NPP/VIIRS Active Fires product description

The NPP Active Fires products are produced by a detection method similar to that used by MODIS. The input to the Active Fires production is Level 1B moderate-resolution reflective band M7 and emissive bands M13 and M15. The fire algorithm first calculates band M13 and band M15 brightness temperature (BT) statistics for a group of background pixels adjacent to each potential fire pixel. These statistics are used to set thresholds for several contextual fire detection tests. There is also an absolute fire detection test based on a pre-set M13 BT threshold. If the results of the absolute and relative fire detection tests meet certain criteria, the pixel is labeled as fire. The designation of a pixel as fire from the results of the BT threshold tests may be overridden under sun glint conditions or if too few pixels were used to calculate the background statistics.

There are multiple fire products. The IDPS operational fire product, NPP_AVAF_L2 (AS 3000 and 3001), contains only a list of pixels where fire was detected. If fire is present within a given granule, the NPP_AVAF_L2 product will contain latitude and longitude, row and column indices, and quality flags for each fire pixel. If no fire is present within the granule, these data fields will not be included in the NPP_AVAF_L2 file. Other Level 2 fire products (NPP_VAFIP_L2 in AS 3001 and 3002, NPP_VAFIRE_L2D in AS 3001) contain two-dimensional fire masks and associated quality information.

There are two versions of the Active Fires algorithm being used to generate NPP fire products. The first is the algorithm that is operating at IDPS, which is used to generate NPP_AVAF_L2 and NPP_VAFIP_L2. This version of the fire algorithm is based on MODIS C4 fire detection methods. The second is the NASA/NOAA Science Team algorithm based on the MODIS C6 Fire algorithm, which is used to generate NPP_VAFIRE_L2D. All Level 2G and Level 3 DDRs are composited from NPP_VAFIP_L2, so contain data generated by the IDPS algorithm.

NPP_VAFIRE_L2D contains several pieces of information for each fire pixel: pixel coordinates, latitude and longitude, pixel M7 reflectance, background M7 reflectance, pixel M13 and M15 BT, background M13 and M15 BT, mean background BT difference, background M13, M15, and BT difference mean absolute deviation, fire radiative power, number of adjacent cloud pixels, number of adjacent water pixels, background window size, number of valid background pixels, detection confidence, land pixel flag, background M7 reflectance, and reflectance mean absolute deviation.
Figure 1: Example of Level 2 fire data. Fires are shown in red. Black areas are bowtie deletion pixels. (Subset of NPP_VAFIP_L2.A2013286.1130.P1_03001.2013286213506.hdf)
Figure 2: Example of Level 3 8-day composite fire data. Fires are shown in red.
(Subset of NPP_D8AF1KM_L3D.A2013281.h21v10.C1_03002.2013289183907.hdf.)
<table>
<thead>
<tr>
<th>Product</th>
<th>Type/ format</th>
<th>Resolution</th>
<th>Found in Archive Sets</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPP_AVAF_L2</td>
<td>Level 2, 1-D vector of fire pixels</td>
<td>750m</td>
<td>3000/IDPS, 3001/LPEATE, 3002/LPA</td>
<td>Several data fields not present if no fires in granule; IDPS OPS algorithm</td>
</tr>
<tr>
<td>NPP_VAFIP_L2</td>
<td>Level 2, 2-D fire mask swath pixel array</td>
<td>750m</td>
<td>3001/LPEATE, 3002/LPA</td>
<td>Same data as NPP_AVAF_L2; IDPS OPS algorithm</td>
</tr>
<tr>
<td>NPP_VAFIRE_L2D</td>
<td>Level 2, 2-D fire mask swath pixel array</td>
<td>750m</td>
<td>3001/LPEATE</td>
<td>Science Team algorithm (based on MODIS C6)</td>
</tr>
<tr>
<td>NPP_DVAF1KD_L2GD</td>
<td>Level 2G grid/tile (multiple data layers)</td>
<td>1km</td>
<td>3001/LPEATE, 3002/LPA</td>
<td>Daily, daytime only. Generated from NPP_VAFIP_L2.</td>
</tr>
<tr>
<td>NPP_DVAF1KN_L2GD</td>
<td>Level 2G grid/tile (multiple data layers)</td>
<td>1km</td>
<td>3001/LPEATE, 3002/LPA</td>
<td>Daily, nighttime only. Generated from NPP_VAFIP_L2.</td>
</tr>
<tr>
<td>NPP_DAF1KM_L3D</td>
<td>Level 3 grid/tile</td>
<td>1km</td>
<td>3001/LPEATE, 3002/LPA</td>
<td>Daily. Generated from NPP_DVAF1KD_L2GD and NPP_DVAF1KN_L2GD</td>
</tr>
<tr>
<td>NPP_D8AF1KM_L3D</td>
<td>Level 3 grid/tile</td>
<td>1km</td>
<td>3001/LPEATE, 3002/LPA</td>
<td>8-day composite Generated from NPP_DVAF1KD_L2GD and NPP_DVAF1KN_L2GD</td>
</tr>
</tbody>
</table>
Table 2: NPP fire products and MODIS equivalents (MOD for Terra and MYD for Aqua)

<table>
<thead>
<tr>
<th>Description</th>
<th>NPP product</th>
<th>MODIS equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 2 Active Fire pixel list (one-dimensional) from IDPS algorithm</td>
<td>NPP_AVAF_L2</td>
<td>None</td>
</tr>
<tr>
<td>Level 2 Active Fire mask (two-dimensional) from IDPS algorithm</td>
<td>NPP_VAFIP_L2</td>
<td>MOD14/ MYD14 (C4)</td>
</tr>
<tr>
<td>Level 2 Active Fire mask (two-dimensional) from Science Team algorithm</td>
<td>NPP_VAFIRE_L2D</td>
<td>MOD14/ MYD14 (C6)</td>
</tr>
<tr>
<td>Level 2G Active Fire mask, day</td>
<td>NPP_DVAF1KD_L2GD</td>
<td>MOD14GD/ MYD14GD</td>
</tr>
<tr>
<td>Level 2G Active Fire mask, night</td>
<td>NPP_DVAF1KN_L2GD</td>
<td>MOD14GN/ MYD14GN</td>
</tr>
<tr>
<td>Level 3 daily Active Fire mask</td>
<td>NPP_DAF1KM_L3D</td>
<td>MOD14A1/ MYD14A1 (but only 1 day of data in each data file)</td>
</tr>
<tr>
<td>Level 3 8-day composite Active Fire mask</td>
<td>NPP_D8AF1KM_L3D</td>
<td>MOD14A2/ MYD14A2</td>
</tr>
</tbody>
</table>

Figure 3: Interdependencies of NPP/VIIRS fire products
NPP PRODUCT FILE SPECIFICATIONS

NPP_DVAF1KN_L2G(AS3001)

Dimensions:
- YDim:NPP_Grid_L2g_2d
- XDim:NPP_Grid_L2g_2d

Total Additional Observations
Data Rows

Variables:
- byte fireMask_1(YDim:NPP_Grid_L2g_2d, XDim:NPP_Grid_L2g_2d)
  
  long_name = "fire mask - first layer"
  units = "bit field"

  0 = "missing input data"
  1 = "not processed (obsolete)"
  2 = "not processed (obsolete)"
  3 = "water"
  4 = "cloud"
  5 = "non-fire"
  6 = "unknown"
  7 = "fire (low confidence)"
  8 = "fire (nominal confidence)"
  9 = "fire (high confidence)"

  FILL_VALUES = "NA_UINT8_FILL = 255"
  MISS_UINT8_FILL = 254
  ONBOARD_PT_UINT8_FILL = 253
  ONGROUND_PT_UINT8_FILL = 252
  ERR_UINT8_FILL = 251
  ELLIPSOID_UINT8_FILL = 250
  VDNE_UINT8_FILL = 249
  SOUB_UINT8_FILL = 248"

- byte fireMask_QCFlags_byte1_1(YDim:NPP_Grid_L2g_2d, XDim:NPP_Grid_L2g_2d)
  
  long_name = "fire mask QCFlags Byte 1 - first layer"
  units = "bit field"

  FILL_VALUES = "NA_UINT8_FILL = 255, MISS_UINT8_FILL = 254"
ONBOARD_PT_UINT8_FILL = 253
ONGROUND_PT_UINT8_FILL = 252
ERR_UINT8_FILL = 251
ELLIPSOID_UINT8_FILL = 250
VDNE_UINT8_FILL = 249
SOUB_UINT8_FILL = 248

byte fireMask_QCFlags_byte2_1(YDim:NPP_Grid_L2g_2d, XDim:NPP_Grid_L2g_2d)
    long_name = "fire mask QCFlags Byte 2 - first layer"
    units = "bit field"
    FILL_VALUES = "NA_UINT8_FILL = 255
                   MISS_UINT8_FILL = 254
                   ONBOARD_PT_UINT8_FILL = 253
                   ONGROUND_PT_UINT8_FILL = 252
                   ERR_UINT8_FILL = 251
                   ELLIPSOID_UINT8_FILL = 250
                   VDNE_UINT8_FILL = 249
                   SOUB_UINT8_FILL = 248"

byte fireMask_QCFlags_byte3_1(YDim:NPP_Grid_L2g_2d, XDim:NPP_Grid_L2g_2d)
    long_name = "fire mask QCFlags Byte 3 - first layer"
    units = "bit field"
    FILL_VALUES = "NA_UINT8_FILL = 255
                   MISS_UINT8_FILL = 254
                   ONBOARD_PT_UINT8_FILL = 253
                   ONGROUND_PT_UINT8_FILL = 252
                   ERR_UINT8_FILL = 251
                   ELLIPSOID_UINT8_FILL = 250
                   VDNE_UINT8_FILL = 249
                   SOUB_UINT8_FILL = 248"

byte fireMask_QCFlags_byte4_1(YDim:NPP_Grid_L2g_2d, XDim:NPP_Grid_L2g_2d)
    long_name = "fire mask QCFlags Byte 4 - first layer"
    units = "bit field"
    FILL_VALUES = "NA_UINT8_FILL = 255
                   MISS_UINT8_FILL = 254
                   ONBOARD_PT_UINT8_FILL = 253
ONGROUND_PT_UINT8_FILL = 252
ERR_UINT8_FILL = 251
ELLIPSOID_UINT8_FILL = 250
VDNE_UINT8_FILL = 249,
SOUB_UINT8_FILL = 248

long FP_line_1(YDim:NPP_Grid_L2g_2d, XDim:NPP_Grid_L2g_2d)
    long_name = "granule line of fire pixel - first layer"
    units = "none"
    valid_range = 0, 32767
    FillValue = 0

long FP_sample_1(YDim:NPP_Grid_L2g_2d, XDim:NPP_Grid_L2g_2d)
    long_name = "granule sample of fire pixel - first layer"
    units = "none"
    valid_range = 0, 32767
    FillValue = 0

byte FP_QualFlag1_1(YDim:NPP_Grid_L2g_2d, XDim:NPP_Grid_L2g_2d)
    long_name = "QualFlag1 - first layer"
    units = "bit field"
    valid_range = 0, 255

byte FP_QualFlag2_1(YDim:NPP_Grid_L2g_2d, XDim:NPP_Grid_L2g_2d)
    long_name = "QualFlag2 - first layer"
    units = "bit field"
    valid_range = 0, 255

byte FP_QualFlag3_1(YDim:NPP_Grid_L2g_2d, XDim:NPP_Grid_L2g_2d)
    long_name = "QualFlag3 - first layer"
    units = "bit field"
    valid_range = 0, 255

byte FP_QualFlag4_1(YDim:NPP_Grid_L2g_2d, XDim:NPP_Grid_L2g_2d)
    long_name = "QualFlag4 - first layer"
    units = "bit field"
    valid_range = 0, 255
    FillValue = '\0'
byte num_observations(YDim:NPP_Grid_L2g_2d, XDim:NPP_Grid_L2g_2d)
    long_name = "Number of Observations"
    units = "none"
    valid_range = 0, 127
    FillValue = -1

byte fireMask_c(Total Additional Observations)
    long_name = "fire mask - additional layer, compact"
    units = "bit field"

    0 = "missing input data"
    1 = "not processed (obsolete)"
    2 = "not processed (obsolete)"
    3 = "water"
    4 = "cloud"
    5 = "non-fire"
    6 = "unknown"
    7 = "fire (low confidence)"
    8 = "fire (nominal confidence)"
    9 = "fire (high confidence)"

FILL_VALUES = "NA_UINT8_FILL = 255"
            MISS_UINT8_FILL = 254
            ONBOARD_PT_UINT8_FILL = 253
            ONGROUND_PT_UINT8_FILL = 252
            ERR_UINT8_FILL = 251, ELLIPSOID_UINT8_FILL = 250
            VDNE_UINT8_FILL = 249
            SOUB_UINT8_FILL = 248"

byte fireMask_QCFlags_byte1_c(Total Additional Observations)
    long_name = "fire mask QCFlags Byte 1 - additional layer, compact"
    fireMask_QCFlags_byte1_c:units = "bit field"

FILL_VALUES = "NA_UINT8_FILL = 255"
            MISS_UINT8_FILL = 254
            ONBOARD_PT_UINT8_FILL = 253
            ONGROUND_PT_UINT8_FILL = 252
            ERR_UINT8_FILL = 251
            ELLIPSOID_UINT8_FILL = 250
VDNE_UINT8_FILL = 249
SOUB_UINT8_FILL = 248

byte fireMask_QCFlags_byte2_c(Total Additional Observations)
    long_name = "fire mask QCFlags Byte 2 - additional layer, compact"
    fireMask_QCFlags_byte2_c:units = "bit field"
    fireMask_QCFlags_byte2_c:valid_range = \'0\', \'377\'
    fireMask_QCFlags_byte2_c:_FillValue = \'0\'
    FILL_VALUES = "NA_UINT8_FILL = 255, MISS_UINT8_FILL = 254, ONBOARD_PT_UINT8_FILL = 253, ONGROUND_PT_UINT8_FILL = 252, ERR_UINT8_FILL = 251, ELLIPSOID_UINT8_FILL = 250, VDNE_UINT8_FILL = 249, SOUB_UINT8_FILL = 248"

byte fireMask_QCFlags_byte3_c(Total Additional Observations)
    long_name = "fire mask QCFlags Byte 3 - additional layer, compact"
    units = "bit field"
    FILL_VALUES = "NA_UINT8_FILL = 255, MISS_UINT8_FILL = 254, ONBOARD_PT_UINT8_FILL = 253, ONGROUND_PT_UINT8_FILL = 252, ERR_UINT8_FILL = 251, ELLIPSOID_UINT8_FILL = 250, VDNE_UINT8_FILL = 249, SOUB_UINT8_FILL = 248"

byte fireMask_QCFlags_byte4_c(Total Additional Observations)
    long_name = "fire mask QCFlags Byte 4 - additional layer, compact"
    units = "bit field"
    FILL_VALUES = "NA_UINT8_FILL = 255, MISS_UINT8_FILL = 254, ONBOARD_PT_UINT8_FILL = 253, ONGROUND_PT_UINT8_FILL = 252, ERR_UINT8_FILL = 251"
ELLIPSOID_UINT8_FILL = 250
VDNE_UINT8_FILL = 249
SOUB_UINT8_FILL = 248

long FP_line_c(Total Additional Observations)
    long_name = "granule line of fire pixel - additional layer"
    units = "none"
    valid_range = 0, 32767

long FP_sample_c(Total Additional Observations)
    long_name = "granule sample of fire pixel - additional layer"
    units = "none"
    valid_range = 0, 32767

byte FP_QualFlag1_c(Total Additional Observations)
    long_name = "QualFlag1 - additional layer"
    units = "bit field"

byte FP_QualFlag2_c(Total Additional Observations)
    long_name = "QualFlag2 - additional layer"
    units = "bit field"

byte FP_QualFlag3_c(Total Additional Observations)
    long_name = "QualFlag3 - additional layer"
    units = "bit field"

byte FP_QualFlag4_c(Total Additional Observations)
    long_name = "QualFlag4 - additional layer"
    units = "bit field"

long nadd_obs_row(Data Rows)
    long_name = "Number of additional observations per row"
    units = "none"
    valid_range = 0, 2147483647
    FillValue = -1