Supplementary Material of paper acp-2011-697:

The direct effect of aerosols on solar radiation over the broader Mediterranean basin

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Table S1. Comparison between model and GEBA surface solar radiation fluxes at four selected GEBA stations located in the Mediterranean basin. The mean regional values and changes of SSR with respect to the means (in Wm^{-2} and %, respectively), the bias and the correlation coefficients between model and GEBA fluxes are given.

	Station 1274 Corsica (41.92N, 8.8E)		**Station 1479 Italy (48.25N, 16.4E)**		**Station 3703 Greece (40.63N, 22.96E)**		**Station 3757 Switzerland (46.0N, 8.96E)**	
	GEBA	*Model*	*GEBA*	*Model*	*GEBA*	*Model*	*GEBA*	*Model*
Mean value	185.6	178.6	141.5	125.7	182.5	163.9	148.2	136.1
Change (%) (2000-2007)	-6.3	-3.1	7.3	3.8	11.7	10.3	2.6	2.2
Bias	-7		-15.8		-18.6		-12.1	
$R_{model\text{-}GEBA}$	0.99		0.98		0.99		0.99	

Table S2. Regional mean values of aerosol direct radiative effect (DRE, in Wm^{-2}) over the eastern Mediterranean basin (20°E to 38.5°E) under all-sky conditions. DRE on outgoing solar radiation at TOA (DRE_{TOA}), on solar radiation absorbed in the atmosphere (DRE_{atm}), on downward surface solar radiation (DRE_{surf}), and on net downward (or absorbed) radiation at surface ($DRE_{surfnet}$). Seasonal mean values are given for winter (November-December-January, DJF), spring (March-April-May, MAM), summer (June-July-August, JJA), autumn (September-October-November, SON) and for the entire period (2000-2007). The values in parentheses indicate the corresponding quantities under clear-sky conditions.

	TOA ($\boldsymbol{DRE_{TOA}}$)	**Atmosphere** ($\boldsymbol{DRE_{atm}}$)	**Surface**	
			$\boldsymbol{DRE_{surf}}$	$\boldsymbol{DRE_{netsurf}}$
Year	-2.5±0.3 (-4.5±0.4)	11.6±0.9 (14.9±0.7)	-17.4±1.5 (-23.9±1.9)	-14.1±1.1 (-19.4±1.2)
DJF	-0.6±0.3 (-2.2±0.3)	5.5±2.7 (9.4±4.2)	-8.3±3.5 (-15.6±5.6)	-6.1±2.4 (-11.6±3.9)
MAM	-2.3±0.6 (-5.1±0.1)	15.9±3.2 (20.4±3.3)	-22.5±4.5 (-31.4±4.8)	-18.1±3.8 (-25.5±4.2)
JJA	-4.5±0.1 (-6.3±0.1)	17.5±0.8 (19.6±1.6)	-26.7±2.2 (-31.3±2.1)	-22.0±1.7 (-25.9±1.5)
SON	-2.5±0.7 (-4.4±0.6)	7.6±3.7 (10.0±3.2)	-12.3±5.5 (-17.4±4.8)	-10.1±4.4 (-14.4±3.8)

Table S3. As in Table S2, but for the central Mediterranean basin (10°E to 20°E).

	TOA (DRE_{TOA})	**Atmosphere** (DRE_{atm})	**Surface**	
			DRE_{surf}	$DRE_{netsurf}$
Year	-3.4±0.4 (-5.8±0.5)	10.3±0.4 (13.4±0.6)	-16.2±1.2 (-22.7±1.0)	-13.7±0.9 (-19.2±1.1)
DJF	-1.3±0.1 (-3.1±0.3)	4.1±2.2 (7.2±3.6)	-6.8±3.0 (-13.0±5.0)	-5.4±2.3 (-10.2±3.6)
MAM	-3.9±1.1 (-7.3±1.6)	13.3±2.9 (17.5±2.9)	-20.2±4.1 (-29.1±4.1)	-17.2±3.9 (-24.8±4.2)
JJA	-6.1±0.7 (-8.2±0.5)	16.3±1.4 (18.8±2.0)	-25.8±1.5 (-31.1±2.3)	-22.4±1.2 (-27.0±1.9)
SON	-2.4±0.8 (-4.5±0.6)	7.5±3.9 (10.3±3.5)	-12.0±5.6 (-17.7±5.4)	-9.9±4.7 (-14.9±4.4)

Table S4. As in Table S2, but for the western Mediterranean basin (10.5°W to 10°E).

	TOA (DRE_{TOA})	**Atmosphere** (DRE_{atm})	**Surface**	
			DRE_{surf}	$DRE_{netsurf}$
Year	-1.2±0.1 (-2.5±0.2)	11.4±0.3 (14.5±0.3)	-15.9±0.4 (-22.2±0.5)	-12.6±0.4 (-17.7±0.5)
DJF	-0.7±0.3 (-2.5±0.7)	3.9±1.6 (5.6±2.1)	-6.0±2.2 (-10.5±3.3)	-4.6±1.7 (-8.2±2.6)
MAM	-0.9±0.3 (-3.3±0.2)	14.9±2.2 (19.6±2.9)	-20.1±3.1 (-28.6±3.9)	-15.9±2.5 (-22.9±3.1)
JJA	-2.3±0.6 (-4.4±0.7)	18.8±2.1 (22.1±2.7)	-26.2±2.4 (-32.7±3.1)	-21.1±1.9 (-26.5±2.4)
SON	-0.8±0.3 (-2.5±0.3)	7.9±4.6 (10.8±5.4)	-11.2±6.0 (-16.8±6.8)	-8.8±4.6 (-13.3±5.2)

Table S5. Relative percentage changes of aerosol direct radiative effects (DRE) over the broader Mediterranean basin over the period 2000-2007, based on deseasonalized anomalies of DREs. The numbers in parentheses indicate corresponding changes of DREs under clear-sky-conditions.

	TOA (DRE_{TOA})	**Atmospheric column** (DRE_{atm})	**Surface**	
			DRE_{surf}	$DRE_{netsurf}$
Year	-26.8 (-22.9)	-16.6 (-12.5)	-17.1 (-13.8)	-18.4 (-15.0)
DJF	-10.3 (-10.6)	-12.0 (-3.3)	-11.8 (-5.2)	-11.7 (-5.1)
MAM	-31.0 (-21.4)	-17.4 (-13.4)	-17.7 (-13.7)	-19.3 (-15.2)
JJA	-21.0 (-18.9)	-16.8 (-15.0)	-16.6 (-14.9)	-17.6 (-16.0)
SON	-25.3 (-30.0)	-20.9 (-17.7)	-21.3 (-20.5)	-21.8 (-20.9)

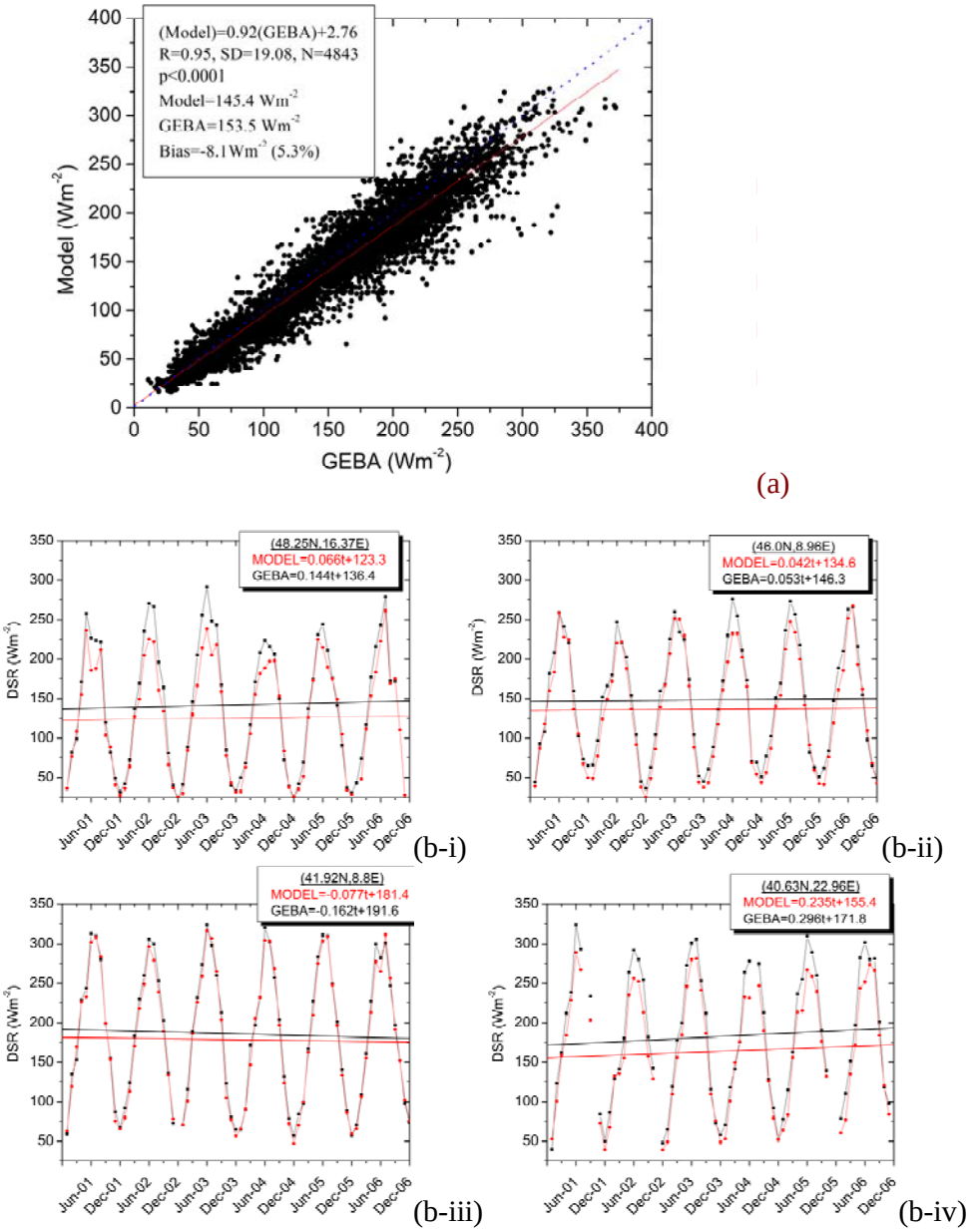
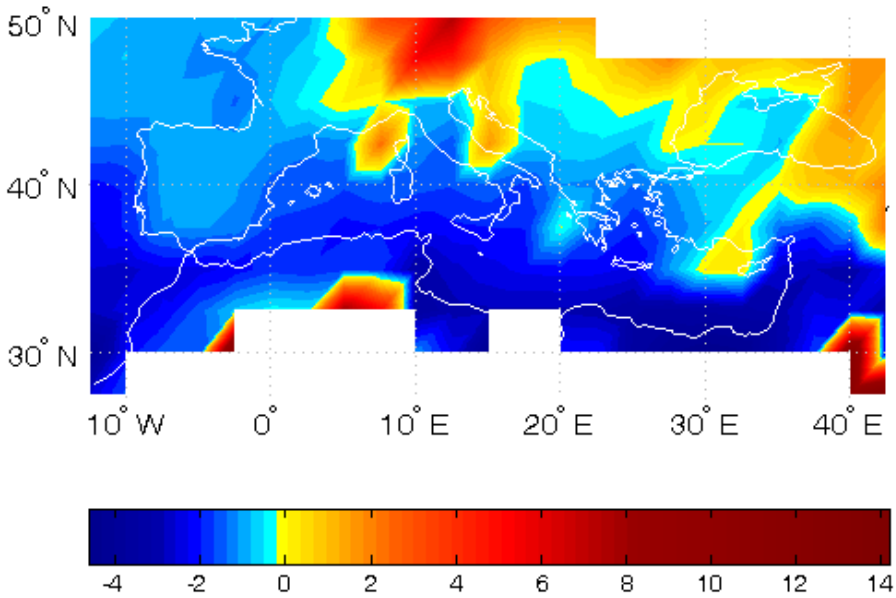
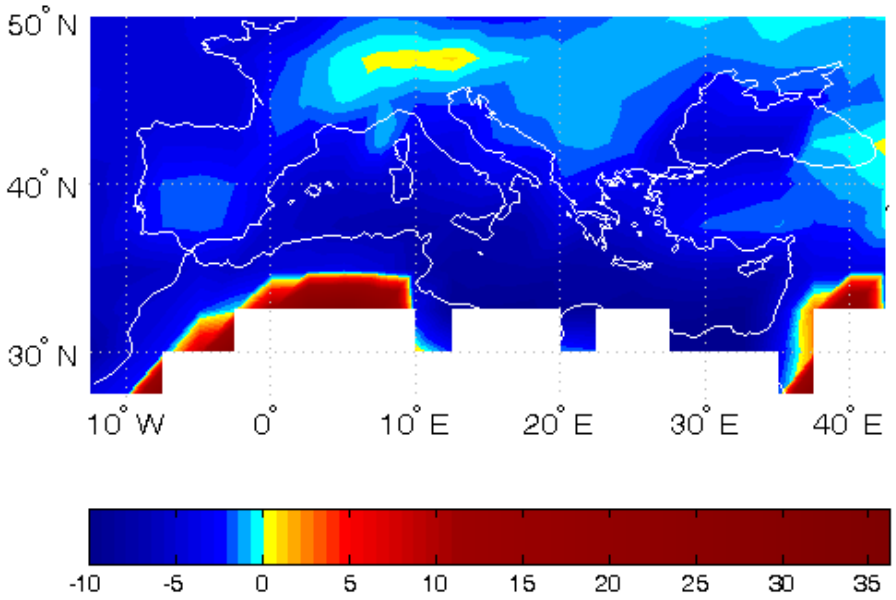


Figure S1. (a) Scatterplot comparison between model-computed and Global Energy Balance Archive (GEBA) grid-cell data of monthly average downward surface solar radiation (SSR) over the broader Mediterranean basin for the time period 2000–2007. The correlation coefficient (R), the standard deviation (SD) of differences between GEBA and model data, the total number of matched data pairs (N), the mean SSR values for GEBA and model together with their bias, and the equation for the applied linear regression fit between model and GEBA are also given. (b) Time-series of GEBA (black points) and model (red points) monthly SSR for the four selected

GEBA stations (see Table 6). The linear fits to the time-series are also shown (black solid lines for GEBA and red solid lines for model)**.**

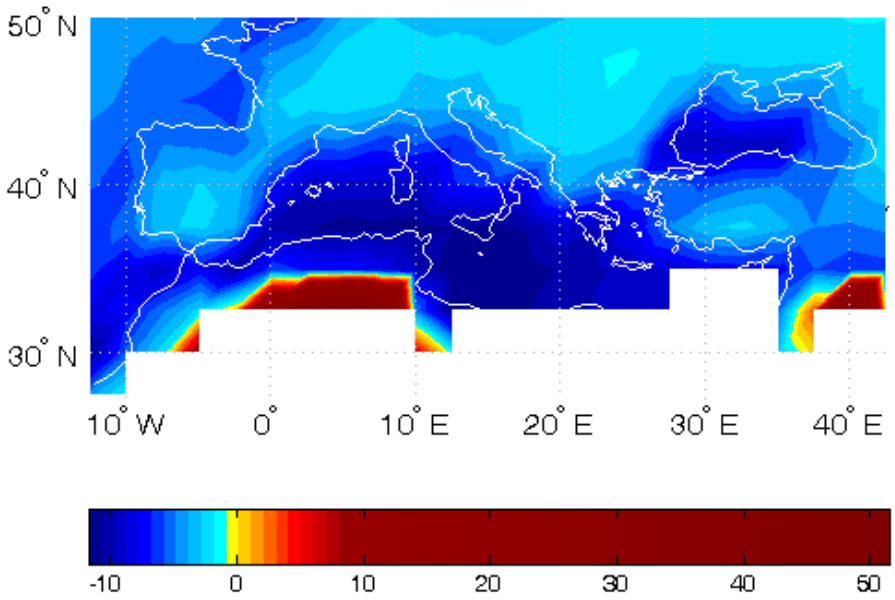


(i)



(ii)

Figure S2. Seasonal seven-year (2000-2007) average geographical distribution of aerosol direct radiative effect on the outgoing shortwave radiation at the top of the atmosphere (DRE_{TOA}, in Wm^{-2}) over the broader Mediterranean basin under all-sky conditions. Results are given for: (i) winter, (ii) spring, (iii) summer and (iv) autumn.



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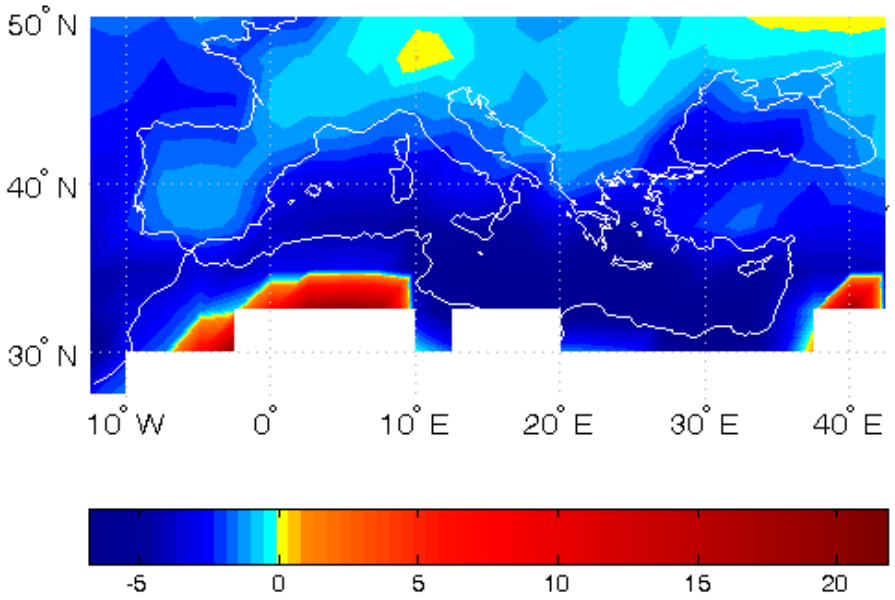
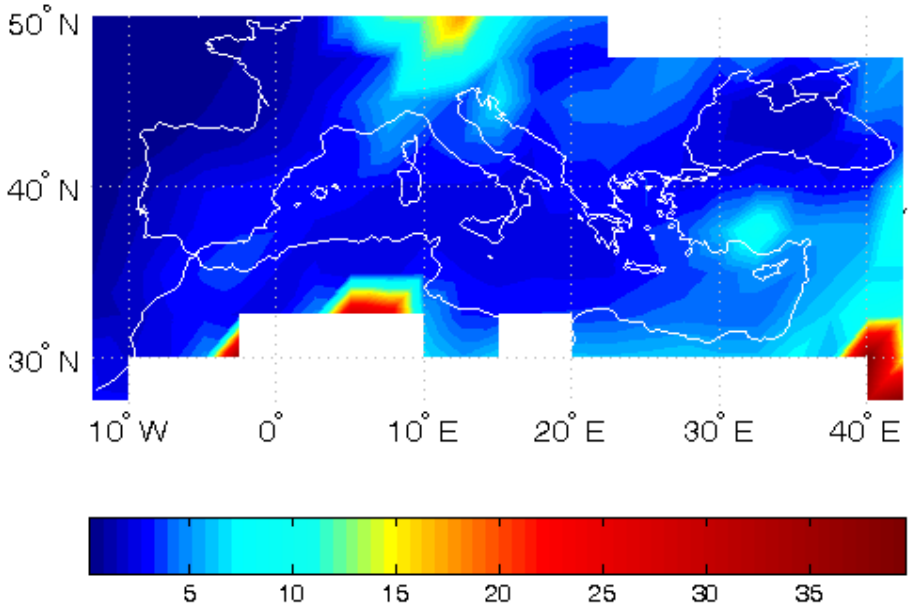
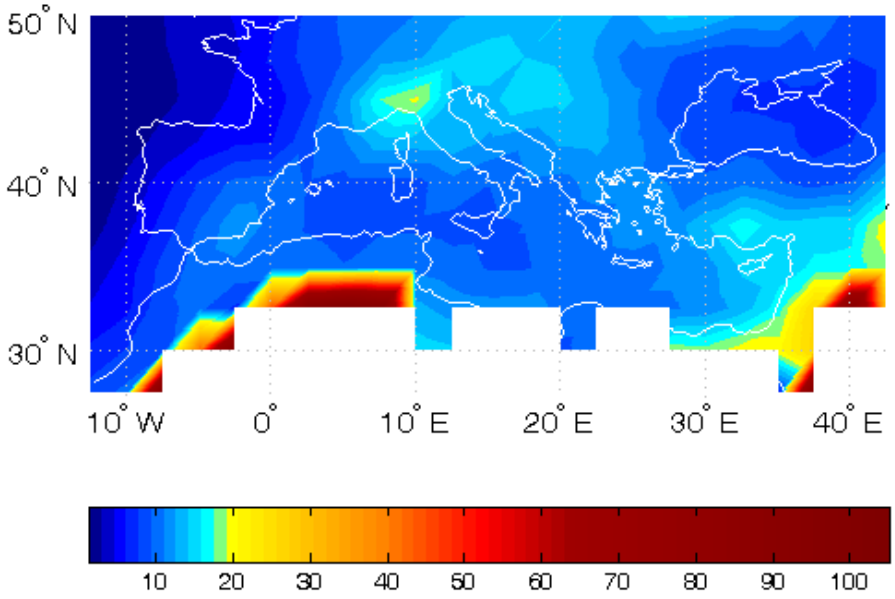


(iv)

Figure S2 (continued). Seasonal seven-year (2000-2007) average geographical distribution of aerosol direct radiative effect on the outgoing shortwave radiation at the top of the atmosphere (DRE_{TOA}, in Wm^{-2}) over the broader Mediterranean basin under all-sky conditions. Results are given for: (i) winter, (ii) spring, (iii) summer and (iv) autumn.

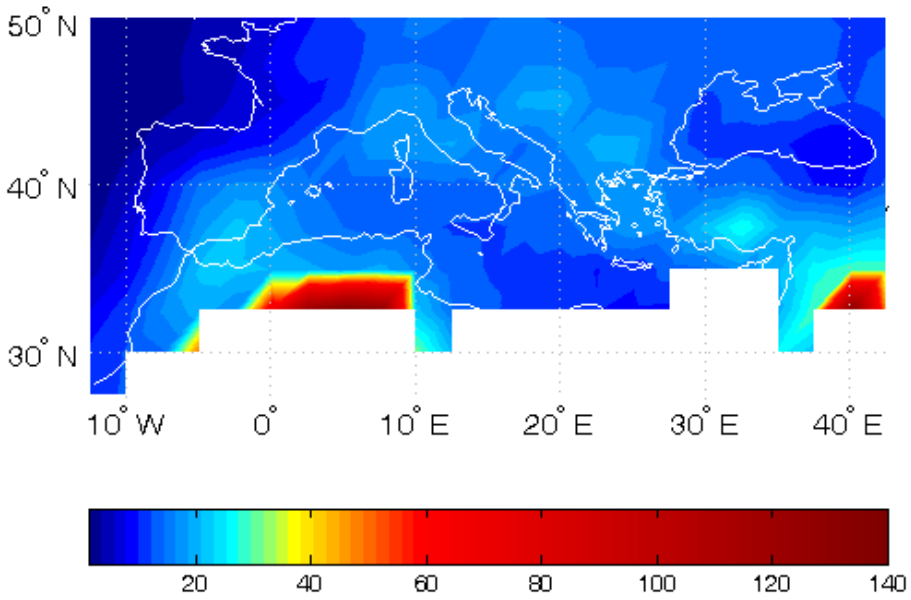


(i)

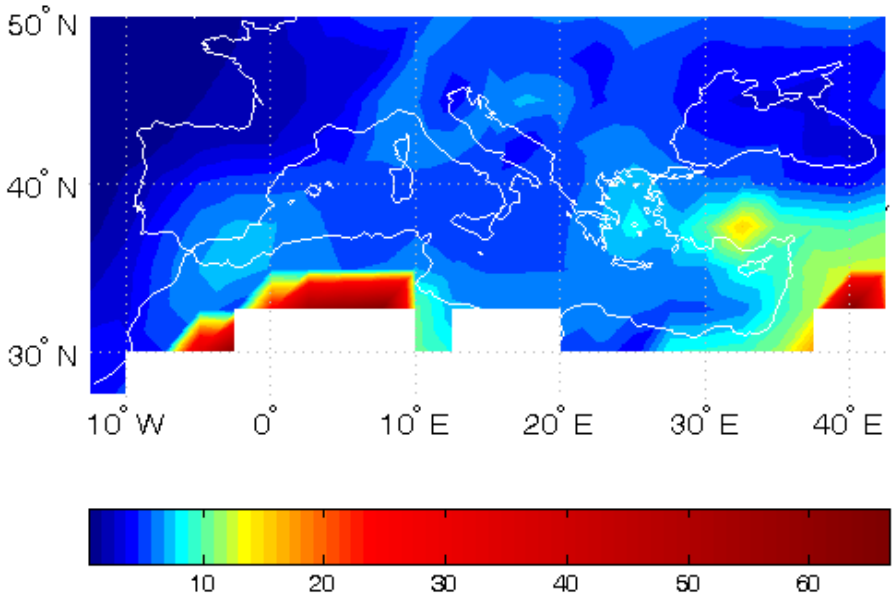


(ii)

Figure S3. Seasonal seven-year (2000-2007) average geographical distribution of aerosol direct radiative effect on the atmospheric absorption of shortwave radiation (DRE_{atm}, in Wm^{-2}) over the broader Mediterranean basin under all-sky conditions. Results are given for: (i) winter, (ii) spring, (iii) summer and (iv) autumn.

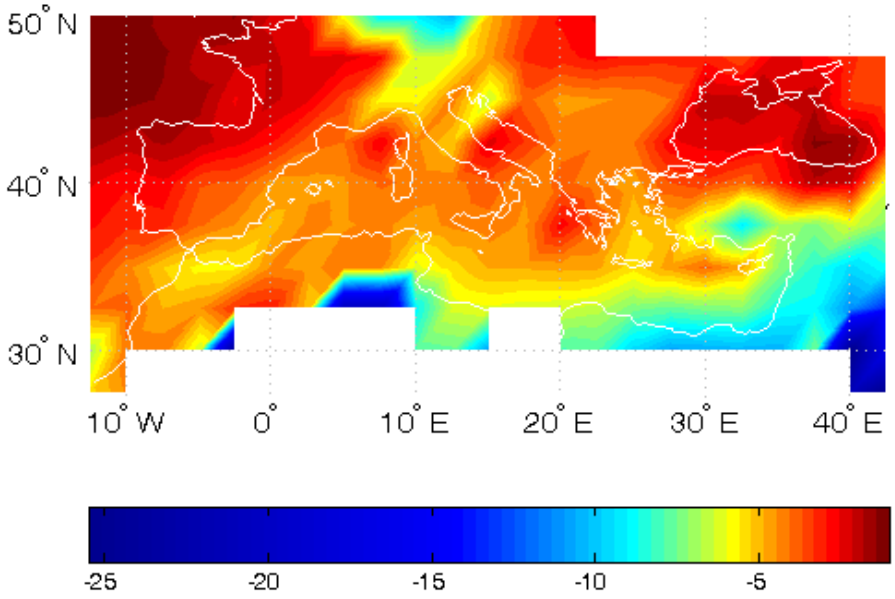


(iii)



(iv)

Figure S3 (continued). Seasonal seven-year (2000-2007) average geographical distribution of aerosol direct radiative effect on the atmospheric absorption of shortwave radiation (DRE_{atm}, in Wm^{-2}) over the broader Mediterranean basin under all-sky conditions. Results are given for: (i) winter, (ii) spring, (iii) summer and (iv) autumn.



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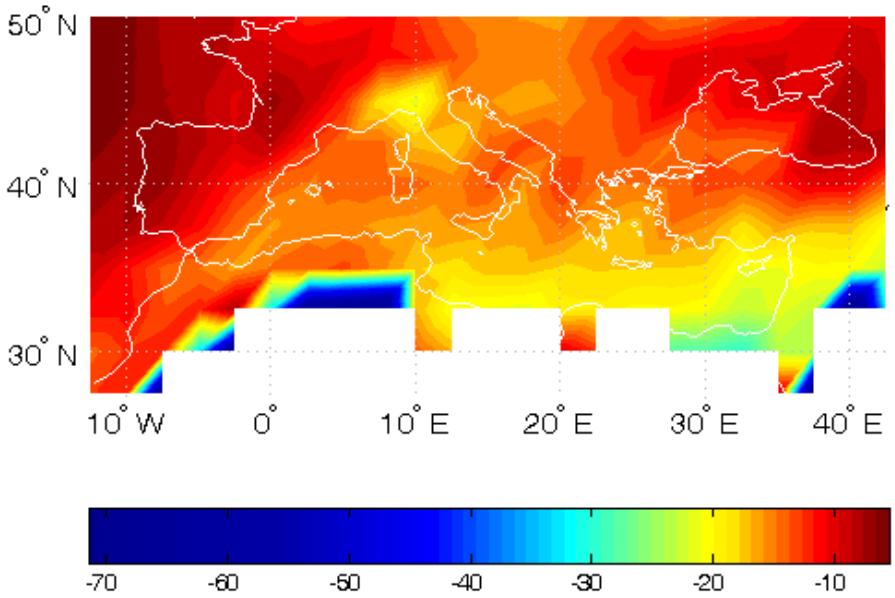
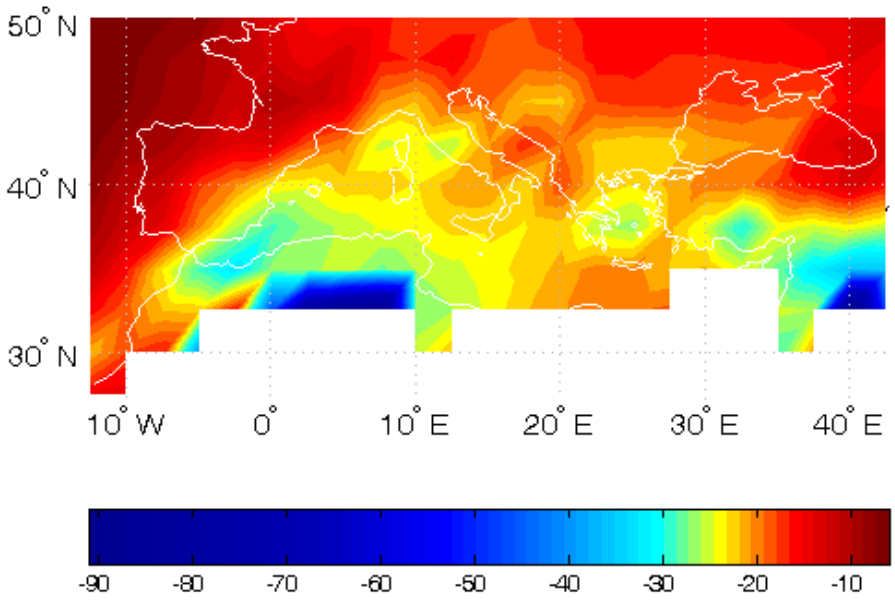
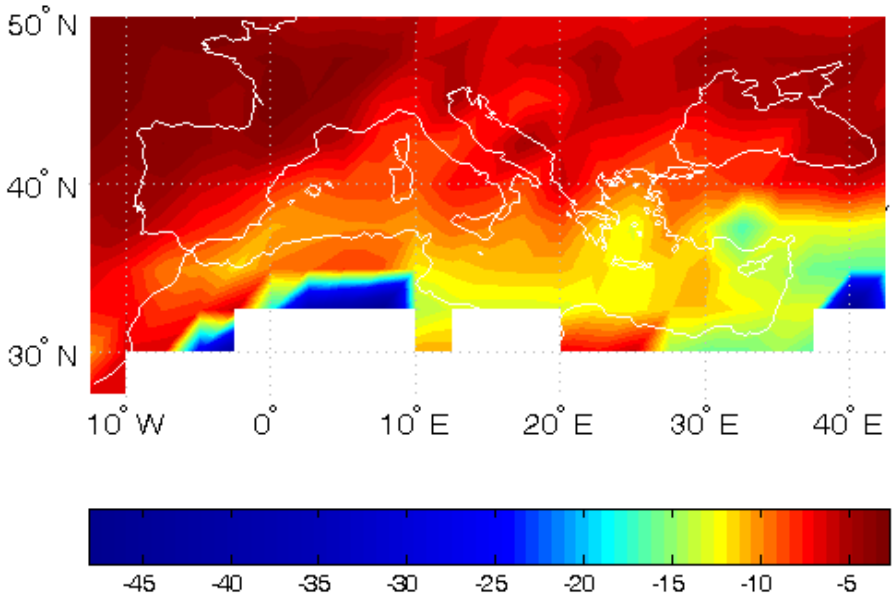


(ii)

Figure S4. Seasonal seven-year (2000-2007) average geographical distribution of aerosol direct radiative effect on the absorbed solar radiation at the Earth's surface ($DRE_{netsurf}$, in Wm^{-2}) over the broader Mediterranean basin under all-sky conditions. Results are given for: (i) winter, (ii) spring, (iii) summer and (iv) autumn.

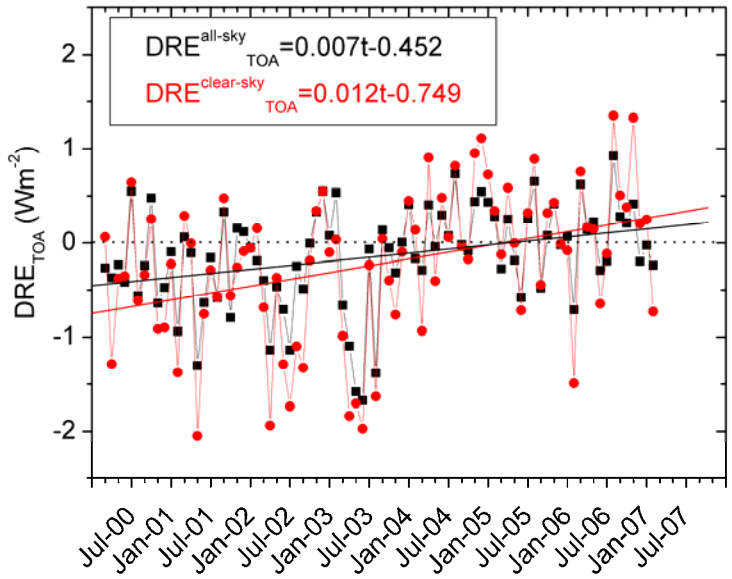


(iii)

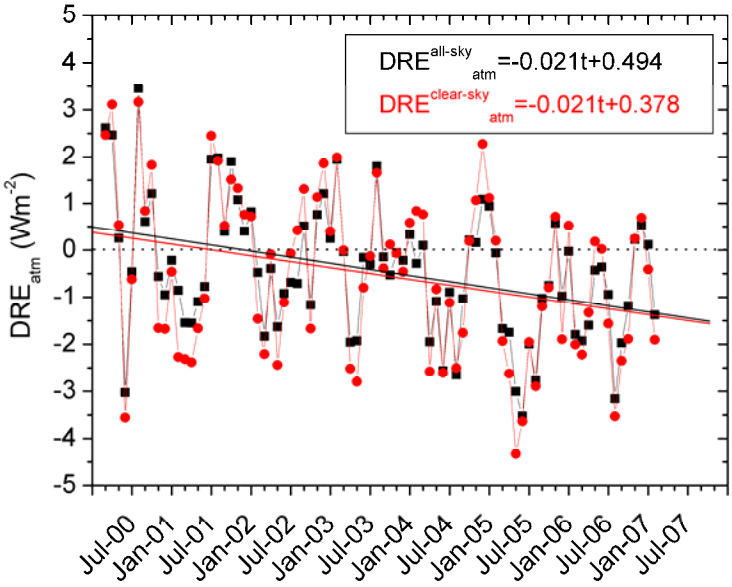


(iv)

Figure S4 (continued). Seasonal seven-year (2000-2007) average geographical distribution of aerosol direct radiative effect on the absorbed solar radiation at the Earth's surface ($DRE_{netsurf}$, in Wm^{-2}) over the broader Mediterranean basin under all-sky conditions. Results are given for: (i) winter, (ii) spring, (iii) summer and (iv) autumn.

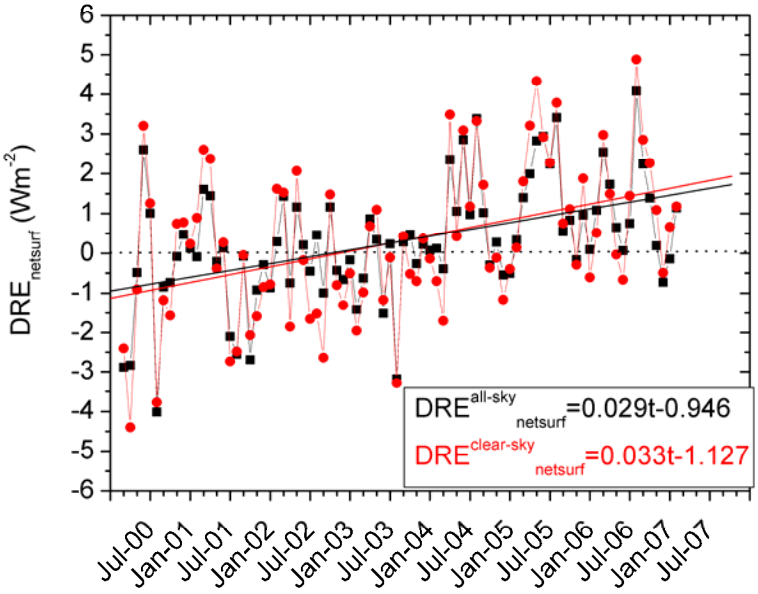


(a)



(b)

Figure S5. Time series (2000-2007) of mean regional monthly values of deseasonalized anomalies of: (a) DRE_{TOA}, (b) DRE_{atm} and (c) $DRE_{netsurf}$ (in Wm^{-2}) for the broader Mediterranean basin, under all-sky (black line) and clear-sky (red line) conditions.



(c)

Figure S5 (continued). Time series (2000-2007) of mean regional monthly values of deseasonalized anomalies of: (a) DRE_{TOA}, (b) DRE_{atm} and (c) $DRE_{netsurf}$ (in Wm^{-2}) for the broader Mediterranean basin, under all-sky (black line) and clear-sky (red line) conditions.