



The **BUZZ** *A Quarterly Newsletter*

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The BUZZ is a forum for Silver Jackets teams' successes, opportunities and resources.

Atmospheric Rivers account for 30-50 percent of California's total rainfall and snowfall.

Planning for the Atmospheric River Threat

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The ARkStorm is a detailed scenario describing a very severe winter storm sequence that impacts both northern and southern California over a 23-day period. The scenario was designed by the U.S. Geological Survey (USGS) Multi Hazards Demonstration Project with inputs from experts at the National Oceanic and Atmospheric Administration (NOAA), USGS, Scripps Institution of Oceanography, the State of California, California Geological Survey, the University of Colorado, Federal Emergency Management Agency (FEMA), the National Center for Atmospheric Research (NCAR), California Department of Water Resources, California Emergency

Management Agency (CalEMA), and other organizations.

It was constructed as a basis for emergency-preparedness exercises and disaster planning by agencies and communities all over the state. The scenario is broadly patterned after an extraordinary set of historical storms during the winter of 1861–62, but was populated by modern modeling methods and with data from large storms in 1969 and 1986.

The ARkStorm draws heat and moisture from the tropical Pacific, through a series of Atmospheric Rivers that approach the ferocity of hurricanes and then slam into the U.S. West Coast over several weeks. The “AR” stands for “Atmospheric River”, the “k” for 1,000 (as the storm intensities, in some locale, might reach 1-in-1000 year levels), and, of course, “ARkStorm” is meant to summon visions of biblical-scale deluge, similar to the great flood of 1862.

“Atmospheric Rivers” is a term coined in the 1990s to describe plumes of moisture that rise up out of the subtropics into the mid-latitudes in advance

of strong cold fronts. Traditional water vapor satellite imagery does not show these plumes well, and it was only when microwave satellite imagery from polar orbiting satellites became available in the late 1990s that the full importance of these Atmospheric Rivers was revealed.

Although they are not numerous, Atmospheric Rivers account for 30-50 percent of California's total rainfall and snowfall. Over the last 1,800 years, the geologic record shows at least six storms have occurred that were worse than the 1861-1862 storms in California. If the planet continues to warm, as expected, the odds of such an event will increase significantly by 2100 due to the extra moisture in the air from the increased, oceans' evaporation. (Pictures and video are available [online](#).)

The ARkStorm project engages emergency planners, businesses, universities, government agencies, and others in preparing for major natural disasters. The project also helps to set research goals and provides decision-making information to emergency responders, resource managers, and the public. Recent studies and emergency-preparedness exercises have been conducted in California, based on the ARkStorm scenario.



On the basis of a dozen expert panels convened as part of the project, the scenario was calculated to have the potential to cause short- and long-term economic costs greater than \$700 billion. The scenario has been the basis for emergency preparedness exercises by the Navy, NASA, Ventura County, San Diego County, and the State of California through the California Emergency Management Agency.

Now, a new exercise is underway, dubbed ARkStorm@Tahoe. This effort is using the ARkStorm scenario to explore potential impacts of a megastorm in the Sierra Nevada, with an initial focus on the Tahoe basin and overspilling impacts reaching as far as Reno, Sparks, and Carson City.

The exercise will add considerably to previous applications of the scenario because of the following:

- (i) It is the first exploration of the scenario in a mountain setting with steep terrains, snowpack issues, and wild lands.
- (ii) It is the first to address impacts on ecosystems along with the societal impacts that have been primary foci of previous exercises.
- (iii) By the nature of the ecosystems

and landscape at Tahoe, many storm impacts (including those on the lake and its clarity, on erosion, and on forests and meadows) will only play out over subsequent months and even years, rather than being more or less limited to during-storm impacts.

Thus, ARkStorm@Tahoe is providing emergency, resource, and environmental managers with useful information to better manage and prepare for the hazards of extreme events, including those likely under climate change.

The exercise has involved linking models (mostly existing) of a range of processes in the basin and lake, as well as drawing on the judgment and experiences of a wide variety of local area and sectoral experts. In the long-term, it is intended to provide a shared experience upon which the scientific community can draw in planning for new, integrated predictive tools to support many forms of mitigation and preparedness for extreme events. The USGS is working with the Tahoe Science Consortium, through the University of Nevada at Reno, to complete the following:

1. Host six or more panel discussions of relevant emergency, environmental and resource managers, experts, and institutions to determine impacts and interde-

pendencies.

2. Design injects or scenario communiques for a regional emergency-response, table-top exercise in March 2014.

3. Eventually host a large summit of relevant experts, managers and institutions, and the broader community to present results, foster discussions, and generate real-world action for ameliorating potential risks with summary reports and scientific articles to follow thereafter.

Perhaps the most striking finding from the ARkStorm@Tahoe explorations thus far has been the strong and positive response from agencies and communities all over the Tahoe, Reno, and Carson City area. The ARkStorm discussions have tapped into deep-seated and immediate concerns in these communities more widely and personally than has been the case in most other communities where it has been presented previously.

The reasons for this unique response remain unclear but probably relate to still-vivid memories of floods in 1997 and the often precarious relations between these communities and their natural environments, particularly in terms of natural hazards.



New exercise scenario will explore potential impacts of a megastorm in the Sierra Nevada.