Computation of Things in the Perspective of Climate Implications

Justyna Zander
HHI, Harvard University
14 Story Street, Cambridge, 02138 MA, USA
justyna.zander@gmail.com
http://sites.google.com/site/justynazander/

Fraunhofer Institute FOKUS
Kaiserin-Augusta-Allee 31
10589 Berlin, Germany

Recently, the attention around climate change and global warming has been raised in the context of the models capabilities, their predictive power, and the reliability of the results. In the proceedings, a few examples of failures in climate models and their execution are pointed out, main reasons of the problems are discussed, and a novel perspective on analysis of those issues is proposed. The sources of information are extensively referenced to the multimedia publications elsewhere.

Failures in Climate Predictions

Failures in weather and climate prediction happen. As posted on the WUWT blog [1] climate models have been predicting less snow in the Northern hemisphere, whereas the snow storms in the Winter 2010 have been at least as extensive as in 1970 in the United States and the situation has been even more exacerbated all over the world. Similarly the predictions on tsunami scale that reached Hawaii in March 2010 failed [6]. Fortunately, this was good news for the society.

What are the problems to be solved so as to improve the forecasting, though? Clearly, the measurement data are the first source of information for the models. Then, historical data play a crucial role. Further, the assumptions and the abstraction level of the models, as well as the simulation itself belong to the prediction artefacts.

To that end, as it has been proven in the Hawaiian case the priorities in searching for the *reason* of failures should be reconsidered. For example, it is estimated that there is less need for additional measuring equipment. Instead, a rigorous examination of long-standing assumptions on the models that are used to estimate the strength and impact of tsunamis should be reinvestigated. As an example, one of the hypotheses that were taken for granted constitutes that the Chilean quake occurred in deeper waters than actually happened, so it should be reassessed. An abruption in deeper seas would have displaced more water and thus resulted in a larger tsunami. Further issues are related to abstracting from such parameters as tsunami waves' intervals and their dispersion [6]. Including those facts would increase computational cost of the simulation, though. Also, the computation and simulation fidelity are still questionable [4].

Computation of Things as a Workaround for the Needs of Humanity

Seeing that there are still so many problems to be solved on many levels, here an *individual-driven* as opposed to the *mass-centered approach* is proposed. In different words, what if *we* could start a *complementary solution* to the current practices from scratch, in a certain parallel sense?

As introduced in previous work [7] the chain of (1) participatory sensing of the environmental changes (including flora and fauna [5], and human behavior changes), (2) their analysis in a common computational framework, (3) and a single-human-oriented synthesis (cf. Figure 1) holds the potential of turning the paradigm of prediction understanding towards multitude different directions. It is not only the analysis that is now tackled from a completely different angle and that may increase the general forecasting capabilities, but also the public awareness is exponentially growing. In fact, it is not only *them* who do *some sort of climate-related predictions* anymore, but it is all of *us* who provide data to the system and expect to get the results that are significant for the quality of *our lives.* In terms of the analyzed disaster scenario, this refers to the warnings, but also prevention, and mitigation actions.

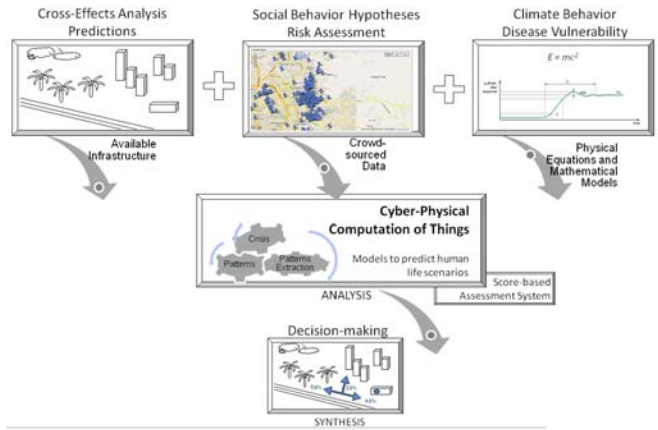

Fig. 1. The Vision for *Computation of Things*

Does it guarantee avoiding the general problems that are struggled with when doing predictions? To some extent it does. Naturally, it generates further challenges, though. The main issue is the notion of computation and the paramount significance of its faithful accuracy [4]. Further challenges are, for example, the semantics of the crowd-sourced data, their proper cross-effects analysis, the merge with the existing sets of information, and a personalized interface enabling a proper understanding of the results in a user-friendly fashion.

On the more abstract level, the concept described above is called *Computation of Things (CoTh)* [7][8]. It is an approach to understanding the individual self and its surrounding based on the micro-scale information that combines with macro-scale data to enable prediction of different life scenarios. It serves to deliver guidance towards sustainable development for an individual, but if projected and combined with behavioral patterns of groups, communities, and nations, it provides knowledge about the world-wide changes and their possible global effects.

CoTh includes *Humans in the Loop*. It is further defined as an abundant supply of predictive computation capabilities of high performance and large-scale applicability with high accuracy and quality so as to allow for providing humanity's physical, physiological, mental, and spiritual needs in a profound and as of yet unfathomed manner. Its core is strongly connoted with physical systems engineering, though it does not neglect the knowledge, measurements, and experience from such fields as life sciences, humanities, and social sciences. In this spirit, it displays an interdisciplinary character. *CoTh* is related to such terms as ubiquitous computing, pervasive computing, and everyware. It also builds up on such concepts as Internet of Things or Web of Things.

As illustrated in Figure 2 there are four scenario types when predicting the future. Relating to a climate-induced disaster, if a catastrophic event happens and no preventive action is taken (left upper corner) the amount of fatalities is very high and the cost of mitigation is only growing. In the case when the investment is done in the preliminary time (right upper corner) the number of victims is reduced and the cost remain more stable. The scenarios where no event occurs are then self-explanatory. This simple example shows how important it is to provide a choice to *every individual* so as to let her/him control and create the destiny. *CoTh* is a means to achieve this goal.

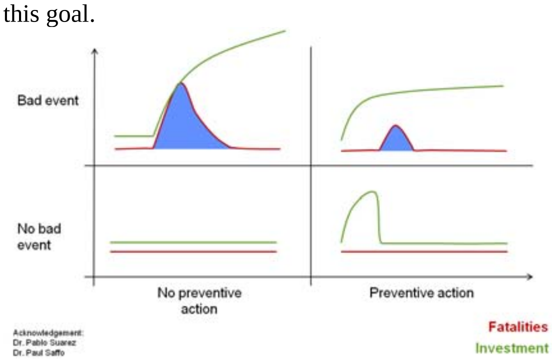

Fig. 2. Four Prediction Scenarios

The proposed integration goes along with the research statement of B. Grosz [2] who is emphasizing that one of the major challenges for computer science in the next decade is to create the scientific and technological base for easy-to-use, large-scale information systems based on human-computer interaction. In terms of design this then leads to the questions comprising such fields as sociology, psychology, or demography analyses discussed more extensively in previous work [8]. Furthermore, although *CoTh* is based on the principle '*to share is to gain'*, it will require more and more personalization for a single user. Thus, its price shall be the lack of the privacy and a total transparency of things [3].

References:

[1] S. Goddard, *Watts Up With That?*, Commentary on puzzling things in life, nature, science, weather, climate change, technology, and recent news, (Ed. Anthony Watts), 2010, http://wattsupwiththat.com/2010/02/19/north-america-snow-models-miss-the-mark/

[2] B. J. Grosz, Personal website, Higgins Professor of Natural Sciences, Dean of Radcliffe Institute for Advanced Study at Harvard University, http://www.seas.harvard.edu/directory/grosz

[3] K. Kelly, *On the next 5,000 days of the web*, TED Talk, 2007 http://www.ted.com/talks/kevin_kelly_on_the_next_5_000_days_of_the_web.html

[4] P. J. Mosterman, J. Zander, G. Hamon, B. Denckla, Towards Computational Hybrid System Semantics for Time-Based Block Diagram Modeling, In *Proceedings of the 3rd IFAC Conference on Analysis and Design of Hybrid Systems (ADHS'09)*, A. Giua, C. Mahulea, M. Silva, and J. Zaytoon (editors), pp. 376-385, Zaragoza, Spain, September 16-18, 2009, plenary paper, http://msdl.cs.mcgill.ca/people/mosterman/papers/adhs09/fp.pdf

[5] M. Mott, National Geographic News, *Did Animals Sense Tsunami Was Coming?*, 2005, http://news.nationalgeographic.com/news/2005/01/0104_050104_tsunami_animals.html

[6] H. A. Sample, *Scientists say tsunami models should be tested*, March 2010, http://www.msnbc.msn.com/id/35661638/

[7] J. Zander, P.J. Mosterman, *Computation of Things for Sustainable Development*, Homeland Security Workshop on Grand Challenges in Modeling, Simulation, and Analysis, March 2010 http://hhi.harvard.edu/images/resources/reports/computation%20of%20things%20pdf.pdf http://hhi.harvard.edu/images/resources/images/program_and_research/CMEW/computation%20of%20things%20ppt.pdf

[8] J. Zander, Professional blog, *Empathy-driven Design*, 2010, http://crisismapping.ning.com/profiles/blogs/empathydriven-design http://crisismapping.ning.com/profiles/blog/list?user=0w54ml5sd05gi