NOAA-20 Green Vegetation Fraction (GVF) Product

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VIIRS GVF

- Green Vegetation fraction (GVF) is defined as the fraction of a pixel covered by green vegetation if it were viewed vertically.
- Real-time GVF is needed in the numeric weather, climate and hydrological models.
- The Suomi National Polar-orbiting Partnership (SNPP) Visible Infrared Imager Radiometer Suite (VIIRS) GVF has been operationally produced since Feb 2015 at NOAA.
- GVF are produced as a daily rolling weekly composite at 4-km resolution (global scale) and 1-km resolution (regional scale).
- As NOAA-20 (JPSS-1) data became available, the new NOAA-20 GVF product is developed and introduced in this poster

VIIRS GVF Algorithm

The GVF processing system generates daily rolling weekly GVF through the following steps:

Step 1: VIIRS swath surface reflectance data in bands I1 (red), I2 (NIR), and M3 (blue) during a calendar day (0000 – 2400 UTC) are mapped to the native GVF geographic grid (0.003 degree plate carree projection) to produce a gridded daily surface reflectance map.

Step 2: At the end of a 7-day period, the daily surface reflectance maps of the 7 days are composited to produce a weekly surface reflectance map using the MVA-SAVI compositing algorithm, which selects, at each GVF grid point (pixel), the observation with maximum view-angle adjusted SAVI (soil adjusted vegetation index) value in the 7-day period. The 7-day compositing is conducted daily using data in the previous 7 days as input data, which is called daily rolling weekly compositing.

Step 3: EVI is calculated from the daily rolling weekly composited VIIRS surface reflectance data in bands I1, I2 and M3.

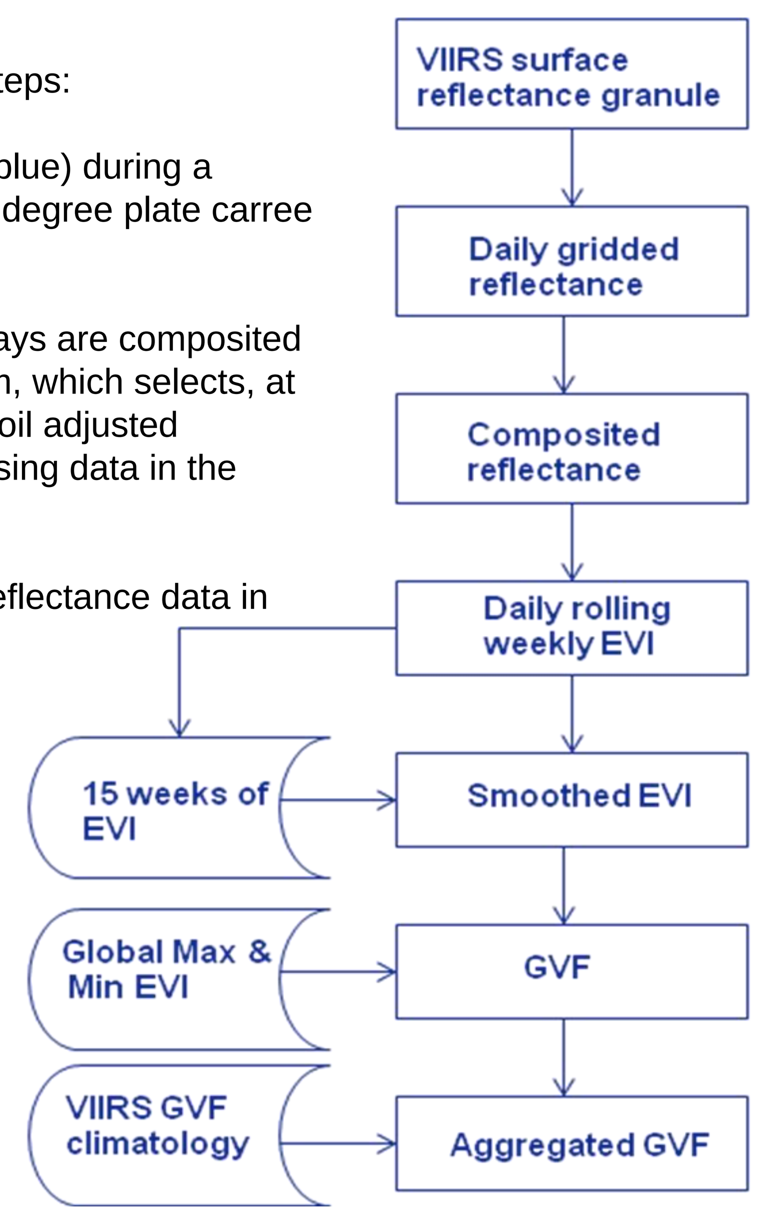
$$EVI = 2.5\frac{NIR - Red}{NIR + 6Red - 7.5Blue + 1}$$

Step 4: High frequency noise in EVI is reduced by applying a 15-week digital smoothing filter (Sullivan, 1993) on EVI.

Step 5: GVF is calculated by comparing the smoothed EVI against the global maximum (EVI_∞) and minimum EVI (EVI_0) values assuming a linear relationship between EVI and GVF.

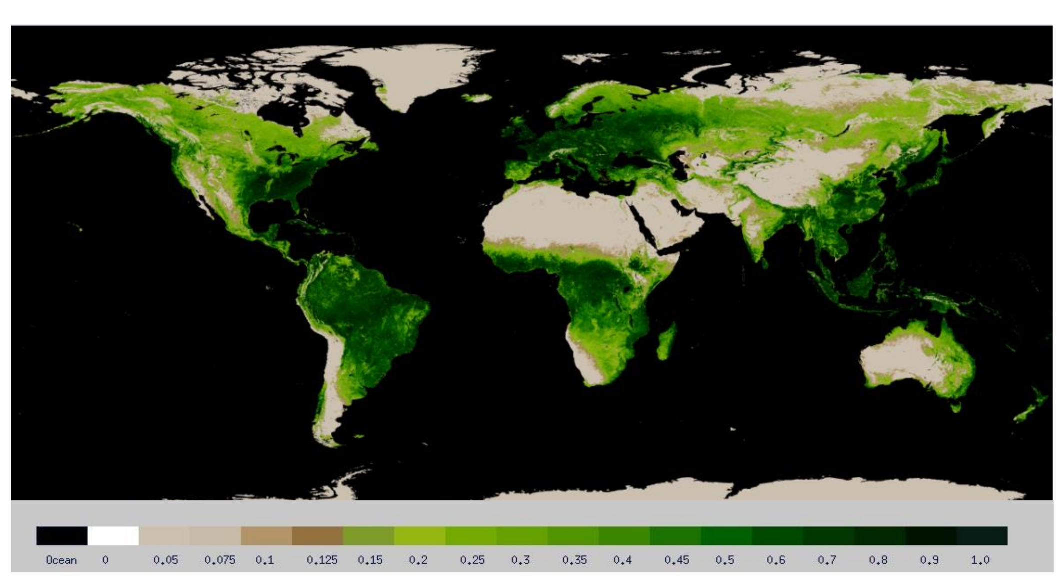
$$GVF = \frac{EVI - EVI_0}{EVI_\infty - EVI_0}$$

Step 6: GVF is aggregated to 0.009 degree (1-km) and 0.036 degree (4-km) resolution for output maps. Potential gaps on the output maps at high latitudes are filled using monthly VIIRS GVF climatology.



Flow chart of the GVF system

NOAA-20 Global 4-km GVF product



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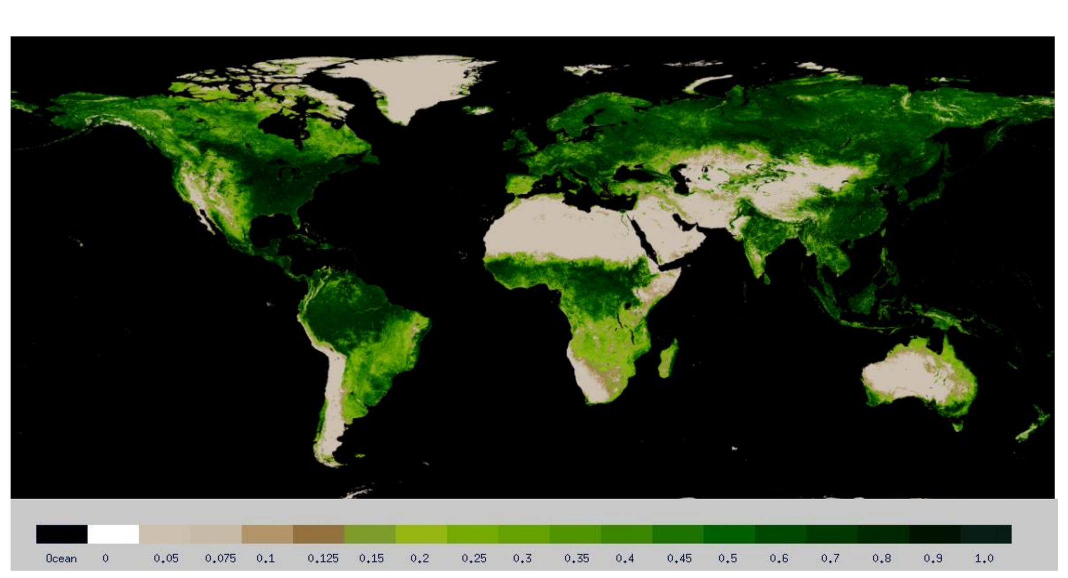

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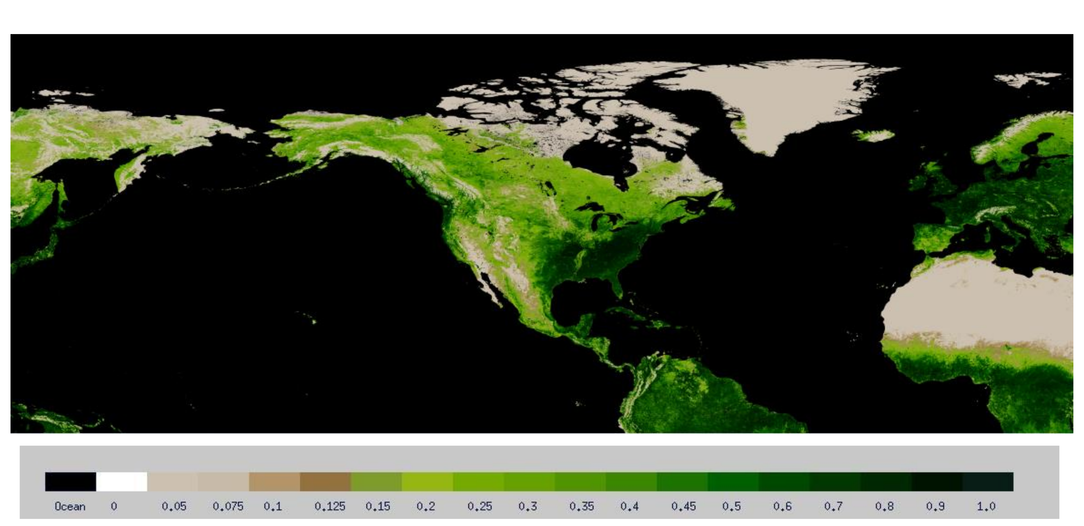
Regional 1-km GVF product



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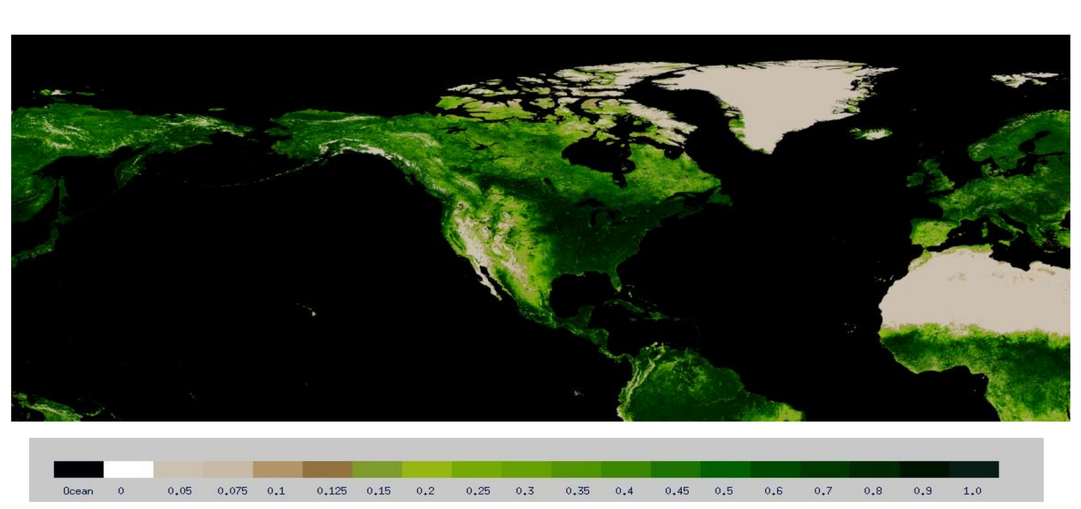

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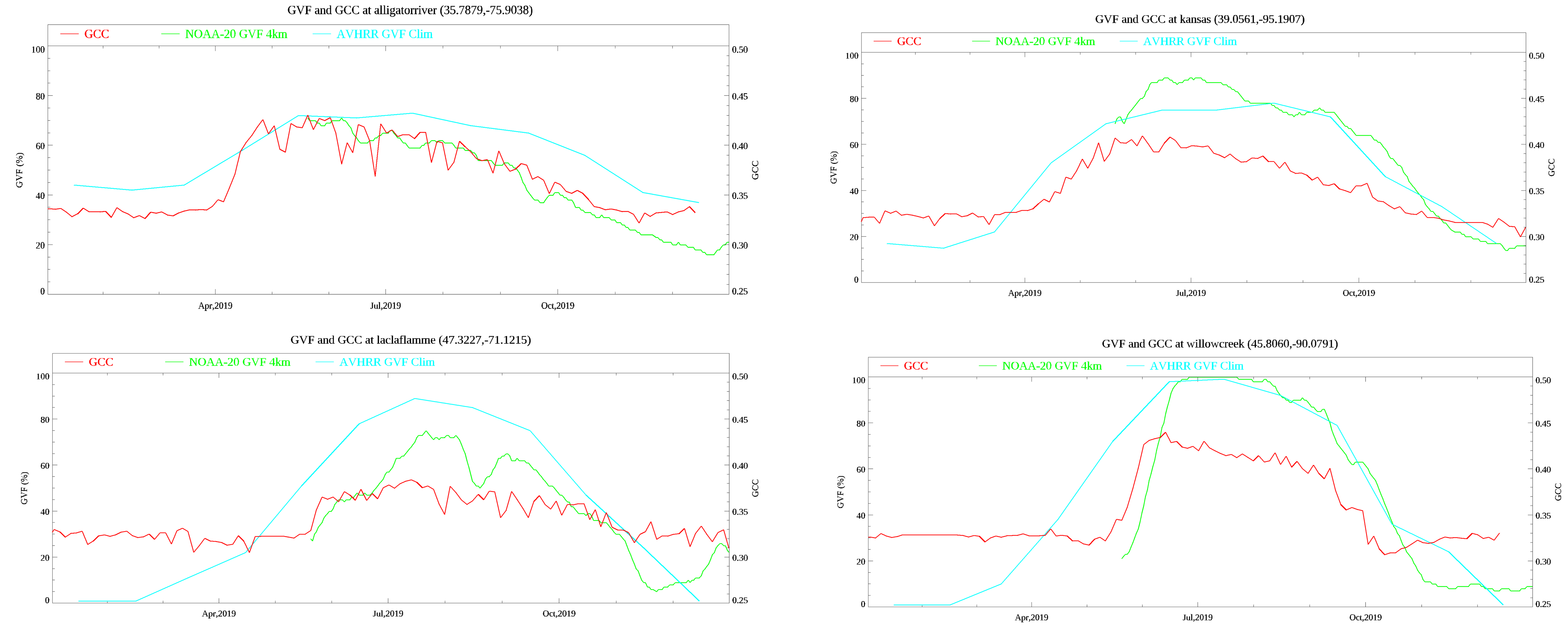
NOAA-20 GVF VS. PhenoCam GCC

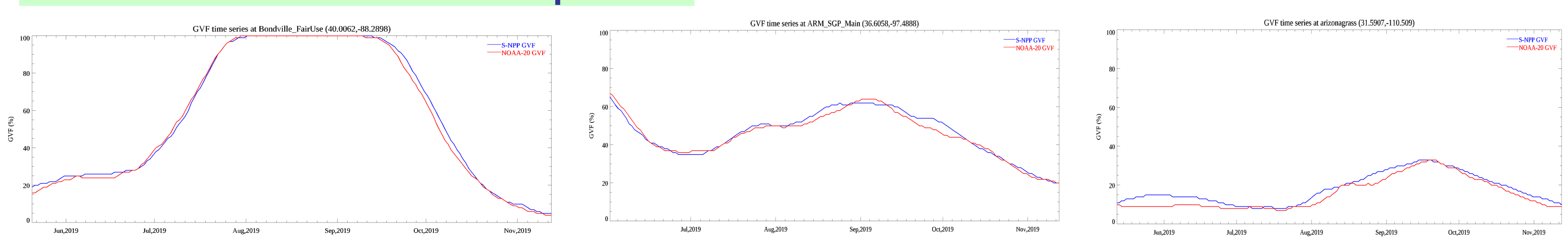


The PhenoCam Network provides automated, near-surface RGB images of canopy phenology across the North America.
(GCC) was calculated based on the daily mean R, G, B values for each site (Klosterman et al 2014; Richardson et al 2009).

GCC=G/(R+G+B)

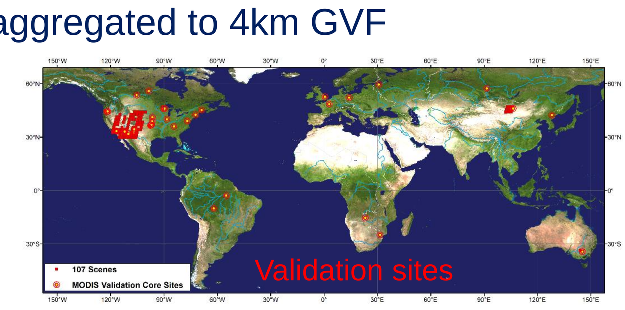
NOAA-20 GVF time series showed similar seasonal variation as the ground measured greenness index (GCC)

NOAA-20 and S-NPP GVF comparison

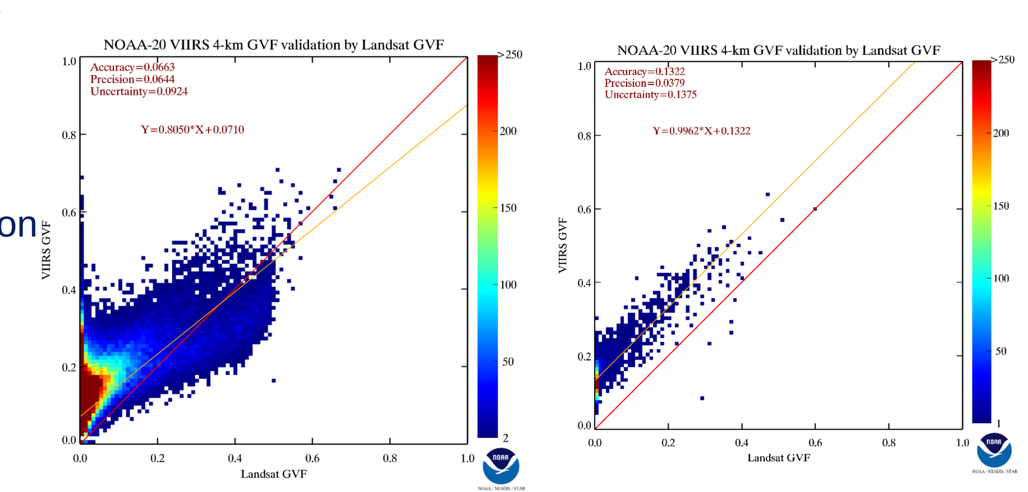


Validation

- Reference GVF data derived from 107 Landsat ETM+ images distributed globally
- Period: 1/3/2019 - 2/28/2019 (winter at north hemisphere)
- Decision-tree classification method used to classify the 30-m Landsat pixels into 3 vegetation levels (GVF=0, 0.5 or 1)
- Landsat classified images reprojected to the VIIRS GVF projection and 30-m GVF are aggregated to 4km GVF



North America Australia



Validation of the NOAA-20 4-km GVF

	Specifications	VIIRS GVF
Measurement accuracy		
Global	0.12	0.058
Regional	0.12	0.067
Measurement precision		
Global	0.15	0.063
Regional	0.15	0.076
Measurement uncertainty		
Global	0.17	0.086
Regional	0.17	0.101

Summary:

1) **The NOAA-20 VIIRS GVF system produces a global 4-km resolution GVF map and a regional 1-km GVF map once a day**
2) **NOAA-20 GVF time series showed similar seasonal variation as the ground measured greenness index (GCC)**
3) **VIIRS GVF accuracy, precision and uncertainty were lower than the specifications, indicating that the global and regional VIIRS GVF products meet the design requirements**
4) **Operational NOAA-20 VIIRS GVF product has been available for the public at NOAA comprehensive large array-data stewardship system (CLASS) since 6/4/2019 (https://www.bou.class.noaa.gov/saa/products/welcome)**