

Module Description Document

Module 1: Mosaick_Subset_Flood_Process

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1 Module 1: Mosaick_Subset_Flood_Process

1.1 Introduction

This module is used to split large floodwater datasets from VIIRS and ABI into small pieces and mosaick small pieces into one image with defined domain. Functions of the module include:

Mosaick ABI regional flood maps from G17 and G16 into new maps with defined domain: Given a defined domain, the module can create an ABI flood map in the domain from different ABI flood maps from G16 and G17. Fig.1 shows an example on how to create a CONUS ABI flood map from G16 and G17 in the same folder.

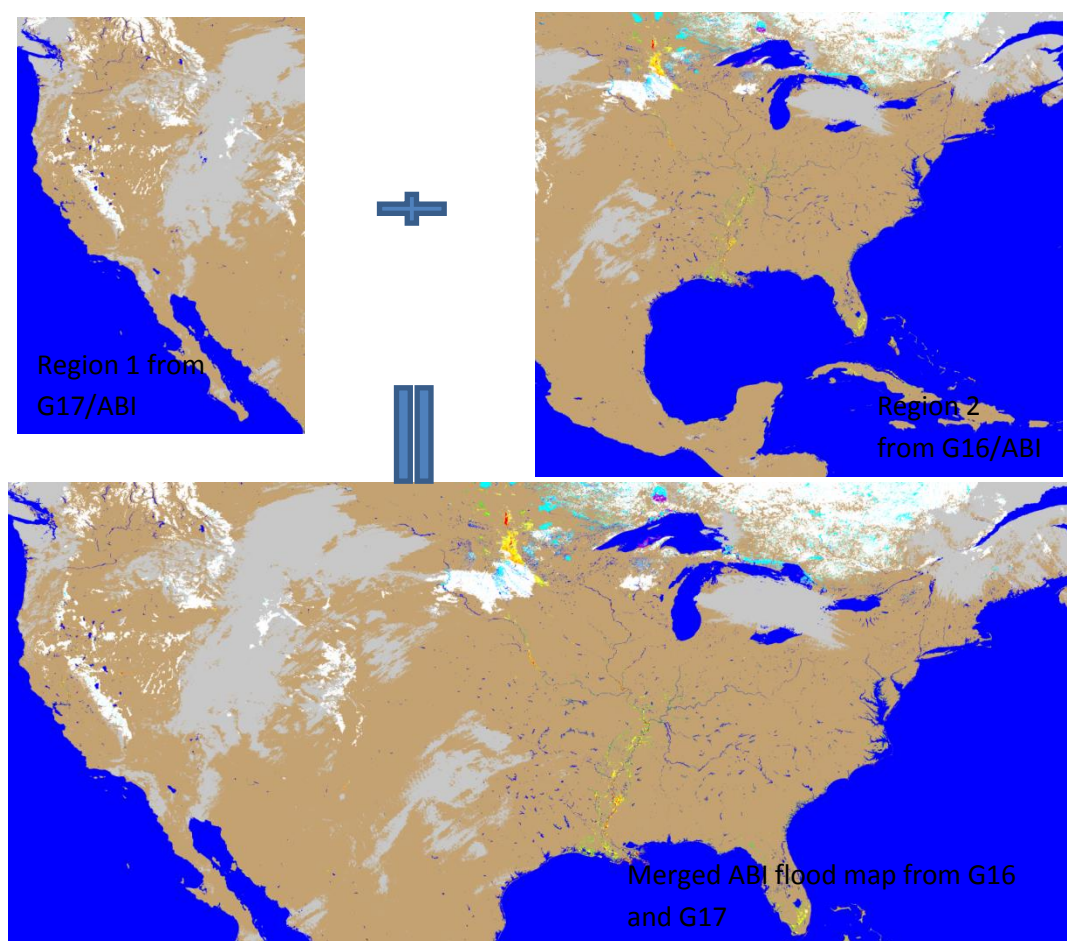


Fig. Mosaick a CONUS ABI flood map from G16 and G17

Mosaick VIIRS near real-time flood maps into new maps with defined domain: Given a defined domain, the module can generate a VIIRS flood map from multiple VIIRS 89-S granules with similar observing time in the same folder.

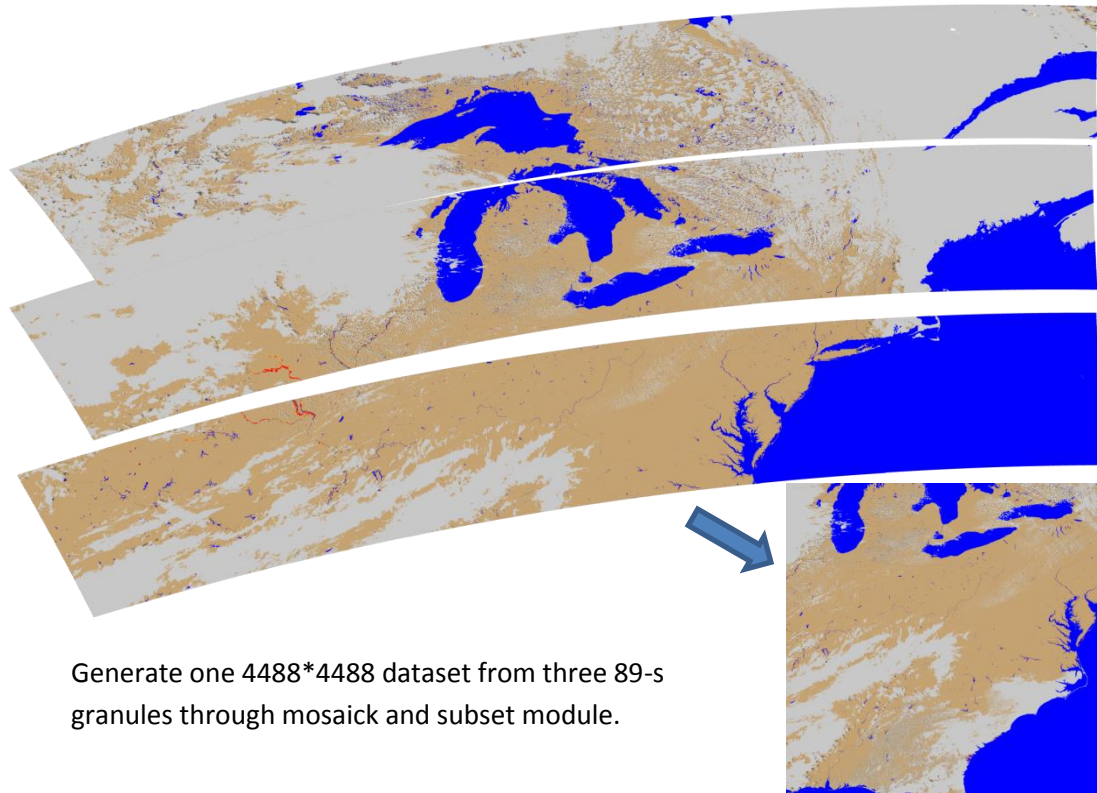


Fig.2 Example to generate a new flood map (bottom right) from multiple VIIRS 89-s granules

Mosaick the VIIRS composited flood maps into new maps with defined domain:

Given a defined domain, the module can generate a flood map in this domain from VIIRS composited flood datasets.

1.2 Data flow

1.2.1 Input

The ancillary input of this module is a user defined text file, which is in the format shown in Table 1:

Table 1 Format of user-define text file (e.g. User_AOI_Definition_WestHemisphere.txt)

| Region ID (int) | Min Longitude (float) | Max Longitude (float) | Min Latitude (float) | Max Latitude (float) |
|-----------------|-----------------------|-----------------------|----------------------|----------------------|
| 001 | -180.00 | -165.00 | 60.00 | 75.00 |
| 002 | -165.00 | -150.00 | 60.00 | 75.00 |
| 003 | -150.00 | -135.00 | 60.00 | 75.00 |
| 004 | -135.00 | -120.00 | 60.00 | 75.00 |
| 005 | -120.00 | -105.00 | 60.00 | 75.00 |
| 006 | -105.00 | -90.00 | 60.00 | 75.00 |
| 007 | -90.00 | -75.00 | 60.00 | 75.00 |
| 008 | -75.00 | -60.00 | 60.00 | 75.00 |
| 009 | -180.00 | -165.00 | 45.00 | 60.00 |

1.2.2 Output and naming rules

The output files include a log file: Mosaick_Subset_Flood_Process_log.txt, and mosaicked regional files in hdf4 format defined in the user-define text file (e.g. User_AOI_Definition_WestHemisphere.txt).

The naming rules of the mosaicked files are made based on the datasets.

1) Naming rule of the mosaicked files from ABI hourly composites:

For the ABI hourly-composited flood datasets, the naming rule is:

Mosaicked_G1617_WATER_COM_ABI_dYYYYMMDD_YYYYJJJ_HHMMSSS_column_row_RRR.hdf
YYYY: year; MM: month; DD: day; JJJ: Julian day; HH: hour; MM: minute; SSS: second; *column*: number of columns; *row*: number of rows; RRR: region id (001).

A mosaicked ABI hourly composites at 22:00 (UTC) on April 16, 2019 in region 20 (020 -90.0 -75.0 30.0 45.0) is with the name:

Mosaicked_G1617_WATER_COM_ABI_d20190416_2019106_2200000_1500_1500_020.hdf

2) Naming rule of the mosaicked files from ABI daily composites:

For the ABI daily-composited flood datasets, the naming rule is:

Mosaicked_G1617_WATER_COM_ABI_dYYYYMMDD_YYYYJJJ_column_row_RRR.hdf
YYYY: year; MM: month; DD: day; JJJ: Julian day; *column*: number of columns; *row*: number of rows; RRR: region id (001).

A mosaicked ABI daily composites on April 16, 2019 in region 20 (020 -90.0 -75.0 30.0 45.0) is with the name:

Mosaicked_G1617_WATER_COM_ABI_d20190416_2019106_1500_1500_020.hdf

3) Naming rule of the mosaicked files from AHI hourly composites:

For the AHI hourly-composited flood datasets, the naming rule is:

Mosaicked_H08_WATER_COM_ABI_dYYYYMMDD_YYYYJJJ_HHMMSSS_column_row_RRR.hdf
YYYY: year; MM: month; DD: day; JJJ: Julian day; HH: hour; MM: minute; SSS: second; *column*: number of columns; *row*: number of rows; RRR: region id (001).

A mosaicked AHI hourly composites at 22:00 (UTC) on April 16, 2019 in region 20 (020 -90.0 -75.0 30.0 45.0) is with the name:

Mosaicked_H08_WATER_COM_AHI_d20190416_2019106_2200000_1500_1500_020.hdf

4) Naming rule of the mosaicked files from AHI daily composites:

For the AHI daily-composited flood datasets, the naming rule is:

Mosaicked_H08_WATER_COM_ABI_dYYYYMMDD_YYYYJJJ_column_row_RRR.hdf
YYYY: year; MM: month; DD: day; JJJ: Julian day; *column*: number of columns; *row*: number of rows; RRR: region id (001).

A mosaicked AHI hourly composites at 22:00 (UTC) on April 16, 2019 in region 20 (020 -90.0 -75.0 30.0 45.0) is with the name:

Mosaicked_H08_WATER_COM_AHI_d20190416_2019106_1500_1500_020.hdf

5) Naming rule of the mosaicked files from VIIRS near real-time datasets

For the VIIRS near real-time flood datasets, the naming rule is:

Mosaicked_TTT_WATER_VIIRS_Prj_SVI_dYYYYMMDD_YYYYJJJ_HHMMSSS_column_row_RRR.hdf

TTT: satellite name, j01 for NOAA-20 and npp for Suomi-NPP.

YYYY: year; *MM*: month; *DD*: day; *JJJ*: Julian day; *HH*: hour; *MM*: minute; *SSS*: second; *column*: number of columns; *row*: number of rows; *RRR*: region id (001).

A mosaicked near real-time NOAA-20 VIIRS dataset around 16:00 (UTC) on June 11, 2019 in region 20 (020 -90.0 -75.0 30.0 45.0) is with the name:

Mosaicked_j01_WATER_VIIRS_Prj_SVI_d20190611_2019162_1600000_4448_4448_020.hdf

6) Naming rule of the mosaicked files from VIIRS composited datasets

For the VIIRS multiple-day composited flood datasets, the naming rule is:

Mosaicked_WATER_COM_VIIRS_Prj_SVI_dYYYYMMDD_YYYYJJJ_column_row_NNNday_RRR.hdf

YYYY: year; *MM*: month; *DD*: day; *JJJ*: Julian day; *column*: number of columns; *row*: number of rows; *NNN*: number of composition days; *RRR*: region id (001).

A mosaicked VIIRS 1-day composited dataset on June 11, 2019 in region 95 (095 -85.0 -75.0 30.0 40.0) is with the name:

Mosaicked_WATER_COM_VIIRS_Prj_SVI_d20190611_2019162_2966_2966_001day_095.hdf

1.3 Run module

The parameters to run **Mosaick_Subset_Flood_Process** include:

h:s:m:a:f:d:t:l:c:n:

- **-h**: [Necessary], file path of VIIRS and ABI flood dataset files
- **-s**: [Necessary], sensor name: ABI, VIIRS or AHI
- **-m**: [Necessary], satellite name: npp, j01, G16, G17, H08
- **-a**: [Necessary], file path of the ancillary files
- **-f**: [Necessary], filename of user-defined domain text file
- **-d**: [Necessary], dates of the files to mosaick, e.g.: 20190808
- **-t**: [Optional], hour of the files to mosaick. If the files are from hourly ABI/AHI, then this parameter must be set
- **-l**: [Necessary], file path of the log file
- **-c**: [Necessary], number of composited days, e.g. 1 or 5
- **-n**: [Necessary], flag to determine the input files are the near real-time or composited flood datasets: 0 is VIIRS near real-time granules, 1 is ABI hourly composites, 2 is VIIRS multiple-day composited datasets, 3 is ABI daily composites.

Examples:

To mosaick NOAA-20/VIIRS near real-time flood maps defined in the User_AOI_Definition_WestHemisphere.txt from VIIRS 89-s granules on June 11, 2019:

```
./Mosaick_Subset_Flood_Process -h /data/sli/VIIRS -s VIIRS -m j01 -a /data/sli/assdata -f User_AOI_Definition_WestHemisphere.txt -d 20190611 -l /data/sli/logfile -c 1 -n 0
```

If there are one-day NOAA-20 VIIRS 89-s granules from 13:00 to 23:59 (UTC) covering the west hemisphere in the folder: /data/sli/VIIRS, and in the text file:

User_AOI_Definition_WestHemisphere.txt, the land regions are defined in 15°×15° (4448×4448), then the mosaicked files will be generated each hour for each region. In region 002 (002 -165.0 -150.0 60.0 75.0), there will be four files generated in the folder:

```
Mosaicked_j01_WATER_VIIRS_Prj_SVI_d20190611_2019162_1300000_4448_4448_002.hdf
Mosaicked_j01_WATER_VIIRS_Prj_SVI_d20190611_2019162_1500000_4448_4448_002.hdf
Mosaicked_j01_WATER_VIIRS_Prj_SVI_d20190611_2019162_2000000_4448_4448_002.hdf
Mosaicked_j01_WATER_VIIRS_Prj_SVI_d20190611_2019162_2300000_4448_4448_002.hdf
```

To mosaick NOAA-20/VIIRS 1-day composited flood map defined in the test.txt (only one region is defined: 095 -85.0 -75.0 30.0 40.0) on June 11, 2019:

```
./Mosaick_Subset_Flood_Process -h /data/sli/test -s VIIRS -m j01 -a
/data/sli/assdata -f test.txt -d 20190611 -l /data/sli/logfile -c 1 -n 2
```

The following file will be generated:

```
Mosaicked_WATER_COM_VIIRS_Prj_SVI_d20190611_2019162_2966_2966_001day_095.hdf
```

To mosaick ABI hourly composites around 22:00 (UTC) on April 16, 2019 defined in the CONUS (defined in the txt file: Test_CONUS_ABI.txt: 001 -125.0 -65.0 24.5 50.5) from G16 and G17:

```
./Mosaick_Subset_Flood_Process -h /data/sli/test -s ABI -m G16 -a
/data/sli/assdata -f test_CONUS_ABI.txt -d 20190416 -t 22 -l /data/sli/logfile -c 1 -n 1
Mosaicked_G16G17_WATER_COM_ABI_d20190416_2019106_2200000_6000_2600_001.hdf
```

To mosaick ABI daily composites on April 16, 2019 defined in the CONUS (defined in the txt file: Test_CONUS_ABI.txt: 001 -125.0 -65.0 24.5 50.5) from G16 and G17:

```
./Mosaick_Subset_Flood_Process -h /data/sli/test -s ABI -m G16 -a
/data/sli/assdata -f test_CONUS_ABI.txt -d 20190416 -l /data/sli/logfile -c 1 -n 3
Mosaicked_G16G17_WATER_COM_ABI_d20190416_2019106_6000_2600_001.hdf
```

2 Module 2: VIIRS_Composition

2.1 Introduction

This module is used to do multiple-day composition on the VIIRS floodwater datasets.

2.2 Data flow

2.2.1 Input

The input of this module include:

- Land/sea mask: lw_geo_2001001_v03m_1km.raw
- MOD44W water mask: VIIRS_Global_MOD44W_Water_Mask.raw
- VIIRS near real-time floodwater datasets including:

1) Mosaicked VIIRS near real-time floodwater datasets listed below:

```
Mosaicked_WATER_VIIRS_Prj_SVI_d20190611_2019162_1300000_4448_4448_002.hdf
```

Mosaicked_WATER_VIIRS_Prj_SVI_d20190611_2019162_1500000_4448_4448_002.hdf
Mosaicked_WATER_VIIRS_Prj_SVI_d20190611_2019162_2000000_4448_4448_002.hdf
Mosaicked_WATER_VIIRS_Prj_SVI_d20190611_2019162_2300000_4448_4448_002.hdf

2) VIIRS near real-time datasets in granules directly output by the module:

VIIRS_Flood_Detection

WATER_VIIRS_Prj_SVI_npp_d20190225_t1710_t1710_cspp_dev_4152_6524_01_158.hdf
WATER_VIIRS_Prj_SVI_npp_d20190227_t1806_t1811_cspp_dev_4152_6524_01_158.hdf
WATER_VIIRS_Prj_SVI_npp_d20190227_t1948_t1948_cspp_dev_4152_6524_01_158.hdf
WATER_VIIRS_Prj_SVI_j01_d20190227_t1715_t1720_cspp_dev_4152_6524_01_158.hdf
WATER_VIIRS_Prj_SVI_j01_d20190226_t1914_t1920_cspp_dev_4152_6524_01_158.hdf

2.2.2 Output and naming rule

The output of this module include:

Logfile: VIIRS_Composite_log.txt

VIIRS multiple-day composited datasets in hdf4 format with the naming rule:

WATER_COM_VIIRS_Prj_SVI_dYYYYMMDD_dYYYYJJJ_column_row_T_NNNday_RRR.hdf

YYYY: year; MM: month; DD: day; JJJ: Julian day; *column*: number of columns; *row*: number of rows; *T*: total number of files used for the composition; *NNN*: number of composition days; *RRR*: region id (001)

For example, to do a one-day composition on the files:

Mosaicked_WATER_VIIRS_Prj_SVI_d20190611_2019162_1300000_4448_4448_002.hdf
Mosaicked_WATER_VIIRS_Prj_SVI_d20190611_2019162_1500000_4448_4448_002.hdf
Mosaicked_WATER_VIIRS_Prj_SVI_d20190611_2019162_2000000_4448_4448_002.hdf
Mosaicked_WATER_VIIRS_Prj_SVI_d20190611_2019162_2300000_4448_4448_002.hdf

The name of the output composited VIIRS dataset is:

WATER_COM_VIIRS_Prj_SVI_d20190611_d20190611_4448_4448_4_001day_002.hdf

2.3 Run module

The parameters to run **VIIRS_Composition** include:

- **-h**: [Necessary], file path of VIIRS near real-time flood dataset files
- **-v**: [Necessary], filename of the VIIRS near real-time flood dataset file with the last date among all the files. For example, if to composite VIIRS granules from Aug. 01 to 05, 2019, the filename must be a VIIRS near real-time file on Aug. 05, 2019.

- **-a**: [Necessary], file path of the ancillary files
- **-o**: [Necessary], file path of the output composited results
- **-l**: [Necessary], file path of the log file
- **-n**: [Necessary], number of composited days, e.g. 1 or 5 days
- **-r**: [Optional], region id. If to do the composition based on the mosaicked files, this parameter must be used.

Examples:

To do composition on VIIRS files:

Mosaicked_WATER_VIIRS_Prj_SVI_d20190611_2019162_1300000_4448_4448_002.hdf
Mosaicked_WATER_VIIRS_Prj_SVI_d20190611_2019162_1500000_4448_4448_002.hdf
Mosaicked_WATER_VIIRS_Prj_SVI_d20190611_2019162_2000000_4448_4448_002.hdf

Mosaicked_WATER_VIIRS_Prj_SVI_d20190611_2019162_2300000_4448_4448_002.hdf

The script can be written as:

```
./VIIRS_Composition -h /data/sli/test -v
```

```
Mosaicked_WATER_VIIRS_Prj_SVI_d20190611_2019162_2300000_4448_4448_002.hdf -a  
/data/sli/assdata -o /data/sli/test/output -l /data/sli/logfile -n 1 -r 2
```

Then the module will output a 1-day composited dataset in the folder
/data/sli/test/output:

WATER_COM_VIIRS_Prj_SVI_d20190611_d20190611_4448_4448_4_001day_002.hdf

To do 3-day composition on VIIRS files:

```
WATER_VIIRS_Prj_SVI_npp_d20190225_t1710_t1710_cspp_dev_158_4152_6524_01.hdf  
WATER_VIIRS_Prj_SVI_npp_d20190227_t1806_t1811_cspp_dev_158_4152_6524_01.hdf  
WATER_VIIRS_Prj_SVI_npp_d20190227_t1948_t1948_cspp_dev_158_4152_6524_01.hdf  
WATER_VIIRS_Prj_SVI_j01_d20190227_t1715_t1720_cspp_dev_158_4152_6524_01.hdf  
WATER_VIIRS_Prj_SVI_j01_d20190226_t1914_t1920_cspp_dev_158_4152_6524_01.hdf
```

The script can be written as:

```
./VIIRS_Composition -h /data/sli/test -v
```

```
WATER_VIIRS_Prj_SVI_j01_d20190227_t1715_t1720_cspp_dev_158_4152_6524_01.hdf -a  
/data/sli/assdata -o /data/sli/test/output -l /data/sli/logfile -n 3
```

Then the module will output a 3-day composited dataset in the folder
/data/sli/test/output:

WATER_COM_VIIRS_Prj_SVI_d20190227_d20190227_4152_6524_5_003day.hdf

3 Environment requirements

3.1 Source Codes:

The two modules are written in C/C++.

3.2 System requirements:

The software is recommended to run in Linux 64-bit system with at least 4GB memory. It can also be run in Linux 32-bit system with at least 4GB memory.

To compile, build and run the software, the **GNU Compiler Collection** including GCC/GCC C++ and hdf4 libraries are required.

4 Module 3: Merge_ABI_VIIRS_Flood

4.1 Introduction

This module is used to blend VIIRS and ABI/AHI flood detection results using the nearest neighboring interpolation method.

4.2 Data flow

4.2.1 Input

The input of this module include:

- MOD44W water mask: VIIRS_Global_MOD44W_Water_Mask.raw

- VIIRS NRT or daily composited floodwater datasets
- ABI/AHI hourly composited floodwater datasets

4.2.2 Output and naming rule

The output of this module include:

Logfile: VIIRS_ABI_Merge_Log.txt

VIIRS/ABI/AHI blended datasets in hdf4 format with the naming rule:

Joint_VIIRS_ABI(or AHI)_WATER_Prj_SVI_dYYYYMMDD_HH_ column_row_RRR.hdf
 YYYY: year; MM: month; DD: day; HH: hour of VIIRS datasets; column:
 number of columns; row: number of rows; RRR: region id (e.g. 001)

For example, to do a blending process on the VIIRS file:

WATER_COM_VIIRS_Prj_SVI_d20190515_d20190515_3559_4448_3_001day_148.hdf,

and ABI file:

COM_G16_ABI_WATER_20190515_2019135_1200_1500_001.hdf

The name of the output joint VIIRS/ABI dataset is:

Joint_VIIRS_ABI_WATER_Prj_SVI_d20190515_17_3559_4448_148.hdf

4.3 Run module

The parameters to run Merge_ABI_VIIRS_Flood include:

- h:v:f:g:a:o:l:
 - **-h: [Necessary]**, file path of VIIRS NRT or daily composited flood dataset files
 - **-v: [Necessary]**, filename of the VIIRS NRT or daily composited flood dataset file
 - **-f: [Necessary]**, file path of ABI/AHI hourly or daily composited flood dataset
 - **-g: [Necessary]**, file name of the ABI/AHI hourly or daily composited flood dataset
 - **-a: [Necessary]**, file path of the ancillary files
 - **-o: [Necessary]**, file path of the output joint results
 - **-l: [Necessary]**, file path of the log file

Examples:

To do blending process on VIIRS file:

WATER_COM_VIIRS_Prj_SVI_d20190515_d20190515_3559_4448_3_001day_148.hdf,

And ABI file:

COM_G16_ABI_WATER_20190515_2019135_1200_1500_001.hdf

The script can be written as:

```
./Merge_ABI_VIIRS_Flood -h /data/sli/VIIRS -v
WATER_COM_VIIRS_Prj_SVI_d20190515_d20190515_3559_4448_3_001day_148.hdf -f
/data/sli/ABI -g COM_G16_ABI_WATER_20190515_2019135_1200_1500_41_001.hdf -a
/data/sli/assdata -o /data/sli/joint -l /data/sli/logfile
```

Then the module will output a 1-day composited dataset in the folder
 /data/sli/joint:

Joint_VIIRS_ABI_WATER_Prj_SVI_d20190515_17_3559_4448_148.hdf

5 Environment requirements

5.1 Source Codes:

The two modules are written in C/C++.

5.2 System requirements:

The software is recommended to run in Linux 64-bit system with at least 4GB memory. It can also be run in Linux 32-bit system with at least 4GB memory.

To compile, build and run the software, the **GNU Compiler Collection** including GCC/GCC C++ and hdf4 libraries are required.