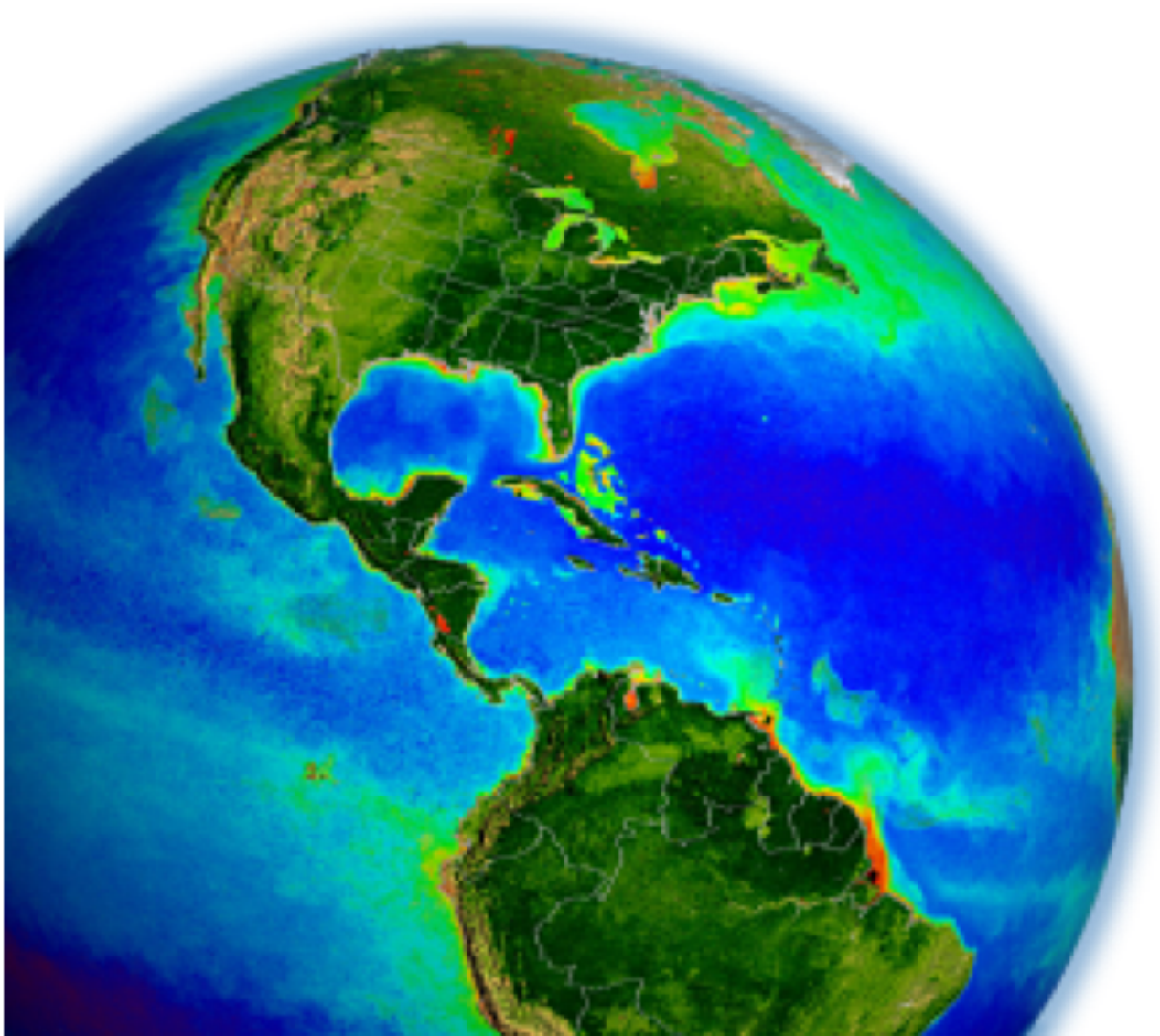
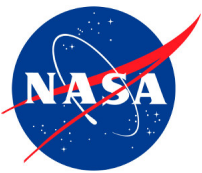


# CODE WALKTHROUGH / CLOUD MASK

22 OCTOBER 2019





# ALGORITHMS CURRENTLY SUPPORTED

- Heritage MODIS cloud mask modified to exclude TEB tests

## INPUT REQUIREMENTS

- Spectral Bands
  - Visible/IR: 412nm, 469nm, 555nm, 645nm, 859nm
  - SWIR: 1240nm, 1640nm, 2130nm
  - Cirrus: 1375nm
- NDVI Climatology
- Land Cover Type (“EcoMap”)

## OUTPUT PRODUCTS

- |                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>• ADJ_MASK</li><li>• CF_OVERALL_CONFIDENCE</li><li>• GLINT_ANGLE</li><li>• GLINT_MASK</li><li>• SNOW_MASK</li><li>• LS_MASK</li><li>• NonCloudObstruction</li><li>• CF_SOLAR_CIRRUS</li><li>• SnowFromAncillary</li><li>• HighCloud</li></ul> | <ul style="list-style-type: none"><li>• ClearSkyRestoralSpatialConsistencyOcean</li><li>• ClearSkyRestoralLand</li><li>• ClearSkyRestoralSunGlint</li><li>• SuspendedDust</li><li>• DUST_RATIO_MASK</li><li>• OceanDayThreshold</li><li>• TURBID_MASK</li><li>• SnowCoverOverVegetatedRegion</li><li>• CF_CATEGORY</li><li>• SPAT_SD_086</li></ul> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

# FOCS

- The cloud mask algorithm has been implemented within FOCS, the Framework for Ocean Color Software. FOCS is a flexible, modular system for the implementation of science algorithms, data manipulation programs, and scientific data processing. It is a simplified directed graph processing framework with the specific goal of lowering the barrier for algorithm developers to provide “production-ready” code.
- In its current form, FOCS will determine the processing path based on the requested output products and provide input files.

## COMMAND LINE EXAMPLE

```
$ focs process "[include input.par]"
```

## EXAMPLE INPUT PAR

```
tile_size=32
ifile1=A2004001023000.GEO
ifile2=A2004001023000.L1B_LAC

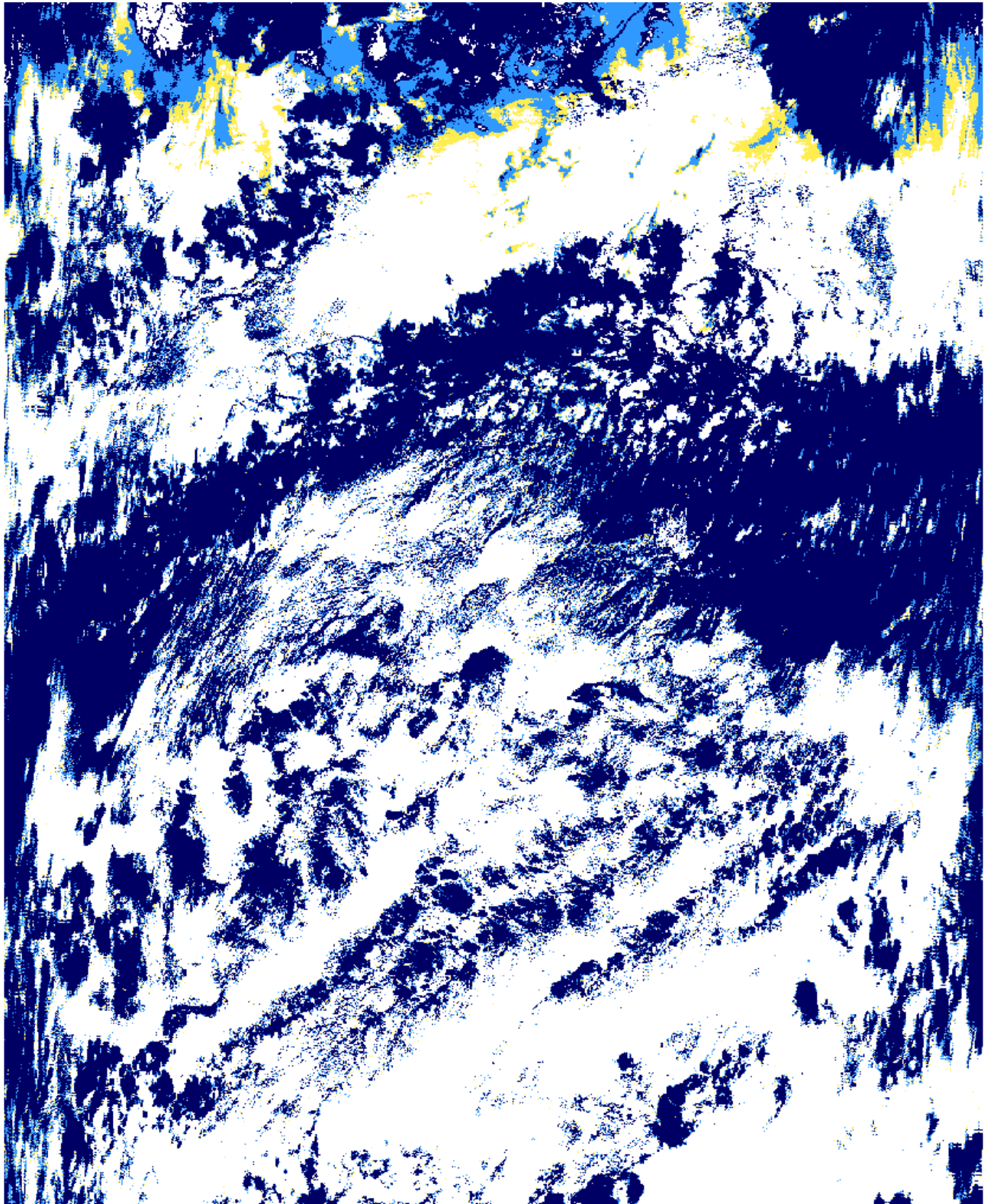
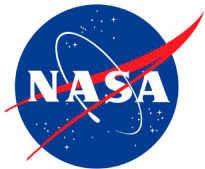
ECOMAP_FILE = /ancillary/IGBP.EcoMap.v1.0.2004.129.v004.hdf
NDVI_DIR = /ancillary/ndvi_climatology/

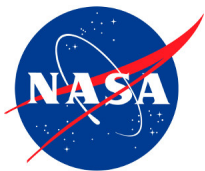
[output]
writer = NetCDF
ofile=A2004001023000.CldMsk.nc
product = latitude, longitude, CF_CATEGORY, ADJ_MASK, LS_MASK
```



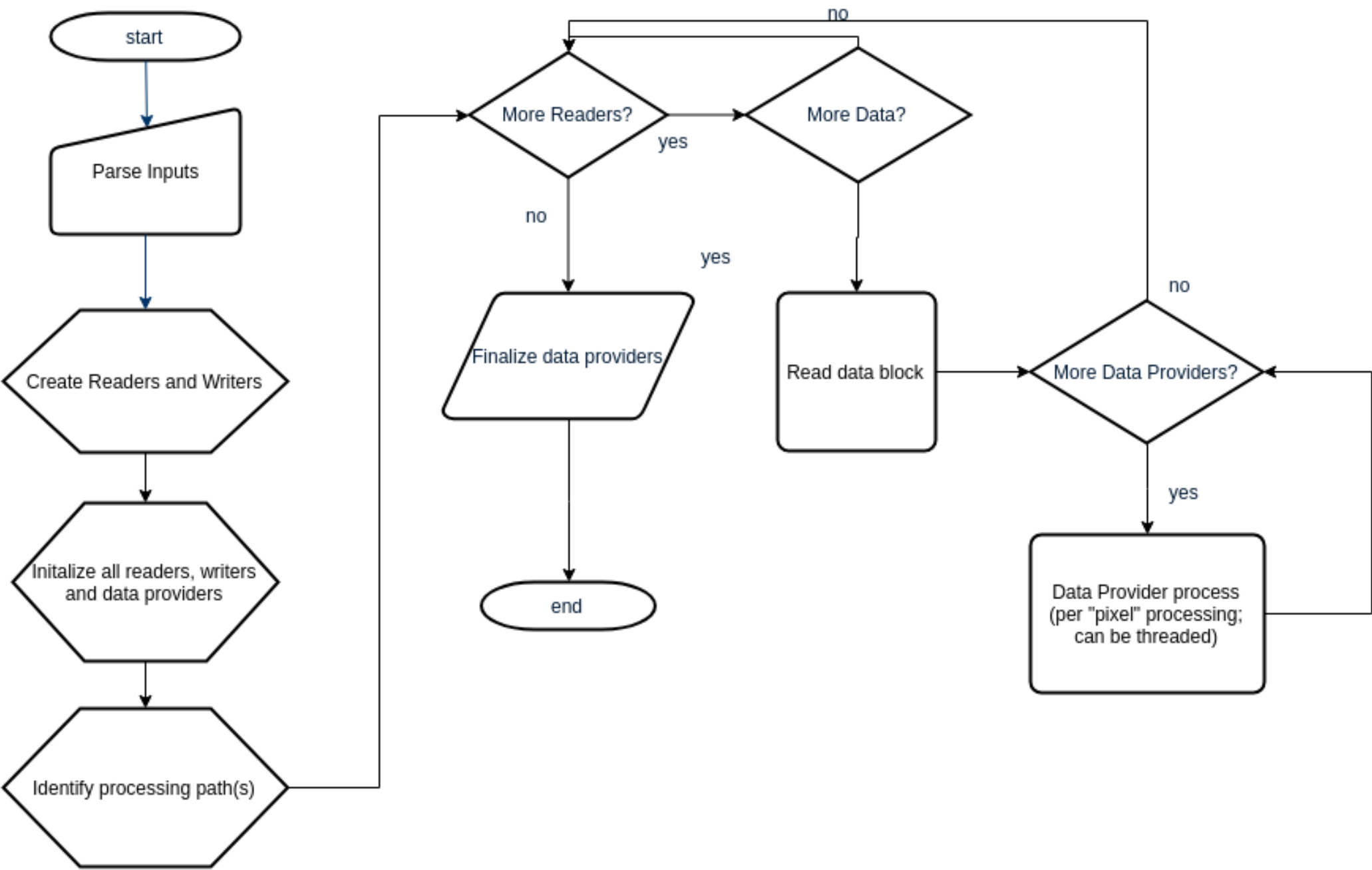
# Example Cloud Fraction Category Output (CF\_CATEGORY)

Source: A2004001023000.L1A\_LAC





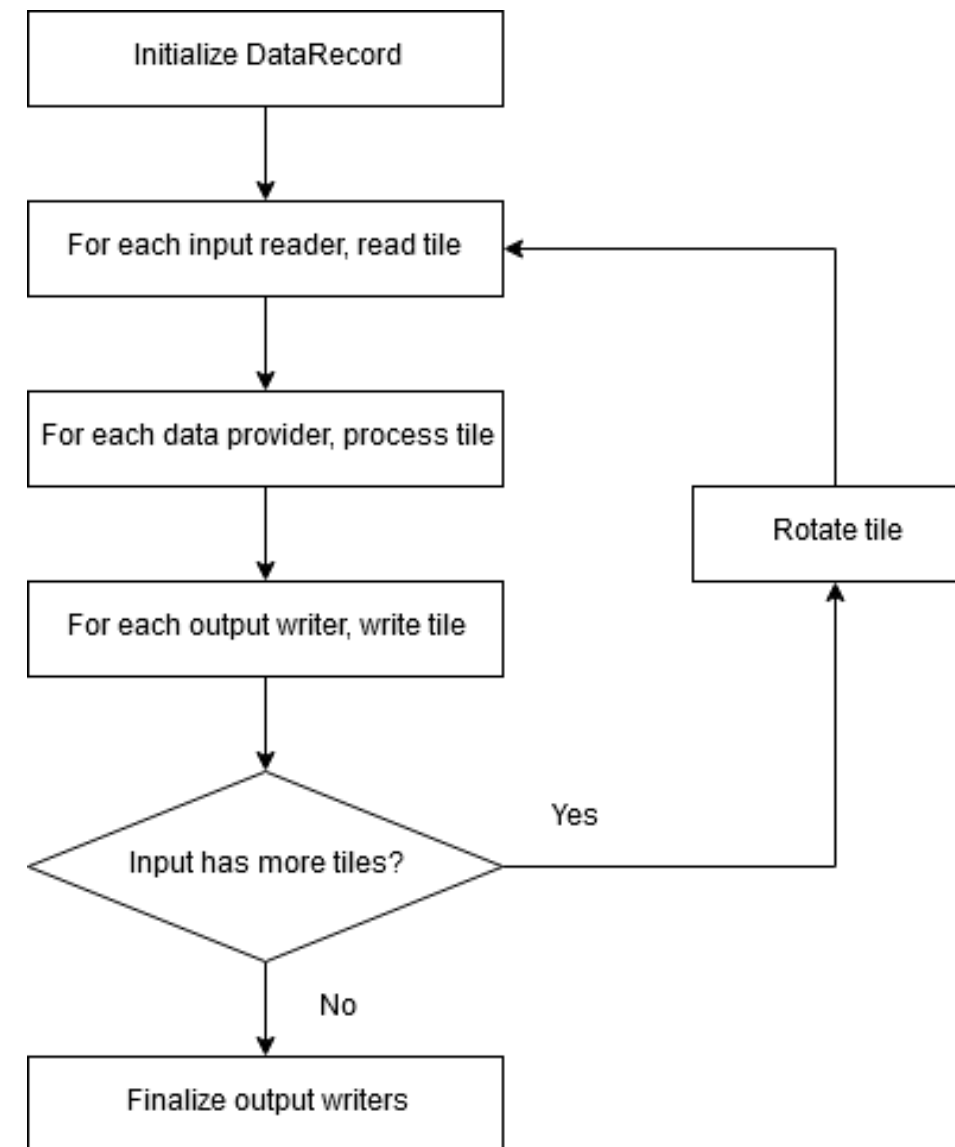
# GENERALIZED FOCS PROCESSING FLOW

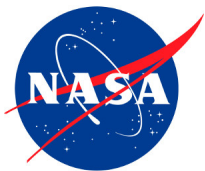


FOCS processing flow diagram

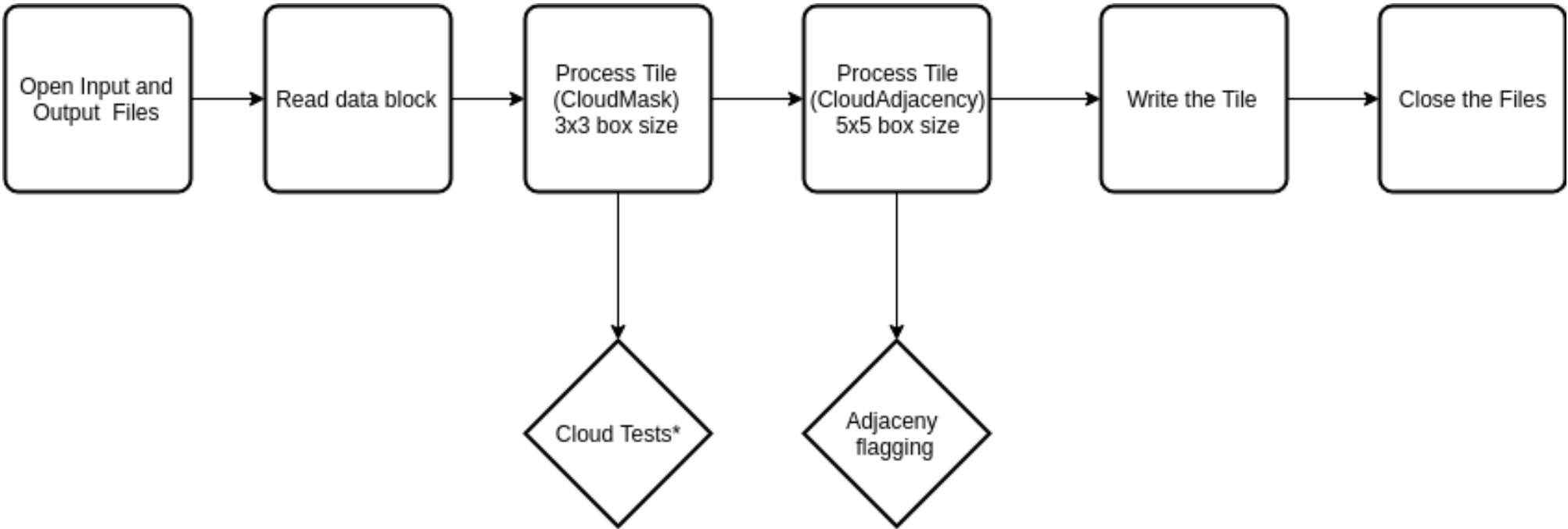
# FOCS - THE FRAMEWORK

- The Core
  - process
  - help
  - list-commands
  - list-modules
- The Master Command
  - loads any Module found in the modules directory (shared objects)
- Data Providers
  - any module that can provide data - including algorithms
- Data Records
  - a chunk of data, initially filled via FileReaders, updated via DataProviders, and written out via FileWriters. DataRecords are nothing more than a vector of Variables, which in turn are just vector-of-vectors-of-data.

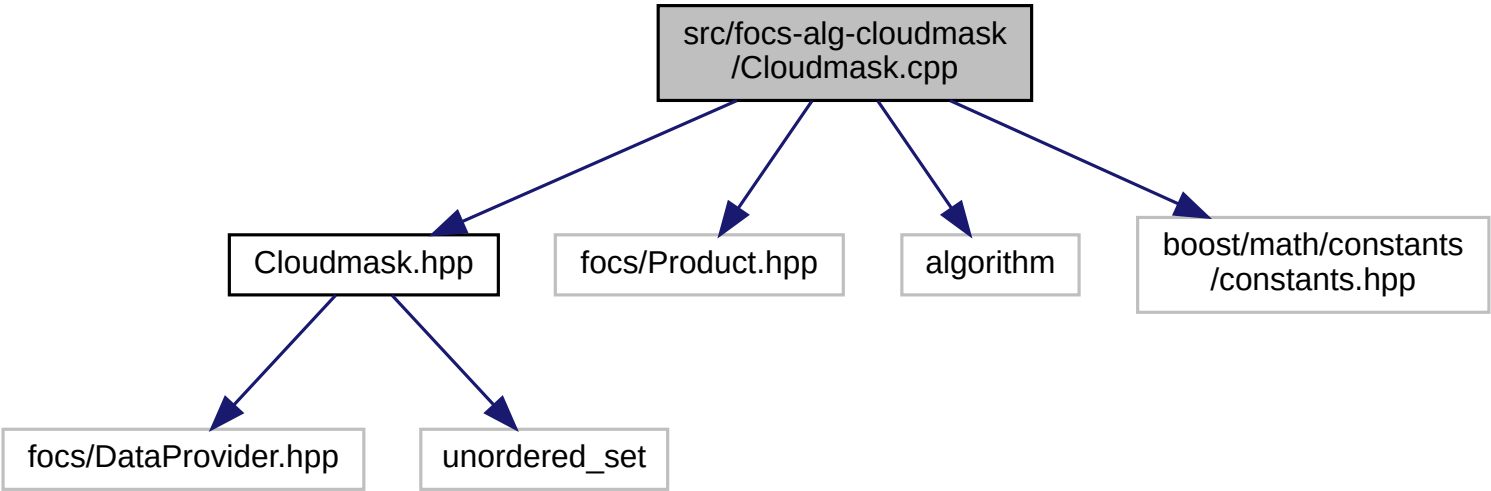


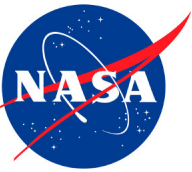


# CLOUD MASK PROCESSING FLOW



\* See MODIS MOD35 Users Guide





## LUTS

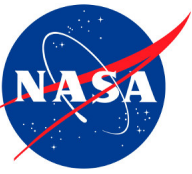
- NDVI Climatology
  - The current climatology is a “cloud cleared” 16-Day 1 arc-minute data set from MODIS Collection 4
  - Used for estimating surface reflectance in cloud tests
- IGBP Land Cover Type
  - A 1 arc-minute resolution land cover classification map generated from MODIS data following the classification scheme defined by the International Geosphere–Biosphere Programme
  - Currently using a fixed file
  - Used only as a binary flag to distinguish land as desert or not desert



## OUTPUT FILE FORMAT

```
$ ncdump -h A2004001023000.CldMsk.nc
netcdf A2004001023000.CldMsk {
dimensions:
    nscans\*10\:MODIS_Swath_Type_GEO = 2030 ;
    mframes\:MODIS_Swath_Type_GEO = 1354 ;
    \10\*nscans\:MODIS_SWATH_Type_L1B = 2030 ;
    Max_EV_frames\:MODIS_SWATH_Type_L1B = 1354 ;
variables:
    float Latitude(nscans\*10\:MODIS_Swath_Type_GEO, mframes\:MODIS_Swath_Type_GEO) ;
        Latitude:_FillValue = -999.f ;
        Latitude:resolution = "1km" ;
        Latitude:units = "degrees" ;
        Latitude:valid_range = "-90, 90" ;
    float Longitude(nscans\*10\:MODIS_Swath_Type_GEO, mframes\:MODIS_Swath_Type_GEO) ;
        Longitude:_FillValue = -999.f ;
        Longitude:resolution = "1km" ;
        Longitude:units = "degrees" ;
        Longitude:valid_range = "-180, 180" ;
    byte CF_CATEGORY(\10\*nscans\:MODIS_SWATH_Type_L1B, Max_EV_frames\:MODIS_SWATH_Type_L1B)
    byte ADJ_MASK(\10\*nscans\:MODIS_SWATH_Type_L1B, Max_EV_frames\:MODIS_SWATH_Type_L1B) ;
    byte LS_MASK(\10\*nscans\:MODIS_SWATH_Type_L1B, Max_EV_frames\:MODIS_SWATH_Type_L1B) ;
}
```

# Dependencies



## OCSSW LIBRARIES

- genutils

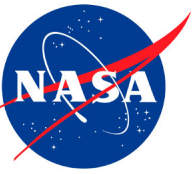
## THIRD PARTY LIBRARIES

- boost
- netcdf

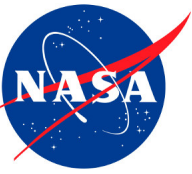
## ANCILLARY DATA REQUIREMENTS

- See input requirements...

# Efficiency



- Memory footprint is approximately 500MB for a full MODIS granule, 25MB if tile\_size=32 is used
- Processing time (wall clock) is approximate 35 seconds for a full MODIS granule (regardless of tile\_size)



## CLOUDMASK

- Add OCI instrument as input
- Generalize “needs” based on Lt in wavelength space (as opposed to the current band index space)
- Modify output to be in line with ODPS-standard Level-2 format

## FOCS

- Add readers for all missions
- Migrate useful functions from OCSSW (e.g. bits of libgenutils)
- Add writers for OBPG standard outputs (e.g. generalized L2 format)
- Modify command line argument processing to be more “typical”