

# "Committed" (Practically Unavoidable) Global Warming by 2100 and Northern Hemisphere Food Productivity

"Future climate change and other human-induced pressures are virtually certain to be unprecedented in the past several hundred millennia." (IPCC AR4 WG2 4.1.2)

**Decline of Northern Hemisphere crop yields in top world food-producing regions**

**The two most catastrophic climate change impacts**

**Multiple Arctic positive amplifying global warming feedbacks:**

- Albedo loss
- GHG feedback emissions

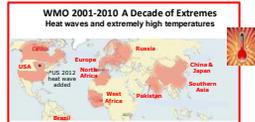
**Both are increased by loss of Arctic albedo cooling**

**Adverse effects of increasing Arctic albedo cooling loss to be expected on Northern Hemisphere crops**

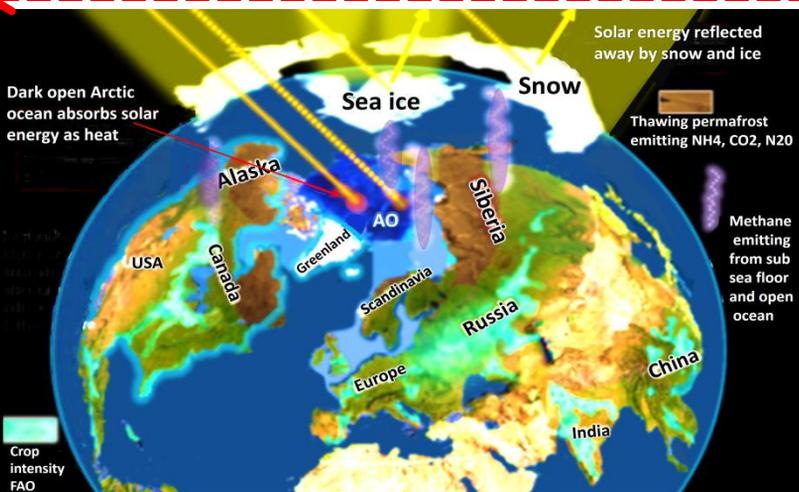
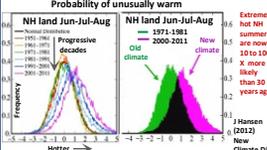
- Increased**
- NH warming
  - moisture loss
  - extreme heat
  - drought
  - other extreme weather
  - climate variability
  - ground-level ozone

- Other climate change crop impacts**
- severe storms
  - floods
  - waterlogged land
  - soil erosion
  - weeds
  - pests
  - plant pathogens
  - combined impacts

**Increasing NH Extreme Heat**

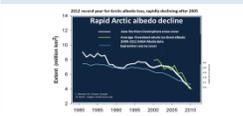


**Increasing NH extreme heat, past 30 years**



**Albedo Loss**

- faster retreat of Far North snow
- larger surface melt Greenland ice sheet
- decline in Arctic summer sea ice extent

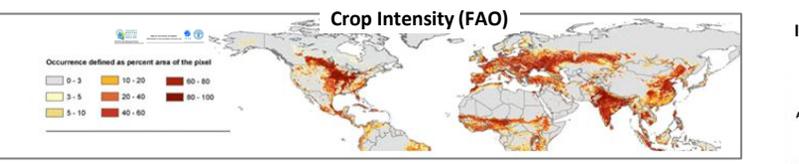


**Greenhouse Gas Feedback-Sourced Emissions** (all are operant)

- Far North peat rich wetlands (CH4)
- thawing permafrost (CH4, CO2, N2O)
- open Arctic Ocean (CH4)
- subsea floor methane gas (CH4)

**Arctic Tipping Points**

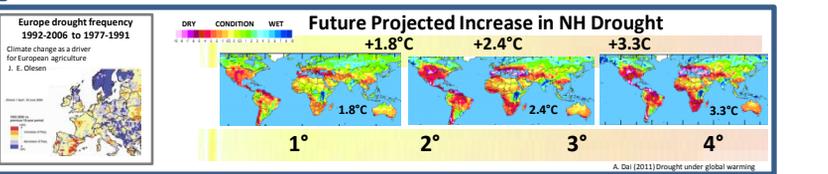
- Arctic summer sea ice -0.8°C (today)
- Permafrost -1.5°C or less
- Methane hydrate -1.5°C or less



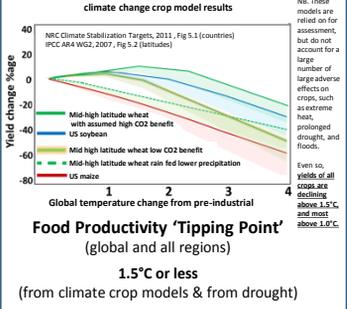
**Inter-reinforcing Arctic feedback loops boost Arctic, NH and global warming**



**NH Drought**



**NH Climate Crop Model Results**



**Committed (Practically Unavoidable) Warming**

**Sources of unavoidable warming**

- Time to atmospheric GHG stabilization
- Ocean heat lag
- Unmasking air pollution aerosol cooling
- Carbon feedback

**'Tipping points'**

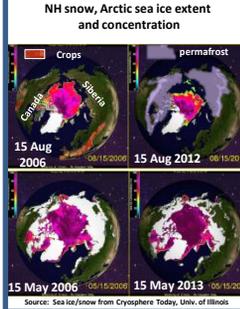
- Arctic GHG emissions 1.5°C
- Food production 1.5°C

**Warming limit by 2100 to avoid 1.5°C tipping points**

- by 2100 >3°C
- by 2100 1.4°C
- Ocean heat lag alone

Another 0.8°C for ocean heat lag alone

**NH Albedo**



**SUMMARY**

- NH food productivity decline and the effect of multiple Arctic positive amplifying feedbacks are not a consideration for concern in assessments.
- Committed global warming exceeds the tipping point by a factor of 2 for large declines in world food output and crop yields in all regions.
- It exceeds, by a factor of 2, tipping points for large Arctic albedo loss feedbacks and irreversible Arctic methane feedbacks. These will increase the rate and extent of crop declines.
- This is a committed global climate change food production decline emergency.
- The only real emergency response plan for mitigating these catastrophes is Bill Hare's (2009) 1°C target response: rapid total decarbonization with CO2 draw down to achieve zero carbon emissions by 2050.

**Introduction**

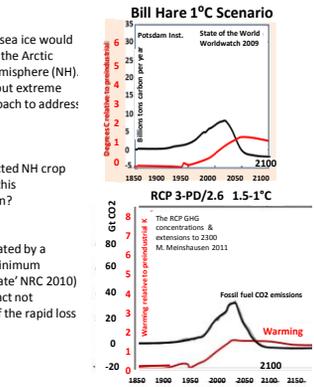
Scientists have for long warned that the loss of the Arctic summer sea ice would be a large positive feedback to global warming, and have said that the Arctic summer sea ice is the "air conditioner" for the entire Northern Hemisphere (NH). Assessments foresee a decline in NH food production after 2050, but extreme weather is already affecting NH crops. A best policy-relevant approach to address this situation is offered here.

**Objectives**

Is there a global climate change emergency situation due to projected NH crop yield declines at today's total committed global warming? If so, is this catastrophic situation recognized as the priority for policy attention?

**Methods**

Total committed (practically unavoidable) global warming is estimated by a simple summation of all unavoidable sources of warming (using minimum projections). The impact on crop yields is assessed from ('adequate' NRC 2010) climate crop model results, and from drought projections (an impact not accounted in the climate crop models). On top of this, the effect of the rapid loss of Arctic snow and ice and albedo cooling is considered.



**Results**

A review of the IPCC AR4 assessment (2007) showed there is no consideration of a world food emergency this century; in contrast, NH food production is assessed to increase for many decades.

There is no consideration of an Arctic albedo loss emergency; the Arctic sea ice decline is currently assessed to take many decades until it starts to become ice free. There is no consideration given to the loss of Far North snow and Arctic summer sea ice affecting NH crops. The Arctic positive feedback additional warming is excluded from the "most likely" global warming projections.

Total committed global warming by 2100 is over 3.0°C. According to (inadequate) climate crop model results and according to 'fought projections, this will result in dangerous reductions of all crop yields in all NH food-producing regions. The loss of Far North and Arctic snow and ice albedo cooling can only be expected to greatly increase these NH crop yield losses.

**Conclusions**

The world is committed to a NH food productivity decline, which is a most dangerous global climate change emergency for the entire world – a situation that is not being acknowledged or addressed.

To mitigate NH crop yield declines, emergency attention is necessary to protect the Far North and Arctic spring to autumn albedo cooling effect. To avoid large food production declines, and Arctic methane feedback tipping points at 1.5°C, we would have to limit warming to (today's) 0.8°C by 2100. This requires emergency action today for world food security.

The only published (not peer reviewed) emergency response to mitigate now unavoidable catastrophic impacts is Bill Hare's 1°C zero carbon scenario (Worldwatch, 2009). The IPCC's AR5 (in print) RCP 2.6°C scenario has an eventual equilibrium warming of 1°C but takes too long to reach zero carbon emissions, with warming of 1.5°C for too long.

