

OMNISCAPE

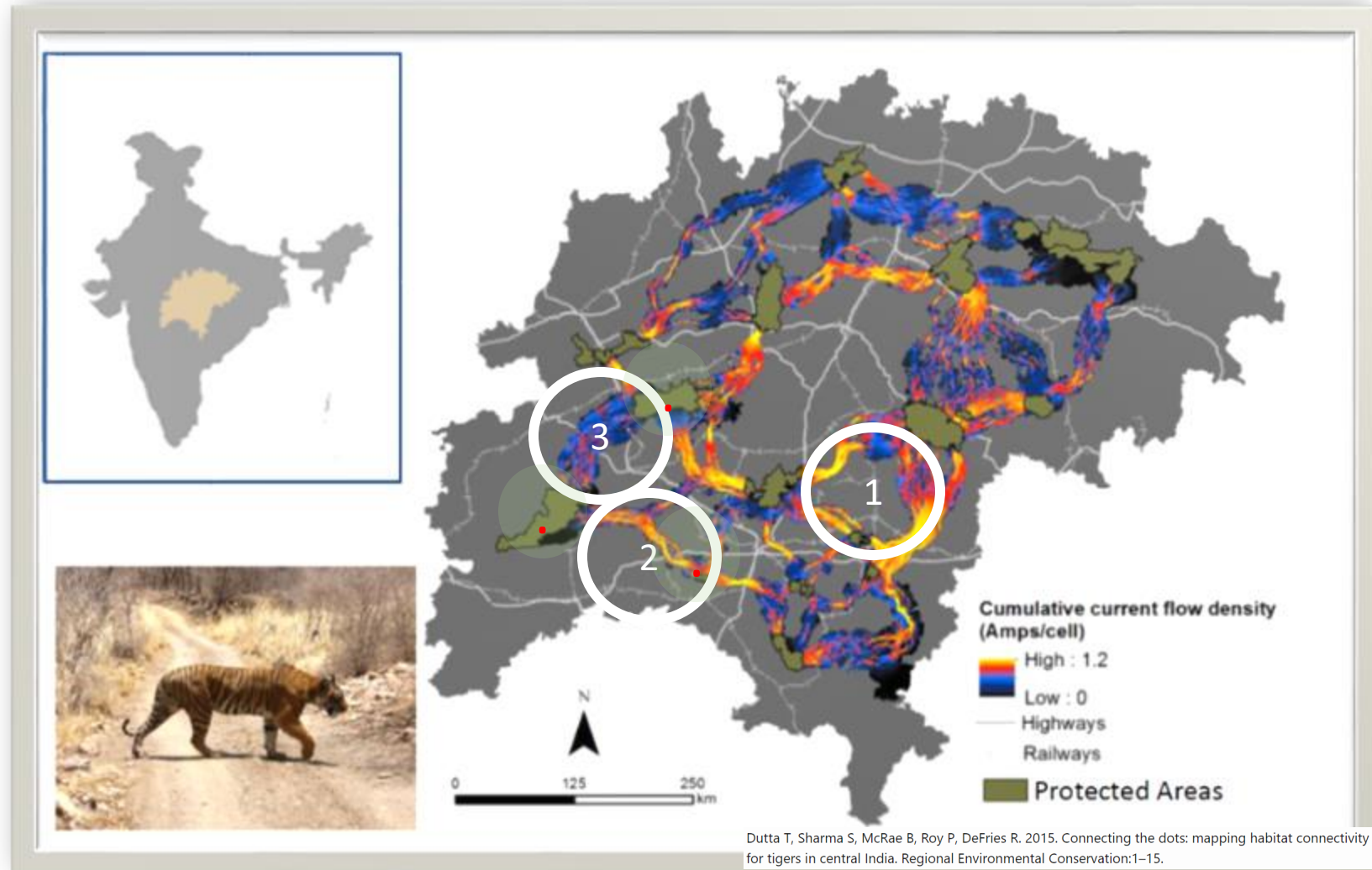
An omnidirectional approach to landscape connectivity

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.

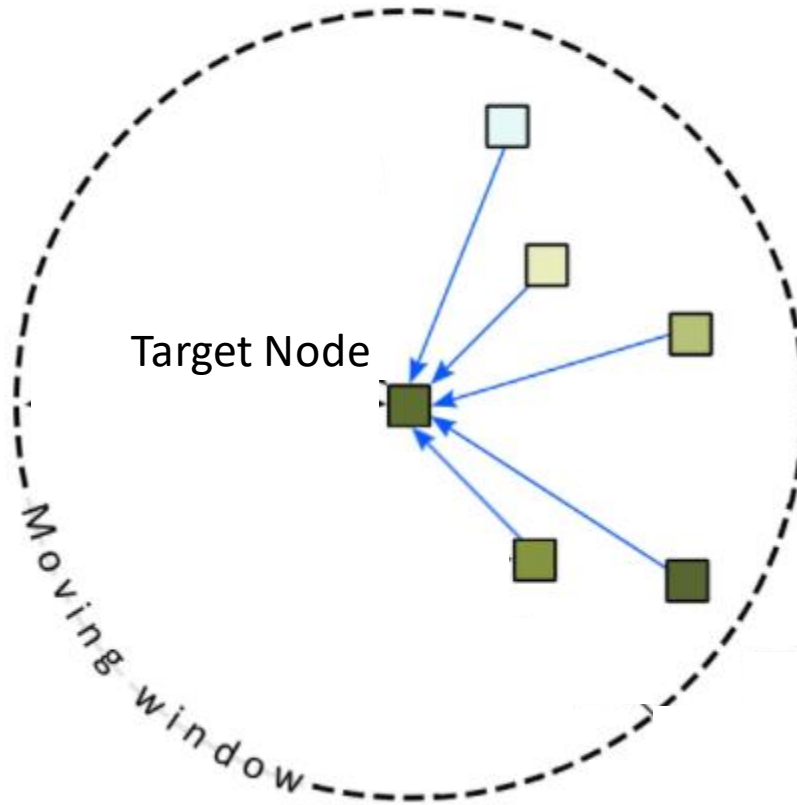
Output: Current flow

- 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



Omniscape: applies Circuitscape iteratively through nodes within a moving window

 Nodes (Sources)



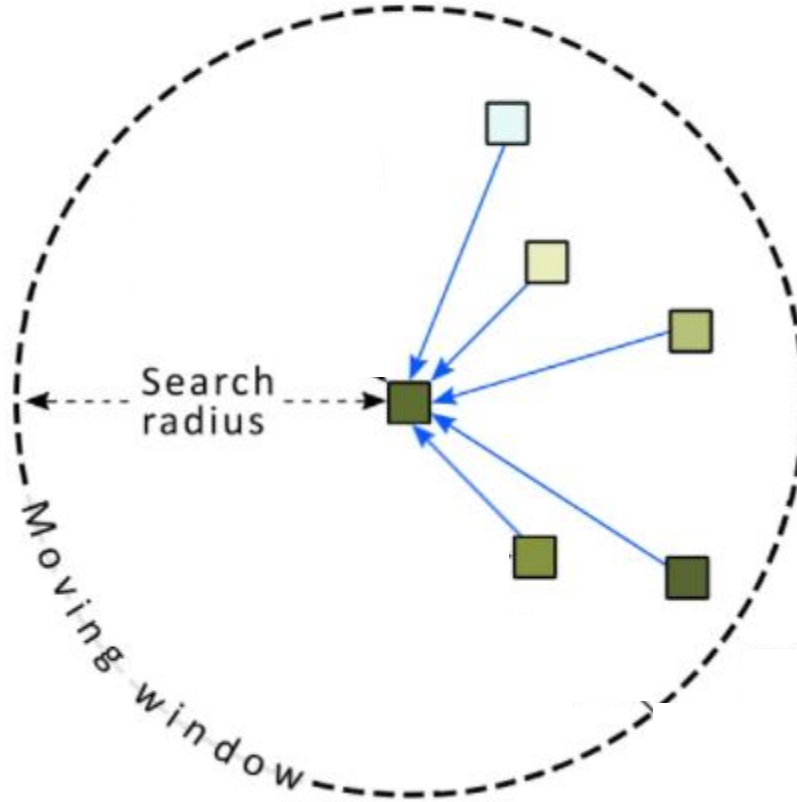
Total current injected = source strength of the target pixel

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

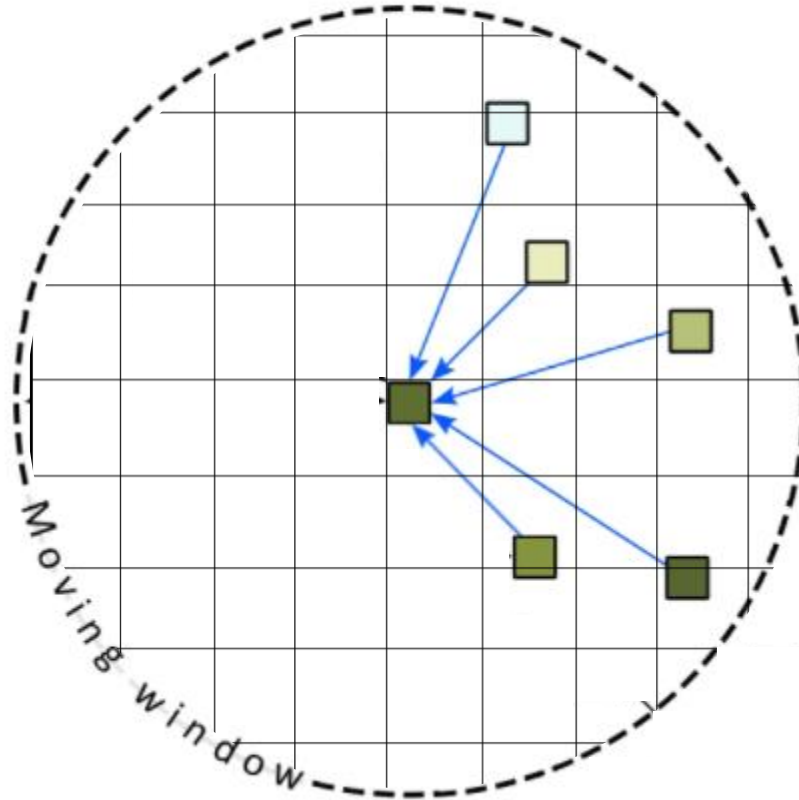


500 radius in 30m resolution = 15,000m = 15km

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.

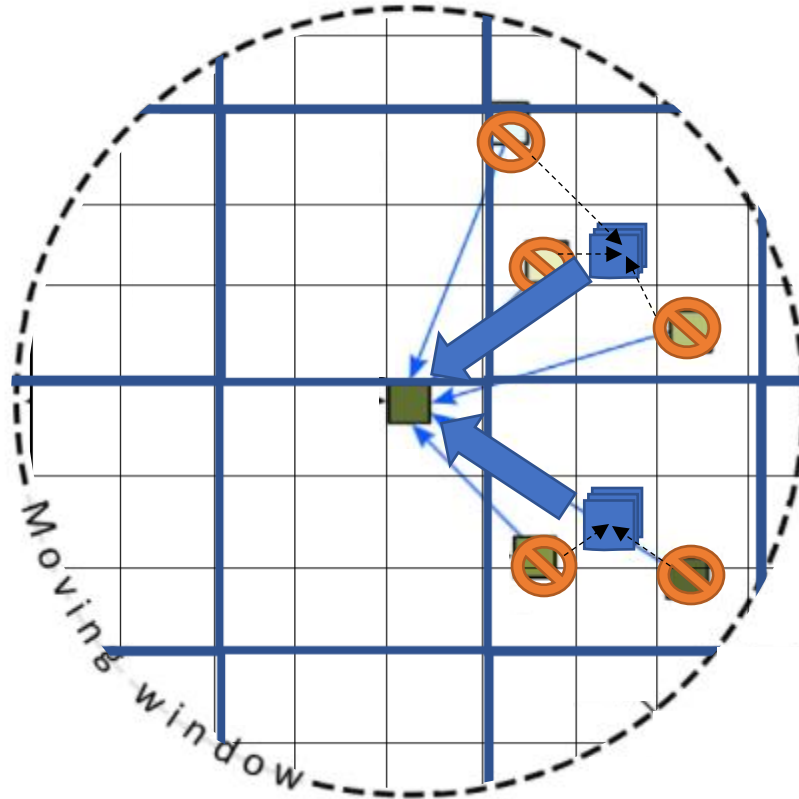
Blocksize 1



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



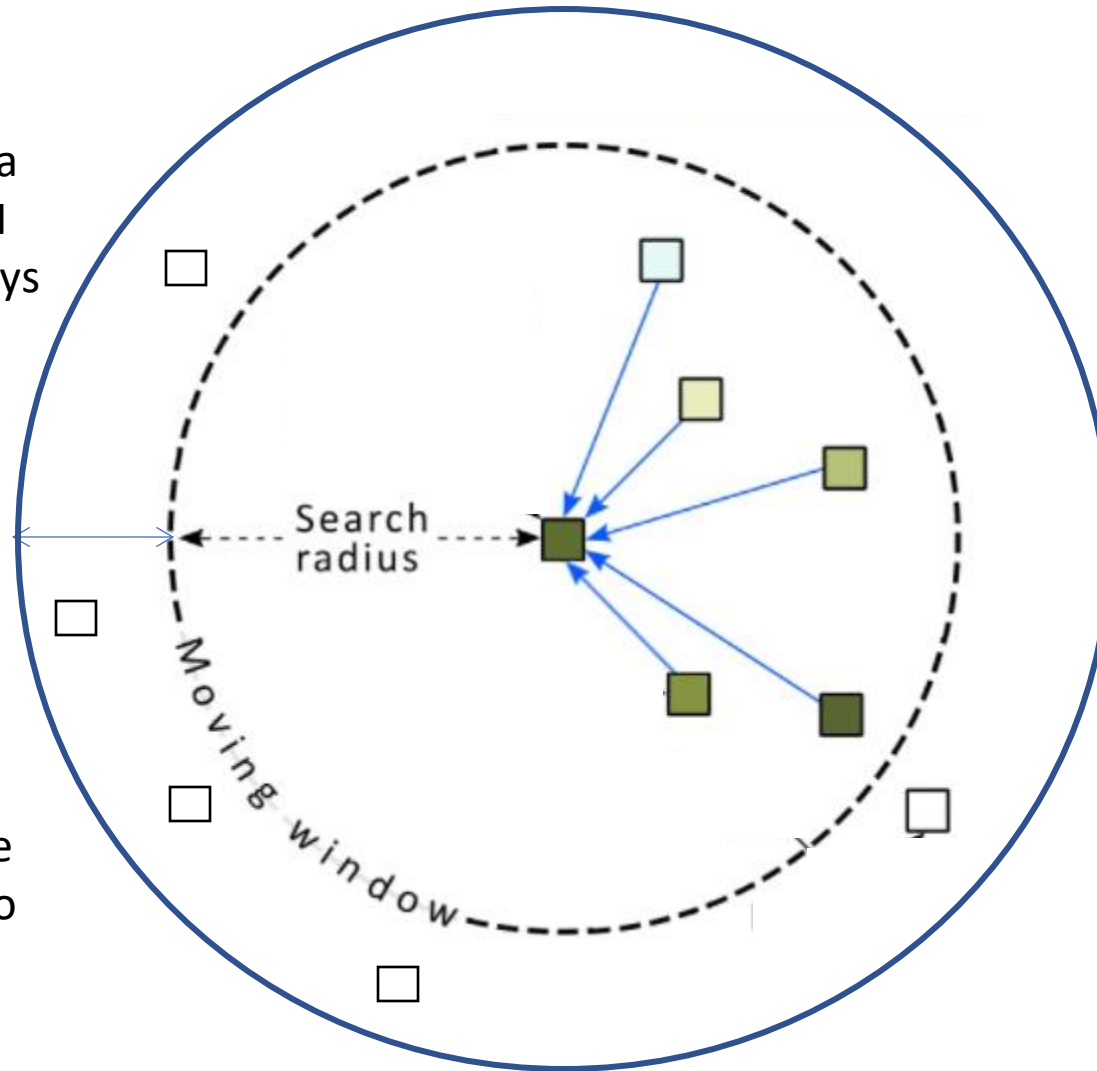
Acceptable sizes to reduce computational requirements without increasing patchyness, some examples that have been used:

- 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.



Omniscapc needs three things from you:

1

Resistance map
.tif or .asc

2

Source map
.tif or .asc

3

Parameters in a
textfile (.ini)

Make sure
projections
match!

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.

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]

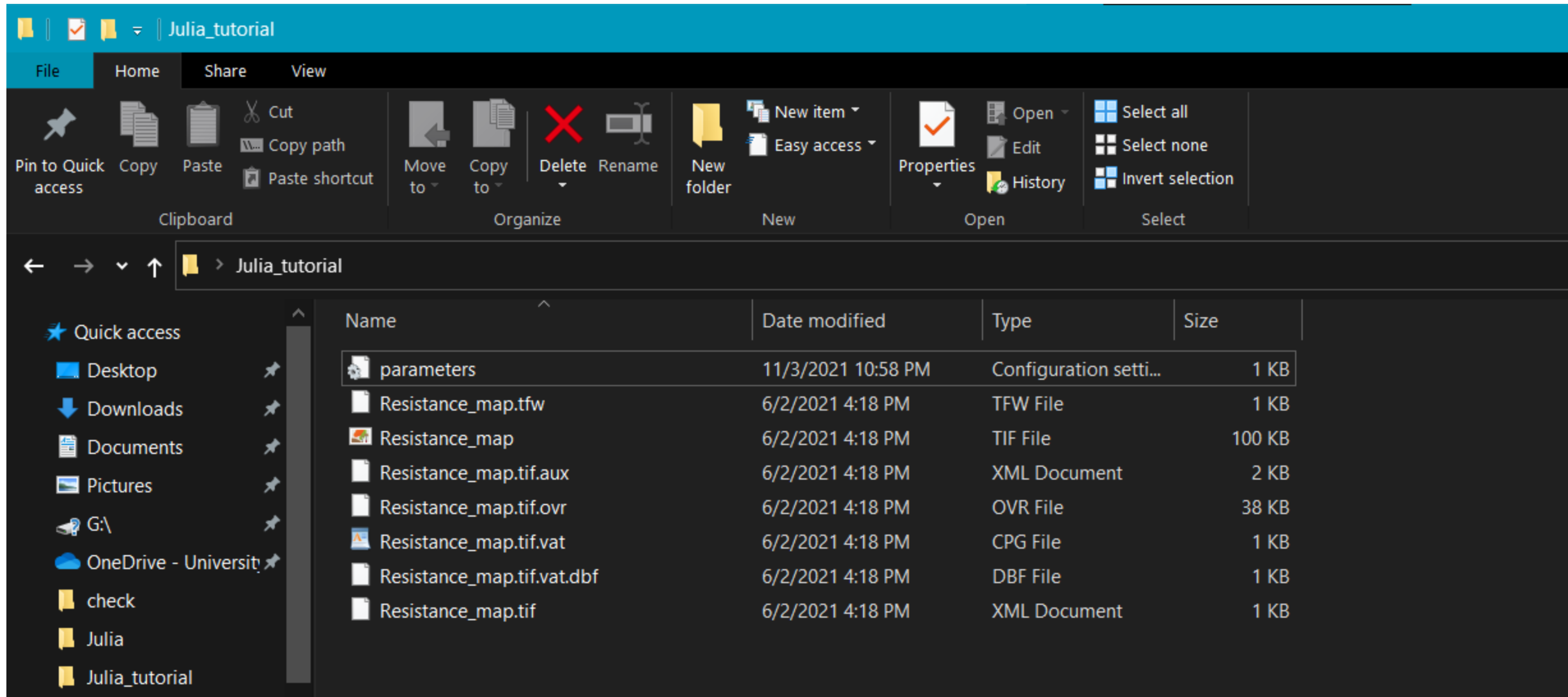
[Resistance reclassification]
reclassify_resistance = false [if you want to change the resistance values]

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

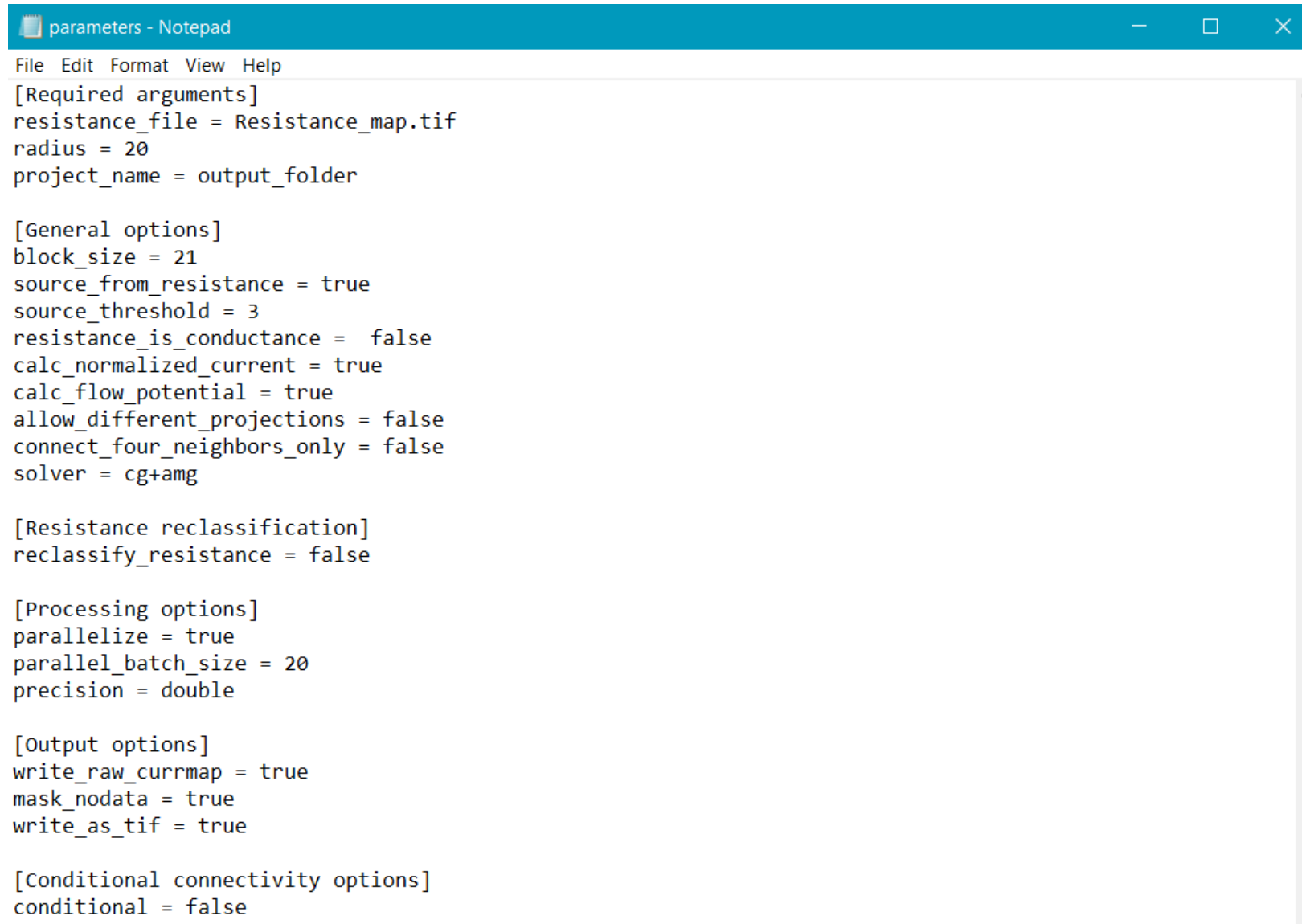
[Output options]
write_raw_currmap = true
mask_nodata = true
write_as_tif = true

[Conditional connectivity options]
conditional = false
```

Running Omniscap: check that you have all the files



Running Omniscape : check your parameters file



```
parameters - Notepad
File Edit Format View Help
[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
```

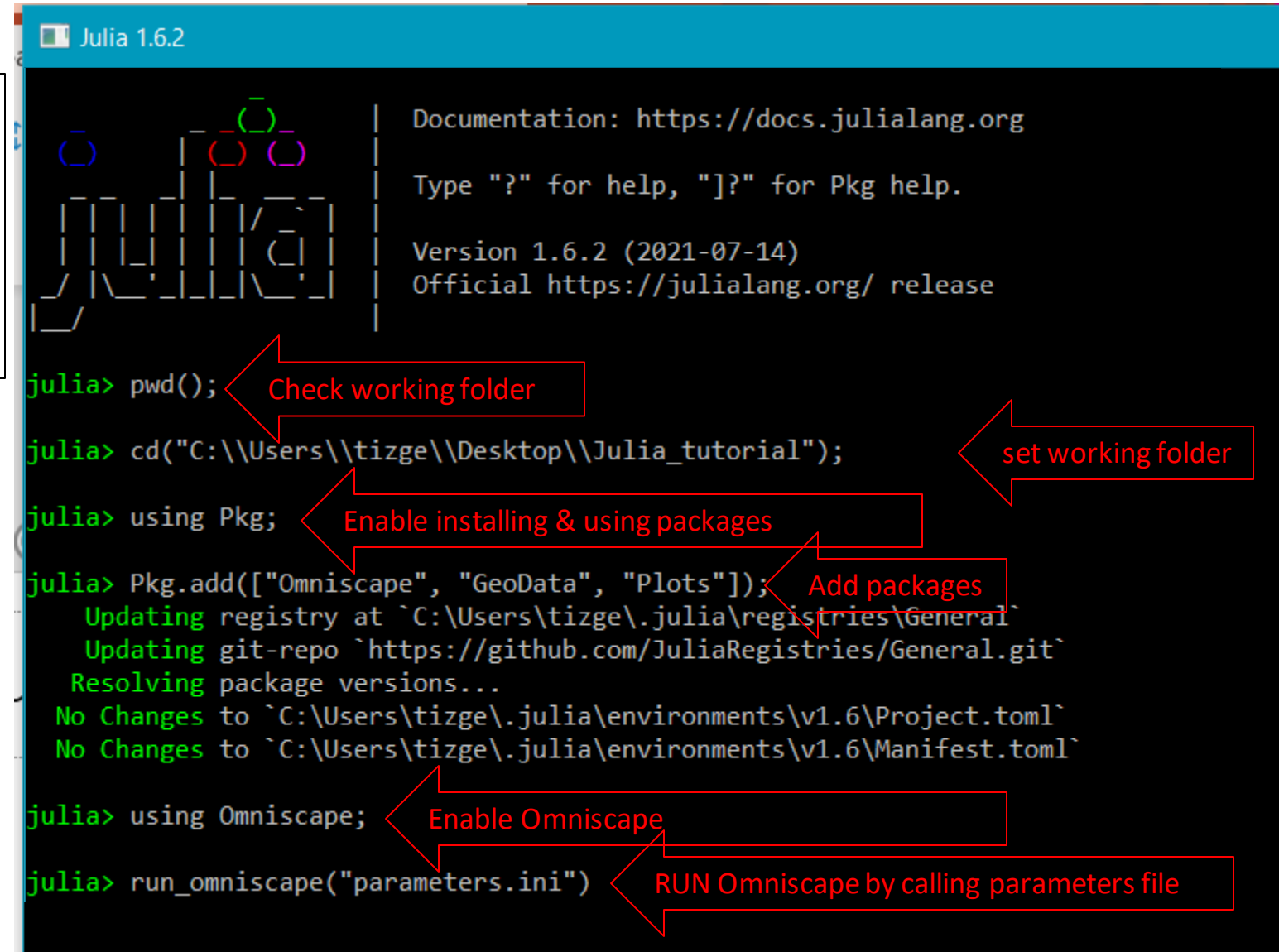
Running Omniscap : open Julia

CODE: PART I

```
pwd();  
cd("C:\\Users\\tizge\\Desktop\\Julia_tutorial");  
using Pkg;  
Pkg.add(["Omniscap", "GeoData", "Plots"]);  
using Omniscap;  
run_omniscap("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



The screenshot shows the Julia 1.6.2 REPL interface. The title bar is blue and says "Julia 1.6.2". The main area has a dark background with a Julia logo on the left and documentation links on the right. The command history on the left shows the steps taken. Red arrows point from text boxes to specific lines of code in the REPL.

```
Julia 1.6.2  
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(["Omniscap", "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 Omniscap;  
julia> run_omniscap("parameters.ini")
```

Annotations (red arrows):

- Check working folder (points to `pwd();`)
- set working folder (points to `cd("C:\\Users\\tizge\\Desktop\\Julia_tutorial");`)
- Enable installing & using packages (points to `using Pkg;`)
- Add packages (points to `Pkg.add(["Omniscap", "GeoData", "Plots"]);`)
- Enable Omniscap (points to `using Omniscap;`)
- RUN Omniscap by calling parameters file (points to `run_omniscap("parameters.ini")`)

Running Omniscap : open Julia

```
julia> run_omniscap("parameters.ini")
[ Info: Starting up Omniscap 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}[0.00816790109204385 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 0.01719708014918204 ... 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])
```

Check your working folder
for the subfolder with your
output maps

```
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 Omniscap;
```

Enable Omniscap

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

RUN Omniscap by calling parameters file

Running Omniscap: check your output map

CODE: PART II

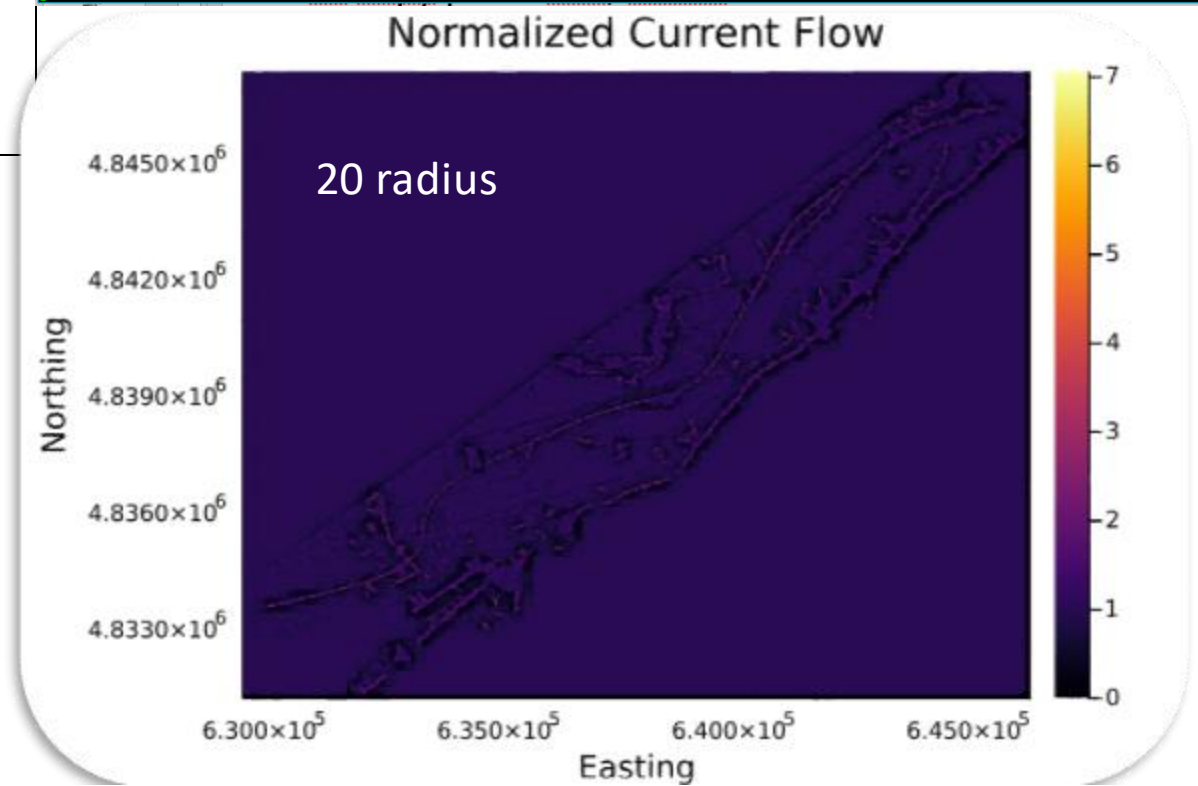
```
using GeoData;  
normalized_current =  
GDALArray("output_folder/normalized_cum_currmap.tif");  
using Plots;  
plot(normalized_current,  
      title = "Normalized Current Flow", xlabel = "Easting",  
      ylabel = "Northing")
```

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:

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



Running Omniscap: check your output map

CODE: PART II

```
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GDALArray("output_folder/normalized_cum_currmap.tif");  
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      title = "Normalized Current Flow", xlabel = "Easting",  
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```

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HOW IT LOOKS:

```
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julia> using Plots;  
julia> plot(normalized_current,
```

