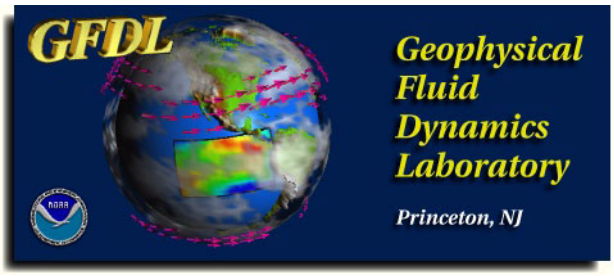
Greenhouse Warming Expected To Be Greatest Over Continents & During Winter



The term "global warming" is commonly used to refer to surface air temperature changes that are a response to increasing atmospheric greenhouse gas (GHG) concentrations. However, the warming is not expected to be uniform over the globe. Computer model simulations conducted at NOAA's Geophysical Fluid Dynamics Laboratory (GFDL) and elsewhere strongly suggest that GHG-induced warming will be more rapid over land masses than over oceans. The greatest warming is expected during the winter over northern North America and north-central Asia (see figure).

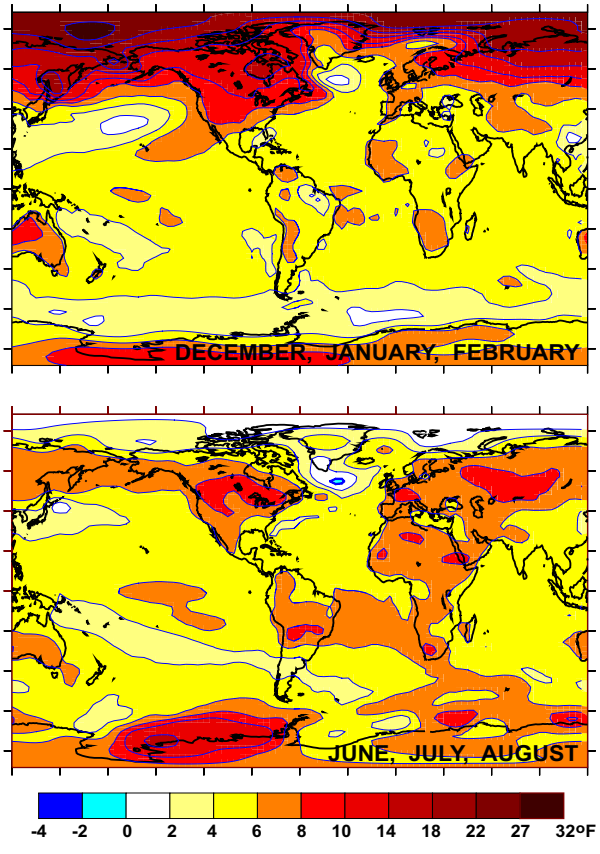
Warming over the ocean tends to lag the warming over land in part due to water's high heat capacity and its ability to mix heat vertically. As water moves vertically in the ocean, water that has been warmed via exposure to the atmosphere at the surface is replaced by colder water from below. The replenished water can then absorb some of the excess greenhouse heat from the air directly above the sea surface, thus moderating the air temperature increase.

IIn the far north, melting occurs as areas previously covered by snow or ice warm. A highly reflective surface (snow or ice) is replaced by a darker surface. The darker surface absorbs more sunlight, leading to more warming and more melting - a positive feedback. In the summer, soil drying often accompanies enhanced continental warming.

The patterns and seasonality of the warming response seen in the GFDL climate model results are broadly consistent with those simulated at other international research centers. The similarity of the different models' warming patterns, and the highly plausible reasons for the non-uniform warming, led the Intergovernmental Panel on Climate Change (IPCC) to conclude that it is very likely that temperatures will warm most rapidly over continents during the 21st century, especially during winter in the northern latitudes of the Northern Hemisphere.

TAKE HOME POINTS

- The warming of surface air temperatures in response to increasing levels of greenhouse gases will not be geographically uniform.
- Computer models indicate that 21st century temperatures will tend to warm more rapidly over continents than over the oceans.
- The largest warming is expected to occur during the winter months in northern North America and north-central Asia.
- Summer warming over continents may be accompanied by drier soils in many regions.



REFERENCES:

Delworth, T., R. Stouffer, K. Dixon, M. Spelman, T. Knutson, A. Broccoli, P. Kushner, and R. Wetherald, (2002): , Review of simulations of climate variability and change with the GFDL R30 coupled climate model. *Climate Dynamics*, vol 19, pp 555-574. (available online at http://www.gfdl.noaa.gov/~gth/netscape/2002/td0201.pdf)

IPCC, (2001): Summary For Policy Makers, A Report of Working Group 1 of the Intergovernmental Panel on Climate Change, Cambridge University Press. (available online at http://www.ipcc.ch/pub/spm22-01.pdf)

FIGURES: Surface air temperature changes simulated to occur by the latter portion of the 21st century. TOP: Northern Hemisphere winter. BOTTOM: Northern Hemisphere summer. Results are averages computed from three GFDL climate model experiments. Estimates of historical and future changes in GHGs and sulfate aerosols (IS92a scenario) are given to the model which then simulates the climate response over time. Temperature changes are calculated as the average of the projections for years 2065 to 2089 minus the average from a control model having pre-industrial GHG levels. Note irregular contour intervals. Temperature changes are shown in units of degrees Fahrenheit.

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