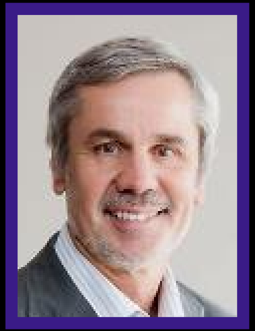
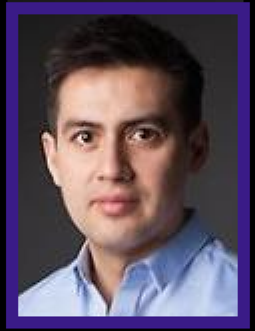




Will Steffen
Australian National University

Victor Galaz
Stockholm Resilience Center

Alice Dauriach
Royal Swedish Academy of Science

Sleeping Financial Giants

Opportunities for financial leadership for climate stability

Beatrice Crona

Executive Director,
Global Economic Dynamics and the Biosphere,
Royal Swedish Academy of Science

Associate Professor
Stockholm Resilience Centre
Stockholm University

Information disclosed during the meeting may be reported by those present, but the source of that information may not be explicitly or implicitly identified

NEWS & VIEWS

COMPLEX SYSTEMS

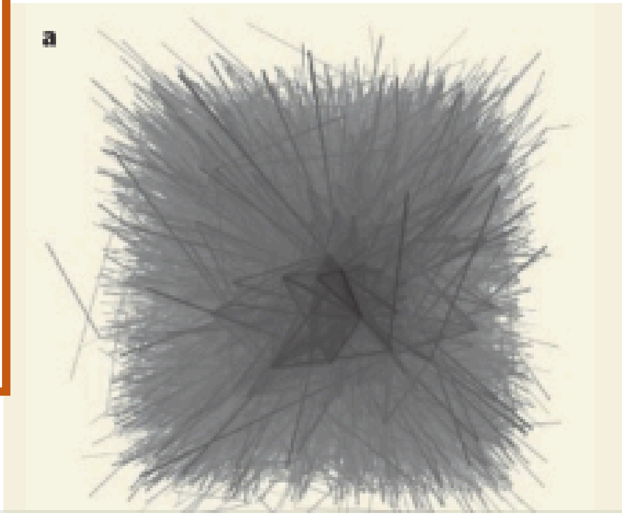
Ecology for bankers

Robert M. May, Simon A. Levin and George Sugihara

There is common ground in analysing financial systems and ecosystems, especially in the need to identify conditions that dispose a system to be knocked from seeming stability into another, less happy state.

'Tipping points', 'thresholds and breakpoints', 'regime shifts' — all are terms that describe the flip of a complex dynamical system from one state to another. For banking and other financial institutions, the Wall Street Crash of 1929 and the Great Depression epitomize such an event. These days, the increasingly complicated and globally interlinked financial markets are no less immune to such system-wide (systemic) threats. Who knows, for instance, how the present concern over sub-prime loans will pan out?

Well before this recent crisis emerged, the



spent on studying systemic risk as compared with that spent on conventional risk management in individual firms? Second, how expensive is a systemic-risk event to a national or global economy (examples being the stock market crash of 1987, or the turmoil of 1998 associated with the Russian loan default, and the subsequent collapse of the hedge fund Long-Term Capital Management)? The answer to the first question is "comparatively very little"; to the second, "hugely expensive".

An analogous situation exists within fisheries management. For the past half-century,

People are embedded parts of the biosphere and we shape it

At the same time - people are fundamentally dependent on the capacity of the biosphere to sustain human development

The Holocene – Humankind's 10,000 years of grace

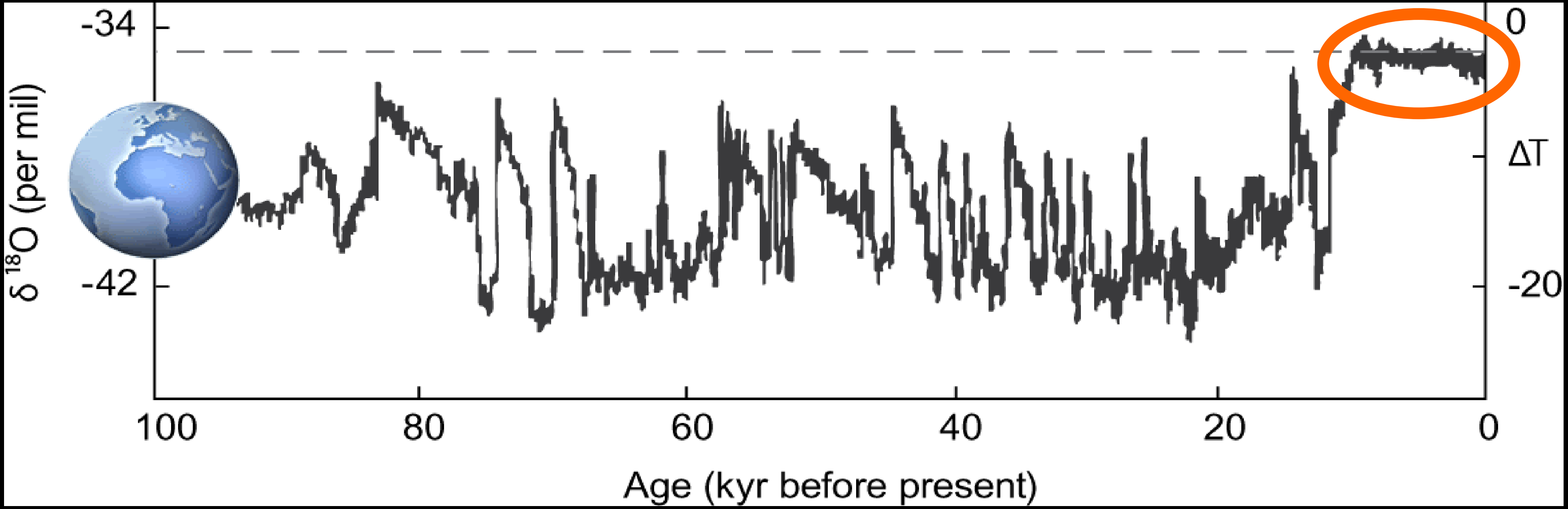
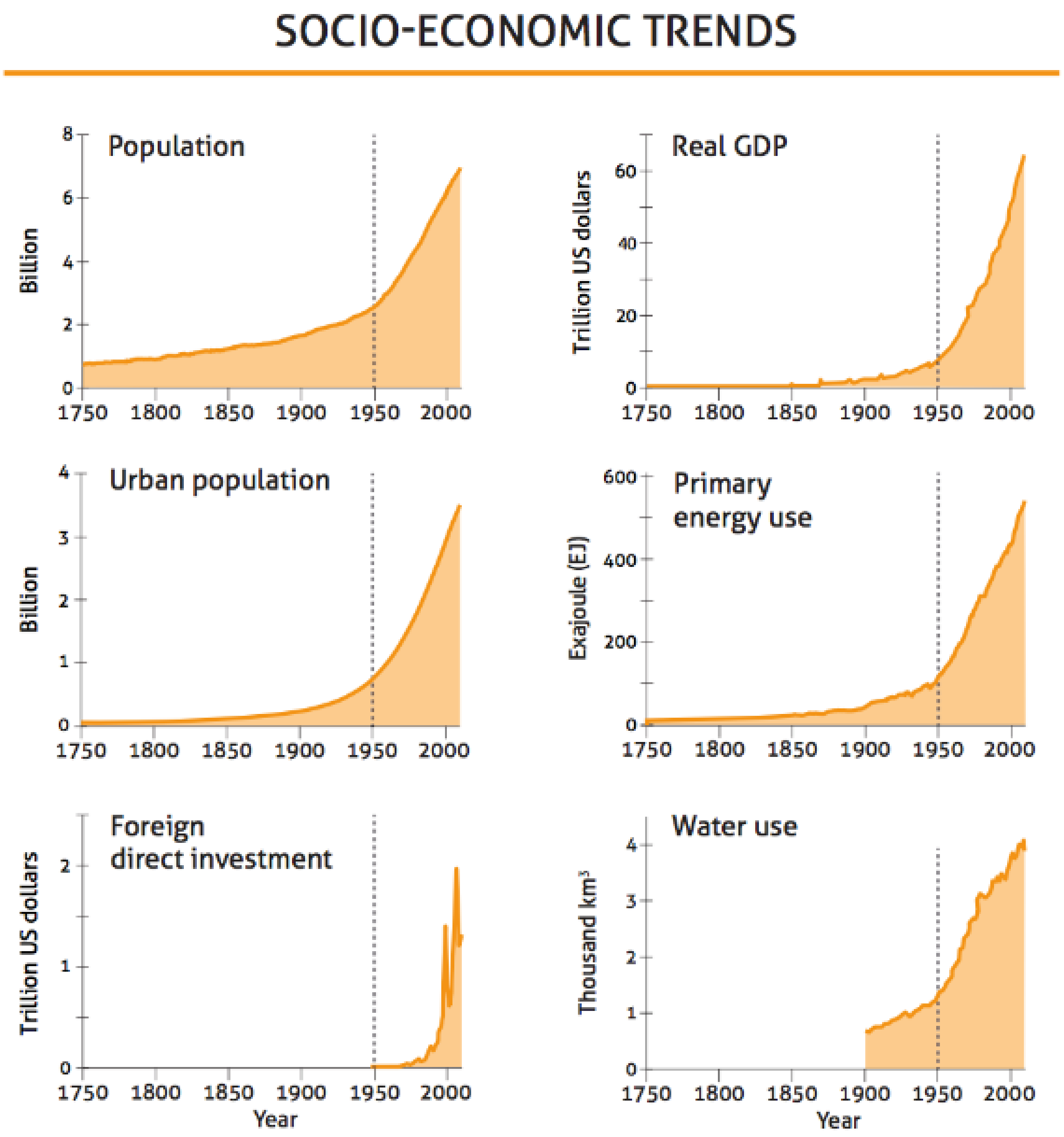


Image: Michael A. Stecker

The Great Acceleration



Tipping points in the Earth's System

Will Steffen

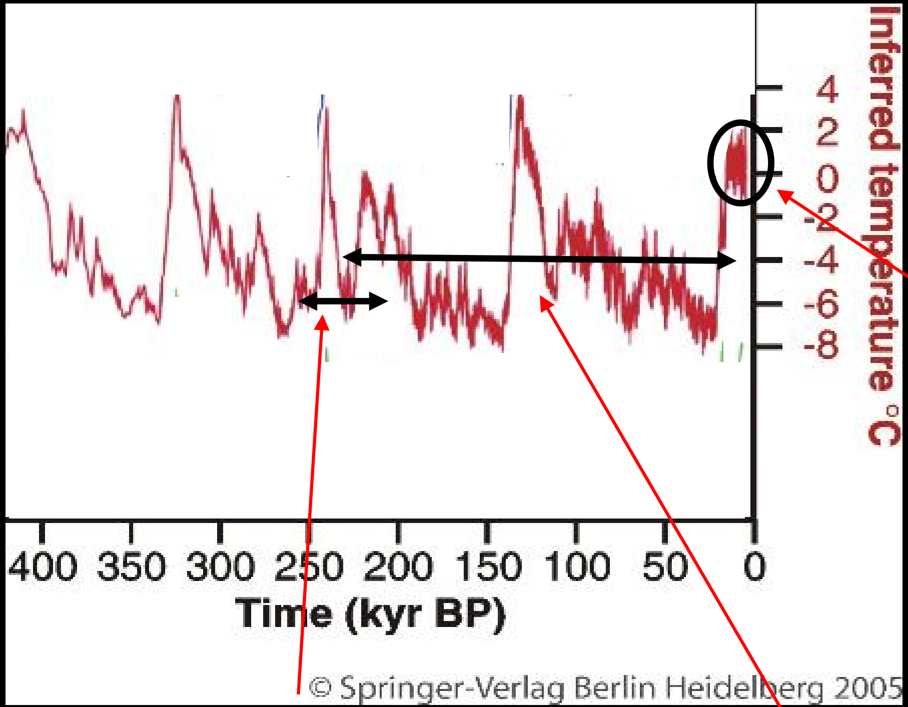
The Anthropocene:
Where on Earth are We Going?

Will Steffen
Emeritus Professor, Australian National University
Senior Fellow, Stockholm Resilience Centre

Our planet is a single system…

…the Earth System

Human Development
and
the Earth System



Beginning of agriculture

Evolution of fully modern humans in Africa

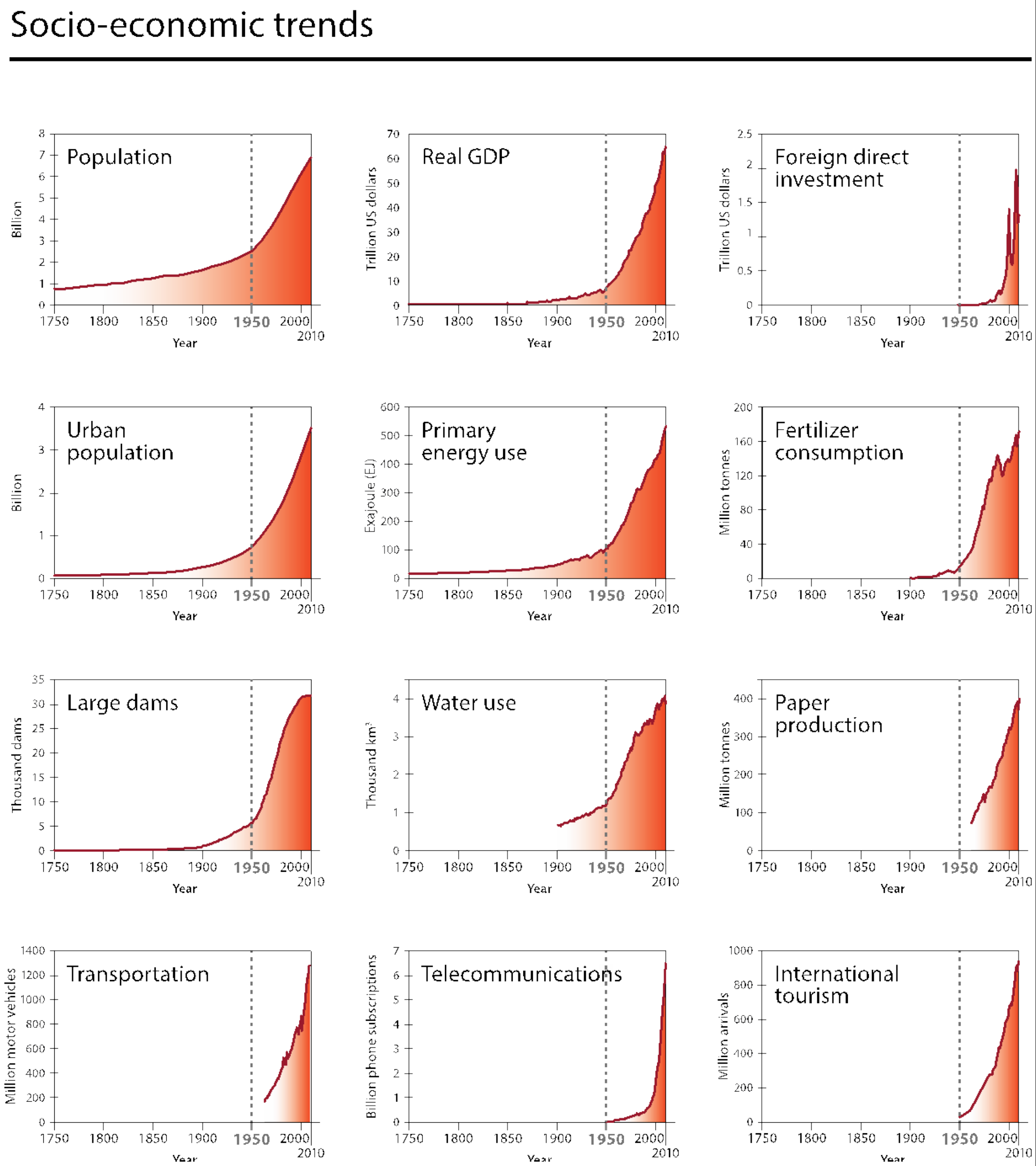
Hunter-gatherer societies only

Adapted from Steffen et al. 2004; ice core data from Petit et al. 1999

The Great Acceleration

The Human Enterprise

- **Population**
- **Economic Growth**
- **Freshwater use**
- **Energy use**
- **Urbanization**
- **Globalization**
- **Transport**
- **Communication**



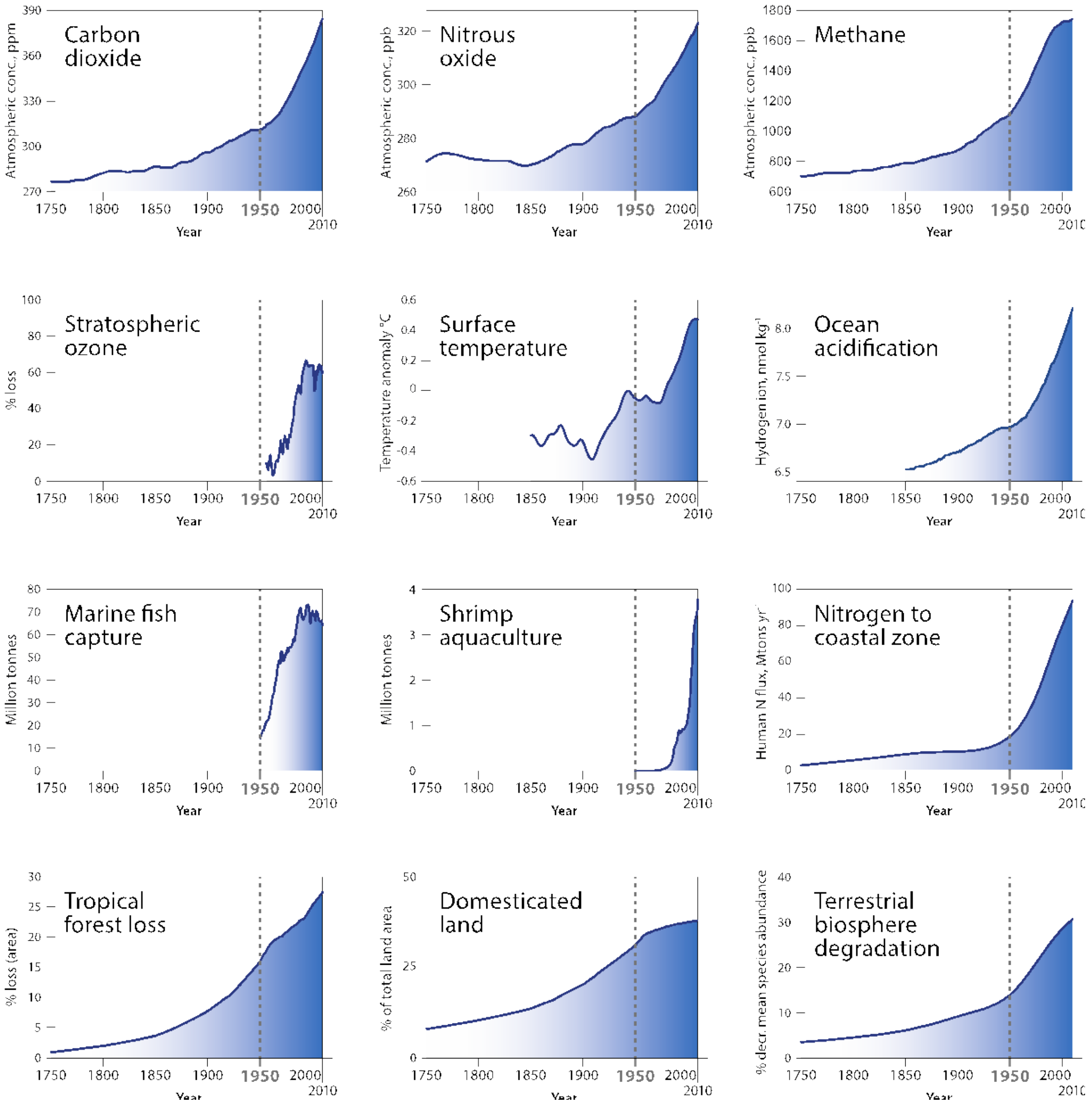
Steffen et al. 2015

The Great Acceleration

Global Impact

- Greenhouse gases
- Ozone depletion
- Climate
- Marine ecosystems
- Coastal zone
- Nitrogen cycle
- Tropical forests
- Land systems
- Biosphere integrity

Earth system trends



Steffen et al. 2015

IGBP Newsletter 41: May 2000

The "Anthropocene"

by Paul J. Crutzen and Eugene F. Stoermer

The name Holocene ("Recent Whole") for the post-glacial geological epoch of the past ten to twelve thousand years seems to have been proposed for the first time by Sir Charles Lyell in 1833, and adopted by the International Geological Congress in Bologna in 1885 (1). During the Holocene mankind's activities gradually grew into a significant geological, morphological force, as recognised early on by a number of scientists. Thus, G.P. Marsh already in 1864 published a book with the title "Man and Nature", more recently reprinted as "The Earth as Modified by Human Action" (2). Stoppani in 1873 rated mankind's activities as a "new telluric force which in power and universality may be compared to the greater forces of earth" [quoted from Clark (3)]. Stoppani already spoke of the anthropozoic era. Mankind has now inhabited or visited almost all places on Earth; he has even set foot on the moon.

The great Russian geologist V.I. Vernadsky (4) in 1926 recognized the increasing power of mankind as part of the biosphere with the following excerpt "... the direction in which the processes of evolution must proceed, namely towards increasing consciousness and thought, and forms having greater and greater influence on their surroundings".

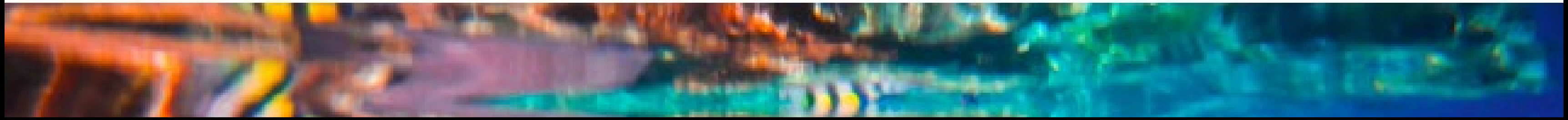
panied e.g. by a growth in cattle population to 1400 million (6) (about one cow per average size family). Urbanisation has even increased tenfold in the past century. In a few generations mankind is exhausting the fossil fuels that were generated over several hundred million years. The release of SO_2, globally about 160 Tg/year to the atmosphere by coal and oil burning, is at least two times larger than the sum of all natural emissions, occurring mainly as marine dimethyl-sulfide from the oceans (7); from Vitousek et al. (8) we learn that 30-50% of the land surface has been transformed by human action; more nitrogen is now fixed synthetically and applied as fertilizers in agriculture than fixed naturally in all terrestrial ecosystems; the escape into the atmosphere of NO from fossil fuel and biomass combustion likewise is larger than the natural inputs, giving rise to photochemical ozone ("smog") formation in extensive regions of the world; more than half of all accessible fresh water is used by mankind; human activity has increased the species extinction rate by thousand to ten thousand fold in the tropical rain forests (9) and several climatically important "greenhouse" gases have substantially increased in the atmosphere: CO_2 by more

groves. Finally, mechanized human p dation ("fisheries") removes more th 25% of the primary production of t oceans in the upwelling regions and 3 in the temperate continental shelf gions (10). Anthropogenic effects are a well illustrated by the history of biotic communities that leave remains in lake sediments. The effects documented include modification of the geochemical cycle in large freshwater systems and occur in systems remote from primary sources (11-13).

Considering these and many other major and still growing impacts of human activities on earth and atmosphere, and at all, including global, scales, it seems to us more than appropriate to emphasize the central role of mankind in geology and ecology by proposing to use the term "anthropocene" for the current geological epoch. The impacts of current human activities will continue over long periods. According to a study by Berger and Loutre (14), because of the anthropogenic emissions of CO_2, climate may depart significantly from natural behaviour over the next 50,000 years.

To assign a more specific date to the onset of the "anthropocene" seems somewhat arbitrary, but we propose the latter part of the 18th century, although

Nature's Dangerous Decline



Nature is declining globally at rates unprecedented In human history

Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, 2019

Nature's Dangerous Decline

The health of ecosystems on which we and all other species depend is deteriorating more rapidly than ever.

We are eroding the very foundations of our economies, livelihoods, food security, health and qualify of life worldwide.

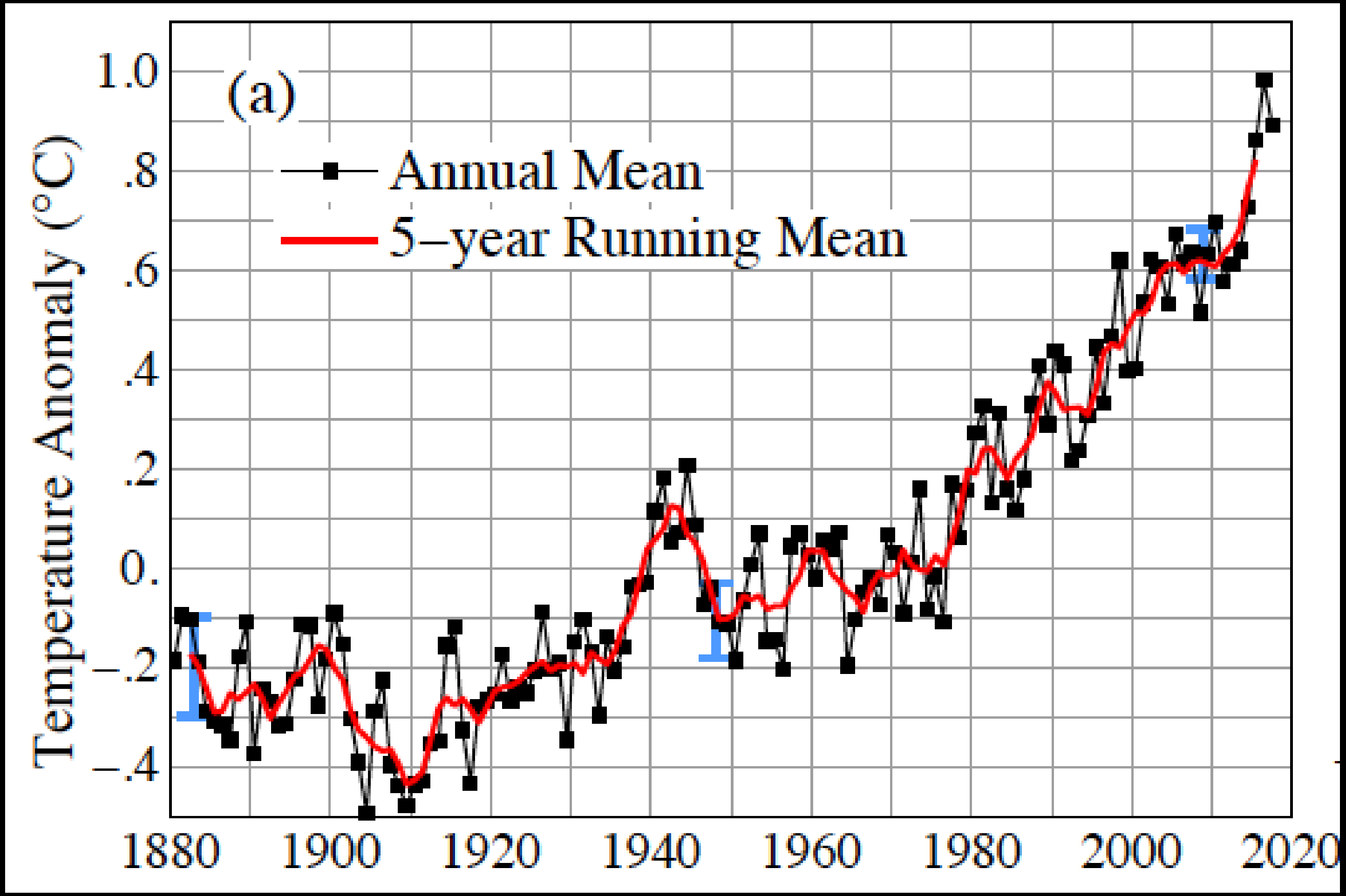
Around 1 million animal and plant species are now threatened with extinction, many within decades.

The essential, interconnected web of life on Earth is getting smaller and increasingly frayed.

Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, 2019

Climate Change

Global Average Temperature Anomaly, 1880-2017



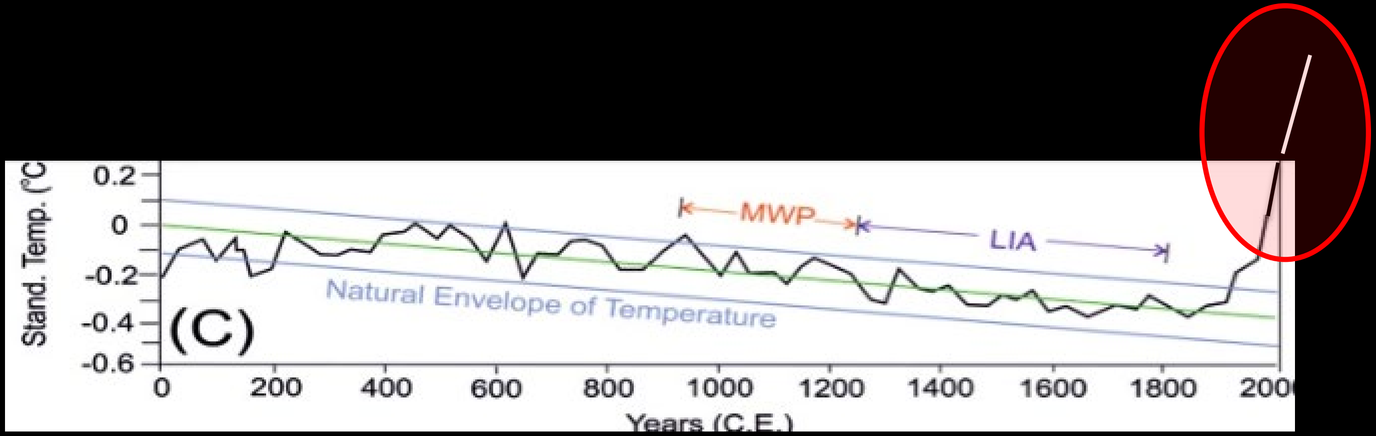
Baseline is 1951-1980

NASA 2018

An Earth System Perspective

Temperature rise:
Beyond the envelope of natural variability!

Human influence



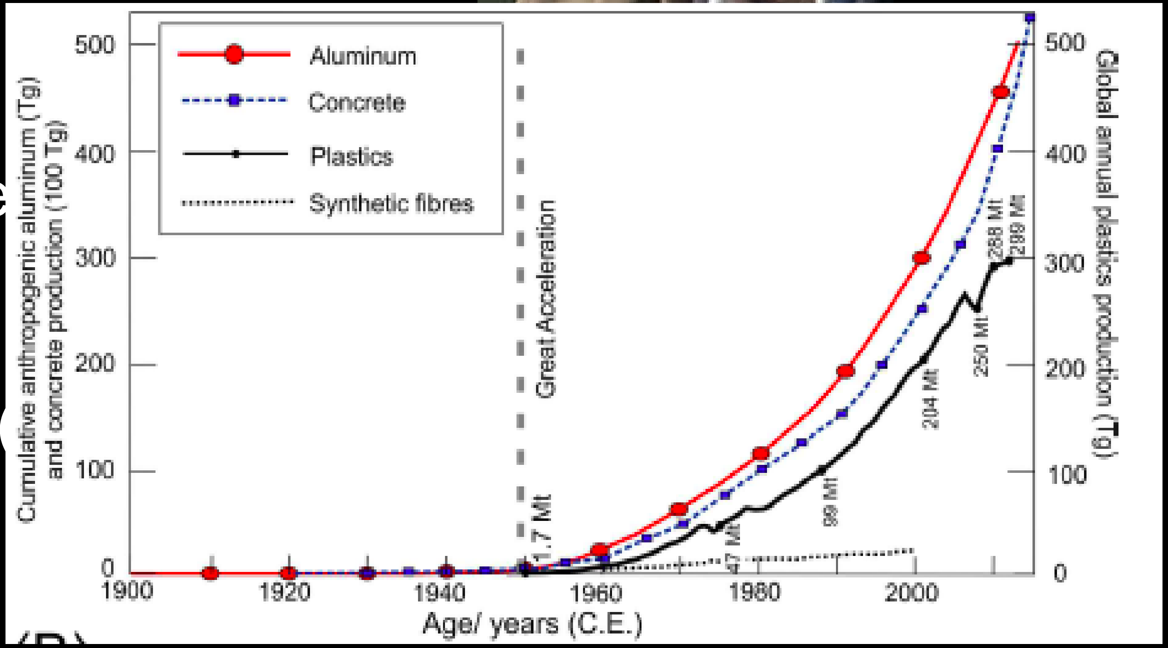
Summerhayes 2015

Formalization of the Anthropocene: Current Status

Jan Zalasiewicz, Convenor
Anthropocene Working Group
University of Leicester, UK

Should the Anthropocene be formalise
Scale?

Should the base of the Anthropocene
mid-20th century?.

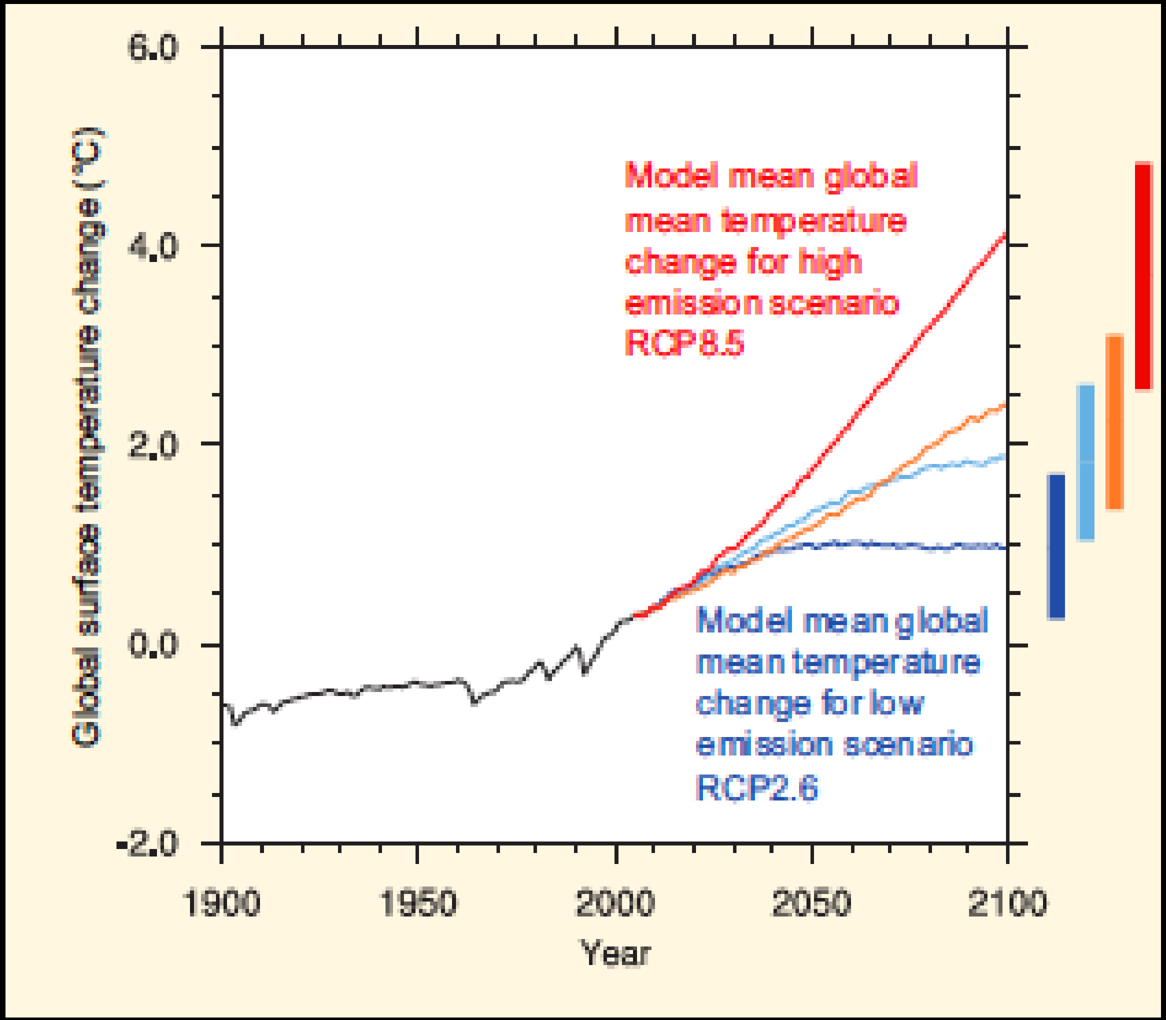


‘YES’ won the formal vote by 29 to 4

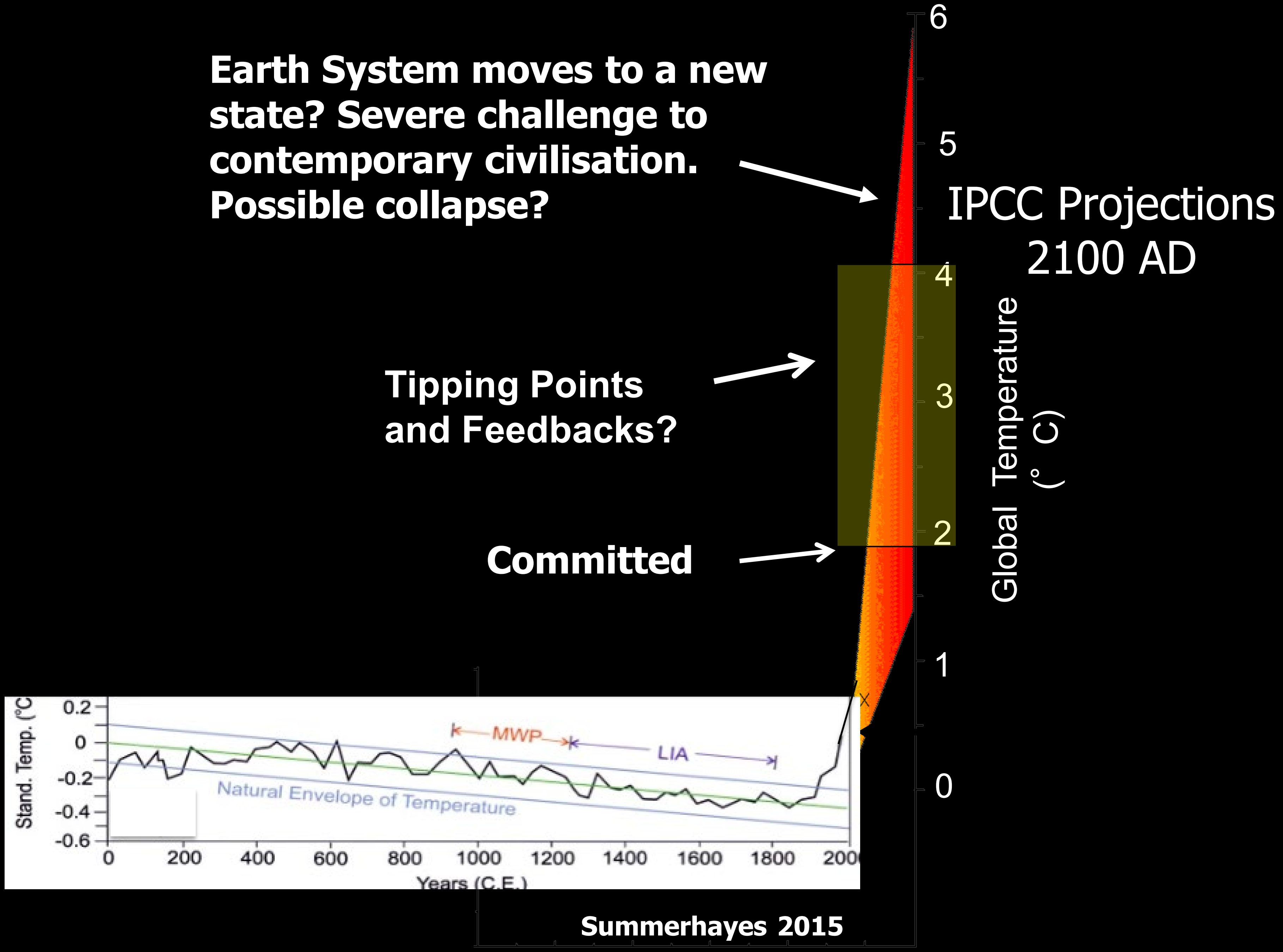
Anthropocene Working Group 2019

Where is the Earth System going?

IPCC temperature projections

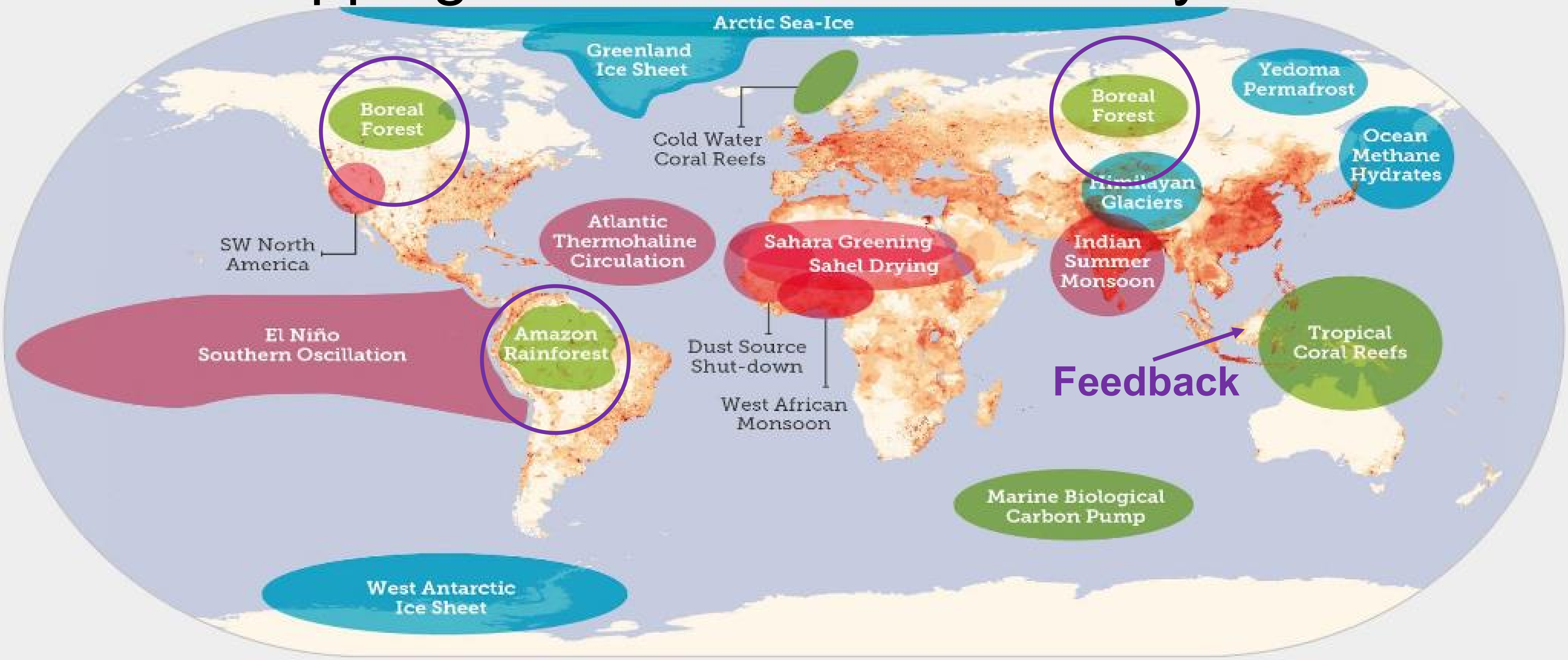


IPCC 2013

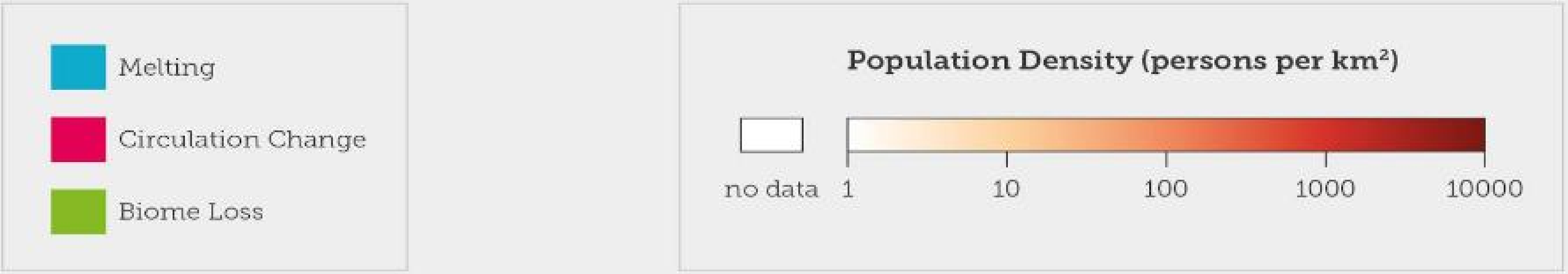


Earth System moves to a new state? Severe challenge to contemporary civilisation. Possible collapse?
Tipping Points and Feedbacks?
Committed
IPCC Projections 2100 AD
Global Temperature (° C)
6
5
4
3
2
1
0
Stand. Temp. (°C
0.2
0
-0.2
-0.4
-0.6
MWP
LIA
Natural Envelope of Temperature
0
200
400
600
800
1000
1200
1400
1600
1800
200
Years (C.E.)
Summerhayes 2015

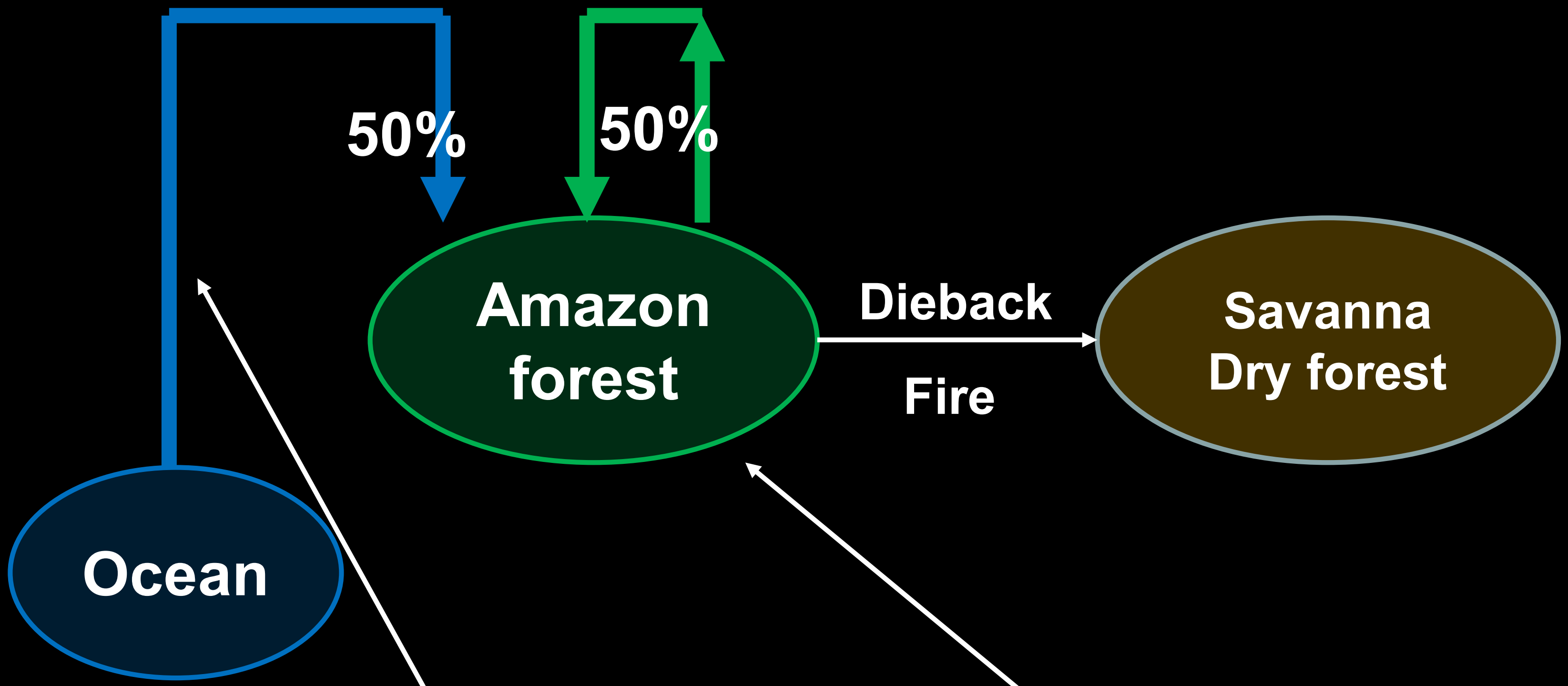
Tipping Elements in the Earth System



Huber, Lenton, and Schellnhuber, in Richardson et al. 2011



The Amazon tipping element



Climate change: change in ocean/atmos circulation → reduced rainfall; increased drought

Deforestation: conversion to cropland or pasture → reduced evaporation and water recycling

The Amazon tipping element

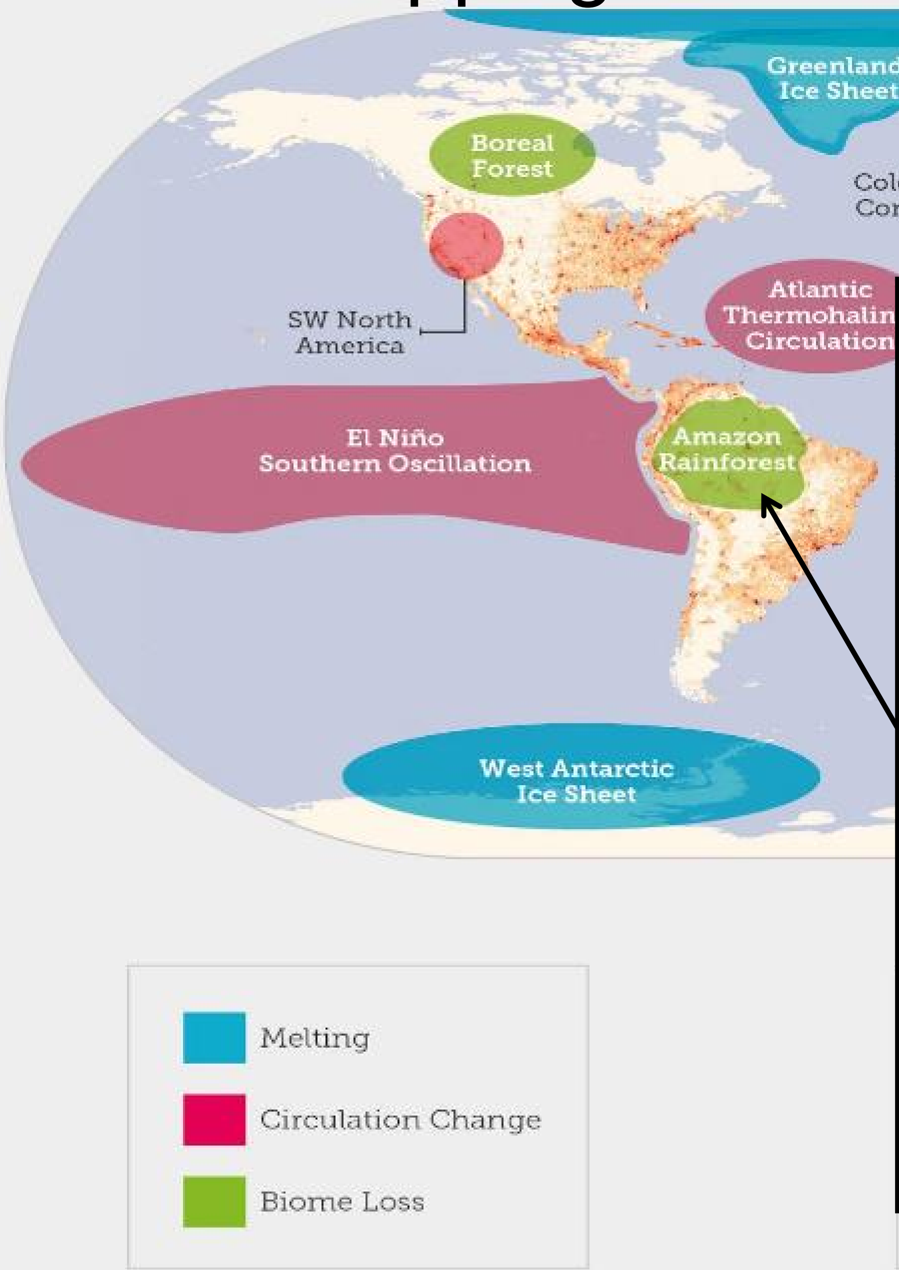
Deforestation alone: tipping point at ~20-25% clearing of forest and conversion to cropland and pasture.

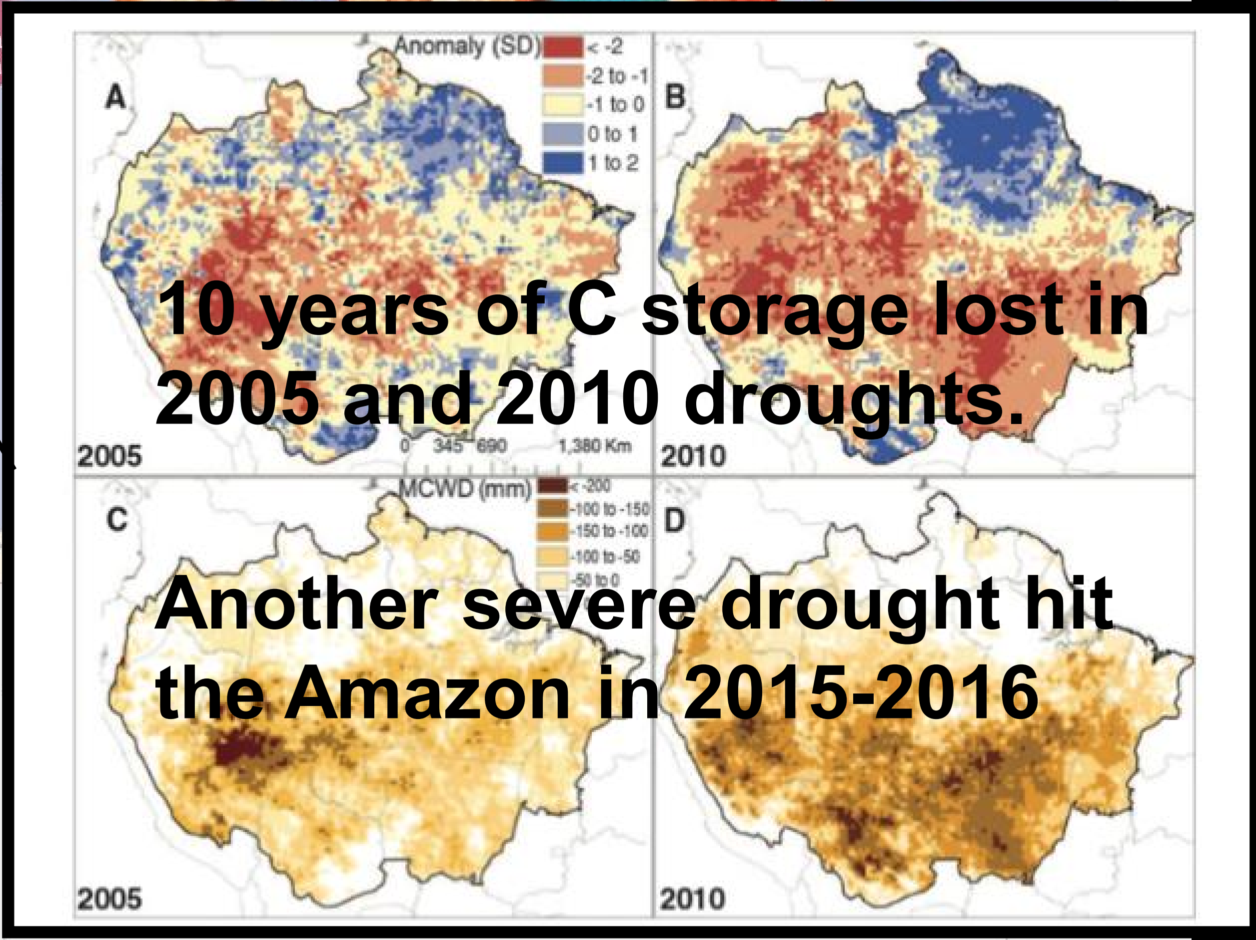
Climate change alone: 3-4^{o}C temperature increase in the Amazon region.

Deforestation + climate change: Paris 2^{o}C target would reduce allowable deforestation to significantly less than 25%. Paris commitments - ~3^{o}C temperature rise – would reduce allowable deforestation to near zero.

Nobre and de Simone Borma 2009; Lovejoy and Nobre 2018

Tipping Elements in the Earth System



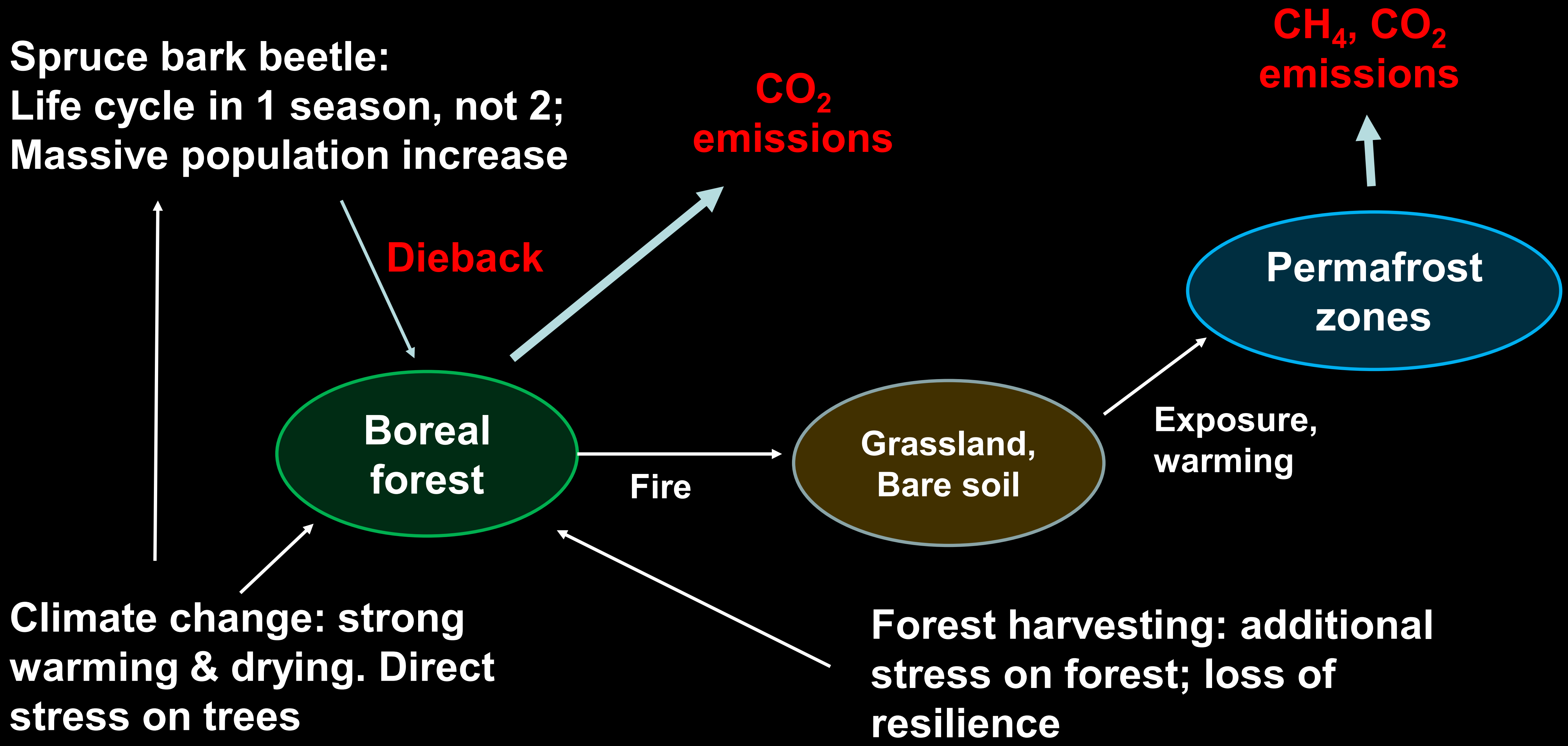


10 years of C storage lost in 2005 and 2010 droughts.

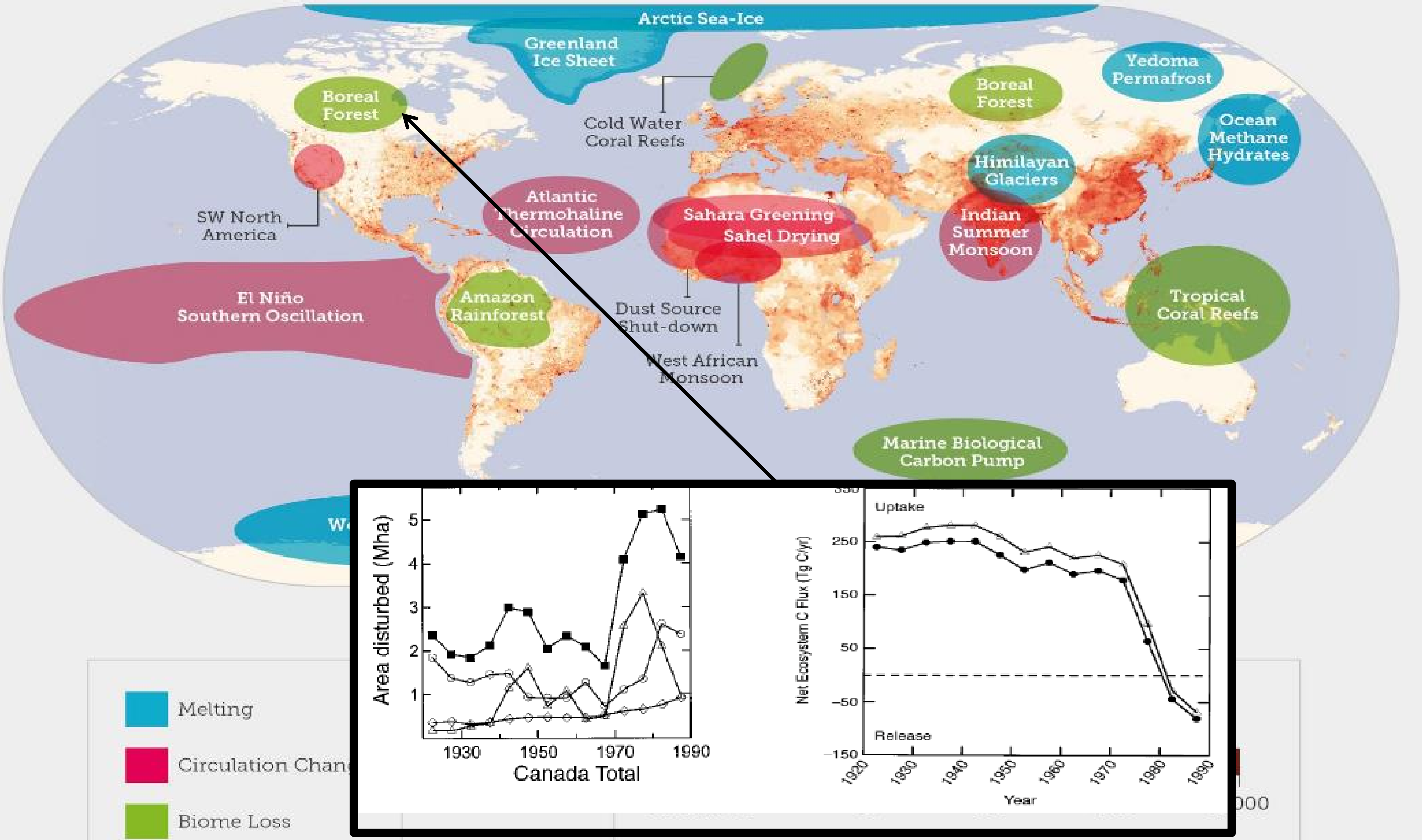
Another severe drought hit the Amazon in 2015-2016

Huber et al., in Richardson et al. 2011; Phillips et al. 2009; Lewis et al. 2011; Brien

The boreal forest tipping element

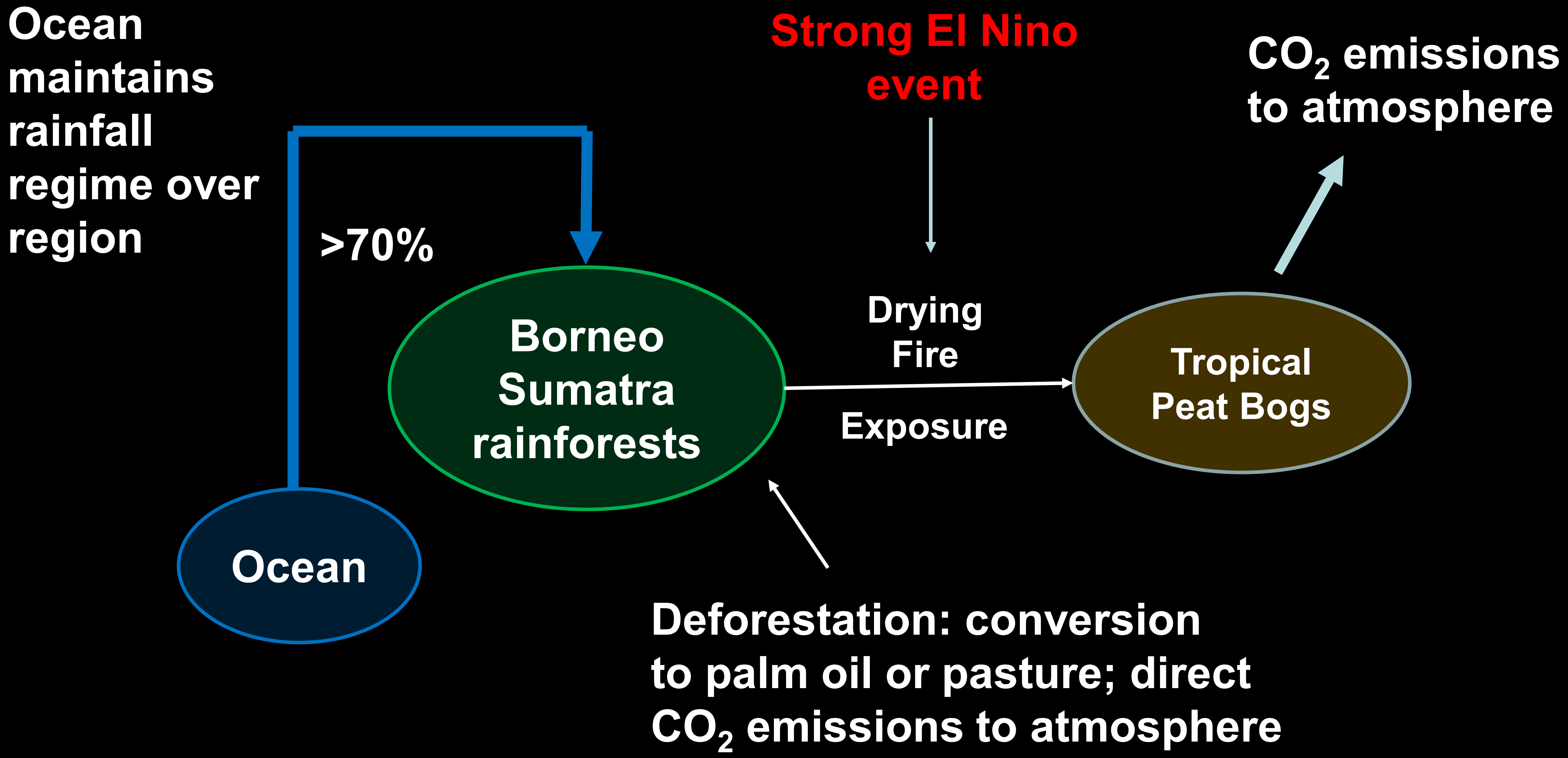


Tipping Elements in the Earth System



Huber et al., in Richardson et al. 2011; Kurz and Apps 1999

The SE Asian forest feedback



The Paris 2^{o}C Target: Can We Meet It?

The total carbon budget from 1870 is about 1,000 Gt C (emitted as CO_2) for a 66% probability of meeting the 2^{o}C target.

Cumulative human emissions (fossil fuels, cement, land use) from 1870 through 2018 were about 585 Gt C, leaving 415 Gt C in the budget.

Accounting for non-CO_2 gases (e.g. CH_4, N_2O) reduces the C budget by 210 Gt C.

The remaining budget is 205 Gt C in total.

At current rates 10 Gt C per year at current rates, the budget would last only two decades.

Sources; IPCC AR5 WGI SPM; GCP 2018

Carbon Cycle Feedbacks

Assumption: 2^{o}C temperature rise; no deforestation; estimates of C loss by 2100

- **Amazon dieback could release 25 (15-55) Gt C**
- **Boreal forest dieback could release 30 (10-40) Gt C**
- **Permafrost thawing could release 40 Gt C**
- **Peat fires in Borneo and Sumatra could release more C**

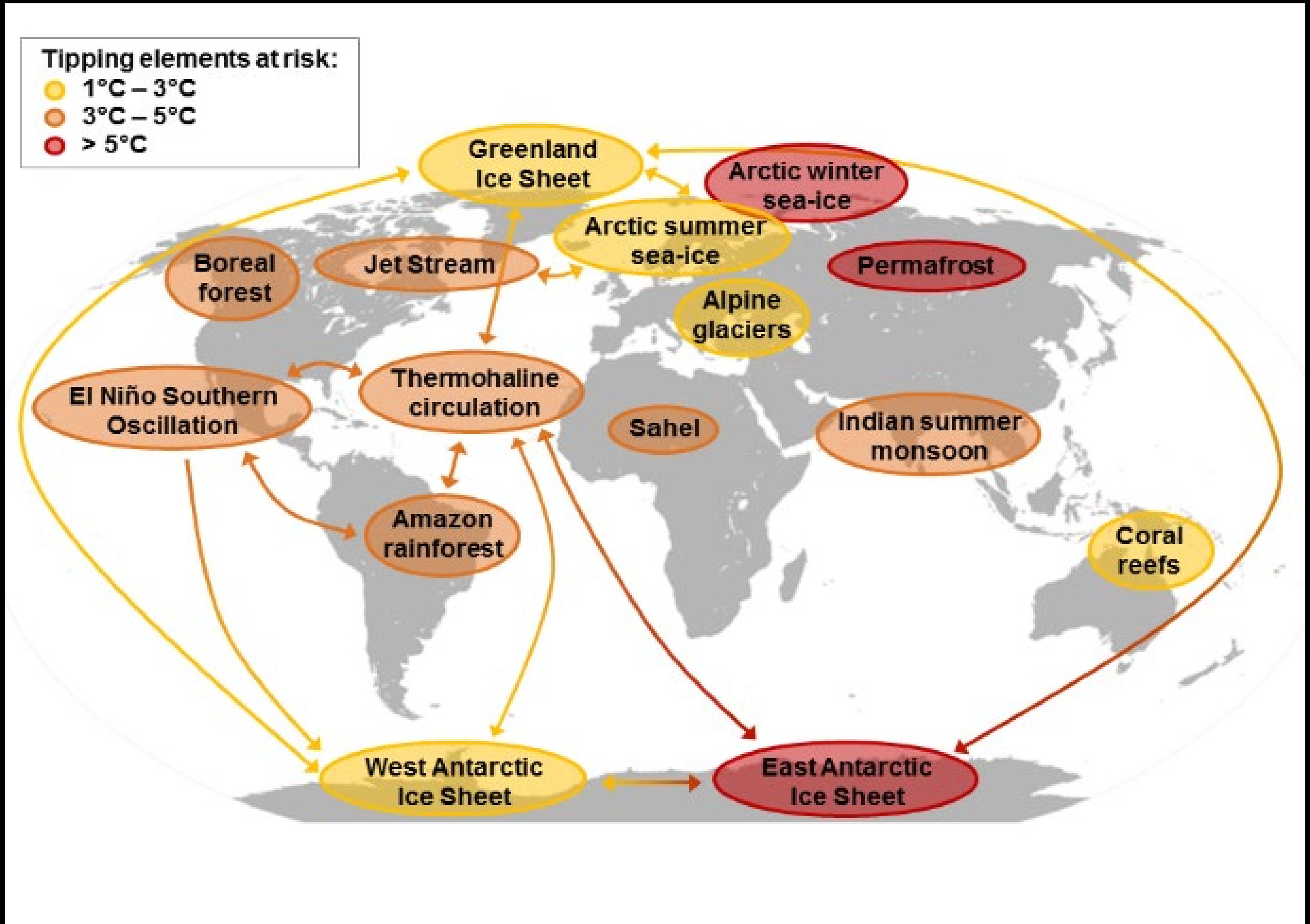
Notes:
1. Higher temperature rises (e.g. ~3^{o}C) would lead to much higher losses of carbon
2. Including the effects of human-driven deforestation would also lead to much higher losses of carbon
3. By comparison, current human emissions are ~10 Gt C yr^{-1}

Steffen et al. 2018

Feedbacks from the Amazon, boreal forest-tundra and Borneo/Sumatra regions could release enough carbon to cut the 2°C carbon budget in half – down to ~100 Gt C, or about 10 years of emissions.

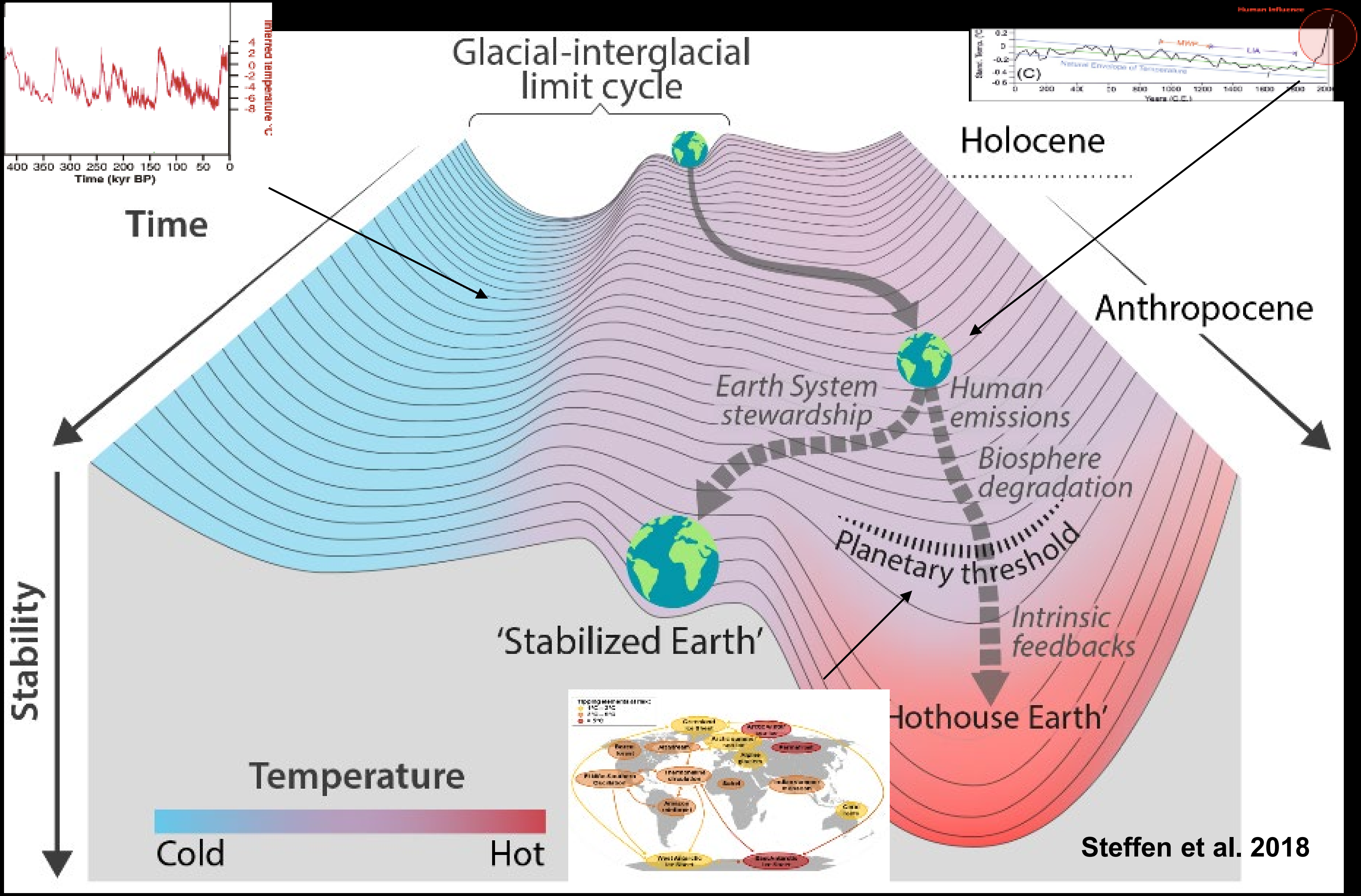
Key finance/investment decisions could make the difference between meeting the Paris climate targets or not.

Tipping Cascades



Source: J. Donges and R. Winkelmann in Steffen et al. 2018

Earth System Trajectories



Is ‘Hothouse Earth’ inhabitable?

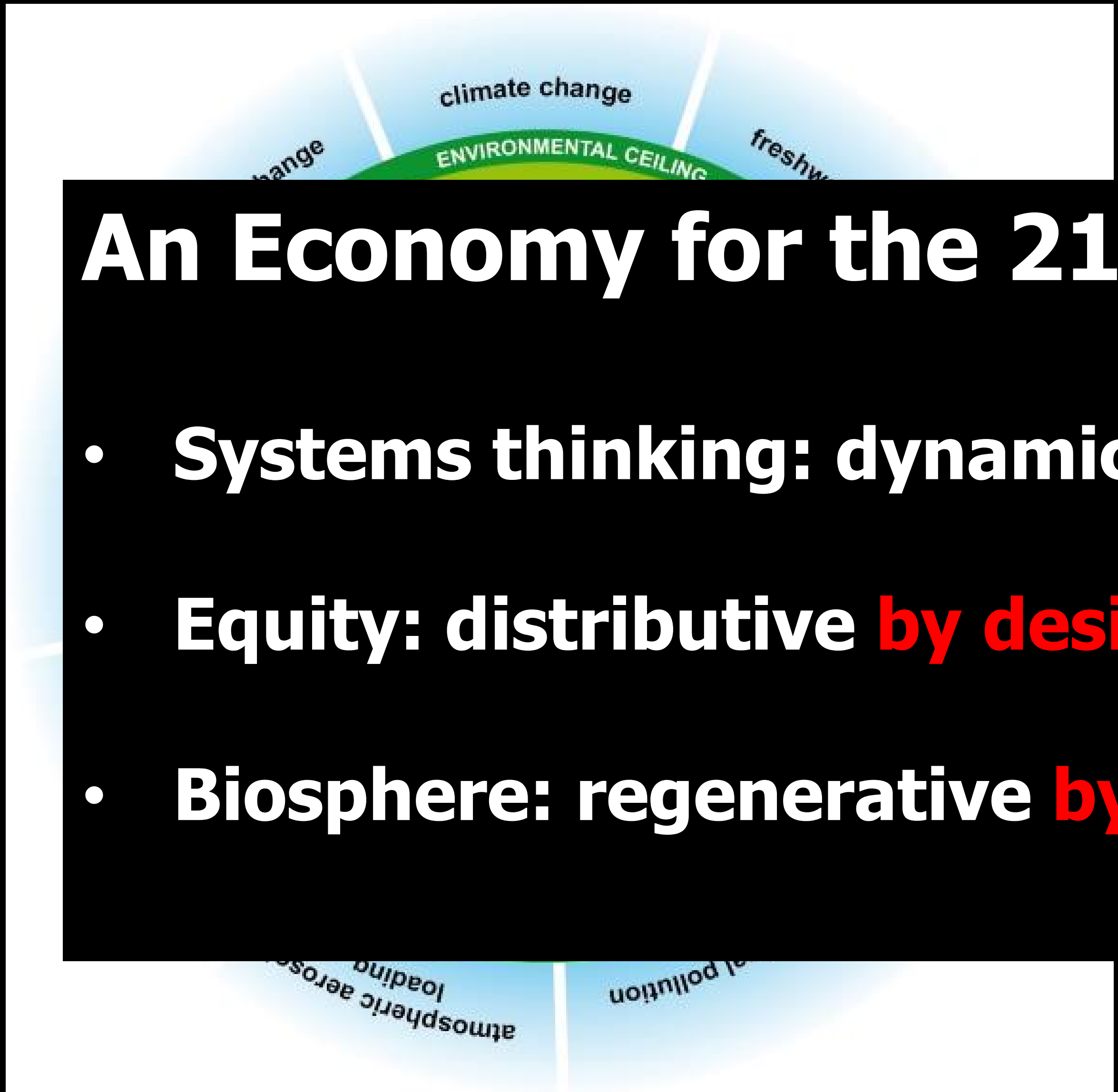
- Most of the tropics and subtropics will be too hot for human habitation.

- Changing temperature & rainfall patterns will likely make current large agricultural zones unproductive.

- Sea-level rise of 20-40 m ultimately likely, drowning coastal cities, agricultural areas and infrastructure.

- Maximum carrying capacity of ~1 billion humans (today’s population is 7.5 billion)

The ‘Doughnut’: a safe and just space for humanity



An Economy for the 21st Century

- Systems thinking: dynamic complexity
- Equity: distributive by design
- Biosphere: regenerative by design

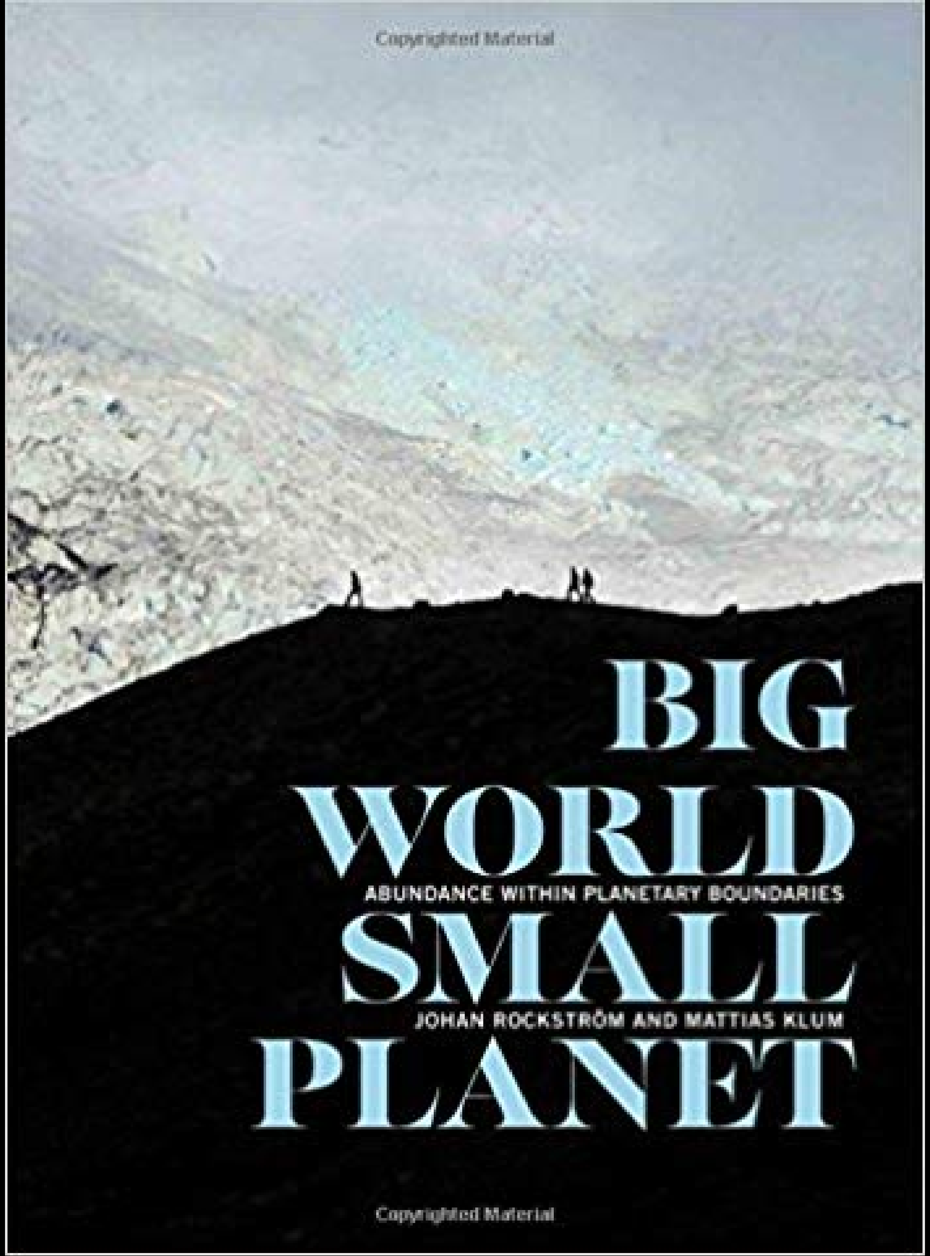
Conclusions

Boreal forests, SE Asia tropical forests and the Amazon basin are all important tipping elements/feedbacks in the Earth System. Together they could ‘make or break’ the Paris climate agreement .

Halting deforestation of these regions is also critical for avoiding the Earth’s sixth great extinction event.

The finance sector has an absolutely crucial role to play in keeping these ‘Sleeping Giants in the Earth System’ asleep (or putting them back to sleep).

Halting deforestation is the necessary first step in moving from an exploitative to a regenerative global economy.



Johan Rockström and Matthias Klum


RISK

FINANCIAL TIMES

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Glencore

Glencore to limit coal production after pressure from investors

Church of England and large Australian superannuation funds among shareholders who pushed for environmental decision

Rob Davies

@ByRobDavies

Wed 20 Feb 2019 12.59 GMT

807

Save

REPUTATIONAL RISK

MATERIAL RISK

REGULATORY RISK

Climate change + Add to myFT

Central bankers plan for disruption caused by climate change

More freak weather and rising temperatures threaten more economic shocks

Save

Mark Carney, Bank of England governor © Bloomberg


Avoiding dangerous climate change requires
• Reduction of GHG
• Bolstering the resilience of key biomes/regions
Investments determine material risks from climate change
Allocation of capital to economic activities that threaten to trigger Earth System tipping points

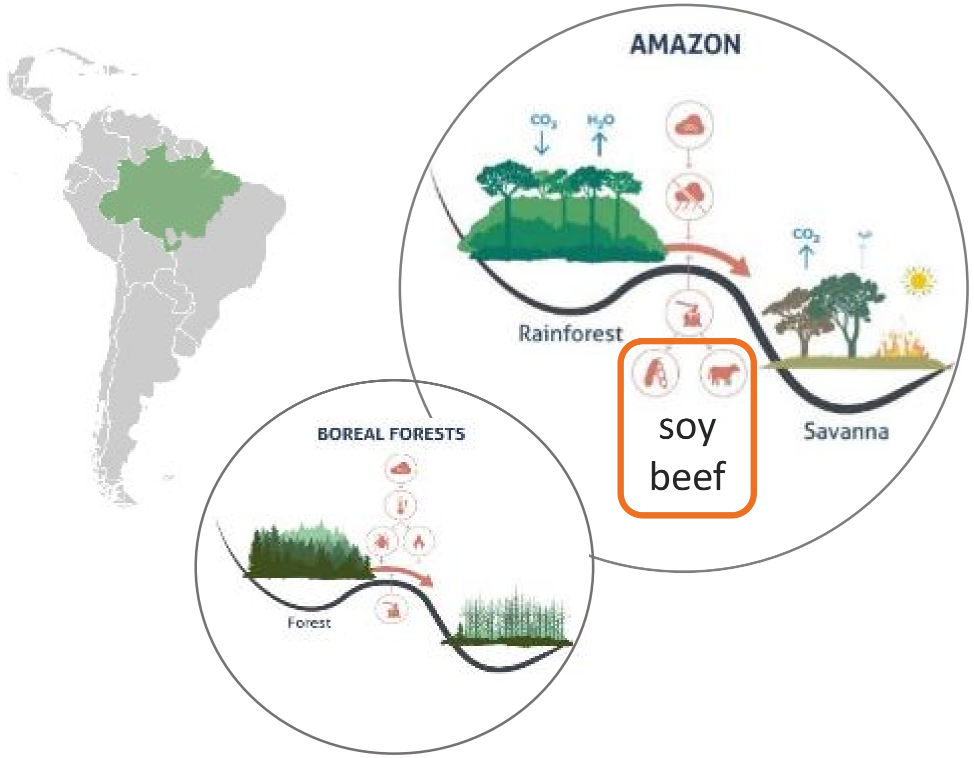
https://sleepinggiants.earth

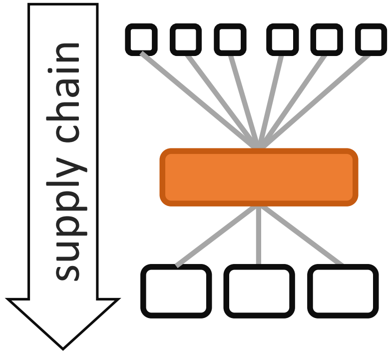
Method

Step 1:
Geographical scope

Step 2:
Key economic sectors

Step 3:
Key economic actors



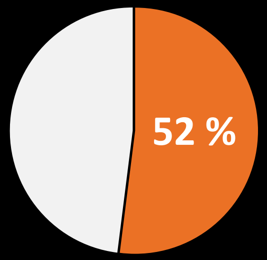


Victor Galaz, Beatrice Crona, Alice Dauriach, Bert Scholtens, Will Steffen

Selecting companies

Soybean processing

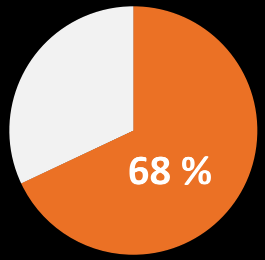
5 companies representing



Export value of soy products from **Brazil**

Beef processing

3 companies representing

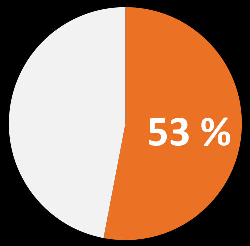


Export value of beef products from **Brazil**

AMAZON

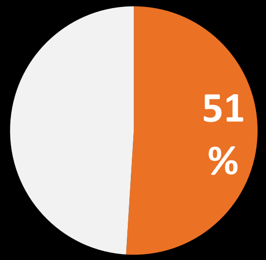
Wood, pulp and paper sector

4 companies representing



Total revenue of top 50 companies in the sector in **Russia**

18 companies representing

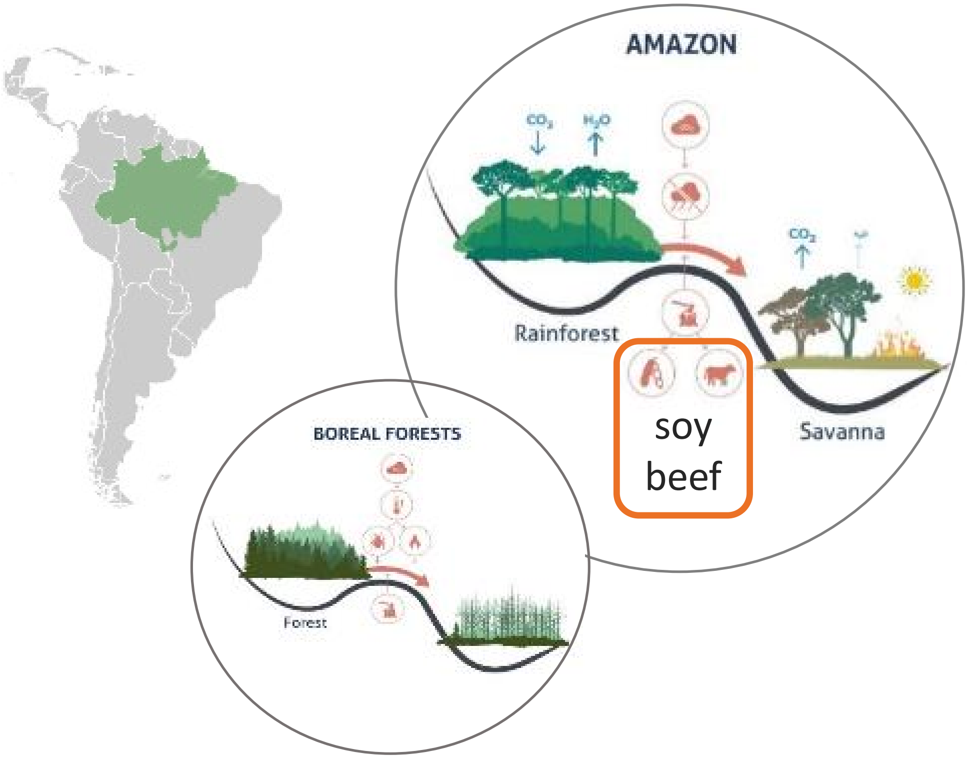


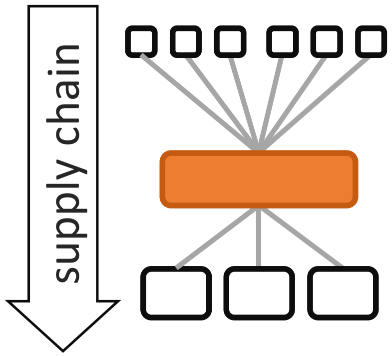
Industrial forest tenure area in **Canada**

BOREAL FORESTS

Method

Step 1: Geographical scope → **Step 2:** Key economic sectors → **Step 3:** Key economic actors → **Step 4:** Key financial sources → **Step 5:** Investors





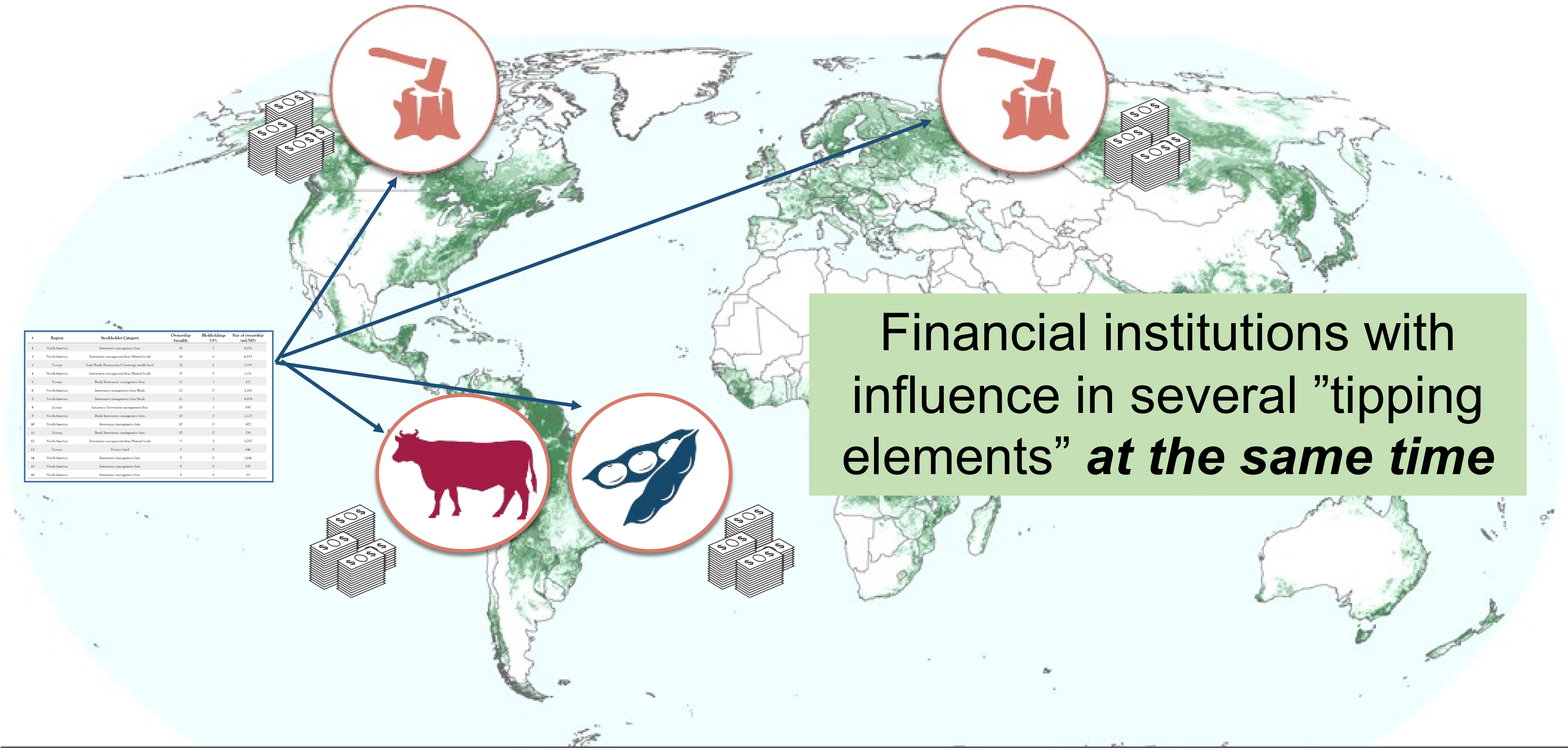
$ € ¥ £

Equity

(Debt)

1
2
3
...

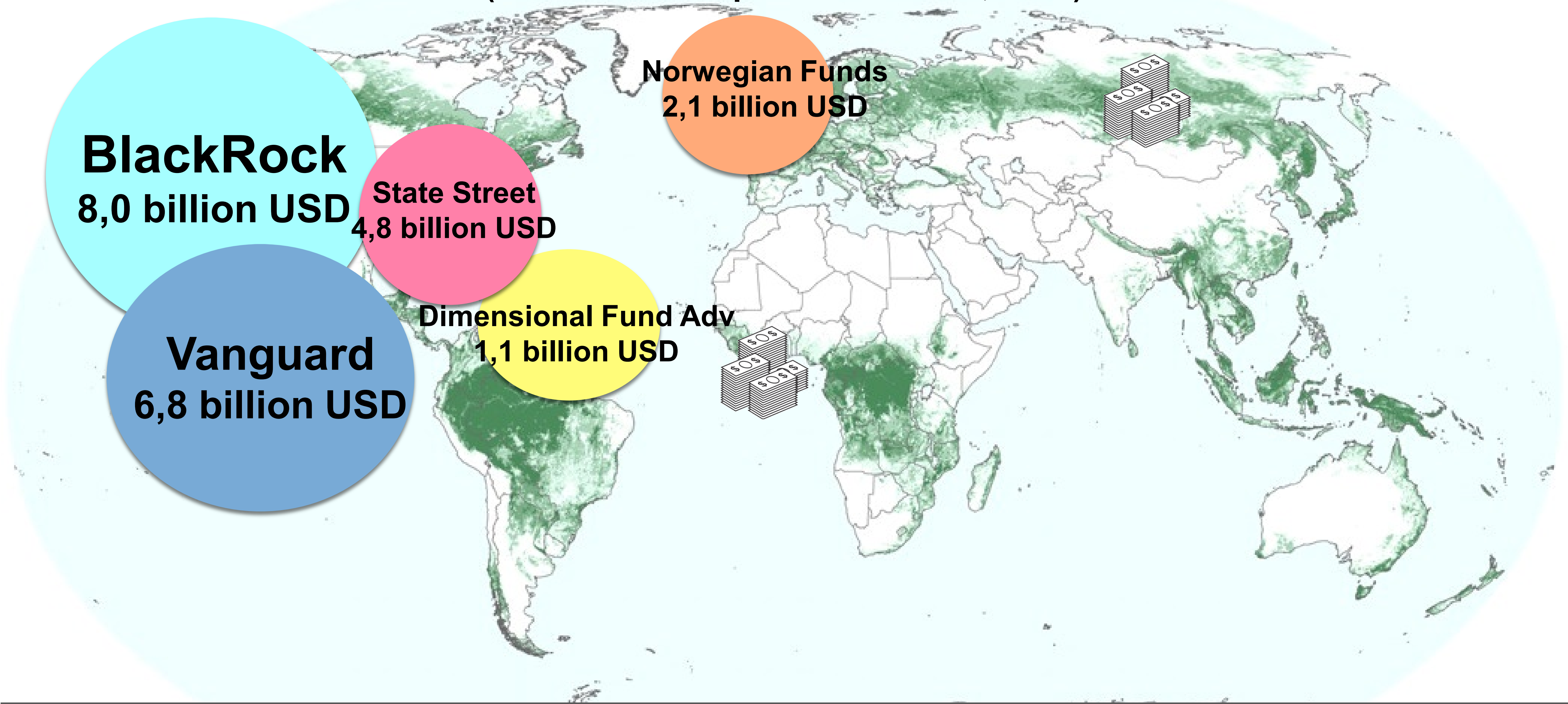
Victor Galaz, Beatrice Crona, Alice Dauriach, Bert Scholtens, Will Steffen



Financial institutions with influence in several ”tipping elements” ***at the same time***

Identifying investors (Financial Giants)

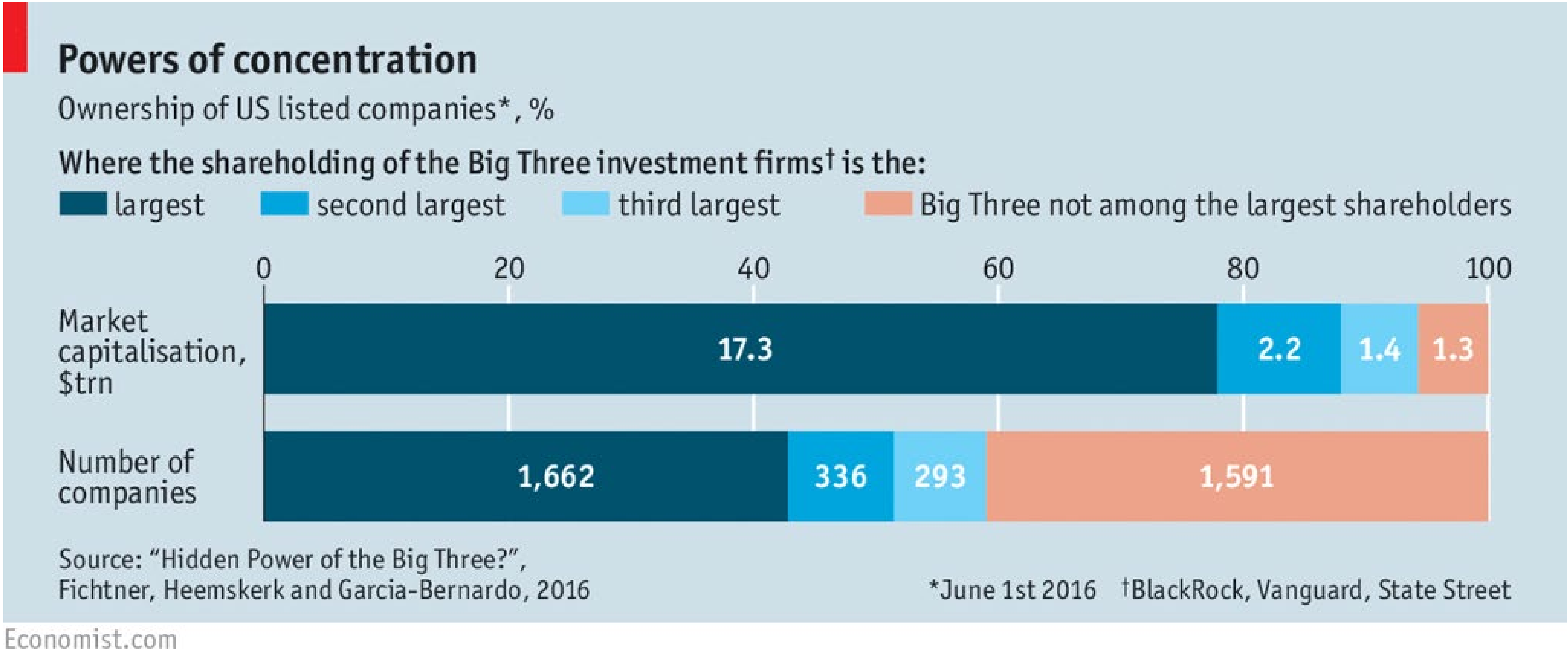
(stock ownership in million USD, 2016)



Top 5 Financial Giants

’Big Three’

Blackrock, Vanguard, State Street



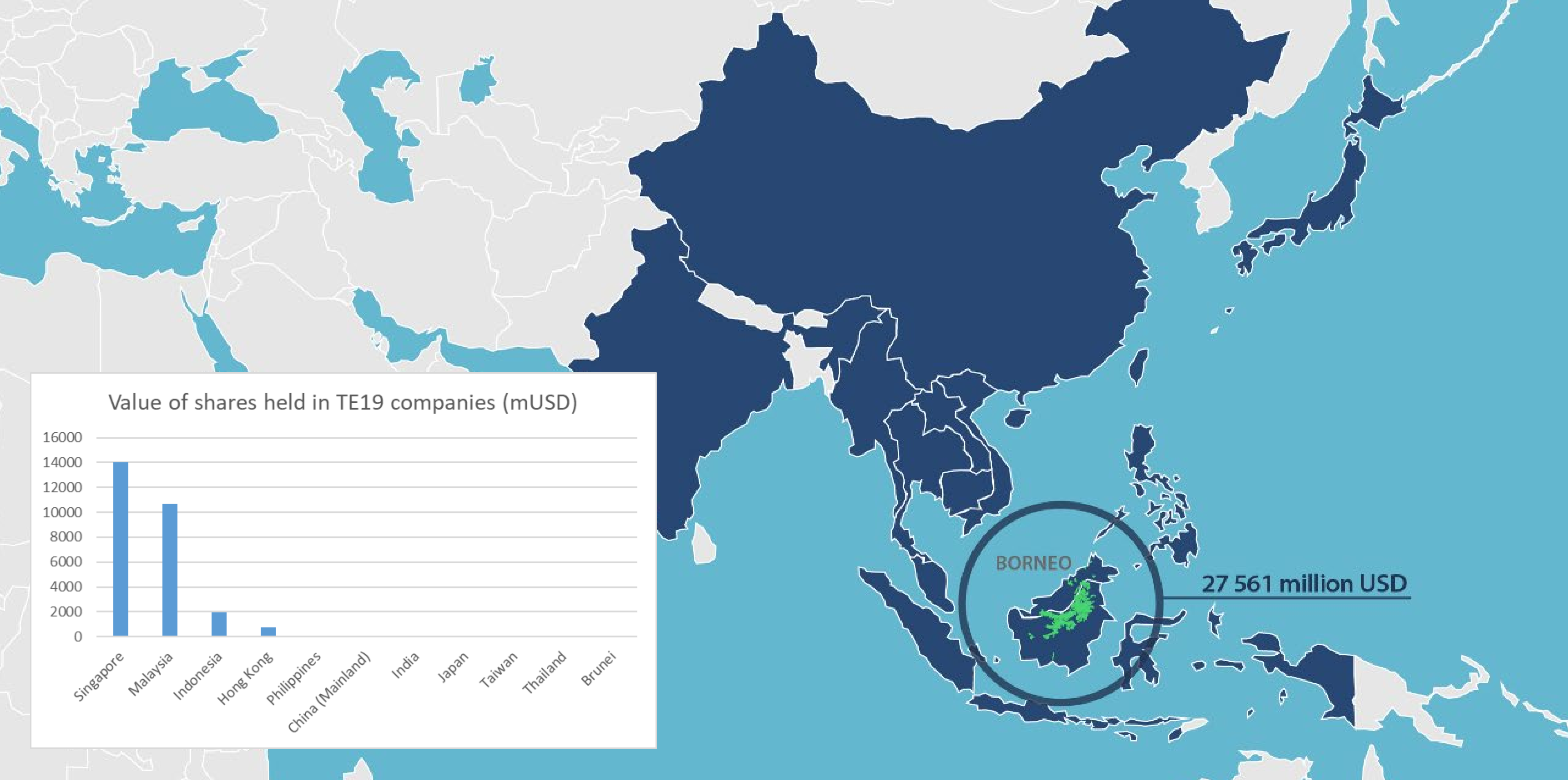
‘Financial Giants’ reach the 10%-threshold in

- 3 of 6 companies* in the Amazon
- 4 of 18 in Canadian boreal forests
- 2 of 4 in Russian boreal forests
- In 6 of the 30 companies, the ‘financial giants’ collectively represent the largest single stockholder.

* Publicly listed companies, 16 of 30 in sample.


RUSSIA
CANADA
BRAZIL
270 million USD
4 745 million USD
263 million USD

Institutional investments from ASEAN countries, in the 19 publically trading companies that own or operate the largest forest concessions in Borneo, according to Global Forest Watch data dated (2010-2014)



Converging trends: window for climate action is closing, increased financial influence in “tipping elements” in the climate system

This is an opportunity for institutions in the financial sector, to show pivotal climate leadership

- What does the existence of Earth System tipping points mean for your considerations regarding sustainable finance?

- How does (could) the existence of tipping elements affect how you do business?

- What kinds of information or tools do you believe you would need to take this further in your institution?

https://sleepinggiants.earth

Thank you!

Alice Dauriach,
Bert Scholtens,
Ami Golland,
Amar Causevic

https://sleepinggiants.earth

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