"SOLAR ELECTRICITY" INDICATOR

thanks to

GRASS, PYTHON & LEAFLET

Jean Pierre Huart - FOSS4G - 2016-09-22

THE LEADING PROJECT

(where ideas come from...)

ENERGIZAIR

http://energizair.eu

APERE ASBL

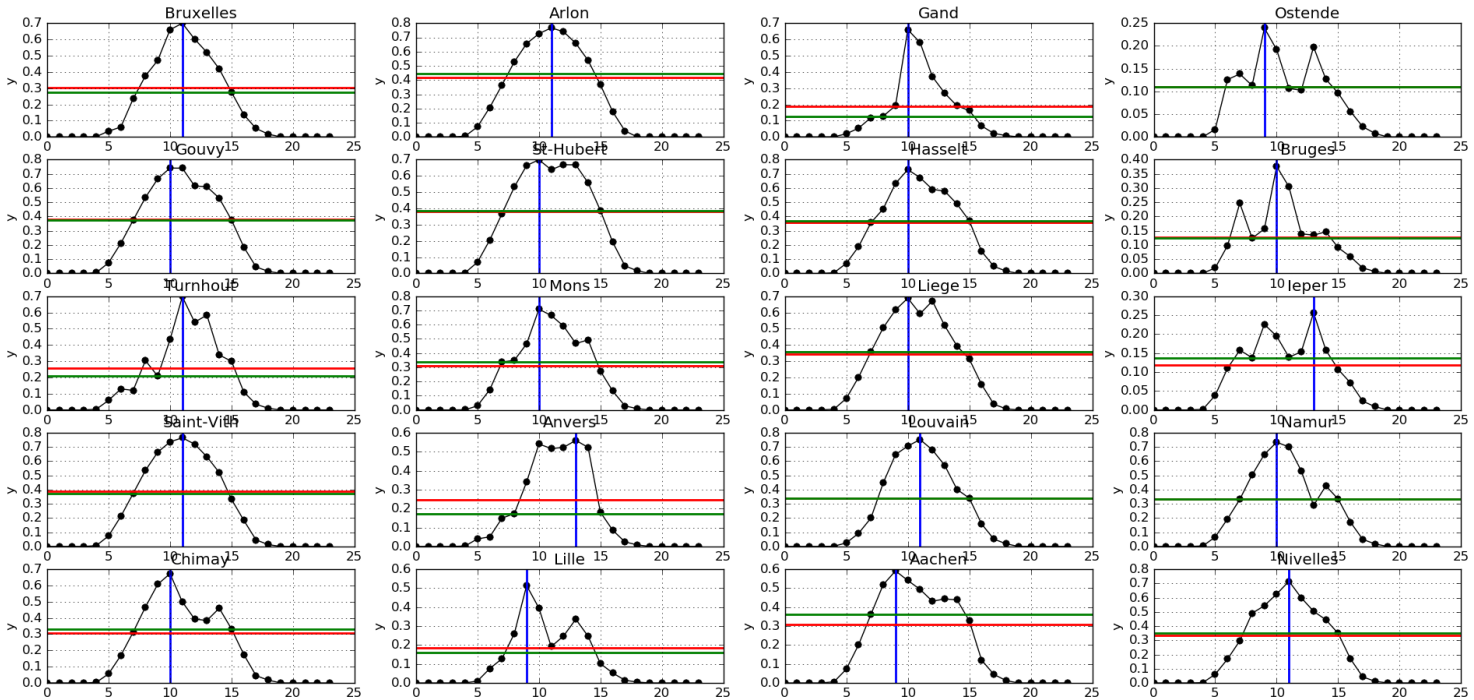
http://www.meteo-renouvelable.be

DATA SOURCES

The french partner of EnergizAIR (Hespul) provides hourly forecasts of PV production for 20 points in Belgium.

(or very near to it)

map_daily_2015_08_11



How can we summarize this to be presented in 20" on TV?

Can we build a map about it?

GRASS

HOW TO FIND YOUR WAY IN GRASS?

The **help** structure disappointed me, but it's well done.

Subscribe to the mailing list:

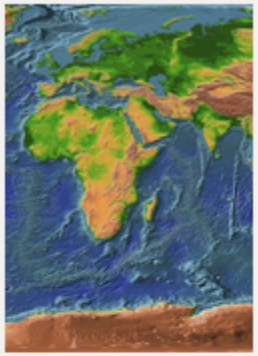
```
http://lists.osgeo.org/mailman/listinfo/grass-user
```

LET'S GRASS

- Launch the GUI
- Selecting the GIS Database directory
- Create your LOCATION
- Create your MAPSET
- Start the GRASS session


GRASS GIS 7.0.4 startup
grass gis
Bringing advanced geospatial technologies to the world
1. Select GRASS GIS database directory
/home/jph/dev/aaa-foss4g/grass_db
Browse
GRASS GIS database directory contains Locations.
No GRASS Location found in '/home/jph/dev/aaa-foss4g/grass_db'. Create a new Location or choose different GRASS database directory.
2. Select GRASS Location
New
Rename
Delete
All data in one Location is in the same coordinate reference system (projection). One Location can be one project. Location contains Mapsets.
3. Select GRASS Mapset
New
Rename
Delete
Mapset contains GIS data related to one project, task within one project, subregion or user.
Start GRASS session
Quit
Help

Define new GRASS Location



Define GRASS Database and Location Name

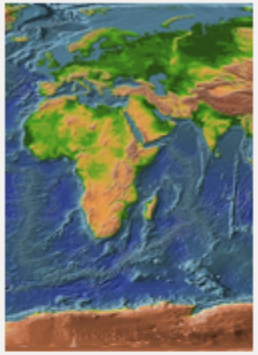
GIS Data Directory: /home/jph/dev/aaa-foss4g/grass_db [Browse]

Project Location: foss4g

Location Title: foss4g

[Help] [< Back] [Next >] [Cancel]

Define new GRASS Location

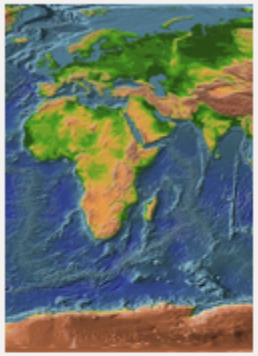


Choose method for creating a new location

- (•) Select EPSG code of spatial reference system
- ( ) Read projection and datum terms from a georeferenced data file
- ( ) Read projection and datum terms from a Well Known Text (WKT) .prj file
- ( ) Select coordinate system parameters from a list
- ( ) Specify projection and datum terms using custom PROJ.4 parameters
- ( ) Create a generic Cartesian coordinate system (XY)

Help | < Back | Next > | Cancel

Define new GRASS Location



Choose EPSG Code

Path to the EPSG-codes file: /usr/share/proj/epsg Browse

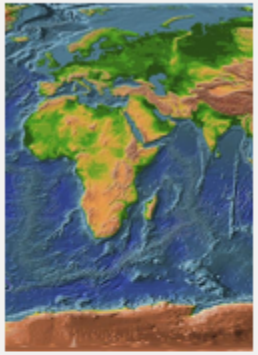
EPSG code: 31370

belge

Code	Description	Parameters
4215	Belge 1950	+proj=longlat +ellps...
4313	Belge 1972	+proj=longlat +ellps...
4809	Belge 1950 (Brussels)	+proj=longlat +ellps...
6190	Belge 1972 / Belgian Lambert 72 + Osten...	+proj=lcc +lat_1=51.1...
21500	Belge 1950 (Brussels) / Belge Lambert 50	+proj=lcc +lat_1=49.8...
31300	Belge 1972 / Belge Lambert 72	+proj=lcc +lat_1=49.8...
31370	Belge 1972 / Belgian Lambert 72	+proj=lcc +lat_1=51.1...

Help < Back Next > Cancel

Define new GRASS Location



Summary

GRASS Database:	/home/jph/dev/aaa-foss4g/grass_db
Location Name:	foss4g
Location Title:	foss4g
Projection:	EPSG code 31370 (Belge 1972 / Belgian Lambert 72)
PROJ.4 definition: (non-definitive)	+proj=lcc +lat_1=51.16666723333333 +lat_2=49.8333339 +lat_0=90 +lon_0=4.367486666666666 +x_0=150000.013 +y_0=5400088.438 +no_defs

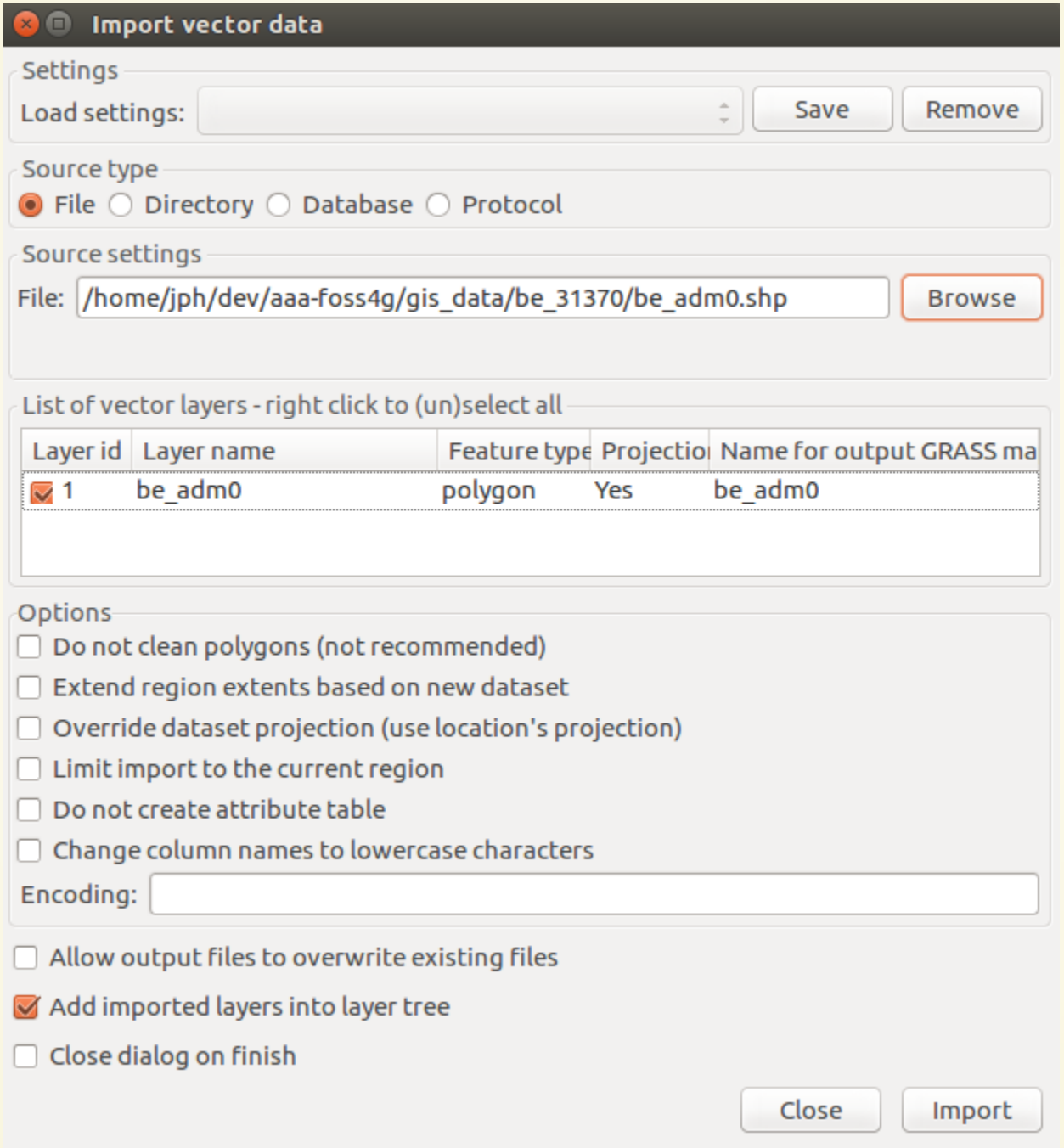
Help | < Back | Finish | Cancel

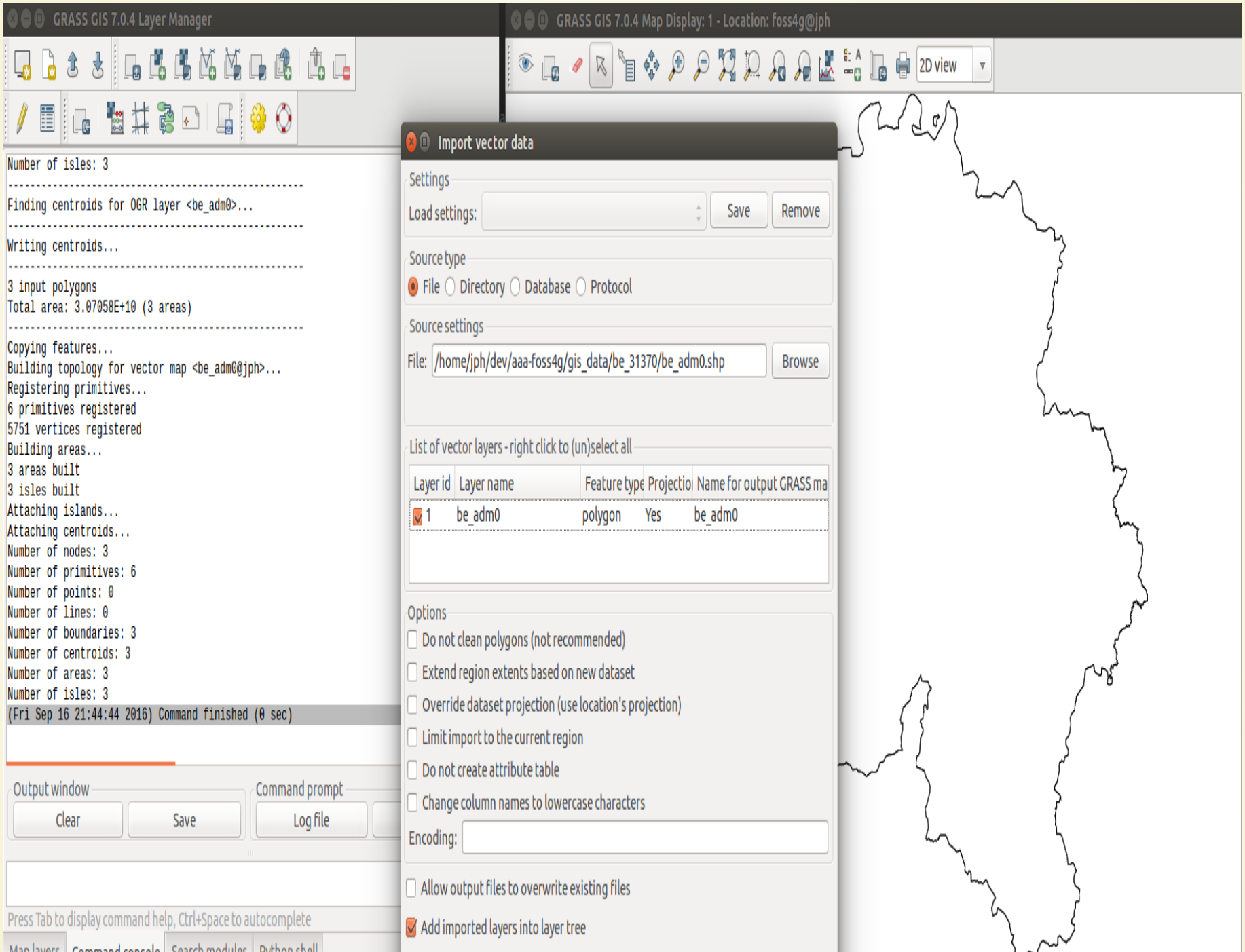

GRASS GIS 7.0.4 startup
grass gis
Bringing advanced geospatial technologies to the world
1. Select GRASS GIS database directory
/home/jph/dev/aaa-foss4g/grass_db
Browse
GRASS GIS database directory contains Locations.
Location <foss4g> created
Location <foss4g> created.
Do you want to set the default region extents and resolution now?
No
Yes
2. Select GRASS Loca
foss4g
New
Rename
Delete
All data in one Location is in the same coordinate reference system (projection). One Location can be one project. Location contains Mapsets.
Mapset contains GIS data related to one project, task within one project, subregion or user.
Start GRASS session
Quit
Help

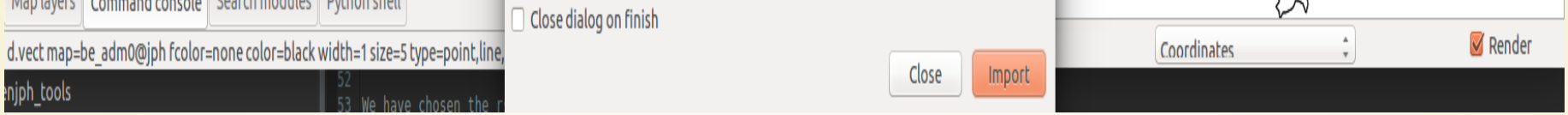

GRASS GIS 7.0.4 startup
grass gis
Bringing advanced geospatial technologies to the world
1. Select GRASS GIS database directory
/home/jph/dev/aaa-foss4g/grass_db
Browse
GRASS GIS database directory contains Locations.
Create new mapset
Do you want to create new mapset?
jph
Help
Cancel
OK
2. Select GRASS Loca
foss4g
New
Rename
Delete
All data in one Location is in the same coordinate reference system (projection). One Location can be one project. Location contains Mapsets.
Mapset contains GIS data related to one project, task within one project, subregion or user.
Start GRASS session
Quit
Help

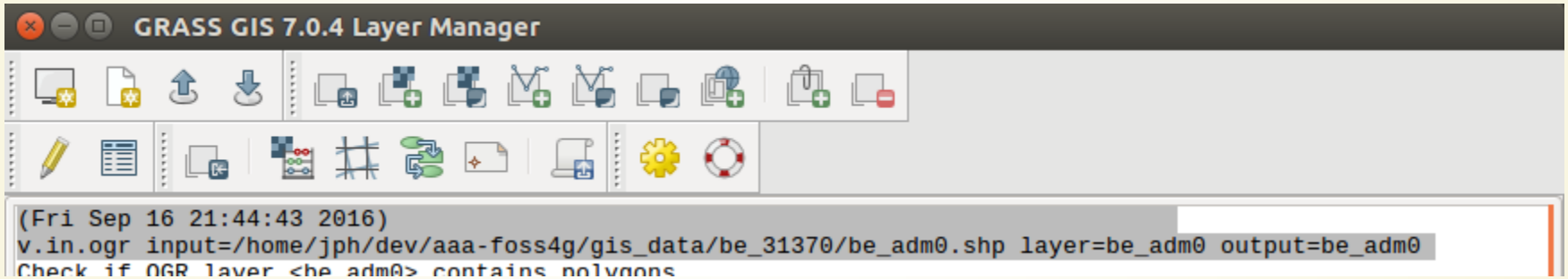

GRASS GIS 7.0.4 startup
grass gis
Bringing advanced geospatial technologies to the world
1. Select GRASS GIS database directory
/home/jph/dev/aaa-foss4g/grass_db
Browse
GRASS GIS database directory contains Locations.
2. Select GRASS Location
foss4g
New
Rename
Delete
All data in one Location is in the same coordinate reference system (projection). One Location can be one project. Location contains Mapsets.
3. Select GRASS Mapset
jph
PERMANENT
New
Rename
Delete
Mapset contains GIS data related to one project, task within one project, subregion or user.
Start GRASS session
Quit
Help

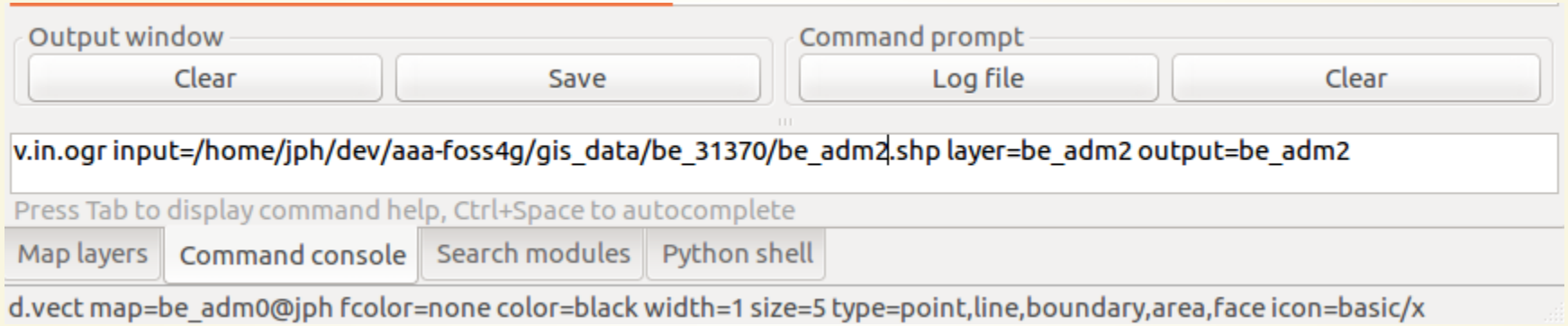
ADD THE VECTOR MAP OF BELGIUM


Import vector data
Settings
Load settings:
Save
Remove
Source type
File
Directory
Database
Protocol
Source settings
File:
/home/jph/dev/aaa-foss4g/gis_data/be_31370/be_adm0.shp
Browse
List of vector layers - right click to (un)select all
Layer id
Layer name
Feature type
Projectio
Name for output GRASS ma
1
be_adm0
polygon
Yes
be_adm0
Options
Do not clean polygons (not recommended)
Extend region extents based on new dataset
Override dataset projection (use location's projection)
Limit import to the current region
Do not create attribute table
Change column names to lowercase characters
Encoding:
Allow output files to overwrite existing files
Add imported layers into layer tree
Close dialog on finish
Close
Import


GRASS GIS 7.0.4 Layer Manager
Number of isles: 3
Finding centroids for OGR layer <be_adm0>...
Writing centroids...
3 input polygons
Total area: 3.07058E+10 (3 areas)
Copying features...
Building topology for vector map <be_adm0@jph>...
Registering primitives...
6 primitives registered
5751 vertices registered
Building areas...
3 areas built
3 isles built
Attaching islands...
Attaching centroids...
Number of nodes: 3
Number of primitives: 6
Number of points: 0
Number of lines: 0
Number of boundaries: 3
Number of centroids: 3
Number of areas: 3
Number of isles: 3
(Fri Sep 16 21:44:44 2016) Command finished (0 sec)
Output window
Clear
Save
Command prompt
Log file
Press Tab to display command help, Ctrl+Space to autocomplete
Map layers
Command console
Search modules
Python shell
GRASS GIS 7.0.4 Map Display: 1 - Location: foss4g@jph
2D view
Import vector data
Settings
Load settings:
Save
Remove
Source type
File
Directory
Database
Protocol
Source settings
File:
/home/jph/dev/aaa-foss4g/gis_data/be_31370/be_adm0.shp
Browse
List of vector layers - right click to (un)select all
Layer id
Layer name
Feature type
Projectio
Name for output GRASS ma
1
be_adm0
polygon
Yes
be_adm0
Options
Do not clean polygons (not recommended)
Extend region extents based on new dataset
Override dataset projection (use location's projection)
Limit import to the current region
Do not create attribute table
Change column names to lowercase characters
Encoding:
Allow output files to overwrite existing files
Add imported layers into layer tree


Map layers
Command console
Search modules
Python shell
d.vect map=be_adm0@jph fcolor=none color=black width=1 size=5 type=point,line,
njph_tools
52
53 We have chosen the r
Close dialog on finish
Close
Import
Coordinates
Render


GRASS GIS 7.0.4 Layer Manager
(Fri Sep 16 21:44:43 2016)
v.in.ogr input=/home/jph/dev/aaa-foss4g/gis_data/be_31370/be_adm0.shp layer=be_adm0 output=be_adm0
Check if OGR layer <be_adm0> contains polygons


Output window
Clear
Save
Command prompt
Log file
Clear
v.in.ogr input=/home/jph/dev/aaa-foss4g/gis_data/be_31370/be_adm2.shp layer=be_adm2 output=be_adm2
Press Tab to display command help, Ctrl+Space to autocomplete
Map layers
Command console
Search modules
Python shell
d.vect map=be_adm0@jph fcolor=none color=black width=1 size=5 type=point,line,boundary,area,face icon=basic/x

GRASS GIS 7.0.4 Layer Manager

```
Total area: 3.07058E+10 (21 areas)
Overlapping area: 3.14456E-05 (5 areas)
-----------------------------------------------------
Copying features...
Building topology for vector map <be_adm2@jph>...
Registering primitives...
74 primitives registered
8228 vertices registered
Building areas...
21 areas built
4 isles built
Attaching islands...
Attaching centroids...
Number of nodes: 37
Number of primitives: 74
Number of points: 0
Number of lines: 0
Number of boundaries: 54
Number of centroids: 20
Number of areas: 21
Number of isles: 4
-----------------------------------------------------
Some input polygons are overlapping each other.
If overlapping is not desired, the data need to be cleaned.
The input could be cleaned by snapping vertices to each other.
Estimated range of snapping threshold: [1e-10, 0.1]
Try to import again, snapping with at least 1e-10: 'snap=1e-10'
(Fri Sep 16 21:47:59 2016) Command finished (0 sec)
```

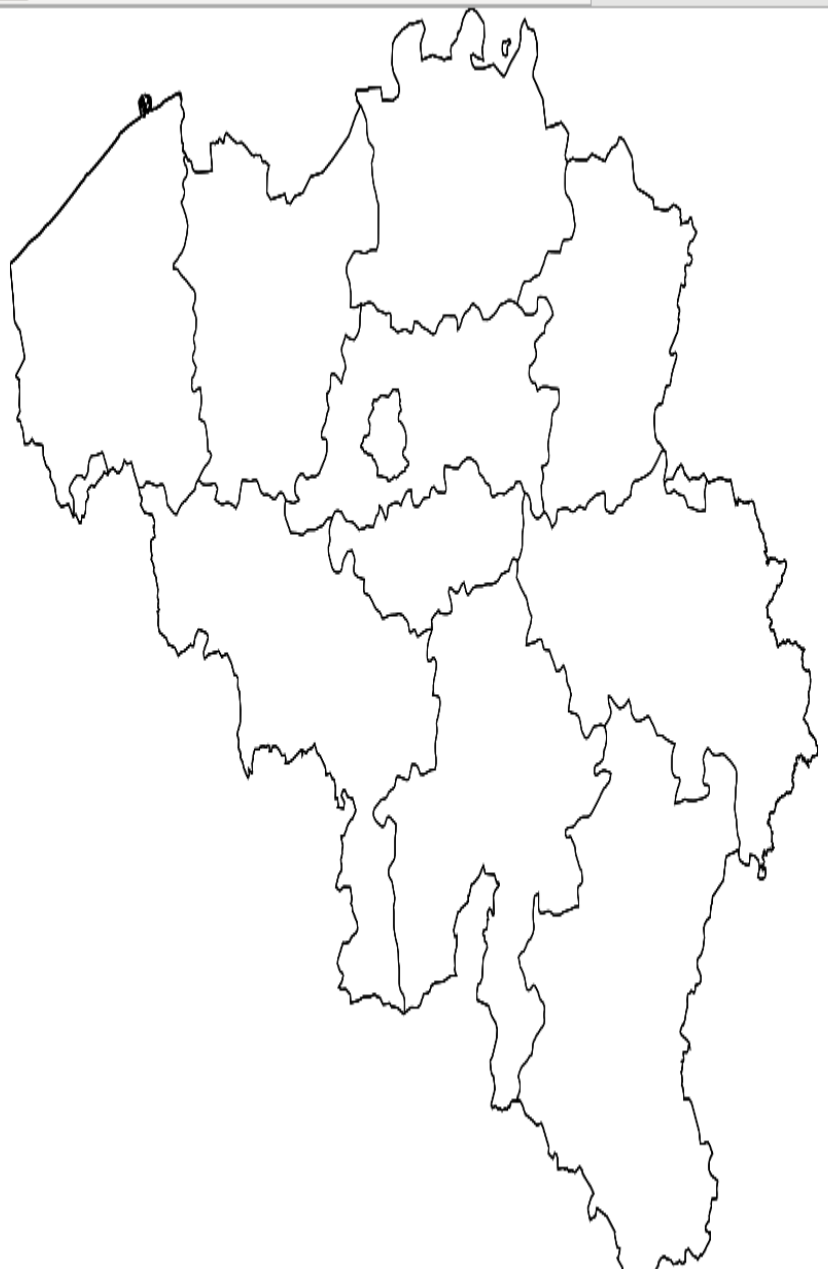
Output window: Clear | Save

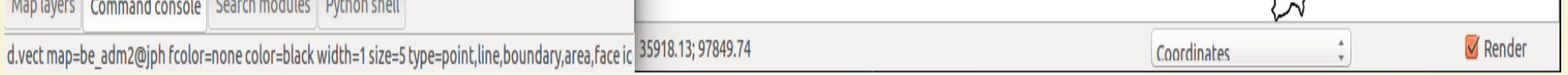
Command prompt: Log file | Clear

Press Tab to display command help, Ctrl+Space to autocomplete

GRASS GIS 7.0.4 Map Display: 1 - Location: foss4g@jph

2D view




Map layers
Command console
Search modules
Python shell
d.vect map=be_adm2@jph fcolor=none color=black width=1 size=5 type=point,line,boundary,area,face ic
35918.13; 97849.74
Coordinates
Render

Belgium:

```
v.in.ogr
input=/home/jph/dev/aaa-foss4g/gis_data/be_31370/be_adm0.shp
layer=be_adm0 output=be_adm0
```

Belgian provinces:

```
v.in.ogr
input=/home/jph/dev/aaa-foss4g/gis_data/be_31370/be_adm2.shp
layer=be_adm2 output=be_adm2
```

SETUP YOUR PROJECT REGION

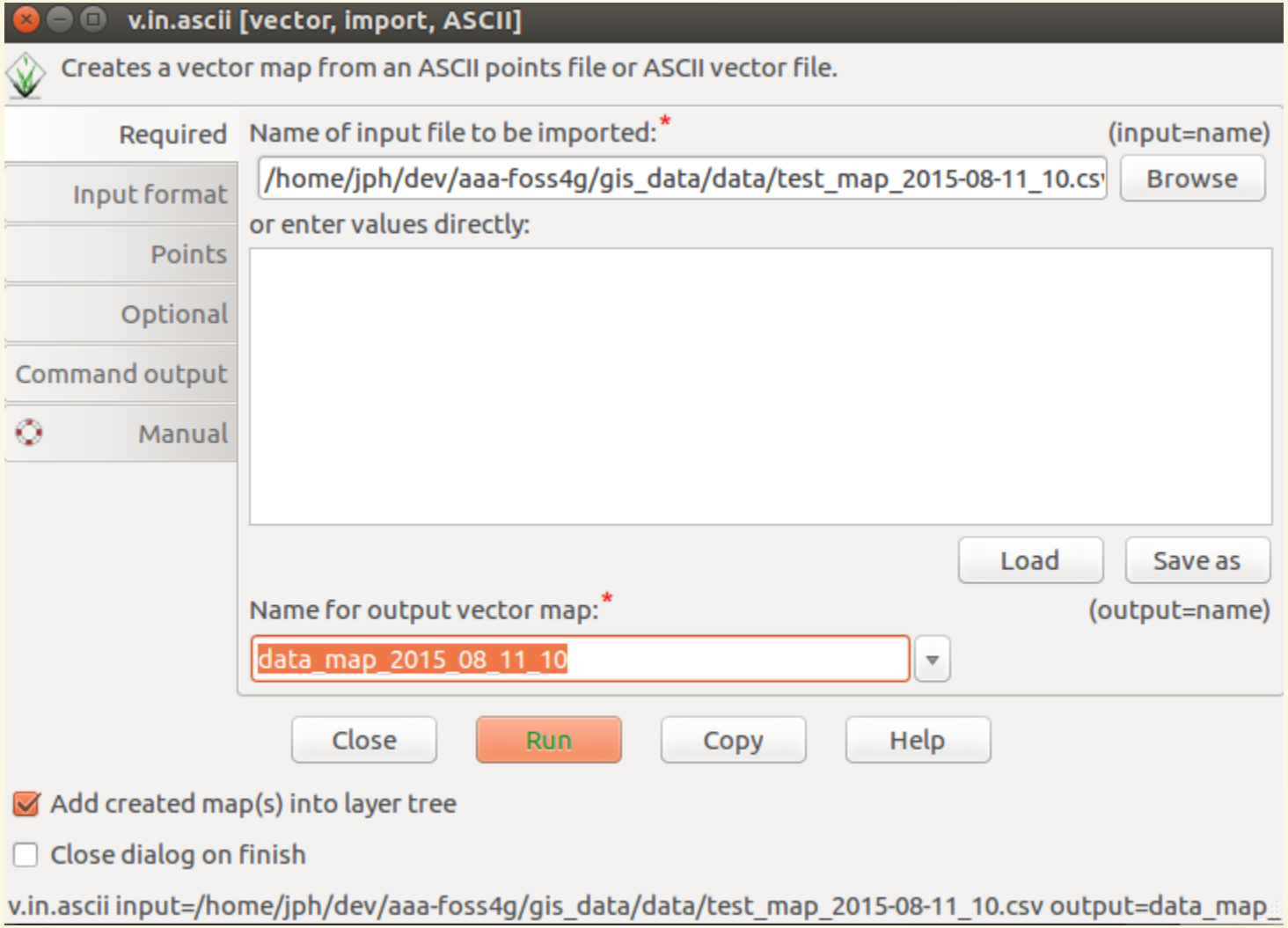
The geographic area in which GRASS should work:

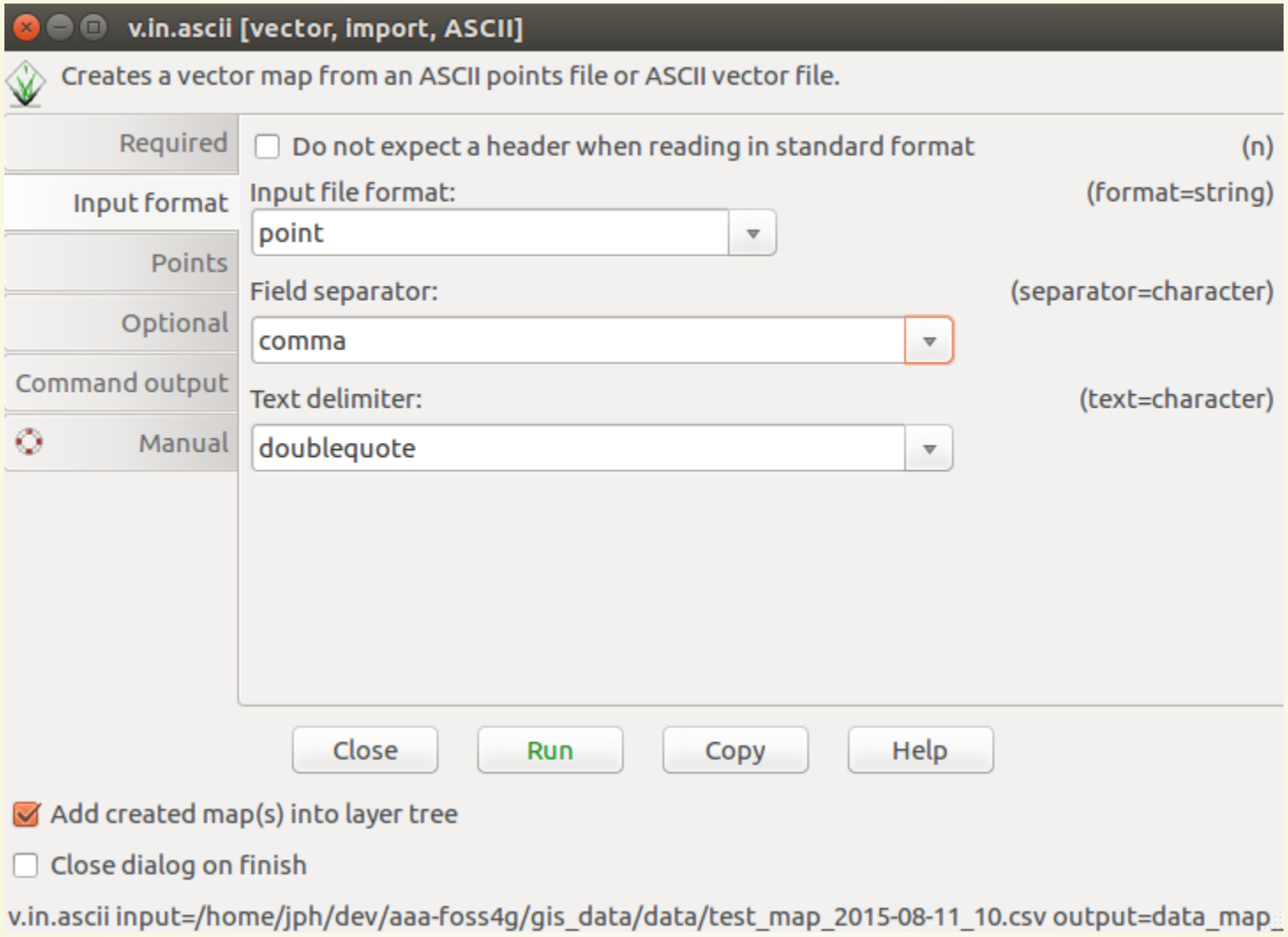
- geographical projection (e.g. Belgian Lambert 72, etc)
- geographical extension, i.e. the North/South/East/West limits of the area covered
- number of columns and number of rows for the data
- resolution, i.e. the extension divided by the number of rows (N-S resolution), respectively columns (E-W resolution).

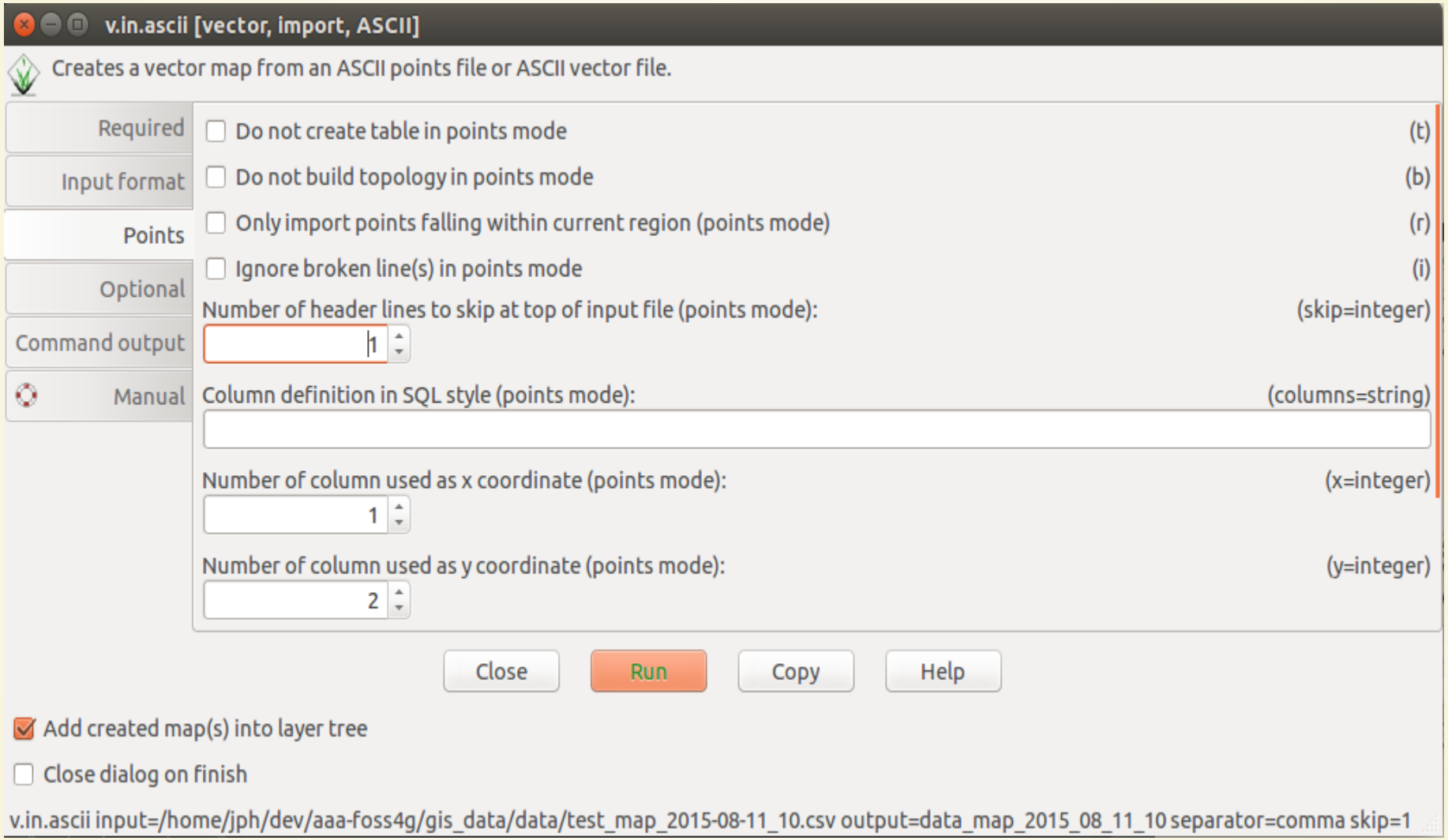
In other words, ***you need a good friend*** to set the region:

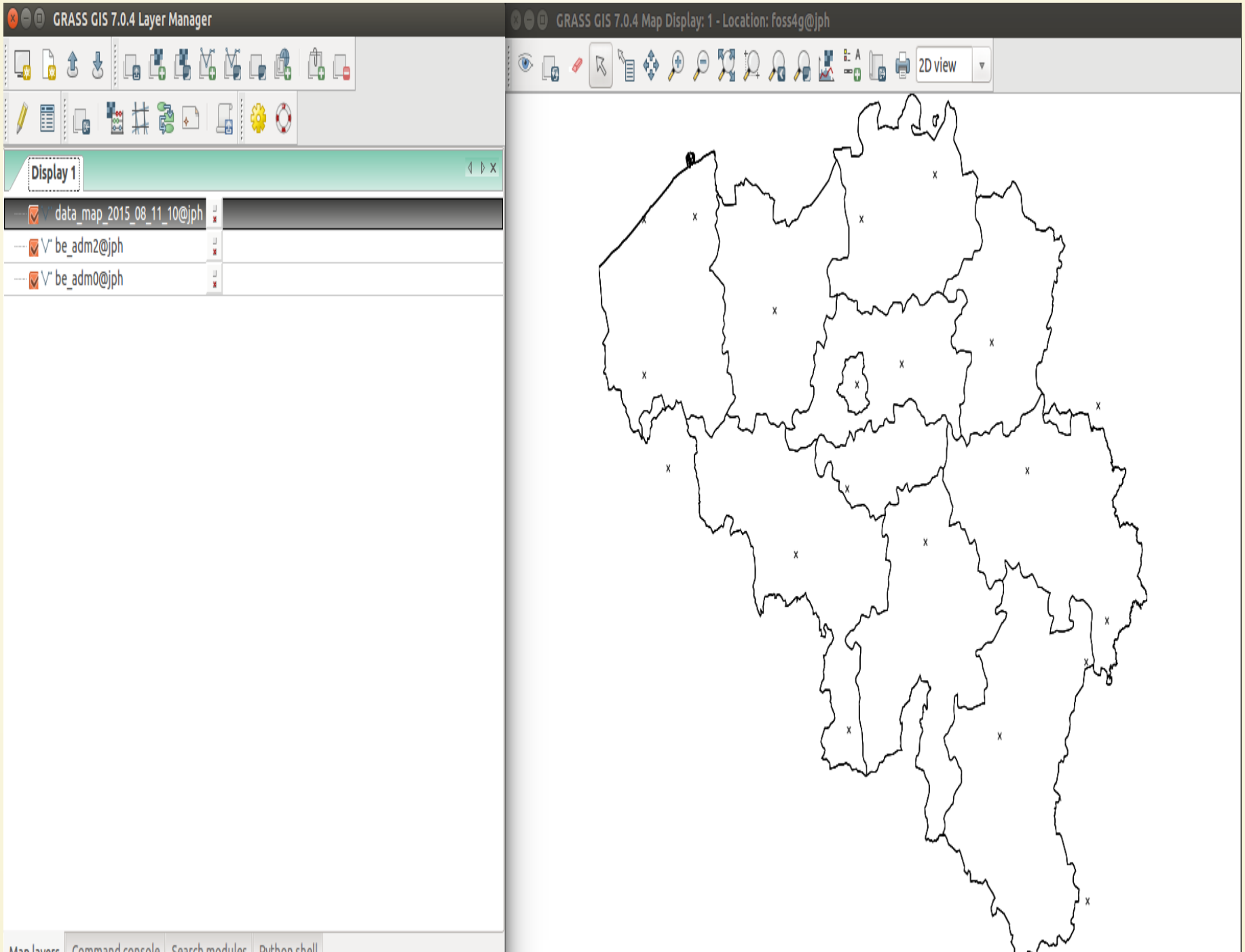
```
g.region n=243900 s=21200 e=295950 w=23700 rows=4454 cols=5445 nsres=50
```

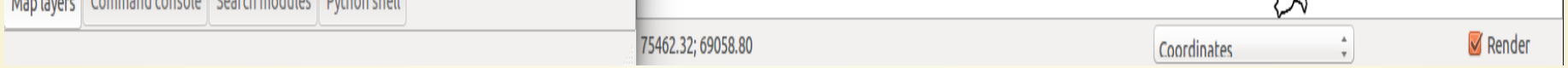
ADD THE PV FORECASTS AS VECTOR POINT MAP


v.in.ascii [vector, import, ASCII]
Creates a vector map from an ASCII points file or ASCII vector file.
Required
Input format
Points
Optional
Command output
Manual
Name of input file to be imported:*
(input=name)
/home/jph/dev/aaa-foss4g/gis_data/data/test_map_2015-08-11_10.cs
Browse
or enter values directly:
Load
Save as
Name for output vector map:*
(output=name)
data_map_2015_08_11_10
Close
Run
Copy
Help
Add created map(s) into layer tree
Close dialog on finish
v.in.ascii input=/home/jph/dev/aaa-foss4g/gis_data/data/test_map_2015-08-11_10.csv output=data_map_


v.in.ascii [vector, import, ASCII]
Creates a vector map from an ASCII points file or ASCII vector file.
Required
Input format
Points
Optional
Command output
Manual
Do not expect a header when reading in standard format
(n)
Input file format:
(format=string)
point
Field separator:
(separator=character)
comma
Text delimiter:
(text=character)
doublequote
Close
Run
Copy
Help
Add created map(s) into layer tree
Close dialog on finish
v.in.ascii input=/home/jph/dev/aaa-foss4g/gis_data/data/test_map_2015-08-11_10.csv output=data_map_


v.in.ascii [vector, import, ASCII]
Creates a vector map from an ASCII points file or ASCII vector file.
Required
Input format
Points
Optional
Command output
Manual
Do not create table in points mode (t)
Do not build topology in points mode (b)
Only import points falling within current region (points mode) (r)
Ignore broken line(s) in points mode (i)
Number of header lines to skip at top of input file (points mode): (skip=integer)
1
Column definition in SQL style (points mode): (columns=string)
Number of column used as x coordinate (points mode): (x=integer)
1
Number of column used as y coordinate (points mode): (y=integer)
2
Close
Run
Copy
Help
Add created map(s) into layer tree
Close dialog on finish
v.in.ascii input=/home/jph/dev/aaa-foss4g/gis_data/data/test_map_2015-08-11_10.csv output=data_map_2015_08_11_10 separator=comma skip=1

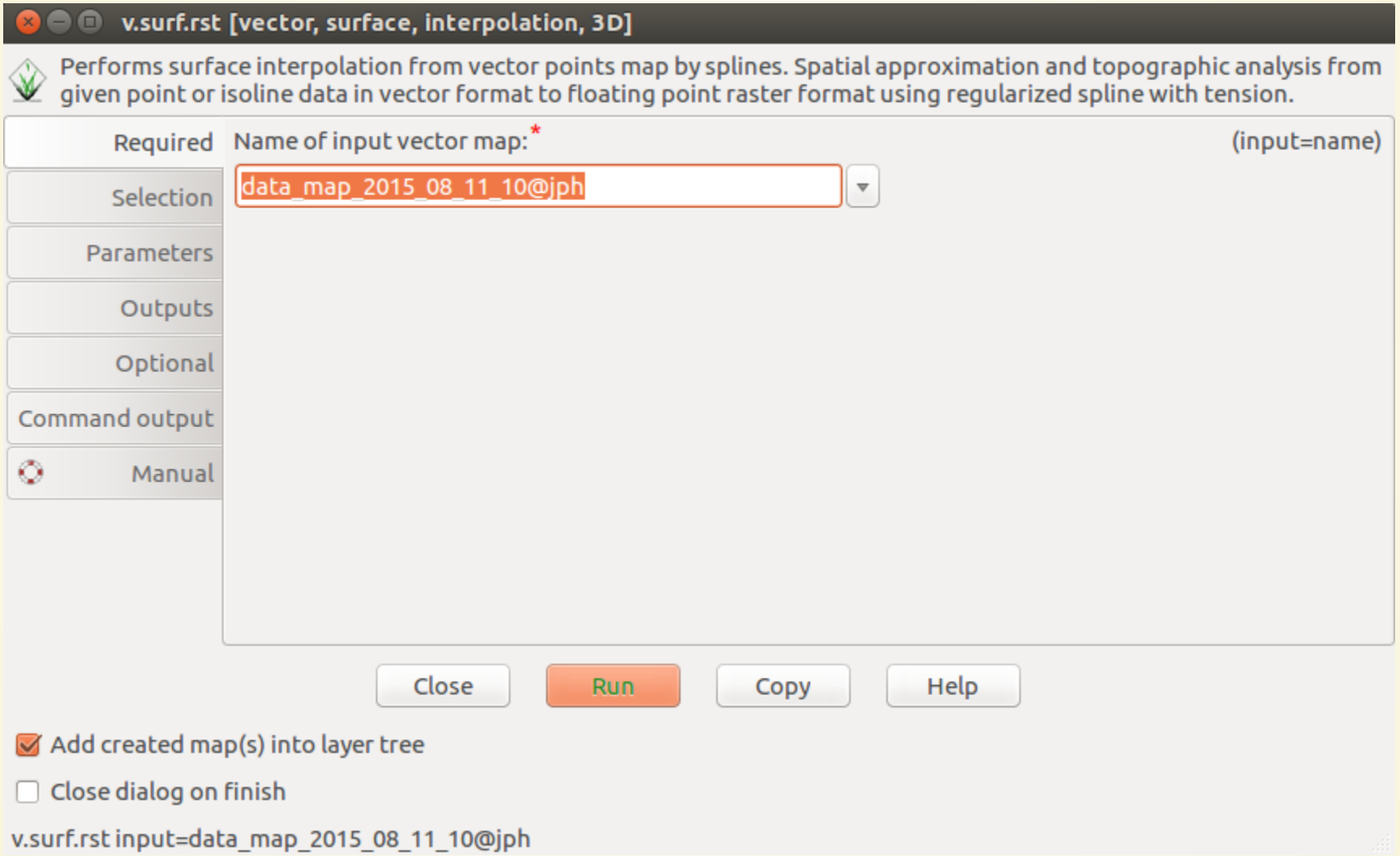

GRASS GIS 7.0.4 Layer Manager
Display 1
data_map_2015_08_11_10@jph
be_adm2@jph
be_adm0@jph
Map layers
Command console
Search modules
Python shell
GRASS GIS 7.0.4 Map Display: 1 - Location: foss4g@jph
2D view

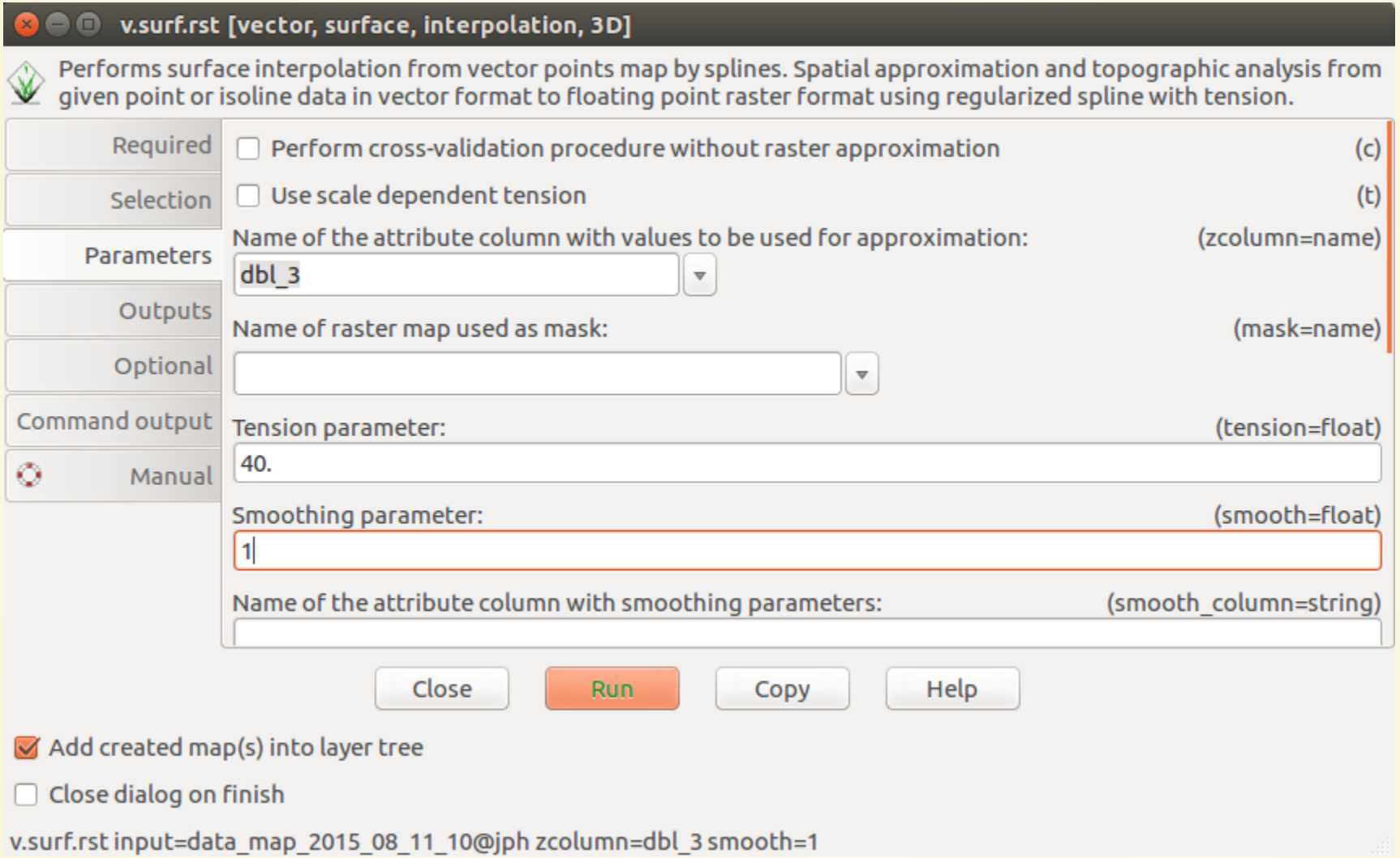

Map layers
Command console
Search modules
Python shell
75462.32; 69058.80
Coordinates
Render

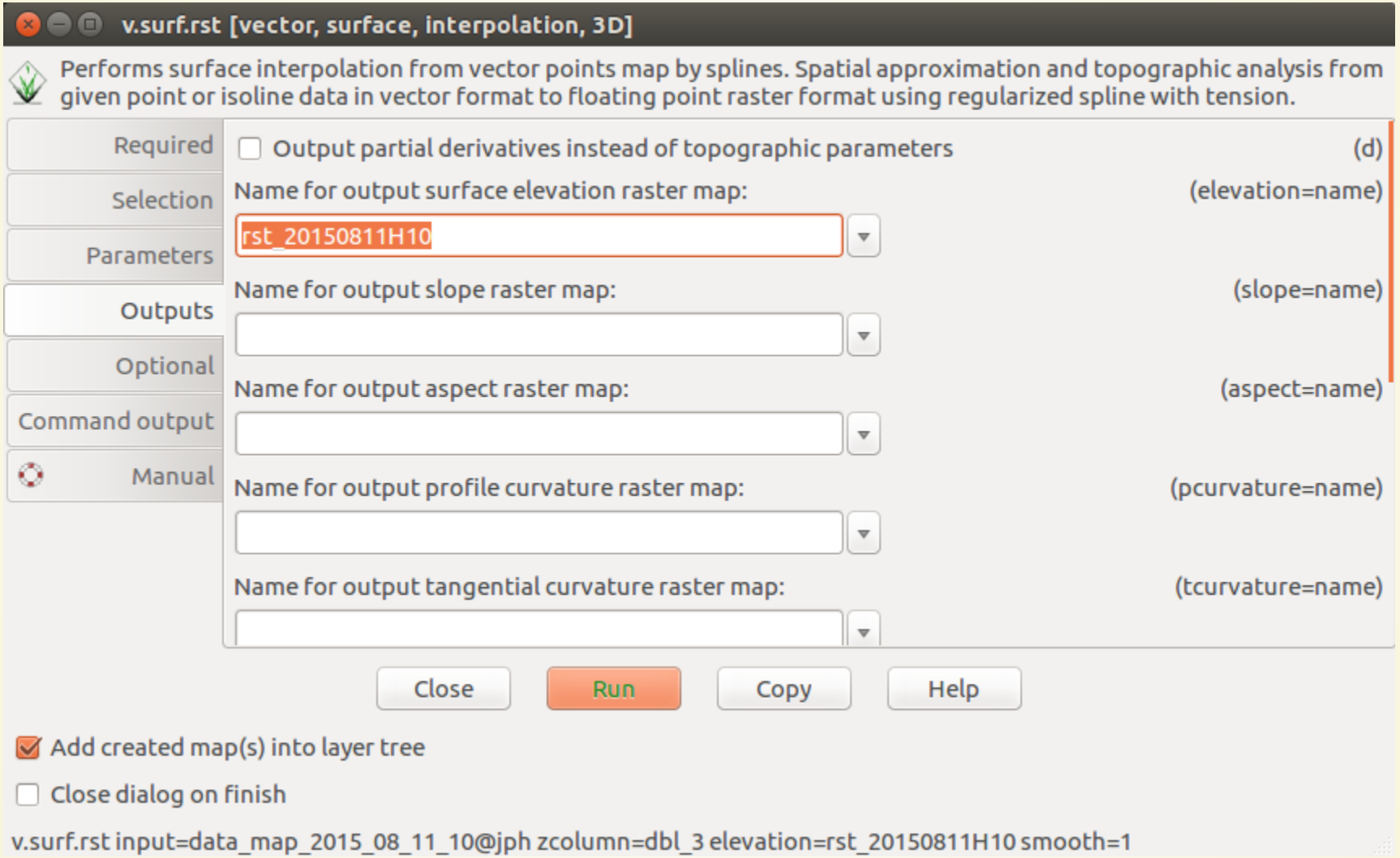
All this is summarized in this command:

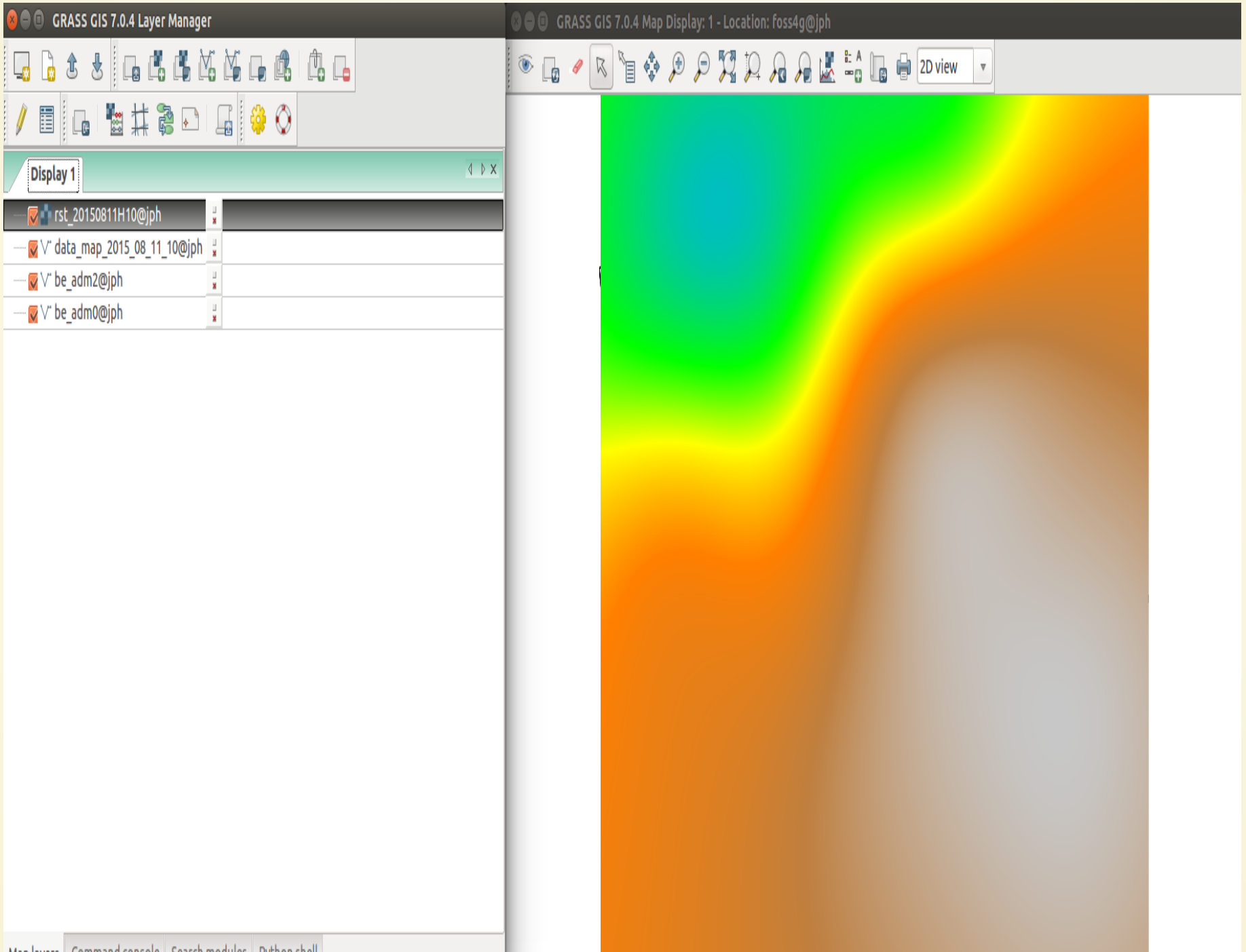
```
v.in.ascii --overwrite
input=/home/jph/dev/aaa-foss4g/gis_data/data/test_map_2015-08-11_10.csv
output=data_map_2015_08_11_10
separator=comma
skip=1
```

BUILD A RASTER FROM THE VECTOR POINT MAP


v.surf.rst [vector, surface, interpolation, 3D]
Performs surface interpolation from vector points map by splines. Spatial approximation and topographic analysis from given point or isoline data in vector format to floating point raster format using regularized spline with tension.
Required
Selection
Parameters
Outputs
Optional
Command output
Manual
Name of input vector map:*
(input=name)
data_map_2015_08_11_10@jph
Close
Run
Copy
Help
Add created map(s) into layer tree
Close dialog on finish
v.surf.rst input=data_map_2015_08_11_10@jph


v.surf.rst [vector, surface, interpolation, 3D]
Performs surface interpolation from vector points map by splines. Spatial approximation and topographic analysis from given point or isoline data in vector format to floating point raster format using regularized spline with tension.
Required
Selection
Parameters
Outputs
Optional
Command output
Manual
Perform cross-validation procedure without raster approximation
(c)
Use scale dependent tension
(t)
Name of the attribute column with values to be used for approximation:
(zcolumn=name)
dbl_3
Name of raster map used as mask:
(mask=name)
Tension parameter:
(tension=float)
40.
Smoothing parameter:
(smooth=float)
1
Name of the attribute column with smoothing parameters:
(smooth_column=string)
Close
Run
Copy
Help
Add created map(s) into layer tree
Close dialog on finish
v.surf.rst input=data_map_2015_08_11_10@jph zcolumn=dbl_3 smooth=1


v.surf.rst [vector, surface, interpolation, 3D]
Performs surface interpolation from vector points map by splines. Spatial approximation and topographic analysis from given point or isoline data in vector format to floating point raster format using regularized spline with tension.
Required
Selection
Parameters
Outputs
Optional
Command output
Manual
Output partial derivatives instead of topographic parameters
(d)
Name for output surface elevation raster map:
(elevation=name)
rst_20150811H10
Name for output slope raster map:
(slope=name)
Name for output aspect raster map:
(aspect=name)
Name for output profile curvature raster map:
(pcurvature=name)
Name for output tangential curvature raster map:
(tcurvature=name)
Close
Run
Copy
Help
Add created map(s) into layer tree
Close dialog on finish
v.surf.rst input=data_map_2015_08_11_10@jph zcolumn=dbl_3 elevation=rst_20150811H10 smooth=1

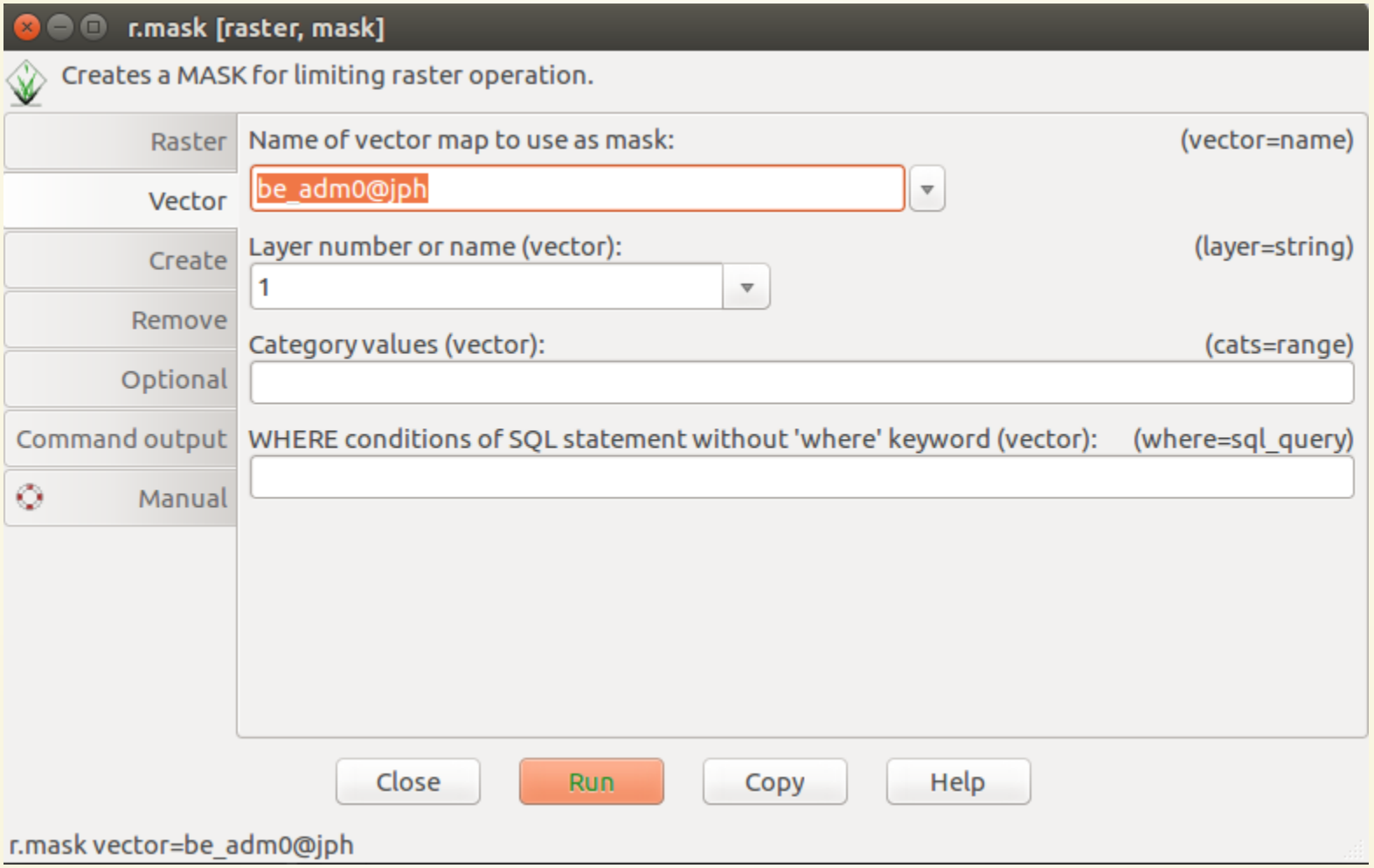

GRASS GIS 7.0.4 Layer Manager
Display 1
rst_20150811H10@jph
data_map_2015_08_11_10@jph
be_adm2@jph
be_adm0@jph
GRASS GIS 7.0.4 Map Display: 1 - Location: foss4g@jph
2D view

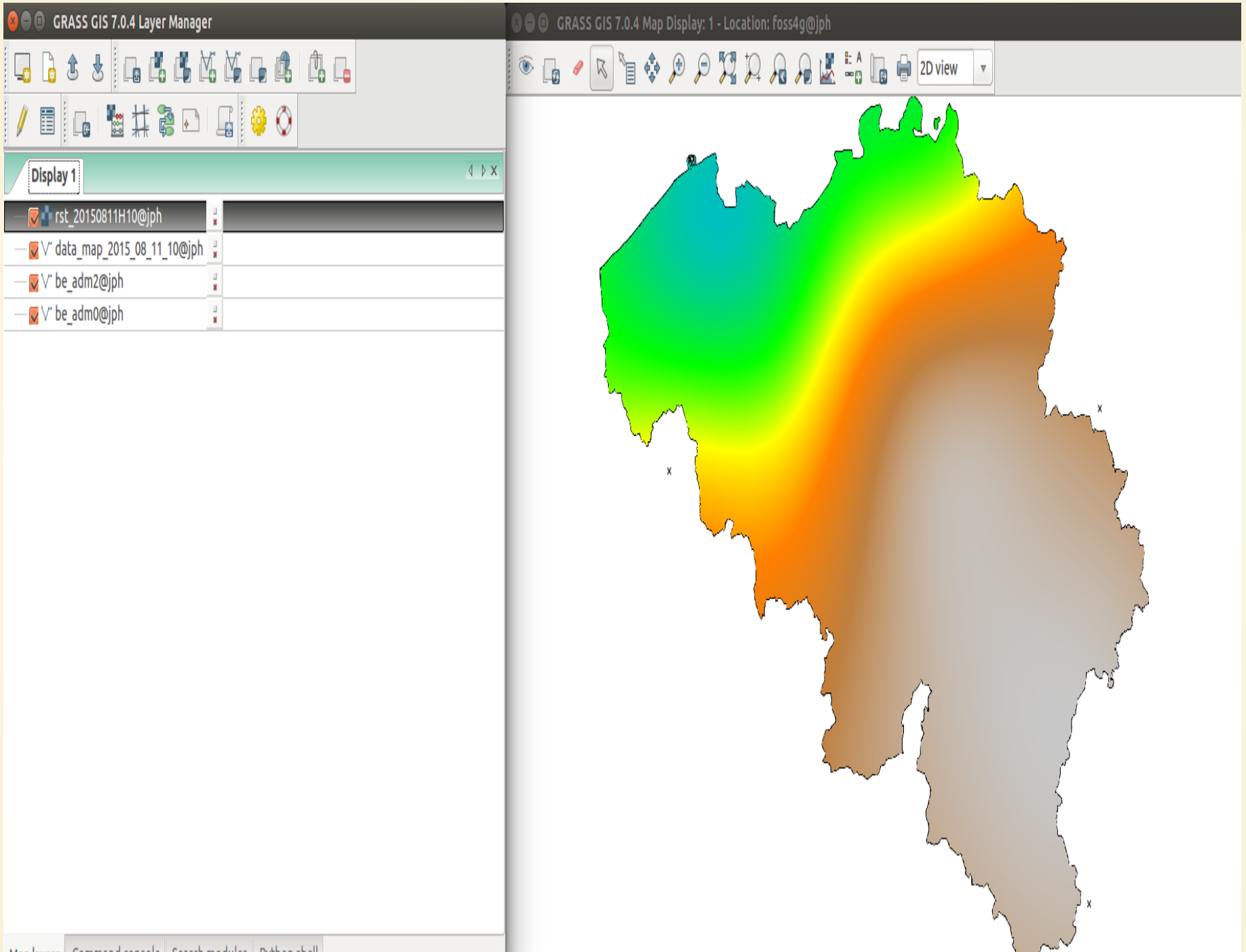

Map layers
Command console
Search modules
Python shell
d.rast map=rst_20150811H10@jph
56730.86; 72874.46
Coordinates
Render

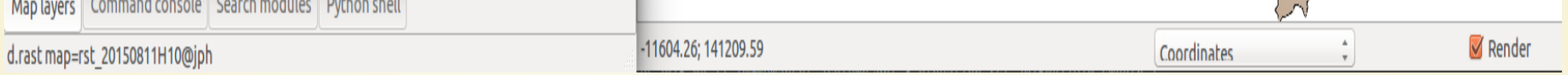
We have chosen the Regularized Spline Tension (rst) interpolation:

```
v.surf.rst --overwrite
input=data_map_2015_08_11_10@jph
zcolumn=dbl_3
elevation=rst_20150811H10
smooth=1
```

ADD A MASK


r.mask [raster, mask]
Creates a MASK for limiting raster operation.
Raster
Vector
Create
Remove
Optional
Command output
Manual
Name of vector map to use as mask:
(vector=name)
be_adm0@jph
Layer number or name (vector):
(layer=string)
1
Category values (vector):
(cats=range)
WHERE conditions of SQL statement without 'where' keyword (vector):
(where=sql_query)
Close
Run
Copy
Help
r.mask vector=be_adm0@jph


GRASS GIS 7.0.4 Layer Manager
Display 1
rst_20150811H10@jph
data_map_2015_08_11_10@jph
be_adm2@jph
be_adm0@jph
GRASS GIS 7.0.4 Map Display: 1 - Location: foss4g@jph
2D view


Map layers
Command console
Search modules
Python shell
d.rast map=rst_20150811H10@jph
-11604.26; 141209.59
Coordinates
Render

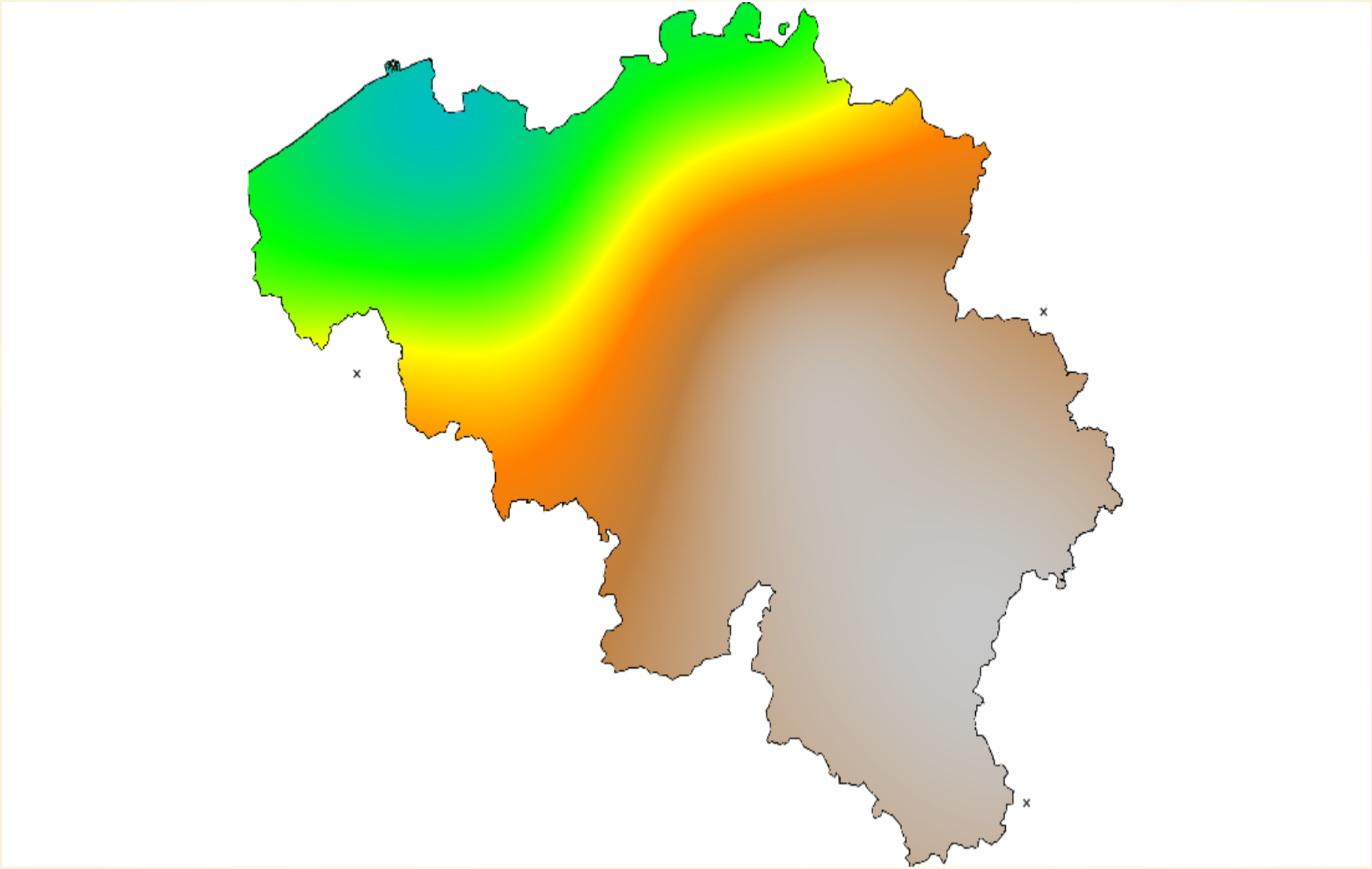
To limit my raster to the country limits:

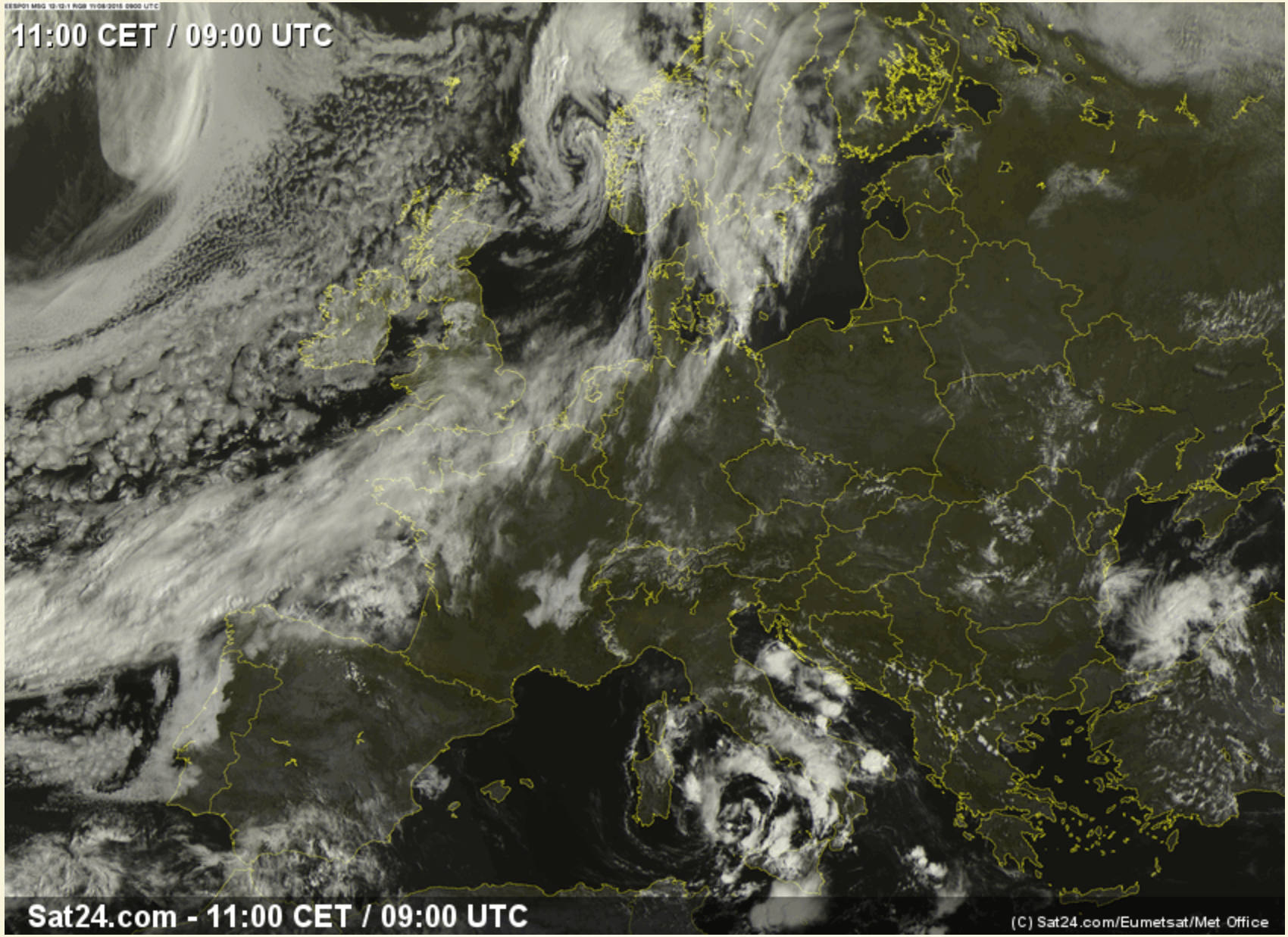
```
r.mask --overwrite vector=be_adm0@jph
```

To directly build the raster including the mask:

```
v.surf.rst --overwrite
input=test_map_2015_08_11_10@jph
zcolumn=dbl_3
elevation=rst_20150811H10
smooth=1
mask=MASK@jph
```

SAVE THE RESULT AS AN IMAGE




11:00 CET / 09:00 UTC
Sat24.com - 11:00 CET / 09:00 UTC
(C) Sat24.com/Eumetsat/Met Office

We would like to use an indicator that can be easily interpreted by anybody whatever installation he is using and something valid across seasons.

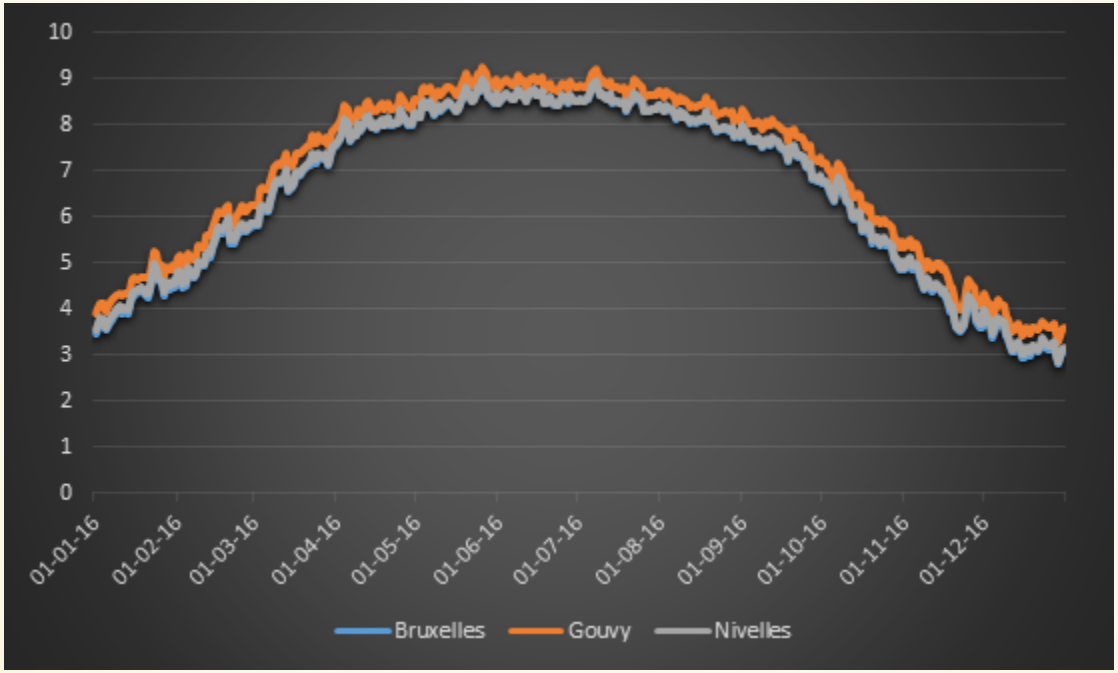
We decided to display a percentage of the **clear sky PV production**.

In other words, **is it a bright day for the season?**

TMY CLEAR SKY

Clear sky solar energy received on an inclined plane during a **normal year**.

This is an amount of solar energy expressed in kWh/m²*day (source météonorm).



A	B	C	D	E	F	G
Year	Month	Day	Hour	Extraterrestrial Horizontal Radiation [Wh/m^2]	Extraterrestrial Direct Normal Radiation [Wh/m^2]	Global Horizontal Radiation [Wh/m^2]
5	1	1	1	0	0	0
5	1	1	2	0	0	0
5	1	1	3	0	0	0
5	1	1	4	0	0	0
5	1	1	5	0	0	0
5	1	1	6	0	0	0
5	1	1	7	0	0	0
5	1	1	8	0	0	0
5	1	1	9	2	1412	0
5	1	1	10	111	1412	23
5	1	1	11	253	1412	58
5	1	1	12	348	1412	89
5	1	1	13	391	1412	112
5	1	1	14	377	1412	104
5	1	1	15	309	1412	78
5	1	1	16	190	1412	42
5	1	1	17	37	1412	2
5	1	1	18	0	0	0
5	1	1	19	0	0	0
5	1	1	20	0	0	0
5	1	1	21	0	0	0
5	1	1	22	0	0	0
5	1	1	23	0	0	0
5	1	1	24	0	0	0
5	1	2	1	0	0	0
5	1	2	2	0	0	0
5	1	2	3	0	0	0
5	1	2	4	0	0	0
5	1	2	5	0	0	0
5	1	2	6	0	0	0
5	1	2	7	0	0	0
5	1	2	8	0	0	0
5	1	2	9	2	1412	0
5	1	2	10	112	1412	43
5	1	2	11	254	1412	110
5	1	2	12	350	1412	172
5	1	2	13	392	1412	187
5	1	2	14	379	1412	161
5	1	2	15	311	1412	119
5	1	2	16	193	1412	64

5	1	2	17	39	1412	2
5	1	2	18	0	0	0
5	1	2	19	0	0	0
5	1	2	20	0	0	0
5	1	2	21	0	0	0
5	1	2	22	0	0	0
5	1	2	23	0	0	0

Uccle-horizon

CSV DATA FILE

Result daily power is expressed in percentage of clear sky.
Result hourly power is expressed in Wh/Wp.

A	B	C	D	E	F	G	H	I
SOLPOINT	DATE	CLEARSKY	PEAK	PEAKPOWER	MEAN	MEDIAN	OPTIMUM	GRAPHOPTIMUM
Bruxelles	2016-02-14	11.3316441441	11	0.0683333333333	0.0447222222222	0.0580555555556	[10-11|13-15]	oM_oMo
Arlon	2016-02-14	22.2972972973	9	153	88	0.0901666666666	[9-9|11-12|14-15]	M_oo_oo
Gand	2016-02-14	17.6858108108	13	118	0.0698	0.0748333333333	[11-14|16-16]	ooMo_o
Ostende	2016-02-14	33.5810810811	12	0.400666666667	0.132533333333	0.0876666666667	[11-14]	oMoo
Gouvy	2016-02-14	19.3918918919	9	0.105333333333	0.0765333333333	0.0793333333333	[9-9|11-14|16-16]	M_oooo_o
St-Hubert	2016-02-14	14.6199324324	14	0.105333333333	0.0577	0.0656666666666	[11-15]	oooMo
Hasselt	2016-02-14	12.1199324324	14	0.0766666666667	0.0478333333333	57	[10-14]	ooooM
Bruges	2016-02-14	34.2736486486	13	251	0.135266666667	127	[12-15]	oMoo
Turnhout	2016-02-14	15.152027027	12	0.0973333333333	0.0598	0.0701666666667	[11-15]	oMooo
Mons	2016-02-14	14.2652027027	12	0.0893333333333	0.0563	0.0601666666666	[11-14|16-16]	oMoo_o
Liege	2016-02-14	11.2922297297	11	69	0.0445666666667	48	[10-14]	oMooo
Ieper	2016-02-14	35.0337837838	13	373	0.138266666667	0.122166666667	[11-15]	ooMoo
Saint-Vith	2016-02-14	18.4121621622	9	0.130333333333	0.0726666666666	0.0791666666667	[9-9|11-14]	M_oooo
Anvers	2016-02-14	13.1418918919	14	0.0773333333333	0.0518666666667	0.0623333333333	[10-15]	ooooMo
Louvain	2016-02-14	13.5557432432	11	0.120666666667	0.0535	0.0555	[10-12|14-15]	oMo_oo
Namur	2016-02-14	11.6891891892	12	78	0.0461333333333	0.0493333333334	[11-15]	oMooo
Chimay	2016-02-14	11.7803350225	12	0.0715277777778	0.0464930555556	0.0513888888889	[10-14]	ooMoo
Lille	2016-02-14	25.0823302294	12	0.183613445378	0.0989915966386	0.12268907563	[12-16]	Moooo
Aachen	2016-02-14	11.2837837838	9	67	0.0445333333333	0.0518333333333	[9-10|12-14]	Mo_ooo
Nivelles	2016-02-14	13.7162162162	12	0.107333333333	0.0541333333333	53	[11-15]	oMooo

PYTHON SCRIPTS

SCRIPTING GRASS

https://grasswiki.osgeo.org/wiki/Working_with_GRASS_without_

The EnergizAIR GRASS session class.

```
mysession = Grass7Session()
mysession.start_grass()
mysession.gscript.message('Current GRASS GIS 7 environment:')
print mysession.gscript.gisenv()
""" Do what you want """
```

Now you have access to **gscript.run_command()** to run the following functions.

GENERATE MAPS

ADD THE PV FORECASTS AS VECTOR POINT MAP

```
def insert_vector_csv(self, input, output):
    columns = 'long double precision , lat double precision, power doubl
    result = self.gscript.run_command(
                    'v.in.ascii'
                    , overwrite=True
                    , input=input
                    , separator='comma'
                    , skip=1
                    , output=output
                    , columns=columns
                    , quiet=not self.debug)
```

ADD A MASK

```
def set_mask(self, name):
    result = self.gscript.run_command(
                      'r.mask',
                      , overwrite=True,
                      , vector='{0}@{1}'.format(name, self.mapset)
                      , quiet=not self.debug)
```

BUILD A RASTER FROM THE VECTOR POINT MAP

```
def create_rst_interpolation_raster(self, input, elevation, zcolumn,
                        smooth=0, tension=40, npmin=20, segmax=40):

    result = self.gscript.run_command(
                        'v.surf.rst'
                        , overwrite=True
                        , input='{0}@{1}'.format(input, self.mapset)
                        , zcolumn=zcolumn
                        , elevation=elevation
                        , mask='MASK@{0}'.format(self.mapset)
                        , smooth=smooth
                        , tension=tension
                        , npmin=npmin
                        , segmax=segmax
                        , quiet=not self.debug)
```

DEFINE THE COLOR PALETTE

Define the palette rules and colors in a separate file:

```
0 78:148:228
10.0 78:198:228
20.0 21:177:98
30.0 37:211:24
40.0 122:237:20
50.0 218:255:10
60.0 255:229:10
70.0 255:177:10
80.0 255:99:5
90.0 188:38:13
150.0 188:38:13
```

Pass it to the python script (rules):

```
def set_color_palette(self, map, rules):
    result = self.gscript.run_command(
                    'r.colors'
                    , map='{0}@{1}'.format(map, self.mapset)
                    , rules=rules
                    , quiet=not self.debug)
```

SAVE THE MAP IN A PNG FILE WITH TRANSPARENT BACKGROUND

```
def save_png(self, filename, raster, map, height=960, width=1280):
    # SETTINGS for PNG DRIVER
    os.system('rm {0}'.format(filename))
    os.environ['GRASS_RENDER_IMMEDIATE'] = 'png'
    os.environ['GRASS_RENDER_FILE'] = filename
    os.environ['GRASS_RENDER_FILE_READ'] = 'TRUE'
    os.environ['GRASS_RENDER_TRANSPARENT'] = 'TRUE'
    os.environ['GRASS_RENDER_HEIGHT'] = str(height)
    os.environ['GRASS_RENDER_WIDTH'] = str(width)

    self.gscript.run_command('d.rast'
                             , map='{0}@{1}'.format(raster, self.mapset)
                             , quiet=not self.debug)

    self.gscript.run_command('d.vect'
                             , map='{0}@{1}'.format(map, self.mapset)
                             , color='white'
                             , fill_color='none'
```

SAVE ALL VALUES AS XML AND JSON ARRAY

- To be able to build friendly reports for the radio stations.
- To pass values to the leaflet Iframe for popups.

BUILD A PDF FRIENDLY REPORT

```
""" Load the xml summary """
content, fc_date = self._generate_daily_xml_content(datafile, True)

""" Transform it in HTML format with XSL stylesheet """
htmlcontent = self.apply_xsl_transformation('radio_report.xsl', content)
with open('report.html', 'w') as f:
    f.write(htmlcontent.encode('latin1'))

""" Transform HTML in PDF """
os.system("wkhtmltopdf -q {0} {1}".format('report.html', 'report.pdf'))
```

NB to insert the image into the xml, it is encoded in base64

```
with open('mymap.png'), "rb") as f:
    myimage = f.read()
    image_io = myimage.encode("base64")
```

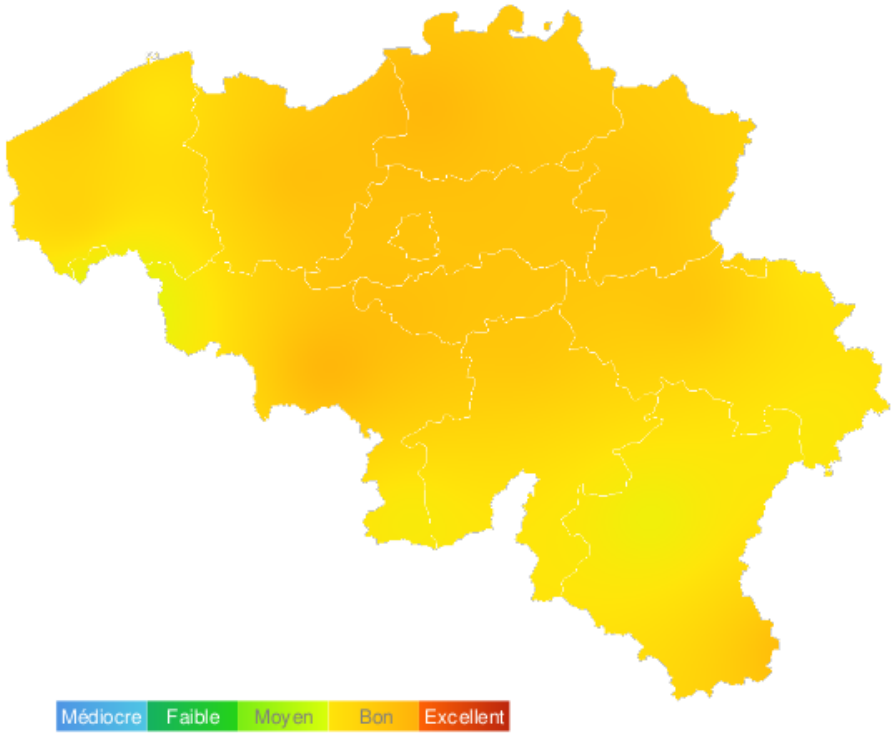
XSL transformation:

```
def apply_xsl_transformation(self, pxslFileName, pxmlString):
    """ apply a xsl transformation to an xml file """
    """ load the xsl file that will perform the transformation """
    parser = etree.XMLParser(remove_blank_text=True)
    myxslt = etree.parse(pxslFileName, parser)
    transform = etree.XSLT(myxslt)
    """ load the xml string to be transformed
        erase any encoding declaration to avoid error with the next trea
    pxmlString = re.sub(' encoding=\'utf-8\'', ' ', pxmlString)
    myxml = etree.XML(pxmlString)
    result = transform(myxml)

    return unicode(result)
```

Bonjour à tous,

Voici la carte et les chiffres du 22/06/2016 calculés le 22/06/2016 à 11:35.



Localités Viva Namur

Localité	Ou aussi	Appréciation	Pic	Visualisation
Namur	Profondeville, Jambes, Champion, Wépion, Beez, Malonne, Bouge	Bon	13h	10 11 12 **13** 14 15 16 17
Chimay	Saint-Rémy, Virelle, Vaulx, Lompret, Forges, Robechies	Moyen	14h	10 11 12 13 **14** 15 16 17
St-Hubert	Sartay, Libin, Lorcy, Vesqueville, Poix-Saint-Hubert, Jenneville	Moyen	14h	10 11 12 13 **14** 15 16 17
Nivelles	Monstreux, Thines, Baulers, Witterzée, Rosseignies, Croiseau	Bon	13h	10 11 12 **13** 14 15 16 17

LEAFLET

Used libraries:

- jquery-2.2.3.min.js
- leaflet-1.0.0.js
- proj4-compressed.js
- proj4leaflet.js

GLOBAL SETTINGS

Windows bounds:

```
beBounds : [[ 51.49, 2.54],[49.49, 6.42]],
```

Projection used by the map:

```
belProjection : "+proj=lcc +lat_1=51.16666723333333 +lat_2=49.8333339 +l

EPSG31370 : new L.Proj.CRS("urn:ogc:def:crs:EPSG::31370", belProjection,
        {
            resolutions: [8192, 4096, 2048, 1024, 512, 256, 128],
            origin: [0, 0]
          }),
```

Solar image bounds in EPSG31370:

```
beimgBounds : L.bounds([12500.00, 244000.00],[308600.00, 21000.00]),
```

LOAD THE COUNTRY MAP

buildMap :

```
map = L.map('map-container',
            {center: [50.50, 4.50], zoom: 2.7, crs: EPSG31370});
addPane('beadm2', 400);
beadm2 = L.Proj.geoJson(map_be,
                        {weight:0.5,
                        color:"#fff",
                        fill: false,
                        pane: 'beadm2'}
                        ).addTo(map);

buildPointsLayer();
""" Add map event for responsiveness """
map.on('popupclose', function(){
    resizeMap();
});
```

LOAD PV POINTS AND MANAGE PROJECTION SETTINGS WITH PROJ4

buildPointsLayer :

```
solpv_points = [];
$.each(summaryData.zpoints, function(key, point){

    myIconPv = L.divIcon({className: 'geopoint-icon'
        , html: '<a tooltip="'+ point.solptname + '" href="#" class="geo
        , iconAnchor: icon_anchor
        });

    myPopup = L.popup({className:"pv_popup"})
                    .setContent(buildPopupContent(point));

    belCoords = proj4(belProjection)
                    .inverse([ point.longitude, point.latitude]);

    L.marker([belCoords[1], belCoords[0]],{icon: myIconPv})
        .bindPopup(myPopup).openPopup().addTo(map);

});
```

ADD EACH HOURLY IMAGE AND THE DAILY SUMMARY AS A PANE

What are panes?

In Leaflet, map panes group layers together implicitly. This grouping allows web browsers to work with several layers at once in a more efficient way than working with layers individually.

*Map panes use the **z-index** CSS property to always show some layers on top of others. This is why, popups always show "on top" of other layers, markers always show on top of tile layers, etc.*

Add the solar image as background pane:

```
sl = [];
for (i = 0; i < (endHour - startHour); i++) {
    hr = startHour + i;
    sl[i] = {id: 'sl_' + hr,
        layer : addSolarLayer('map_hourly' + hr + '.png', 'sl_' + hr)};
}
```

Add the daily synthesis map:

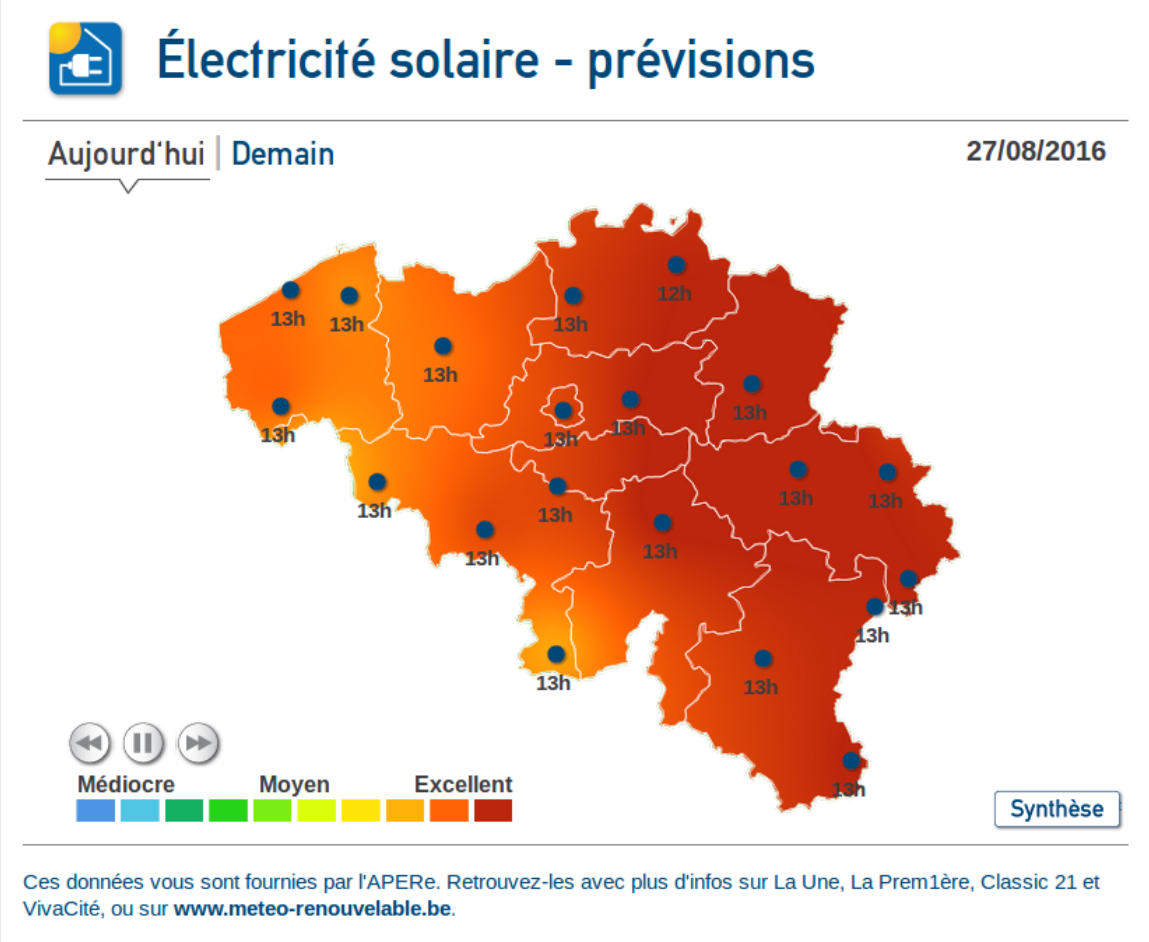
```
sl[i] = {id: 'sl_day',
        layer : addSolarLayer('map_daily.png', 'sl_day')};
```

Add pane functions:

```
addSolarLayer : function(imageUrl, id){
    var SL;
    addPane(id, 300);
    SL = L.Proj.imageOverlay(imageUrl,
                             beimgBounds,
                             {pane: id}).addTo(map);
    return SL
},

addPane : function(id, startZi){
    map.createPane(id);
    map.getPane(id).style.zIndex = startZi;
},
```

NOW YOU CAN PLAY WITH THE Z-INDEX OF THE DIFFERENT PANES



#VaVersLeSoleil IFrame

@jphuart jph@openjph.be

Thank **you** for your kind attention.

This presentation is available at

https://github.com/jphuart/openjph-presentations/tree/master/FOSS4G-2016

Thanks to reveal.js https://github.com/hakimel/reveal.js for the presentation framework.

Jean Pierre Huart - FOSS4G - 2016-09-22