LIFE15 ENV/IT/000392

Viticoltura e Cambiamento Climatico: Responsabilità, minacce e opportuniità

Andrea Pitacco, University of Padova

Il problema: troppa energia recuperata dal passato

Umanità, ricerca ed effetto serra

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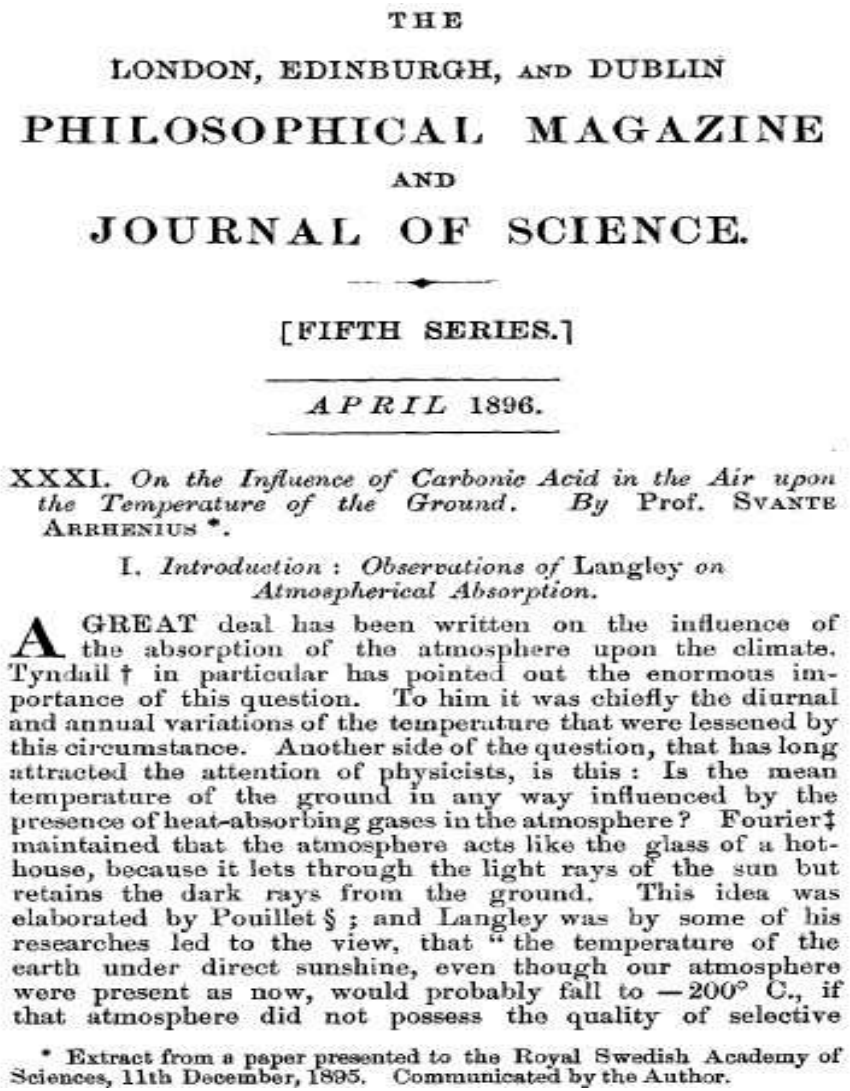


THE

LONDON, EDINBURGH, AND DUBLIN

PHILOSOPHICAL MAGAZINE

AND

JOURNAL OF SCIENCE.

[FIFTH SERIES.]

APRIL 1896.

XXXI. *On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground.* By Prof. SVANTE ARRHENIUS *.

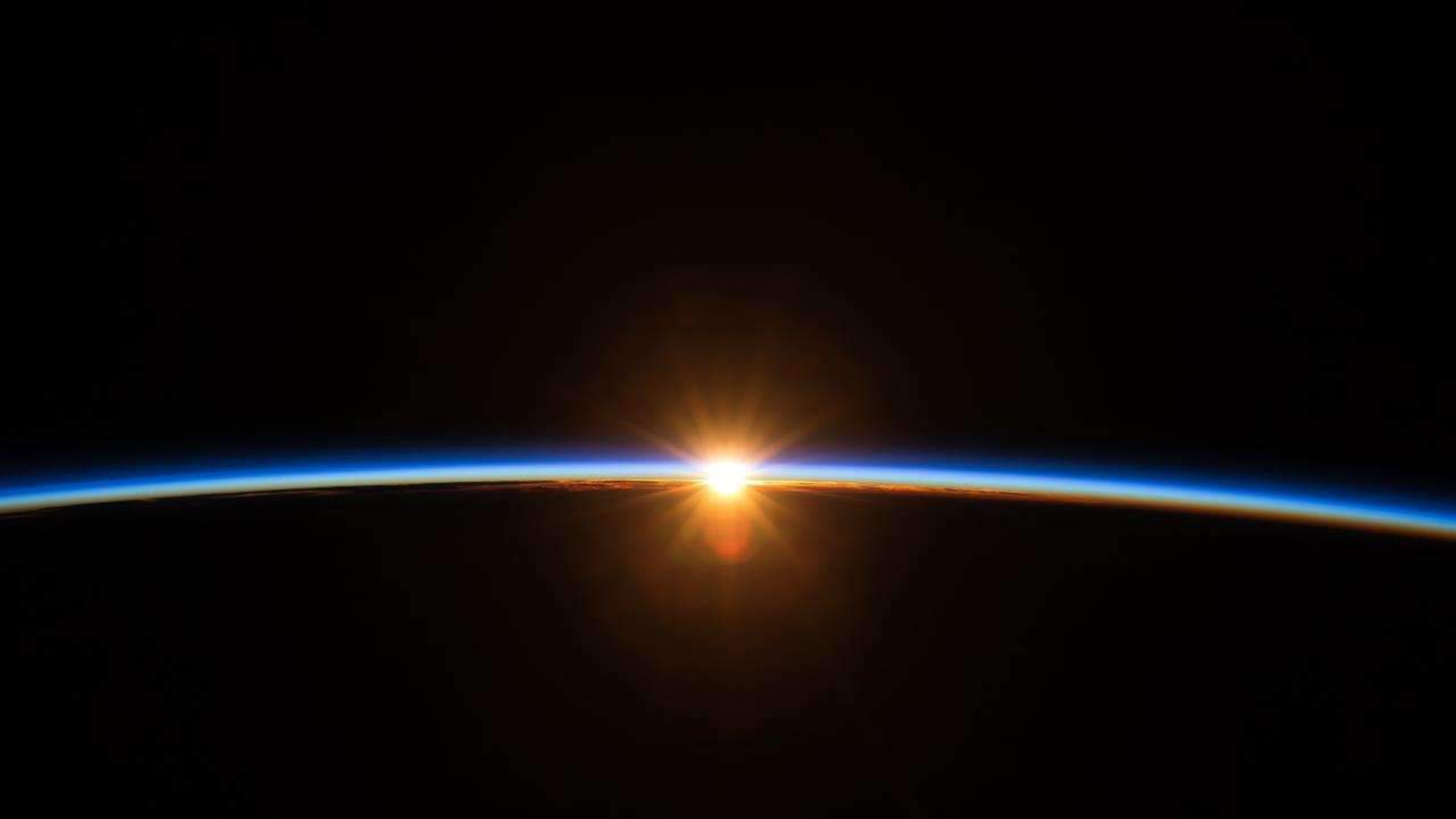
I. *Introduction : Observations of* Langley *on Atmospherical Absorption.*

A GREAT deal has been written on the influence of the absorption of the atmosphere upon the climate. Tyndall † in particular has pointed out the enormous importance of this question. To him it was chiefly the diurnal and annual variations of the temperature that were lessened by this circumstance. Another side of the question, that has long attracted the attention of physicists, is this: Is the mean temperature of the ground in any way influenced by the presence of heat-absorbing gases in the atmosphere? Fourier‡ maintained that the atmosphere acts like the glass of a hot-house, because it lets through the light rays of the sun but retains the dark rays from the ground. This idea was elaborated by Pouillet § ; and Langley was by some of his researches led to the view, that "the temperature of the earth under direct sunshine, even though our atmosphere were present as now, would probably fall to —200° C., if that atmosphere did not possess the quality of selective

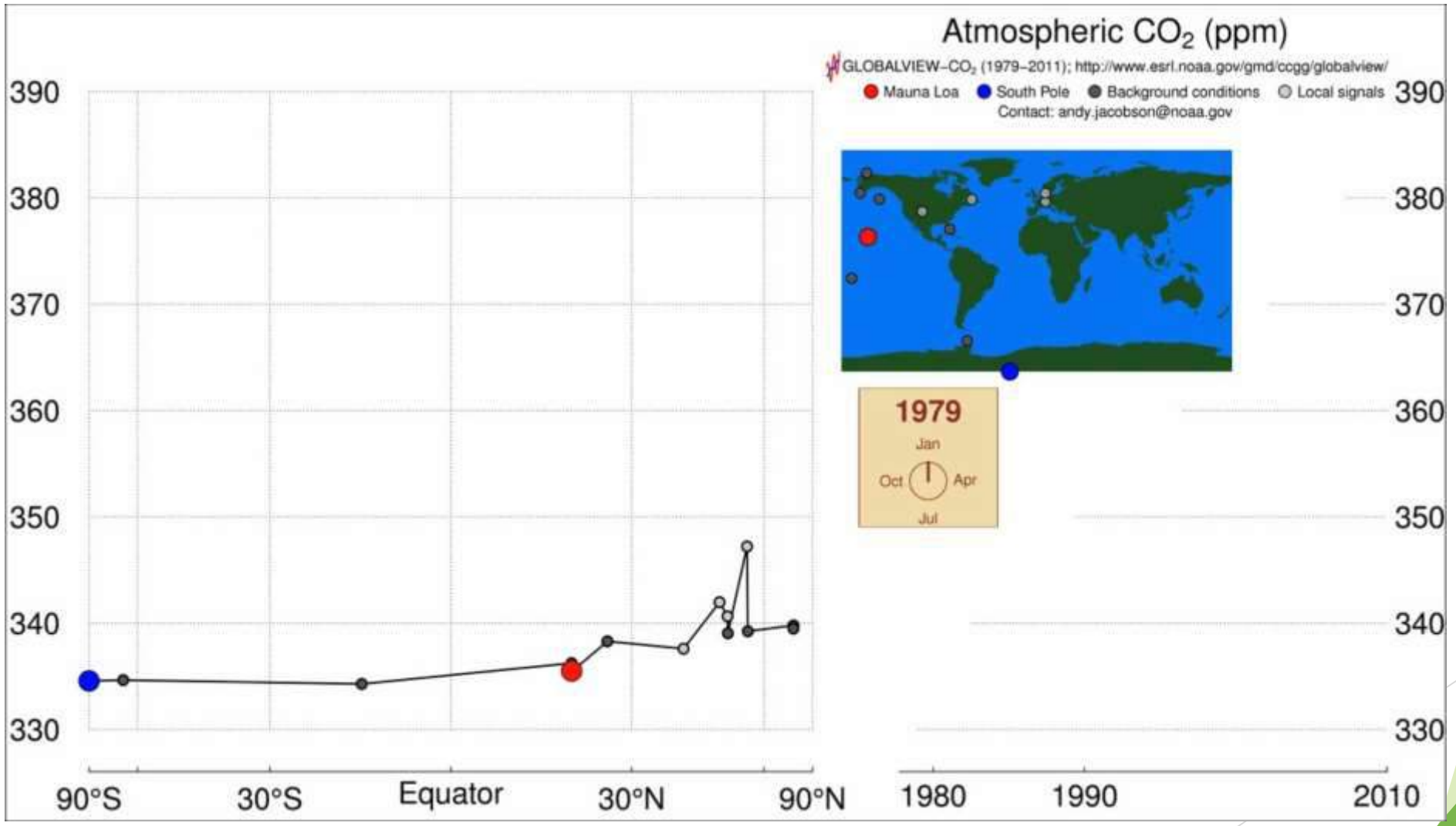
* Extract from a paper presented to the Royal Swedish Academy of Sciences, 11th December, 1895. Communicated by the Author.

Già nel 1896 Arrhenius individua chiaramente il ruolo dell'effetto serra, e ipotizza che le massicce combustioni possano rappresen- tare una minaccia per la stabilità del clima.

"The air retains heat (light or dark) in two different ways. On the one hand, the heat suffers a selective diffusion on its passage through the air; on the other hand, some of the atmospheric gases absorb considerable quantities of heat. These two actions are very different."



Dinamica della concentrazione atmosferica di CO_2



Umanità, ricerca ed effetto serra

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Cinderella science

On-the-ground monitoring is unglamorous work, seldom rewarded by funding agencies or the science community. But we neglect it at our peril, warns Euan Nisbet.

Sometimes discovery comes slowly, not with a flash of revelation but creepingly, as larger patterns emerge painfully from years of data. Researchers who work in Mauna Loa, Hawaii, are celebrating the fiftieth anniversary of a measurement programme responsible for the longest continuous recording of atmospheric carbon dioxide. Seldom can such insight have grown (and continued to grow) over so long a time. Now that we look back, the resulting 'Keeling curve' of CO_2 concentrations ranks very high indeed among the achievements of twentieth-century science.

Charles David Keeling's account of his tribulations[1], "Rewards and penalties of monitoring the Earth", should be compulsory reading for politicians and science administrators. Idealistic young scientists, as yet unscarred, should read it and take note: courage and perseverance are required. Before Keeling, little was known about CO_2 in the atmosphere and available measurements had little value. Success came from Keeling's painstaking years of effort and innovation. Despite the import of the results, the work was often threatened, as is attested by a gap in 1964 when underfunding briefly halted measurement.

Charles David Keeling's work made us aware of rising amounts of carbon dioxide in the atmosphere.

Il monitoraggio sistematico della concentrazione dei Gas ad effetto serra è stabilito da Keeling nel 1958

Fate of anthropogenic CO_2 emissions (2007–2016)

Sources

34.4 $GtCO_2$/yr

88%

12%

4.8 $GtCO_2$/yr

= Sinks

17.2 $GtCO_2$/yr

46%

30%

11.0 $GtCO_2$/yr

24%

8.8 $GtCO_2$/yr

Budget Imbalance:
(the difference between estimated sources & sinks)

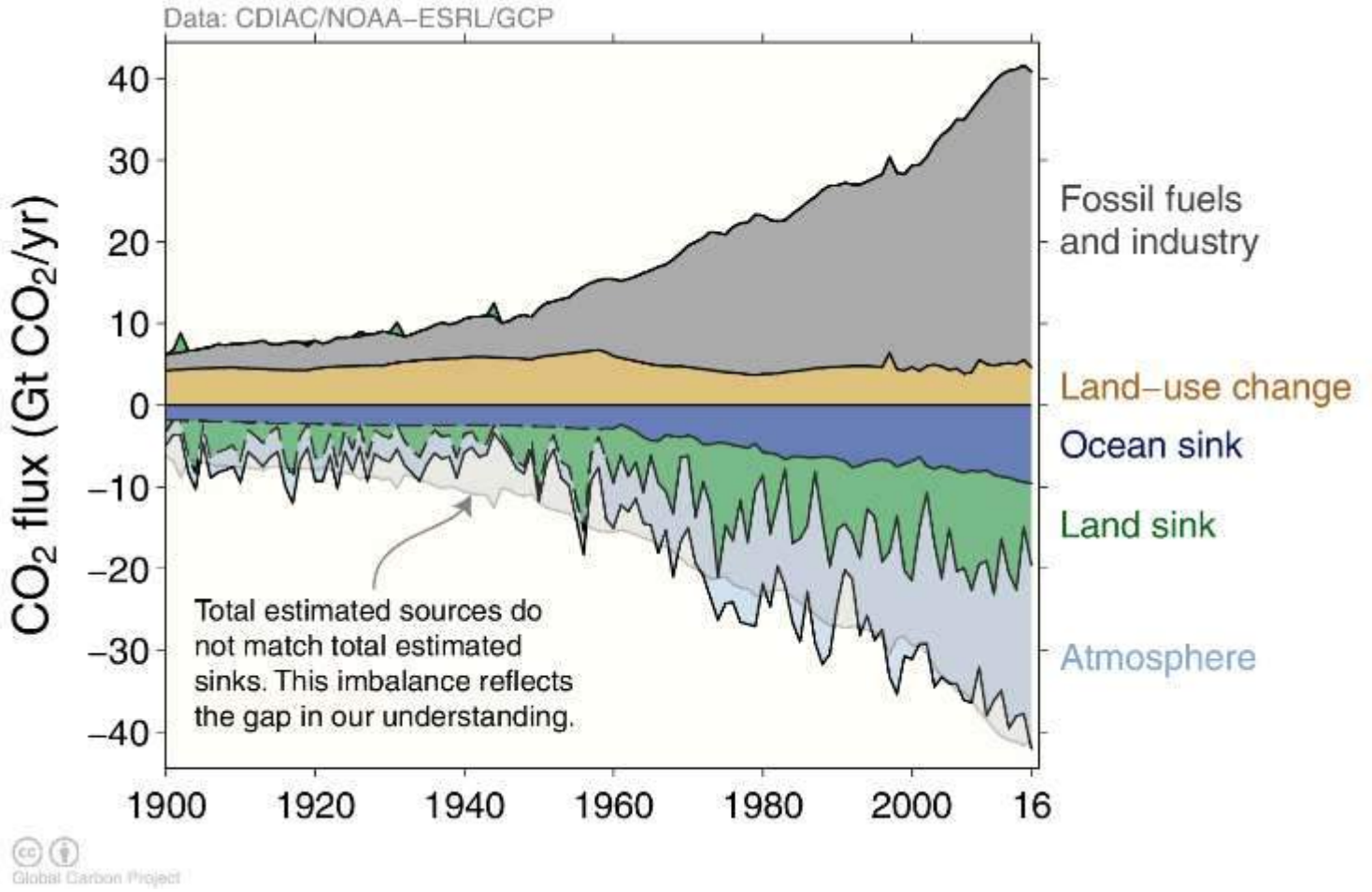
6%

2.2 $GtCO_2$/yr

Source: CDIAC; NOAA-ESRL; Houghton and Nassikas 2017; Hansis et al 2015; Le Quéré et al 2017; Global Carbon Budget 2017

Global carbon budget

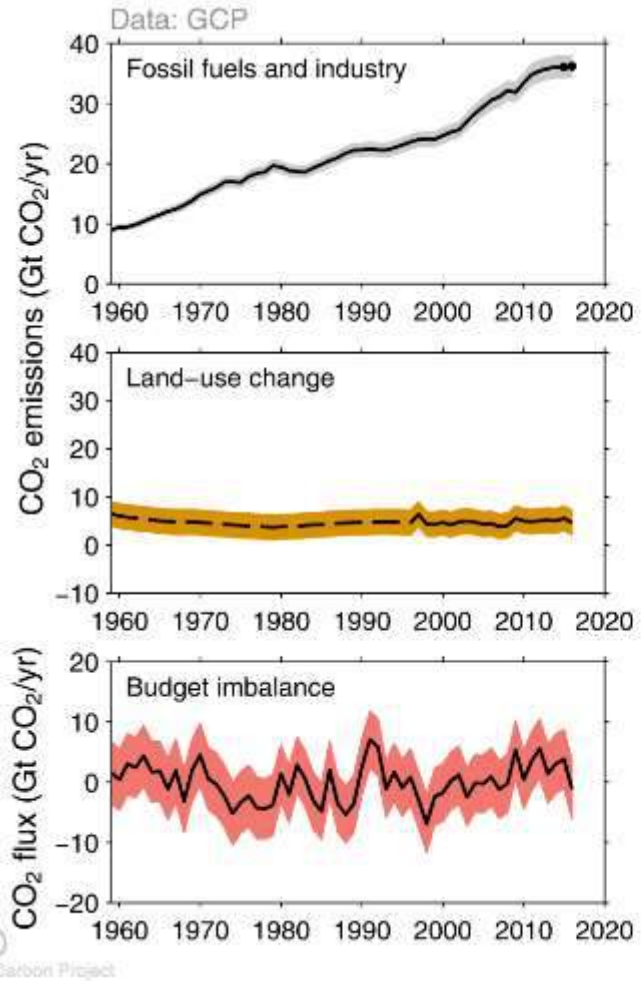
Carbon emissions are partitioned among the atmosphere and carbon sinks on land and in the ocean
The “imbalance” between total emissions and total sinks reflects the gap in our understanding



Source: CDIAC; NOAA-ESRL; Houghton and Nassikas 2017; Hansis et al 2015; Joos et al 2013; Khatiwala et al. 2013; DeVries 2014; Le Quéré et al 2017; Global Carbon Budget 2017

Changes in the budget over time

The sinks have continued to grow with increasing emissions, but climate change will affect carbon cycle processes in a way that will exacerbate the increase of CO_2 in the atmosphere

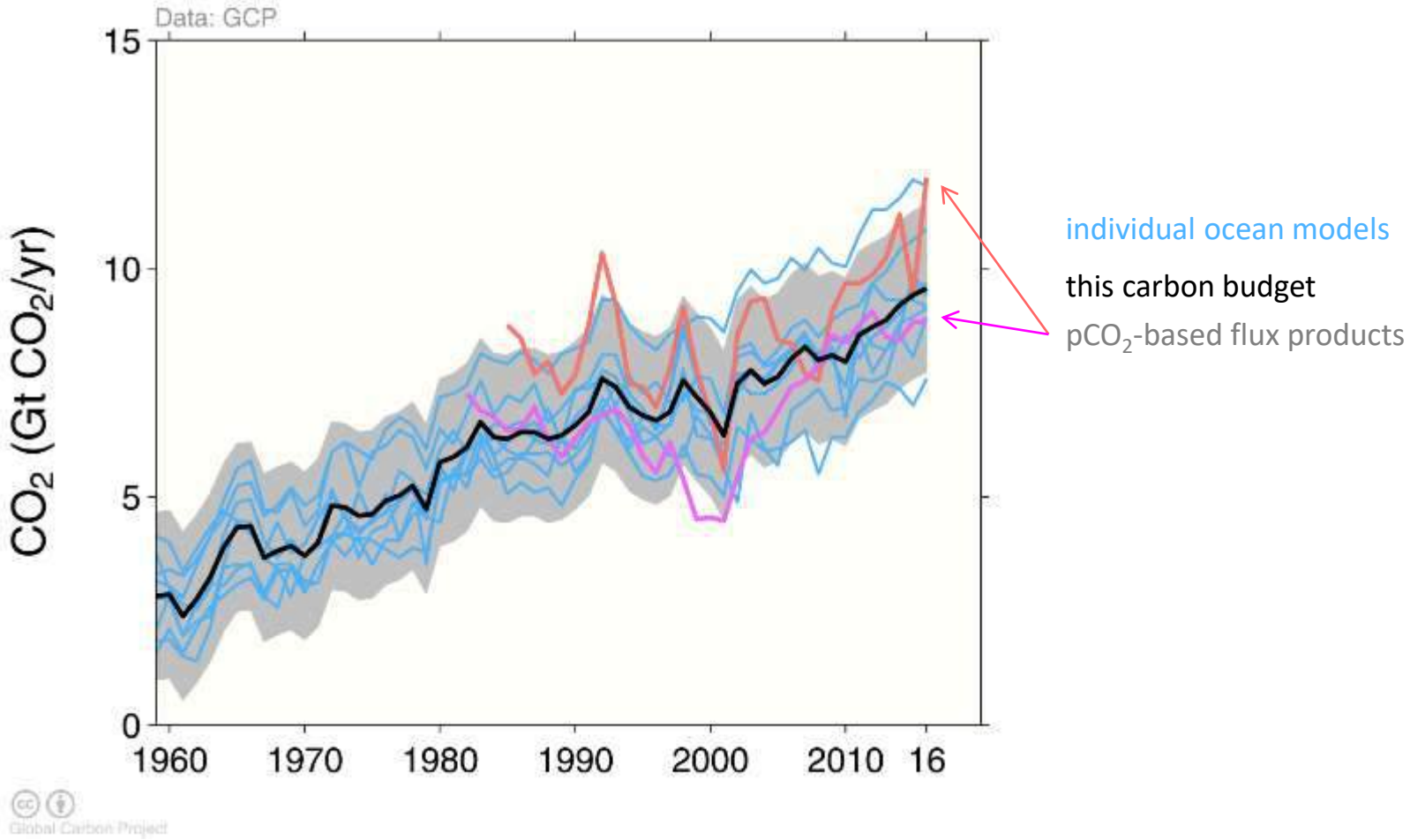


The budget imbalance is the total emissions minus the estimated growth in the atmosphere, land and ocean.
It reflects the limits of our understanding of the carbon cycle.

Source: CDIAC; NOAA-ESRL; Houghton and Nassikas 2017; Hansis et al 2015; Le Quéré et al 2017; Global Carbon Budget 2017

Ocean sink

The ocean carbon sink continues to increase
8.7±2 $GtCO_2$/yr for 2007–2016 and 9.6±2 $GtCO_2$/yr in 2016

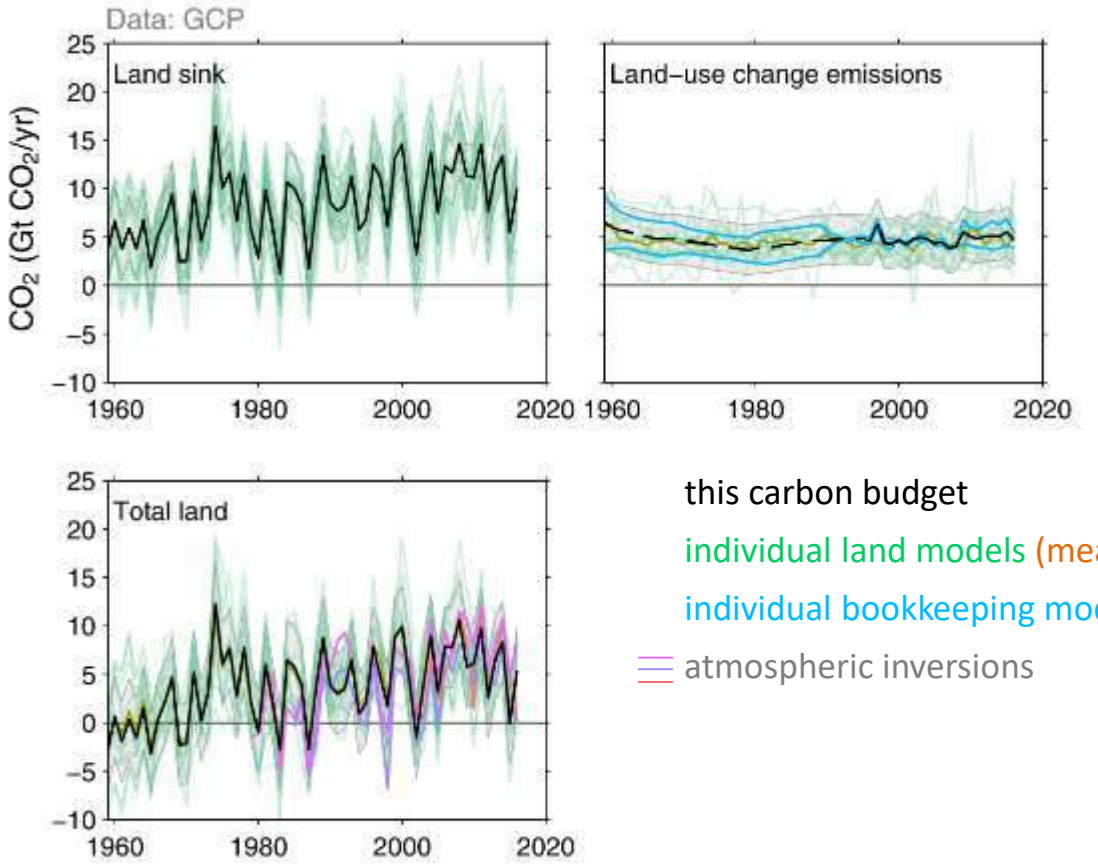


Source: SOCATv5; Bakker et al 2016; Le Quéré et al 2017; Global Carbon Budget 2017

Individual estimates from: Aumont and Bopp (2006); Buitenhuis et al. (2010); Doney et al. (2009); Hauck et al. (2016); Ilyiana et al. (2013); Landschützer et al. (2016); Law et al. (2017); ; Rödenbeck et al. (2014). Séférian et al. (2013); Schwinger et al. (2016). Full references provided in Le Quéré et al. (2017).

Terrestrial sink

The land sink was 11.2±3 GtCO2/yr during 2007-2016 and 10±3 $GtCO_2$/yr in 2016
Total CO_2 fluxes on land (including land-use change) are constrained by atmospheric inversions

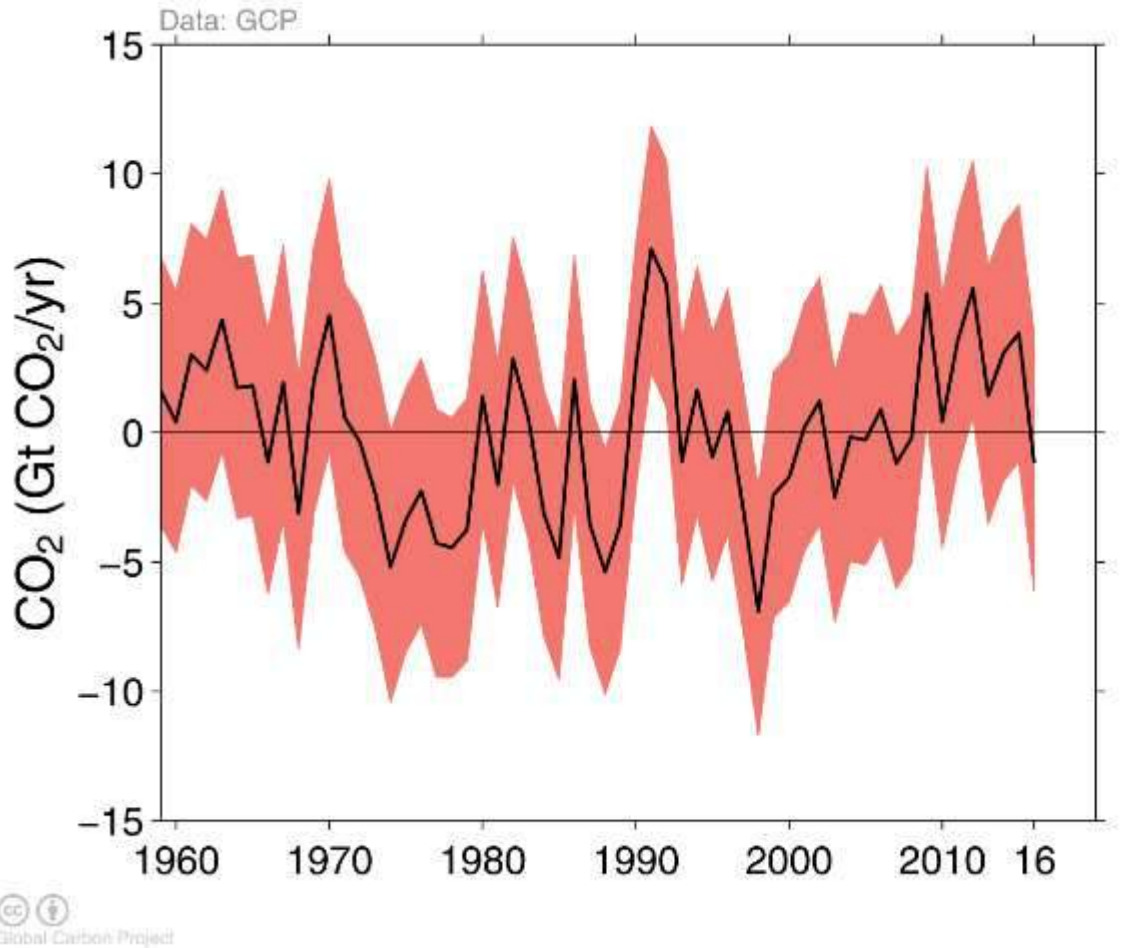


Source: Le Quéré et al 2017; Global Carbon Budget 2017

Individual estimates from: Chevallier et al. (2005); Clarke et al. (2011); Guimberteau et al. (2017); Hansis et al. (2015); Haverd et al. (2017); Houghton and Nassikas (2017); Jain et al. (2013); Kato et al. (2013); Keller et al. (2017); Krinner et al. (2005); Melton and Arora (2016); Oleson et al. (2013); Reick et al. (2013); Rodenbeck et al. (2003); Sitch et al. (2003); Smith et al. (2014); Tian et al. (2015); van der Laan-Luijkx et al. (2017); Woodward et al. (1995); Zaehle and Friend (2010). Full references provided in Le Quéré et al. (2017).

Remaining carbon budget imbalance

Large and unexplained variability in the global carbon balance caused by uncertainty and understanding hinder independent verification of reported CO_2 emissions



positive values mean overestimated emissions and/or underestimated sinks

The budget imbalance is the carbon left after adding independent estimates for total emissions, minus the atmospheric growth rate and estimates for the land and ocean carbon sinks using models constrained by observations

Source: Le Quéré et al 2017; Global Carbon Budget 2017

Global carbon budget

The cumulative contributions to the global carbon budget from 1870
The carbon imbalance represents the gap in our current understanding of sources and sinks

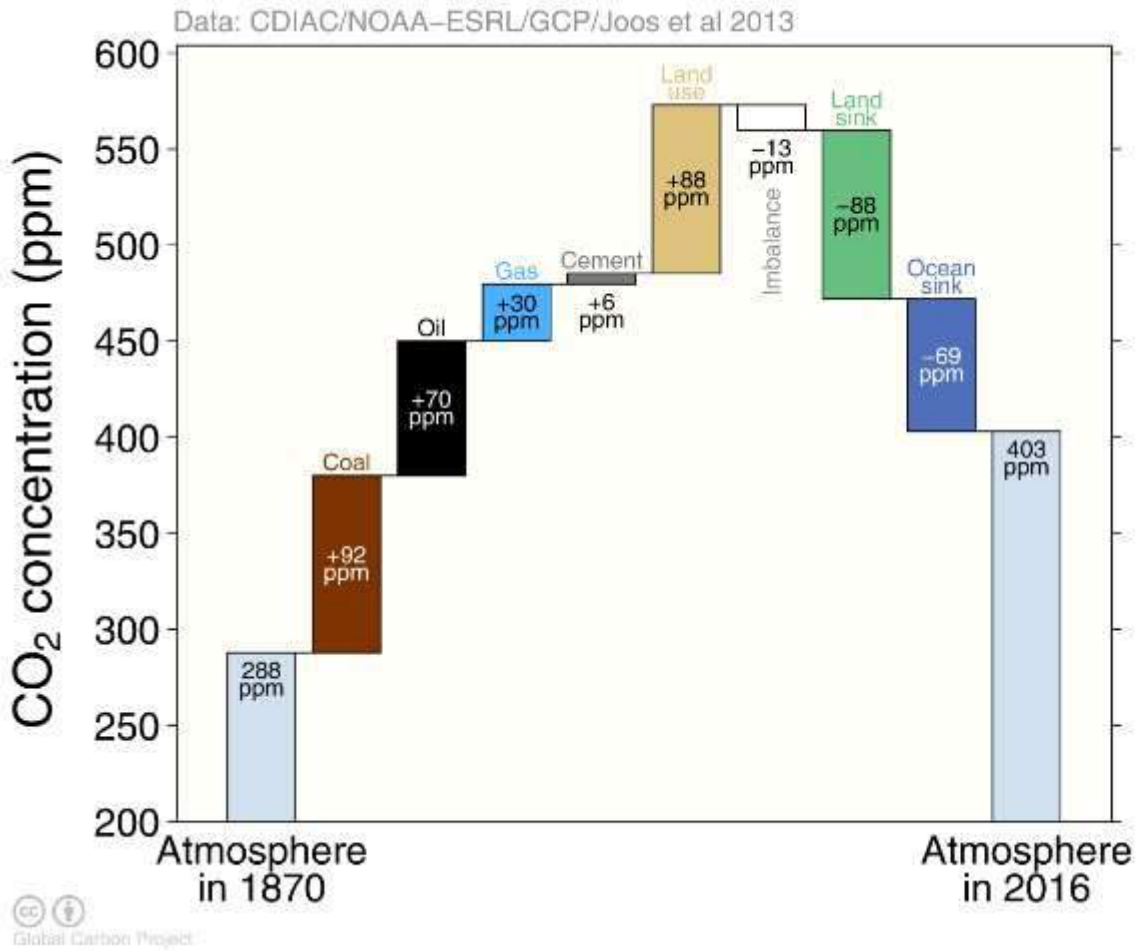
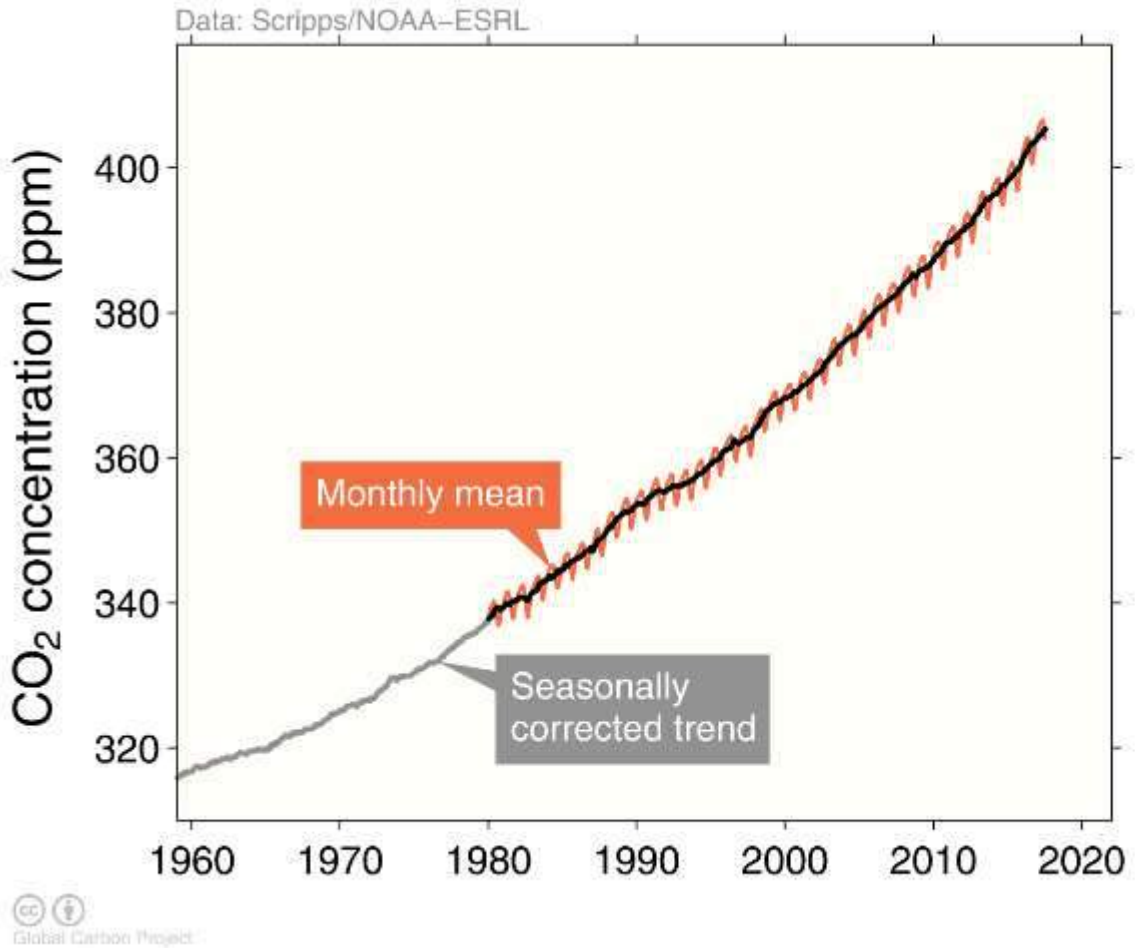


Figure concept from Shrink That Footprint

Source: CDIAC; NOAA-ESRL; Houghton and Nassikas 2017; Hansis et al 2015; Joos et al 2013; Khatiwala et al. 2013; DeVries 2014; Le Quéré et al 2017; Global Carbon Budget 2016

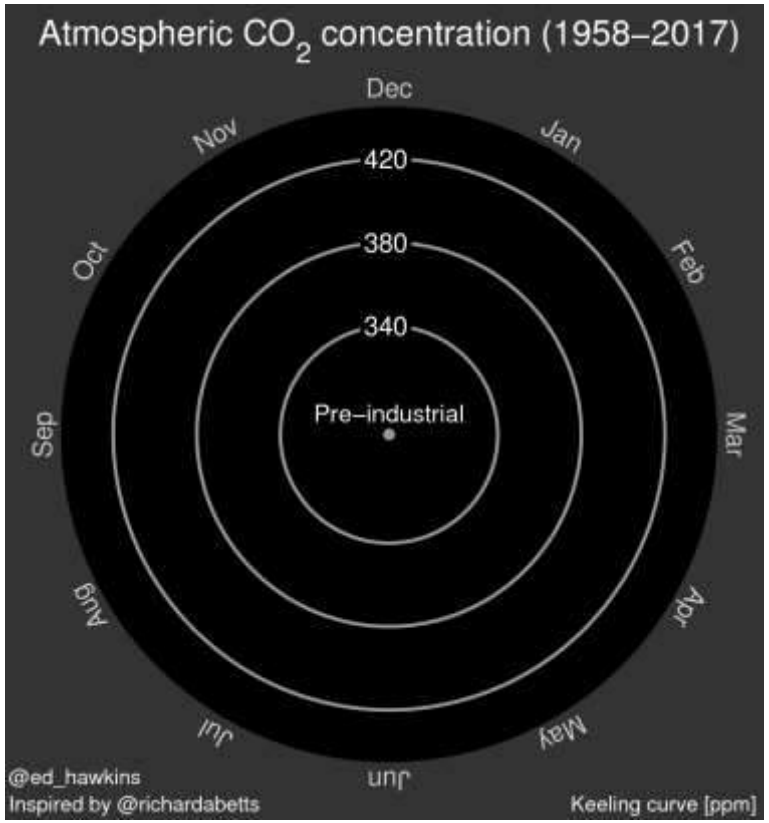
Atmospheric concentration

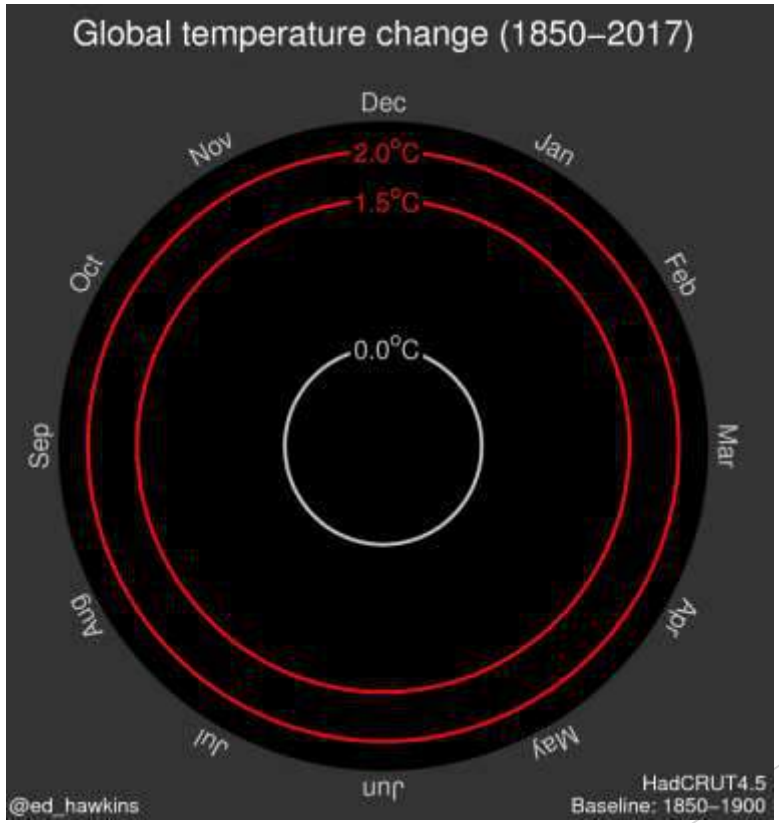
The global CO_2 concentration increased from ~277ppm in 1750 to 403ppm in 2016 (up 45%)
2016 was the first full year with concentration above 400ppm



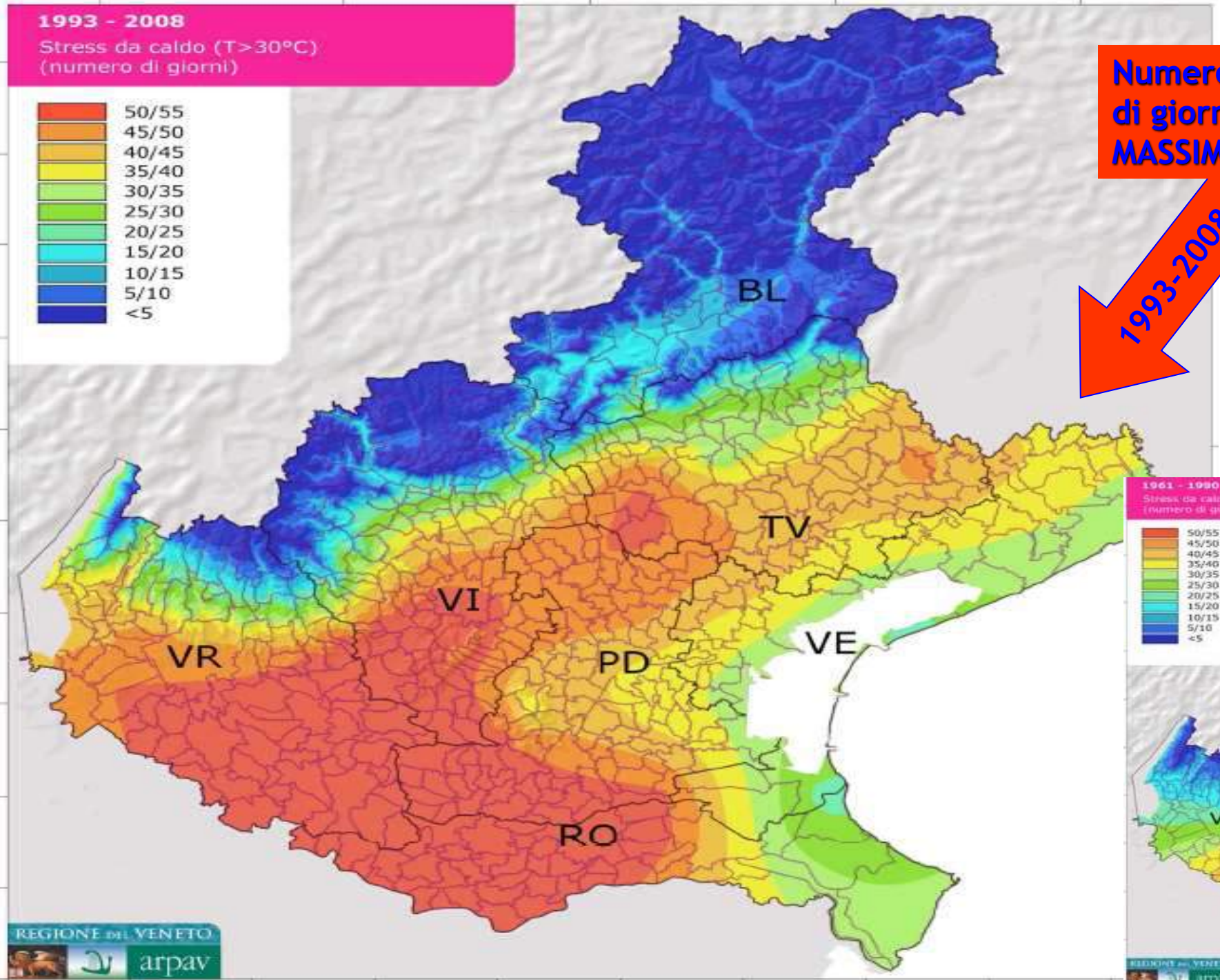
Globally averaged surface atmospheric CO_2 concentration. Data from: NOAA-ESRL after 1980;
the Scripps Institution of Oceanography before 1980 (harmonised to recent data by adding 0.542ppm)
Source: NOAA-ESRL; Scripps Institution of Oceanography; Le Quéré et al 2017; Global Carbon Budget 2017

La realtà del cambiamento climatico



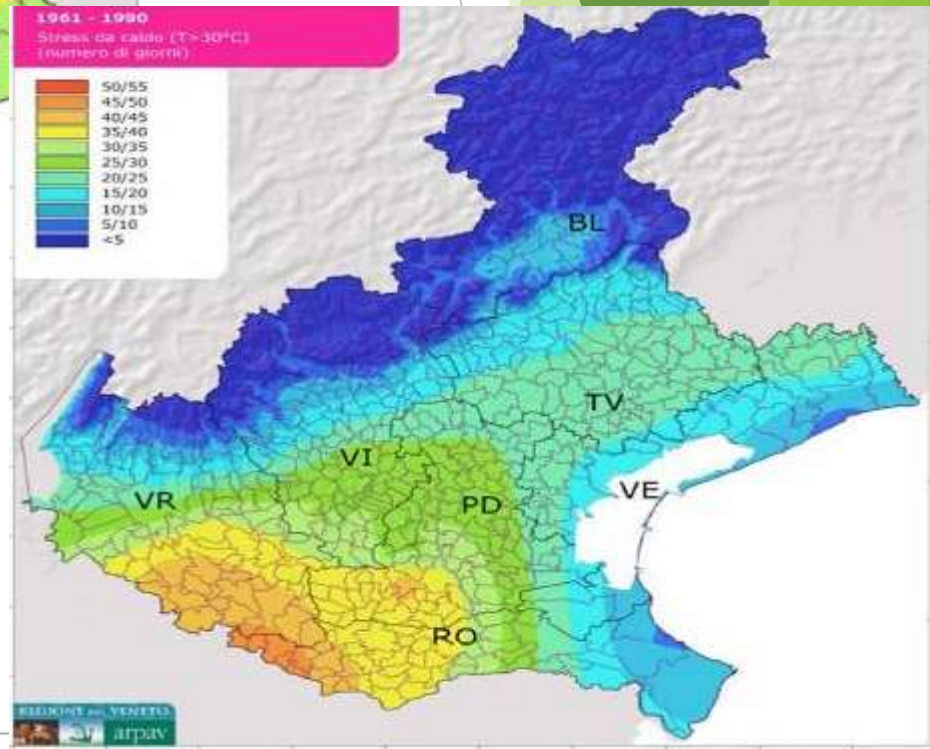


Numero medio di giorni all'anno con TEMPERATURA MASSIMA maggiore di 30 °C



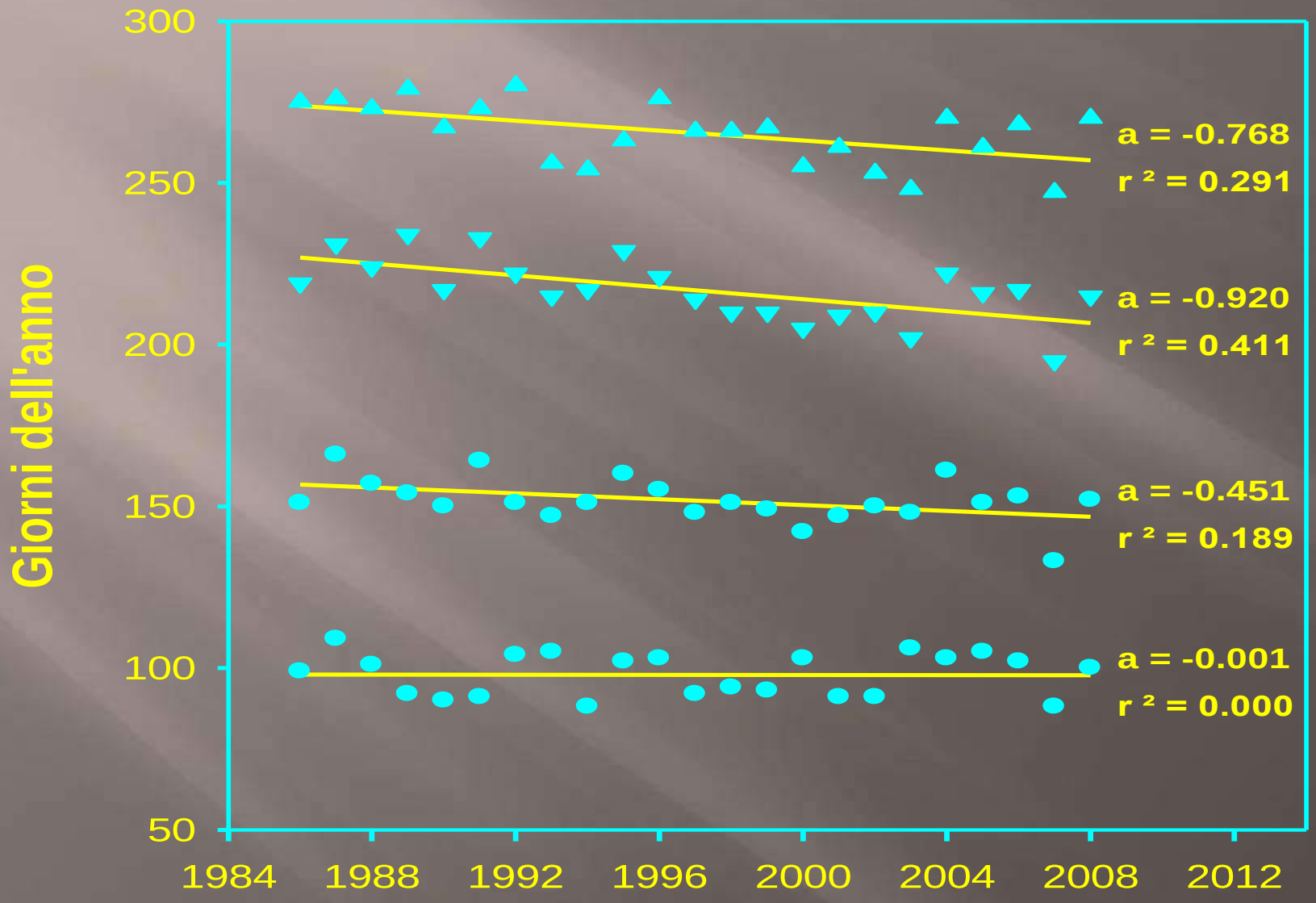
1993-2008

1961-1990




12 aprile ‘12
12 aprile ‘12
12 aprile ‘12
Foto D. Tomasi

TREND POLIENNALI FENOLOGIA DELLA VITE



VENDEMMIA

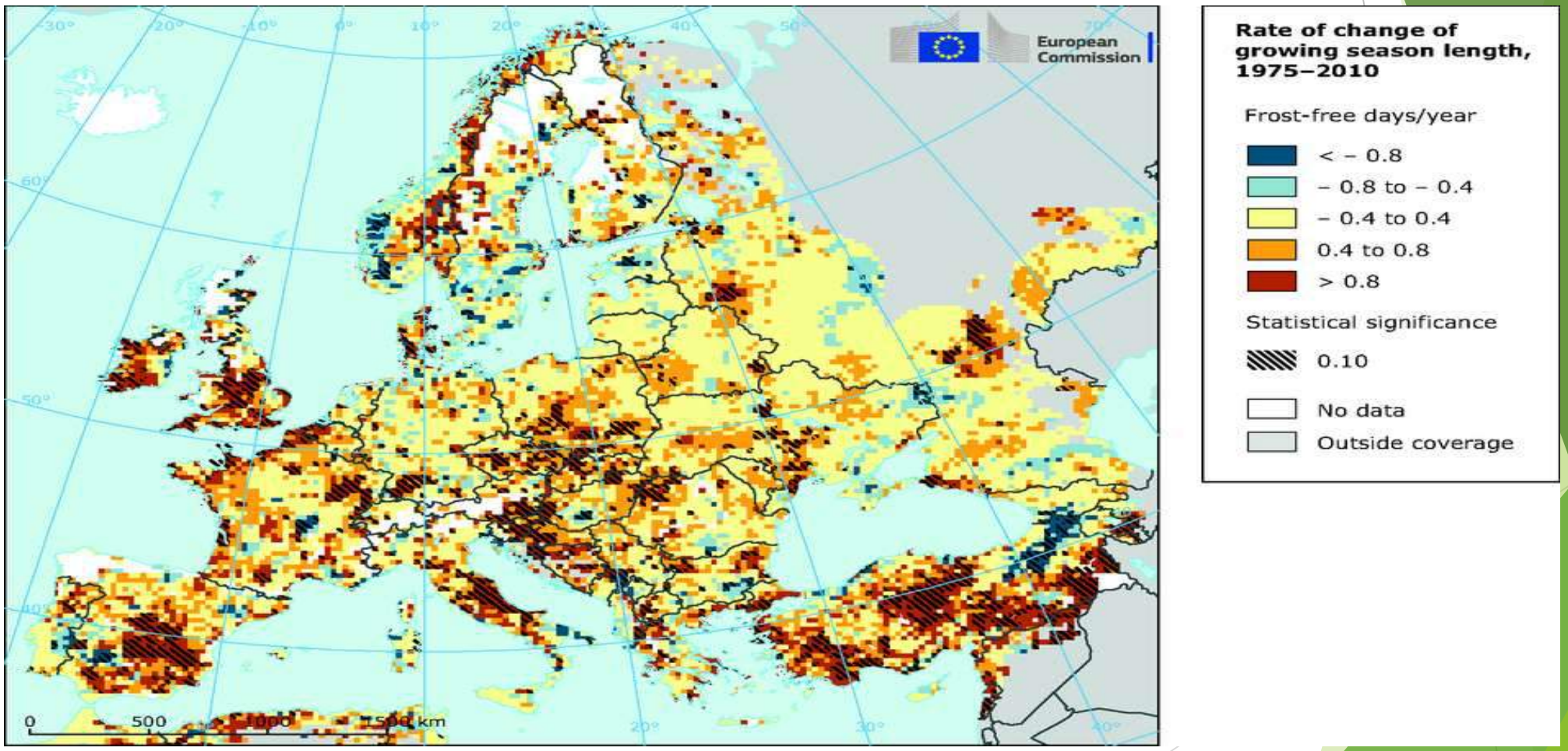
PIENA INVAIATURA

PIENA FIORIURA

GERMOGLIAMENTO

MERLOT-ISTRANA

Effetti (positivi???) del riscaldamento



Il rischio di gelate tardive aumenta!

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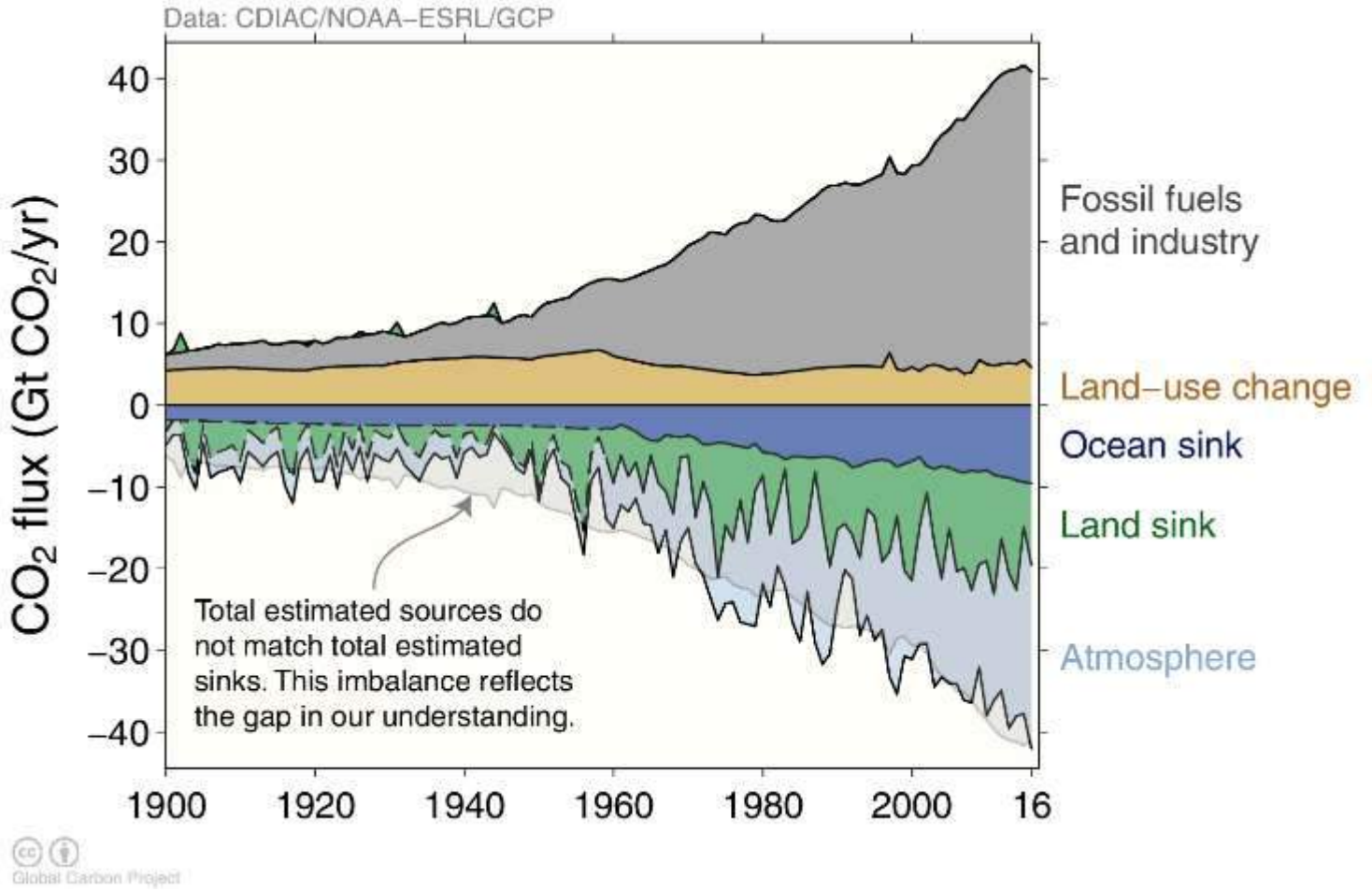

Source: CDIAC; NOAA-ESRL; Houghton and Nassikas 2017; Hansis et al 2015; Joos et al 2013; Khatiwala et al. 2013; DeVries 2014; Le Quéré et al 2017; Global Carbon Budget 2017

FLUXNET

(oggi ~ 600 stazioni)

Un network internazionale
di stazioni di misura dei flussi
di anidride carbonica (e altri GHG)