



ACTRIS 2026 inter-laboratory comparison for the measurement of organic and elemental carbon in atmospheric particulate matter deposited on filters

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European Reference Laboratory for Air Pollution



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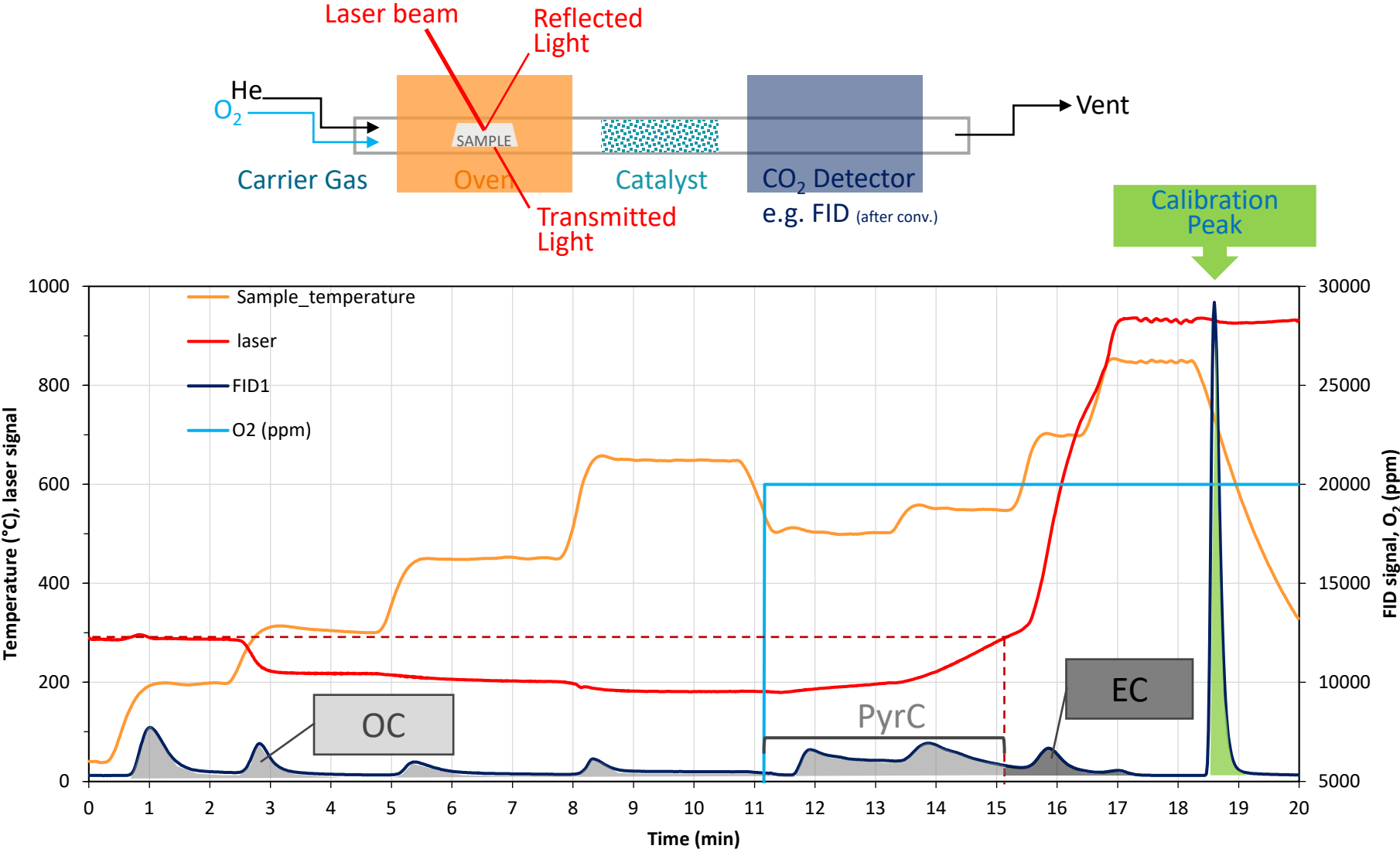


EUROPEAN
REFERENCE
LABORATORY
FOR AIR
POLLUTION



OC & EC Thermal-Optical Analysis (both off-line and on-line)

Principle



Inter-Laboratory Comparisons for OC and EC

TYPICAL PURPOSES OF A LABORATORY INTER-COMPARISON SCHEME INCLUDE:

- **EVALUATION OF THE LABORATORY PERFORMANCE AGAINST PRE-ESTABLISHED CRITERIA;**
- **IDENTIFICATION OF PROBLEMS IN LABORATORIES (PROCEDURE, CALIBRATION, STAFF TRAINING, ETC.);**
- **QUANTIFICATION OF INTER-LABORATORY DIFFERENCES.**

Inter-Laboratory Comparisons

SELECTION OF APPROPRIATE TEST SAMPLES

RANGE: RANGE OF APPLICATION OF EN 16909 (LOADINGS)

AND VARIOUS AIR POLLUTION CONDITIONS;

HOMOGENEITY: ASSESSMENT OF THE HOMOGENEITY OF THE DEPOSIT ON
A SEPARATE FILTER SAMPLE: BETTER THAN 3% FOR EC AND 2% FOR TC AND OC;

STABILITY: TEST ITEMS RESULTED STABLE WHEN EXPOSED AT $25\pm0.5^{\circ}\text{C}$ FOR 7
WEEKS; MONITORING THE TEMPERATURE EXPERIENCED BY THE TEST ITEMS
THROUGHOUT THE EXERCISE, BY MEAN OF USB TEMPERATURE-DATA LOGGER.

Participant performance

- Analysers performance in determining total carbon (TC) loadings ($\mu\text{g}/\text{cm}^2$) and EC/TC ratios in ambient PM_{2.5} samples deposited on quartz fiber filters evaluated in term of z-scores.

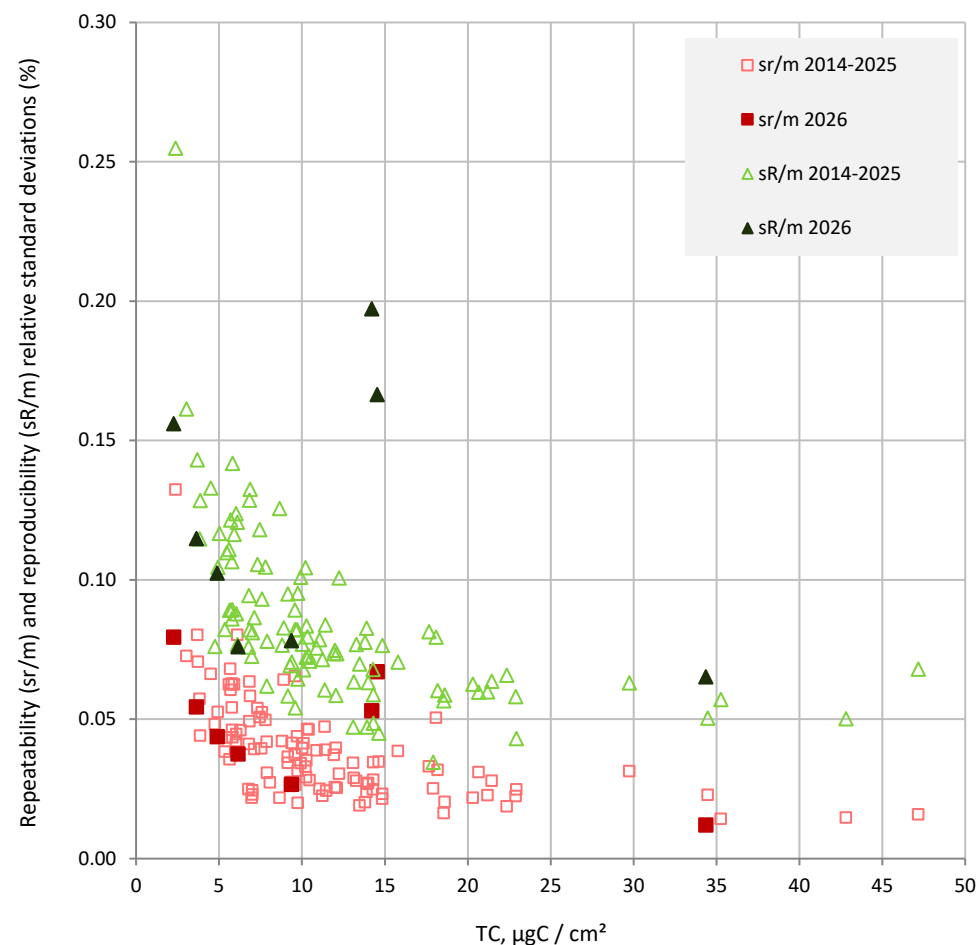
$$z_{ij} = \frac{x_{ij} - X_j}{\sigma_j^*}$$

- Assigned values (X) and standard deviations (σ^*) determined from participant results (consensus)
- $|z| \geq 3,0$ INDICATES “UNSATISFACTORY” PERFORMANCE AND TRIGGERS AN ACTION SIGNAL**

2026 Inter-Laboratory Comparison Participants (41) , about ¼ external users, all \1 using EUSAAR-2 thermal protocol

	Full Name	Country Code	Acronym	Affiliation				
1	Francisco Sánchez Soberón	ES	ISCIH	Instituto De Salud Carlos III [ISCIH]				
2	Judita Burger	SI	SEA	Environment Agency of Republic of Slovenia [SEA]				
3	Izabela Kałużńska	PL	GIOS	Chief Inspectorate of Environmental Protection [GIOS]				
4	Karl Yttri	NO	NILU	Norwegian Institute for Air Research [NILU]				
5	Lucie Böhmová	CZ	CHMI					
6	Claus NORDSTROEM	DK	DCE		21	Laurent Poulain	DE	TROPOS Leibniz Institute for Tropospheric Research [TROPOS]
7	Fabrizia CAVALLI	IT	ERLAP		22	Anne KASPER-GIEBL	AT	TU Wien Technische Universität Wien [TU Wien]
8	Ranka Godec	HR	IMI		23	Maria Tsagkaraki	GR	ECPL_UOC Environmental Chemical Processes Laboratory_ University of Crete [ECPL_UOC]
9	Toivo TRUUTS	EE	EERC		24	Gael NOYALET	FR	LISA Laboratoire Inter-Universitaire des Systèmes Atmosphériques (LISA CNRS UMR 7583) [LISA]
10	Minna Aurela	FI	FMI		25	Evangelia DIAPOULI	GR	NCSR D National Centre for Scientific Research Demokritos [NCSR D]
11	Krzysztof Ciupek	UK	NPL		26	Jean SCIARE	CY	Cyl The Cyprus Institute [Cyl]
12	Luca Tofful	IT	CNR-IIA		27	Petr Vodička	CZ	ICPF Institute of Chemical Process Fundamentals of the Czech Academy of Sciences [ICPF]
13	Benjamin BERGMANS	BE	ISSeP		28	Barbara Mathews	PL	IPIS PAN Institute of Environmental Engineering Polish Academy of Sciences [IPIS PAN]
14	Chadia Kebbi	FR	AIRPARIF		29	Nicolas Bonnaire	FR	LSCE Laboratoire des Sciences du Climat et de l'Environnement [LSCE]
15	Julian Rüdiger	DE	UBA-L		30	Agnieszka KUPC	AT	UNIVIE University of Vienna, Faculty of Physics, Aerosol Physics and Environmental Physics Group [UNIVIE]
16	DANIELE CONTINI	IT	CNR-ISAC		31	Adam Kristensson	SE	LU_Physics Lund University, Department of Physics [LU_Physics]
17	Veronique Pont	FR	LAERO		32	Birgitta Noone	SE	SU-ACES Department of Environmental Science, Stockholm University [SU-ACES]
18	Federico Mazzei	IT	UNIGE/INFN		33	Nataly Lopez	ES	IPNA-CSIC Institute of Natural Products and Agrobiology - Spanish National Research Council [IPNA-CSIC]
19	Saliou MBENGUE	CZ	CzechGlobe		34	Massimo CHIARI	IT	INFN Istituto Nazionale di Fisica Nucleare - Sezione di Firenze [INFN]
20	Angeliki KARANASIOU	ES	IDAEA-CSIC		35	Céline VOIRON	FR	IGE Institut des Géosciences de l'Environnement [IGE]
					36	Andrej ŠOŠTARIĆ	RS	IPH-Bg Institute of Public Health of Belgrade [IPH-Bg]
					37	EDUARDO YUBERO	ES	LCA-UMH Laboratorio de Contaminación Atmosférica- Universidad Miguel Hernandez de Elche [LCA-UMH]
					38	David Czorny	DE	LANUK Landesamt für Natur, Umwelt und Klima [LANUK]
					39	Aikaterini Bougiatioti	GR	NOA National Observatory of Athens [NOA]
					40	Minna Aurela	FI	FMI Finnish Metereological Institute [FMI]
					41	Evangelia DIAPOULI	GR	NCSR D National Centre for Scientific Research Demokritos [NCSR D]

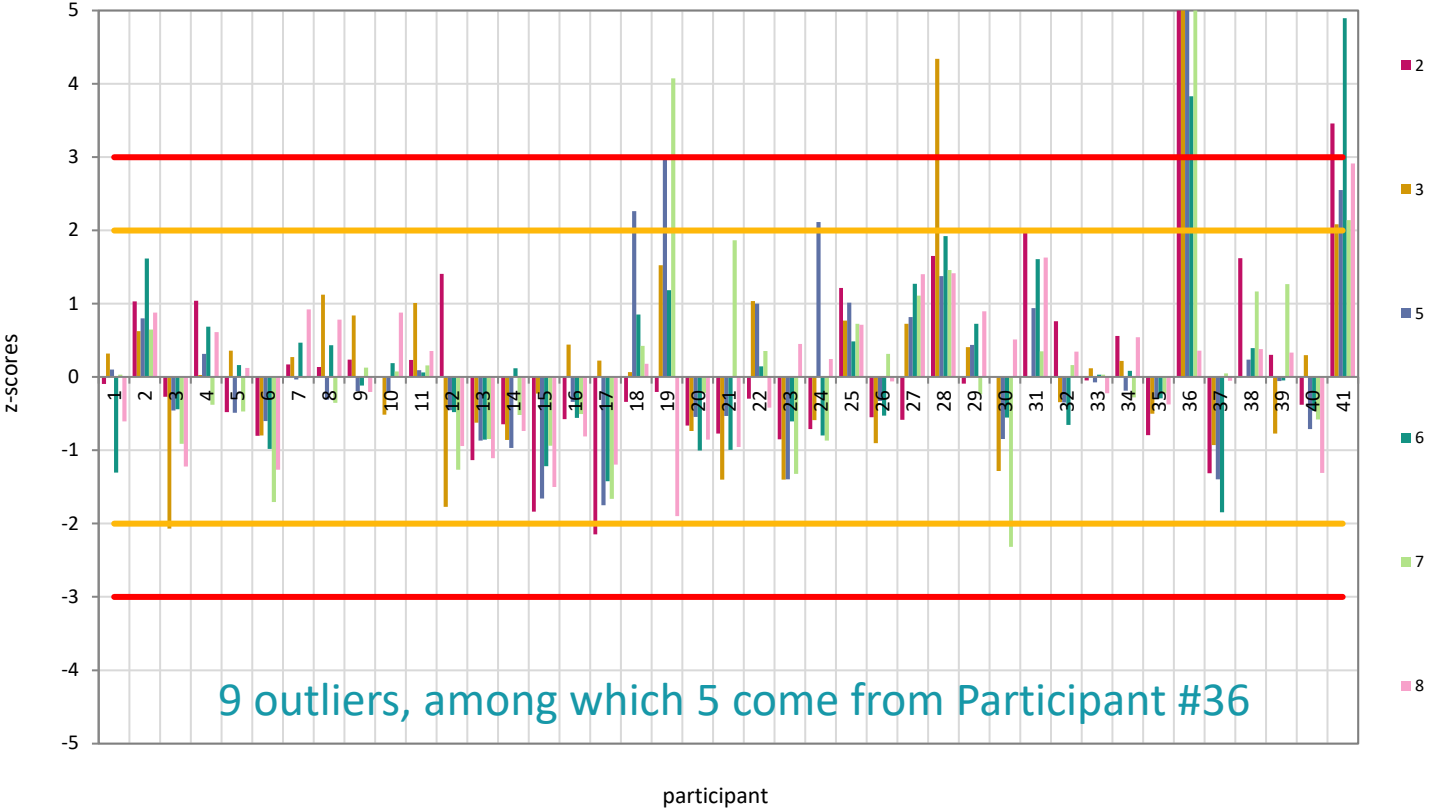
Homogeneity for two 2026 samples was questionable (Total Carbon, TC)



Repeatability (squares) and reproducibility (triangles) relative standard deviation of the EUSAAR_2 protocol for TC measurement obtained during the previous inter-laboratory comparisons and the 2026 one.

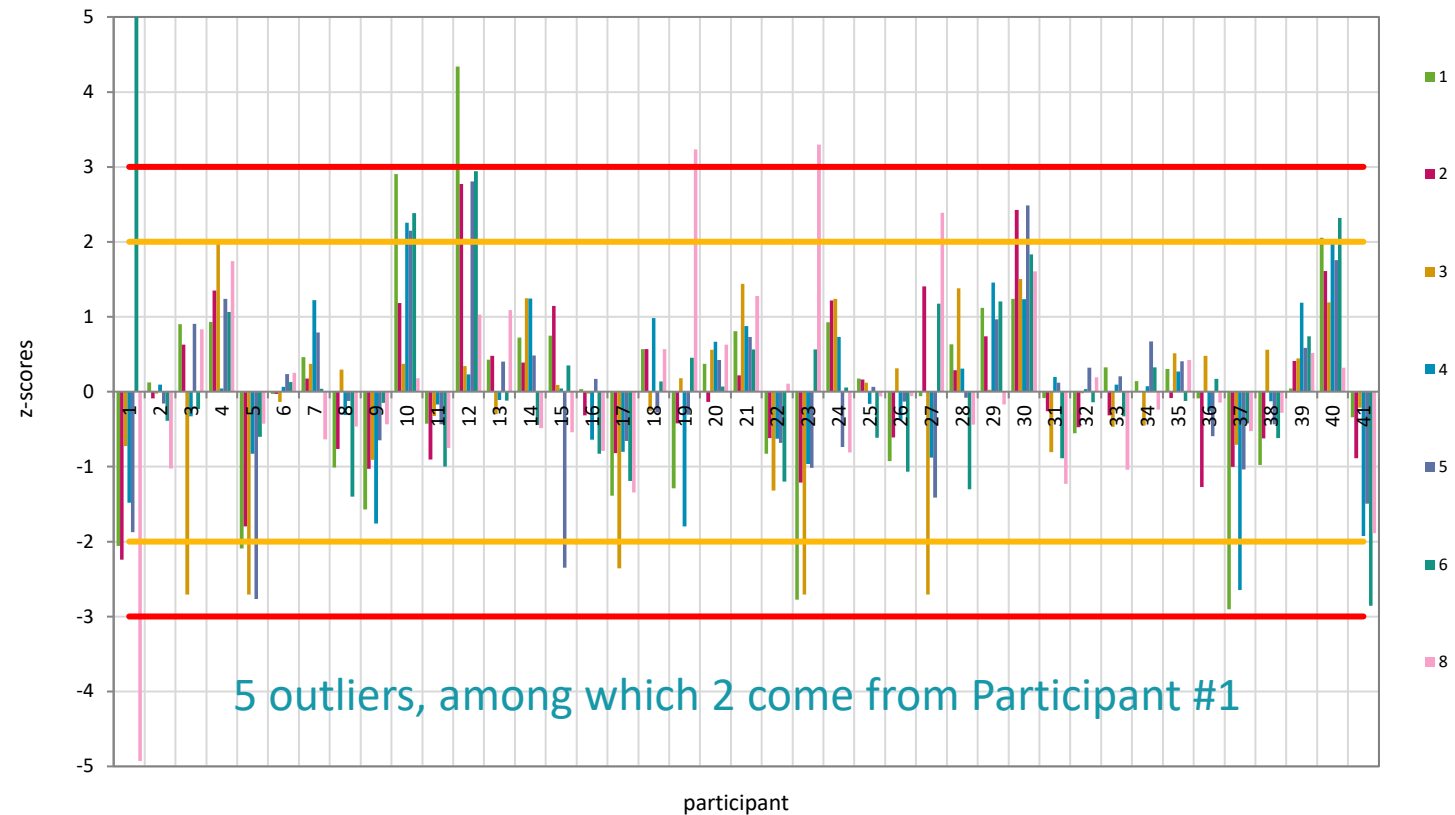
2026 Participant performance (TC)

TC		2	3	5	6	7	8
assigned value, X	$\mu\text{g}/\text{cm}^2$	6.15	2.25	4.93	9.33	3.70	34.3
standard deviation, σ^*	$\mu\text{g}/\text{cm}^2$	0.40	0.28	0.48	0.66	0.41	2.21
$1\sigma^*$		6%	13%	10%	7%	11%	6%
$2\sigma^*$		13%	25%	19%	14%	22%	13%
$3\sigma^*$		19%	38%	29%	21%	33%	19%



2026 Participant performance (EC/TC ratio)

EC / TC		1	2	3	4	5	6	8
assigned value X	Ratio	0.0838	0.143	0.0908	0.0103	0.130	0.111	0.125
standard deviation, σ^*	ratio	0.014	0.021	0.034	0.017	0.023	0.016	0.013
1 σ^*		17%	15%	37%	17%	18%	14%	10%
2 σ^*		34%	30%	74%	33%	36%	29%	20%
3 σ^*		51%	45%	111%	50%	54%	43%	31%

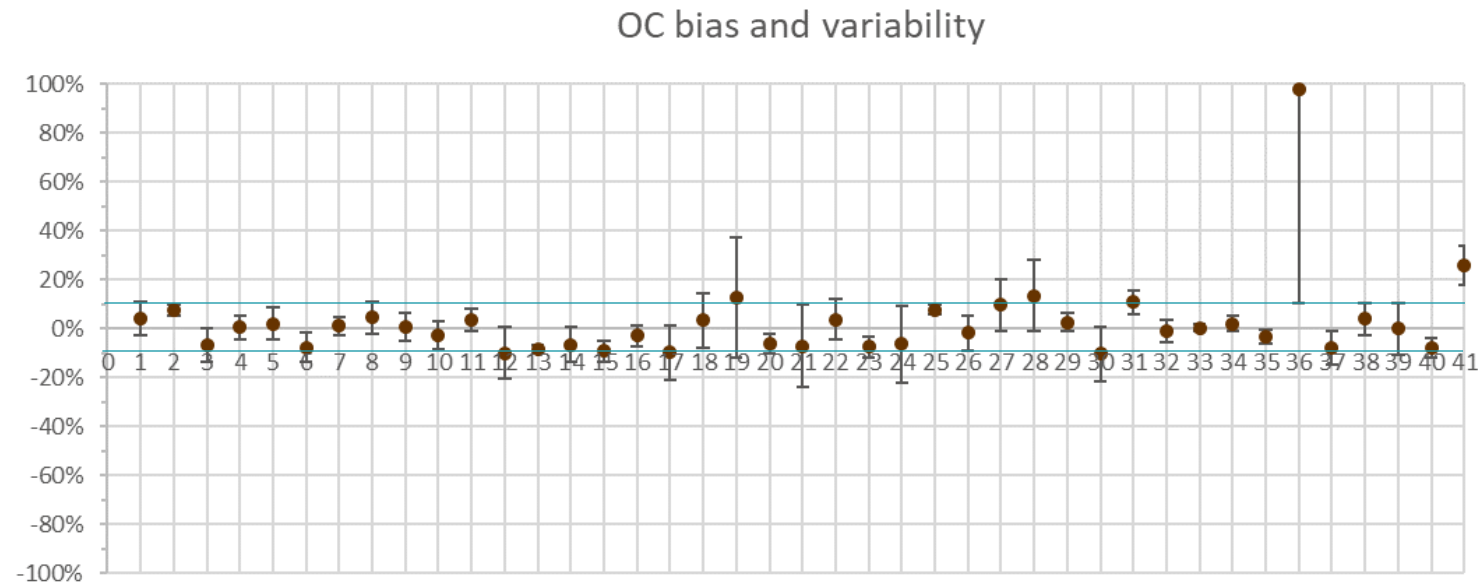


Bias and Variability

- Bias (RB_i) and variability ($2 \cdot RSD_i$) were calculated to be reported as metadata in files submitted to EBAS.

$$RB_i = \text{median} \left(\frac{x_{ij} - X_j}{X_j} \right) \quad 2 \cdot RSD_i = \frac{8 \cdot \left((x_{ij} - X_j)_{\max} - (x_{ij} - X_j)_{\min} \right)}{\sqrt{6} \cdot \sum_1^8 X_j}$$

- OC biases are less than 10% for most participants (2026)

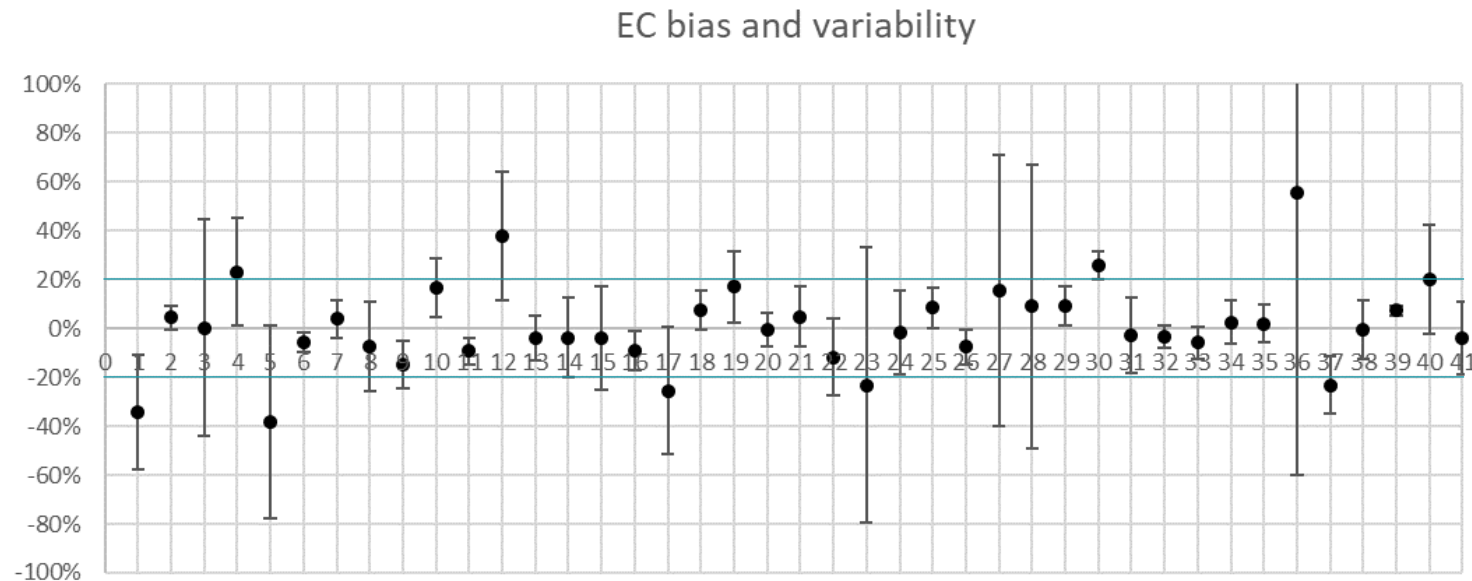


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- EC bias are less than 20% for most participants (2026)



Conclusions

- **ACTRIS PARTICIPANTS IN THE 2026 ILC FOR OC AND EC GENERALLY PERFORMED WELL**
- **PARTICIPANTS GETTING RECURRENT STRAGGLERS ($|z|>2$) OR OUTLIERS ($|z|>3$) SHOULD ACT !**
- **NEXT ILC (2027): REGISTRATION OPEN FROM DECEMBER 2026, ILC FINALIZED IN MAY 2027**

Thank you

QUESTIONS ?

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