River delta areas can provide clue to environmental changes

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Sediments released by many of the world's largest river deltas to the global oceans have been changed drastically in the last 50 years, largely as a result of human activity, says a Texas A&M University researcher who emphasizes that the historical information that can be gathered from sediment cores collected in and around these large deltaic regions is critical for a better understanding of environmental changes in the 21st century.

Thomas Bianchi, a professor in the Department of Oceanography who specializes in estuarine and marine systems, and colleague Mead Allison of the University of Texas have examined sediments from delta areas around the world, most notably the Mississippi in the United States and the (Huanghe) Yellow and Yangtze in China. These sediments contain information that can provide data on past changes in nitrogen application in the drainage basin from agricultural fertilizers, records of past flooding and hurricane events, to name a few, Bianchi says.

Their work is published in the current issue of the "Proceedings of the National Academy of Sciences."

"These deltaic sediments can serve as a history book of sorts on land-use change in these large drainage basins which is useful for upland and coastal management decisions as related to climate change issues," Bianchi explains.

"Although the information stored in these sediments can be altered

during its transport from the upper drainage basin to the coast, we still find very stable tracers, both organic and inorganic, that can be used to document changes induced by natural and human forces."

Such sediments are ever-present, the authors say, noting that 87 percent of the Earth's land surface is connected to the ocean by river systems. They also explain that 61 percent of the world's population lives along a coastal boundary, and that number is expected to climb to 75 percent by 2025.

Much of the sediment from rivers forms into what are called large river delta-front estuaries, or LDEs, and human activity in some of these can be traced back more than 5,000 years ago to some of the first cities in Mesopotamia, along the Nile and in regions of China.

The knowledge learned from these delta areas tell about the history of the region from how the land was used - or not used - through time, the authors say. The world's largest 25 rivers drain about one-half of the Earth's surface and transport 50 percent of the fresh water and 40 percent of particulate materials into the ocean, they confirm.

The Mississippi River, the largest in the U.S., drains about 40 percent of the country's total land mass, plus parts of two Canadian provinces, the authors say, and we can learn critical information from its delta regions.

In the U.S., hypoxic areas - where there is little or no oxygen - can in some cases be linked with deltaic regions that are releasing large amounts of water and nutrients, Bianchi explains. "Low oxygen in aquatic systems is clearly not good for the organisms in those systems, but not all aquatic systems respond in the same way," he notes. "It affects marine life in some areas severely, while other areas seem unchanged. We need to find out why.

"Some LDE areas such as the Mississippi/Atchafalaya River system have had significant increases in the nutrient loading from fertilizers" Bianchi adds. "We know we need to reduce the amount of these nutrients from draining into our rivers, but by how much? In this particular case, the linkages between excessive nutrients, hypoxia and their affects on aquatic life are not well understood.

"It's a big problem that China is facing right now as it attempts to manage severe water shortages, over-grazing and desertification issues for a growing population by manipulating natural water sources from their major rivers through damming and diversions. Over the last 20 years, China has become the world's largest consumer of fertilizers and two of its rivers, the Yellow and the Yangtze, are among the top five in the world in terms of sediment discharge.

"Also, many scientists are expecting global temperatures to rise over the next 50 years due to climate changes, and how will these changes affect precipitation and soil erosion issues? We really don't know now because in many cases, land-use change by growing populations can be very short-term and unpredictable, making modeling very difficult. These deltaic sediments might be able to give us some clues about what is ahead for us."

Source: Texas A&M University