**Supplementary file to Jha et al., 2017, Toolbox for Analysis of Flexural Isostasy (TAFI) – A Matlab® toolbox for modeling flexural deformation of the lithosphere.**

**This supplementary file describes TAFI's directory structure, GUI use and input file formats.**

**TAFI Directory Structure**

TAFI is organized into a main directory, “TAFI”, which contains the files defining the GUI ("TAFI.fig" and "TAFI.m") and a README file describing TAFI’s installation and use (manuscript Figure 2, Table 2). The main TAFI directory also contains nine subdirectories. The subdirectory "GUI\_Functions” contains files accessed by the GUI that define icons, the default parameter values that populate the GUI when it is opened (defined in the file GUI\_Functions/Defaults/TAFI\_Defaults.m), and functions needed to enable or disable GUI elements depending on the plate and load geometry combinations. The subdirectories “Geodynamic\_Functions” and “Gravity\_Functions” contain the functions used to calculate the flexure and gravity profiles (2-D) or fields (3-D). The “Load\_Functions” subdirectory contains functions to read and re-sample the user-provided discretized load, and functions to convolve the uniformly sampled load function with the Green’s Function. The resampling and convolution functions can be called from the Matlab command line, as well as from within TAFI’s GUI. The sub-directory “Plot\_Function” contains functions to generate the flexural deformation and gravity plots located in the GUI “Plot panel”. The “Output\_Parameters” sub-directory contains the TAFI functions used to find the maximum and minimum flexural deflections (*wmax* and *wb*) and the locations of the crest of the peripheral uplift and zero-crossing between the flexural basin and peripheral uplift (*xb* and *xo*). Sample bathymetry and Free Air gravity data from the Aleutian trench that is used for the case study presented in Section 5 are included in the subdirectory “Example\_Data”. A pdf help manual, which can be accessed from TAFI’s GUI, is located in the subdirectory “TAFI\_Manual”.

 **GUI Use**

TAFI’s GUI allows the flexure and gravity curves to be modified interactively by changing the model parameter values using TAFI’s sliders and edit boxes. Parameter values entered in the edit boxes should be given in scientific notation (i.e., 1.2e+8, etc.). When edit boxes have corresponding sliders, values entered in the edit box must lie within the range of the sliders. The Matlab tool used to create the sliders in TAFI changes the associated parameter value in discrete increments. TAFI sets the slider increment to be equal to 0.01% of the slider’s range. Users can enter more precise parameter values in the edit boxes corresponding to each slider.

When TAFI is initialized, the model parameters and the ranges of the sliders are preset to default values based on existing literature that are intended to span realistic ranges for Earth models. The parameter value and range defaults can be modified from the “Change defaults – TAFI Defaults” contextual menu in the TAFI GUI or by editing the “TAFI\_Defaults.m” file. The flexural rigidity of the Earth’s lithosphere is estimated to range from a low of 7x1015 N-m near mid-ocean ridges to a high of 1.4x1025 N-m in continental interiors (Watts, 2001). Accordingly, the default range of the “Flexural Rigidity” slider is 1015 to 1026 N-m and the default value is 2x1020 N-m. The “Load Magnitude” slider ranges from 1 to a maximum of 1020 (units depend of the plate geometry chosen, and are N/m for a line load or N for a point load), with a default initial value of 5x1011N/m. The default maximum value of the load slider is chosen to exceed the largest reasonable Earth topographic load (the Himalayan topographic load, for example, is approximately 3x1011 N/m, based on an average elevation of 5 km, average width of 2000 km, and an average density of 2.7x103 kg/m3). The default “Load Position” slider limits are -1000 km to +1000 km (approximately 3 default model flexural wavelengths to either side of the origin), with a default value of 0 km. The “Load Magnitude” slider changes to “Load Scaling” slider with a range from 0 to 10 (with a default value of 1) when a spatially distributed load is chosen in the “Load Geometry” pulldown menu. When a spatially distributed load is chosen, the user is prompted for the location of a file containing a discretely sampled load function (the format of the file is described in in the next section). The imported load function is multiplied by the scaling factor selected from the “Load Scaling” slider or edit box before computing the modeled deflection. The “Load Wavelength” slider is active only when the ”Periodic loading” option is selected from the "Load Geometry" dropdown menu, and ranges from 1 to 40,000 km (roughly the circumference of the Earth), with a default value of 1 km.

The flexure and gravity curves calculated by TAFI are plotted in the “Plot panel” on the right side of the TAFI GUI. The dimensions of the plots are specified in the "Xmin" and "Xmax" edit boxes. In the case of 3-D models, the plot dimensions are the same size as the input load grid. The user should be certain that the size of the input load grid spans the region of interest, not just the region encompassing the load. These plots are updated automatically when the model parameters are changed using the sliders, by adding new curves in 2-D plots and replacing the flexural and gravity surfaces in 3-D plots. If the parameters are changed using the edit boxes, the “Plot Flexure” and “Plot Gravity” buttons located below the "Model Parameters" panel must be used to add the new curves to the flexure and gravity plots.

The primary purpose of TAFI is to facilitate fitting of the elastic flexural model to gravity and/or vertical displacement data provided by the user. The “Open File” and “Plot Data” buttons in the “Data Import Utility” panel allow input and plotting of gravity and vertical deformation data that can be used to constrain the flexural model. The type of data file being imported is specified in the “Data Type” dropdown menu in the “Data Import Utility” panel. Free Air gravity should be used for marine flexural models and Bouguer gravity on land, as TAFI does not explicitly model the gravitational anomaly associated with surface topography. Constraints on vertical displacements are referred to in the TAFI “Data Type” menu as flexure constraints. Examples of flexure constraints include subsidence data from wells (generally in the form of horizon depth or isopach thicknesses), depth or isopach data digitized from maps, cross sections, or seismic data, and bathymetry. Once the gravity and/or flexure constraints are loaded, the “Plot Data” button at the bottom of the “Data Import Utility” is selected to plot the constraining data. Changes in the model parameters, made either through the sliders or text boxes in the “Model Parameter” panel, produce changes in the modeled flexural and gravity curves that can be directly compared to the data in the graphs shown in the “Plot panel”. The flexural and gravity data can be shifted vertically or horizontally to better match the modeled curves using the edit box and X, Y or Z buttons in the “Data Shift” panel. This panel appears when the “Plot Data” button is selected.

The push buttons located below the “Model Parameters” panel control the plots shown in the “Plot panel”. As noted previously, the “Plot Flexure” and “Plot Gravity” buttons are needed to update the flexural and gravity curves when the text boxes, rather than sliders, are used to change the model parameters. “Clear All Curves” removes the flexural and gravity curves from the plot area, leaving only the imported data plotted. “Clear All Data” removes the imported data points from the plot, leaving only the modeled curves. “Clear All Data” also erases the constraining data from the data table. “Reset All Plots” clears all curves and data from the Plot panels. After “Reset All Plots” is selected, the curves for the most recent flexural and gravity model can be refreshed using the “Plot Flexure” and “Plot Gravity” buttons.

**Input Files**

The input files containing the flexure and gravity constraints and load functions can be in either text or Excel format. The flexure and gravity constraints are read when the appropriate file type is selected from the dropdown menu in the “Data Import Utility” panel. The flexure and gravity data files for 2-D models should be formatted in two columns, the first providing the position (in km) of the data point relative to an origin chosen by the user, and the second column providing either the vertical deflection (in km) or gravity value (in mGal). In case of a 3-D model, the flexure and gravity data files have to be formatted in three columns , the first two columns providing the position (X and Y, in km) of the data point relative to an origin and third column providing the vertical deflection (in km) or gravity (in mGal). The file containing the discretized load function is accessed through the “Import 2-D Distributed Load”, “Import Distributed Axisymmetric Load” or “Import 3-D Distributed Load” option in the “Load Geometry” menu. This opens a popup window prompting the user for the load file location. The load file for a 2-D or axisymmetric distributed load has the same format as the 2-D flexure and gravity constraint files, with the first column specifying the position (in km) and the second column specifying the magnitude of load at the sample points (in N/m2). The sample positions in the load file should be relative to the same coordinate origin as in the flexural and gravity constraint files (although, as noted previously, the positions of all of these can be adjusted with sliders and edit boxes in the TAFI GUI). In the case of a 3-D load, the load file is formatted in one column. The first two rows provide the discretization interval (in km) in the load grid’s X (grid row) and Y (grid column) directions. The next two rows of the load file specify the number of nodes in the X and Y directions. The remaining rows specify the load magnitude (in N/m2) at each grid node. Load values are given sequentially for each grid column (Y coordinates) in the first grid row (first X coordinate), and the sequence repeated for all grid rows.

**Saving the TAFI Model**

The deflection and gravity profiles and surfaces can be saved as ASCII text files by selecting “Export Flexure” or “Export Gravity” from the “File-Export” menu at the top of the TAFI window. The exported files are saved in the same format as the load input files, described previously. The model parameters (flexural rigidity, elastic thickness, load position and magnitude/scaling, discretization interval, etc.) and key output parameters (manuscript Table 1) can be exported into text files using the “Export Parameter-Export Inputs” or, “Export Parameter–Export Outputs” options in the “File” menu. The flexure and gravity plots can be saved by using the Matlab Figure Palette tool from the “Edit Figures-Edit Flexure” or “Edit Figures-Edit Gravity” options in TAFI’s “File” menu. The figure palette can also be used to edit plot properties such as line thicknesses, and data point size, colors, text labels, etc.