**CACIE Tool 10.1**– **Build Surface Flux Tool**

**Version** **1.1**

**QA**: **QA**

# Description and Purpose

The Build Surface Flux tool reads a STOMP input file and extracts the grid card. The tool then reads a MODFLOW shapefile and extracts the corresponding grids that are within the STOMP grid coordinates. It then creates a ~surface flux card, mapping the STOMP grid into the MODFLOW grid.

# Functional Requirements

The following are the functional requirements (FR) of the Build Surface Flux tool:

FR-1: Parse arguments

FR-2: Extract STOMP Grid template (~Grid Card)

FR-3: Build x index values based on input file STOMP Grid template

FR-4: Build y index values based on input file STOMP Grid template

FR-5: Find all MODFLOW shapefile nodes that fall within the STOMP x-y boundaries (x1≤…<xn, y1≤…<yn)

FR-6: Find all applicable x-indices for each MODFLOW shapefile grid from FR-5

FR-7: Find all applicable y-indices for each MODFLOW shapefile grid from FR-5

FR-8: Write to surface flux card text file: for each MODFLOW grid from FR-5, summarize the relevant STOMP coordinate indices for each contaminant.

# Software Requirements Specifications

Programming Language and required modules/libraries:

* Python 3.6
* Libraries:
  + Pyshp
  + Shapefile
  + Datetime
  + Os
  + Argparse
  + Logging
  + itemgetter from operator

# Software Design Description

Arguments:

* -s: Name of Sim Model, default="Unknown"
* -i: the stomp input file containing the ~grid card
* -shp: shapefile that the stomp grid card is being mapped to
* -c: Constituents used in this model
* -v: Use this to bypass validation of the list of contaminate names
* -o: Directory and name of output file default: output/{model}/{date}/\_solute\_flux\_card.txt
* -csv: location to create csv file to check shapefile grid to stomp grid conversion. default: csv/{model}/{date}/{model}\_grid\_conversion.csv")
* -b: Turn on boundaries for solute flux and Aqueous Volumetric. example: BNS will turn on bottom, North, and South. example 2(default): B will turn on bottom only.

Input Files:

There are 2 required files:

* STOMP input file. This gives us the grid used by the stomp model
* ShapeFile. This file contains the grid the STOMP grid is going to mapped to

Output Files:

There are 5 files that are output.

* log/error\_modify\_cards\_log\_{date}.txt: file containing all log entries generated during execution
* csv/{model}\_grid\_conversion.csv: contains coordinates that were used in the mapping between the two grids
* output/{model}\_solute\_flux\_card.txt: Contains the stomp ~Surface Flux Card that was generated.

Tool Runner:

The following is the shell script configuration that will be passed as an argument to the Tool Runner for qualified runs:

* python directory path]/ca-surf/ca\_build\_surface\_flux.py -c {copc list} -shp {shape file} -i {stomp input} -s {ModelName} -o {output file}
* Basic usage: -c contaminates, -shp shape file to use, -i stomp input file to get grid card from, -s what model this is for, -o (optional) file name and directory to create the surface flux card

Code Review:

Code walkthrough was performed by Sara Lindberg on 06/11/2019. Subsequent updates to the code were reviewed by Sara Lindberg on 03/05/2020. The code relies on standard python libraries and consists of a single python file which references only the standard python libraries as noted in Section 3.

# Requirements Traceability Matrix

The requirements traceability matrix for the Build Surface Flux Tool is presented in Table 1.

| Table 1  Requirements Traceability Matrix | | |
| --- | --- | --- |
| **Functional Requirement ID** | **Acceptance Test ID** | **Test Case** |
| QA Level | IT-1 | Installation Test |
| FR-1 | ATC 1 step: 3.1 | Check log file “input data” values against arguments |
| FR-2 | ATC 1 step: 3.2 | Check the following in log file:   * “stomp grid size,” * stomp grid x,” “stomp grid y,” and * “stomp grid k” values   against STOMP input file “Grid Card” values |
| FR-3 | ATC 1 step: 3.3 | Check log file “stomp grid i” values against STOMP input file |
| FR-4 | ATC 1 step: 3.4 | Check log file “stomp grid j” values against STOMP input file |
| FR-5 | ATC 1 step: 3.5 | Check log file “shape\_file\_grids” values against STOMP x-y boundaries (x1≤…<xn, y1≤…<yn) |
| FR-6 | ATC 1 step: 3.6 | Check contaminants and x-indices for one node in rad[]\_surface\_flux.txt |
| FR-7 | ATC 1 step: 3.7 | Check contaminants and y-indices for one node rad[]\_surface\_flux.txt |
| FR-8 | ATC 1 step: 3.8 | Check rad[]\_surface\_flux.txt “grid” values against log file “node” values |

# Installation Test Plan and Acceptance Test Plan Cases

The installation test plan for Build Surface Flux Tool is presented in Table 2 and the acceptance test plan case for Build Surface Flux Tool is presented in Table 3.

| **Table 2**  **Build Surface Flux Tool Installation Test Plan** | | | |
| --- | --- | --- | --- |
| **Build Surface Flux Tool Installation Testing**  **CACIE-Build Surface Flux Tool – IT-1** | | **Date:** | |
| **Tool Runner File Location for this test:**  **[PUT LINK TO THE DIRECTORY HERE]** | | **Test Performed By:** | |
| **Testing Directory: [PROVIDE LINK TO TESTING DIRECTORY]** | | | |
| **Test Step** | **Test Instruction** | **Expected Result** | **Test Result  (Pass/Fail)** |
| Tools Code Repository Directory: | | | |
| Navigate to the testing directory | | | |
| 1 | Invoke Tool runner and test the tool using *runner\_run\_IT-1.bat* as follows:  *./runner\_run\_IT-1\_Build Surface Flux Tool.bat* | | |
| 2 | Verify Tool Runner is invoked and executed. |  |  |

| Table 3 **Build Surface Flux Tool Acceptance Test Plan Case 1** | | | |
| --- | --- | --- | --- |
| **Build Surface Flux Tool Acceptance Testing**  **CACIE-Build Surface Flux Tool – AT-1** | | **Date:** | |
| **Tool Runner File Location for this test:**  **[PUT LINK TO THE DIRECTORY HERE]** | | **Test Performed By:** | |
| **Testing Directory: [PROVIDE LINK TO TESTING DIRECTORY]** | | | |
| **Test Step** | **Test Instruction** | **Expected Result** | **Test Result  (Pass/Fail)** |
| Navigate to the Testing Directory | | | |
| 1 | Invoke Build Surface Flux tool by entering the following entering the following:  ./ca-surf\_rad1\_run\_ATC-1thru8.sh |  |  |
| 2 | Print out the following files:   * [Testing\_Directory]\/ca-surf-test/log/error\_modify\_cards\_log\_yyymmdd.txt * [Testing\_Directory]\/ca-surf-test \rad[]\_surface\_flux.txt * [Testing\_Directory]\/ca-surf-test\ ca-surf\_rad1\_run\_ATC-1thru8.sh   ([Testing\_Directory]\ca-surf-test\ss\input | … |  |
| 3 | Compare generated output files (./ca-surf-test/log/error\_modify\_cards\_log\_yyymmdd.txt and rad[]\_surface\_flux.txt) against ca-surf\_rad1\_run\_ATC-1thru8.sh and STOMP input file ([Testing\_Directory]\ca-surf-test\ss\input) as follows:  … |  |  |
| 3.1 | Check the following values in log file:   * “stomp grid size,” * stomp grid x,” “stomp grid y,” and * “stomp grid k” values   against STOMP input file “Grid Card” values (see Appendix A Attachment A-3) |  |  |
| 3.2 | Check log file “stomp grid i” values against STOMP input file |  |  |
| 3.3 | Check log file “stomp grid j” values against STOMP input file |  |  |
| 3.5 | Check log file “shape\_file\_grids” values against STOMP x-y boundaries (x1≤…<xn, y1≤…<yn) |  |  |
| 3.6 | Check contaminants and x-indices for one node in check rad[]\_surface\_flux.txt (see Appendix A Attachment A-4) |  |  |
| 3.7 | Check contaminants and y-indices for one node in check rad[]\_surface\_flux.txt |  |  |
| 3.8 | Check rad[]\_surface\_flux.txt nodes against log file nodes |  |  |
| 3.9 | Check rad[]\_surface\_flux.txt nodes against [model]\_grid\_conversion.csv |  |  |
| 3.9.1 | Rad[]\_surface\_flux.txt: “2, srf/modflow\_xx-xx.srf,” | xx-xx. should match up with p2r I-J in the csv file |  |
| 3.9.2 | Rad[]\_surface\_flux.txt: “Solute Flux, , 1/yr, , Bottom, X, Xe, Y, Ye, 1, 1,” | Correspond to fields in csv:  x = i\_start  Xe = i\_end  Y = j\_start  Ye = j\_end |  |

# Acceptance Test Report

To complete the Acceptance Testing use Appendix A. The two test cases are described as follows:

* Acceptance Test 1 is in Table A-1.

Details of these tests, when they were conducted, by whom, and if they Passed or Failed are in each table of Appendix A.

# User Guide

The Build Surface Flux tool will be invoked using the Tool Runner tool using a shell script as defined in Section 4. The following defines the arguments specific to the Build Surface Flux tool.

Command line Arguments:

-s: Name of Sim Model, defaults to “Unknown”

-i: location and name of the input file with the ~grid card to be used. Defaults to the sim template

-shp: shapefile with the ground water grid to be used

-c: Constituents used in this model

-o: Directory and name of output file default: output/{model}/{date}/\_solute\_flux\_card.txt

-csv: location to create csv file to check shapefile grid to stomp grid conversion. default: csv/{model}/{date}/{model}\_grid\_conversion.csv

-b: turn on boundaries for solute flux and Aqueous Volumetric:

* example: BNS will turn on bottom, North, and South.
* example 2(default): B will turn on bottom only

# Tool Versions

This section details changes incorporated into each version of the **Build Surface Flux Tool**.

* 1.0 – Tool was developed.
  + Adding to the Tool Runner Approved Tool list and removed comments from output that were no longer needed.
* 1.1 – Corrected issue where could not read northing and easting values. Used to only allow whole numbers for easting/northing, now can be floats.

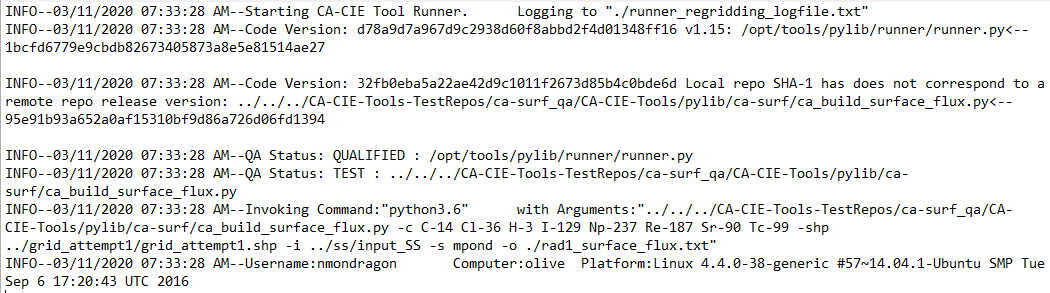
# Appendix A

**Completed Acceptance Test Cases**

**Testing Process Description**

The tool was executed using a shell file on linux, with the Tool Runner.

**Tool Runner Log**



| Table A-1  **Build Surface Flux Tool Acceptance Test Plan Case 1** | | | |
| --- | --- | --- | --- |
| **Build Surface Flux Tool Acceptance Testing**  **CACIE-Build Surface Flux Tool – AT-1** | | **Date: 3/11/2020** | |
| **Tool Runner File Location for this test:**  **Z:\CA-CIE-Tools-TestEnv\v4-2\_ca-surf\_test\ca-surf-QA-test\rad1surface\_flux.txt** | | **Test Performed By: Neira M.O.** | |
| **Testing Directory: Z:\CA-CIE-Tools-TestEnv\v4-2\_ca-surf\_test\ca-surf-QA-test** | | | |
| **Test Step** | **Test Instruction** | **Expected Result** | **Test Result  (Pass/Fail)** |
| Navigate to the Testing Directory | | | |
| 1 | Invoke Build Surface Flux tool by entering the following entering the following:  ./ca-surf\_rad1\_run\_ATC-1thru8.sh |  | Pass |
| 2 | Print out the following files:   * [Testing\_Directory]\/ca-surf-test/log/error\_modify\_cards\_log\_yyymmdd.txt * [Testing\_Directory]\/ca-surf-test \rad[]\_surface\_flux.txt * [Testing\_Directory]\/ca-surf-test\ ca-surf\_rad1\_run\_ATC-1thru8.sh   ([Testing\_Directory]\ca-surf-test\ss\input |  | Pass |
| 3 | Compare generated output files (./ca-surf-test/log/error\_modify\_cards\_log\_yyymmdd.txt and rad[]\_surface\_flux.txt) against ca-surf\_rad1\_run\_ATC-1thru8.sh and STOMP input file ([Testing\_Directory]\ca-surf-test\ss\input) as follows:  … | | Pass |
| 3.1 | Check the following values in log file:   * “stomp grid size,” / * stomp grid x,” “stomp grid y,” and * “stomp grid k” values   against STOMP input file “Grid Card” values (see Appendix A Attachment A-3) |  | Pass |
| 3.2 | Check log file “stomp grid i” values against STOMP input file |  | Pass |
| 3.3 | Check log file “stomp grid j” values against STOMP input file |  | Pass |
| 3.5 | Check log file “shape\_file\_grids” values against STOMP x-y boundaries (x1≤…<xn, y1≤…<yn) |  | Pass |
| 3.6 | Check contaminants and x-indices for one node in check rad[]\_surface\_flux.txt (see Appendix A Attachment A-4) |  | Pass |
| 3.7 | Check contaminants and y-indices for one node in check rad[]\_surface\_flux.txt |  | Pass |
| 3.8 | Check rad[]\_surface\_flux.txt nodes against log file nodes |  | Pass |

# Appendix B

**Completed Installation Test**

| Table B-1  **Build Surface Flux Tool Installation Test Plan** | | | |
| --- | --- | --- | --- |
| **Build Surface Flux Tool Installation Testing**  **CACIE-Build Surface Flux Tool – IT-1** | | **Date:** | |
| **Tool Runner File Location for this test:**  **[PUT LINK TO THE DIRECTORY HERE]** | | **Test Performed By: [FIRST & LAST NAME]** | |
| **Testing Directory: [PROVIDE LINK TO TESTING DIRECTORY]** | | | |
| **Test Step** | **Test Instruction** | **Expected Result** | **Test Result  (Pass/Fail)** |
| Tools Code Repository Directory: | | | |
| Navigate to the testing directory | | | |
| 1 | Invoke Tool runner and test the tool using *runner\_run\_IT-1.bat* as follows:  *./runner\_run\_IT-1\_Build Surface Flux Tool.bat* | | |
| 2 | Verify Tool Runner is invoked and executed. |  |  |
| 3 |  |  |  |
| … | … | … | … |