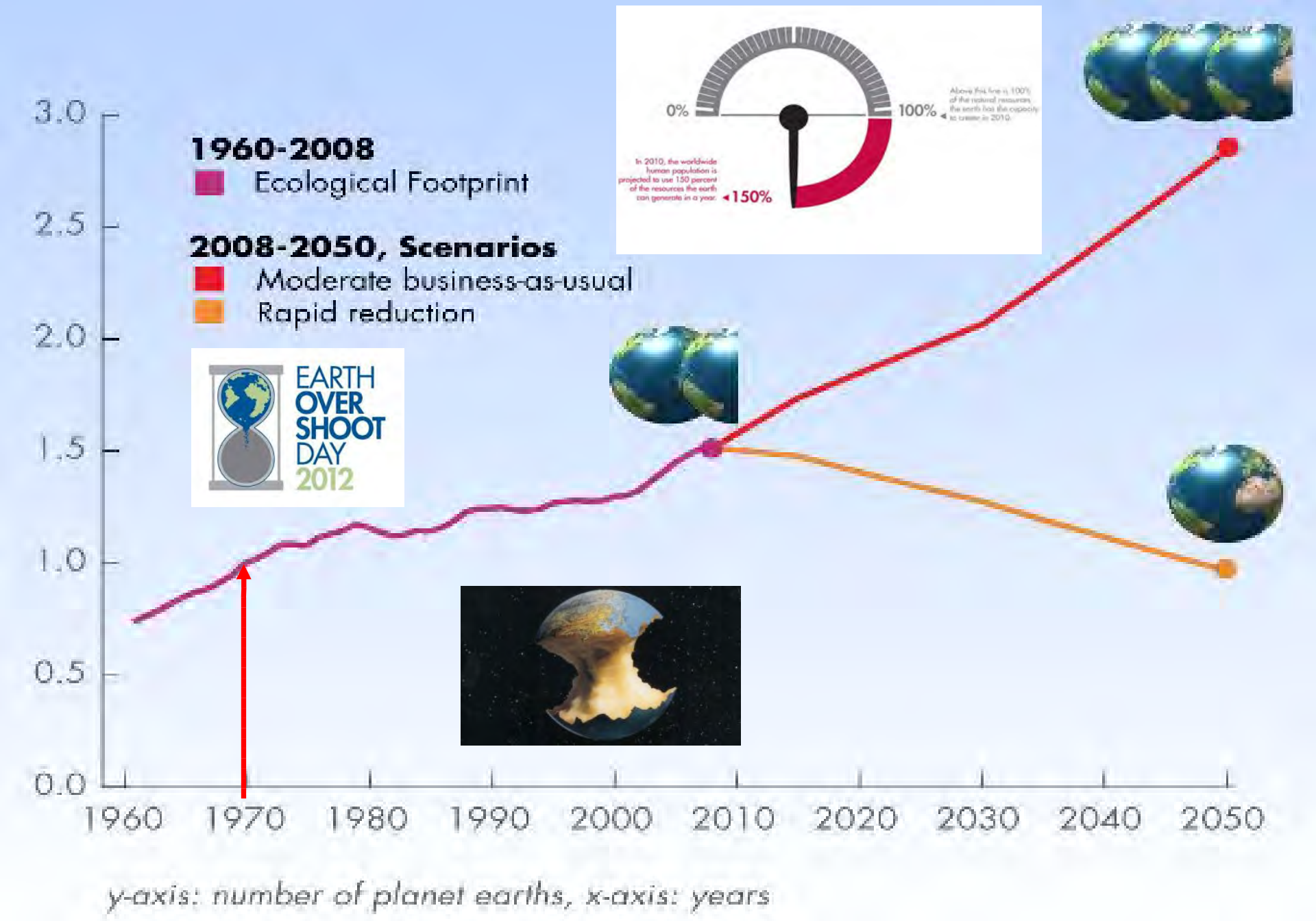
Allarme rosso per l'acqua di domani...

Luca Mercalli – Società Meteorologica Italiana - www.nimbus.it

Ghiacciaio Meridionale d'Hohsand
dalla diga del Sabbione (Val d'Ossola), 29.07.2011


1960-2008
Ecological Footprint
2008-2050, Scenarios
Moderate business-as-usual
Rapid reduction
EARTH OVER SHOOT DAY 2012
0%
100%
150%
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050
y-axis: number of planet earths, x-axis: years

Rockstrom & al., Nature 2009

9.4GtonC/yr, 15% (34 GtCO2)

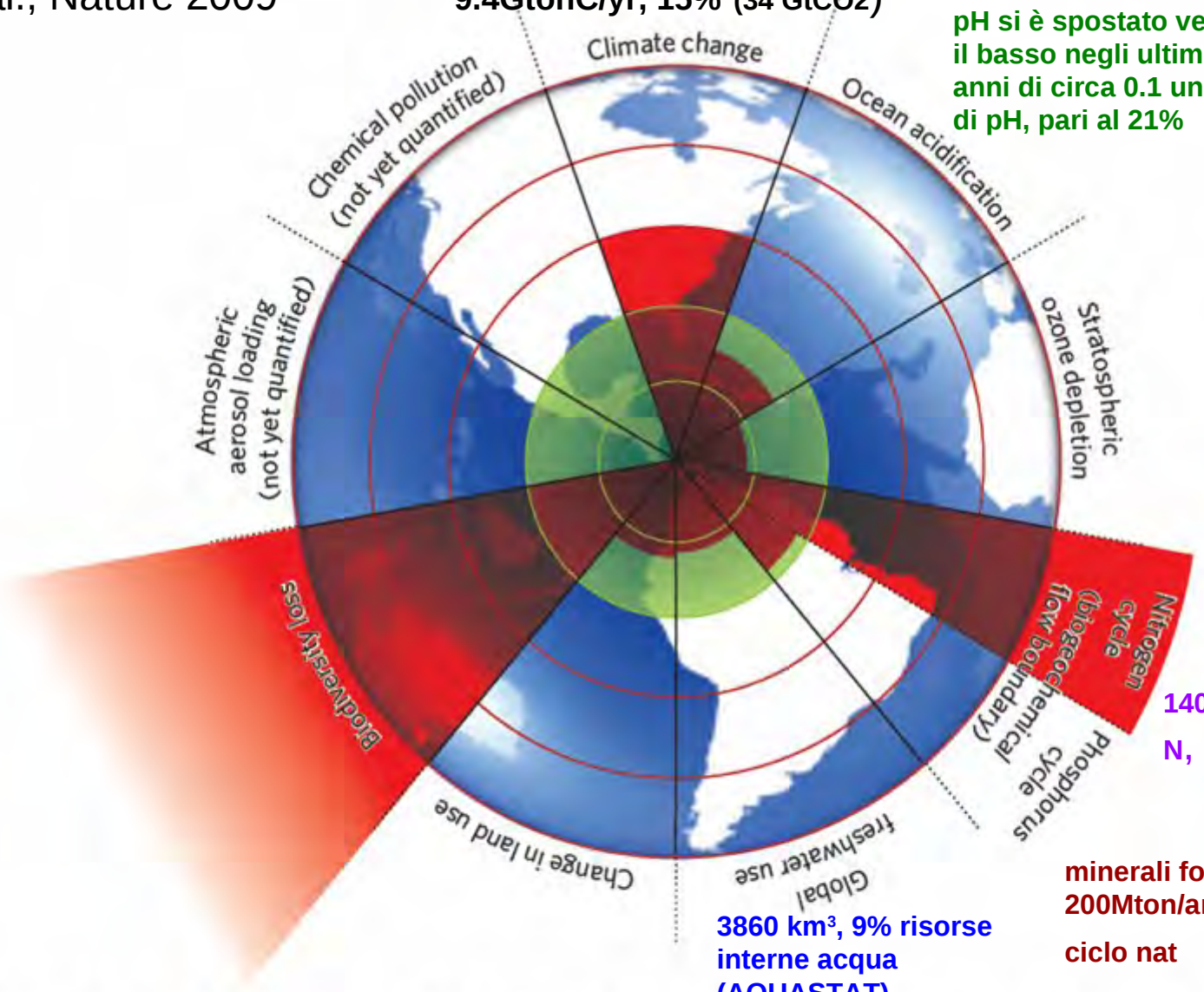
pH si è spostato verso il basso negli ultimi 250 anni di circa 0.1 unità di pH, pari al 21%

Vol 461|24 September 2009

FEATURE

A safe operating space for humanity

Identifying and quantifying planetary boundaries that must not be transgressed could help prevent human activities from causing unacceptable environmental change, argue **Johan Rockström** and colleagues.



140Mton N, 100%

minerali fosfatici 200Mton/anno; 1/7

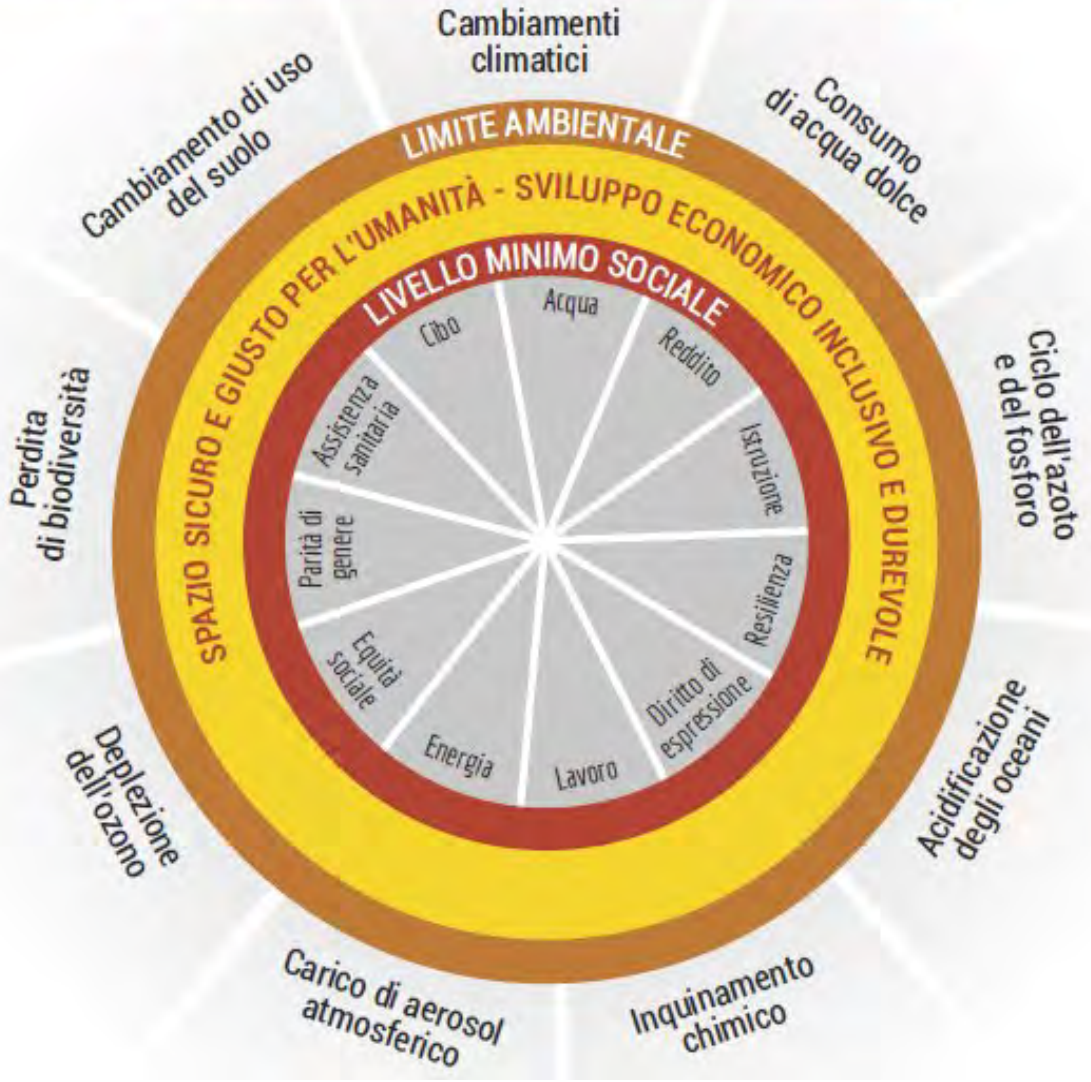
ciclo nat

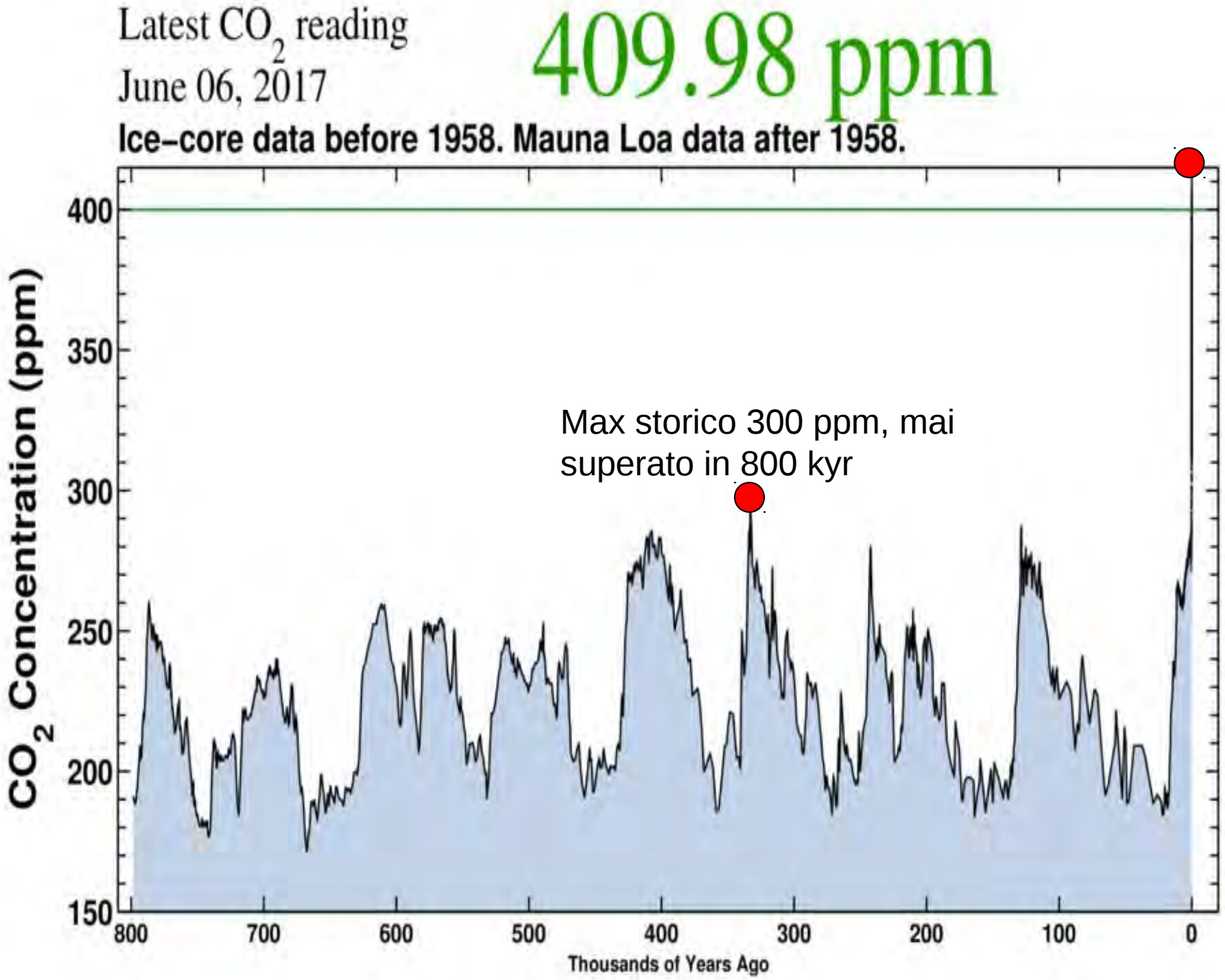
3860 km³, 9% risorse interne acqua (AQUASTAT)

Figure 1 | Beyond the boundary. The inner green shading represents the proposed safe operating space for nine planetary systems. The red wedges represent an estimate of the current position for each variable. The boundaries in three systems (rate of biodiversity loss, climate change and human interference with the nitrogen cycle), have already been exceeded.

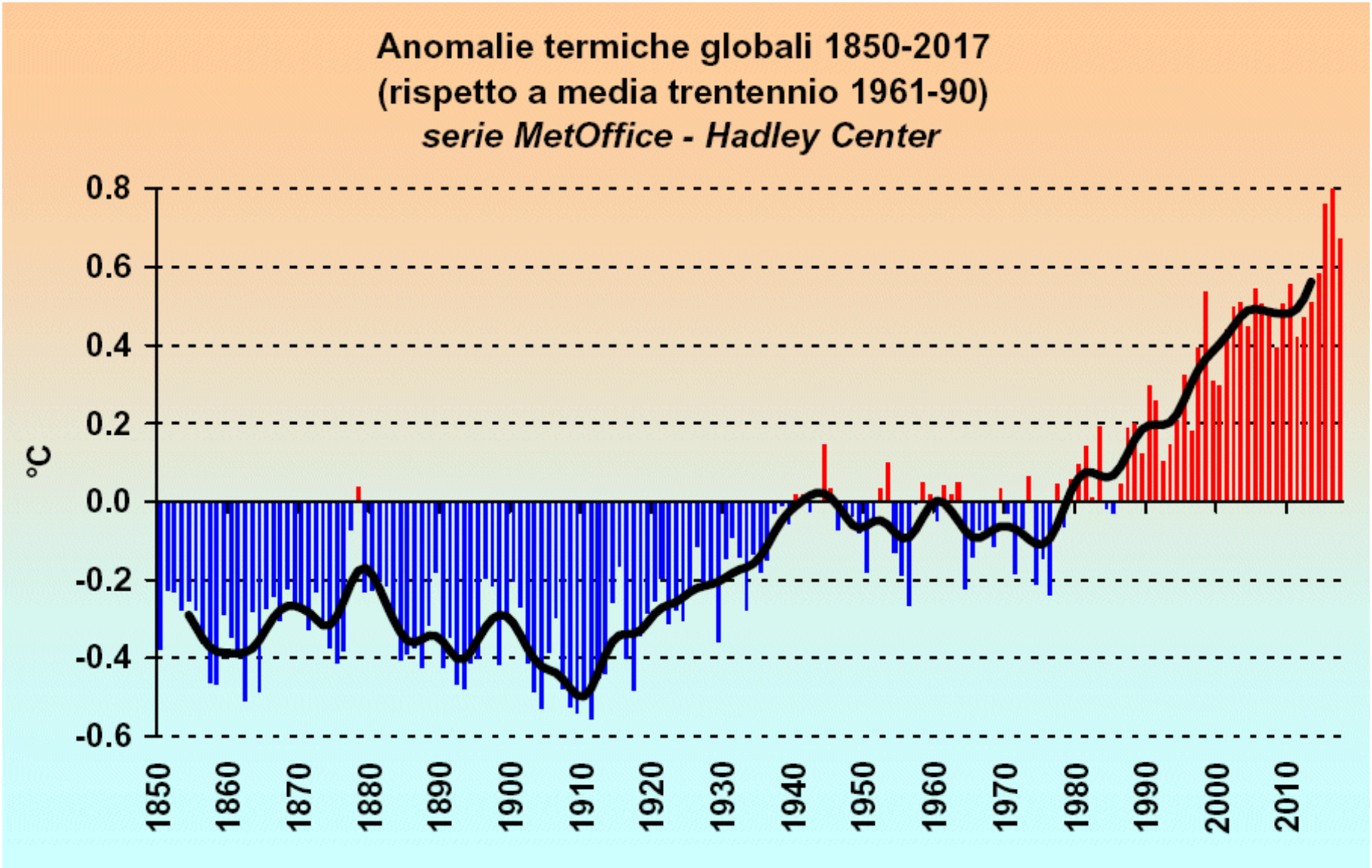
LA "CIAMBELLA" DEI LIMITI SOCIALI E PLANETARI

FONTE: A SAFE AND JUST SPACE FOR HUMANITY - OXFAM DISCUSSION PAPERS.



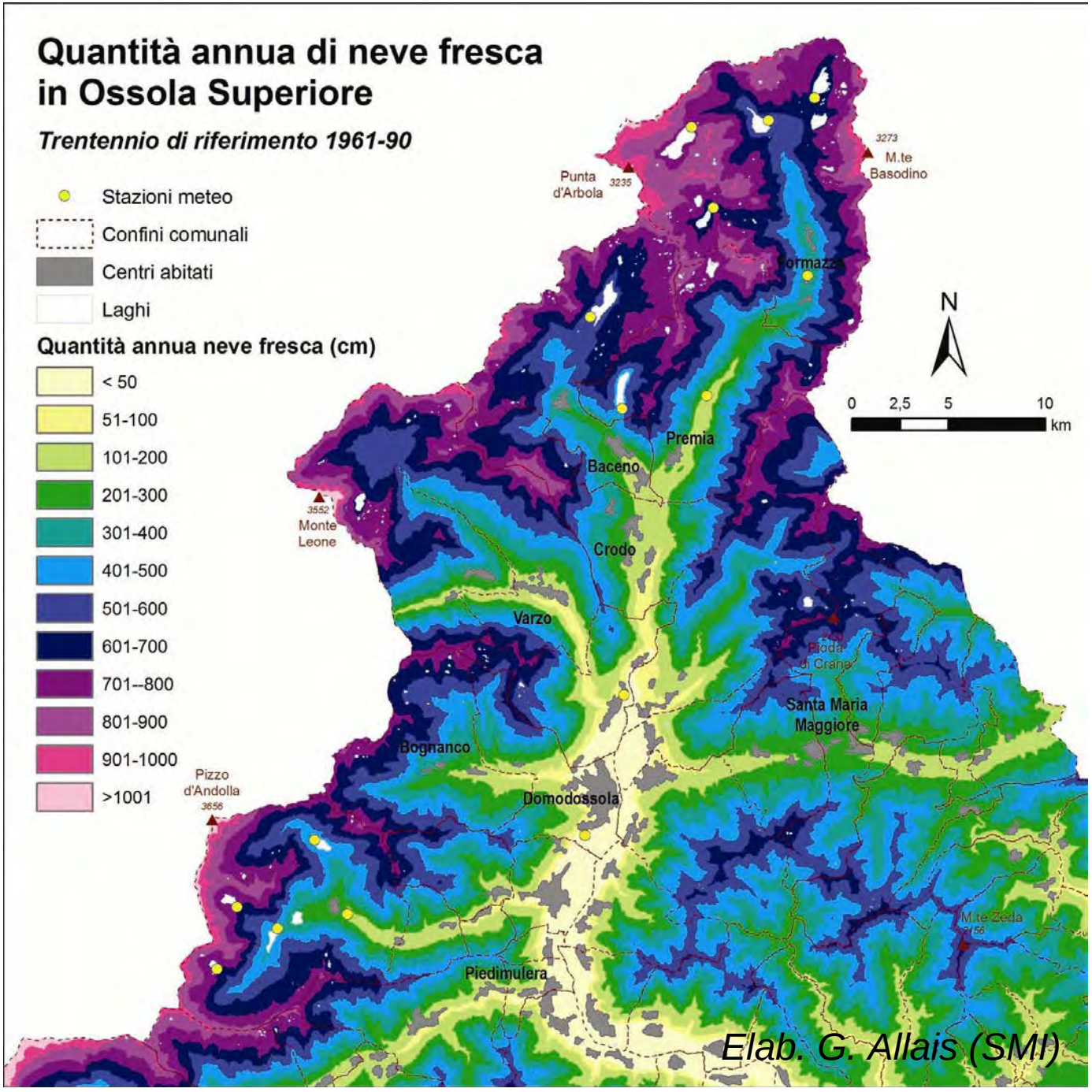

Latest CO_2 reading
June 06, 2017
409.98 ppm
Ice–core data before 1958. Mauna Loa data after 1958.
Max storico 300 ppm, mai superato in 800 kyr
CO_2 Concentration (ppm)
400
350
300
250
200
150
800
700
600
500
400
300
200
100
0
Thousands of Years Ago

Temperatura media globale: +1°C in più nell'ultimo secolo



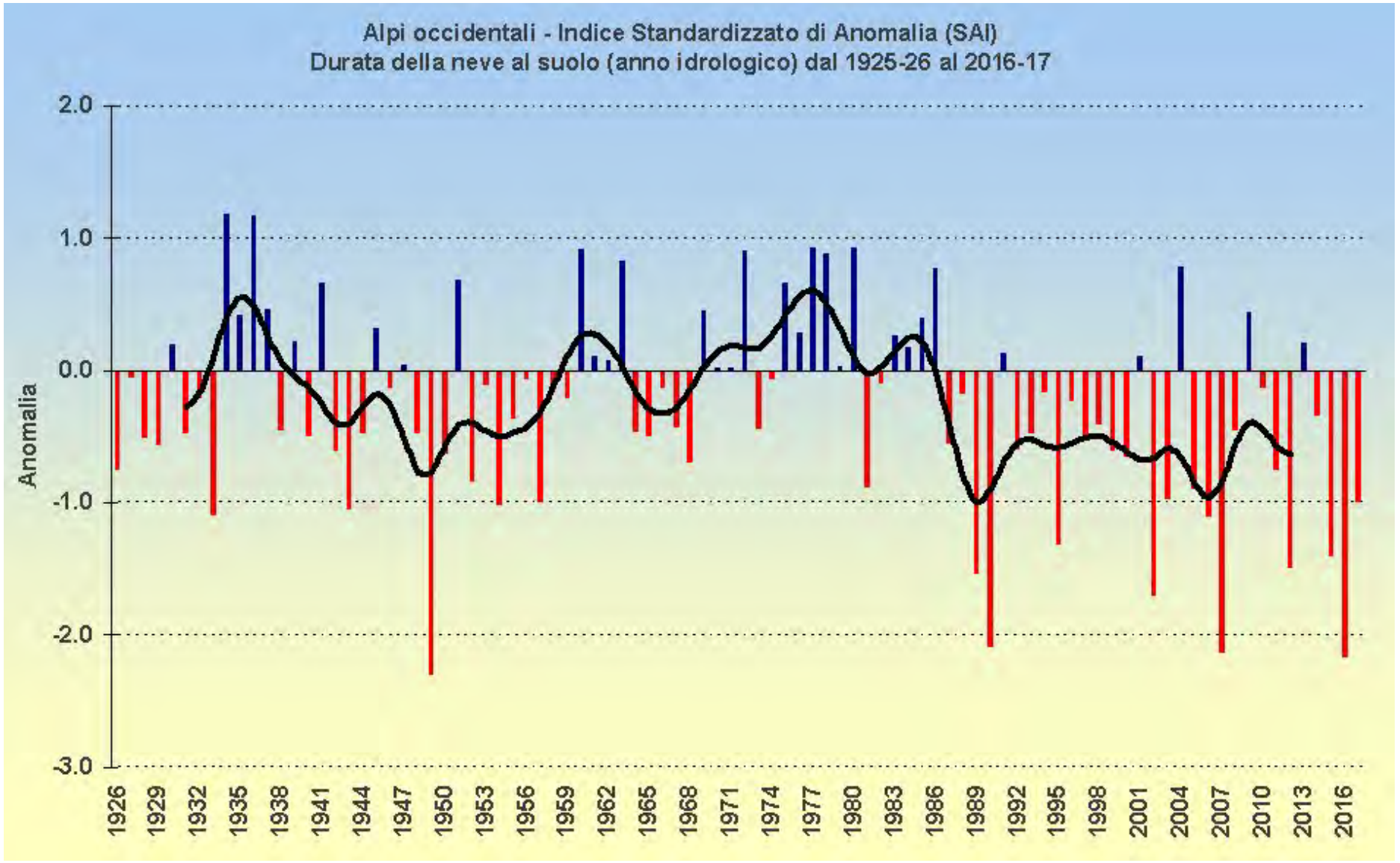
La neve, capitale idrologico delle Alpi

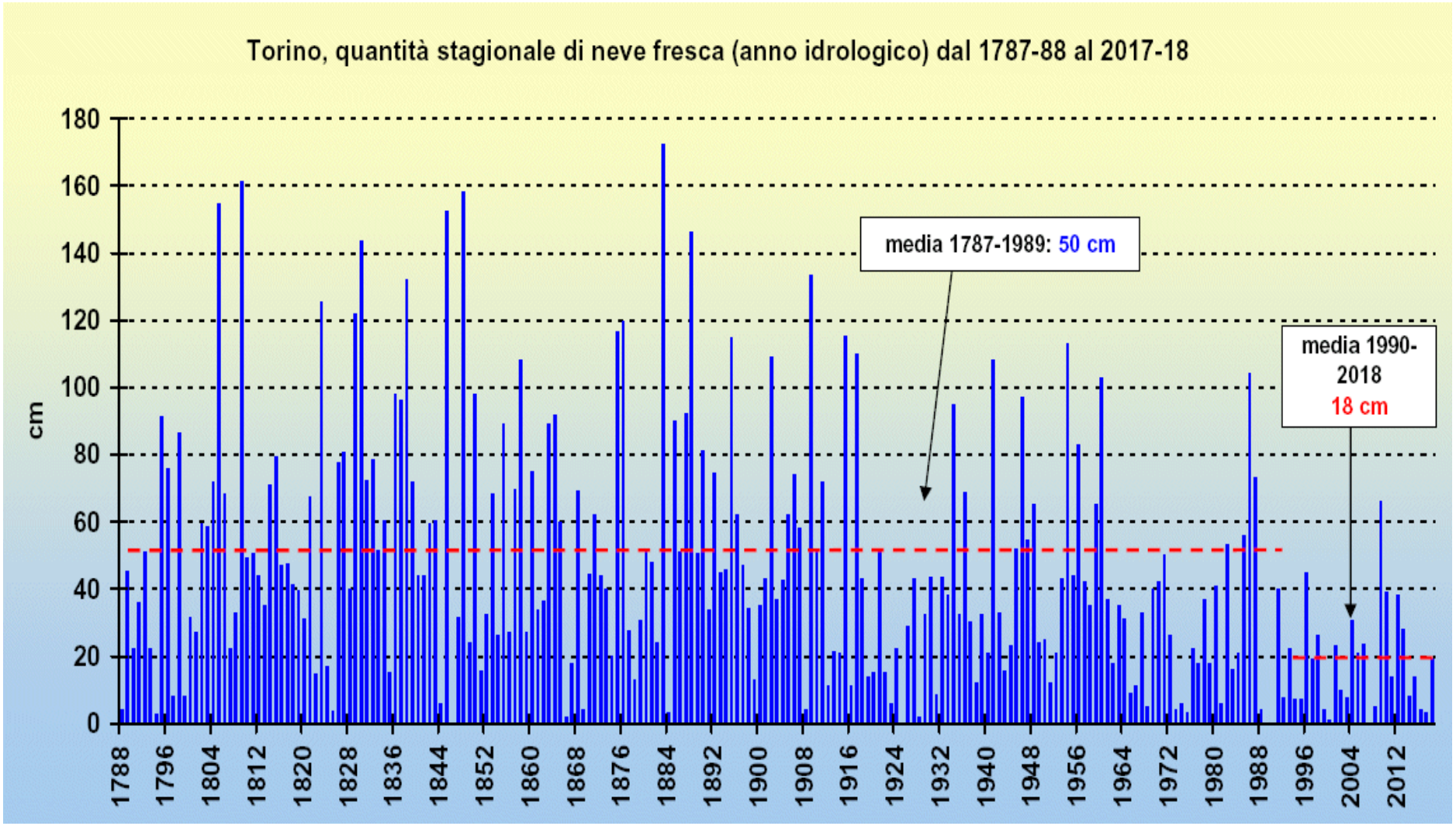
Alpe Devero
(Val d'Ossola)
Marzo 2014
(f. Studio Pessina)



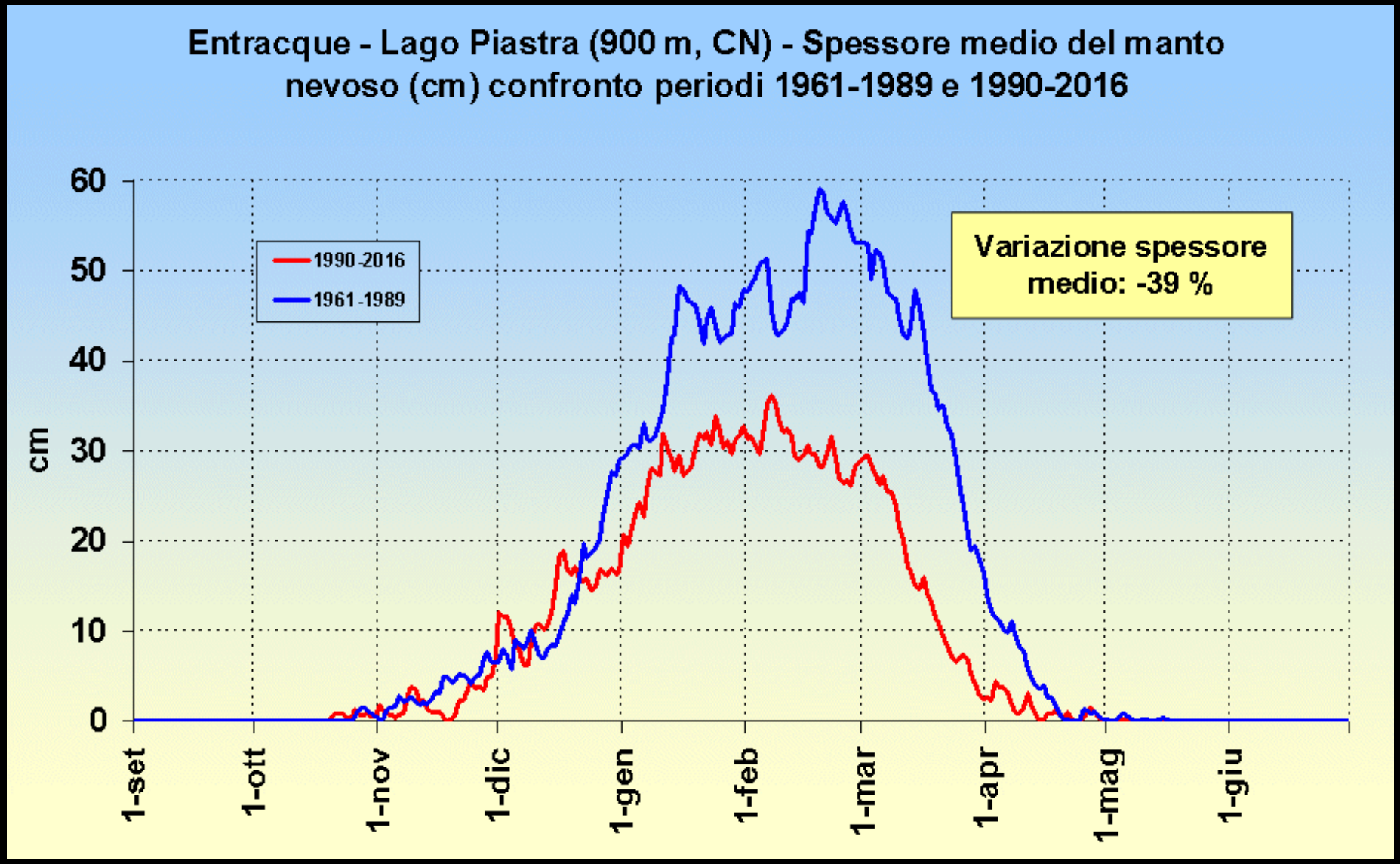
Ossola:
Medie annue:
50 cm a fondovalle,
oltre 6 m a quota 2000 m, >10-15 m oltre 2800 m

Sulle Alpi la neve al suolo dura meno

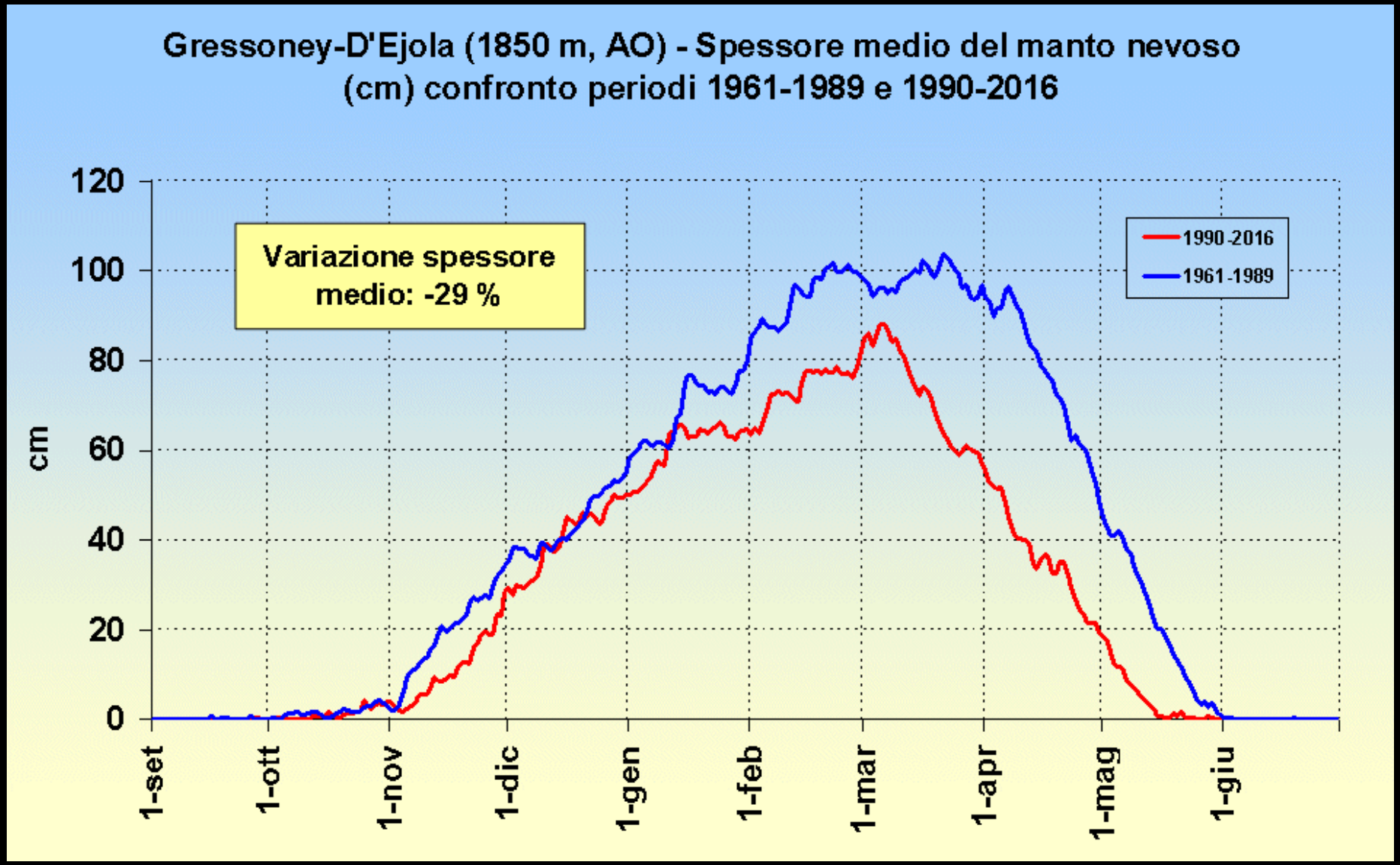




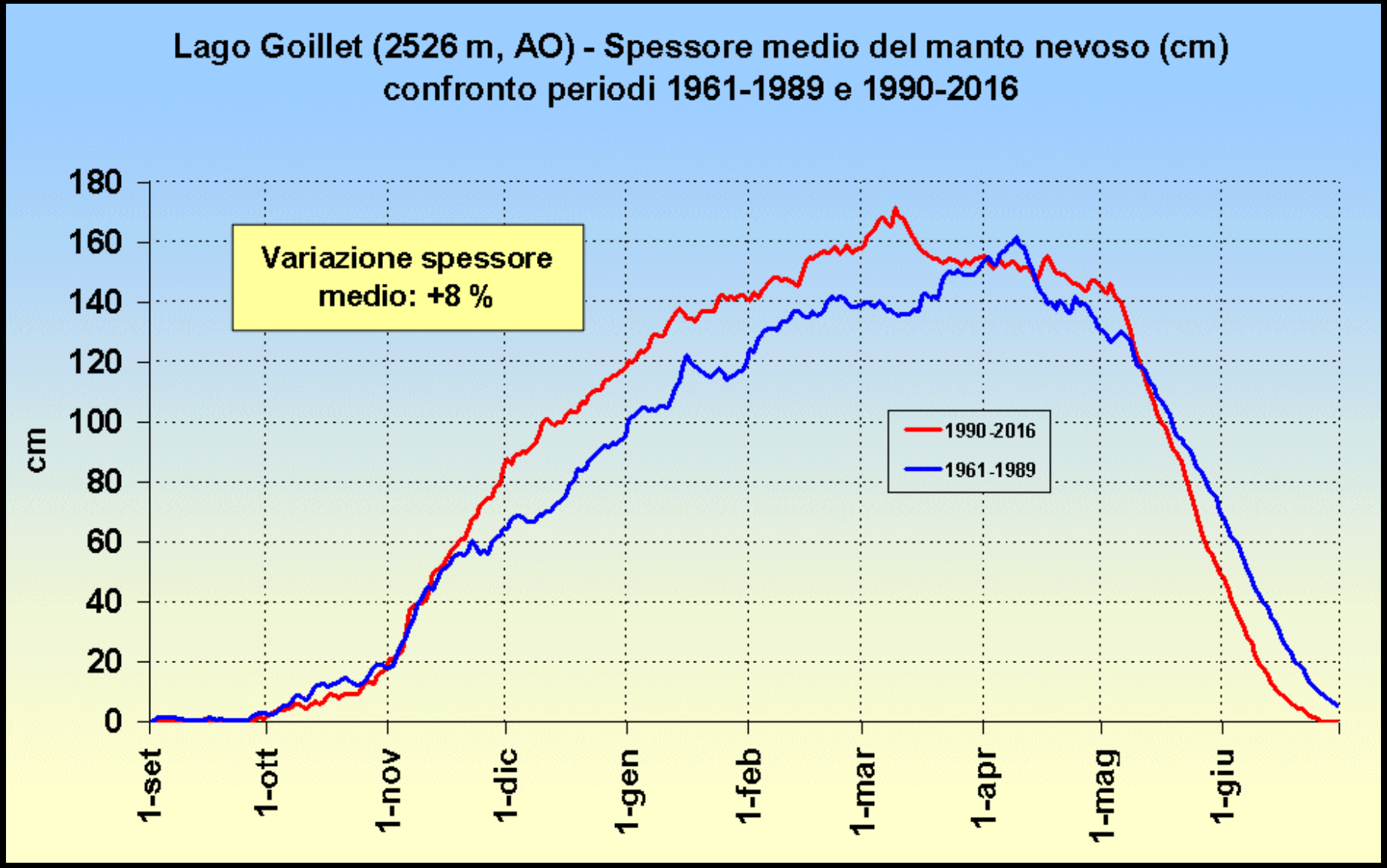
Quantità di neve fresca più che dimezzata
(-64% nel 1990-2018 vs. 1787-1989)



Riduzione recente dello spessore nevoso medio al suolo, molto evidente sotto i 1000 m

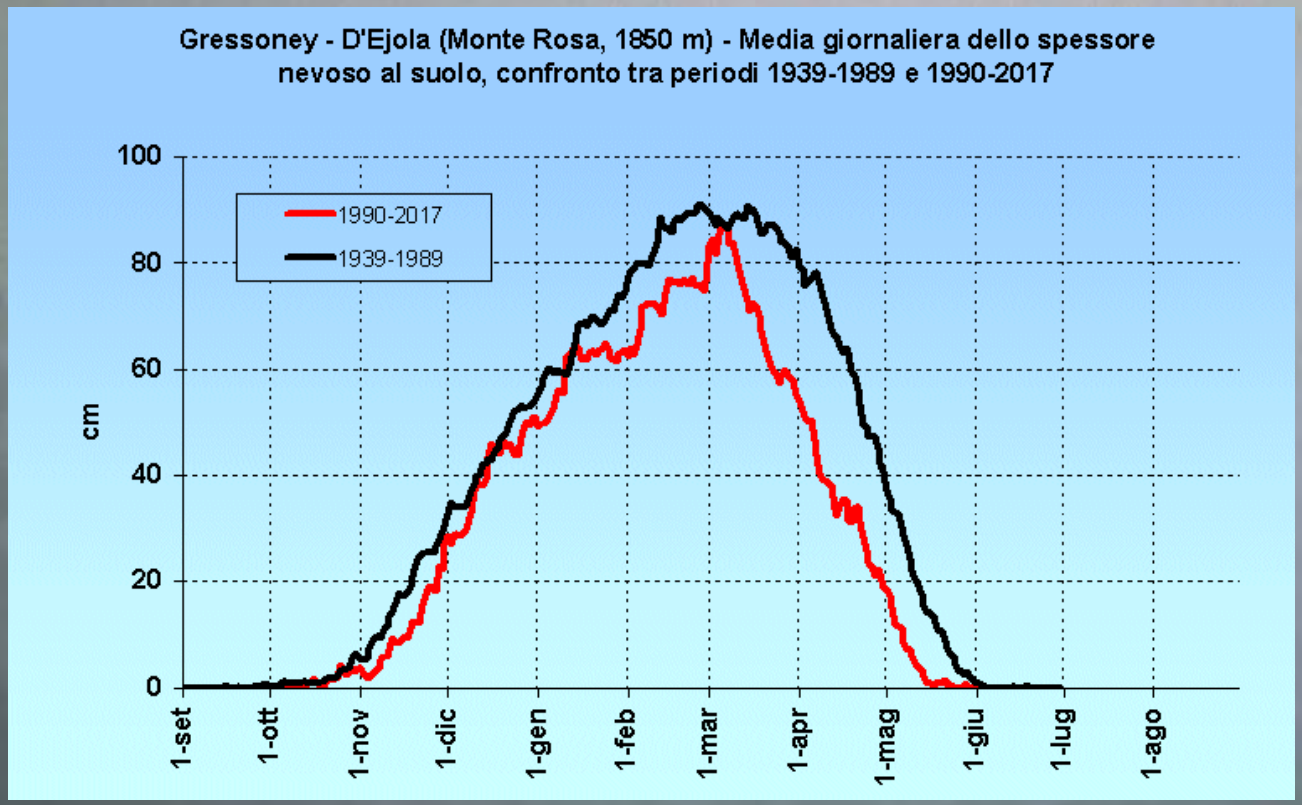


Influenza del riscaldamento più evidente in primavera (fusione più precoce di circa 15 giorni)

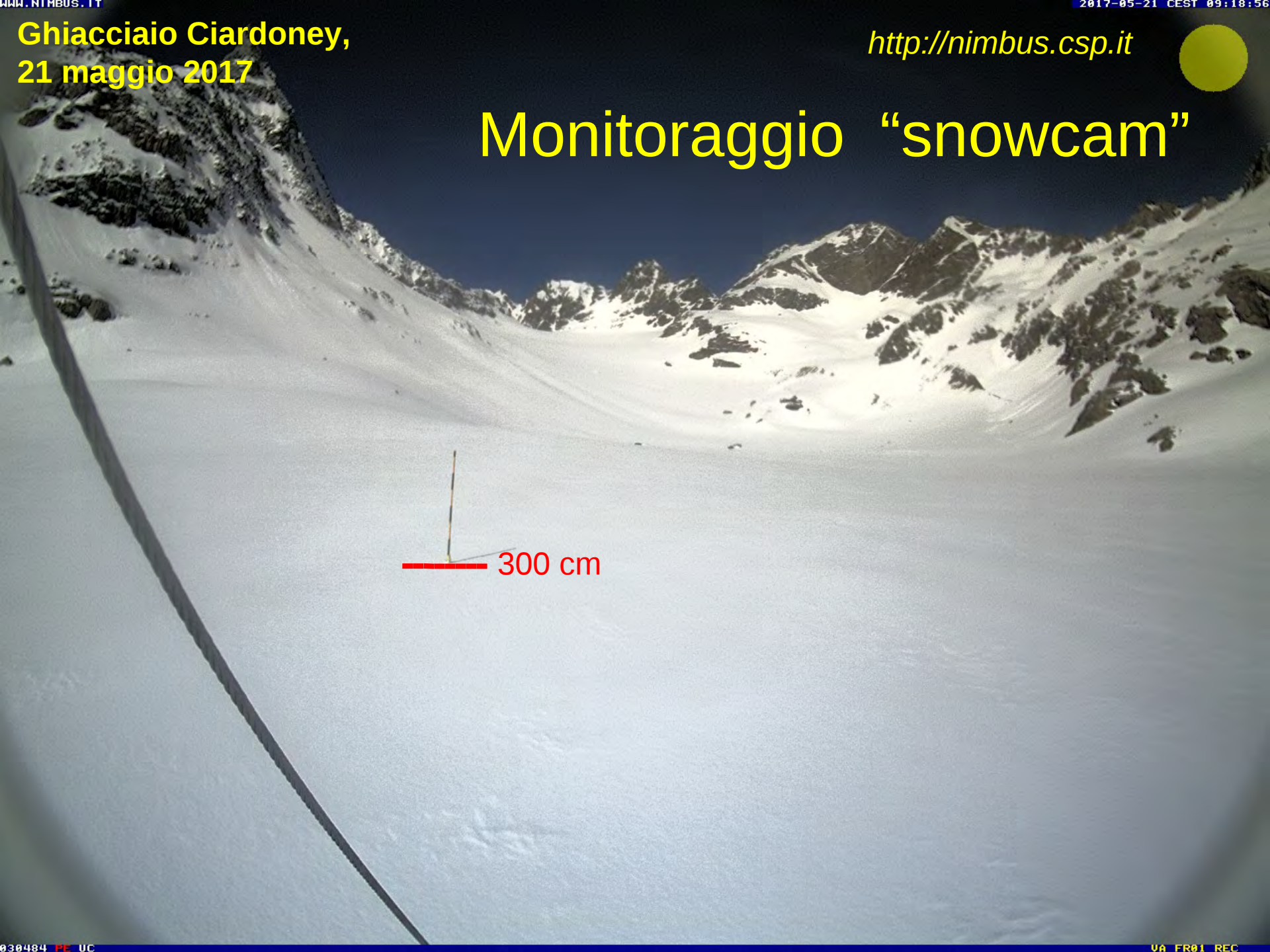


Perfino un lieve aumento ad alta quota,
ma resta la precoce fusione primaverile

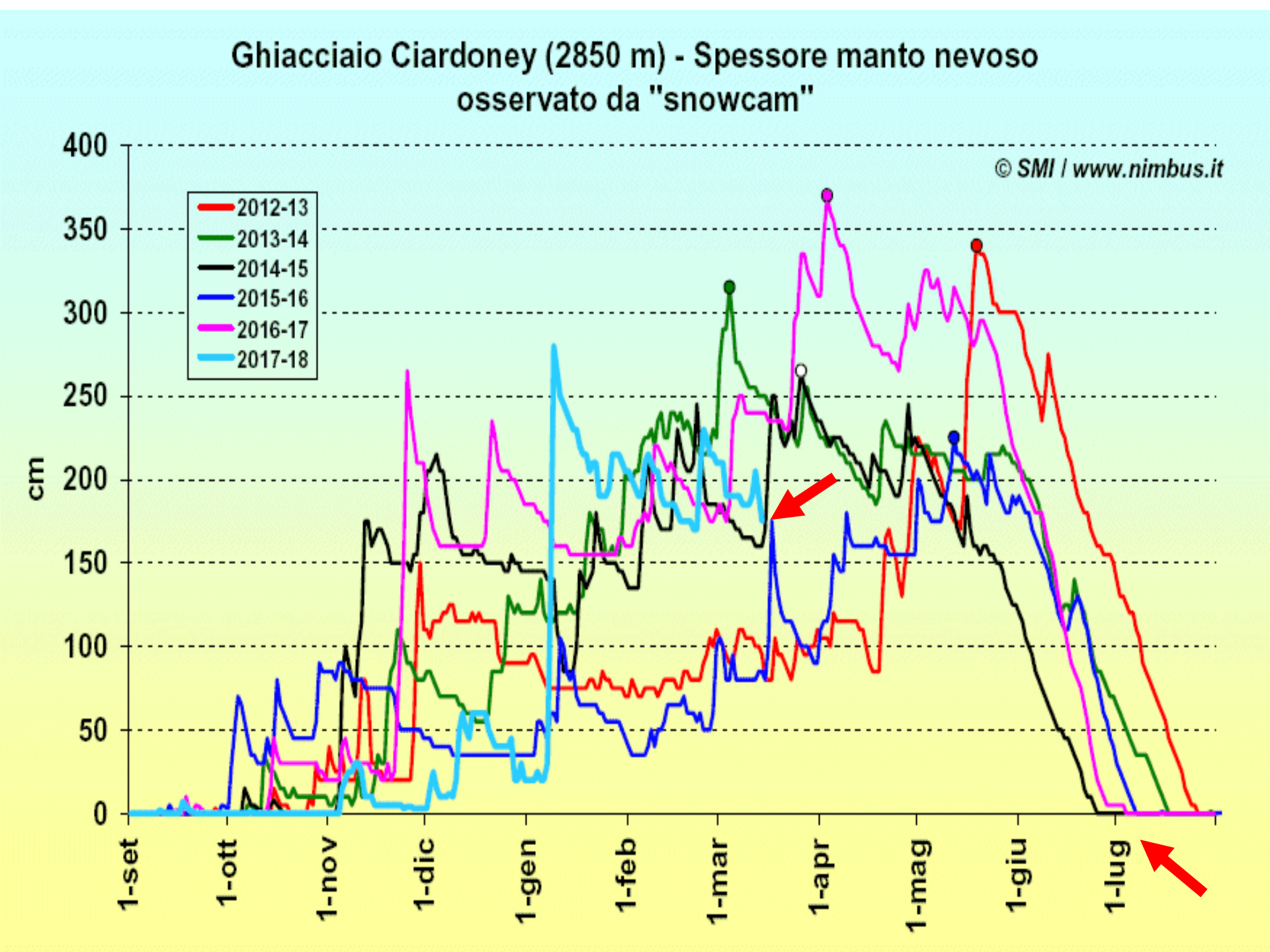
10.03.2018: 176 cm (media storica: 83 cm)



2017-18: inverno non freddo, ma umido e ricco di neve sulle Alpi oltre i 1500 m, però la nevosità nel lungo periodo è in calo


WWW.NIMBUS.IT
2017-05-21 CEST 09:18:56
Ghiacciaio Ciardoney,
21 maggio 2017
http://nimbus.csp.it
Monitoraggio “snowcam”
300 cm
030484 PE UC
VA FR01 REC


WWW.NIMBUS.IT
2017-07-11 CEST 07:10:25
Ghiacciaio Ciardoney,
11 luglio 2017
031229 PE UC
VA FR01 REC


Ghiacciaio Ciardoney (2850 m) - Spessore manto nevoso
osservato da "snowcam"
© SMI / www.nimbus.it
2012-13
2013-14
2014-15
2015-16
2016-17
2017-18
cm
400
350
300
250
200
150
100
50
0
1-set
1-ott
1-nov
1-dic
1-gen
1-feb
1-mar
1-apr
1-mag
1-giu
1-lug

In futuro, copertura nevosa sempre più “inaffidabile” sotto i 1500-2000 m

Bardonecchia
8 dicembre 2015
(f. L. Mercalli)

The Cryosphere Discuss., doi:10.5194/tc-2017-7, 2017
Manuscript under review for journal The Cryosphere
Discussion started: 27 February 2017

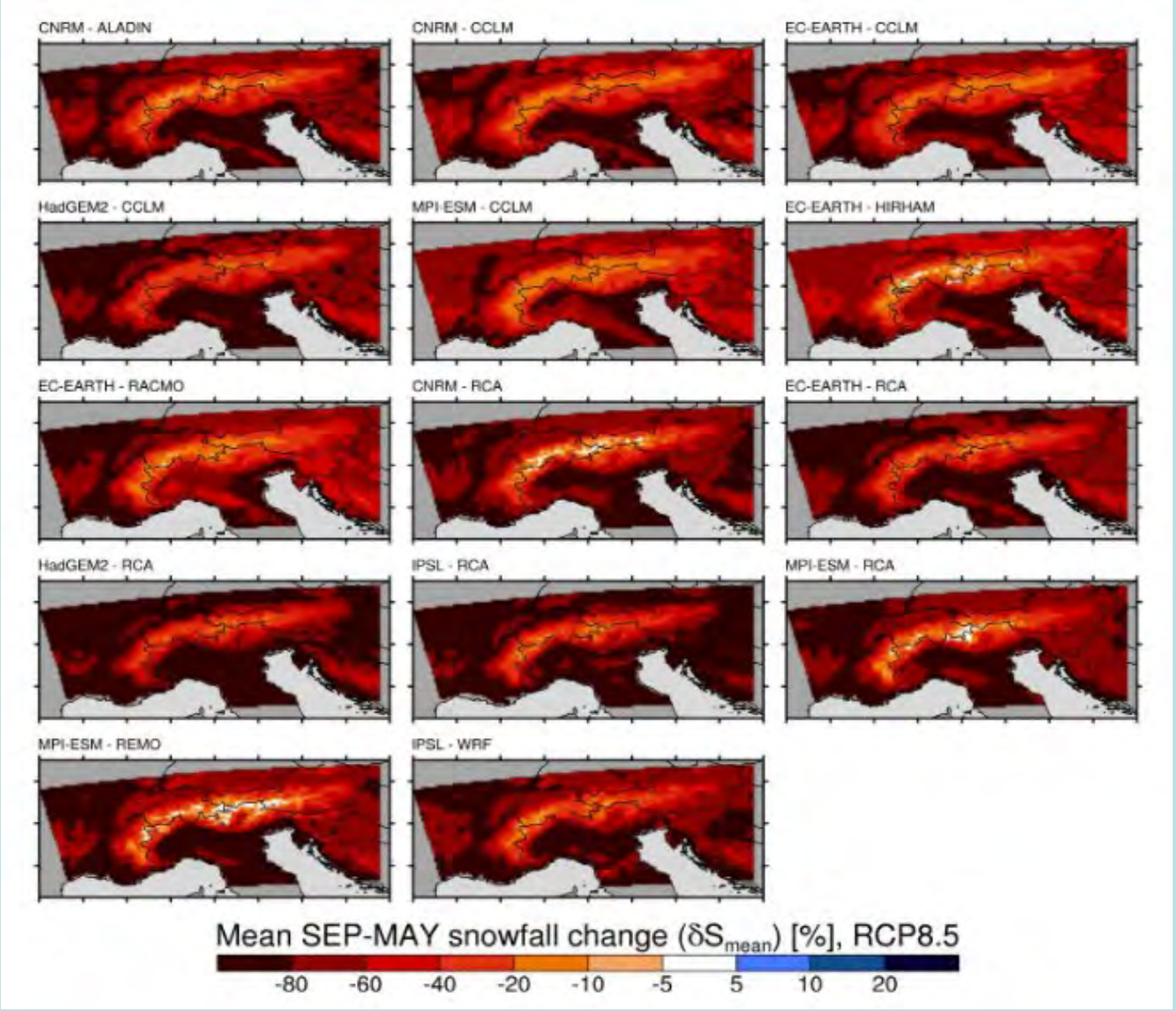
The Cryosphere Discussions
Open Access
EGU

Snowfall in the Alps: Evaluation and projections based on the EURO-CORDEX regional climate models

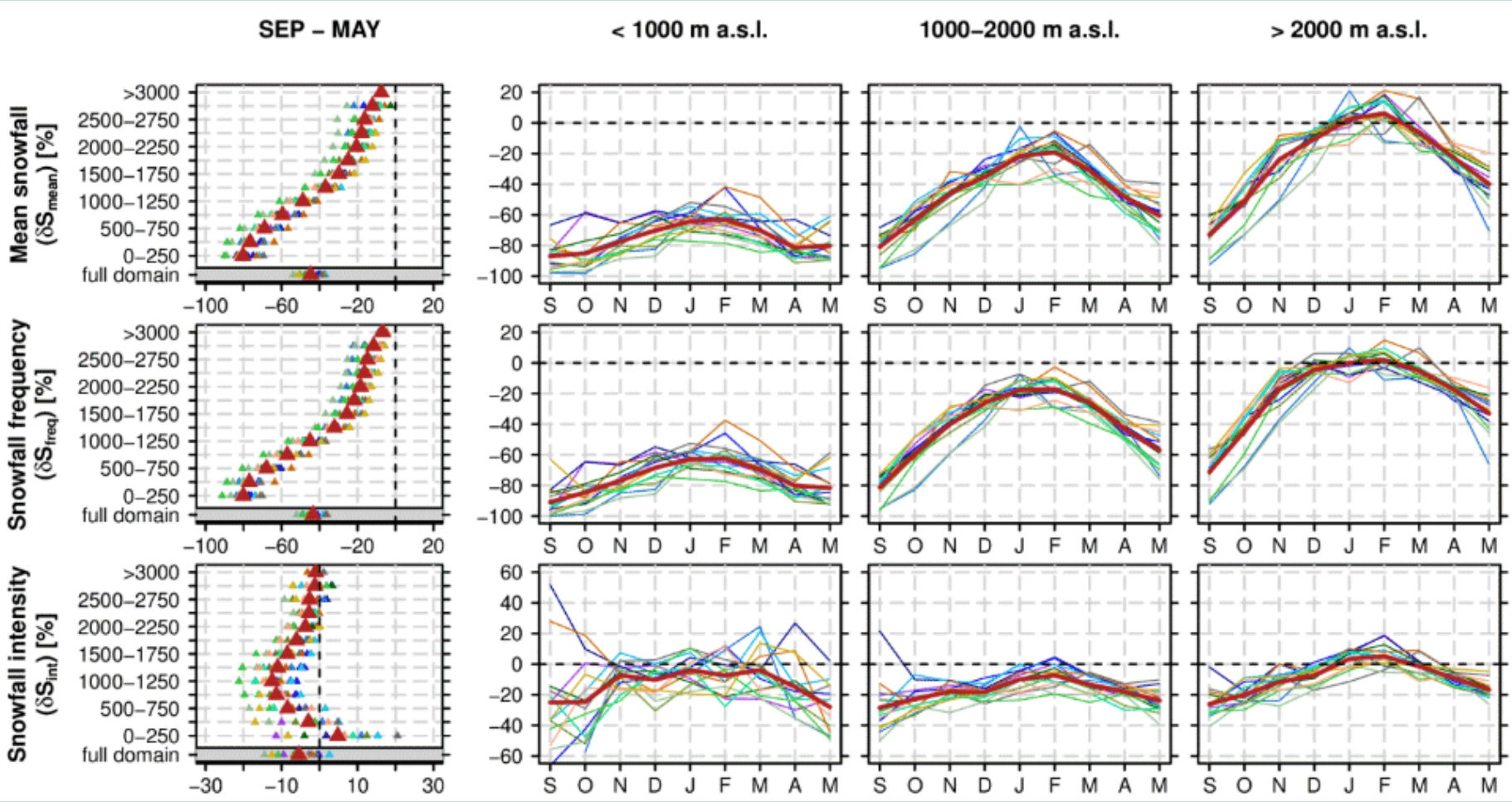
Prisco Frei[1], Sven Kotlarski[2,*], Mark A. Liniger[2], Christoph Schär[1]

[1] Institute for Atmospheric and Climate Sciences, ETH Zurich, 8006, Zurich, Switzerland
[2] Federal Office of Meteorology and Climatology, MeteoSwiss, 8058 Zurich-Airport, Switzerland

[*] Corresponding author: *sven.kotlarski@meteoswiss.ch*



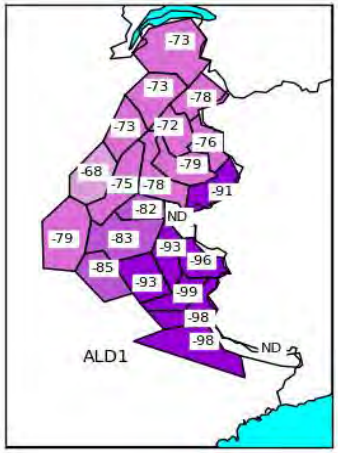
2100: senza tagli alle emissioni serra,
neve quasi scomparsa in Pianura Padana

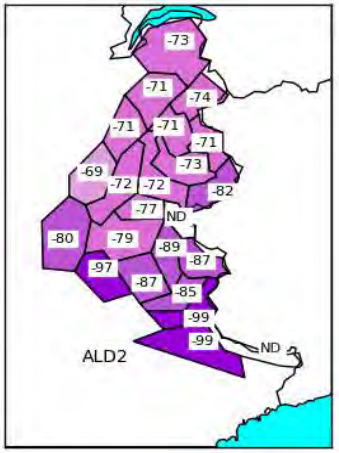


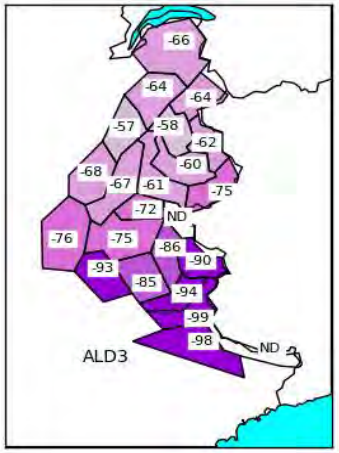
Effetti del futuro riscaldamento sulle nevicate: più vistosi a media-bassa quota

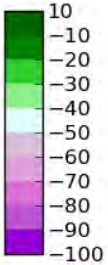
e in primavera-autunno

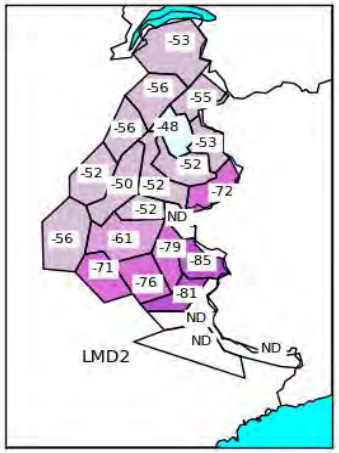
Alpes Francaises - Hauteur minimale de neige sur 100 jours (% 2030 vs 1970), alt. 1200 m

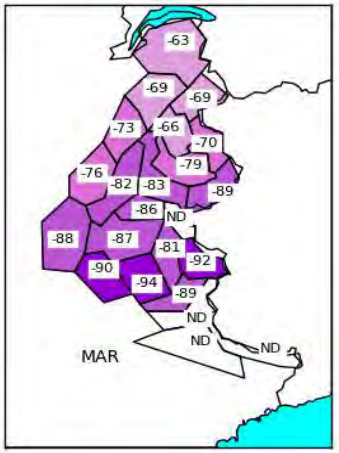






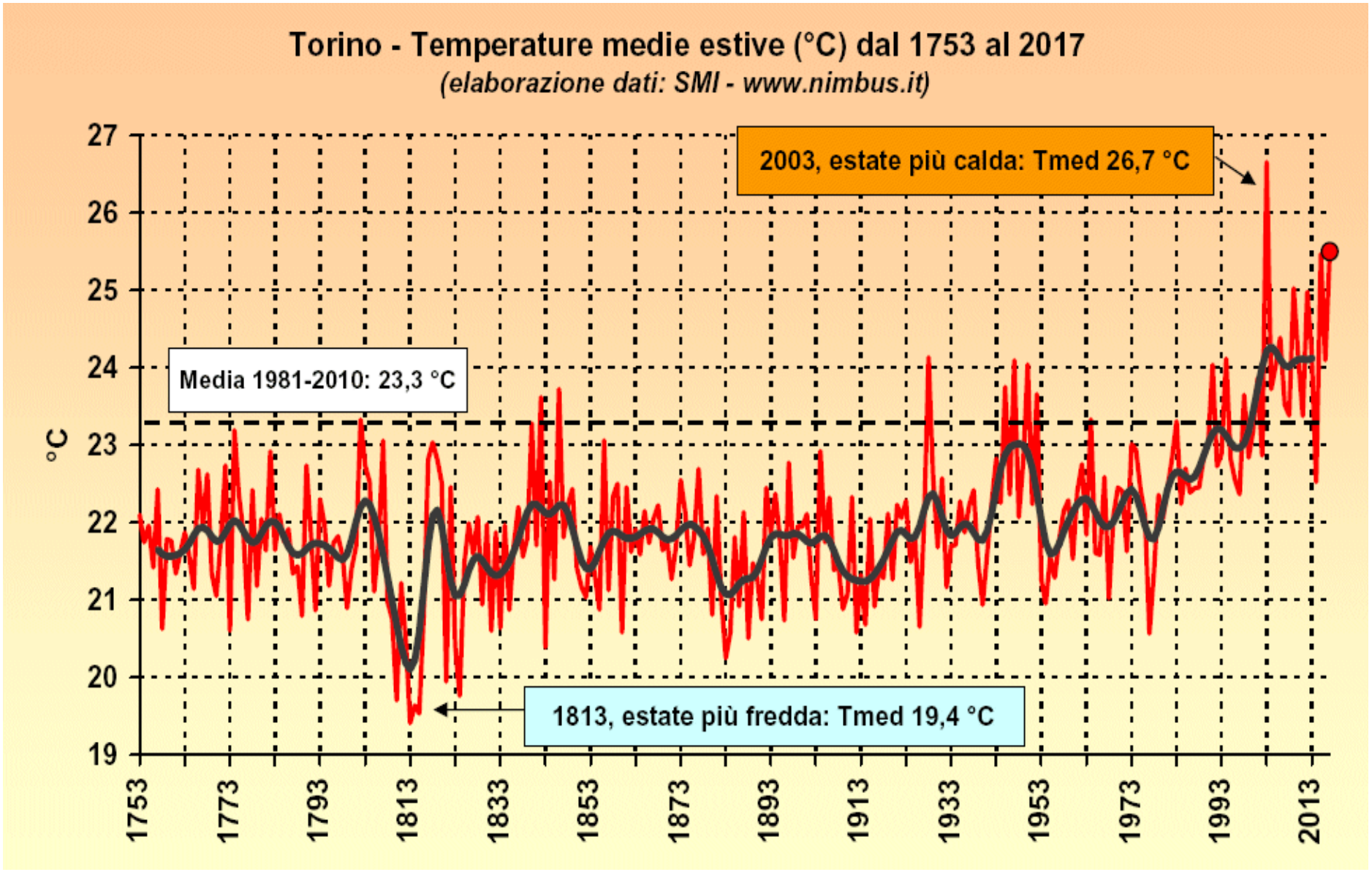




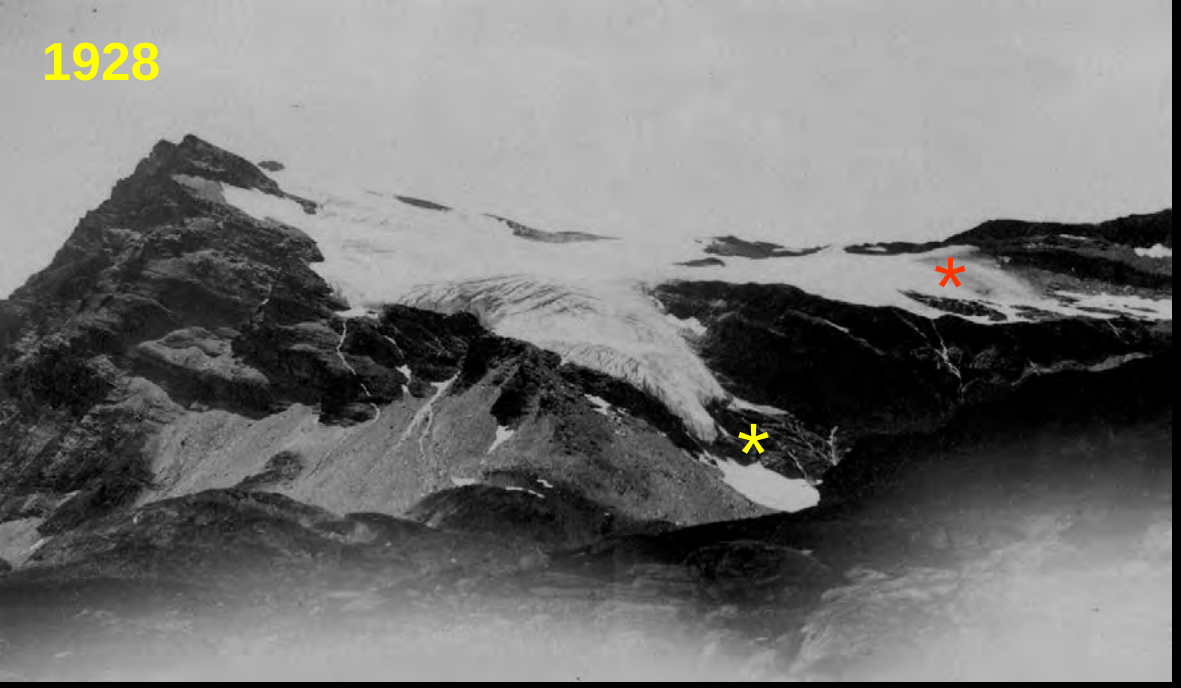


Scénarios Climatiques Adaptés aux zones de Montagne : Phénomènes extrêmes, Enneigement et Incertitudes

www.umr-cnrm.fr/scampei/



Calura estiva inedita nel 2003, 2015 e 2017



Meno neve, più caldo = meno ghiacciai! In un secolo superficie ghiacciai alpini dimezzata.

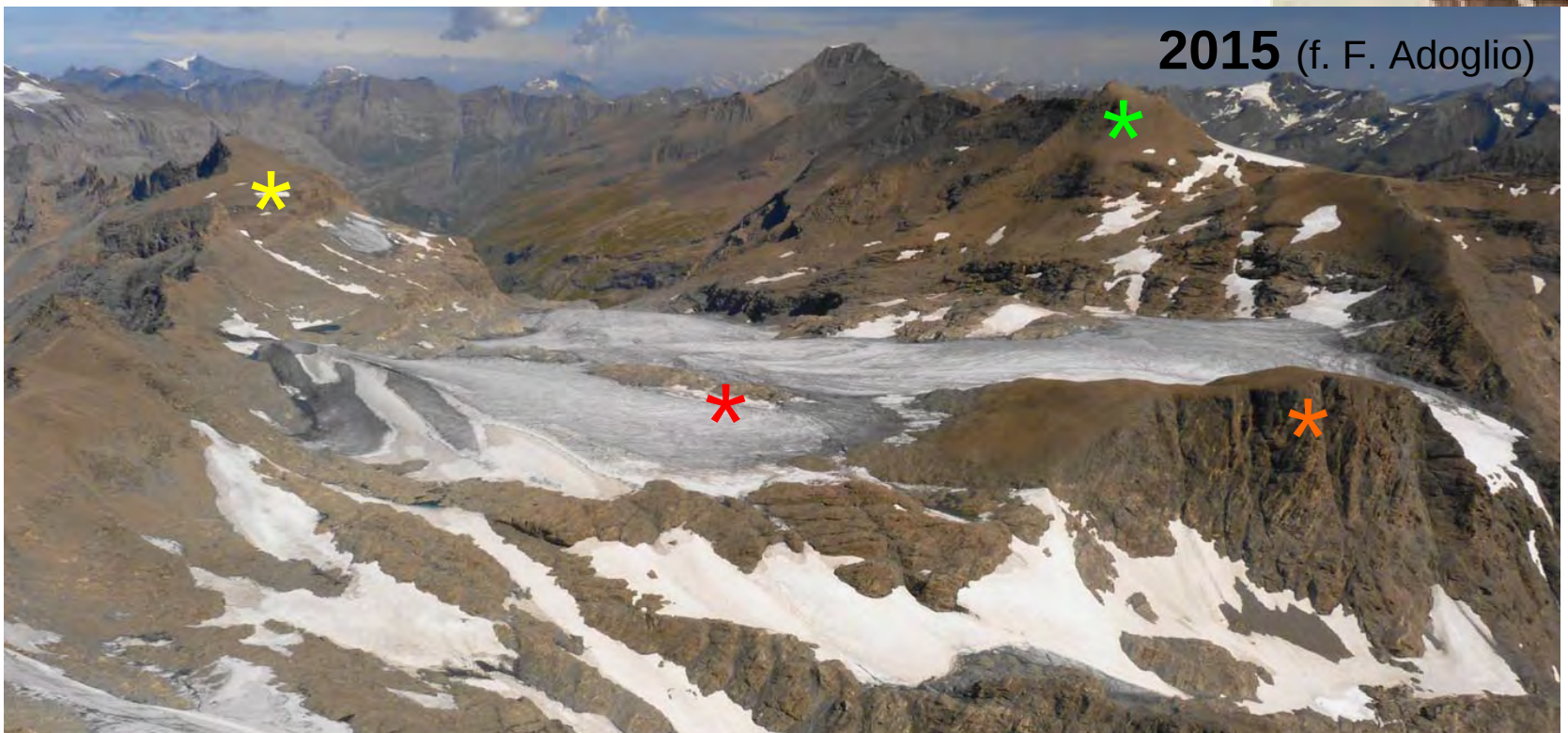
Ghiacciaio Basei (Colle del Nivolet)

Ghiacciaio Galambra nel 1930 circa e nel 2007 (f. M. Tron)

Pressoché estinto

1894
(f. Gabinio)

Ghiacciaio del Rocciamelone (Val di Susa/Maurienne)



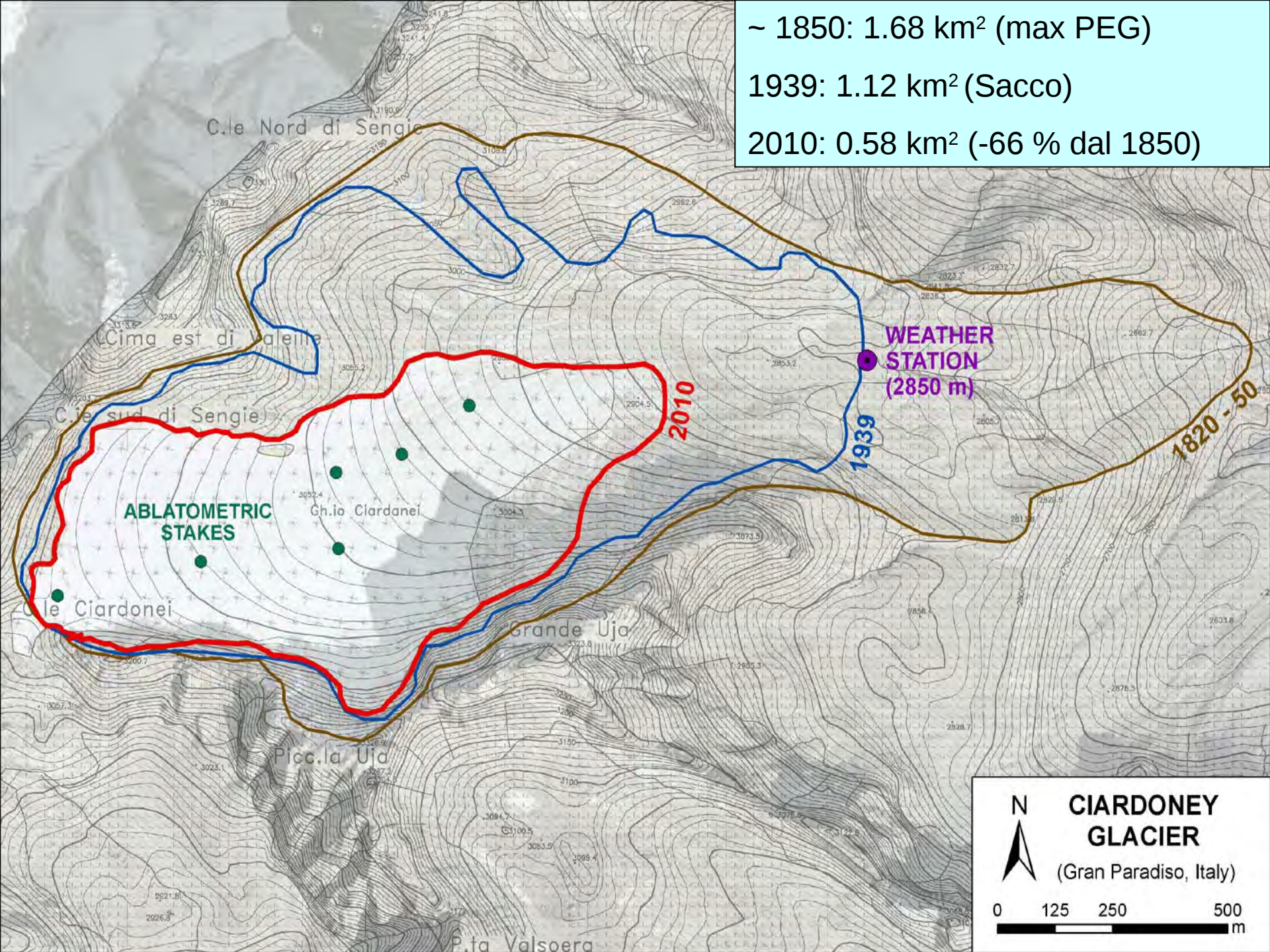
1897
(f. Druetti)

2005
(f. L. Mercalli)

2015
(f. S. Jobard)

Ghiacciaio Pré de Bar (Monte Bianco):

ritiro della fronte di oltre 800 m dal 1897 al 2015


~ 1850: 1.68 km² (max PEG)
1939: 1.12 km² (Sacco)
2010: 0.58 km² (-66 % dal 1850)
C.le Nord di Sengie
Cima est di Taleille
C.le sud di Sengie
C.le Ciardonei
ABLATOMETRIC STAKES
Gh.io Ciardanei
Grande Uja
Picc.la Uja
P.ta Valsoera
WEATHER STATION (2850 m)
2010
1939
1820 - 50
N
CIARDONEY GLACIER
(Gran Paradiso, Italy)
0
125
250
500
m

Ghiacciaio Ciardoney 1986, ultima stagione di avanzata glaciale

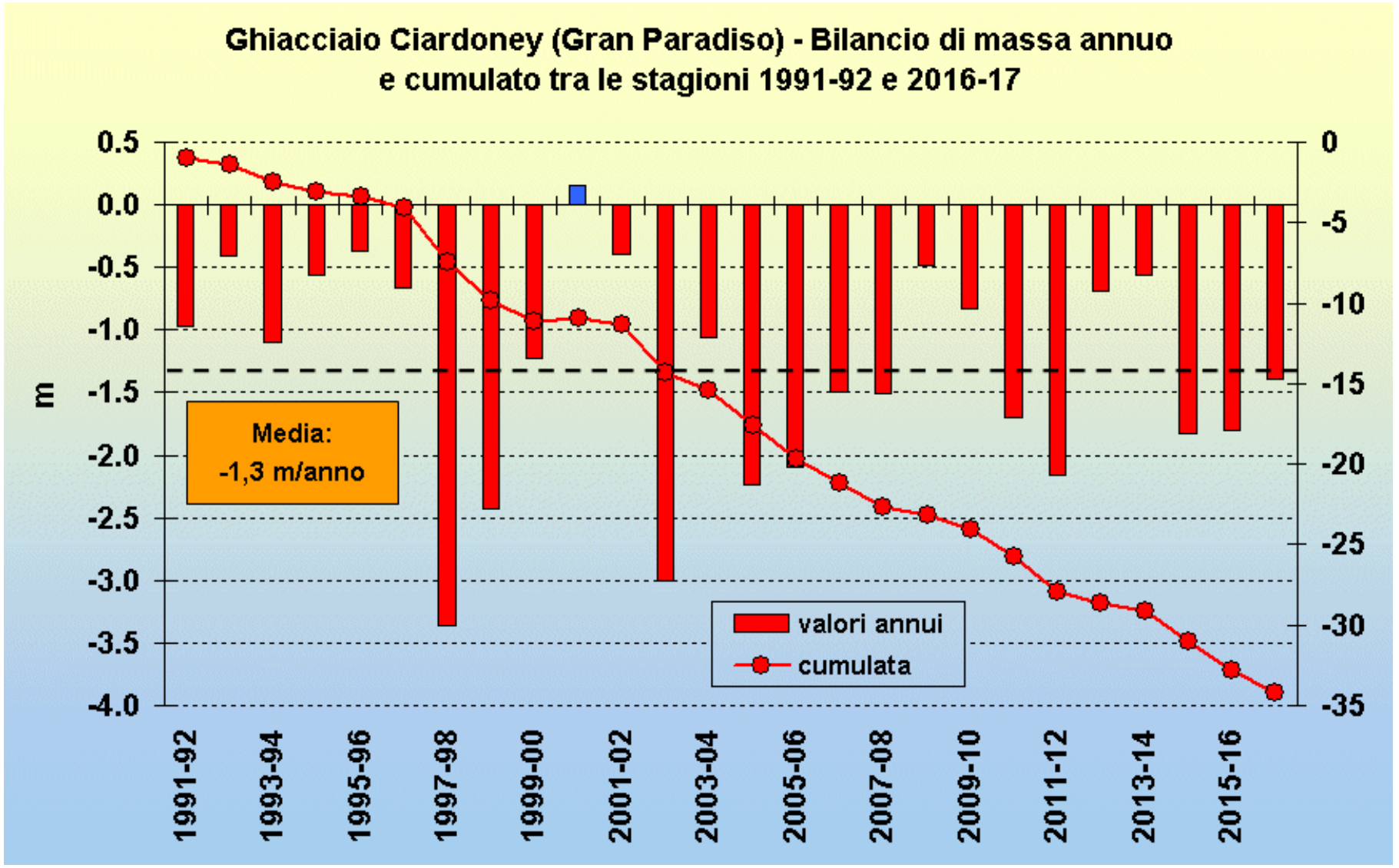
2014: ghiacciaio in continuo ritiro

Si pesano i campioni di neve

Rete di 6 paline ablatometriche per determinare le perdite annue di spessore glaciale.

15 settembre 2015

Sempre più caldo, sempre meno ghiaccio!
Tratto di palina ablatometrica fuoriuscita dal ghiaccio
in appena 3 estati, dal settembre 2012 (720 cm!)



Bilancio stagione idrologica 2016-17: -1,4 m acqua eq.

Sopravvivenza prevista: 20-30 anni.

The Cryosphere, 6, 713–727, 2012
www.the-cryosphere.net/6/713/2012/
doi:10.5194/tc-6-713-2012

The Cryosphere

Extrapolating glacier mass balance to the mountain-range scale: the European Alps 1900–2100

M. Huss[1,*]

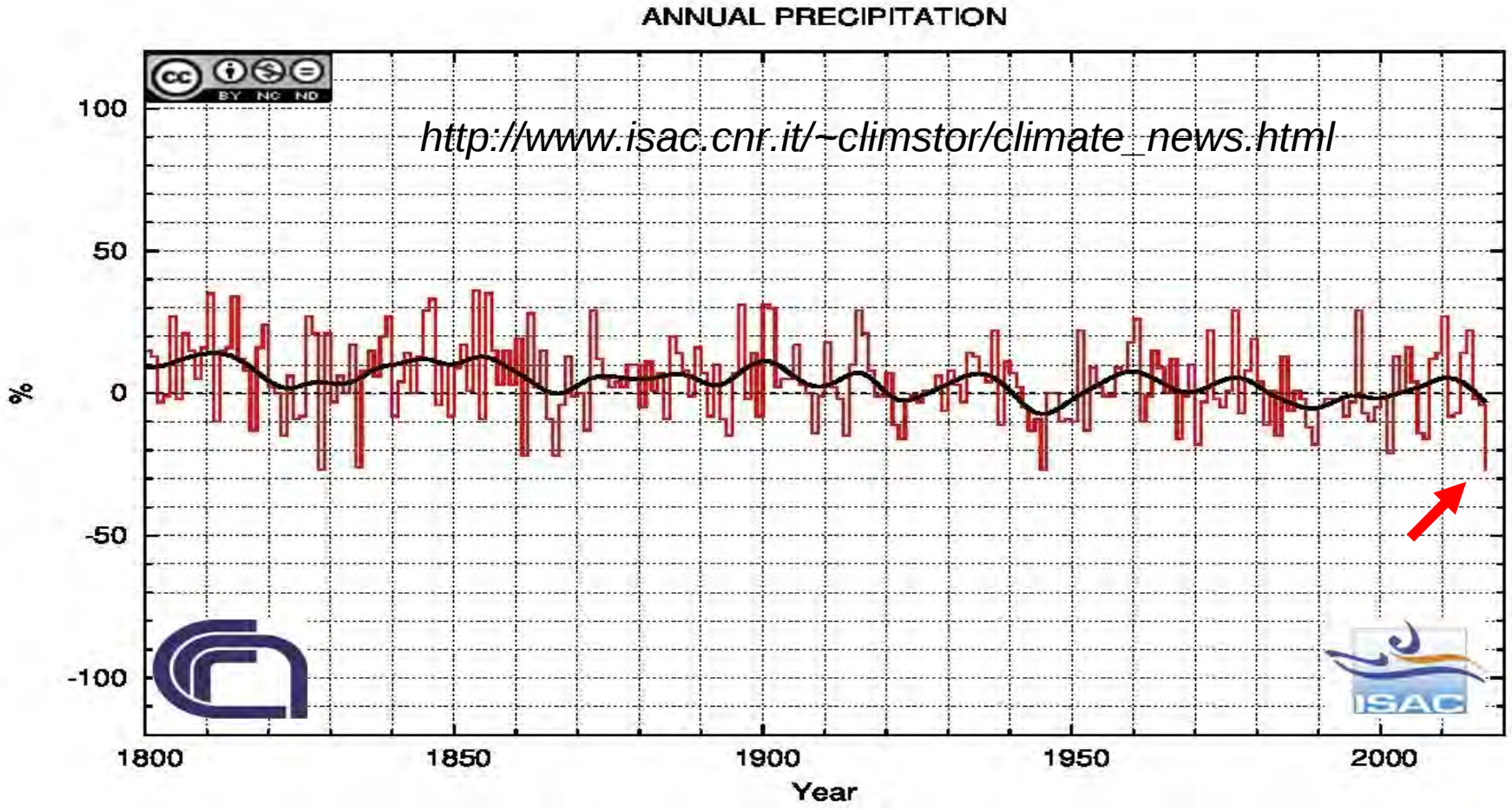
[1]Department of Geosciences, University of Fribourg, 1700 Fribourg, Switzerland

[*]*Invited contribution by M. Huss, recipient of the EGU Young Scientist Outstanding Poster Paper (YSOPP) Award 2010.*

Correspondence to: M. Huss (matthias.huss@unifr.ch)

vary between $-5.9\,km^3$ (1947) and $+3.9\,km^3$ (1977). Mean mass balances are expected to be around $-1.3\,m\,w.e.\,a^{-1}$ by 2050. Model results indicate a glacier area reduction of 4–18 % relative to 2003 for the end of the 21st century.

Italia: precipitazioni totali in lieve calo, ma più concentrate



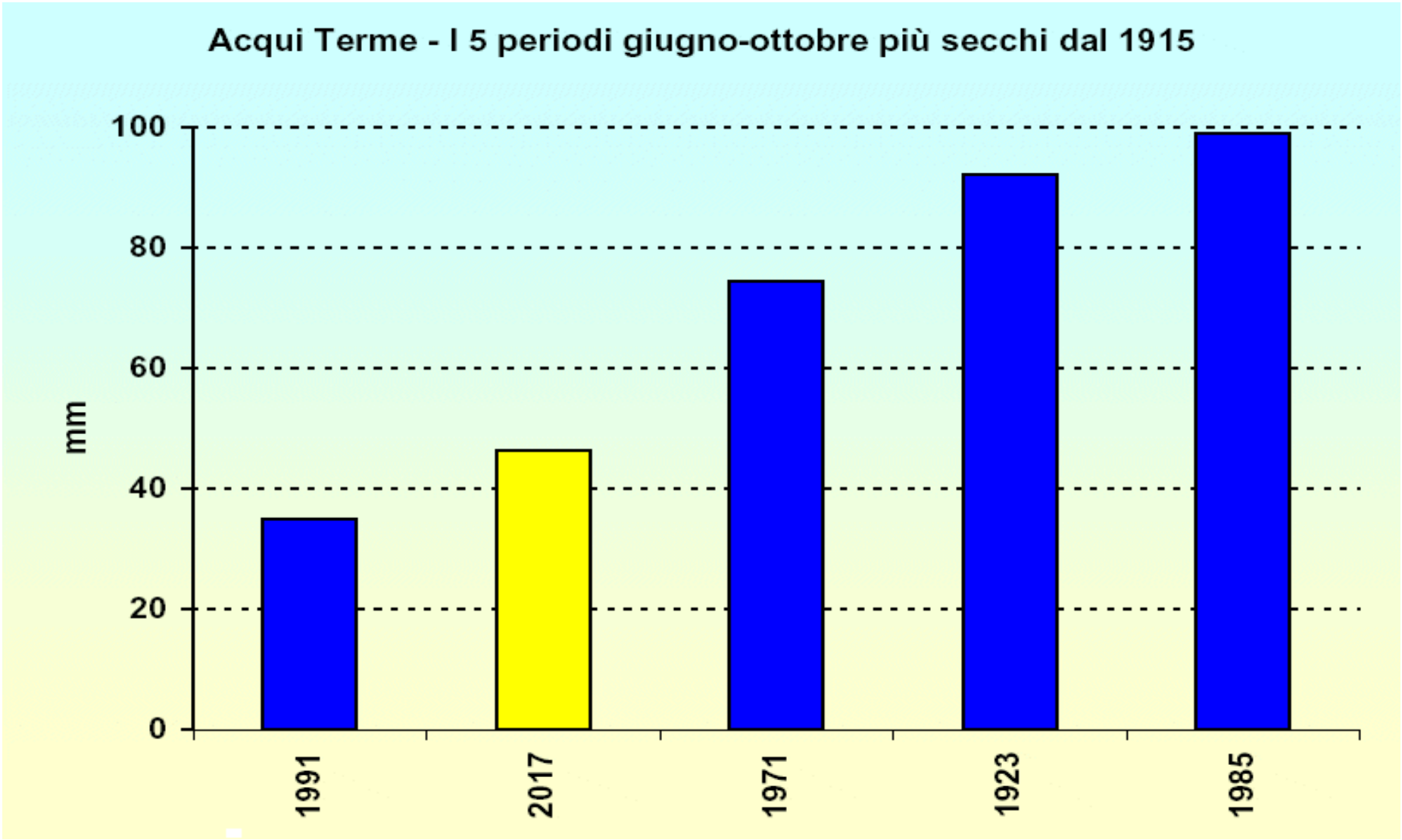
Precipitazioni annue in Italia (1800-2017): tendenze per ora poco evidenti, solo lieve calo rispetto all'Ottocento

Siccità e caldo estremo dell’estate 2003

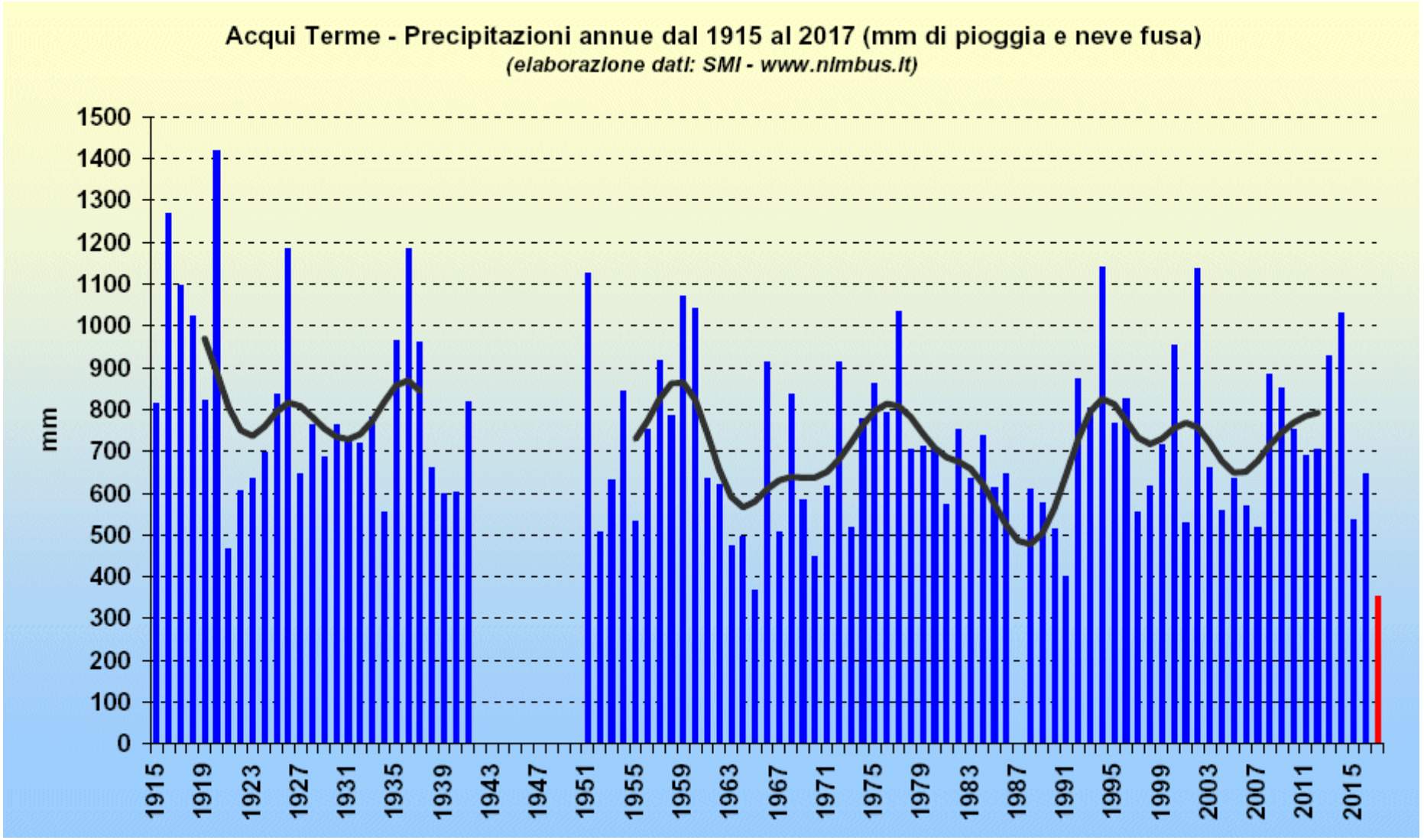
Siccità estrema 2017
in Piemonte
(-40% precipitazioni).

Colpa dei cambiamenti
climatici? In parte sì.

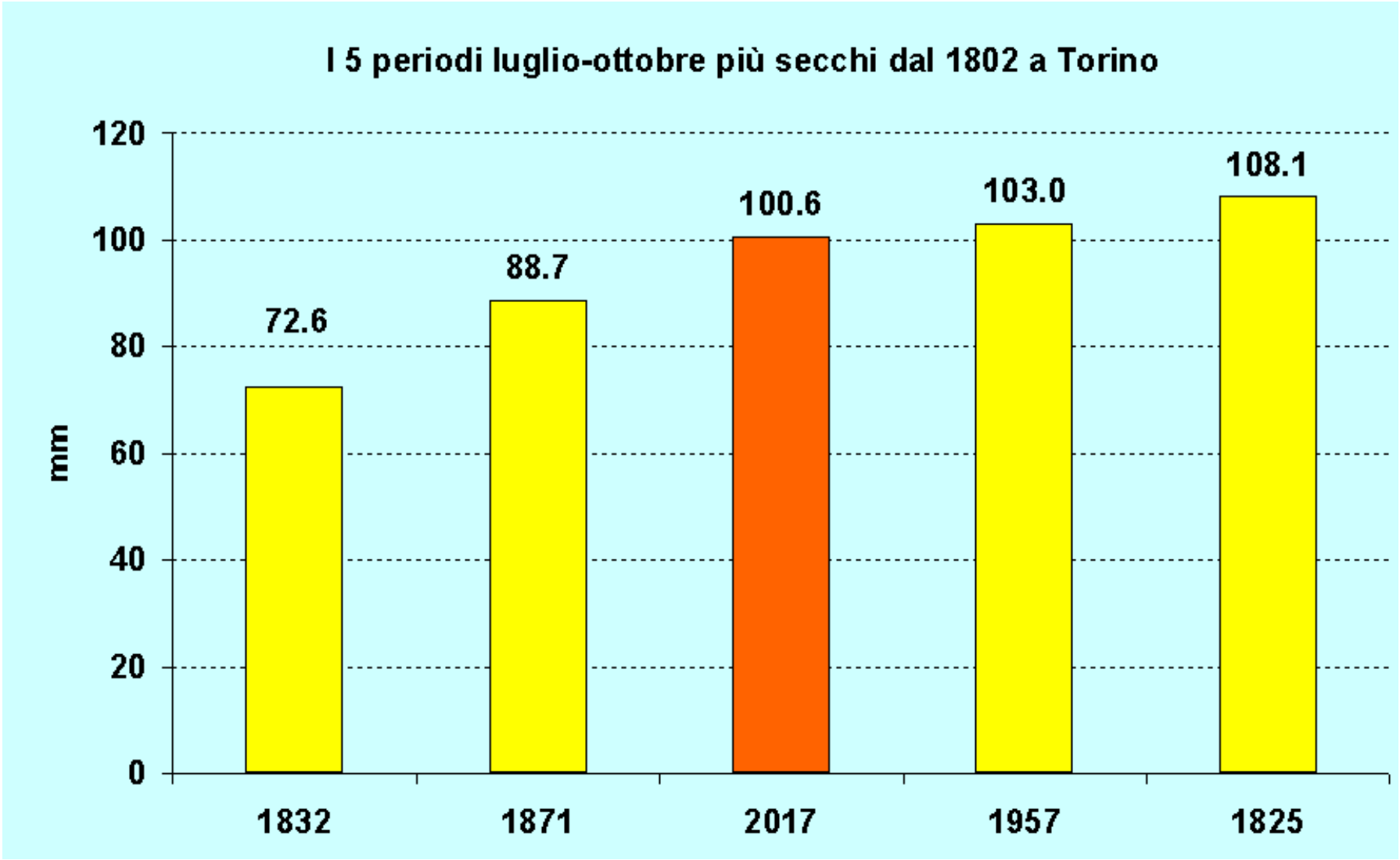
Effetti aggravati
dal caldo anomalo.



Straordinaria siccità estiva-autunnale nel Piemonte meridionale: peggio di così ad Acqui solo nel 1991. 46 mm (ARPA Piemonte), 16% del normale.

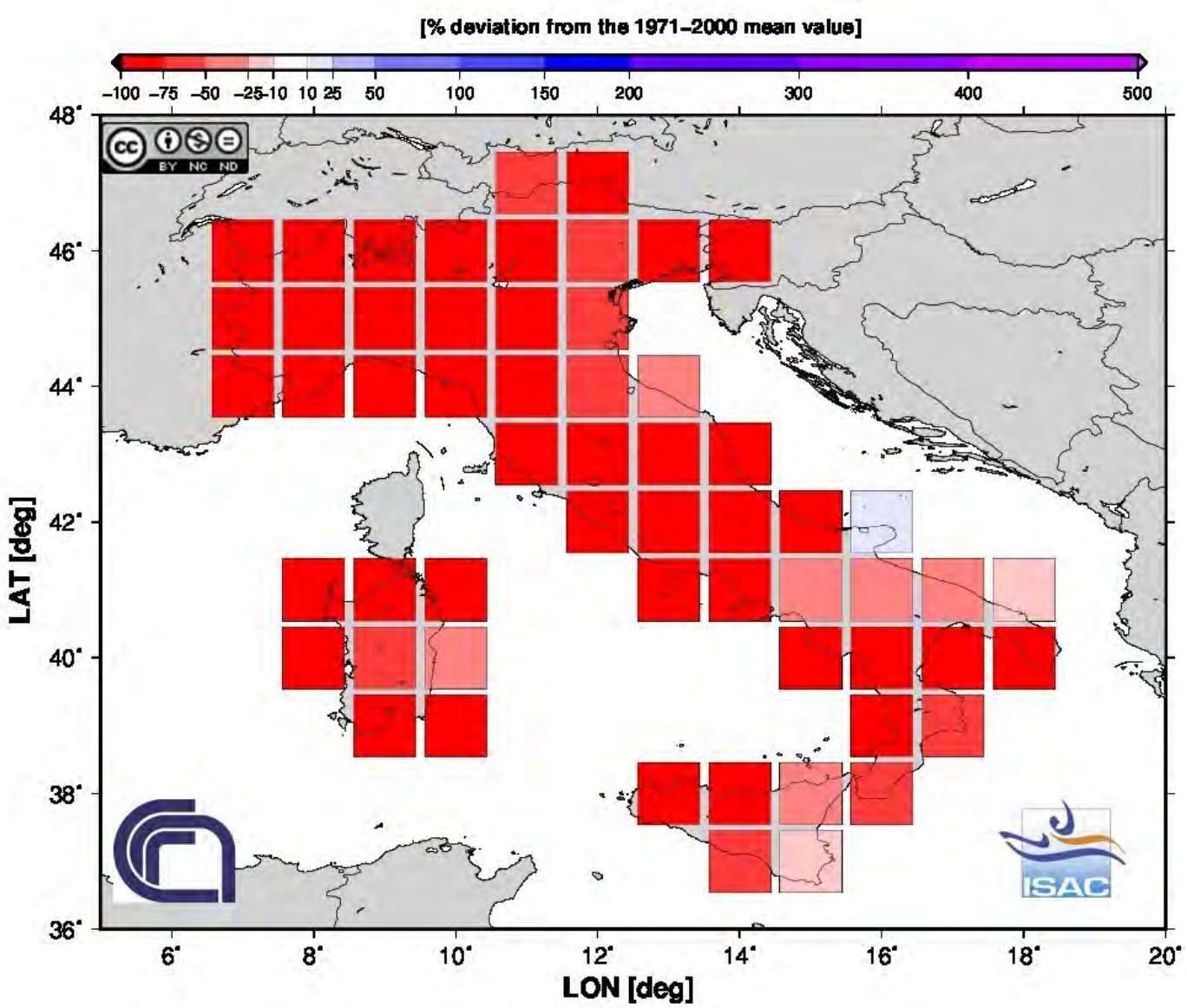


2017: anno più secco (353 mm, metà del normale)
Simile solo al 1965 (369 mm)



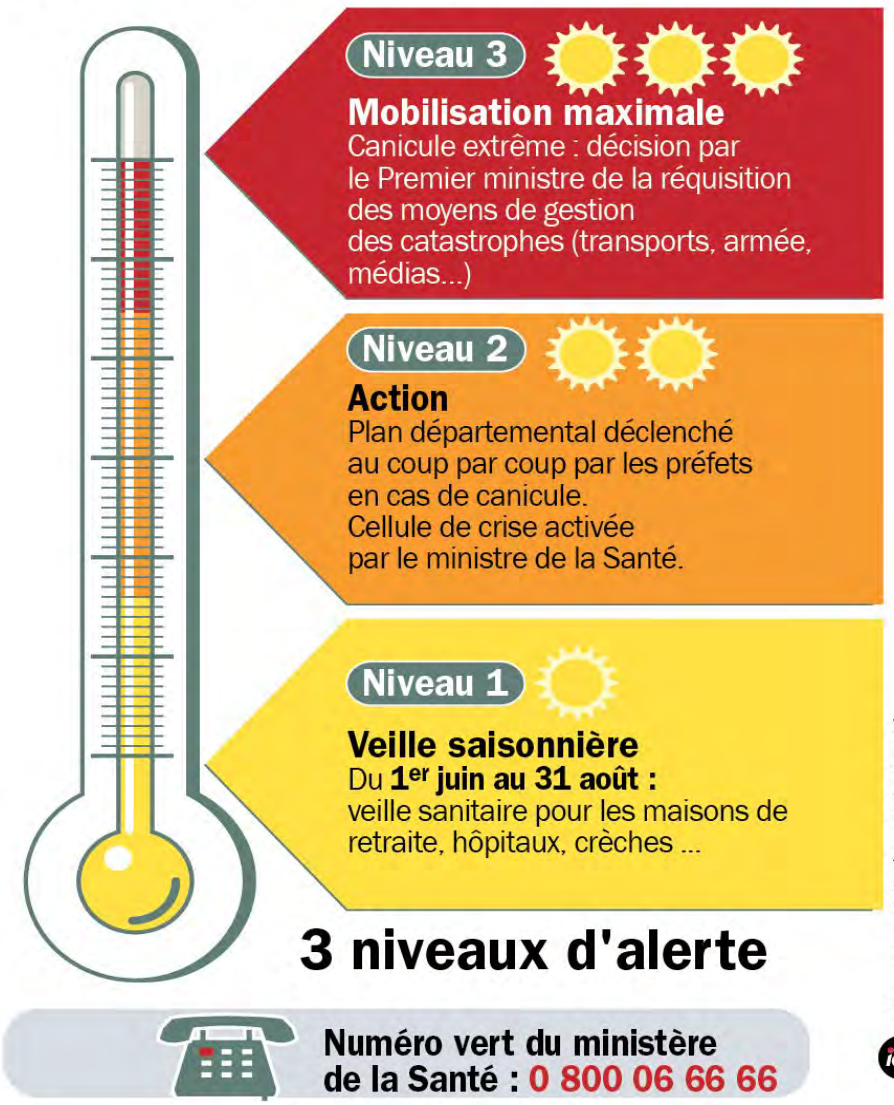
Molto secco anche a Torino:
101 mm luglio-ottobre, solo un terzo del normale

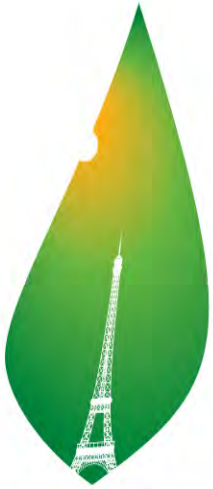
Oltre 7000 ettari bruciati sulle Alpi piemontesi



Secondo ottobre più secco dal 1800 in Italia (deficit 79%) dopo quello del 1995

Maggior consumo di acqua durante ondate di caldo estivo





PARIS2015
UN CLIMATE CHANGE CONFERENCE
COP21·CMP11

30 NOVEMBRE - 11 DÉCEMBRE 2015

21E CONFÉRENCE DES NATIONS UNIES SUR LE CHANGEMENT CLIMATIQUE

TOUS ENSEMBLE POUR LE CLIMAT

30 NOVEMBER - 11 DECEMBER 2015

21ST UNITED NATIONS CLIMATE CHANGE CONFERENCE

UNITED FOR CLIMATE ACTION

cop21.gouv.fr

www.ipcc.ch
UNFCCC 1992
Kyoto 1997-2005
Accordo Parigi 2015

Modeling Earth's future

Integrated assessments of linked human-natural systems

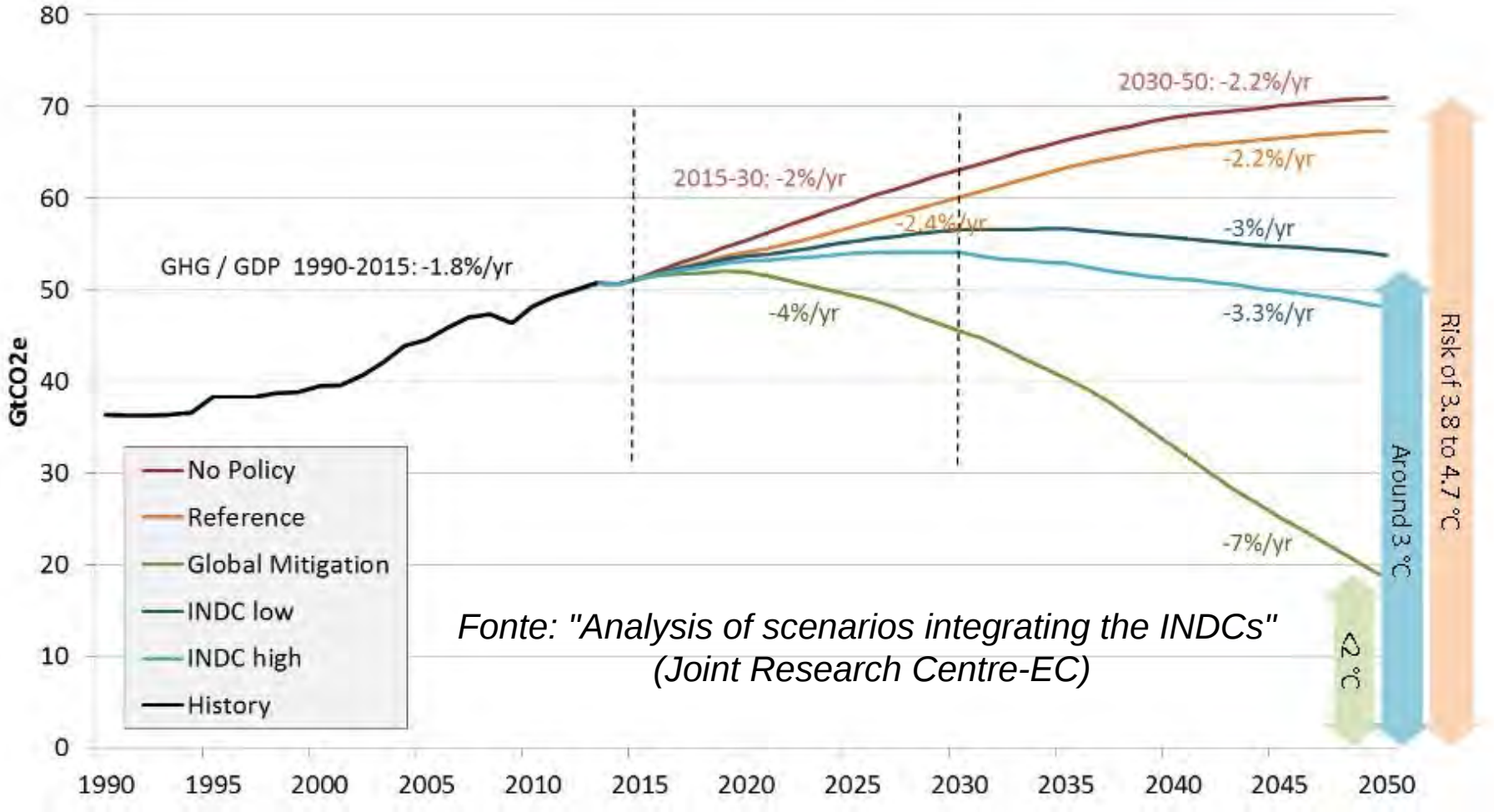
THE ROYAL SOCIETY

NATIONAL ACADEMY OF SCIENCES
1863–2013
Celebrating 150 Years of Service to the Nation

Il futuro della temperatura globale secondo IPCC AR5 (2013)

(a) Global average surface temperature change

Promesse ambiziose, ma non bastano: se applicate, circa +3 °C nel 2100 !



Fonte: "Analysis of scenarios integrating the INDCs" (Joint Research Centre-EC)

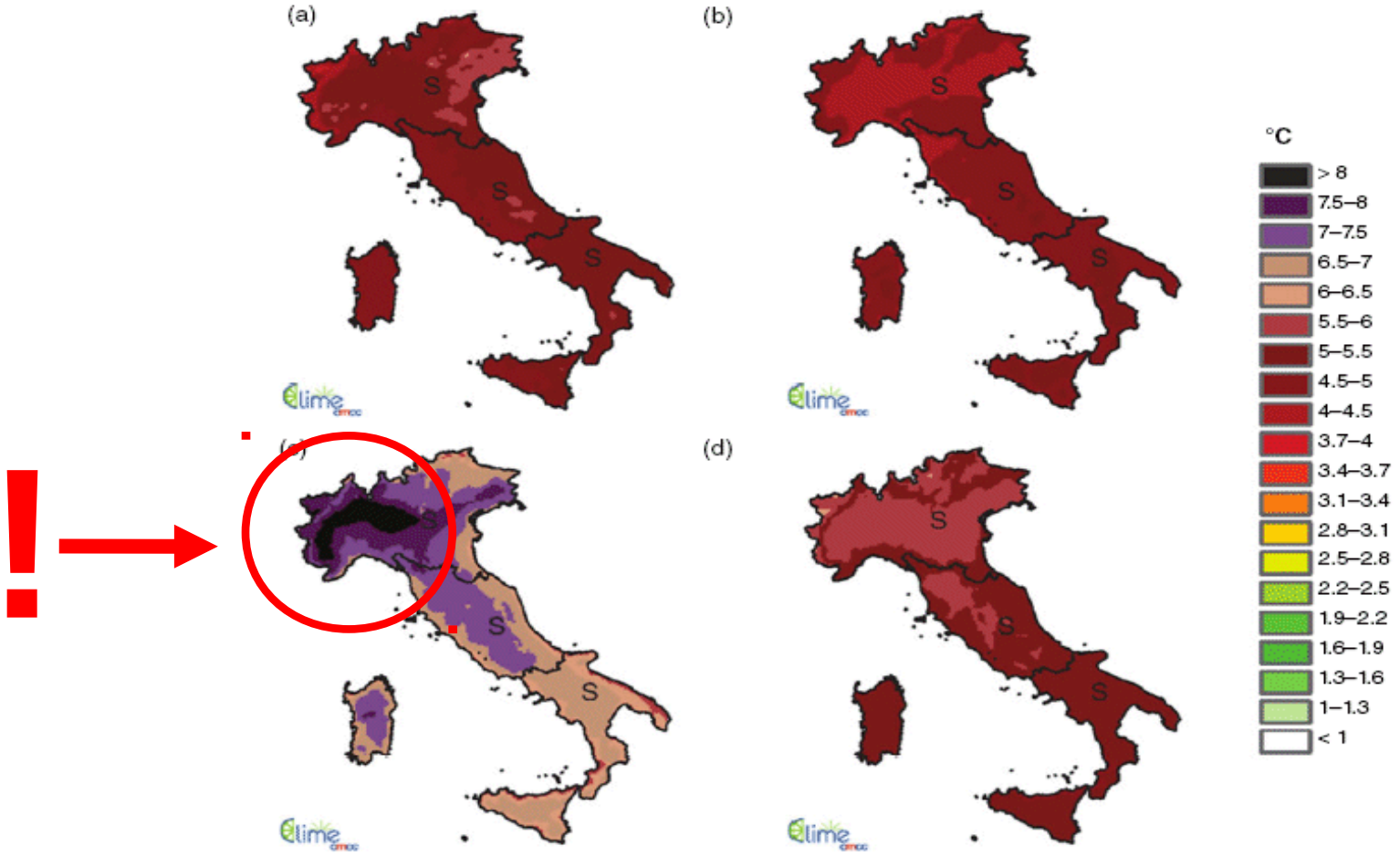


Figure 9. Temperature climate projections, RCP8.5: seasonal differences (°C), between the average value over 2071–2100 and 1971–2000 for (a) DJF, (b) MAM, (c) JJA and (d) SON (S, significant; NS, not significant).

E se non facessimo nulla? NW Italiano + 8 °C nel 2100!

Torino come Karachi…

Bucchignani et al. (2015) *High-resolution climate simulations with COSMO-CLM over Italy*, Int. J. Climatol.

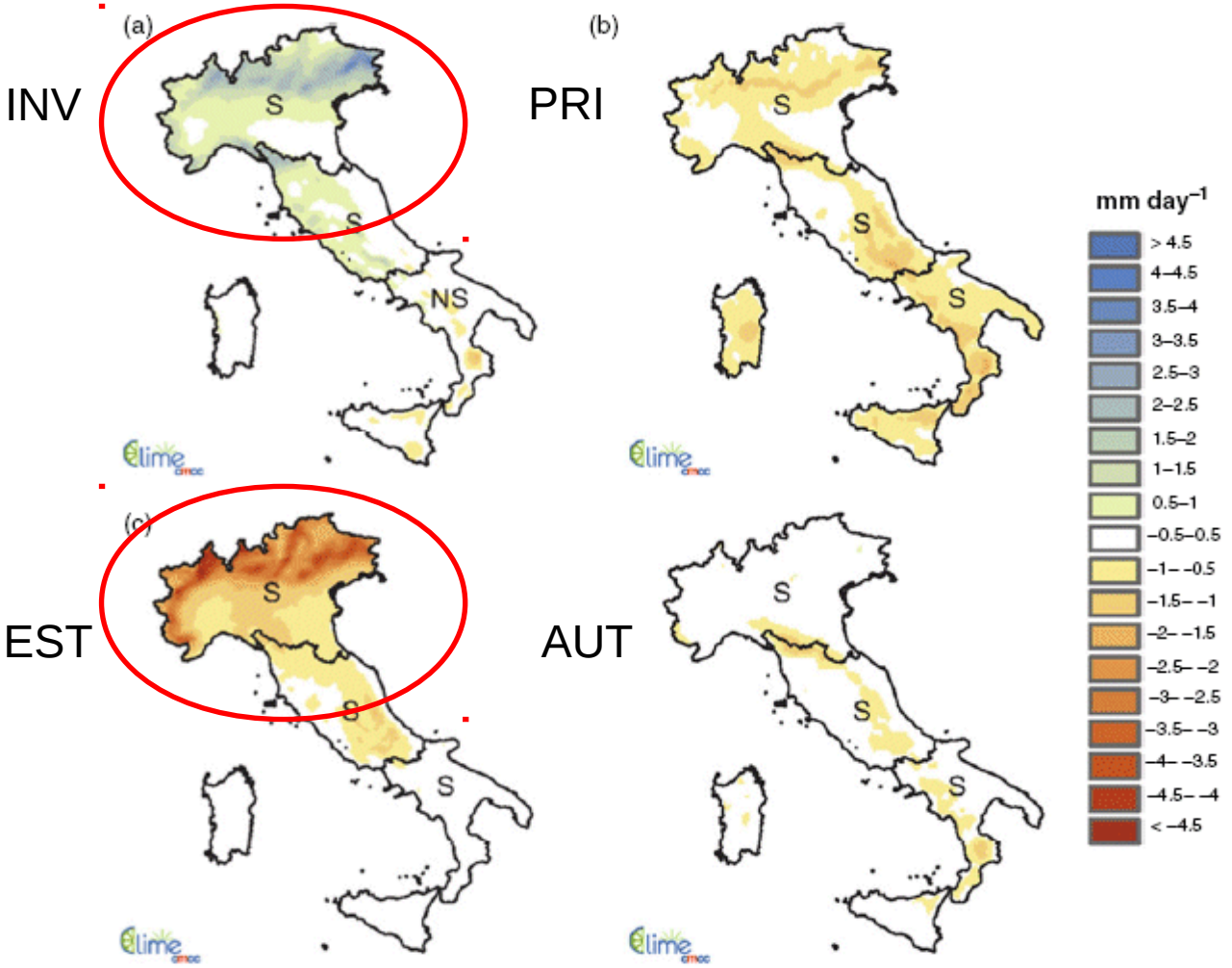


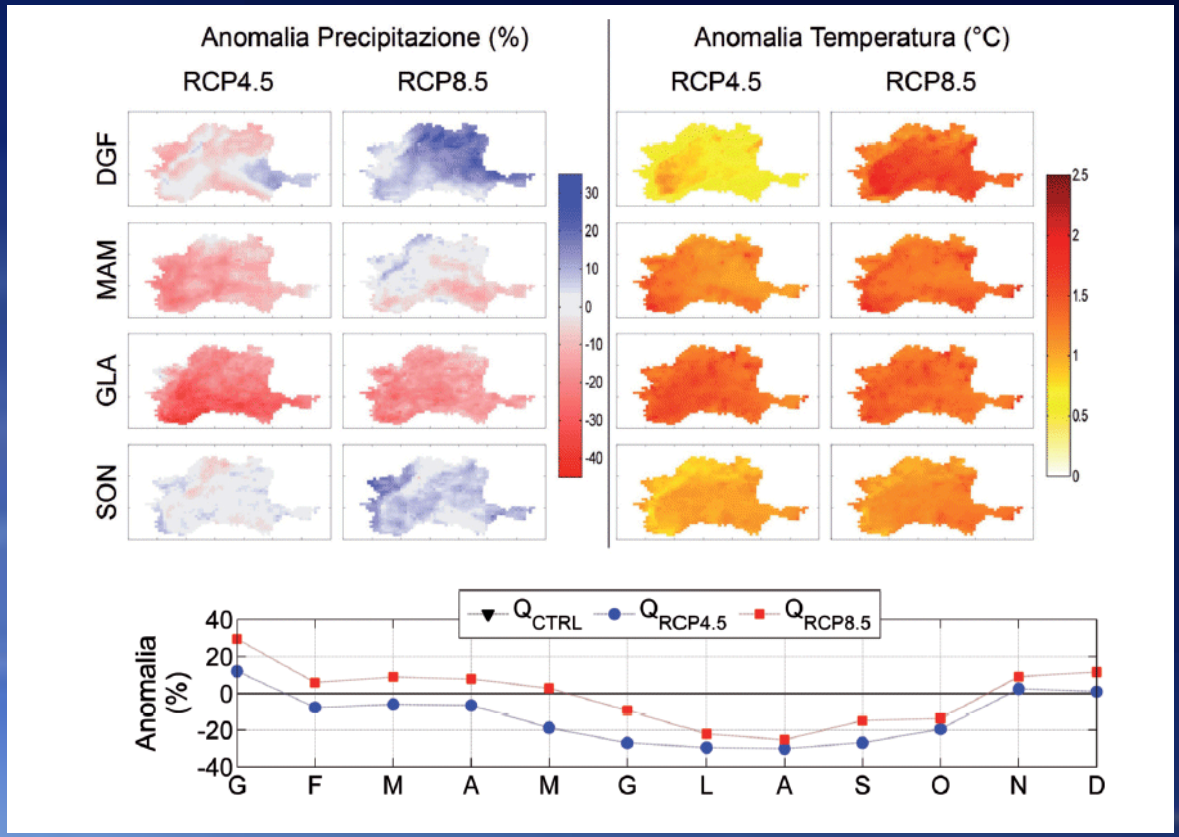
Figure 12. Precipitation climate projections, RCP8.5: seasonal differences (mm day^{-1}), between the average value over 2071–2100 and 1971–2000 for (a) DJF, (b) MAM, (c) JJA and (d) SON (S, significant; NS, not significant).

Scenario ad alte emissioni (RCP8.5): nel 2071-2100 piogge più forti in inverno ma grandi siccità estive

Bucchignani et al. (2015) *High-resolution climate simulations with COSMO-CLM over Italy*, Int. J. Climatol.

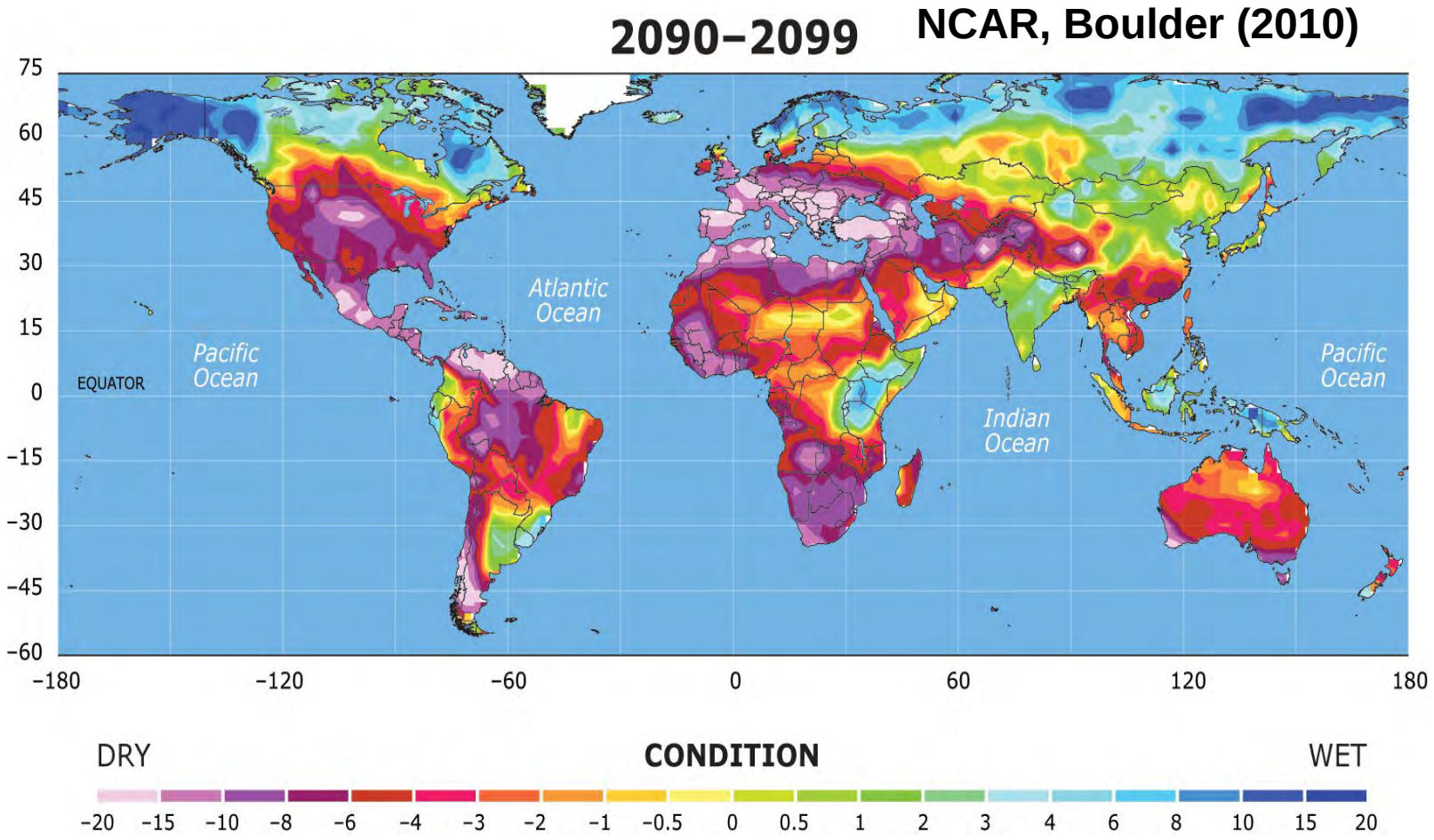
4 febbraio 2016, presso Casale (f. Toni Farina)

In futuro più siccità estive e minore portata di Po e affluenti (fino a -30% verso il 2050)



Vezzoli R. et al. (2016)
"Scenari di cambiamenti climatici nel periodo 2021-2050: quale disponibilità idrica nel bacino del Fiume Po?"
su "Ingegneria dell'Ambiente"

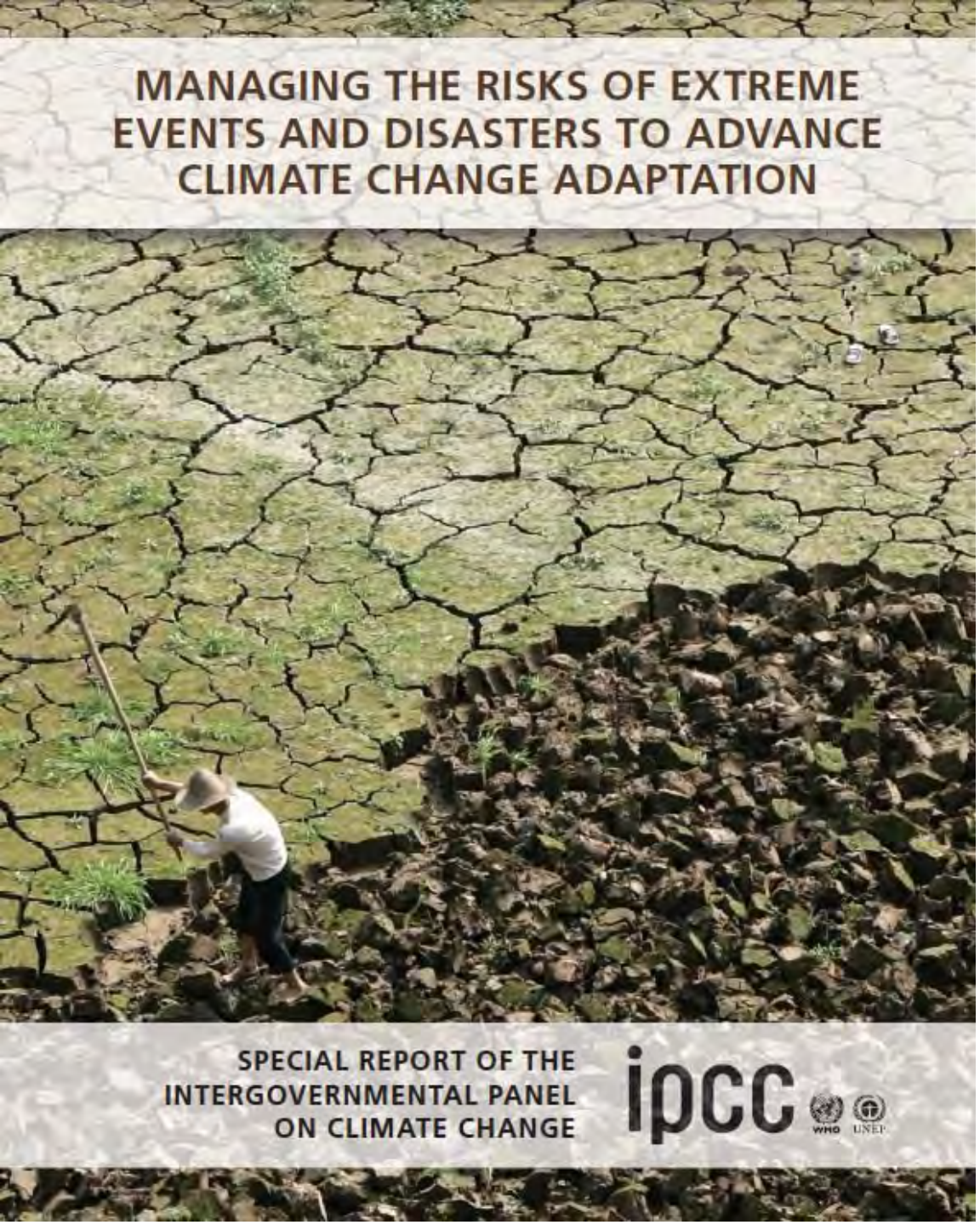
Future “megasiccità” in USA e Mediterraneo?



Indice di severità potenziale delle siccità future nel mondo

< -4 = siccità estrema

Previsto: da -15 a -20 in molte zone mediterranee e America



Adattarsi ai cambiamenti climatici e gestire il rischio

Rapporto IPCC-SREX (2012)

www.ipcc-wg2.gov/SREX

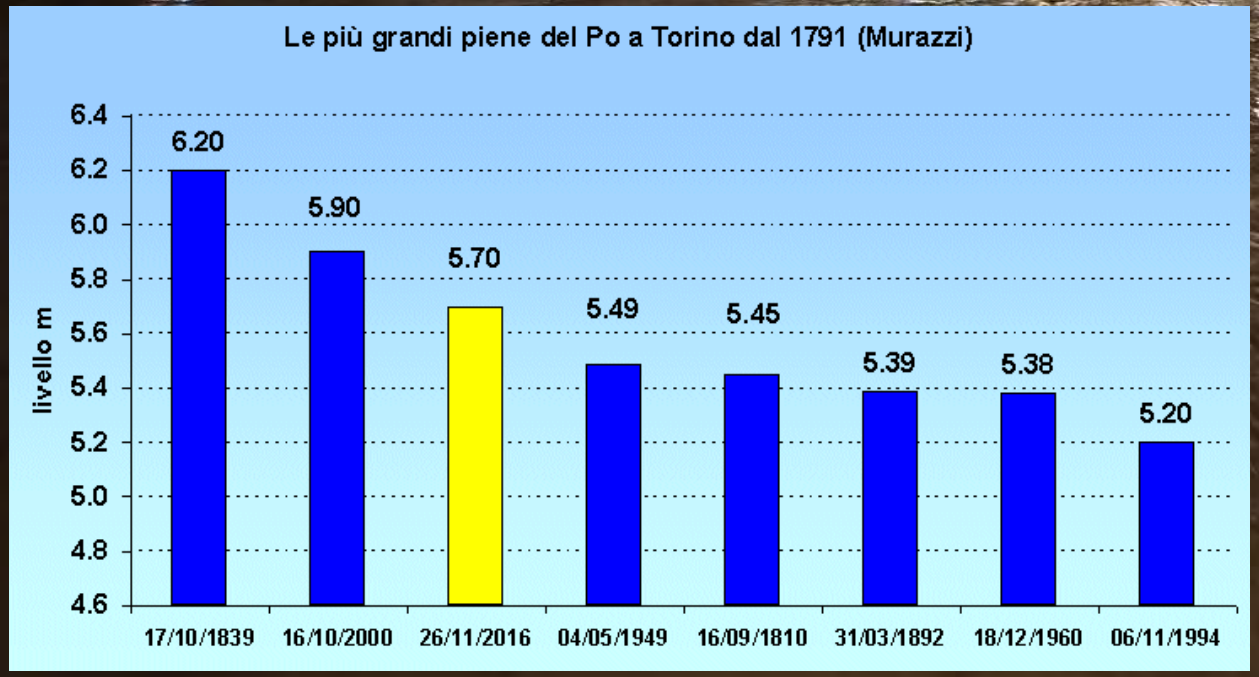
Atmosfera più calda, più energia e vapore, più eventi estremi, danni, carestie e rifugiati climatici > migrazioni

Colorado (USA), settembre 2013

Eventi estesi su grandi bacini (ben prevedibili)

Nubifragi localizzati > flash-flood (talora meno prevedibili)

Dopo il 1998, due delle tre più grandi piene del Po a Torino dal 1791



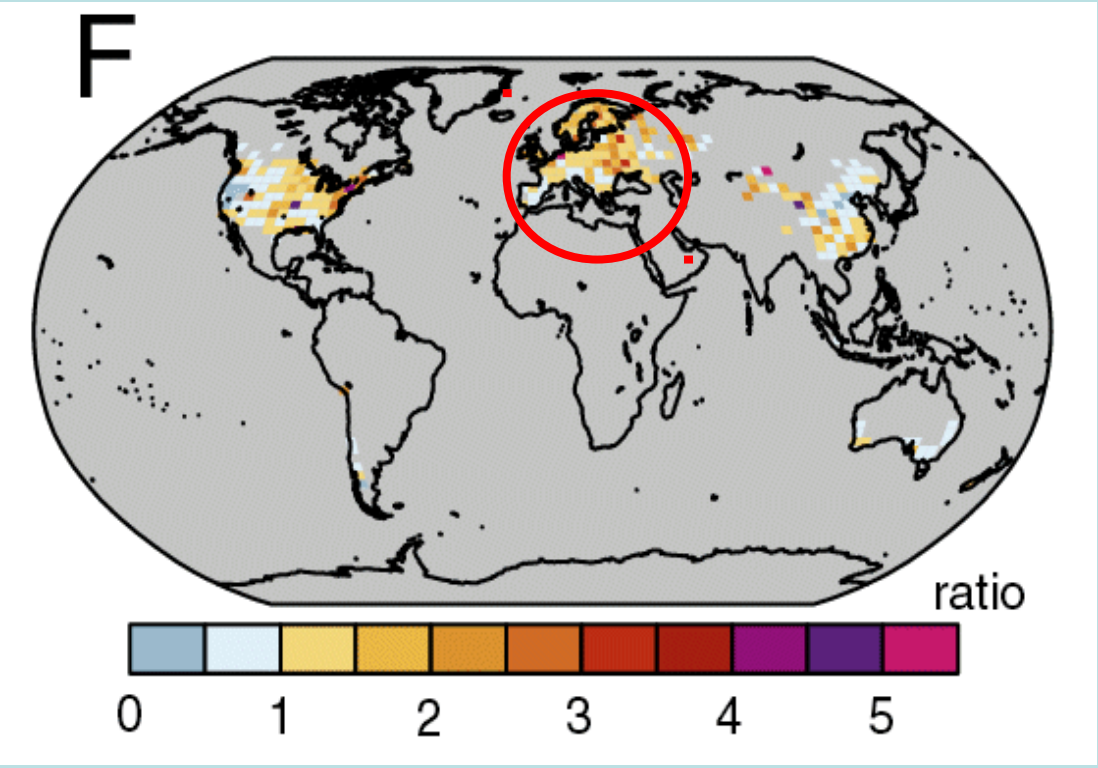
Torino-Murazzi,
25 novembre 2016
(f. L. Mercalli)

Quantifying the influence of global warming on unprecedented extreme climate events

Noah S. Diffenbaugh[a,b,1], Deepti Singh[a,c], Justin S. Mankin[a,c,d,e], Daniel E. Horton[a,f], Daniel L. Swain[a,g], Danielle Touma[a], Allison Charland[a], Yunjie Liu[a], Matz Haugen[a], Michael Tsiang[a,h], and Bala Rajaratnam[a,b,i]

[a]Department of Earth System Science, Stanford University, Stanford, CA 94305; [b]Woods Institute for the Environment, Stanford University, Stanford, CA 94305; [c]Lamont-Doherty Earth Observatory, Columbia University, Palisades, NY 10964; [d]Emmett Interdisciplinary Program in Environment and Resources, Stanford University, Stanford, CA 94305; [e]NASA Goddard Institute for Space Studies, New York, NY 10025; [f]Department of Earth and Planetary Sciences, Northwestern University, Evanston, IL 60208; [g]Institute of the Environment and Sustainability, University of California, Los Angeles, CA 90095; [h]Department of Statistics, University of California, Los Angeles, CA 90095; and [i]Department of Statistics, Stanford University, Stanford, CA 94305

Edited by Kerry A. Emanuel, Massachusetts Institute of Technology, Cambridge, MA, and approved March 10, 2017 (received for review October 31, 2016)

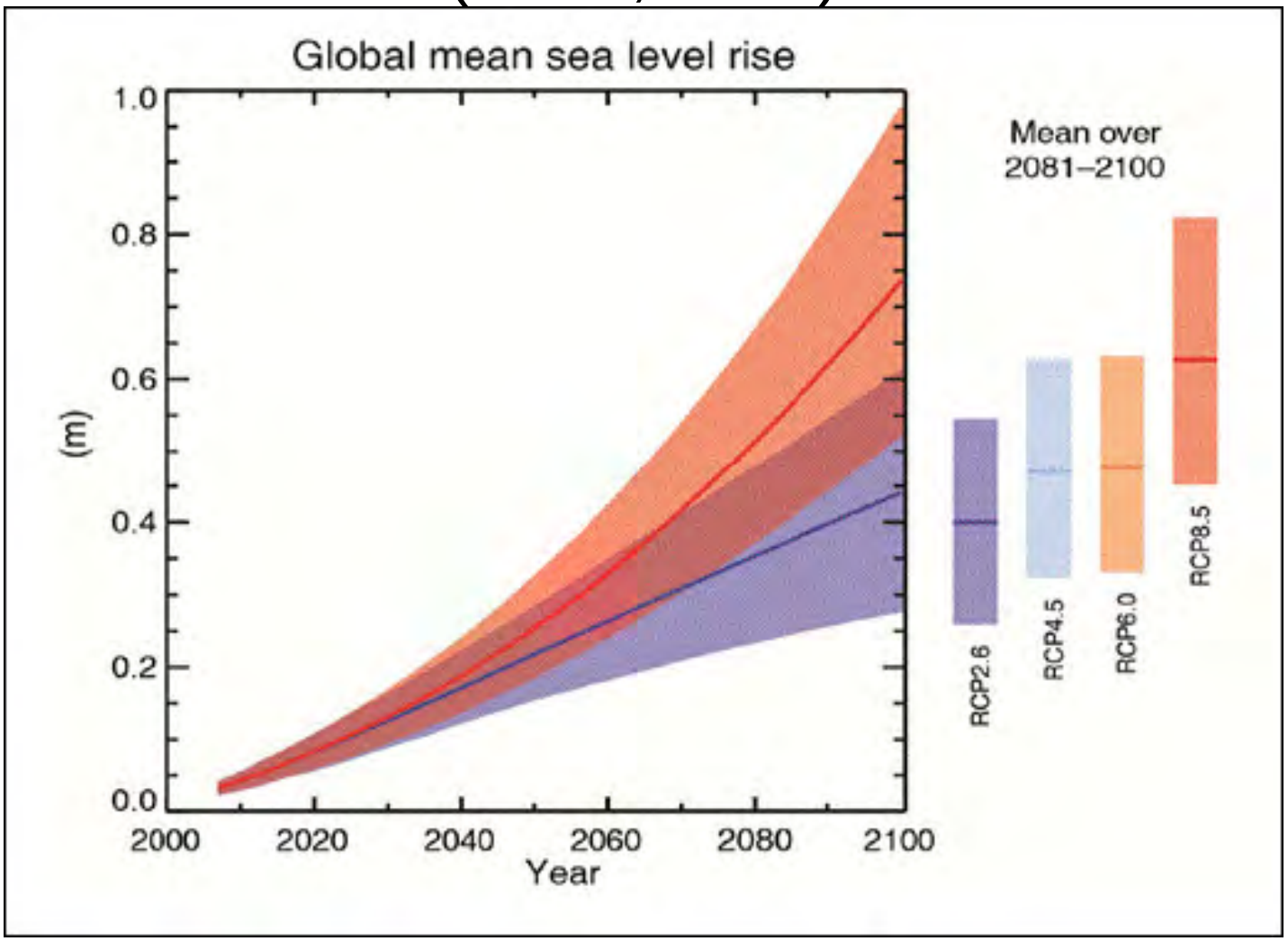


Primi segnali da altri studi

Piogge estreme su 5 giorni, divenute più probabili nel 41% delle aree mondiali considerate in questo studio (tra cui Europa Centrale)

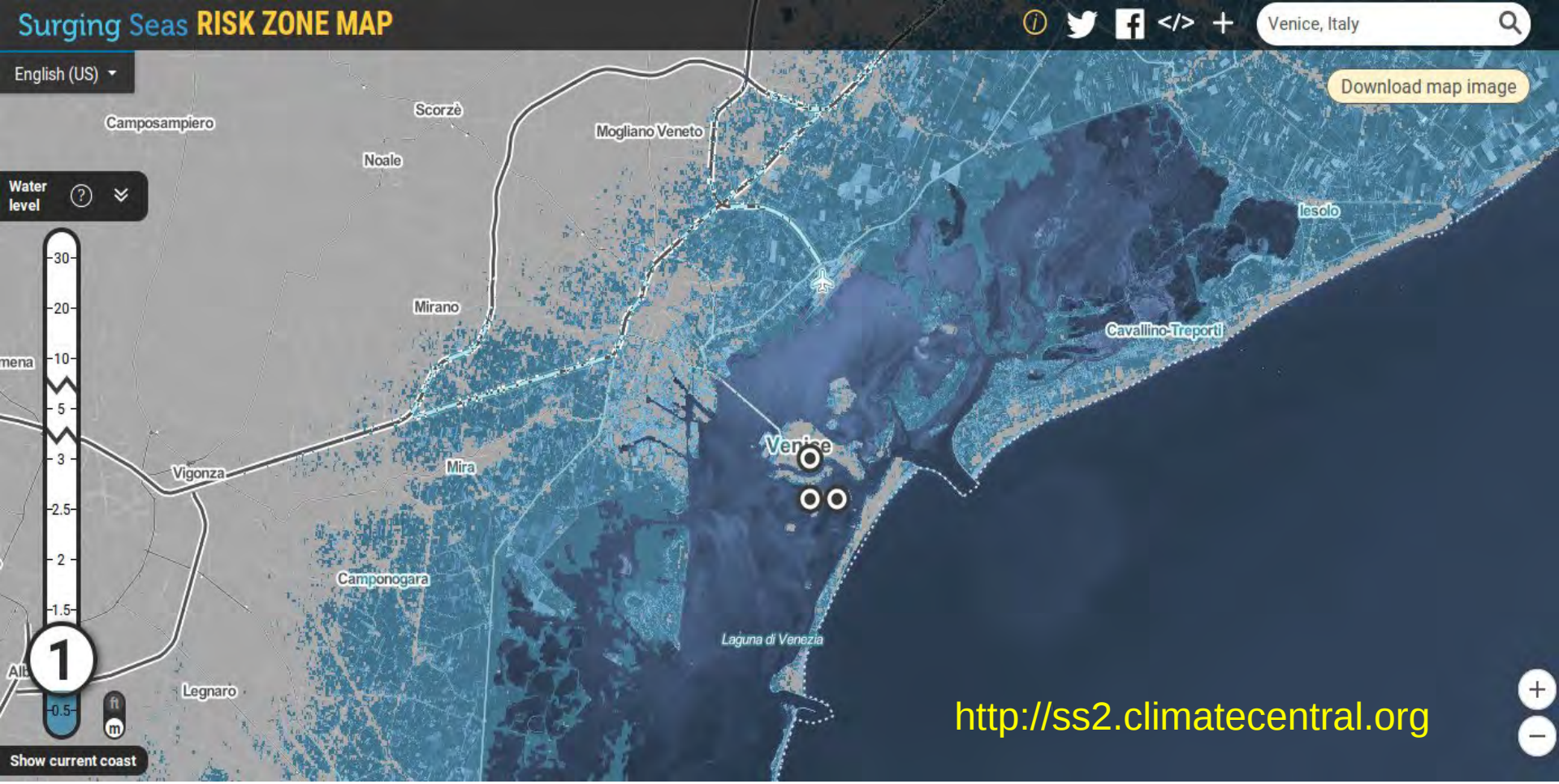

Aumento livello marino

Quasi un metro di livello marino in più nel 2100? (IPCC, 2013)

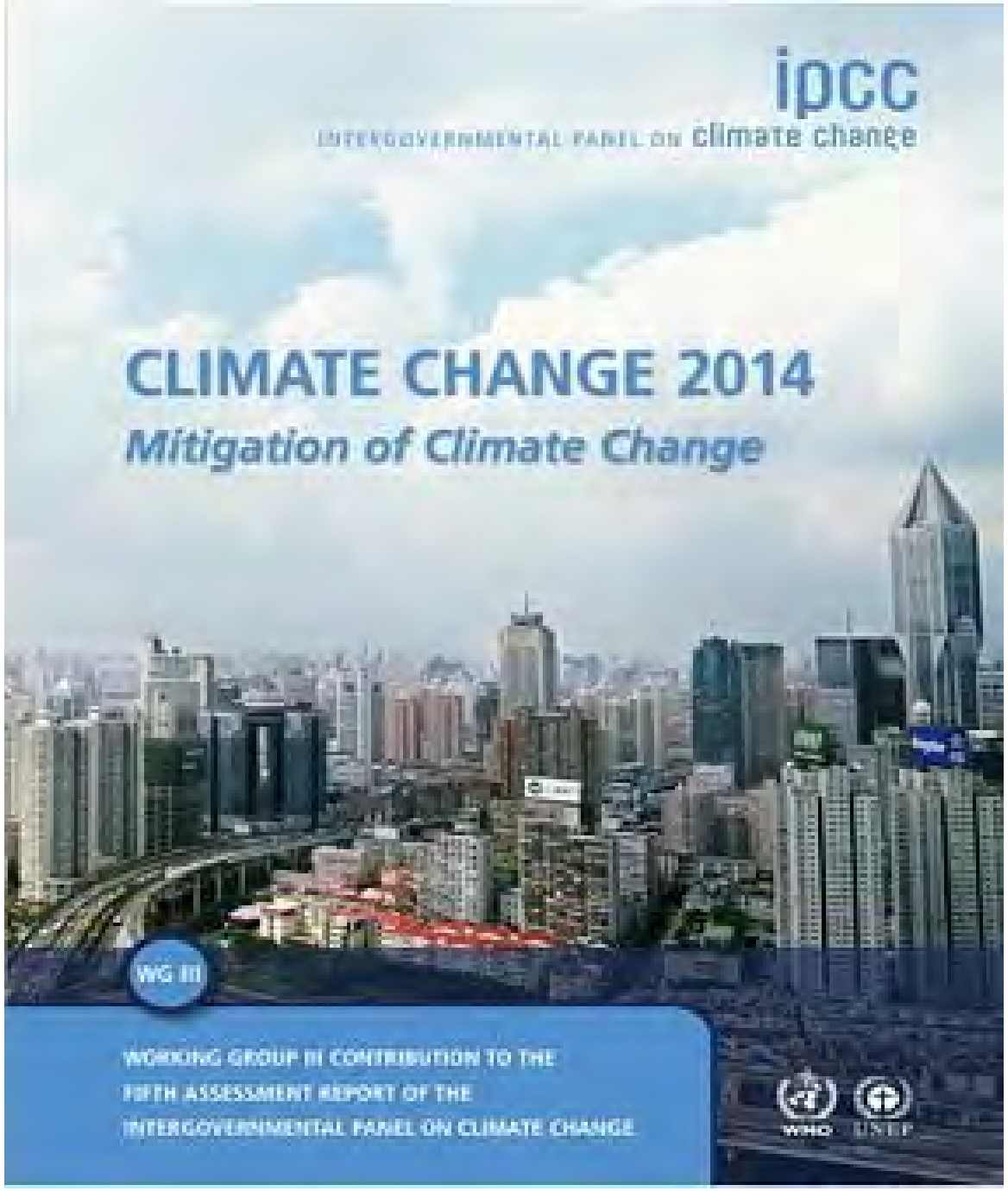


Nuovi studi indicano anche 2 metri in più!

DeConto R., Pollard D. (2016) *Contribution of Antarctica to past and future sea-level rise*. Nature, 531.



Senza andare lontano… migranti padani?
+1 m di livello mare,
laguna e costa veneta sott'acqua



Berlino
(7-12 aprile 2014)
terzo volume del
Quinto Rapporto di
Valutazione sui
Cambiamenti
Climatici, dedicato
alla mitigazione.
www.ipcc.ch

Acqua ed energia idroelettrica

Pulita e rinnovabile

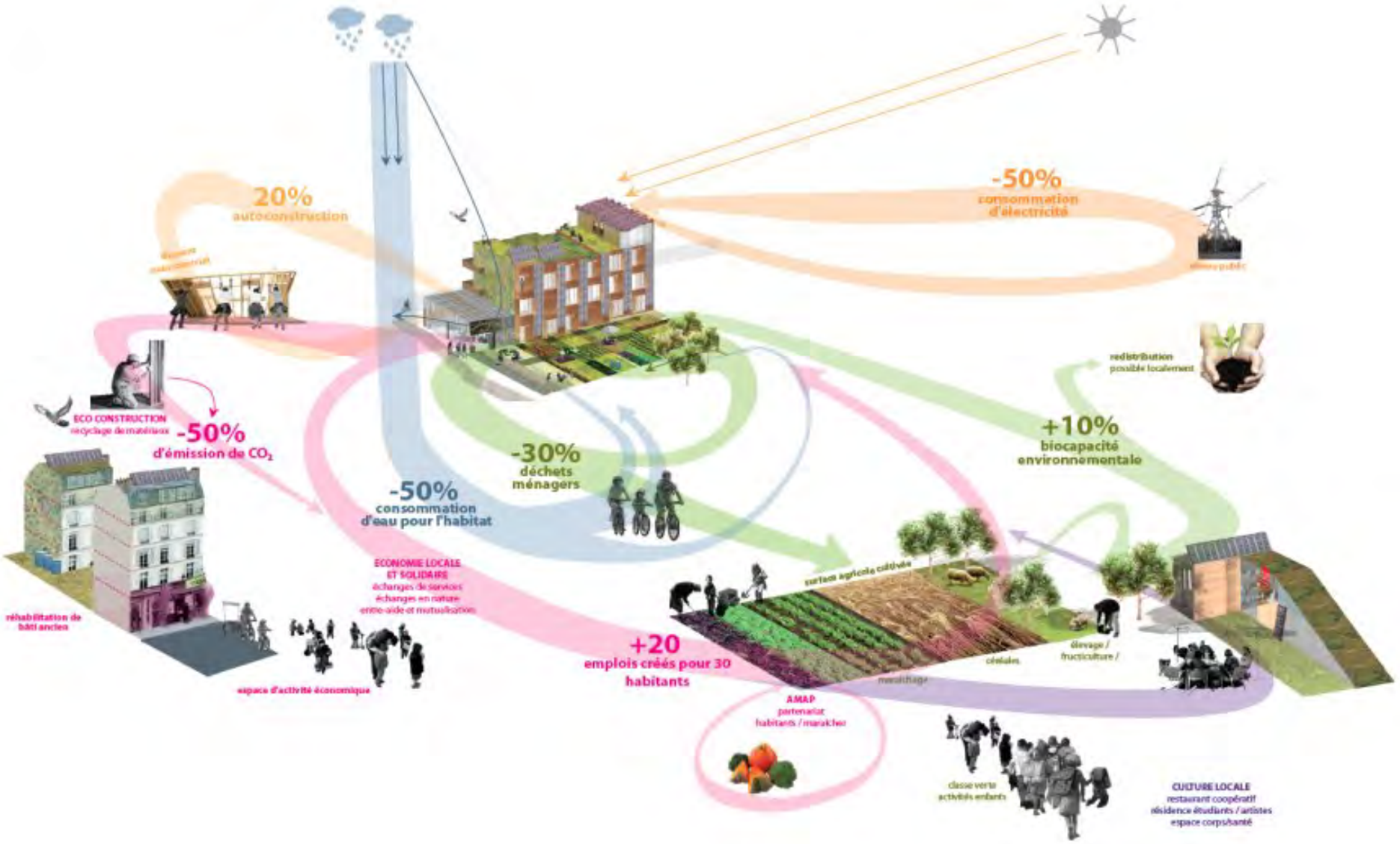
16% della produzione elettrica mondiale

Uso plurimo: agricoltura, potabile

Diga AEM del Serrù (Valle Orco)

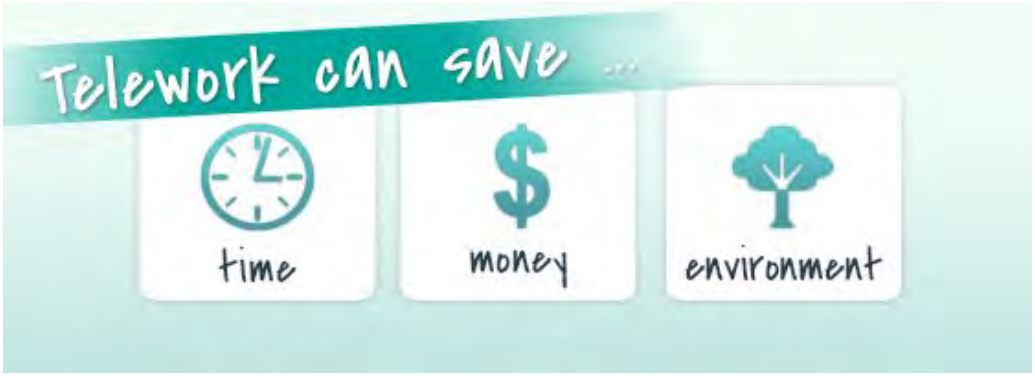
Raccolta domestica acqua piovana

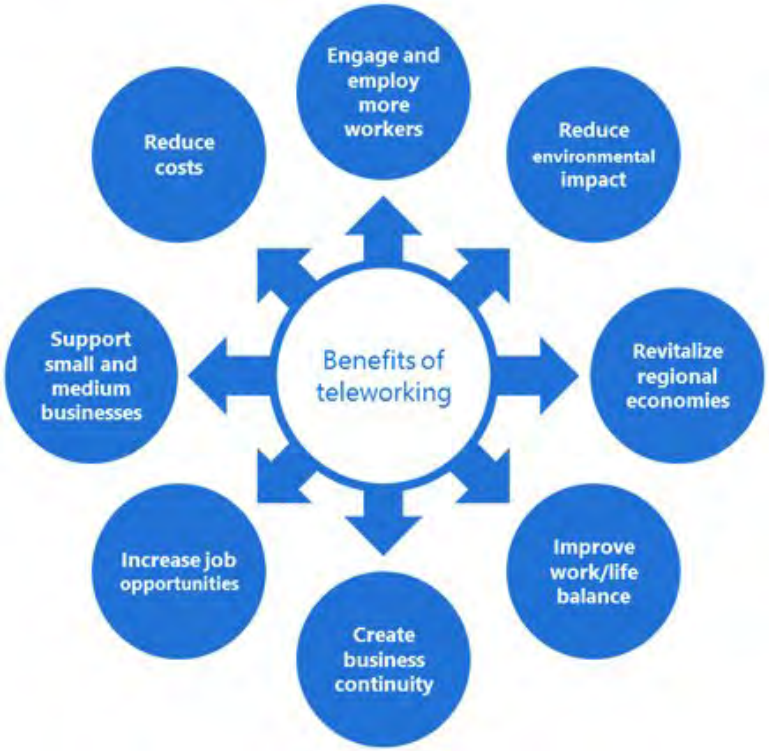
Sostenibilità e resilienza




Energie rinnovabili ed efficienza
energetica abitazioni


is
TELEWORK
the
Future?


Telework can save ...
time
money
environment


Benefits of teleworking
Engage and employ more workers
Reduce environmental impact
Revitalize regional economies
Improve work/life balance
Create business continuity
Increase job opportunities
Support small and medium businesses
Reduce costs

PAPA FRANCESCO

LAUDATO SI'

TESTO INTEGRALE DELL'ENCICLICA

CON GUIDA ALLA LETTURA DI

CRISTINA SIMONELLI

PRESIDENTE COORDINAMENTO TEOLOGHE ITALIANE

PIEMME

Maggio 2015, storica enciclica di Papa Francesco **“Laudato si’”**: per la prima volta la Chiesa sposa ufficialmente la lotta ai cambiamenti climatici e al degrado ambientale

Siamo ancora in tempo?

Nonlinear climate sensitivity and its implications for future greenhouse warming

Tobias Friedrich, Axel Timmermann, Michelle Tigchelaar, Oliver Elison Timm and Andrey Ganopolski

Science Advances 09 Nov 2016:Vol. 2, no. 11, DOI: 10.1126/sciadv.1501923

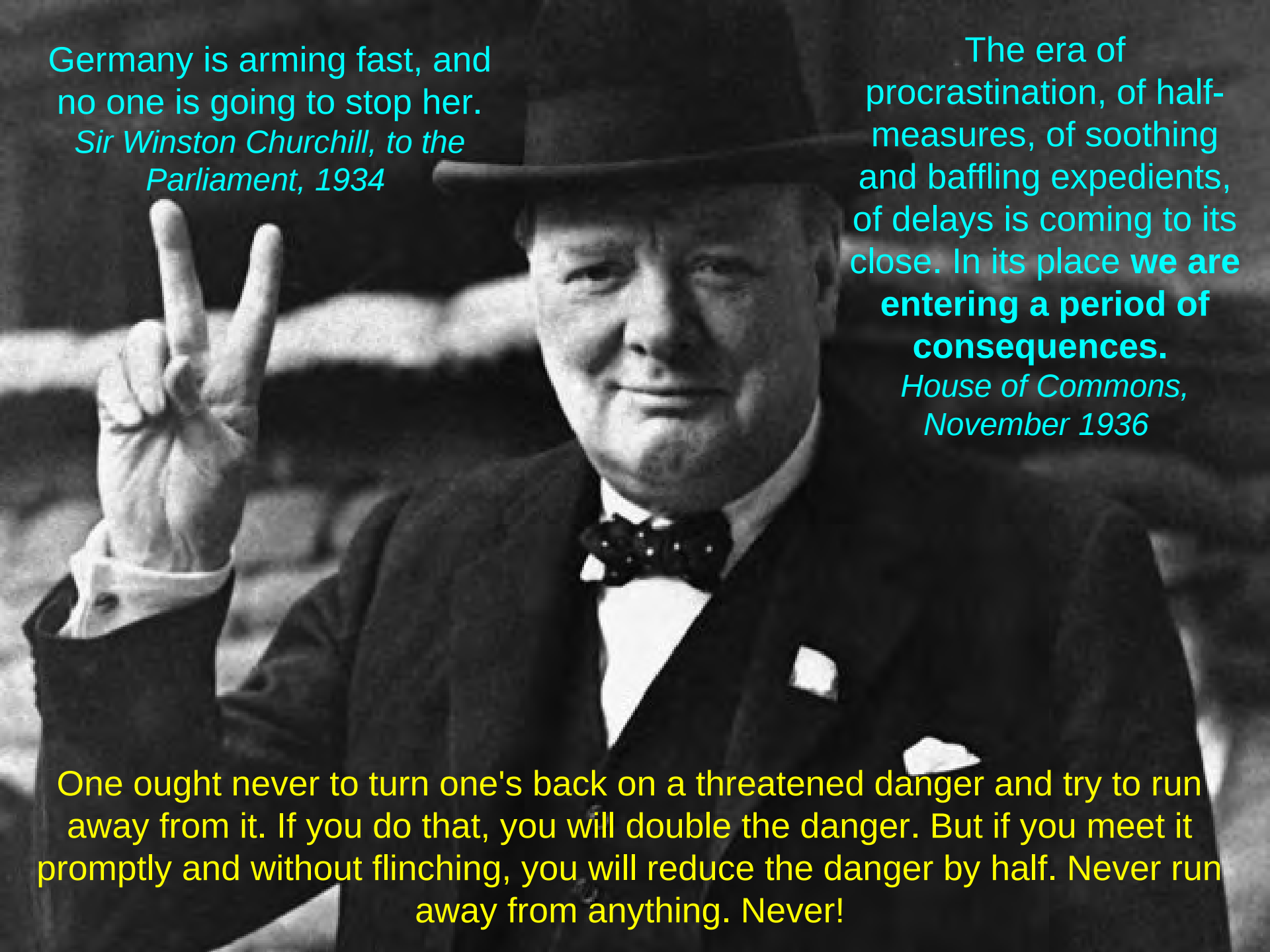
News › Science

Climate change may be escalating so fast it could be 'game over', scientists warn

New research suggests the Earth's climate could be more sensitive to greenhouse gases than thought, raising the spectre of an 'apocalyptic side of bad' temperature rise of more than 7C within a lifetime

Ian Johnston Environment Correspondent | Thursday 10 November 2016 | 421 comments

43K shares



Germany is arming fast, and no one is going to stop her.
Sir Winston Churchill, to the Parliament, 1934

The era of procrastination, of half-measures, of soothing and baffling expedients, of delays is coming to its close. In its place **we are entering a period of consequences.**
House of Commons, November 1936

One ought never to turn one's back on a threatened danger and try to run away from it. If you do that, you will double the danger. But if you meet it promptly and without flinching, you will reduce the danger by half. Never run away from anything. Never!