Monitoring and Forecasting the Impact of the 2018 Summer Heatwave on Vegetation using LDAS-Monde

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Overview

This study aims to assess the potential of the LDAS-Monde platform, a land data assimilation system developed by Météo-France, to monitor the impact on vegetation of the 2018 summer heatwave over Western Europe. The LDAS-Monde is forced by ECMWF’s 3D-LEAS analysis and a) the Integrated Forecasting System High Resolution operational analysis (IFS-LES), used in conjunction with the assimilation of Copernicus Global Land Service (CGLS) satellite-derived products, namely the Surface Soil Moisture (SSM) and the Leaf Area Index (LAI).

The study of long time series of satellite derived CGLS LAI (2000-2018) and SSM (2008-2018) highlights marked negative anomalies for July 2018 affecting large areas of northwestern Europe and reflects the impact of the heatwave. Such large anomalies, spanning over a large part of the domain of interest have never been observed in the LAI product over this 19yr period.

LDAS-Monde

An offline global capacity integration of satellite derived Surface Soil Moisture and Leaf Area Index in the SURFEX modelling platforms of Météo-France, it includes:

- The ISBA Land Surface Model (LSM) that solves the energy and water budgets at the surface level and describes the exchanges between the land surface and the atmosphere. We use the CO2-responsive version of ISBA that simulates the diurnal cycle of water and carbon fluxes, plant growth and key vegetation variables. Transfers of water and heat through the soil rely on a multi-layer diffusion scheme.
- The T Aff river exchange system: coupled daily with ISBA to simulate streamflows of the main rivers.
- Data assimilation schemes like the Simplified Extended Kalman Filter, SEEK also available, PF under development.

LDAS-Monde monads involves several data-set:

- Atmospheric forcing like ECMWF IFS-HRES (LDAS-HRES) forcing like ECMWF ERA5 (LDAS-ERA5).
- Satellite Soil Moisture observations (LSM) that solves the energy and water budgets at the surface level and describes the exchanges between the land surface and the atmosphere. We use the CO2-responsive version of ISBA that simulates the diurnal cycle of water and carbon fluxes, plant growth and key vegetation variables. Transfers of water and heat through the soil rely on a multi-layer diffusion scheme.
- Leaf Area Index observations (LAI): we use the CGLS LAI product, Observations are available on a 10-d basis.

Summer 2018 heatwave in Europe


The Earth Observations point of view: CGLS LAI and SWAT, strong impact of the heatwave

LAI monthly anomaly (LAI Obs. GEOD2)

Figure 2: LAI monthly anomalies (scaled by StdDev) over 2000-2018 for May to August

Monthly Anomaly (LAI Obs. GEOD2)

Figure 3: Monthly anomaly time-series (scaled by the standard deviation) of satellite derived GEOD2 LAI from 2000-2018. Months of July are highlighted in red, straight dashed lines represent values for July 2018.

Monthly Anomaly (LAI ASCAT SWAT Obs.)

Figure 4: SWAT monthly anomalies (scaled by StdDev) over 2000-2018 for May to August

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LDAS-Monde forced by ERAS (LDAS-ERAS) could lead to large scale long term analysis of the Land Surface Variables: useful to monitor the impact of extreme events...

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