.0
Percent complete:    83.3
Percent complete:    91.7
Percent complete:   100.0
Complete Hysplit
```
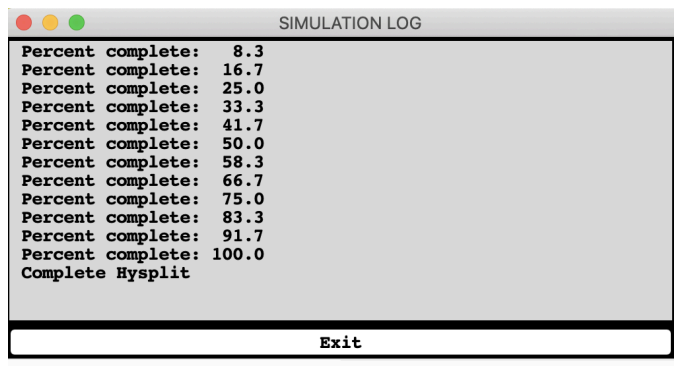
Exit

- ○ Click *Exit* on the simulation log. Then from the menu go to *Trajectory > Display > Trajectory*; hit *Execute Display* at the bottom. A .ps graphic will be produced, and pop up right away.
  - ■ Depending on the Hysplit version and your OS, may default to producing an SVG file instead, and displaying in your browser
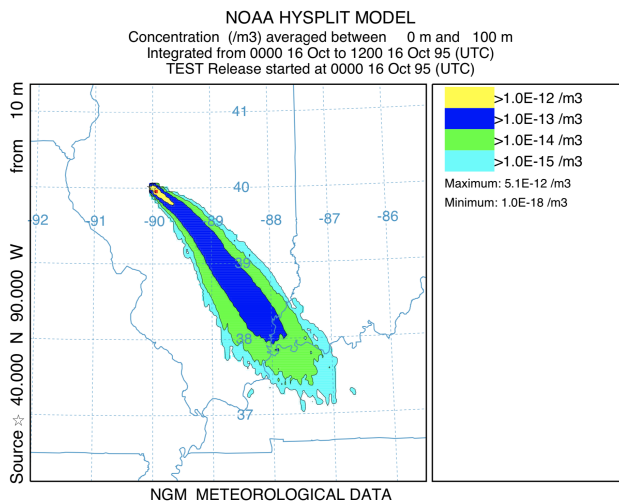- ○ You should see:

NOAA HYSPLIT MODEL
Forward trajectories starting at 0000 UTC 16 Oct 95
NGM Meteorological Data

- ● Concentration test
  - ○ *Concentration > Setup Run > Save*, to accept default configuration and set up the model

○ *Concentration > Run Model*. The model will execute. You should see:

○ Click *Exit* on the simulation log. Then from the menu go to *Concentration > Display > Concentration > Contours*; hit *Execute Display* at the bottom. A .ps graphic will be produced, and pop up right away.
○ You should see:

● If you `ls ~/hysplit/working` (or just navigate there using your Finder window), you should see all of the files you just created

- Meteorology test
  - Download sample CAPTEX (27-km WRF binary) file and place into your working directory:
    - **`cd ~/hysplit/working`**
    - **`wget http://www.ready.noaa.gov/documents/Tutorial/captex/captex2_wrf27uw.bin`**
    - ^One line, of course
    - If wget doesn't work, then download by hand and place into ~/hysplit/working by drag and drop
      - i.e. In your browser navigate to **`http://www.ready.noaa.gov/documents/Tutorial/captex`** and click captex2_wrf27.bin to download
  - Visualize the domain by going back to the hysplit menu and *Meteorology > Display Data > Grid Domain.* Click *Set File Name of ARL format Data* and select captex2_wrf27uw
  - Click *Create Map,* and you should see:
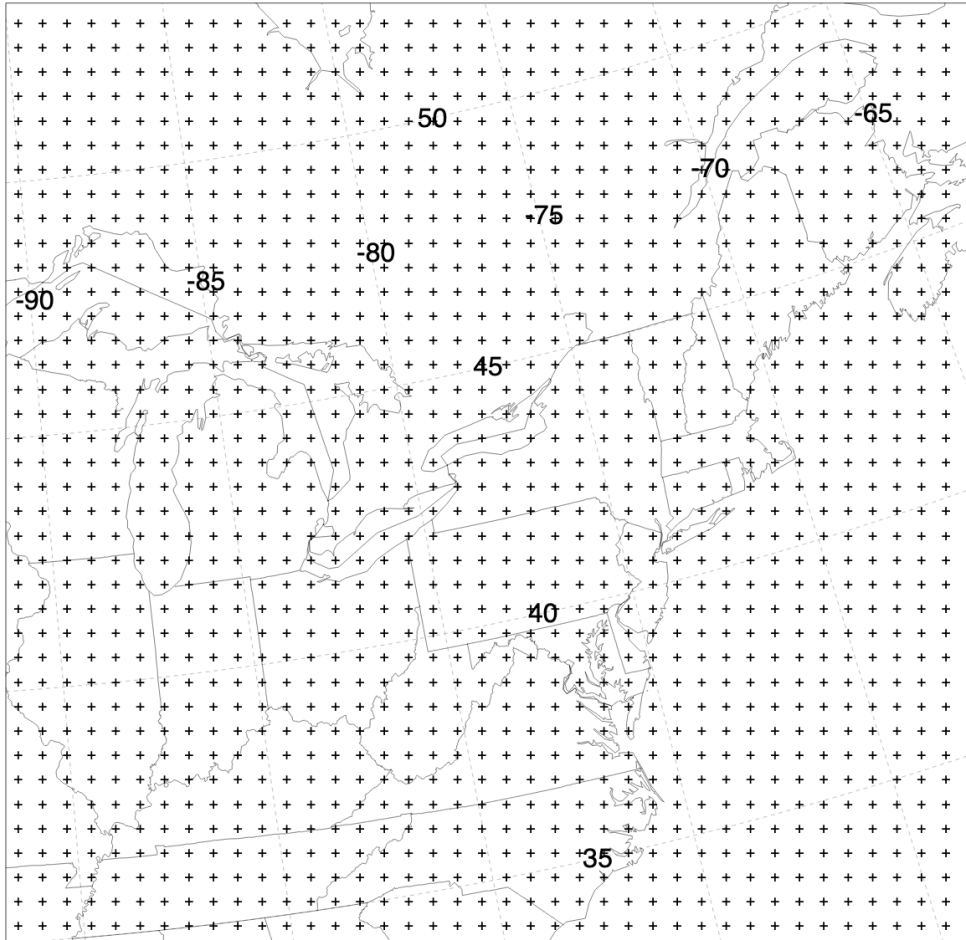
- ○ To see the details of the domain, *Meteorology > Display Data > Check File*, set the file name as captex2_wrf27uw, then *Run File Program*
- ○ You should see the details of the file as:

SIMULATION LOG

```
METEOROLOGICAL DATA LISTING ...
 Enter meteorological directory ...
 Enter meteorological file name ...
 |

    File start time:   83    9   25    0    0
    File ending time:  83    9   28   23    0

Last record number :29760
Record length bytes:     6290
Meteo data model    : AWRF
 Grid size x,y,z    :    80   78   34
Vertical coordinate:     1
First forecast hour:    18
Last forecast hour :    41
Records per time    :   310
```

Exit

<u>Install + GUI HYSPLIT (Win Unregistered, V5.3.0)</u>

- Instructions by Reagan McKinney, worked for V5.1.0 in 2021

Step 1: Download Graphical Utilities

More information on the graphical utilities can be found on the hysplit download page, but a summary of their install is provided here.
https://www.ready.noaa.gov/HYSPLIT.php

1. **Tcl/Tk GUI interface**

   This software allows hysplit to run as a GUI on windows.

   Click the link below to download the interface.

   https://www.ready.noaa.gov/data/web/models/hysplit4/trial/tcl.zip

   Unzip the folder and move to your C drive so the path is **C:\tcl**

2. **GhostScript Editor**

   In order to view the graphics you create in hysplit. This program must be downloaded.

   You can download it via this link (32 bit):

   https://github.com/ArtifexSoftware/ghostpdl-downloads/releases/download/gs9550/gs9550w32.exe

   or you can look for other options here.

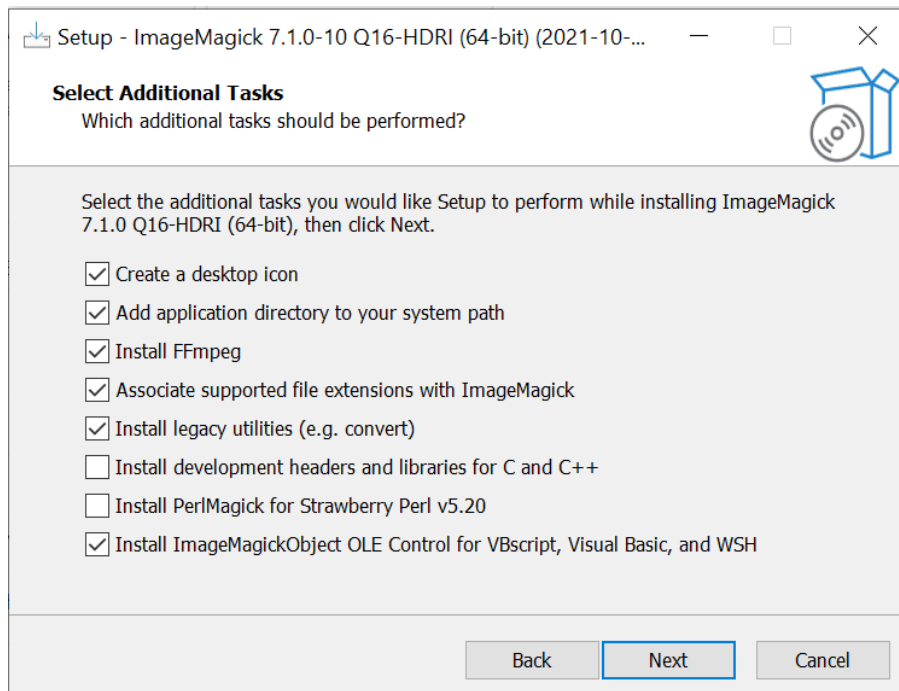   https://www.ghostscript.com/download/gsdnld.html

3. **ImageMagick**

   You can download the program using this link:

   https://imagemagick.org/archive/binaries/ImageMagick-7.1.1-27-Q16-HDRI-x64-dll.exe

   Install the software to the suggested default directory, but when prompted for additional tasks check the box to **Install Legacy Utilities**.

Step 2: Download Hysplit

Enter your email address at this link, and log in:
https://www.ready.noaa.gov/HYSPLIT_hytrial.php

You will then be sent to a page with the Windows downloads for hysplit. Use the first link if you can. Otherwise follow the instructions for the second option.

Click on the following link to download the installation file:

The latest version is available at:

- **HYSPLIT_win64U_v5.3.0.exe** - 64-bit version 5.3.0, November 2023, 376 MB.
- **HYSPLIT_win64U_v5.3.0.zip** - 64-bit version 5.3.0, November 2023, 494 MB. Unzip the file and move the HYSPLIT folder and everything therein to the C: drive. The end result should have directories C:\HYSPLIT\exec, C:\HYSPLIT\working, and others. Then create the "Run Hysplit" shortcut on your desktop. To create the shortcut, open Windows Explorer and navigate to the C:\HYSPLIT\guicode directory. Right-click the hysplit.tcl file and then choose "Send To > Desktop (Create shortcut)." Rename the created shortcut to "Run Hysplit."

Once hysplit has been downloaded, right click on the *RUN HYSPLIT* shortcut and click *Properties*. In the target field, add **C:\tcl\bin\wish86t.exe** *before* the other paths.
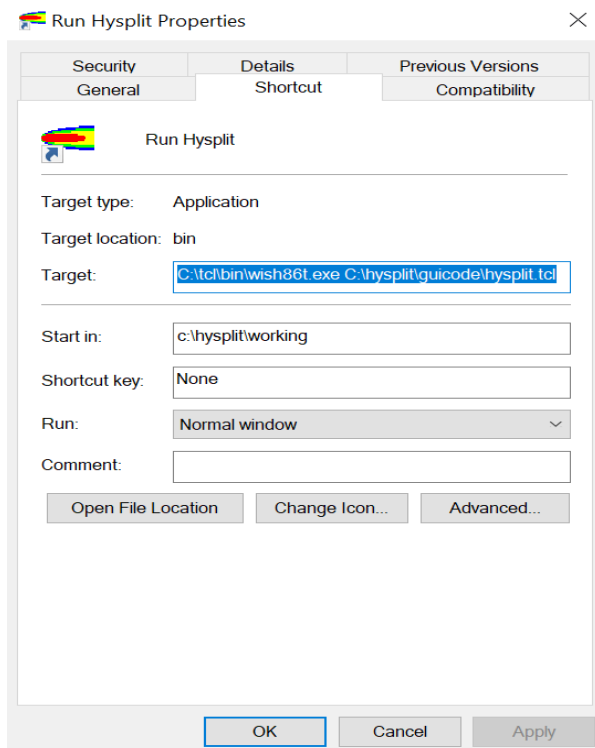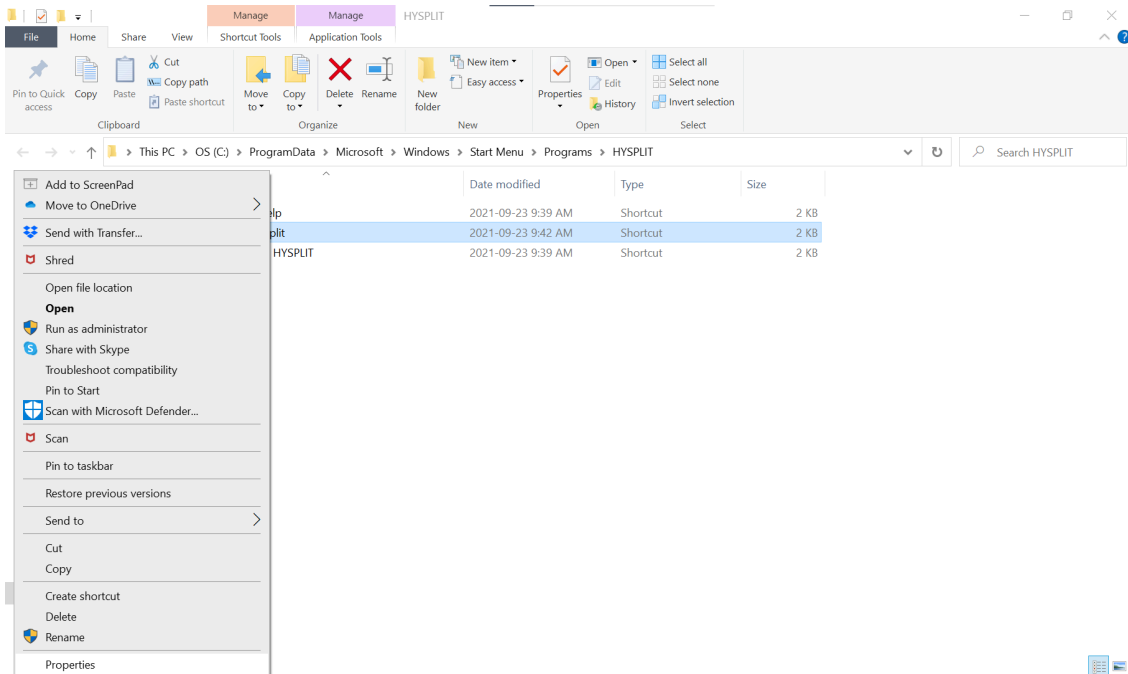
Step 3: Test HYSPLIT GUI

Follow the instructions in the Mac section above to do the test run.

Install + GUI HYSPLIT (Linux Unregistered, V5.3.0)

- Enter your email address at this link, and log in:
  https://www.ready.noaa.gov/hyreg/HYSPLIT_linux.php

- Download and open the .tar.gz that MATCHES the OS of your system, and place into your home directory
  - If you're working on a personal laptop, it's probably the Ubuntu version: **hysplit.v5.3.0_UbuntuOS20.04.6LTS_public.tar.gz**
  - If you're working on a server, it's probably one of the RedHat/CentOS versions
  - Move it to your home directory, and unzip
    - `mv <path_to_downloaded_tar.gz> ~`
    - `tar -xvzf <name_of_tar.gz>`

- Rename the output directory to hysplit, e.g.
  - `mv hysplit.v5.3.0_UbuntuOS20.04.6LTS_public hysplit` (cmd line)
  - Or can just rename in your finder window

- The Linux build of HYSPLIT uses shared libraries, not static...meaning that you need to have all the libraries (i.e. C, Fortran) already installed and in your paths:
  - `export PATH=/path/to/gcc_and_gfortran/bin:$PATH`
  - `export LD_LIBRARY_PATH=/path/to/gcc_and_gfortran/lib` **[**might be `lib64]`

- Go into the guicode directory
  - **cd hysplit/guicode**

- Run hysplit.tcl
  - **./hysplit.tcl**

- You should now see the GUI menu as shown in the Mac section above; follow the guide to continue with the tutorial

- Should you have trouble with running HYSPLIT, or come across errors in relation to missing libraries...well, make sure they're all there!
  - https://www.ready.noaa.gov/data/web/models/hysplit4/linux//README_external_libraries.txt
  - Also: https://www.ready.noaa.gov/documents/Tutorial/html/install_unix.html
  - In particular: "The graphical user interface requires Tcl/Tk. The native graphical format for HYSPLIT is Postscript, which can be viewed using Ghostscript. Postscript graphics are converted to other formats using ImageMagick. If not already available on your system, they may be easily installed using **yum**, **apt**, or **brew**. For some systems, just entering one of the commands, for instance **wish** for Tcl, **gs** for Ghostscript, or **convert** for ImageMagick will prompt the system to download and install the required libraries and software."

- Should you continue to have trouble, you could try logging into a shared server, or onto Compute Canada

- Compute Canada Instructions (Cedar)
  - Copy over the .tar.gz to Cedar (note: Cedar is on CentOS 7)
    - **scp <path_to_hysplit.v5.3.0_CentOS7.9.2009_public.tar.gz> <username>@cedar.computecanada.ca:~**
  - Login to Cedar using passwordless X11 forwarding
    - **ssh -Y <username>@cedar.computecanada.ca**

- ○ Rename the output directory to hysplit, e.g.
  - ■ `mv hysplit.v5.3.0_CentOS7.9.2009_public hysplit`

- ○ Go into the guicode directory
  - ■ `cd hysplit/guicode`

- ○ Run hysplit.tcl
  - ■ `./hysplit.tcl`

- ○ You should now see the GUI menu as shown in the Mac section above; follow the guide in that section to continue with the tutorial

- **Optimum Instructions**
  - ○ Log on to Optimum with X11 forwarding
    - ■ `ssh -Y <username>@optimum.eos.ubc.ca`
  - ○ Download the **x86_64** version
    - ■ `wget`
      `https://www.ready.noaa.gov/data/web/models/hysplit4/linux_trial/hysplit.v5.3.0_x86_64_public.tar.gz`

  - ○ Untar, and rename:
    - ■ `tar -xvzf hysplit.v5.3.0_x86_64_public.tar.gz`
    - ■ `mv hysplit.v5.3.0_x86_64_public hysplit`

  - ○ Go into the guicode directory
    - ■ `cd hysplit/guicode`

  - ○ Run hysplit.tcl
    - ■ `./hysplit.tcl`

  - ○ You should now see the GUI menu as shown in the Mac section above; follow the guide in that section to continue with the tutorial

<u>Command Line HYSPLIT (Mac/Linux)</u>

- Download the Tutorial files and unzip
    - **cd ~/hysplit**
    - **wget**
      **https://www.ready.noaa.gov/data/web/workshop/20
      23/Tutorial.zip**
        - Note: Tutorial.zip is 1.75 GB; when unzipped it's 3.2 GB
    - **unzip Tutorial.zip**

- Go into the Tutorial directory
    - **cd Tutorial**

- The test scripts are in Tutorial/batch; the converted meteorological binary
  files are in Tutorial/captex (for use in more advanced tutorials:
  https://www.ready.noaa.gov/documents/Tutorial/html/index.html)

- Go into the batch directory
    - **cd batch**
    - **ls**

- You'll see a bunch of .bat files, i.e. batch scripts for Windows. For
  Linux/Mac users...we know the drill now, don't we?

- We want to do the concentration test run, so we'll be editing from
  test_conc.bat

- First, change permissions
    - **chmod 755 test_conc.bat**

- Copy to a shell script, test_conc.sh
    - **cp test_conc.bat test_conc.sh**

- Edit the script test_conc.sh with vim (or your favourite editor)
  - **vi test_conc.sh**
  - May or may not need to convert to Unix format with
    :set ff=unix
  - For your convenience you can just copy in the edited script after the following screenshots

```
 1 #!/bin/bash
 2
 3 # ----------------------------------------------
 4
 5 export DIR=~
 6 export PGM="$DIR/hysplit"
 7 cd "$PGM/working"
 8
 9 # ----------------------------------------------
10
11 if [[ -f ASCDATA.CFG ]]; then rm ASCDATA.CFG; fi
12
13 echo -90.0    -180.0  lat/lon of lower left corner   >ASCDATA.CFG
14 echo 1.0      1.0     lat/lon spacing in degrees     >>ASCDATA.CFG
15 echo 180      360     lat/lon number of data points >>ASCDATA.CFG
16 echo 2                default land use category      >>ASCDATA.CFG
17 echo 0.2              default roughness length "(m)"  >>ASCDATA.CFG
18 echo "$PGM/bdyfiles/"  directory of files            >>ASCDATA.CFG
19
20 # ----------------------------------------------
21
22 echo 95 10 16 00               >CONTROL
23 echo 1                        >>CONTROL
24 echo 40.0 -90.0 10.0          >>CONTROL
25 echo 12                       >>CONTROL
26 echo 0                        >>CONTROL
27 echo 10000.0                 >>CONTROL
28 echo 1                        >>CONTROL
29 echo "$PGM/working/"          >>CONTROL
30 echo "oct1618.BIN"       >>CONTROL
31 echo 1                        >>CONTROL
32 echo "TEST"                    >>CONTROL
33 echo 1.0                      >>CONTROL
34 echo 1.0                      >>CONTROL
35 echo 00 00 00 00 00           >>CONTROL
36 echo 1                        >>CONTROL
37 echo 0.0 0.0                  >>CONTROL
38 echo 0.05 0.05                >>CONTROL
39 echo 30.0 30.0                >>CONTROL
```

```
40 echo "./"                      >>CONTROL
41 echo "cdump"                   >>CONTROL
42 echo 1                         >>CONTROL
43 echo 100                       >>CONTROL
44 echo 00 00 00 00 00            >>CONTROL
45 echo 00 00 00 00 00            >>CONTROL
46 echo 00 12 00                  >>CONTROL
47 echo 1                         >>CONTROL
48 echo 0.0 0.0 0.0               >>CONTROL
49 echo 0.0 0.0 0.0 0.0 0.0       >>CONTROL
50 echo 0.0 0.0 0.0               >>CONTROL
51 echo 0.0                       >>CONTROL
52 echo 0.0                       >>CONTROL
53
54 # ------------------------------------------------
55
56 if [[ -f cdump ]]; then rm cdump; fi
57 if [[ -f SETUP.CFG ]]; then rm SETUP.CFG; fi
58
59 $PGM/exec/hycs_std
60
61 echo ------------------------------------------------
62
63 echo 'TITLE^&','### %0 ### ^&' >LABELS.CFG
64 $PGM/exec/concplot -icdump -c50 -j$PGM/graphics/arlmap
65
66 xdg-open concplot.html
```

#!/bin/bash

 # ---

export DIR=~
export PGM="$DIR/hysplit"
cd "$PGM/working"

```
# -------------------------------------------------

if [[ -f ASCDATA.CFG ]]; then rm ASCDATA.CFG; fi

echo -90.0   -180.0  lat/lon of lower left corner   >ASCDATA.CFG
echo 1.0      1.0     lat/lon spacing in degrees        >>ASCDATA.CFG
echo 180      360     lat/lon number of data points >>ASCDATA.CFG
echo 2                default land use category        >>ASCDATA.CFG
echo 0.2              default roughness length "(m)"  >>ASCDATA.CFG
echo "$PGM/bdyfiles/"  directory of files            >>ASCDATA.CFG


# -------------------------------------------------

echo 95 10 16 00          >CONTROL
echo 1                >>CONTROL
echo 40.0 -90.0 10.0      >>CONTROL
echo 12               >>CONTROL
echo 0                >>CONTROL
echo 10000.0             >>CONTROL
echo 1                >>CONTROL
echo "$PGM/working/"        >>CONTROL
echo "oct1618.BIN"     >>CONTROL
echo 1                >>CONTROL
echo "TEST"           >>CONTROL
echo 1.0              >>CONTROL
echo 1.0              >>CONTROL
echo 00 00 00 00 00      >>CONTROL
echo 1                >>CONTROL
echo 0.0 0.0             >>CONTROL
echo 0.05 0.05           >>CONTROL
echo 30.0 30.0           >>CONTROL
echo "./"                >>CONTROL
echo "cdump"            >>CONTROL
echo 1                >>CONTROL
echo 100              >>CONTROL
```

```
echo 00 00 00 00 00      >>CONTROL
echo 00 00 00 00 00      >>CONTROL
echo 00 12 00            >>CONTROL
echo 1            >>CONTROL
echo 0.0 0.0 0.0         >>CONTROL
echo 0.0 0.0 0.0 0.0 0.0  >>CONTROL
echo 0.0 0.0 0.0         >>CONTROL
echo 0.0           >>CONTROL
echo 0.0           >>CONTROL


# ------------------------------------------------

if [[ -f cdump ]]; then rm cdump; fi
if [[ -f SETUP.CFG ]]; then rm SETUP.CFG; fi

$PGM/exec/hycs_std


echo ------------------------------------------------

echo 'TITLE^&','### %0 ### ^&' >LABELS.CFG
$PGM/exec/concplot -icdump -c50 -j$PGM/graphics/arlmap

xdg-open concplot.html
```

- Run the script
  - `./test_conc.sh`

- If you did this right, you should see:

```
HYSPLIT - Initialization
HYSPLIT version: hysplit.v5.1.0
Last Changed Date: 2021-05-13
Calculation Started ... please be patient
Percent complete:    8.3
Percent complete:   16.7
Percent complete:   25.0
Percent complete:   33.3
Percent complete:   41.7
Percent complete:   50.0
Percent complete:   58.3
Percent complete:   66.7
Percent complete:   75.0
Percent complete:   83.3
Percent complete:   91.7
Percent complete: 100.0
Complete Hysplit
-----------------------------------------------
Started Concentration Drawing
HYSPLIT version: hysplit.v5.1.0
Last Changed Date: 2021-05-13
USING COLOR TABLE (../graphics/CLRTBL.CFG)
Finished map:            1
Complete Concplot:            1  time periods
```

- ...and the conc plot should also be displayed (should look familiar):

NOAA HYSPLIT MODEL
Concentration (mass/m3) averaged between   0 m and   100 m
Integrated from 0000 16 Oct to 1200 16 Oct 95 (UTC)
TEST Release started at 0000 16 Oct 95 (UTC)

NGM METEOROLOGICAL DATA