specific requests submitted by global or regional institutions. Members of the SSCZP TC are participating in developing a report on the *Status World Soil Resources* to be presented at the upcoming world soil day in December 2014.

The ISMC and a few other initiatives related to the GEWEX-Soil effort are led by Harry Vereecken from Julich research center (Germany) – Harry was elected and approved as the incoming co-chair of the SSCZP TC from the Hydrology section (starting Dec. 2014). I take this opportunity to welcome Harry - he will serve with Kate Lajtha (Oregon State Univ.) the Biogeosciences co-chair.

The Fellow Speaks: Seeing the Forest from the Deep in the Trees

Michael Dettinger (USGS)

We hydrologists often are so focused on the details of the river or reach at hand that everything about it seems special. However, the world's rivers, aquifers, and water resources are tied together in ways that we neglect at our peril. One key tie that binds disparate rivers and streams is shared responses to regional-scale climatic forces. Recognition of these ties is increasingly allowing us to detect and anticipate important parallels between hydrologic fluctuations and trends in seemingly distant river basins and regions. Knowledge of those distant connections (Fig. 1) provides a better scientific basis for prediction of droughts, floods, and water resources from months to years in advance. And, our growing understanding of the shared fluctuations are a scientific foundation for projecting effects of future climate changes on our rivers and resources.

Figure 1: Large-scale climate variations influence the oceans, wind patterns, and storm tracks in the Northern Hemisphere, ultimately driving large-scale fluctuations of rivers and water supplies (e.g., Dettinger and Diaz, J. Hydromet., 2000)

The catch is that the variations of hydroclimatic conditions that determine streamflow and groundwater recharge generally seem erratic and unpredictable. This does not mean, however, that they are strictly random.

My career in hydrology began back in the late 1970s as an MIT student at a time when the new thing was developing ever more devious forms of randomness to represent inflows to water systems. Other approaches incorporated more "upstream" physical process but still represented weather as random. Upon emerging from school to deal with real-world systems, though, I found myself confronting progressively larger geographic scales and hydrologic systems. The larger my "focus" grew, the more the large-scale organization and parallels between atmospheric forcings and responses (e.g., across the Great Basin and western US) that I encountered gave lie to simplifying assumptions about a random hydrology.

Rather, when viewed on time scales and geographic scales close to the atmospheric processes that give rise to them, coherent regional patterns of hydrology were evident. As an example, consider fluctuations of rivers as far apart as the Sierra Nevada, Yellowstone, and the southern Rockies. On a day-to-day basis, my colleagues and I saw that springtime fluctuations are synchronized by essentially simultaneously waxing and waning snowmelts (Fig. 2). Although each river's fluctuations *are* its own, discharge in streams vary in a remarkable lockstep across the western states. This synchronization of snowmelts and streams reflects (mostly) temperature changes from broad weather systems marching across the West every few days. Considered further, this sort of synchronization extends well beyond day-to-day to include seasonal, interannual, and increasingly centuries-long changes.

As another example, viewed across the rivers of western North America—which is roughly the scale of winter-to-winter differences between north-south positions of Pacific storm tracks—El Nino events in the tropical Pacific most often yield recognizable and recurring patterns of precipitation that favor a wetter-than-normal

Southwest and Florida, and drier-than-normal Northwest. The opposite of an El Nino in the tropical Pacific is a "La Nina", and La Ninas very reliably yield a wetter-than-normal Northwest and drier-than-normal Southwest. At these scales, El Ninos, along with other large-scale climatic processes like the Madden-Julian Oscillation, North Pacific decadal variations, and various still more distant climate modes, impose geographic organization on time scales ranging from weeks to decades. Although these climate processes are not as predictable in time as we would like, they yield geographically well-organized patterns of hydrology and water resources.

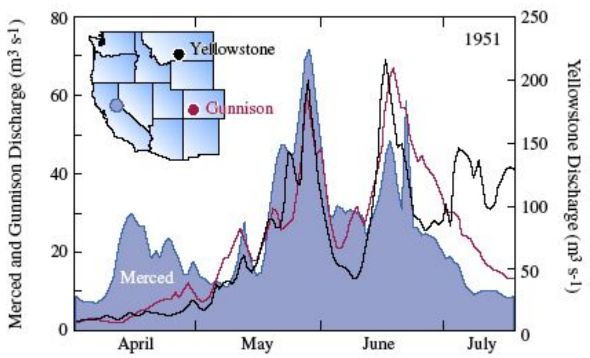

Figure 2: Comparison of streamflows in the Merced, Gunnison, and Yellowstone Rivers during spring 1951 (Peterson et al., JAWRA, 2000).

So a lot of my research has been about untangling the unpredictable from the organized, trying to push back frontiers of what we (for practical purposes) end up treating as "random". Hydrologic implications of climate fluctuations and climate changes have yielded to analysis to a considerable extent in recent years, in terms of providing better understanding of large-area patterns of hydrologic variation. At the same time, short-term weather-driven hydrologic fluctuations are being forecasted with increasing skill. Indeed, the current scientific frontier is the problem of making and using connections between the geographic organization that climate provides and the improving temporal forecastability of weather. In traditional terms, climate is essentially long-term statistics of weather, but increasingly we are recognizing that weather is organized or modulated by a whole other set of conditions and processes that we recognize as climate. An example of the kinds of problems at this climate-weather interface: An accurate 5-day forecast of some weather event that tripped us into a new climatic state would have predictive uses far beyond the weather scale…but only if we recognize how much that weather forecast implies.

One avenue into the weather-climate interface, especially as applies to hydrology, that I have been pursuing--with the help of many indulgent colleagues from Scripps, USGS, NOAA and elsewhere--is through the mechanism and impacts of atmospheric rivers (ARs, Fig. 3). ARs are continually moving and evolving, long, narrow corridors along which many Mississippis-worth of water (vapor) are transported. It has been estimated that >90% of all atmospheric vapor transport outside the tropics is conducted along these "rivers", and when one of them runs aground upon mountains, the amounts of precipitation that they yield is often prodigious. More than 80% of all floods in our Pacific Coast states have been fed directly by the structures and 85% of variance in multiyear wet-dry cycles in California are associated with periods of AR presence or absence. Between conducting >90% of the atmospheric water cycle (surely, a climate-scale role) and their rapid and erratic movements and evolutions (a weather-scale characteristic), I suspect that ARs can provide us access to the weather-climate interface. If we can better understand connections, like these, between climate and weather, we may be able to leverage our understanding of each: our ability to predict long-term patterns of hydrology, if not the temporal details, afforded by growing understanding of climate, and our increasing capacity to forecast temporal variations of weather. One can only hope.

Thus, there is a whole spectrum of levels of organization and predictability of hydroclimates and, consequently, of hydrology once a geographically broader viewpoint is taken. That spectrum ranges from extremely regular and largely predictable variations (like changing seasons) to spatially organized but essentially unpredictable modes. In the midst of this spectrum, and interacting with it, we—of course--now have another form of climate variation, one that is actually becoming more organized and more predictable as time goes on. This "other" mode is long-term anthropogenic climate change in response to increasing greenhouse-gas concentrations in the atmosphere (along with many poorly understood contributions from other human-induced insults to Earth and climate systems). The increasing predictability of the climate changes that we have in store comes both because our understanding of the processes involved is improving *and* because their predictable consequences are themselves rapidly rising above noisy natural climate variations.

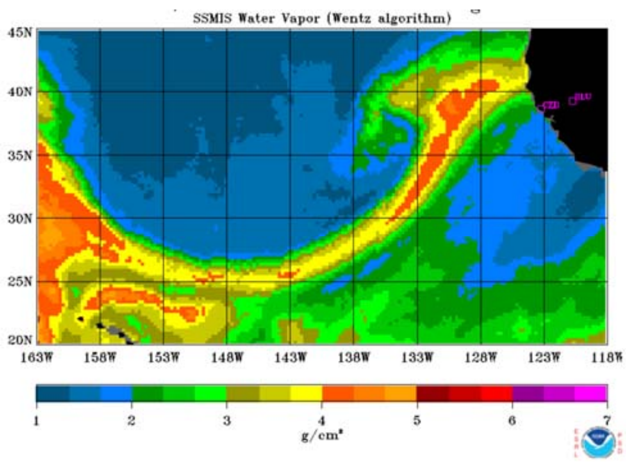

Figure 3: An atmospheric river (AR) making landfall on the coast of the Pacific North Northwest, as visualized from SSM/I vertically integrated water vapor imagery, October 24, 2014 (see Ralph and Dettinger, Eos, 2011, for more AR background).

Admittedly, the large-scale patterns that I have been writing about are often beyond any water managers' control. By learning to recognize and subtract the climatic patterns in streamflow, though, other, more local and more locally managed influences on streamflow can be better understood. Studies of the largest scale fluctuations of water resources thus provide a scientific basis for understanding, predicting, and managing water resources on time scales from days to decades. They advance our ability to protect and integrate resources among basins and across borders, and extend the effectiveness and reliability of water supplies and land-management policies even within basins. Modern hydroclimate and hydrometeorologic research is teaching us to "see the forest from deep in the trees," to step back from views of hydrology that concede too much to randomness. And, as I go forward, I certainly want to keep pushing back on the random.

The Fellow Speaks: Sometimes You Get Only One Chance

Paul Hsieh (U. S. Geological Survey)

I am grateful to AGU for selecting me as one of the five recipient of the 2014 Ambassador Award, which also includes election as a Union Fellow. I thank my colleague Steve Ingebritsen for nominating me. As Steve's citation mentions my work on the Deepwater Horizon oil spill response, I would like to reflect on this experience.

The Deepwater Horizon oil spill is well documented in the report of the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling (2011). *Washington Post* writer John Achenbach's (2011) book gives a behind-the-scene portrayal of the crisis and explains oil drilling technology in layman's terms. A special feature in the *Proceedings of the National Academy of Sciences* (v. 109, no. 50, December 11, 2012) presents 4 perspectives and 11 research articles on "Science Applications in the Deepwater Horizon Oil Spill." Here, I will simply share my personal perspective.

In June of 2010, when I was detailed to the oil spill response effort, a government-led science team had already been in operation for over a month. Headed by then Secretary of Energy, Steven Chu, the team consisted of several prominent scientists, serving as advisors to the Secretary, and a group of staff scientists, comprised of individuals from the Department of Energy National Laboratories and the U.S. Geological Survey. The role of the staff scientists was to analyze the condition of the Macondo well and the operations to contain the spill. Given the crisis setting, these analyses had to be done within a matter of a few hours to a few days. The results would then be presented and discussed at meetings, often with sharp questioning by the Secretary and his advisors. At times, the meetings took on the atmosphere of a dissertation defense. Even seasoned scientists would be mentally transported back to their graduate school days!

When the Macondo well was shut in on the afternoon of July 15, the elation from the cessation of oil flow was subdued by the lower than expected pressure observed in the capping stack. Might this indicate that the well casing was damaged by the explosion that started the spill, and now oil was leaking out of the casing beneath the seafloor? Such a leak could cause an underground blowout, which would not only restart the oil spill, but create a situation much more difficult to control (Hickman et al., 2012). To avert this potential catastrophe, the well would have to be reopened if it was believed to be leaking. According to the protocol developed by the science team, a decision on whether or not to reopen the well would have to be made within 24 hours after shut in.

The immediate path forward lay in analyzing the pressure data collected as the well was shut in. Perhaps this additional information could shed new light on the oil reservoir. As the person providing reservoir modeling support for the science team, I was given the assignment