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To: Delta Independent Science Board disb@deltacouncil.ca.gov

Sent: June 26, 2023, 10:48 AM

From: Richard Norgaard norgaard@berkeley.edu

Subject: Decision Making Under Deep Uncertainty (DMDU) Review, Prospectus of May 15

Dear DISB Members:

I appreciated the elaborations and expansions from the March to the May 15 draft. I have enjoyed listening to some of the talks that have been organized to help inform this assessment. I look forward to the report. Please excuse my comments coming at the deadline.

First, a very small and not too controversial comment: on page 3, last paragraph, second line "in the Delta" should be changed to "related to the Delta" or "affecting the Delta".

Second, and a little more controversial. The prospectus mentions that one of the advantages of working with the DMDU approach developed within the field of decision science is that it opens the minds of scientists and decision makers as well as possibly stakeholders and the broader public. In my humble judgment, this may be the greatest advantage of the approach. In the case of benefit-cost analysis, doing the analysis sharpens our understanding of existing questions and raises unexpected questions. Unfortunately, very few people engage in the process of doing B-C analysis, most do not have time to do so, and most prefer simple answers. Opening minds when the times are changing is extremely important. And so, I am hoping that the Board will ask interviewees about the extent to which they have been able to broaden participation in, or through, the DMDU process and how it can be furthered. I am less sure about how to guide the closing of minds around decisions. I can simply point out that it is important to sustain options for adopting later in changing and uncertain times.

Third, the prospectus repeatedly refers to risk but never to whom: the state at large, agricultural interests, urban interests, poor communities, or future generations. I sense that DMDU is better fit for questions of long-term investments in water reliability than, for example, maintaining biological diversity. Politics is mostly about "to whom" though of course politicians frequently prefer not to be open about such matters and appreciate "scientific" analyses that hide such questions.

Fourth, and related to the above, for what kinds of decision-making is DMDU suitable? The California water system is complex, its environmental, especially ecological, issues are much more complex, and then when we add in risk to whom, things become extremely complex ... though I think we went beyond our computational limits for scenario checking the robustness of decision options before considering ecology. What is the scope that is possible. California is undergoing agricultural changes in response to climate change. Can these changes be included in a DMDU analysis? What sort of decisions are we realistically thinking about in this review?

Fifth, in comparing the robustness of alternative plans to different scenarios, how are the values of risks to life versus risks to agriculture weighed? Are economic values used or are these reported separately for policymakers to choose? How are plans that might fail early compared with plans that fail later, perhaps affecting future generations? Are we not back to the classical economic conundrum of appropriate discount rates?

Sixth, I am frustrated, though this is by no means unusual. To put it positively, I am torn between the advantages of 1) taking a best available decision science method and reviewing the extent to which it is being used and could be better used by federal, state, regional, academic, and NGO scientists for informing policy and management decisions related to the Delta versus 2) cautioning scientists, policymakers, and managers on the limits of DMDU or other best available methods for decision-making in rapidly changing, indeed tumultuous, times and what the limits imply for decision-making. I think the DISB can take both approaches, though this will entail some complications in communicating the value of DMDU.

Seventh, and now to the heart of my concern. As I understand it, DMDU relies on scenarios from "somewhere", scenarios that somehow appropriately incorporate the known and unknowable uncertainties for testing the robustness of plausible decision choices. Climate scenarios have often been referred to because we are most frustrated currently over the uncertainties of climate change. There have been climate scenarios for California, though I am not sure when they were last updated and, in rapidly changing and more tumultuous times, updating is essential.

In any case, I am having difficulty perceiving how climate scenarios incorporate unknowable uncertainties. IPCC climate scenarios, for example, are being updated as new science better explains how the oceans are responding to the global redistribution of heat given that Earth is radiating less energy out to space. These new ocean responses were previously unknown to oceanographers who had been engaged in understanding Earth's climate system.¹ And it is how the oceans are responding that drives the new weather extremes that we are experiencing. These extremes are the most dramatic evidence of climate change to date and

¹ As I recall, there were two issues: the rate of vertical mixing of heat and the rate of ocean absorption of carbon that was related to vertical mixing of heat and to how positive the

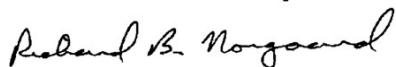
response of phytoplankton would be to more carbon. It is not that no one had thought of these things, but that IPCC is itself an assessment process of the existing scientific literature in which higher rates of vertical mixing and a very positive phytoplankton response were very rarely taken as serious possibilities.

of great interest, indeed matters of life and death, for California water policy and management.

Thus, as I understand it, DMDU assumes some “higher authority” is characterizing the unknowable in “extreme” scenarios in a way that is appropriate for “lower authorities”. Yes, California water agencies should at least be working with this best available method. But California is also the fifth largest economy in the world. It has some of the top universities, governmental research institutes, and NGOs with scientific staffs in the world. California has scientists who have been playing key roles within the IPCC and regional climate assessments who can discuss the epistemological issues with scenarios. In short, Californians are strong players in the “higher authority” that DMDU seems to rely on. Should not the DISB extend its review to include assessing the scenario building process related to California? Indeed, the concerns of California water scientists, policymakers, and managers might also lead to better scenario construction. But maybe this would be another assessment for the near future.

To reiterate, I better understand the importance of asking questions and opening minds under changing conditions than I understand how to reach appropriate methods for making public decisions under changing conditions, especially within the existing organizational structure of moving from science to action. Please interpret my comments within this context.

Sincerely yours,

A handwritten signature in black ink that reads "Richard B. Norgaard". The signature is written in a cursive style with a prominent loop at the end of the last name.

Richard B. Norgaard