This is a README file orienting you to the different files of the network-based, bed-material sediment code developed by Jon Czuba (Univ. of Minnesota; as of April 18, 2016).

This code is capable of reproducing the results (with some work by the end user) described in the following publications:

Czuba, J.A., and E. Foufoula-Georgiou (2014), A network-based framework for identifying potential synchronizations and amplifications of sediment delivery in river basins, Water Resources Research, 50(5), 3826–3851, doi:10.1002/2013WR014227.

Czuba, J.A., and E. Foufoula-Georgiou (2015), Dynamic connectivity in a fluvial network for identifying hotspots of geomorphic change, Water Resources Research, 51(3), 1401-1421, doi:10.1002/2014WR016139.

Gran, K.G., and J.A. Czuba, (2016), Sediment pulse evolution and the role of network structure, Geomorphology, doi:10.1016/j.geomorph.2015.12.015.

As well as some currently (as of April 18, 2016) unpublished work as part of J. Czuba’s Ph.D. thesis.

I typically run the code in cell mode and progress cell by cell as I have developed this research code. Due to this, if you just try to run one entire .m file then it is likely not to work or produce unanticipated results. To use this code effectively you will have to sit down and try to understand what it is doing in order to make sure it is working the way you expect it to. The code presented here has evolved over the past 4 years with some changes to variable names/functions through time. I commented out some legacy code that may prove useful to some but it may need the end user to update some variable names/functions in order to work properly. I have provided some data to run the code on for you to see how the model functions. But you will have to adapt the input data and some of the code for your study basin. This code is intended to be used by researchers with an understanding of river morphodynamics/fluvial geomorphology or equivalent and be experienced in the use of Matlab.

This code is written in Matlab and takes advantage of the Statistics Toolbox (necessary) and the Mapping Toolbox (convenient but not critical).

DISCLAIMER: The code provided here is offered as-is, with no guarantees or technical support. It is meant to provide an entry for the interested user to begin to produce results described in the above publications. You will need to adapt the input data and some of the code for your study basin at your own risk. Jon Czuba, the University of Minnesota, and any coauthors of the above publications are not responsible for the misuse or misinterpretation of the results generated by this code.

The files include:

***CODE:***

**BMS\_Preprocessing.m**

This file provides a collection of codes that help take a network shapefile with attributes into Matlab variables. The most important piece is to use this code to obtain a network with the following Matlab variables: LinkNum, GridID, ToNode, Length, Area, Slope, usarea. Other important network variables are created such as Connect, which is one of a number of variables that can be created for mapping out the connectivity structure of the network.

**BMS\_Width\_Function\_Analysis.m**

**BMS\_Plot\_Width\_Function2.m**

**BMS\_Plot\_Area\_Function.m**

These files were used to generate the width function results of Czuba and Foufoula [2014]. The first file is the main file that calls the second file for plotting. The third file here is in case you are interested in plotting the network area function instead of the network width function. For these files there is no simulation, just a simple network computation.

**BMS\_Master.m**

**BMS\_Inputs.m**

**BMS\_CapacitySlope.m**

These files are the most important files for running the simulation model and tracking parcels through the network. The first file initializes the model based on network variables created in the preprocessing step. The second file assigns the temporal and spatial distribution of inputs. The third file is used to identify links at capacity and then adjust slopes; this is only useful if you are adding enough parcels to accurately simulate the supply. The essence of the model is to add inputs to the network and track them through time as they move on the network. The remaining codes are largely used to analyze the results created by this file and for plotting.

**BMS\_Pardist\_Cluster.m**

**BMS\_ClusterAnalysisPlotting.m**

These files are used to compute the cluster properties following an instantaneous and uniform input of parcels to all links in the network (best to drive the model with BE\_NHD.mat when intending to use this code) as described in Czuba and Foufoula-Georgiou [2015]. The cluster persistence index is the sum of LCS\_spdist through time. The second file has some legacy code that may not work well as well as some that does work well for plotting parcel distance and cluster sizes through time.

**BMS\_Interarrival.m**

**BMS\_Analytical\_bed\_sed\_pdf.m**

These files are used to analyze results generated using a temporally recurrent and spatially variable inputs provided by a sediment budget. The results from these files will be published as part of J. Czuba’s Ph.D. thesis and a forthcoming journal article.

**BMS\_PlotParcels.m**

**BMS\_Plot\_Network\_Parcels\_Size2.m**

**BMS\_Plot\_Network\_Map.m**

**BMS\_MovieParcels.m**

These are miscellaneous files for plotting data on the network. To use these files requires Matlab’s Mapping Toolbox. If you do not have this toolbox then you can export the results to a text file and view in ArcGIS. The first two files are for plotting parcels on the network and coloring them according to some variable. The third file is for coloring the links of the network according to some variable. The fourth file is for generating a movie of these spatial results.

**BMS\_SingleReachStorageDynamics.m**

This file is used to simulate single reach storage dynamics as described in the forthcoming Ph.D. thesis of J. Czuba and journal article. It essentially isolates only the storage dynamics of a single link and removes any effects of the network in restructuring the Poisson inputs.

***DATA:***

**BE\_NHD.mat**

This data file contains the Blue Earth River Network properties for use in the code as described by Czuba and Foufoula-Georgiou [2015]. This is only a river network that corresponds to the shapefile BE\_NHD\_network\_prj.shp. These data should be used for the cluster dynamics because there are no lakes included.

**BE\_NHD\_MartinLakes4.mat**

This data file contains the Blue Earth River Network properties for use in the code as described by Gran and Czuba [2016] and forthcoming publications. This contains the river network and in-line lakes corresponding to the other shapefiles.

***GIS SHAPEFILES:***

**BE\_NHD\_network\_prj.shp**

Network described by Czuba and Foufoula-Georgiou [2015] corresponding to BE\_NHD.mat

**BE\_NHD\_network\_MartinLake\_ds\_prj\_lakeid.shp**

Network described by Gran and Czuba [2016] and forthcoming publications corresponding to BE\_NHD\_MartinLakes4.mat

**nhd\_waterbody\_netintsct\_gt04km\_poly2\_prj.shp**

Lake shapefile incorporated into the network described above in Gran and Czuba [2016].

**Catchment\_NHD\_MRB5\_BE2\_diss\_prj.shp**

Catchment shapefile for the Greater Blue Earth River Basin for use with either network.