

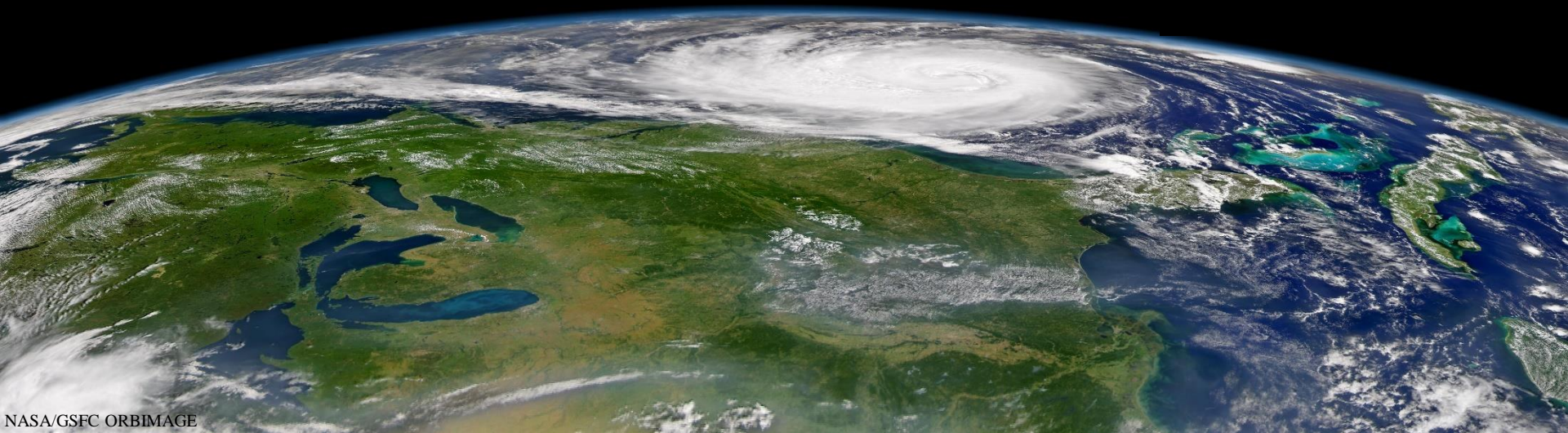


# Globális klímaváltozás: mit tanultunk az elmúlt 14 évben?

Jánosi Imre

ELTE TTK, Komplex Rendszerek Fizikája Tanszék  
Kármán Környezeti Áramlások Laboratórium

<http://www.atomcsill.elte.hu>

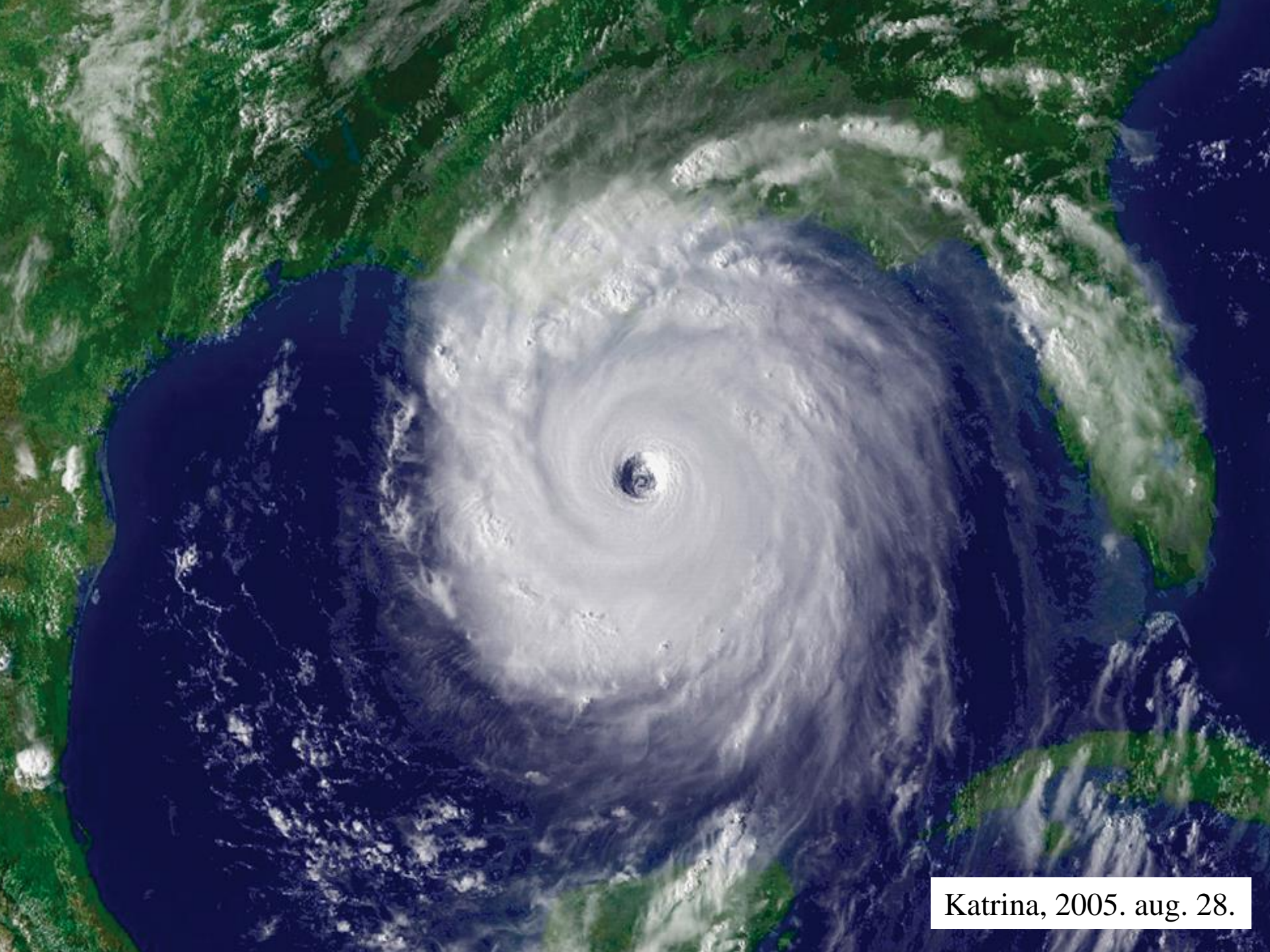


New Orleans, 2005. aug. 31.









Katrina, 2005. aug. 28.

Bahama-szigetek, 2019. szept. 4.







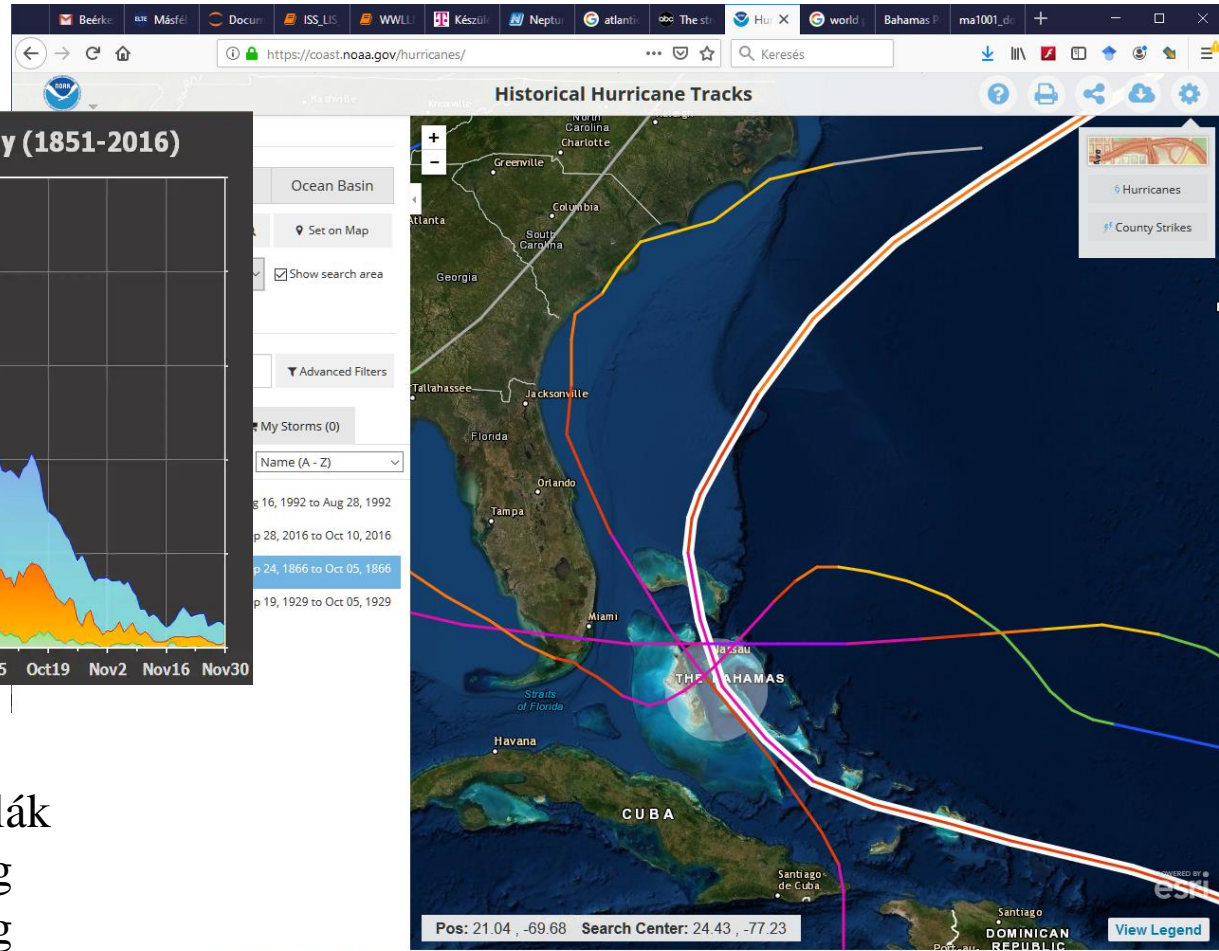
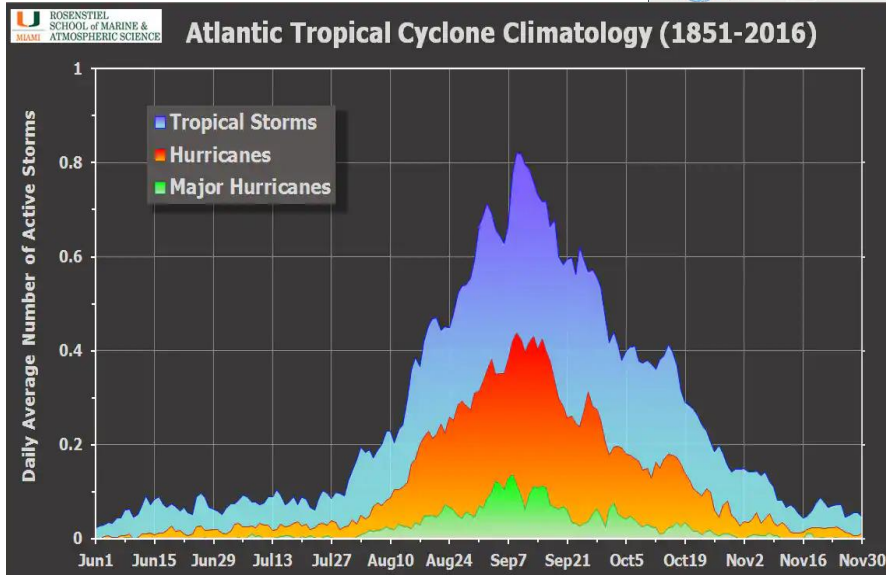




Dorian, 2019. szept. 2.

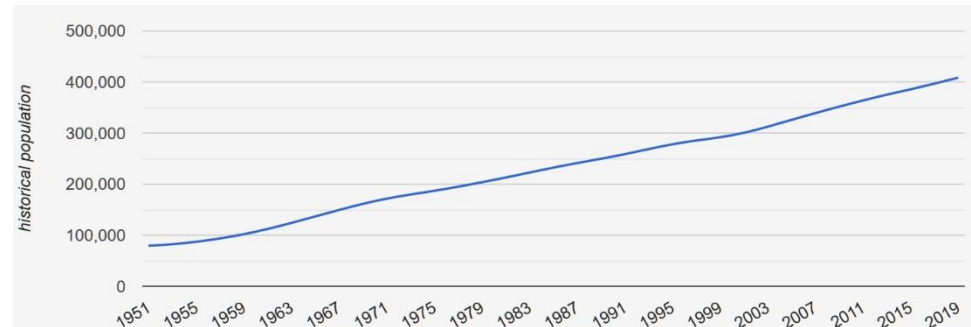
# Micsoda egybeesés!?

(Nem.)

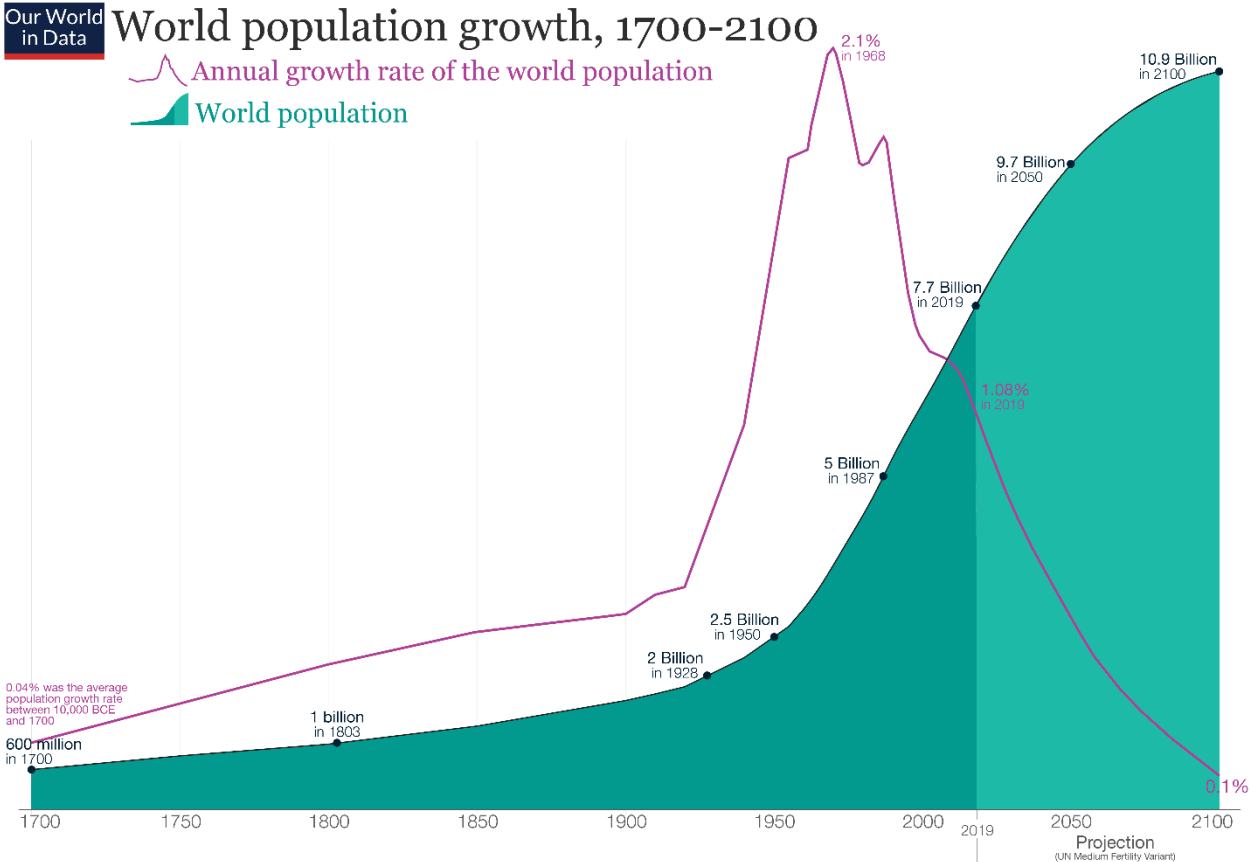


- 2005 Katrina(5) Louisiana
- 2008 Ike(4) Nagy-Antillák
- 2011 Irene(3) Karib-térség
- 2012 Sandy(3) Karib-térség
- 2016 Matthew(5) Kolumbia, Venezuela
- 2017 Harvey(4) Texas
- 2017 Maria(5) Puerto Rico
- 2018 Michael(5) Közép-Amerika
- 2019 Dorian(5) Bahama-szigetek

.....

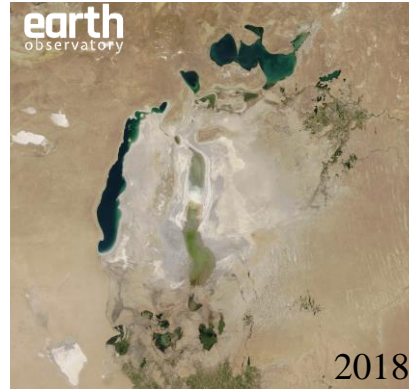


# A leggyakoribb félreértés.....



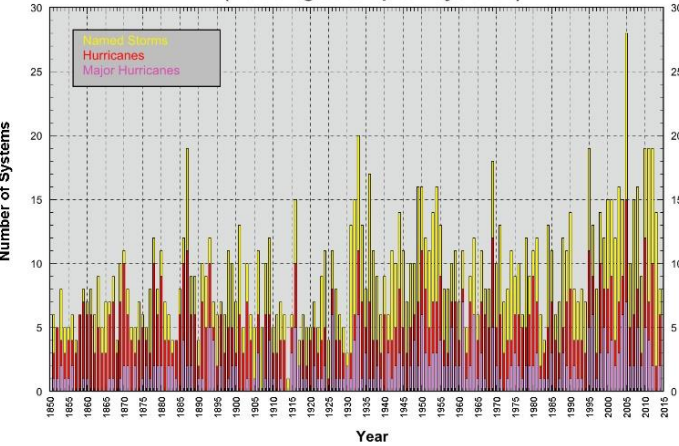
Data sources: Our World in Data based on HYDE, UN, and UN Population Division [2019 Revision]  
This is a visualization from [OurWorldinData.org](https://ourworldindata.org), where you find data and research on how the world is changing.

Licensed under CC-BY by the author Max Roser.



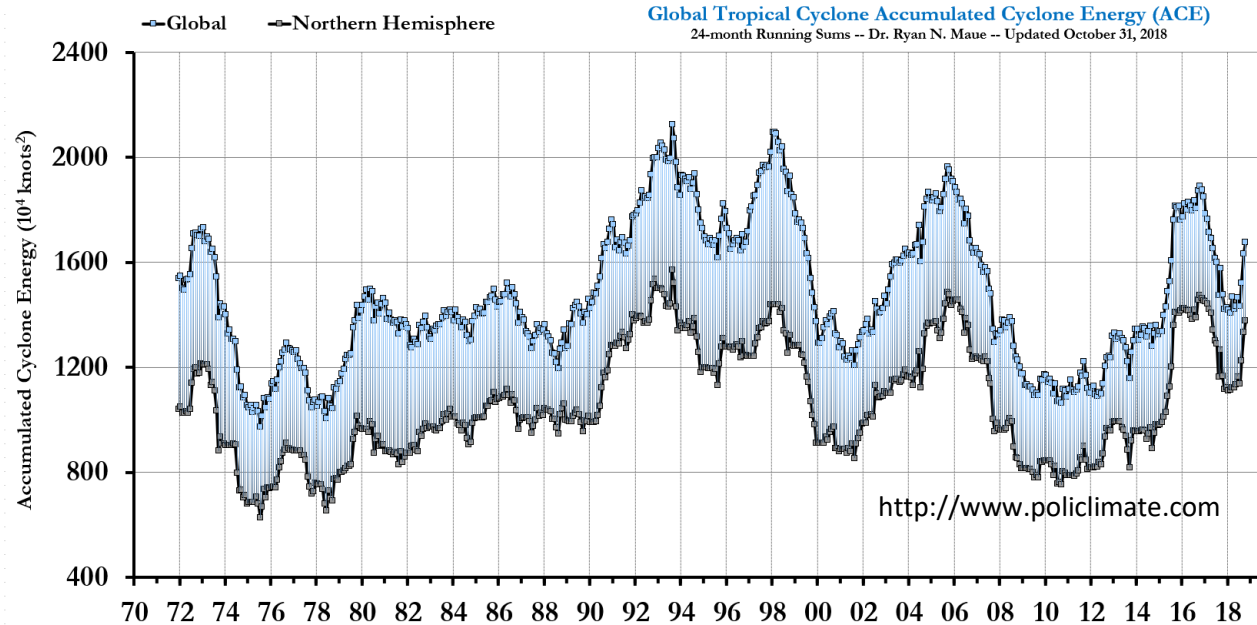
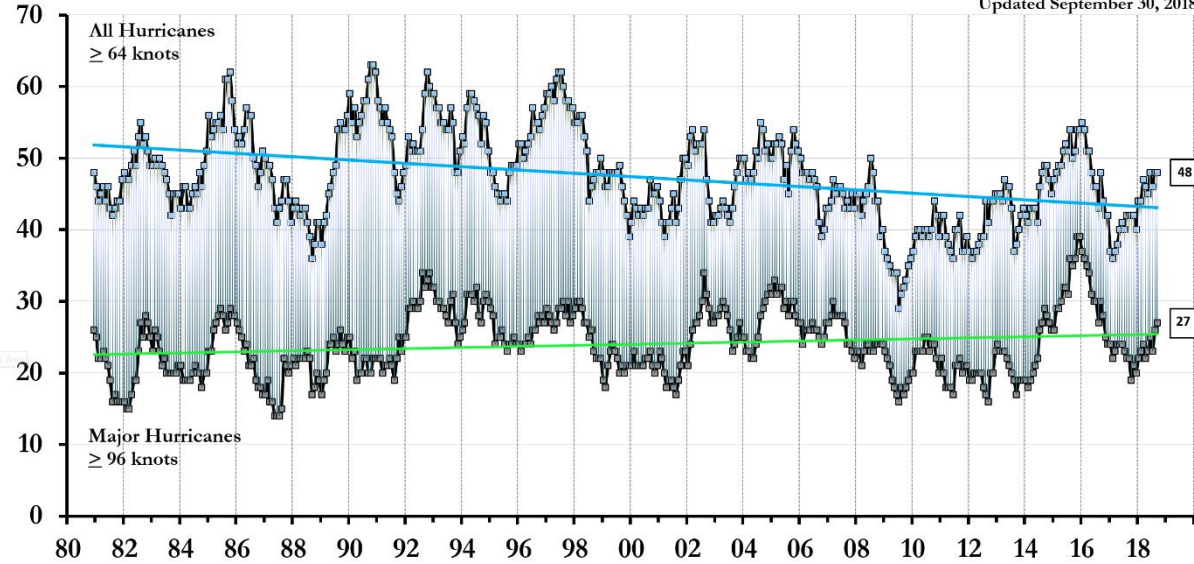
“The environment for all such storms has changed because of climate change.”  
 (Kevin Trenberth, NCAR – *Sci. Am.* 3 Sept. 2019)

Atlantic Basin Storm Count  
 (Including Subtropical Cyclones)



Global Major Hurricane Frequency -- 12 month running sums

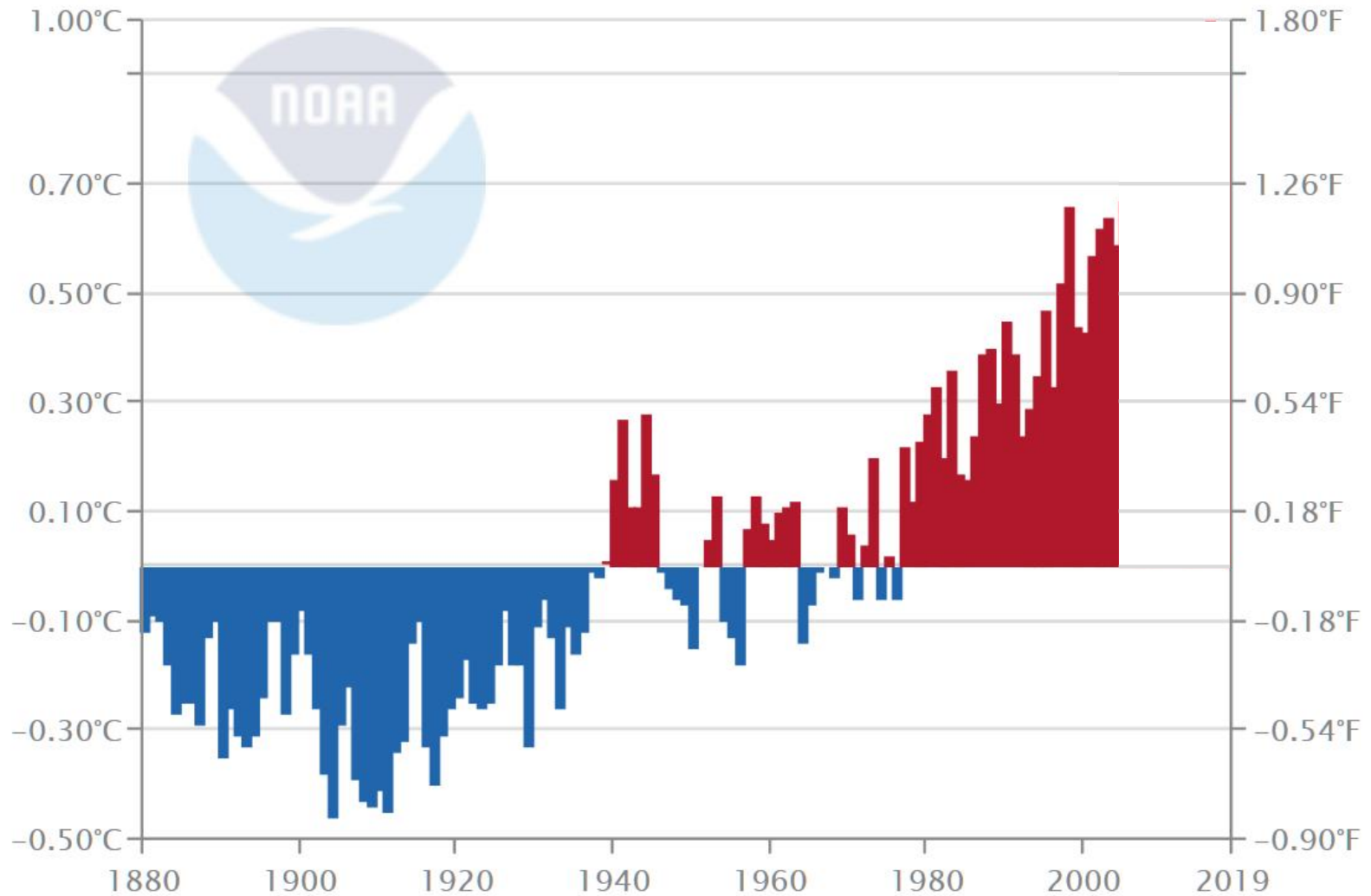
Dr. Ryan N. Maue  
 Updated September 30, 2018



# 1. Globális felmelegedés

## Global Land and Ocean

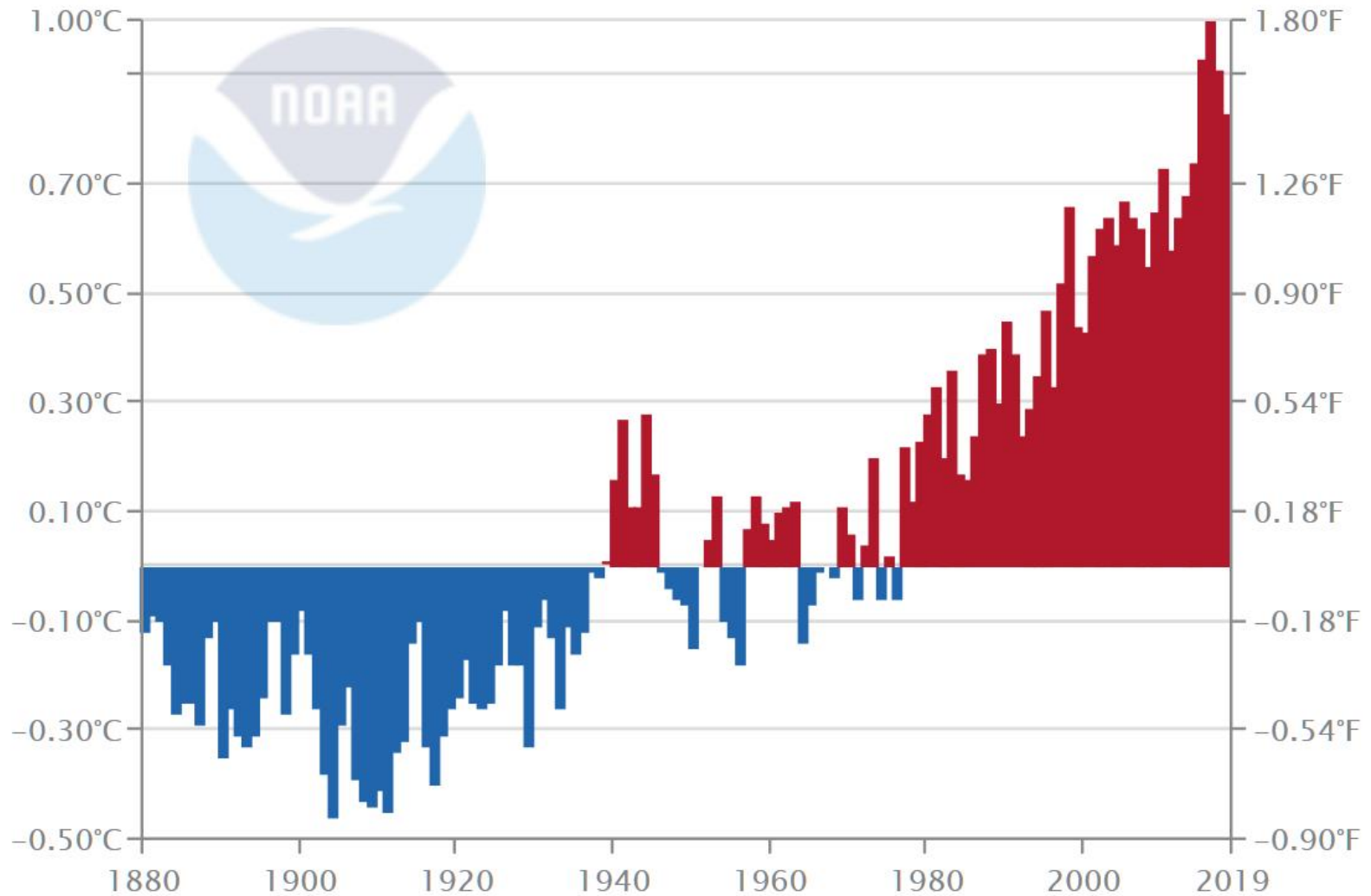
### January–December Temperature Anomalies



# 1. Globális felmelegedés

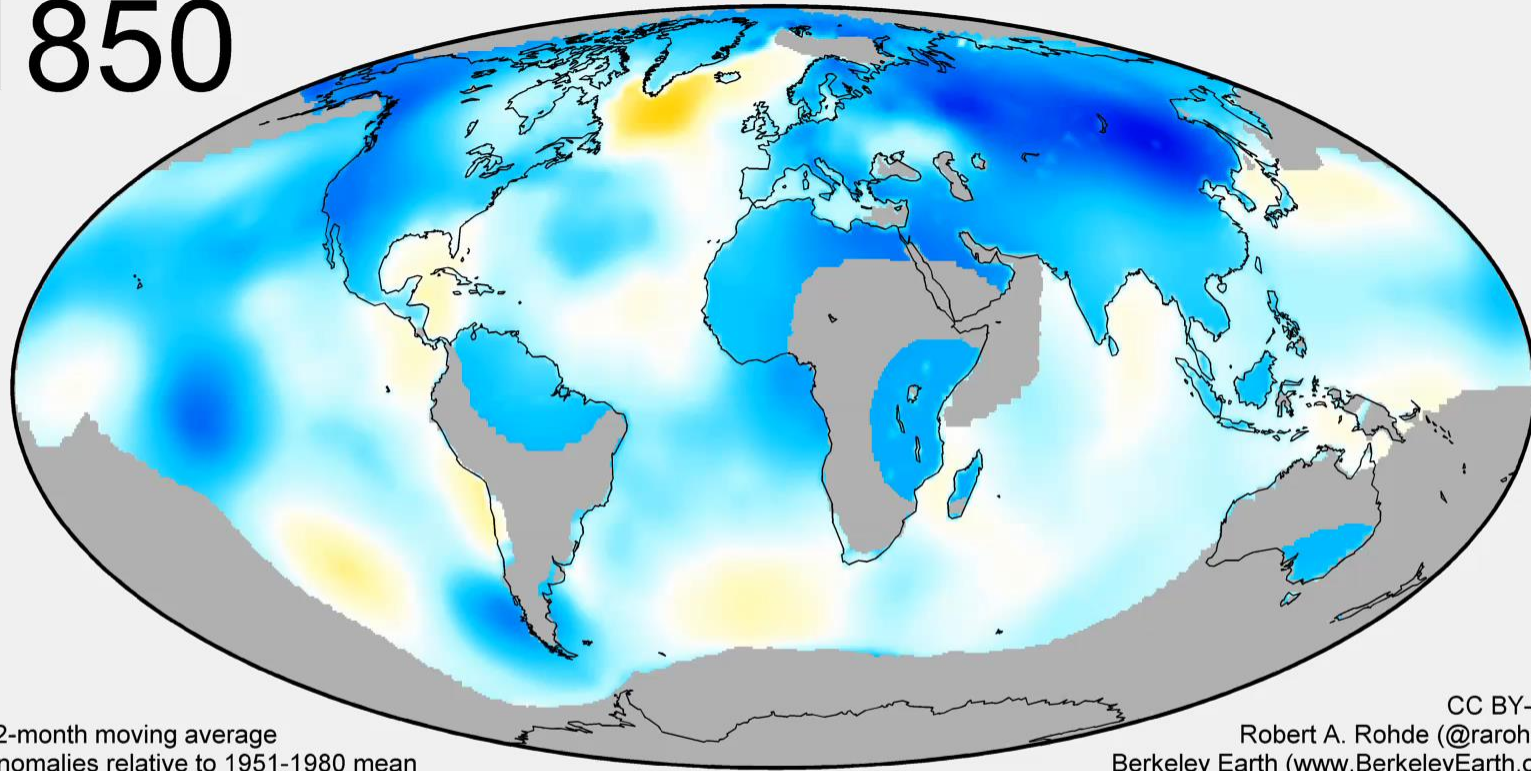
## Global Land and Ocean

### January–December Temperature Anomalies



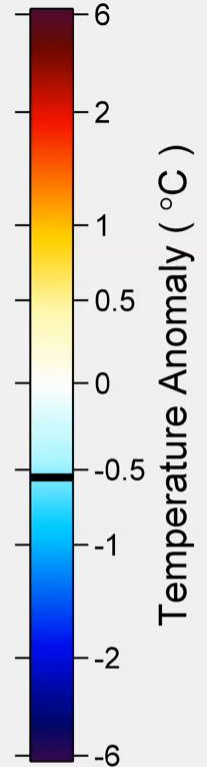
# 1. Globális felmelegedés

# 1850

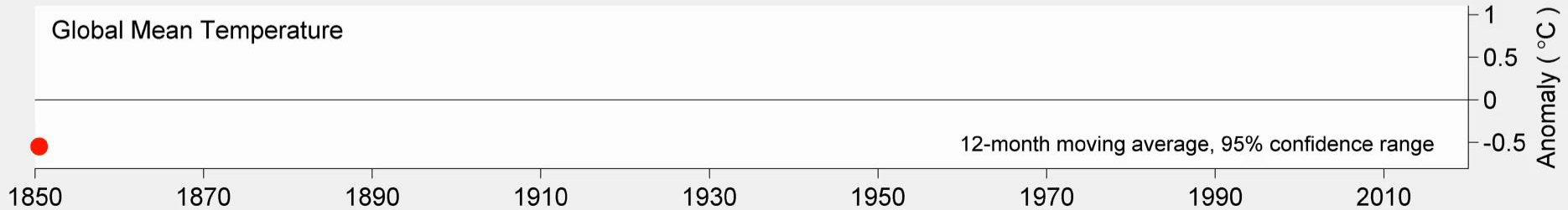


12-month moving average  
Anomalies relative to 1951-1980 mean

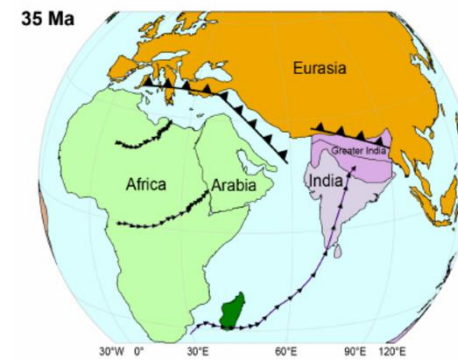
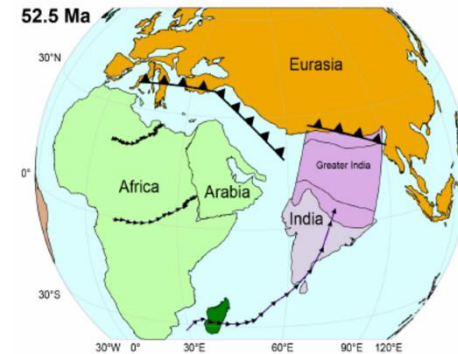
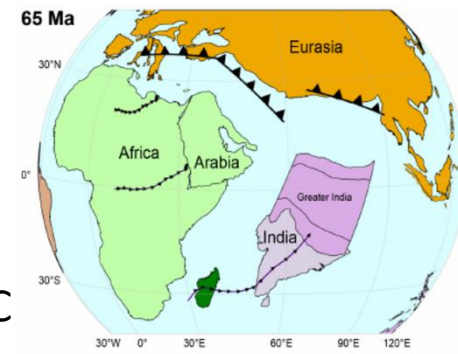
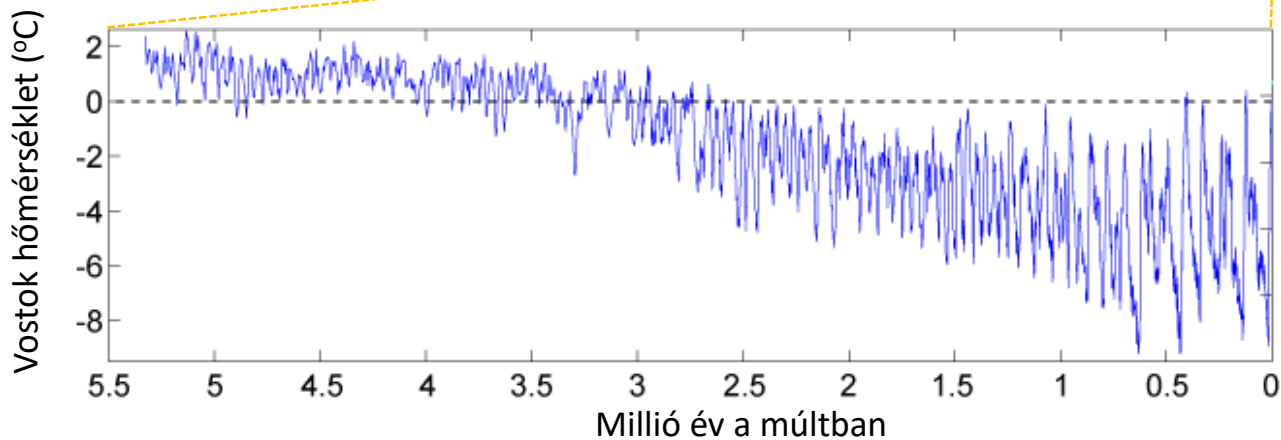
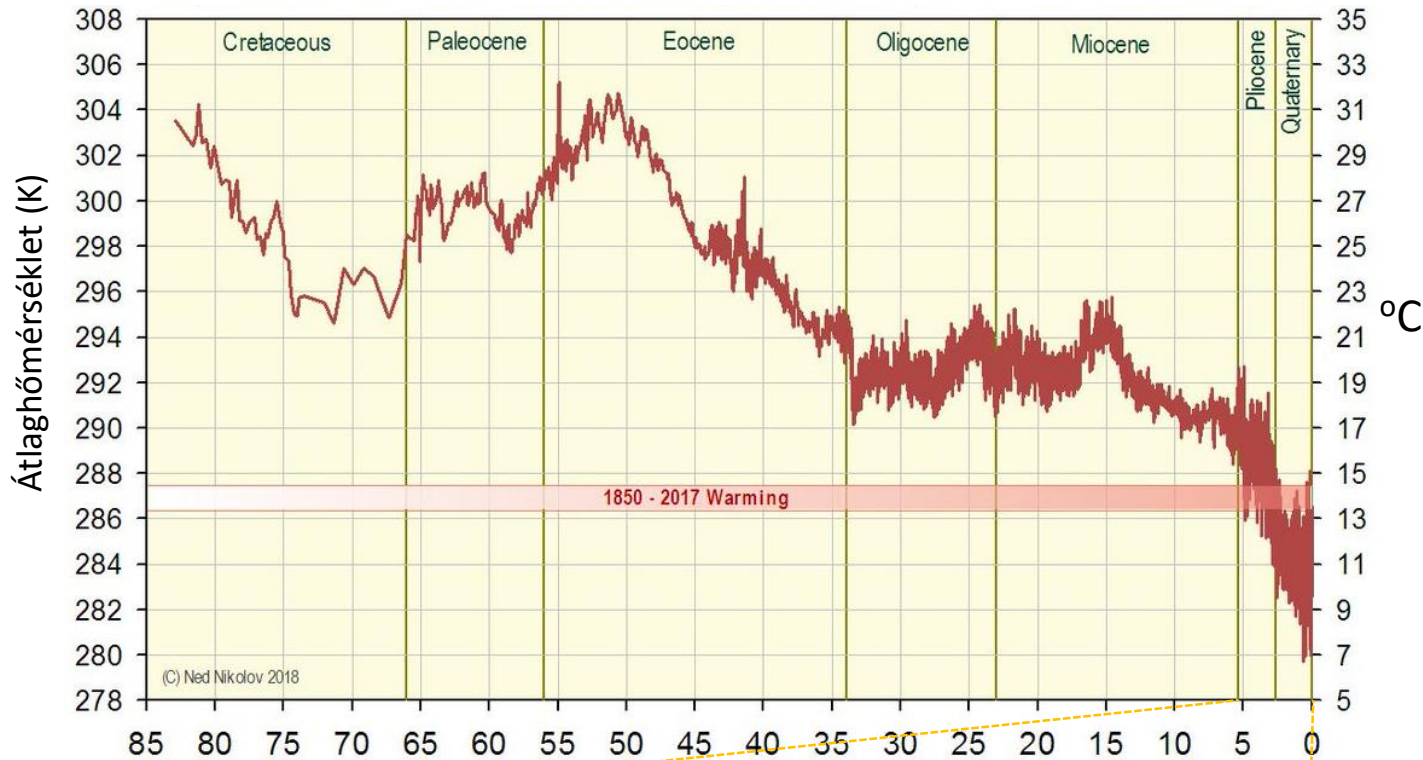
CC BY-4.0  
Robert A. Rohde (@rarohde)  
Berkeley Earth ([www.BerkeleyEarth.org](http://www.BerkeleyEarth.org))



Global Mean Temperature

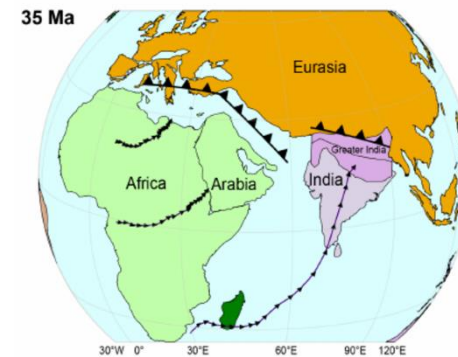
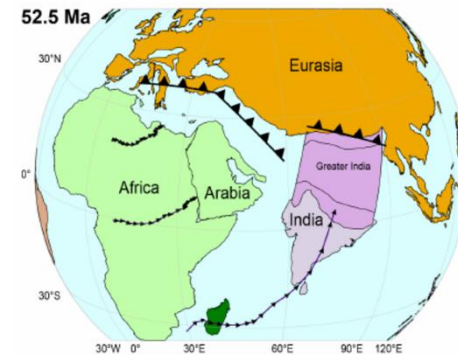
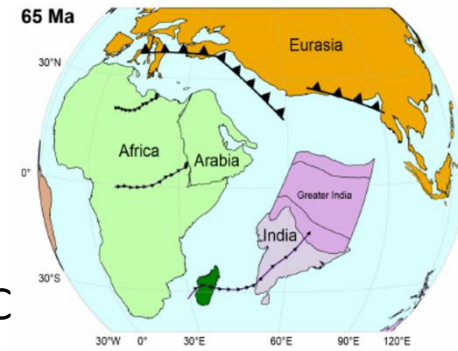
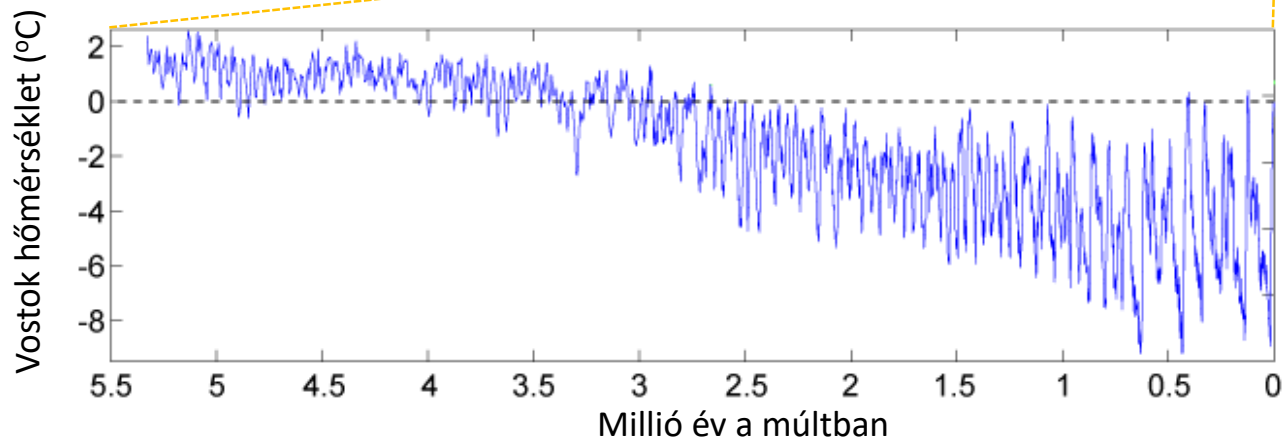


# 1. Globális felmelegedés a paleoklimatológia tükrében

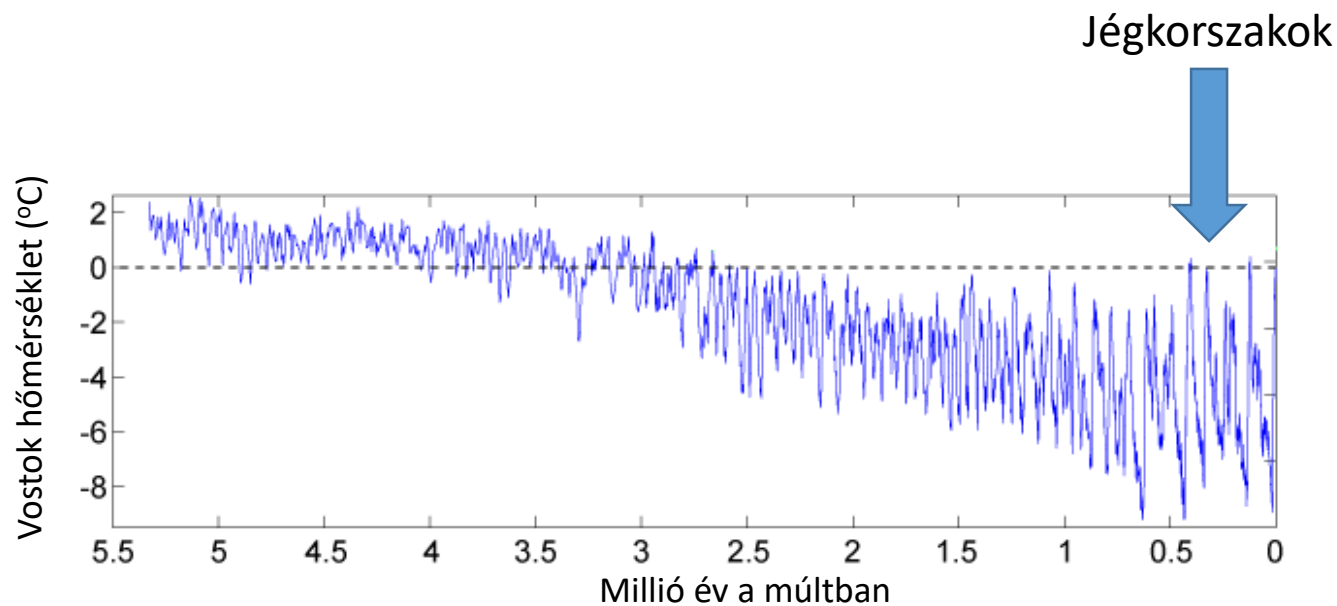




# 1. Globális felmelegedés a paleoklimatológia tükrében



# 1. Globális felmelegedés a paleoklimatológia tükrében

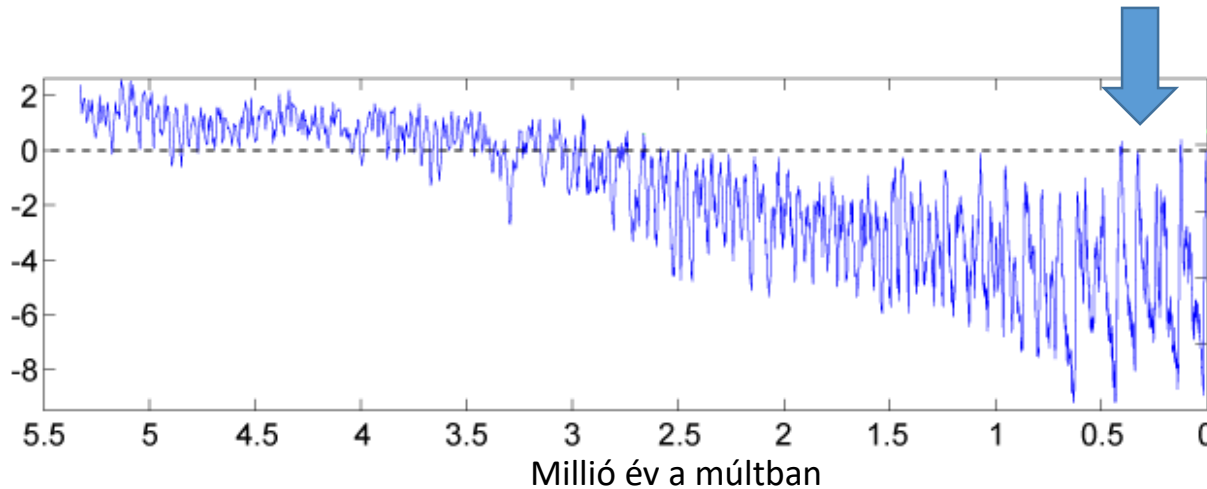


# 1. Globális felmelegedés a paleoklimatológia tükrében

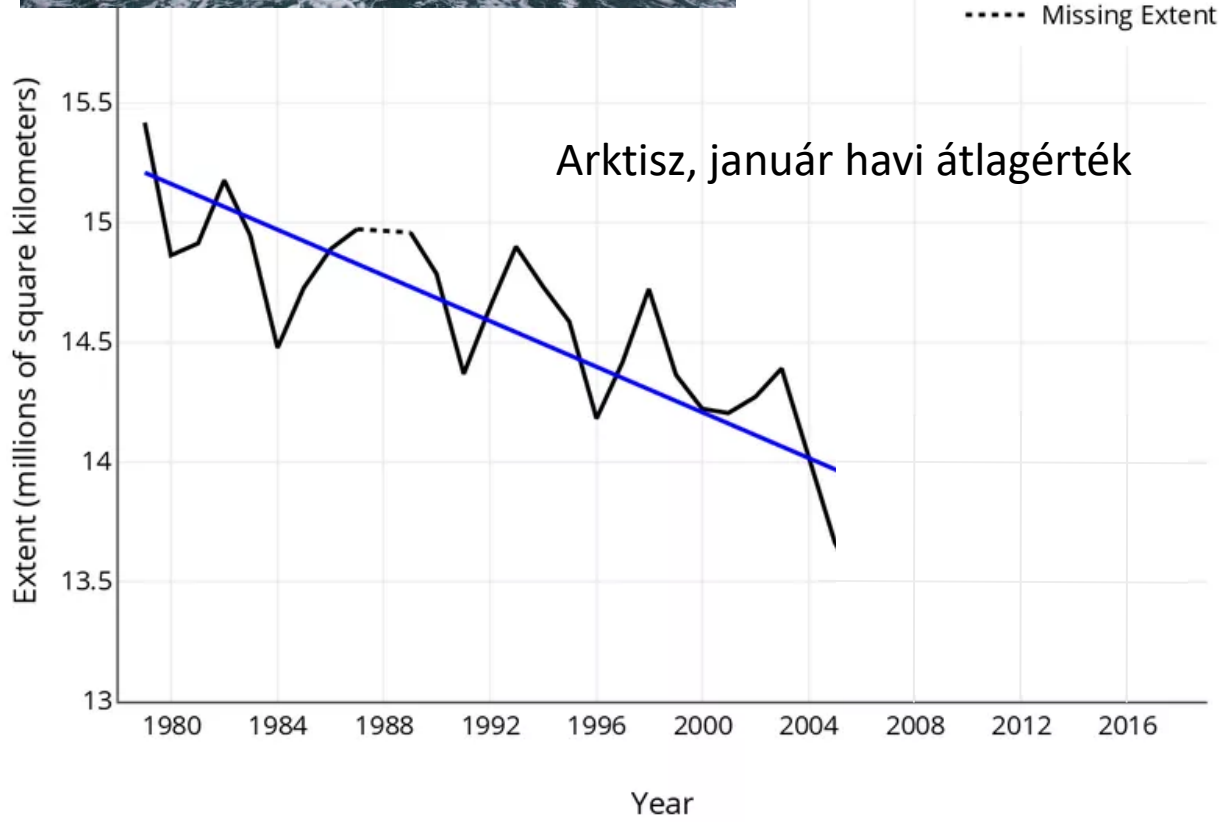
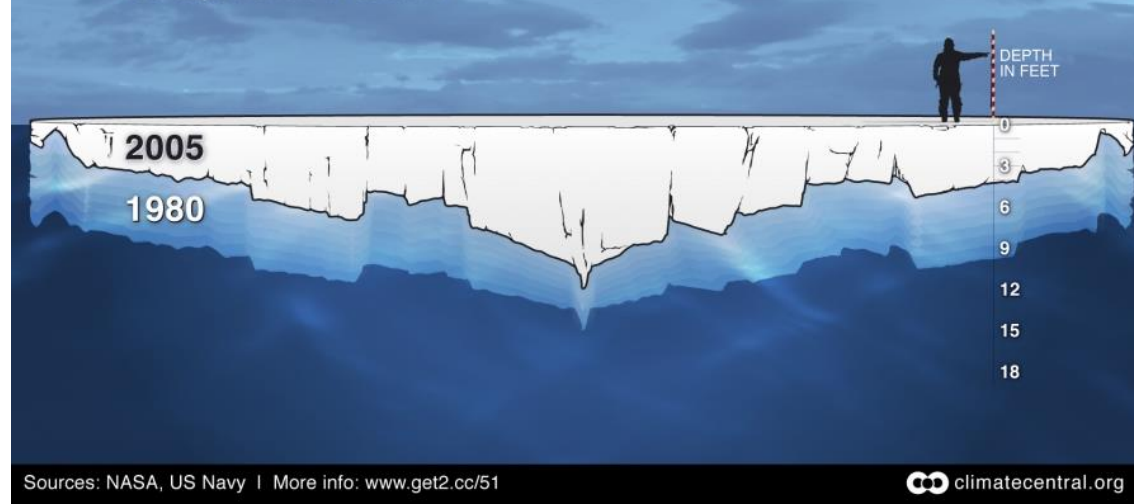


Jégkorszakok

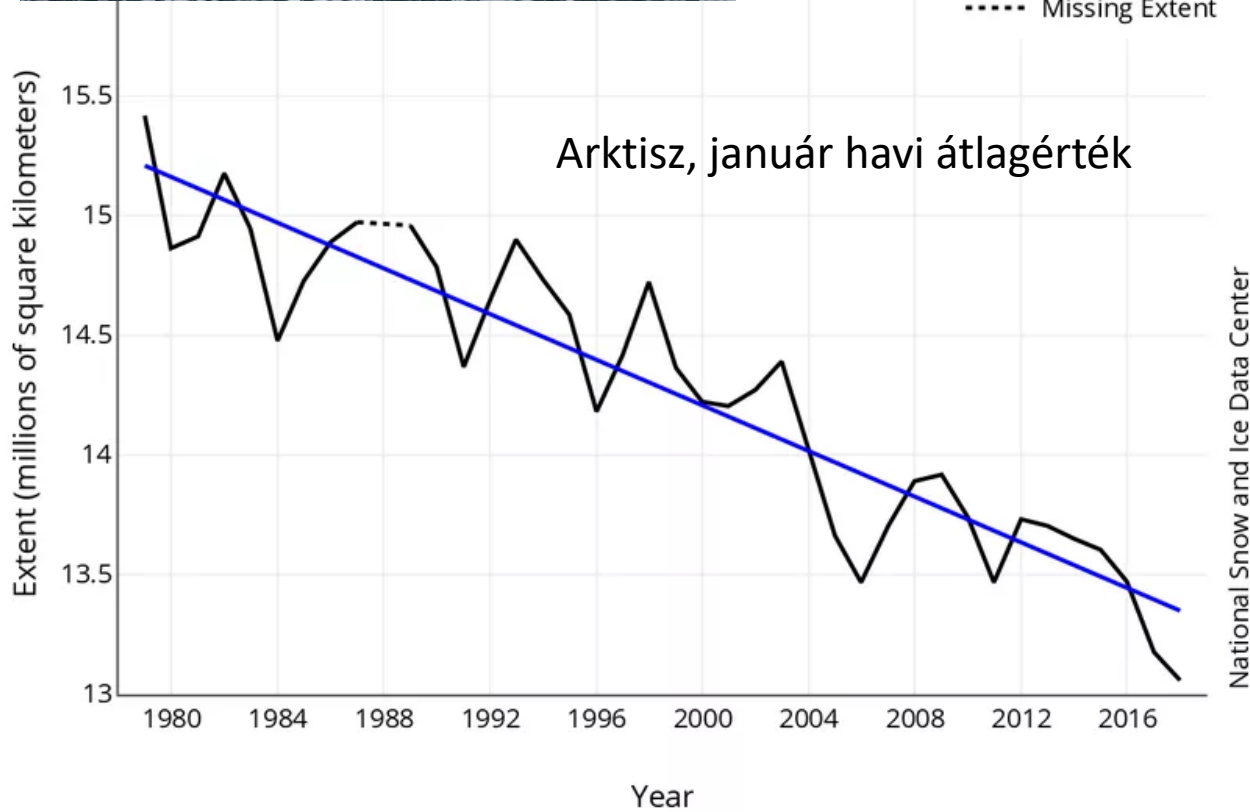
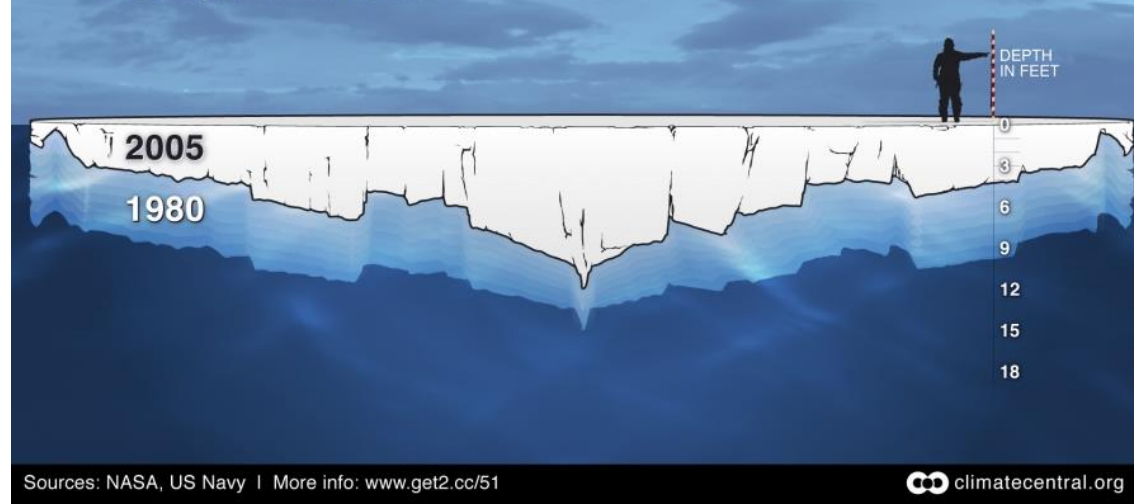
Vostok hőmérséklet (°C)



## 2. Jégtakaró zsugorodik

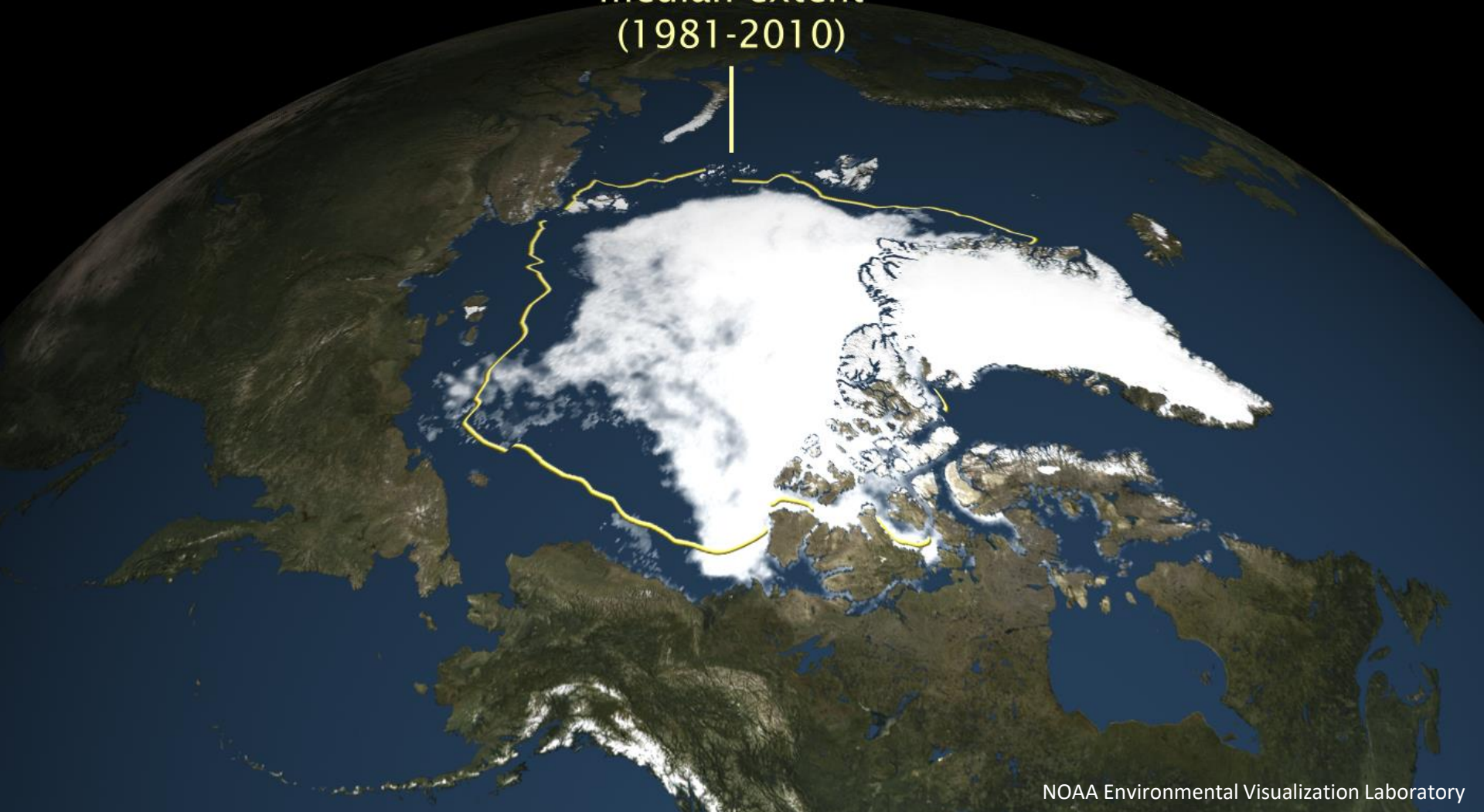


## 2. Jégtakaró zsugorodik

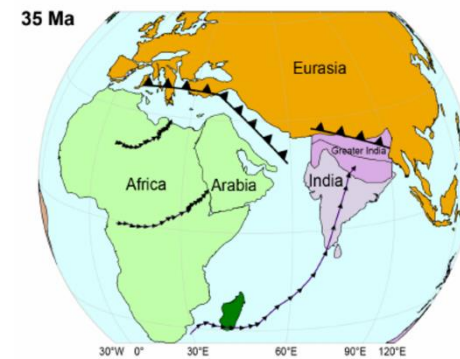
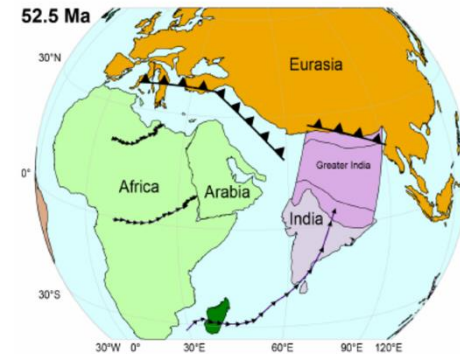
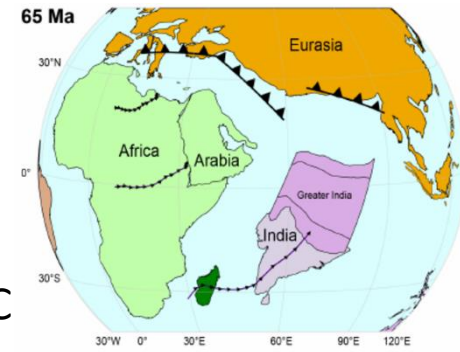
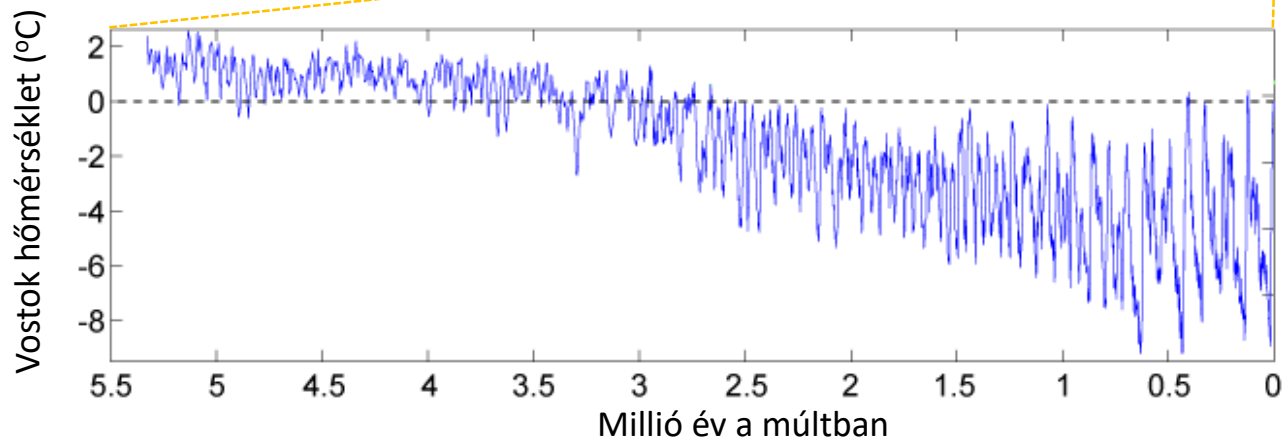
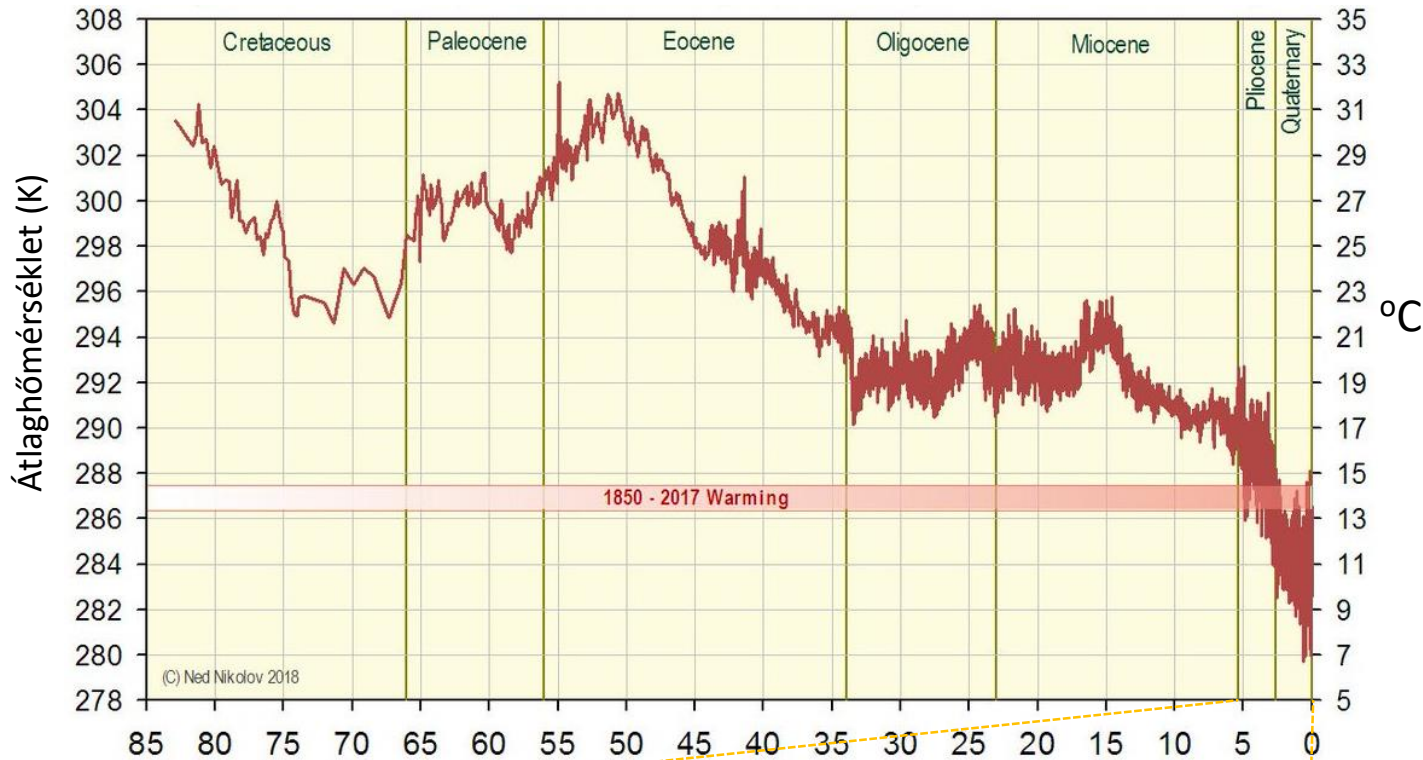


## 2. Jégtakaró zsugorodik

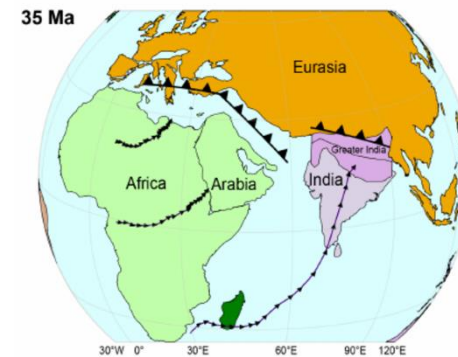
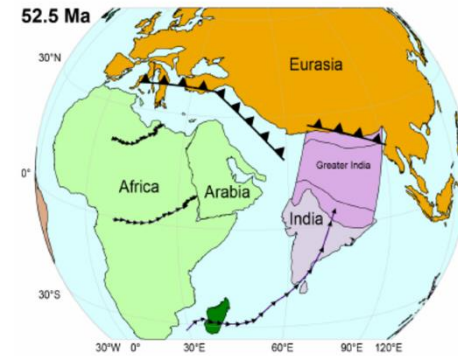
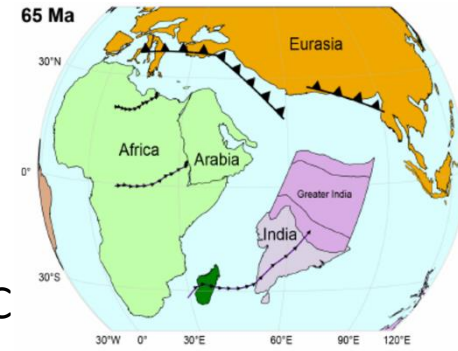
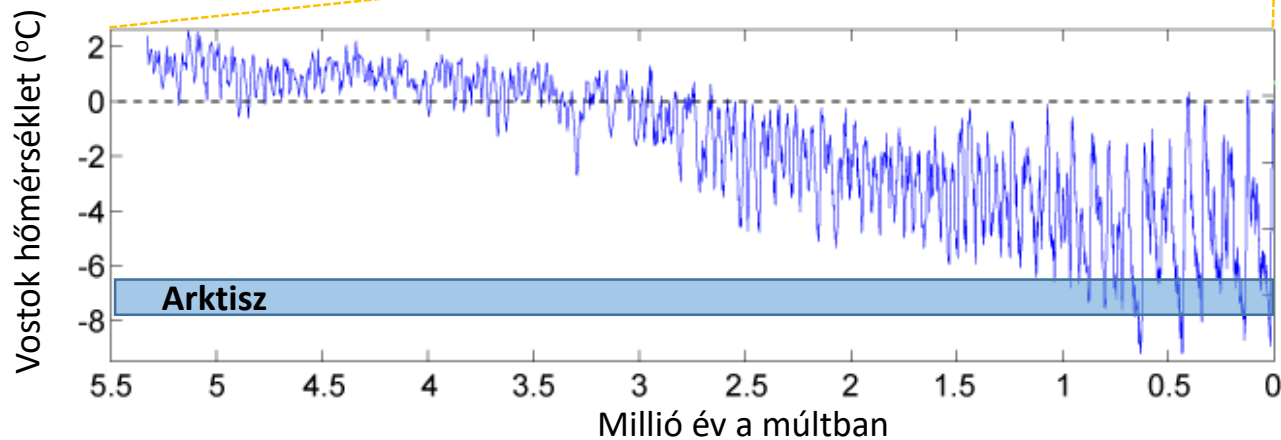
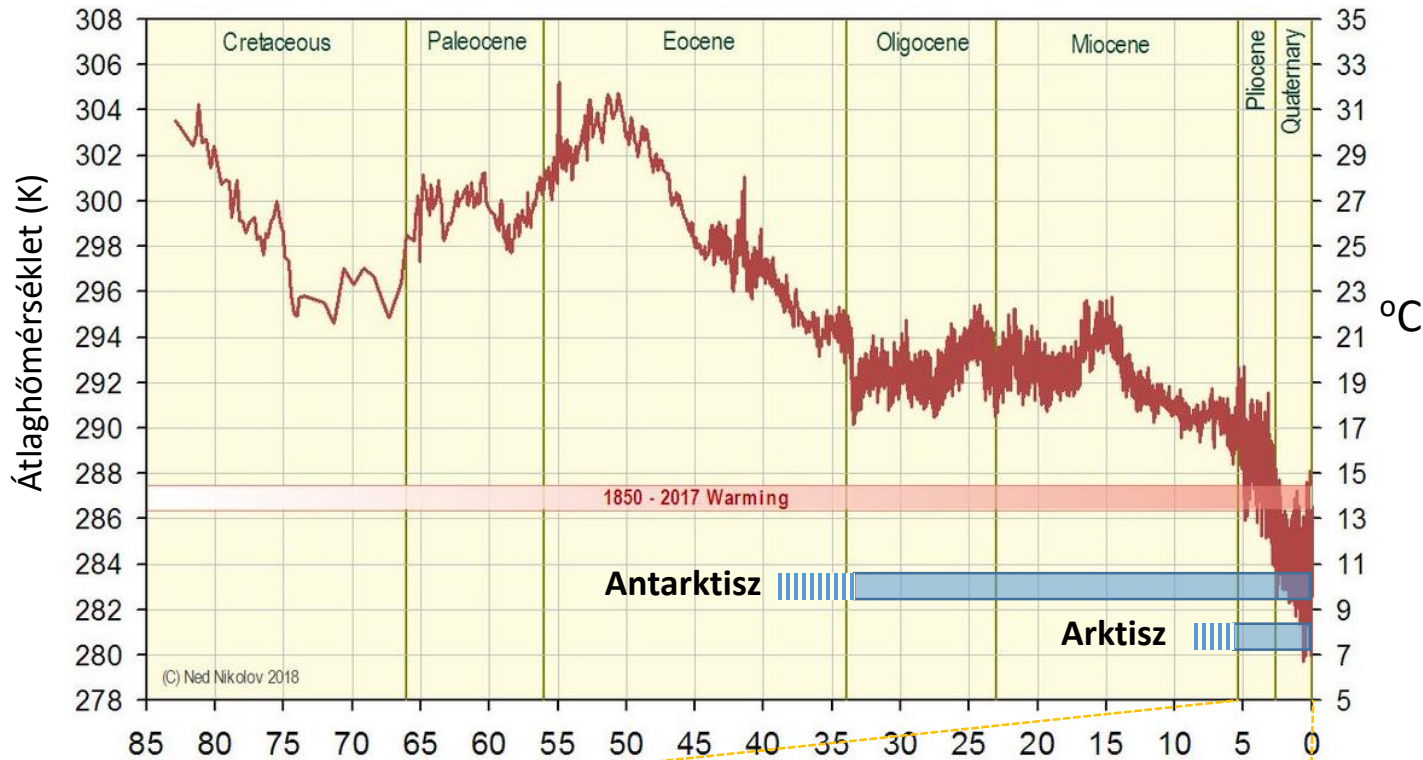
September 23<sup>rd</sup> 2018  
median extent  
(1981-2010)



## 2. Jégtakaró zsugorodik

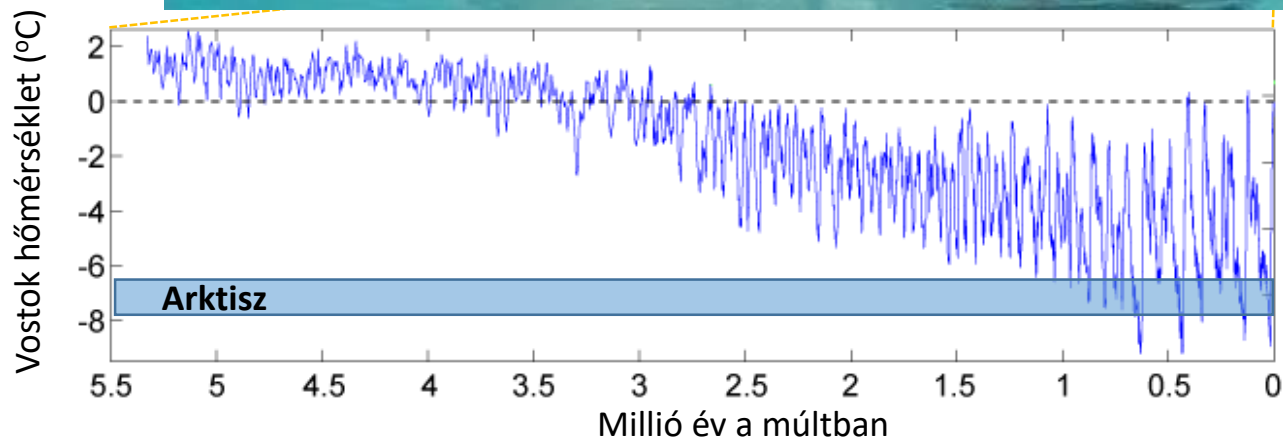


## 2. Jégtakaró zsugorodik





## 2. Jégtakaró zsugorodik



### 3. Óceánok vízszintje emelkedik

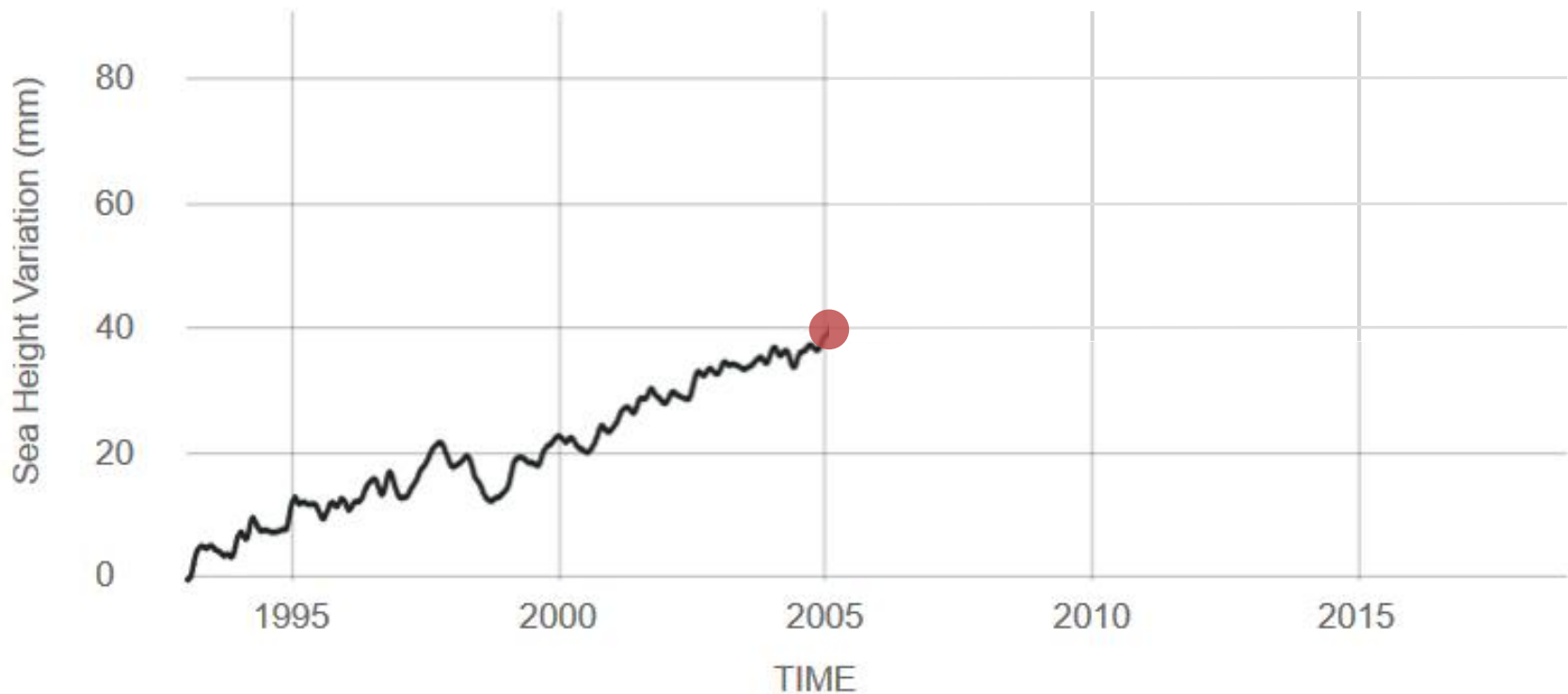
#### SATELLITE DATA: 1993-PRESENT

Data source: Satellite sea level observations.  
Credit: NASA Goddard Space Flight Center

RATE OF CHANGE

↑ **3.1**

millimeters per year



### 3. Óceánok vízszintje emelkedik

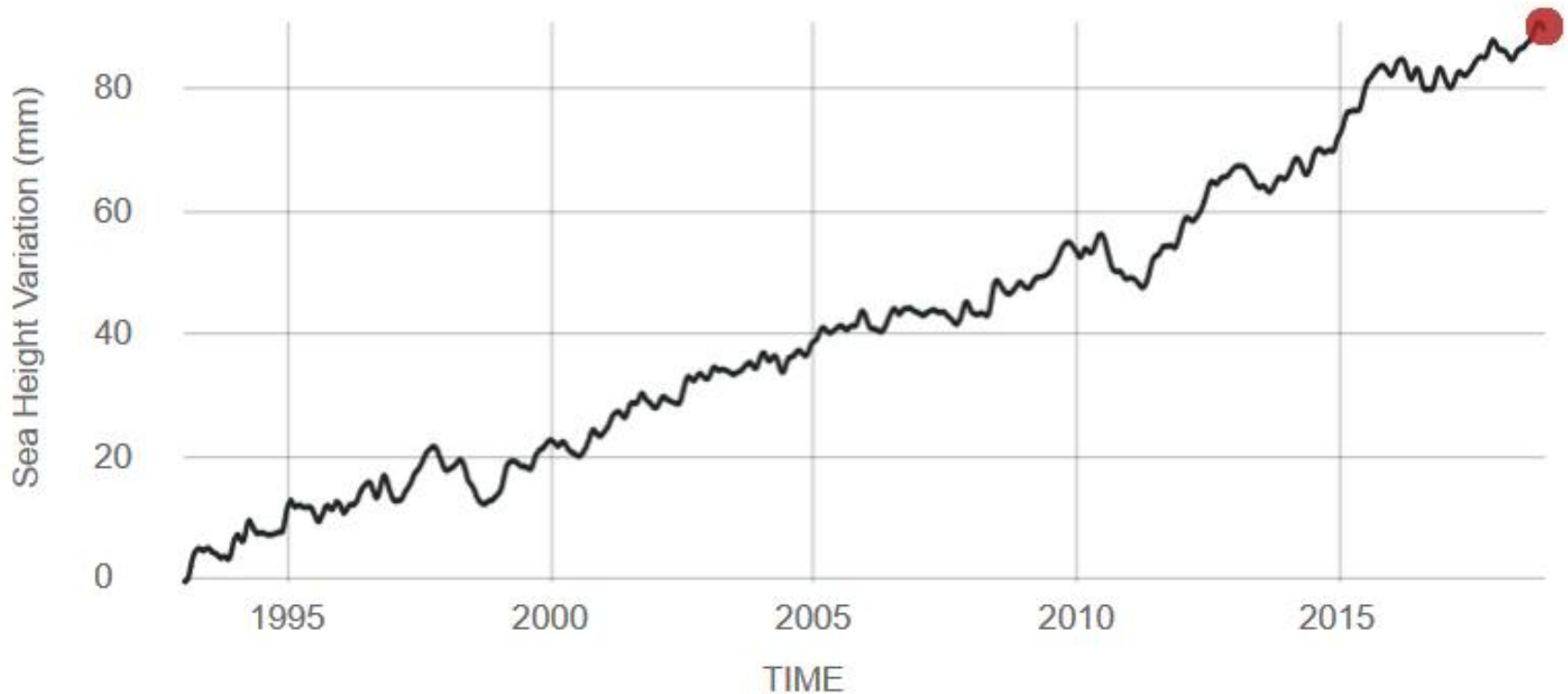
#### SATELLITE DATA: 1993-PRESENT

Data source: Satellite sea level observations.  
Credit: NASA Goddard Space Flight Center

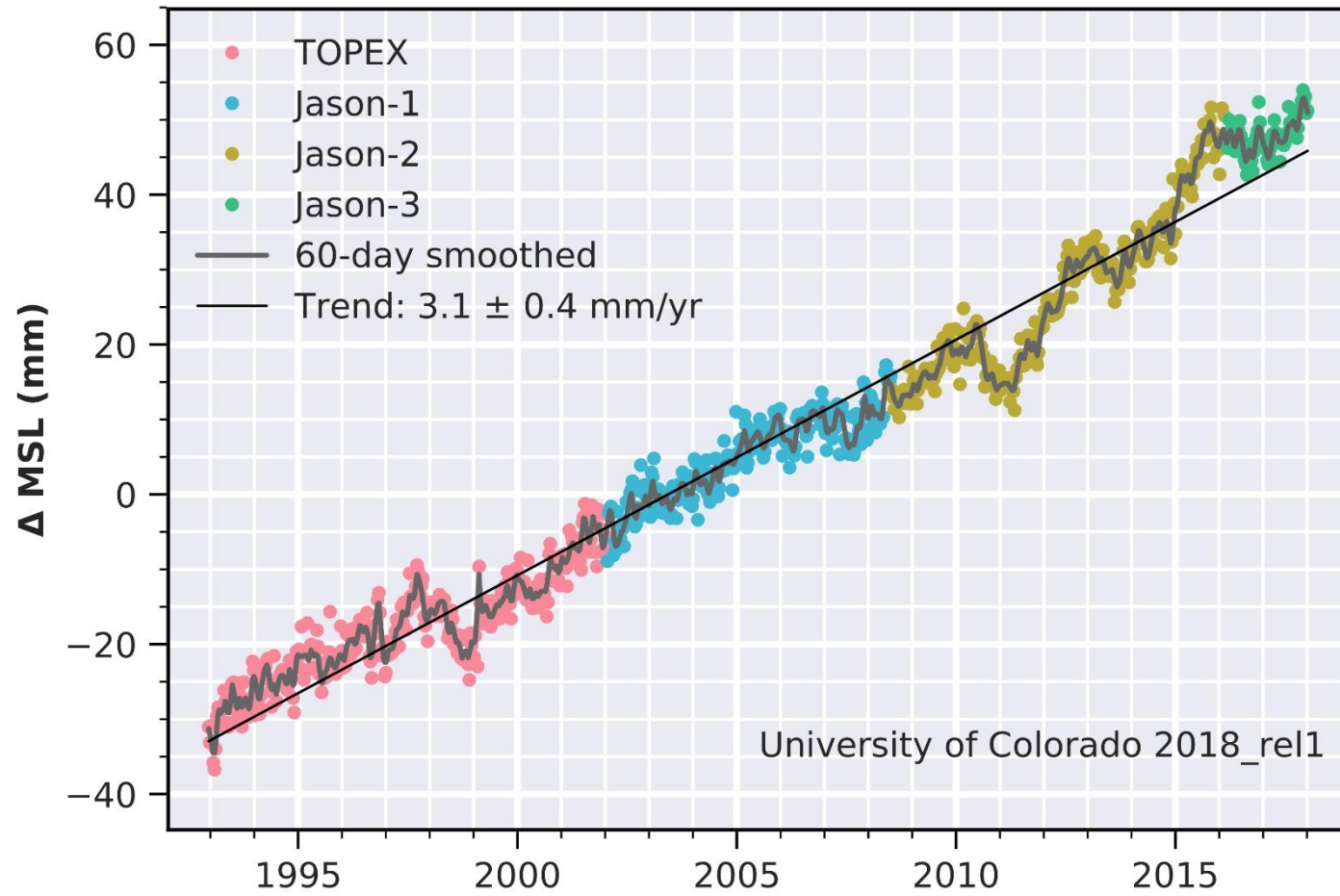
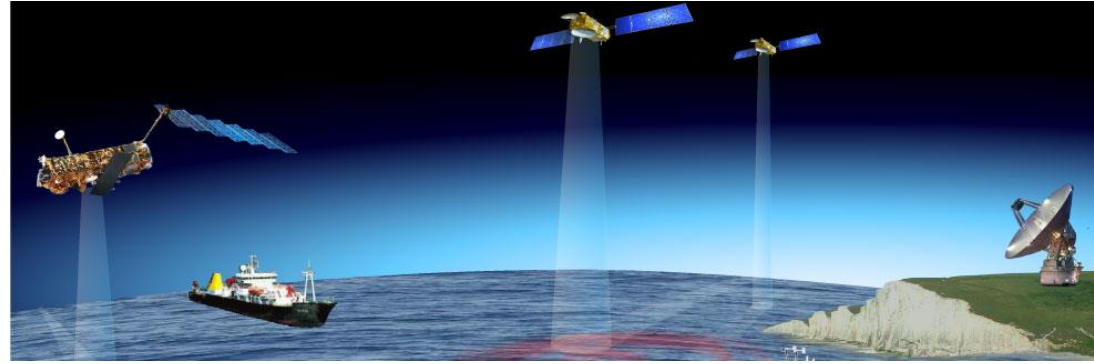
RATE OF CHANGE

↑ 3.3

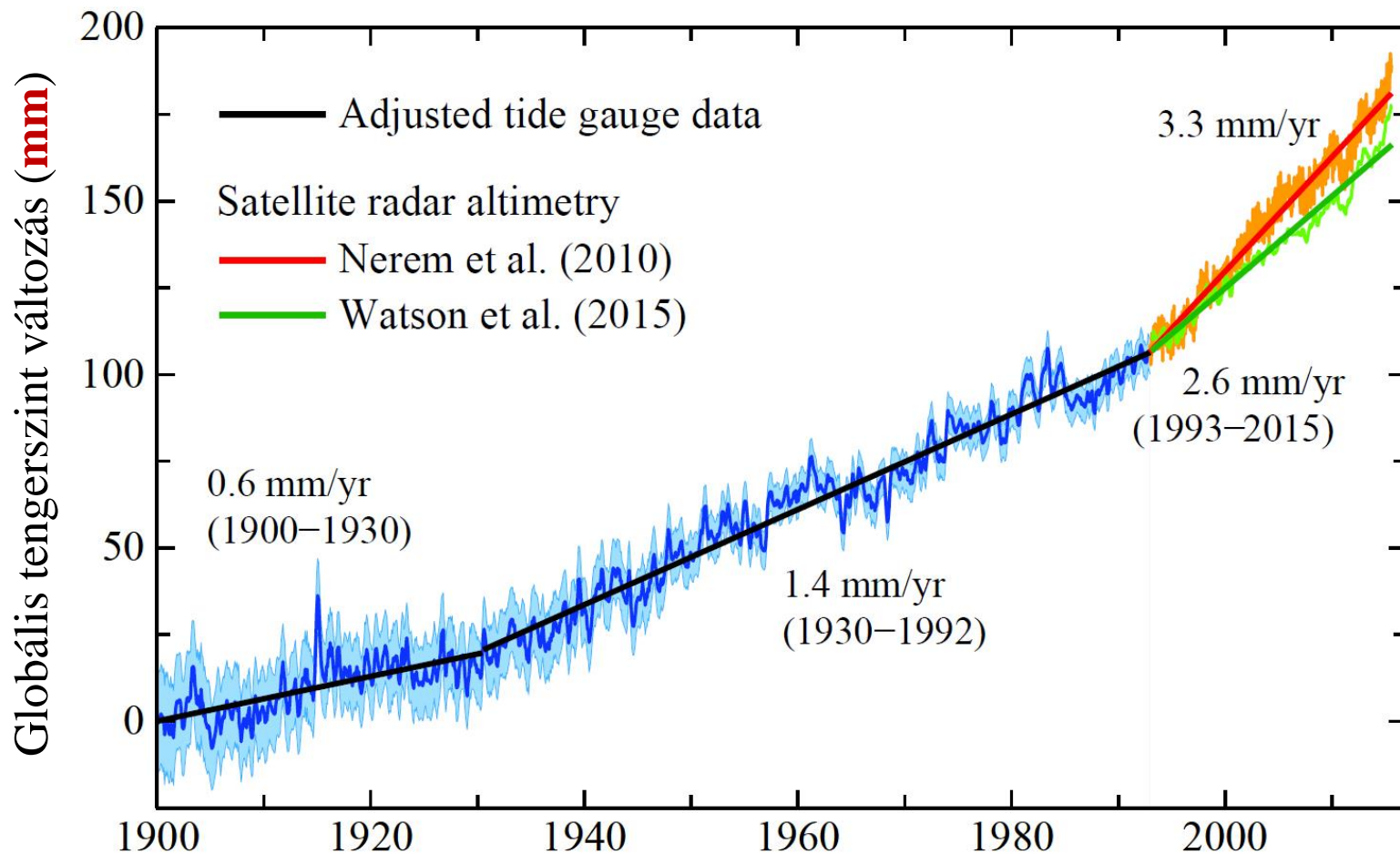
millimeters per year



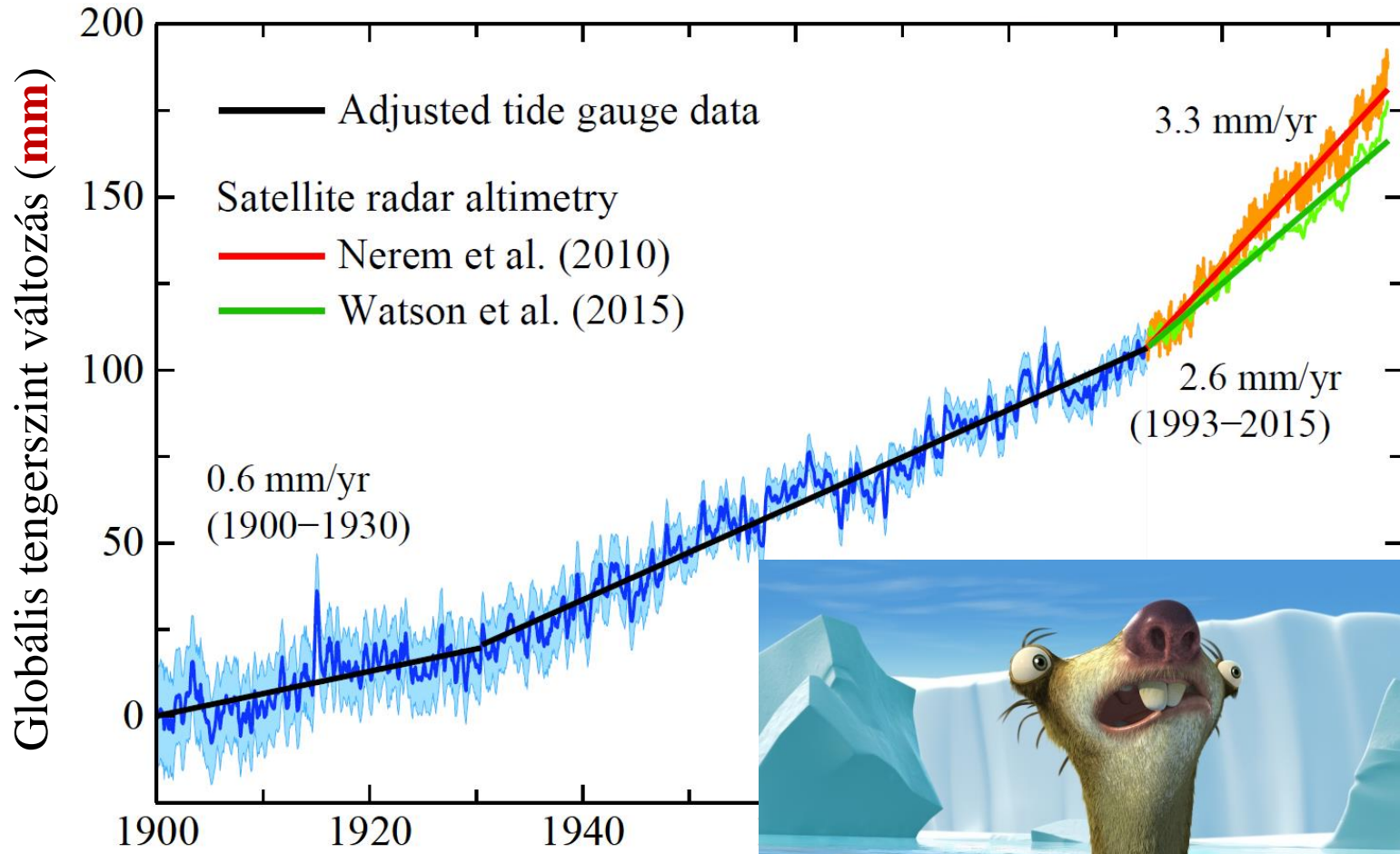
### 3. Óceánok vízszintje emelkedik



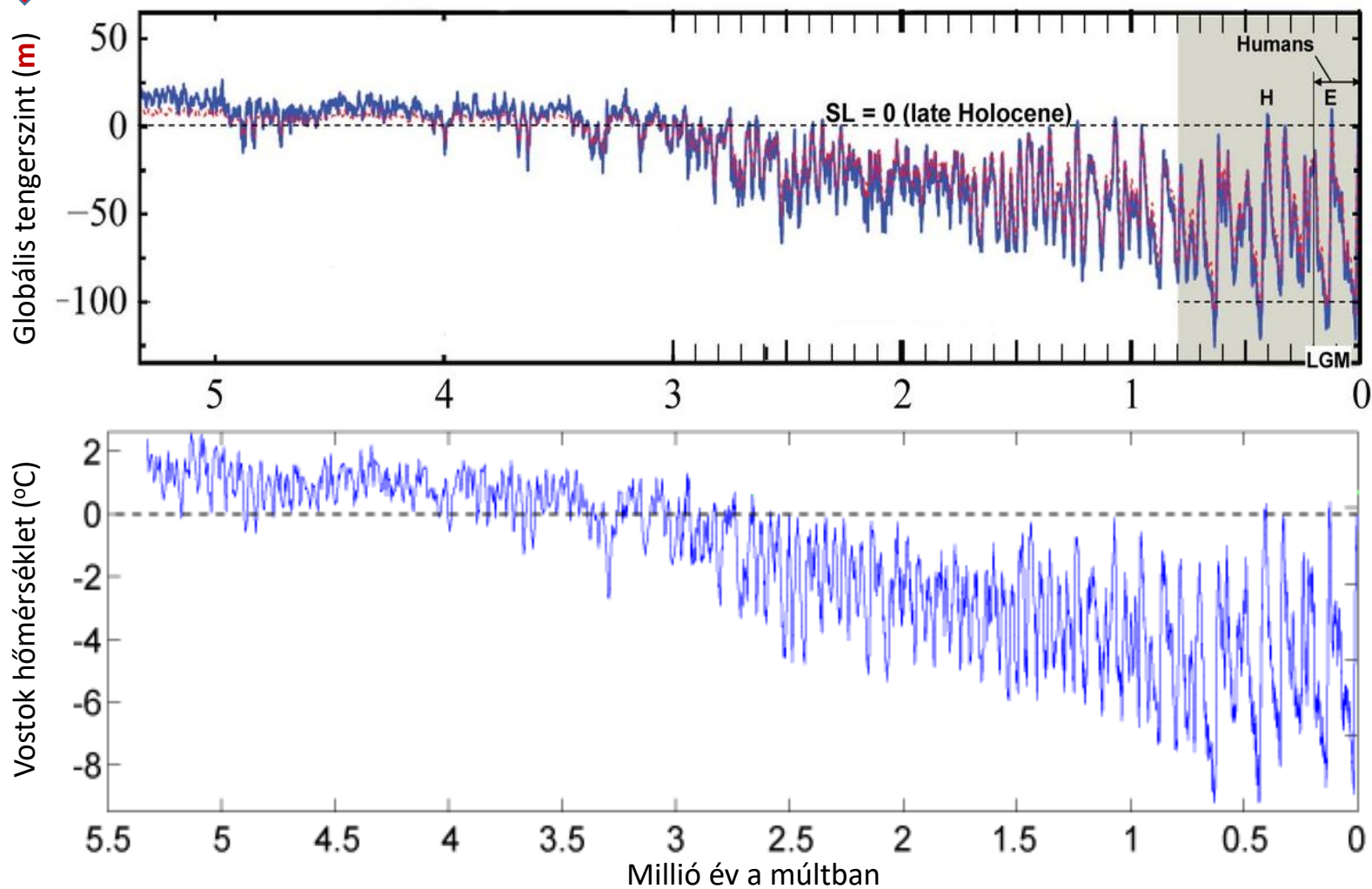
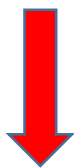
### 3. Óceánok vízszintje emelkedik



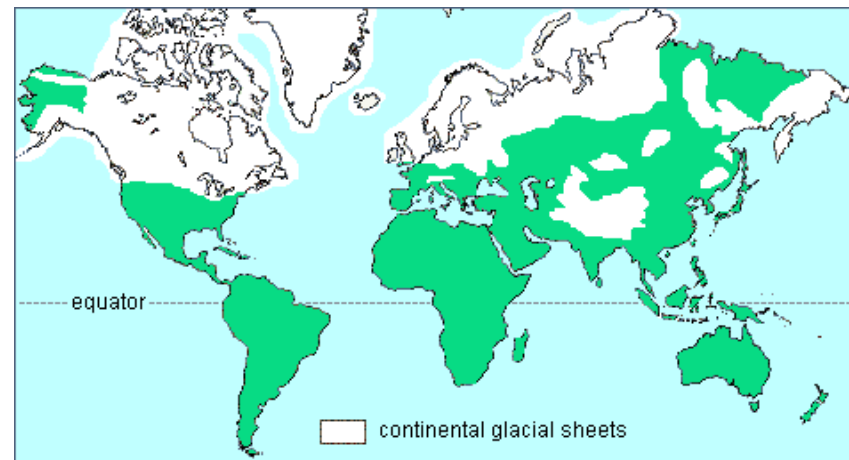
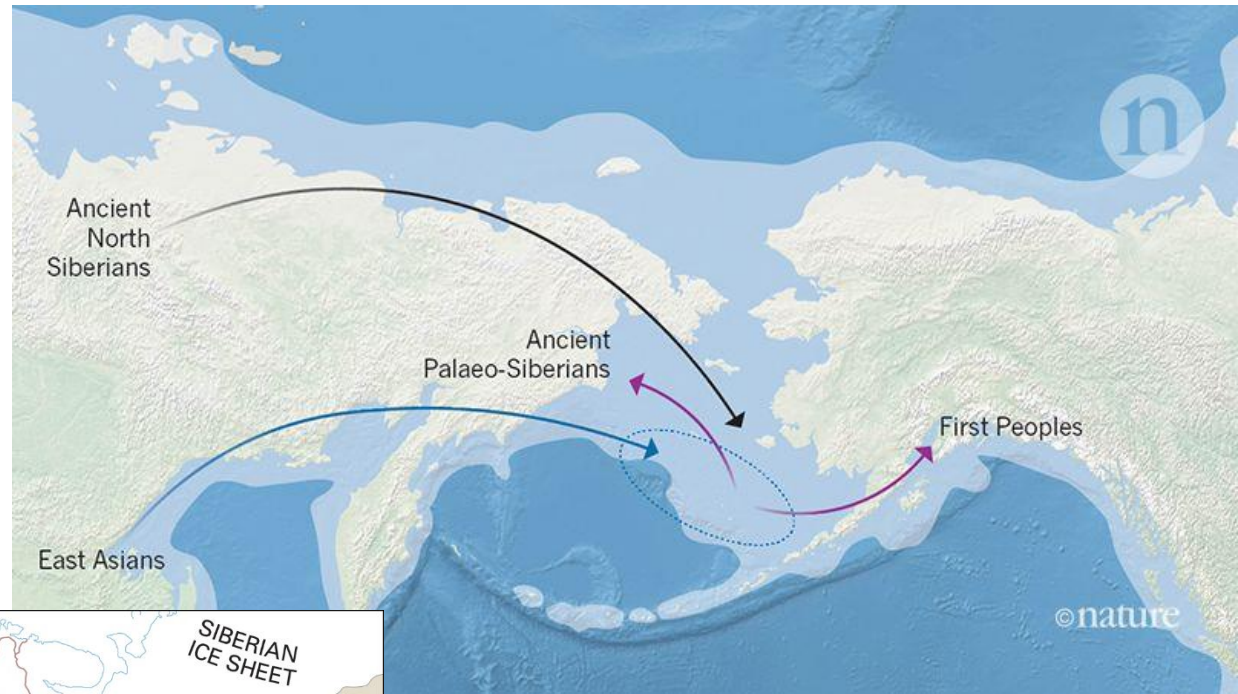
### 3. Óceánok vízszintje emelkedik



### 3. Óceánok vízszintje: paleoklimatológia

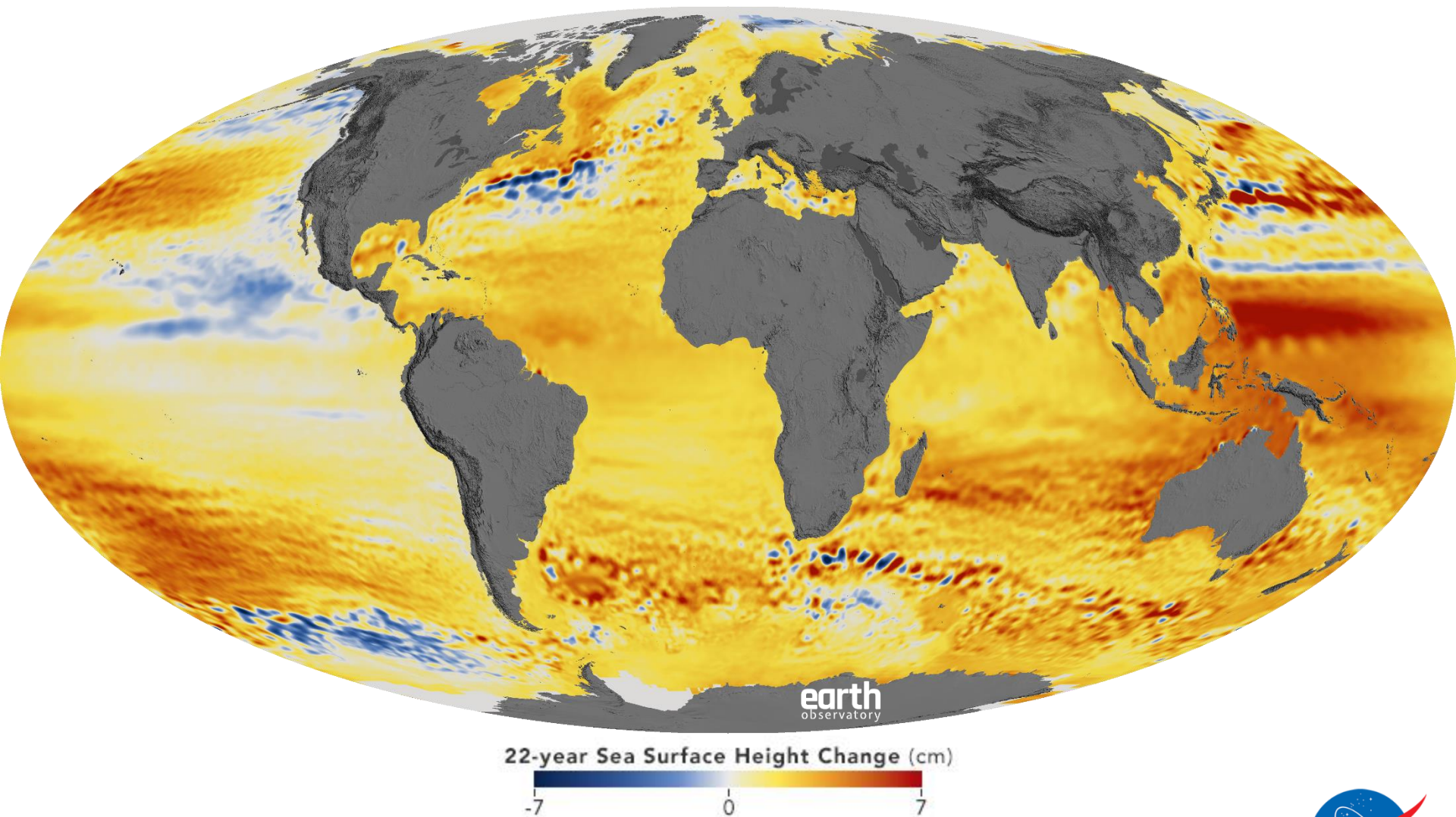


### 3. Óceánok vízszintje: paleoklimatológia





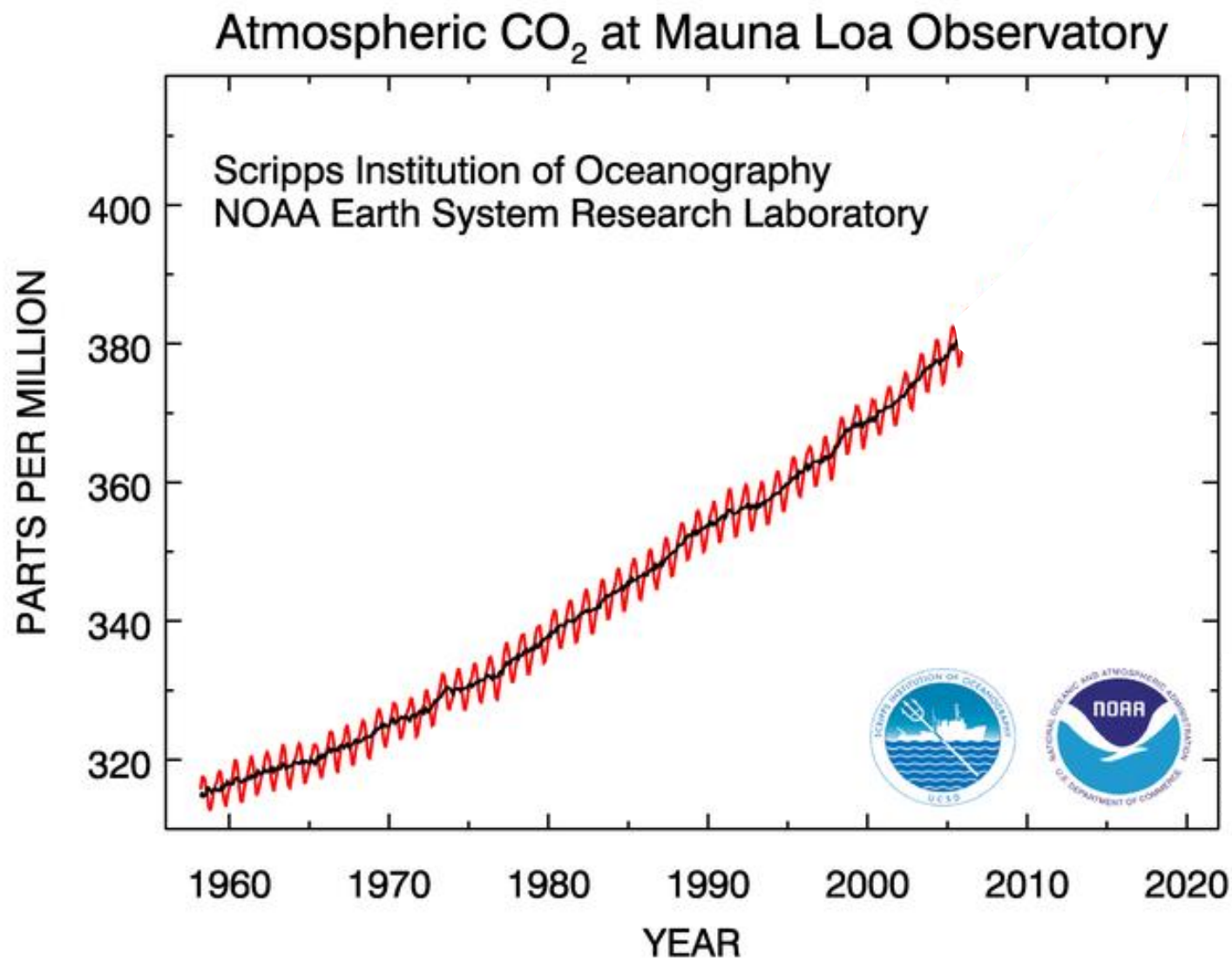
### 3. Óceánok vízszintje emelkedik



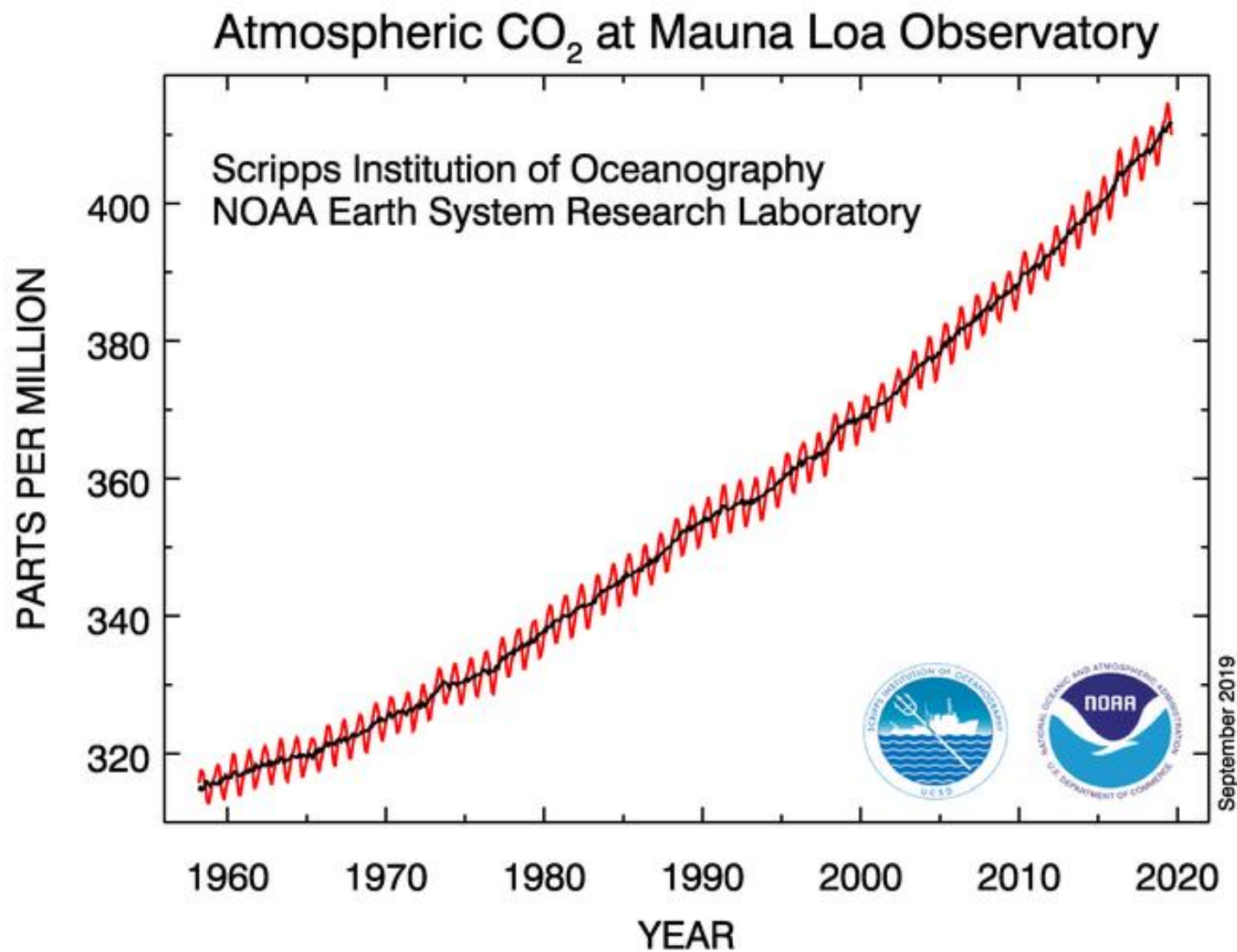
22-year Sea Surface Height Change (cm)



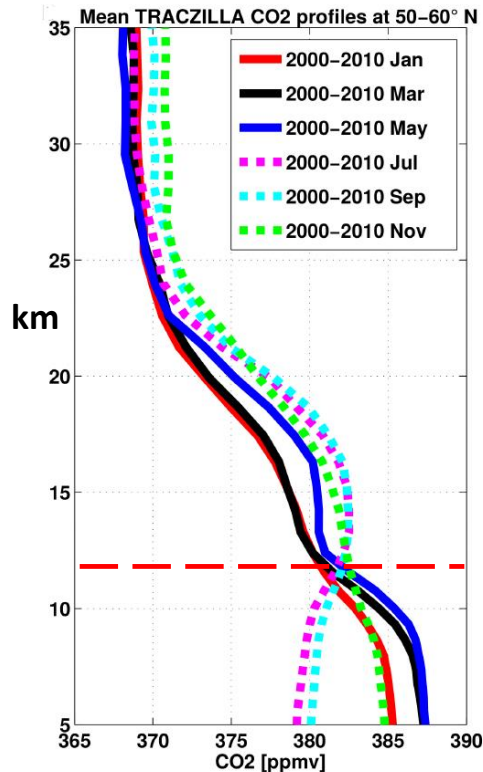
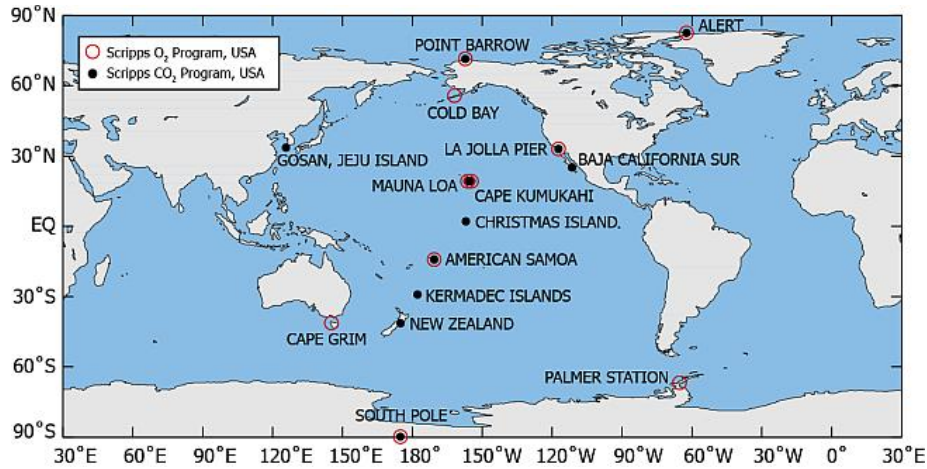
## 4. Emberi tevékenység



## 4. Emberi tevékenység

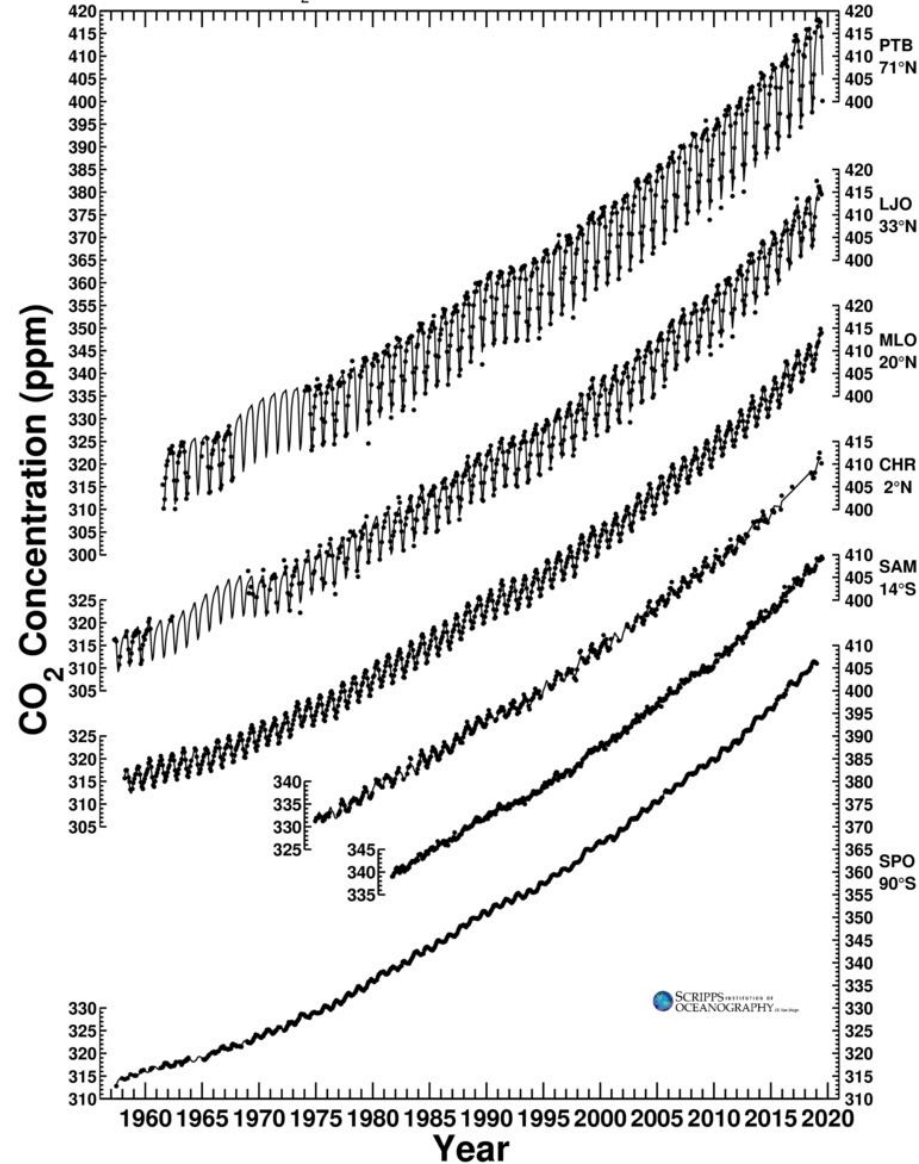


# 4. Emberi tevékenység

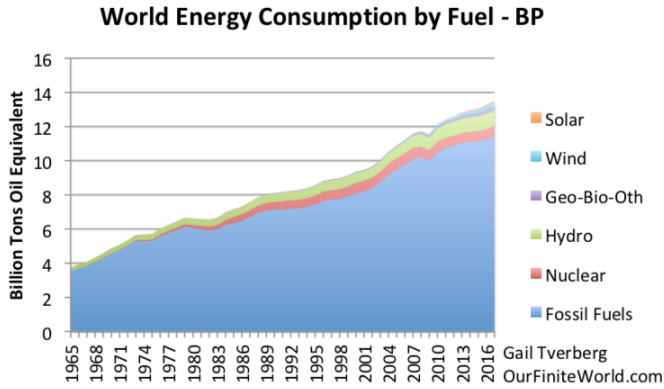


## Global Stations Carbon Dioxide Concentration Trends

Data from Scripps CO<sub>2</sub> Program Last updated August 2019

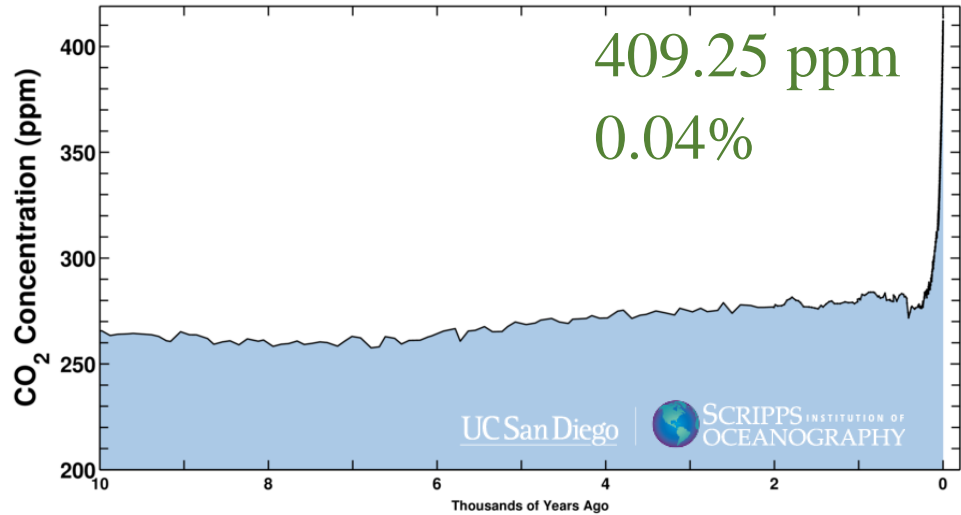


# 4. Emberi tevékenység



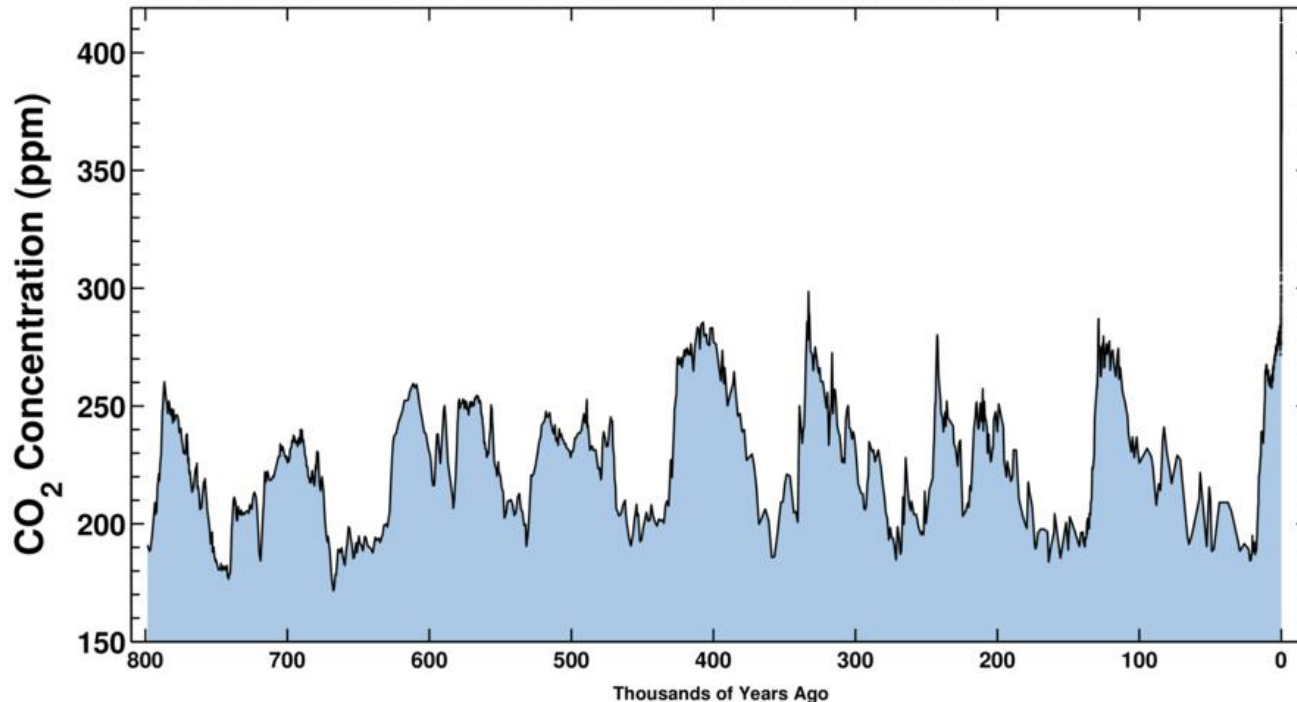
Latest CO<sub>2</sub> reading  
September 08, 2019

Ice-core data before 1958. Mauna Loa data after 1958.

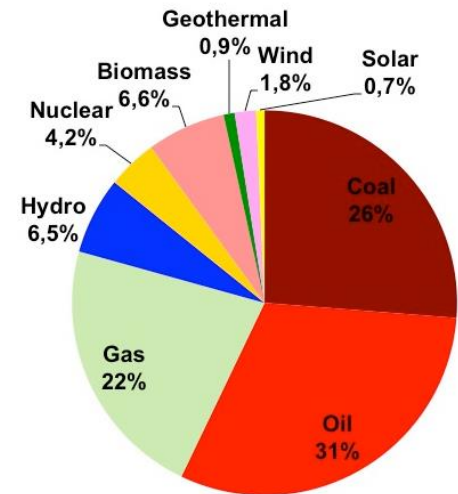


Latest CO<sub>2</sub> reading  
September 08, 2019

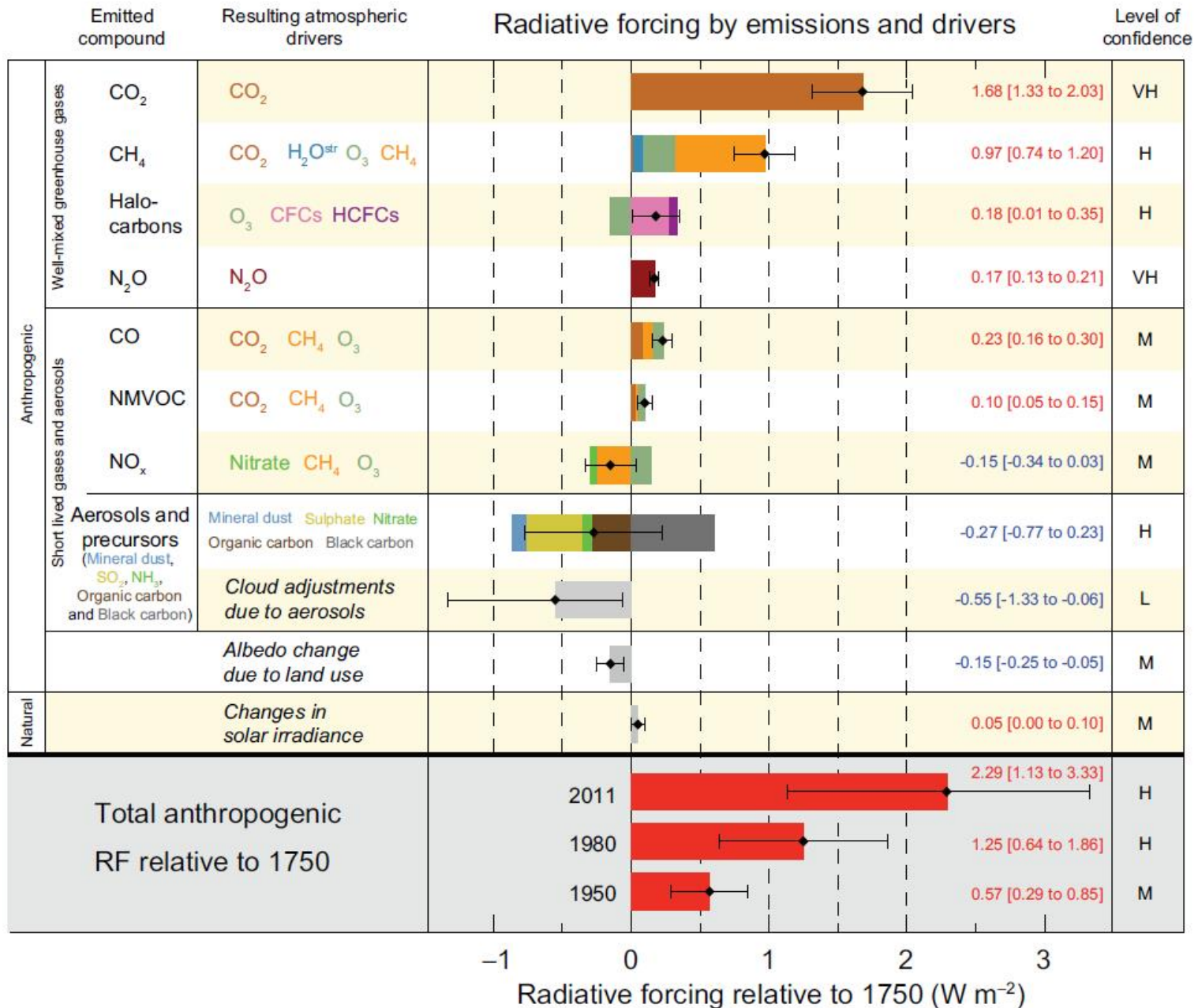
Ice-core data before 1958. Mauna Loa data after 1958.



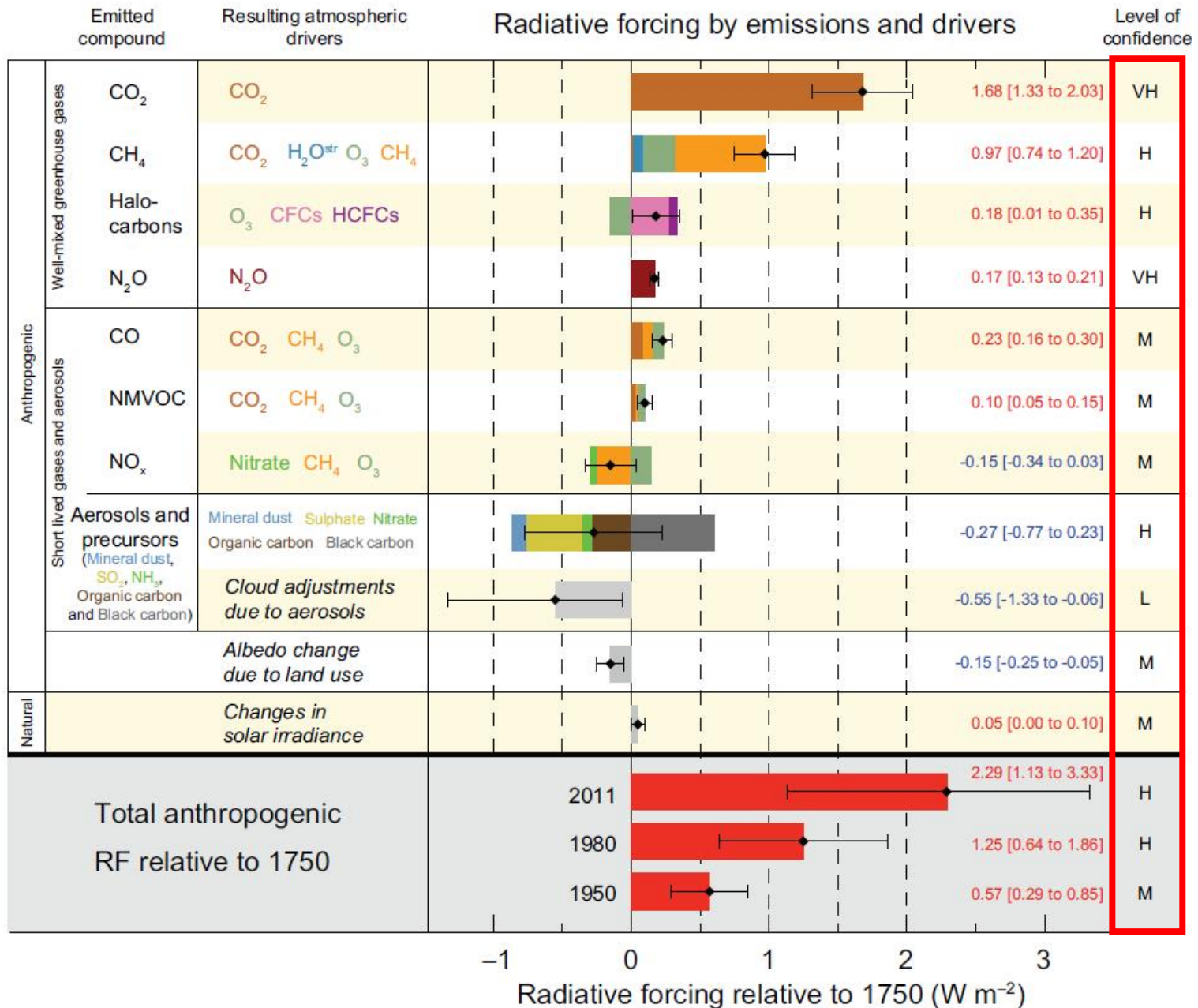
**World primary energy consumption, 2017**



# 4. Emberi tevékenység

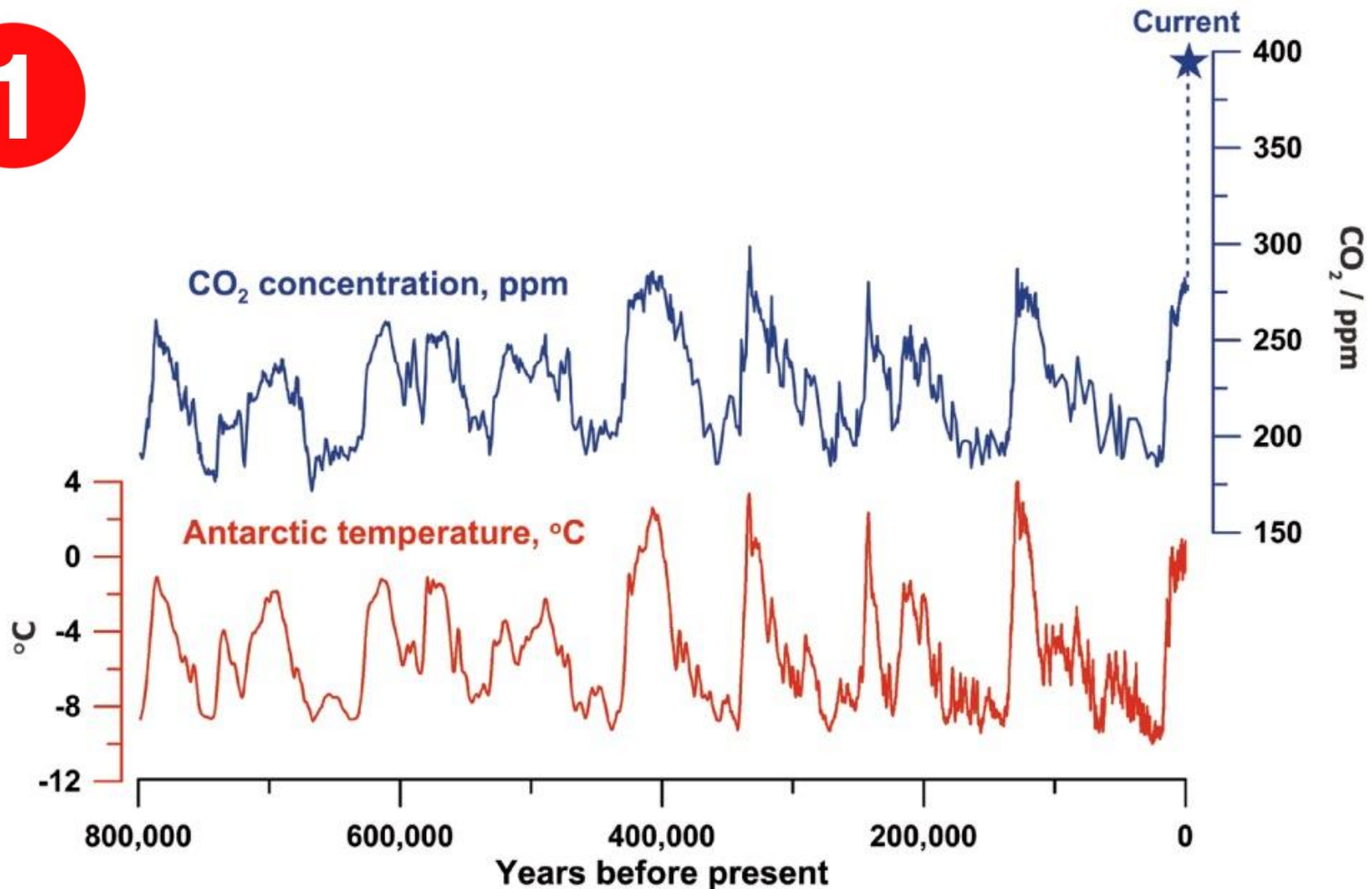


# 4. Emberi tevékenység



## 4. Emberi tevékenység – klímamódosítás – mi a bizonyíték?

1

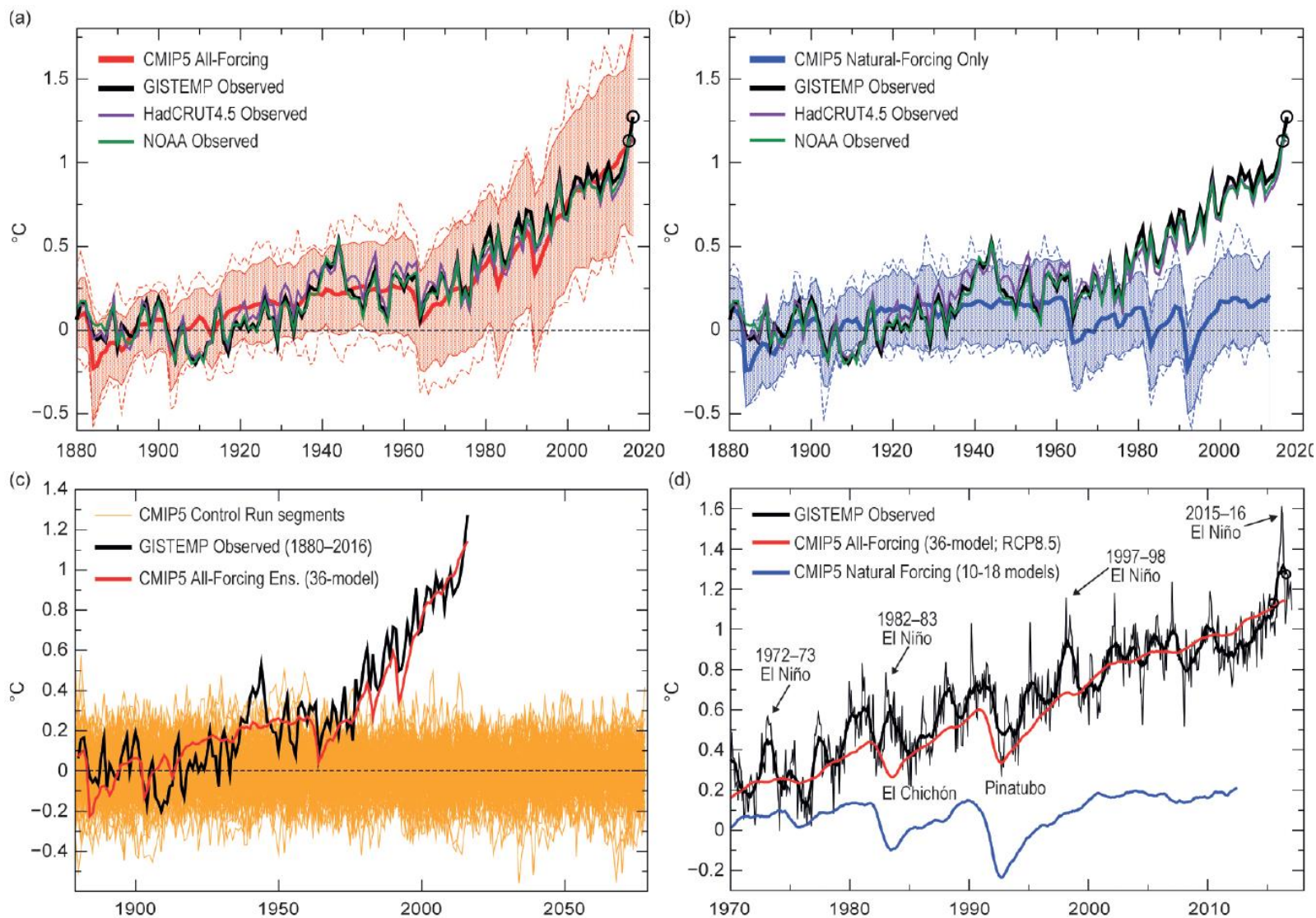




# 4. Emberi tevékenység – klímamódosítás – mi a bizonyíték?

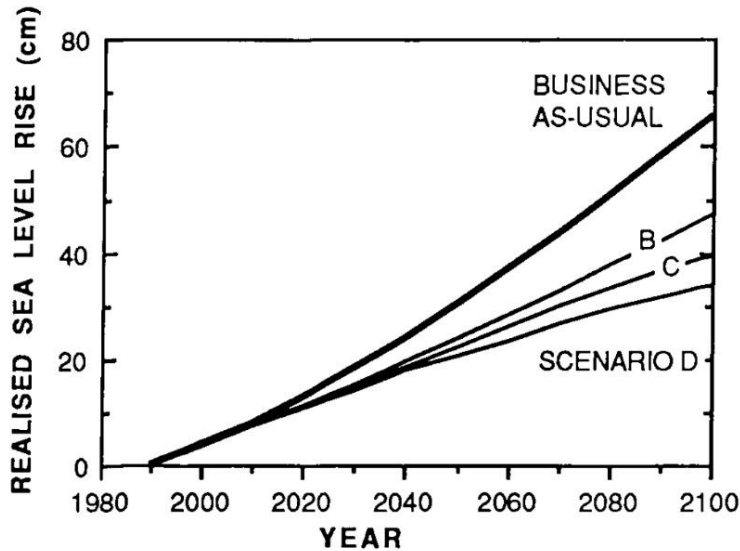
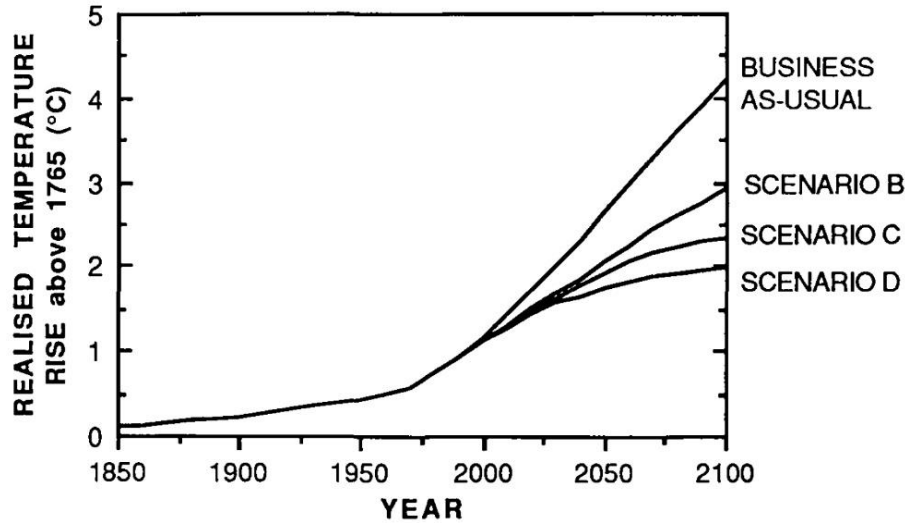
CMIP5: 36 globális csatolt atmoszféra-óceán modell

2

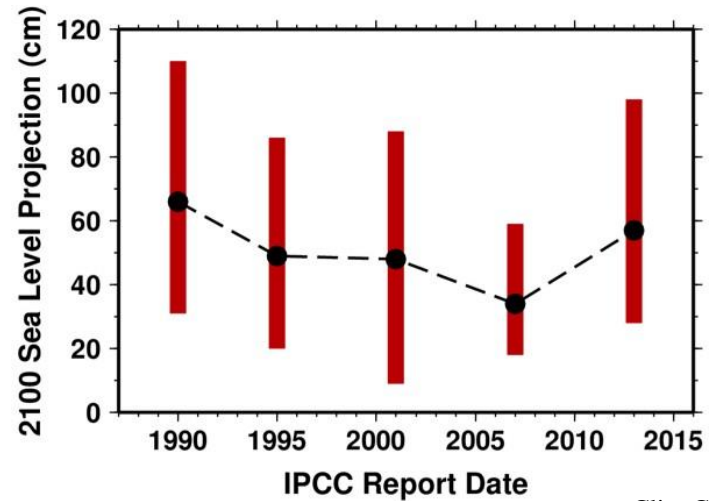
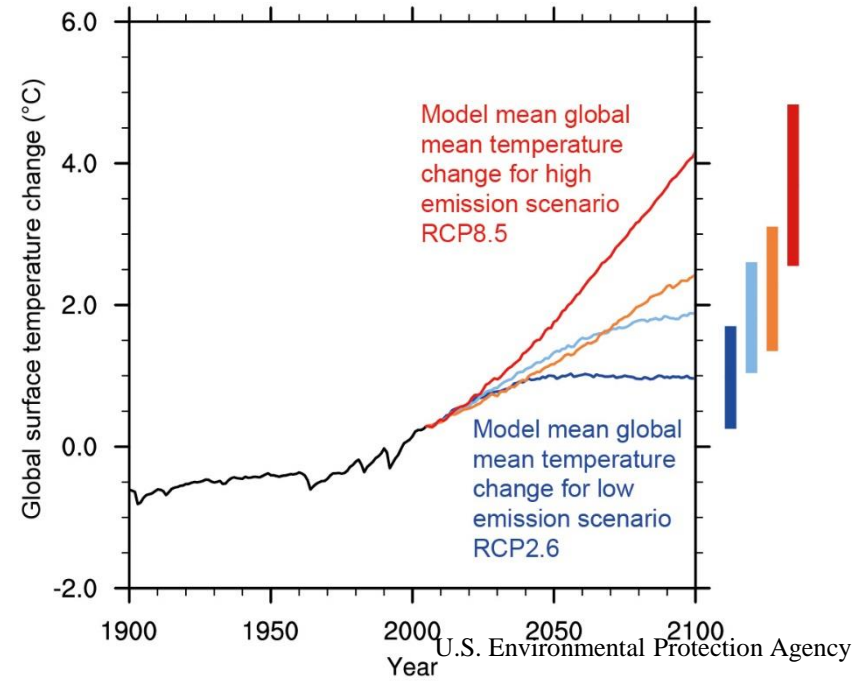


# 5. Klíma projekciók

IPCC, 1990: AR1, Scientific Assessment of Climate Change

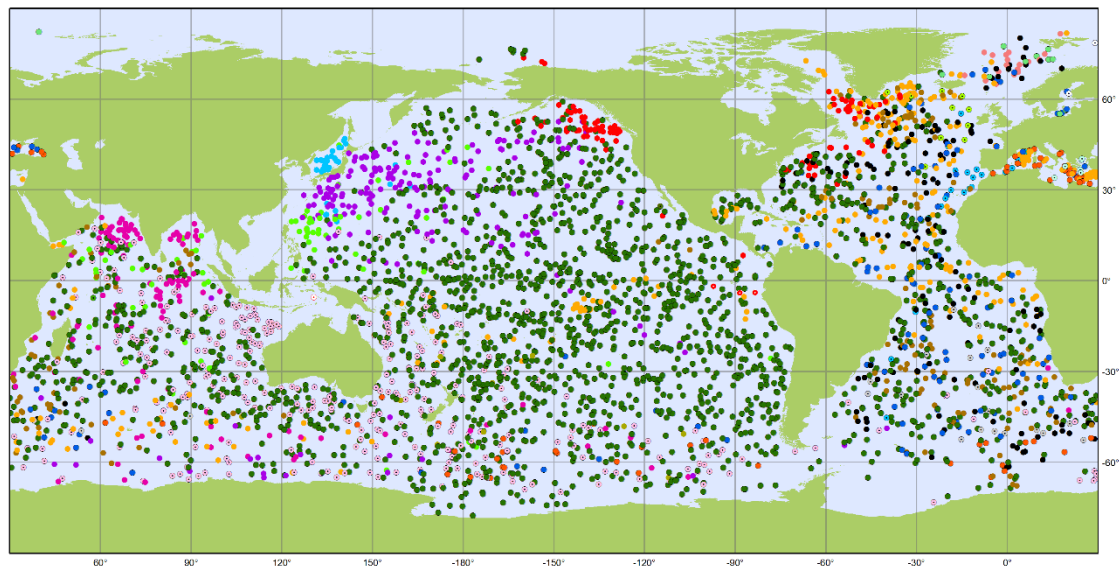


IPCC, 2013: AR5, The Physical Science Basis.



## 6. Új eredmények

- Meg kell érteni, mi folyik az óceánokban



Argo

National contributions - 3852 Operational Floats

August 2019

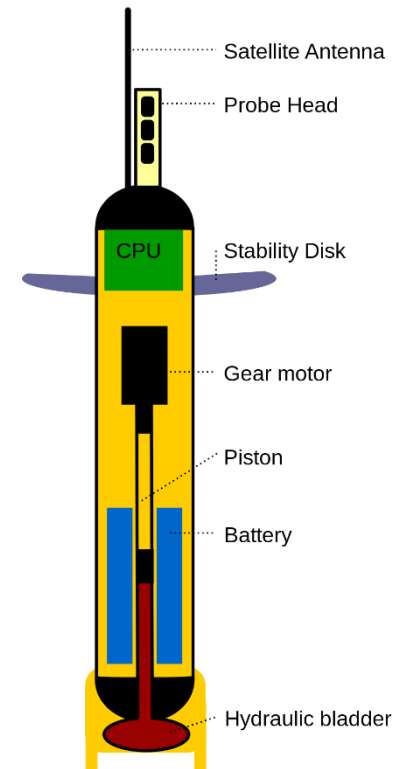
Latest location of operational floats (data distributed within the last 30 days)



• AUSTRALIA (337)	• FINLAND (2)	• INDIA (139)	• JAPAN (199)	• NEW ZEALAND (10)	• KOREA, REPUBLIC OF (35)
• CANADA (99)	• FRANCE (286)	• INDONESIA (1)	• KENYA (1)	• NORWAY (19)	• SPAIN (24)
• CHINA (81)	• GERMANY (153)	• IRELAND (11)	• MEXICO (1)	• PERU (3)	• UK (155)
• EUROPE (118)	• GREECE (6)	• ITALY (69)	• NETHERLANDS (21)	• POLAND (11)	• USA (2073)



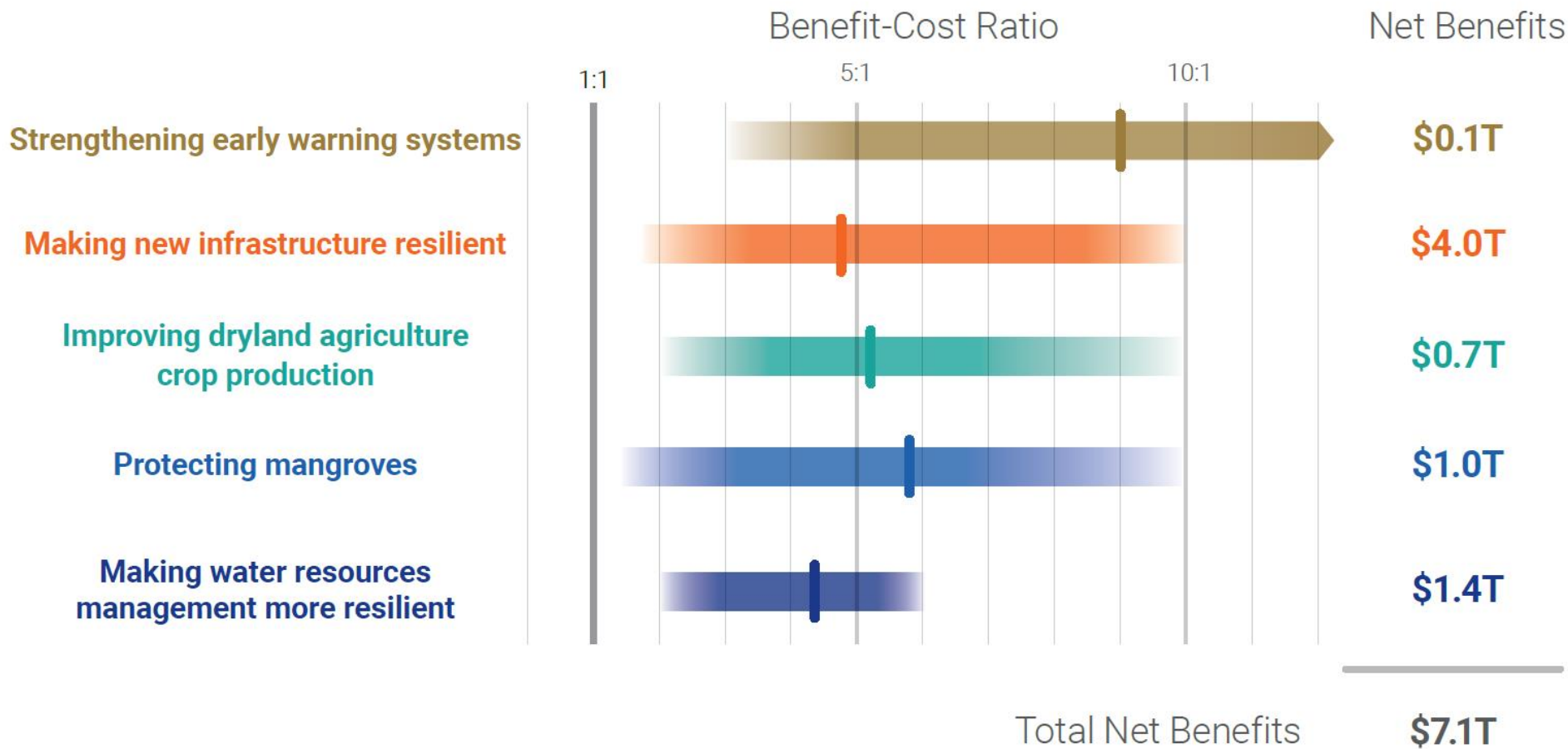
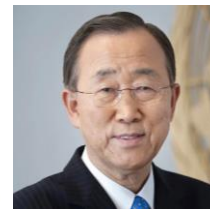
Generated by [www.jcommaps.org](http://www.jcommaps.org), 06/09/2019



- Az erdőtüzek lassítják a felmelegedést (*Science*, 2006)
- Az óceánokban nem érdemes algavirágzást indukálni (*Nature*, 2009)
- Nem az iparszerű állattenyésztés a légköri CH<sub>4</sub> fő forrása (*Nature Climate Change*, 2015)
- Az Amazonas vidéke nem a „Föld tüdeje” (*Science*, 2017)
- A (hagyományos) bio-üzemanyag előállítás zsákutca (EU, 2017)
- Az Antarktisz olvadó jége hűti a légkört (*Nature*, 2018)
- ....

# 6. Ajánlások

## Economics of Adaptation: Benefits and Costs of Selected Investments in Adaptation



Teljes befektetés 2020-2030: \$1.8T

2019. szept. 10.

# Összegzés

- Globális klímaváltozás: jól mérhető trend
- Példátlan? (nem)
- Környezetszennyezés: tény
- Csatolás a kettő között? (nem tudjuk)
- Mi a teendő? (nem tudjuk)