Climate change could diminish drinking water more than expected

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As sea levels rise, coastal communities could lose up to 50 percent more of their fresh water supplies than previously thought, according to a new study from Ohio State University.

Hydrologists here have simulated how saltwater will intrude into fresh water aquifers, given the sea level rise predicted by the Intergovernmental Panel on Climate Change (IPCC). The IPCC has concluded that within the next 100 years, sea level could rise as much as 23 inches, flooding coasts worldwide.

Scientists previously assumed that, as saltwater moved inland, it would penetrate underground only as far as it did above ground.

But this new research shows that when saltwater and fresh water meet, they mix in complex ways, depending on the texture of the sand along the coastline. In some cases, a zone of mixed, or brackish, water can extend 50 percent further inland underground than it does above ground.

Like saltwater, brackish water is not safe to drink because it causes dehydration. Water that contains less than 250 milligrams of salt per liter is considered fresh water and safe to drink.

Motomu Ibaraki, associate professor of earth sciences at Ohio State, led the study. Graduate student Jun Mizuno presented the results Tuesday, October 30, 2007, at the Geological Society of America meeting in Denver.

“Most people are probably aware of the damage that rising sea levels can do above ground, but not underground, which is where the fresh water is,” Ibaraki said. “Climate change is already diminishing fresh water resources, with changes in precipitation patterns and the melting of glaciers. With this work, we are pointing out another way that climate change can potentially reduce available drinking water. The coastlines that are vulnerable include some of the most densely populated regions of the world.”

In the United States, lands along the East Coast and the Gulf of Mexico -- especially Florida and Louisiana -- are most likely to be flooded as sea levels rise. Vulnerable areas worldwide include Southeast Asia, the Middle East, and northern Europe.

“Almost 40 percent of the world population lives in coastal areas, less than 60 kilometers from the shoreline,” Mizuno said. “These regions may face loss of freshwater resources more than we originally thought.”

Scientists have used the IPCC reports to draw maps of how the world's

coastlines will change as waters rise, and they have produced some of the most striking images of the potential consequences of climate change.

Ibaraki said that he would like to create similar maps that show how the water supply could be affected.

That's not an easy task, since scientists don't know exactly where all of the world's fresh water is located, or how much is there. Nor do they know the details of the subterranean structure in many places.

One finding of this study is that saltwater will penetrate further into areas that have a complex underground structure.

Typically, coastlines are made of different sandy layers that have built up over time, Ibaraki explained. Some layers may contain coarse sand and others fine sand. Fine sand tends to block more water, while coarse sand lets more flow through.

The researchers simulated coastlines made entirely of coarse or fine sand, and different textures in between. They also simulated more realistic, layered underground structures.

The simulation showed that, the more layers a coastline has, the more the saltwater and fresh water mix. The mixing causes convection -- similar to the currents that stir water in the open sea. Between the incoming saltwater and the inland fresh water, a pool of brackish water forms.

Further sea level rise increases the mixing even more.

Depending on how these two factors interact, underground brackish water can extend 10 to 50 percent further inland than the saltwater on the surface.

According to the United States Geological Survey, about half the country gets its drinking water from groundwater. Fresh water is also used nationwide for irrigating crops.

“In order to obtain cheap water for everybody, we need to use groundwater, river water, or lake water,” Ibaraki said. “But all those waters are disappearing due to several factors --including an increase in demand and climate change.”

One way to create more fresh water is to desalinate saltwater, but that's expensive to do, he said.

“To desalinate, we need energy, so our water problem would become an energy problem in the future.”

Source: Ohio State University