Requirements Specifications

# Functional Requirements (FR)

High Priority (HP):

1. FR-HP01: Calculate dominant Plant Functional Type (PFT: Evergreen Needleleaf, Evergreen Broadleaf, Deciduous Needleleaf, Deciduous Broadleaf, Shrub, Grass, Cereal Crop, and Broadleaf Crop)for each tower site
2. FR-HP02: Read in 4 input datasets (L4C reference dataset, L4C meteorological input dataset, Flux Tower Fluxes dataset, IGBP FAO Soil Organic Carbon Inventory dataset) for calibration
3. FR-HP03: Compile the L4C meteorological inputs provided from NASA/NTSG and ground-truth data from flux tower sites into table
4. FR-HP04: Allow the user to choose one of the nine PFTs (High-1)
5. FR-HP05: Guide the user through removing outliers in average annual GPP and RECO calculations
6. FR-HP06: Allow user to choose which parameters to use when optimizing GPP and RECO, such as LUE (light use efficiency) for GPP or faut (autotrophic/plant respiration fraction) for RECO
7. FR-HP07: Calculate linear ramp functions given current BLPUT (High-6)
8. FR-HP08: Allow user to specify number of Numerical Spin-Up iterations
9. FR-HP09: Compute comprehensive validation and fit statistics: graph flux tower data against model-estimated data
10. FR-HP10: Output updated BLPUT, 4 SOC stock-size maps, and SMRZ minimum and maximum for 2000-2018
11. FR-HP11: Calculate flux tower weights as some tower sites are located in same 9km section

Medium Priority (MP):

1. FR-MP01: Calculate percentage of area that is occupied for each PFT at each tower site
2. FR-MP02: Compile historical data and error metrics for each day for each PFT into table
3. FR-MP03: Subset time series variables to user configurable period (High-2)
4. FR-MP04: Subset L4C meteorological and L4C reference input to sites that have dominant selected PFT (High-4)
5. FR-MP05: Compile ancillary info on each site for selected PFT such as dominant PFT at 9km scale and SOC stock size for the site (High-4)
6. FR-MP06: Compile all important data for calibration of selected PFT that includes FPAR, PAR, TSURF, TSOIL, SMSF, VPD, TMIN, SMRZ, minimum SMRZ, maximum SMRZ, and PAW (High-4)
7. FR-MP07: Average data for PFT each day of the year (High-5)
8. FR-MP08: Display current ramp functions to the user and allow them to save the plots as files (High-7)
9. FR-MP09: Allow the user to plot GPP against Emult separately form the ramp functions (Medium-8)
10. FR-MP10: Report the differences between new and old value parameters after optimization (High-7)
11. FR-MP11: Allow the user to specify Pk and Prh for RECO (High-6)
12. FR-MP12: Create 2 plots: Rh/Cbar against TSOIL with the Arrhenius curve on top, Rh/Cbar against SMSF with the SMSF ramp function on top (High-7)
13. FR-MP13: Calculate Cbar for each tower site after optimization (High-7, Medium-12)
14. FR-MP14: Calculate σ and Bsoc for each tower site to plot σ \* Bsoc against ground truth SOC sizes
15. FR-MP15: Run the Analytical and Numerical Model Spin-Ups (High-8)
16. FR-MP16: Run preliminary spin up arbitrary period over full operational record 2000-2019
17. FR-MP17: Run L4C soil model forward runs
18. FR-MP18: Prepare vectors of initial optimized parameters and GPP and RECO optimization objective functions to iteratively change optimization parameters
19. FR-MP19: Calculate GPP\*, Kmult\*, NPP\* based off of calculations (Medium-7)
20. FR-MP20: Calculate RMSE for each subset of towers for observed both GPP and RECO against L4C Reference Dataset, optimized GPP/RECO, and L4C Forward Model Run (High-9)
21. FR-MP21: Calculate NEE (NEE= RECO – GPP) based on optimized parameters then report stats of NEE against L4C Reference Dataset, optimized GPP/RECO, and L4C Forward Model Run

Low Priority (LP):

1. FR-LP01: Remove negative values in annual GPP and RECO for each flux tower site (Medium-7)
2. FR-LP02: Calculate lower and upper limits for APAR (Medium-8)
3. FR-LP03: Allow the user to repeat optimizations after the initial optimization (High-6, Medium-10)
4. FR-LP04: Allow the user to plot GPP against Emult and Rh/Cbar against Kmult

# Non-functional Requirements (NF)

High Priority (HP):

1. Have accuracy of calibration that meets or exceeds the current implementation.
2. Be able to process data while maintaining the size being used in the current implementation.
3. Pass a holistic test suite (a script that individually and automatically tests the functionality of the entire project, such as Python’s built-in “unittest”).
4. Be subjectively rated better than the current implementation by the client.
5. Follow a modular, object-oriented design pattern.
6. Have basic documentation for all features.

Medium Priority (MP):

1. Have well-written inline documentation for every class, method, and variable (the code itself).
2. Allow the process, as a whole, to run 20% faster than the current implementation.
3. Use 30% less total, saved memory than the current implementation.
4. Make use of Python virtual environments.
5. Have a test suite for every component.
6. Have sufficient maintainability as determined by the client.

Low Priority (LP):

1. Have a test case written for every method.
2. Have a test suite with 95% code coverage or higher.
3. Be validated on systems other than those specified in the software requirements.
4. Be validated on browsers other than those specified in the software requirements.

# Hardware Requirements (HW)

1. Program to be developed on x86\_64 architecture with SSE4 extensions or later.

# Software Requirements (SW)

1. The Software shall be written in Python 3.
2. The Software shall run on Unix and GNU/Linux based systems.