Supplementary Material for "EURODELTA-Trends, a multi-model experiment of air quality hindcast in Europe over 1990-2010" Submitted to GMDD by Colette et al, 2016.

Table S1: Main features of the Chemistry-Transport Models involved in the Eurodelta-Trends modelling exercise

MODEL	CHIMERE	CMAQB	EMEP	LOTOS-EUROS	MATCH	MINNI	POLYPHEMUS	WRF-CHEM
version	Modified Chimere2013	V5.0.2	rv4.7	v1.10.005	VSOA April 2016	V4.7	V1.9.1	V3.5.1
operator	INERIS	BSC	MET Norway	TNO	SMHI	ENEA/Arianet S.r.l.	CEREA	IASS
Chemistry/Meteorology coupling	offline	offline	offline	offline	offline	offline	Offline	Online
Vertical layers	9 sigma	15 sigma	20 sigma	5(4 dynamic layers and a surface layer)	39 hybrid eta utilizing the meteorological model layers	16 fixed terrain-following layers	9 Fixed terrain following layers	35 terrain-following
Vertical extent	500 hPa	50 hPa	100 hPa	5000 m	ca 5000 m (4700 – 6000 m)	10000 m	12000m	10 hPa
Depth first layer	20 m	40 m	90 m	25 m	ca 60m	40 m	40m	50 m
Surface concentration	First model level	First model level	Downscaled to 3m using dry deposition velocity and similarity theory	Downscaled to 3m	Downscaled to 3m	First model level	First model level	First model level
Biogenic VOC	MEGAN model v2.1 with high resolution spatial and temporal LAI (Yuan et al., 2011) and recomputed emissions factors based on the landuse (Guenther et al., 2006)	MEGAN model v2.04 (Guenther et al., 2006)	Based upon maps of 115 species from (Koeble and Seufert, 2001), and hourly temperature and light using (Guenther et al., 1993;Guenther et al., 1994). See (Simpson et al., 1995;Simpson et al., 2012)	Based upon maps of 115 species from (Koeble and Seufert, 2001), and hourly temperature and light (Guenther et al 1991, Guenther et al 1993). See (Beltman et al., 2013)	(Simpson et al., 2012), based on hourly temperature and light.	MEGAN v2.04 (Guenther et al., 2006)	MEGAN V2.04 (Guenther et al., 2006)	MEGAN v2.04 (Guenther et al., 2006)
Forest fires	None	None	None	None	None	None	None	None

Soil-NO	MEGAN model v2.04	MEGAN model v2.04	See in (Simpson et al., 2012)	Not used here	None	MEGAN v2.04	MEGAN V2.04	MEGAN v2.04
Lightning	None	None	Monthly climatological fields, (Köhler et al., 1995)	None	None	None	None	None
Sea salt	(Monahan, 1986)	Open ocean and surface-zone (Kelly et al., 2010)	(Monahan, 1986) and (Martensson et al., 2003), see (Tsyro et al., 2011)	(Martensson et al., 2003) and (Monahan, 1986), see (Schaap et al., 2009)	Based on parameterization by (Sofiev et al., 2011)	(Zhang K.M. et al., 2005)	(Monahan, 1986)	(Gong et al., 1997), (O'Dowd et al., 1997)
Windblown Dust	(Vautard et al., 2005), not used here	None	See (Simpson et al., 2012)	(Schaap et al., 2009)	Not used here	(Vautard et al., 2005)	None	None
Dust traffic suspension	None	None	(Denier van der Gon et al., 2010)	None	Not used here	None	None	None
Landuse database	GLOBCOVER (24 classes)	Corine Land Cover 2006 (44 classes)	CCE/SEI for Europe, elsewhere GLC2000	Corine Land Cover 2000 (13 classes)	CCE/SEI for Europe	Corine Land Cover 2006 (22 classes)	Global Land Cover 2000 (24 classes)	24-category USGS landuse
Advection scheme	(van Leer, 1984)	Horizontal: WRF-based scheme, vertical: Piecewise Parabolic Method	(Bott, 1989)	(Walcek, 2000)	Fourth order mass-conserved advection scheme based on (Bott, 1989)	Blackman cubic polynomials (Yamartino, 1993)	Third-order Direct Space Time scheme (Spee, 1998) with Koren-Sweby flux limiter function	Runge-Kutta 3rd order
Vertical diffusion	Kz approach following (Troen and Mahrt, 1986)	ACM2 PBL scheme (Pleim, 2007)	Kz approach following (O'Brien, 1970) and (Jeričevič et al., 2010)	Kz approach Yamartino et al (2004)	Implicit mass conservative Kz approach, see (Robertson et al., 1999) Boundary layer parameterisation as detailed in (Robertson et al., 1999) forms the basis for vertical diffusion and dry deposition	Kz approach following (Lange, 1989)	Kz approach following (Troen and Mahrt, 1986)	Yonsei University PBL scheme (Hong et al., 2004)

Dry deposition	Resistance approach (Emberson et al., 2000a;Emberson et al., 2000b)	Resistance approach (Venkatram and Pleim, 1999)	Resistance approach for gases (Venkatram and Pleim, 1999) for aerosols, (Simpson et al., 2012)	Resistance approach,DEPAC3.11 for gases, (Van Zanten et al., 2010) and (Zhang et al., 2001) for aerosols	Resistance approach depending on aerodynamic resistance, and land use (vegetation). Similar to (Andersson et al., 2007)	Resistance model based on (Wesely, 1989)	Resistance approach for gases (Zhang et al., 2003) and aerosols (Zhang et al., 2001)	(Wesely, 1989) and (Erisman et al., 1994)
Ammonia compensation points	None	None	None, but zero NH_3 deposition over growing crops	Only for NH_3 (for stomatal, external leaf surface and soil (= 0))	None	None	None	None
Stomatal resistance	(Emberson et al., 2000a;Emberson et al., 2000b)	(Wesely, 1989)	DO3SE-EMEP: (Emberson et al., 2000a;Emberson et al., 2000b), (Tuovinen et al., 2004;Simpson et al., 2012)	(Emberson et al., 2000a;Emberson et al., 2000b)	Simple, seasonally varying, diurnal variation of surface resistance for gases with stomatal resistance (similar to (Andersson et al., 2007))	(Wesely, 1989)	(Zhang et al., 2003)	(Wesely, 1989) and (Erisman et al., 1994)
Wet deposition gases	In-cloud and sub-cloud scavenging coefficients	In-cloud and sub-cloud scavenging which depends on Henry's law constants, dissociation constants and cloud water pH (Chang et al., 1987)	In-cloud and sub-cloud scavenging coefficients	sub-cloud scavenging coefficient	In-cloud scavenging of some species based on Henry's law constants. Simple in-cloud and sub-cloud scavenging coefficients for other gases.	In-cloud and sub-cloud scavenging coefficients (EMEP, 2003)	In-cloud (monodispersed raindrops with constant collection efficiency) and bellow cloud (Sportisse and Dubois, 2002) scavenging coefficients	In-cloud and sub-cloud scavenging coefficients
Wet deposition particles	In-cloud and sub-cloud scavenging	In-cloud and sub-cloud scavenging	In-cloud and sub-cloud scavenging	sub-cloud scavenging coefficient	In-cloud and sub-cloud scavenging. Similar to (Simpson et al., 2012)	In-cloud and sub-cloud scavenging coefficients	In-cloud (as for gas) and bellow cloud (Slinn, 1983) scavenging coefficients	In-cloud and sub-cloud scavenging coefficients
Gas phase chemistry	MELCHIOR2	CB-05 with chlorine chemistry extensions (Yarwood. G. et al., 2005)	EmChem09 (Simpson et al., 2012)	TNO-CBM-IV	Based on EMEP (Simpson et al., 2012), with modified isoprene chemistry (Carter, 1996;Langner et al., 1998)	SAPRC99 (Carter;Carter, 2000)	CB-05 (Yarwood. G. et al., 2005)	RADM2 (Stockwell et al., 1990)

Cloud chemistry	Aqueous SO_2 chemistry and ph dependent SO_2 chemistry	Aqueous SO_2 chemistry (Walcek and Taylor, 1986)	Aqueous SO_2 chemistry, pH dependent	Aqueous SO2 chemistry, pH dependent (Banzhaf et al., 2012)	Aqueous SO_2 chemistry	Aqueous SO_2 chemistry (Seinfeld and Pandis, 1998)	Aqueous SO_2 chemistry (Seinfeld and Pandis, 1998)	None
Coarse nitrate	No reaction with Ca even if reaction with Na is taken into account. Coarse nitrate might exists with transfer from smaller particles	None	Two formation rates of coarse NO_3 from $HNO_3$for relative humidity below/above 90%	(Wichink Kruit et al., 2012)	Yes, transfer of HNO_3(g) to aerosol nitrate using rate from (Strand and Hov, 1994)	None	No heterogeneous nitrate formation	None
Ammonium nitrate equilibrium	ISORROPIA v2.1 (Nenes et al., 1999)	ISORROPIAv2.1	MARS (Binkowski and Shankar, 1995)	ISORROPIA v.2	RH & T dependent equilibrium constant (Mozurkewich, 1993)	ISORROPIA v1.7 (Nenes et al., 1998)	ISORROPIA v1.7 (Nenes et al., 1999)	MARS (Binkowski and Shankar, 1995)
SOA formation	H_2O (Couvidat et al., 2012) mechanism coupled with the thermodynamic model SOAP (Couvidat and Sartelet, 2015)	SORGAM module (Schell et al., 2001)	VBS-NPAS –(Simpson et al., 2012)	Not used here	Similar to VBS-NPNA (Bergström et al., 2012)	SORGAM module (Schell et al., 2001)	H_2O (Couvidat et al., 2012)	SORGAM module (Schell et al., 2001)
Volatility basis set for aerosols	None	None	(Simpson et al., 2012;Bergström et al., 2012)	Not used here	Yes, based on Bergström et al. (2012)	None	None	None
Aerosol model	9 bins (10 nm to 10 µm)	AERO5 (Carlton et al., 2010), log-normal approach (3 modes)	Bulk- approach (fine and coarse modes)	Bulk- approach (2 modes)	Bulk approach	AERO3 (Binkowski, 1999); 3 modes: Aitken, accumulation, coarse	5 bins (0.01 to 10µm)	MADE (Ackermann et al., 1998)
Aerosol physics	coagulation/condensation/nucleation Computation of the wet diameter for each bins as a function of humidity (used for coagulation, condensation, deposition)	Coagulation/condensation/nucleation	Not used here	Not used here	Not used here	Coagulation/condensation/nucleation	Coagulation/Condensation	Coagulation/condensation/nucleation