

Tools

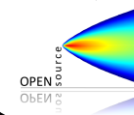
For geospatial analysis of 3d data in R

B. Kelly |



Open access tools mentioned

- mapview [Tim Appelhans/Florian Detsch](#) <https://github.com/r-spatial/mapview>
- openair [David Carslaw/Jack Davidson](#) <https://openair-project.github.io/book/>
- worldmet [David Carslaw](#) <https://github.com/openair-project/worldmet>
- tmap [Martijn Tennekes](#) <https://r-tmap.github.io/tmap/>
- exactextractr (c++) [Dan Baston](#) <https://isciences.gitlab.io/exactextractr/>
- terra/raster (c++) [Robert Hijmans](#) <https://r-spatial.github.io/terra/>
- stplanr transport planning [Robin Lovelace](#) <https://docs.ropensci.org/stplanr/>
- saqgetr [Stuart Grange](#) <https://drive.google.com/file/d/1lgDODHqBHewCTKLdAAxRyR7ml8ht6Ods/view>

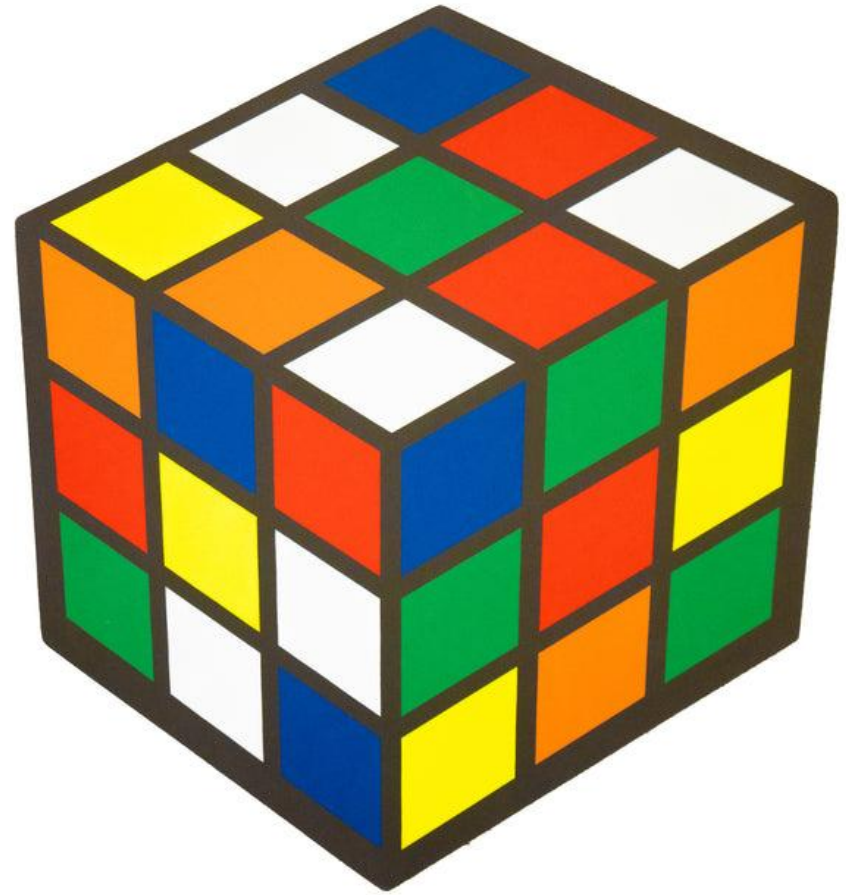


Georeferenced Raster Bricks

Convert multidimension netcdf file to 3d raster brick

Advantages:

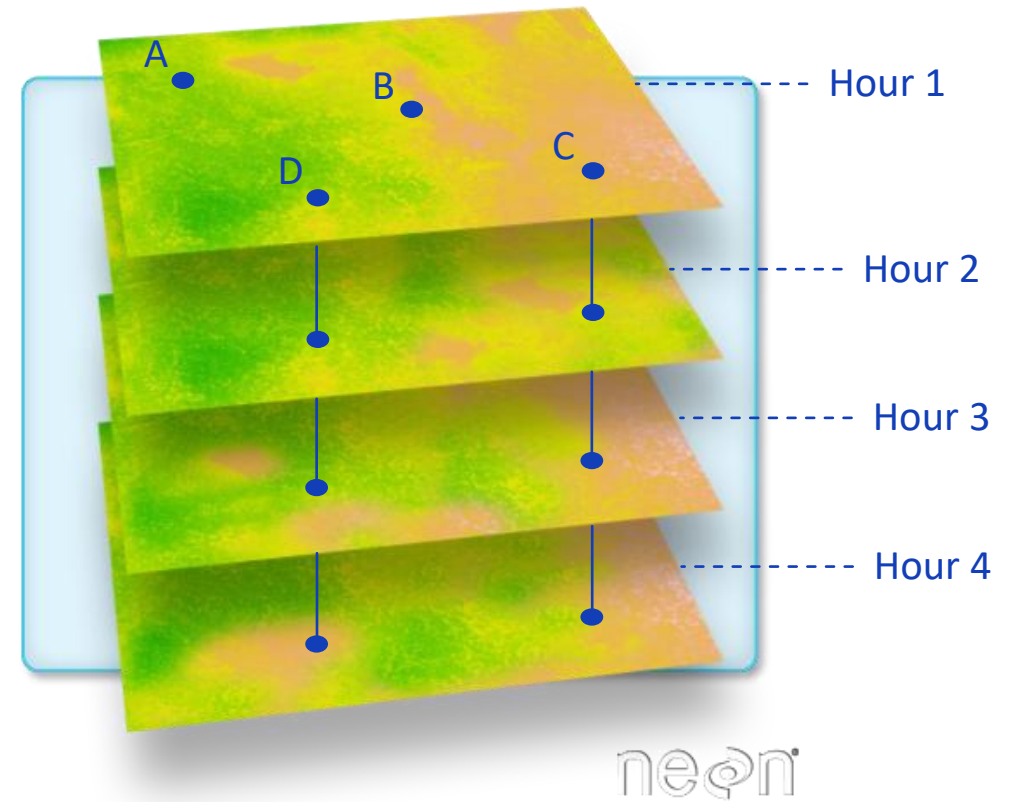
- Portability
- Efficient spatial analysis
- Quicker visualisation



Extracting time series

Quick extraction of data with **terra** and **exactextract**

	Hour 1	Hour 2	Hour 3	Hour 4
A				
B				
C				
D				



Case Study: Rasterising AIS data

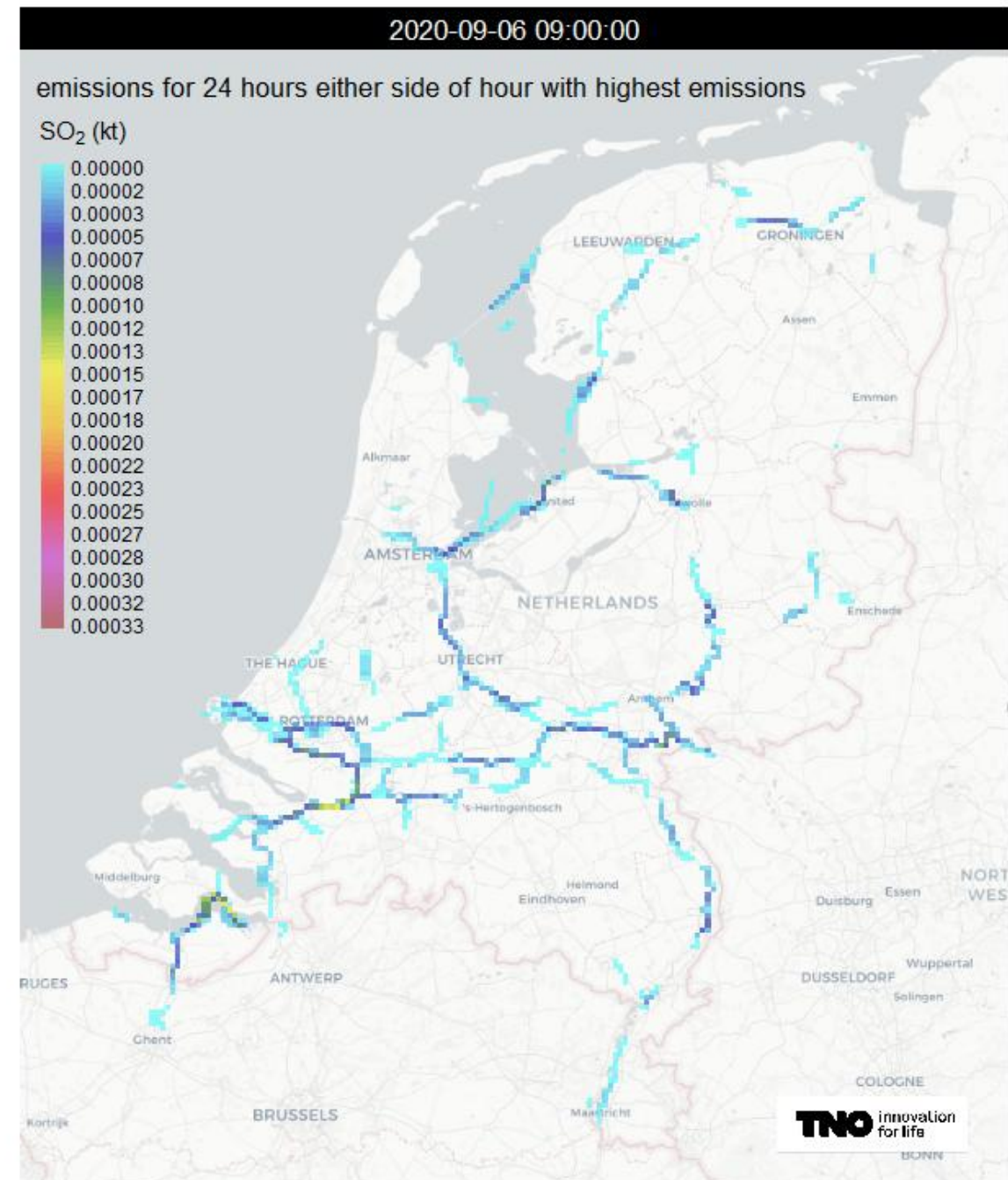
AIS – ship locations and data. File with ship emissions and location for each minute.

1x1km grid generated and

```
Raster_brick = rasterize(ship_emissions, grid, field = 'so2',  
by = 'date', fun = sum, na.rm = TRUE)
```

Raster_brick = 3d grid with ship emissions for full year that
can be converted to a netcdf if desired

Plotted using **tmap**



Tools Place text here

Case Study: TOPAS

‘Shiny’ app GUI to visualise
TOPAS data.

TOPAS netcdf’s post processed
to bricks

Label/year/species
combinations selected and
bricks added together

Core code of APP:

```
species = filter(spec_list, V2 == input$species)
```

```
rb = brick(paste0(dat_folder, "conc_bricks/EU_", species$V1, "_", input$yoi, "_lbs.TIF"))
```

```
ss = as.integer(which(lblz$full_name %in% input$label_checks))
```

```
r_sub = terra::subset(rb, ss)
```

```
r_out = calc(r_sub, sum)
```

TOPAS pollutant map

Area to show:
☒ Europe ☐ Netherlands

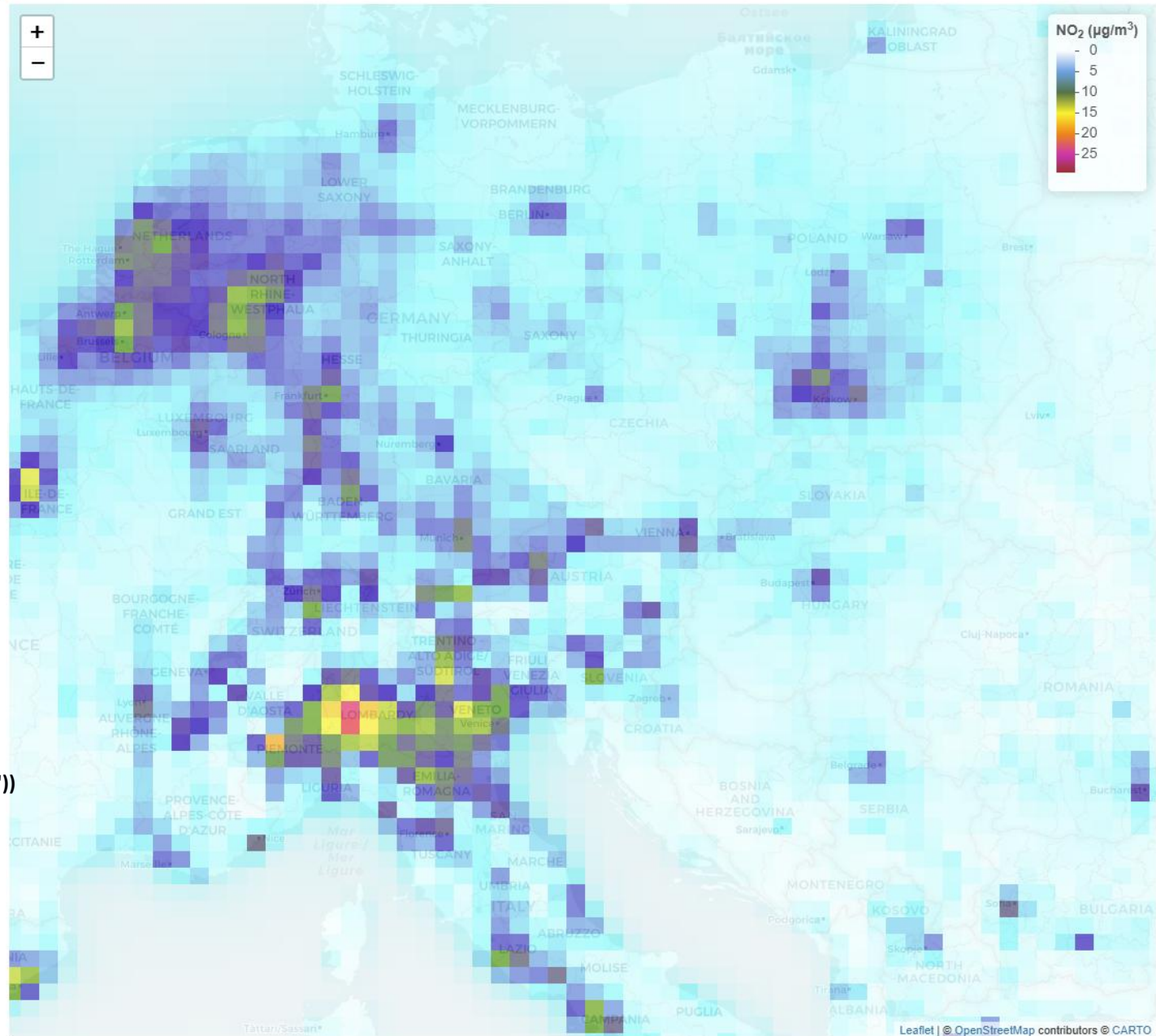
Year
2020

Species
Nitrogen dioxide

Emission labels
☒ Energy
☐ Residential Combustion
☐ Industry ☐ Fuel Production
☐ Solvent Use
☒ Road Traffic Exhaust
☐ Road Traffic Non-Exhaust
☐ Non-road Transport
☐ Waste ☐ Agriculture
☐ Wildfires ☐ Saharan Dust
☐ Seasalt ☐ Biogenic
☐ Outside model area

UPDATE

Select options and click 'UPDATE'



Showing annual average concentrations for Nitrogen dioxide in Europe for the year of 2020 for labels:
Energy native , Road Transport - exh. native , Energy non-native , Road Transport - exh. non-native

Case Study: Setting up LE

Simple GUI for new users

- single script available to download on git that uses geospatial tools to alter the base .rc files
- User has a basic, bug free, model run as a starting point
- Allows visualisation of domains
- Halo on all boundary runs
- Can prevent incorrect emissions combinations

LE setup

Select Umbrella Project
Hollandse_Luchten

Sub-Project Name

Run Type:
☐ Full ☒ Zoom

Domain 1
European_macc_25_25

Emissions - Parent 1
CAMS-REG_v5_1_RWC_GrETa_ER cams_v5_1_shipping_non_EU bio bio-no sea_salt dust-wind
dust-resuspension dust-agriculture gfas-daily

Select species - parent 1
o3 no2 no nh3 so2 hno3 co n2o5 form iso pan no3a_f no3a_c so4a_f so4a_c nh4a_f ppm_f
ppm_c ec_f ec_c pom_f pom_c na_ff na_f na_c na_cc na_ccc dust_ff dust_f dust_c dust_cc dust_ccc
tpm25 tpm10 tnmvoc tdust tss

☐ halo output?

Domain 2
german_pinetl_7_7

Emissions - Parent 2
CAMS-REG_v5_1_RWC_GrETa_ER cams_v5_1_shipping_non_EU bio bio-no sea_salt dust-wind
dust-resuspension dust-agriculture gfas-daily

Select species - parent 2
o3 no2 no nh3 so2 hno3 co n2o5 form iso pan no3a_f no3a_c so4a_f so4a_c nh4a_f ppm_f
ppm_c ec_f ec_c pom_f pom_c na_ff na_f na_c na_cc na_ccc dust_ff dust_f dust_c dust_cc dust_ccc
tpm25 tpm10 tnmvoc tdust tss

☐ halo output?

Boundary Conditions File
CAMS Global

Zoom
topas_NL_3.5_2.7

Emissions - Zoom
CAMS-REG_v5_1_RWC_GrETa_ER cams_v5_1_shipping_non_EU bio bio-no sea_salt dust-wind
dust-resuspension dust-agriculture gfas-daily

Select species - zoom
o3 no2 no nh3 so2 hno3 co n2o5 form iso pan no3a_f no3a_c so4a_f so4a_c nh4a_f ppm_f
ppm_c ec_f ec_c pom_f pom_c na_ff na_f na_c na_cc na_ccc dust_ff dust_f dust_c dust_cc dust_ccc
tpm25 tpm10 tnmvoc tdust tss

☐ 3d_outputs for zoom run?

Show Domains

☐ Labelled sectors?

Select labels

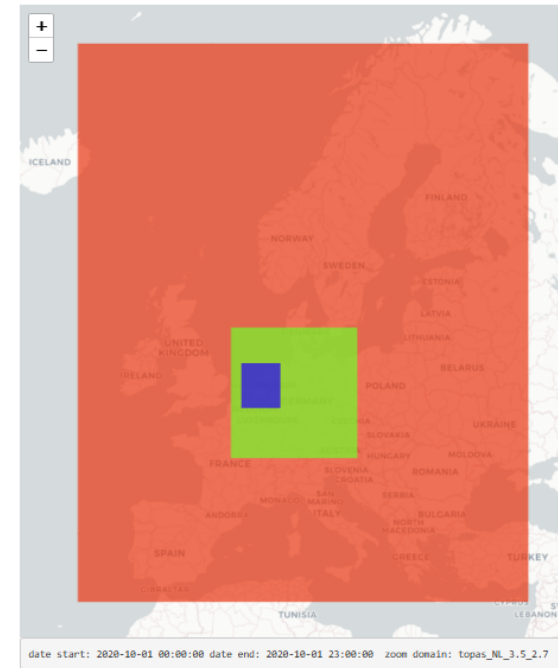
Select sub-labels

☐ Mixing layers

Date range:
2020/10/01 - 2020/10/01

Create Model Files

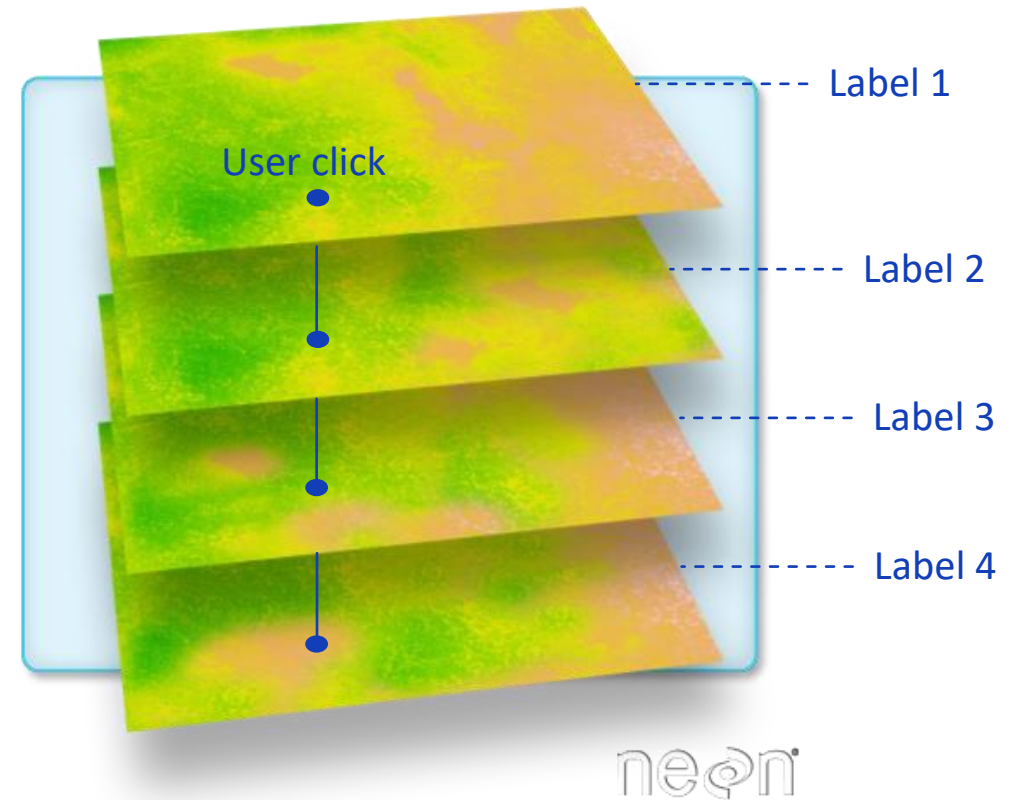
Select model options and click 'Create Model Files' then navigate to the HPC and execute them using ./base/002/bin/setup-le proj/UMBRELLA_PROJECT/002/proj/SUB_PROJ/lotos-euros.rc



Case Study: TOPAS Labels

Quick extraction of data with **terra** and shown in R shiny

	User click
Label 1	
Label 2	
Label 3	
Label 4	

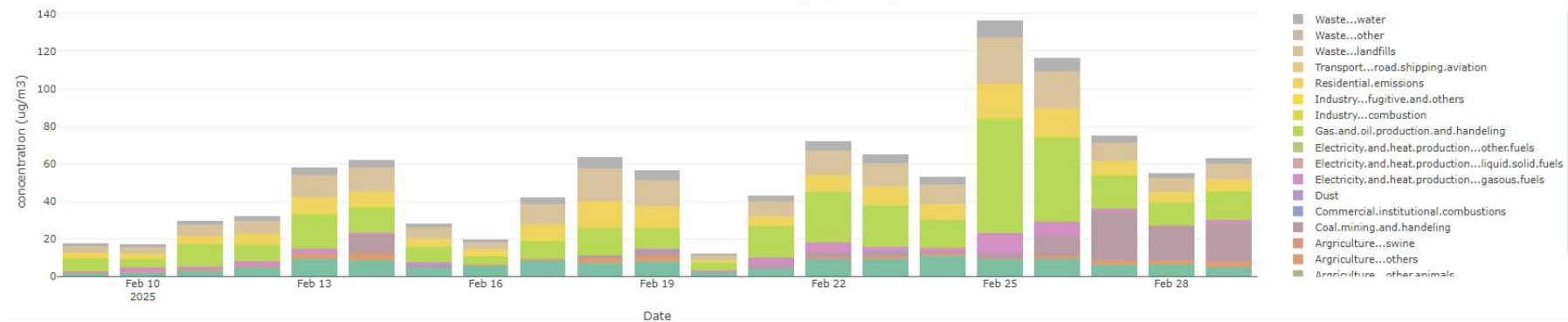
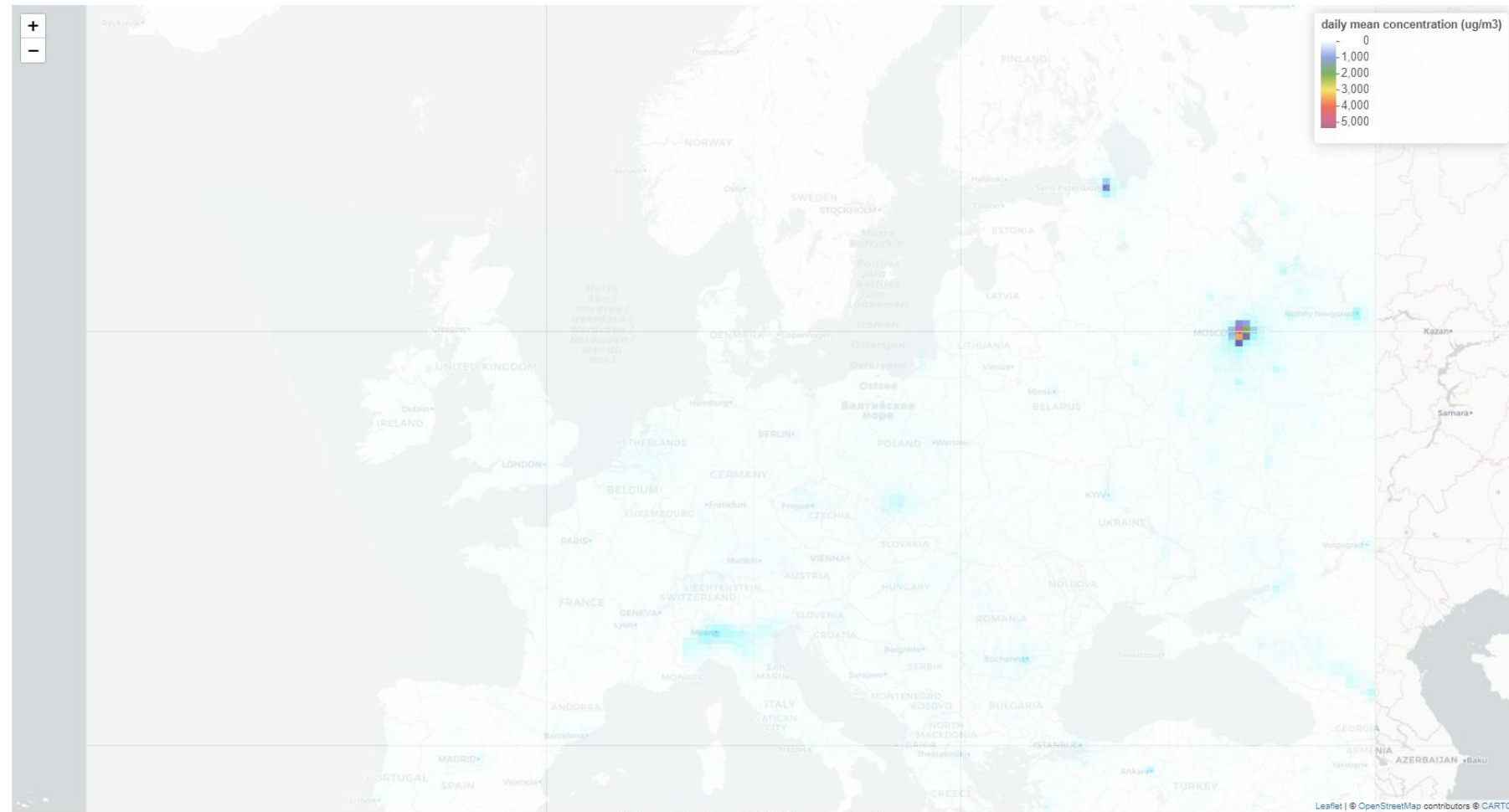


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Case Study: TOPAS Website

- Labels and dates stucked in a raster brick.
- Click a location and it extracts the time series and creates small data frame
- Then plotted

Extract Time Series from Raster



Clicked Location: Longitude = 32.2461, Latitude = 50.8657



TNO innovation
for life

https://ci.tno.nl/gitlab/aq_modelling/bricks4topas