Case 1

Propeller Open Water Curves in Oblique Flow

Content

1 Participants

The following institutes have participated:

Group	Solver	Acronym
ACCUSIM	ANSYS-CFX	ACCUSIM-CFX
	OpenFOAM	ACCUSIM-OF
CNRS-ECN	ISIS	CNRS-ISIS
CRADLE	SCTetra steady	CRADLE-SCTetra-st.
	SCTetra unsteady	CRADLE-SCTetra-unst.
CSSRC	ANSYS-Fluent	CSSRC-Fluent
ROTAM	ANSYS-Fluent	ROTAM-Fluent
MARIN	ReFresco	MARIN-ReFresco
TUHH	ANSYS-CFX	TUHH-CFX
	OpenFOAM	TUHH-OF
	panMARE	TUHH-panMARE
UDE	ISIS	UDE-ISIS
University of Genoa	BEM	UniGenoa-BEM
	StarCCM+	UniGenoa-StarCCM
VTT	FinFlo	VTT-FinFlo

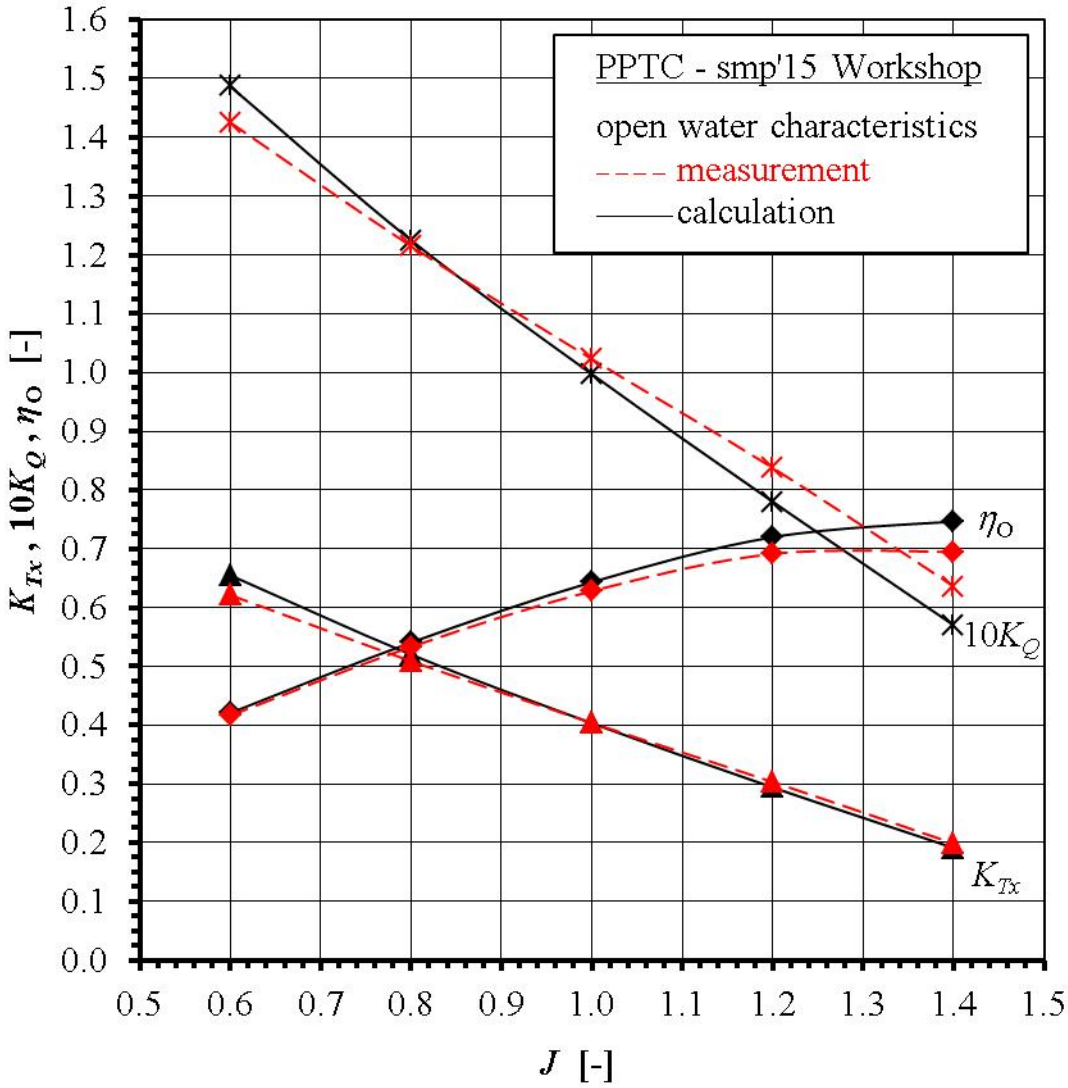
In the following the data is evaluated with respect to the thrust coefficient K_{Tx} (along the rotation axis, PCS coordinate system), the torque coefficient $10K_Q$ and the open water efficiency $\eta_{O\,(}$on basis of K_{Tx}), for an inclination angle between shaft and inflow direction of $\Psi^{bP} = 12°$. For each value an absolute (e.g. ΔK_{Tx}) and a relative comparison (e.g. ΔK_{Tx} [%]) to the measured value is made. The absolute difference is defined as the difference between the calculated to the measured value, while the relative difference is the same value expressed as percentage with respect to the measured value.

1.1 Open water curves for Ψ^{bP} = 12°: ACCUSIM-CFX

J	K_{Tx} EFD	K_{Tx} CFD	ΔK_{Tx}	ΔK_{Tx} [%]
0.60	0.621	0.655	0.034	5.4
0.80	0.509	0.520	0.011	2.2
1.00	0.404	0.403	-0.001	-0.1
1.20	0.303	0.294	-0.009	-3.0
1.40	0.198	0.191	-0.007	-3.7

J	$10K_Q$ EFD	$10K_Q$ CFD	$\Delta 10K_Q$	$\Delta 10K_Q$ [%]
0.60	1.425	1.487	0.062	4.3
0.80	1.215	1.225	0.010	0.8
1.00	1.023	0.997	-0.026	-2.5
1.20	0.838	0.780	-0.058	-6.9
1.40	0.636	0.570	-0.066	-10.4

J	η_O EFD	η_O CFD	$\Delta\eta_O$	$\Delta\eta_O$ [%]
0.60	0.416	0.421	0.004	1.0
0.80	0.533	0.540	0.007	1.4
1.00	0.628	0.643	0.015	2.4
1.20	0.691	0.720	0.029	4.1
1.40	0.695	0.747	0.052	7.5

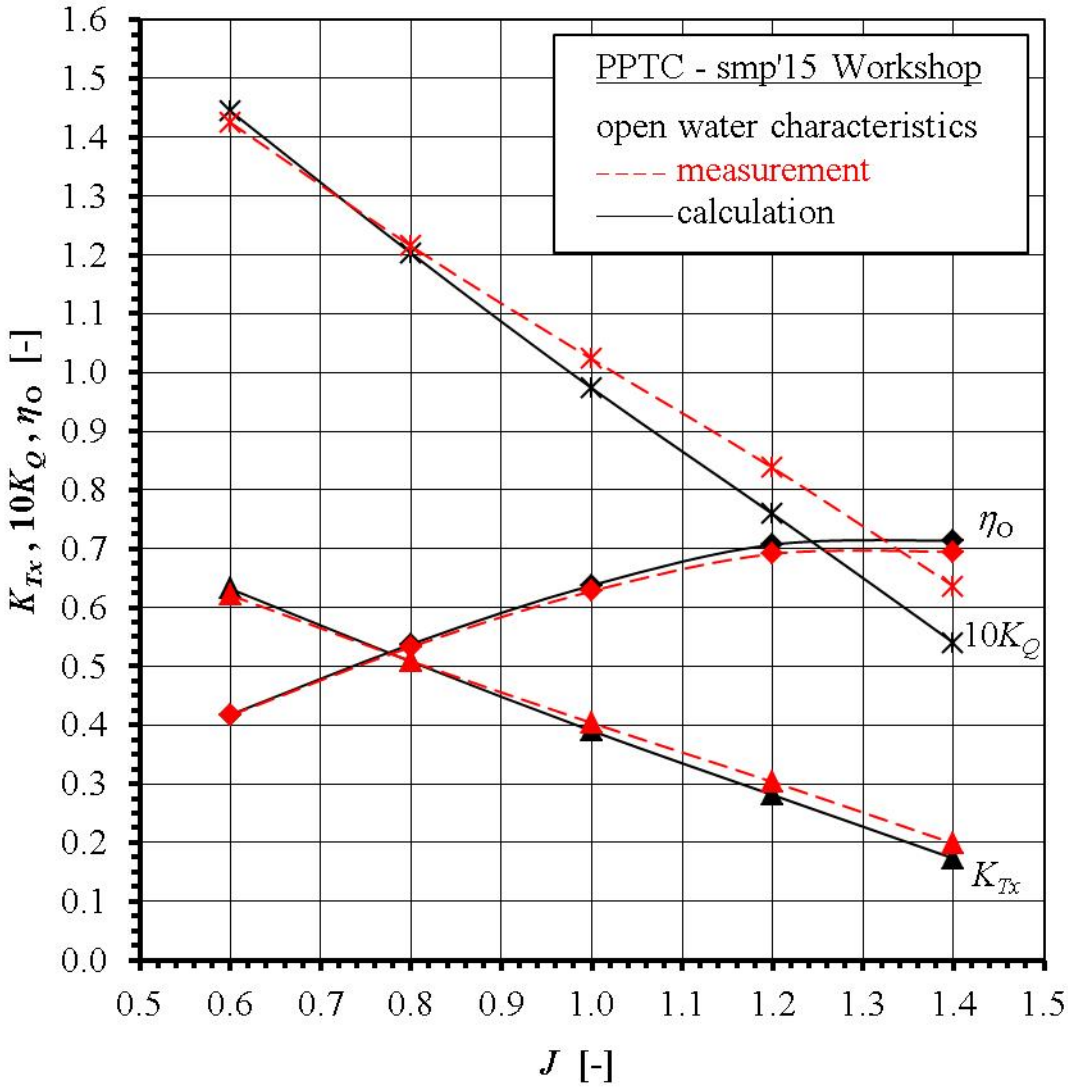


1.2 Open water curves for $\Psi^{bP} = 12°$: ACCUSIM-OF

J	K_{Tx} EFD	K_{Tx} CFD	ΔK_{Tx}	ΔK_{Tx} [%]
0.60	0.621	0.632	0.011	1.7
0.80	0.509	0.508	-0.001	-0.1
1.00	0.404	0.390	-0.014	-3.4
1.20	0.303	0.281	-0.022	-7.3
1.40	0.198	0.173	-0.025	-12.8

J	$10K_Q$ EFD	$10K_Q$ CFD	$\Delta 10K_Q$	$\Delta 10K_Q$ [%]
0.60	1.425	1.445	0.020	1.4
0.80	1.215	1.203	-0.012	-1.0
1.00	1.023	0.973	-0.050	-4.9
1.20	0.838	0.759	-0.079	-9.4
1.40	0.636	0.540	-0.096	-15.1

J	η_O EFD	η_O CFD	$\Delta\eta_O$	$\Delta\eta_O$ [%]
0.60	0.416	0.418	0.001	0.3
0.80	0.533	0.538	0.004	0.8
1.00	0.628	0.638	0.010	1.6
1.20	0.691	0.707	0.016	2.3
1.40	0.695	0.714	0.019	2.7



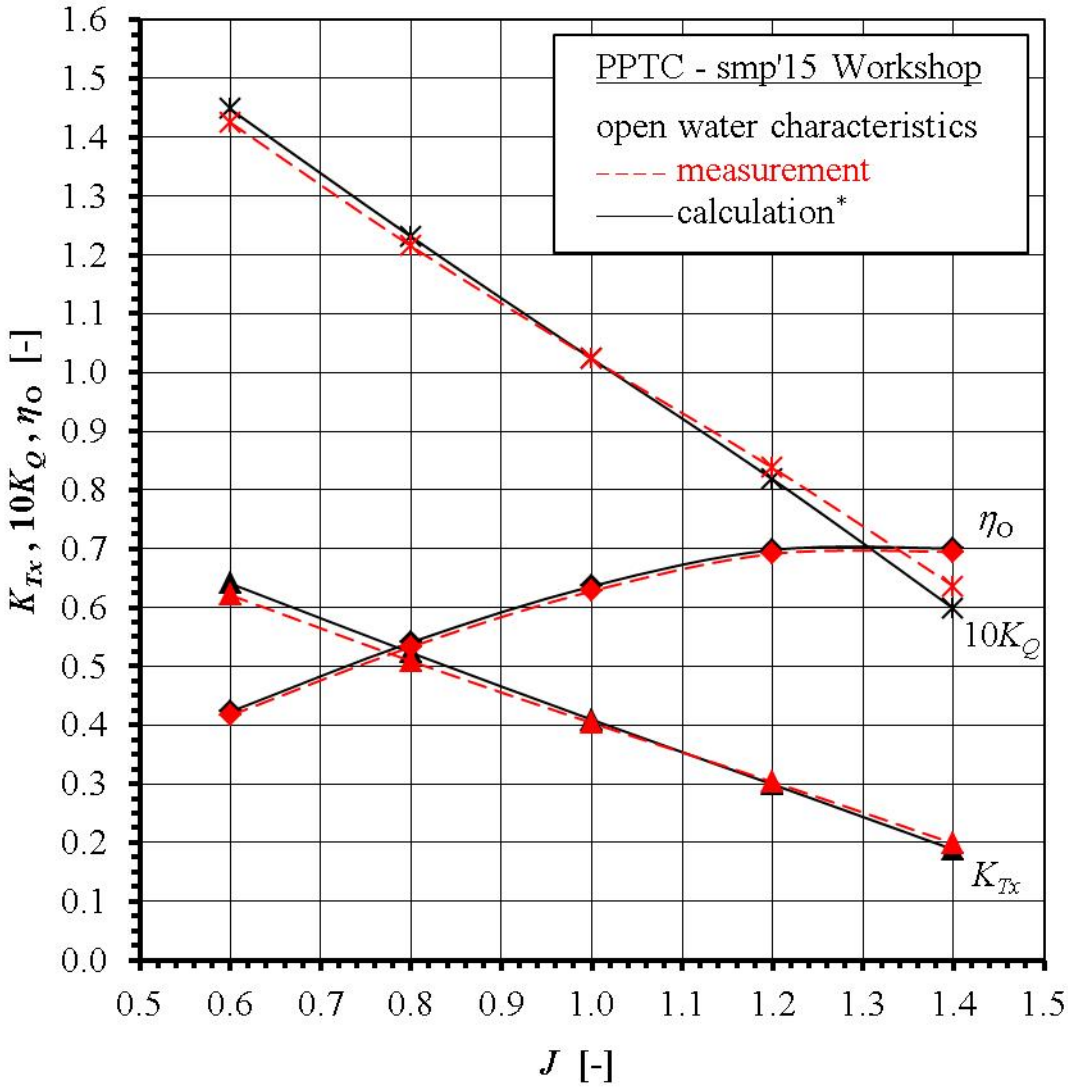
1.3 Open water curves for Ψ^{bP} = 12°: CNRS-ISIS

J	K_{Tx} EFD	K_{Tx}^* CFD	ΔK_{Tx}	ΔK_{Tx} [%]
0.60	0.621	0.641	0.020	3.2
0.80	0.509	0.523	0.014	2.8
1.00	0.404	0.409	0.005	1.3
1.20	0.303	0.299	-0.004	-1.4
1.40	0.198	0.188	-0.010	-5.2

J	$10K_Q$ EFD	$10K_Q^*$ CFD	$\Delta 10K_Q$	$\Delta 10K_Q$ [%]
0.60	1.425	1.448	0.023	1.6
0.80	1.215	1.231	0.016	1.3
1.00	1.023	1.023	0.000	0.0
1.20	0.838	0.818	-0.020	-2.3
1.40	0.636	0.598	-0.038	-6.0

J	η_O EFD	η_O^* CFD	$\Delta\eta_O$	$\Delta\eta_O$ [%]
0.60	0.416	0.423	0.006	1.5
0.80	0.533	0.541	0.008	1.5
1.00	0.628	0.636	0.008	1.3
1.20	0.691	0.698	0.007	1.0
1.40	0.695	0.700	0.006	0.8

* data updated

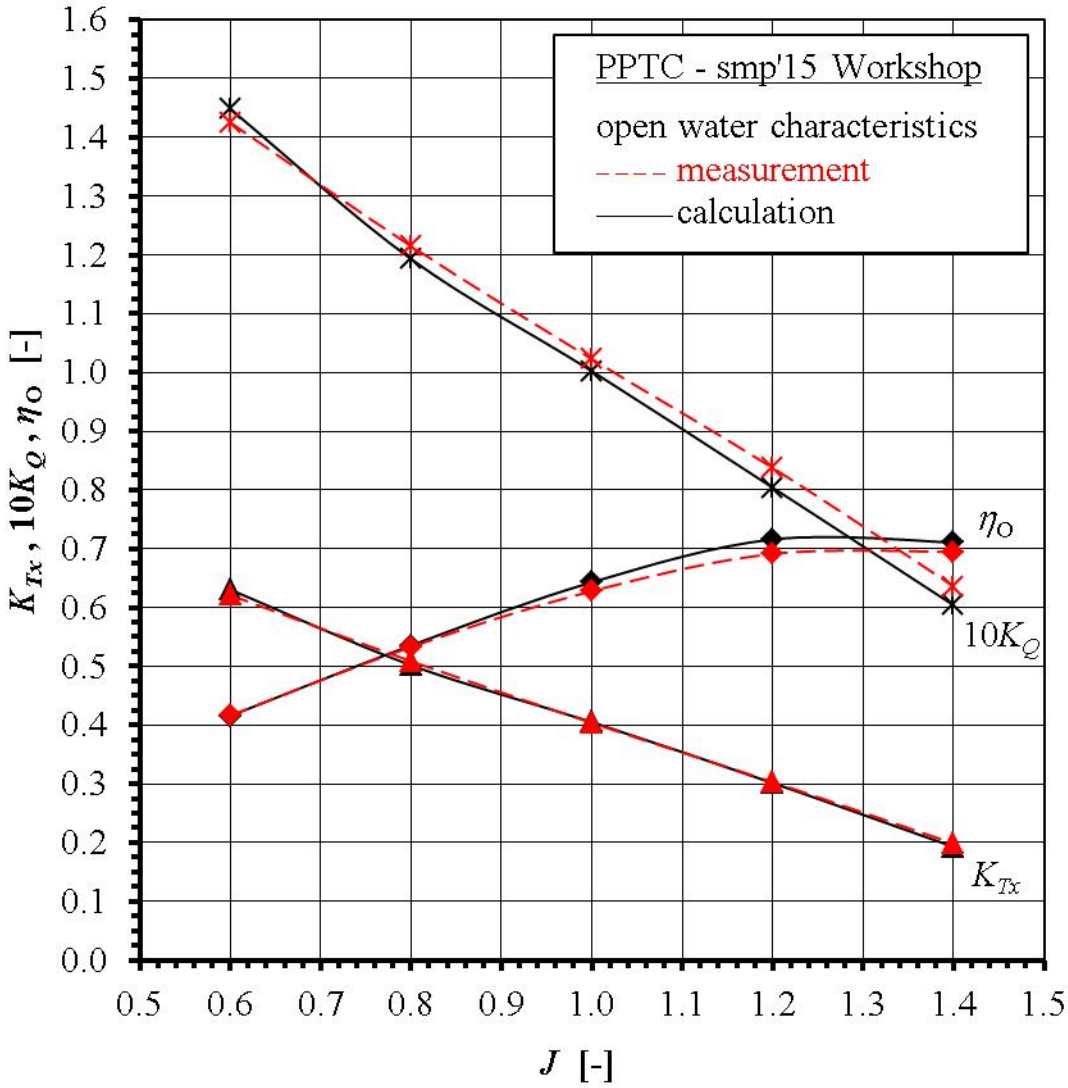


1.4 Open water curves for Ψ^{bP} = 12°: CRADLE-SCTetra steady

J	K_{Tx} EFD	K_{Tx} CFD	ΔK_{Tx}	ΔK_{Tx} [%]
0.60	0.621	0.631	0.009	1.5
0.80	0.509	0.502	-0.007	-1.3
1.00	0.404	0.405	0.001	0.4
1.20	0.303	0.301	-0.002	-0.6
1.40	0.198	0.193	-0.006	-2.9

J	$10K_Q$ EFD	$10K_Q$ CFD	$\Delta 10K_Q$	$\Delta 10K_Q$ [%]
0.60	1.425	1.449	0.023	1.6
0.80	1.215	1.193	-0.022	-1.8
1.00	1.023	1.002	-0.020	-2.0
1.20	0.838	0.804	-0.034	-4.0
1.40	0.636	0.604	-0.032	-5.1

J	η_O EFD	η_O CFD	$\Delta\eta_O$	$\Delta\eta_O$ [%]
0.60	0.416	0.416	-0.001	-0.1
0.80	0.533	0.536	0.003	0.5
1.00	0.628	0.643	0.015	2.4
1.20	0.691	0.716	0.025	3.6
1.40	0.695	0.711	0.016	2.3

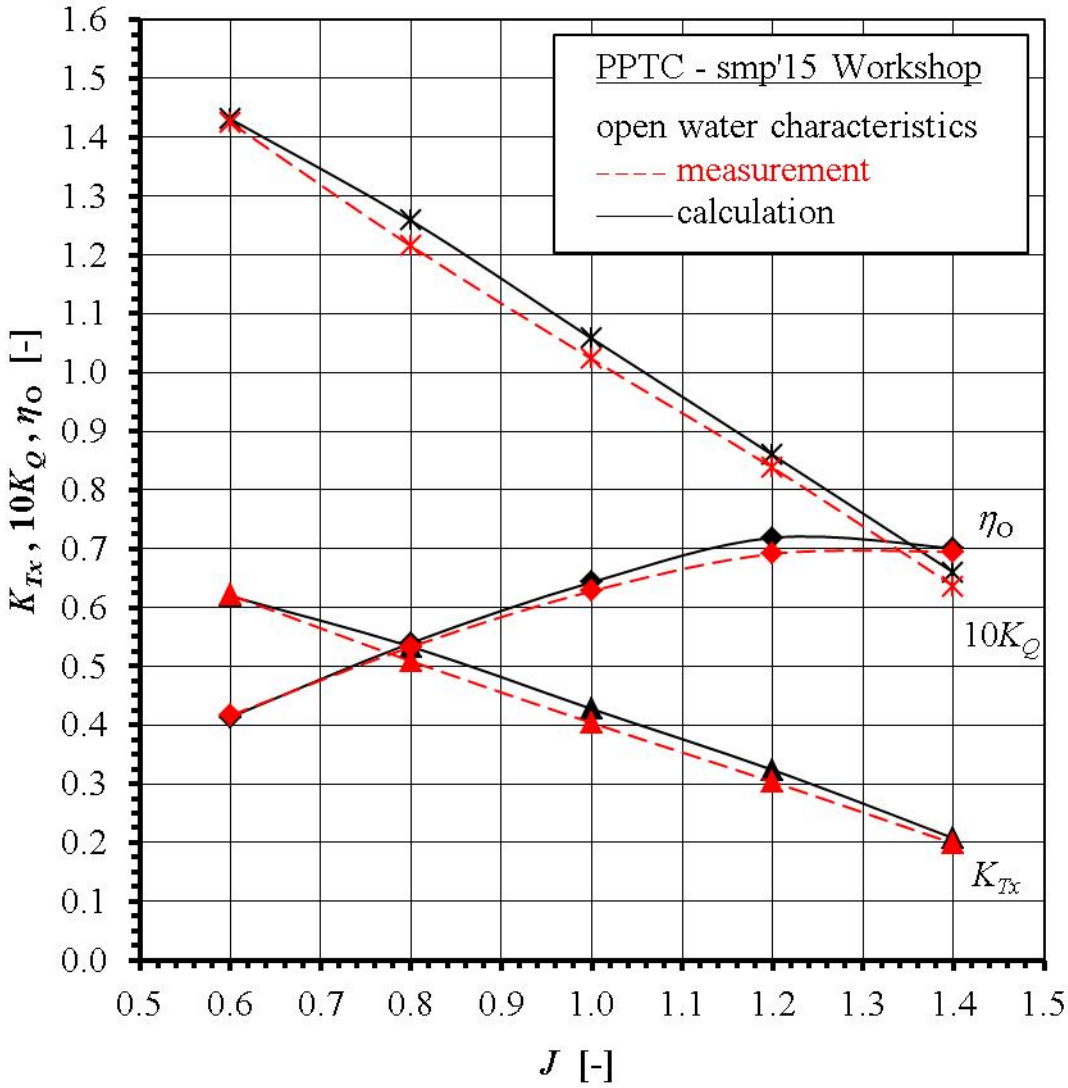


1.5 Open water curves for Ψ^{bP} = 12°: CRADLE-SCTetra unsteady

J	K_{Tx} EFD	K_{Tx} CFD	ΔK_{Tx}	ΔK_{Tx} [%]
0.60	0.621	0.620	-0.002	-0.3
0.80	0.509	0.533	0.025	4.9
1.00	0.404	0.427	0.024	5.9
1.20	0.303	0.324	0.020	6.7
1.40	0.198	0.207	0.009	4.6

J	$10K_Q$ EFD	$10K_Q$ CFD	$\Delta 10K_Q$	$\Delta 10K_Q$ [%]
0.60	1.425	1.431	0.006	0.4
0.80	1.215	1.258	0.043	3.6
1.00	1.023	1.058	0.035	3.4
1.20	0.838	0.860	0.022	2.6
1.40	0.636	0.660	0.023	3.7

J	η_O EFD	η_O CFD	$\Delta\eta_O$	$\Delta\eta_O$ [%]
0.60	0.416	0.413	-0.003	-0.7
0.80	0.533	0.540	0.007	1.2
1.00	0.628	0.643	0.015	2.4
1.20	0.691	0.719	0.027	4.0
1.40	0.695	0.701	0.006	0.9

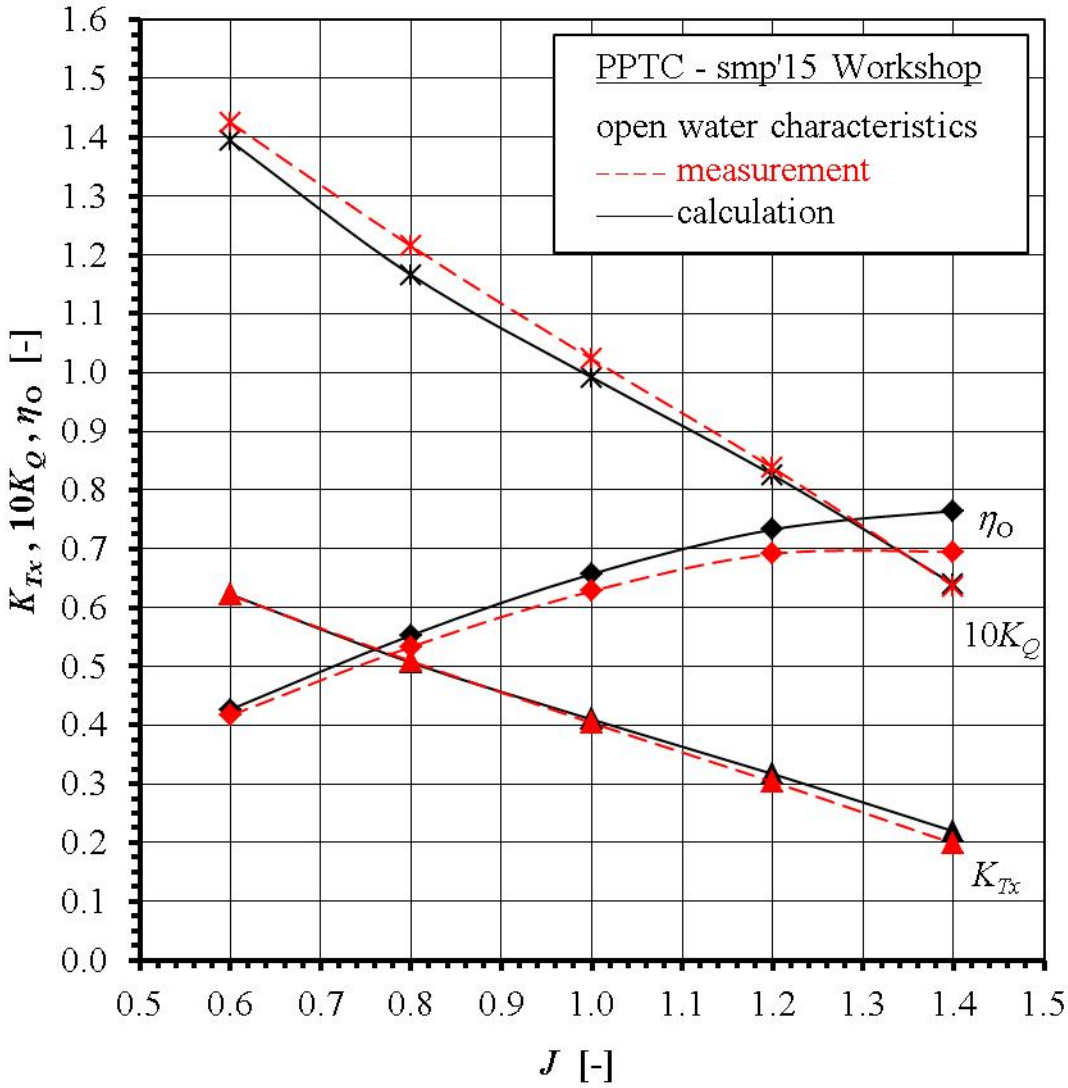


1.6 Open water curves for Ψ^{bP} = 12°: CSSRC-Fluent

J	K_{Tx} EFD	K_{Tx} CFD	ΔK_{Tx}	ΔK_{Tx} [%]
0.60	0.621	0.623	0.001	0.2
0.80	0.509	0.506	-0.003	-0.5
1.00	0.404	0.409	0.006	1.4
1.20	0.303	0.317	0.014	4.5
1.40	0.198	0.219	0.021	10.6

J	$10K_Q$ EFD	$10K_Q$ CFD	$\Delta 10K_Q$	$\Delta 10K_Q$ [%]
0.60	1.425	1.394	-0.031	-2.2
0.80	1.215	1.166	-0.049	-4.0
1.00	1.023	0.992	-0.031	-3.0
1.20	0.838	0.825	-0.012	-1.4
1.40	0.636	0.639	0.003	0.5

J	η_O EFD	η_O CFD	$\Delta\eta_O$	$\Delta\eta_O$ [%]
0.60	0.416	0.426	0.010	2.4
0.80	0.533	0.553	0.020	3.7
1.00	0.628	0.657	0.029	4.6
1.20	0.691	0.733	0.041	6.0
1.40	0.695	0.764	0.070	10.0

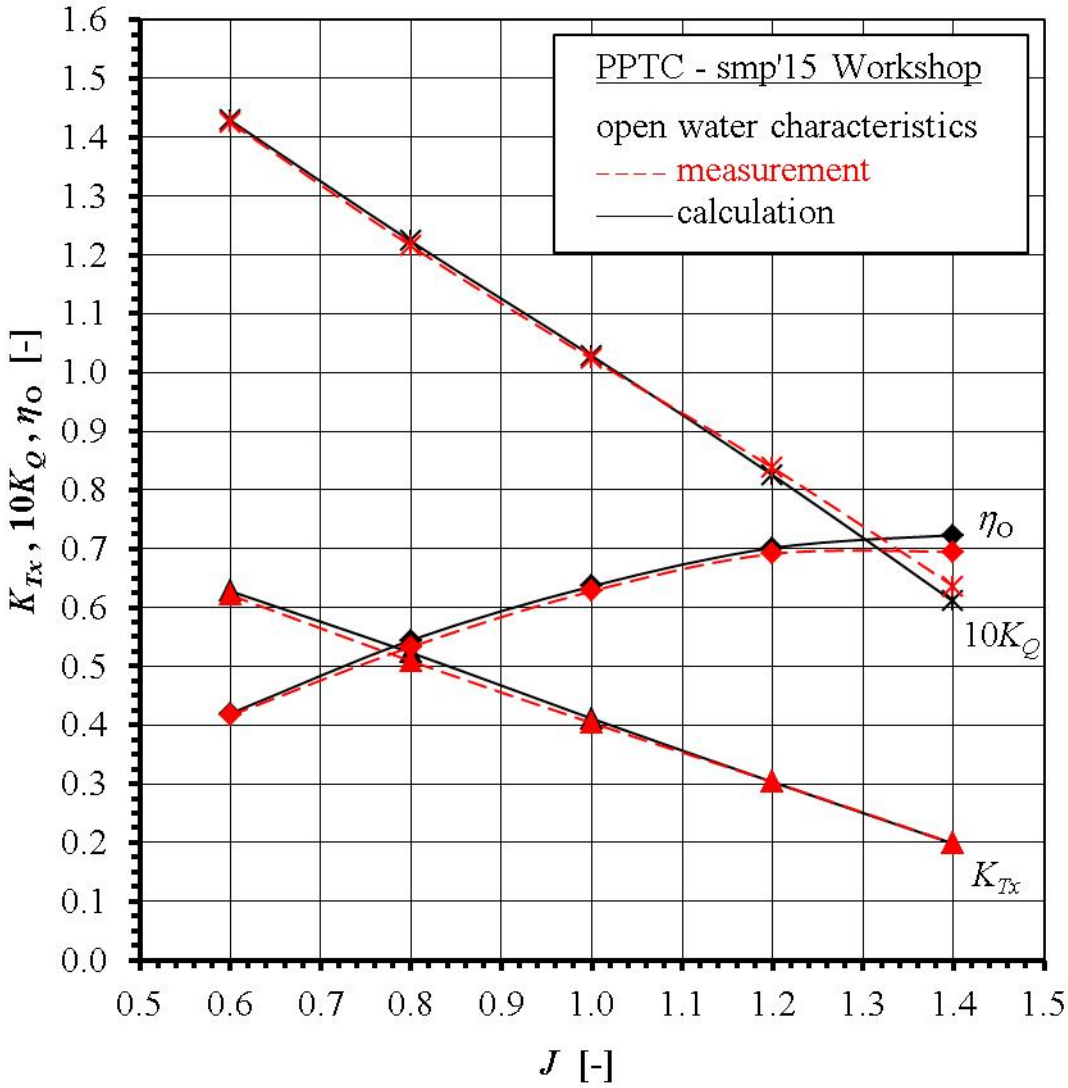


1.7 Open water curves for Ψ^{bP} = 12°: MARIN-ReFresco

J	K_{Tx} EFD	K_{Tx} CFD	ΔK_{Tx}	ΔK_{Tx} [%]
0.60	0.621	0.628	0.007	1.1
0.80	0.509	0.523	0.014	2.8
1.00	0.404	0.411	0.007	1.8
1.20	0.303	0.303	0.000	-0.1
1.40	0.198	0.198	0.000	-0.2

J	$10K_Q$ EFD	$10K_Q$ CFD	$\Delta 10K_Q$	$\Delta 10K_Q$ [%]
0.60	1.425	1.429	0.004	0.3
0.80	1.215	1.223	0.008	0.7
1.00	1.023	1.028	0.005	0.5
1.20	0.838	0.825	-0.013	-1.5
1.40	0.636	0.610	-0.026	-4.1

J	η_O EFD	η_O CFD	$\Delta\eta_O$	$\Delta\eta_O$ [%]
0.60	0.416	0.420	0.003	0.8
0.80	0.533	0.544	0.011	2.1
1.00	0.628	0.636	0.008	1.3
1.20	0.691	0.701	0.010	1.5
1.40	0.695	0.723	0.028	4.1

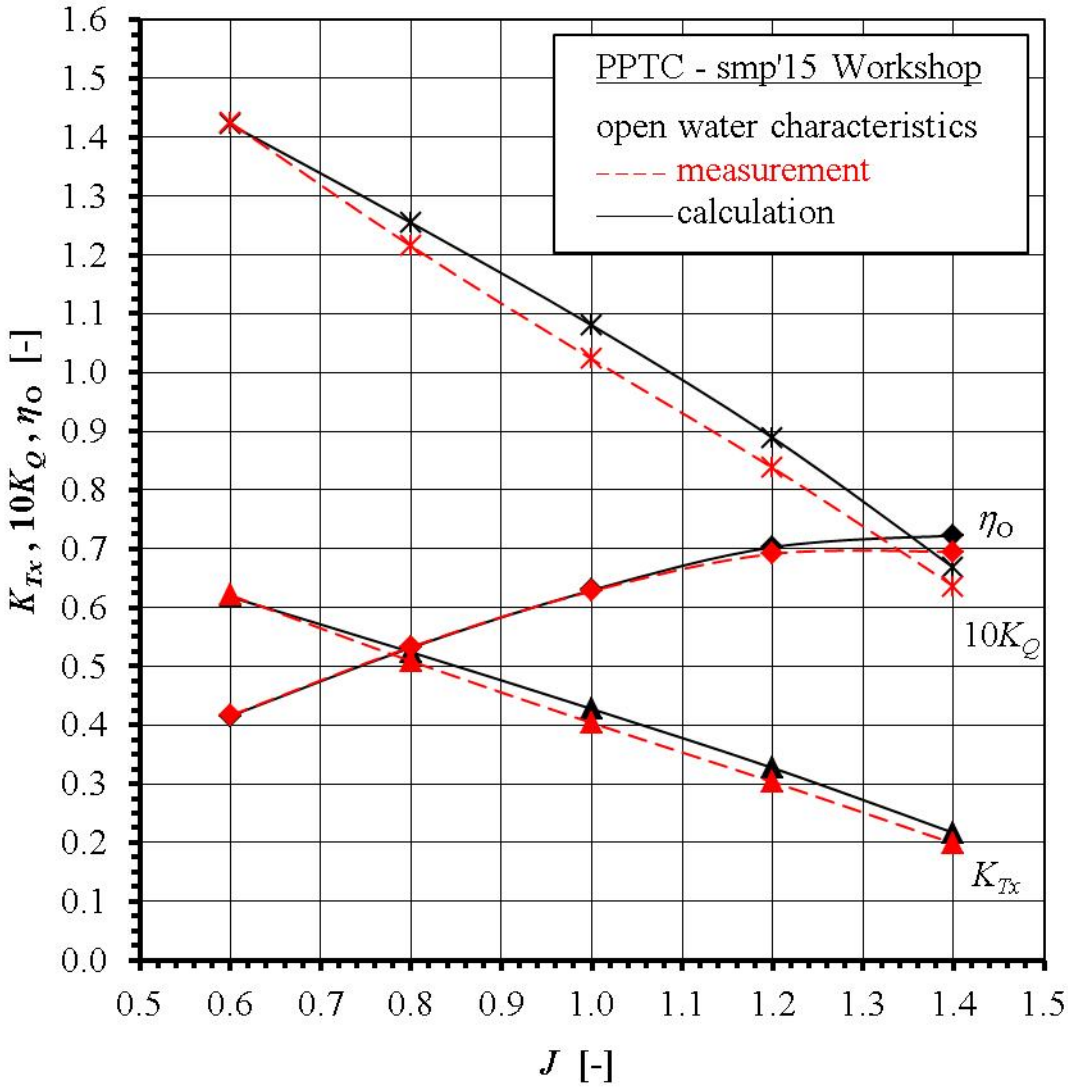


1.8 Open water curves for Ψ^{bP} = 12°: ROTAM-Fluent

J	K_{Tx} EFD	K_{Tx} CFD	ΔK_{Tx}	ΔK_{Tx} [%]
0.60	0.621	0.618	-0.003	-0.5
0.80	0.509	0.524	0.015	3.0
1.00	0.404	0.427	0.024	5.9
1.20	0.303	0.327	0.024	7.9
1.40	0.198	0.217	0.018	9.2

J	$10K_Q$ EFD	$10K_Q$ CFD	$\Delta 10K_Q$	$\Delta 10K_Q$ [%]
0.60	1.425	1.422	-0.003	-0.2
0.80	1.215	1.255	0.040	3.3
1.00	1.023	1.080	0.057	5.6
1.20	0.838	0.889	0.051	6.1
1.40	0.636	0.668	0.032	5.0

J	η_O EFD	η_O CFD	$\Delta\eta_O$	$\Delta\eta_O$ [%]
0.60	0.416	0.415	-0.001	-0.3
0.80	0.533	0.532	-0.001	-0.2
1.00	0.628	0.630	0.002	0.2
1.20	0.691	0.703	0.011	1.6
1.40	0.695	0.722	0.028	4.0

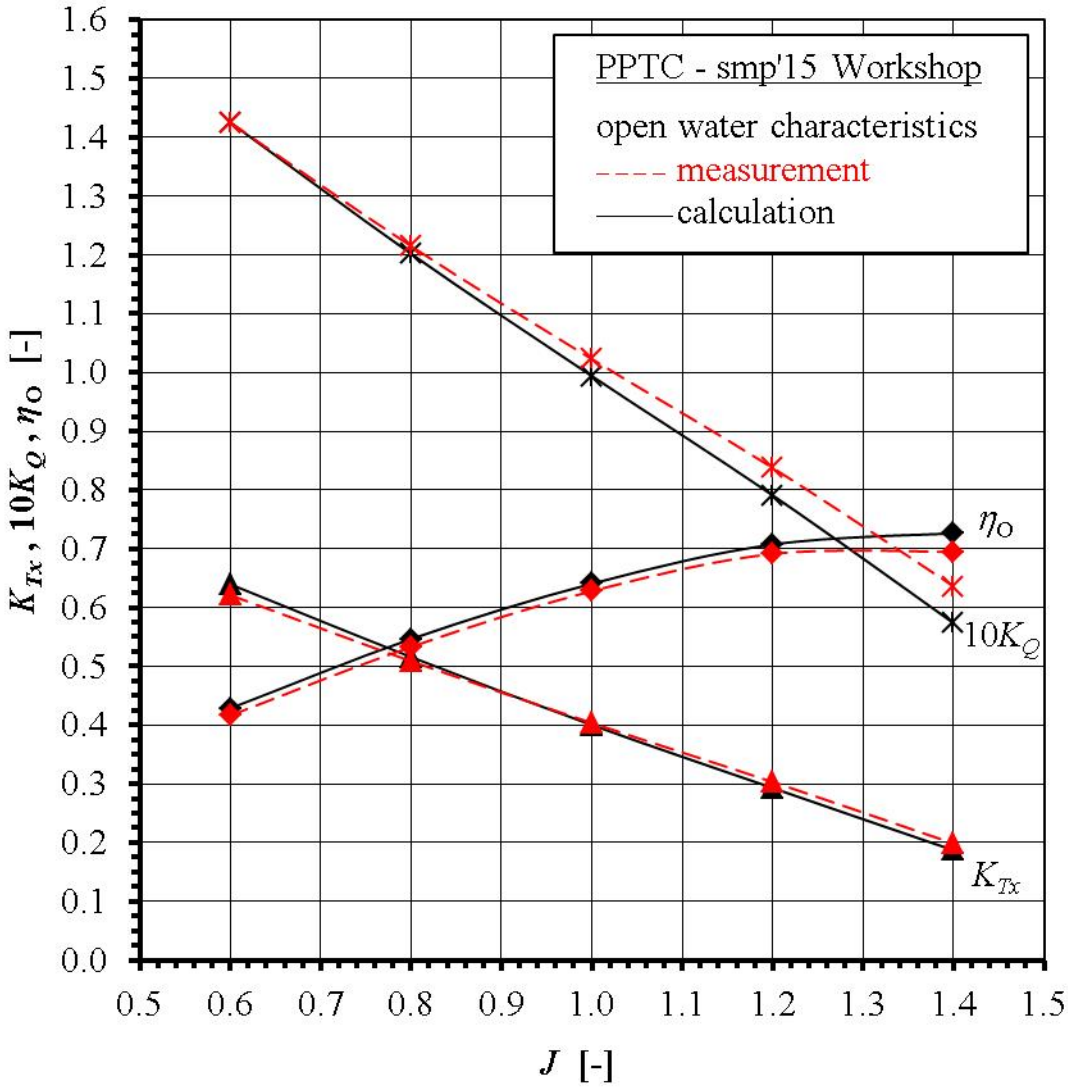


1.9 Open water curves for Ψ^{bP} = 12°: TUHH-CFX

J	K_{Tx} EFD	K_{Tx} CFD	ΔK_{Tx}	ΔK_{Tx} [%]
0.60	0.621	0.640	0.018	2.9
0.80	0.509	0.516	0.007	1.4
1.00	0.404	0.400	-0.003	-0.9
1.20	0.303	0.293	-0.010	-3.4
1.40	0.198	0.187	-0.011	-5.8

J	$10K_Q$ EFD	$10K_Q$ CFD	$\Delta 10K_Q$	$\Delta 10K_Q$ [%]
0.60	1.425	1.426	0.000	0.0
0.80	1.215	1.202	-0.013	-1.1
1.00	1.023	0.994	-0.029	-2.8
1.20	0.838	0.791	-0.047	-5.6
1.40	0.636	0.573	-0.063	-9.9

J	η_O EFD	η_O CFD	$\Delta\eta_O$	$\Delta\eta_O$ [%]
0.60	0.416	0.428	0.012	2.9
0.80	0.533	0.546	0.013	2.5
1.00	0.628	0.641	0.013	2.0
1.20	0.691	0.707	0.016	2.3
1.40	0.695	0.726	0.032	4.5

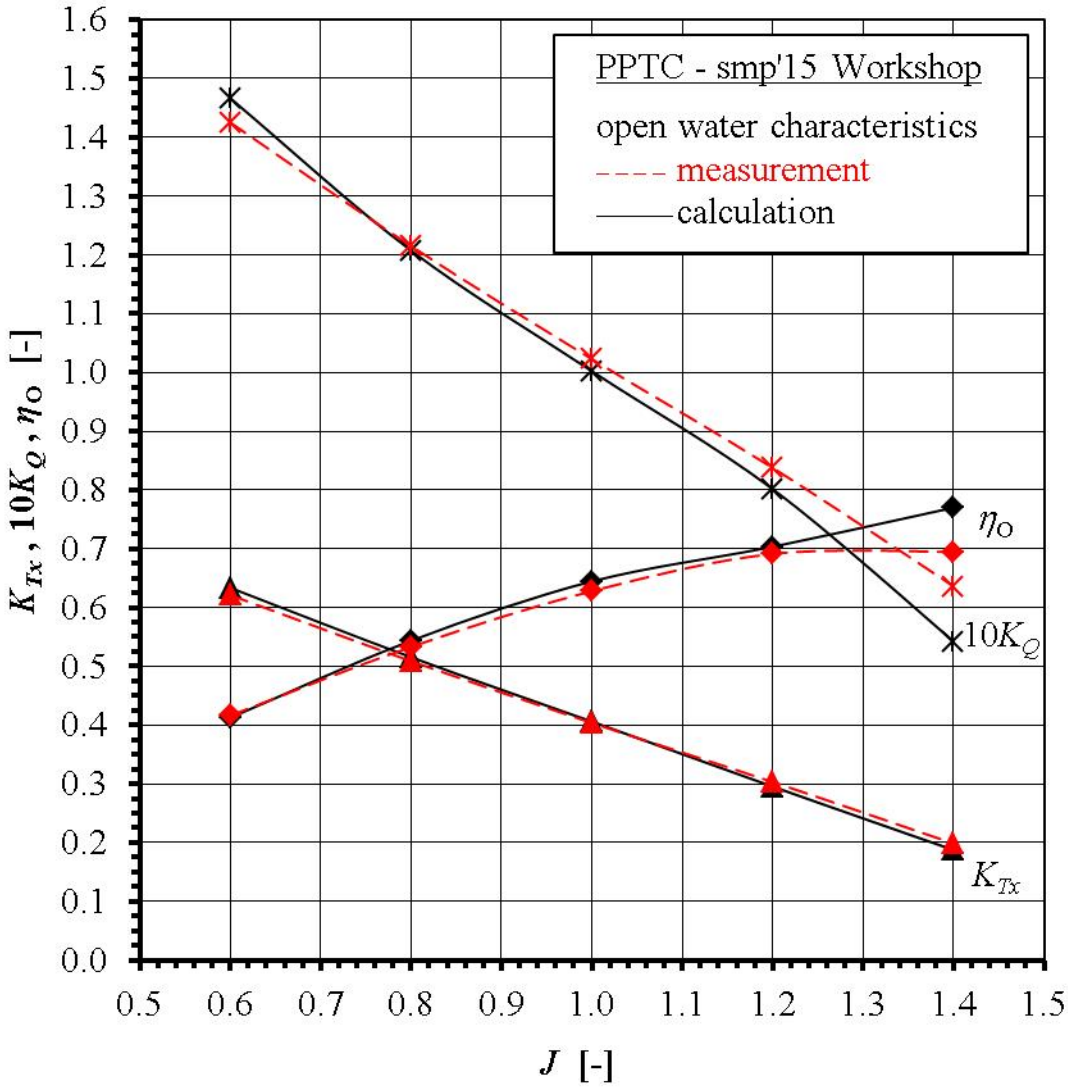


1.10 Open water curves for Ψ^{bP} = 12°: TUHH-OF

J	K_{Tx} EFD	K_{Tx} CFD	ΔK_{Tx}	ΔK_{Tx} [%]
0.60	0.621	0.634	0.012	2.0
0.80	0.509	0.516	0.007	1.3
1.00	0.404	0.406	0.002	0.6
1.20	0.303	0.295	-0.008	-2.6
1.40	0.198	0.187	-0.011	-5.5

J	$10K_Q$ EFD	$10K_Q$ CFD	$\Delta 10K_Q$	$\Delta 10K_Q$ [%]
0.60	1.425	1.467	0.041	2.9
0.80	1.215	1.207	-0.008	-0.6
1.00	1.023	1.002	-0.020	-2.0
1.20	0.838	0.801	-0.036	-4.3
1.40	0.636	0.542	-0.094	-14.8

J	η_O EFD	η_O CFD	$\Delta\eta_O$	$\Delta\eta_O$ [%]
0.60	0.416	0.413	-0.004	-0.9
0.80	0.533	0.544	0.010	2.0
1.00	0.628	0.645	0.017	2.6
1.20	0.691	0.704	0.012	1.8
1.40	0.695	0.770	0.075	10.8

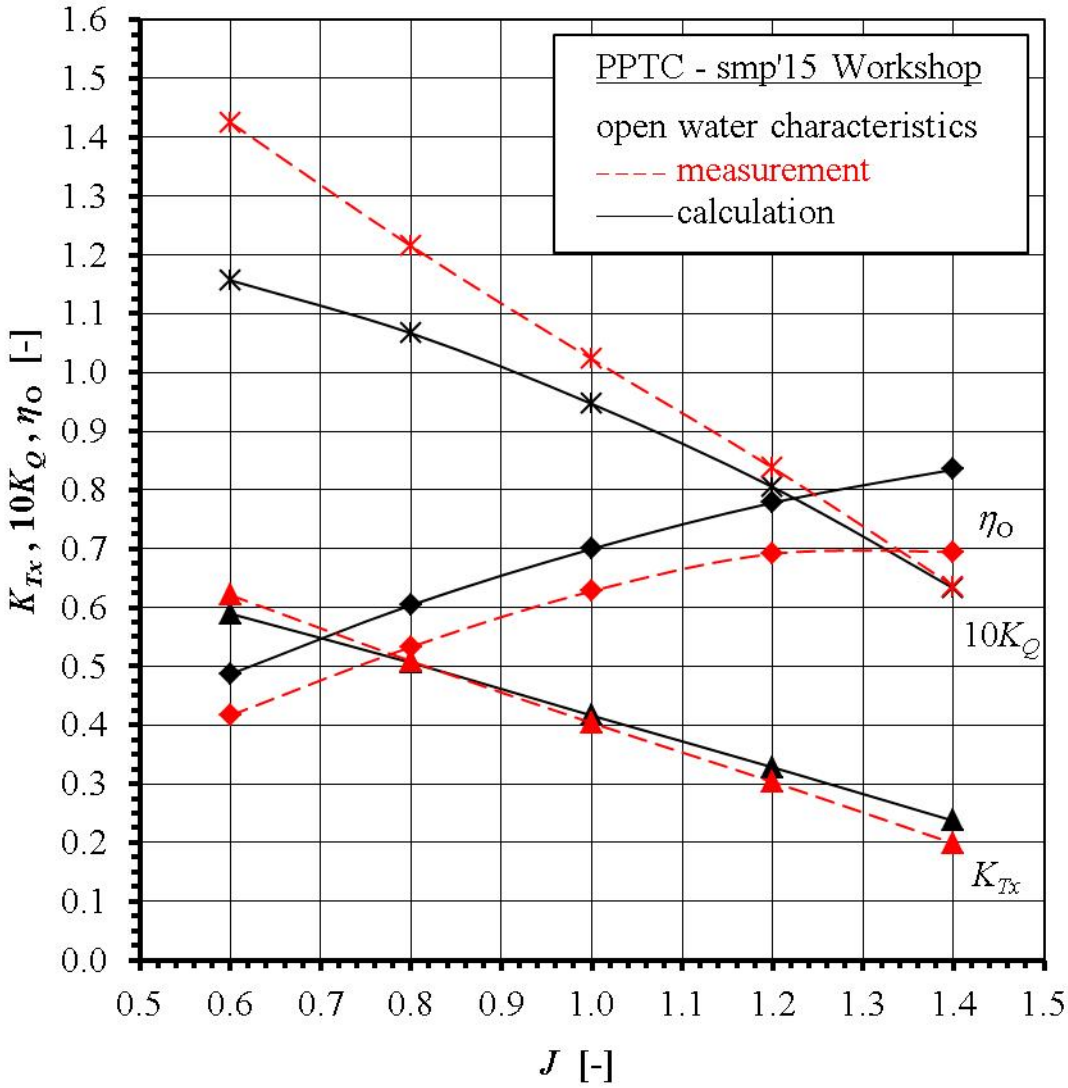


1.11 Open water curves for Ψ^{bP} = 12°: TUHH-panMARE

J	K_{Tx} EFD	K_{Tx} CFD	ΔK_{Tx}	ΔK_{Tx} [%]
0.60	0.621	0.590	-0.032	-5.1
0.80	0.509	0.506	-0.003	-0.5
1.00	0.404	0.416	0.013	3.1
1.20	0.303	0.328	0.025	8.2
1.40	0.198	0.237	0.039	19.5

J	$10K_Q$ EFD	$10K_Q$ CFD	$\Delta 10K_Q$	$\Delta 10K_Q$ [%]
0.60	1.425	1.157	-0.268	-18.8
0.80	1.215	1.067	-0.148	-12.2
1.00	1.023	0.946	-0.076	-7.5
1.20	0.838	0.805	-0.033	-3.9
1.40	0.636	0.633	-0.004	-0.6

J	η_O EFD	η_O CFD	$\Delta\eta_O$	$\Delta\eta_O$ [%]
0.60	0.416	0.487	0.070	16.9
0.80	0.533	0.604	0.071	13.3
1.00	0.628	0.700	0.072	11.4
1.20	0.691	0.778	0.087	12.6
1.40	0.695	0.835	0.140	20.2

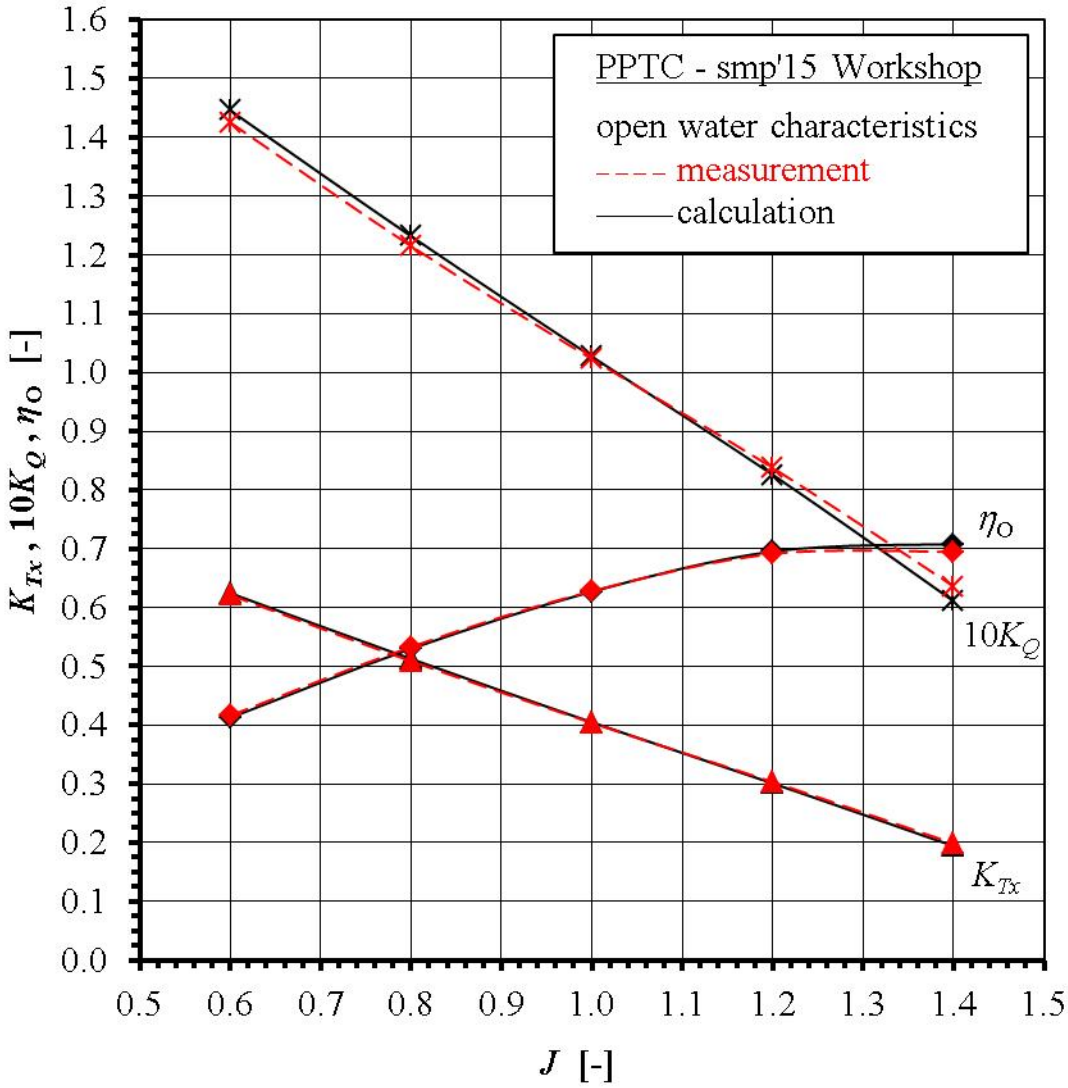


1.12 Open water curves for $\Psi^{bP} = 12°$: UDE-ISIS

J	K_{Tx} EFD	K_{Tx} CFD	ΔK_{Tx}	ΔK_{Tx} [%]
0.60	0.621	0.625	0.003	0.5
0.80	0.509	0.513	0.004	0.8
1.00	0.404	0.405	0.001	0.3
1.20	0.303	0.301	-0.002	-0.8
1.40	0.198	0.194	-0.004	-2.1

J	$10K_Q$ EFD	$10K_Q$ CFD	$\Delta 10K_Q$	$\Delta 10K_Q$ [%]
0.60	1.425	1.446	0.021	1.4
0.80	1.215	1.232	0.017	1.4
1.00	1.023	1.027	0.004	0.4
1.20	0.838	0.826	-0.012	-1.4
1.40	0.636	0.611	-0.025	-4.0

J	η_O EFD	η_O CFD	$\Delta\eta_O$	$\Delta\eta_O$ [%]
0.60	0.416	0.412	-0.004	-0.9
0.80	0.533	0.530	-0.003	-0.6
1.00	0.628	0.627	-0.001	-0.1
1.20	0.691	0.696	0.004	0.6
1.40	0.695	0.708	0.013	1.9



1.13 Open water curves for Ψ^{bP} = 12°: UniGenoa-BEM

J	K_{Tx} EFD	K_{Tx} CFD	ΔK_{Tx}	ΔK_{Tx} [%]
0.60				
0.80	0.509	0.475	-0.034	-6.6
1.00	0.404	0.383	-0.021	-5.1
1.20	0.303	0.287	-0.016	-5.2
1.40	0.198	0.189	-0.010	-4.9

J	$10K_Q$ EFD	$10K_Q$ CFD	$\Delta 10K_Q$	$\Delta 10K_Q$ [%]
0.60				
0.80	1.215	1.106	-0.109	-9.0
1.00	1.023	0.962	-0.061	-6.0
1.20	0.838	0.790	-0.047	-5.6
1.40	0.636	0.593	-0.044	-6.8

J	η_O EFD	η_O CFD	$\Delta\eta_O$	$\Delta\eta_O$ [%]
0.60				
0.80	0.533	0.547	0.014	2.6
1.00	0.628	0.634	0.006	0.9
1.20	0.691	0.694	0.003	0.4
1.40	0.695	0.709	0.014	2.1

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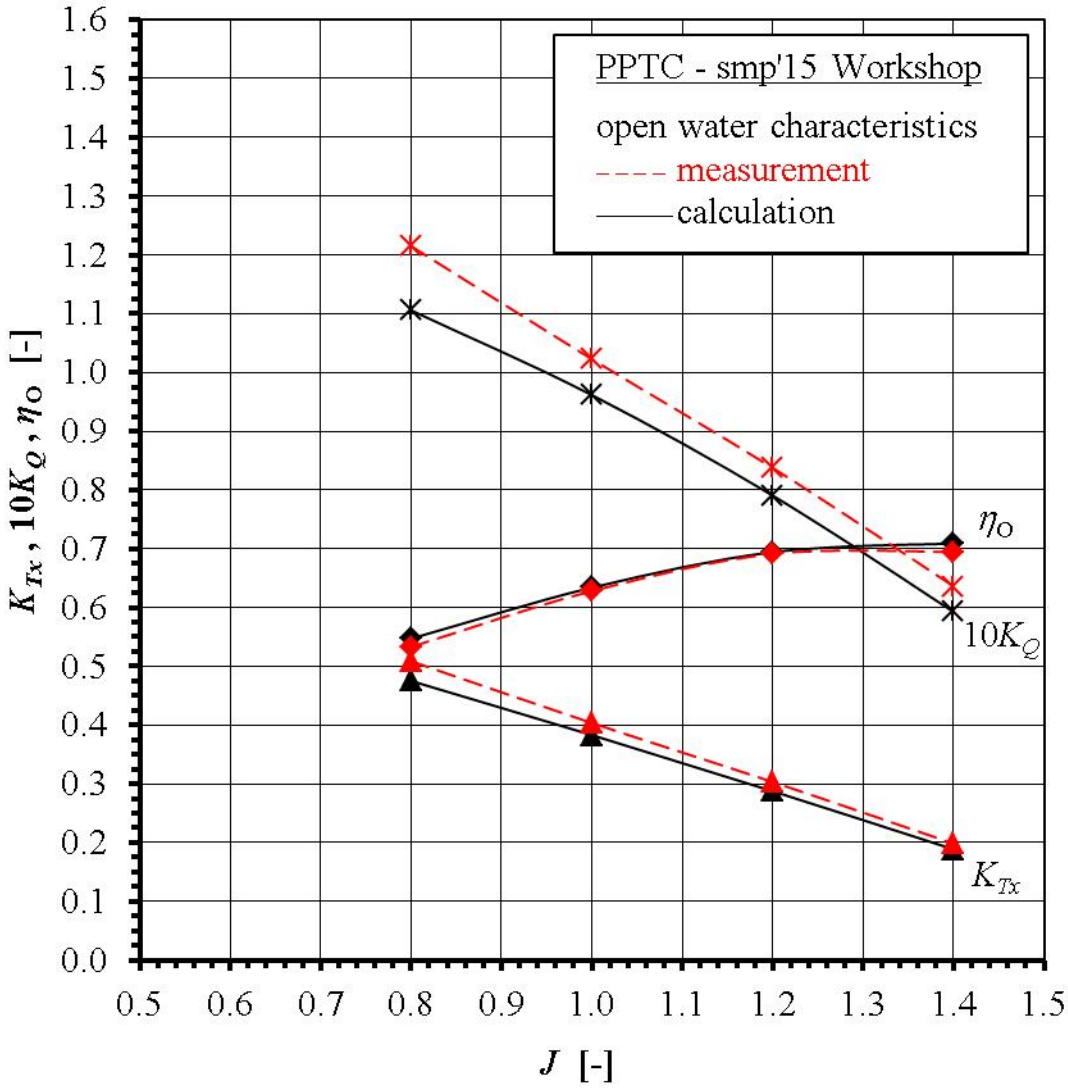


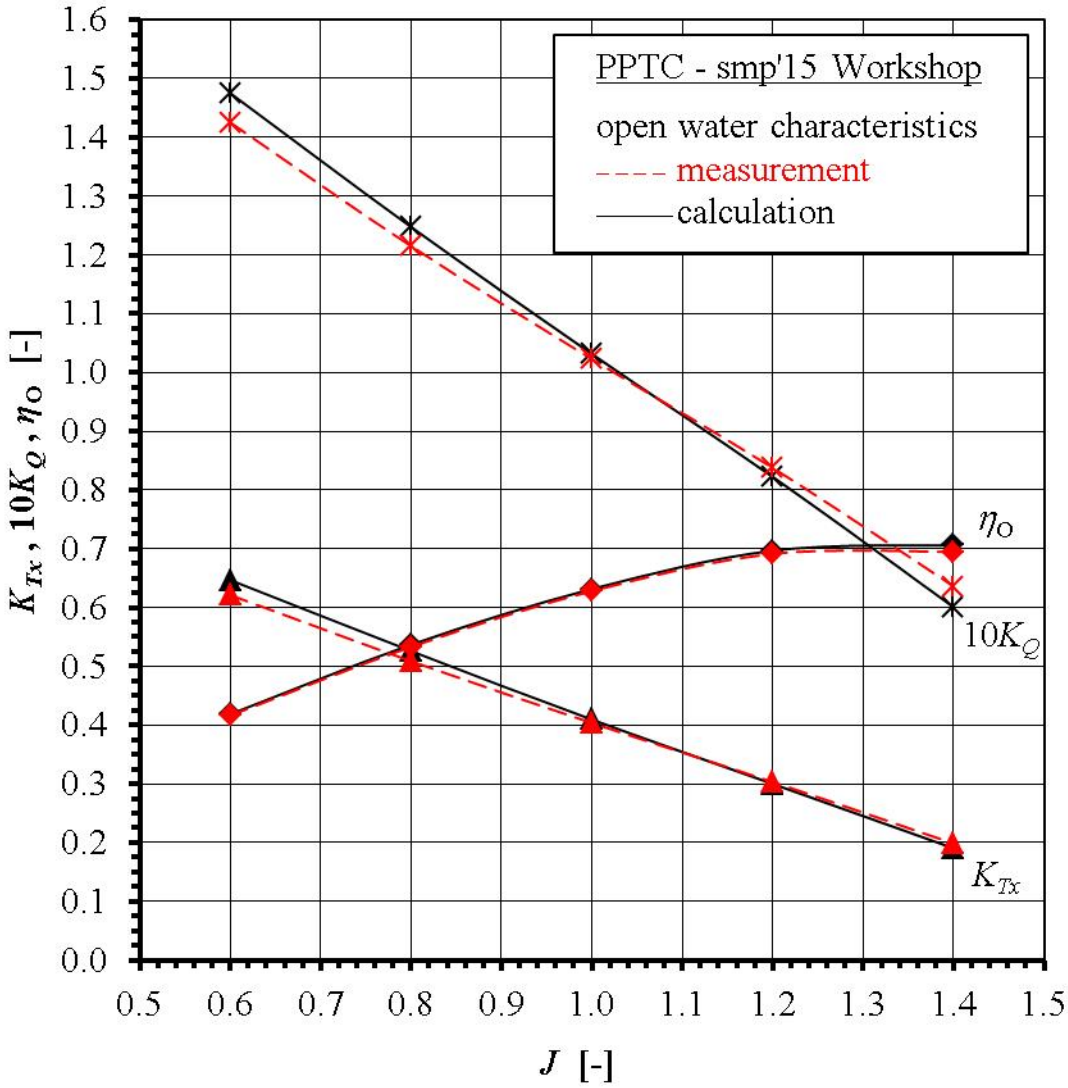
1.14 Open water curves for Ψ^{bP} = 12°: UniGenoa-StarCCM

J	K_{Tx} EFD	K_{Tx} CFD	ΔK_{Tx}	ΔK_{Tx} [%]
0.60	0.621	0.647	0.025	4.1
0.80	0.509	0.526	0.017	3.4
1.00	0.404	0.409	0.006	1.4
1.20	0.303	0.300	-0.003	-1.0
1.40	0.198	0.190	-0.008	-4.1

J	$10K_Q$ EFD	$10K_Q$ CFD	$\Delta 10K_Q$	$\Delta 10K_Q$ [%]
0.60	1.425	1.475	0.050	3.5
0.80	1.215	1.248	0.033	2.7
1.00	1.023	1.031	0.009	0.8
1.20	0.838	0.822	-0.015	-1.8
1.40	0.636	0.601	-0.036	-5.6

J	η_O EFD	η_O CFD	$\Delta\eta_O$	$\Delta\eta_O$ [%]
0.60	0.416	0.419	0.002	0.6
0.80	0.533	0.537	0.004	0.7
1.00	0.628	0.632	0.004	0.6
1.20	0.691	0.697	0.006	0.8
1.40	0.695	0.706	0.011	1.6

..

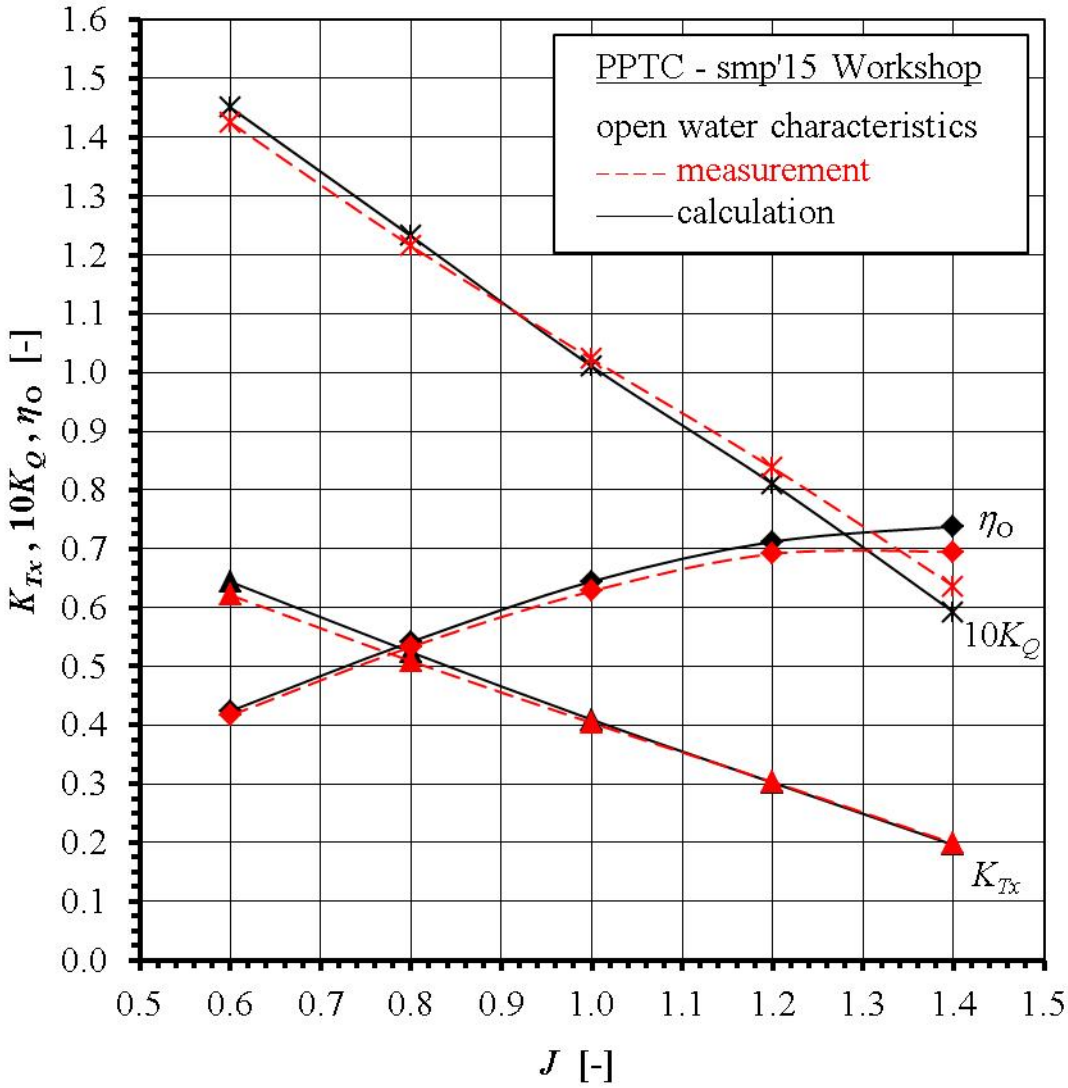


1.15 Open water curves for Ψ^{bP} = 12°: VTT-FinFlo

J	K_{Tx} EFD	K_{Tx} CFD	ΔK_{Tx}	ΔK_{Tx} [%]
0.60	0.621	0.644	0.023	3.6
0.80	0.509	0.524	0.015	3.0
1.00	0.404	0.409	0.005	1.3
1.20	0.303	0.302	-0.001	-0.4
1.40	0.198	0.196	-0.002	-1.2

J	$10K_Q$ EFD	$10K_Q$ CFD	$\Delta 10K_Q$	$\Delta 10K_Q$ [%]
0.60	1.425	1.451	0.026	1.8
0.80	1.215	1.232	0.017	1.4
1.00	1.023	1.010	-0.013	-1.2
1.20	0.838	0.810	-0.028	-3.3
1.40	0.636	0.592	-0.044	-6.9

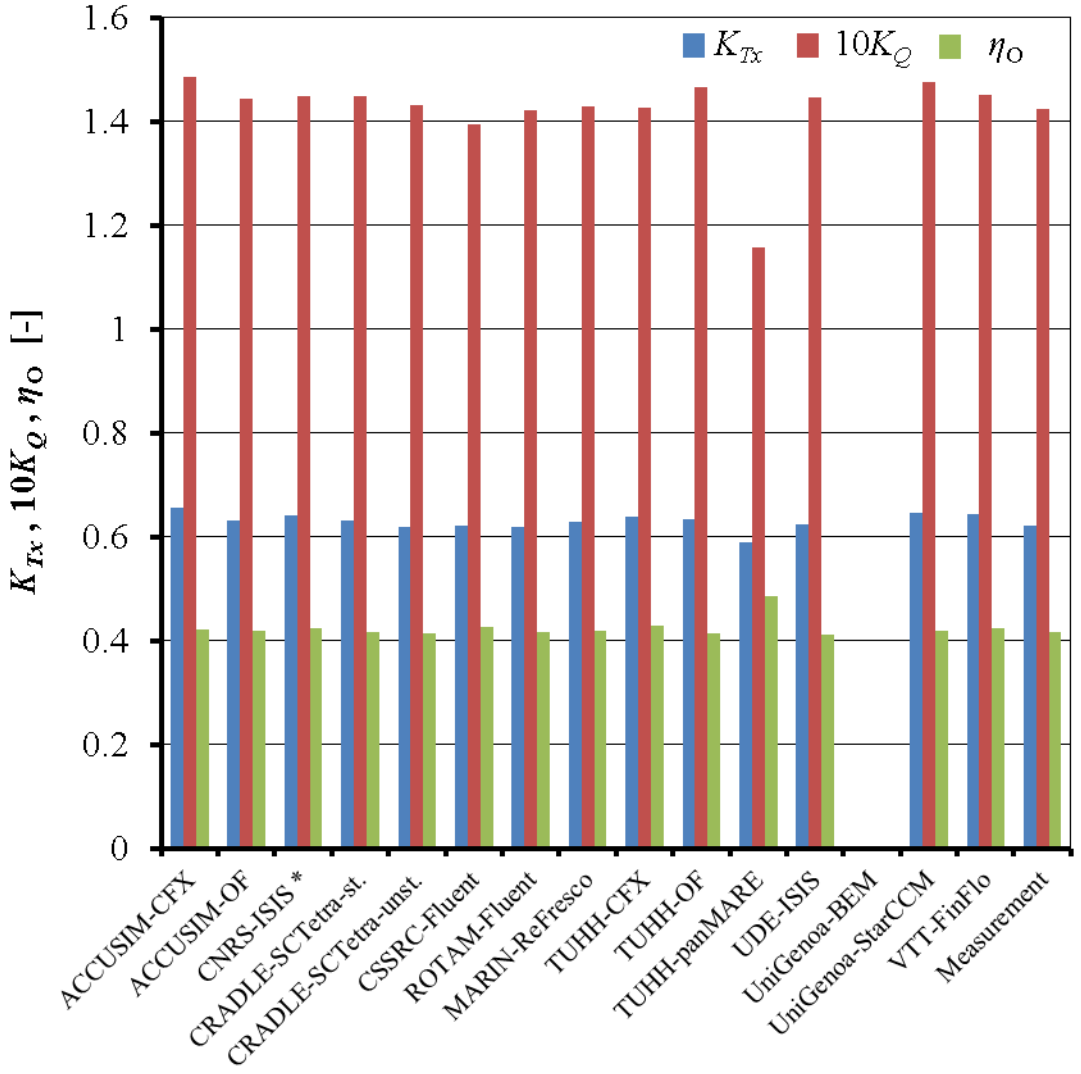
J	η_O EFD	η_O CFD	$\Delta\eta_O$	$\Delta\eta_O$ [%]
0.60	0.416	0.424	0.008	1.8
0.80	0.533	0.542	0.008	1.6
1.00	0.628	0.644	0.016	2.6
1.20	0.691	0.712	0.021	3.0
1.40	0.695	0.738	0.043	6.2



1.16 Comparison of open water characteristics, $\Psi^{bP} = 12°$, $J = 0.6$

	K_{Tx} [-]	$10K_Q$ [-]	η_O [-]
ACCUSIM-CFX	0.655	1.487	0.421
ACCUSIM-OF	0.632	1.445	0.418
CNRS-ISIS *	0.641	1.448	0.423
CRADLE-SCTetra-st.	0.631	1.449	0.416
CRADLE-SCTetra-unst.	0.620	1.431	0.413
CSSRC-Fluent	0.623	1.394	0.426
ROTAM-Fluent	0.618	1.422	0.415
MARIN-ReFresco	0.628	1.429	0.420
TUHH-CFX	0.640	1.426	0.428
TUHH-OF	0.634	1.467	0.413
TUHH-panMARE	0.590	1.157	0.487
UDE-ISIS	0.625	1.446	0.412
UniGenoa-BEM			
UniGenoa-StarCCM	0.647	1.475	0.419
VTT-FinFlo	0.644	1.451	0.424
Measurement	0.621	1.425	0.416

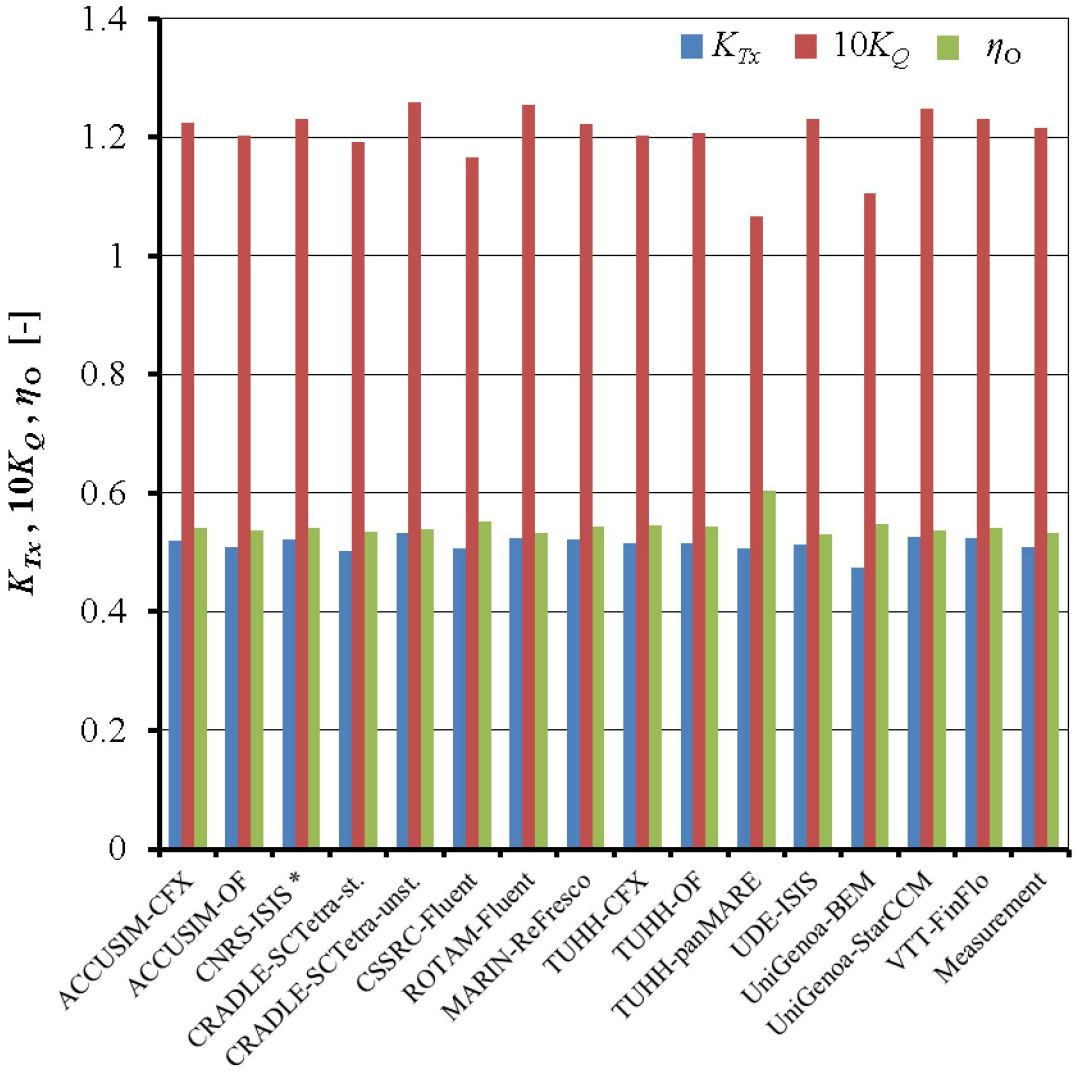
* data updated



1.17 Comparison of open water characteristics, $\Psi^{bP} = 12°$, $J = 0.8$

	K_{Tx} [-]	$10K_Q$ [-]	η_O [-]
ACCUSIM-CFX	0.520	1.225	0.540
ACCUSIM-OF	0.508	1.203	0.538
CNRS-ISIS *	0.523	1.231	0.541
CRADLE-SCTetra-st.	0.502	1.193	0.536
CRADLE-SCTetra-unst.	0.533	1.258	0.540
CSSRC-Fluent	0.506	1.166	0.553
ROTAM-Fluent	0.524	1.255	0.532
MARIN-ReFresco	0.523	1.223	0.544
TUHH-CFX	0.516	1.202	0.546
TUHH-OF	0.516	1.207	0.544
TUHH-panMARE	0.506	1.067	0.604
UDE-ISIS	0.513	1.232	0.530
UniGenoa-BEM	0.475	1.106	0.547
UniGenoa-StarCCM	0.526	1.248	0.537
VTT-FinFlo	0.524	1.232	0.542
Measurement	0.509	1.215	0.533

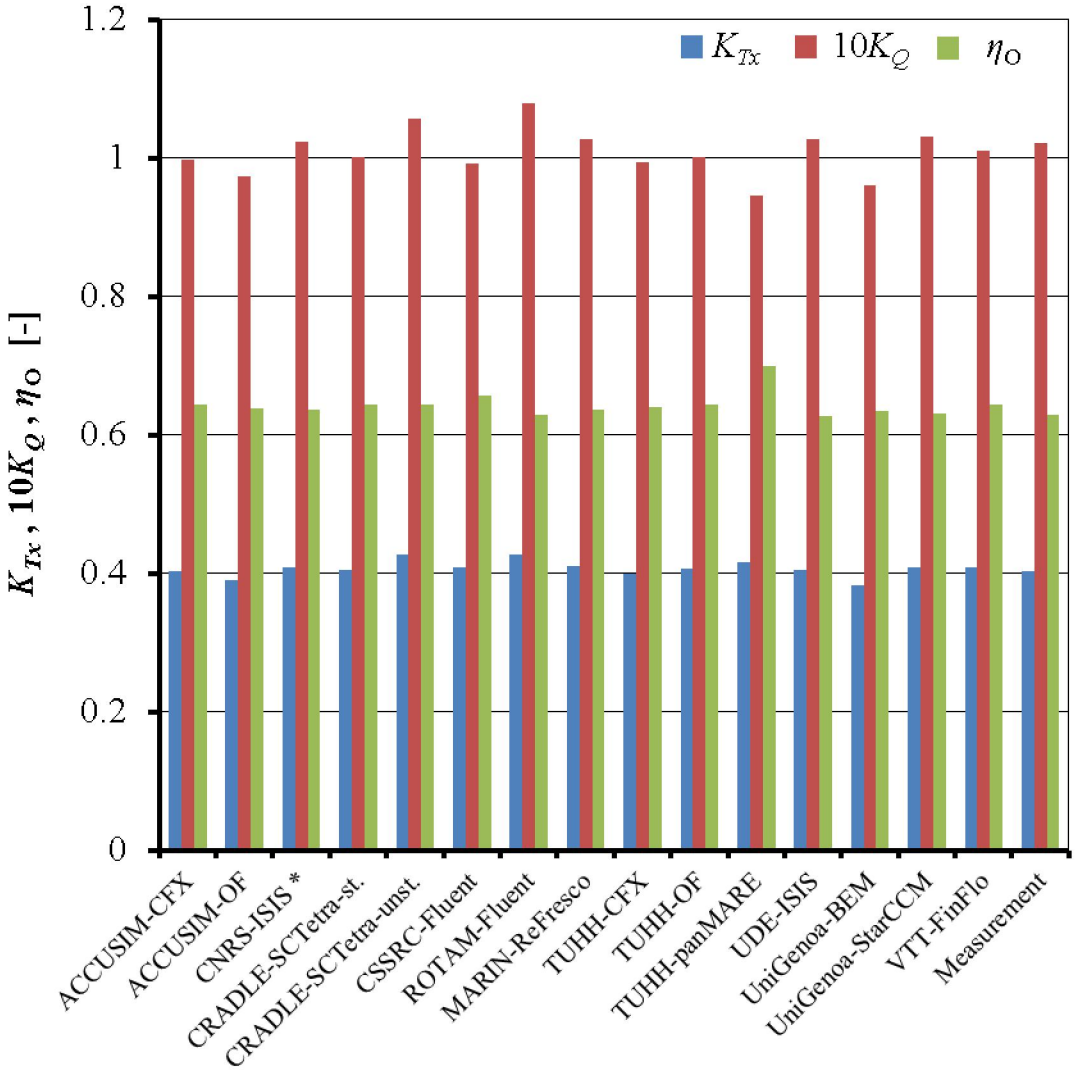
* data updated



1.18 Comparison of open water characteristics, $\Psi^{bP} = 12°$, $J = 1.0$

	K_{Tx} [-]	$10K_Q$ [-]	η_O [-]
ACCUSIM-CFX	0.403	0.997	0.643
ACCUSIM-OF	0.390	0.973	0.638
CNRS-ISIS *	0.409	1.023	0.636
CRADLE-SCTetra-st.	0.405	1.002	0.643
CRADLE-SCTetra-unst.	0.427	1.058	0.643
CSSRC-Fluent	0.409	0.992	0.657
ROTAM-Fluent	0.427	1.080	0.630
MARIN-ReFresco	0.411	1.028	0.636
TUHH-CFX	0.400	0.994	0.641
TUHH-OF	0.406	1.002	0.645
TUHH-panMARE	0.416	0.946	0.700
UDE-ISIS	0.405	1.027	0.627
UniGenoa-BEM	0.383	0.962	0.634
UniGenoa-StarCCM	0.409	1.031	0.632
VTT-FinFlo	0.409	1.010	0.644
Measurement	0.404	1.023	0.628

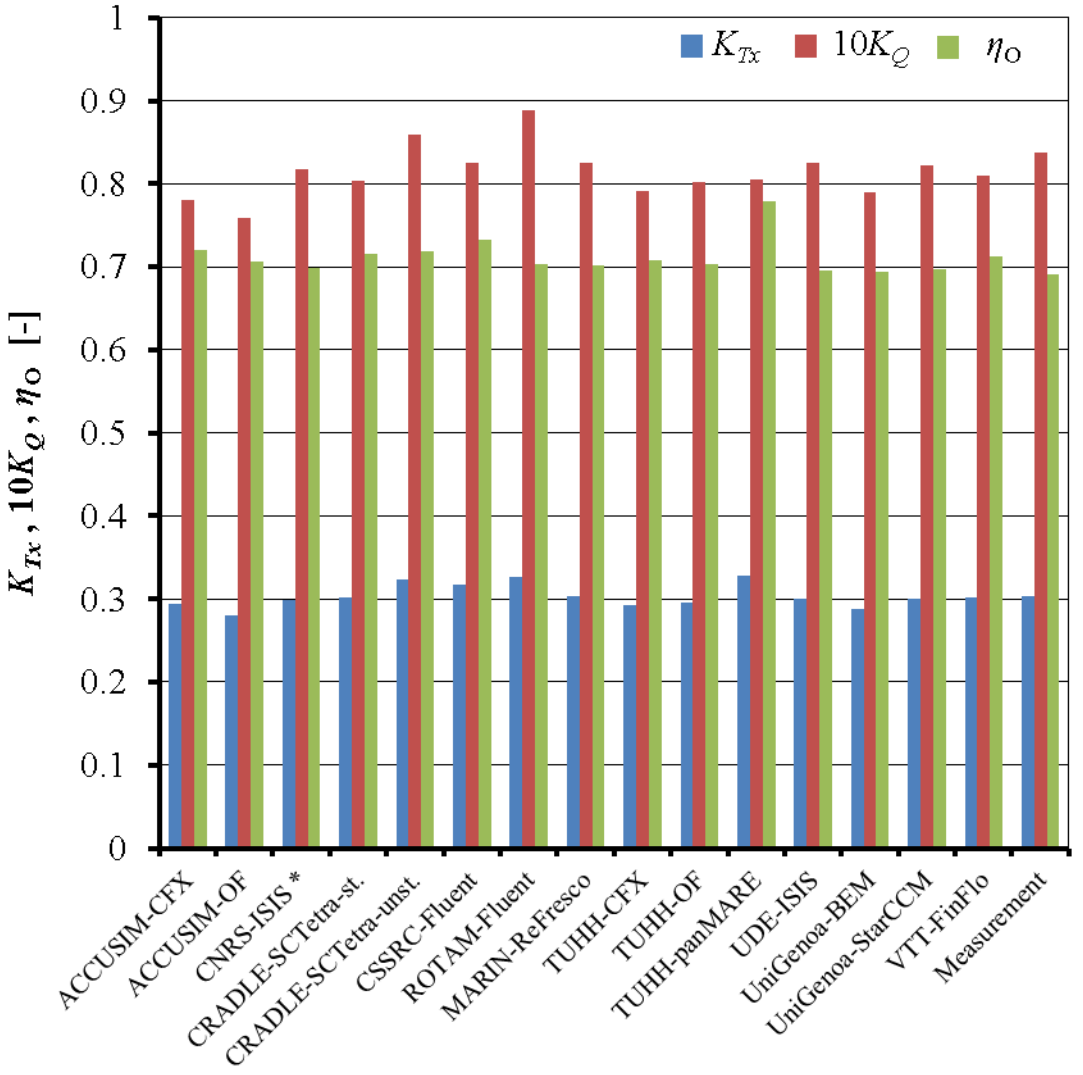
* data updated



1.19 Comparison of open water characteristics, $\Psi^{bP} = 12°$, $J = 1.2$

	K_{Tx} [-]	$10K_Q$ [-]	η_O [-]
ACCUSIM-CFX	0.294	0.780	0.720
ACCUSIM-OF	0.281	0.759	0.707
CNRS-ISIS *	0.299	0.818	0.698
CRADLE-SCTetra-st.	0.301	0.804	0.716
CRADLE-SCTetra-unst.	0.324	0.860	0.719
CSSRC-Fluent	0.317	0.825	0.733
ROTAM-Fluent	0.327	0.889	0.703
MARIN-ReFresco	0.303	0.825	0.701
TUHH-CFX	0.293	0.791	0.707
TUHH-OF	0.295	0.801	0.704
TUHH-panMARE	0.328	0.805	0.778
UDE-ISIS	0.301	0.826	0.696
UniGenoa-BEM	0.287	0.790	0.694
UniGenoa-StarCCM	0.300	0.822	0.697
VTT-FinFlo	0.302	0.810	0.712
Measurement	0.303	0.838	0.691

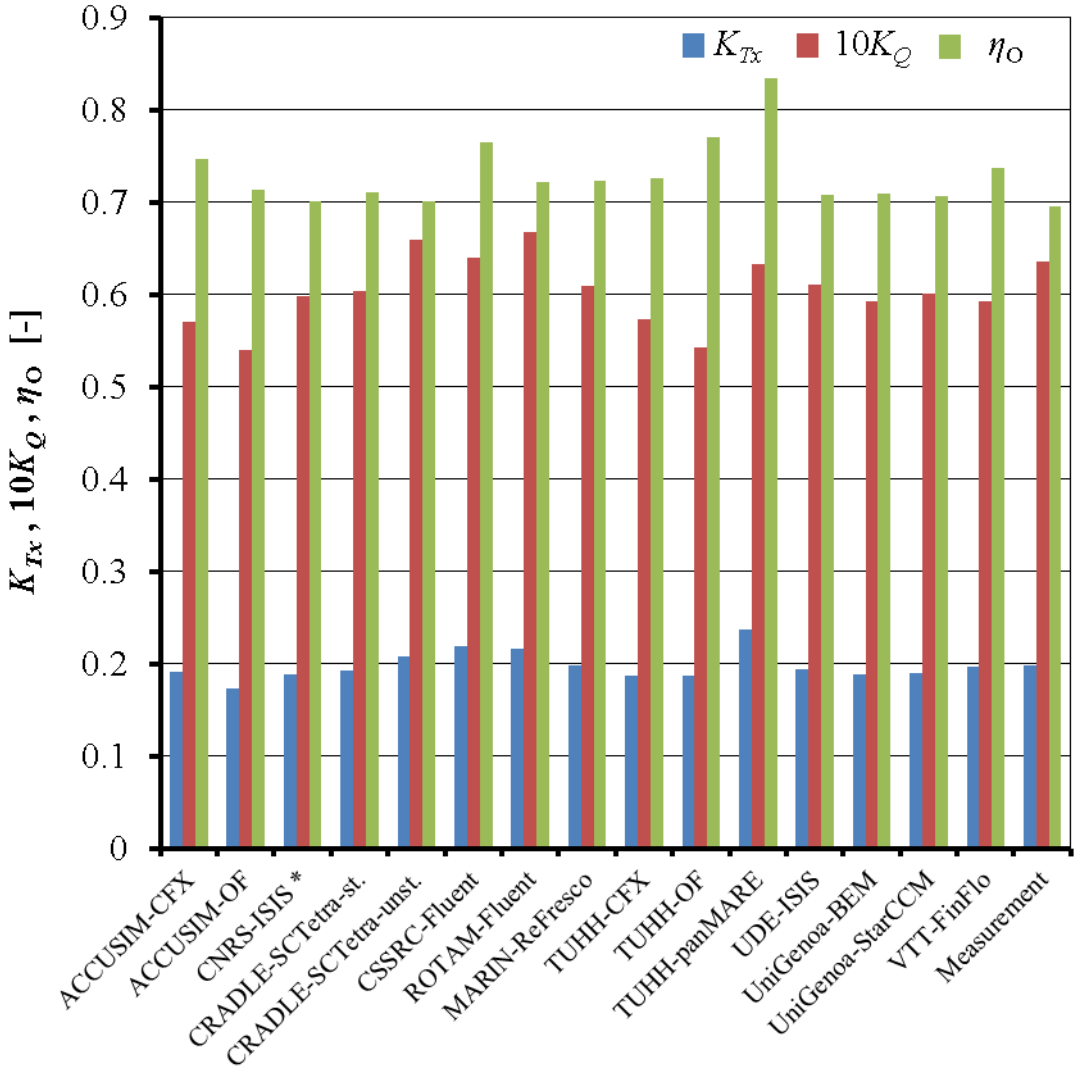
* data updated



1.20 Comparison of open water characteristics, $\psi^{bP} = 12°$, $J = 1.4$

	K_{Tx} [-]	$10K_Q$ [-]	η_O [-]
ACCUSIM-CFX	0.191	0.570	0.747
ACCUSIM-OF	0.173	0.540	0.714
CNRS-ISIS *	0.188	0.598	0.700
CRADLE-SCTetra-st.	0.193	0.604	0.711
CRADLE-SCTetra-unst.	0.207	0.660	0.701
CSSRC-Fluent	0.219	0.639	0.764
ROTAM-Fluent	0.217	0.668	0.722
MARIN-ReFresco	0.198	0.610	0.723
TUHH-CFX	0.187	0.573	0.726
TUHH-OF	0.187	0.542	0.770
TUHH-panMARE	0.237	0.633	0.835
UDE-ISIS	0.194	0.611	0.708
UniGenoa-BEM	0.189	0.593	0.709
UniGenoa-StarCCM	0.190	0.601	0.706
VTT-FinFlo	0.196	0.592	0.738
Measurement	0.198	0.636	0.695

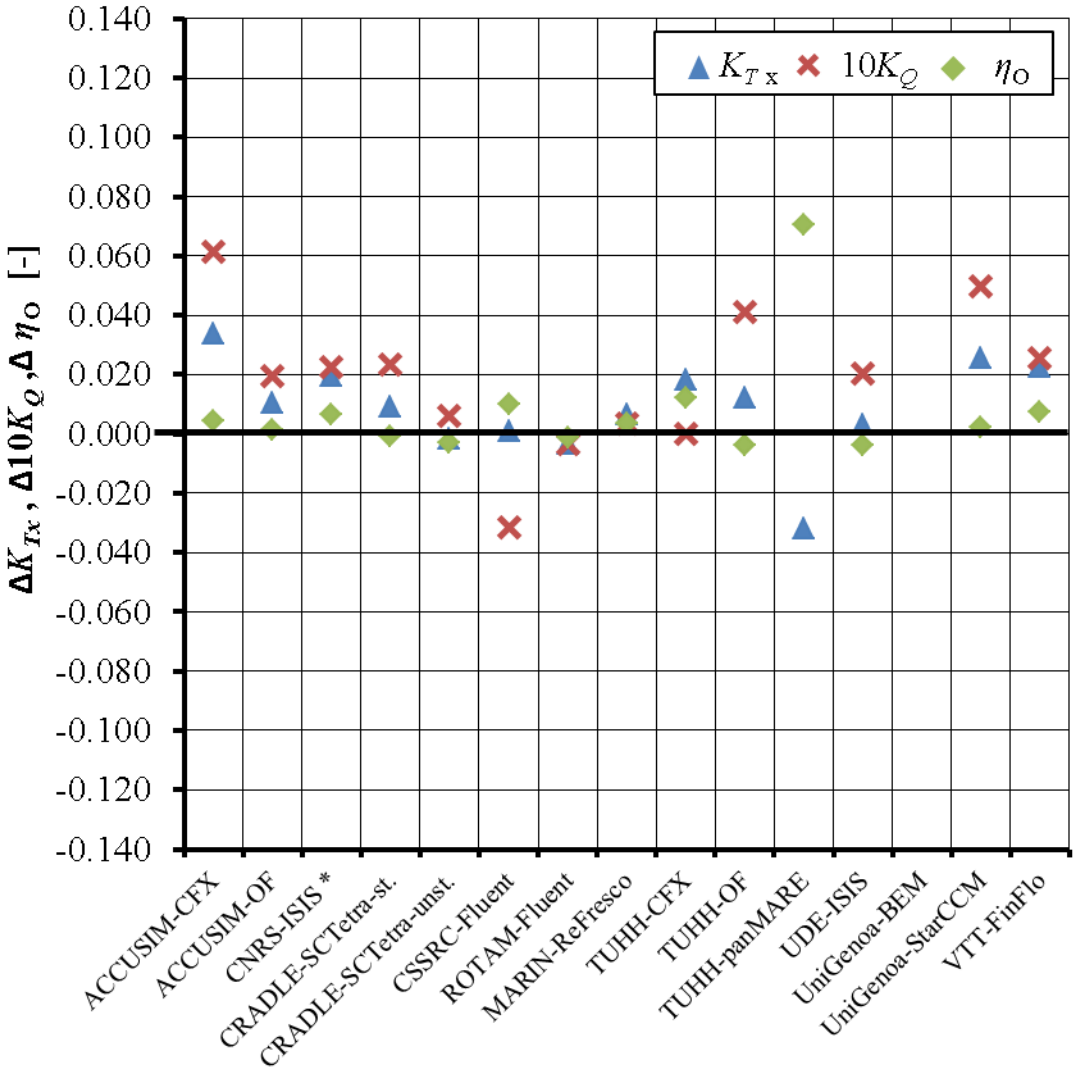
* data updated



1.21 Absolute difference between measured and calculated values: $\Psi^{bP} = 12°$, $J = 0.6$

	ΔK_{Tx} [-]	$\Delta 10K_Q$ [-]	$\Delta\eta_O$ [-]
ACCUSIM-CFX	0.034	0.062	0.004
ACCUSIM-OF	0.011	0.020	0.001
CNRS-ISIS *	0.020	0.023	0.006
CRADLE-SCTetra-st.	0.009	0.023	-0.001
CRADLE-SCTetra-unst.	-0.002	0.006	-0.003
CSSRC-Fluent	0.001	-0.031	0.010
ROTAM-Fluent	-0.003	-0.003	-0.001
MARIN-ReFresco	0.007	0.004	0.003
TUHH-CFX	0.018	0.000	0.012
TUHH-OF	0.012	0.041	-0.004
TUHH-panMARE	-0.032	-0.268	0.070
UDE-ISIS	0.003	0.021	-0.004
UniGenoa-BEM			
UniGenoa-StarCCM	0.025	0.050	0.002
VTT-FinFlo	0.023	0.026	0.008

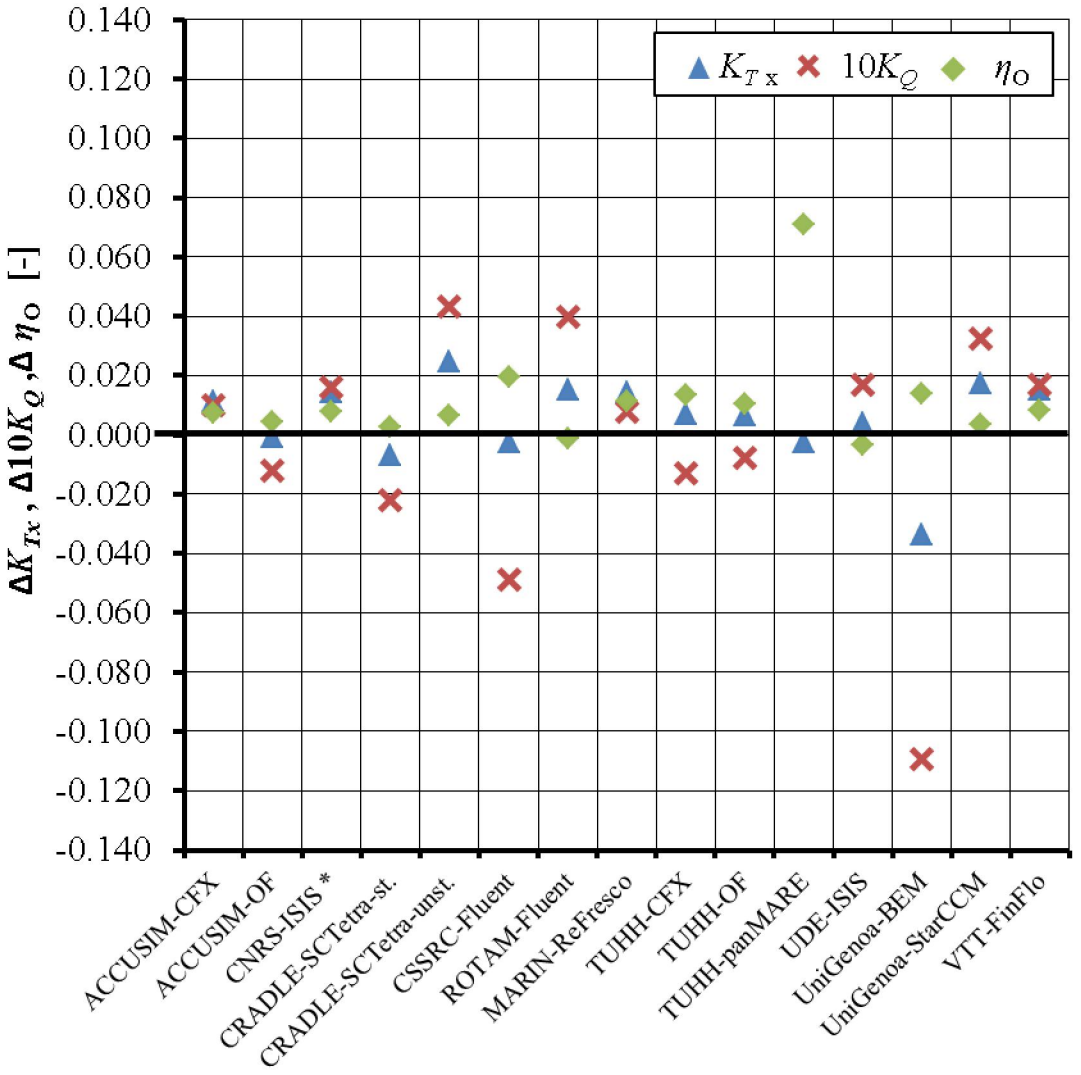
* data updated



1.22 Absolute difference between measured and calculated values: $\Psi^{bP} = 12°$, $J = 0.8$

	ΔK_{Tx} [-]	$\Delta 10K_Q$ [-]	$\Delta\eta_O$ [-]
ACCUSIM-CFX	0.011	0.010	0.007
ACCUSIM-OF	-0.001	-0.012	0.004
CNRS-ISIS *	0.014	0.016	0.008
CRADLE-SCTetra-st.	-0.007	-0.022	0.003
CRADLE-SCTetra-unst.	0.025	0.043	0.007
CSSRC-Fluent	-0.003	-0.049	0.020
ROTAM-Fluent	0.015	0.040	-0.001
MARIN-ReFresco	0.014	0.008	0.011
TUHH-CFX	0.007	-0.013	0.013
TUHH-OF	0.007	-0.008	0.010
TUHH-panMARE	-0.003	-0.148	0.071
UDE-ISIS	0.004	0.017	-0.003
UniGenoa-BEM	-0.034	-0.109	0.014
UniGenoa-StarCCM	0.017	0.033	0.004
VTT-FinFlo	0.015	0.017	0.008

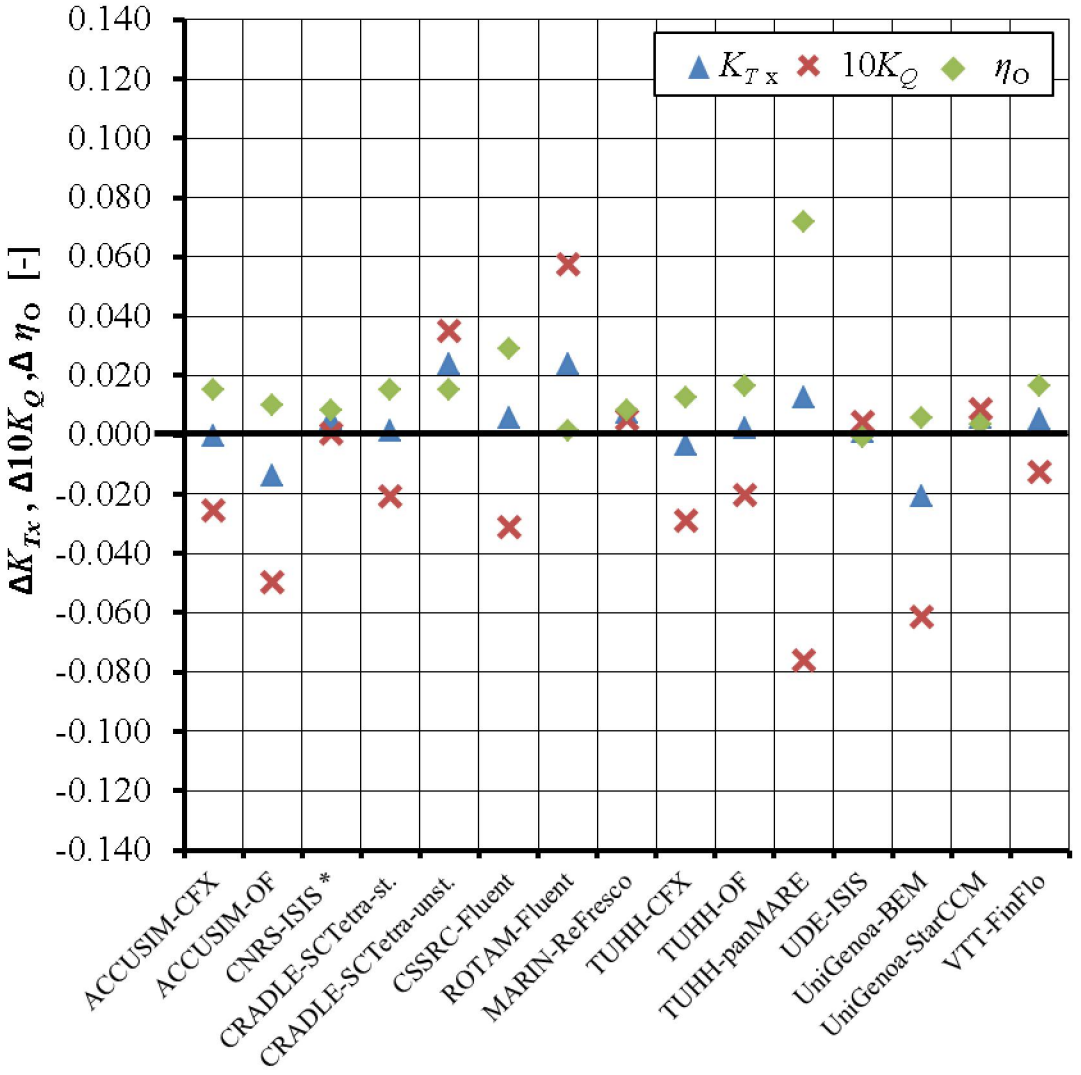
* data updated



1.23 Absolute difference between measured and calculated values: $\Psi^{bP} = 12°$, $J = 1.0$

	ΔK_{Tx} [-]	$\Delta 10K_Q$ [-]	$\Delta\eta_O$ [-]
ACCUSIM-CFX	-0.001	-0.026	0.015
ACCUSIM-OF	-0.014	-0.050	0.010
CNRS-ISIS*	0.005	0.000	0.008
CRADLE-SCTetra-st.	0.001	-0.020	0.015
CRADLE-SCTetra-unst.	0.024	0.035	0.015
CSSRC-Fluent	0.006	-0.031	0.029
ROTAM-Fluent	0.024	0.057	0.002
MARIN-ReFresco	0.007	0.005	0.008
TUHH-CFX	-0.003	-0.029	0.013
TUHH-OF	0.002	-0.020	0.017
TUHH-panMARE	0.013	-0.076	0.072
UDE-ISIS	0.001	0.004	-0.001
UniGenoa-BEM	-0.021	-0.061	0.006
UniGenoa-StarCCM	0.006	0.009	0.004
VTT-FinFlo	0.005	-0.013	0.016

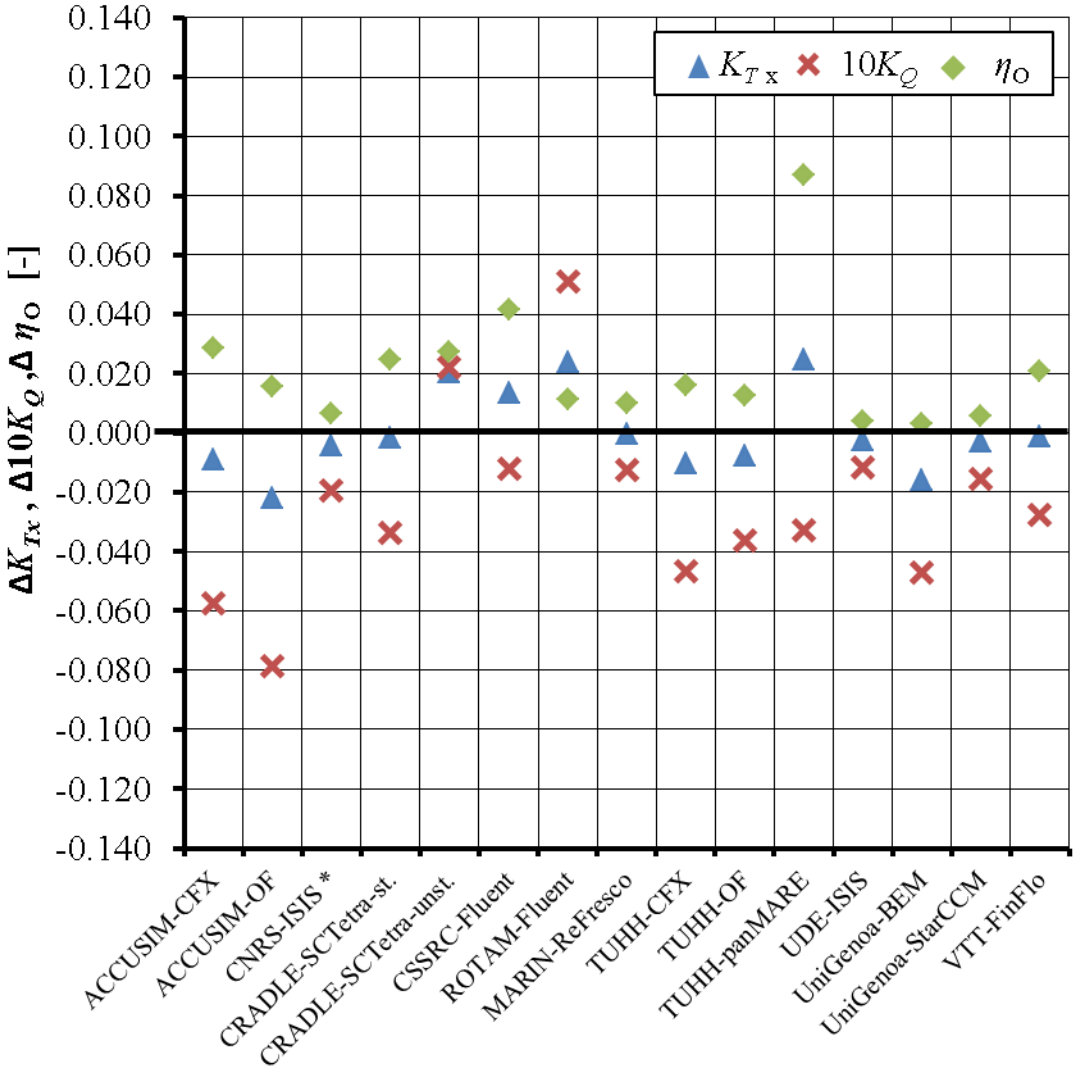
* data updated



1.24 Absolute difference between measured and calculated values: $\Psi^{bP} = 12°$, $J = 1.2$

	ΔK_{Tx} [-]	$\Delta 10K_Q$ [-]	$\Delta\eta_O$ [-]
ACCUSIM-CFX	-0.009	-0.058	0.029
ACCUSIM-OF	-0.022	-0.079	0.016
CNRS-ISIS *	-0.004	-0.020	0.007
CRADLE-SCTetra-st.	-0.002	-0.034	0.025
CRADLE-SCTetra-unst.	0.020	0.022	0.027
CSSRC-Fluent	0.014	-0.012	0.041
ROTAM-Fluent	0.024	0.051	0.011
MARIN-ReFresco	0.000	-0.013	0.010
TUHH-CFX	-0.010	-0.047	0.016
TUHH-OF	-0.008	-0.036	0.012
TUHH-panMARE	0.025	-0.033	0.087
UDE-ISIS	-0.002	-0.012	0.004
UniGenoa-BEM	-0.016	-0.047	0.003
UniGenoa-StarCCM	-0.003	-0.015	0.006
VTT-FinFlo	-0.001	-0.028	0.021

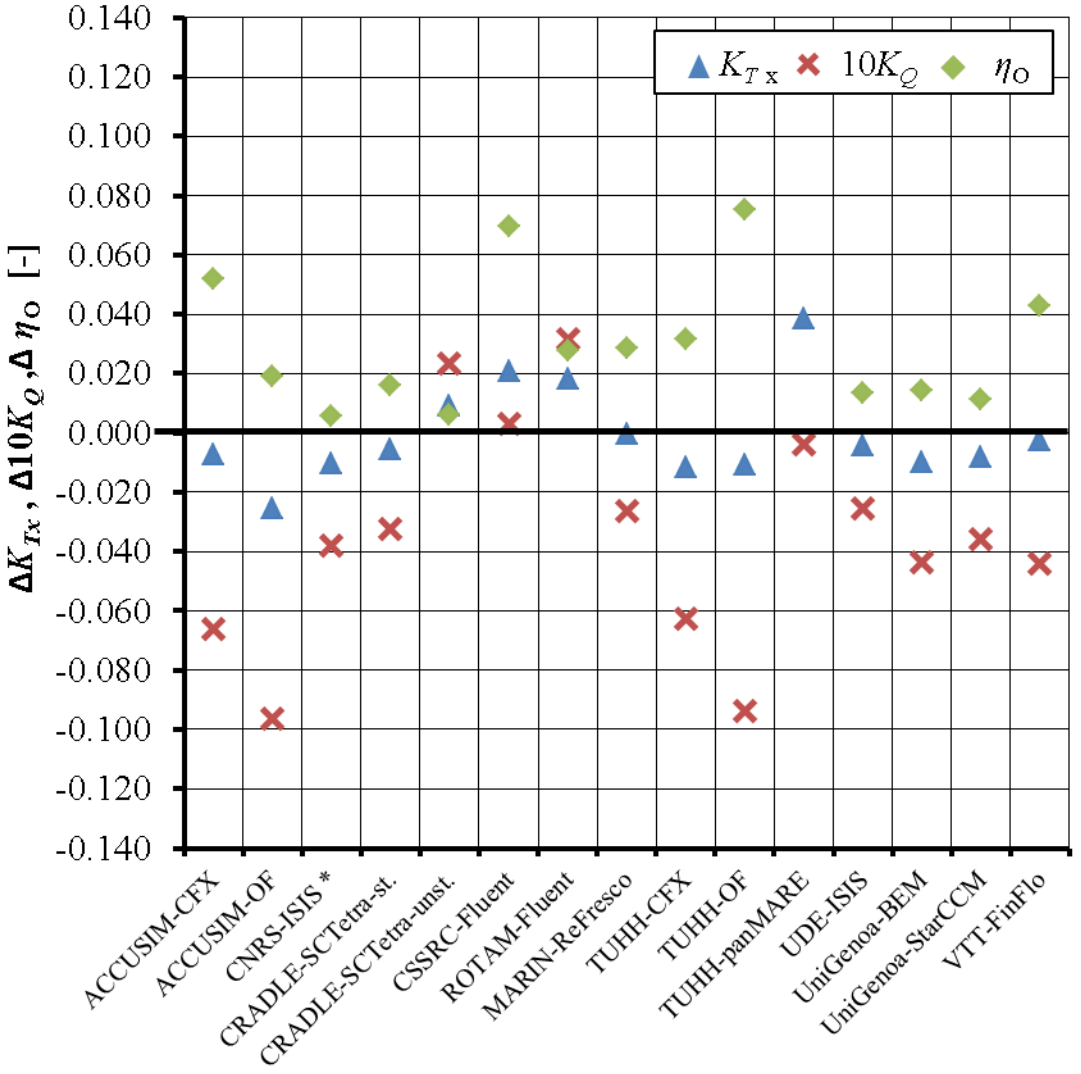
* data updated



1.25 Absolute difference between measured and calculated values: $\Psi^{bP} = 12°$, $J = 1.4$

	ΔK_{Tx} [-]	$\Delta 10K_Q$ [-]	$\Delta\eta_O$ [-]
ACCUSIM-CFX	-0.007	-0.066	0.052
ACCUSIM-OF	-0.025	-0.096	0.019
CNRS-ISIS *	-0.010	-0.038	0.006
CRADLE-SCTetra-st.	-0.006	-0.032	0.016
CRADLE-SCTetra-unst.	0.009	0.023	0.006
CSSRC-Fluent	0.021	0.003	0.070
ROTAM-Fluent	0.018	0.032	0.028
MARIN-ReFresco	0.000	-0.026	0.028
TUHH-CFX	-0.011	-0.063	0.032
TUHH-OF	-0.011	-0.094	0.075
TUHH-panMARE	0.039	-0.004	0.140
UDE-ISIS	-0.004	-0.025	0.013
UniGenoa-BEM	-0.010	-0.044	0.014
UniGenoa-StarCCM	-0.008	-0.036	0.011
VTT-FinFlo	-0.002	-0.044	0.043

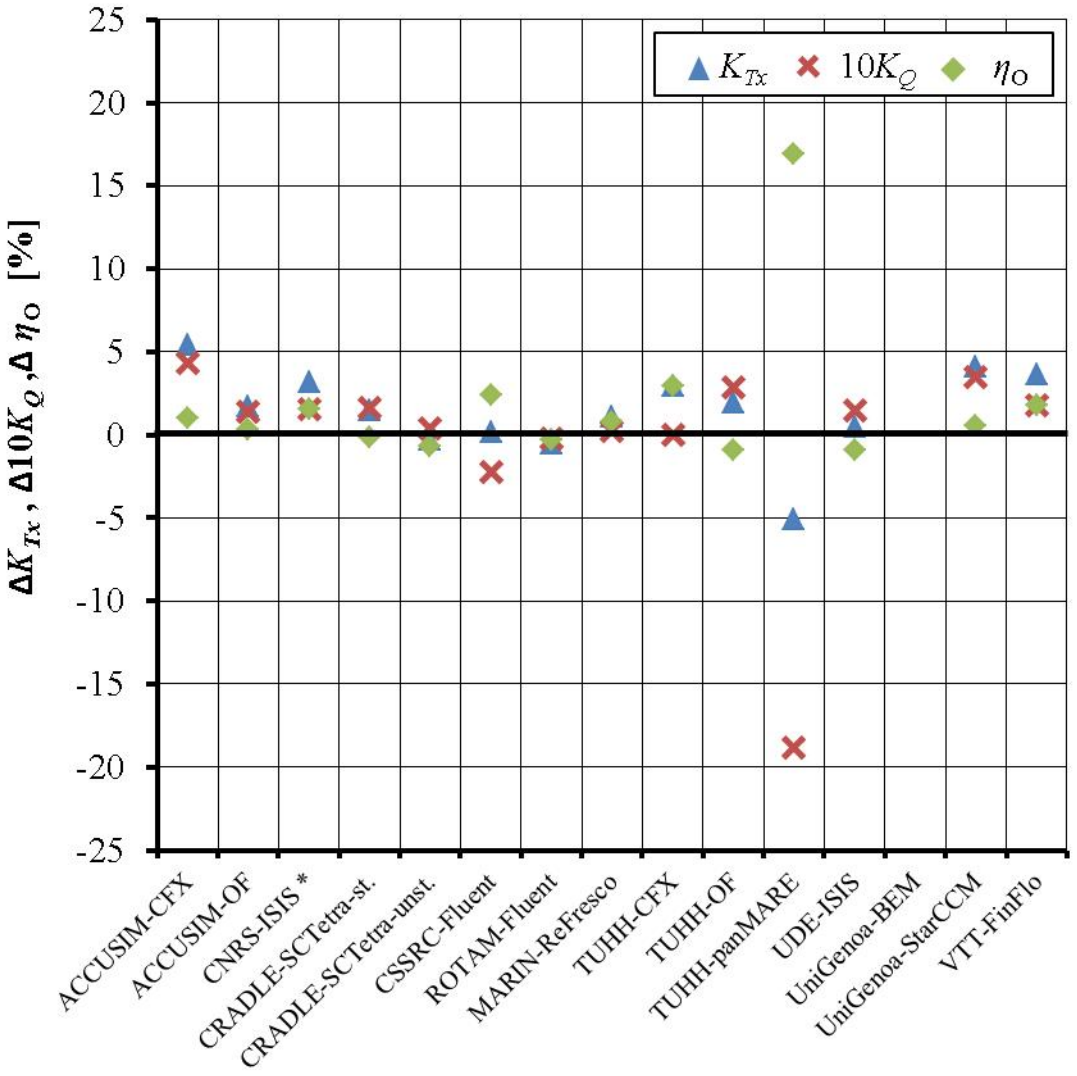
* data updated



1.26 Relative difference between measured and calculated values: $\Psi^{bP} = 12°$, $J = 0.6$

	ΔK_{Tx} [%]	$\Delta 10K_Q$ [%]	$\Delta\eta_O$ [%]
ACCUSIM-CFX	5.4	4.3	1.0
ACCUSIM-OF	1.7	1.4	0.3
CNRS-ISIS *	3.2	1.6	1.5
CRADLE-SCTetra-st.	1.5	1.6	-0.1
CRADLE-SCTetra-unst.	-0.3	0.4	-0.7
CSSRC-Fluent	0.2	-2.2	2.4
ROTAM-Fluent	-0.5	-0.2	-0.3
MARIN-ReFresco	1.1	0.3	0.8
TUHH-CFX	2.9	0.0	2.9
TUHH-OF	2.0	2.9	-0.9
TUHH-panMARE	-5.1	-18.8	16.9
UDE-ISIS	0.5	1.4	-0.9
UniGenoa-BEM			
UniGenoa-StarCCM	4.1	3.5	0.6
VTT-FinFlo	3.6	1.8	1.8

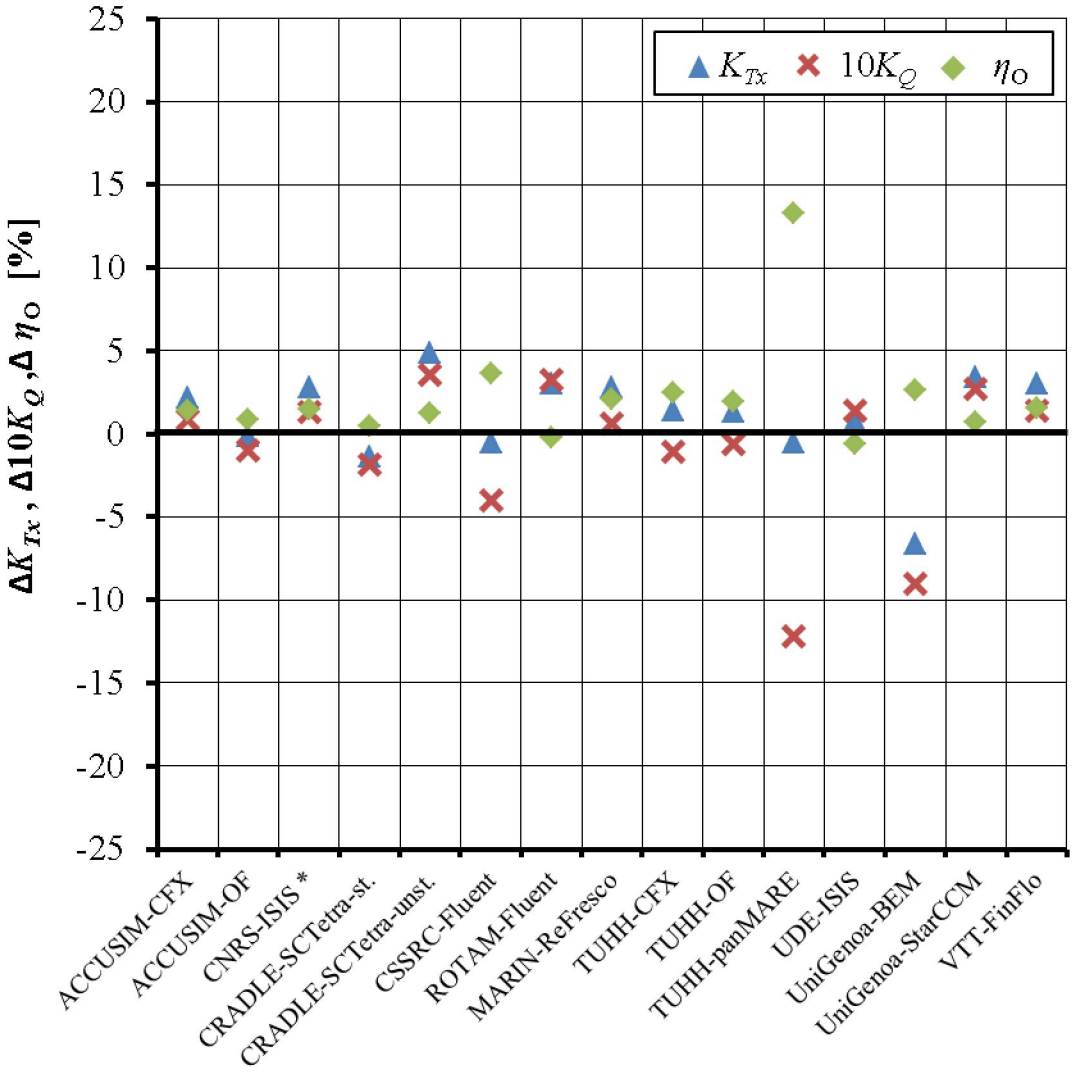
* data updated



1.27 Relative difference between measured and calculated values: $\Psi^{bP} = 12°$, $J = 0.8$

	ΔK_{Tx} [%]	$\Delta 10K_Q$ [%]	$\Delta\eta_O$ [%]
ACCUSIM-CFX	2.2	0.8	1.4
ACCUSIM-OF	-0.1	-1.0	0.8
CNRS-ISIS *	2.8	1.3	1.5
CRADLE-SCTetra-st.	-1.3	-1.8	0.5
CRADLE-SCTetra-unst.	4.9	3.6	1.2
CSSRC-Fluent	-0.5	-4.0	3.7
ROTAM-Fluent	3.0	3.3	-0.2
MARIN-ReFresco	2.8	0.7	2.1
TUHH-CFX	1.4	-1.1	2.5
TUHH-OF	1.3	-0.6	2.0
TUHH-panMARE	-0.5	-12.2	13.3
UDE-ISIS	0.8	1.4	-0.6
UniGenoa-BEM	-6.6	-9.0	2.6
UniGenoa-StarCCM	3.4	2.7	0.7
VTT-FinFlo	3.0	1.4	1.6

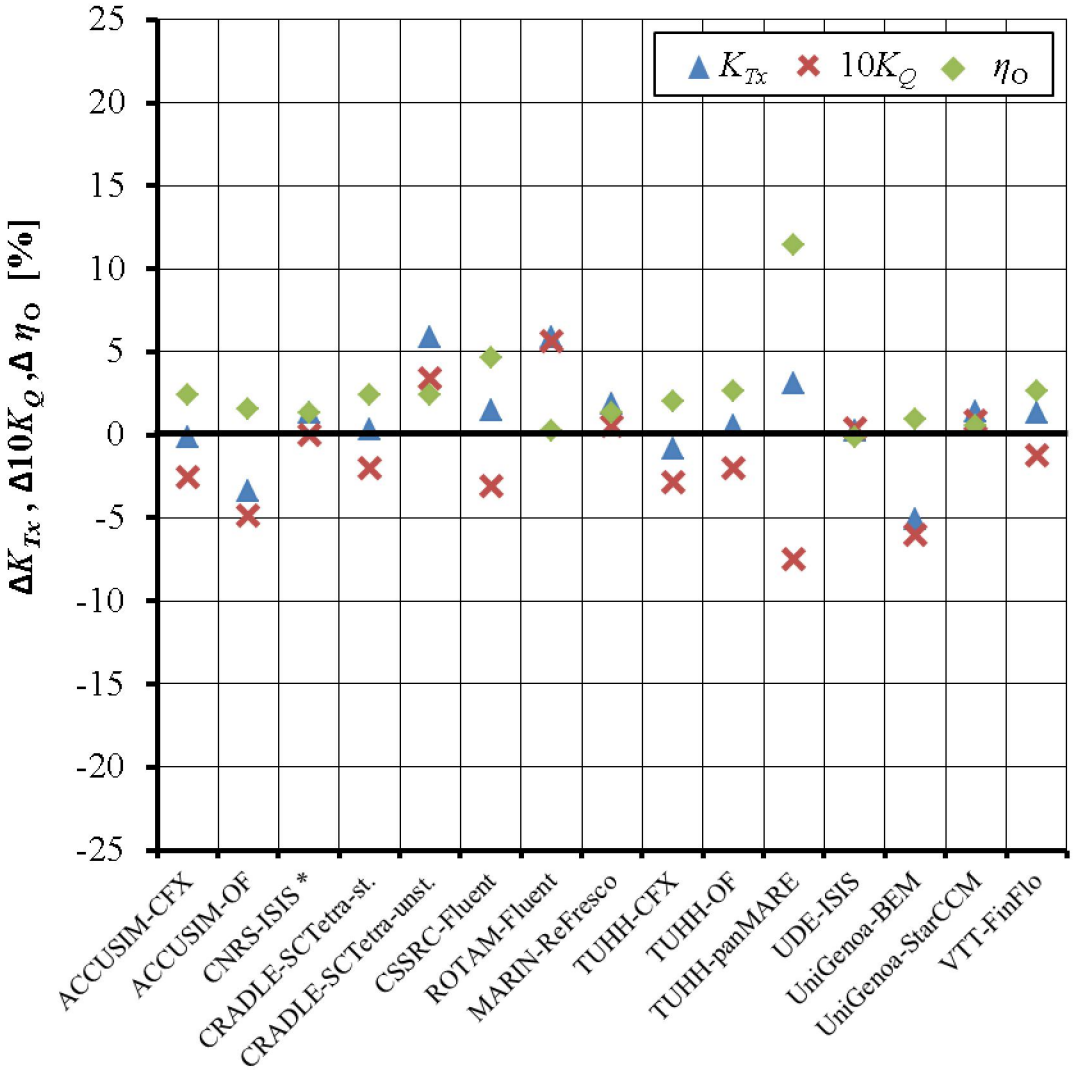
* data updated



1.28 Relative difference between measured and calculated values: $\Psi^{bP} = 12°$, $J = 1.0$

	ΔK_{Tx} [%]	$\Delta 10K_Q$ [%]	$\Delta\eta_O$ [%]
ACCUSIM-CFX	-0.1	-2.5	2.4
ACCUSIM-OF	-3.4	-4.9	1.6
CNRS-ISIS *	1.3	0.0	1.3
CRADLE-SCTetra-st.	0.4	-2.0	2.4
CRADLE-SCTetra-unst.	5.9	3.4	2.4
CSSRC-Fluent	1.4	-3.0	4.6
ROTAM-Fluent	5.9	5.6	0.2
MARIN-ReFresco	1.8	0.5	1.3
TUHH-CFX	-0.9	-2.8	2.0
TUHH-OF	0.6	-2.0	2.6
TUHH-panMARE	3.1	-7.5	11.4
UDE-ISIS	0.3	0.4	-0.1
UniGenoa-BEM	-5.1	-6.0	0.9
UniGenoa-StarCCM	1.4	0.8	0.6
VTT-FinFlo	1.3	-1.2	2.6

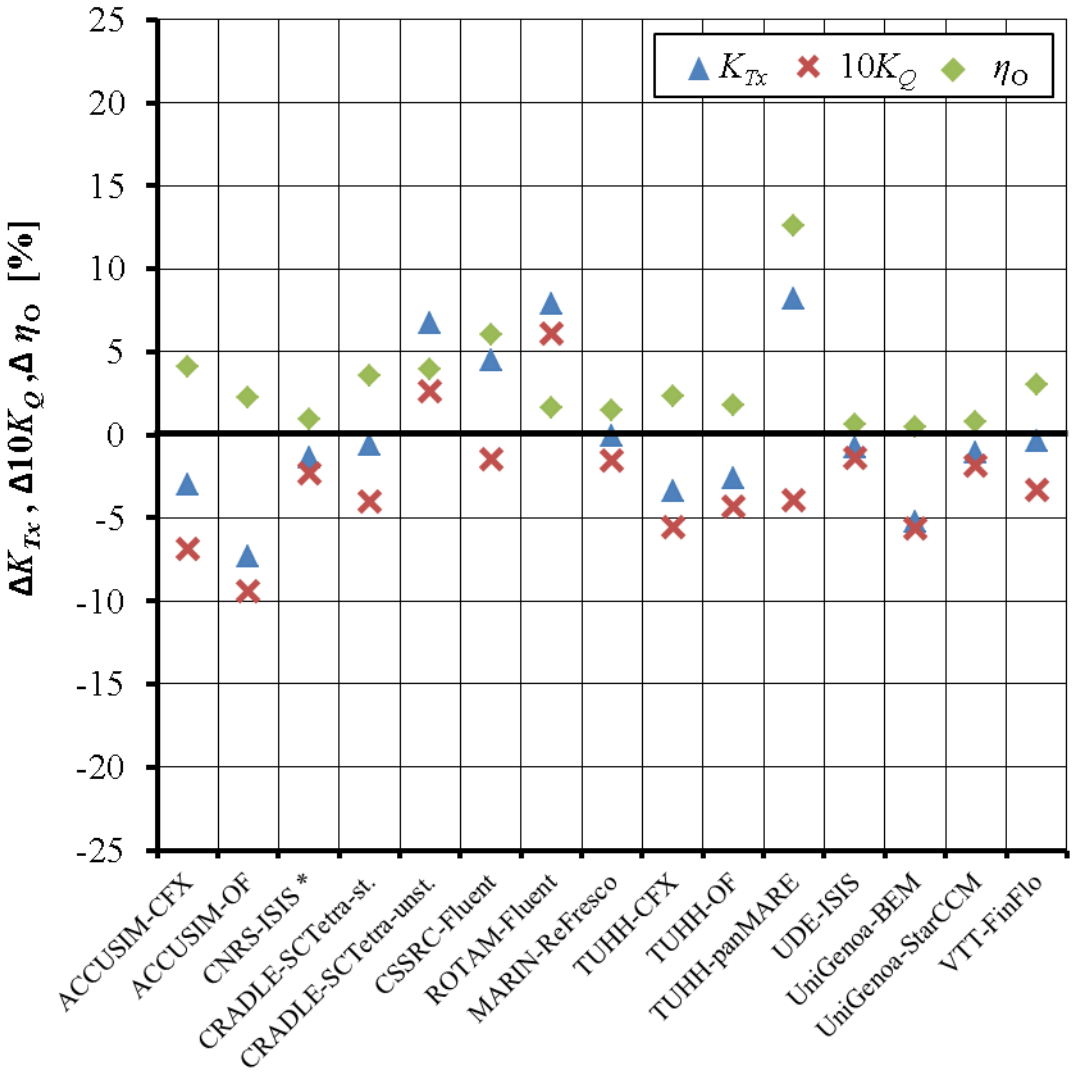
* data updated



1.29 Relative difference between measured and calculated values: $\Psi^{bP} = 12°$, $J = 1.2$

	ΔK_{Tx} [%]	$\Delta 10K_Q$ [%]	$\Delta\eta_O$ [%]
ACCUSIM-CFX	-3.0	-6.9	4.1
ACCUSIM-OF	-7.3	-9.4	2.3
CNRS-ISIS *	-1.4	-2.3	1.0
CRADLE-SCTetra-st.	-0.6	-4.0	3.6
CRADLE-SCTetra-unst.	6.7	2.6	4.0
CSSRC-Fluent	4.5	-1.4	6.0
ROTAM-Fluent	7.9	6.1	1.6
MARIN-ReFresco	-0.1	-1.5	1.5
TUHH-CFX	-3.4	-5.6	2.3
TUHH-OF	-2.6	-4.3	1.8
TUHH-panMARE	8.2	-3.9	12.6
UDE-ISIS	-0.8	-1.4	0.6
UniGenoa-BEM	-5.2	-5.6	0.4
UniGenoa-StarCCM	-1.0	-1.8	0.8
VTT-FinFlo	-0.4	-3.3	3.0

* data updated



1.30 Relative difference between measured and calculated values: $\Psi^{bP} = 12°$, $J = 1.4$

	ΔK_{Tx} [%]	$\Delta 10K_Q$ [%]	$\Delta\eta_O$ [%]
ACCUSIM-CFX	-3.7	-10.4	7.5
ACCUSIM-OF	-12.8	-15.1	2.7
CNRS-ISIS *	-5.2	-6.0	0.8
CRADLE-SCTetra-st.	-2.9	-5.1	2.3
CRADLE-SCTetra-unst.	4.6	3.7	0.9
CSSRC-Fluent	10.6	0.5	10.0
ROTAM-Fluent	9.2	5.0	4.0
MARIN-ReFresco	-0.2	-4.1	4.1
TUHH-CFX	-5.8	-9.9	4.5
TUHH-OF	-5.5	-14.8	10.8
TUHH-panMARE	19.5	-0.6	20.2
UDE-ISIS	-2.1	-4.0	1.9
UniGenoa-BEM	-4.9	-6.8	2.1
UniGenoa-StarCCM	-4.1	-5.6	1.6
VTT-FinFlo	-1.2	-6.9	6.2

* data updated