



**Contrastare il cambiamento
climatico: strategie e azioni
di mitigazione**

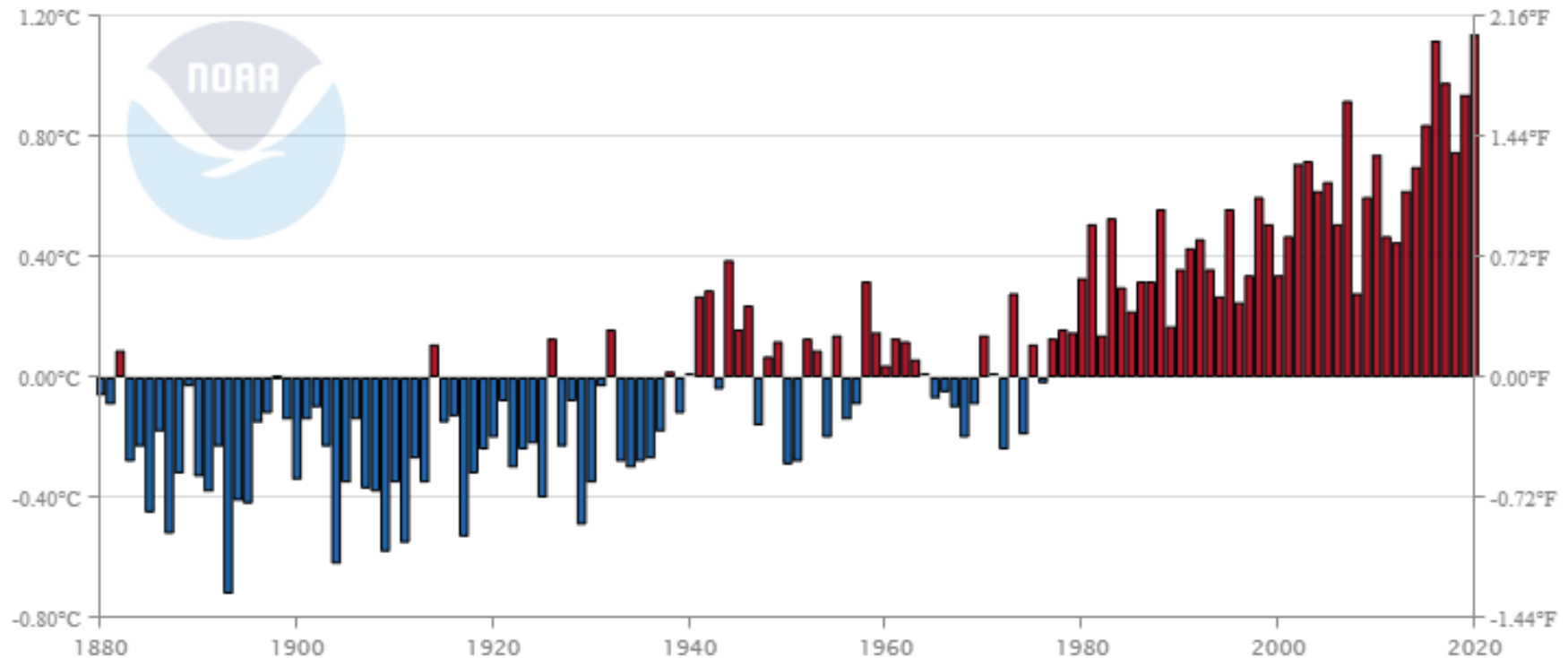
Ugo Bardi

AGENDA 2030

DI COSA DOVREMMO PREOCCUPARCI?

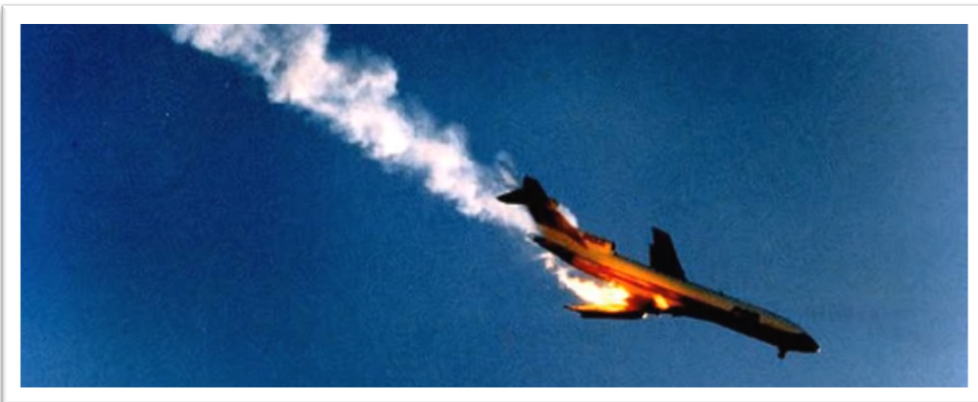


Global Land and Ocean
January Temperature Anomalies





Prevenzione



Mitigazione



Adattamento

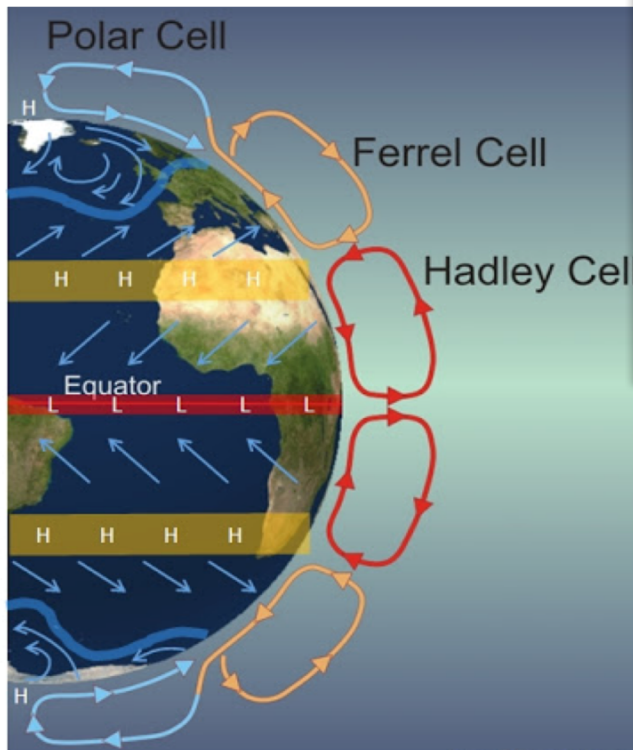
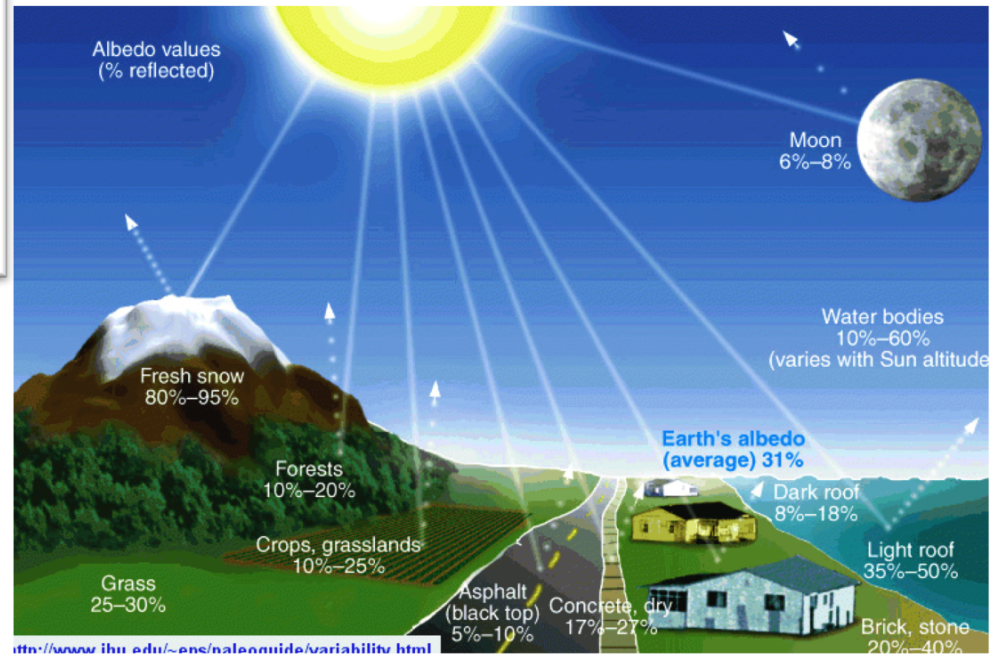


The Greenhouse Effect

Some sunlight that hits the earth is reflected. Some becomes heat.

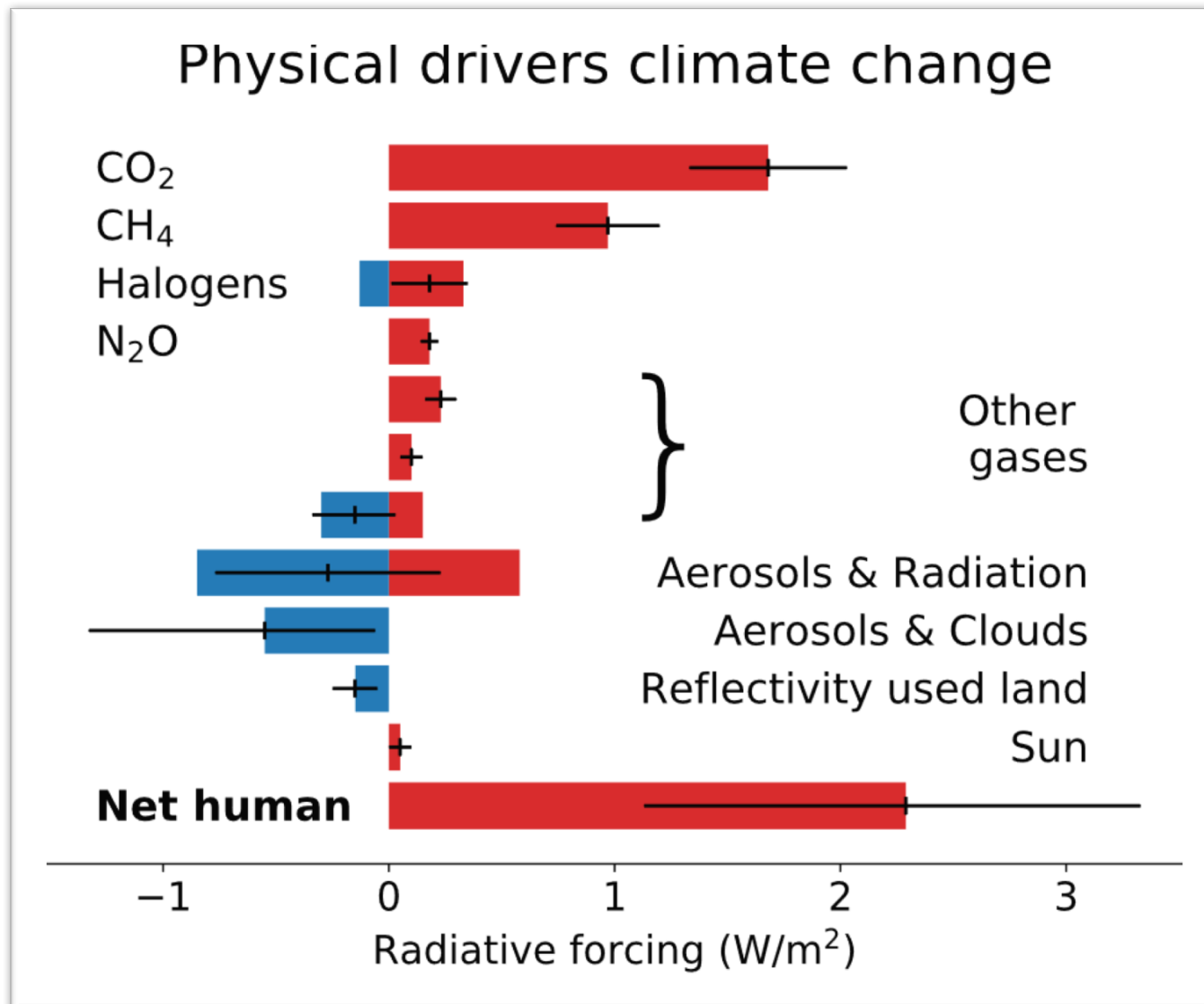
CO₂ and other gases in the atmosphere trap heat, keeping the earth warm.

Albedo

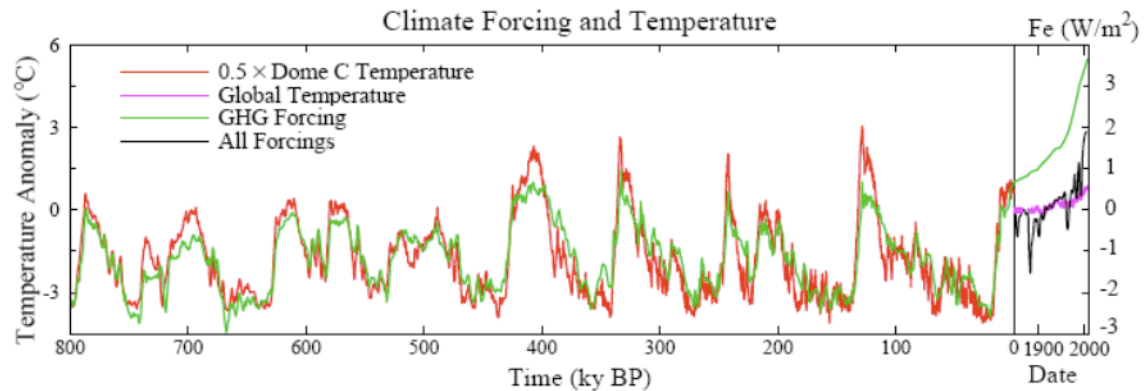


Altri Effetti

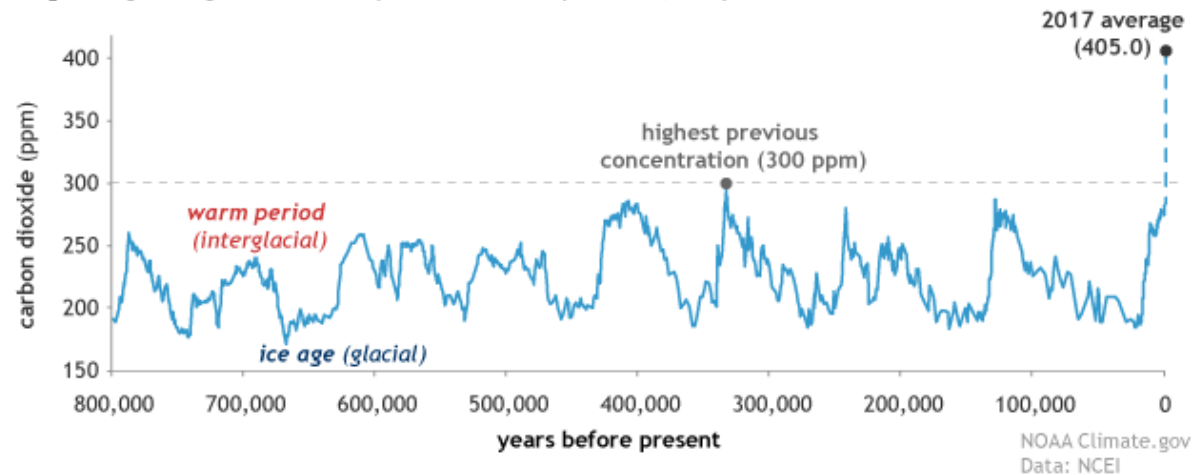
FORZANTI DELLA TEMPERATURA TERRESTRE

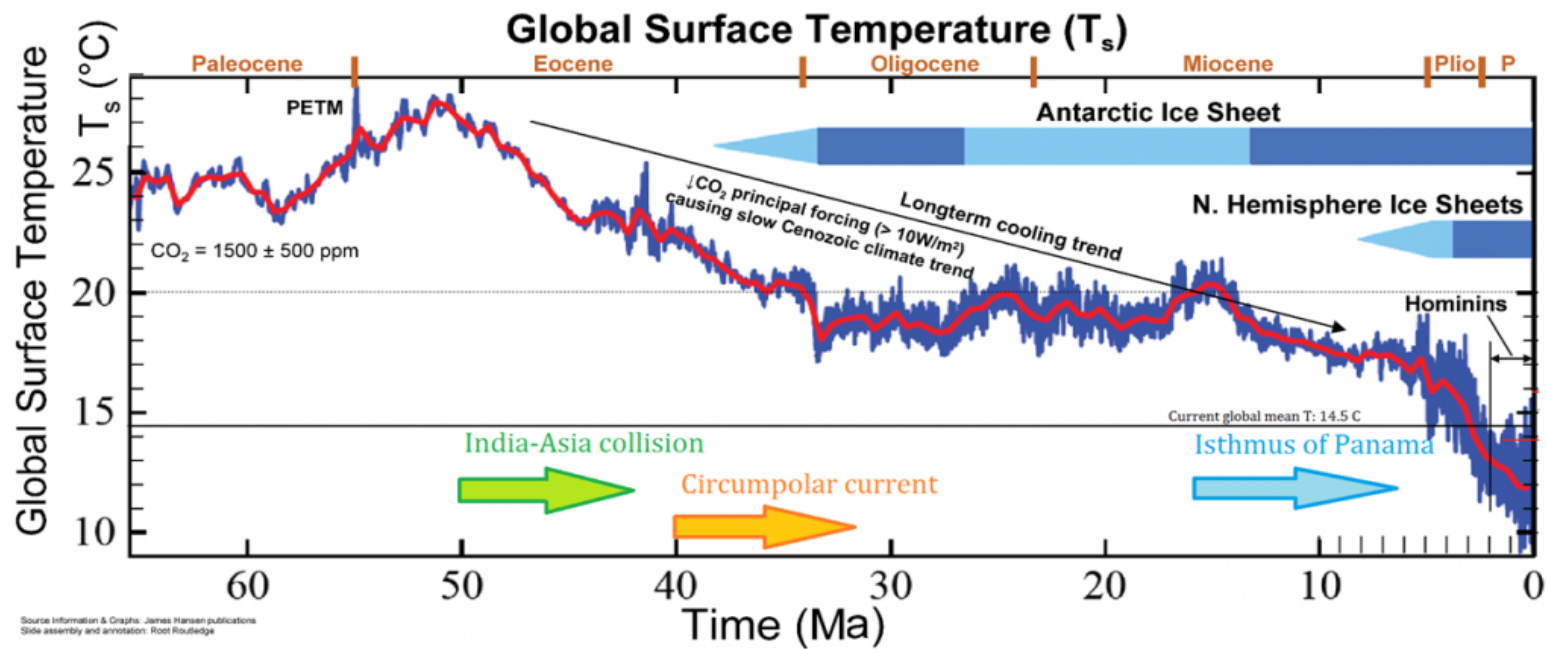


MAI PIÙ ERE GLACIALI

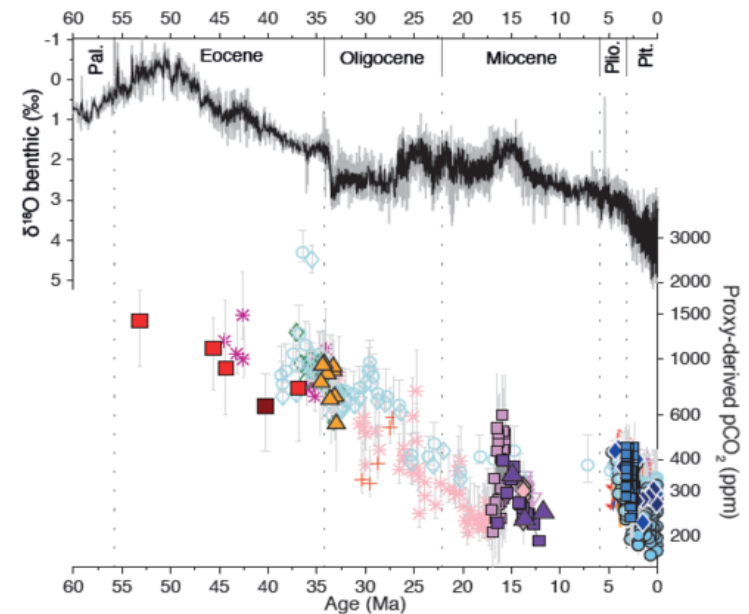


CO₂ during ice ages and warm periods for the past 800,000 years





Massima Temperatura Misurata:
+ 12 C rispetto all'attuale



LA LOGICA DELLA MITIGAZIONE PER LA RIDUZIONE DELLE EMISSIONI

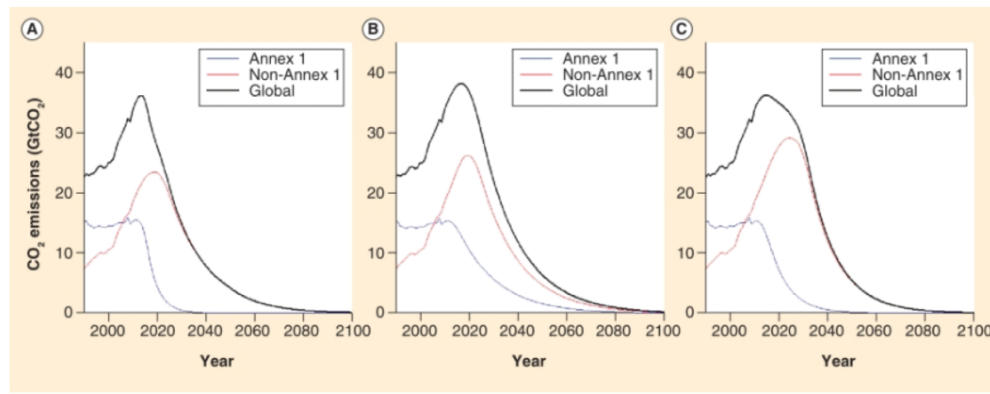
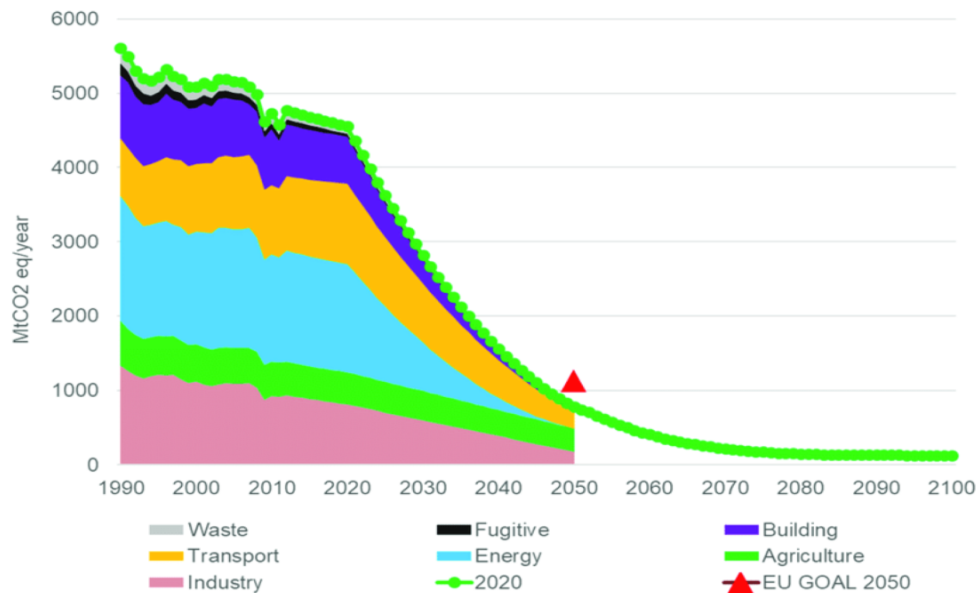


Figure 1. Global, Annex 1 and non-Annex 1 emission pathways of CO₂ only from energy with different probabilities of not exceeding 2°C. (A) Has an approximately 60% chance; (B) an approximately 50% chance with a later peak; (C) an approximately 50% chance with an earlier global (and later non-Annex 1) peak. All pathways are updated versions of those within Anderson and Bows [10].



FONTE: <http://grist.org/climate-energy/the-brutal-logic-of-climate-change-international-shipping-edition/>

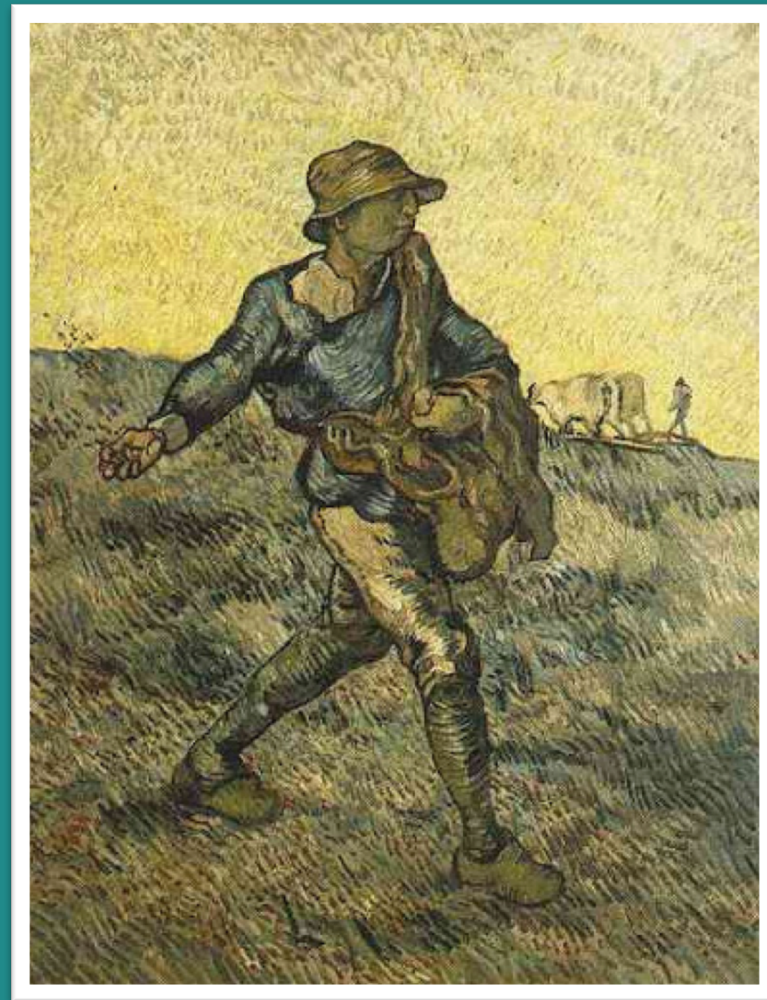
Perissi, Falsini, Bardi, 2003

ENERGIA RINNOVABILE

EOLICA

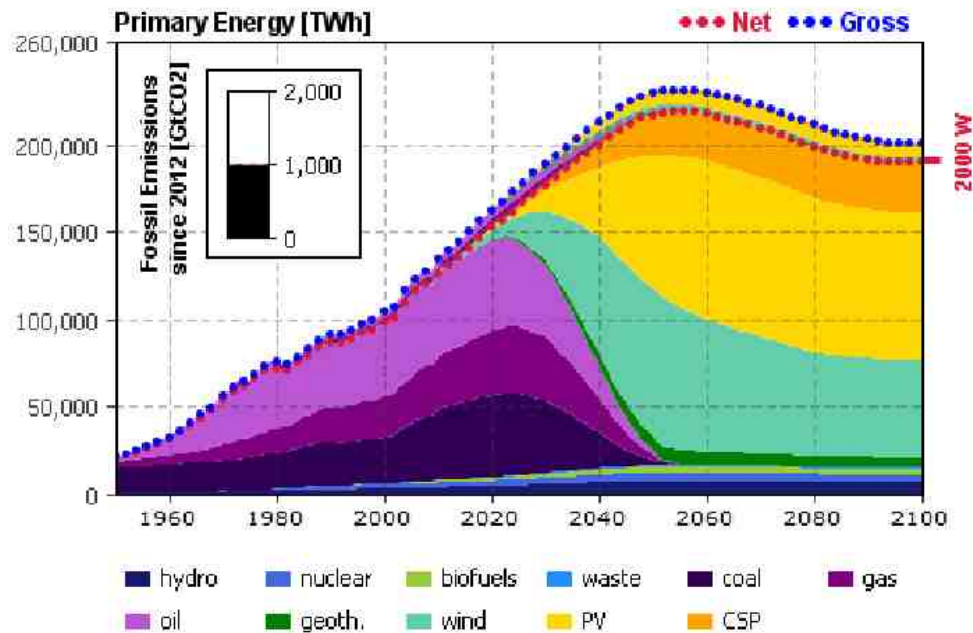
SOLARE

**LA STRATEGIA
DEL SEMINATORE:
SEMINARE L'ENERGIA
DI OGGI
PER IL RACCOLTO
DI ENERGIA
DI DOMANI**

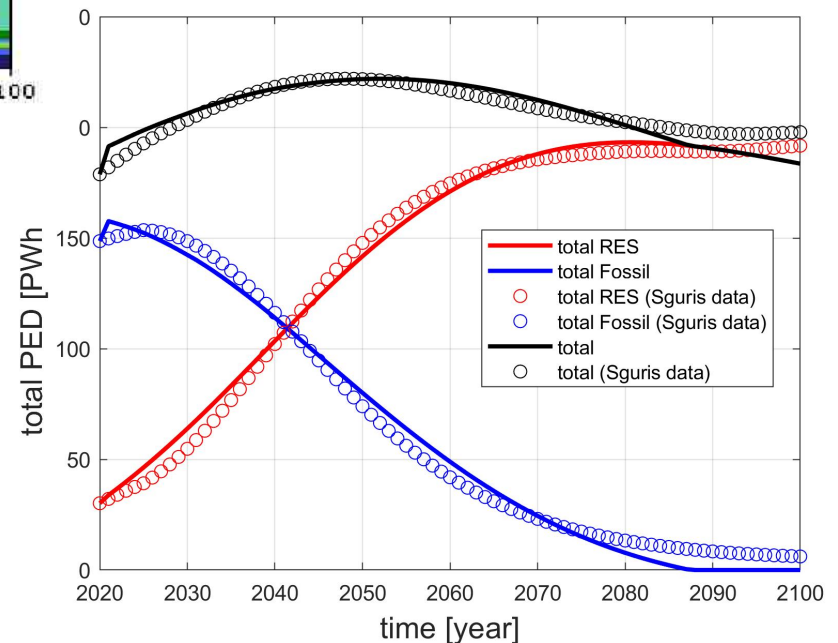


Sgouridis, Csala, Bardi 2016

THE GREAT SUSTAINABLE TRANSITION



Sgouridis, Bardi, Csala,
<http://arxiv.org/abs/1503.06832>



SURFACE AREA REQUIRED TO POWER THE WORLD

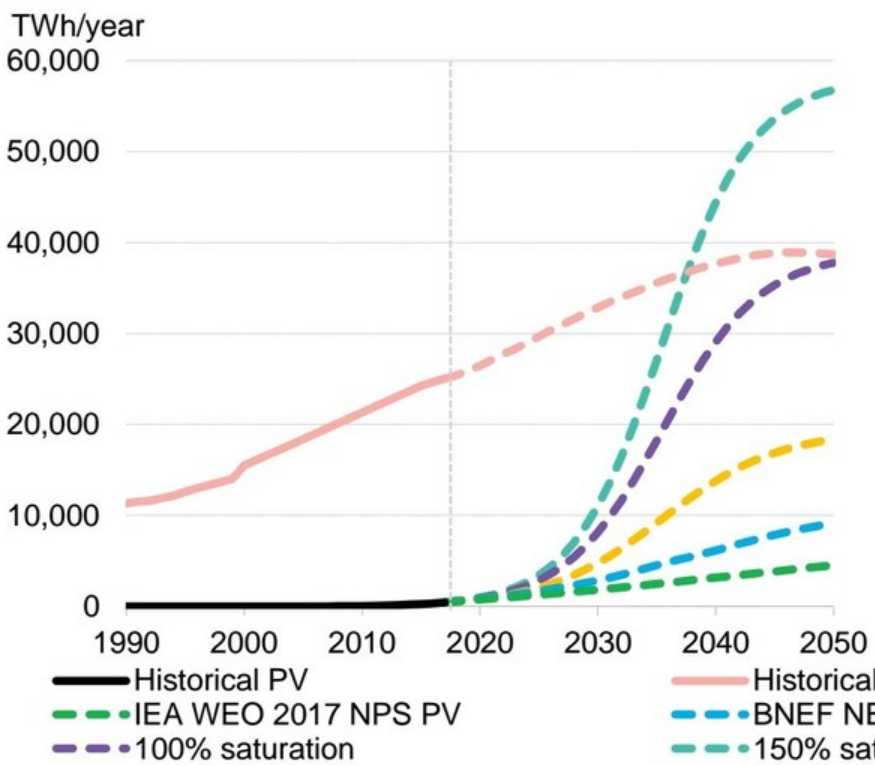
WITH ZERO CARBON EMISSIONS AND WITH SOLAR ALONE → www.landartgenerator.org



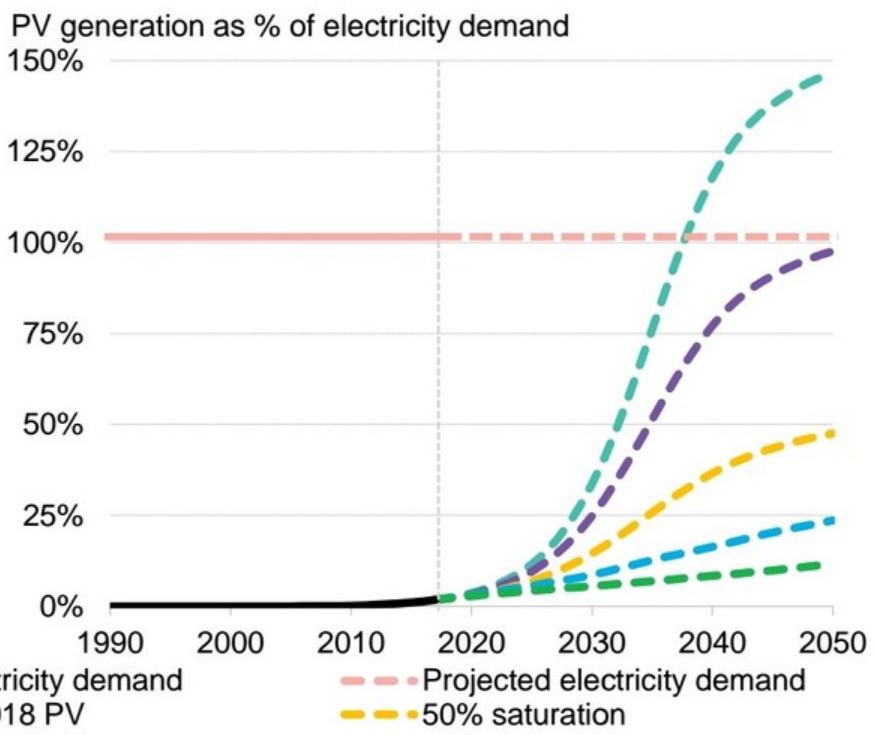
Required area that would be needed in the year 2030 is shown as one large square in the key above and also as distributed around the world relative to use and available sunlight.

- Areas are calculated based on an assumption of 20% operating efficiency of collection devices and a 2000 hour per year natural solar input of 1000 watts per square meter striking the surface.
- These 19 areas distributed on the map show roughly what would be a reasonable responsibility for various parts of the world based on 2009 usage. They would be further divided many times, the more the better to reach a diversified infrastructure that localizes use as much as possible.
- The large square in the Saharan Desert (1/4 of the overall 2030 required area) would power all of Europe and North Africa. Though very large, it is 18 times less than the total area of that desert.
- The definition of "power" covers the fuel required to run all electrical consumption, all machinery, and all forms of transportation. It is based on the US Department of Energy statistics of worldwide Btu consumption and estimates the 2030 usage (678 quadrillion Btu) to be 44% greater than that of 2008.
- Area calculations do not include magenta border lines.

Solar singularity



Note: NPS refers to IEA New Policies Scenario

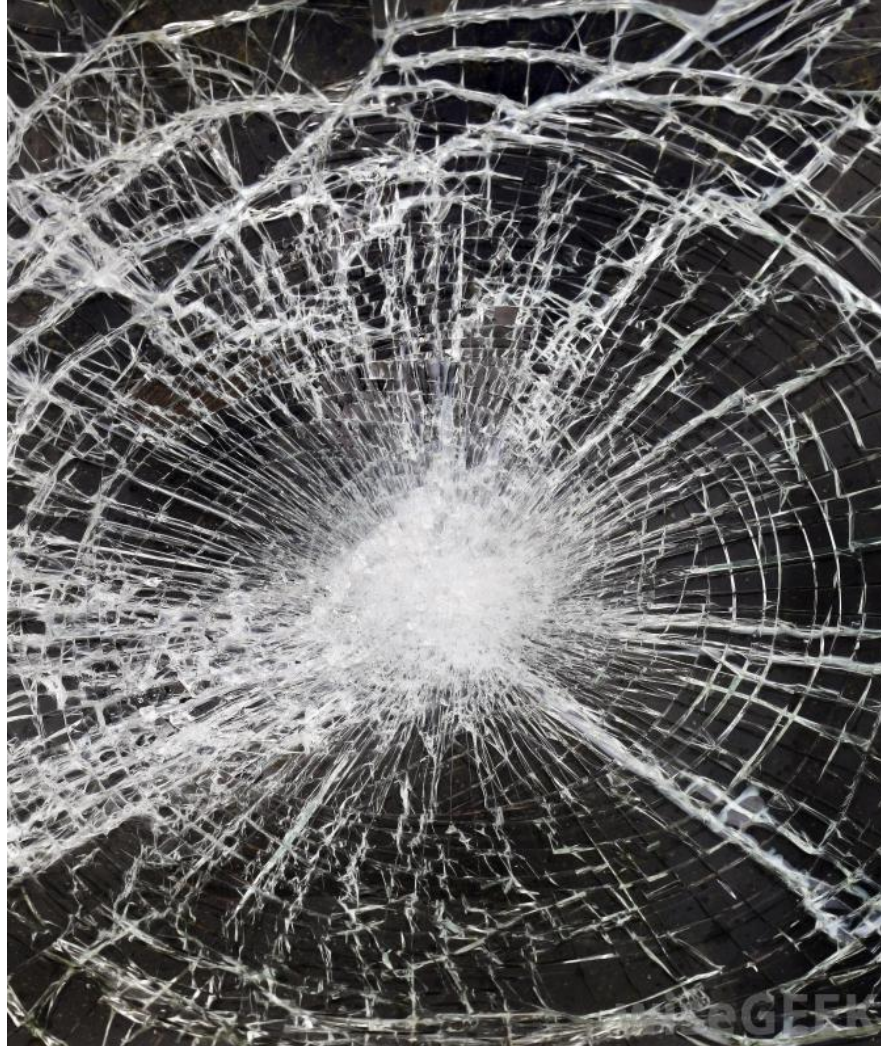


Source: Liebreich Associates; BNEF NEO 2018; BP; IEA WEO 2017

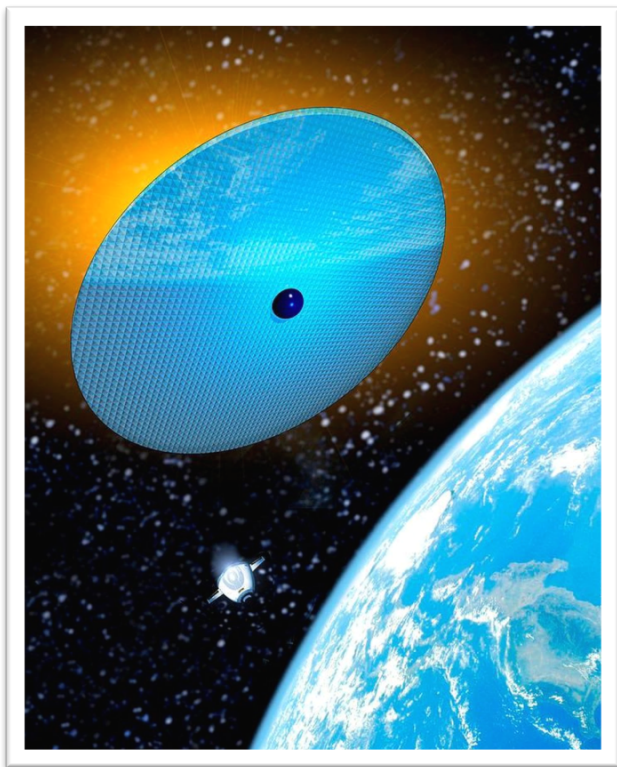
UN MONDO BASATO SULL'ELETTRICITÀ



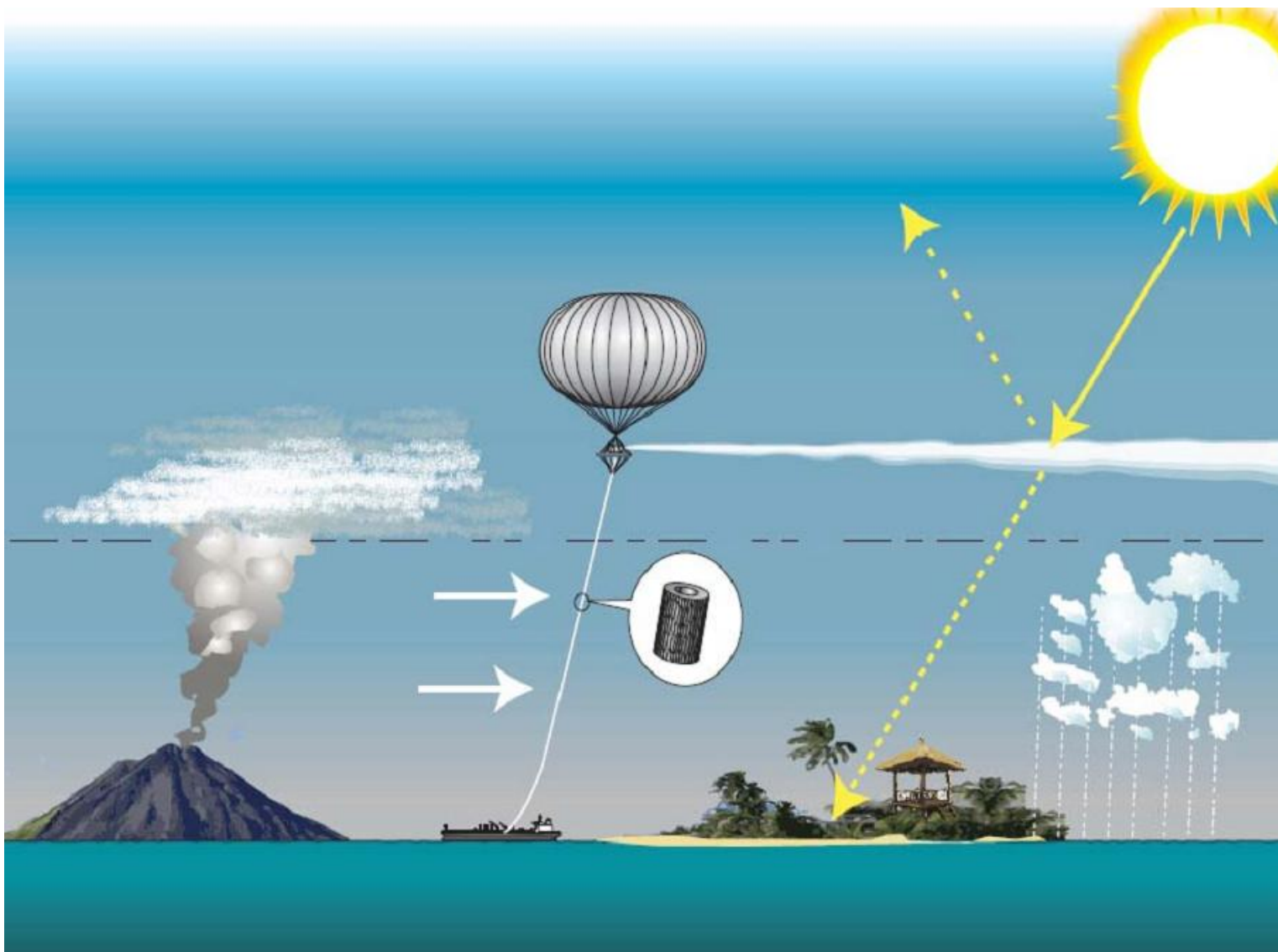
L'EREDITÀ DI CASSANDRA: MAI TRASCURARE L'IPOTESI PEGGIORE



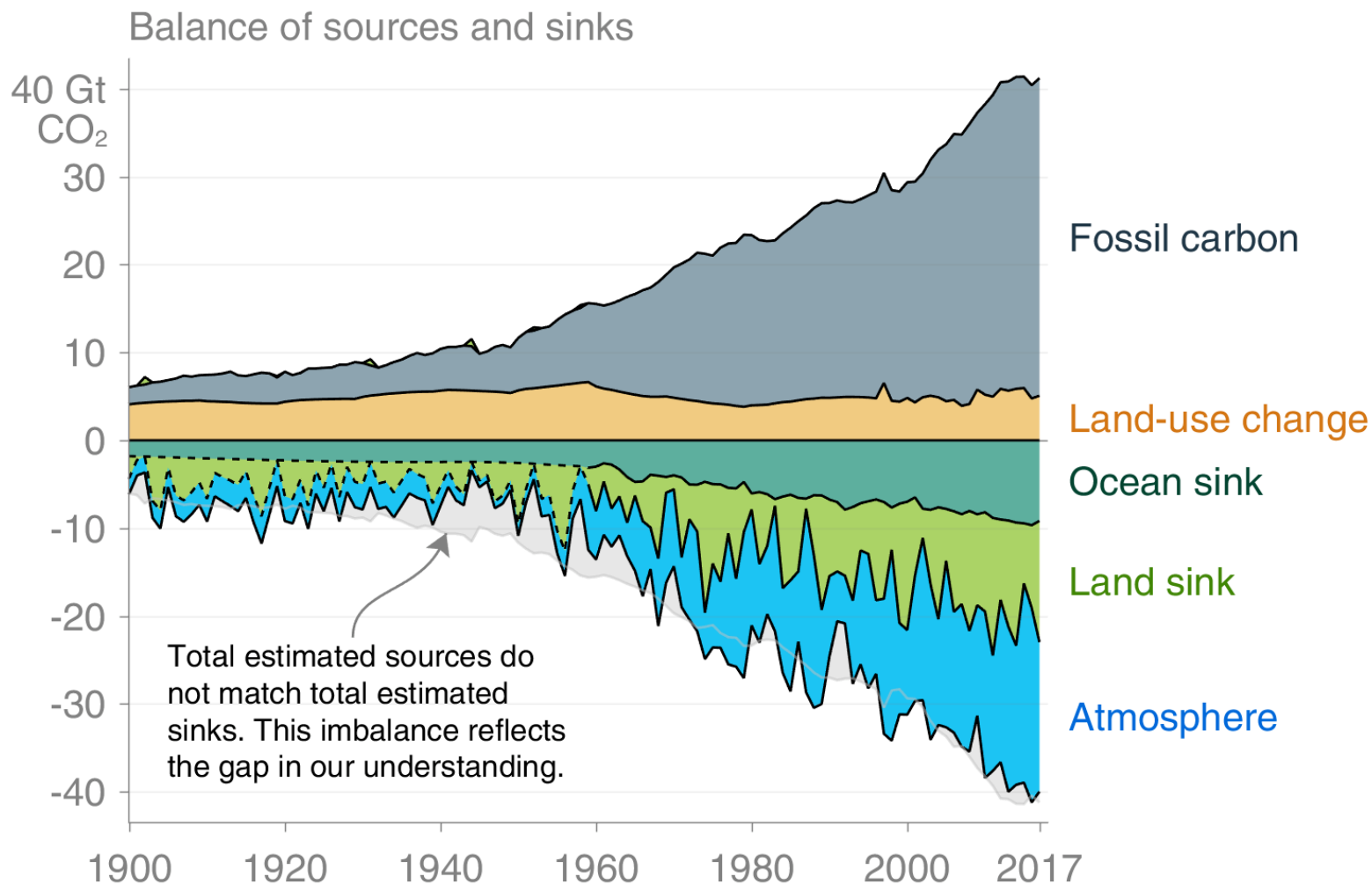
AGIRE SULL'ALBEDO



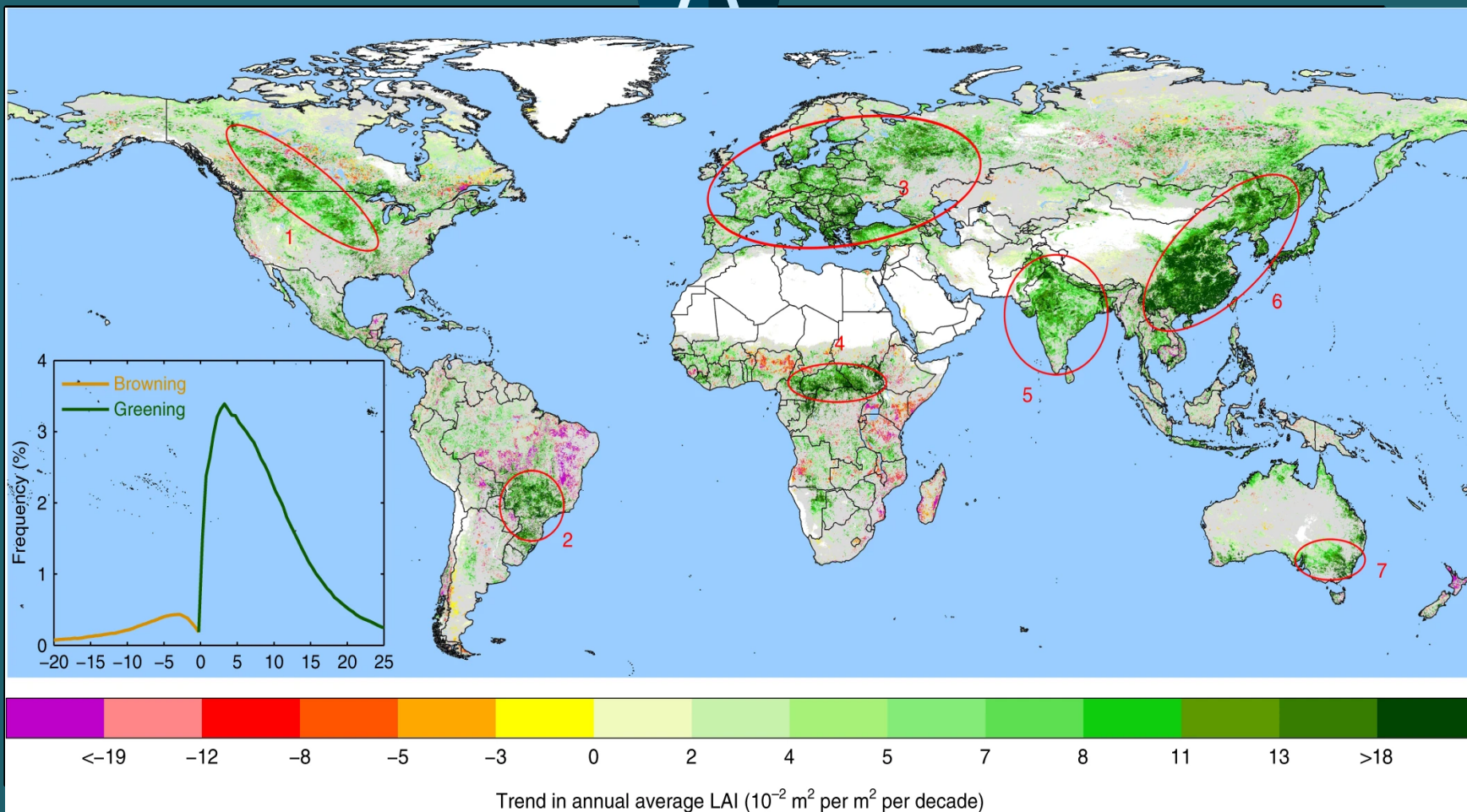
AEROSOL NELLA STRATOSFERA

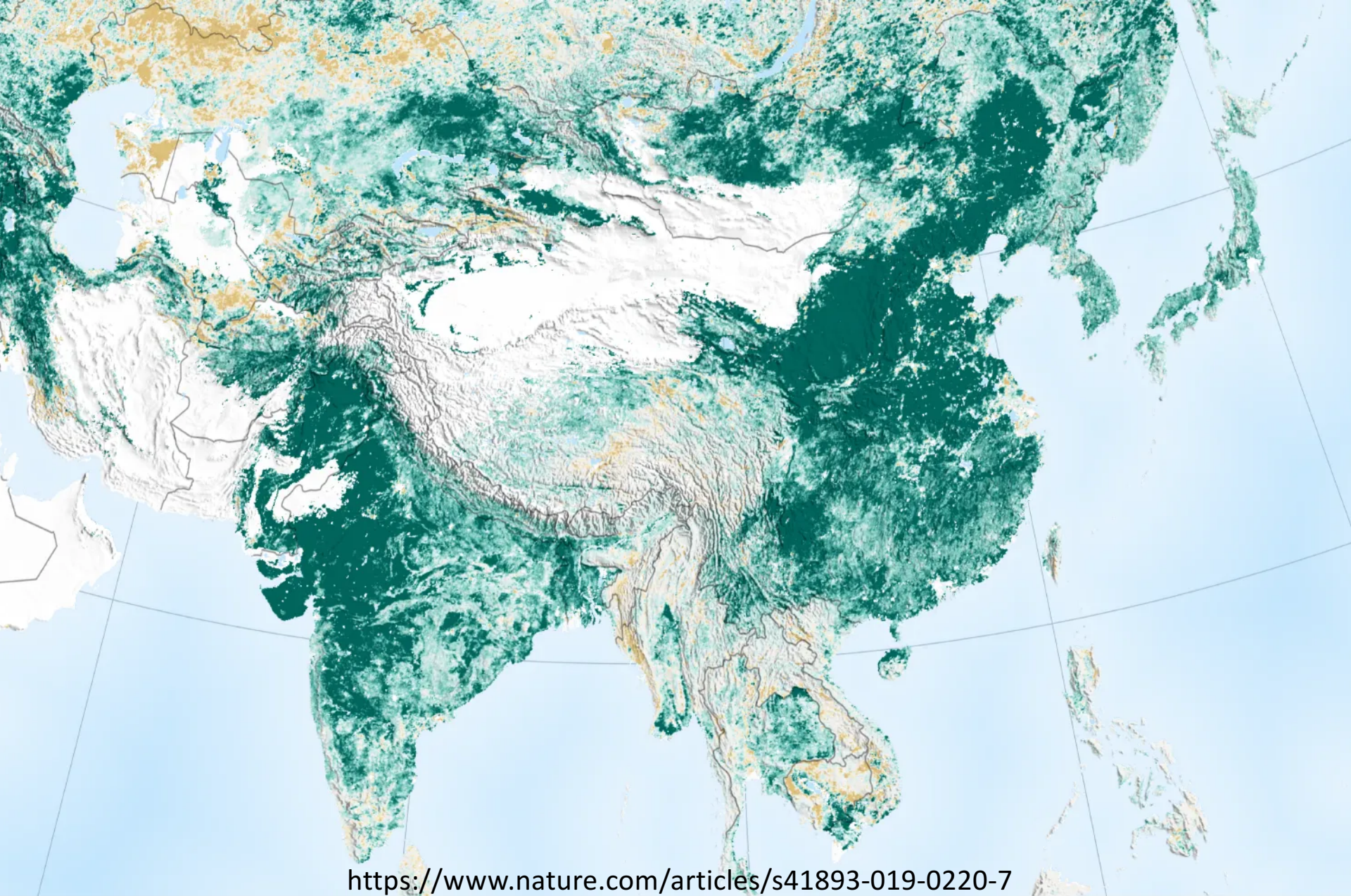


POTENZIARE I POZZI DI ASSORBIMENTO



© Global Carbon Project • Data: CDIAC/GCP/NOAA-ESRL/UNFCCC/BP/USGS



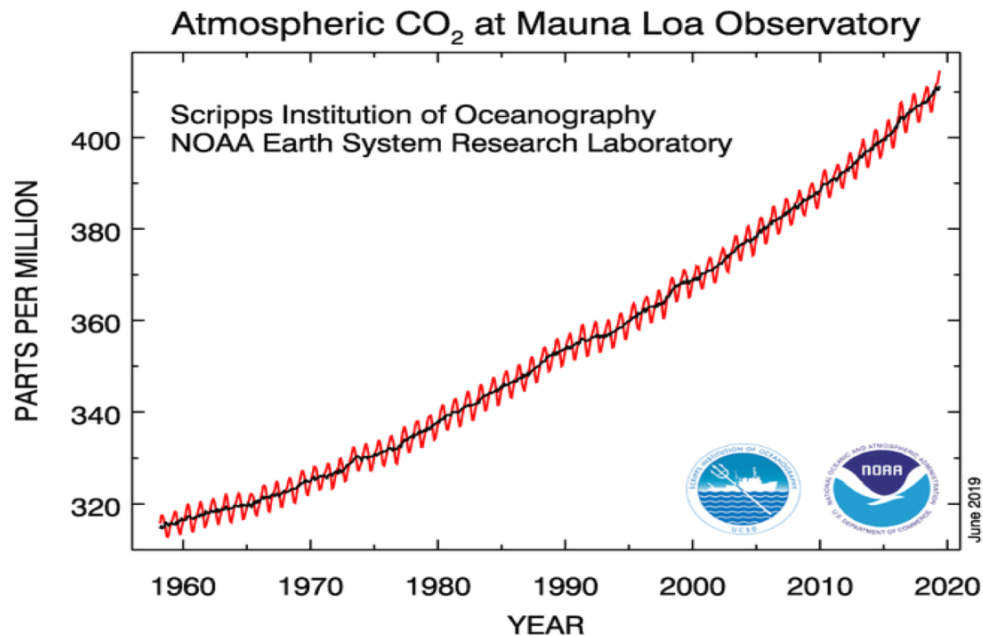
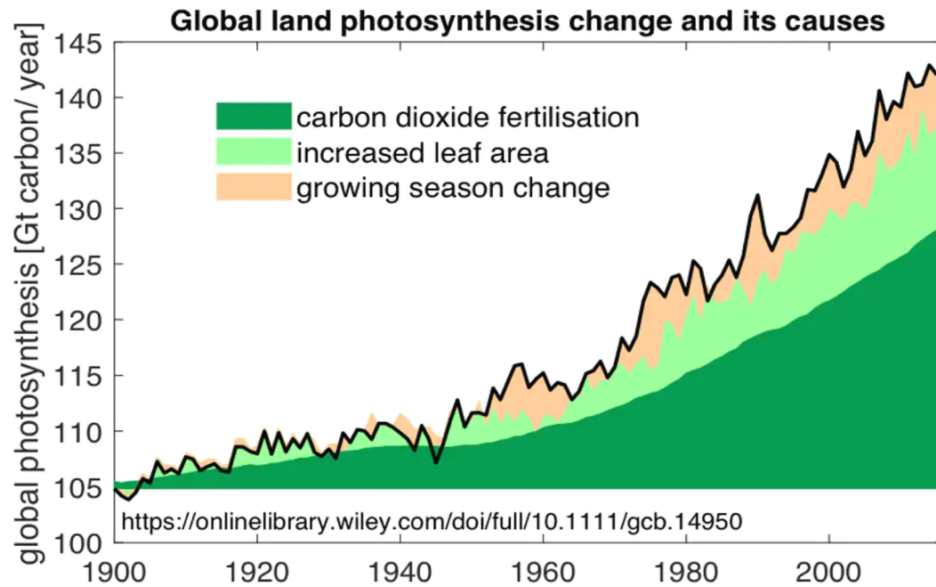


<https://www.nature.com/articles/s41893-019-0220-7>

Trend in Annual Average Leaf Area (% per decade, 2000-2017)



ASSORBIMENTO DEL CO₂ DALLE FORESTE



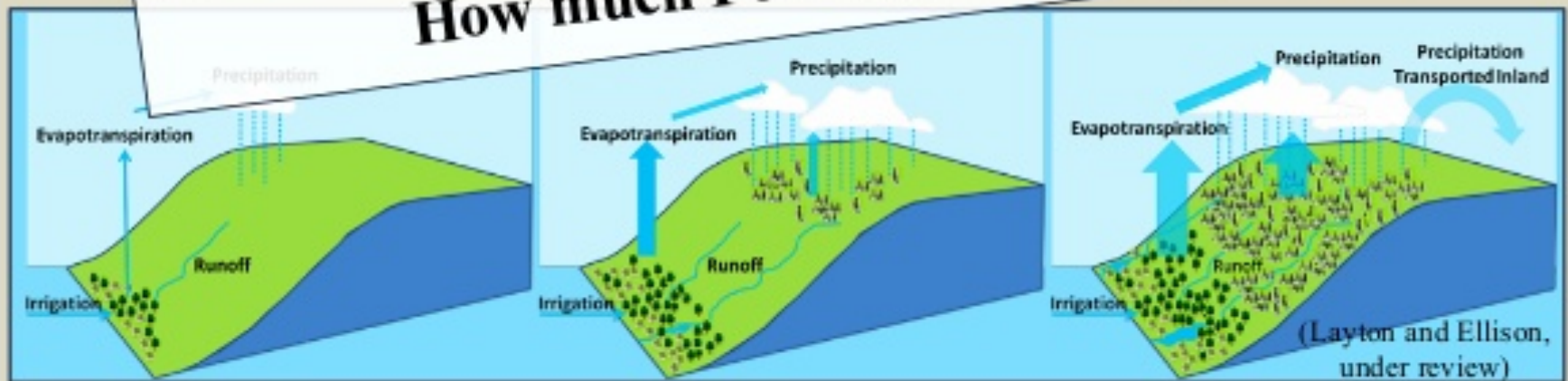


Atmospheric Moisture Transport Mechanisms

(Biotic Pump, Makarieva et al.)

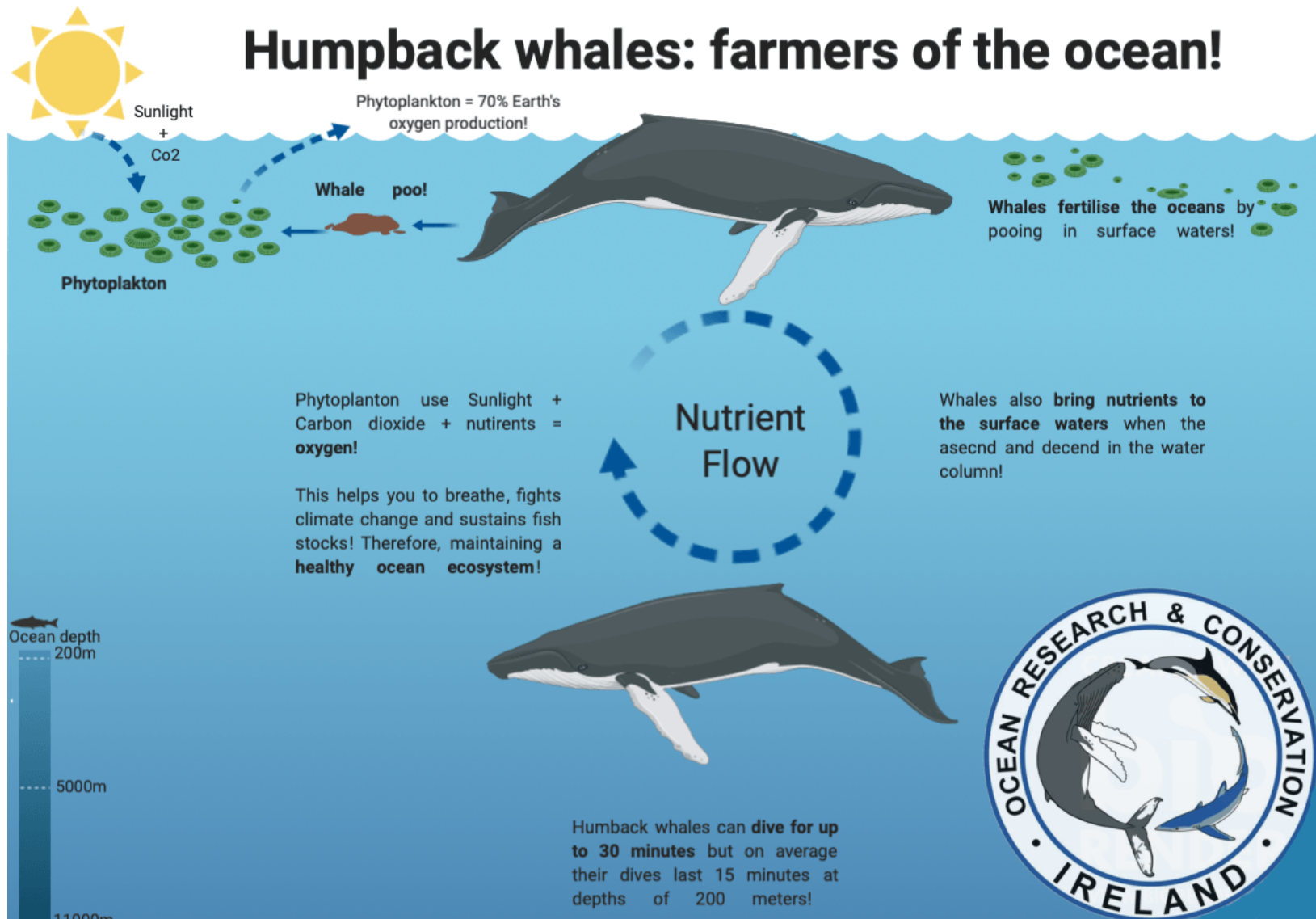


How much Forest is enough?

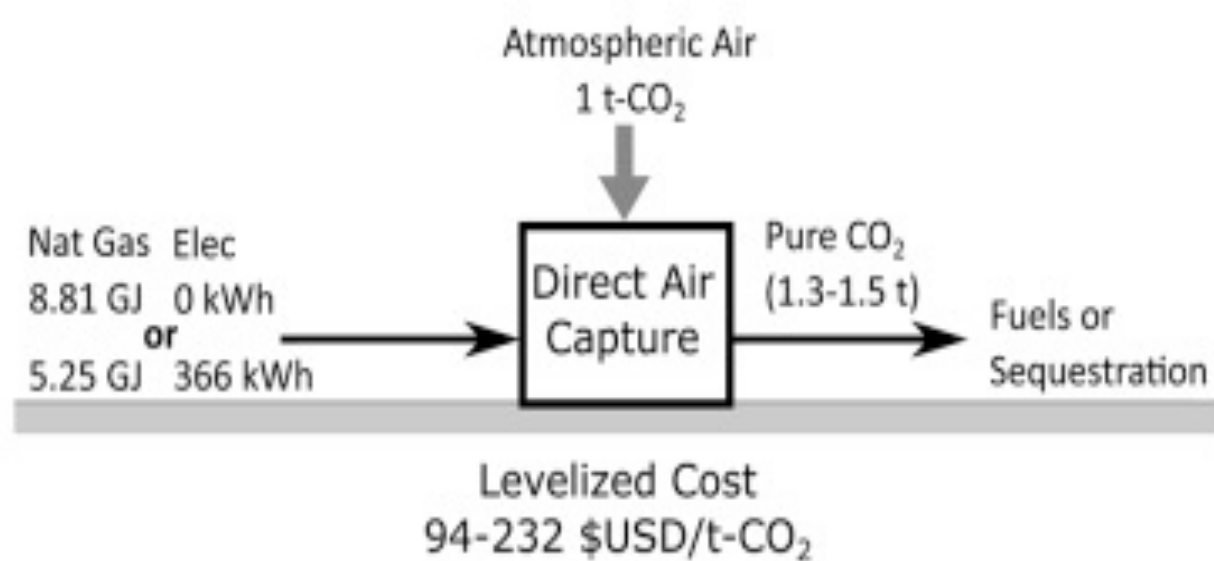


Virtuous cycle of increased Precipitation, ET and Forest Growth

RIASSORBIRE IL CO2



SOLUZIONI DISPERATE: DIRECT AIR CAPTURE (DAC)



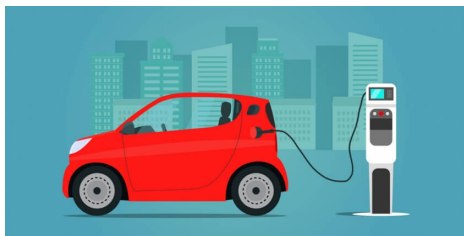
Process simulation & EPC cost estimate



Pilot plant performance data

Commercial scale reference design

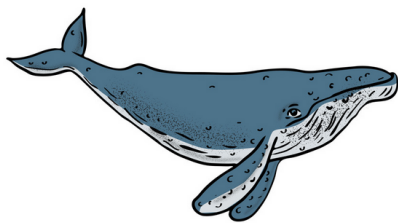
CONCLUSIONE: PROSPETTIVE DI MITIGAZIONE DEL CAMBIAMENTO CLIMATICO



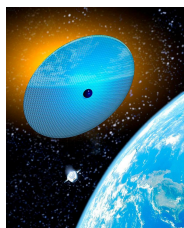
1. La singolarità delle rinnovabili: Elettificazione della società



2. Riforestare: Abbiamo bisogno di foreste, non solo alberi!



3. Ripopolare l'oceano: ci vogliono più balene!



4. In Emergenza: Geoingegneria(o emigrare su Marte)

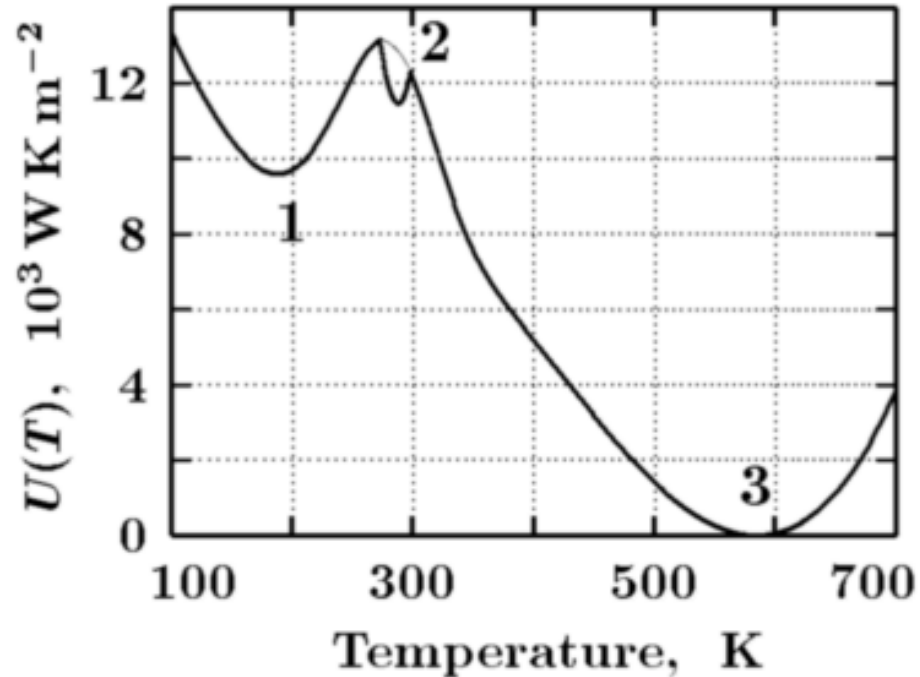


L'EREDITÀ DI CASSANDRA

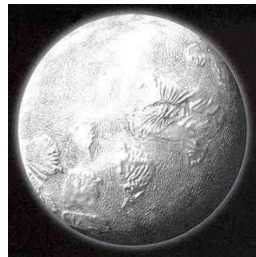
Mai trascurare l'ipotesi peggiore

STABILITÀ DEL CLIMA TERRESTRE

(Gorshkov e Makarieva)



Palla di neve-Terra



Terra



Inferno-Terra

SPAZIO ALLE DOMANDE



Scrivi le tue domande al relatore nella chat

Grazie!

eventi.digitali@deascuola.it



blog.deascuola.it



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LA STRATEGIA DEL SEMINATORE: SEMINARE L'ENERGIA DI OGGI PER IL RACCOLTO DI ENERGIA DI DOMANI



As a man himself sows, so he himself reaps... The fruit is of the same quality as the action.

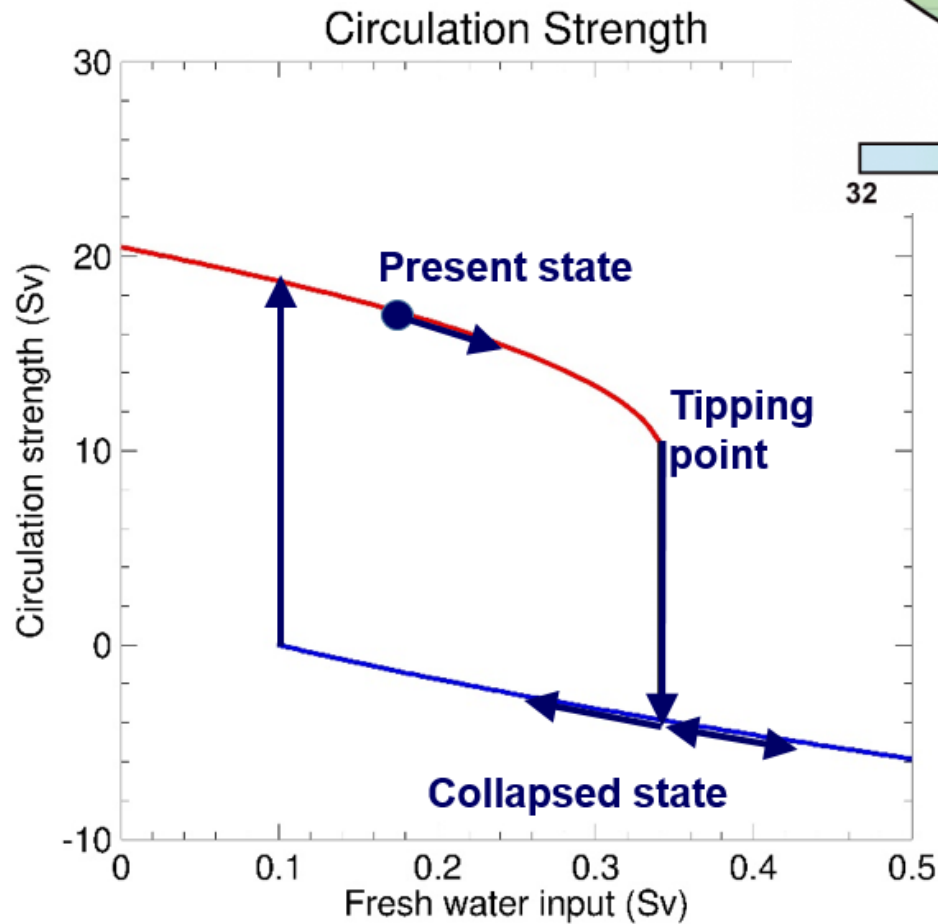
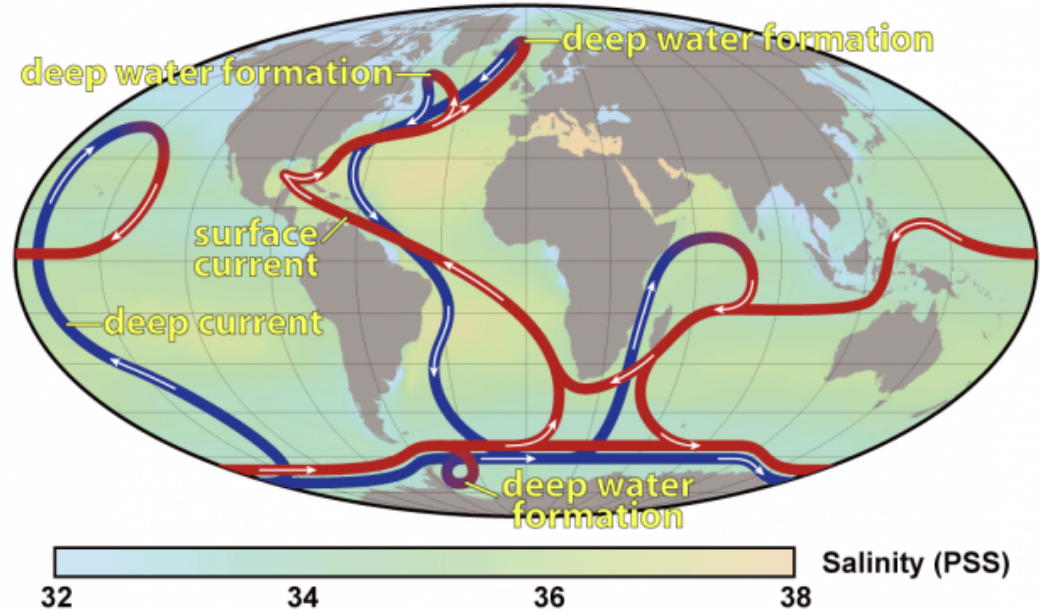
—Mahabharata,
xii.291.22

Whoever sows sparingly will also reap sparingly, and whoever sows bountifully will also reap bountifully.

Corinthians 9:6



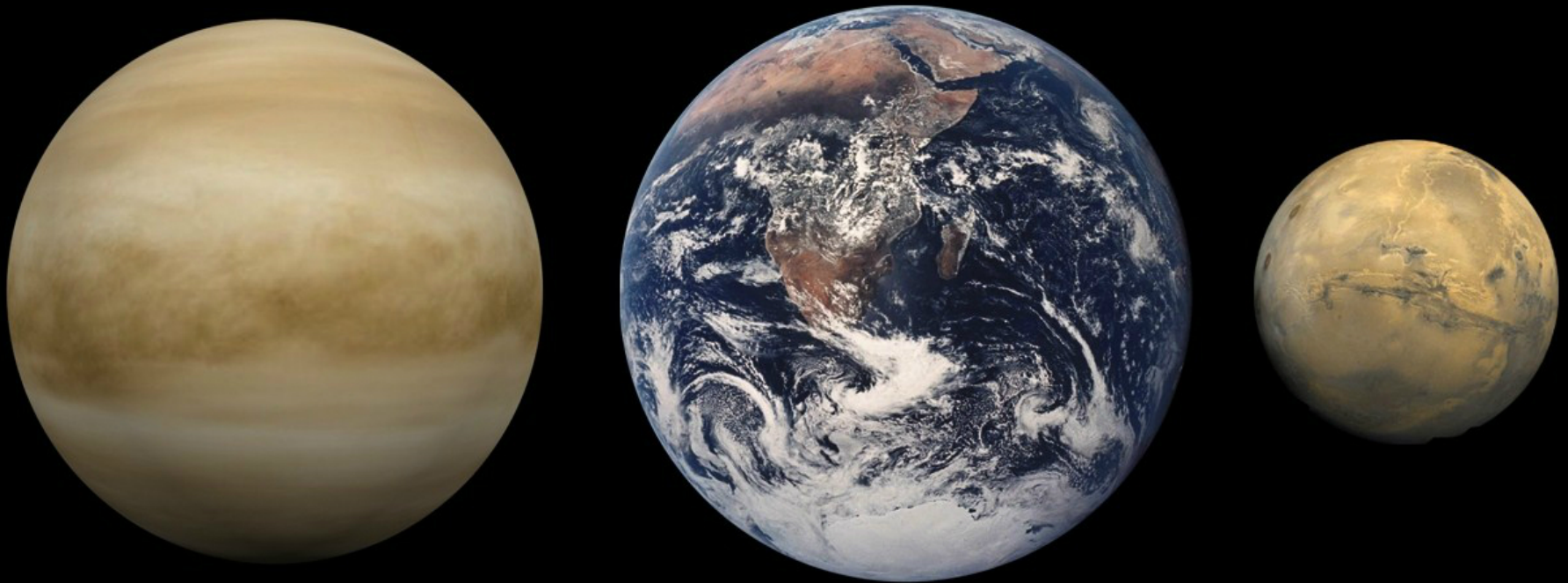
Thermohaline Circulation



Venere

Terra

Marte



				
Planet	Mercury	Venus	Earth	Mars
T _p , K (°C)	437 (163)	232 (-41)	255 (-18)	209 (-64)
T _{obs} , K (°C)	~440 (167)	735 (462)	288 (15)	215 (-58)
Atmosphere: Pressure, kPa composition [trace gases]	none	9300 CO ₂ (0.965), N ₂ (0.035), [SO ₂ , Ar]	101 N ₂ (0.78), O ₂ (0.21), Ar(0.009), [CO ₂ , H ₂ O]	0.64 CO ₂ (0.95), N ₂ (0.03), Ar(0.02), [O ₂ , CO]