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Monitoring and forecasting the impact of the 2018 summer heatwave on vegetation

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This study aims to assess the potential of the LDAS-Monde offline land data assimilation system to monitor the impact on vegetation of the 2018 summer heatwave over western Europe. LDAS-Monde forced by ECMWF's (i) latest reanalysis, ERA-5, and (ii) operational high resolution analysis (IFS, Integrated Forecasting System, HRES), are used in conjunction with the assimilation of Copernicus Global Land Service (CGLS) satellite derived variables produced by CGLS: Surface Soil Moisture (SSM) and Leaf Area Index (LAI). The land surface reanalyses were produced at spatial resolutions of 0.25°x0.25° (over 01/2008-08/2018) and 0.10°x0.10° (over 04/2016-09/2018). Analysis of long time series of satellite derived CGLS LAI (01/2000-09/2018) and SSM (01/2008-09/2018) highlights marked negative anomalies for July 2018 affecting large areas of North Western Europe and reflects the impact of the heatwave. Such large anomalies spreading over a large part of the considered domain have never been observed in the LAI product over this 18-yr period. LDAS-Monde forced by either ERA-5 or HRES captures the vegetation state in general and for this specific event, with HRES configuration exhibiting better monitoring skills than ERA-5 configuration. The consistency of ERA5 and IFS HRES driven simulations over the common period (April 2016 to August 2018) is further investigated. To understand if the improvement from the use of ERA-5 to HRES was due to the resolution only (e.g. better representation of the land cover, topography) or the forcing quality, two other experiments down-scaling ERA-5 to HRES spatial resolutions were performed. Results suggest that spatial resolution is key but using HRES forcing still adds some skills. While there are advantages in using HRES, there is added value in down-scaling ERA5, which can provide long term high resolution land reanalysis. If the improvement from LDAS-Monde analysis on control variables (soil moisture from layers 2 to 8 of the model representing the first meter of soil and LAI) from the assimilation of SSM and LAI was expected, other model variables benefit from the assimilation through biophysical processes and feedbacks in the model. Finally, we also found added value of initializing 8-day forecasts from LDAS-Monde analysis when compared with model only initial conditions.

Key words- land surface modelling, data assimilation, Leaf Area Index, Surface Soil Moisture, Summer 2018 heatwave.