

CCQM-K19, CCQM-K19.1, and APMP.QM-K19

Key comparison CCQM-K19

MEASURAND : Acidity function at zero chloride molality of an unknown borate buffer
pH ~ 9.17

Measurement temperatures : 15 °C, 25 °C and 37 °C

x_i : result of measurement carried out by laboratory i

U_{Labi} : expanded uncertainty of x_i ($k = 2$), $U_{\text{Labi}} = 2 u_i$

Lab i	Temperature / °C						Date of measurement
	15		25		37		
	x_i	U_{Labi}	x_i	U_{Labi}	x_i	U_{Labi}	
CENAM	9.3212	0.0148	9.2291	0.0063	9.1401	0.0034	Sep 05
Radiometer A/S	9.3268	0.0019	9.2361	0.0017	9.1485	0.0017	Sep 05
GUM	9.3266	0.0026	9.2269	0.0046	9.1429	0.0054	Oct 05
KRISS	9.3247	0.0034	9.2343	0.0030	9.1471	0.0031	Sep 05
NCM	9.2955	0.0045	9.2295	0.0044	9.1400	0.0045	Sep 05
NMIJ	9.3224	0.0028	9.2303	0.0030	9.1426	0.0026	Sep 05
NIST	9.3220	0.011	9.2300	0.011	9.1420	0.011	Sep 05
OMH	9.3220	0.0054	9.2230	0.0054	9.1370	0.0040	Sep 05
PTB	9.3214	0.0025	9.2300	0.0025	9.1421	0.0025	Aug - Sep 05
SMU	9.3210	0.0025	9.2289	0.0023	9.1415	0.0023	Sep 05
VNIFTRI	9.3296	0.0040	9.2372	0.0040	9.1495	0.0040	Sep 05

Key comparison CCQM-K19.1

MEASURAND : Acidity function at zero chloride molality of an unknown borate buffer
pH ~ 9.17

Measurement temperatures : 15 °C, 25 °C and 37 °C

x_{i1} : result of measurement carried out by laboratory i

u_{i1} : combined standard uncertainty of x_i ($k = 1$)

Lab i	Temperature / °C						Date of measurement
	15		25		37		
	x_{i1}	u_{i1}	x_{i1}	u_{i1}	x_{i1}	u_{i1}	
INMETRO	9.3250	0.0039	9.2367	0.0022	9.1541	0.0041	2010
NIM	9.3385	0.0016	9.2465	0.0017	9.1592	0.0016	2010
PTB	9.3314	0.0011	9.2399	0.0011	9.1522	0.0011	2010
DFM	9.3352	0.00085	9.2432	0.00094	9.1550	0.00098	2010
LNE	9.3236	0.0025	9.2321	0.0020	9.1441	0.0024	2010
NMIJ	9.3305	0.00119	9.2379	0.00117	9.1503	0.00117	2010
SMU	9.3325	0.00110	9.2390	0.00109	9.1505	0.00109	2010
NIST	9.3337	0.00069	9.2409	0.00056	9.1516	0.00078	2010

Key comparison APMP.QM-K19

MEASURAND : pH of an unknown borate buffer
pH ~ 9.2

Measurement temperatures : 15 °C, 25 °C and 37 °C

x_i : result of measurement carried out by laboratory i

u_i : combined standard uncertainty of x_i

Lab i	Temperature / °C						Date of measurement
	15		25		37		
	x_i	u_i	x_i	u_i	x_i	u_i	
NMIJ	9.2726	0.0012	9.1802	0.0011	9.0912	0.0011	2013
NIMT	9.2905	0.0045	9.2110	0.0034	9.1156	0.0041	2013
GL	9.280	0.0073	9.188	0.0061	9.100	0.0062	2013
NML-SIRIM	9.2919	0.0035	9.2030	0.0035	9.1125	0.0035	2013
VMI-STAMEQ	9.270	0.0065	9.208	0.0053	9.131	0.0052	2013
SMU	9.2739	0.0014	9.1799	0.0010	9.0898	0.0018	2013
LNE	9.2735	0.0014	9.1804	0.0014	9.0907	0.0014	2013
NPLI	-	-	8.9775	0.0343	8.845	0.0572	2013
INDECOPI	9.274	0.002	9.182	0.002	9.093	0.002	2013
INMETRO	9.2682	0.0010	9.1759	0.0011	9.0853	0.0017	2013
CMI	9.2759	0.0011	9.1787	0.0018	9.0875	0.0011	2013
BelGIM	9.297	0.0032	9.1977	0.0022	9.1073	0.0031	2013
KazInMetr	-	-	9.1814	0.0015	-	-	2013

CCQM-K19, CCQM-K19.1, and APMP.QM-K19

Key comparison CCQM-K19

MEASURAND : Acidity function at zero chloride molality of an unknown borate buffer
pH ~ 9.17

Measurement temperatures : 15 °C, 25 °C and 37 °C

The key comparison reference value, x_R , is computed as the median of all results, except at 15 °C for which the NCM result is identified as an outlier and thus not taken into account (see Annex B of the CCQM-K19 Final Report). Its standard uncertainty, u_R , is the standard uncertainty of the median.

Temperature / °C	15	25	37
x_R	9.3222	9.2300	9.1421
$2u_R$	0.0014	0.0013	0.0024

The degree of equivalence of each laboratory i with respect to the reference value is given by a pair of terms:

$D_i = (x_i - x_R)$ and U_i , its expanded uncertainty ($k = 2$), $U_i = 2(u_i^2 + u_R^2)^{1/2}$.

The NCM degree of equivalence is not computed for 15 °C.

The degree of equivalence between two laboratories i and j is given by a pair of terms:

$D_{ij} = D_i - D_j = x_i - x_j$ and U_{ij} , its expanded uncertainty ($k = 2$), $U_{ij} = 2(u_i^2 + u_j^2)^{1/2}$.

No pair-wise degrees of equivalence are explicitly computed here.

Linking key comparison CCQM-K19.1 to key comparison CCQM-K19

The linkage of key comparison CCQM-K19.1 to key comparison CCQM-K19 is explained on page 15 of the CCQM-K19.1 Final Report. It relies on the common participation of NMIJ, PTB and SMU. Each of these laboratories demonstrated consistent results and uncertainties in both comparisons for the three measurement temperatures.

For each measurement temperature, the degrees of equivalence of participants in CCQM-K19.1 only, relative to the CCQM-K19 key comparison reference value, is given by two terms: D_i and U_i , its expanded uncertainty ($k = 2$), computed according to equations 11 and 12 of the CCQM-K19.1 Final Report.

Linking key comparison APMP.QM-K19 to key comparison CCQM-K19

The results of the participants in APMP.QM-K19 are linked to those of CCQM-K19 through the results of the two linking laboratories, NMIJ and SMU, as explained in Section 8 of the APMP.QM-K19 Final Report.

CCQM-K19, CCQM-K19.1, and APMP.QM-K19

MEASURAND : Acidity function at zero chloride molality of an unknown borate buffer
pH ~ 9.17

Measurement temperatures : 15 °C, 25 °C and 37 °C

Degrees of equivalence D_i and expanded uncertainty U_i ($k = 2$)

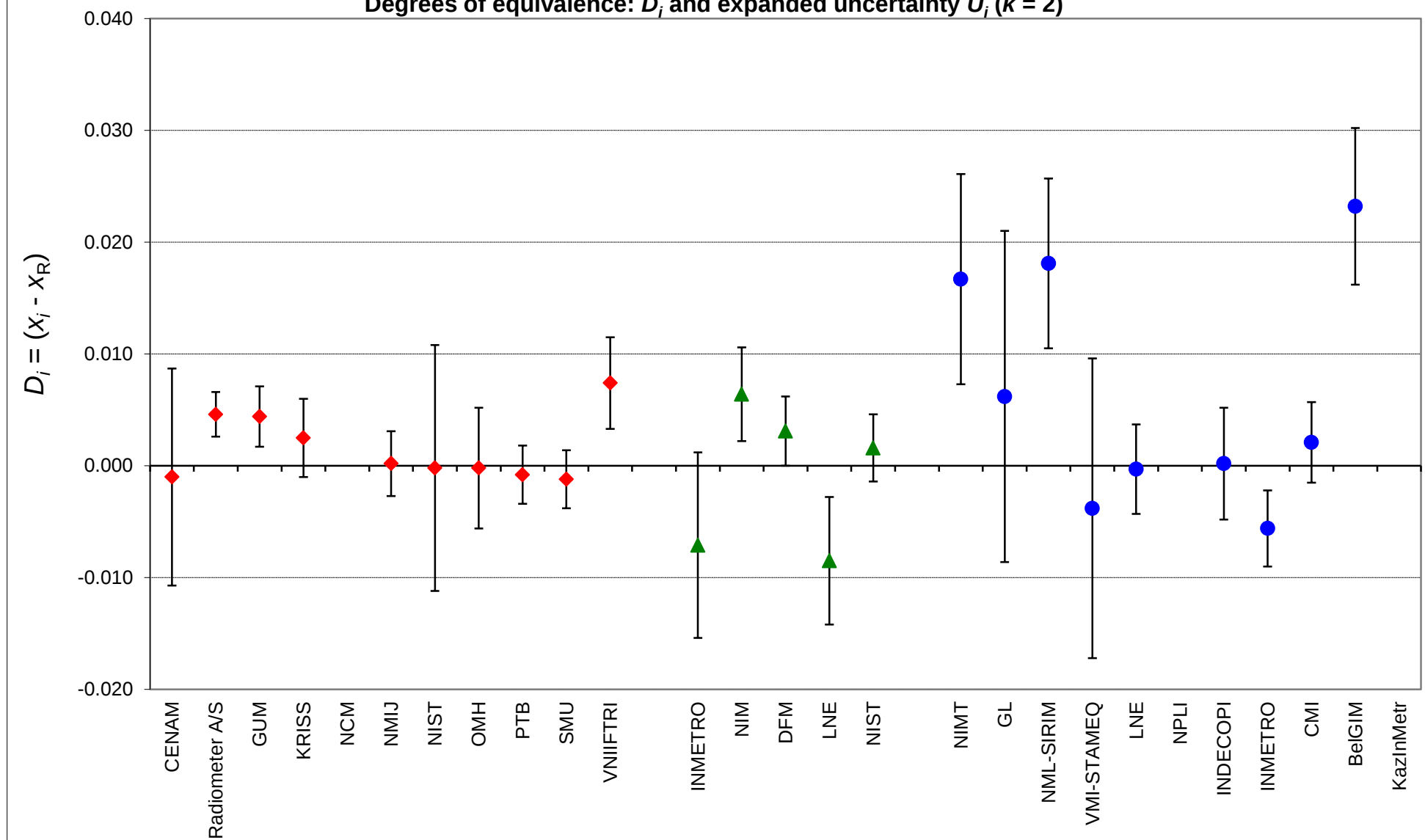
Lab <i>i</i> ↓	Temperature / °C					
	15		25		37	
	D_i	U_i	D_i	U_i	D_i	U_i
CENAM	-0.0010	0.0097	-0.0009	0.0063	-0.0020	0.0036
Radiometer A/S	0.0046	0.0020	0.0061	0.0018	0.0064	0.0021
GUM	0.0044	0.0027	-0.0031	0.0046	0.0008	0.0055
KRISS	0.0025	0.0035	0.0043	0.0031	0.0050	0.0033
NCM	-	-	-0.0005	0.0044	-0.0021	0.0047
NMIJ	0.0002	0.0029	0.0003	0.0031	0.0005	0.0029
NIST	-0.0002	0.0110	0.0000	0.0110	-0.0001	0.0111
OMH	-0.0002	0.0054	-0.0070	0.0054	-0.0051	0.0042
PTB	-0.0008	0.0026	0.0000	0.0026	0.0000	0.0028
SMU	-0.0012	0.0026	-0.0011	0.0024	-0.0006	0.0026
VNIIFTRI	0.0074	0.0041	0.0072	0.0041	0.0074	0.0042
INMETRO	-0.0071	0.0083	-0.0025	0.0051	0.0031	0.0089
NIM	0.0064	0.0042	0.0073	0.0043	0.0082	0.0046
DFM	0.0031	0.0031	0.0040	0.0033	0.0040	0.0040
LNE	-0.0085	0.0057	-0.0071	0.0048	-0.0069	0.0059
NIST	0.0016	0.0030	0.0017	0.0029	0.0006	0.0037
NIMT	0.0167	0.0094	0.0305	0.0072	0.0251	0.0088
GL	0.0062	0.0148	0.0076	0.0124	0.0095	0.0128
NML-SIRIM	0.0181	0.0076	0.0225	0.0074	0.0220	0.0078
VMI-STAMEQ	-0.0038	0.0134	0.0275	0.0110	0.0405	0.0110
LNE	-0.0003	0.0040	0.0000	0.0038	0.0002	0.0044
NPLI	-	-	-0.2030	0.0686	-0.2455	0.1144
INDECOPI	0.0002	0.0050	0.0015	0.0048	0.0025	0.0052
INMETRO	-0.0056	0.0034	-0.0046	0.0034	-0.0052	0.0048
CMI	0.0021	0.0036	-0.0018	0.0044	-0.0030	0.0040
BeIGIM	0.0232	0.0070	0.0172	0.0052	0.0168	0.0070
KazInMetr	-	-	0.0009	0.0040	-	-

In green: participants in CCQM-K19.1 only

In blue: participants in APMP.QM-K19 only

CCQM-K19, CCQM-K19.1 and APMP.QM-K19
pH of borate buffer (~ 9.17), temperature 15 °C

Degrees of equivalence: D_i and expanded uncertainty U_i ($k = 2$)



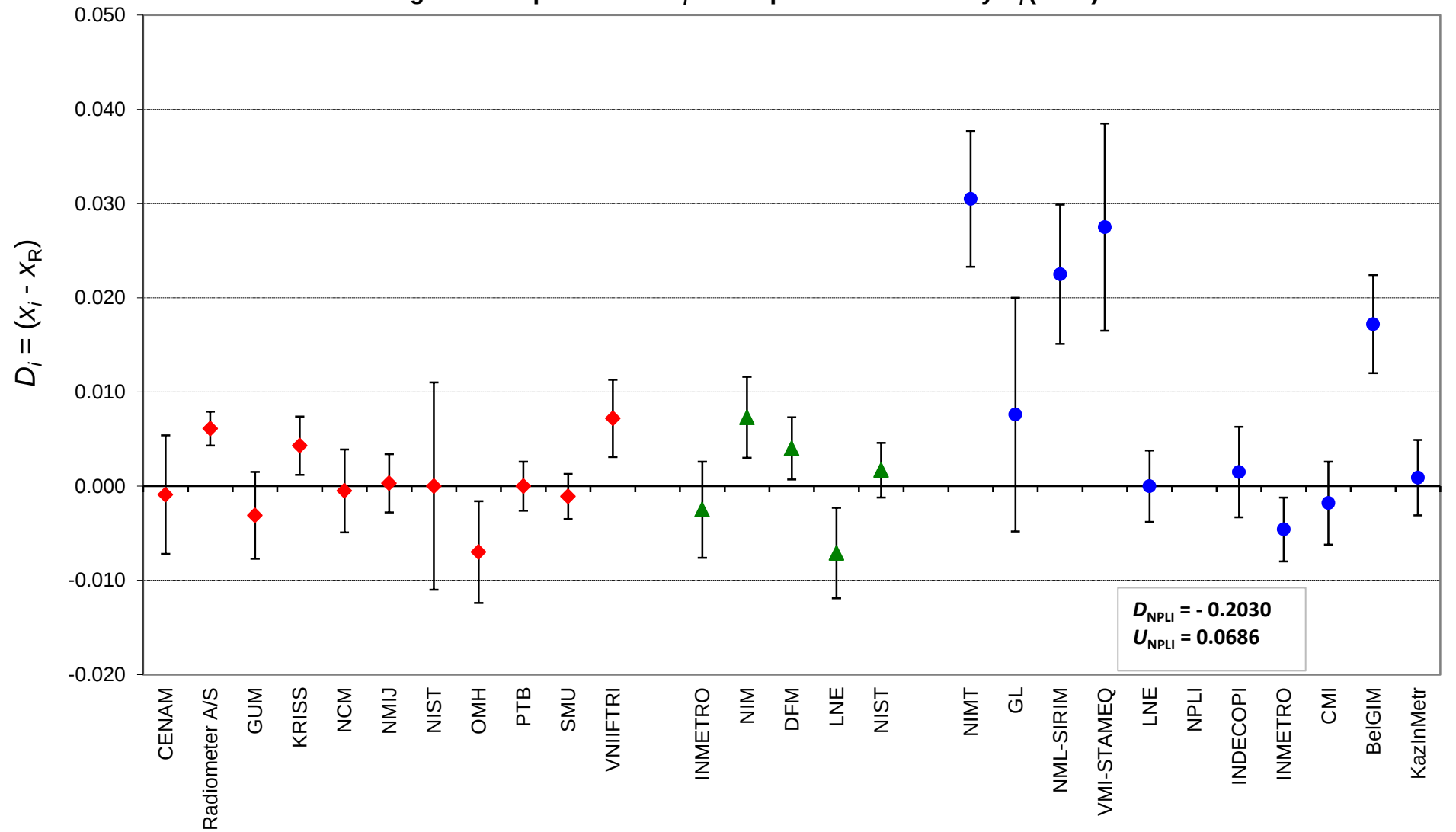
Red diamonds: participants in CCQM-K19

Green triangles: participants in CCQM-K19.1 only

Blue circles: participants in APMP.QM-K19 only

CCQM-K19, CCQM-K19.1 and APMP.QM-K19
pH of borate buffer (~ 9.17), temperature 25 °C

Degrees of equivalence: D_i and expanded uncertainty $U_i (k = 2)$



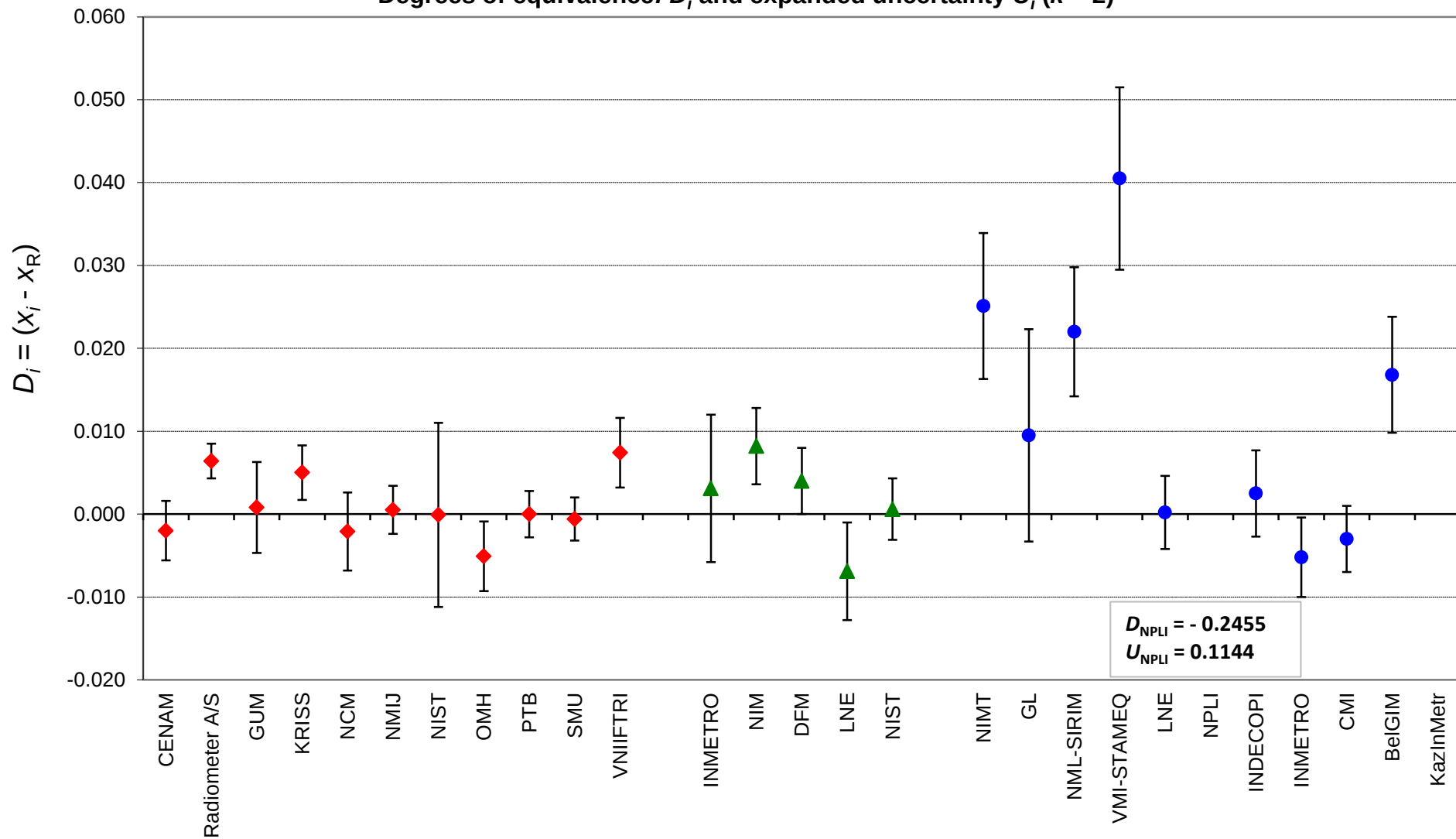
Red diamonds: participants in CCQM-K19

Green triangles: participants in CCQM-K19.1 only

Blue circles: participants in APMP.QM-K19 only

CCQM-K19, CCQM-K19.1 and APMP.QM-K19
pH of borate buffer (~ 9.17), temperature 37 °C

Degrees of equivalence: D_i and expanded uncertainty U_i ($k = 2$)



Red diamonds: participants in CCQM-K19

Green triangles: participants in CCQM-K19.1 only

Blue circles: participants in APMP.QM-K19 only