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Application of SNPP VIIRS Green Vegetation Fraction in the NCEP Global Forecast System

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1. Abstract

The weekly real-time global green vegetation fraction (GVF) derived from the Visible Infrared Imager Radiometer Suite (VIIRS) sensor onboard the Suomi National Polar-orbiting Partnership (SNPP) satellite has been developed at NOAA-NESDIS. This new product uses VIIRS red (I1), near-infrared (I2) and blue (M3) bands centered at 0.640 µm, 0.865 µm and 0.490 µm, respectively, to calculate the Enhanced Vegetation Index (EVI) and derive GVF from EVI. Compared to the multi-year GVF monthly climatology currently used in the operational National Centers for Environmental Prediction (NCEP) Global Forecast System (GFS), the new product provides quality-improved and real-time surface vegetation information. To examine its impact on numerical weather prediction, the full cycle runs of the NCEP GFS and Gridpoint Statistical Interpolation (GSI) analysis system were performed. The results indicate that the new data sets reduce errors of temperature, humidity and wind speed forecasts, and improve precipitation scores.

2. Comparison of GVF between VIIRS and Climatology

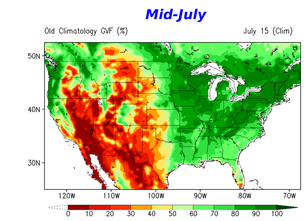
Climatology data: (Gutman & Ignatov, 1998)

- 5 year mean monthly climatology from AVHRR;
- Resolution: 0.144 degrees (~16km);
- Period: April 1985 – March 1991 (1988 excluded)

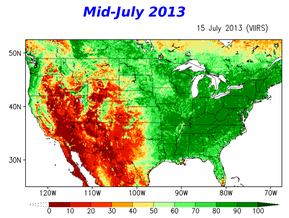
VIIRS weekly real-time data:

By Marco Vargas et al. (see Zhangyan Jiang's poster)

- Weekly real-time;
- Resolution: 0.036 degrees (~4km, global) & 0.009 degrees (~1km, regional)
- Algorithm: Uses VIIRS red (I1), near-infrared (I2) and blue (M3) bands centered at 0.640 µm, 0.865 µm and 0.490 µm, respectively, to calculate the Enhanced Vegetation Index (EVI) and derive GVF from EVI.

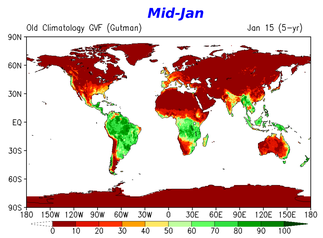


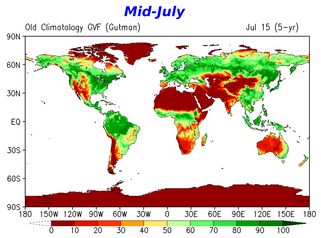
Climatology Green Vegetation Fraction
(Multi-year, NESDIS/AVHRR)



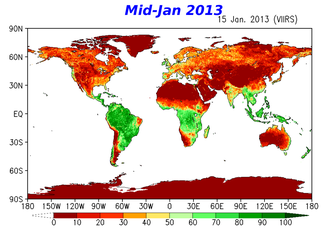
VIIRS Green Vegetation Fraction
(Weekly real-time, NESDIS/VIIRS)

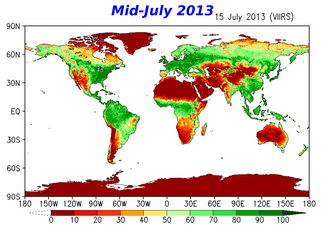
3. Comparison of GVF between VIIRS and Climatology (cont.)





Climatology Green Vegetation Fraction
(Multi-year, NESDIS/AVHRR)

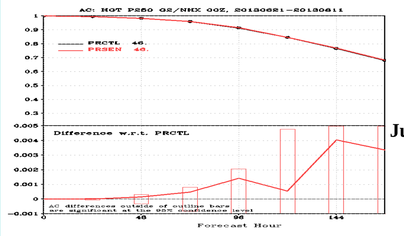




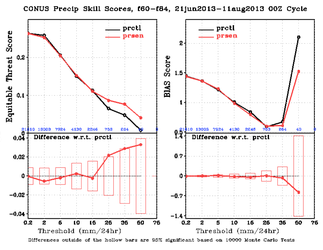
VIIRS Green Vegetation Fraction
(Weekly real-time, NESDIS/VIIRS)

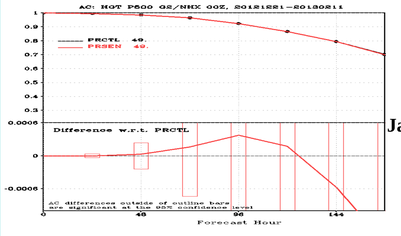
4. Impact of Weekly Real-Time VIIRS GVF in NCEP GFS

- **Cases: (1) Dec 20, 2012 – Feb 11, 2013**
  (2) Jun 20, 2013 – Aug 11, 2013
- **Experiments: (GFS/GSI full cycle runs)**
  CTL: Use Climatology GVF data
  SEN: Use Weekly real-time VIIRS GVF

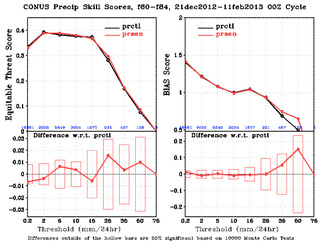


July 2013





Jan. 2013

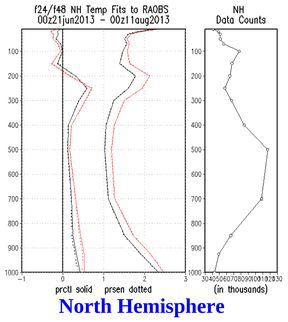


Analysis on anomaly correlation at 500 hPa (Day 5)

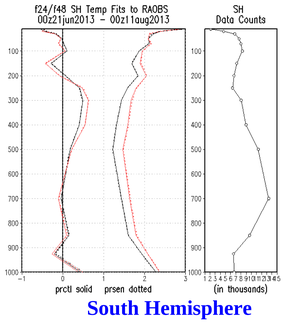
Precipitation skill scores over CONUS (f60-f84)

5. Impact of weekly real-time VIIRS GVF in NCEP GFS (Cont.)

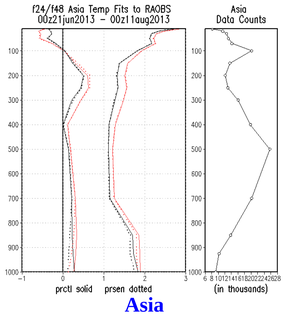
- ***Temperature fits to RAOBS (f24 and f48): July 2013***
  Reduced bias and root-mean-square errors in the lower atmosphere for summer 2013.



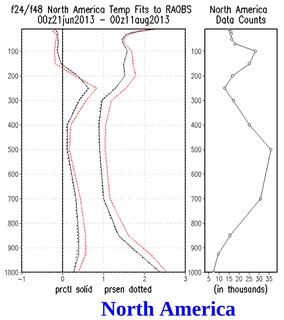
North Hemisphere



South Hemisphere



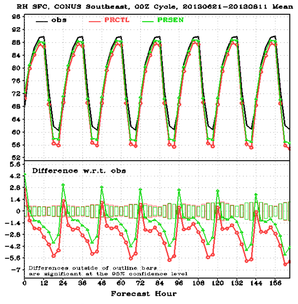
Asia



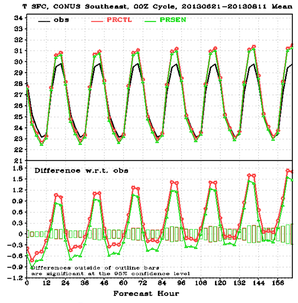
North America

6. Impact of weekly real-time VIIRS GVF in NCEP GFS (Cont.)

- ***Surface humidity and temperature over Southeast CONUS: July 2013***
  Reduced errors of surface relative humidity daytime and nighttime, and slightly reduced daytime warm bias of surface temperature.



Surface relative humidity



Surface 2 m temperature

7. Summery and discussion

- **Several satellite data sets developed recently have been tested in the NCEP models and the results show good improvements, compared with the current data sets;**
- **In this presentation, the weekly real-time VIRRS GVF data shows reduction of errors of temperature, humidity and wind speed forecasts, and improvement of precipitation scores, especially for the summer case.**
- **We have been continuing our efforts and working with many research teams to improve satellite data utilization over land in NCEP data assimilation system and then improve the GFS numerical weather prediction (NWP).**