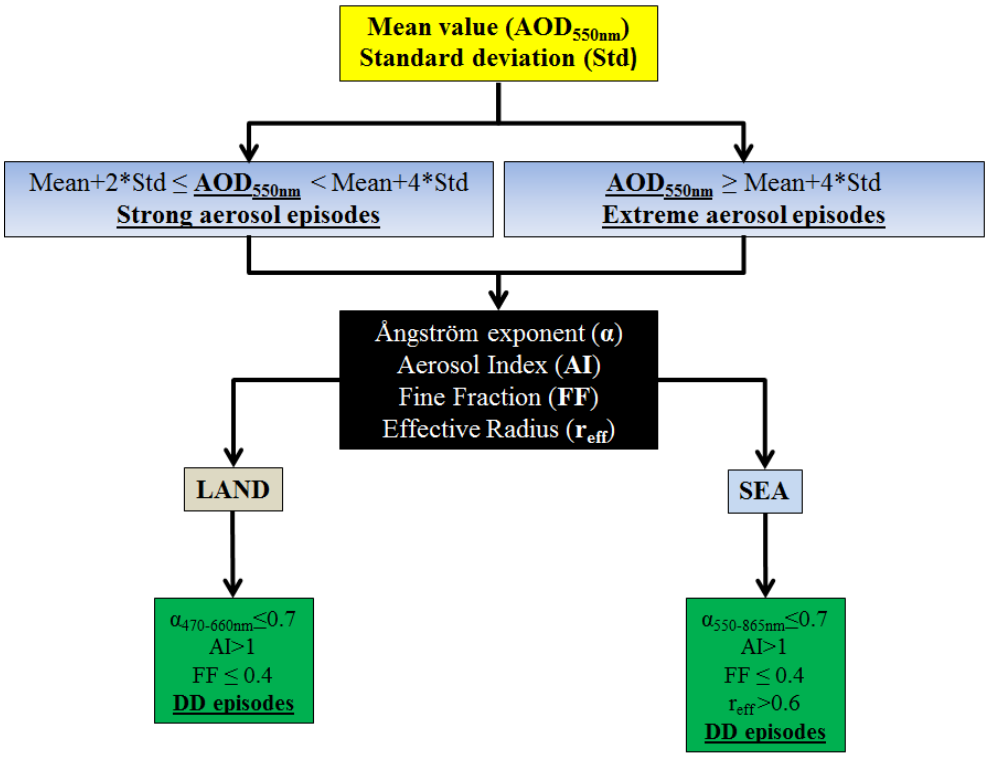



**Figure 1:** Methodology flowchart for the identification of the intense Mediterranean desert dust outbreaks.

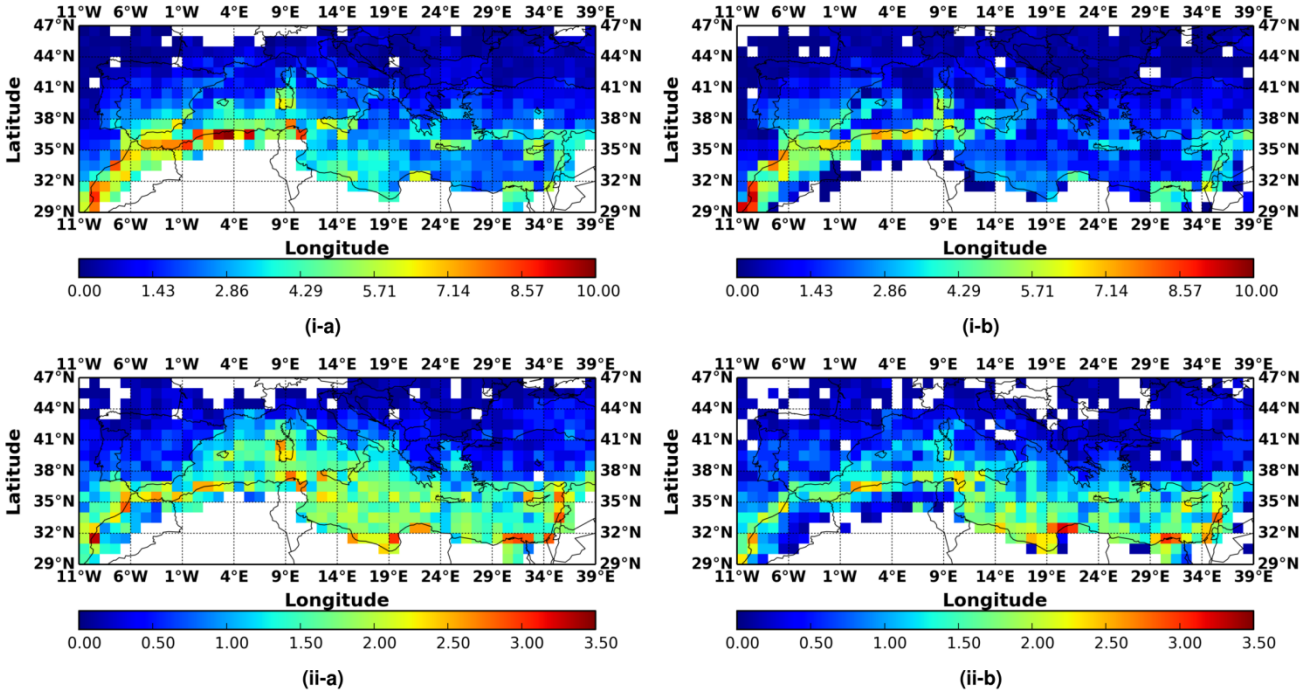



**Figure 2:** Geographical distributions of the occurrence frequency (episodes $yr^{-1}$) of: (i) strong and (ii) extreme desert dust episodes, averaged over the periods: (a) Mar. 2000 – Feb. 2013 (MODIS-Terra) and (b) 2003 – 2012 (MODIS-Aqua), over the broader area of the Mediterranean basin.

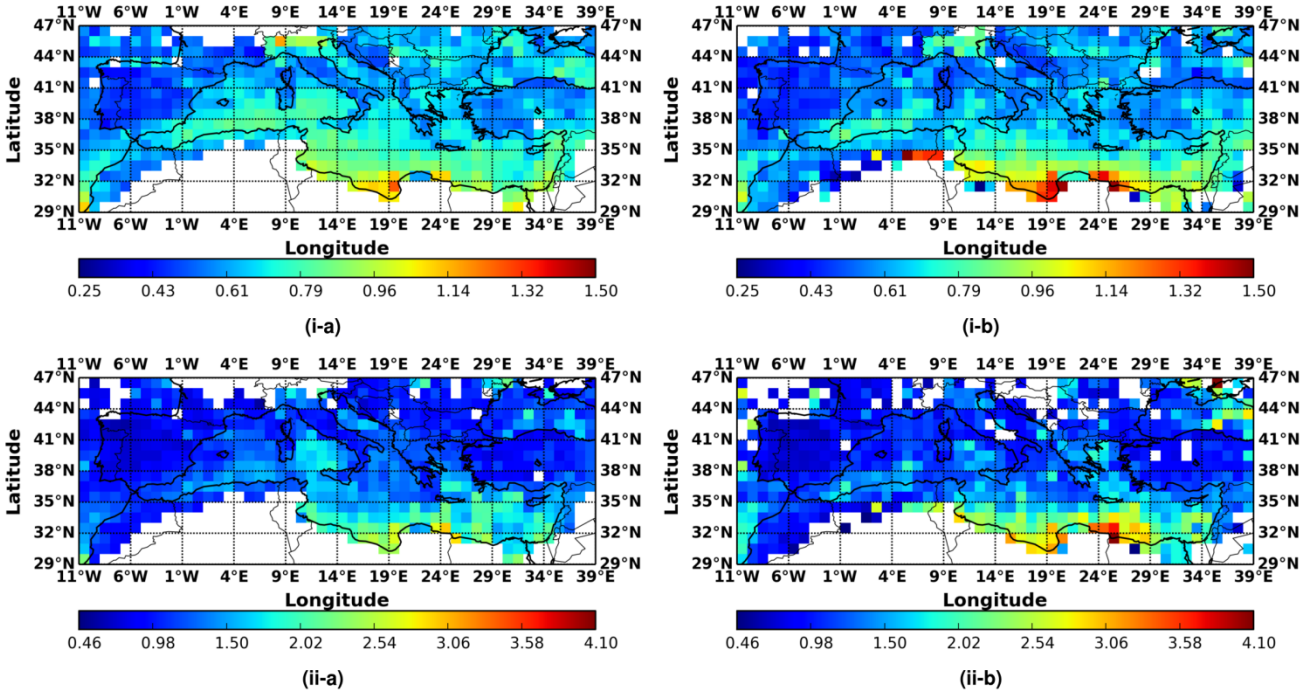
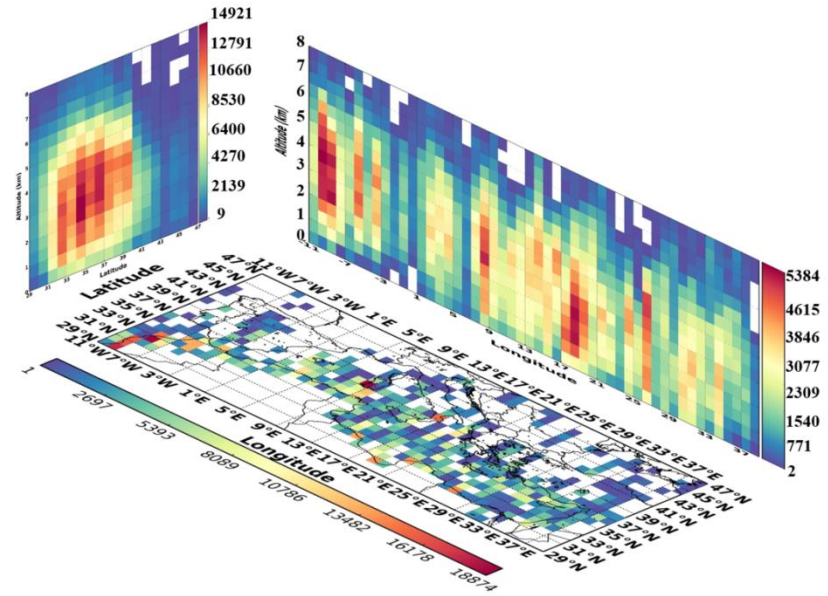
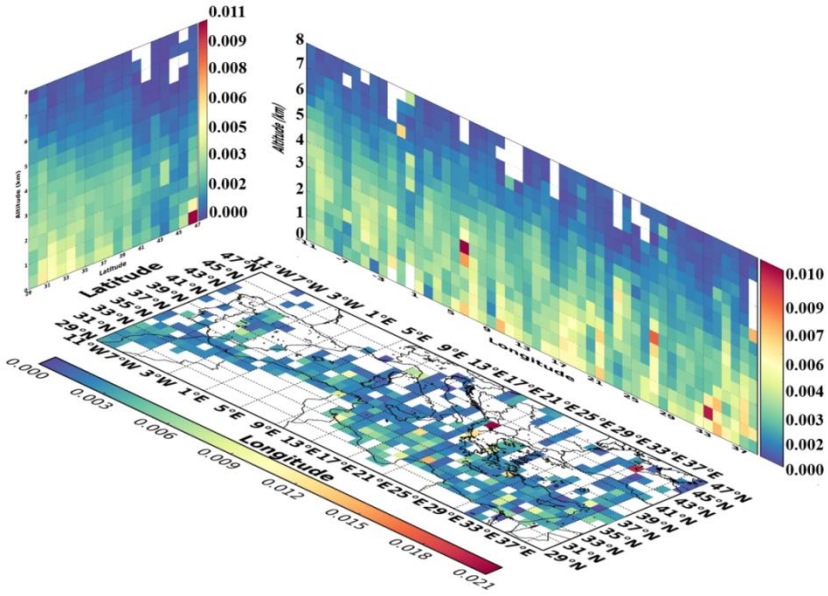



**Figure 3:** Geographical distributions of the intensity (in terms of $AOD_{550nm}$) of: (i) strong and (ii) extreme desert dust episodes, averaged over the periods: (a) Mar. 2000 – Feb. 2013 (MODIS-Terra) and (b) 2003 – 2012 (MODIS-Aqua), over the broader area of the Mediterranean basin.

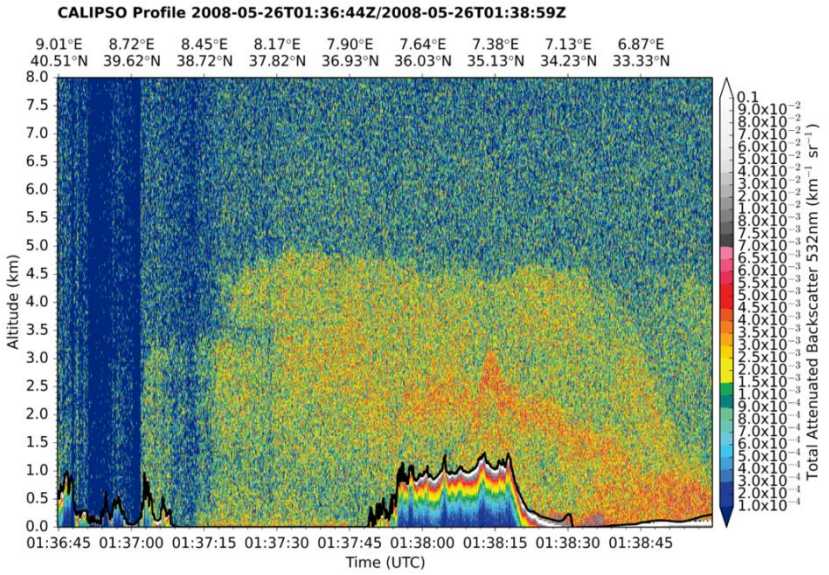



(i)

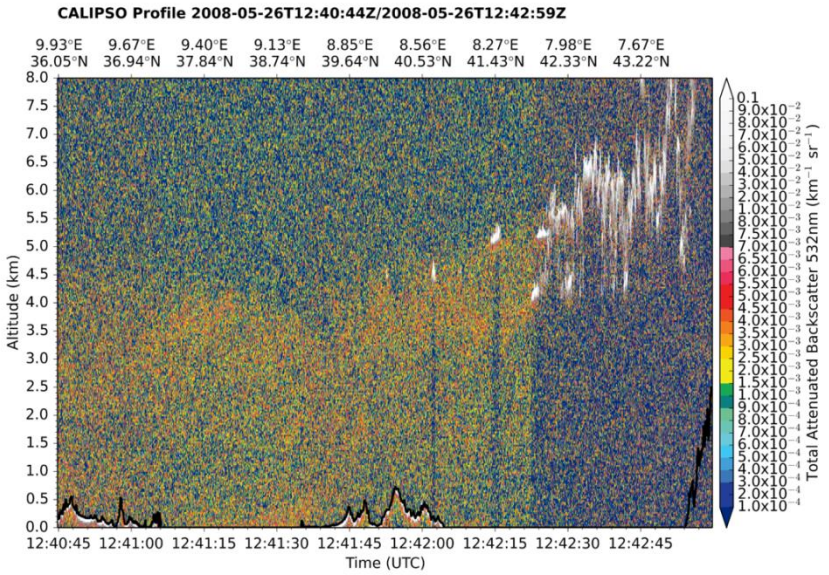



(ii)

**Figure 4:** Three dimensional structure of the: (i) overall number of dust and polluted dust observations and (ii) total backscatter coefficient at 532 nm (in $km^{-1}$ $sr^{-1}$), over the broader Mediterranean basin under DD episodes conditions, based on CALIOP-CALIPSO vertically resolved retrievals for the period Jun. 2006 – Feb. 2013.

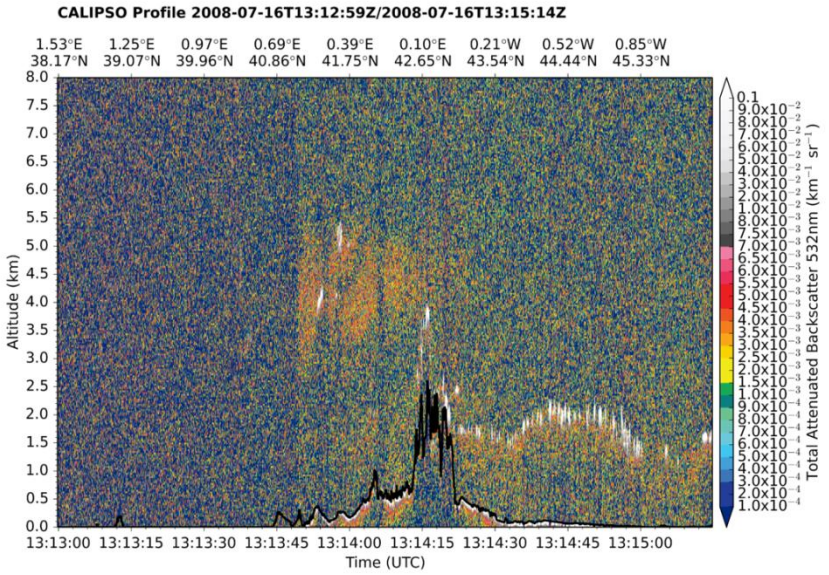



**(i)**

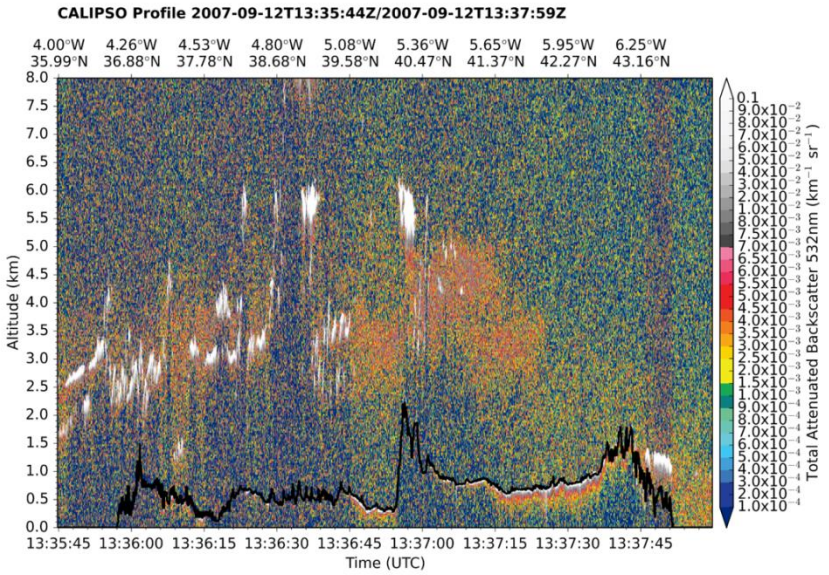



**(ii)**

**Figure 5:** Cross sections of the total backscatter coefficient at 532 nm (in $km^{-1}$ $sr^{-1}$) vertical profiles along the CALIOP-CALIPSO track during: (i) nighttime and (ii) daytime, on 26$^{th}$ May 2008, over the station Censt (Lat: 39.064, Lon: 8.457). The black thick solid line represents the surface elevation.




**(i)**




**(ii)**

**Figure 6:** Cross sections of the total backscatter coefficient at 532 nm (in $km^{-1}$ $sr^{-1}$) vertical profiles along the CALIOP-CALIPSO track during daytime over the stations: (i) Els Torms (Lat: 41.395, Lon: 0.721) on 16$^{th}$ July 2008 and (ii) San Pablo (Lat: 39.525, Lon: -4.353) on 12$^{th}$ September 2007. The black thick solid line represents the surface elevation.

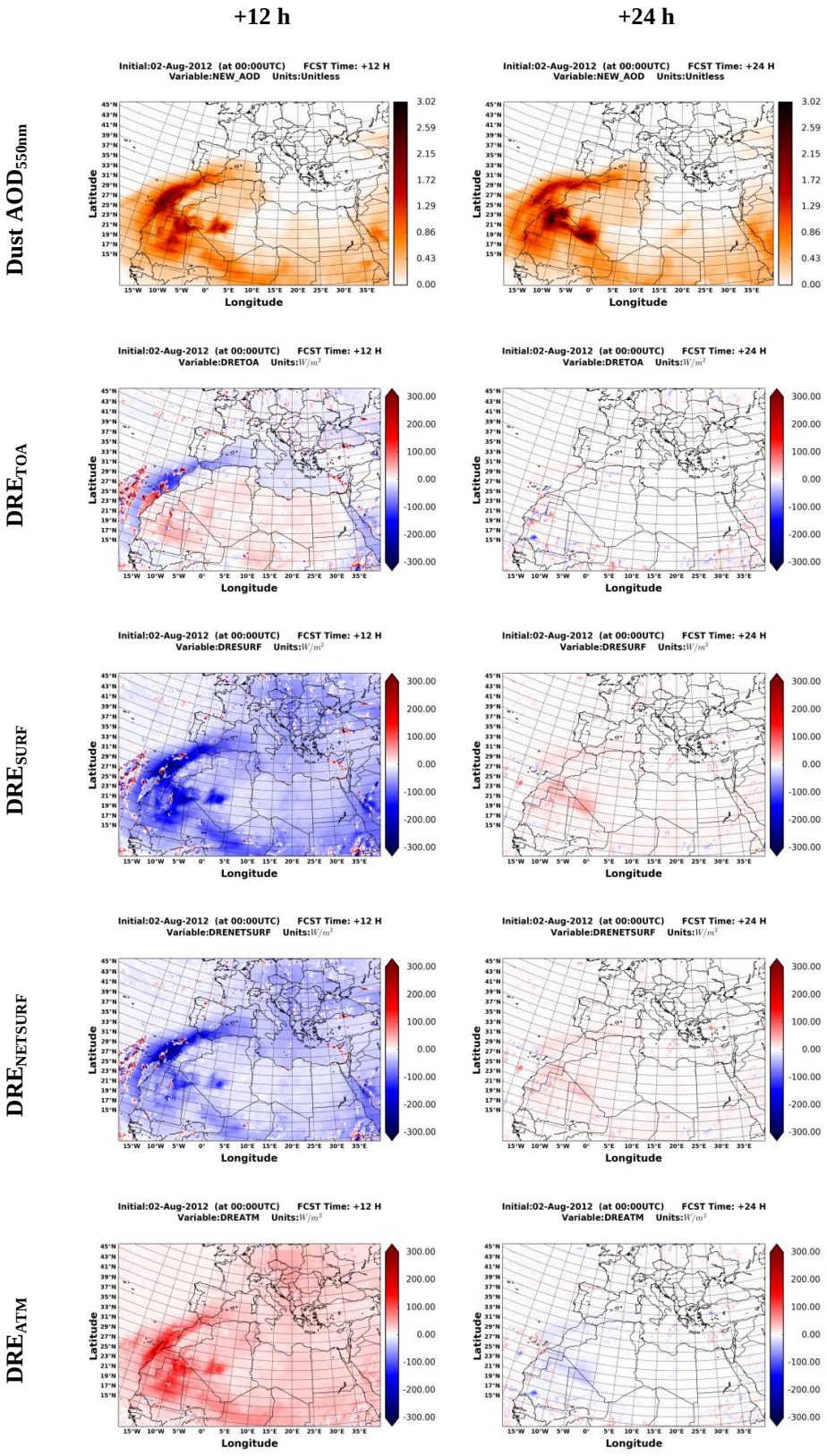



**Figure 7:** Dust aerosol optical depth at 550nm (Dust $AOD_{550nm}$) and instantaneous NET (SW+LW) direct radiative effects (DREs) at the top of the atmosphere (TOA), for the downwelling (SURF) and the absorbed radiation at the surface (NETSURF) and into the atmosphere (ATM), based on NMMB/BSC-Dust model simulations, for the 12 and 24 hours forecast of the 00 UTC cycle on 2nd August 2012.

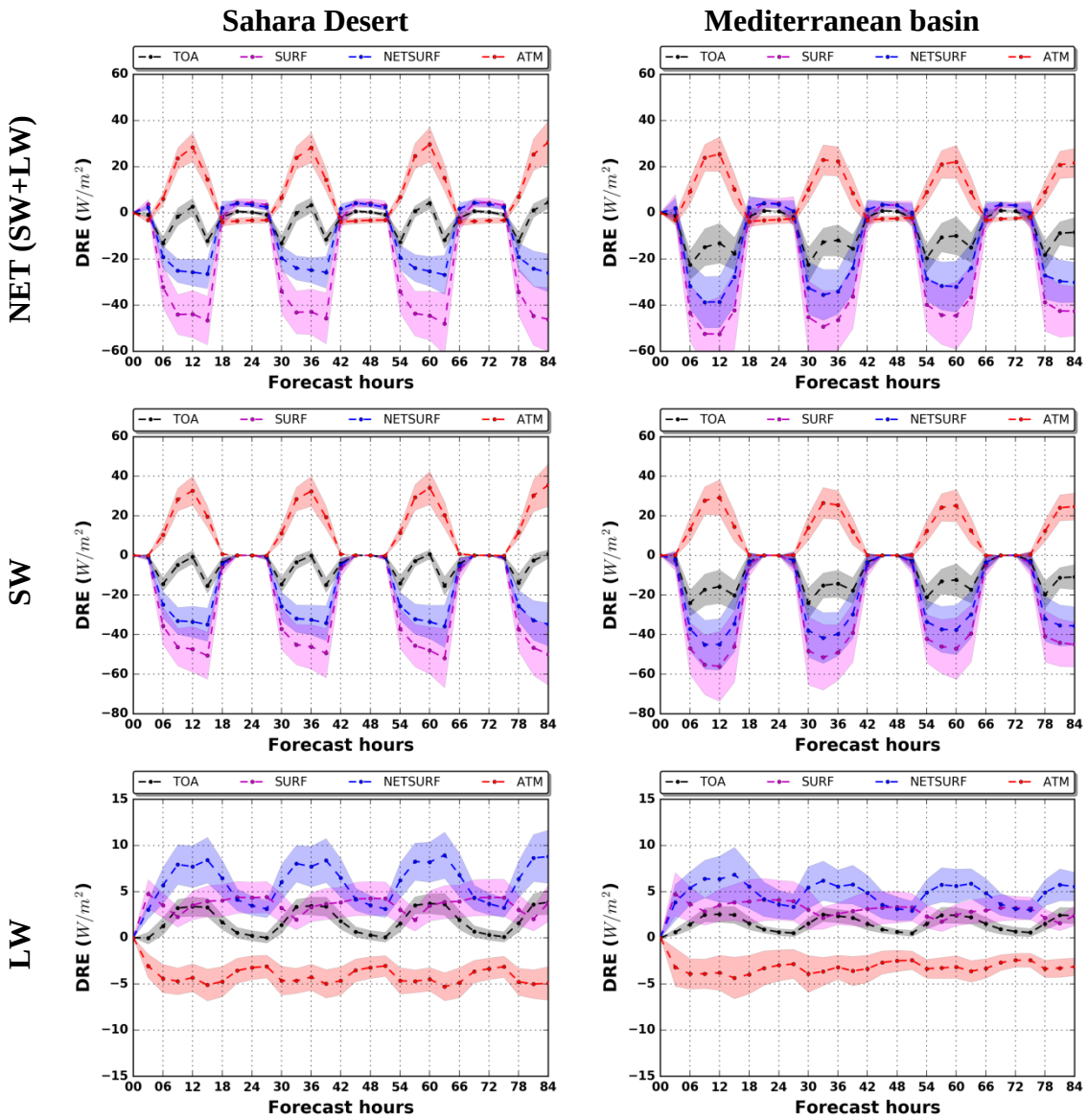



**Figure 8:** Regional NET (SW+LW), SW and LW DREs, calculated under clear sky conditions, over the Sahara desert and the broader Mediterranean basin, at the top of the atmosphere (TOA, black), for the downwelling (SURF, magenta) and the absorbed radiation at the surface (NETSURF, blue) and into the atmosphere (ATM, red). Each curve corresponds to the mean value calculated from the 20 desert dust outbreaks which are analyzed and the shaded areas represent the associated standard deviations.

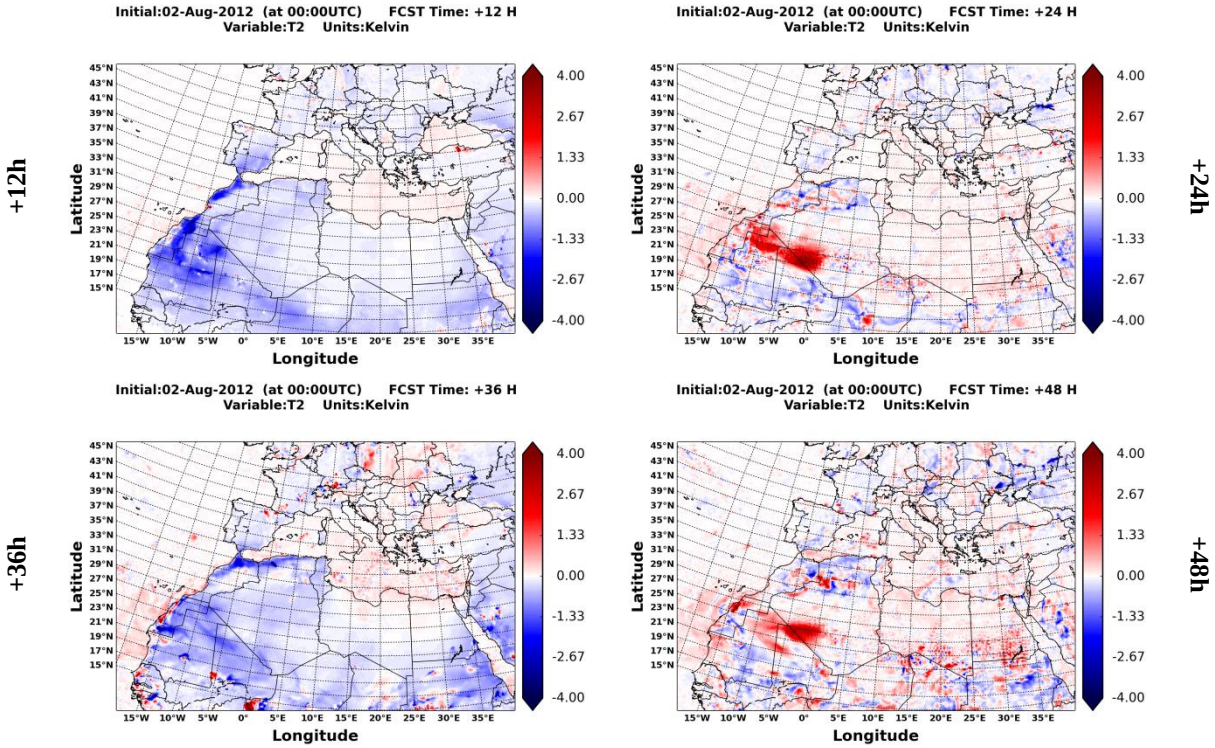



**Figure 9:** Spatial patterns of temperature differences at 2 meters, between the RADON and RADOFF NMMB/BSC-Dust simulations, for the 12, 24, 36 and 48 hours forecast of the 00 UTC cycle on 2nd August 2012.

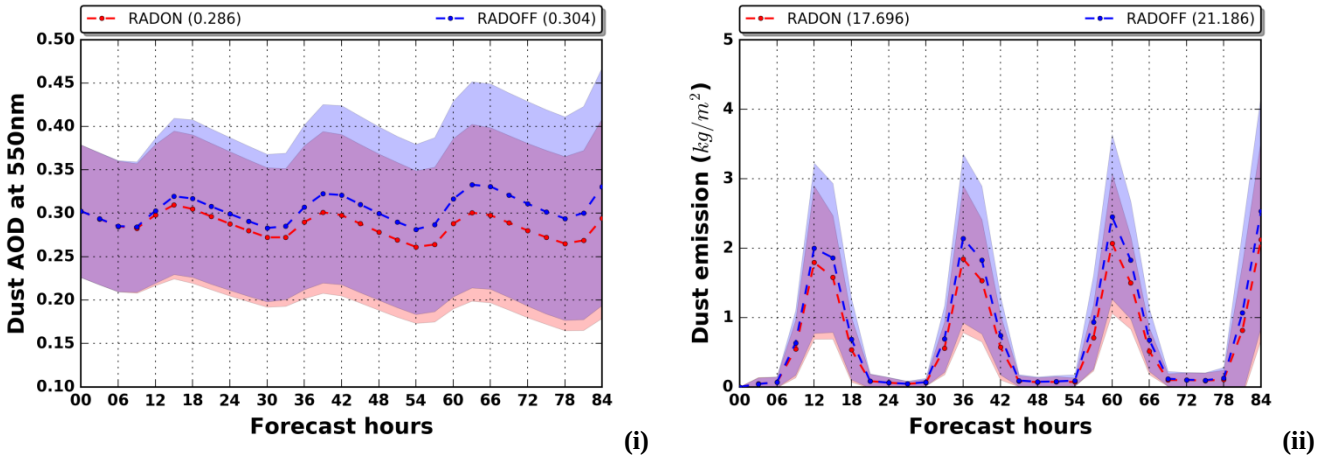



**Figure 10:** (i) Regional dust AOD at 550nm averaged over the whole simulation domain and (ii) Regional dust emission (in kg $m^{-2}$) aggregated over the whole simulation domain. Blue and red curves correspond to the mean values, calculated from the 20 desert dust outbreaks, for the RADOFF and RADON simulations, respectively, while the shaded areas represent the associated standard deviation values.

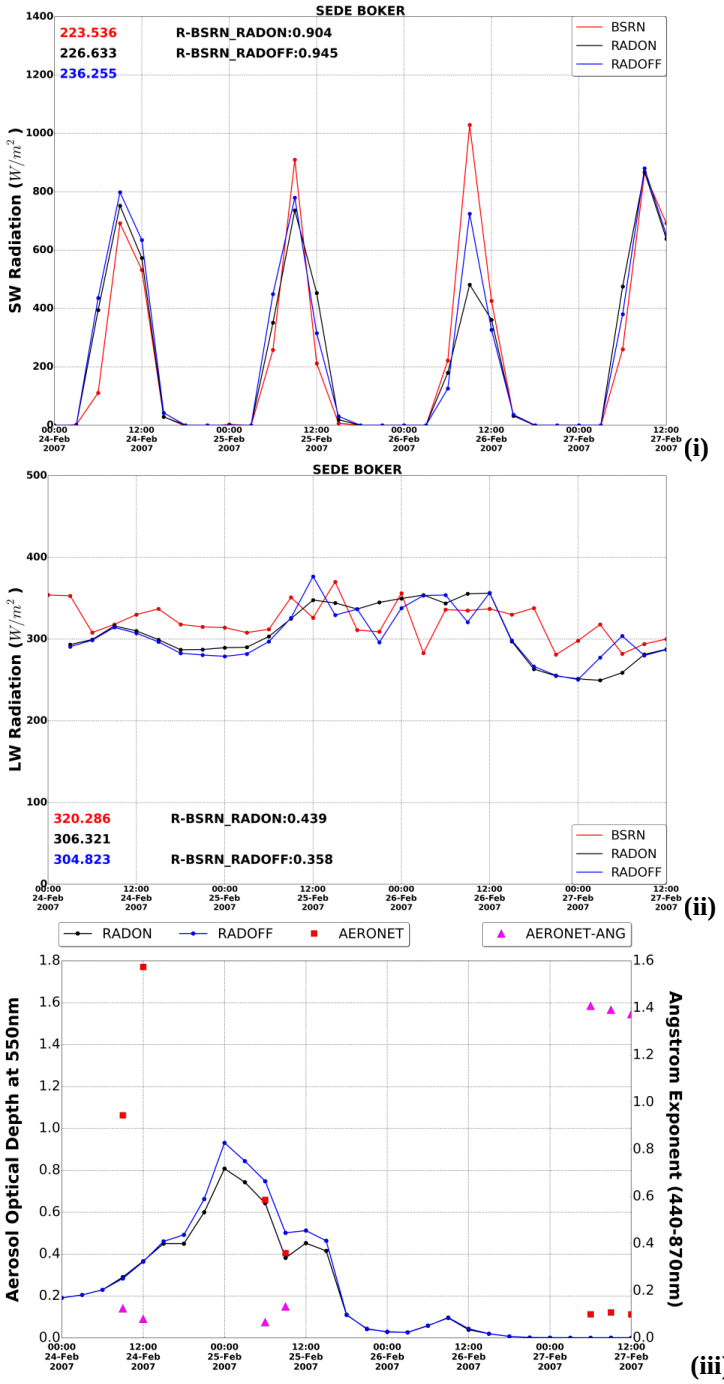
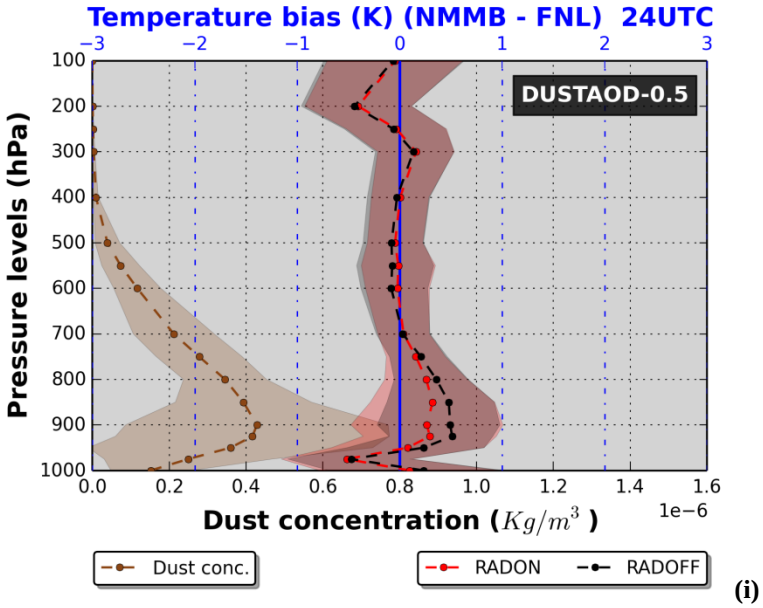
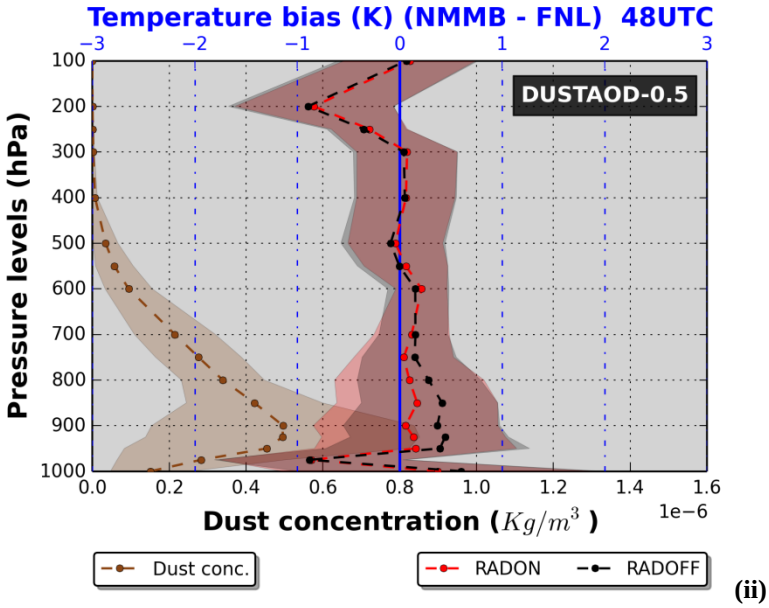



**Figure 11:** Timeseries of the downwelling: (i) SW and (ii) LW radiation measured at Sede Boker (red line), simulated based on the RADON (black line) and RADOFF (blue line) configuration of the NMMB/BSC-Dust model, between 00UTC on 24 February 2007 and 12UTC on 27 February 2007. The mean ground and modelled values along with the computed correlation coefficients (R) between RADON-BSRN and RADOFF-BSRN, both calculated over the simulation period, are also provided. (iii) Timeseries of the simulated dust AOD at 550 nm for the RADON (black line) and RADOFF (blue line) configuration of the NMMB/BSC-Dust model. Moreover, the AERONET total AOD at 550nm (blue squares) and AERONET Ångström exponent ($\alpha_{440\text{-}870nm}$) (magenta triangles) are provided.




**(i)**




**(ii)**

**Figure 12:** Mean vertical profiles, calculated from the 20 desert dust outbreaks, of regional biases, calculated over the whole simulation domain considering grid points where the dust AOD at 550nm is higher/equal than 0.5, between RADON-FNL (red line) and between RADOFF-FNL (black line). In addition, the mean vertical profile of the simulated dust concentration (in kg $m^{-3}$) is provided (brown curve). The shaded areas correspond to the computed standard deviation values from the 20 desert dust outbreaks.