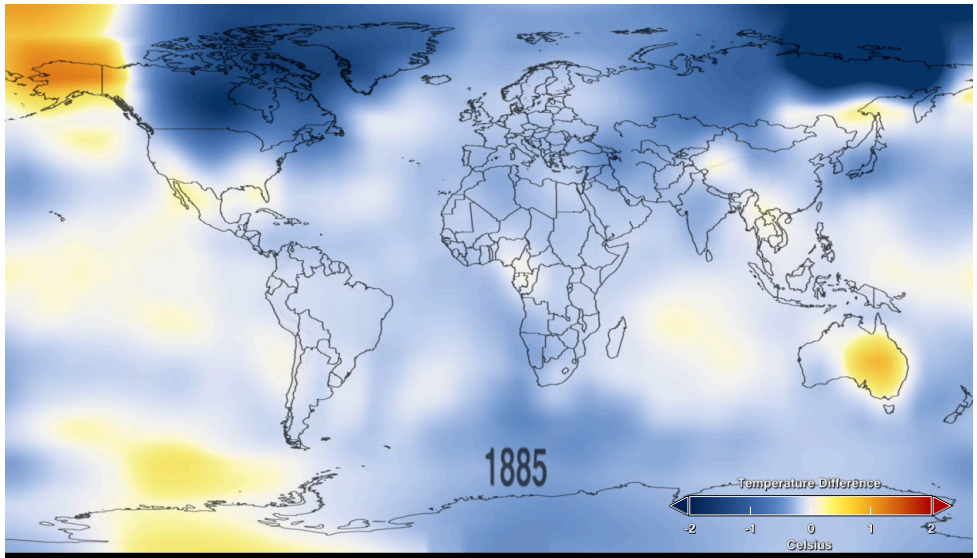
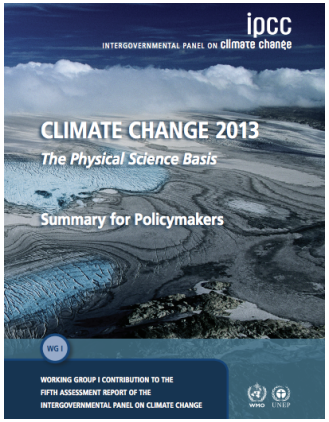


NASA Goddard Institute for Space Studies analyzis of global temperature data.

http://svs.gsfc.nasa.gov/vis/a000000/a003600/a003674/index.html



Confidence Terminology	Degree of confidence in being correct
Very high confidence	At least 9 out of 10 chance
High confidence	About 8 out of 10 chance
Medium confidence	About 5 out of 10 chance
Low confidence	About 2 out of 10 chance
Very low confidence	Less than 1 out of 10 chance

Likelihood Terminology	Likelihood of the occurrence/ outcome
Virtually certain	> 99% probability
Extremely likely	> 95% probability
Very likely	> 90% probability
Likely	> 66% probability
More likely than not	> 50% probability
About as likely as not	33 to 66% probability
Unlikely	< 33% probability
Very unlikely	< 10% probability
Extremely unlikely	< 5% probability
Exceptionally unlikely	< 1% probability

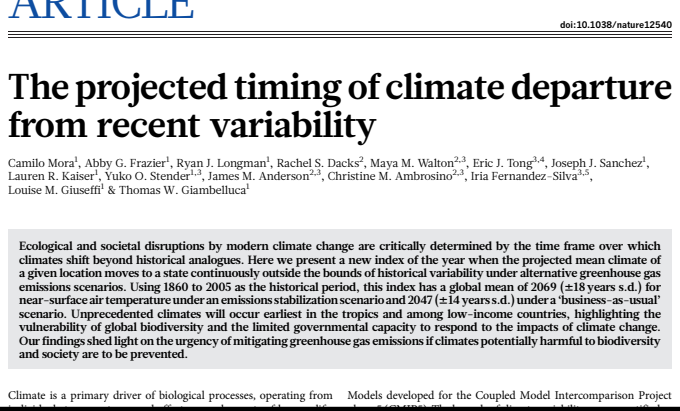
SO WHAT DOES THE FUTURE HOLD?

So…

According to the latest data (October 2015) on the prevalence of global warming denial among the US public, 1 in 6 of Americans do not believe that global warming is happening. About 2/3 do believe that global warming is happening, but half of these don't think this has anything to do with human activities.

Note that these statistics are much better than 2 years ago, where 1 in 4 Americans thought that global warming was not happening - this happened to represent a 6 year high.

http://environment.yale.edu/climate-communication/article/more-americans-perceive-harm-from-global-warming-survey-finds



ARTICLE

doi:10.1038/nature12540

The projected timing of climate departure from recent variability

Camilo Mora[1], Abby G. Frazier[1], Ryan J. Longman[1], Rachel S. Dacks[2], Maya M. Walton[2,3], Eric J. Tong[3,4], Joseph J. Sanchez[1], Lauren R. Kaiser[1], Yuko O. Stender[1,3], James M. Anderson[2,3], Christine M. Ambrosino[2,3], Iria Fernandez-Silva[3,5], Louise M. Giuseffi[1] & Thomas W. Giambelluca[1]

Ecological and societal disruptions by modern climate change are critically determined by the time frame over which climates shift beyond historical analogues. Here we present a new index of the year when the projected mean climate of a given location moves to a state continuously outside the bounds of historical variability under alternative greenhouse gas emissions scenarios. Using 1860 to 2005 as the historical period, this index has a global mean of 2069 (±18 years s.d.) for near-surface air temperature under an emissions stabilization scenario and 2047 (±14 years s.d.) under a 'business-as-usual' scenario. Unprecedented climates will occur earliest in the tropics and among low-income countries, highlighting the vulnerability of global biodiversity and the limited governmental capacity to respond to the impacts of climate change. Our findings shed light on the urgency of mitigating greenhouse gas emissions if climates potentially harmful to biodiversity and society are to be prevented.

Climate is a primary driver of biological processes, operating from … Models developed for the Coupled Model Intercomparison Project

E8: A large fraction of anthropogenic climate change resulting from CO_2 emissions is irreversible on a multi-century to millennial time scale, except in the case of a large net removal of CO_2 from the atmosphere over a sustained period. Surface temperatures will remain approximately constant at elevated levels for many centuries after a complete cessation of net anthropogenic CO_2 emissions. Due to the long time scales of heat transfer from the ocean surface to depth, ocean warming will continue for centuries. Depending on the scenario, about 15 to 40% of emitted CO_2 will remain in the atmosphere longer than 1,000 years.

ARTICLE

doi:10.1038/nature12829

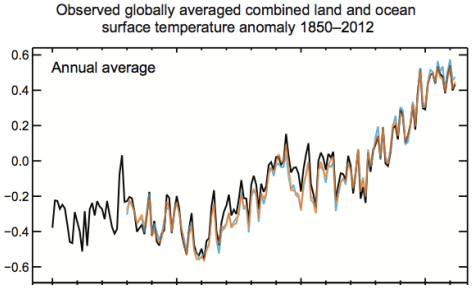
Spread in model climate sensitivity traced to atmospheric convective mixing

Steven C. Sherwood[1], Sandrine Bony[2] & Jean-Louis Dufresne[2]

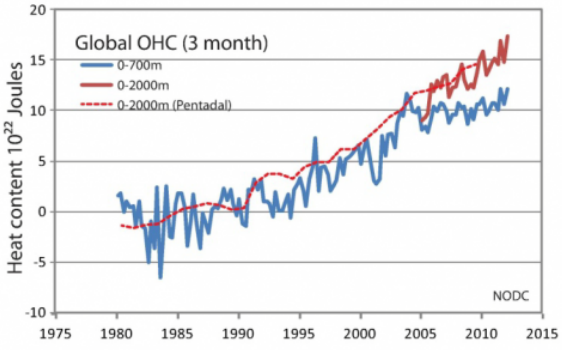
Equilibrium climate sensitivity refers to the ultimate change in global mean temperature in response to a change in external forcing. Despite decades of research attempting to narrow uncertainties, equilibrium climate sensitivity estimates from climate models still span roughly 1.5 to 5 degrees Celsius for a doubling of atmospheric carbon dioxide concentration, precluding accurate projections of future climate. The spread arises largely from differences in the feedback from low clouds, for reasons not yet understood. Here we show that differences in the simulated strength of

E1: Increase of global mean surface temperatures for 2081–2100 relative to 1986–2005 is projected to *likely* be in the ranges derived from the concentration-driven CMIP5 model simulations, that is, 0.3°C to 1.7°C (RCP2.6), 1.1°C to 2.6°C (RCP4.5), 1.4°C to 3.1°C (RCP6.0), 2.6°C to 4.8°C (RCP8.5). The Arctic region will warm more rapidly than the global mean, and mean warming over land will be larger than over the ocean (*very high confidence*)

E1: Relative to the average from year 1850 to 1900, global surface temperature change by the end of the 21st century is projected to *likely* exceed 1.5°C for RCP4.5, RCP6.0 and RCP8.5 (*high confidence*). Warming is *likely* to exceed 2°C for RCP6.0 and RCP8.5 (*high confidence*), *more likely than not* to exceed 2°C for RCP4.5 (*high confidence*), but *unlikely* to exceed 2°C for RCP2.6 (*medium confidence*). Warming is *unlikely* to exceed 4°C for RCP2.6, RCP4.5 and RCP6.0 (*high confidence*) and is about *as likely as not* to exceed 4°C for RCP8.5 (*medium confidence*).



D1: The observed reduction in surface warming trend over the period 1998 to 2012 as compared to the period 1951 to 2012, is due in roughly equal measure to a reduced trend in radiative forcing and a cooling contribution from natural internal variability, which includes a possible redistribution of heat within the ocean (*medium confidence*). The reduced trend in radiative forcing is primarily due to volcanic eruptions and the timing of the downward phase of the 11-year solar cycle. However, there is *low confidence* in quantifying the role of changes in radiative forcing in causing the reduced warming trend. There is *medium confidence* that natural internal decadal variability causes to a substantial degree the difference between observations and the simulations; the latter are not expected to reproduce the timing of natural internal variability. There may also be a contribution from forcing inadequacies and, in some models, an overestimate of the response to increasing greenhouse gas and other anthropogenic forcing (dominated by the effects of aerosols).



Abrahams et al., 2013. A review of global ocean temperature observations: Implications for ocean heat content estimates and climate change. 10.1002/rog.20022

B2: More than 60% of the net energy increase in the climate system is stored in the upper ocean (0–700 m) during the relatively well-sampled 40-year period from 1971 to 2010, and about 30% is stored in the ocean below 700 m. The increase in upper ocean heat content during this time period estimated from a linear trend is *likely* 17 [15 to 19] × 10^{22} J

It is about *as likely as not* that ocean heat content from 0–700 m increased more slowly during 2003 to 2010 than during 1993 to 2002. Ocean heat uptake from 700–2000 m, where interannual variability is smaller, *likely* continued unabated from 1993 to 2009.

ticle

Coverage bias in the HadCRUT4 temperature series and its impact on recent temperature trends.

Kevin Cowtan[a]* Robert G. Way[b]
[a]*Department of Chemistry, University of York, UK*
[b]*Department of Geography, University of Ottawa, Canada*
*Correspondence to: kevin.cowtan@york.ac.uk

Incomplete global coverage is a potential source of bias in global temperature reconstructions if the unsampled regions are not uniformly distributed over the planet's surface. The widely used HadCRUT4 dataset covers on average about 84% of the globe over recent decades, with the unsampled regions being concentrated at the poles and over Africa. Three existing reconstructions with near-global coverage are examined, each suggesting that HadCRUT4 is subject

B1: It is *virtually certain* that globally the troposphere has warmed since the mid-20th century. More complete observations allow greater confidence in estimates of tropospheric temperature changes in the extratropical Northern Hemisphere than elsewhere. There is *medium confidence* in the rate of warming and its vertical structure in the Northern Hemisphere extra-tropical troposphere and *low confidence* elsewhere.

Confidence in precipitation change averaged over global land areas since 1901 is *low* prior to 1951 and *medium* afterwards. Averaged over the mid-latitude land areas of the Northern Hemisphere, precipitation has increased since 1901 (*medium confidence* before and *high confidence* after 1951). For other latitudes area-averaged long-term positive or negative trends have *low confidence*

REVIEW

EARTH HISTORY

The Anthropocene is functionally and stratigraphically distinct from the Holocene

Colin N. Waters,[1]* Jan Zalasiewicz,[2] Colin Summerhayes,[3] Anthony D. Barnosky,[4] Clément Poirier,[5] Agnieszka Gałuszka,[6] Alejandro Cearreta,[7] Matt Edgeworth,[8] Erle C. Ellis,[9] Michael Ellis,[1] Catherine Jeandel,[10] Reinhold Leinfelder,[11] J. R. McNeill,[12] Daniel deB. Richter,[13] Will Steffen,[14] James Syvitski,[15] Davor Vidas,[16] Michael Wagreich,[17] Mark Williams,[2] An Zhisheng,[18] Jacques Grinevald,[19] Eric Odada,[20] Naomi Oreskes,[21] Alexander P. Wolfe[22]

Human activity is leaving a pervasive and persistent signature on Earth. Vigorous debate continues about whether this warrants recognition as a new geologic time unit known as the Anthropocene. We review anthropogenic markers of functional changes in the Earth system through the stratigraphic record. The appearance of manufactured materials in sediments, including aluminum, plastics, and concrete, coincides with global spikes in fallout radionuclides and particulates from fossil fuel combustion. Carbon, nitrogen, and phosphorus cycles have been substantially modified over the past century. Rates of sea-level rise and the extent of human perturbation of the climate system exceed Late Holocene changes. Biotic changes include species invasions worldwide and accelerating rates of extinction. These combined signals render the Anthropocene stratigraphically distinct from the Holocene and earlier epochs.

The term "Anthropocene" is currently used informally to encompass different geological, ecological, sociological, and anthropological changes in recent Earth history. The

Here we review several lines of evidence suggesting that the Anthropocene's stratigraphic signatures distinguish it from the Holocene (Fig. 1). We find that criteria available to recognize the (expressed as marine isotope stages), in association with paleomagnetic reversals (*11*). This contrasts with the subdivision of most of the Phanerozoic eon (the past ~541 ± 1 Ma), for which the first or last appearance of key fossil taxa is typically used to define time units. Fossil-based boundaries represent change at rates too slow and time-transgressive for the geologically recent past, in which the time units are of comparatively short duration (about 12,000 years for the Holocene versus 2 million years or more for earlier epochs). These time intervals are recognizable in the geologic record as chronostratigraphic units (series and stages), which, in contrast to the time units, are physical entities, including rocks, sediments, and glacier ice. Ideally, a chronostratigraphic unit is exemplified, and its lower boundary defined, at a single locality termed the Global Boundary Stratotype Section and Point (GSSP), which is typically in marine strata for pre-Holocene series (*12*).

The start of the Holocene epoch (or series) is based on the termination of the transition from the last glacial phase into an interval of warming accompanied by ~120 m of sea-level rise. The warming took place over about 1600 years and is recorded by a variety of stratigraphic signals that are not all globally synchronous. In the Northern Hemisphere, the signal for the Holocene's beginning

[1]British Geological Survey, Keyworth, Nottingham NG12 5GG, UK. [2]Department of Geology, University of Leicester, University Road, Leicester LE1 7RH, UK. [3]Scott Polar Research Institute, Cambridge University, Lensfield Road, Cambridge CB2 1ER, UK. [4]Department of Integrative Biology, Museum of Paleontology, and Museum of Vertebrate Zoology, University of California–Berkeley, Berkeley, CA 94720, USA. [5]Morphodynamique Continentale et Côtière, Université de Caen Normandie, Centre National de la Recherche Scientifique (CNRS), 24 Rue des Tilleuls, F-14000

Waters et al., (2016) The Anthropocene is functionally and stratigraphically distinct from the Holocene. DOI: 10.1126/science.aad2622

WHICH ONE IS FALSE?

1. A paper examining the *albedo* effects of the vast sheep population in New Zealand has been previously published. In this paper, it noted the sharp decline in sheep numbers in a 2006 foot and mouth outbreak correlated strongly with noticeably lowered reflection measurements.

2. If we were to assume that Spongebob Squarepants is real, various ocean models suggest that he would be in serious trouble in about 50 years or so.

3. Research has shown that cow farts contribute significant positive radiative forcing.

Vol 437|29 September 2005|doi:10.1038/nature04095 nature

ARTICLES

Anthropogenic ocean acidification over the twenty-first century and its impact on calcifying organisms

James C. Orr[1], Victoria J. Fabry[2], Olivier Aumont[3], Laurent Bopp[1], Scott C. Doney[4], Richard A. Feely[5], Anand Gnanadesikan[6], Nicolas Gruber[7], Akio Ishida[8], Fortunat Joos[9], Robert M. Key[10], Keith Lindsay[11], Ernst Maier-Reimer[12], Richard Matear[13], Patrick Monfray[1]†, Anne Mouchet[14], Raymond G. Najjar[15], Gian-Kasper Plattner[7,9], Keith B. Rodgers[1,16]†, Christopher L. Sabine[5], Jorge L. Sarmiento[10], Reiner Schlitzer[17], Richard D. Slater[10], Ian J. Totterdell[13]†, Marie-France Weirig[17], Yasuhiro Yamanaka[8] & Andrew Yool[18]

Today's surface ocean is saturated with respect to calcium carbonate, but increasing atmospheric carbon dioxide concentrations are reducing ocean pH and carbonate ion concentrations, and thus the level of calcium carbonate saturation. Experimental evidence suggests that if these trends continue, key marine organisms—such as corals and some plankton—will have difficulty maintaining their external calcium carbonate skeletons. Here we use 13 models of the ocean–carbon cycle to assess calcium carbonate saturation under the IS92a 'business-as-usual' scenario for future emissions of anthropogenic carbon dioxide. In our projections, Southern Ocean surface waters will begin to become undersaturated with respect to aragonite, a metastable form of calcium carbonate, by the year 2050. By 2100, this undersaturation could extend throughout the entire Southern Ocean and into the subarctic Pacific Ocean. When live pteropods were exposed to our predicted level of undersaturation during a two-day shipboard experiment, their aragonite shells showed notable dissolution. Our findings indicate that conditions detrimental to high-latitude ecosystems could develop within decades, not centuries as suggested previously.

Ocean uptake of CO_2 will help moderate future climate change, but These rates decline even when surface waters remain supersaturated

B5: Ocean acidification is quantified by decreases in pH. The pH of ocean surface water has decreased by 0.1 since the beginning of the industrial era (*high confidence*), corresponding to a 26% increase in hydrogen ion concentration

$$CO_2 + H_2O \rightarrow H_2CO_3 \rightarrow H^+ + HCO_3^-$$

E7: Earth System Models project a global increase in ocean acidification for all RCP scenarios. The corresponding decrease in surface ocean pH by the end of 21st century is in the range of 0.06 to 0.07 for RCP2.6, 0.14 to 0.15 for RCP4.5, 0.20 to 0.21 for RCP6.0, and 0.30 to 0.32 for RCP8.5

Methane Emissions from Cattle

K. A. Johnson* and D. E. Johnson†

Departments of Animal Science, *Washington State University, Pullman 99164 and †Colorado State University Fort Collins, 48824

ABSTRACT: Increasing atmospheric concentrations of methane have led scientists to examine its sources of origin. Ruminant livestock can produce 250 to 500 L of methane per day. This level of production results in estimates of the contribution by cattle to global warming that may occur in the next 50 to 100 yr to be a little less than 2%. Many factors influence methane emissions from cattle and include the following: level of feed intake, type of carbohydrate in the diet, feed processing, addition of lipids or ionophores to the diet, and alterations in the ruminal microflora. Manipulation of these factors can reduce methane emissions from cattle. Many techniques exist to quantify methane emissions from individual or groups of animals. Enclosure techniques are precise but require trained animals and may limit animal movement. Isotopic and nonisotopic tracer techniques may also be used effectively. Prediction equations based on fermentation balance or feed characteristics have been used to estimate methane production. These equations are useful, but the assumptions and conditions that must be met for each equation limit their ability to accurately predict methane production. Methane production from groups of animals can be measured by mass balance, micrometeorological, or tracer methods. These techniques can measure methane emissions from animals in either indoor or outdoor enclosures. Use of these techniques and knowledge of the factors that impact methane production can result in the development of mitigation strategies to reduce methane losses by cattle. Implementation of these strategies should result in enhanced animal productivity and decreased contributions by cattle to the atmospheric methane budget.

Key Words: Cattle, Methane, Global Warming

J. Anim. Sci. 1995. 73:2483–2492

Introduction

Cattle typically lose 6% of their ingested energy as eructated methane. Animal science nutrition research

present levels of approximately 1,800 ppb (Khalil et al., 1993). The more than 500 Tg (1 Tg = 1 million metric tons) of methane that enters the atmosphere annually exceeds its atmospheric and terrestrial

B5: Concentrations of CO_2, CH_4, and N_2O now substantially exceed the highest concentrations recorded in ice cores during the past 800,000 years. The mean rates of increase in atmospheric concentrations over the past century are, with very *high confidence*, unprecedented in the last 22,000 years.

OPEN ACCESS
IOP Publishing
Environmental Research Letters
Environ. Res. Lett. **8** (2013) 035014 (7pp)
doi:10.1088/1748-9326/8/3/035014

Permafrost degradation and methane: low risk of biogeochemical climate-warming feedback

Xiang Gao[1], C Adam Schlosser[1], Andrei Sokolov[1], Katey Walter Anthony[2], Qianlai Zhuang[3] and David Kicklighter[4]

[1] Joint Program on the Science and Policy of Global Change, Massachusetts Institute of Technology, Cambridge, MA, USA
[2] Water and Environmental Research Center, University of Alaska, Fairbanks, AK, USA
[3] Departments of Earth and Atmospheric Science, Purdue University, West Lafayette, IN, USA
[4] The Ecosystems Center, Marine Biology Laboratory, Woods Hole, MA, USA

E-mail: xgao304@mit.edu

Received 29 March 2013
Accepted for publication 20 June 2013
Published 10 July 2013
Online at stacks.iop.org/ERL/8/035014

Abstract
Climate change and permafrost thaw have been suggested to increase high latitude methane emissions that could potentially represent a strong feedback to the climate system. Using an integrated earth-system model framework, we examine the degradation of near-surface permafrost, temporal dynamics of inundation (lakes and wetlands) induced by hydro-climatic change, subsequent methane emission, and potential climate feedback. We find that increases

E7: The release of CO_2 or CH_4 to the atmosphere from thawing permafrost carbon stocks over the 21st century is assessed to be in the range of 50 to 250 GtC for RCP8.5 (*low confidence*).

Global Change Biology

Global Change Biology (2011), doi: 10.1111/j.1365-2486.2011.02577.x

Radiative forcing of natural forest disturbances

THOMAS L. O'HALLORAN*, BEVERLY E. LAW*, MICHAEL L. GOULDEN†, ZHUOSEN WANG‡, JORDAN G. BARR§, CRYSTAL SCHAAF‡, MATHEW BROWN¶, JOSÉ D. FUENTES**, MATHIAS GÖCKEDE*, ANDREW BLACK¶ and VIC ENGEL§

**Department of Forest Ecosystems and Society, Oregon State University, Corvallis, OR 97331, USA, †Department of Earth System Science, University of California, Irvine, CA 92697, USA, ‡Center for Remote Sensing, Boston University, Boston, MA 02215, USA, §South Florida Natural Resource Center, Everglades National Park, Homestead, FL 33030, USA, ¶Faculty of Land and Food Systems, University of British Columbia, Vancouver, BC V6T 1Z4, Canada, **Department of Meteorology, Penn State University, University Park, PA 16802, USA*

Abstract

Forest disturbances are major sources of carbon dioxide to the atmosphere, and therefore impact global climate. Biogeophysical attributes, such as surface albedo (reflectivity), further control the climate-regulating properties of forests. Using both tower-based and remotely sensed data sets, we show that natural disturbances from wildfire, beetle outbreaks, and hurricane wind throw can significantly alter surface albedo, and the associated radiative forcing either offsets or enhances the CO_2 forcing caused by reducing ecosystem carbon sequestration over multiple years. In the examined cases, the radiative forcing from albedo change is on the same order of magnitude as the CO_2 forcing. The net radiative forcing resulting from these two factors leads to a local heating effect in a hurricane-damaged mangrove forest in the subtropics, and a cooling effect following wildfire and mountain pine beetle attack in boreal forests with winter snow. Although natural forest disturbances currently represent less than half of gross forest cover loss, that area will probably increase in the future under climate change, making it imperative to represent these processes accurately in global climate models.

Keywords: albedo, beetles, carbon, disturbance, fire, forests, hurricane, radiative forcing

Received 24 August 2011; revised version received 24 August 2011 and accepted 15 September 2011

Introduction

Terrestrial disturbances are primary regulators of the global carbon cycle (Running, 2008), and can switch

et al., 2003). Warming climate has also contributed to increasing the size and frequency of wildfires (Kasischke & Turetsky, 2006). Over the last 50 years, an average 2 million ha of boreal forest have burned each

D3: It is *likely* that there has been an anthropogenic contribution to observed reductions in Northern Hemisphere spring snow cover since 1970.

WHICH ONE IS FALSE?

1. Research on the effect of climate change on squirrel sex has been published in peer reviewed journals.

2. Survey evidence has shown that viewers do statistically become more concerned about global warming after watching the "*The Day After Tomorrow*" - a big budget action movie about a catastrophic change in thermohaline circulation.

3. In 2011, the state of North Carolina passed a bill that deemed it *illegal* for the sea level to increase greater than a "projected" 20cm by 2100.

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B

rstb.royalsocietypublishing.org

Research

Cite this article: Sheriff MJ, Richter MM, Buck CL, Barnes BM. 2013 Changing seasonality and phenological responses of free-living male arctic ground squirrels: the importance of sex. Phil Trans R Soc B 368: 20120480.

Changing seasonality and phenological responses of free-living male arctic ground squirrels: the importance of sex

Michael J. Sheriff[1], Melanie M. Richter[2,3], C. Loren Buck[2] and Brian M. Barnes[4]

[1]Department of Ecosystem Science and Management, Pennsylvania State University, 117 Forest Resources Building, University Park, PA 16802, USA
[2]Department of Biological Sciences, University of Alaska, Anchorage, 3101 Science Circle, Anchorage, AK 99508, USA
[3]Department of Biology and Wildlife, and [4]Institute of Arctic Biology, University of Alaska Fairbanks, 902 N. Koyukuk Dr., Fairbanks, AK 99775, USA

Many studies have addressed the effects of climate change on species as a whole; however, few have examined the possibility of sex-specific differences. To understand better the impact that changing patterns of snow-cover have on an important resident Arctic mammal, we investigated the long-term (13 years) phenology of hibernating male arctic ground squirrels living at two nearby sites in northern Alaska that experience significantly different snow-cover regimes. Previously, we demonstrated that snow-cover influences the timing of phenological events in females. Our results here suggest that the end of

D3: Greenhouse gases contributed a global mean surface warming *likely* to be in the range of 0.5°C to 1.3°C over the period 1951 to 2010, with the contributions from other anthropogenic forcings, including the cooling effect of aerosols, *likely* to be in the range of –0.6°C to 0.1°C. The contribution from natural forcings is *likely* to be in the range of –0.1°C to 0.1°C, and from natural internal variability is likely to be in the range of –0.1°C to 0.1°C. Together these assessed contributions are consistent with the observed warming of approximately 0.6°C to 0.7°C over this period.

General Assembly of North Carolina **SESSION 2011**

(b) No county, municipality, or other local public body shall adopt any rule, ordinance, policy, or planning guideline addressing sea-level rise, unless it is a coastal-area county or is located within a coastal-area county.

(c) No rule, ordinance, policy, or planning guideline that defines the rate of sea-level rise shall be adopted except as provided by this section.

(d) The General Assembly does not intend to mandate the development of sea-level rise policy or rates of sea-level rise. If, however, the Coastal Resources Commission decides to develop rates of sea-level rise, the Commission may do so, but only by instructing the Division of Coastal Management to calculate the rates.

(e) The Division of Coastal Management shall be the only State agency authorized to develop rates of sea-level rise and shall do so only at the request of the Commission. These rates shall only be determined using historical data, and these data shall be limited to the time period following the year 1900. Rates of sea-level rise may be extrapolated linearly to estimate future rates of rise but shall not include scenarios of accelerated rates of sea-level rise. Rates of sea-level rise shall not be one rate for the entire coast but, rather, the Division shall consider separately oceanfront and estuarine shorelines. For oceanfront shorelines, the Division shall use no fewer than the four regions defined in the April 2011 report entitled "North Carolina Beach and Inlet Management Plan" published by the Department of Environment and Natural Resources. The oceanfront regions are: Region 1 (Brunswick County), Region 2 (New Hanover, Pender, and Onslow Counties and a portion of Carteret County), Region 3 (a portion of Carteret County and Hyde County), and Region 4 (Dare and Currituck Counties). For estuarine shorelines, the Division shall consider no fewer than two separate regions defined as

Replacement House Bill 819, section 2, paragraph e.

E6: Global mean sea level rise for 2081–2100 relative to 1986–2005 will *likely* be in the ranges of 0.26 to 0.55 m for RCP2.6, 0.32 to 0.63 m for RCP4.5, 0.33 to 0.63 m for RCP6.0, and 0.45 to 0.82 m for RCP8.5 (*medium confidence*). For RCP8.5, the rise by the year 2100 is 0.52 to 0.98 m, with a rate during 2081 to 2100 of 8 to 16 mm yr^{-1} (*medium confidence*). These ranges are derived from CMIP5 climate projections in combination with process-based models and literature assessment of glacier and ice sheet contributions

of worry.[16] While many Americans are concerned about global warming, fewer of them actively worry about it. This helps to explain the seeming paradox between public opinion surveys that show Americans expressing high concerns about the issue yet giving it low priority in either national or environmental issue rankings.[17]

This study also included a series of questions measuring public likelihood assessments of various global-warming impacts on the United States (see Figure 1 on this page). Again, across the board, moviegoers perceived global warming as a greater threat than the rest of the

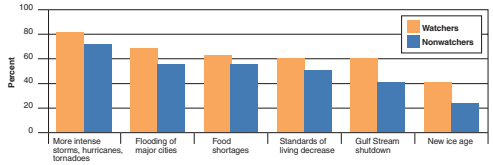
Table 1. Concern and worry about global warming

	Percent nonwatchers[a]	Percent watchers[b]
How concerned are you about global warming?		
a. Somewhat or strongly concerned	72	83**‡
b. Not very or not at all concerned	28	17
How much do you worry about global warming?		
a. Fair amount to great deal	31	40**
b. Only a little to not at all	69	60

[a]weighted (n = 390)
[b]weighted (n = 139)
**p < .01, watchers vs. nonwatchers
‡p < .05, watchers vs. nonwatchers after controlling for demographics and political variables
SOURCE: A. Leiserowitz.

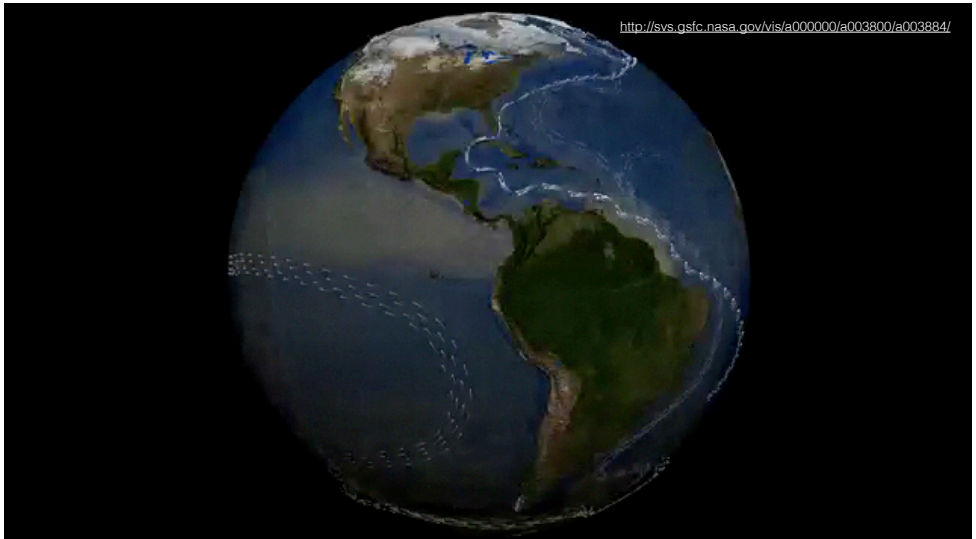
Figure 1. Percent of watchers and nonwatchers who found each item *somewhat* or *very likely*.

"In the United States, how likely do you think it is that each of the following will occur during the next 50 years due to global warming?"



NOTE: Nonwatchers weighted (n = 390), watchers weighted (n = 139).
SOURCE: A. Leiserowitz.

E4: It is very *likely* that the Atlantic Meridional Overturning Circulation (AMOC) will weaken over the 21st century. Best estimates and ranges for the reduction are 11% (1 to 24%) in RCP2.6 and 34% (12 to 54%) in RCP8.5. It is *likely* that there will be some decline in the AMOC by about 2050, but there may be some decades when the AMOC increases due to large natural internal variability.



E4: It is *very unlikely* that the AMOC will undergo an abrupt transition or collapse in the 21st century for the scenarios considered. There is *low confidence* in assessing the evolution of the AMOC beyond the 21st century because of the limited number of analyses and equivocal results. However, a collapse beyond the 21st century for large sustained warming cannot be excluded.

WHICH ONE IS FALSE?

1. One informal study found that only one academic, out of over 9000 published in recent peer reviewed climate change research (all scientific papers published from November 2012 to December 2013), rejected man made global warming.

2. Calculations suggest that on average, each North American wastes approximately 500kcal of food each day - roughly equivalent to a quarter of the total dietary needs of an average woman.

3. The first convincing model of geoengineering effects suggests that use of sulphates in the atmosphere can inadvertently lead to issues of global inequity.

ISSN 1019-3316, Herald of the Russian Academy of Sciences, 2013, Vol. 83, No. 3, pp. 275–285. © Pleiades Publishing, Ltd., 2013.
Original Russian Text © S.V. Avakyan, 2013, published in Vestnik Rossiiskoi Akademii Nauk, 2013, Vol. 83, No. 5, pp. 425–436.

Environmental Problems

The author associates the recently observed climate warming and carbon dioxide concentration growth in the lower atmospheric layers with variations of solar–geomagnetic activity in global cloud formation and the significant decrease in the role of forests in carbon dioxide accumulation in the process of photosynthesis. The contribution of the greenhouse effect of carbon-containing gases to global warming turns out to be insignificant.

DOI: 10.1134/S1019331613030015

The Role of Solar Activity in Global Warming

S. V. Avakyan*

More than 40 years ago, in the fall of 1972, the first All-Union conference "Solar–Atmospheric Correlations in Climate Theory and Weather Forecasts" was held in Moscow. It adopted a resolution that formulated still topical problems and objectives. The conference stated [1, p. 463],

> Studies on the Sun–atmosphere problem, which have been performed in the Soviet Union and abroad for several decades, make it possible to regard as proved the existence of a considerable influence of solar activity and other cosmic and geophysical factors on atmospheric processes. Consequently, studies on this problem are of high practical significance ....

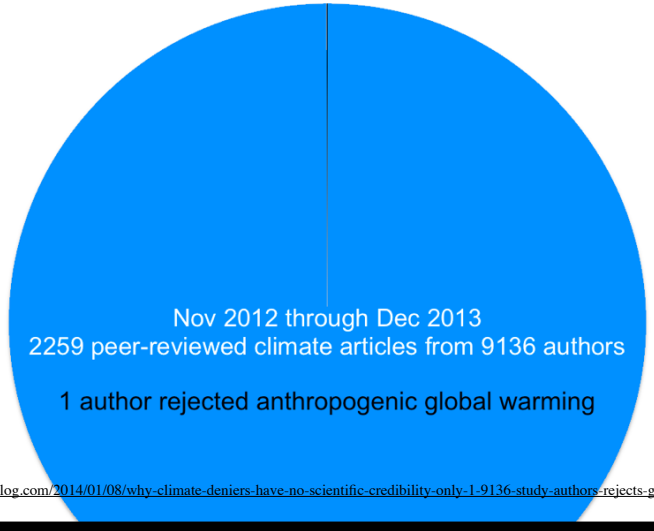
In May 1973, the Hydrometeorological Service Headquarters organized the Scientific Council on Solar–Atmospheric Correlations in Weather Forecasts; before this, the Laboratory of Solar–Terrestrial Correlations at the Hydrometeorological Center was opened. However, it is becoming obvious that the then natural science was short of the necessary data about the environment. Moreover, meteorologists and climatologists were not prepared for taking into account solar activity.

Today the scientific world enjoys a significantly larger reserve of knowledge about the nature and intensity of solar–geomagnetic disturbances and their manifestations in the environment, including the biosphere and human beings. On the other hand, the problem of the global increase in the mean surface and then to carbon-free energy within the framework of the Kyoto Protocol may lead to economic collapse for Russia as a consequence of the reduction and, probably, even loss of the possibility to sell oil and natural gas on the world market. The basis for this concern is that our most important industries (defense, aerospace, heavy engineering) have been in crisis for decades.

THE IONOSPHERE AS A CURRENT SOLAR ACTIVITY SIGNAL GENERATOR

The modern science of climatology gives no answer sufficiently accurate and reliable for practical applications to the question of what the main cause of the current climate warming is and of how this process will develop in the near future. To date, the main difficulty has been to assess the role of variations in solar activity. As a rule, all attempts to account for the contribution of solar–cosmic factors to the external impact on the weather–climate system are reduced to considering variations in the full flux of solar radiant energy or cosmic rays. However, the changes in both are very insignificant.

It is worth recalling in this respect the constant value of the main part of the Sun's radiant energy flux (this value is called the solar constant) coming to the lower atmosphere, the troposphere. This flux is now 342 $W m^{-2}$ with account for the Earth's sphericity.



http://www.desmogblog.com/2014/01/08/why-climate-deniers-have-no-scientific-credibility-only-1-9136-study-authors-rejects-global-warming

D3: It is *extremely likely* that more than half of the observed increase in global average surface temperature from 1951 to 2010 was caused by the anthropogenic increase in greenhouse gas concentrations and other anthropogenic forcings together. The best estimate of the human-induced contribution to warming is similar to the observed warming over this period.

Q: Do you think human activity is a significant contributing factor in changing mean global temperatures?

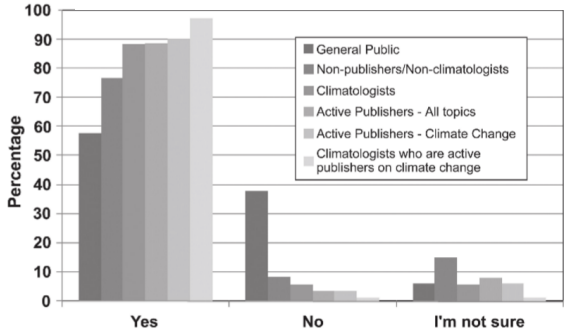


Fig. 1. Response distribution to our survey question 2. The general public data come from a 2008 Gallup poll (see http://www.gallup.com/poll/1615/Environment.aspx). Original color image appears at the back of this volume.

Doran and Zimmerman (2009). Examining the Scientific Consensus on Climate Change. 10.1029/2009EO030002

D3: It is *extremely likely* that more than half of the observed increase in global average surface temperature from 1951 to 2010 was caused by the anthropogenic increase in greenhouse gas concentrations and other anthropogenic forcings together. The best estimate of the human-induced contribution to warming is similar to the observed warming over this period.

OPEN ACCESS
IOP Publishing
Environmental Research Letters
Environ. Res. Lett. **9** (2014) 014001 (7pp)
doi:10.1088/1748-9326/9/1/014001

Weakened tropical circulation and reduced precipitation in response to geoengineering

Angus J Ferraro, Eleanor J Highwood and Andrew J Charlton-Perez

Department of Meteorology, University of Reading, Reading, UK

E8: Methods that aim to deliberately alter the climate system to counter climate change, termed geoengineering, have been proposed. Limited evidence precludes a comprehensive quantitative assessment of both Solar Radiation Management (SRM) and Carbon D ioxide Removal (CDR) and their impact on the climate system. CDR methods have biogeochemical and technological limitations to their potential on a global scale. There is insufficient knowledge to quantify how much CO_2 emissions could be partially offset by CDR on a century timescale. Modelling indicates that SRM methods, if realizable, have the potential to substantially offset a global temperature rise, but they would also modify the global water cycle, and would not reduce ocean acidification. If SRM were terminated for any reason, there is *high confidence* that global surface temperatures would rise very rapidly to values consistent with the greenhouse gas forcing. CDR and SRM methods carry side effects and long-term consequences on a global scale.

OPEN ACCESS Freely available online
PLoS one

The Progressive Increase of Food Waste in America and Its Environmental Impact

Kevin D. Hall*, Juen Guo, Michael Dore, Carson C. Chow*

Laboratory of Biological Modeling, National Institute of Diabetes and Digestive and Kidney Diseases, Bethesda, Maryland, United States of America

Abstract

Food waste contributes to excess consumption of freshwater and fossil fuels which, along with methane and CO_2 emissions from decomposing food, impacts global climate change. Here, we calculate the energy content of nationwide food waste from the difference between the US food supply and the food consumed by the population. The latter was estimated using a validated mathematical model of metabolism relating body weight to the amount of food eaten. We found that US per capita food waste has progressively increased by ~50% since 1974 reaching more than 1400 kcal per person per day or 150 trillion kcal per year. Food waste now accounts for more than one quarter of the total freshwater consumption and ~300 million barrels of oil per year.

Citation: Hall KD, Guo J, Dore M, Chow CC (2009) The Progressive Increase of Food Waste in America and Its Environmental Impact. PLoS ONE 4(11): e7940. doi:10.1371/journal.pone.0007940

Editor: Thorkild I. A. Sorensen, Institute of Preventive Medicine, Denmark

Received September 8, 2009; **Accepted** October 26, 2009; **Published** November 25, 2009

Funding: This research was supported by the Intramural Research Program of the National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Competing Interests: The authors have declared that no competing interests exist.

* E-mail: kevinh@niddk.nih.gov (KDH); carsonc@niddk.nih.gov (CCC)

Introduction

Recent spikes in food prices have led to increasing concern about global food shortages and the apparent need to increase agricultural production [1,2]. Surprisingly little discussion has been devoted to the issue of food waste. Quantifying food waste at a national level is difficult because traditional methods rely on structured interviews, measurement of plate waste, direct examination of garbage, and application of inferential methods using

validate a mathematical model of human energy expenditure that includes all of these factors and used the model to calculate the average increase of food intake underlying the observed increase of average adult body weight in the US since 1974 as measured by the US National Health and Nutrition Examination Survey (NHANES) [9].

Results

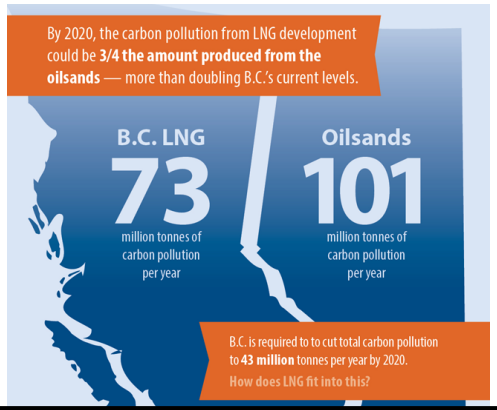
We very wasteful.

We like stuff.

http://www.chrisjordan.com/gallery/rtn/#plastic-bottles

We like stuff.

We like stuff.



E8: Limiting the warming caused by anthropogenic CO_2 emissions alone with a probability of >33%, >50%, and >66% to less than 2°C since the period 1861–1880, will require cumulative CO_2 emissions from all anthropogenic sources to stay between 0 and about 1570 GtC (5760 $GtCO_2$), 0 and about 1210 GtC (4440 $GtCO_2$), and 0 and about 1000 GtC (3670 $GtCO_2$) since that period, respectively. These upper amounts are reduced to about 900 GtC (3300 $GtCO_2$), 820 GtC (3010 $GtCO_2$), and 790 GtC (2900 $GtCO_2$), respectively, when accounting for non-CO_2 forcings as in RCP2.6. An amount of 515 [445 to 585] GtC (1890 [1630 to 2150] $GtCO_2$), was already emitted by 2011.

IF YOU THINK ABOUT IT

SCIENCE, IN A WAY, HAS ALREADY PROVIDED US WITH THE KNOWLEDGE TO "FIX" CLIMATE CHANGE.

WE KNOW WHAT IS "AT FAULT."

WE KNOW WHAT SHOULD BE "CHANGED."

WE KNOW WHAT "MIGHT HAPPEN" IF WE DON'T CHANGE.

WE EVEN HAVE BENCHMARKS OF CHANGE TO AIM FOR.

SO WHY IS THIS SO DIFFICULT?