Future water storage changes over the Mediterranean, Middle East, and North Africa in response to global warming and stratospheric aerosol intervention

Abolfazl Rezaei[1,2], Khalil Karami[3], Simone Tilmes[4], John C. Moore[5]

[1] Department of Earth Sciences, Institute for Advanced Studies in Basic Sciences (IASBS), Zanjan 45137-66731, Iran. arezaei@iasbs.ac.ir; abolfazlrezaei64@gmail.com.

[2] Center for Research in Climate Change and Global Warming (CRCC), Institute for Advanced Studies in Basic Sciences (IASBS), Zanjan 45137-66731, Iran

[3] Institut für Meteorologie, Stephanstraße 3, 04103 Leipzig, Germany. khalil.karami@uni-leipzig.de

[4] National Center for Atmospheric Research, Boulder, CO, USA. tilmes@ucar.edu

[5] Arctic Centre, University of Lapland, Rovaniemi, 96101, Finland. john.moore.bnu@gmail.com

Table S1. As in Table 1 but for the SSP5-8.5 global warming and SSP5-8.5-SAI scenarios over 2071-2100.

Region	R1		R2		R3		R4		R5		R6	
Future climate scenario	SSP5-8.5	SSP5-8.5-SAI	SSP5-8.5	SSP5-8.5-SAI	SSP5-8.5	SSP5-8.5-SAI	SSP5-8.5	SSP5-8.5-SAI	SSP5-8.5	SSP5-8.5-SAI	SSP5-8.5	SSP5-8.5-SAI
Precipitation (mm/yr)	337	328	219	212	403	419	97	83	50	48	91	103
Temperature (^{0}C)	19.7	14.8	26.1	21.5	21.2	17	32.3	28.6	29.4	24.8	30.8	27.4
Real ET (mm/yr)	470	419	213	205	347	353	89	80	53	50	94	104
Soil moisture (Kg/m^2)	1756	1813	1768	1792	1485	1530	1428	1416	1156	1164	1283	1299
TWS (Kg/m^2)	2013	2065	1773	1797	1543	1586	1423	1411	1171	1178	1309	1325
Potential ET (mm/yr)	116	78	296	150	114	79	686	299	385	183	613	259

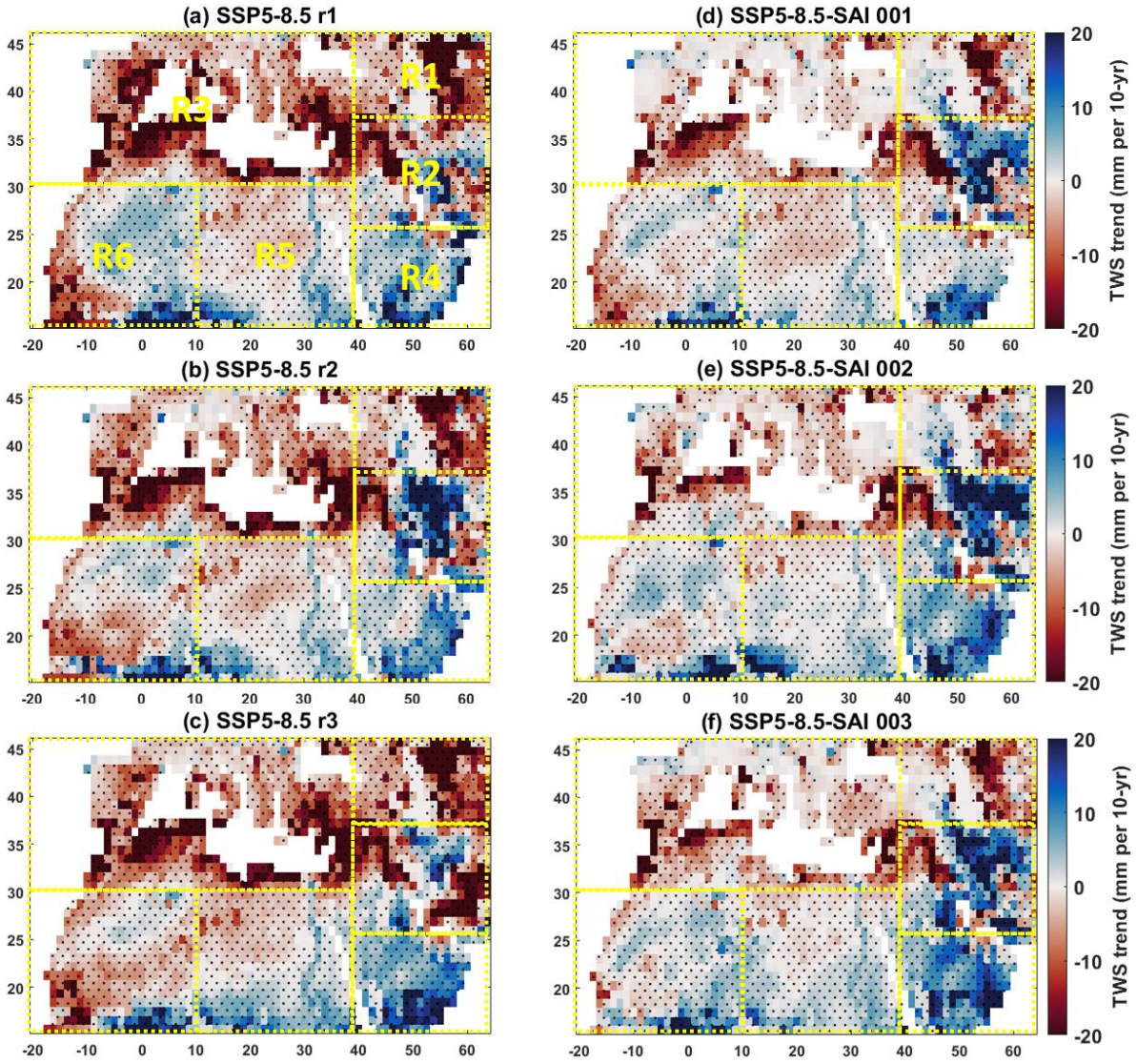

Figure S1. The TWS trend maps across MENA over the period (1984–2100) under purely GHG forcing (SSP5-8.5 in a to c) and combined with SAI (SSP5-8.5-SAI in d to f). The dotted regions have trends significant at a 95% confidence level according to the standard simple Mann-Kendall test. R1 to R6 shown in Figure S1a denote the selected regions 1 to 6, respectively.

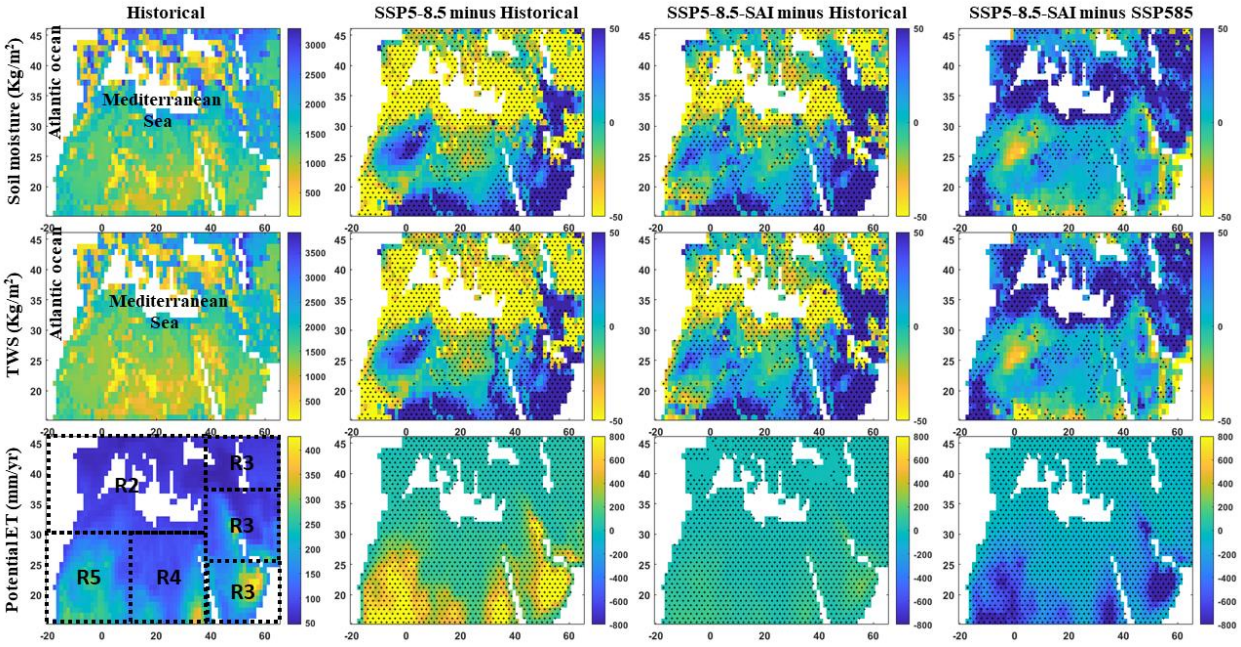

Figure S2. The maps of soil moisture (upper row), terrestrial water storage (TWS, middle row), and potential evapotranspiration (ET, bottom row) over MENA in the historical climate (1984-2014) and their projected future changes in the period (2071–2100) under the SSP5-85 scenario without and with SAI (SSP5-8.5 minus historical and SAI minus historical, respectively). The extent to which the SAI impacts the global warming effects on the climate variables is further shown (SAI minus SSP5-8.5). The cross sign (+) highlights where all ensemble members agree on the sign of the changes. R1 to R6 denote to the selected regions 1 to 6, respectively.

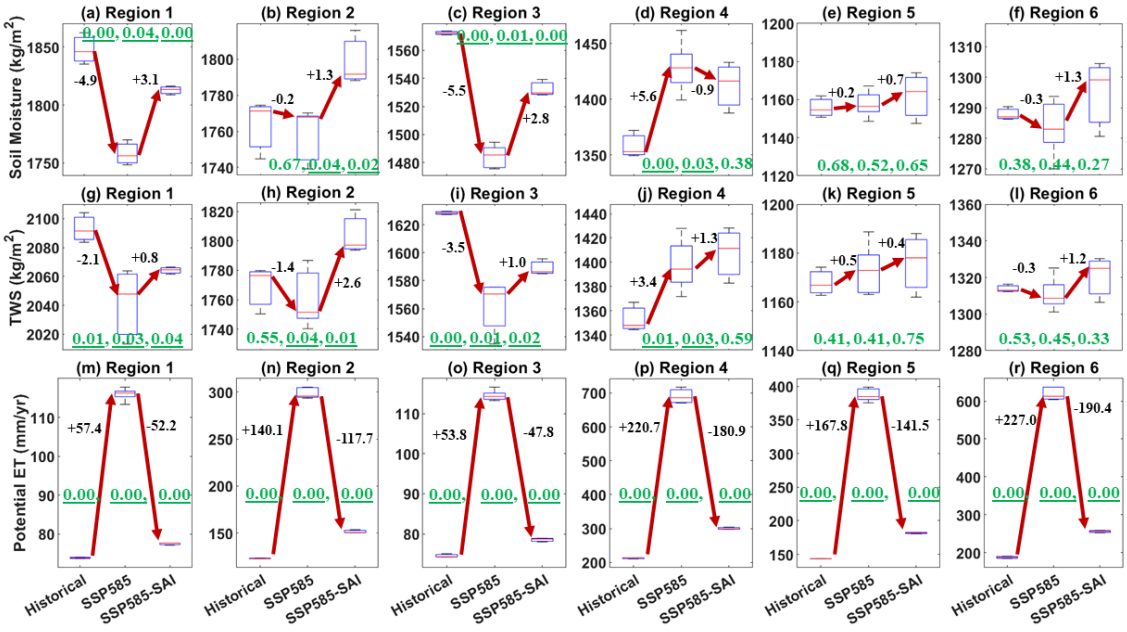

Figure S3. Box and whiskers plot of the changes in soil moisture (upper row), terrestrial water storage (TWS, middle row), and potential evapotranspiration (ET, bottom row) in each region from R1 to R6 e row). The titles of each subplot refer to the regions. The median for each experiment is denoted by the red line, the upper (75^{th}) and lower (25^{th}) quartiles by the top and bottom of the box and ensemble limits by

the whisker extents. The positive/negative values in black are the change percent relative to the median of the historical 20th period data for each variable, respectively. The three values in green refer to p-values obtained from t-test analysis in which the underlined p-values are statistically significant.

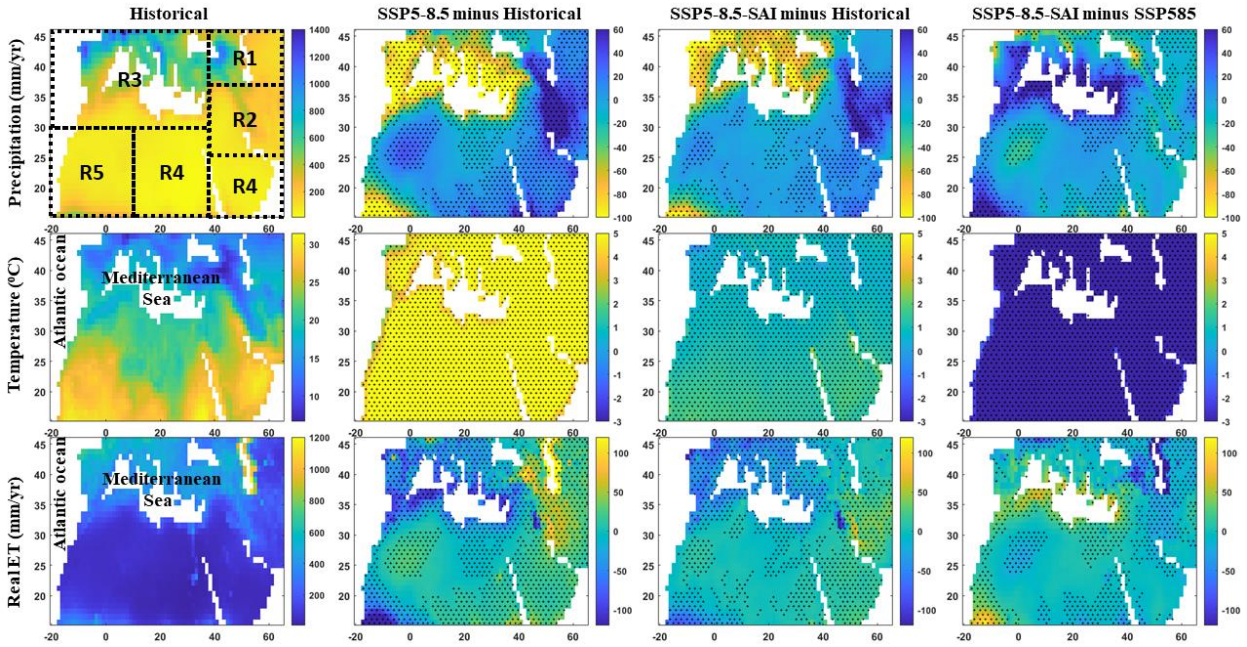

Figure S4. As in Fig. S2, but for the variables of precipitation (upper row), surface temperature (middle row), and real evapotranspiration (ET, bottom row).

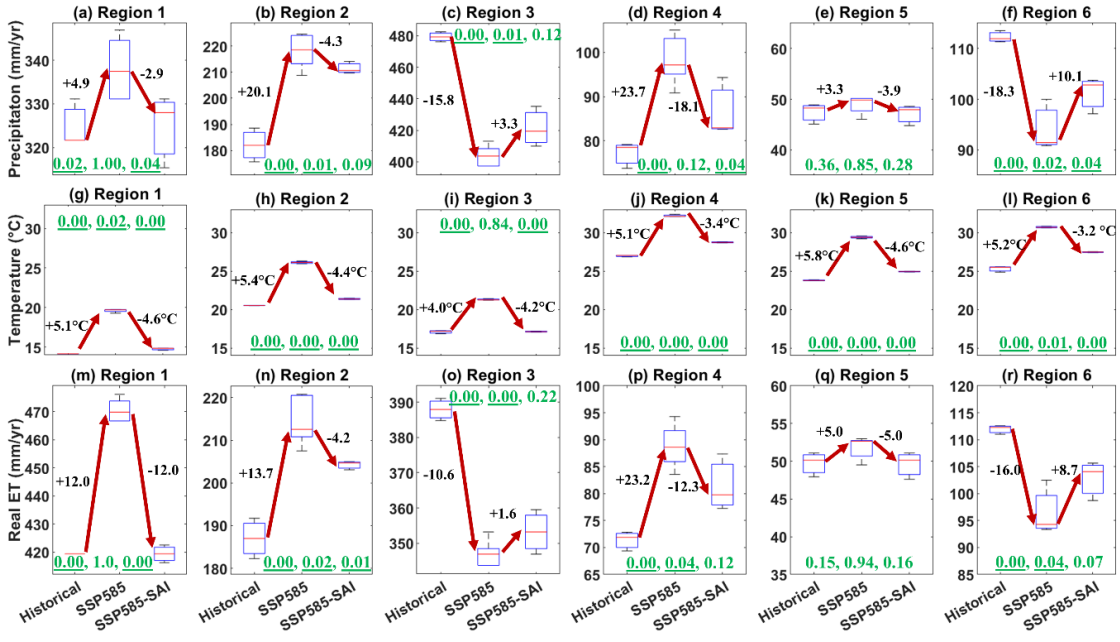

Figure S5. As Fig. 3, but for the variables of precipitation (upper row), surface temperature (middle row), and real evapotranspiration (ET, bottom row).