Climate change and its Impact

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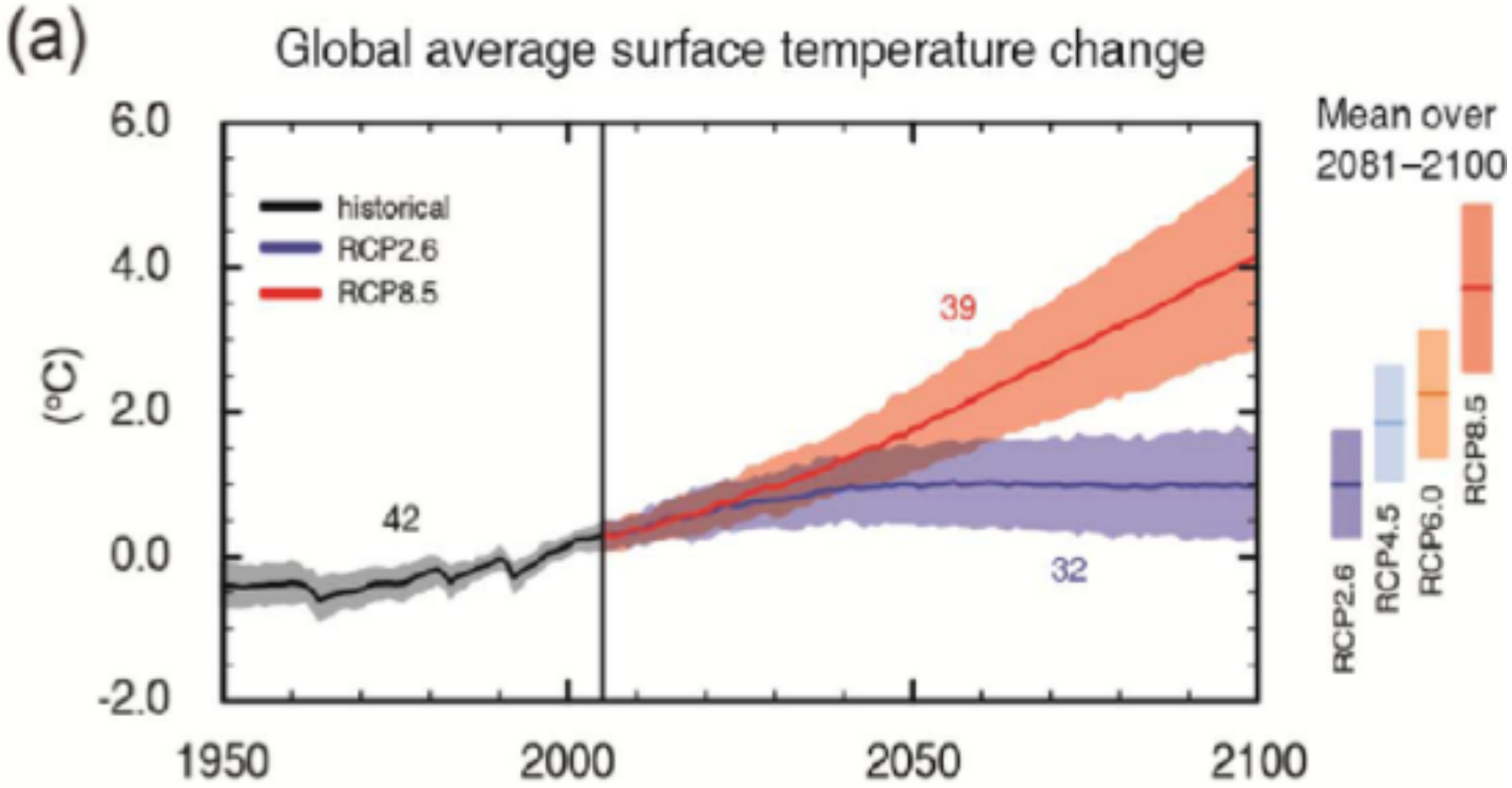
EUROFOUND, Dublin

I. Climate change (mostly bad news)

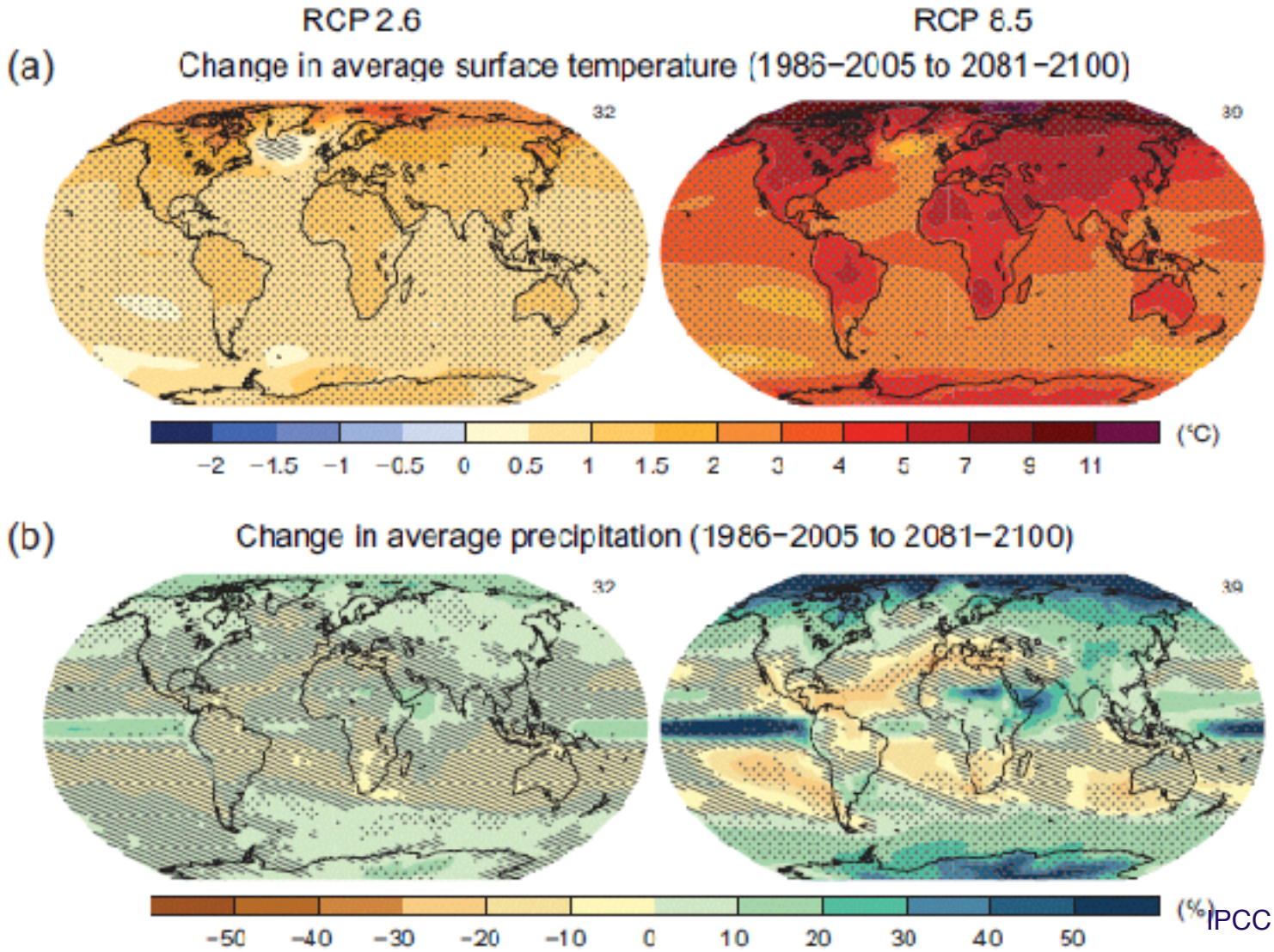
II. Reconstructing macro-economics

Business as usual leads to + 5°C.
Too late for <+2°C.



IPCC 2013

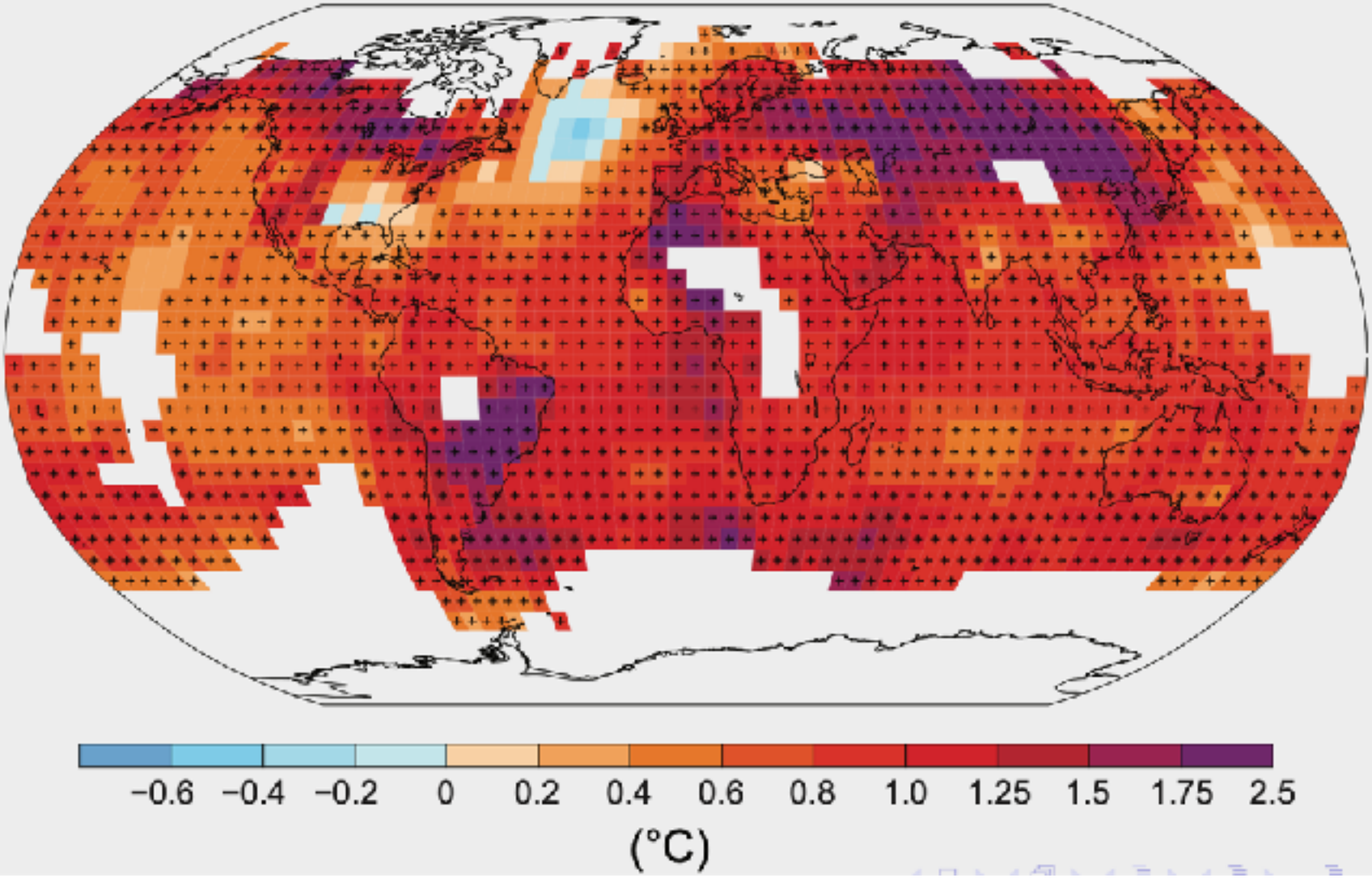
Change in temperature and rainfalls

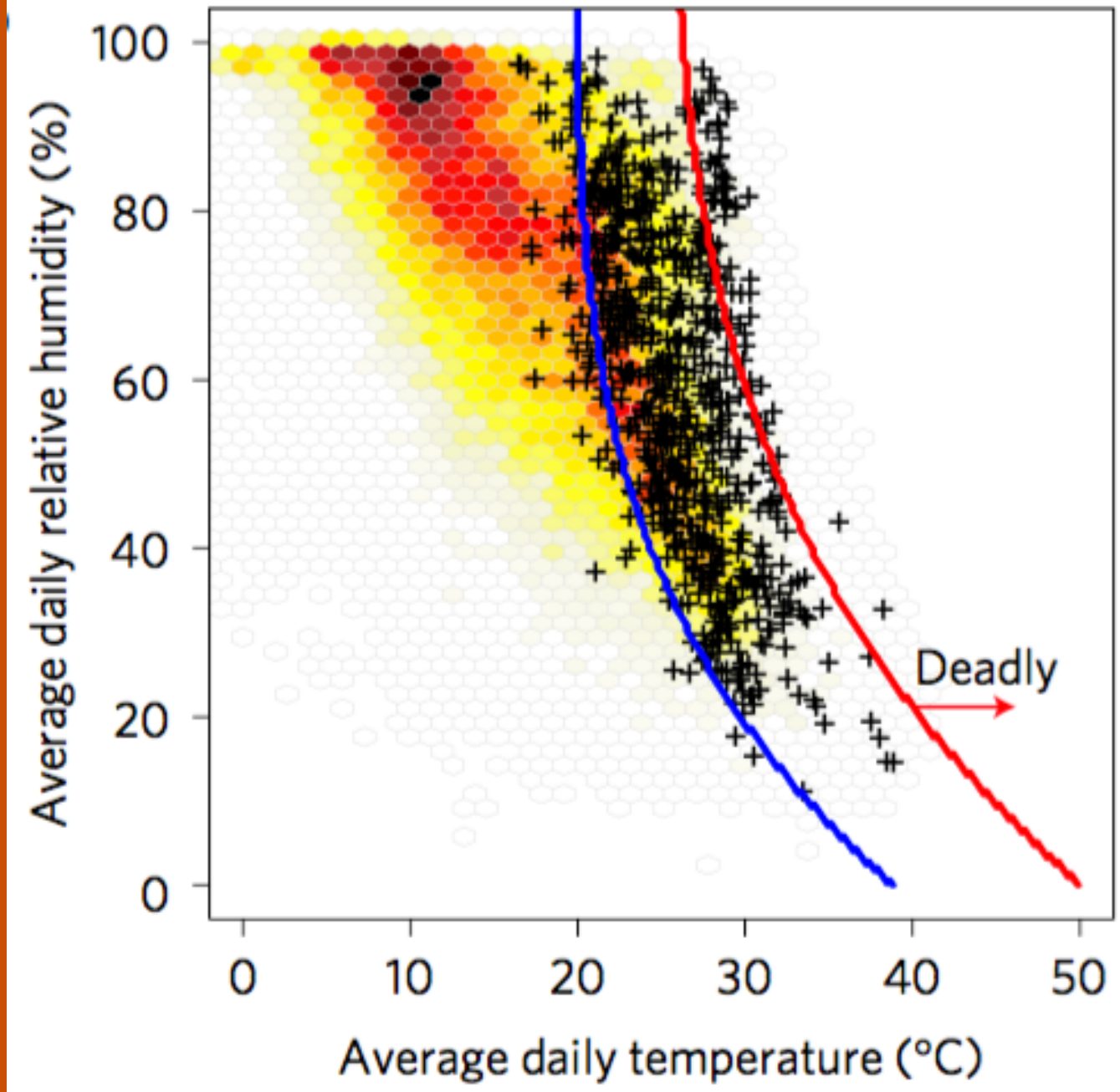


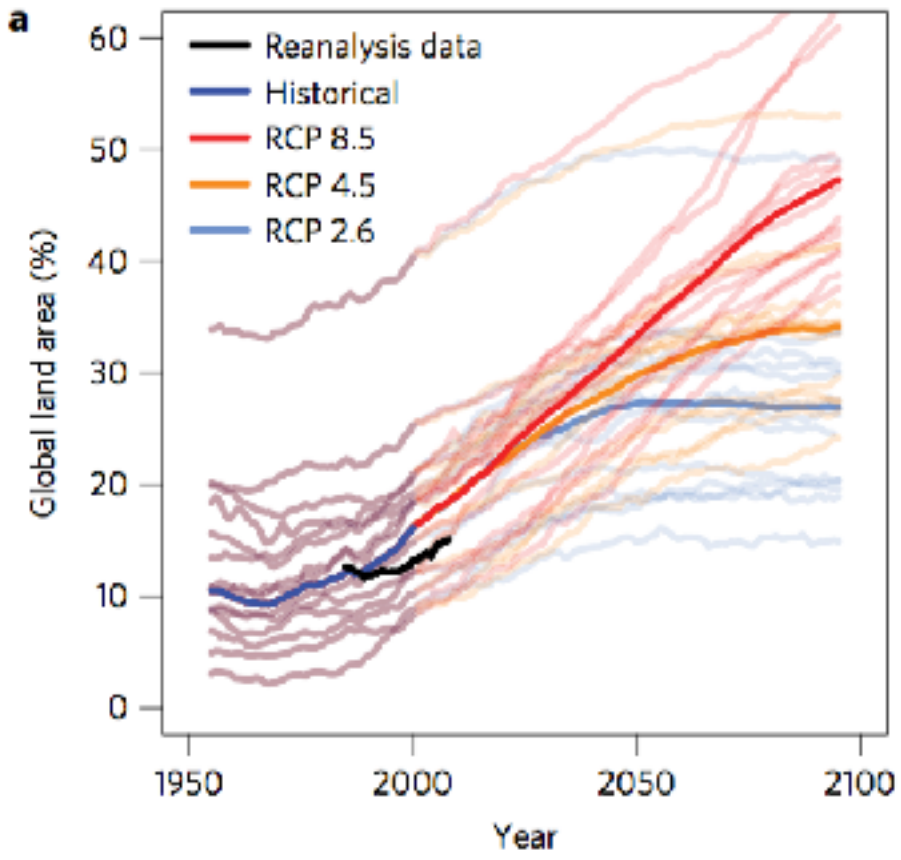
IPCC 2013, SMP.8

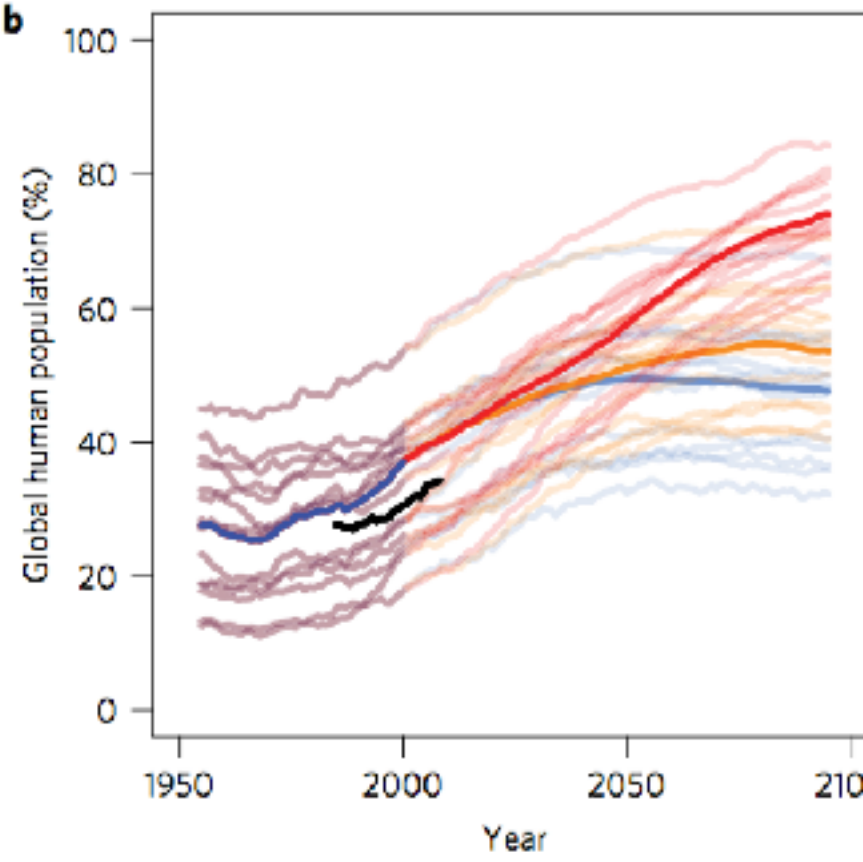
Rayures = la moyenne multi-modèle de l'anomalie est petite par rapport à la variabilité
Pointillés = régions où l'anomalie moyenne (multi-modèles) est grande par rapport à la variabilité naturelle et où au moins 90% des modèles s'accordent sur le signe de changement.

Observed change in surface temperature 1901–2012

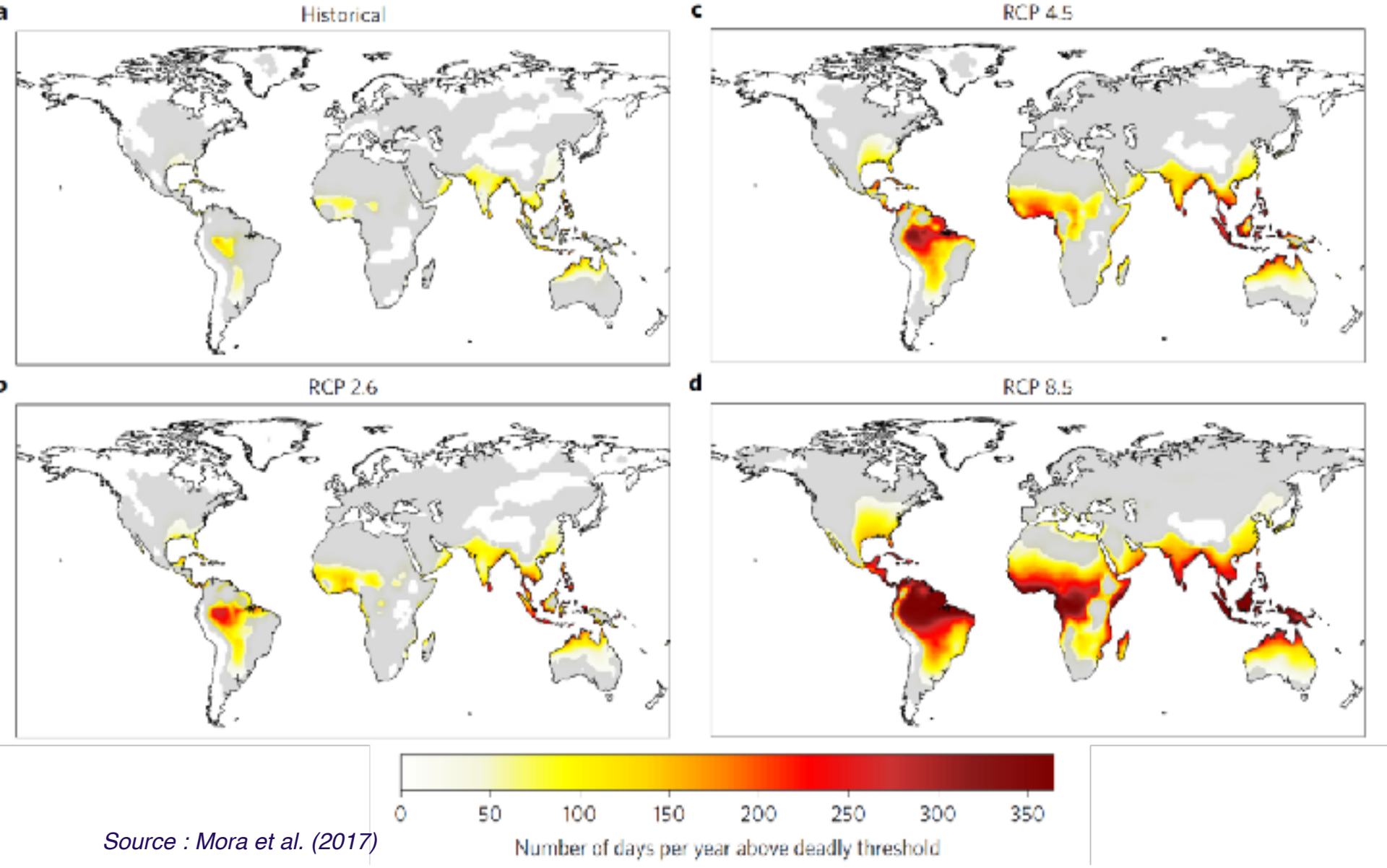



Average daily relative humidity (%)
100
80
60
40
20
0
0
10
20
30
40
50
Average daily temperature (°C)
Deadly


a
Reanalysis data
Historical
RCP 8.5
RCP 4.5
RCP 2.6
Global land area (%)
0
10
20
30
40
50
60
1950
2000
2050
2100
Year


b
Global human population (%)
0
20
40
60
80
100
1950
2000
2050
Year

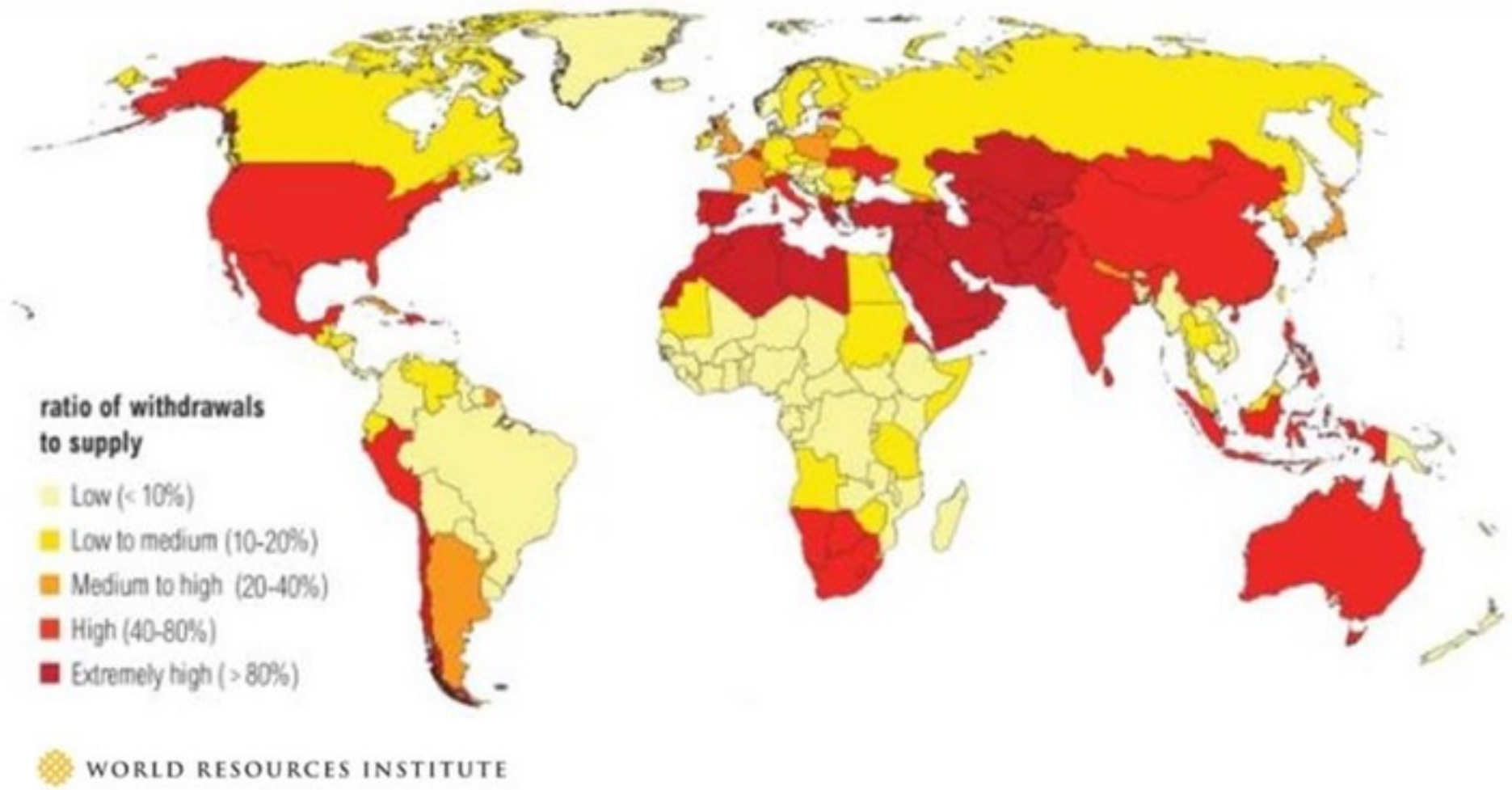
Hyperthermia and humidity



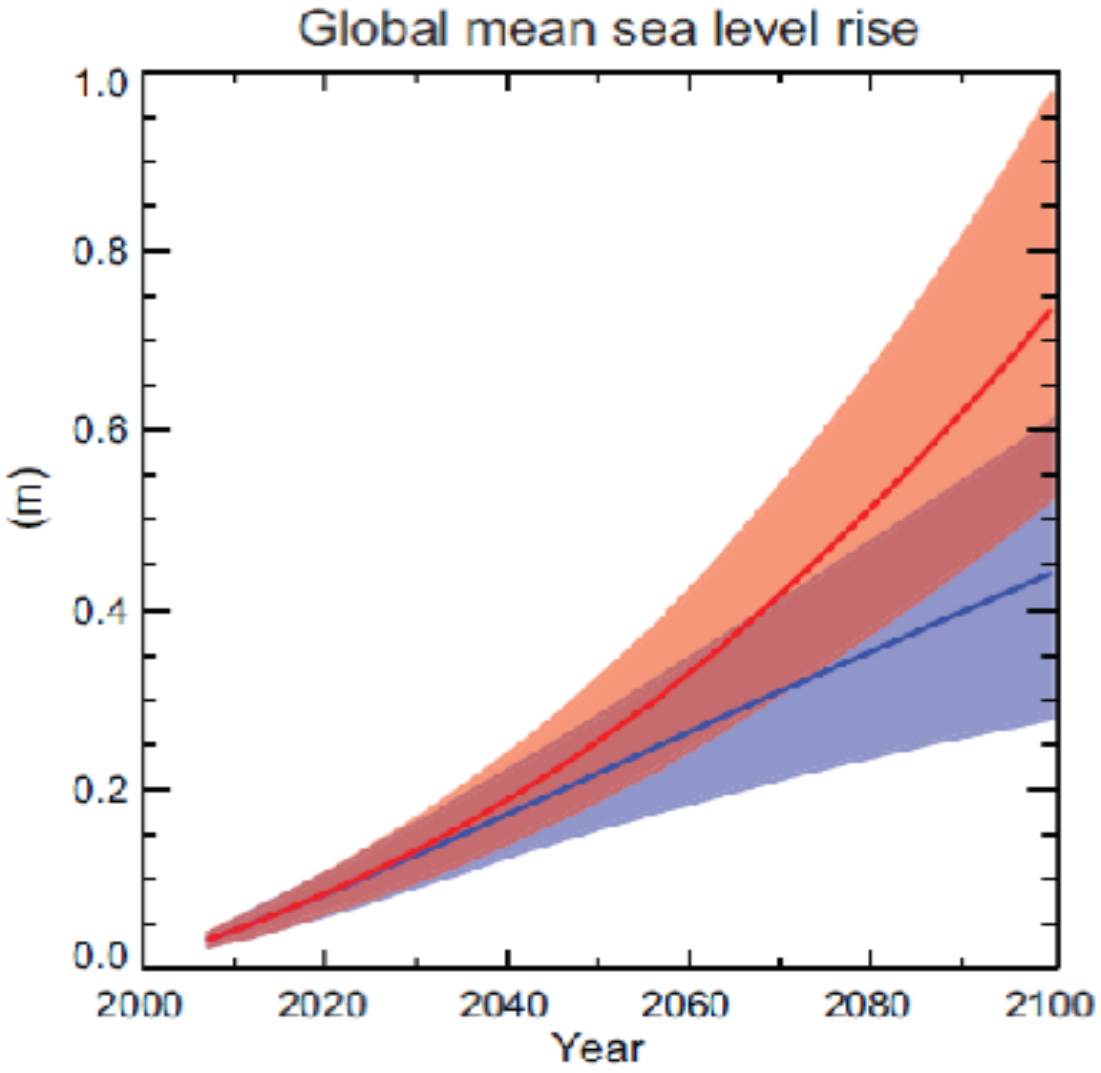
Source : Mora et al. (2017)

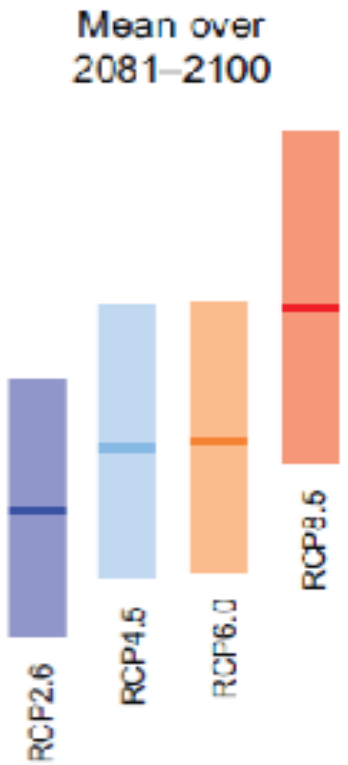
Hydric Stress

Projection of hydric stress in 2040

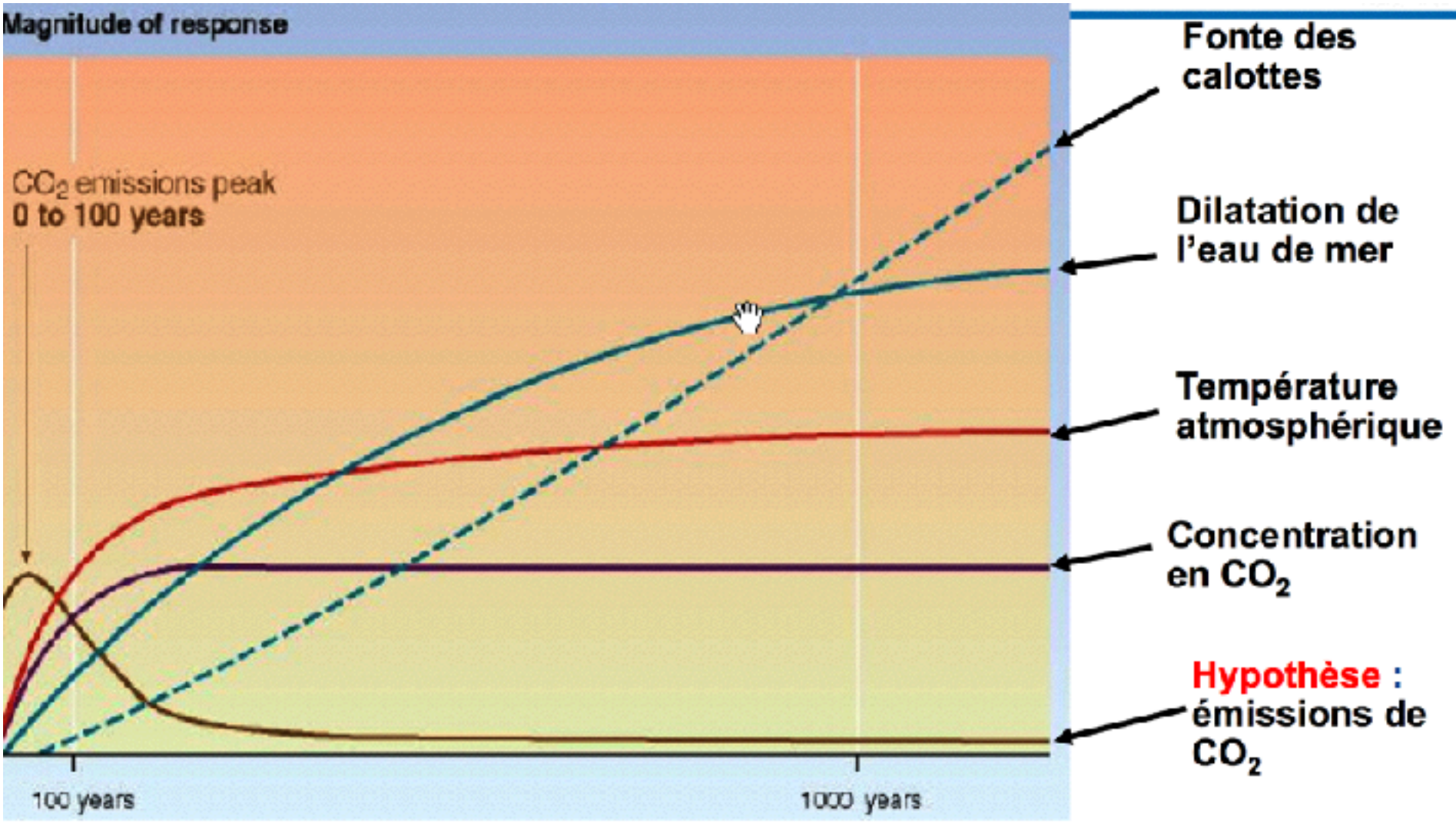


Rise of the seal level





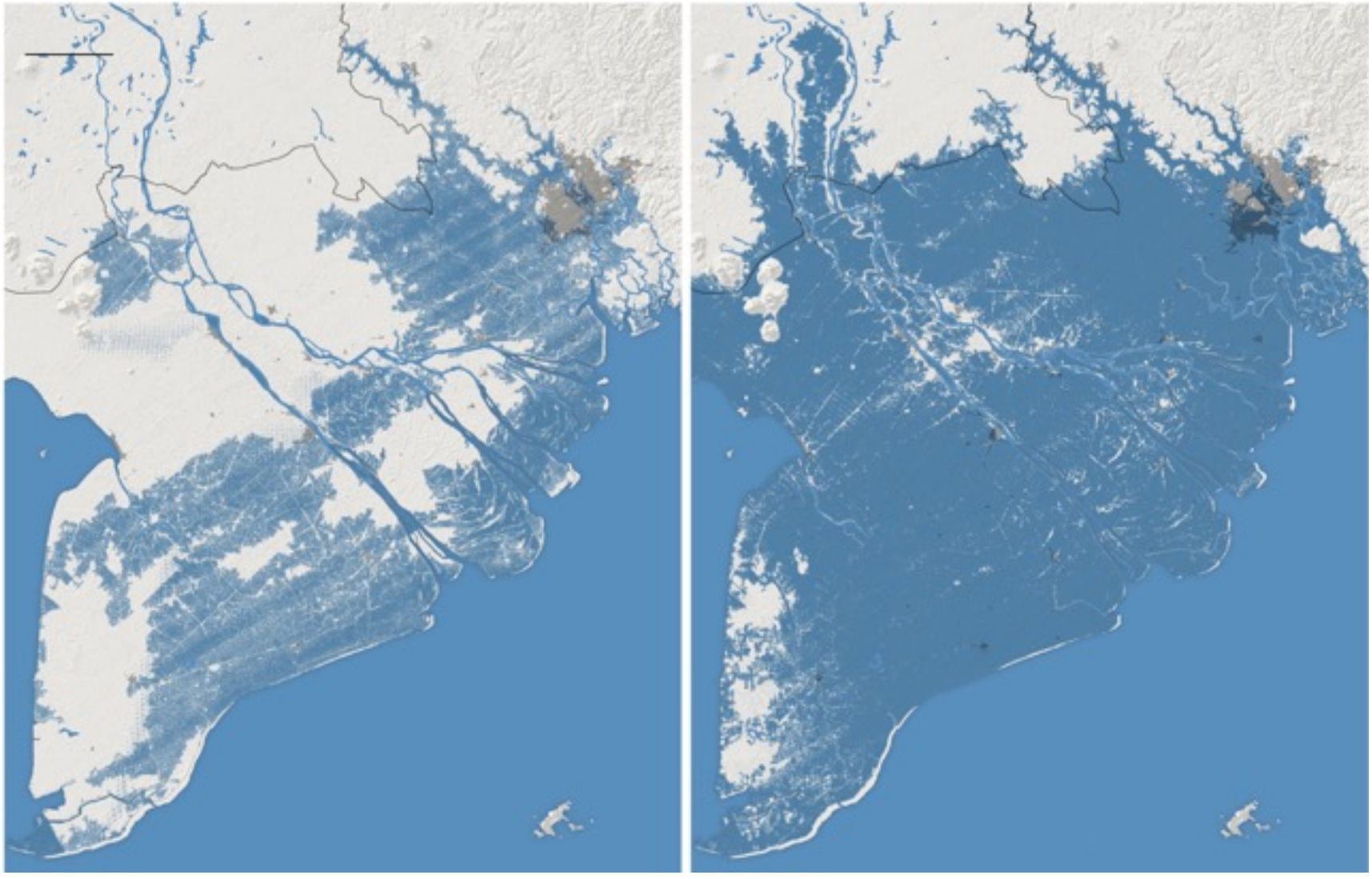
Projections IPCC 2013



Source : Climate Change 2001, the scientific Basis, GIEC

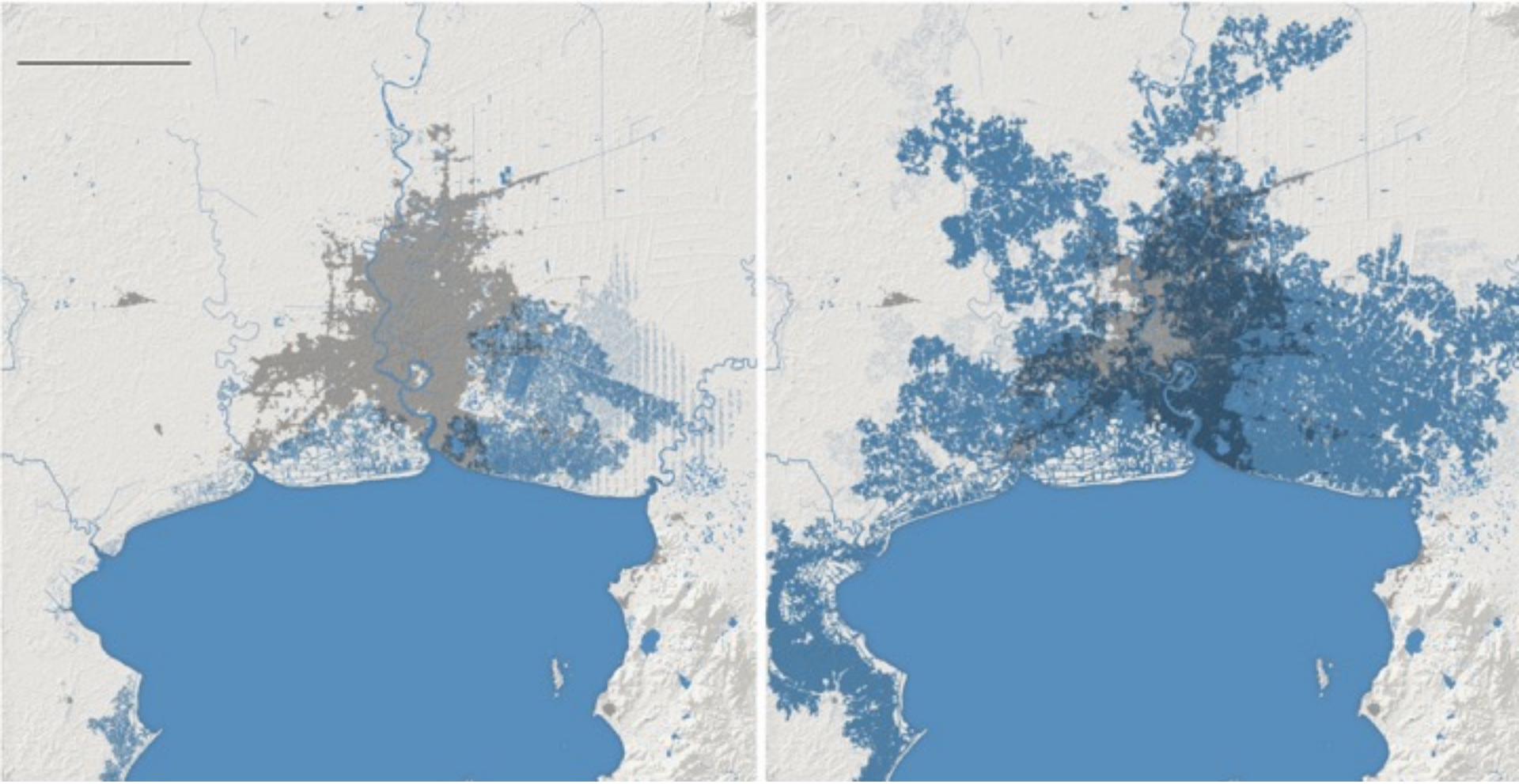
Mekong Delta under water by 2050 (high tide)

Lu and Flavelle (2019)



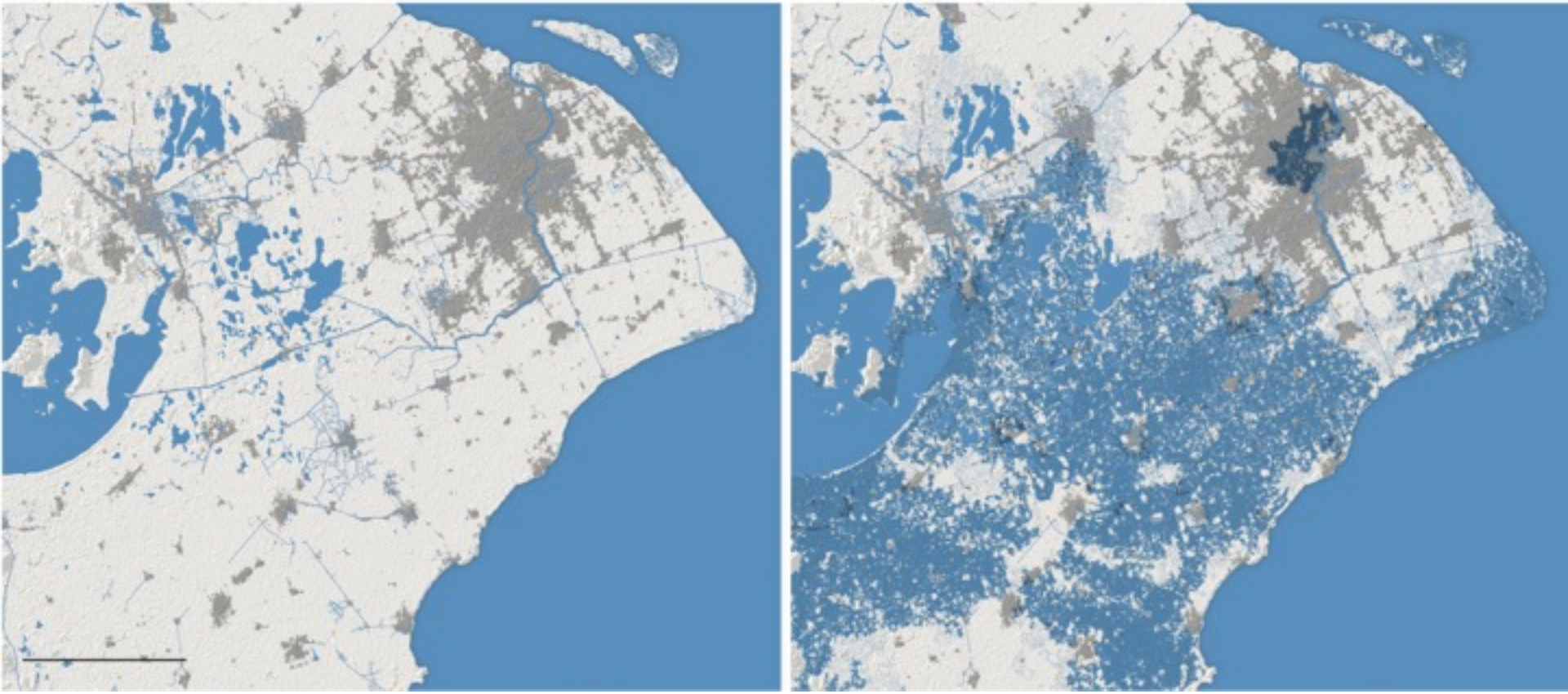
Bangkok 2050

Lu and Flavelle (2019)



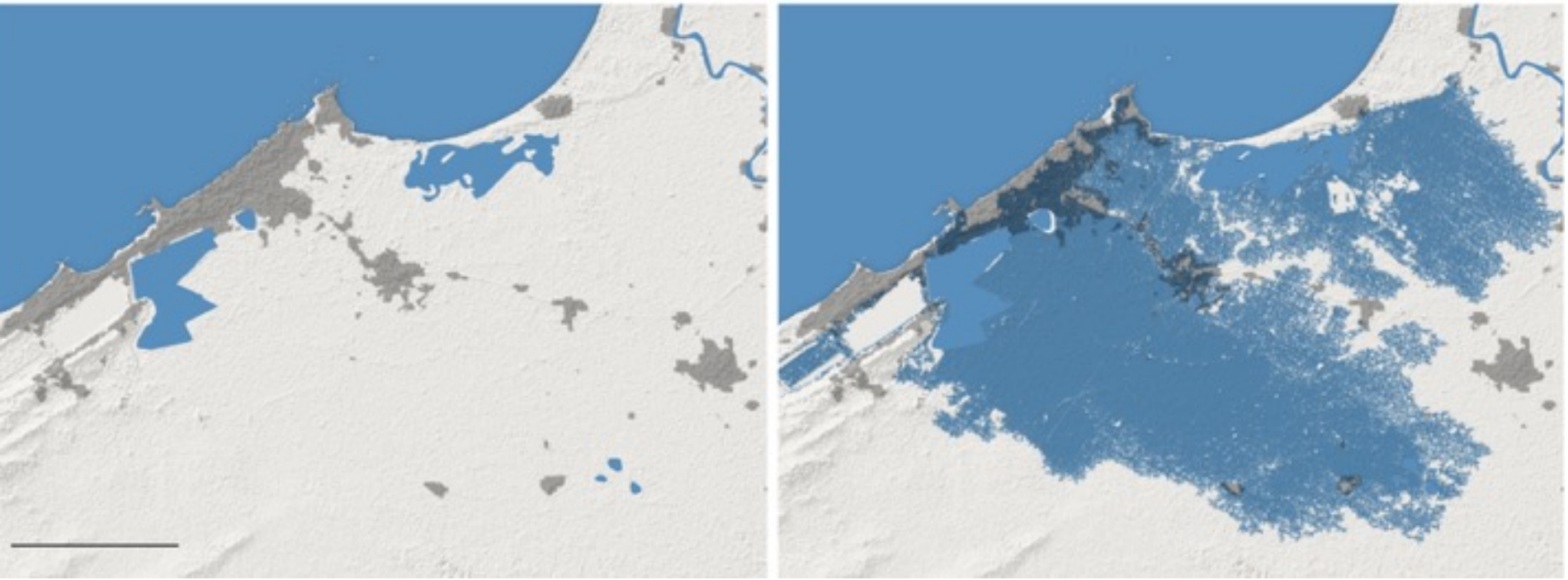
Shanghai 2050

Lu and Flavelle (2019)



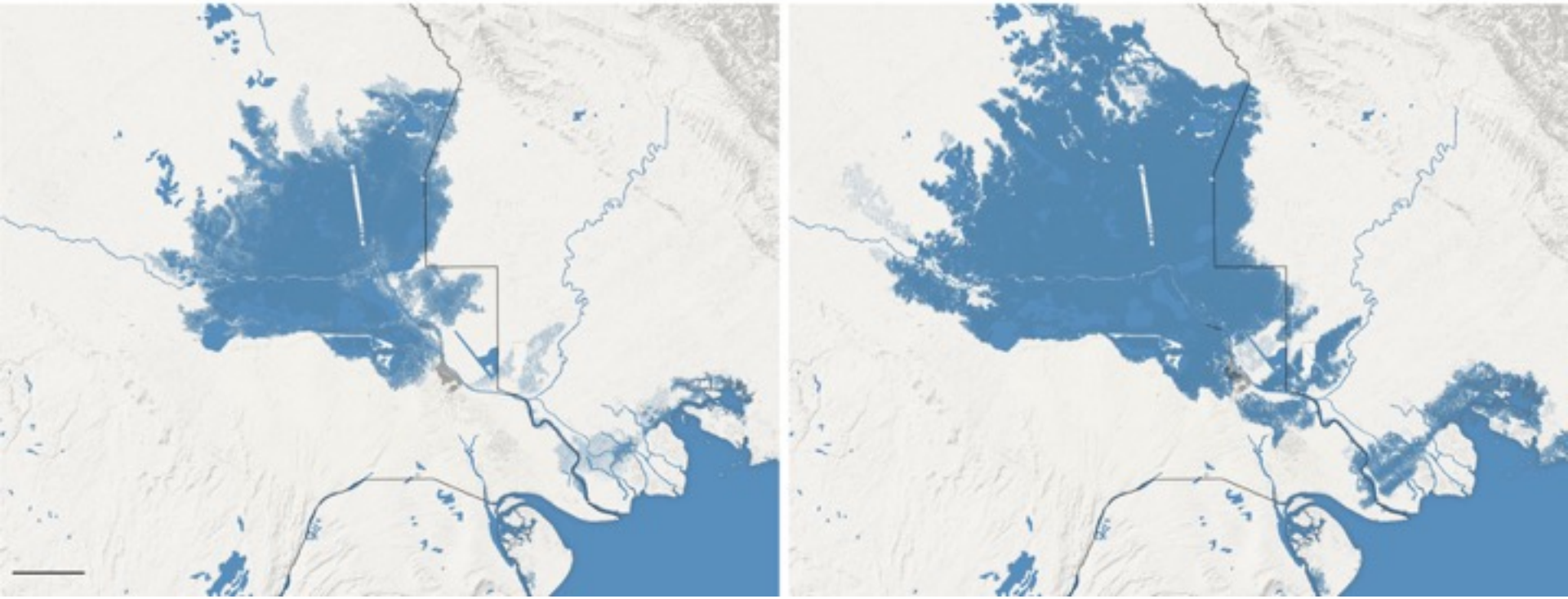
Alexandria 2050

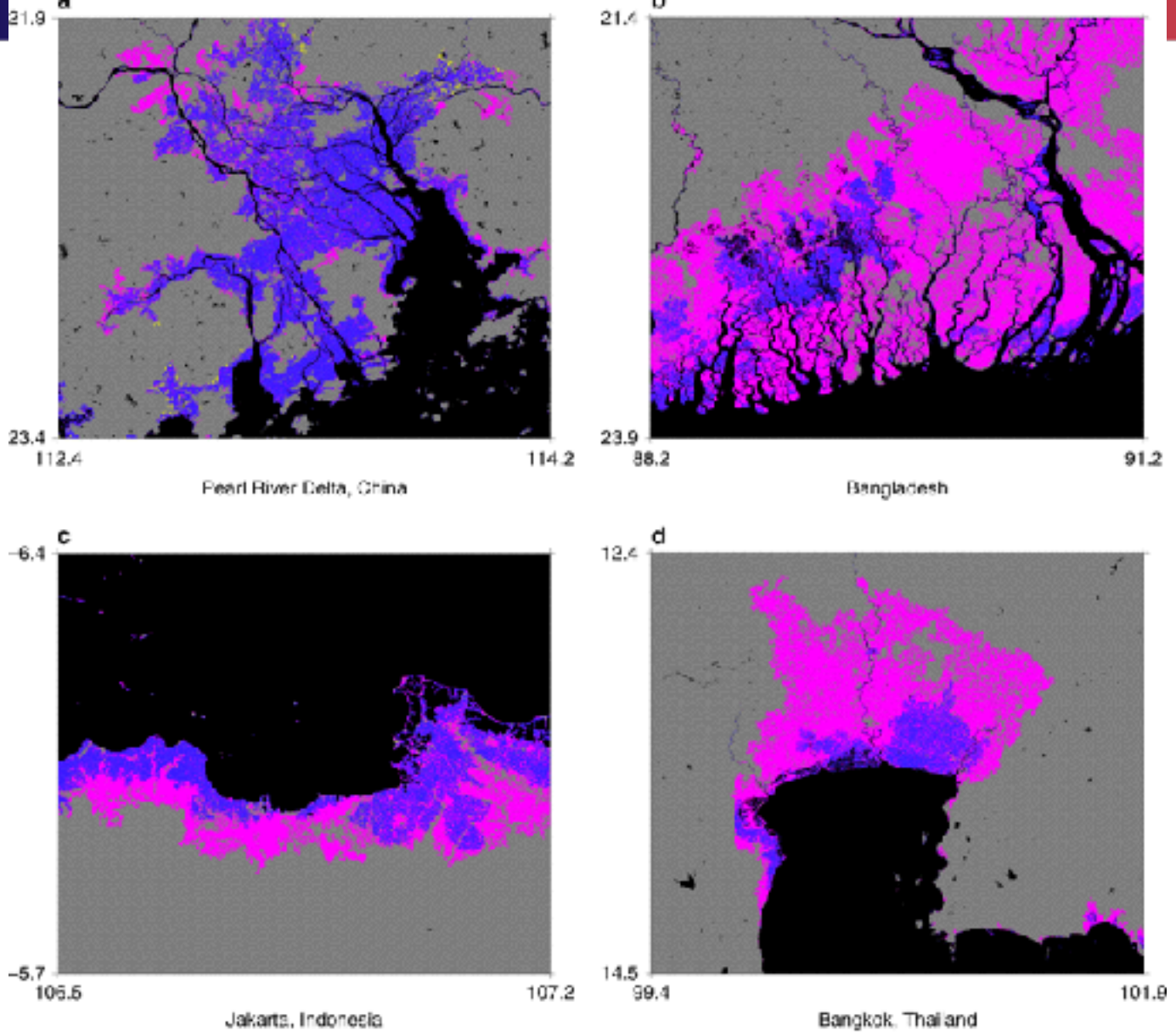
Lu and Flavelle (2019)



Basra: a military issue for Middle-East 2050

Lu and Flavelle (2019)



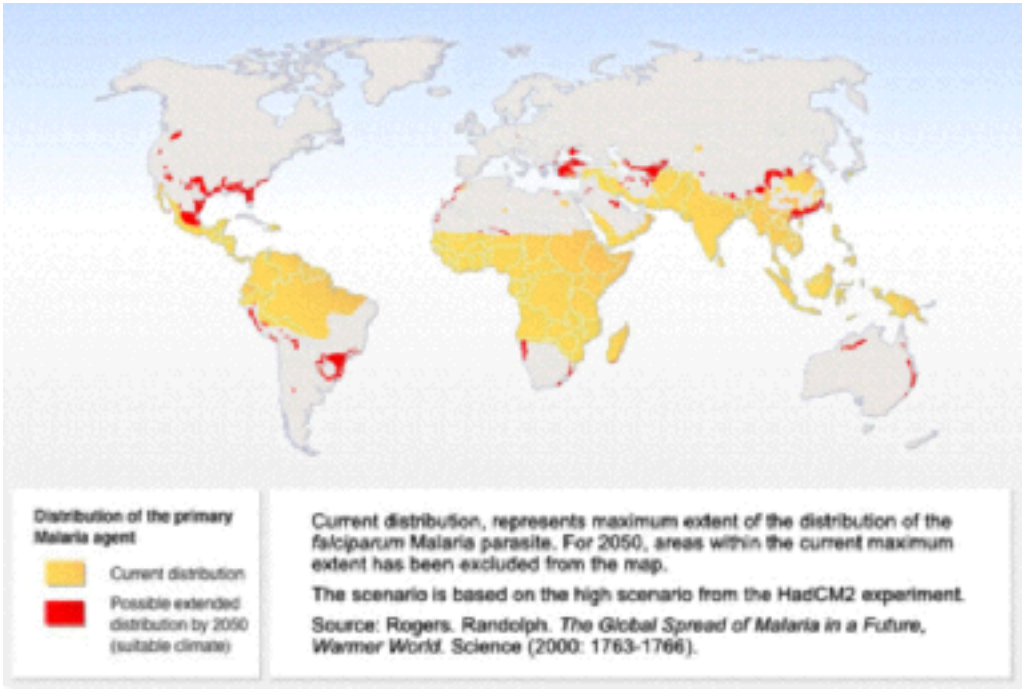


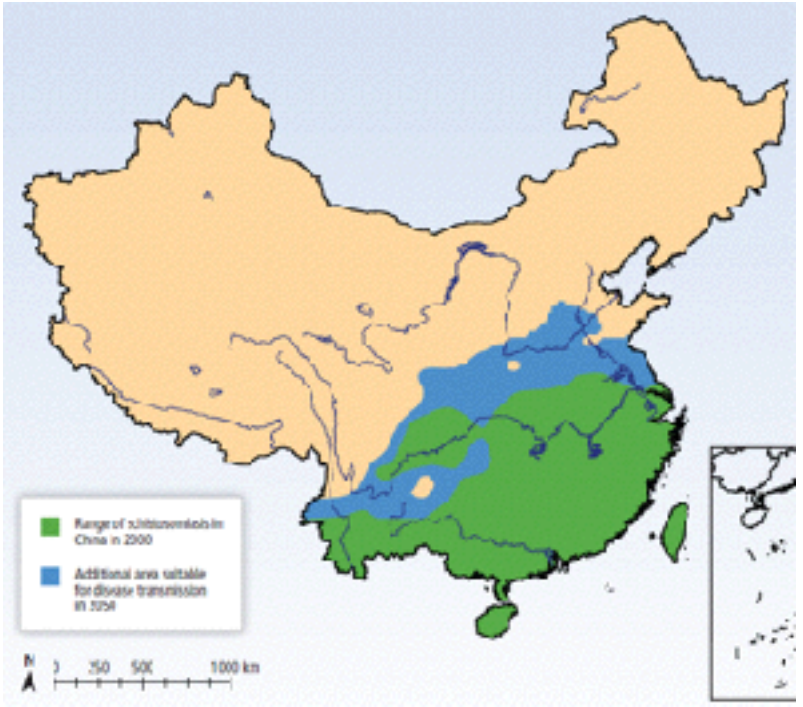
Modelling uncertainties

Scott and Strauss (2019)

Extension of pandemic diseases

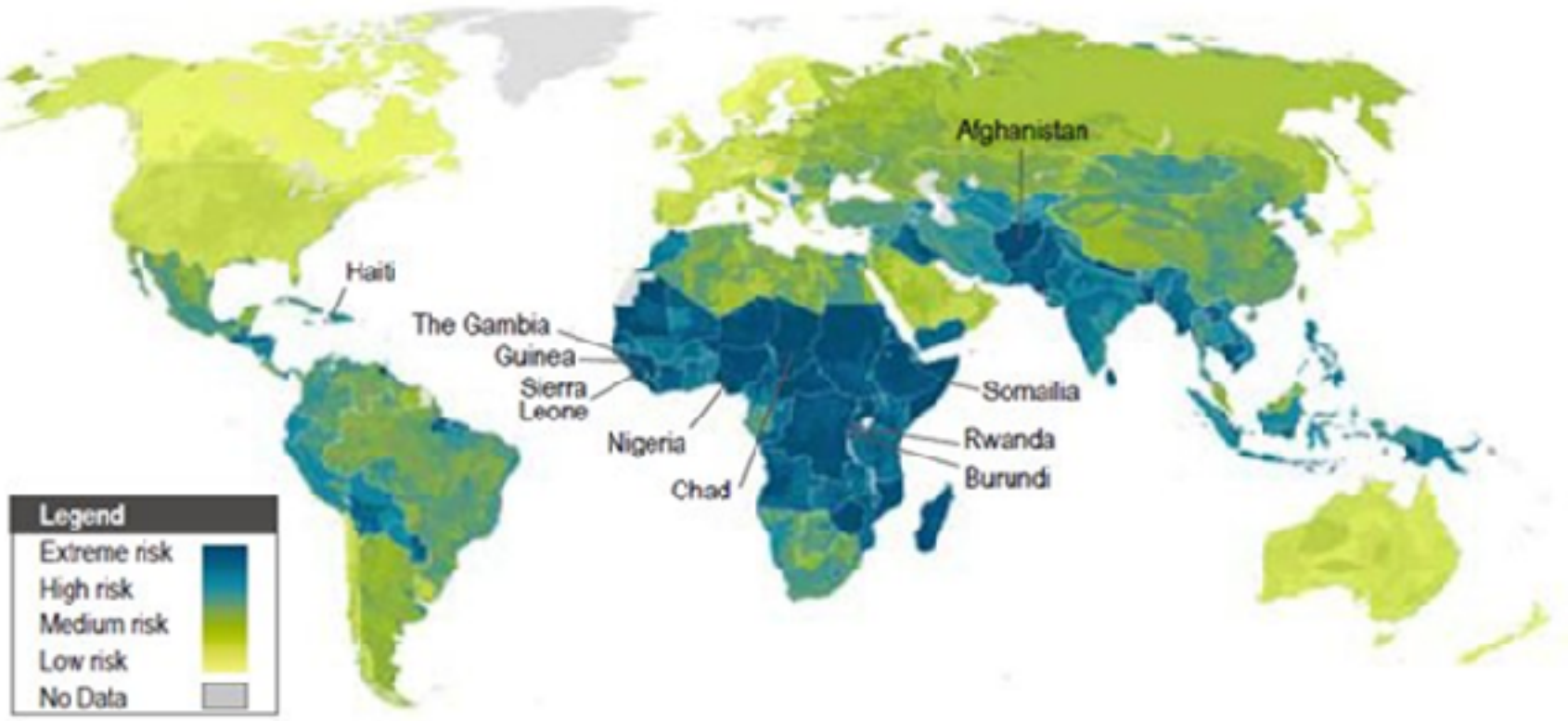
Projected extension of malaria in 2050





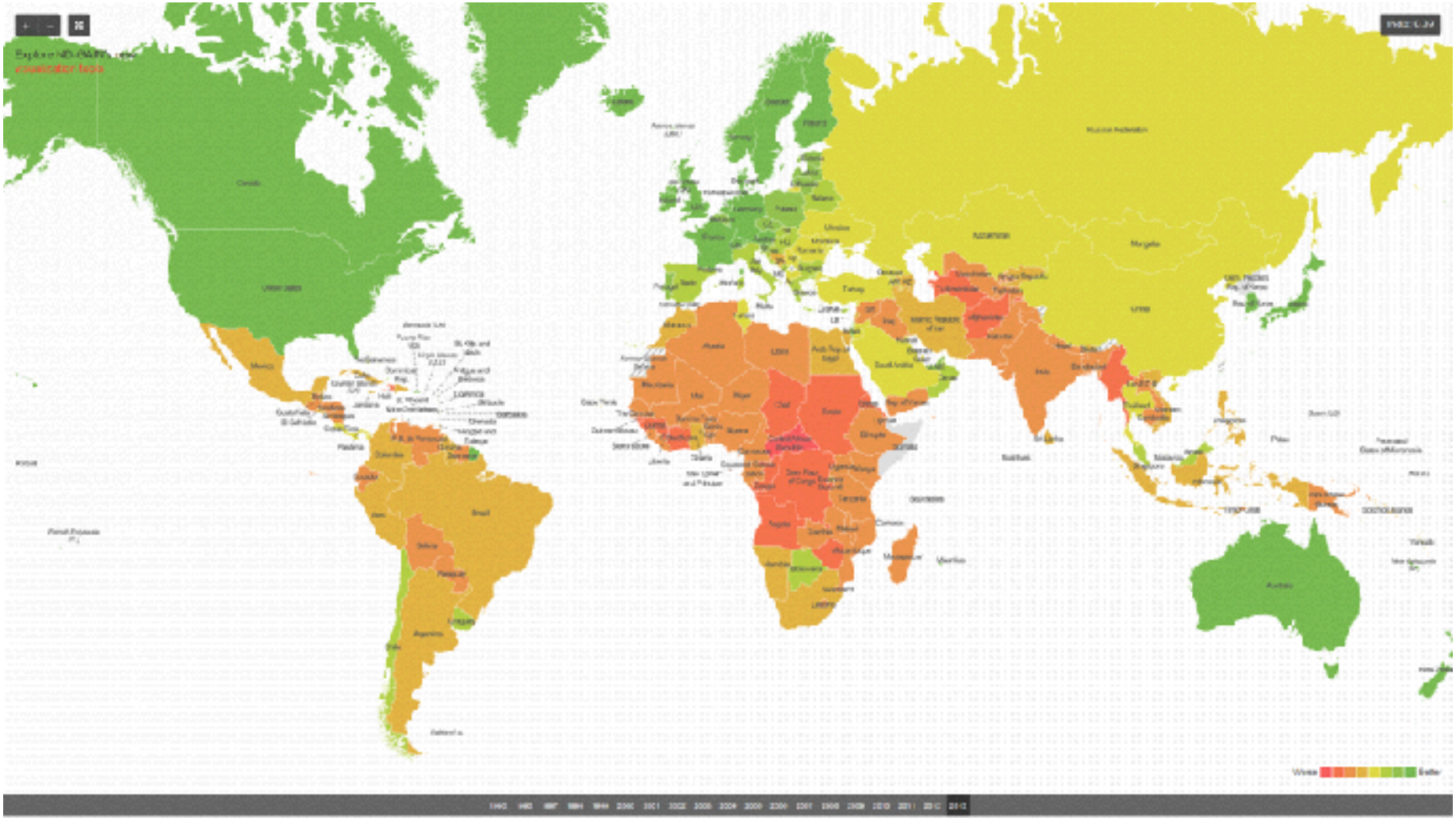
Extension of Schistosomiasis japonica (parasite)
(+1,6°C in China in 2050) (IPCC 2013, Fig.11.4)

Climate Change Vulnerability Index



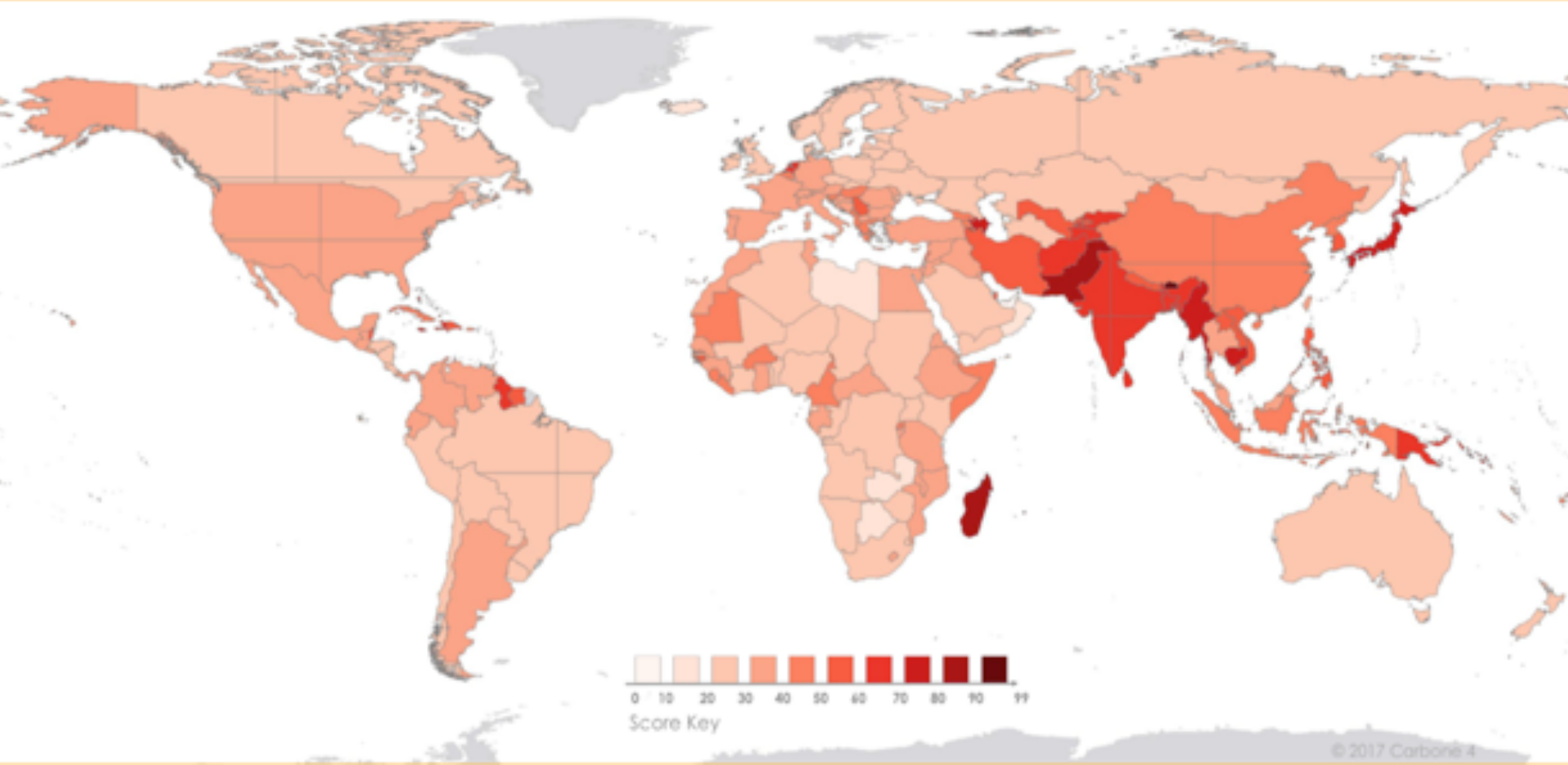
Source : Maplecroft 2014

Adaptation capability



Source : GAIN Index / readiness map

Exposure to extreme events



- **The countries most at risk account for 11% of the world economy** and 28% of global population.

- **These countries are** particularly exposed and vulnerable to the intensification of flooding, sea level rise and storms.

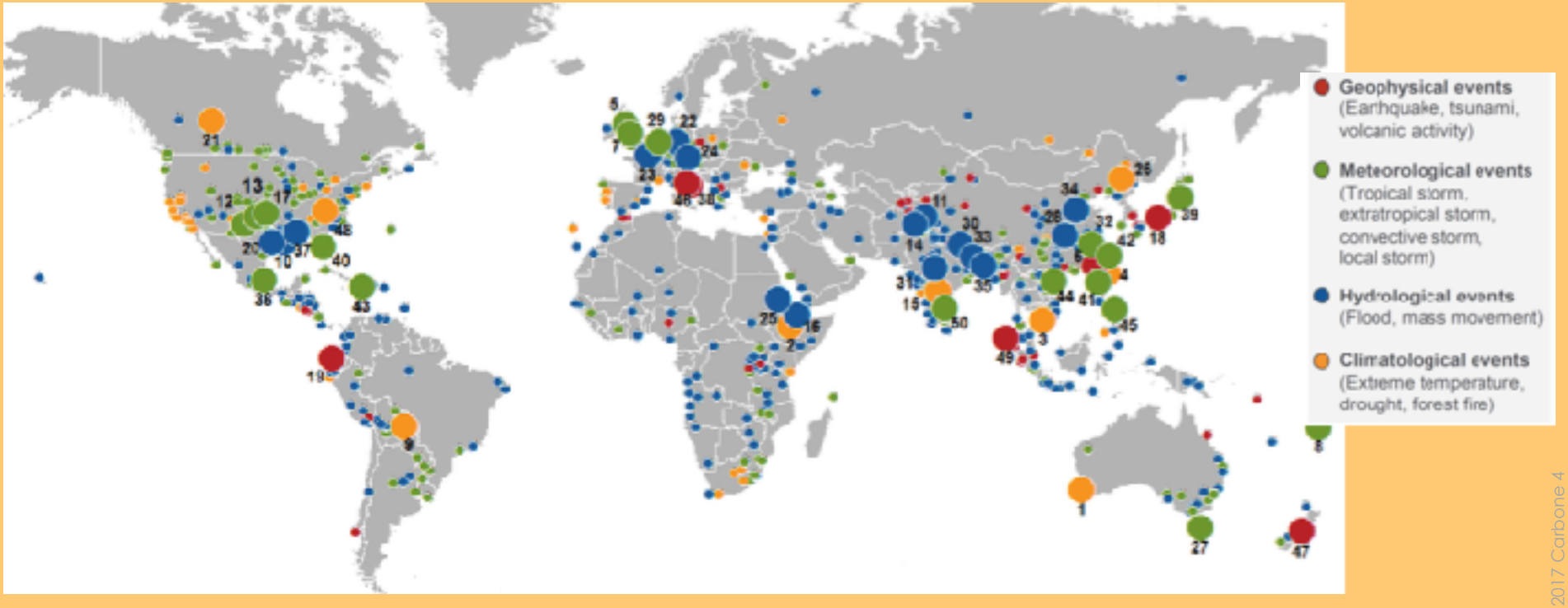
Climate change impacts have significant economic losses

1,900 loss events in 2016, overall loss amount in 2016 climbed to **US$ 175bn**

93% of all events are weather related

Number of events causing economic losses has tripled between 1980 and 2014.

In 2016, **only 30% of 2016 weather-related loss events are insured.**



2015 worldwide natural disasters

Source : Munich Re 2016

Climate change can disrupt entire supply chains

The example of the 2011 Thailand floods

An economic cost estimated at more than $45 billion whose only 22% were insured: 9,859 factories closed, 1,700 roads destroyed or paralysed, etc.

Direct and indirect impacts on:

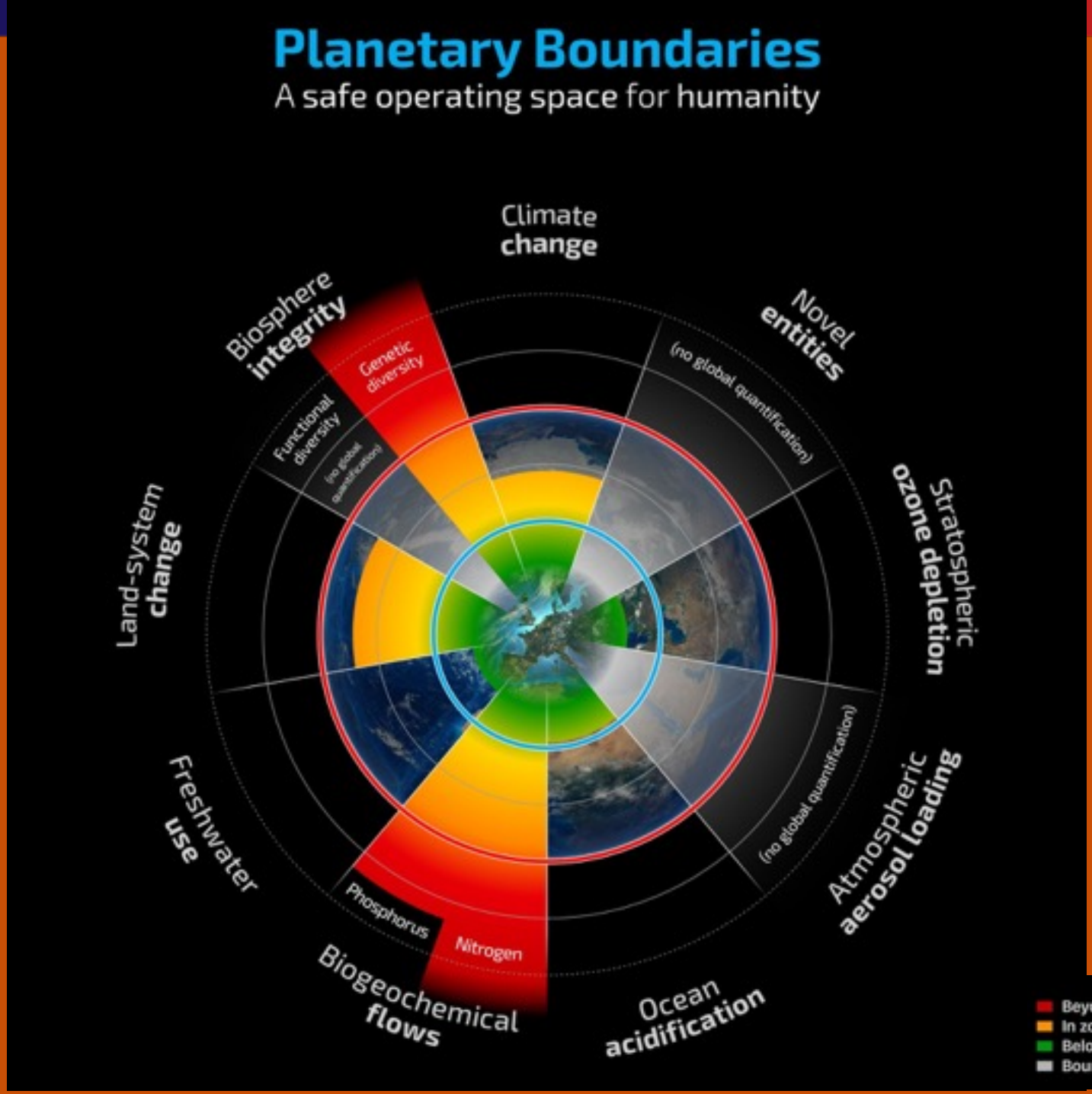
The automotive industry

- **6,000** cars not produced each day in the Thai car factories
- **67 M$** the cost incurred by Nissan to restore its production line
- **50%** decrease in production of Honda's factories in the US and Canada

The electronic industry

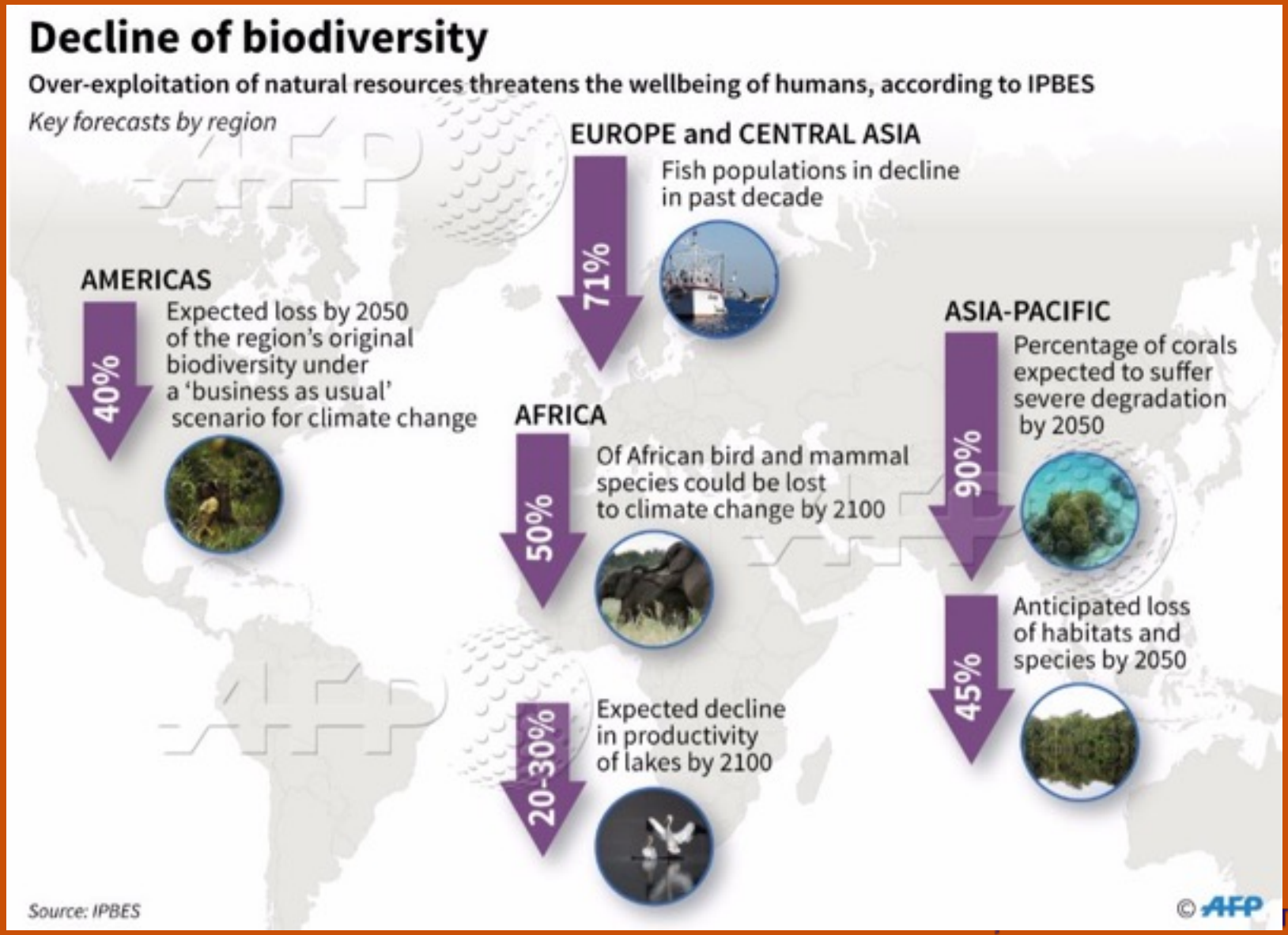
- **45%** of hard disks in the world were produced in Thailand in 2011
- **235 M$** the loss for the industrial company Western Digital
- **x2** the increase in hard disk prices following the floods

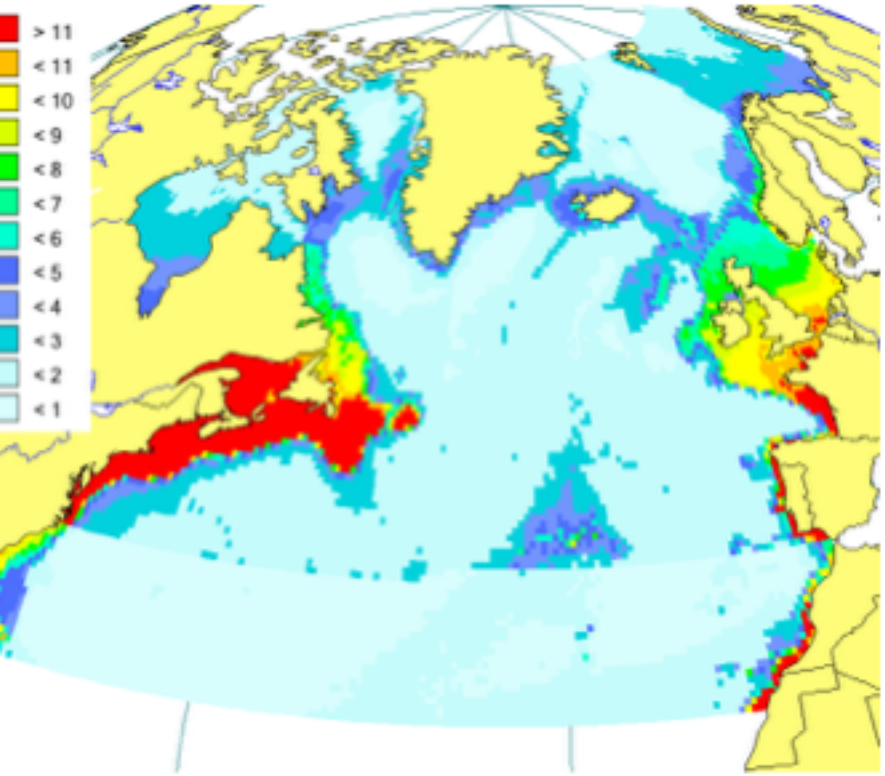
***Source**: Riverside (2012)*



Source: Steffen et al. Planetary boundaries (2015)

IPBES - Heading towards the 6th mass species extinction?





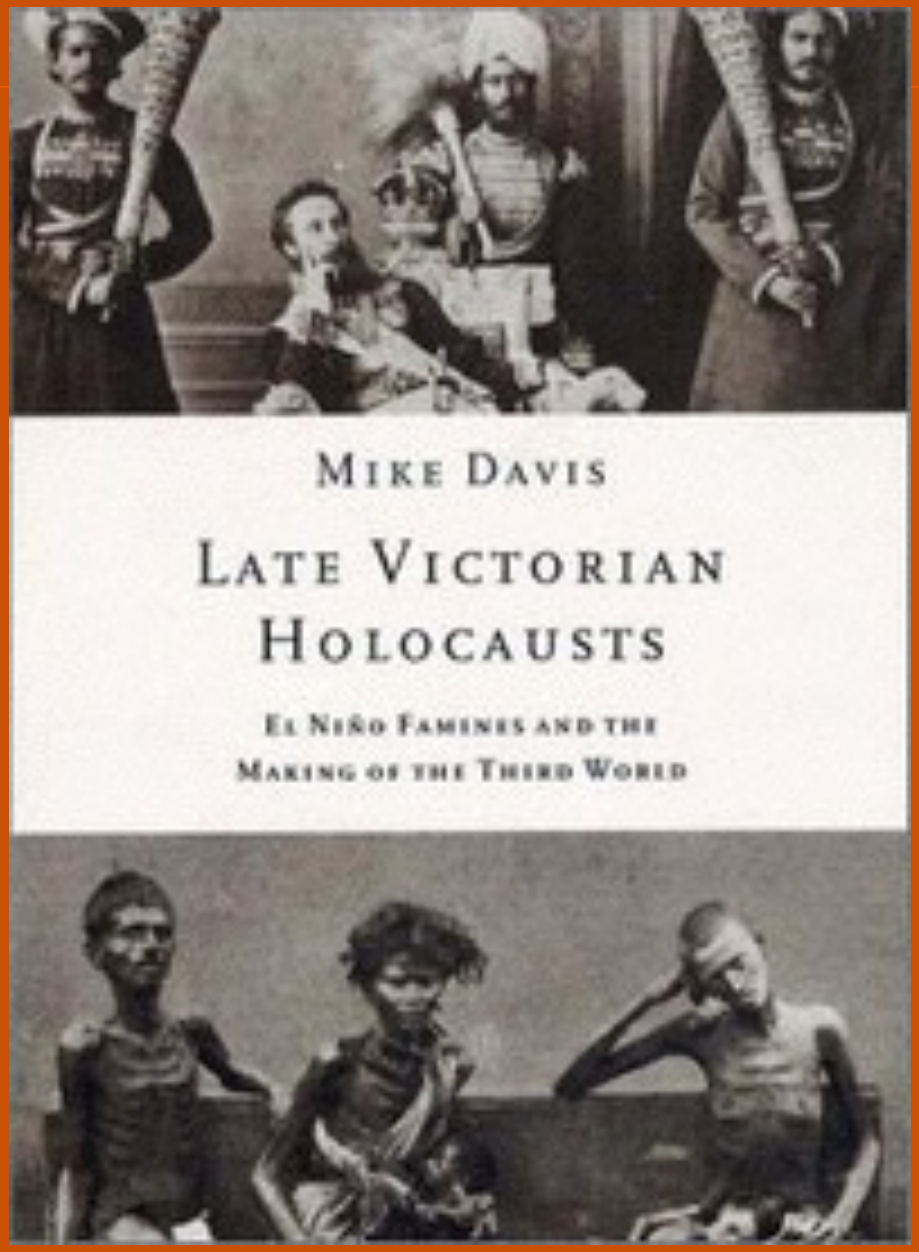
Abondance des poissons Atlantique nord en 1900

Une mer sans poissons en 2050?

(Philippe Cury, Calmann-Lévy, 2008)

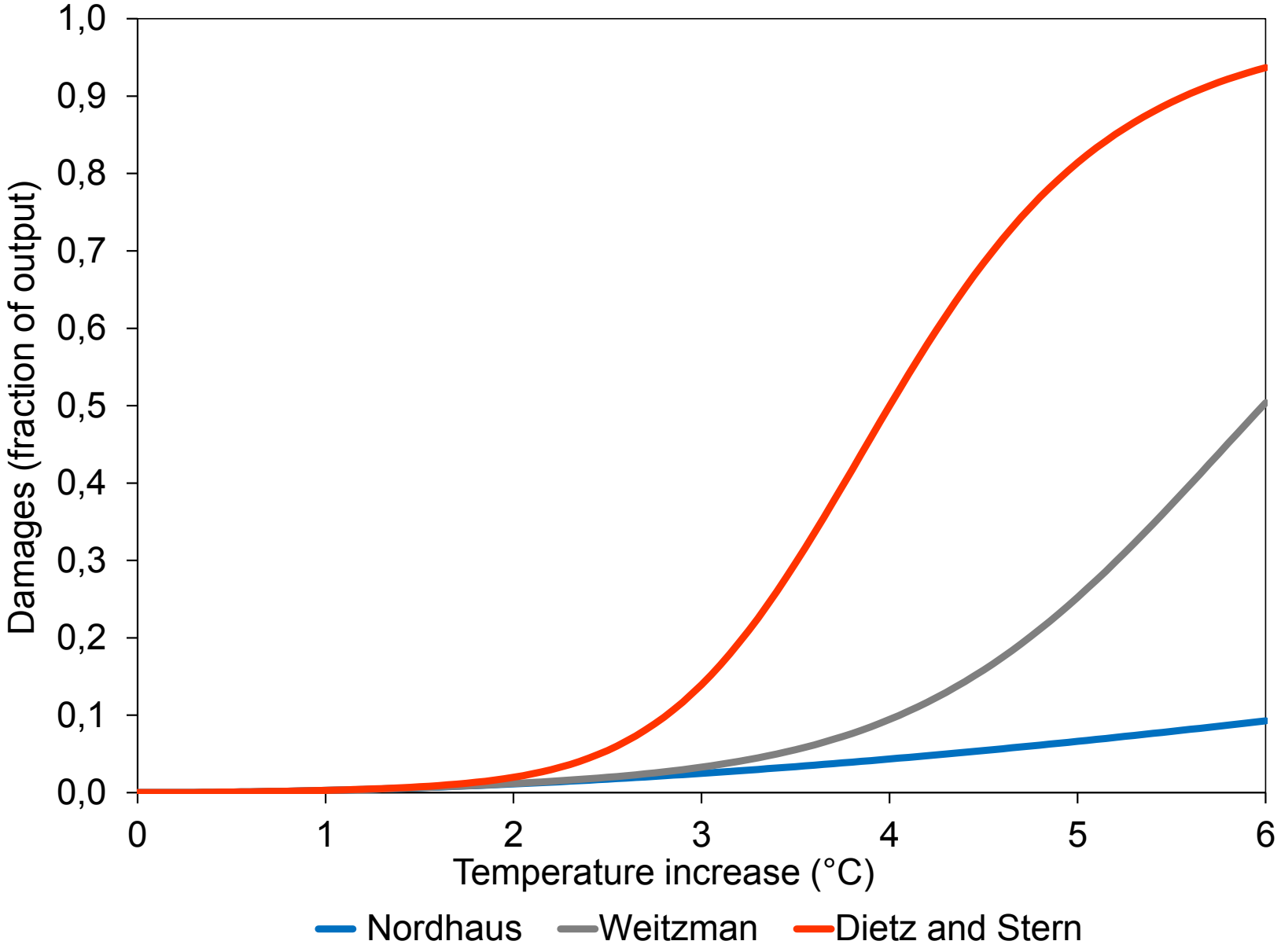
Abondance des poissons Atlantique nord en 2000

Christensen et al. (Fish & Fisheries, 2003)



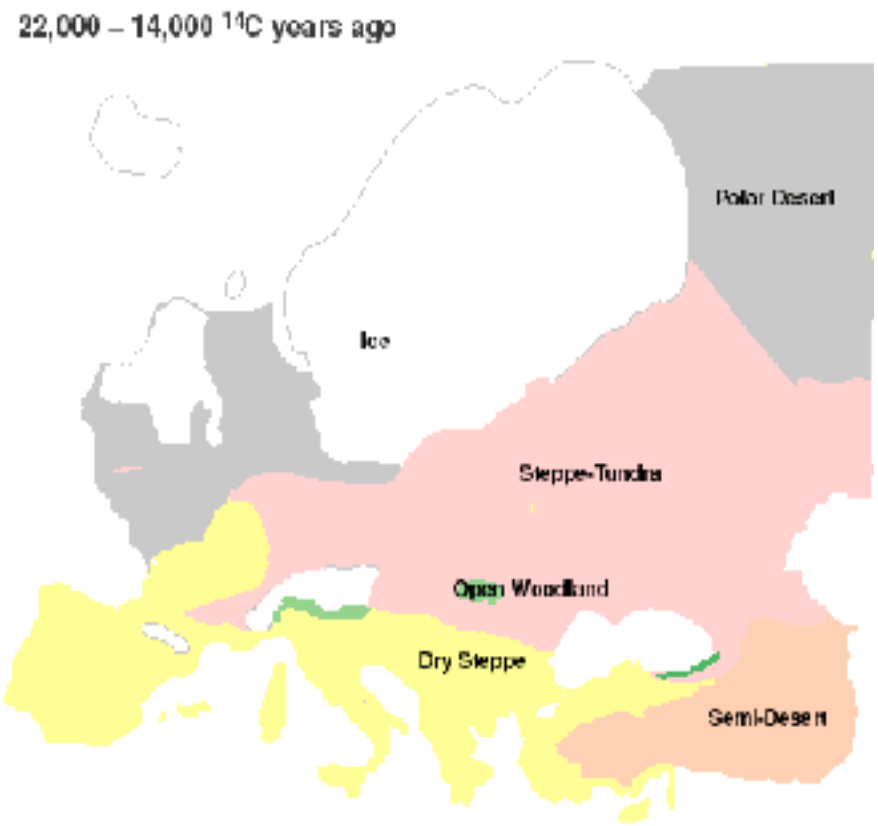
I. Climate change (mostly bad news)

II. Reconstructing macro-economics


1,0
0,9
0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0,0
Damages (fraction of output)
0
1
2
3
4
5
6
Temperature increase (°C)
Nordhaus
Weitzman
Dietz and Stern

+4°C, it's a change of climatic era

Europe -20,000 years



Europe today

+5°C

Source: Quaternary Environments Network

-4°C, a thought experiment

Woillez, Giraud & Godin (2020)

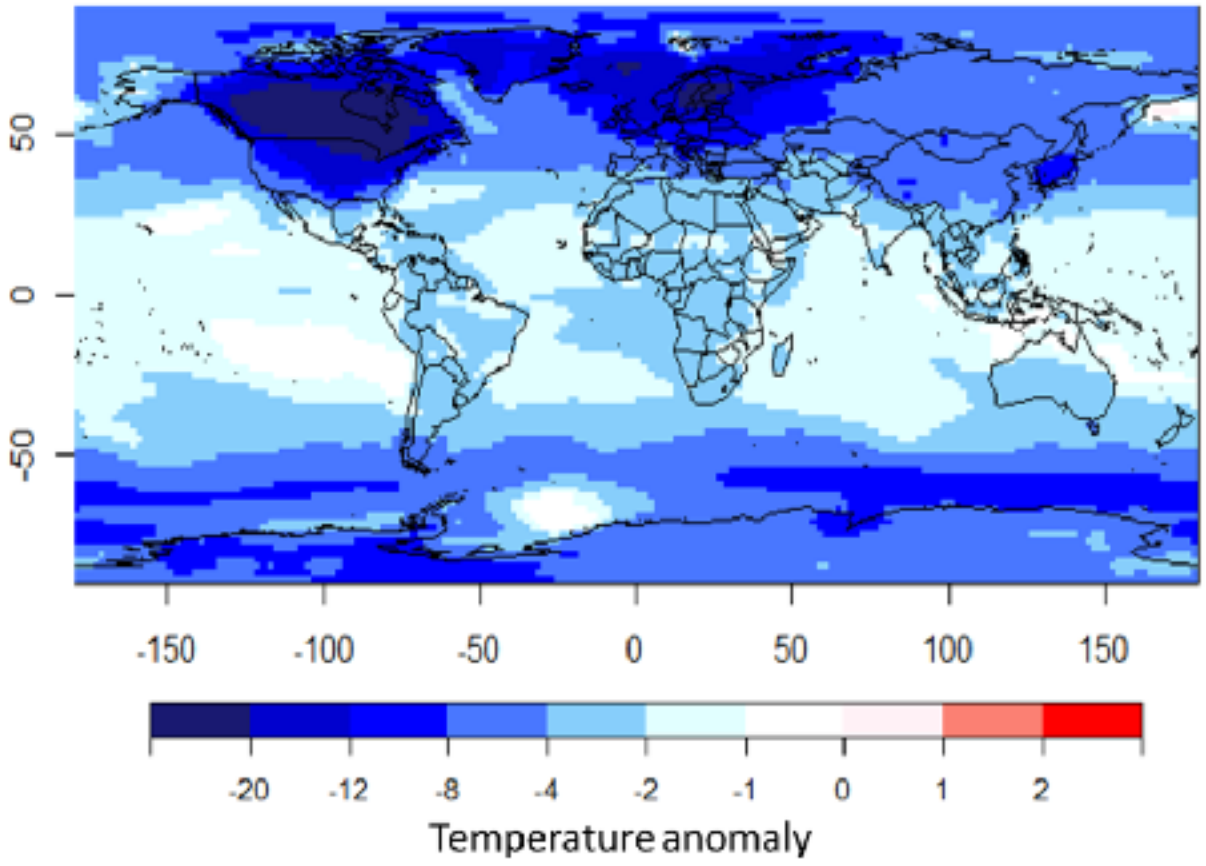


Figure 1: Reconstruction of Last Glacial Maximum surface air temperature anomaly (°C)

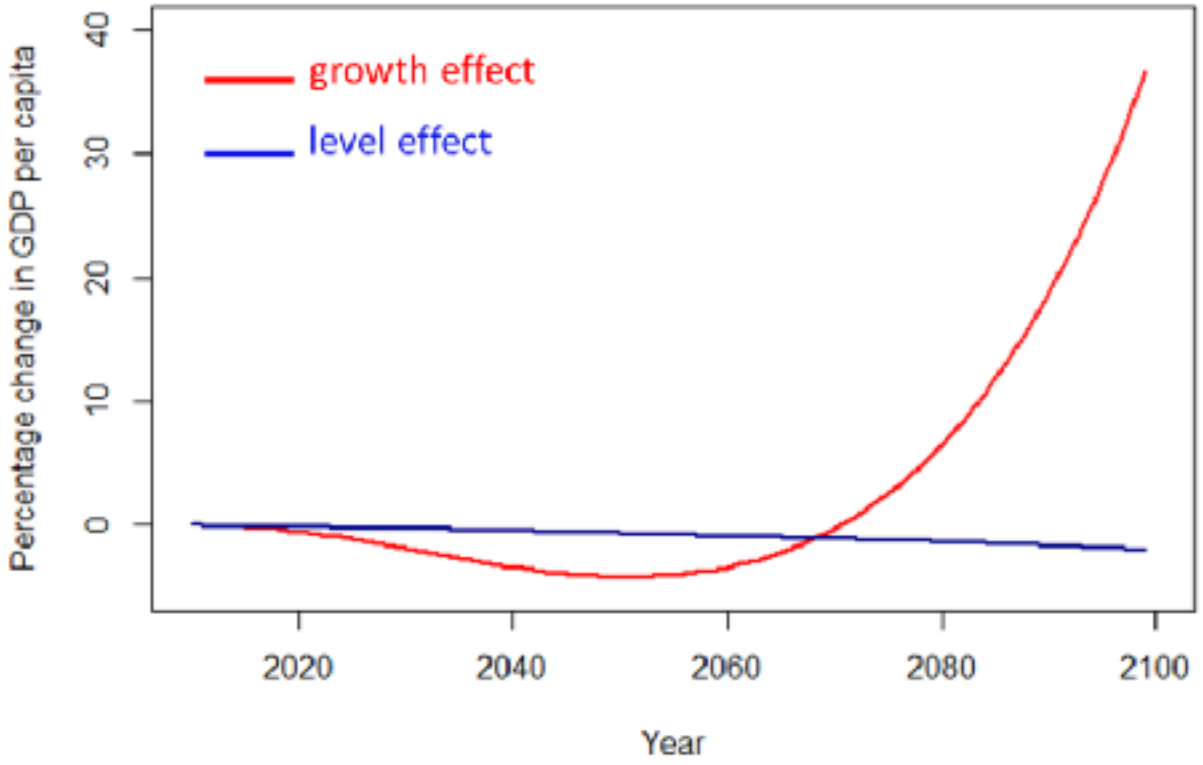


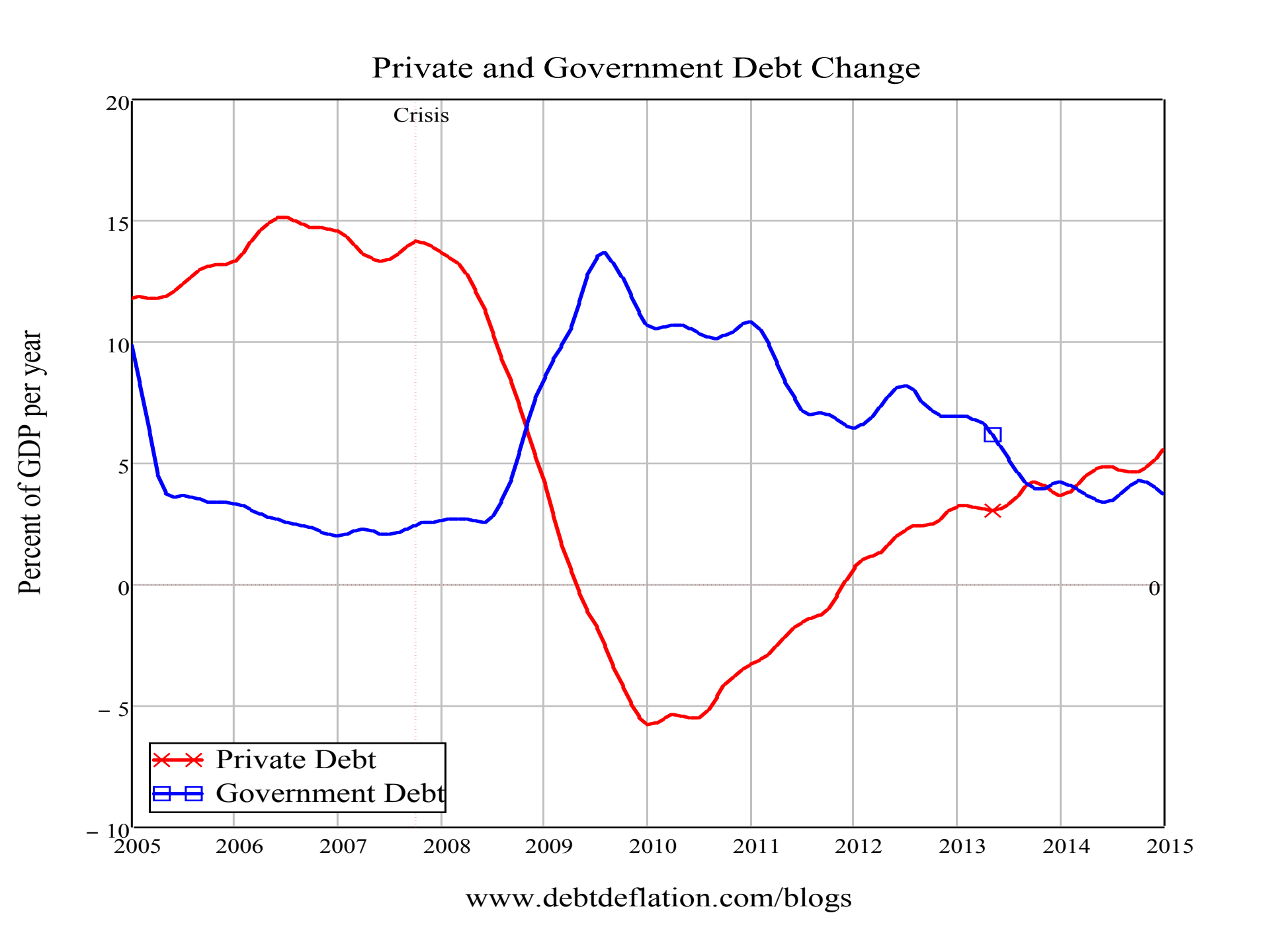
Figure 2: Percentage change in average GDP per capita (world level) for a global cooling of $-4\,^{\circ}\mathrm{C}$ in 2100 as projected from non-linear effects of temperature on GDP level (blue curve, Newell et al. (2018) damage function) or growth (red curve, Burke et al. (2015) damage function). Reference GDP path according to the SSP5 scenario.

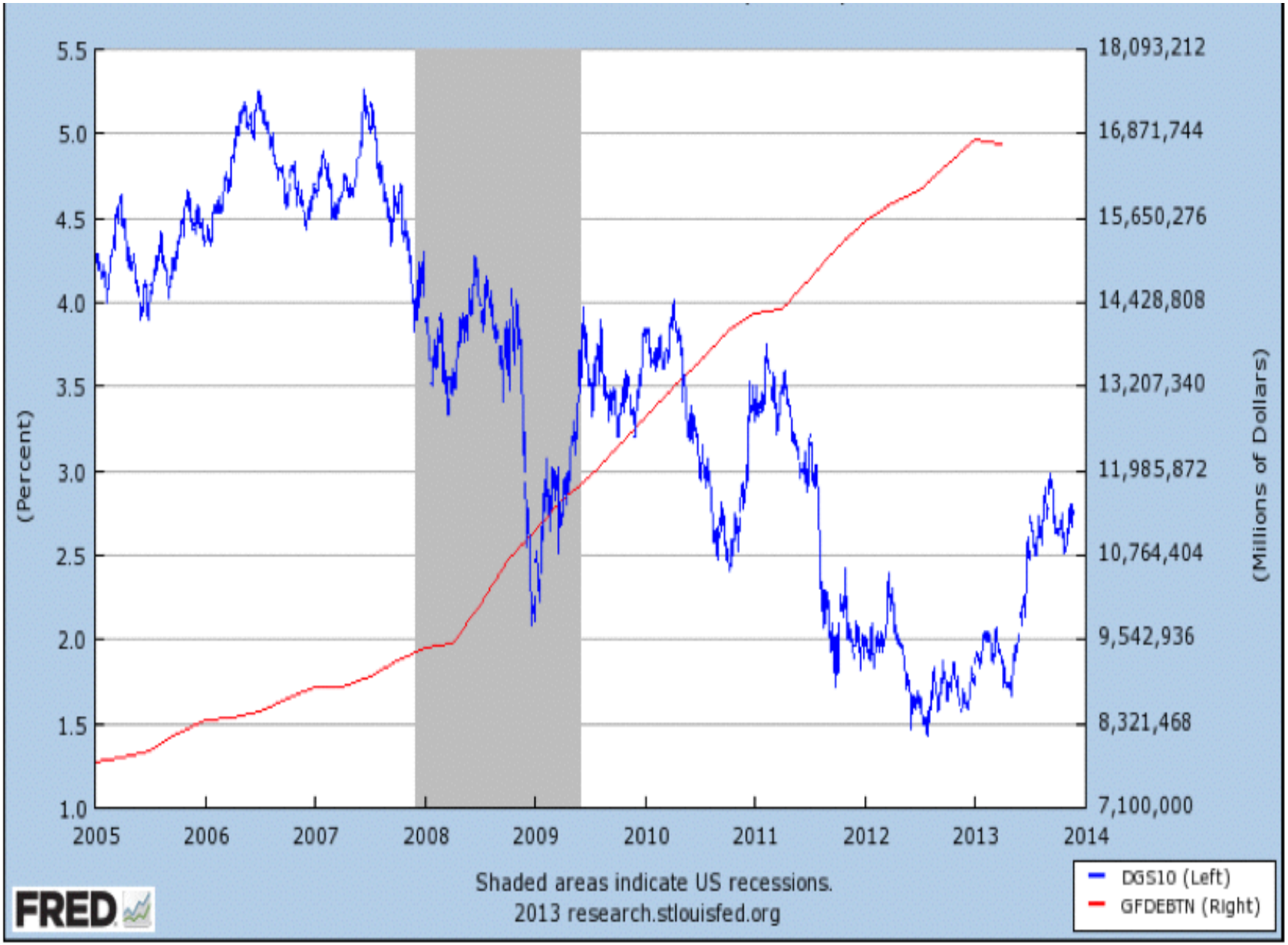
Stranded assets?

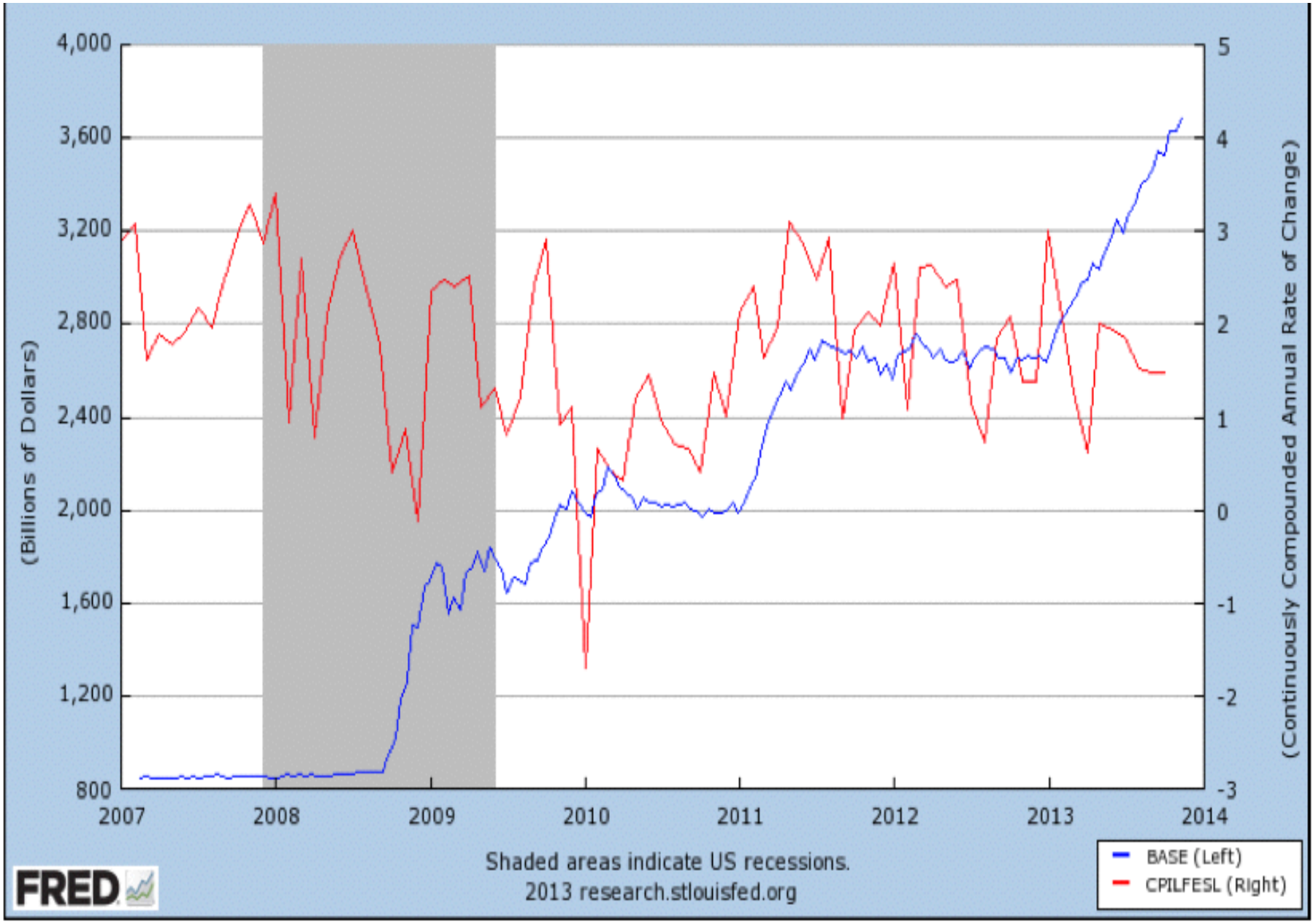
Carbon Tracker Initiative

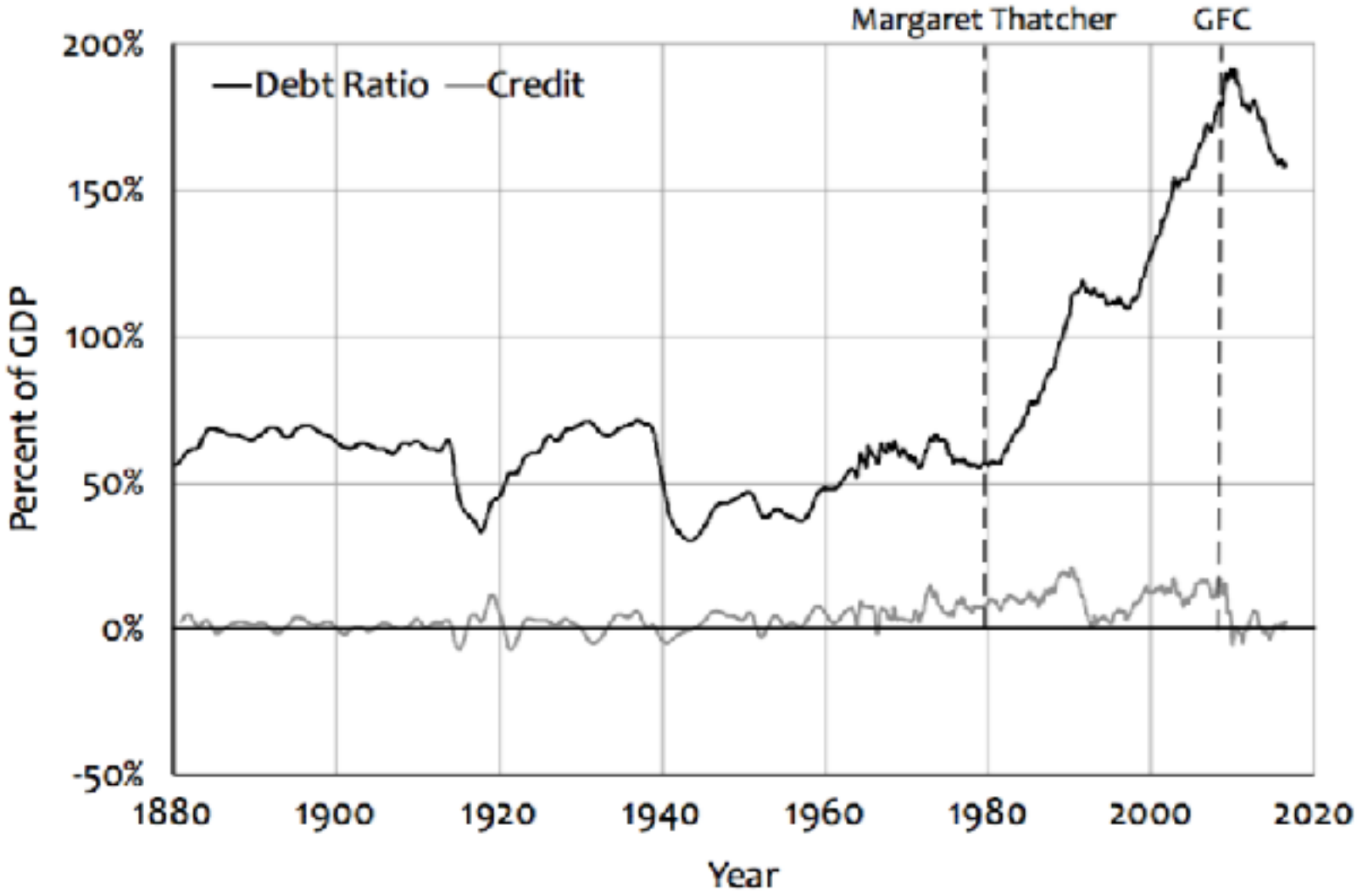
- From 2013 report :
  - 65% to 80% of listed coal, oil and gas companies' reserves must remain unburned to stay within 2°C 2050 carbon budget (at 80% prob)
  - Approx $650bn wasted capital is spent every year on developing new reserves

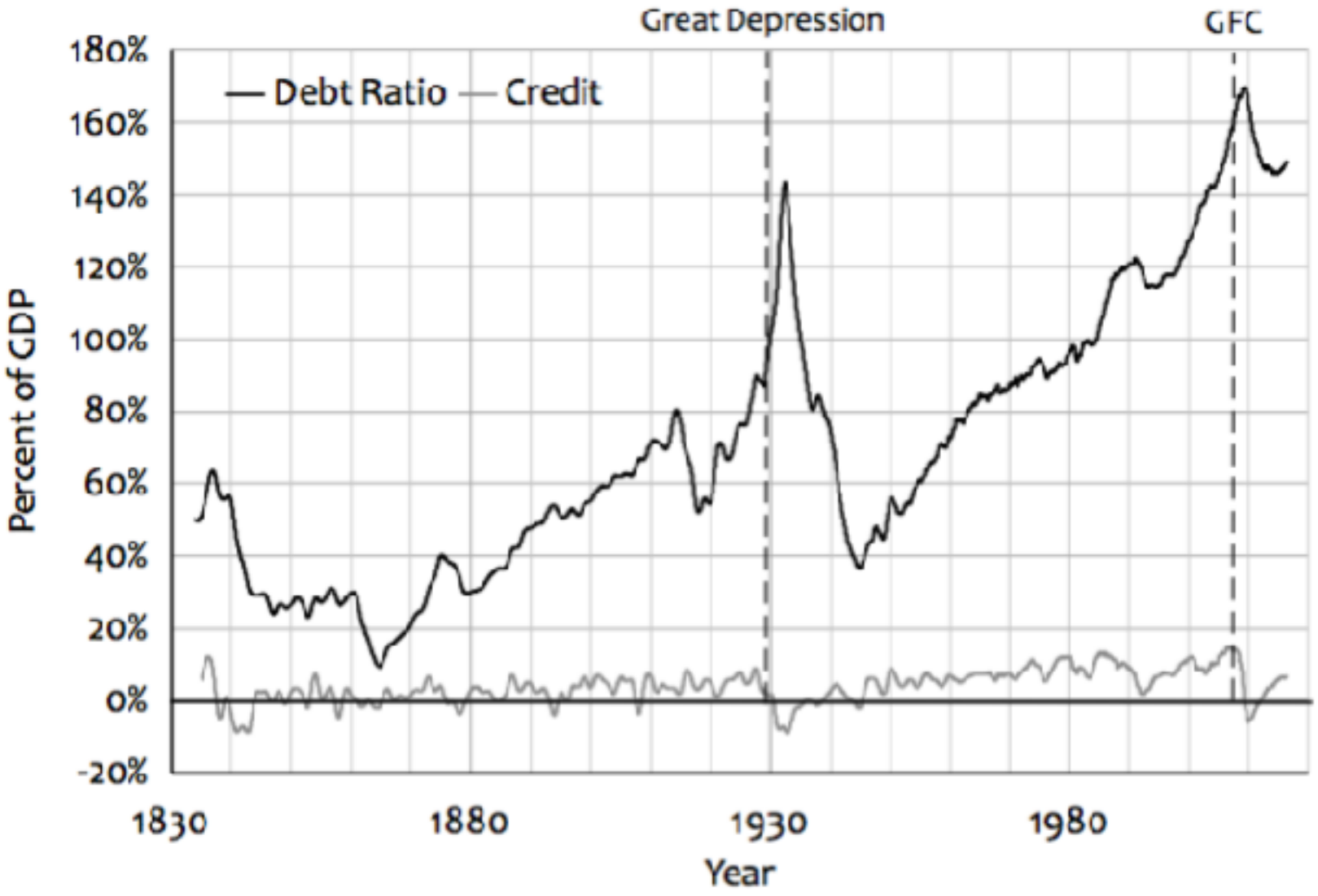
- HSBC: 40% to 60% of market cap of coal, oil and gas companies is at risk from the carbon bubble (200 top companies = $4 trillion market cap)

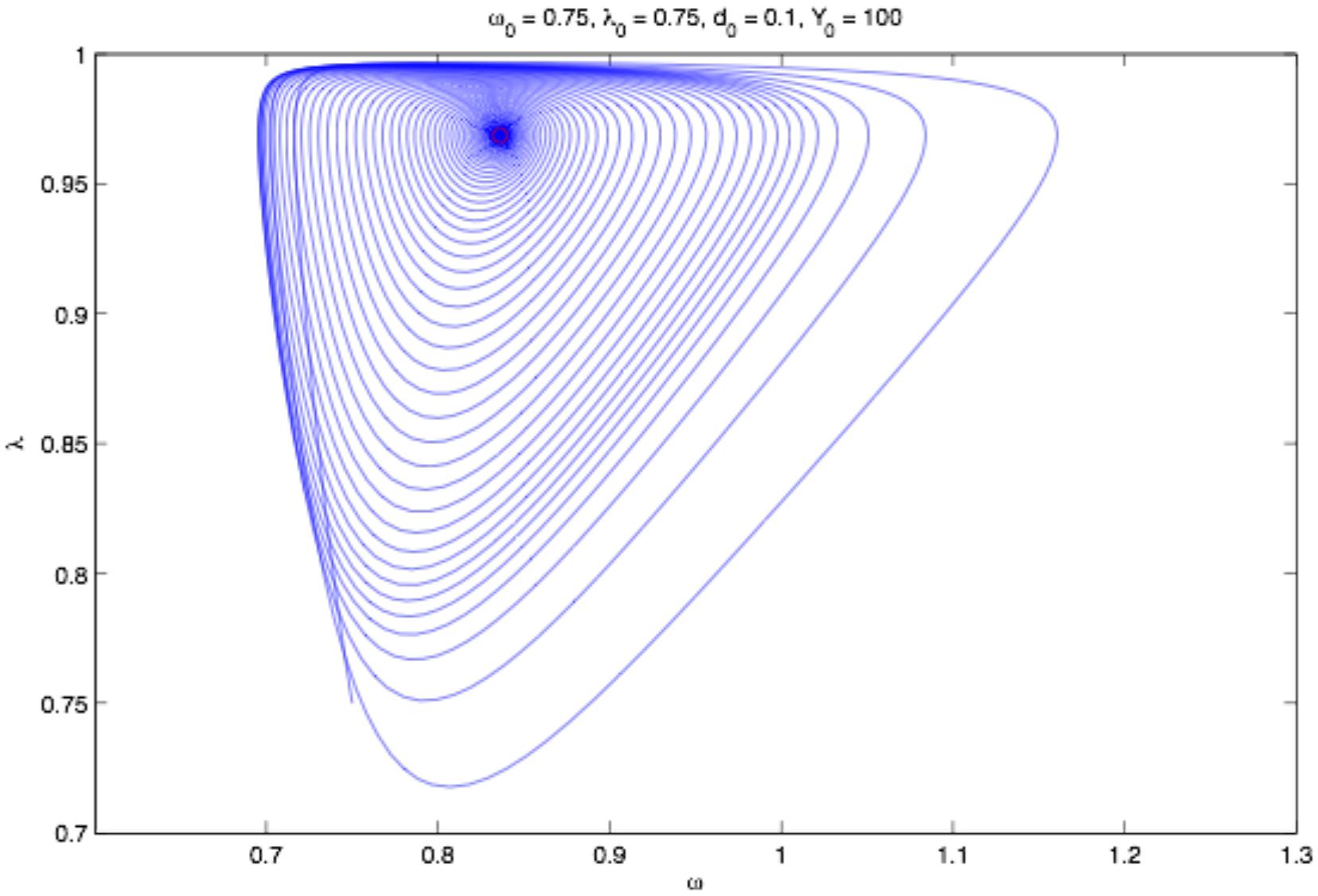

Private and Government Debt Change
Crisis
20
15
10
5
0
– 5
– 10
Percent of GDP per year
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Private Debt
Government Debt
www.debtdeflation.com/blogs

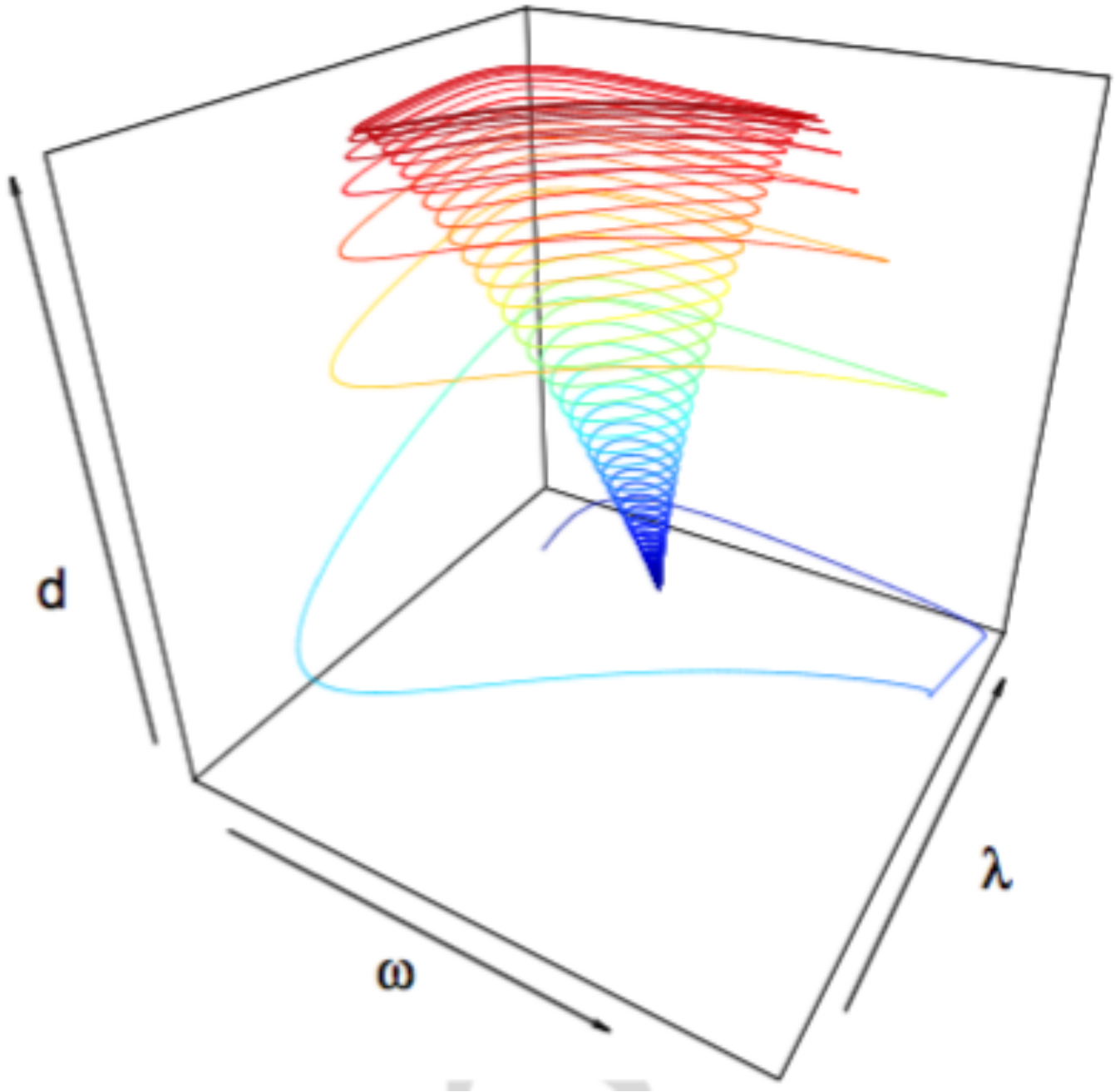

5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
(Percent)
18,093,212
16,871,744
15,650,276
14,428,808
13,207,340
11,985,872
10,764,404
9,542,936
8,321,468
7,100,000
(Millions of Dollars)
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Shaded areas indicate US recessions.
2013 research.stlouisfed.org
FRED
DGS10 (Left)
GFDEBTN (Right)

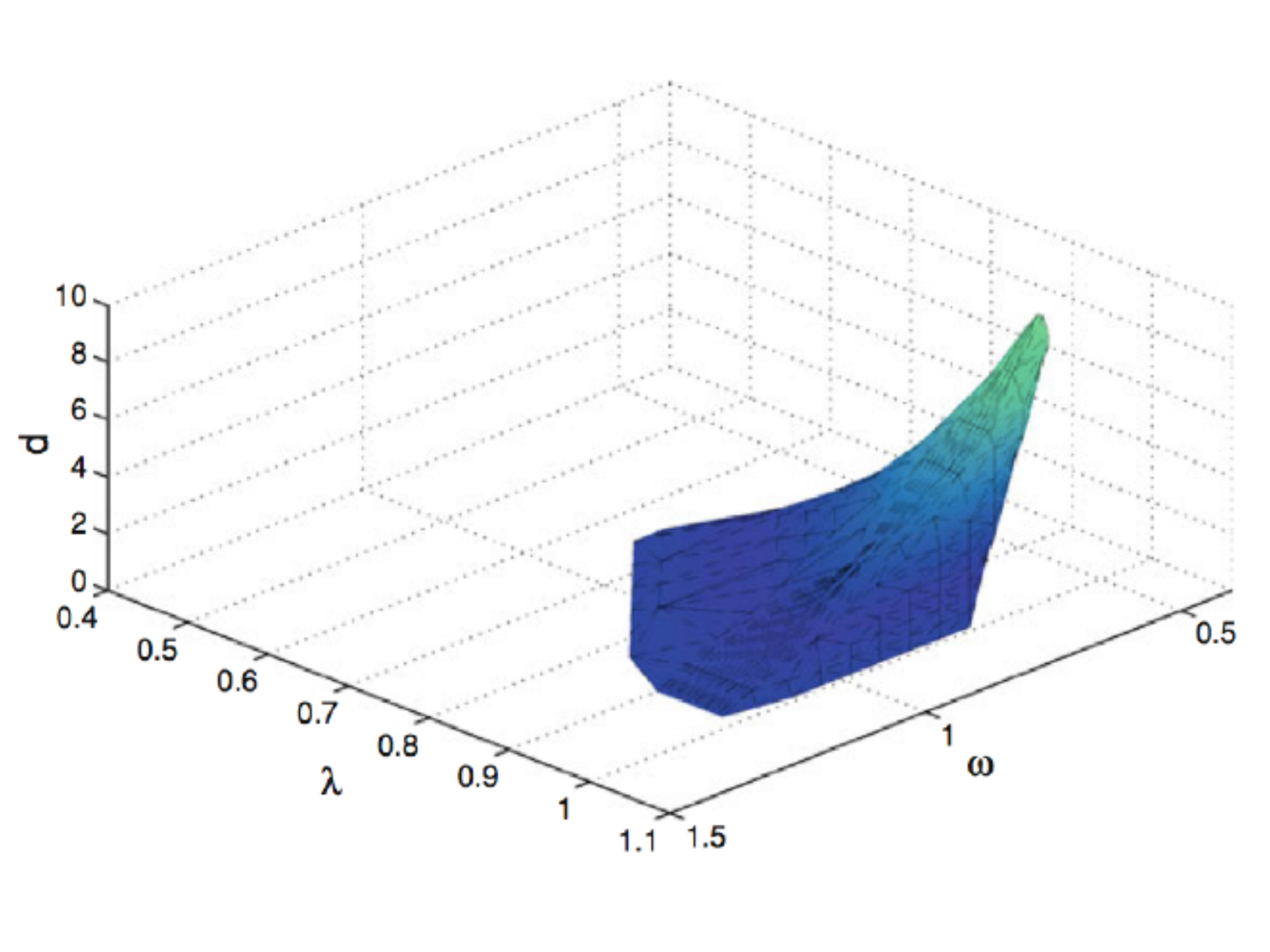

4,000
3,600
3,200
2,800
2,400
2,000
1,600
1,200
800
(Billions of Dollars)
5
4
3
2
1
0
-1
-2
-3
(Continuously Compounded Annual Rate of Change)
2007
2008
2009
2010
2011
2012
2013
2014
Shaded areas indicate US recessions.
2013 research.stlouisfed.org
FRED
BASE (Left)
CPILFESL (Right)


Margaret Thatcher
GFC
Debt Ratio
Credit
200%
150%
100%
50%
0%
-50%
Percent of GDP
1880
1900
1920
1940
1960
1980
2000
2020
Year


Great Depression
GFC
Debt Ratio
Credit
180%
160%
140%
120%
100%
80%
60%
40%
20%
0%
-20%
Percent of GDP
1830
1880
1930
1980
Year


$\omega_0 = 0.75, \lambda_0 = 0.75, d_0 = 0.1, Y_0 = 100$
1
0.95
0.9
0.85
0.8
0.75
0.7
λ
0.7
0.8
0.9
1
1.1
1.2
1.3
ω


d
ω
λ


d
10
8
6
4
2
0
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
λ
1.5
1
0.5
ω

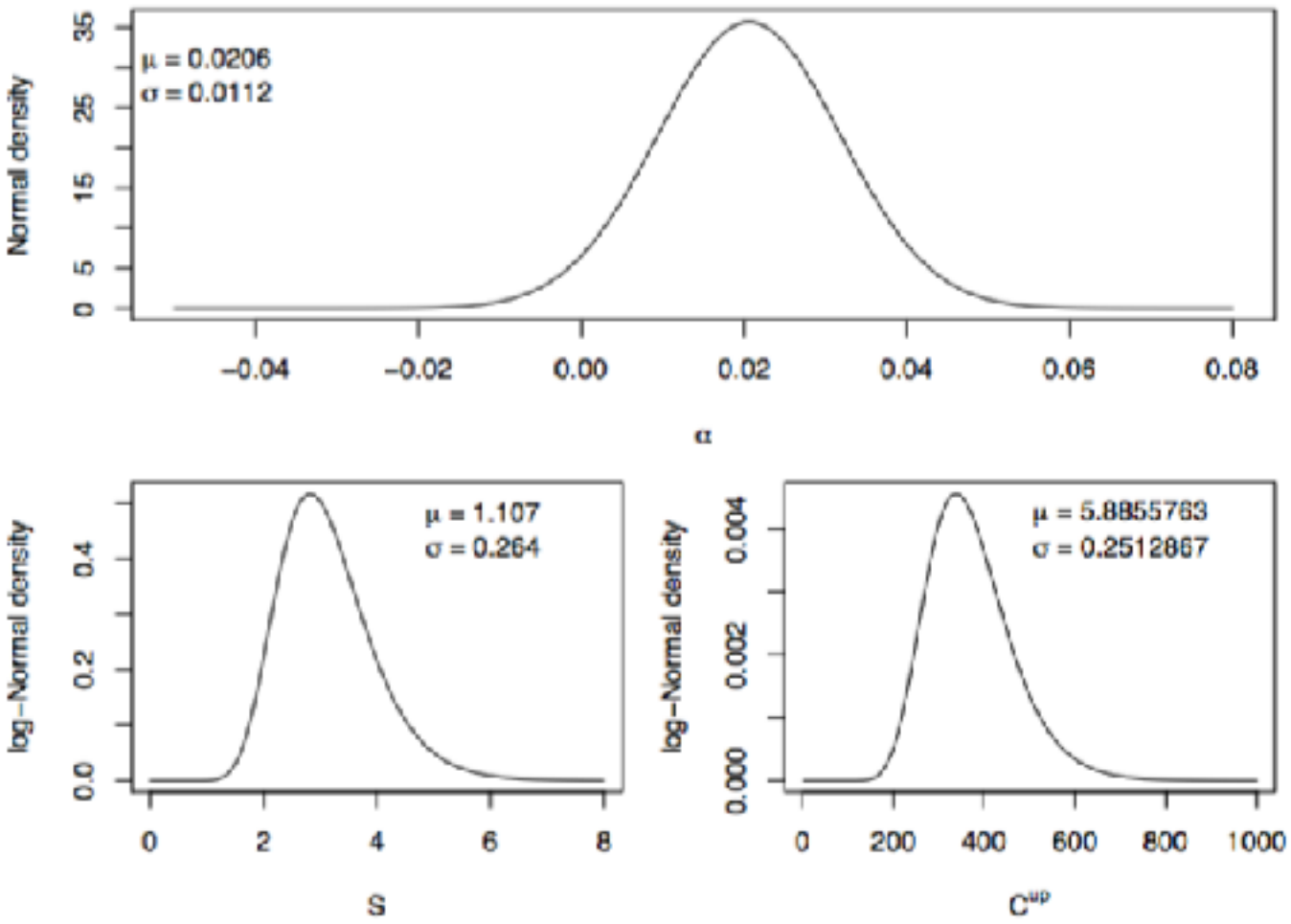
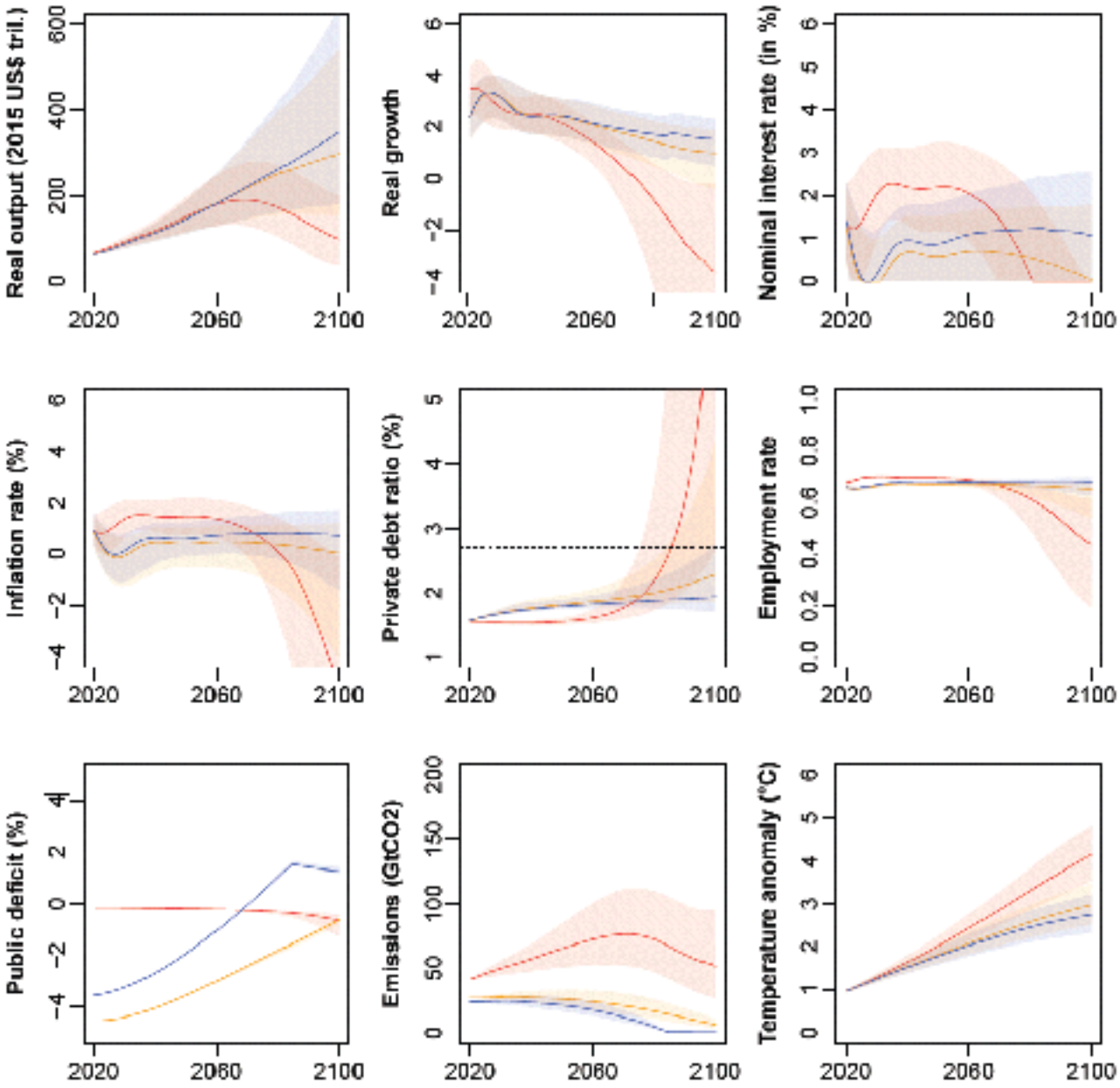


Figure: PDF of uncertain parameters.

Bovari et al. (2018)



Scénario 1 (red) : Business-as-usual

Scénario 2 (orange) : Carbon tax (upper-bound, Stern-Stiglitz report)

Scénario 1 (blue) : Carbon tax + public spending

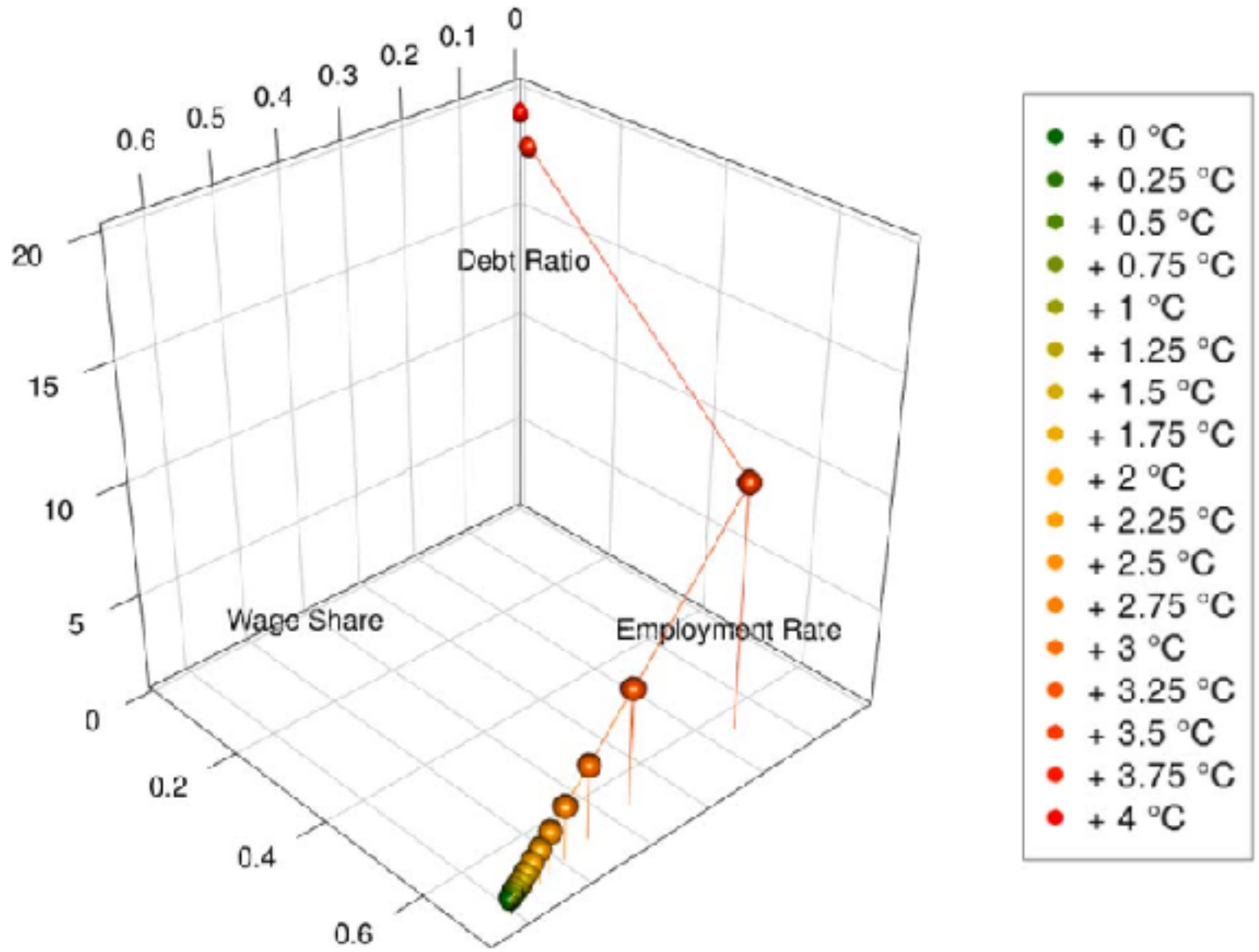


Fig. 2. Solovian steady state as a function of temperature anomaly in the *High damage K scenario*.

Impact of global warming on attraction basins

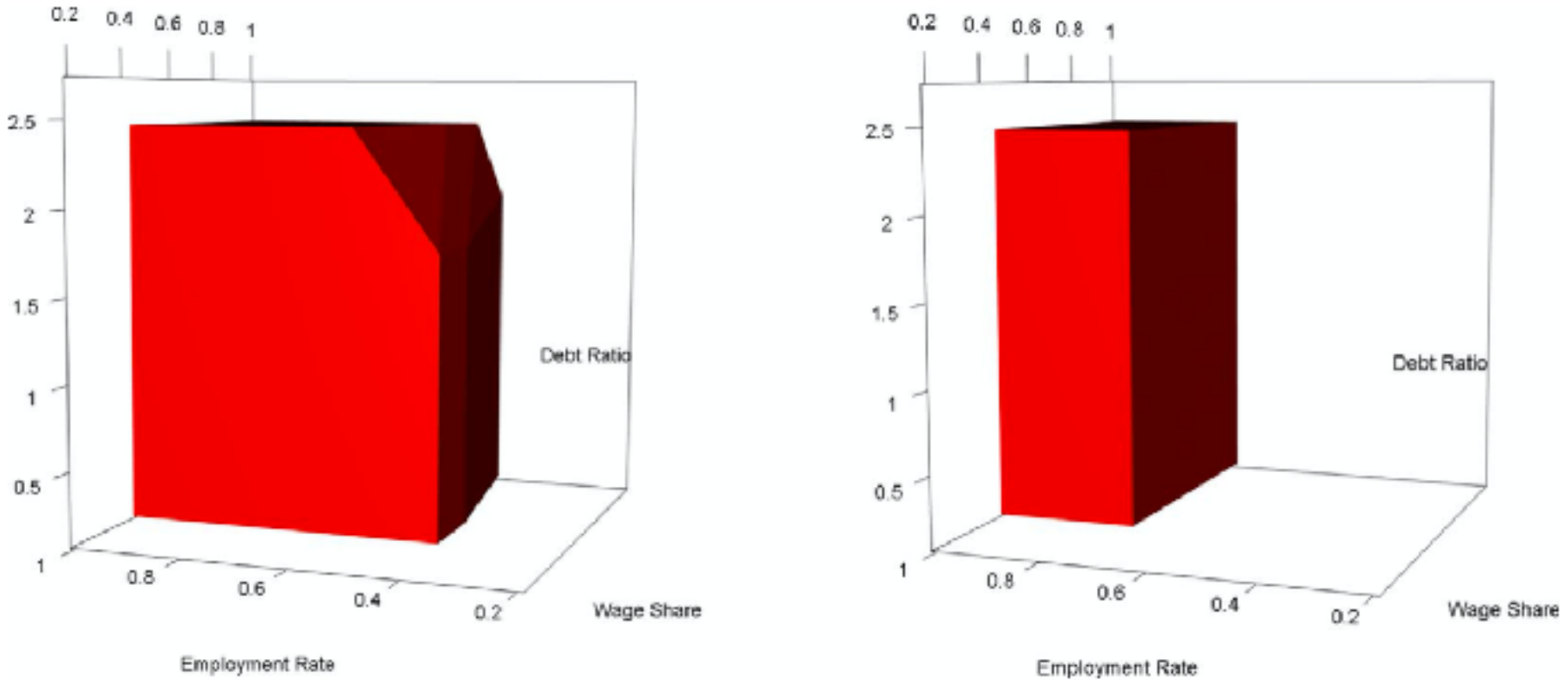


Fig. 3. "Good" basins of attraction in the *No feedback loop scenario* (left) and in the *Low damage scenario* (right).

Can we stay below +2°C ?

source : Bovari, Giraud et al. (2018)

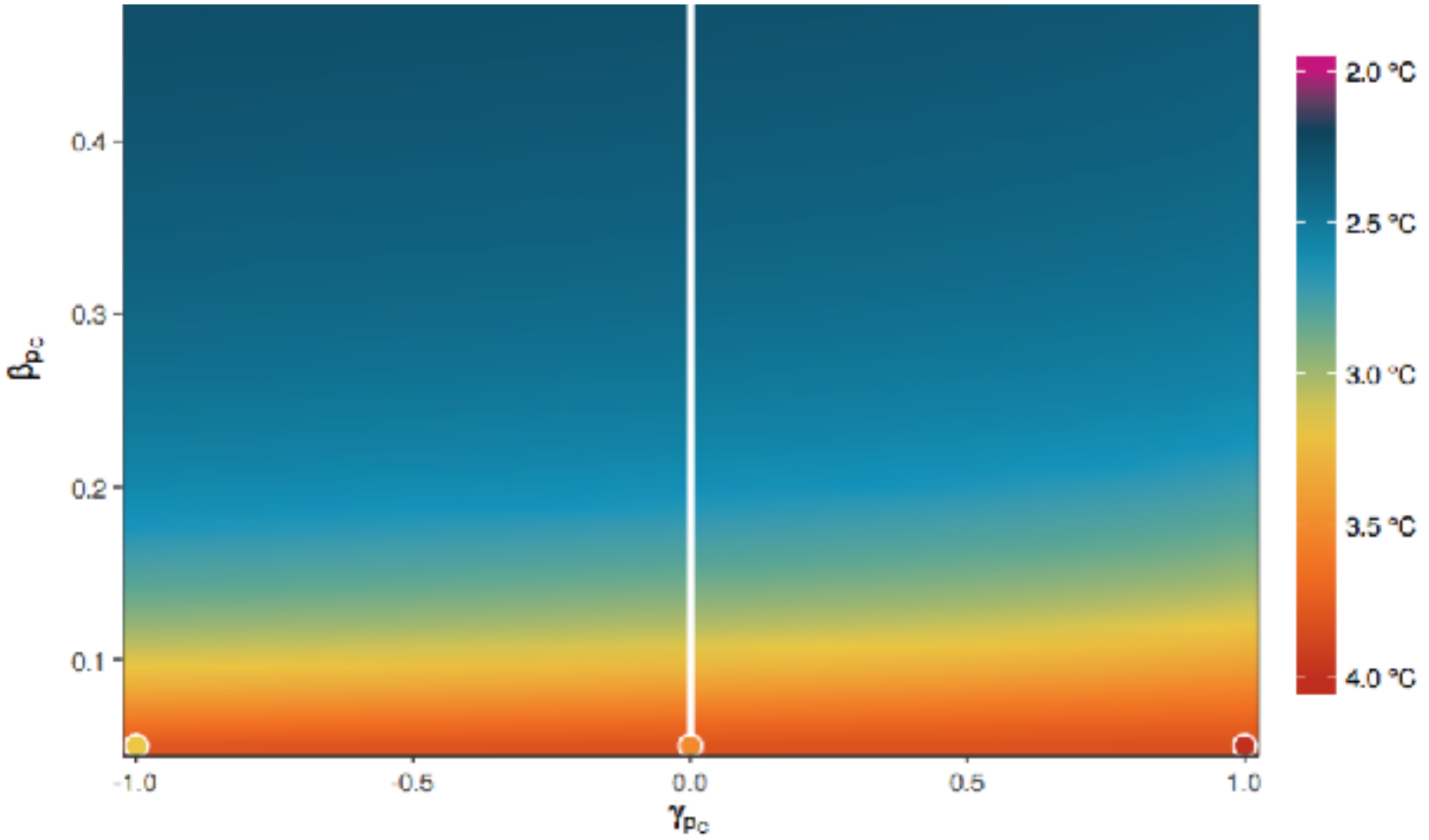


Figure: Heatmap in 2100 depending on the carbon price path in the Type 3 scenario (exponen
case in the white line).

Go Raibh Maith Agat!

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