An Overview On the Complexity of the Climate System and the Role of Humans Within It

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The climate issue, with respect to how humans are influencing the climate system, can be segmented into three distinct hypotheses. These are:

1. The human influence is minimal and natural variations dominate climate variations on all time scales;

2. While natural variations are important, the human influence is significant and involves a diverse range of first-order climate forcings (including, but not limited to the human input of CO$_2$);

3. The human influence is dominated by the emissions into the atmosphere of greenhouse gases, particularly carbon dioxide.
What Does The Data Tell Us?
Vertical relative weighting functions for each of the channels discussed on this website. The vertical weighting function describes the relative contribution that microwave radiation emitted by a layer in the atmosphere makes to the total intensity measured above the atmosphere by the satellite.

The weighting functions are available at ftp.ssmi.com/msu/weighting_functions

From: http://www.remss.com/msu/msu_data_description.html
Global, monthly time series of brightness temperature anomaly for channels TLT, TMT, TTS, and TLS (from top to bottom). For Channel TLT (Lower Troposphere) and Channel TMT (Middle Troposphere), the anomaly time series is dominated by ENSO events and slow tropospheric warming. The three primary El Niños during the past 20 years are clearly evident as peaks in the time series occurring during 1982-83, 1987-88, and 1997-98, with the most recent one being the largest. Channel TLS (Lower Stratosphere) is dominated by stratospheric cooling, punctuated by dramatic warming events caused by the eruptions of El Chichon (1982) and Mt Pinatubo (1991). Channel TTS (Troposphere / Stratosphere) appears to be a mixture of both effects. From: http://www.remss.com/msu/msu_data_description.htm
Current Northern Hemisphere Sea Ice Area

recent 365 days shown

Ice Area (million square km)

Year

N.H. Sea Ice Area
Anomaly from 1979-2000 mean
Current Southern Hemisphere Sea Ice Area

recent 365 days shown

Ice Area (million square km)

Year

S.H. Sea Ice Area

Anomaly from 1979-2000 mean

http://arctic.atmos.uiuc.edu/cryosphere/IMAGES/current.365.south.jpg
Figure 1: Four-year rate of the global upper 700 m of ocean heat changes in Joules at monthly time intervals. One standard error value is also shown. (Figure courtesy of Josh Willis of NASA’s Jet Propulsion Laboratory).
The Data Presents A Complex Variation In Time That Is Not Accurately Simulated By The Global Models
Poor Microclimate Exposure At Many Climate Observing Sites

http://wattsupwiththat.wordpress.com/

Fort Morgan site showing images of the cardinal directions from the sensor (from Hanamean et al. 2003)
Santa Ana, Orange County CA site situated on the rooftop of the local fire department.
See related article and photos at:
http://wattsupwiththat.wordpress.com/ and
Photo taken at Roseburg, OR (MMTS shelter on roof, near a/c exhaust)
http://www.surfacestations.org/images/Roseburg_OR_USHCN.jpg
Buffalo Bill Dam, Cody WY shelter on top of a stone wall at the edge of the river. It is surrounded by stone building heat sinks except on the river side. On the river it is exposed to waters of varying temperatures, cold in spring and winter, warm in summer and fall as the river flows vary with the season. The level of spray also varies, depending on river flow.
Climate Reference Network Rating Guide:

**Class 1** Flat and horizontal ground surrounded by a clear surface with a slope below 1/3 (<19deg). Grass/low vegetation ground cover <10 centimeters high. Sensors located at least 100 meters from artificial heating or reflecting surfaces, such as buildings, concrete surfaces, and parking lots. Far from large bodies of water, except if it is representative of the area, and then located at least 100 meters away. No shading when the sun elevation >3 degrees.

**Class 2** Same as Class 1 with the following differences. Surrounding Vegetation <25 centimeters. No artificial heating sources within 30m. No shading for a sun elevation >5deg.

**Class 3** (error 1C) - Same as Class 2, except no artificial heating sources within 10 meters.

**Class 4** (error >= 2C) - Artificial heating sources <10 meters.

**Class 5** (error >= 5C) - Temperature sensor located next to/above an artificial heating source, such as a building, roof top, parking lot, or concrete surface.

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*Surveyed CRN Site Quality Rating*

- CRN=1: 3%
- CRN=2: 9%
- CRN=3: 19%
- CRN=4: 57%
- CRN=5: 12%

724 stations rated as of 12/21/2008
Global Radiative Forcing

Figure SPM.2. Global average radiative forcing (RF) estimates and ranges in 2005 for anthropogenic carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O) and other important agents and mechanisms, together with the typical geographical extent (spatial scale) of the forcing and the assessed level of scientific understanding (LOSU). The net anthropogenic radiative forcing and its range are also shown. These require summing asymmetric uncertainty estimates from the component terms, and cannot be obtained by simple addition. Additional forcing factors not included here are considered to have a very low LOSU. Volcanic aerosols contribute an additional natural forcing but are not included in this figure due to their episodic nature. The range for linear contrails does not include other possible effects of aviation on cloudiness. (2.9, Figure 2.20)
FIGURE 1-1 The climate system, consisting of the atmosphere, oceans, land, and cryosphere. Important state variables for each sphere of the climate system are listed in the boxes. For the purposes of this report, the Sun, volcanic emissions, and human-caused emissions of greenhouse gases and changes to the land surface are considered external to the climate system.
FIGURE 1-2 Conceptual framework of climate forcing, response, and feedbacks under present-day climate conditions. Examples of human activities, forcing agents, climate system components, and variables that can be involved in climate response are provided in the lists in each box.
Despite all... [its]... advantages, the traditional global mean TOA radiative forcing concept has some important limitations, which have come increasingly to light over the past decade. The concept is inadequate for some forcing agents, such as absorbing aerosols and land-use changes, that may have regional climate impacts much greater than would be predicted from TOA radiative forcing. Also, it diagnoses only one measure of climate change - global mean surface temperature response - while offering little information on regional climate change or precipitation.
Global Climate Effects Occur with ENSOs for the Following Reasons:

1. Large Magnitude
2. Long Persistence
3. Spatial Coherence

The 2005 National Research Council report concluded that:

"regional variations in radiative forcing may have important regional and global climate implications that are not resolved by the concept of global mean radiative forcing."

And furthermore:

"Regional diabatic heating can cause atmospheric teleconnections that influence regional climate thousands of kilometers away from the point of forcing."

This regional diabatic heating produces temperature increases or decreases in the layer-averaged regional troposphere. This necessarily alters the regional pressure fields and thus the wind pattern. This pressure and wind pattern then affects the pressure and wind patterns at large distances from the region of the forcing which we refer to as teleconnections.
WE SHOULD, THEREFORE EXPECT GLOBAL CLIMATE EFFECTS FROM ANY HUMAN AND NATURAL CLIMATE FORCING THAT HAS THE SAME THREE CHARACTERISTICS
THE REGIONAL ALTERATION IN TROPOSPHERIC DIABATIC HEATING HAS A GREATER INFLUENCE ON THE CLIMATE SYSTEM THAN A CHANGE IN THE GLOBALLY-AVERAGED SURFACE AND TROPOSPHERIC TEMPERATURES
WHAT IS THE IMPORTANCE OF MORE HETEROGENEOUS CLIMATE FORCINGS RELATIVE TO MORE HOMOGENEOUS CLIMATE FORCING SUCH AS THE RADIATIVE FORCING OF CO$_2$?
AN EXAMPLE FOR AEROSOL CLIMATE FORCING
In Matsui and Pielke Sr. (2006), it was found from observations of the spatial distribution of aerosols in the atmosphere in the lower latitudes, that the aerosol effect on atmospheric circulations, as a result of their alteration in the heating of regions of the atmosphere, is 60 times greater than due to the heating effect of the human addition of well-mixed greenhouse gases.

http://climatesci.colorado.edu/publications/pdf/R-312.pdf
Can We Predict Regional Climate With Dynamic Downscaling Better Than By Using Statistical Downscaling
Table 1. Dependence of Regional Model on Indicated Constraints

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<th>Type 1</th>
<th>Type 2</th>
<th>Type 3</th>
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<td>terrain; climatological vegetation; observed SSTs</td>
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<td>global model</td>
<td>IPCC(^d), U.S. National Assessment(^e)</td>
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<tr>
<td>Atmospheric Model(^b)</td>
<td>ETA(^f)</td>
<td>forced by observed SSTs</td>
<td>International Panel on Climate Change and the Future of Life, Agriculture, and Forests.(^f)</td>
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<tr>
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<td>PIRCS(^i)</td>
<td>COLA(^k)/ETA(^l)</td>
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<td>Regional</td>
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\(^a\)Available at [http://ldas.gsfc.nasa.gov/](http://ldas.gsfc.nasa.gov/).
\(^b\)Available at [http://www.emc.ncep.noaa.gov/gmb/moorhi/gam.html](http://www.emc.ncep.noaa.gov/gmb/moorhi/gam.html).
\(^c\)Kalnay et al. [1996].
\(^d\)Houghton et al. [2001].
\(^e\)Available at [http://www.gerio.org/NationalAssessment/](http://www.gerio.org/NationalAssessment/).
\(^f\)Black [1994].
\(^g\)Grell et al. [1994].
\(^h\)Pielke et al. [1992].
\(^i\)Xue et al. [2000, 2001].
\(^j\)Tokle et al. [1999].
\(^k\)Available at [http://www-pcmdi.llnl.gov/moldoc/amip/14cola.html](http://www-pcmdi.llnl.gov/moldoc/amip/14cola.html).
\(^l\)Meesing et al. [1997].
\(^m\)Giorgi et al. [1993a, 1993b].

<table>
<thead>
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<th>Type</th>
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<tr>
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<td>lateral boundary conditions; topography; other bottom land boundary conditions; solar irradiance; well-mixed greenhouse gases</td>
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<tr>
<td>Season weather prediction</td>
<td>topography; other bottom land boundary conditions; sea surface temperatures; solar irradiance; well-mixed greenhouse gases</td>
</tr>
<tr>
<td>Multiyear climate prediction</td>
<td>topography; solar irradiance; well-mixed greenhouse gases</td>
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</tbody>
</table>

\(^a\)From top to bottom of table: more constraints to fewer constraints; from bottom to top of table: less predictive skill to greater predictive skill.

Figure 2. The 500-mbar height (m) on 0Z UTC, 12 May 1993, for indicated model basic experiments and NCEP Reanalysis.
Geographically distributed predictions of future climate, obtained through climate models, are widely used in hydrology and many other disciplines, typically without assessing their reliability. Here we compare the output of various models to temperature and precipitation observations from eight stations with long (over 100 years) records from around the globe. The results show that models perform poorly, even at a climatic (30-year) scale. Thus local model projections cannot be credible, whereas a common argument that models can perform better at larger spatial scales is unsupported.
In Conclusion

The role of humans within the climate system must, therefore, be one of the following three possibilities:

1. The human influence is minimal and natural variations dominate climate variations on all time scales;

2. While natural variations are important, the human influence is significant and involves a diverse range of first-order climate forcings, including, but not limited to the human input of CO$_2$;

3. The human influence is dominated by the emissions into the atmosphere of greenhouse gases, particularly carbon dioxide.
To Move Forward We Need A Bottom-Up Resource Based Focus, Rather Than Relying On Downscaling From Global Climate Models
FINALLY

There is a clear conflict of interest in the preparation of the IPCC and CCSP reports. The lead authors are individuals who are assessing their own research. There need to be new Committees convened which can provide a more objective assessment of climate, including the human role within it. Unless this is done, we are doomed to a continued repetition of the same information, which is misleading the public and policymakers with respect to what policy actions should be taken with respect to climate.
Roger A. Pielke Sr. Weblog
http://climatesci.org

Roger A. Pielke Sr. Website
http://cires.colorado.edu/science/groups/pielke