Natural Hazards and Disaster

Lab 13: Final Exam Preparation

Final Exam Preparation

Basics:

- Hazard, Disaster, and the links between them
- Probability of hazards; including probability density function
- Risks, risk assessment, risk governance
- Are probabilities of some hazards changing over time and, if so, why?

Four specific examples:

- April 6, 2009 L'Aquila Earthquake (class 5)
- Comparison of Hurricane Katrina and Typhoon Haiyan (class 9)
- The 1974 Super Outbreak of Tornados (class 10)
- Holocene and Post-Holocene: Leaving the Safe-Operating Space for Humanity, including modern climate change (classes 11 - 12)

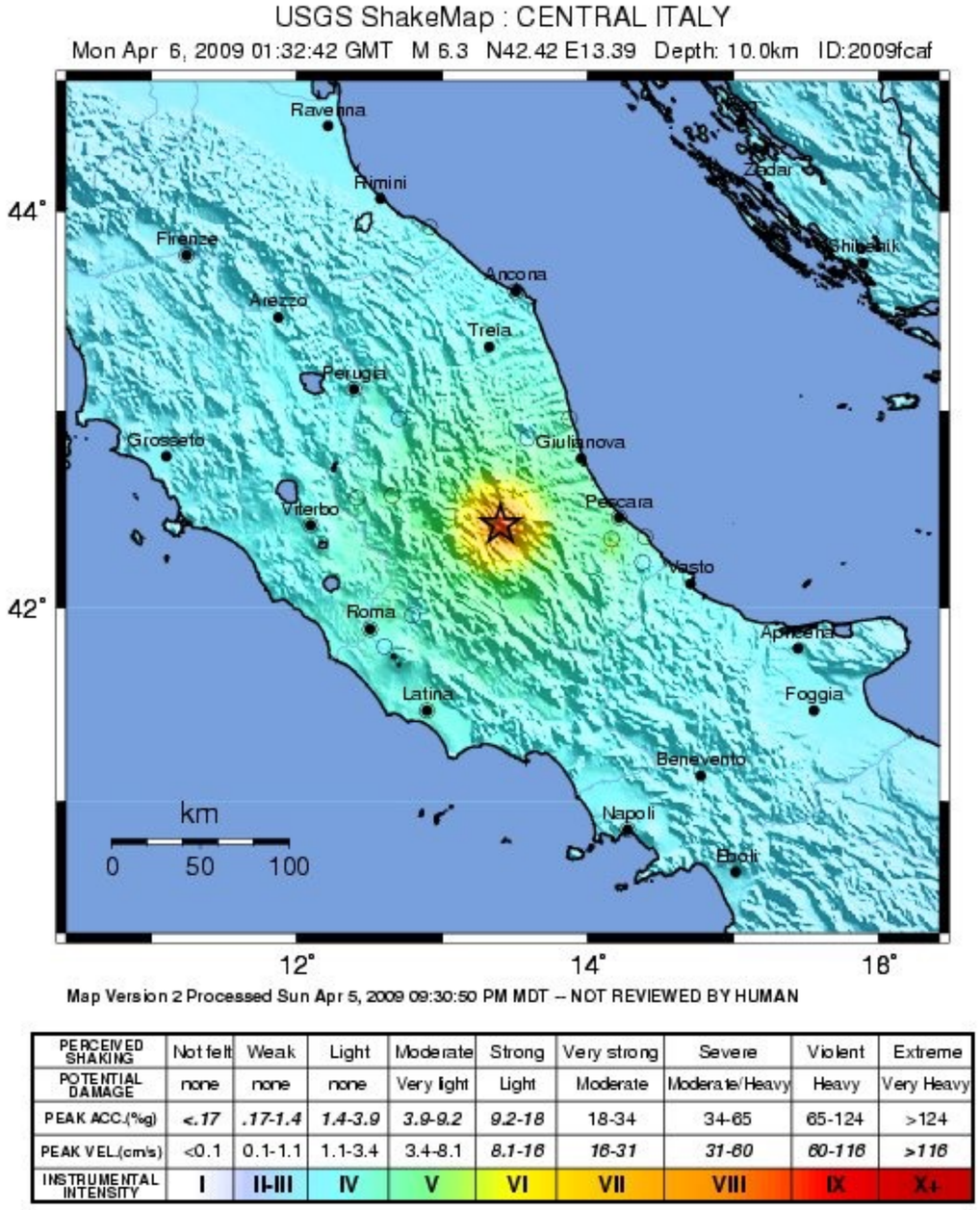
Questions will relate to:

- the hazard (earthquake, hurricane, tornado, climate change, extinction): general description of the type, the specific event;
- the disaster: extent of damage and lives lost;
- cascading impacts, if any;
- the specific reasons for the extent of the disaster (what led to the disaster?);
- particulars of the risk management cycle, in particular: risk assessment prior to the event, early warning; hazard mitigation, if any; impact mitigation, and recovery;

Cases Earthquake

Apr. 6, 2009, L'Aquila M 6.3, I=VIII, Depth 9.5 km
Deaths 309, Damage $16 billion

The L'Aquila earthquake occurred in the region of Abruzzo, in central Italy. The epicentre near L'Aquila, the capital of Abruzzo, which together with surrounding villages suffered most damage. There were **several thousand foreshocks** and aftershocks since December 2008, more than thirty of which had magnitude greater than 3.5. 309 people are known to have died, making this the deadliest earthquake to hit Italy since the 1980 Irpinia earthquake.



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	*<.17*	*.17-1.4*	*1.4-3.9*	*3.9-9.2*	*9.2-18*	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	*8.1-16*	*16-31*	*31-60*	*60-116*	*>116*
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

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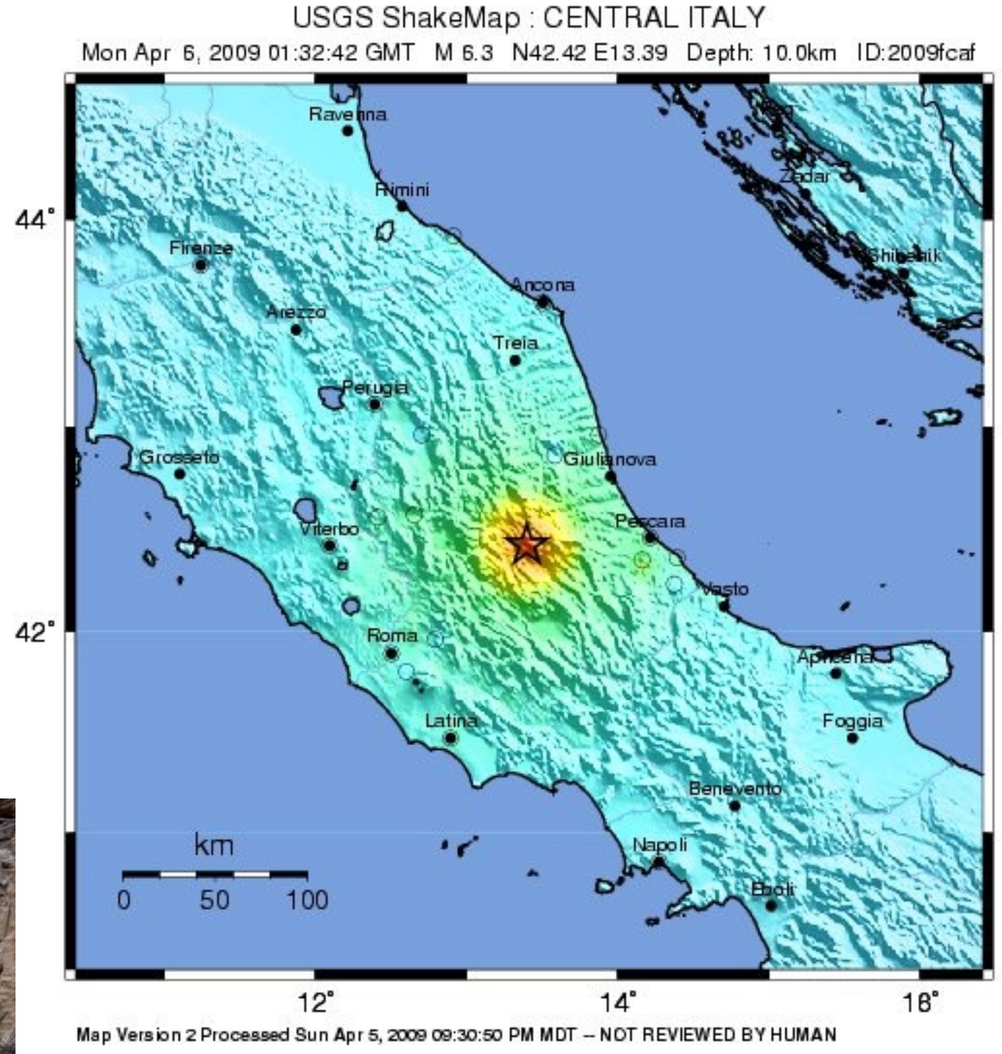

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Criticism was applied to poor building standards that led to the failure of many modern buildings in a known earthquake zone: an official at Italy's Civil Protection Agency, Franco Barberi, said that "in California, an earthquake like this one would not have killed a single person".

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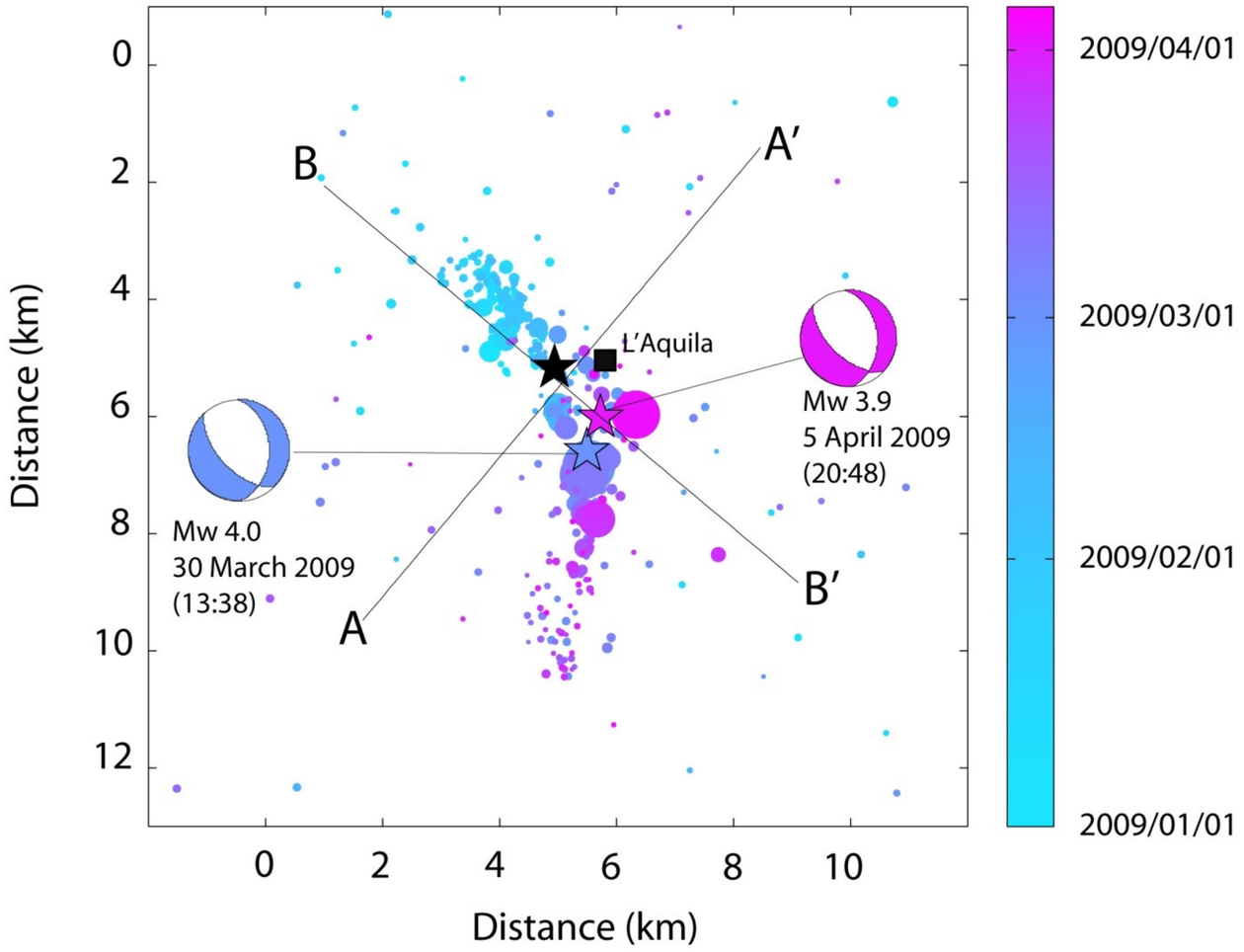

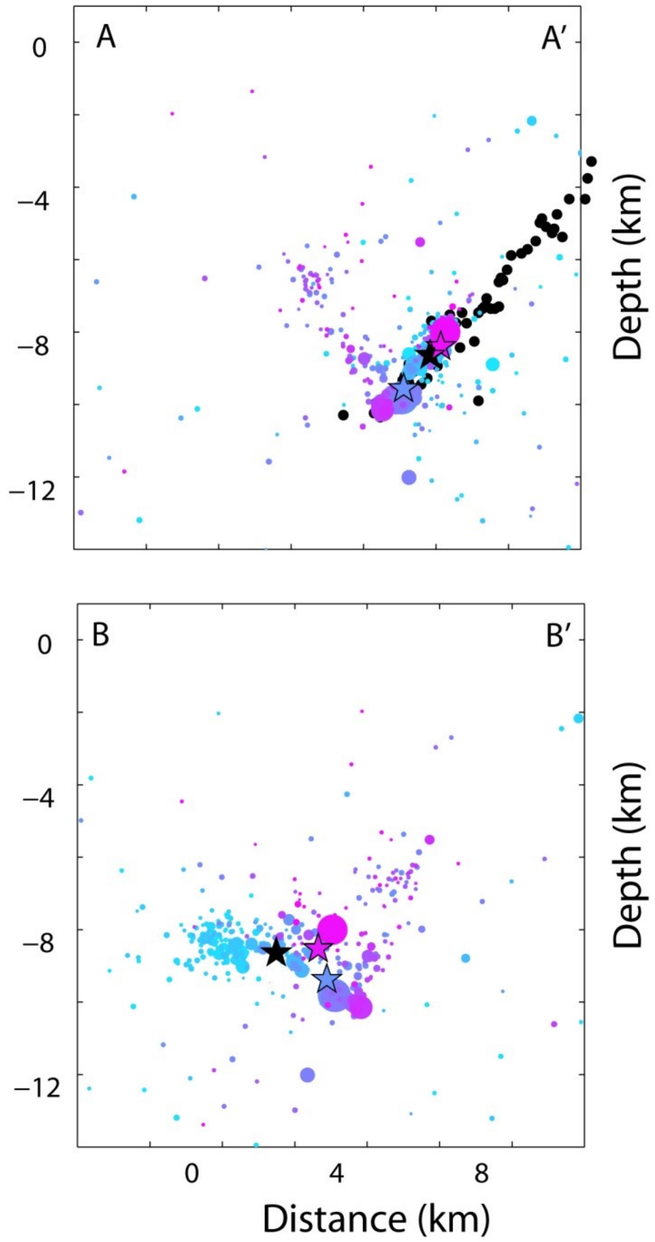

(Chiaraluce et al., 2011)

Cases Earthquake

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Before the Earthquake:

- The rate of earthquake production increased on March 30th 2009 after a M_L 4.1 earthquake that struck the L'Aquila area
- Preoccupation and panic in population raised
- After a prediction broadcasted by Giuliani, vans mounted with loudspeakers blare warnings to Sulmona residents to flee. Many people do. No earthquake occurs in the prediction window.
- On March 31st the Italian Civil Protection organize in L'Aquila a meeting of the Commissione Grandi Rischi (Major Risks Committee), an expert group that advises the Civil Protection agency on the risks of natural disasters
- Immediately after that meeting, De Bernardinis and Barberi, acting president of the committee, held a press conference in L'Aquila, where De Bernardinis told reporters that "**the scientific community tells us there is no danger, because there is an ongoing discharge of energy. The situation looks favorable**".

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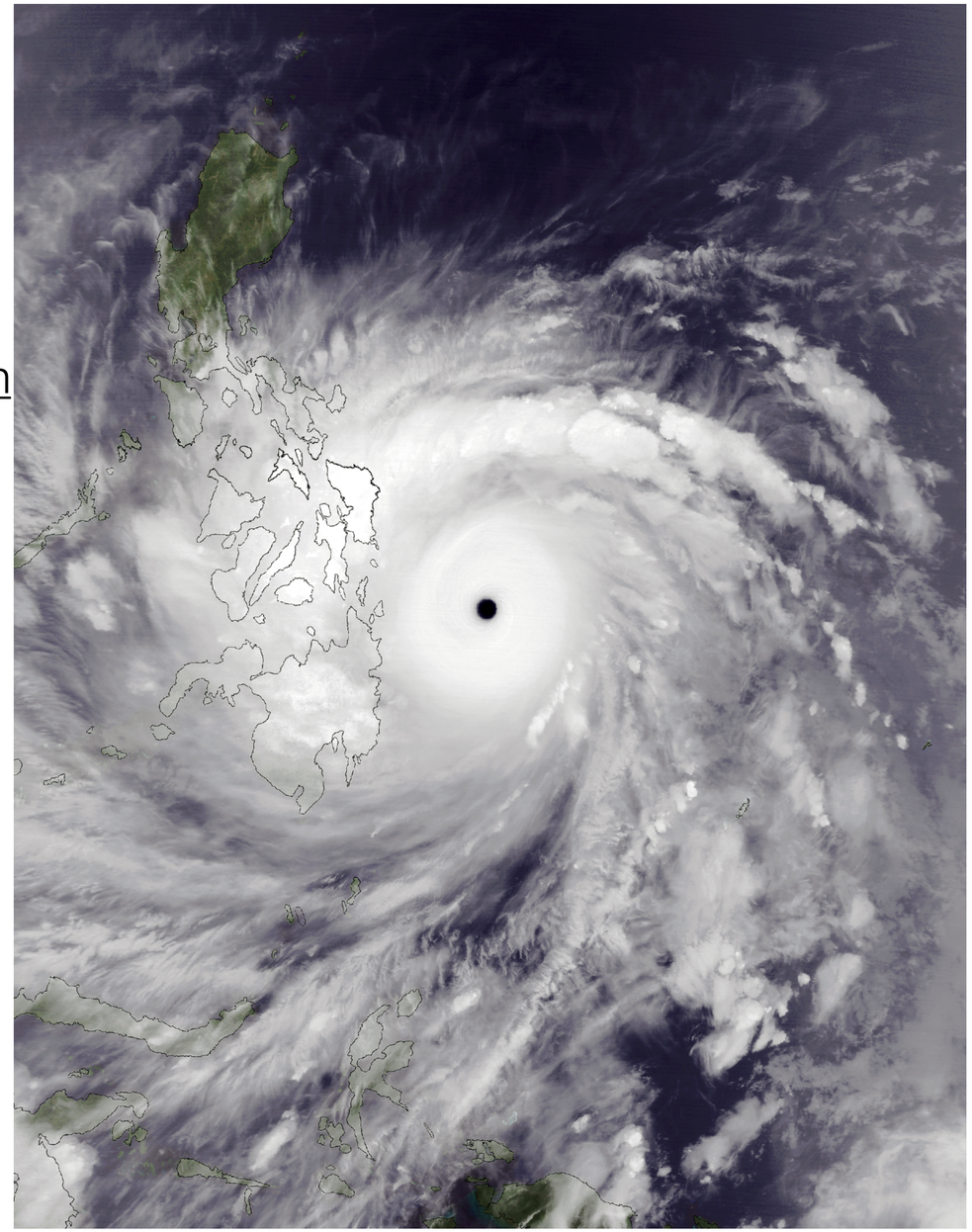
In a subsequent inquiry of the handling of the disaster, seven members of the Italian National Commission for the Forecast and Prevention of Major Risks were accused of giving "inexact, incomplete and contradictory" information about the danger of the tremors prior to the main quake. On 22 October 2012, six scientists and one ex-government official were convicted of multiple manslaughter for downplaying the likelihood of a major earthquake six days before it took place. They were each sentenced to six years' imprisonment. On 10 November 2014, the scientists convicted of manslaughter for failing to predict the deadly earthquake have had the verdict overturned.

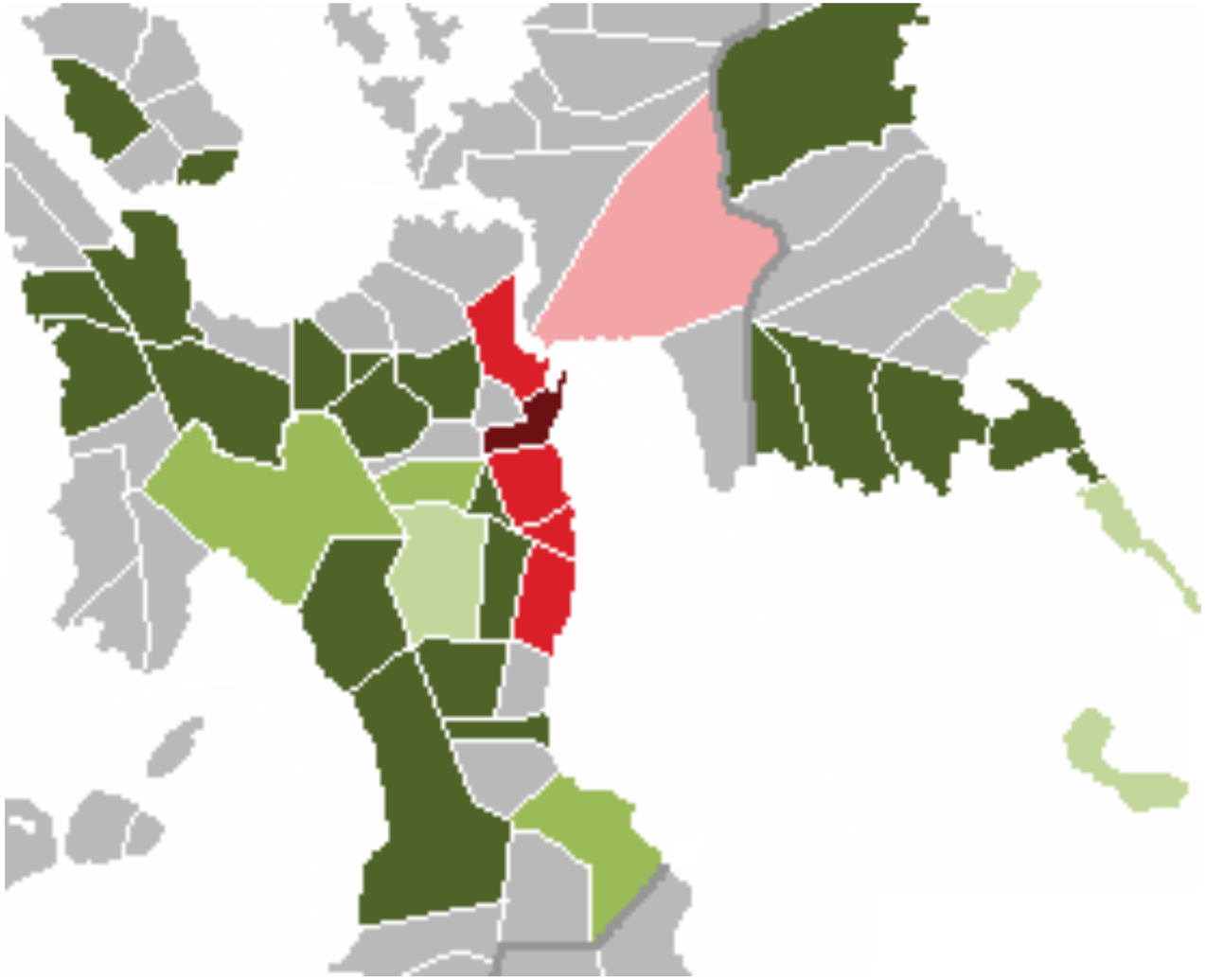
Cases

Typhoon Haiyan was an extremely deadly and intense typhoon, known as Super Typhoon Yolanda in the Philippines. On making landfall, Haiyan devastated portions of Southeast Asia, particularly the Philippines. It is the deadliest Philippine typhoon on record, killing at least 6,300 people in that country alone. In terms of JTWC-estimated 1-minute sustained winds, Haiyan is tied with Meranti for being the strongest landfalling tropical cyclone on record. In January 2014, bodies were still being found.

https://en.wikipedia.org/wiki/Typhoon_Haiyan

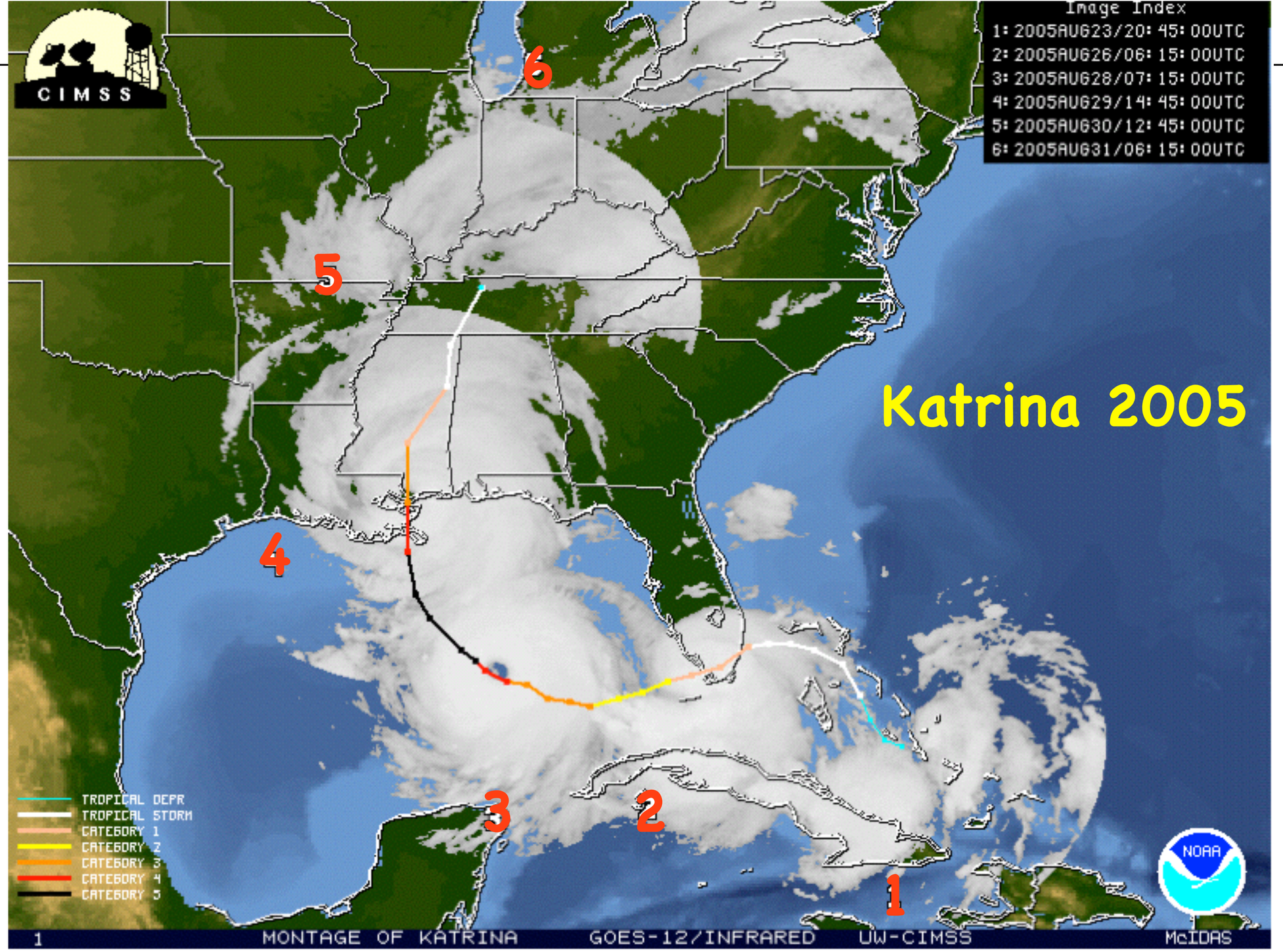


Cases



Color coded map of Eastern Visayas showing the number of deaths caused by Typhoon Haiyan. More than 1,000 500-999 100-499 50-99 25-49 1-24 0

Cases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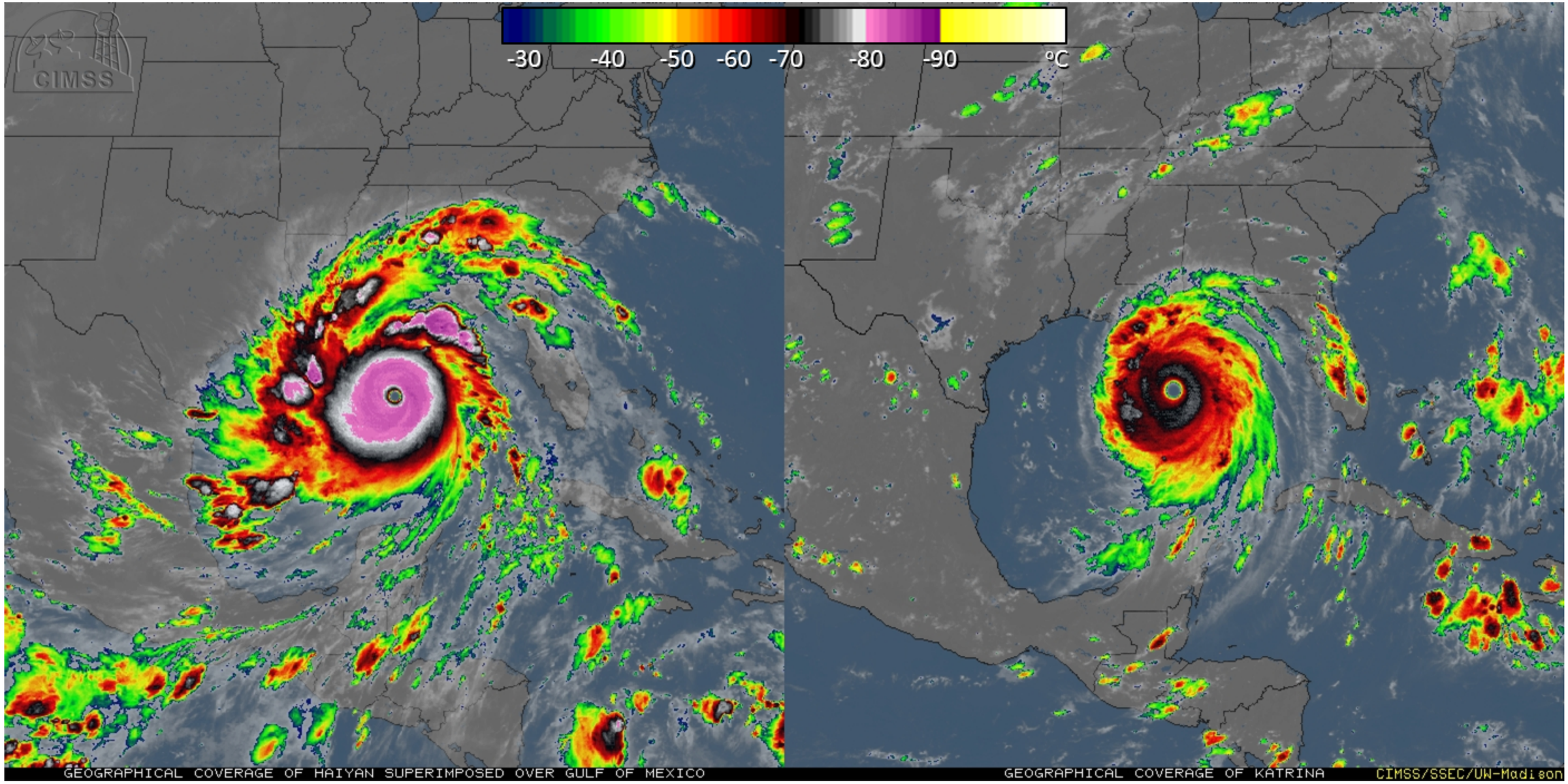
Comparison of Katrina and Haiyan



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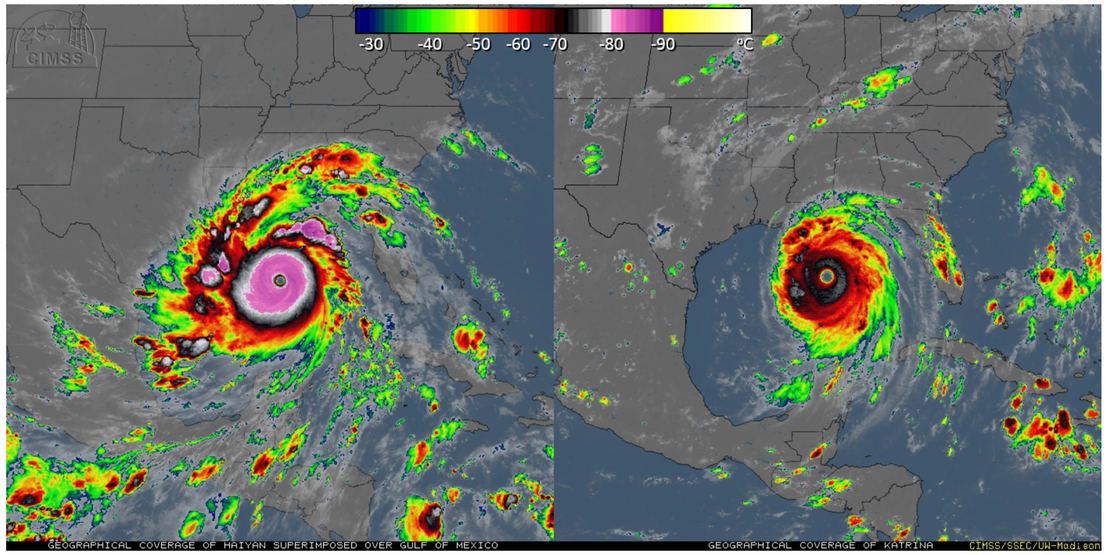
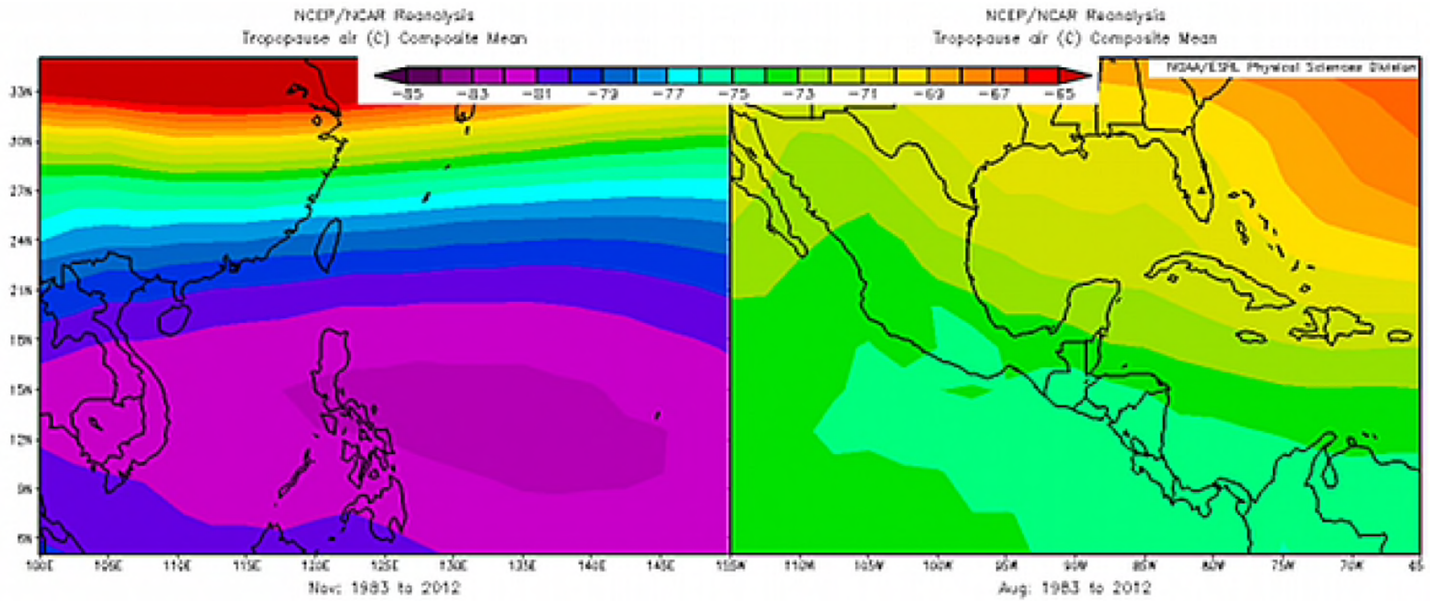




Haiyan (left) was more intense than Katrina (right) at its peak. The ring of clouds over the eyewall is much colder and thicker in Haiyan. While both storms were over very warm water – around 30°C, the tropopause is higher and colder in the western tropical Pacific than it is in the tropical Atlantic, giving storms a decided intensity advantage. The average November tropopause temperature in the West Pacific (corresponding to Haiyan) is about 12°C colder than the average August tropopause temperature in the Gulf of Mexico (corresponding to Katrina).

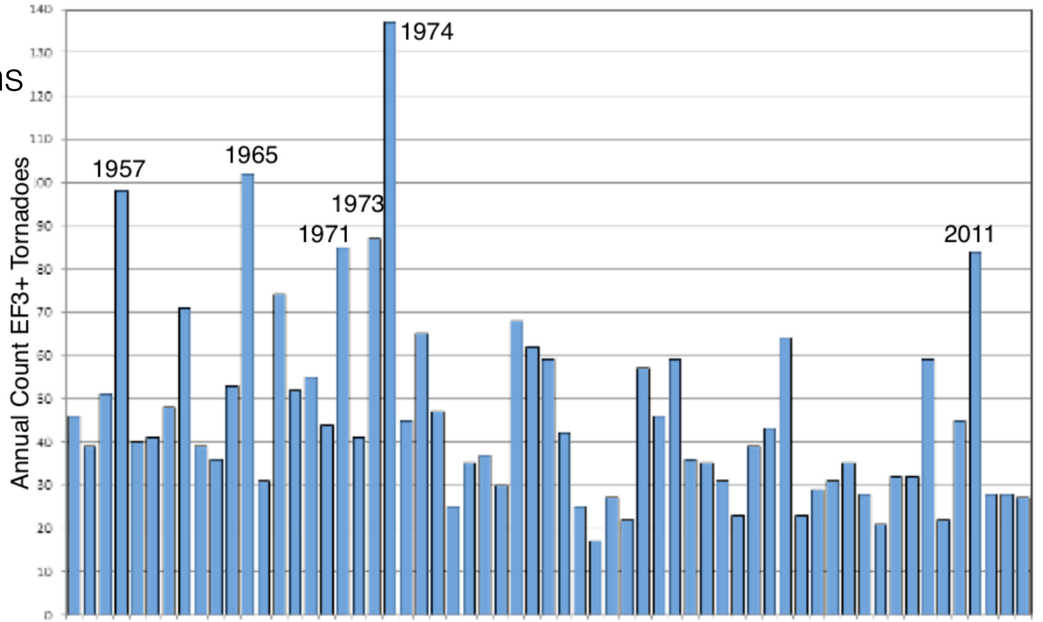
Tornadoes: Cases

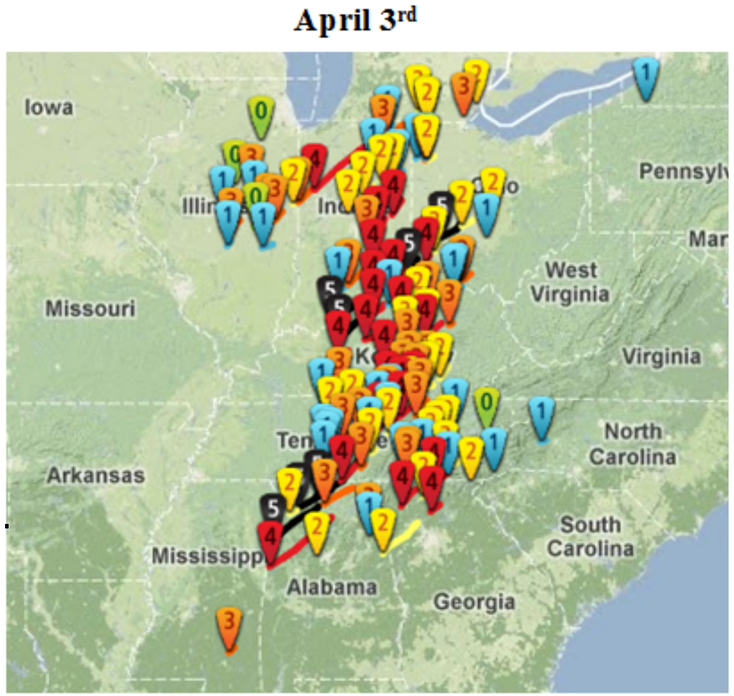
The 1974 Super Outbreak

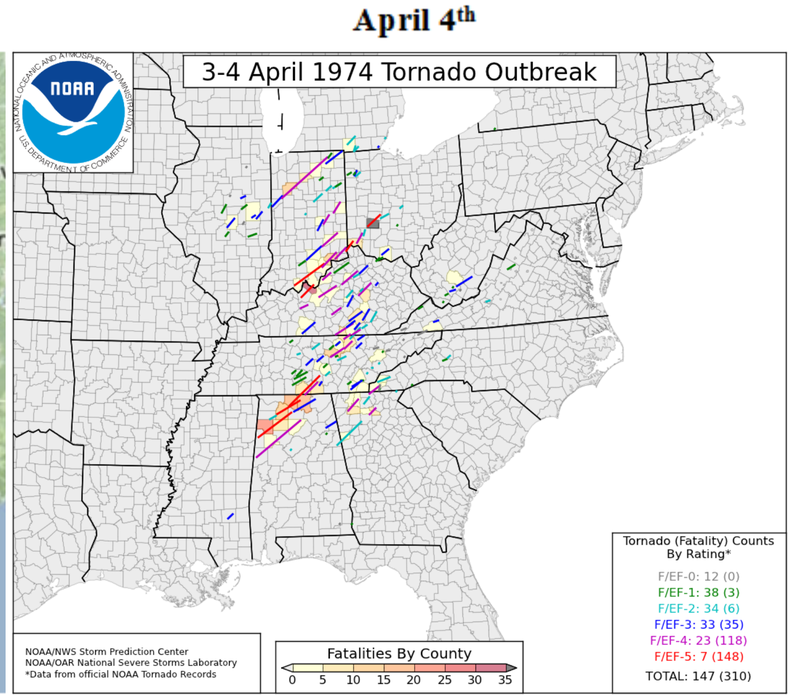
A Super Outbreak is one in which there is an exceptional number of tornadoes in one day.

Although the April 2011 Super Outbreak now holds the record for the most tornadoes generated in a 24-hour period, a Super Outbreak in 1974 still holds the record for the total number of EF3 and higher-rated tornadoes, and April 3, 1974 holds the record for the number of severe EF4 and EF5 tornadoes in one 18-hour period. Of the 148 tornadoes that occurred across 13 states on April 3 and 4, 1974, on a path covering 4,000 km from Alabama to the Great Lakes region, 23 were EF4 and 7 were EF5 tornadoes. By the time the storm system had dissipated, almost 5,500 people had been injured and 330 killed, with northern Alabama suffering the worst number of fatalities. An excellent summary of the 1974 Super Outbreak is available at https://en.wikipedia.org/wiki/1974_Super_Outbreak.

Annual count of EF3 and higher tornado touchdowns in the U.S.A. from 1954 to 2014.







Tornado touchdowns in the eastern U.S.A. on April 3, 1974. Left: Number/color indicates EF rating. Right: Tornado tracks for April 3 and 4, 1974: blue = EF3; magenta = EF4; red = EF5.

The Diagnosis: Leaving the “Safe Operating Space”

Impacts on the Earth’s Life-Support System

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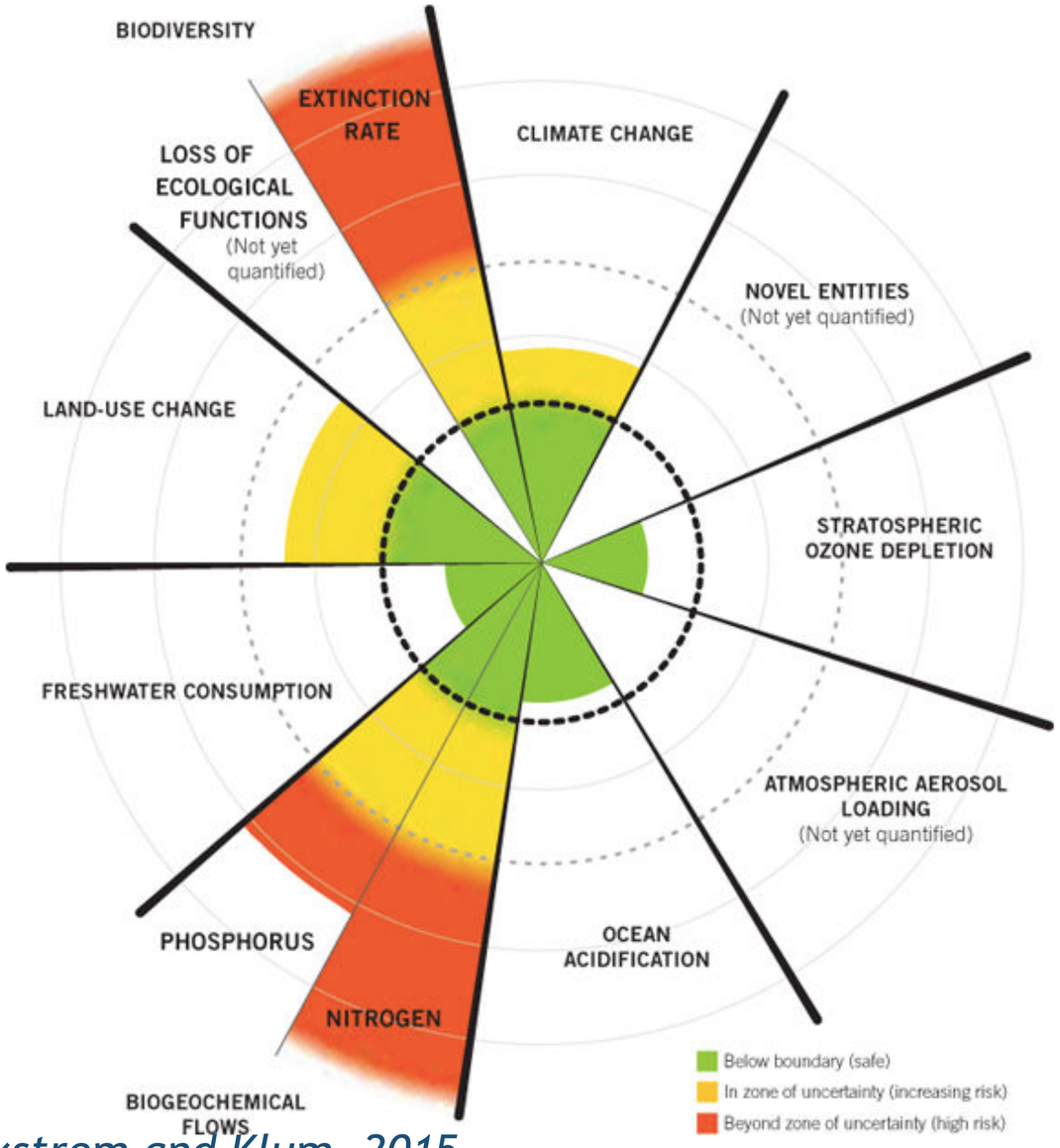

Rockstrom and Klum, 2015

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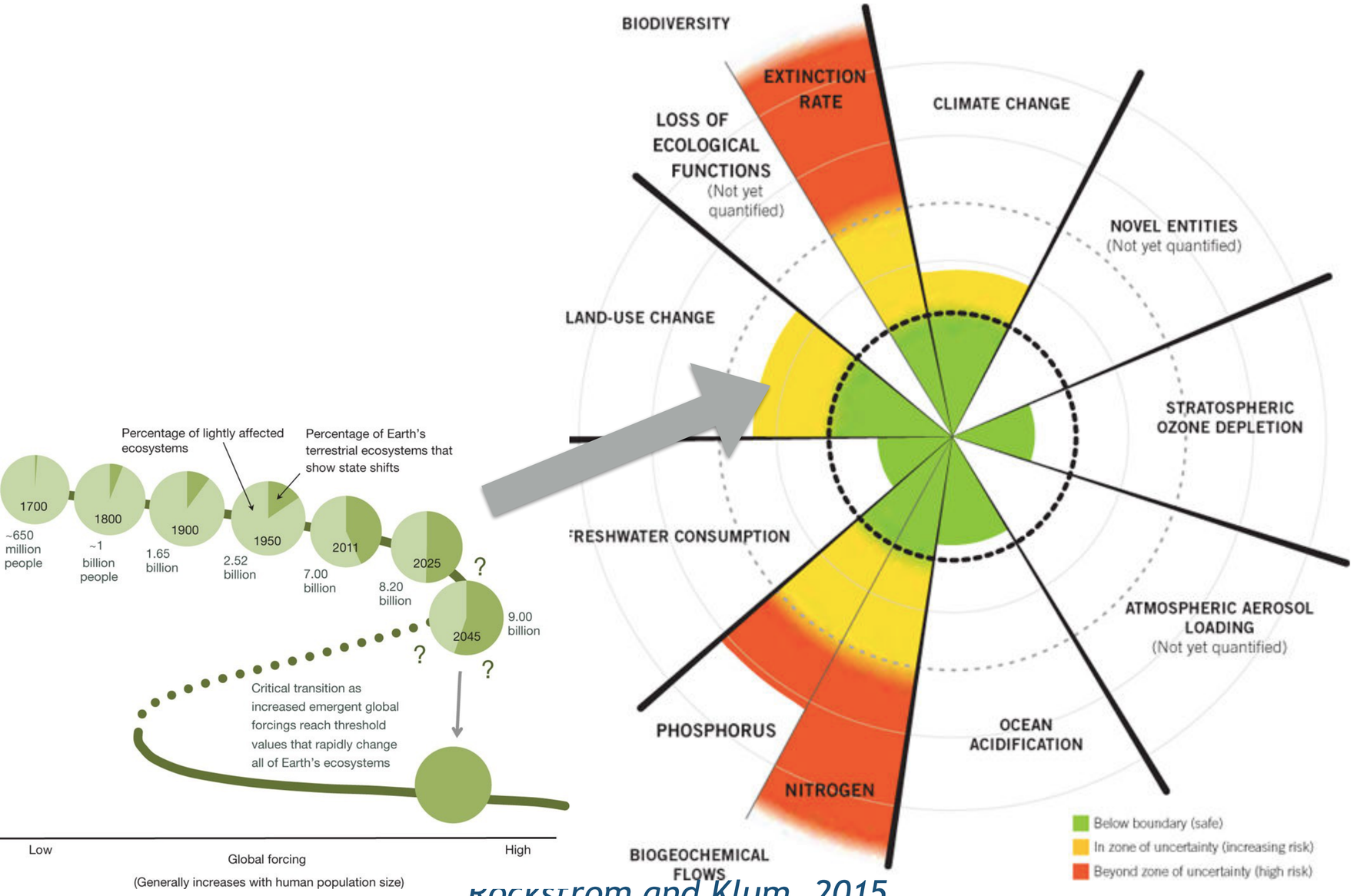

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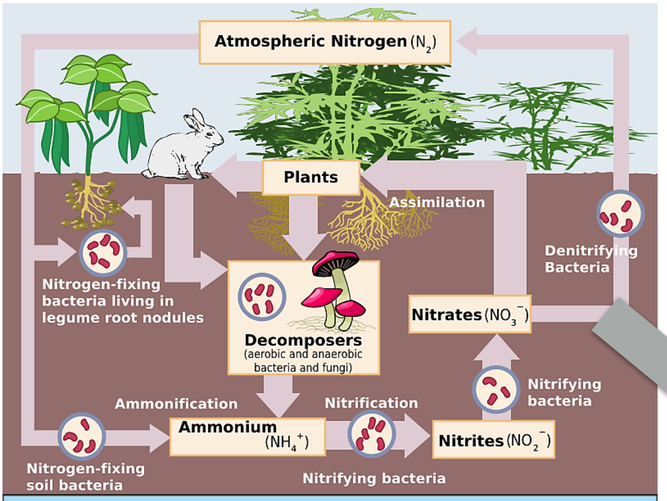

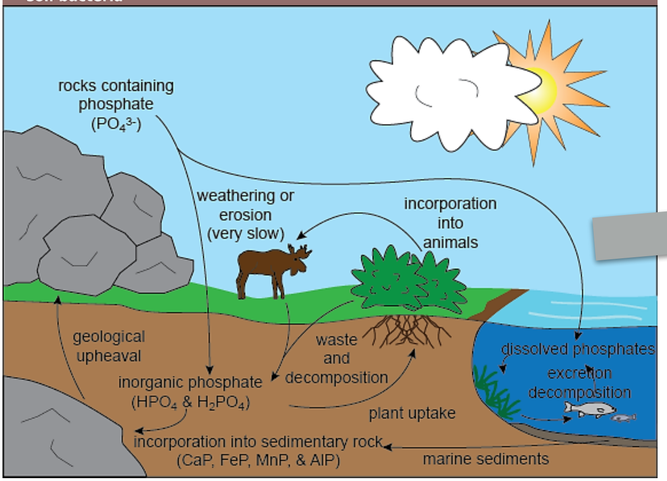

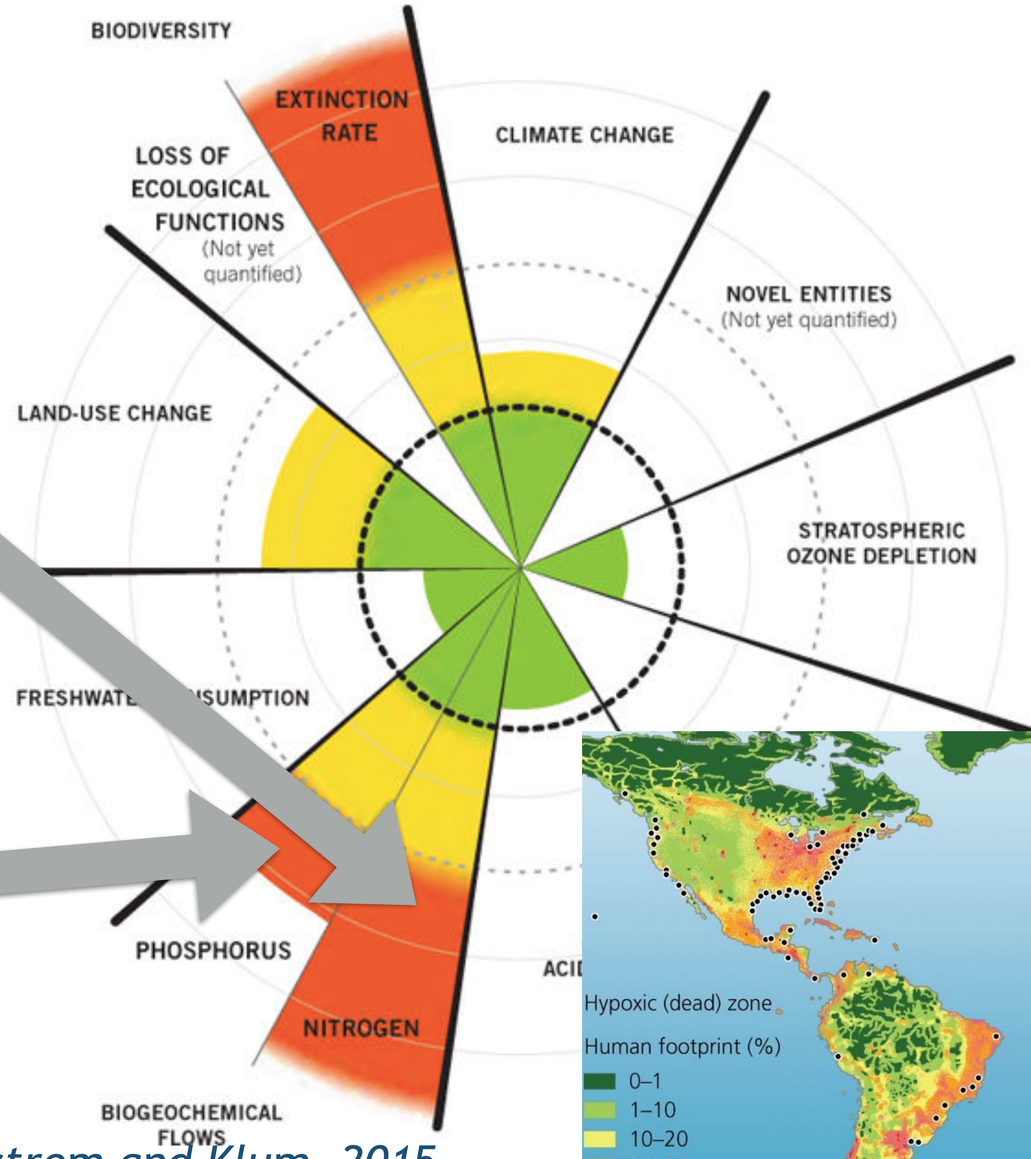

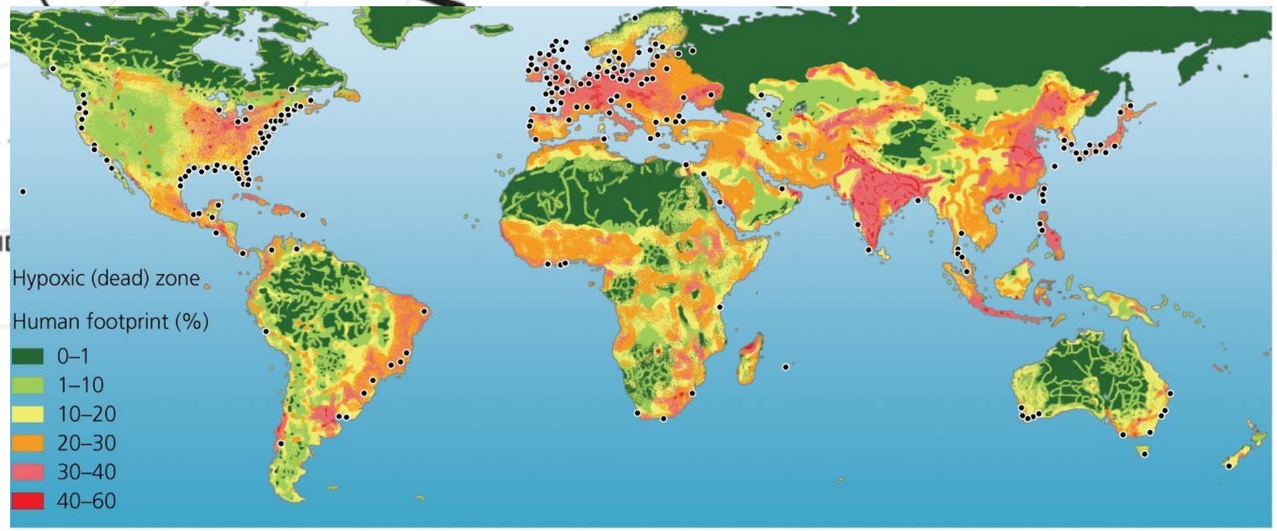

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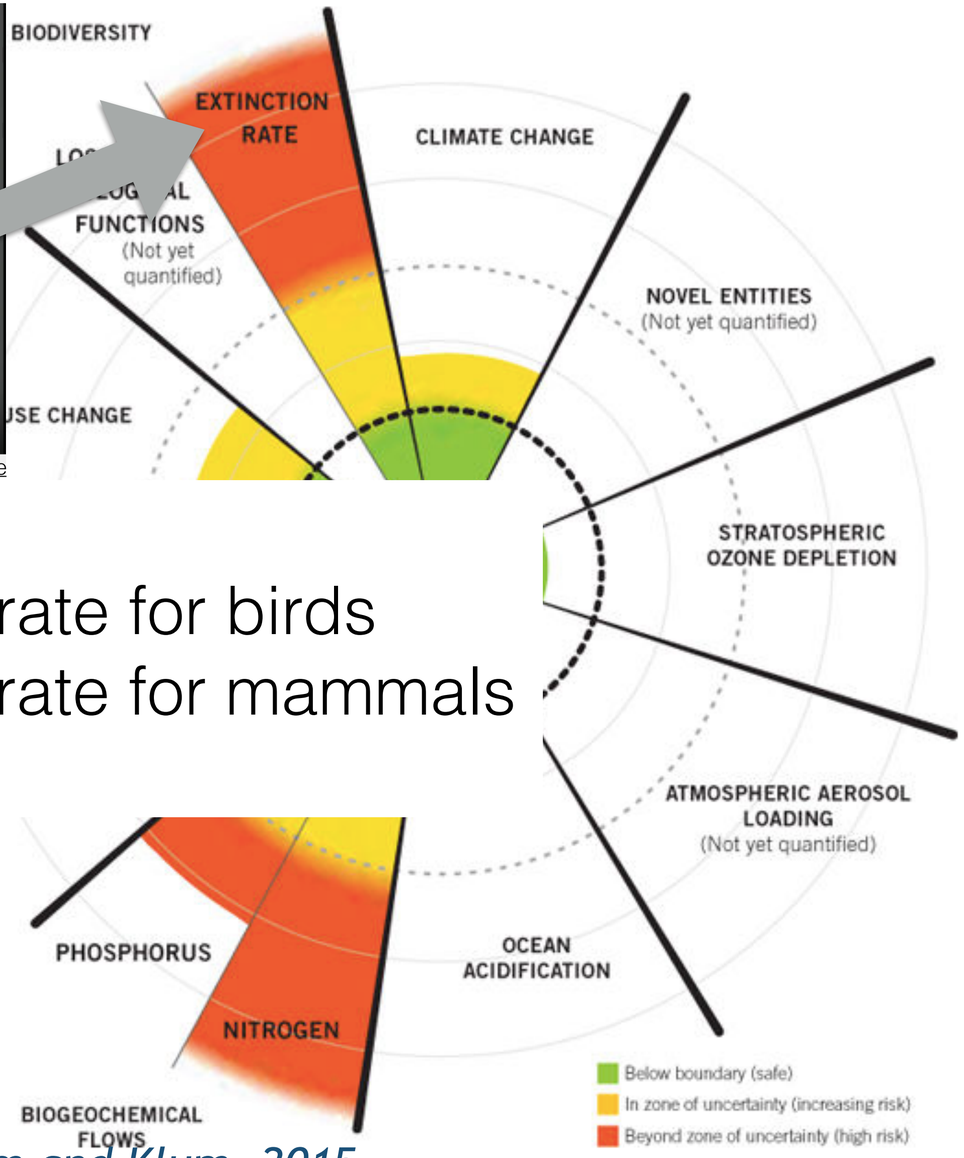
https://www.youtube.com/watch?v=gPq9YAg9mfc&feature=youtu.be

Current extinction rates:

300 times background rate for birds

80,000 times background rate for mammals



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“We are the asteroid …”

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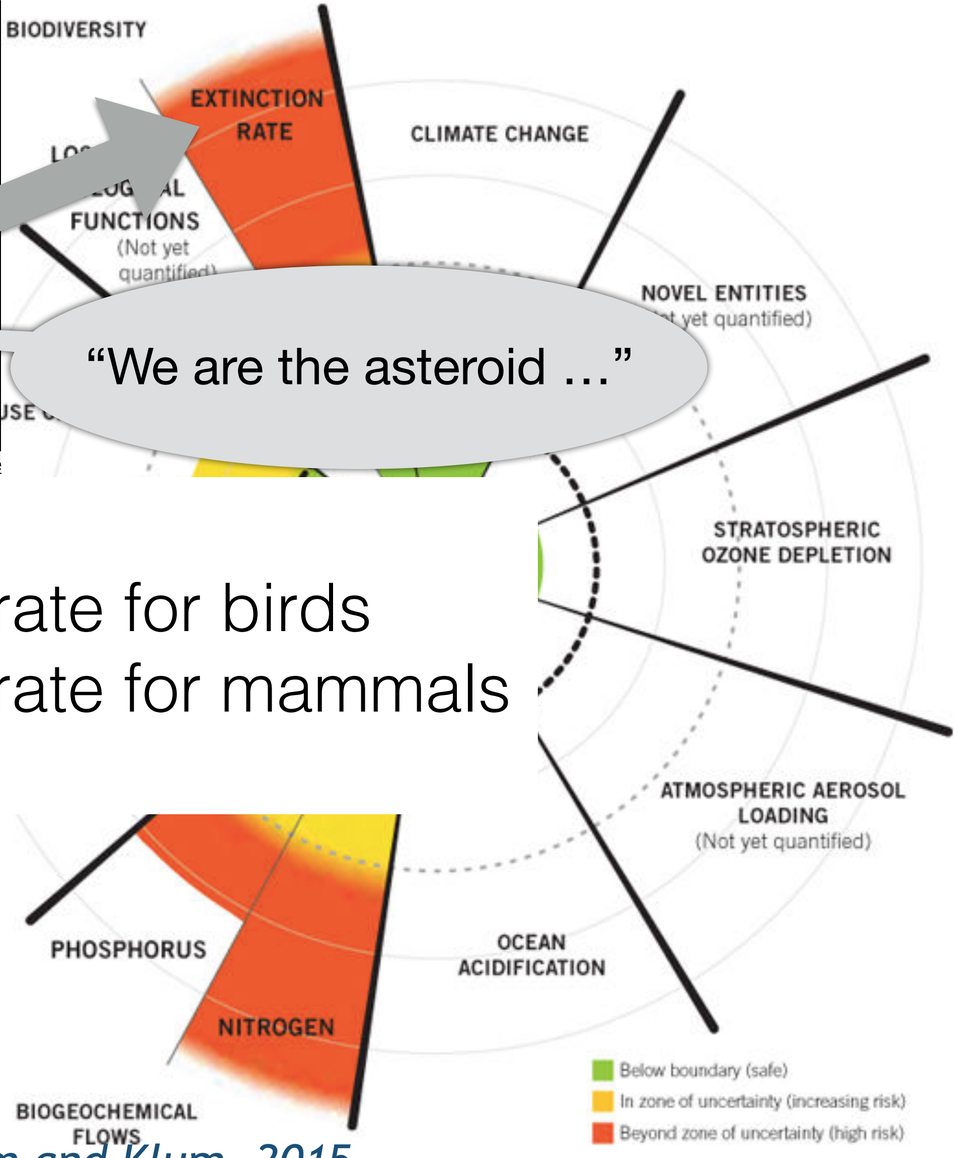

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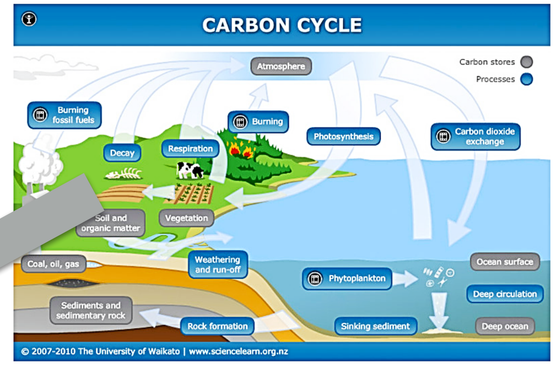
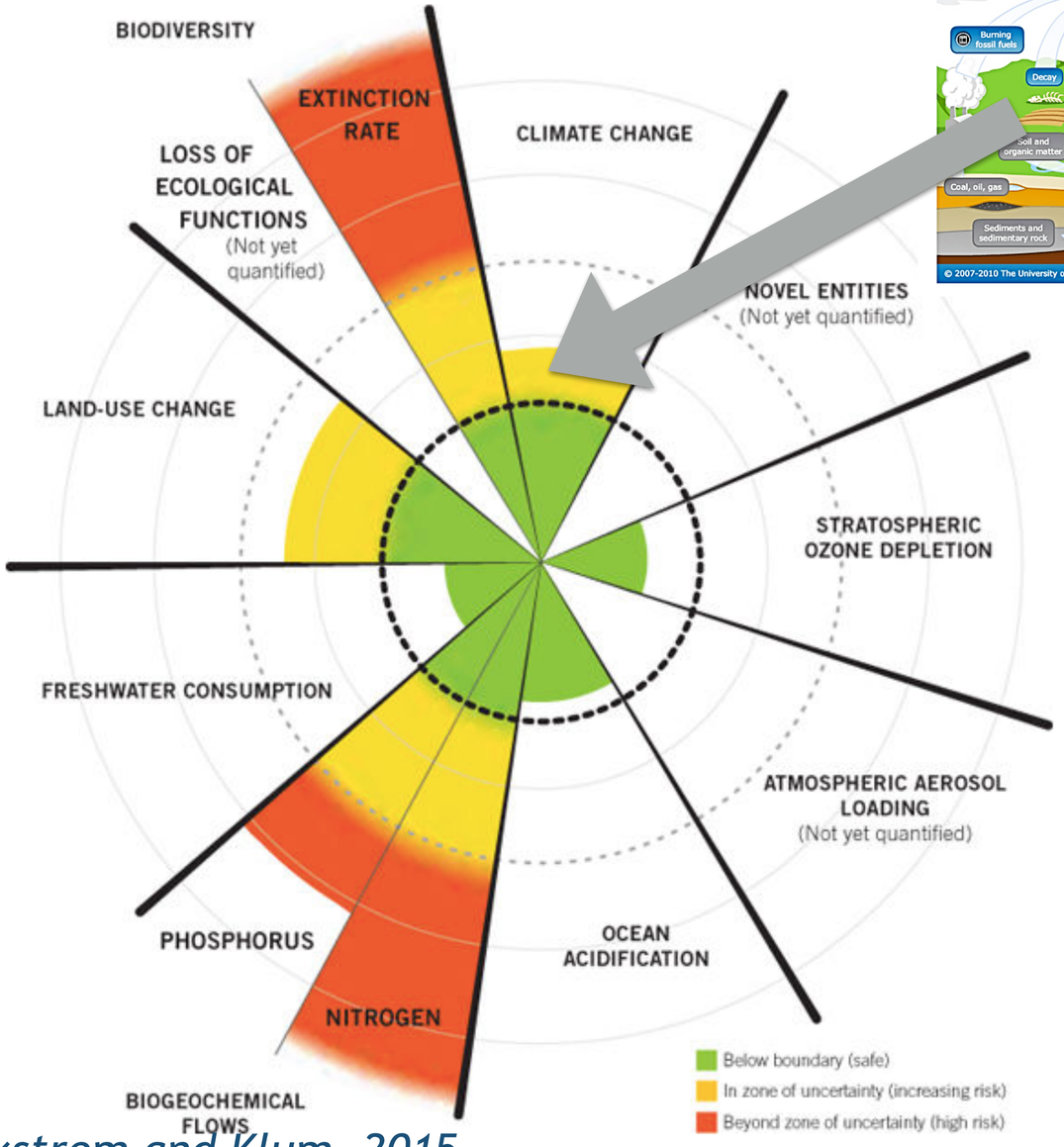
Impacts on the Earth’s Life-Support System





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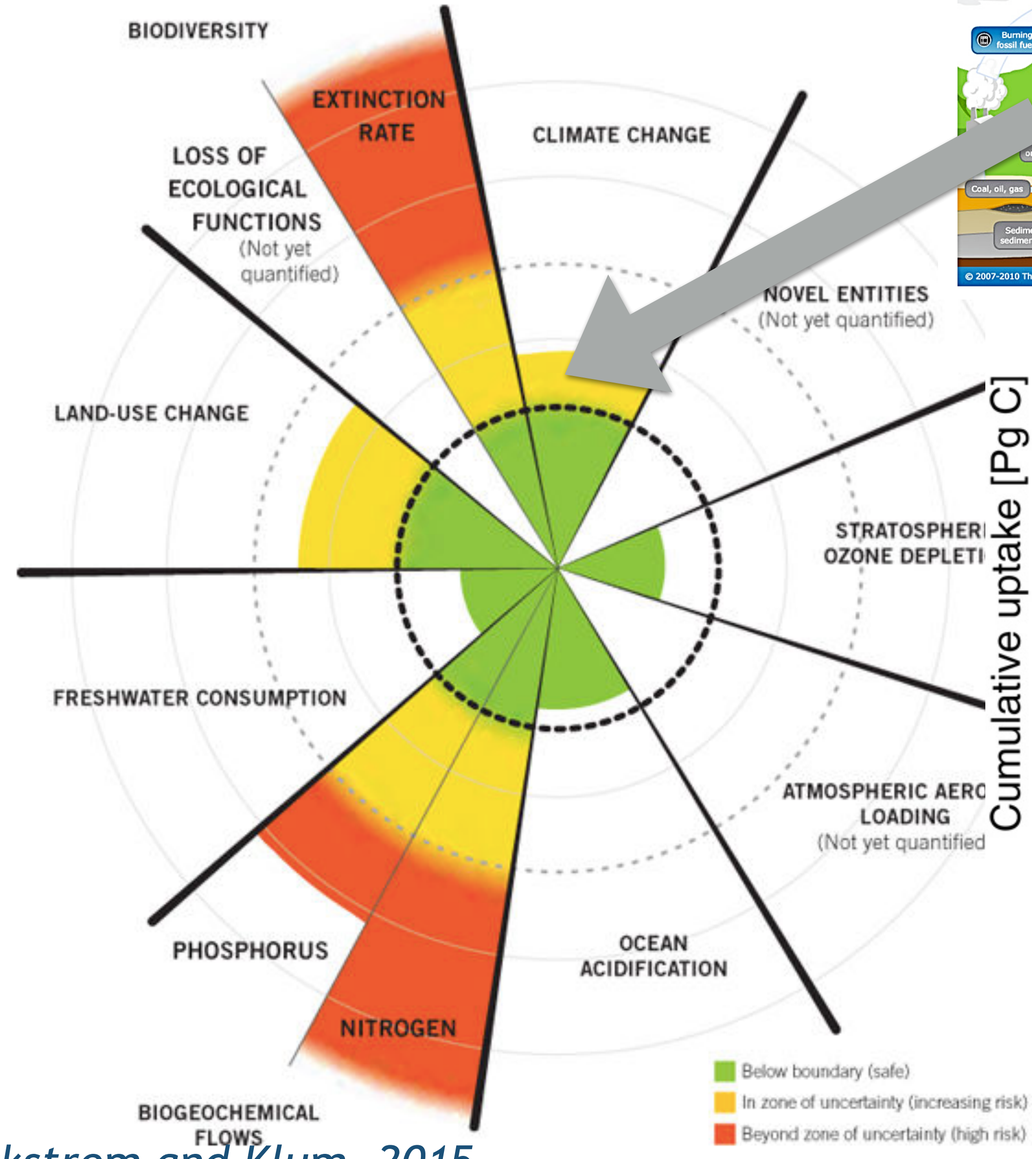

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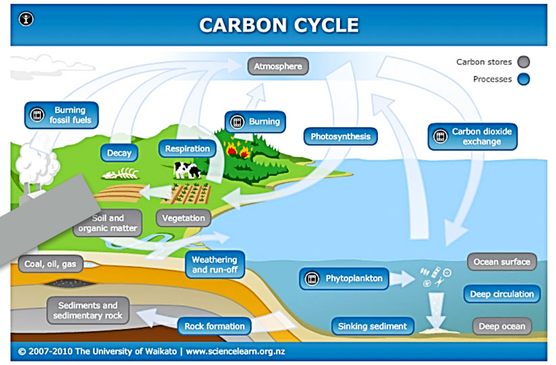

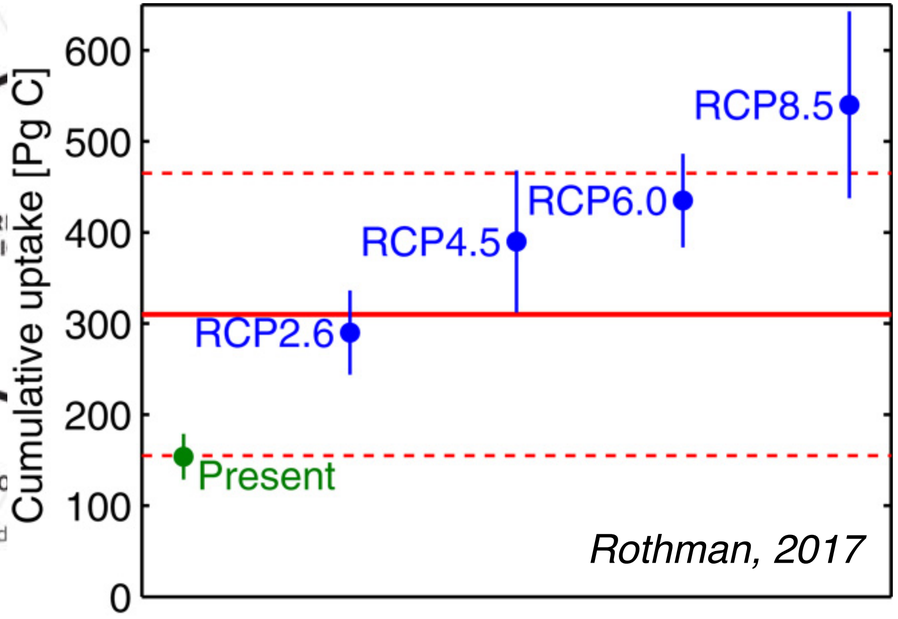

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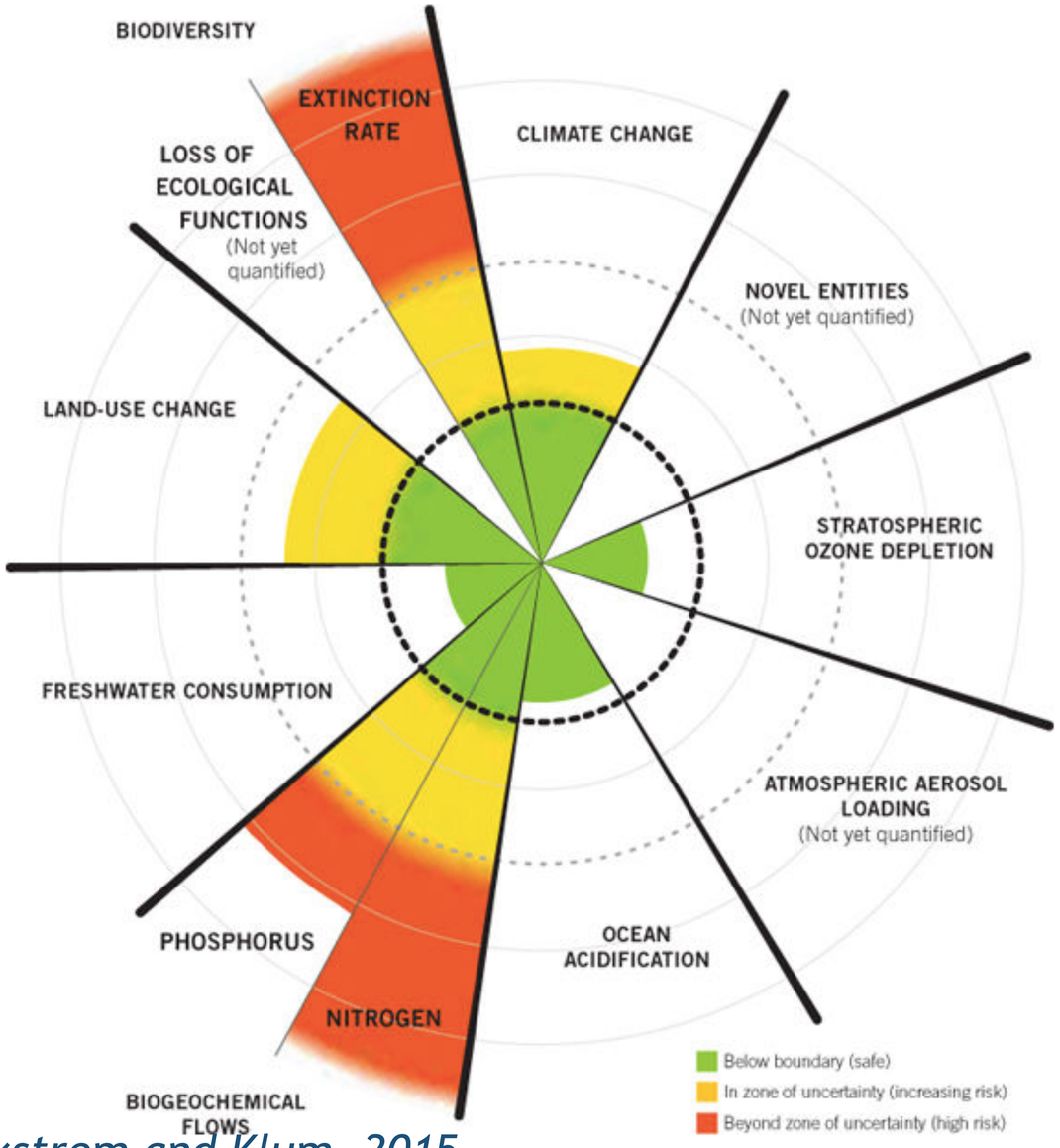
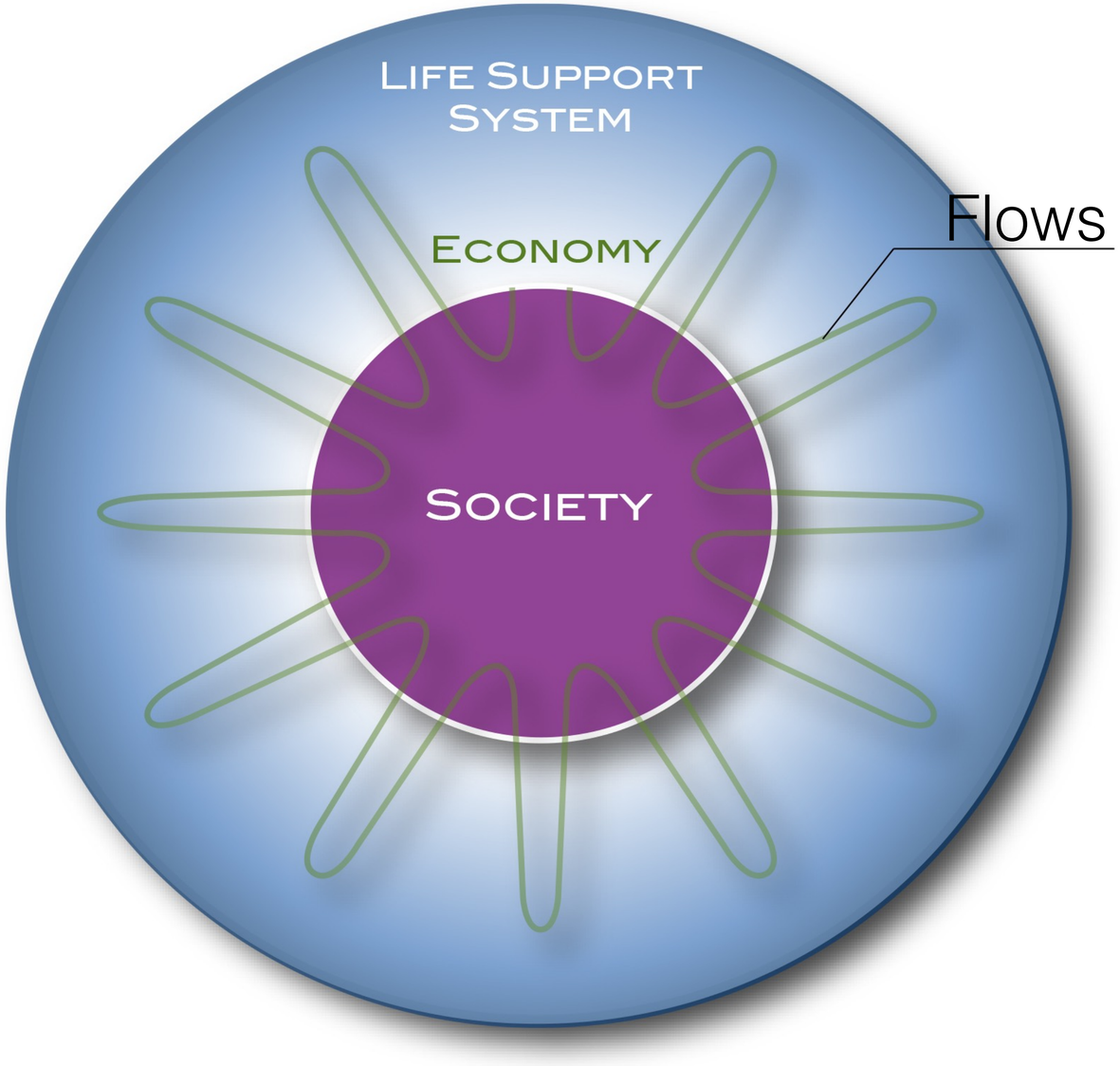


Rockstrom and Klum, 2015

Modern climate change is a symptom, not the cause, not the “sickness.”

Prognosis: Journey into the Unknown

Physiology of the Life-Support System: Flow



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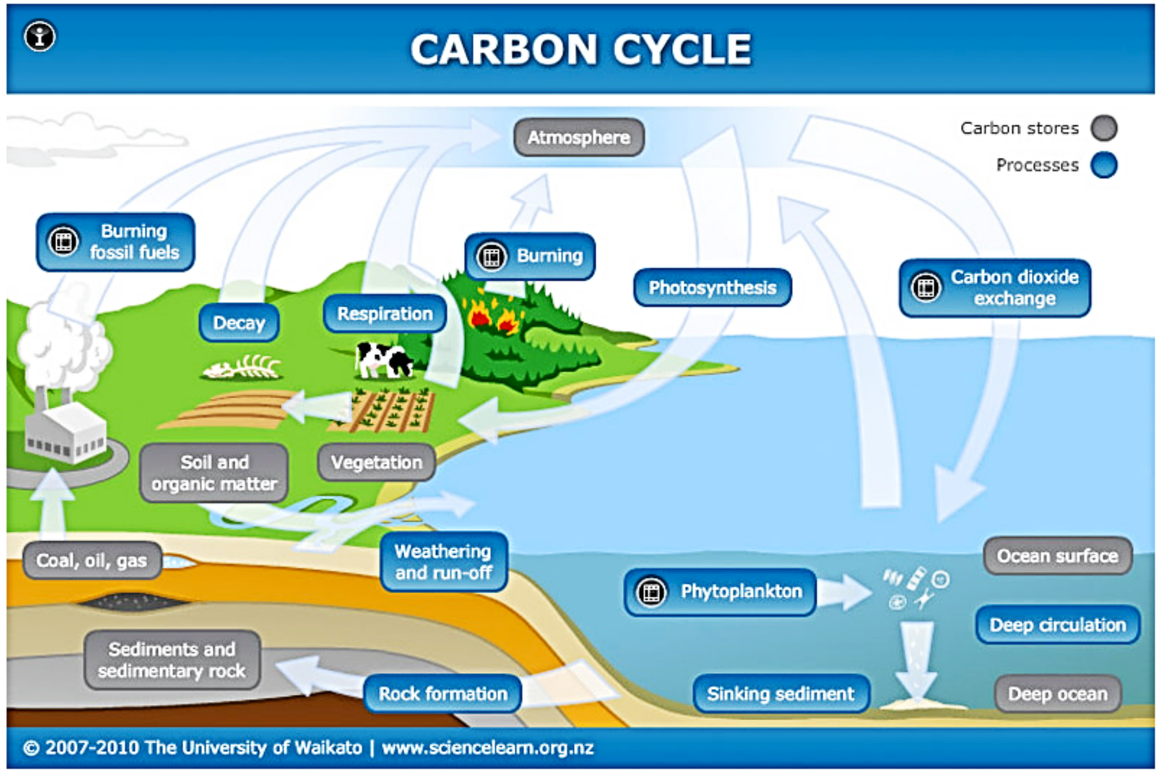

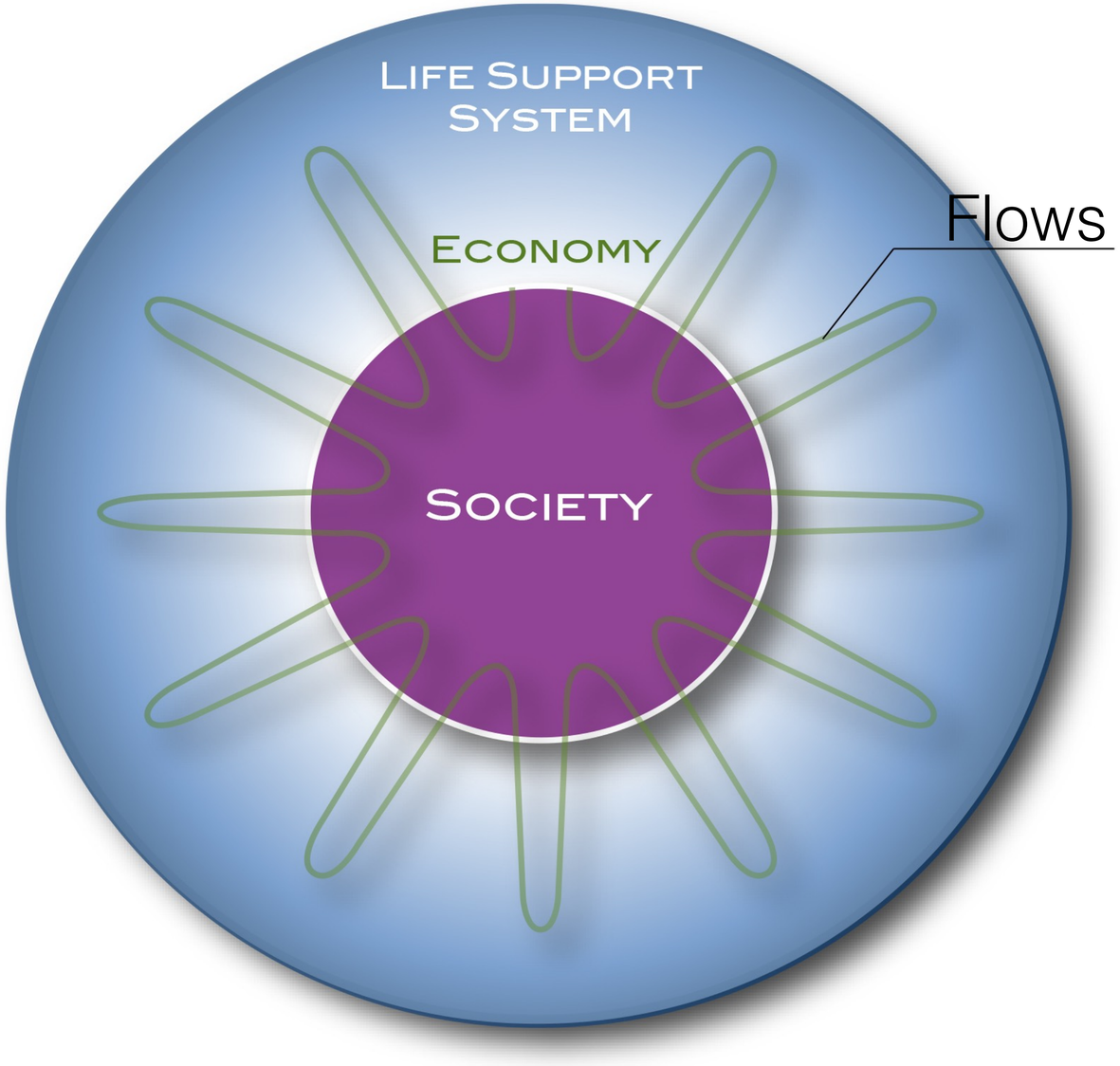

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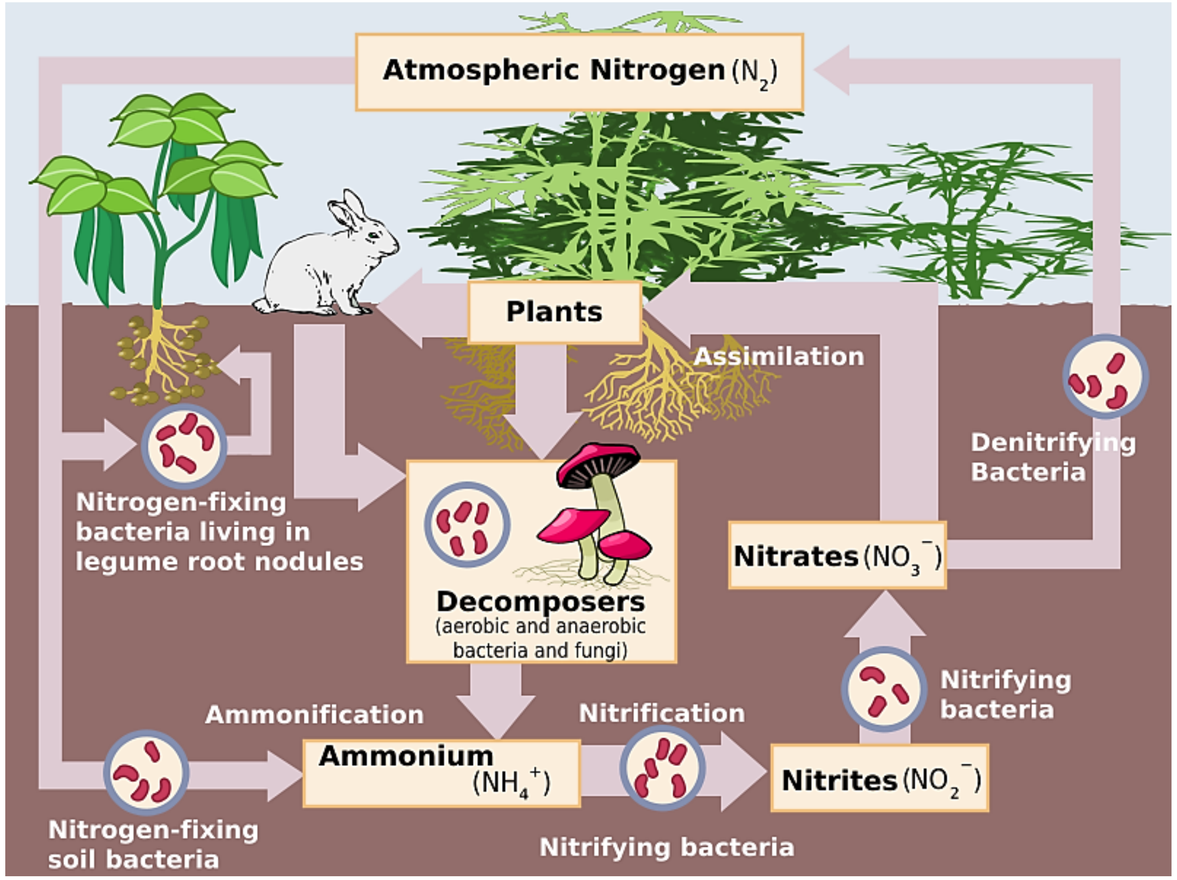

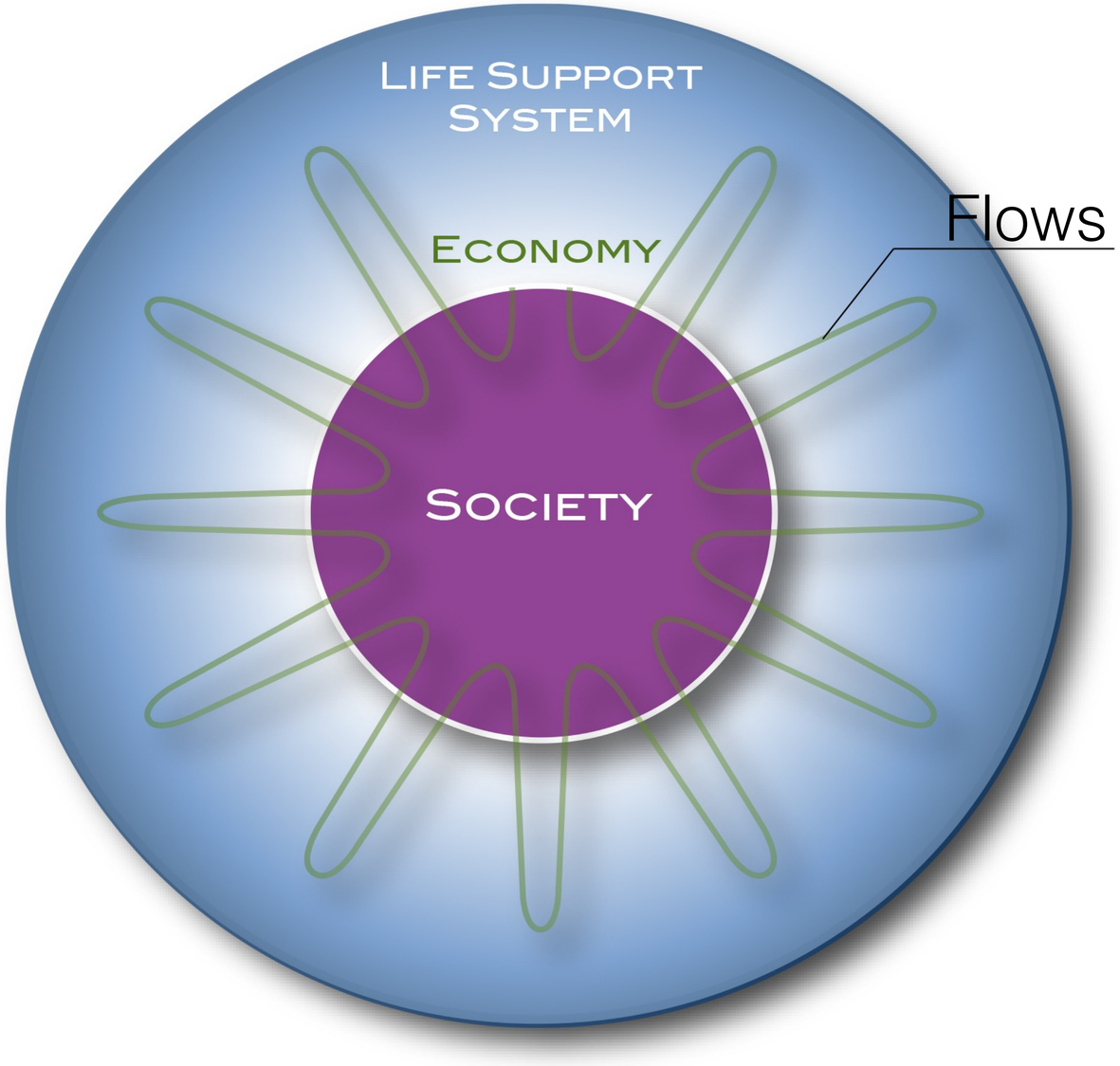

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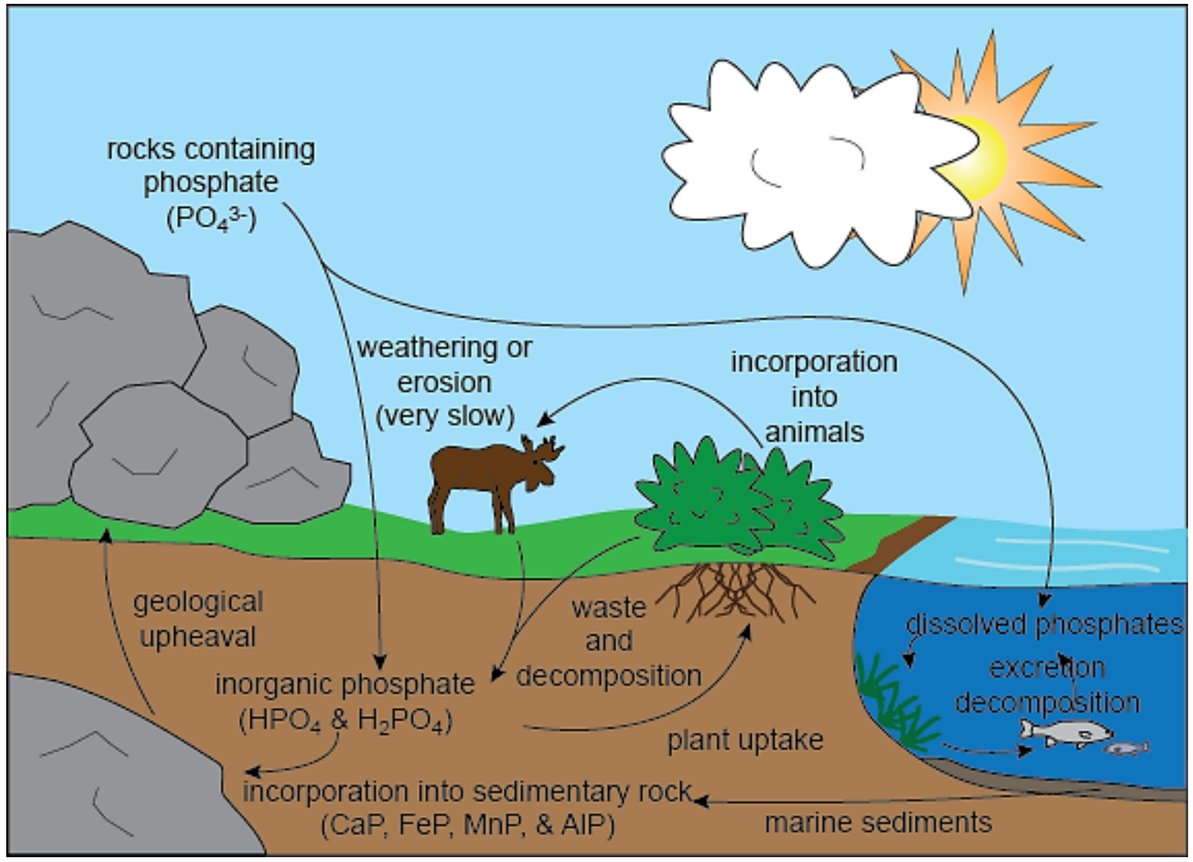

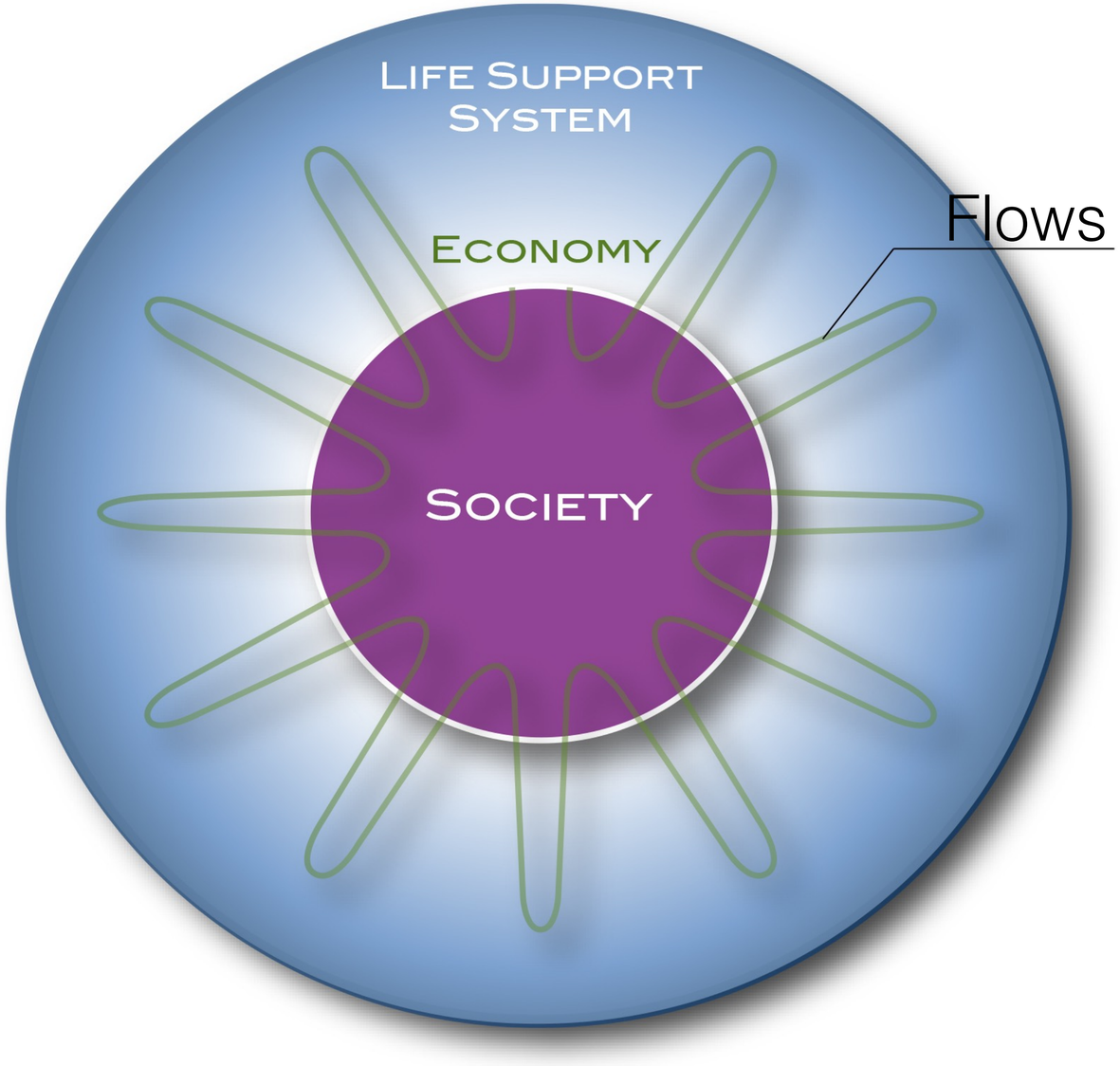

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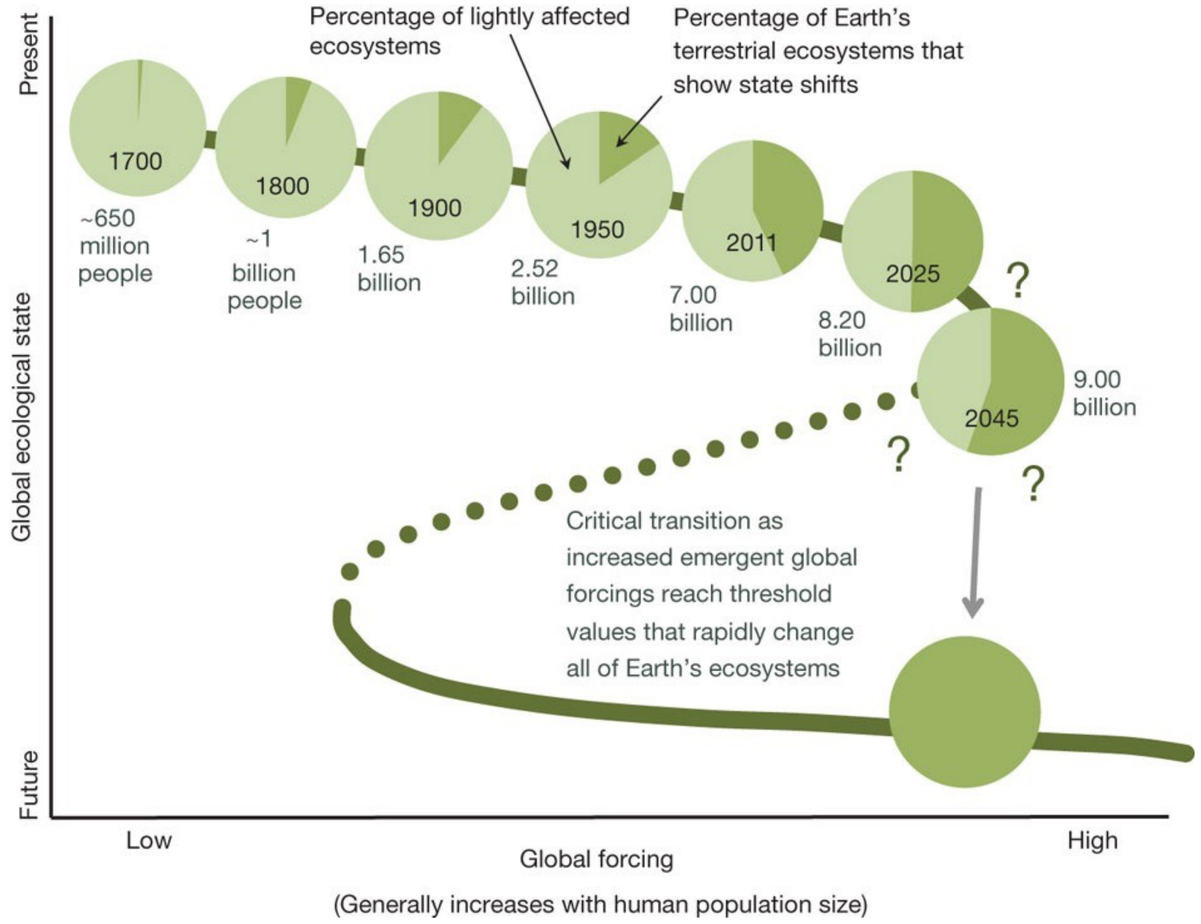
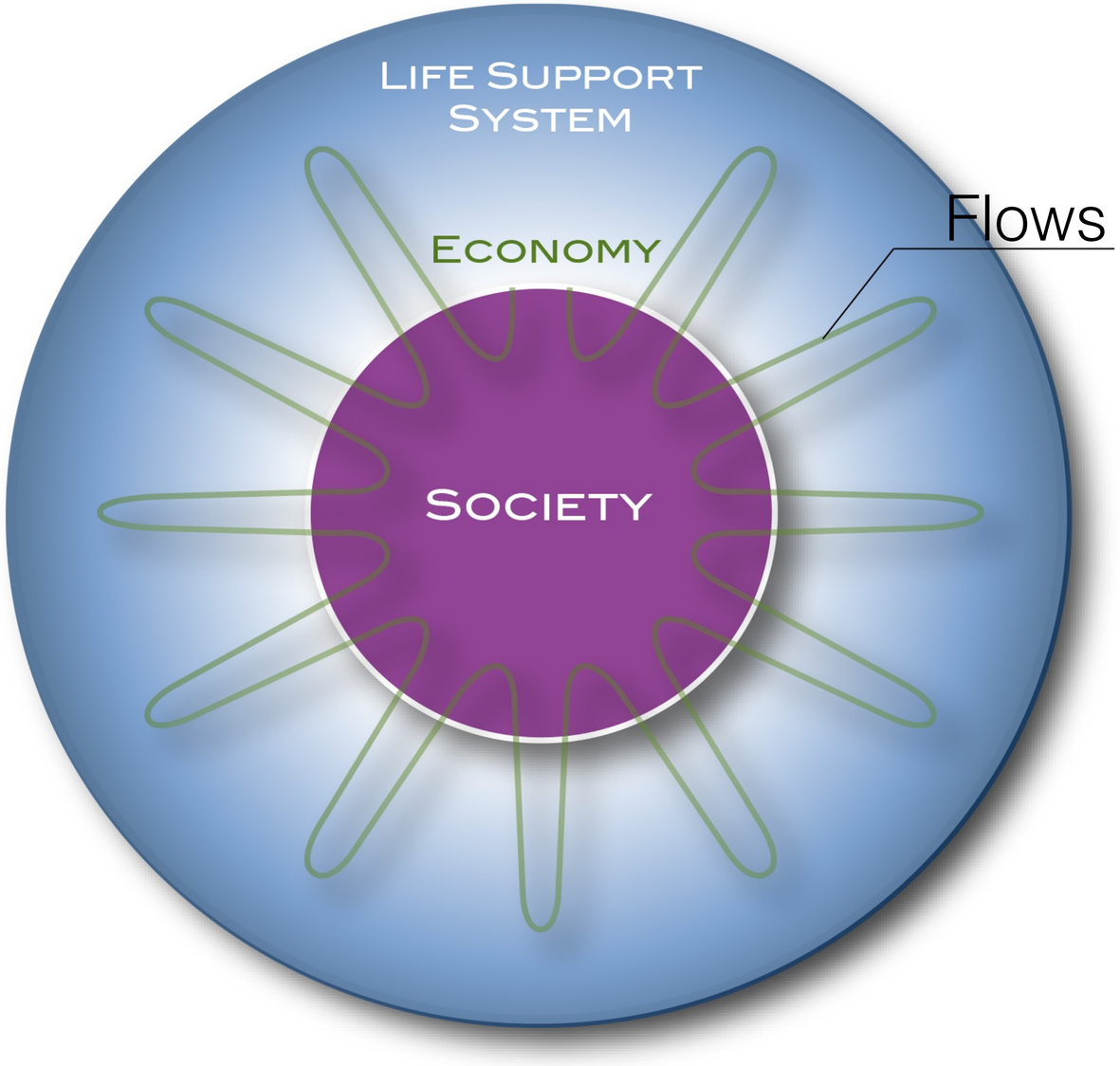
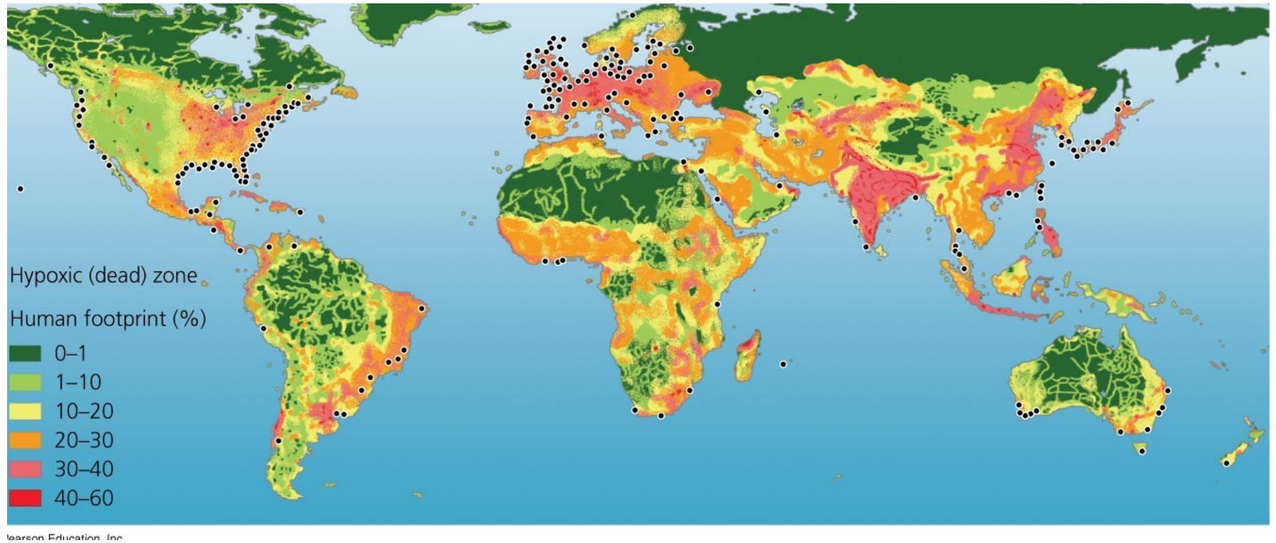


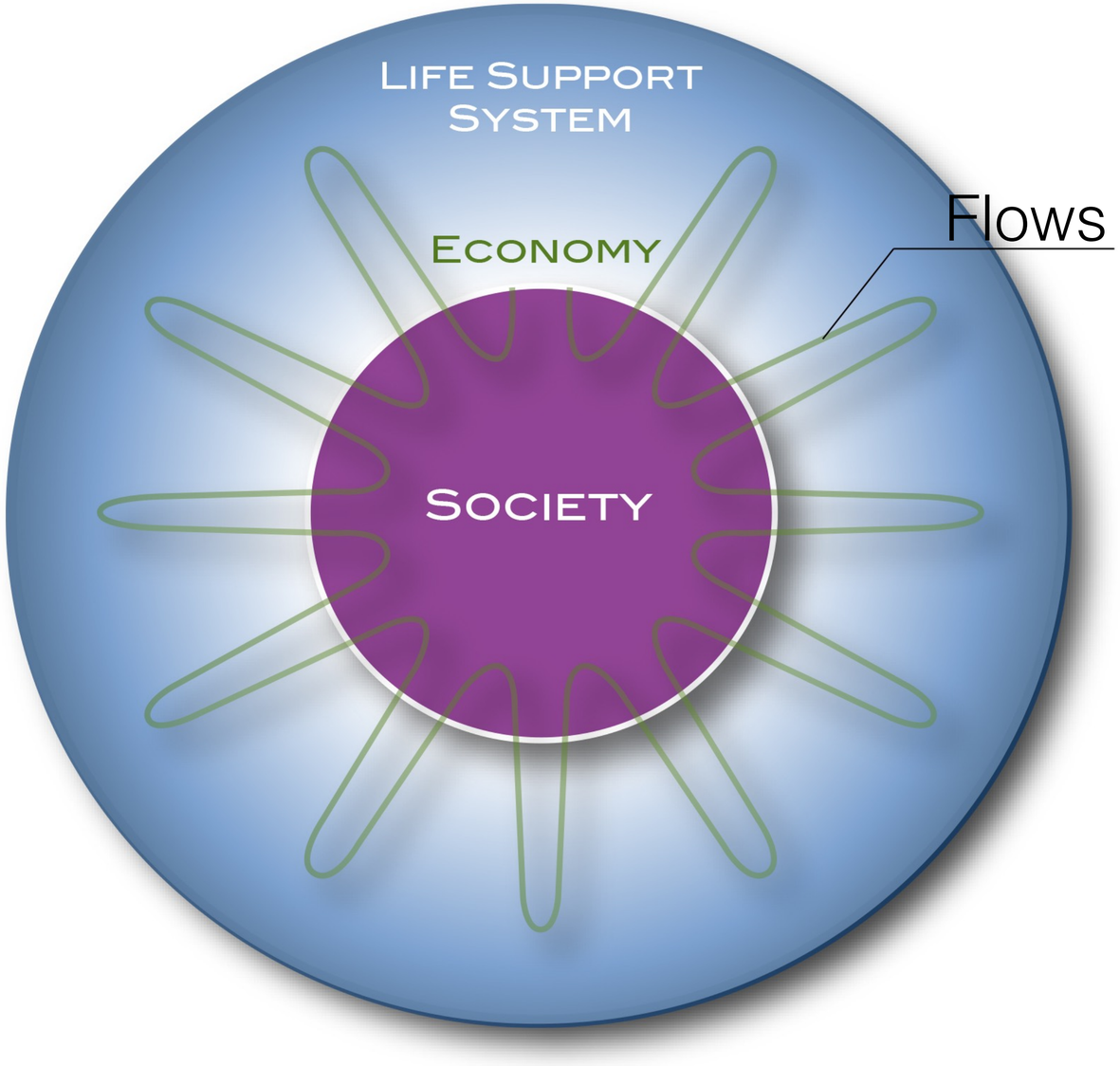


Prognosis: Journey into the Unknown

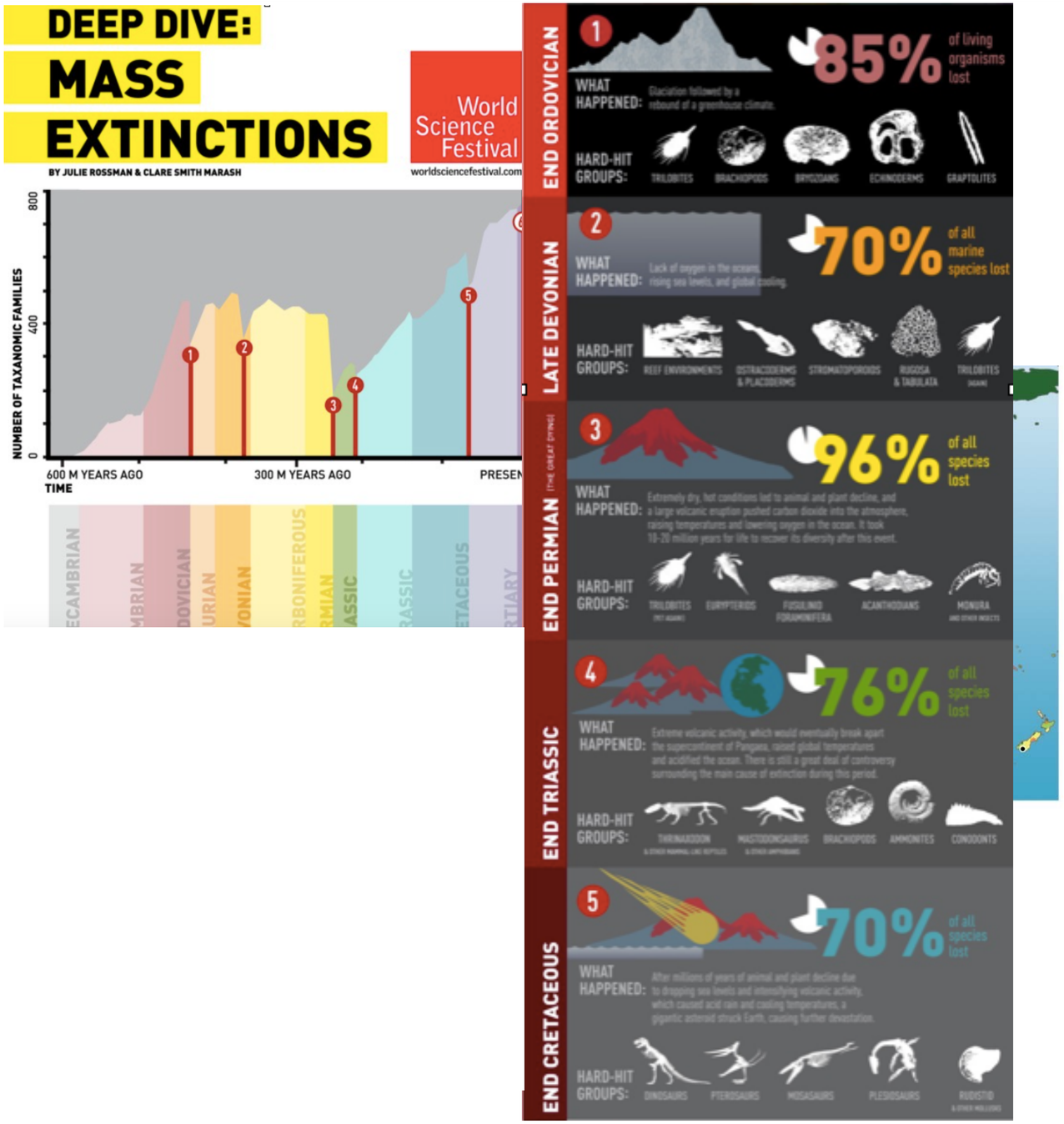
Physiology of the Life-Support System: Flow

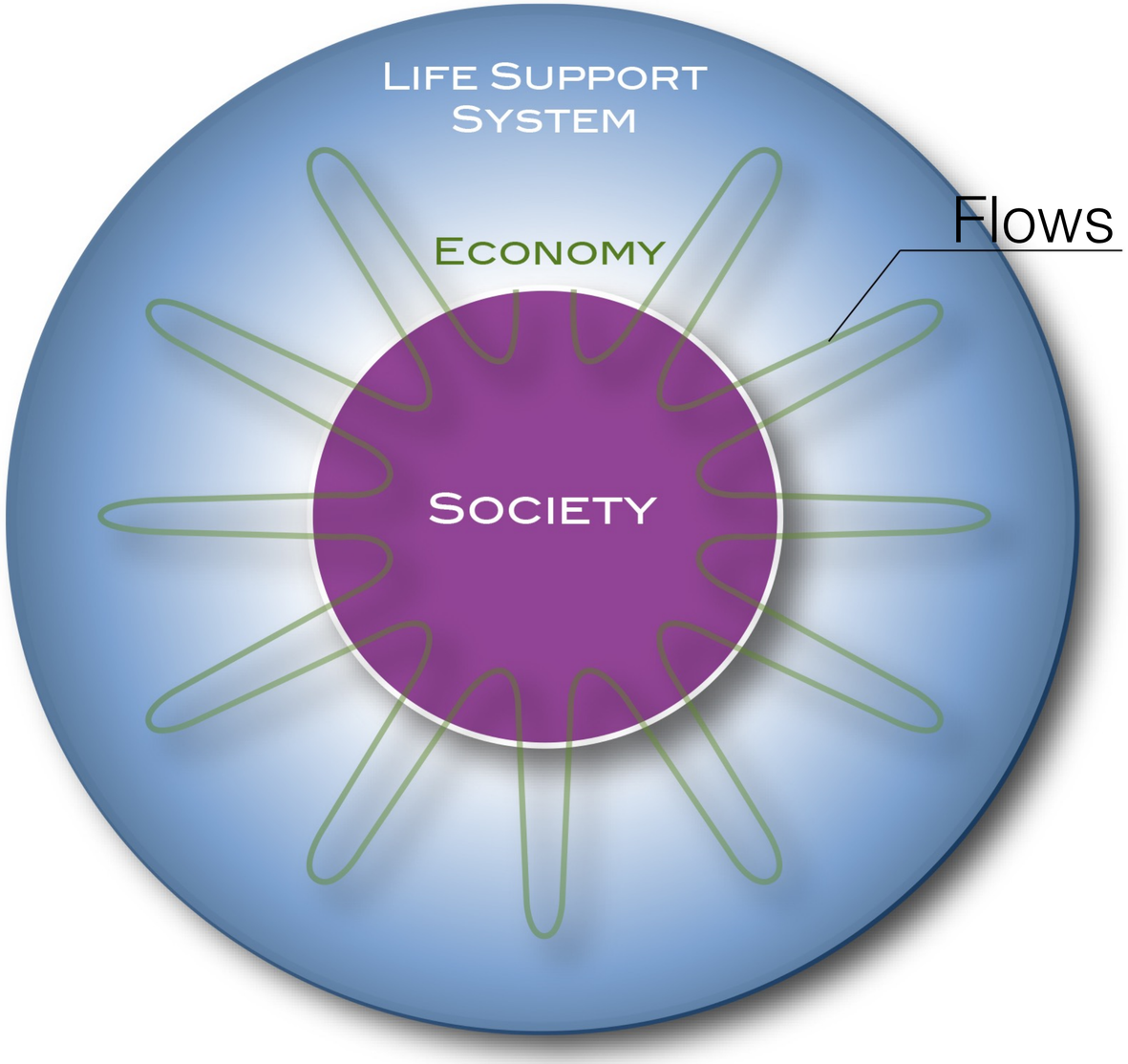
Hypoxic (dead) zones





Prognosis: Journey into the Unknown





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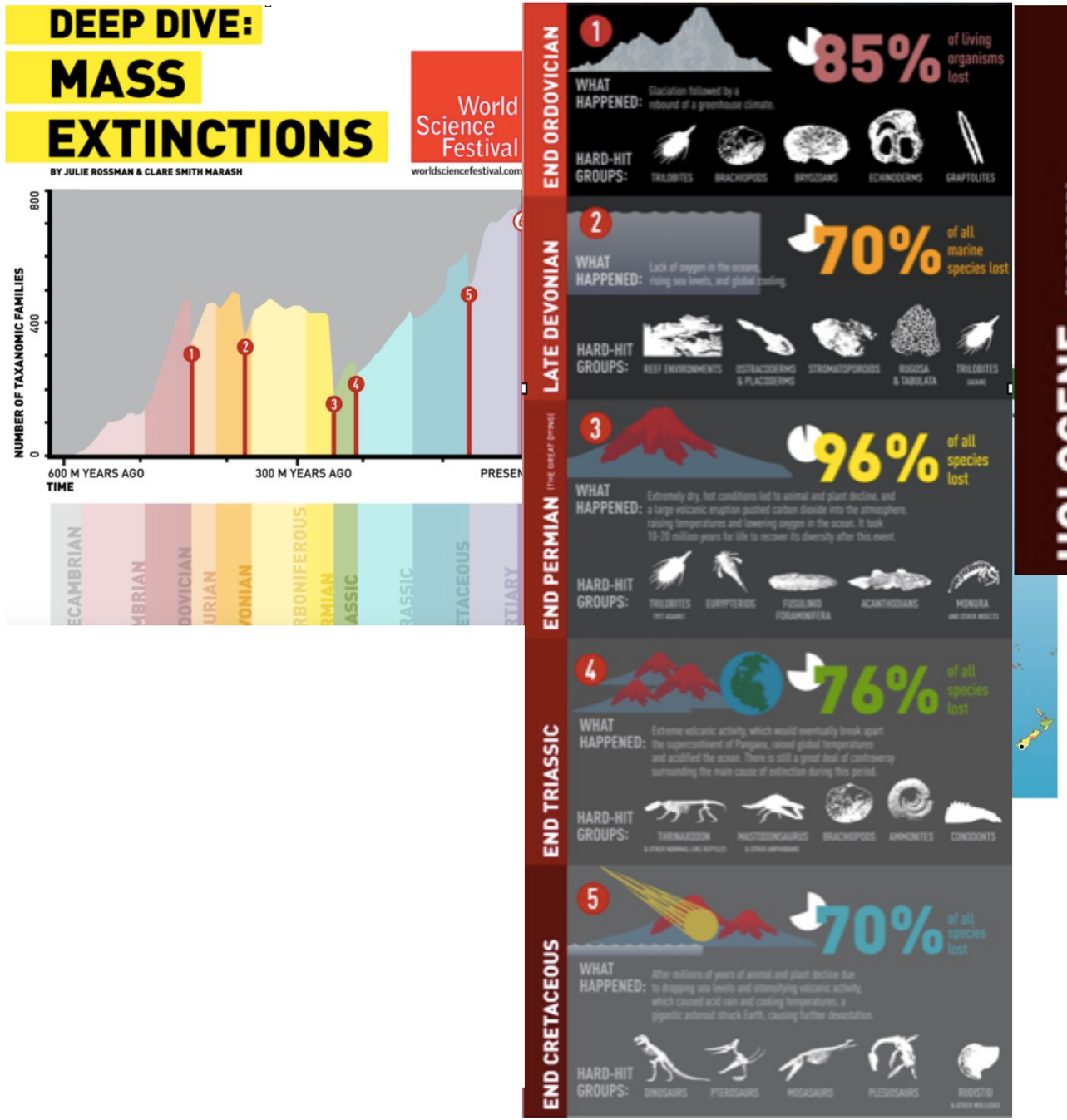

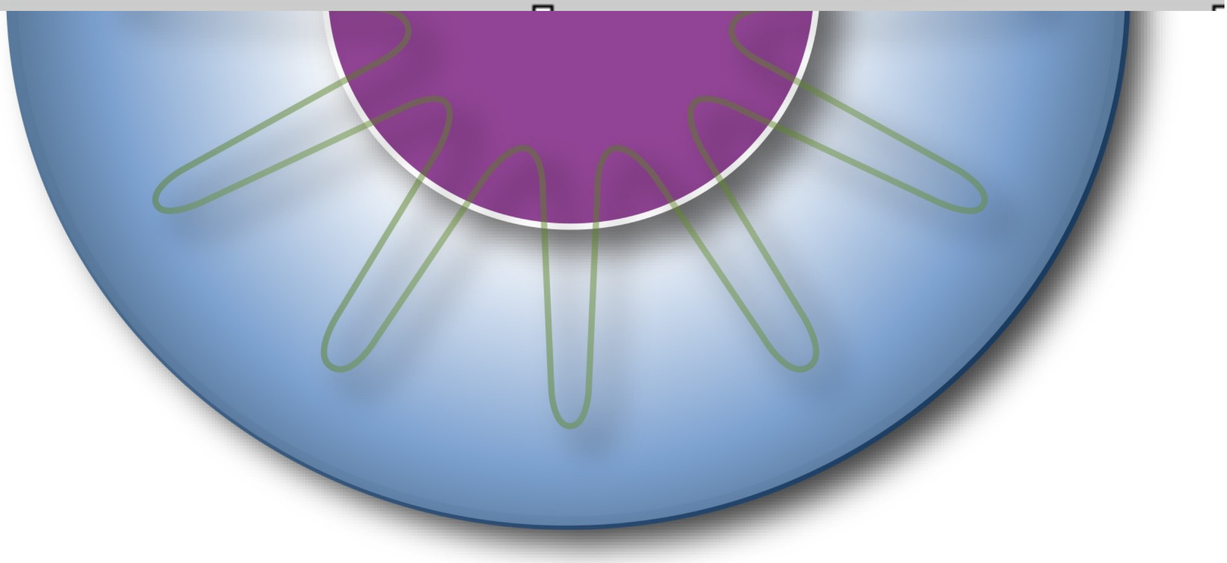

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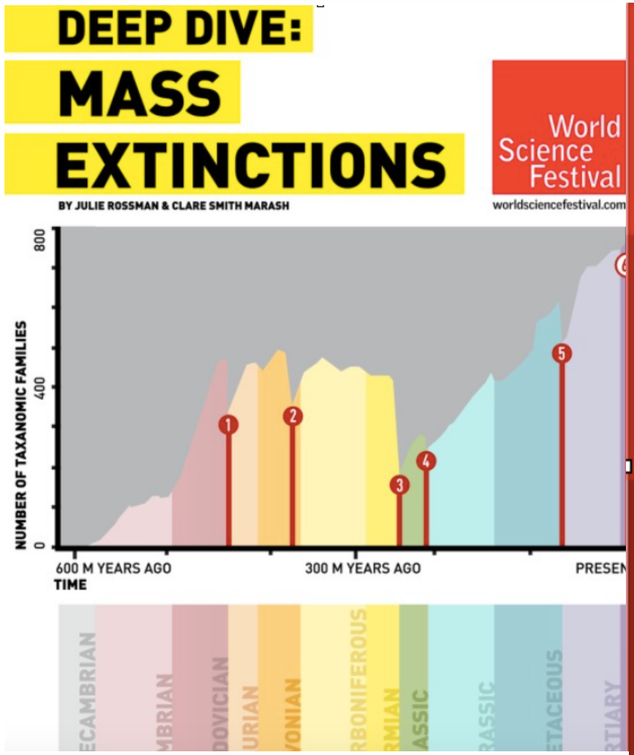

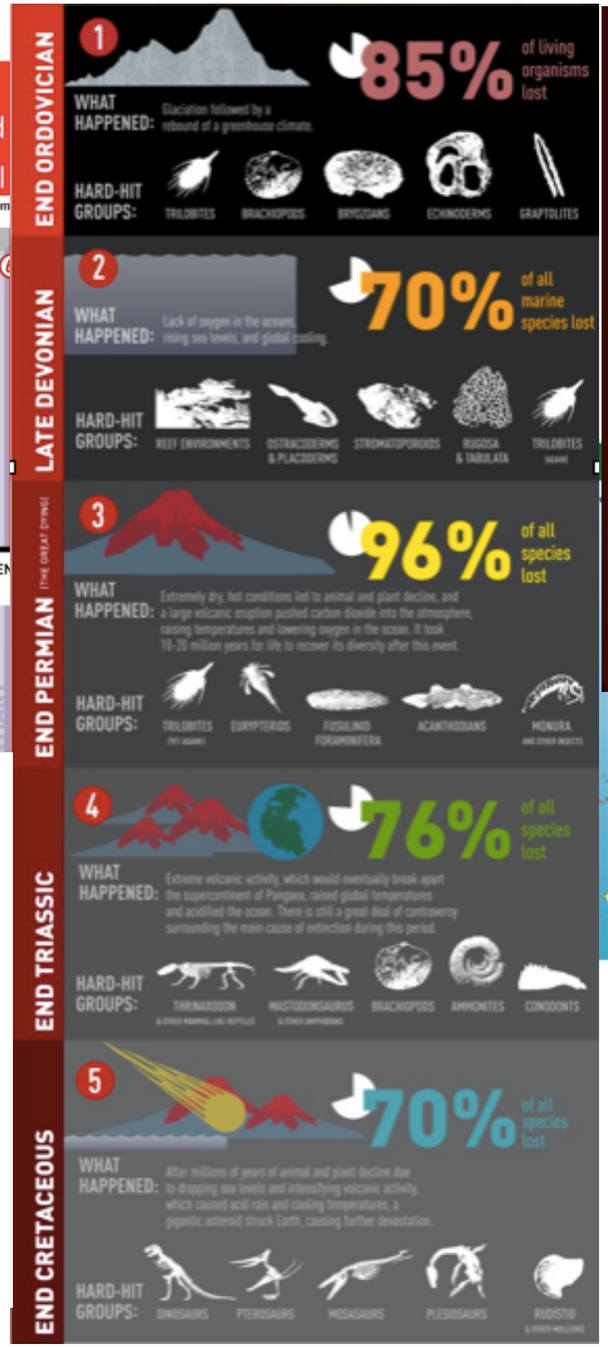

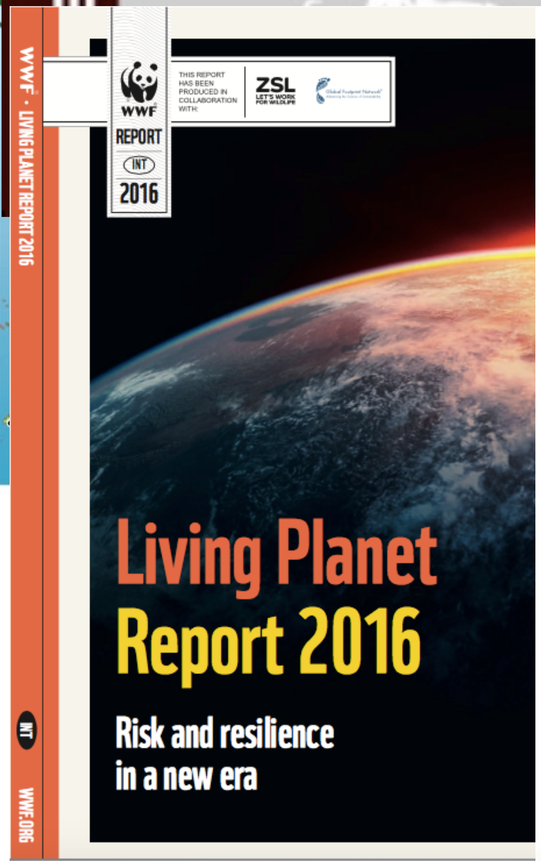

Science & Environment

World wildlife 'falls by 58% in 40 years'

By Rebecca Morelle
Science Correspondent, BBC News

27 October 2016 | Science & Environment

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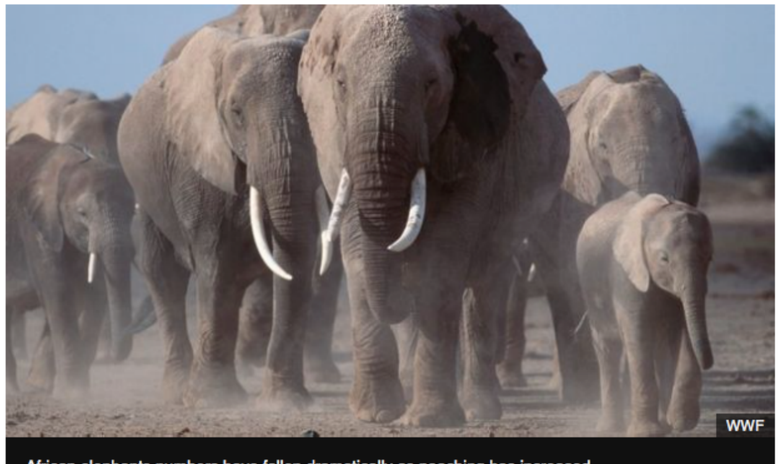
"We do see particularly strong declines in the freshwater environment - for freshwater species alone, the decline stands at 81% since 1970. This is related to the way water is used and taken out of fresh water systems, and also the fragmentation of freshwater systems through dam building, for example."



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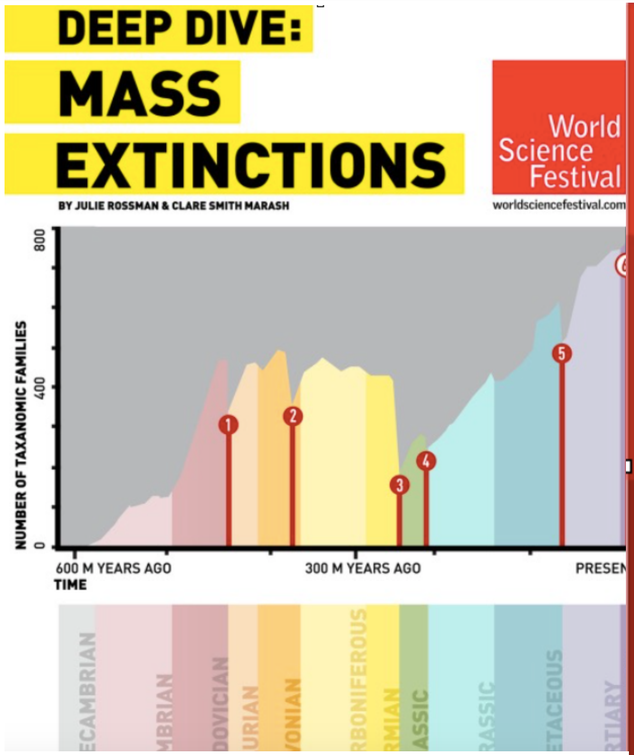

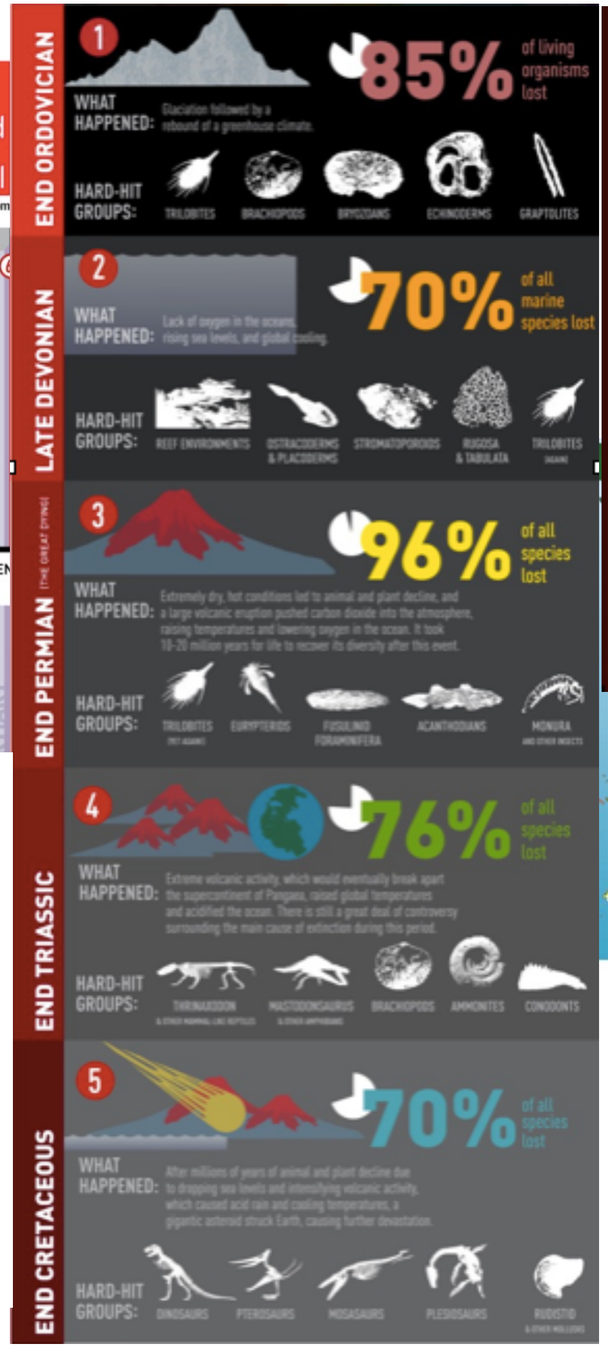

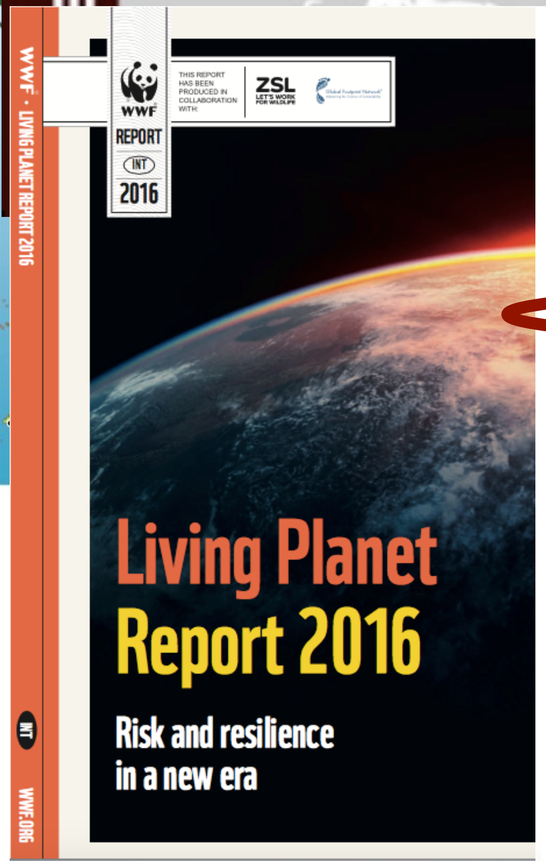

Science & Environment

World wildlife 'fall… …years'

By Rebecca Morelle
Science Correspondent, BBC…

27 October 2016 | Science &… Share

Freshwater: 81% since 1970

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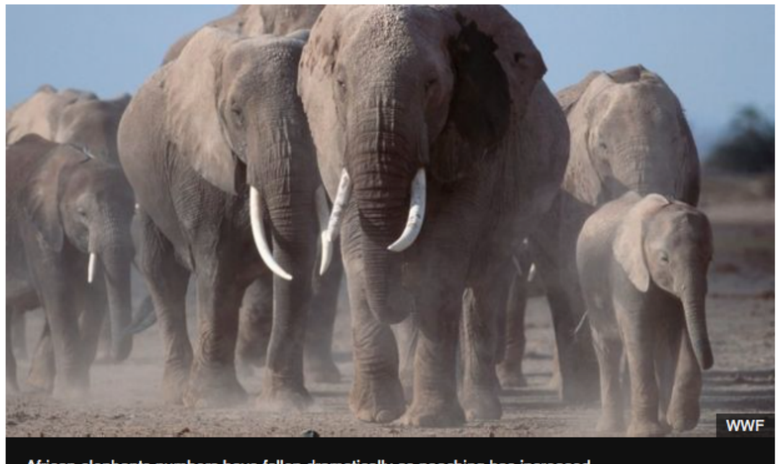

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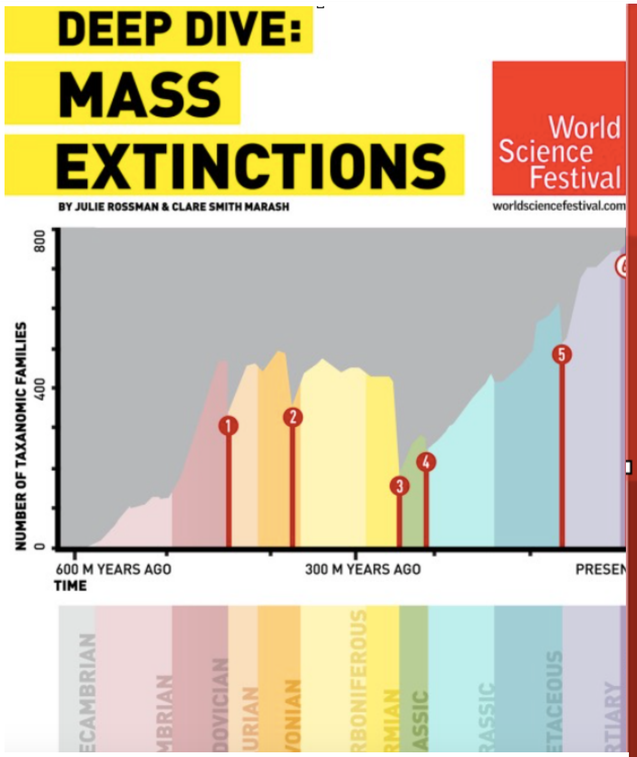
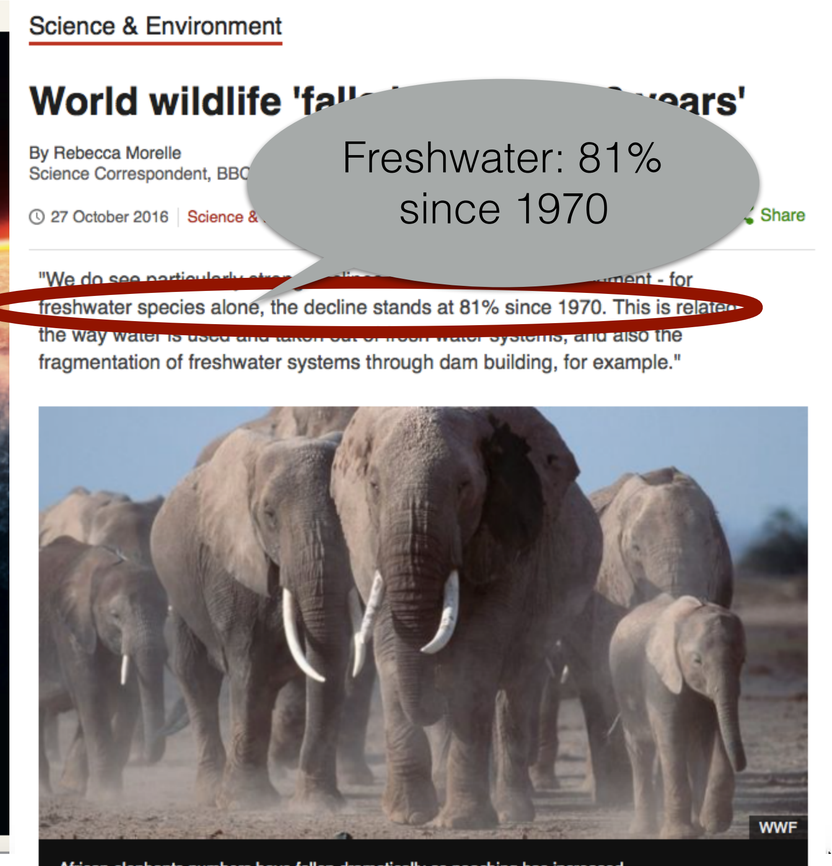


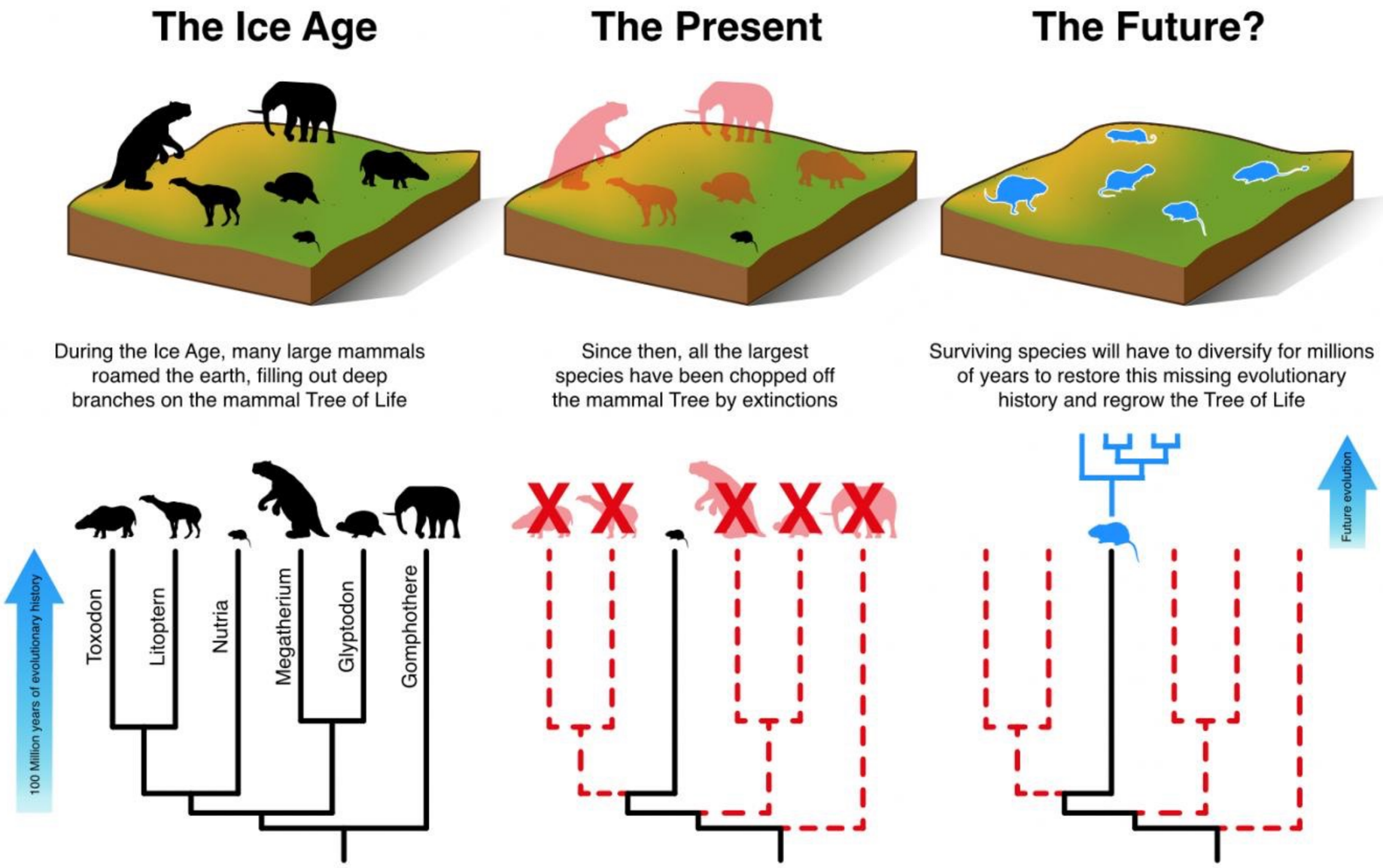


Current extinction rates:

300 times background rate for birds

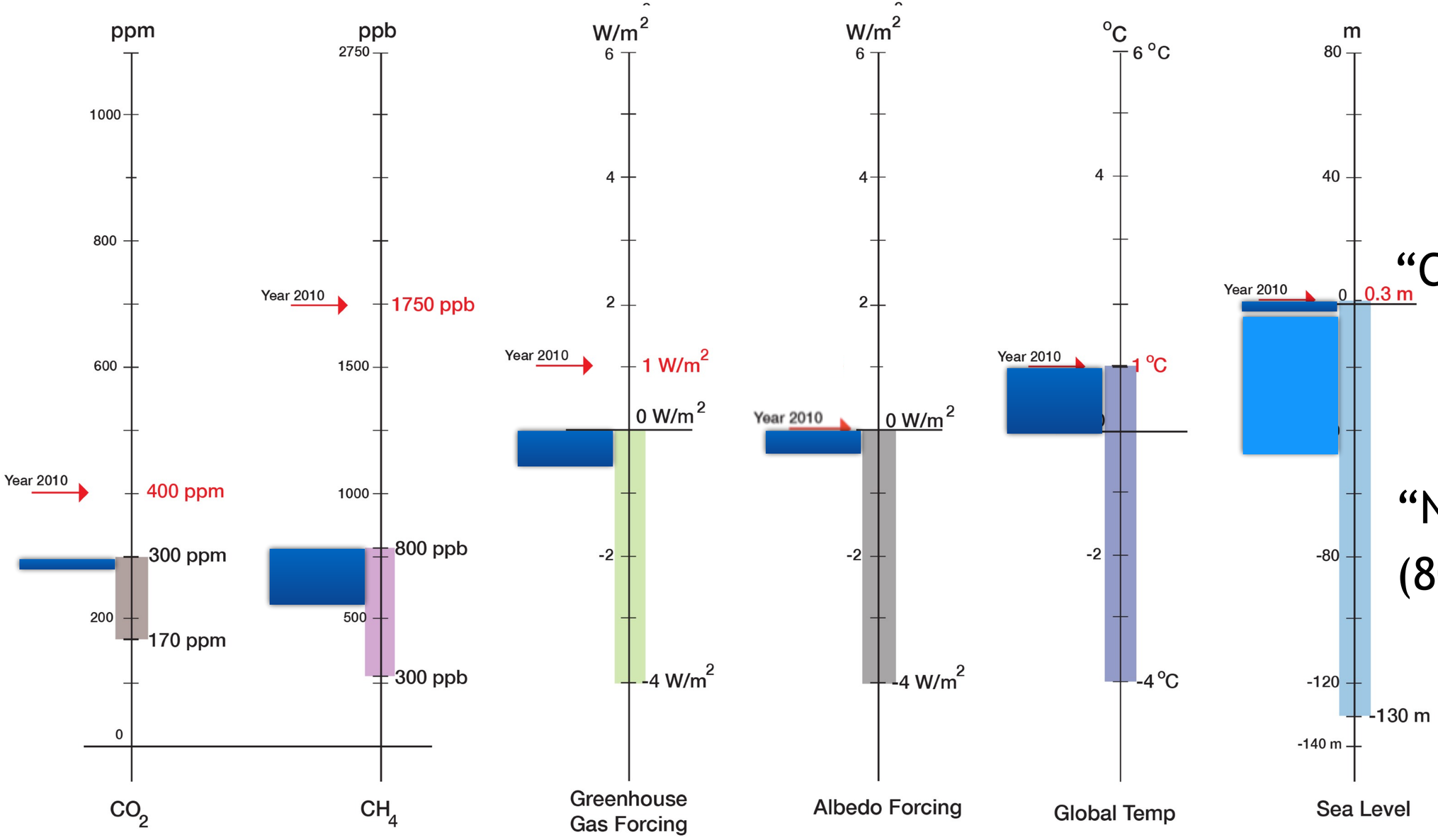
80,000 times background rate for mammals

Prognosis: Journey into the Unknown



Davis et al., 2018

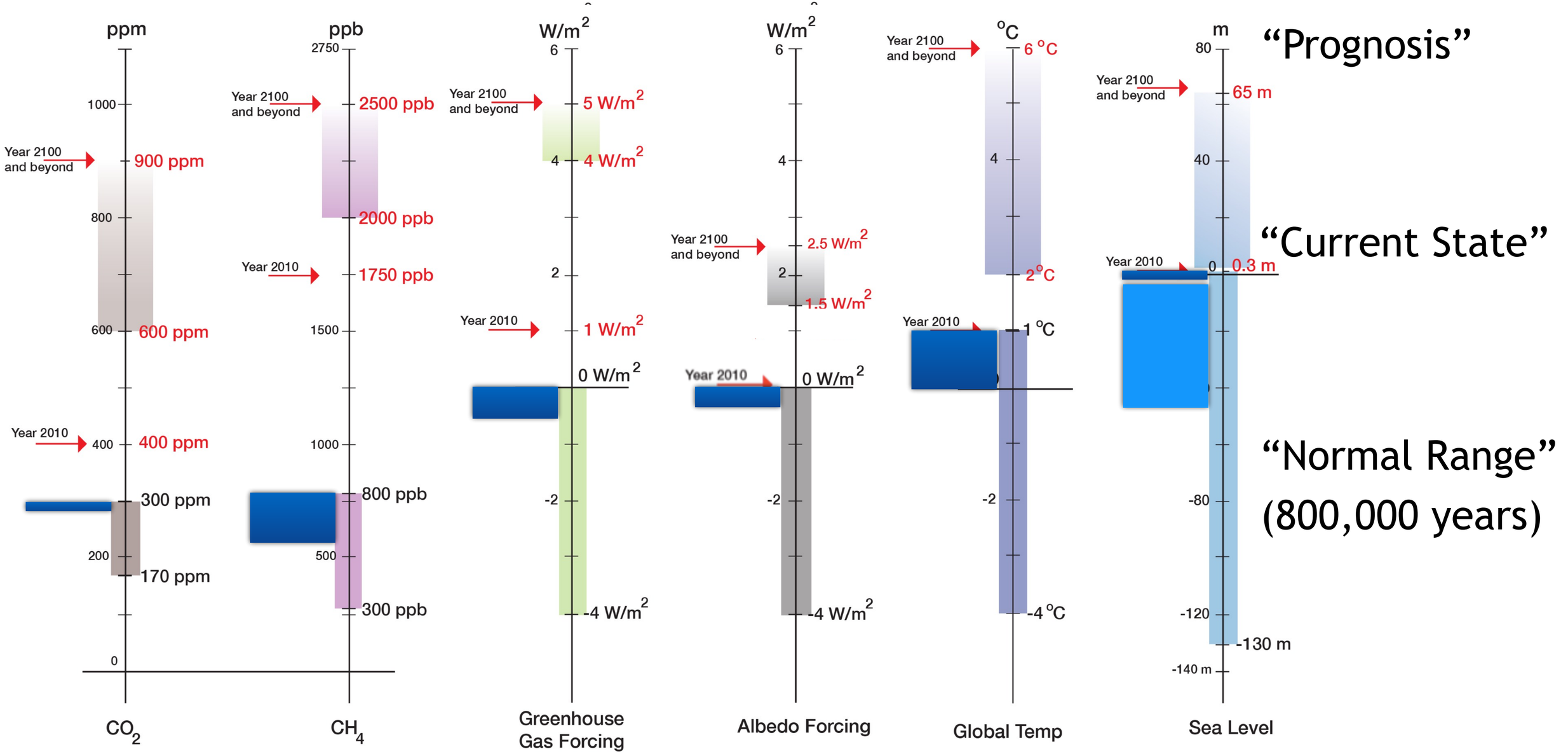
Holocene and Post-Holocene: Leaving the Safe-Operating Space for Humanity



"Current State"

"Normal Range" (800,000 years)

Holocene and Post-Holocene: Leaving the Safe-Operating Space for Humanity



“Prognosis”

“Current State”

“Normal Range”
(800,000 years)