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With increasing numbers of new chemicals reaching the marketplace, there is an ongoing need for defensible estimates of the concentrations of chemicals that should provide an acceptable level of protection to aquatic ecosystems, including both the water column and sediments. Depending on the jurisdiction, these "safe" concentrations are called Guidelines or Guideline Values (Australia and New Zealand, and Canada), Water Quality Criteria (USA), or Environmental Quality Standards (EQSs) (European Union). The standards and criteria are typically legal limits whereas the guidelines have no legal status and are used to indicate when concentrations of chemicals may be exerting a non-acceptable impact and further action is required to assess the actual magnitude of the impact. Throughout this article, the term guideline value (GV) is used to describe the various "safe concentrations". For each chemical, the derivation of water quality GV requires extensive toxicity testing on a large number of species from different taxonomic groups. The considerable costs that this involves, makes it highly desirable that acquiring such data is shared across multiple jurisdictions, such that GVs derived in Canada, for example, are equally applicable to Australia and New Zealand, the United States or the European Union (EU). The development of water quality GVs has largely occurred independently in jurisdictions, although in many instances they are based on common or very similar sets of published ecotoxicity data.

While agreeing on a single term for "safe concentrations" and how it is used is unlikely to be achieved due to the degree of policy and regulatory change that would be required, harmonizing of the derivation methods is a reasonable, but long-term, goal. An opportunity to make progress towards achieving this, has arisen with the USEPA commencing a long-term revision of their water quality criteria derivation method, originally developed over 30 years ago (Stephan et al., 1985) as discussed at a recent meeting (https://www.epa.gov/wqc/invited-expert-meeting-revising-us-epas-guidelines-deriving-aquatic-life-criteria).

The preferred method for deriving involves the use of species sensitivity distributions (SSDs) (genus sensitivity distribution method used by the USEPA) of toxicity data. The older assessment factor (AF) method is out of favour in the vast majority of countries, unless there is no alternative. The magnitude of the AFs has little scientific basis and consequently there are differences in the AFs used in different jurisdictions and to which data they are applied, including the choice of the critical study (Hahn et al., (2013).

Further analysis by Hahn et al. (2013) of the causes of variation in GVs derived by different scientists and organisations using the SSD method applied to the same toxicity data, revealed that the largest source of variation (a factor of up to 10) was whether the data were defined as acute or chronic. Given that these are such central concepts in ecotoxicology, you would expect that there would be minimal or no differences in the definitions and interpretation of these terms. However, this is not the case, for example, for microalgal growth inhibition tests, the EU regards a 72-h NOEC as chronic and 72-h EC50 values as acute (European Commission, 2011), whereas Australia and New Zealand consider both to be chronic (Warne et al., 2015).

Other differences in SSD methods that would benefit from harmonization are:

- the criteria for data quality acceptability;
- the minimum data requirements. These range from a minimum of data for at least 5 species (but >8 preferred) from at least 4 taxonomic groups (Australia and New Zealand), to 15 species from 10 taxonomic groups (EU);
- the statistical distribution(s) fitted to the data;

- the agreed toxicity test endpoints; (e.g. are sub-cellular endpoints such as photosynthesis inhibition for short periods of time useable);
- the agreed measures of toxicity – specifically whether NOEC, LOEC and MATC data are useable or their use should be phased out;
- whether GVs can only be derived using chronic data or a combination with converted acute data;
- the use of additional application factors (other than one) after estimation of the HC5 (EU).

A plea to expand the definition of 'acceptable data' with respect to US water quality criteria revisions was recently raised by Buchwalter et al. (2017). Other challenges include dealing with short- and long-term exposure. In Canada and the EU, acute data are used for short-term exposure and chronic data for long term. With the acute data, desirably acute NOECs or LC10 values should be used. Options also exist for using time-dependent toxicity data to develop GVs. It is now timely to start progressing these issues. The concept of a common quality-assessed toxicity database that jurisdictions can share even if their subsequent methods/approaches might differ might be a useful first step. This alone would be a huge cost saving.

International approaches to derive sediment GVs (Batley et al., 2005; Kwok et al., 2014) predominantly rely on field-based effects data (the approach first developed by Long et al., 1995), or in some instances, mechanistic guidelines based on equilibrium partitioning (Batley et al., 2005). The GVs derived using these methods by various jurisdiction are quite variable and have been summarised by Buchman (2008) although an analysis of the causes of this variation has not been conducted. The limitations of these approaches are well known and many of these can be overcome by conducting whole sediment toxicity tests in which physicochemical properties (e.g., sediment grain size and organic carbon content (Simpson et al., 2011)) can be modified. This will permit sediment GVs to be modified in accordance with the properties of the sediment and thus provide a more flexible and rigorous approach to managing contaminants in sediments. Given the relative infancy of deriving sediment quality GVs, there are less entrenched positions globally and therefore perhaps a greater chance of achieving harmonization than for water quality GVs.

While reaching a single internationally recognised GV derivation method for waters and for sediments remains a long-term aspirational goal, it should not prevent us from collectively moving forward and harmonizing those parts of the derivation process where agreement is most likely. We believe that international organisations (e.g. SETAC, OECD or UNESCO) and national regulatory authorities (e.g. in USA, Canada, China, Australia and Europe) can all play an important role in facilitating meetings to reach agreement and can ultimately provide their imprimatur to those agreements reached. Harmonization has been a focus of the recent international conferences on Deriving Environmental Quality Standards for the Protection of Aquatic Ecosystems (EQSPAE) organized in 2011 and 2016 by Professor Kenny Leung (Merrington et al., 2014; Kwok et al., 2014). It is incumbent on those involved in GV derivation to openly discuss the available evidence without regard for their own or their own country's method. It is only through such unbiased assessment that agreement can be reached and progress to harmonization occur.

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