In due course, climate change science no doubt will provide an explanation for global dimming and brightening and enable these oscillations to be reconciled with those in global warming. What is difficult to account for is the way in which the Intergovernmental Panel on Climate Change (IPCC), charged with providing the world’s governments with an overview of climate change science, has responded to this major challenge to the consensus explanation.

It is now 30 years since the publication of a paper calling attention to a large reduction in shortwave radiation measured over a 40-year interval at an isolated mountaintop desert site [Suraqui et al., 1974]. This finding was followed by the more than 70 others listed in the bibliography previously cited.

No reference to these findings has appeared in the three massive IPCC assessment reports published during the past 15 years. This omission is surprising in view of the important practical consequences of changes in $E_{s}$ in addition to their theoretical significance for climate change. These consequences stem from the ubiquitous role of solar energy in powering the Earth’s life-sustaining water, carbon, and atmospheric cycles. One such effect of global dimming already noted can be seen in the widespread reports of reductions in potential evaporation listed in the global dimming bibliography site. Another practical consequence, that of global brightening, may have already appeared in the increased net primary production of vegetation monitored from satellites over most of the Northern Hemisphere since the early 1980s [Brown et al., 2004].

The omission of reference to changes in $E_{s}$ in the IPCC assessments brings into question the confidence that can be placed in a top-down, “consensus” science system that ignores such a major and significant element of climate change.

A separate and more fundamental question is whether scientific understanding of climate change is now sufficient to produce a useful consensus vision. Is climate change a science or is it a trans-science, asking questions that can be stated in the language of science but that are currently beyond its ability to answer?

The cautionary note global dimming and brightening sounds for climate change scientists is not a new one; rather it strikingly vindicates the two rules of climate change set out by Peter Wright 30 years ago [Wright, 1971]. The first rule states that some feature of the atmosphere can always be found that will oscillate in accordance with your hypothesis; the second states that shortly after its discovery, the oscillation will disappear.

References


Beyond this, debate has continued, focusing on two broad questions that are explored by the articles here. The first question is whether the GPS data show any motion. The motions are so slow that minor differences in the length of data used, the processing method, or assumptions in the error analysis can lead to different interpretations (Figure 1, top). Smalley et al. (2005) conclude that significant motion occurs at two sites, RLAP and NWCC on opposite sides of the scarp thought to have been part of the fault break in 1811–1812. In contrast, Calais et al. (2005, 2006) find that none of the sites shows significant motion and that the inferred motion between RLAP and NWCC is due to a puzzling offset in the time series, suggestive of problems in the data or analysis rather than tectonic motion (Figure 1, bottom).

Newman [this issue] explores a related issue, showing that reporting small motions as strains—differences between small motions at two sites divided by the distance between them—can be misleading.

The second question is what the small or nil motions imply for past and future earthquakes. Analyses to date have explored the implications of the slow motions for the time and magnitude of future large earthquakes. Another possibility is that the motions are nil, perhaps implying that the seismic zone is shutting down and will not generate future large earthquakes. Alternatively, Rydelek [this issue] shows that the motions may be transient effects from the 1811–1812 earthquakes and thus give no direct information about future earthquakes.

The two articles here illustrate the complexity of the issues, which will likely be debated for many years. GPS velocity issues will eventually be resolved because the precision of velocity estimates increases with time. Hence the estimated motion will either continue shrinking closer to zero or climb above the uncertainties to show significant motion. However, the tectonic issues and their implications for seismic hazard policy may take
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Discrete geodetic measurements made near active faults may capture only small bits of a relatively complex field of deformation surrounding a fault, making it difficult to accurately describe the nature of ongoing activity along the fault. This difficulty is compounded when geodetic measurements are reported as strain rates, which involve differences in the displacement between two or more sites over time. As a result, very small displacement rates can be quoted as very high strain rates, which may lead to incorrectly inferring high seismic risk. As an example, I look at a recent deformation study across the New Madrid Seismic Zone (NMSZ). The NMSZ, located in east central United States and away from rapidly deforming plate boundaries, is best known for its slow deformation and low seismic hazard at the New Madrid seismic zone. Science, 284, 619–621.

2.7 ± 1.6 millimeters per year (Figure 1). Using the simple linear relation for strain rate,

$$\varepsilon = \frac{\Delta u}{T}$$

where $\Delta u$ is the change in velocity over the distance $T$ between measurements, they find a strain rate of approximately $10^{-7}$ per year. Unfortunately, this resultant strain rate alone does not yield useful information about the true strain accumulation across a slipping fault. That is because for a given

![Image](https://example.com/image.png)

Fig. 1. (a) New Madrid seismicity since 1974 (grey circles), GPS horizontal site velocities and 2σ errors (arrows and ellipses [Smalley et al., 2005]), and approximate surface location of the Reelfoot thrust fault (thick toothed line). Solid arrows are site velocities nearest the thrust and were used to infer strain rates of $10^{-7}$ per year at the distance site RLAP. (b) Predicted fault-normal displacements and strain rates (thick solid line for ongoing slip across a simple thrust).