Report on activities of the SCOR/IAPWS/IAPSO Joint Committee on the Properties of Seawater (JCS)

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Chair, JCS
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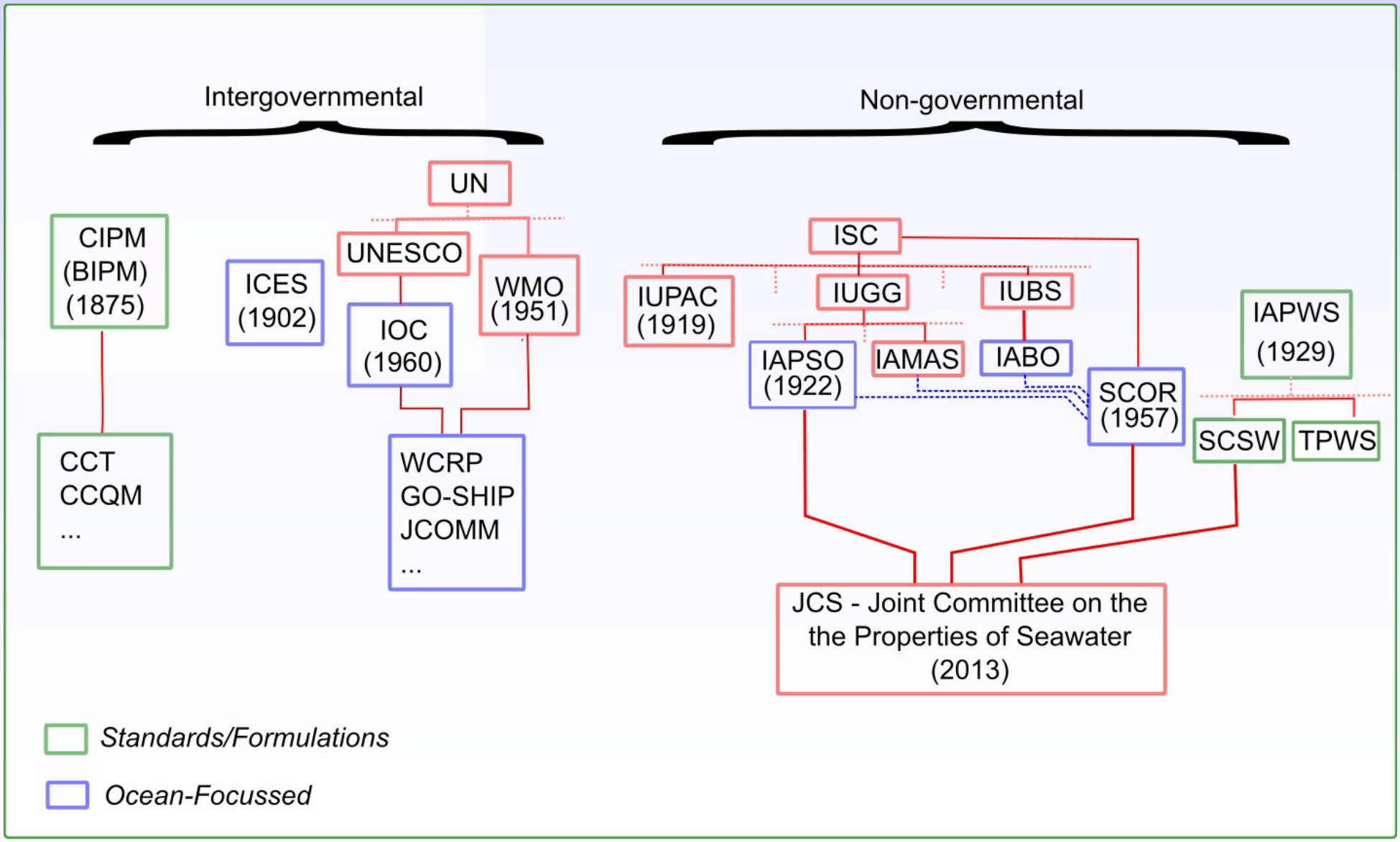
Purpose of JCS

- JCS is meant to act as:
  - an “international point of contact” for seawater-related questions
  - a permanent source of expertise on seawater issues for “parent” organizations
  - the maintainers of seawater-related software and standards for the scientific community (especially for **TEOS-10**)
  - a conduit for cooperation with other scientific/technical organizations, e.g., BIPM, WMO, IUPAC
- JCS supports and promotes research activities related to the properties of seawater (field, lab, numerical)
- JCS may, from time to time, summarize knowledge and suggest gaps

Terms of Reference set in 2013, reaffirmed in 2018

JCS and its parents



Relationship with IAPWS currently in discussion

JCS Structure (2023)

- **Executive**
  - Chair: R. Pawlowicz, Vice Chairs: S. Seitz
- **Taskgroups:**
  - **Salinity/Density**
    - Chair: (Pawlowicz), (Seitz), H. Uchida, R. Woosley, Y. Kayukawa
  - **pH**
    - Chair: A. Dickson, M.F. Camoes, D. Stoica, S. Clegg, F. Bastkowski
  - **Moist Air**
    - Chair: O. Hellmuth, J. Lovell-Smith, R. Feistel, S. Bell
  - **Chemical Speciation**
    - Chair: D. Turner, (S. Clegg), P. Croot, C. Foti. M. Gledhill, M. Hain, P. Lodeiro, S. Sander
- **Expert Subgroups**
  - **Thermodynamics** (Feistel)
  - **Numerical modelling and applications** T. McDougall
  - **Software** (vacant)
  - **Industry** C. Bachler/Anton Paar, R. Williams/OSIL

International Council for Science
SCOR
Scientific Committee on Oceanic Research

IAPWS

IAPSO
The International Association for the Physical Sciences of the Oceans (IAPSO)

(24 members: Canada/US, Germany/Portugal/France/ UK/Austria, Australia/NZ, China/Japan)

- New addition – Chemical Speciation Taskgroup (from SCOR WG 145)
- Several members have rotated off/retired; most problematic has been responsibility for software (incl. TEOS-10 website)

TEOS-10 related activities: Web site www.teos-10.org

- **Software**:
  - GSW (8 languages), SIA (2 languages)
- **Educational resources**:
  - Slides
  - TEOS-10 Primer
  - Full course on thermodynamics
  - 2 lecture overview of seawater thermodynamics
- JCS news (annual reports)
- JCS membership
- List of Publications (relevant to definition of TEOS-10)

- Web site contents remain stable, but future not clear

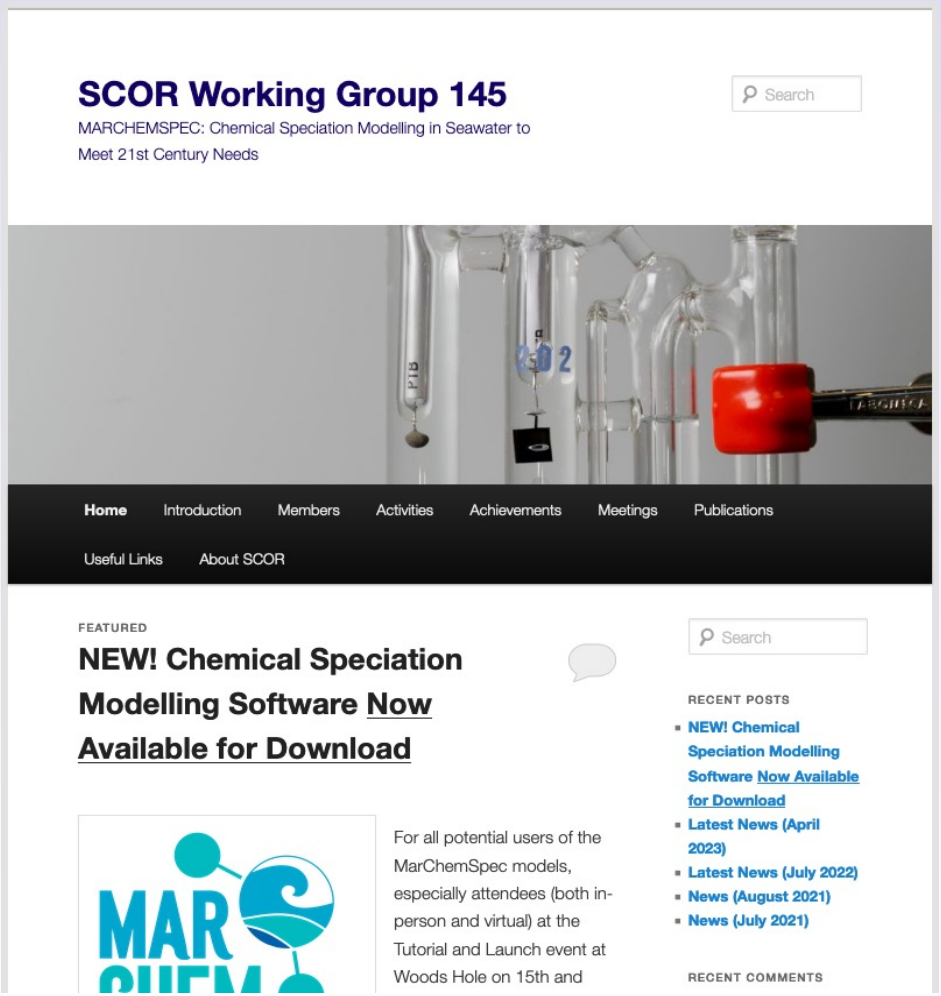
TEOS-10 related activities: Web site www.teos-10.org

Unique downloads:	June 2011 June 2013	June 2013 June 2014	June 2014 June 2015	June 2015 June 2016	June 2016 June 2017	June 2017 June 2018	June 2018- Apr 2019	May 2019- May 2020	May 2020- June 2021	June 2021- June 2022	June 2022- June 2023
Manual	920	360	535	552	418	427	349	472	479	482	530
“Getting Started”	879	362	558	547	427	475	349	444	460	483	479
Slides	704	284	374	318	219	248	204	272	272	231	272
Primer	584	197	289	297	222	217	187	253	260	226	268
Lecture Notes								22	34	30	27
Thermo Overview								24	27	27	23
GSW MATLAB	1920	1102	1485	1814	1235	1552	1233	1556	1504	1747	1897
GSW FORTRAN	366	222	171	162	127	116	82	98	83	92	87
GSW C	202	84	133	151	85	96	59	81	58	49	57
GSW PHP	-	55	61	43	29	60	28	52	22	22	21
SIA VB	72	100	46	45	45	48	43	47	47	38	30
SIA FORTRAN	59	118	58	44	36	42	37	42	31	33	31

- 87397 “unique user views” since Oct 2010 (10753 in past year)
- 750-1300 views per month

- Uploads of GSW and the manual have increased over the last year
- EXCEL implementation has been implemented by 3rd parties

Other web activity in progress…



- Website development for chemical speciation software (now live) and for JCS (soon to be live, once hosting issues solved)

Recent meetings

- No in-person meetings of JCS occurred over the past year. A planned JCS virtual meeting for January 2023 was postponed, and a possible meeting at the 2023 IAPWS Annual Working Group Meeting did not occur. However, the proposed membership of the new Chemical Speciation Taskgroup has been finalized and they have been holding regular (monthly) virtual meetings as part of software finalization from the completion of SCOR WG 145, and the development of a website containing that software.
- Considering plans for in-person meeting in 2024 or 2025 to reconsider Terms of Reference (3rd iteration).

Recent papers

1) M.P. Humphreys, J.F. Waters, D.R. Turner, A,G. Dickson and S.L. Clegg. Chemical speciation models based upon the Pitzer activity coefficient equations, and including the propagation of uncertainties: Artificial seawater from 0 to 45 °C. *Marine Chemistry*, 244, 104095. doi: http://dx.doi.org/10.1016/j.marchem.2022.104095

2) S.L. Clegg, M.P. Humphreys, J.F. Waters, D.R. Turner, and A.G. Dickson. Chemical Speciation models based upon the Pitzer activity coefficient equations, including the propagation of uncertainties. II. Tris buffers in artificial seawater at 25 °C, and the seawater 'Total' pH scale. *Marine Chemistry*, 244, 104096. doi: 10.1016/j.marchem.2022.104096

3) S.L. Clegg, J.F. Waters, D.R. Turner, and A.G. Dickson. Chemical speciation models based upon the pitzer activity coefficient equations, including the propagation of uncertainties. III. Standard seawater from the freezing point to 45 °C, including acid-base equilibria, *Marine Chemistry,* 250, 104196. doi: 10.1016/j.marchem.2022.104196

4) R. Feistel, O. Hellmuth, and J. W. Lovell-Smith (2022) Defining relative humidity in terms of water activity. Part 3: Relations to dew-point and frost-point temperatures, Metrologia, 59 (4), https://doi.org/10.1088/1681-7575/ac7185

5) R. Feistel and O. Hellmuth, (2023), Thermodynamics of Evaporation from the Ocean Surface, Atmosphere 14, 560, https://doi.org/10.3390/atmos14030560

6) Uchida, H., M. Oe and M. Wakita (2023): History of batch-to-batch comparative studies of International Association for the Physical Sciences of the Oceans Standard Seawater, Chapter 7 in Chemical reference materials of ocean science: history, production, certification and current status, Akihiko Murata and Cheong Chikako (eds.), Springer, (in press)

7) Uchida, H., M. Wakita, A. Makabe, A. Murata, Changes in the Composition of International Association for the Physical Sciences of the Oceans Standard Seawater, Chapter 8 in Chemical reference materials of ocean science: history, production, certification and current status, Akihiko Murata and Cheong Chikako (eds.), Springer, (in press)

8) Christoph Waldmann, Philipp Friedrich Fischer, Steffen Seitz, Manuela Köllner, Jens-Georg Fischer, Markus Bergenthal, Holger Brix, Stefan Weinreben and Robert Huber, A Methodology to Uncertainty Quantification of Essential Ocean Variables, Frontiers in Marine Science 15, 2022, Sec Ocean Observation, Vol 9, 2022, https://doi.org/10.3389/fmars.2022.1002153