



**CLEAN
STONE**

Aims of the CLEANSTONE project:

- to analyse the natural-stone fabrication sector in the Italy/Austria region
- to identify and implement protocols and best-practices to significantly increase the efficiency and productivity of the process
- to identify and implement protocols and best-practices to reduce to a bare minimum the environmental impact during the extraction and processing of the materials
- to identify the best recycling options for waste materials produced, reducing as much as possible the amount of stone waste disposed
- to evaluate recycling options based on the local industrial context
- to disseminate the know-how produced by the project, thus making the sector more competitive.

In this first phase, we focus on studying the environmental impact of the extraction and processing of the materials.

To study the environmental impact, we employ the CALPUFF software suite.

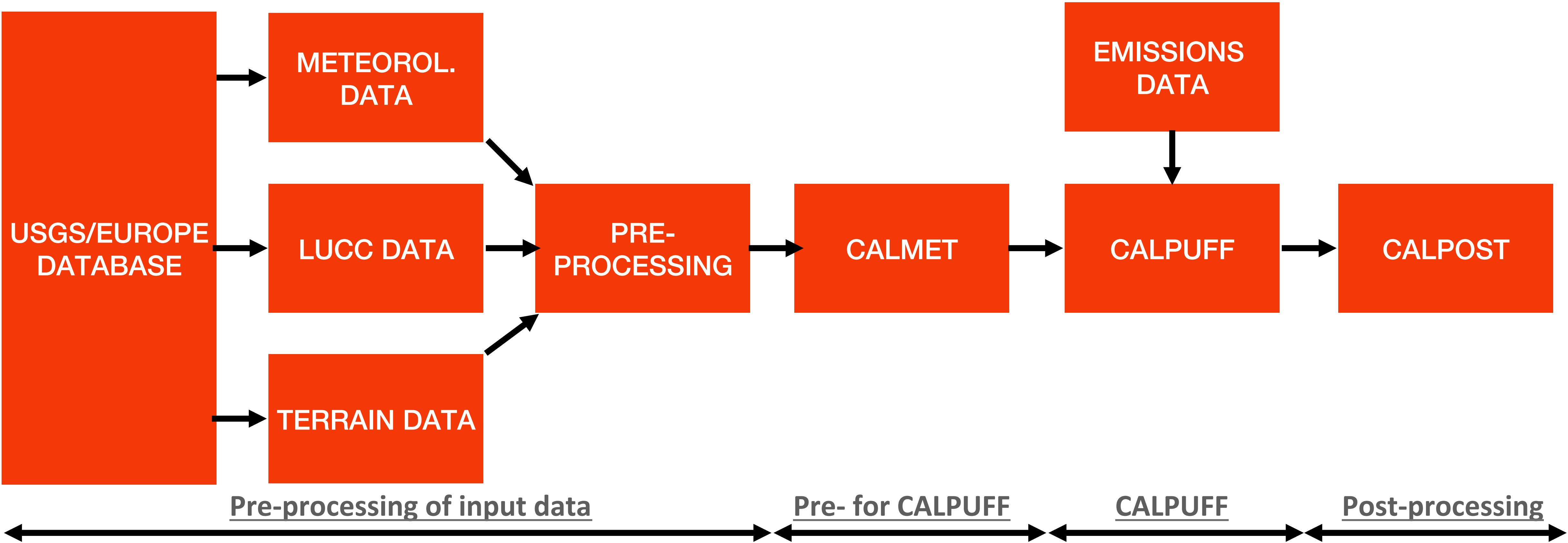
The main workflow of the study can be described as follows:

Pre-processing of input data: input of terrain elevation data, land use and cover change data, meteorological data.

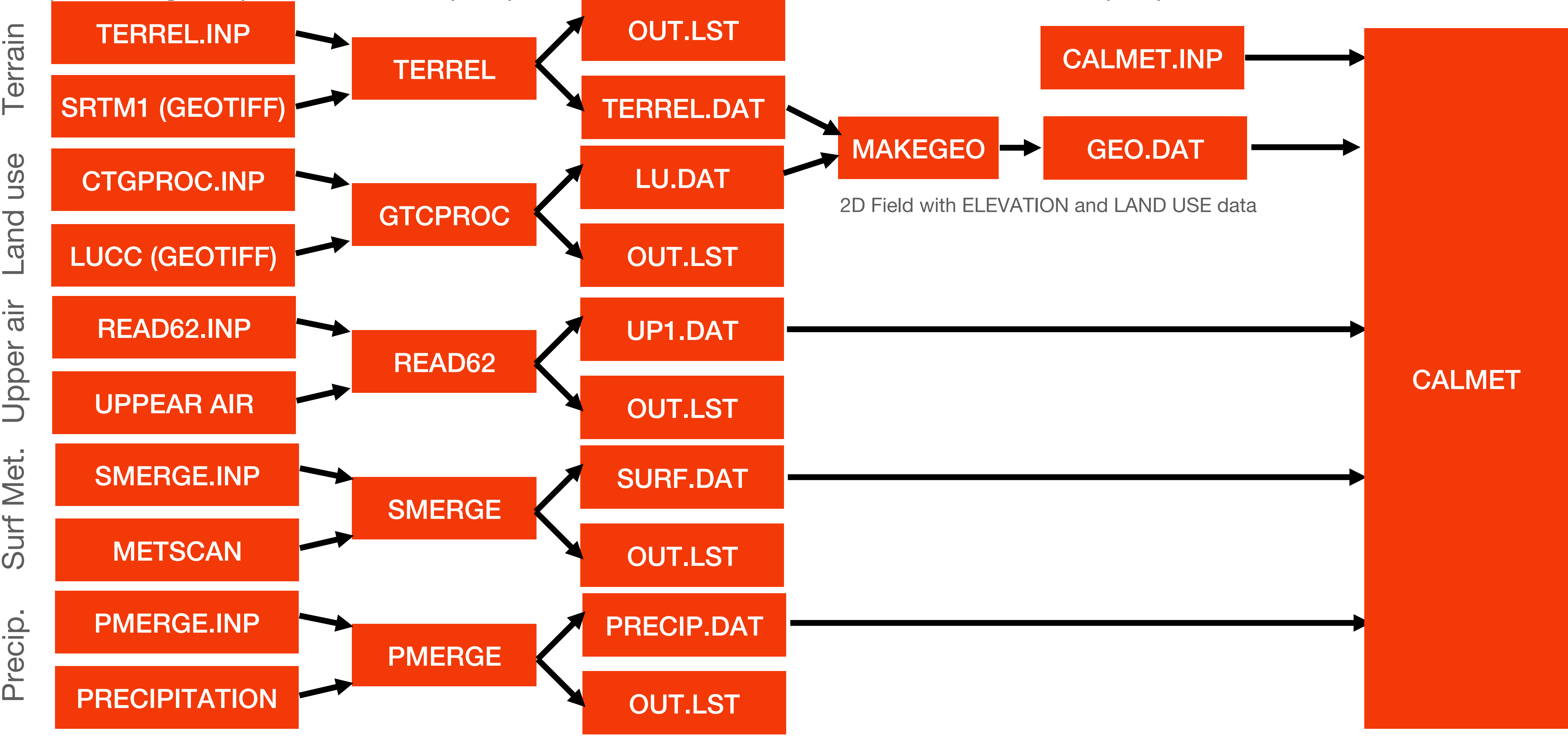
Pre-processing for CALPUFF: data processed at the previous step are read by CALMET and the respective input file for CALPUFF is generated.

Main simulation (CALPUFF): CALMET input files and emissions data are read by CALPUFF and the main simulation is run.

Post-processing (CALPOST): Dispersion and pollutant deposition.



Pre-processing of input data. This step requires the use of different database and different pre-processor tools:



Pre-processing of input data

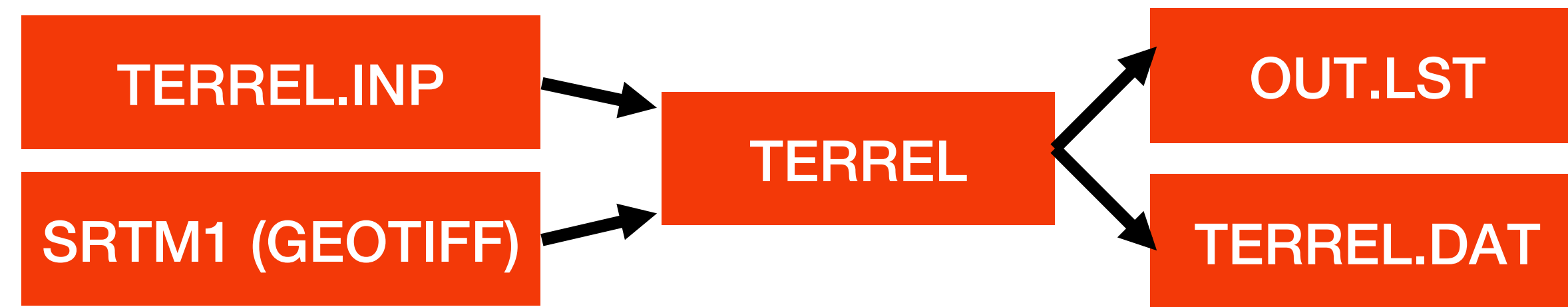
Pre-processing of input data:
Location of the production sites (ITALY):
Time zone: 33

- Cava Pietra Piasentina - “Noglar”
46.14038777000248 N, 13.456136579839253 E
(46° 8’ 25.396” N, 13° 27’ 22.091” E)
- Cava Tarpezzo
46.1373722 N, 13.503988888888889 E
(46° 8’ 14.54” N, 13°30’ 14.36 E)
- Cava Clastra
46.1306083 N, 13.511447222222221 E
(46° 7’ 50.19 N, 13°30’ 41.21 E)

All production sites are located between 46°N - 47°N
and 13°E and 14°E.



Terrain elevation data pre-processing workflow:



Terrain database (provided and maintained by USGS):

- GTOPO30 (Global digital elevation model)
- SRTM (Shuttle Radar Topography mission)

The following files can be downloaded from:

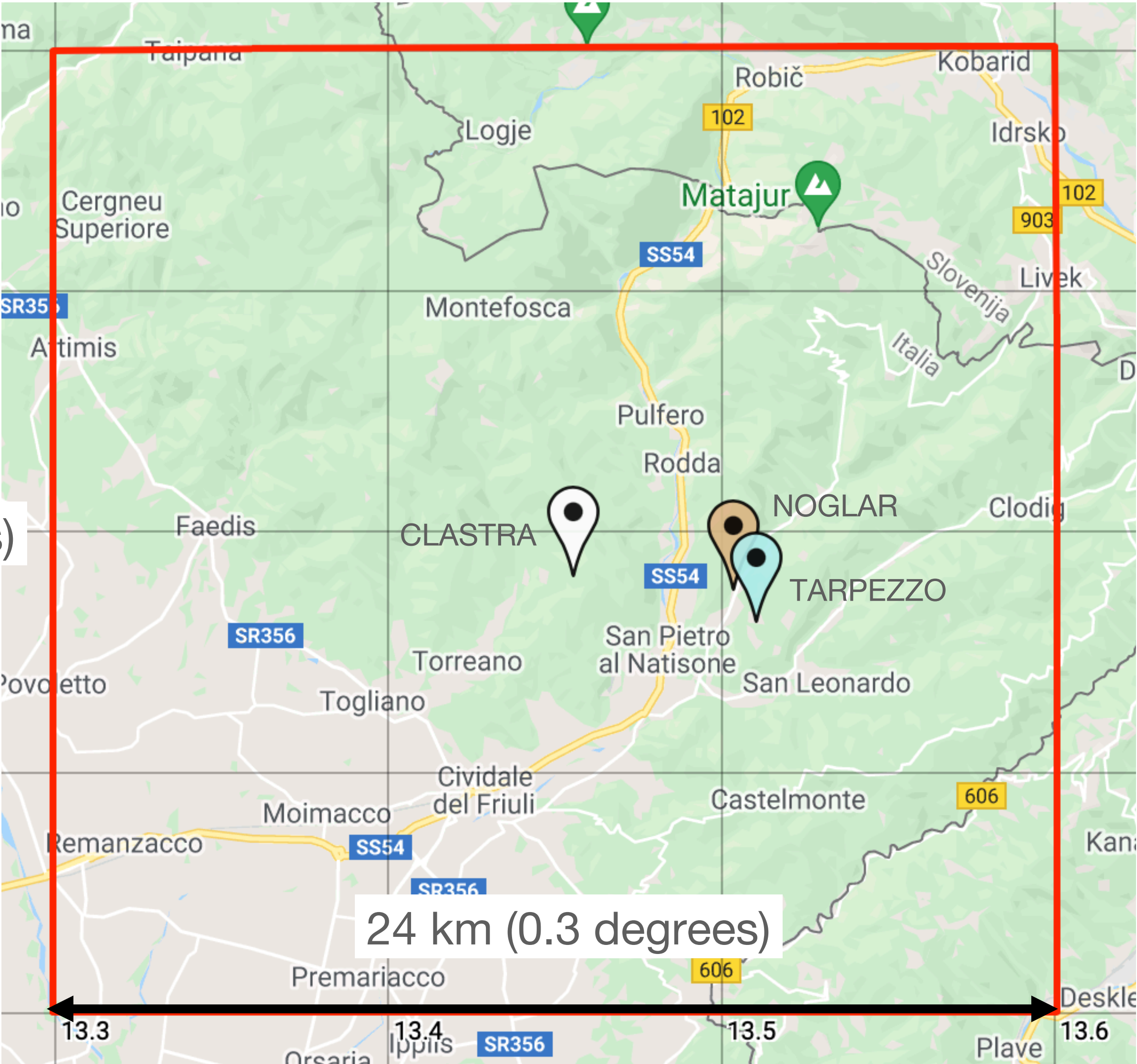
- GTOPO30 (GeoTiff format, 30 arc-second = 1km resolution) from earthexplorer.usgs.gov/
- SRTM3 (GeoTiff format, 3 arc-second = 90 m resolution) from earthexplorer.usgs.gov/
- SRTM1 (GeoTiff format, 1 arc-second = 30 m resolution) from earthexplorer.usgs.gov/
- SRTM1 (oil format, 1 arc-second = 30 m resolution) from earthexplorer.usgs.gov/
- SRTM1 (hgt format, 1 arc-second = 30 m resolution) from <http://viewfinderpanoramas.org/dem3.html>

Definition of computational domain:

NE corner (46.25 N, 13.60 E)
NE corner (46°15' N, 13°36' E)

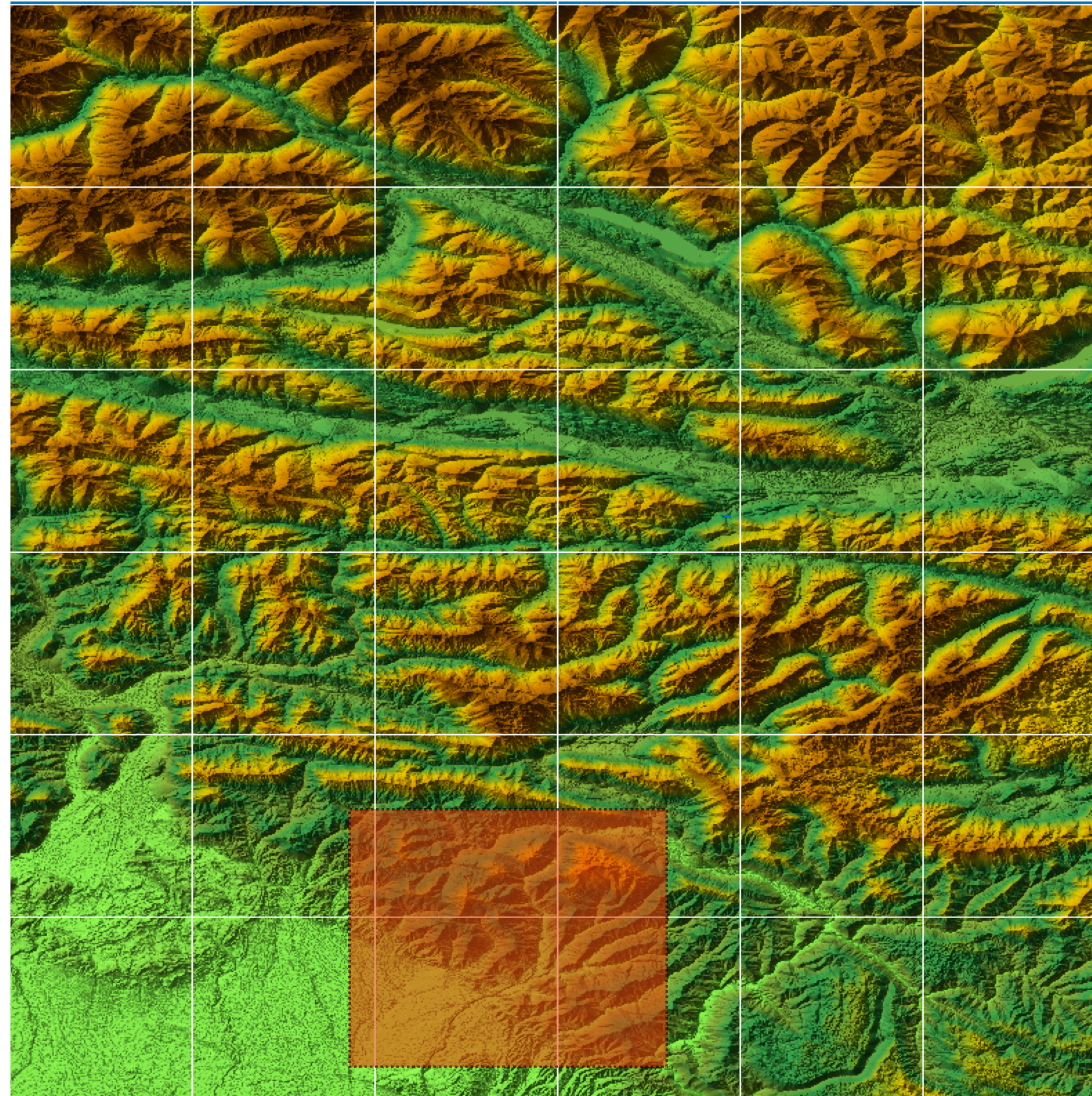
22 km (0.20 degrees)

SW corner (46.05 N, 13.30 E)
SW corner (46°3' N, 13°18' E)
Corresponding to
(WGS-84)
XREF: 368.5 km
YREF 5101.0 km



24 km (0.3 degrees)

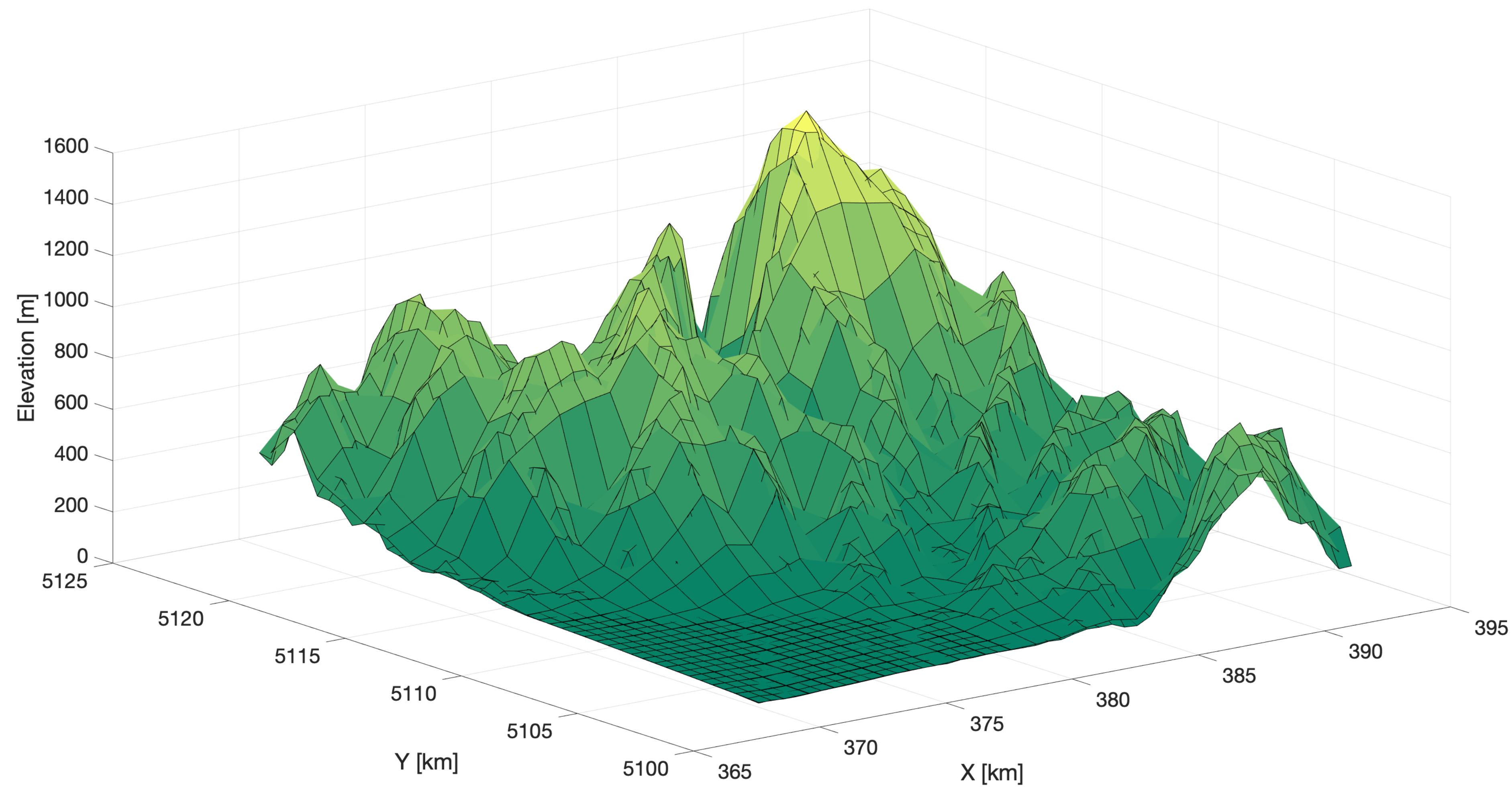
We use the SRTM1 files (1 arc-second resolution = 30 m resolution).
File: 46NE13 (GeoTIFF or hgt): from 46N,13E (SW) to 47N,14E (NE).



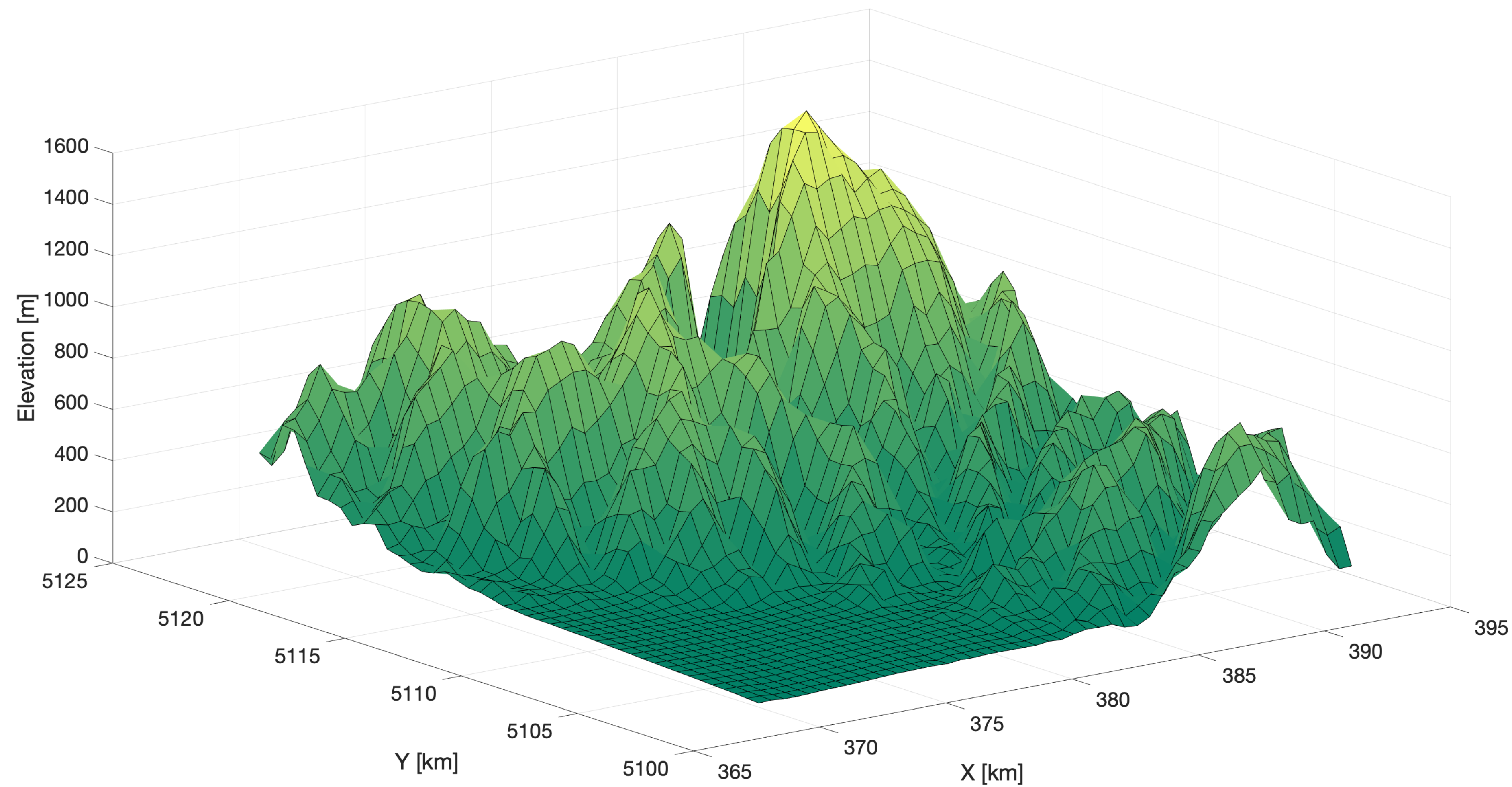
Same computational domain (28km x 28 km) and we consider three different grid resolution:

- 1 kilometer
- 500 meters
- 250 meters
- 125 meters

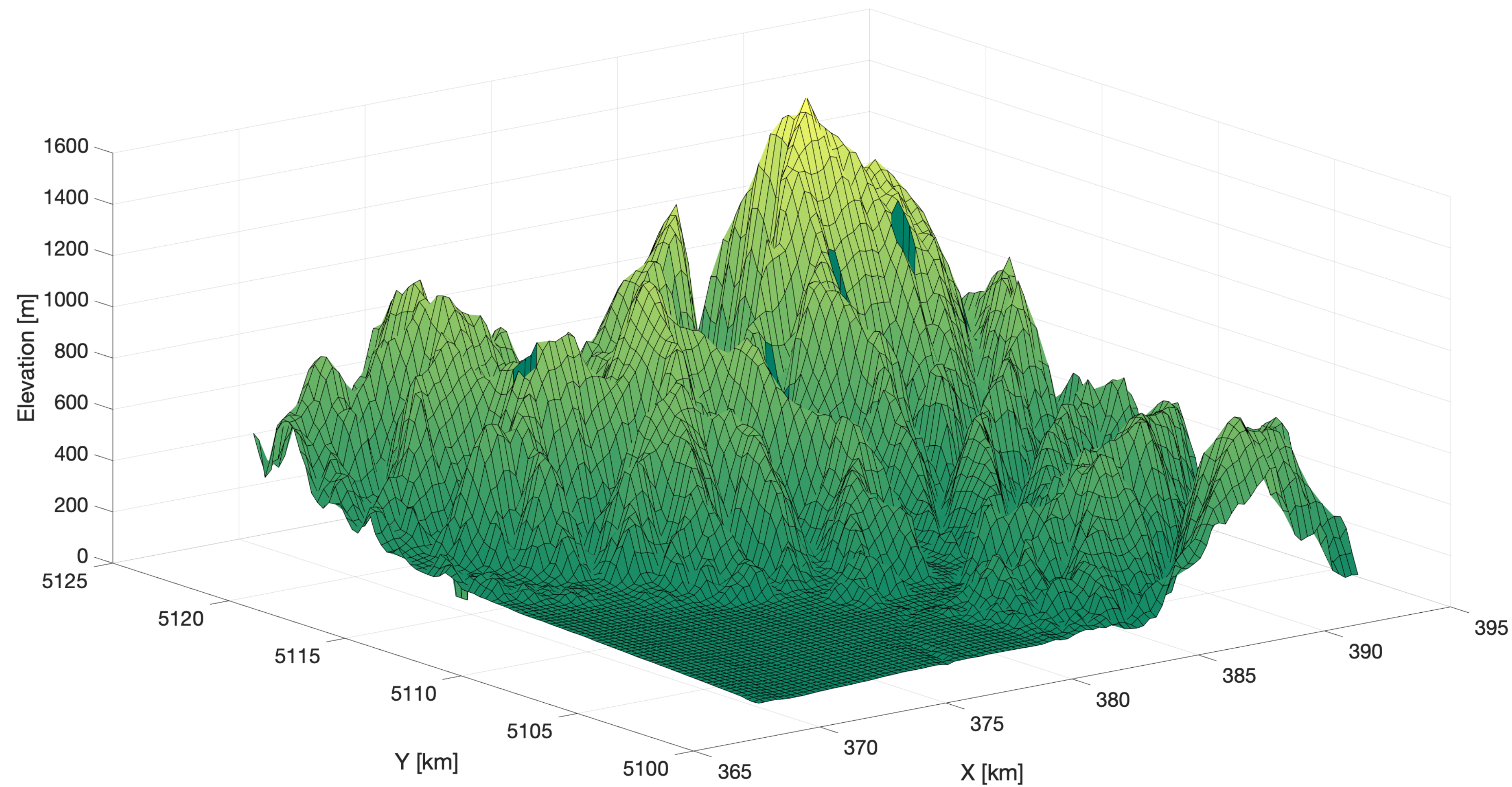
Resulting elevation files (TERREL.DAT) - 1km resolution (NX x NY = 24 x 22)



Resulting elevation files (TERREL.DAT) - 1km resolution (NX x NY = 48 x 44)



Resulting elevation files (TERREL.DAT) - 1km resolution (NX x NY = 96 x 88)



Land use and cover change data pre-processing workflow:



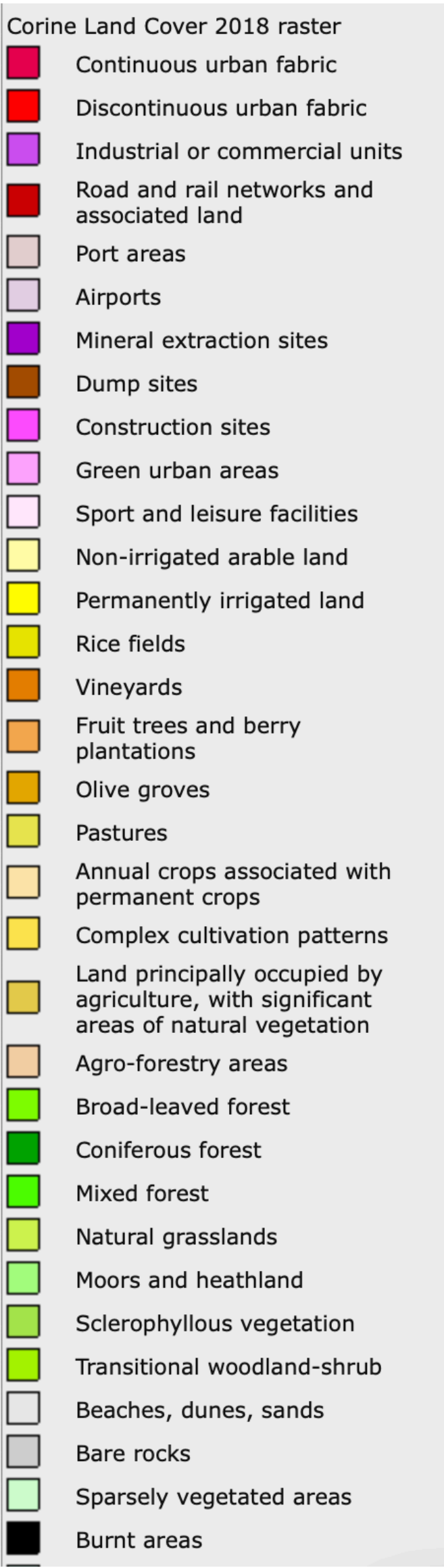
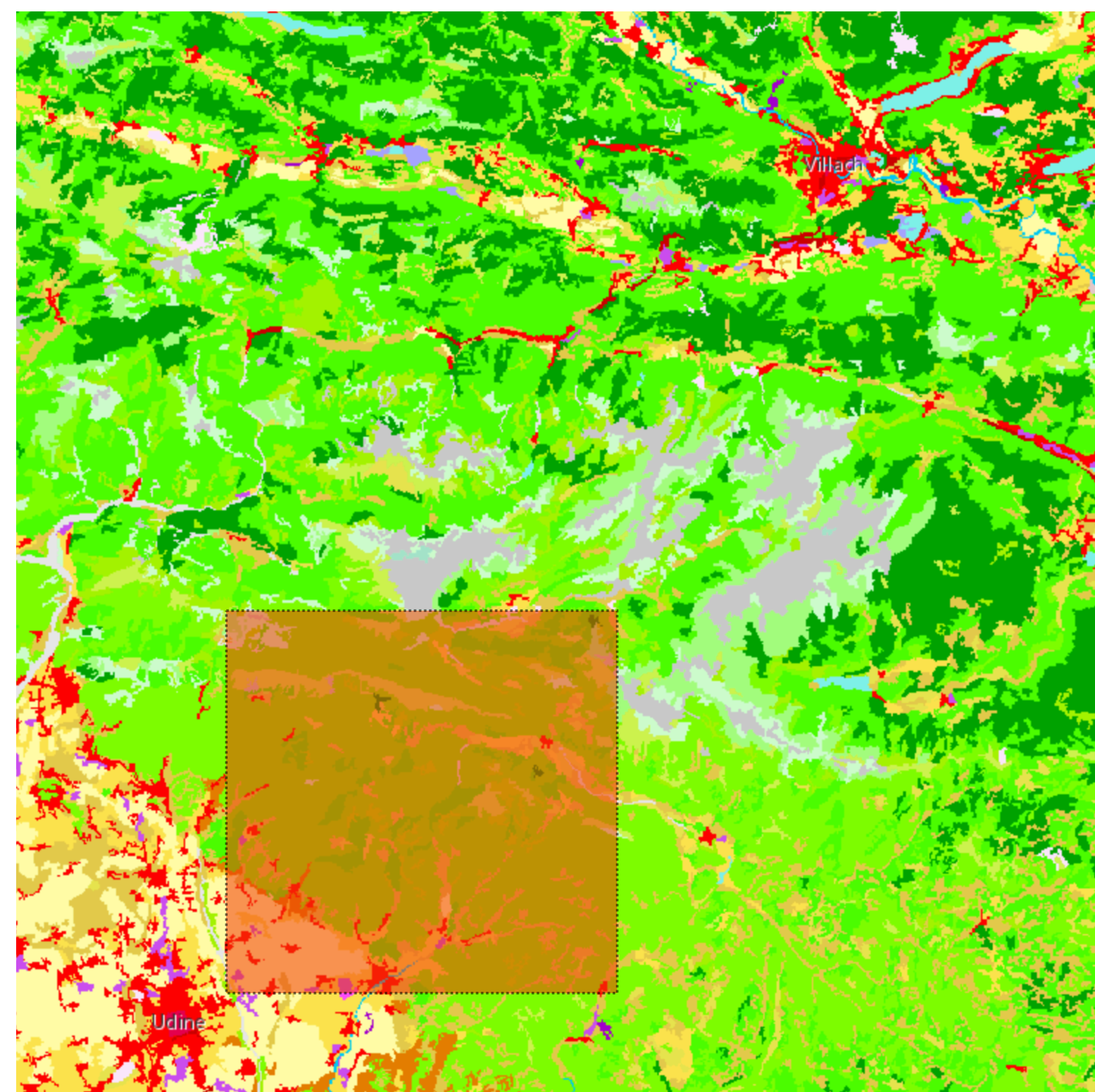
Land use and cover change database:

- LUCC (Provided and maintained by USGS, 1km resolution for Europe)
- CORINE Database (Provided and maintained by European Environment agency, 100m and 30m resolutions)

The following files can be downloaded from:

- USGS Global (GlazaEU format, 1km resolution) from earthexplorer.usgs.gov/
- CORINE (GeoTiff format, 100 m resolution) from <https://land.copernicus.eu/pan-european/corine-land-cover>
- CORINE (GeoTiff format, 30 m resolution) from <https://land.copernicus.eu/pan-european/corine-land-cover>

Corine Database:



The use of the database files is not straightforward: CALPUFF (USGS) and CORINE use different classification:

CODIFICA		ETICHETTA		RGB
CORINE	USGS	CORINE livello 3	USGS livello 2	CORINE
111	11	Continuous urban fabric	Residential	230-000-077
112	11	Discontinuous urban fabric	Residential	255-000-000
121	15	Industrial or commercial units	Industrial and Commercial Complexes	204-077-242
122	14	Road and rail networks and associated land	Transportation, Communications and Utilities	204-000-000
123	14	Port areas	Transportation, Communications and Utilities	230-204-204
124	14	Airports	Transportation, Communications and Utilities	230-204-230
131	75	Mineral extraction sites	Strip Mines, Quarries, and Gravel Pits	166-000-204
132	17	Dump sites	Other Urban or Built-up Land	166-077-000
133	16	Construction sites	Mixed Urban or Built-up Land	255-077-255
141	16	Green urban areas	Mixed Urban or Built-up Land	255-166-255
142	14	Sport and leisure facilities	Transportation, Communications and Utilities	255-230-255
211	24	Non-irrigated arable land	Transportation, Communications and Utilities	255-255-168
212	-21	Permanently irrigated land	Cropland and Pasture	255-255-000
213	-22	Rice fields	Orchards, Groves, Vineyards, Nurseries, and Ornamental Horticultural Areas	230-230-000
221	22	Vineyards	Orchards, Groves, Vineyards, Nurseries, and Ornamental Horticultural Areas	230-128-000
222	22	Fruit trees and berry plantations	Orchards, Groves, Vineyards, Nurseries, and Ornamental Horticultural Areas	242-166-077
223	22	Olive groves	Orchards, Groves, Vineyards, Nurseries, and Ornamental Horticultural Areas	230-166-000
231	21	Pastures	Cropland and Pasture	230-230-077
241	21	Annual crops associated with permanent crops	Cropland and Pasture	255-230-166
242	22	Complex cultivation patterns	Orchards, Groves, Vineyards, Nurseries, and Ornamental Horticultural Areas	255-230-077
243	23	Land principally occupied by agriculture, with significant areas of natural vegetation	Confined Feeding Operations	230-204-077
244	22	Agro-forestry areas	Orchards, Groves, Vineyards, Nurseries, and Ornamental Horticultural Areas	242-204-166
311	41	Broad-leaved forest	Deciduous Forest Land	128-255-000
312	42	Coniferous forest	Evergreen Forest Land	000-166-000
313	43	Mixed forest	Mixed Forest Land	077-255-000

Current work:

- Reading of the CORINE database files in Matlab and assignment of the USGS categories.
- Generation of the LU.DAT file that will be used by MAKEGEO in Matlab.
- Source-code (Fortran-77) of CTGPROC cannot be modified since the program is compiled with a commercial compiler with non-st