SIS Scuola Interdipartimentale delle Scienze, dell'Ingegneria e della Salute

DiST Dipartimento di Scienze e Tecnologie

Laurea Magistrale in STN

Applicazioni di Calcolo Scientifico e Laboratorio di ACS

(12 cfu)

prof. Mariarosaria Rizzardi

Centro Direzionale di Napoli – Isola C4
stanza: n. 423 – Lato Nord, 4° piano
tel.: 081 547 6545
email: mariarosaria.rizzardi@uniparthenope.it

Leggere geodati da file testo

- Dati altimetrici su griglia (GEBCO 2022 data).
- Dati altrimetrici da laser scanner (EA lidar elevation data).

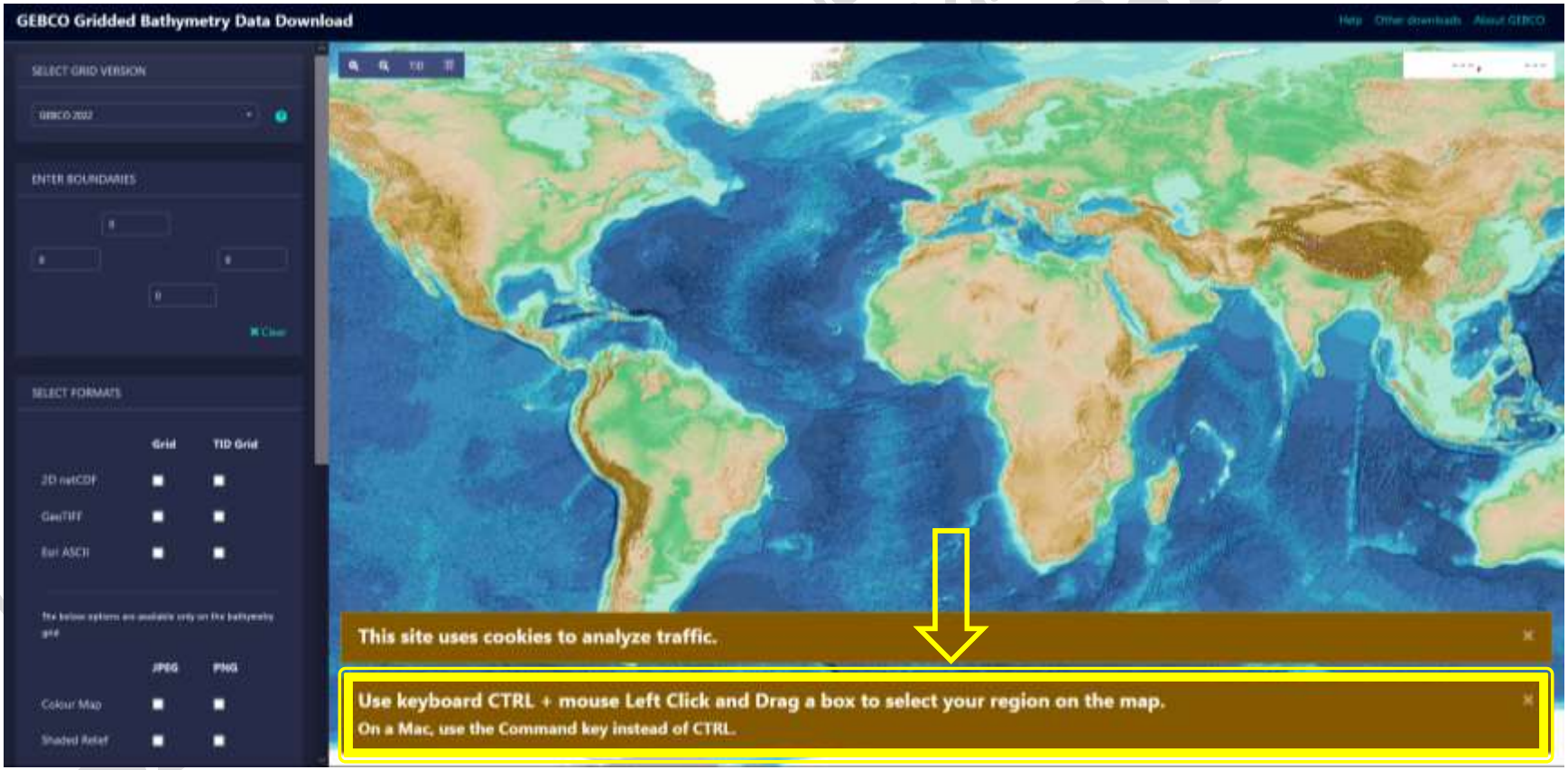
Leggere dati altimetrici su griglia da un file testo

OTTENERE I DATI:

https://www.gebco.net/data_and_products/gridded_bathymetry_data/#area,

⇨ https://download.gebco.net/

l'utente può selezionare un'area sulla mappa del mondo



per esempio, si voglia selezionare la Sicilia.

1) Add to basket
2) View basket
3) Download

Bounds:

North=38.3643

West=12.3871 East=15.8752

South=36.6751

file: gebco_2022_n38.3643_s36.6751_w12.3871_e15.8752.asc

(xllcorner, yllcorner): lower left corner

West=12.3871
South=36.6751

```
ncols         837
nrows         405
xllcorner     12.387500000000
yllcorner     36.675000000000
cellsize      0.004166666667
NODATA_value -32767
```

header

6 linee di intestazione

```
-1294 -1275 -1260 -1258 -1266 -1278 -1286 -1296 -1310 -1323 -1337
-1357 -1376 -1388 -1378 -1357 -1335 -1311 -1286 -1265 -1242 -1227
-1211 -1194 -1225 -1171 -1106 -1015 -937 -823 -712 -568 -545 -539
-533 -525 -524 -525 -572 -686 -763 -909 -1112 -1327 -1529 -1709 -
1896 -1962 -1970 -1973 -1976 -1977 -1977 -1978 -1976 -1977 -1979 -
1978 -1978 -1980 -1998 -2000 -1999 -1997 -1995 -2000 -1994 -1993 -
1992 -1990 -1992 -1987 -1991 -1986 -1975 -1962 -1941 -1927 -1892 -
1875 -1907 -1919 -1926 -1888 -1849 -1810 -1784 -1699 -1633 -1583 -
1501 -1463 -1433 -1410 -1377 -1352 -1319 -1309 -1300 -1295 -1296 -
1291 -1289 -1282 -1276 -1269 -1258 …
```

dati altimetrici

in MATLAB: 1) Modo manuale (semplice)

Copiare il file in **GEBCO2022_Sicilia.m** e modificarlo in uno script come segue:

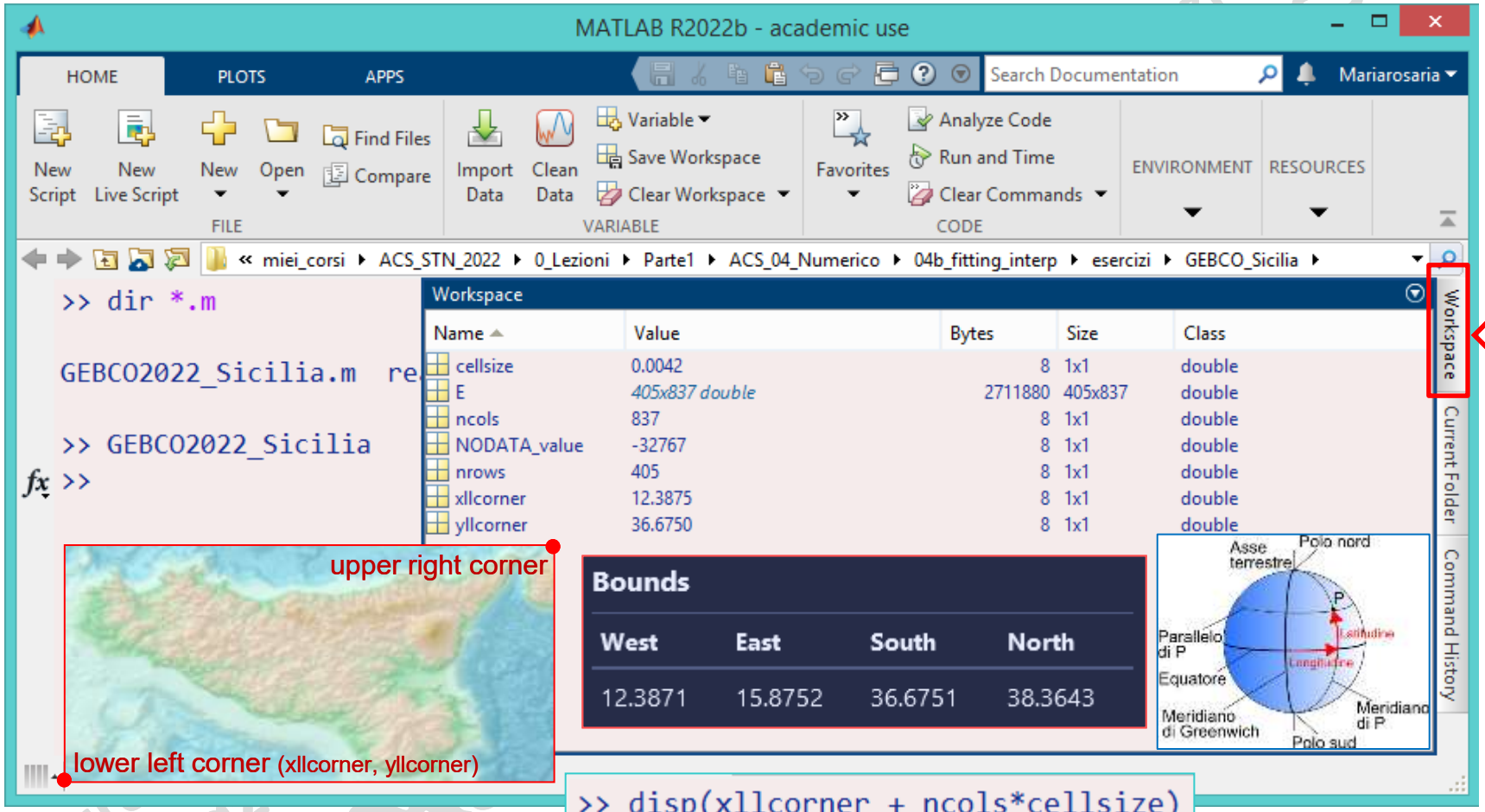
```
ncols        = 837;
nrows        = 405;
xllcorner    = 12.387500000000;
yllcorner    = 36.675000000000;
cellsize     = 0.004166666667;
NODATA_value = -32767;
E = [  % Elevation
-1294 -1275 -1260 -1258 -1266 -1278 -1286 -1296 -1310 -1323 -1337
-1357 -1376 -1388 -1378 -1357 -1335 -1311 -1286 -1265 -1242 -1227
-1211 -1194 -1225 -1171 -1106 -1015 -937 -823 -712 -568 -545 -539
-533 -525 -524 -525 -572 -686 -763 -909 -1112 -1327 -1529 -1709 -
1896 -1962 -1970 -1973 -1976 -1977 -1977 -1978 -1976 -1977 -1979 -
1978 -1978 -1980 -1998 -2000 -1999 -1997 -1995 -2000 -1994 -1993 -
1992 -1990 -1992 -1987 -1991 -1986 -1975 -1962 -1941 -1927 -1892 -
1875 -1907 -1919 -1926 -1888 -1849 -1810 -1784 -1699 -1633 -1583 -
1501 -1463 -1433 -1410 -1377 -1352 -1319 -1309 -1300 -1295 -1296 -
1291 -1289 -1282 -1276 -1269 -1258 …
];
```

contenuto del file

```
ncols         837
nrows         405
xllcorner     12.387500000000
yllcorner     36.675000000000
cellsize      0.004166666667
NODATA_value -32767
-1294 -1275 -1260 -1258 -1266 -1278 -1286 -1296 -1310
-1323 -1337 -1357 -1376 -1388 -1378 -1357 -1335 -1311
-1286 -1265 -1242 -1227 -1211 -1194 -1225 -1171 -1106
-1015 -937 -823 -712 -568 -545 -539 -533 -525 -524 -
525 -572 -686 -763 -909 -1112 -1327 -1529 -1709 -1896
-1962 -1970 -1973 -1976 …
```

Il file può essere eseguito in MATLAB

in MATLAB: 1) Modo manuale (semplice)



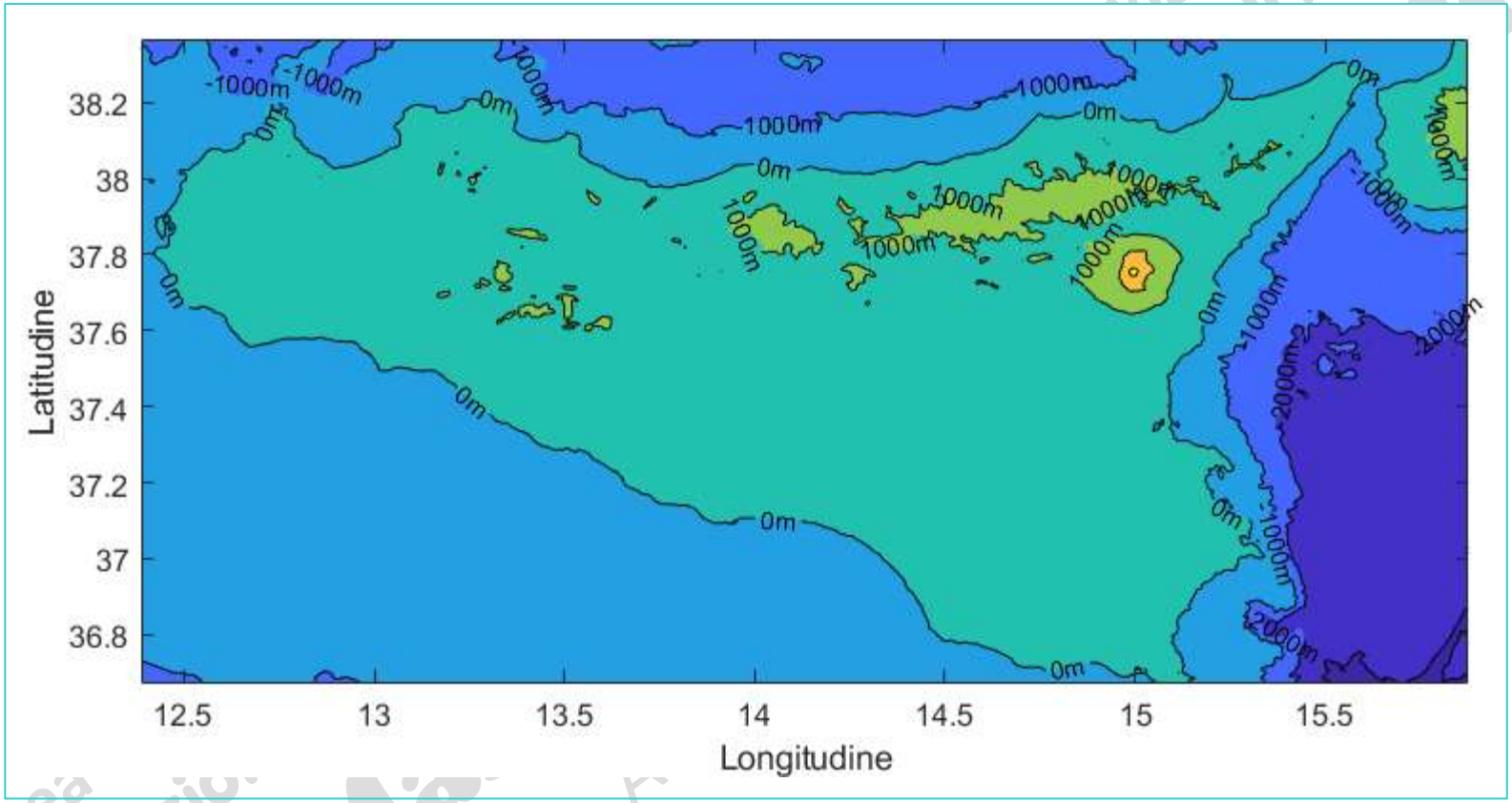
griglia in longitudine, latitudine

```
>> disp(xllcorner + ncols*cellsize)
      15.875
>> disp(yllcorner + nrows*cellsize)
      38.363
```

upper right corner

```
Lon=xllcorner+linspace(0,ncols*cellsize,ncols);
Lat=yllcorner+linspace(0,nrows*cellsize,nrows);
[x,y]=meshgrid(Lon,Lat);
```

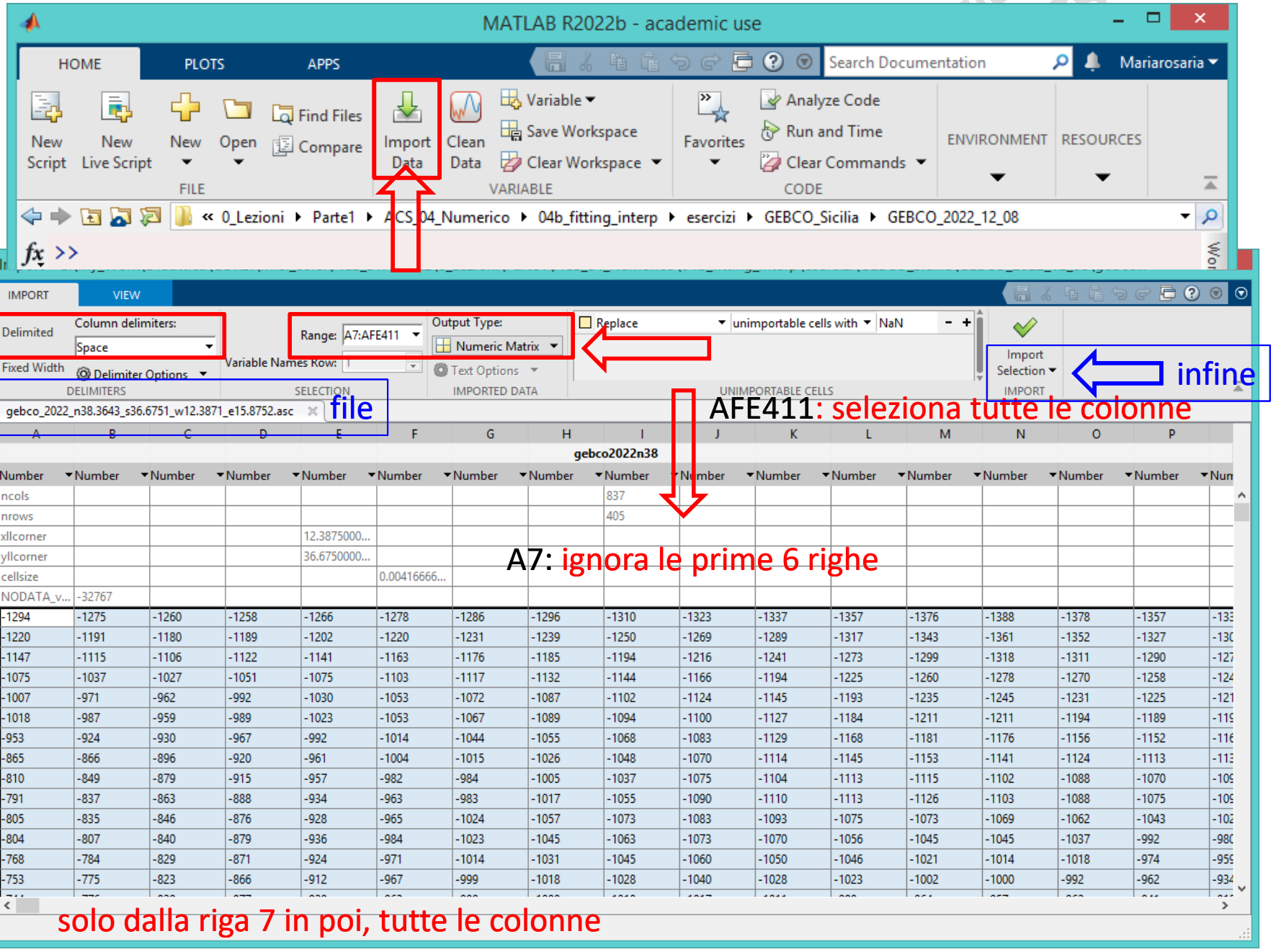
in MATLAB: 1) Modo manuale (semplice)



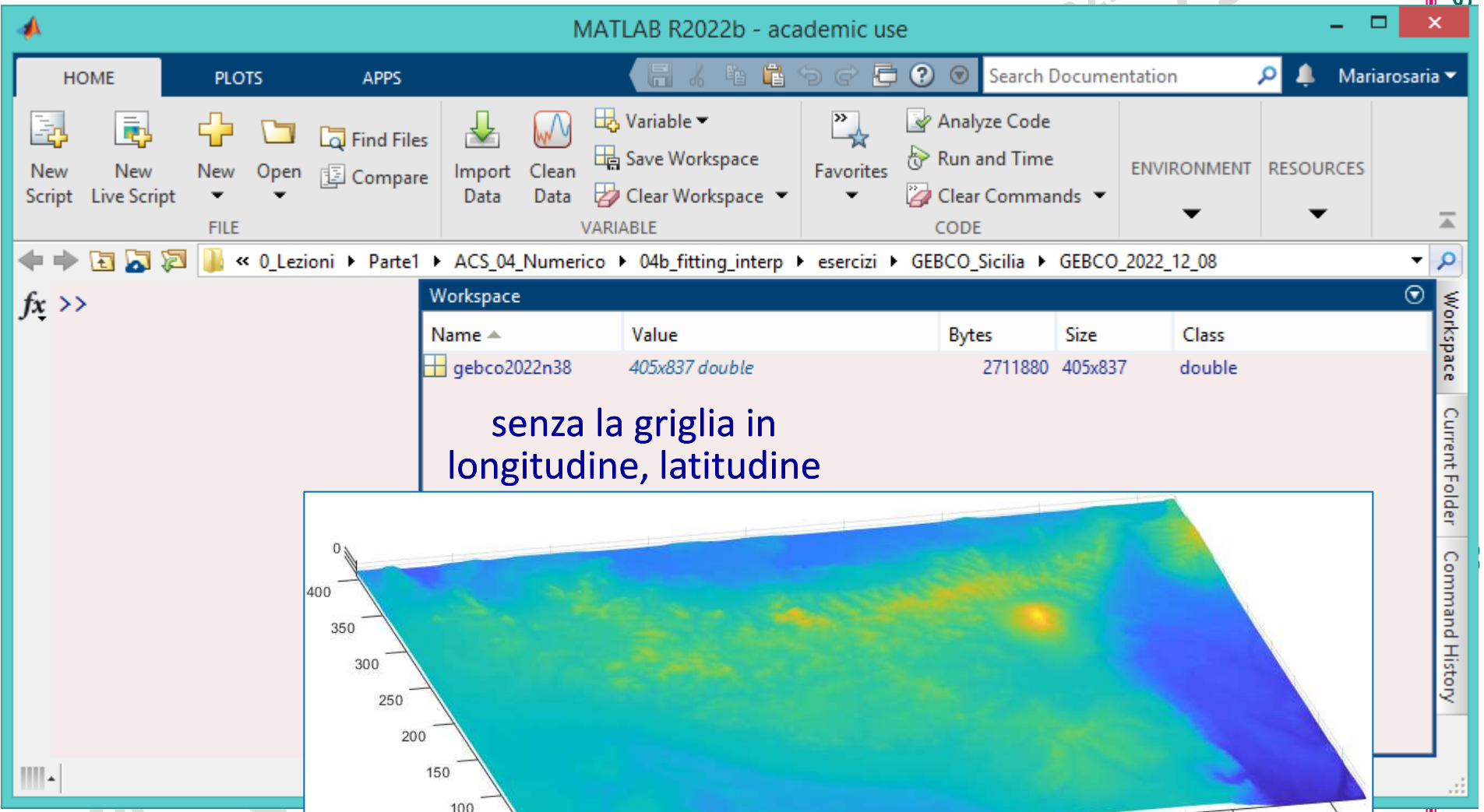

```
…
E=flipud(E);
contourf(x,y,E,"ShowText",true,"LabelFormat","%0.0fm")
axis equal
…
```

solo parte intera + m

2) Strumento importazione dati di MATLAB



2) Strumento importazione dati di MATLAB



senza la griglia in
longitudine, latitudine


```
mesh(flipud(gebco2022n38)); axis tight
view(-24,87); colormap('parula')
```

2) Strumento importazione dati di MATLAB

MATLAB R2022b - academic use

HOME | PLOTS | APPS | Search Documentation | Mariarosaria

New Script | New Live Script | New | Open | Find Files | Compare — FILE

Import Data | Clean Data | Variable | Save Workspace | Clear Workspace — VARIABLE

Favorites | Analyze Code | Run and Time | Clear Commands — CODE

ENVIRONMENT | RESOURCES

« 0_Lezioni ▸ Parte1 ▸ ACS_04_Numerico ▸ 04b_fitting_interp ▸ esercizi ▸ GEBCO_Sicilia ▸ GEBCO_2022_12_08

fx >>

Workspace

Name	Value	Bytes	Size	Class
gebco2022n38	*405x837 double*	2711880	405x837	double

con la griglia in longitudine, latitudine

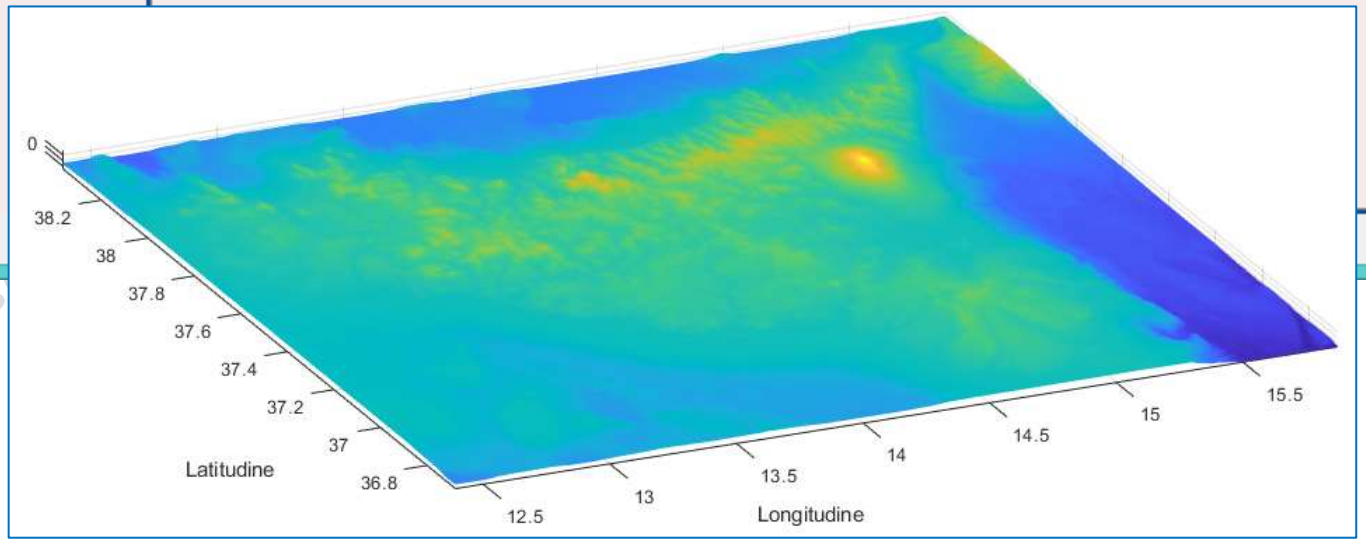
Bounds

West	East	South	North
12.3871	15.8752	36.6751	38.3643

Grid dimensions

W 837 **H** 405

```
Lon=linspace(12.387,15.875,837);
Lat=linspace(36.675,38.364,405);
[x,y]=meshgrid(Lon,Lat);
mesh(x,y,flipud(gebco2022n38)); axis tight
view(-24,87); colormap('parula')
```



file: gebco_2022_tid_n38.3643_s36.6751_w12.3871_e15.8752.asc

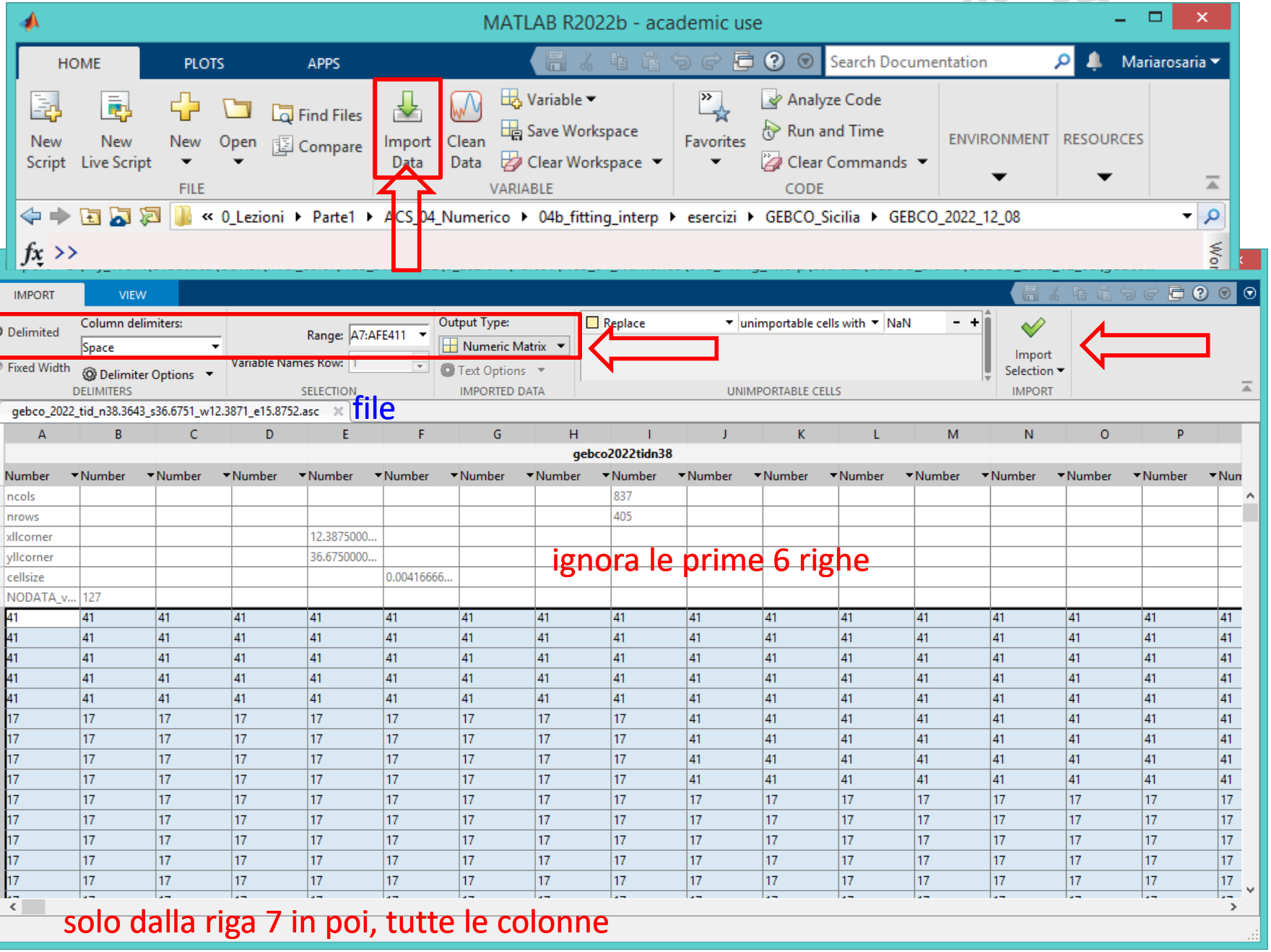
TID: Type Identifier Grid

- 41: Depth value is an interpolated value based on a computer algorithm.
- 40: Depth value is an interpolated value guided by satellite-derived gravity data.
- 17: Combination of direct measurement methods.
- 11: Depth value collected by a multibeam echo-sounder.
- 0: Land.
- …

```
ncols        837
nrows        405
xllcorner    12.387500000000
yllcorner    36.675000000000
cellsize     0.004166666667
NODATA_value 127
41 41 41 41 41 41 41 41 41 41 41 41 41 41 41 41 41 41 41 41 41 41
41 41 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17
17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17
17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17
17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17
17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17
17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17
17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17
17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17
17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17 17   …
```

← 6 linee di intestazione

2) Strumento importazione dati di MATLAB



2) Strumento importazione dati di MATLAB

MATLAB R2022b - academic use

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New Script | New Live Script | New | Open | Find Files | Compare — FILE

Import Data | Clean Data | Variable | Save Workspace | Clear Workspace — VARIABLE

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ENVIRONMENT | RESOURCES

« 0_Lezioni ▸ Parte1 ▸ ACS_04_Numerico ▸ 04b_fitting_interp ▸ esercizi ▸ GEBCO_Sicilia ▸ GEBCO_2022_12_08

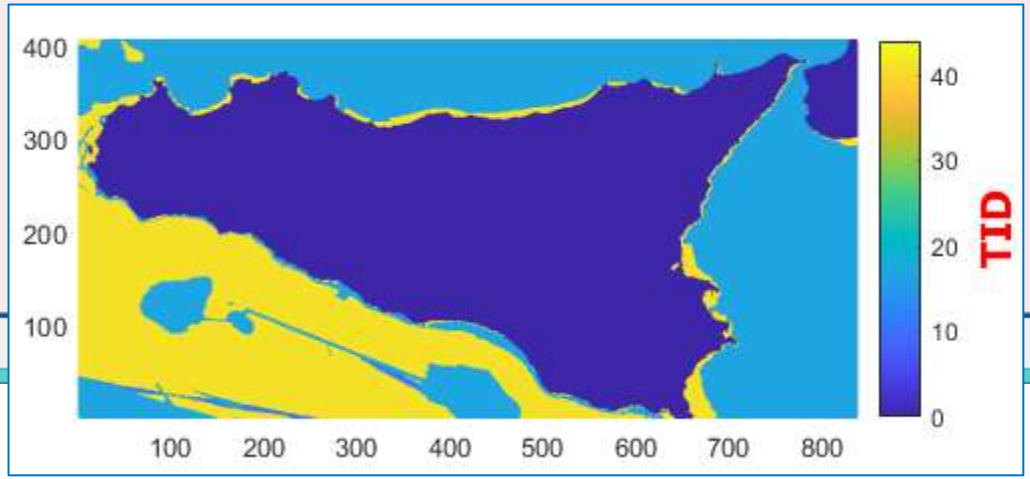
fx >>

Workspace

Name	Value	Bytes	Size	Class
gebco2022tidn38	*405x837 double*	2711880	405x837	double

Workspace | Current Folder | Command History

Ready




```
mesh(flipud(gebco2022tidn38)); colorbar
axis tight; axis equal; view(2)
```

1) Leggere da script i dati senza l'intestazione

```
folder="./GEBCO_2022_12_08/";
fileName="gebco_2022_n38.3643_s36.6751_w12.3871_e15.8752.asc";
Fname = folder + fileName; % concatena 2 stringhe
delimiterIn = ' '; % carattere tra i dati
headerlinesIn = 6; % numero linee da ignorare

A = importdata(Fname,delimiterIn,headerlinesIn)

A =
  struct with fields:

        data: [405×837 double]
    textdata: {6×1 cell}

A.textdata
ans =
  6×1 cell array
    {'ncols         837'            }
    {'nrows         405'            }
    {'xllcorner     12.387500000000'}
    {'yllcorner     36.675000000000'}
    {'cellsize      0.004166666667' }
    {'NODATA_value -32767'          }
```

A.data contiene i dati altimetrici
A.textdata contiene le righe di intestazione

contenuto del file

```
ncols         837
nrows         405
xllcorner     12.387500000000
yllcorner     36.675000000000
cellsize      0.004166666667
NODATA_value -32767
-1294 -1275 -1260 -1258 -1266 -1278 -1286 -1296 -
1310 -1323 -1337 -1357 -1376 -1388 -1378 -1357 -
1335 -1311 -1286 -1265 -1242 -1227 -1211 -1194 -
1225 -1171 -1106 -1015 -937 -823 -712 -568 -545 -
539 -533 -525 -524 -525 -572 -686 -763 -909 -1112
-1327 -1529 -1709 -1896 -1962 -1970 -1973 -1976 …
```

1.1) Leggere da script i dati senza l'intestazione
1.2) Creare variabili dall'intestazione

```
%% dati altimetrici (A.data)
E=A.data;  E=flipud(E);

%% elabora intestazione (A.textdata) creando le variabili
for k=1:numel(A.textdata)
    J=find(A.textdata{k} == ' ',1,'first'); var=A.textdata{k}(1:J-1);
    J=find(A.textdata{k} == ' ',1,'last');  val=A.textdata{k}(J+1:end);
    eval([var '=' val ';']) % esegue la stringa come istruzione
end

clear J k val var
whos
```

A.textdata contiene le righe di intestazione

```
 Name                Size                Bytes  Class
  A                   1x1               2713108  struct
  E                 405x837             2711880  double
  Fname               1x1                   278  string
  NODATA_value        1x1                     8  double
  cellsize            1x1                     8  double
  delimiterIn         1x1                     2  char
  fileName            1x1                   246  string
  folder              1x1                   182  string
  headerlinesIn       1x1                     8  double
  ncols               1x1                     8  double
  nrows               1x1                     8  double
  xllcorner           1x1                     8  double
  yllcorner           1x1                     8  double
```

variabili create

```
ncols          837
nrows          405
xllcorner      12.387500000000
yllcorner      36.675000000000
cellsize       0.004166666667
NODATA_value   -32767
```

2) Leggere anche le linee di intestazione e creare le relative variabili nel Workspace

```
folder="./GEBCO_2022_12_08/";
fileName="gebco_2022_n38.3643_s36.6751_w12.3871_e15.8752.asc";
Fname = folder + fileName; % concatena 2 stringhe
fileID=fopen(Fname,'r');
headerlinesIn=6;
for k=1:headerlinesIn
    str=fgetl(fileID) % fgetl rimuove il newline
    J=find(str == ' ',1,'first'); var=str(1:J-1);
    J=find(str == ' ',1,'last');  val=str(J+1:end);
    eval([var '=' val ';'])
end
formatSpec=' %g';
M=fscanf(fileID,formatSpec);
fclose(fileID);
numM=numel(M);
if numM ~= nrows*ncols
error('Errore in lettura file')
end
…
```

prima di leggere un file, bisogna aprirlo

è necessario sapere il numero delle righe di instestazione

come prima

esegue la stringa come un comando

legge i dati (reali) dal file secondo il formato “spazio numero”

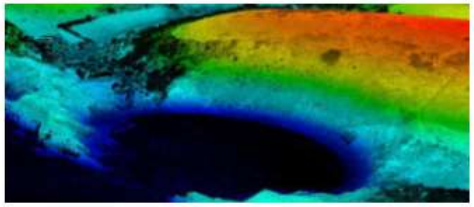
dopo la lettura del file, bisogna chiuderlo

controlla di aver letto tutti i dati

Leggere dati altimetrici scattered da file testo

OTTENERE I DATI:

https://www.emapsite.com/digital-maps-and-data/3d-and-terrain-data?p=EALiDARElevationData



EA LiDAR Elevation Data

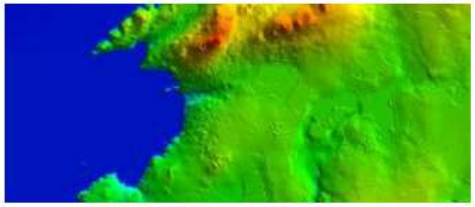
Detailed elevation data captured by aircraft, up to 25cm resolution

Product Details

Other LiDAR Elevation Data

Detailed elevation data captured by aircraft, up to 25cm resolution

Product Details



OS Terrain 5

OS Terrain 5 is a Digital Terrain Model (DTM) showing the bare surface of the ground, without vegetation or buildings and is ideal for 3D modelling.

Product Details

Lidar Elevation data captured by aircraft is typically the most detailed elevation data available.

The Environment Agency captures Lidar Elevation databy aircraft on an ongoing basis for the purpose of creating up to date flood maps. The data is available with a resolution of up to 25cm depending on your study area (other Lidar resolutions include 2m, 1m and 50cm), and comes as both a DTM (Digital Terrain Model) - 'bald earth' - and a DSM (Digital Surface Model).

LIght Imaging Detection and Ranging (LIDAR) technology provides an extremely high vertical resolution for heights of buildings, vegetation and bare ground in open areas,

Technical Details

Supplier: Environment Agency
Update Cycle: Varies
Coverage: England and Wales (non-continuous c
Scale: Resolutions from 0.25m to 2m
Formats Available: ASC, XYZ, TXT, DXF
Stated Accuracy: dependent on resolution
Licence Options: Open
Delivery Timescale: within minutes

Download Samples

1m

DTM: XYZ, ASC, SHP, DWG, DXF

DSM: XYZ, ASC, SHP, DWG, DXF

2m

DTM: XYZ, ASC, SHP, DWG, DXF

DSM: XYZ, ASC, SHP, DWG, DXF

Esempi di file

lidar_2m_dsm_-_ea.asc (file testo)

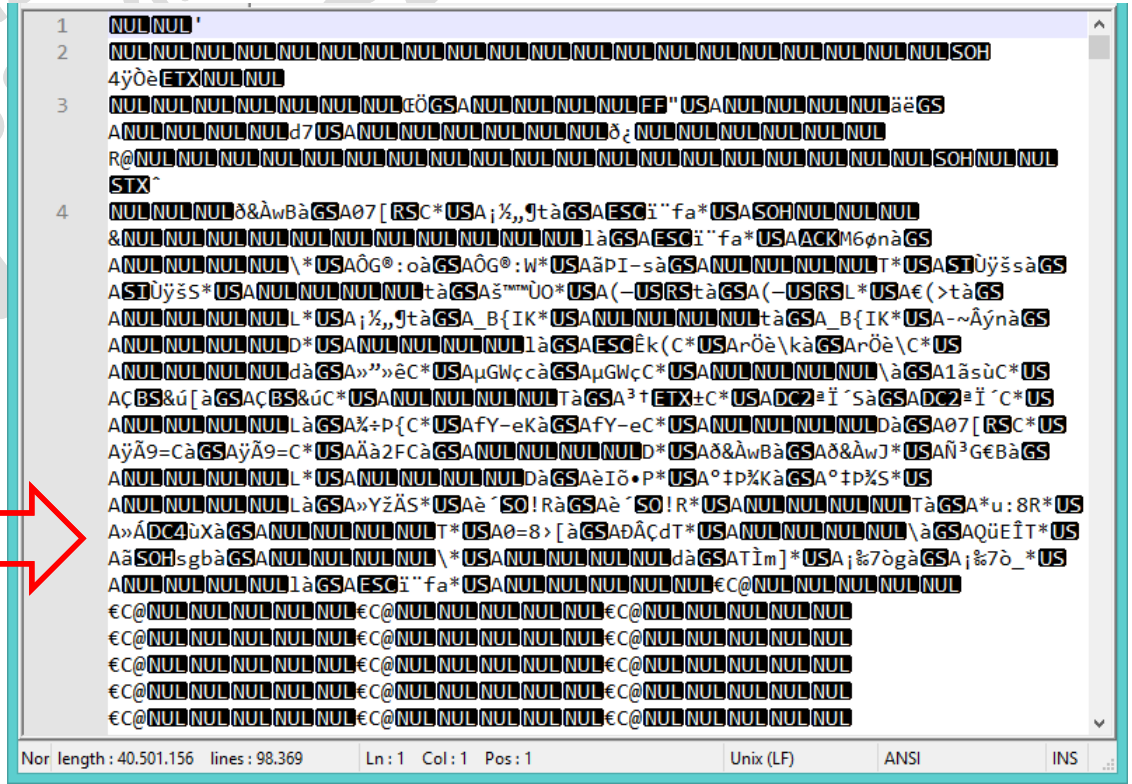
```
ncols 684
nrows 684
xllcorner 488866
yllcorner 510082
cellsize 2
49.29 49.287 49.25 49.243 49.198 49.195
49.175 49.167 49.177 49.16 49.145 49.14
49.107 49.085 49.095 49.065 49.03 49.025
49.012 49.02 49.03 49.007 48.988 49.017
48.988 48.995 48.995 48.96 48.942 48.955
48.948 48.935 48.93 48.93 48.92 48.893 …
```

lidar_2m_dsm_-_ea.xyz (file testo)

```
488867,511449,49.290
488869,511449,49.287
488871,511449,49.250
488873,511449,49.243
488875,511449,49.198
488877,511449,49.195
488879,511449,49.175
488881,511449,49.167
488883,511449,49.177
488885,511449,49.160
488891,511449,49.107 …
```

si legge come i file .asc da GEBCO

LIDAR_2m_DSM_EA.shp (file binario)



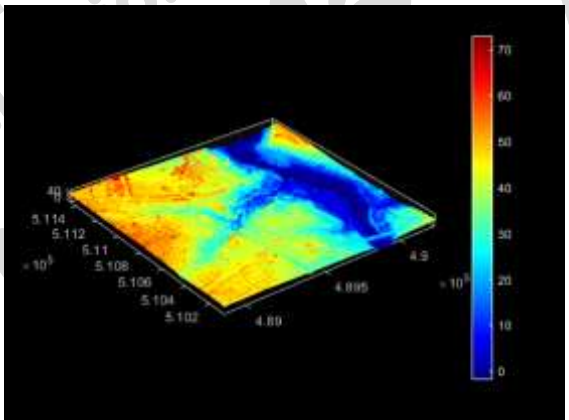
Lettura e visualizzazione di un file .xyz

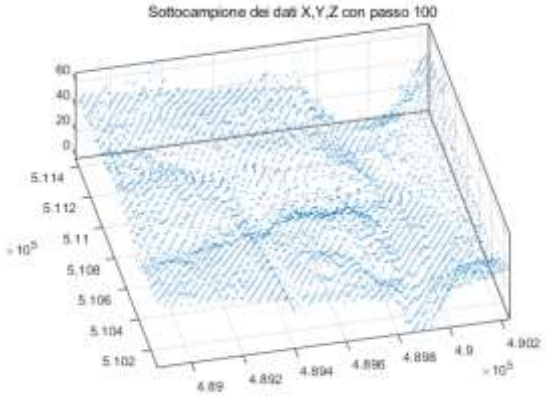
```
folder="./xxx/";  fileName="lidar_2m_dsm_ea.xyz“
Fname=folder + fileName; % nome del file completo di path
fileID=fopen(fileName,'r');
formatSpec='%g,%g,%g';
M=fscanf(fileID,formatSpec);
fclose(fileID);
numM=numel(M);
if rem(numM,3) > 0
    error('Errore in lettura file')
end
M=reshape(M,3,numM/3);
M=M'; X=M(:,1); Y=M(:,2); Z=M(:,3); % ogni riga contiene (X,Y,Z) di un punto
figure; pcshow([X Y Z]); % pcshow: richiede il Computer Vision Toolbox
colormap('jet'); colorbar('Color','w'); axis on; axis equal; box on
step=100;
Xj=X(1:step:end); Yj=Y(1:step:end); Zj=Z(1:step:end); % sottocampione dei dati
figure; plot3(Xj,Yj,Zj,'.','MarkerSize',2); grid on; box on
```

lidar_2m_dsm_-_ea.xyz

```
488867,511449,49.290
488869,511449,49.287
488871,511449,49.250
488873,511449,49.243
488875,511449,49.198 …
```

controlla di aver letto tutti i dati





Lettura e visualizzazione di uno shape file

```
folder="./xxx/";
fileName="LIDAR_2m_DSM_EA.shp";
Fname = folder + fileName;
T=readgeotable(Fname);
figure
mapshow(T,'DisplayType','line')
xlabel("x (metri)"); ylabel("y (metri)")
grid on; box on; axis equal
figure
geoplot(T); geobasemap streets
```