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TOTGS

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User manual

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1 Introduction

TOTGS is an upgraded version of the code provided in Bonadonna and Houghton (2005) for the calculation of the total grainsize distribution of tephra deposits. This manual strictly aims at describing the use of this script. Refer to the aforementioned article for details on the Voronoi technique. This code is written in *Matlab* and is available in two versions. The first one is a `.m` file, in which users can access and modify the code. The second one is dedicated for users without access to Matlab and is compiled as a stand–alone software. The compiled versions of the code are located in the `Compiled/` folder for MacOS, Unix and Windows.

This script uses Voronoi tessellation techniques on individual grainsize distributions of single localities to calculate the total grain–size distribution. Voronoi functions rely on the http://www.qhull.org/.

If you happened to find this script useful, we would greatly appreciate if you could cite as:
Biass, S., Bonadonna, C., (2014), TOTGS: Total grainsize distribution of tephra fallout, https://vhub.org/resources/3297.

2 Before starting

This script requires one input file containing the grain–size analyses at each outcrop. Outcrop coordinates are used by Voronoi functions to define a zone of closest distance around each outcrop and calculate the area of each zone, which implies that:

1. Since calculations depend on the area of each zone, calculations must be performed on projected coordinates in order to avoid distortion occurring with increasing latitudes;
2. A zero-mass contour must be drawn in order to close the Voronoi cells located on the edge of the deposit and avoid their areas to tend to infinity.

In order to address these issues:

1. The script can work with both outcrop in geographic or projected coordinates, depending on which the script will perform the necessary transformations. In case the users adopts to input projected coordinates, the projection must be Universal Transverse Mercator (UTM) on a WGS84 ellipsoid;
2. In case the zero-mass contour is not defined *a priori*, this scripts includes an interactive module to define it.

3 Input file

The input file can be either a tab–delimited text or an Excel file. As the user has the choice of inputting two kind of coordinates, the files must be shaped accordingly. Tables 1 and 2 depict examples for each case. The first row is a header, and data should start from the second row. The header of columns 5-n (geographic coordinates) or 6-n (projected coordinates) contains the the grain–size binning, which are directly input in the calculations and should be defined with care.

Table 1: Shape of the input file with geographic coordinates. North and East coordinates are expressed as >0, South and West coordinates as <0.

	Row 1 (header)	**Row 2–m (data)**
Column 1	Lat	Latitude (decimal degrees)
Column 2	Lon	Longitude (decimal degrees)
Column 3	g/m^2	Tephra accumulation (g/m^2)
Column 4	Empty	Empty column
Column 5	Grain–size bin	Weight % of a grain–size class at a given outcrop

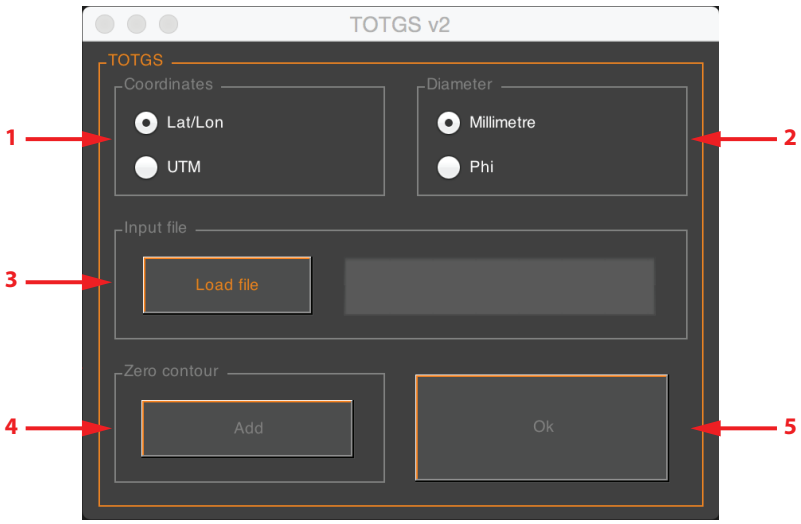

Figure 1: Main interface

Grain–size bins can be defined either in *mm* or ϕ units, but must necessarily be equally-spaced ϕ classes. Examples of input files can be found in the `Examples/` folder.

Table 2: Shape of the input file with projected coordinates.

	Row 1 (header)	**Row 2–m (data)**
Column 1	East	Easting (m)
Column 2	North	Northing (m)
Column 3	Zone	Zone number (i.e. 19 H)
Column 4	g/m^2	Tephra accumulation (g/m^2)
Column 5	Empty	Empty column
Column 6	Grain–size bin	Weight % of a grain–size class at a given outcrop

4 Usage

4.1 Using Matlab

Once in Matlab, navigate to the location of the `TOTGS.m` script and type:

```
>> TOTGS
```

Press enter and a GUI opens (Fig. 1).

1. Before loading a file, it is necessary to set 1 the type of coordinates used and 2 the unit of grain–size binning accordingly to the file you are about to load.
2. Load a file (3). At this point, four different warnings can occur:
   - If the bins are not perfectly equally–spaced, you will be asked whether you want to continue;
   - If missing data are found in the input file, you will be asked whether you want to fill them with zeros;
   - If the sum of the different bins are not equal to 100% for a given outcrop, you will be asked whether the code should round it;
   - If coordinates span over different UTM zones, you will be asked to choose a reference UTM zone.
3. Add a zero–mass contour by clicking (4). A new window opens (Fig. 2), from which you can:
   1 Add the contour points. Click on the *Add points* button to enable the function allowing to click on the map. Right–click to leave the interactive mode;

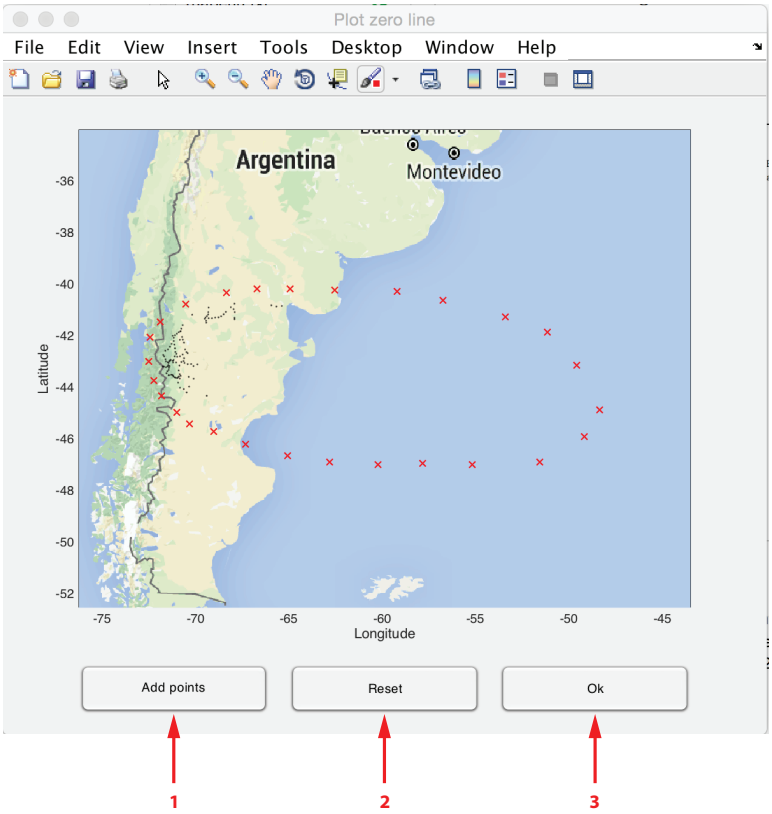

Figure 2: Interactive contouring of the zero–mass line. Once in contouring mode, right–click on the mouse to stop.

2 Reset the points;

3 Save the data and proceed. Again, you might be asked to chose a reference UTM zone.

4. Click the *Ok* button to proceed. First, a map showing the Voronoi polygons appears, followed by the main *Results* interface (Fig 3). The main components of this new window are:

1 Result table, showing probability density and cumulative functions in millimetres and phi units. Note that for visibility, data in the table are rounded to 2 decimals;

2 Probability density and cumulative distributions displayed graphically;

3 Main total grain–size distribution parameters (as defined by Inman, 1952);

4 Export the table as a text file. Unlike in the GUI table, the file resulting from the export comprise up to 7 decimals;

5 Export the probability density function as a separate plot for saving;

6 Export the cumulative density function as a separate plot for saving;

7 Close the interface.

4.2 Using the compiled version

If you do not have any access to *Matlab*, you can use the stand–alone version provided in the `Compiled/` folder, which only requires to install the *Matlab Runtime* libraries (mathworks.com/products/compiler/mcr/). Note that the *MCR* version should match the version in which TOTGS was compiled, namely:

2015b on MacOS (10.10);

2014a on Unix (Ubuntu 14.04);

2014a on Windows (Windows 7).

Each folder for the different operating systems contain an executable called `Download_MCR` to help the downloading and installing of the libraries, which requires admin privileges. Once the libraries are installed, TOTGS can be used as a regular software. Refer to `readme.txt` for more details on the *Matlab* compiler.

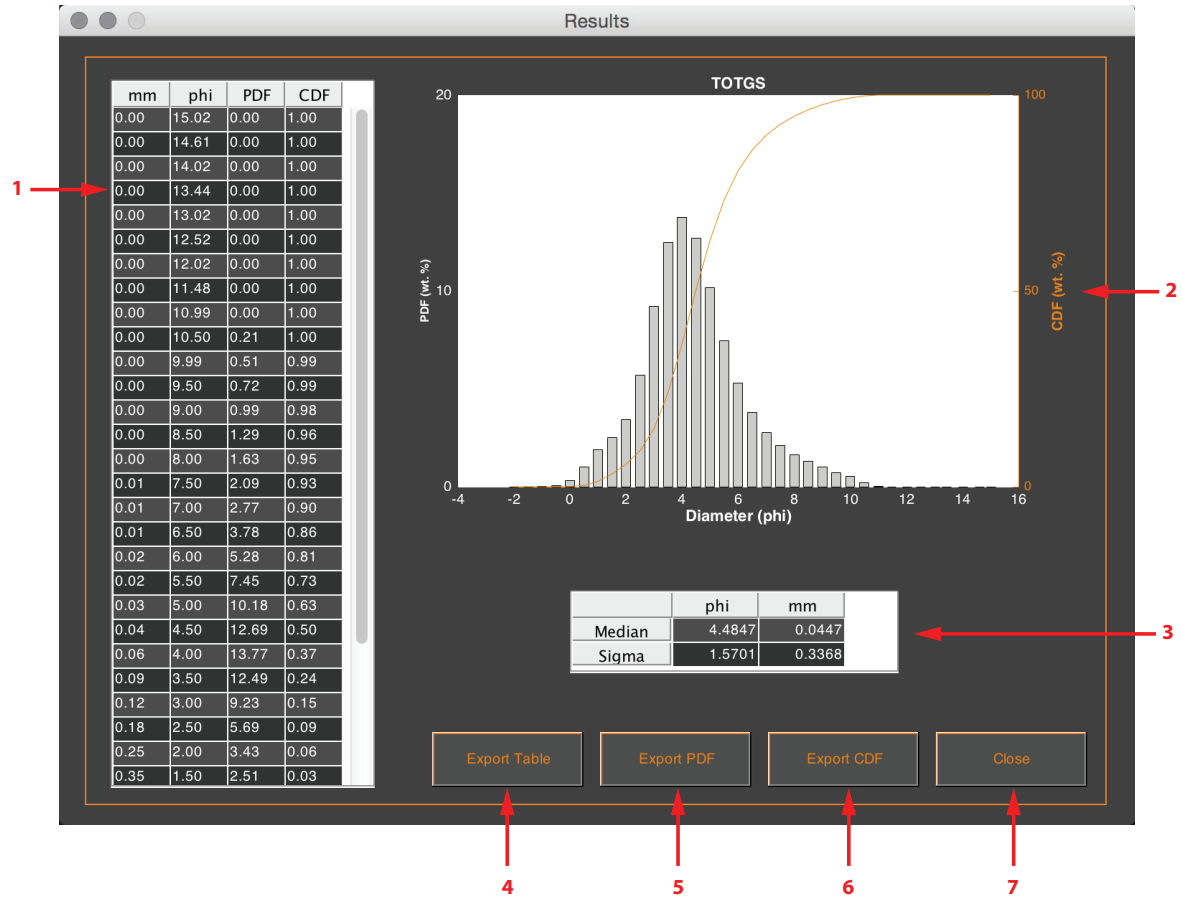

Figure 3: Results interface

5 Releases

October 2013: First release

November 2015: Version 2 with the following upgrades:

- Possibility to use *Excel* files;
- Use of phi units
- Upgraded interface to define the zero–mass contour

6 Dependencies

TOTGS use two additional functions available on the Matlab File Exchange website. All credits go to their respective authors!

- utm2deg by Rafael Palacios (contribution 10914)
- deg2utm by Rafael Palacios (contribution 10915)
- plot_google_map by Zohar Bar-Yehuda (contribution 27627)

The data used as example are the property of Fabrizio Alfano.

References

Bonadonna C, Houghton B (2005) Total grain-size distribution and volume of tephra-fall deposits. Bull Volcanol 67(5):441–456

Inman DL (1952) Measures for describing the size distribution of sediments. Journal of Sedimentary Research 22(3):125–145