Since May 2010 there has been
- 5,826 unique downloads of the GSW Oceanographic Toolbox,
- 1,802 downloads of the TEOS-10 manual and
- 1,789 downloads of the “Getting Started with GSW” document.

An increasing number of articles in the literature have used TEOS-10 rather than EOS-80.

The Millero et al. (2008) paper in Deep-Sea Research which defines Reference-Composition Salinity has been the most downloaded paper of that journal for half of the years since its publication.

The uptake of TEOS-10 into global ocean models has been slow. The European model (NEMO) has been converted to TEOS-10, while the MOM model of the USA has TEOS-10 partly implemented.
Update on the GSW Toolbox and the Oceanographic use of TEOS-10

Version 3.05 of the GSW Toolbox was released on 22nd May 2015. This latest version contains 304 programs, 57 of which are new (the previous version, version 3.04, was released in December 2013).

Version 3.05 has introduced many new ice functions, including those treating frazil ice (which is in thermodynamic equilibrium with seawater).

Version 3.05 has replaced the 48-term rational function of specific volume in terms of Conservative Temperature with a 75-term polynomial, following the publication of Roquet et al., 2015. This change was made so that the integrals and derivatives of specific volume are simple to derive and compute.

Reference
The JCS has been active over the past two years in championing three issues that need better definition for the purposes of climate research.

These issues are:
1. SI-traceability of the measurement of Practical Salinity
2. The definition and measurement of pH
3. The definition and measurement of relative humidity

The JCS (spearheaded by Rainer Feistel) has raised these issues in the BIPM (International Bureau of Weights and Measures), and we are now publishing four review papers in *Metrologia*. These papers involve 20 co-authors and their purpose is to thoroughly expose the issues raised by the different definitions of pH and relative humidity.

The publication of these articles is a necessary prerequisite to obtaining international consensus on the most appropriate ways to resolve each of the issues. It is very encouraging to see the key experts not only in IAPSO, SCOR and IAPWS, but also in the BIPM community taking these issues seriously.
Joint Committee (of IAPSO, SCOR, IAPWS) on the Properties of Seawater

MET-100397, revision 1, submitted to Metrologia, 18 May 2015

REVIEW PAPER

Metrological challenges for measurements of key climatological observables: Oceanic salinity and pH, and atmospheric humidity. Part 1: Overview

R Feistel¹, R Wielgosz², S A Bell³, M F Camões⁴, J R Cooper⁵, P Dexter⁶, A G Dickson⁷, P Fisicaro⁸, A H Harvey⁹, M Heinonen¹⁰, O Hellmuth¹¹, H-J Kretzschmar¹², J W Lovell-Smith¹³, T J McDougall¹⁴, R Pawlowicz¹⁵, P Ridout¹⁶, S Seitz¹⁷, P Spitzer¹⁷, D Stoica⁸ and H Wolf¹⁷
Revision of MET-100397, 22 May 2015: changes after paper splitting

REVIEW PAPER

Metrological challenges for measurements of key climatological observables, Part 2: Oceanic salinity

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Abstract

Salinity is a key variable in the modelling and observation of ocean circulation and ocean-atmosphere fluxes of heat and water. In this paper, we examine the climatological relevance of ocean salinity, noting fundamental deficiencies in the definition of this key observable, and its lack of a secure foundation on the International System of Units, the SI. The metrological history of salinity is reviewed, problems with its current definitions and measurement practices are analysed, and options for future improvements are discussed in conjunction with the recent seawater standard TEOS-10.
REVIEW PAPER

Metrological challenges for measurements of key climatological observables, Part 3: Seawater pH

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Abstract

Water dissolves many substances with which it comes into contact, leading to a variety of aqueous solutions ranging from simple and dilute to complex and highly concentrated. Of the multiple chemical species present in these solutions, the hydrogen ion, H⁺, stands out in importance due to its relevance to a variety of chemical reactions and equilibria that take place in aquatic systems. This importance, and the fact that its presence can be assessed by reliable and inexpensive procedures, are the reasons why pH is perhaps the most measured chemical parameter. In this paper, while examining climatologically relevant ocean pH, we note fundamental problems in the definition of this key observable, and its lack of secure foundation on the International System of Units, the SI. The metrological history of seawater pH is reviewed, difficulties arising from its current definition and measurement practices are analysed, and options for future improvements are discussed in conjunction with the recent TEOS-10 seawater standard. It is concluded that the International Bureau of Weights and Measures (BIPM), in cooperation with the International Association for the Properties of Water and Steam (IAPWS), along with other international organisations and institutions, can make significant contributions by developing and recommending state-of-the-art solutions for these long standing metrological problems.
Metrological challenges for measurements of key climatological observables, Part 4: Atmospheric relative humidity

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Abstract

Water in its three ambient phases plays the central thermodynamic role in the terrestrial climate system. Clouds control Earth’s radiation balance, atmospheric water vapour is the strongest “greenhouse” gas, and non-equilibrium relative humidity at the air-sea interface drives evaporation and latent heat export from the ocean. In this paper, we examine the climatologically relevant atmospheric relative humidity, noting fundamental deficiencies in the definition of this key observable. The metrological history of this quantity is reviewed, problems with its current definition and measurement practice are analysed, and options for future improvements are discussed in conjunction with the recent seawater standard TEOS-10. It is concluded that the International Bureau of Weights and Measures, (BIPM), in cooperation with the International Association for the Properties of Water and Steam, IAPWS, along with other international organisations and institutions, can make significant contributions by developing and recommending state-of-the-art solutions for this long standing metrological problem, such as are suggested here.
Joint Committee (of IAPSO, SCOR, IAPWS) on the Properties of Seawater

1.  SI-traceability of the measurement of Practical Salinity
   Following on from the work of SCOR/IAPSO Working Group 127 on using densimeter measurements of seawater density to evaluate Absolute Salinity, this project has been further developed. We are working with national standards labs in Europe and with IPSL to develop workable protocols for these measurements.

2.  The definition and measurement of pH
   The Joint Committee on Seawater has developed a Pitzer equation-based definition of seawater pH, and it is hoped that this will be the basis of an internationally agreed definition of seawater pH.

3.  The definition and measurement of relative humidity
   An equation for the fugacity of humid air is likely to be adopted this week at the IAPWS congress in Stockholm. This will likely become the basis for an SI definition of relative humidity.

So the Joint Committee has been very active, involving more than 20 people, and making considerable progress in these three areas.