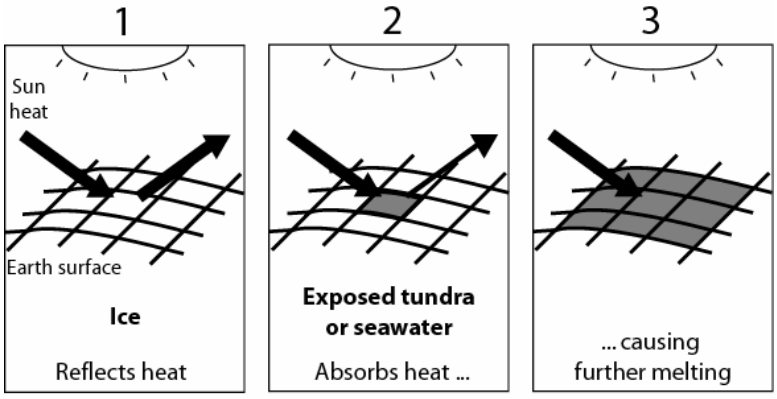
Rivers - Arteries of our Earth

Most folks who get paid to think about and predict these sorts of things are by now pretty much agreed: human activity can influence the state of Earth's climate. This article is about something that is as uncontroversial, but much less talked about: the vital role that rivers have to play in the story – that is, our children's story.

Carbon dioxide (CO_2) is one of the most potent so-called greenhouse gases, which efficiently trap heat and thereby raise temperatures (the others are nitrous oxide, N_2O and methane, CH_4). Today, human-caused emissions of CO_2 which have continued to climb since the Industrial Revolution have engrossed our Earth in a slew of 'positive feedback cycles', which are processes that accelerate climate change and other effects. For example, the melting of ice brought about by increasing temperatures is rapidly removing a very efficient heat reflector from high latitudes. Where at first there was ice to reflect incoming radiation away into space, arctic tundra or seawater has now come to be exposed. Because both tundra and seawater are dark and readily absorb heat, their exposure heats up the Earth surface even faster, melting even more of the surrounding ice ... and the process accelerates.

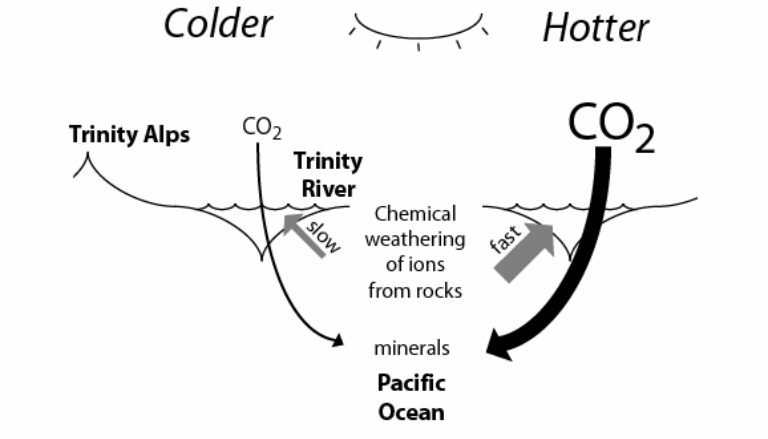


A positive feedback: melting of ice causes Earth's surface to heat up, leading to even further melting

Unfortunately, the forgoing example is but one of many potent positive feedback cycles known. What few people appreciate, however, is that there also exists a powerful *negative* feedback cycle. That is, the Earth has a way to regulate itself when atmospheric CO_2 concentrations and temperatures get too high – a mechanism that has operated successfully ever since the first rivers started flowing on the first continents, almost three-and-a-half billion years ago.

To see how it works, let's take our Trinity and Klamath rivers as examples. As their main stems and tributaries cut their way through our mountains, they pull huge numbers of ions (especially calcium, magnesium and sodium) out of surrounding rocks in a process called *chemical weathering*. To balance their charge, these positively charged ions bind with negatively charged dissolved CO_2, drawing it out of the atmosphere into the flowing water. This bound CO_2 is transported to the ocean, where it can come to be safely locked away in mineral form, thereby circumventing its potentially harmful atmospheric impact.

Now, as mounting CO_2 concentrations give rise to an increase in average temperatures, the regulatory feedback cycle kicks in: increased temperatures greatly speed up chemical reactions like the chemical weathering that dissolves ions from rocks into our rivers, thereby sucking out more CO_2 out of the air, faster. In this way, big rivers have acted like a planetary thermostat whenever CO_2 concentrations threatened to get out of control, as would have happened during massive past volcanic eruptions, for instance. Without this mechanism in place, much of our planet could easily turn into a sparse desert! Indeed, the British scientist James Lovelock predicts that we are in danger of making exactly this happen over the unfolding century.



Our rivers act as a planetary thermostat. When higher temperatures cause the chemical weathering of rocks to speed up, more CO_2 gets pulled out of the atmosphere, cooling down the planet.

For the present readers of the *Tribune*, the river-thermostat will act too sluggishly to make an appreciable difference. For our offspring, however, the combined power of healthy rivers here and elsewhere provides the single most important brake on CO_2-induced climate change that our Earth has to offer. If we choose to continue burdening our grandchildren with the effects of our greenhouse gas emissions, then the least we owe them is to keep our rivers flowing clear. Consider that the once-mighty Colorado river shrivels to a mere trickle, or less, where it once spilled out through a luscious delta into the Sea of Cortez. In this regard, the partial undamming of the Klamath River promised in a recent agreement in Oregon could set an example to communities everywhere. It's not just our salmon that are at stake.

Send your science questions to:
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