CLIMATE AND FIRE

Is global warming causing larger and more frequent wildfires?

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According to model-based predictions, larger and more intense wildfires will increase as a result of CO_2-induced global warming; and as a result, many scientists have begun to search for a link between fire and climate, often examining trends of the past to see if they support the model projections. In the following summary, therefore, we examine what has been learned, starting with studies conducted in North America and ending with the planet as a whole.

Campbell and Campbell (2000)[1] analyzed pollen and charcoal records obtained from sediment cores retrieved from three small ponds -- South Pond (AD 1655-1993), Birch Island Pond (AD 1499-1993) and Pen 5 Pond (400 BC-AD 1993) -- located within Canada's Elk Island National Park, which covers close to 200 km^2 of the Beaver Hills region of east-central Alberta. "Counter to the intuitive increase in fire activity with warmer and drier climate," the Canadian researchers report that "declining groundwater levels during the Medieval Warm Period [MWP] allowed the replacement of substantial areas of shrub birch with the less fire-prone aspen, causing a decline in fire frequency and/or severity, while increasing carbon storage on the landscape," as implied by their Pen 5 Pond data. And they therefore conclude that this scenario "is likely playing out again today," as *all three* of the sites they studied "show historic increases in *Populus* pollen and declines in charcoal."

A future warmer climate is likely to be less favorable for fire ignition and spread in the east Canadian boreal forest than over the last 2 millennia, which is good news for Canada and similar parts of the world.

Further east, Carcaillet *et al.* (2001)[2] developed high-resolution charcoal records from laminated sediment cores extracted from three small kettle lakes located within the mixed-boreal and coniferous-boreal forest region of eastern Canada, after which they determined whether vegetation change or climate change was the primary determinant of changes in fire frequency, comparing their fire history with hydro-climatic reconstructions derived from $\delta^{18}O$ and lake-level data. Throughout the Climatic Optimum of the mid-Holocene, between about 7000 and 3000 years ago, when it was significantly warmer than it is today, they report that "fire intervals were double those in the last 2000 years," meaning fires were only half as frequent throughout the earlier warmer period as they were during the subsequent cooler period. They also determined that "vegetation does not control the long-term fire regime in the boreal forest," but that "climate appears to be the main process triggering fire." In addition, they report that "dendroecological studies show that both frequency and size of fire decreased during the 20th century in both west (e.g. Van Wagner, 1978; Johnson *et al*., 1990; Larsen, 1997; Weir *et al*., 2000) and east Canadian coniferous forests (e.g. Cwynar, 1997; Foster, 1983; Bergeron, 1991; Bergeron *et al*., 2001), possibly due to a drop in drought frequency and an increase in long-term annual precipitation (Bergeron and Archambault, 1993)." These several findings thus led them

[1] http://www.co2science.org/articles/V11/N48/C2.php.
[2] http://www.co2science.org/articles/V7/N15/C3.php.

to conclude that a "future warmer climate is likely to be less favorable for fire ignition and spread in the east Canadian boreal forest than over the last 2 millennia," which is good news for Canada and similar parts of the world.

Also working in this region were Le Goff *et al*., 2007[3], who investigated "regional fire activity as measured by the decadal proportion of area burned and the frequency of fire years vs. non-fire years in the Waswanipi area of northeastern Canada [49.5-50.5°N, 75-76.5°W], and the long-term relationship with large-scale climate variations ... using dendroecological sampling along with forest inventories, aerial photographs, and ecoforest maps." Results of their analysis showed that instead of the interval of time between wildfires *shortening* as time progressed and the climate warmed, there was "a major *lengthening* [italics added] of the fire cycle," in the words of the researchers, that expanded "from 99 years before 1940 to 282 years after 1940." In addition, Le Goff *et al*. note that "in the context of the past 300 years, many regional fire regimes of the Canadian boreal forest, as reconstructed from dendroecological analysis, experienced a decrease in fire frequency after 1850 [or the "end of the Little Ice Age," as they describe it] (Bergeron and Archambault, 1993; Larsen, 1996) and a further decrease after 1940 (Bergeron *et al*., 2001, 2004a,b, 2006)."

> Instead of the interval of time between wildfires *shortening* as time progressed and the climate warmed, there was a major *lengthening* of the fire cycle, that expanded from 99 years before 1940 to 282 years after 1940.

Similar findings were reported by Lauzon *et al*. (2007)[4] while investigating the fire history of a 6,480-km^2 area located in the Baie-Des-Chaleurs region of Gaspesie at the southeastern edge of Quebec "using Quebec Ministry of Natural Resource archival data and aerial photographs combined with dendrochronological data." Coincident with the 150-year warming that led to the demise of the Little Ice Age and the establishment of the Current Warm Period, the three researchers report there was "an increase in the fire cycle from the pre-1850 period (89 years) to the post-1850 period (176 years)," and that "both maximum and mean values of the Fire Weather Index decreased statistically between 1920 and 2003," during which period "extreme values dropped from the very high to high categories, while mean values changed from moderate to low categories." In contrast with model projections, therefore, and in this particular part of the world, twentieth-century global warming has led to a significant *decrease* in the frequency of forest fires, as weather conditions conducive to their occurrence have gradually become less prevalent and extreme.

Girardin *et al*. (2006)[5] introduced their study of the subject by writing that "human-induced climate change could lead to an increase in forest fire activity in Ontario, owing to the increased frequency and severity of drought years, increased climatic variability and incidence of extreme climatic events, and increased spring and fall temperatures," noting that "climate change therefore could cause longer fire seasons (Wotton and Flannigan, 1993), with greater fire activity and greater incidence of extreme fire activity years (Colombo *et al*., 1998; Parker *et al*., 2000)." Consequently, they decided that to provide a more rigorous test of these hypotheses than could be provided by the historical observational record, it should be placed in a much longer context. And in doing so, Girardin *et al*. inferred past area burned in

3 http://www.co2science.org/articles/V11/N10/C1.php.
4 http://www.co2science.org/articles/V10/N45/C1.php.
5 http://www.co2science.org/articles/V10/N6/C2.php.

Ontario for the period AD 1781-1982 by regressing various tree-ring chronologies against actual area burned data and developing transfer functions that they used "to estimate annual area burned at times during which there were no instrumental data." So what did they find?

The three researchers report that "while in recent decades area burned has increased, it remained below the level recorded prior to 1850 and particularly below levels recorded in the 1910s and 1920s," noting further that "the most recent increase in area burned in the province of Ontario was preceded by the period of lowest fire activity ever estimated for the past 200 years (1940s-1960s)," and this in spite of the fact that "humans during the past decades have been an important source of fire ignition." Consequently, although they say that, *according to theory*, "one should expect greater area burned in a changing climate," especially one that is driven by anthropogenic-induced increases in atmospheric CO_2 concentration, their findings revealed no support for this contention. In fact, they revealed just the *opposite*.

That the findings of the Canadian scientists are robust is substantiated by their noting that "numerous studies of forest stand age distributions [which is a totally independent way of assessing the matter] across the Canadian boreal forest [which is an even larger area than Ontario alone] report lower fire activity since circa 1850 (Masters, 1990; Johnson and Larsen, 1991; Larsen, 1997; Bergeron *et al*., 2001, 2004a, 2004b; Tardif, 2004)." Hence, it is clear that over vast regions of Canada, climate-alarmist concerns of recent global warming-induced increases in forest fire activity have been found to be unfounded.

> A *contrary* example, where warming *does* appear to enhance fire occurrence, is provided by Pierce *et al.* (2004) in central Idaho, USA. They report that over the twentieth century, fire size and severity have increased in most ponderosa pine forests.

Moving southward to the United States, Beaty and Taylor (2009)[6] developed a 14,000-year record of fire frequency based on high-resolution charcoal analysis of a 5.5-m-long sediment core extracted from Lily Pond (39°3'26"N, 120°7'21"W) in the General Creek Watershed on the west shore of Lake Tahoe in the northern Sierra Nevada in California (USA), as well as a 20-cm-long surface core that "preserved the sediment-water interface."

The results of this effort revealed that "fire episode frequency was low during the Lateglacial period but increased through the middle Holocene to a maximum frequency around 6500 cal. yr BP," which "corresponded with the Holocene temperature maximum (7000-4000 cal. yr BP)." Thereafter, as the temperature gradually declined, so too did fire frequency decline, except for a multi-century aberration they describe as "a similar peak in fire episode frequency [that] occurred between c. 1000 and 600 cal. yr BP during the 'Medieval Warm Period'," which they say was followed by an interval "between c. 500 and 200 cal. yr BP with few charcoal peaks [that] corresponded with the so-called 'Little Ice Age'." Ultimately arriving at the present, however, they found that the "current fire episode frequency on the west shore of Lake Tahoe is at one of its lowest points in at least the last 14,000 years."

A *contrary* example, where warming *does* appear to enhance fire occurrence, is provided by Pierce *et al.* (2004)[7], who dated fire-related sediment deposits in alluvial fans in central Idaho, USA, in a research

6 http://www.co2science.org/articles/V12/N29/C2.php.
7 http://www.co2science.org/articles/V7/N46/EDIT.php.

program designed to reconstruct Holocene fire history in xeric ponderosa pine forests and to look for links to past climate change. This endeavor focused on tributary alluvial fans of the South Fork Payette (SFP) River area, where fans receive sediment from small but steep basins in weathered batholith granitic rocks that are conducive to post-fire erosion. Altogether, they obtained 133 AMS ^{14}C-derived dates from 33 stratigraphic sites in 32 different alluvial fans. In addition, they compared their findings with those of Meyer *et al*. (1995), who had earlier reconstructed a similar fire history for nearby Yellowstone National Park in Wyoming, USA.

Pierce *et al*.'s work revealed, in their words, that "intervals of stand-replacing fires and large debris-flow events are largely coincident in SFP ponderosa pine forests and Yellowstone, most notably during the 'Medieval Climatic Anomaly' (MCA), ~1,050-650 cal. yr BP." What is more, they note that "in the western USA, the MCA included widespread, severe miltidecadal droughts (Stine, 1998; Woodhouse and Overpeck, 1998), with increased fire activity across diverse northwestern conifer forests (Meyer *et al*., 1995; Rollins *et al*., 2002)."

Following the Medieval Warm Period and its frequent large-event fires was the Little Ice Age, when, as Pierce *et al*. describe it, "colder conditions maintained high canopy moisture, inhibiting stand-replacing fires in both Yellowstone lodgepole pine forests and SFP ponderosa pine forests (Meyer *et al*., 1995; Rollins *et al*., 2002; Whitlock *et al*., 2003)." Subsequently, however, they report that "over the twentieth century, fire size and severity have increased in most ponderosa pine forests," which they suggest may be largely due to "the rapidity and magnitude of twentieth-century global climate change."

Also working in the United States, and coming to much the same general conclusion, were Westerling *et al*. (2006)[8], who compiled a comprehensive database of large wildfires in western United States forests since 1970 and compared it to hydro-climatic and land-surface data. Their findings are succinctly summarized by Running (2006) in an accompanying Perspective, wherein he writes that "since 1986, longer warmer summers have resulted in a fourfold increase of major wildfires and a sixfold increase in the area of forest burned, compared to the period from 1970 to 1986," noting also that "the length of the active wildfire season in the western United States has increased by 78 days, and that the average burn duration of large fires has increased from 7.5 to 37.1 days." In addition, he notes that "four critical factors - earlier snowmelt [by one to four weeks], higher summer temperatures [by about 0.9°C], longer fire season, and expanded vulnerable area of high-elevation forests - are combining to produce the observed increase in wildfire activity."

Focusing on the relationship between fire and climate in western Colorado, Schoennagel *et al*. (2007)[9] investigated "climatic mechanisms influencing subalpine forest fire occurrence in western Colorado, which provide a key to the intuitive link between drought and large, high-severity fires that are keystone disturbance processes in many high-elevation forests in the western United States," focusing on three major climatic oscillations: the El Niño Southern Oscillation (ENSO), the Pacific Decadal Oscillation (PDO), and the Atlantic Multidecadal Oscillation (AMO).

In doing so, they found that "fires occurred during short-term periods of significant drought and extreme cool (negative) phases of ENSO and [the Pacific Decadal Oscillation (PDO)] and during positive departures from [the mean Atlantic Multidecadal Oscillation (AMO)] index," while "at longer time scales, fires exhibited 20-year periods of synchrony with the cool phase of the PDO, and 80-year periods of synchrony with extreme warm (positive) phases of the AMO." In addition, they say that "years of combined positive AMO and negative ENSO and PDO phases represent 'triple whammies' that

8 http://www.co2science.org/articles/V9/N28/C1.php.
9 http://www.co2science.org/articles/V11/N12/B2.php.

significantly increased the occurrence of drought-induced fires." On the other hand, they write that "drought and wildfire are associated with warm phases of ENSO and PDO in the Pacific Northwest and northern Rockies while the opposite occurs in the Southwest and southern Rockies," citing the findings of Westerling and Swetnam (2003), McCabe *et al*. (2004), and Schoennagel *et al*. (2005). Schoennagel *et al*. thus conclude that "there remains considerable uncertainty regarding the effects of CO_2-induced warming at regional scales." Nevertheless, they report "there is mounting evidence that the recent shift to the positive phase of the AMO will promote higher fire frequencies" in the region of their study, i.e., high-elevation western U.S. forests, yet such a consequence should not necessarily be viewed as a response to CO_2-induced global warming.

In one final study from North America, Brunelle *et al*. (2010)[10] collected sediments during the summers of 2004 and 2005 from a drainage basin located in southeastern Arizona (USA) and northeastern Sonora (Mexico), from which samples were taken, as they describe it, "for charcoal analysis to reconstruct fire history," as well as pollen data to infer something about climate.

According to the U.S. and Mexican researchers, "preliminary pollen data show taxa that reflect winter-dominated precipitation [which implies summer drought] correspond to times of greater fire activity," and that the results from the fire reconstruction "show an increase in fire activity coincident with the onset of ENSO, and an increase in fire frequency during the Medieval Climate Anomaly." In fact, they write that during this latter period, from approximately AD 900 to 1260, "background charcoal reaches the highest level of the entire record and fire peaks are frequent," after which they say "the end of the MCA shows a decline in both background charcoal and fire frequency, likely associated with the end of the MCA-related drought in western North America (Cook *et al*., 2004)."

There remains considerable uncertainty regarding the effects of CO_2-induced warming at regional scales.

With respect to the future -- based on their findings -- Brunelle *et al*. speculate that if the region of their study *warms*, "the role of fire in the desert grasslands is likely to change," such that "warming and the continuation of ENSO variability will likely increase fire frequency (similar to the MCA) while extreme warming and the shift to a persistent El Niño climate would likely lead to the absence of fires, similar to >5000 cal yr BP." Consequently, it would appear that if the region's temperature ever were to significantly eclipse that of the MCA, wildfires there could well drop to a barely noticeable level.

Moving across the Atlantic Ocean to Europe, Pitkanen *et al*. (2003)[11] constructed a Holocene fire history of dry heath forests in eastern Finland on the basis of charcoal layer data obtained from two small mire basins and fire scars on living and dead pine trees. This work revealed a "decrease in fires during climatic warming in the Atlantic chronozone (about 9000-6000 cal. yr. BP)," prompting them to conclude that "the very low fire frequency during the Atlantic chronozone *despite climatic warming with higher summer temperatures* [italics added], is contrary to assumptions about possible implications of the present climatic warming due to greenhouse gasses." Thereafter, the researchers observed an increase in fire frequency at the transition between the Atlantic and Subboreal chronozones around 6000 cal. yr. BP, noting that "the climatic change that triggered the increase in fire frequency was cooling and a shift to a more continental climate." In addition, they report that the data of Bergeron and Archambault

[10] http://www.co2science.org/articles/V13/N41/C2.php.
[11] http://www.co2science.org/articles/V6/N29/B1.php.

(1993) and Carcaillet *et al*. (2001) from Canada suggest much the same thing, i.e., less boreal forest fires during periods of greater warmth. Consequently, "as regards the concern that fire frequency will increase in [the] near future owing to global warming," the researchers say their data "suggest that fires from 'natural' causes (lightening) are not likely to increase significantly in eastern Finland and in geographically and climatically related areas."

Introducing their study, Wallenius *et al*. (2011)[12] write that "the effect of ongoing climate change on forest fires is a hotly debated topic," with many "experts" arguing that "the climatic warming in the 20th and 21st century has resulted and will result in an increase in forest fires." Against this backdrop Wallenius *et al*. set out to "add information about forest fire history of the as-yet poorly studied *Larix*-dominated forests of central Siberia by means of high-precision dendrochronological dating of past fires."

Working in the northern part of the Irkutsk district of central Siberia (centered at approximately 60.75°N, 107.75°E), in areas "untouched by modern forestry and agriculture," where "population density is low, with less than 0.1 inhabitant per square kilometer," the group of Finnish, Panamanian and Russian researchers determined that "in the 18th century, on average, 1.9% of the forests burned annually, but in the 20th century, this figure was only 0.6%," while "the fire cycles for these periods were 52 and 164 years, respectively." In addition, they say that "a further analysis of the period before the enhanced fire control program in the 1950s revealed a significant lengthening in the fire cycle between the periods 1650-1799 and 1800-1949, from 61 to 152 years, respectively." And they report that "a similar phenomenon has been observed in Fennoscandia, southern Canada and the western United States, where the annually burned proportions have decreased since the 19th century (Niklasson and Granstrom, 2000; Weir *et al*., 2000; Heyerdahl *et al*., 2001; Bergeron *et al*., 2004b)." And they note that "in these regions, the decrease has been mostly much steeper, and the current fire cycles are several hundreds or thousands of years."

In another paper Turner *et al*. (2008)[13] analyzed micro-charcoal, pollen and stable oxygen isotope ($\delta^{18}O$) data obtained from sediment cores extracted from two crater lake basins in central Turkey, from which they reconstructed synchronized fire, vegetation and climate histories that extend back in time more than 15,000 years. Based on this analysis, the authors determined that "climatically-induced variation in biomass availability was the main factor controlling the timing of regional fire activity during the Last Glacial-Interglacial climatic transition, and again during Mid-Holocene times, with fire frequency and magnitude increasing during wetter climatic phases." In addition, they say that spectral analysis of the Holocene part of the record "indicates significant cyclicity with a periodicity of ~1500 years that may be linked with large-scale climate forcing."

Approaching the subject from a different angle was McAneney *et al*. (2009)[14], who assembled a much different database for evaluating the global warming/fire relationship as it pertains to Australia. Their primary source of information for their study was the "Risk Frontiers' disaster database of historic building losses -- PerilAUS -- which provides a reasonably faithful testimony of national building losses from 1900," with additional information being provided by the Insurance Council of Australia's database of significant insured losses.

In conducting their analysis, the three researchers noted that "the annual aggregate numbers of buildings destroyed by bushfire since 1926 ... is 84," but that "most historical losses have taken place in

12 http://www.co2science.org/articles/V14/N30/C2.php.
13 http://www.co2science.org/articles/V12/N1/C5.php.
14 http://www.co2science.org/articles/V12/N42/C2.php.

a few extreme fires." Nevertheless, they state that "the most salient result is that the annual probability of building destruction has remained almost constant over the last century," even in the face of "large demographic and social changes as well as improvements in fire fighting technique and resources."

Reemphasizing this fact, they restate it again and again and again and again: (1) "the historical evidence shows no obvious trend," (2) "the likelihood of losing homes to bushfire has remained remarkably stable over the last century with some building destruction expected in around 55% of years," (3) "this same stability is also exhibited for the bigger events with an annual probability of losing more than 25 or 100 homes in a single week remaining around 40% and 20% respectively," and (4) "the statistics on home destruction have remained obstinately invariant over time." What is more, McAneney *et al*. state that "Australia's population has increased from around 4 to 20 million over the last century," and, therefore, that we might logically have *expected* "the likelihood of bushfire losses to have increased with population or at least with the population living immediately adjacent to bushlands." However, they once again state what their data clearly reveal, i.e., that this expectation "is not so." And as a result, McAneney *et al*. conclude, in the final sentence of their paper's abstract, that "despite predictions of an increasing likelihood of conditions favoring bushfires under global climate change, we suspect that building losses due to bushfires are unlikely to alter materially in the near future."

Although specific parts of the planet can readily be identified as having experienced both significant increases and decreases in land area burned over the last two or three decades of the twentieth century, as illustrated in the materials reviewed above, what is the case for *the world as a whole*, i.e., what is the *net result* of the often *opposite* wildfire responses to warming that are typical of different parts of the planet?

> Considering *all* of the above findings, although one can readily identify specific parts of the planet that have experienced both significant increases and decreases in land area burned over the last several decades, *for the globe as a whole* there has been absolutely <u>*no*</u> relationship between rising temperatures and total area burned over this latter period.
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Some idea can be gleaned from the study of Girardin *et al*. (2009)[15], who investigated "changes in wildfire risk over the 1901-2002 period with an analysis of broad-scale patterns of drought variability on forested eco-regions of the North American and Eurasian continents." In doing so, the seven scientists report that "despite warming since about 1850 and increased incidence of large forest fires in the 1980s, a number of studies indicated a decrease in boreal fire activity in the last 150 years or so (e.g. Masters, 1990; Johnson and Larsen, 1991; Larsen, 1997; Lehtonen and Kolstrom, 2000; Bergeron *et al*., 2001, 2004a,b; Mouillot and Field, 2005)." And they say that "this holds true for boreal southeastern Canada, British Columbia, northwestern Canada and Russia."

With respect to this long-term "diminishing fire activity," Girardin *et al*. state that "the spatial extent for these long-term changes is large enough to suggest that climate is likely to have played a key role in their induction." And, interestingly, that role would appear to be one of *reducing* fire activity, which is

[15] http://www.co2science.org/articles/V13/N5/C1.php.

just the opposite of what the IPCC contends should occur. And to emphasize that point, and provide still more evidence for it, they state that "the fact that diminishing fire activity has also been detected on lake islands on which fire suppression has never been conducted provides another argument in support of climate control."

Also exploring this issue on a much larger spatial scale was Riano *et al*. (2007)[16], who conducted "an analysis of the spatial and temporal patterns of global burned area with the Daily Tile US National Oceanic and Atmospheric Administration-Advanced Very High-Resolution Radiometer Pathfinder 8 km Land dataset between 1981 and 2000." As demonstrated previously, for several areas of the world, this effort revealed there were indeed significant upward trends in land area burned. Some parts of Eurasia and western North America, for example, had annual upward trends as high as 24.2 pixels per year, where a pixel represents an area of 64 km^2. These *increases* in burned area, however, were offset by equivalent *decreases* in burned area in tropical southeast Asia and Central America. Consequently, in the words of Riano *et al*., "there was no significant global annual upward or downward trend in burned area." In fact, they say "there was also no significant upward or downward global trend in the burned area for any individual month." In addition, they say that "latitude was not determinative, as divergent fire patterns were encountered for various land cover areas at the same latitude."

In one additional paper providing a global view of the subject, but over a longer time scale, Marlon *et al*. (2008)[17] write as background for their study that "large, well-documented wildfires have recently generated worldwide attention, and raised concerns about the impacts of humans and climate change on wildfire regimes," noting that "climate-change projections indicate that we will be moving quickly out of the range of the natural variability of the past few centuries." In an effort to see what the global wildfire "range of natural variability" has actually been in this regard, Marlon *et al*. used "sedimentary charcoal records spanning six continents to document trends in both natural and anthropogenic biomass burning [over] the past two millennia." So what did they find?

There is little support for the model-based contention that future CO_2-induced global warming (if it occurs at all) will have any effect on global fire trends.

The international team of researchers reported that "global biomass burning declined from AD 1 to ~1750, before rising sharply between 1750 and 1870," after which it "declined abruptly." In terms of *attribution*, they say the initial long-term decline in global biomass burning was due to "a long-term global cooling trend," while they suggest that the rise in fires that followed was "linked to increasing human influences." With respect to the final decline in fires that took place after 1870, however, they note it occurred "despite increasing air temperatures and population." As for what may have overpowered the tendency for increased global wildfires that would "normally" have been expected to result from the global warming of the Little Ice Age-to-Current Warm Period transition, the nine scientists say they attribute the "reduction in the amount of biomass burned over the past 150 years to the global expansion of intensive grazing, agriculture and fire management."

16 http://www.co2science.org/articles/V10/N19/B3.php.
17 http://www.co2science.org/articles/V11/N51/B2.php.

In spite of evidence from prior centuries that global warming may indeed have had a tendency to promote wildfires on a global basis (since global cooling had a tendency to reduce them), technological developments during the industrial age appear to have overpowered this natural tendency to the point that man has become a dominant factor for good in actually leading to a decrease in global wildfires over the past century and a half.

Consequently, considering *all* of the above findings, although one can readily identify specific parts of the planet that have experienced both significant increases and decreases in land area burned over the last several decades, *for the globe as a whole* there has been absolutely ***no*** relationship between rising temperatures and total area burned over this latter period, when climate alarmists claim the world warmed at a rate and to a degree that were unprecedented over the past several millennia. And as a result, there is little support for the model-based contention that future CO_2-induced *global* warming (if it occurs at all) will have any effect on *global* fire trends.

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Cover photo of a fire in the Big Horn Mountains of Wyoming, USA provided by Jenn Stewart.

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