Nach Paris: Wie kriegen wir die Klimakrise noch in den Griff?

Prof. Stefan Rahmstorf
Potsdam-Institut für Klimafolgenforschung
Der Mensch verändert das Klima „durch Fällen der Wälder [...] und durch die Entwicklung großer Dampf- und Gasmassen an den Mittelpunkten der Industrie“. 

Alexander von Humboldt, 1843
Latest CO$_2$ reading
March 09, 2019
413.45 ppm

2 Watt/m$^2$
Strahlungsantrieb: die Ursache der Erwärmung

Quelle: US Climate Science Report 2017

Strahlungsantrieb in Watt pro Quadratmeter seit 1750
XXXI. On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground. By Prof. Svante Arrhenius.*

I. Introduction: Observations of Langley on Atmospheric Absorption.

A great deal has been written on the influence of the absorption of the atmosphere upon the climate. Tyndall† in particular has pointed out the enormous importance of this question. To him it was chiefly the diurnal and annual variations of the temperature that were lessened by this circumstance. Another side of the question, that has long attracted the attention of physicists, is this: Is the mean temperature of the ground in any way influenced by the presence of heat-absorbing gases in the atmosphere? Fourier‡ maintained that the atmosphere acts like the glass of a hot-house, because it lets through the light rays of the sun but retains the dark rays from the ground. This idea was elaborated by Pouillet§ and Langley was by some of his researches led to the view, that the temperature of the earth under direct sunshine, even though our atmosphere were present as now, would probably fall to −200°C, if that atmosphere did not possess the quality of selective

* Extract from a paper presented to the Royal Swedish Academy of Sciences, 11th December, 1885. Communicated by the Author.
† 'Heat a Mode of Motion,' 2nd ed. p. 435 (Lon., 1885).

Erwärmung bei CO2-Verdopplung: Klimasensitivität
Global Warming Has Begun, Expert Tells Senate

Sharp Cut in Burning of Fossil Fuels Is Urged to Battle Shift in Climate

By PHILIP SHABECOFF

WASHINGTON, June 26 — The earth has been warmer in the first five months of this year than in any comparable period since measurements began 130 years ago, and the higher temperatures can now be attributed to a long-expected global warming trend linked to pollution, a space agency scientist reported today.

Until now, scientists have been cautious about attributing rising global

1988
Europa-Temperatur, April - September
Globale Temperaturänderung seit der Eiszeit

Zukunft bis 2100

Paläodaten

heute

Globaler Temperaturtrend 1901 - 2013

Rahmstorf et al. Nature Climate Change 2015
Die Zukunft liegt in unserer Hand.
Die heißesten Sommer in Europa seit AD 1500:

- 2018
- 2010
- 2003
- 2016
- 2002

Barriopedro et al. (Science 2011) & update 2019

2003

Jahrhundertsonn
70 000 Hitzetote
Prozentsatz der Landfläche mit ungewöhnlich hohen Temperaturen

nach Coumou & Robinson (ERL 2013)
Extremwetter durch aufschaukeln der planetaren Wellen
California Fire Season Weather
Average Temperature and Precipitation May-Oct

Cool & Wet
- 1895-1919
- 1920-1939
- 1940-1959
- 1960-1979
- 1980-1999
- 2000-2018

Cool & Dry
- 2003
- 2017
- 2018

Hot & Wet
- 2000-2018

Hot & Dry
- 10 Largest Wildfires
- 10 Most Destructive Wildfires

Source: USGS
Sommer 2018: Über 400 Waldbrände in Brandenburg
Climate change rate to turn southern Spain to desert by 2100, report warns

Mediterranean ecosystems will change to a state unprecedented in the past 10,000 years unless temperature rises are held to within 1.5°C, say scientists

Syria's water security by exploiting limited land and water resources without regard for sustainability (10).

One critical consequence of these unsustainable policies is the decline of groundwater. Nearly all rainfall in the FC occurs during the 6-month winter season, November through April, and this rainfall exhibits large year-to-year variability (Figs. 1A and 2A). In Syria, the rain falls along the country's Mediterranean Sea coast and in the north and northeast, the primary agricultural region and the cultivated land in Syria is rain fed, but the remainder relies upon irrigation and groundwater (11). For those farms with access to irrigation canals linked to river tributaries, pump groundwater supplies over half (60%) of all water used for irrigation purposes, and this groundwater has become increasingly limited as extraction has been greatly overexploited (4). The government attempted to stem the rate of groundwater depletion by enacting a law in 2005 requiring a license to dig wells, but vegetation has been unaffected (6). Overuse of groundwater has been blamed for the recent drying of the Khabur River in the northeast (6). The depletion of groundwater during the last decade is clearly evident from remotely sensed data.
Tagesrekorde bei Niederschlägen

Lehmann et al. (Climatic Change 2015)
Die stärksten Tropenstürme in der Satellitenära (ab 1979)


Data from IBTrACS (v03r10, 1851-2015)
Historische Zugbahnen: Robert Rohde

Robert A. Rohde (@rarohde)
Anstieg des Meeresspiegels

Hohe Emissionen

Niedrige Emissionen

nach IPCC 2013
"Immediate global action to curb future warming is essential to secure a future for coral reefs"

I saw the Great Barrier Reef die last weekend, and I wept
There will be no rescue. We have killed the world’s greatest living structure. 11.3.2017
“...holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels.”
Three years to safeguard our climate

Christiana Figueres and colleagues set out a six-point plan for turning the tide of the world’s carbon dioxide by 2020.

Historic emissions

600-Gt carbon budget
- 2016 peak (best)
- 2020
- 2025

800-Gt carbon budget
- 2020 peak

Figueres et al. Nature 2017
Mit den Paris-Zielen kompatibles Emissionsbudget für Deutschland

IPCC 2018: für 1,75 °C ist das Budget 880 Gt CO2 ab Anfang 2016
Davon 1,1 % sind 9,7 Gt ab Anfang 2016, d.h. 7,3 Gt ab Anfang 2019
Naht die globale Emissionswende?

Globale CO2-Emissionen aus fossilen Quellen

- 1990–2000: +1.1%/yr
- 2000–10: +3.1%/yr
- 2010–17: +1.0%/yr

Prognose 2018: 37.1 Gt CO2
△ 2.7% (1.8–3.7%)

Quelle: Global Carbon Project
CO2-Ausstoß nach Ländern

Die Hauptverursacher
1. China
2. USA
3. EU
Etwas Optimismus...

Annual PV additions: historic data vs IEA WEO predictions
In GW of added capacity per year - source International Energy Agency - World Energy Outlook

please send comments to:
a.e.hoekstra@tue.nl
@aukehoekstra

Stromerzeugung
Deutschland 2018
Einige Folgerungen

Die Klimakrise ist real, von uns verursacht und dringend

Die Folgen für uns Menschen in Form von Extremereignissen, Ernteausfällen usw. sind heute schon spürbar und werden massiv zunehmen

Die Ziele des Pariser Klimaabkommens müssen daher konsequent umgesetzt werden

Sie bedeuten Nullemision weltweit bis spätestens 2050!

Weltweit und auch in Deutschland reicht das Tempo der Emissionsreduktion noch lange nicht aus.
Herzlichen Dank für Ihr Interesse! Mehr lesen?

Blog: KlimaLounge

Folgen Sie mir:/twitter/facebook/instagram