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Supplement of

Better representation of dust can improve climate models with too weak an African monsoon

Yves Balkanski et al.

Correspondence to: Yves Balkanski (yves.balkanski@lsce.ipsl.fr)

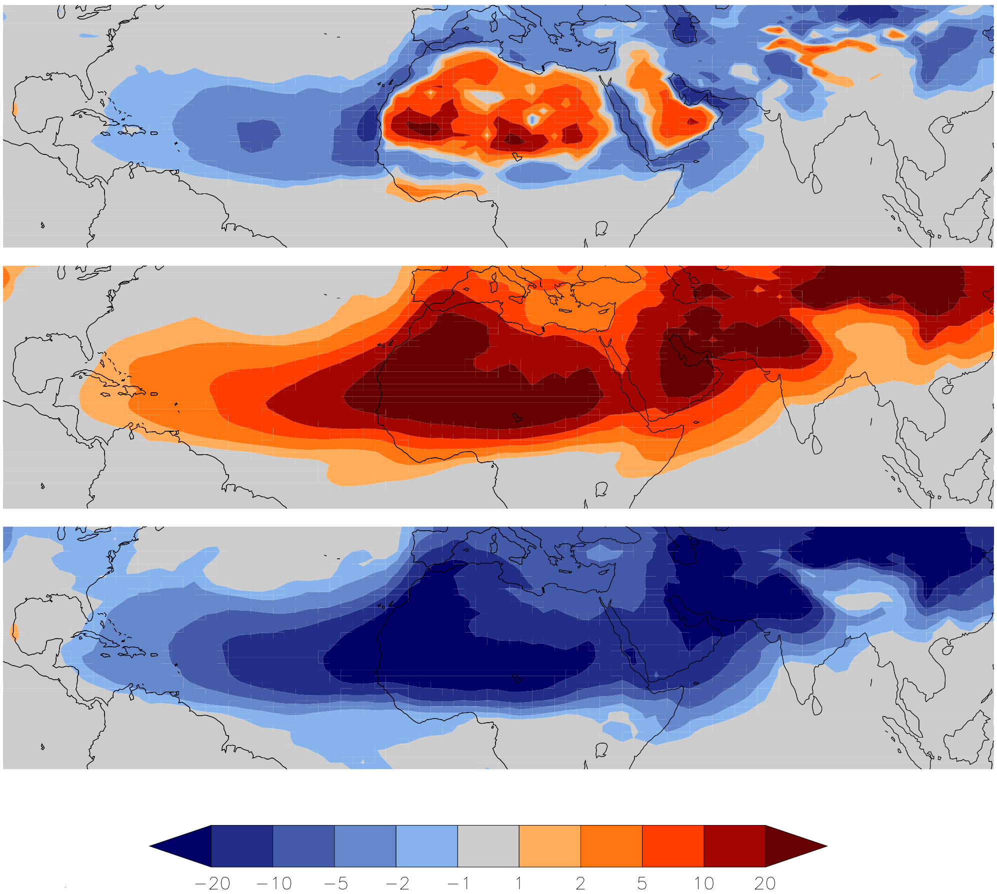

Figure S1. Top panel: Mean JJAS SW top-of-atmosphere (TOA) Dust Direct Radiative Effect (in W m^{-2}); Middle panel: Mean JJAS SW dust Atmospheric Absorption (W m^{-2}) which is obtained as the difference between top-of-atmosphere and surface effects; Bottom Panel: Mean JJAS SW surface Dust Radiative effect (W m^{-2}) . Over the Sahel region (10°N to 20°N; 15°W to 35°E), at the SW TOA effect amounts to +4.1 W.m^{-2}; the SW atmospheric absorption amounts to +19.9 W.m^{-2}; and at the surface, the SW radiative effect is -15.8 W.m^{-2}. See Table 1 of the main text that lists the values for the dust global direct radiative effect.

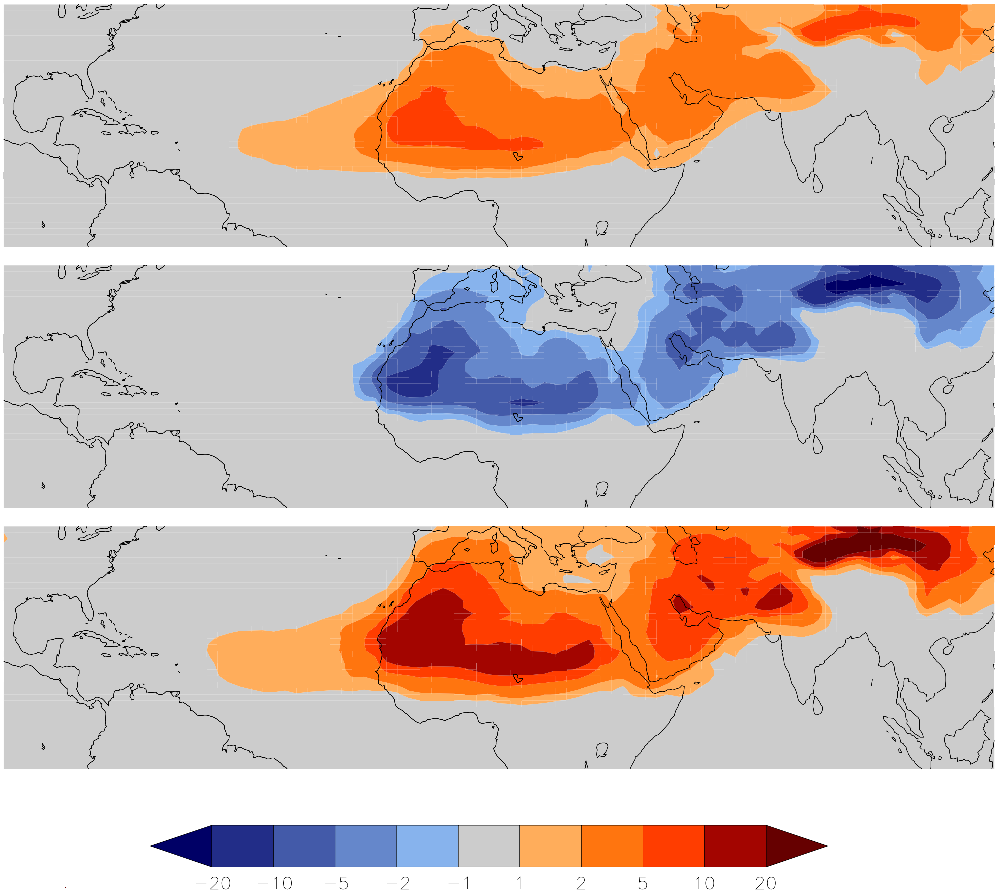

Figure S2. Top panel: Mean JJAS LW top-of-atmosphere (TOA) Dust Direct Radiative Effect (in W m^{-2}); Middle panel: Mean JJAS LW dust Atmospheric Absorption (W m^{-2}) which is obtained as the difference between top-of-atmosphere and surface effects; Bottom Panel: Mean JJAS LW surface Dust Radiative effect (W m^{-2}) . Over the Sahel region (10°N to 20°N; 15°W to 35°E), at the TOA LW effect amounts to +1.9 W.m^{-2}; the atmospheric absorption amounts to -3.2 W.m^{-2}; and at the surface, the radiative effect is +5.1 W.m^{-2}. See Table 1 of the main text that lists the values for the dust global direct radiative effect.

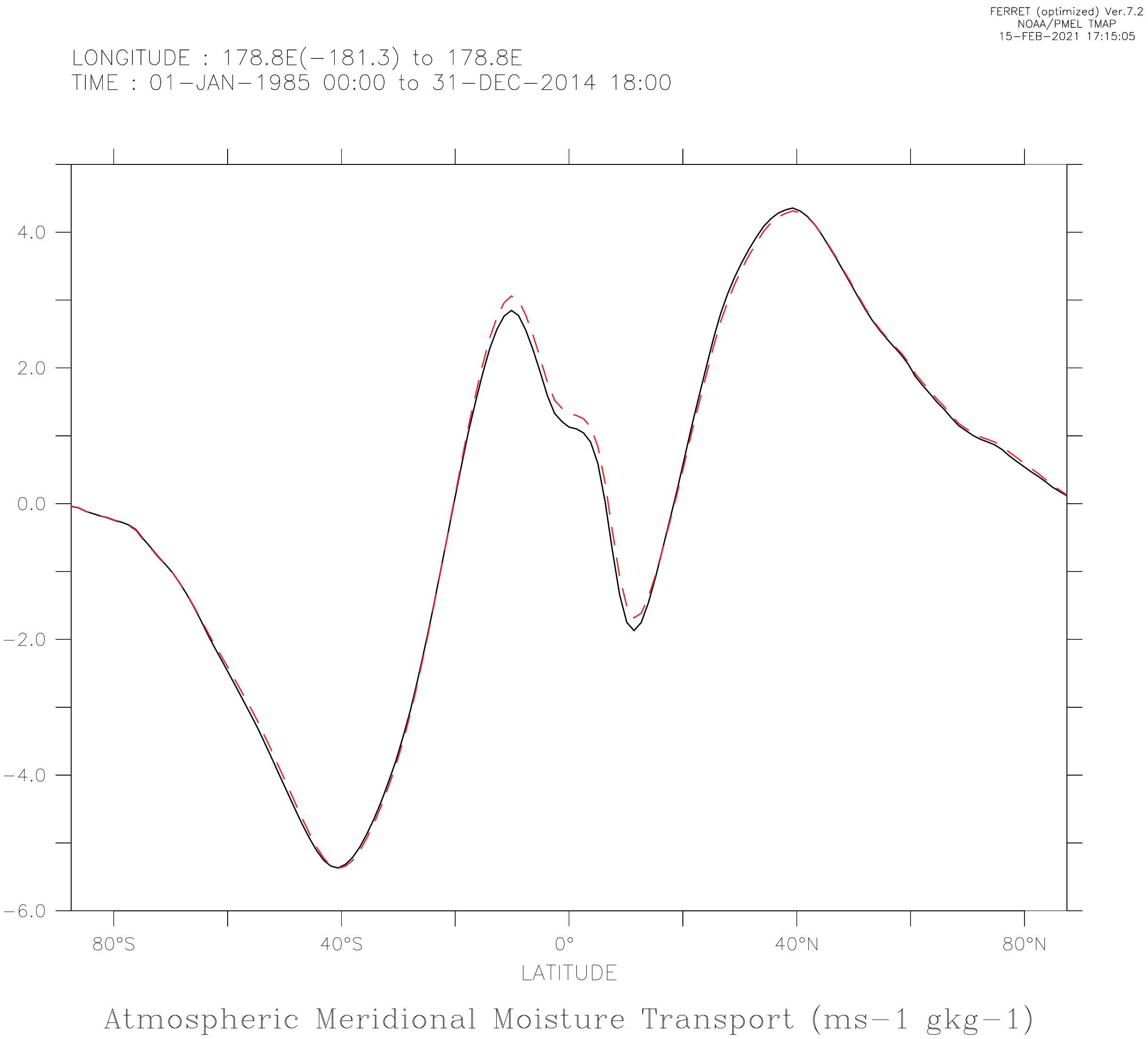

Figure S3. Meridional transport of moisture (ms^{-1} g kg^{-1}) to compare with Fig. 3 from Haywood et al 2016.The values at the Equator are respectively: 1.128 ms^{-1} g kg^{-1} for the run NO DUST (solid black line) and 1. 326 ms^{-1} g kg^{-1} for the run with DUST, hence the enhancement factor as defined by Haywood et al. (2016) is 1.18.

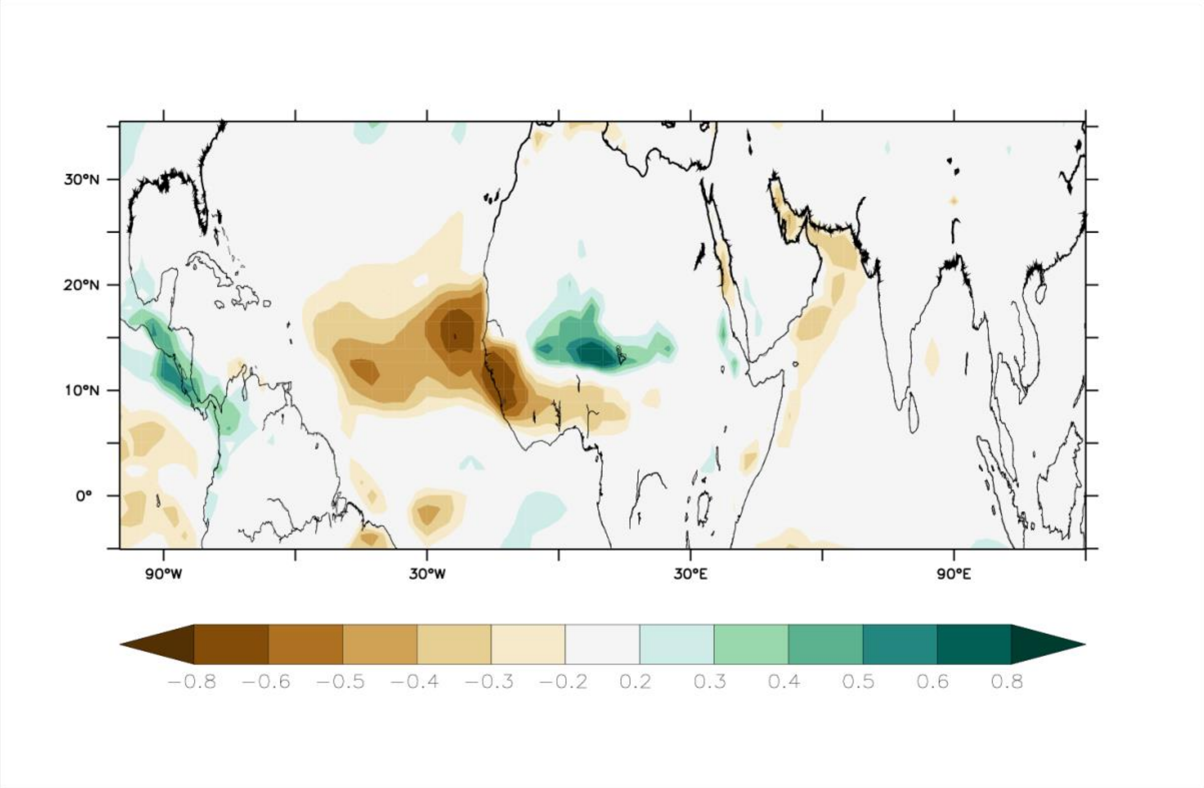

Figure S4. Difference in annual mean evaporation (mm.day-1) for the 30-year period (1985-2014) showing the evaporation increase over the Sahel due to dust absorption.

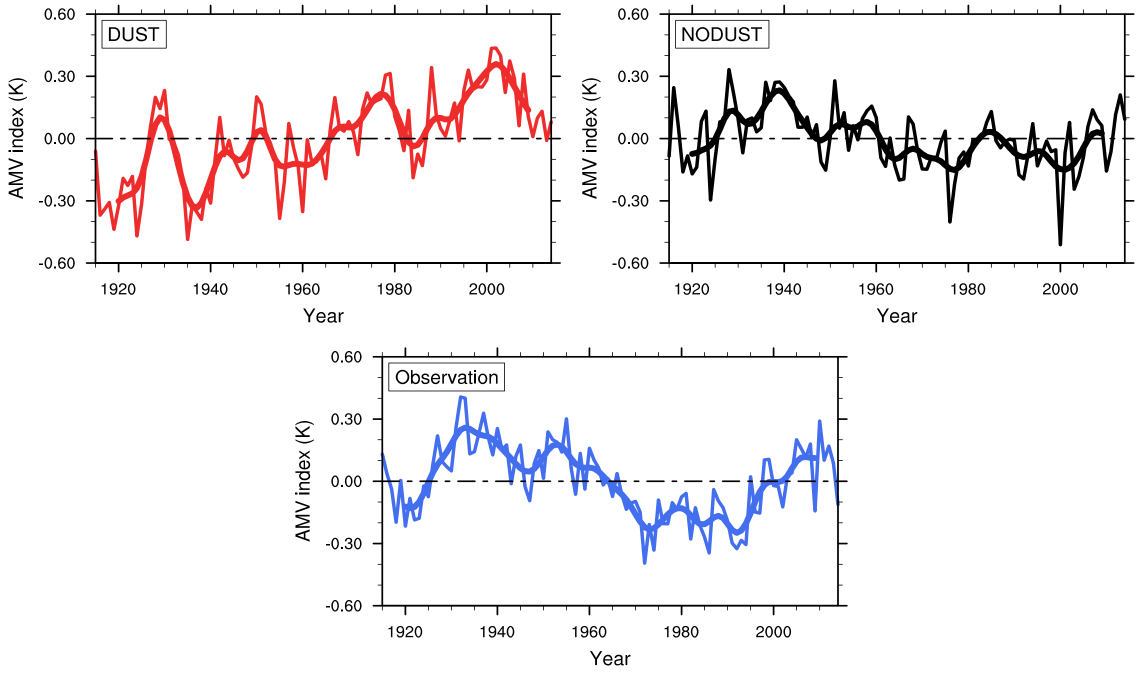

Figure S5. Representation of the Atlantic Multidecadal Variability (AMV) evolution. Time evolution of the AMV index over the 1915-2014 period from the simulation including interactive dust (top left), the simulation without dust (top right) and the ERSSTv5 observational dataset (Huang et al., 2017) (bottom). The AMV index is defined as the monthly anomaly over the North Atlantic Ocean, with the response from the external forcings removed (Deser et al., 2010). The external forcing are estimated by the average SST between -60°N and 60°N (Trenberth and Shea, 2006). A low-pass filter with a cutoff period of 10 years is applied to the AMV index (thicker line).

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