

# De geobserveerde en verwachte effecten van klimaatverandering

**Prof. Dr. Rik Leemans**

Environmental Systems Analysis Groups  
Wageningen University

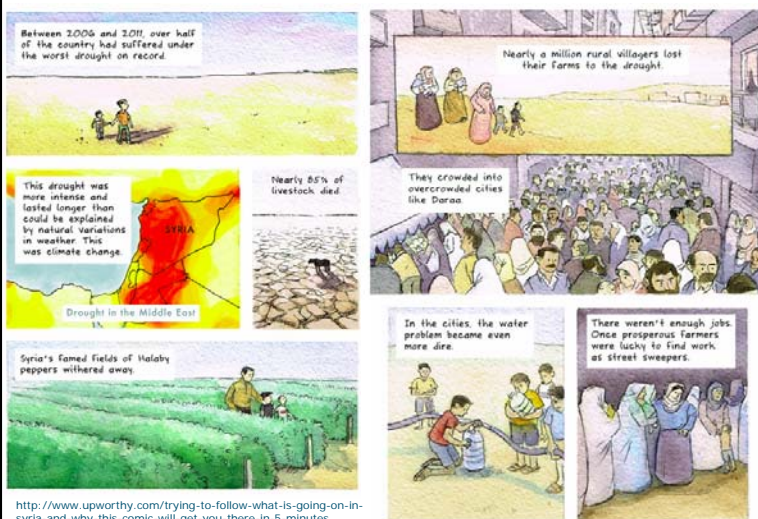
29 oktober 2015

NVV-symposium Klimaat & Energie, KNMI



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# Het Syrische conflict: Droogte, klimaatverandering en effecten op gewassen



<http://www.upworthy.com/trying-to-follow-what-is-going-on-in-syria-and-why-this-comic-will-get-you-there-in-5-minutes>



Kelley CP, Mohitadi S, Cane MA, Seager R, Kushnir Y: Climate change in the Fertile Crescent and implications of the recent Syrian drought. *Proceedings of the National Academy of Sciences* 2015, 112:3241-3246.  
Gleick PH: Water, Drought, Climate Change, and Conflict in Syria. *Weather, Climate, and Society* 2014, 6:331-340.

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## Klimaateffecten altijd al benoemd maar zijn in de loop van de tijd robuuster geworden

**Svante Arrhenius** (1896) dacht dat de wereld "may hope to enjoy ages with more equable and better climates"

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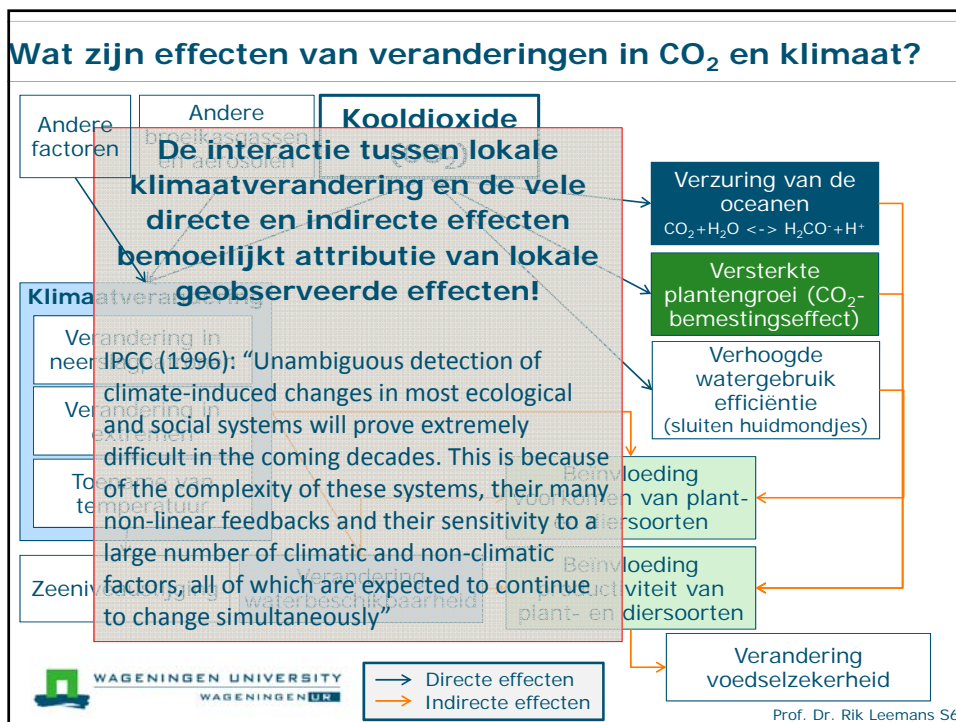
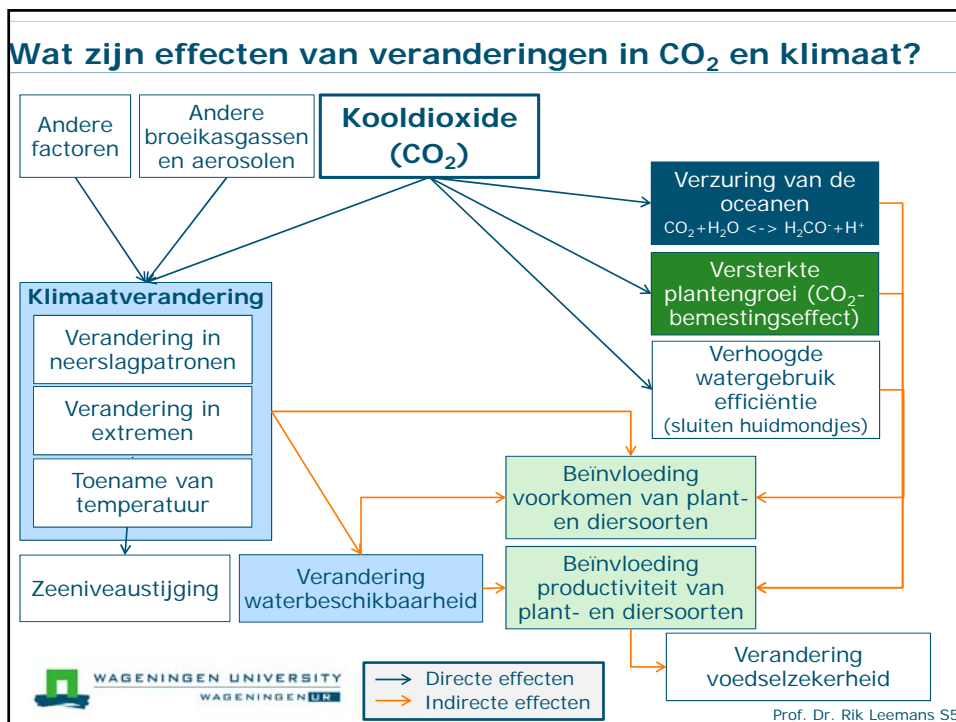
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**In de zeventiger en tachtiger jaren heeft de milieueffectrapportage zich ontwikkeld en worden effecten studies langzamerhand beter.**



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## The WG2 IPCC impact assessments (1990-2015)

1990	1995	2001	2007	2014
				
Impacts, Adaptations & Mitigation of CC		Impacts, Adaptation & Vulnerability		

Effecten op sectoren (landbouw, visserij etc.) en systemen (bossen, oceanen etc.)


Gebruik van klimaatscenario's

Gebruik van geïntegreerde klimaat, landgebruik en CO<sub>2</sub> scenario's

Effecten op regio's

Adaptatie

Geobserveerde effecten



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### HET KLIMAAT • Toename ziektes valt mee • Nederlandse natuur lijdt • Franse druiven houden het niet meer vol in Italië

## Dramatisch rapport dat alarmerende toon vermijdt

Het vandaag verschenen rapport van het IPCC geeft een gedetailleerd beeld van de gevolgen van de verandering van het klimaat. Op zakelijke toon worden rampen voorspeld.

**Door onze redacteur BART KUIJPER**

De IPCC-adviesgroep heeft in zijn laatste rapport, uitgebracht op 6 april 2014, de gevolgen van de verandering van het klimaat beschreven. Het is het meest uitgebreide rapport van het IPCC, dat de gevolgen van de verandering van het klimaat beschrijft. Het rapport is het resultaat van de werkgroep II van het IPCC, die de gevolgen van de verandering van het klimaat beschrijft. Het rapport is het resultaat van de werkgroep II van het IPCC, die de gevolgen van de verandering van het klimaat beschrijft.

**Drie IPCC-rapporten**

- De rapporten van het IPCC, die de gevolgen van de verandering van het klimaat beschrijven, zijn het resultaat van de werkgroep II van het IPCC, die de gevolgen van de verandering van het klimaat beschrijft.
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Voce bijeen op meubende bijeen in het meer van de Klau. Foto: foto: IPCC



Landbouw op de weg naar de toekomst. Foto: IPCC

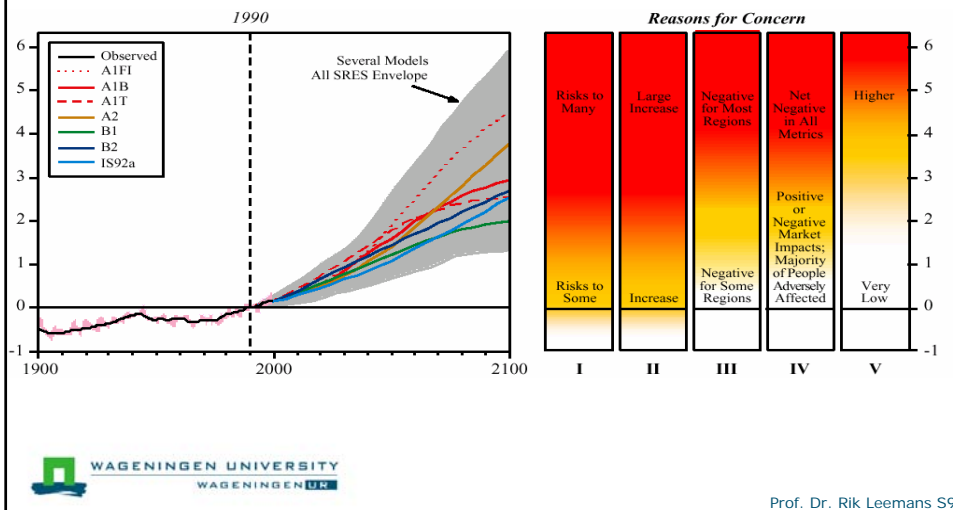


Een boer in de toekomst. Foto: IPCC

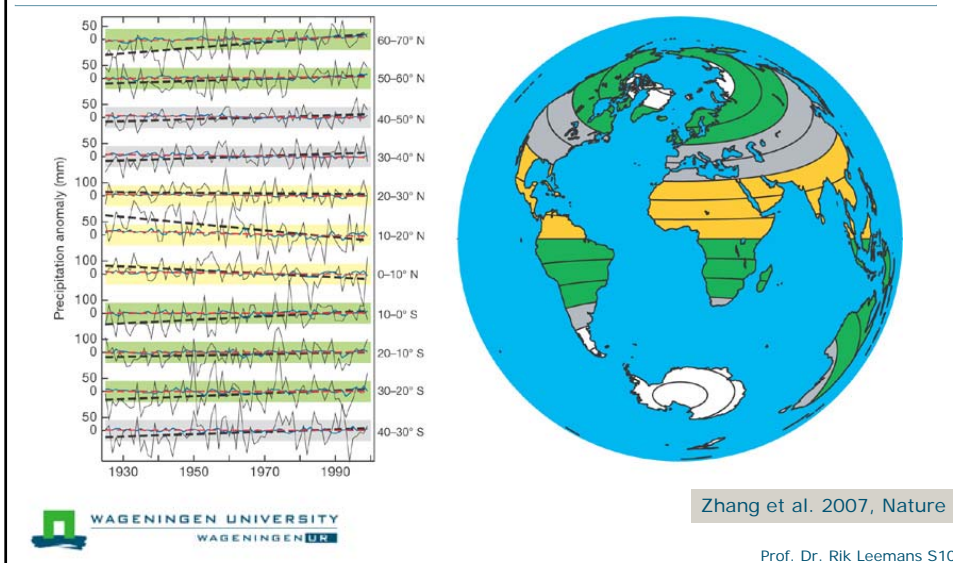


De klimaatverandering in de toekomst. Foto: IPCC

## Wat is gevaarlijke klimaatverandering? The burning-ember diagram 'Reasons for Concern'



## Geobserveerde veranderingen in gemiddelde zonale neerslagverschillen



# Effecten op ecosystemen



**Global Change Biology**

**Effects of climate warming on polar bears: a review of the evidence**

Stirling, I. and A. E. Derocher

DOI: 10.1111/gcb.12486

Abstract: Climate warming is driving substantial changes in annual patterns of sea ice distribution, structure, and thickness. The summertime evidence that documents low rates of sea ice, the primary habitat of polar bears (Ursus maritimus), suggests that long-term survival of the species could be compromised, even being trapped on ice as a condition that could be fatal due to the long energy deficit prior to accessible offshore energy. This is not the only concern, as sea ice is also a critical link in the marine food web. Because of phytoplankton blooms in spring, which are heavily dependent upon sea ice, the loss of this link could have cascading effects on the entire marine food web. Climate warming is also driving changes in hunting grounds, prey, and overall health. The loss of sea ice is also driving changes in the genetic diversity of polar bears, which is a concern for the species' long-term survival. The combination of climate change and sea ice loss is driving substantial changes in the genetic diversity of polar bears, which is a concern for the species' long-term survival. The combination of climate change and sea ice loss is driving substantial changes in the genetic diversity of polar bears, which is a concern for the species' long-term survival.

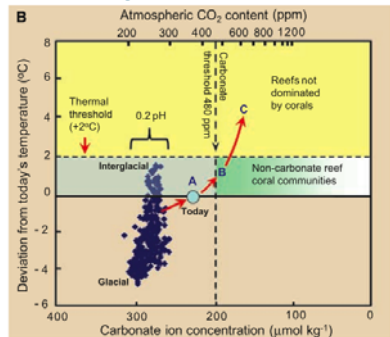
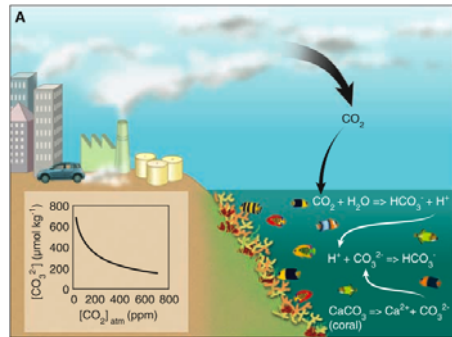
Stirling, I. and A. E. Derocher. 2012. Effects of climate warming on polar bears: a review of the evidence. *Global Change Biology* 18:2694-2706.



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# Snelle klimaatverandering en toenemende CO<sub>2</sub> is desastreus voor koraalriffen

- 1) Stijgende CO<sub>2</sub> concentraties verzuren de oceanen. Dit vermindert de capaciteit van harde koralen om riffen te bouwen
- 2) Hoge temperaturen verdrijven de symbiotische algen uit de rif poliepen ('bleking').



**1 + 2 = erg slecht nieuws voor koralen**



Hoegh-Guldberg et al. 2007 Science

## Snelle klimaatverandering en toenemende CO<sub>2</sub> is desastreuus voor koraalriffen

*Voorbeelden hoe de toekomst er uit kan zien*  
(foto's van het Great Barrier Reef)

**'gezond' koraalrif**



375 ppm  
+1°C

**'Gebleekt' koraalrif**

Bedekts al grote gebieden en dit zal in de komende decennia verder uitbreiden



450-500 ppm  
+2°C

**'Dood' rif**

Waarschijnlijk in hert midden van deze eeuw



> 500 ppm  
>+3°C

Hoegh-Guldberg et al. 2007 Science

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## De effecten van Klimaatverandering op vegetatie en branden: Observaties

Gonzalez et al. 2010

Global Ecology and Biogeography

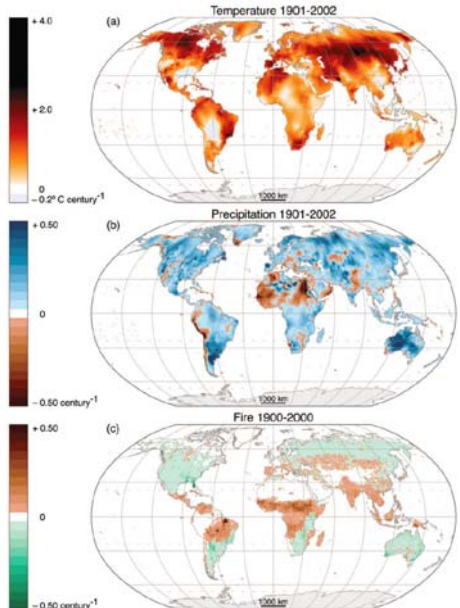
**Global patterns in the vulnerability of ecosystems to vegetation shifts due to climate change**

*Global Ecology and Biogeography*, 2010, Volume 19, Issue 1, Pages 1-12

**ABSTRACT**

**Key words:** climate change, vegetation, global vegetation models, ecosystem vulnerability, vegetation shifts, resiliability

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## De effecten van Klimaatverandering op vegetatie en branden: Projecties

Gonzalez et al. 2010

Global Ecology and Biogeography

**Global patterns in the vulnerability of ecosystems to vegetation shifts due to climate change**

**ABSTRACT**

**Methods:** We assessed the vulnerability of the world's potential vegetation to the projected changes in temperature, precipitation and CO<sub>2</sub> concentration using a global vegetation model. We used a global vegetation model to project the potential vegetation under different climate change scenarios (RCP2.6, RCP4.5, and RCP8.5) and compared the results with the current potential vegetation. We used a global vegetation model to project the potential vegetation under different climate change scenarios (RCP2.6, RCP4.5, and RCP8.5) and compared the results with the current potential vegetation.

**Results:** The world's potential vegetation is highly vulnerable to the projected changes in temperature, precipitation and CO<sub>2</sub> concentration. The potential vegetation under RCP8.5 is projected to be significantly different from the current potential vegetation. The potential vegetation under RCP8.5 is projected to be significantly different from the current potential vegetation.

**Key words:** Climate Change, Global Ecology, Global Vegetation Model, Potential Vegetation, Vulnerability, Vegetation Shifts, Vegetation Model.

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Global Vulnerability to Climate Change

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## De effecten van Klimaatverandering op vegetatie en branden: Veranderingen

Gonzalez et al. 2010

Global Ecology and Biogeography

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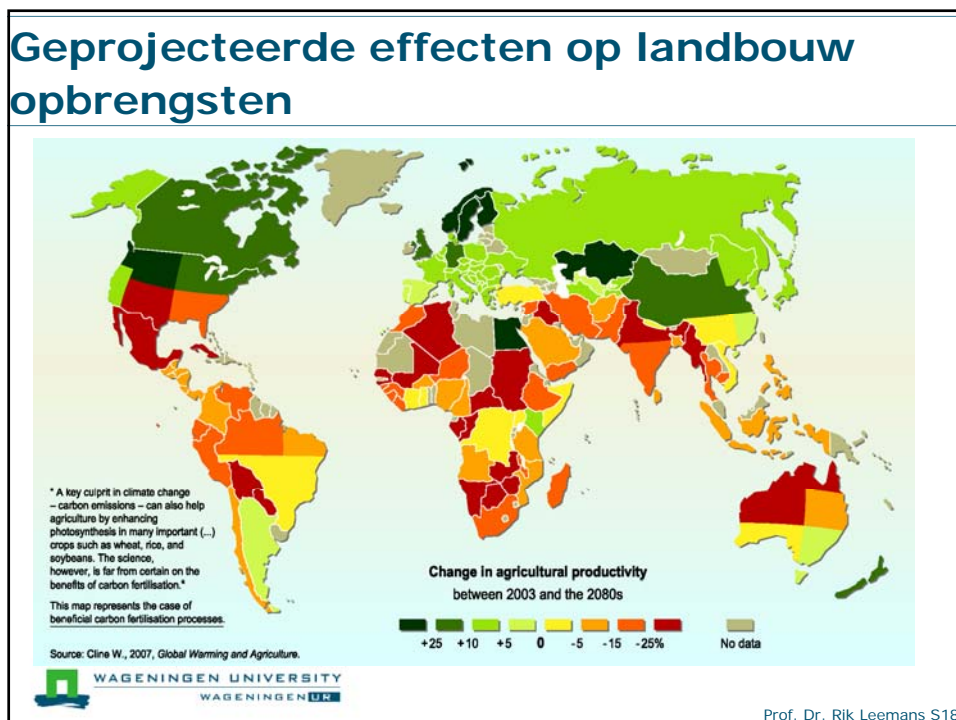
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## Economische effecten op landbouw in 'Nature' vandaag

**LETTER**

**Global non-linear effect of temperature on economic production**

Mansour Bahari<sup>1</sup>, Johannes M. Hoesung<sup>2,3</sup> & Edward Miguel<sup>4</sup>

Climate change adaptation that allows countries to have a profound impact on the functioning of modern human societies. The effect is economic growth, because modern human societies are able to produce more food, clothing and other goods, which in turn leads to higher living standards. The effect is also non-linear, because the impact of climate change on economic production is not linear. The impact is non-linear because the impact of climate change on economic production is not linear. The impact is non-linear because the impact of climate change on economic production is not linear.

If future adaptation mimics past adaptation, unmitigated warming is expected to reshape the global economy by reducing average global incomes roughly 23% by 2100 and widening global income inequality, relative to scenarios with-out climate change. In contrast to prior estimates, expected global losses are approximately linear in global mean temperature, with median losses many times larger than leading models indicate.

-100 -50 0 50 100  
Percentage change in GDP per capita

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## Gerrit Hansen PhD thesis

**Assessing the observed impact of anthropogenic climate change**

ma 14-09-2015

Today Gerrit Hansen defends her PhD thesis on the impact of anthropogenic climate change. She addresses the question whether and to what extent the impacts of anthropogenic climate change are already observed, i.e. detected and attributed, in natural and human systems. Promotor is Rik Leemans.

Global climate change is unequivocal, and greenhouse gas emissions continue rising despite international mitigation efforts. Hence whether and to what extent the impacts of human-induced climate change are already being felt around the world is a timely question. To this end, Gerrit Hansen assesses the observed impact of anthropogenic climate change across systems, sectors, and world regions. To lay out a clear framework for impact attribution studies and apply this to several examples from the literature. It documents the development of the evidence of climate change impacts over the last few decades, and provides an overview of the status of knowledge with a focus on recent trends in human and managed systems.

In her Thesis Gerrit assesses the size of human influence, compared to natural variability, for climate related impacts for a large range of individual observations that have been reported in the Intergovernmental Panel on Climate Change's Fifth Assessment Report. Her analysis is based on a novel method that explicitly considers information on the quality and appropriateness of observational and model data for each observation. The thesis discusses strengths and challenges in attributing observed effects to climate change, and points out the consequences of those limitations for scientific policy advice.

Key issues concern the question whether extreme weather events and their impacts can be attributed to human-induced climate change and the limited availability of long-term monitoring records in many vulnerable regions. Gerrit Hansen: "It concludes that the impact of anthropogenic climate change is confirmed for a broad range of natural system effects, and to a lesser degree for human systems, albeit confidence conclusions are mostly limited to direct temperature effects with precipitation effects remaining more uncertain."

Gerrit Hansen, 'Assessing the observed impact of anthropogenic climate change'

**Assessing the observed impact of anthropogenic climate change**

Gerrit Hansen

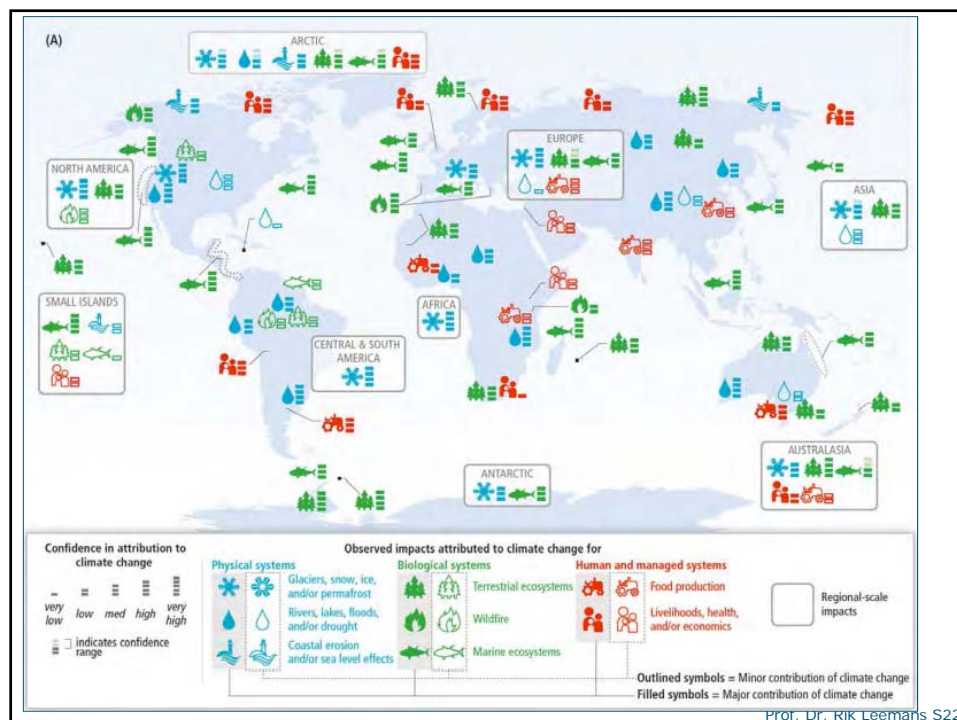
**Promotors:**

Max Affhammer (Univ. of Berkeley, California) & Rik Leemans (WUR)

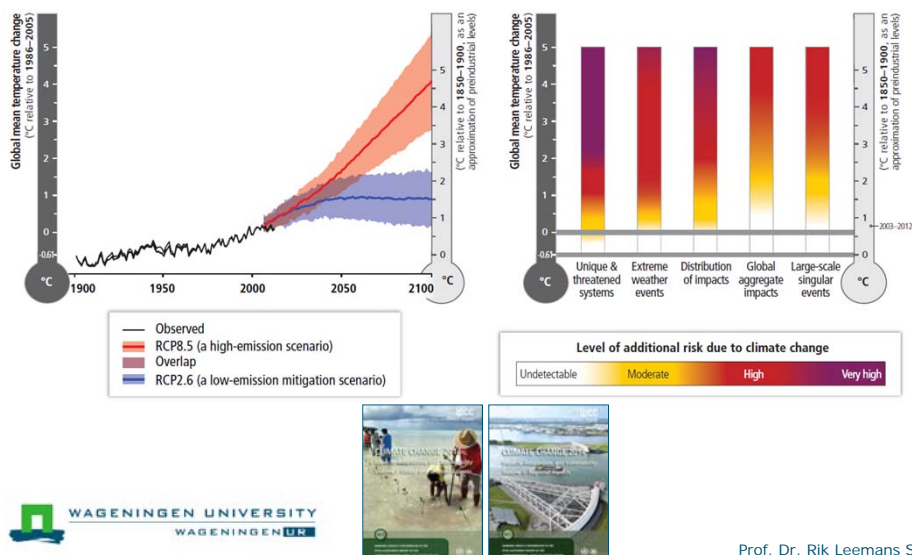
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## Gerrit's vijf stappen voor attributie van effecten

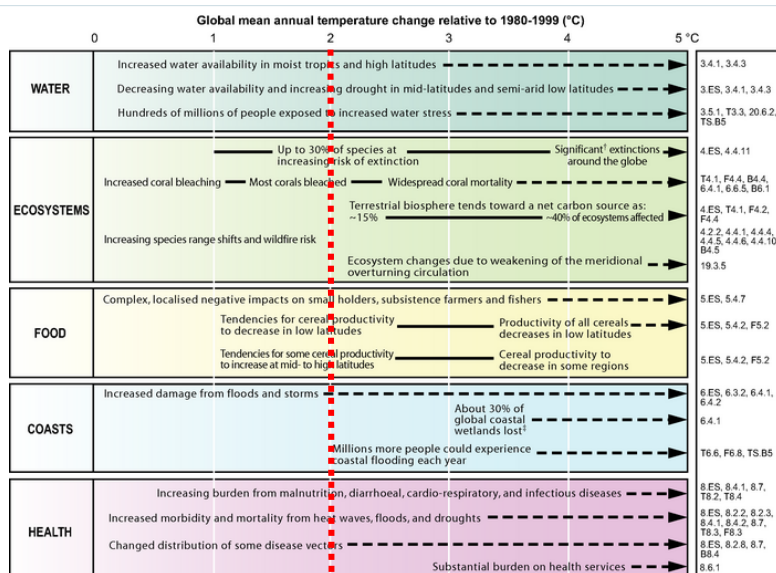
- Formuleren van een hypothese: Identificeer een potentieel effect van klimaatverandering op een systeem;
- Observatie van een klimaatrend in het relevante ruimtelijke domain en tijdspanne van dat systeem;
- Identificatie van het gedrag van het systeem in de afwezigheid van klimaatverandering;
- Demonstreer dat de geobserveerde verandering is consistent met het verwachte response op de klimaatrend en inconsistent met alle andere plausibele responses op niet-klimaatrends (**i.e. detectie van effecten**);
- Analyseer de grootte van de bijdrage van klimaatverandering tot de overall verandering, relatief tot de bijdragen van de andere trends (**i.e. attributie van effecten**).

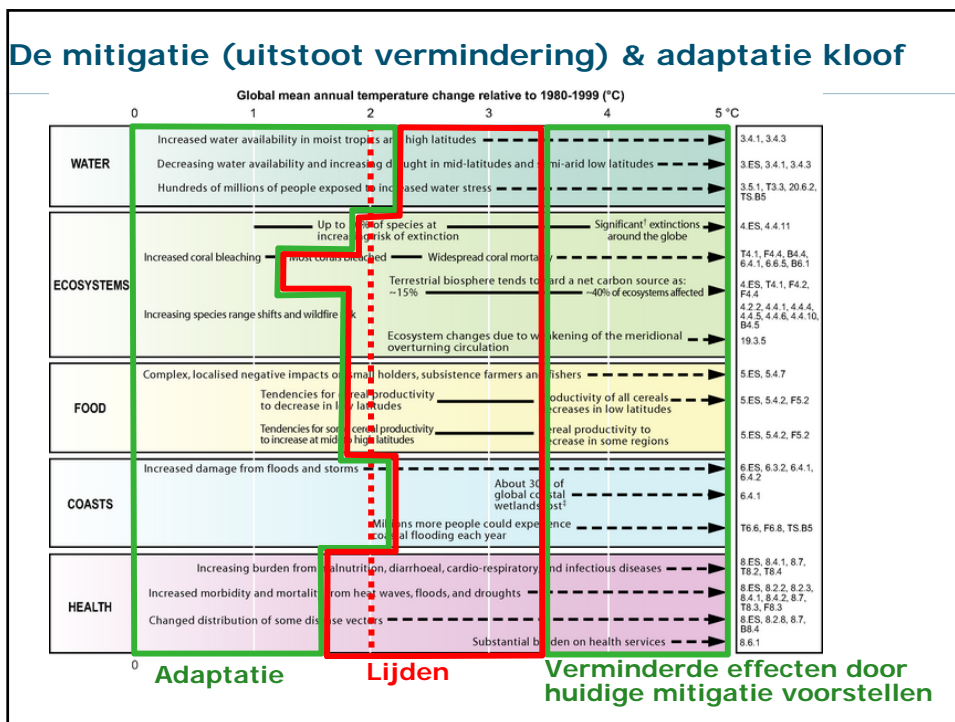


Risks associated with reasons for concern are shown at right for increasing levels of climate change.



### De mitigatie (uitstoot vermindering) & adaptatie kloof





## Twee recente wetenschappelijke rapporten die oproepen to meer en gecoördineerde actie!



Stichting Biowetenschappen en Maatschappij is ondergebracht bij ZonMw.



European Academies' Science Advisory Council

statement

### Facing critical decisions on climate change in 2015

**Summary**

This statement has three main purposes. Firstly, to provide scientific background to some issues with particular media/misconceptions, secondly, to highlight some recent science (such as the IPCC Assessment Report of the United Nations Intergovernmental Panel on Climate Change (IPCC, AR5) that has improved our understanding of the pace at which the climate is changing, and thirdly, to emphasize issues of particular importance to European Union policy makers.

We start with a brief overview of current trends in emissions of carbon dioxide (CO<sub>2</sub>). We go on to consider the importance of shorter lived greenhouse gases (including methane) and the response of natural ecosystems to global warming. We highlight the importance of adaptation and resilience in parallel with mitigation. On new scientific evidence, we provide a detailed explanation of why the medium term of a 'warming pause' is incorrect. We provide updated information on the rate of melting in the cryosphere (ice, snow, and glaciers), and local effects on the Gulf Stream.

Our conclusion is that recent evidence suggests that climate model predictions are in some respects particularly the cryosphere, more sensitive about the pace at which climate change is proceeding. This emphasizes the urgency for the 2015 United Nations Climate Change Conference in Paris (COP21) to produce an agreement that can deliver not just the target of a 2°C limit but to **limit warming below that figure**. This has major implications for the world's use of fossil fuels in the coming decades, the majority of whose reserves must remain unused if the target of there is to be a 50% chance of limiting warming to 2°C.

We note that the EU's Climate and Energy Policy Framework for 2030 puts the EU in a position of leadership through its target of reducing emissions by at least 40% below 1990 levels. We thus recommend that, for COP21, the EU should:

- negotiate energetically for an agreement that is capable of reducing emissions sufficient to limit global warming to less than 2°C;
- independently of the outcome of COP21, strengthen its leadership position by implementing its commitment to reduce emissions by 30% by 2020;
- emphasize the importance of parallel efforts to increase resilience to the risks posed by unavoidable climate change.

For further information: [secretariat@easac.eu](mailto:secretariat@easac.eu)  
[www.easac.eu](http://www.easac.eu)

Critical Decisions on Climate Change | October 2015 | 1

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