# Global and Regional Climate Change Pre-test
All answers should be concise and succinct.

1) Please refer to the IPPC figure on the right (SPM.1) and state the relationship between carbon dioxide, methane gas, and nitrous oxide, including any patterns you notice during the last 200 years.

*$NO_2$ and $CH_4$ are represented along the y-axis in parts per billion while $CO_2$ is in parts per million. All three gases show a sharp increase in the past two centuries, the steeper slope from 1900 to 2000 shown on the inset graphs indicate that the rate of increase is also increasing.*

2) Based on your current knowledge, please provide a brief definition for the following terms:

anthropogenic
*Resulting from or produced by human beings*

albedo
*The fraction of solar radiation reflected by a surface or an object*

contrails
*Clouds formed when water vapor in airplane exhaust condenses into liquid water (**con**densation **trails**)*
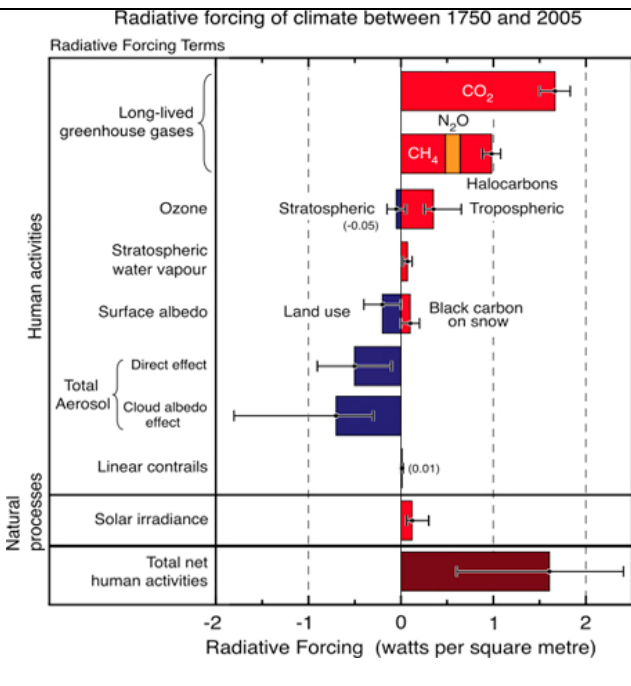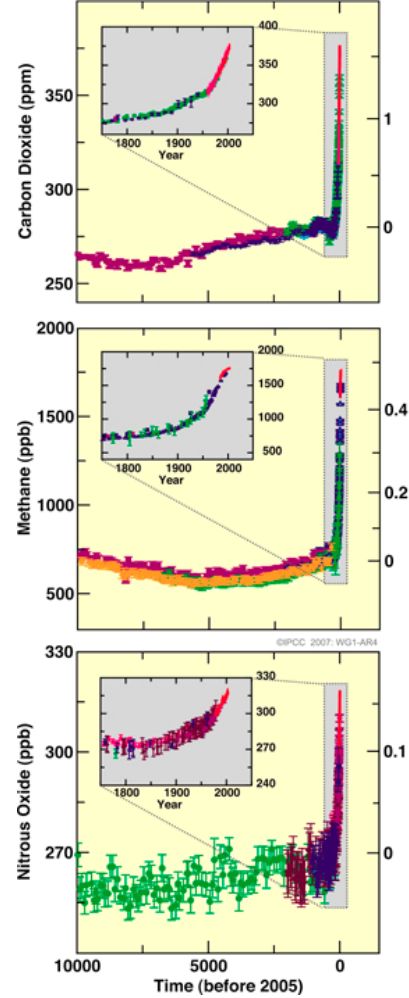
irradiance
*Radiant energy incident per unit area, in global climate studies this is at the top of the atmosphere & expressed in watts per square meter*

aerosols
*A collection of liquid or solid particles suspended in the atmosphere*

radiative forcing
*An externally imposed perturbation in the radiative energy budget of the Earth's climate system.*





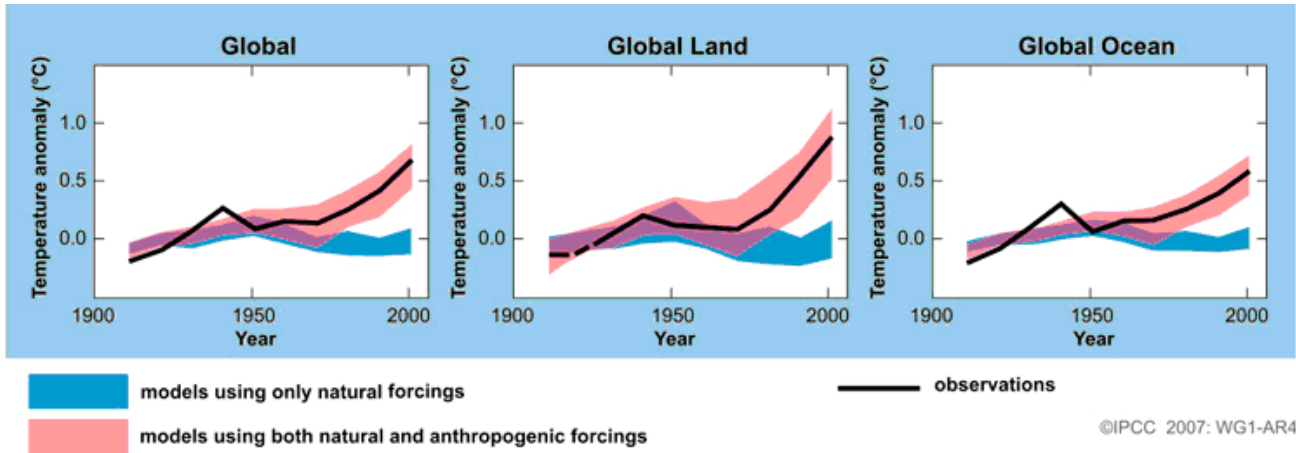3) What is the significance of the adjacent IPCC figure? (FAQ 2.1)

*The red bars depict the extent that an atmospheric component (listed on the y-axis) has caused positive forcing of the Earth's radiative balance, or warming, while the blue bars depict negative forcing or cooling in watts per square meter along the x-axis.*
*The brown bar at the bottom shows that total radiative forcing from human activities between 1750 and 2005 has been positive, or that Earth's radiative balance is being pushed away from its normal state towards warmer temperatures.*
*Note that most of the warming has been from CO, readily apparent from the similar lengths of the top and bottom bars.*

4) State what "W m$^{-2}$" stands for and why you think this might be a useful unit of measurement.
*Watts per square meter which measures the exchanged heat energy (1 watt = 1 joule per second) over a specific surface area (square meter), useful for monitoring solar energy.*

Global / Global Land / Global Ocean — Temperature anomaly (°C) vs Year

- models using only natural forcings
- models using both natural and anthropogenic forcings
- observations

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5) Refer to the IPCC figure above (SPM.4) that plots observed and modeled data. What does this graph tell you about the relationship between recent global warming and natural processes?

*Observed warming (in black) matches computer climate models only when human activities are included in the model runs. Contributions for natural processes (shown in blue) can not account for the increase in temperatures during the 20*[th] *century.*
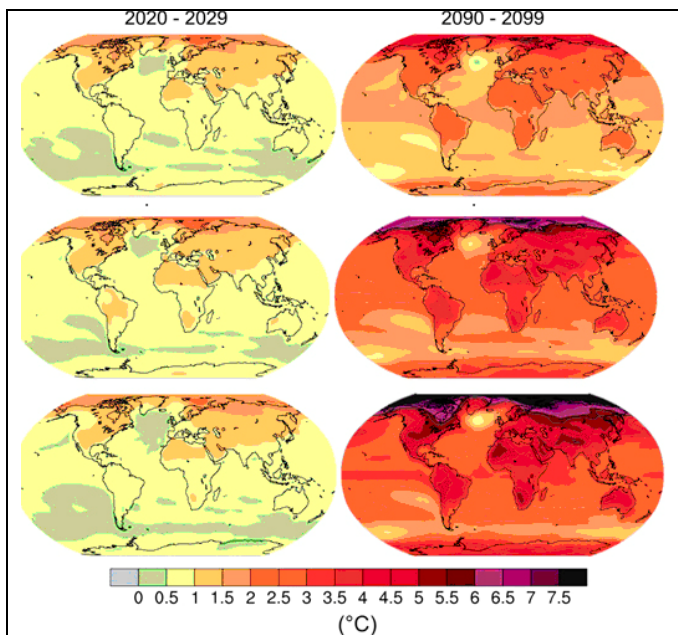
|  | 6) Refer to the graphs to the left from the IPPC report and list a few locations where computer models predict that warming will be the greatest:<br><br>*Land mass in the northern hemisphere & arctic ocean waters*<br><br><br>7) Why might this be the case?<br>*The abundance of land in the northern hemisphere facilitates human populations and human activities while also warming much faster than the southern hemispheric oceans* |
| --- | --- |



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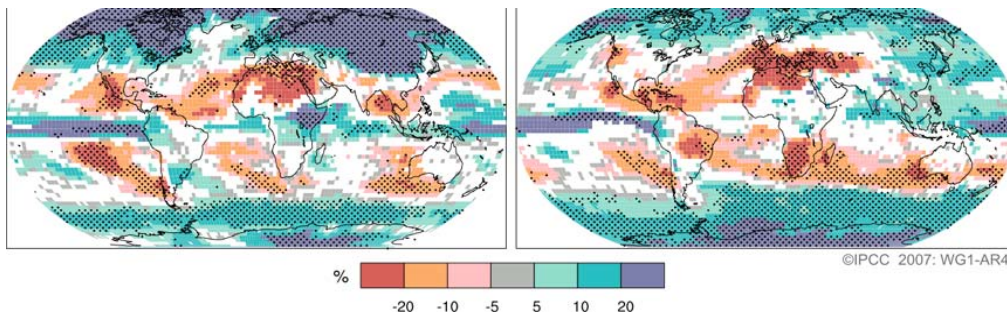
8) Refer to the IPCC precipitation graphic above (figure SPM.7) and list three places where climate models predict drier than normal conditions in the next 100 years:

*Mexico, Northern Africa, Brazil, Southern Africa, Western Australia, Central America*

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9) What is the most abundant greenhouse gas?
   *Water Vapor ($H_2O$)*
10) Which greenhouse gas is of most concern to climate scientist studying warming?
   *Carbon Dioxide ($CO_2$)*
11) What constitutes the bulk of the mass in any single tree?
   *Carbon*
12) What is the biggest force behind climate change prior to the industrial revolution?
   *Changes in the Earths orbit and tilt*
13) What was the first creature added to the endangered species list because of human-induced global warming? *Polar Bear*

TRUE or FALSE
14) The Ozone Hole contributes to global warming.
   *False*
15) Global Warming is accelerated by the melting of snow and ice covered surfaces.
   *True*
16) Melting of Arctic snow and ice will likely result in rising sea levels.
   *False*
17) Melting of snow and ice in Antarctica will likely result in rising sea levels.
   *True*
MULTIPLE CHOICE
18) How long does it take for $CO_2$ in the atmosphere to disperse?
   20, 50, 75, or 100 yrs
   *100 Years*
19) According to the IPCC report, how many inches could sea levels rise by 2100?
   1-4 inches, 4-7inches, 7-24inches
   *7-24inches*

20) Refer to the adjacent IPCC graph (figure SPM.3.) This figure shows the change in the global average temperature (top), the change in the global average sea level (middle) and the change in the Northern Hemisphere snow cover (bottom) since the year 1850. What are the trends in these three variables?
   *Temperatures and Sea Levels are rising*
   *Snow Cover is decreasing*

Can you explain the connection(s) between an increase in air temperatures and Northern Hemisphere snow cover?
   *Reductions in NH snow cover are enhanced by warmer atmospheric temperatures*

Can you explain the connection(s) between an increase in air temperatures and global average sea level?
   *While warming of atmospheric temperatures can enhance the melting of snow and ice which may flow into the sea and cause increases in sea level, the main connection is that the surface ocean waters have been warming in response to warmer air temperatures and expand, causing sea level rise.*



(a) Global average temperature
(b) Global average sea level
(c) Northern Hemisphere snow cover
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