



Water in the World We Want: Water & Climate Security in a Warming World



Flooding during Winter Storm Juno, Eastern Seaboard, December, 2014

A presentation by

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Water in the World World We Want:

Water & Climate Security in a Warming World

Slide 1: Title Slide

Thank you very much for the kind introduction. I wish to thank the organizers of this event for this opportunity to speak to such an expert audience. I would like to begin, if I may, by explaining my work.

Slide 2: UNU Map

Centred in Tokyo, the United Nations University system is comprised of 18 different research institutions located in 14 countries around the world. Each institution deals with a different global challenge. As it happens, the United Nations Institute for Water, Environment and Health is located in Canada, at McMaster University in Hamilton.

The goal of my work with the UN is to build a better bridge between science and public understanding and policy action on water and climate issues in Canada.

One of the principal roles of our initiative is to bring national and international example to bear on Canadian water and water-related climate issues. Our goal here is to put what others are learning elsewhere before the public and before decision-makers in Canada for their consideration. I am grateful to EPCOR for the opportunity to undertake this work. As I am sure many of you have noticed; water and water-related climate matters have become hotly contested issues.

Slide 3: Follow the Water

My principal focus is on water security. Water security means having and being able to reliably provide adequate water of the right quality where and when you need it for all purposes, including those related to sustainable natural bio-diversity-based Earth system function. It also means ensuring that your use and management of water in the region in which you live does not in any way negatively affect the water security of regions up or downstream from you now or in the future.

Over the last decade water security has also come to mean being able to achieve these goals in the face of new circumstances created by the acceleration of the global hydrological cycle. The intensification of the Earth's hydrological cycle has been brought about by changes in the composition of our planet's atmosphere for which we are responsible. These changes demand that water security now means managing not just the water you once thought was reliably available to you; but also managing water in sometimes far greater extremes of abundance and scarcity than we have experienced in the past.

What we now realize is that water security and climate security are inseparable; one is implicit in the other. It could even be said they are the same thing. As everyone in this room knows; water and water-related climate concerns are critical issues. These concerns, however, are not something everyone likes to talk about.

One of the big challenges we face right now is that there is a silence even around the silence related to climate change issues. This silence is beginning to attract a lot of attention.

Slide 4: Washington Conference Title

At a very high level meeting on the communication of climate science sponsored by the World Bank in Washington last November, a senior researcher shocked his distinguished colleagues with a scandalous remark. Be prepared to be similarly shocked. “Climate change is the new sex,” he said. “Everybody knows about it. A lot of people get it. But nobody wants to talk about it.” (It’s OK, nobody there knew quite how to respond, either.)

So why the silence? Psychologists and sociologists have been examining the silence for some time.

Slide 5: George Marshall Book Cover

They have found that some people don’t want to talk about climate disruption because they simply don’t believe it is happening. The fundamental laws of atmospheric physics and our already demonstrated impacts on the global ocean notwithstanding, they simply don’t accept that people could have that kind of impact on an entire planet.

Still others don’t want to accept climate disruption because they don’t like or trust the people who are sounding the alarm. They simply don’t share the same views or values and they don’t trust environmentalists.

Many who are of this view reason that if climate disruption really was the threat environmentalists claim, then mainstream political and market energies would already be focussed on addressing it.

Some people deny climate change because they ideologically oppose the extent of the presence and influence government would have to have to address a problem that can clearly only be resolved through common cooperative action and sacrifice.

A great many others don't want to talk about climate disruption because they are consciously or unconsciously troubled by the moral, ethical and legal implications of not having acted upon what they know. The central factor that determines moral and hence legal responsibility is intention to harm. Certainly, no one intended for climate change to happen. No one, as far as we know at least, has set out to hurt anyone else by contributing to climate change. Or at least this was the ways things stood at the beginning of the climate debate.

But now, with five IPCC assessment reviews before us and clear evidence of climate disruption on the television news every night, it is getting hard for certain interests to claim innocence when it has become clear they are, in fact, contributing significantly to the problem. The question then becomes this: Once evidence clearly demonstrates that you are harming others by contributing to climate disruption and don't do anything about it, at what point does the harm you are causing become intentional?

At what point does the fact that you refuse to acknowledge that what you are doing is causing harm to others and to future generations become morally and ethically indefensible? At what point does willful blindness become negligence? When does negligence become a crime?

Many politicians would rather remain silent on the climate question than risk opening the door to the pending societal divisiveness that could crowd into the room behind moral, ethical and legal liability claims of this kind.

In the middle of all of this is the average person who would just like to have the opportunity to carry on with the business of being. They remain silent hoping it will all go away – but it won't.

It is becoming very clear that the climate issue could tear our society apart. It is the duty of everyone in this room to prevent that from happening. Our strategy so far has been to try to fix this problem internally without conflict; but unfortunately we've run out of time. We are not going to be able to keep the undeclared civil war we are trying to containing secret much longer. The problem is water.

Slide 6: Follow the Water

As many of you know, even the best hydro-climatic models available to us today can only reveal a glimpse of how implicit water is in the construct and maintenance of our Earthly reality at any given time.

Reality is saturated with water and life made possible by all the ways in which water reacts with nearly every element in the physical world. Change a few parameters that pertain to water and the world you see out your window becomes different.

Some parameters, however, have more influence than others over the nature and function of any given hydro-climatic circumstance. The changing of a single defining parameter – temperature for example – changes all of the other biogeochemical parameters. If our global temperature changes, an entire new geometry is created around that change. The most frightening discovery of this young century is that this is exactly what is happening; and it is happening right before our very eyes – here and everywhere.

Rising mean temperatures have begun to change a vast array of visible and invisible parameters that define the very foundation of the world as we have come to know it – at least how it is defined by water. The genie is out of the bottle. Upon what evidence could one make such a claim?

Slide 7: The Hydrological Cycle

This is the 359th consecutive month during which temperatures were above the 20th century average globally. If you are younger than 29 years old, which is to say you were born after the end of March, 1985, you live in a different climate regime than those who came before you.

Nor will the climate in which we currently live be with us long. Projections by the normally staid and highly conservative World Bank put average global atmospheric temperature increases at between 4°C and 6°C by 2060. If the World Bank projections are correct, we will be living on a different planet in barely fifty years.

Thus we arrive at the realization that perhaps the most important question that we should be asking at this critical turning point in the human journey is this: What will happen to water – and the water cycle – if the mean average temperature of our planet's oceans and land surfaces continue to rise? The first thing warming of the atmosphere does to the global water cycle is increase the amount of water vapour that the atmosphere can hold. Again this is very basic atmospheric physics. For more than a century we have known exactly what changes in the amount of water vapour transport will occur in the atmosphere in response to any given change in temperature.

Slide 8: The Clausius-Clapeyron Relation

We now know for certain that for every degree Celsius of warming we can expect the atmosphere to carry 7% more water vapour. If you increase the temperature of the atmosphere by 2°C the atmosphere can carry as much as 14% more water vapour. If you raise the temperature of the atmosphere by 4°C it will carry 28% more water vapour. That changes everything.

It is important to note, however, that the amount of water vapour that the atmosphere can carry increases in a non-linear manner because with each degree rise in temperature the percentage increase is always added to a higher number. And that is why recently identified phenomena such as atmospheric rivers demand our full attention.

Slide 9: Atmospheric Rivers

These huge rivers of water vapour aloft are carrying more water and are causing flooding of magnitudes we have not witnessed before. We have recently discovered that atmospheric rivers derive their energy from temperature differences between the poles and the tropics. Their intensity also derives from the Clausius-Clapeyron Relation in that the warmer the air the more water atmospheric rivers can carry.

The other thing we need to keep in mind is that water vapour is a powerful greenhouse gas in its own right. The more water vapour there is in an energized atmosphere, the warmer it becomes. You can see how this will become a climate feedback in its own right. Other critical weather phenomena are also tremendously affected by differences in the temperature gradient between the poles and the tropics.

Slide 10: The Jet Stream

What we are seeing in Canada is that the loss of Arctic sea ice and the rapid reduction of the extent and duration of snow cover in the Northern Hemisphere are reducing the temperature gradient between the pole and the tropics. It is this difference in temperature between the polar region and the warmer air to the south that largely defines the behaviour of the jet stream. The less ice there is in the Arctic the slower and wavier the jet stream becomes and the more erratically it behaves.

We see from the altered behaviour of the jet stream that warmer atmospheric temperatures do not automatically translate into warmer weather. In a uniformly warmer and therefore more turbulent atmosphere both warm and cold fronts end up and persist in places in the mid-latitudes in which they were not common in the past.

Slide 11: The Polar Vortex

That is why, in combination with the atmosphere's capacity to hold more water vapour, both summer rains and winter snow storms are persisting longer and causing greater and greater damage. So you can see from this that the Arctic is not like Las Vegas. What happens in the Arctic doesn't stay in the Arctic.

Slide 12: Prairie Flooding

What we are also seeing in Canada is that changes in atmospheric circulation patterns are pushing major sub-tropical storm tracks toward the poles often causing flooding widely of magnitudes we are poorly equipped to manage. That storm intensity is increasing was obvious all across Canada during the summer of 2014 but most devastatingly clear on the Canadian prairies which experienced catastrophic flooding for the second time in four years.

Slide 13: Flooding on the Prairies

Presently, the most obvious effect of changing hydro-climatic regimes on the central prairies is the pole-ward advance of sub-tropical storm tracks. But there is another problem: the spectre of deep and persistent drought. We don't know if there are other invisible thresholds that will be crossed as mean temperatures continue to rise. Temperatures on the prairies are expected to rise between 5°C and 8°C. We don't know what threshold of temperature increase will cause the hydrological coin to land on its dry side. All we know is that sooner or later it will. What we have seen in California and in the American southwest give us a good idea of what is to come, globally.

Slide 14: The Ice Circle (Loss of sea ice to flooding).

At the same meeting at the World Bank to which I referred earlier it was pointed out that there was some urgency in doing a better job of helping others understand how our hydro-climatic circumstances are changing.

We of course know that hydrological conditions on this planet have always been changing. We also know that have been fortunate to have had a century or so of relative hydro-climatic stability. That era, however, is over. The long-term hydrologic stability of the climate we experienced in the past will not return during the lifetime of anyone alive today.

What we haven't understood until now is the extent to which the fundamental stability of our political structures and global economy are in part predicated on relative hydrologic predictability. As a result of the loss of relative hydrologic stability, political stability and the stability of our global economy in a number of regions in the world are now at risk. We are only now beginning to understand how complex this issue has become.

Slide 15: Munich Re Complexity Drawing

This is a map of interconnections between various economic, environmental, geopolitical, societal and technologic risks associated with the failure to effectively and meaningfully adapt to climate change. It was presented by the global insurance giant Munich Re a few weeks ago at the World Economic Forum in Davos. What this map illustrates is the cascading effect of the failure to adapt to hydro-climatic change. On a global scale failure leads first to greater vulnerability to extreme weather events; food crises; water crises; large-scale involuntary migration; further man-made environmental catastrophes which in turn lead to biodiversity loss and Earth system collapse.

The failure to adapt to climate disruption has even more devastating effects at the national level where it can generate fiscal crises; unemployment; profound social instability; the failure of national governance; internal interstate conflict; terrorist and cyber-attacks resulting in on-going state crises leading to potential collapse. These risks are not theoretical. They are real.

A strong case was recently made by the World Bank that hydro-climatic destabilization is now a major threat to advancing development. Extreme weather events are now, in fact, seen to be reversing development in some regions.

Slide 16: Flooding in Pakistan

An example of this is Pakistan. In 2010 and 2011, Pakistan was affected by major floods caused by heavy rainfall during the monsoon period. Land-use changes had altered natural drainage patterns and river flows aggravating flood risk. More than 2500 people died, 27 million people – almost the entire population of Canada, were displaced. The economic losses were estimated to be USD 7.4 billion. The country's development has been reversed set back perhaps by decades.

In a separate meeting with the Disaster Risk and Climate Change Unit of the World Bank – and note I am talking about a bank here not an environmental lobby – it was clearly stated that we now have to start thinking the unthinkable.

The unthinkable, of course, is that these kinds of events might reverse development here in North America thereby reducing or threatening our prosperity. The fact is that it is already happening. In 2014 the Weather Channel published a list of 50 U.S. counties which they identified as being of high risk in terms of weather, climate and natural disasters that damage and destroy homes, putting lives and livelihoods at stake. Who would want to move to such places? How can such places sustain their tax base? How can such counties reverse de-development?

Climate-related de-development is already happening in Canada also. We just don't see it that way yet. Where it is happening is on the prairies – particularly in Manitoba – and in Atlantic Canada. Please allow me to put forward evidence for this claim.

Slide 17: Flooding in Manitoba

After the flood of 2011 our initiative worked closely with the Centre for Hydrology at the University of Saskatchewan to analyze the hydrological circumstances on the Canadian prairies. It was our view that Manitoba had crossed an invisible threshold into a new hydro-climatic regime in which there is an increasing likelihood of a significant increase in the frequency, duration and extent of flooding as a consequence of a combination of regional land-use alteration, drainage effects, stream-flow changes and the intensification of the larger hydrological cycle.

We publicly stated that we feared that the crossing of this threshold could over time bankrupt provinces like Manitoba. We did not say that flippantly. That year a quarter of Manitoba's productive farmland went unseeded. The total cost of flood damage in 2011 combined with disaster relief in Manitoba alone was a billion dollars; nearly the exact amount of the province's deficit the following year. But the damage didn't stop there. Law suits totalling more than a billion dollars were later brought forward as a result of the 2011 flood alone.

I urge you now to consider how the effects of hydro-climatic change have impacted the economy and political stability of Manitoba since 2011. Even though politically toxic, an unpopular increase in the provincial sales tax was deemed necessary to catch up with and great ahead of the infrastructure damage caused by the 2011 flood. As you might guess, that tax increase has remained a source of divisiveness and is now a pending election issue.

Slide 18: Flooding in Calgary

Many consider 2013 the year that really demonstrated that the prairies may in fact have crossed over an invisible threshold into a new hydro-climatic regime. But, despite all the attention it received, it was not the spring flooding in Alberta that provided the evidence of that transition. The flooding in Calgary was a 1 in 45 year event, well within the natural variability we have come to expect over the last century. Calgary and area were simply not ready for it.

Slide 19: Regina Snowpack in April of 2013.

The real water-related climate story of 2013 was not Calgary but the fact that despite a record late-season snowpack there was no spring flooding in Manitoba. What most Manitobans have probably forgotten, however, was why flooding didn't occur. It didn't happen because a series of other equally unlikely extremes came into play that slowed the melt of the record late-season snowpack. Near-record cold conditions slowed snowmelt while timely thaw and warm deep soil temperatures accommodated twice the normal rate of soil absorption.

What the U.S. National Weather Service wanted people to understand in reporting this was that because there was no flood in 2013 did not in any way mean that hydro-climatic regimes in the Red River Basin had somehow returned to what had historically been perceived as normal. They wanted the public to know that we have entered a period in which more frequent extremes in hydrological conditions now make it impossible to use past experience as a guide to prediction.

Slide 20: Then Comes 2014

Now let's talk about this past year, 2014. Manitoba again missed a spring flood. Though it was close, so did Alberta. Then pow! The flooding comes not in association with the spring melt but as a result of remarkably heavy rainfall in early summer storms. While it is still too early to fully calculate the full cost of flood damage in 2014, the bill is likely to be over a billion dollars. *Deja-vu* all over again.

Evidently, what at one time were once loosely considered 1 in 300 year events on the prairies have begun to appear every three years. The prairies are not the only place experiencing this. So is the rest of the country.

Slide 21: Flooding in Kamloops

On July 24th, 25 millimeters of rain – as much as normally falls in a month – fell in 20 minutes on Kamloops, British Columbia. At the time of the storm the entire region was in drought and the area around Kelowna was on fire.

Slide 22: Flooding in Burlington

On August 4th, 200 millimetres – more rainfall than normally falls in two months – fell on Burlington, Ontario in the length of time it normally takes to get through the morning rush hour. In Toronto and region there have been three 1 in 100 year and six 1 in 50 year storms in the last 25 years.

Slide 23: Flooding in Steinbach

Winnipeg also flooded in late August. A week later, Steinbach and nearby Niverville in southern Manitoba got hit with up to 120 millimetres – nearly 5 inches of rain – in an overnight storm that overwhelmed expensive flood mitigation systems put in place after flooding in 2002.

Slide 24: Flooding in Nova Scotia

It was flooding in Nova Scotia in December of 2014 that drew the attention of our initiative of the fact that Nova Scotia has relied on federal flood disaster relief in 14 of the past 15 years.

It was in reference to this flooding that the rest of the country found out about an obscure reference in a federal government news release indicating that in order to balance its budget the federal government quietly raised the amount of storm damage needed to trigger federal disaster assistance from \$1 to \$3 million. Evidently 8 of the last 14 storms would not have qualified for disaster relief under these new criteria. Nova Scotia's population is shrinking. Many municipalities are already having difficulty maintaining aging and inadequate infrastructure.

Problems with extreme events in Atlantic Canada are not going to go away. In combination with sea level rise and related higher storm surges, people are already being forced to move out of vulnerable flood plains. Short-sighted political measures such as cutting disaster relief are contributing to unintended de-development.

Slide 25: Winter Storm Juno

The region now has named winter storms which simultaneously bring heavy snow and flooding as we saw along the Eastern seaboard in January of 2015.

Slide 26: What Are The Larger Lessons We Can All Learn From What Is Happening?

There is a lot of troubled water and wild weather out there – and it is trying to tell us something. What water is trying to tell us is that the hydrological game is clearly changing in fundamental ways. We don't know how to put the genie back in the bottle. We do know, however, that we have no choice now but to work with changing hydro-climatic circumstances, not against them.

Careful examination of how our hydrology is changing suggests that we may have to reframe our situation so that we can adapt more quickly and effectively. One way our current situation is being reframed is through the notion that we have entered a new geological era in which human activities rival the processes of nature itself. So what is this new geological epoch and how is it different from the geological periods of the past?

Slide 27: A New Geological Era: The Anthropocene?

This new geological era is being called the Anthropocene. Unlike earlier epochs in the Earth's history which were brought about by meteorite strikes and other geological events which resulted in mass extinctions, this epoch is marked by our overall impact on the Earth system. Climate disruption is only one of these impacts.

By virtue of our numbers and our activities we have altered global carbon, nitrogen and phosphorous cycles. We are causing changes in the chemistry, salinity and temperature of our oceans and the composition of our atmosphere.

Changes in the composition of the atmosphere in tandem with land use changes and our growing water demands have also altered the global water cycle. The cumulative measure of the extent to which we have crossed these boundaries is the rate of biodiversity loss.

What this means is that we have entered an era in which we can no longer count on self-willed natural landscapes to absorb human impacts on Earth system function. We have to assume responsibility for Earth system function. With respect to humanity assuming responsibility for directing previously self-regulating functions of the Earth system I am haunted by General Colin Powell's advice to President George W. Bush on the risks of going to war in Iraq. "If you break it, you own it."

If we disrupt the stability of our biodiversity-based planetary life support system then we are going to have to re-create those functions ourselves. We might be able to do that briefly for a space station but we don't know how to perform these functions for the planet that created the conditions suitable for life that we emulate in space. We don't know how, nor could we ever afford to turn Earth into a space station. "If you break it, you own it."

It is widely held that whether or not we want to remain in the Anthropocene is something we should be talking about as a global community. At the very least the satisfactory or at least tolerable coevolution of the ecosphere and the anthroposphere is no longer an option.

Slide 28: Restorative Development

So what do we do now? There was a time when I thought that the first clear signal that the public would pick up with respect to the extent and rate that our climate is changing would be an obvious decline in local ecosystem function. I was wrong.

The surprising thing about ecosystems is how resilient they are. Under the influence of changing temperatures they will move out from under you leaving in their wake opportunities for invasive species which will succeed or fail as they may until some sort of new ecosystem stability emerges. As long as human numbers and activities don't cause the Earth system to move to a completely new and different state life on Earth will likely adapt as it has for billions of years to these changing conditions. We may find ourselves in what we consider a much altered and diminished world, but life will go with or without us.

What has captured public attention with respect to climate disruption, however, is the increasing threat it is posing to public safety and its growing impact on expensive public infrastructure. The cost of climate disruption is enormous and has been rising for 40 years. It is becoming increasingly clear that our failure to break the silence over climate disruption and change the behaviour of our society in ways that lead to action could cost some of us our prosperity. It could also cost some of us our lives.

Our changing hydro-climatic circumstances tell us that what we thought was sustainable isn't. What the loss of hydrologic stability tells us that true sustainability may be beyond our grasp if we don't do the right thing now. What this suggests is that we have to view sustainable development in a completely new light.

Sustainable development as we have defined it is not enough. What we need is restorative development. We cannot simply accommodate ourselves we have to put vital Earth system function back in place in doing so. Economic and social development must be restorative as well as sustainable.

Slide 29: Atmosphere Over Great Slave Lake

One of the great breakthroughs in the Earth Sciences in the past century is the realization of the extent to which that which we considered to be a solid physical part of the world is in fact the creation of living things over time.

We are taught as children that the atmosphere of this planet is composed of 78% nitrogen, 21% oxygen and 1% argon. From this description one might surmise that the atmosphere is nothing more than a transparent swirl of inert gases that somehow came into equilibrium through physical interaction of elements present at the birth of the planet. But we now know that is not so.

What we are seeing when we look upward into the blue of the sky is not just air but the suspended residue of every geological event and the cumulative exhalation of every life form and ecological process that has ever taken place on or near the surface of the Earth and its oceans since the beginning of the time.

Slide 30: Keeling Curve

Charles David Keeling began precise measurement of the concentration of carbon dioxide in the Earth's atmosphere on behalf of the U.S. National Centre for Atmospheric Research in 1956. As Keeling's Curve so elegantly demonstrates, our atmosphere is in part the inhaled and exhaled breath of life on Earth. The northern hemisphere breathes in with the coming of spring and breathes out in autumn.

It took only 2 ½ years of observations on Mauna Loa in Hawaii to see what was going on. With each semi-annual breath the Earth system is inhaling and exhaling more carbon dioxide. By the early 1960s the scientific evidence was clear and the implications of rising carbon dioxide concentrations on climate system function obvious.

We now fully understand how sensitive the global atmosphere is to what we put into it and what the consequences will be of ignoring changes.

Leaders are defined as those who can identify the major trends that will influence their business or organization and ride the crest of those trends toward a sustainable and profitable future. The Keeling Curve may well be the defining trend of our age. If you are a leader and ignore this trend, you may not be a leader long.

We are faced with the fact that we have no choice but to accept that our climate is no longer stable and that this poses a huge danger to our future. If a sustainable world is what we want we have to catch up with and get and stay ahead of the Keeling Curve. So how are we doing in Canada?

Slide 31: The Canadian Water Attitudes Survey Title Slides

According to the 8th Annual RBC Canadian Water Attitudes Survey which was released in association with World Water Day in 2015, Canadian attitudes might be shifting; but only very slowly.

A major finding of the survey is that Canadians continue to take high quality drinking water utterly for granted. Four of ten Canadians have no idea where their drinking water comes from. This has changed little over the past eight years. Unless they had emigrated from somewhere else, lived on a First Nations reserve or suffered recent flooding, most Canadians have never experienced the fear and deep anxiety that comes with losing confidence in their water supply.

Slide 32: CWAS Flood Impacts Results

The survey also shows that we are complacent about climate change. Few Canadians know that our hydrology is changing. Only 28 per cent of Canadians are concerned in any way about future water security. So where is the possible shift I mentioned? Here it is: The 2015 survey found that 7% of Canadians were personally affected by flooding in 2014 and 27% knew someone personally affected in 2014.

Slide 33: CWAS Public Concern Results

An amazing finding is that some 30% of Canadians have now claim to have been impacted in the past by flooding due to spring snow melt or extreme rainfall in their communities. The survey findings indicated that nearly half - some 46% of Canadians – worry about flooding when heavy rain or snowmelt is expected. It is interesting to note that some 36% of Canadians actually experience significant emotional distress in instances where heavy rain or rapid snowmelt is anticipated and where flooding may be a possibility.

Slide 34: CWAS Taking Personal Responsibility Results

Matters related to insurance have also begun to haunt Canadians. Some 30% of respondents registered concerns over adequate insurance coverage. Some 55% of those polled registered serious concern over their ability to pay additional costs from flooding not covered by insurance.

The point I hope to make here is it will just be a matter of time before the growing number of people personally affected by climate disruption forms a constituency of its own. You can bet that if what we have seen elsewhere is any indication that the moral, ethical and legal implications of climate disruption will be high on the political agenda of this constituency.

Slide 35: Pathsight Lake Winnipeg Analysis (4 clicks)

I would like to juxtapose these results with those of another survey conducted in association with major concerns over the appearance of 17,000 square kilometer toxic algal blooms in Lake Winnipeg. These blooms have come into existence as a result of short-sighted agricultural practices and inadequate municipal sewage treatment which have been exacerbated by increased flooding. The survey was based on new techniques for analyzing how best to communicate urgency to different types of people in ways that transcended traditional demographic categories such as age, gender, education and ethnicity.

The survey results revealed that despite the millions of dollars spent on trying to convince Manitobans of the seriousness of the problem they face we are sending messages that will not appeal to the people who might if appropriately inspired create a powerful movement in support of meaningful change. Only a third of the messages we are sending out connect with those whose behaviour needs to change if we are to address what has become one of the largest and most alarming fresh water disasters in the world.

What we have learned from this is that we have to adapt our messages to different kinds of people with different views and values. In the critical global campaign to act on climate disruption it is important to understand that only a combination of positive peer pressure, trusted communicators, and inspired appeals to in-group loyalty will persuade enough people to reconsider their views and change their behaviour. Moralistic slogans – no matter how clever they might be – will not be enough.

To restore our global hydro-climatic circumstances to tolerable stability we have to break the socially constructed silence related to climate disruption. The best way to start that conversation perhaps is to talk something none of us can do without: water.

Our civilization may be powered by petroleum and lubricated by oil; but our planet runs on water. Earth system research has identified nine planetary boundaries that we dare not cross for fear of making conditions on Earth irreversibly hostile to most life and threatening to even human existence. Seven of these boundaries relate directly or indirectly to water.

In breaking the silence over climate change we have to harness the power of informed choice. We can do this by giving people the capacity to understand and think about water and climate on their own terms. We have to make it personal. To make climate disruption a personal matter we need to tap that oldest and deepest human trait – the one that since the beginning of human time has recognized that in order to survive and prosper as individuals we have to account for each other and not just for ourselves. And then we work back from there.

Slide 36: Leadership

Working back from there means reversing the damage we have done to Earth system function before population growth, further ecological decline and climate disruption further destabilize our already fragile global economic system and reverse hard-won development.

One of the most immediate and cost-effective ways to do this is to invest in thoughtful, forward-thinking management of our total water and related natural resources.

Catching up with and staying ahead of the Keeling Curve demands that we decide what hydro-climatic steady state we want where we live and then set self-regulation on the road to achieving that state.

Slide 37: The Times are Changing.

Continuing to address hydro-climatic change in the way we are now will eventually bankrupt us. Water and climate security are within our means. Achieving this goal, however, will require relentlessly courageous citizenship and inspired political leadership based on new ways of thinking and more effective ways of communicating.

It will also require peerless science and innovative technology. What is needed most now, however, is a sense of urgency. And that urgency starts with water.

We know what to do. We have to do it. Welcome to the Anthropocene.

Thank you.

Slide 38: Back to the Title Slide



Robert Sandford

A Life Shaped By Water



Bob Sandford is the EPCOR Chair for Water Security at the United Nations University Institute for Water, Environment and Health. He also remains the Chair of the Canadian Partnership Initiative in support of United Nations “Water for Life” Decade, a national partnership initiative that aims to inform the public on water issues and translate scientific research outcomes into language decision-makers can use to craft timely and meaningful public policy. Bob is also a Fellow of the Centre for at the University of Saskatchewan and a Fellow of the Biogeoscience Institute at the University of Calgary. He sits on the Advisory Board of Living Lakes Canada and is also a member of the Forum for Leadership on Water (FLOW), a national water policy research group centred in Toronto. Bob is also senior advisor on water issues for the Interaction Council, a global public policy forum composed of more than thirty former Heads of State including Canadian Prime Minister Jean Chretien, U.S. President Bill Clinton and the former Prime Minister of Norway, Gro Brundtland. In 2013, *Alberta Ventures* magazine recognized Bob as one of the year’s 50 most influential Albertans.

In addition to many other books, Bob is also the author of a number of high-profile works on water including *Cold Matters: The State & Fate of Canada’s Snow and Ice* and *Saving Lake Winnipeg*. Bob is also the co-author with Kerry Freek of *Flood Forecast: Climate Risk & Resilience in Canada*, all published by Rocky Mountain Books. His latest book, *The Columbia River Treaty: a Primer* was published in association with Simon Fraser University’s Adaptation to Climate Change Team in the fall of 2014.