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

# Report to SCOR and IAPSO on JCS Activities July 2014-June 2015

## Membership

| | |
|---|---|
| **Executive** | |
| Rich Pawlowicz (Chair) | Canada |
| Rainer Feistel Vice-chair | Germany |
| Trevor J. McDougall (Vice-chair) | Australia |
| **Salinity/Density Subgroup** | |
| Frank J. Millero | USA |
| (Rich Pawlowicz) | Canada |
| Steffen Seitz | Germany |
| Hiroshi Uchida | Japan |
| Stefan Weinreben | Germany |
| Youngchao Pang | China |
| **Henning Wolf** | **Germany < Proposed** |
| **pH Subgroup** | |
| Maria Filomena Camoes | Portugal |
| Andrew Dickson | USA |
| **Daniela Stoica** | **France < Proposed** |
| **Relative Humidity Subgroup** | |
| Olaf Hellmuth | Germany |
| Jeremy Lovell-Smith | New Zealand |
| **Thermodynamics** | |
| (Rainer Feistel) | |
| **Numerical Modelling and Applications** | |
| (Trevor J. McDougall) | |
| **Software** | |
| Paul Barker | Australia |
| **Industry Representatives** | |
| Paul Ridout (OSIL) | UK |
| Barbara Laky (Anton Paar) | Austria |

NB: Former member Petra Spitzer has retired.

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## Meetings

JCS did not meet as a full group in 2014-15. However, 7 JCS members did attend the 2015 IAPWS Annual Meeting in Stockholm, Sweden, including Y. Pang (and two of his colleagues). Detailed updates were provided on "other progress" items listed below, and on the JCS tasks agreed on at the Salinity and pH workshops held during the 2013 International Conference on the Properties of Water and Steam (Greenwich, UK). Significant progress was also made on some of these tasks during discussions in the IAPWS Subcommittee on Seawater workshop at this meeting and in a separate (closed) JCS meeting.

RF attended the 4th JCOMM Marine Instrument Workshop for ASIA-PACIFIC, Weihai, China, 21-23 Oct. 2014 as a JCS representative, at the invitation of the GOOS Project Office (IOC/UNESCO). RF provided information on TEOS-10 to this group.

## Web site

JCS maintains a web site at www.teos-10.org. This site gets 1500-2000 visitors per month with 34136 "unique views" since Oct 2010. Annual downloads in the past year are increasing over past years.

| **Web site Item** | **Unique downloads June 2011-June 2013** | **Unique downloads June 2013-June 2014** | **Unique downloads June 2014-June 2015** |
|---|---|---|---|
| Manual | 920 | 360 | 535 |
| Getting Started | 879 | 362 | 558 |
| Slides | 704 | 284 | 374 |
| Primer | 584 | 197 | 289 |
| GSW_MATLAB_v3_0 | 1920 | 1102 | 1485 |
| GSW_FORTRAN_v3_ | 366 | 222 | 171 |
| GSW_C_v3_0 | 202 | 84 | 133 |
| GSW_PHP | - | 55 | 61 |
| SIA_VB_V3_0 | 72 | 100 | 46 |
| SIA_FORTRAN_V3_0 | 59 | 118 | 58 |

## Other Progress

1. TM is working with several modelling groups (MOM, NEMO) to add TEOS-10 support.
2. RP/FM carried out density anomaly measurements in N. Pacific (Line-P program, Feb 2014).

3. RP/HU carried out density anomaly measurements in N. Pacific (Salish Sea, Oct 2014).
4. HU carried out density anomaly measurements in N. Pacific (WHP P01) and Arctic (Mirai MR14-05).
5. HU, FM, HW are continuing measurements of density in SSW batches; this information will be collated in a planned publication.
6. MFC working towards a Pitzer equation for seawater pH.
7. HW,HU,SW,RP are still writing the 'Best Practices Guide for seawater Density Measurements' (now at version 13).
8. SS is still investigating instrument effects on conductance measurements.
9. RF is working on uncertainty budgets for correlation equations.
10. TM, PB released version 3.05 of GSW software.
11. AD continues to provide seawater buffers for pH, and is also a member for SCOR WG147 on speciation (discussing a seawater Pitzer model).

## Papers published

1. Feistel, R., Lovell-Smith, J.W., Hellmuth, O. , Virial Equation for the Fugacity of Water in Humid Air. International Journal of Thermophysics 36, Issue 1, pp. 44-68 (2015).

2. Feistel, R., Lovell-Smith, J.W., Hellmuth O., Erratum to: Virial Approximation of the TEOS-10 Equation for the Fugacity of Water in Humid Air. International Journal of Thermophysics 36, Issue 1, p. 204 (2015).

3. Feistel, R., Lovell-Smith, J.W., Hellmuth, O. (Proposers):Guideline on a Virial Equation for the Fugacity of H2O in Humid Air.The International Association for the Properties of Water and Steam.Stockholm, Sweden, July 2015

4. Hellmuth, O., R. Feistel, J. Lovell-Smith and J. Kalova, 2015: Metrological Aspects of Humidity: State of Discussion on Common Positions, Challenges, and Needs. Technical Report of the Joint BIPM, CCT-WG6/CCQM and JCS Workshop on Hygrometry, held during the 16th International Conference on the Properties of Water and Steam 2013 (ICPWS 2013), Greenwich, UK. Online available: http://www.teos-10.org/pubs/ICPWS2013_WS_TechnicalReport_Humidity_20150211primo.pdf

5. Hellmuth, O., Shchekin, A. K.: Determination of interfacial parameters of a soluble particle in a nonideal solution from measured deliquescence and efflorescence humidities, Atmos. Chem. Phys., 15, 3851-3871, (2015)

6. Kretzschmar, H.-J., Feistel, R., Wagner, W., Miyagawa, K., Harvey, A.H., Cooper, J.R., Hiegemann, M., Blangetti, F.L., Orlov, K.A., Weber, I., Singh, A. Herrmann, S.: The IAPWS Industrial Formulation for the Thermodynamic Properties of Seawater. Desalination and Water Treatment 55, 1177-1199 (2015) , doi: 10.1080/19443994.2014.925838

7. McDougall, T.J., Barker, P., Feistel, R., Galton-Fenzi B. K., Melting of Ice and Sea Ice into Seawater and Frazil Ice Formation, J. Phys. Oceanog., 44, 1751-1775, (2014)

8. Pawlowicz, R., The Absolute Salinity of seawater diluted by riverwater, Deep Sea Research I, 101, 71-79 (2015)

9. Woosley, R., Huang, F., Millero, F., Estimating absolute salinity (S_A) in the worlds oceans using density and composition, Deep Sea Research I, 92, 14-20 (2014).

## Papers Submitted:

1. R Feistel, J W Lovell-Smith, P Saunders and S Seitz: Uncertainty of Empirical Correlation Equations. Submitted to Metrologia, 26 May 2015

2. R Feistel, R Wielgosz, S A Bell, M F Camões, J R Cooper, P Dexter, A G Dickson, P Fisicaro, A H Harvey, M Heinonen, O Hellmuth, H-J Kretzschmar, J W Lovell-Smith, T J McDougall, R Pawlowicz, P Ridout, S Seitz, P Spitzer, D Stoica and H Wolf:Metrological challenges for measurements of key climatological observables: Oceanic salinity and pH, and atmospheric humidity. Part 1: Overview. REVIEW PAPER. Submitted to Metrologia, in press

3. R Pawlowicz, R Feistel, T J McDougall, P Ridout, S Seitz, H Wolf: Metrological challenges for measurements of key climatological observables, Part 2: Oceanic salinity. Submitted to Metrologia, 26 May 2015

4. A G Dickson, M F Camões, P Spitzer, P Fisicaro, D Stoica, R Pawlowicz and R Feistel: Metrological challenges for measurements of key climatological observables, Part 3: Seawater pH. Submitted to Metrologia, 28 May 2015

5. J W Lovell-Smith, R Feistel, A H Harvey, O Hellmuth, S A Bell, M Heinonen, J R Cooper:Metrological challenges for measurements of key climatological observables, Part 4: Atmospheric relative humidity. Submitted to Metrologia, in press

7. Feistel, R. (2015): Salinity and relative humidity: climatological relevance and metrological needs, Acta Imeko, in press

8. H.-J. Kretzschmar, Herrmann, S., Feistel, R., Wagner, W.: The International IAPWS Formulation for the Thermodynamic Properties of Seawater for Desalination Processes. The International Desalination Association World Congress on Desalination and Water Reuse 2015/San Diego, CA, USA. Submitted 15 Febr. 2015

R. Pawlowicz

JCS chair, Aug 1, 2015