The new CAMS global and regional emission temporal profiles

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[1] Barcelona Supercomputing Center - Centro Nacional de Supercomputación, Earth Sciences Department, Barcelona, Spain
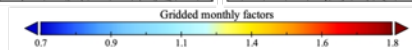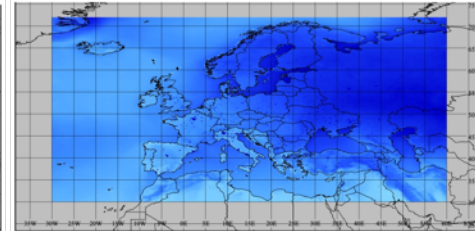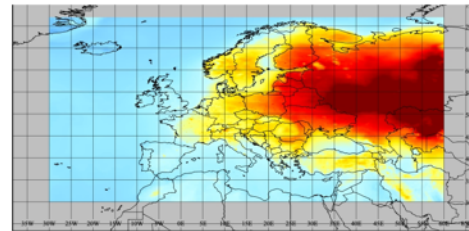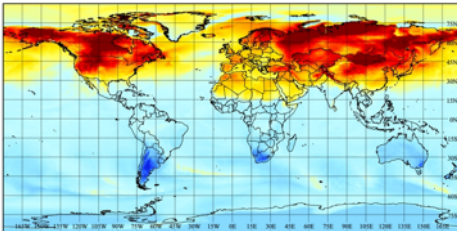[2] ICREA, Passeig Lluís Companys 23, Barcelona, 08010, Spain

19th GEIA 2020 WEB Conference
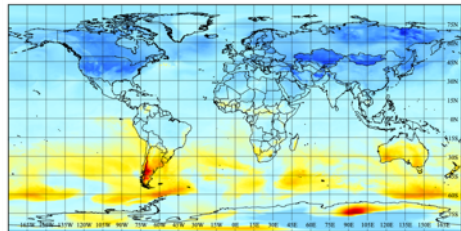
Highlights:

- A collection of **gridded monthly, weekly, daily and hourly temporal profiles** to be combined with the global and regional anthropogenic **CAMS emission inventories**

- Consideration of **year and pollutant-dependency, spatial variability and meteorological influence**

- Comparison against **real world measurement-based** profiles shows **high correlations**

- Profiles available as **open-access dataset** distributed through the **ECCAD** system

- **Future works** include the **evaluation** of the profiles when used for **air quality modelling activities**

Motivation

Current profiles used in CAMS

Main limitations:

➢ Mostly based on Western European old source datasets
➢ Reported as fixed profiles per sector
➢ Changes in meteorology neglected
➢ Variable sociodemographic patterns not accounted for

- 01 power generation
- 02 combustion
- 03 indust. combust.
- 04 indust. process.
- 05 extract./distr. fossil fuels
- 06 solvent use
- 07 road transport
- 08 other mobile
- 09 waste treatment
- 10 agriculture
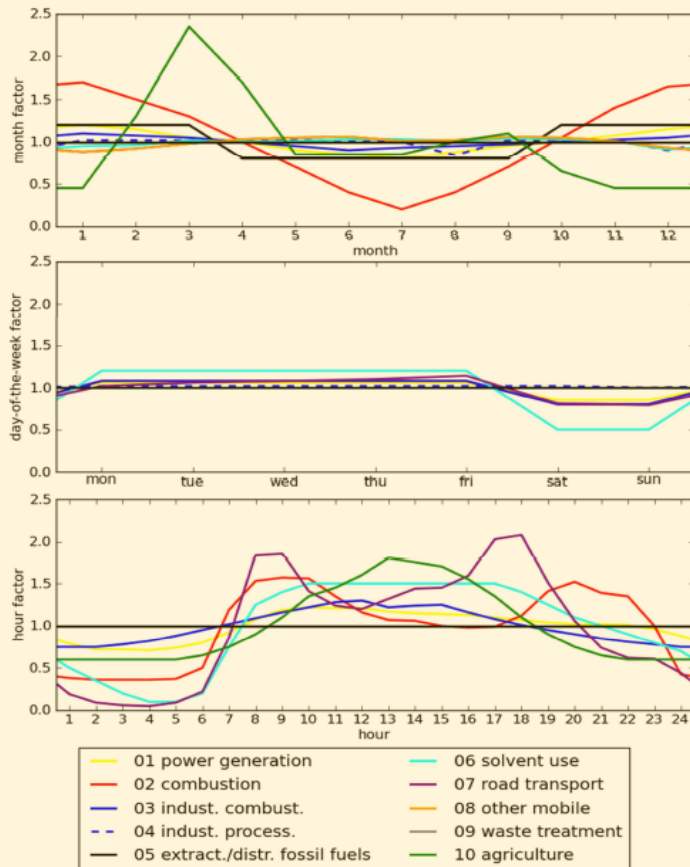
New CAMS-TEMPO profiles

New Features:

➢ Use of global/national/local up-to-date datasets
➢ Reported as spatial variant profiles (gridded data)
➢ Use of meteorological parametrizations
➢ Consideration of cultural aspects & pollutant dependencies

Fertilizers: Influence of national crop calendars

Agriculture-fertilizers (NH_3) – April   Agriculture-fertilizers (NH_3) – November
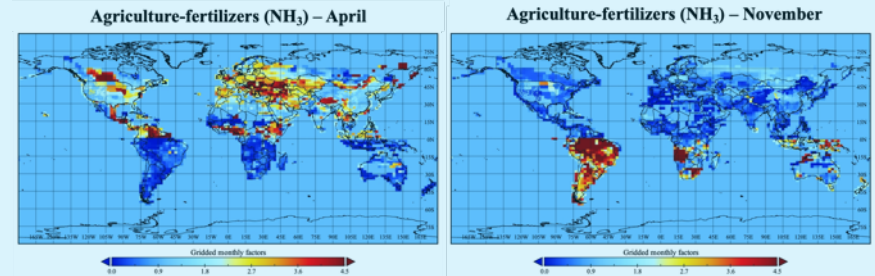
Residential combustion: Influence of temperature and year

Daily profiles residential/commercial (2010)   Daily profiles residential/commercial (2017)

— Athens — Barcelona — Oslo — Buenos Aires   — Athens — Barcelona — Oslo — Buenos Aires
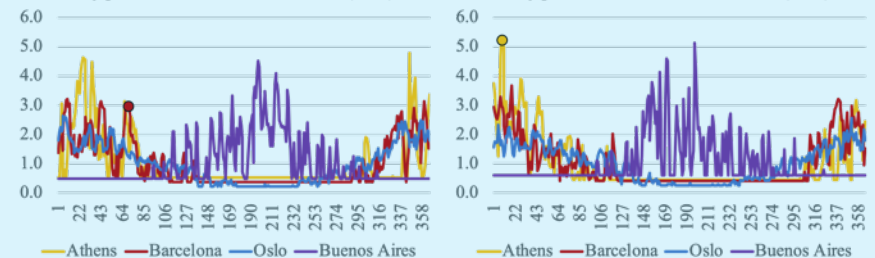
Traffic: Influence of behaviour & process (exhaust vs. evaporative)

Hourly profiles traffic (weekdays)

Athens — Barcelona — Berlin — Copenhagen
Madrid — Milano — Oslo — Paris
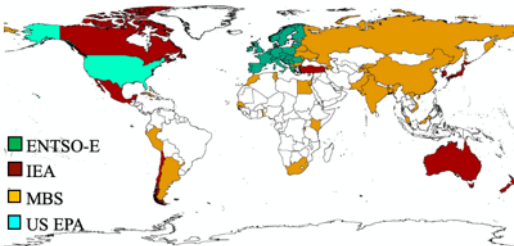Utrecht — Valencia — Evaporative
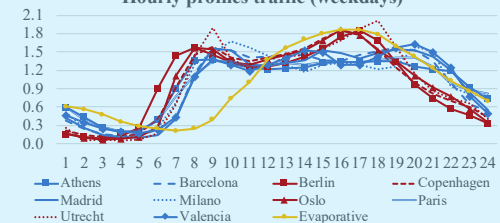
Methodology

- Collection and processing of **multiple open-access socio-economic and statistical datasets**

- Use of **meteorological parametrizations** to consider influence of **temperature/wind speed**

| Energy industry	Manufacturing industry	Residential/ Commercial	Road transport	Agriculture
- National electricity production data[1]	- National industrial production index values[2]	- Temperature-dependency (Heating Degree Day) [3] - Measured-based energy consumptions[4]	- Traffic counts from multiple cities/countries - Temperature-dependency for CO and NMVOC gasoline[5] and NO_x diesel emissions[6]	- Temperature & wind-dependency for livestock & fertilizer NH_3[7] - Mosaic of regional inventories for crop calendars [8]

Spatial coverage of input datasets

Energy industry

Manufacturing industry
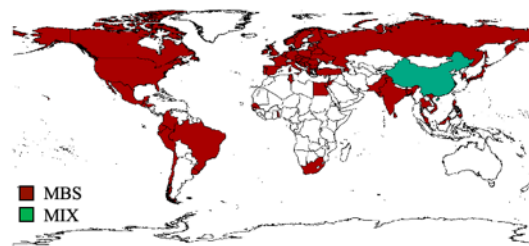
Road transport

Agriculture
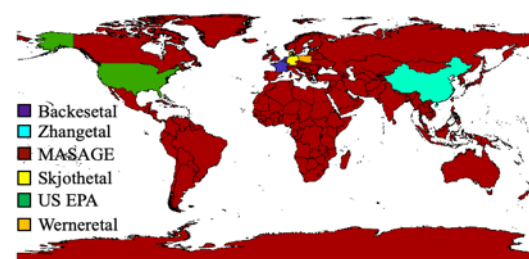
[1] ENTSO-E Transparency Platform, IEA monthly electricity statistics, MBS electricity production, US EPA CEM data

[2] MBS IPI database, Li et al. (2017)

[3] Mues et al., (2014), CS3 (2017)

[4] Finstad et al. (2004), Gröndahl et al. (2010), Athanasopoulou et al. (2017), Carter et al. (2016)

[5] US EPA (2015)

[6] Keller et al. (2017)

[7] Gyldenkærne et al. (2005), Skjøth et al. (2011), CS3 (2017)

[8] Paulot et al. (2014), Zhang et al. (2018), US EPA (2019), Skjoth et al. (2011), Werner et al. (2015), Backes et al. (2016)

Dataset overview

- CAMS-TEMPO **follows the domain description and sector classification** reported by the **CAMS-GLOB_ANT and CAMS-REG_AP/GHG** emission inventories

- Depending on the source and resolution (i.e. monthly, weekly, daily, hourly), profiles are **reported as gridded values/spatial invariant, yearly dependent (2010-2017) and/or pollutant dependent**

GNFR Sector	Monthly (Σ=12)	Daily (Σ=365/366)	Weekly (Σ=7)	Hourly (Σ=24)
A: Public Power	(per country, pollutant)	-	(per country, pollutant)	(per country, pollutant)
B: Industry	(per country)	-	-	-
C: Other Stationary Combustion	(per region, year)	(per region, year)	-	(per region, pollutant)
F1: Road Transport exhaust gasoline	(per year, region for CO and NMVOC; per region for others)	-	(per region)	(per region, day type)
F2: Road Transport exhaust diesel	(per year, region for NO_x; per region for others)	-	(per region)	(per region, day type)
F3: Road Transport exhaust LPG	Road transport exhaust LPG	(per region)	-	(per region)
F4: Road Transport non-exhaust	(per region for PM; fixed for NMVOC)	-	-	(per region for PM; fixed for NMVOC)
H: Aviation	(per country)	-	-	(fixed)
K: Agriculture Livestock	(per region, year for NH_3 and NO_x; fixed for others)	(per region, year for NH_3 and NO_x)	-	-
L: Agriculture Others (fertilizers and a.w.b.)	(per region)	(per region, year for NH_3)	-	(fixed for non-NH3)

CAMS-GLOB-TEMPOv2.1
Spatial coverage: Global (0.1x0.1 deg)
Sector classification: CAMS-GLOB_ANT
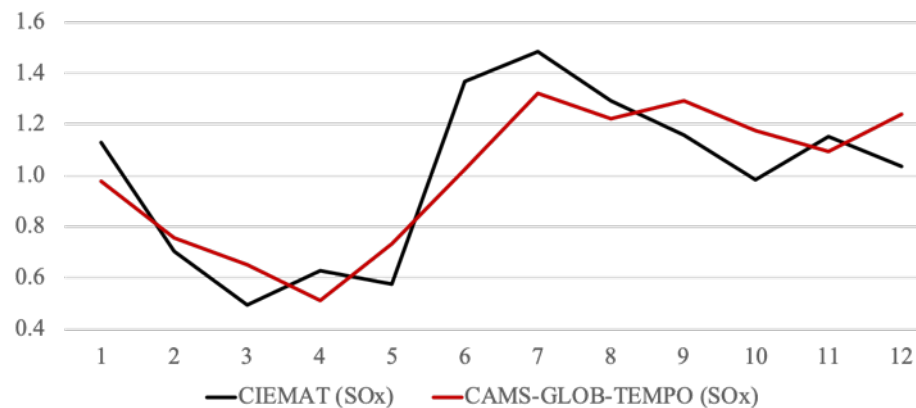
ECCAD

CAMS-REG-TEMPOv2.1
Spatial coverage: Europe (0.05x0.1 deg)
Sector classification: CAMS-REG-AP/GHG

Comparison to observational datasets

Comparison of **CAMS-TEMPO** against **real world measurement-based** profiles, including….
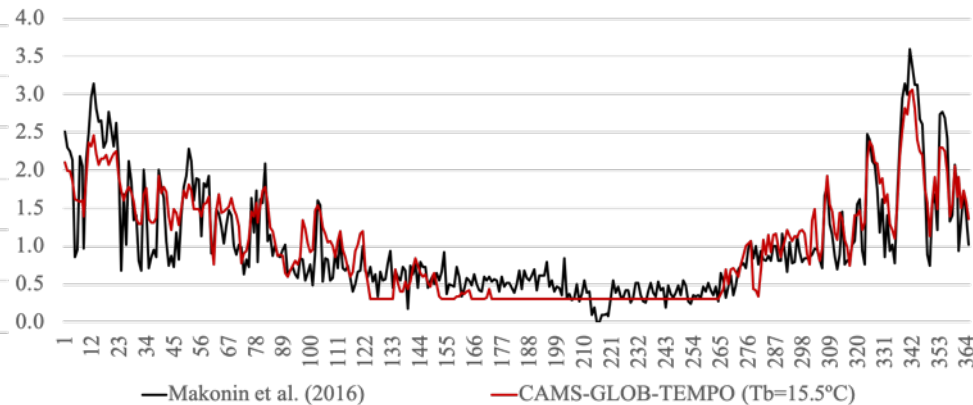
SO$_2$ measured emissions in power plants (r=0.84)


Monthly profiles energy industry (Spain)
—CIEMAT (SOx) —CAMS-GLOB-TEMPO (SOx)

Measurements of residential natural gas consumption (r=0.81)

Daily profiles for residential sector (Vancouver, Canada, 2013)
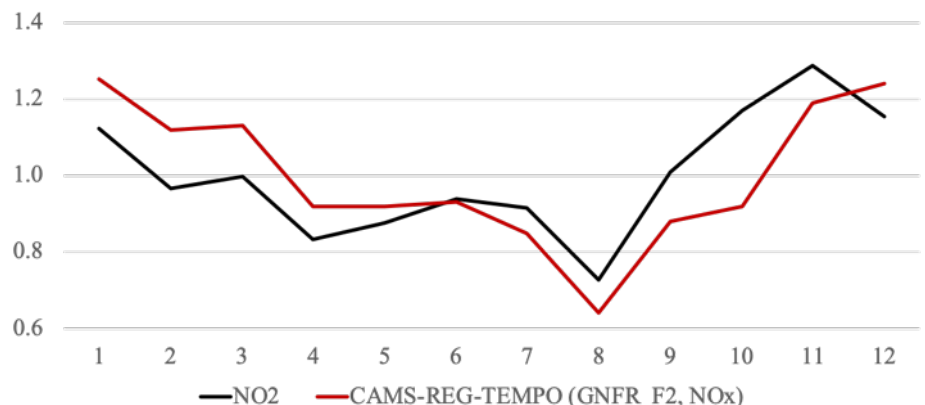—Makonin et al. (2016) —CAMS-GLOB-TEMPO (Tb=15.5ºC)

Measurements of industrial natural gas consumption (r=0.61)

Monthly profiles manufacturing industry (Italy)
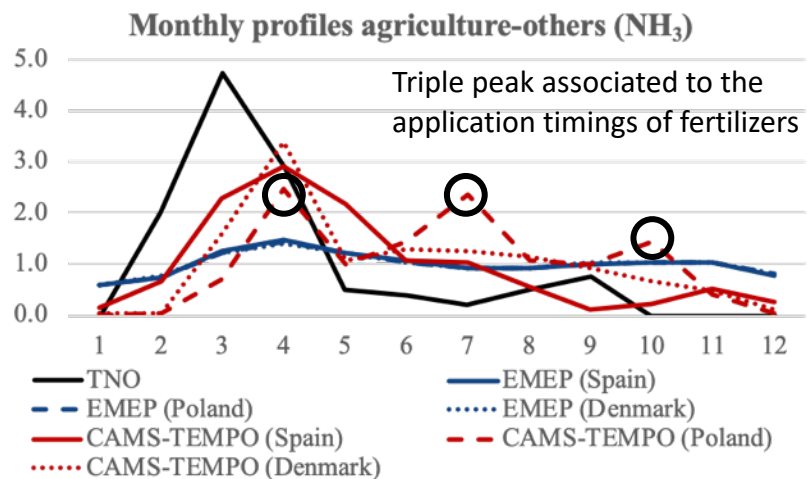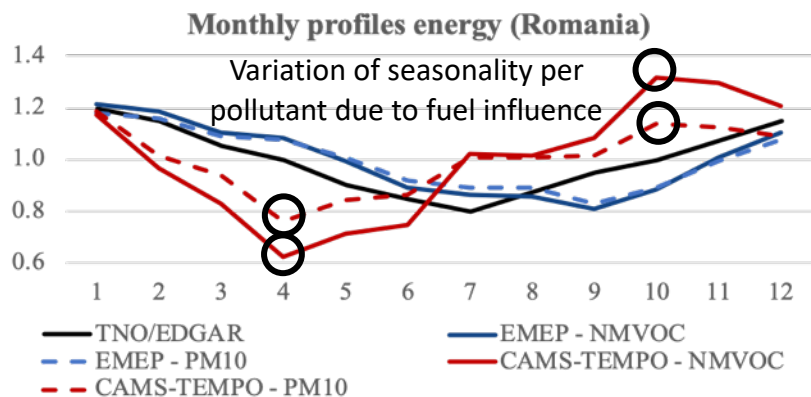—ENTSO-G —CAMS-GLOB-TEMPO
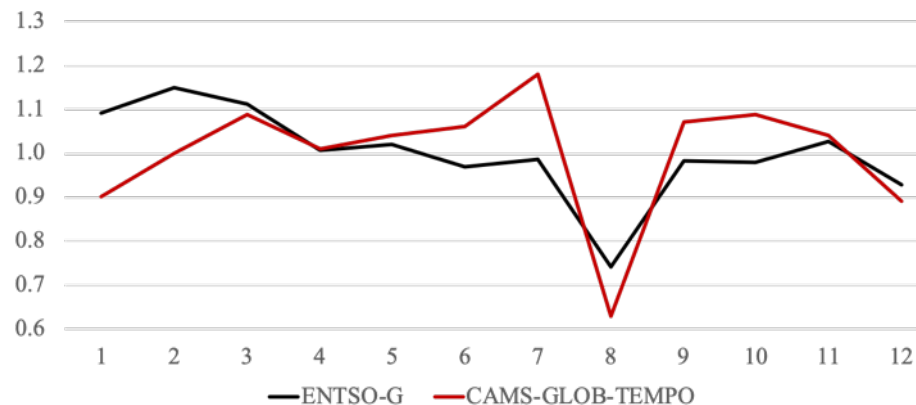
Measurements of NO$_2$ concentrations at a traffic site (r=0.74)

Monthly profiles traffic (Madrid, 2017)
—NO2 —CAMS-REG-TEMPO (GNFR_F2, NOx)

Comparison to current CAMS profiles

Comparison of **CAMS-TEMPO** against **TNO[1]**, **EMEP[2] and EDGAR[3,4]** profiles
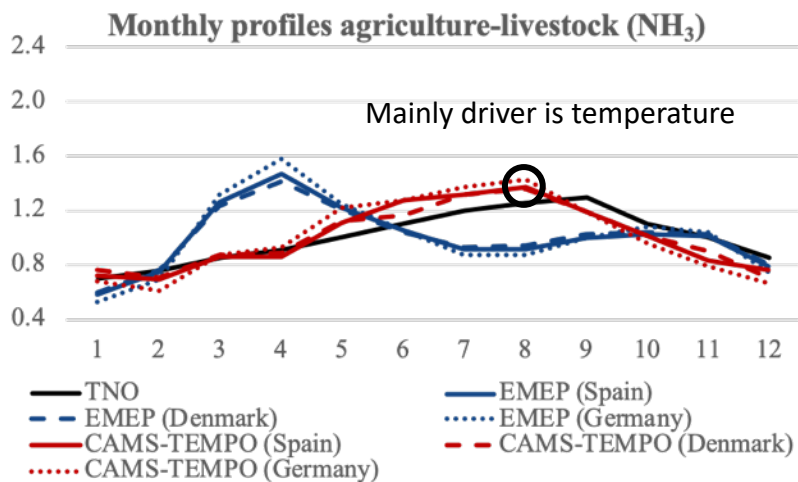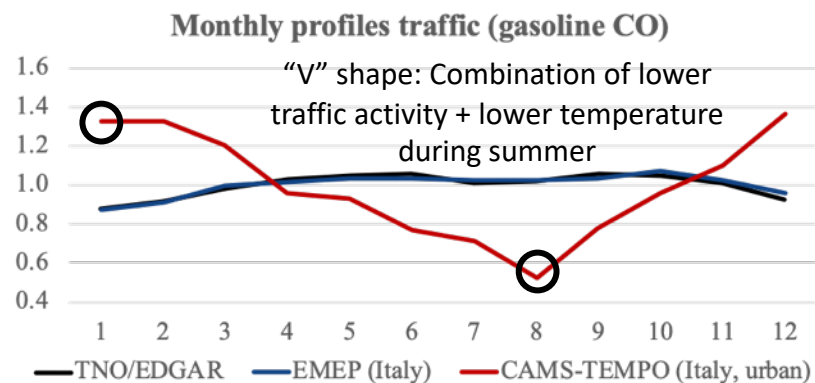
[1] Denier van der Gon et al. (2011), [2] Simpson et al. (2012), [3] Janssens-Maenhout et al. (2019), [4] Just recently (April 2020) new EDGAR profiles published (Crippa et al., 2020). Comparison not included in the present work.