JCSDA Annual Workshop, University of Maryland at Baltimore County, Maryland, May 12 – 13, 2009

Update on AVHRR-based Green Vegetation Fraction Product: Continuity and Preliminary Results from NOAA-19

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Purpose – To provide Green Vegetation Fraction (GVF) operational data product continuity by using the newly launched polar-orbiting satellite observations from NOAA-19

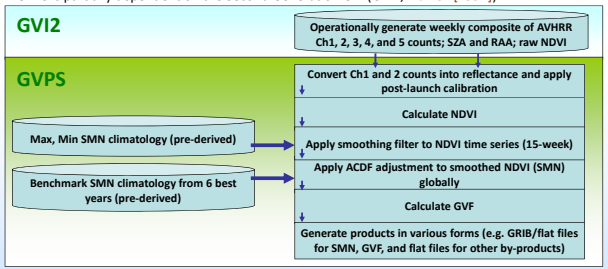
1. Background

- GVF represents the fraction of a model grid covered by full green vegetation, while the "green" portion is assumed transpiring, versus the non-green portion which does not transpire .
- GVF is required by NCEP/EMC weather and climate models.
- Noah Land Surface Model (LSM) uses GVF to determine the fraction of the model over which vegetation is transpiring and the fraction of soil surface exposed for direct evaporation.
- GVF is produced by the Global Vegetation Processing System (GVPS) maintained by NESDIS/OSDPD/SSD, depending **partially** on outputs from the NOAA Global Vegetation Index (GVI) system, using NOAA polar-orbiting satellite GAC inputs from NOAA-7, -9, -11, -14, -16, -17, and -18.
- With the launch of NOAA-19 (in February 2009), it is required to continue the GVF operational data product using this new satellite observations.

2. Processing Framework

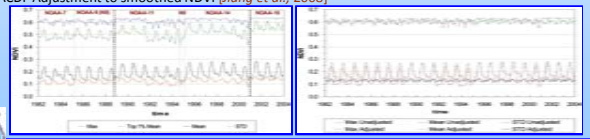
a. System Legacy and Processing Data Flow

- GVPS is partially dependent on the Second Generation GVI (GVI2, *Kidwell* [1997])



b. Key GVPS Algorithm Elements

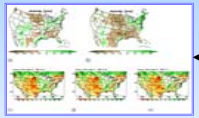
- Post-launch calibration to VIS (Ch1) and NIR (Ch2) reflectance [*Rao and Chen*, 1995]
- NDVI = (Ch2 – Ch1) / (Ch2 + Ch2)
- Smoothing and filtering to NDVI time series [*Kogan et al.*, 1990]
- ACDF Adjustment to smoothed NDVI [*Jiang et al.*, 2008]



- Deriving GVF from NDVI [*Gutman and Ignatov*, 1998; *Jiang et al.*, 2009]

$$GVF = \frac{NDVI - NDVI_0}{NDVI_\infty - NDVI_0} \quad \text{or} \quad GVF = \frac{NDVI - C_0}{C_1}$$

Where C_0 =0.05 and C_1=0.44



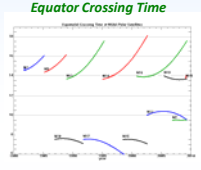
Accumulated precip. anomaly (mm) and weekly GVF anomaly at CONUS. (a) 30-day accumulated precip. anomaly ending 07/31/2006; (b) 90-day accumulated precipi. anomaly ending 07/31/2006; (c) GVF anomaly for week 26 (starting 06/27/2006); (d) GVF anomaly for week 27 (starting 07/04/2006); (e). GVF anomaly for week 28 (starting 07/11/2006)

- Consistent & quality controlled processing made GVPS product quality better than GVI2

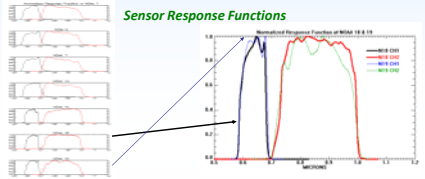
3. Preliminary Results from NOAA-19

a. General Differences between NOAA-19 and Earlier NOAA Satellites

Equator Crossing Time

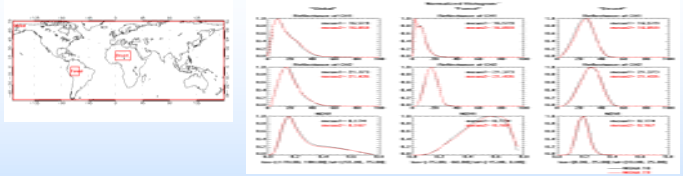


Sensor Response Functions



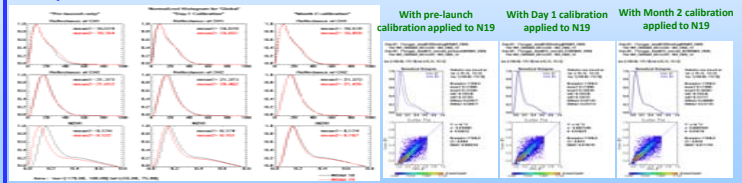
b. Comparison of Channel Counts, Reflectances, and NDVIs from NOAA-19 and NOAA-18

Global Field | Tropical Forest | Desert



c. Impact of Post-Launch Calibration on NDVIs from NOAA-19 and NOAA-18

With pre-launch calibration applied to N19 | With Day 1 calibration applied to N19 | With Month 2 calibration applied to N19

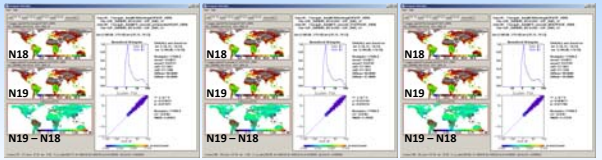


With pre-launch calibration applied to N19 | With Day 1 (02/07/2009) calibration applied to N19 | With Month 2 (04/30/2009) calibration applied to N19

$NDVI_{N19}$ vs. $NDVI_{N18}$

d. Comparison of GVF from NOAA-19 and NOAA-18

With pre-launch calibration applied to N19 | With Day 1 calibration applied to N19 | With Month 2 calibration applied to N19



GVF_{N19} vs. GVF_{N18}

4. Summary

- Differences in sensor and observation characteristics lead to moderate to significant differences in channel reflectances and NDVIs from NOAA-18 and -19
- Post-Launch calibration to NOAA-19 based on longer period helps to reduce VIS and NIR channel reflectances and NDVI differences from those of NOAA-18
- Differences in GVFs are much less given they are calculated from the ACDF adjusted SMN.

5. Future Work

- Comprehensively investigate the causes of differences between NOAA-19 and -18
- Refine approaches to minimize systematic differences from NOAA-19 and -18, aiming at a seamless end products (NDVI and GVF) generation operationally
- Upgrade the GVPS operational system

6. Key References

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Acknowledgement

The results were achieved under IMSG Contract task orders supporting NOAA/NESDIS/STAR. Funding from STAR, and JCSDA are gratefully acknowledged.

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