DoD 3.0 Beta Read Me
DEM of Difference Uncertainty Analysis Software

Produced by Joe Wheaton

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WHAT DOES IT DO?

The DoD3 software was developed primarily for morphological sediment budgeting in rivers. The volumetric change in storage is calculated from the difference in surface elevations from digital elevation models (DEMs) derived from repeat topographic surveys. As each DEM has an uncertain surface representation (which might vary in space and time), DoD3 provides a suite of tools for quantifying those uncertainties and propagating them through to the DEM of difference. The program also provides ways for segregating the best estimates change spatially using different types of masks. The overall suite of tools is more generically applicable to many different spatial change detection problems.

BACKGROUND

Thank you for downloading our DoD 3.0 Beta Software. This release was made available to accompany a paper published in Earth Surface Processes and Landforms. It is a fully functioning Matlab version of the code, which was used in the ESPL paper (Wheaton *et al.*, 2009b), the Wheaton (2008) thesis, and the Wheaton *et al.* (2009a) RRA paper. This code is provided as supplemental information with the ESPL paper so that readers can test or extend the code as they see fit for their purposes.

Together with the paper and Wheaton (2008) thesis (particularly Chapters, 4 and 5), this readme and a tutorial act as the documentation for this version of the source code. The tutorial file is intended to help walk you through application of the code. Additionally, some sample input data used in Chapter 6 of the Wheaton (2008) thesis is provided to show you how the input data should be pre-processed and so you can compare the outputs with the analyses published there. The code has

reasonably verbose comments to help you follow along what its doing, however the main interface is a wizard driven dialog, that prompts you to enter your inputs and specify your preferences for the analyses. Based on the answers to your questions, you can work your way through the multiple pathways outlined in Chapter four of the Wheaton (2008) thesis (for reference, pathways 3 & 4 are what are reported in the ESPL paper). Alternatively, you can skip the verbose instructions and just cut right to running DoD3 from a command line in Matlab, and then just refer back to the tutorial if you get stuck.

USER REQUIREMENTS:

- Some understanding of DEM differencing
- Familiarity with Matlab

SYSTEM REQUIREMENTS:

- Matlab 7 or later (tested on 7.8.0.347 (R2009a) on Mac OSX 10.6.2)
- Fuzzy Logic Toolbox for Matlab
- Machine with enough RAM to handle your input rasters

INPUT DATA REQUIREMENTS:

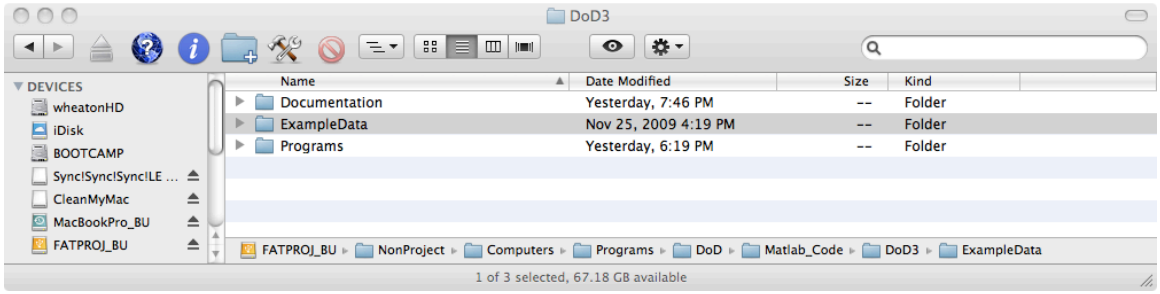
- Everything you need to run this software can be derived from a raw x-y-z point cloud of your topographic survey data. From this you can build a TIN and derive a raster DEM. You can also derive a point density grid and slope analysis (the only two required inputs for the fuzzy inference system)
- Input data are on collinear rasters of equal extent and resolution and in an Arc ASCII format (see example input files); the headers should be identical
- Data are assumed to be in meters and on the same vertical datum
- Inputs to Fuzzy Inference system:
    - If you use slope input rasters, slope should be calculated as a percent slope
    - If you use point density rasters, point density should be calculated in points per square meter
    - If you use roughness input rasters, roughness heights should be reported in meters
    - If you use 3D GPS Point quality input rasters, quality should be reported in meters
    - If you use water depth input rasters, depth should be reported in meters
- Inputs to Geomorphic Interpretation / Masking
    - Whether you use the classification of difference method or straight masking method, the input masks should be raster integer grids with 1, 2, 3, … n corresponding to unique mask categories (you will be prompted to enter what linguistic categories these values correspond to)

INSTALLATION PROCEDURE:

To start, unzip the contents of DoD3_Beta using folder names to a desired location visible by Matlab. There are three folders:

- Documentation -> contains readme, tutorial and license files
- Programs -> contains all the Matlab scripts and functions that collectively comprise the program
- ExampleData -> Contains some sample data from Sulphur Creek California for you to use to become familiar with the program and compare your results with Chapter 6 of Wheaton (2008).

The vast majority of analyses available to you are accessed from running the DoD3.m file in the Progam directory (see 'Matlab Scipts & Function – Program Folder' section of DoD3_Tutorial File for more info). Below are the three folders found in the root of the zip file:



FUTURE RELEASES, SUPPORT & UPDATES:

The DoD software is under ongoing development. That development is extending the software to other survey technologies, capability of handling larger raster sizes, and other change detection problems. At the time of this release, the code is being refactored into an open-source C++ library, which will be the backbone to a web-application and an ArcGIS plug-in. However, this Matlab version of the software is perfectly functional and should be easily extendible to users familiar with Matlab. Given the ease of development within Matlab, we felt it was important to make this version of the code available to others. Future releases will just be of the C++ library, and will automatically apply to the web-application that anyone will be able to use without proprietary Matlab or ArcGIS software licenses.

No formal support is available with this free software, but you can always contact the developer if you have questions or suggestions.

Good luck.

REFERENCES:

Wheaton JM. 2008. *Uncertainty in Morphological Sediment Budgeting of Rivers*. Unpublished PhD, University of Southampton, Southampton, 412 pp.

Available at: http://www.joewheaton.org.uk/Research/Projects/PhDThesis.asp.

Wheaton JM, Brasington J, Darby SE, Merz JE, Pasternack GB, Sear DA and Vericat D. 2009a. Linking Geomorphic Changes to Salmonid Habitat at a Scale Relevant to Fish. *River Research and Applications*. DOI: 10.1002/rra.1305.

Wheaton JM, Brasington J, Darby SE and Sear D. 2009b. Accounting for uncertainty in DEMs from repeat topographic surveys: Improved sediment budgets *Earth Surface Processes and Landforms.* **34**. DOI: 10.1002/esp.1886.