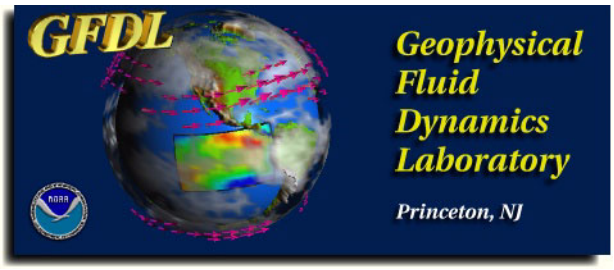
Global Warming Will Change World's River Flows



The same forces that drive global warming also change the flow rates of the world's rivers, which are the source of water for much of the world's population. A numerical climate model at NOAA's Geophysical Fluid Dynamics Laboratory (GFDL) indicates that flow of most of the major world rivers may increase by the middle of the 21st century, but that flows in water-scarce regions may decrease.

"Global warming" has become a familiar phrase in the popular press, but warming also implies more evaporation from the world's oceans, leading to an overall intensification of the world's water cycle. In a recently completed study, Richard T. Wetherald and Syukuro Manabe used the results of a computer model simulation of global warming to analyze the effects of the warming on runoff from the continents.

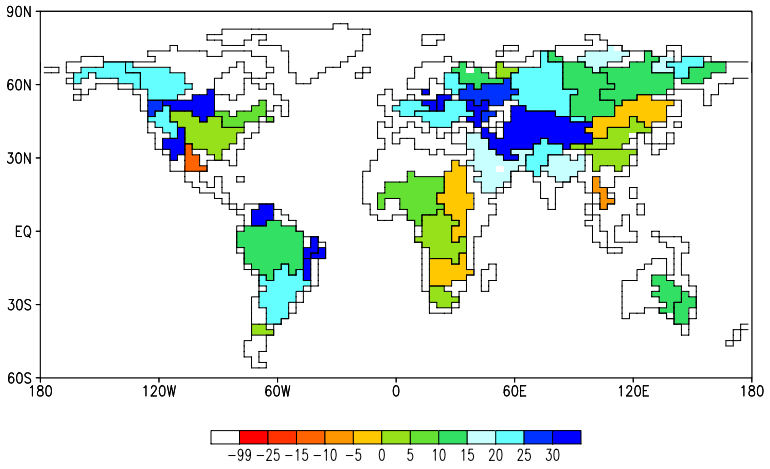
The model was given estimates of historical and future changes in atmospheric composition (greenhouse gases and sulfate aerosols) over time and allowed to compute the resulting climate effects.

TAKE HOME POINTS

- Global warming will probably be accompanied by changes in flows of the world's rivers
- Estimates of possible magnitudes of flow changes for major rivers can be obtained from numerical climate models
- Flows of middle- and high-latitude rivers are generally expected to increase
- Flows of some rivers in water-scarce regions may decrease

The global mean surface air temperature in the model rose by 4.5°F (2.5°C) by the middle of the 21st century. By the same time, global evaporation and precipitation had risen by 5.2%, and runoff from the continents had risen by 7.3%.

The authors caution that results for specific river basins are highly uncertain, but note that certain general patterns emerge in their analysis. As shown in the accompanying figure, the modeled discharges of the great northern rivers (Yukon and Mackenzie in North America; Ob', Yenisey, and Lena in Siberian Russia) increase robustly by 10 to 25%. Flows from major basins in the Pacific Northwest regions of North America and in Europe increase by 20-30% or more. In the tropics, however, increases are generally smaller, with changes of less than 15% in both the Amazon and Zaire (Congo) River basins.



Percent changes in mean annual outflow of major world rivers estimated for the period 2035-2065 from results of a numerical climate model. The entire drainage area of each river basin is colored according to the change in flow at the downstream end of the river, generally where it discharges to the ocean.

In some regions, dessication is seen in the model. The tendency is for decreased flows to be associated with basins that already have arid climates. Such basins include the Rio Grande in North America and the Nile and Zambezi Rivers in Africa. When one considers that warming will also increase evaporative demand and, hence, agricultural and domestic demand for water in these regions, the implications for water resources in some semi-arid, subtropical regions appear generally negative.

REFERENCE: Wetherald, R., and S. Manabe, 2002: Simulation of hydrologic changes associated with global warming, *Journal of Geophysical Research -Atmospheres,* vol. 107(D19), 4379, doi:10.1029/2001JD001195, 2002.

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