Mudança Climática

Onde estamos, para onde vamos?

Plataforma para o CRESCIMENTO SUSTENTÁVEL

Carlos Pimenta

De acordo com estudos de Angus Maddison, a variação do PIB mundial *per capita* a preços constantes em dólares internacionais de 1990, desde o ano 1 a 1700, foi muito pequena, de 467 para 615. Calcula-se que nesses mesmos anos a população global era 226 e 603 milhões. Porém, de 1820 a 2006 o PIB *per capita* nas mesmas unidades, subiu de 666 para 7215 e a população global de 1041 para 6560 milhões. Dois aumentos à escala global verdadeiramente prodigiosos que vieram dar maior qualidade de vida, bem-estar e riqueza a uma humanidade muito mais numerosa.

De 1820 a 2006 a população mundial aumentou por um factor de 6,3 e o PIB mundial *per capita* aumentou por um factor de 10,8. Porém as diferenças neste indicador de crescimento económico entre países são muito elevadas. Por exemplo, o seu valor é 24,7 nos EUA, 7,1 no Egipto e 4,6 na Índia.

http://www.ggdc.net/maddison/maddison-project/home.htm

https://ourworldindata.org/gdp-data/

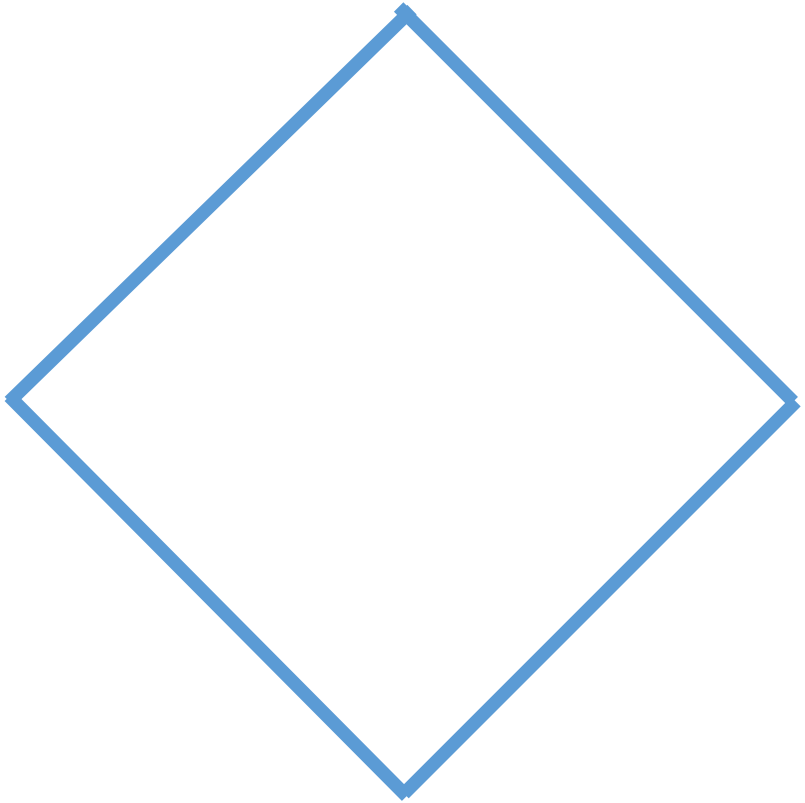
https://www.gapminder.org

Desafios da Sustentabilidade

Desigualdades sociais e económicas crescentes

Pobreza extrema e severa, fome, deficiências de assistência e cuidados de saúde e educação. Conflitos e migrações

Insegurança alimentar, escassez de água e de outros recursos naturais, perda de biodiversidade, degradação ambiental



Insustentabilidade dos sistemas de energia

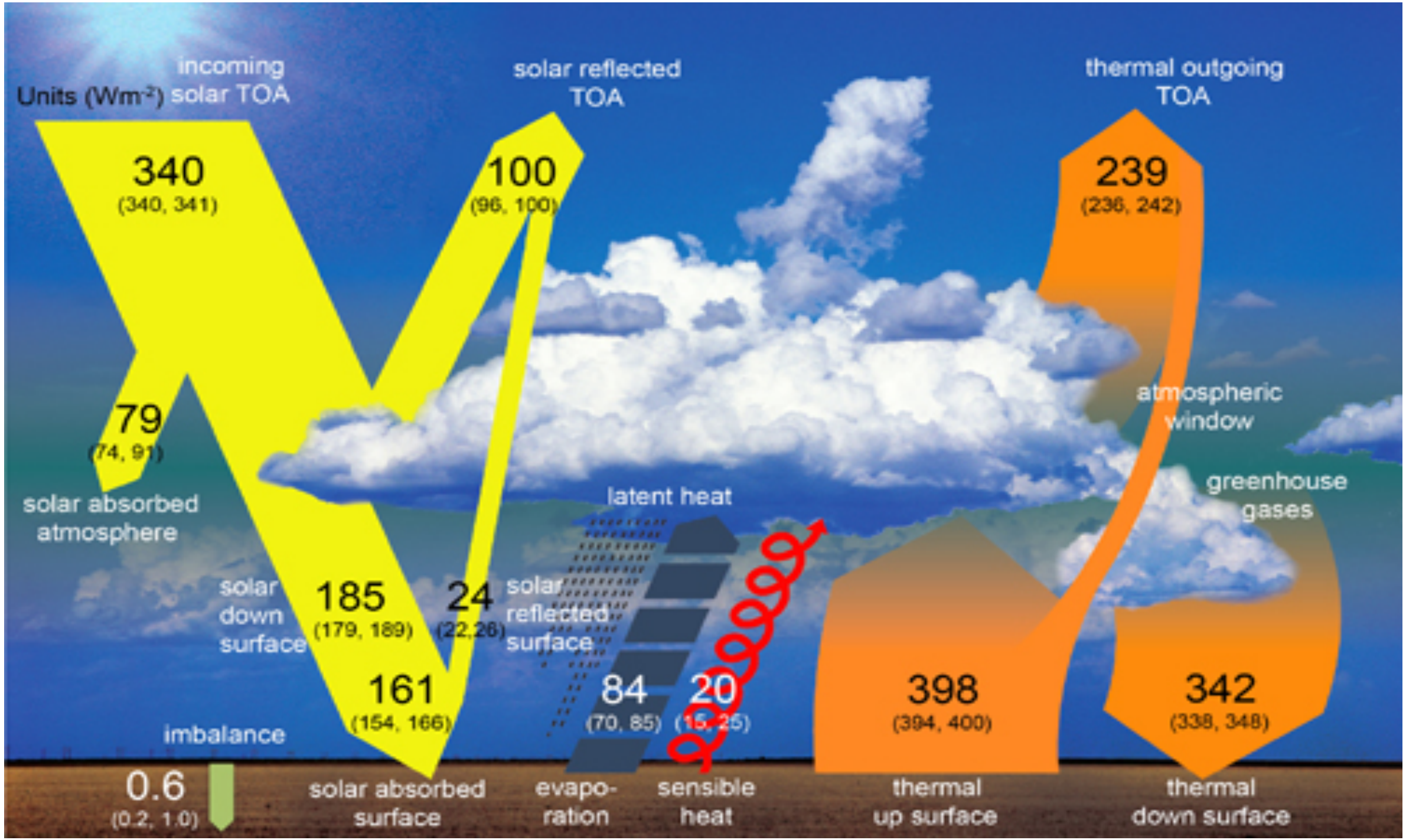
Alterações Climáticas

Climate change is a change in the statistical distribution of weather patterns when that change lasts for an extended period of time

Climate change may refer to a change in average weather conditions, or in the time variation of weather around longer-term average conditions (i.e., more or fewer extreme weather events).

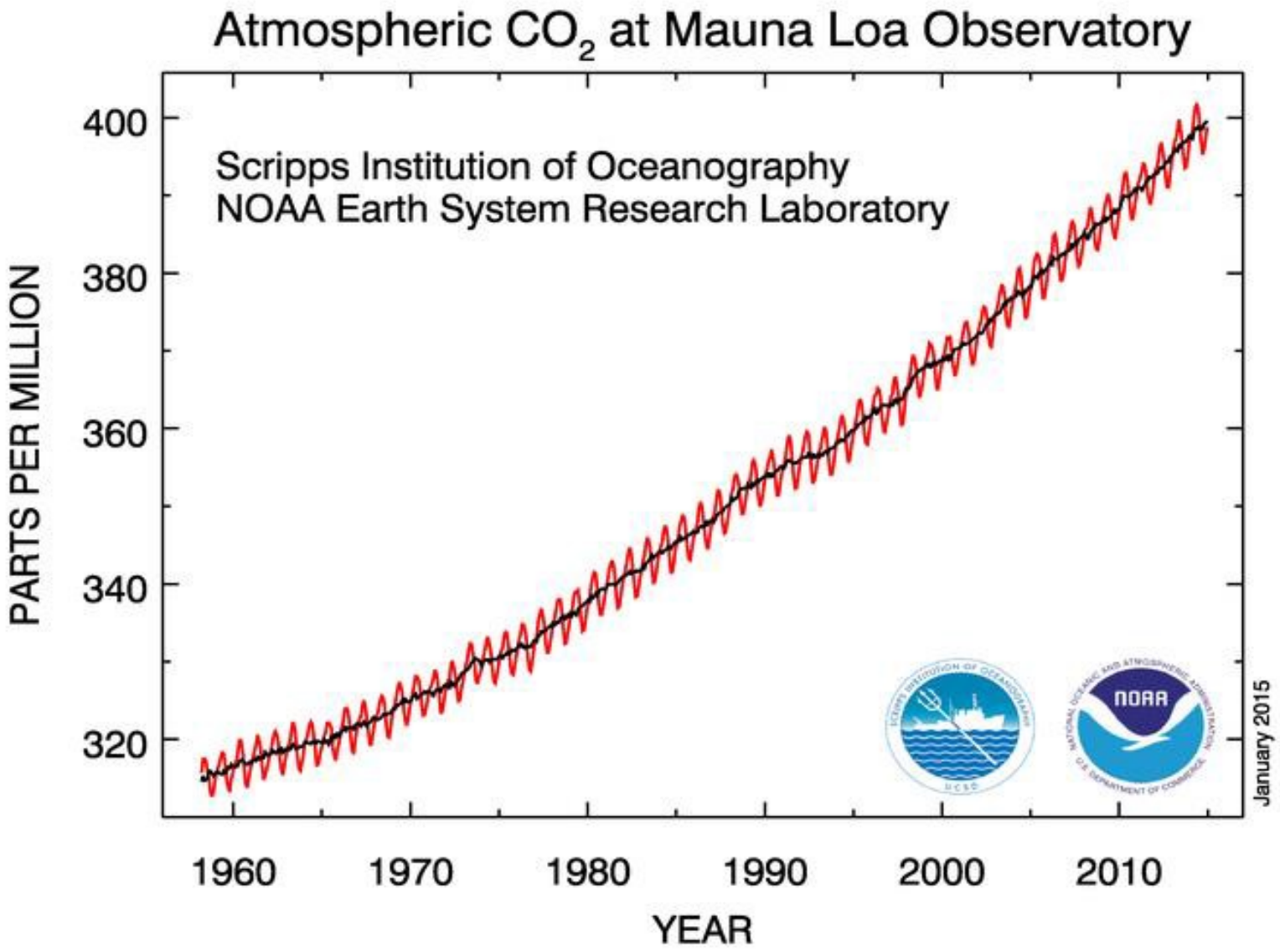
Climate change is caused by factors such as biotic processes, variations in solar radiation received by Earth, plate tectonics, volcanic eruptions and anthropogenic factors.

Note- the IPCC Summary for Policymakers *is a clear summary of the main scientific questions relating to Climate Change*
http://www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_SPM.pdf


Units (Wm-2)
incoming solar TOA
340
(340, 341)
solar reflected TOA
100
(96, 100)
thermal outgoing TOA
239
(236, 242)
79
(74, 91)
solar absorbed atmosphere
atmospheric window
greenhouse gases
latent heat
solar down surface
185
(179, 189)
24
(22,26)
solar reflected surface
161
(154, 166)
84
(70, 85)
20
(15, 25)
398
(394, 400)
342
(338, 348)
imbalance
0.6
(0.2, 1.0)
solar absorbed surface
evapo-ration
sensible heat
thermal up surface
thermal down surface

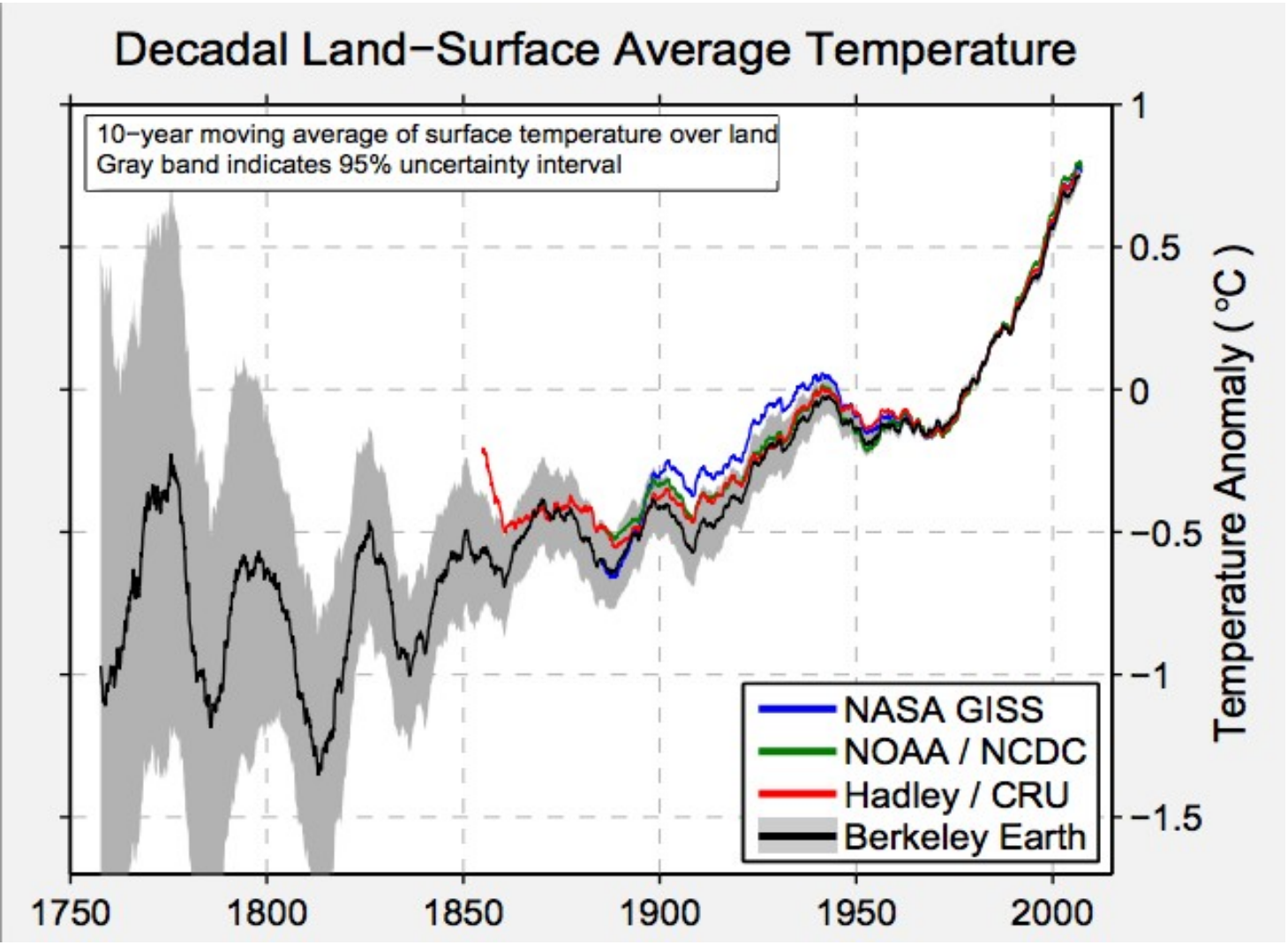
IPCC

Concentração do dióxido de carbono aumentou de 42% desde o século XVIII



http://www.esrl.noaa.gov/gmd/ccgg/trends/full.html

Global land temperatures have increased by 1.5 degrees Celsius over the past 250 years



1.6 billion meteorological records

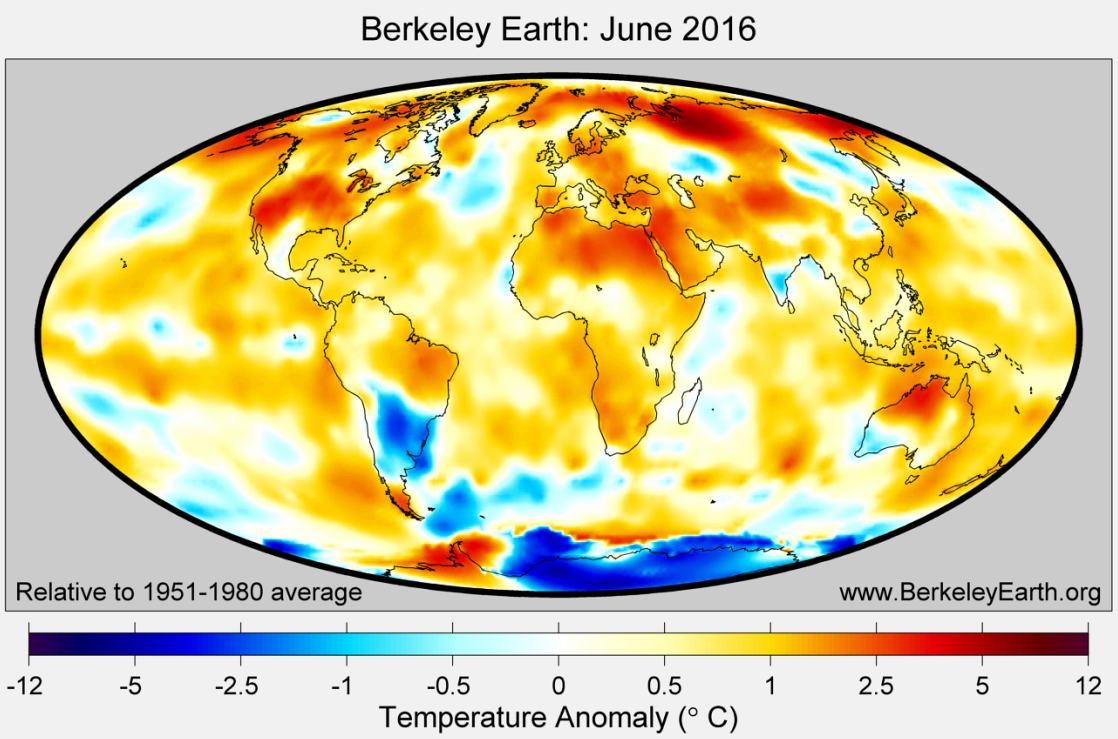
http://berkeleyearth.org/results-summary/

"Our results show that the average temperature of the earth's land has risen by two and a half degrees Fahrenheit over the past 250 years, including an increase of one and a half degrees over the most recent 50 years. Moreover, it appears likely that essentially all of this increase results from the human emission of greenhouse gases."

Prof Richard A. Muller
University of California, Berkeley

OP-ED CONTRIBUTOR
The Conversion of a Climate-Change Skeptic
By RICHARD A. MULLER
Published: July 28, 2012

http://www.nytimes.com/2012/07/30/opinion/the-conversion-of-a-climate-change-skeptic.html?_r=3&pagewanted=all&



July was hottest month on record for the globe

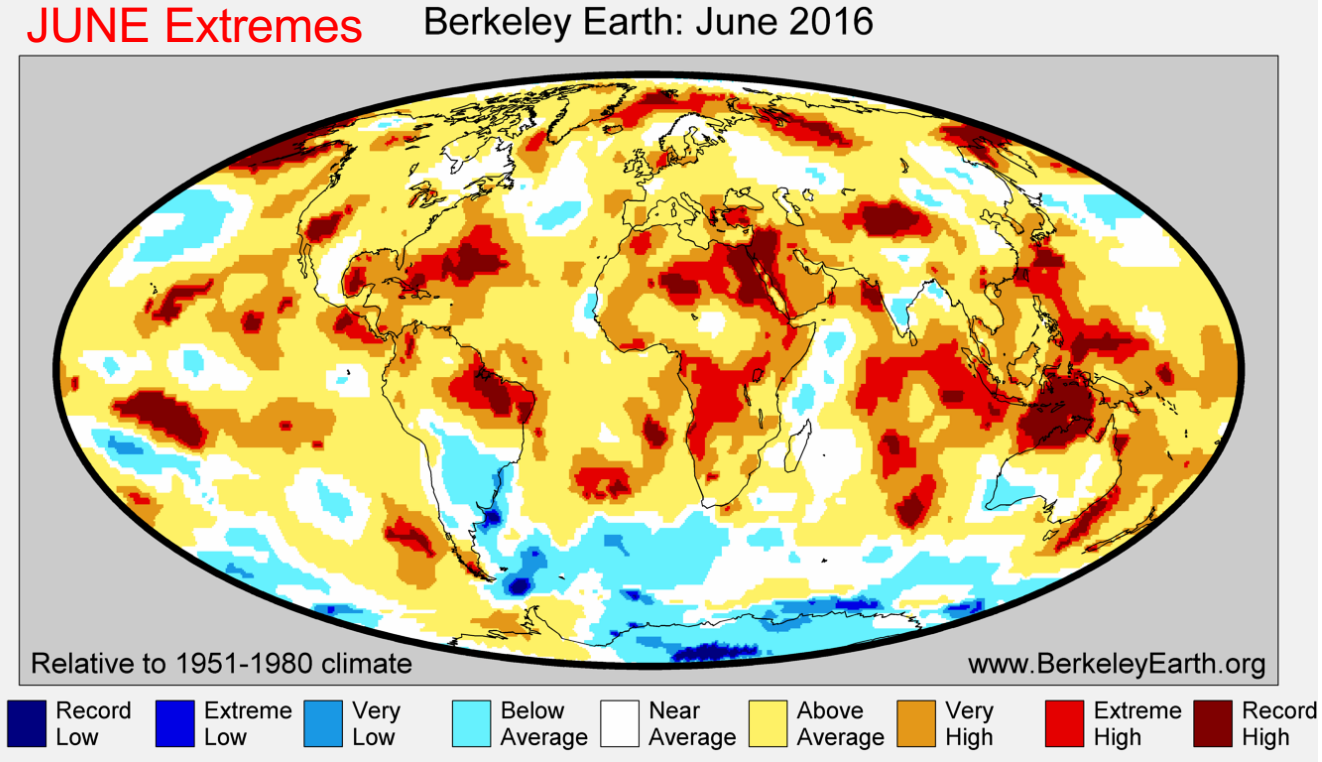
Analysis confirms 15 consecutive months of record-breaking heat

Temperature Anomaly 0.925C 1951-1980

Period 1850-	Trend C/decade
Present	0.06 C/decade
1900-Present	0.086 C/decade
1950-Present	0.12 C/decade
1970-Present	0.179 C/decade
1990-Present	0.19 C/decade

http://berkeleyearth.org/temperature-reports/june-2016/

JUNE Extremes



Canada 2016

Os Oceanos estão a aquecer

Bleached coral in American Samoa spring 2015.

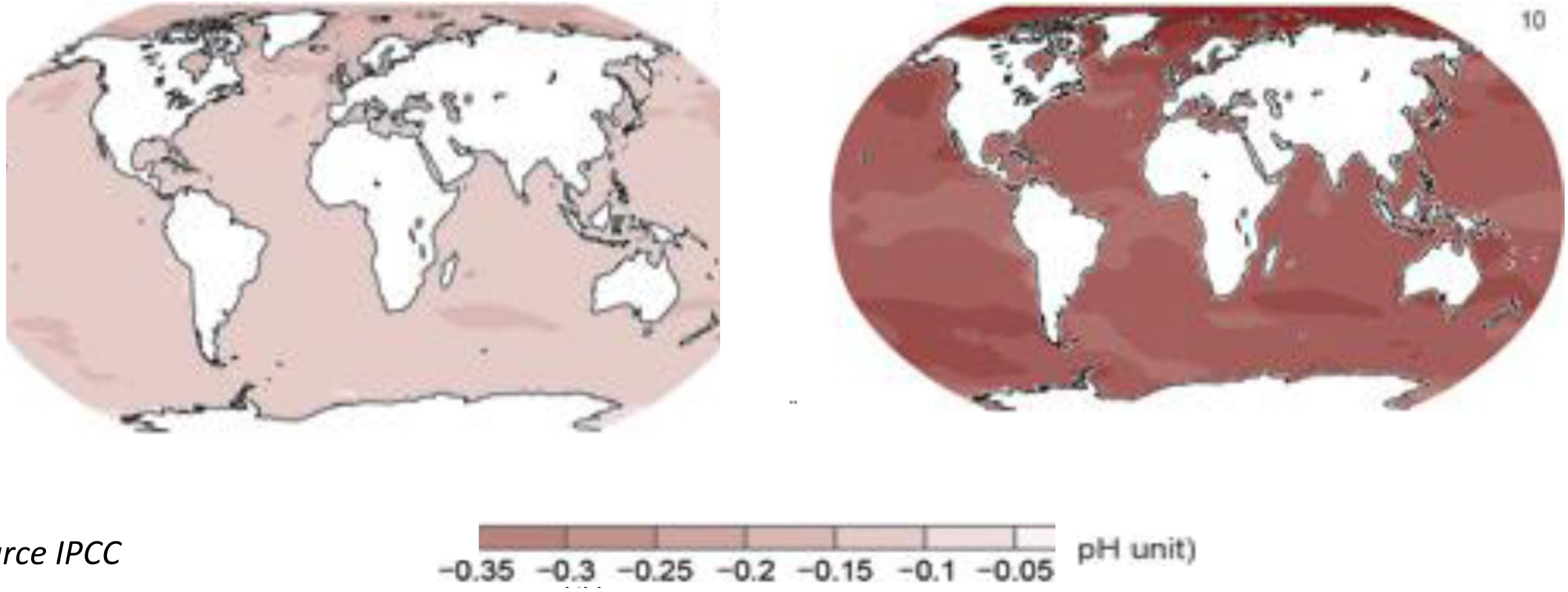
Os Oceanos tornam-se mais ácidos

O litoral em risco

Pacific Palisades section of Los Angeles

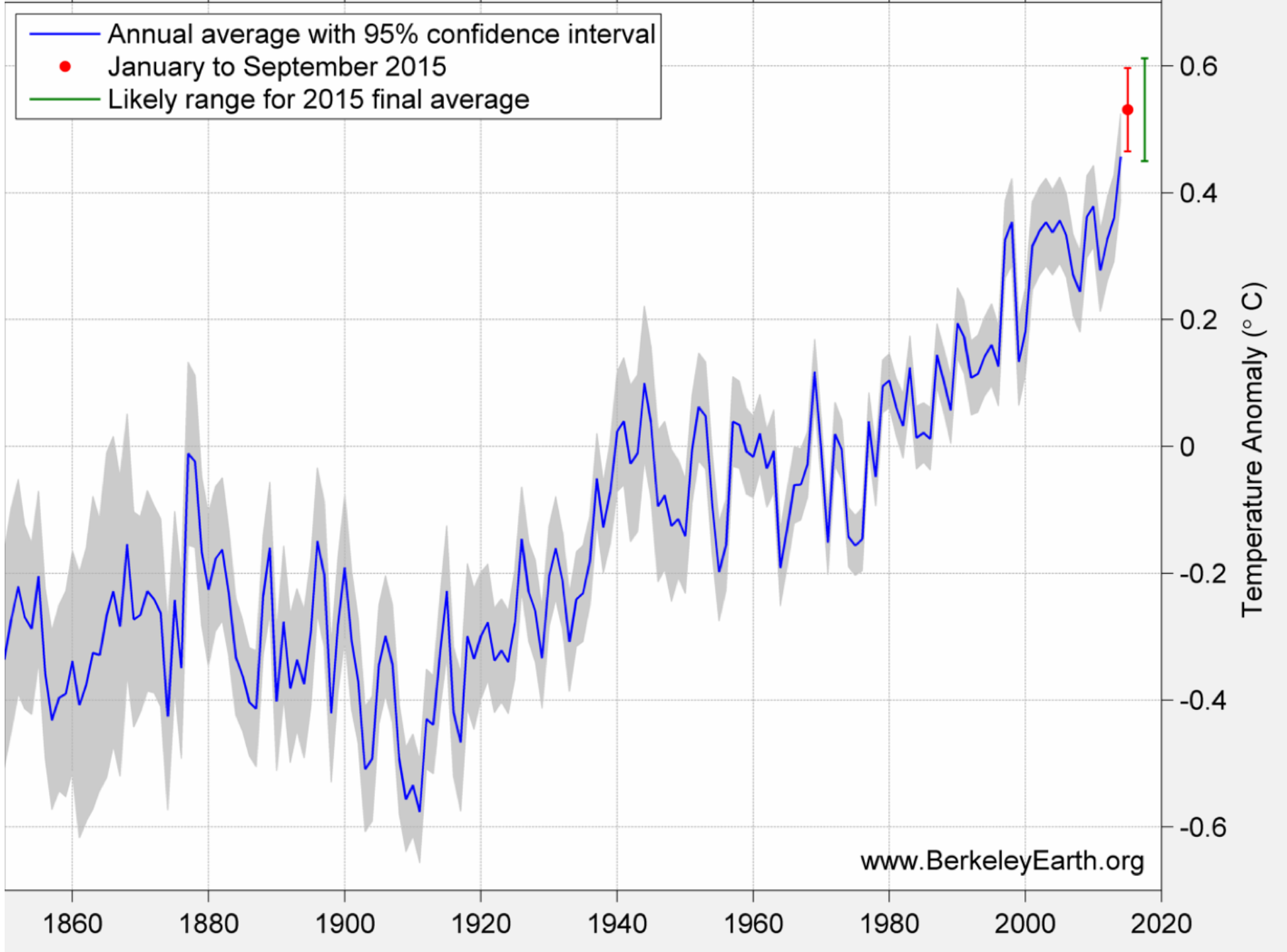
Change of ocean surface pH (1986-2005 to 2081-2100)

O oceano está cada vez mais ácido



Source IPCC

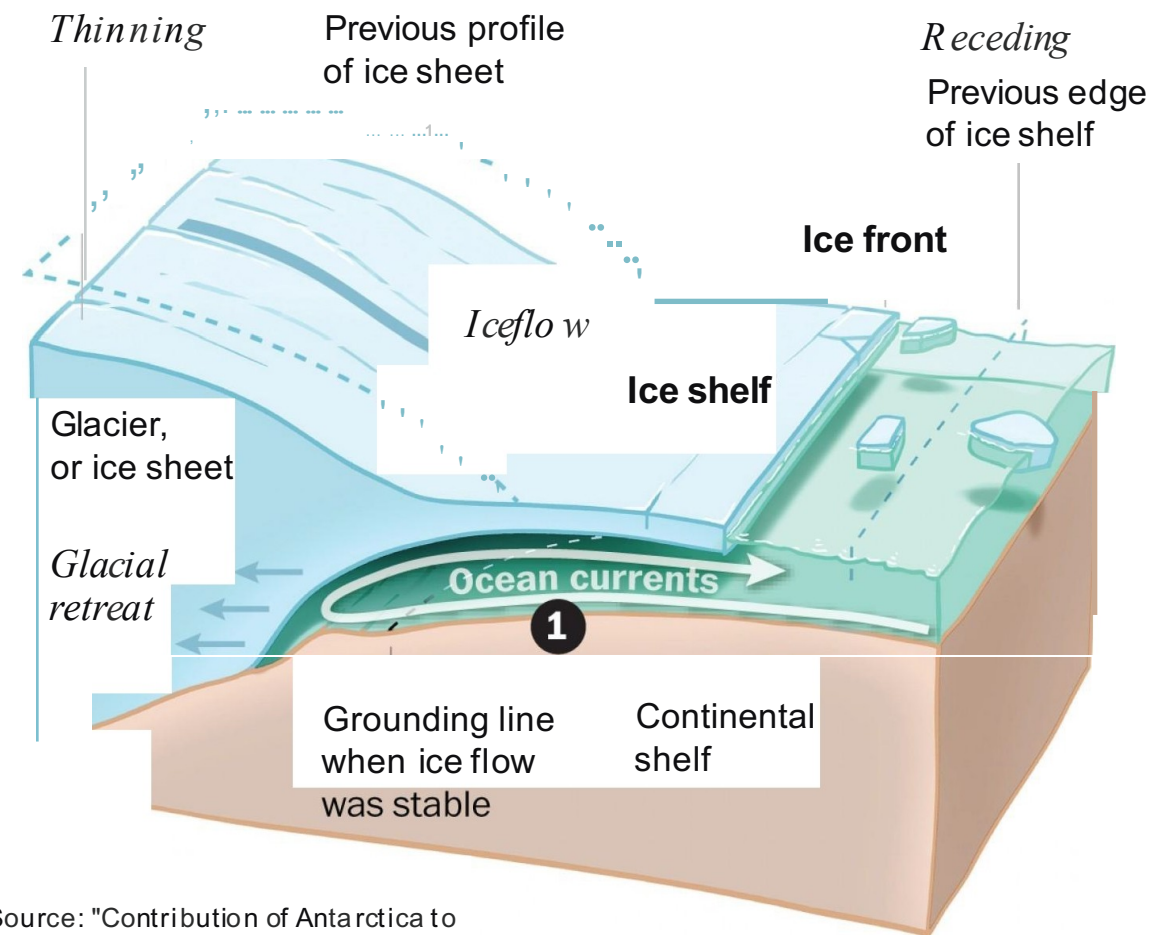
Ocean Temperature rising



Melting from below

Scientists have long known that glaciers resting under sea level can be unstable if they rest on a downward sloping sea bed.

1. Warmer ocean currents erode the glacier's base from below. The grounding line retreats downhill, and as it does, even more of the glacier is exposed to warm water. It melts more, and flows faster.



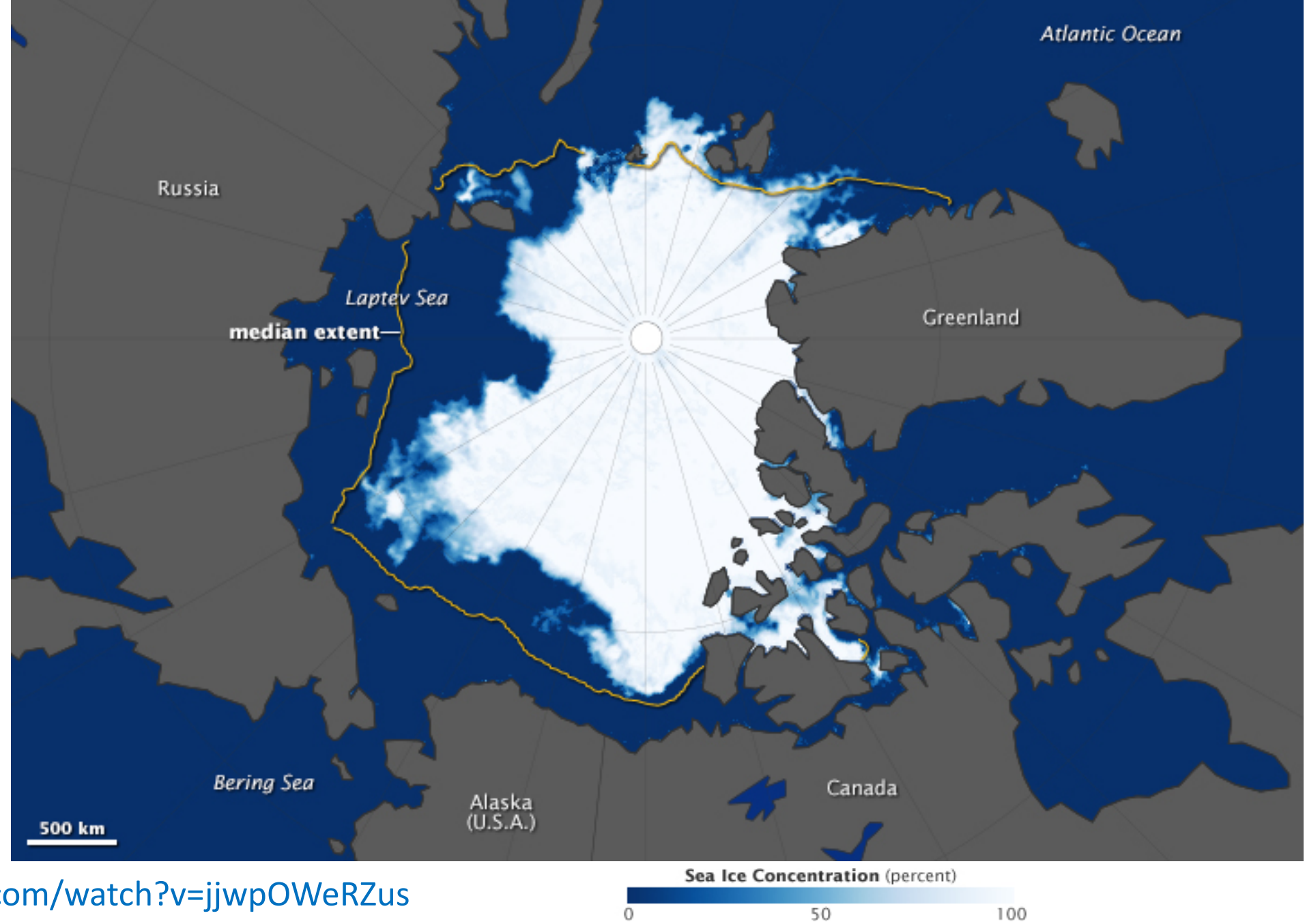
Source: "Contribution of Antarctica to Past and Future Sea-Level Rise," by Robert M. DeConto and David Pollard, in Nature

CHIQUI ESTEBAN, BONNIE BERKOWITZ, PATIERSON CLARK / THE WASHINGTON POST

Arctic sea ice in the summer may soon be a memory

Sea ice acts as an air conditioner for the planet, reflecting energy from the sun. On September 17, the Arctic sea ice reached its minimum extent for 2014.

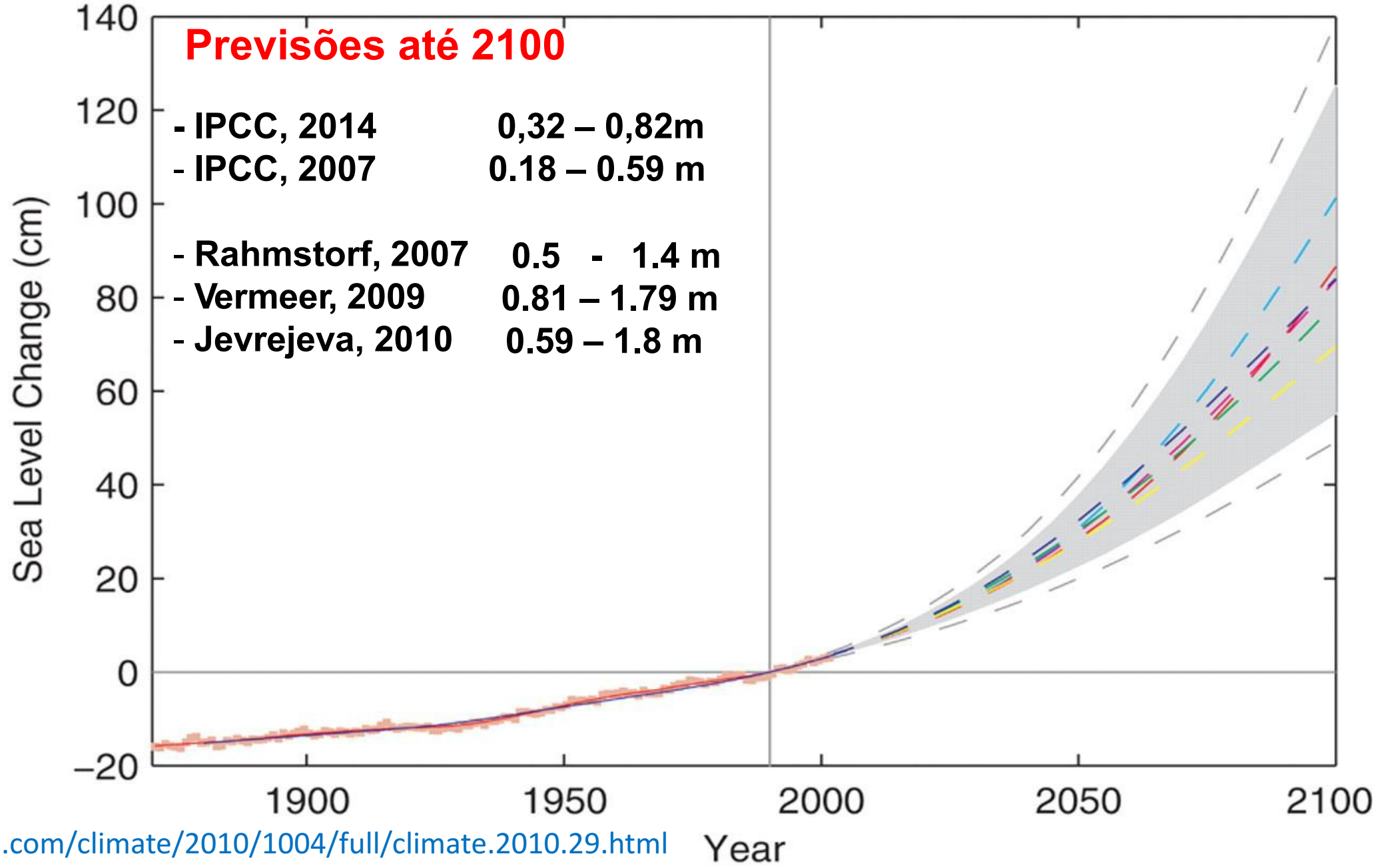
At 5.02 million square kilometers, it's the sixth lowest extent of the satellite record



https://www.youtube.com/watch?v=jjwpOWeRZus

http://earthobservatory.nasa.gov/IOTD/view.php?id=84418&src=eoa-iotd

Aumento do nível médio do mar



Rahmstorf, 2007

http://www.nature.com/climate/2010/1004/full/climate.2010.29.html

United nations conference on climate change
COP21/CMP11

http://www.cop21.gouv.fr/en/learn/

ipcc
INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP

http://www.ipcc.ch/index.htm

Regrettably, many efforts to seek concrete solutions to the environmental crisis have proved ineffective, not only because of powerful opposition but also because of a more general lack of interest. Obstructionist attitudes, even on the part of believers, can range from denial of the problem to indifference, nonchalant resignation or blind confidence in technical solutions. We require a new and universal solidarity

Laudato si

http://w2.vatican.va/content/francesco/en/encyclicals/documents/papa-francesco_20150524_enciclica-laudato-si.html

PARIS Climate Agreement – COP 21

Keeping temperatures below 1.5C

EMISSIONS TARGETS - Pledges to curb emissions, *but The INDCs are recognised under the agreement, but are not legally binding. (180 countries have pledges)*

Long-term global goal for net zero emissions
"net zero emissions" between 2050 and 2100. The UN's climate science panel says net zero emissions must happen by 2070 to avoid dangerous warming.
Aiming to the End of Fossil fuels?

Climate Justice and Money
flow of $100bn (£66bn) a year will continue beyond 2020. By 2025 the draft agreement undertakes to improve on that "from a floor of $100bn".

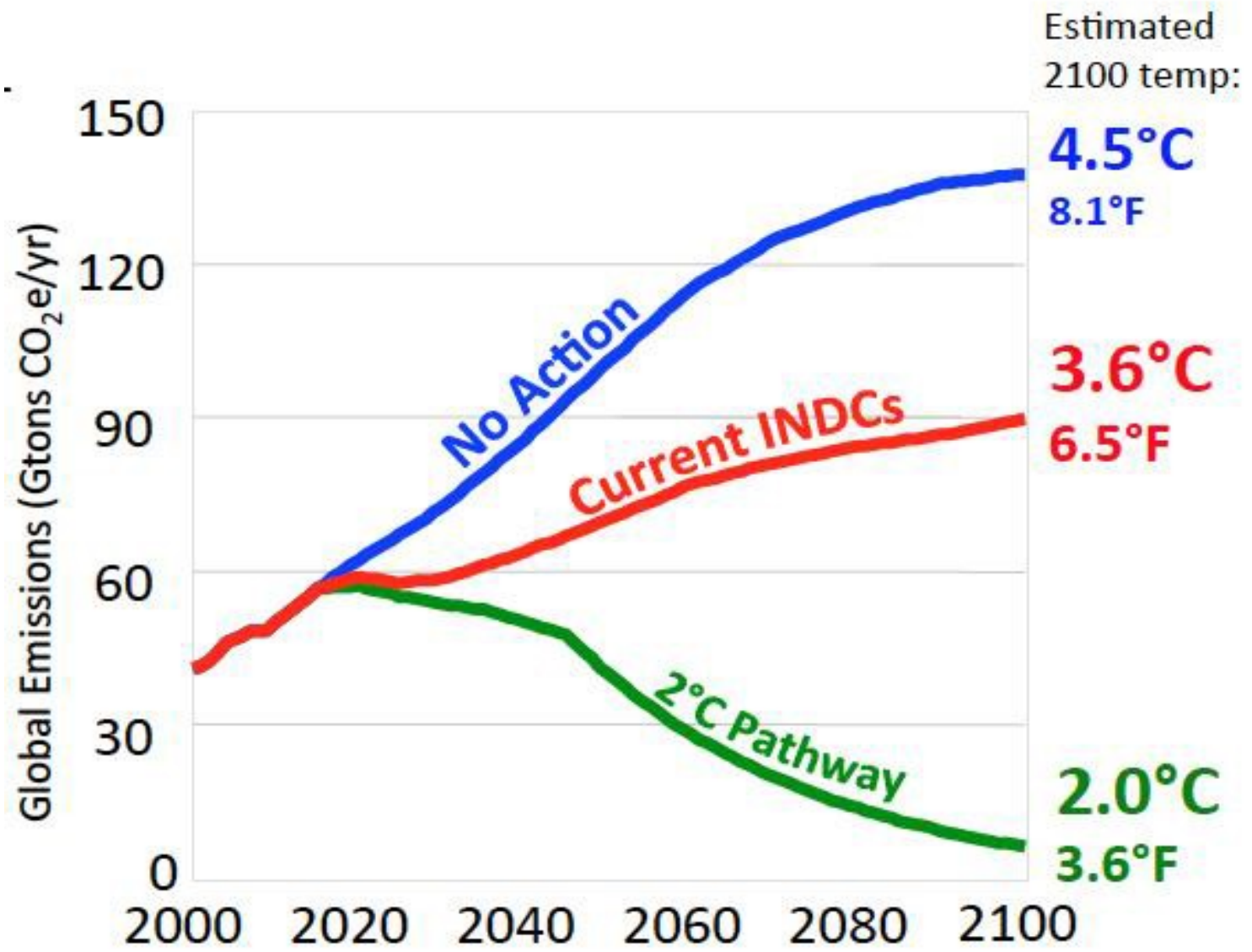
Stocktake every five years,
Transparency **-** a review mechanism to ramp up those pledges every five years

Loss and damage
a mechanism for addressing the financial losses vulnerable countries face from climate impacts such as extreme weather.

http://www.cop21.gouv.fr/en

http://www.theguardian.com/environment/climate-change

ACORDO DE PARIS, COP 21, 2015



Impact of national climate pledges (aka INDCs) on world's greenhouse gas emissions measured in CO2 equivalents (CO2e).

As of 17 August 2016, 22 Parties have ratified.
Climate Analytics projects that at least another 35 Parties are likely to ratify the Agreement by the end of 2016.

Based on ratifications to date (22) ,i.e. August 2016, national statements and indications given to a high level meeting on early ratification in New York on Friday 22 April 2016 and other information, it is estimated that at least 57 countries are likely to have ratified the Paris Agreement by the end of 2016, accounting for 59.88% of global emissions.

SOME EXPECTED CONSEQUENCES OF CLIMATE CHANGE

Ecosystems deterioration

Rise in sea level and its acidity

Increase in frequency and intensity of extreme climatic events (e.g. floods, hurricanes, long droughts)

Increase of desertification

Climate change is not merely the long-term forecast. It is already here, and it is likely to get significantly worse by the end of this century. *The seas will sour as the water grows more acidic, extreme weather will become more extreme and more common, and Arctic sea ice in the summer may be a memory.*

Source: IPCC AR5 http://www.ipcc.ch/report/ar5/index.shtml

How hot does it get in a world run by economists?

And the answer was, well, **really rather warm** if we use conventional “market” rates of discounting to weigh up the benefits of avoided impacts in the future against the costs of avoiding emissions today.

Because carbon dioxide accumulates in the climate system, the marginal benefits of one more puff will always exceed the costs on the environment if we discount the future fast enough.

Professor Myles Allen

http://www.eci.ox.ac.uk/news/2015/1208.html

Biodiversity Loss

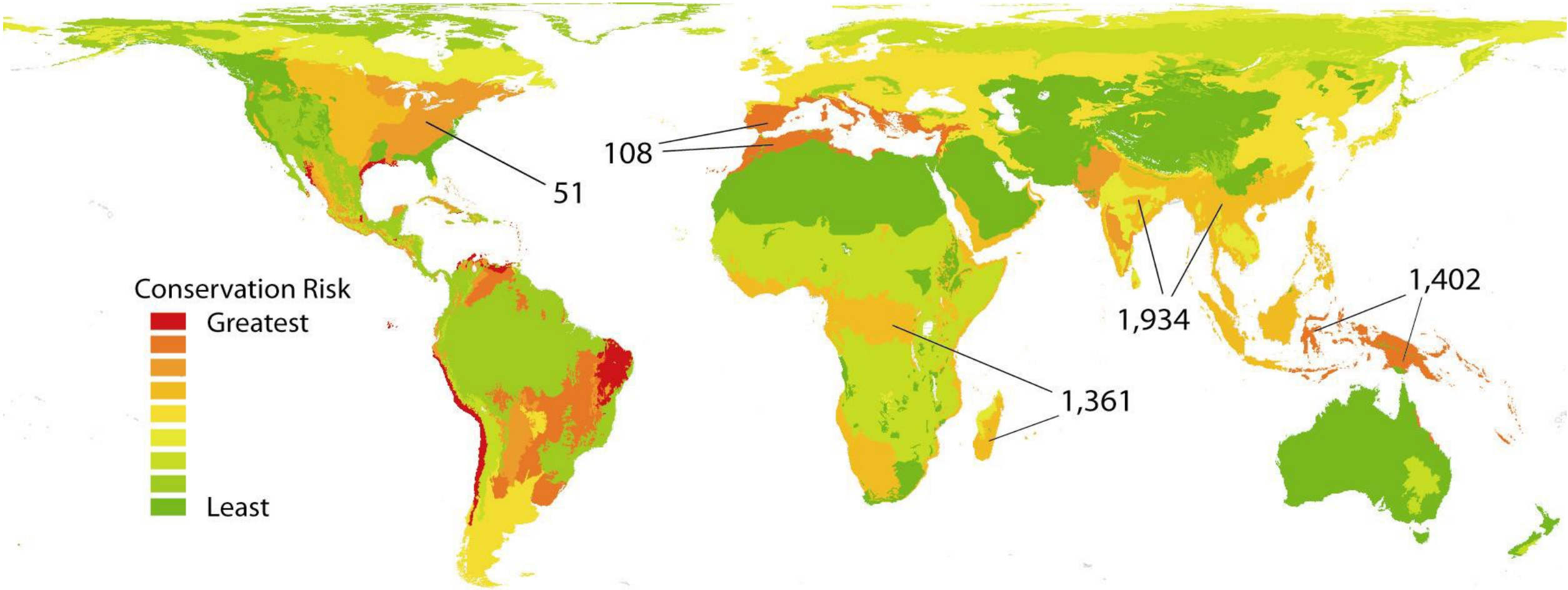
Ecological threshold is the point at which there is an abrupt change in an ecosystem that produces large, persistent and potentially irreversible changes.

- Slight changes in climate may trigger major abrupt ecosystem responses that are not easily reversible. Some of these responses, including insect outbreaks, wildfire, and forest dieback, may adversely affect people as well as ecosystems and their plants and animals.
- One of the greatest concerns is that once an ecological threshold is crossed, the ecosystem in question will most likely not return to its previous state.

USGS *Thresholds of Climate Change in Ecosystems*

http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1009&context=usgspubs

Projected habitat loss and risk to biodiversity



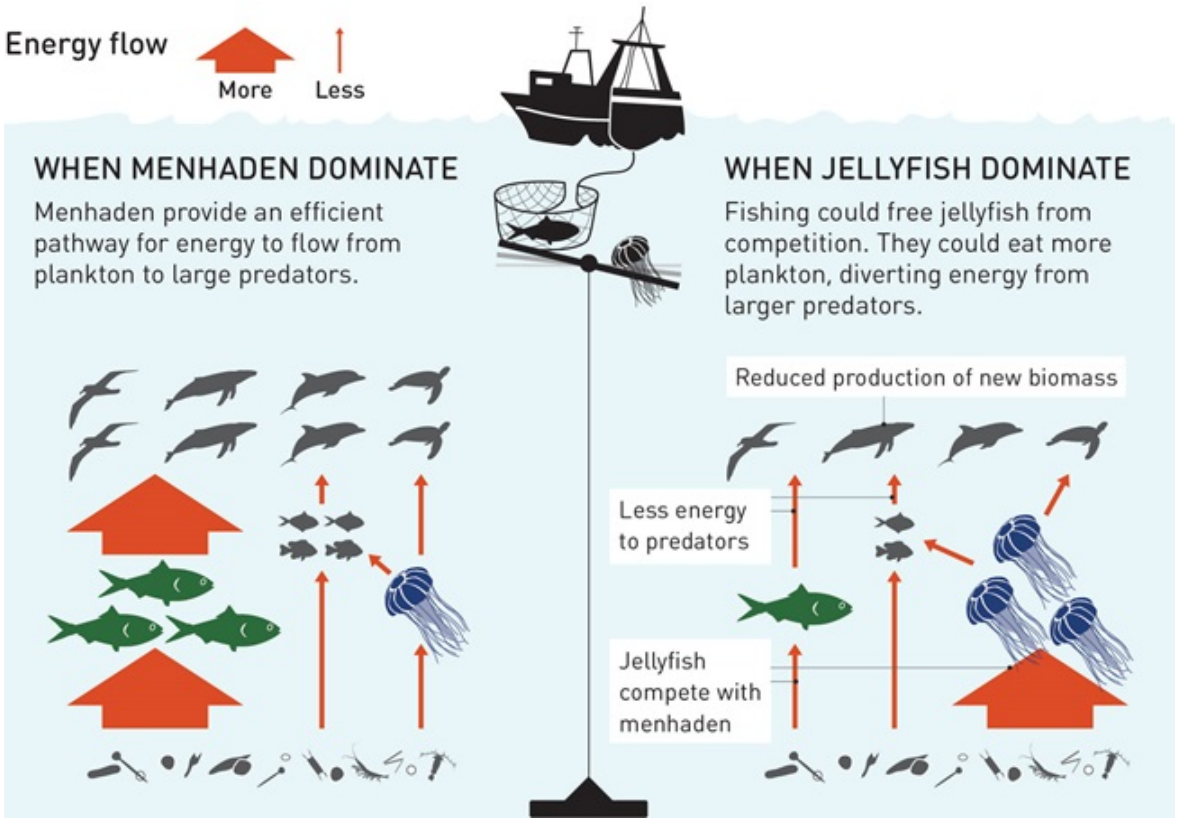
Source Univ California

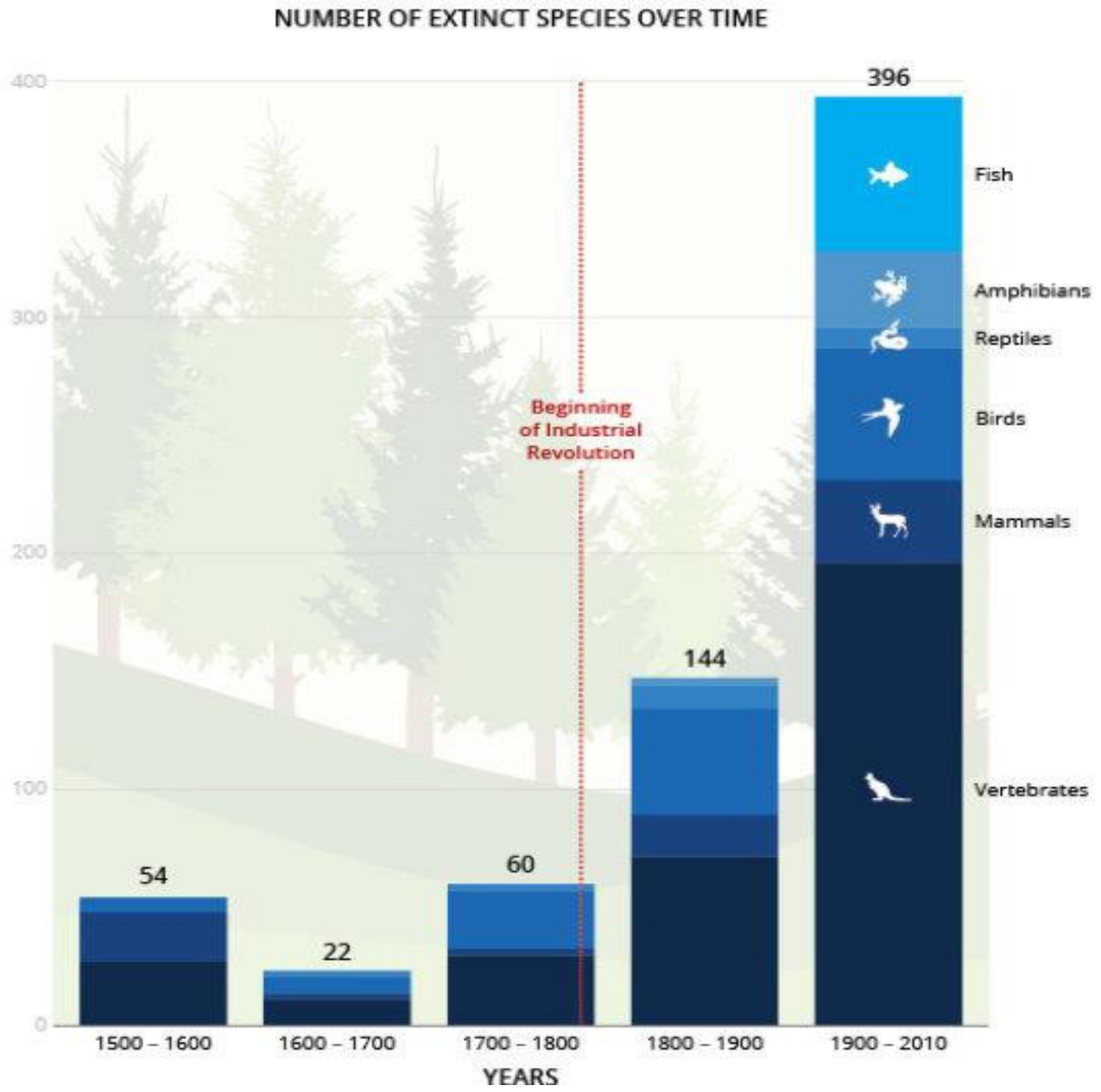
http://ucsdnews.ucsd.edu/archive/newsrel/science/02-08BattlegroundsForConservation.asp

Sexta extinção massiva de espécies

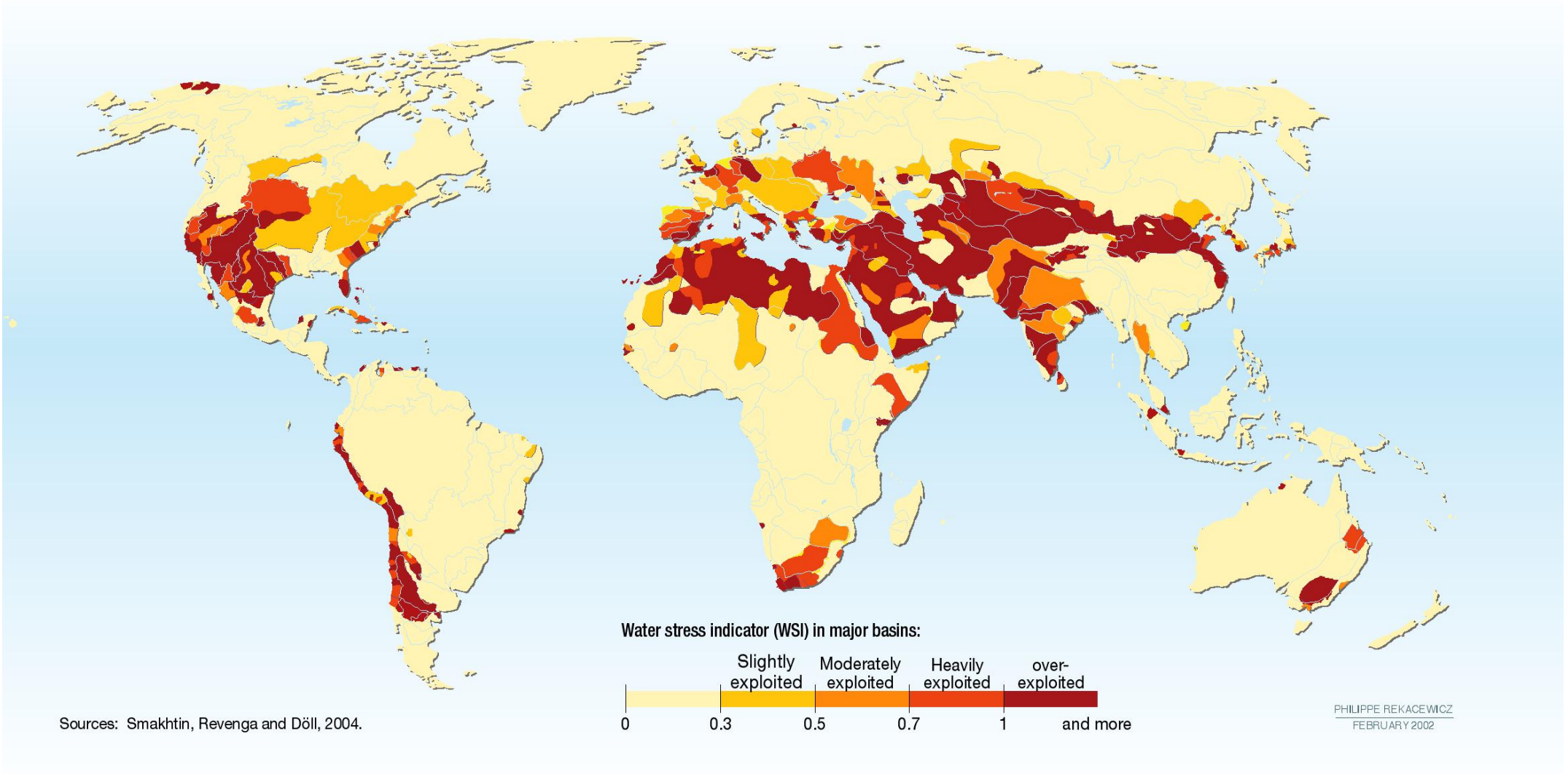
e o empobrecimento de ecossistemas

O exemplo da “explosão das alforrecas”





http://www.lenfestocean.org/en/news-and-publications/data-visualizations/could-fishing-and-jellyfish-suppress-gulf-menhaden
http://advances.sciencemag.org/content/advances/1/5/e1400253.full.pdf



Escassez de água

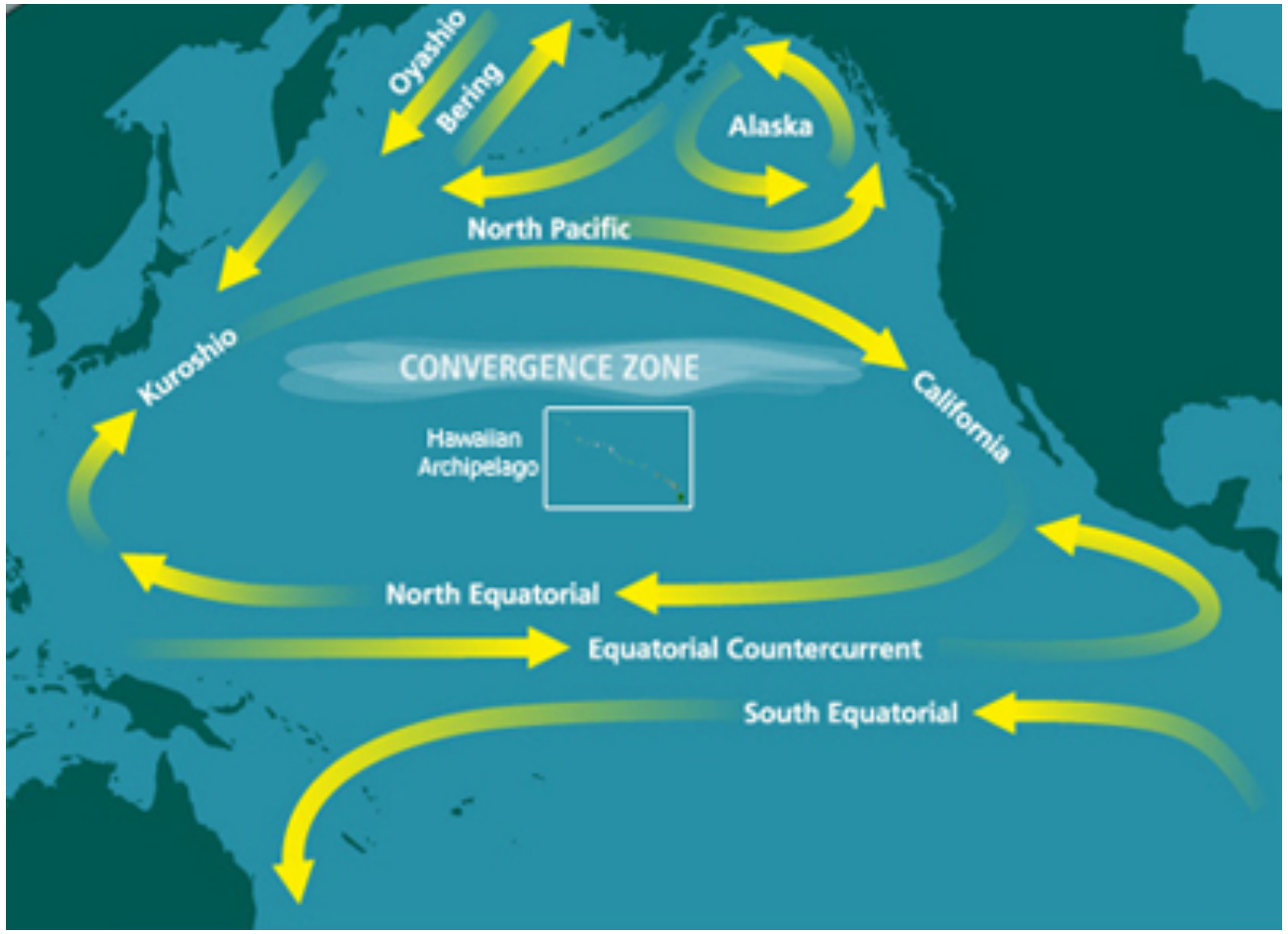
http://www.unep.org/dewa/vitalwater/jpg/0222-waterstress-overuse-EN.jpg

The greatest threat to our planet is the belief that someone else will save it

Robert Swan

Over 80% of marine pollution comes from land-based activities.

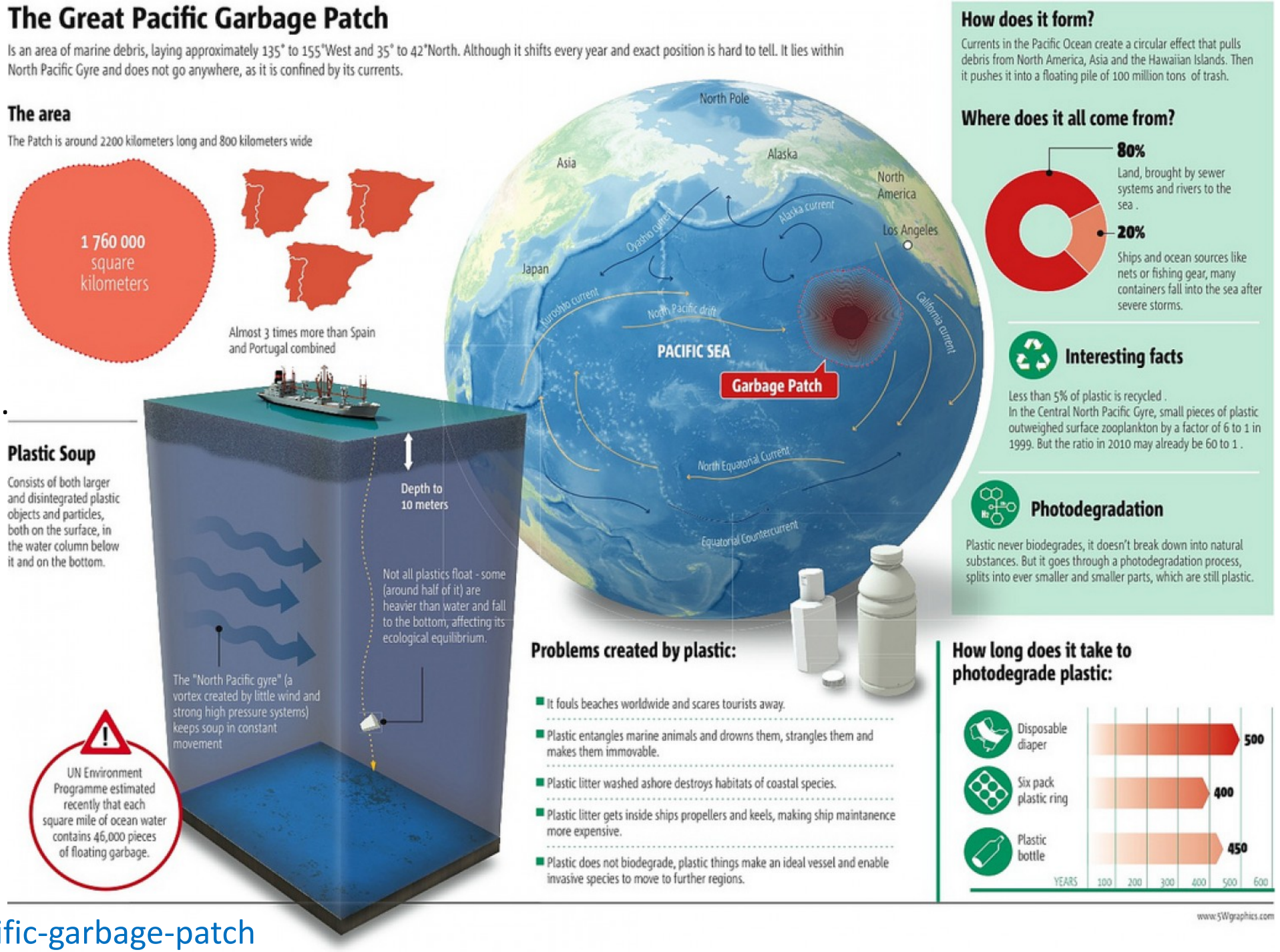
From plastic bags to pesticides - most of the waste we produce on land eventually reaches the oceans, either through deliberate dumping or from run-off through drains and rivers



http://www.noaa.gov http://dels.nas.edu/resources/static-assets/osb/miscellaneous/osb-pollution-in-ocean.pdf
http://www.unoceans.org/activities/en/

http://www.plasticoceans.org http://www.algalita.org
https://en.wikipedia.org/wiki/Great_Pacific_garbage_patch

Somewhere in the pacific ocean is a floating mass of sinister proportions. Stuck in the North Pacific Gyre and trapped by currents, it remains there. The great pacific garbage patch is about 1,760,000square kilometers of marine debris. Mainly consisting of plastic, it is almost three times the size of Spain and Portugal combined.



http://visual.ly/great-pacific-garbage-patch

Início da escassez de alguns recursos naturais

Economia Circular

http://www.easac.eu/fileadmin/Reports/Easac_15_CE_web_corrected.pdf

commentary

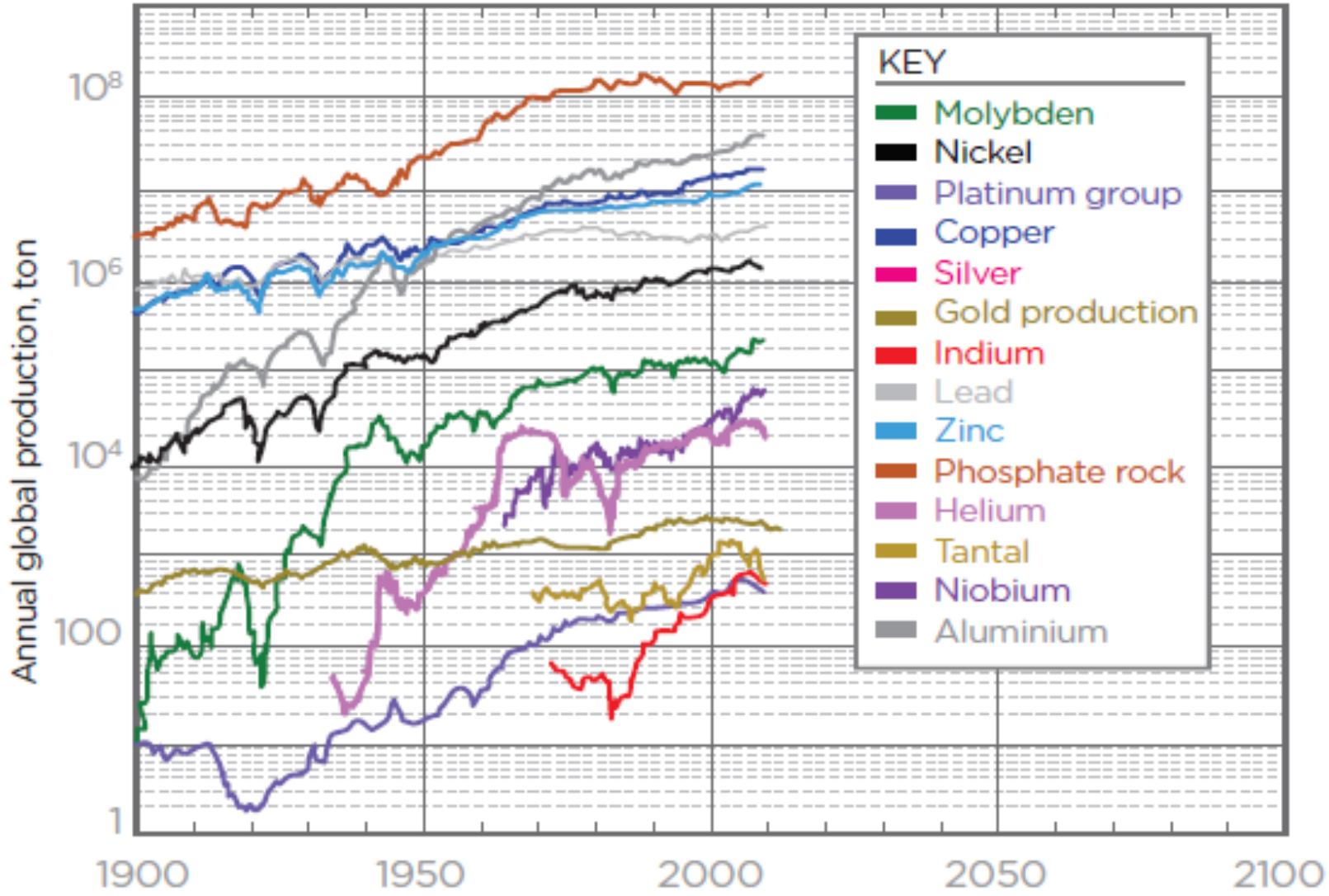
European Academies' easac Science Advisory Council

Circular economy: a commentary from the perspectives of the natural and social sciences

Summary

In May 2015, the European Academies' Science Advisory Council (EASAC) started a review of issues related to the 'circular economy'. The circular economy involves many aspects of science, technology and social science but this commentary is intended to contribute to the debate between stakeholders on the principles and objectives of the European Commission's policy. This has been compiled by a Working Group of scientists and economists nominated by member academies of EASAC.

This commentary provides background on natural and social science aspects relevant to policy devlopment on the circular economy; it may be used to inform debate on the principles and broad approach to the circular economy. It reviews the benefits foreseen for a circular economy and potential risks for the transition phase. In a world of increasing population and per capita consumption where existing levels of consumption of resources are already well above sustainable levels, improving the efficiency with which humanity uses resources is a priority. However, barriers that stand in the way of a transition to a circular economy are substantial and increased by some current trends in corporate and consumer behaviour. EASAC accepts the rationale for, and potential qualitative benefits of, the circular economy. However, there are uncertainties over models used in quantifying the benefits, and questions remain over transition to a circular economy. Further research options to reduce these uncertainties are identified.



Extração de metais desde 1900

Figure 1.1 Extraction of many metals grew exponentially since the year 1900 (the ordinate on the picture being logarithmic)
From Sverdrup et al, 2013

Energy, Environment and Climate- Key urgent measures:

- Limit and put a proper price for the emissions of CO2 and other GHG
- Establish targets for renewables and energy efficiency
- Establish Goals for sustainable mobility
- Enforce the legal protection of Biodiversity and the sustainable management of the Global Commons
- Promote Circular Economy and combat poverty

Carlos Pimenta 2016

Energy in transition

Energy is the main cause of Climate Change, but the other sectors, such as food production, urban management, industry, etc, should not be forgotten

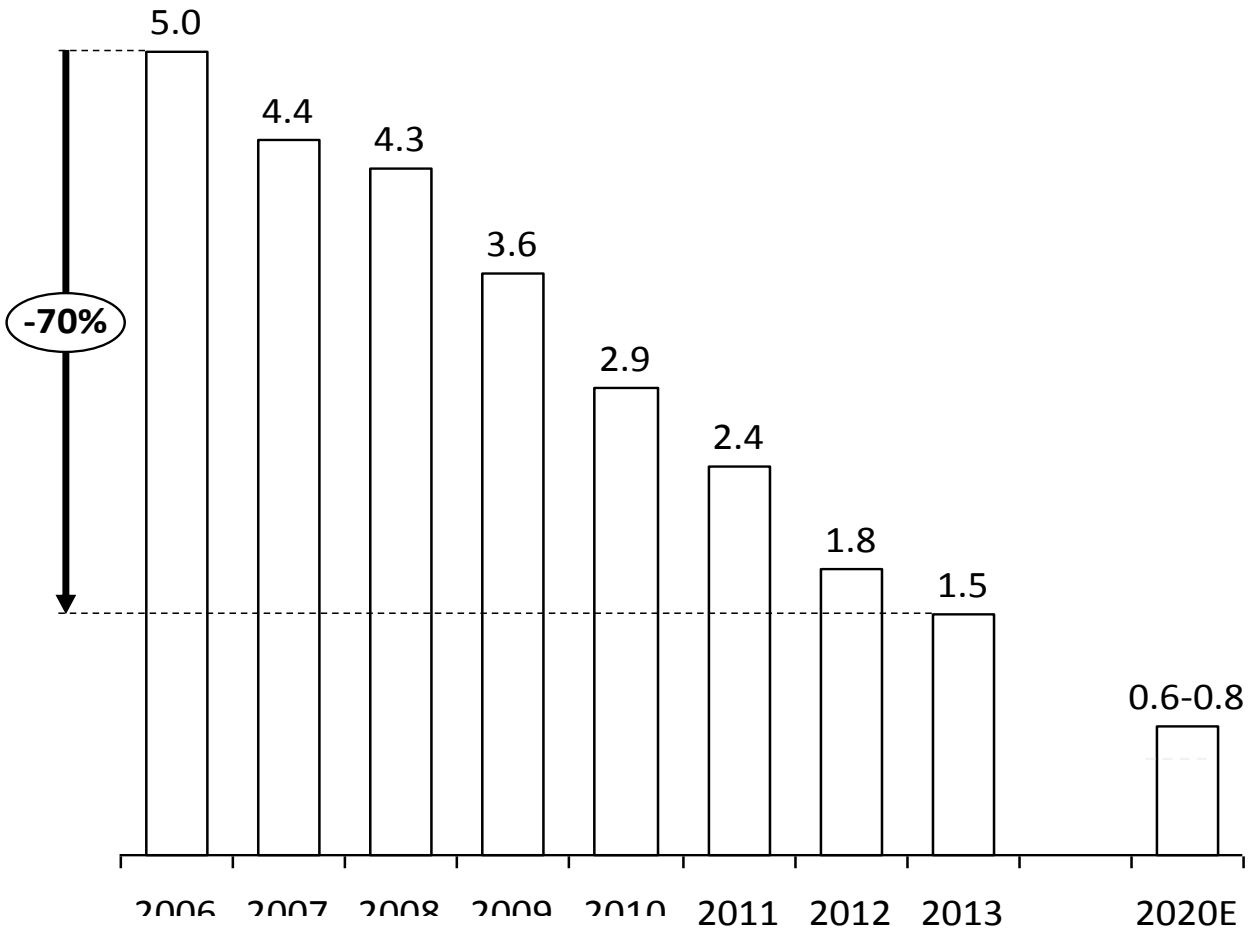
Environment and Climate Change are permanent main determinants in the choice of Energy Policies

Technology is now the main driver of evolution
(not policy or regulation)

A new Paradigm for (*Energy*) Business is emerging
(new actors, old actors doing new things, smart systems, "prosumers", electrification of energy, decarbonisation, etc.) it will be part of the movement to a ***Shared economy; startup mentality; in a internet based economy***

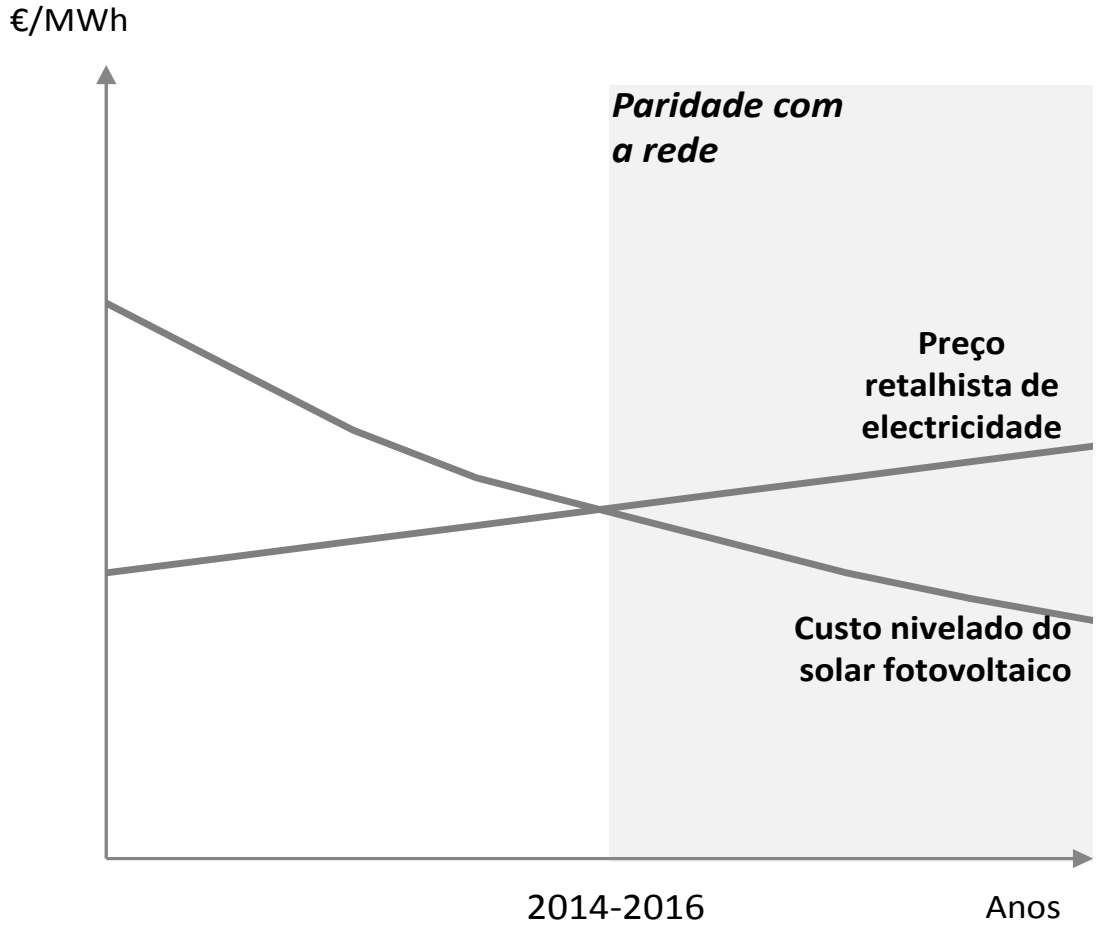
A queda acentuada do custo do solar fotovoltaico tornou o "grid-parity" uma realidade, tornando-se um investimento atractivo para os clientes

Custos do solar PV distribuído para sistemas <100 kW
€/Wp, 2006-2013, 2020E



Fonte: BSW-Solar PV Price Index 5/2012, EDP

Ilustração do conceito de paridade com a rede

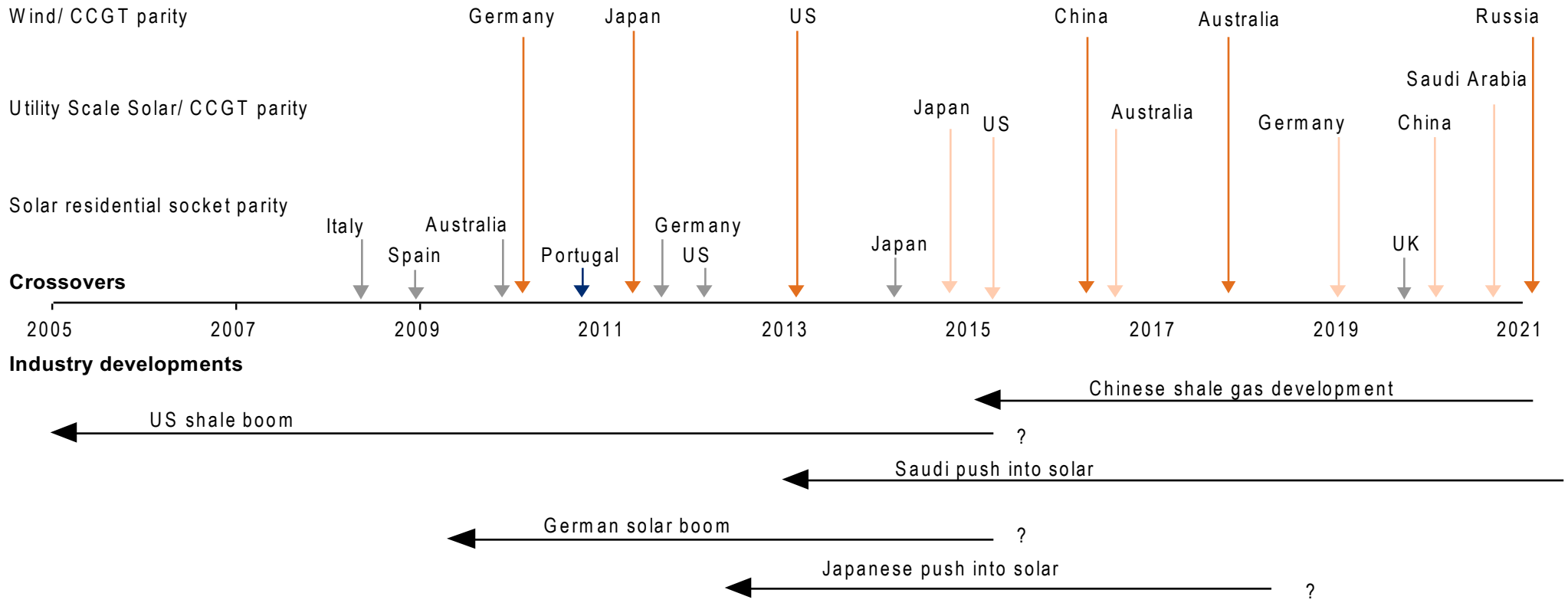


The parity timeline solar

There are an enormous number of variables in calculating socket and grid parity in differing markets, not least what happens to fossil commodity prices which can vary dramatically between regions. However, Figure 73 shows our estimate of a parity timeline, showing residential 'socket parity' already having been achieved in many markets, with utility scale solar achieving parity vs. CCGT's potentially from the middle of this decade and wind already there in some markets.

Parity for renewables is already a reality in some market, and will become more widespread in a short timeframe

Figure 73. The parity timeline, showing cost competitiveness of residential and utility scale solar in various countries, with reference to wind generation and the development of shale resources.



Source: Citi Research

The Economist

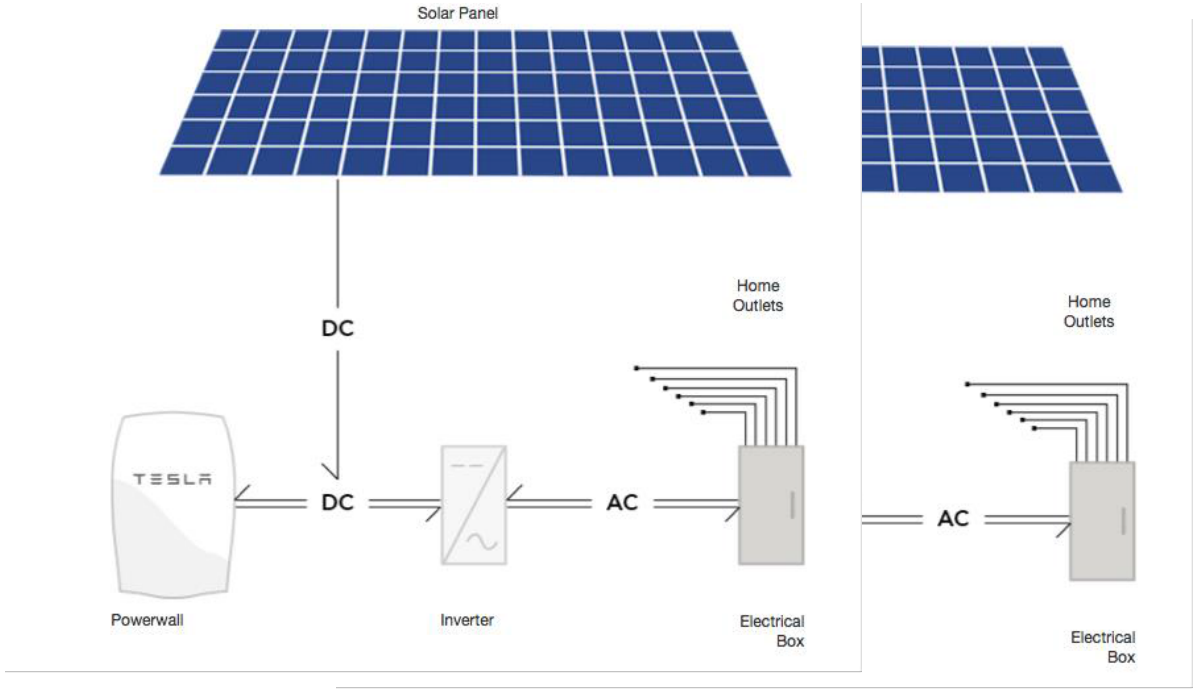
Renewables We make our own

Renewables are no longer a fad but a fact of life, supercharged by advances in power storage

Jan 17th 2015 | From the print edition

Energy Storage for a Sustainable Home

Powerwall from TESLA is a home battery that charges using electricity generated from solar panels, or when utility rates are low, and powers your home in the evening. It also fortifies your home against power outages by providing a backup electricity supply. Automated, compact and simple to install, Powerwall offers independence from the utility grid and the security of an emergency backup.



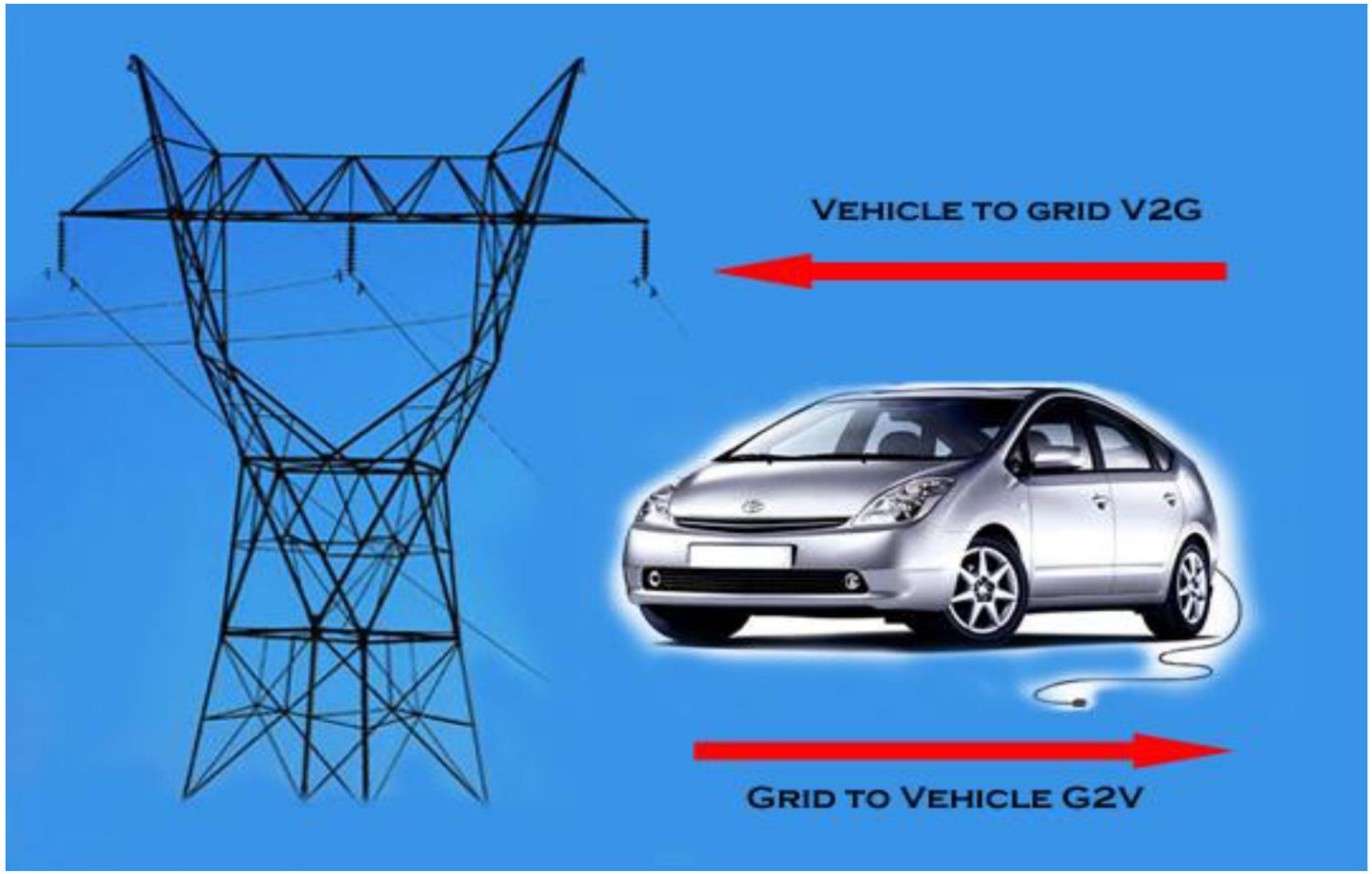
Mercedes-Benz To Follow Tesla With Its Own Home Batteries

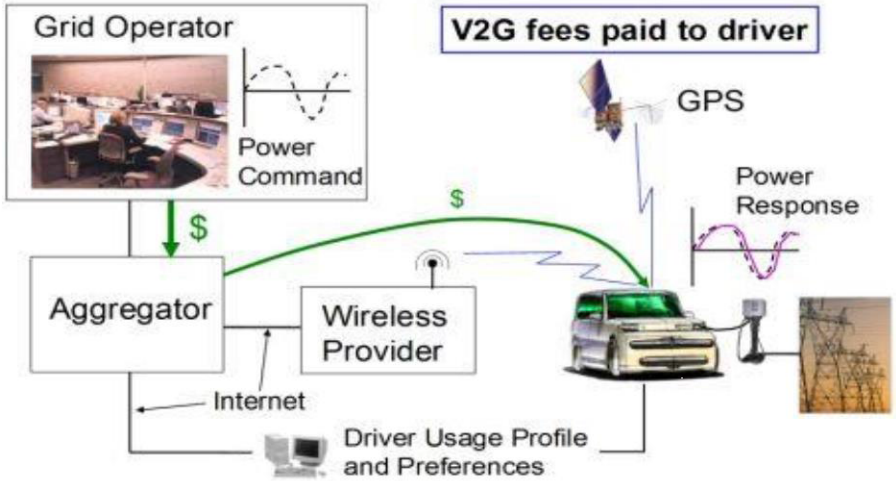
MotorAuthority
Stephen Edelstein
June 5, 2015

If there's a holy grail out there these days, it's storage, because innovations in electricity storage would change the economics of wind and solar power.

Daniel Yergin

V2G may be part of the solution





No futuro os automóveis serão usados também como baterias que podem acumular energia e devolvê-la à rede quando necessário ou económico (Vehicle to Grid – V2G)

O CO_2 como critério de gestão urbana

	Ton CO_2/capita	GJ/capita	Ton CO_2/TJ
Vaxjo	3,8	101,8	37
Stockolm	3,9	95,9	41
Malmoe	4,9	105,0	46
Victoria-Gasteiz	6,4	102,0	63
Porto	5,5	85,3	64
Bizcaia	6,4	101,2	64
Pori	11,7	165,7	70
Burgos	8,0	115,0	70
Barcelona	2,8	38,6	71
Parma	8,4	103,6	81
Pavia	6,0	71,2	84
Tampere	8,1	94,8	85
Ancona	6,3	73,1	86
Provincia Torino	7,6	87,1	87
Verbania	8,6	97,1	89
Maribor	8,4	93,7	90
Nord Milano	8,8	89,8	98
Catarina	5,0	49,9	100

Växjö kommun
The Greenest City in Europe

City of Växjö received Sustainable Energy Europe Award 2007 during the European Sustainable Energy Week.

Fossil Fuel Free Växjö is an overall programme initiated by the City of Växjö to reduce human impact on the global climate change. In 1996, Växjö politicians decided unanimously to strive towards a fossil fuel free municipality. The share of renwable energy is now over 50%.

Natureza da energia primária é crítica!

An unparalleled technological and scientific revolution

- New matter
- New “Life”
- Health, longevity and demography revolution
- Real-time decentralized data processing
- Shared Globalization with millions of users
- Dematerialization and Mass Customization
- New energy forms

A basic 3D printer, also known as a fabricator or “fabber”, now costs less than a laser printer did in 1985