

# FROM ETERNITY TO TOMORROW

V. M. CANUTO

*DEPT. APPLIED PHYS. AND APPLIED MATH.  
COLUMBIA UNIVERSITY, NEW YORK*

*NASA  
GODDARD INSTITUTE FOR SPACE STUDIES, NEW YORK*

# OUR PLANET TODAY

- 7 BILLION PEOPLE
- 3000 DOCTORS
- 1 DOCTOR EVERY 2 MILLION PEOPLE

## DIAGNOSIS

- 1770, H. B. DE SAUSSURE

***GLACIERS, THE CASSANDRA OF CLIMATE***

- 1827, J.B. FOURIER
- 1837, L. AGAZZIZ

***GLACIERS ARE MOVING IN TIME!!!***

## ***GOD'S GREAT PLOUGH***

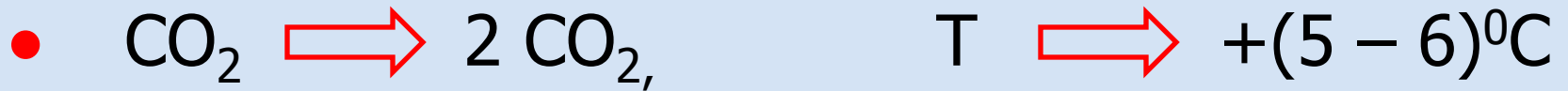
### ***REAL INVENTOR OF THE IDEA OF CLIMATE CHANGE***

- **1859, J.TYNDALL :  $N, O_2 \Rightarrow CO_2$**
- **MAY 18, 1859, ROYAL INSTITUTION  
LONDON**
- **PRINCE ALBERT, QUEEN VICTORIA**

- **ATMOSPHERE ADMITS OF THE ENTRANCE OF SOLAR HEAT, BUT CHECKS ITS EXIT.**
- **RESULT: A TENDENCY TO ACCUMULATE HEAT AT THE SURFACE OF THE PLANET**

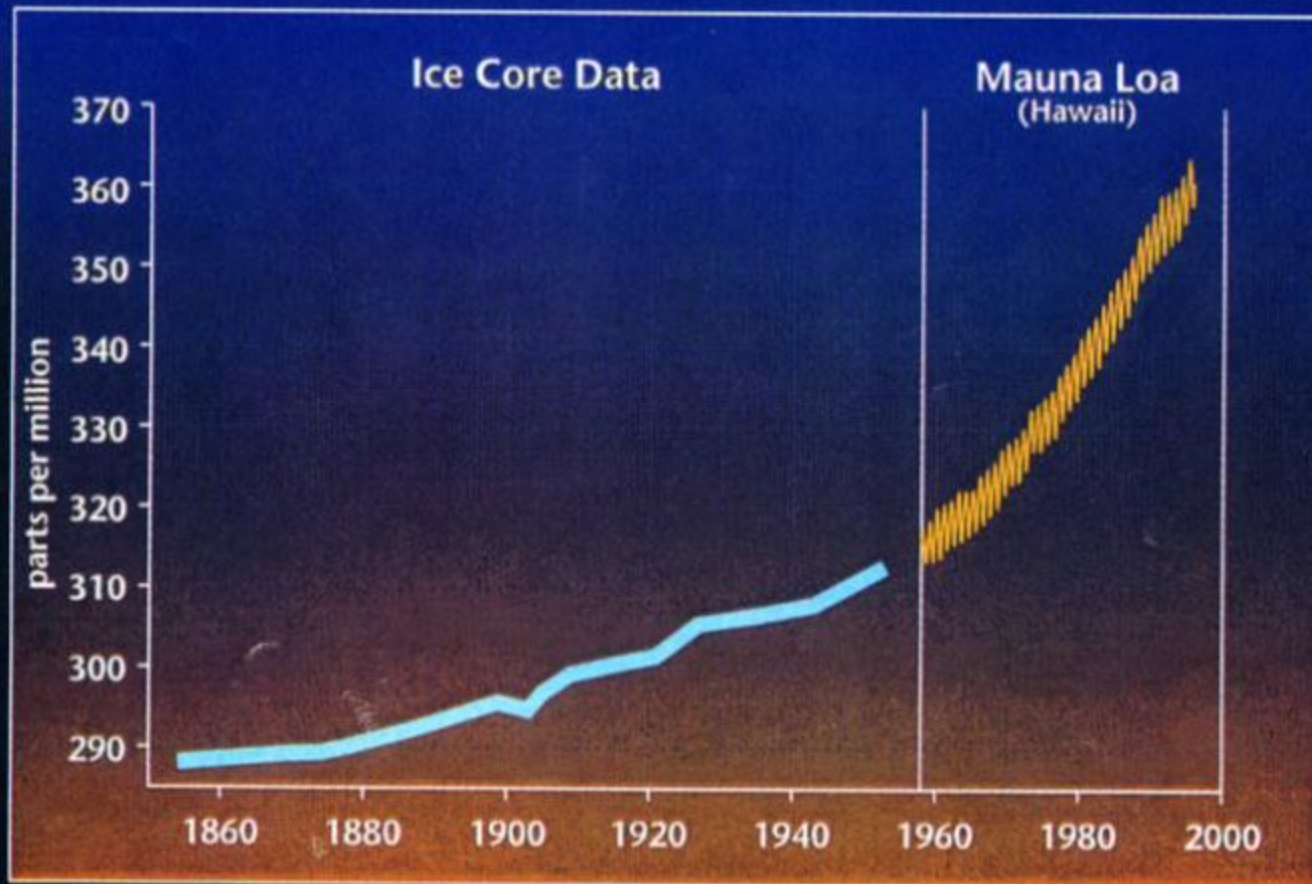
## **GREENHOUSE EFFECT**

- **1896, S. ARRHENIUS**

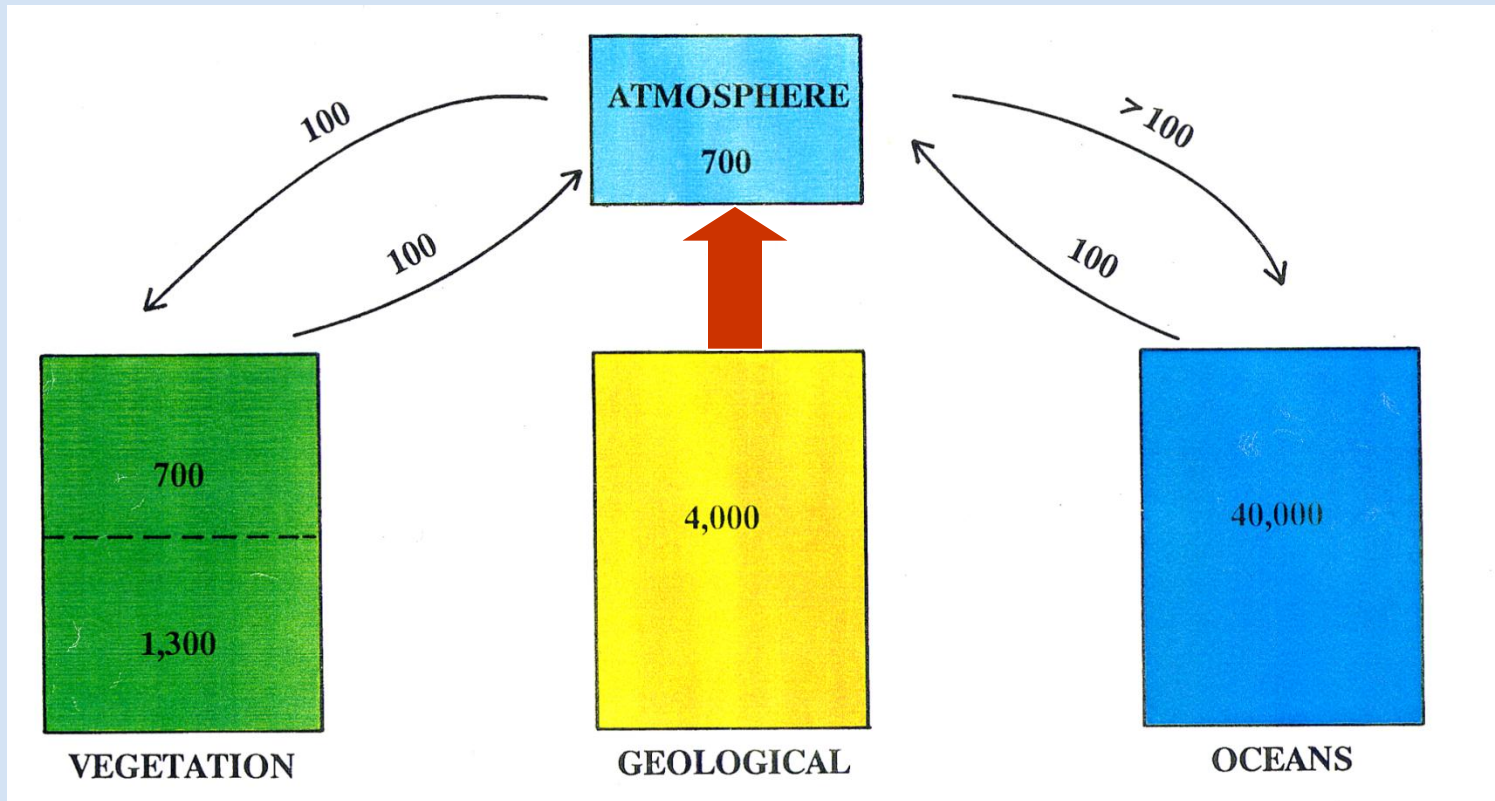


- **1958, IGY, C. D. KEELING**

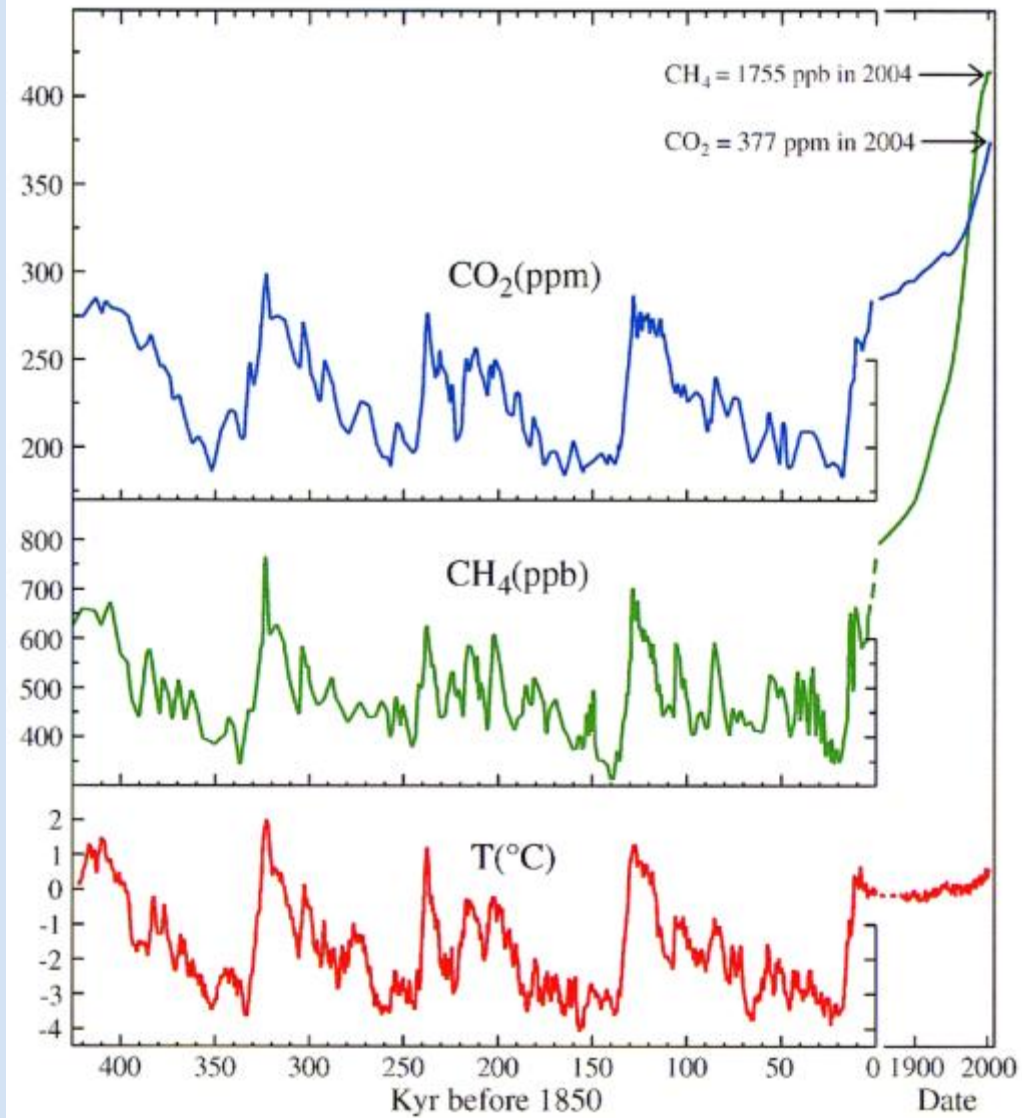
# Carbon Dioxide Concentrations



# THE BREATHING PLANET

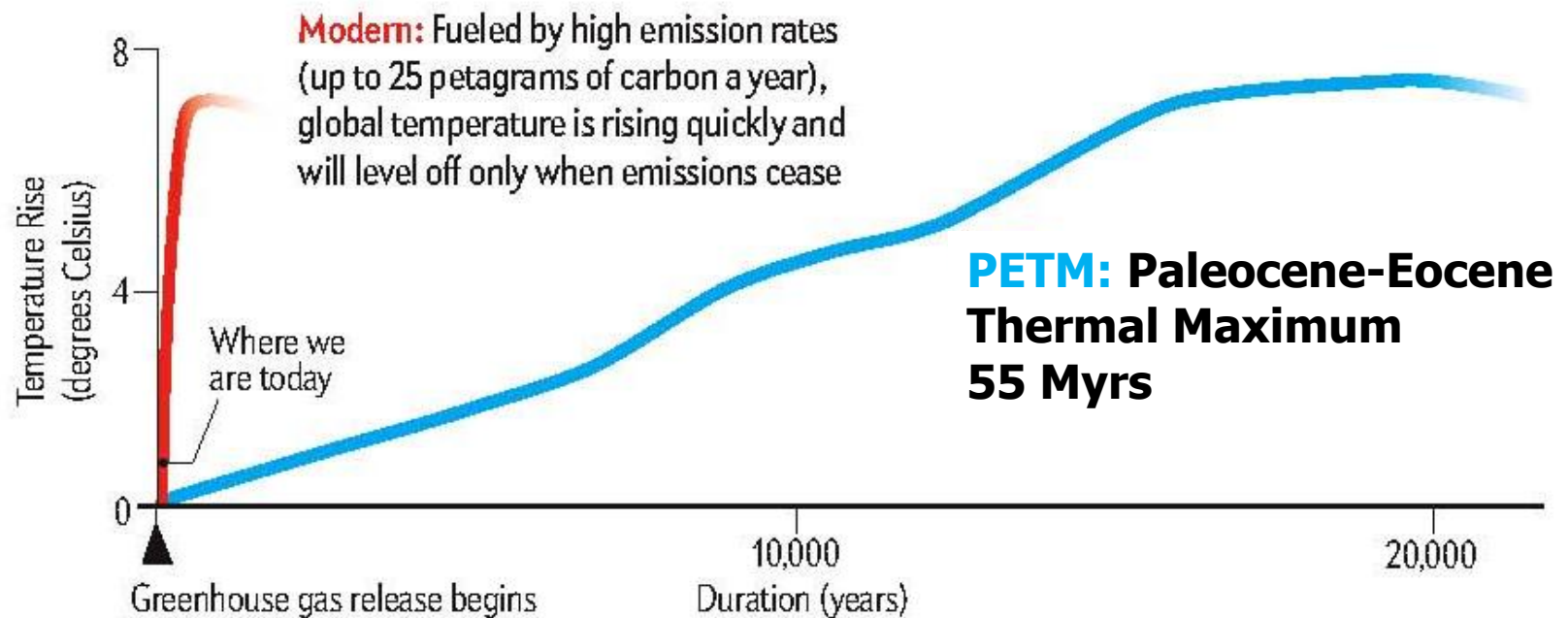


**A MIDGET AMONG GIANTS**





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



*L. R. Kump, 2011, Scientific American*

# **SINCE THE BEGINNING OF THE INDUSTRIAL REVOLUTION**

## **ANTHROPOCENE**

**REAL WORLD:      TODAY: 380 ppm**

**NO OCEANS:      TODAY:**  
**380+55 = 435 ppm**

**The river is within us.....**




**The sea is all about us**

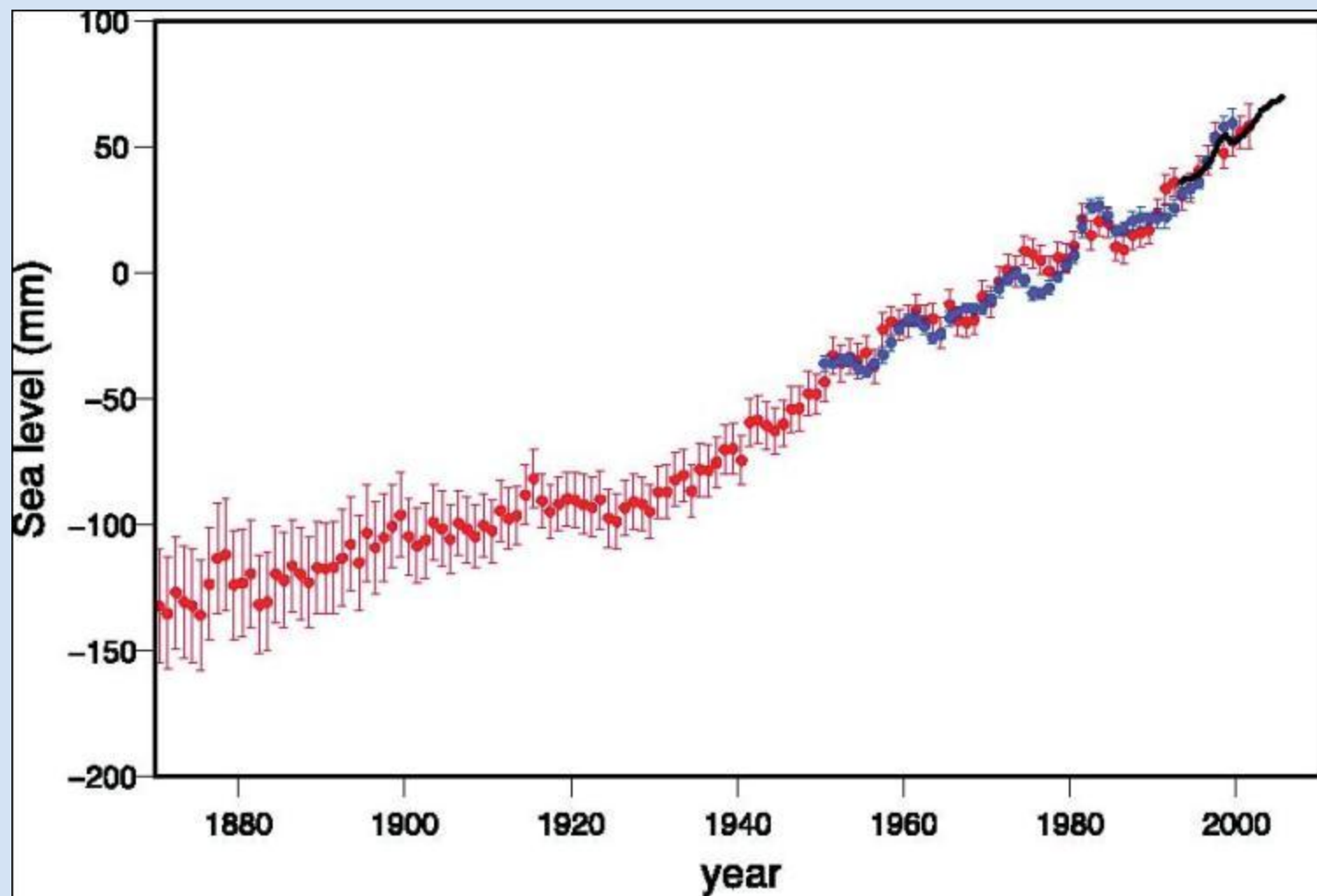
**T.S.ELIOT**

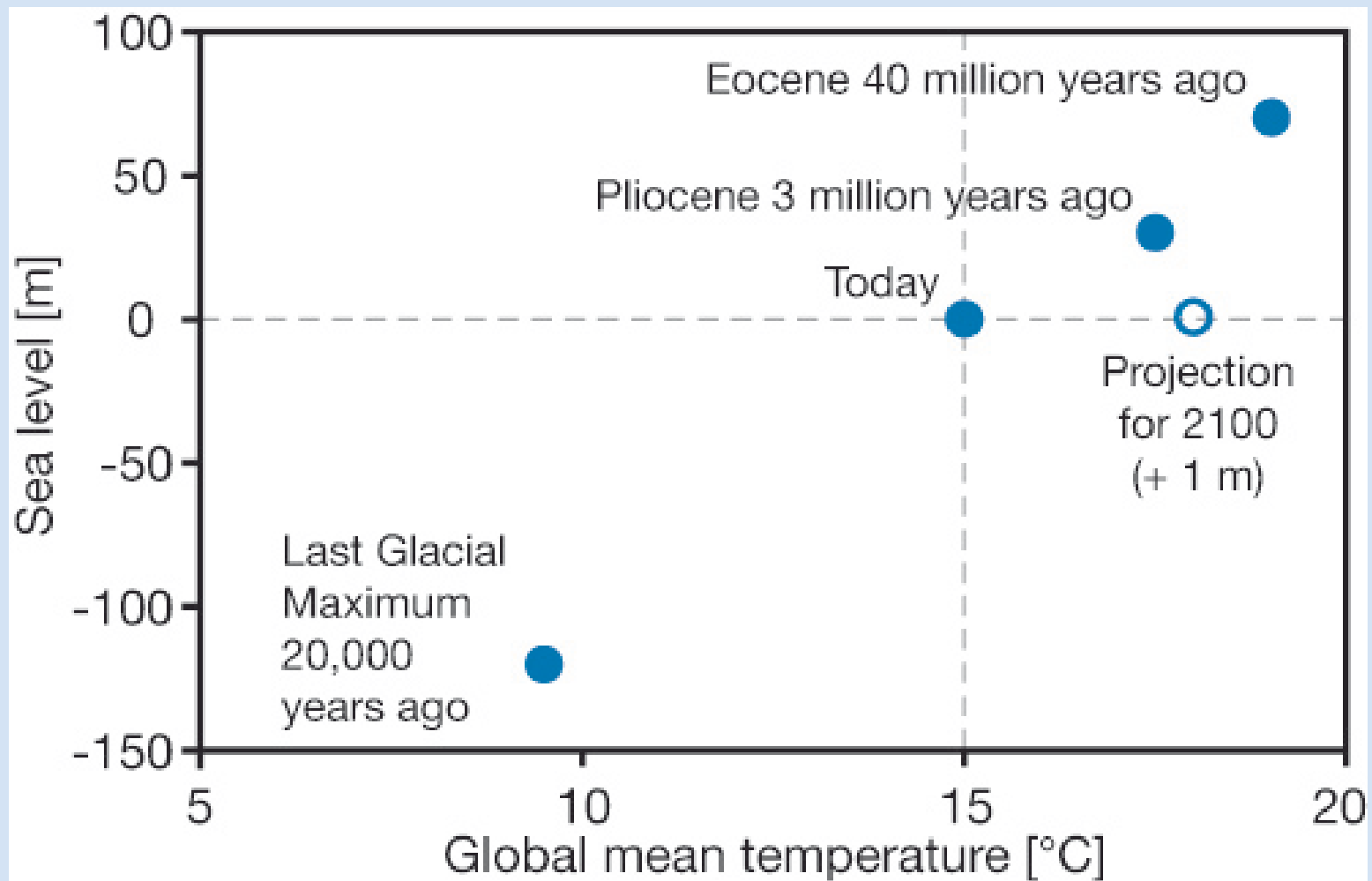
# OCEANS

- **HUGE HEAT CAPACITY**
- **FIRST 2.5m UPPER OCEAN  
ENTIRE TROPOSPHERE**

## **INCREASE CO<sub>2</sub>:**

- **MEAN TEMPERATURE** 
- **SEA LEVEL** 
- **OCEAN ACIDITY** 



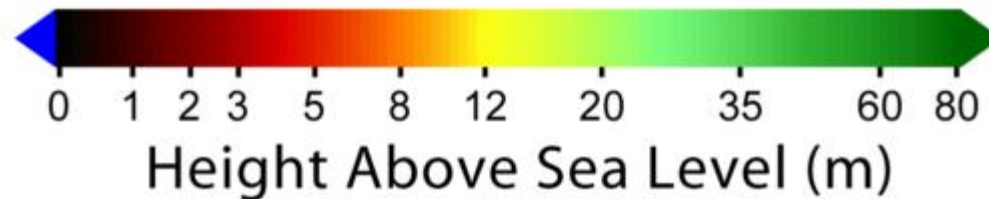
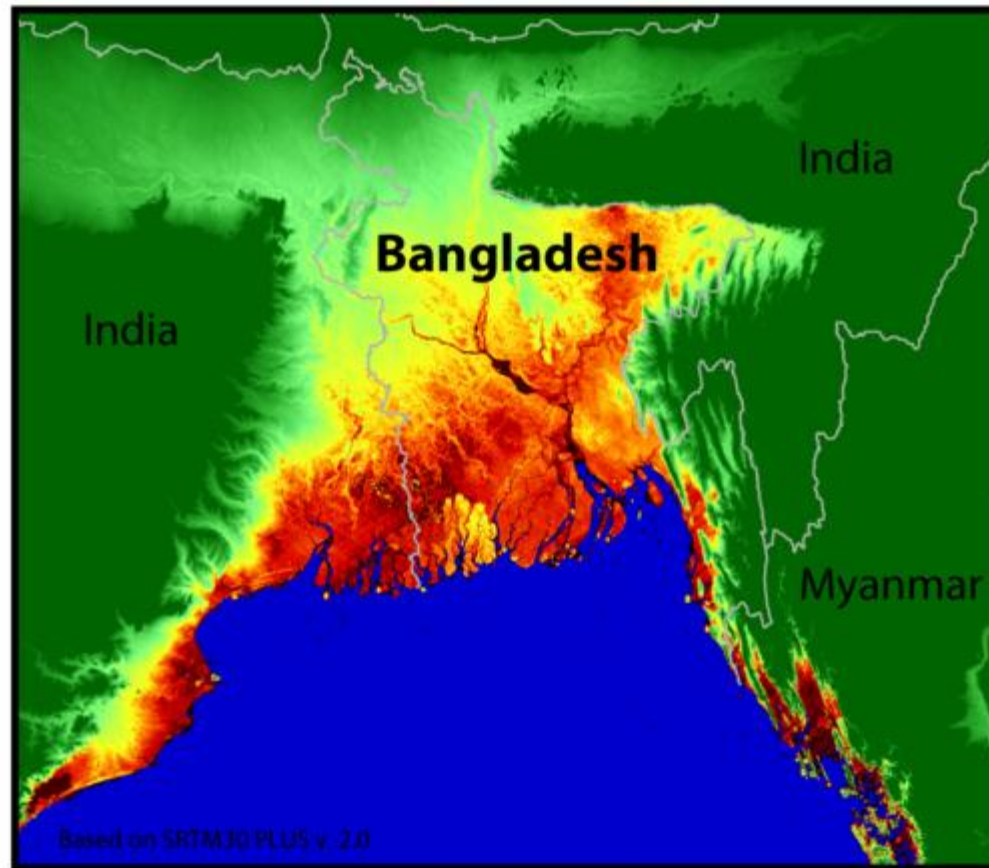


# SEA LEVEL RISE



- 23% WORLD POPULATION (1.5 BILLION) LIVE WITHIN 100KM OF COASTAL AREAS <100M ABOVE SEA LEVEL
- 600 MILLIONS LIVE IN COASTAL AREAS, <1M ABOVE SEA LEVEL



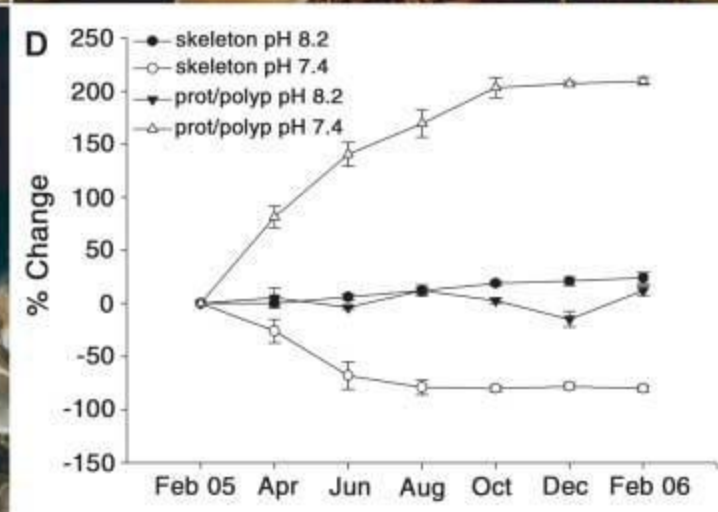
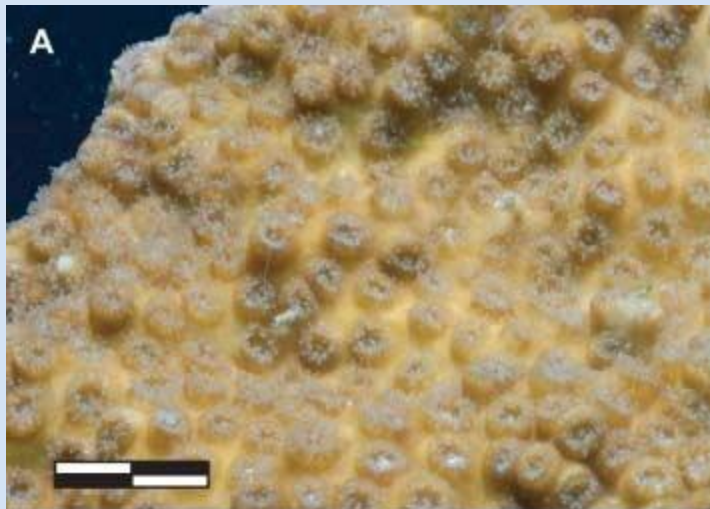
## Sea Level Risks - Bangladesh



# **OCEAN ACIDIFICATION**

- **OCEANIC pH** 
- **CALCIFICATION** 





# **Future Oceans ...**

**Warming Up**

**Rising High**

**Turning Sour**

# OCEANS - LIFE

- **$4 \times 10^9$  yrs ago: life on earth began in the oceans**
- **$500 \times 10^6$  yrs ago: life emerged from the oceans**
- **0.004%: humankind on earth**
- **working against the oceans' buffering action as a CO<sub>2</sub> sink**



- **GROWTH RATE: 10,000 PEOPLE/HOUR**
- **ONLY A MADMAN (OR AN ECONOMIST)  
BELIEVES THAT EXPONENTIAL GROWTH CAN  
GO ON FOREVER**
- **TENDENCY IS NOT DESTINY**
- **HUMANITY: NOT THE SUM OF ITS PEOPLE  
SUM OF ITS NECESSITIES (J.P. SARTRE)**

**S. Arrhenius:**

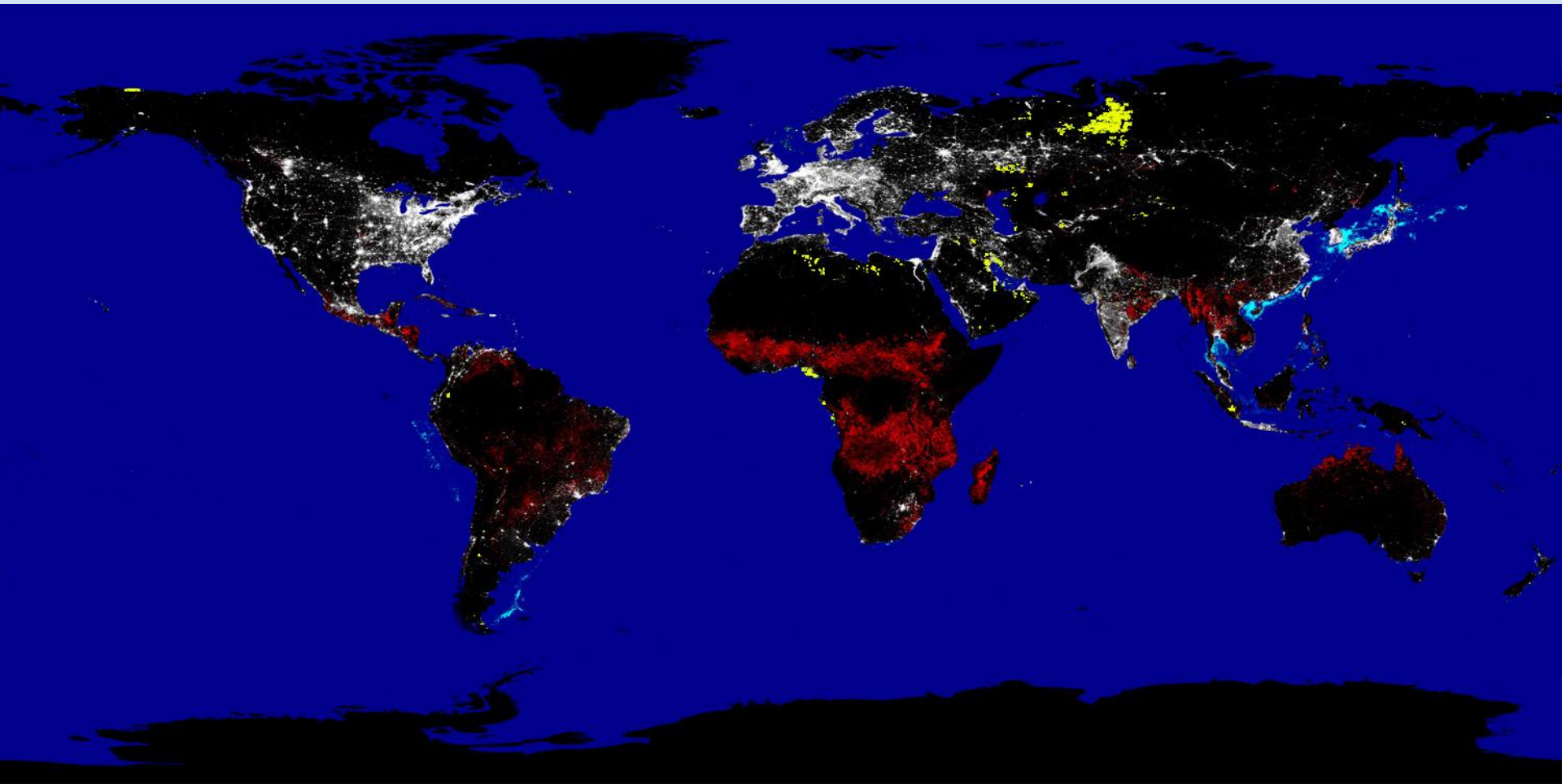
**We are evaporating our  
coal mines into the air**



**J. Lovelock:**

**Our comprehension of the Earth is no better than an eel's comprehension of the ocean in which it swims**

# **CIVILIZATION : AN INTERLUDE**



**WE KNOW THE PRICE OF  
EVERYTHING BUT THE VALUE OF  
NOTHING**

**ECONOMIES ARE GLOBALIZED  
MORAL VALUES ARE NOT**

**TECHNOLOGICAL GIANTS BUT  
MORAL DWARFS**

**CO<sub>2</sub>**

- **40%** STAYS IN THE ATMOSPHERE
- **60%** OCEAN AND VEGETATION

