Climate, Energy and Community: Vermont 2010

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Abstract:

This is a compilation of my 2010 Weekly Planet articles (plus two feature articles) from the Sunday Environment page in the Rutland Herald and Barre/Montpelier Time Argus**.** This series started in January 2008 - the set of 2008 columns has an introductory narrative. These columns go through the seasons, dealing with weather, climate, climate change, energy and policy issues. They blend science with a systems perspective, and encourage the reader to explore alternative and hopeful paths for themselves, their families and society. They are written them so that a scientist will perceive them as accurate (although simplified); while the public can relate their tangible experience of the weather to the much broader issues of climate and climate change. This year I will revisit the seasonal climate transitions in greater detail. I will also suggest that humanity base planning and decisions on Earth system reasoning, rather than traditional economic arguments; since it is likely that we have passed the carrying capacity of the planet. The future of our societies and the Earth depends on our creativity and willingness to work together.

Footnote: All my articles can be freely reused under a Creative Commons license. The old Herald web references have not been maintained. You can find articles at http://rutlandherald.com/section/archives. However, they charge for access.

List of topics in 2010 *[Index is live]*

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a) Earth science and society (January 31, 2010)

http://rutlandherald.com/article/20100131/ENVIRONMENT/1310305

Our big environmental challenges, especially climate change, come from the conflict between human individualism and consumerism, nationalism and the limits imposed on us by the earth system. We must confront so many treasured beliefs. Can earth science help us in this? The recent U.N. conference in Copenhagen is a stark example of this issue. Every country came with its own very reasonable negotiating position; reasonable in that it had some broad support from that nation's perspective. Vulnerable countries and countries with well-informed populations pushed for stronger action to reduce climate change. Many nations, including the United States, resisted large reductions in fossil fuel use because of the potential impact on wealth and free market philosophy. Our negotiators also knew that Congress and large segments of our population would oppose any treaty. For years our political system has treated scientific evidence about the likely future of our planet as simply untrue or at least adaptable to "political reality."

Certainly our knowledge of the future of the earth system is very incomplete. But the earth, in all its living glory and complexity, doesn't read the blogs and doesn't negotiate with our "reasonable requests" for a 30-year extension. The earth's climate just responds to increasing pollution and greenhouse gases; and all life on earth, which includes humanity, will have to adapt. Ignoring this reality and simply trumpeting our faith in growing energy use and consumerism is a recipe for the collapse of our human system.

As a society we recognize that if we ignore bridge maintenance because we don't like taxes, then it is unfair to blame the engineer who designed the bridge when it eventually collapses. Yet even in such a relatively straightforward case of cause and effect, it's very hard to accept our obvious responsibility. The parallel for the earth's environment is even more difficult, because we didn't design it, and we barely understand it. But as crises approach because of our shoddy human practices, whom can we blame but ourselves? Instead, some just shout louder: "Don't worry; anthropogenic climate change is just a scientific conspiracy."

This extraordinary claim, which collapses the moment anyone tests it, is believed by many in the United States. It is used for political leverage, mostly to avoid discussing issues of the wealth and power that must be faced if we accept our responsibility for the future of Earth.

Understanding the Earth requires several fundamental shifts. The first big step, always the hardest, is a shift from an annual to a generational perspective. For our capitalist society, this means we must look beyond quarterly profits and start the "real costing" of goods and services for humanity and the earth system for the next 30 years. Even this perspective is not really big enough, but it is a tangible first step for those with children and grandchildren. In reality, the longer seven-generational time frame of many native peoples is a better timescale for the earth's ecosystem.

Of course we don't know enough, so we have to build in resilience and adaptability. Where we lack detailed knowledge, we need the vision to follow broad principles that are earth-centered rather than human-centered. Yes, it will cost more and slow down "growth." But we must build in feedbacks that slow down the growth of our human impacts if we are to thrive as a species on this planet; rather than grow exponentially to a glorious crash from which it may take us centuries to recover.

This is not easy. It means changing our fossil bureaucracies to a more adaptive system of government. The United States is now in the regrettable position that it is too big to fail but is crumbling as a system because it is too fearful to adapt. This is just one more transition issue to face in our local communities, now that this week's big rainstorm has washed away some of our winter snow!

b) Winter waste management (March 7, 2010)

http://rutlandherald.com/article/20100307/ENVIRONMENT/3070323/

As I walk down to the covered bridge every morning in winter, I see many items that have been thrown from car windows into the flood plain of the Otter Creek. There is a banana skin, now blackened and freeze- dried, which by spring will have crumbled away. There must be a dozen aluminum beer cans that have been tossed out. Every now and then one gets flattened by a passing car. These cans took a lot of energy to make, and it will be years before they oxidize and return to the earth. There are many plastic bottles, some still intact that will float away on the spring flood, and perhaps a few will eventually join the plastic rubble that is filling our distant oceans.

Winter is recovery and cleanup time for the biosphere. Many creatures have to hide deep in the earth to survive the cold, which kills off many pests. Cold winters across the Rocky Mountains used to kill the pine beetles, but as minimum temperatures rise, more beetles survive and pine forests are dying even up into Canada.

But winter cannot clean up our industrial waste.

In my last column, I talked about the need to extend our time-frame of reference — if we are to accommodate the needs of the Earth's biosphere. Cooperating with the Earth requires another fundamental shift.

When human beings were few in number and our industrial production small, the Earth could absorb our waste products. Yes, from time to time we overstressed a region's resources, and a civilization fell — but people moved on, and humanity prospered elsewhere.

Now, however, the global population, at our present levels of consumption and waste production, exceeds the carrying capacity of this planet. We cannot move on, so we face the collapse of the human system on a grand scale, unless we wake up and get smarter. There are several issues here. One is that we must stabilize and then reduce the global population, a process that will take generations. The second, immediate issue is that we need to minimize the lifetime of all the waste products from human industrial society in the earth system. This is essential, because of the global scale of our impacts — and it can be done more quickly, on a decadal time-scale, simply by replacing manufacturing infrastructure.

How do we manage the Earth, when there is so much we don't know? Here are a few simple rules we must follow to be responsible caretakers:

- All our waste products must have short lifetimes in the biosphere.

- We must minimize the use of raw materials by recycling for remanufacture.

- We must maximize the efficiency with which we use energy and water.

You know many examples of long-lived waste. The CFCs (chlorofluorocarbons) were wonderful, stable refrigerants, until we found out that their final breakdown in the stratosphere destroyed the ozone, which protects life from harmful ultraviolet rays. It will take decades to get them out of old refrigerators and out of the atmosphere. And carbon dioxide, coming largely from burning so much fossil fuel, is accumulating in the atmosphere. We didn't think that would be a problem, but the Earth's climate will warm for a century or more. We knew nuclear weapons were a disaster, but we have kept building nuclear power plants that make plutonium, which may be with us as bomb material for tens of thousands of years.

So bundle up and notice the garbage by our roadsides that will outlive you. Of course it wasn't you that tossed it. But since we as a species can't manage our waste responsibly, we need to stop making it in the first place.

Caretaking this precious Earth is necessary — it will take a patient, creative and joyful rebuilding of our society.

c) Spring climate transition and new beginnings (April 25, 2010)

http://rutlandherald.com/article/20100425/ENVIRONMENT/4250314/

During the warm weeks in March the snow melted and the soil in my garden thawed, so I could start digging over my winter cover crop. As the ice in the soil turns to water, growth again becomes possible. I planted seeds to celebrate the coming of spring and covered them with a glass cold frame for warmth and protection.

During this spring climate transition, our gardens reveal some of the important factors that control Earth's climate. We can see the role of water in its three forms (phases) — ice, liquid and vapor. The spring transition really starts after the sun's energy has melted the snow and thawed the ground. Then with warmer soil and liquid water, plants and deciduous trees prepare to grow new leaves. This process takes many weeks for trees. Until the leaves emerge and are fully grown, evaporation (transpiration) is very low. Without evaporation to take up a lot of the sun's energy, the ground and air warm rapidly. With little evaporation, the atmosphere stays dry. With clear skies and less water vapor — a powerful greenhouse gas — to reduce the cooling of the Earth to space, we get frosts at night. This doesn't bother the south-facing daffodils, which bloomed very early this year around the beginning of April.

Of course, weather systems can upset this simple pattern by blowing in warm moist air from the south or cold dry air from the north. This year the spring transition started early with an especially warm spell in mid-March. Then it rained and got cold again. My lettuce and spinach had sprouted, so I covered them again with the cold frame. Then a high pressure system settled in over us with warm, moist air from the south. On April 2 and 3 we shattered high-temperature records across northern New England, reaching the lower 80s in Burlington. And warm moist air aloft meant no frosts.

Soon, rather suddenly in early May, the climate will change again as the trees leaf out, and transpiration becomes significant. Evaporation of water takes up a lot of energy. This cools and moistens the air so that more clouds form. Frosts are usually over until the leaves die in autumn, because both moist air and clouds stop the Earth from cooling as fast at night.

As we move towards summer, the sun climbs higher in the noon sky and the nights get shorter, so that temperatures again move upward. Vermonters used to wait till Memorial Day before planting frost-sensitive plants like tomatoes; but as our climate gets warmer, the last frost is coming earlier by about three days each decade. The spring ice-melt on small lakes in Vermont shows a similar trend. My garden is at a low elevation, and I now plant frost-hardy plants in April and start planting frost-sensitive ones in early May. With this year's exceptional spring warmth, I hopefully planted lettuce, spinach, radishes and peas in mid-March — and they are all growing well!

Spring is a time for new beginnings. Plant some new seeds in your life — seeds that will grow for a fall harvest and ideas that will help you reconcile your wants with the needs of the Earth. Despite all our past foolishness, the future is not inevitable. What will happen to our society and the Earth depends on our collective creativity and vision and our willingness to work together to create a more resilient world for our children.

Will you support our local farmers this summer as they expand our food supply? Will you support the development of renewable energy supplies in Vermont? Whatever your choices, breathe in the scents of spring and give thanks.

d) Oil disasters and the transition to sustainability (June 6, 2010)

http://rutlandherald.com/article/20100606/ENVIRONMENT/6060320/

After a relatively warm winter, Spring came some ten days early this year. Around May 1, early for Vermont, I planted four yellow cherry tomatoes in my garden soil. They are growing well, although I covered them with upturned pots on two nights when we had a frost. My peas, planted back on March 15 in that unusually warm spell, have also grown well.

Since I moved to Vermont in the 1970s, our winters have gotten milder and shorter. Our growing season has become longer by more than 3 days every decade. The last frost in the spring is on average earlier, and the first frost in fall is coming later. This is the upside of the climate transition that we are facing, and it will help as we move towards growing more of our food locally. There is now a wide range of fresh vegetables available in the spring farmers markets across the state; many started under row covers as early as February.

But in many other ways our society is becoming less resilient and more vulnerable. A small volcanic eruption in Iceland paralyzed air travel in Europe for a week – and the volcano is still erupting. A very few hospitable airports like Amsterdam provided free food, showers and entertainment to those passengers stranded for days; but in many other airports, people were just left to suffer. Commerce was affected as the transport of perishable goods by air stopped. Ironically older turboprop planes are less vulnerable to volcanic ash than modern turbofan jets.

In the past there have been far larger volcanic eruptions that have drastically affected weather and agriculture. The explosion of Mount Tambora in Indonesia in 1815 cooled the earth by 5 degrees and had a global impact. In 1816, the 'year without a summer,' there were frosts every month in New England and people starved.

The sinking of the Deepwater Horizon oil-rig in the Gulf of Mexico on Earth day after an explosion and fire is another tragic reminder of the fragility of the environment. The 2009 environmental impact analysis for this rig claimed that this type of accident was impossible. As with nuclear power, it is easy to claim that catastrophic accidents are impossible – until one happens. In reality the issue is simpler: drilling in deep water is a risky technology and, with responsibilities scattered among many contractors and very little regulation, unforeseen accidents do happen!

There are a thousand drilling platforms in the Gulf of Mexico. As we drill deeper into the ocean floor to feed our addiction to oil, oil blow-outs are inevitable. And they are not like oil gushers on land — it is much more difficult to repair things at a depth of 5,000 feet, where methane hydrate "ice" forms. And in stormy seas we cannot control and mop up oil spills. Once millions of gallons of crude oil have leaked into the ocean, they follow the wind and the ocean currents.

Are we ready to lose all our coastal zones and marine life to feed our SUVs? Blaming the government or oil industry is of little use. Yes, we need much tighter regulation and backup safety systems, but the day of reckoning is coming. If we want a sustainable society, we must prepare for a great transition.
The era of cheap oil is over; oil-rig disasters and climate change are among the undesirable consequences. Our technology has to be managed with care and compassion; and laissez-faire capitalism is not management!

Back in late April, Transition Vermont gathered in Montpelier to make community plans for our state. With prayerful song, warmth and a kaleidoscope of views, they faced the many complex and interconnected issues that are before us. It was a glorious spring day — and a joyful occasion. Nothing is more liberating than facing the truth in a trusting, thoughtful and hopeful community.

www.transitiontowns.org
http://transitionVermont.ning.com

e) Lilacs grow green earlier ... and winter shrinks (July 4, 2010)

http://rutlandherald.com/article/20100704/ENVIRONMENT/7040320 (Feature Article)

ALAN K. BETTS (akbetts@aol.com)

In the past 40 years, the growing season for frost-sensitive plants in Vermont has increased by almost two weeks; and for frost-hardy plants the growing season may have increased by as much as three to four weeks. The winter cold season has been getting shorter and less severe.

We hear a lot about climate change on the global scale: melting polar ice, receding glaciers and rising sea levels. But what is happening here in Vermont? To get the picture closer to home, we can look at certain local indicators of climate change: freeze dates, the length of the growing season, the frozen duration of small lakes and the onset of spring. All these climate indicators show a consistent pattern of a warming climate in Vermont during the past few decades.

The burning of fossil fuels (coal, oil, gas) has increased the concentration of greenhouse gases — especially carbon dioxide — in the atmosphere. The greenhouse gases are causing the surface temperature of the Earth to warm because they trap thermal radiation from the planet's surface and send some of it back. We are now witnessing unprecedented climate change as a result.

As Vermont's climate warms and the temperature shifts upward relative to freezing, the amount of snow cover diminishes. Snow cover reflects solar radiation back into the atmosphere. With less snow, the surface of the Earth absorbs more heat. The warmer surface temperature of the Earth causes more evaporation. More water vapor in the Earth's atmosphere increases the greenhouse heating of the Earth's surface.

Freeze period, grow season

There is a long record of climate station data in Vermont going back to 1893. During this time, the Vermont landscape has changed dramatically as forests have grown back. Regional and global climates have also changed substantially.

Between 1951 and 2008, data from four Vermont climate stations (Burlington, Cavendish, Enosburg Falls and St. Johnsbury) shows that the freeze period has become shorter and the growing season longer in Vermont:

Last spring freeze has come earlier by 1.4 days per decade, first autumn freeze has come later by 1.8 days per decade; and freeze-period has decreased and growing season has increased by 3.2 days per decade.

The actual first and last freeze dates, which are critical to the growing season for frost-sensitive plants, are sensitive to the local topography as well as to specific daily weather events, which vary a lot from year to year.

Freeze, ice-out, freeze length

The freeze and ice-out dates for small lakes are good "integrated" climate indicators for the length and severity of the cold season in Vermont. The date of freeze-up depends on lake and air temperatures

over several weeks in the fall. Ice thickness depends on the severity of the winter and the date of spring melt depends on ice thickness and air temperatures in spring. These dates are important for the ecology of the lakes and the frozen period (and ice thickness) matter to the public for winter recreation, including ice fishing.

Each year there is a contest to guess the ice-out date on Joe's Pond in West Danville, and these dates and the trend have been recorded since 1988. The ice-out date and time are defined as when an electric clock tethered to a block on the ice stops as a result of the ice break-up. The freeze-up and ice-out dates for Stile's Pond in Waterford at a lower elevation have been recorded since 1971 by the Fairbanks Museum in St. Johnsbury. Of course there is a lot of variability from year to year, but data shows that on average over the 40 winters *freeze-up has occurred later by four days per decade, ice-out has gotten earlier by three days per decade, and winter frozen duration has decreased by seven days per decade.*

Stile's Pond, for instance, is frozen for four weeks less on average than 40 years ago, a trend that is likely to continue as the global climate warms.

Lilac first leaf, first bloom

The first leaf and first bloom dates have been recorded for lilacs since 1965. Data are now available from six sites over the past 45 years — Swanton, Cavendish, Essex Junction, Newport, Union Village Dam and West Burke. Results show that the date of lilac first leaf in spring has advanced nearly three days per decade, while the later date of lilac first bloom has advanced more slowly by 1.6 days per decade.

Figure 1. Lilacs in Pittsford, Vermont

In fact, the dates of lilac first leaf and the ice-out dates for Stile's Pond are closely correlated. These are very different climate indicators, but they depend on the same late winter and spring temperatures — and in most years they occur within less than a week of each other. *Both dates have advanced by about three days per decade*, indicating the trend towards warmer temperatures in late winter and early spring.

Looking ahead

This shrinking of the cold season and lengthening of the growing season in Vermont are almost certain to continue in the next few decades, as the Earth's climate warms. In the short run this will help our transition to a local food economy — but unless we drastically reduce our burning of fossil fuels, this transformation of Vermont's climate will accelerate and threaten the survival of Vermont's forests and wildlife.

Alan Betts is a past president of the Vermont Academy of Science and Engineering. His research is supported by the National Science Foundation. See http://alanbetts.com for the complete analysis.

f) Human actions have local and global impacts (July 18, 2010)

http://www.rutlandherald.com/article/20100718/ENVIRONMENT/707189945

For the third year in a row the month of June was rather wet. Flowers, vegetables and weeds flourished. The peas I planted back in mid-March, during that exceptionally early spring warmth, produced a good crop. I pulled them up before the end of June and planted kale and more beets into the moist soil.

Ample water also kept early summer temperatures lower than usual, partly because more evaporation takes up more of the sun's energy. Also, more evaporation means more clouds, which reflect sunlight before it even reaches the ground. Winter temperatures have been rising quite sharply in New England in recent decades — but as long as we get plenty of summer rain, the warm-season temperature rise is reduced.

In early July the weather pattern shifted, bringing a ridge of high pressure over us for a week. This brought subsiding dry air that gave us clear skies with 90-degree temperatures. Evaporation continued, but without rain the soil dried down and lost an inch of water every week to evaporation. This is about the amount of available water stored in the first 6 inches of soil — so many garden crops with only shallow roots need water after a week or so with no rain. Forests, on the other hand, have deeper roots, which simply draw water from deeper levels in the ground. This is one of the important ways that forests buffer our climate: They can evaporate water for weeks without rain. Fortunately the high pressure of early July moved away, and surface evaporation again produced clouds and thunderstorms.

On the global front, several recent reports in the journal Science paint a disturbing picture of humanity's impact on the oceans. As atmospheric greenhouse gases rise, the oceans are storing the trapped heat and getting warmer — especially in the Arctic, where the ice cap, which reflects sunlight, is melting and shrinking. The rise in sea levels will be a wake-up call for our coastal cities.

Humanity's demands for resources also keep growing, while our waste products and our thoughtlessness could transform the ocean web of life. Overfishing has reduced many wild stocks. The oceans are filling with our long-lived plastic debris. Consider the irony that our precious plastic water bottles may end up as fragments in the ocean. And this summer the Gulf of Mexico is being poisoned by crude oil from our reckless drilling practices. Above all, the acidity of the oceans is increasing as billions of tons of CO2 (from the burning of fossil fuels) are dissolving in all the Earth's seas. With increasing acidity, many creatures will be unable to extract calcium from seawater to make their shells or corals within a few decades. In one century, we will roll the acidity of the oceans back twenty million years — a foolish experiment with unknown consequences.

Has the United States, one of the great polluters of the Earth, woken up to its responsibilities? Some citizens have, but our nation seems to be either dreaming or in paralysis. We hear daily about the need to return to a wasteful, fossil fuel-powered, consumer "growth" economy. But really we need to build a resilient sustainable society, powered by renewable energy — a society designed to produce no waste, a society that understands and treasures its place in the Earth's ecosystem, a society that cares for its citizens and all life on this planet.

This too seems like a dream from where we are today, but it is really a choice about changing our direction and our values. It is a personal matter, a societal issue and a global problem. We can only start from where we are. We must talk to our neighbors and colleagues and bravely take the first step. The Earth changes slowly — but it is more powerful and in many ways smarter than we are. It is up to us to understand and adapt to the real world.

g) Earth's response to human stresses on the natural landscape (August 29, 2010)

http://www.rutlandherald.com/article/20100829/ENVIRONMENT/708299991

The summer here in Pittsford has been really enjoyable, with plenty of rain and sunshine and, for the first summer in years, almost no mosquitoes in our garden. This year we have an extraordinary crop of summer and winter squash, and plenty of tomatoes and basil. I have been mixing weeds and leaves with the waste food from the Rutland Food Coop for years, and this has given us an abundant supply of compost. Improving soil fertility takes time but is symbolic of the need to give back more to the Earth than we take from it, if we are to create a resilient, sustainable world.

Globally the supply of phosphorus is dwindling. Phosphorus is an intrinsic part of our DNA. We add phosphorus-rich fertilizers to increase world food production, but much washes off into rivers and lakes, where it feeds excessive growth of weeds and algae and removes dissolved oxygen. When animal manure is applied directly to fields, rain also washes off some phosphorus that pollutes streams. Phosphorus is generally not recovered from human waste water treatment, so a "peak phosphorus" crisis is approaching.

Like the peak oil crisis, it is double-edged. We have a growing population dependent on finite resources — phosphorus and food, oil and energy — and growing waste problems affecting the natural environment, including fresh water pollution and atmospheric greenhouse gas pollution. Yet in both cases, we are afraid to invest in non-polluting sustainable solutions, because they are costly and require structural changes in society.

Back in Washington as election season approaches, our Congress still seems lost and blind. Another year has passed, and our government has failed to pass a bill to regulate greenhouse gas emissions and develop a sustainable energy policy — despite the growing challenge of finding enough oil and the disaster in the Gulf. Instead our military expenditure approaches a trillion dollars and is one of the largest components of the federal budget. This will not solve any of the real threats we face: climate, fresh water, energy and the global food supply. We need to move from a military economy to a productive and sustainable economy.

The U.S. Constitution gave no rights to the Earth, and the Earth has no vote in our elections. But in one generation, the response of the Earth to our foolish, short-sighted behavior is going to transform our world and our politics. It is time for us as citizens to take stock and see if we can collectively build an alternative vision.

What can a scientist do? I decided this summer to set up a Web site (http://alanbetts.com) to archive my research, my public talks and these columns. I have also been working on local climate change indicators for Vermont, to get a picture of what has been happening to the state's climate and ecosystems during the past few decades. This helps us connect global climate change to our local experience of the weather and the seasons. It also gives us a rough guide to likely trends in Vermont over the next few decades.

We need this information because we will have to adapt to the climate change that is coming. As rainfall intensity increases with warming temperatures, we must plan for increased runoff. We must manage our human stresses on the natural landscape, as it will be hard for Vermont's forests and wildlife to adapt to a rapidly changing climate.

The days are getting shorter, and fall is only a few weeks away. I hope that what you planted in spring has brought you a full harvest.

Peak Phosphorus: http://www.foreignpolicy.com/articles/2010/04/20/peak_phosphorus

h) Today is a day of climate action around the world (October 10, 2010)

http://www.rutlandherald.com/article/20101010/FEATURES/710109835

From a climate perspective, this year has toppled many records. Global temperatures for January to August set a new record high, and ten states in the eastern United States reported the hottest summer on record. It was far worse elsewhere on Earth. In Pakistan, extreme temperatures of 129 degrees were followed by the worst monsoon floods in living memory. Moscow experienced 99-degree temperatures for the first time, with devastating forest and peat fires that produced dense smog and dangerous levels of carbon monoxide. Up north in Canada large regions have been 5 degrees warmer than normal this year. Again the thinning Arctic ice cap had melted substantially by September.

Year-to-year and place-to-place variations are of course large — but on the long timescale of the Earth, the trend to a warming planet is unmistakable. It is almost certain that none of these extremes would have happened if atmospheric CO2 had remained at its preindustrial level of 280 parts per million (ppm), rather than the 390 ppm it has now reached.

A few years ago, a group of students started meeting at Middlebury College on Sunday evenings to talk and dream about action on climate change. They assumed that government action by aging politicians was so remote that it would be too late to be of value to the Earth — and they knew that they would inherit and be responsible for cleaning up the Earth. One offshoot of this group, inspired by Bill McKibben, was a series of campaigns, starting in Vermont, and culminating in 350.org, which mobilized the first International Day of Climate Action a year ago this month in 181 countries.

Last December this group took their campaign to the UN climate conference in Copenhagen. They were stunned but delighted when over a hundred countries signed their petition, in recognition that stabilizing the Earth's climate requires reducing atmospheric CO2 concentration from its present 390 ppm back down to 350 ppm — its value in 1987. But their elation was brief. These hundred countries were not the rich and powerful countries that fear change because they have so much to lose; but mostly the poorer countries, whose people will suffer the most from rising temperatures and spreading droughts.

No agreement was reached in Copenhagen, because the wealthy nations put their short-term self interest above the needs of the Earth and its ecosystems. Transforming their consumer economies and standing up to the powerful fossil fuel industry was simply too much of a political risk. In private, our noble leaders told the 350 team just this — until you can convince the American people that it is in their interest to change direction, we can do nothing!

We are slow to recognize that in this conflict between our fossil fuel technology and the Earth system, the Earth wins, hands-down. There were reminders this summer. An oil disaster in the Gulf of Mexico showed that a profit-driven and unregulated oil industry is no match for a pressurized deep-water reservoir. The Russian heat wave caused massive wildfires and drought that destroyed a third of that country's grain crop, driving up global wheat prices.

After Copenhagen the U.S. 350 group felt defeated, but their colleagues from around the planet offered encouragement with this reminder: "Governments everywhere are corrupt: we, the people, must take action." As the American empire declines, our lost ideals are reflected back to us by a global democratic community. So today, 10/10/10, is again a day of climate action around the world.

At 350.org you can see the kaleidoscope of people from almost every country on Earth planning for our collective future. They know that it will not be easy — but we are one planet and one people, and together we create the future of the Earth. Will you join them? It is not too late.

WEB: www.350.org; www.billmckibben.com

i) Climate change affects fall and winter transitions in Vermont (Nov. 7, 2010)

http://rutlandherald.com/article/20101107/ENVIRONMENT/711079999/

Winter snow is shown in Pittsford. If Vermont (and other nations) reduce our dependence on fossil fuels by improving efficiency and developing alternative energy technologies, the consequences of climate change will not be as severe

Photo: Alan Betts

The fall transition that occurs with the first hard frost shows how life, water and climate are linked together. The first hard frost kills some plants and is one signal for maple trees to shut down photosynthesis for winter. As long as plants are alive, they transpire and put water vapor into the air. Water vapor is a powerful greenhouse gas that prevents the ground from cooling rapidly at night. More water vapor in the air produces more clouds, which also trap heat at night. Transpiration from the forests delays the first frost in the fall — until one day a northerly flow brings cool dry air, and the earth cools rapidly at night so that frost forms by sunrise.

Data taken over the past four decades show significant changes in Vermont's climate. The fall transition is coming later by about 2 days per decade. Over the past forty years, the growing season for frost-sensitive plants has increased by 2 weeks; and for frost-hardy plants the growing season may have increased by as much as three to four weeks.

This fall was very unusual. We had a remarkable 10 inches of rain in October, and so there were few frosts because the ground and air were so wet. This extended the fall foliage season. The first part of November has been marked by several hard frosts and most recently, the first snowfall of the season.

Autumn is considered by many the most beautiful season in Vermont. The leaves turn brilliant colors of red, orange and yellow — a seasonal burst that attracts many tourists to the Green Mountain State. Forests cover almost 80 percent of Vermont, and roughly one in every four trees is a maple. Almost half of the Northeast's commercial woodlands consist of maple, beech and birch.

The USDA Forest Service projects that oaks and hickories, which predominate in warmer placers like Virginia and now account for less than 15 percent of Vermont woodlands, will overshadow the state's maples by the end of the century. Leaf-peepers attracted by the red, yellow and orange foliage of maple, birch and beech may see those colors shifting to the blander browns characteristic of oaks and hickories.

A recent report "The Northeast Climate Impacts Assessment," sponsored by the Union of Concerned Scientists, explains that Vermont's climate is warming and is in for significant changes. Between 2040 and 2069, Vermont's climate will shift to that of Pennsylvania's now. And if we continue to rely heavily on fossil fuels, by late century Vermont's climate will shift farther to the south, more similar to that currently experienced in the Mid-Atlantic states.

The USDA's Agricultural Research Service is revising its 1990 plant hardiness zone map to reflect climate changes that we are already experiencing. In Vermont, warmer conditions and an extended growing season allow growers to experiment with new crops, but maple syrup production and harvests of cooler-season plants, such as broccoli and Brussels sprouts, may be reduced.

Catherine Stevens, marketing director for Vermont Maple Sugar Makers' Association, says sugar makers are discussing what climate change could do to their livelihoods. In the Northeast, the sugaring season has, on average, begun seven days earlier and ended 10 days sooner than it did 40 years ago.

In Vermont, we often experience a sharp transition into winter. The first heavy snowfall typically occurs in December. This fresh blanket of snow reflects sunlight and causes the mean temperature to drop sharply. But as Vermont's climate warms and the temperature shifts upward relative to freezing, the length and chill of the cold season are reduced. The net result is less snow cover. The first heavy snow is coming later in the year (sometimes even shifted into January), so the winter transition is coming later.

Milder winters will adversely affect Vermont's ski and snowboarding industries. Other winter recreation activities, including ice fishing and snowmobiling, will also feel the impact. Ski areas haven't been significantly affected by climate change so far, as variations in recent winter weather represent natural weather fluctuations. But the industry is bracing for long-term forecasted trends.

Alan Betts is a past president of the Vermont Academy of Science and Engineering. His research is supported by the National Science Foundation. More discussion of the seasonal transitions and climate change can be found at http://alanbetts.com.

Climate change, Vermont Agency of Natural Resources: http://www.anr.state.vt.us/anr/climatechange/

j) What to do with all this rain! (Nov. 21, 2010)

http://www.rutlandherald.com/article/20101121/ENVIRONMENT/711219991

Vermont is not subject to coastal flooding, but as the Earth's climate warms we still need to think ahead and plan how to manage water resources. The global water cycle is changing quite rapidly. This October my garden in Pittsford had an astonishing eleven inches of rain, and the Otter Creek flooded several times. A big storm early in the month gave widespread flooding across Vermont.

Throughout the Northeast annual precipitation has increased by 15-20 percent in the past 50 years, and very heavy precipitation is up more than 60 percent. Streamflows in Vermont have also risen substantially in recent decades in fall and early winter. All our models tell us that these trends will continue in coming decades, and indeed they will accelerate — until we finally make the shift away from fossil fuels as our primary energy source.

What can we do? We must plan ahead when we build infrastructure that lasts for decades. We need to install larger culverts and build larger storm water systems. Design capacities based on old standards from the 1960s are far too small for the heavy rains we now face. We must redesign our urban environment to allow more rainfall to infiltrate into the soil — with porous parking lots, for example! Building in floodplains, which has always been foolish, is now even more so.

Precipitation in Vermont will increase in every season except summer. In summer, total rainfall is likely to change little, but one-to-three month droughts between heavy rain events will become more frequent. Heavy rain runs off quickly and can wash away soil and still more fertilizer into rivers and lakes. Faster runoff increases streamflow and the likelihood of flooding; but it also leaves less water to soak into the ground and replenish the soil and the deep water reservoirs. One bright side of increasing streamflow is that we could judiciously renovate some old hydro-facilities to provide some badly needed local renewable power.

How can we slow runoff so that more soaks into the ground? Keeping our forest cover on the hills is critical. In the early part of the 20th century when Vermont had far less forest cover, the state experienced many devastating floods. Richer organic soils help retain water, as does contour farming on hillsides. Evaporation increases with warmer temperatures, and there will often be longer dry periods between rain storms — so we need to store more water in the ground or in ponds as a buffer. We may also have to plant crops that have deeper roots.

In the coming decades Vermont will probably have enough water on an annual basis, but we will need to maximize seasonal water storage to carry us through more frequent droughts in the crucial summer growing season. Just as we need to use energy as efficiently as possible, we will have to use water more prudently during the warm season.

Precipitation during the winter season will likely shift from dry snow toward more wet snow and freezing rain. The very cold winter period with lying snow is shrinking surprisingly quickly. In the past forty years, the length of time when our small lakes are frozen has shrunk by seven days each decade. Ski areas will make snow whenever it is cold enough, but cross-country skiing and snowmobiling will come to depend ever more on fresh snowfall.

Fresh water is precious to all of life on land. As the drier zones spread northward from the subtropics into the southern United States in summer, we Vermonters will consider ourselves fortunate to have more rather than less water for much of the year. Let us be grateful and make plans to use it wisely.

National Weather Service Summary: http://www.erh.noaa.gov/btv/climo/MonthlySummary/