GAUSSIAN DISPERSION MODELS

AERMOD: [HANDS ON!!]

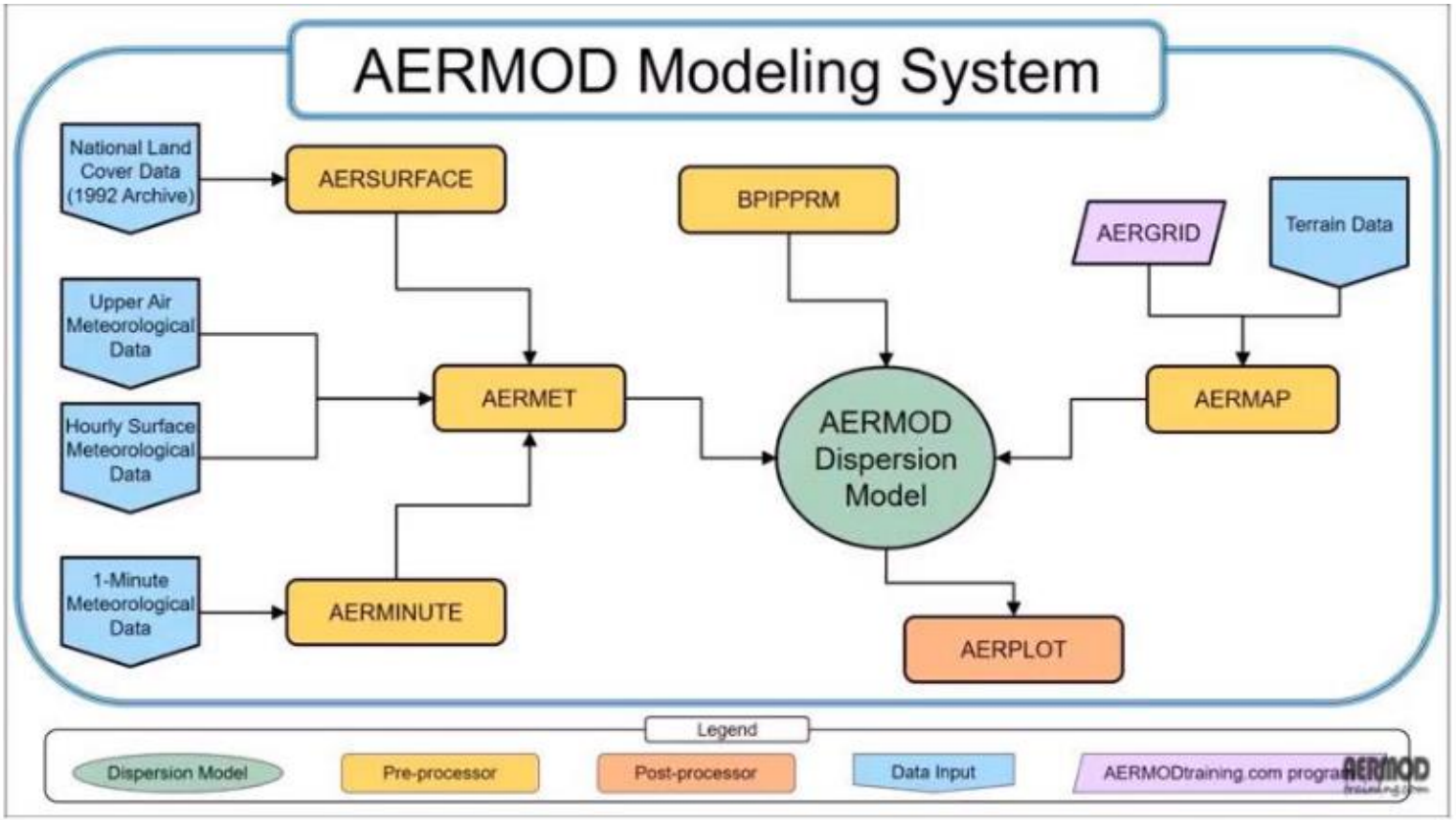
UFES

Tutor: M.Eng. Davi de Ferreyro Monticelli
e-mail: davimonticelli@gmail.com

Professor: Dra. Jane Meri Santos

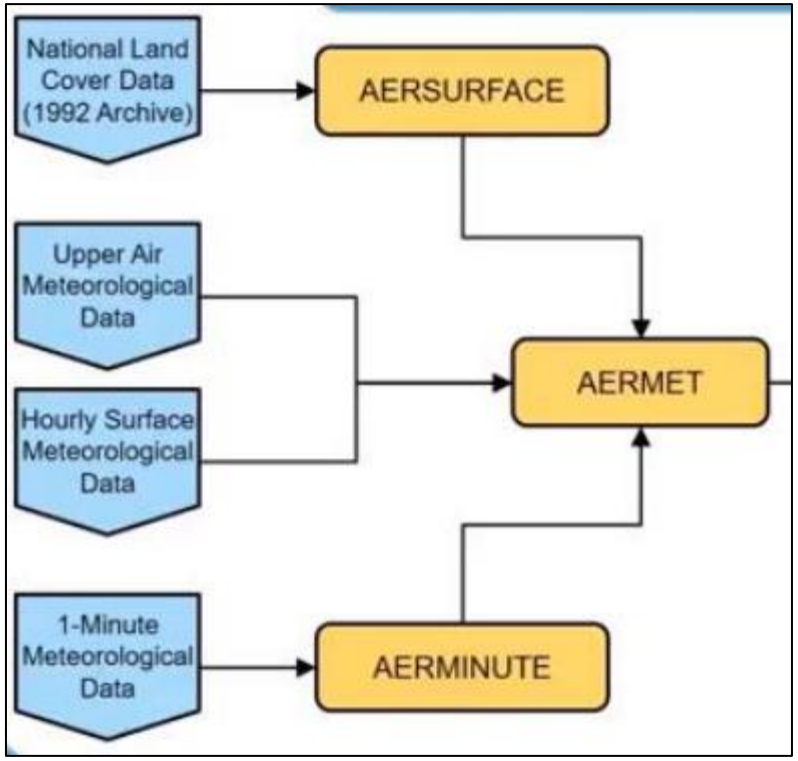
05/19

AERMOD CONFIGURATION

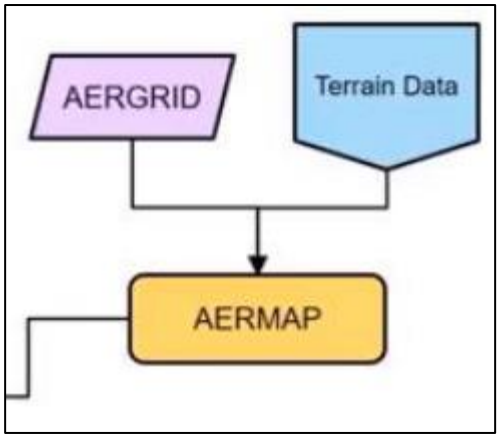


Source: from AERMODtraining.com

PRE-PROCESSORS

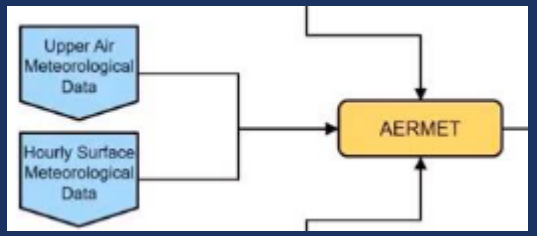


METEOROLOGY



TERRAIN

PRE-PROCESSOR: AERMET



- Pre-processor that prepares the file containing **meteorological information** for the studied period to be input in AERMOD;

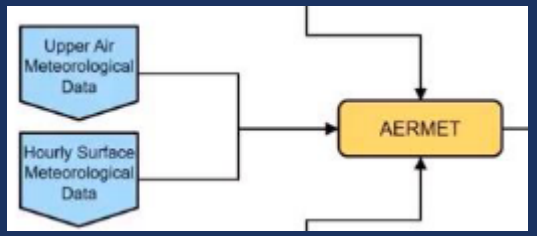
- It consists of 3 execution stages

Meteorological information needed:

#1: Surface hourly observations

#2: Daily upper air soundings (0h and 12h)

PRE-PROCESSOR: AERMET



AERMET	
Input data (Surface observations)	**Output data**
• Wind velocity; • Wind direction; • Dry-bulb temperature; • Cloud cover; • Atmospheric pressure (optional) • Relative humidity (optional) • Precipitation rate (optional)	• Sensible and latent heat flux; • Friction velocity; • Monin-Obukhov length; • Potential temperature profile; • Mixed/convective layer height; • Convective velocity profile;.
Input data (Upper air sounding)	
• Wind velocity vertical profile; • Vertical turbulent coefficient; • Temperature vertical profile; • Wind direction standard deviation with height.	

Source: (USEPA, 2004).

PRE-PROCESSOR: AERMET

- **LAND USE INPUTS**

Mandatory reading:
AERMET User's Guide – Section 4.7.8

Albedo (r), represents the reflected fraction of solar radiation by the surface;

Bowen ratio (Bo), ratio between the sensible heat flux and evaporative heat flux;

Roughness length (zo), theoretical height above the ground in which the horizontal velocity is still equal to zero.

PRE-PROCESSOR: AERMET

- **LAND USE INPUTS**

Auxiliary software:
QGIS and ARCGIS

Complementary readings:

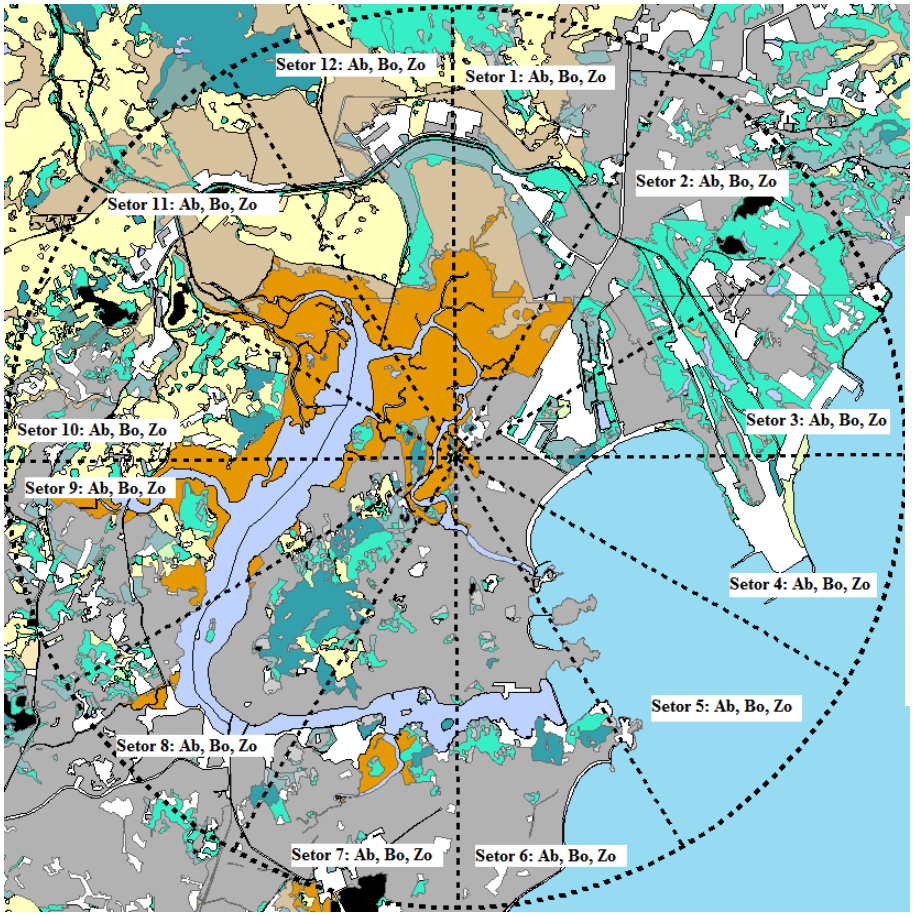
- AERSURFACE User's Guide (2013);

- Carbonell et al. (2011) *Methodological guide for implementation of the AERMOD system with incomplete local data;*

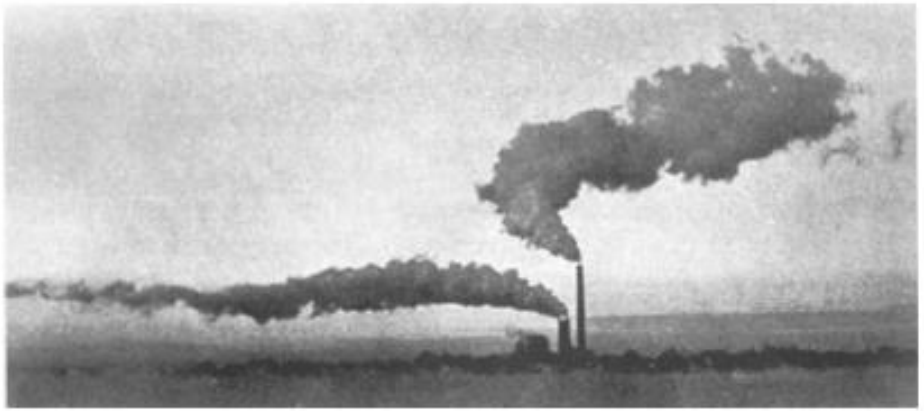
PRE-PROCESSOR: AERMET

- **LAND USE INPUTS**

10km x10km

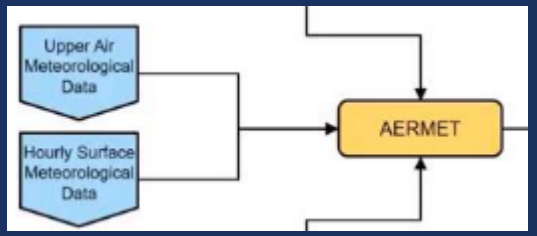


Consider the land use effects in situations such as strong sea/land breezes:



Source: (SIMPSON J. E., 1994).

PRE-PROCESSOR: AERMET



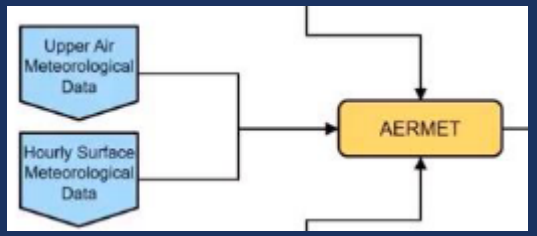
STAGE 1/3 AERMET.INP

```
JOB                                   First command of Stage 1
  MESSAGES    ANYNAME.MSG             Message and report file names
  REPORT      ANYNAME.RPT

SURFACE                               Command to read surface data
  DATA        S1473588.144     CD144  Input file name and type
  EXTRACT     SFCEXOUT.DSK            Output file 1 (name)
  XDATES      88/3/1 TO 88/03/10      Study period of interest (always good to get one day before and after)
  LOCATION    14735  42.75N  73.8W  0  83.8  Station number, Coordinates , Time zone, Reference height
  QAOUT       SFQAOUT.DSK             Output file 2 (name)

UPPERAIR                              Command to read upper air data
  DATA         14735-88.UA 6201FB     Input file name and type
  EXTRACT      UAEXOUT.DSK            Output file 1 (name)
  XDATES       88/3/1 TO 88/3/10      Study period of interest (always good to get one day before and after)
  LOCATION     00014735  73.8W  42.75N  5  Station number, Coordinates , Time zone, Reference height
  QAOUT        UAQAOUT.DSK            Output file 2 (name)
  AUDIT        UATT UAWS UALR         Variables to be checked (see AERMET manual for codes)

ONSITE                                Command to read ONSITE data (created by the user)
  DATA          ONSITE.MET            Input file name and type
  XDATES        88/3/1  TO  88/3/10   Study period of interest (always good to get one day before and after)
  LOCATION      99999  74.0W  41.3N  0  115.0  Station number, Coordinates , Time zone, Reference height
  QAOUT         OSQAOUT.DSK           Output file 1 (name)
  READ  1  OSDY OSMO OSYR OSHR HT01 SA01 SW01 TT01 WD01 WS01   Meteorological variable
  READ  2                       HT02 SA02 SW02 TT02 WD02 WS02   to be read
  READ  3                       HT03 SA03 SW03 TT03 WD03 WS03
  FORMAT  1  (4(I2,1X),4X,F5.1,1X,F5.1,1X,F7.3,1X,F6.2,1X,F7.2,1X,F7.2)
  FORMAT  2  (16X,F5.1,1X,F5.1,1X,F7.3,1X,F6.2,1X,F7.2,1X,F7.2)   File FORTRAN format
  FORMAT  3  (16X,F5.1,1X,F5.1,1X,F7.3,1X,F6.2,1X,F7.2,1X,F7.2)
  RANGE  TT  -30 <   40   -99
  RANGE  SA    0  <=  95   -99   Range for meteorological variables check
  RANGE  WS    0  <   50  -999
  RANGE  WD    0  <= 360  -999
  THRESHOLD    0.3  Wind speed critical velocity
```

Stage 1 reads the input files contaning the surface station data and upper air sounding. It makes a checking considering reference values and returns any potential problems to the user.

*optional

PRE-PROCESSOR: AERMET

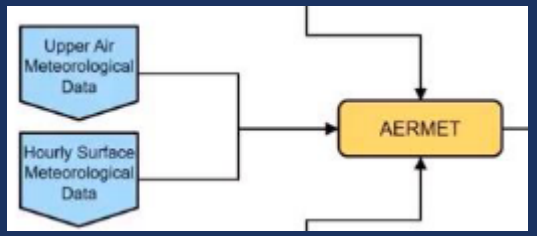


STAGE 2/3 AERMET.INP

```
JOB                                 Start of JOB pathway
  REPORT      MERGE-2.RPT           Report file
  MESSAGES    MERGE-2.MSG           Message file
UPPERAIR                            Start of UPPERAIR pathway
  QAOUT       UAQAOUT.DSK           UPPERAIR input file to Stage 2

SURFACE                             Start of SURFACE pathway
  QAOUT       SFQAOUT.DSK           SURFACE input file to Stage 2

ONSITE                              Start of ONSITE pathway
  QAOUT       OSQAOUT.DSK           ONSITE input file  to Stage   2

MERGE                               Start of MERGE pathway
  OUTPUT MERGE2.DSK                 Output of merged meteorological data
  XDATES      88/03/01  88/03/04    Period of observations to merge
```

Stage 2 merges the files created in **Stage I**, and prepare them for **Stage 3**.

PRE-PROCESSADORES: AERMET



ETAPA 3/3 AERMET.INP

```
JOB                                     Start of the JOB pathway
  REPORT     STAGE3-2.RPT               File for all messages
  MESSAGES   STAGE3-2.MSG               File for the run  summary

METPREP                                 Start of the   METPREP  pathway
  DATA       MERGE2.DSK                 Input meteorological data file from Stage 2
  METHOD     REFLEVEL  SUBNWS           Processing method: allow substitution of NWS  data
  METHOD     WIND_DIR  RANDOM           Processing method: randomize NWS wind  directions
  NWS_HGT    WIND   6.1                 NWS wind measurement height
  OUTPUT     AERMET2.SFC                Output file with boundary layer parameters
  PROFILE    AERMET2.PFL                Output   file with profile  data
  FREQ_SECT  MONTHLY 2                  Frequency and number of wind direction sectors to
                                        define the site characteristics for site-specific
                                        observations (primary site)
  SECTOR      1   35  225               Definition of 1st wind sector for site-specific
                                        observations (primary site)
  SECTOR      2  225   35               Definition of 2nd wind sector for site-specific
                                        observations (primary site)
  SITE_CHAR   11  2  0.200  1.000  1.250    November,  sector  2
  SITE_CHAR   12  2  0.500  1.500  0.750    December,  sector  2
  FREQ_SECT2  ANNUAL  1                 Frequency and number of wind direction sectors to
                                        define the site characteristics for NWS surface
                                        observations (secondary site)
  SECTOR2     1  0  360                Definition of wind direction sectors for NWS surface
                                        observations (secondary site)
  SITE_CHAR2  1  1  0.15  2.00  0.12    Definition of site characteristics by period
                                        and wind direction sector for NWS surface
                                        observations (secondary site)
```

Stage 3 creates the final files to be read by AERMOD, 1) containing the estimated micrometeorology of the boundary layer 2) the vertical profile of these data.

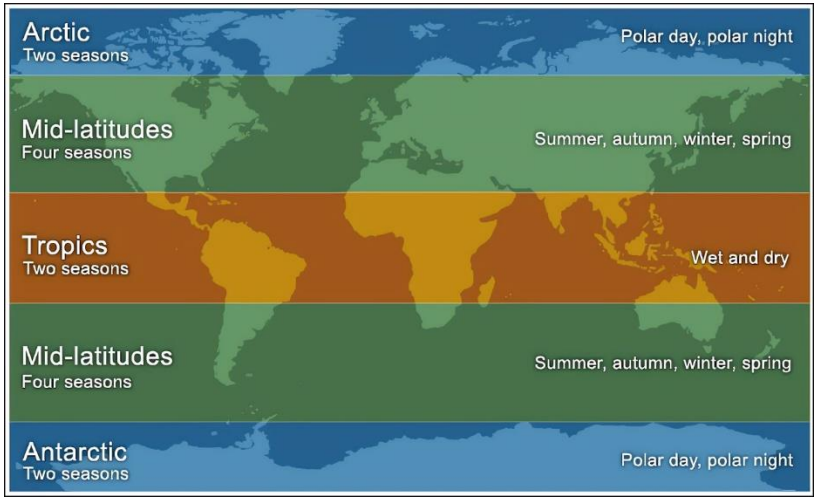
In this stage the user must input the values of land use following the sectoring approach.

It is important to know the output file format! Thus read:

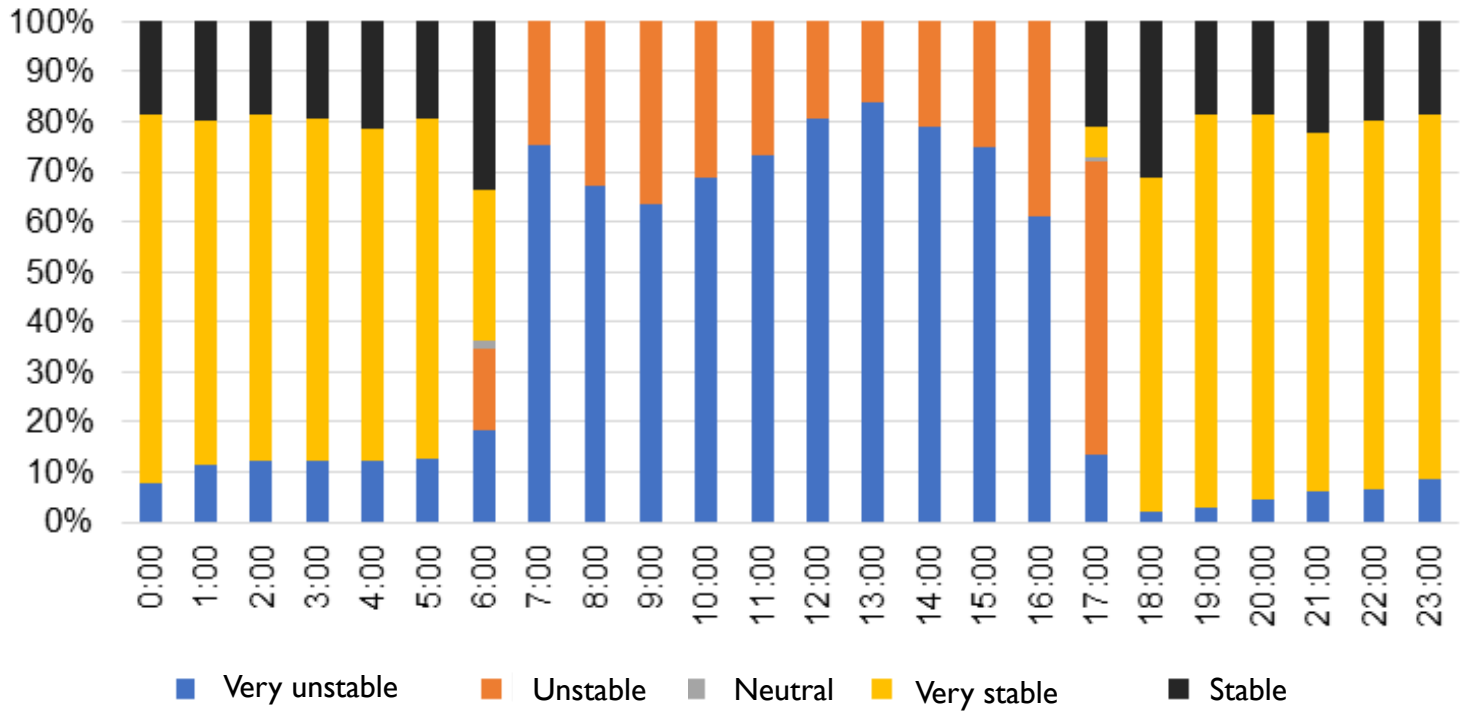
Appendix C of AERMET User's Guide

ASSUMPTIONS

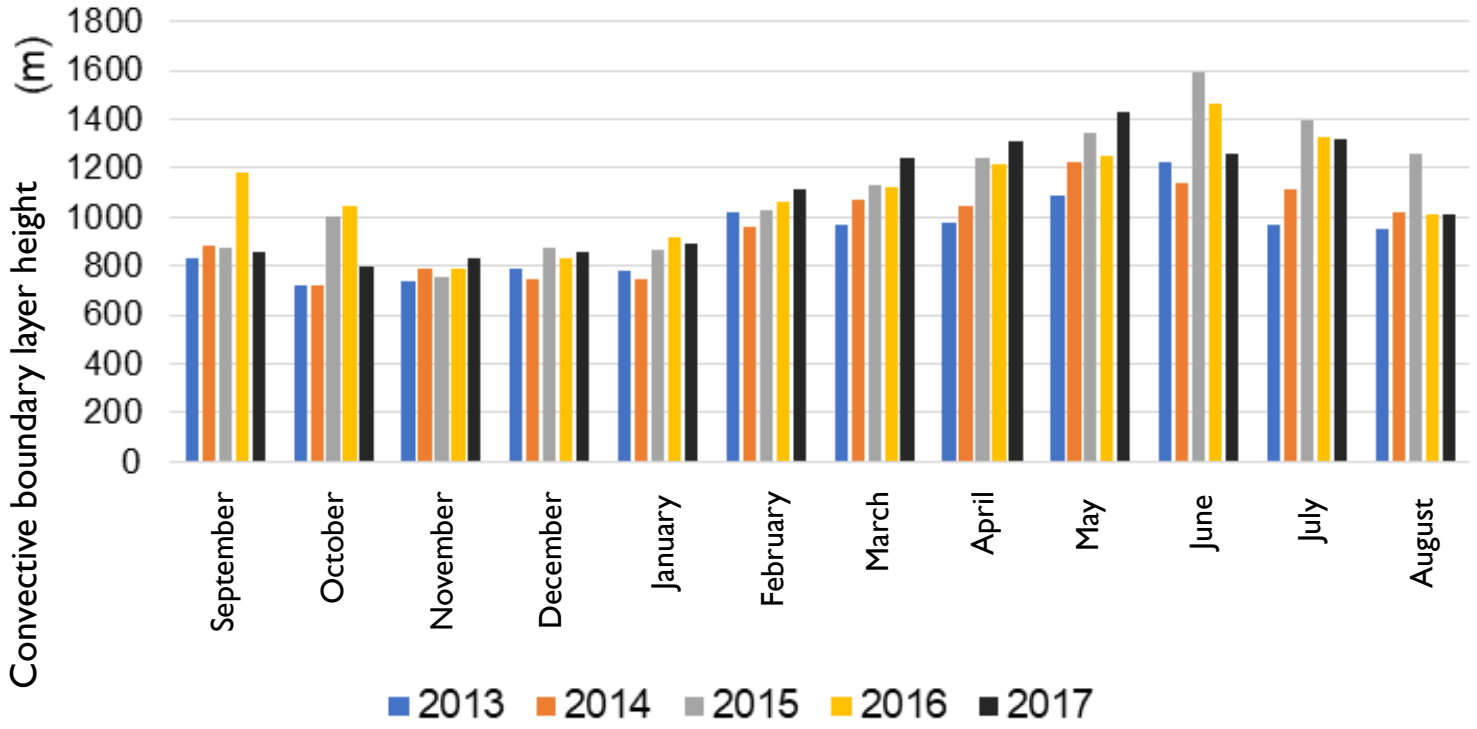
- Mid-latitudes (30°S and 60 °S or 30°N and 60 °N)
- Upper limit of 100 meters for reference wind speed and temperature measurements for the purpose of computing the similarity theory
- Convective mixing height is no higher than 4000 m
- Reference heights (for wind speed and temperature) below $7*Z_0$ are not considered representative of the area



TYPICAL RESULTS FOR ONE YEAR DATA



TYPICAL RESULTS FOR MULTI-YEAR DATA



THANK YOU!

Next:

Feedback

- Any relevant feedback for my next presentations

Questions

- Was something unclear?

References

- AERMOD Model Formulation and Evaluation (US EPA)
- AERMET User's Guide (US EPA)

In case a question comes up later:
davimonticelli@gmail.com or daviubc1@student.ubc.ca