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Summary of Comments by Panelist William James

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Conference on 50y of watershed models
Bill James' comments

At the conference in Boulder, CO, held in Sept 2012, I was on a panel discussing models, hopefully to make some provocative statements. Also, during the rest of the conference, from time to time I asked from the floor a number of what could also have been considered potentially confrontational questions. One or more of my comments might have indeed been irritating, so I decided to scribble them down before I forget…

1. There are two types of model complexity: that of the generalised model, and that of the specific case study model or application – while the total number of uncertain input parameters in the latter may be in the millions, they may be reduced to a handful of dominant parameters, by zeroing out processes with dormant parameters. Sensitivity analysis can do this automatically and instantly.
   Far from model parsimony being a desirable end in itself, a point made by many speakers at the conference, only by increasing model complexity can we achieve a solution at the next acceptable level. (Model building being a sequential procedure of critical thinking and scientific discovery.)Don't separate data collection from model building; they are equal components in design, problem solving and creative thinking. Neither works without the other.
   Nothing marginally relevant should be ignored - never ignore information. The basic and unstated need to increase model complexity has probably driven the whole model-integration race, which this conference in many ways is highlighting.
2. Urban drainage models (in particular) materially benefit society. On the other hand, medicine gets a noticeably big share of public support. Conservation does too. Urban drainage does not enjoy similar attention. We need to make our case. We should collect good data on how urban drainage models materially benefit society.
3. There is a case for working collaboratively. The watershed-model business is fractured, and efforts to integrate the models are being widely duplicated. Different agencies build essentially similar models, e.g. for public works (USACE), agricultural watersheds (USDA), natural systems (USGS), environmental issues (USEPA), rainfall (NWS), roads and highways (FHRA?), floods (FEMA), and more. However only a handful of models are supported and widely used (by folks in my sphere, e.g. SWMM, SWAT, HEC-RAS, HSPF). On the other hand it seems, at this conference particularly, that almost everyone, and also every other university and research support agency,is actively building model environments to integrate these key models with physical, GIS, time series and other data. Even worse, in our narrower business, different engineering departments are responsible for planning, design, construction, operation, management and litigation, and separately for water supply, sewerage, stormwater and pavement. Not well represented at the conference, various commercial software packages perhaps more successfully also attempt to integrate across these divisions. While several of these efforts involve collaborating across departmental lines, there seems to be a huge amount of duplicated effort, especially disconcerting where some departments are backlogged with massive workloads.
4. Folks talk about *water scarcity*, but there is no water scarcity anywhere, really. (If there were, where has the water gone?) Probably there is the same amount of water now as there was 100,000 y ago, so the problem would clearly be better expressed as *there are too many profligate people using water*. Expressing the problem in this way – asking a different question – can lead to radically different solutionstrategies. My point is that as well as further engineering

end-of-pipe models, we need models that have been deliberately written to include principles that evaluate human and animal **populution**(product of population and consumption rates). This is a difficult issue, but numerous ideas have been promoted, and I list about 30 below.
All problems are caused by bad human behaviour, and can be corrected by changing that bad behaviour (as opposed to end-of-pipe engineered construction).
It all starts with drains. Help supply water to a struggling population before building drains, and you develop a slum; build the drains first and you develop a community.

5. There are no solutions, only more problems. Every analysis produces ever more questions.
All engineering design is a provisional lash-up; we can only replace a critical situation with a chronic condition, and the price is always vigilance.
In a contest of alternative explanations, the most prosaic should be considered the most likely. Poetic explanations are likely to be pipe-dreams.
6. Some models are both useful and reliable. But it is often said, especially at this conference, that *even useful models are wrong*, however USCEA (uncertainty, sensitivity, calibration/optimisation and error analyses) produces models that are in an engineering sense *solid, robust and reliable*. Focus not on quoting cute phrases out of context, but focus instead on reliability. We have shown how a classroom of (say) 50 even novice users can determine the set of "correct" or best input parameters in a set of e.g. 2K uncertain input parameters, in (say) 30 minutes (whereas so-called automatic methods take hours or even days to set up and run for equivalent problems). Intelligent users with powerful computing trump dumb computers. The problem with automatic calibration methods is that they are unintelligent, and cannot match the speed of an intelligent modeller, especially when using sensitivity-based radio tuning. We plan to run and publish the results of a speed test.
From this it also follows that the best model will partner with the user to both train the user and also optimize the design. Above all the best model has to encourage intelligent management of the model by an informed user.
7. Ideas for a better future: ethical bases for models:
   - Develop a sacred ecology or ethos.
   - Zoom from Newtonian to the wider Darwinian view.
   - Admit that in a growth-oriented world true sustainability is a pipe dream.
   - Admit that there are no water shortages (only people surpluses).
   - Modify our quest for unlimited growth.
   - Test human population density as a LID.
   - Never build to the advantage of one segment of a community (and detriment of another).
   - Eat lower on the food chain.
   - Manage animal populations.
   - Restore more natural habitat.
   - Respect biological equity.
   - Maximize bio-diversity.
   - Restore cold-water fisheries.
   - Re-create nature/wild life values in cities.
   - Test human population density as a LID.
   - Use renewable energy exclusively
   - Eliminate water basin transfers.
   - Enforce pollution prevention.
   - Recycle water locally.
   - Revitalize the infrastructure business.
   - Integrate the human management of the ***four*** component water infrastructures.

- Build intelligent, integrated computer-based infrastructure information and control systems
- Share information by posting it on the web.
- Learn from regions of financial and water scarcity.
- Rearrange financial priorities to favor infrastructure maintenance.
- Design sewers for autonomous robots.
- Make intelligent use of distributed storage.
- Build macroscopic models.
- Use multi-threaded models
- Publicize successful, aesthetically pleasing infrastructure.
- Reduce our dependence on end-of-pipe vis-à-vis source control solutions.