WORLD METEOROLOGICAL ORGANIZATION

WMO COMMISSION FOR HYDROLOGY

Establishing a Community of Practice on Flood Forecasting (CoP FF) Meeting

FINAL REPORT

13 - 17 November 2017
World Meteorological Organization
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Table of Contents

1 INTRODUCTION

From 7 to 13 December 2016, the WMO Commission for Hydrology (CHy) held its Fifteenth Session (CHy-15), in Rome, Italy. At this session, the Commission discussed the advances made under the WMO Flood Forecasting Initiative (FFI) and was pleased to learn that the Executive Council, through Decision 7 (EC-68), had endorsed the FFI-Advisory Group (FFI-AG) and its work plan for 2016–2019. Of particular note was that the FFI-AG work plan was directed to activities that were intended to assist Members in advancing flood forecast early warning systems. CHy-15 also expressed its satisfaction with the general direction being taken by the FFI-AG.

During its discussion, the Commission expressed:

- support for the development of assessment guidelines for End-to-End Early Warning Systems (E2E EWS) for flood forecasting and in assisting Members capabilities in this regard;
- the need to establish a compendium of freely available technology that could be recommended to Members to strengthen areas identified as weaknesses in the assessment process;
- that this E2E EWS interoperable technology to enhance flood forecasting could constitute the basis of a new CHy community of practice;
- that it envisaged such technology should be interoperable at all levels from data collection to informing users and decision-makers;
- that freely available technology exists within the CHy community, which could potentially support E2E EWS, such as the DEWETRA and the Meteorological, Climatological and Hydrological Database Management System (MCH) systems, with these two systems being considered excellent examples of building blocks of E2E EWS covering the value chain from data acquisition and processing to decision support; and
- that combining the community of practice approach with assistance offered through a HelpDesk was an excellent means of overcoming perceived weaknesses identified through the assessment process.

Following the Commission's discussions on the FFI-AG work plan, it adopted Resolutions 6 (CHy-15) to further support the FFI and advance its work in the area of early warning systems for flood forecasting. Resolution 6, entitled "The Flood Forecasting Initiative and the Contribution of the Commission for Hydrology to the Disaster Risk Management Programme", reaffirmed the Commission's support for the recommendations made by the FFI-AG at its second meeting, which were to strengthen the focus of the Initiative on activities associated with short- to medium-term forecasting, and it also supported the FFI-AG Work Plan for 2016–2019.

The Commission also discussed recent experiences in capacity building following adoption of Resolution 6 (CHy-14) entitled "Capacity-Building in Hydrology and Water Resources Management". This Resolution noted that the opinion of its Advisory Working Group (AWG) was that a new, more focused approach was called for in support of technology transfer activities in hydrology and water resources management. Furthermore this Resolution decided to ask the AWG and the Secretariat to develop open source and community of practice solutions to promote the transfer of technology.

CHy-15 noted that since CHy-14 some of the communities of practice had been successful, with a high level of participation and contributions, others had been useful as a repository of material, and some had not awoken much interest. Several experts at CHy-15 also expressed that one possible improvement would consist in creating communities of practice to support the value chain of particular National Hydrological Services (NHSs) products, such as for flood forecasting, from data collection, management and quality control to modelling, forecast production and dissemination. It was felt that such a comprehensive approach could be more attractive than that based on individual elements of the chain.

Furthermore, CHy-15 adopted Resolution 10, entitled "Work Programme and Structure of the Commission for Hydrology", and its Annex 1 entitled the "Future Programme of Work for CHy". This annex describes 3 focus areas, one of which is on Hydrological Applications, Products, and Services. This focus area contains 7 activities, one of which focuses on the FFI, and a second on the "Implementation Strategy for the End-to-End Early Warning Systems (E2E EWS) for flood forecasting (using the Community of Practice approach)". This latter activity listed a number of associated activities that were further discussed and elaborated upon during the First Session of the CHy Advisory Working Group Meeting (AWG-1), which was held in early 2017.

The AWG-1 developed a detailed work plan for its focus areas including that of Hydrological Applications, Products and Services, and captured the above mentioned latter activity as "E". This activity contained 6 actions. The purpose of this meeting was to initiate discussions and further the development of the Community of Practice (CoP) for the Implementation Strategy for the End-to-End Early Warning Systems (E2E EWS) for flood forecasting, as per the AWG developed work plans. As well, the meeting also allowed two CoP-related CHy task teams to meet to advance work on their specific topics associated with Activity "E", namely the Task Team on Developing Assessment Guidelines for Evaluation of NHSs Capabilities in E2E Flood Forecasting and the Task Team on Interoperable Technologies to Advance Flood Forecasting.

The agenda for the meeting is provided in **Annex 1**. **Annex 2** is the list of participants. All documents of the meeting can be accessed at http://www.wmo.int/pages/prog/hwrp/chy/E2E-EarlyWarningSystems/flood-forecasting/index.php.

2 COMMUNITY OF PRACTICE

At the start of the meeting, Mr Marcelo Uriburu Quirno provided a brief presentation on the genesis of the concept of a community of practice. The intent was to provide the group with a common understanding of the concept that would allow fuller exploration on how best this concept could be adapted in advancing national capabilities in flood forecasting. This section of the report captures a brief overview of what is a community of practice.

2.1 Definition

A community of practice (CoP) is a group of people who share a concern or a passion for something they do, and learn how to do it better as they interact regularly (Wenger and Lave, 1991). The term was first used in 1991 by cognitive anthropologist Jean Lave and educational theorist Etienne Wenger, who discussed the notion of legitimate peripheral participation.

Communities of practice are formed by people who engage in a process of collective learning in a shared domain of human endeavour: a tribe learning to survive, a band of artists seeking new forms of expression, a group of engineers working on similar problems, a clique of pupils defining their identity in the school, a network of surgeons exploring novel techniques, a gathering of first-time managers helping each other cope, a group of hydrologists improving the flood forecasting methods and sharing their findings.

The definition provided above reflects the fundamentally social nature of human learning. Three key elements of a community of practice are:

- **The domain**: members are brought together by a learning need they share (whether this shared learning need is explicit or not and whether learning is the motivation for their coming together or a by-product of it). A CoP has an identity defined by a shared domain of interest. Membership therefore implies a commitment to the domain and therefore a shared competence that distinguishes members from other people.
- **The community**: their collective learning becomes a bond among them over time (experienced in various ways and thus not a source of homogeneity). In pursuing their interest in their domain, members engage in joint activities and discussions, help each other, and share information. They build relationships that enable them to learn from each other.
- **The practice**: their interactions produce resources that affect their practice (whether they engage in actual practice together or separately). Members of a community of practice are practitioners. They develop a shared repertoire of resources: experiences, stories, tools, ways of addressing recurring problems, in short, a shared practice.

It is the combination of these three elements that constitutes a community of practice. It is by developing these three elements in parallel that such a community is cultivated.

Communities develop their practice through a variety of methods, including: problem solving, requests for information, seeking the experiences of others, reusing assets, coordination and synergy, discussing developments, visiting other members, mapping knowledge and identifying gaps.

A CoP can evolve naturally because of the members' common interest in a particular domain or area, or it can be created deliberately with the goal of gaining knowledge related to a specific field. It is through the process of sharing information and experiences with the group that members learn from each other, and have an opportunity to develop personally and professionally.

2.2 Levels of participation in CoPs

In communities of practice, there are generally three levels of participation. The first level is a hard core of individuals who participate very actively in the community and lead it. This group usually does not represent more than 10% to 15% of the community. Then there are the active members,

who regularly participate in the meetings and discussions online, but without the regularity or intensity of the people in the hard core. This group is also small, usually less than 15% to 20% of the community. Finally, the majority of the members of the CoP are in the periphery and do not participate actively in community activities (a visual representation is provided in Figure 1). The important point here is precisely to legitimize participation even when it is peripheral, that is, when the learner listens, reads, but does not say or write anything. Traditionally, this type of participation is not considered as such and is discouraged but, in the theory of communities of practice, on the contrary, is an essential part of learning.

In online communities, for example, peripheral participation is made by those people who do not send messages, who do not contribute to the fora, but who connect and read what is said in the debates and clearly take advantage of the debates and the shared knowledge.

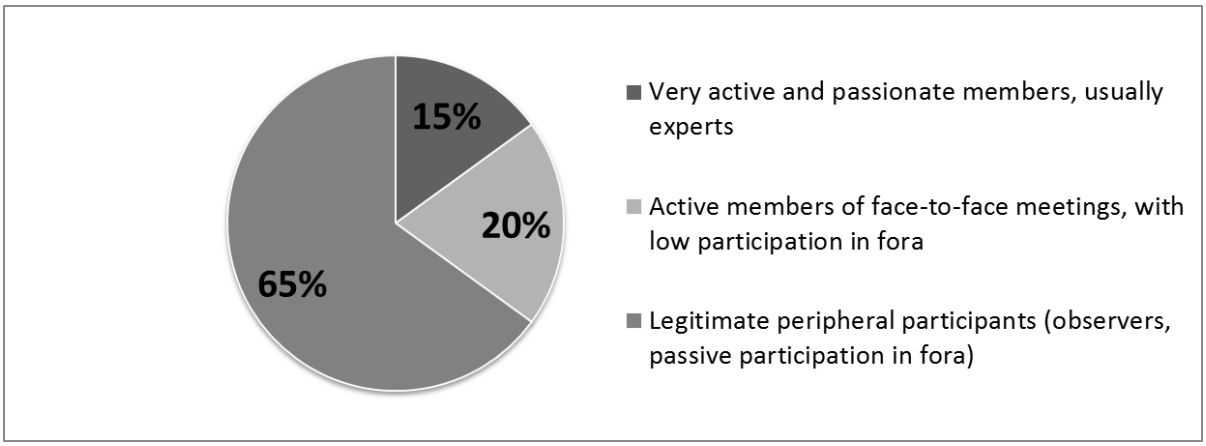

Figure 1. Levels of participation within a CoP.

2.3 Application of the CoP concept

The concept of community of practice has found a number of practical applications in business, organisational design, government, education, professional associations, development projects, and civic life. The concept has been adopted most readily by people in business because of the recognition that knowledge is a critical asset that needs to be managed strategically. Initial efforts at managing knowledge had focused on information systems with disappointing results. Communities of practice provided a new approach, which focused on people and on the social structures that enable them to learn with and from each other.

Communities of practice enable practitioners to take collective responsibility for managing the knowledge they need, recognizing that, given the proper structure, they are in the best position to do this. Communities are not limited by formal structures; they create connections among people across organizational and geographical boundaries.

2.4 The role of technology in communities of practice

Technology is a critical building block. However, its role should not be overestimated and should be viewed as a support to the social aspects of sharing knowledge (building trust, personal communication, and meeting face-to-face). To be effective, technology should be adapted and customized to the needs of the community. After all, the best tools will have little worth if the members do not use them or find them difficult to use. The best technology usually involves tools that help community members find, disseminate, and apply knowledge and enhances communication among them.

It is unlikely that online interaction is sufficient for a CoP since it cannot substitute entirely for face-to-face events that create much of the trust and common purpose within a community. Although

online tools can greatly enhance communication and cohesion, they do not by themselves constitute a community. Face-to-face events are vital, particularly in the early stages of a community. These events are largely responsible for fostering and personalizing the links between members.

2.5 Building blocks

Every CoP is unique in how it creates a sense of community among its members. However, all CoPs share essential features:

- leaders / facilitators
- critical mass of active members
- management support / being an integral part of the organizational structure
- resources
- topic focus
- problem-solving emphasis (practical aspect)
- technology
- knowledge transfer and dissemination mechanisms
- trust
- passion

2.6 Sources of information

Please refer to the items below for additional information on a CoP approach.

- Brown, John Seely and Duguid, Paul (1991). Organizational Learning and Communities-of-Practice: Toward a unified view of working, learning, and innovation. Organization Science, Vol. 2. No. 1, February 1991, Printed in U.S.A.
- Community of Practice (https://en.wikipedia.org/wiki/Community_of_practice).
- Lave, Jean, and Etienne Wenger. 1991. Situated Learning: Legitimate Peripheral Participation. Cambridge: Cambridge University.
- Orr, Julian E. (1990) Talking about Machines: An Ethnography of a Modern Job. ILR Press, Collection on Technology and Work.
- Vásquez Bronfman, Sergio (2011). Comunidades de práctica. EDUCAR, vol. 47, núm. 1, 2011, pp. 51-68. Universitat Autònoma de Barcelona, Barcelona, España.
- Wenger, Etienne (1998). Communities of practice: Learning, meaning and identity. Cambridge, UK: Cambridge University Press. ISBN 0521430178hbk;0521663636pbk
- Wenger, E. and Snyder, W. (2000). Communities of Practice: the new organizational frontier. Harvard Business Review, Jan-Feb, 139-145.
- Wenger, Etienne, Richard McDermott, and William M. Snyder (2002) Cultivating Communities of Practice: A Guide to Managing Knowledge. Harvard Business School Press, Boston, U.S.A.
- World Bank Group. Communities of Practice: Questions and Answers (siteresources.worldbank.org/WBI/Resources/CoP_QA.doc)

3 CHy WORK PLAN: Hydrological Applications, Products and Services - Activity E

Activity E is entitled the “Implementation Strategy for the End-to-End Early Warning Systems (E2E EWS) for flood forecasting (using the Community of Practice (CoP) approach)”. It comprises 6 actions, of which 4 were discussed at this meeting. These 4 included:

- E0: Establish the CoP approach for FF;
- E1: Develop a generic and living list of requirements/best practices in E2E EWS for FF (based on existing materials); prepare assessment guidelines making use of existing material including assessment instructions;
- E2: Make an inventory and assessment of capabilities of existing platforms and hydrological forecast models; make an inventory of existing guidance material (what is available and what is missing), including river-ocean modelling and forecasting; make an inventory of existing training material (what is available and what is missing); and
- E3: Design (assemble content) web portal (using existing IFM Helpdesk capabilities) allowing access to technologies (e.g. models), guidance and training material.

The latter item, E3, was discussed as part of the overall discussions on advancing Activity E.

The 5-day meeting was split into two different parts:

- the first part (2 days) was conducted using two parallel sessions, devoted (i) to the Assessment Guidelines for evaluation of the NHSs capabilities in E2E Flood Forecasting (Activity E1), and (ii) to interoperable technologies to advance flood forecasting (Activity E2); and
- the second part (3 days) was conducted in a joint session, devoted firstly to discussing the results of each parallel session, and finally to the implementation of a Community of Practice for the End-to-End Early Warning Systems (E2E EWS) for flood forecasting (Activity E0).

3.1 Activity E0

A presentation on the concept of community of practice was first given. It provided information on its focus, main purposes and characteristics. Examples of communities of practice (CoP) were also shown. Following the introductory presentation, a discussion was held by the group in order to clarify to what extent and under what framework a CoP could be established to support the E2E EWS chain. The discussion covered potential membership, contents, ways of communication, what constituted adequate platforms, downloadable material, and CoP dynamics. As a result of the fruitful exchange and discussions, some agreements were made on the future steps and actions, as presented in section 4 of this report.

3.2 Activity E1

This parallel session of the meeting was devoted to the Task Team on the development of the Assessment Guidelines for Evaluating NHSs Capabilities in E2E EWS for Flood Forecasting (for the purposes of this document, shortened as TT E1). During the session, several important issues were discussed, including:

- the structure of the Assessment Guidelines template;
- the list of the items to be addressed in the template;
- the grading scheme for the assessment;
- implementation of the Assessment Guidelines in practice;
- connectivity with and its place within the Community of Practice of E2E EWS in FF.

The basis for this portion of the meeting was an initial draft version of the Assessment Guidelines template. This draft had been developed based on earlier efforts of experts pertaining to “Improving the efficiency flood forecasting services” resulting from meetings held in 2011 and 2013 (see WMO 2011 and 2013). Further refinement of the draft also resulted from discussions from a teleconference held in October 2017 with the newly formed expert task team. As a result of this meeting, a revised structure of the Assessment Guidelines was developed. As well, fruitful discussions resulted in refinements on template items including the addition of a few new ones. Of

particular importance were discussions on how the template might best be implemented in practice.

The resulting current version of the Assessment Guidelines template (Ver. Nov.2017) was developed (this is a living document, please refer to the website to download the most updated version: http://www.wmo.int/pages/prog/hwrp/chy/E2E-EarlyWarningSystems/flood-forecasting/index.php). It was agreed that Assessment Guidelines could be used by both external experts and experts of the particular NHS, and it should be made available within the Community of Practice web portal.

A work plan for the task team comprising various activities was developed and agreed upon by its experts (see Table 1 in section 5.2). The work plan includes activities such as finalization of the template item list, its application in practice, and user documentation development.

3.3 ACTIVITY E2

This parallel session was devoted to the Task Team on Interoperable Technologies to Advance Flood Forecasting (for the purposes of this document, shortened as TT E2). In it, key terms were defined, such as Interoperability, Platform, and Interoperable Technology (see **Annex 3**). The task team also developed draft evaluation criteria for flood forecasting models, and platforms were established. These included three requirement classifications as being “must, should, or could”, in accordance with the importance given a specific requirement. In essence, any model or platform must pass the “must” criteria before being further considered within this exercise.

During the session, a few existing hydrological models (HEC-HMS, HYPE, URBS, HBV96, GRM, and GR4H), one hydraulic model (HEC-RAS) and a few platforms (HEC-RTS, AEGIR+HYFO, Delft FEWS, K-EWS, and SWIFT) were screened using the draft criteria (see **Annex 4**). In addition, the draft Template for Hydrological Models was developed. This template was fulfilled using the HBV model as an example (see **Annex 5**).

The future work plan of this Task Team (see Table 3 section 5.3) includes:

- the development of a draft *Reference Guide* containing an explanation of what is required in each field or item in the evaluation criteria and draft templates;
- an investigation into hydrological models, hydraulic models, platforms, and reservoir management/operation models that satisfy the “must” criteria;
- the preparation of draft templates for selected models and platforms.

As soon as the above mentioned draft documents are all prepared, the Task Team will request Regional Hydrological Advisors, NMHSs, Open Panel of CHy Experts (OPACHE), and AWG members to review the documents and to propose candidate models and platforms. Case studies illustrating their application in an operational flood forecasting context will also be requested. In order to support the CoP, the Task Team plans to develop an inventory of existing guidance material (what is available and what is missing) including river-ocean modelling and an inventory of existing training material (what is available and what is missing).

4 AGREEMENTS

The Community of Practice meeting discussed several items and agreed on the following points on the concepts and practices to be adopted in moving forward with the CoP approach for flood forecasting:

(a) To keep the name of the Community of Practice the Commission for Hydrology had incorporated in its recommendation, so as to avoid confusion, namely “Community of Practice on E2E EWS for Flood Forecasting”. However, the selection of a friendlier name for informal reference among members was also suggested;

(b) To use several means of engagement to allow members of the CoP to exchange ideas and to achieve its goals;

(c) To designate a CoP facilitator, to be selected by CHy AWG and Task Team (TT) members;

(d) To postpone member recruitment until a minimum amount of content has been prepared, organized and put in place;

(e) Right after that minimum content has been compiled, organized, and made available, to make an initial member recruitment from the following sources, which amounts to potentially over 500 potential candidates: (i) staff of NHSs through NHAs, (ii) Regional Association Working Groups on Hydrology, (iii) OPACHE members, (iv) AWG and TT members, (v) CHy experts;

(f) To agree on a structure for the CoP website (under section 4.1). Additionally, the task teams requested the Secretariat to recommend website software with the following properties (no order of priority):

i. All approved content can be viewed by the public

ii. All approved content can be indexed by search engines

iii. Registration is required to start a topic for discussion or respond to one [the objective being to reduce spam and inappropriate comments]

iv. Pictures and attachments can be added to the topic responses

v. Log-ins will be administered by the Secretariat

vi. There should be public and private repositories for documents

vii. Internal links to threads should be possible and topics should be searchable

viii. If possible, include the option for private workspaces as task teams develop documents

ix. The software should allow flexible ways of accessing and interacting with different devices/platforms

x. The webmaster should have the ability to moderate (including removing comments and members) as appropriate.

xi. A username / password should be required to access and interact (comment, ask questions, reply, etc.) with the virtual CoP. However, anyone should be able to view the content. Collaboration on documents (and downloading them) should be restricted to registered users;

(g) To designate a short list of registered members to appoint or admit new members at their individual discretion;

(h) To define general members of the CoP as people from item (e), research community on flood forecasting (research to operations component), private industry whose models are in the inventory of freely available models and platforms of the CoP, water management and flood forecasting institutions (at regional, national, state and provincial levels), disaster risk reduction agencies and transboundary water authorities. This list is not to be taken as final. Other people requesting membership will be allowed on an ad hoc basis (initially to be done by the Secretariat under the guidance of the CHy);

(i) To develop a standard of conduct for the CoP (based on WIPO – including copyright issues) and a screening process for new members (based on a similar one used for OPACHE);

(j) To launch the CoP before the next CHy (end of 2020);

(k) With respect to *IFM HelpDesk: Developing E2E capabilities*, to establish linkages between the CoP and the IFM HelpDesk under the following considerations:

i. The IFM HelpDesk might act as an entry point for beneficiaries to access the know-how and expertise of the CoP [and beneficiaries might also express interest in joining the CoP as members].

ii. The IFM HelpDesk would also act as a public interface for some of the CoP products and outcomes (especially training and guidance material, e.g. the assessment guidelines) and *vice versa*.

iii. Noting that the CoP would anyway remain independent from the IFM HelpDesk, the CoP would also benefit from a relationship (in terms of expertise) with the IFM HelpDesk Support Base Partners. The IFM HelpDesk would also benefit from relationship with the CoP.

iv. Visual identity issues should be further considered in order to have the WMO label clearly appearing on CoP outputs. Details on visual identity will be discussed at a later stage, involving communication experts.

v. Some draft proposals for the restructured IFM HelpDesk might be proposed for evaluation by the AWG member responsible for the CoP.

(l) Finally, the group identified the action Items and agreed on timelines and resource requirements as described in section 5.

4.1 Structure of the website for the CoP on E2E EWS for Flood Forecasting

The meeting also discussed the structure of the CoP on E2E EWS for Flood Forecasting. A proposal was refined and agreed upon containing a number of sections and subsections. Please see **Annex 6** for the proposed CoP structure. The Modelling and Forecasting subsection was further explored and a preliminary expansion of this section of the CoP structure is provided in **Annex 7** (both the structure and subsection are not final and might be subject to modifications). As well, the CoP meeting also explored how the contents of the CoP could be designed. It included:

4.1.1 CoP Contents

The CoP contents were also discussed and a short list of the various forms of mediums was agreed-upon for use within the CoP. These were felt to be applicable for each subsection of the CoP structure (see **Annex 6**) and included:

- Downloadable contents (Training material, Software and SW documentation, Case studies)
- Links (to other related CoPs, to sites of interest on related topics, etc.)
- Webinars (with increasing frequency)
- Videos
- Events
- News

5 PATH FORWARD

5.1 Action items – CoP on Flood Forecasting

The participants of the meeting agreed to the following action items to be completed in order to establish the CoP on EWS for flood forecasting:

Table 1. CoP action items

Action Items	Timeline	Comments	Responsible
Draft report of the meeting	Before 2018		Marcelo, Secretariat
Initial page including preamble and statement of membership	February 2018		Marcelo
Structure for the content of the 4 main items of the CoP	April 2018	CoP Team formed to develop the website structure	Marcelo, Hwirin, Yuri, Reggina, Jeff, Secretariat

Action Items	Timeline	Comments	Responsible
		(Marcelo, Hwirin, Yuri, Reggina, Jeff, Secretariat)	
Code of conduct for the CoP (based on WIPOs document for forums)	Before February 2018	To be discussed during the Task Teams (TTs) teleconferences	Secretariat
Develop a table with the next steps for the TT E1	End of November 2017	To be circulated with the TT E1 on Nov 20 2017	Yuri
Implement next steps for the TT E1 as identified in its table	February 2018	See next steps table of the TT E1	TT E1
Implement next steps for the TT E2 as identified in its table	March 2018	See next steps table of the TT E2	TT E2
TT E1 Teleconference on assessment guidelines	February 2018	Detailed matrix for the assessment guidelines	TT E1
TT E2 Teleconference on Interoperable platforms	February 16 2018	See plan of the TT E2	TT E2
Research existing WMO documents, publications, and relevant initiatives (e.g. alerting protocols, HydroHub, MCH, DEWETRA, etc.) to the CoP	As required	Secretariat to share existing list to be reviewed by both TTs (End of 2017)	Both TTs
Initial version of guidance material on how to use the assessment template	June 2018		TT E1
Request for reviewing and populating models and platforms templates & collecting case studies	March 2018		Hwirin
Test the assessment guidelines template and guidance material	Late 2018	To get feedback from applying the guidelines and template	Yuri, Leandro and others
Develop prototype for the website	End of 2018		Nirina (Secretariat)
Involve an expert for communication and dissemination for the assessment guidelines	done, 2nd expert to be identified January 2018	Experts to help TT E1	Jeff has volunteered. Giacomo will provide someone from CIMA
Identify and involve communication's expert to assist on the website's design (including populating the website)	done/continuous	To populate the website, the expert will use inputs from the TTs	Secretariat
Test CoP prototype	Early 2020		
Launch of the 1st version of the CoP	Late 2020		
Next meeting of the TTs or CoP group	Tentatively for early 2019		

5.2 Next steps for the Task Team on Assessment Guidelines (TT E1)

Table 2. TT E1 next steps

Actions	Responsible	Deadline
Identifying missing items in the template	See table 2 below	Before February 2018
Classifying template items by flood mechanism/type		
Developing guidance comments for the template items to assist the evaluator		
Developing a generic and living list of requirements/best practices in E2E EWS for FF (based on existing materials) (as	Yuri	?

part of the national assessment guidelines)		

Table 3. List of items of the AG template and the people responsible for each of them

Items in the template	Responsible
I. Observations/data acquisition/real-time data	John / Yuri
II. Historical and ancillary data	John / Yuri
III. Data management	John / Leandro
IV. Meteorological forecasts and products	Reggina / Bill
V. Hydrological models and forecast based warnings	Leandro / Reggina / Bill
VI. Flood forecast products and their dissemination	Jeff / Reggina
VII. Communications to Support Decision Making (includes individual citizens)	Jeff / CIMA expert
VIII. Performance and sustainability	Paolo / Yuri
IX. Training	Liu

5.3 Next steps for the Task Team on Interoperable Technologies (TT E2)

Table 4. TT E2 next steps

Action	Name	Deadline
Reviewing and finalizing the Hydrologic Model Template	William / Hwirin	Jan 2018
Further develop the draft Platforms Template	Jeff	Jan 2018
Further develop the draft Hydraulic Model Template	Jeff	Jan 2018
Further develop the draft Reservoir Operation Model Template	William / Yeshewatesfa	Jan 2018
Guidance material of NWP formulation for Flood Forecasting	Narendra / Yuri	TBD
Guidance material on river-ocean model coupling of CIFDP (the Coastal Inundation Forecasting Demonstration Project)	Yuri	? 2018
Develop a draft Reference Guide containing explanations of what is required in each field or item in the Evaluation Criteria and the draft Hydrologic Model templates	William	Jan 2018
Further development of the Reference Guide to cover the fields or items of all the draft templates	William / Jeff / Yeshewatesfa	Feb and Mar 2018
Request for reviewing and populating models and platforms templates & collecting case studies to Regional Hydrology Advisors, NMHSs, OPACHE, AWG of CHy	Hwirin	Mar 2018
Collect existing guidance and training materials, consider what is available and what is missing	Hwirin / Yeshewatersfa/ Secretariat	Late 2018
Develop final inventory and assessment of capabilities of existing platforms and hydrological forecast models	TT E2 and others	During Next TT meeting, 2019
Develop final inventory of existing guidance and training material	TT E2 and others	During Next TT meeting, 2019

5.4 Visual Work Plan

A Gantt chart was also developed following the meeting to facilitate seeing the timelines on actions and next steps. This chart depicts the duration of the activities in light green while the darker shade of green represents the month or quarter when a deadline has to be met. Please see below:

			2017		2018								2019				2020			
Action Items	**Timeline**	**Responsible**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**3Q**	**4Q**	**1Q**	**2Q**	**3Q**	**4Q**	**1Q**	**2Q**	**3Q**	**4Q**
Draft report of the meeting	Before 2018	Marcelo, Secretariat																		
Initial page including preamble and statement of membership (Website)	Feb-18	Marcelo																		
Structure for the content of the 4 main items of the CoP	Apr-18	Marcelo, Hwirin, Yuri, Reggina, Jeff, Secretariat																		
Code of conduct for the CoP (based on WIPOs document for forums)	Before February 2018	Secretariat																		
Implement next steps for the TT E1 as identified in its table	Feb-18	TT E1 members																		
Implement next steps for the TT E2 as identified in its table	Mar-18	TT E2 members																		
Teleconference of the TT E2	February 16 2018	TT E2 members																		
Teleconference on TT E1	Feb-18	TT E1 members																		

			2017		2018								2019				2020			
Action Items	**Timeline**	**Responsible**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**3Q**	**4Q**	**1Q**	**2Q**	**3Q**	**4Q**	**1Q**	**2Q**	**3Q**	**4Q**
Research existing WMO documents, publications, and relevant initiatives (e.g. alerting protocols, HydroHub, MCH, DEWETRA, etc.) to the CoP	As required	Both TTs																		
Initial version of guidance material on how to use the assessment template	Jun-18	TT E1																		
Request for reviewing and populating models and platforms templates & collecting case studies	Mar-18	Hwirin																		
Test the assessment guidelines template and guidance material	Late 2018	Yuri, Leandro and others																		
Develop prototype for the website	End of 2018	Nirina (Secretariat)																		
Involve an expert for communication and dissemination for the assessment guidelines	January 2018	Giacomo will provide someone from CIMA																		
Identify and involve a communication's expert to assist on the website's design	Done/continuous	Secretariat																		
Next meeting of the TTs or CoP group	Tentatively for early 2019	CoP Team																		
Test the CoP prototype	Early 2020																			
Launch of the 1st version of the CoP	Late 2020	Secretariat																		

References

WMO (2011), Final Report of the Expert Meeting: Improving the Efficiency of Flood Forecast Services, Development of a Framework for the Assessment of Service Delivery Capabilities of Hydrological Services, 12-14 October, Geneva, Switzerland (http://www.wmo.int/pages/prog/hwrp/documents/FFI/improving_efficiency_ffservices_final_report23-10-2012.pdf).

WMO (2012), Commission for Hydrology, Fourteenth Session, Abridged Final Report with Conclusions and Recommendations, Geneva, Switzerland, WMO-No.1105 (http://www.wmo.int/pages/prog/hwrp/chy/chy14/documents/final_report/1105_en.pdf)

WMO (2013), Final Report of the Expert Meeting: Improving the Efficiency of Flood Forecast Services, Development of a Framework for the Assessment of Service Delivery Capabilities of Hydrological Services, 25-27 November, Geneva, Switzerland (http://www.wmo.int/pages/prog/hwrp/documents/FFI/FINAL-REPORT_%20Expert_meeting_EFFICIENCY_FF-SERVICES_2013.pdf)

WMO (2016), Commission for Hydrology, Fifteenth Session, Abridged Final Report with Conclusions and Recommendations, Rome, Italy, WMO-No. 1184 (file:///E:/New%20folder/CHy-15.pdf)

Annex 1

Meeting Agenda

Monday 13
Joint Session [Room Jura7]

08:30 Registration
09:00 Introduction of participants of both task teams
09:10 Overview of the meeting

- Presentation of CHy's AWG Focus area 3 [15 mins]
- WMO's Community of Practice (CoP) cases on Flood Forecasting [Marcelo, 15 mins]
- Overview of Task Team for developing assessment guidelines for evaluating national capabilities for End-to-End Early Warning Systems [Yuri, 15 mins]
- Overview of Task Team on Interoperable Technologies to Advance Flood Forecasting [Hwirin, 15 mins]
- Logistics for the meeting [5 mins]

10:15 Health break

17:30 Icebreaker event for both task teams

Parallel sessions: Task Team for developing assessment guidelines for evaluating national capabilities for End-to-End Early Warning Systems [Room Jura 7]

10:30 Introduction of the Assessment Guidelines (AG)

- Main goal and proposed mechanism of the assessment
- Status of the Assessment Guidelines (overview of the current Draft version)
- Feedbacks from the Secretariat on the Fiji and Burkina Faso evaluations

11:30 Structure of the Assessment Guidelines

12:30 Lunch break

13:30 Structure of the Assessment Guidelines (cont.)

15:00 Health break

15:15 Development of the item list
17:30 Session adjourns

Parallel sessions: Task Team on Interoperable Technologies to Advance Flood Forecasting [Room Jura 5]

10:30 Introduction to the Interoperable Technologies to Advance Flood Forecasting

- Main goals
- CHy's advice for models and platforms

11:30 Discussion on criteria to discern which models/platforms should be part of the initial inventory

12:30 Lunch break

13:00 Discussion on criteria to discern which models/platforms should be part of the initial inventory

13:30 Identified hydrological models suitable for operational hydrological services to use for flood forecasting, including guidance and training material:

- Participant will present their identified models (10 mins each)
- Discussion on identified models (20 mins)

15:15 Health break

15:30 Identified routing models suitable for operational hydrological services to use for flood forecasting, including guidance and training material:

- Participant will present their identified models (10 mins each)
- Discussion on identified models (15 mins)

16:30 Identified platforms suitable for operational hydrological services to use for flood forecasting, including guidance and training material:

- Participant will present their identified models (10 mins each)
- Discussion on identified platforms (20 mins)

17:30 Session adjourns

Tuesday 14

Parallel sessions: Task Team for developing assessment guidelines for evaluating national capabilities for End-to-End Early Warning Systems [Room Jura 7]

09:00 Classifying items according to the different types/mechanisms of a flood

10:30 Health break

10:45 Recall and outcomes of the grading scheme of the previous effort.

- Proposals on grading scheme

Development the dictionary for the grading scheme

12:30 Lunch break

13:30 Development the dictionary for the grading scheme (cont.)

15:00 Health break

15:15 Comments on how to apply the AG in practice.

- Recommendations for evaluators/NHSs experts
- its place within the WMO's Community of Practice
- linkages with Interoperable Technologies

17:00 Sessions adjourns

Parallel sessions: Task Team on Interoperable Technologies to Advance Flood Forecasting [Room Jura 5]

09:00 Discussions on how to combine models for coastal flooding (river-ocean flooding)

10:30 Health break

10:45 Discussions on the inventory of existing operational hydrological models, routing models, and platforms, including river-ocean situation

12:30 Lunch break

13:30 Discussions on the inventory of existing operational hydrological models, routing models, and platforms, including river-ocean situation (cont.)

15:00 Health break

15:15 Discussions on the inventory of existing operational hydrological models, routing models, and platforms, including river-ocean situation (cont.)

16:30 Next steps

17:00 Sessions adjourns

Wednesday 15 November [Room Jura 7] – Joint Session

09:00 Reporting on Task Team for developing assessment guidelines for evaluating national capabilities for End-to-End Early Warning Systems [Yuri]

09:45 Feedback and Input

10:15 Health break

10:30 Reporting on Task Team on Interoperable Technologies to Advance Flood Forecasting [Hwirin]

11:15 Feedback and Input

11:45 Next Steps – Facilitated Discussion

12:30 Lunch break

13:30 What is WMO's Community of Practice approach in reflection of CHy's discussions [Marcelo]

- Examples or experience on the CoP from other WMO programs, UN/nonUN organizations (if any).
- Linkages with FFI projects and demo-projects (FFGS, CIFDP, SWFDP)

14:00 Facilitated discussion on concepts

15:00 Health break

15:15 WMO's Community of Practice

- Approach [15 mins]
- Focus area(s)
  - Assessment Guidelines for Evaluating National Capabilities for End-to-End Early Warning Systems [45 mins]

- Interoperable Technologies to Advance Flood Forecasting including training material [45 mins]

17:00 Session adjourns

Thursday 16 November [Room Jura 7]

09:00 Brief summary of Day 3 (Marcelo)
09:15 Designing the CoP Mechanism

10:30 Health break

10:45 Discussions on how to make the CoP advance and provide support End-to-End Early Warning Systems development (cont.)

12:30 Lunch break

13:30 IFM HelpDesk: Developing End-to-End Early Warning Systems capability (Giacomo)

15:00 Health break

15:15 Feedback on Help Desk Concept
17:00 Session adjourns

Friday 17 November [Room Jura 7] – Joint Session

09:00 Brief summary of Day 4
09:15 Discussions on how the CoP can advance and provide support End-to-End Early Warning Systems development

10:30 Health break

10:45 What is missing?

12:30 Lunch break

13:30 Path forward

- Action Items, Timelines and resource Requirements
- Work Plan Development
- Implementation of the CoP (steps)

15:00 Health break
15:30 Path Forward (Continued)
16:30 Final Remarks
17:00 Closure

Annex 2

MEETING ON THE ESTABLISHMENT OF A COMMUNITY OF PRACTICE ON FLOOD FORECASTING

(Geneva, Switzerland, 13 – 17 November 2017)

List of Participants

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Annex 3

Definitions from the Task Team on Interoperable Technologies to Advance Flood Forecasting

Interoperability: the ability of modelling systems or software to automatically exchange and make use of information from one to another. In the context of the flood forecasting domain, this can also mean interoperability between models and/or data provided by different individuals or groups, such that they can easily interface with a platform.

Interoperable Technology promoted by this CHy initiative ***must*** be operationally used, be freely available, have low hardware requirements, be available in one of the official UN languages, have available training material, be sustainable (longevity aspect) and be institutionally supported. Such technology ***should*** also be open source and be easy to use (simplicity).

Criteria for "data format" for models: To promote interoperability, the hydrological, hydraulic or reservoir model's data structure (input/output) ***should*** be documented with the programming Application Programming Interface (API) being made freely available.

Criteria for "data format" for platforms: To promote interoperability, the platform ***must*** allow multiple input formats (documented), ***should*** support at least one WMO format, and ***should*** document its output format with the programming Application Programming Interface (API) being made freely available.

Open versus closed systems: open systems can easily incorporate a variety of hydrological, hydraulic and reservoir models, while closed systems are built for specific models and cannot easily add other models without undertaking complex coding.

Platform: A major piece of software, as an operating system or database, under which various smaller application programs can be designed to run. It should be able to provide interoperability of modelling systems that do not possess this capability. It may also allow input of data with different formats and may provide output in multiple ways (graphs, tables). This definition is not final.

Coastal flooding

Coastal flooding (river-ocean modelling and forecasting): ocean model, near-shore marine, hydrodynamic riverine model, hydrological model, and NWP input. Computational resources need to be considered when wishing to approach the solution using say a 200 member ensembles on tropical cyclones, combining these with NWP outputs and hydrological and hydraulic models, requires extensive computing power. Does the National Service have the computational resources to run the entire system or does the National Service need to consider using a third-party solution for computational resources and for provision of forecasting function (as a cloud-based service)?Sustainability will remain an issue to consider.

It may also possible to consider live or pre-processed flood maps for impacted communities. In pre-processing, archived maps are selected for the forecasted events. However, some models are becoming much faster and can now provide such real-time services for unsteady flow conditions. Stages can also be linked to economic models for damages and loss of life estimates. USACE have developed modelling systems on commonly available computers that provide real-time solutions in 3 to 5 minutes, which is considered timely for the intended purpose. Model performance is verified following events using satellite-based techniques and field surveys. Process of continuous improvements for terrain data and model formulation should be done as a best practice.

Annex 4

Draft criteria for Interoperable Technologies to Advance Flood Forecasting

This is a living document.
[For the most current version please refer to: http://www.wmo.int/pages/prog/hwrp/chy/E2E-EarlyWarningSystems/flood-forecasting/index.php]

Criteria	Model (HEC-HMS)	Platform (HEC-RTS) designed for HEC software
Operationally used (must) model and platform	Y	Y (internally and possibly a few external)
Freely available	Y	Y
Hardware requirements (low end)	Y	Y (windows server, 8-12 cores)
Availability of training material	Y	Under development
Institutional Support	Y	Y
Languages training and software	Y - English	Y - English
Sustainability - longevity	Y	Y (new initiative, uncertain future)
Peer review OR Case studies (modelling only)	Y	
Open source or source is available (should)	N	N
Updating (modelling only)	Y	
Simplicity – calibration, parsimony (modelling only)	Y	
Simplicity – usability (m & p)	Y	N (Powerful & flexible)
Pre-existing CoP (m & p) could	N	N
Data Format (model) could	Y (HEC-DSS)	
Data Format (platform) must/should		Y, possibly one WMO format, Y API used
Visualization (platform)		Y
Data QA/QC (platform) s to m		Y
Open/closed platforms		Y (open)(but complex to do)
Internet-based system (platforms)		N
Redundancy capability (platforms)		Y

Criteria	Model (HYPE)	Platform (AEGIR + HYFO by SMHI)
Operationally used (must) model and platform	Y (for Sweden)	Y
Freely available	Y	N
Hardware requirements (low end)	Y	N
Availability of training material	Y	Y
Institutional Support	Y	Y
Languages training and software	Y- English	N (Swedish)
Sustainability - longevity	Y	Y
Peer review OR Case studies (modelling only)	Y	
Open source or source is available (should)	Y	N
Updating (modelling only)	Y	
Simplicity – calibration, parsimony (modelling only)	Y	
Simplicity (easy to use) – usability (m & p)	Y	N
Pre-existing CoP (m &p) could	Y	N
Data Format (model) could	Y (ASCII)	
Data Format (platform) must/should		Y,Y,Y
Visualization (platform)		Y
Data QA/QC (platform) s to m		Y
Open/closed platforms		Y (at the moment HBV and HYPE)
Internet-based system (platforms)		Y (HYFO), but AEGIR does not have this feature
Redundancy capability (platforms)		Y

Criteria	Model (URBS (event model for peaks))	Platform (Delft FEWS)
Operationally used (must) model and platform	Y	Y
Freely available	Y	Y (charges for initial set-up)
Hardware requirements (low end)	Y	Y
Availability of training material	Y - English	Y
Institutional Support	N (provided by owner, just BoM as user)	Y
Languages training and software	Y - English	Y
Sustainability - longevity	N (needs contract with owner)	Y
Peer review OR Case studies (modelling only)	Y	
Open source or source is available (should)	N (BoM has source)	N (but will provide it)
Updating (modelling only)	Y	
Simplicity – calibration, parsimony (modelling only)	Y	
Simplicity – usability (m & p)	Y	N (Powerful & flexible)
Pre-existing CoP (m &p) could	N	Y
Data Format (model) could	Y (ASCII)	
Data Format (platform) must/should		Y, Y, Y
Visualization (platform)		Y
Data QA/QC (platform) s to m		Y
Open/closed platforms		Y - Open
Internet-based system (platforms)		Desktop or Internet-based or Cloud
Redundancy capability (platforms)		Y

Criteria	Model (HBV aka HBV96)	Platforms
Operationally used (must) model and platform	Y	
Freely available	N	
Hardware requirements (low end)	Y	
Availability of training material	Y	
Institutional Support	Y	
Languages training and software	Y – English/Swedish	
Sustainability - longevity	Y	
Peer review OR Case studies (modelling only)	Y	
Open source or source is available (should)	N	
Updating (modelling only)	Y	
Simplicity – calibration, parsimony (modelling only)	Y	
Simplicity – usability (m & p)	Y	
Pre-existing CoP (m &p) could	N	
Data Format (model) could	Y (ASCII)	
Data Format (platform) must/should		
Visualization (platform)		
Data QA/QC (platform) s to m		
Open/closed platforms		
Internet-based system (platforms)		
Redundancy capability (platforms)		

Criteria	Model (GRM by KICT)	Platform (K-EWS Korea - Early Warning System)
Operationally used (must) model and platform	Y	Y
Freely available	Y	N
Hardware requirements (low end)	Y small watershed N – HPC for national application	N
Availability of training material	Y- English	Y - English
Institutional Support	Y	Y
Languages training and software	Y - English	Y
Sustainability - longevity	Y	Y
Peer review OR Case studies (modelling only)	Y	
Open source or source is available (should)	Y	N
Updating (modelling only)	Y	
Simplicity – calibration, parsimony (modelling only)	Y	
Simplicity – usability (m & p)	Y	Y
Pre-existing CoP (m &p) could	N	Y
Data Format (model) could	Y – ASCII, XML, text	
Data Format (platform) must/should		Y, possibly one WMO format?, ?
Visualization (platform)		Y
Data QA/QC (platform) s to m		Y
Open/closed platforms		Open
Internet-based system (platforms)		?
Redundancy capability (platforms)		?

Criteria	Model (GR4H (hourly))	Platform (SWIFT within Delft FEWS)
Operationally used (must) model and platform	Y flood forecasting in France, flow forecasting in Australia for 7-d volumes, but looking into flood forecasting	Y (only Australia) (looking into making it a community model, python work flow environment)
Freely available	Y	Y
Hardware requirements (low end)	Y	Y
Availability of training material	Y	Y
Institutional Support	Y	Y
Languages training and software	Y – English/French	Y - English
Sustainability - longevity	Y	Y (future work flow platform of choice for FF)
Peer review OR Case studies (modelling only)	Y	Y
Open source or source is available (should)	Y	N (will be when community model launched)
Updating (modelling only)	N- Done in SWIFT not model	Y
Simplicity – calibration, parsimony (modelling only)	Y	
Simplicity – usability (m & p)	Y	Y (command line)
Pre-existing CoP (m & p) could	Y (small)	N
Data Format (model) could	Y ASCII	
Data Format (platform) must/should		Y, netCDF, N
Visualization (platform)		N (Done within Delft FEWS where it is a Y)
Data QA/QC (platform) s to m		Y for calibration, Delft FEWS for forecast mode
Open/closed platforms		Open
Internet-based system (platforms)		Y
Redundancy capability (platforms)		N (Delft FEWS provides this)

SWIFT can be run on its own, but for flood forecasting is run within Delft FEWS.

Criteria	Model (HEC-RAS) 1- and 2-D	Platform (HEC-RTS)
Operationally used (must) model and platform	Y	
Freely available	Y	
Hardware requirements (low end)	Y	
Availability of training material	Y	
Institutional Support	Y	
Languages training and software	Y - English	
Sustainability - longevity	Y	
Peer review OR Case studies (modelling only)	Y	
Open source or source is available (should)	N	
Updating (modelling only)	Y (can force computed wl through an observed level)	
Simplicity – calibration, parsimony (modelling only)	Y	
Simplicity – usability (m & p)	Y	
Pre-existing CoP (m &p) could	N	
Data Format (model) could	Y (HEC-DSS data format)	
Data Format (platform) must/should		
Visualization (platform)		
Data QA/QC (platform) s to m		
Open/closed platforms		
Internet-based system (platforms)		
Redundancy capability (platforms)		

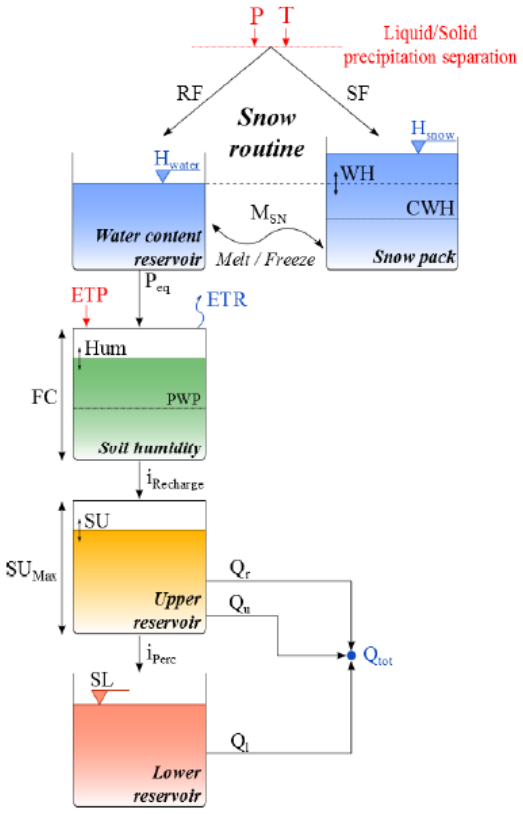
Criteria	Models	Platforms
Operationally used (must) model and platform		
Freely available		
Hardware requirements (low end)		
Availability of training material		
Institutional Support		
Languages training and software		
Sustainability - longevity		
Peer review OR Case studies (modelling only)		
Open source or source is available (should)		
Updating (modelling only)		
Simplicity – calibration, parsimony (modelling only)		
Simplicity – usability (m & p)		
Pre-existing CoP (m &p) could		
Data Format (model) could		
Data Format (platform) must/should		
Visualization (platform)		
Data QA/QC (platform) s to m		
Open/closed platforms		
Internet-based system (platforms)		
Redundancy capability (platforms)		

Criteria	Models	Platforms
Operationally used (must) model and platform		
Freely available		
Hardware requirements (low end)		
Availability of training material		
Institutional Support		
Languages training and software		
Sustainability - longevity		
Peer review OR Case studies (modelling only)		
Open source or source is available (should)		
Updating (modelling only)		
Simplicity – calibration, parsimony (modelling only)		
Simplicity – usability (m & p)		
Pre-existing CoP (m &p) could		
Data Format (model) could		
Data Format (platform) must/should		
Visualization (platform)		
Data QA/QC (platform) s to m		
Open/closed platforms		
Internet-based system (platforms)		
Redundancy capability (platforms)		

Draft Template for Hydrological Models

HBV model example

Short Name	. HBV
Long Name	. Hydrologiska Byråns Vattenbalansavdelning model
Model Type	. Continuous, semi-distributed model
Usage	. Riverine Flood Forecasting and Flow(low to high) Forecasting . Simulation of hydrological time-series . Short range forecast . Inflow volume forecast . Simulations in ungauged catchments . Climate change studies
Background	. A computer simulation used to analyze river discharge and water pollution . To create a conceptual hydrological model with reasonable demands on computer facilities and calibration data . The model is a standard forecasting tool in Sweden and other Nordic countries, and also used for simulations in ungauged catchments, mainly in small and unregulated rivers . Developed by SMHI in the early 70´s to assist. . first version has some major drawbacks concerning areal representation, a fact which limits the use of distributed data. . In 1993 the Swedish Association of River Regulation Enterprises (VASO) and the SMHI initiated a major revision of the structure of the HBV model . HBV-96 is the final result of this model revision
Developer	. SMHI
Channel Routing	. Muskingum or Nonlinear storage function for channel routing?
Reservoir Operation	
Number of Calibration Parameters	
Institutional and operational effort	
Snow Accumulation	. calculated after defining a threshold melting temperature . the result is divided into a liquid part that is the surface runoff and a second part that infiltrates
Precipitation	. Sub-basin average
Evapotranspiration	. input to the model
Calibration/Optimization	

Updating/Assimilation	
Input Data	. Daily Temperature, Rainfall, Monthly Potential Evapotranspiration
Model Output	. Daily Discharge
Hardware requirements	. PC
Operating System	. Windows
Programming Language	. Fortran
Open Source	. Yes
Download URL	.
Language of Software	. Swedish and English
Training Material URL	
Guidance Material URL (including case studies)	.
Latest Update & Version	. 1996?
References	. Bergstrom, S. (1995) The HBV Model. In V.P. Singh (Ed.) Computer models of watershed hydrology, pp. 443-476, Water Resources Publications, Highland Ranch, Colorado, USA.
Contact Organization	. https://www.smhi.se/en/services/professional-services/energy/hbv-state-of-the-art-hydrological-modelling-1.7540
Model Schematic	

Annex 6

Structure for the Community of Practice on E2E EWS for Flood Forecasting

The structure for the CoP was discussed and an initial proposal was agreed with the sections Data, Modelling and Forecasting, Warning Products and Services, and Communication and Decision Support (this structure is not final).

DATA	MODELLING AND FORECASTING	WARNING PRODUCTS AND SERVICES	COMMUNICATION AND DECISION SUPPORT
I. Observations/data acquisition/real-time data	M/P Selection	Deterministic / Probabilistic / Ensemble	Formats
Collection	Model cal / val	Product V&V	Media
Management / Quality control	*Research to operations*	Data Assimilation / updating	Communication of uncertainty
Field measurements		Uncertainty analysis	
II. Historical and ancillary data		Assessment Guidelines (capabilities of NHS)	
Data rescue			
Remote sensing data			
GIS / Raster processing			
Data Post-processing			
III. Data management			
Data base Administration			
Research to operations			
		FORUM	

Annex 7

Preliminary expansion of the Modelling and Forecasting section of the CoP Structure of Annex 6

Example of subsections for section Modelling and Forecasting (this structure is not final):

2. Modelling & Forecasting
- Models
    - Inventory of models
    - By type of flood
    - Training material for models
    - [Use TT E2 outcomes for further categorization]
- Calibration, validation, verification
    - Tools
- Updating (Forecast adjustments, corrections, simulations, etc.)
- Platforms
    - Inventory of platforms
    - Training material for platforms
- Training material
- Case studies
- Test your model
- Reference materials
    - Manual on Flood Forecasting and Early Warning -1072
    - Guide to Hydrological Practices-168
    - CHy [documents and statements]