

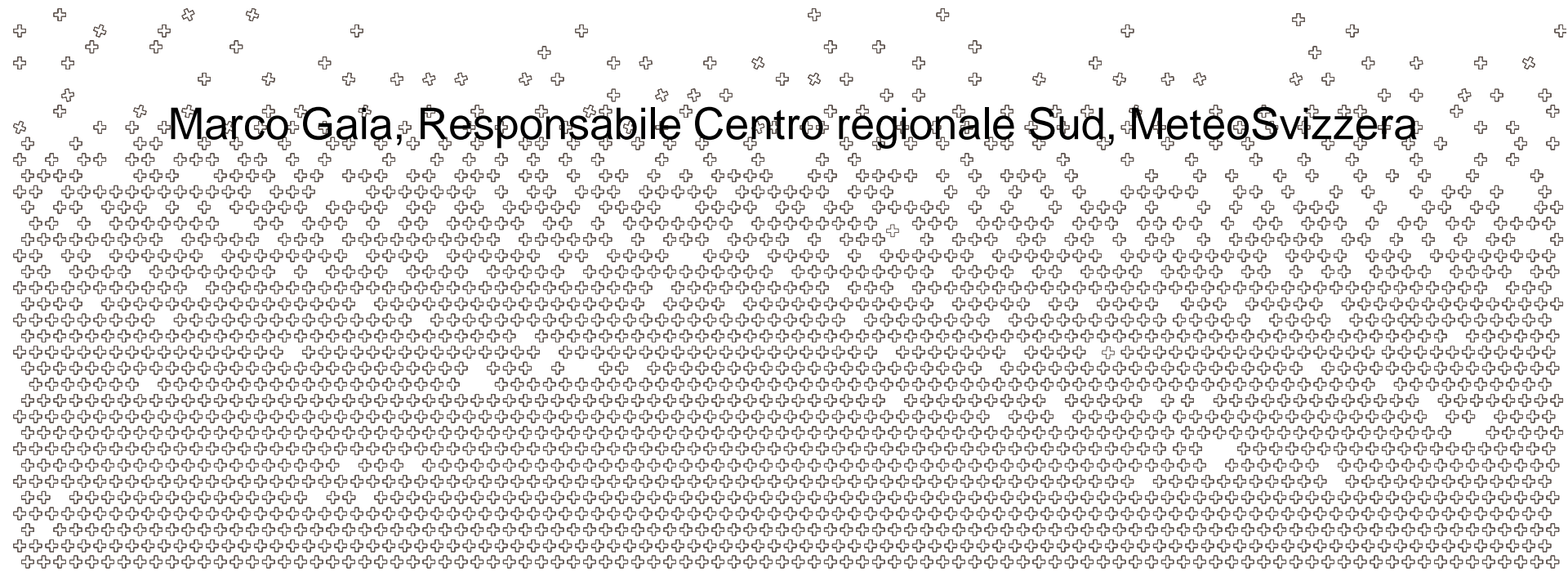


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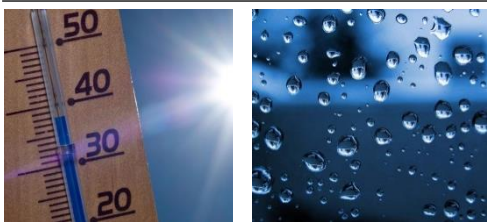
Cambiamenti climatici in atto nell'arco alpino e scenari futuri: intensificazione dei fenomeni estremi?

Marco Gaia, Responsabile Centro regionale Sud, MeteoSvizzera

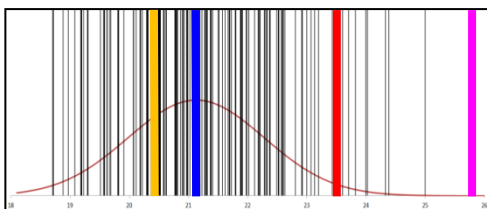




The climate is changing !



The averages



The extremes

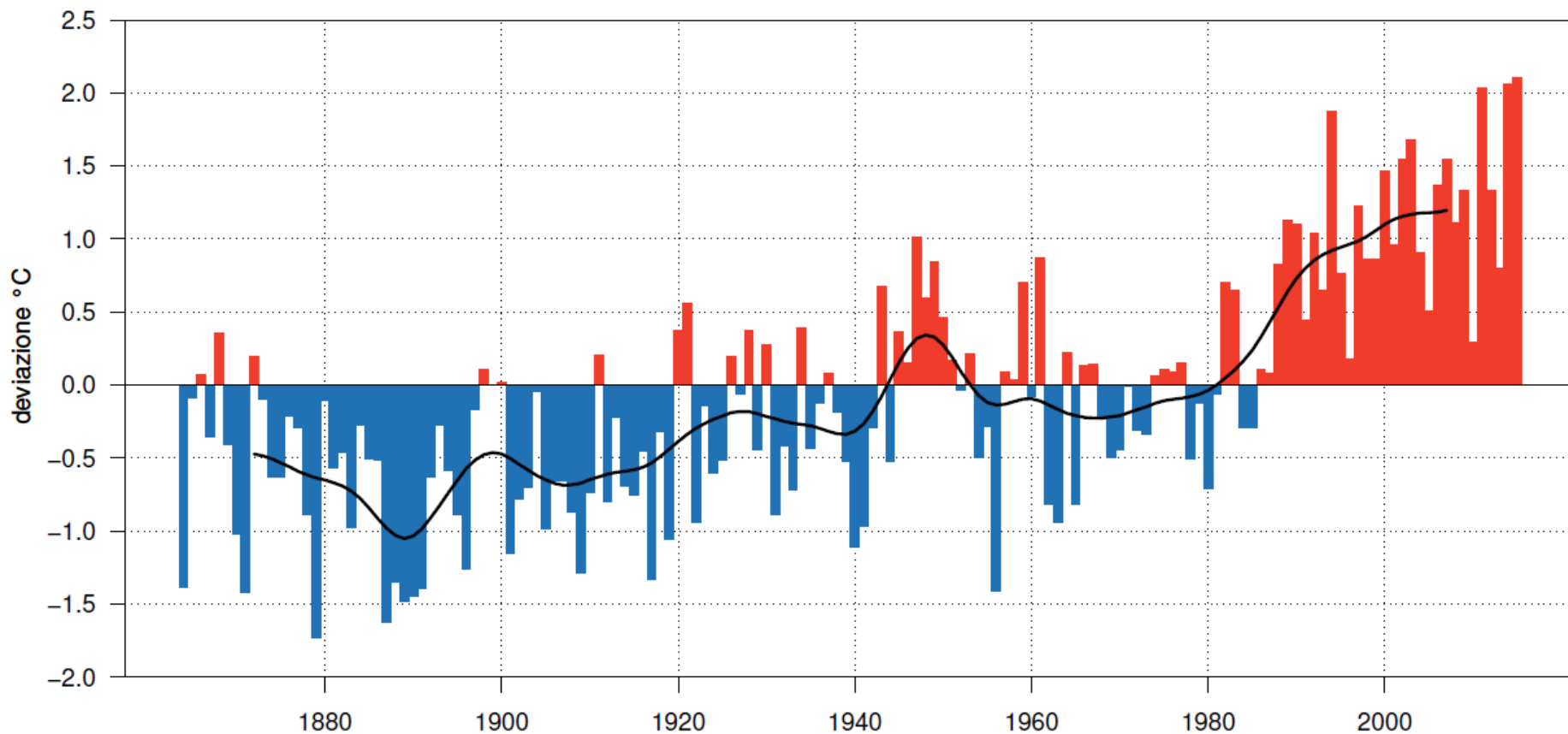





The future

... gestire l'inevitabile, evitare l'ingestibile ...

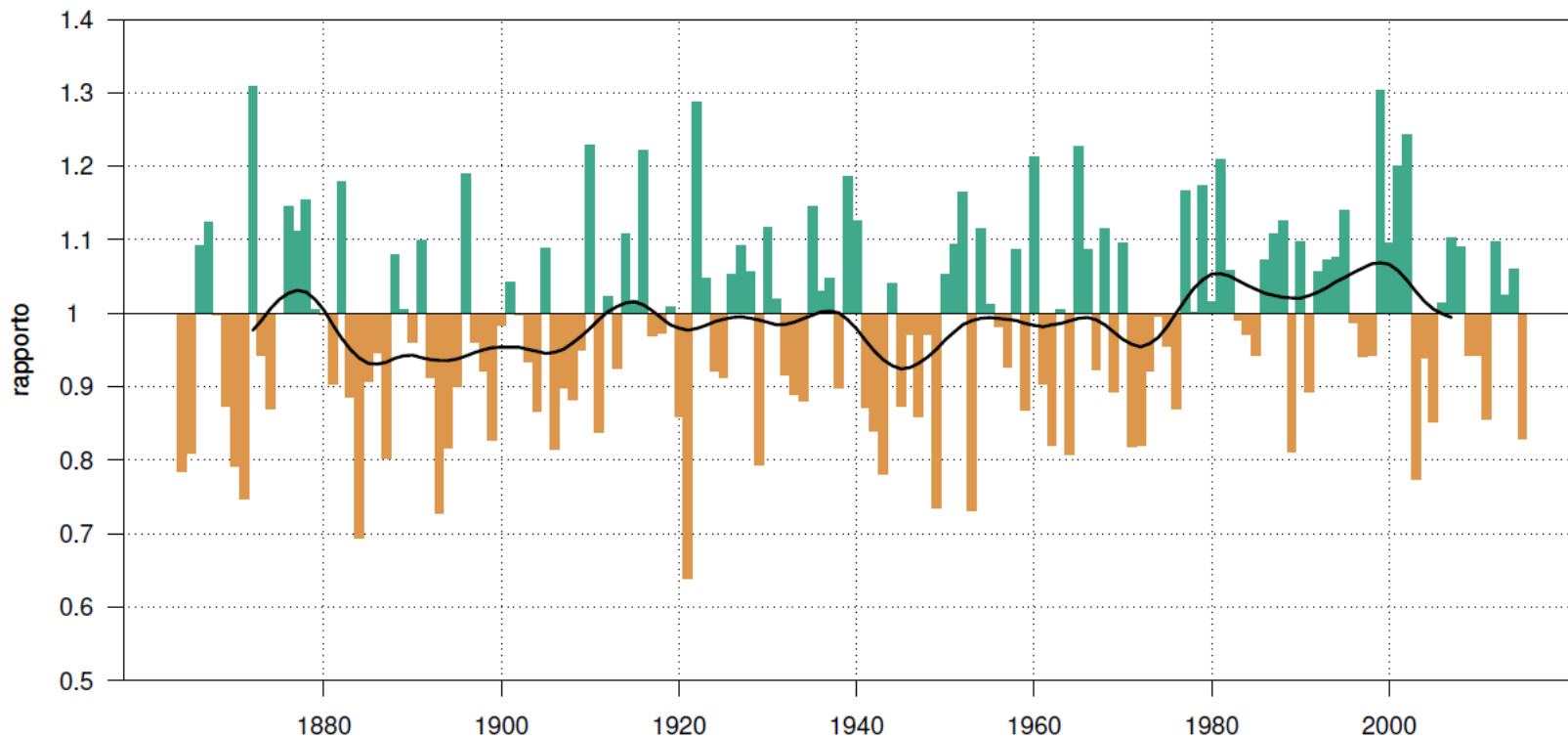
(F. Giorgi)




Annual mean temperature in Switzerland



-  Anni sopra la media 1961–1990
-  Anni sotto la media 1961–1990
-  Media ponderata su 20 anni (filtro gaussiano a banda passante bassa)

Annual mean precipitation in Switzerland



-  Anni sopra la media 1961–1990
-  Anni sotto la media 1961–1990
-  Media ponderata su 20 anni (filtro gaussiano a banda passante bassa)



Bresciana Glacier (Adula)



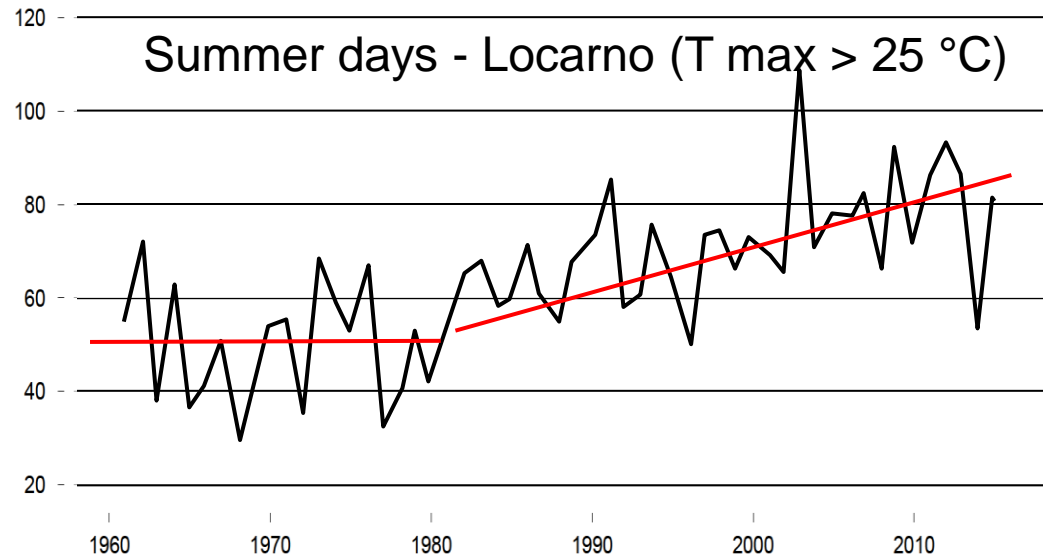
(Foto: 1929: G. Ferrazzini)



(Foto: sito www.ti.ch)



Not extreme, but intense

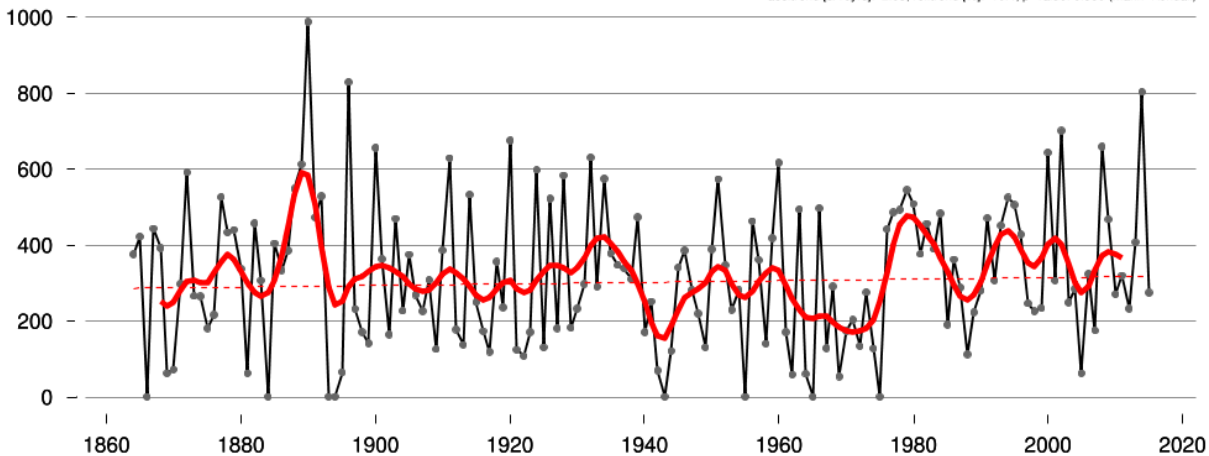


Precipitation on very wet days [> 95th percentile] (mm)
Calendar year (Jan.–Dec.) 1864–2015

Lugano

© MeteoSwiss

abs.trend [u/10yrs]: 2.05; rel.trend [%]: 10.4; p-value: 0.530 (Mann-Kendall)





What about the extreme weather?



Foto: Corriere del Ticino / Fotogonnella / Focus



July 2015, the hottest month since 1864

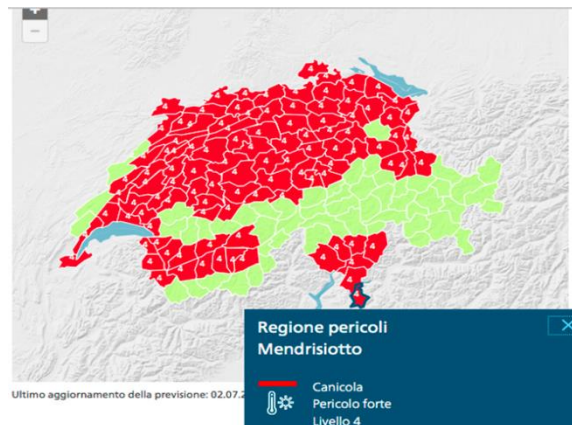
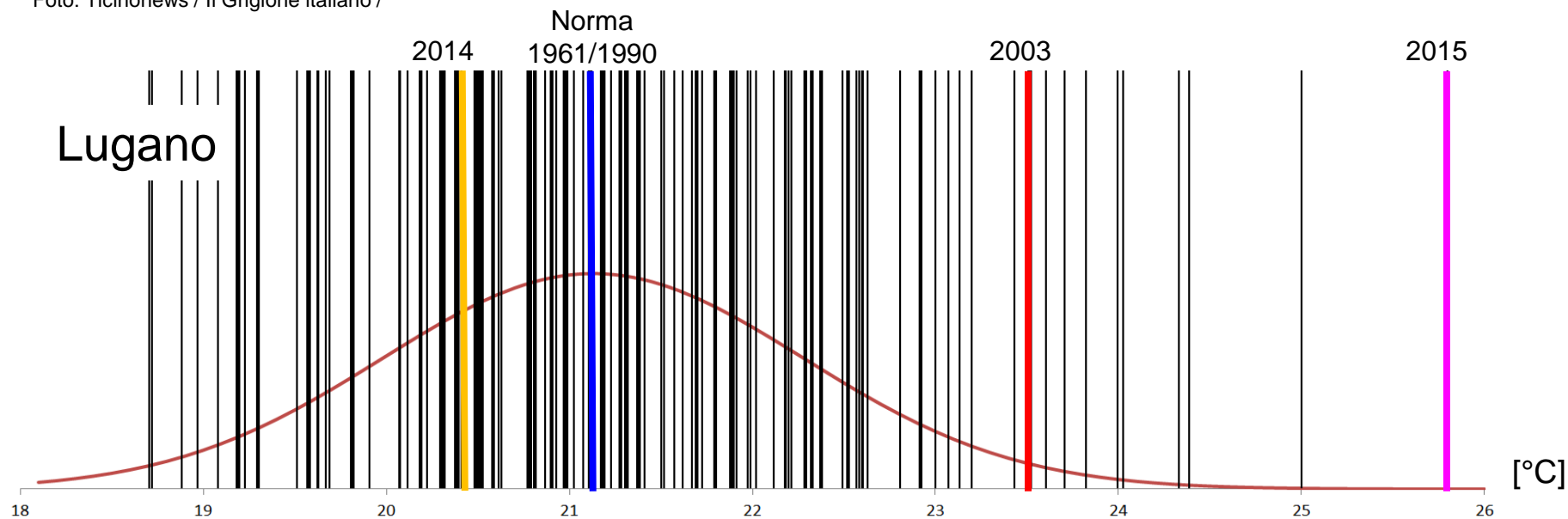


Foto: Ticinonews / Il Grigione italiano /

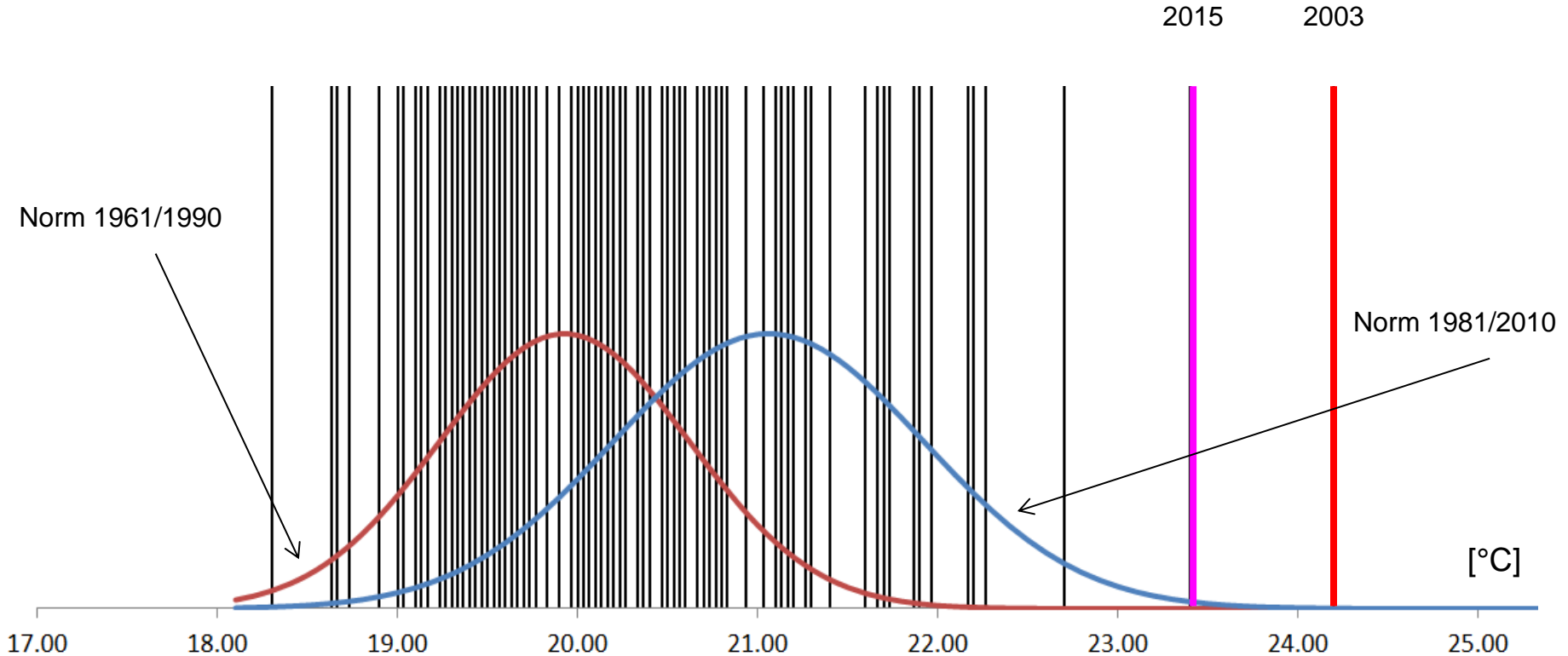


Curva marrone: distribuzione di Gauss, riferita alla norma 1961/1990



Summer mean temperature – Lugano

(homogenized data 1864 – 2015)



Curva rossa: distribuzione di Gauss, riferita alla norma 1961/1990

Curva blu: distribuzione di Gauss, riferita alla norma 1981/2010



Floods in the region of Locarno

1868



1978



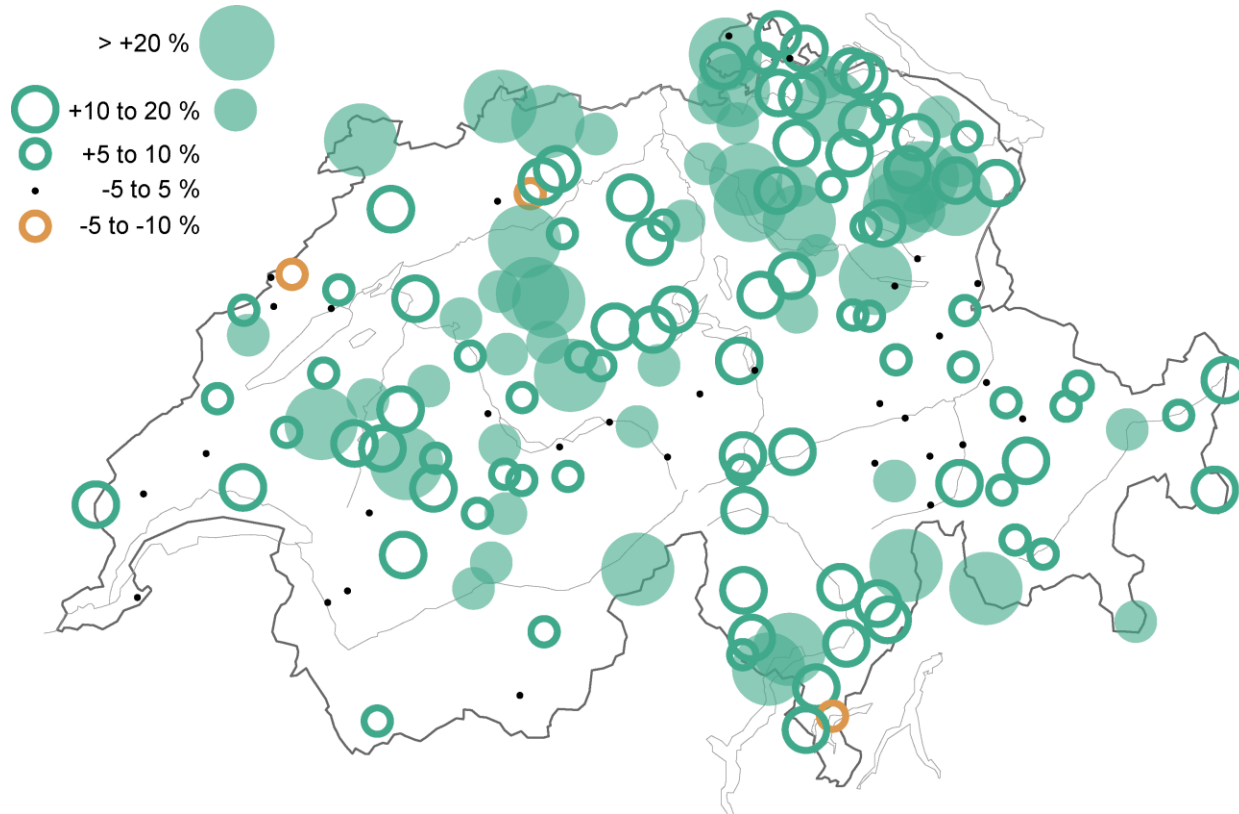
2014



- ... November 2014: the wettest month in Lugano since 1864
- ... in other sites: 300% - 500% of the precipitation of November

Increasing trend in heavy precip. intensity

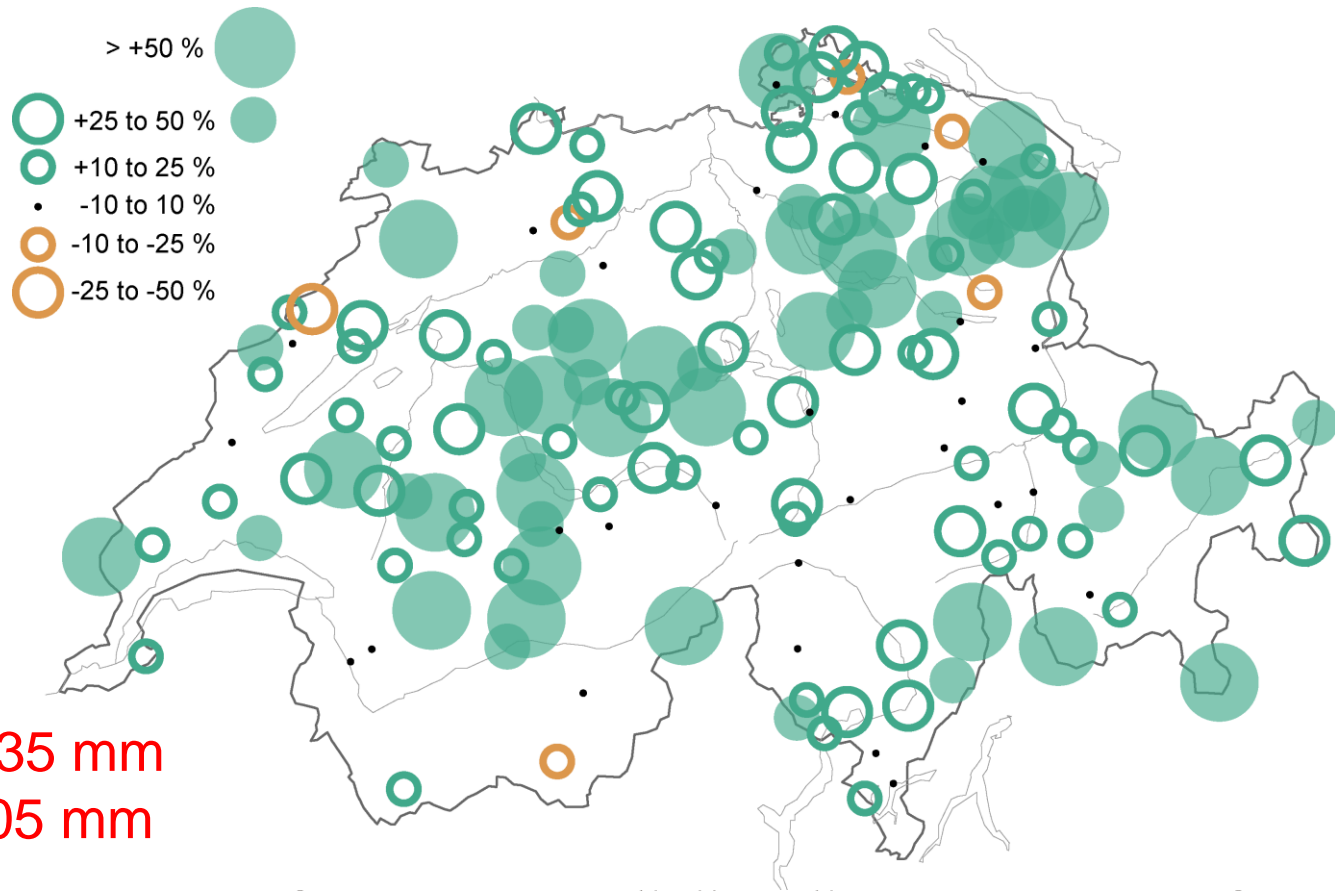
Annual **daily** maximum precipitation (Rx1day); 1900 – 2014
changes in % 100yrs-1. Filled significant at 5%





Increasing trend in frequency

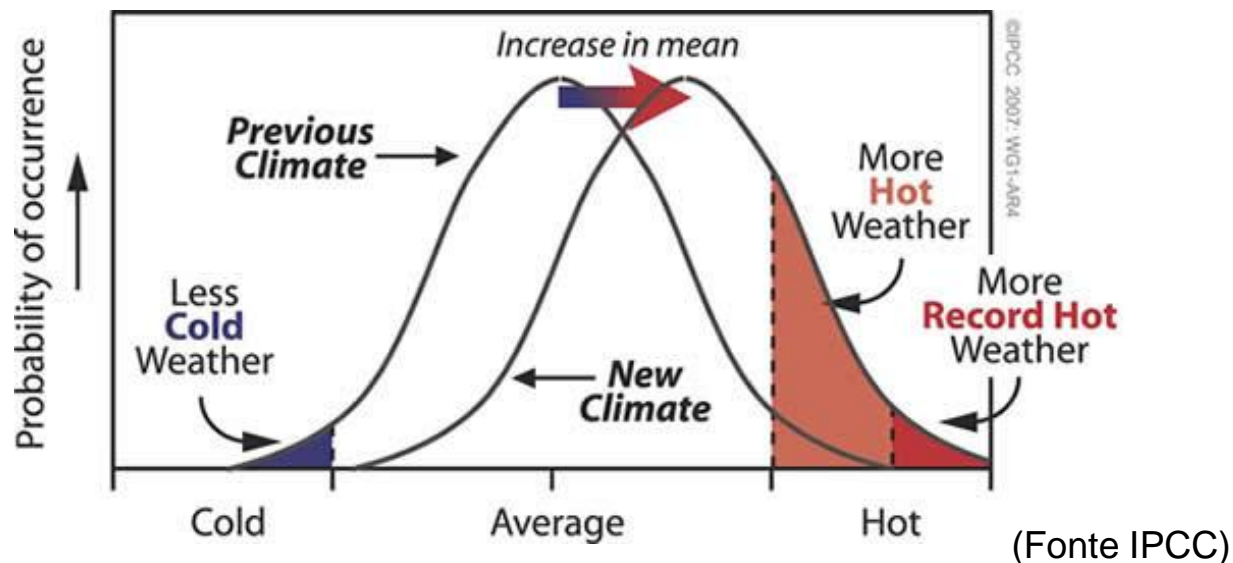
Trend in the frequency for the q99 daily accumulation, 1900 - 2014 changes in % 100yrs-1. Filled significant at 5%



q99:
Plateau: 25-35 mm
Ticino: 55-105 mm

Why should extreme weather increase?

Temperature



Precipitation

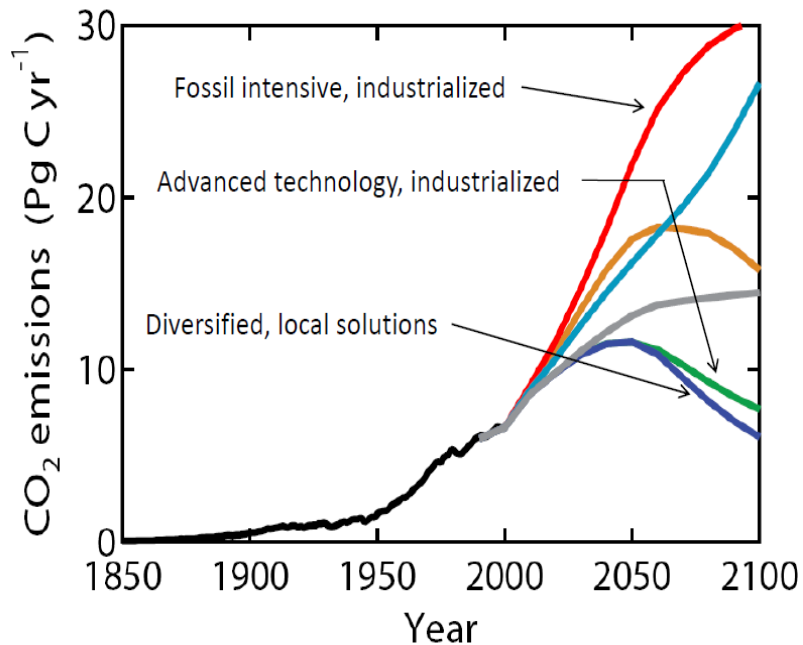
Clausius-Clapeyron Equation (Thermodynamics)

🇨🇭 The future: how will our society change?

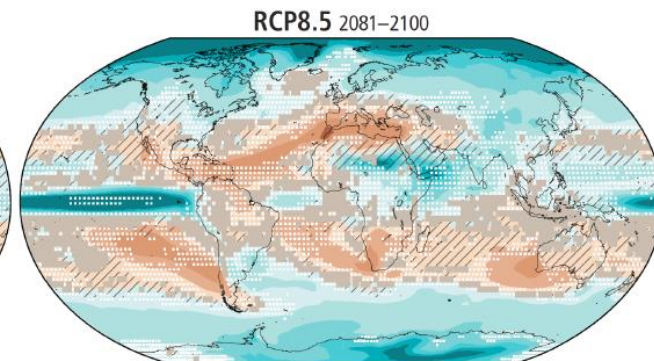
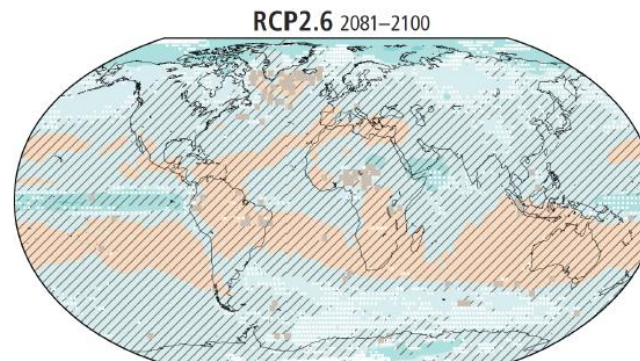
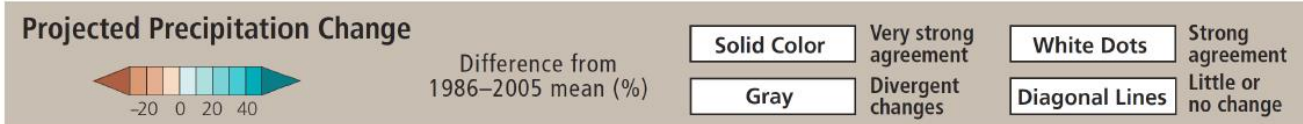
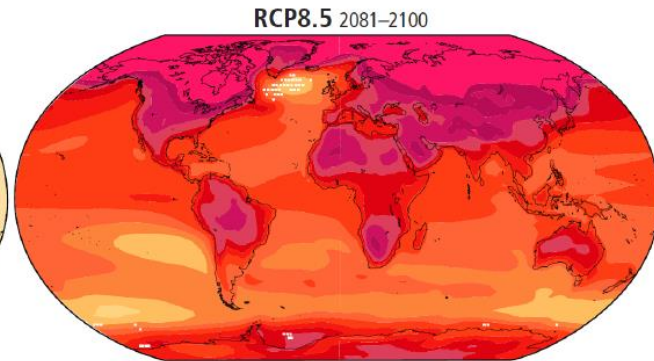
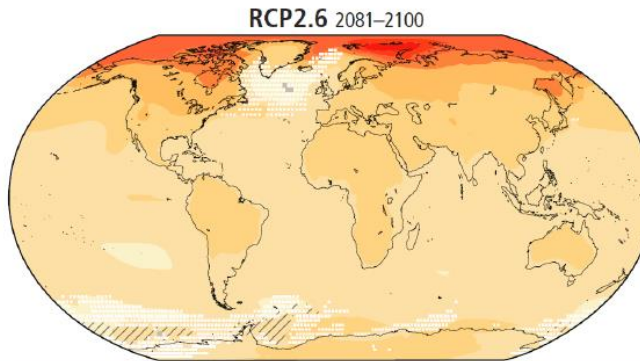
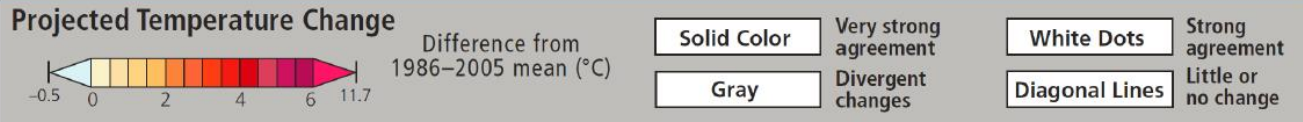
(why we need CO₂ emissions scenarios)



Fonte: IPCC 2013

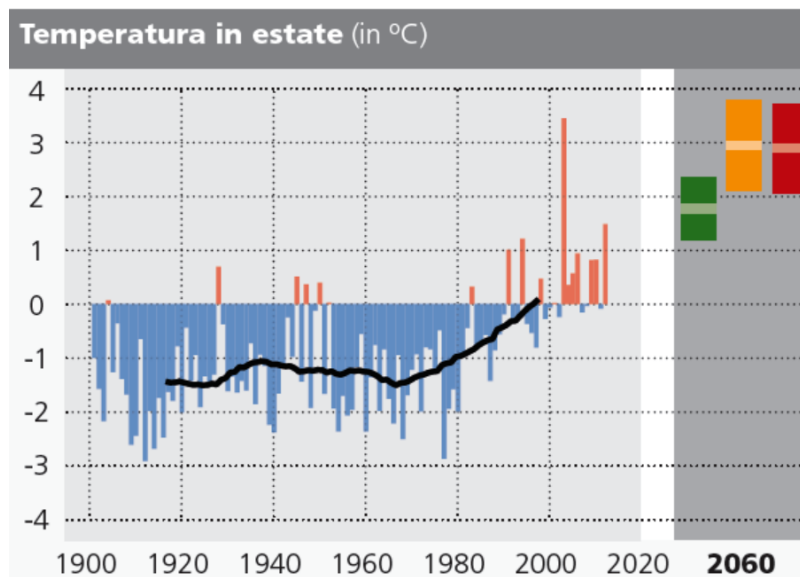
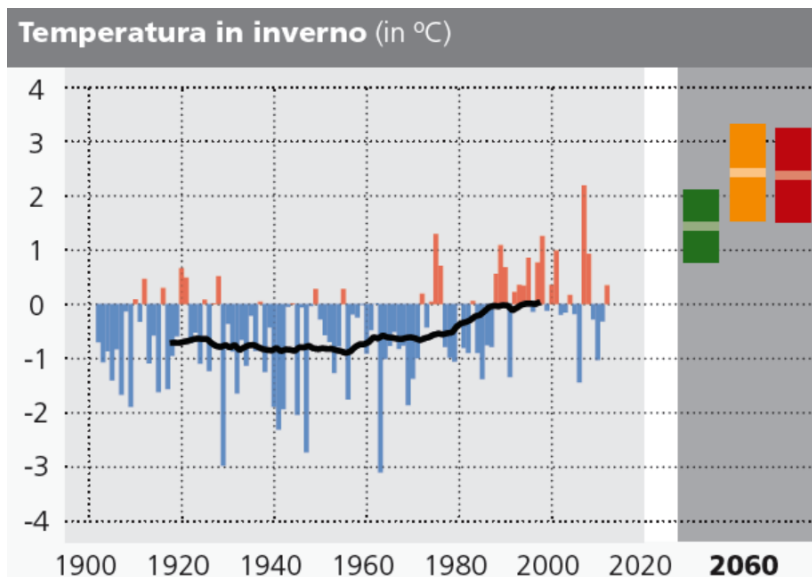


The future temperature and precipitation





Temperature projections - Lugano



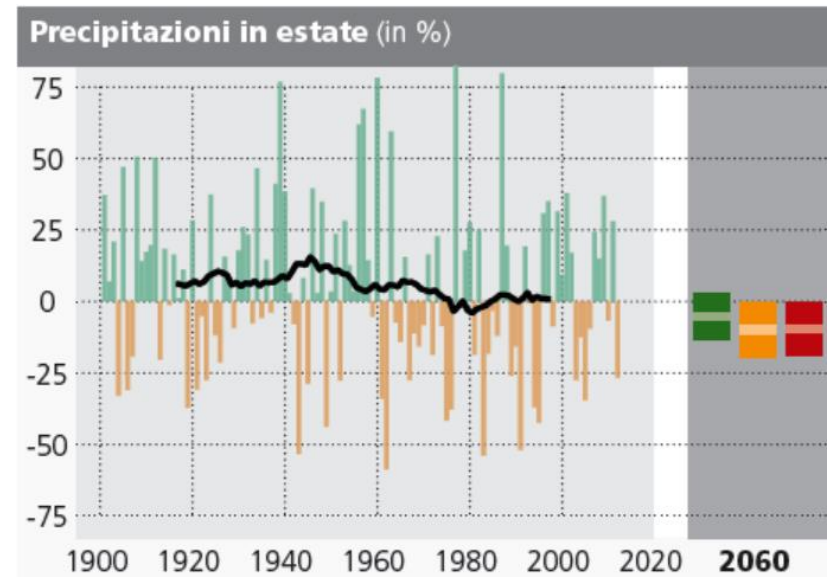
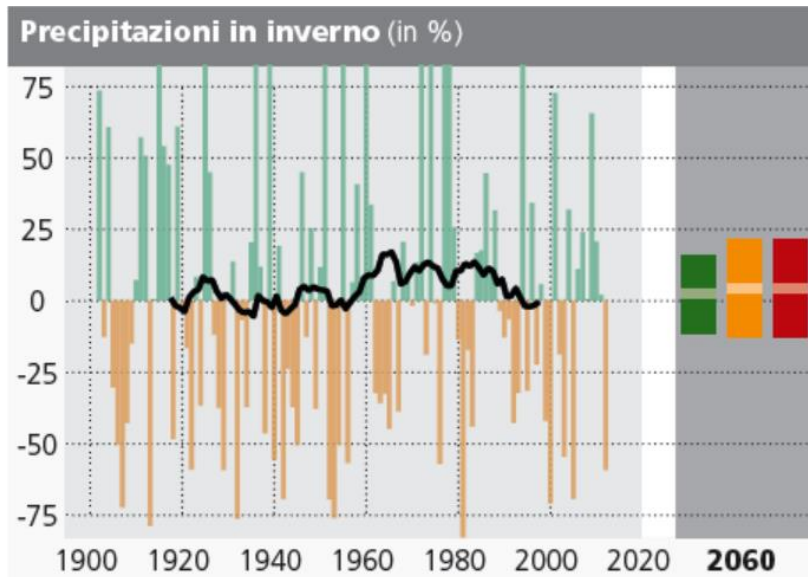
Scenari di emissione

- A2
- A1B
- RCP3PD

«0» = average 1981 - 2010



Precipitation projections - Lugano



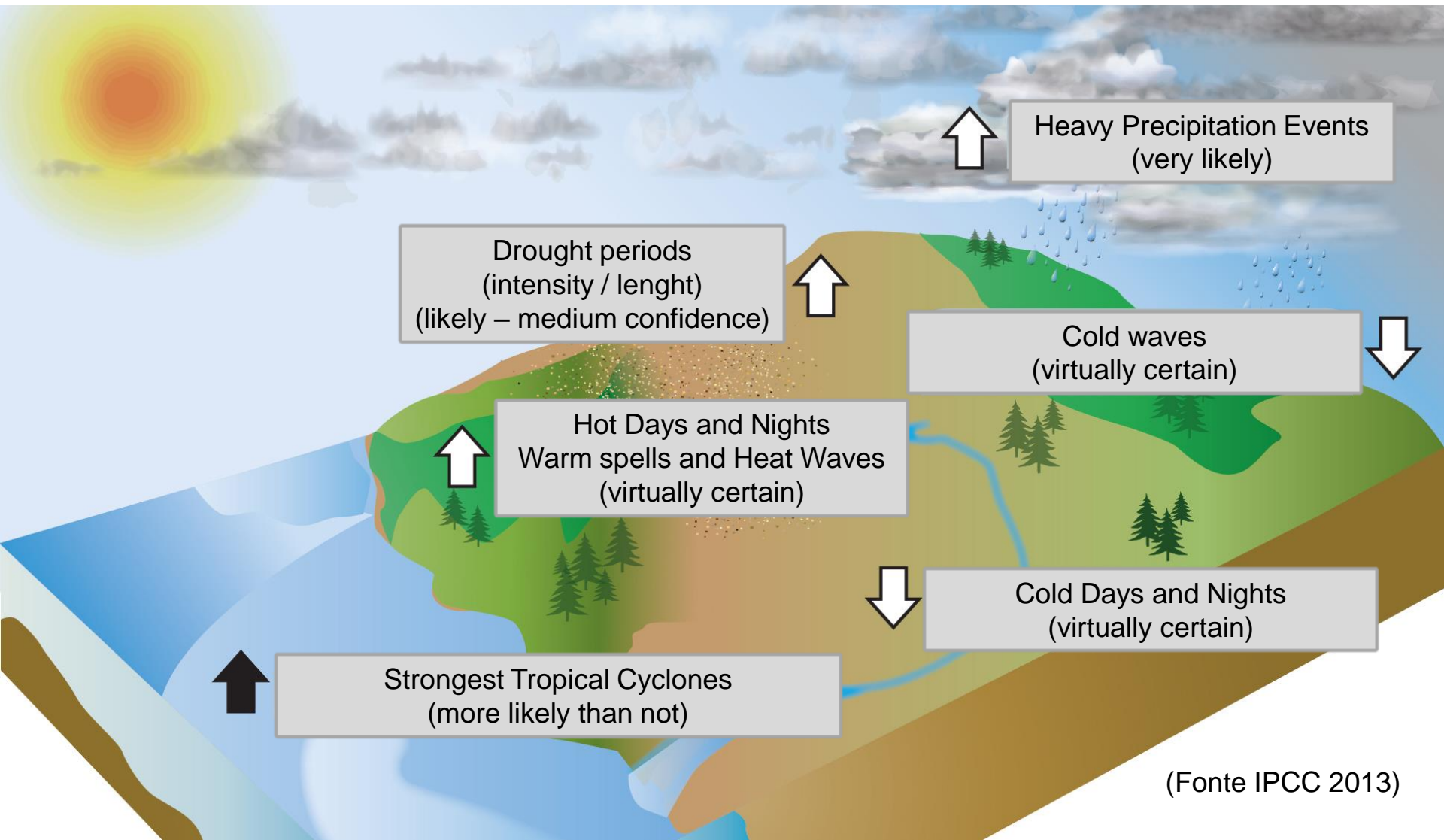
Scenari di emissione

- A2
- A1B
- RCP3PD

«0» = average 1981 - 2010



Changes in the extreme weather



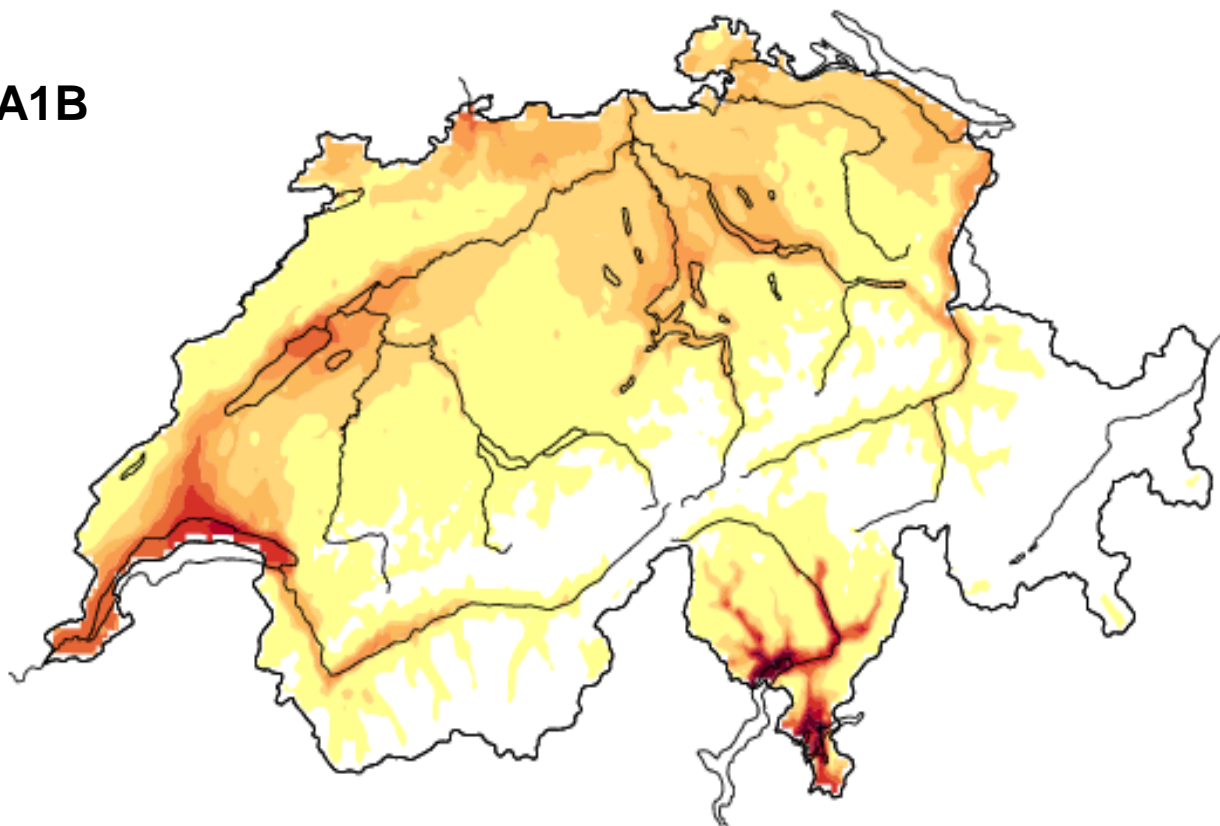
(Fonte IPCC 2013)



Tropical nights ($T_{min} \geq 20 \text{ }^\circ\text{C}$)

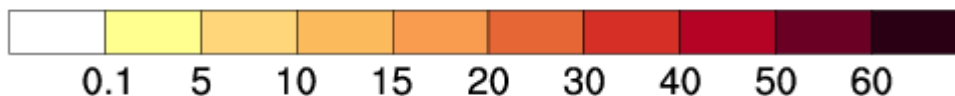
Scenario A1B

~ 2085



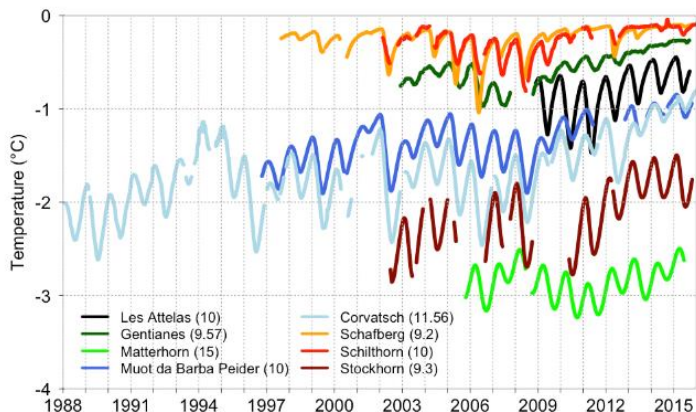
(Fonte Scenari climatici CH2011)

Numero medio di notti
tropicali per anno





Not only the extremes are important



Borehole temperature (~10m depth)

Source: PERMOS

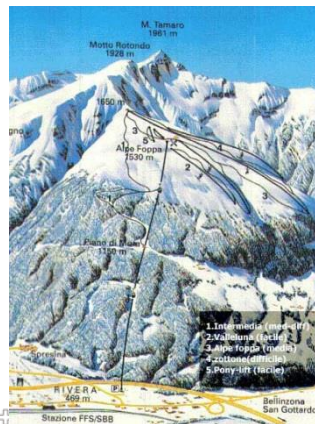


Foto: <http://www.filipponi.info/> www.rsi.ch

MeteoSvizzera

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Marco Gaia



Conclusions

- The climate has changed, is changing, will change in the future.
- Climate change is present in Ticino and in the Alps.
- The impact on temperature is (statistically) very clear.
The impact on the precipitation is not so robust.
- The human induced climate change will continue in the future.
- Not only the extremes are important,
but the shift of the average weather conditions as well.



*« Nous n'héritons pas de la terre de nos parents,
nous l'empruntons à nos enfants . »*

Antoine de Saint-Exupéry, *Citadelle*, 1948



Grazie per l'attenzione!

