Science for Environment Policy

Unsustainable water consumption contributes to sea level rise

The global sea level is rising, yet only part of that rise can be attributed to the effects of climate change. New research has calculated that human impacts on terrestrial water storage make up around 42% of total sea level rise, in particular, the extraction of groundwater that eventually makes its way to the ocean.

27 September 2012. Issue 299

Subscribe to free weekly News Alert

Contact:
pokhrel@rainbow.iis.u-tokyo.ac.jp

Theme(s): Climate change and energy, Water

1. See: http://www.ipcc.ch/publications_and_data/ar4/syr/en/contents.html

Tidal measurements have revealed that the global sea level rose by 1.8mm per year between 1951 and 2000. This was partly caused by thermal expansion of the oceans, melting glaciers and icecaps, and loss of ice in Antarctica and Greenland, all of which were climate change-driven. However, the IPCC's Fourth Assessment Report[1] estimated that these factors accounted for just 1.1mm per year of sea level rise, leaving 0.7mm unaccounted for.

To address this gap in knowledge, the researchers used an integrated water resources assessment model to measure the effects of different types of terrestrial water storage on sea level change between 1951 and 2000.

They found artificial reservoirs caused the sea level to fall, by withholding water on land. Averaged over the global ocean area, this was calculated to be a drop of 15mm over the 50 year period. This figure assumes that large reservoirs were used at 70% capacity, as an annual average to account for seasonal changes in weather. When the researchers included an estimate of water seepage from reservoirs into surrounding aquifers, the total predicted drop in sea level increased to 21mm.

However, more than counteracting this drop in sea level, the researchers found that unsustainable groundwater use resulted in a sea level rise of 48mm, as most water extracted from the ground for domestic, industrial and agricultural uses eventually makes its way to the sea. They indicate that groundwater depletion has been increasing and may continue to do so, heightening concerns about sea-level rise in the twenty-first century.

Climate-driven changes to terrestrial water storage, such as changes to soil moisture, rivers and snow storage, contributed a further 8mm of sea level rise. Net water loss from enclosed bodies of water, such as the Aral Sea in central Asia where water is extracted for irrigation, resulted in a sea level rise of around 1.4mm.

When the model results were compared to the gap in sea level rise reported by the IPCC Fourth Assessment Report, covering the period 1961-2003, they found that net effects of terrestrial water storage sources accounted for an extra 0.77mm per year of sea level rise. This closely matched the 0.7mm difference between total sea level rise and the effects of climate change.
The 0.77mm per year rise consisted of a fall of 0.39mm due to reservoir storage and a rise of 1.05mm from groundwater, 0.08mm from climate-driven factors, and 0.03mm from the Aral Sea.

The researchers caution that there are still some uncertainties in the data. For example, their estimate of groundwater use was relatively high, although within reasonable limits based on estimates produced by other studies. They also excluded some smaller influencing factors on sea level, such as wetland drainage and the atmosphere's water content.

Environment