

ScoRE—A Simple Approach to Select a Water Quality Model

Marcos Mateus ^{1,*}, Ricardo da Silva Vieira ¹, Carina Almeida ^{1,2}, Miguel Silva ² and Filipa Reis ²

¹ MARETEC, Instituto Superior Técnico, Universidade de Lisboa, 1049-001 Lisboa, Portugal; ricardosilvavieira@tecnico.ulisboa.pt (R.d.S.V.); calmeida@aqualogus.pt (C.A.)

² AQUALOGUS, Rua do Mar da China N° 1 Escritório 2.4, Parque das Nações, 1990-137 Lisboa, Portugal; msilva@aqualogus.pt (M.S.); filipareis@aqualogus.pt (F.R.)

* Correspondence: marcos.mateus@tecnico.ulisboa.pt; Tel.: +351-96-184-0326

Received: 26 October 2018; Accepted: 6 December 2018; Published: 9 December 2018

Abstract: Over the past decades, water quality models have become unique tools in the management of aquatic resources. A consequence of their widespread application is the significant number of models now available. Available methodologies to compare models provide limited support for their choice in the first place, especially to end-users or modelers with limited experience. Here we propose a method to assist in the selection of a particular model from a set of apparently similar models. The method is termed ScoRE, as it grades models according to three main aspects: Scope (aim, simulated processes, constituents, etc.), Record (reference to the model in publications, its range of applications, etc.), and the Experience of using the model from the user perspective (support material, graphical user interface, etc.). End-users define the criteria to be evaluated and their relative importance, as well as the conditions for model exclusion. The evaluation of models is still performed by the modelers, in open discussion with end-users. ScoRE is a complete approach, as it provides guidance not only to exclude models but also to select the most appropriate model for a particular situation. An application of this method is provided to illustrate its use in the choice of a model. The application resulted in the definition of 18 criteria, where 6 of these were defined exclusively by the end-users. Based on these and the relative importance of each criterion, ScoRE produced a ranking of models, facilitating model selection. The results illustrate how the contributions from modelers and end-users are integrated to select a model for a particular task.

Table 2. Models evaluated.

Model	Origin and model website
CE-QUAL-W2	US Army Corps of Engineers/Portland State University, Portland, USA http://www.ce.pdx.edu/w2/
MIKE HYDRO River	Danish Hydraulic Institute, Hørsholm, Denmark http://www.mikepoweredbydhi.com/products/mike-hydro-river
MOHID Water	Instituto Superior Técnico, Lisbon, Portugal http://www.mohid.com
QUAL2KW	Washington State Department of Ecology, Olympia, WA, USA http://www.ecy.wa.gov/programs/eap/models.html
SIMCAT	Environment Agency, Rotherham, UK
SisBaHIA	Fundação COPPETEC - COPPE/UFRJ, Rio de Janeiro, Brazil http://www.sisbahia.coppe.ufrj.br/
TOMCAT	Environment Agency, Rotherham, UK
WASP7	The United States Environmental Protection Agency, Washington, DC, USA http://www.epa.gov/athens/wwqtsc/html/wasp.html

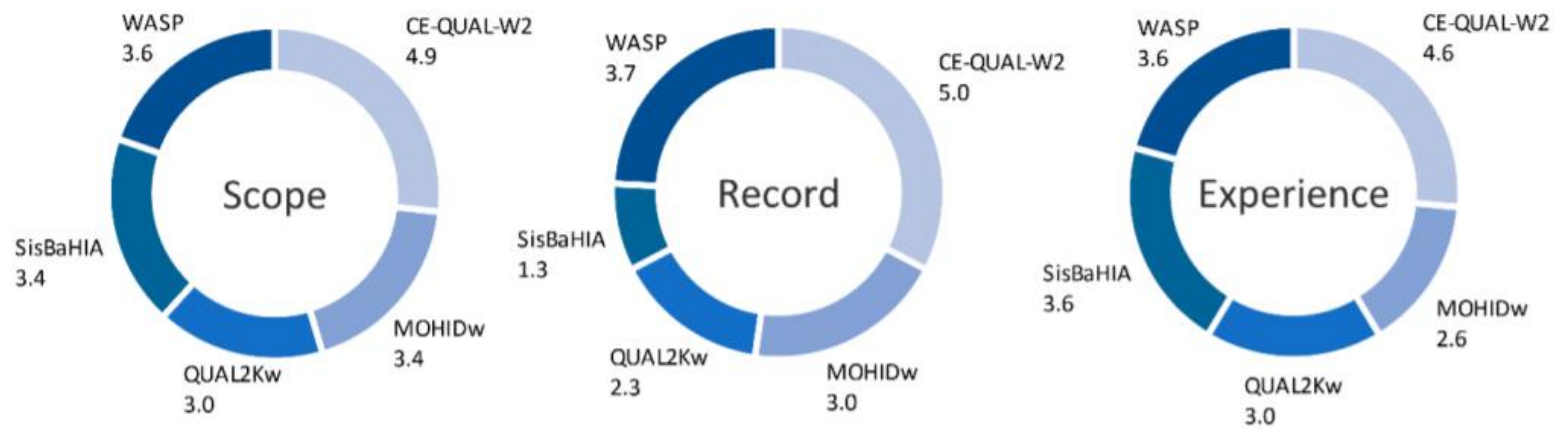


Figure 4. Scoring of models within each cluster, according to Equation (1) applied to their defining criteria (see text for details).

Criteria/Item	CE-QUAL-W2	MOHIDw
S ₁ : chlorophyll	5	3
S ₂ : cyanobacteria	5	3
S ₃ : iron	5	4
S ₄ : pH	5	3
S ₅ : O, N and P cycles	5	3
S ₆ : carbon dynamics	5	3
S ₇ : sediment-water fluxes	5	3
S ₈ : hydrodynamic processes	4	5
Scope	4.9	3.4
R ₁ : publications	5	4
R ₂ : model dissemination	5	3
R ₃ : type of water systems	5	2
Record	5.0	3.0
E ₁ : GUI	4	1
E ₂ : support manuals	5	2
E ₃ : examples	5	4
E ₄ : user forums	5	4
E ₅ : technical support	4	2
Experience	4.6	2.6

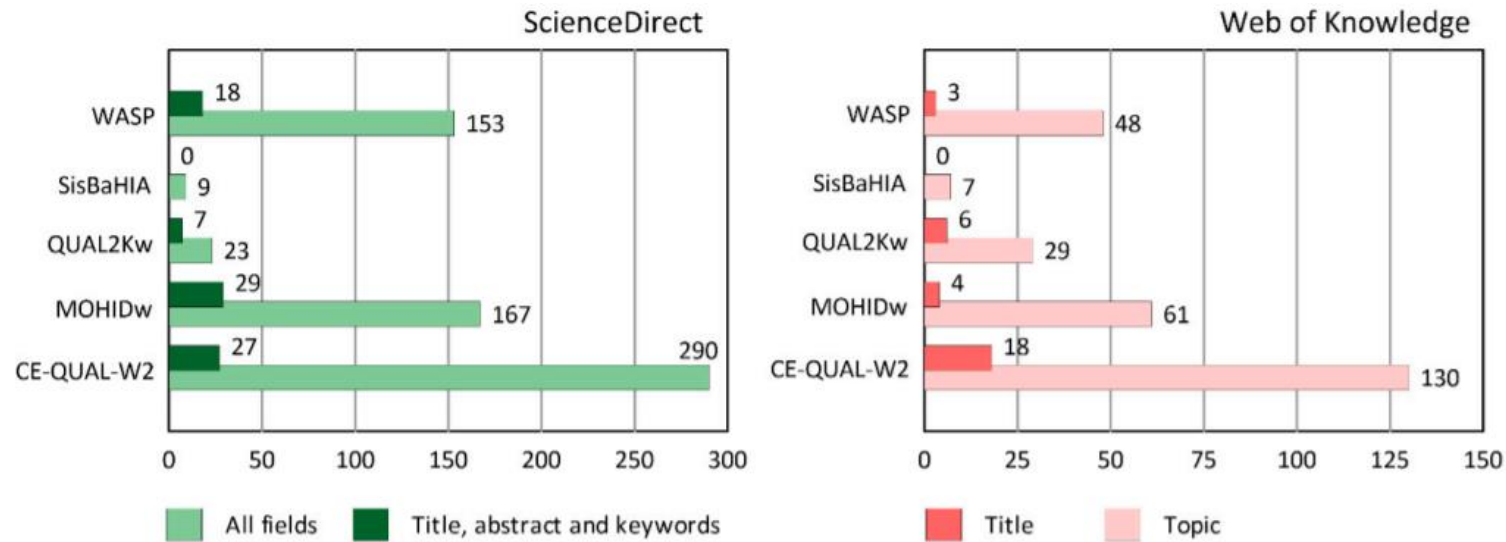


Figure 5. Number of hits obtained for each model in *ScienceDirect* and *Web of Knowledge* by 20 December 2016. Conditions for search: all journals and books available in *ScienceDirect* (SD) and available papers in *Web of Knowledge* (WoK); WASP model versions from 4 to 7 were considered.

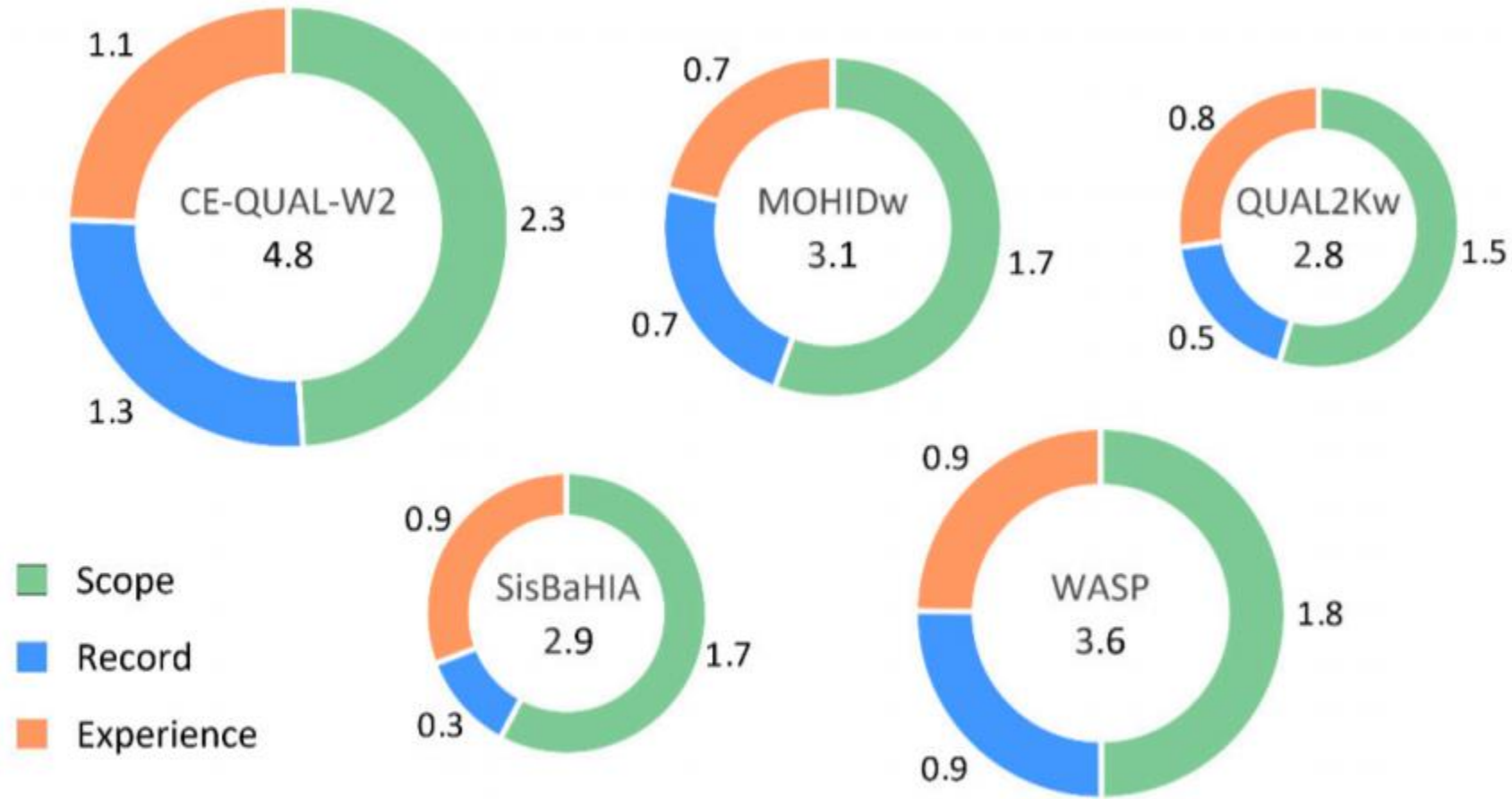


Figure 6. The SCORE results for the evaluated models. Scope, Record and Experience values are calculated in Table 5. SCORE was determined using Equation (2), with the following relative weights: $W_S = 50\%$, $W_R = 25\%$ and $W_E = 25\%$.