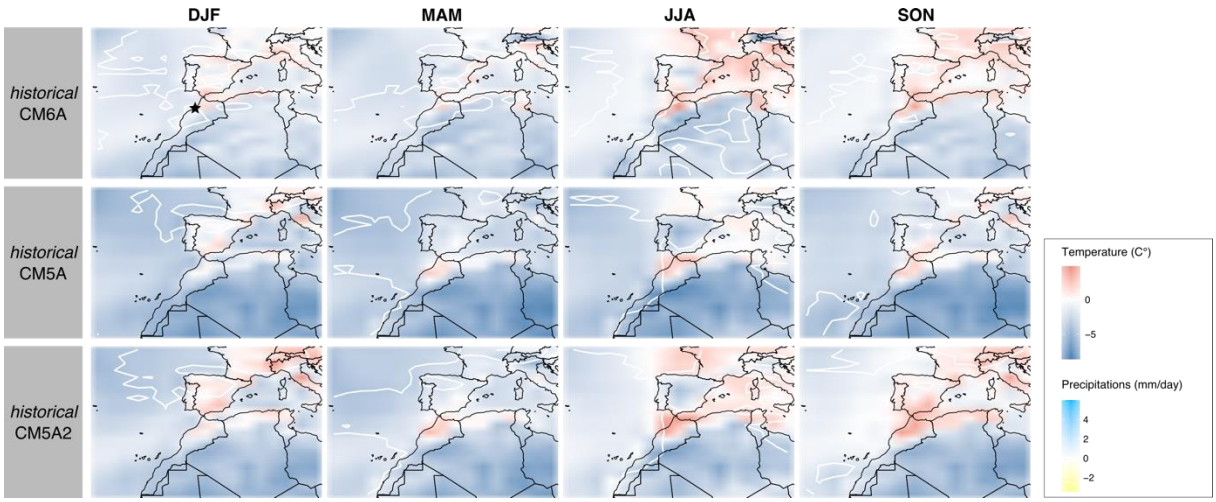
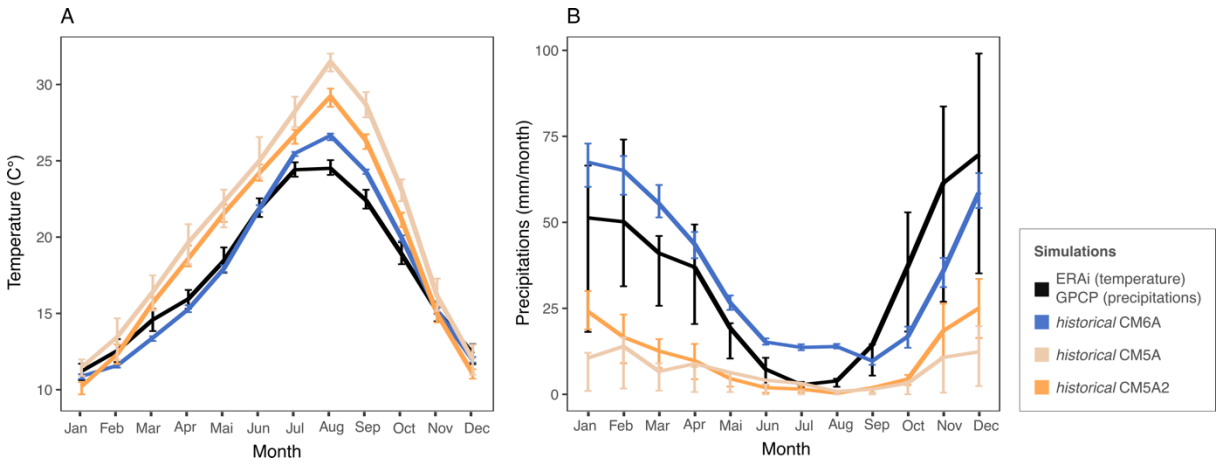
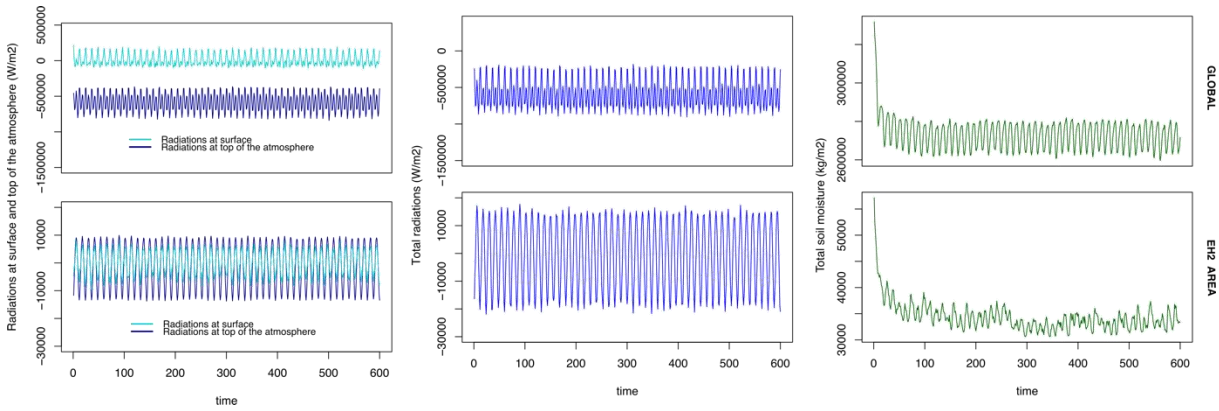
Supplementary material



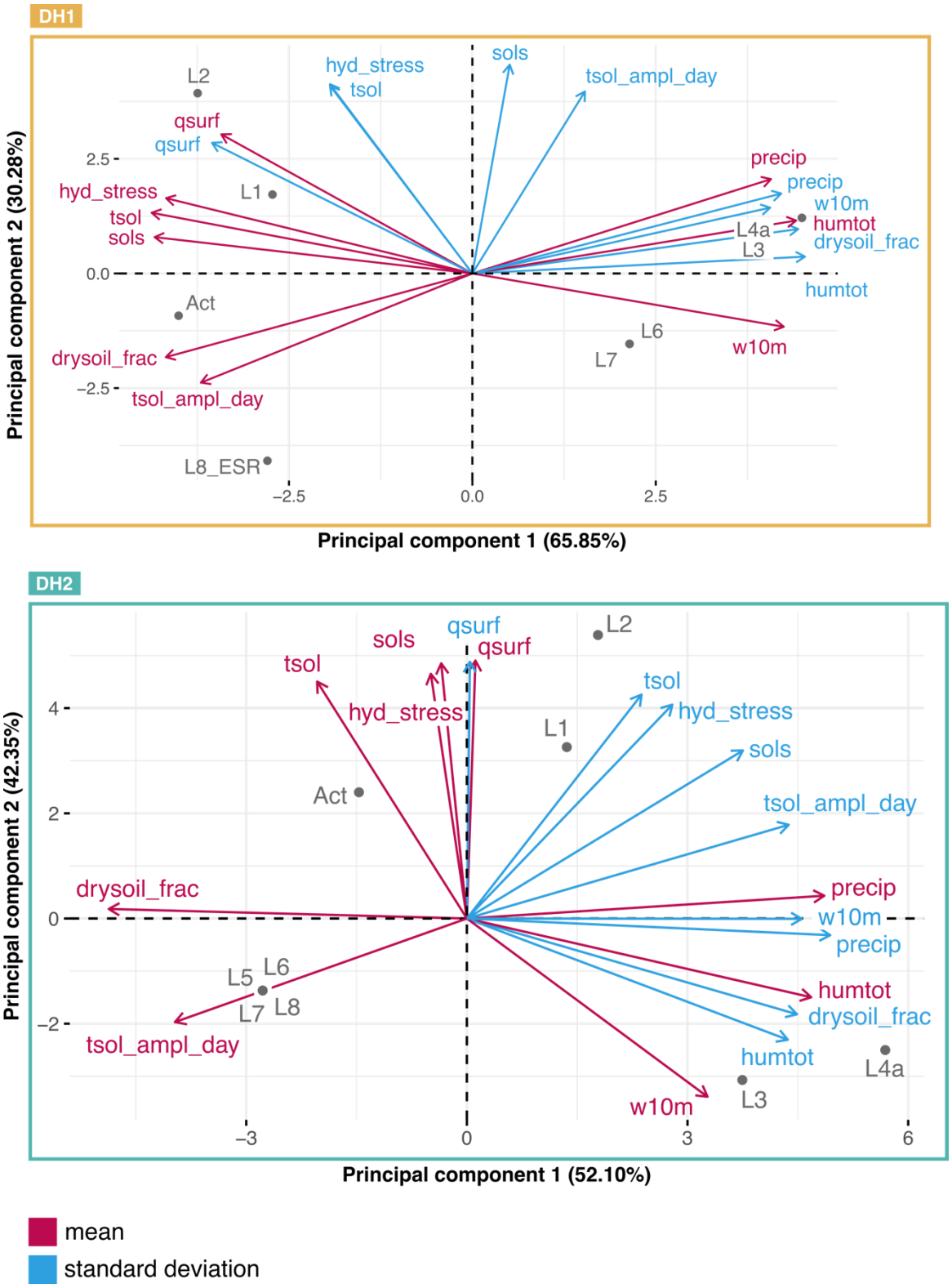
SM Fig. 1. Maps of EH2 region comparing temperature and precipitations of the *historical* simulations of IPSL-CM5A-LR, IPSL-CM5A2-LR and IPSL-CM6A-LR with ERAi and GPCP data. IPSL-CM5A2-LR was design to have improved computing performance, correct the general cold bias identified in IPSL-CM5A-LR and better handle past geological configurations (Sepulchre et al., 2020). IPSL-CM6A-LR, has a strongly improved climatology in contrast to previous versions of the model, but has been mainly developed and tested under present day climate (Boucher *et al.*, 2020). Model outputs of the *historical* simulations are stored on CICLAD (Calcul Intensif pour le Climat, l'Atmosphère et la Dynamique). As a reference for current climate we used monthly data from the global atmospheric reanalysis ERA-interim for temperature (Berrisford et al., 2011) and from the GPCP v2.3 (Global Precipitation Climatology Project) for precipitations (Adler et al., 2018). Data were averaged on 30 seasonal cycles (1980-2009). Red areas designate higher simulated than reanalyzed temperatures while blue areas indicate lower temperatures. Light blue isolines represent areas subject to more precipitation in the simulation outputs than is reanalyzed while the yellow isolines indicate areas with less precipitation. EH2 cave location is represented by the star. DJF: December, January, February (winter); MAM: March, April, May (spring); JJA: June, July, August (summer); SON: September, October, November (autumn).



SM Fig. 2. Graph of monthly variations in temperature and precipitations of the *historical* simulations of IPSL-CM5A-LR, IPSL-CM5A2-LR and IPSL-CM6-LR models and ERAi and GPCP data on the four grid cells containing EH2 cave. Interannual variation over the averaged 30 years is visualized by quartiles.



SM Fig. 3. Monitoring variables of *Ctrl* in global and in the EH2 region: radiations at top of the atmosphere (nettop), radiations at surface (bils), total radiations (nettop + bils) and total soil moisture (mrso).



SM Fig. 4. Biplots of El Harhoura 2 layers and climate variables according to DH1 (Dating Hypothesis 1; upper) and DH2 (Dating Hypothesis 2; lower).