It's a Hard-Knock Butterfly's Life

Can a Lady Monarch Provide a Role Model?

First the bad news. It has been a tough year for milkweeds and Monarch butterflies on our 7½ acres in eastern Pennsylvania. Common milkweeds that we transplanted from Frogtown Road two years ago ("Storms of My Grandchildren"), and later fertilized, grew so large that many fell over until supported by bamboo sticks – but their large leaves failed to attract any butterflies.

Exotic milkweeds that we planted by our pasture, where we let our neighbor's horses graze, grew well. However, two of the horses are 18-hand draft horses (like Budweiser Clydesdales, but coal-black) with neck and head so huge that they could reach over the fence. They don't eat common milkweeds, but they chewed the exotic milkweeds almost to the ground.

The only successful milkweeds were some other exotic ones, which my grandson Connor started in pots and I transplanted near the house. One or two Monarchs flitted about these a few weeks ago. When I looked closely, I noticed that the persistent Monarch had a broken (incomplete) wing. It was a female, as revealed by the black 'veins' in the wings (Figure 1), which were thick and did not include two black nodules.

The next several days I saw only one butterfly – the same broken-wing female. I noticed more than a dozen caterpillars (larvae) on the milkweed leaves. They were already middle-aged (about a week old).

I drove off to a tar sands rally at the White House. It was almost a week later before I returned to the farm. In the interim we had endured a deluge from a tropical storm – about eight inches of rain. Could the butterfly and/or the larvae possibly have survived that storm?

To my surprise there was one butterfly flitting about – the same broken-wing female. Evidently she had decided that our meager patch of milkweeds (now chewed-up by the larvae)

Figure 1. The broken-wing female Monarch on our butterfly bush.

Figure 2. The larvae devouring the milkweeds.

and the nearby butterfly bush were going to be the end of the line for her. The trip to northern Mexico would be the task of her children or grandchildren. The larvae were mostly in their final stage, so I put a bench by the milkweed patch with a long plank on it where the caterpillars could conveniently proceed through their miraculous chrysalis stage.

Unfortunately, their migration path to Mexico includes a long stretch over Texas. Would this remarkable insect be able to find enough sustenance for an almost 1000-mile trek over such desolate baked-out territory? It seems unlikely that milkweeds are thriving there this year.

Monarchs are just one of many species in danger. IPCC WGII (2007) estimates that, if business-as-usual (BAU) CO_2 emissions continue this century, between 21% and 52% of all species will be committed to extinction. Humanity is putting pressure on species in many ways, but the principal factor determining how many species will be exterminated is global warming and the consequent shifting of climate zones, which has proceeded with unprecedented speed over the past 30 years (Tipping Point).

Well-oiled Governors and Senators in Texas and Oklahoma bear a responsibility. Asserting that global warming is a hoax, they take actions that help BAU CO_2 emissions continue, even if it requires spoiling pristine places to extract the dirtiest fuels on the planet.[1]

How can they get away with this? When will they finally be smoked out? Do the current drought and fires in Texas provide a legitimate basis for exposing the reprehensible behavior of these mountebanks, a chance to pull the curtain aside revealing the charlatans behind?

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[1] Our fossil fuel-government oligarchy will not tolerate even peaceful citizen objection to actions that could leave young people with a planet spiraling toward a desolate state. Tim DeChristopher's attempt to block sale of rights to exploit public lands in Utah resulted in his arrest by the Bush administration and his prosecution, conviction and imprisonment by the Obama administration. Both administrations refused to allow his defense in court to present the argument that Tim's 'crime' was an attempt to prevent an even greater crime against humanity and nature.

The British justice system allowed the 'necessity' defense in the Kingsnorth trial. In testifying there, I noted that coal burned at Kingsnorth would be responsible for extermination of more than 200 species, assuming that BAU continued and that Kingsnorth was assigned species in proportion to its CO_2 emissions. That argument was an important factor in persuading the jury to find the Kingsnorth defendants innocent. It is not surprising that the fossil fuel-government oligarchy in the U.S. sets rules so as to avoid a trial that exposes the main issue to the public.

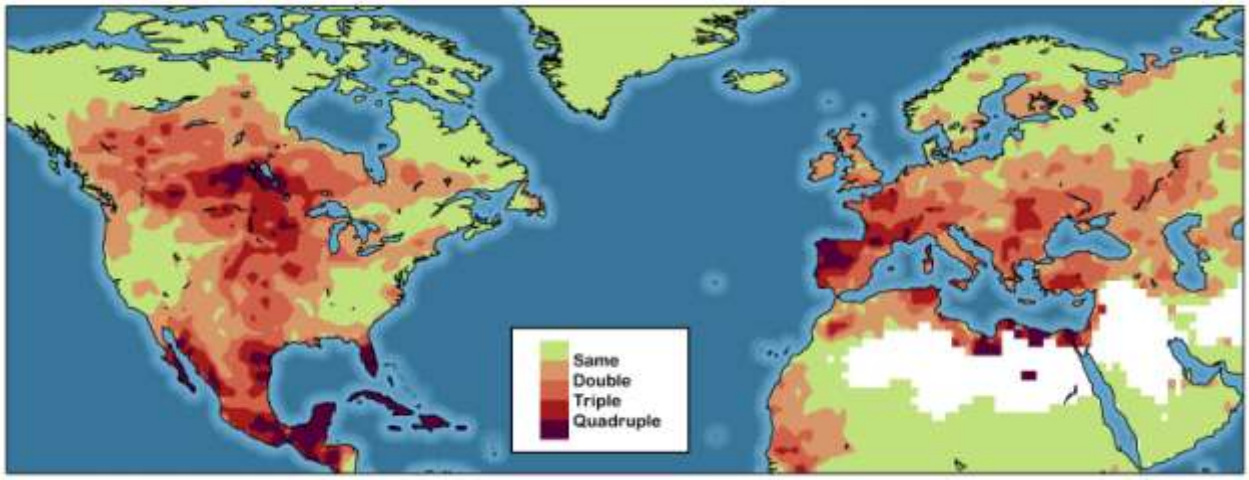

Figure 3. Change of summer drought likelihood this century with BAU CO_2 increase, as simulated by ECMWF (European Center for Medium-range Weather Forecasts).

Silent Summer

There is ample evidence of growing climate disruption. But despite record or near-record heat and drought in the United States this past summer with simultaneous extreme flooding, and despite comparable extremes in China and elsewhere, there has been little public discussion of the connection of these climate extremes with human-made climate forcing.

The media are partly responsible for the silent summer, as they have mainly chosen not to examine connections between climate anomalies and human-made causes. A cynic may ask whether their silent summer is related to increasing right-wing control of media and large advertising revenues from fossil fuel companies. Regardless of reasons for media silence, should scientists be making more effort to draw public attention to the human role in climate anomalies?

Scientists face one long-standing obstacle to public communication and one new factor. The old difficulty arises from limits on our ability to detect expected change in a chaotic climate system, especially concerning the significance of specific regional events. The new factor is the likelihood of being pilloried for reporting evidence of a human role in climate change.

Limits on Detection

Global warming is expected to intensify climate extremes: (1) Warmer air holds more water vapor, and precipitation occurs in more extreme events. '100-year floods' and even '500-year floods' will become more likely. Storms fueled by water vapor (latent heat), including thunderstorms, tornadoes and tropical storms, will have the potential to be stronger. Storm damage will increase because of increased flooding and stronger winds. (2) Where weather patterns create dry conditions, global warming will intensify the drought, because of increased evaporation and evapotranspiration. Thus fires will be more frequent and burn hotter.

Observations confirm that heat waves and regional drought have become more frequent and intense over the past 50 years. Rainfall in the heaviest downpours has increased about 20 percent. The destructive energy in hurricanes has increased (USGCRP, 2009).

Is the Texas drought related to human-made global warming? There is strong reason to believe that it is. Basic theory and models (Held and Soden, 2006) and empirical evidence (Seidal and Randel, 2006) indicate that the global overturning circulation, air rising in the tropics and subsiding in the subtropics, expands in latitude with global warming. Such expansion tends to make droughts more frequent and severe in the southern United States and the Mediterranean

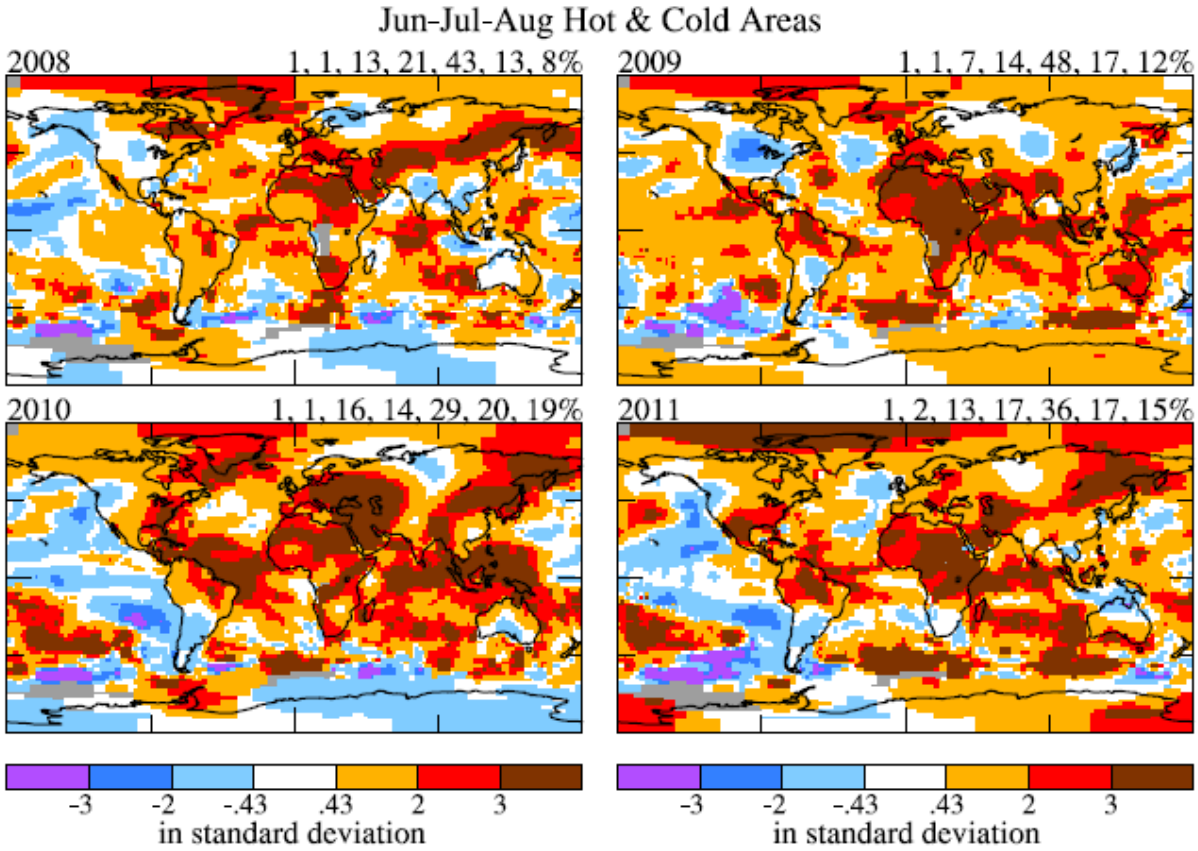

Figure 4. June-July-August surface temperature anomalies in units of standard deviations relative to the climate of 1951-1980.

region, for example. Climate simulations, shown in Figure 3 for one of the best climate models, support that expectation.

So the occurrence of unusual Texas heat and drought is consistent with expectations for increasing CO_2. But is this year's event just climate 'noise'? Scientists need to help the public distinguish climate change caused by global warming from natural climate variability.

I used 'climate dice' in conjunction with testimony to Congress in 1988 to try to help the public understand that the human-made climate 'signal' must be extracted from the large 'noise' of natural climate variability. I believe the public can grasp the concept of natural climate variability and its effect on perceptions of climate change.

In an upcoming post (Climate Variability and Climate Change, Hansen, Sato and Ruedy) we try to clarify this matter via simple maps and graphs that show how the odds have changed, allowing comparison of expectations and reality. We believe this is a truer approach than the frequently suggested alternative of dropping the long-standing 'global warming' terminology in favor of anything ('climate disruption', 'global wierding', etc.) that avoids the need to explain the occurrence of unusually cold conditions.

We show that a 'signal' due to global warming is already rising out of the climate 'noise', even on regional scales. Figure 4 is an example, showing surface air temperature anomalies in the last four Northern Hemisphere summers relative to the climate of 1951-1980, the time when the 'baby-boomers grew up – it was a time of relatively stable climate, just prior to the rapid global warming of the past three decades.

During 1951-1980 the world had equal areas of blue (cool), white (near average), and red (warm) temperature anomalies. The division 0.43σ, where σ is the local standard deviation about

the local 1951-1980 mean, was chosen to yield equal area categories for a normal ('bell curve') distribution of temperature anomalies. The other divisions in the figure, 2σ and 3σ, allow us to see the areas that have extreme anomalies relative to climatology. The frequency of an anomaly greater than +2σ is only 2-3 percent in the period of climatology for a normal distribution. The frequency of a +3σ event is normally less than one-half of one percent of the time. The numbers on the upper right corner of each map are the percentages of the global area covered by each of the seven categories of the color bar.

Figure 4 reveals that the area with temperature anomaly greater than +2σ covers 20-40 percent of the planet in these recent years, and the area greater than +3σ is almost 10-20 percent. The United States has been relatively 'lucky', with the only +2-3σ areas being the Texas region in 2011 and a smaller area in the Southeast in 2010. However, these events are sufficiently fresh in people's memories that they provide a useful measure of the practical impact of a 3σ anomaly.

There is no good reason to believe that the United States, or any other region, will continue to be so 'lucky'. On the contrary, as shown in our upcoming post, there is a clear positive trend to increasing areas of +2-3σ anomalies, consistent with expectations for the climate response to increasing greenhouse gases. If BAU emissions continue, the area with anomalies of +2-3σ and larger will continue to increase.

The chaotic element in climate variability makes it impossible to say exactly where large anomalies will occur in a given year. However, we can say with assurance that the area and magnitude of the anomalies and their practical impact will continue to increase. Clear presentations of the data should help the public appreciate the situation as global warming continues to rise further above the level of natural variability.

However, as Mother Nature makes the dominance of human-made climate change more obvious, proponents of business-as-usual have engaged in another method to stifle communication by scientists about global warming.

Character Assassination

There was criticism of my congressional testimony about global warming in the 1980s, but it was mainly normal healthy scientific skepticism (Kerr, 1989). A different sort of criticism, including an element of character assassination, has developed since then and has been leveled most heavily against scientists Ben Santer, Michael Mann and Phil Jones. The approach has included acquiring and digging into personal correspondences of scientists in search of any inappropriate or questionable statements, as well as fine-toothed scrutiny of their scientific analyses in search of any element, however minor, that could be criticized.

The ultimate target of the critics in Santer's case was a specific sentence that Santer was responsible for as a lead author in the 1995 IPCC report: "Taken together, these results point towards a human influence on climate." The target in Mann's case was the temperature record of the past millennium, which Mann had shown to resemble a "hockey stick", bending upward into rapid warming in the past century. The target in Jones' case was his analysis of observations showing the rapid warming of the past century.

The important point I wish to note is that each of these three targets, the scientific conclusions that provoked the critics and which they aimed to destroy or discredit, have been shown in subsequent analyses to have been correct, indeed, dead-on-the-mark.

However, the scientific community is well aware of the toll that these attacks took on the scientists, despite the fact that their work was eventually vindicated and corroborated.

Thus, it would not be surprising if these experiences have an effect on the willingness of other scientists to make statements that draw attention to the likely role of human-made forcings as a contributor to the climate extremes of the past summer.

In any case, there is abundant evidence that the attacks on the science and the scientists have contributed to a pullback in public support for national and international efforts to find a path forward that would lead to the large reductions in emissions that are needed to stabilize climate and provide young people with a promising future.

This is important, because the actions that are required can only be achieved through the political process. That will not happen until the public understands and supports what is needed.

Making the Climate Story Clear

Climate science involves more than the atmosphere and ocean – it now involves fossil fuels. Indeed, the science reveals that fossil fuels have become the dominant cause of climate change, and that, if fossil fuel emissions are not reduced rapidly, Earth will be rapidly exiting the stable Holocene climate in which civilization developed. The rate of global warming, with BAU fossil fuel emissions, would exceed anything that Earth's species have experienced.

It is clear that science, with its inherent objectivity, is needed to help society find a path that provides a bright future for young people and nature. Yet, as I learned in visiting several nations (Storms), governments want scientists to stop short of policy implications of the science.

If scientists do not connect all of the dots in this story, the dots will be connected by people with a vested interest in preserving the fossil fuel industry. The resources that the fossil fuel industry brings to bear in protecting its economic interests are formidable. The public is immersed daily in advertisements using effective spokespeople including skilled professional actors. Their message has appeal. They say that efforts to extract fossil fuels in tar sands, in the Arctic, and so on, would provide jobs and produce needed energy.

Existing irrefragable climate science makes clear that this path – advocated by the fossil fuel industry and supported by governments worldwide – would be calamitous for young people and nature. Yet if scientists bring only this negative message, there is no hope of stopping the fossil fuel juggernaut with its aim to exploit all fossil fuels.

The public must also be convinced that a better energy alternative exists. The alternative must be economically realistic and it must provide jobs.

That's a tall order. Before giving some reasons for optimism, let me admit the obstacles.

Obstacles

The fossil fuel industry has a stranglehold on government energy policies. This is possible because our democracy is not functioning as well as our founding fathers hoped. It is not one person one equal vote – lobbyists bringing large campaign contributions are more equal than others, like the pigs in Animal Farm.

Politicians move freely between government and corporations. A 'retired' politician becomes a lobbyist or a well-paid board member. Can they be serving the public interest? .

An epitome of the Washington syndrome is the cap-and-trade-with-offsets scheme that was hatched as a 'solution' to global warming. It assures big roles and a continuing stream of big money for big banks, big coal, big oil, and utilities. Who is left screwed and tattooed? You guessed it. John Q. Public. Every single cent in expanded corporation 'profits' and the compensation for multi-million-dollar executive salaries, including salaries for a new class of bankers, 'carbon traders', is extracted via increased energy costs paid by John Q. Public.

Most proponents of cap-and-trade must admit that it is inferior to a simple honest rising price on carbon emissions (a fee collected from fossil fuel companies). Their defense of cap-and-trade is reduced to a fatuous "don't let the perfect be the enemy of the good". In fact cap-and-trade is not 'good' – it is designed to allow business-as-usual, leading to certain mining of all fossil fuels on the planet and a debacle for young people.

Reasons for Optimism

As global warming increases, scientists can help the public appropriately assess the situation by providing understandable comparisons of climate change and natural variability. However, given the iron grip that the fossil fuel industry has on government, is there any chance of effective actions to slow climate change? I see several reasons for optimism.

One reason for optimism is growing public anger at Washington's modus operandi, including the revolving doors and cronyism. With the public paying attention, big banker-economists will not be able to get away with a cap-and-trade shill game. It's time for an approach designed for the public that honestly addresses our energy, national security, and environmental issues – indeed, it is decades overdue.

A second reason for optimism is growing recognition, by young people and others, that it is not enough to elect politicians who say good words about climate and the environment. There is increased sophistication, realization that token support of 'renewable' energies will not slow the fossil fuel juggernaut. There is better understanding that solution of fossil fuel addiction is impossible unless fossil fuels are made to pay their true costs to society via a rising fee collected from fossil fuel companies.[2]

The carbon fee must rise to substantial levels if it is to affect consumer choices and cause strong movement toward greater energy efficiencies and carbon-free energies. If the fee rises gradually over a decade to a level of $115 per ton of CO_2, economic simulations indicate that United States CO_2 emissions would be reduced about 30 percent, which is the equivalent of 13 Keystone XL pipelines![3]

A third reason for optimism is the growing support for just such a simple honest price on carbon, with 100 percent of the fee distributed monthly electronically to legal residents. Jim Dipeso of Republicans for Environmental Protection describes it as "Transparent. Market-based. Does not enlarge government. Leaves energy decisions to individual choices. Takes a better-safe-than-sorry approach to throttling back oil dependence and keeping heat-trapping gases out of the atmosphere. Sounds like a conservative climate plan."[4]

Most impressive is the work of the Citizens Climate Lobby, a relatively new, fast-growing, nonpartisan, nonprofit group with 35 chapters across the United States and Canada. Their mission is to get the U.S. Congress and the Canadian Parliament to pass effective climate legislation – specifically fee-and-dividend legislation.

The Citizens Climate Lobby works via (1) using newspapers and other media to communicate with the public, (2) educating and motivating citizens to lobby members of Congress and Parliament in support of fee-and-dividend legislation. If you want to join the fight to save the planet, to save creation for your grandchildren, there is no more effective step you could take than becoming an active member of this group (www.citizensclimatelobby.org).

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[2] Governments must also support technology R&D and enforce efficiency standards on buildings, vehicles and electronics, for example, but it is the carbon fee (and the knowledge that the fee will continue to rise) that is the essential underlying policy needed to make the other policies effective and to allow the market place to drive choices among energy efficiency and clean energy alternatives.

[3] The fee collected from fossil fuel companies will increase energy prices for the public. $115/ton of CO_2 is equivalent to about $1/gallon of gasoline. The collected fee will be about $600B, amounting to $2000-3000 per legal adult resident, with half a share for children up to two children per family. About 60 percent of households would receive more in the dividend, received electronically monthly in their bank account or debit card, than they pay in increased energy costs. The monthly dividends will stimulate the economy and create jobs.

[4] With this approach tipping points will be reached at which given technologies become more cost-effective and rapidly supplant fossil fuels. This is the requirement for leaving dirty fuels such as tar sands in the ground.

It is time for all of us to get Tea-Party-angry about what our political system has become and about the intergenerational injustice being perpetrated on young people. However, that anger needs to be tempered by rationality. It is necessary for the public to understand what is needed and demand action designed for the public's interest, not for special financial interests.

It's a Girl – and a Boy! Good Luck in Texas

The ravenous caterpillars (Figure 5) began to disappear, but they studiously avoided forming any chrysalis on visible sites. I could not find what had happened to them until eventually an orange spot appeared in our nearby privet hedge.

Simultaneously two newly emergent butterflies were hanging upside down, seemingly exhausted by their breakneck trip from the land of the worm, waiting for their new-found wings to dry (Figure 5). After a while the male began steadily crawling up the privet sprig. At the apex he sat for some time, beat his wings several times while holding on to the sprig, and then set sail to heights of 20-30 feet, flying once all around the yard before returning to land on the butterfly bush (Figure 6), where he presumably was gathering nourishment for a long trip.

When I returned late in the day, both butterflies were long gone, presumably headed toward Texas and eventually Mexico. It will be interesting to see how many of these remarkable insects make it this year to the small forest in Mexico where they winter.

The broken-wing female was not there to witness her magnificent offspring, but she had done her job for future generations. Adult Monarchs live for only a few weeks – except, miraculously, the generation that completes the migration to Mexico (or Southern California, in the case of the western Monarch) can live for several months.

The pathway over Texas should not be as difficult in the next few years as it is this year. We show in our upcoming post that hot summer 2011 climate anomaly in Texas jumped above the trend. However, the trend is such that in a few decades the 2011 summer will be the typical climate in Texas, if fossil fuel use and greenhouse gases continue their business-as-usual trend.

Survival of the Monarch will depend more on conditions in Mexico than in Texas. If business-as-usual continues and we burn most of the fossil fuels this century, it is unlikely that those forests or the Monarchs will survive. There is not much that the Monarch can do about this matter. Their fate will be up to the intelligent species.

Jim Hansen 28 September 2011

References

Dipeso, J., 2010: Jim Hansen's conservative climate plan, blog post at Republican's for Environmental Protection, 11 Oct. 2010: http://www.rep.org/opinions/weblog/weblog10-10-11.html.

European Centre for Medium-range Weather Forecasts, IFS Documentation – Cy33r1: Oper. Implementation 3 June 2008, http://www.ecmwf.int/research/ifsdocs/CY33r1/index.html, 2009.

Hansen, J., 2008: Tipping point: Perspective of a climatologist. In *State of the Wild 2008-2009: A Global Portrait of Wildlife, Wildlands, and Oceans*. E. Fearn, Ed. Wildlife Conservation Society/Island Press, pp. 6-15.

Hansen, J., 2009: Storms of My Grandchildren, Bloomsbury (http://www.columbia.edu/~jeh1/).

Held, I,M., Soden, B.J., 2006: Robust responses of the hydrologic cycle to global warming, *J. Climate*, **19**, 5686-5699.

Intergovernmental Panel on Climate Change (WGII), *Climate Change 2007: Impacts, Adaptation and Vulnerability*, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden, C.E. Hanson (eds., Cambridge Univ. Press, 996 pp.

Kerr, R.A., 1989: Hansen vs. the world on the greenhouse threat, *Science*, **244**, 1041-1043.

Seidel, D.J., Randel, W.J., 2006: Variability and trends in the global tropopause estimated from radiosonde data, *J. Geophys. Res.*, **111**, D21101.

United States Global Change Research Program USGCRP, 2009: http://www.globalchange.gov/publications/reports/scientific-assessments/us-impacts/full-report/national-climate-change

Figure 5. Newly-emergent Monarchs, each beside its popped chrysalis, waiting for its wings to dry.

Figure 6. The male Monarch after its first landing, on the butterfly bush.

Figure 7. The female Monarch on the remains of a wildflower.