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Supplement of

Development of an inorganic and organic aerosol model (CHIMERE 2017 β v1.0): seasonal and spatial evaluation over Europe

Florian Couvidat et al.

Correspondence to: Florian Couvidat (florian.couvidat@ineris.fr)

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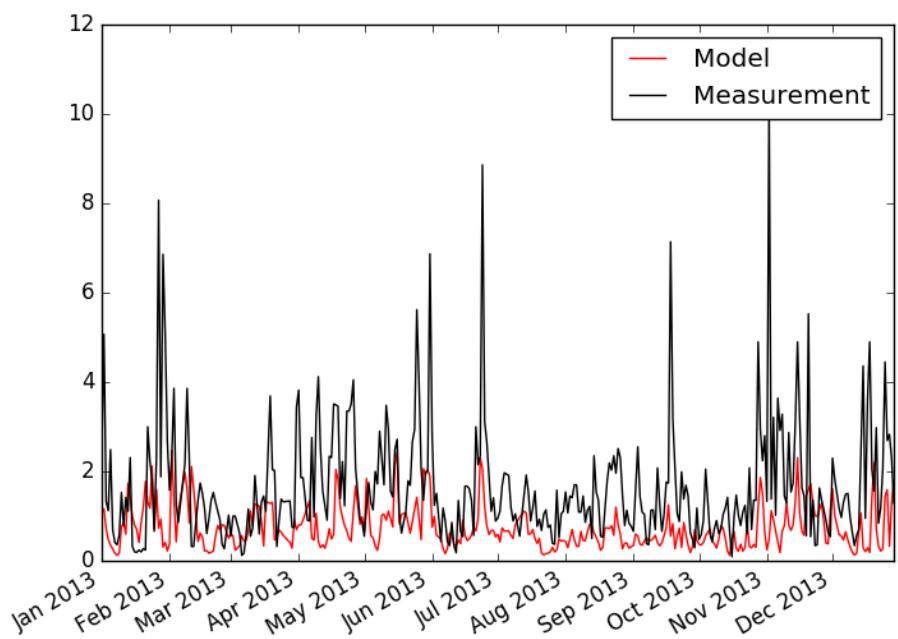


Figure S1. Temporal evolution of modeled (red line) and measured (black line) Na^+ concentrations (in $\mu\text{g m}^{-3}$) for station ES0008R.

Table S1. Comparison of the Chimere 2013 version with the Chimere 2017 β version.

	Chimere 2013 (Menut et al., 2013)	Chimere 2017 β
Biogenic emissions	older version of MEGAN (Guenther et al., 2006) Monthly LAI at 150 arc seconds 150 arc seconds emission factors	MEGAN 2.1 (Guenther et al., 2012) 8-day LAI at 30 arc seconds 30 arc seconds emission factors
Sea salt emissions	Monahan et al. (1986)	Monahan et al. (1986)
Transport	Scheme of Van Leer (1979)	Scheme of Van Leer (1979)
Gaseous chemistry	Melchior 2 (Derognat et al., 2003)	Melchior 2 (Derognat et al., 2003)
SOA thermodynamic model	Tabulation of the AEC model (Bessagnet et al., 2008)	SOAP (Couvidat and Sartelet, 2015)
SIA thermodynamic model	Tabulation of ISORROPIA (Nenes et al., 1998)	ISORROPIA 2.1 (Fountoukis and Nenes, 2007)
SIA formation mechanism	gas-phase oxidation of inorganic precursors from Melchior 2 (Derognat et al., 2003) aqueous-phase oxidation of SO ₂ using a pH constrained between 4.5 and 6 and computed by electroneutrality with the concentrations of sulfate, nitrate and ammonium	gas-phase oxidation of inorganic precursors from Melchior 2 (Derognat et al., 2003) aqueous-phase oxidation of SO ₂ using an unconstrained pH computed by electroneutrality with the concentrations of sulfate, nitrate, ammonium, sodium, chloride and the concentrations of dissolved SO ₂ , CO ₂ , HNO ₃ , NH ₃ , HCl HNO ₃ condensing onto sea salts and dusts
SOA formation mechanism	Bessagnet et al. (2008)	H ₂ O with POA split into SVOC compounds (Couvidat et al., 2012)
Wet diameter	No estimation	Based on ISORROPIA and Semmler et al. (2006)
Coagulation	Gelbard and Seinfeld (1980) using parameters based on Fuchs (1994)	Jacobson and Turco (1994) based on the number of particles and using coagulation kernel coefficients of Debray et al. (2007)
Nucleation	Kulmala and Pirjola (1998) for sulfuric acid	Kulmala and Pirjola (1998) for sulfuric acid
Condensation Evaporation	Algorithm combining a dynamic approach with an equilibrium approach based on Bowman et al. (1997)	Pandis et al. (1993) using thermodynamic equilibria. Condensing mass is redistributed over bins
Wet deposition	In cloud scavenging based on an empirical scavenging coefficient Below-cloud scavenging assuming a rain droplet diameter of 2 mm taking into account the collision efficiency between particles and raining drop and the irreversible dissolution into rain droplets (Menut et al., 2013)	In cloud scavenging proportional to the amount of cloud water lost by precipitations (Croft et al., 2010) Below-cloud scavenging using a polydisperse distribution of rain droplet diameters (Henzing et al., 2006) and taking into account the collision efficiency between particles and raining drop and the irreversible dissolution into rain droplets
Dry deposition	Wesely (1989)	Wesely (1989) using the wet diameter and density of particles

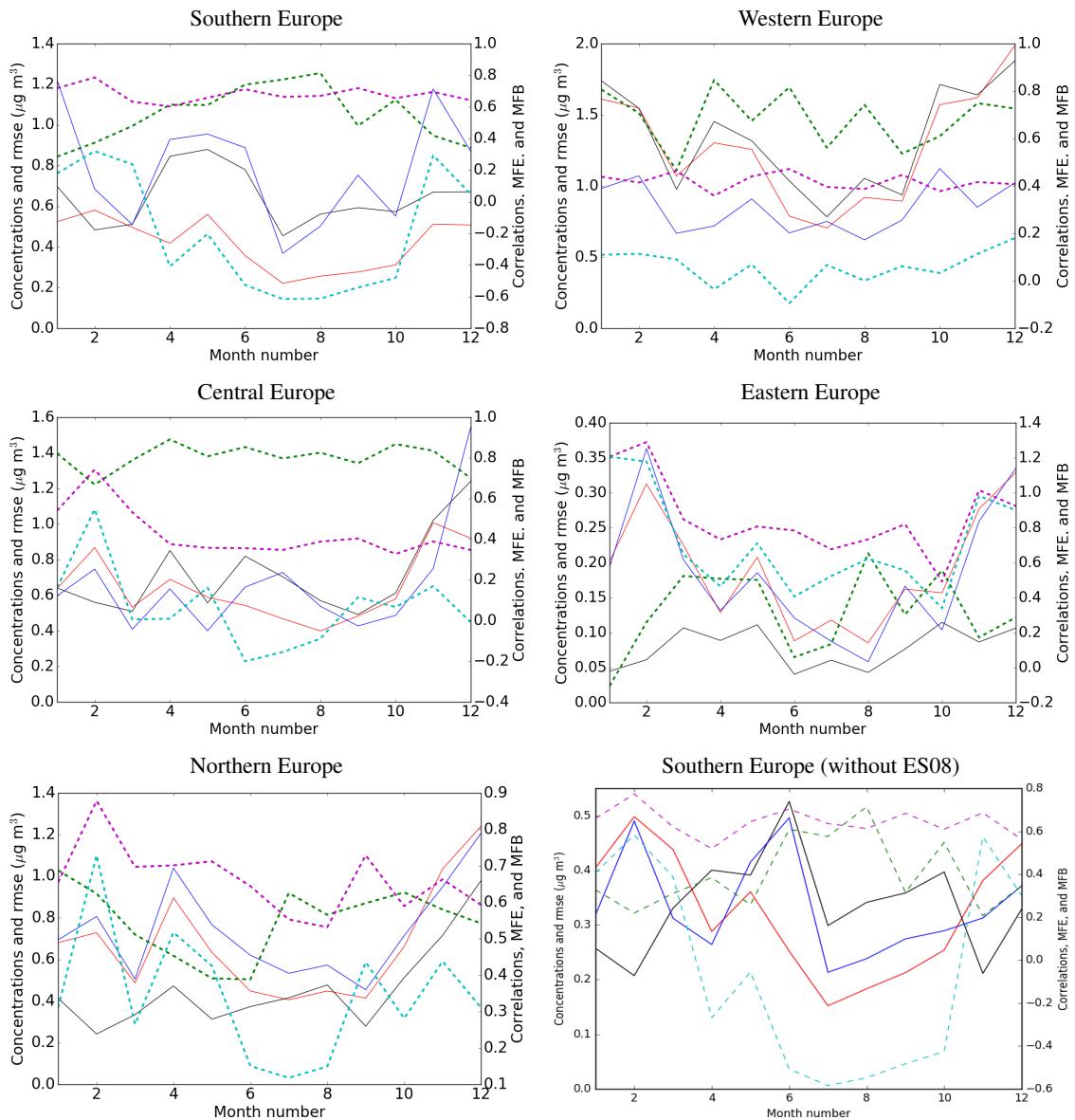


Figure S2. Seasonal evolution of statistics by regions for Na^+ : Monthly mean measured concentrations (black), monthly mean modeled concentrations (red), monthly RMSE (blue), monthly spatiotemporal correlations (green), monthly MFB (cyan) and monthly MFE (magenta). Solid curves refer to the left axis while dotted curves refer to the right axis.

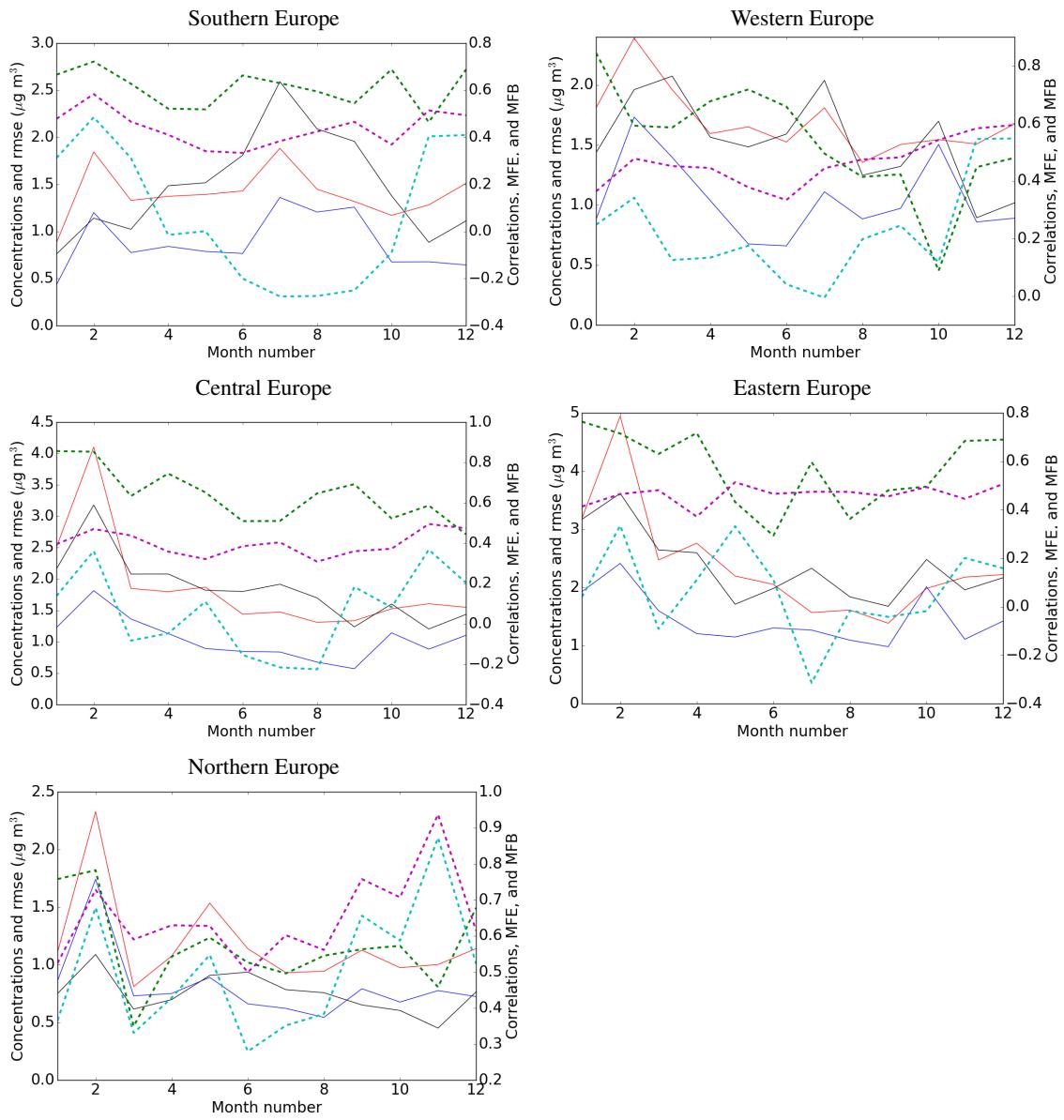


Figure S3. Seasonal evolution of statistics by regions for SO_4^{2-} : Monthly mean measured concentrations (black), monthly mean modeled concentrations (red), monthly RMSE (blue), monthly spatiotemporal correlations (green), monthly MFB (cyan) and monthly MFE (magenta). Solid curves refer to the left axis while dotted curves refer to the right axis.

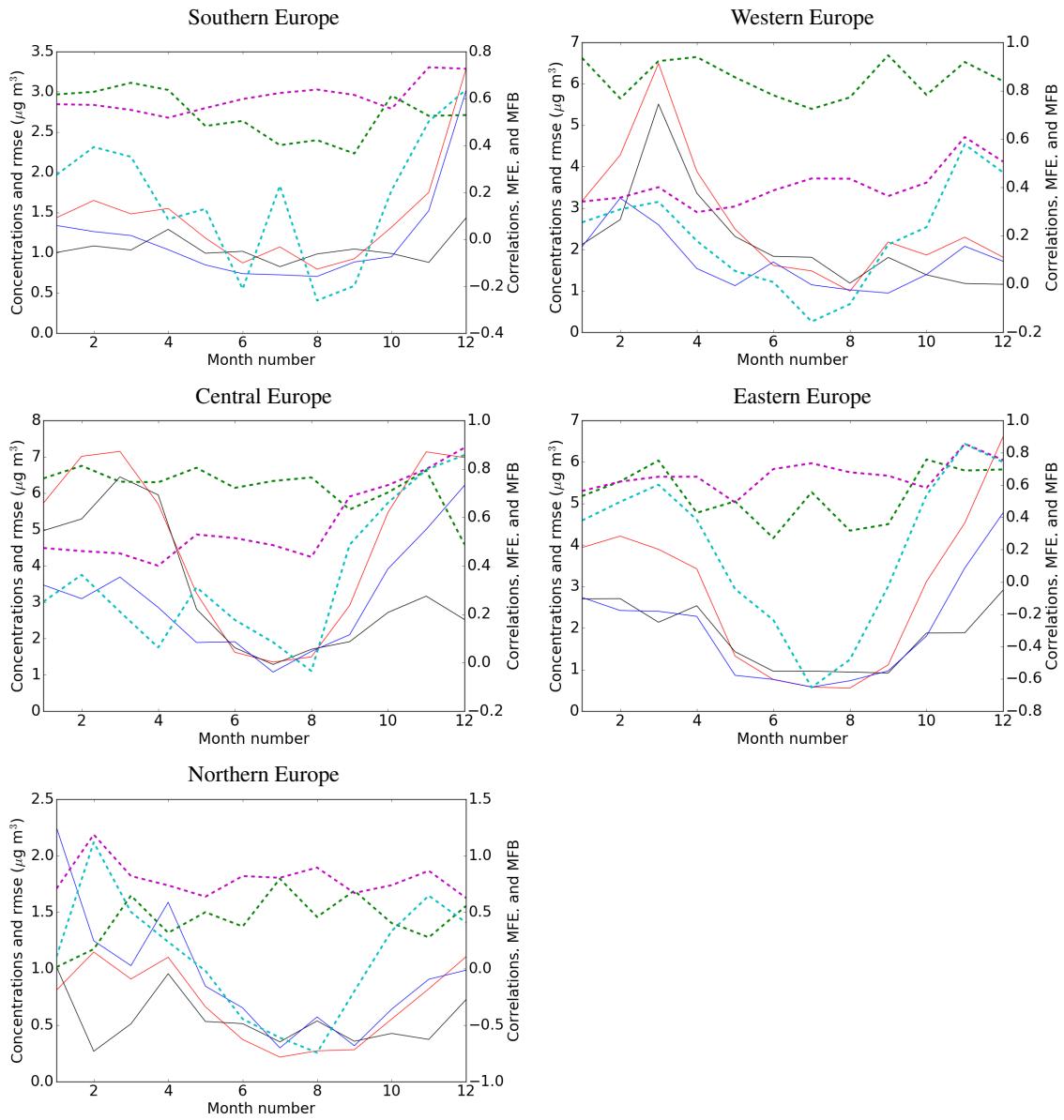


Figure S4. Seasonal evolution of statistics by regions for NO_3^- : Monthly mean measured concentrations (black), monthly mean modeled concentrations (red), monthly RMSE (blue), monthly spatiotemporal correlations (green), monthly MFB (cyan) and monthly MFE (magenta). Solid curves refer to the left axis while dotted curves refer to the right axis.

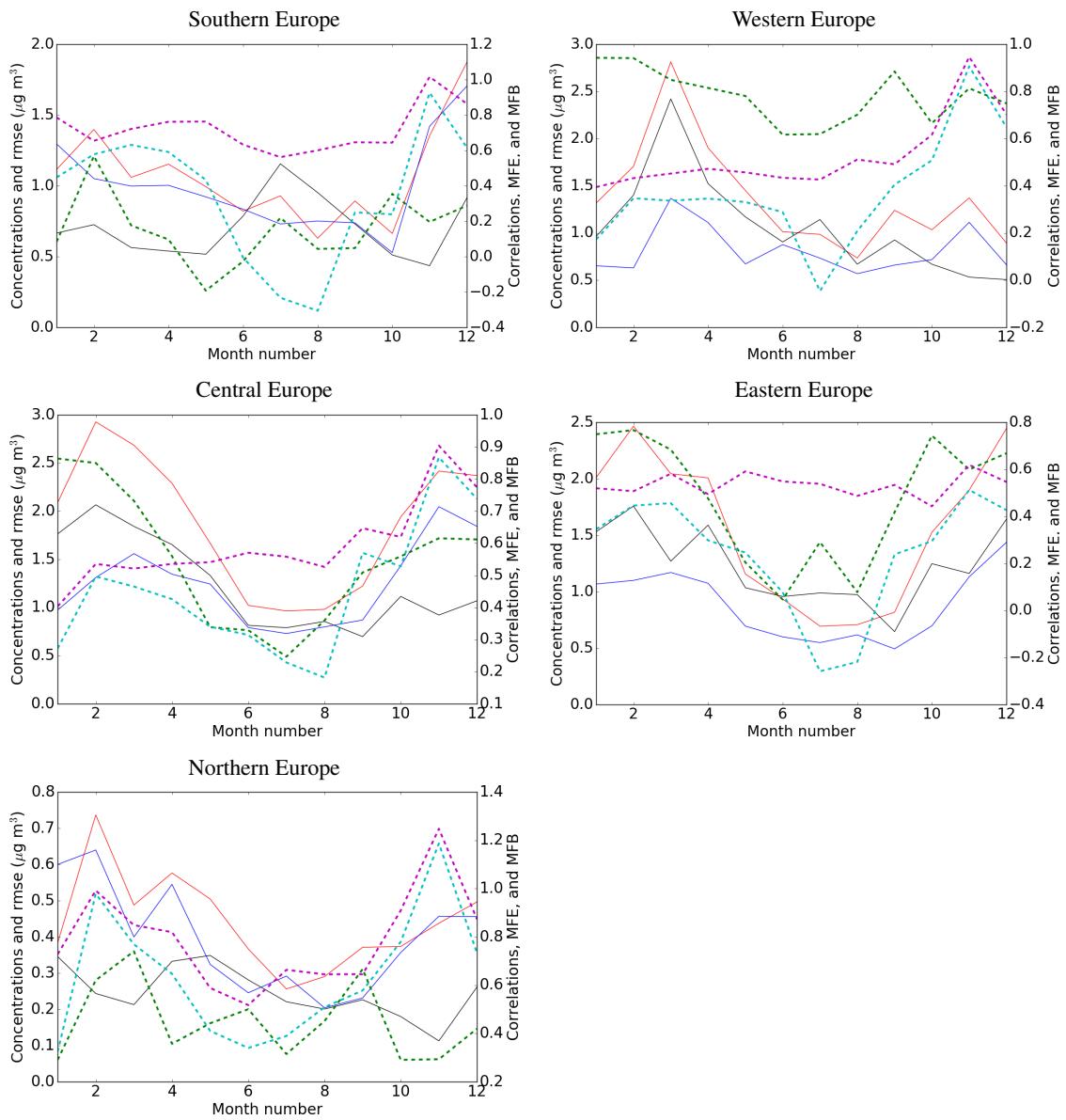


Figure S5. Seasonal evolution of statistics by regions for NH_4^+ : Monthly mean measured concentrations (black), monthly mean modeled concentrations (red), monthly RMSE (blue), monthly spatiotemporal correlations (green), monthly MFB (cyan) and monthly MFE (magenta). Solid curves refer to the left axis while dotted curves refer to the right axis.

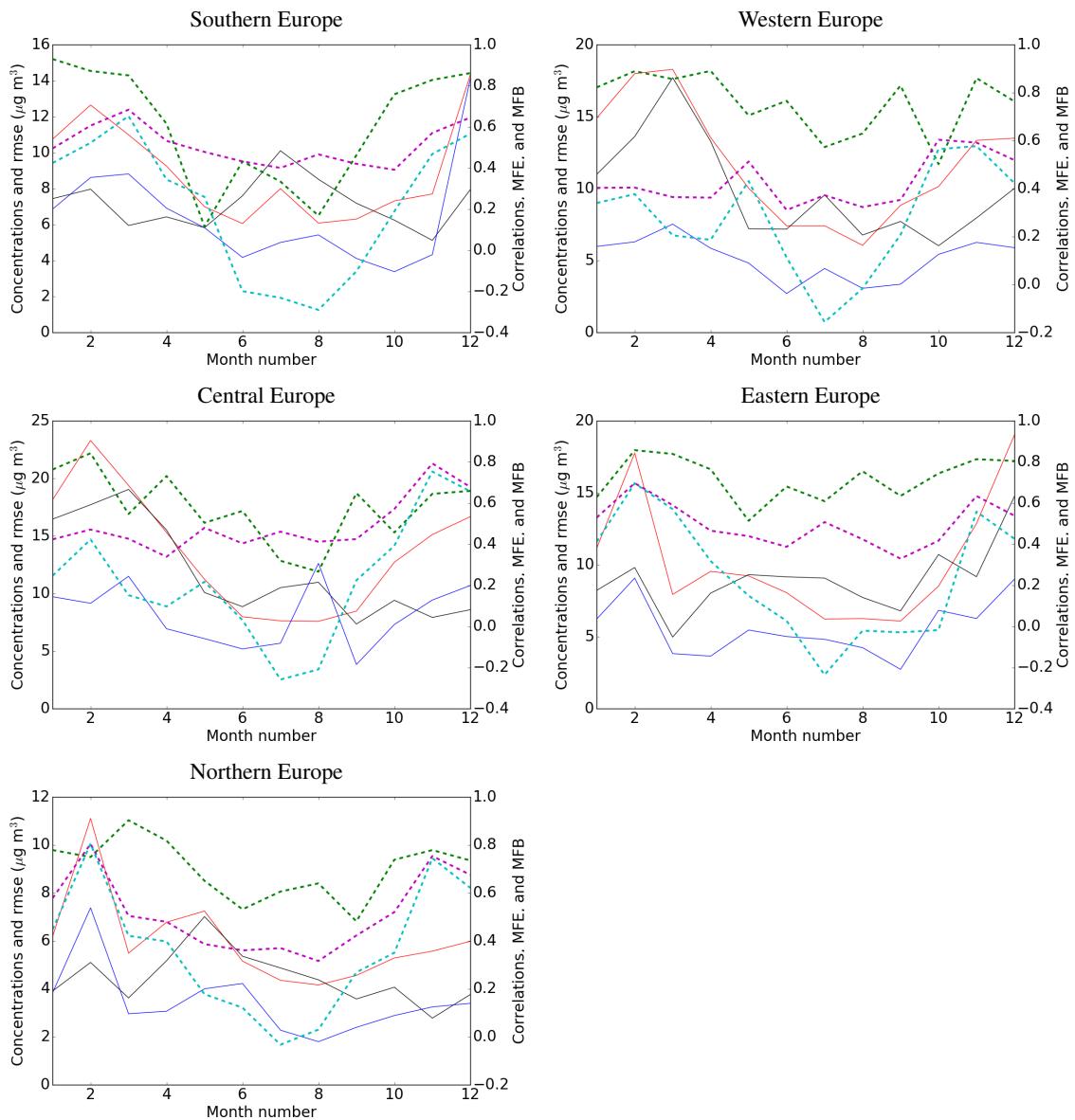


Figure S6. Seasonal evolution of statistics by regions for PM_{2.5}: Monthly mean measured concentrations (black), monthly mean modeled concentrations (red), monthly RMSE (blue), monthly spatiotemporal correlations (green), monthly MFB (cyan) and monthly MFE (magenta). Solid curves refer to the left axis while dotted curves refer to the right axis.

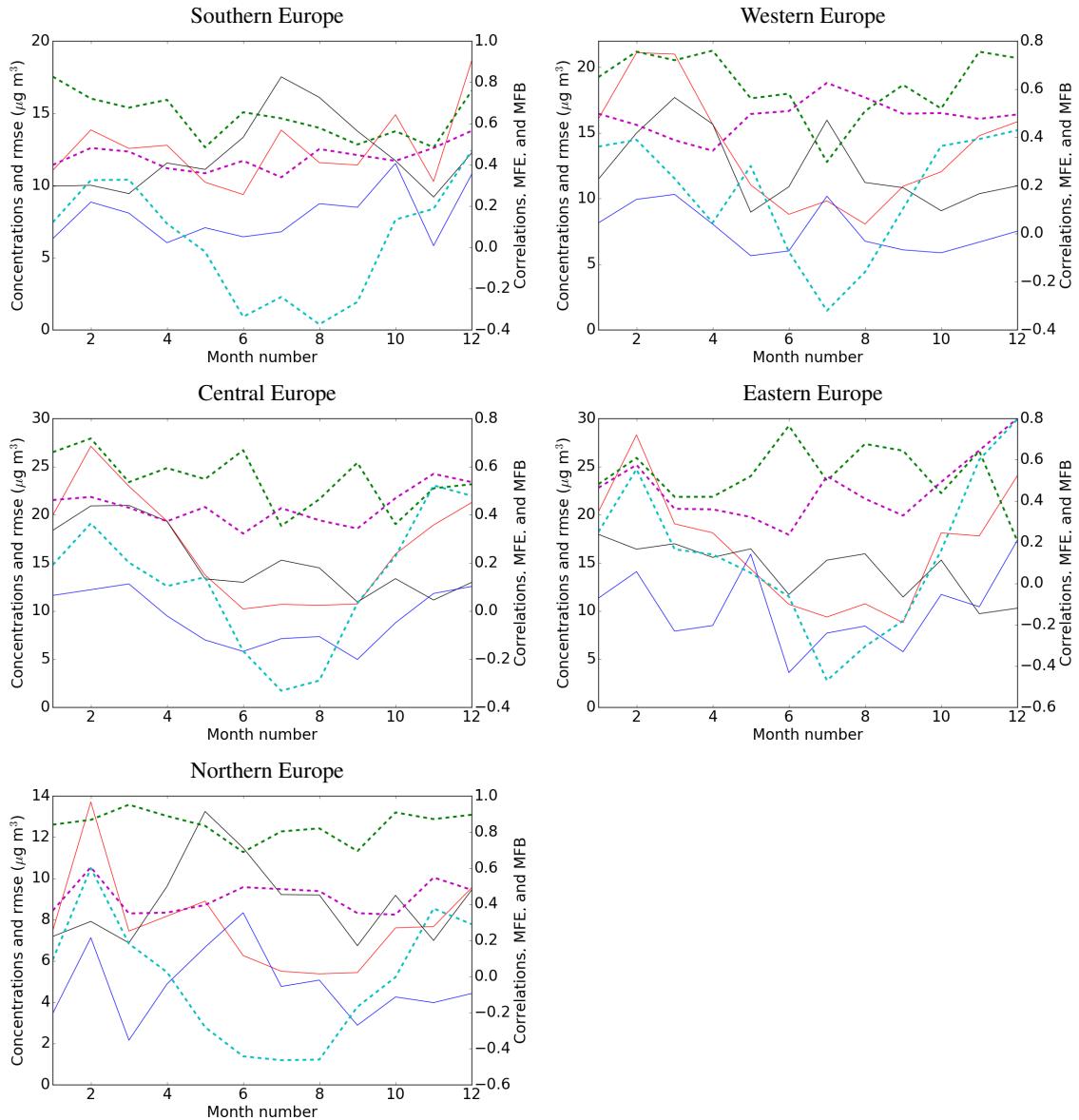


Figure S7. Seasonal evolution of statistics by regions for PM₁₀: Monthly mean measured concentrations (black), monthly mean modeled concentrations (red), monthly RMSE (blue), monthly spatiotemporal correlations (green), monthly MFB (cyan) and monthly MFE (magenta). Solid curves refer to the left axis while dotted curves refer to the right axis.

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