

FRED PROVENZA



# Nourishment

What Animals Can Teach Us About  
Rediscovering Our Nutritional Wisdom

# COWS SAVE THE PLANET

AND OTHER IMPROBABLE  
WAYS OF RESTORING SOIL  
TO HEAL THE EARTH



UNMAKING THE DESERTS, RETHINKING CLIMATE  
CHANGE, BRINGING BACK BIODIVERSITY, AND  
RESTORING NUTRIENTS TO OUR FOOD

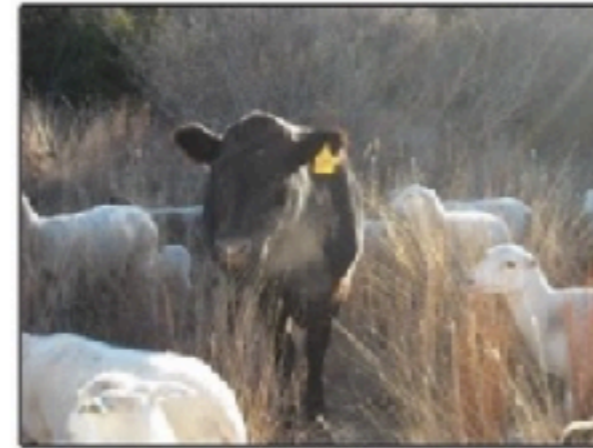
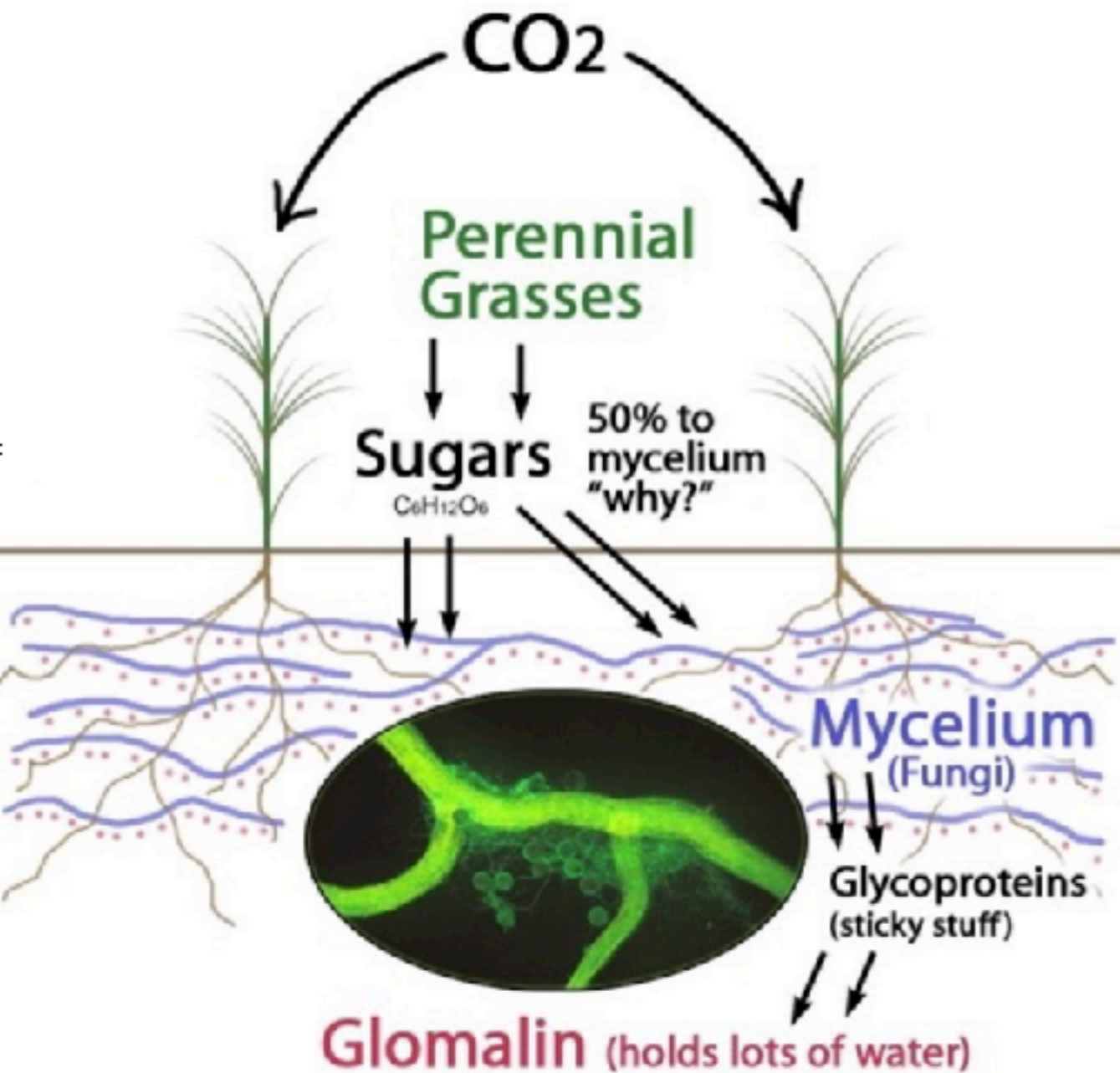
JUDITH D. SCHWARTZ  
FOREWORD BY GRETEL EHRLICH

# “Cows Save the Planet”

by Judy Schwartz

- Peter Donovan - Testing Soil Traveling in a School Bus.
- Christine Jones - Australian Soil Scientist “[amazingcarbon.com](http://amazingcarbon.com)”
- Allan Savory - Holistic Management - Zimbabwe & Western USA
- Michale Kravčík - Small Water Cycle - Slovakia
- Anastassia Makarieva - Rain Pump or Biotic Pump
- Dan Kittredge - Nutrition - NOFA

# Make Soil - End Global Warming



Mega Herds of Buffalo  
or  
well-timed pulsed  
grazing of livestock



hoof action  
breaks cap

**Animal Impact  
Enriches Soil**

water infiltration

dung  
urine

Carbon Farmers  
in Vermont

Dung beetles  
bury tons of  
manure several  
feet deep.



**Humus**  
(carbon rich "bug poop")



# Water Infiltration Tests

by Stan Boltz, State of South Dakota Range Scientist

How long does it take for 1 inch of water to infiltrate soil?



- |   | Minutes      |
|---|--------------|
| • Continuous Grazing<br>(Blue Grama, <b>Kentucky Bluegrass</b> , low diversity)                                       | <b>7:03</b>  |
| • Convert to Corn Cropland<br>- 1st Year  | <b>31:13</b> |
| • Planned Grazing w/<br>Adequate Recovery<br>( <b>Big Bluestem</b> , Western<br>Wheatgrass, forbs, high<br>diversity) | <b>0:10</b>  |

200 lbs more grass produced per inch infiltration.  
Management Matters!

# Peter Donovan Soil Carbon Coalition

3 Infiltration Tests were run at U Mass - Amherst. Turf Grass, mostly **Kentucky Bluegrass**, covers the campus. It is very lush and green, but can it absorb rainfall?

How long did it take for 1 inch of water to infiltrate into the soil?

- Test #1      28 minutes
- Test# 2      54 minutes
- Test # 3    > 62 minutes
- **Average    48 minutes**

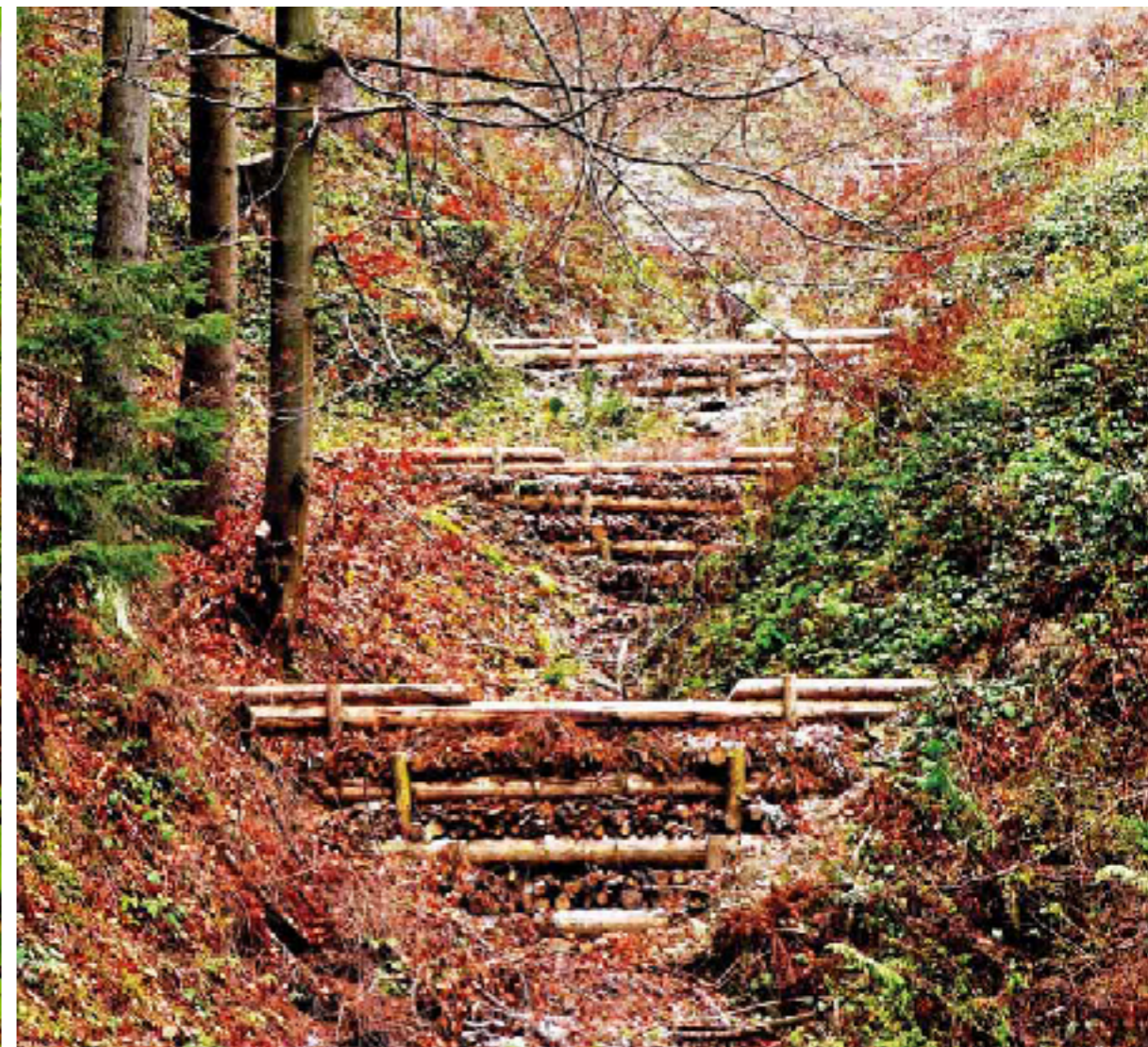












## Forests plus Wetlands - Slow the Flow

- Infiltration: raises water table, more photosynthesis pumping sugars to soil
- Transpiration: cools the surface, rising vapor carries bacteria & isoprene
- Condensation: airborne bacteria form droplets, energy escapes to space

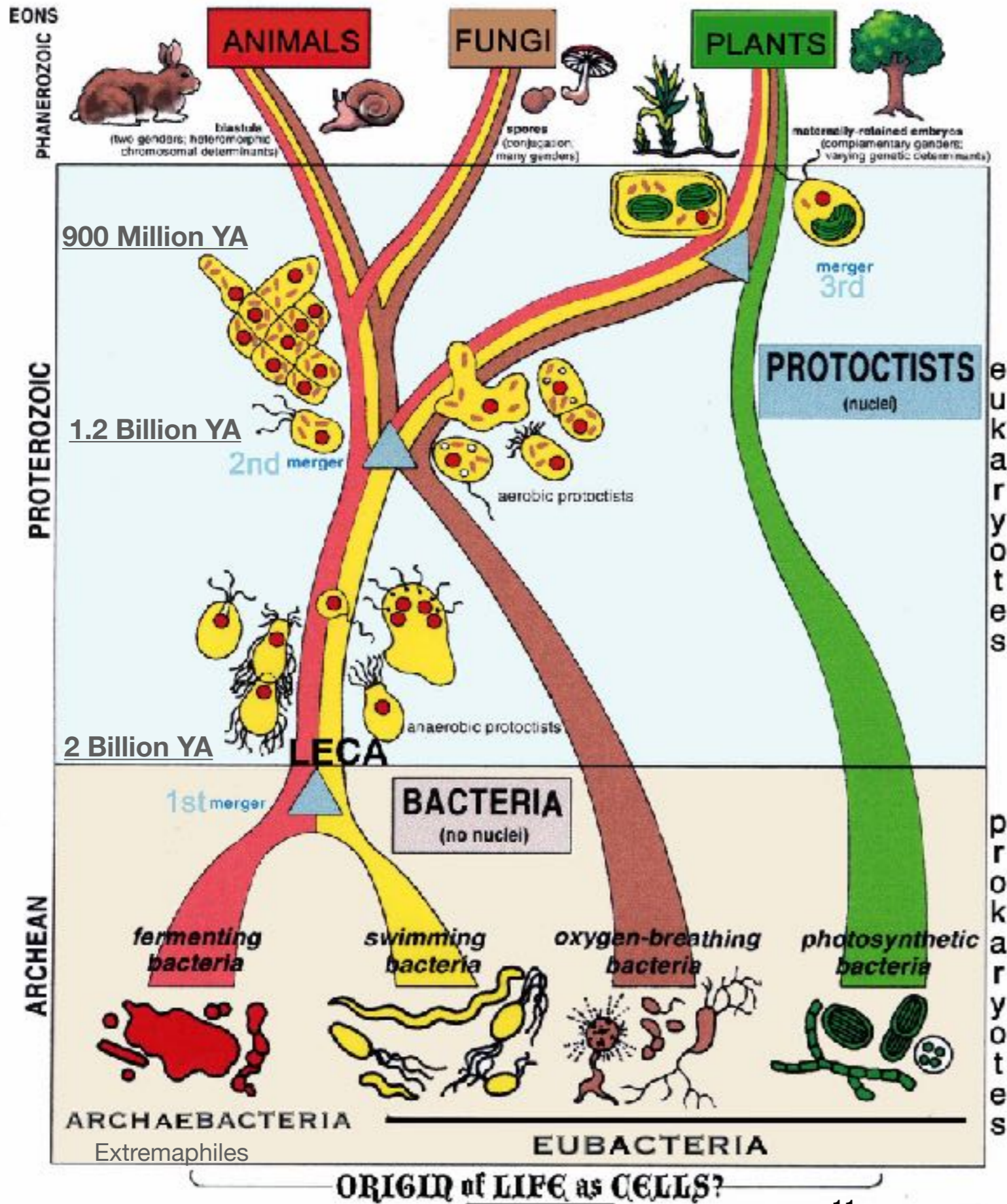
“Small Water Cycle” - Michal Kravčák

Link: [http://www.waterparadigm.org/download/Water for the Recovery of the Climate A New Water Paradigm.pdf](http://www.waterparadigm.org/download/Water%20for%20the%20Recovery%20of%20the%20Climate%20A%20New%20Water%20Paradigm.pdf)

# “Nourishment”

by Fred Provenza

- Point of Departure - Transformation
- Part 1 - “Dining with Change”
- Part 2 - “Dancing with the Wisdom of the Body”
- Part 3 - “Savoring the Artist’s Palette”
- Part 4 - “Grappling with Uncertainty”
- Part 5 - “Fading into Mystery”
- Dining on Earth : A Visitor’s Reflections
  
- Microbiomes !!!



# 6 Kingdoms of Life

2 are Prokaryotic  
4 are Eukaryotic

1. Bacteria
2. Archaea
3. Protists - (or Protoctists)
4. Fungi
5. Animals
6. Plants

# Planet Earth - Situation in 2017

- Major Extinction in Progress - (Loss of Biodiversity)
- Soil Erosion > 75 billion tons annually (10 tons/human every year)
- Land Desiccation and Fires (Water tables dropping.)
- 400 Dead Zones in the Oceans
- Arctic Ocean is almost free of Summer Ice
- Is a Methane Spike imminent? Rapid temperature rise of 2 to 5°C?

*There are those that are trying  
to set fire to our world.*

*We are in Danger!*

*There is time only to move slowly.*

*There is no time not to Love.*

*-Deena Metzger*

David Pimental - Cornell University  
SOIL EROSION: A FOOD AND ENVIRONMENTAL THREAT  
Environment, Development and Sustainability (2006) 8: 119-137

Jeremy Jackson  
"Ocean Apocalypse" Lecture at US Naval War College (2013)  
<https://www.youtube.com/watch?v=2zMN3dTvrwY>



**Greta Thunberg**  
Age 15 in August 2018

Link: <https://www.youtube.com/watch?v=gsy6DofvdNo>



December 2019

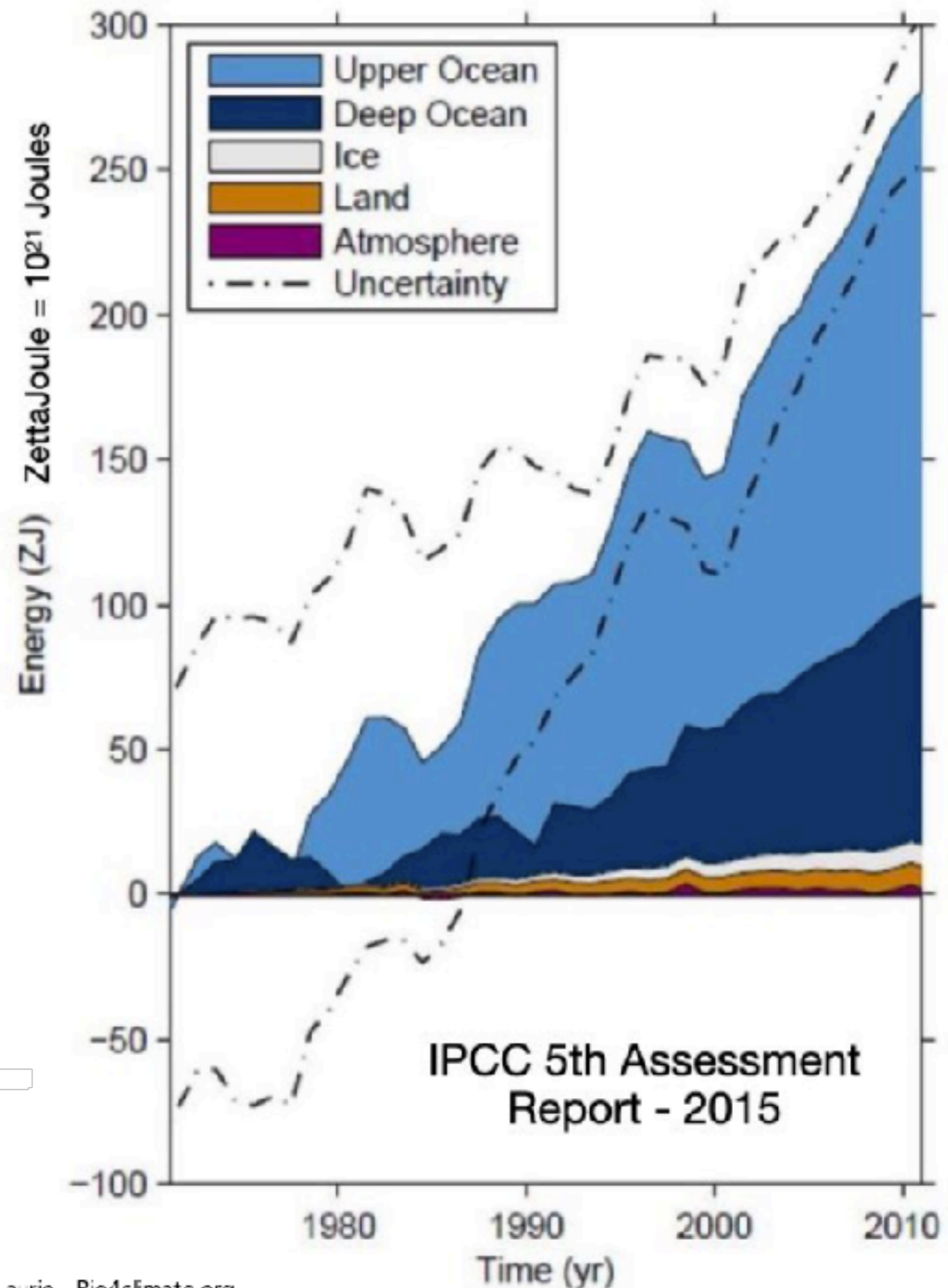
Ocean Energy Increase equals a  
Mount St. Helens explosion  
every 6 minutes.



The Oceans  
have a fever.  
Explains:  
Sea Ice Melt  
Bigger Storms

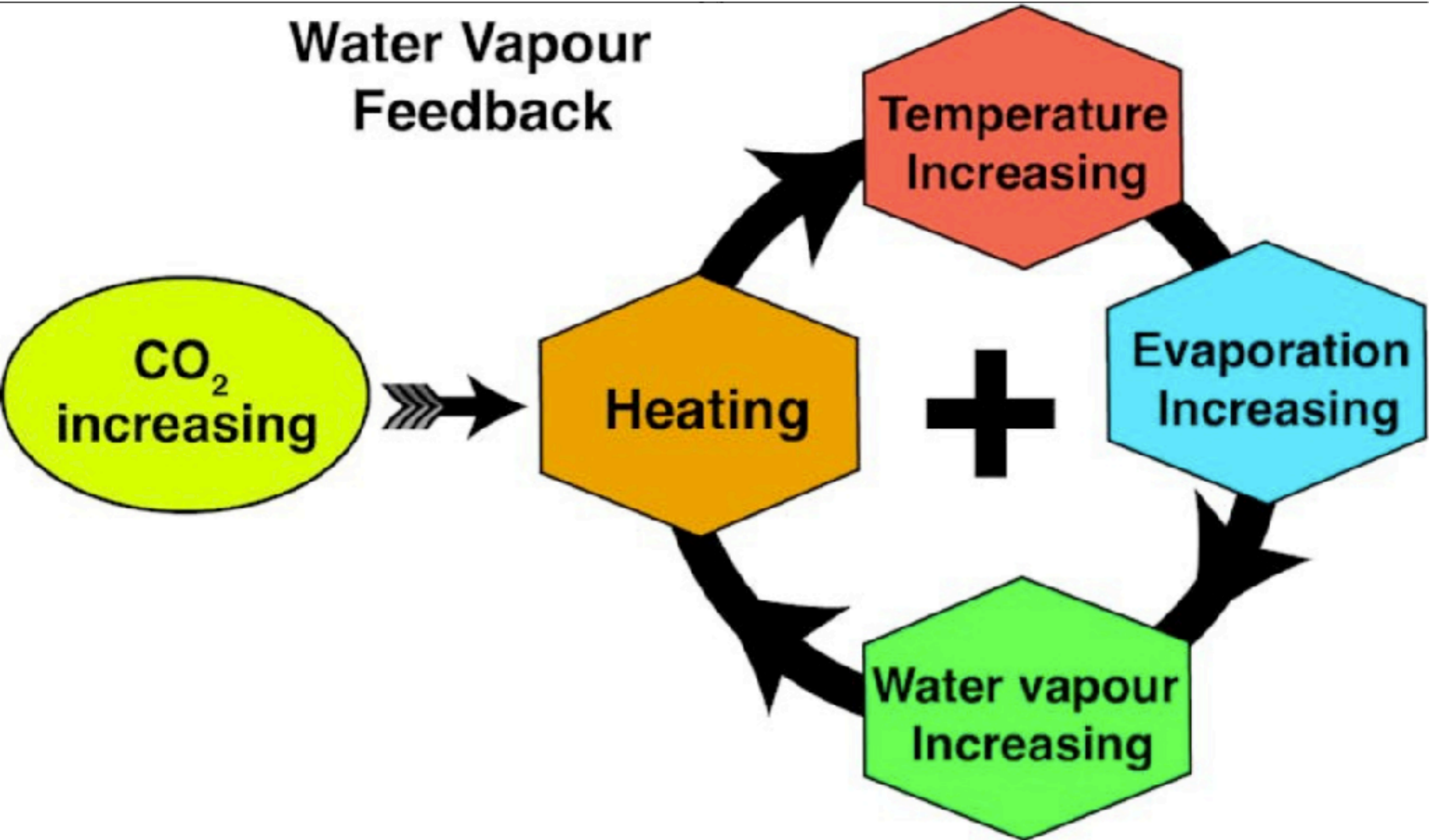
Photo: Mike Doukas USGS  
7-22-1980 (Public Domain)

**Earth's Energy Accumulation**  
is about 9 x ZettaJoules / yr.  
~ 93% is stored in Oceans.  
IPCC is now saying humans  
have one decade to change,  
not 50 or 100 years.



# Kevin Trembley Model - CO<sub>2</sub> “Control Knob”

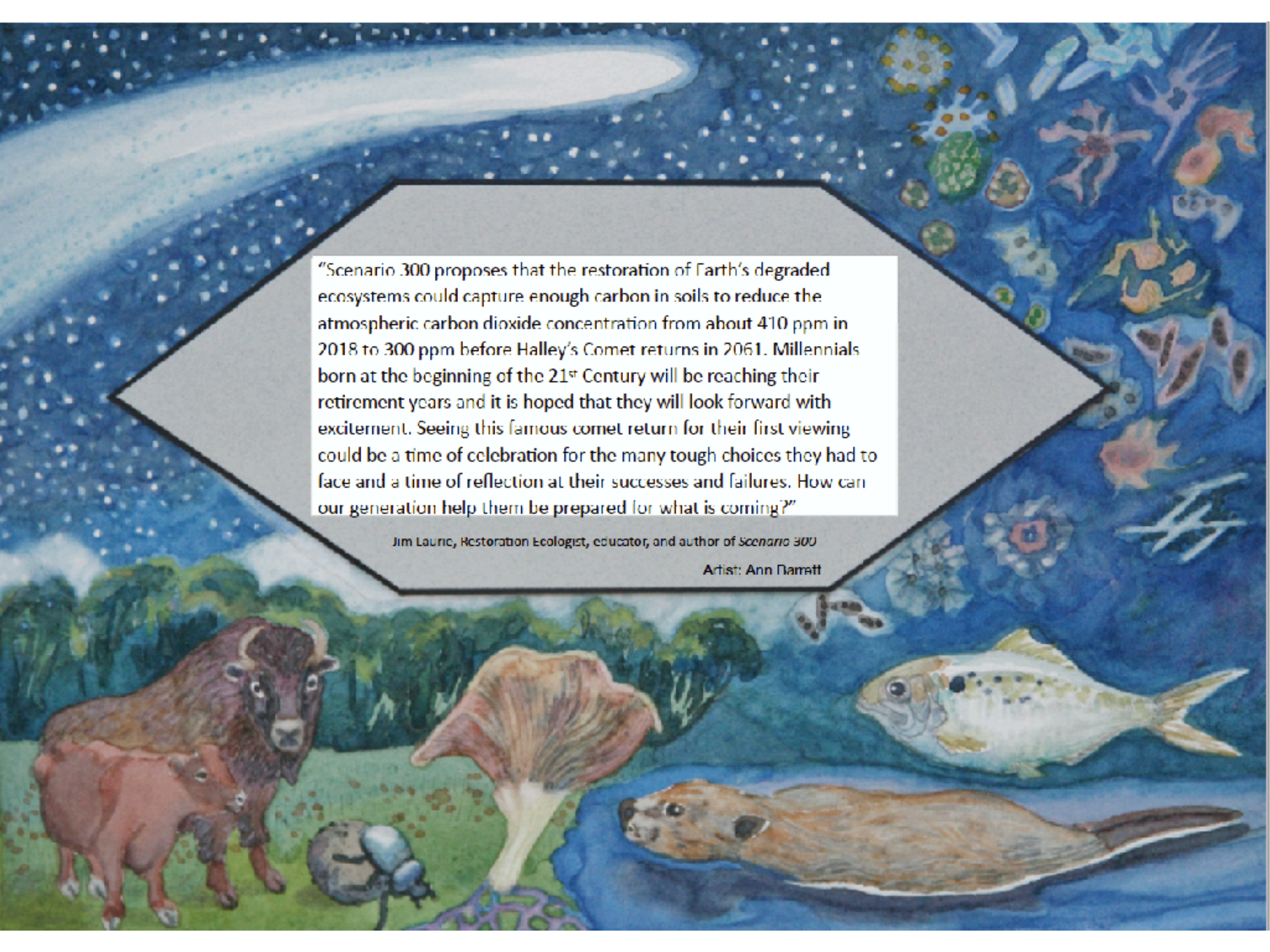
Water Vapour  
Feedback



# CO<sub>2</sub> Scenarios

- Scenario 200 - Ice Age
- Scenario 300 - in 1910 - Below 300 for several million years
- Scenario 400 - Now - Moving toward Ice Free Planet
- Scenario 500 - BAU - Will reach before the Comet comes in 2061

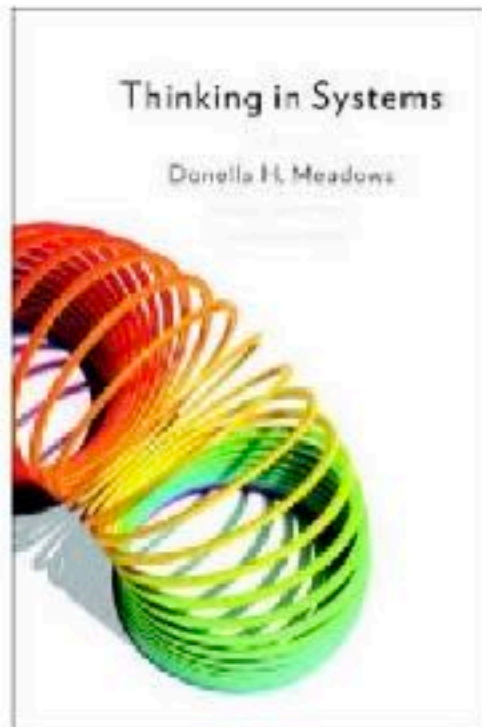




"Scenario 300 proposes that the restoration of Earth's degraded ecosystems could capture enough carbon in soils to reduce the atmospheric carbon dioxide concentration from about 410 ppm in 2018 to 300 ppm before Halley's Comet returns in 2061. Millennials born at the beginning of the 21<sup>st</sup> Century will be reaching their retirement years and it is hoped that they will look forward with excitement. Seeing this famous comet return for their first viewing could be a time of celebration for the many tough choices they had to face and a time of reflection at their successes and failures. How can our generation help them be prepared for what is coming?"

Jim Lauric, Restoration Ecologist, educator, and author of *Scenario 300*

Artist: Ann Parrett



“When you understand the power of **self-organization**, you begin to understand why biologists worship **biodiversity** even more than economists worship technology.”

**“Hierarchical Systems evolve from the bottom up. The purpose of the upper layers of the hierarchy is to serve the purposes of the lower layers.”**

from **Thinking in Systems**  
by Donella Meadows

## Places to Intervene in a System

12. Numbers - “Mostly, the numbers are not worth the sweat put into them”

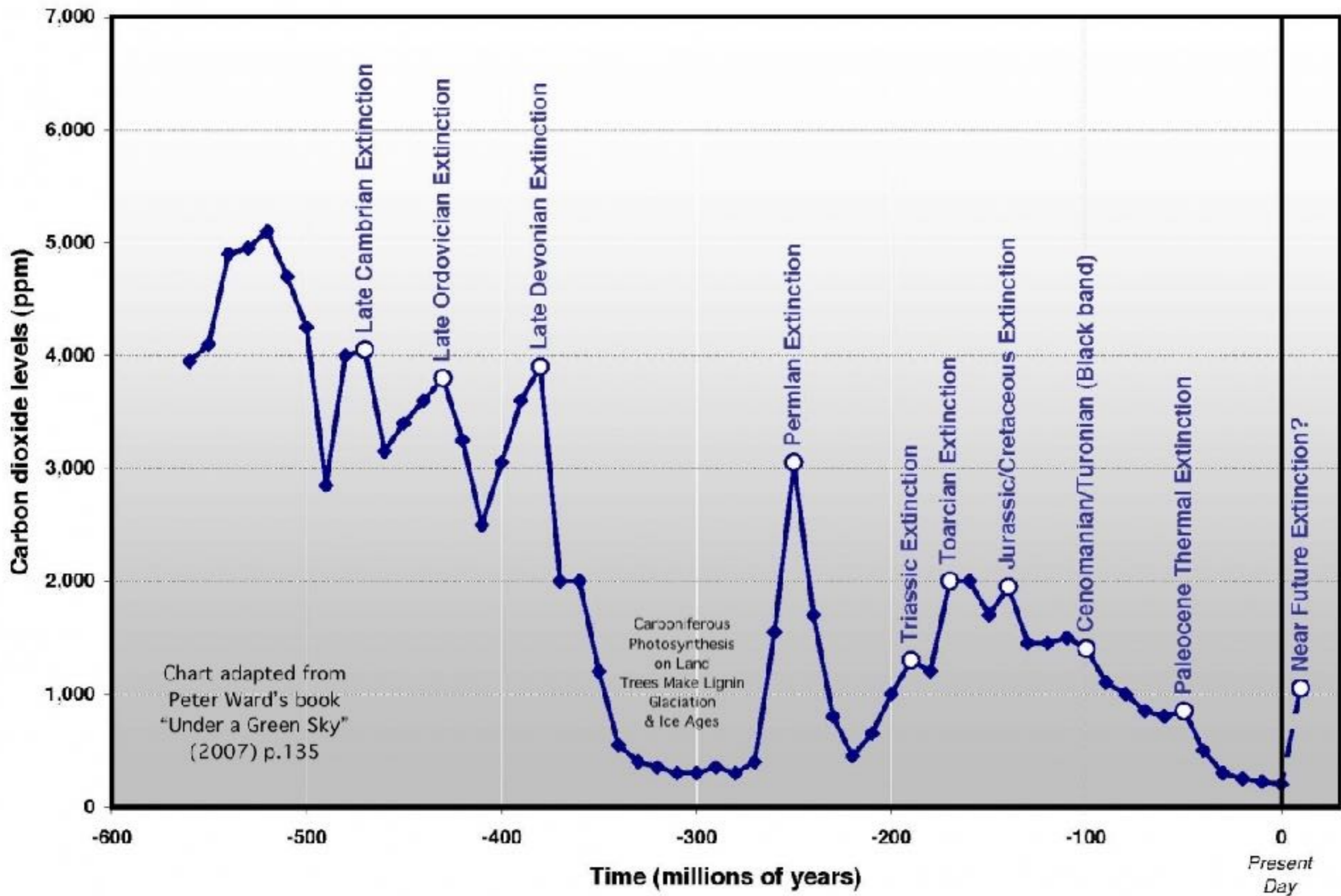
(I’ll skip a few.)

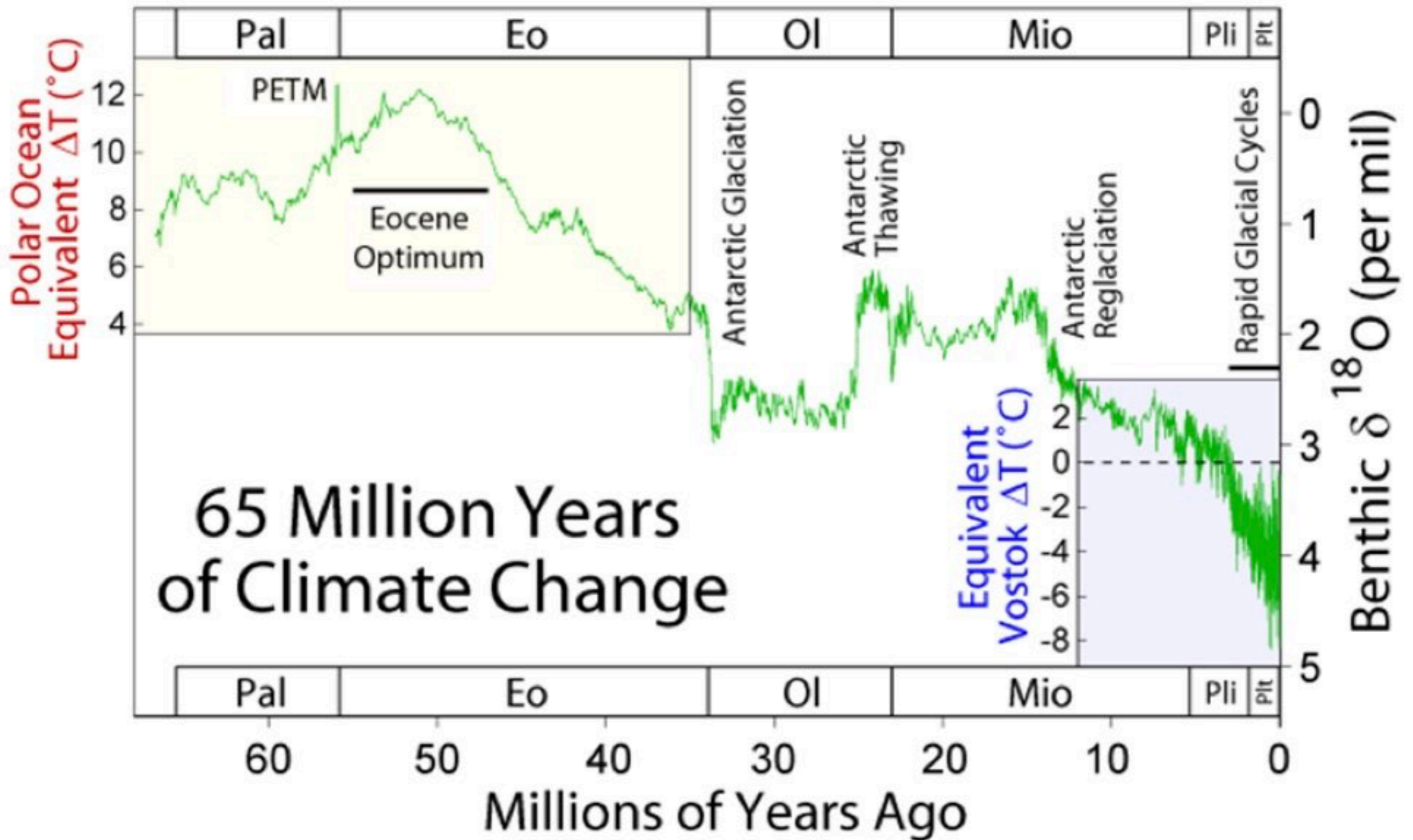
4. Self-Organizing Systems (John Todd & Eco-Machines)

3. Goals (What do you want? - Allan Savory & HM)

2. Paradigms (Lynn Margulis - Microbial Symbiosis)

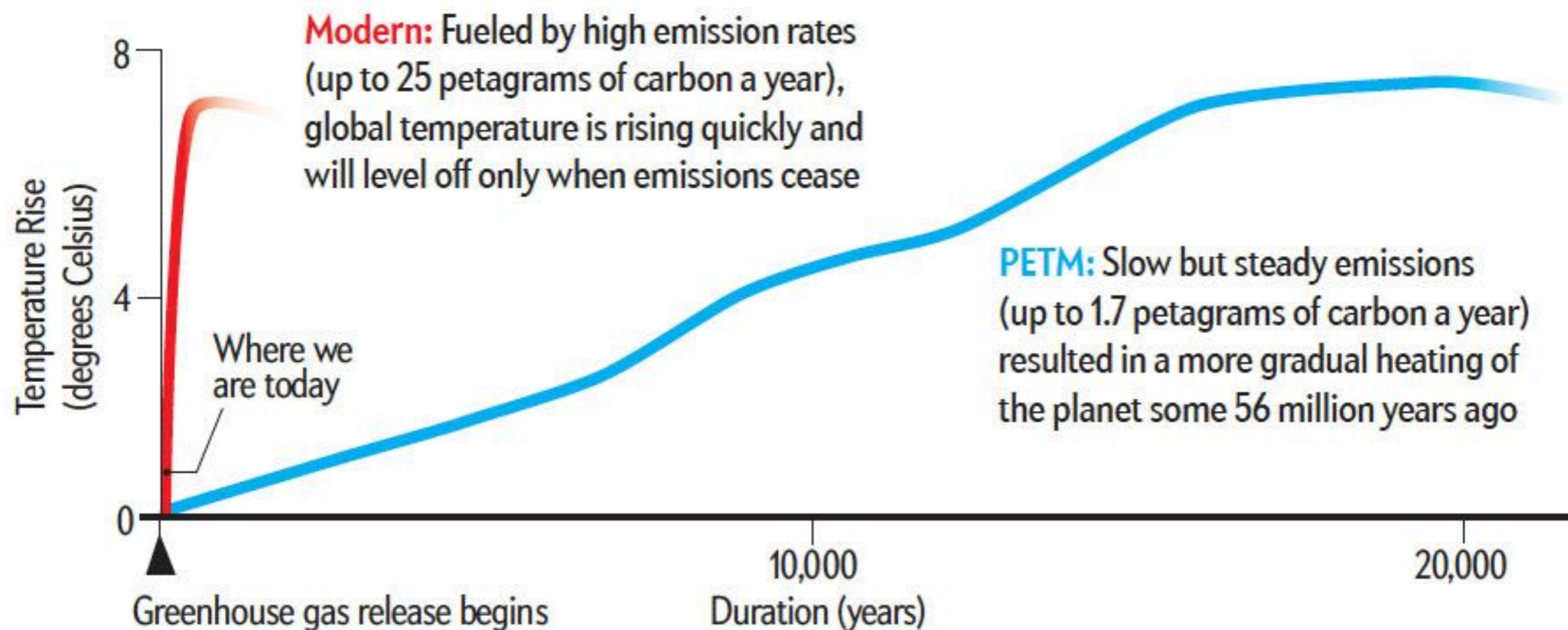
1. Transforming Paradigms (questioning your own beliefs and paradigms)

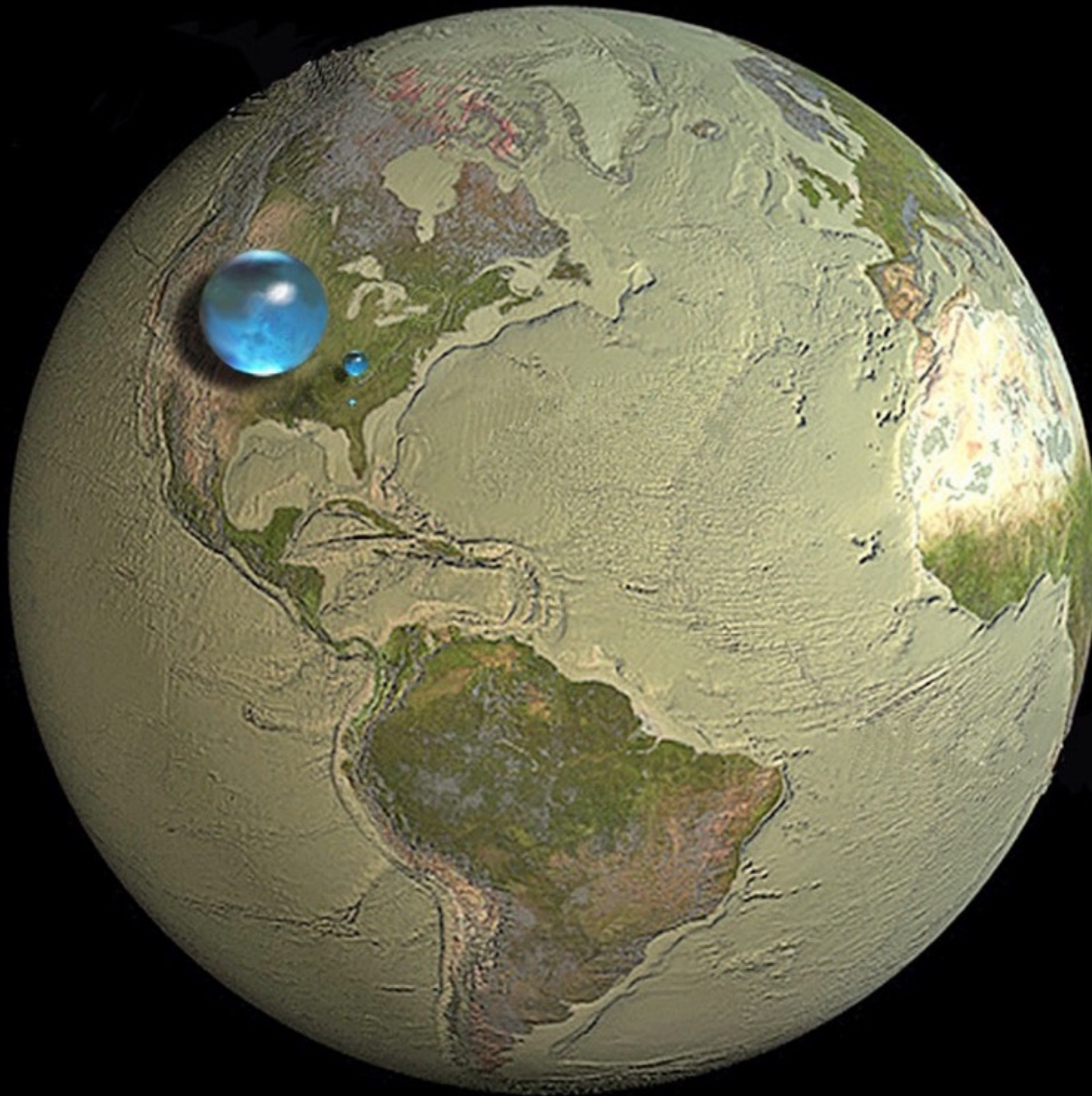




- We are experiencing the first extinction episode since the Eocene. (50 million years ago)
- PETM - Methane Spike (May have been 2 to 4 times larger than shown here.)
- Antarctica and Australia separated during the Eocene.
- Azolla Event built 25 feet+ of permafrost.
- Miocene Grasslands - Greg Rettalick @ Tufts November 2014.

## Global temperature is rising much more quickly today than it did during the PETM





## 3 Spheres of Water

### 1. All Water

860 miles in diameter  
332 million mi<sup>3</sup>

### 2. Fresh Liquid Water

170 miles in diameter  
2.5 million mi<sup>3</sup>

### 3. Fresh Water in Lakes and Rivers

35 miles in diameter  
22,300 mi<sup>3</sup>

**or 93,000 km<sup>3</sup>**

### Yearly Net Rain from Oceans to Land

~ 10,000 mi<sup>3</sup>

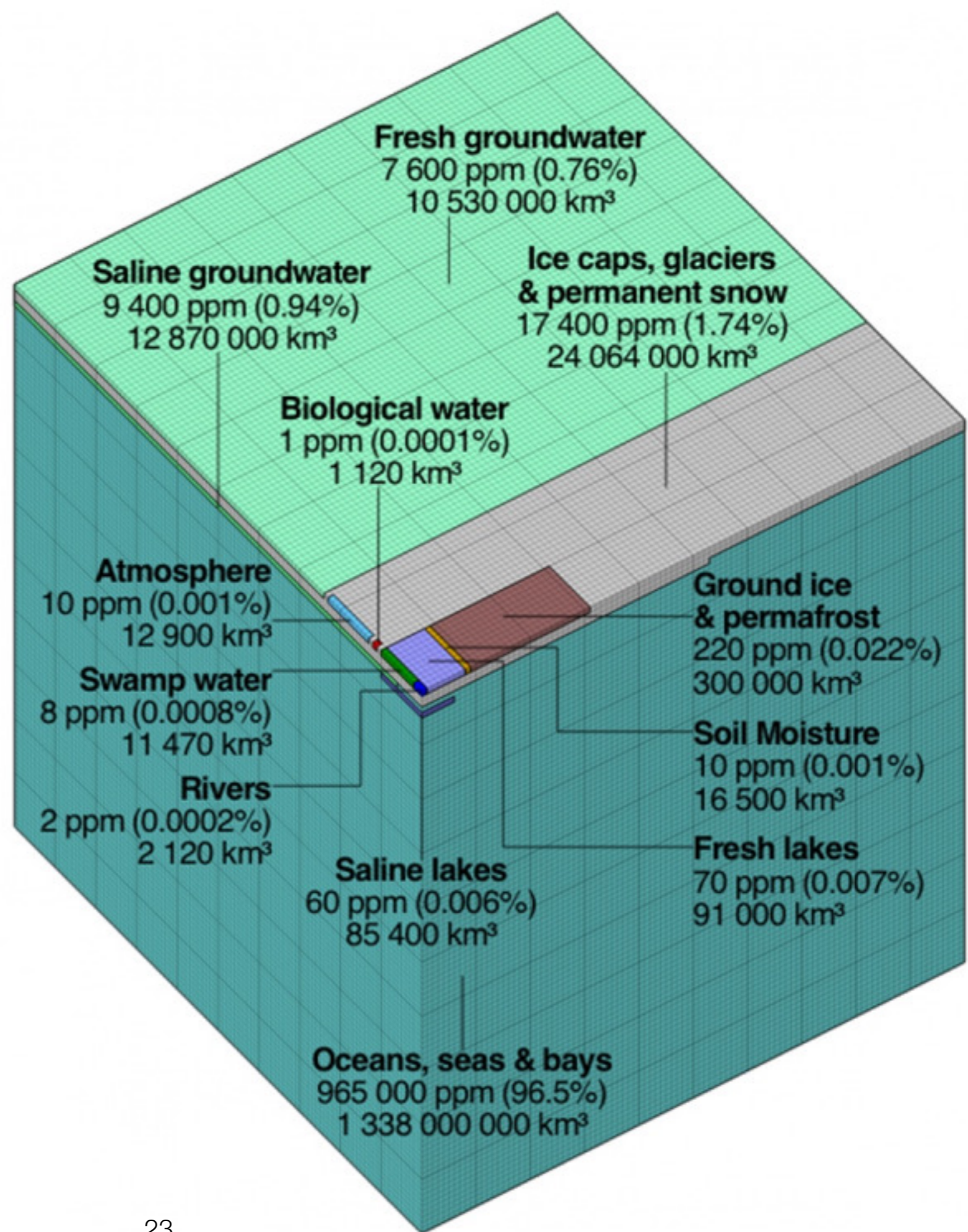
**or 42,000 km<sup>3</sup>**

Source: [Howard Perlman](#), USGS; globe illustration by [Jack Cook](#), Woods Hole Oceanographic Institution

<http://water.usgs.gov/edu/earthhowmuch.html>

# How much fresh water is available?

- Salt water = 97.5%
- Ice caps = half of remainder
- Biological water is 1120 km<sup>3</sup> (1 ppm)
- 0.28 km<sup>3</sup> water in humans (0.2 ppb)
- Biological water is 4000x that in humans



Source: USGS Howard Perlman

<http://water.usgs.gov/edu/gallery/global-water-volume.html>

Energy - Powers of Ten

Increasing Energy Measurement	Unit or Factor	Joules	Joules	Joules
Heat 1gm water 1°C (1 cc)	1 calorie (1/1000 Kcal)	4.187	4.187	
Heat 1kg water 1°C (1 liter)	1 Kcal (1 Calorie or 1000 calories)	4,187	4.187 KJ Kilo-	<b>4.187x10<sup>3</sup></b>
Gasoline (1 gallon)	125,000 BTU	137,000,000	137.2 MJ Mega-	<b>137x10<sup>6</sup></b>
Human per day	2500 Kcal	10,470,000	10.47 MJ Mega-	<b>10.47x10<sup>6</sup></b>
Human per year	913,000 Kcal	3,823,000,000	3.823 GJ Giga-	<b>3.82x10<sup>9</sup></b>
1 ton TNT	1,000,000 Kcal	4,187,000,000	4.187 GJ Giga-	<b>4.19x10<sup>9</sup></b>
Hiroshima (15,000 tons TNT)	15 Kilotons TNT	62,800,000,000,000	62.8 TJ Tera-	<b>62.8x10<sup>12</sup></b>
Mount St. Helens	24 Megatons TNT	100,500,000,000,000,000	100 PJ Peta-	<b>100x10<sup>15</sup></b>
Hurricane Harvey (33 trillion gallons rain)	3000 Mount St. Helens	300,000,000,000,000,000,000	300 EJ Exa-	<b>300x10<sup>18</sup></b>
Global Warming of Oceans (yearly)	25 Hurricane Harveys	7,500,000,000,000,000,000,000	8 ZJ Zetta-	<b>7.5x10<sup>21</sup></b>
Global Warming of Oceans (since 1955)	800 Harveys - (times three?)	250,000,000,000,000,000,000,000	250 ZJ Zetta-	<b>250x10<sup>21</sup></b>
<b>E = mc<sup>2</sup></b> (1 gram matter > energy)		90,000,000,000,000	90 TJ Tera-	<b>90 x10<sup>12</sup></b>
Thinking about energy at different scales.				
Compare Human Days vs. Gasoline				
Compare Human Years vs. TNT				
How much of a hurricane's condensation energy escapes to space?				

Jim Laurie - Bio4climate.org  
jmlaurie7@gmail.com

**E = 1/2 x Mass x Velocity<sup>2</sup>** : The "Dinosaur Extinction" Meteor was about 10 Kilometers in diameter. It had a density of about 3 times water and was moving about 20 Kilometers per second or 72,000 Km / hour. ( Velocity<sup>2</sup> = 400 Km<sup>2</sup> per sec<sup>2</sup> ) This meteor released about 300 to 350 Zettajoules of energy when it hit the Gulf of Mexico 65 million years ago.



Dr. William Moomaw - Humanity's Mortality Moment  
w/ Stuart Scott & Virginia Valdez -  
at COP25 in Madrid, Spain

December 11, 2019

Video Link below - (27:28)

[https://www.youtube.com/watch?v=Wl9Z\\_miGBNw&vl=nl](https://www.youtube.com/watch?v=Wl9Z_miGBNw&vl=nl)

Dr Peter Carter: summarizing the lack of interest in  
"Climate Emergency" at #COP25  
Gives Greta credit for giving the scientists a voice.

Video Link - 23 minutes

<https://www.youtube.com/watch?v=oa13KrOvE2s&t=3s>

	Land Ice Volume	Sea Level Rise
Antarctica	$27 \times 10^6 \text{ Km}^3$	190 ft.
Greenland	$3.4 \times 10^6 \text{ Km}^3$	24 ft.
Mountains	$0.25 \times 10^6 \text{ Km}^3$	1 ft.
<hr/>		
Total Ice	$30.55 \times 10^6 \text{ Km}^3$	215 ft.

$308 \times 10^{15} \text{ Joules}$

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 $\text{Km}^3 \text{ Ice Melted}$

How much melting ice is needed to cool the oceans back to 1980 energy levels?  
How much sea level rise would result from all this melting ice?

Oceans have warmed ~ 320 Zettajoules or  $320 \times 10^{21} \text{ J}$  since 1980.

$$\frac{320 \times 10^{21} \cancel{\text{J}}}{308 \times 10^{17} \cancel{\text{J}}} \times \text{Km}^3 = 1.04 \times 10^6 \text{ Km}^3 \text{ (will melt)}$$

3.4% of Land Ice will melt (7 ft. 4 in.) plus 3 in. / yr if continued.

# Holobionts - Nurturing Microbiomes

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- Multicellular Organisms must nurture a microbiome.
- Animals - Microbiomes in the gut.
- Ruminants - Grazing Animals have as many as 4 guts
- Plants & Fungi feed the microbiome in the soil.
- They create a “Soil Sponge” which holds lots of water.
- Ecosystem Restoration requires all 6 Kingdoms of Life.

# Water Cycles

## Nature keeps water moving.

- **Large Water Cycle** - Ocean Evaporation brings water to land.
- **Small Water Cycles** on Land
  1. Infiltration: 80% is better than 20%. Biodiversity can maximize with an “Infiltration Team” (Insects, Fungi, Rodents)
  2. Evapo-Transpiration: Plants moving water from soil to atmospheric water vapor cooling the surface. “Biotic Pump”
  3. Condensation: Airborne Microbes help form water droplets, some condensation energy escapes to space.
  4. Many small water cycles before water returns to the ocean can help cool the planet.
- **Mini-Water Cycles** - Rocks and driftwood in streams and ponds create eddies and circulation patterns. This allows more contact of nutrients & pollutants with pond microbes and plants. “Living Machines” are designed to maximize water circulation loops and often to invigorate natural systems.