2023-10-17

DSCOVR EPIC vegetation earth system data record: product status and science

DSCOVR EPIC L2 VEGETATION EARTH SYSTEM DATA RECORD: PRODUCT STATUS AND SCIENCE

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VEGETATION EARTH SYSTEM DATA RECORD (VESDR): VERSION 2

- Version 2 (08_LUT02) VESDR product for the period from June-2015 to December -2021
- There was a small bug causing ambiguity in the QA information about the reason for the algorithm failure. A new cod version (08ALUT02) was delivered to NCCS. Since January 2022, the VESDR product has been generated using the new version of the code
- Data for the period from January 2015 to July-2023 is publicly available from the NASA ASDC.
- The VESDR parameters follows regularities expected from physics
- Our focus on Science with the DSCOVR EPIC observations

VERSION 2 VESDR: PRODUCT DESCRIPTION

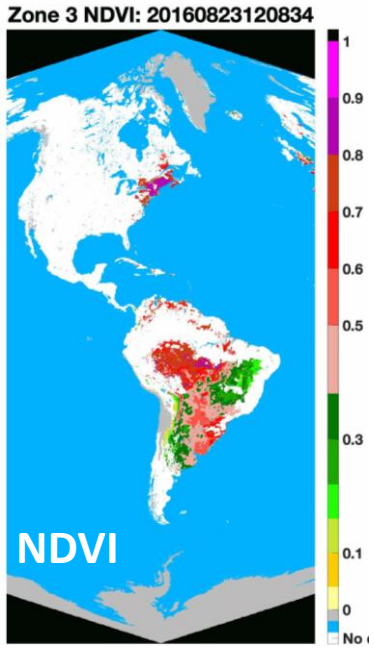
Vegetation Parameter Suite in the Level 2 VESDR Product (derived from the upstream EPIC L2 MAIAC Product)

Parameter name	Units	Resolution		Definition
		Temporal	*Spatial*	
Normalized Difference Vegetation Index (NDVI)	none	65 - 110 min	10018.7542 m	difference between Bidirectional Reflectance Factor at 779.5 nm and 680 nm normalized by their sum
Fraction vegetation absorbed Photosynthetically Active Radiation (FPAR)	fraction	65 - 110 min	10018.7542 m	fraction of photosynthetically active radiation (400 – 700nm) absorbed by vegetation
Leaf Area Index (LAI)	$\frac{m^2_{plant}}{m^2_{ground}}$	65 - 110 min	10018.7542 m	total hemi-surface leaf area per unit ground area
Sunlit Leaf Area Index(SLAI)	$\frac{m^2_{plant}}{m^2_{ground}}$	65 - 110 min	10018.7542 m	sunlit green leaf area per unit ground area
Precision of Leaf Area Index (Dlai)	$\frac{m^2_{plant}}{m^2_{ground}}$	65 - 110 min	10018.7542 m	retrieval dispersion of LAI
Directional Area Scattering Factor (DASF)	none	65 - 110 min	10018.7542 m	estimate of Canopy Bidirectional Reflectance Factor as if the foliage does not absorb radiation
Quality Assessment variable (QA_VESDR)	none	65 - 110 min	10018.7542 m	Overall quality of the VESDR parameters and upstream MAIAC BRF data
Earth Reflector Type Index (ERTI)	none	65 to 110 min	10018.7542 m	Estimates of the recollision probability p transformed to the interval [0°,180°] as $\mathrm{atan}(p)$ if $\mathrm{atan}\,p \geq 0$ and $\mathrm{atan}(p) + 180°$ otherwise.
Scattering coefficient at 443 nm	none	65 to 110 min	10018.7542 m	EPIC BRF normalized by DASF, i.e., $W_{443} = BRF_{443}/DASF$
Scattering coefficient at 551 nm	none	65 to 110 min	10018.7542 m	EPIC BRF normalized by DASF, i.e., $W_{551} = BRF_{551}/DASF$
Scattering coefficient at 680 nm	none	65 to 110 min	10018.7542 m	EPIC BRF normalized by DASF, i.e., $W_{680} = BRF_{680}/DASF$
Scattering coefficient at 779 nm	none	65 to 110 min	10018.7542 m	EPIC BRF normalized by DASF, i.e., $W_{779} = BRF_{779}/DASF$
Aerosol Optical Depth at 443 nm	none	65 to 110 min	10018.7542 m	copied from the upstream DSCOVR EPIC L2 MAIAC product
Aerosol Optical Depth at 551 nm	none	65 to 110 min	10018.7542 m	copied from the upstream DSCOVR EPIC L2 MAIAC product
Cloud Mask and Land- Water Mask	none	65 to 110 min	10018.7542 m	copied from the upstream DSCOVR EPIC L2 MAIAC product

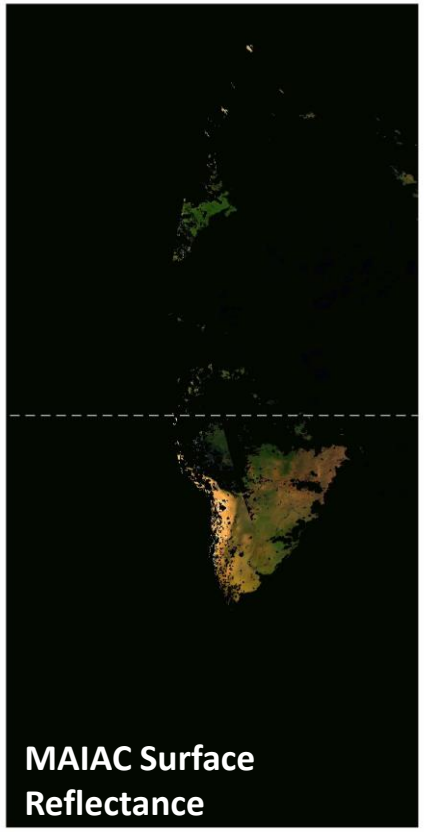
Added in version 2

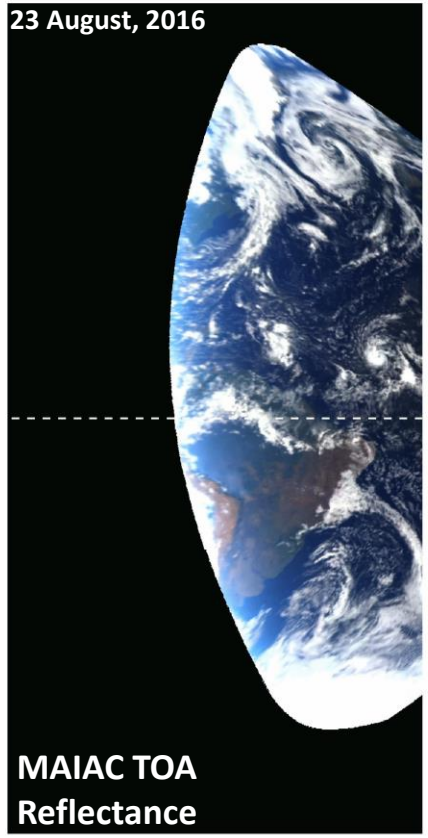
The VESDR h5 file also includes Solar Zenith Angle (SZA), Solar Azimuthal Angle (SAA), View Zenith (VZA) and Azimuthal (VAA) angles at the same temporal and spatial resolutions. Granule size is below 37MB.

VERSION 2 VESDR: 10 KM NDVI, FPAR, SLAI, DASF

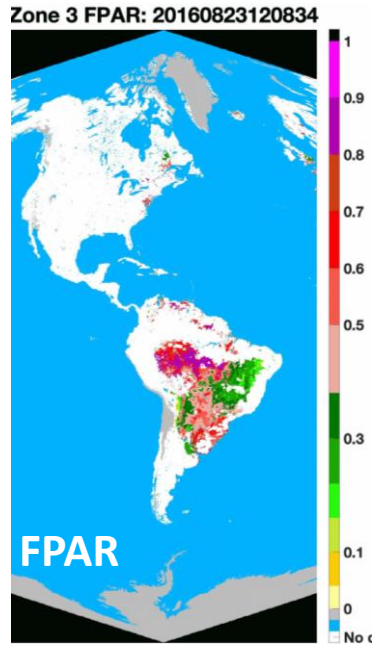


Normalized Difference Vegetation Index (NDVI): difference bet-ween Bidirectional Re-flectance Factor (BRF) at 779.5 nm and 680 nm normalized by their sum

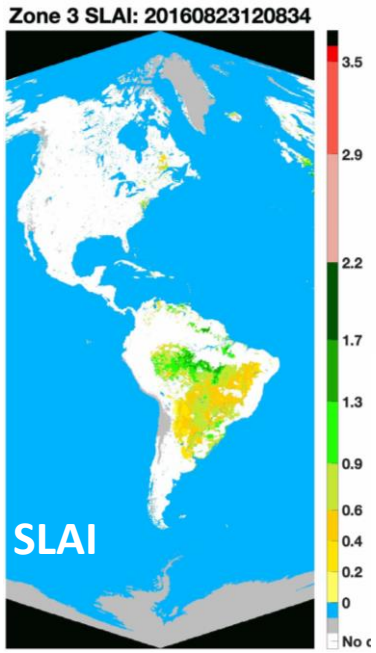




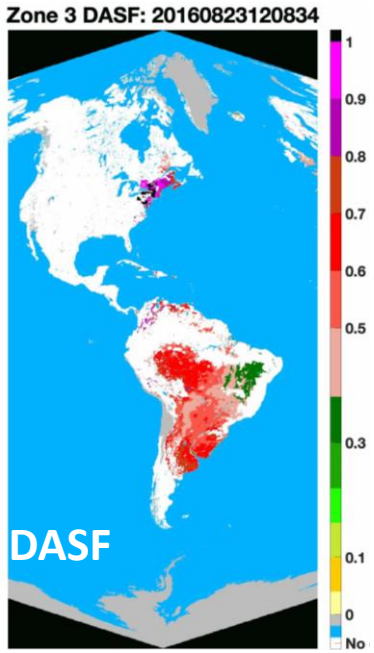
Fraction of Photosy-nthetically Active Ra-diation (400 – 700nm, FPAR) absorbed by vegetation



Sunlit Leaf Area Index (SLAI): leaf area illuminated by the direct solar beam per unit ground area



LAI, SLAI and FPAR are key state parameters in most ecosystem productivity models and carbon/nitrogen cycle. DASF provides information critical to accounting for structural contributions to measurements of leaf biochemistry from remote sensing.

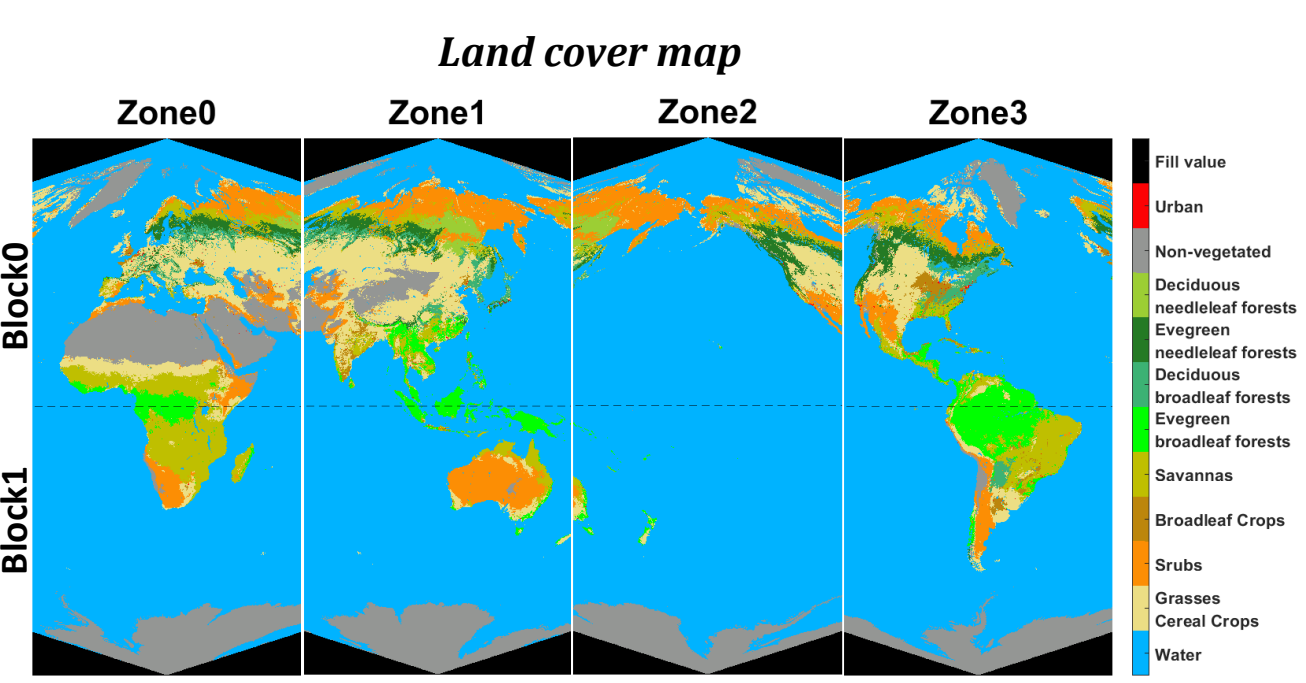


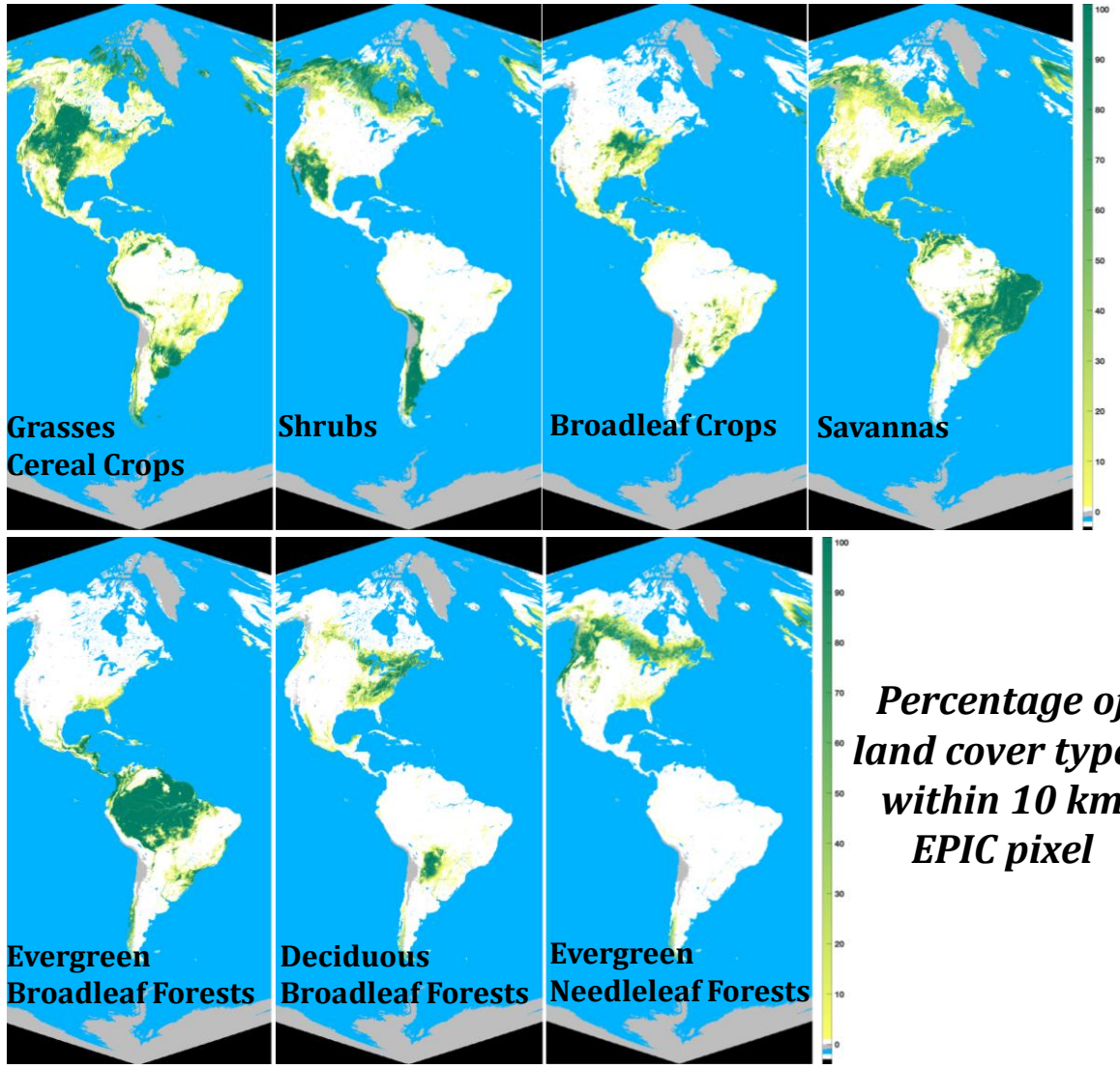
Directional Area Scattering Factor (DASF): canopy BRF if the foliage does not absorb radiation

VERSION 2 ANCILLARY SCIENCE DATA PRODUCTS: 10 KM LAND COVER MAP

We also provide ancillary science data products (derived from 500 m MODIS land cover product)

Parameter name	Units	Resolution		Comments
		Temporal	*Spatial*	
Land Cover Type	none	static	10 km	10 km SIN Land Cover type
Land Cover Type Distribution	none	static	10 km	Distribution of land cover types within 10 km EPIC pixel





Percentage of land cover types within 10 km EPIC pixel

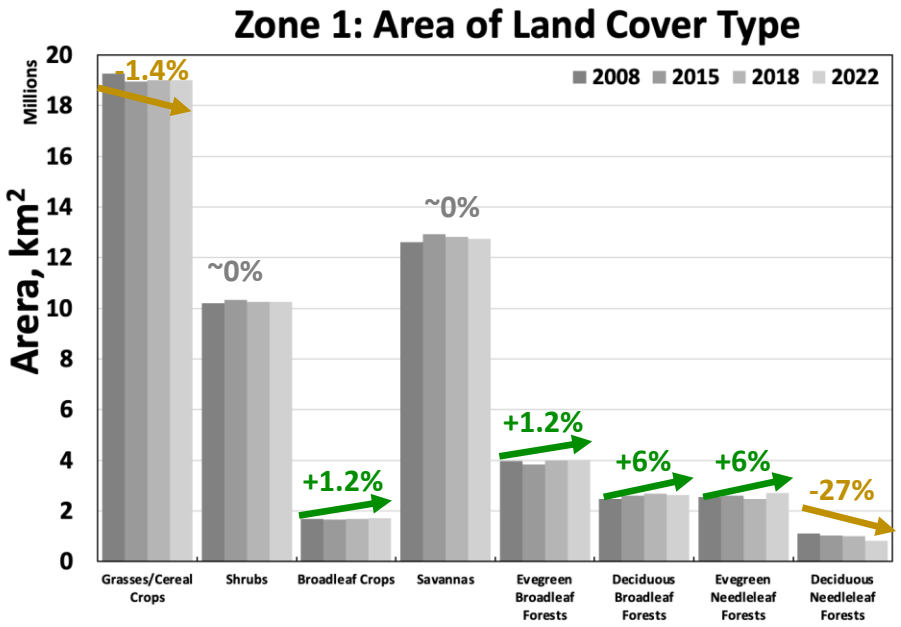
Available from the NASA Langley Atmospheric Science Data Center (https://asdc.larc.nasa.gov/project/DSCOVR/DSCOVR_EPIC_L2_VESDR_02)

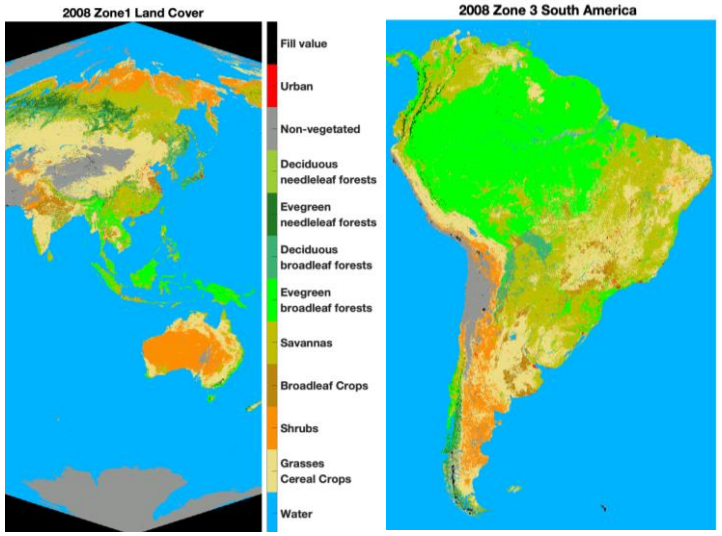
VERSION 2 ANCILLARY SCIENCE DATA PRODUCTS: 10 KM LAND COVER MAP

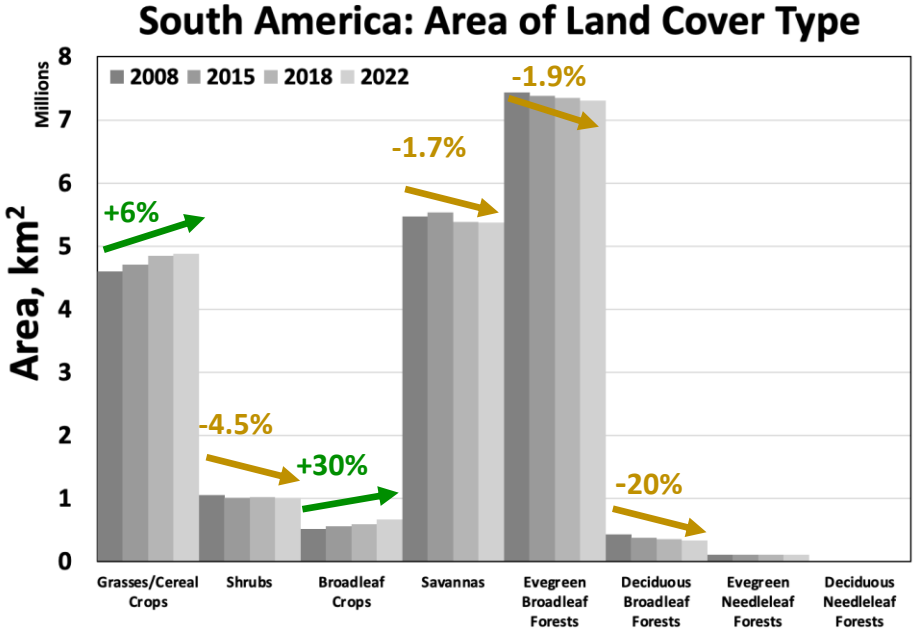
Parameter name	Units	Resolution		Comments
		Temporal	*Spatial*	
Land Cover Type	none	static	10 km	10 km SIN Land Cover type
Land Cover Type Distribution	none	static	10 km	Distribution of land cover types within 10 km EPIC pixel

Senior Review: "*Figure 3.2.9b shows various land types observed by EPIC. What is the time period of this figure? Are there any plans to examine trends in land cover type using EPIC data? If so, over what time periods and time intervals*"

- **Version 2 Ancillary Science Data Products were derived from 500m MODIS land cover type 3 product (MCDLCHKM), which was generated from 2008, 2009, and 2010 land cover products (MCD12Q1, v051)**
- **This is a static land cover map**
- **The map is important input used by the VESDR retrieval algorithm**

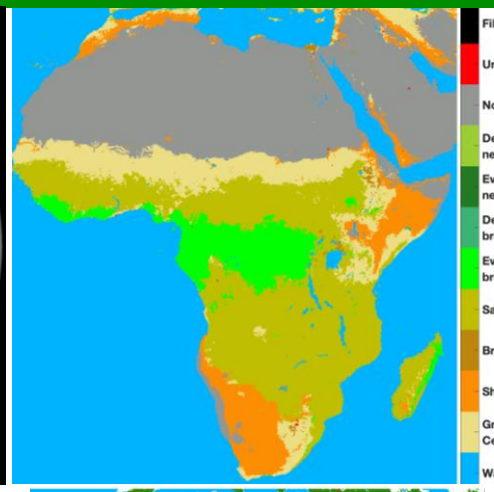


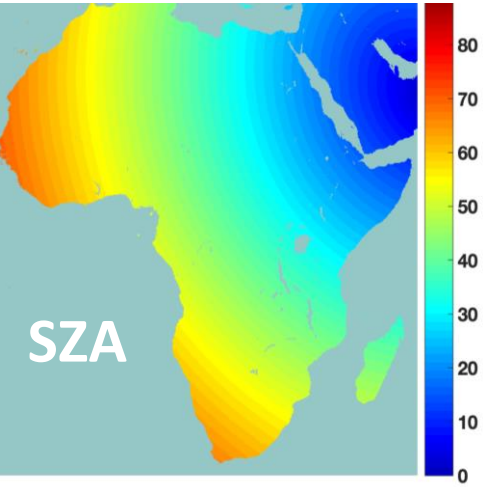


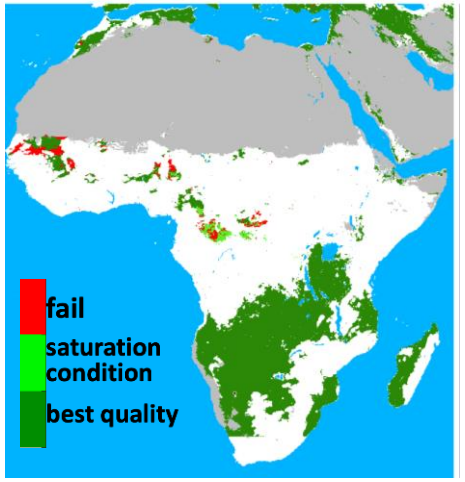


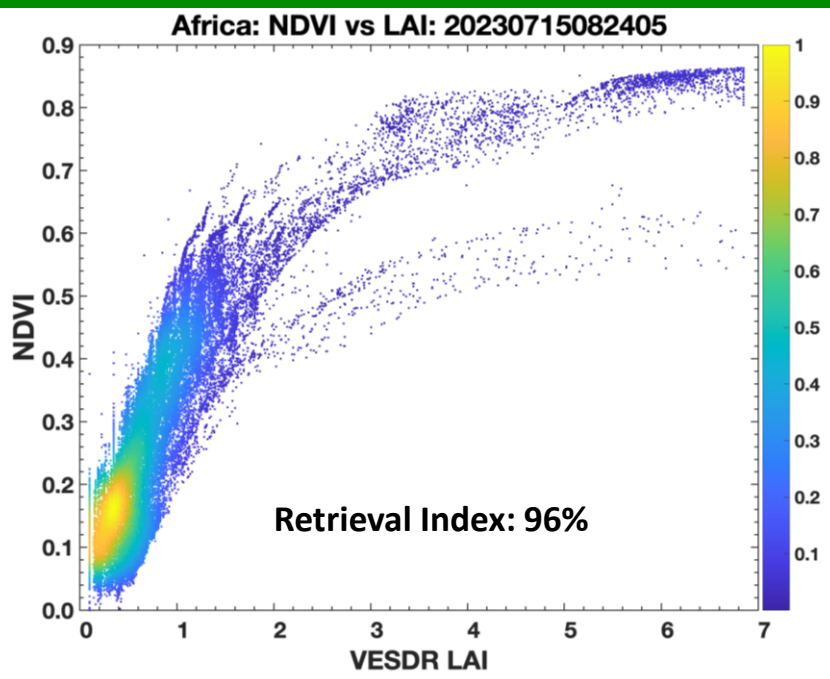
We plan to replace this static land cover map with a dynamic 1-year temporal resolution map starting in 2015

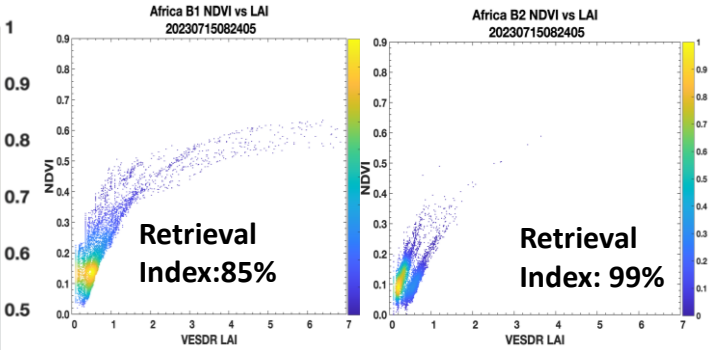
TEST OF PHYSICS: DSCOVR_EPIC_L2_VESDR_02_20230715082405_03.H5

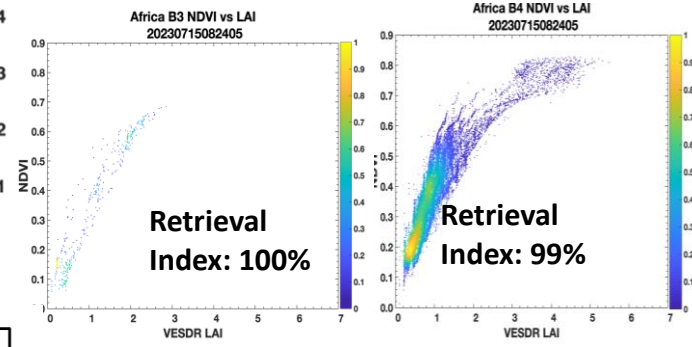


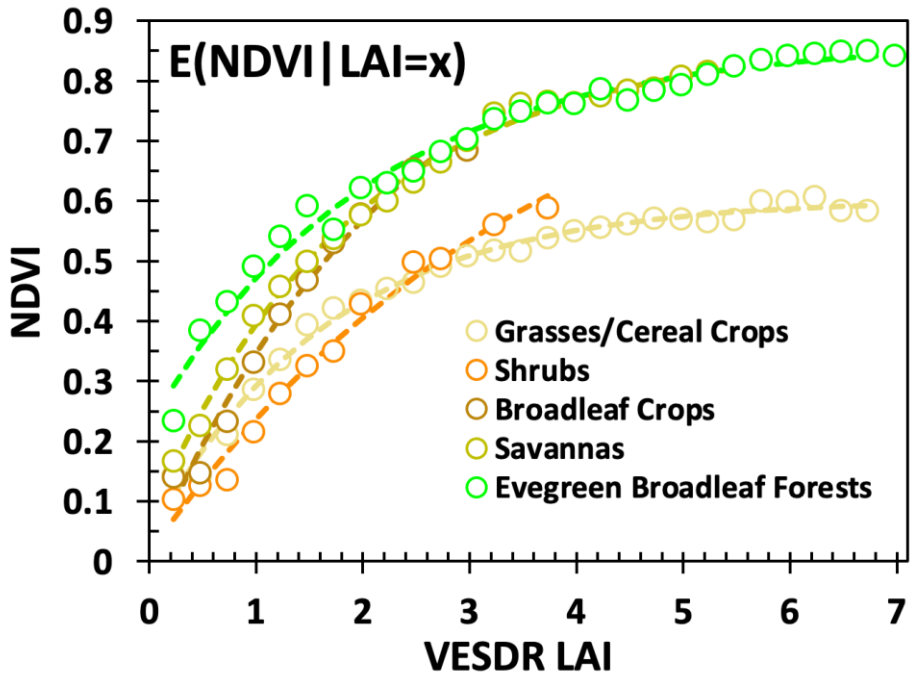


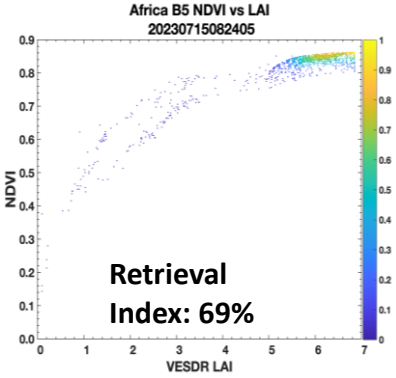






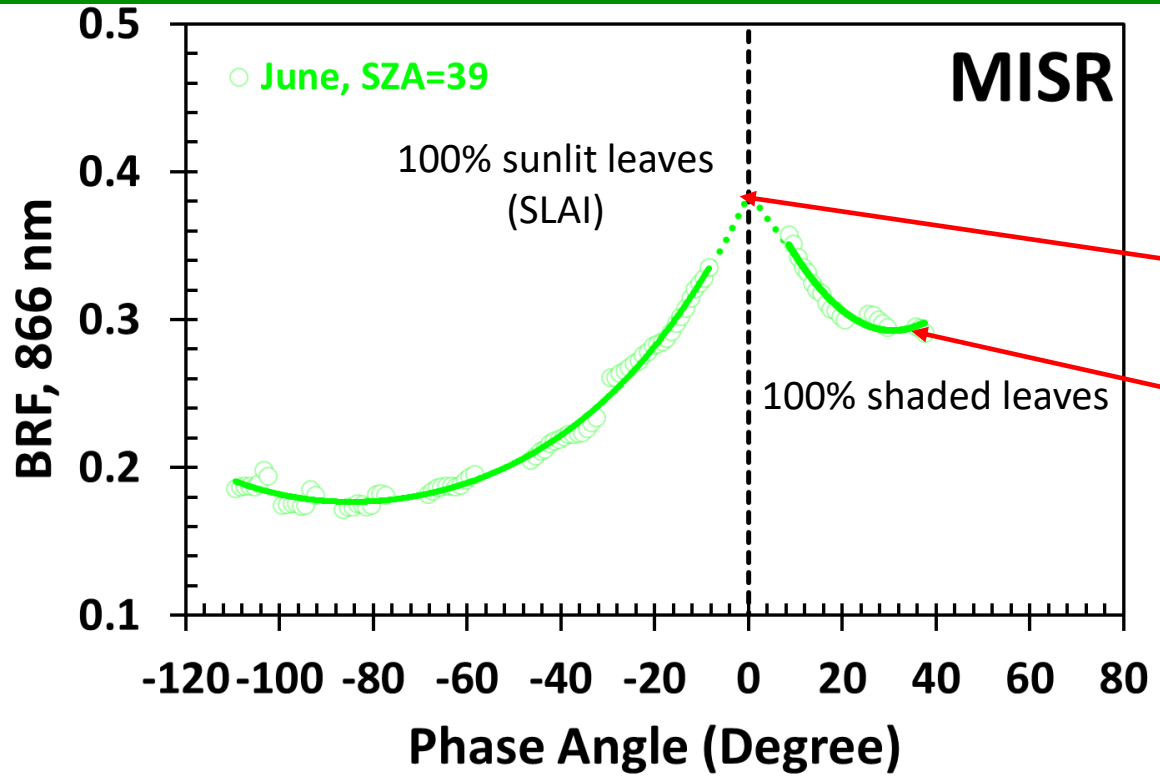






The VESDR LAI parameters follows regularities expected from physics

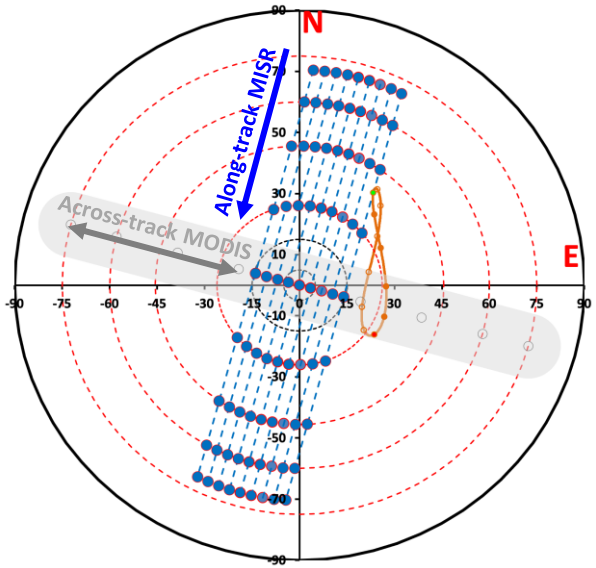
CANOPY HOT SPOT EFFECT

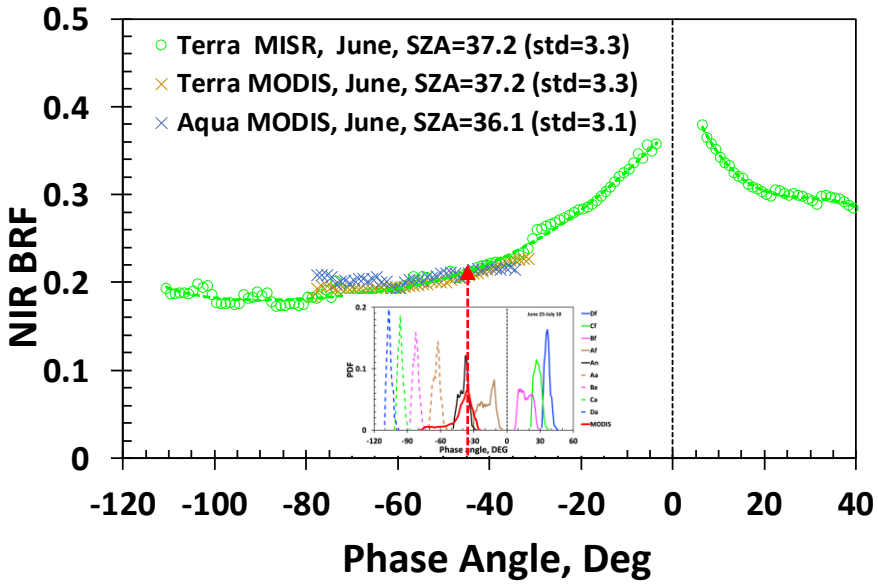


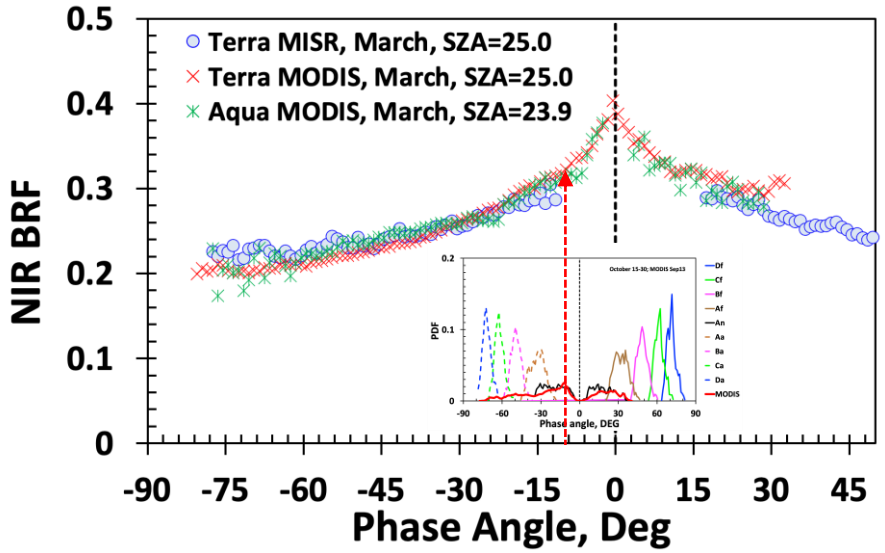
- cross-shading between finite dimensional leaves leads to a peak in reflectance in the retro-illumination direction
- the hotspot region represents the most information-rich directions in BRF
- BRFs that include the hot spot region are critical to monitor phenological changes in dense vegetation such as equatorial forests

MONITORING OF DENSE VEGETATION

Amazon: 8S, 62W; 10:30 LST







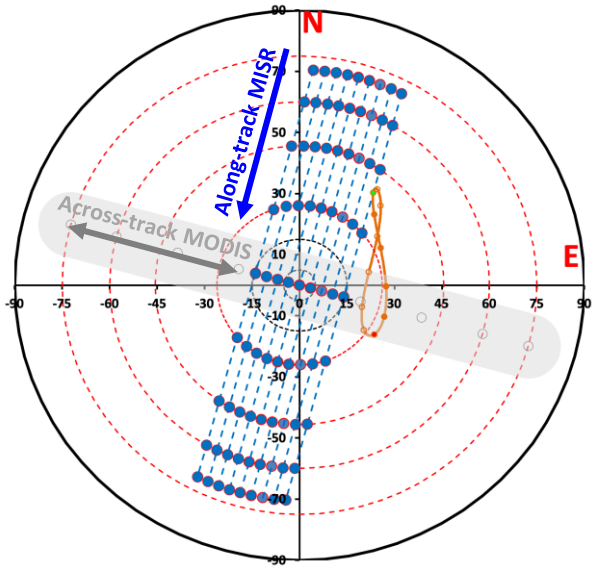
Monitoring of dense vegetation such as equatorial forests represents the most complicated case in optical remote sensing

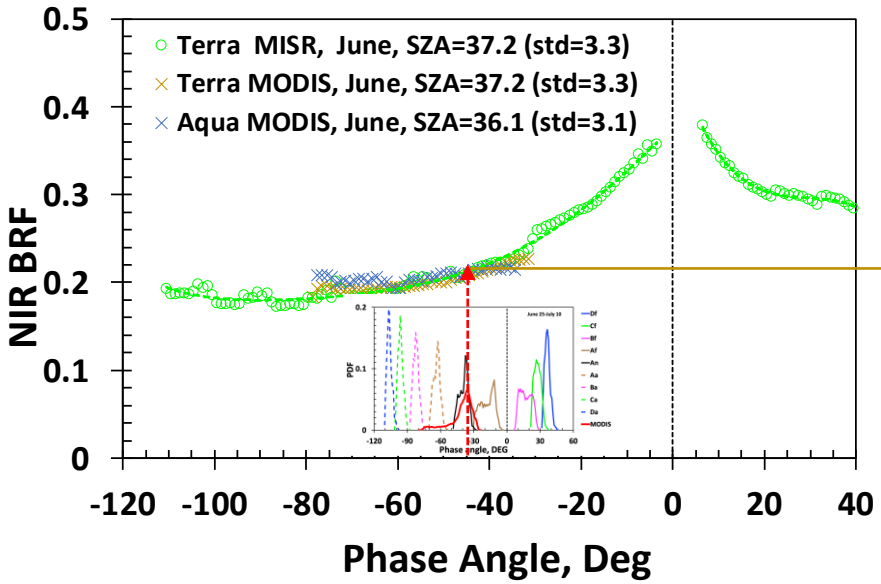
- the satellite data are strongly influenced by changing sun-sensor geometry
- Reflection of solar radiation saturates and becomes weakly sensitive to vegetation changes
- difficult to discriminate between vegetation changes and sun-sensor geometry effects

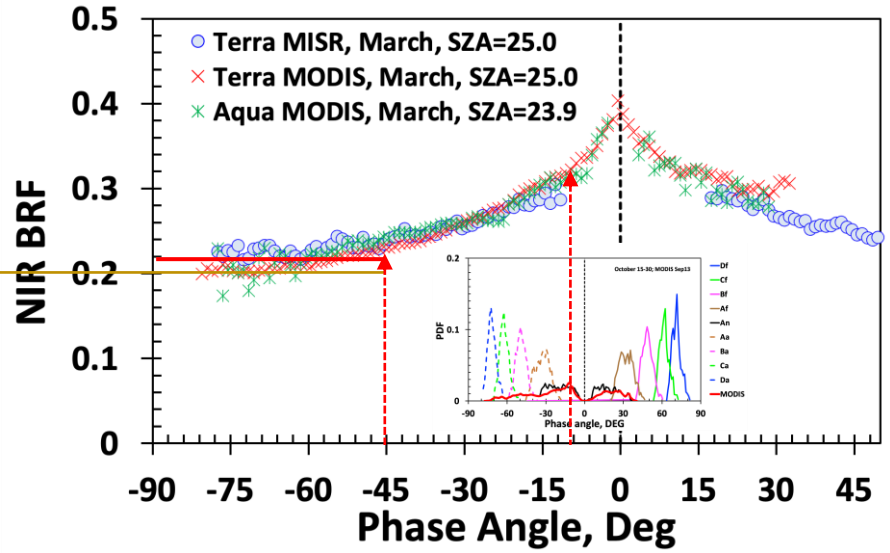
The availability of hot spot data will enhance our ability to unambiguously detect and characterize changes in forests

MONITORING OF DENSE VEGETATION

Amazon: 8S, 62W; 10:30 LST







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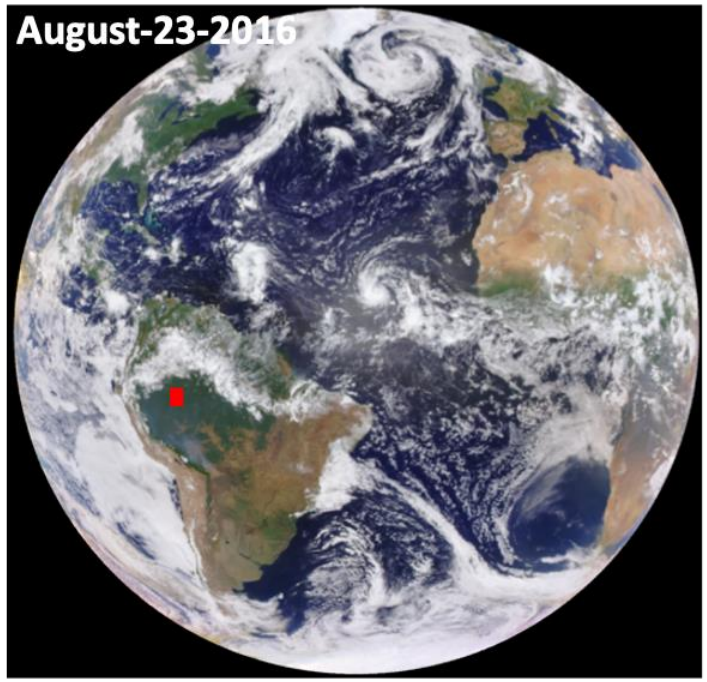
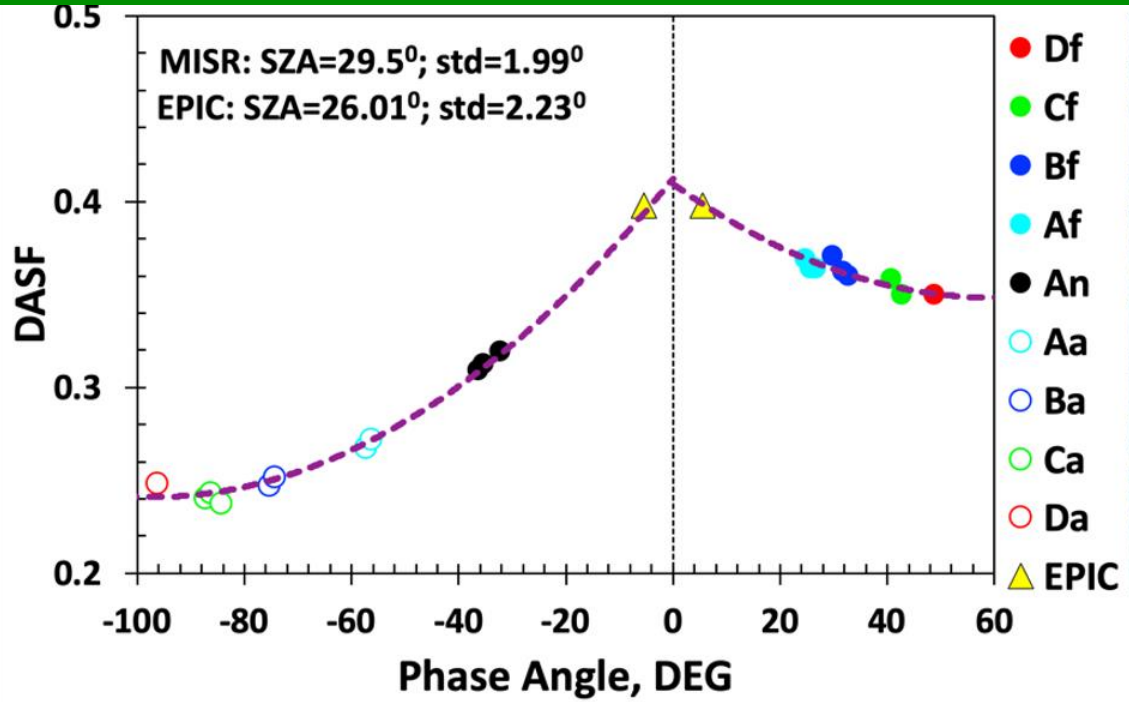
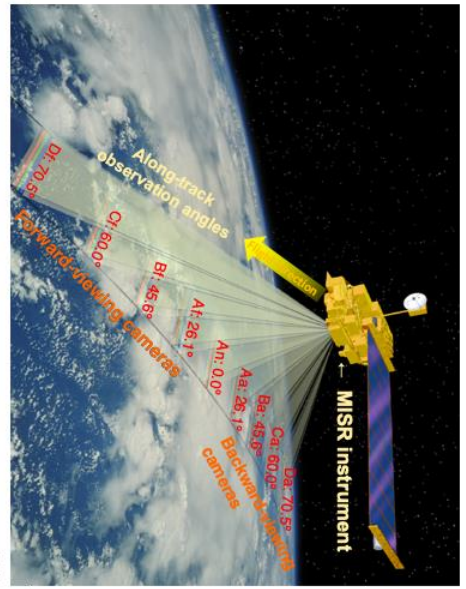
VEGETATION ANGULAR SIGNATURES OF EQUATORIAL FORESTS FROM EPIC AND TERRA MISR



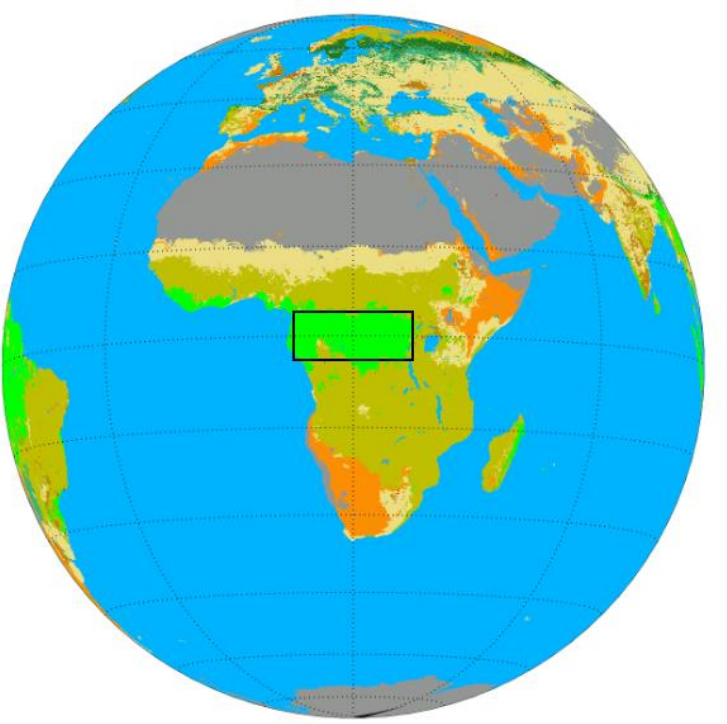


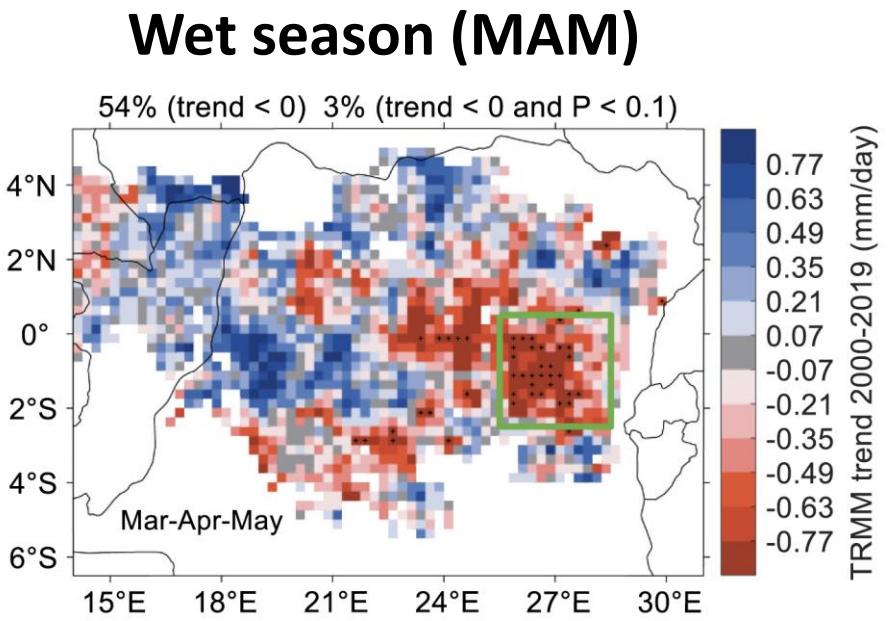


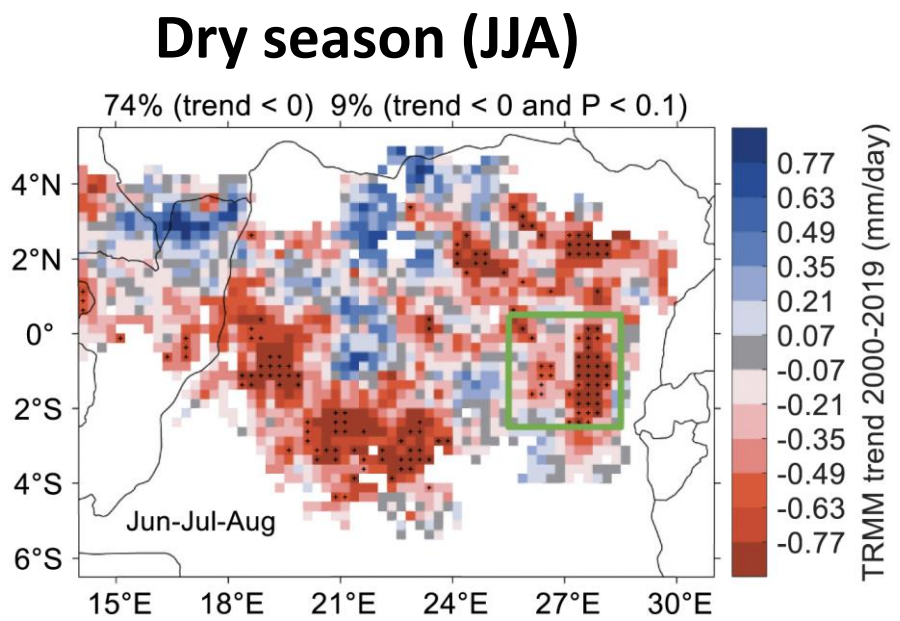
- the Terra MISR provides simultaneous multiangle observations
- sampling strategy allows for a good angular variation of surface reflectance in equatorial zone
- spatially and temporally varying phase angle could be far from the hot spot region
- The DSCOVR EPIC provides imageries in near backscattering directions

We generated a time series of DASF over equatorial forests using data from Terra MISR and DSCOVR EPIC data. Our model can accurately reproduce both MISR angular signatures acquired at 10:30 local solar time and diurnal courses of EPIC reflectance.

DRYING TRENDS IN CONGOLESE RAINFORESTS



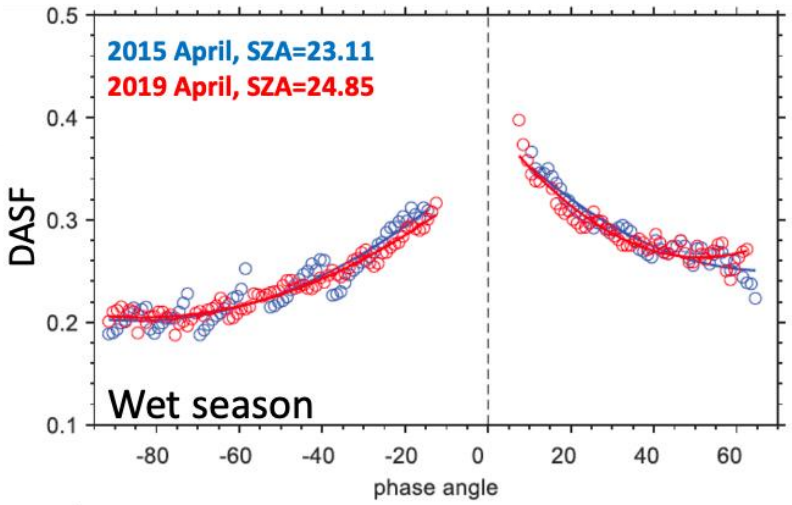


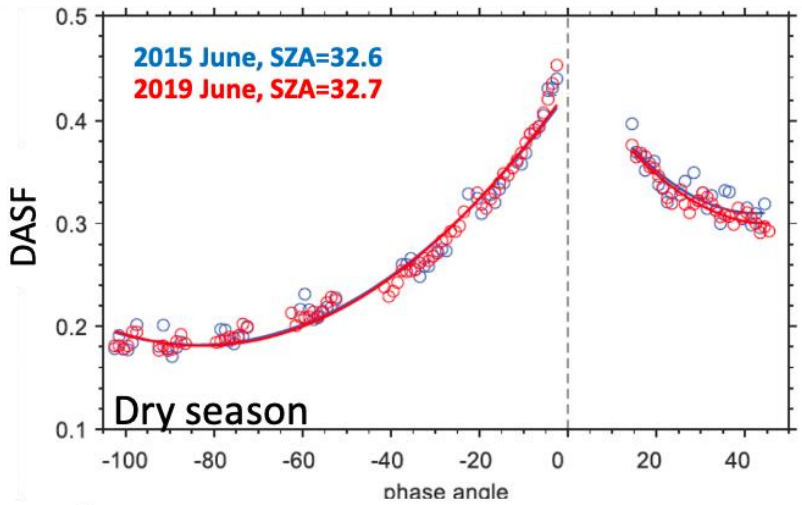


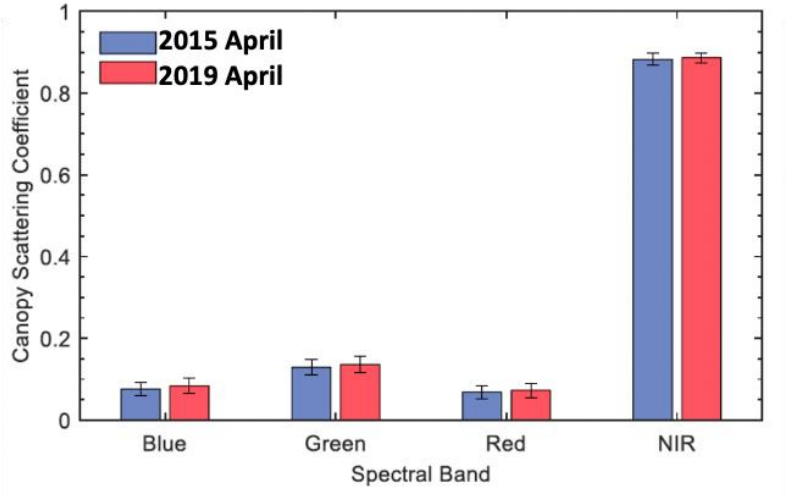
A significant precipitation decline during the wet and dry seasons over the period of 2000-2019 is observed in the southeastern part of Congolese forests

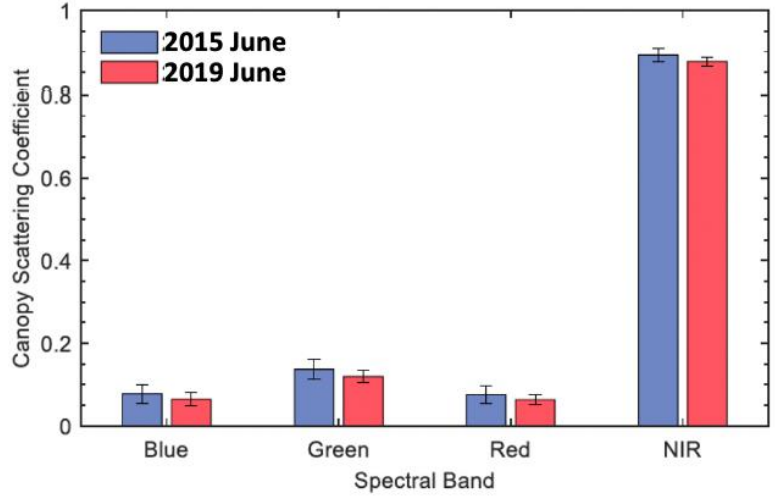
Sun, Yuanheng, Yuri Knyazikhin, Xiaojun She, Xiangnan Ni, Chi Chen, Huazhong Ren, and Ranga B. Myneni. 2022. "Seasonal and long-term variations in leaf area of Congolese rainforest." Remote Sensing of Environment 268:112762. doi: 10.1016/j.rse.2021.112762.

IMPACT OF DRYING TRENDS ON STRUCTURE AND LEAF OPTICS IN CONGO FORESTS









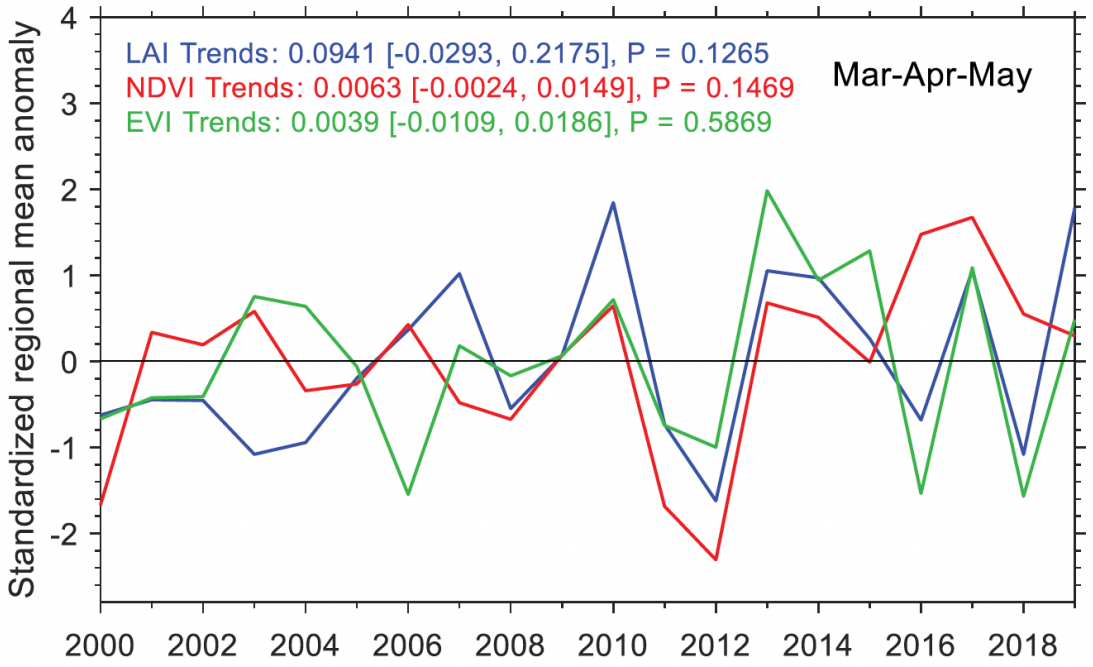
No significant differences in magnitude and shape of MISR-EPIC DASF in April 2015 and the end of the 2000-2019 observation period have been detected

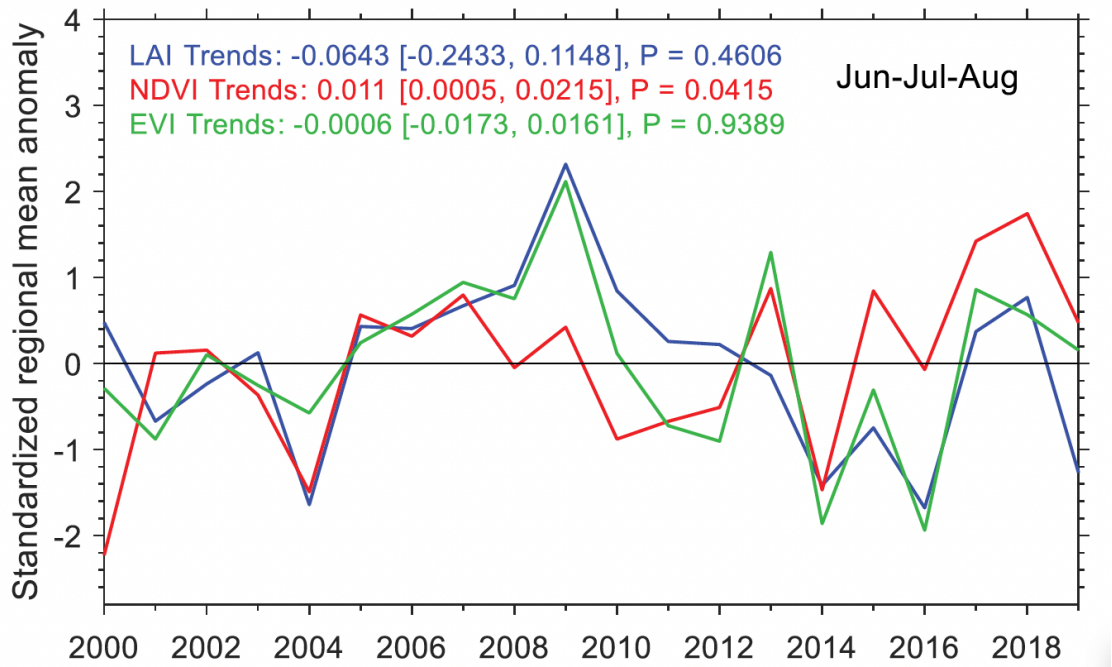
no changes in the canopy spectral coefficient at all blue, green, red and NIR spectral bands are found

Time series of the MISR-EPIC DASF of forest reflected radiation show no signs of long-term drying impact on structure and leaf optics of the Congolese forest

Sun, Yuanheng, Yuri Knyazikhin, Xiaojun She, Xiangnan Ni, Chi Chen, Huazhong Ren, and Ranga B. Myneni. 2022. "Seasonal and long-term variations in leaf area of Congolese rainforest." Remote Sensing of Environment 268:112762. doi: 10.1016/j.rse.2021.112762.

ANALYSES OF NDVI, EVI AND LAI CORROBORATE DASF-BASED RESULTS





With the exception of NDVI in the June to August dry season, no significant decline or increase in trends in regional mean NDVI, EVI and LAI over the past two decades are detected, suggesting no long-term drying impact on structure and leaf optics of the Congolese forests

Sun, Yuanheng, Yuri Knyazikhin, Xiaojun She, Xiangnan Ni, Chi Chen, Huazhong Ren, and Ranga B. Myneni. 2022. "Seasonal and long-term variations in leaf area of Congolese rainforest." Remote Sensing of Environment 268:112762. doi: 10.1016/j.rse.2021.112762.

SUMMARY

- Version 2 (08_LUT02) VESDR product for the period from June-2015 to December -2021 is publicly available from the NASA Langley Atmospheric Science Data Center (ASDC)
- A new cod version (08ALUT02) was delivered to NCCS. The VESDR version 2 (08ALUT02) product is being generated. Data for the period from January 2022 to July-2023 is publicly available from the NASA ASDC
  - ambiguity in the QA information about the reason for the algorithm failure has been fixed
- The VESDR parameters follows regularities expected from physics
- Anew approach to detect changes in properties of the Congolese rainforest using angular variation of DASF as a source of diagnostic information