Preliminary results of the source apportionment inter-comparison exercise 2015-2016 (part 3)

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and the Fairmode community

Fairmode Technical meeting
Zagreb, 27-29 June 2016

Participants

European Commission

RM: 33 participants – 38 results

AGH-UST	ISAC LE	RIVM
APPATN	FMI	SAGE
ARPA ER	IDAEA_T	UCC
ARPA LO	IDAEA_A	UMH
ARPA PU	IMROH	UNIBO
ARSO	ISSeP	UNIHE
AUTH	IST	UNIMI
CARES	LGGE+	UNMIB
CNR IIA	NCSR	UNIFI
ENEA	PSI	UNIGE
ISAC BO	PUC	WUT

A,B,C,D,E,F,G,H,I,J,K,L,M,N,O,P,Q,R,S,T,U,V,W,X,Y,Z,*A,*B,*C,*D,*E,*F,*G,*H,*I,*J,*K,*L

CTM: 7 participants – 11 results

ENEA /ARIANET/ ARPA PIEMONTE	joint result
CIEMAT/LISA CNRS	jont result
RIER- UNI KOLN	independent result
TNO	independent result
ARPAV	coodinated result
RSE	coordinated results
UNIAVE	cordinated results

cA,cAo,cAs,cAso,cAs2,cB,cBo,cD,cDo,cE,cEo,cF

Intercomparison set up

RM

09/03/2011 to 06/03/2012

every 3 days

24 hours mean

116 time steps (samples)

PM10

98 chemical species

CTM

Summer: 1/6/2011 to 1/08/2011

Winter: 15/11/2011 to 5/2/2012

Hourly data

c.a 4300 time steps (hours)

PM10 and PM2.5

7 chemical species

CHEMICAL SPECIES - comparison between RM and CTM

	RMs	CTMs
IONS	8 species	nitrate (NO3), sulphate (SO4), ammonium (NH4),
carbonaceous fraction	EC/OC 2 species	elemental carbon (EC), organic carbon x k = (POA+SOA)
TRACE ELEMENTS	25 species	other primary aerosol (OPA)
PAHs	15 species	POA+SOA
LEVO/MANN	3 species	
HOPANES	10 species	
N-ALKANES	29 species	
CHOLESTEROL		
POA MARKERS	4 species	primary organic aerosol (POA),
OTHER	Pristane, Phytane, Glucose	
		secondary organic aerosol (SOA),
TOTAL	98	7

Definition of sources CTM

SNAP		Mandatory 8	Optional 14
1	Energy industry	01_ENI	01_ENI
21	R & C combustion, coal	99_OTH	**02_OTH**
22	R & C combustion, light liquid fuel	99_OTH	**02_OTH**
23	R & C combustion, medium liquid fuel	99_OTH	**02_OTH**
24	R & C combustion, heavy liquid fuel	99_OTH	**02_OTH**
25	R & C combustion, gas	99_OTH	**02_OTH**
26	R & C combustion, solid biomass (wood)	02_BIO	02_BIO
34	Industry (combustion & processes)	34_IND	34_IND
5	Fugitive emissions from fuels	99_OTH	99_OTH
6	Product use including solvents	99_OTH	99_OTH
71	Road transport, exhaust, gasoline	07_RTR	**71_RTG**
72	Road transport, exhaust, diesel	07_RTR	**72_RTD**
73	Road transport, exhaust, LPG/natural gas	07_RTR	07_RTR
74	Road transport, non-exhaust, evaporation	07_RTR	07_RTR
75	Road transport, non-exhaust, wear	07_RTR	**75_RTW**
8	Non-road transport	99_OTH	99_OTH
81	International shipping, marine diesel oil	08_SHP	08_SHP
82	International shipping, heavy fuel oil	08_SHP	08_SHP
9	Waste treatment	99_OTH	99_OTH
10	Agriculture	10_AGR	10_AGR
11P	Dust	11_DST	11_DST
11	Sea Salt	99_OTH	**11_SLT**
11	Biogenic SOA	99_OTH	**11_BSO**

8 - 14 source categories defined for comparability with RM source categories (SPECIEUROPE used as reference)
The optional set with higher detail on domestic, traffic and primary inorganic aerosol (dust/salt)

3 + 3 summer/winter months
Hourly concentrations (current evaluation for daily averages)
Primary and secondary PM
PM precursors

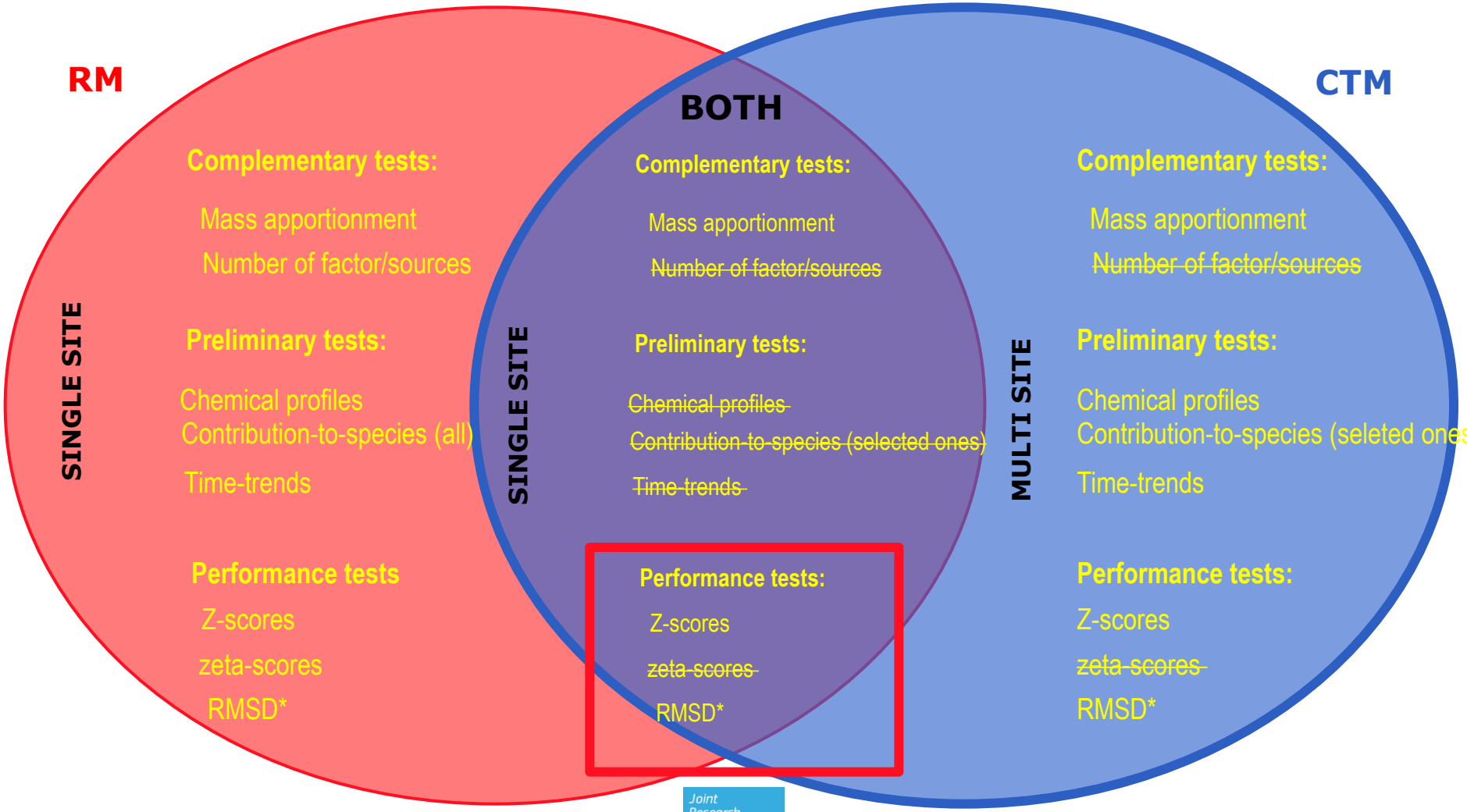
SOURCES - comparison between RM and CTM

CTM	RM corresp.	CTM	RM corresp.
Mandatory	Mandatory	**Optional**	Optional
01_ENI	28 power plant or 30 fuel oil combustion	01_ENI	28 power plant or 30 fuel oil combustion
99_OTH		**02_OTH**	
99_OTH			
99_OTH			
99_OTH			
99_OTH			
02_BIO	40 biomass burn.	02_BIO	40 biomass burn.
34_IND	20 industry	34_IND	20 industry
99_OTH		99_OTH	
99_OTH		99_OTH	
07_RTR	1 traffic	**71_RTG**	2 exhaust
		72_RTD	
		07_RTR (OTH)	
		07_RTR (OTH)	
		75_RTW	5 road dust
99_OTH		99_OTH	
08_SHP	37 ship, 30 fuel oil	08_SHP	37 ship, 30 fuel oil
99_OTH		99_OTH	
10_AGR	NH4 sum	10_AGR	NH4 sum
11_DST	10 dust	11_DST	10 dust
99_OTH		**11_SLT**	12 marine, 71 aged sea salt
99_OTH		**11_BSO**	
NN4+NO3+SO4	60 SIA	NN4+NO3+SO4	60 SIA

not shown

	SOURCE CATEGS, (SPECIEUROPE)
1	traffic
2	exhaust
10	soil
12	marine (fresh sea salt)
20	industry
28	power plant
30	fuel oil
31	coal
37	ship
40	biomass burning
41	wood burning
5	road dust
60	SIA
61	ammonium nitrate
62	ammonium sulphate
66	deicing salt
70	POA
71	aged sea salt
74	combustion

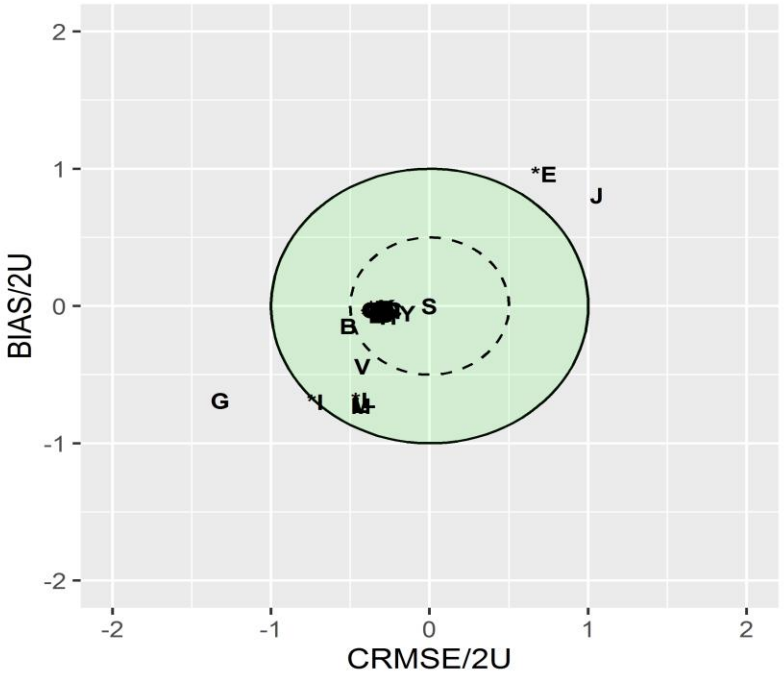
Evaluation in this IE

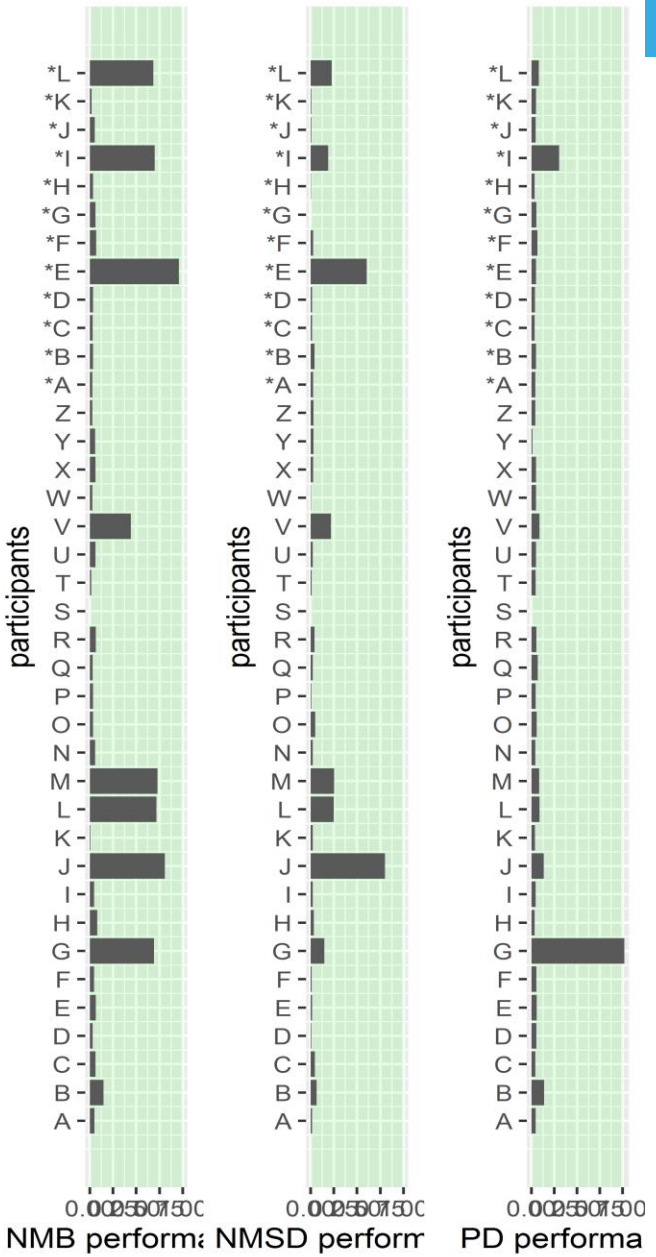


RM-CTM preliminary tests

MASS CLOSURE RM

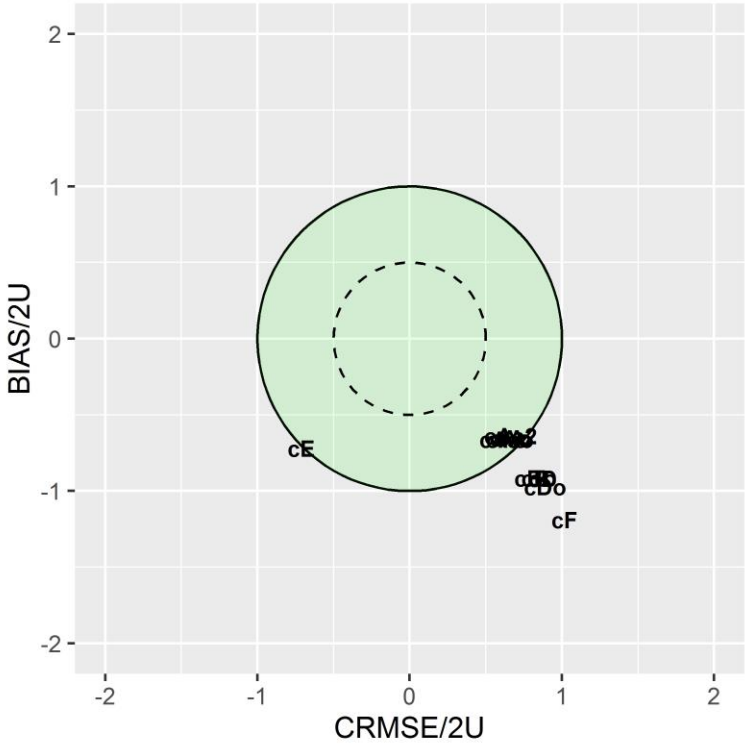
Lens

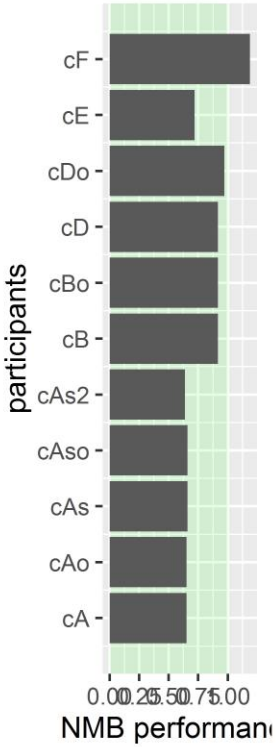


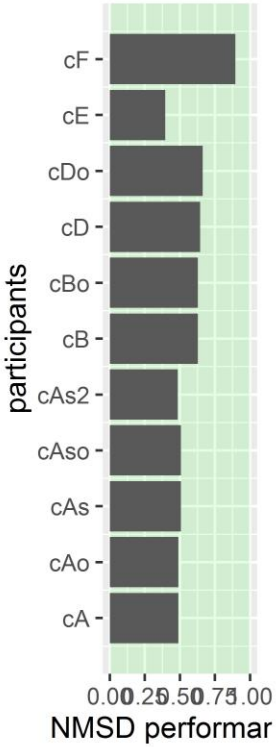


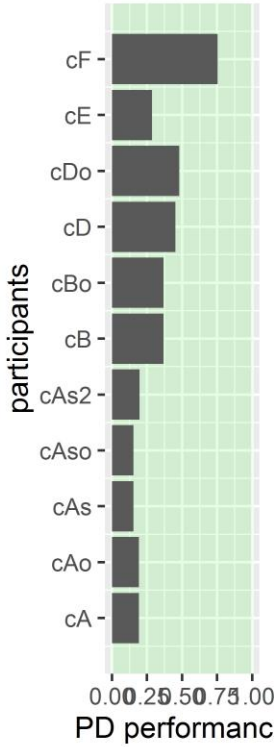
MASS CLOSURE CTM

Lens







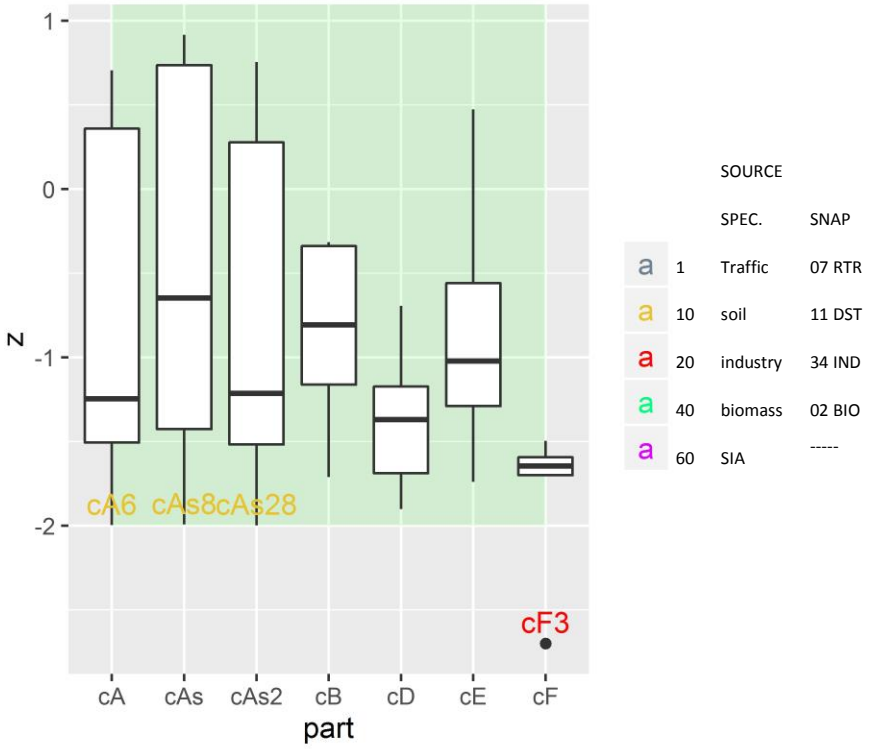


CTM performance tests using the RM references

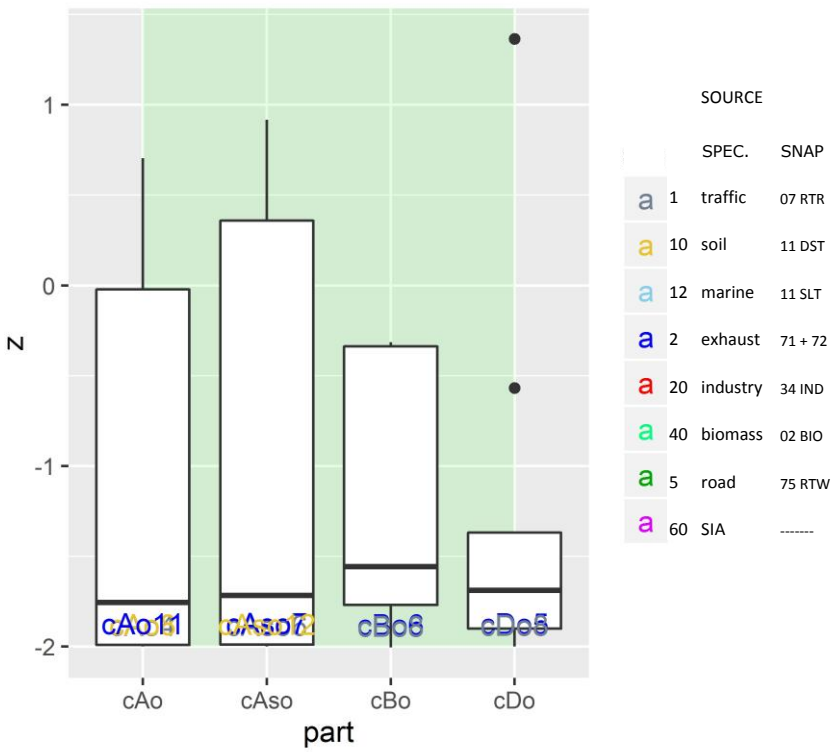
Performance RM CTMs z-score (overall sce)

Lens

mandatory



optional



In general CTM tend to underestimate sce

Mandatory: Underestimation of soil for result A and of SIA for result F

Optional: understimation of soil and exhaust

Performance RM CTMs
Target plot (sce time series)

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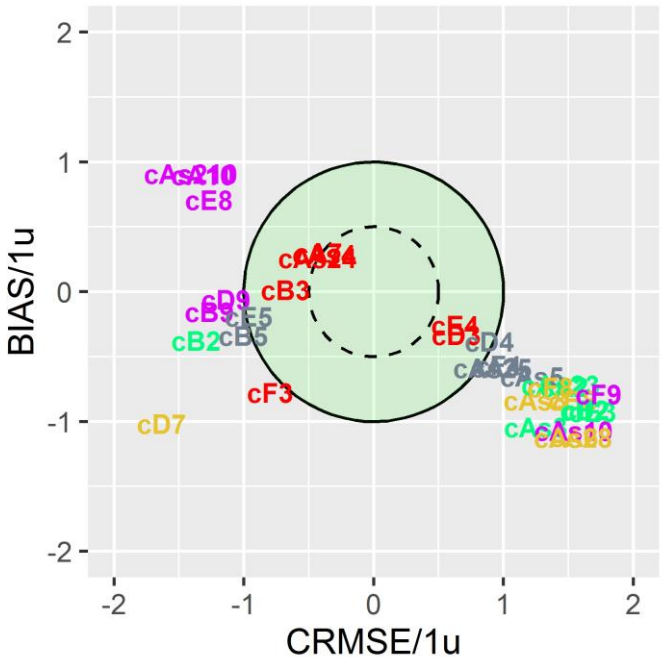
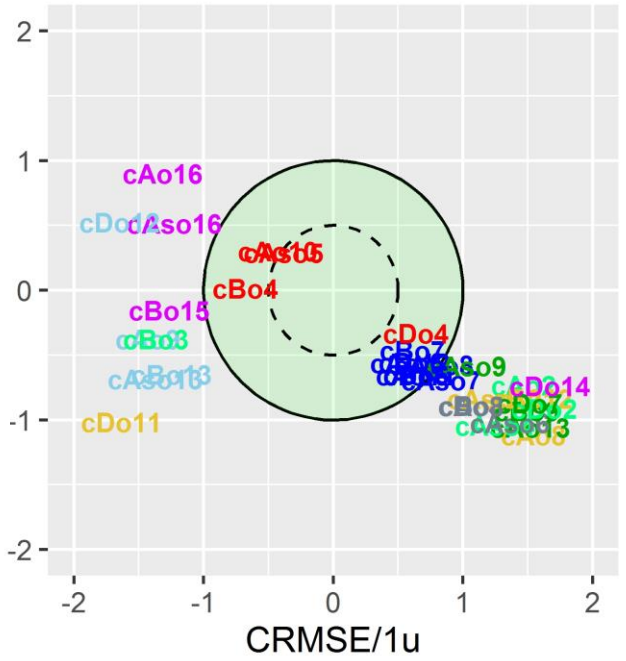
mandatory



		SOURCE SPEC.	SNAP
a	1	Traffic	07 RTR
a	10	soil	11 DST
a	20	industry	34 IND
a	40	biomass	02 BIO
a	60	SIA	-----

optional



		SOURCE SPEC.	SNAP
a	1	traffic	07 RTR
a	10	soil	11 DST
a	12	marine	11 SLT
a	2	exhaust	71 + 72
a	20	industry	34 IND
a	40	biomass	02 BIO
a	5	road	75 RTW
a	60	SIA	-------

Target values normalized by 1 x (not 2x) uncertainty of the reference -> more stringent criteria

Mandatory: industy often in the acceptance area.

Optional: both industry and exhaust in the acceptance area

Performance RM CTMs z-score and target

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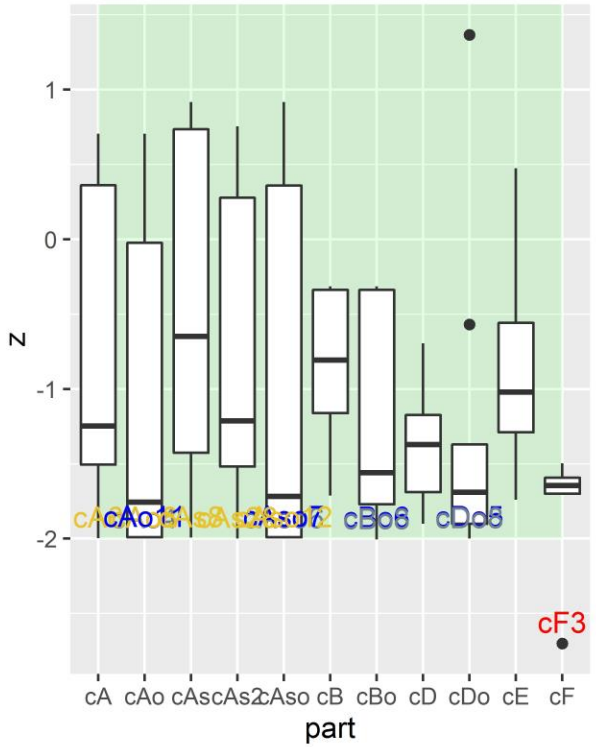
z-score (m+o)



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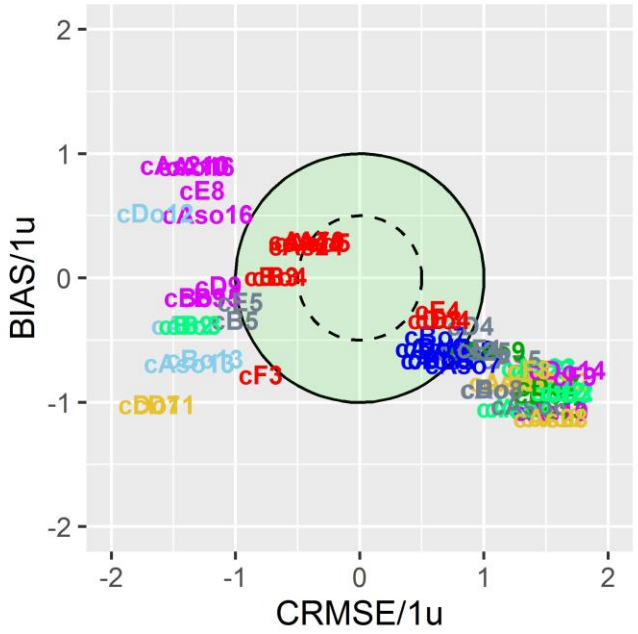
a	5	road	75 RTW
a	60	SIA	-------

target (m+o)



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a	5	road	75 RTW
a	60	SIA	-------

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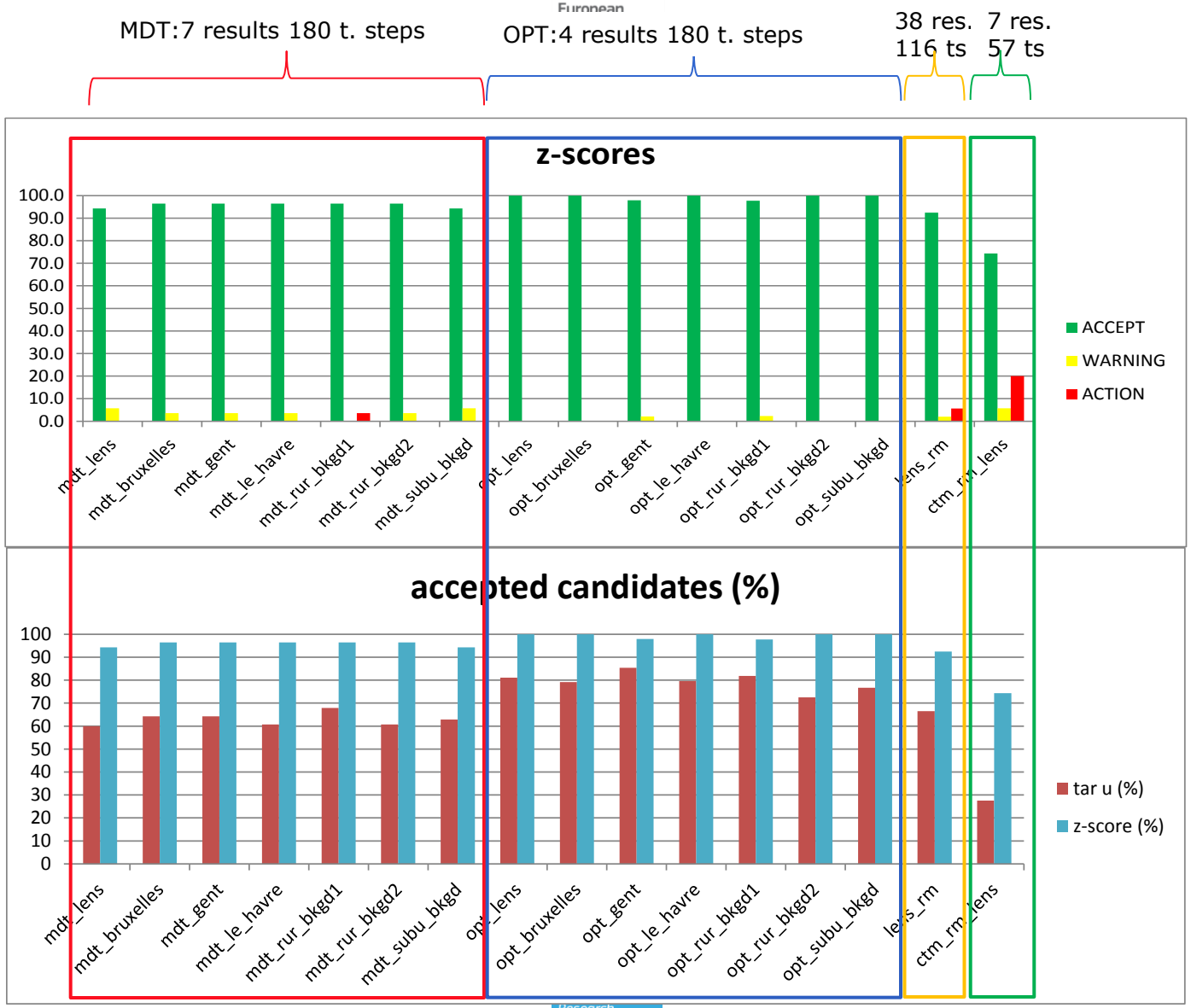
z-scores show understimation of soil and exhaust for the overall average; industry underestimated by model not reporting amm nitrate.

Target plot show more discrepancies with a tendency to underestimate for most sources with the exception of SIA; industry and exhaust performing well.

Performance RM CTMs ALL RECEPTORS



London and Paris not included in this analysis

Preliminary synthesis of the IE

- High number of participants and high quality of input data => robust results
- RM: mainly one model (PMF5) good performance for overall dataset (z-score 92%), more difficulties with time series (target (1u) 66%).
- RM: industry most problematic source.
- RM: uncertainty of chemical profiles in line with the reference
- CTM: high homogeneity among participants/models (z-scores >90%; target (1u) 60-70% in mandatory and 70 – 80% in optional sets, respectively.
- CTM: no meaningful differences in the performance between sites (slightly lower performances in Lens).
- CTM: better results with set of 14 sources (OPT) than with 8 sources (MDT)
- CTM: mass closure with a tendency to underestimate when compared to gravimetric PM10
- CTM: good performance when compared with RM reference for the overall dataset (z-score 75%), more difficulties with time series (target (1u) 30%)
- CTM: soil and exhaust sources with higher negative bias when compared with RM (overall average).

Preliminary conclusions of the IE

- The RM uniformation towards PMF5 (in part due to the good performances in previous IE) contributes to more homogeneous results.
- RM: Industry source needs better definition because too generic and risk of allocation of other combustion sources in there.
- CTM show quite homogeneous performances when using exactly the same input data.
- the comparison of CTM with RM reference points out a general underestimation of the single sources. Most critical situation for dust.
- Better perfomance for exhaust (as a whole) which is probably seen well by the two families of models. Good CTM scores with industry likely due to high uncertainty (tollerance) of the RM reference.
- Need to analyze the results more in detail.

Future work

- Detailed analysis of intercomparsion data; e.g. influence of seasons, size fraction, time resolution, specific compounds (EC, toxics etc…)
- Work towards studying geographical origin of pollution in addition to source categories (e.g. CTM vs RM+trajectories)
- Improved use of constrained analysis to improve the results in RM; e.g. force sensible factor profiles. More focus on data pre-treatment to remove noise.
- Work to include key tracers/species in EI to support the CTM performance (e.g. levoglucosan)?
- More focus on formation of organics (volatility, reactivity, degradation, precursors); dedicated IE including filter based and AMS/ACSM measurements?
- How to deal with dust, road dust sources in CTM
- Need to improve dialogue between CTM and RM communities
- Find what aspect of the IE outcome could be useful for other WGS.

European Commission

Thank you for your attention