

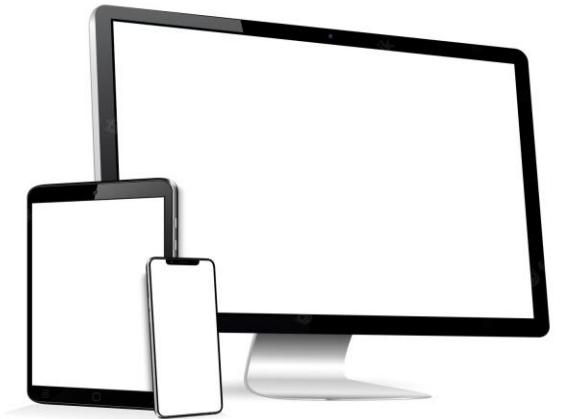


# Online mapy a nástroje, Flow mapper

Mgr. Katarína Onačillová, PhD.

## Výhody

- bez potreby inštalácie
- rýchlosť
- výber a využitie dát (GEE – „cloud“ = dostupné odkiaľkoľvek, z akéhokoľvek zariadenia)
- cenová dostupnosť – mnoho bezplatných nástrojov
- spolupráca
- informácie v reálnom čase



## Nevýhody

- pre pokročilejšie analýzy – potreba znalosti skriptovania
- obmedzené funkcie
- niektoré platformy/funkcie platené
- len online





## ArcGIS Online

Spojte ľudí, umiestnenia a údaje použitím interaktívnych máp. Pracujte s inteligentnými štýlmi založenými na údajoch a intuitívnymi analytickými nástrojmi. Podelte sa o svoje poznatky so svetom alebo s konkrétnymi skupinami.

[Dozvedieť sa viac o ArcGIS Online](#)

[Prihlásiť sa](#)



# ArcGIS Online

Untitled map

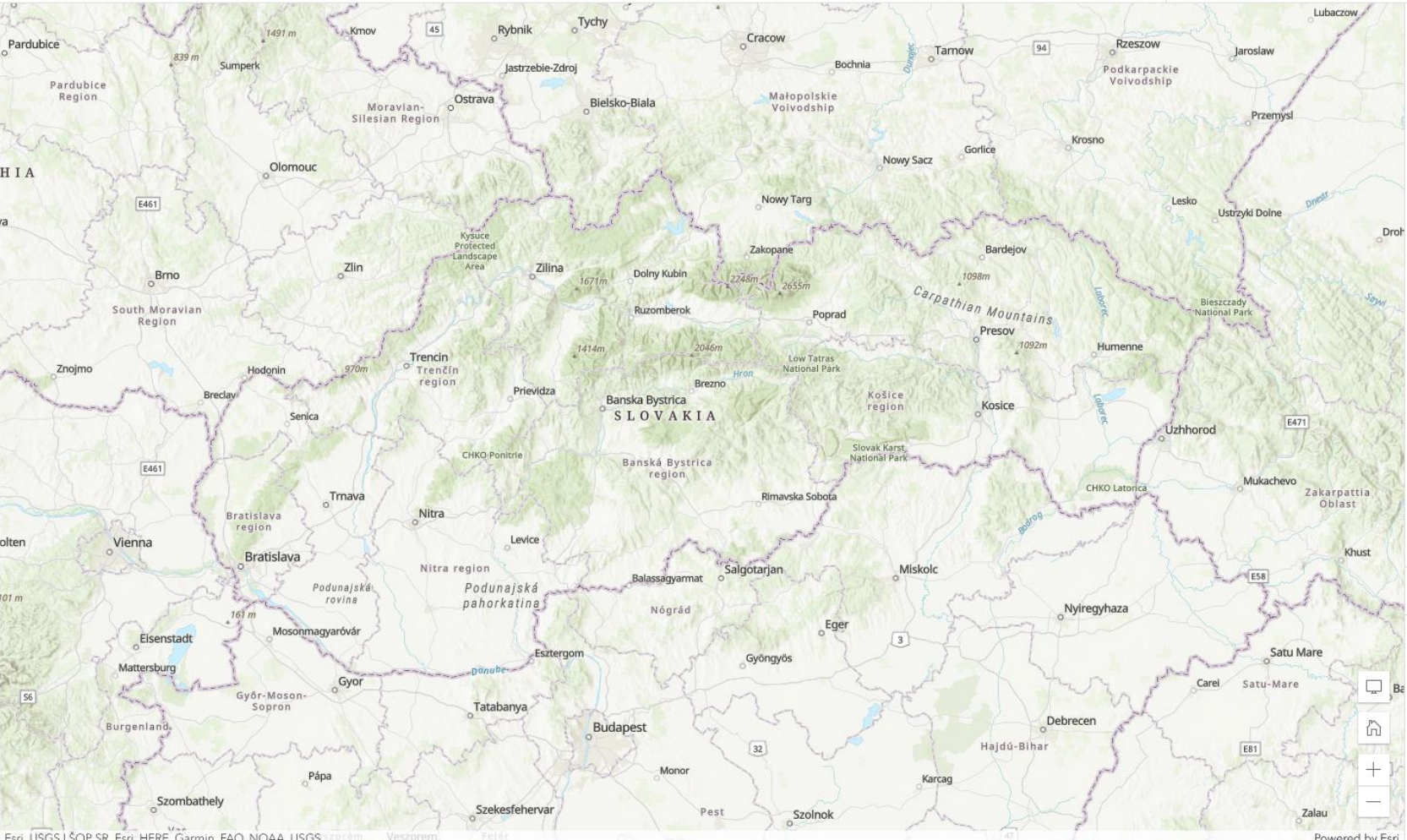
Open in Map Viewer Classic

Štefan Gábor  
stefan.gabor

Layers

Add layers to your map and they will appear here.

+ Add layer



Esri, USGS | SRTM, Esri, HERE, Garmin, FAO, NOAA, USGS

Powered by Esri



# ArcGIS Online

Home ▾ My Map

Open in Map Viewer New Map Štefan ▾

Details Add ▾ Basemap Analysis

Save ▾ Share Print ▾ Directions Measure Bookmarks Find address or place

About Content Legend

Make your own map

It's easy to make your own map. Just follow these steps:

1. Choose an area.

Pan and zoom the map to an area or search by its name or address.

2. Decide what to show.

Choose a Basemap then Add layers on top of it.

3. Add more to your map.

Add map notes to draw features on the map.

Display descriptive text, images, and charts for map features in a pop-up.

4. Save and share your map.

Give your map a name and description then share it with other people.

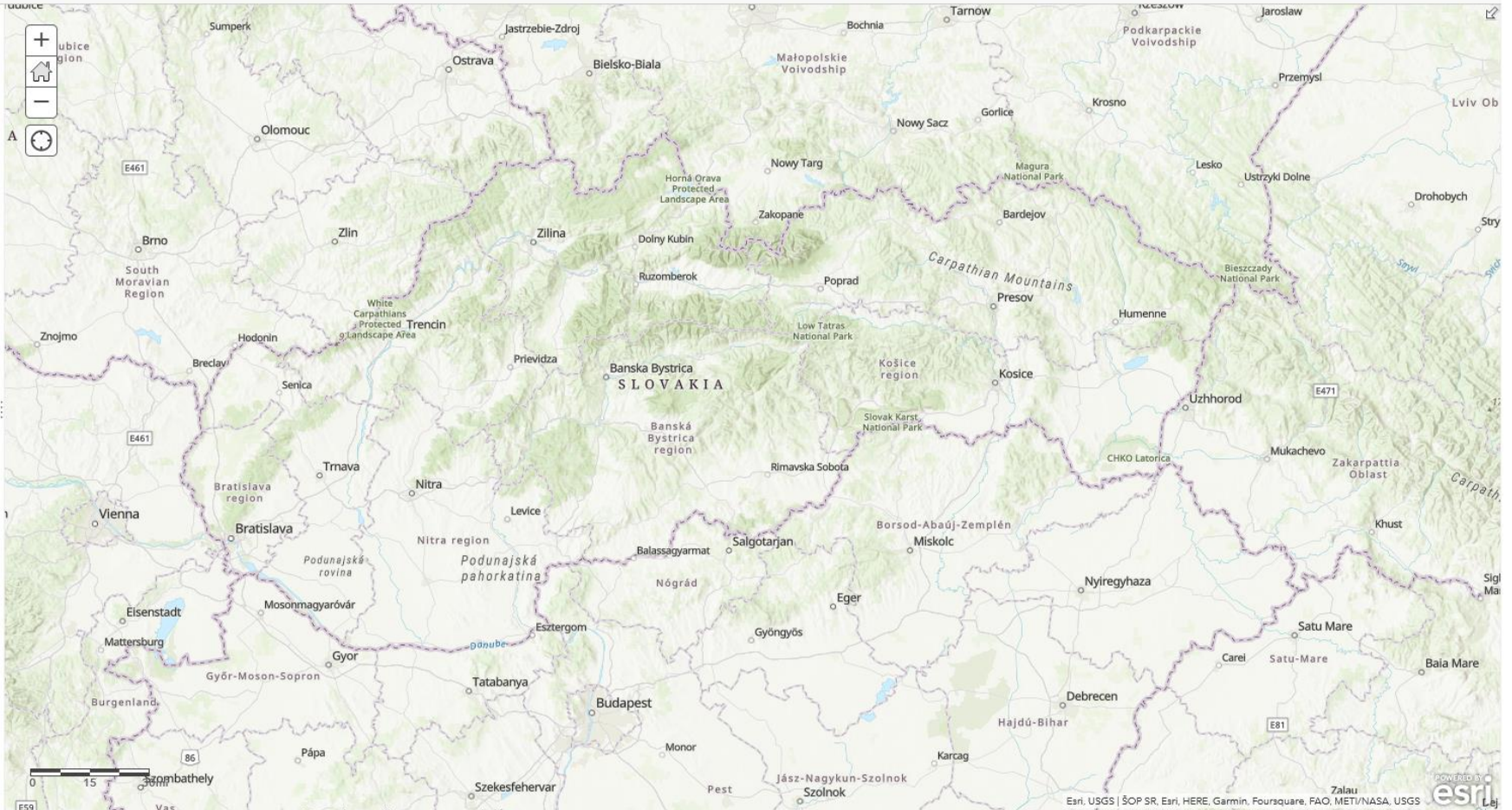
+

Home

-

Refresh

A



0 15 30

ES9

Trust Center Contact Esri Report Abuse

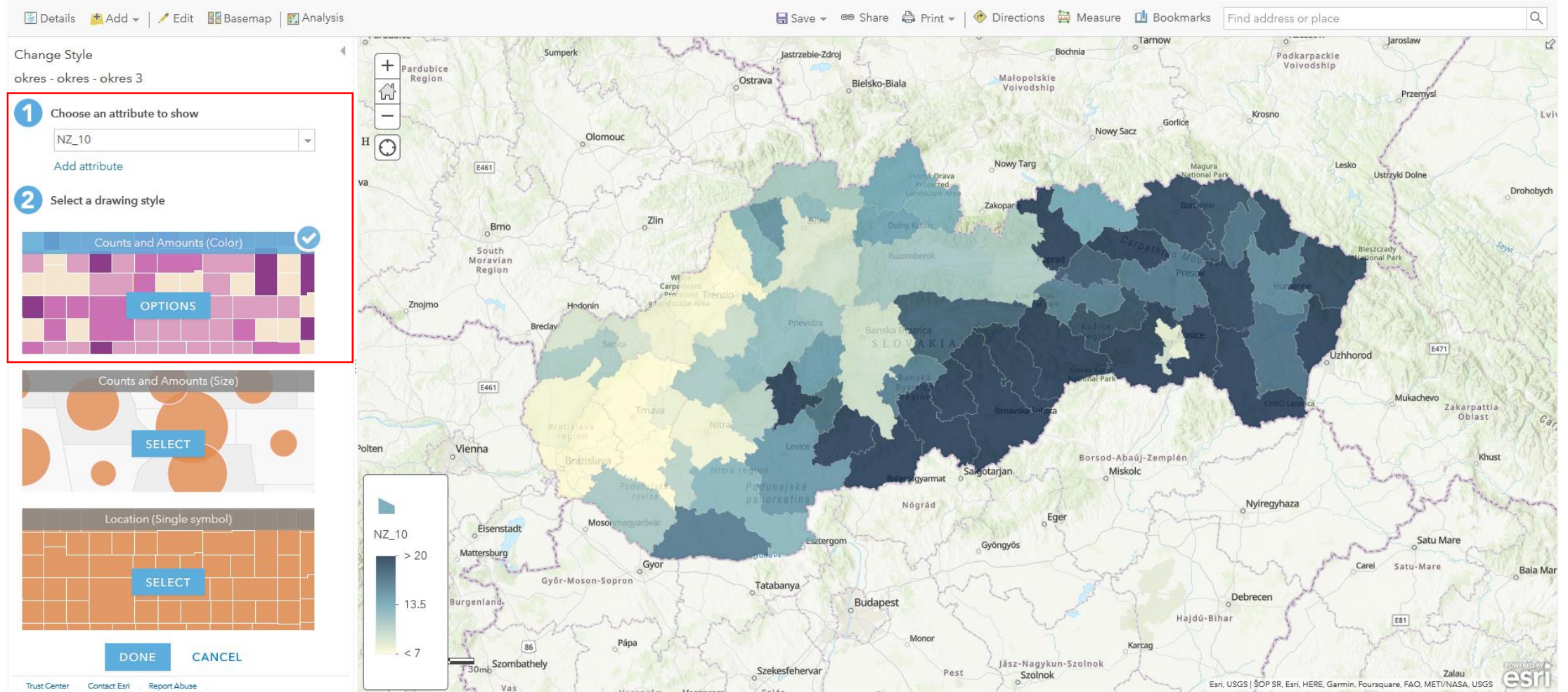
Esri, USGS | © 2018 Esri, HERE, Garmin, Foursquare, FAO, METI/NASA, USGS



# ArcGIS Online

Home ▾ My Map

Open in Map Viewer New Map Štefan ▾

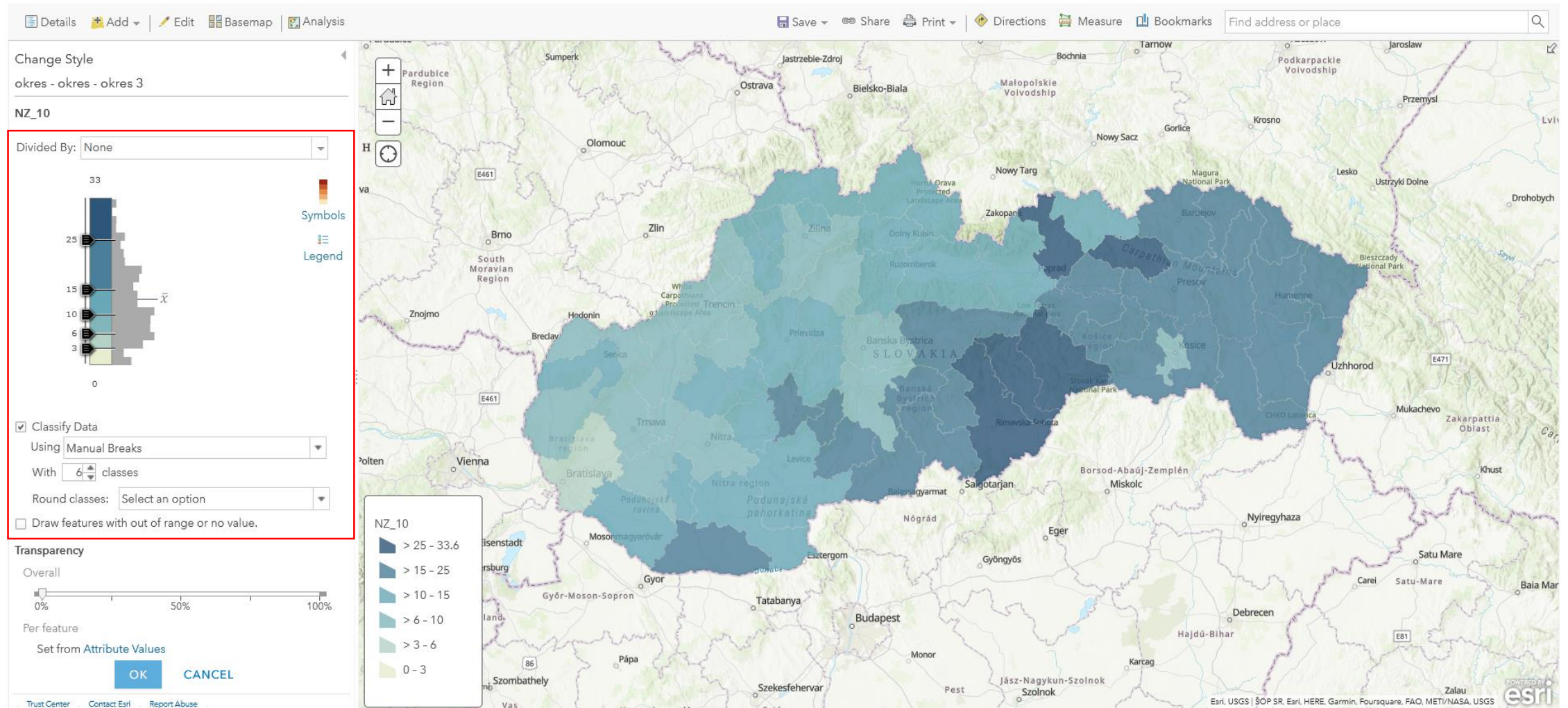




# ArcGIS Online

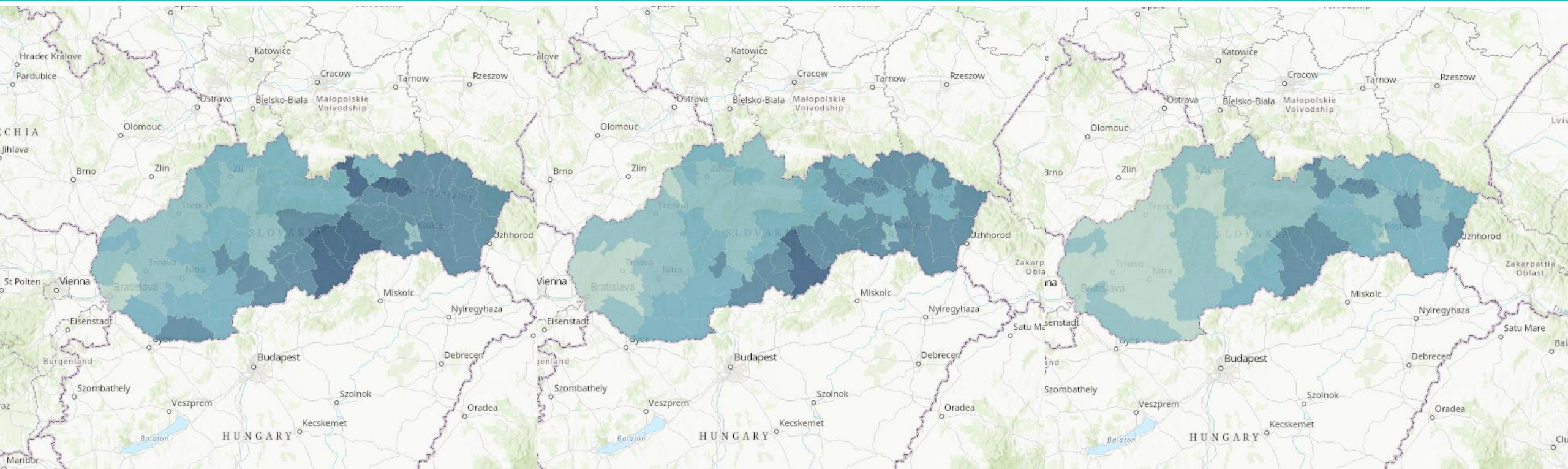
Home ▾ My Map

Open in Map Viewer New Map Štefan ▾





# ArcGIS Online



2010

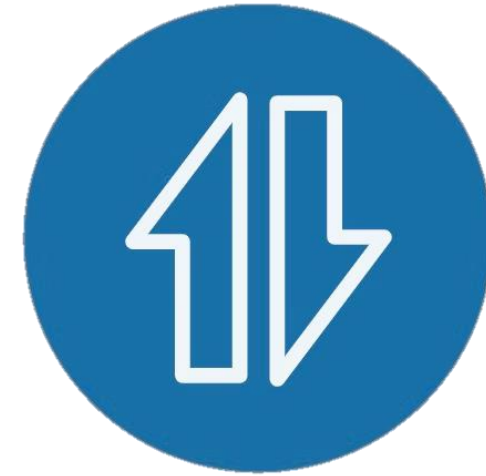
2015

2020



# Flowmap.blue

- interaktívna webová aplikácia
- jazyk JavaScript
- tvorca: Ilya Boyandin
- statická a dynamická simulácia O-D tokov v rôznych časových obdobiach
- zobrazenie aj najmenších tokov, ktoré by mohli ostať v statickej podobe skryté





# Flowmap.blue

Flowmap.blue template spreadsheet ☆ 📄 🗑️

Súbor Upraviť Zobrazíť Vložiť Formát Údaje Nástroje Rozšírenia Pomocník

🖨️ 🔍 100% 📄 iba zobrazenie

| A1 | fx | property                     |                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                               |
|----|----|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    |    | A                            | B                                                                                                                                                                                                                | C                                                                                                                                                                                                                                                                                                                                                                             |
| 1  |    | property                     | value                                                                                                                                                                                                            | comment                                                                                                                                                                                                                                                                                                                                                                       |
| 2  |    | title                        | Template Spreadsheet                                                                                                                                                                                             | First step: make a copy of this spreadsheet by going to "File" / "Make a copy..."                                                                                                                                                                                                                                                                                             |
| 3  |    | description                  | This is just a template prepared to help you publish your dataset. Make a copy of this spreadsheet by going to "File" / "Make a copy..." then you can fill your data in. You must be logged in for this to work. |                                                                                                                                                                                                                                                                                                                                                                               |
| 4  |    | source.name                  | Not specified                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                               |
| 5  |    | source.url                   | <a href="http://some.url.here">http://some.url.here</a>                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                               |
| 6  |    | createdBy.name               | Your name                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                               |
| 7  |    | createdBy.email              | Your email                                                                                                                                                                                                       | ← We may contact you asking for a permission to add your flow map to the list of examples on the homepage of flowmap.blue.                                                                                                                                                                                                                                                    |
| 8  |    | createdBy.url                | <a href="http://your.website">http://your.website</a>                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                               |
| 9  |    | mapbox.accessToken           |                                                                                                                                                                                                                  | ← (optional) If you link or embed your map on a web site where you expect high traffic, please, register and use your own Mapbox access token. <a href="https://account.mapbox.com/">https://account.mapbox.com/</a>                                                                                                                                                          |
| 10 |    | mapbox.mapStyle              |                                                                                                                                                                                                                  | ← (optional) Custom Mapbox style URL (you can fine tune map rendering or upload your shapes as a tileset or a dataset and add them as a layer). Your style must be public. We recommend to base your style on the "Light" template. <a href="https://docs.mapbox.com/help/tutorials/create-a-custom-style/">https://docs.mapbox.com/help/tutorials/create-a-custom-style/</a> |
| 11 |    | colors.scheme                | Default                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                               |
| 12 |    | colors.darkMode              | yes                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                               |
| 13 |    | animate.flows                | no                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                               |
| 14 |    | clustering                   | yes                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                               |
| 15 |    | flows.sheets                 | flows                                                                                                                                                                                                            | ← Here you can list multiple comma-separated sheet names if you want to split your flows data into several subsets. There will be a drop-down menu in the UI with the subsets to select from. Here is an example: → <a href="https://flowmap.blue/1mK1ZMxNmGtSSxMhtoK0Sh7nxyDMXFC">https://flowmap.blue/1mK1ZMxNmGtSSxMhtoK0Sh7nxyDMXFC</a>                                   |
| 16 |    | msg.locationTooltip.incoming | Incoming trips                                                                                                                                                                                                   | ← Here you can customize some of the messages.                                                                                                                                                                                                                                                                                                                                |
| 17 |    | msg.locationTooltip.outgoing | Outgoing trips                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                               |
| 18 |    | msg.locationTooltip.internal | Internal & round trips                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                               |
| 19 |    | msg.flowTooltip.numOfTrips   | Number of trips                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                               |
| 20 |    | msg.totalCount.allTrips      | {0} trips                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                               |
| 21 |    | msg.totalCount.countOfTrips  | {0} of {1} trips                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                               |

☰ properties locations flows

a) šablóna tabuľky Google

A1 fx id

|   | A  | B              | C          | D          | E                                                                                                                                                                                                     |
|---|----|----------------|------------|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | id | name           | lat        | lon        |                                                                                                                                                                                                       |
| 2 | 1  | New York       | 40.713543  | -74.011219 | If you only have the location names in your dataset and no geographic coordinates, our Geocoding utility can be of help → <a href="https://flowmap.blue/geocoding">https://flowmap.blue/geocoding</a> |
| 3 | 2  | London         | 51.507425  | -0.127738  |                                                                                                                                                                                                       |
| 4 | 3  | Rio de Janeiro | -22.906241 | -43.180244 |                                                                                                                                                                                                       |
| 5 |    |                |            |            |                                                                                                                                                                                                       |
| 6 |    |                |            |            |                                                                                                                                                                                                       |

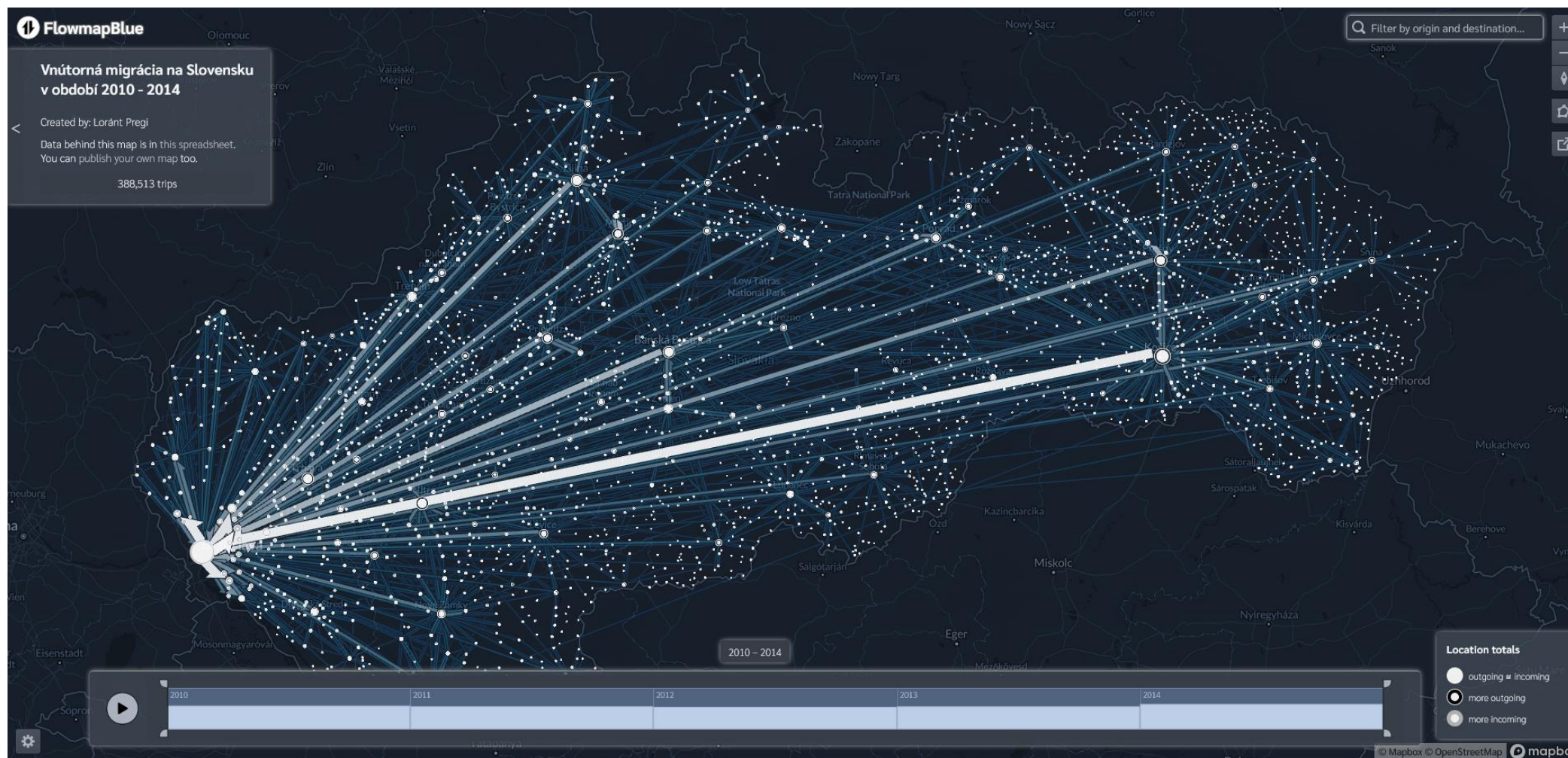
b) hárok *locations*

A1 fx origin

|   | A      | B    | C     | D                                                                                                                                                                                            | E |
|---|--------|------|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| 1 | origin | dest | count | time                                                                                                                                                                                         |   |
| 2 | 1      | 2    | 42    | ↑ It's better to delete the unused columns if you have many rows in your dataset ↑                                                                                                           |   |
| 3 | 2      | 1    | 51    | ← The "time" column is optional. Supported formats: YYYY-MM-DD HH:MM:SS, YYYY-MM-DD HH:MM, YYYY-MM-DD, YYYY-MM, YYYY                                                                         |   |
| 4 | 3      | 1    | 50    |                                                                                                                                                                                              |   |
| 5 | 2      | 3    | 40    | Use the OD-matrix data conversion tool if your movement counts are stored as an OD-matrix. → <a href="https://flowmap.blue/od-matrix-converter">https://flowmap.blue/od-matrix-converter</a> |   |
| 6 | 1      | 3    | 22    |                                                                                                                                                                                              |   |
| 7 | 3      | 2    | 42    |                                                                                                                                                                                              |   |
| 8 |        |      |       |                                                                                                                                                                                              |   |

c) hárok *flows*

# Flowmap.blue



mapa je dostupná na [tomto linku](#)



# Flowmapper

**Flow Mapper**FileViewToolsHelpContactAbout

Base MapRegionsNodesFlows

Base Map: ?

Esri Light Gray Canvas

☐ Display base map references

Base map opacity(%): ? 100

Projection: ?

Albers Equal Area Europe

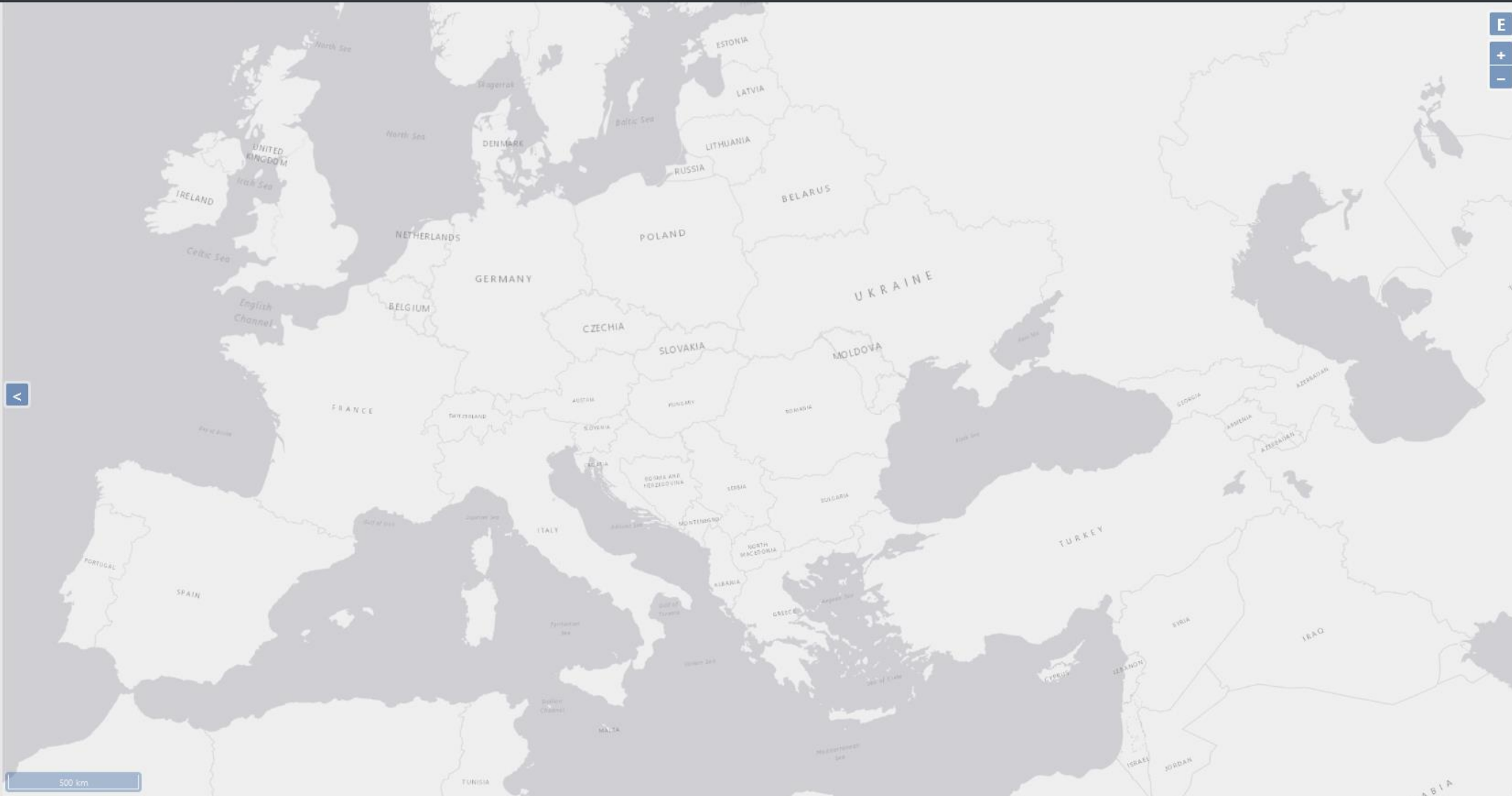
☐ Add title ?

☐ Add description ?

☐ Add north arrow

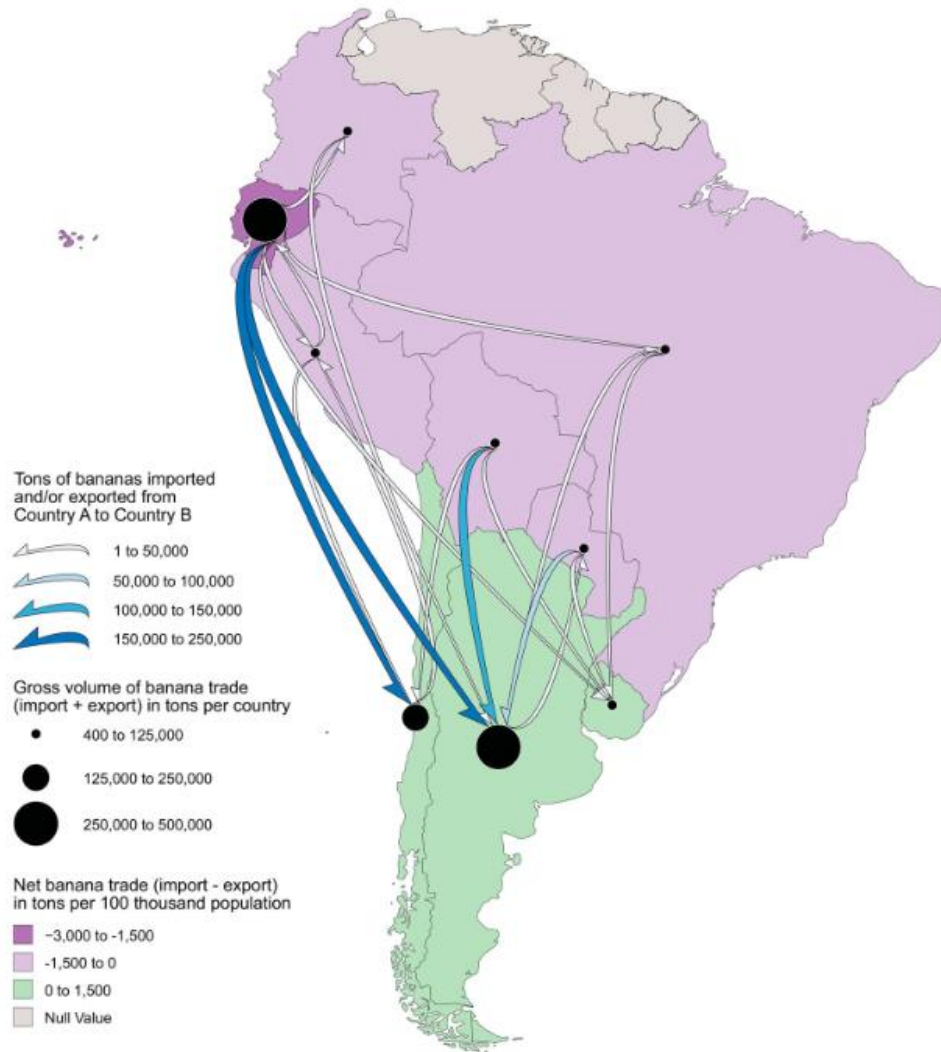
☐ Add projection label

☐ Upload custom references ?

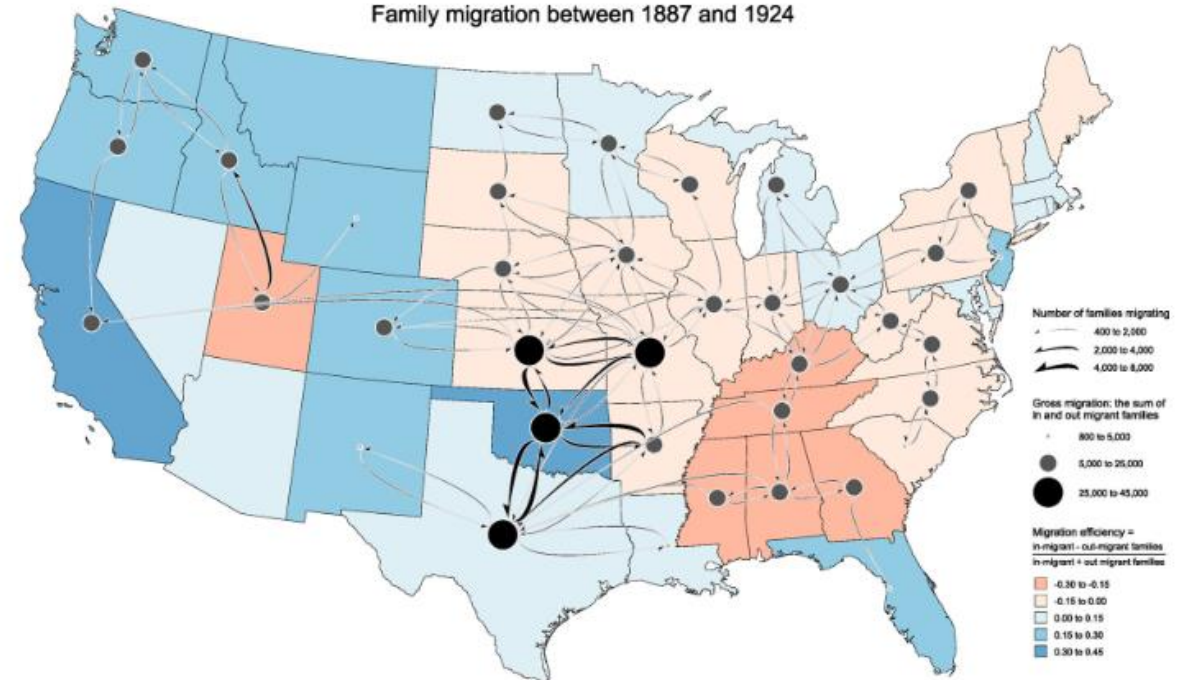


# Flowmapper

Banana trade between countries in South America



Family migration between 1887 and 1924



Koylu, Tian, Windsor, 2022





# Google Earth Engine

~ využitie sily cloudu

- Cloudová platforma pre geopriestorové analýzy
- Voľne prístupný katalóg dát > 200 datasetov, >5 PB dát
- Import vlastných dát a ich integrácia s datasetmi GEE
- Aplikácia rôznych algoritmov
- Export mapových výstupov, tabuliek, grafov...

## The Earth Engine Public Data Catalog



**Landsat and Sentinel**  
Raw, TOA, SR, ...



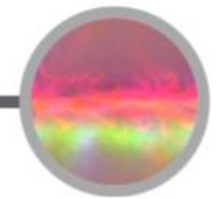
**MODIS**  
Daily, NBAR, LST, ...



**Terrain**  
SRTM, GTOPO, NED, ...



**Land Cover**  
GlobCover, NLCD, ...



**Atmospheric**  
NOAA NCEP, OMI, ...

... and many more, updating daily!

> 200 public datasets

> 5 million images

> 4000 new images every day

> 5 petabytes of data



# Google Earth Engine

~ využitie sily cloudu

- Prevažné využitie JavaScript
- Nie je potrebné byť expertom v kódovaní, mnoho tutoriálov je dostupných aj online:
- <https://developers.google.com/earth-engine/getstarted>
- <https://developers.google.com/earth-engine/tutorials>

The screenshot shows a web browser displaying the Google Earth Engine community page. The URL in the address bar is `developers.google.com/earth-engine/tutorials/community/modis-ndvi-time-series-animation`. The page title is "MODIS NDVI Times Series Animation". The author is listed as "jdbcode". There are links for "EDIT ON GITHUB", "REPORT ISSUE", and "PAGE HISTORY". A blue banner states: "★ Tutorials contributed by the Earth Engine developer community are not part of the official Earth Engine product documentation." Below this, there is a link "Open In Code Editor". The main text describes the tutorial: "Time series animations of Earth observation imagery are captivating and engaging. In this tutorial, you'll learn how to generate an animated GIF representing 20-year median NDVI for serial 16-day MODIS composites spanning January 1st through December 31st. The following image is an example of the resulting animation." Below the text is a satellite image of Africa showing a color gradient from green to brown, representing vegetation indices. On the left side of the page, there is a sidebar with a "Filter" box and a list of tutorials under "JavaScript Tutorials", including "Beginner's Cookbook", "Combining FeatureCollections", "Customizing Base Map Styles", "Dynamic World (Part 1)", "Dynamic World (Part 2)", "Dynamic World (Part 3)", "Extracting Raster Values for Points", "Forest Cover and Loss Estimation", "Getting Started with Drawing Tools", "HISTARFM - How to Work with Gap-Filled Imagery", "Identifying Annual First Day of No Snow Cover", "Interactive Region Reduction App", "Land Surface Temperature in Uganda", "MODIS NDVI Times Series Animation" (which is highlighted), and "Monitoring Forest Vegetation Condition".





# Google Earth Engine

~ využitie sily cloudu

Príklady kódov,  
uložené skripty

The screenshot displays the Google Earth Engine web interface. On the left, the 'Scripts' panel lists various scripts, including 'downscaling\_27\_9', 'emissivity', 'karst\_sinkholes', 'maya', 'no2\_concentrations\_london', and 'veronika\_DP'. A red arrow points from the text 'Príklady kódov, uložené skripty' to this panel. The central 'Code editor' shows a script for LST calculation, with a red arrow pointing to it from the text 'Code editor – písanie skriptu'. The right panel features the 'Inspector' and 'Console' tabs. The 'Inspector' shows a 'Sentinel-2 image collection' and a scatter plot titled 'Correlation LST - NDVI based on Landsat 8 image', with a red arrow pointing to it from the text 'Code management – spravovanie skriptu, výsledky analýzy dát...'. The bottom of the interface shows a map view with a 'Downscaled LST (°C)' color scale ranging from 21 to 43. The Google logo and footer information are visible at the bottom.



# Google Earth Engine

~ porovnanie tradičnej metódy analýzy s analýzou v GEE

## ANALÝZA ZMIEN LESA V OBDOBÍ MEDZI ROKMI 2000 – 2010

### TRADIČNÝ POSTUP

- Výber záujmového územia
- Príprava dát:
  - stiahnutie a uloženie satelitnej scény (snímky) počas vegetačného obdobia (1 scéna ~ 1 GB/zip)
  - orezanie scény a zmozaikovanie (výsledná scéna ~ 1.75 GB)

$= \sim 48 \text{ scén za rok} * 11 \text{ rokov} = \sim 528 \text{ scén} = \sim 924 \text{ GB}$

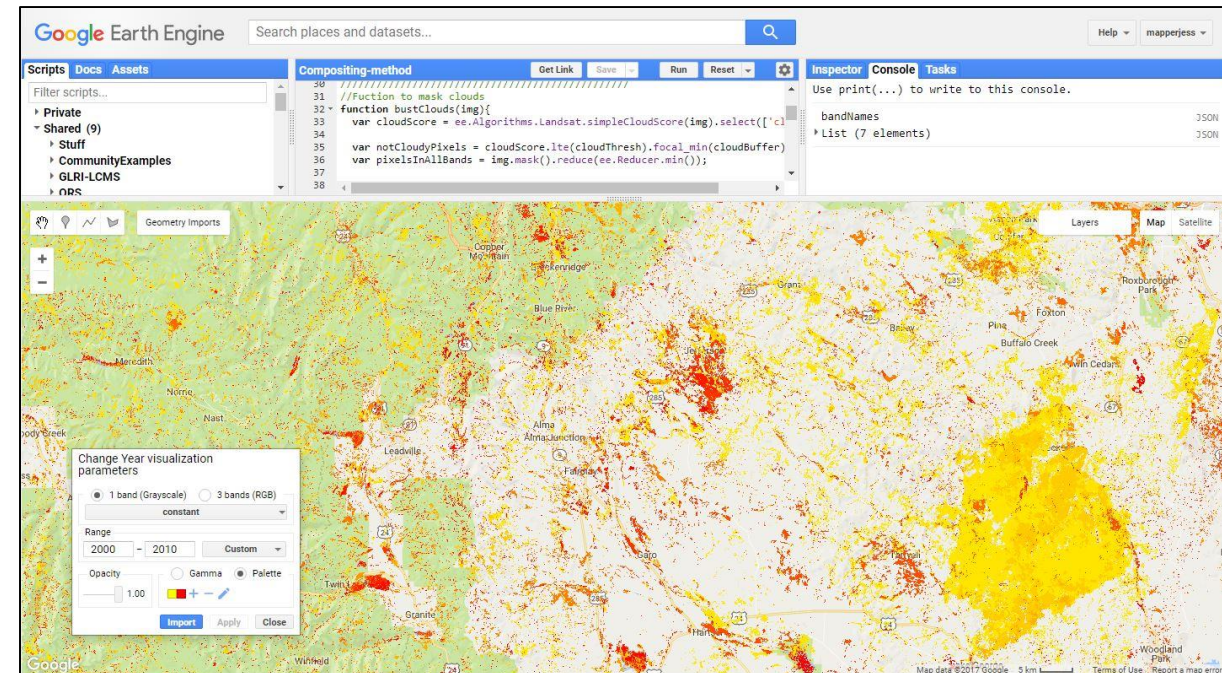
+ aplikácia korekcií, odstránenie oblačnosti, vytvorenie výslednej kompozície za 1 rok, výpočet vegetačného indexu NDVI (+ďalšie stovky GB)

- Analýza dát

➔ *Niekoľko mesiacov práce pre dosiahnutie výsledku*

### GOOGLE EARTH ENGINE

V GEE získa skúsenejší programátor ten istý výsledok za *~1 hodinu a pomocou 100 riadkov kódu*





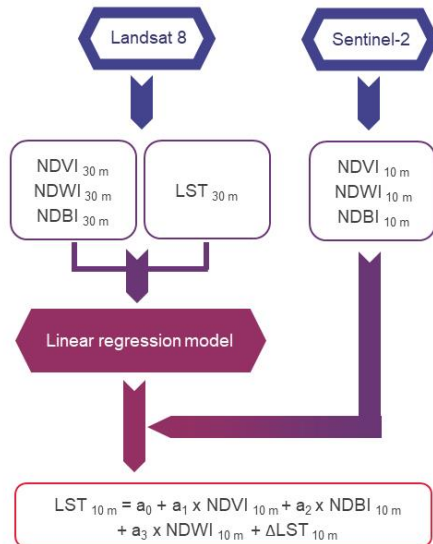


# Google Earth Engine

~ príklad využitia

## Combining Landsat 8 and Sentinel-2 Data in Google Earth Engine to Derive Higher Resolution Land Surface Temperature Maps

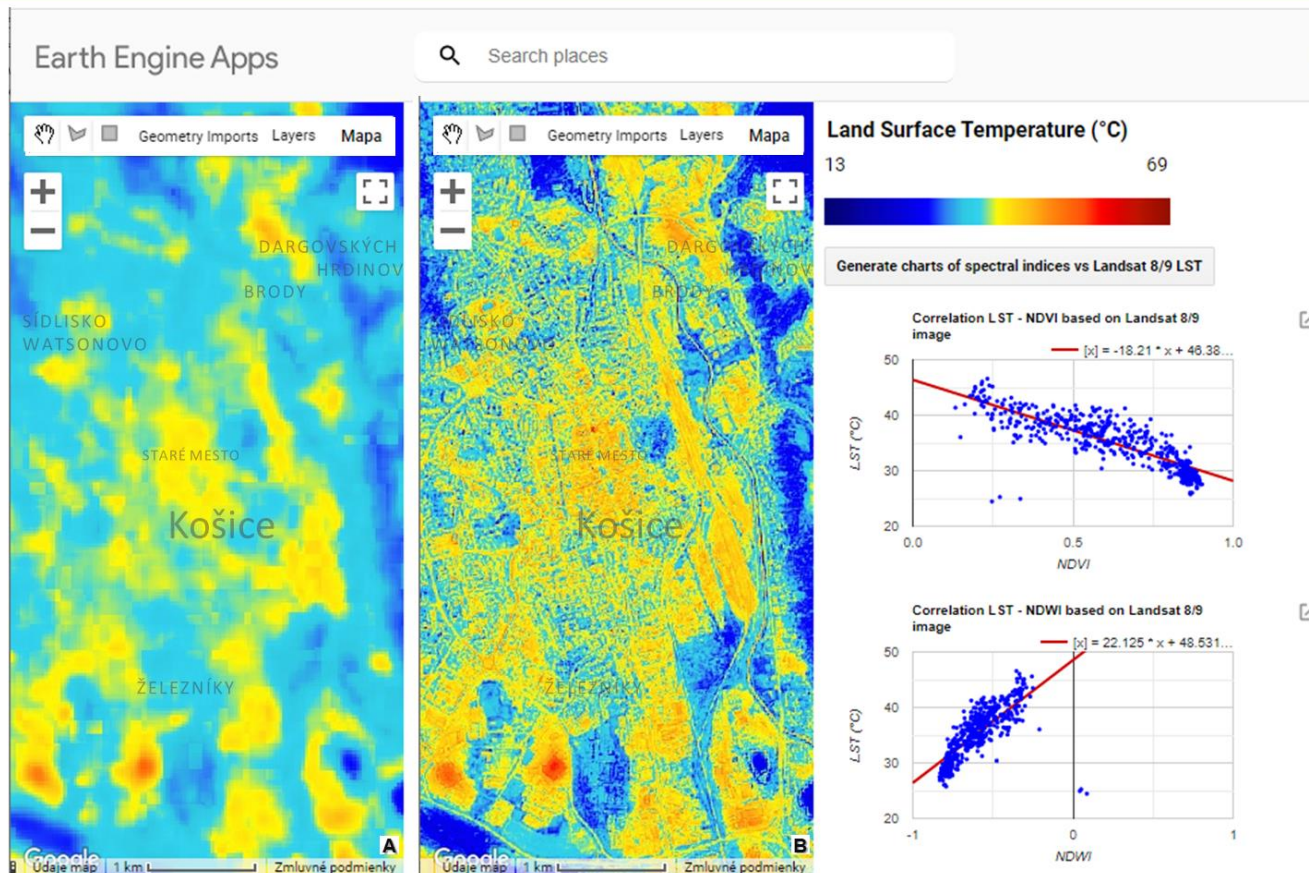
### THE FLOWCHART OF PROCEDURAL STEPS



### SUPPLEMENTARY MATERIAL

The GEE application for downscaling Landsat LST imagery to 10 m spatial resolution:  
<https://danielp.users.earthengine.app/view/lst-downscaling>

The source code of the application and a short manual on how to use it:  
<https://github.com/palubad/LST-downscaling-to-10m-GEE>



Example of the custom output of the implementation of the L8 LST downscaling at 10 m resolution, over the city of Košice, Slovakia, in Google Earth Engine.

LST derived: A) from Landsat 8 TIRS data at 30 m resolution, B) as downscaled LST at 10 m resolution with residuals

*Kombinácia dát z družíc Landsat 8 a Sentinel-2 v Google Earth Engine pre odvodenie máp teploty povrchu krajinej pokrývky (LST) vo vyššom priestorovom rozlíšení*

<https://danielp.users.earthengine.app/view/lst-downscaling>

ONAČILLOVÁ, K., GALLAY, M., PÉLIOVÁ, A., PALUBA, D., TOKARČÍK, O., LAUBERTOVÁ, D. (2022). Combining Landsat 8 and Sentinel-2 Data in Google Earth Engine to Derive Higher Resolution Land Surface Temperature Maps in Urban Environment. *Remote Sensing*, 14(16), 4076.



Flow mapper

# PRAKTICKÁ UKÁŽKA

Base Map Regions Nodes Flows

Base Map: ?

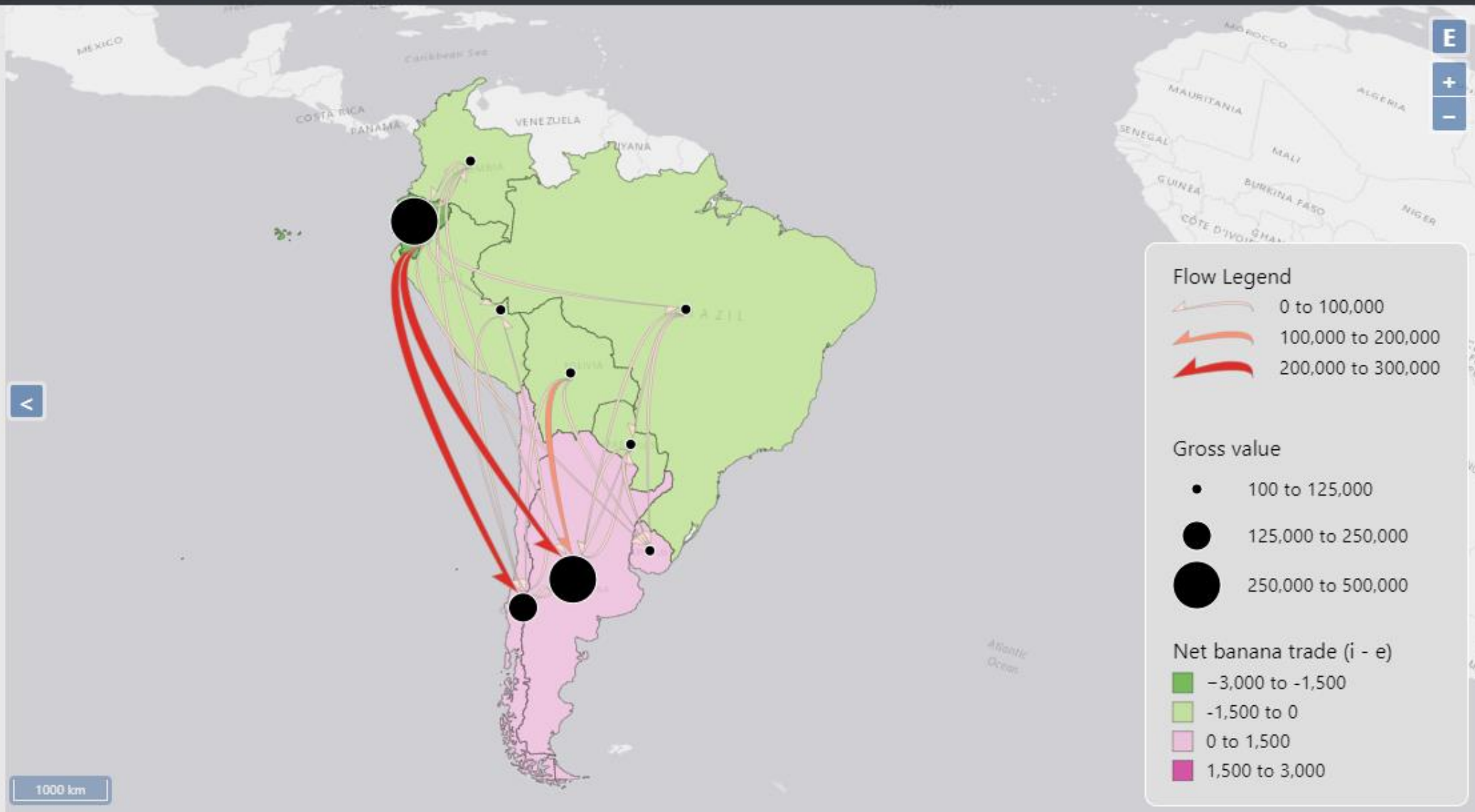
Esri Light Gray Canvas

☐ Display base map references

Base map opacity(%): ? 100

Projection: ?

Albers Equal Area South America

☐ Add title ?☐ Add description ?☐ Add north arrow☐ Add projection label☐ Upload custom references ?



Base Map Regions Nodes Flows

Upload Polygon Data: ?

Vybrať súbor SA\_BO... (1).json

Join CSV Data: ?

Vybrať súbor nodes\_...nas3.csv

☐ Hide null values ?

JSON ID Field: ?

CntryCode

CSV ID Field: ?

Country\_ID

Map Field: ?

Netflow\_per100k

Classification: ? Manual Break

Manual break setting: ?

-3000 -1500 0 1500 3000

Color scheme: ?

Pink-Yellow-(☒ Flip

Fill opacity (%): ? 70

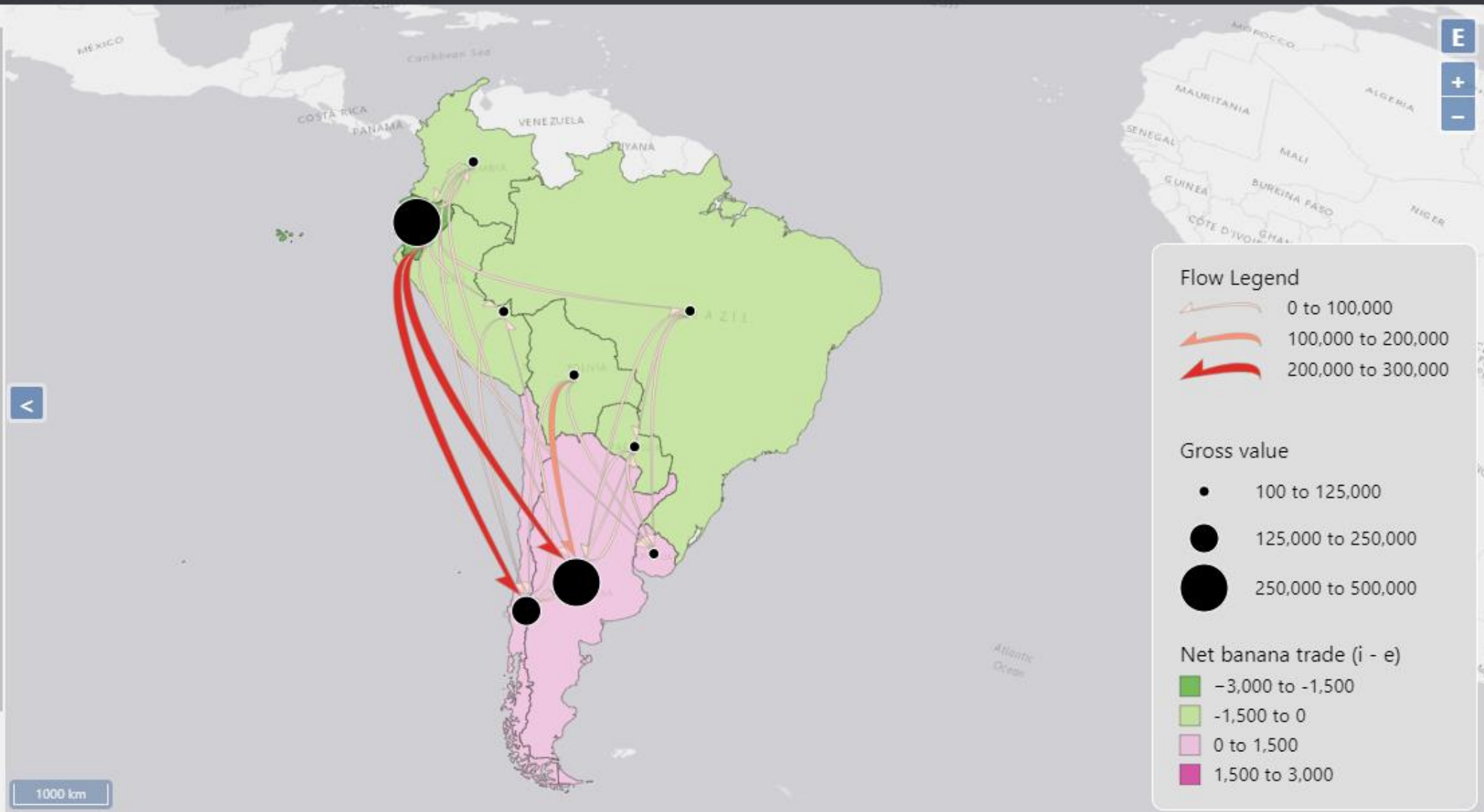
Stroke color: ?



Stroke width: ?

0,3

Legend title: ?



Node Data: ?

Vybrať súbor nodes\_...anas.csv

ID field: ? Country\_ID

X field: ? X

Y field: ? Y

☒ Map node attribute ?

Total\_Flow

Scale: ? Manual Breaks

Manual breaks setting: ?

100 125000 250000 500000

Fill color: ? All Black

☐ Flip

Fill opacity (%): ? 100

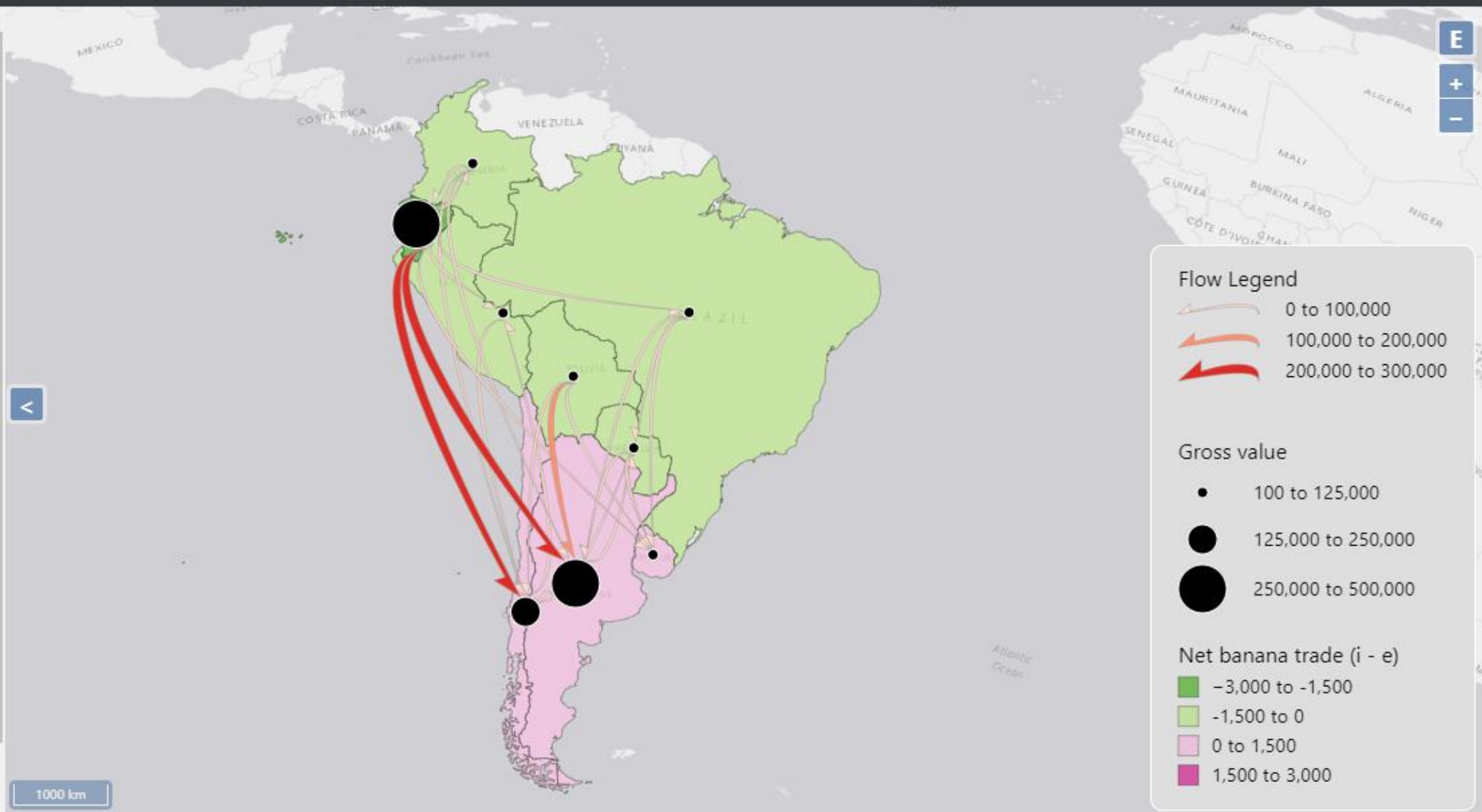
Min radius: ? 4

Max radius: ? 18

Stroke color: ?

Stroke width: ? 1

Legend title: ? Gross value



Base Map Regions Nodes Flows

Flow Data: ?

Vybrať súbor flows\_b...2019.csv

Origin ID: ? From\_Country\_

Destination ID: ? To Country\_

Volume: ? Value

Show top flows: ? 18

Style: ? Curve Half Arrow

Classification: ? Manual Bre:

Manual breaks setting: ?

0 100000 200000 300000

Color: ? Reds

☐ Flip

Fill opacity (%): ? 100

Min width: ? 4

Max width: ? 14

Stroke color: ?

Stroke width: ? 0,5

Legend title: ? Flow Legend

Decimal places: ? 0







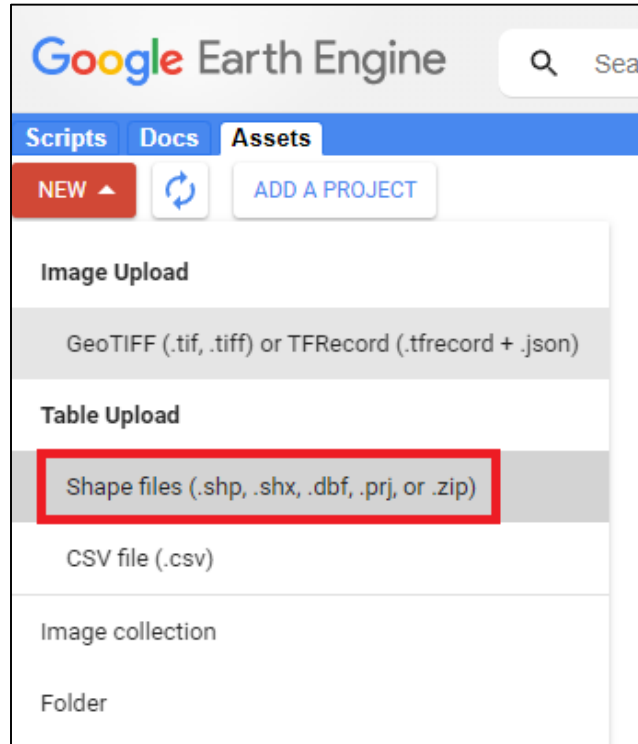
Google Earth Engine

# PRAKTICKÁ UKÁŽKA

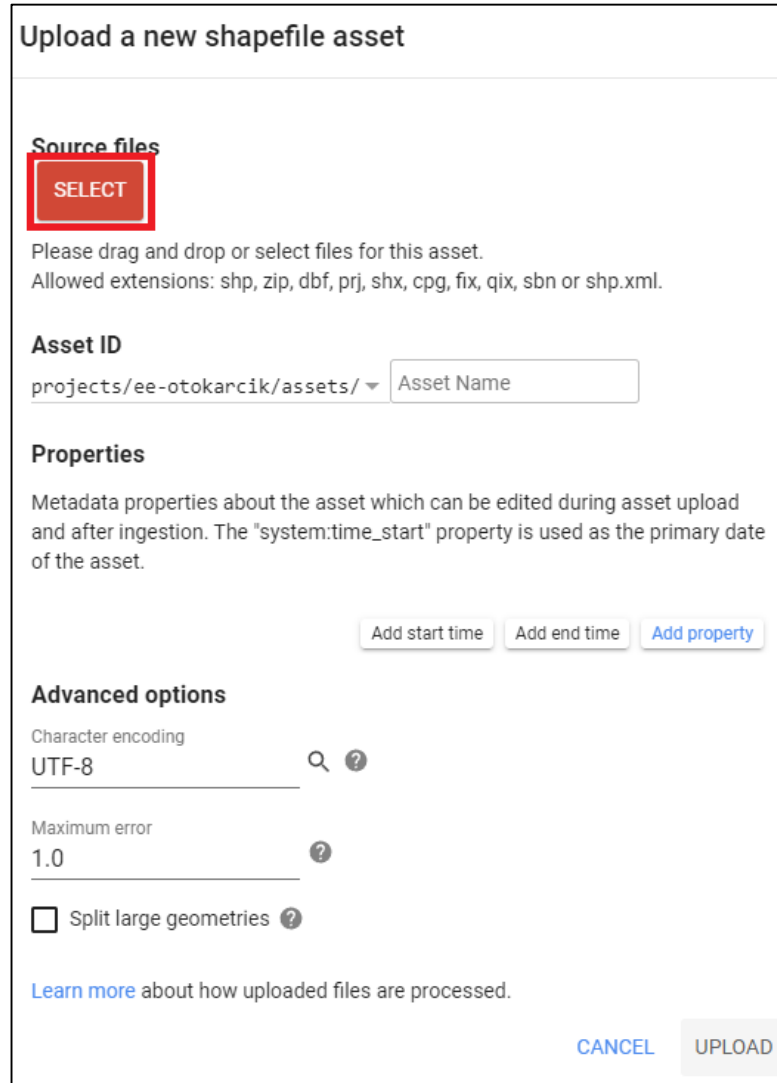
# 1. Nahratie vlastných vektorových dát do GEE

(administratívnych hraníc SR)

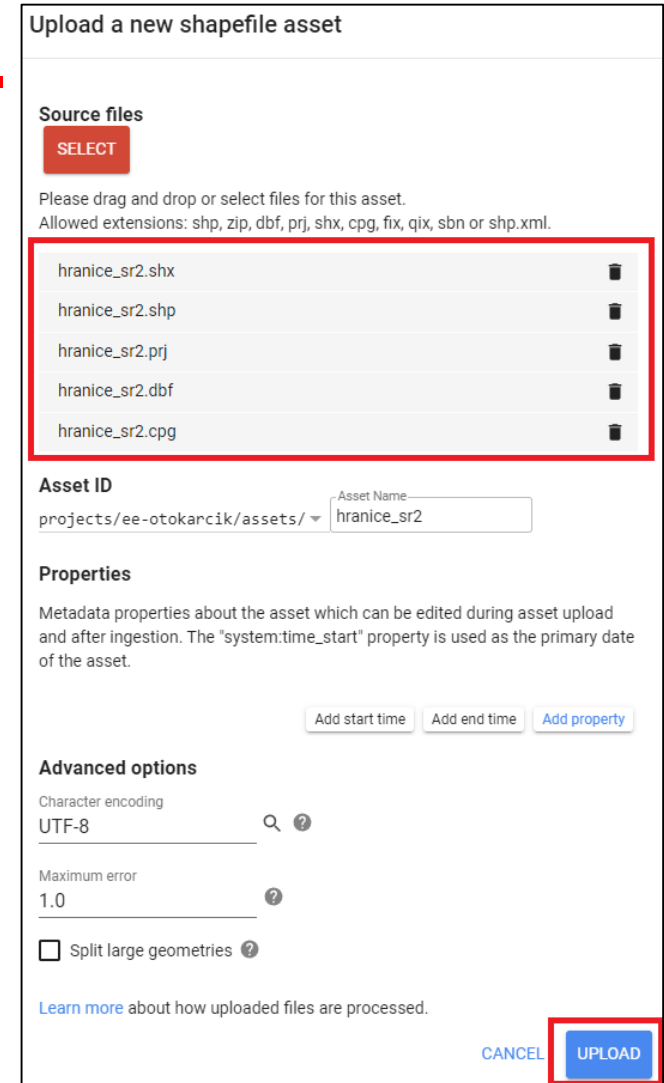
1.



2.

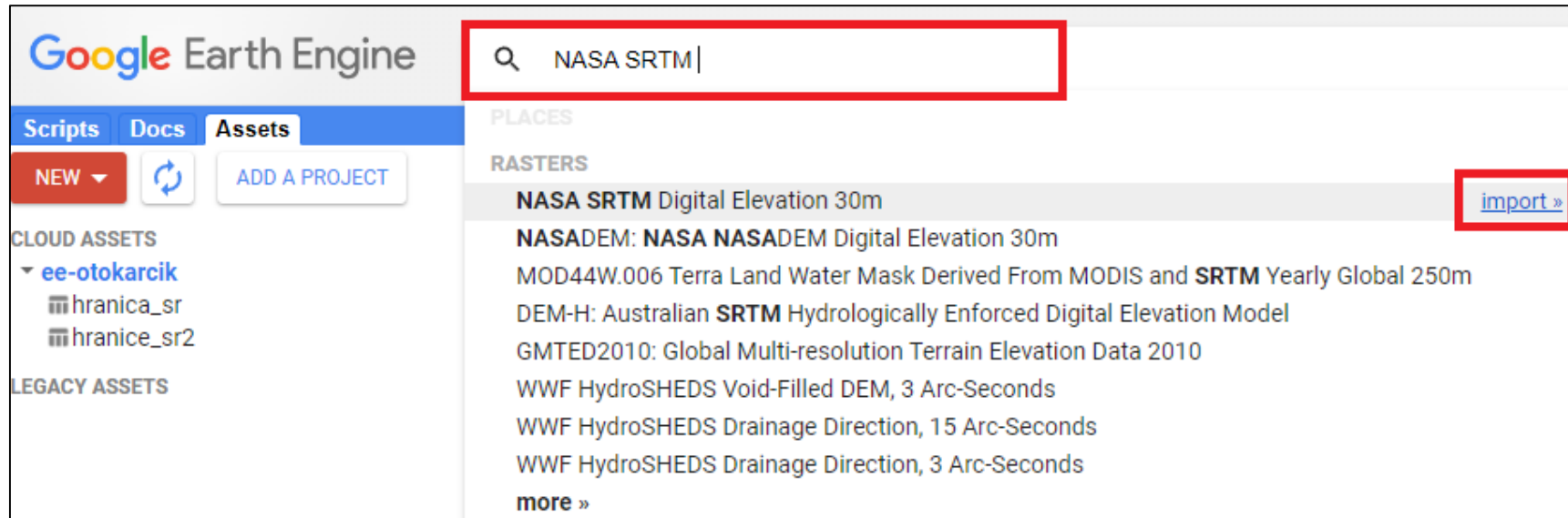


3.

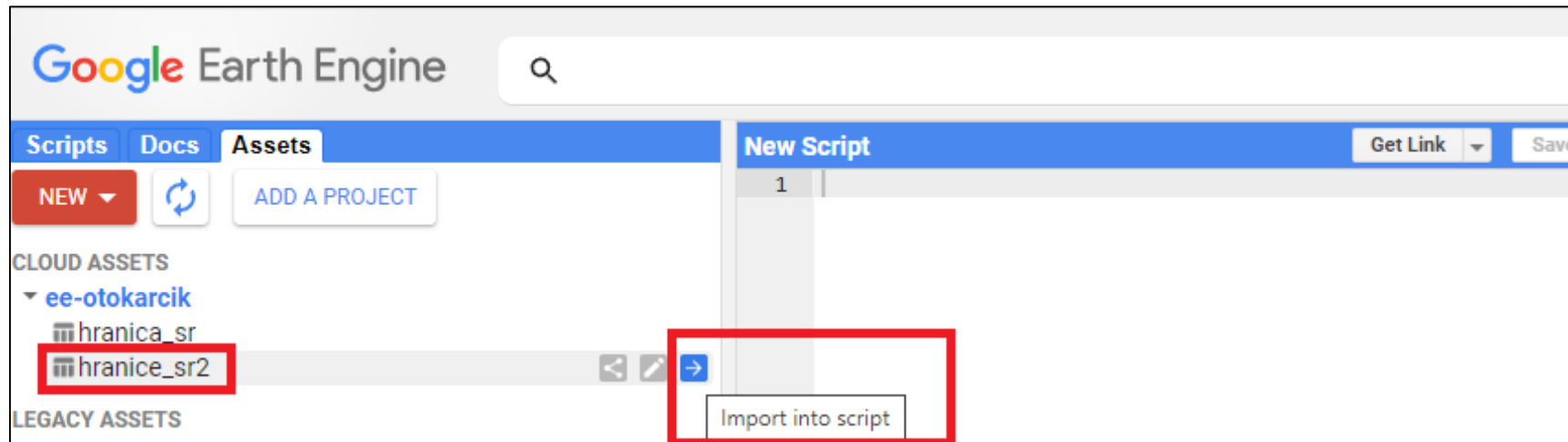


## 2. Import potřebných dát do skriptu (NASA SRTM Digital elevation, hranice SR)

1.



2.

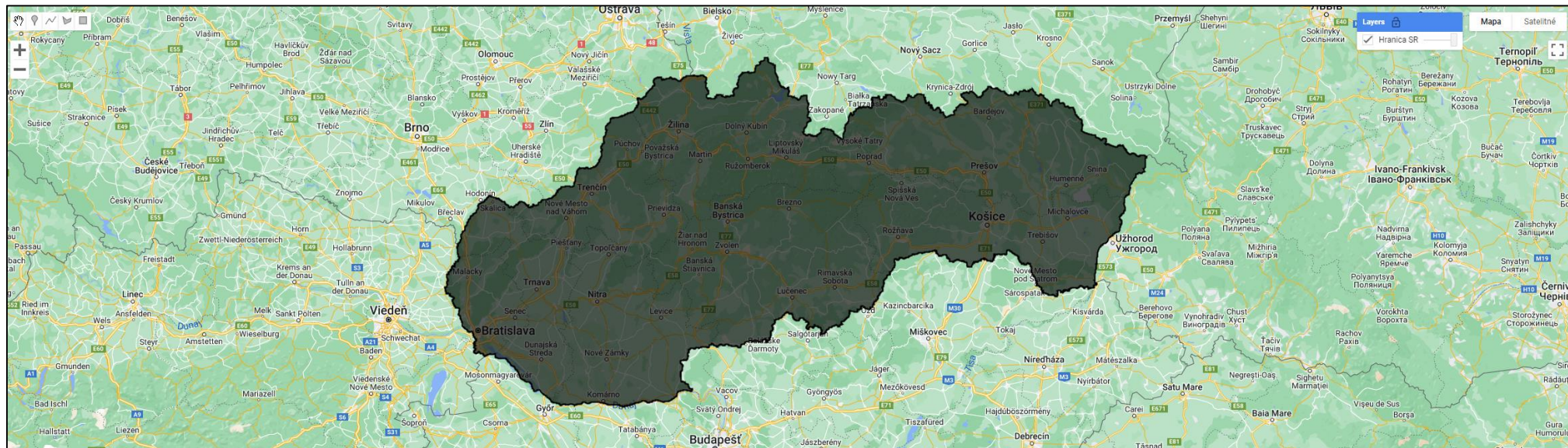




### 3. Nastavenie geometrie pre tabuľku a pridanie administratívnych hraníc do mapového okna

```
var sr=table.geometry();  
Map.addLayer(sr, {color:"black"}, "Hranica SR");
```

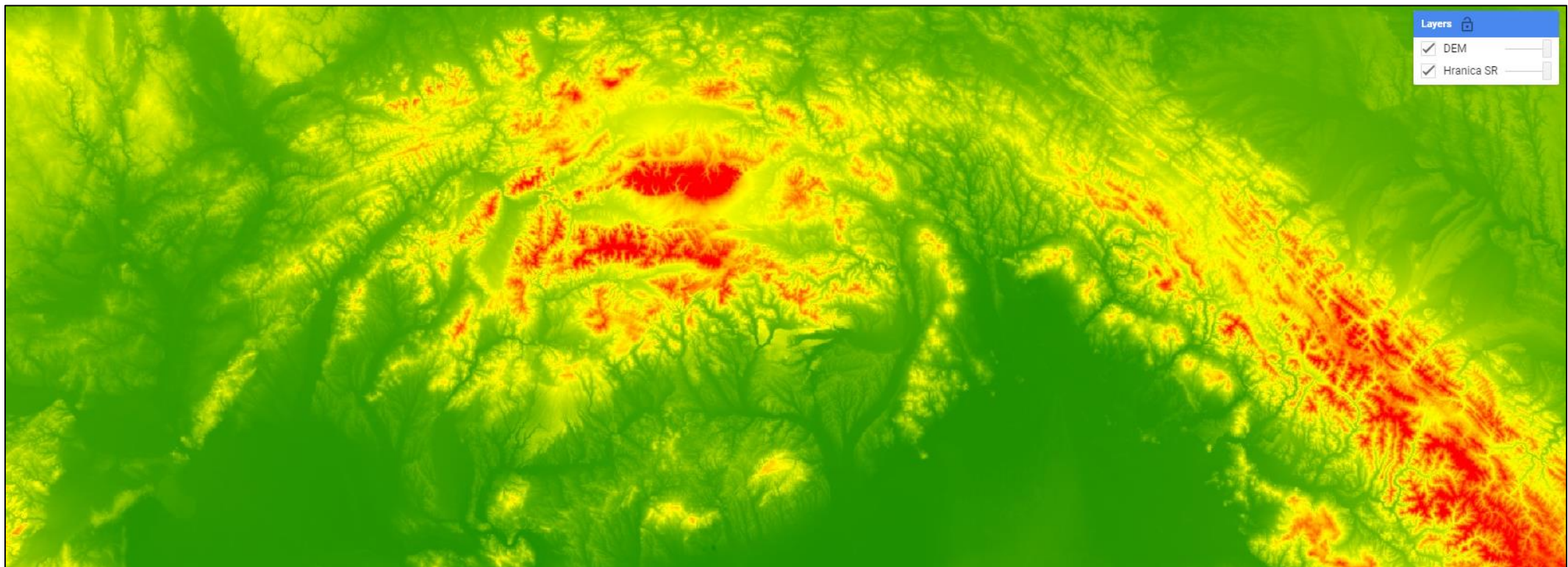
```
New Script *  
Imports (2 entries)   
  var raster: Image "NASA SRTM Digital Elevation 30m" (1 band)   
  var table: Table projects/ee-otokarcik/assets/hranice_sr2  
  
1 //importované hranice SR majú formát tabuľky preto jej potrebujeme pridať geomtriu//  
2  
3 var sr=table.geometry();  
4  
5 //pomocou funkcie "Map.addLayer" pridáme hranice SR do mapového okna, nastavíme farbu a vrstvu pomenujeme//  
6  
7 Map.addLayer(sr, {color:"black"}, "Hranica SR");  
8
```



## 4. Pridanie DEM do mapového okna

```
Map.addLayer(raster, {min:0, max:1500, palette:"green, yellow, red"}, "DEM");
```

```
//do mapového okna pridáme digitálny výškový model, nastavíme farebnú škálu a intervaly//  
Map.addLayer(raster, {min:0, max:1500, palette:"green, yellow, red"}, "DEM");
```



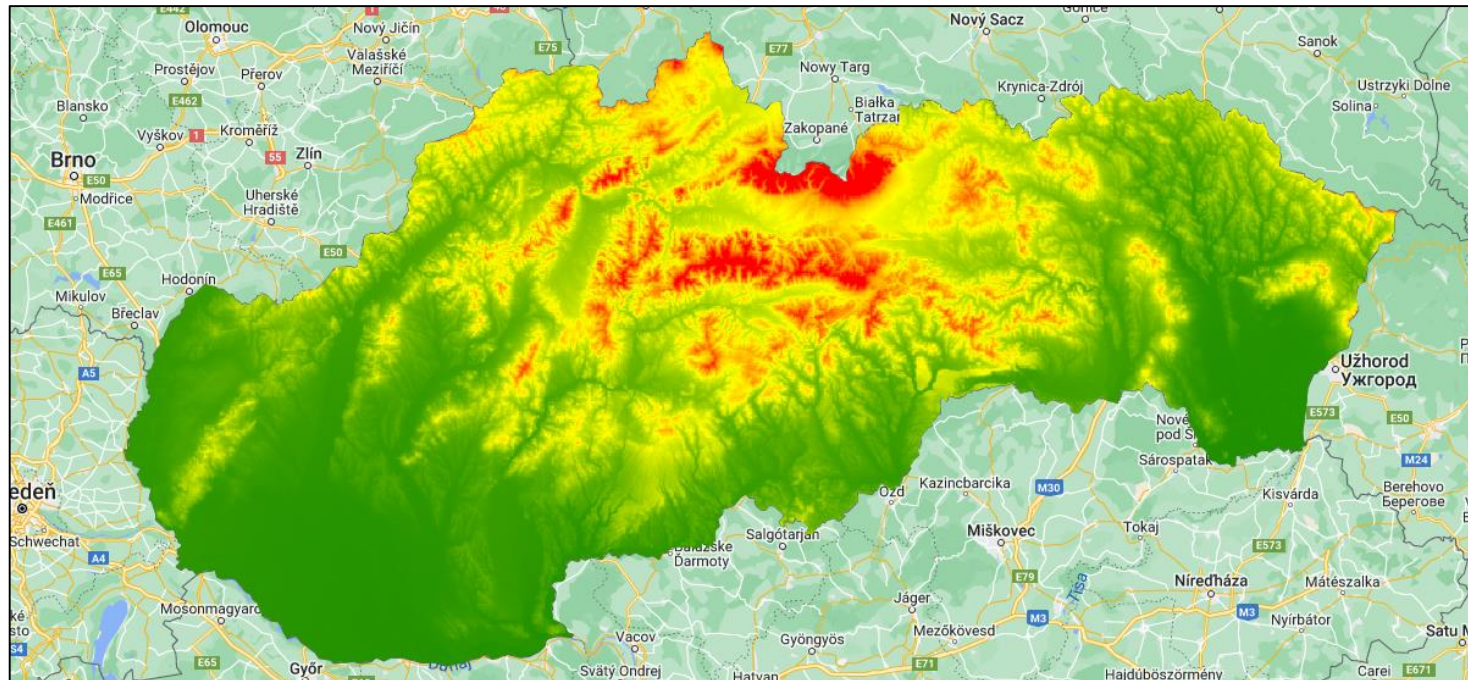


## 5. Orezanie DEM podľa hraníc SR

```
var clip_sr=raster.clip(sr);
```

```
Map.addLayer(clip_sr, {min:0, max:1500, palette:"green, yellow, red"}, "DEM_sr");
```

```
//pomocou nástroja clip orežeme DEM podľa hraníc SR//  
var clip_sr=raster.clip(sr);  
  
//orezané DEM pridáme do mapového okna opäť pomocou nástroja Map.addLayer//  
Map.addLayer(clip_sr, {min:0, max:1500, palette:"green, yellow, red"}, "DEM_sr");
```





## 6. Analýzy terénu pomocou príkazu „ee.Terrain“ a pridanie výsledkov do mapového okna

```
var hillshade= ee.Terrain.hillshade(clip_sr);  
var slope=ee.Terrain.slope(clip_sr);  
var aspect=ee.Terrain.aspect(clip_sr);  
Map.addLayer(hillshade, {min:0, max:255}, "Hillshade");  
Map.addLayer(slope, {min:0, max:40, palette:"green, yellow, red"}, "Slope");  
Map.addLayer(aspect, {min:0, max:360, palette:"green, yellow, red, blue"}, "Aspect");
```

```
//s orezaným DEM urobíme ešte ďalšie analýzy: tieňovaný reliéf (hillshade), mapu sklonov(slope) a orientáciu voči svetovým stranám, použijeme nástroj "ee.Terrain"/>  
var hillshade= ee.Terrain.hillshade(clip_sr);  
var slope=ee.Terrain.slope(clip_sr);  
var aspect=ee.Terrain.aspect(clip_sr);  
  
//výsledky analýz pridáme do mapového okna//  
Map.addLayer(hillshade, {min:0, max:255}, "Hillshade");  
Map.addLayer(slope, {min:0, max:40, palette:"green, yellow, red"}, "Slope");  
Map.addLayer(aspect, {min:0, max:360, palette:"green, yellow, red, blue"}, "Aspect");
```



## 7. Export mapy na disk

```
Export.image.toDrive({image: clip_sr, description: 'Digitální výškový model SR', scale: 20,  
                    region: sr, maxPixels: 1e13,});
```

```
//export mapy na disk//  
Export.image.toDrive({image: clip_sr, description: 'Digitální výškový model SR', scale: 20, region: sr, maxPixels: 1e13,});
```

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# Ďakujeme za pozornosť!

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