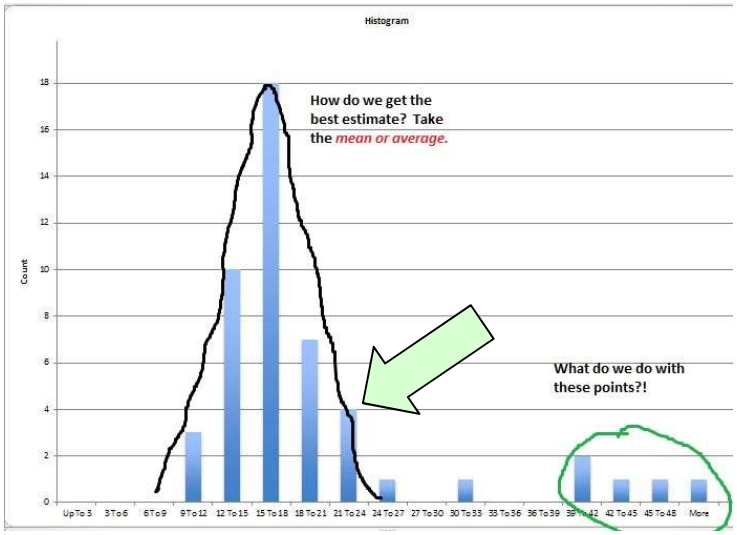
Distinguishing Good Science from Bad D. Duncan NAME _____

Comparing a Scientific Publication to TV Coverage about Climate Change

Part I – Analyzing Data

As we've discussed in class, "Science is a way of trying not to fool yourself (or be fooled by others). " You don't have to be a scientist to think scientifically. But you need to understand the process of science and beware of fake, slanted, or pseudoscience. This includes understanding why different groups of scientists often get different results.

As we also discussed in class, scientists repeat measurements to get an idea of their accuracy and to improve it by averaging individual measurements. Below are student measurements of the height of the C4C building:

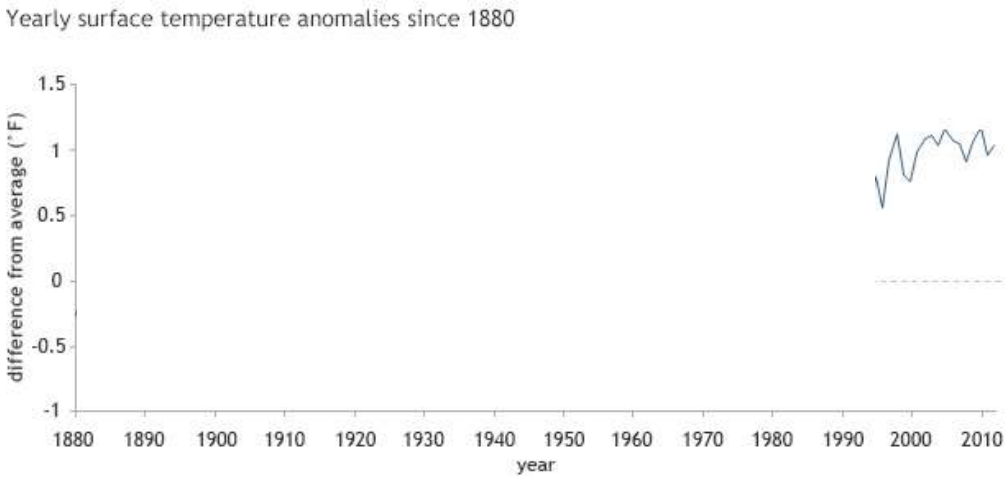


1. Is the point indicated by the arrow a valid measurement of the height?

2. Do you think it is ethical to pick out a measurement other than the mean and say "This is what was found?"

3. What would be a good way of expressing the uncertainty of the measurement?

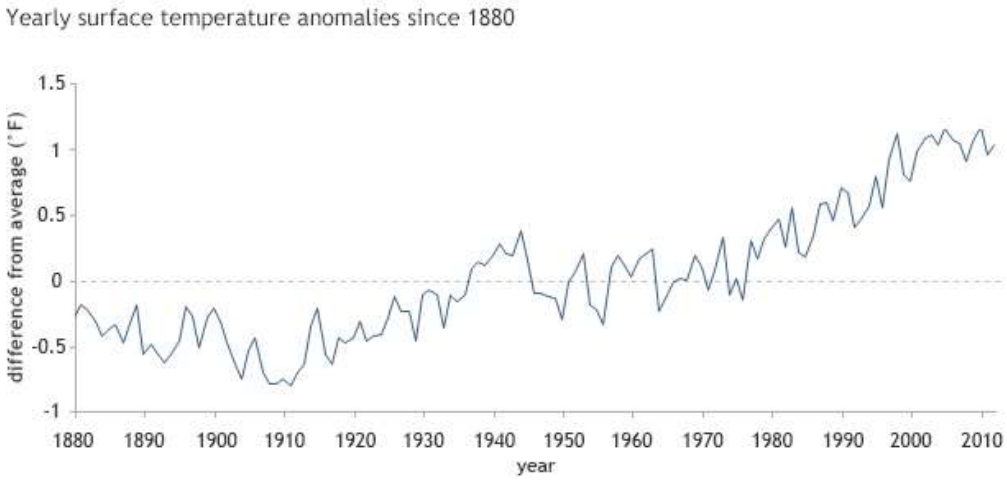
4. You may have heard the statement, "Climate Change has stopped." In this plot are air temperatures, averaged over the Earth, for about the last 15 years.



Is the temperature of the atmosphere rising?

Do you think that climate change has stopped? Why or why not?

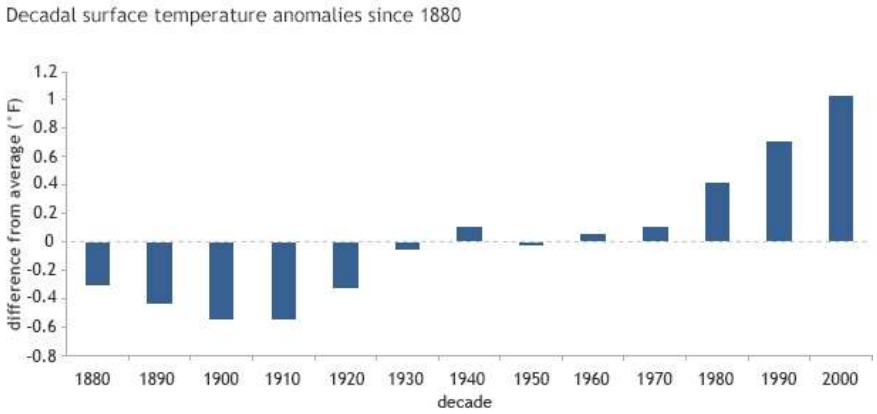
5. Here is the same data as #4. Do you draw a different conclusion than from the data in #4?



Why do you think the line wiggles up and down from year to year?

Can you think of a way to better see the long-term trends, and not the yearly variation?

Here is the same data averaged over each decade:



What other sorts of data could you look at to decide if the earth's climate was still changing or not?

[Your Teaching or Learning Assistant has some examples to show you]

Part II Analyzing TV and Newspaper Reports

6. Watch the short TV report from Fox News. They say that "Scientists from the Cato Institute say there is no indication that Global Warming will resume." It is good that they give a reference to their source of data. Look up the Cato Institute on line. What kind of science do they specialize in?

Compare that to the American Association for the Advancement of Science (http://www.aaas.org/about-aaas) or http://en.wikipedia.org/wiki/American_Association_for_the_Advancement_of_Science

About how many members does the AAAS have?

7. The video on Fox is similar to the Wall St. Journal article that appeared a few days earlier:

OPINION

Whatever Happened to Global Warming?

Now come climate scientists' implausible explanations for why the 'hiatus' has passed the 15-year mark.

By MATT RIDLEY
Sept. 4, 2014 7:20 p.m. ET

On Sept. 23 the United Nations will host a party for world leaders in New York to pledge urgent action against climate change. Yet leaders from China, India and Germany have already announced that they won't attend the summit and others are likely to follow, leaving President Obama looking a bit lonely. Could it be that they no longer regard it as an urgent threat that some time later in this century the air may get a bit warmer?

In effect, this is all that's left of the global-warming emergency the U.N. declared in its first report on the subject in 1990. The U.N. no longer claims that there will be dangerous or rapid climate change in the next two decades. Last September, between the second and final draft of its fifth assessment report, the U.N.'s Intergovernmental Panel on Climate Change quietly downgraded the warming it expected in the 30 years following 1995, to about 0.5 degrees Celsius from 0.7 (or, in Fahrenheit, to about 0.9 degrees, from 1.3).

Even that is likely to be too high. The climate-research establishment has finally admitted openly what skeptic scientists have been saying for nearly a decade: Global warming has stopped since shortly before this century began.

Here is the original scientific article. See if you are more accurate than the Wall St. Journal writer:

Varying planetary heat sink led to global-warming slowdown and acceleration

Xianyao Chen[1,2] and Ka-Kit Tung[2]*

A vacillating global heat sink at intermediate ocean depths is associated with different climate regimes of surface warming under anthropogenic forcing: The latter part of the 20th century saw rapid global warming as more heat stayed near the surface. In the 21st century, surface warming slowed as more heat moved into deeper oceans. In situ and reanalyzed data are used to trace the pathways of ocean heat uptake. In addition to the shallow La Niña–like patterns in the Pacific that were the previous focus, we found that the slowdown is mainly caused by heat transported to deeper layers in the Atlantic and the Southern oceans, initiated by a recurrent salinity anomaly in the subpolar North Atlantic. Cooling periods associated with the latter deeper heat-sequestration mechanism historically lasted 20 to 35 years.

Increasing anthropogenic greenhouse-gas emissions perturb Earth's radiative equilibrium, leading to a persistent imbalance at the top of the atmosphere (TOA) despite some long-wave radiative adjustment. Energy balance requires that this TOA imbalance for the planet equal the time rate of increase of the total heat content in the atmosphere-ocean system (*1*). Because the heat capacity of the atmosphere and the cryosphere is small, about 90% of the total heat content is in the form of ocean heat content (OHC) (*2*, *3*). Although the magnitude of the TOA

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Note that "vacillating" means changing, a heat "sink" is something that stores energy, and anthropogenic means, "human-caused."
Do the scientists report that warming of the earth has stopped?

Where do the scientists say the energy caused by humans is (mostly) going?

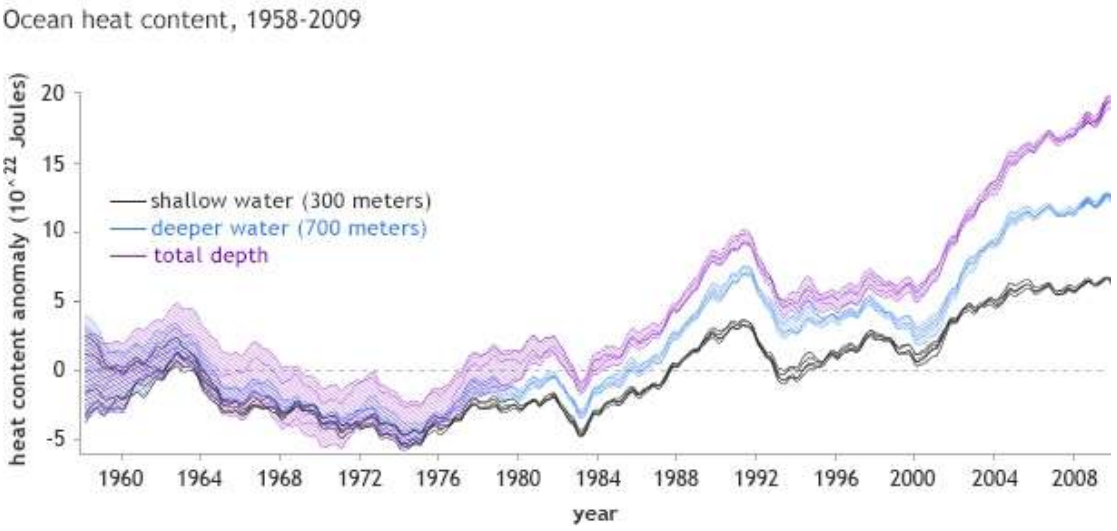
What changed from the later part of the 20th century to the start of the 21st? (Where did more of the human-caused heat go?)

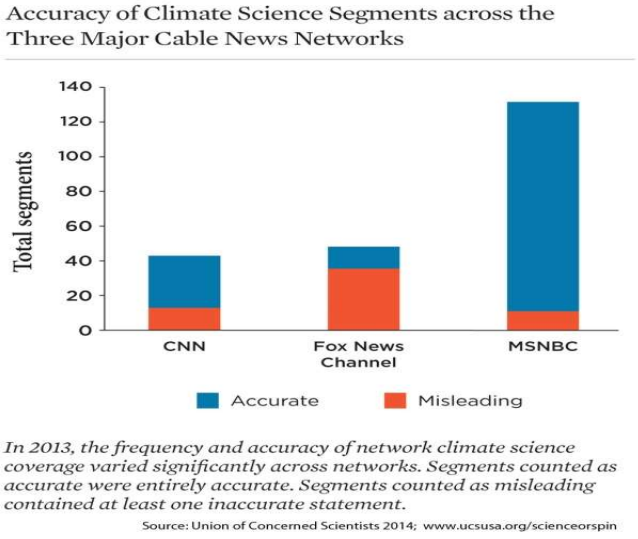
About how long is this trend likely to continue?

What fraction of heat energy is stored in the ocean vs. the atmosphere and cryosphere (ice)?

When we talk about climate change should we be talking about air or sea temperatures?

Here are ocean temperatures for the last 50 years.





In 2013, the frequency and accuracy of network climate science coverage varied significantly across networks. Segments counted as accurate were entirely accurate. Segments counted as misleading contained at least one inaccurate statement.

Source: Union of Concerned Scientists 2014; www.ucsusa.org/scienceorspin

Here is a survey of TV climate reports, made by scientists who checked them for accuracy. What grade would you give the 3 networks if you were grading them? (A, B, B+, C, etc.)

You might find this response interesting. It is by a Professor at Columbia who is not a scientist himself, but who obviously reads carefully. A great example of what a careful nonscientist can learn…

Ridley's "smoking gun" is a paper last week in Science Magazine by two scientists Xianyao Chen and Ka-Kit Tung, which Ridley somehow believes refutes all previous climate science. Ridley quotes a sentence fragment from the press release suggesting that roughly half of the global warming in the last three decades of the past century (1970-2000) was due to global warming and half to a natural Atlantic Ocean cycle. He then states that "the man-made warming of the past 20 years has been so feeble that a shifting current in one ocean was enough to wipe it out altogether," and "That to put the icing on the case of good news, Xianyao Chen and Ka-Kit Tung think the Atlantic Ocean may continue to prevent any warming for the next two decades."

The Wall Street Journal editors don't give a hoot about the nonsense they publish if it serves their cause of fighting measures to limit human-induced climate change. If they had simply gone online to read the actual paper, they would have found that the paper's conclusions are the very opposite of Ridley's.

First, the paper makes perfectly clear that the Earth is warming in line with standard climate science, and that the Earth's warming is unabated in recent years. In the scientific lingo of the paper (it's very first line, so Ridley didn't have far to read!), "Increasing anthropogenic greenhouse-gas-emissions perturb Earth's radiative equilibrium, leading to a persistent imbalance at the top of the atmosphere (TOA) despite some long-wave radiative adjustment." (Infrared) In short, we humans are filling the atmosphere with carbon dioxide from fossil-fuel use, and we are warming the planet.

Second, the total warming is distributed between the land and ocean surface on the one hand and the ocean deep water on the other. The total rise of ocean heat content has continued unabated, while the proportion of heat absorbed at the surface and in the deeper ocean varies over time. Again, in the scientific lingo of the paper, "[T]his forced total OHC [ocean heat content] should be increasing monotonically over longer periods even through the current period of slowed warming. In fact, that expectation is verified by observation ...". In other words, the ocean has continued to warm in line with predictions of just such a phenomenon seen in climate models.

Third, it is the "vertical distribution" of the warming, between the surface and deep water, which affects the warming observed on land and at the sea surface. The point of the paper is that the allocation of the warming vertically varies over time, sometimes warming the surface rapidly, other times warming the deeper ocean to a great extent and the surface water less rapidly. According to the paper, the period of the late 20th century was a period in which the surface was warmed relative to the deeper ocean. The period since 2000 is the opposite, with more warming of the deeper ocean. How do the scientists know? They measure the ocean temperature at varying depths with a sophisticated system of "Argo profiling floats," which periodically dive into the ocean depths to take temperature readings and resurface to transmit them to the data centers.

So, what is Ridley's "smoking gun" when you strip away his absurd version of the paper? It goes like this. The Earth is continuing to warm just as greenhouse gas theory holds. The warming heats the land and the ocean. The ocean distributes some of the warming to the surface waters and some to the deeper waters, depending on the complex circulation of ocean waters. The shares of warming of the surface and deeper ocean vary over time, in fluctuations that can last a few years or a few decades.

If the surface warming is somewhat less in recent years than in the last part of the 20th century, is that reason for complacency? Hardly. The warming is continuing, and the consequences of our current trajectory will be devastating unless greenhouse gas emissions (mainly carbon dioxide) are stopped during this century. As Chen and Tung conclude in their Science paper, "When the internal variability [of the ocean] that is responsible for the current hiatus [in warming] switches sign, as it inevitably will, another episode of accelerated global warming should ensue."