Inter-Annual variability of the 1993-2019 harmonized land use/land cover and vegetation state evaluated within the ECMWF system and perspectives for future reanalysis

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CONFESS @ ECMWF

The CONFESS EU project aim is to improve the Copernicus Climate Change Services (C3S) capabilities for monitoring and predicting extreme events and climate trends through its seasonal and reanalysis products. Accurate and up-to-date satellites observations that relate the land surface state have become available though spanning different periods and different sensors. To be used within the global ECMWF system, an adaptation and harmonization of these satellite products with a model operator is needed.

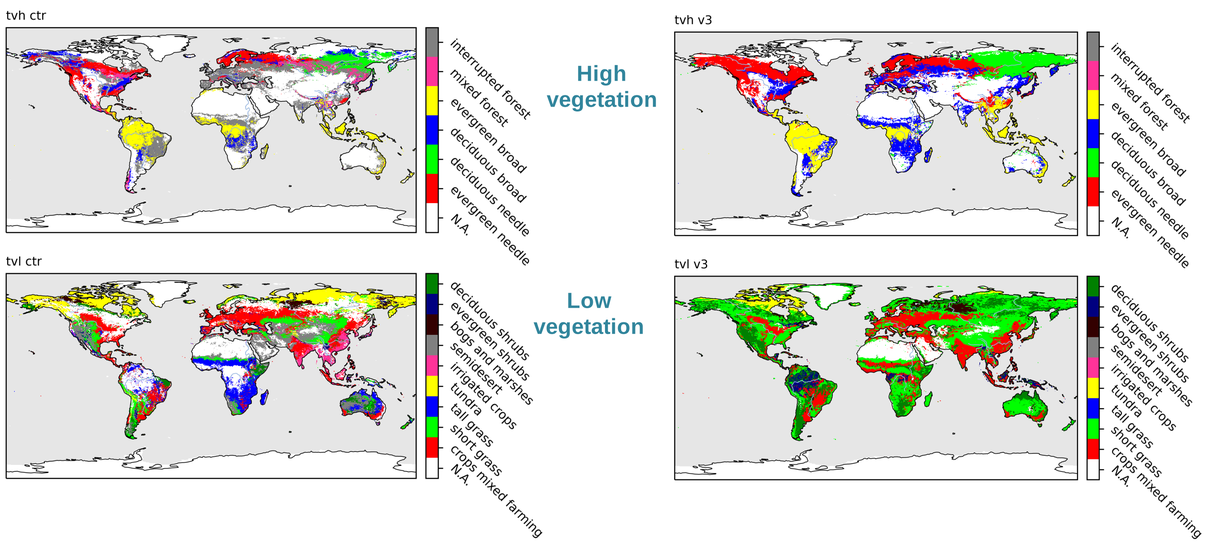
The focus in this study is to provide better time varying vegetation state based on satellite product to the ECMWF land surface model (ECLand) and assess its impact on the land-atmosphere system.

C3S land Use land cover (LULC) data based on the ESACCI products from 1993 –2019 is processed and used with a harmonized version of the Copernicus Global land (CGLS) and THEIA GEOV2 Leaf Area Index (LAI) to drive ECLand and assess their impact the surface fluxes.

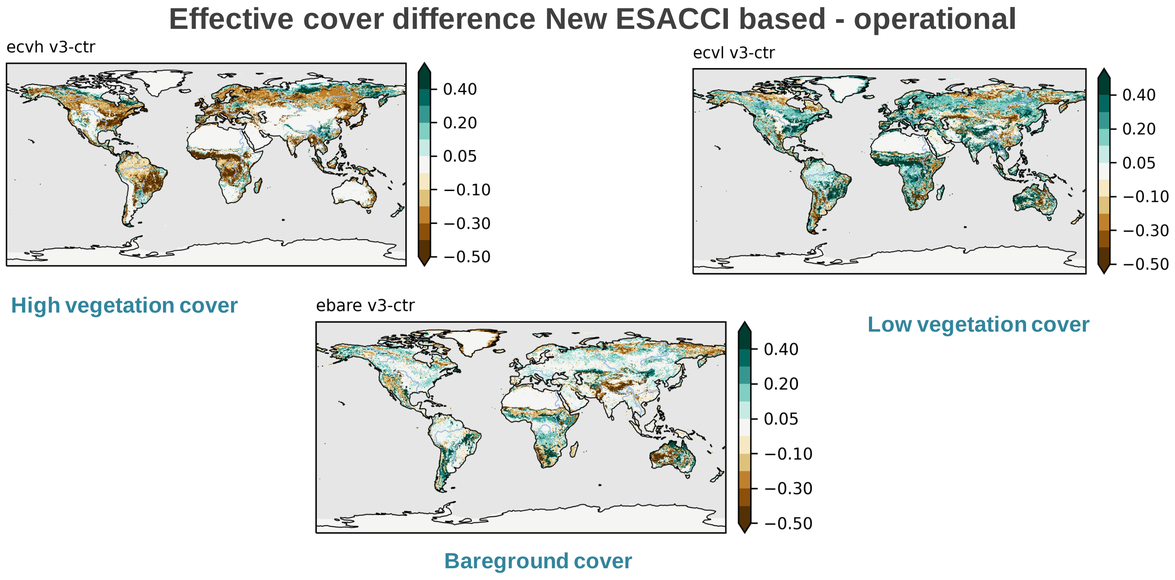
Adaptation of the C3S-ESACCI LULC data to the ECMWF vegetation classification

Vegetation types of the operational system based on GLCCv1.2

Processed vegetation types from ESACCI data adapted to the ECMWF Classification



Effective cover difference New ESACCI based - operational



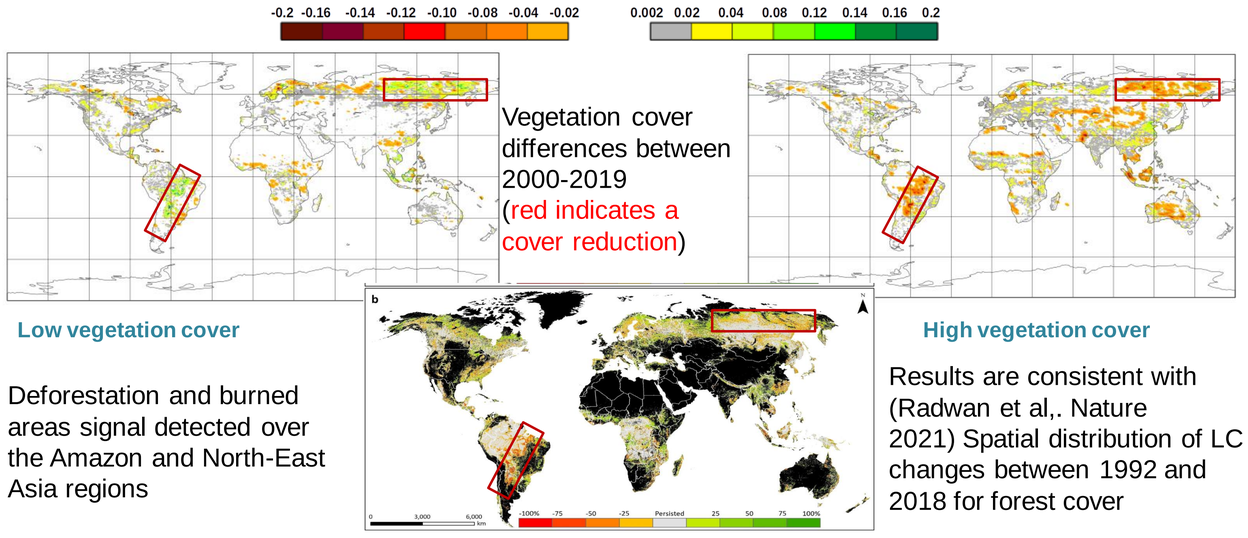
High vegetation cover

Low vegetation cover

Bareground cover

- "Hybrid" vegetation types (interrupted or mixed forest) disappear ==> Would allow better model parameters characterization
- Higher bareground and low vegetation cover at the expence of the high vegetation

LULC Inter-annual variability



Vegetation cover differences between 2000-2019 (red indicates a cover reduction)

Low vegetation cover

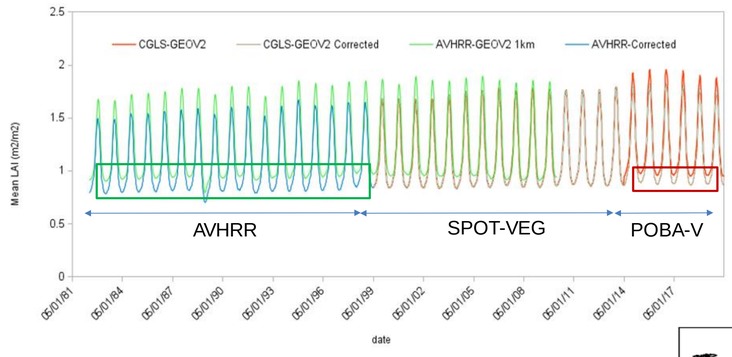
Deforestation and burned areas signal detected over the Amazon and North-East Asia regions

High vegetation cover

Results are consistent with (Radwan et al,. Nature 2021) Spatial distribution of LC changes between 1992 and 2018 for forest cover

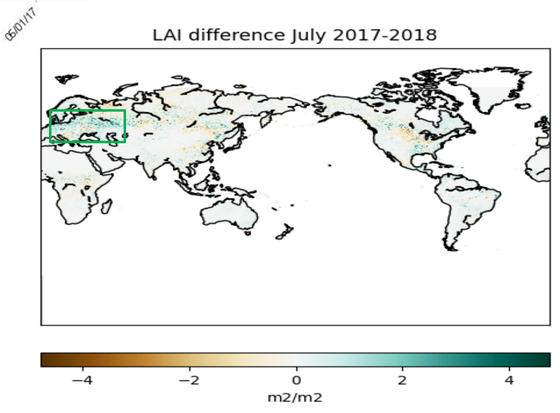
Harmonization of Multi-Annual LAI data based on the GEOV2 CGLS/AVHRR/THEIA

Global mean Leaf Area Index from harmonized CGLS and AVHRR GEOV2 products



The Multi-Annual time series can detect regions with anomalous signal (2018 European drought w.r.t 2017 July mean: green box below)

Full 1993-2019 period with high resolution LAI data is possible by combining multiple sensor products (AVHRR/SPOT Vegetation/PROBA-V) using cumulative distribution function matching correction method (CDF matching) that conserves the mean and the variance of the data

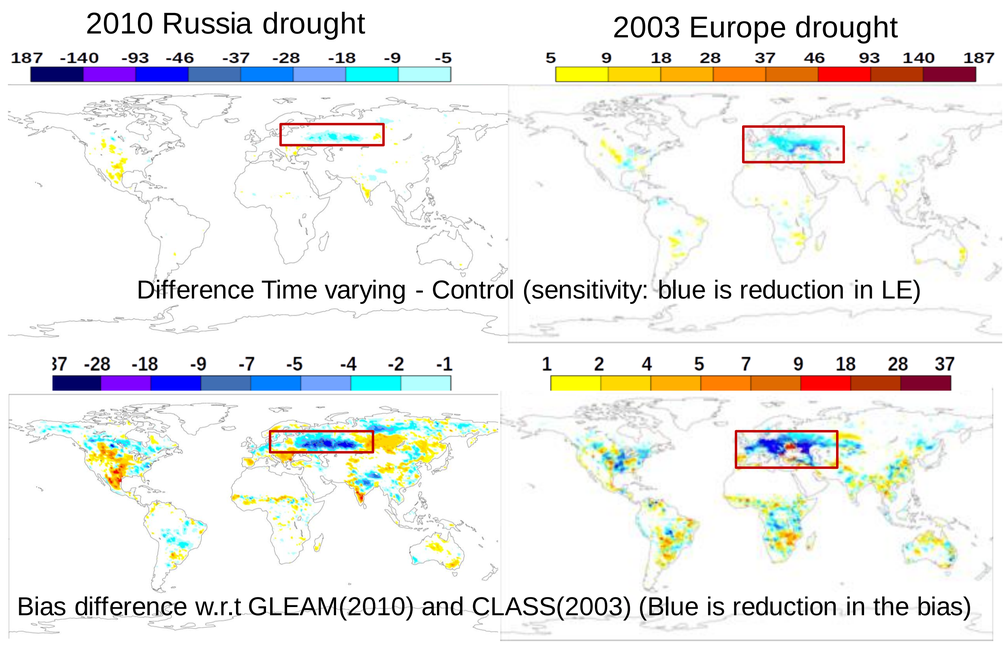


Offline Surface simulations IAV impact

Experiments settings

N	Exp Id	Period	Forcing	Resolution	LAI Configuration	LU/LC Configuration
1	hqzj	1993010100-2019123100	ERA5	TL639	Climatological CONFESS LAI	Fixed CONFESS LULC (2019-based)
2	hqzk	1993010100-2019123100	ERA5	TL639	Climatological CONFESS LAI	Time varying CONFESS LULC
3	hqzl	1993010100-2019123100	ERA5	TL639	Time varying CONFESS LAI (perfect interactive)	Fixed CONFESS LULC (2019-based)
4	hqzg	1993010100-2019123100	ERA5	TL639	Time varying CONFESS LAI (perfect interactive)	Time varying CONFESS LULC

Extreme event evaluation: Latent heat flux (LE)



- The IAV simulations could detect a reduction in LE of the order of 5-15 Wm^{-2}
- Comparison with CLASS data (Hobeichi et al. 2020) shows 5-12 Wm^{-2} reduction in the bias when using the IAV vegetation data

References

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Hobeichi, S., Abramowitz, G., & Evans, J. (2020). Conserving Land–Atmosphere Synthesis Suite (CLASS), Journal of Climate, 33(5), 1821-1844. https://journals.ametsoc.org/view/journals/clim/33/5/jcli-d-19-0036.1.xml

Acknowledgements

This work was supported by the European Union's Horizon 2020 research and innovation program under grant agreement no. 101004156 (CONFESS project). The use of the AVHRR-GEOV2 provided through the THEIA platform is acknowledged with the following: “The GEOV2/AVHRR product was generated by CNES in the framework of the Theia land data centre, a French national inter-agency organization. The GEOV2/AVHRR algorithm was developed by CREAF and INRA. The research leading to the current version of the product has received initial funding from various European Commission Research and Technical Development programs. The product is based on AVHRR 1km data (© NOAA) and is distributed by Theia.”