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Calculations of anthropogenic EC with the EMEP model

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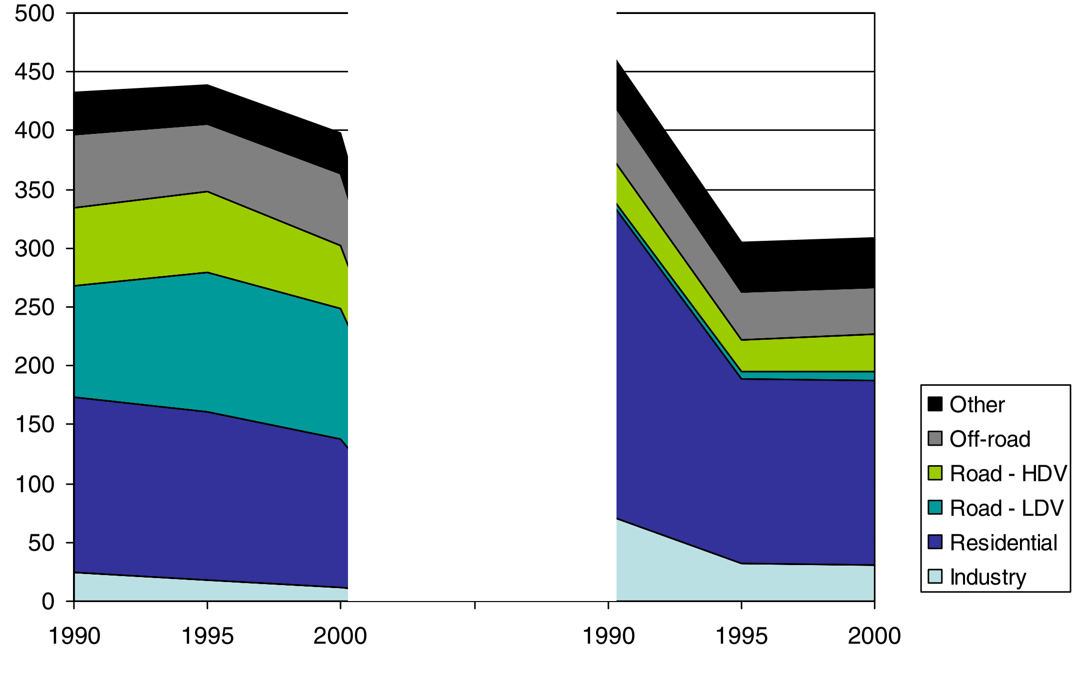
NORPAC meeting; 2 November 2005

Black carbon emissions in Europe *[Gg]*

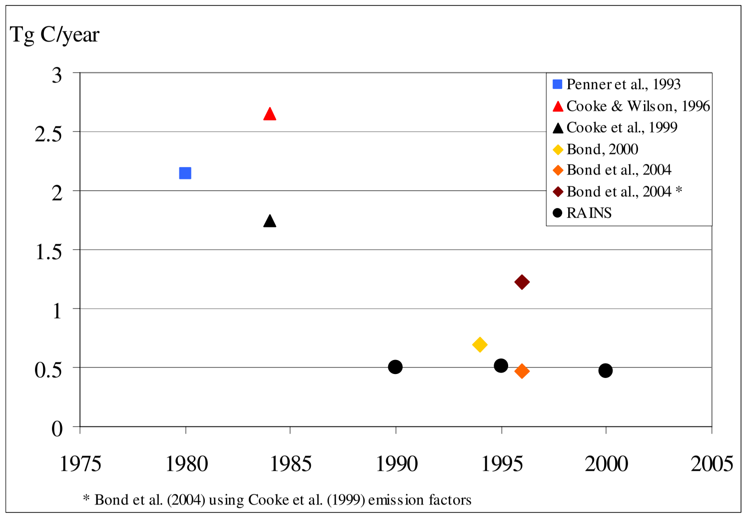
IIASA *RAINS* model (Kupiainen and Klimont, 2004)

Total European BC emissions in 2000 – 670 Ktons

About 85% from traffic and residential



European Union **Non EU Europe**



excluding FSU, Turkey and wildfires

EC fraction in PM emissions

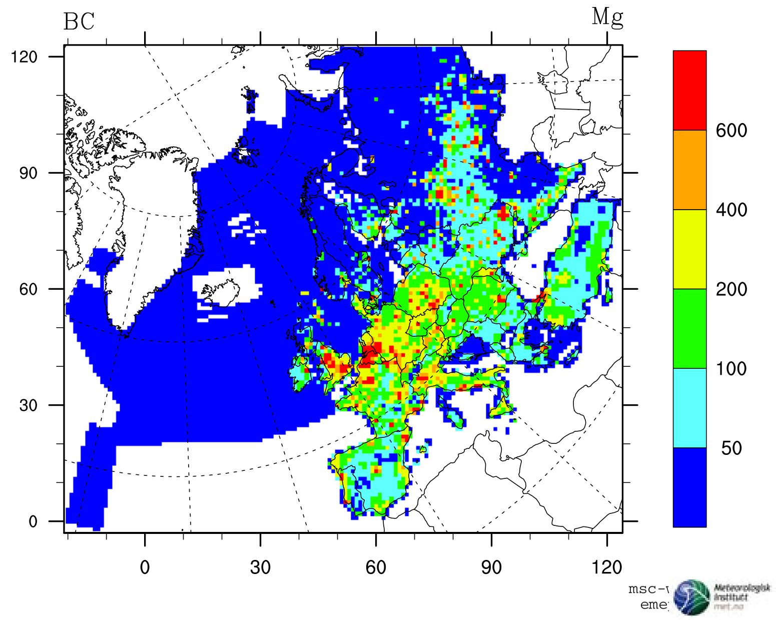
$PM_{2.5}$ (%)	EC fine		EC fine(*)	EC coar(*)
	OLD (Andersson-Sköld and Simpson, 2000)		**NEW** (based on Kupiainen, K. and Klimont, 2004)	
Power generation	33		3.8	0
Non-industrial combustion	20		17	56
Industrial combustion	33		2.0	0
Production processes	20		2.9	0
Extraction & distribution of fossil fuels	50		0	0
Solvent and other product use	20		-	-
Road transport	20		46	43
Other mobile sources and machinery	20		42	66
Waste treatment and disposal	60		22	31
Agriculture	0		7	0

(*) EC in PM_1 emissions in 2000

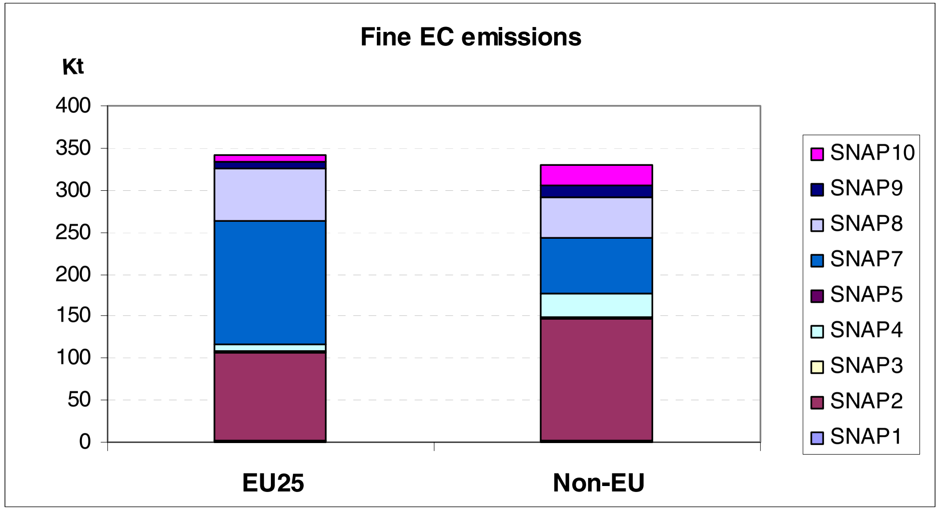
(**) EC (PM_{10}) – EC ($PM_{2.5}$) in 2000 - preliminary

EC emissions in the EMEP model

Fine EC emissions (2000)



Sector allocation of fine EC emissions

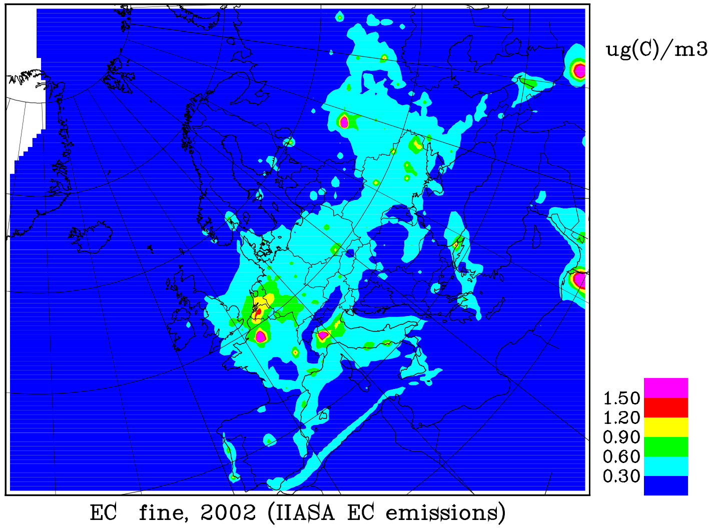


SNAP1 – Combustion in energy production
SNAP2 – Residential combustion
SNAP3 – Industrial combustion
SNAP4 – Production processes
SNAP5 – Extraction and distribution

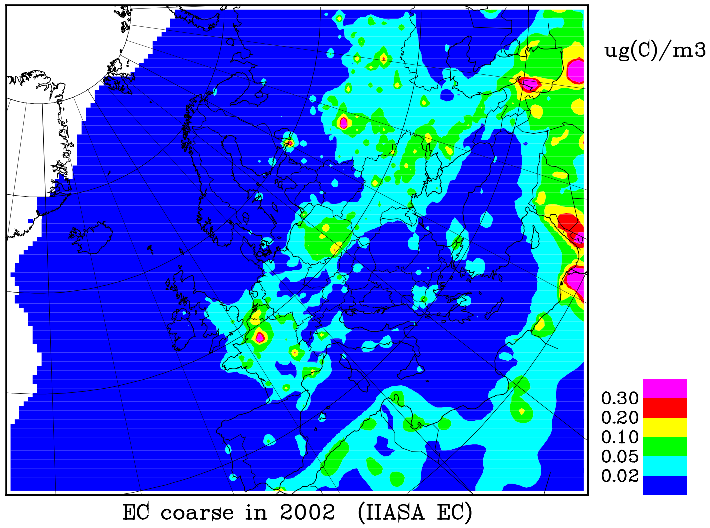
SNAP6 – Solvent and product use
SNAP7 – Road transport
SNAP8 – Other mobile sources
SNAP9 – Waste treatment
SNAP10 - Agriculture

Calculated EC in 2002

Fine

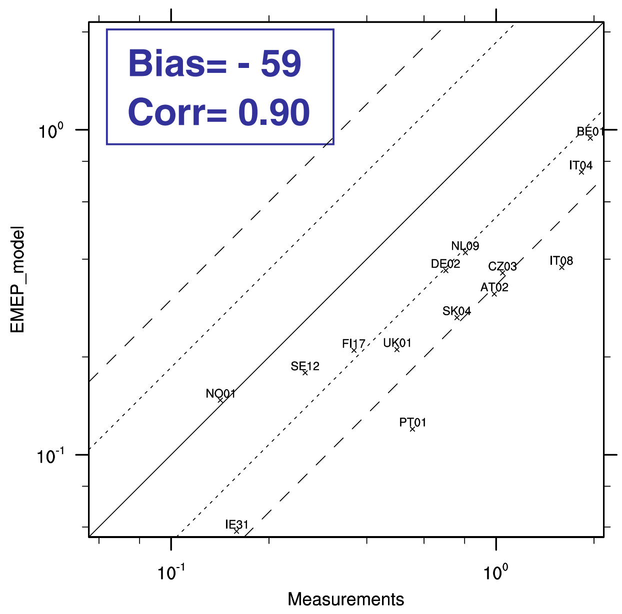


Coarse

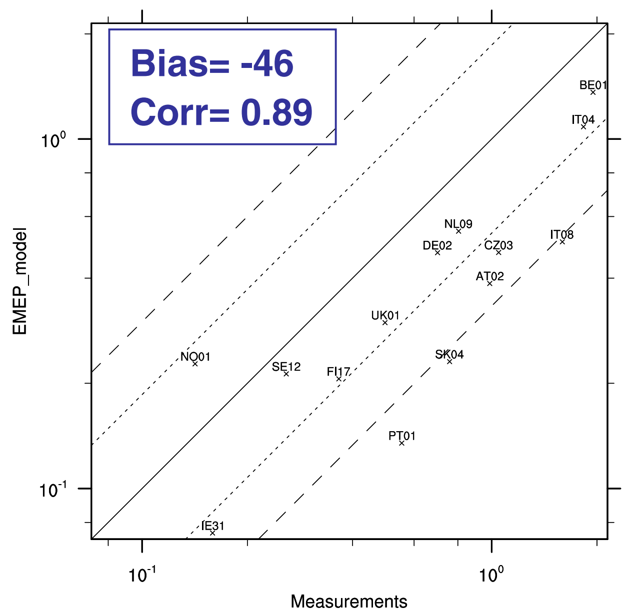


EC in 2002 :
effect of emission sector allocation

Old EC fractions



IIASA EC



- Emissions underestimation (diesel cars, trucks)
- Inter-annual variability of emission factors not accounted for
- Forest fires (8-10%?)

<u>Needed</u>: improvement of the spatial distribution of EC (PM) emissions! Esp. Traffic and residential

Treatment of EC hygroscopic properties

1. ***Internally mixed*** – **hydrophilic** (scav. eff. ~0.5-0.6)

2. ***Ageing*** **hydrophobic → hydrophilic:**

   turnover rate 2.5% h^{-1} (e-time scale $\tau \cong 1$ day) (Cook and Wilson, JGR, 1996)

   variable turnover rate (Riemer et al. ACP, 2004)

   daytime summer, winter: $\tau = 8$ h (below 250m)

   ---- # ---- # ---- # $\tau = 2$ h (above 250m)

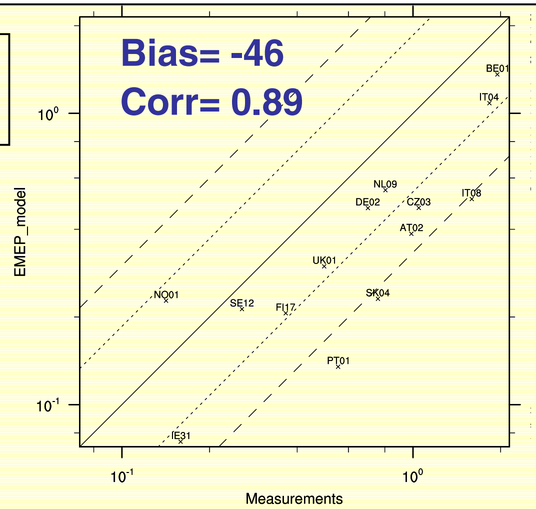
   night $\tau = 30$ h (10 - 40 h)

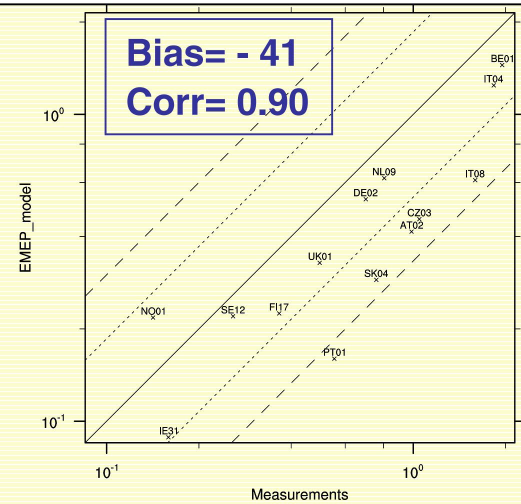
3. ***Externally mixed*** – **hydrophobic (no in-cloud scavenging)**

EC in 2002 : effect of EC ageing

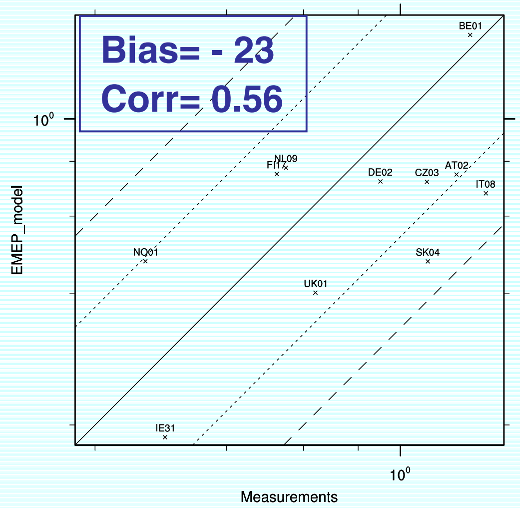
Internally mixed EC | **Hydrophobic & Ageing EC**

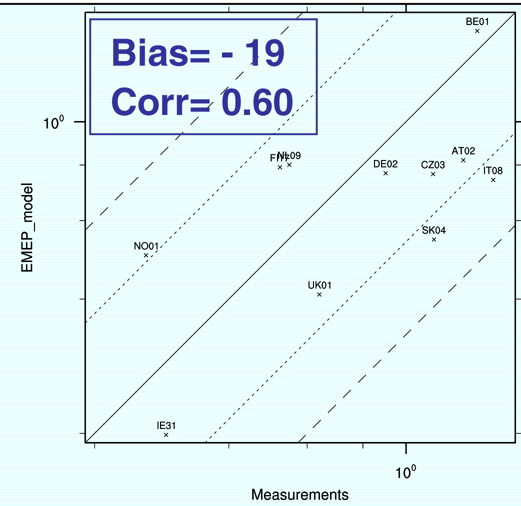
July-Dec. 2002



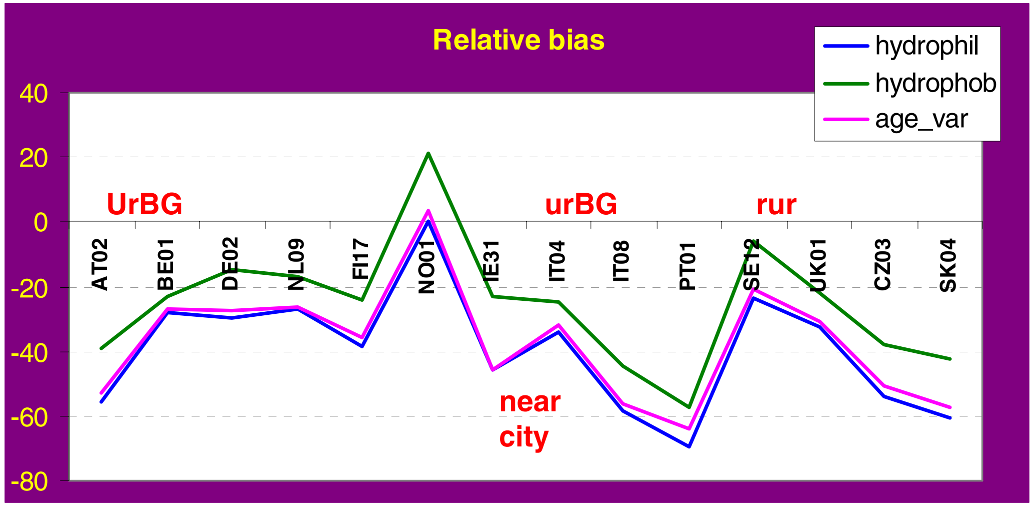


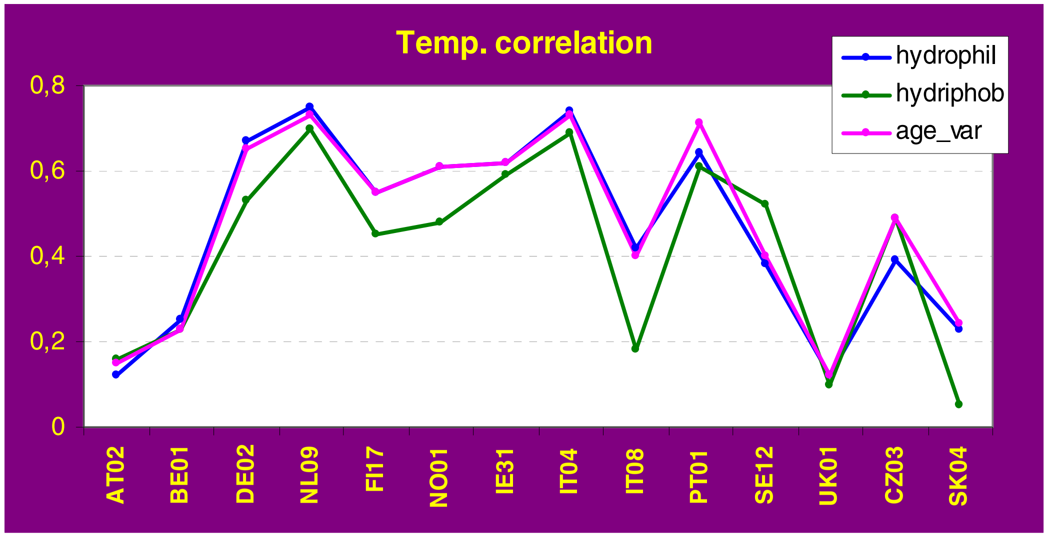
Jan.- May 2003





Modelled vs. Measured EC in 2002 :
effect of EC ageing





Measurements of EC are subject to large sampling and analytical uncertainties!!

RETRO Emissions

- Within the RETRO project, global gridded data sets for anthropogenic and **vegetation fire emissions** of several trace gases were generated, covering the period from **1960 to 2000** with **monthly time resolution**
- The data made available through GEIA (Global Emissions Inventory Activity). Provided with **spatial resolution of 0.5 x 0.5**

Wildland fire emissions

- Vegetation fire emissions were constructed from a large variety of sources with the **objective** to provide a **reasonable estimate of emissions including their seasonal and inter-annual variability in the major burning regions** of the world.
- Basically, the inventory is based on **burned area time series** (Reg_FIRM) and **area-specific total carbon emission** fluxes (GWEM). **Emissions for different species** are then derived using **emission factors**