THE 16 MAY 2005 FLOOD IN YOSEMITE--

A glimpse into high-country flood generation in the Sierra Nevada

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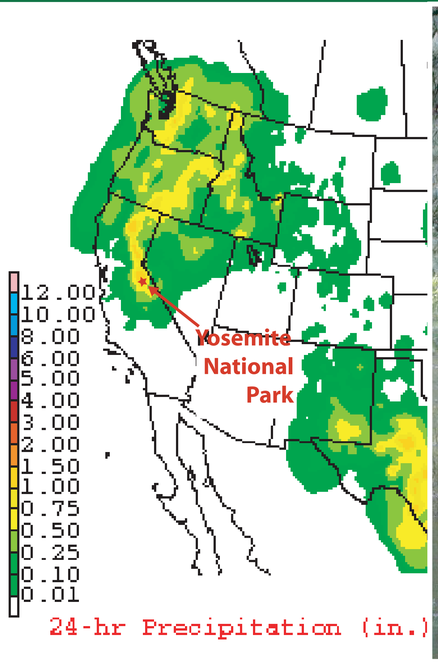
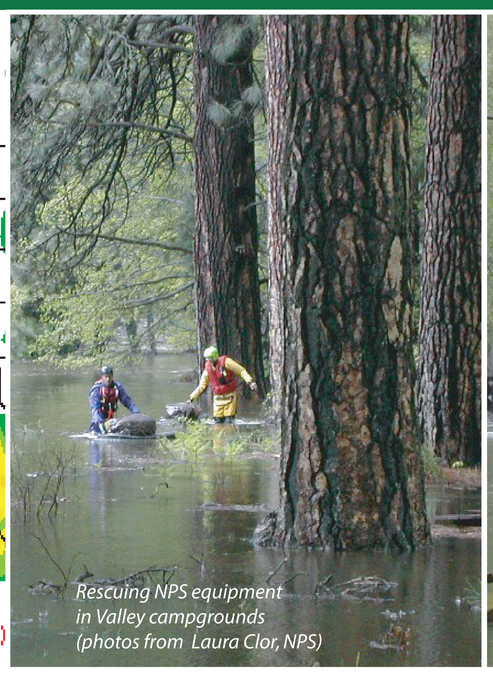
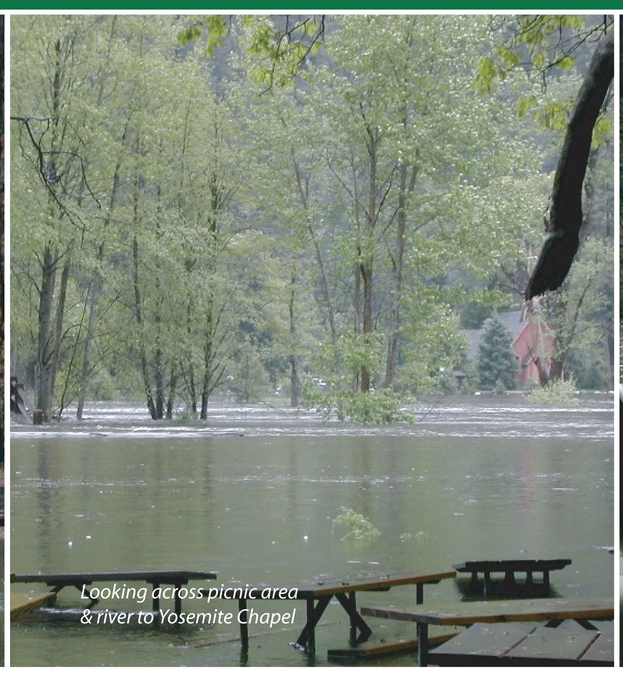
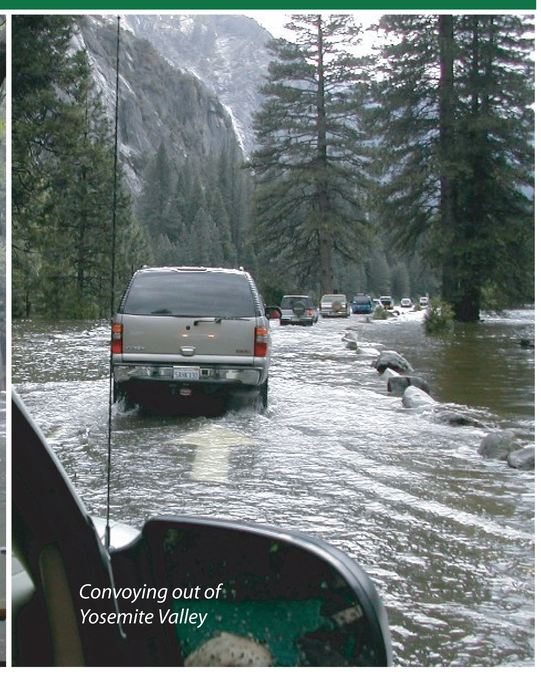




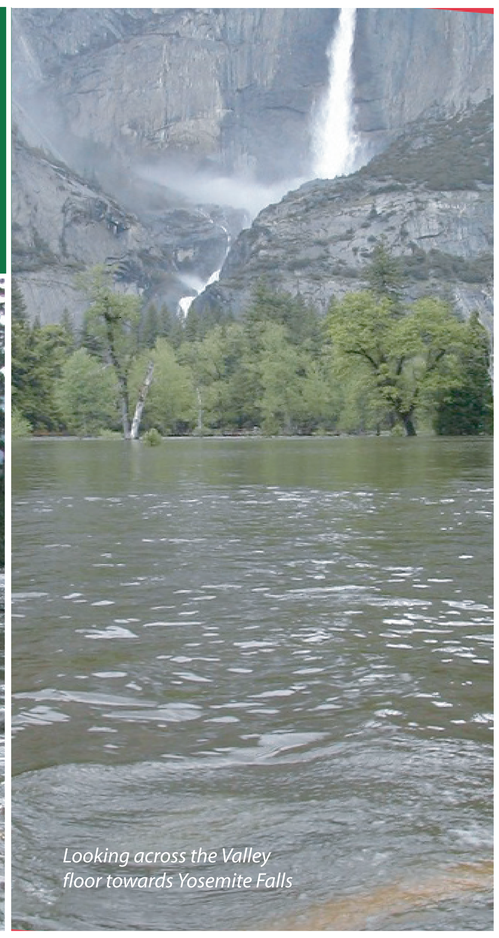
Rescuing NPS equipment in Valley campgrounds (photos from Laura Clor, NPS)



Looking across picnic area & river to Yosemite Chapel



Convoying out of Yosemite Valley

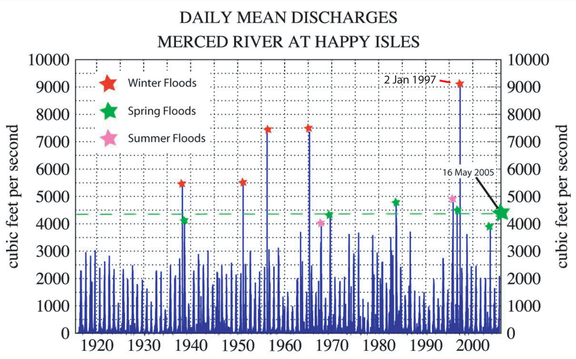


Looking across the Valley floor towards Yosemite Falls

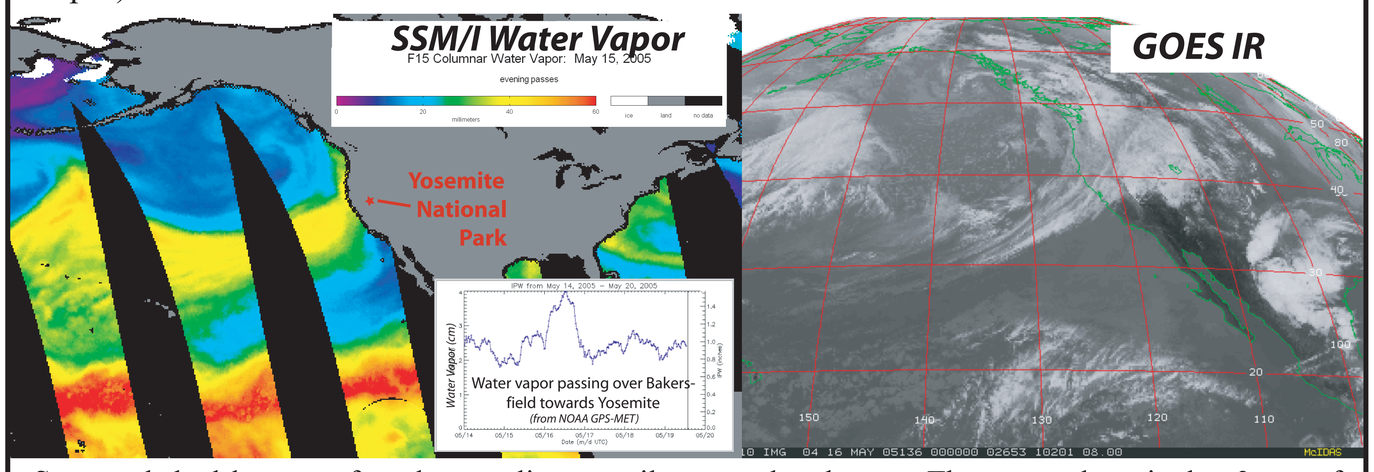
ABSTRACT--On 16 May 2005, a storm drew warm, wet subtropical air into the Sierra Nevada, bringing moderate rains and major flooding. In Yosemite National Park, the flood raised Hetch Hetchy and Tenaya Lake levels markedly and inundated large parts of Yosemite Valley. This was the first major flood observed by a new high-country hydroclimatic network in the Park. Since 2001, scientists from the USGS, Scripps Institution of Oceanography, Califor- nia DWR, National Park Service, and other institutions have developed the network of >30 streamflow and 50 air-temperature loggers between <1500 m to >3000 m altitude, and 8 snow-instrumentation sites measuring snow-water contents (SWC), snow depths, radiation, soil moisture, and air/snow/soil temperatures.

The network documented flooding that derived its runoff mostly from high-altitude rainfall on soils wetted by earlier snowmelt. Temperatures were >0ºC to altitudes of 3000 m, so that rain fell to ~3000 m, compared with normal snowlines nearer 1500 m. Streams flooded below 3000 m, but not above. No significant SWC changes were measured.

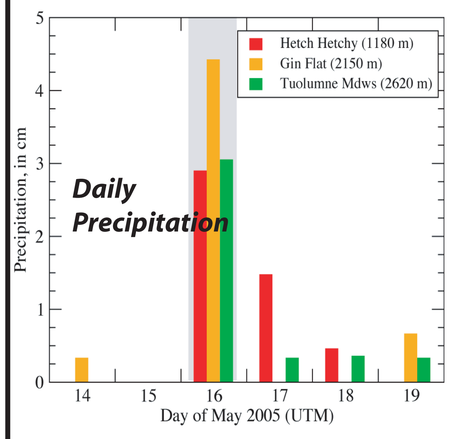
Thus this flood resulted from rain-through-snow runoff rather than rain-on-snow melting. Within the Park, about five times more catchment area received rain than during typical winter storms. Because snowmelt did not contribute much to the flooding, snowpack reductions that are expected if recent warming trends continue would not have reduced the flood. Instead, the opportunity for warm storms may increase, in which case the potential for this kind of flooding will increase.

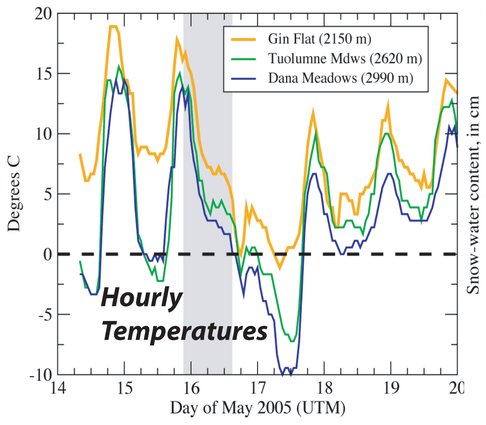


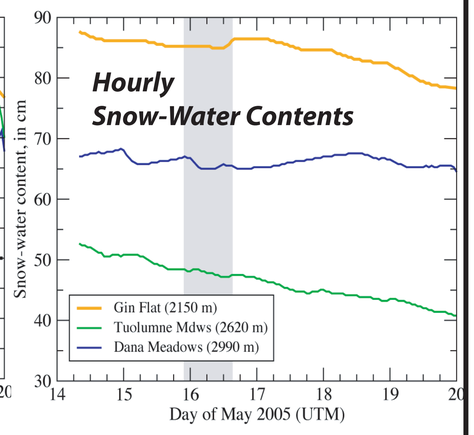
1. THE STORM--A late-season May storm drew warm wet (~ 2 cm of "extra" water vapor) air into the central Sierra Nevada from near Hawaii.



Snowmelt had begun a few days earlier so soils were already wet. The storm deposited ~ 3 cm of precipitation, which fell while temperatures were > 0ºC and thus mostly as rain. Measured snowpack water contents did not decline significantly during the storm.

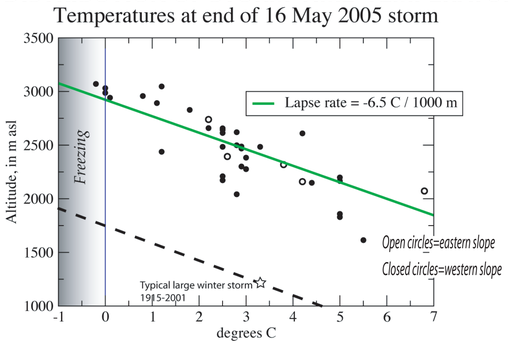


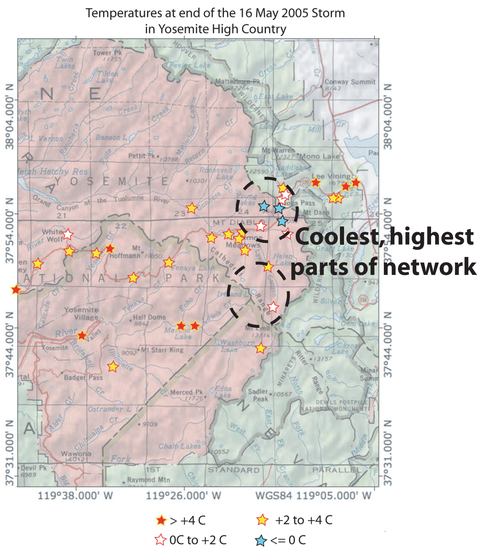




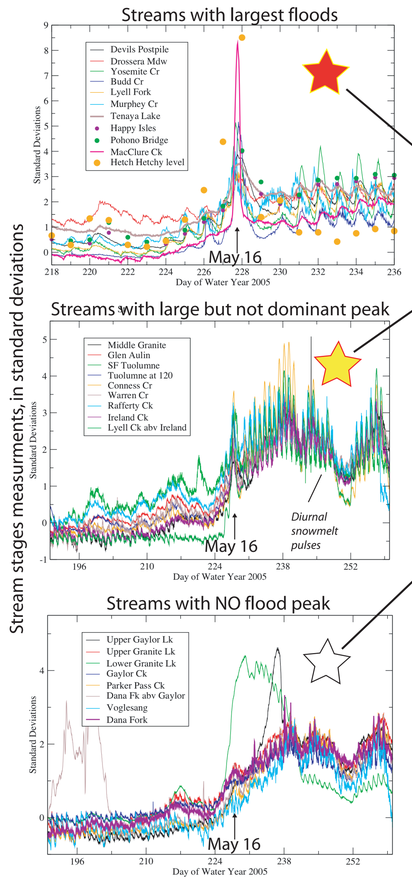
2. THE FLOOD--Like so many cool-season floods in this part of the range, the flood was mostly due to unusually warm temperatures and large catchment areas that received (moderate) rainfall rather than snowfall. Temperatures were >0ºC up to ~3000 m above sea level. Rain fell and streams filled up to 3000 m compared to typical freezing levels of ~1500 m. Above Happy Isles on the Merced River, ~1.2 cm of runoff was generated, on average, from areas that received rain.

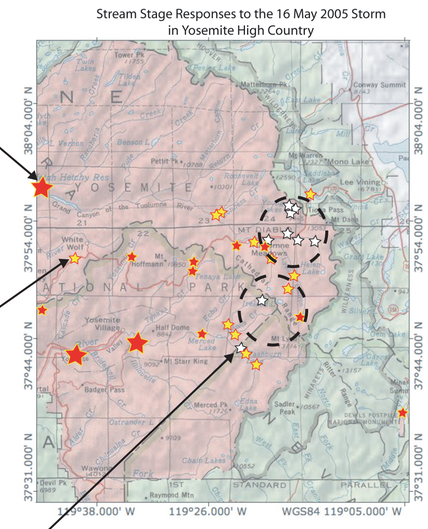
DISTRIBUTION OF STORM-TIME TEMPERATURES

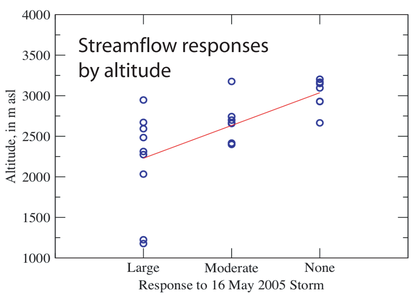




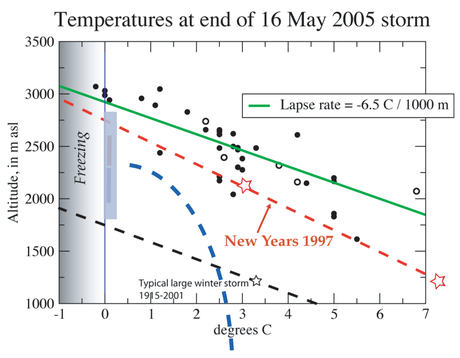
DISTRIBUTION OF STREAMFLOW RESPONSES

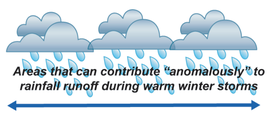


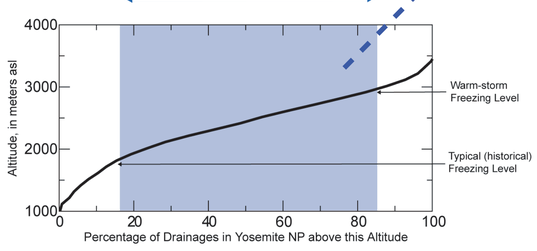


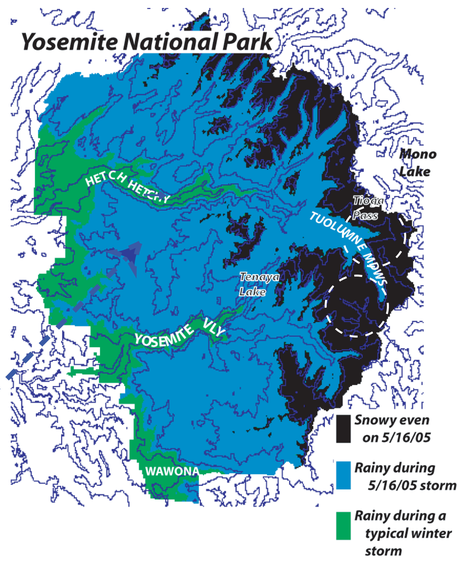


3. THE FUTURE--Warm storms--past & future--can unleash floods when rain falls over unusually large catchment areas (e.g., in this flood, the area receiving rainfall may have been as much as five times normal). Warmer temperatures in the future may increase the numbers & severity of these floods, even as snowpack volumes decline.









Every river basin drains a unique set of elevations and thus every basin will respond uniquely to the temperatures that unleash these floods.

For more information:
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