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Communicating climate (change) uncertainties: Simulation games as boundary objects

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ABSTRACT

Climate science is characterized by large uncertainties about the direction, extent and time frame of climate change. Communicating these uncertainties is important for decision making on robust adaptation strategies, but proves to be a challenge for scientists particularly because of the complexity of uncertainties that are part of natural variability and of human induced climate change. The aim of this paper is to assess the role of a simulation game, as intermediate, to the communication of climate change uncertainties to water managers. In three workshops with water managers, the simulation game 'Sustainable Delta' was played to test the influence of the game on their understanding of climate change uncertainty using ex ante and ex post surveys. In each workshop an experimental- and control group were given different assignments to measure the influence of the game. The results show that although the differences between groups were not statistically significant, a change in their understanding of uncertainties was observed. The paper concludes that the learning effect of the game is inconclusive, but that the game does fosters a broader understanding of the concept climate change uncertainty. In doing so, simulation games are a promising approach to support the communication of climate change uncertainties meaningfully and support the process of adaptation to an uncertain future.

1. Introduction

Climate change projections are an important source of knowledge for water managers to adapt their strategy to the expected intensification of the hydrological cycle due to climate change (Arnell et al., 2014). In its 5th Assessment Report the Intergovernmental Panel on Climate Change (IPCC) listed inland flooding as one of the eight major climate risk and concluded that "a first step towards adaptation to future climate change is reducing vulnerability and exposure to present climate variability" (IPCC, 2014). However, scientific knowledge on climate change is incomplete and fraught with uncertainties. For example, it is uncertain how the earth

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system responds to changes in radiative forcings and how society responds to climate change by means of adaptation and mitigation strategies (Kunreuther et al., 2013). Recent studies have reported numerous barriers to adaptation that challenge decision making in water management, ranging from institutional and political to social and cognitive barriers (Biesbroek et al., 2013). One of the more frequently reported barriers is climate change uncertainty, even though it is well argued that it should not be a limit to adaptation (Maslin and Austin, 2012; Wilby and Dessai, 2010; Mozumder et al., 2011). Several studies have argued that water managers require understanding of climate change uncertainties to make informed decisions to adapt to climate change adaptation, which includes information about the different types of uncertainty and some indication of the level of confidence in the projections of future changes (Tribbia and Moser, 2008; Wardekker et al., 2008). Although many sources of climate change uncertainty exists, one can classify uncertainty originating from human-induced climate change, and uncertainty inherent to natural climate variability. Recent studies have shown that future climate model projections are uncertain, but that part of this uncertainty can be explained by natural variability (Deser et al., 2012; Van Pelt et al., 2014). These studies have shown that natural variability is a key source of climate change uncertainty. And even though the impact of climate change on variability of precipitation is not yet fully understood, it is important to communicate about the difference between uncertainty related to the (human induced) climate change signal and the uncertainty related to climate variability. Knowledge about these two different types of uncertainty can support adaptation to climate change, because water managers already have experience in dealing with natural variability through their daily practices. If water managers learn about the role of natural variability in the uncertainty of climate change it may, on the one hand, remove part of the barrier of climate change uncertainty and, on the other hand, give them more trust to use instruments they are already familiar with to deal with climate change. However, climate change in general and climate change uncertainty in particular is a difficult message to communicate to water managers. For such information to be usable it should be comprehensible for decision makers (Tang and Dessai, 2012; Tribbia and Moser, 2008). Consequently, the communication of uncertainties from science and policy plays an essential role.

In general, communication on climate change takes place within the linear communication model where science 'speaks truth to power' (Hoppe, 1999): scientific research analyses the projected impacts and vulnerabilities, identifies possible response options, and informs politicians of these findings, often in codified forms (Weingart et al., 2000). This linear model has been questioned in general (Hoppe, 2005; Huitema and Turnhout, 2009; Wesselink et al., 2013) and is for several reasons particularly troublesome in the context of communicating climate change uncertainties. First, climate change uncertainties have many different sources and it is not possible to quantify all the components (Alley et al., 2003; Dessai and Van der Sluis, 2007; Hall, 2007; Jones, 2000; Maslin and Austin, 2012). This makes climate change uncertainties complex and for scientists difficult to explain to decision makers. Second, climate science is a physical science and the term 'uncertainty' can be perceived by the decision makers as something that can be reduced. Scientists oftentimes reinforce this idea by expressing their confidence in the usefulness in climate projections and, more importantly, in their ability to continuously produce better information and reduce uncertainties (Lemos and Rood, 2010; Shukla et al., 2009). However, it is not likely that the large uncertainties will be reduced in the near future (Dessai et al., 2009). Third, the issue of climate change is epistemologically and psychologically distant for many people and effects of climate change are not visible to everyone and some effects may take decades to occur (Carolan, 2004; Milfont, 2010).

Intermediaries or boundary objects might play an important role in clarifying scientific knowledge on climate change uncertainties by which the information becomes more understandable and useful for decision making (Clark et al., 2011). In this context, boundary objects are instruments used to facilitate the interactions between science and practice and function as the operating space between different 'social worlds' in which actors come together and share interpretations without the need for consensus (Shackley and Wynne, 1996; Star and Griesemer, 1989). One specific type of intermediary that has recently been proposed for linking environmental science to policy is the use of simulation games. Three noteworthy examples are: 'Keep Cool' a climate change board game developed to create a common language between students, scientists and public (Eisenack, 2012); 'WaterSim' a boundary object designed to bridge boundaries between scientific researchers and water policy stakeholders in central Arizona (White et al., 2010); and 'Broken Cities' a strategy board game that requires participants to maximize rent while keeping carbon emissions under the limit (Juhola et al., 2013). Such interactive simulation games can be used to transfer or communicate complex scientific information into understandable and tailored information which is tacitly connected to the target group (Haug et al., 2011). Despite the increasing attention to simulation games, no studies have used simulation games in communicating about climate change uncertainties.

The aim of this study is to explore the role of a simulation game in the communication of climate change uncertainties between science and water managers. More specifically, we analysed how a simulation game functions as intermediate in the understanding of the uncertainties on natural variability and human induced climate change of water managers in the Netherlands. We used quantitative and qualitative methods to explore the influence of a simulation game with the 'Sustainable Delta', which is an interactive simulation game based on a hypothetical river stretch (Haasnoot et al., 2012; Valkering et al., 2012; Deltares, 2014).

2. Communicating climate change uncertainties: simulation games

Describing uncertainty on future climate change has proven to be a major challenge for the climate science community (Risbey and Kandlikar, 2007; Swart et al., 2009). Making informed decisions on inherently wicked problems, in which