Recent changes of relative humidity: regional connection with land and ocean processes

Sergio M. Vicente-Serrano¹, Raquel Nieto², Luis Gimeno², Cesar Azorin-Molina³, Anita Drumond², Ahmed El Kenawy^{1,4}, Fernando Dominguez-Castro¹, Miquel Tomas-Burguera⁵, Marina Peña-Gallardo¹

¹ Instituto Pirenaico de Ecología, Consejo Superior de Investigaciones Científicas (IPE-CSIC), Zaragoza, Spain; ²Environmental Physics Laboratory, Universidade de Vigo, Ourense, Spain. ³Regional Climate Group, Department of Earth Sciences, University of Gothenburg, Sweden. ⁴Department of Geography, Mansoura University, Mansoura, Egypt; ⁵Estación Experimental Aula Dei, Consejo Superior de Investigaciones Científicas (EEAD-CSIC), Zaragoza, Spain;

* Corresponding author: svicen@ipe.csic.es

This document contains 48 Supplementary figures and 1 supplementary table



Suppl. Figure 1. Annual and seasonal statistical significance of RH trend from HadISDH and ERA-Interim for 1979-2014



Suppl. Figure 2. Spatial distribution of the Person's r between HadISDH and ERA-Interim RH at the seasonal and annual scales



Suppl. Figure 3. Frequency density plots of the Pearson's r coefficients between the HadISDH and ERA-Interim RH annually and seasonally.



Suppl. Figure 4: Scatterplot showing the global relationship between the annual magnitude of change in ERA-Interim q and the magnitude of change of RH. Colors represent the density of points with red color showing the highest density of points.



Suppl. Figure 5: Top left: Annual RH humidity trends in the West Europe (region 1), top right: average E-P at the annual scale to identify the main humidity sources in the region. Center: Relationship between de-trended annual RH and de-trended annual variables between 1979 and 2014. Bottom: Annual evolution of the different variables corresponding to the West Europe region. The magnitude of change and signification of the trend is indicated for each variable.



Suppl. Figure 6: The same as Suppl. Fig. 5 but for Scandinavia (region 2).



Suppl. Figure 7: The same as Suppl. Fig. 5 but for Central-East Europe (region 3).



Suppl. Figure 8: The same as Suppl. Fig. 5 but for South-East Europe and Turkey (region 4).



Suppl. Figure 9: The same as Suppl. Fig. 5 but for India (region 6).



Suppl. Figure 10: The same as Suppl. Fig. 5 but for East China (region 7).



Suppl. Figure 11: The same as Suppl. Fig. 5 but for North East Asia (region 8).



Suppl. Figure 12: The same as Suppl. Fig. 5 but for Canada (region 10).



Suppl. Figure 13: The same as Suppl. Fig. 5 but for central USA (region 11).



Suppl. Figure 14: The same as Suppl. Fig. 5 but for Amazonian (region 13).



Suppl. Figure 15: The same as Suppl. Fig. 5 but for East Sahel (region 14).



Suppl. Figure 16: Top left: Boreal cold season RH humidity trends in West Europe (region 1), top right: average E-P in the boreal cold season to identify the main humidity sources in the region. Center: Relationship between de-trended cold season RH and de-trended cold season variables between 1979 and 2014. Bottom: Boreal cold season evolution of the different variables corresponding to West Europe region. The magnitude of change and signification of the trend is indicated for each variable.



Suppl. Figure 17: The same as Suppl. Fig. 16 but for Scandinavia (region 2).



Suppl. Figure 18: The same as Suppl. Fig. 16 but for Central-East Europe (region 3).



Suppl. Figure 19: The same as Suppl. Fig. 16 but for South-East Europe and Turkey (region 4).



Suppl. Figure 20: The same as Suppl. Fig. 16 but for West Sahel (region 6).



Suppl. Figure 21: The same as Suppl. Fig. 16 but for India (region 6).



Suppl. Figure 22: The same as Suppl. Fig. 16 but for East China (region 7).



Suppl. Figure 23: The same as Suppl. Fig. 16 but for North East Asia (region 8).



Suppl. Figure 24: The same as Suppl. Fig. 16 but for La Plata (region 9).



Suppl. Figure 25: The same as Suppl. Fig. 16 but for Canada (region 10).



Suppl. Figure 26: The same as Suppl. Fig. 16 but for central USA (region 11).



Suppl. Figure 27: The same as Suppl. Fig. 16 but for West North America (region 12).



Suppl. Figure 28: The same as Suppl. Fig. 16 but for Amazonian (region 13)



Suppl. Figure 29: The same as Suppl. Fig. 16 but for East Sahel (region 14).



Suppl. Figure 30: Top left: Boreal warm season RH humidity trends in West Europe (region 1), top right: average E-P in the boreal cold season to identify the main humidity sources in the region. Center: Relationship between de-trended boreal warm season RH and de-trended boreal warm season variables between 1979 and 2014. Bottom: Boreal cold season evolution of the different variables corresponding to West Europe region. The magnitude of change and signification of the trend is indicated for each variable.



Suppl. Figure 31: The same as Suppl. Fig. 30 but for Scandinavia (region 2).



Suppl. Figure 32: The same as Suppl. Fig. 30 but for Central-East Europe (region 3).



Suppl. Figure 33: The same as Suppl. Fig. 30 but for South-East Europe and Turkey (region 4).



Suppl. Figure 34: The same as Suppl. Fig. 30 but for West Sahel (region 6).



Suppl. Figure 35: The same as Suppl. Fig. 30 but for India (region 6).



Suppl. Figure 36: The same as Suppl. Fig. 30 but for East China (region 7).



Suppl. Figure 37: The same as Suppl. Fig. 30 but for North East Asia (region 8).



Suppl. Figure 38: The same as Suppl. Fig. 30 but for La Plata (region 9).



Suppl. Figure 39: The same as Suppl. Fig. 30 but for Canada (region 10).



Suppl. Figure 40: The same as Suppl. Fig. 30 but for central USA (region 11).



Suppl. Figure 41: The same as Suppl. Fig. 30 but for West North America (region 12).



Suppl. Figure 42: The same as Suppl. Fig. 30 but for Amazonian (region 13).



Suppl. Figure 43: The same as Suppl. Fig. 30 but for East Sahel (region 14).



Suppl. Figure 44: Relationship between the average cold season magnitude of change in RH identified in each one of the 14 analysed region and the cold season magnitude of change in precipitation, the ratio between air temperature/SST, ocean evaporation, land evapotranspiration and the ratio between the ocean evaporation and the land evapotranspiration.



Suppl. Figure 45: Relationship between the average warm season magnitude of change in RH identified in each one of the 14 analysed region and the warm season magnitude of change in precipitation, the ratio between air temperature/SST, ocean evaporation, land evapotranspiration and the ratio between the ocean evaporation and the land evapotranspiration.



Suppl. Figure 46: 1979-2014 annual and seasonal signification of trends in SST and OAFLUX ocean evaporation



Suppl. Figure 47: Spatial relationship between the annual and seasonal magnitude of change of SST and Ocean evaporation (1979-2014)



Suppl. Figure 48: Density plots with the annual and seasonal magnitude of change in SST and Ocean Evaporation (1979-2014)

				Cold		Warm
		Annual	Cold	Season	Warm	Season
	Annual SST	Evap.	Season SST	Evap.	Season SST	Evap.
Positive (p < 0.05)	48.2	28.9	40.8	25.9	46.0	23.4
Positive (n.s.)	24.4	34.1	27.4	36.6	28.6	36.0
Negative (n.s.)	19.4	24.7	23.0	27.9	21.1	28.4
Negative (p < 0.05)	8.0	12.2	8.8	9.6	4.3	12.1

Supplementary Table 1: Percentage of Ocean areas showing positive and negative trends in annual and seasonal SST and Evaporation (1979-2014)