

Standardisation of a European measurement method for organic carbon and elemental carbon in ambient air: results of the field trial campaign and the determination of a measurement uncertainty and working range

Richard J. C. Brown^{*1}, Sonya Beccaceci¹, David M. Butterfield¹, Paul G. Quincey¹, Peter M. Harris¹
Thomas Maggos², Pavlos Panteliadis³, Astrid John⁴, Aleksandra Jedynska⁵, Thomas A.J.
Kuhlbusch^{6,7}, Jean-Philippe Putaud⁸, Angeliki Karanasiou⁹

1 National Physical Laboratory, Teddington, TW11 0LW, UK

2 National Centre for Scientific Research "Demokritos", Institute of Nuclear & Radiological Sciences & Technology, Energy & Safety, Environmental Research Laboratory, 15310 Ag. Paraskevi, Athens, Greece

3 Public Health Service (GGD) Amsterdam, Department of Air Quality, Nieuwe Achtergracht 100, 1018 WT Amsterdam, Netherlands

4 Institute for Energy and Environmental Technology e.V. (IUTA), Air Quality & Aerosols, Bliersheimer Str. 58 – 60, 47229 Duisburg, Germany

5 TNO Utrecht, Princetonlaan 6, 3584 CB Utrecht, Netherlands

6 Federal Institute for Occupational Safety and Health (BAuA), Friedrich-Henkel-Weg 1-25, 44149 Dortmund, Germany

7 CENIDE, University Duisburg-Essen, Carl-Benz-Str. 199, 47057 Duisburg, Germany

8 European Commission, Joint Research Centre, Directorate for Energy, Transport and Climate, Air and Climate Unit, Via E. Fermi 2749, I-21027 Ispra (VA), Italy

9 Institute of Environmental Assessment and Water Research, Spanish Research Council, IDAEA-CSIC, 08034 Barcelona, Spain

* Corresponding author. Tel.: +44 20 8943 6409, E-mail: richard.brown@npl.co.uk

Electronic Supplementary Material

Table S1. The combined variability – calculated from the between laboratory variability and internal laboratory variability added in quadrature – at each field trial site: CAB, Cabauw; IPR, Ispra; WAL, Waldhof; BCN, Barcelona; MUL, Mülheim; AMS, Amsterdam. Results for: EC are shown in Table S1(a), OC in Table S1(b) and TC in Table S1(c). 'Trans' and 'Refl' indicate transmittance and reflectance corrections respectively.

Site	Analysis Protocol	Combined variability / %
CAB	IMPROVE Trans	14
	EUSAAR2 Trans	19
	NIOSH Trans	24
	IMPROVE Refl	27
	EUSAAR2 Refl	29
	NIOSH Refl	34
IPR	IMPROVE Refl	11
	IMPROVE Trans	11
	NIOSH Refl	11
	EUSAAR2 Refl	16
	EUSAAR2 Trans	16
	NIOSH Trans	16
WAL	EUSAAR2 Trans	15
	IMPROVE Trans	20
	NIOSH Trans	30
	EUSAAR2 Refl	>100
	IMPROVE Refl	>100
	NIOSH Refl	>100
BCN	IMPROVE Trans	4.8
	EUSAAR2 Trans	6.6
	NIOSH Trans	12
	EUSAAR2 Refl	16
	IMPROVE Refl	19
	NIOSH Refl	30
MUL	EUSAAR2 Trans	5.2
	NIOSH Refl	6.6
	IMPROVE Trans	8.9
	EUSAAR2 Refl	10
	IMPROVE Refl	11
	NIOSH Trans	15
AMS	EUSAAR2 Trans	9.3
	IMPROVE Trans	10
	EUSAAR2 Refl	12
	NIOSH Trans	13
	NIOSH Refl	17
	IMPROVE Refl	17

Table S1(a): Elemental Carbon

Site	Analysis Protocol	Combined variability / %
CAB	EUSAAR2 Trans	7.1
	IMPROVE Trans	7.4
	NIOSH Trans	9.2
	NIOSH Refl	11.9
	EUSAAR2 Refl	12.5
	IMPROVE Refl	14.3
IPR	NIOSH Trans	5.1
	IMPROVE Trans	5.4
	NIOSH Refl	5.7
	IMPROVE Refl	7.2
	EUSAAR2 Trans	11.3
	EUSAAR2 Refl	11.5
WAL	NIOSH Trans	5.0
	NIOSH Refl	5.5
	EUSAAR2 Refl	9.1
	EUSAAR2 Trans	9.6
	IMPROVE Refl	11.3
	IMPROVE Trans	11.6
BCN	NIOSH Trans	3.3
	IMPROVE Trans	4.0
	EUSAAR2 Trans	5.5
	EUSAAR2 Refl	6.9
	IMPROVE Refl	7.1
	NIOSH Refl	9.4
MUL	EUSAAR2 Trans	2.9
	NIOSH Trans	3.5
	NIOSH Refl	3.6
	IMPROVE Trans	4.4
	EUSAAR2 Refl	4.7
	IMPROVE Refl	5.3
AMS	IMPROVE Refl	5.0
	IMPROVE Trans	5.0
	NIOSH Trans	5.5
	NIOSH Refl	5.8
	EUSAAR2 Trans	8.2
	EUSAAR2 Refl	8.3

Table S1(b): Organic Carbon

Site	Analysis Protocol	Combined variability / %
CAB	EUSAAR2 Refl	6.0
	EUSAAR2 Trans	6.0
	IMPROVE Refl	6.5
	IMPROVE Trans	6.5
	NIOSH Refl	8.4
	NIOSH Trans	8.4
IPR	IMPROVE Trans	4.3
	IMPROVE Refl	4.3
	NIOSH Refl	4.6
	NIOSH Trans	4.6
	EUSAAR2 Refl	11
	EUSAAR2 Trans	11
WAL	NIOSH Refl	5.2
	NIOSH Trans	5.2
	EUSAAR2 Refl	8.9
	EUSAAR2 Trans	8.9
	IMPROVE Refl	11
	IMPROVE Trans	11
BCN	NIOSH Refl	3.0
	NIOSH Trans	3.0
	IMPROVE Refl	3.3
	IMPROVE Trans	3.3
	EUSAAR2 Trans	4.2
	EUSAAR2 Refl	4.2
MUL	EUSAAR2 Trans	2.7
	EUSAAR2 Refl	2.7
	NIOSH Refl	3.2
	NIOSH Trans	3.2
	IMPROVE Trans	4.1
	IMPROVE Refl	4.1
AMS	IMPROVE Refl	3.4
	IMPROVE Trans	3.4
	NIOSH Refl	4.2
	NIOSH Trans	4.2
	EUSAAR2 Refl	6.8
	EUSAAR2 Trans	6.8

Table S1(c): Total Carbon