CLIMATE EMERGENCY INSTITUTE
The medical and human rights approach to global climate change

International Study of Arctic Change (ISAC)
Arctic Observing Summit Vancouver 2013

An 'Apollo-Manhattan' Arctic Surveillance Mission

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Executive Summary

This white paper presents the evidence that rapid Arctic warming is a planetary emergency and that the focus priority for Arctic monitoring needs to be this new world reality.

It is intended to help decision makers and funders understand the planetary security urgent priority of a rapid upgrading in Arctic monitoring capacity.

By any definition, Arctic monitoring today is dangerously inadequate for world security due to the risk of committing humanity to Arctic feedback-induced catastrophe. An 'Apollo-Manhattan' scale emergency Arctic surveillance program is the approach now needed for adequate Arctic monitoring.

The reason for the imperative of an Arctic planetary emergency response is the convergence of several factors that, without drastic emergency intervention, can only be expected to lead to a global humanitarian catastrophe and eventually planetary catastrophe.

- Steadily increasing amplification of Arctic warming
- Accelerating loss of Arctic albedo cooling from the melting of Far North snow cover, Greenland ice sheet surface and Arctic summer sea ice
- The Arctic summer sea ice has passed its tipping point for a virtually complete loss, and leading Arctic experts predict that the Arctic summer sea ice may start to become ice free in just a few years.
- Renewed, sustained increase of atmospheric methane due to feedback planetary methane emissions, some sources of which are Arctic
- Increasing rate of methane emissions from warming subarctic wetlands
- Increasing rate of methane emissions from thawing permafrost
- Destabilized Arctic sea floor methane gas hydrates
- An increase in northern hemisphere extreme heat and drought over the past few years affecting the world's best food-producing regions, especially in the American grain belt
- Northern hemisphere drought continues to increase over the winter of 2012-2013 and the US Drought Monitor forecasts that US grain belt drought, which is intensifying, will persist into April 2013 – and this may be linked to Arctic albedo loss
- Today's unavoidable committed global warming is several times today's warming, which is causing the above Arctic changes

BIO:

Dr. Peter D. Carter is the environmental health protection policy adviser with the Climate Emergency Institute (ArcticClimateEmergency.com). This paper received input from members of the Arctic Methane Emergency Group (AMEG).

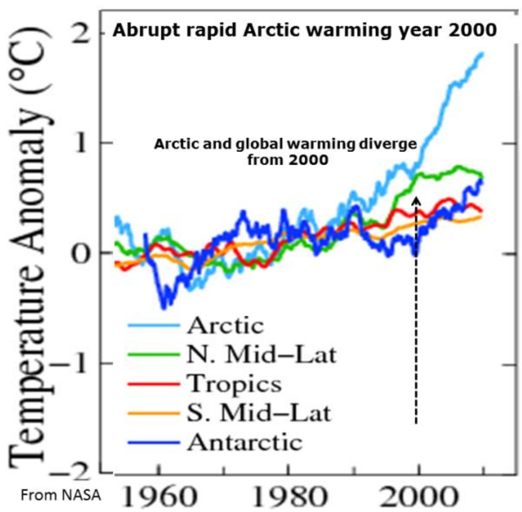
"Given the available scientific knowledge of the climate system, it is prudent for security analysts to expect climate surprises in the coming decade, including unexpected and potentially disruptive single events as well as conjunctions of events occurring simultaneously or in sequence, and for them to become progressively more serious and more frequent thereafter, most likely at an accelerating rate."
— National Research Council, Climate and Social Stress: Implications for Security Analysis, 2012

"One of the frameworks we use is that climate change acts as 'threat multiplier' or a 'risk accelerant' – terms first coined by the Center for Naval Analyses."
— Center for Climate and Security

Nothing short of a world emergency Arctic surveillance project on the scale of the Manhattan Project or the Apollo Program is required for world security under already committed global warming.

Security
The rapid, global warming-driven changes in the Arctic constitute the global security crisis of all time, because of impacts on northern hemisphere food production as well as increasing extreme weather.

It is also an emergency for the security of all future generations because of multiple, already operant, and potentially cascading Arctic positive feedbacks. From now on, currently established Arctic trends will progressively change the world to one of increasing **insecurity.**



Arctic Feedback Tipping Points

The threat to security from multiple Arctic feedbacks reaching tipping points requires a planetary emergency response. This is because:

1. loss of summer Arctic sea ice has passed tipping point (J. Hansen, 2009; P. Wadhams, 2012; T. Lenton, 2012);

2. since the big 2007 Arctic summer sea ice drop due to high Arctic warming, atmospheric methane has been increasing as a result of planetary feedback methane emissions, initially and recently thought to be, in large part, from the Arctic and high latitudes;

3. Arctic temperature is increasing rapidly (even while the NH warming is at standstill) with an Arctic amplification up to 4X the global average (Local and remote controls on observed Arctic warming , J. Screen 2012)

4.. we are absolutely committed to a global warming of several times higher than today's, which is already causing all these highly dangerous Arctic changes (K. Anderson, 2011; R. Watson, 2012) .

"The past six years (2005–2010) have been the warmest period ever recorded in the Arctic. There is evidence that two components of the Arctic cryosphere – snow and sea ice – are interacting with the climate system to accelerate warming.

"Loss of ice and snow in the Arctic enhances climate warming by increasing absorption of the sun's energy at the surface of the planet. It could also dramatically increase emissions of carbon dioxide and methane and change large-scale ocean currents. The combined outcome of these effects is not yet known.

"Arctic countries and international organizations should: Improve and expand systematic, comprehensive surface-based monitoring of the cryosphere. Maintain and support development of remote sensing methods for observing the cryosphere. Develop and enhance systems to observe the cascading effects of cryospheric change on ecosystems and human society. Expand research into processes that are important for modeling the cryosphere, to reduce uncertainty in predicting cryospheric change. In particular, improvements are needed in modeling permafrost dynamics, snow vegetation interactions, and mass loss from glaciers, ice caps, and the Greenland Ice Sheet." (SWIPA key findings, the AMAP Working Group recommendations, 2011)

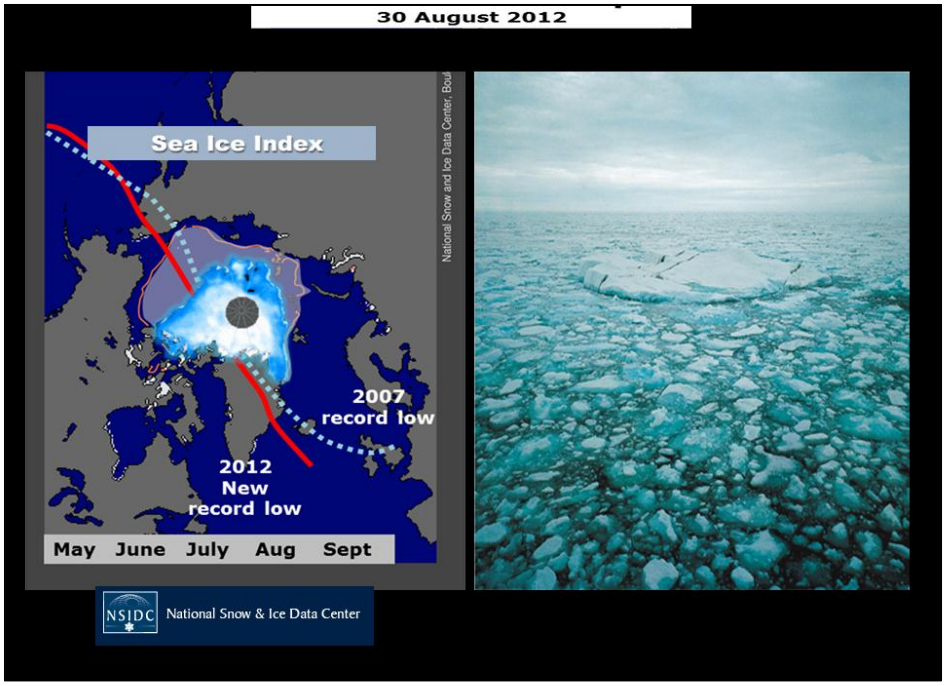
Arctic Scientists Warn of Dangerous Climate Change, January 2012
"In a paper published in the Royal Swedish Academy of Sciences' journal AMBIO and a parallel commentary in Nature Climate Change, the lead author and Director of the University's Oceans Institute, Winthrop Professor Carlos Duarte, said the Arctic region contained arguably the greatest concentration of potential tipping elements for global climate change. 'If set in motion, they can generate profound climate change which places the Arctic not at the periphery but at the core of the Earth system,' Professor Duarte said. 'There is evidence that these forces are starting to be set in motion. […] This has major consequences for the future of humankind as climate change progresses.' Professor Duarte said the loss of Arctic summer sea ice forecast over the next four decades – if not before – was expected to have abrupt knock-on effects in northern mid-latitudes…."
(http://insciences.org/article.php?article_id=10653)

Focus Area
The focus of this paper is the urgency of assessing and monitoring the risk of Arctic albedo loss to world food security and for carbon feedback "runaway" rapid global warming.

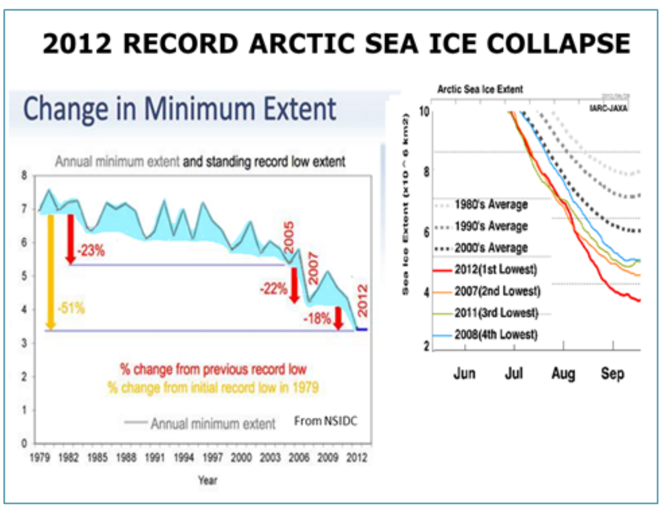
The Arctic Warming Planetary Emergency
What are the Arctic changes that are priorities for Arctic monitoring and what are the timeframes involved? How adequate is the current Arctic monitoring capacity to satisfy the above?

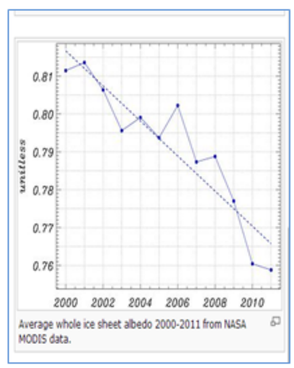
Arctic changes are:

- **Arctic albedo loss is accelerating from loss of snow, Greenland ice sheet surface and sea ice extent and thickness.**
- **All known sources of Arctic carbon feedback emissions are operant.**
- **In particular, Arctic emissions of methane are increasing.**
- **The rate of increase of atmospheric methane may be increasing.**

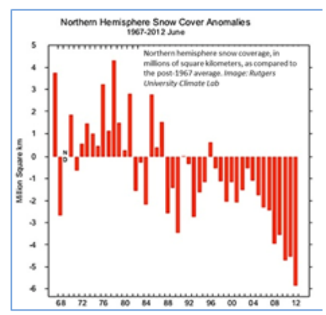


2012 Record Loss of Far North Snow and Ice Albedo





Greenland ice surface albedo



NH Snow Cover

Arctic Monitoring is Extremely Dangerously Inadequate

This paper argues and provides the evidence that Arctic monitoring is extremely dangerously inadequate. It is no exaggeration to say that the future survival of civilization and humanity depends now on adequate Arctic monitoring of climate change vital processes.

Why are adequate funding and other resources not provided for the necessary level of Arctic monitoring? Can it be assumed that the sources of funding and resources do not appreciate that today's rate of Arctic warming and its impacts already observed constitute a planetary emergency? Having insufficient monitoring has resulted in a reduced ability to assess catastrophic risks linked to Arctic changes and hence confirm that we now live in a state of planetary emergency.

*"Global warming is accelerating the pace at which climate change is affecting the Arctic region as well as climatic and environmental conditions in the U.S. While evidence that global warming is affecting both the Arctic region and the world's environment is incontrovertible, **the scientific basis for understanding these***

phenomena and the information available for making policy decisions remains inadequate. In order to define issues for decision and set priorities for action, governments should demand accelerated scientific study of issues critical to informed policy making and should be willing to fund needed research. (The Arctic Climate Change and Security Policy Conference, Final Report and Findings, Dartmouth, USA, 1-3 December 2008)

"Long-term time series of climate and climate-related parameters are available from only a few locations in the Arctic. The need for continuing long-term acquisition of data is crucial, including upgrading of the climate observing system throughout the Arctic and monitoring snow and ice features, the discharge of major arctic rivers, ocean parameters, and changes in vegetation, biodiversity, and ecosystem processes." (Summary and Synthesis of the ACIA, 2004 http://www.amap.no/acia/index.html)

"It is important to monitor Arctic greenhouse gases as they have great potential to influence global climate through positive feedbacks. Consequently, NOAA ESRL currently measures atmospheric CO2 and CH4 weekly in air samples from 6 Arctic sites (north of 53°N, Table 1.1). This is down from 8 sites in 2011; sites in the Baltic Sea and Station M in the North Atlantic were discontinued due to budget cuts.

Shallow Arctic sea sediments, especially offshore of Siberia, are thought to be rich in organic matter that may be emitted to the atmosphere as the seawater temperature increases. In addition, ice hydrates deep within the Arctic sea shelf sediments may destabilize due to warmer water temperatures and release methane to the atmosphere. Currently, the amount of CH4 emitted to the atmosphere by these processes is thought to be about one third of that emitted from wetlands in the Arctic tundra (Shakhova et al., 2010; McGuire et al., 2012); ***however, the sparseness of atmospheric observations*** *makes this difficult to confirm."* (L. Bruhwiler and E. Dlugokencky, *Carbon Dioxide (CO2) and Methane (CH4),* NOAA Earth System Research Laboratory, Global Monitoring Division, Boulder, CO, 11 November 2012 Arctic Report Card)

David Palmer, a researcher who has used limited satellite data to estimate the increase in planetary methane emissions, was quoted by *The Guardian*, 14 Jan 2010: *"Our study reinforces the idea that satellites can pinpoint changes in the amount of greenhouse gases emitted from a particular place on earth. This opens the door to quantifying greenhouse gas emissions made from a variety of natural and man-made sources."* Palmer said it was a **"disgrace" that so few satellites were launched to monitor levels of greenhouse gases such as carbon dioxide and methane.**

Exclusion of Arctic Carbon Feedbacks from Climate Change Assessments
Another huge danger is that, partly because of poor data, the IPCC assessments are not including the carbon feedback warming from Arctic methane feedback emissions (UNEP, Nov 2012).

Some vital (re climate change) monitoring data need to be analyzed more rapidly by increasing science and human resources.

Concentrate Resources for Arctic Monitoring on Climate Change
In view of the Arctic planetary climate emergency, current Arctic monitoring resources should be reallocated and focused on climate change in the Arctic.

1. Research funding should be concentrated on observations
Arctic modeling reliability is proving to be dangerously poor and suffers from insufficient and inadequate observed data. We can assess risk with sufficient observations. We cannot assess risk with unreliable modeling. Resources being wasted in space flight and exploring other planets should be

redirected to protecting our own planet (e.g., through a comprehensive satellite monitoring system for all climate sensitive regions and processes).

2. Another Arctic Climate Impact Assessment is urgently needed

This should address risk by documenting trends and citing worst-case potential outcomes from changes in progress.

Knowledge Communication

It is most important that the results of Arctic monitoring be available in a manner that environmental and sustainability organizations can comprehend. There is still a need for improvement in this regard. Agencies must also communicate the reasons and uses for the monitoring.

The existing in situ ground data should be released for the public faster (say, with periodicity of 10 days or a week, at most monthly).

Arctic Warming Risk Assessment

The Arctic is so central and crucial to the security of humanity and life that the monitoring technology must be adequate to assessing risk as well as assessing impacts. Below is a list of monitoring requirements for a risk assessment of Arctic warming on humanity and the planet. We do not as yet have such a risk assessment, which is most urgently needed.

Risk = Probability x Magnitude

The IPCC endorses the standard precautionary risk assessment formula of risk being the product of the probability of an impact and its magnitude.

In the case of Arctic warming planetary, risks apply to the immediate term (abrupt changes) and the very long term (global warming lasts over 1000 years), hence the great urgency of Arctic monitoring directed at ongoing risk assessment.

Arctic Warming over Methane Hydrates

We need a gauge of regional Arctic warming at sites of vulnerable Arctic carbon pools and of ocean warming at various depths over methane hydrates.

Arctic Albedo Monitoring

- Average and regional Arctic temperature, monthly
- Far North snow cover, monthly, for albedo
- Greenland ice sheet surface albedo, monthly
- Arctic sea ice for volume/thickness and extent, monthly
- Snow contamination by black carbon (which reduces snow albedo)

Direct Snow and Sea Ice Measurements

We need direct, onsite monitoring of snow and sea ice.

For sea ice, this includes boreholes for ice thickness each winter and summer (e.g., Catlin Survey), as well as regular submarine measurements.

How Much Vulnerable Arctic Carbon?

We need an accurate estimate of Arctic carbon pools. Only a few years ago, the estimate of permafrost carbon was doubled. There is an urgent need for a reliable gauge of Arctic terrestrial permafrost carbon and subsea permafrost methane hydrate, together with a gauge of vulnerable gas below permafrost methane hydrate. The estimates of the latter are very wide ranging.

Arctic Greenhouse Gas Emissions

- Monthly for all regions of emissions and vulnerability to warming
- Carbon dioxide
- Methane to include industrial sources (e.g., natural gas industry) and carbon isotopes
- Nitrous oxide
- Arctic carbon flux

Direct monitoring of Arctic GHG emissions

Flask sampling should be replaced by continuous monitoring instruments. Such monitors are currently operational at Svalbard and Barrow, but the data become available only after a year or two. These continuous monitors with fast data release should be deployed at additional sites (especially in Siberia: Tiksi - Lena delta, Kolyma delta, etc.).

Ships sailing across the Arctic should be equipped with automatic monitors.

We need a greatly improved, up-scaled, ongoing low-altitude aircraft aerial GHG emissions direct monitoring program for all GHGs, similar to HIPPO and CARVE.

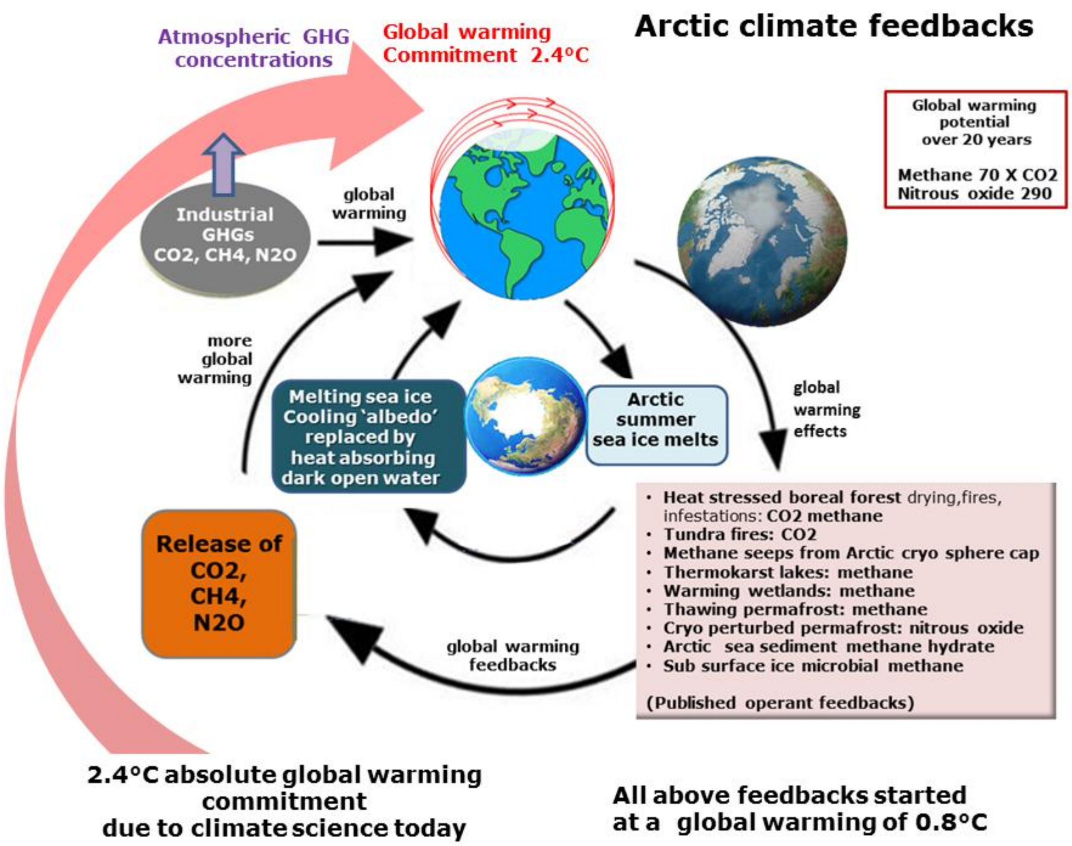
The existing radiation data of thermal IR high spectral resolution nadir-viewing sounders are retrieved for methane concentration, but this is very slow, with accuracy of retrievals and validation insufficient.

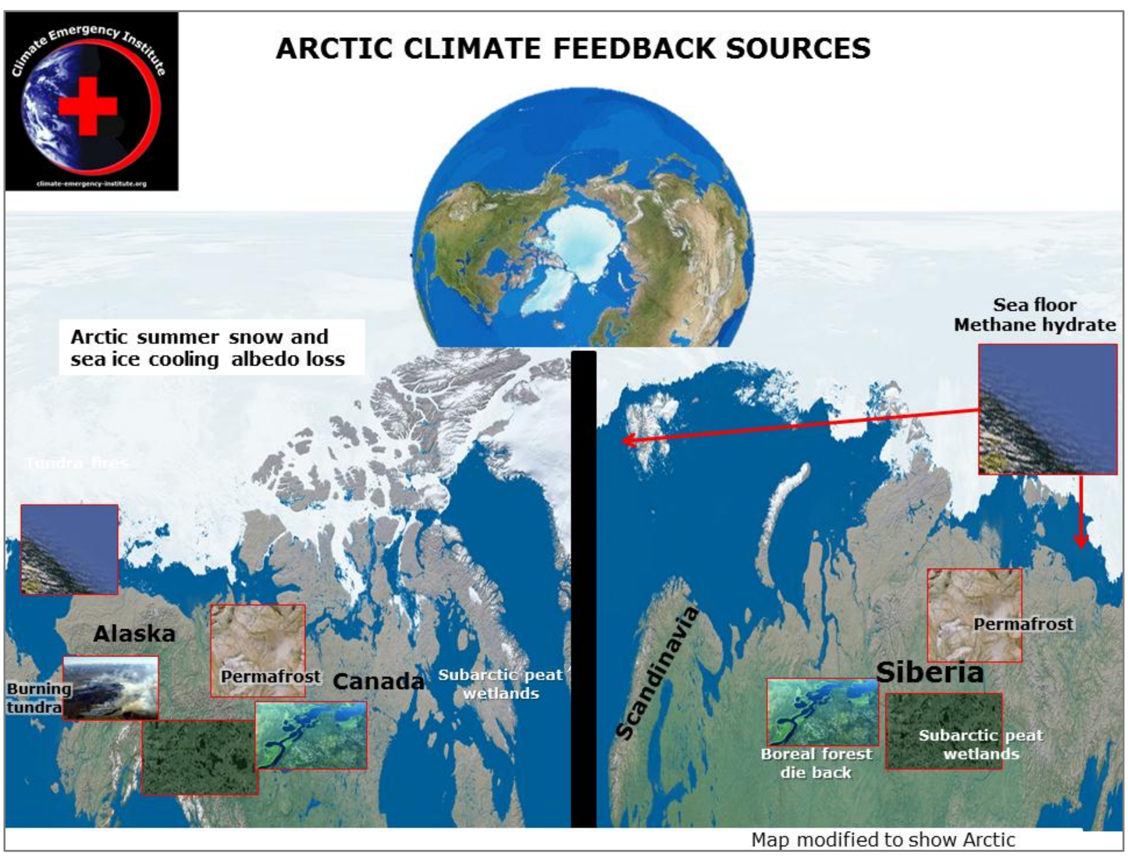
Arctic Methane Emissions – Feedback Runaway Risk

Atmospheric methane increased 2.5 times with industrialization, and then leveled off after 2000. But since 2007, methane has been on a renewed, sustained increase up to the present time.

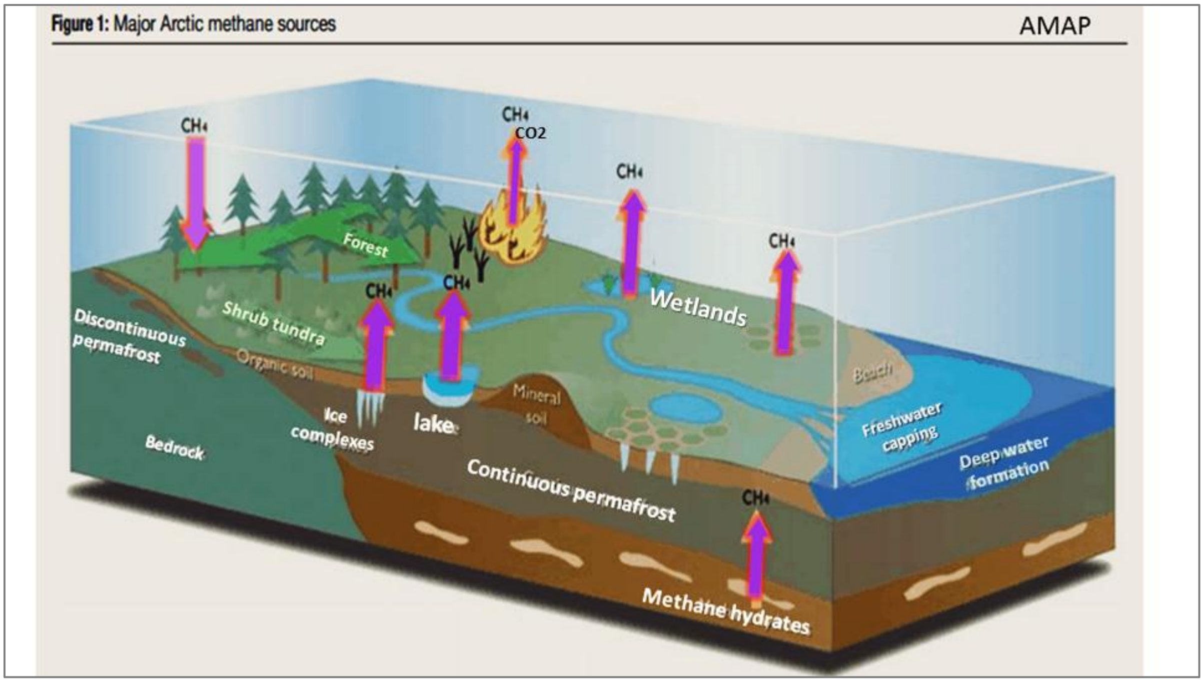
Methane Arctic concentration has reached 1900 ppb – its maximum over the past 800,000 years was 800 ppb.

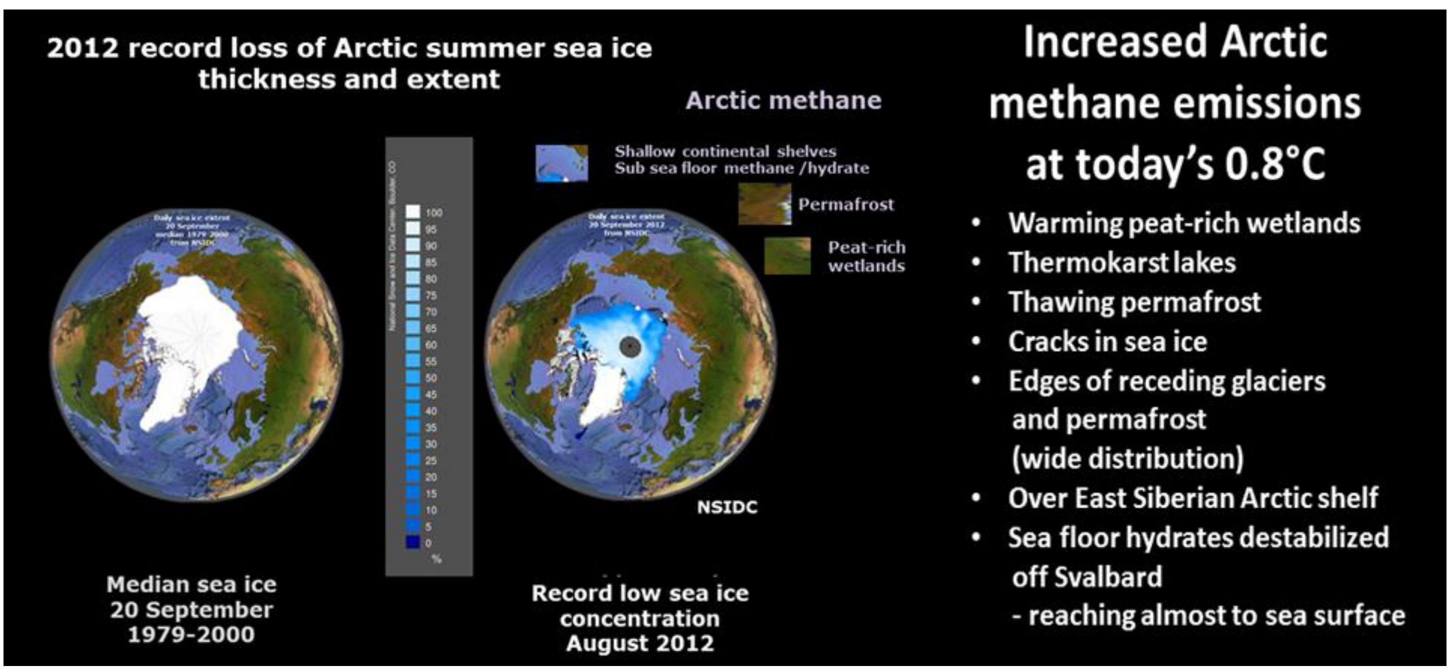
*"During the first half of 2009, globally averaged atmospheric CH4 was 7ppb greater than it was in 2008, suggesting that the increase will continue in 2009. There is the potential for increased CH4 emissions from strong positive climate feedbacks in the Arctic where there are unstable stores of carbon in permafrost [...] **so the causes of these recent increases must be understood.**"* (Euan Nisbet and Ed Dlugokencky, Global atmospheric methane in 2010: budget, changes and dangers, Earth System Research Laboratory, Colorado, 22 Feb 2010)

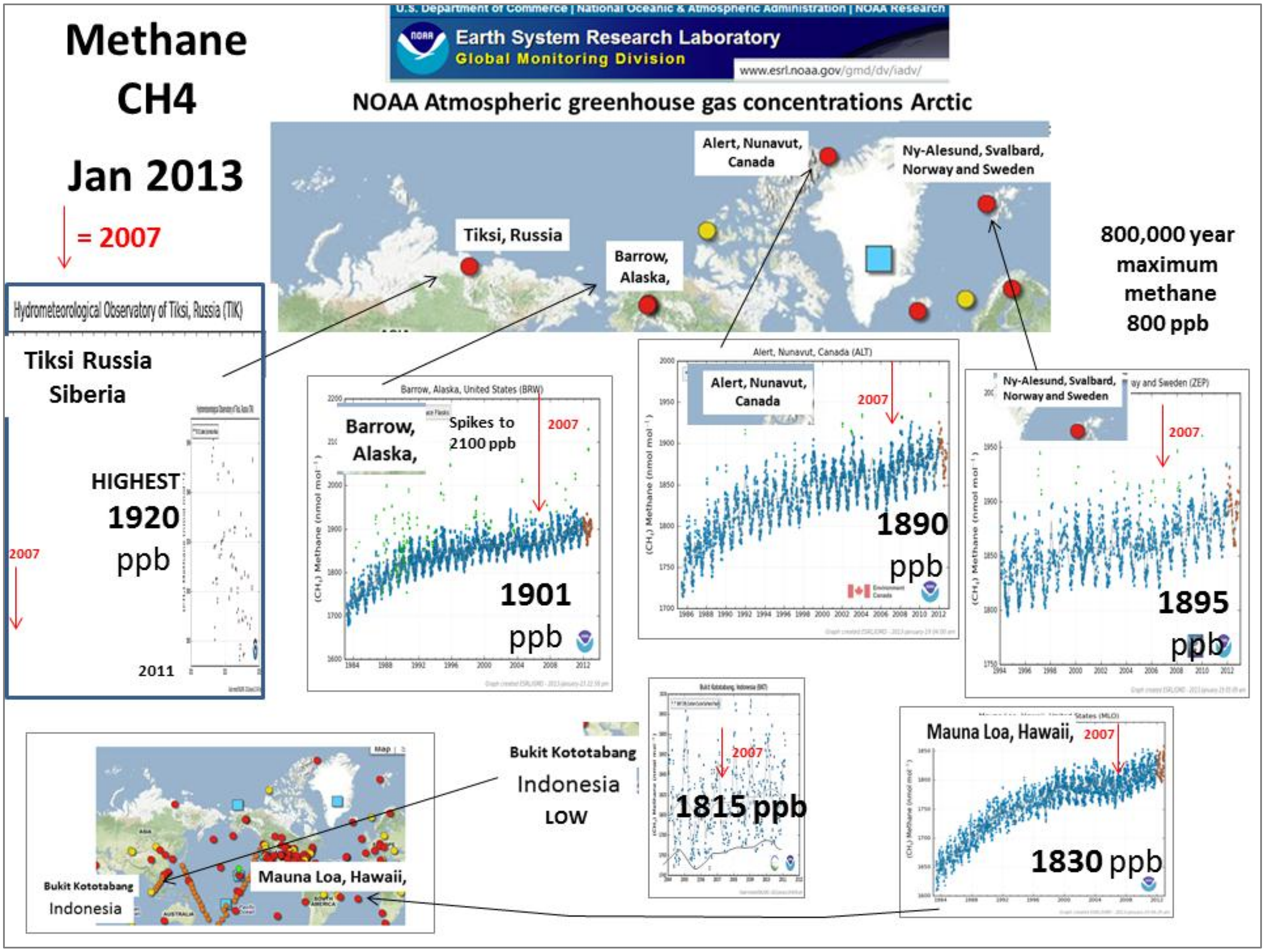

Arctic climate feedbacks
Atmospheric GHG concentrations
Global warming Commitment 2.4°C
Global warming potential over 20 years
Methane 70 X CO2
Nitrous oxide 290
Industrial GHGs CO2, CH4, N2O
global warming
more global warming
Melting sea ice Cooling 'albedo' replaced by heat absorbing dark open water
Arctic summer sea ice melts
global warming effects
Release of CO2, CH4, N2O
global warming feedbacks
• Heat stressed boreal forest drying,fires, infestations: CO2 methane
• Tundra fires: CO2
• Methane seeps from Arctic cryo sphere cap
• Thermokarst lakes: methane
• Warming wetlands: methane
• Thawing permafrost: methane
• Cryo perturbed permafrost: nitrous oxide
• Arctic sea sediment methane hydrate
• Sub surface ice microbial methane
(Published operant feedbacks)
2.4°C absolute global warming commitment due to climate science today
All above feedbacks started at a global warming of 0.8°C


ARCTIC CLIMATE FEEDBACK SOURCES
Climate Emergency Institute
climate-emergency-institute.org
Arctic summer snow and sea ice cooling albedo loss
Sea floor Methane hydrate
Alaska
Burning tundra
Permafrost
Canada
Subarctic peat wetlands
Scandinavia
Permafrost
Siberia
Boreal forest die back
Subarctic peat wetlands
Map modified to show Arctic

Major Arctic methane sources







The catastrophic dangers of Arctic methane with the inadequacy of the monitoring and the knowledge base are documented in this major review of the situation:

Fiona M. O'Connor O. Boucher, N. Gedney, C. D. Jones, G. A. Folberth, R. Coppell, P. Friedlingstein, W. J. Collins, J. Chappellaz, J. Ridley, and C. E. Johnson, **POSSIBLE ROLE OF WETLANDS, PERMAFROST, AND METHANE HYDRATES IN THE METHANE CYCLE UNDER FUTURE CLIMATE CHANGE: A REVIEW,** January 2010 http://www.lmd.jussieu.fr/~obolmd/PDF/2010_OConnor_et_al_RG.pdf

Arctic Wetland Methane

Although warming subarctic wetlands (which respond rapidly to warming) are emitting increasing amounts of methane, we have no regular monitoring of methane emissions from Arctic/high latitude wetlands. *"Experts say methane emissions from the Arctic have risen by almost one-third in just five years, and that sharply rising temperatures are to blame. Paul Palmer, a scientist at Edinburgh University who worked on the new study, said: 'High latitude wetlands are currently only a small source of methane but for these emissions to increase by a third in just five years is very significant. It shows that even a relatively small amount of warming can cause a large increase in the amount of methane emissions.'"* (The Guardian reporting research published in Science, January 2010)

Arctic Nitrous Oxide

It is not generally realized that there might be a very large amount of nitrous oxide coming out of the Arctic from cryoperturbed permafrost. Nitrous oxide is an extremely powerful greenhouse gas. It has 300 times the global warming effect of CO_2 and lasts in the atmosphere for 115 years. It is currently the fastest increasing of the three main GHGs in the atmosphere. Here are two recent papers on this phenomenon:

1. Bo Elberling et al. High nitrous oxide production from thawing permafrost, Nature Geoscience, 26 May 2010

2. Maija E. Repo et al. Large N_2O emissions from cryoturbated peat soil in tundra, Nature Geoscience, 15 February 2009

The Arctic and the Risk of Global Climate Planetary Catastrophe

The observed changes in the Arctic are now so extreme and increasing so fast that they provide overwhelming evidence that catastrophic risks now exist. This paper provides the evidence above for the imperative of an emergency-scale upgrading of Arctic monitoring. The paper proposes, and provides the background for, a risk assessment of the current Arctic changes. Although observed Arctic research data are available, they have not been applied to a risk assessment. This is the most important policy-relevant information in order to avoid any risk of committing humanity to global climate catastrophe.

Following the unexpectedly large and sudden drop in Arctic summer sea ice of 2007, James Hansen made a public statement that the world was in a state of planetary emergency. In 2012, following the new record drop of Arctic summer sea ice, Hansen repeated his public statement that we are in a planetary emergency as a result of these rapid Arctic changes. In his metrics for dangerous climate change, Hansen includes the destabilization of planetary ice sheets and the emission of Arctic methane feedback.

Leading climate change experts have made public statements that the world is beyond dangerous interference with the climate system, committed to a warming of 3-5ºC, facing a risk of global climate catastrophe, and in a state of planetary emergency. These conclusions involve rapid changes to the Arctic.

Arctic Warming Risks to Global Environmental Population Health and Planetary Catastrophes

The main parameters for Arctic warming-induced global catastrophic impacts and planetary emergency, which urgently require risk assessment and monitoring today, are:

1. **Increased and/or prolonged northern hemisphere extreme heat, drought and flooding events (northern hemisphere and therefore world food security)**
2. **Carbon feedback "runaway" or rapid global warming (the Arctic holds by far the largest pool of carbon vulnerable to warming)**
3. **Disruptions to the thermohaline circulation (extreme cold affecting Europe)**
4. **Irreversible destabilization of the Greenland ice sheet (sea level rise)**
5. **Arctic albedo loss (a common cause of these global catastrophic risks)**

The first four global catastrophic risks above all result from the increasing rate of loss of Arctic albedo cooling influence.

Comprehensive and intensive ongoing Arctic monitoring is essential to assess and monitor the risks of all five of the above potentially globally catastrophic effects.

These are all subject to increasing or accelerating impacts as a result of Arctic amplification inherent in the Arctic climate system. Research has found that Arctic amplification is mainly a result of the loss of Arctic albedo from the melting of snow and ice.

It is therefore imperative that Arctic monitoring be adequate to providing an ongoing, accurately reliable, indication of the rate of Arctic albedo loss.

2012 was a record year for Arctic albedo loss. The rapid albedo loss is a result of (1) the Far North snow's spring/summer cover receding more rapidly year, (2) meltwater cooling on the surface of the Greenland ice sheet, and (3) the thinning as well as the collapsing extent of the Arctic summer sea ice. Research estimates that the albedo effect of the Far North snow cover is equivalent to that of the Arctic summer sea ice.

Monitoring for Arctic albedo loss has to adequately and accurately cover Far North snow extent, Greenland ice sheet surface melt, Arctic summer sea ice volume and Arctic summer sea ice extent. An additional monitoring requirement for snow cover is to assess and monitor the effect of black carbon deposition

It is generally said that the Arctic is warming two to four times faster than the rest of the planet, with sensitive regions, e.g., Siberian permafrost, at times warming even faster.

Greenland destabilization and sea level rise are generally referred to as the most dangerous result of Arctic warming, with the possibility of a catastrophic cooling of Europe resulting from alteration to the thermohaline circulation as the next greatest concern.

Greenland ice destabilization risk increases with Arctic warming.

Changes to the meridional overturning circulation (MOC) deep conveyor current are due to the increase of fresh water being added to the North Atlantic and increases with the rate of ice melting. The MOC catastrophic risk is plunging Europe into a freezing climate too cold for agriculture.

Threats to food security and carbon feedback runaway are potentially far more catastrophic than even the Greenland ice sheet slowly slipping into the ocean and affecting coastal regions.

The Risks Recognized by Climate Change Assessments

1. Research has only recently recognized a link from Arctic warming albedo loss and northern hemisphere extreme weather events with risks to food productivity.

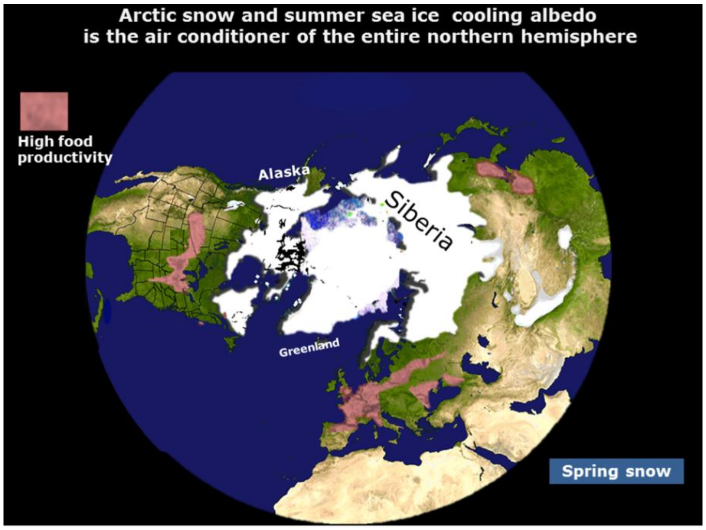
2. The last two IPCC assessments have recognized the risk of catastrophic impacts from Arctic carbon feedbacks as well as loss of the Greenland ice sheet and thermohaline disruption.

"Abrupt climate change on decadal time scales is normally thought of as involving ocean circulation changes. In addition on longer time scales, ice sheet … may also play a role." (IPCC AR4 2007, 3.4 Risk of abrupt or irreversible changes, http://www.ipcc.ch/publications_and_data/ar4/syr/en/mains3-4.html).

Arctic Albedo, Northern Hemisphere Food Productivity, and World Food Security

Scientists have said for a long time that if global warming was allowed to reach the point of melting away the Arctic summer sea ice, it would boost global warming by its large feedback effect.

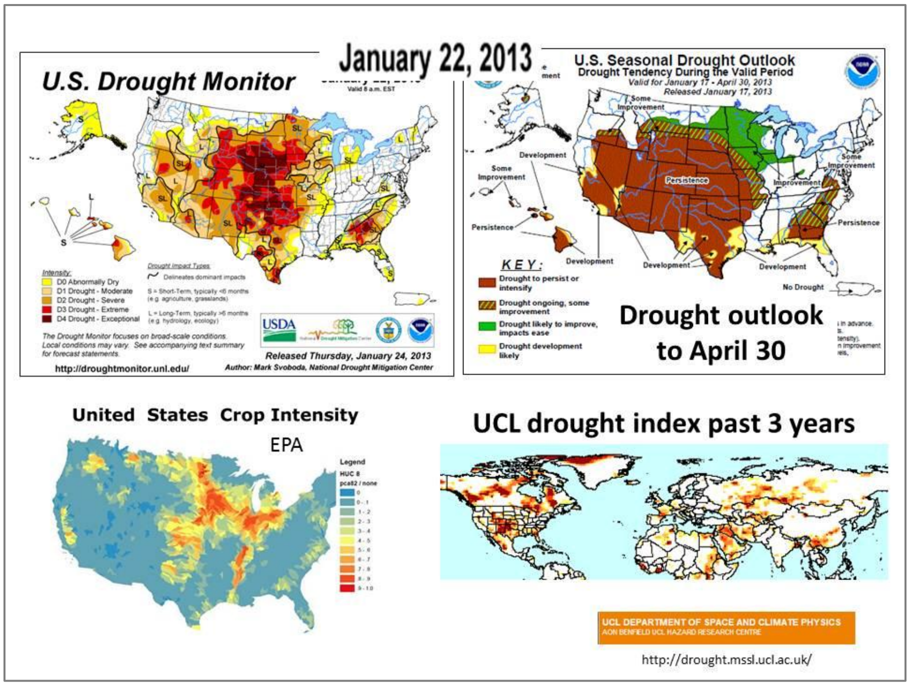
They also call the Arctic summer sea ice the "air conditioner" of the entire northern hemisphere.



We now know that the air conditioner is the Arctic albedo provided by Far North spring/summer snow, the Greenland ice sheet surface, and the Arctic summer sea ice. 2012 was a record year for albedo loss affecting all three. It was a record year for US and northern hemisphere heat and a near-record year for US and northern hemisphere drought. Global warming (not surprisingly) has been projected by the IPCC assessments to increase global extreme heat and drought.

All of the best food-producing regions are in the northern hemisphere. The high productivity of the great American grain belt is crucial to world food security, because of both world food prices and surplus US food availability.

The US great grain belt has been in an increasing drought for the past three years (UCL World Drought Monitor, US Drought Monitor). This three year increase in northern hemisphere drought is affecting the US worst, followed by the Russian grain belt and then S Europe and S.W. China.



The northern hemisphere, being relatively more land and less ocean, warms faster than the southern hemisphere – currently twice as fast. The central regions of large continents warm faster, and under high degrees of global warming are projected to warm up to twice as fast as the global average. This factor puts the US grain belt at highest vulnerability to warming, followed by the Russian grain belt.

There are northern hemisphere food producing regions are inherently vulnerable to heat and drought. The North American Great Plains region is subject to prolonged drought; tree core studies have revealed very long-lasting droughts in the distant past. The equatorial region is expanding due to global warming, affecting the northern hemisphere. This makes the southern US, India, and southern China more likely to experience extreme heat and drought.

As the Arctic loses its albedo cooling influence on the northern hemisphere, it is intuitive that the normally temperate regions will be affected by increasing extreme heat and drought, and the drought record indicates this is happening. The jet stream is being altered by the loss of Arctic sea ice and the effect is projected to increase northern hemisphere extreme heat events and to "block" (i.e., prolong) extreme weather patterns (J. Francis, 2012). It is thought that the faster retreat of Far North snow is a factor in the US extreme heat and drought (J. Francis; D. Robinson, Global Snow Lab, Rutgers University).

At the time of writing (January 2013), American drought has intensified over the US grain belt and the US Drought Monitor projects a very large area of drought persisting into April 2013. The current global drought severity index from University College London shows extreme to exceptional drought affecting the US grain belt, southern Europe, central Europe and into Russia.

Monitoring for an Emergency Arctic Cooling Intervention

Today's absolutely committed global warming is at least three times and probably four times the amount of today's warming.

There is no plan by world powers to do anything except continue to burn increasing amounts of fossil fuels.

It is therefore clear from the above points that the Arctic will have to be cooled – although it looks as if by the time world powers realize that intervention is a matter of our survival, it will be too late.

Limited regional Arctic cooling is far preferable to resorting to planetary geo-engineered cooling.

An emergency-scale Arctic surveillance program needs to be established now to provide an opportunity to conduct an Arctic cooling trial that can assess effectiveness and safety.

References

All references may be found linked at http://ArcticClimateEmergency.com/.

IPCC 2007 Assessment references with respect to catastrophic feedback risk from Arctic warming

IPCC AR 4 WG 3 2.2.4 Risk of Catastrophic or Abrupt Change

The possibility of abrupt climate change and/or abrupt changes in the earth system triggered by climate change, with potentially catastrophic consequences, cannot be ruled out. Positive feedback from warming may cause the release of carbon or methane from the terrestrial biosphere and oceans.
http://www.ipcc.ch/publications_and_data/ar4/wg3/en/ch2s2-2-4.html

As permafrost thaws due to a warmer climate, CO2 and CH4 trapped in permafrost are released to the atmosphere. Since CO2 and CH4 are greenhouse gases, atmospheric temperature is likely to increase in turn, resulting in a feedback loop with more permafrost thawing. The permafrost and seasonally thawed soil layers at high latitudes contain a significant amount (about one-quarter) of the global total amount of soil carbon. Because global warming signals are amplified in high-latitude regions, the potential for permafrost thawing and consequent greenhouse gas releases is thus large.
http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch1s1-4-5.html

In both polar regions, components of the terrestrial cryosphere and hydrology are increasingly being affected by climate change (very high confidence). These changes will have cascading effects on key regional bio-physical systems and cause global climatic feedbacks (very high confidence).
http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-chapter15.pdf

8.7.2.4 Methane Hydrate Instability/ Permafrost Methane
Methane hydrates are stored on the seabed along continental margins where they are stabilised by high pressures and low temperatures, implying that ocean warming may cause hydrate instability and release of methane into the atmosphere. Methane is also stored in the soils in areas of permafrost and warming increases the likelihood of a positive feedback in the climate system via permafrost melting and the release of trapped methane into the atmosphere.

Both forms of methane release represent a potential threshold in the climate system. As the climate warms, the likelihood of the system crossing a threshold for a sudden release increases. Since these changes produce changes in the radiative forcing through changes in the greenhouse gas concentrations, the climatic impacts of such a release are the same as an increase in the rate of change in the radiative forcing.
http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch8s8-7-2-4.html

Chapter 7: Climate System-Biogeochemistry Couplings
"Recent modeling suggests that today's seafloor CH4 inventory would be diminished by 85% with a warming of bottom water temperatures by 3°C." (Buffett and Archer, 2004). (Ch. 7.4.1.1)

Chapter 10: Global Climate Projections
"… some sources of future radiative forcing are yet to be accounted for in the ensemble projections, including those from land use change, variations in solar and volcanic activity, and CH4 release from permafrost or ocean hydrates." (Ch. 10.5.1)

Ch. 19: Assessing Key Vulnerabilities and the Risk
From Climate Change (“key vulnerability”)
"AR4 temperature range (1.1-6.4°C) accounts for this [climate-carbon cycle] feedback from all scenarios and models but additional CO2 and CH4 releases are possible from permafrost, peat lands, wetlands, and large stores of marine hydrates at high latitudes."