The Cooling

While most climate models predict steady rises in global air temperatures over the 21st century, there is abundant evidence suggesting otherwise. Many scientists believe that projections from the IPCC and other agencies are unrealistic, and that in the next several decades temperatures may level off or even decline.

Below are discussions of potential future trends in several major "forcing" categories suggesting relatively flat or even negative temperature trends in the future.

Ocean temperatures

According to Bratcher and Giese (2002), analysis of ocean surface temperature records shows that low frequency changes of tropical Pacific temperature lead global surface air temperature changes by about 4 years. Anomalies of tropical Pacific surface temperature are in turn preceded by subsurface temperature anomalies in the southern tropical Pacific by approximately 7 years. The results suggest that much of the decade to decade variations in global air temperature may be attributed to tropical Pacific decadal variability, and that subsurface temperature anomalies in the southern tropical Pacific can be used as a predictor for decadal variations of global surface air temperature. Since the southern tropical Pacific temperature shows a distinct cooling over the last 8 years, the possibility exists that the warming trend in global surface air temperature observed since the late 1970's may soon weaken.

Chavez, et al (2003) reviewed physical and biological fluctuations with periods of about 50 years that involves Pacific Ocean conditions. They identified multidecadal variations that strongly influence sea and air temperatures, and cite evidence that a shift from warm to cool Pacific conditions may already be in progress.

DiLorenzo et al (2005) studied long-term changes in the observed temperature and salinity along the Southern California coast using a four-dimensional space–time analysis of the period 1949–2000. Sea surface temperatures warmed by about 1.3°C between 1950 and 1999, primarily because of large-scale decadal fluctuations in surface heat fluxes combined with horizontal advection by the mean currents. After 1998 the surface heat fluxes suggest the beginning of a period of cooling, consistent with colder observed ocean temperatures.

Lyman et al (2006) reported a net loss of 3.2 (± 1.1) × 10^{22} J of heat from the upper ocean between 2003 and 2005, in contrast to assumptions of increased ocean heat content due to rising air temperatures. It appears that both the recent and previous global cooling events are significant and unlikely to be artifacts of inadequate ocean sampling.

Peterson and Schwing (2003) describe a rapid and striking transition in the North Pacific in late 1998. Upwelling-favorable winds strengthened over the California Current (CC), and winds weakened in the Gulf of Alaska (GOA). Coastal waters of the CC and GOA cooled by several degrees, and the Pacific Decadal Oscillation (PDO) reversed sign and remained negative through summer 2002. Zooplankton biomass in the northern CC doubled and switched from warm to cold water species dominance, coho and chinook salmon stocks rebounded, and anchovy and osmeriids increased. Persistent changes in atmosphere and upper ocean fields and ecosystem structure suggest a climate regime shift has occurred, similar (opposite) to shifts observed in 1947 (1925 and 1976). If the 1998 regime shift in the northern CC is completely analogous to earlier shifts, then ecosystem structure should have changed in the GOA. Recent surveys indicate this ecosystem has transformed as well.

According to Freeland et al (2003), subsurface upper ocean waters off Oregon and Vancouver Island were about 1 deg C cooler in July 2002 than in July 2001. The anomalously cool layer coincides with the permanent halocline which has salinities of 32.2 to 33.8, suggesting an invasion of nutrient-rich Subarctic waters. The anomalously cool layer lies at 30–150 m. The cool anomaly is likely caused by stronger southward flow in the California Current and weaker northward flow in the Alaska and Davidson Currents during spring 2002. Other factors may include reduced coastal downwelling in late winter and early spring 2002, enhanced eastward flow in the Subarctic Current, and enhanced winter mixing offshore.

Mullin, et al (2003) studied macrozooplankton in the southern California sector of the California Current from 1951 to 1999. Total biovolume increased in 1999 to the pre-1975 level, consistent with a possible shift to a new regime. Their results are consistent with (i) a change in biovolume of the large zooplankton over the sampled period; and (ii) a regime shift in the mid-1970s and, possibly, the late 1990s.

Ocean-atmosphere variability

Gedalof and Smith (2001) used a transect of climate sensitive tree ring-width chronologies from coastal western North America to obtain a useful proxy index of North Pacific ocean-atmosphere variability since 1600 AD. They identified intervals of an enhanced interdecadal climate signal in the North Pacific. In the context of this record, the step-like climate shift that occurred in 1976-1977 is not a unique event, with similar events having occurred frequently during the past 400 years. Furthermore, most of the pre-instrumental portion of this record is characterized by pronounced interdecadal variability, while the secular portion is more strongly interannual in nature. If the 1976-1977 event marks a return to this mode of variability there may be significant consequences for natural resources management in the North Pacific Sector.

Aerosols

Matsui and Pielke (2006) compared the spatial mean and the spatial gradient of the aerosol radiative forcing in comparison with those of well-mixed green-house gases (GHG). Although greenhouse gases have a larger forcing than aerosol direct possible indirect effects, the aerosol direct and indirect effects have far greater "Normalized Gradient of Radiative Effects" than greenhouse gases.

According to Bréon (2006), anthropogenic aerosol emissions may increase cloud cover by up to 5%, resulting in a substantial net cooling of Earth's atmosphere.

Kaufman and. Koren (2006) note that pollution and smoke aerosols can either increase or decrease the cloud cover. This duality in the effects of aerosols forms one of the largest uncertainties in climate research. Using solar measurements from Aerosol Robotic Network sites around the globe, they show an increase in cloud cover with an increase in the aerosol column concentration and an inverse dependence on the aerosol absorption of sunlight. The emerging rule appears to be independent of geographical location or aerosol type, thus increasing the confidence in the understanding of these aerosol effects on the clouds and climate. Preliminary estimates suggest an increase of 5% in cloud cover.

Earth Albedo

Pallé, et al, 2004 compared earthshine measurements of Earth's reflectance (from 1999 through mid-2001) with satellite observations of global cloud properties to construct an estimate of Earth's global shortwave reflectance. The analysis indicates a steady decrease in Earth's reflectance from 1984 to 2000, with a strong climatologically significant drop after 1995. From 2001 to 2003, only earthshine data are available, and they indicate a complete reversal of the decline.

Solar changes

Scafetta and West (2006) studied the role of solar forcing on global surface temperature since 1900 using a sun-climate coupling model.They estimate that the sun contributed as much as 45–50% of the 1900–2000 global warming, and 25–35% of the 1980–2000 global warming. This suggests that the solar impact on climate change during the same period is significantly stronger than what some theoretical models have predicted.

Usoskin et al (2003) and Usoskin et al (2004) used records of the 10Be concentration in polar ice to reconstruct the average sunspot activity level from 850 A.D. to the present. The reconstruction shows that the period of high solar activity during the last 60 years is unique throughout the past 1150 years.

NASA solar physicist David Hathaway ("Solar Cycle 25 peaking around 2022 could be one of the weakest in centuries.") has studied large-scale circulation within the sun using sunspot information. He described "The Great Conveyor Belt," a massive circulating current of hot plasma within the Sun. Researchers believe the turning of the belt controls the sunspot cycle, and currently they are seeing a slowdown in the conveyor. According to theory and observation, the speed of the belt foretells the intensity of sunspot activity ABOUT 20 years in the future. A slow belt means lower solar activity; a fast belt means stronger activity. "The slowdown we see now means that Solar Cycle 25, peaking around the year 2022, could be one of the weakest in centuries," says Hathaway, and therefore would usher in a very cold period.

"There is no need for the Kyoto Protocol – scientists." Astronomers in St. Petersburg claim the planet will see a cooler period in the next few decades. Khabibulla Abdusamatov, head of space research at the Academic Pulkovo Observatory, reiterated his warning of an imminent recurrence of the so-called minor Ice Age, similar to the one that was registered in the 17th century. Abdusamatov and his colleagues made their prediction based on data of 11-year and 100-year fluctuations in solar activity. They said that sun emissions increased in the 20th century and have now reached their peak, implying that this period should be followed by a decline in solar activity. Therefore, the mean annual temperature should drop in 2012, with an even colder period setting in between 2055 and 2060.

Long Historical Trends

Martrat et al (2004) studied sediment data that indicated trends in western Mediterranean sea surface temperatures (SST) over the last 250,000 years. A recurring pattern was seen: rapid warming, followed by gradual and then rapid coolings, followed again by rapid warmings, and so on. For the Holocene, the authors report "a stable SST trend similar to those in previous interstadial stages, tending toward progressively cooler climate conditions." Suggested from their results is that "the next bifurcation of the climate system may appear as an extremely intense cooling if the future natural climate is going to develop as an analog of some of the preceding warm periods."

Ruddiman et al (2005) state that human intervention in the climate system over the last several thousand years may have affected climate sufficiently to prevent or delay the onset of an ice age. They say, "ice-core evidence from previous interglaciations indicates that forcing by orbital-scale changes in solar radiation and greenhouse-gas concentrations should have driven earth's climate significantly toward glacial conditions during the last several thousand years." The reason that an ice age has not yet begun is because “humans intervened in the natural operation of the climate system by adding significant amounts of CO_2 and CH_4 to the atmosphere, thereby offsetting most of the natural cooling.” This “fortuitously [produced] the climatic stability of the last several thousand years." The authors attributed most of the forcing to deforestation and biomass burning (CO_2) and rice farming and animal husbandry (CH_4).

Conclusion

Prediction of future climate is difficult due to the wide variety of forcings known to impact climate – to say nothing of hidden forcings not yet known or understood. While greenhouse gas forcings may indeed continue to increase, there appear to be many other factors which may serve to minimize or cancel out those effects.

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