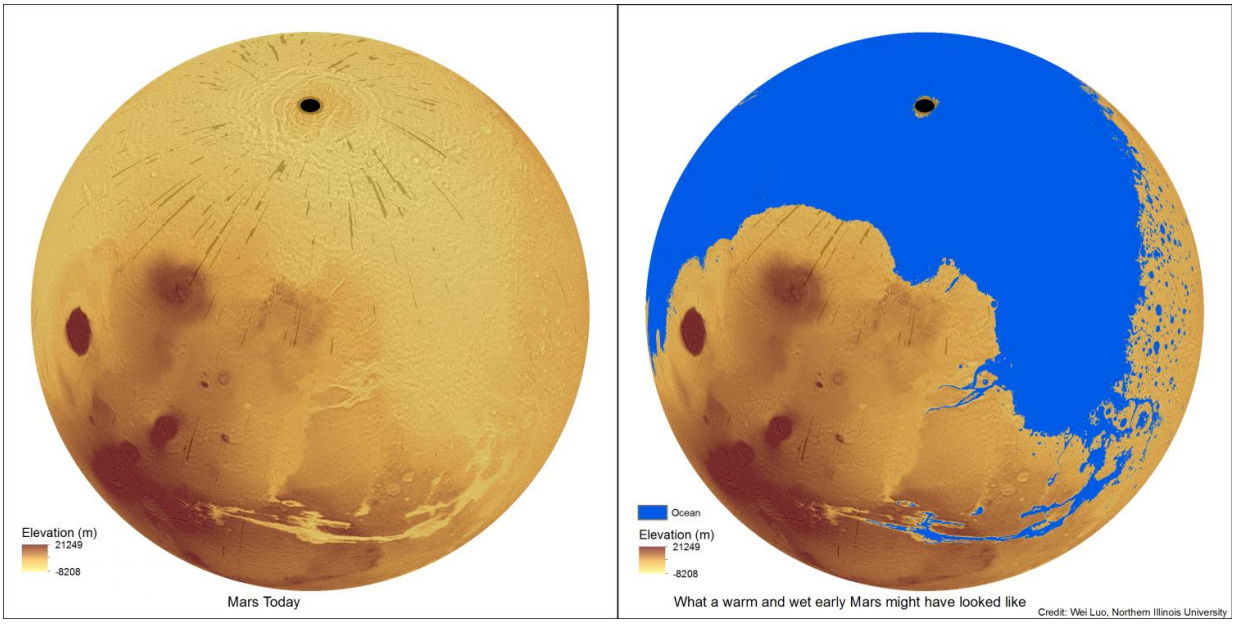
Study estimates amount of water needed to carve Martian valleys

June 5 2017



Depiction of Mars today and what a warm and wet ancient Mars might have looked like. Credit: Wei Luo, Northern Illinois University

A new study led by Northern Illinois University geography professor Wei Luo calculates the amount of water needed to carve the ancient network of valleys on Mars and concludes the Red Planet's surface was once much more watery than previously thought.

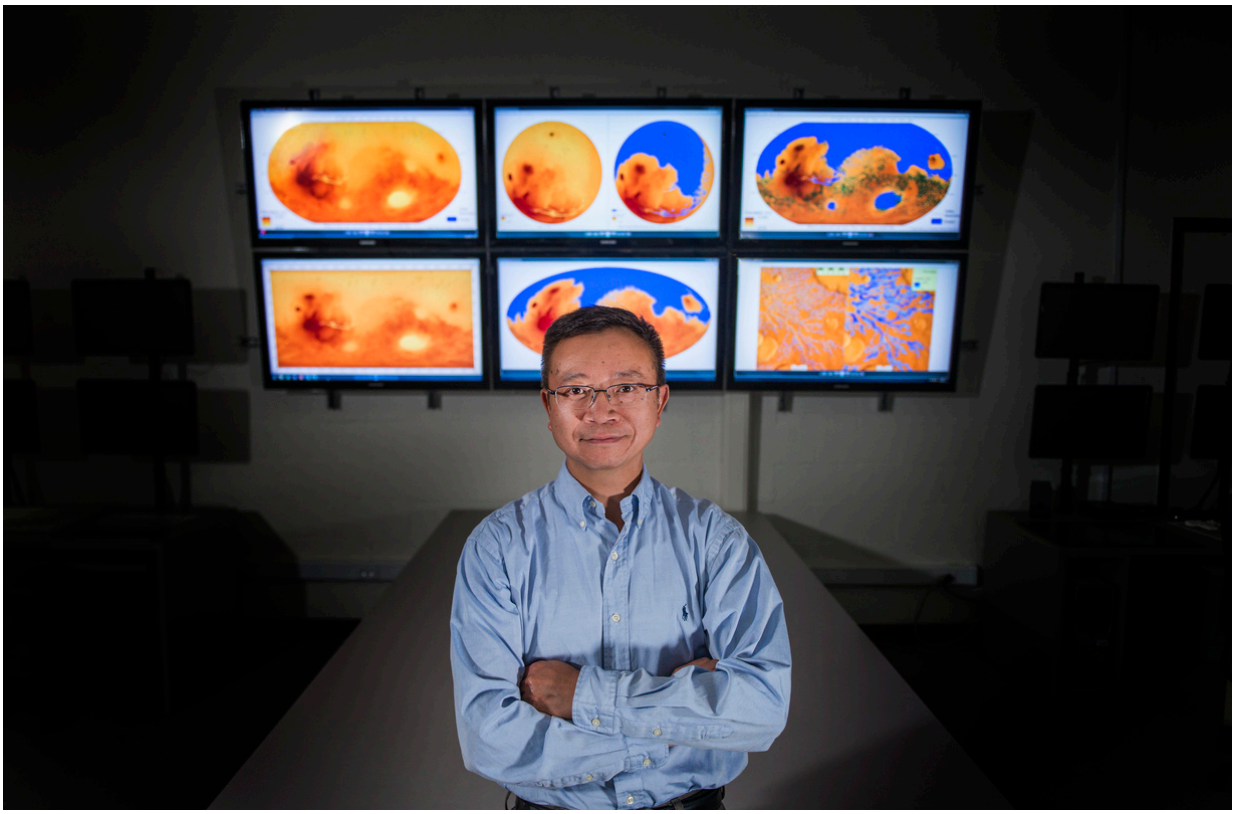
The study bolsters the idea that Mars once had a warmer climate and

active hydrologic cycle, with water evaporating from an ancient ocean, returning to the surface as rainfall and eroding the planet's extensive network of valleys.

Satellites orbiting Mars and rovers on its surface have provided scientists with convincing evidence that water helped shape the planet's landscape billions of years ago. But questions have lingered over how much water actually flowed on the planet, and the ocean hypothesis has been hotly debated.

In the new study, published June 5, in the online journal *Nature Communications*, Luo and colleagues used an innovative algorithm to more precisely calculate the volume of cavity space within Mars valleys and the amount of water that would have been needed to create those cavities through erosion over time. The majority of the valley networks are more than 3 billion years old.

"Our most conservative estimates of the global volume of the Martian valley networks and the cumulative amount of water needed to carve those valleys are at least 10 times greater than most previous estimates," Luo said.



Wei Luo. Credit: Northern Illinois University

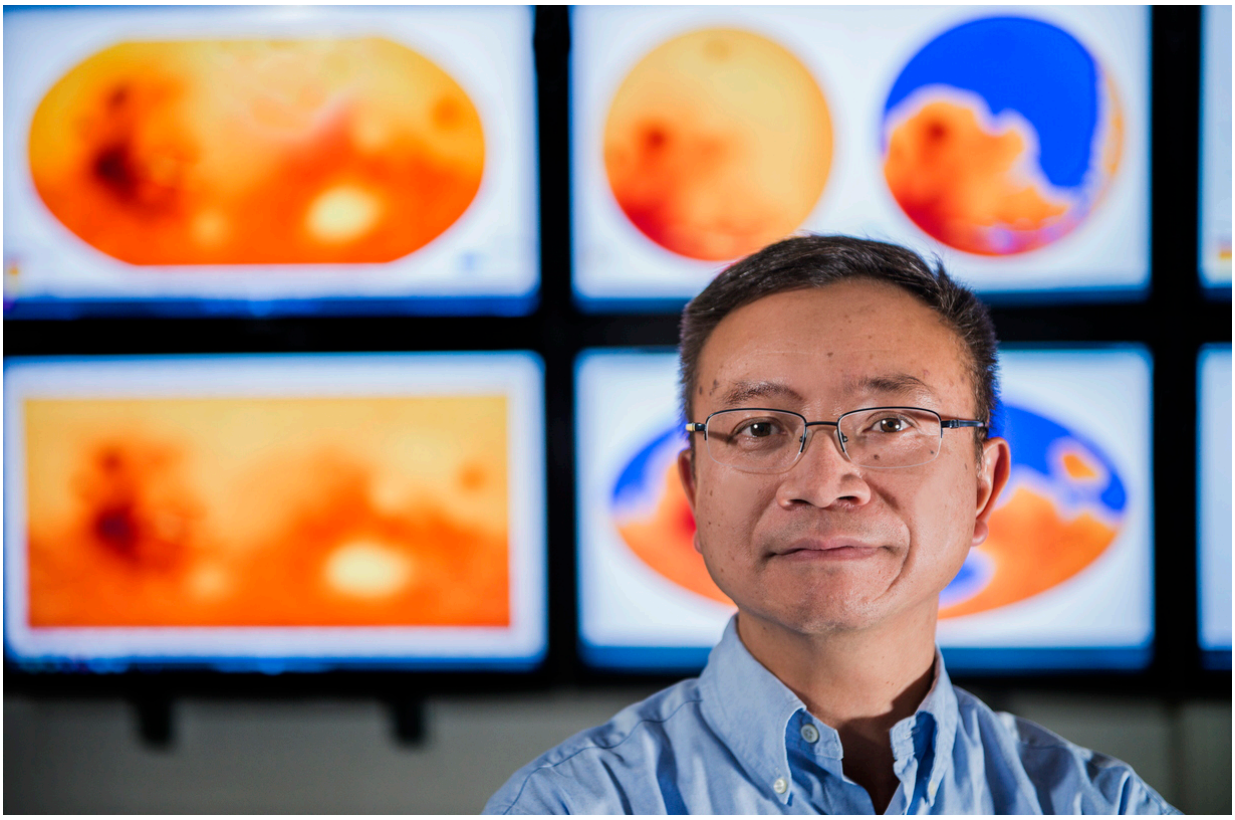
Additionally, the new estimate of the amount of water needed to sculpt the valleys is at least one order of magnitude larger than the volume of a hypothesized ocean and 4,000 times the volume of the valley cavities, Luo said.

"That means water must have recycled through the valley systems on Mars many times, and a large open body of water or ocean is needed to facilitate such active cycling," Luo said. "I would imagine early Mars as being similar to what we have on Earth—with an ocean, lakes, running rivers and rainfall."

But a large piece of the puzzle is missing, he added, because climate

models have not been able to reproduce an early Mars climate sufficiently warm enough to promote an active hydrologic cycle.

"Mars is much farther way from the sun than Earth, and when the sun was younger, it was not as bright as it is today," Luo said. "So there's still a lot to work out in trying to reconcile the evidence for more water."



Wei Luo. Credit: Northern Illinois University

NASA's Mars Data Analysis Program provided funding to conduct the investigation. Professor Alan Howard of the University of Virginia and NIU Ph.D. student Xuezhi Cang collaborated on the research and co-authored the *Nature Communications* article.

To determine the volume of Mars' valley networks globally, the scientists developed computer algorithms, based on those used in terrestrial laser-generated data analyses with very high resolution. They applied the algorithms to the digital elevation model data, estimating the depth of all the Mars' valleys at pixel level.

"The increase in the estimated volume of valley erosion in this study primarily results from taking into account the incision of the many small tributaries draining into the main valleys," co-author Howard said.

More information: *Nature Communications* (2017). DOI: 10.1038/NCOMMS15766

Provided by Northern Illinois University