

Comments on Transboundary Water Issues

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A recent *Eos* article has raised a number of interesting points regarding the manner in which global change and related water issues are commonly perceived and addressed [Lakshmi 2003]. I would like to suggest some additional ways in which we, as Earth scientists, might consider addressing and describing (particularly to nonscientists) our water-related challenges. The article correctly pointed out that the inordinate amount of media and political attention paid to the single topic of carbon dioxide emissions has led to a general confusion between the terms “global change” and “global warming.” Global change has been identified as the environmental transformations that result primarily from the warming of the lower atmosphere.

In addition to the confusion between the terms “global change” and “global warming,” there seems to be a common misconception among the general public that the latter is the sole cause of the former. Whereas some global changes have been attributed to recent trends in the warming of the lower atmosphere, others have not. For example, variations in solar activity, ocean circulation, and Earth’s orbit have been linked to global changes. Exactly how much of the global change is attributable to anthropogenic activities, as opposed to natural cycles, we do not know. What we do know is that changes in weather and climate patterns are mediated primarily through water and its myriad roles within the hydrologic cycle. As the only substance that can either enhance or mitigate CO₂-induced global warming [Webster 1994], water is sometimes referred to as the mediator of rapid climate change.

The article identifies the most important issues arising from global change as those related generally to the water cycle and specifically to excess or insufficient water (e.g., floods or droughts). Moreover, the underlying causes of local water problems are actually global in scope and, therefore, must be addressed on that scale. I agree with his approach; however, I would go even further in suggesting that many of our water-related problems have resulted directly from managing water in accordance with man-made structures and boundaries rather than with natural watersheds and flow regimes. Motivated predominantly by political and financial considerations, we divert rivers, drain wetlands, flood valleys, mine aquifers, and pump water halfway across continents in order to exploit otherwise uninhabitable and, from our limited perspective, unproductive environments. Recent global changes have simply served to exacerbate the unforeseen outcomes of our modern-day management of water and watersheds.

In outlining recent water problems associated with global change, the article makes a distinction between anthropogenic factors (e.g., coastline and floodplain development) and natural factors (e.g., more frequent droughts and floods). I am not inclined to make such a distinction because anthropogenic factors not only amplify the water-related consequences of global change, they likely contribute to global change itself. For

instance, deforestation and wetland agricultural practices have contributed to increased levels of atmospheric greenhouse gases and to changes in the distribution of planetary water that, in turn, intensify some of the aforementioned climate forcings. Like most natural (nonlinear) systems, it is extremely difficult to separate water-related causes from effects when the two are endlessly connected via feedback loops. Additionally, climate and other complex natural systems are frequently recognized as operating on multiple hierarchical levels, such that effects observed on any particular level may not necessarily be related to causes on that same level.

It has been recommended that a global water inventory be conducted and that the results be used to develop international protocols for water usage. I support such conservation efforts in spite of the substantial uncertainties associated with tallying global water resources and enforcing international protocols. I also consider that, besides conducting research and proposing regulations, an important task for Earth scientists is to offer nonscientists an expanded perspective on water. The common view of water as just another commodity is one that, in my opinion, complicates any attempt to seriously influence usage patterns. Topics ranging from water's role in facilitating crucial processes (e.g., biological, geological, chemical) that sustain our planet and its inhabitants to the impacts of diverting water from a local watershed need to be effectively communicated to people who are often unaware of the origins of their own water. Assisting people to expand their perception of water is, perhaps, the key to their treating it differently.

Questions about utilizing Earth's resources without degrading them and about managing natural resources during rapid climate change were raised in another recent *Eos* article [Narasimhan, 2003]. T.N. Narasimhan suggests that we develop methods of using resources that are flexible enough so that we can alter our use patterns when the resource becomes stressed or degraded. Of course, the adaptive approach implies that we can monitor (in real time) the resource status and that we are willing to alter our use patterns accordingly. In the case of water, real time evaluation is a difficult proposition because significant impacts to watersheds and aquatic ecosystems often occur prior to our recognizing water scarcity. Narasimhan asks whether we will choose to begin living with nature in a more adaptive manner (probably incurring economic costs and socio-political disruptions), or whether we will continue modifying nature to meet our desires (largely depending on technological solutions to address resource scarcity).

With regard to global water, the question of "adaptation vs. modification" is moot. We humans and all of our institutions (i.e., political, financial) are wholly dependent on the Earth and its resources (water and otherwise); hence, we ultimately have no choice but to adapt. The choice is whether we adapt to a planet that has been slightly modified, or to one that has been continually modified in an attempt to fix the unforeseen consequences of prior modifications. In my view, today's water-related effects of global change are largely a consequence of yesterday's decisions to modify, rather than to respect and emulate, natural systems. As Earth scientists, we play a pivotal role in communicating to others (and perhaps especially nonscientists) our understanding of natural systems.

References

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