NETVOLC [version 1.1]

http://cediac.uncu.edu.ar/software

User Manual

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1.   Introduction

NETVOLC is an IDL command-line application that computes the outline or boundary of volcanic edifices. It uses a Minimum Cost Flow algorithm jointly with several products derived from a Digital Elevation Model (DEM). An in depth description of the NETVOLC algorithm and its limitations can be found in the documentation indicated in the Related Documents section.

This document is intended for those who want to install and use the NETVOLC application. It contains step by step instructions on how to run it.

1.1 Related Documents

The related documents for NETVOLC are:

- Euillades, Leonardo D., Pablo Grosse, and Pablo A. Euillades. "NETVOLC: An Algorithm for Automatic Delimitation of Volcano Edifice Boundaries Using DEMs." Computers & Geosciences 56 (July 2013): 151–160. doi:10.1016/j.cageo.2013.03.011.

- Loebel, A. MCF Version 1.3 - A Network Simplex Implementation (version 1.3). Berlin, Germany: Available for academic use free of charge at www.zib.de, 2004. www.zib.de.

1.2 Contacts

For comments, assistance or reporting of errors, please contact:

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For better assistance, please provide us with a detailed description of the error.

2. Overview and Functional Description

NETVOLC is composed of several IDL programs that are compiled using the IDL version 7.0.1. As mentioned in the Introduction section, NETVOLC also uses external functions and programs. Regarding external functions, NETVOLC employs several functions from the ENVI software for extracting and/or generating DEM-derived products. Concerning external programs, NETVOLC uses two:

1. grep: a Linux command line for regular expression analysis.
2. mcflight: a solver for Minimum Cost Flow problems.

NETVOLC supports *batch* operation mode. It is intended for analyzing several cases automatically. The user must upload/create a folder containing:

1. A DEM of the whole study area (i.e. a DEM with different volcanoes where the user wants to apply the NETVOLC algorithm). Input DEM must be in the ENVI format and have an associated ENVI header file.

2. A processing parameters text file containing the general parameters to be used.

3. A text file containing the list of volcanoes to be processed.

In this mode, NETVOLC creates a singular folder for each volcano present in the list and saves outputs in this folder. The volcanoes list must have a particular format. It consists of a text file where each row corresponds to a volcano to be processed, and each row contains the following parameters separated by blank spaces:

Volcano	*Latitude*	*Longitude*	*winSize_x*	*winSize_y*

Where:
Volcano: user-defined name/id associated to the volcano (the folder created by NETVOLC containing outputs will have this name).
Latitude: Latitude (or Northing) of a central point within the volcano (e.g. summit, center of crater) in decimal degrees (or meters). Latitude or Northing will depend on the geographic projection of the supplied DEM.
Longitude: Longitude (or Easting) of a central point within the volcano (e.g. summit, center of crater) in decimal degrees (or meters). Longitude or Easting will depend on the geographic projection of the supplied DEM.
*winSize_x: Dimension (x) in number of pixels of the window to be extracted from the input DEM.*

winSize_y: Dimension (y) in number of pixels of the window to be extracted from the input DEM.

Note that the extracted window should cover the volcano of interest completely, as it defines the maximum possible extension for the resulting outline, but should not be too large, as processing time directly depends on window size; preferentially, inclusion of neighboring volcanoes/landforms should be avoided. The window will be centered on the central point defined above by Latitude (or Northing) and Longitude (or Easting).

An example of this file is provided with the test data package.

The basic functionality of NETVOLC is schematized below. We advise users to read the article indicated in the Related Documents Section in order to understand the whole processing chain associated to the algorithm.
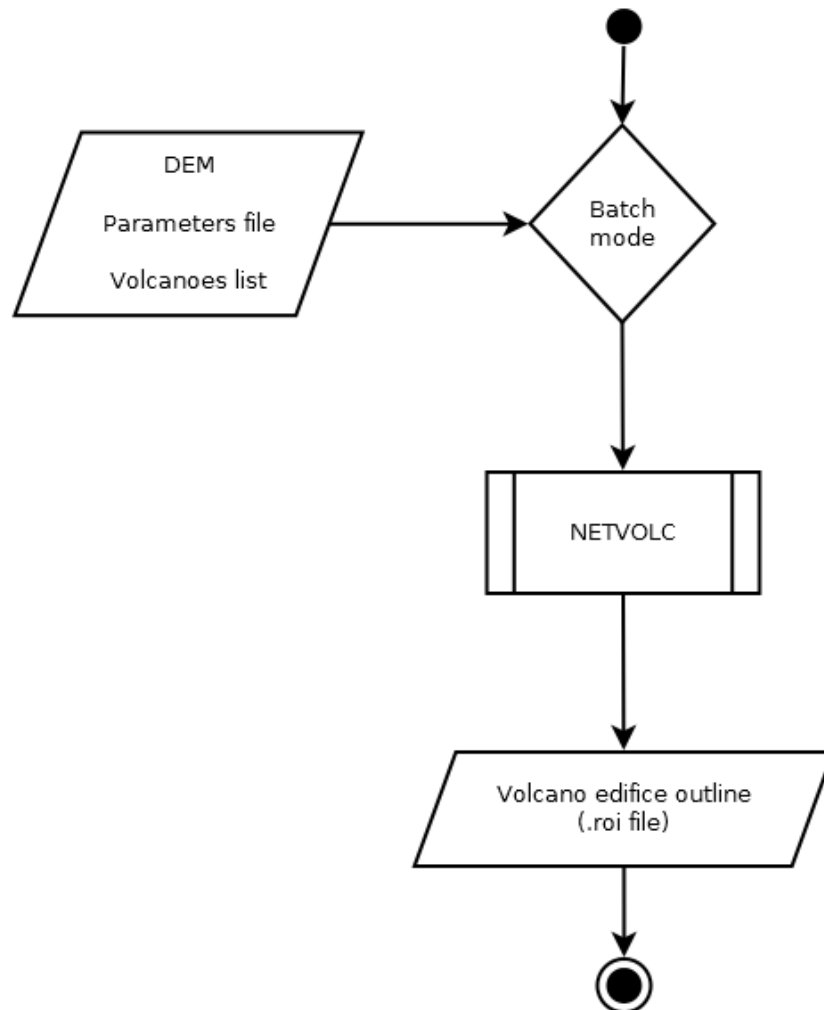
3. Setup

3.1 Download

The NETVOLC package (**netvolc_v1.1.zip**) can be download from:

http://cediac.uncu.edu.ar/software/

The package contains the following files:

- **netvolc_v1.1.sav**: the NETVOLC programs.
- **input_param.txt**: a file containing necessary input parameters.
- **calcENVIProd.pro**: ENVI product generation programs.
- **enviUtilityLib.pro:** Read/Write ENVI products routines.
- **polygonROI_v2.pro:** Routines for writing output as ROI ENVI format.
- **compile.go:** Script for compiling and restoring netvolc suite.
- **mcf-1.3.tgz**: a version of the MCF library.
- **mariana.zip**: test data consisting of a DEM of the Mariana volcanic islands.

3.2 Requirements

NETVOLC requires a PC or Virtual machine with Linux or Windows operating system and ENVI/IDL 4.5 or later installed.
In a Linux environment, a C/C++ compiler must be present.
In a Windows environment, Cygwin (provided) or a Linux Virtual Machine with C/C++ compiler capabilities must be present.
In both cases, C/C++ compiler capabilities assumes availability of *make* and *gcc* utilities.

3.3 External function installation

Installation depends on the installed Operating System.

Linux

MCF installation. A version of the MCF library is distributed with NETVOLC. Installation requires the following steps to be executed in a terminal:
1. Uncompress the MCF suite: ***tar –xvf mcf-1.3.tgz***
2. Go to the extracted folder mcf-1.3/gnu-make: ***cd mcf-1.3/gnu-make***
3. Create an environmental variable referencing the operating system: ***export ARCH="Linux"***
4. Compile the source code: ***make***
5. Install: ***make install***

Note: executable will be installed in a folder named **bin.Linux** inside mcf-1.3 folder. Created files must be: **libmcf.a**, **mcf** and **mcflight**

6. Copy compiled files to a bin folder in your Linux distribution (i.e. /usr/local/bin) in order to be accessible to anyone.

Windows

In a Windows OS, the NETVOLC dependence on external Linux functions can be solved by using Cygwin. Installation requires the following steps to be executed in a Cygwin terminal.

1. Uncompress the MCF suite: ***tar –xvf mcf-1.3.tgz***
2. Go to folder mcf-1.3/gnu-make: ***cd mcf-1.3/gnu-make***
3. Create an environmental variable referencing the operating system: ***export ARCH="Cygwin"***
4. Compile the source code: ***make***
5. Install: ***make install***
   Note: executable will be installed in a folder named **bin.Cygwin** inside mcf-1.3 folder. Created files must be: **libmcf.a**, **mcf** and **mcflight**
6. Copy compiled files to a bin folder in your Cygwin installation directory (i.e. c:\cygwin\bin) in order to be accessible to anyone.
7. Rename **mcflight** file (inside c:\cygwin\bin) to **mcflight.exe**.

NOTE: In version 1.1 mcf-1.3.tgz has been updated in order to obtain greater compatibility with 64-bits systems. It is not necessary to install mcf-1.3.tgz again if it has been installed previously.

3.4 NETVOLC installation

It doesn't require a specific installation. A new distribution way have been implemented in order to obtain greater compatibility with several ENVI/IDL versions. Now, a series of IDL source files (.pro), pre-compiled files (netvolc_v1.1.sav) and an IDL compilation script are distributed. All files must be copied in the folder where users want to execute the algorithm and setting up the **input_param.txt** and **volcanoes.txt** file if necessary.

NOTE: templateVolcanoes.sav is now obsolete.

3.5 NETVOLC parameters

The following are the parameters associated to NETVOLC. They are present in the file named ***input_param.txt***, which must be located in the folder where NETVOLC will be executed. The user should set up/modify the parameters as desired before running NETVOLC; see Euillades et al. (2013) for details.

NOTE: Don't use Windows Notepad for modifying the input-param.txt file. Instead use Notepad++, Microsoft WordPad o any other text processor.

```
[BATCH]
dem=Mariana_UTM55N_dem          ;DEM file name
volcanoesList=volcanoes.txt     ;Volcanoes file name


[ENVIRONMENT]
appMCF=mcflight                 ;MCF solver
appGREP=grep                    ;grep command


[NETVOLC]
net_plot_triang=y               ;flag indicating if network triangulation plot is desired
                                (y/n). Default is y.
polar_plot_triang=y             ;flag indicating if polar coordinate network
                                triangulation plot is desired (y/n). Default is y.
perc_threshold=100              ;percentage of arcs to be considered based on its
                                cost. Default is 100.
perc_threshold_arcs=99          ;percentage of arcs to be considered based on its
                                length. Default is 99.
bin_size=1                      ;bin size for estimating histogram (see idl histogram
                                documentation). Default is 1.
ang_threshold=5                 ;border to be considered in the polar coordinate
                                system for linking fictitious nodes to the network (in
                                degrees). It means that nodes with an azimuth polar
                                coordinate value within (−180; -180+ang_threshold)
                                degrees will be linked to the supply node. Nodes with
                                an azimuth polar coordinate value within (180-
                                ang_threshold; 180) degrees will be linked to the
                                demand node. Default is 5.
smooth_width=2                  ;smoothing factor of the final solution: default is 2.
min_threshold_separation=0      ;minimum radial distance (in pixel units) from the
                                central point of the solution. Default is 0.
max_threshold_separation=200    ;maximum radial distance (in pixel units)  from the
                                central point of the solution. Default is equal or
                                greater to window size extracted from the DEM.
use_dem=n                       ;flag indicating if height information must be
                                considered (y/n). Default is n.
min_dem_height_filter=2000      ;minimum height of the solution (if use_dem flag is
                                set to y).
max_dem_height_filter=4300      ;maximum height of the solution (if use_dem flag is
                                set to y).
use_slope=n                     ;flag indicating if slope information must be
```

	considered (y/n). Default is n.
slope_factor=1.	*; factor establishing the influence of slope on the solution (when slope_factor flag is set to y). Default is 1.*
iterations=10	*;number of iterations to be performed. Default is 10.*
overflow=1.e+07	*;number considered an overflow. It is used for filtering arcs with an associated cost greater than this value. Default is 1.e+07.*
stdev_factor=1	*;number of standard deviations to be considered when statistics are calculated. Default is 1.*
cancel_strategy=a	*; It is used for reducing the network in every iteration. a: indicates network must be reduced cancelling arcs. n: indicates network must be reduced cancelling nodes.* *Default is a.*
[ENVI]	
KERNEL=3	*;kernel to be used for estimating DEM derived products. Default is 3.*
SHADED_RELIEF_AZIMUTH=45	*;azimuthal angle to be used for calculating shaded relief product. Default is 45.*
SHADED_RELIEF_ELEVATION=45	*;elevation angle to be used for calculating shaded relief product. Default is 45.*

For the Windows environment, the section [ENVIRONMENT] in parametros_batch.txt file must be replaced by:

[ENVIRONMENT]
appMCF= c:\cygwin\bin\mcflight   *;MCF solver*
appGREP= c:\cygwin\bin\grep   *;grep command*

Considering a Cygwin installation in the path: c:\cygwin.

4. Usage

Once installed, we recommend testing NETVOLC with the supplied test data package in order to verify the correct installation and functionality. The simple procedure indicated next for processing the test data can be used as a usage guide for the final user.

1. Create a folder. Henceforth, we will refer to this folder as *netvolc folder*.
2. Extract the test data (mariana.zip) into the *netvolc folder*. The test data is composed of the following files:
   a. Mariana_UTM55N_dem with ancillary data (Mariana_UTM55N_dem.hdr)
   b. volcanoes.txt
3. Copy the following files to the *netvolc folder*:
   a. netvolc_v1.1.sav
   b. input_param.txt
   c. calcENVIProd.pro
   d. enviUtilityLib.pro
   e. polygonROI_v2.pro
   f. compile.go
4. Update section *[ENVIRONMENT]* inside input_param.txt file in order to reflect the location of the external functions.
5. Open an IDL session. In the command line, place yourself inside the *netvolc folder*.
6. Compile y restore functions by typing: @compile.go
7. Execute netvolc by typing: *netvolc*

In this way, the volcanoes listed in volcanoes.txt will be processed by the NETVOLC algorithm and results will be distributed in a folder per volcano within the *netvolc folder*. For each volcano, output will consist in the following files:
   a. A [volcano_name].roi file associated to the input DEM with the volcano edifice outline. It is an ENVI/IDL ROI file that can be restored using the ENVI suite. It can be used as an input parameter for MORVOLC (see the corresponding User Manual).
   b. A [volcano_name]_nodes.roi file associated to the input DEM with the list of points corresponding to the volcano edifice outline (same than above but nodes are not linked between them). It is an ENVI/IDL ROI file that can be restored using the ENVI suite.
   c. Several intermediate DEM derived products and the cost map used in the estimation of the edifice outline.

In order to process a different area than the example, the following steps must be reproduced:

1. Make available a DEM of your area of interest and place it inside the *netvolc folder*.
2. Create a volcanoes file (volcanoes.txt) as indicated in the previous section. Note: every line in this folder starting with a # character will be skipped.
3. Set up the input_param.txt as desired (see above).
4. Follow steps 4-8 of the test data procedure.

NOTE: if a failure occurs during NETVOLC execution (i.e. mcflight is not found), NETVOLC will be stopped with an error. In order to restart the NETVOLC execution, the following steps must be carried out just after failures have been identified and solved:

- Exit from any IDL procedure: **RETALL**
- Place yourself inside the *netvolc folder*.
- Restart netvolc procedure by typing: **netvolc**