

SPPI Monthly CO₂ Report



February

2009

Vol. I

Issue 2

Christopher Monckton, Editor

CONTENTS

Sea level has not risen for three years
CO2 concentration is rising, but still well below IPCC predictions
IPCC predicts rapid, exponential CO₂ growth that is not occurring
The 29-year global warming trend is just 2.5 °F (1.5 °C) per century
A long decline: 7 years' global cooling at 3.6 °F (2 °C) per century
Pachauri's endpoint fallacy: "Global Warming' is getting worse"
Why the endpoint fallacy is a fallacy: global cooling is accelerating
For the past three full years, global sea level has not risen
Arctic sea-ice extent has scarcely declined in the 29 years since 1980
Antarctic sea-ice extent reached a 30-year peak in late 2007
The regular "heartbeat" of global sea-ice extent: steady for 30 years
Hurricane and tropical cyclone activity reached a new low in 2008
Spotlight on the changing science behind the changing climate
 How the UN bloats CO₂'s warming effect
 Your climate-sensitivity ready reckoner
BREAKING NEWS IN THE JOURNALS, FROM www.co2science.org
 Thirty-Second Summary
 Amphibian Population Declines
 A Century of Parana River Streamflow Data
 Tropical Cyclones off the Northwestern Coast of Australia
 Floods of the Mississippi River System
 The Middle Ages were warmer than today: Owens Valley, White Mountains, California, USA

SPPI MONTHLY CO₂ REPORT :: FEBRUARY 2009

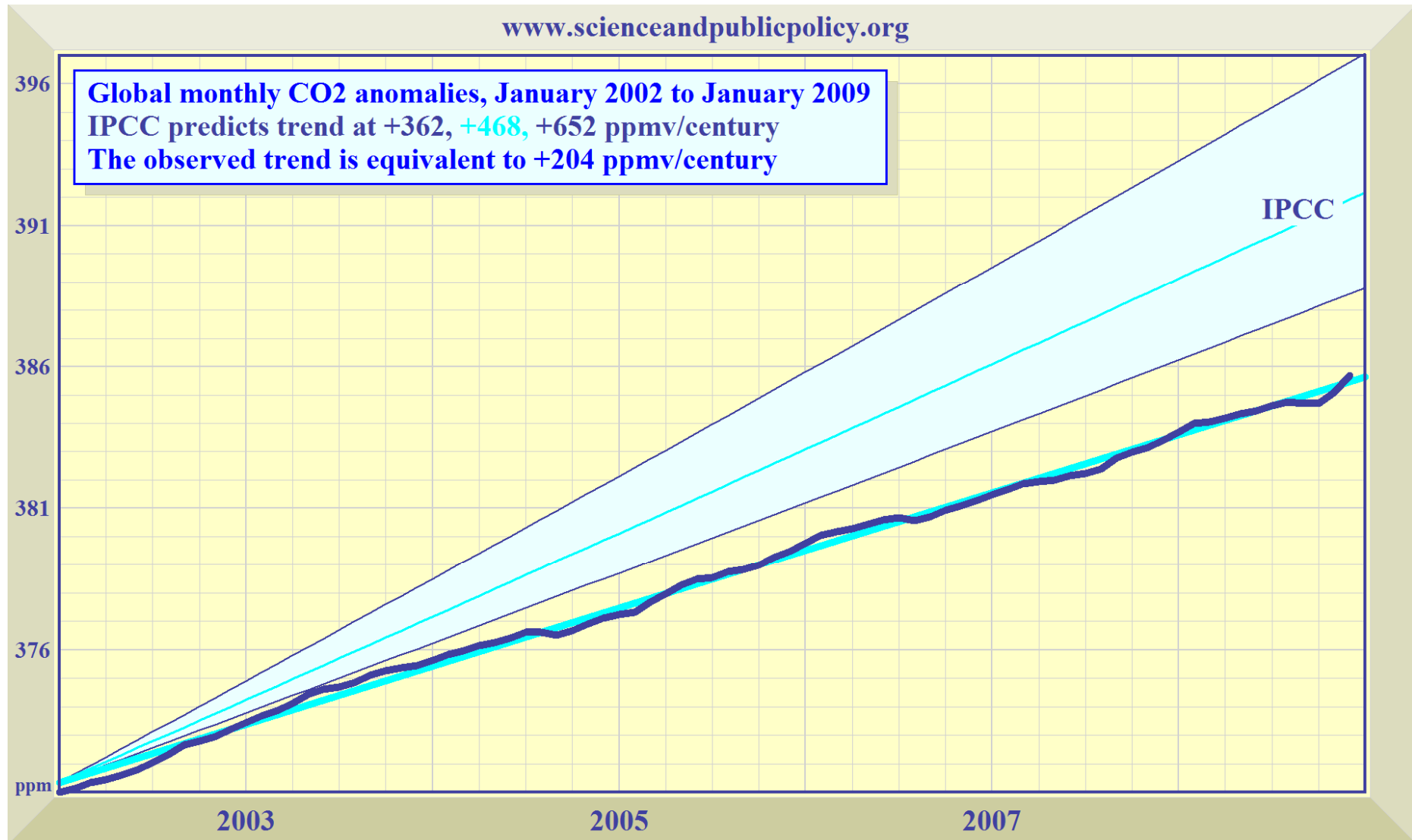
ACCURATE, AUTHORITATIVE ANALYSIS FOR TODAY'S POLICYMAKERS

Sea level has not risen for three years

SPPI's authoritative **MONTHLY CO₂ REPORT** shows that in recent years global mean sea level, as measured by the JASON satellite, has not risen for three years, probably in response to ocean cooling. Main points –

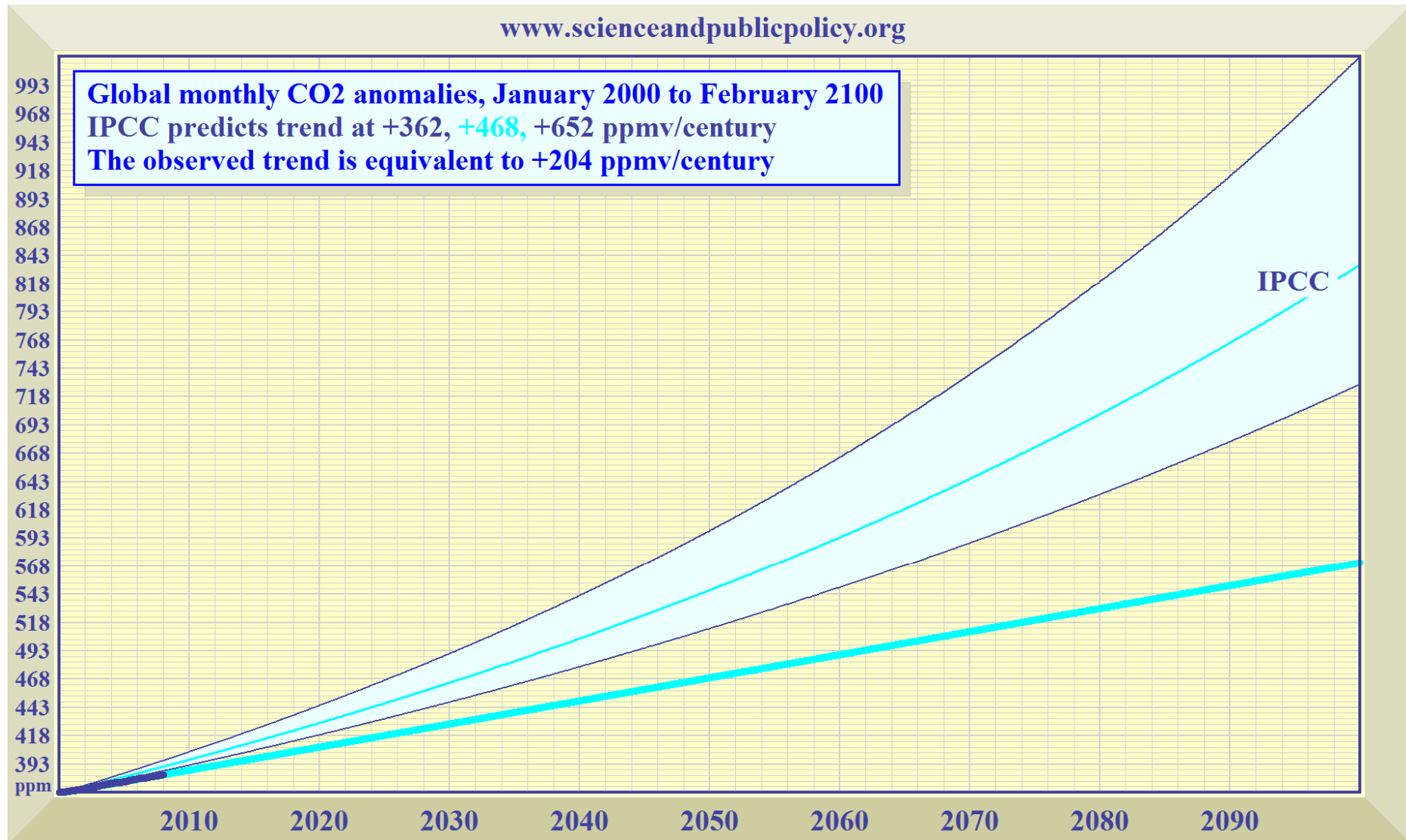
- ✚ The University of Colorado, at SPPI's request, has updated the sea-level data from the JASON satellite to the end of 2008. Though James Hansen of NASA says sea level will rise 246 feet, **sea level has not risen since the beginning of 2006.**
- ✚ **Sea level rose just 8 inches in the 20th century** and has been rising at just 1 ft/century since 1993.
- ✚ Since Al Gore's climate movie *An Inconvenient Truth* was launched in January 2005, global *cooling* has occurred at the equivalent of 10 °F (5.5 °C) per century. If this rapid cooling were to continue, the Earth would be in **an Ice Age by 2100.**
- ✚ The UN's climate panel, the IPCC, had projected temperature increases at 4.5 to 9.5 °F (2.4 to 5.3 °C) per century, with a central estimate of 7 °F (3.9 °C) per century. **None of the IPCC's computer models had predicted a prolonged cooling.**
- ✚ The **IPCC's estimates of growth in atmospheric CO₂ concentration are excessive.** They assume CO₂ concentration will rise exponentially from today's 385 parts per million to reach 730 to 1020 ppm, central estimate 836 ppm, by 2100.
- ✚ However, for seven years, CO₂ concentration has been rising in a straight line towards just 575 ppmv by 2100. This alone **halves the IPCC's temperature projections.** Since 1980 temperature has risen at only 2.5 °F (1.5 °C) per century.
- ✚ Sea ice extent in the Arctic recovered to the 30-year average during the early winter of 2008. In the Antarctic, sea ice extent reached a record high late in 2007, and has remained plentiful since. **Global sea ice extent shows no trend for 30 years.**
- ✚ The Accumulated Cyclone Energy Index is a 24-month running sum of monthly energy levels in all hurricanes, typhoons and tropical cyclones. **The Accumulated Cyclone Energy Index hit a 30-year low in October 2008.**

CO2 concentration is rising, but still well below IPCC predictions



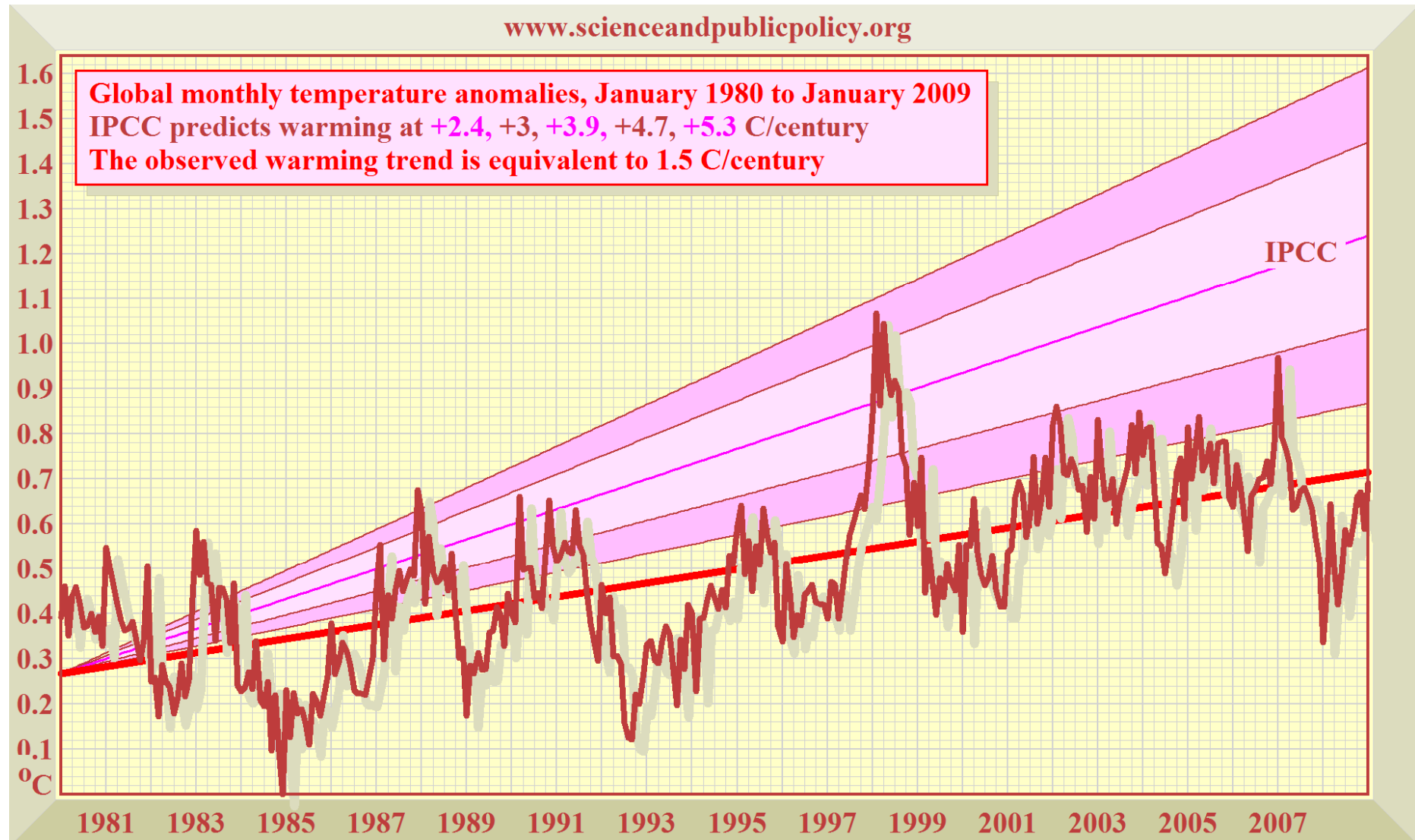
CO2 is rising in a straight line, well below the IPCC's projected range of increases in CO2 concentration (pale blue region). The deseasonalized real-world data are shown as a thick, dark-blue line superimposed on the least-squares linear-regression trend. Data source: NOAA.

IPCC predicts rapid, exponential CO₂ growth that is not occurring



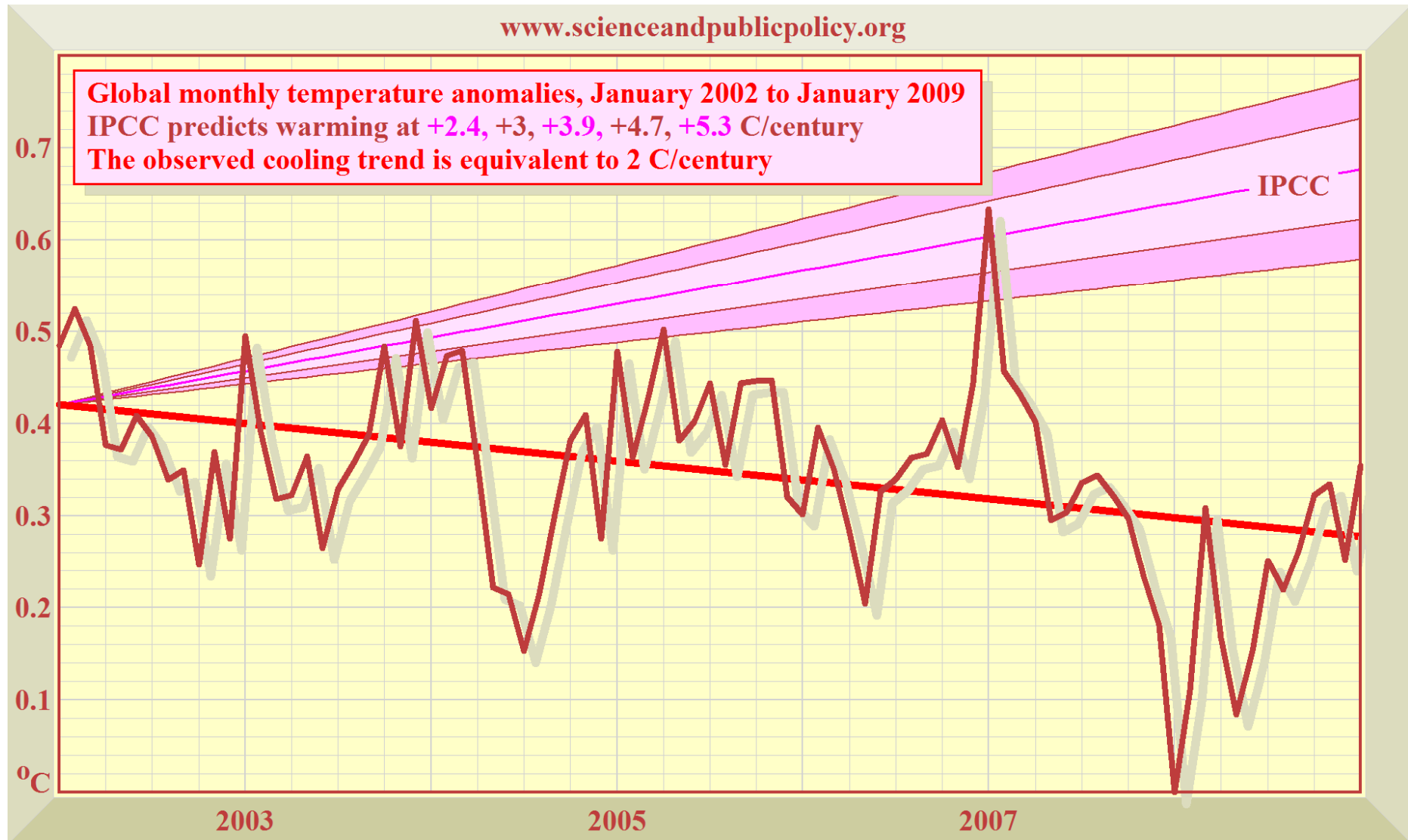
Observed CO₂ growth is linear, and is also well below the exponential-growth curves (bounding the pale blue region) predicted by the IPCC in its 2007 report. If CO₂ continues on its present path, the IPCC's central temperature projection for the year 2100 must be halved. **Data source:** NOAA.

The 29-year global warming trend is just 2.5 °F (1.5 °C) per century



Global temperature for the past 29 full years has been undershooting the IPCC's currently-predicted warming rates (pink region). The warming trend (thick red line) has been rising at well below half of the IPCC's central estimate. **Data source:** SPPI index, compiled from HadCRUt3, NCDC, RSS, and UAH.

A long decline: 7 years' global cooling at 3.6 °F (2 °C) per century



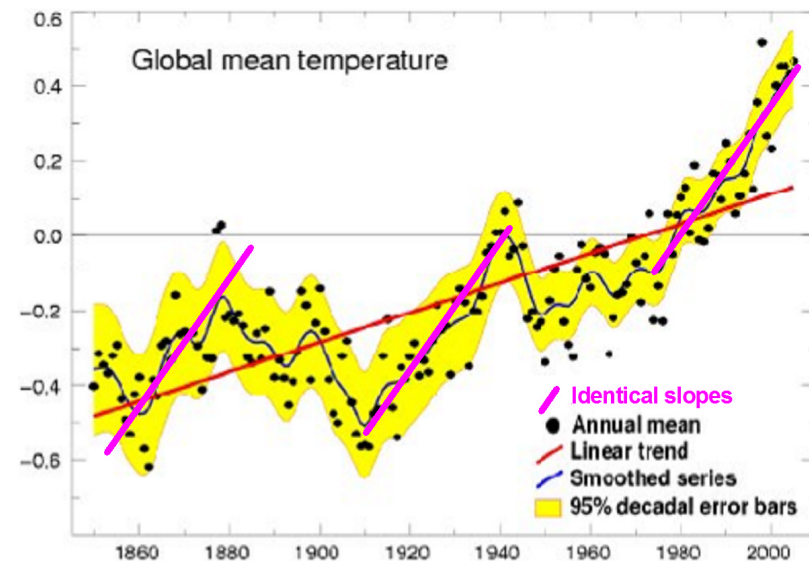
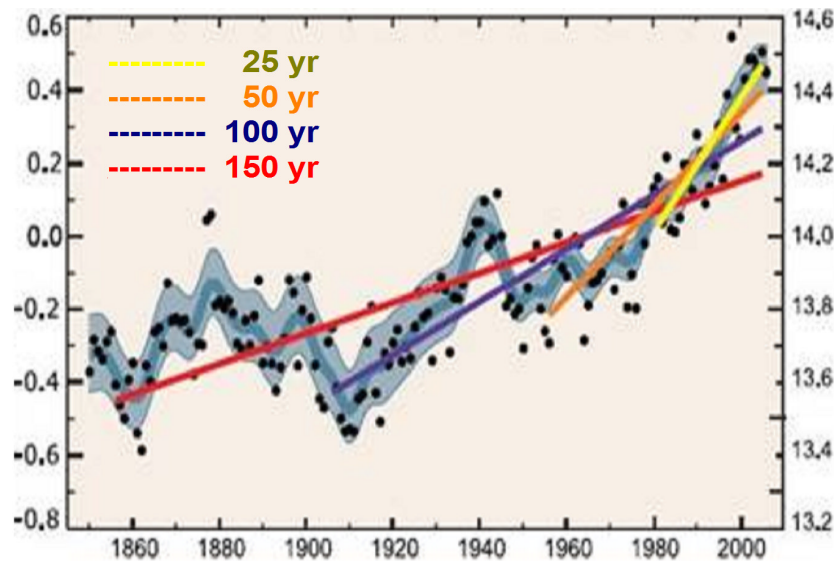
For the past seven full years, global temperatures have exhibited a pronounced downtrend. The IPCC's predicted warming path (pink region) bears no relation to the global cooling that has been observed in the 21st century to date. Source: SPPI global temperature index.

Pachauri's endpoint fallacy: "Global Warming' is getting worse"

LATE in 2008, Dr. Rajendra Pachauri, the railway engineer who heads the Science Working Group of the UN's climate panel, the IPCC, gave a lecture at the University of New South Wales in which he said:

"In recent decades this [left-hand] graph [of global mean surface temperature anomalies] has become much steeper. If you draw a line through the last 100 years [deep purple line on left-hand graph], temperature rose 0.74 Celsius. But if you look at the last 50 years, almost twice as steep as the total 100-year period. So it would be appropriate to conclude that we are now at a stage where warming is taking place much faster."

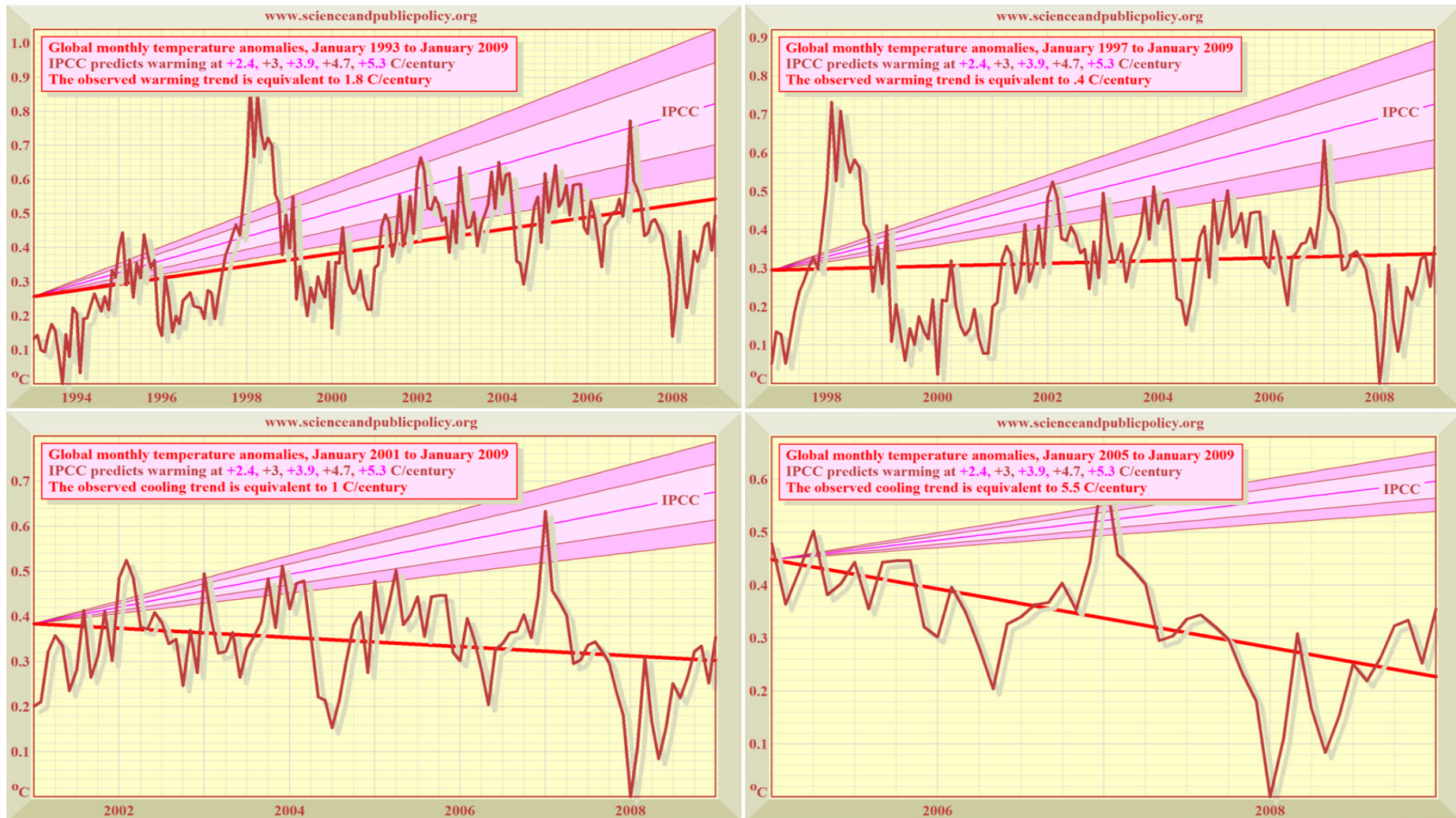
It would not be appropriate to conclude any such thing. Removing most of Dr. Pachauri's regrettable railway lines [right-hand graph below] and adding three parallel magenta lines representing the slope of the temperature increases in three separate multi-decadal periods over the past 150 years, it becomes clearly visible that the rate of increase in temperatures during the 23 years 1975-1998 was *exactly* the same as the warming rate in the 20 years 1860-1880 and the warming rate in the 30 years 1910-1940 –



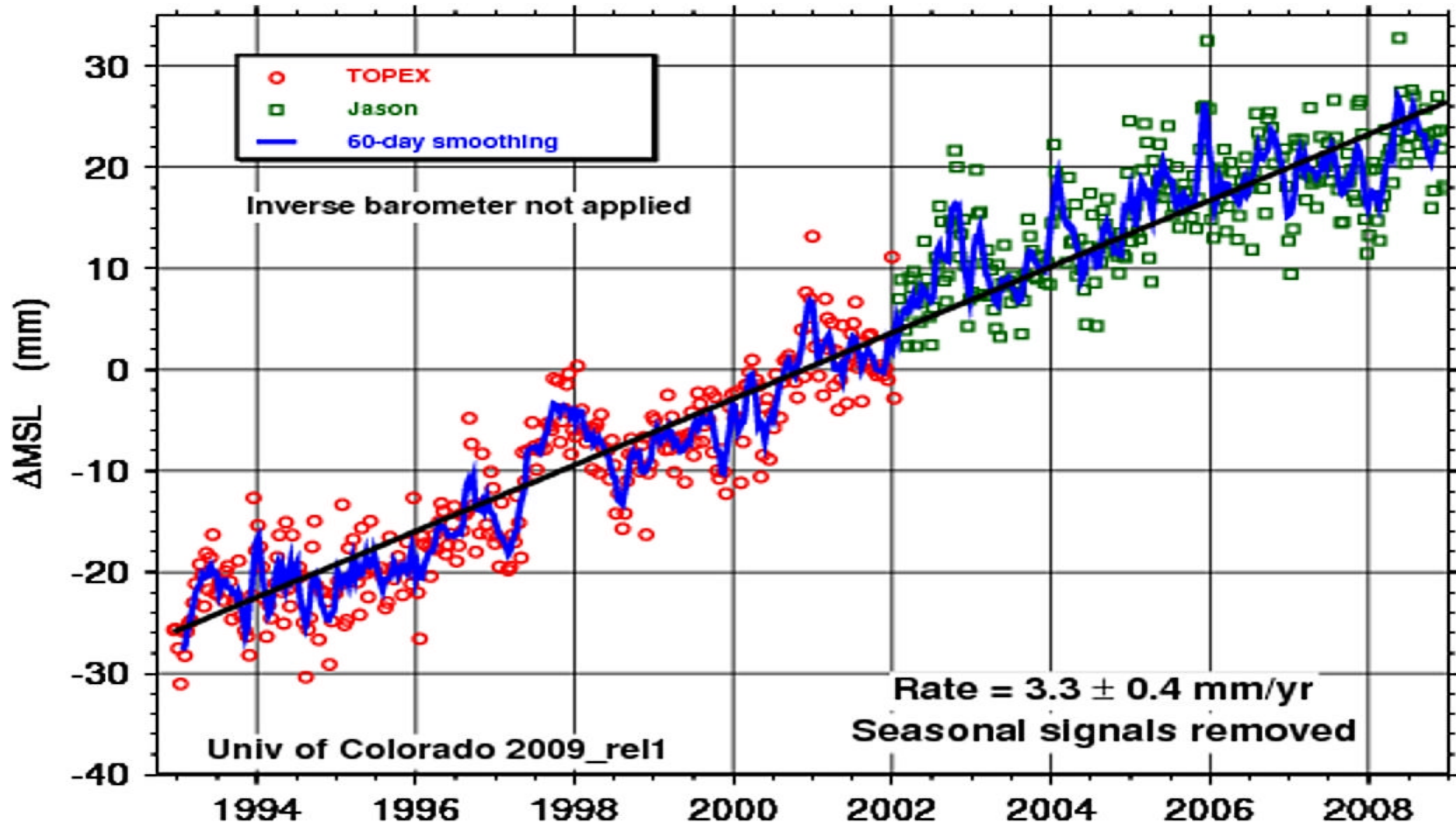
Dr. Pachauri's mistake, which was politely unchallenged by his learned audience, is an elementary instance of the insidious but well-known statistical fallacy known as the "endpoint fallacy", by which inappropriate conclusions are drawn through the careful selection of the start-point and end-point of a graph. On the next page, we demonstrate that the same fallacy could be deployed, using the same dataset, to reach an opposite conclusion, to the effect that the planet is *cooling* faster and faster as the years pass.

Why the endpoint fallacy is a fallacy: global cooling is accelerating

Using the SPPI global temperature index, which is the mean of two terrestrial and two satellite global mean temperature anomaly datasets, we now illustrate why Dr. Pachauri's endpoint fallacy is a fallacy. By starting in 1993 and advancing the start-point in successive four-year steps, a result precisely the opposite of Dr. Pachauri's conclusion is obtained – “global warming” has declined into global cooling which, if the cooling rate of the last four years were to continue for a century, would usher in a new Ice Age –

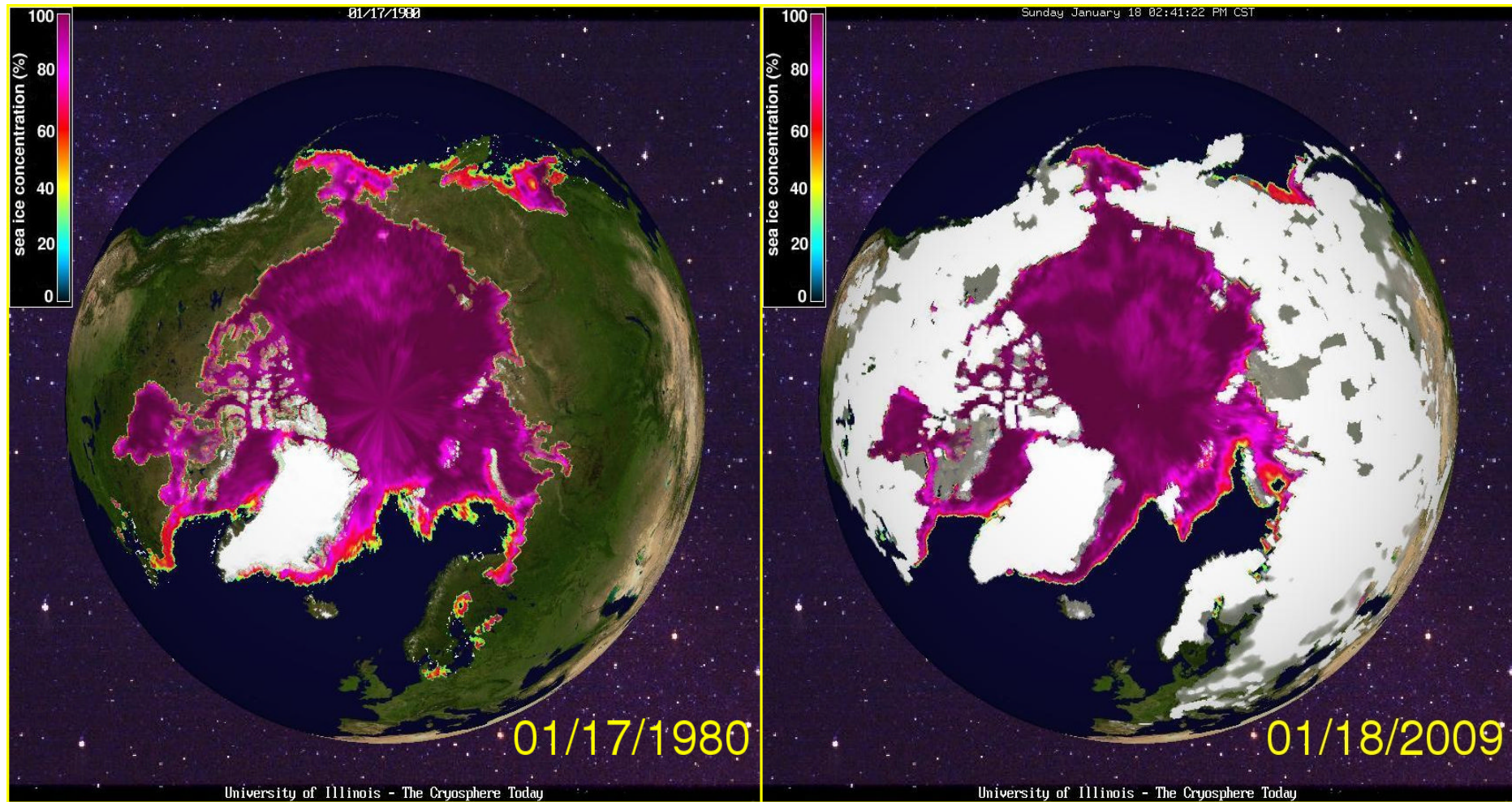


For the past three full years, global sea level has not risen



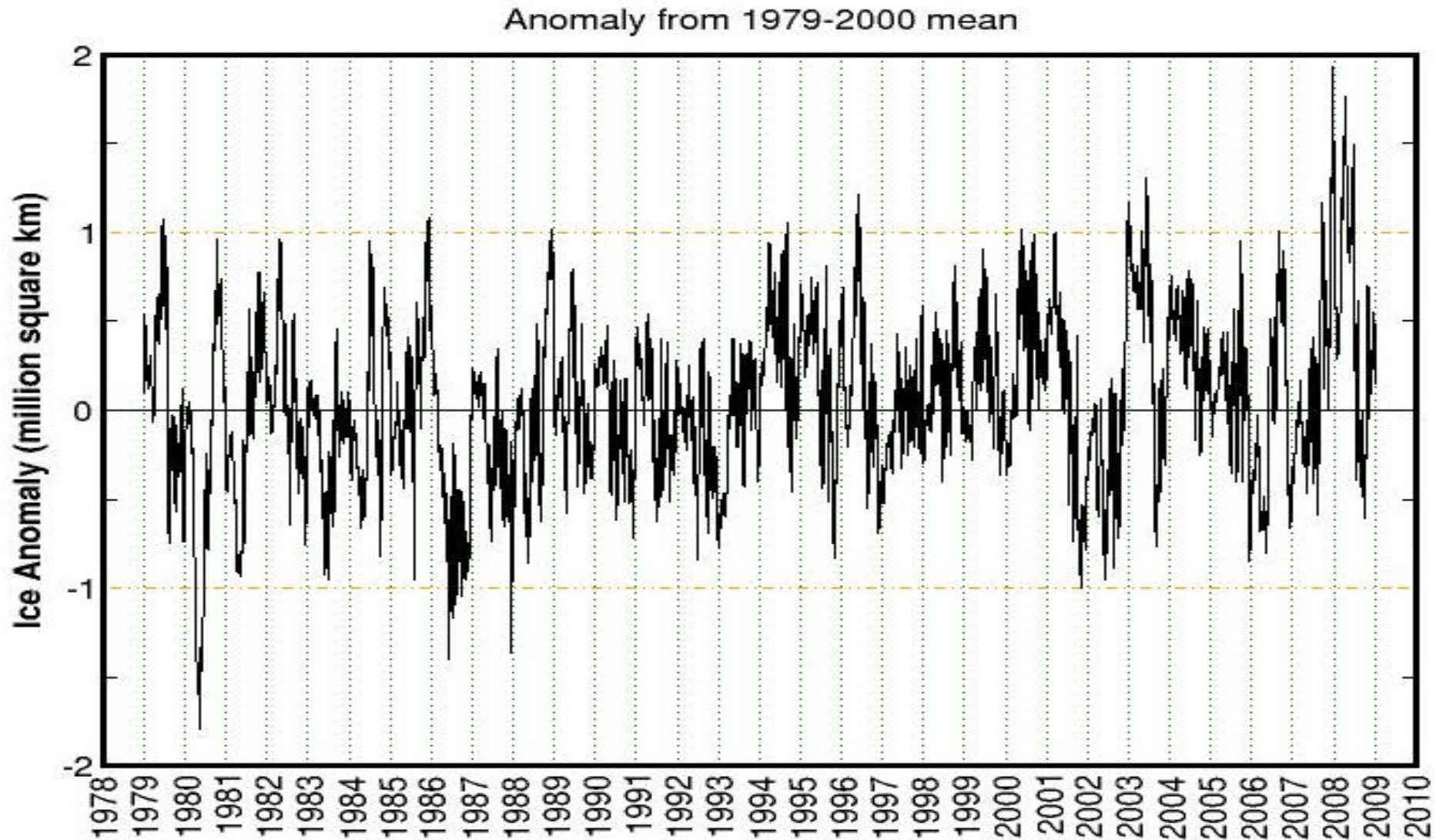
Sea level is no longer rising: The average rise in sea level over the past 10,000 years was 4 feet/century. During the 20th century it was 8 inches. In the past three years, sea level has not risen at all. As recently as 2001, the IPCC had predicted that sea level might rise as much as 3 ft in the 21st century. However, this maximum was cut by more than one-third to less than 2 feet in the IPCC's 2007 report. Moerner (2004) says sea level will rise about 8 inches in the 21st century. Mr. Justice Burton, in the UK High Court, bluntly commented on Al Gore's predicted 20ft sea-level rise as follows: "The Armageddon scenario that he depicts is not based on any scientific view." For the past three years, sea level has not risen. **Source:** University of Colorado.

Arctic sea-ice extent has scarcely declined in the 29 years since 1980



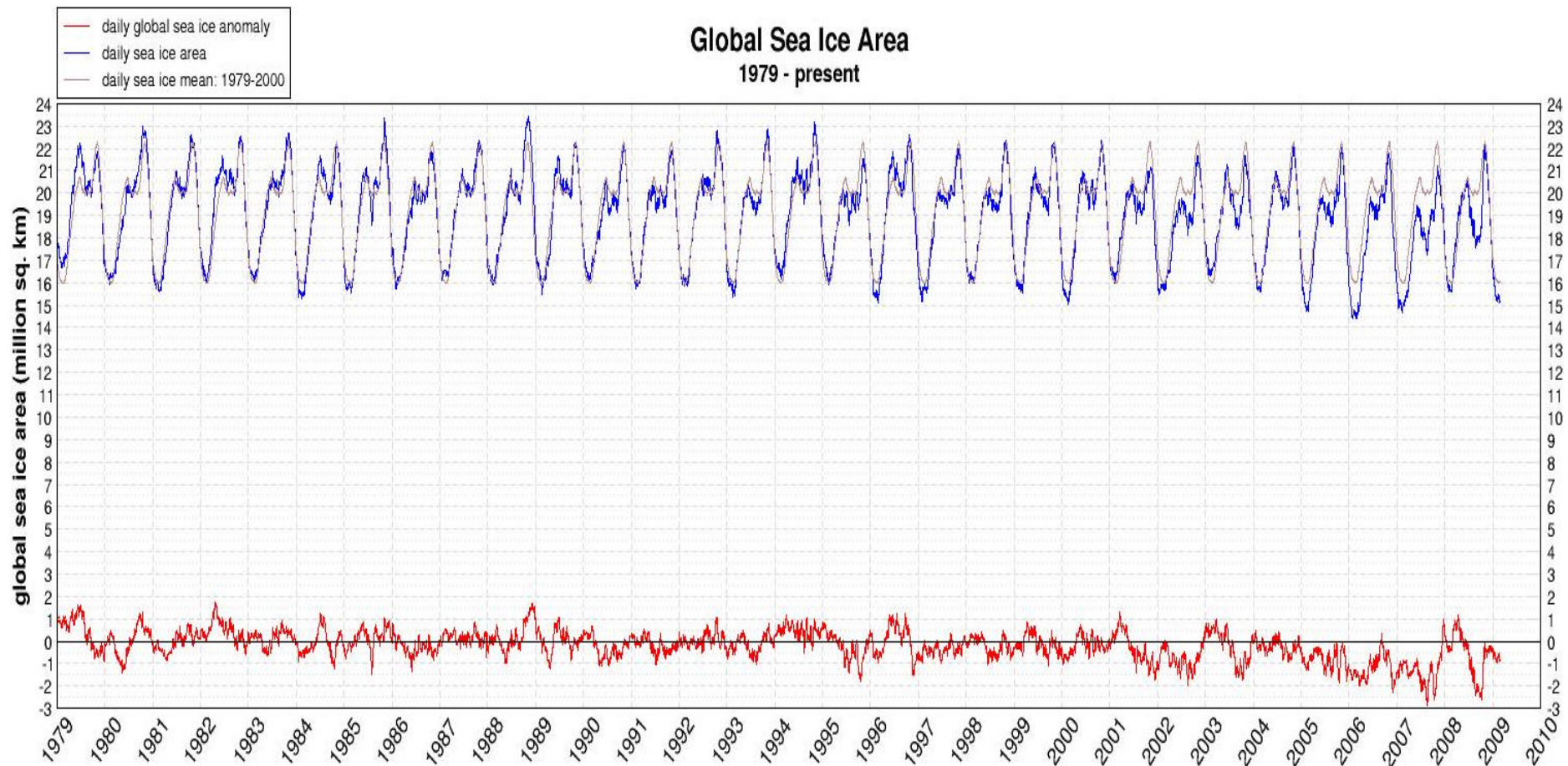
Arctic sea ice: the satellite sensor has failed: We are unable to produce a February 2009 sea-ice image (purple region), because the satellite sensor has failed. Sea ice covered almost the same area of the Northern Hemisphere in mid-January 2009 as it had done 29 years previously in mid-January 1980. Except in Greenland, snow cover was not shown in 1980, but is shown (white) in 2009. Summer sea ice covered its least extent in 30 years during the late summer of 2007. However, NASA has attributed that sudden decline to unusual poleward movements of heat transported by currents and winds. The decline cannot have been caused by “global warming”, because, as the SPPI Global Temperature Index shows, there has been a cooling trend globally during the past eight years. At almost the same moment as summer sea-ice extent reached its minimum in the Arctic, sea-ice extent in the Antarctic reached its maximum, though the latter event was very much less widely reported in the media than the former. **Source:** University of Illinois.

Antarctic sea-ice extent reached a 30-year peak in late 2007



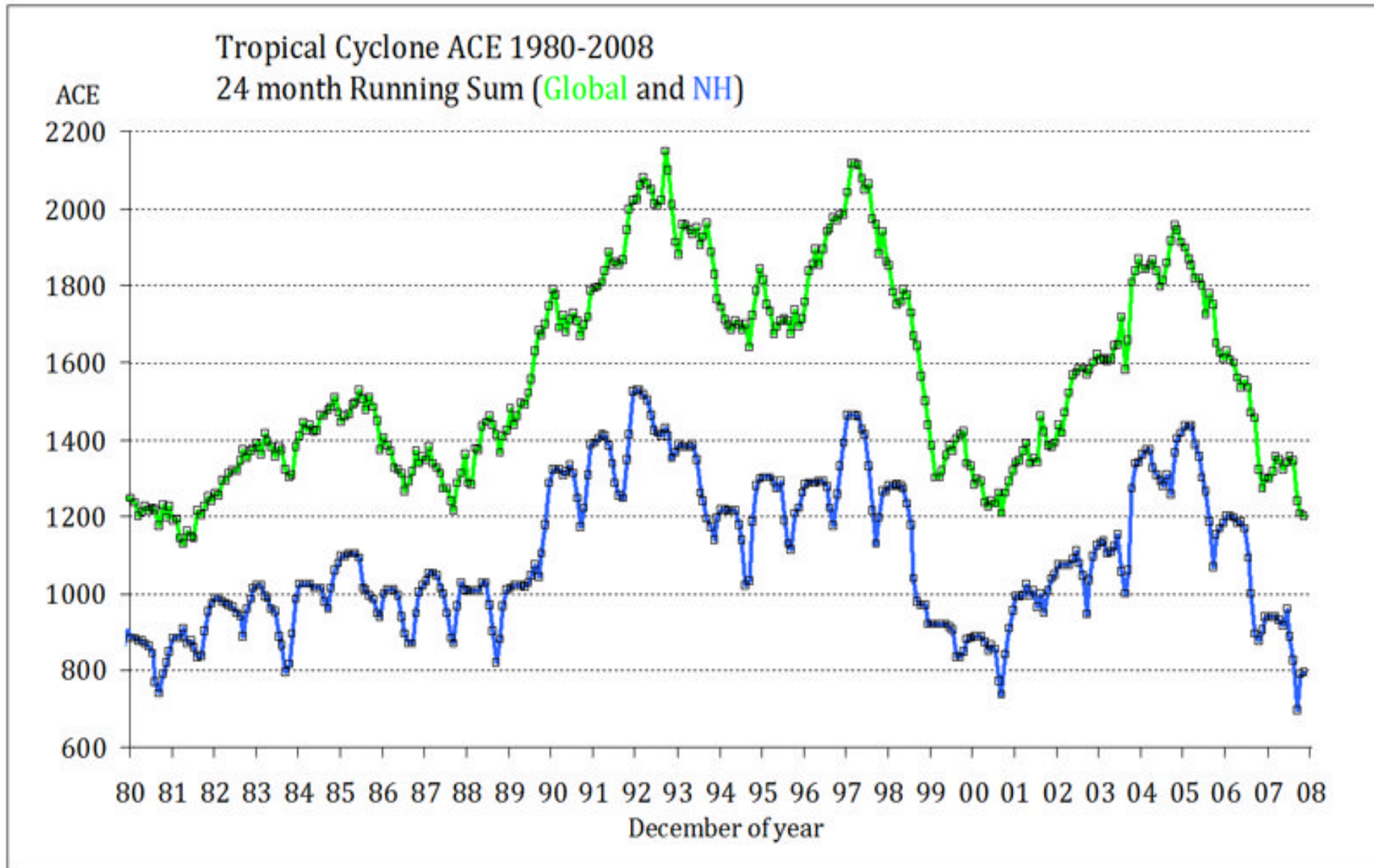
No threat to penguins: The extent of Antarctic sea ice shows a gentle but definite uptrend over the past 30 years. The peak extent, which occurred late in 2007, followed shortly after the sharp decline in Arctic sea ice in the late summer of that year. **Source:** University of Illinois, 2009.

The regular “heartbeat” of global sea-ice extent: steady for 30 years



Planetary “cardiogram”: There has been a very slight decline in the trend (red) of global sea-ice extent over the decades, chiefly attributable to loss of sea ice in the Arctic during the summer, which was well below the mean in 2007, with some recovery in 2008. However, the 2008 peak sea-ice extent was exactly on the 1979-2000 mean. The decline in summer sea-ice extent in the Arctic, reflected in the global anomalies over most of the past eight years, runs counter to the global cooling trend over the same period, suggesting that the cause of the regional sea-ice loss cannot have been “global warming”. Seabed volcanic activity recently reported in the Greenland/Iceland gap, with seabed temperatures of up to 574 °F, may have contributed to the loss of Arctic sea-ice. **Source:** University of Illinois.

Hurricane and tropical cyclone activity reached a new low in 2008



Hurricanes, typhoons, and other tropical cyclones have declined recently. Global activity of intense tropical storms is measured using a two-year running sum, known as the Accumulated Cyclone Energy Index, whose least value in 30 years was recorded in October 2008. Source: ACE.

SPPI MONTHLY CO₂ REPORT :: SCIENCE FOCUS

SPOTLIGHT ON THE CHANGING SCIENCE BEHIND THE CHANGING CLIMATE

How the UN bloats CO₂'s warming effect

HOW has the UN's climate panel, the IPCC, overstated CO₂'s effect on global temperature by the year 2100? It has made small, individually innocuous-seeming increases (hype factors) in the values of four key parameters. These hype factors, when multiplied together, produce a very large overstatement – **possibly as much as a 15-fold exaggeration** – in the predicted temperature response to increased CO₂ in the atmosphere. Our true effect on global temperature by 2100 could be below 0.3 Celsius degrees (0.5 Fahrenheit degrees), not the 3.9 C° (7 F°) imagined by the IPCC.

Parameter (2100 vs. 2000)	IPCC value	True value	Hype factor
<u>ln(proportionate increase)</u>	<u>ln(836/368)</u>	<u>ln(575/368)</u>	1.84
<u>CO₂ radiative forcing coeff.</u>	5.35	1.78	3.00
<u>Planck parameter</u>	288/(4 x 230)	0.9 x 254/(4 x 236)	1.29
<u>Feedback multiplier x .92</u>	1/(1 - 2.16 x .313)	1/(1 - 1.17 x .269)	2.1
PRODUCT x .92	3.9 C°	0.26 C°	15.0

Parameter 1: The natural logarithm of the proportionate increase in CO₂ concentration: CO₂-induced warming is a logarithmic function of the proportionate increase in CO₂ concentration. The IPCC's central estimate, from just *one* model (the BERN model) is that by 2100 there will be 836 parts per million of CO₂ in the atmosphere, but it admits that more than half of the CO₂ we emit does not stay in the atmosphere as predicted. It vanishes. On current trends (see the CO₂ chart earlier in this report), there will be no more than 575 ppmv of CO₂ in the atmosphere by 2100. **Hype factor: 1.84.**

Parameter 2: The CO₂ radiative forcing coefficient: The IPCC, citing just *one* paper, takes this coefficient as 5.35. However, it admits that the warming in the upper troposphere six miles above the tropics, which its models say should be thrice the surface

warming, has not been observed in half a century. Professor Dick Lindzen says the radiative forcing should therefore be divided by at least three. **Hype factor: 3.00.**

Parameter 3: The Planck zero-feedbacks climate-sensitivity parameter: This parameter is the reciprocal of the first differential of the Stefan-Boltzmann radiative-transfer equation with respect to temperature and radiant energy at the characteristic-emission level about 6 miles up in the troposphere, reduced by 10 per cent to allow for diurnal and latitudinal variation. However, the IPCC makes no 10% reduction to allow for these variations, and breaches the conditions of the radiative-transfer equation by taking temperature and radiant energy from two different planetary emitting surfaces 6 miles apart, rather than from the same surface. The IPCC bases its central estimate of the Planck parameter on just *two* papers, neither of which states a value as high as that which the IPCC uses. **Hype factor: 1.29.**

Parameter 4: The feedback multiplier: The IPCC, which bases its values for temperature feedbacks on just *one* paper, overstates the value of the water-vapor feedback by omitting to take account of two-thirds of the cooling effect of evaporation (Wentz *et al.*, 2007), and finds the cloud-albedo feedback strongly net-positive when it is in fact slightly net-negative (Spencer, 2007). Also, its value for the Planck parameter is too large, and this also influences the IPCC's overstatement of the feedback multiplier. **Hype factor: 2.10**

The combined effect of the four hype factors, which are based not on thousands of papers but on just *four* papers and *one* computer model, is to turn a true and entirely harmless CO₂-induced 21st-century global-temperature increase of just 0.26 C° (less than 0.5 F°) into a 15-times-bigger increase of 3.9 C° (7 F°).

Individually, each of the hype factors – the multiple of the true value that the IPCC has adopted – is comparatively small. But when they are multiplied together they have a disproportionately large apparent effect on temperature. By 2100, we will have added little more than a quarter of a Celsius degree (half a Fahrenheit degree) to global temperature (*cf.* Monckton, 2008; *cf.* Lindzen, 2008; Spencer *et al.*, 2007; Schwartz, 2007).

The overwhelming majority of the scientists participating in the IPCC's deliberations do not take part in the discussions about the magnitude of "climate sensitivity". To them, the climate sensitivity values produced by the tiny handful of scientists specializing in this central question are merely the starting-point from which they calculate the imagined effects of warming on the planet. They cannot and do not verify or query the values they are given.

The entire case for alarm about "global warming" rests on the combined effect of the four hype factors in leading to a 15-fold exaggeration by the IPCC of the true effect of CO₂ on temperature. Once this very large exaggeration is removed, all the rest of the IPCC's conclusions about ice-melt, sea level, floods, droughts, hurricanes, species loss etc. etc. fall away.

Without the IPCC's erroneously-high climate sensitivity, the "climate crisis" vanishes.

Your climate-sensitivity ready reckoner

Every month we spotlight a scientific issue in plain English. Here is a step-by-step ready-reckoner which will let you use a pocket calculator to make your own instant estimate of global temperature change in response to CO₂ increase.

- ✚ **STEP 1:** Decide how far into the future you want your forecast to go, and estimate how much CO₂ will be in the atmosphere at that date. *Example:* Let us do a forecast to 2100. The **MONTHLY CO₂ REPORT** charts show CO₂ rising to $C = 575$ parts per million by the end of the century, compared with $B = 385$ parts per million in late 2008.
- ✚ **STEP 2:** Next, work out the *proportionate increase* C/B in CO₂ concentration. In our example, $C/B = 575/385 = 1.49$.
- ✚ **STEP 3:** Take the *natural logarithm* $\ln(C/B)$ of the proportionate increase. If you have a scientific calculator, find the natural logarithm directly using the “ln” button. If not, look up the logarithm in the table below. In our example, $\ln 1.49 = 0.40$.

<i>n</i>	1.05	1.10	1.15	1.20	1.25	1.30	1.35	1.40	1.45	1.50	1.55	1.60	1.65	1.70	1.75	1.80	1.85	1.90	1.95	2.00
ln	0.05	0.10	0.14	0.18	0.22	0.26	0.30	0.34	0.37	0.41	0.44	0.47	0.50	0.53	0.56	0.59	0.62	0.64	0.67	0.69
<i>n</i>	2.05	2.10	2.15	2.20	2.25	2.30	2.35	2.40	2.45	2.50	2.55	2.60	2.65	2.70	2.75	2.80	2.85	2.90	2.95	3.00
ln	0.72	0.74	0.77	0.79	0.81	0.83	0.85	0.88	0.90	0.92	0.94	0.96	0.97	0.99	1.01	1.03	1.05	1.06	1.08	1.10

- ✚ **STEP 4:** Choose a *climate sensitivity coefficient* c from the table below –

Coefficient c ...	SPPI minimum	SPPI central	SPPI maximum	IPCC minimum	IPCC central	IPCC maximum
... for C°	0.7	1.4	2.1	2.9	4.7	6.5
... for F°	1.25	2.50	3.75	5.25	8.5	11.75

- ✚ **STEP 5:** Find the *temperature change* ΔT by multiplying the natural logarithm of the proportionate increase in CO₂ concentration by your climate sensitivity coefficient. In our example, we’ll chose the IPCC central estimate $c = 8.5$ F. Then –

$$\Delta T = c \ln(C/B) = 8.5 \times 0.40 = \underline{3.4 \text{ F}^\circ}, \text{ your predicted manmade warming to 2100. It's as simple as that!}$$

SPPI MONTHLY CO₂ REPORT :: NEW SCIENCE

BREAKING NEWS IN THE JOURNALS, FROM [WWW.CO2SCIENCE.ORG](http://www.co2science.org)

The *Monthly CO₂ Report* summarizes key recent scientific papers, selected from those featured weekly at www.co2science.org, that significantly add to our understanding of the climate question. This month we review papers about the effects of “global warming” on floods, streamflow, hurricanes, and amphibian populations. Our final paper gives evidence that the Middle Ages were warmer than today.

Thirty-Second Summary

- Global warming is likely not driving amphibian population declines.
- Streamflow data indicate no evidence for increased flooding, but do reveal a tendency for less drought.
- There is no evidence of a CO₂-induced increase in tropical cyclone intensity in northwest Australia over the past 30 years.
- Factors unrelated to climate are primarily responsible for increased flooding on the Mississippi River system.
- 670 scientists from 391 institutions in 40 countries on the co2science.org Medieval Warm Period database say the Middle Ages were warmer than today.

Amphibian Population Declines

- Rohr, J.R., Raffel, T.R., Romansic, J.M., McCallum, H. and Hudson, P.J. 2008. Evaluating the links between climate, disease spread, and amphibian declines. *Proceedings of the National Academy of Sciences USA* 105: 17,436-17,441.

The authors state that 43% of all amphibian species have experienced some form of population decline, most of which were driven by the chytrid fungus *Batrachochytrium dendrobatidis* or Bd, and that there are two competing hypotheses for the cause of the declines. The first, known as the *chytrid-thermal-optimum hypothesis*, posits that "global warming increased cloud cover in warm years that drove the convergence of daytime and nighttime temperatures toward the thermal optimum for Bd growth," which ultimately led to the population declines. The second, known as the *spatiotemporal-spread hypothesis*, posits that "Bd-related declines are simply caused by the introduction and spread of Bd from a limited number of introduction sites rather than by any interaction between Bd and climate change." After rigorous testing of these hypotheses, Rohr *et al.* conclude that "almost all of our findings are contrary to the predictions of the chytrid-thermal-optimum hypothesis," Thus, on the basis of Rohr *et al.*'s findings, it would appear that the chytrid-thermal-optimum hypothesis, which depicts global warming as the unnatural disturbance that ultimately leads to amphibian declines and extinctions, should *itself* be considered extinct.

A Century of Parana River Streamflow Data

- Mauas, P.J.D., Flamenco, E. and Buccino, A.P. 2008. Solar forcing of the stream flow of a continental scale South American river. *Physical Review Letters* 101: 168501.

Mauas *et al.* analyzed for both trends and periodicities in streamflow data since 1904 for South America's Parana River. With respect to trends, the three researchers report that "the stream flow during the last 30 years has increased in the months in which the flow is *minimum* [our italics], while the flow remains more or less constant during the months of maximum," noting that "the same trend is also found in other rivers of the region." With respect to periodicities, they report that the detrended time series of the streamflow data are correlated with the detrended times series of both sunspot number and total solar irradiance. Whereas climate alarmists contend that both droughts *and* floods should increase in response to global warming, the Parana River data give no hint of enhanced *maximum* streamflow (which could lead to flooding) over the entire course of the 20th century, when climate alarmists claim the planet experienced a warming that was *unprecedented over the past two millennia*. And in an even *stronger* refutation of the two-pronged climate-alarmist claim, the Parana River data reveal a large *increase* in *minimum* streamflow, indicative of a tendency for less *drought* to occur, which is just the *opposite* of what they predict for *this* phenomenon. Last of all, whereas climate alarmists are loathe to acknowledge any significant impact of solar activity on climate, Mauas *et al.* find it to be *incredibly* significant with respect to the hydrologic climate of the Parana River basin, in harmony with what has also been found to be the case for the hydrologic climates of the basins of other South American rivers.

Tropical Cyclones Off the Northwestern Coast of Australia

- Harper, B.A., Stroud, S.A., McCormack, M. and West, S. 2008. A review of historical tropical cyclone intensity in northwestern Australia and implications for climate change trend analysis. *Australian Meteorological Magazine* 57: 121-141.

Noting there is "increasing concern that anthropogenic climate change may be increasing TC [tropical cyclone] intensity," Harper *et al.* analyzed several "potential influences on the accuracy of estimating TC intensity over time due to increasing technology, methodology, knowledge and skill" for TCs that occurred off the coast of northwestern Australia, primarily in a band between 5 and 25°S, over the period 1968/69 to 2000/01. As a result of their analysis, the four Australian researchers show, in their words, that "a bias towards lower intensities likely exists in earlier (mainly pre-1980) TC central pressure deficit estimates of the order of at least 20 per cent in 1970, reducing to around ten per cent by 1980 and to five per cent in 1985," reporting that "inferred temporal trends in the estimated intensity from the original data-sets are therefore significantly reduced in the objectively reviewed data-set." In fact, when all is said and done, they conclude "there is no prima facie evidence of a potential climate-change induced trend in TC intensity in northwestern Australia over the past 30 years."

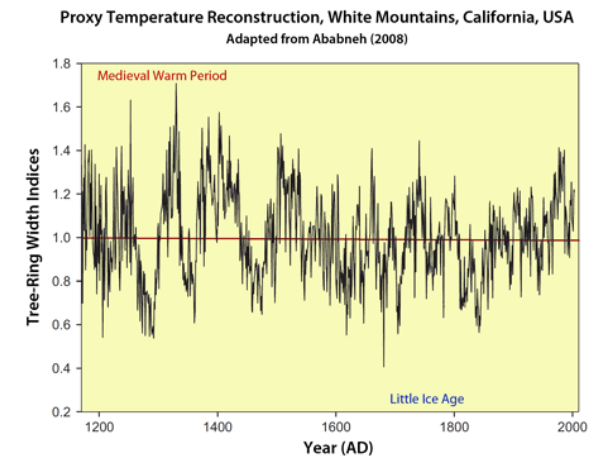
Floods of the Mississippi River System

- Pinter, N., Jemberie, A.A., Remo, J.W.F., Heine, R.A. and Ickes, B.S. 2008. Flood trends and river engineering on the Mississippi River system. *Geophysical Research Letters* 35: 10.1029/2008GL035987.

A common claim of climate alarmists is that flooding becomes more frequent and severe in response to global warming; and as a result, whenever and wherever such a trend may manifest itself, radical environmentalists are quick to attribute it to anthropogenic CO₂ emissions. But could there be *other* things behind such tendencies? This question was recently explored by Pinter *et al.* with respect to floods throughout the Mississippi River system of the United States.

To test for long-term changes in flood magnitudes and frequencies, the five researchers "constructed a hydrologic database consisting of data from 26 rated stations (with both stage and discharge measurements) and 40 stage-only stations." Then, to help "quantify changes in flood levels at each station in response to construction of wing dikes, bendway weirs, meander cutoffs, navigational dams, bridges, and other modifications," they put together a geospatial database consisting of "the locations, emplacement dates, and physical characteristics of over 15,000 structural features constructed along the study rivers over the past 100-150 years." Results indicated that "significant climate- and/or land use-driven increases in flow were detected," but they say that "the *largest* and *most pervasive* [our italics] contributors to increased flooding on the Mississippi River system were wing dikes and related navigational structures, followed by progressive levee construction."

In discussing the implications of their findings, Pinter *et al.* write that "the navigable rivers of the Mississippi system have been intensively engineered, and some of these modifications are associated with large decreases in the rivers' capacity to convey flood flows." Hence, man has indeed been responsible for the majority of the enhanced flooding of the rivers of the Mississippi system over the past century or so, *but not in the way suggested by the world's climate alarmists*. The question that needs addressing by the region's inhabitants, therefore, has nothing to do with CO₂, but everything to do with how to "balance the local benefits of river engineering against the potential for large-scale flood magnification."



The Middle Ages were warmer than today: Owens Valley, White Mountains, California, USA

- Ababneh, L. 2008. Bristlecone pine paleoclimatic model for archeological patters in the White Mountains of California. *Quaternary International* 188: 59-78.

The author derived a history of temperature-related tree-ring width indices from both whole-bark and strip-bark bristlecone pine trees from both Patriarch Grove and Sheep Mountain in California, USA, which commenced at AD 1171 and extended all the way to

AD 2002. This history began in the midst of the Medieval Warm Period, which extended, in our estimation, to approximately AD 1430. During this interval there were several periods when tree-ring width indices were *more than double* those experienced over the final decades of the 20th century; and in a couple of instances they were even *three* times greater.

If you'd like to learn more about climate change science,
request a speaker or have any questions,
contact Robert Ferguson, SPPI President.



Robert Ferguson
SPPI President

bferguson@sppinstitute.org
Washington, D.C.
202-288-5699

5501 Merchant View Square
Box 209
Haymarket, VA 20169-5699

www.scienceandpublicpolicy.org