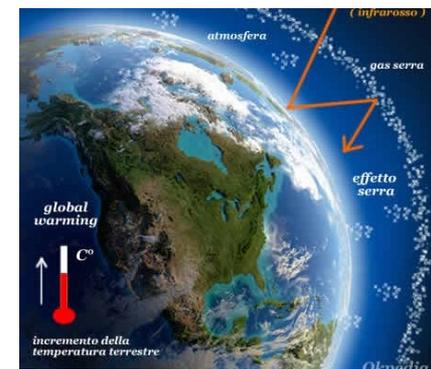
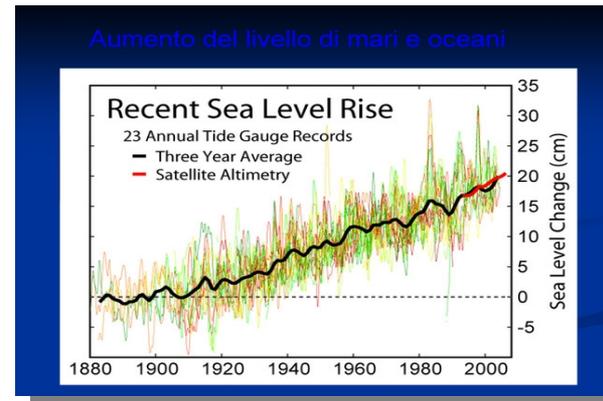
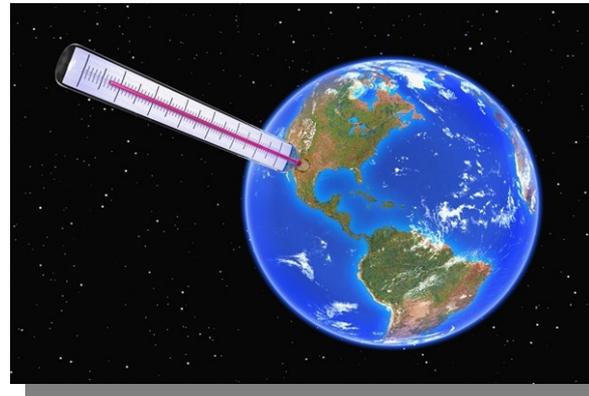


Le problematiche ambientali . . .



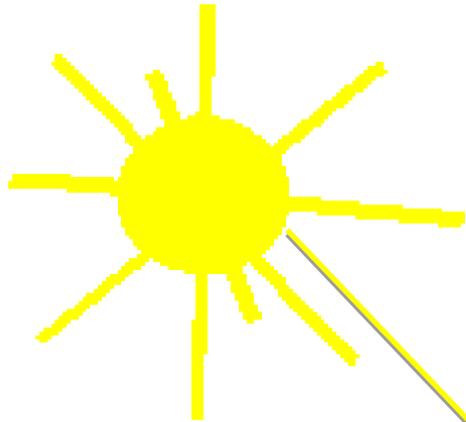
EFFETTO DELL'ATMOSFERA

$T_{\text{media}} \approx -18\text{ }^{\circ}\text{C}$



Senza atmosfera

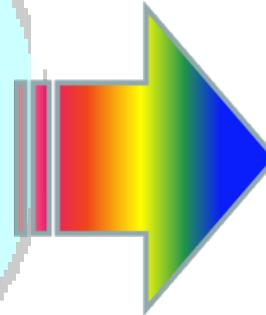
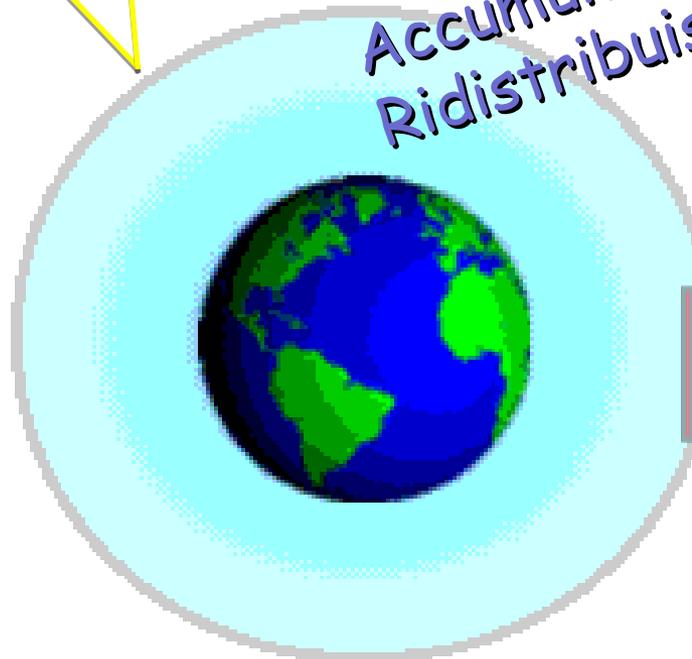
$T_{\text{media}} \approx 15\text{ }^{\circ}\text{C}$



Filtra

GAS SERRA

Accumula e
Ridistribuisce

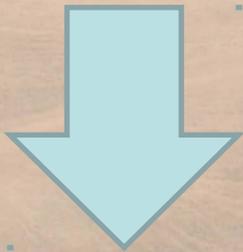


Fino al 960-1000

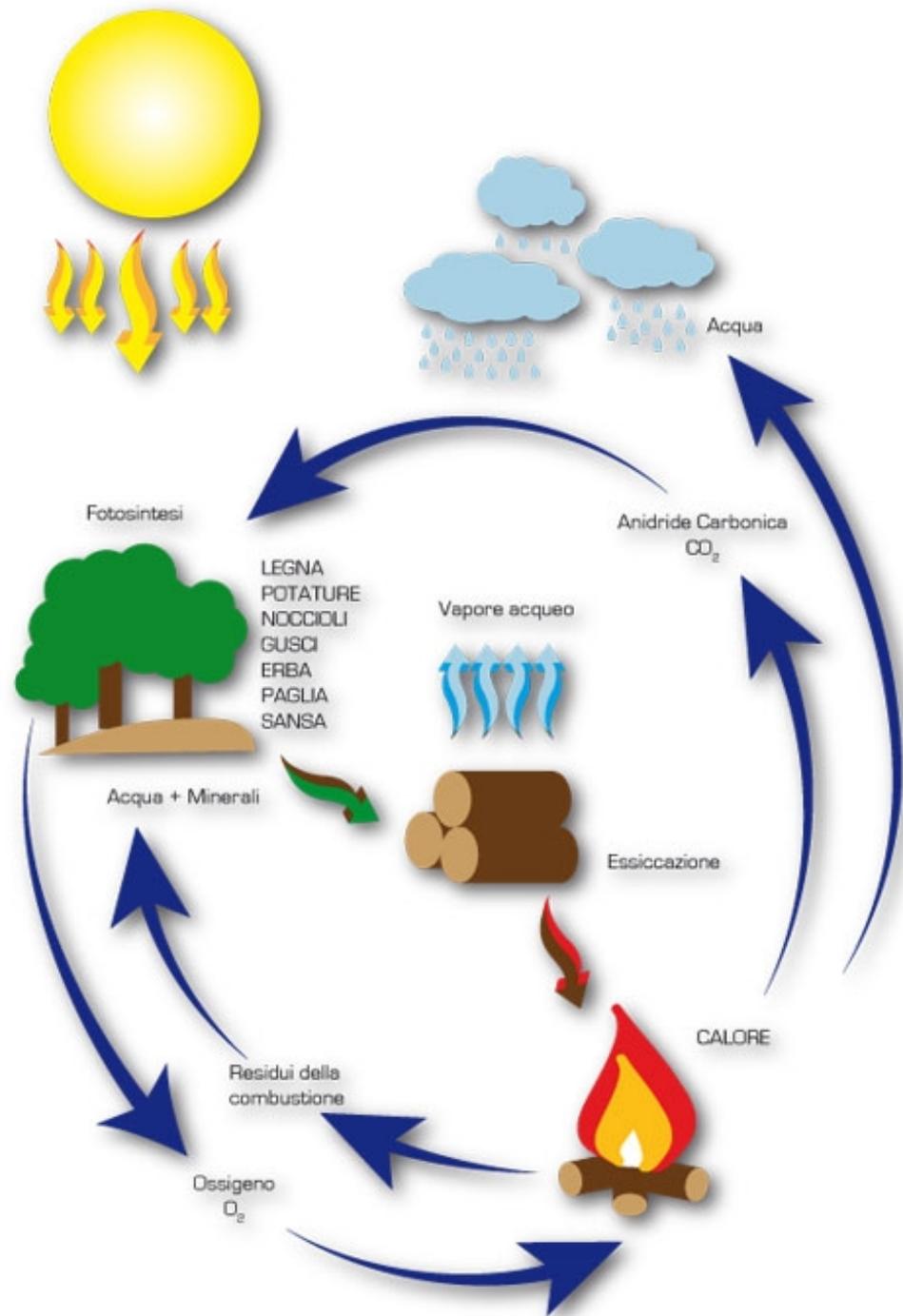
dinastia Song (Cina)

introduce uso carbon fossile

Energia prodotta da legno, acqua, vento



Equilibrio dei gas



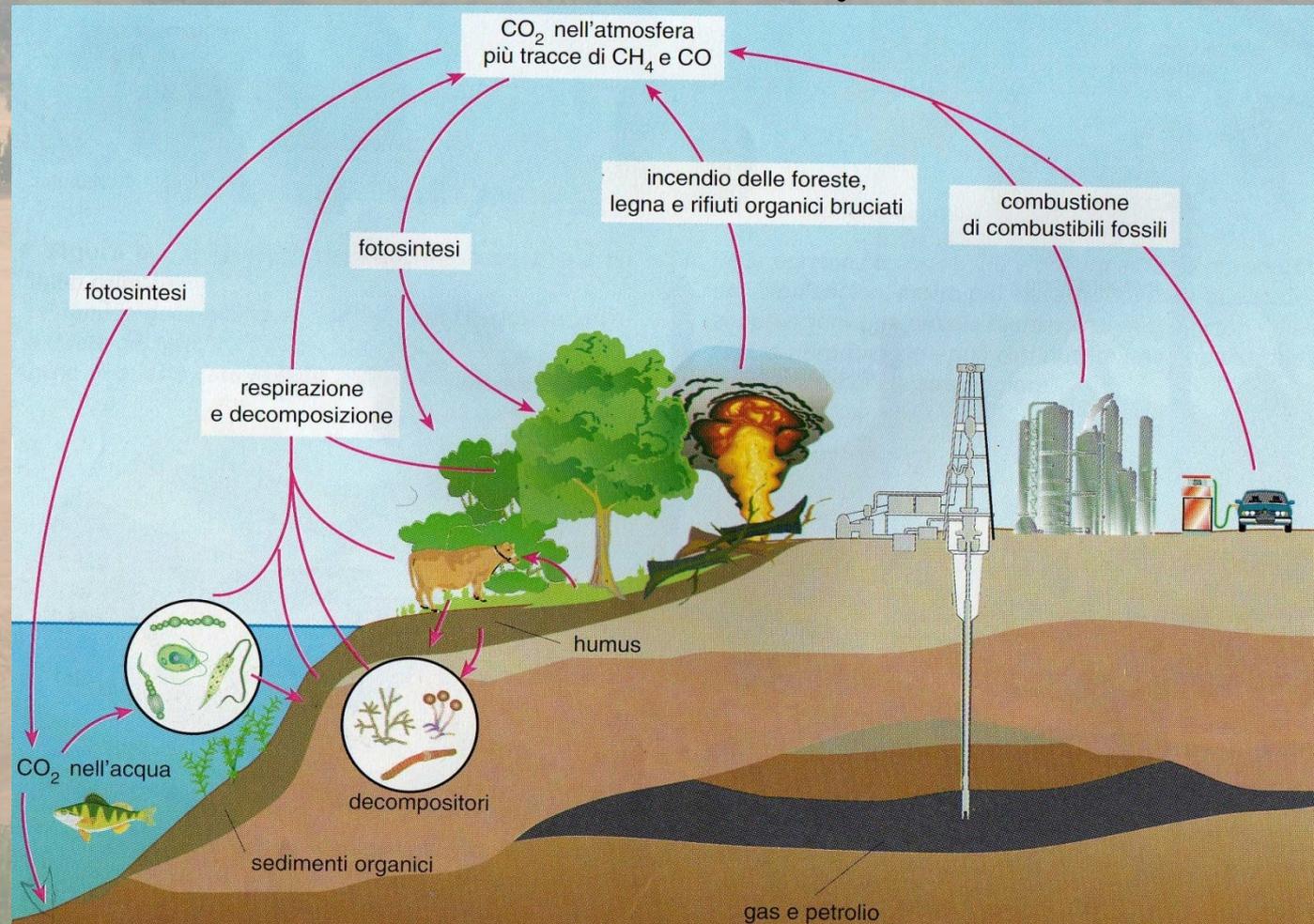
dopo il 1.000
(1859 1° pozzo petrolio)

Energia prodotta
anche da
carbone e petrolio

Titusville (Pennsylvania)



**Aumentano
gas serra**



GAS EFFETTO SERRA

Metano danno 25 volte superiore a CO₂
1,5 miliardi mucche; producono 0,5 mc/gg cadauna
273.000.000.000 mc/anno



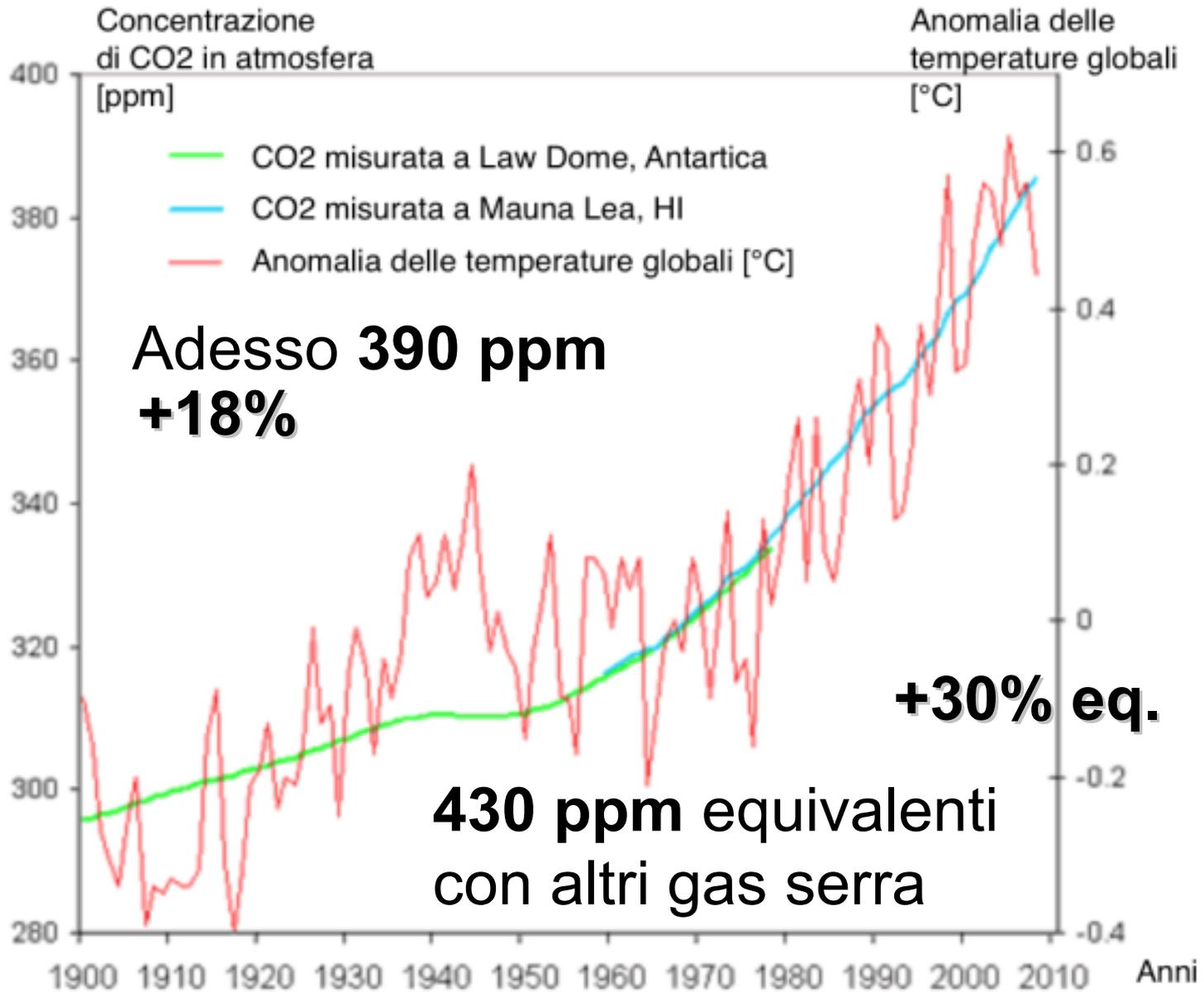
industria



riscaldamento

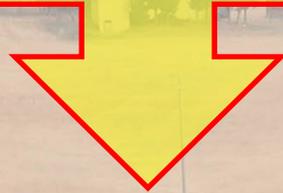


Variazione CO₂



COSA ACCADE?

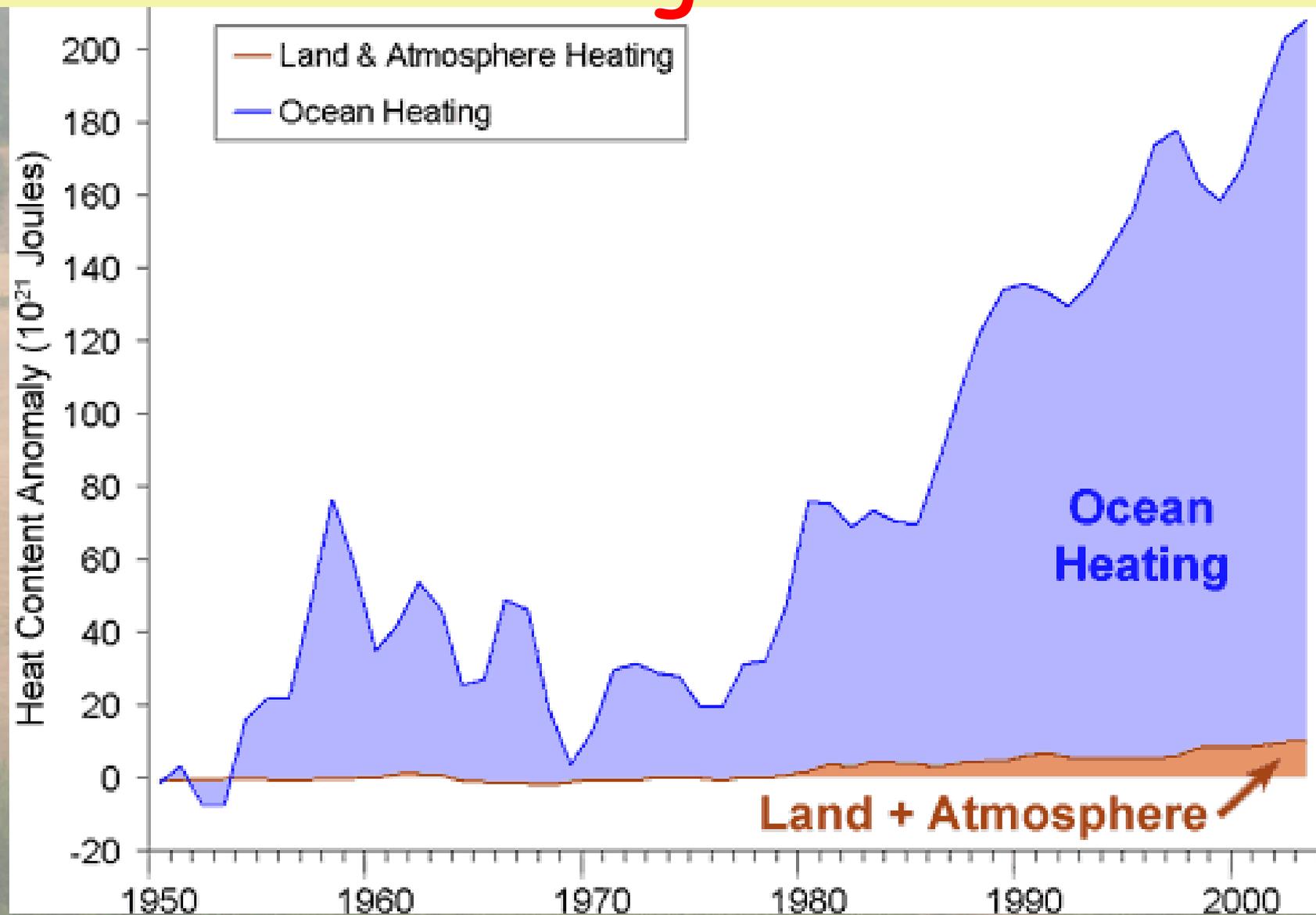
- A Causa delle emissioni di CO₂ e metano aumenta l'EFFETTO SERRA



AUMENTA
ENERGIA E
CALORE DELLA
TERRA



Aumenta il contenuto in calore degli oceani



QUANTA ENERGIA ANOMALA?

Parametro	Energia (J)
Energia anomala accumulata dal 1970 negli oceani per effetto serra (in Joule)	$2 \cdot 10^{23}$
Energia della bomba di Hiroshima (equivalente a 15.000 t di tritolo) in Joule	$6,276 \cdot 10^{13}$

	Energia (n. bombe atomiche)
Energia anomala accumulata dal 1970 negli oceani per effetto serra (espressa in numero di	3.186.743.148

QUANTA ENERGIA ANOMALA?

EQUIVALENTI A:

3.186.743.148

BOMBE ATOMICHE

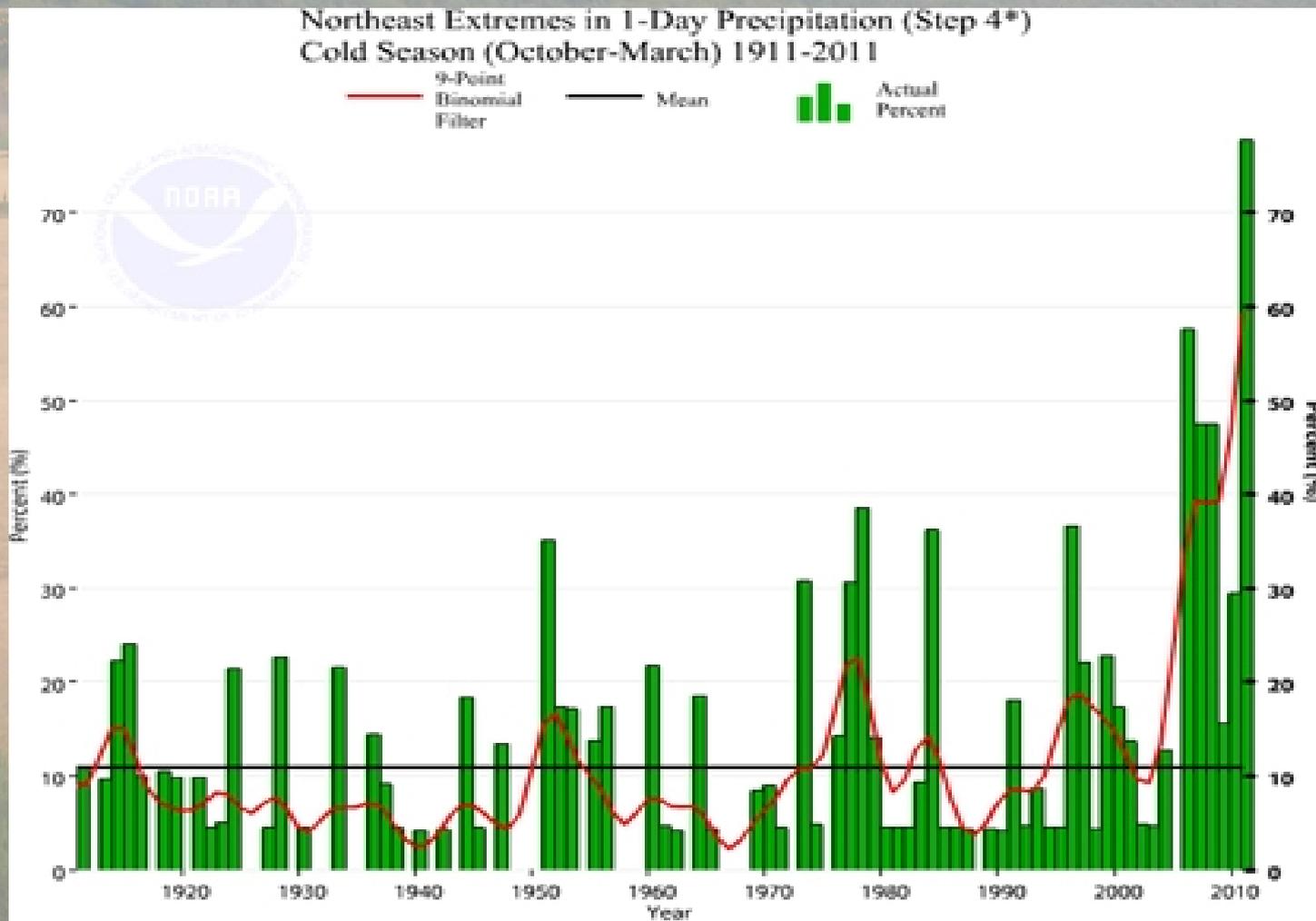


QUESTA ENERGIA COSA
DETERMINA?

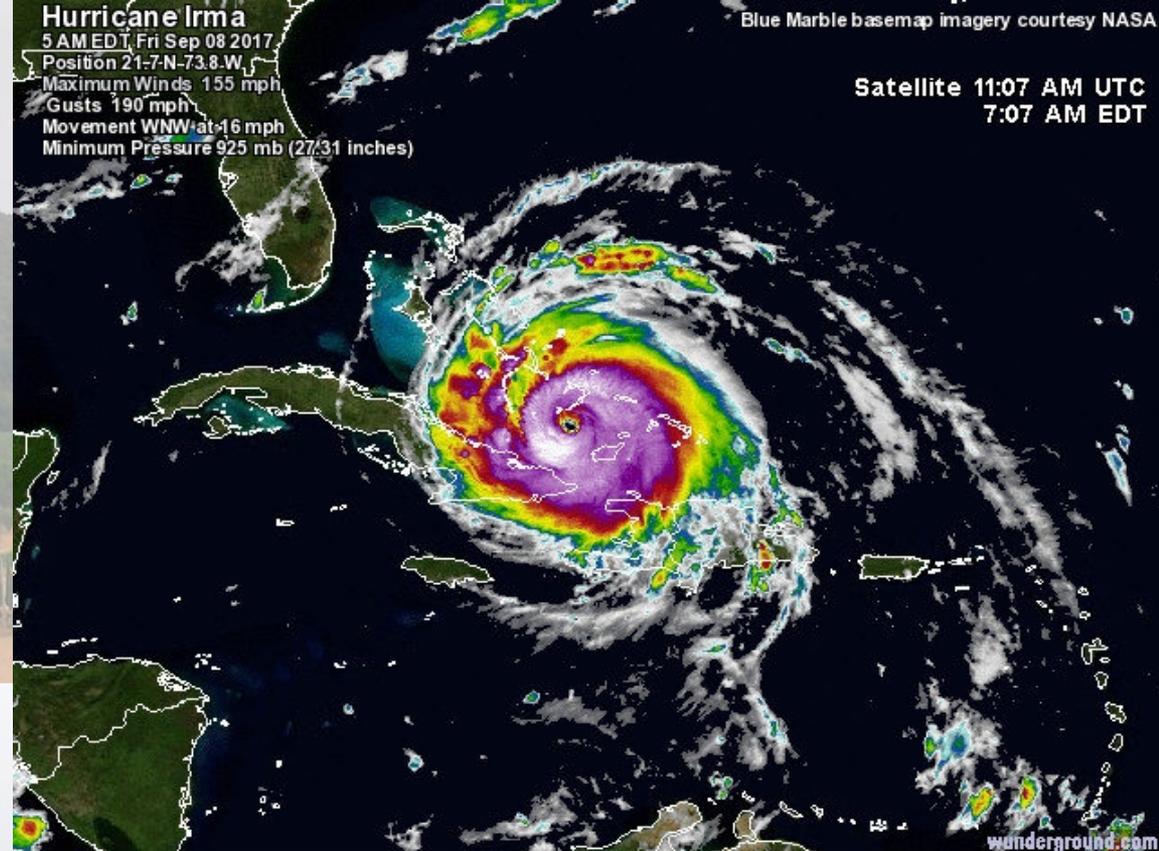
AUMENTA
TEMPERATURA
DELLA TERRA



AUMENTANO le piogge intense



AUMENTANO I CICLONI



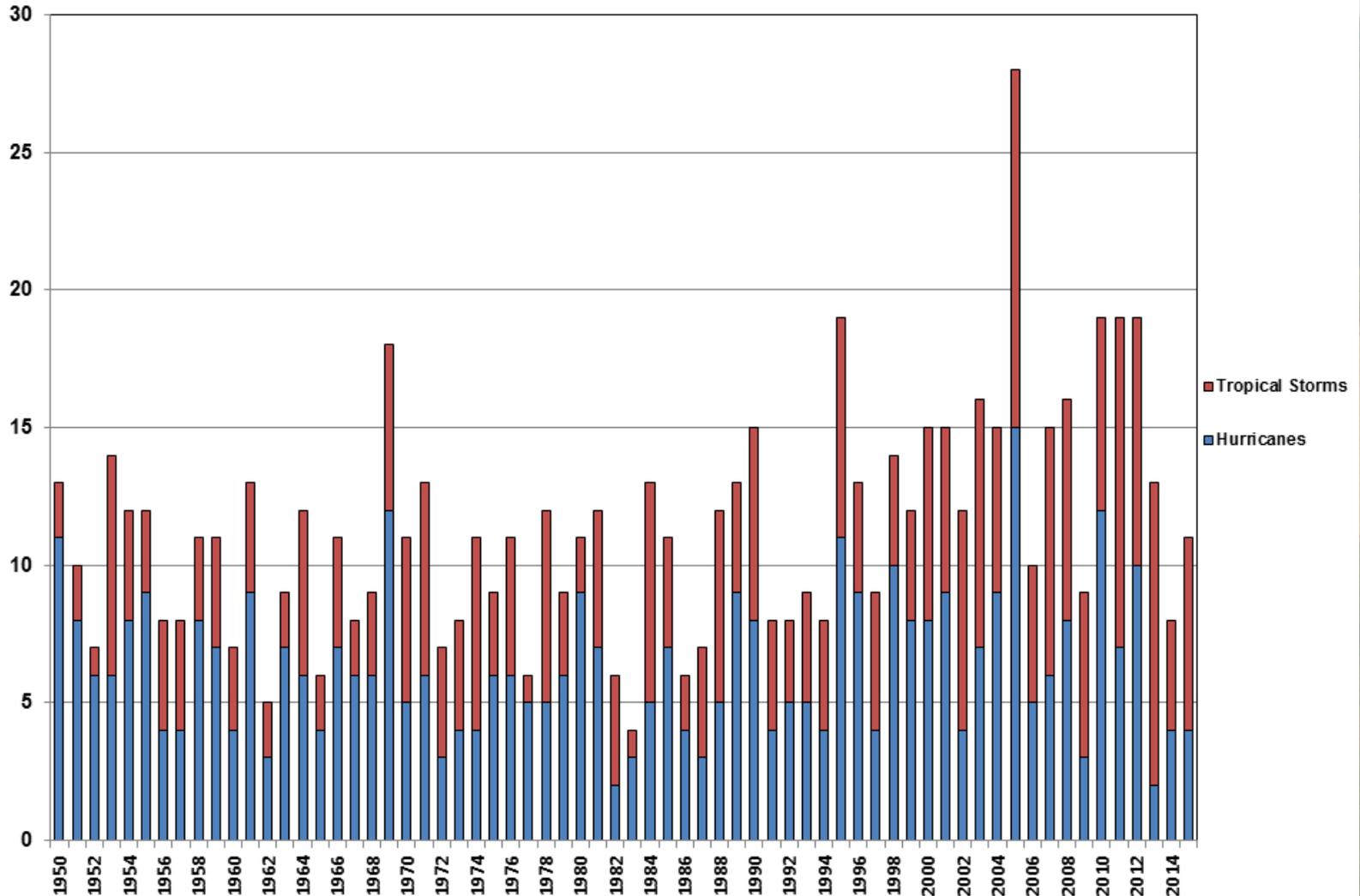
Nel 2018..uragano
Florence, poi tifone
Mangkhut in asia

Aumentano le tempeste tropicali

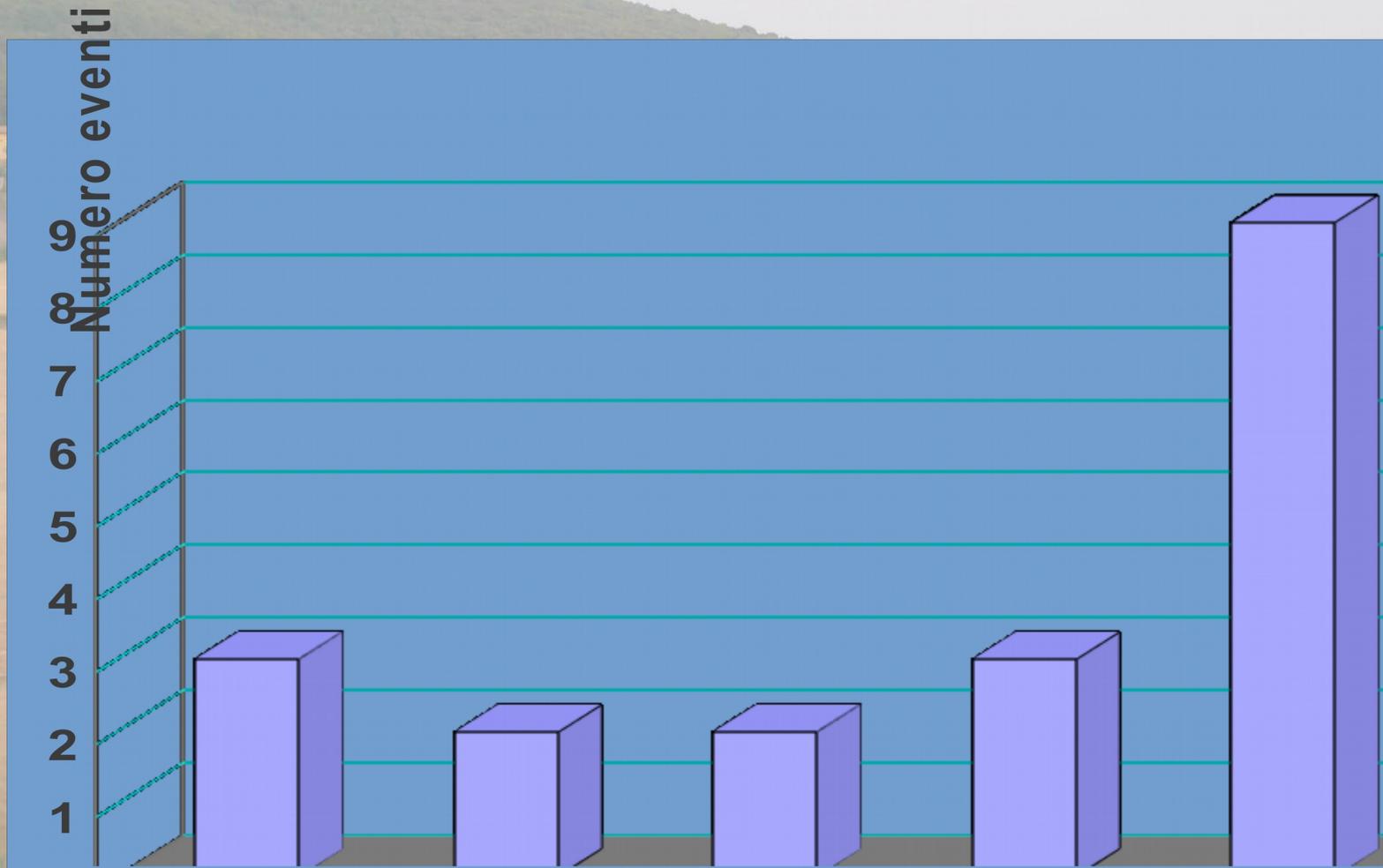
North Atlantic Basin
Number of Tropical Storms and Hurricanes
1950-2015



NOAA's
National Climatic Data Center



Aumento eventi estremi in Italia



Le precipitazioni in Italia

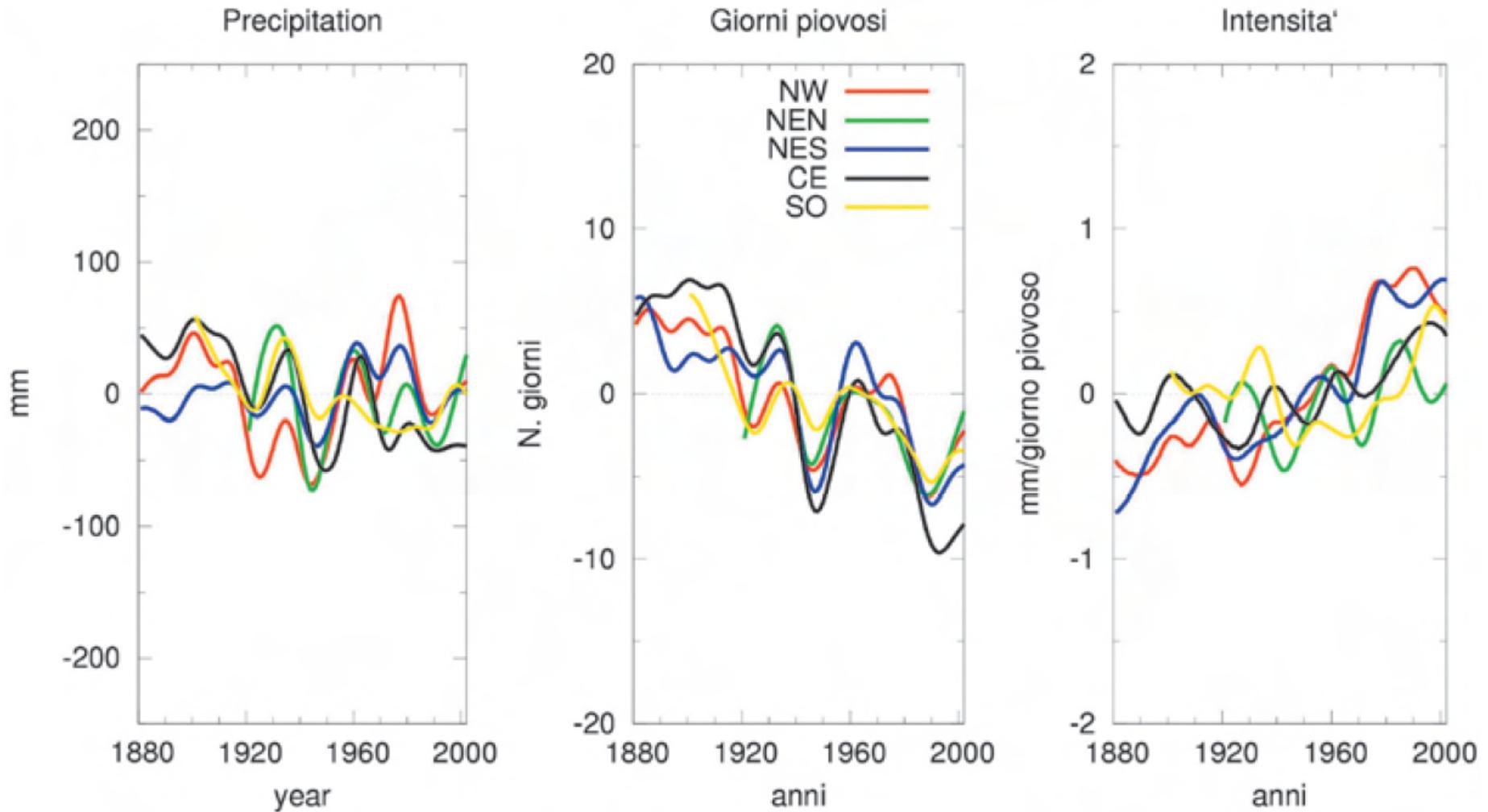
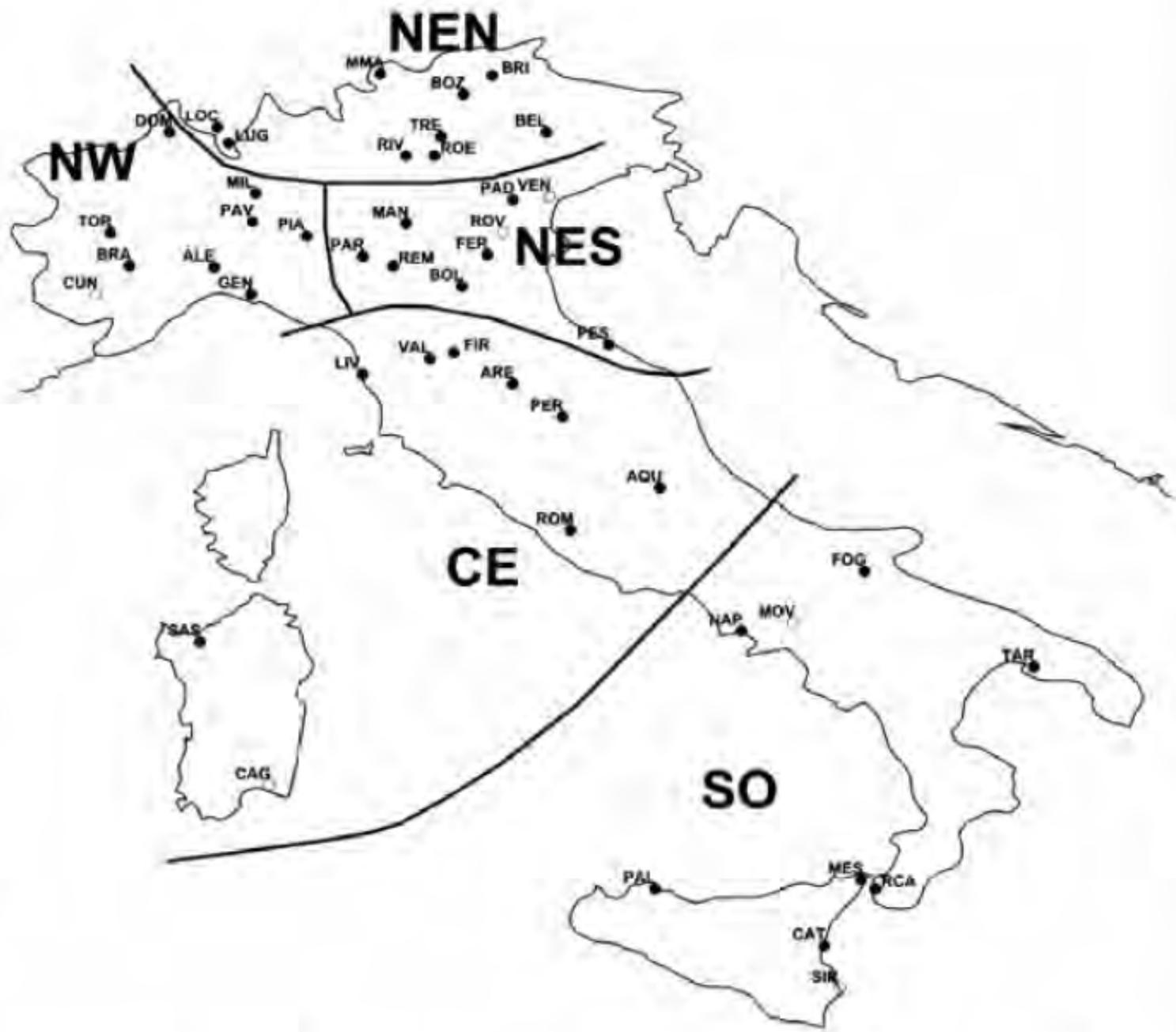


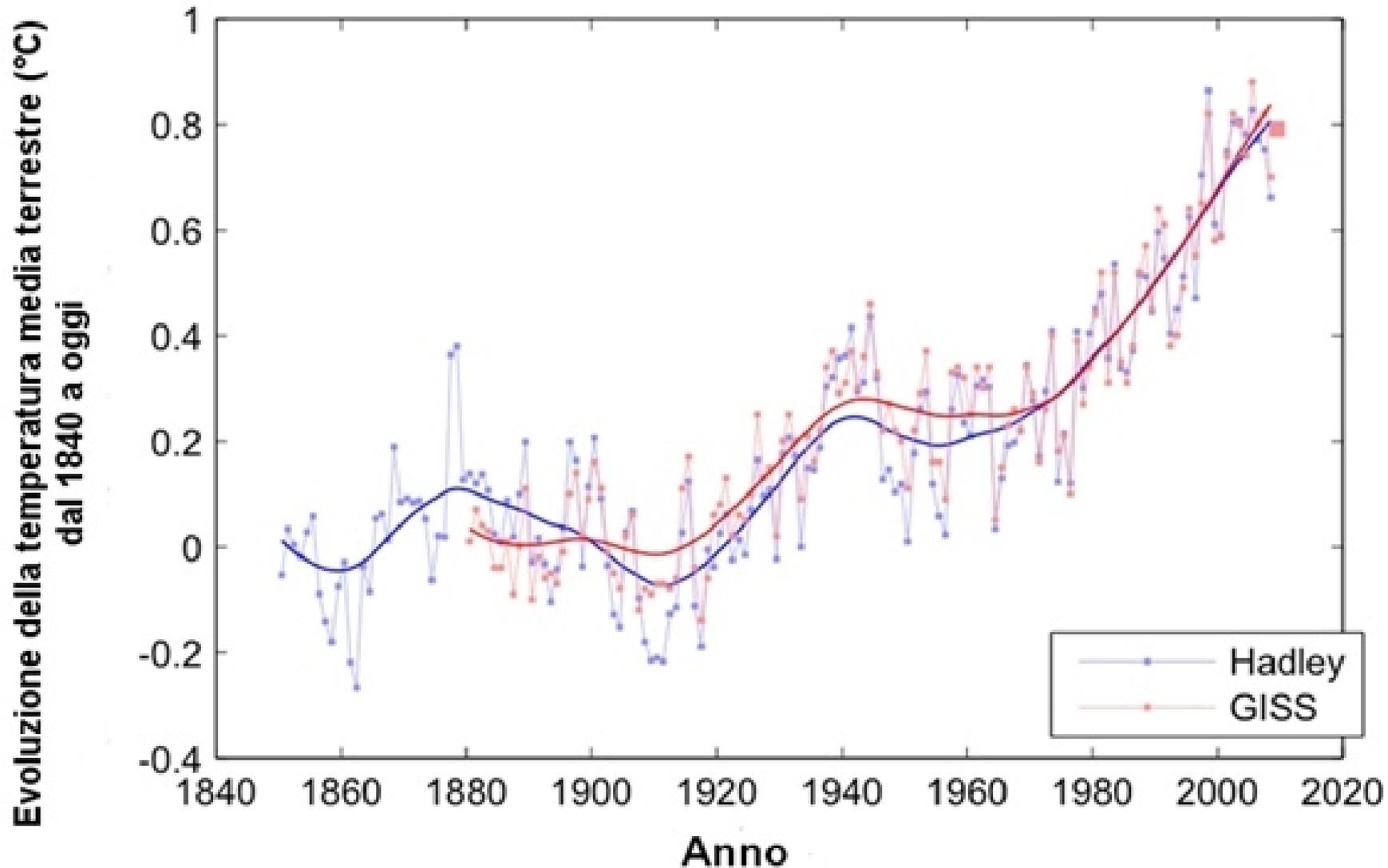
Fig. 3.5 – Serie annuali relative alle precipitazioni totali, al numero di giorni piovosi e all'intensità delle precipitazioni per le cinque regioni. Le serie sono rappresentate mediante un filtro gaussiano con deviazione standard pari a 5 anni.





Le ondate di calore

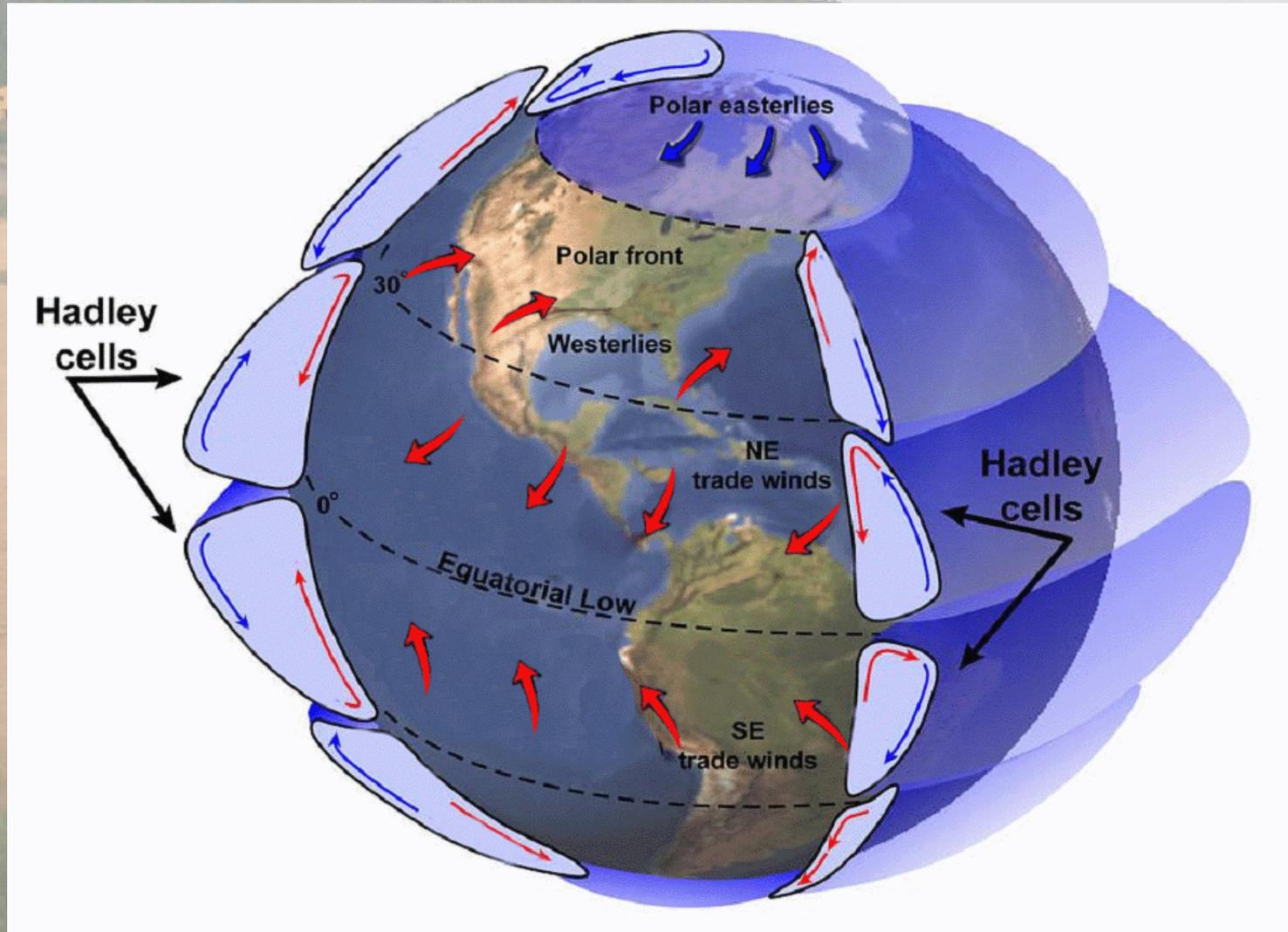
La temperatura media aumenta ma.....



La circolazione generale ed i suoi meccanismi

:

La Cella di Hadley

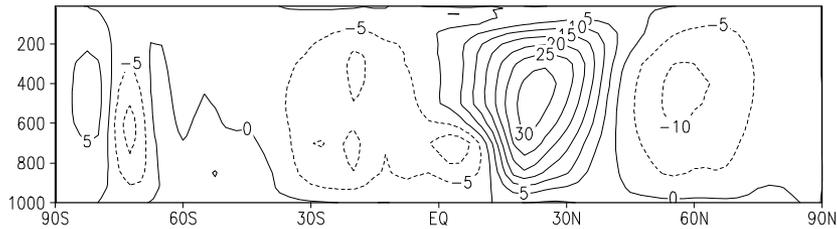


A landscape photograph showing a large, dry, brown field in the foreground, a line of green trees in the middle ground, and a forested hill in the background under a grey, overcast sky. A semi-transparent yellow rectangular box is centered horizontally across the middle of the image, containing the text 'Le ondate di calore' in red.

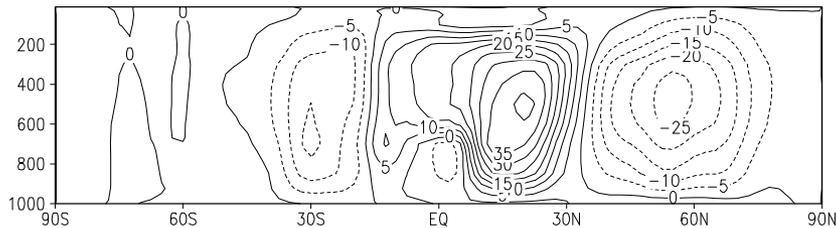
Le ondate di calore

Mass streamfunction [1E10 kg/s] (NCEP/NCAR Reanalysis 1971-2002)

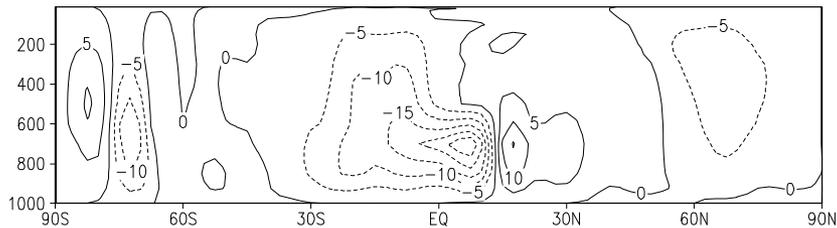
Africa



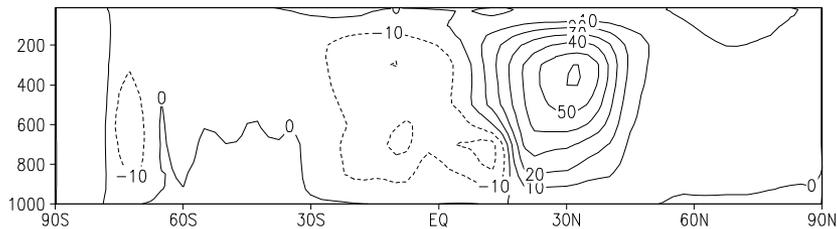
MEAN



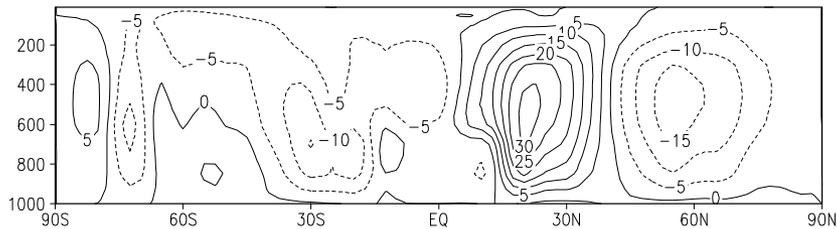
JAN



APR



JUL



OCT



La circolazione dell'emisfero Nord è più intensa rispetto alla media zonale



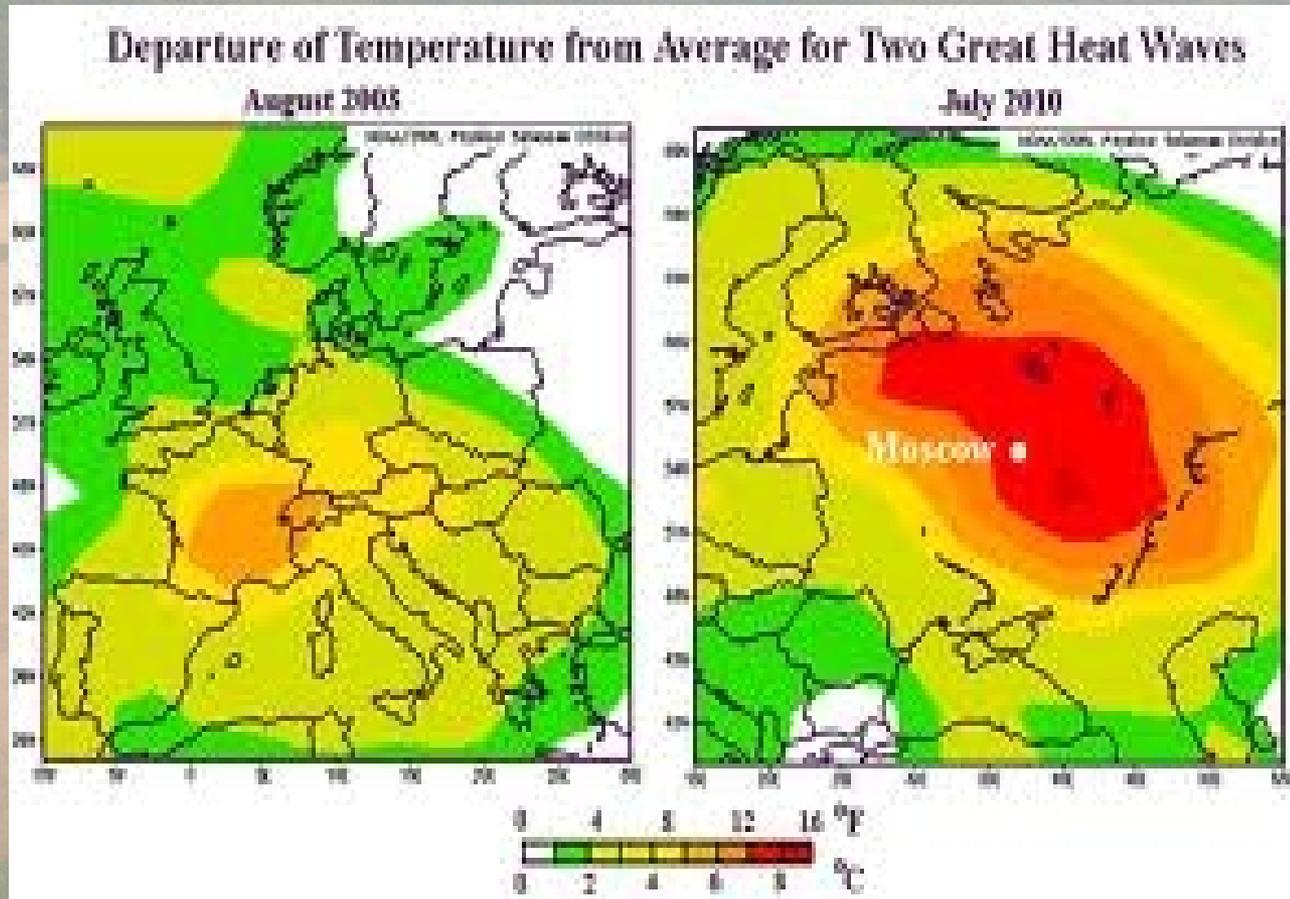
Inverno
Bacino del Congo => circolazione anomala all'Equatore



Estate
La cella di Hadley si estende fino a 45°N (Mediterraneo)

Meccanismi di Charney => intensità anomala della cella di Hadley

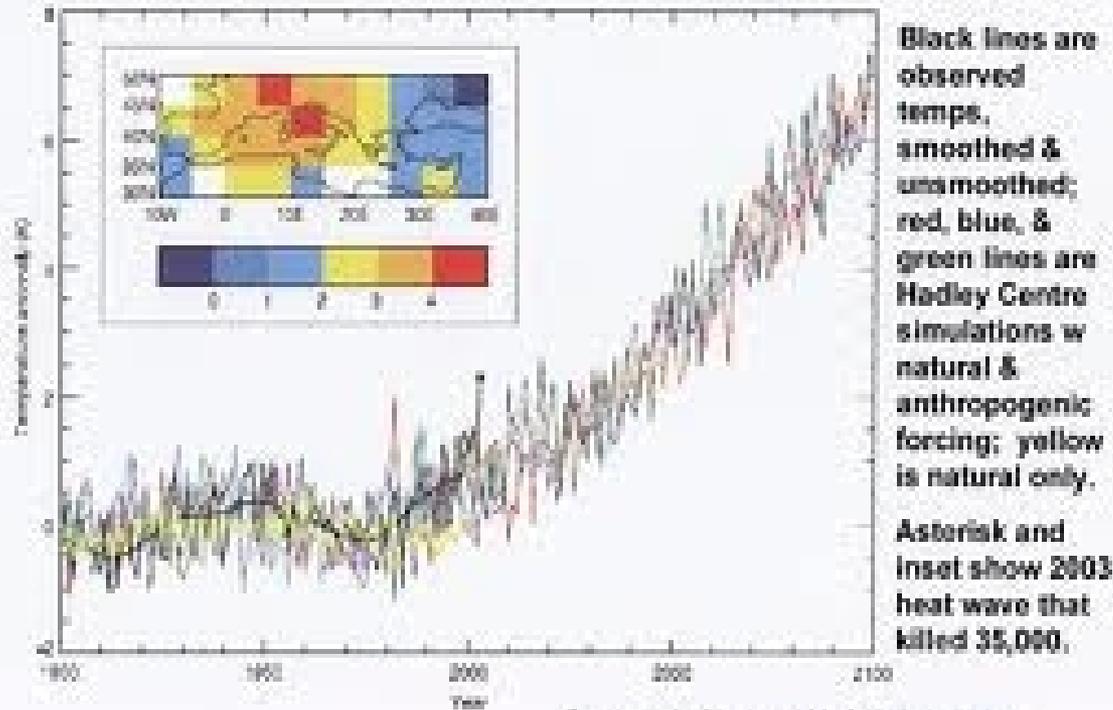
Ondate di calore a latitudini sempre più elevate



.....e le prospettive

Where we're headed: Heat waves

Extreme heat waves in Europe, already 2X more frequent because of global warming, will be "normal" in mid-range scenario by 2050

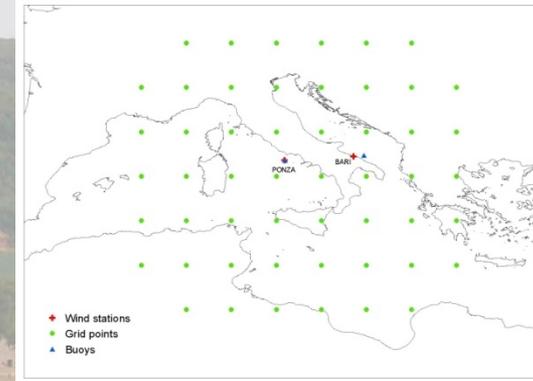
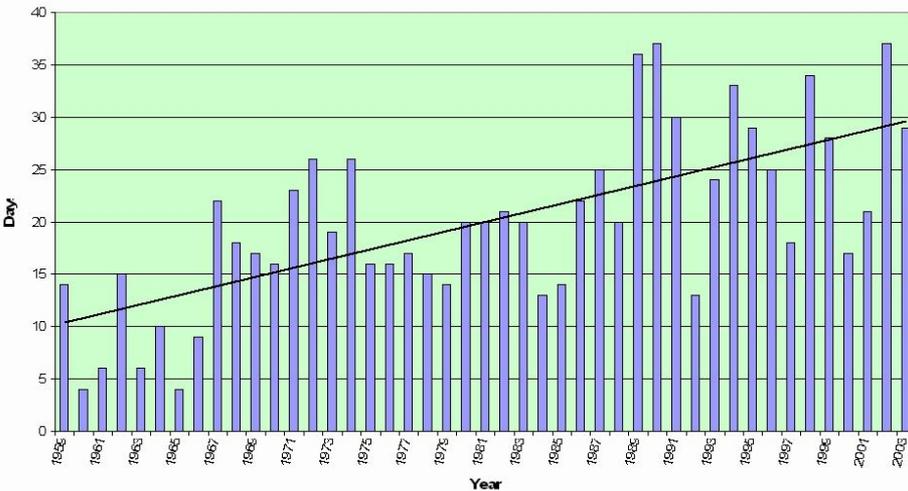


Tendenza dei tipi di tempo (WT)

L'anticiclone delle Azzorre si indebolisce

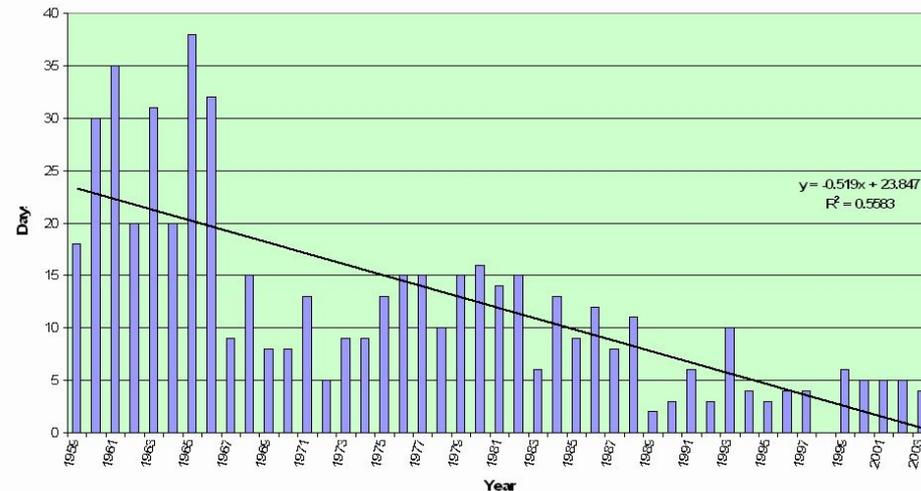
Days with Cyclonic WT - Season: Summer

$$y = 0.4368x + 9.9323$$
$$R^2 = 0.4601$$

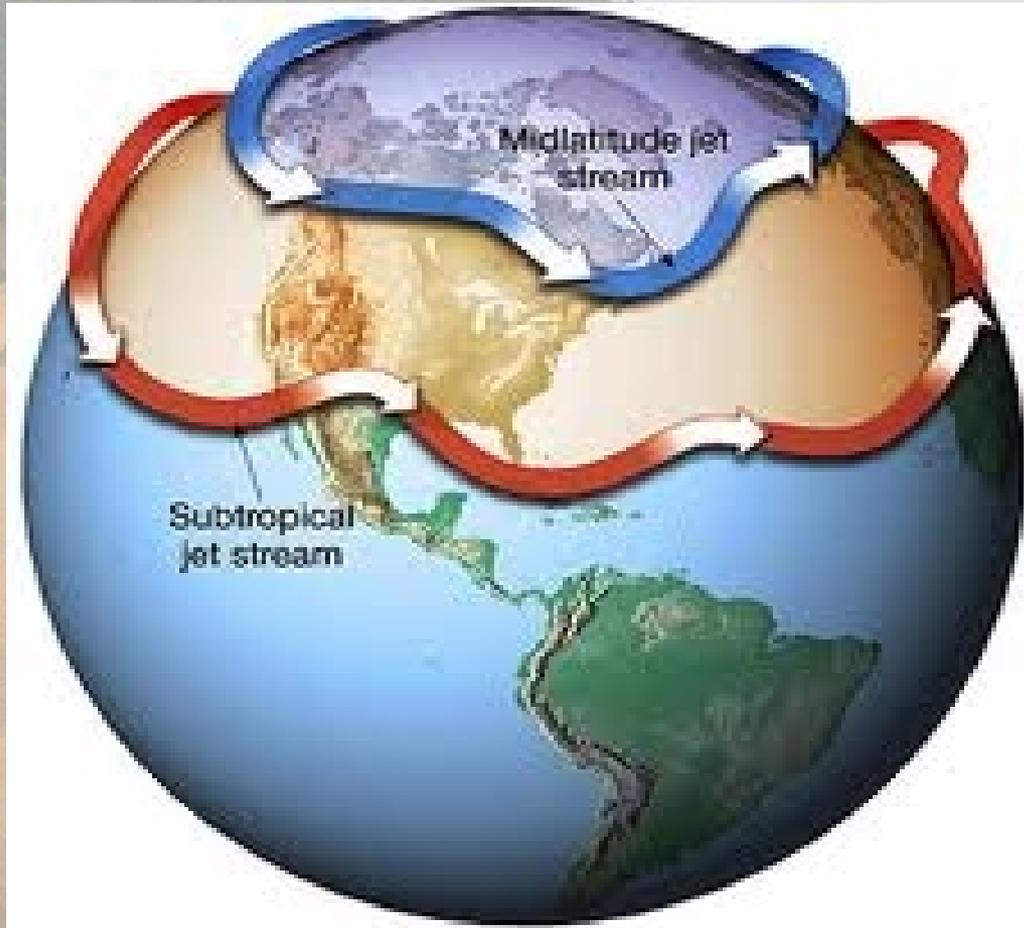


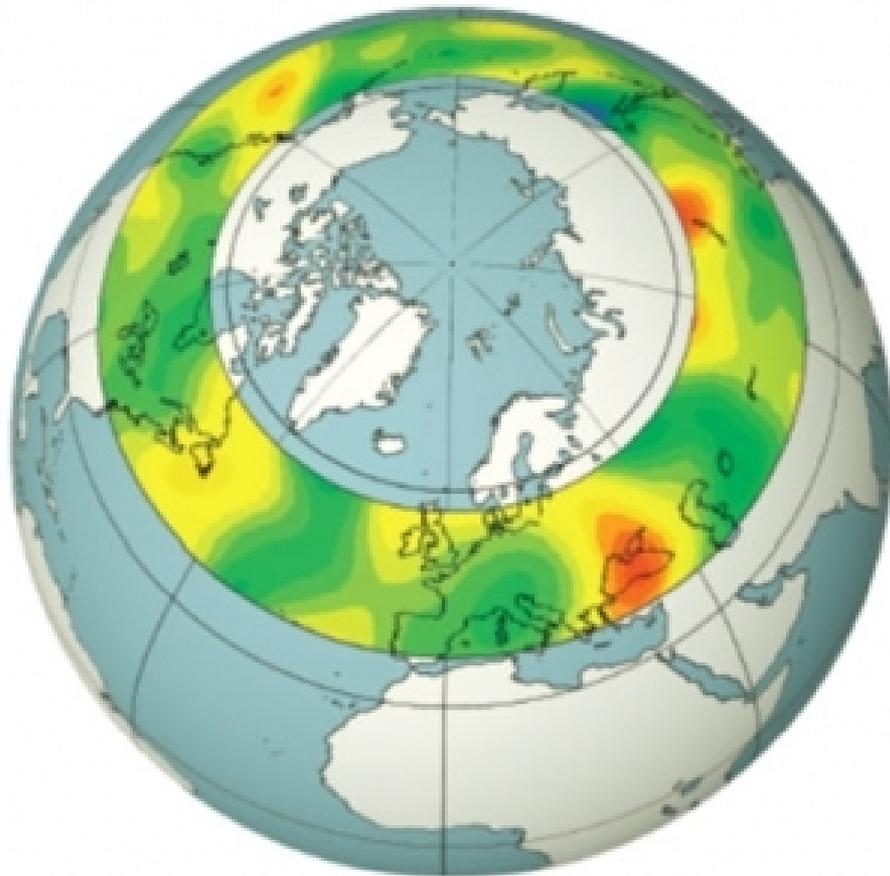
Days with Anticyclonic WT - Season: Summer

$$y = -0.519x + 23.847$$
$$R^2 = 0.5683$$

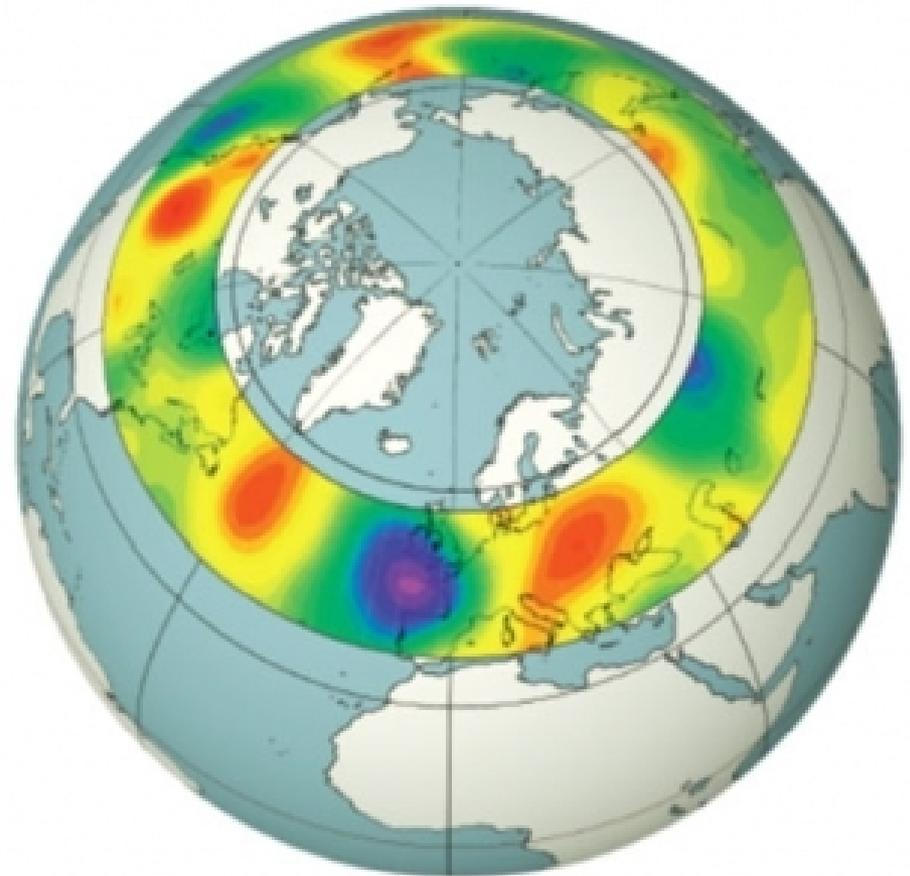


The jet stream





Normal: July 1980



Extreme: May 2013

Wind speed along the lines of longitude (m/s)



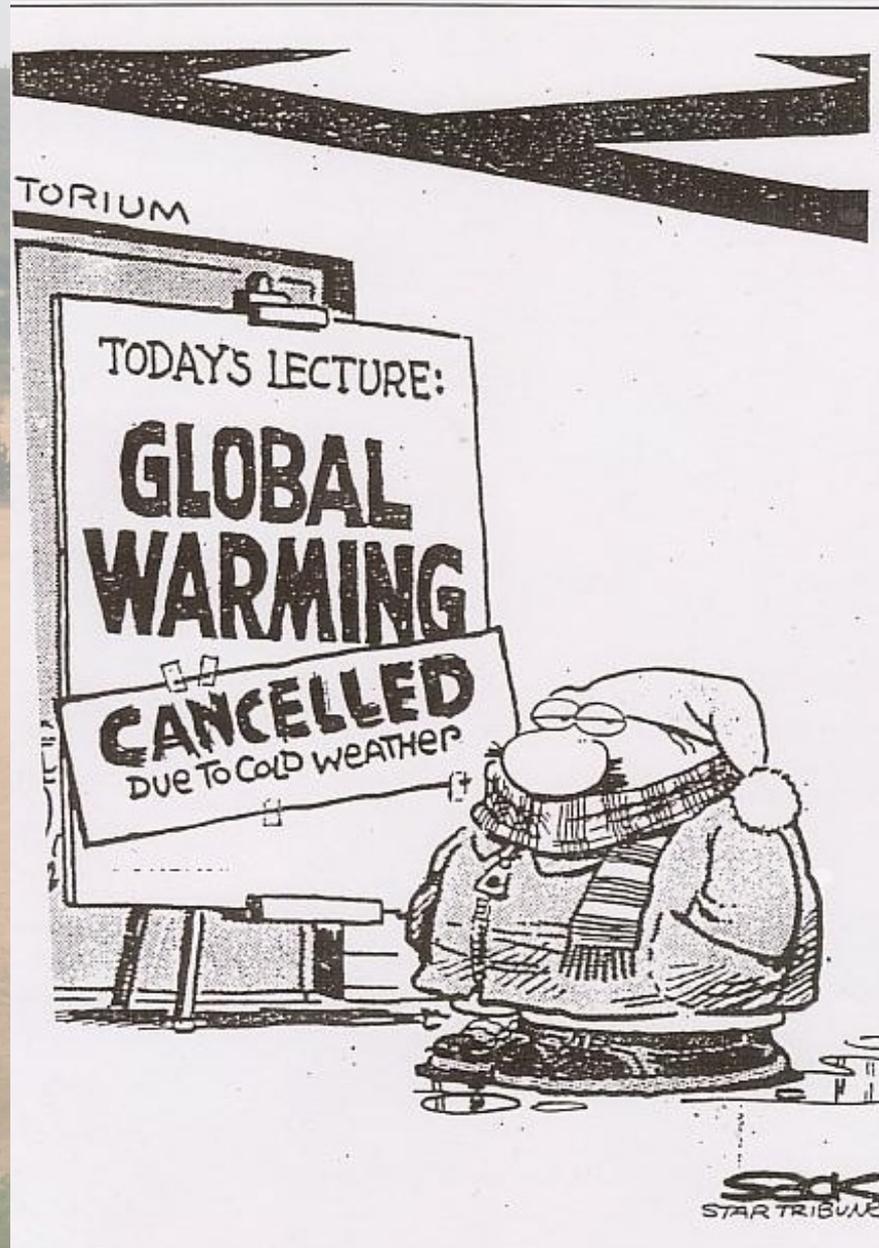
Northwards

Southwards

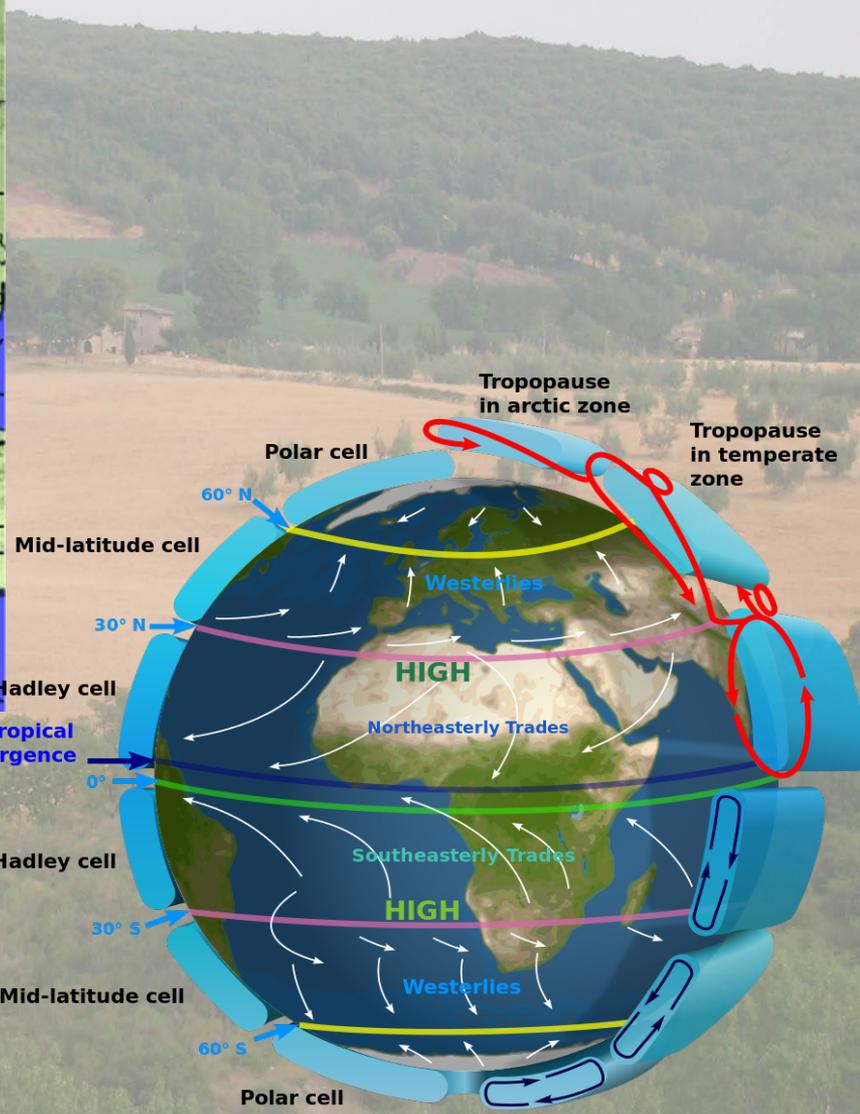
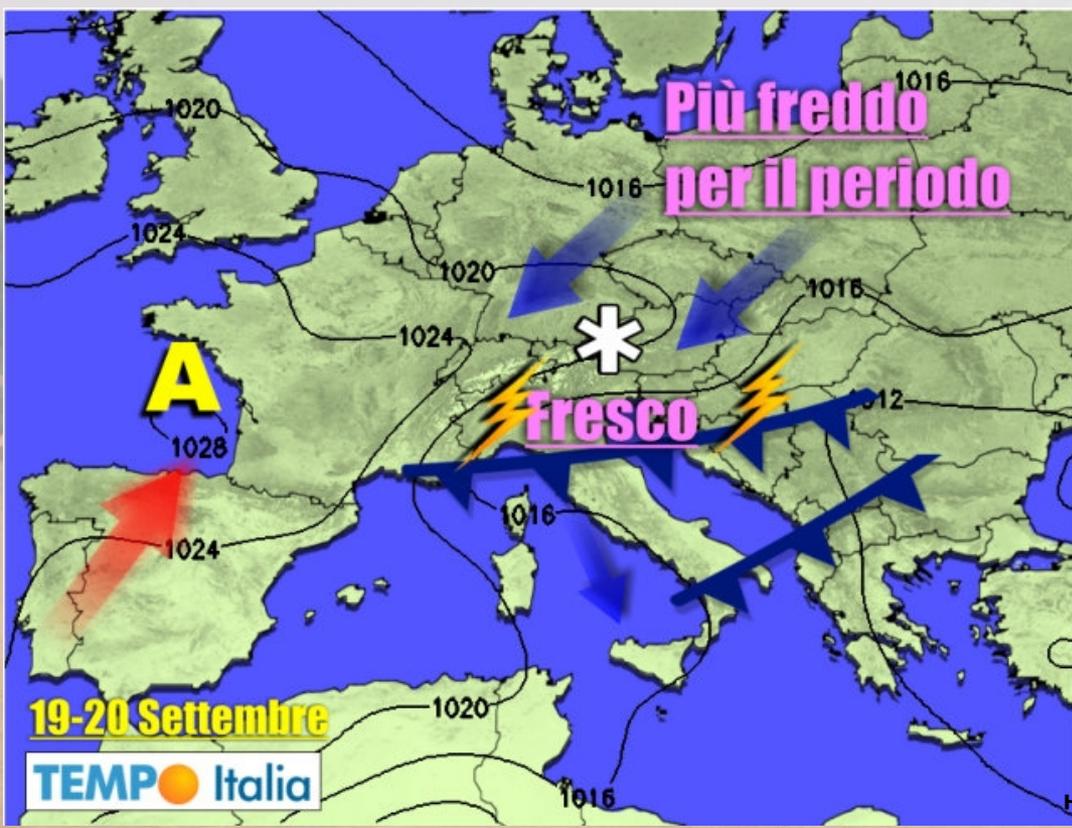


**Aumentano le ondate di
freddo**

può succedere che



cambia la circolazione



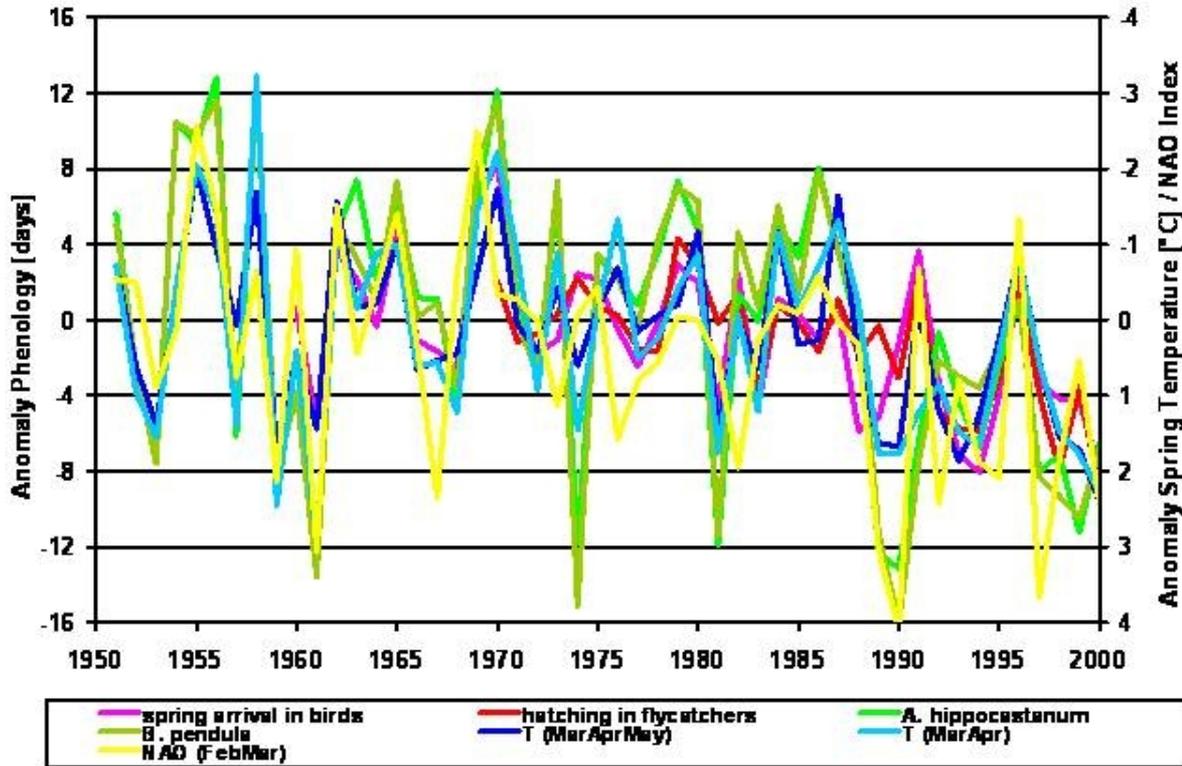
A wide-angle landscape photograph showing a large, golden-brown field in the foreground, likely a harvested field. In the middle ground, there is a small cluster of buildings, including a prominent yellow house on a slight rise. The background features a large, forested hill under a pale sky. The text "Le stagioni slittano" is overlaid in red on the field.

Le stagioni slittano

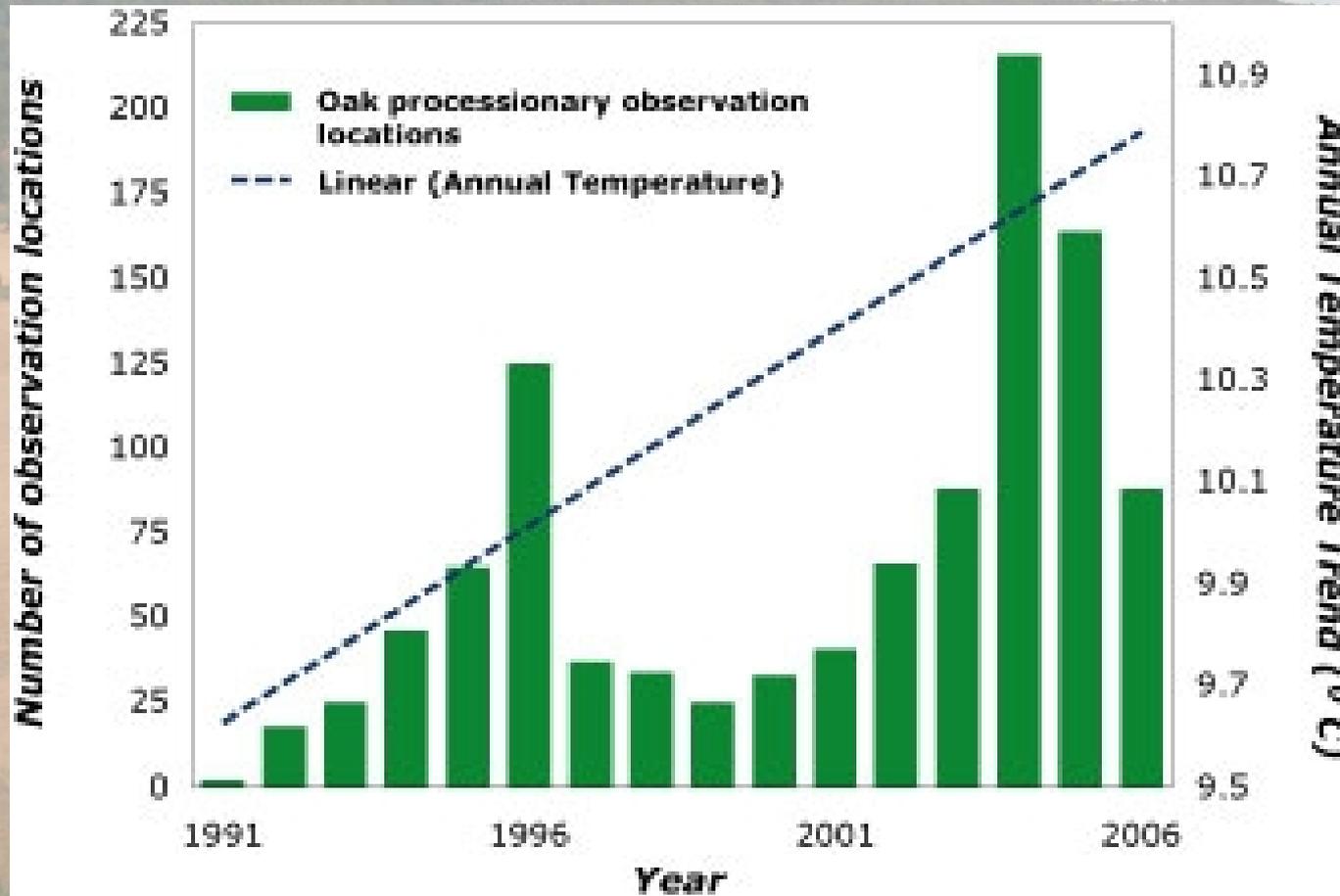
Le fasi della vegetazione cambiano

Spring Phenological Phases, Temperature and North Atlantic Oscillation (NAO) in Germany

graph modified after Walther et al. (2002) Ecological responses to recent climate change. *Nature* 416, 389-395.



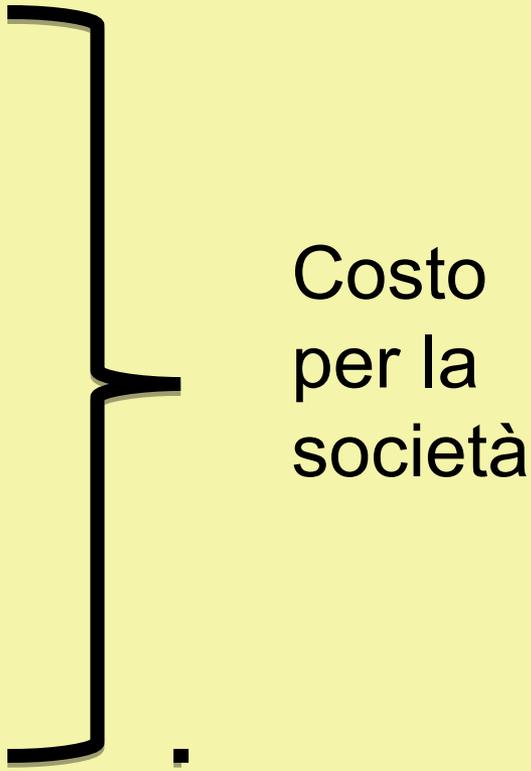
Anche gli insetti cambiano abitudini



Alcune specie svernano più a nord..storno



In conclusione i cambiamenti del clima significano :

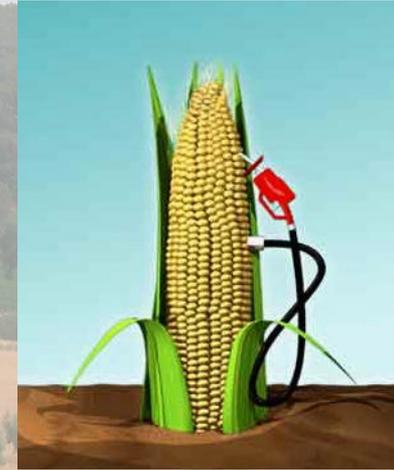
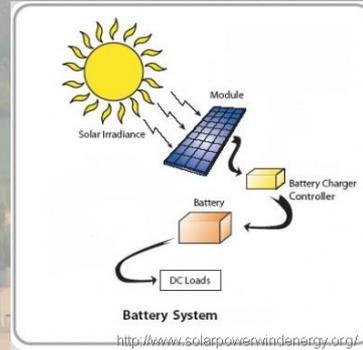
- un aumento degli eventi estremi :
 - piogge intense
 - alluvioni
 - vento forte
 - ondate di calore
 - ondate di freddo
 - siccità
 - sfasamenti stagionali
- 
- Costo per la società

Cosa possiamo fare?

- *Usare energie rinnovabili*
- *Impiegare in modo più efficiente l'energia*

*Dovremmo tornare a prima del 1000
Usando legna, eolico, sole, idraulica*

DOBBIAMO UTILIZZARE ENERGIE RINNOVABILI



Energia idroelettrica



Energia eolica

Aria fredda che scende

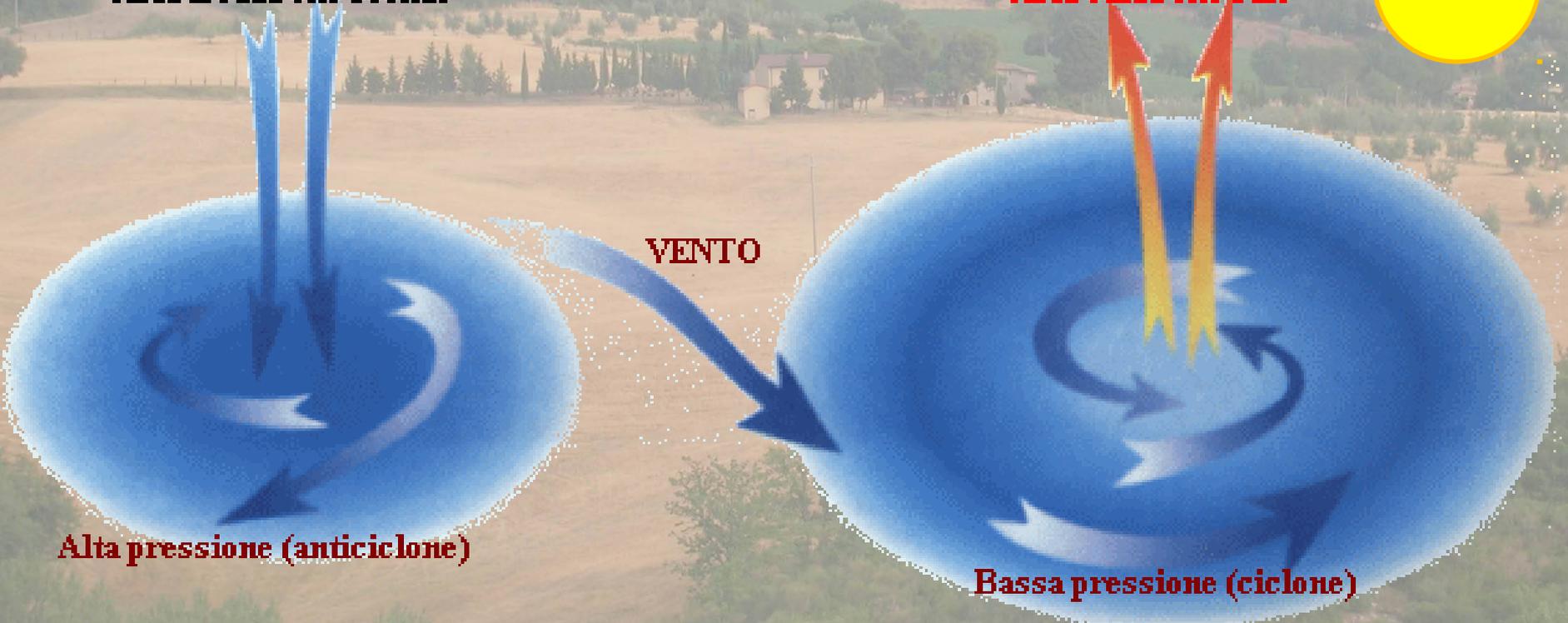
Aria calda che sale



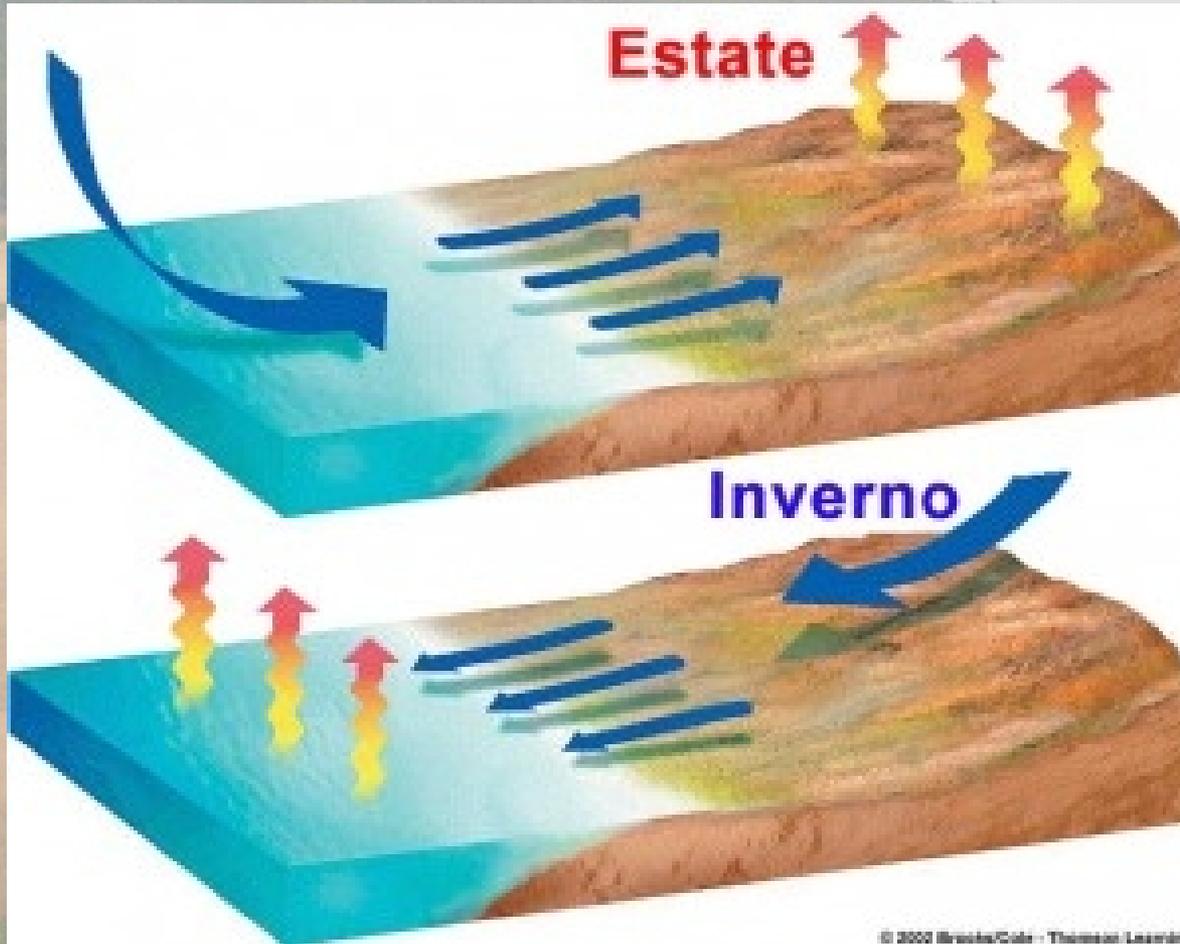
VENTO

Alta pressione (anticiclone)

Bassa pressione (ciclone)

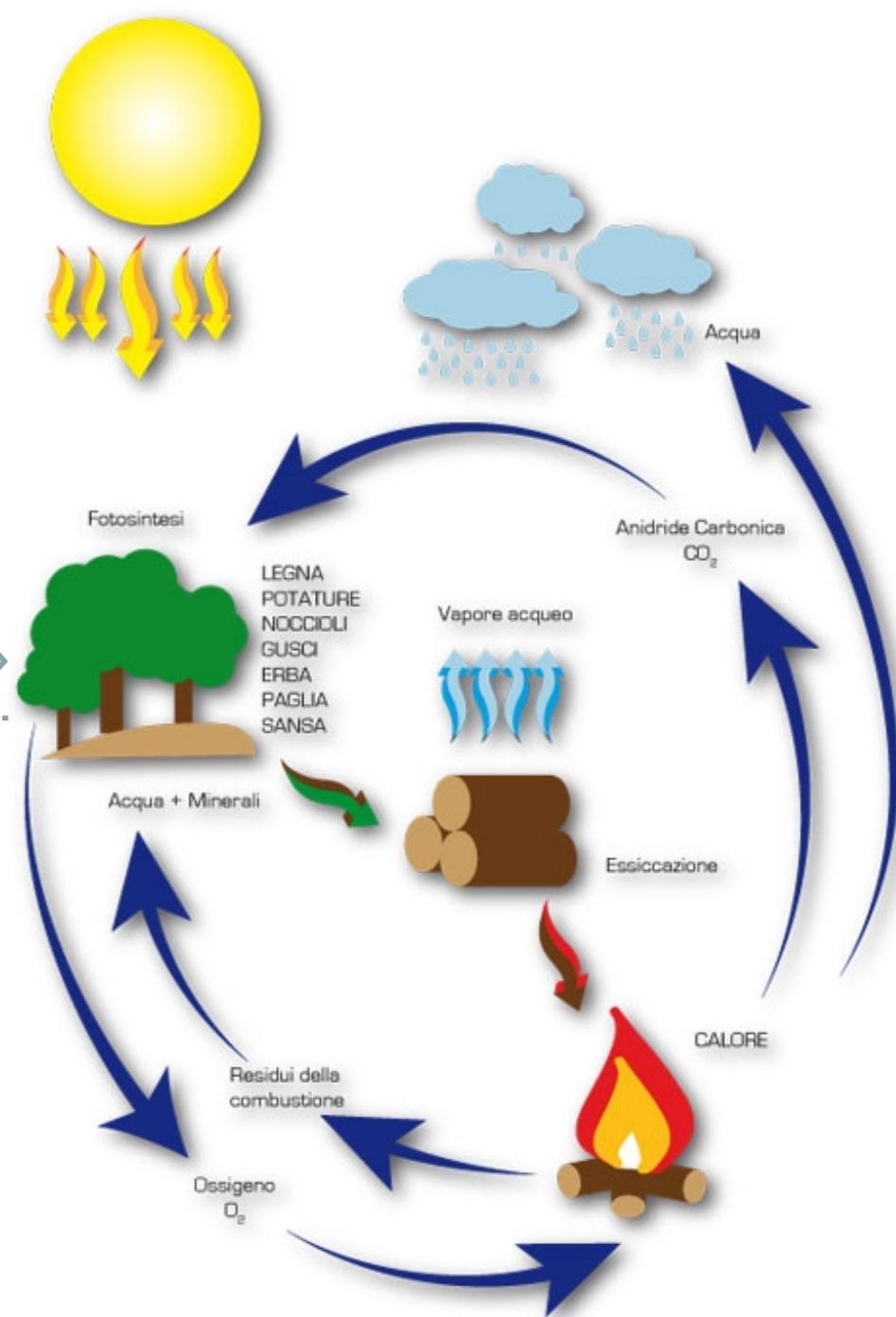


Energia eolica

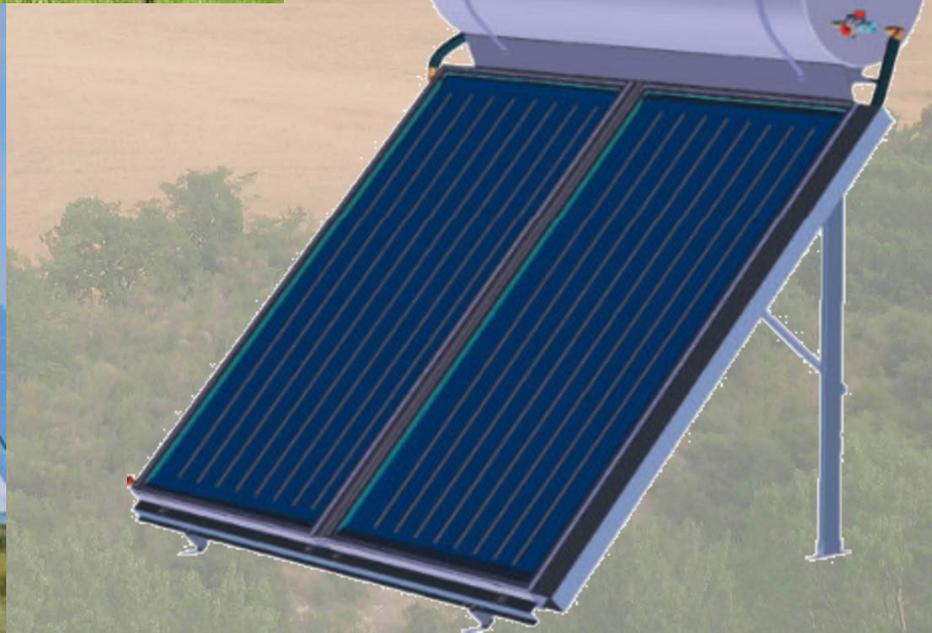


Energia da biomasse solide e liquide

Energia stoccata



Tecnologia solare



Tecnologie eoliche



Quali effetti su clima territorio e popolazione?



CO2



Quali effetti su clima territorio e popolazione?



↓ CO₂

≡ Manutenzione
territorio

≡ Attivazione sociale
(di lungo periodo)

? Paesaggio

Quali effetti su clima territorio e popolazione?



↓ CO₂

≡ Manutenzione
territorio

≡ Attivazione sociale
(di lungo periodo)

? Paesaggio

Quali effetti su clima territorio e popolazione?

↓ CO₂

≡ Manutenzione
territorio

≡ Attivazione sociale
(di lungo periodo)

? Paesaggio



Quali effetti su clima territorio e popolazione?



↓ CO₂



Manutenzione
territorio



Attivazione sociale
(di lungo periodo)



Paesaggio

Energia da biomasse solide e liquide

Uso termico

Prima

adesso

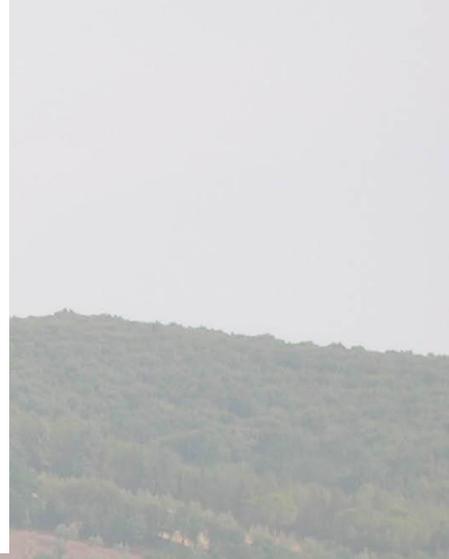
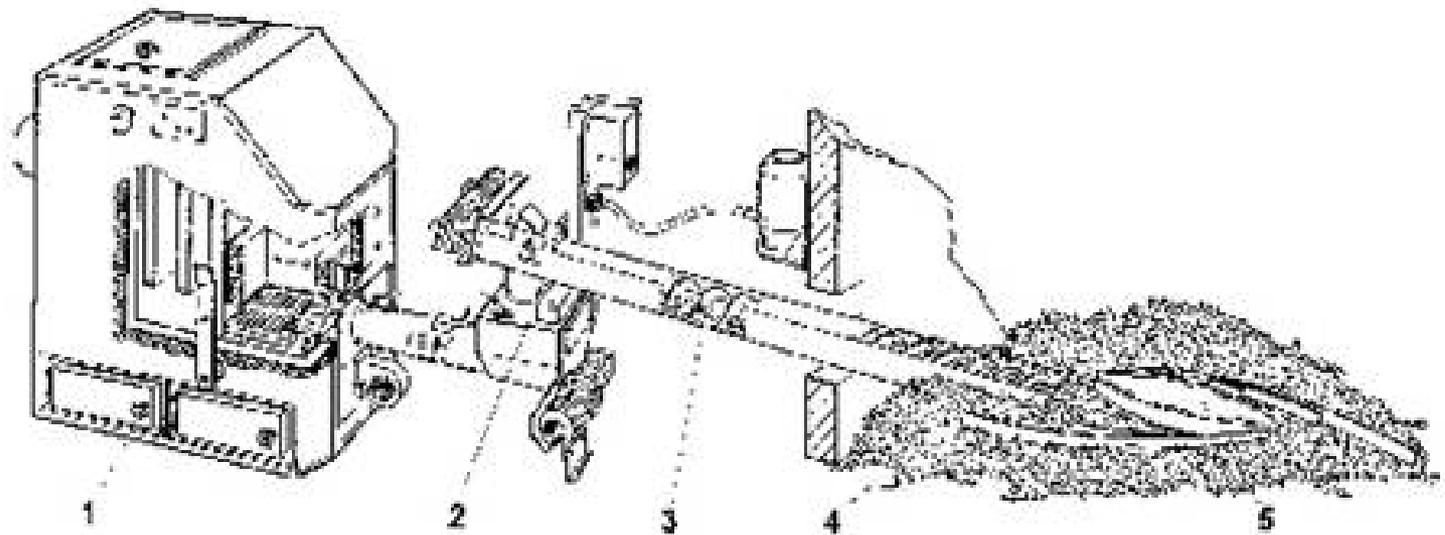


Che biomasse?

Prima

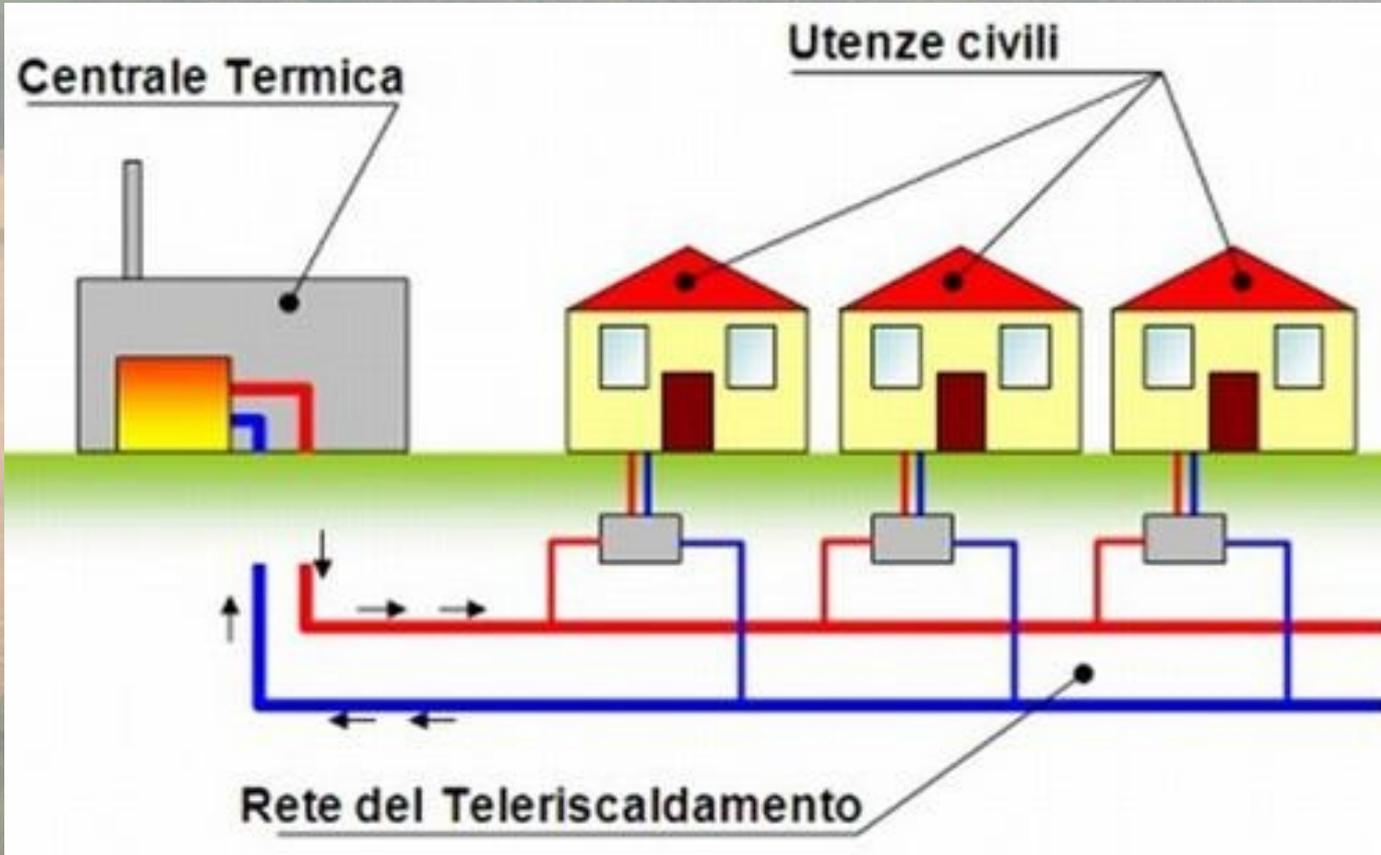
adesso





Comunità il Mulino (Vicchio)

Esempio impianto di teleriscaldamento



Esempio impianto a pellets

Examples for wood chip fuel storage solutions

