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Impact of updated European biogenic emission inventory on air quality using Chimere chemistry-transport model



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NATURAL AND BIOGENIC EMISSIONS FACTS

- include lots of sources: vegetation, soils, sea spray, fires, volcanoes, lightning and others
- non-linearly interact with anthropogenic emissions (e.g. NO_x) contributing to ozone (O₃) and particulate matter (PM) formation
- European Community is discussing the possibility of subtracting their contribution from PM violations (CEC, 2005)

How much do they contribute to European O₃ and PM levels and air quality violations?

CONCLUSIONS

- we evaluated the impact of natural/biogenic sources on O₃ and PM₁₀ using a regional CTM (CHIMERE) for year 2003
 - impact on O₃ is on average **2.8 ppbv (5%)** for summer 2003
 - impact on PM₁₀ is on average **8 µg/m³ (40%)** for year 2003
 - max impact in **Southern Europe**, particularly Iberian Peninsula
 - bio O₃ is coupled with **anthropogenic NO_x**, while bio PM₁₀ is not
 - in extremely hot summer of 2003 impact of BVOC oxidation reach **100 ppbv O₃ and 35 µg/m³ PM₁₀ in Spain**
- ➔ **will this be common during the 21st century?**

CHIMERE eulerian chemistry-transport regional model (V200709C)

METEO: MM5 forced by ECMWF analyses with nudging
DOMAIN: 0.5°x0.5° over Europe
EMISSIONS

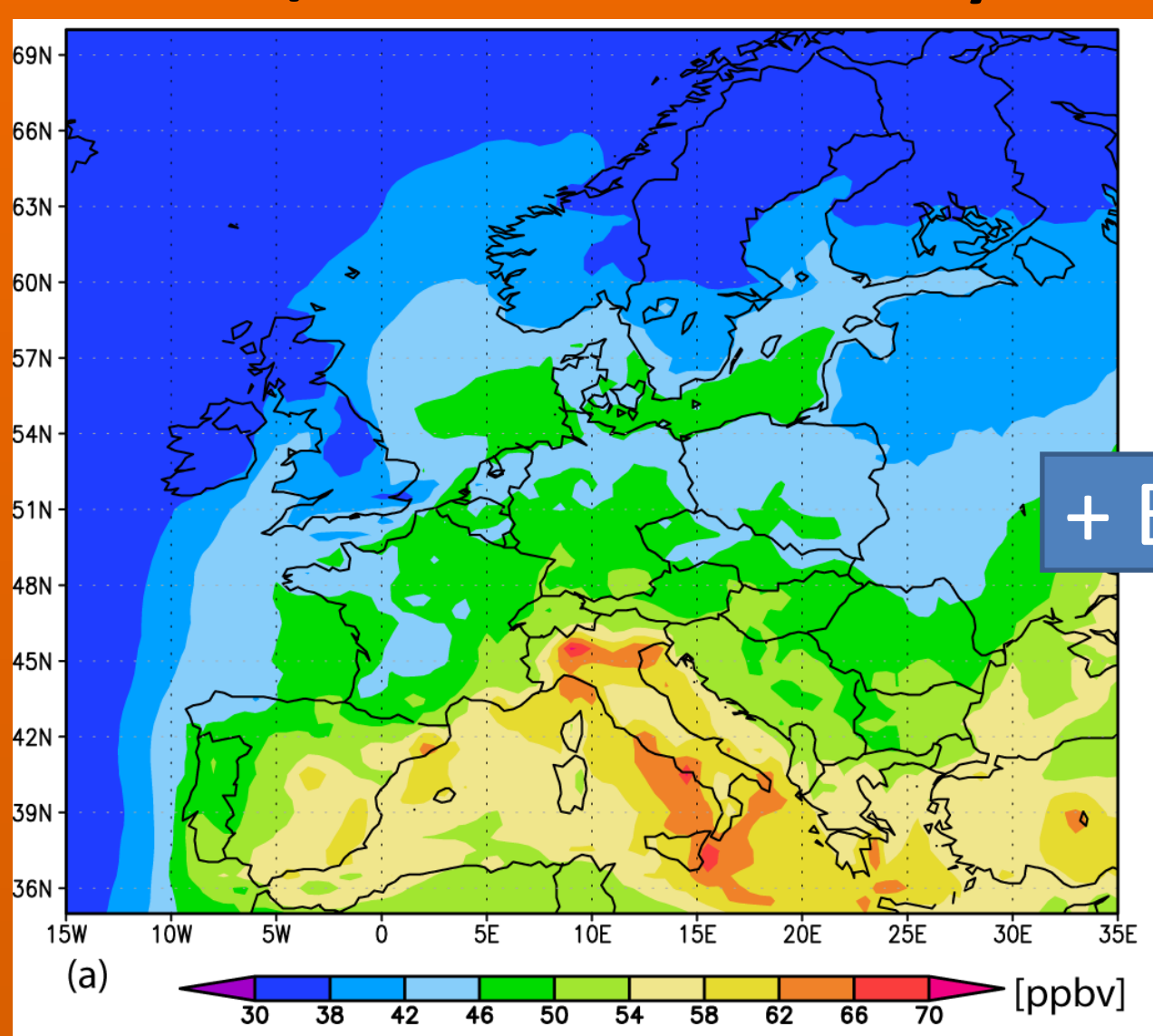
- Anthropogenic: gas and PM (EMEP), EC+OC (Lab. Aérologie)
- Natural/bio: VOC and NO (NatAir), dust, sea salt

BOUNDARY COND.: climatology gas (LMDzINCA) and aerosol (GOCART)
CHEMISTRY: full MELCHIOR (>80 species, >300 reactions, aerosols)
PERFORMANCES (against 2003 EMEP ground measurements)

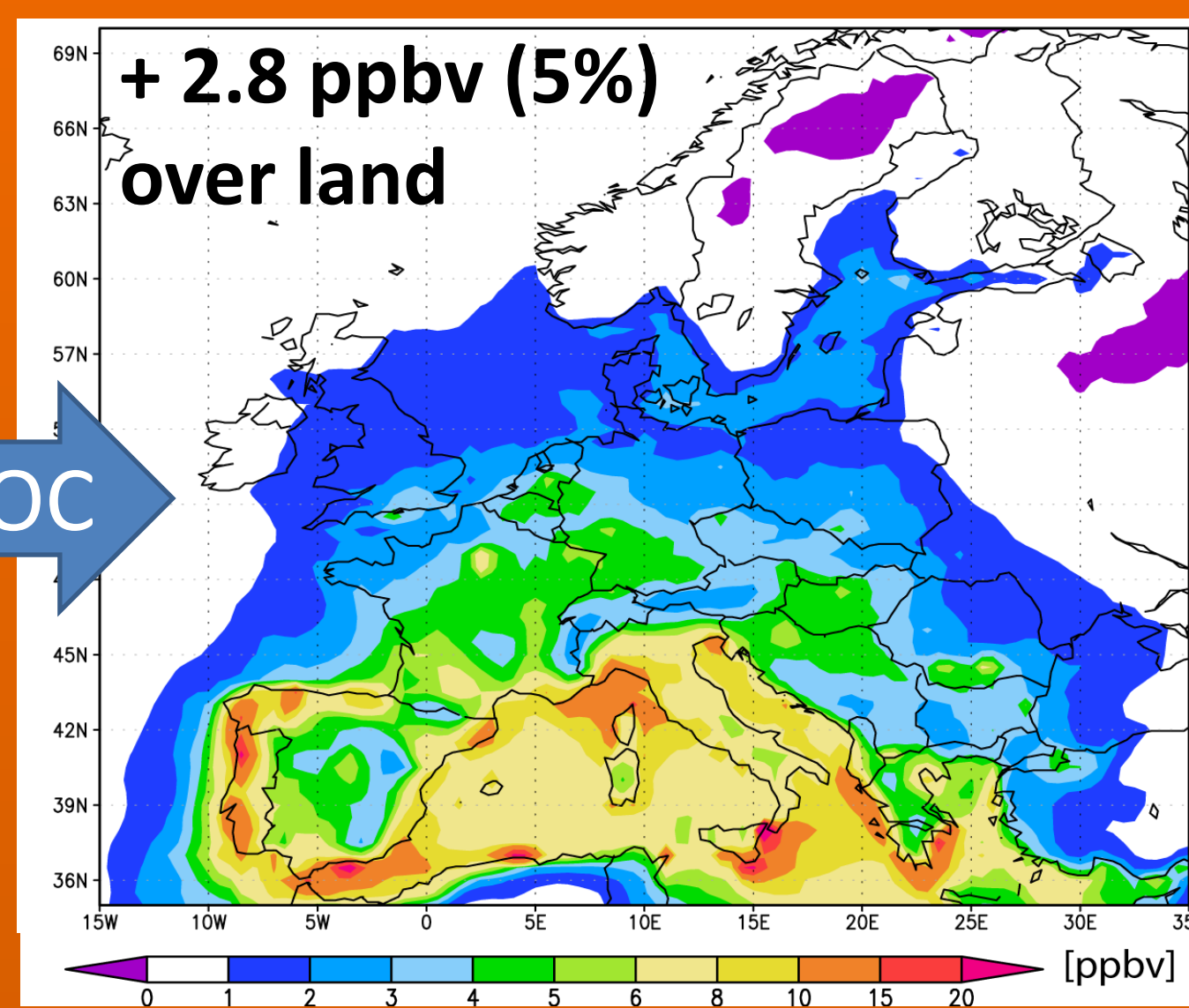
- O₃ 1-h: bias +5 ppbv, RMSE 20 ppbv, correlation 0.75
- PM₁₀ 24-h: bias -0.3 µg/m³, RMSE 10 µg/m³, correlation 0.65

BIOGENIC VOC IMPACT ON OZONE (JJA 2003)

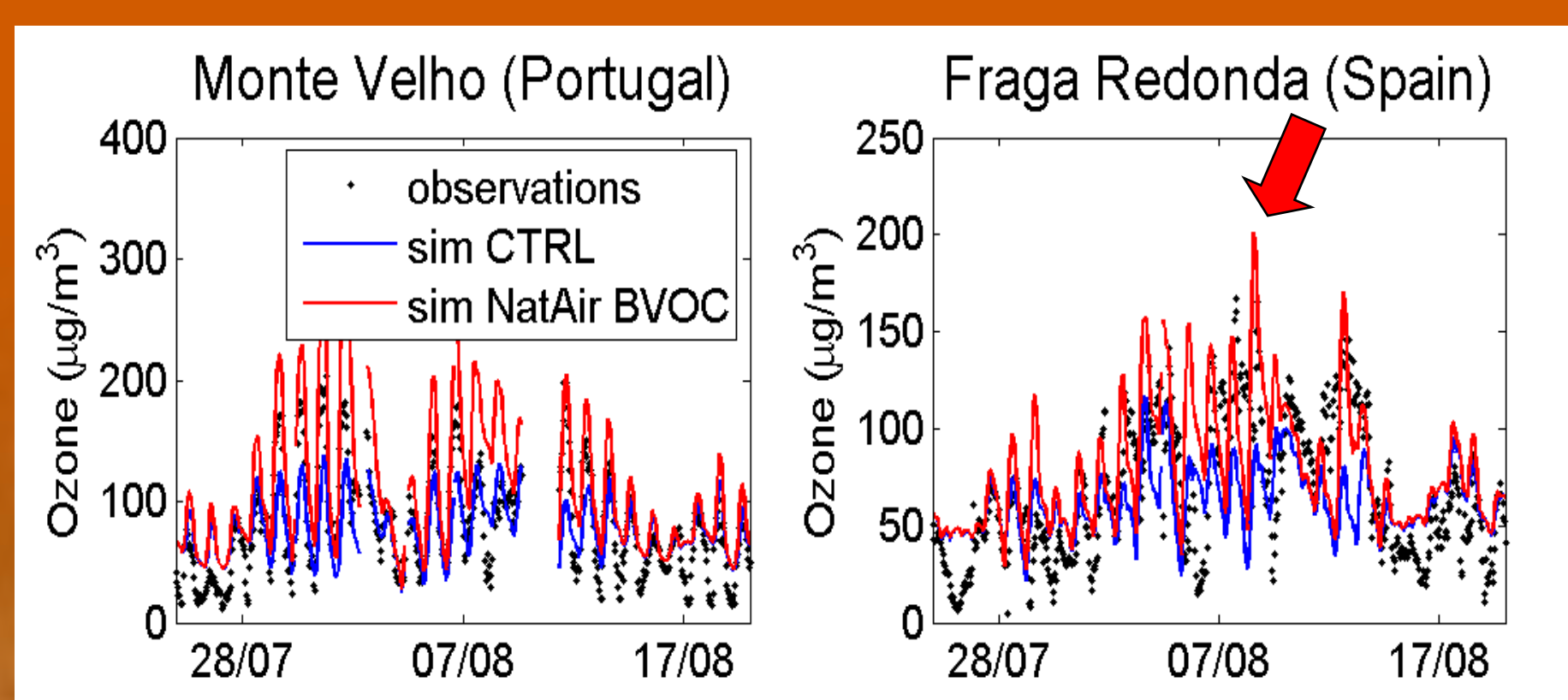
Average O₃ daily max w/ ANTHRO emiss. only



ΔO₃ daily max + BVOC emissions

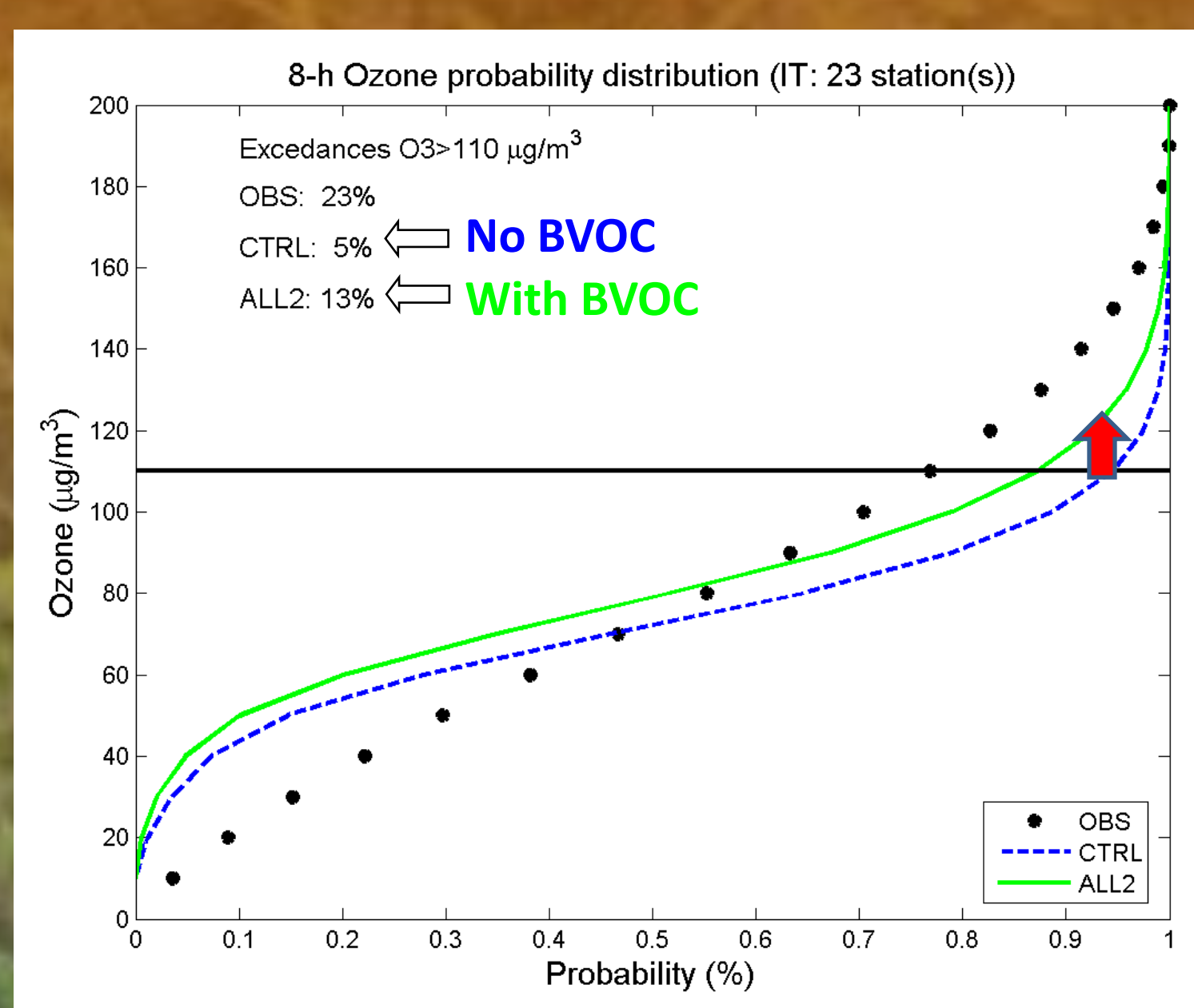


- ➔ Large impact in Southern Europe, in Portugal >15 ppbv
- ➔ Large impact also near major metropolitan areas



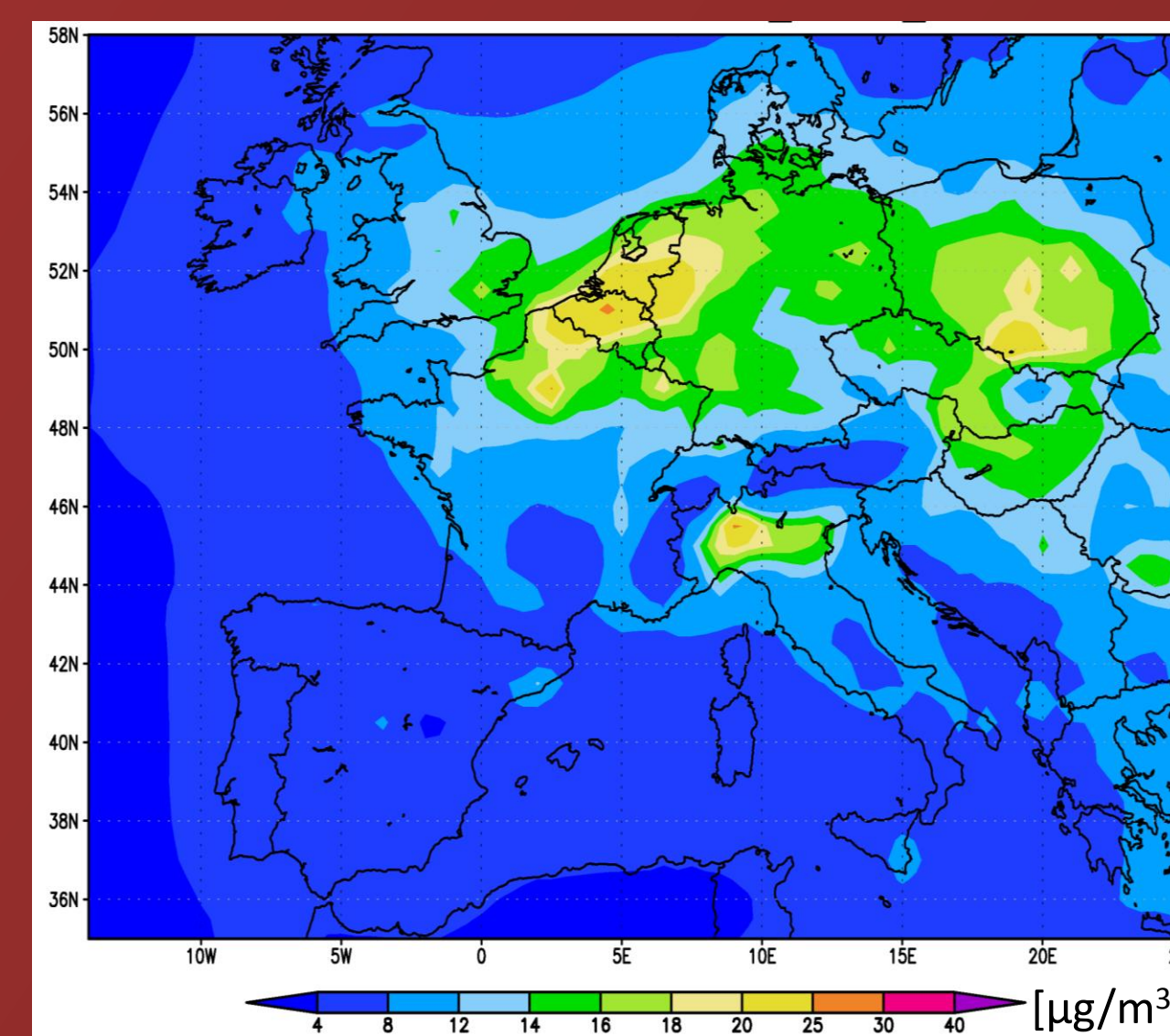
Very large episodic contribution of BVOC to hourly ozone: **up to 100 µg/m³ (~50 ppbv)** for one extreme case in Spain during August 2003!

In polluted regions with significant BVOC emissions the probability of 8-h ozone limit violation is greatly increased. In Italy, **model predicted violations increase from 5% to 13%** when accounting for BVOC emissions.

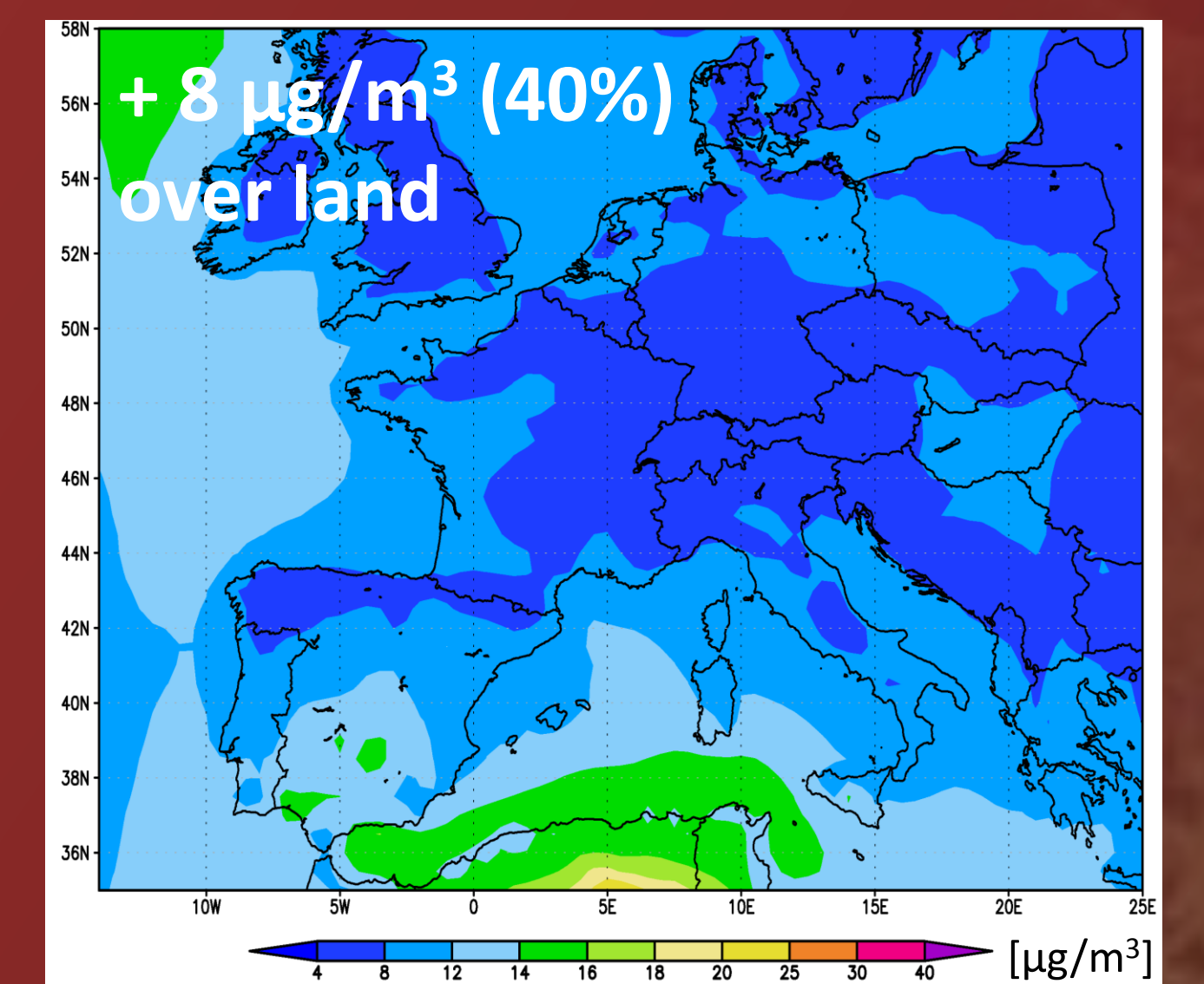


NATURAL/BIOGENIC IMPACT ON PM₁₀ (2003)

Anthropogenic PM₁₀

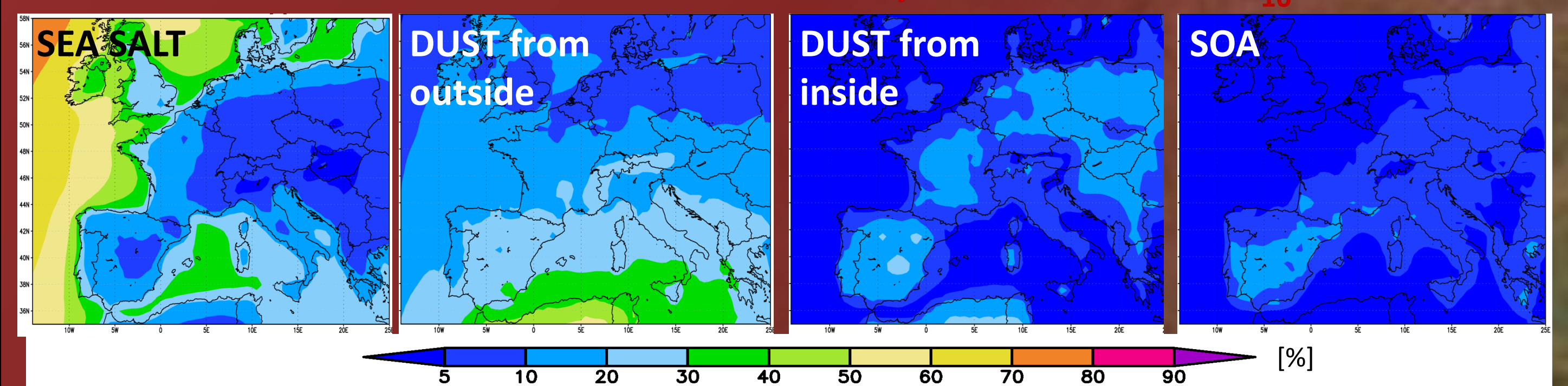


Natural/Bio PM₁₀



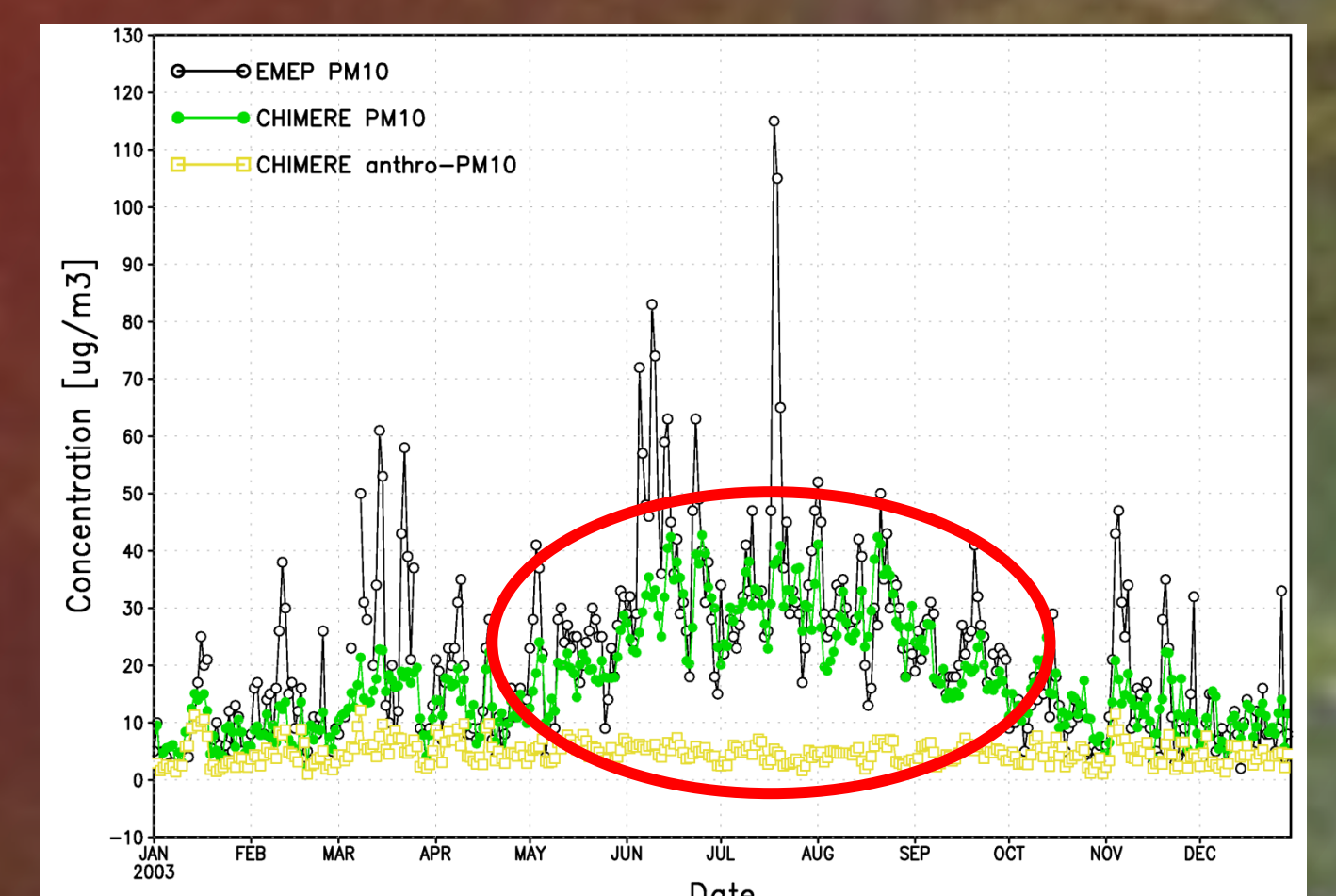
- ➔ Large impact in Southern Europe, > anthro PM₁₀
- ➔ Largely decoupled from anthropogenic PM₁₀

Fractional contribution of natural/bio sources to PM₁₀



Sea salts up to 40% of PM₁₀ at coastal sites. Saharan dust >20% in Southern Europe. Secondary Organic Aerosols (SOA) <10% but in Spain.

Very large contribution in Southern Spain: **up to 35 µg/m³ (>80%)** during summer due to SOA from BVOC oxidation!



REFERENCES

Curci, G., Beekmann, M., Vautard, R., Smiatek, G., Steinbrecher, R., Theloke, J., Friedrich, R., Modelling study of the impact of isoprene and terpene biogenic emissions on European ozone levels, *Atmospheric Environment*, in press, Corrected Proof available on line.