

Climate data:

Centre national de recherches météorologiques (CNRM, Météo France)

NetCDF

Panoply: Panoply — Sources

File Edit View History Bookmarks Plot Window Help

Create Plot Combine Plot Open Dataset

Datasets Catalogs Bookmarks

Name	Long Name	Type
A2003.2.CEN4T.002.nc	A2003.2.CEN4T.002.nc	Local File
ACPRC	ACPRC	Geo2D
ACPRG	ACPRG	Geo2D
ACPRR	ACPRR	Geo2D
ACFRS	ACFRS	Geo2D
ACFRT	ACFRT	Geo2D
ALB_ROAD	ALB ROAD	Geo2D
ALB_ROOF	ALB ROOF	Geo2D
ALB_WALL	ALB WALL	Geo2D
ASN_GD	ASN GD	Geo2D
ASN_RD	ASN RD	Geo2D
ASN_RF	ASN RF	Geo2D
ASN_VEGP1	ASN VEGP1	Geo2D
ASN_VEGP2	ASN VEGP2	Geo2D
ASN_VEGP3	ASN VEGP3	Geo2D
AVG_ZS	AVG ZS	Geo2D
AZIM	AZIM	Geo2D
BETA	BETA	—
BIBUSER	MesoNH: user binary library	—
BLD	BLD	Geo2D
BLD_HEIGHT	BLD HEIGHT	Geo2D
BUOC	BUOC	—
BUG	SURFEX bugfix number	—
BUGFIX	MesoNH bugfix number	—
CARTESIAN	CARTESIAN	—
CIT	CIT	Geo2D
CLDFR	CLDFR	Geo2D
CLEARCOL_TM1	CLEARCOL TM1	Geo2D
COUPLING	COUPLING	—
CPL_AROME	CPL AROME	—
D_RD	D RD	Geo2D
D_ROAD1	D ROAD1	Geo2D
D_ROAD2	D ROAD2	Geo2D
D_ROAD3	D ROAD3	Geo2D
D_ROAD4	D ROAD4	Geo2D
D_ROADS	D ROADS	Geo2D
D_ROOF1	D ROOF1	Geo2D
D_ROOF2	D ROOF2	Geo2D
D_ROOF3	D ROOF3	Geo2D
D_ROOF4	D ROOF4	Geo2D
D_ROOF5	D ROOF5	Geo2D
D_WALL1	D WALL1	Geo2D
D_WALL2	D WALL2	Geo2D
D_WALL3	D WALL3	Geo2D
D_WALL4	D WALL4	Geo2D
D_WALL5	D WALL5	Geo2D
DAD_NAME	filename of the dad file	—
DIR_FULL	DIR FULL	—
DIR_ALB	DIR ALB	Geo2D
DIRFLASWD	DIRFLASWD	Geo2D
DIRSRFSWD	DIRSRFSWD	Geo2D
DRAIN_GD	DRAIN GD	Geo2D
DRYMASST	DRYMASST	—
DTCUR	DTCUR	—
DTEXP	DTEXP	—
DTHRAD	DTHRAD	Geo2D

Show: All variables

File "A2003.2.CEN4T.002.nc"

File type: Hierarchical Data Format, version 5

```
netcdf file:/C:/Users/jgautier/Desktop/urclim/donnees/extraction_paris_garden/source/A2003.2.CEN4T.002.nc {
dimensions:
    size3 = 3;
    char16 = 16;
    char32 = 32;
    size4 = 4;
    size2 = 2;
    size6 = 6;
    ni = 26;
    nj = 22;
    ni_u = 26;
    nj_u = 22;
    ni_v = 26;
    nj_v = 22;
    level = 32;
    level_u = 32;
    time = UNLIMITED; // (1 currently)
variables:
    int NONHVERSION(size3=3);
        :long_name = "MesoNH version";
        :_FillValue = -2147483647; // int
        :valid_min = -2147483646; // int
        :valid_max = 2147483647; // int

    int MASDEV;
        :long_name = "MesoNH version (without bugfix)";

    int BUGFIX;
        :long_name = "MesoNH bugfix number";

    char BIBUSER(char16=16);
        :long_name = "MesoNH: user binary library";

    char PROGRAM(char16=16);
        :long_name = "MesoNH family: used program";

    char STORAGE_TYPE(char16=16);
        :long_name = "STORAGE_TYPE";
        :comment = "Storage type for the information written in the FM files";

    char MY_NAME(char32=32);
        :long_name = "filename (no extension)";

    char DAD_NAME(char32=32);
        :long_name = "filename of the dad file";

    char FILETYPE(char16=16);
        :long_name = "type of this file";

    int DXRATIO;
        :long_name = "DXRATIO";
        :comment = "Resolution ratio between this mesh and its father in x-direction";

    int DYRATIO;
        :long_name = "DYRATIO";
```

Software: panoply

NetCDF

Multidimensional array file

CNRM NetCDF file

Containing:

- Climate simulated data, obtained with Meso-NH and TEB simulation models:
 - Temperature data
 - Pressure data
 - Wind data
- Input data for the simulation model:
 - Albedo
 - Surface elevation
 - ...
- Simulation model information:
 - Climate data coordinates
 - ...

```
netcdf file:/C:/Users/jgautier/Desktop/urclim/donnees/extraction_paris_garden/source/
dimensions:
    size3 = 3;
    char16 = 16;
    char32 = 32;
    size4 = 4;
    size2 = 2;
    size6 = 6;
    ni = 26;
    nj = 22;
    ni_u = 26;
    nj_u = 22;
    ni_v = 26;
    nj_v = 22;
    level = 32;
    level_w = 32;
    time = UNLIMITED; // (1 currently)
variables:
    int MNHVERSION(size3=3);
        :long_name = "MesoNH version";
        :_FillValue = -2147483647; // int
        :valid_min = -2147483646; // int
        :valid_max = 2147483647; // int

    int MASDEV;
        :long_name = "MesoNH version (without bugfix)";

    int BUGFIX;
        :long_name = "MesoNH bugfix number";

    char BIBUSER(char16=16);
        :long_name = "MesoNH: user binary library";

    char PROGRAM(char16=16);
        :long_name = "MesoNH family: used program";

    char STORAGE_TYPE(char16=16);
        :long_name = "STORAGE_TYPE";
        :comment = "Storage type for the information written in the FM files";

    char MY_NAME(char32=32);
        :long_name = "filename (no extension)";

    char DAD_NAME(char32=32);
        :long_name = "filename of the dad file";
```

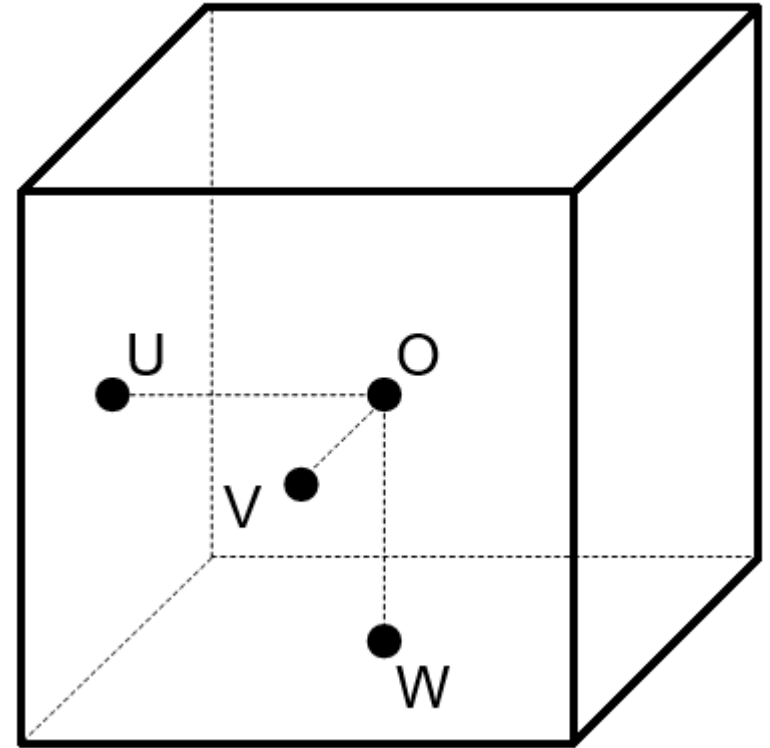
Meso-NH data

Correspond to climate data simulated above buildings roof

Climate data are simulated for a 3D grid

Each Meso-NH grid cell is formed by 4 points:

- O, for which temperature and pressure data are simulated
- U, for which wind speed in UO direction is simulated
- V, for which wind speed in VO direction is simulated
- W, for which wind speed in WO direction is simulated



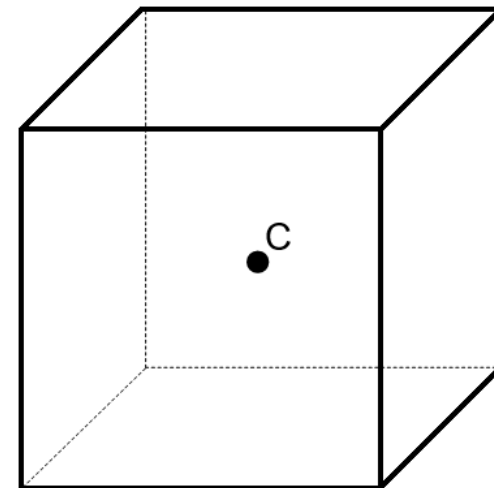
TEB data

Correspond to climate data simulated below the urban canopy

Climate data are simulated for a 3D grid

For each center of a TEB grid cell, following data are simulated:

- Temperature
- Pressure
- Wind data in any direction



TEB and Meso-NH grids share the same XY dimensions and coordinates (WGS84)

Meso-NH model : climate data above
buildings roof

Level 4
between 132.0m and 218.4m above ground
 O_4 at 175.2m

Level 3
between 60m and 132m above ground
 O_3 at 96m

Level 2
between 0m and 60m above ground
 O_2 at 30m

ground

W_2

W_3

O_4

O_3

O_2

For Paris, grid size is:
26 cells East-West
22 cells North-South

Along vertical axis:
Meso-NH has 32 levels, whose thickness grows with
elevation (60m -> 350m)

Meso-NH level 2: first Meso-NH level taken into account

Meso-NH level 1 is considered as below the ground
(between -60m and 0m)

Level 2 is considered as above buildings roofs
Buildings are considered as below the ground surface

TEB and Meso-NH grids share the same XY dimensions and coordinates (WGS84)

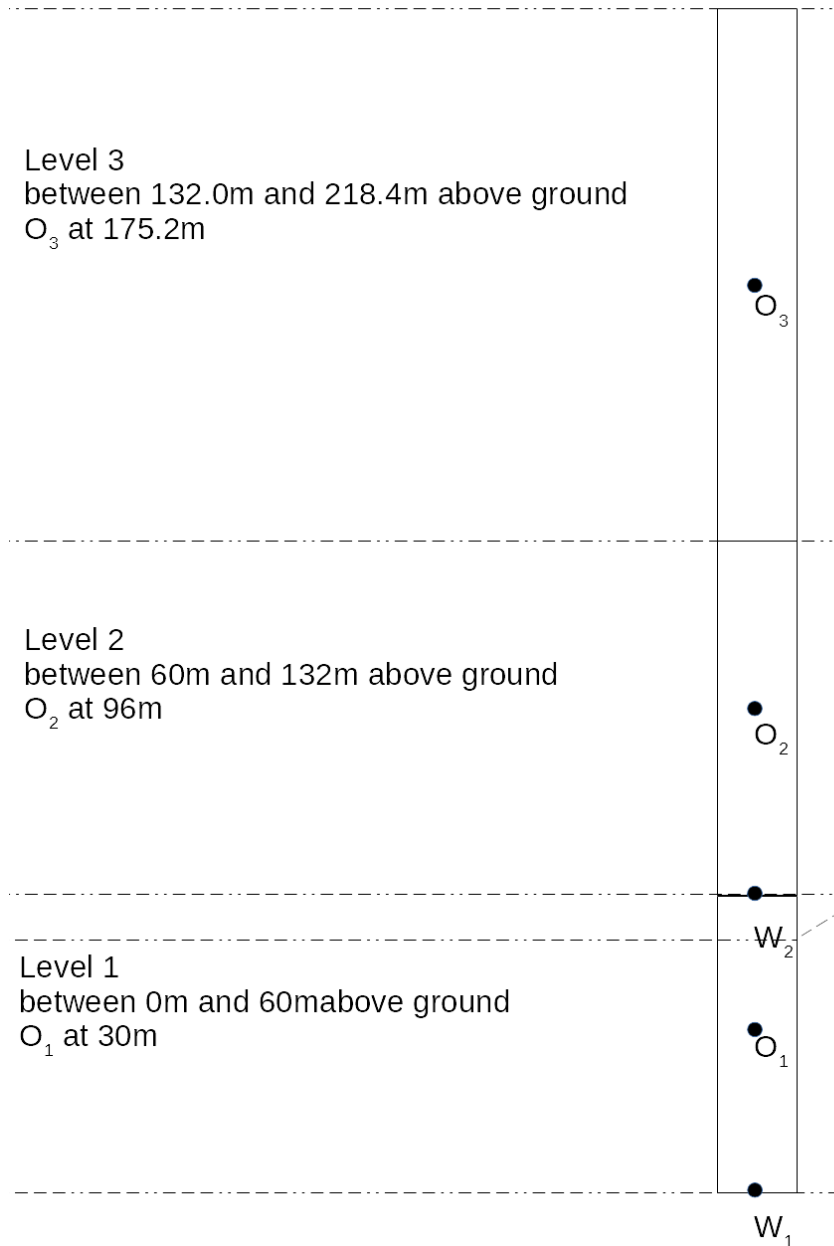
Meso-NH model : climate data above
buildings roof

For Paris, grid size is:
26 cells East-West
22 cells North-South

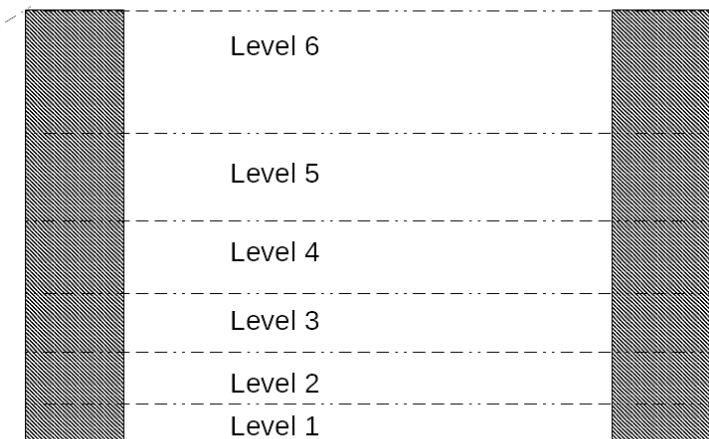
Along vertical axis:

Meso-NH has 32 levels, whose thickness grows with
elevation (60m -> 350m)

TEB grid has 6 levels, whose thickness grows with
elevation (0.5m -> 29m)



TEB model : climate data below
urban canopy



TEB and Meso-NH grids share the same XY dimensions and coordinates (WGS84)

For Paris, grid size is:

26 cells East-West

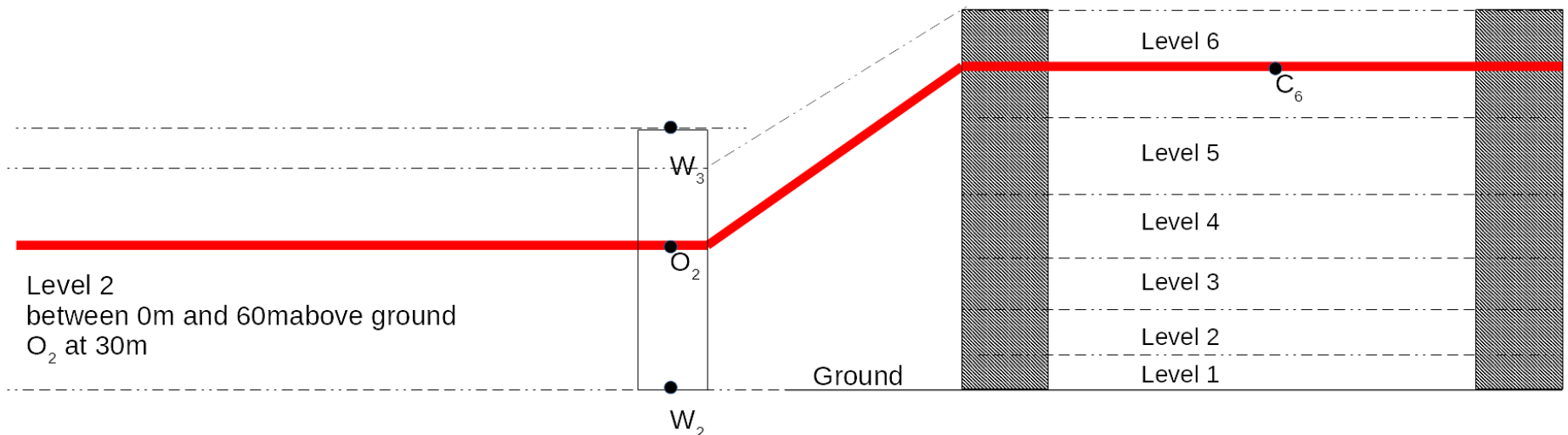
22 cells North-South

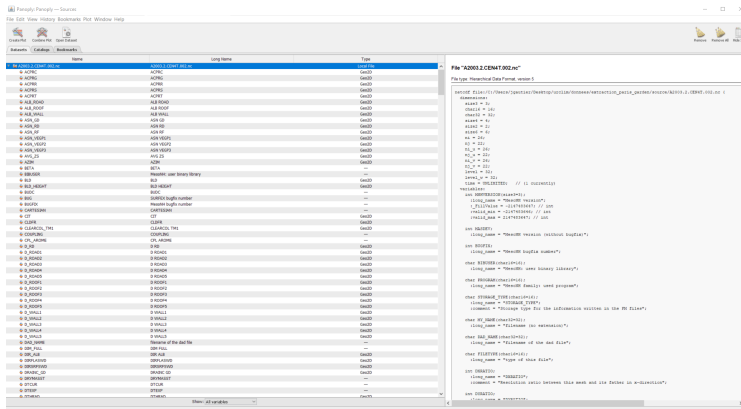
Along vertical axis:

Meso-NH has 32 levels, whose thickness grows with elevation (60m -> 350m)

TEB grid has 6 levels, whose thickness grows with elevation (0.5m -> 29m)

Center of TEB level 6 cells corresponds to center of MesoNH level 2 cells



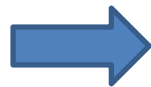


10 dimensions :

- $i_O(x), j_O(y)$,
- $i_U(x), j_U(y)$,
- $i_V(x), j_V(y)$,
- $i_W(x), j_W(y)$,
- level (z)
- Level_W (z)

x variables

Latitude_O(i,j)
Longitude_O(i,j)



List of 2D points O



List of 3D points O



List of 3D
points O
with temp.
values

zs(i,j) : surface altitude

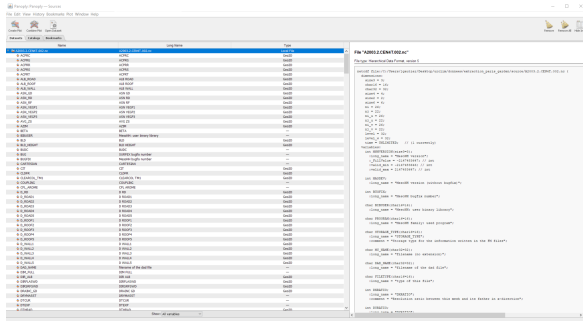
height(level)



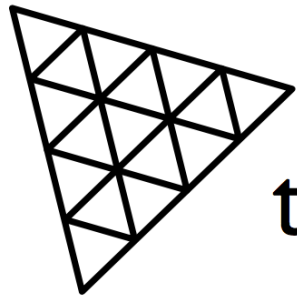
Temperature(i,j,level)



NetCDF



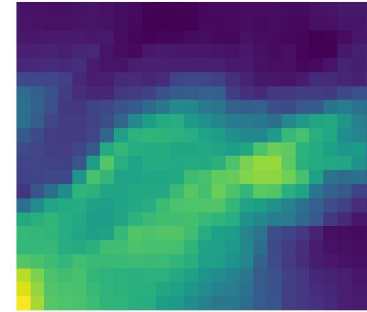
Meso-NH Height
levels (1D)
TEB Height levels
(1D)



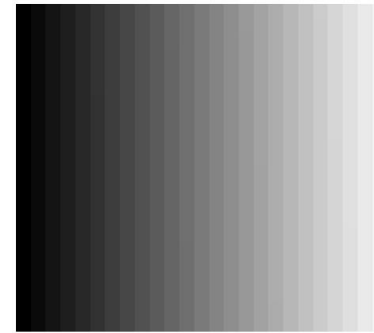
three.js

Creation of 3D grids
Visualization of 3D
climate data

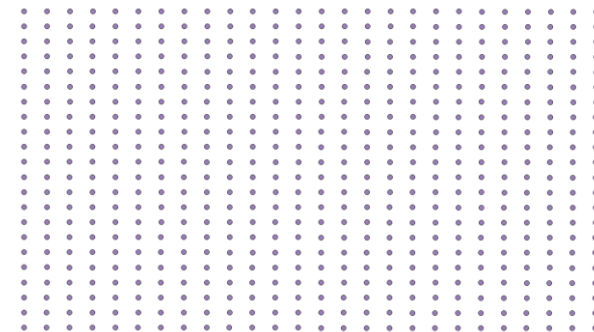
Temperature
data (3D)
One raster, 32
bands



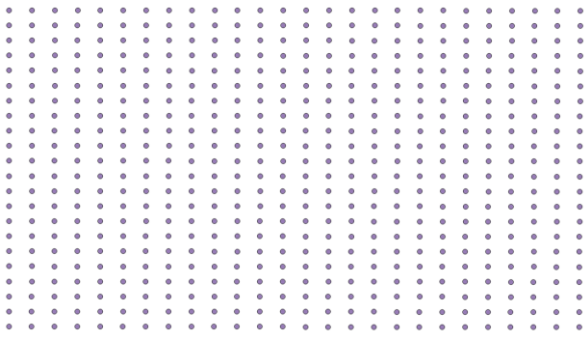
Long/lat/elevation
data (2D)
One raster, one
band



QGIS



Grids of O,U,V,W points with climate
data, xy coordinate, ground elevation
(CSV, geojson)



Grids of O,U,V,W points with climate data, xy coordinate, ground elevation (CSV, geojson)

O points grid:

- Lat, long (WGS84); X,Y (Lambert93)
- ZS
- Building heights
- Pressure for 31 levels (PABST2 - PABST32)
- Potential temperature for 31 levels (THT2 - THT32)
- TEB temperature for 6 levels (TEB_CAN_T01 - TEB_CAN_T06)
- TEB pressure for 6 levels (TEB_CAN_P01 - TEB_CAN_P06)
- TEB wind data for 6 levels (SSO_CAN_U01 - SSO_CAN_U06)
- ISBA temperature for 6 levels (ISBA_CAN_T01 - ISBA_CAN_T06)

U points grid:

- Lat, long (WGS84); X,Y (Lambert93)
- ZS
- Wind for 31 levels (UT2 - UT32)

V points grid:

- Lat, long (WGS84); X,Y (Lambert93)
- ZS
- Wind for 31 levels (VT2 - VT32)

W points grid:

- Lat, long (WGS84); X,Y (Lambert93)
- ZS
- Wind for 31 levels (WT2 - WT32)

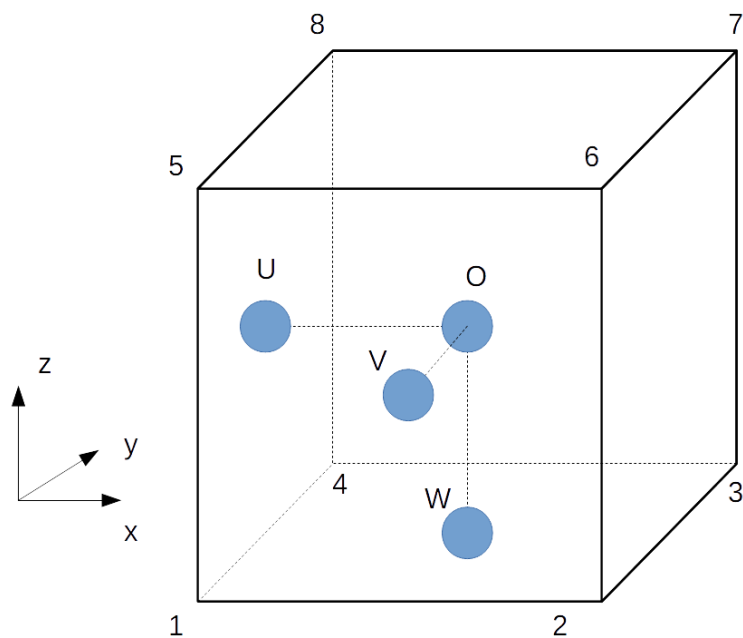
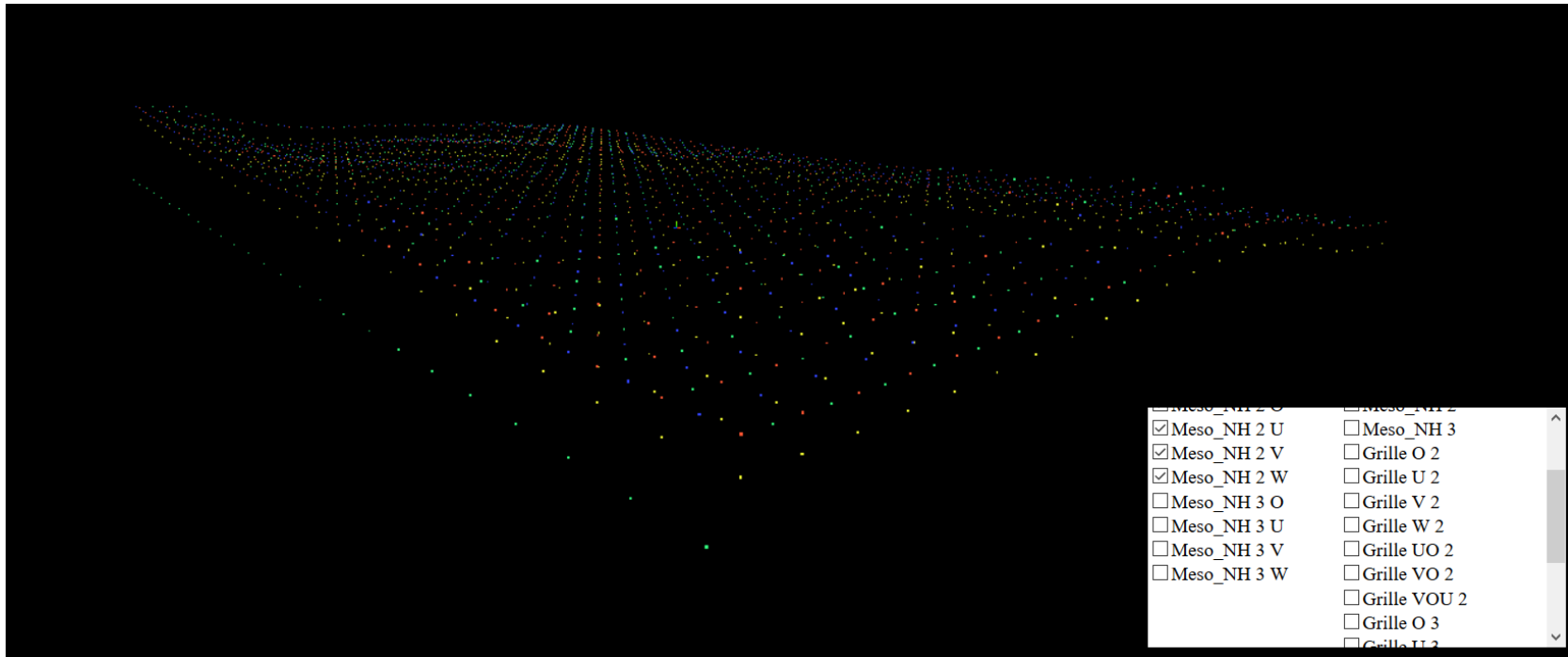
Meso-NH Height levels (1D)

2 * 1D lists (O, W heights)

TEB Height levels (1D)

2 * 1D lists (C, cells bottom heights)

Visualization of TEB and Meso-NH points and grids



$$1 : x = x_U$$

$$y = y_V$$

$$z = z_W$$

$$2 : x = x_O + (x_O - x_U)$$

$$y = y_V$$

$$z = z_W$$

$$3 : x = x_O + (x_O - x_U)$$

$$y = y_V + (y_O - y_V)$$

$$z = z_W$$

$$4 : x = x_U$$

$$y = y_V + (y_O - y_V)$$

$$z = z_W$$

$$5 : x = x_U$$

$$y = y_V$$

$$z = z_O + (z_O - z_W)$$

$$6 : x = x_O + (x_O - x_U)$$

$$y = y_V$$

$$z = z_O + (z_O - z_W)$$

$$7 : x = x_O + (x_O - x_U)$$

$$y = y_V + (y_O - y_V)$$

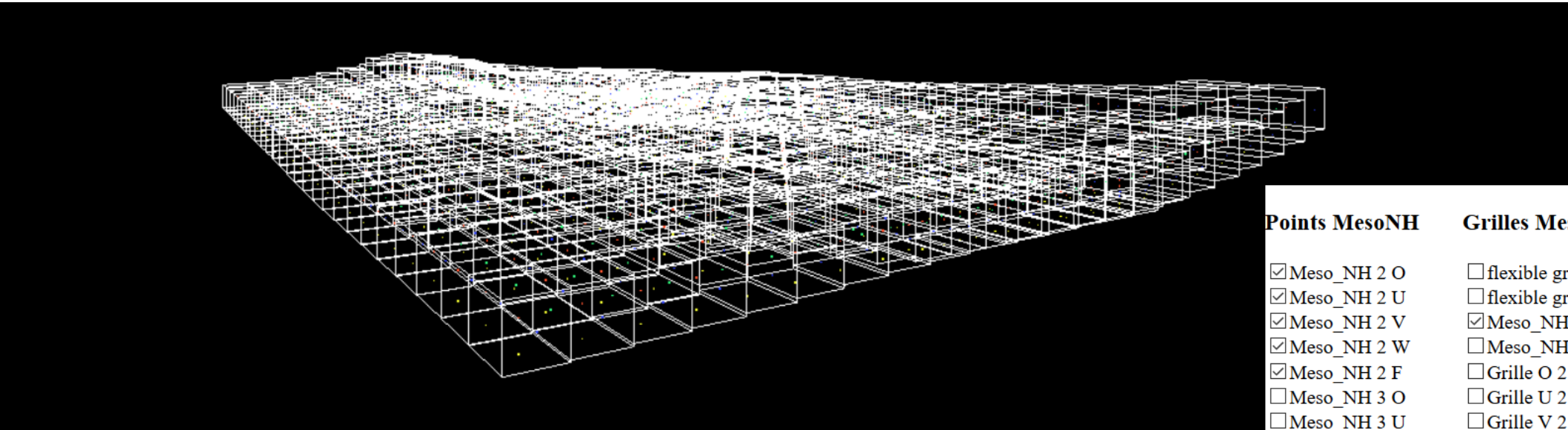
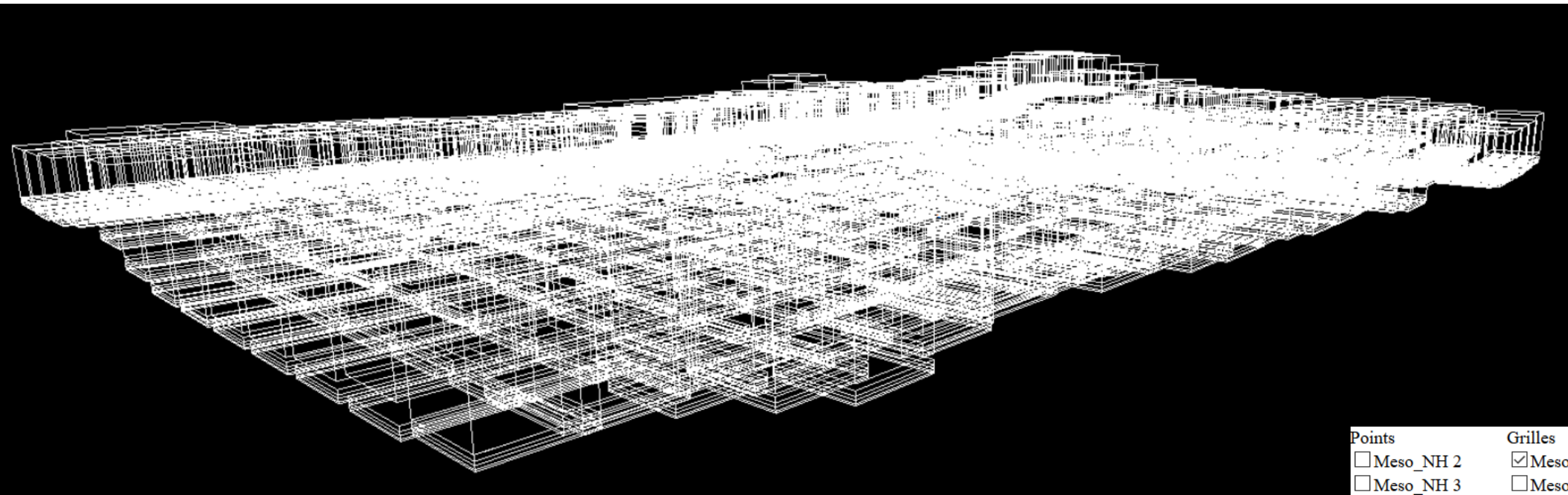
$$z = z_O + (z_O - z_W)$$

$$8 : x = x_U$$

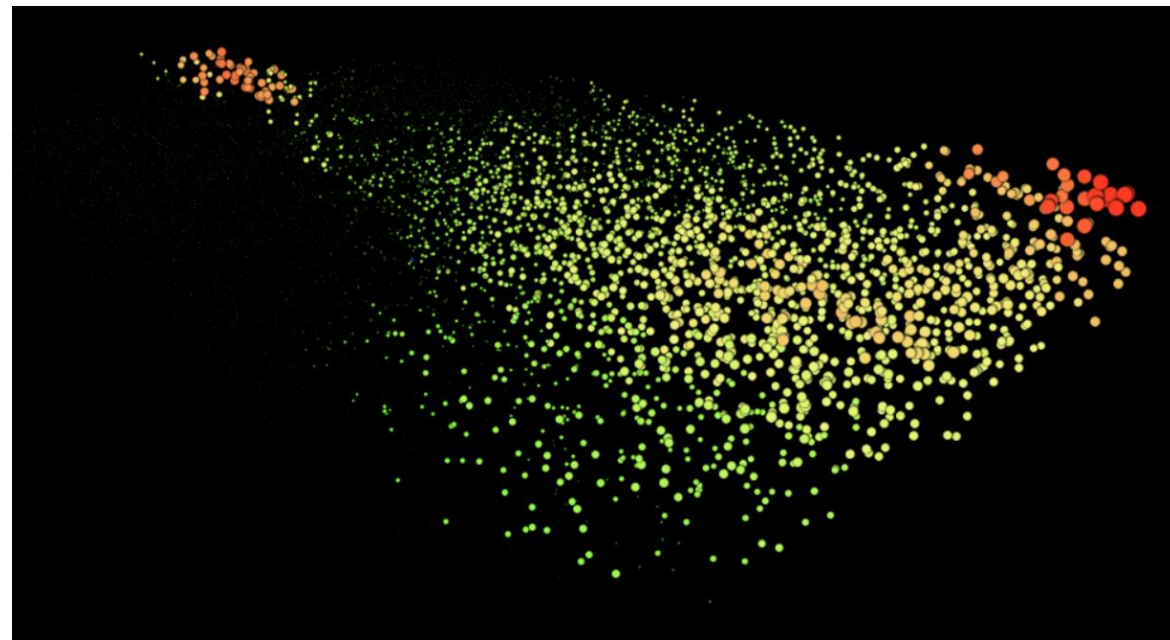
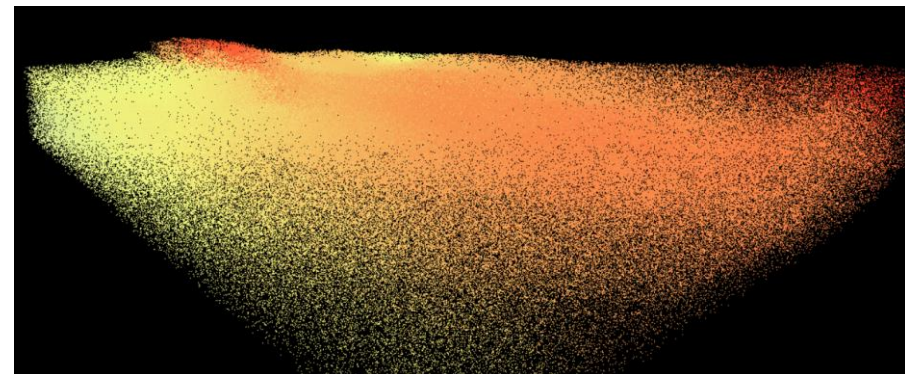
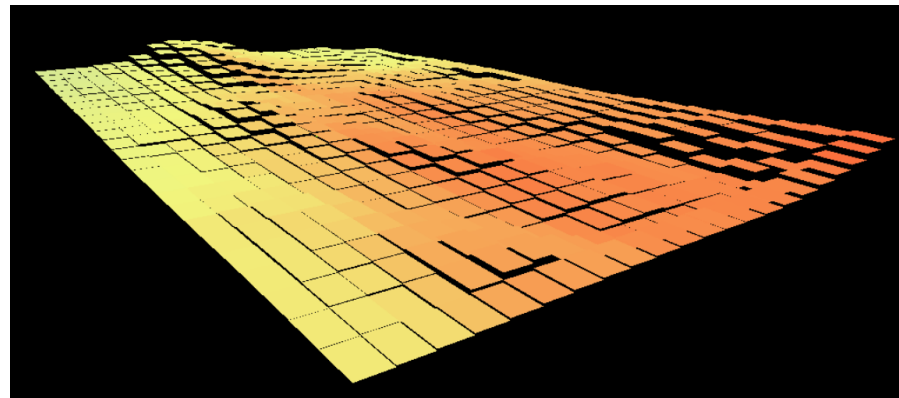
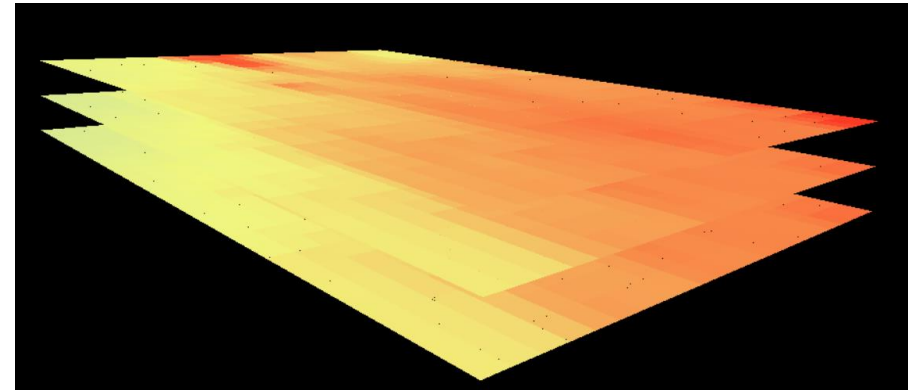
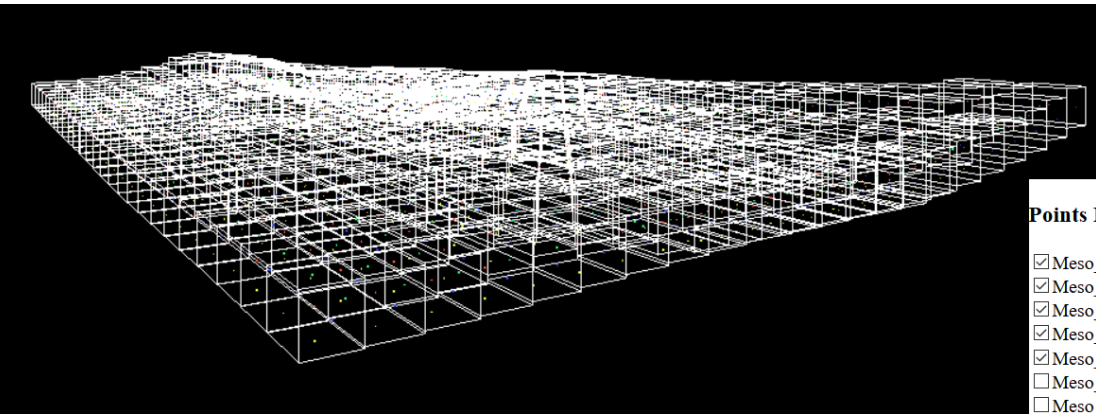
$$y = y_V + (y_O - y_V)$$

$$z = z_O + (z_O - z_W)$$

Visualization of TEB and Meso-NH grids



How visualize temperature data in 3 dimensions



Questions:

Vertical coordinates of points

Z Offset between ground and data z coordinates

ZS? MNT or MNE? (O point for beaubourg case study: ZS = 46.81231; MNT = 35)

Beaubourg case study: large offset between data z coordinate and buildings coordinates

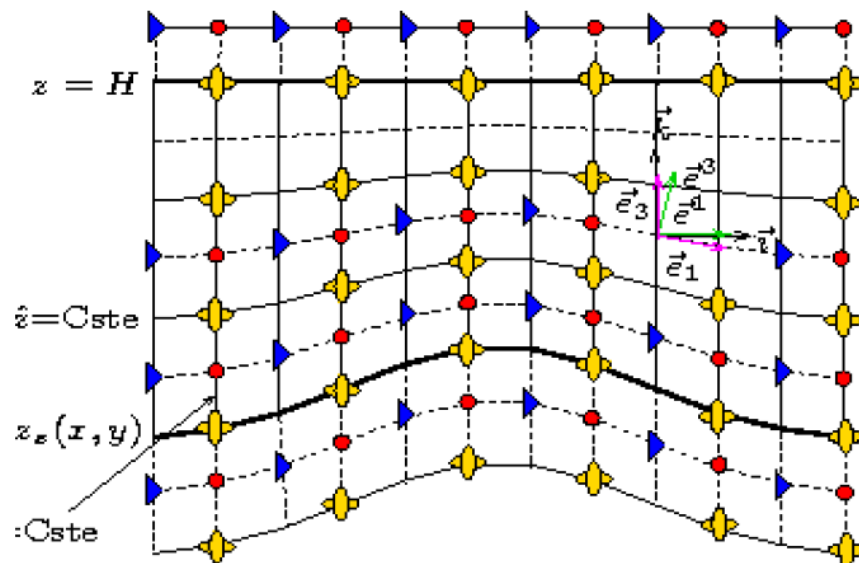
Vertical coordinates

- Vertical coordinate of **Gal-Chen et Sommerville** :

$$\hat{z}(k) = \frac{z(i, j, k) - z_s(i, j)}{H - z_s(i, j)} H \quad z = \text{height of the model level}, z_s = \text{Orography}$$

$$z = z_s \rightarrow \hat{z} = 0, \quad z = H \rightarrow \hat{z} = H \quad z(i, j, k) = \hat{z}(k) \frac{(H - ZS(i, j))}{H} + ZS(i, j)$$

Linear decrease of the orography



$z(i, j, k) = XZZ : \text{flux pt}$

$\hat{z}(k) = XZHAT : \text{flux pt}$

Questions:

Meso-NH model : climate data above buildings roof

Level 3
between 132.0m and 218.4m above ground
 O_3 at 175.2m

Level 2
between 60m and 132m above ground
 O_2 at 96m

Level 1
between 0m and 60m above ground
 O_1 at 30m

Models

Differences between Meso-NH and TEB

Between TEB and ISBA

SBL?

Good correspondence between Meso-NH and TEB

TEB model : climate data below urban canopy

Level 6

Level 5

Level 4

Level 3

Level 2

Level 1

Ground

W_1

O_1

W_2

O_2

O_3