OMNISCAPE

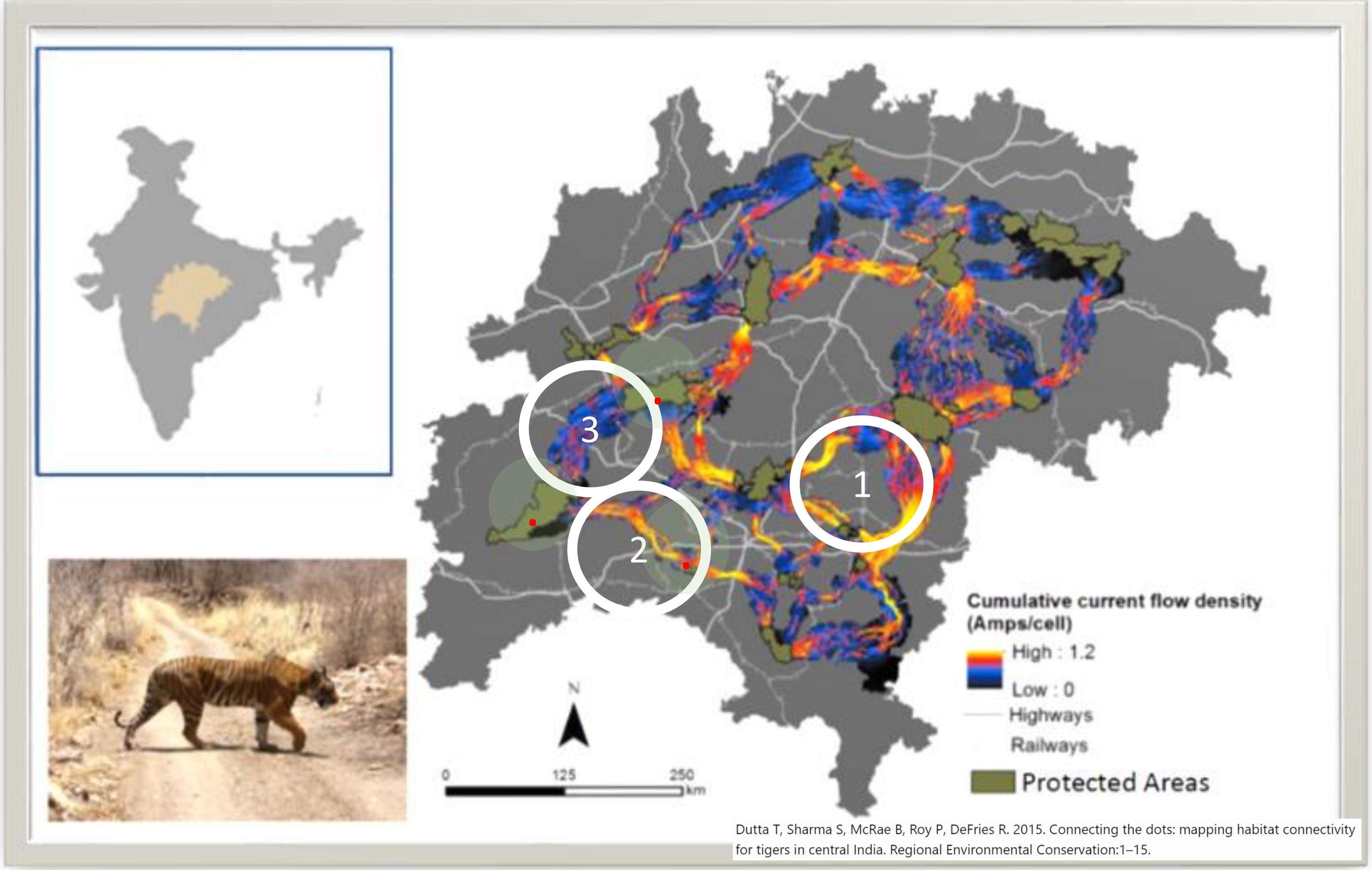
An omnidirectional approach to landscape connectivity

Circuitscape: pairwise connectivity analysis

- Based on circuit theory
- Complements least-cost paths.
- It considers effects of all possible pathways across a landscape simultaneously BETWEEN A PAIR OF NODES .

Output: Current flow

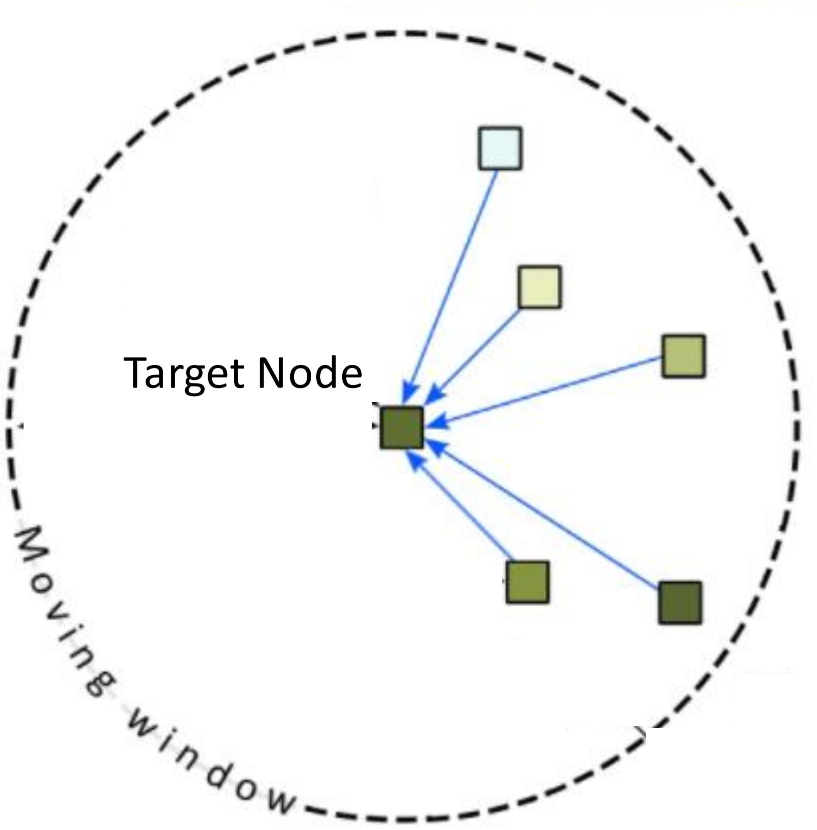
1) Avoid areas with strong movement barriers
2) Concentrate in key linkages where flow *channeled* through *pinch-points (bottlenecks)*
3) Diffuse in highly intact areas with few barriers



Dutta T, Sharma S, McRae B, Roy P, DeFries R. 2015. Connecting the dots: mapping habitat connectivity for tigers in central India. Regional Environmental Conservation:1–15.

Omniscape: applies Circuitscape iteratively through nodes within a moving window

🟩 Nodes (Sources)



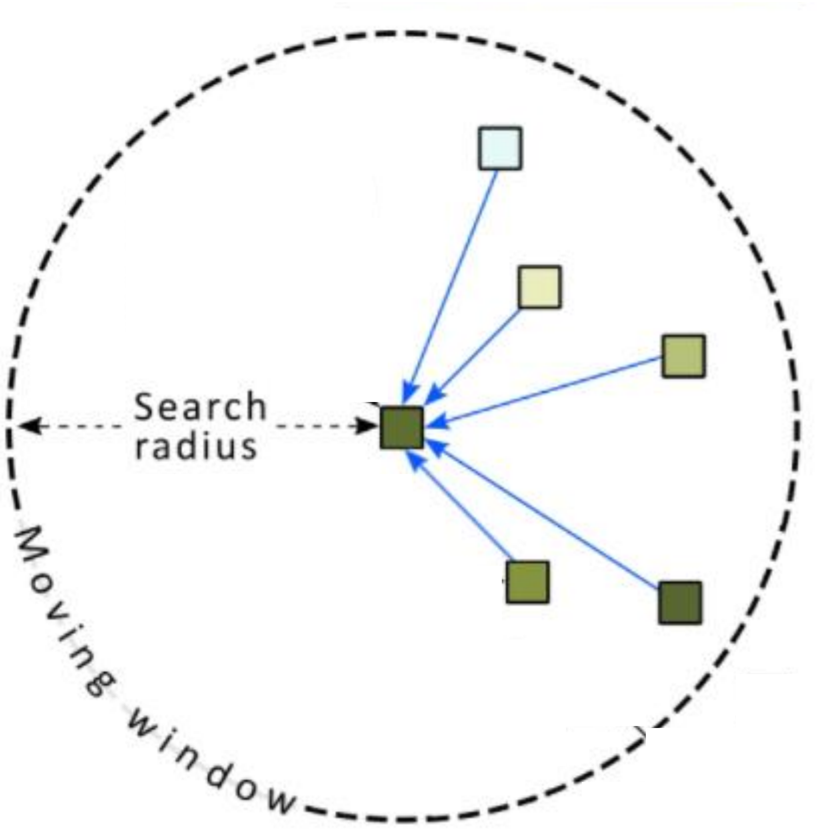
Total current injected = source strength of the target pixel

The current injected is shared among the source pixels in proportion to their source strengths.

Omniscape applies Circuitscape iteratively through nodes within a moving window: RADIUS OF THE WINDOW

The moving window has a radius that can be set according to species movement range

Radius in CELLS *consider resolution to get the actual size of the window

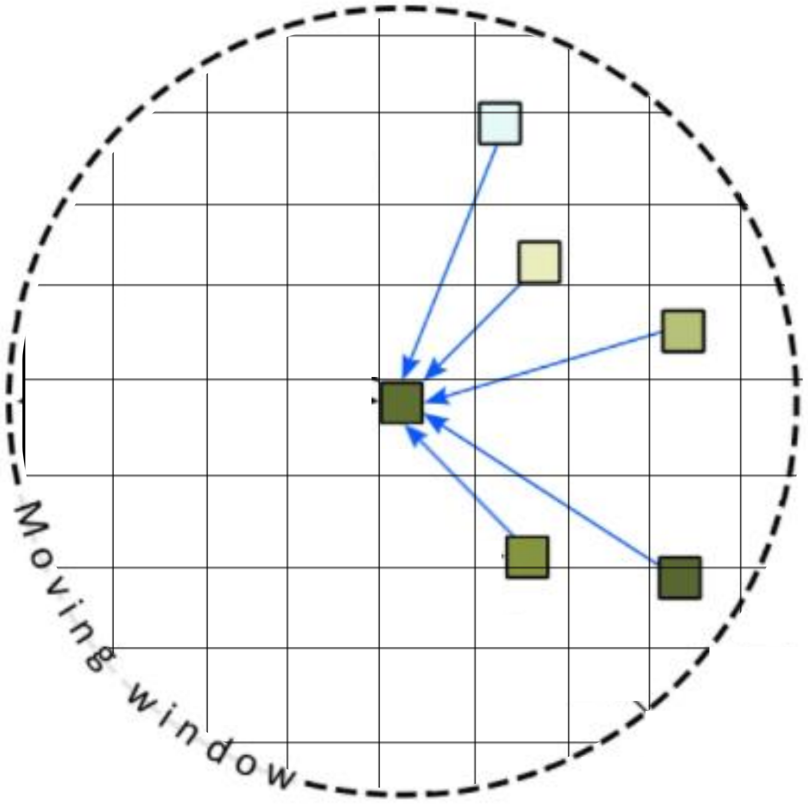


500 radius in 30m resolution = 15,000m = 15km

Omniscape applies Circuitscape iteratively through nodes within a moving window: BLOCKSIZE OF THE WINDOW

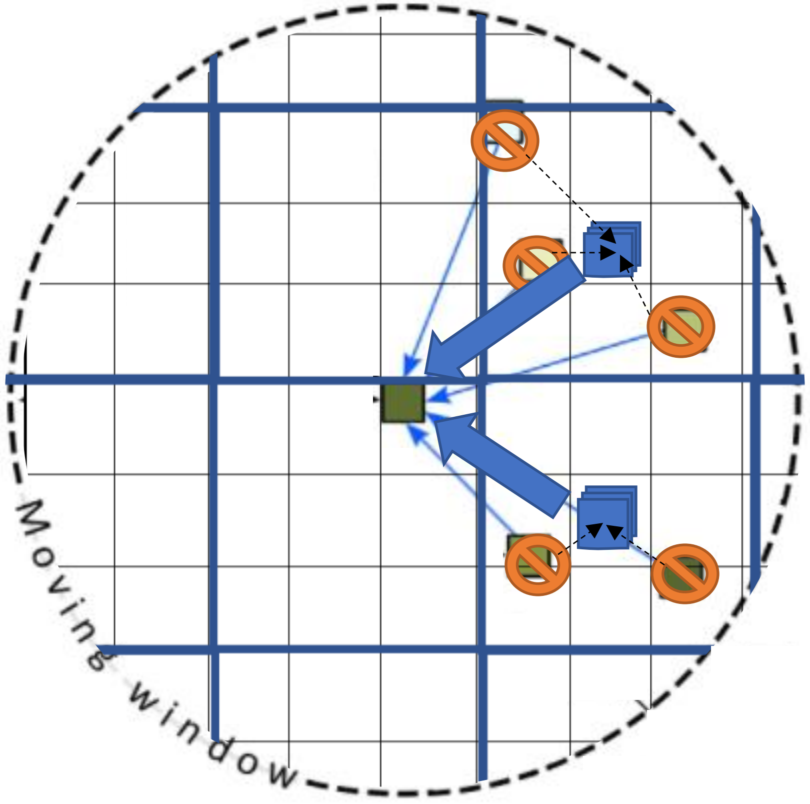
The algorithm considers a blocksize within the moving window, to coarsen it up and reduce computational need.

Blocksize 1



Omniscape applies Circuitscape iteratively through nodes within a moving window: BLOCKSIZE OF THE WINDOW

The algorithm considers a blocksize within the moving window, to coarsen it up and reduce computational need.



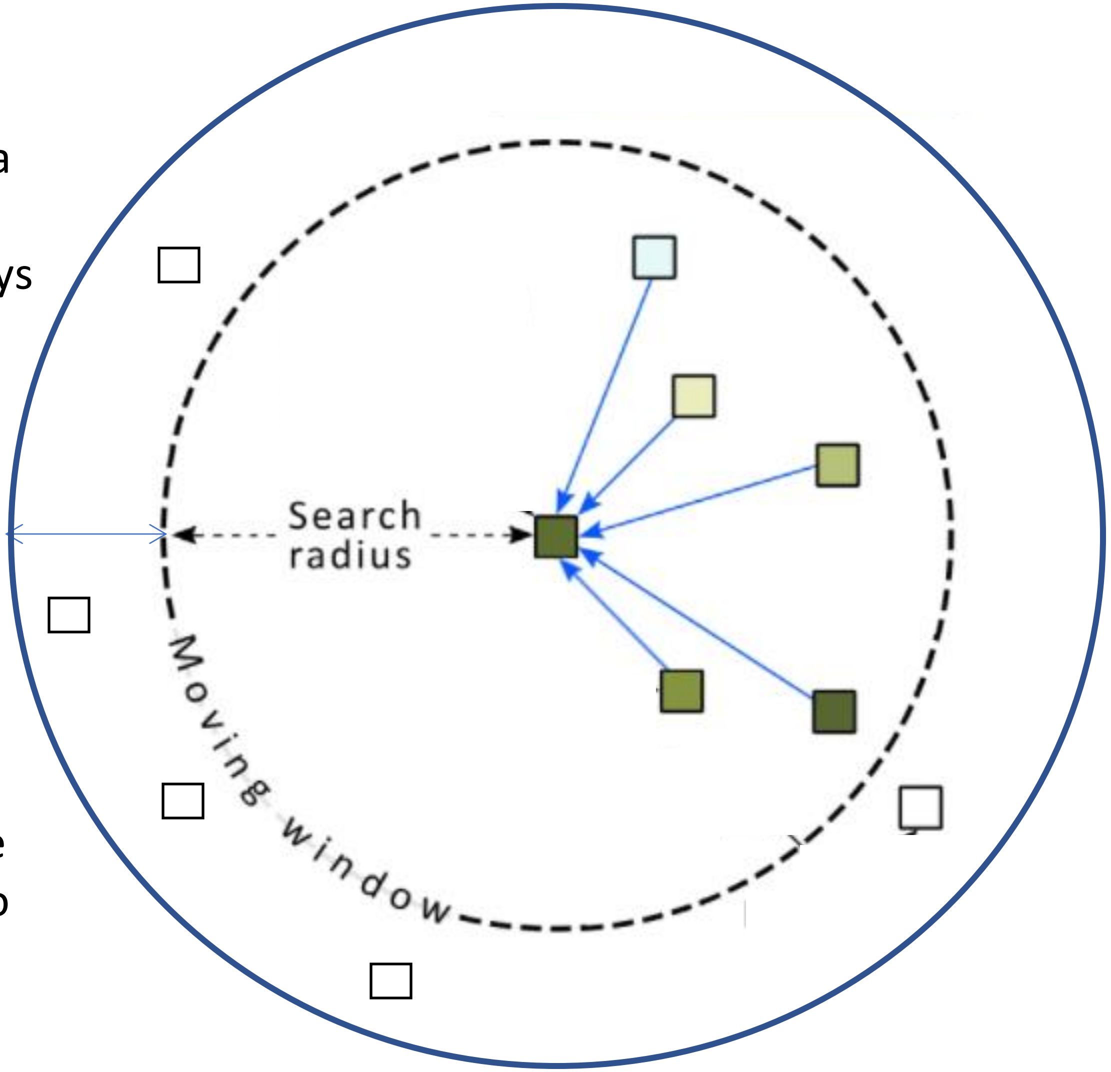
Blocksize 3

Acceptable sizes to reduce computational requirements without increasing patchyness, some examples that have been used:

- Southern Ontario: Blocksize 46
- GTA: Blocksize 21

Omniscape applies Circuitscape iteratively through nodes within a moving window: BUFFER OF THE WINDOW

You can also add a buffer, but so far I have seen it always at default (0)



Clips the resistance and source layers beyond the radius, but nodes within the buffer area are set to zero.

Omniscape needs three things from you:

1

Resistance map
.tif or .asc

2

Source map
.tif or .asc

E.g.

- 1|0 map with 1 as source cells
- Suitable areas defined by habitat suitability map

*optional
Instead resistance map can be used to set source areas by defining a threshold.

3

Parameters in a
textfile (.ini)

Make sure projections match!

Omniscape will give you three things:

1

Current flow map (.tif)

= Total current for each landscape pixel.

2

Flow potential map (.tif)

= predicted current under resistance-free conditions.

3

Normalized current flow map (.tif)

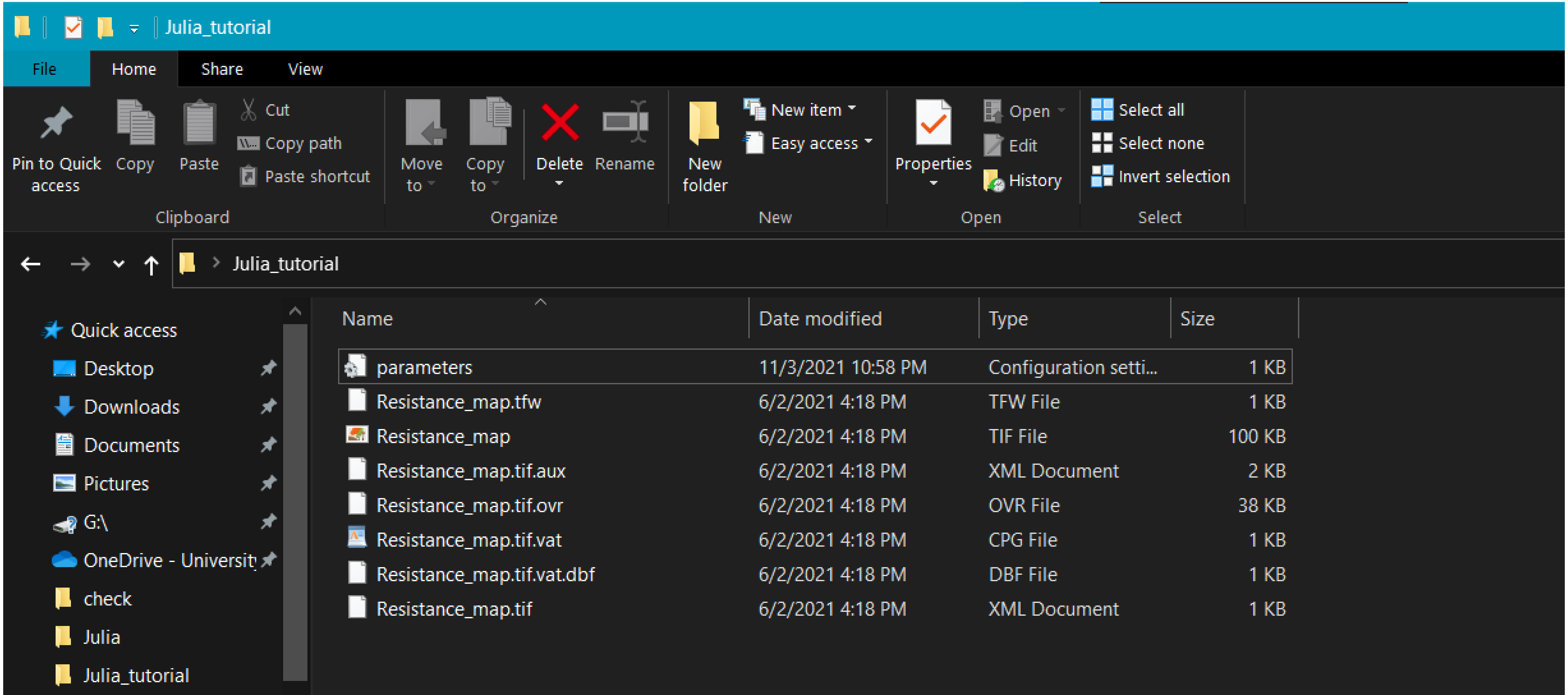
= the degree to which a pixel has more or less current than expected under resistance-free conditions (cumulative current flow divided by flow potential)

Parameter textfile

- Needs to follow this format →
- Everything in [] is not read by the program
- Saved as .ini

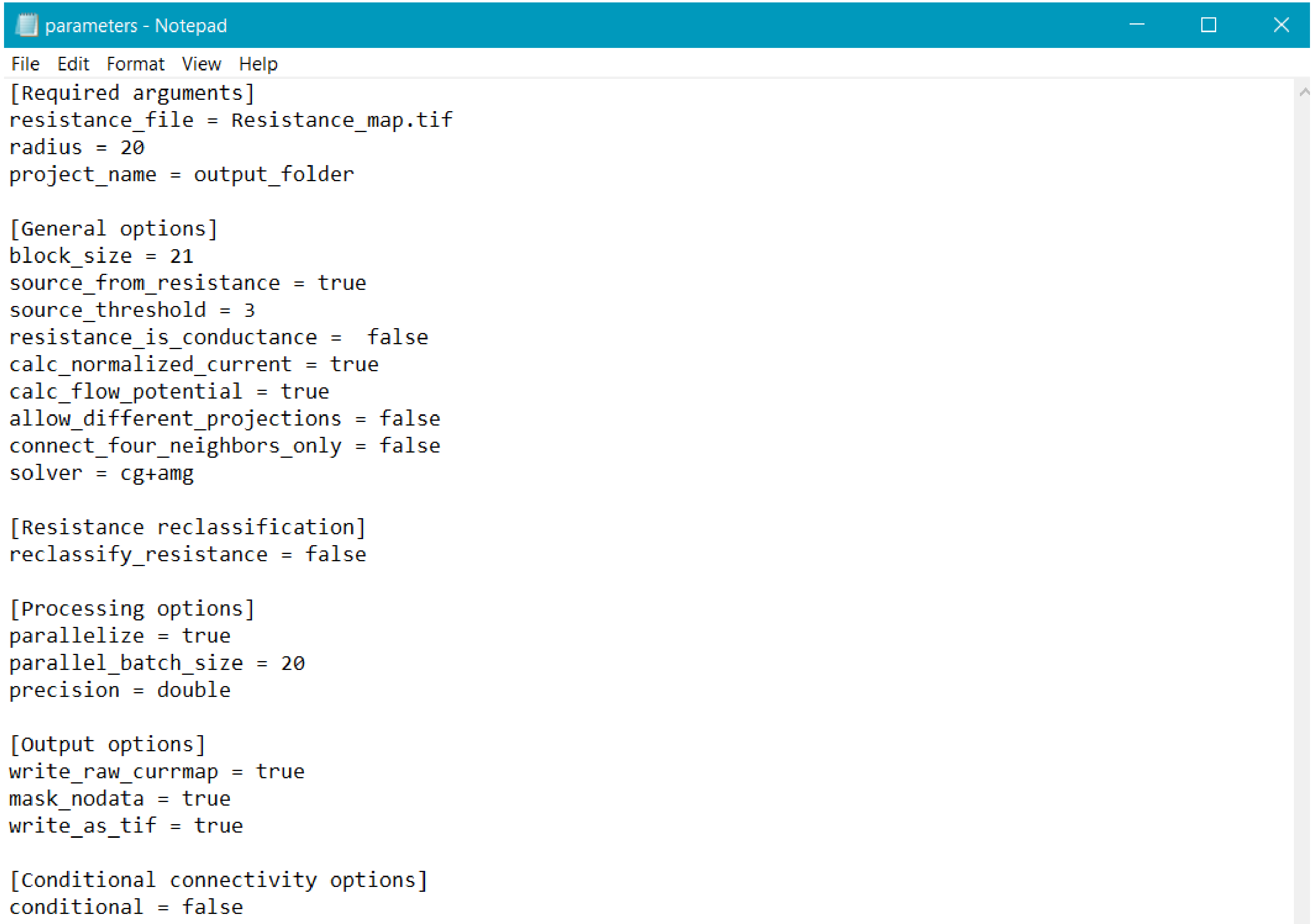
```
[Required arguments]
resistance_file = Resistancefile.tif
radius = 500
project_name = subfolder_output_name
source_file = Sourcefile.tif [can skip if not using]

[General options]
block_size = 21
source_from_resistance = true [if not using a source file set as true]
resistance_is_conductance =  false [if values in resistance map are inverted]
source_threshold = 3
calc_normalized_current = true
calc_flow_potential = true
allow_different_projections = false
connect_four_neighbors_only = false [connects 8 neighboring cells if false]
solver = cg+amg [same process as Circuitscape]

[Resistance reclassification]
reclassify_resistance = false [if you want to change the resistance values]


[Processing options]
parallelize = true
parallel_batch_size = 20
precision = double

[Output options]
write_raw_currmap = true
mask_nodata = true
write_as_tif = true

[Conditional connectivity options]
conditional = false
```

Running Omniscape: check that you have all the files



Name	Date modified	Type	Size
parameters	11/3/2021 10:58 PM	Configuration setti...	1 KB
Resistance_map.tfw	6/2/2021 4:18 PM	TFW File	1 KB
Resistance_map	6/2/2021 4:18 PM	TIF File	100 KB
Resistance_map.tif.aux	6/2/2021 4:18 PM	XML Document	2 KB
Resistance_map.tif.ovr	6/2/2021 4:18 PM	OVR File	38 KB
Resistance_map.tif.vat	6/2/2021 4:18 PM	CPG File	1 KB
Resistance_map.tif.vat.dbf	6/2/2021 4:18 PM	DBF File	1 KB
Resistance_map.tif	6/2/2021 4:18 PM	XML Document	1 KB

Running Omniscape : check your parameters file



```
[Required arguments]
resistance_file = Resistance_map.tif
radius = 20
project_name = output_folder

[General options]
block_size = 21
source_from_resistance = true
source_threshold = 3
resistance_is_conductance =  false
calc_normalized_current = true
calc_flow_potential = true
allow_different_projections = false
connect_four_neighbors_only = false
solver = cg+amg

[Resistance reclassification]
reclassify_resistance = false

[Processing options]
parallelize = true
parallel_batch_size = 20
precision = double

[Output options]
write_raw_currmap = true
mask_nodata = true
write_as_tif = true

[Conditional connectivity options]
conditional = false
```

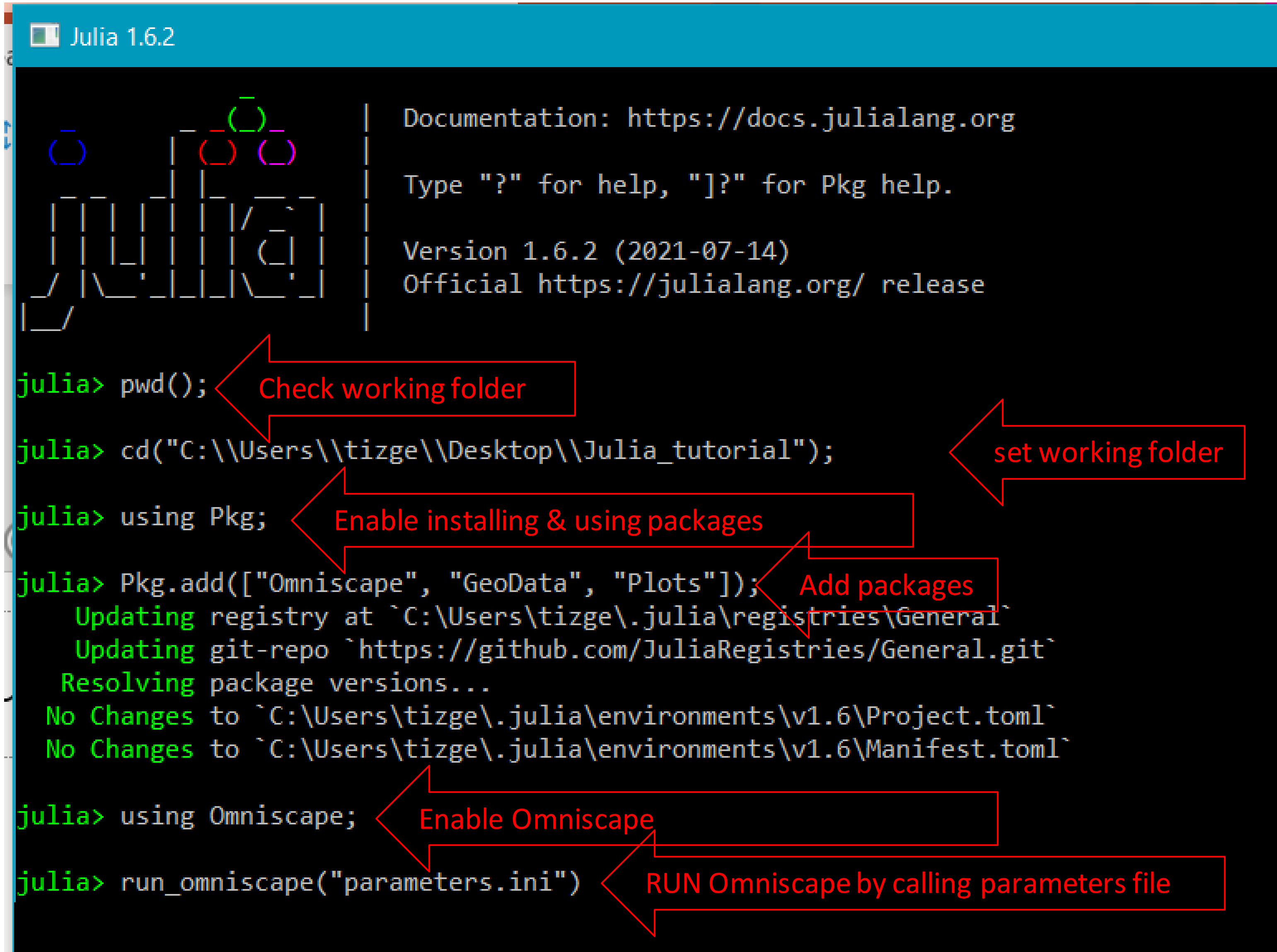
Running Omniscape : open Julia

CODE: PART I

```
pwd();
cd("C:\\Users\\tizge\\Desktop\\Julia_tutorial");
using Pkg;
Pkg.add(["Omniscape","GeoData","Plots"]);
using Omniscape;
run_omniscape("parameters.ini")
```

To copy paste this from the “code.txt” in the folder I sent, select, copy as usual (ctrl+c) but to paste: right click on Julia (not ctrl+v)

Check your working folder for the subfolder with your output maps



```
               _
   _       _ _(_)_     |  Documentation: https://docs.julialang.org
  (_)     | (_) (_)    |
   _ _   _| |_  __ _   |  Type "?" for help, "]?" for Pkg help.
  | | | | | | |/ _` |  |
  | | |_| | | | (_| |  |  Version 1.6.2 (2021-07-14)
 _/ |\__'_|_|_|\__'_|  |  Official https://julialang.org/ release
|__/                   |

julia> pwd();

julia> cd("C:\\Users\\tizge\\Desktop\\Julia_tutorial");

julia> using Pkg;

julia> Pkg.add(["Omniscape", "GeoData", "Plots"]);
    Updating registry at `C:\Users\tizge\.julia\registries\General`
    Updating git-repo `https://github.com/JuliaRegistries/General.git`
   Resolving package versions...
  No Changes to `C:\Users\tizge\.julia\environments\v1.6\Project.toml`
  No Changes to `C:\Users\tizge\.julia\environments\v1.6\Manifest.toml`

julia> using Omniscape;

julia> run_omniscape("parameters.ini")
```

Check working folder

set working folder

Enable installing & using packages

Add packages

Enable Omniscape

RUN Omniscape by calling parameters file

Running Omniscape : open Julia

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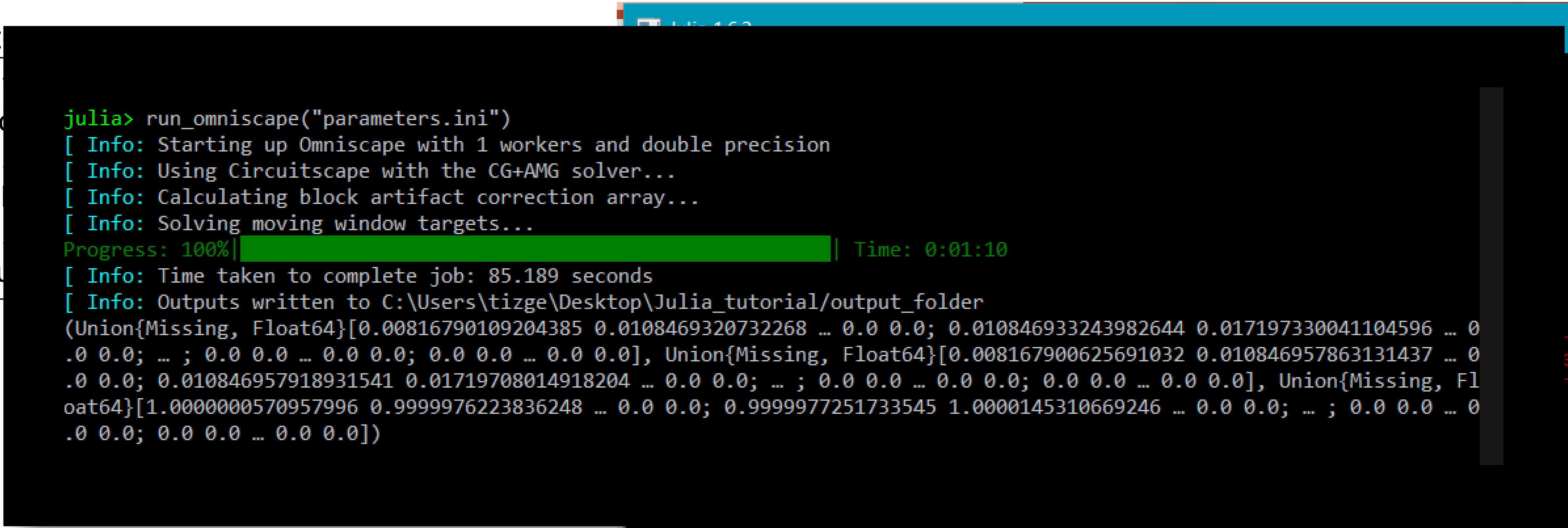
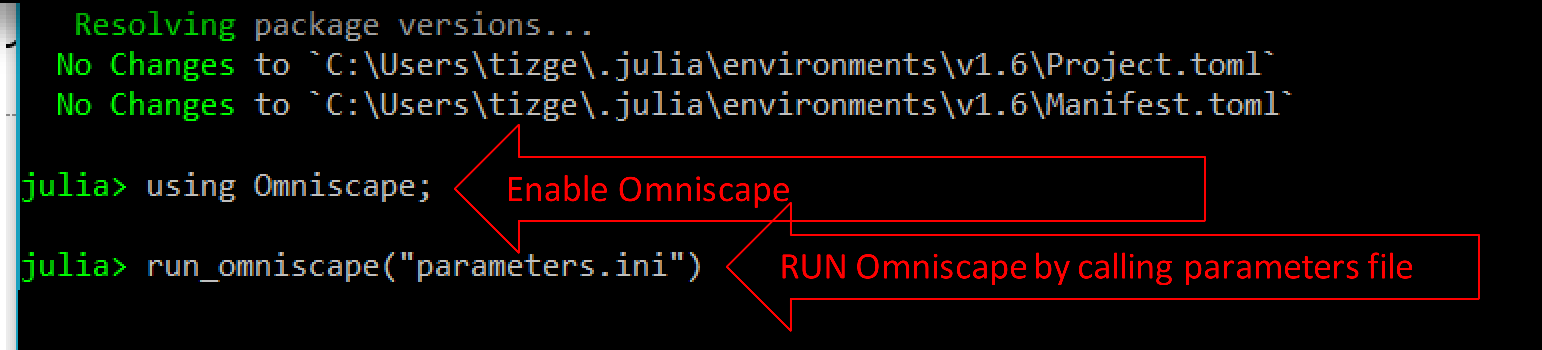


```
julia> run_omniscape("parameters.ini")
[ Info: Starting up Omniscape with 1 workers and double precision
[ Info: Using Circuitscape with the CG+AMG solver...
[ Info: Calculating block artifact correction array...
[ Info: Solving moving window targets...
Progress: 100%|███████████████████████████████████████████| Time: 0:01:10
[ Info: Time taken to complete job: 85.189 seconds
[ Info: Outputs written to C:\Users\tizge\Desktop\Julia_tutorial/output_folder
(Union{Missing, Float64}[0.008167901092043850 0.0108469320732268 … 0.0 0.0; 0.010846933243982644 0.017197330041104596 … 0
.0 0.0; … ; 0.0 0.0 … 0.0 0.0; 0.0 0.0 … 0.0 0.0], Union{Missing, Float64}[0.008167900625691032 0.010846957863131437 … 0
.0 0.0; 0.010846957918931541 0.017197080149182040 … 0.0 0.0; … ; 0.0 0.0 … 0.0 0.0; 0.0 0.0 … 0.0 0.0], Union{Missing, Fl
oat64}[1.0000000570957996 0.9999976223836248 … 0.0 0.0; 0.9999977251733545 1.0000145310669246 … 0.0 0.0; … ; 0.0 0.0 … 0
.0 0.0; 0.0 0.0 … 0.0 0.0])
```



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```

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Enable Omniscape

RUN Omniscape by calling parameters file

Check your working folder for the subfolder with your output maps

Running Omniscape: check your output map

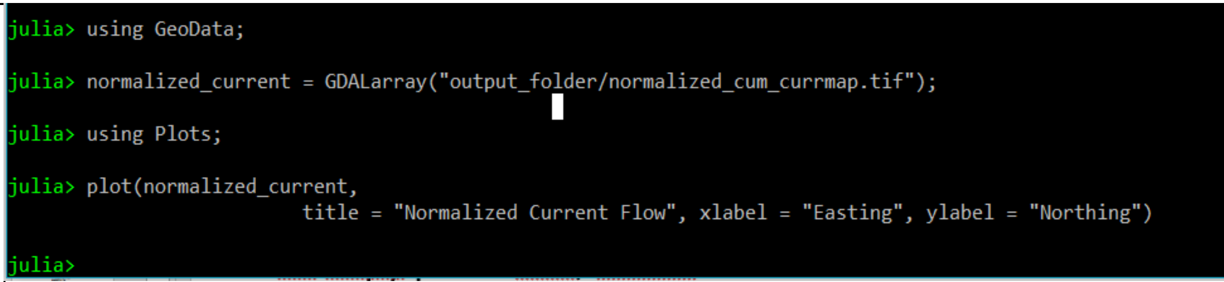
CODE: PART II

```
using GeoData;
normalized_current =
GDALarray("output_folder/normalized_cum_currmap.tif");
using Plots;
plot(normalized_current,
              title = "Normalized Current Flow", xlabel = "Easting",
ylabel = "Northing")
```

To copy paste this, select all, copy as usual (ctrl+c) and to past right click on Julia (not ctrl+v)

An extra window should´ve opened with your map

HOW IT LOOKS:



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julia> using GeoData;

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julia> using Plots;

julia> plot(normalized_current,
                   title = "Normalized Current Flow", xlabel = "Easting", ylabel = "Northing")

julia>
```

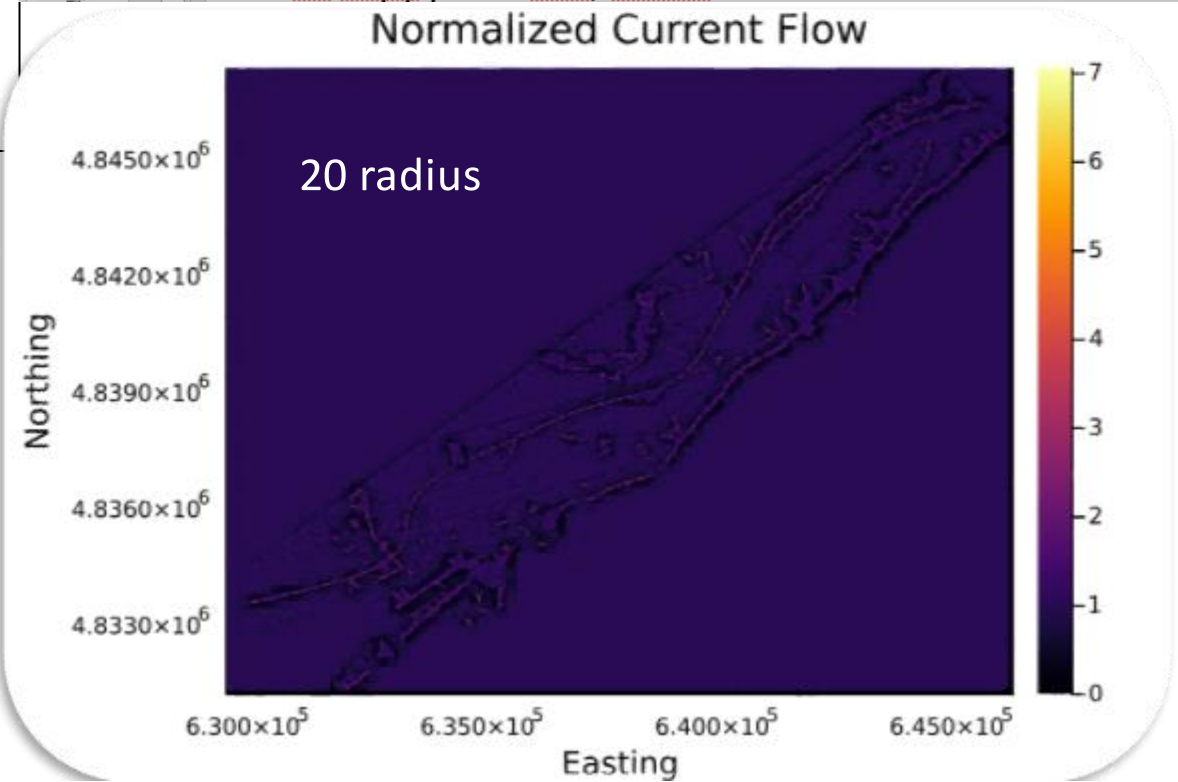

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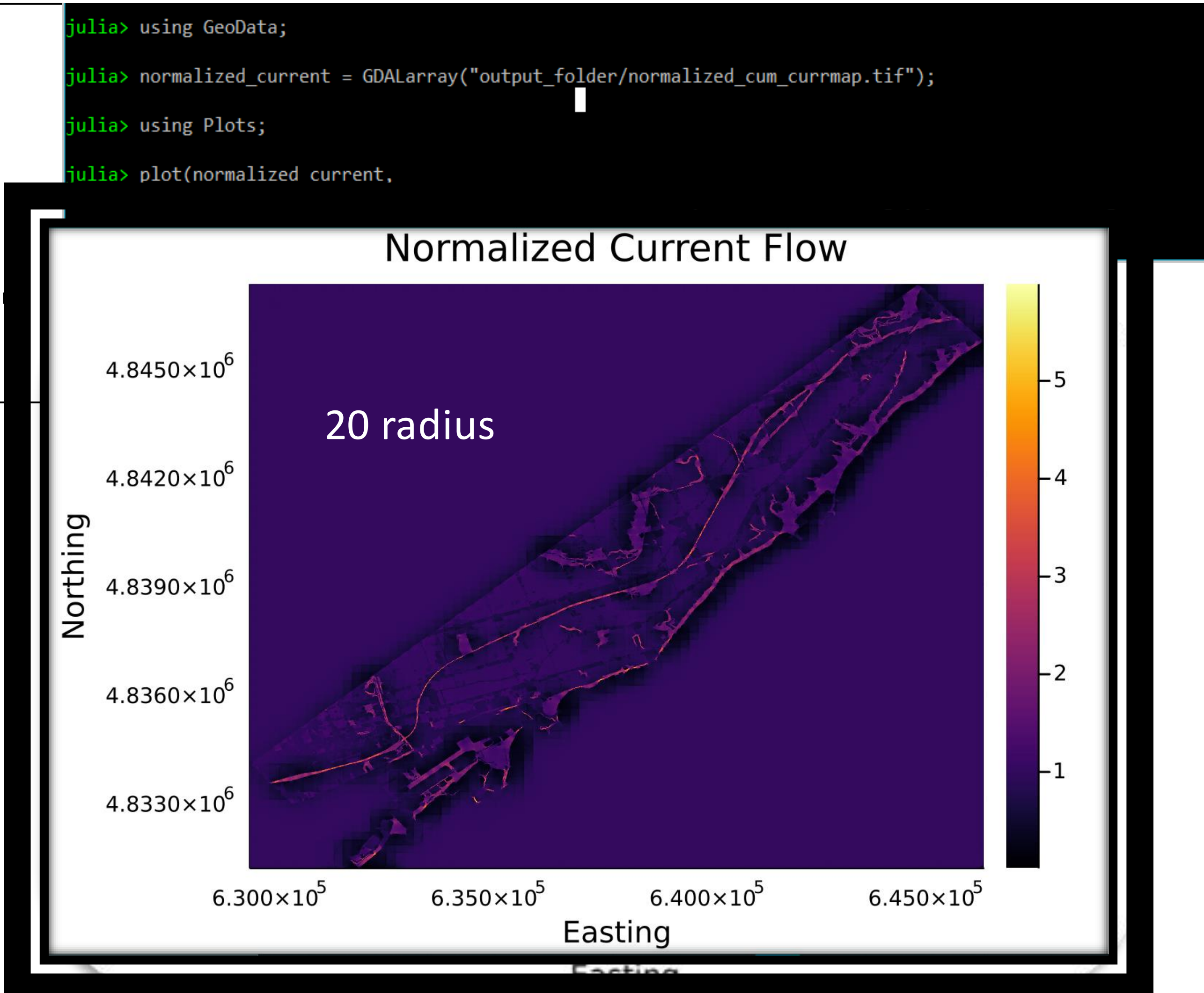

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