



## *Supplement of*

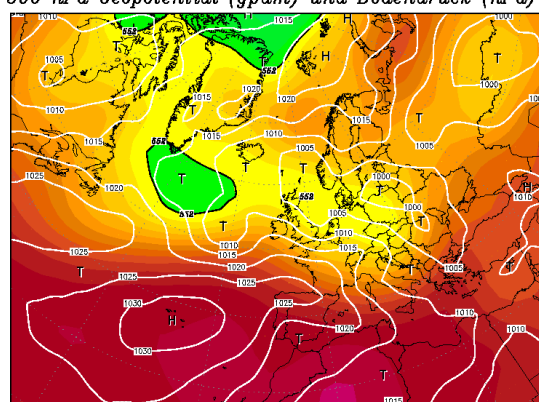
# **How much is particulate matter near the ground influenced by upper-level processes within and above the PBL? A summertime case study in Milan (Italy) evidences the distinctive role of nitrate**

**G. Curci et al.**

*Correspondence to:* G. Curci ([gabriele.curci@aquila.infn.it](mailto:gabriele.curci@aquila.infn.it))

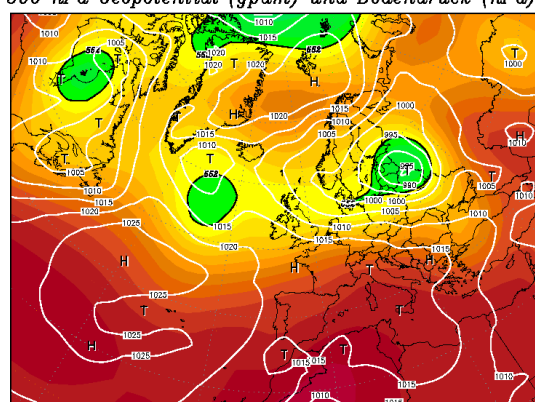
## SUPPLEMENTARY ONLINE MATERIAL

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500 hPa Geopotential (gpm) und Bodendruck (hPa)



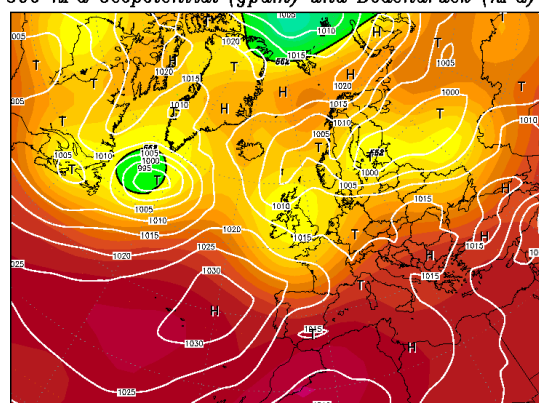
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(C) Wetterzentrale  
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07JUL2007 00Z  
500 hPa Geopotential (gpm) und Bodendruck (hPa)



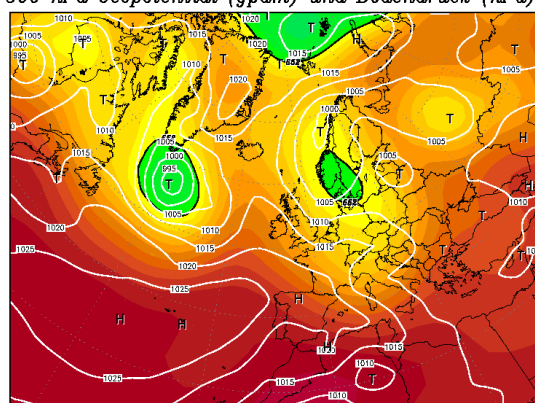
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09JUL2007 00Z  
500 hPa Geopotential (gpm) und Bodendruck (hPa)



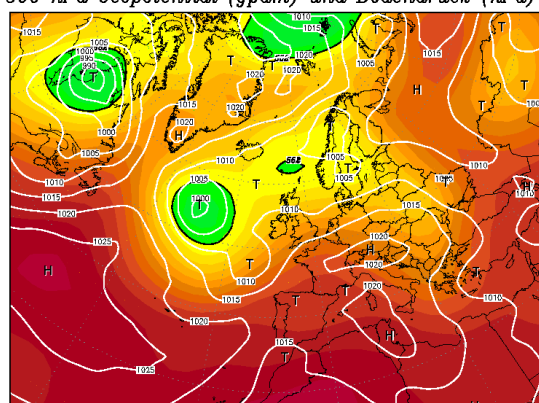
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500 hPa Geopotential (gpm) und Bodendruck (hPa)



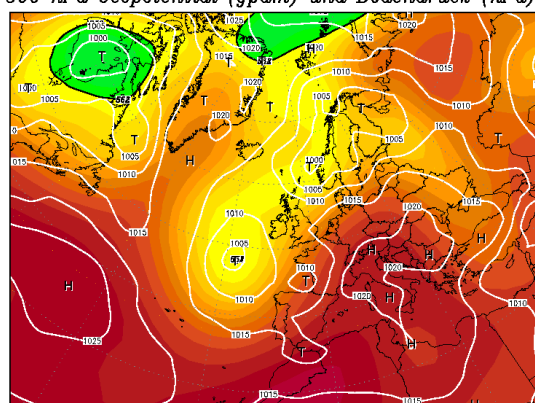
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13JUL2007 00Z  
500 hPa Geopotential (gpm) und Bodendruck (hPa)



Daten: Reanalysis des NCEP  
(C) Wetterzentrale  
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15JUL2007 00Z  
500 hPa Geopotential (gpm) und Bodendruck (hPa)

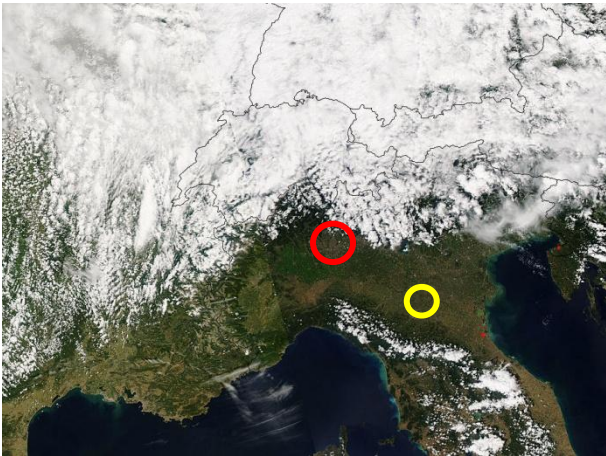


Daten: Reanalysis des NCEP  
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Figure S 1. Sea level pressure (white contours) and 500 hPa geopotential (filled contours) from NCEP/GFS reanalysis for 5, 7, 9, 11, 13, and 15 July 2007 at 00 UTC. Images downloaded from (<http://www.wetterzentrale.de/topkarten/fsreaur.html>).



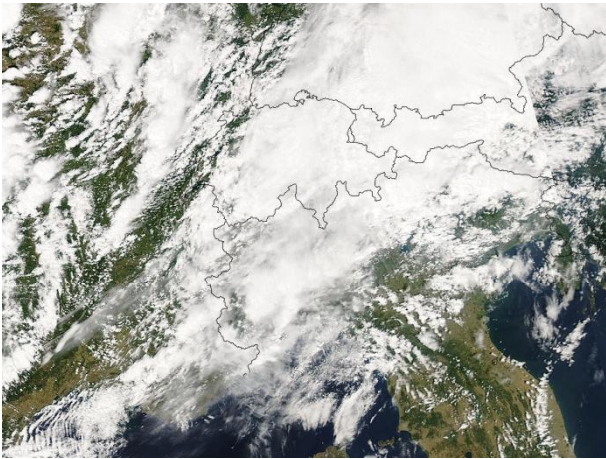
5 July 2007



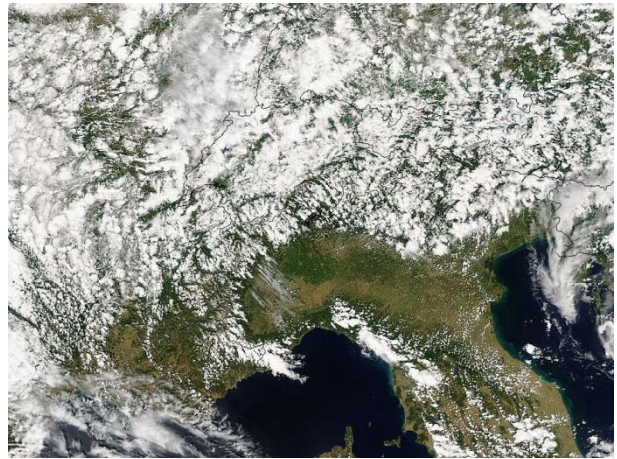
7 July 2007



9 July 2007



11 July 2007



13 July 2007



15 July 2007



Figure S 2. MODIS/Aqua true color images over Norther Italy on 5, 7, 9, 11, 13, and 15 July 2007 at about 13:30 UTC. Images downloaded from MODIS Rapid Response system (<http://earthdata.nasa.gov/data/near-real-time-data/rapid-response/modis-subsets>). The red circle on the first image denotes the location of Milan, while the yellow circle that of Modena AERONET station.

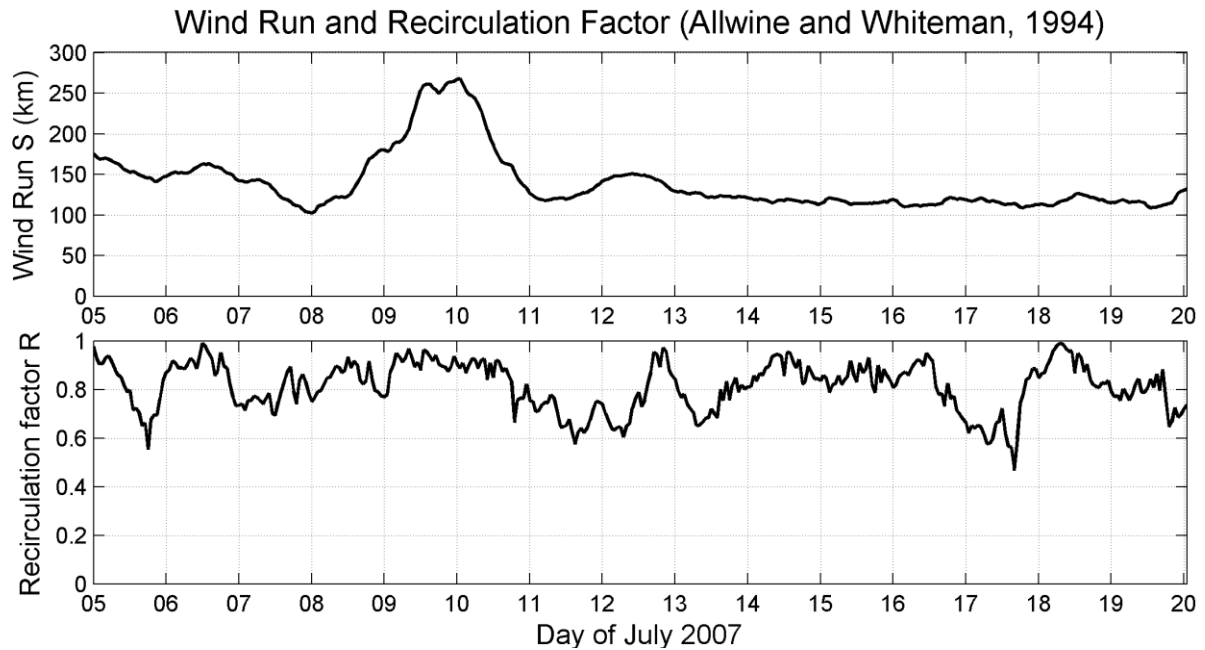


Figure S 3. Stagnation and recirculation metrics proposed by Allwine and Whiteman (1994) for the period 5-20 July 2007 in Milan, calculated from measured wind speed and wind direction at surface level. Wind run  $S$  is a measure of the typical distance travelled by an air parcel in 24 hours, while  $R$  gives an indication of local recirculation on a 24 hour time scale.  $R$  is 0 for no recirculation (one-directional transport) and 1 for total recirculation (null net transport). Considering that the distance of valley walls to the north and south of Milan is less than 100 km, in case of high probability of recirculation ( $R$  close to 1), we may conclude that the valley is well ventilated (i.e. fresh air replaces a good part of the aged one) when  $S$  is  $> 200$  km. In the period under examination, this situation occurs only during 9-11 July, the days of the passage of an Atlantic perturbation. The rest of the time, conditions are highly favourable for stagnation or recirculation, which may both promote pollutant accumulation in the valley.

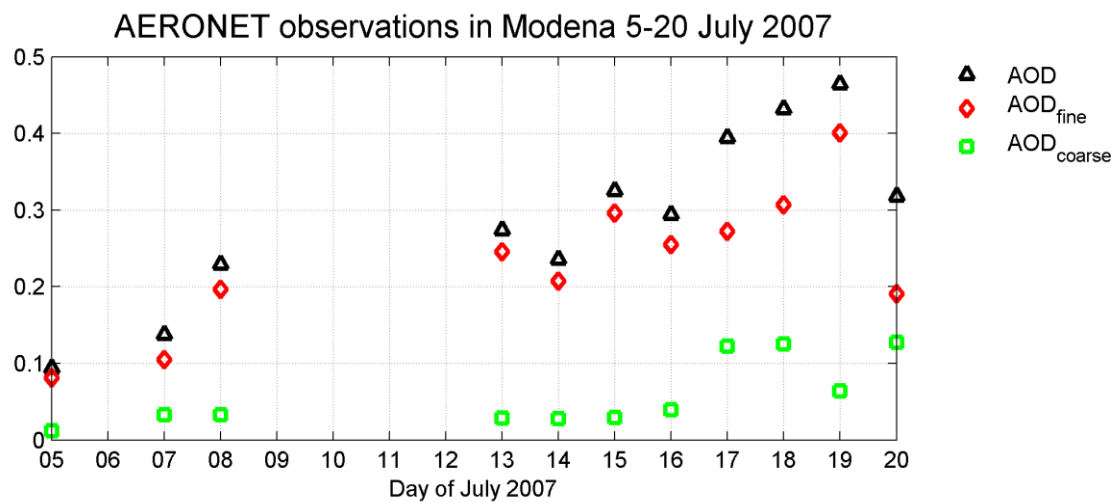


Figure S 4. Aerosol Optical Depth (AOD) measured at Modena ( $44^{\circ}39'N$ ,  $10^{\circ}56'E$ , c.a. 170 km to the South-East of Milan, see Figure S 2) AERONET station on 5-20 July 2007. Black triangles denote the total AOD. Also shown AOD attributed to fine mode aerosol fraction (radius  $< 0.6 \mu m$ , red diamonds), and that attribute to the coarse mode (radius  $> 0.6 \mu m$ , green squares).



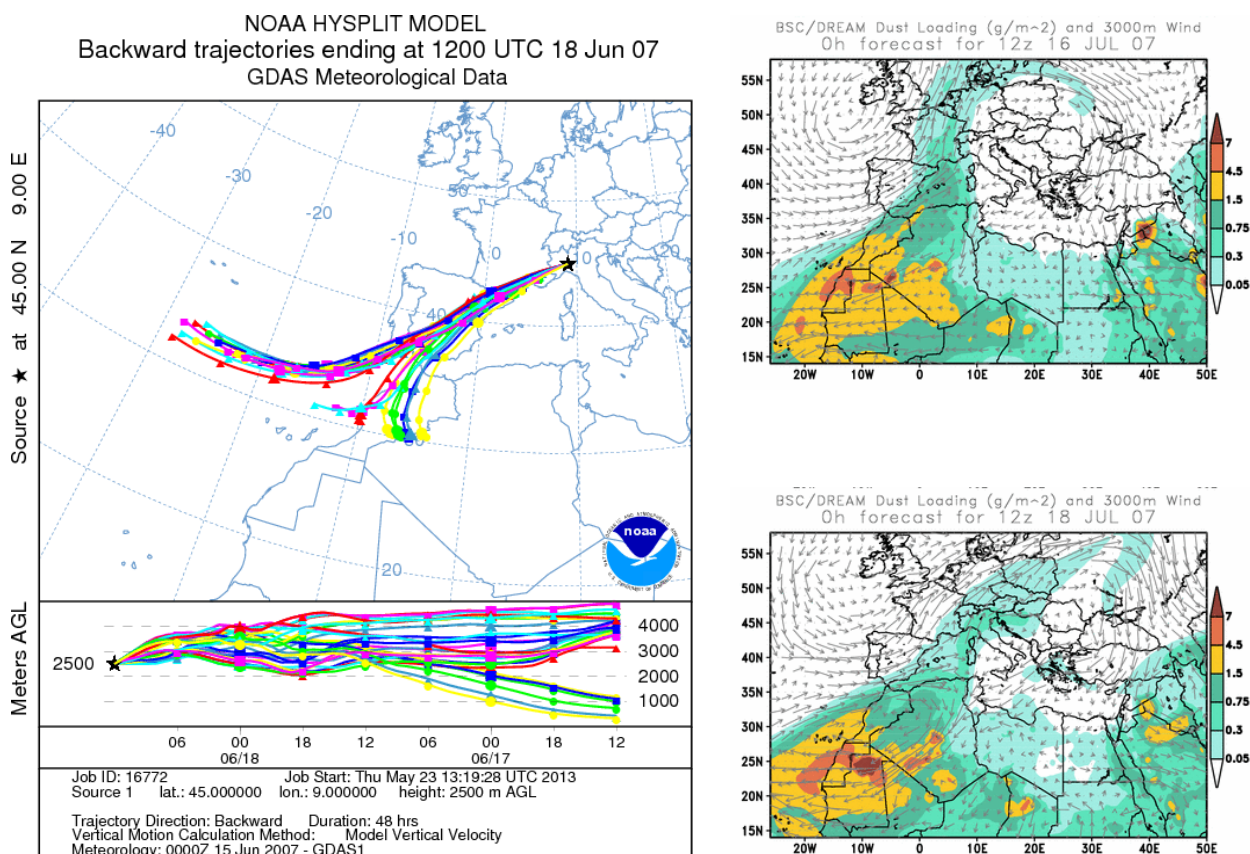


Figure S 5. Left: HYSPLIT (Draxler and Rolph, 2013; Rolph 2013) ensemble backtrajectories started at 2500 m above Milan, and run for 48 hours backwards. Right: BSC-DREAM8b model forecast of dust load on 16 (top) and 18 (bottom) of July 2007 (images from the BSC-DREAM8b (Dust REgional Atmospheric Model) model, operated by the Barcelona Supercomputing Center (<http://www.bsc.es/projects/earthscience/BSC-DREAM/>))

## References

- Allwine, K. J., and Whiteman, C. D.: Single-station integral measures of atmospheric stagnation, recirculation and ventilation. *Atmos. Environ.*, 28, 713-721, 1994.
- Draxler, R.R. and Rolph, G.D., 2013. HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) Model access via NOAA ARL READY Website (<http://www.arl.noaa.gov/HYSPLIT.php>). NOAA Air Resources Laboratory, College Park, MD.
- Rolph, G.D., 2013. Real-time Environmental Applications and Display sYstem (READY) Website (<http://www.ready.noaa.gov>). NOAA Air Resources Laboratory, College Park, MD.