MINUTES
Flood Risk Management Technical Committee Meeting
July 13, 2016, St Louis (River Flow Conference)

Agenda

1. **FRM TC updates since TC initiation:** L. Weber

2. **Discussion of essential planned activities:**
   
a. **Special Flood issue for JRBM** – M. Muste, M. Altinakar (editorial team)

   b. **Strategic Global Initiative on Flood DSS – synthesis** – M. Muste

   c. **Benchmark dataset for flood modeling** – A. Barnett

   d. **Flood damage initiative** – F. Ballio

   e. **Immediate activities:** IAHR World Congress (13-18 August; Kuala Lumpur – Malaysia. One of the Congress theme is on the flood topic.

   International Conference on Flood Management (05-07 September, Leeds – UK). Invitation from LOC for FRM TC event

Participants:

- FRM TC leadership L. Weber, X. Cheng, Mark Babister, F. Ballio, I. Fujita, I. Rifai (on behalf of B.J. Dewals), S. Haun (on behalf of S. Wieprecht);

- Representatives of related groups: G. Terrugi (WMO), H. Koseki (ICHARM)

- W. Krajeski, M. Altinakar, M. Retallick, H. Hong, G. Smart, S. Kudo, N. Young, G. Rosatti, C. Zevenberger, H. Ho, R. Holmes, A. Firoozfar, D. Froehlich, S. Patidar, M. Muste
Discussions:

1. **FRM TC updates since TC initiation:** L. Weber

Activities initiated from the creation of the FRM TC were presented (see below).

<table>
<thead>
<tr>
<th>Activity</th>
<th>Description/Details</th>
<th>Timeline</th>
<th>Charges</th>
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<tbody>
<tr>
<td>3. Special Flood Issue on Floods for IRBM</td>
<td>Selected papers from River Flow SS on Floods will be compiled in a special issue (discussed with J. Ball and Altmakar)</td>
<td>Fall, 2016</td>
<td>Muette, Altmakar</td>
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<td>4. Organization of a flood-focused event for the 2017 IAHR Congress (August 14-18, 2017, Kuala Lumpur, Malaysia)</td>
<td>The event will be most probably a special session or forum on high priority, flood-related topic.</td>
<td>1/1/2016</td>
<td>In standby, Muette, Demir</td>
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<td>5. Reconnection with IFI/ICARM/ICFM activities</td>
<td>Participation at the FLOODrisk Conference [<a href="http://floodrisk2016.net">http://floodrisk2016.net</a>, Lyon, October 17-21, 2016] to learn about the conference and check opportunities for interactions</td>
<td>2/1/2016</td>
<td>Oral paper to be presented, Muette</td>
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<td>Participation to ICFM7 [Leeds, UK, Sept 2017; <a href="http://www.icfm7.org.uk">http://www.icfm7.org.uk</a>] to learn about the event</td>
<td>2/1/2016</td>
<td>Muette</td>
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<td></td>
<td>Preparation of a proposal for ICFM8 in Iowa City in 2020</td>
<td>Spring, 2017</td>
<td>In preparation, Weber, Muste, Simonovic</td>
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<td>6. Building momentum around the IHR - Iowa Flood Center's on-going project: Strategic Global Initiative (SGI) on Decision-Support systems for Flood Mitigation &amp; Resilience (FLOODSS)</td>
<td>Continue discussions with IHR for moving the project to the next steps</td>
<td>Fall, 2015</td>
<td>Initiation: Fall 2015, Finalized: April 2016, Muste, X. Cheng, Muste</td>
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<td>IHR visit to IHR</td>
<td>Nov, 2015</td>
<td>April 25-28, 2016, Muste</td>
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<td></td>
<td>Invitations to potential SGI partners (IAHS-focus): Simonovic, Holmes, IBM to visit IHR</td>
<td>Sept, 2015</td>
<td>February - April, 2016, Muste</td>
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<td></td>
<td>Critical review of the information systems for flood mitigation &amp; resilience (to be shared on TC website)</td>
<td>Oct, 2015</td>
<td>Feb, 2016, Muste, IHR, Li Na (IHR)</td>
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<td></td>
<td>White paper on FLOODSS</td>
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<td>Muste, Simonovic</td>
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<td>7. Creation of a benchmark dataset for development of flood models</td>
<td>Currently, there is no flood data sets that can be used to compare the accuracy of flood simulation models. Collecting and vetting a representative group of datasets under the auspices of FRM TC will benefit the organizations and other interested communities.</td>
<td>Feb, 2016</td>
<td>Alastair Barnett, Barnett and MacMuray Ltd, Hamilton, New Zealand</td>
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All initiated activities were detailed and approved for continuation.
FRM-led activities during the Conference were also presented (See table below)

<table>
<thead>
<tr>
<th></th>
<th>Wednesday (July 13)</th>
<th>Thursday (July 14)</th>
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<tbody>
<tr>
<td>8:15 - 9:00</td>
<td>Conference plenary lecture</td>
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<td>9:15 - 10:00</td>
<td>Flood Special Session I</td>
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<td>10:00 - 11:00</td>
<td>Break</td>
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<td>11:00 - 12:10</td>
<td>Flood Special Session II</td>
<td>(1 invited &amp; 3 oral presentations)</td>
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<td>12:00 - 12:55</td>
<td>Lunch</td>
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<td>12:55 - 14:10</td>
<td>Conference plenary invited lecture</td>
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<td>14:10 - 15:00</td>
<td>Preparatory Meeting for the Strategic Global Initiative (SGI) on Flood Decision Support Systems (FLOODSS). Meeting open to conference community</td>
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<tr>
<td>15:00 - 15:40</td>
<td>Flood Special Session III</td>
<td>(1 invited &amp; 4 oral presentations)</td>
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<td>15:40 - 16:00</td>
<td></td>
<td>FORUM: Strategic Global Initiative (SGI) on Flood Decision Support Systems (FLOODSS). Meeting open to conference community</td>
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<td>16:00 - 17:30</td>
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<td>Flood Risk Management Technical Committee Meeting, Room Wood Ballroom 172 (see the enclosed agenda)</td>
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2.a. Special Flood issue for JRBM – M. Muste, M. Altinakar (guest editors)

About 5-6 papers presented in the Flood-focused Special Session of the River Flow Conference were identified as possible candidates for the JRBM special issue. M.Muste has subsequently contacted the JRBM chief editor for registering the Special Issue with the publisher. More paper candidates will be identified during the FloodRisk 2016 Conference (Lyon, Oct 17-21, 2016)

The JRBM SI timeline is as follows:
- November 1, 2016 – official launch for contributions
- May 31, 2016 – submission of the manuscripts

2.b. Strategic Global Initiative on Flood DSS – synthesis – M. Muste

M. Muste briefly introduced the FLOODSS concept and the rationale for its consideration - Appendix A). A FLOODSS Task Force was created to include: M. Muste, X. Cheng, I. Fujita, F. Ballio, G. Rosatti, C. Zevenberg, M. Babister, M. Retallik. Two subsequent meetings with the FLOODSSST were held during the St Louis to detail the further steps. Capacity building and research proposal opportunities were discussed to further continue the discussions on FLOODSS. Such efforts are currently on-going with WMO, ICHARM and through a proposal preparation for the US’ National Science Foundation.

2.c Benchmark dataset for flood modeling – A. Barnett

The material prepared by Alastair Barnett to introduce the “International Accuracy Benchmark Project” for supporting Flood modeling was introduced to the audience (see Appendix B). A Task Force was initiated with point of contact (in the absence of MR Alastair) in the person of M. Babister. The TF on Flood Modeling Dataset also includes: C. Jenkins, H. Rehman, J. Ball, L. Weber, O. Rodriguez. The group pioneered by Barnett is active through emails and have already shared a sample of observed flood dataset (Benchmark A2). IT continues to look for volunteers to contribute to the expansion of the database.

FRM TC is committed to support the initiative with infrastructural needs such as making the initiative visible through specific channels and organizing dedicated events.
as the Flood Dataset Task Force matures. An immediate opportunity is to submit a Call to community paper to be submitted in the Flood Section of the 37th IAHR Congress.

2.d Flood damage initiative – F. Ballio

Francesco Ballio present a summary of the initiative that he proposed (See Appendix C). A Task Force to support and grow the initiative was created to include: G. Rosatti, C. Zevenberg, M. Babister. Subsequent discussions revealed the need to reach out to flood-related communities as IAHR does not provide the critical mass for supporting alone such an initiative. Suggestions were made that the topic can be included in the FRM TC Special Session slot for the ICFM 7 (2017, Leeds, UK)

APPENDIX A.
SETTING THE STAGE FOR THE DEVELOPMENT OF GENERALIZED FLOOD DECISION SUPPORT SYSTEMS (FLOODSS)

The need for FLOODSS

Flood mitigation has considerably evolved with the adoption of a flood-risk centered decision-making approach that integrates methodologies pertaining to three different domains: hydro-meteorological & hydraulic (H&H) data, H&H modelling, and decision analysis. The connections among the three domains is illustrated in Figure 1. The approach has been successfully incorporated in more efficient early warning systems (e.g., FLOODsite, 2016; FEMA, 2016) and planning tools for flood prevention (e.g., Zorzi et al., 2016; Flood-CBA, 2016). Most of these systems and tools are applicable to local (river reaches of several kilometers long). The systems are fragmentary, and not readily transferable to other flood-affected communities (WMO, 2006). With a continuous and global increase in the flooding frequency and intensity there is an immediate need for new solutions for setting and deploying robust and generalized decision-support systems (DSS) that can be quickly deployed in any flood-prone area irrespective of its location and size (from local to regional). Such DSS can only be attained through deep and wide integration of an unprecedented, and continuously growing, volume of data and information generated by surveys, monitoring, and modeling of multi-domain aspects (from flood hazard forecasts to assessment of flood-risk scenarios and resilience). Attaining these performant DSS is not actually challenged by the lack of knowledge on hydrologic/hydraulic processes or risk management (Giordano et al., 2008; Cutter et al., 2008, Levy, 2005). The obstacles are rather related to the lack of a general framework to integrate multi-scale, multi-domain data and models from heterogeneous sources and assemble them in a generic real-time operational platform (NOAA, 2009). Fortunately, contemporary advancements in computer science and communication technologies offer big promise to make the goal of developing generalized DSS a reality (Muste, 2014; Mackay et al., 2015, Sayers et al., 2002).
Figure 1. Flow diagram of an end-to-end DSS leading to solutions for flood risk management. The three-domain connection illustrated in the figure is an iterative process that evolves continuously in time.

Despite the emergence of a large number of flood-focused DSS in the last decades (Giupponi et. al., 2011; Laine, 2012), there have been fewer efforts for integrating the flood risk management relevant knowledge with information and communication technologies into generalized DSS. Currently, there is no unified vision on the architecture, components, and the needed computer and communications technologies for attaining generic DSS for flood mitigation and resilience. Moreover, there is no guidance of what components should be developed first and how to build human-computer interfaces to ensure efficient stakeholder engagement and consensus. The main challenges associated with the creation of end-to-end (generalized) DSS for flood risk management are to design and develop the needed information and communication infrastructure (i.e., cyberinfrastructure\(^1\)) or e-infrastructure to handle and ingest the data and observations into flood and socio-economic models to obtain the operational flood hazard and risk maps.

What are the FLOODSS?

FLOODSS are interactive web-based platforms aimed at providing customized flood-related services to execute on the fly assembling of hydro-meteorological data, simulations of flood processes, conduct of analyses to support decision-making (from prevention, mitigation, preparedness, response, and recovery from the impacts of flooding) using an inclusive stakeholder participatory approach. The development of FLOODSS is a typical “Big data” use case\(^2\) whereby tasks such as curation, storage, search, transfer, visualization, and sharing of the large amount of data produced from observation and modeling as well as their analysis and updating with fast speed need to be seamlessly accomplished through machine-to-machine interaction (Muste, 2014). Consequently, the methodological aspects for managing flood risk illustrated in Figure 1 require a DSS making extensive use of:

- **Standardized and scalable inter-domain services on-demand** for connecting the data and information required for flood hazard, risk, and resilience assessment irrespective of the geographical location, watershed size, and data status (i.e., data-rich or ungagged basins)
- **High-performance computing for execution of real-time hydro-meteorological simulations using open data services** operating on a library of models for rainfall-runoff (lump, distributed) and river hydraulics (1D, 2D and 3-D) capable of simulating in near-real time over a wide range of spatio-temporal resolutions
- **Grid and cloud infrastructure for handling the voluminous multi-domain data required by the models and tools used for assessing the hazard, risk, and resilience** before, during and after floods with consideration of climate and socio-economic evolution, as well as the preferences of the flood-affected citizens.
- **Software and service infrastructure for enabling open (or selective) access to the decision-making process** during emergencies (short-term protection) and strategic decisions (long-term planning and policy) irrespective of the spatial extent of the river and the temporal resolutions of the solution space.

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\(^1\) Cyberinfrastructure (CI) is an active area of academic research and industrial development jointly carried out by domain and computer area specialists for handling “big data” cases (Firoozfar, 2015; DHRIM, 2016; FLOODIS, 2016; Maidment, 2016; JRC, 2016).

\(^2\) “Big data” are datasets that are so large and complex that traditional data processing applications are inadequate.
• Globally interoperable, open and trusted CI sources for enabling multidisciplinary collaboration and dissemination through user-friendly interfaces and a format and language understood by all stakeholders.

A generic layout of the FLOODSS components, workflows, and the ancillary CI is illustrated in Figure 2. The CI ensures that hazard forecasts and risk management options are generated through data and information exchanges between local and distributed interoperable web servers customized to carry out the functions illustrated in Figure 1, i.e., acquisition and management of data/observations, coupling data with models, and integrating simulation models in a collaborative decision-making modeling platform. Web technologies (e.g., servers, databases, web-programming languages), specialized processing tools (e.g., enterprise or open source GIS applications), and protocols (for interfacing databases with models and models among themselves) are selected to comply with specifications required by a service-oriented system (Mysiak et al, 2005; Power & Sharda, 2007).

Figure 2. Flow diagram of the FLOODSS components and ancillary cyberinfrastructure (CI). Some of the CI is shared by multiple FLOODSS modules and components.

Development of web-based, client–server systems DSS introduces an increased layer of complexity compared with conventional server-based DSS through the consideration of concurrent session management, human–machine interaction, and server performance. Handling multitude of data and information type in real-time combined with capabilities to support multi-user decision-making interactively can be optimally carried out in a cloud computing environment. Successful deployments of web-DSS in other domain areas (e.g., banking, manufacturing) have demonstrated that they can revolutionize the decision-making process by seamlessly integrating in one virtual hub data, models, knowledge, and business processes (Power & Sharda, 2007). Among the distinct advantages of the web-based DSS delivered as a service are (adapted from Zhang et al., 2011):

1) **Centralized control over models and data** (leading to lower costs for hardware, software, distribution, maintenance, and training, as well as greater efficiency in real-time modeling and data update)
2) **Global and easy accessibility** (no need for modeling or GIS knowledge, training, or other specific software)
3) **Platform independence** (encourage stakeholders and public to participate in planning and decision-making)
4) **Scalable and transferable** to watersheds of various sizes
5) **Modular data model construction** (model components can be quickly changed as soon as more efficient versions of the simulation models are available)
6) **Improved communication and coordination** [web-based DSS has become a de-facto standard of collaborative decision-making enabling user to participate during various planning stages that are directly affecting them; facilitating consensus among decision makers, stakeholders, and public (Sun, 2013)];

Progressing from vision to practical implementation requires first the conceptualization of the FLOODSS architecture. This effort can be phased over several steps: a) formulating the workflows for linking the multi-disciplinary processes; b) choosing the resources needed to inform the processes; c) designing the specifications for the hardware-software package that convey the information between the process
components; d) choosing the web technology to execute the modeling architecture of the system; e) developing the interfaces for access, retrieve, visualize the workflow outcomes. Steps a), b), and c) mostly involve domain specialists. Steps d) and e) are typically tackled by CI specialists working in close collaboration with the domain specialists.

**Transitioning FLOODSS from concept to prototype**

A wide collaborative effort is required to translate the FLOODSS ambitious vision from concept to practice. Most of the challenging efforts are related to the assemblage of the CI laid out in Figure 2. The breadth and depth of FLOODSS vision extends well beyond the capabilities of a single research development group, or even one nation (as flooding is tied to local conditions). Thus, it requires the integration of capabilities and efforts of flood and information science experts globally and for a longer term commitment. We propose a multi-institutional and international alliance of core partners that builds on the existing scientific and technologic advancements, selects the necessary flood science and CI, and ensures long-term continuity through upgrades of the FLOODSS as new technologies occur. The FLOODSS core partners would:

1. **Identify and engage strategic partners for FLOODSS development and implementation**. The long-term intention is to develop a partnership to include water-focused professional communities (e.g., IAHR, IAHS, IWA), international scientific and applied sciences governmental agencies (e.g., WMO, UNESCO), specialized research centers (e.g., Wallingford Center, IFC – USA; IWHR – China, UNESCO/IHE – The Netherlands), industrial software producers and decision-support developers (e.g., DELTARES, DHI) are all essential for a robust development of the conceptual architecture, production process, and formulating a business model of FLOODSS. However, the first steps would be more modest and will include significantly less partners such as to ensure continue capacity building progress.

2. **Set short-term and long-term development schedules backed up by formal collaborative agreements** (for ensuring the sustainability of the FLOODSS initiative wide participation from governmental agencies, flood practitioners, universities, and industry is critical)

3. **Formulate the strategy for securing FLOODSS governance and development funding** (among the main targets are international non-governmental organizations (e.g., World Bank, GWP), international scientific agencies, applied sciences agencies (e.g., WMO, UNESCO), flood consulting and insurance companies, and private donors concerned with the flood-related disasters).

4. **Elaborate an evaluation matrix for FLOODSS development** (for ensuring a measure of a sustainable progress of the product development)

5. **Identify early-stage FLOODSS-relevant research testbeds** that can facilitate transparent integration of research components suggested by the alliance and subsequent assessments for identification of further research needs. Launch proof-of-concept studies (using coherent methodology and global scale models and data sets) followed by evaluations to continuously improve individual components of the model cascade. Potential testbed candidates so far: Iowa Flood Center (USA) and China Institute for Water Resources and Hydropower Research (China).

6. **Develop the conceptual architecture and the production process leading to an operational FLOODSS**. Identification of existing components, producers, and early prototypes that are readily usable in the generic platform for accelerating the overall FLOODSS development.

7. **Consult with relevant stakeholders** (governmental agencies, local communities, industry, and flood insurance agencies are expected to engage in formulating the operational requirements, supporting the implementation of the proof-of-concepts to specific testbeds and acting as reviewers for specific platform developments).

8. **Develop a business model for sustained economic development of the FLOODSS** (specifications on the governance model, attraction of industrial partners for attaining industrial grade performance, and solving the intellectual property issues. For a start, check similar efforts carried out through various EC-funded projects [DRIHM (http://www.drihm.eu); OpenMI (http://www.openmi.org); FLOODSite (http://www.floodsite.net), and FLOODIS (http://floodis.eu)].

9. **Foster synergistic collaboration with mission agencies** that has potential to accelerate FLOODSS maturation, demonstration, and transition to practice.

**References**


DRIHM (2016). Distributed Research Infrastructure for Hydro-meteorology (http://www.drihm.eu - last accessed 06/10/2016)
APPENDIX B

Flood Modelling: International Accuracy Benchmark Project

In the light of worsening climate change predictions, the management of river, urban and coastal flood hazards has become an increasing concern to the international engineering community. This has led the International Association for Hydro-Environmental Engineering and Research (IAHR) to set up a new Flood Risk Management Technical Committee (FRM TC), based at the University of Iowa, USA.

Many flood simulation models are now competing to provide a basis for engineering design, but they produce quite different results, even when identical sets of field observations are used as input data. So after a flood disaster, how can forensic studies determine whether engineering designers have used valid or invalid models?

Much of the difficulty stems from a lack of consensus on how channel resistance should be described, and how widely used model parameters such as the Manning $n$ and Darcy-Weisbach $f$ should be determined uniquely from field observations of full scale recorded floods. Existing benchmark comparisons have tried to avoid this problem by restricting model comparisons to the use of specified arbitrary uncalibrated roughness coefficients. However observed flood behaviour cannot be guaranteed to match the response of a given model using any combination of parameter settings unless the validity of that model has first been established. Otherwise accurate calibration will be impossible.

Accordingly the FRM TC have announced an initiative "Creation of a benchmark dataset for development of flood models", led by Alastair Barnett, Director of HYDRA Software Ltd, New Zealand. Dr Barnett has now provided Benchmark A2, a sample observed flood dataset, with a demonstration of separate forensic validation and calibration stages of model application. The TC is now looking internationally for other volunteers to contribute field studies of flood events with sufficient intensity of observations to support comparable accuracy benchmarking over a wider range of model conditions.

Suggested types of event required:

1. Coastal storm surge into urban areas
2. Tsunami inundation
3. Flood hazards through a hydropower or water supply reservoir
4. Dambreak wave modelling
5. Flood routing management through stormwater systems
6. Control gate operations and application of flood rules
7. Laboratory model studies, including large scales up to 1:1

Proposed forthcoming activities for contributors:

- Critically review the draft sample Benchmark A2
- Assess the validity, calibration and accuracy of some existing models against Benchmark A2
- Agree on the necessary steps for creation of an FRM TC benchmark data depository
- Volunteer a comparable Benchmark dataset for similar review by the wider group

APPENDIX C.
Flood damage initiative – F. Ballio

No risk can be assessed without damage evaluation. Modeling flood damages is key for cost-benefit analyses.
At present, (flood) damage models are still at an early stage of development, and no model can be considered as a technical standard. The multi-faced nature of damages (to people, buildings, infrastructures, economic activities, environment, cultural heritage, ...) makes their modeling an inherently multi-disciplinary job. Critical issues are:
1. the lack of extensive and systematic data collections on flood damages (if not at global scales);
2. the lack of a methodology / framework for the analysis and the reporting of the consequences of a flood.
The main question is: should we consider flood damage evaluation as a topic for hydraulic scholars (and work for hydraulic engineers)?
If the answer is yes, perhaps there is scope for a sub-group within the FRM TC.

Proposed activities
• looking for interested people within and outside the hydraulic community
• collecting and comparing some significant reports on flood damages
• proposing some standard for flood damage data collection and reporting
• comparative analysis of available damage models (calibration data and applicability conditions are typically not well known)