



SIS

Scuola Interdipartimentale
delle Scienze, dell'Ingegneria
e della Salute



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

The screenshot shows the GEBCO Gridded Bathymetry Data Download website. The interface is divided into several sections:

- SELECT GRID VERSION:** A dropdown menu showing 'GEBCO 2022'.
- ENTER BOUNDARIES:** Input fields for longitude and latitude, with a 'Clear' button.
- SELECT FORMATS:** A table with columns for 'Grid' and 'TID Grid' and rows for '2D netCDF', 'GeoTIFF', 'Eui ASCII', 'JPEG', 'PNG', 'Colour Map', and 'Shaded Relief'. Each cell contains a checkbox.

The main content area features a world map. A yellow box highlights the Sicily region, and a yellow arrow points to it. Below the map, there is a cookie notice and a yellow box containing instructions: 'Use keyboard CTRL + mouse Left Click and Drag a box to select your region on the map. On a Mac, use the Command key instead of CTRL.'

per esempio, si voglia selezionare la **Sicilia**.

SELECT GRID VERSION

GEBCO 2022

ENTER BOUNDARIES

38.3643

12.3871

15.8752

36.6751

Clear

SELECT FORMATS

Grid

TID Grid

2D netCDF

GeoTIFF

Esri ASCII

The below options are available only on the bathymetry grid

JPEG

PNG

Colour Map

Shaded Relief

GEBCO 2022

Bounds

West	East	South	North
12.3871	15.8752	36.6751	38.3643

File formats

Grid: Esri ASCII
TID grid: Esri ASCII

Grid dimensions

W 837 H 405

File size (estimated)

8 MB

Add to basket

View basket



upper right corner

lower left corner

Bounds:

North=38.3643

West=12.3871

East=15.8752

South=36.6751

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

(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;
```

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 ...
```

```
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 ...
```

```
];
```

Il file può essere eseguito in MATLAB

in MATLAB: 1) Modo manuale (semplice)

The image shows the MATLAB R2022b interface. The workspace window displays the following variables:

Name	Value	Bytes	Size	Class
cellsize	0.0042		8 1x1	double
E	405x837 double	2711880	405x837	double
ncols	837		8 1x1	double
NODATA_value	-32767		8 1x1	double
nrows	405		8 1x1	double
xllcorner	12.3875		8 1x1	double
yllcorner	36.6750		8 1x1	double

The command window shows the following commands and output:

```
>> dir *.m  
GEBCO2022_Sicilia.m re  
  
>> GEBCO2022_Sicilia  
fx >>
```

A map of Sicily is shown with a grid overlay. The upper right corner is marked with a red dot and the text "upper right corner". The lower left corner is marked with a red dot and the text "lower left corner (xllcorner, yllcorner)".

The "Bounds" table is shown below the map:

West	East	South	North
12.3871	15.8752	36.6751	38.3643

A diagram of the Earth is shown to the right of the map, illustrating the coordinate system with labels: Asse terrestre, Polo nord, Polo sud, Parallelo di P, Equatore, Meridiano di Greenwich, Meridiano di P, Latitudine, and Longitudine.

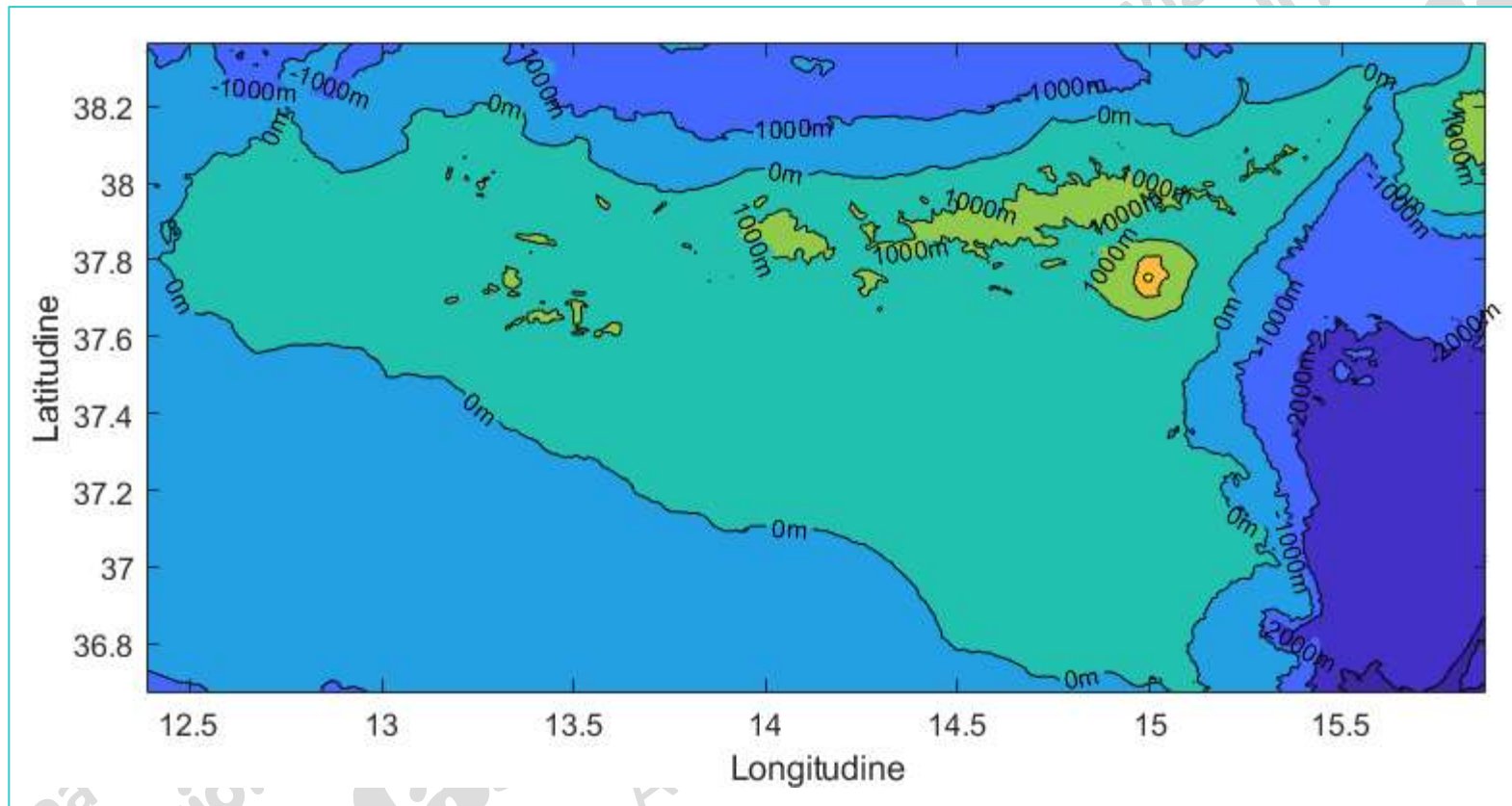
griglia in
longitudine, latitudine

```
>> 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

Import Data dialog box settings:

- Delimited
- Column delimiters: Space
- Range: A7:AFE411
- Output Type: Numeric Matrix
- Replace:
- unimportable cells with: NaN

Imported Data Table:

gebco2022n38															
Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number
1	ncols								837						
2	nrows								405						
3	xllcorner					12.3875000...									
4	yllcorner					36.6750000...									
5	cellsize					0.00416666...									
6	NODATA_v...	-32767													
7	-1294	-1275	-1260	-1258	-1266	-1278	-1286	-1296	-1310	-1323	-1337	-1357	-1376	-1388	-1378
8	-1220	-1191	-1180	-1189	-1202	-1220	-1231	-1239	-1250	-1269	-1289	-1317	-1343	-1361	-1352
9	-1147	-1115	-1106	-1122	-1141	-1163	-1176	-1185	-1194	-1216	-1241	-1273	-1299	-1318	-1311
10	-1075	-1037	-1027	-1051	-1075	-1103	-1117	-1132	-1144	-1166	-1194	-1225	-1260	-1278	-1270
11	-1007	-971	-962	-992	-1030	-1053	-1072	-1087	-1102	-1124	-1145	-1193	-1235	-1245	-1231
12	-1018	-987	-959	-989	-1023	-1053	-1067	-1089	-1094	-1100	-1127	-1184	-1211	-1211	-1194
13	-953	-924	-930	-967	-992	-1014	-1044	-1055	-1068	-1083	-1129	-1168	-1181	-1176	-1156
14	-865	-866	-896	-920	-961	-1004	-1015	-1026	-1048	-1070	-1114	-1145	-1153	-1141	-1124
15	-810	-849	-879	-915	-957	-982	-984	-1005	-1037	-1075	-1104	-1113	-1115	-1102	-1088
16	-791	-837	-863	-888	-934	-963	-983	-1017	-1055	-1090	-1110	-1113	-1126	-1103	-1088
17	-805	-835	-846	-876	-928	-965	-1024	-1057	-1073	-1083	-1093	-1075	-1073	-1069	-1062
18	-804	-807	-840	-879	-936	-984	-1023	-1045	-1063	-1073	-1070	-1056	-1045	-1045	-1037
19	-768	-784	-829	-871	-924	-971	-1014	-1031	-1045	-1060	-1050	-1046	-1021	-1014	-1018
20	-753	-775	-823	-866	-912	-967	-999	-1018	-1028	-1040	-1028	-1023	-1002	-1000	-992

2) Strumento importazione dati di MATLAB

The image shows the MATLAB R2022b - academic use interface. The workspace window displays a table with the following data:

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

Below the workspace window, a 3D surface plot is shown. The plot is a heatmap of the data, with the x-axis ranging from 0 to 800 and the y-axis ranging from 0 to 400. The plot is titled "senza la griglia in longitudine, latitudine".

senza la griglia in
longitudine, latitudine

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

2) Strumento importazione dati di MATLAB

The screenshot shows the MATLAB R2022b interface. The workspace contains a variable named 'gebco2022n38' with a value of '405x837 double'. A 3D surface plot is displayed, showing a color-coded surface representing data over a geographic area. The plot axes are labeled 'Latitudine' and 'Longitudine'. The plot shows a color gradient from blue (low values) to yellow (high values), with a prominent yellow/orange spot in the center.

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')
```

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
```

← 6 linee di intestazione

```
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
```

2) Strumento importazione dati di MATLAB

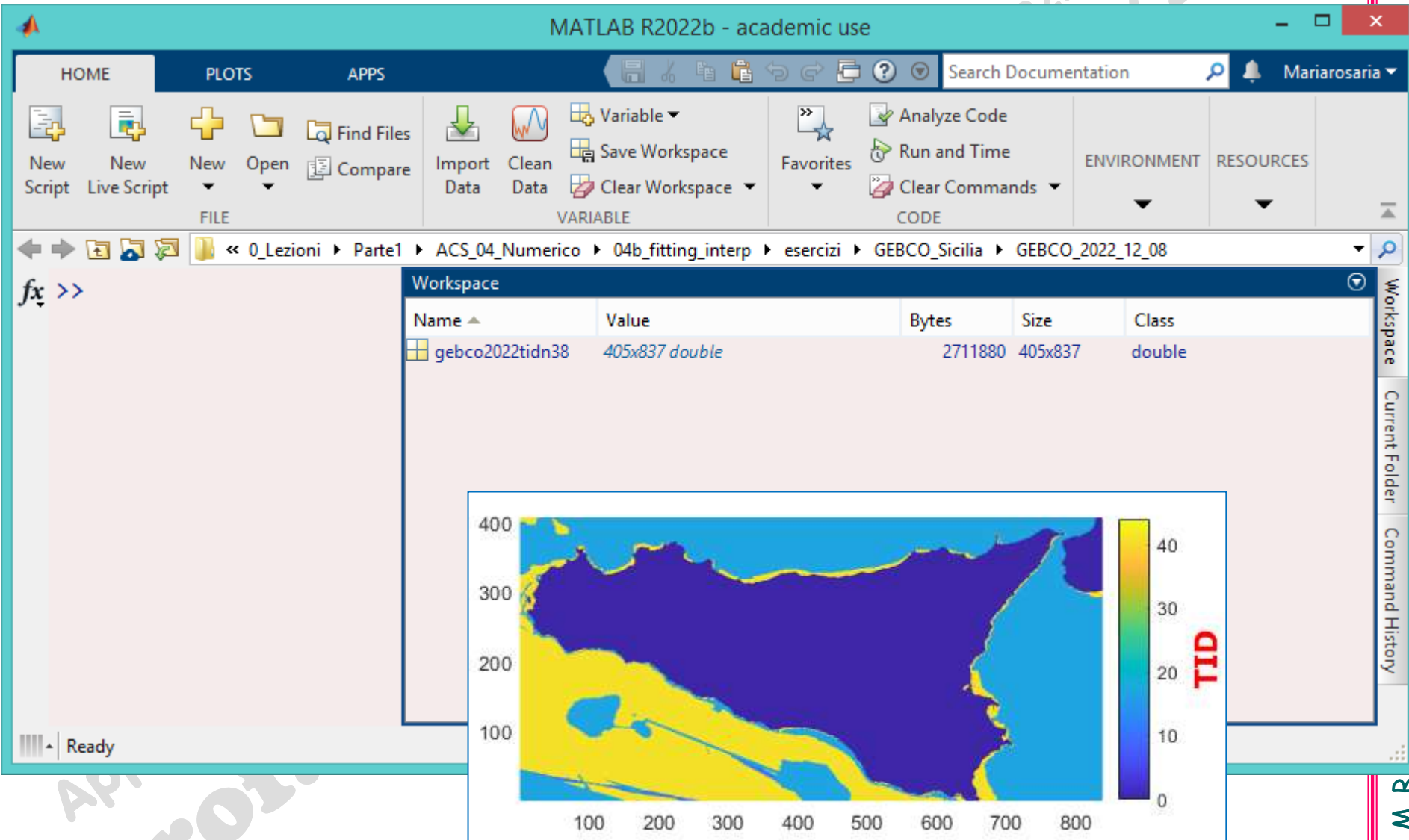
The screenshot shows the MATLAB R2022b interface. The 'Import Data' button in the 'HOME' tab is highlighted with a red box and an arrow. The 'Import Data' dialog box is open, with the 'Delimited' radio button selected. The 'Column delimiters' are set to 'Space', and the 'Output Type' is set to 'Numeric Matrix'. The 'Import Selection' button is also highlighted with a red arrow. The data table below shows the following structure:

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
gebco2022tidn38																
1	ncols								837							
2	nrows								405							
3	xllcorner			12.3875000...												
4	yllcorner			36.6750000...												
5	cellsize				0.00416666...											
6	NODATA_v...	127														
7	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41
8	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41
9	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41
10	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41
11	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41
12	17	17	17	17	17	17	17	17	41	41	41	41	41	41	41	41
13	17	17	17	17	17	17	17	17	41	41	41	41	41	41	41	41
14	17	17	17	17	17	17	17	17	41	41	41	41	41	41	41	41
15	17	17	17	17	17	17	17	17	41	41	41	41	41	41	41	41
16	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
18	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
19	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
20	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17

ignora le prime 6 righe

solo dalla riga 7 in poi, tutte le colonne

2) Strumento importazione dati di MATLAB



```
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: [405x837 double] A.data contiene i dati altimetrici  
    textdata: {6x1 cell} A.textdata contiene le righe di intestazione
```

A.textdata

```
ans =  
6x1 cell array  
{'ncols' 837'  
{'nrows' 405'  
{'xllcorner' 12.387500000000'  
{'yllcorner' 36.675000000000'  
{'cellsize' 0.004166666667'  
{'NODATA_value' -32767'
```

```
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 ...
```

contenuto del file

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
    
```

A.textdata contiene le righe di intestazione

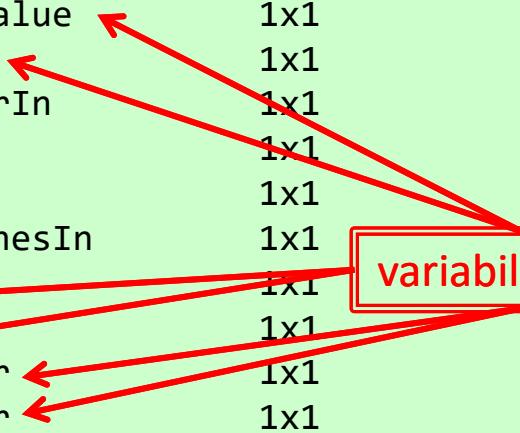
```

clear J k val var
whos
    
```

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	0.0041666666667
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');      prima di leggere un file, bisogna aprirlo
headerlinesIn=6;              è necessario sapere il numero delle righe di intestazione
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 ';' ]) esegue la stringa come un comando
end
formatSpec=' %g';
M=fscanf(fileID,formatSpec); legge i dati (reali) dal file secondo il formato "spazio numero"
fclose(fileID);               dopo la lettura del file, bisogna chiuderlo
numM=numel(M);
if numM ~= nrows*ncols       controlla di aver letto tutti i dati
    error('Errore in lettura file')
end
...

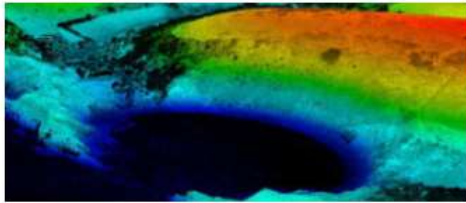
```

come prima

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

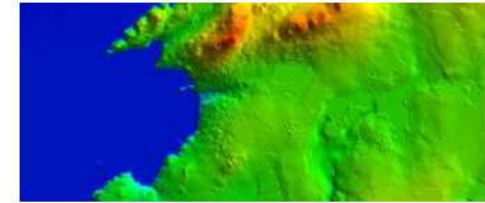
Product Details



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 data by 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) - 'bare 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)

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

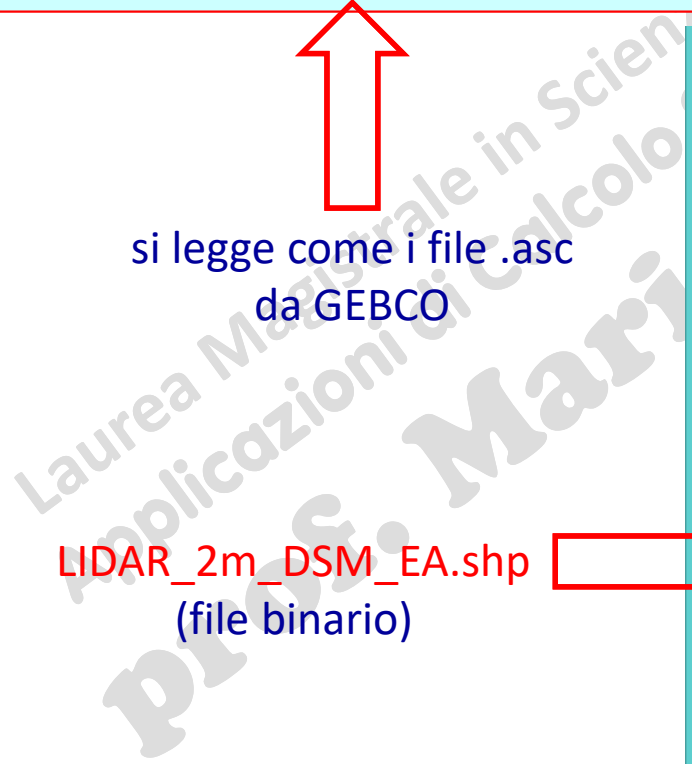
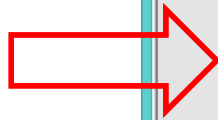
```
ncols 684           lidar_2m_dsm_-_ea.asc
nrows 684           (file testo)
xllcorner 488866
yllcorner 510082
cellsize 2
49.29 49.287 49.25 49.243 49.198 49.195
49.175 49.167 49.177 49.16 49.145 49.14
49.107 49.085 49.095 49.065 49.03 49.025
49.012 49.02 49.03 49.007 48.988 49.017
48.988 48.995 48.995 48.96 48.942 48.955
48.948 48.935 48.93 48.93 48.92 48.893 ...
```

```
488867,511449,49.290 lidar_2m_dsm_-_ea.xyz
488869,511449,49.287 (file testo)
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

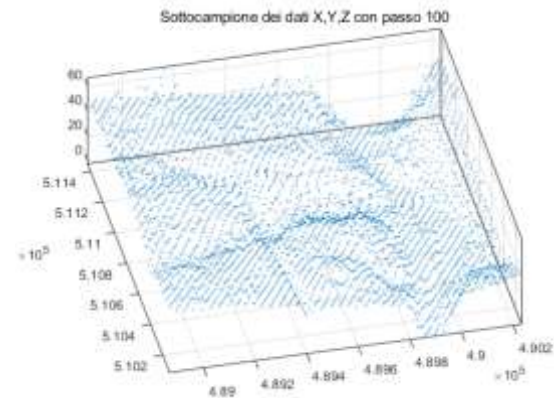
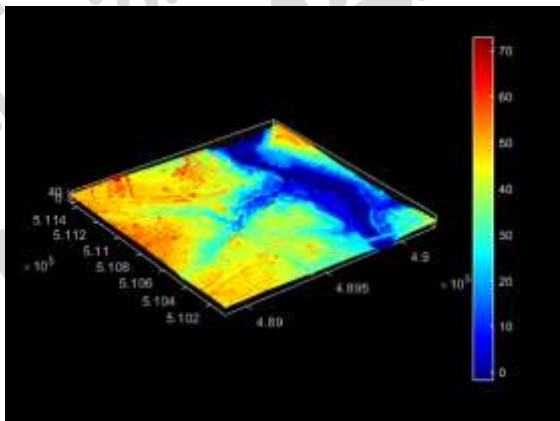
LIDAR_2m_DSM_EA.shp
(file binario)



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')    controlla di aver letto tutti i dati
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
```

```
488867,511449,49.290  lidar_2m_dsm_-_ea.xyz
488869,511449,49.287
488871,511449,49.250
488873,511449,49.243
488875,511449,49.198 ...
```



Letture 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
```

