Impact of forest fires, biogenic emissions and high temperatures on the elevated Eastern Mediterranean ozone levels during the hot summer of 2007

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Table A1. Setup of the Oslo CTM2 model which has been used to provide chemical initial and boundary conditions to the WRF-Chem model.

Model	Oslo CTM2
Operated by	Univ. of Oslo
Developed by	Univ. of Oslo / CICERO
Model type	Global CTM
Horizontal resolution	T42 (approx. $2.8° \times 2.8°$)
Horizontal grid size	128×64
Number of vertical levels	60
Height of lowermost level	~16 m
Model top	0.1 hPa
Meteorology	ECMWF-IFS[a]
Chemistry scheme	Tropospheric (Berntsen and Isaksen, 1997) and stratospheric chemistry (Stordal et al., 1985) using QSSA solver (Hesstvedt et al., 1978)
Chemical species	98 (76 transported)
Chemical reactions	163 thermal + 47 photolytic
Anthropogenic emissions	EMEP (http://www.emep.int) for Europe and MACCity (Granier et al., 2011) for the rest of the world
Biomass burning emissions	GFEDv2 (van der Werf et al., 2006)
Biogenic emissions	POET (Olivier et al., 2003; Granier et al., 2005)
References	(Isaksen et al., 2005; Søvde et al., 2008)

[a]Documentation can be found at http://www.ecmwf.int/research/ifsdocs/

IASI   **WRF-Chem (FINN)**   **WRF-Chem (GFED)**
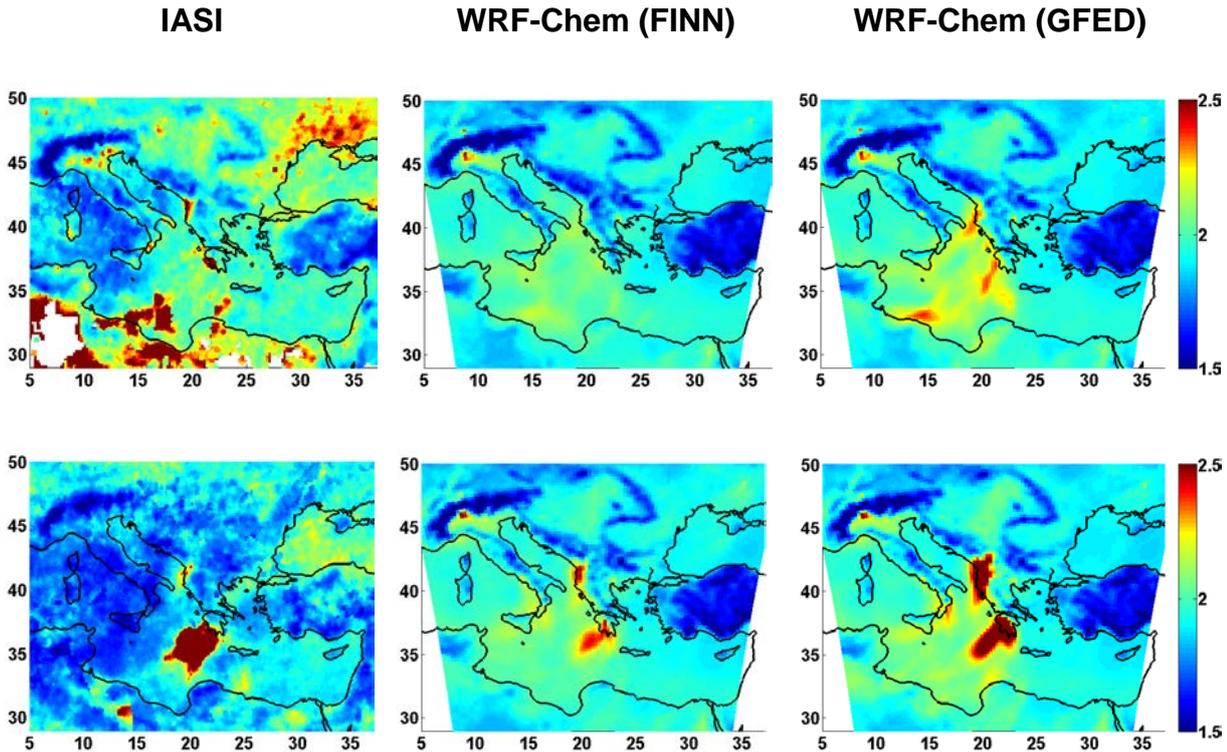
Figure A1. Total columns of CO (10^{18} molec cm^{-2}) as retrieved from the IASI satellite instrument (left), and as modelled with WRF-Chem using FINN (middle) and GFED (right) forest fires emissions. The data are averaged over the period 23-28 August 2007 for daytime (top) and nighttime (bottom) retrievals. The model data have not been weighted with averaging kernels – see Figure 6 in the manuscript for kernel weighted CO columns.
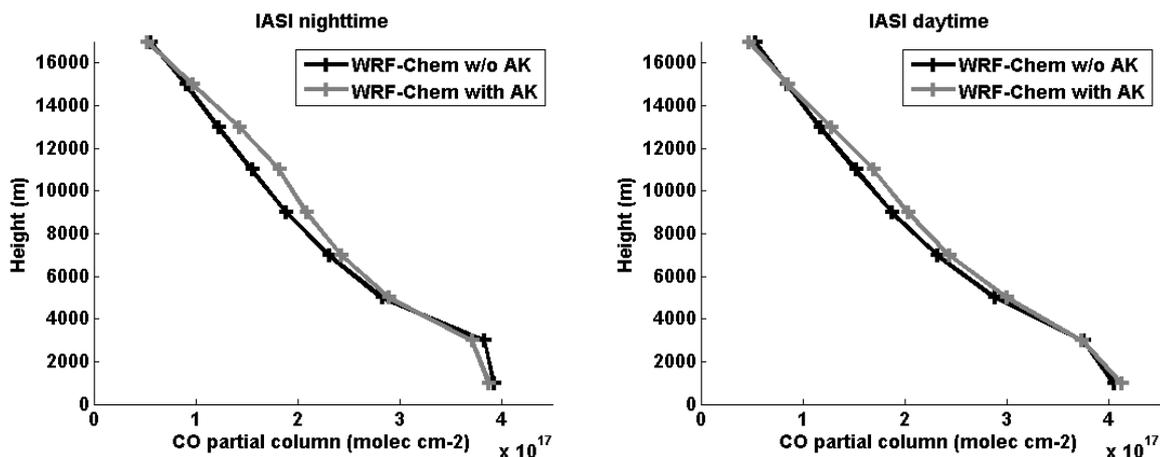
Figure A2. Comparison of partial columns of CO (molec cm^{-2}) simulated with WRF-Chem (without IASI averaging kernels applied; black line) and the WRF-Chem simulated IASI retrieval (with IASI averaging kernels applied; grey line) for nighttime (left) and daytime (right) retrievals. See manuscript text for details on averaging kernels. The partial columns have been averaged spatially over the geographical domain in Figure A1 and temporally for the period 23-28 August 2007.

IASI   **WRF-Chem (FINN)**   **WRF-Chem (GFED)**

Max: 2.9×10^{19} molec cm^{-2} Max: 2.7×10^{18} molec cm^{-2} Max: 2.9×10^{18} molec cm^{-2}

Max: 2.7×10^{19} molec cm^{-2} Max: 3.0×10^{18} molec cm^{-2} Max: 2.9×10^{18} molec cm^{-2}
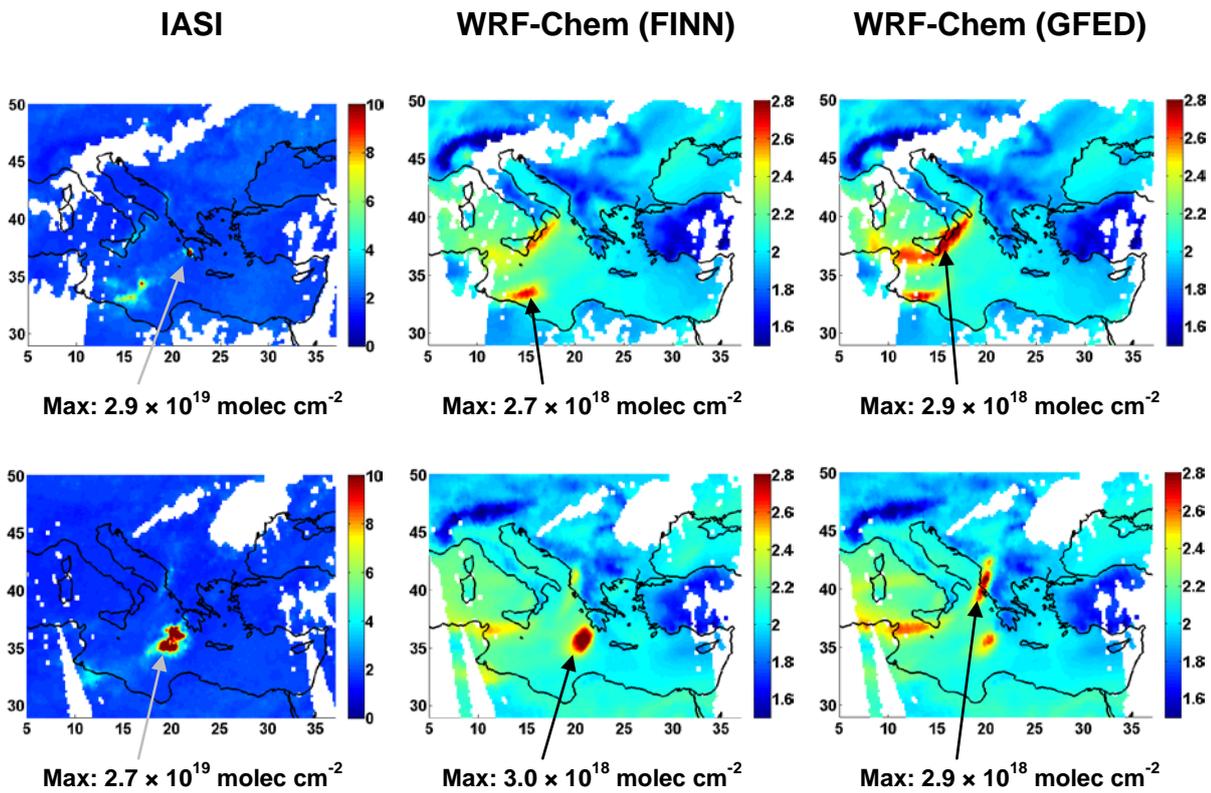
Figure A3. Kernel weighted total columns of CO (10^{18} molec cm^{-2}) as retrieved from the IASI satellite instrument (left), and as modelled with WRF-Chem using FINN (middle) and GFED (right) forest fires emissions. The data are from 25 August 2007 for daytime (top) and nighttime (bottom) retrievals. The model data have been weighted with the same averaging kernels as the IASI data. Note that the scales are different.

OMI   **WRF-Chem (FINN)**   **WRF-Chem (GFED)**   **EMEP (GFED)**

Max: 1.6×10^{16} molec cm^{-2} Max: 3.0×10^{16} molec cm^{-2} Max: 1.8×10^{16} molec cm^{-2} Max: 7.7×10^{15} molec cm^{-2}
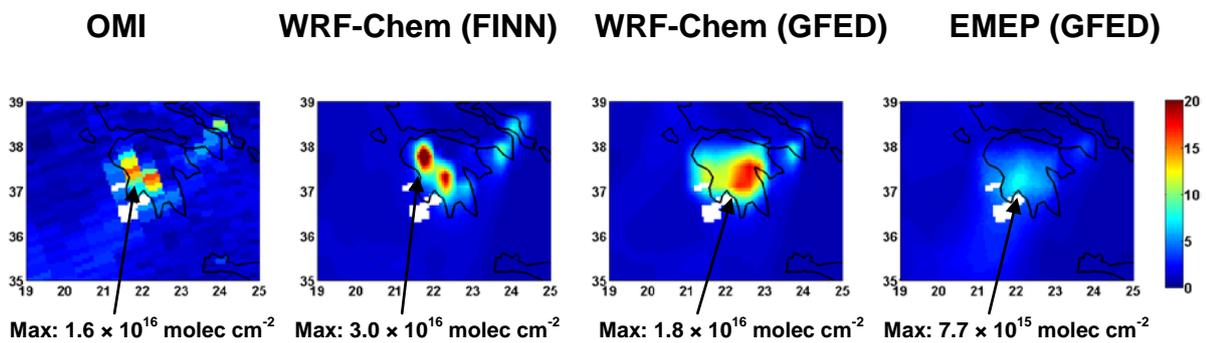
Figure A4. Tropospheric columns of NO$_2$ (10^{15} molec cm^{-2}) as retrieved from the OMI satellite instrument (1st column), and as modelled with the WRF-Chem (2nd and 3rd columns) and EMEP (4th column) models on 26 August 2007. In the second column, FINN forest fire emissions have been used in the simulations, while in the two rightmost columns, GFED emissions have been used.

WRF-Chem (GFED)   **EMEP (GFED)**
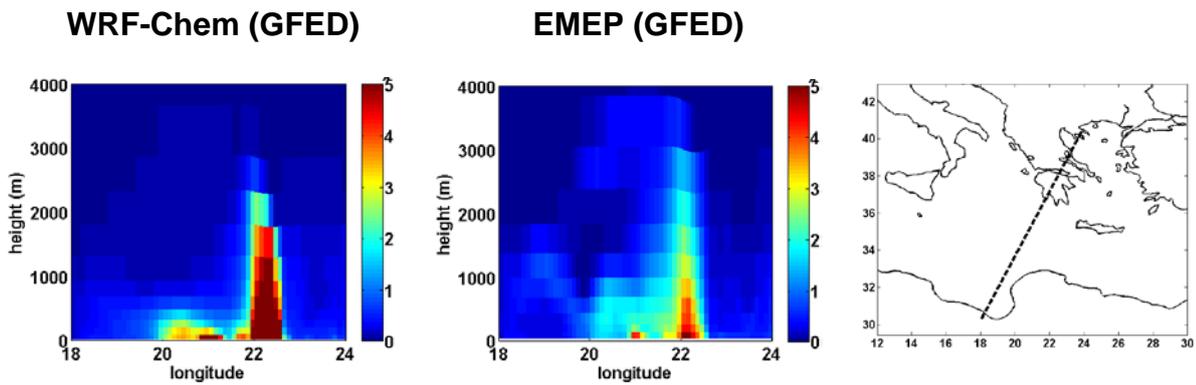
Figure A5. Vertical cross-section of NO_2 (10^{10} molec cm^{-3}) modelled with the WRF-Chem (left) and EMEP (middle) models on 26 August 2007 (both models using GFED forest fire emissions). The location of the vertical cross-sections is indicated by the dashed line in the rightmost plot.

15 July 2007   **16 July 2007**   **17 July 2007**

18 July 2007   **19 July 2007**   **20 July 2007**
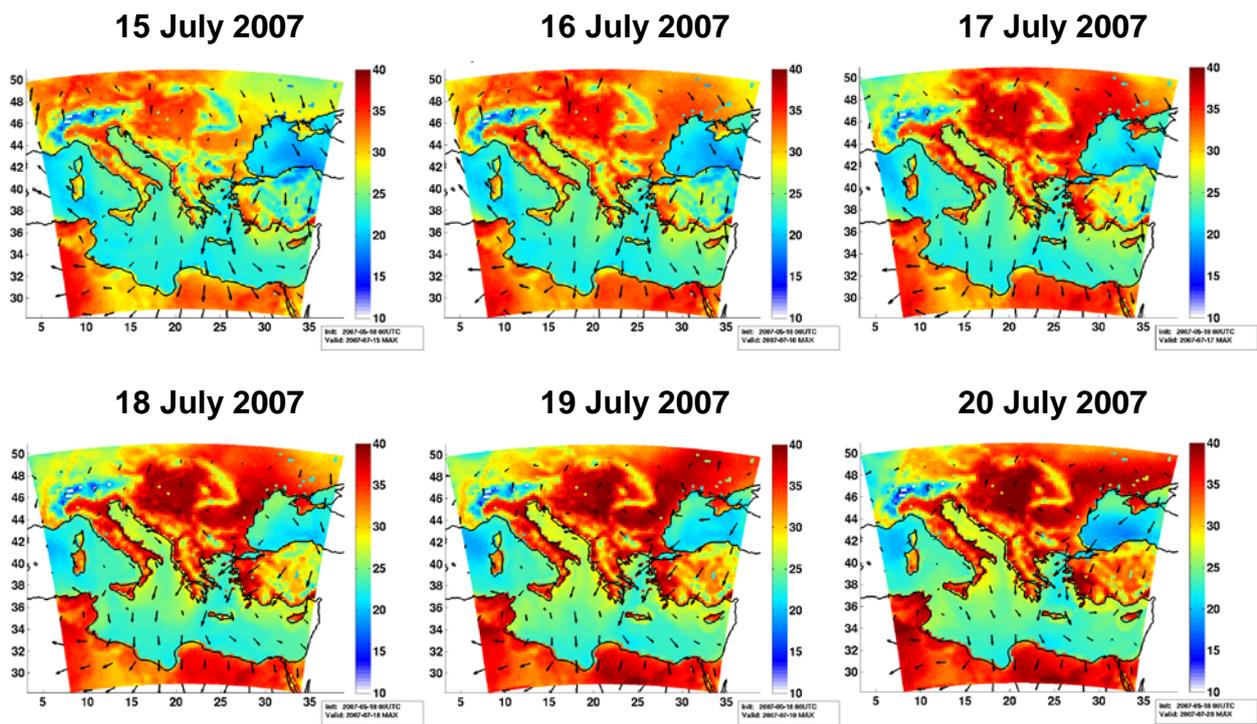
Figure A6. Daily maximum 2 m temperature (°C) and mean 10 m wind vectors for the period July 15-20 in 2007. Both temperature and winds are based on hourly output from the WRF-Chem model.
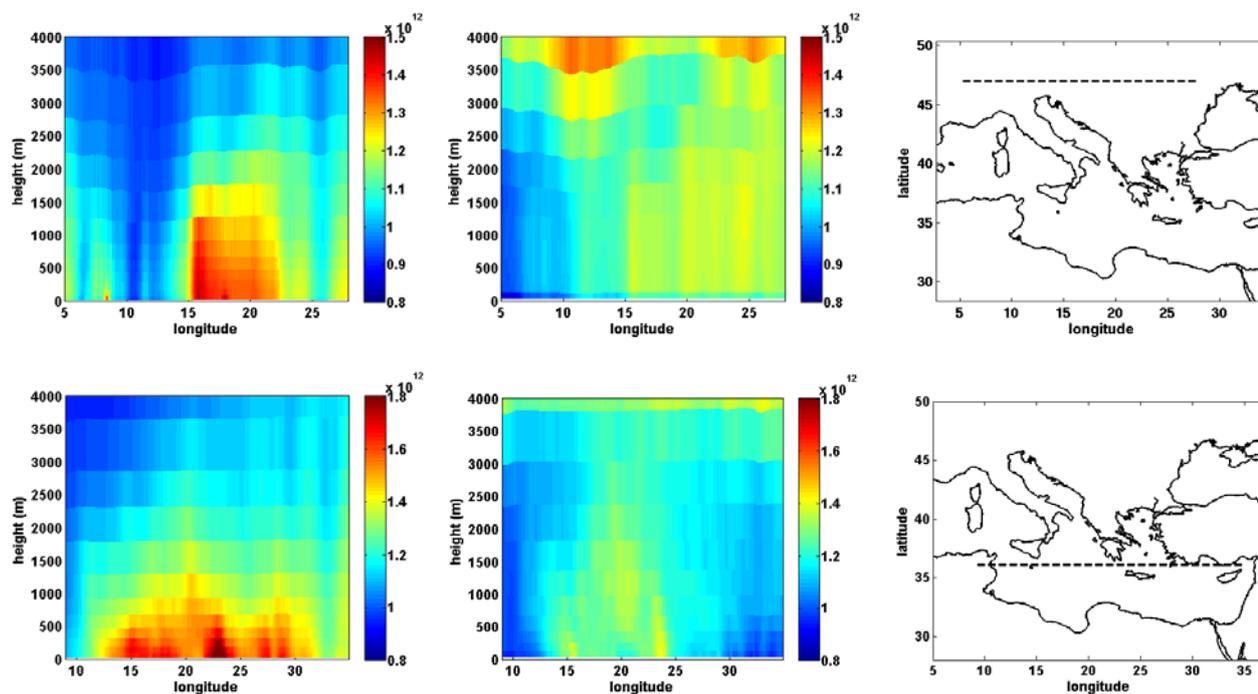
Figure A7. Vertical cross-sections of O$_3$ concentrations (molec cm^{-3}) modelled with WRF-Chem (left) and EMEP (middle) (both models using GFED emissions). The model results are monthly averaged at 12 UTC for each day in July. Cross-sections are shown for two different locations (see dashed line in right column plots); one over land (top row) and one over sea (bottom row).

WRF-Chem

EMEP MSC-W
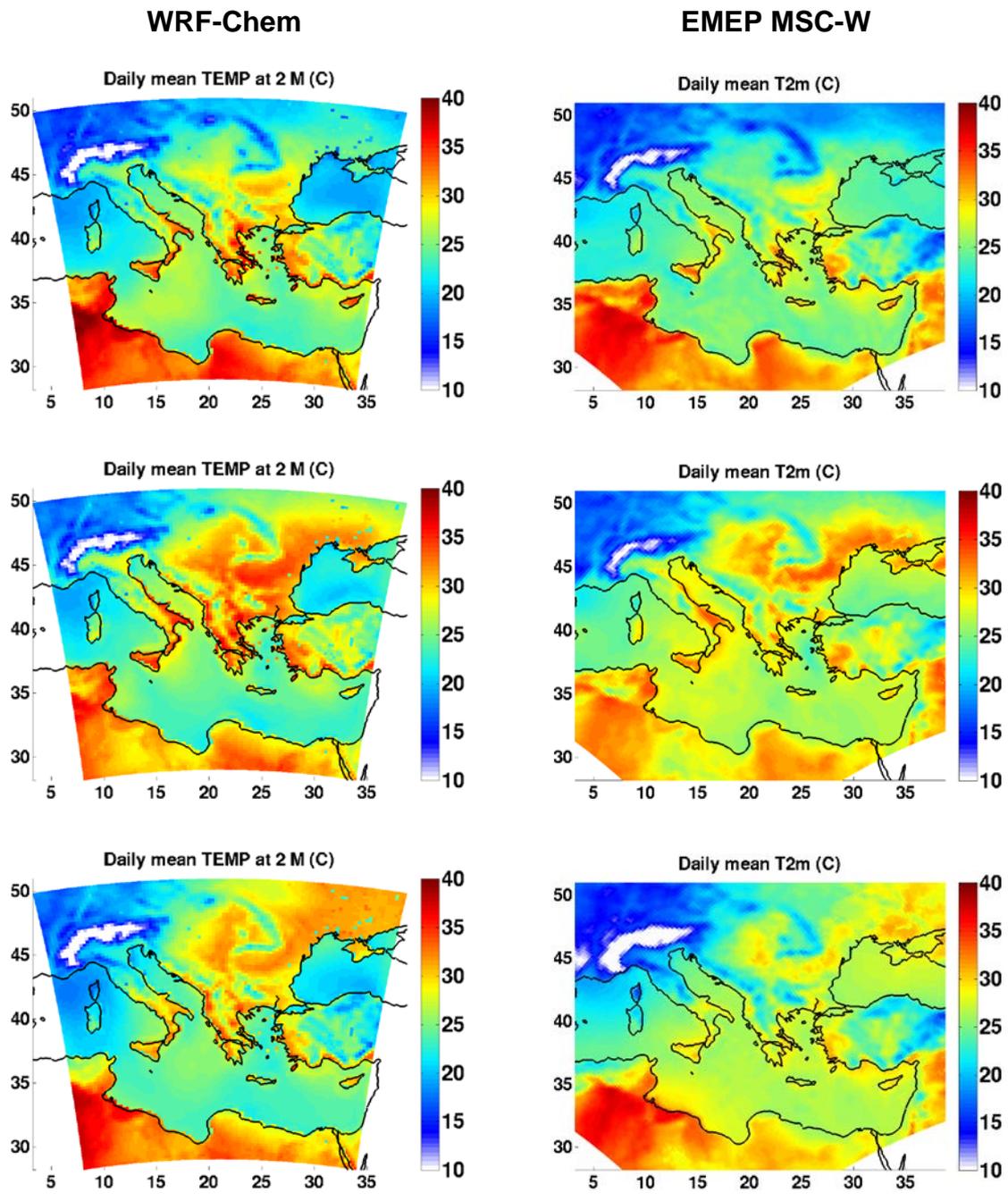
Figure A8. Daily mean 2 m temperature (°C) averaged over the periods June 24-26 (top), July 22-24 (middle), and August 22-24 (bottom) in 2007 as calculated by the WRF-Chem (left) and EMEP (right) models.

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