

# Noah's flood

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Did a great flood once surge into the Black Sea, forming the basis of a Biblical tale? Quirin Schiermeier investigates a computer model that has added weight to the idea.

It sounds like a question more suited to the history of religion than science. Yet it is the driving force behind a whole field of geological research. Could a real event have inspired the Judeo-Christian story of Noah's flood — a deluge lasting 40 days and 40 nights that drowned our sinful predecessors, save one couple and their family, who took refuge with their zoo aboard a wooden ark?

The possibility has its roots in a paper published seven years ago by marine geologists William Ryan and Walter Pitman of Lamont-Doherty Earth Observatory in Palisades, New York<sup>1</sup>. The event that became Noah's flood in the Bible, they hypothesized, was actually a massive flood of the Black Sea basin, which until roughly 8,000 years ago held a large freshwater lake. Then, cataclysmically, sea water burst through a natural dam blocking the narrow Bosphorus Strait and raised the level of the lake some 100 metres in just a few years, inundating Neolithic settlements along its shores. Ryan and Pitman subsequently popularized the idea in a book<sup>2</sup>.

This 'sudden infill' hypothesis has since

become the subject of a prolonged argument between geologists, palaeontologists, oceanographers and archaeologists. Although most of them are not interested in the Biblical part of the question, they would very much like to know whether such a dramatic event happened. And despite an enormous amount of fieldwork, the jury is still out.

Now a group of geologists has taken a novel approach. Previous efforts searched for archaeological evidence of disrupted settlements or for geological evidence of the encroachment of the sea. The new approach, conceived by Mark Siddall, a young oceanographer until recently at Southampton Oceanography Centre, UK, and now at the University of Bern in Switzerland, begins in the lab with computer models of how a massive flood would transform the Black Sea basin. These results are then compared to existing geological features. And lo: most of the predicted effects seem to exist<sup>3</sup>.

Until now, most work on the flood has concentrated on its timing, rather than on its actual dynamics. But as Siddall is not concerned about whether the flood actually

influenced writers of the Bible, he says that it doesn't really matter when it occurred. More interesting, he says, is what such an extreme event would have looked like to an observer standing on the edge of the Bosphorus, and what permanent records it would have left on the sediment.

Siddall developed a fascination with the question as a PhD candidate in Southampton. Two years ago, he flew to New York to visit Ryan with some preliminary data in his luggage. Encouraged by Ryan's enthusiasm, he expanded his work.

Trained as a modeller, Siddall plugged into his computer an idealized model of the Black Sea area as it was thought to have been some 10,000 years ago, at the end of the last ice age. Back then, only a small strip of land — the now submerged Bosphorus sill — separated the Black Sea basin from the Sea of Marmara, which opens into the Aegean and the Mediterranean beyond.

At that time, it is generally agreed that the water level of the Black Sea lake was probably



**Results from Mark Siddall's computer model of the Black Sea match observed geological phenomena.**

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50 to 150 metres lower than the sea outside the sill. Then, fed by melting glaciers during the warming trend of the Holocene period, the Sea of Marmara began to rise. About 8,400 years ago, it reached the height of the sill and began to spill over<sup>4,5</sup>

But at this point things become more blurry. Did the sill break catastrophically, allowing trillions of litres of water to flood through in a massive deluge? Or was it a more gradual event that slowly carved out the Bosphorus Strait — a channel three kilometres wide that now connects the two bodies and marks the border in Turkey between Europe and Asia?

To find out, Siddall ran a series of trials through his computer model in which he allowed the water to flow at various speeds and watched the effects on geology in the shelf, which is the portion of the basin that was covered by the flood. This sounds straightforward, but the model involved extremely complex mathematics. Simulating the ‘hydraulic jump’ — or rapid inflow of water — after a dam break required equations usually used in the lab to study fluid flow over idealized surfaces. They had never before been adapted to such intricate landforms.

### Plotting a course

If water entered the basin gradually, the Coriolis force produced by Earth’s rotation would have deflected the northward flow to the right, Siddall says. A rapid flood, on the other hand — triggered by an earthquake or by rapid erosion of the Bosphorus sill — would have had a different effect. Siddall’s model shows that the powerful jet of water released by such a dam break would defy the Coriolis force by its very momentum, and would be free to take a random course.

As it happens, this latter suggestion matches up with a mysterious sharp left turn of a submerged channel that geologists have discovered in the Black Sea shelf. Seeing the

channel for the first time on a map was something of a eureka moment for Siddall. “Ryan showed me a map the Turkish Navy had made of the channel, and I said, ‘Wow — this is absolutely consistent with what the model tells us,’” he recalls.

The fast-moving current could also have formed some of the striking seafloor features seen at the mouth of the strait and in the open Black Sea, such as a number of hills and sand waves some 2,000 metres down. These sandy hills, several kilometres long and up to several hundred metres high, are likely to be the result of ‘turbidity currents’ — strong undersea flows of sediment — triggered by the moving jet.

The model also shows that the sudden flood could not have taken place in anything like the 40 days specified by the Biblical tale. According to Siddall’s calculations, about 60,000 cubic metres of water per second must have flowed into the Black Sea basin after the sill broke — more than 20 times the flow of the Niagara Falls. But even at that rate it would have taken 33 years to equalize water levels in the Black Sea and the Sea of Marmara. This is in contrast to Ryan’s much simpler flow models, which originally put the filling time at just three years.

This discrepancy does not bother Ryan, because a rise of 150 metres would still have been a notable event, even if it took 33 years. “If a model predicts observations successfully, we should pay attention to it,” says Ryan. “It adds some very important information about the dynamics of the Black Sea infill.”

Still, some scientists are uncomfortable with the whole question, because it seems to have originated from Ryan’s 30-year obsession with Noah’s flood and his eagerness to popularize the idea. In particular, they question the whole notion of basing a hypothesis on the

untestable proposal that a legend was inspired by a geological event.

“It’s all very far-fetched,” says Ali Aksu, a geologist at Memorial University of Newfoundland in St John’s, Canada, whose research suggests that the Black Sea is not likely to have filled so dramatically<sup>6</sup>. “Science should not be mandated by reading religious texts. That’s not the way to make hypotheses.”

And even some who are less bothered by the origins of the idea caution that the catastrophic flood is far from proven. Namik Çagatay, a geochemist and head of marine geology at Istanbul Technical University, points to his own analysis of sediments from the Black Sea’s coastal plain, which suggests that the ancient lake was only 18 metres lower than the present sea level<sup>7</sup>.

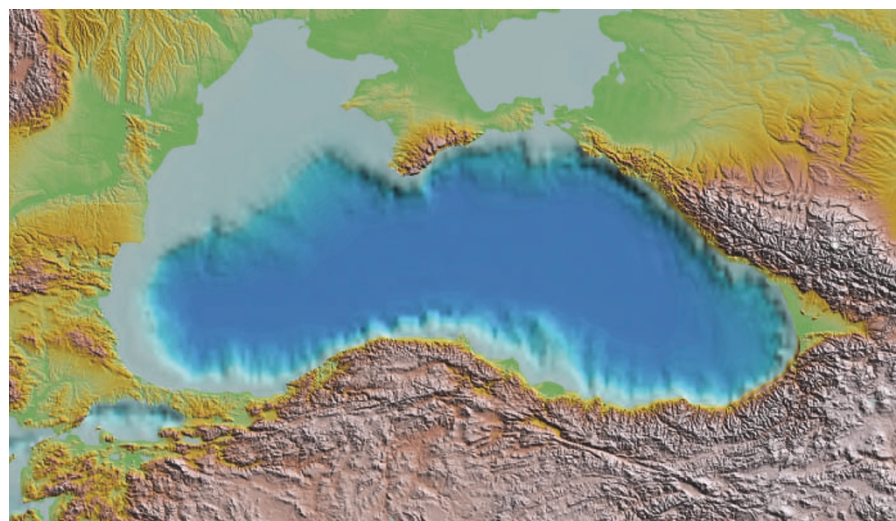
### Sea change

But most researchers concede that the debate might not be so vibrant today had it not been for the flood of interest and cash brought to the field by Ryan and Pitman’s book and the subsequent media coverage. “I do believe that controversies such as this may help you get better money from funding agencies,” says Aksu. And Siddall’s work, which Aksu calls “solid physical oceanography”, shows how new interest in the field can bring a fresh perspective.

Siddall agrees that there is enough real science related to the flood hypothesis to justify talking about links to Bible stories. “Oceanographers must have a natural interest in extreme events, if only to test the robustness of their tools and methods,” he says. “If we can’t resolve the occurrence of such a huge flood, then what can we resolve?”

— Mark Siddall

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Now part of the Black Sea, the areas shown in grey were dry land until a flood some 8,000 years ago.

If nothing else, the new models have pointed Black Sea researchers to the next step in their fieldwork, says Liviu Giosan, a marine geologist at the Woods Hole Oceanographic Institution in Massachusetts and one of Siddall’s collaborators. For instance, they should look again for discontinuities in sediments along the shelf, which might provide evidence for a rapid rise in sea levels, he says. Sediment cores now being examined by several groups may also provide evidence for or against a cataclysmic event. Although none of this can directly link the Black Sea to the Bible story, clearly the book on Noah’s flood is not yet closed. ■

Quirin Schiermeier is *Nature’s* German correspondent.

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