The earth is round, but is the climate warming?

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"With a gesture of great dignity and power he lifted his arm and stood pointing into the distance at the flat land and low-hanging sky. "Look," he said, very slowly and very quietly, "she is flat, and she stands still."

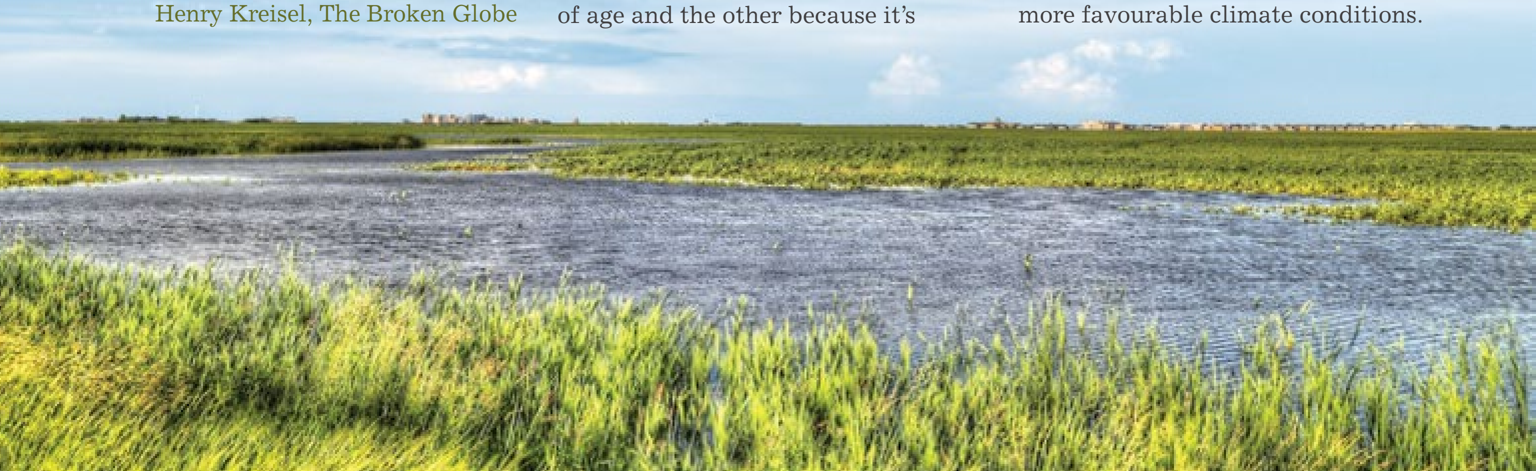
Henry Kreisel, The Broken Globe

The earth is flat. It's obvious. Just watch the first few minutes of any rerun of the TV show Corner Gas, filmed in southern Saskatchewan. As the camera zooms out from Brent Leroy, the gas station proprietor, we see the vast flat prairie landscape and hear the first few lines of the show's theme song:

First you tell me that your dog ran away.
Then you tell me that it took three days.

Out here, where it takes three days for a running dog to disappear, the earth looks flat. Contrary to this earth bound view of the prairies; scientists in the fields of astronomy and geophysics have pretty good evidence that the world is round. Most of us accept this evidence even though we're not astronauts and haven't seen the earth from space.

Similarly, most of us have not seen climate change. There are two exceptions – oldtimers and scientists; both have a long view, one by virtue of age and the other because it's in their job description. Scientists have known about global warming for a surprisingly long time. In the 1820s, the French mathematician Fourier worked out the math of the earth's energy balance including the role of heat trapping gases. In 1896, the Swedish chemist Svante Arrhenius called these greenhouse gases. He realized that, by burning coal and producing carbon dioxide, people were making the earth warmer. (He thought this was good for civilization.) After more than a century of research, including many thousands of studies in the last decade, scientists have conclusive evidence of human-induced global climate change. Much of the scientific effort has now turned to determining the regional and local consequences, and the adaptations, changes in practices, policies and processes, that will be required to avoid damaging impacts and, in come cases, to take advantage of more favourable climate conditions.



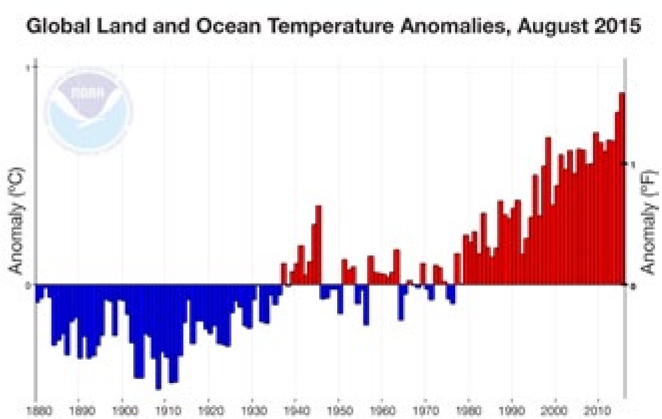
So if scientists can convince us that the earth is round, then why can't they get all of us to accept the reality of global warming? There are various reasons. Social psychologists tell us that we all discard information that does not conform to our existing mindset, basically our cultural biases and common sense. Science is often rejected in a conflict with common sense, which is the product of our personal experiences. These experiences include weather but not climate. On any given day, we expect certain weather based on our past experience and observations. The weather that we expect, but often don't get, is called climate. Scientists describe climate in terms of the average and range of weather conditions. Thus the daily weather forecast includes the normal temperature for that day and the record highs and lows. If we get unexpected weather, well above or below the average or outside the historical range, then it is either just very unusual, beyond our experience, or possibly represents climate change, especially if it happens again and again. The problem is, which of these two possibilities is it? How will we know if unusual weather is climate change?

The answer to this key question depends largely on where you live and how much the weather you expect, that is the climate, can differ from the weather you actually get. Let's contrast Calgary, Alberta and Ochos Rios, Jamaica. Calgarians boarding a plane to the Caribbean for a winter vacation are already dressed in sandals and shorts; the only clothing they'll need. A winter vacation in Calgary, on the other hand, would require packing everything from t-shirts to a parka. At Ochos Rios, the full range of temperature throughout the year is about 5°C, between the low to high 20s. In Calgary, a change of 30°C in one day is not uncommon. Where temperature swings are wide like this, the average (a climate statistic) tells us little or nothing about the actual weather to expect because almost anything is possible. Probably for this reason all conversations in our part of the world start and end with the weather. On a trip to Jamaica, I tried to engage a local gentleman in conversation by, of course, commenting on the weather, to which the stranger, a bit confused and astonished, replied "Hey man we don't talk about the weather; it is what it is" – which is, nearly always the same.

Scientific research shows why a person in the Caribbean is likely to notice global climate change much sooner than someone in western Canada. In one study researchers examined the strength of the 'signal' of anthropogenic climate change as compared to the natural variability or 'noise' in the climate system. A good analogy is trying to measure the clarity of a radio station's signal against the background of interference or random noise. The researchers found that detecting climate change (the signal) was most difficult in the middle to higher latitudes, because it is here that the global climate system has maximum natural variability (noise). The world's most variable climates from season to season, and year to year, are in the interior of the two largest land masses, Eurasia and in North America.

In a similar study, scientists concluded that, more than any other factor, internal climate variability restricts their ability to detect and forecast climate change. Nothing can really be done to reduce this large source of uncertainty, not even a perfect climate model. However, when outputs from many climate models are aggregated for the entire world, consistent patterns of future climate conditions emerge. The strongest and most consistent signal of recent climate change is in the average surface air temperature. A relatively cool year in one region is offset by above average temperature in another place, and the signal of global warming emerges from the background of natural variability. This past August was the 366th consecutive month, since the mid 1980s, with a positive global temperature anomaly, above the 20th century average. Thus the current climate changes are called global warming. It you're not a scientist, however, your mental map, daily routines and livelihood don't span the entire globe; we are focused on our community and local surroundings.

Here in the Canadian Prairies, the most noticeable climate changes are directly related to temperature and our human intervention in the earth's energy balance. As a result of rising temperatures, especially in winter and at night, snow tends to melt earlier in the spring, glaciers and high elevation snowfields are disappearing from the Rocky Mountains, the growing season is

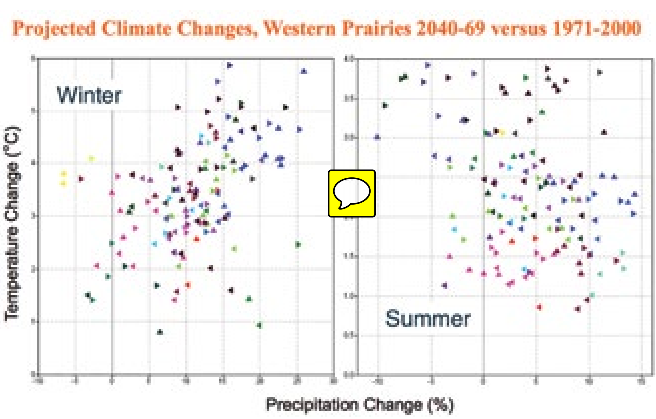


August 2015 was the 366th consecutive month with a global average temperature above the 20th century average getting longer and warmer, and summer river levels are declining. These temperature driven changes are well documented. Other important impacts of climate change are not nearly as clear, because they are related to precipitation, which is a product of the circulation of the atmosphere and oceans, and thus very much linked to the internal variability of the climate system. Once again, this natural variability is hiding the regional signature of global climate change, and limiting our ability to not only notice precipitation-related climate changes but also to anticipate them (notice that I didn't say predict; nobody can do that).

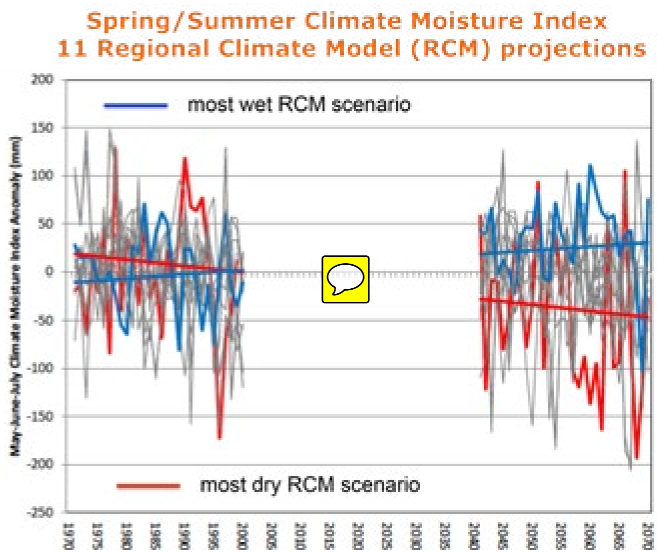
The best scientific tools for projecting future climate changes are the climate models that replicate important features of our present climate and past climate changes. Each time a model is run, using slightly different boundary conditions and assumptions about the future, it produces a different future climate. The following chart shows, for a large number of runs of several Global Climate Models (GCMs), differences in temperature and precipitation between the recent past (1971-2000) and the near future (2040-69) in winter (left) and summer (right). Every run of every GCM shows higher future temperatures especially in winter. There is total agreement, but then again precipitation is a different story. Precipitation is higher in winter for most models, but higher in summer for only about 2/3 of them. We cannot be certain of course, because it's the future, but it's looking very much like a warmer wetter winter and a warmer and possibly drier summer. This is the most likely future scenario for a normal year.

We are losing the advantage of a cold winter

We all know that on the prairies there is no such thing as normal; the average is just a statistical concept. Therefore, the most useful climate scenarios are those that tell us something about the variability from year to year. For these scenarios, we turn to more detailed Regional



Climate Models (RCMs) and data for a critical variable, the growing season climate moisture index (CMI), the difference between precipitation and the water lost by evaporation and transpired by plants. The following chart shows the modeled spring/summer CMI each year from 1971 to 2000 and from 2041 to 2070. From this output from 11 RCMs, we can conclude that the growing season on the prairies is trending somewhere between a little bit wetter (the wet scenario in blue) to a lot drier (the dry scenarios in red). The more useful information, however, is the wider range of moisture conditions in the future, larger than we've had in the past. The most challenging climate change scenario is represented by all those future years of large moisture deficits.



What are the implications of these climate changes for prairie agriculture? The increased precipitation and extra heat suggest major opportunities for the agriculture industry. These opportunities to increase and diversify production will require adaptation of technology, management practices and government programs and policies to minimize the adverse impacts of warming climate: pests, pathogens and invasive species, which are also advantaged by the new climate, and extremes of water and climate. For advice on adaptation, I always turn to folks who have been adapting to a cold, dry and variable climate (and to changing economic and social factors) for more than a century. Nobody knows more about adaptation than prairie agricultural producers.

As our social and climate history have demonstrated, the most effective adaptations and responses to extreme events have been collective, employing rural social capital and good governance, policies and programs

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Initiative in British Columbia and Alberta. They agree that the best way to protect nature in a market economy is to assign it a dollar value and then somehow (that's the tricky part) insert that value into the day to day economics of farming.

How to connect dollars to those who manage EG&S on agricultural land, however, is a question that has yet to be fully answered. Should governments increase regulation and use incentives and disincentives to provide producers with the right signals or do we leave it up to the marketplace and private organizations like ALUS to stimulate agricultural practices that will protect EG&S?

"It's a tough one," Sean says. "In some ways our culture is leaning politically the opposite way from any kind of government intervention. But as a producer, I am providing services that benefit the entire population. We all share the clean air – I think in the long run there will be some form of government intervention in the marketplace. It may look like carbon credits. It could be something like biodiversity offsets where oil and gas or any developer pays into a mitigation fund.

"One of the arguments is that people are already doing it and doing it for free. I know a lot of them and they are role models I look up to. But there is a large contingent getting rid of bush and sloughs and the reality is that the EG&S provided by shelterbelts and wetlands are disappearing faster than they are being created. If you run a 120 foot sprayer, and there's a 60 foot shelter belt along the edge of your field, the economics say you knock down the trees. The obvious thing is to get rid of those trees – it's not right or wrong, it just is.

"What we have to do is find a way to shift those economics a bit. If it's a break-even prospect or even a small negative, lots of guys will take that step to improve their practices. The guy with the 120 foot sprayer, if you pay him something for those 60 feet he will leave them there. And if there is a monetary reward for retaining native grass, people will do it.

"I think we are going to figure this out, but it will take a combination of things. We need to educate the public so there should be some public dollars. That is how they do it in Europe – some public funding, some regulation, and a marketplace with carbon credits and biodiversity credits. Over time, some premium markets emerge. Whether it's animal welfare or wildlife friendly, if that becomes the way the market goes then that becomes the lowest rung on the bar."

While producers, conservation groups, and public policy makers develop programs and practices that help keep farm and ranch land healthy and diverse, a wholesale transformation of the agriculture industry to ecologically-sound management is a long way off. In fact, the more tangible rewards of working well with nature may never get beyond pilot projects and hit the mainstream unless we find a way for EG&S costs and benefits to appear on the financial statements of the corporations that distribute, process, and market the food grown on our farms and ranches. FFT

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that enable and encourage best management practices. Good examples of this collective action are regional emergency preparedness organizations and watershed stewardship groups. Rural communities are the most exposed to climate change but they can lack the financial and technical resources to deal with it. Thus higher levels of government have an essential role in enabling adaption to a changing climate and preparations for extreme episodes of excess water and drought. An inter-provincial agency, with a mandate much like the former PFRA, may have to be resurrected. This new agency is most likely to arise as the result of some devastating floods or a widespread severe drought, the circumstance that led to the founding PFRA, although in the future water shortages will occur in a warmer climate than in the 1930s.

Most of the impact of climate change on people will be caused by shifts in ecosystems and the availability of water. Therefore one of the fundamental principles of adaptation to climate change is building resilient communities and economies by ensuring the health and integrity of the ecosystems that are basis of our food and water security. The resilience of agricultural ecosystems, to withstand climate extremes and change, is ensured through the proper management of water, soil and pasture. This sounds very much like the sustainable agricultural practices and programs that are advocated on the pages of this magazine. FFT