Cold Matters:
Our Arctic Connection

A Presentation
by
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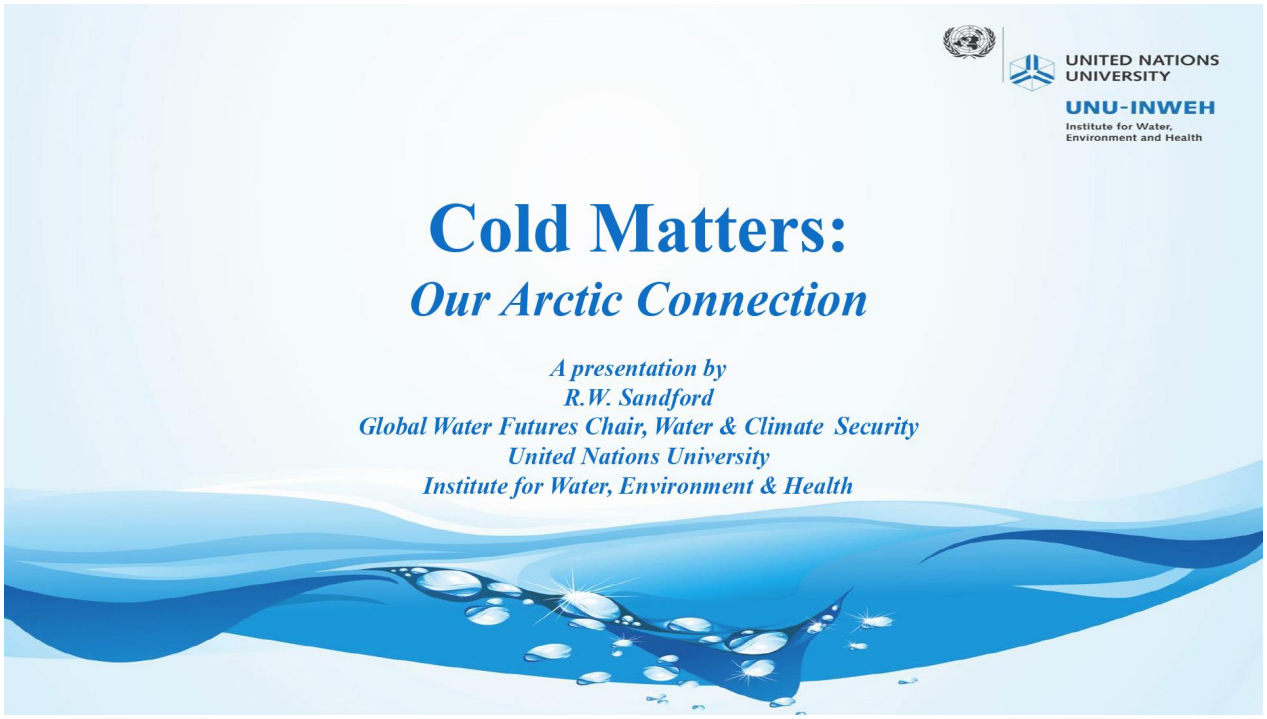
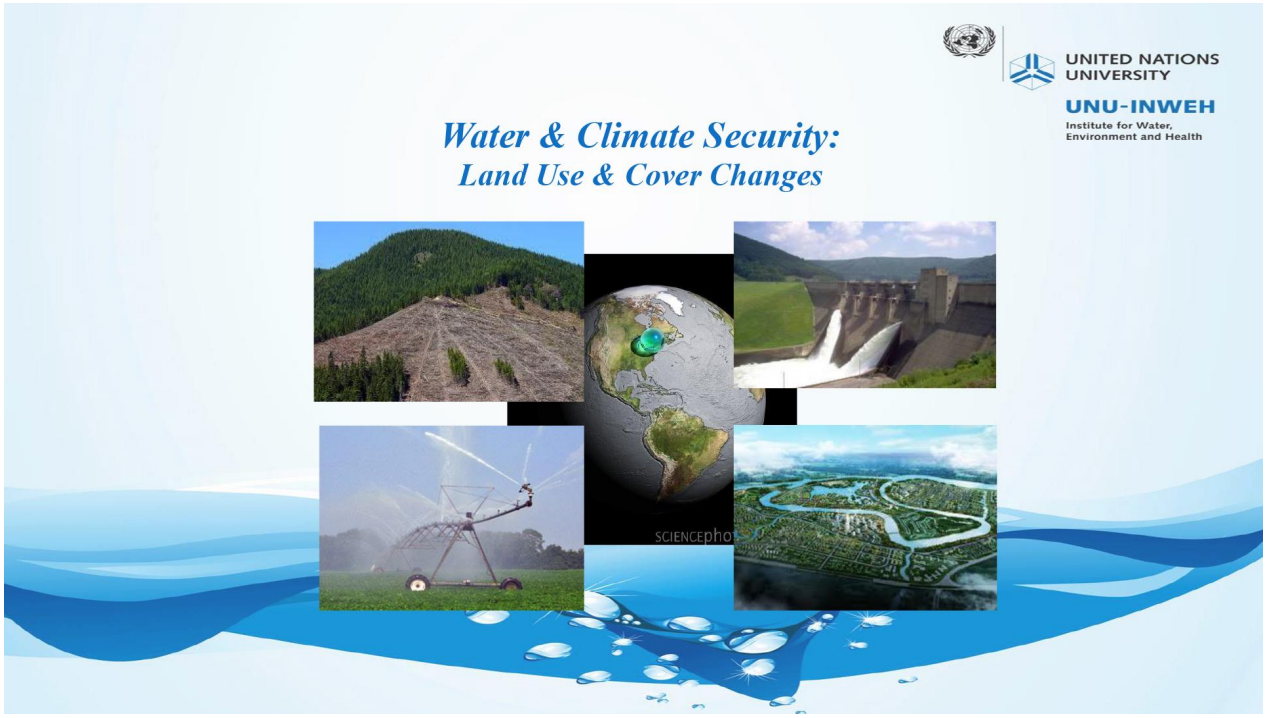
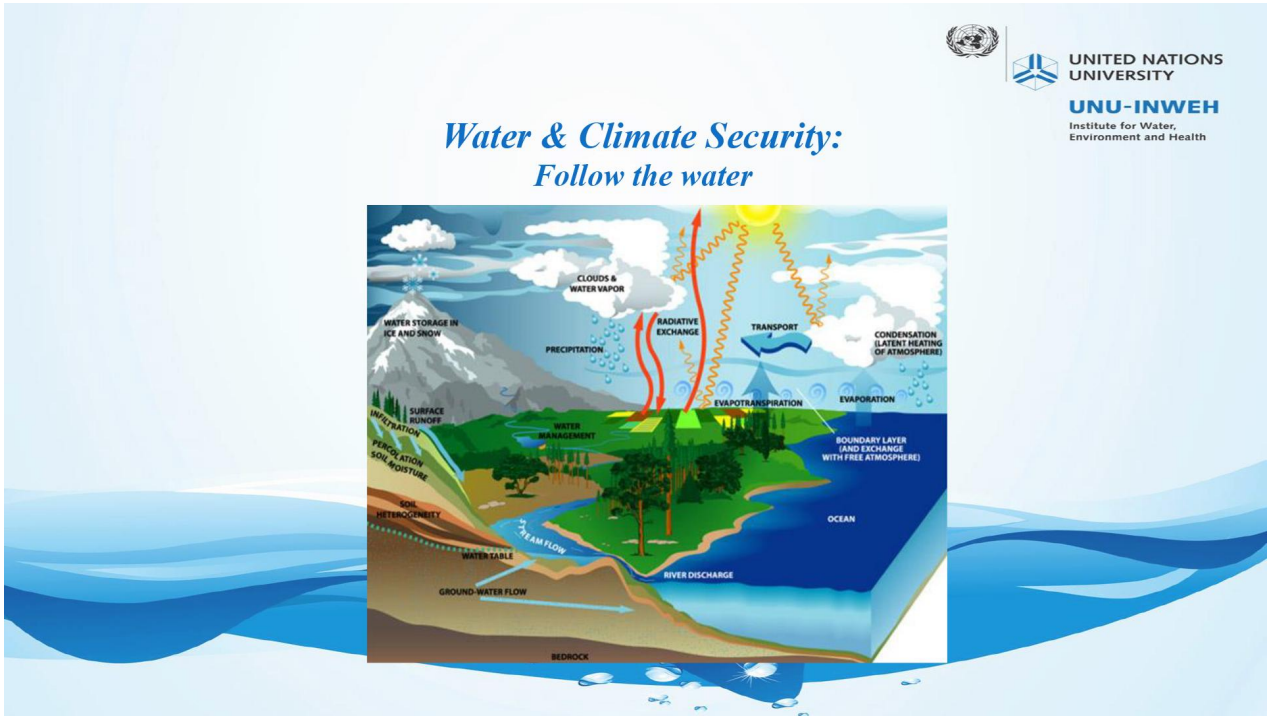
Thank you very much Jon, and thank you Frances, for the Earth Day opportunity today to talk again about water and climate and to demonstrate why cold matters not just in terms of creating a stable climate in this country but in the entire Western Hemisphere.



To begin, let's look quickly at how cumulative and compounding human effects are making sustainability a moving target here where we live in Canada. Here are some of the effects we need to stabilize if we don't want adaptation and resilience to constantly be beyond reach.



Even before climate became an issue, we had already begun altering the global hydrological cycle through rapid and expansive alteration of land use and cover. More than half of the entire of surface of the planet – and much of Canada – has been significantly altered by human activities.

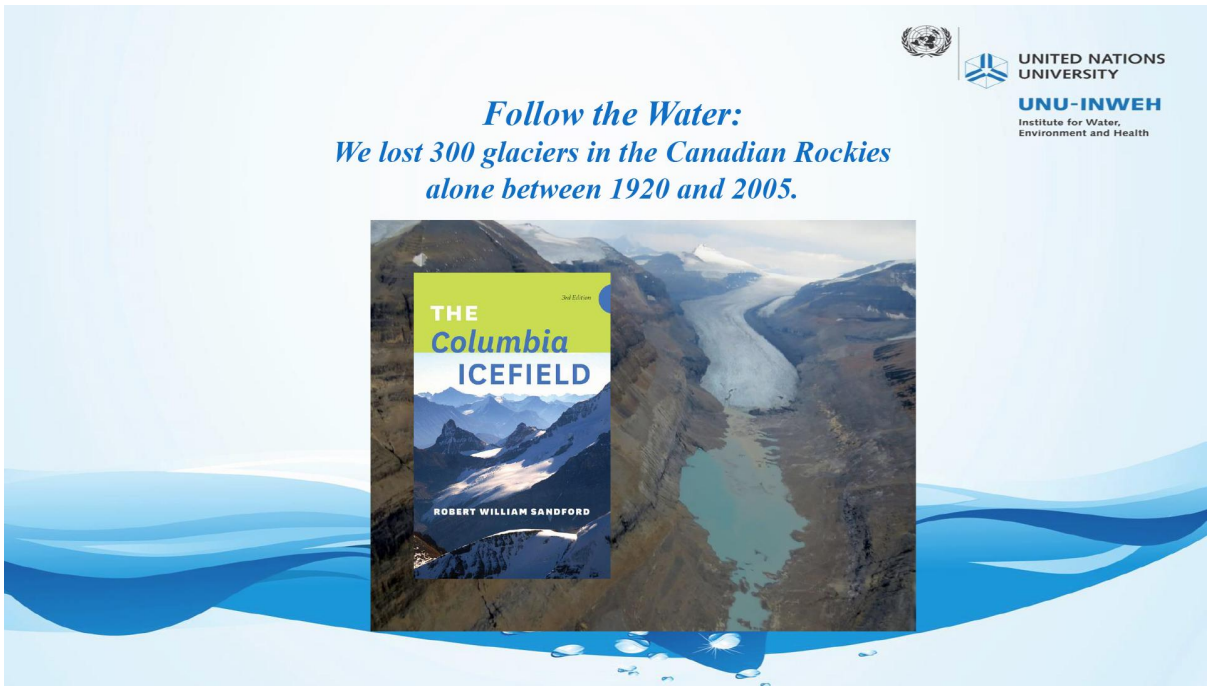


Land-use and cover changes, however, are only the beginning of the effects human activities are having on the global hydrologic cycle. Life is made possible on this

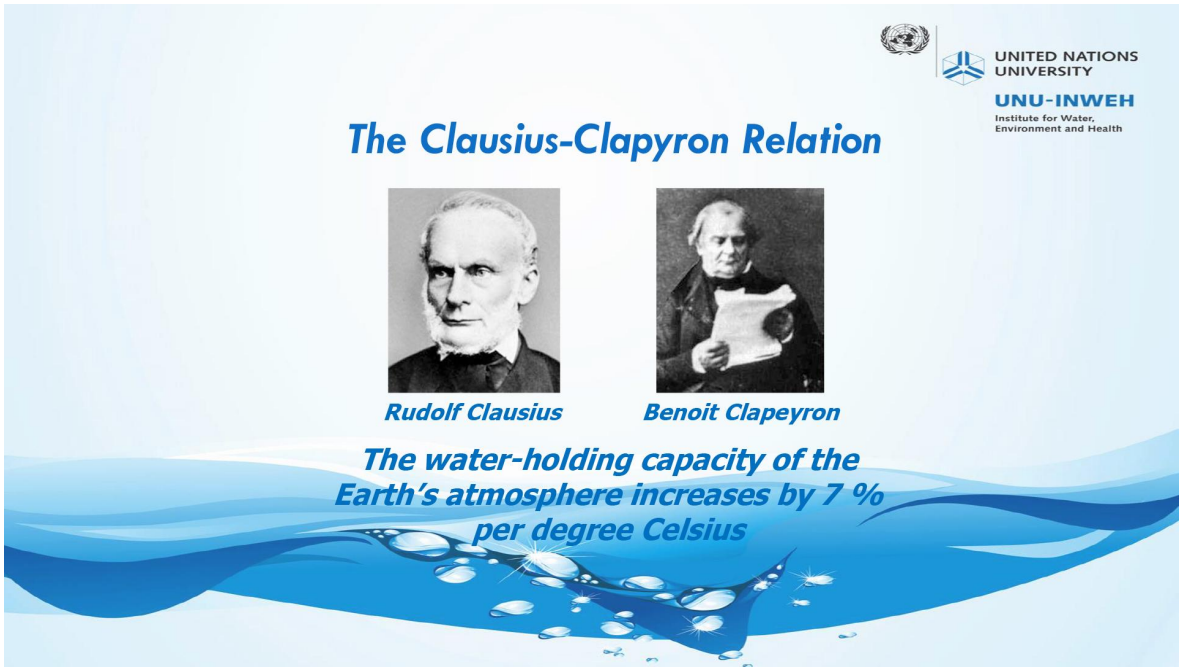
planet by all the ways in which water reacts with nearly every element in the physical world.

Some parameters, however, have more influence than others over the nature and function of any given hydro-climatic circumstance. Changes in temperature for example – cascade through all of the other biogeochemical parameters. The most frightening discovery of this young century is that this is exactly what is happening. The rate and manner in which water moves through the global hydrological cycle is accelerating.

It has been very difficult even for experts to grasp the full extent of what the loss of relative hydrological stability means. Some 52 million cubic kilometers of water are being cyclically redistributed at any given moment through the global hydrological cycle. What we have discovered is that 10 trillion metric tonnes of water are shifted from one hemisphere to the other, in the form of winter snow cover, during only one annual seasonal cycle. What we are discovering is that the ratio of snow to liquid water, in the great seasonal redistribution of precipitation in Northern Hemisphere is changing, with huge potential consequences for all of us. Nowhere is this more evident than here in Canada's mountain West.



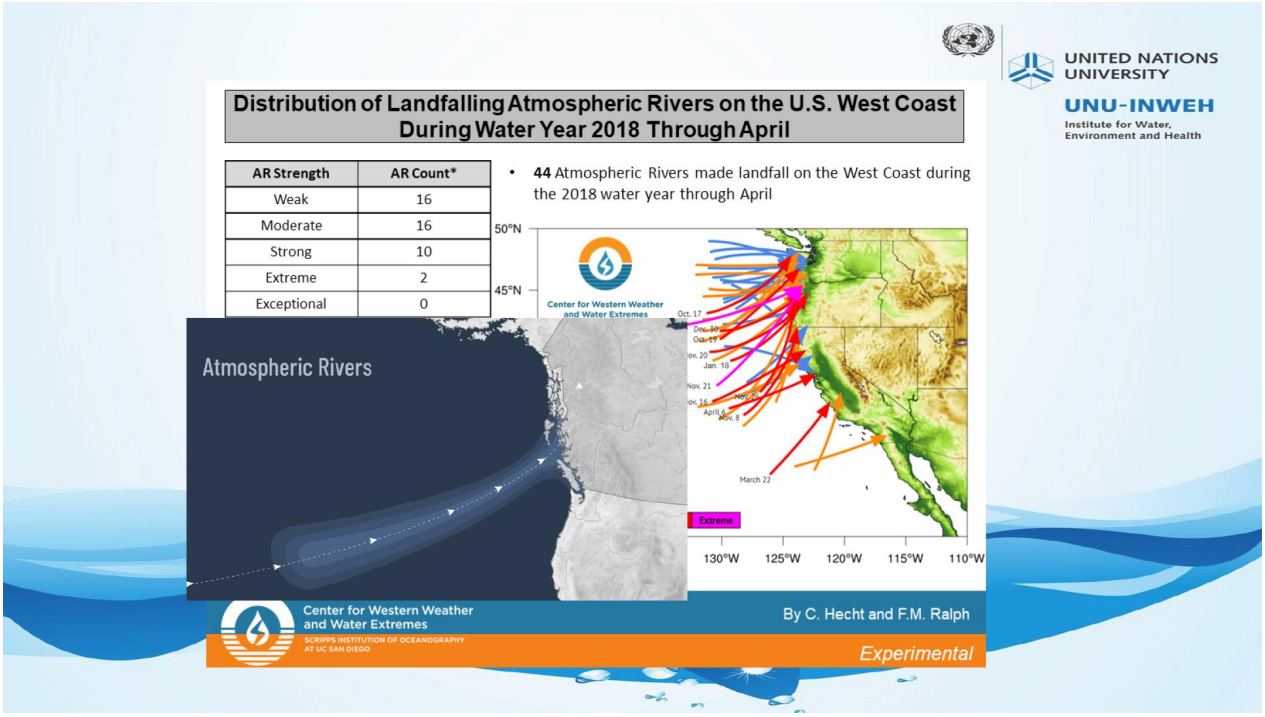
Because of warming we are expected to lose over 90% of the ice that exists in the interior ranges of Canada's western mountains by the end of this century. It should be noted, however, that the loss of glacial ice is a symptom of a much larger problem. The same warming that is causing our glaciers to disappear so quickly is reducing snowpack and the duration and extent of snow cover throughout the mountain West. By mid-century the Canadian West could be as much changed by this as it was by European settlement.



Warming atmospheric temperatures directly affect how much water the global atmosphere can transport. We have known for more than a century that for every degree Celsius of warming we can expect the atmosphere to carry 7% more water vapour. If we raise the temperature of the atmosphere by 4˚C it will carry 28% more water vapour. We would then be living on a different planet.

Remember this relation. The Clausius-Clapyron relation is proving to be a critical driver in climate disruption. We are witnessing extraordinary changes in the global hydrological cycle. The rapid melting of so much glacial ice is creating more liquid water which is evaporating faster into a warmer atmosphere capable of transporting more water. More water vapour in the atmosphere is making storms more powerful; heat waves more intense and drought deeper and more persistent.

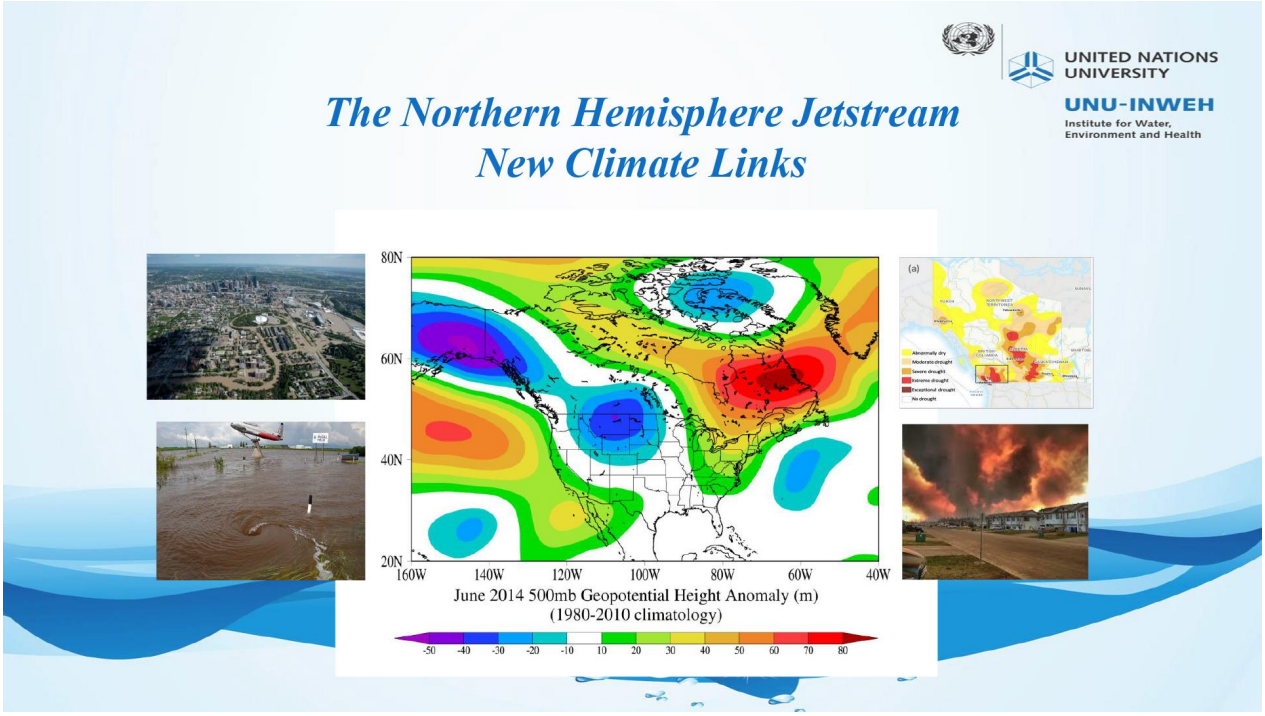
And that is why recently identified phenomena such as atmospheric rivers demand our full attention.



Atmospheric rivers have likely existed for an eternity but only now because of satellite remote sensing capacity do we know of their existence and dynamics. Atmospheric rivers have been called horizontal hurricanes. Since we discovered

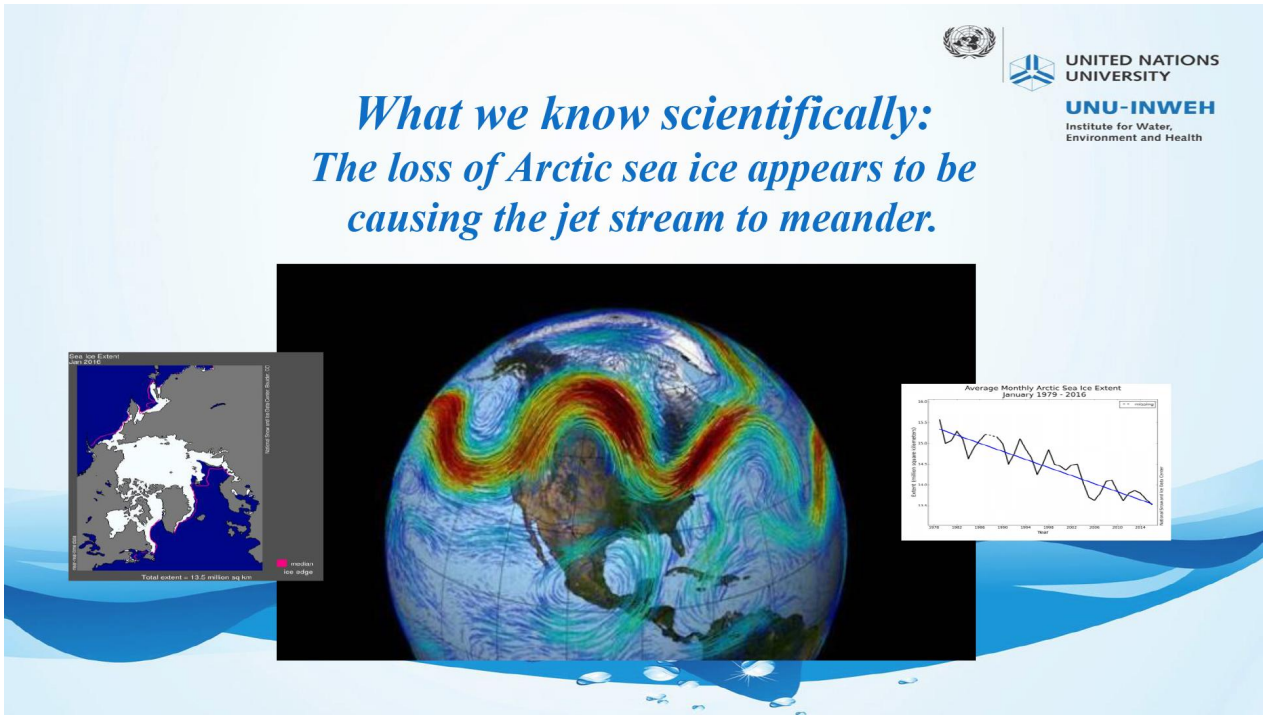
the presence of atmospheric rivers, climate change has been described as a tsunami in the sky.

Keeping up with these changes will require a mindset shift. We need to start thinking of the colossal energy, mass and biogeochemical exchanges between the oceans, the atmosphere, land and snow and ice and water, that power that system as a planetary fresh water source and a driver of the global climate cycle.

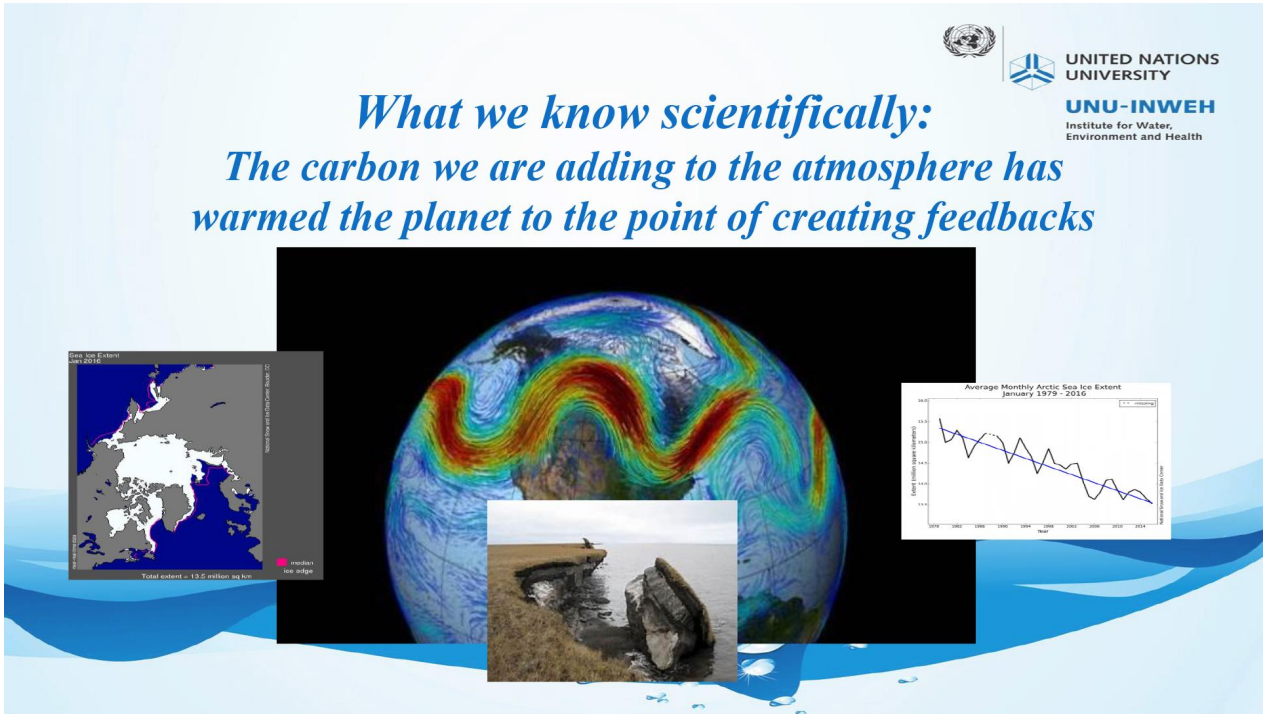


What we are also seeing in Canada is that the loss of Arctic sea ice and the rapid reduction of the extent and duration of snow cover in the Northern Hemisphere are reducing the temperature gradient between the pole and the tropics. It is this difference in temperature between the polar region and the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

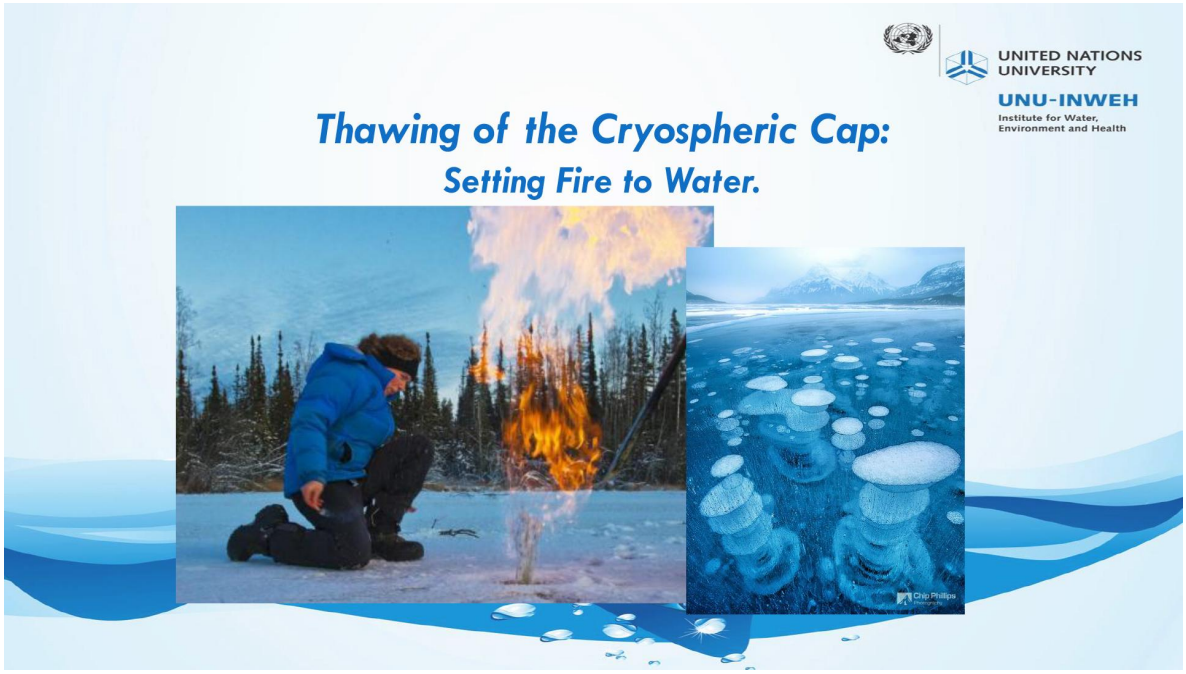
The less ice there is in the Arctic, the slower and wavier the jet stream becomes, and the more erratically it behaves. We see from the altered behaviour of the jet stream that warmer atmospheric temperatures do not automatically translate into warmer weather. In a uniformly warmer and therefore more 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. There is a growing realization of the extent to which Arctic sea ice acts as a thermostat controlling climate right down to the mid-latitudes throughout the Northern Hemisphere.



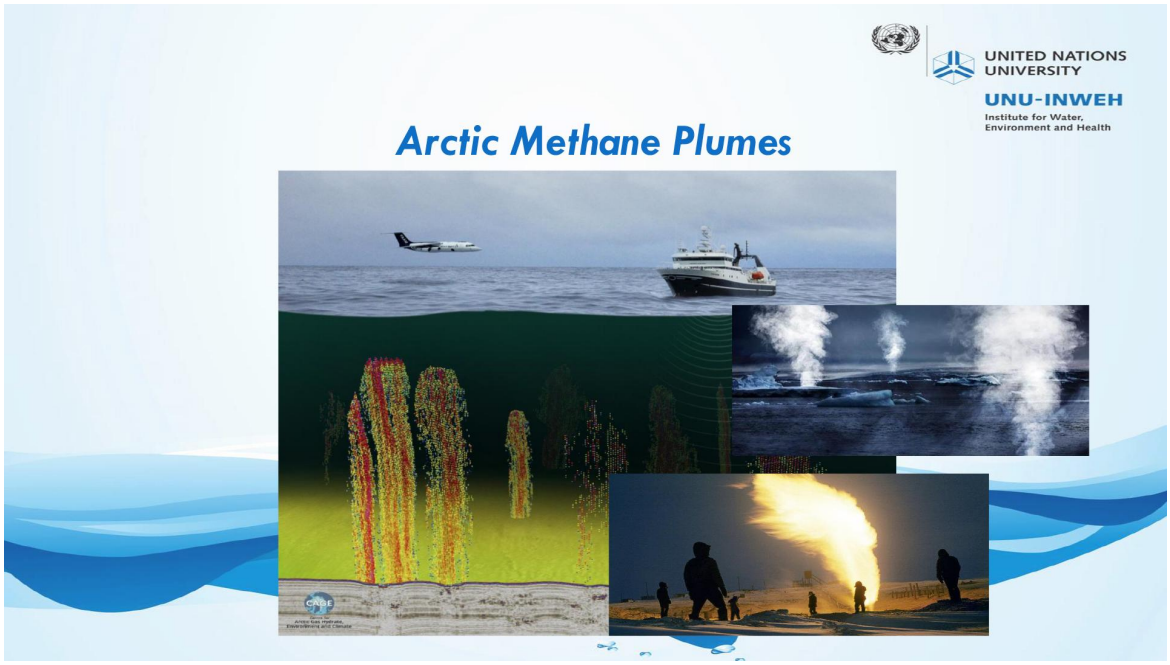
We have also discovered that there are tipping points widely in natural systems, including the climate system. Everything stays relatively stable through a range of changing conditions until an
invisible threshold is crossed, then the dynamics of the system completely change. We don't know enough about the Earth system to know where all the tipping points are. These feedback loops are creating themselves faster than science can keep up. Our greatest fear is that we won't know where they are until we have already crossed them. If a threshold in one system is crossed, there is also the possibility of a ripple effect, causing thresholds in others to be crossed, too.



The importance of this has yet to be generally realized. We are reaching the point at which we should no longer simply say that adding carbon dioxide to the atmosphere by way of our emissions is warming our planet. Instead, we have to say that the carbon dioxide, *which we have added* to the atmosphere has *already* warmed our planet to the point where feedback processes themselves are increasing the effect of those emissions.



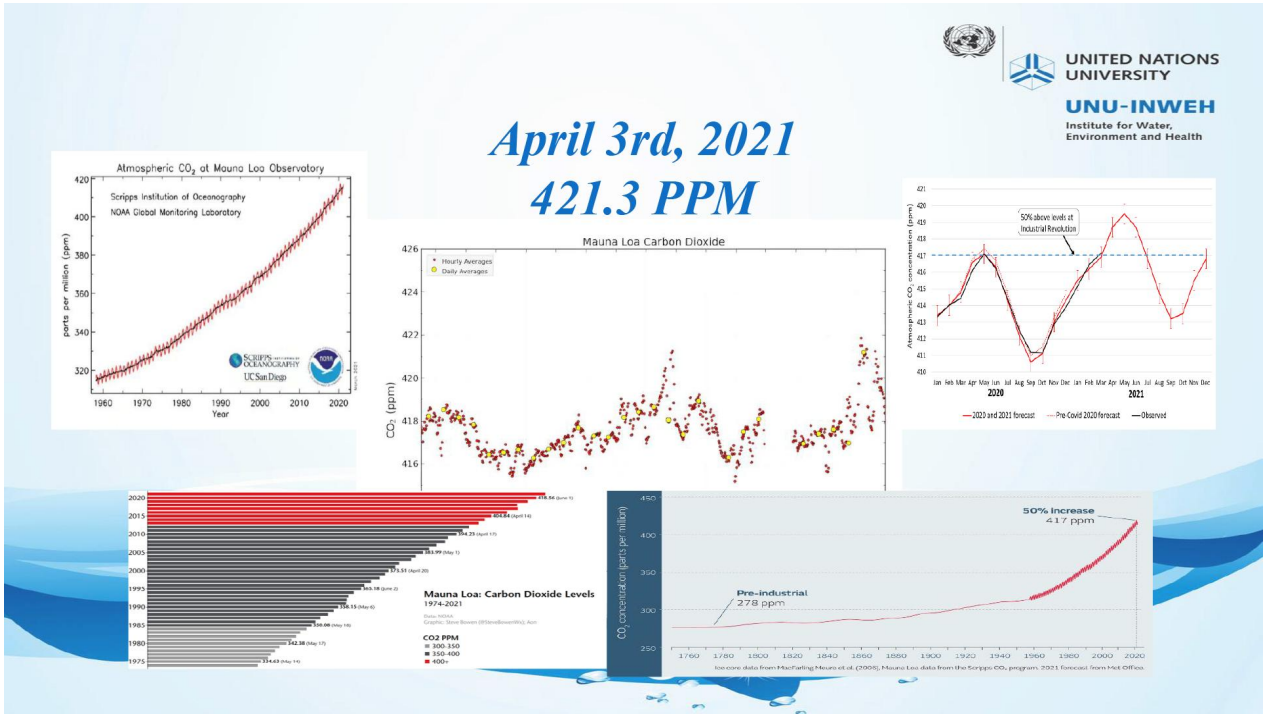
That is exactly what we fear we are seeing in our own Arctic. While recent research suggests that we don't have to worry yet about massive releases of methane from the floor of warming polar seas, the greenhouse release feedback caused by permafrost thaw in our Arctic has the potential to become a tipping point for the entire global climate. Scientists call it arctic amplification.



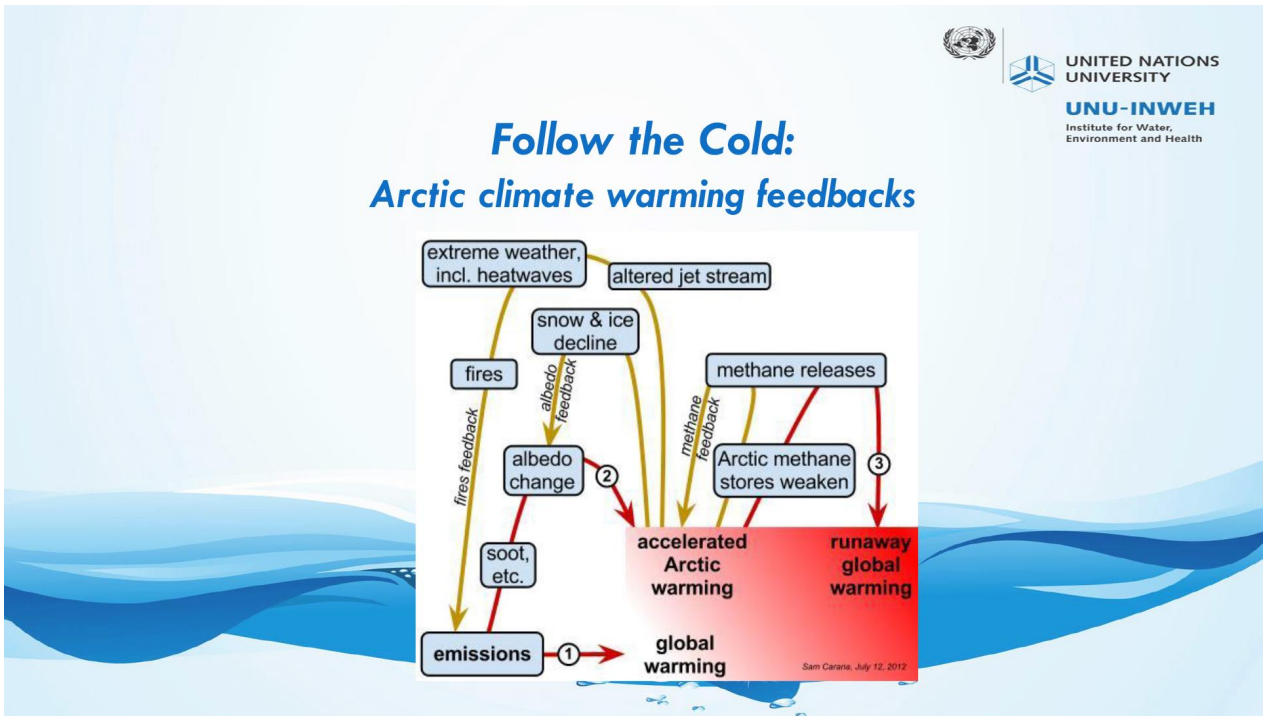
Because of unprecedented warming in the past two decades, the staggering scale of thawing of permafrost has turned the Arctic into a carbon source instead of a carbon sink. As one scientist put it, because of permafrost thaw, the Arctic has become an enormous carbon chimney. This is a feedback we don't want to get away on us. We need to keep that carbon where it is, in the ground.

It is not just what is happening on land in the Arctic that should concern us. Researchers on board a drifting observatory for the Study of Arctic Climate have found that under the sea ice, the Arctic Ocean is a gigantic heating system bringing energy from the south. Thinner ice will impact this under-ice heating system which will accelerate climate change.

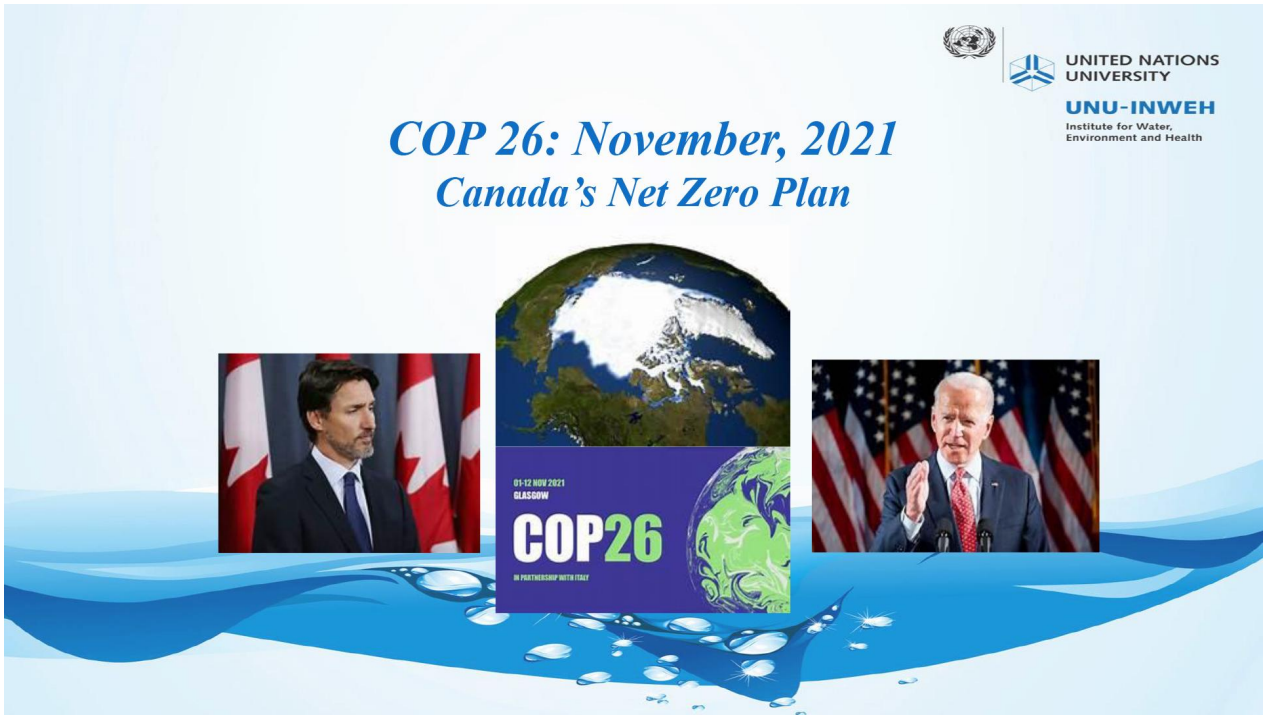
MOSAiC researchers also found that for now, the Arctic Ocean, unlike many of other warming oceans around the world, still fully absorbs carbon dioxide and generates oxygen. Will that still be so if we warm the Arctic Ocean? We don't know.



And that is why what happened in early April of this year should be of great concern to all of us. On Wednesday, April 7th, 2021, NASA made it widely known that on Saturday, April 3rd, carbon dioxide concentrations in the global atmosphere, which have been accurately and reliably measured for the last 65 years on Mauna Loa in Hawaii for the first time in the entire history of humanity exceeded 420 parts per million. This despite being the second year of a pandemic that has slowed human activity to such an extent that it reduced carbon dioxide emissions by as much as 4% globally. On April 3rd, the carbon dioxide concentration in the global atmosphere was an astonishing 421.21 parts per million. So, what does this mean and why does this matter?



The reason this matters is that it means that self-reinforcing feedbacks originating in accelerating carbon emissions from what were previously carbon sinks like the Arctic will continue to increase independent of how much we as society reduce our emissions, which means we need to decarbonize our society even faster over the next decade than we are proposing.



It is for that reason Canada must take its responsibility for dramatically reducing our country's carbon footprint seriously when Canada submits its National Net Zero plan at the UN's next Convention of the Parties scheduled to be held in Glasgow this November. Canada should unfold its plan in lockstep with the new Net Zero plan developed by the Biden administration.

All national plans, however, have to demonstrate that we have reached the most important tipping point of all - *our* tipping point – the point at which enough of us see we are at a point of no return with respect to climate disruption and finally take collective action before it threatens to end our prosperity. I believe that moment could be now. And it is in that realization that hope resides. From this we see that in terms of our climate – in terms of the global climate – cold *really does matter.*

Introduction:
Dr. Thomas Axworthy

It is now my great honour to once again introduce one of this country's most respected statesman and public policy scholars. **Dr. Thomas Axworthy** has a lifetime of experience in the Arctic. He is one of the architects of **The Arctic Council,** and has been tracking concerns associated with accelerating permafrost thaw in terms of how it is impacting northern peoples and cultures in Canada and the geopolitics throughout the circumpolar Arctic. Over to you, Dr. Axworthy.

Introduction:
Dr. Louise Arnal

One of the principal themes of this webinar series is the acknowledgement that while completely understandable to other scientists, charts, graphs and numbers don't always move people, but art does. One of the most remarkable elements of the Global Water Futures program is that it embraces art as a means of

communicating the water and climate story. Dr. Louise Arnal, is remarkable in that she lives in both worlds. She is both a scientist and an artist. She is the genius behind a ground breaking new approach to marrying art and science that she and her artist colleagues call *The Virtual Water Gallery*.

In her session, Dr. Arnal will introduce **Dr. Jenn Baltzer** who is an expert on permafrost thaw and artist **Rhian Brynjolson** with whom she working directly to make scientific research findings more understandable outside the climate science community.
Over to you, Dr. Arnal.

Introduction:
Mace Rosenstein

If you have been following this webinar series then you will have already been introduced to Washington, D. C. lawyer and political and social commentator, **Mace Rosenstein**. His contributions to this webinar series have been so much appreciated that we have created a moment of comment in conclusion of this session on how the theme **Truth Matters** can be applied to the challenged posed by accelerating permafrost thaw and other climate threats in the Arctic. We have started calling this segment **Mace's Climate Corner**, So, Mace, what did you find while tracking the truth in the telling of this climate story**.** Over to you, Mace.

Compelling as always. Thank you, Mace. Over to you Frances.