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Interactive comment on "The European flood risk directive: challenges for research" *by* E. Mostert and S. J. Junier

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The interesting points in this paper are about research and the research process rather than about the Directive. Therefore, I would suggest that the authors invert the structure of the paper so the question of how we should do research, and what research is most useful, comes up front. I agree with the authors' position on this; if anything, it is perhaps too kind too academics.

They point up the necessity of interdisciplinary working and identify the positive disincentives to work in this way as a barrier to academics doing so. There are wider questions. The first is the nature of knowledge itself; if we are lucky, all the different disciplines are working on the same jigsaw of knowledge and eventually all the differ-

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ent pieces will join up to form a whole. But, it is not clear that they are all working on the same jigsaw. Furthermore, from an anthropological perspective, the different disciplines satisfy the definition of cultures: each using a different language, having a different set of social norms, and a different view of the world. Therefore, inter-disciplinary working is an exercise in cross-cultural working. It is not surprising therefore that while there are routine calls for inter-disciplinary working, there is little to show of effective inter-disciplinary working in practice or grounded guidance as how to do it. What is commonly found instead are a collection of discipline based reports under a common cover. A major research question is consequently how to undertake effective interdisciplinary research.

That question is embedded in the wider question of how can we learn most effectively? Sustainable development requires doing more with less: changing from what we have done in the past. To learn is to change. The argument for interdisciplinary research is just that: we will do better research this way. Equally, it shows the institutional limitations of committing to a learning strategy; the difficulty of making changes. There are a raft of research issues here ranging from how policy change occurs, or can be induced, through promoting the adoption of sustainable behaviours, to that of institutional or organisational learning.

The question of the nature of knowledge, what we can know and how or why we can know it, is a theoretical question with very practical implications. The authors discuss uncertainty. I would differentiate between doubt about what to do from uncertainty about the world. If there is no uncertainty about what course of action to adopt, then there is no decision to make; uncertainty is one of the key conditions for the existence of a choice. One of the reasons for decision uncertainty can be uncertainty about the world. Whether such knowledge uncertainty is avoidable or reducible depends upon the nature of knowledge; if knowledge is accretional then uncertainty can be reduced by further accretion. However, both Kuhnian model of scientific revolutions and the Popperian model of science argue that knowledge is contingent and may be subsequently

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found to be false so that uncertainty, in the classic sense of Knight and Keynes, is unavoidable. In the latter case, the current predilection for treating uncertainty as no more than a synonym for probability is a dangerous delusion and we need to learn instead out to take decisions about changing a future which is itself unknowable. Here, the authors refer to Holling's concepts of adaptive management and resilience as partial approaches. Similarly, it has been pointed out that the appropriate interpretation of the benefit-cost ratio is not as a pass-fail criterion but as a measure of confidence that the intervention strategy is preferable to the do nothing baseline: a benefit-cost ratio of one is the point of maximum doubt as to which should be preferred.

The elephant in the room on the treatment of uncertainty as if it is probabilistic is the question of: what is probability? There is a danger that we are treating everything which can be expressed as number between 0 and 1 all as probabilities. I would argue that any claim that a number is a probability is simultaneously a claim as to what can be known and why, and that that claim can be expressed in a form consistent with Kolgomorov's axioms of probability. In that case, the nature of the claim may be different (e.g. Frege's concept of logical probabilities; Keynes's concept of probability as truth values) and they may or may not comply with the Kolgomorov axioms.

At the same time, I'd argue that the concept of variability is more useful than that of probability. What is found in Monte Carlo analyses is that it is the distributions that are critical, and a probability is simply a point from a distribution where at least three measures are necessary to describe a distribution (central tendency, variance, kurtosis) although a graph is always better. A distribution is also a static description when often we are most interested in change over time. There is also a tendency confuse probability and randomness: there are causes, but often we just cannot predict better than probabilistically, as if events were random. A major part of those causes are meteorological; once that is recognised, a key question becomes: how far are event probabilities independent? For example: âĂć If a community experiences a 1 in 100 flood one day, what is the probability that it will experience a similar flood the next day,

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week, month or later in the year? It only reverts to 1 in 100 when the probability of a flood event is truly independent of the preceding events. Thus, flood probabilities often show a seasonal variation. âĂć What is the probability that a country will experience at least one 500 year return period flood in the country during any year? The more catchments for which the probability of each flooding is independent of that for any other, the higher the probability. âĂć What is the probability that the three largest rivers in a country will simultaneously experience a 1 in 200 year flood? The best answer I get from hydrologists is that the answer, for England, is likely to be considerably closer to 1 in 200 than 1 in eight million.

Looking at variability also reminds us that floods are simply part of the natural variation in precipitation and river flows; we should not therefore treat floods, droughts and water resources as separate issues. In some areas, floods are the water resource. And it is variability is a key determinant of the difficulty of water management.

What the authors imply is also that research agendas are also discipline based; what that discipline happens to be curious about. This is one of the causes of the problem of the science-policy interface; not least because confronted with a problem, decision makers have to decide what to do, academics want to study it. Academics also cling to the conveyor belt model of research, starting with pure curiosity driven research, and leaving to others to make practical use of the results as they fall off the end of the conveyor belt. Conversely, if in practice, there is nothing as useful as a good theory, it is from seeking to apply theory that identifies the gaps and weaknesses of theory. So, there is a virtuous circle between theory and practice: it was those doing flood risk management that identified a major theoretical problem, as well as practical problem, was the lack of any method of identifying the probability of failure on demand of flood embankments. So, I agree wholeheartedly with the authors' call for more participatory research.

In the UK, the most recent reports on flood risk management, the Pitt Report and those from the EFRA Select Committee, identify the critical issues as those of governance.

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Those concerns are also at the centre of the debate about the form and content of the proposed Floods and Water Management Bill in the UK. Technical solutions and governance are the Yin and Yang of flood risk management; they really cannot be treated in each in isolation, as the authors observe in their conclusions. I would agree that the dominant approach is technical (with governance then seen as an add-on extra required to make the chosen technical solutions work). Thus, the essential questions about flood risk mapping are: who wants to know what, and how do they want to know it? As the authors note, there are quite different audiences and it is unlikely that any one set of maps will satisfy all their needs. From a crisis management perspective, I would argue that a 'map' must summarise the process, the development of flooding rather than be map of one state of flooding, its extent at some return period.

On mapping, a key question at the moment is: how precise and accurate does a map need to be in order to be useful? My working rule of thumb is that engineers are precise to the nearest millimetre but wrong to the nearest metre. This is not a criticism but a recognition of way in which the lack of, coarseness and inaccuracy of the data, coupled to modelling errors, necessarily results in crude outputs. So, useful models should be generally right but imprecise in detail. This is easier to do for macro-scale models than at the small scale; for example, more is being expected of surface water flood models than can be delivered at present. Similarly, society has unrealistic expectations of the capacity to deliver useful flood warnings in quick to respond catchments.

In terms of governance, many physical scientists and engineers haven't caught up with the new reality. The old style flood management involved a Platonic Philosopher-King model of experts deciding what the public needed and determining the best means of satisfying those needs: one of the authors' references is thus to 'optimal' flood protection. The emerging model is one of decision making by the stakeholders, enabled to make informed decision by the available expertise. The active engagement by the public in decision making is an inevitable consequence of an active, ageing population. So, that in any public meeting, the official experts should expect that the public may

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include a retired partner in a firm of engineers, a retired judge and a retired professor of economics. There will often be more expertise on the public side of the table than amongst the official experts. The challenge is to develop constructive means of enabling this wide group of stakeholders to determine what to do whilst being informed by the best available knowledge. Here, the experts may have a duty not only to answer the questions to which the stakeholders want to know the answers but also to tell them what they ought to want to know even when those answers will make the stakeholders' task more difficult.

From that perspective, I would criticise the authors for accepting the technical framing of the discourse, notably the use of 'risk communication'. That terminology implies that the issue is one of information transfer from the experts to the non-expert. An arguably better term is 'conversation': this stresses that it is a form of social interaction (most obviously in those languages which differentiate between vous and tu), at least as much about social relationships as the content, and that it is a dialogue. Rather about transmitting meaning, it is about constructing and arguing meaning. It also requires that we understand the properties of the symbolic systems which we have to use in order to have these conversations. The Floodsite project attempted to construct a definitive glossary of terms, but if words each had a single meaning then it would be impossible to communicate unless we agreed a common code before hand and then we could only share thoughts which are contained within the signs and meanings of that system. So, for example, in naval flag signalling systems, anything complicated had to be spelt out letter by letter. As Wittgenstein and others have argued, language as communication works through metaphors and analogies; it is its permeability that enables it to work. Whilst it may be possible for me to decide what I mean by 'risk' in a particular context, for others, and in other contexts, it can legitimately have different meanings.

The definition of stakeholders also requires further development. Governance is about power: who has it now, who should have it, and what forms of power may be used by whom for what purposes. Thus, one group of stakeholders is those who have power

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now: governance therefore determines what is physically possible to do. In turn, power is bounded so that flood risk management, like all water management, always involves cross-boundary issues; the nature of those boundaries vary so that they may include national boundaries, but the problem is always to achieve collaboration across boundaries. Here 'trust' has been found to be a key condition for organisational collaboration.

Flood risk management is a problem in spatial planning since floods are the consequence of weather, antecedent weather, and land form as modified by land use: the only factor which can be modified is land use and that is through spatial planning. Therefore, a key question is: how can we integrate land and water planning, a question which the "Water Assessments" in the Netherlands and the SAGE/SDAGE processes in France are attempts to answer. So, spatial planners are key stakeholders in flood risk management.

Like the WFD, the floods Directive leaves it to the individual nation states to designate a 'competent authority'. The obvious question, therefore, is what determines 'competency'? The widely different institutional arrangements adopted in different countries is then a very useful comparative experiment to determine what arrangements are most likely to deliver competency.

That governance is centred on power immediately engages those difficult issues of legitimacy, accountability, and justice. For example, in any decision about reducing the risk of flooding to one community, there are four key stakeholder communities with different interests: 1. those who live or work in that community. 2. those who live or work in other communities in the catchment who will be affected by the form of intervention adopted. 3. those elsewhere in the country at risk of flooding since if one community is protected now, the resources used will mean that protection in other areas will be delayed. 4. the general taxpayer who bears all or part of the cost of the intervention.

Each of those different interests needs to be properly taken into the decision; the prob-

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lem is both how and what weight should be given to each interest? I've previously argued that procedural justice is the key conditionality and that procedural justice is about who may use what form of power for what purpose.

In this discussion, I've avoided mentioning the Floods Directive itself. Whilst the Water Framework Directive came with a series of internal contradictions, it did centre on the concept of Integrated Water Resources Management. In this regard, the rapid introduction of a single function Directive, in the form of the Floods Directive, is a step backwards. Secondly, the Directive is a lowest common denominator model: it won't help us to advance flood risk management, it will still simply raise the lower threshold of achievement. Was the Directive influenced by the state of the art research on flood risk management? I look instead to WMO's Associated Flood Management Programme to see the future direction of flood risk management.

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