

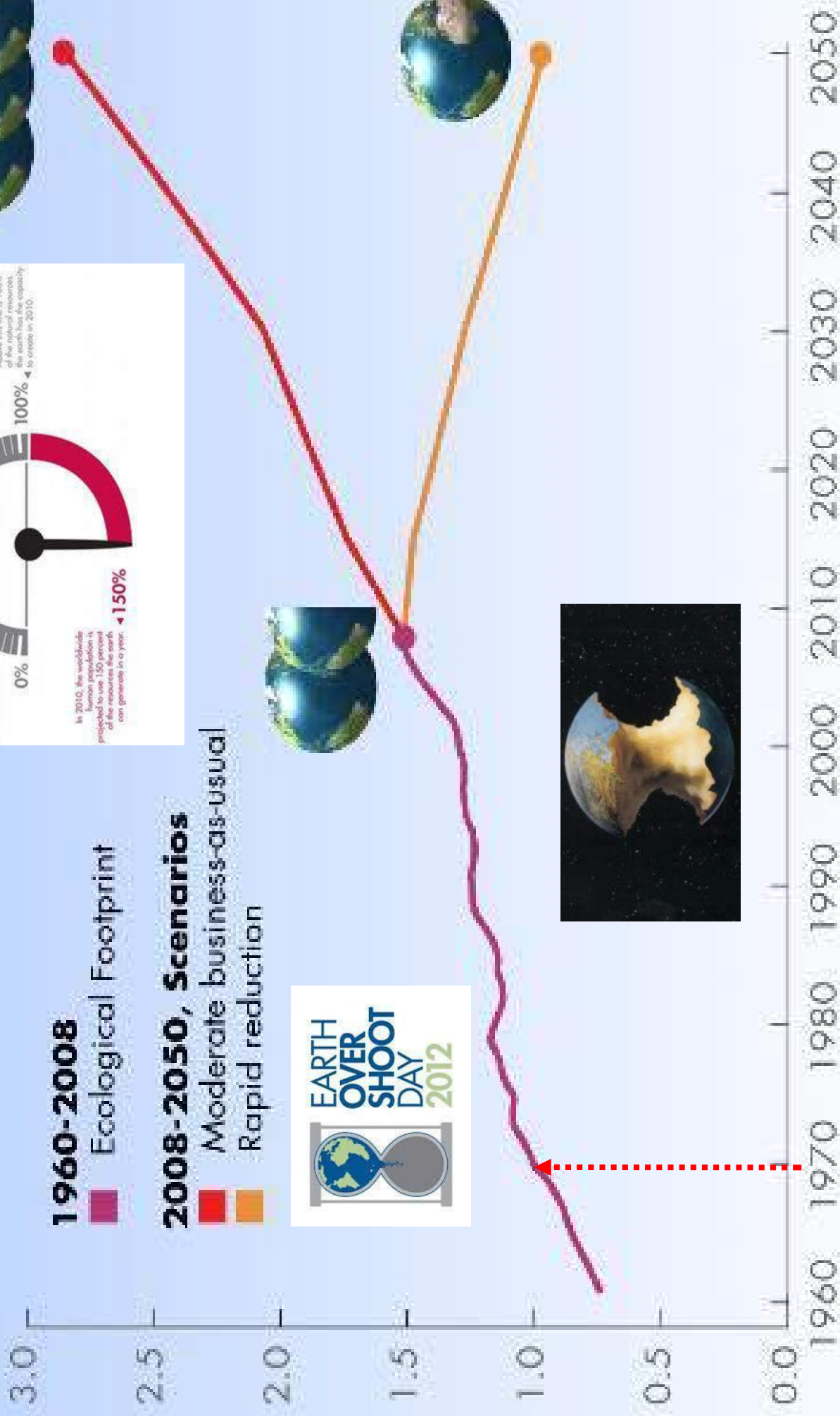
Allarme rosso per l'acqua di domani...

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



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

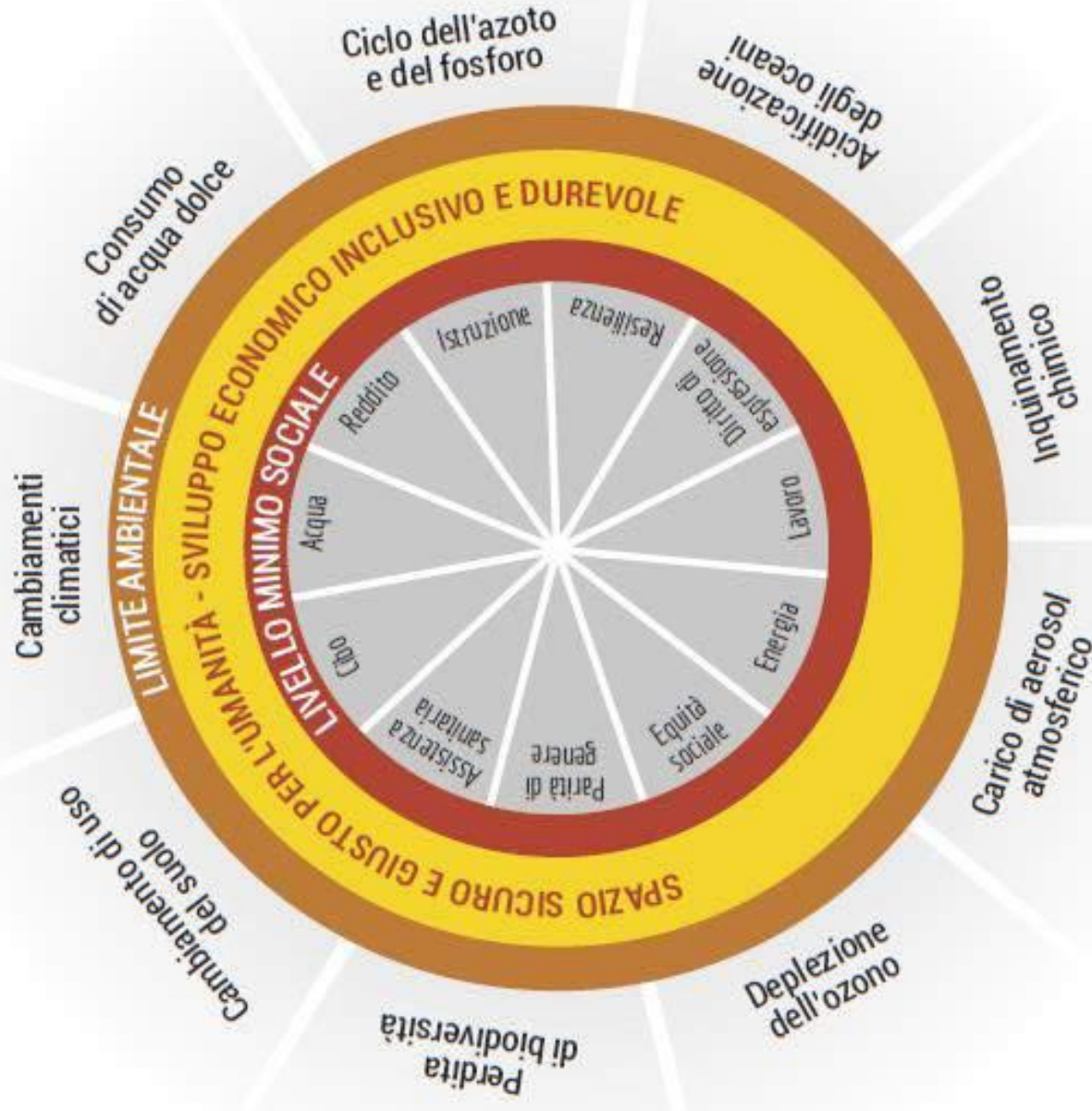




y-axis: number of planet earths, x-axis: years

LA "CIAMBELLA"

DEI LIMITI SOCIALI E PLANETARI



L'economia della ciambella

Sette mosse per pensare
come un economista del XXI secolo



KATE RAWORTH

Introduzione di Gianfranco Bologna ed Enrico Giovannini



Edizioni
Ambiente

Progetto EPICA - EPICA

(European Project for Ice Coring in Antarctica)

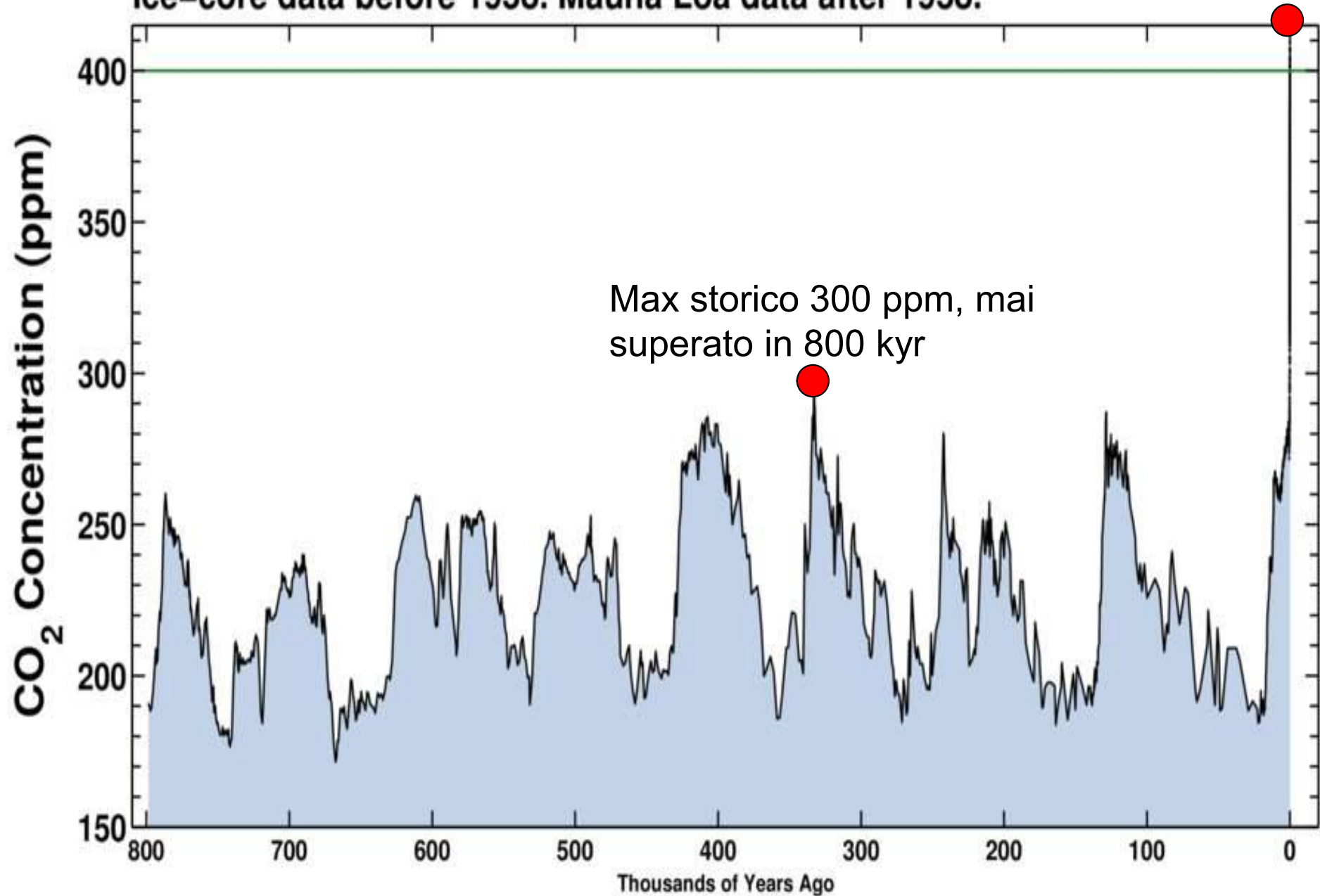
Stazione italo-francese Concordia, a Dome C - Antartide



Latest CO₂ reading
June 06, 2017

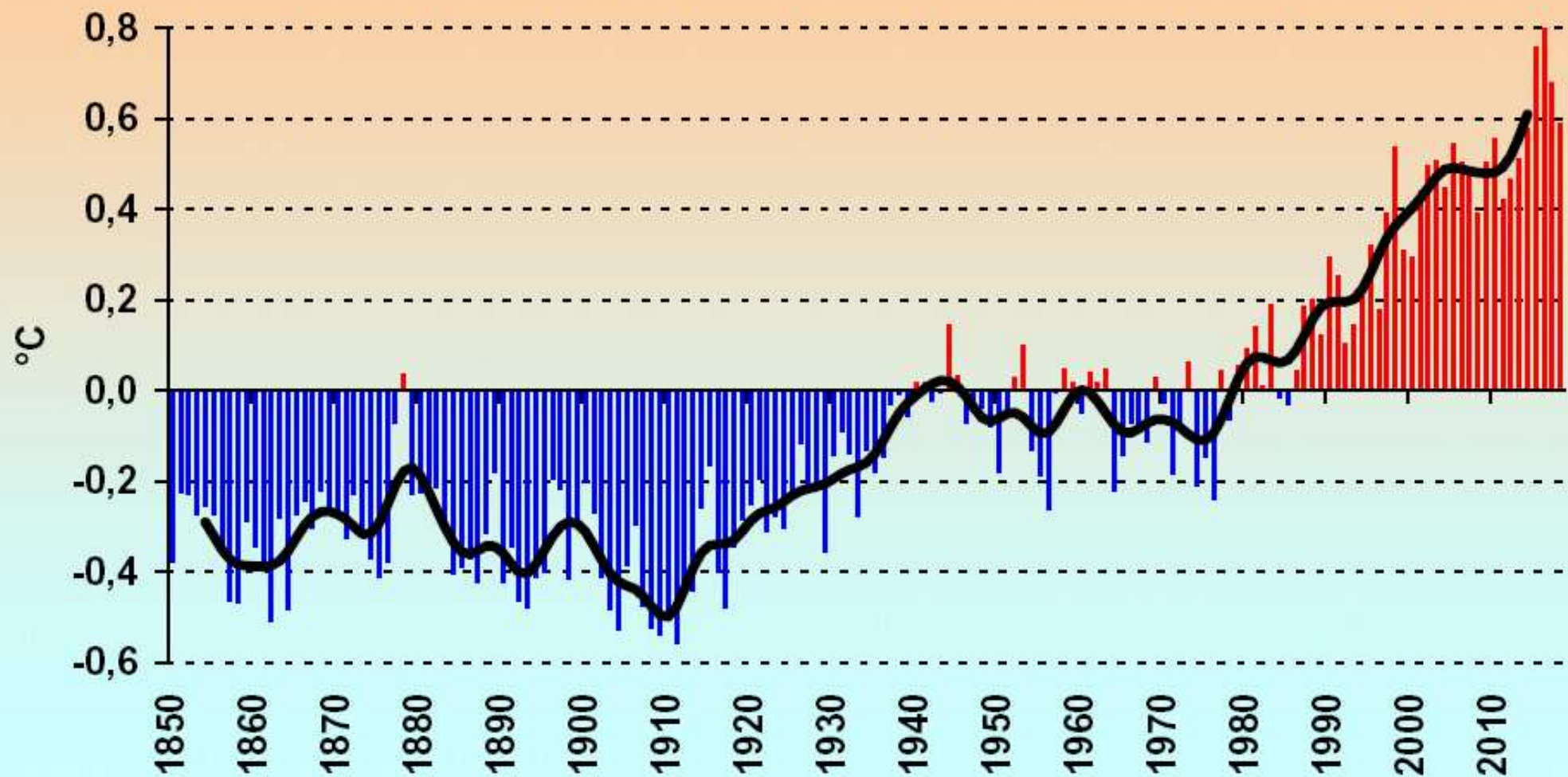
409.98 ppm

Ice-core data before 1958. Mauna Loa data after 1958.



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

Anomalie termiche globali 1850-2018
(rispetto a media trentennio 1961-90)
serie MetOffice - Hadley Center

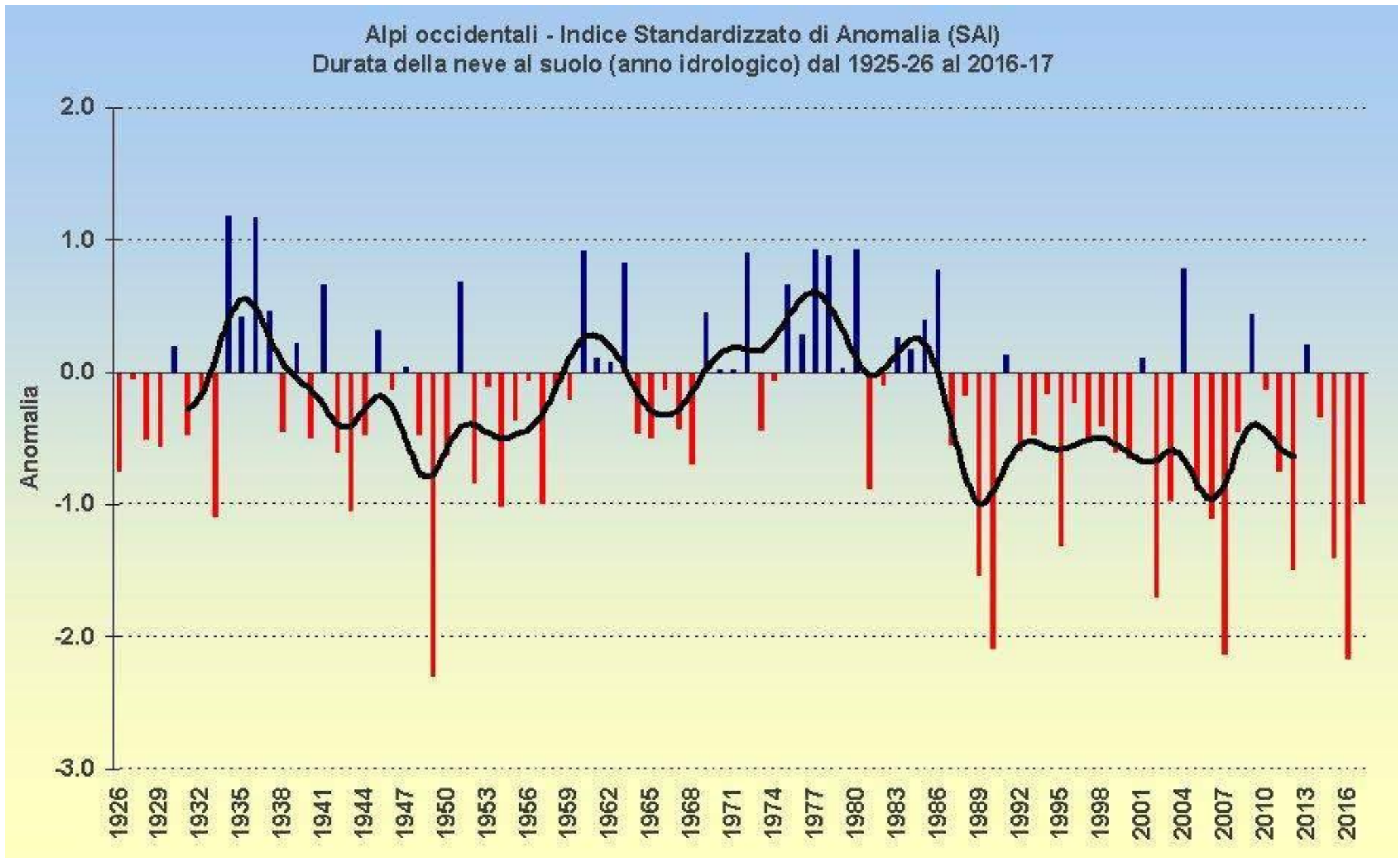


La neve, capitale idrologico delle Alpi

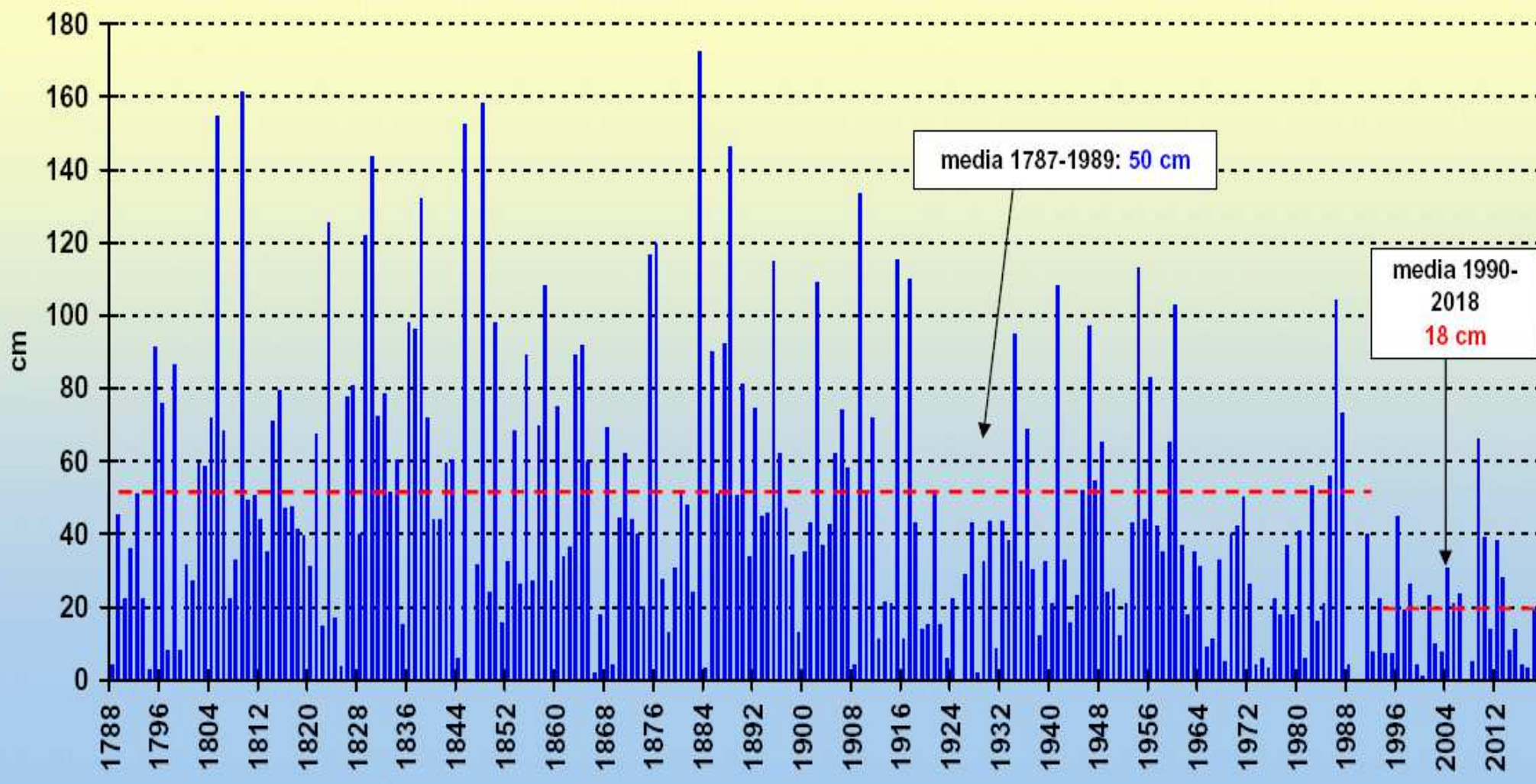


*Alpe Devero
(Val d'Ossola)
Marzo 2014
(f. Studio Pessina)*

Sulle Alpi la neve al suolo dura meno



Torino, quantità stagionale di neve fresca (anno idrologico) dal 1787-88 al 2017-18



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

Entracque - Lago Piastra (900 m, CN) - Spessore medio del manto nevoso (cm) confronto periodi 1961-1989 e 1990-2016



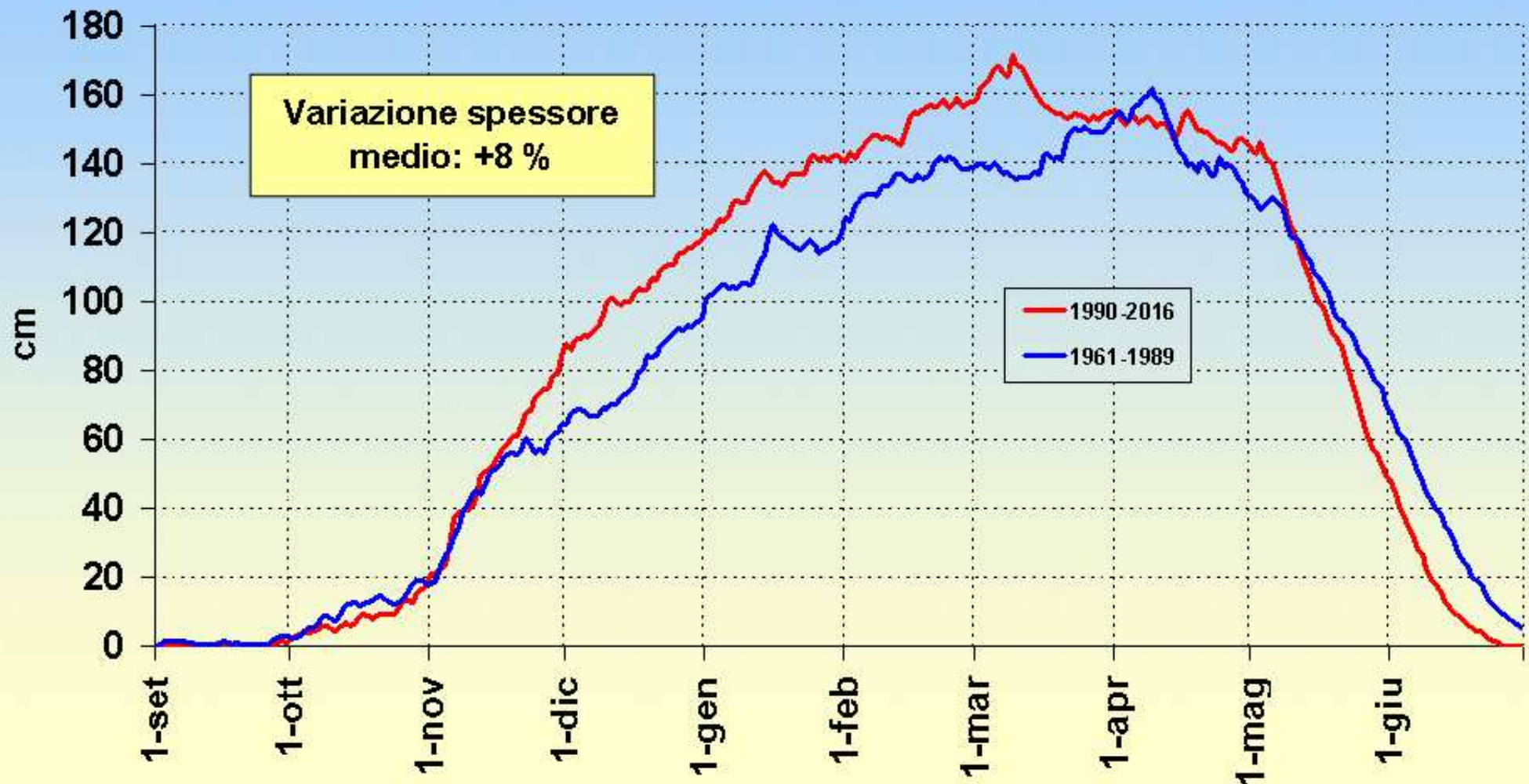
Riduzione recente dello spessore nevoso medio al suolo, molto evidente sotto i 1000 m

Gressoney-D'Ejola (1850 m, AO) - Spessore medio del manto nevoso
(cm) confronto periodi 1961-1989 e 1990-2016



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

Lago Goillet (2526 m, AO) - Spessore medio del manto nevoso (cm)
confronto periodi 1961-1989 e 1990-2016



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

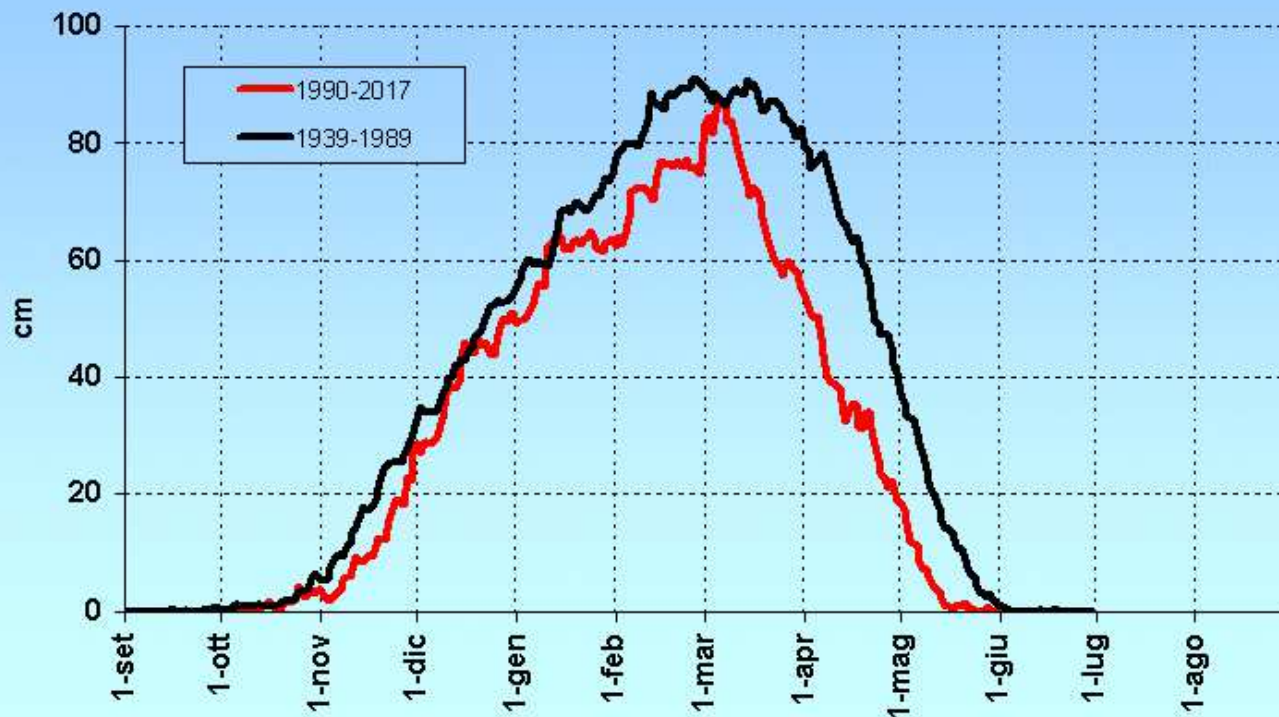


*Breuil-Cervinia, 9 gennaio 2018
(f. Consorzio Turistico Cervino)*



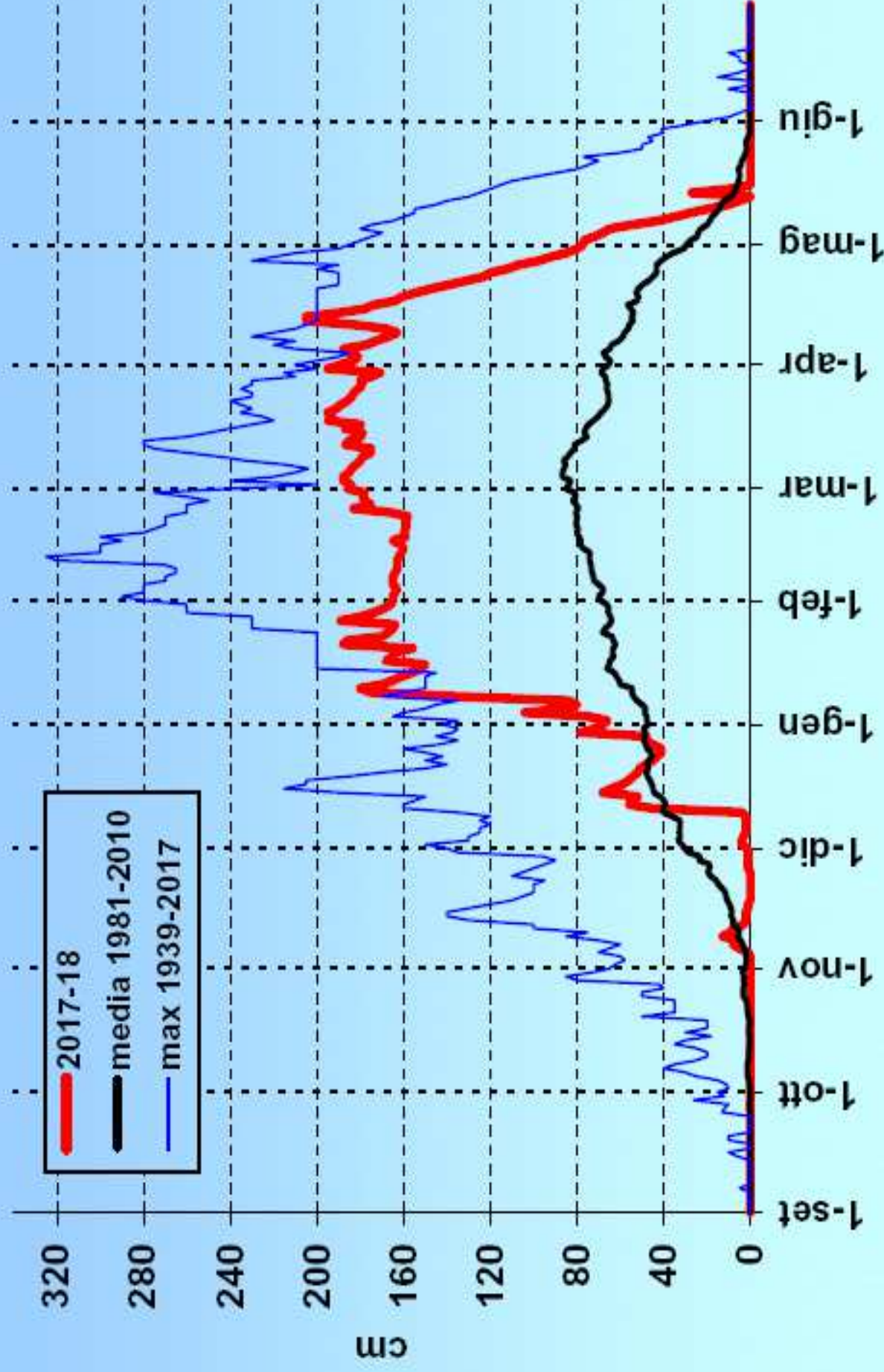
10.03.2018: 176 cm (media storica: 83 cm)

Gressoney - D'Ejola (Monte Rosa, 1850 m) - Media giornaliera dello spessore nevoso al suolo, confronto tra periodi 1939-1989 e 1990-2017



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

**Gressoney - D'Ejola (1850 m) Andamento giornaliero neve al
suolo inverno 2017-18 e confronto con valori medi
e massimi storici**



Ghiacciaio Ciardoney,
21 maggio 2017

<http://nimbus.csp.it>

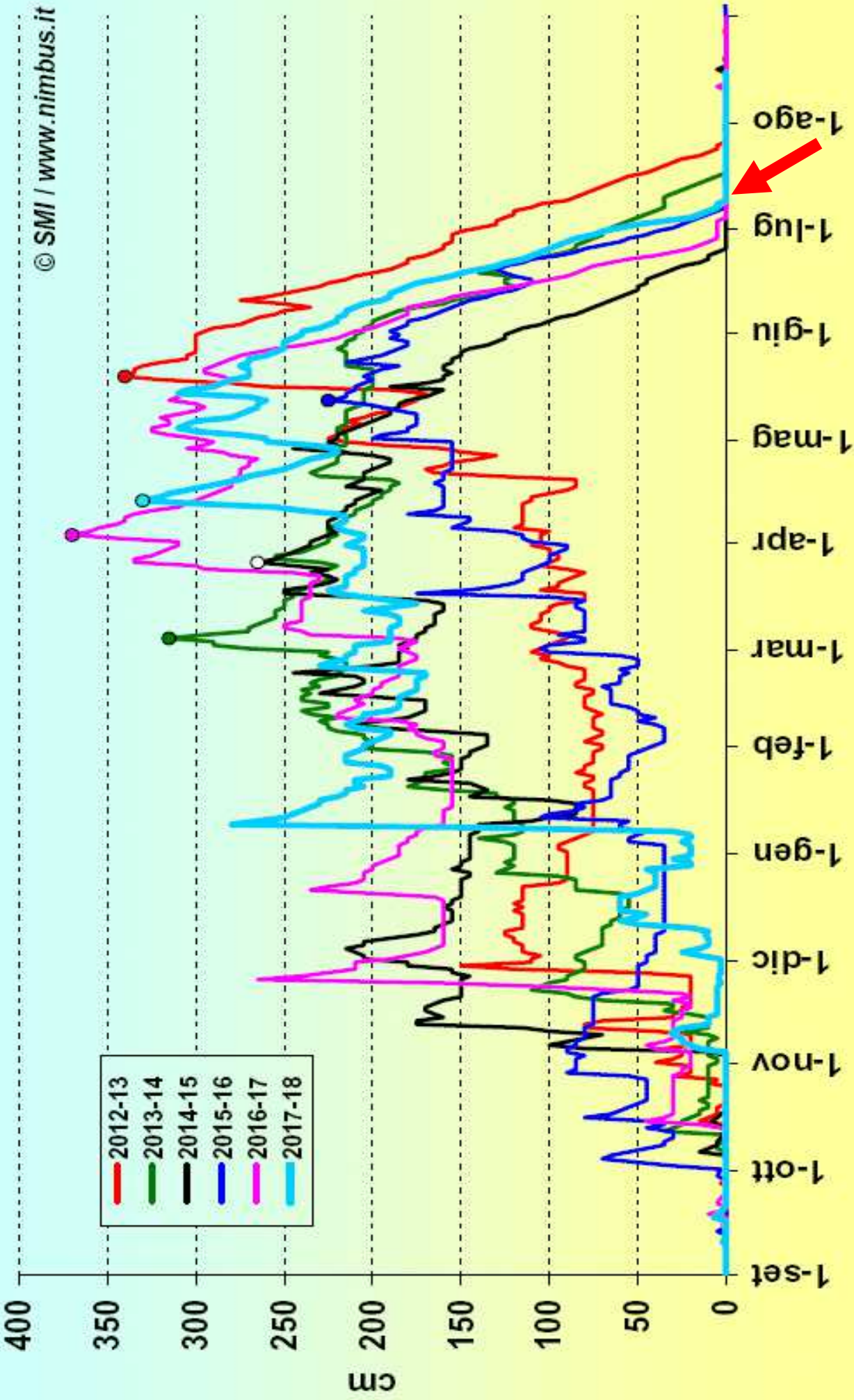
Monitoraggio "snowcam"



Ghiacciaio Ciardoney, 11 luglio 2017



Ghiacciaio Ciardoney (2850 m) - Spessore manto nevoso osservato da "snowcam"



© SMI / www.nimbus.it

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

*Bardonecchia
8 dicembre 2015
(f. L. Mercalli)*





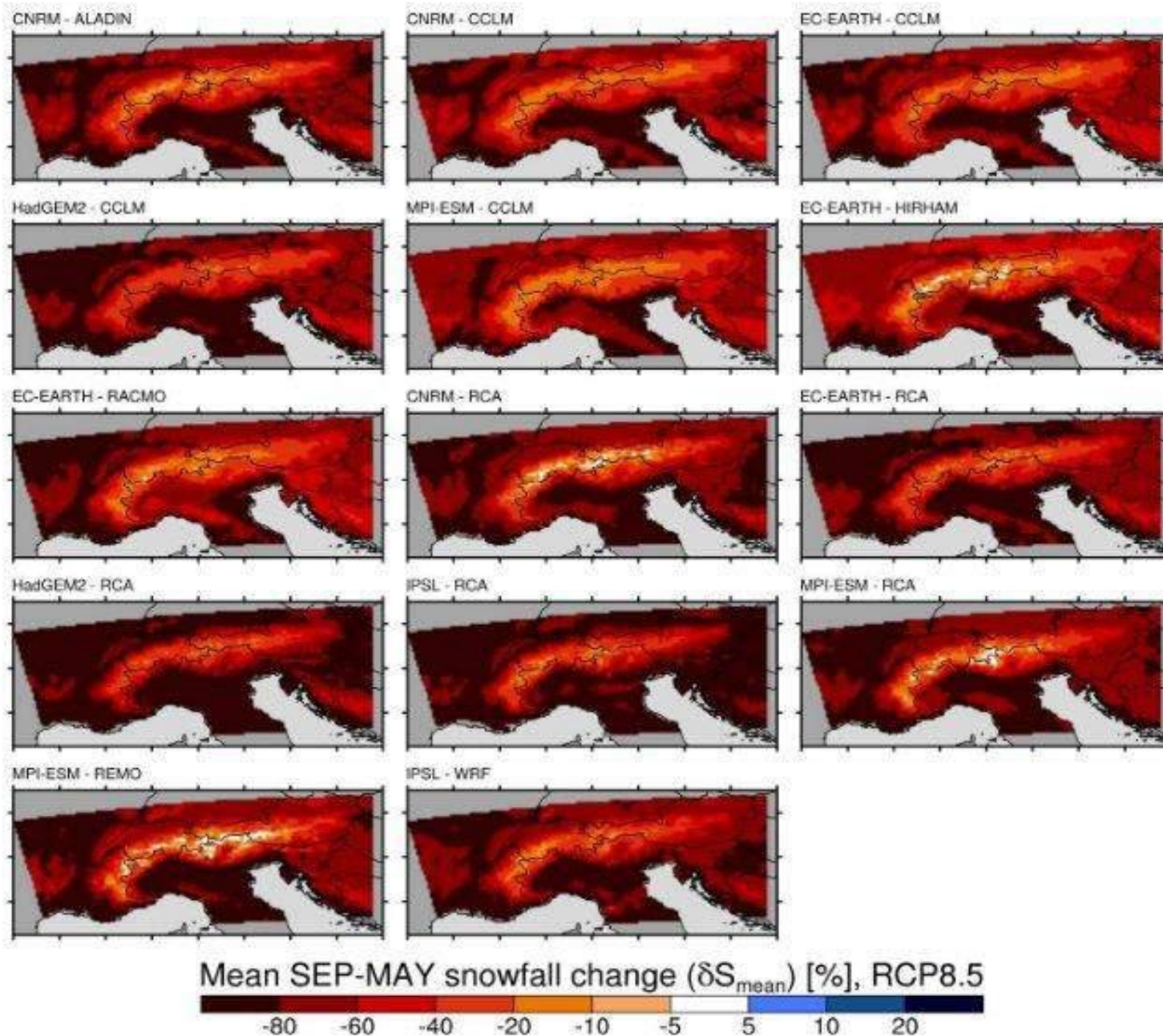
Snowfall in the Alps: Evaluation and projections based on the EURO-CORDEX regional climate models

Prisco Frei¹, Sven Kotlarski^{2,*}, Mark A. Liniger², Christoph Schär¹

¹ Institute for Atmospheric and Climate Sciences, ETH Zurich, 8006, Zurich, Switzerland

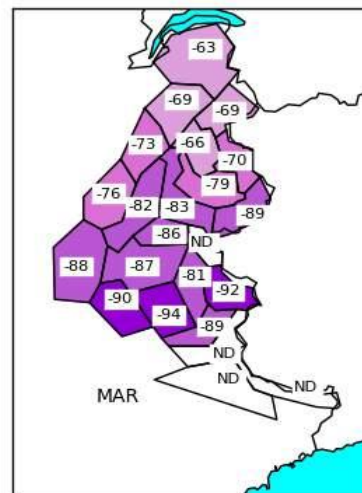
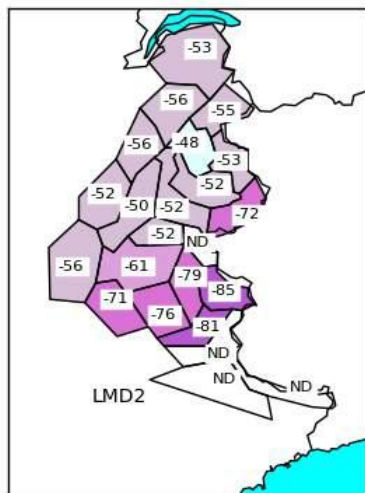
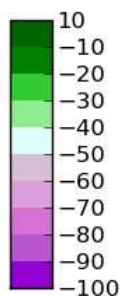
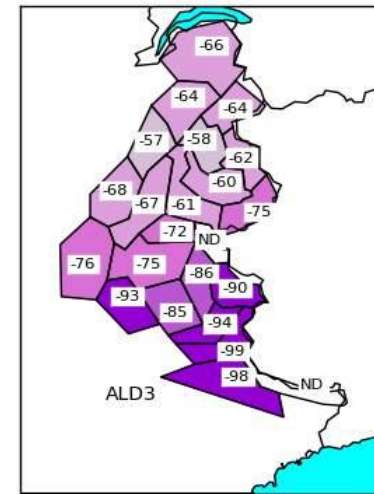
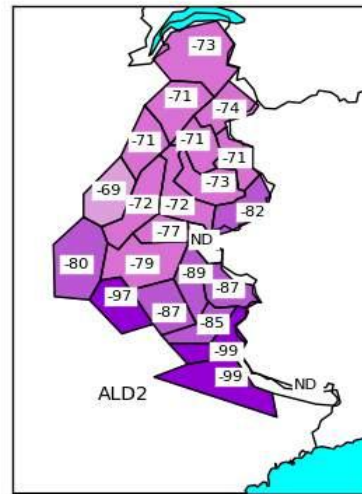
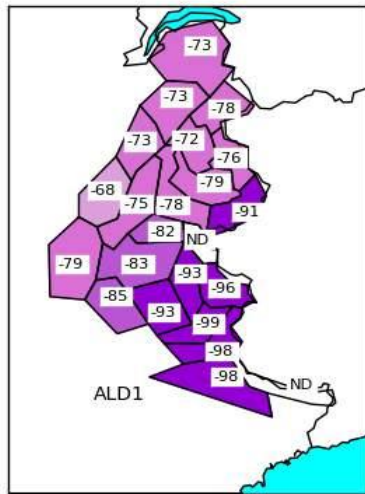
² Federal Office of Meteorology and Climatology, MeteoSwiss, 8058 Zurich-Airport, Switzerland

* Corresponding author: sven.kotlarski@meteoswiss.ch



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

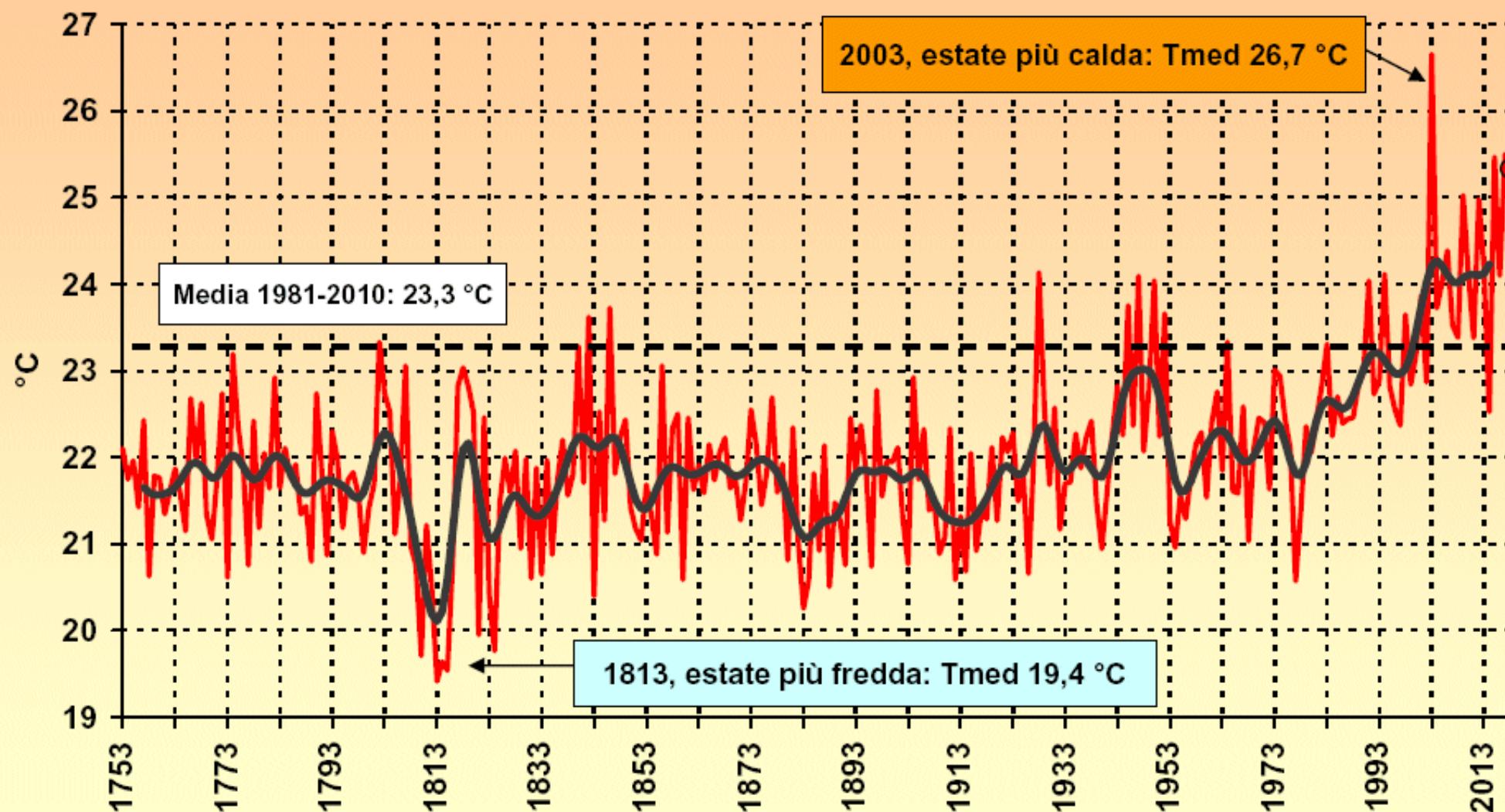
Alpes Françaises - Hauteur minimale de neige sur 100 jours (% 2030 vs 1970), alt. 1200 m



Scénarios Climatiques Adaptés
aux zones de Montagne :
Phénomènes extrêmes,
Enneigement et Incertitudes
www.umr-cnrm.fr/scampe/

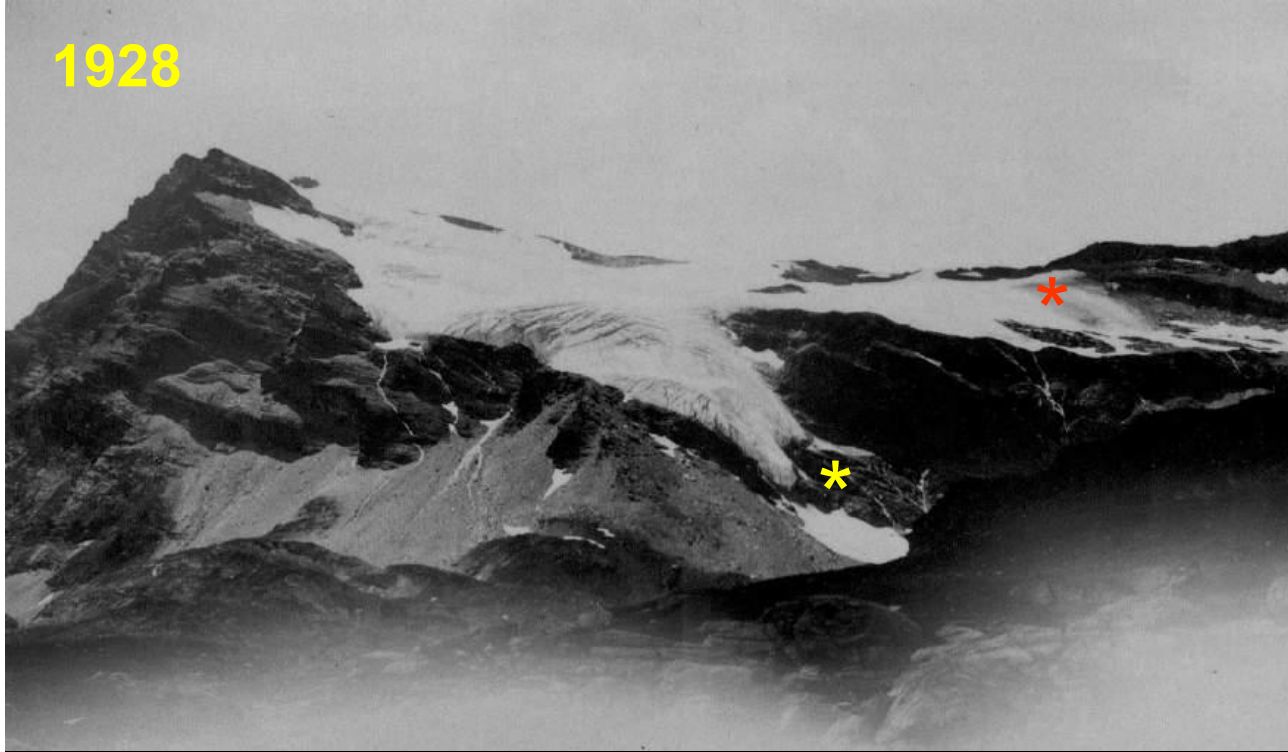
Torino - Temperature medie estive (°C) dal 1753 al 2018

(elaborazione dati: SMI - www.nimbus.it)



Calura estiva inedita nel 2003, 2015, 2017, 2018

1928

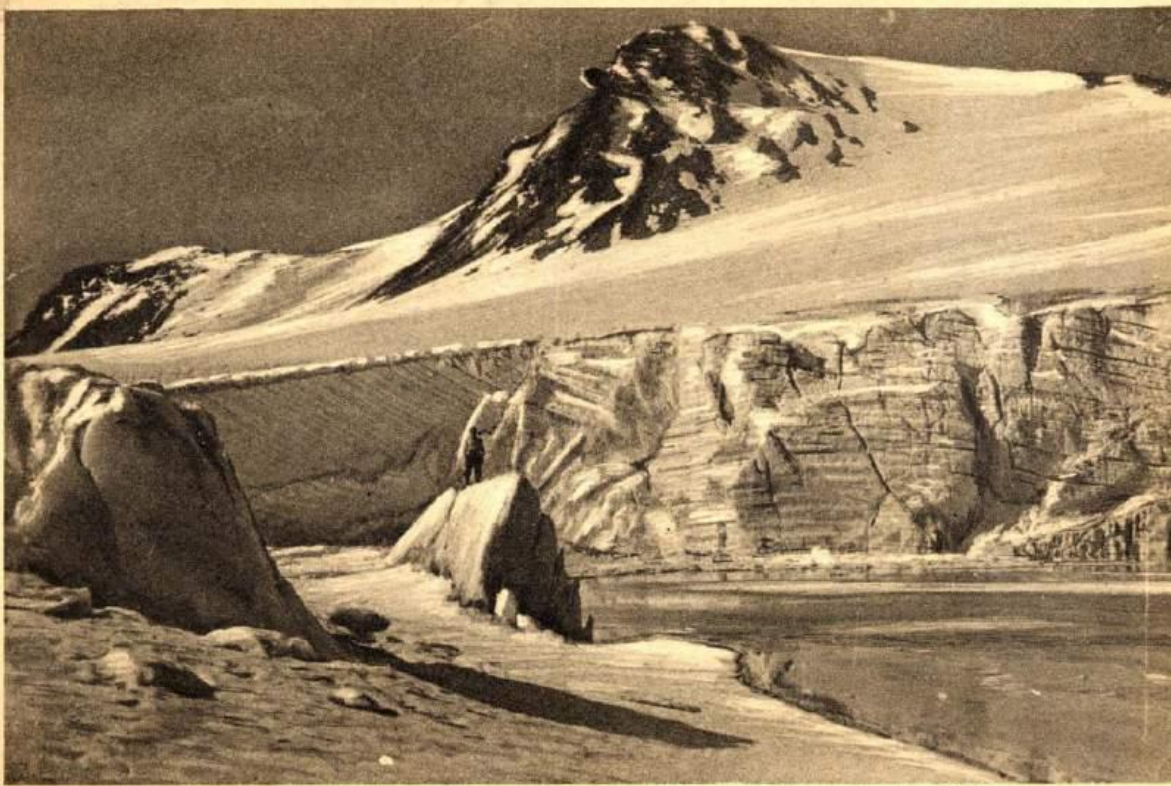


2016



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

Ghiacciaio
Basei (Colle del
Nivolet)

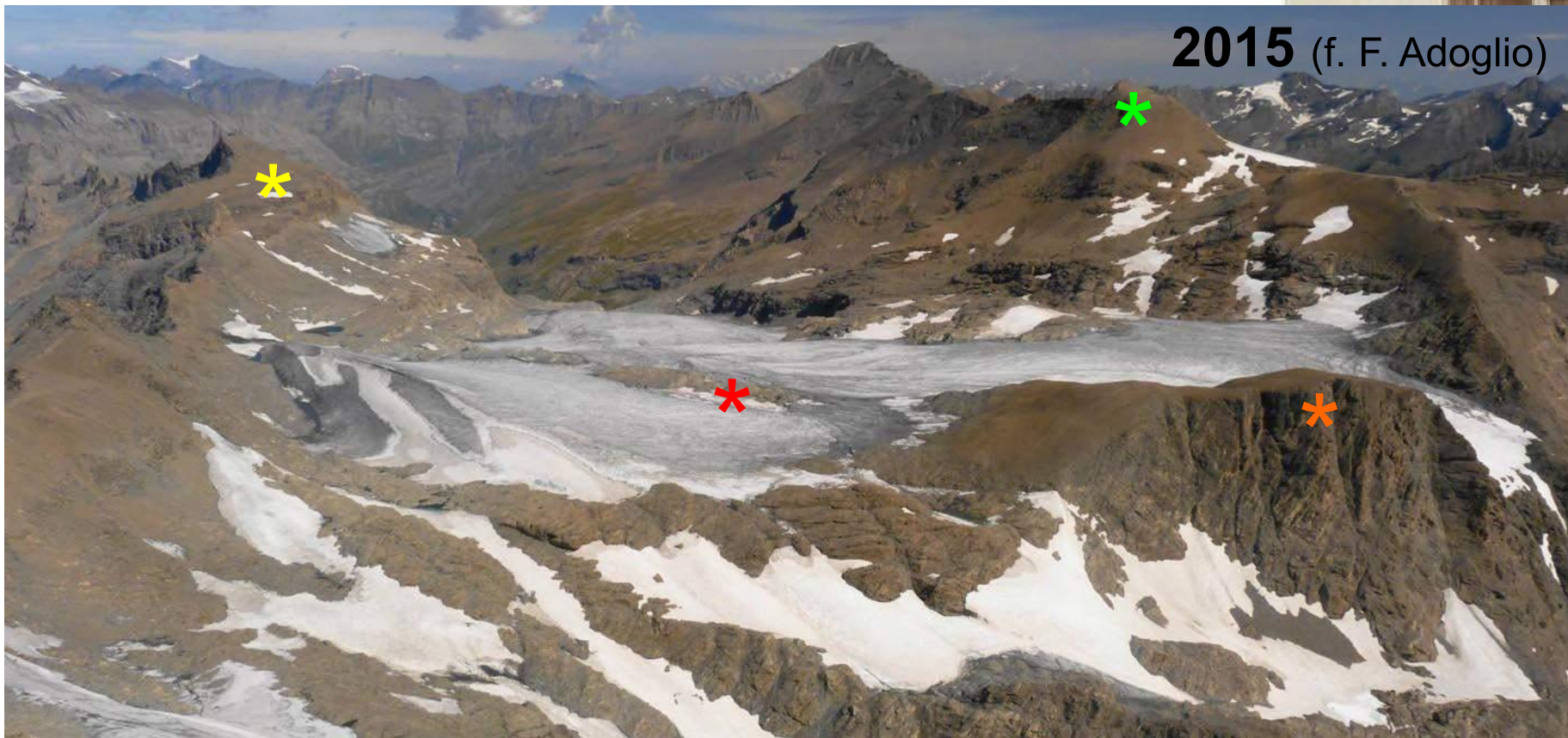


EXILLES - Alta Valle di Susa - Lago e Ghiacciaio Galambra (m. 3100)

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



Pressoché
estinto





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**

~ 1960

Archivio Pessina,
Domodossola



19.09.2018

f. L. Mercalli



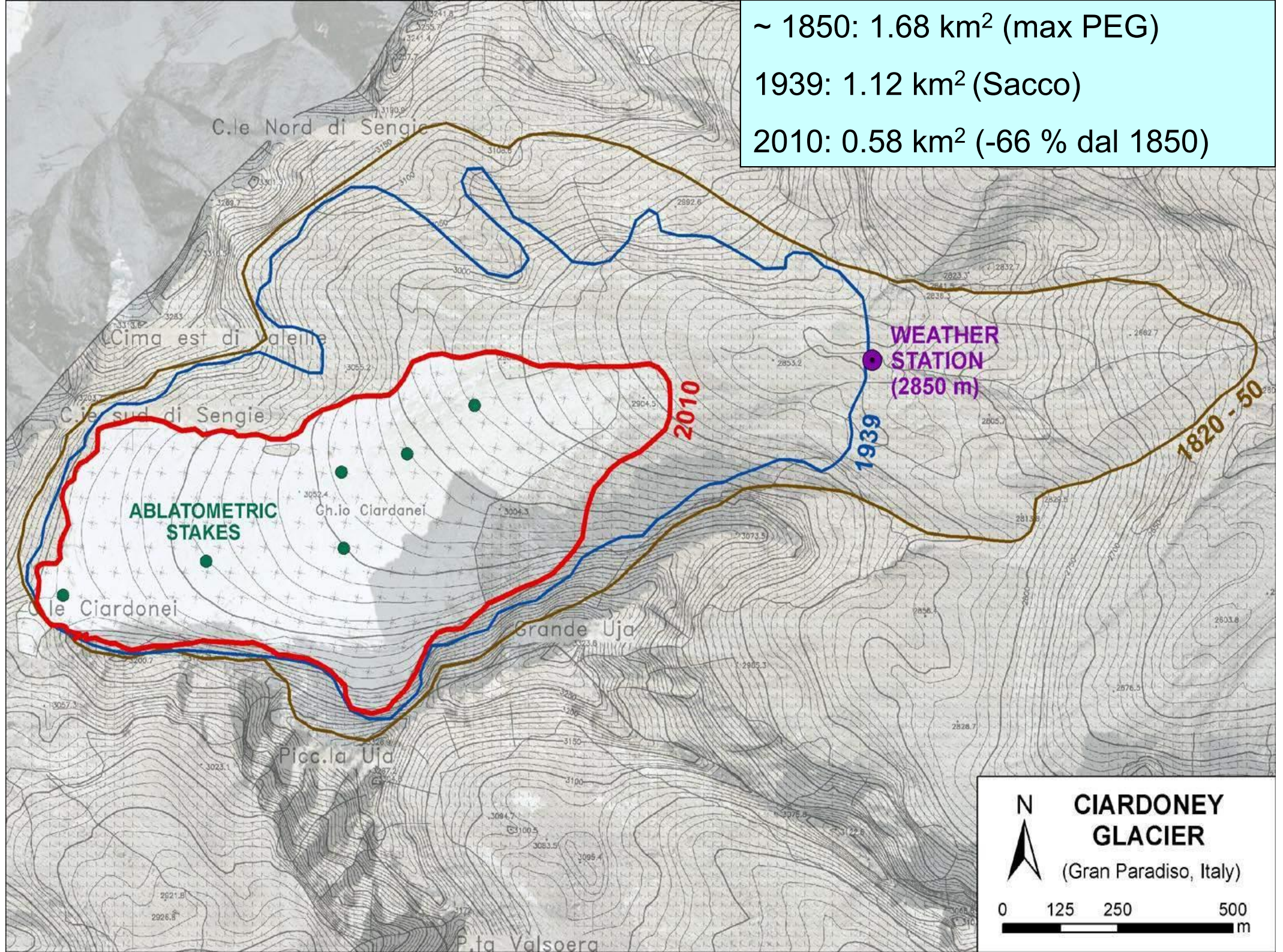
Ghiacciaio
Meridionale del
Sabbione
(Ossola)
dalla diga.

Regresso frontale
circa 1200 m.

~ 1850: 1.68 km² (max PEG)

1939: 1.12 km² (Sacco)

2010: 0.58 km² (-66 % dal 1850)



1986



Ghiacciaio
Ciardoney
1986,
ultima stagione
di avanzata
glaciale

2014



2014:
ghiacciaio in
continuo ritiro



Si pesano i campioni di neve



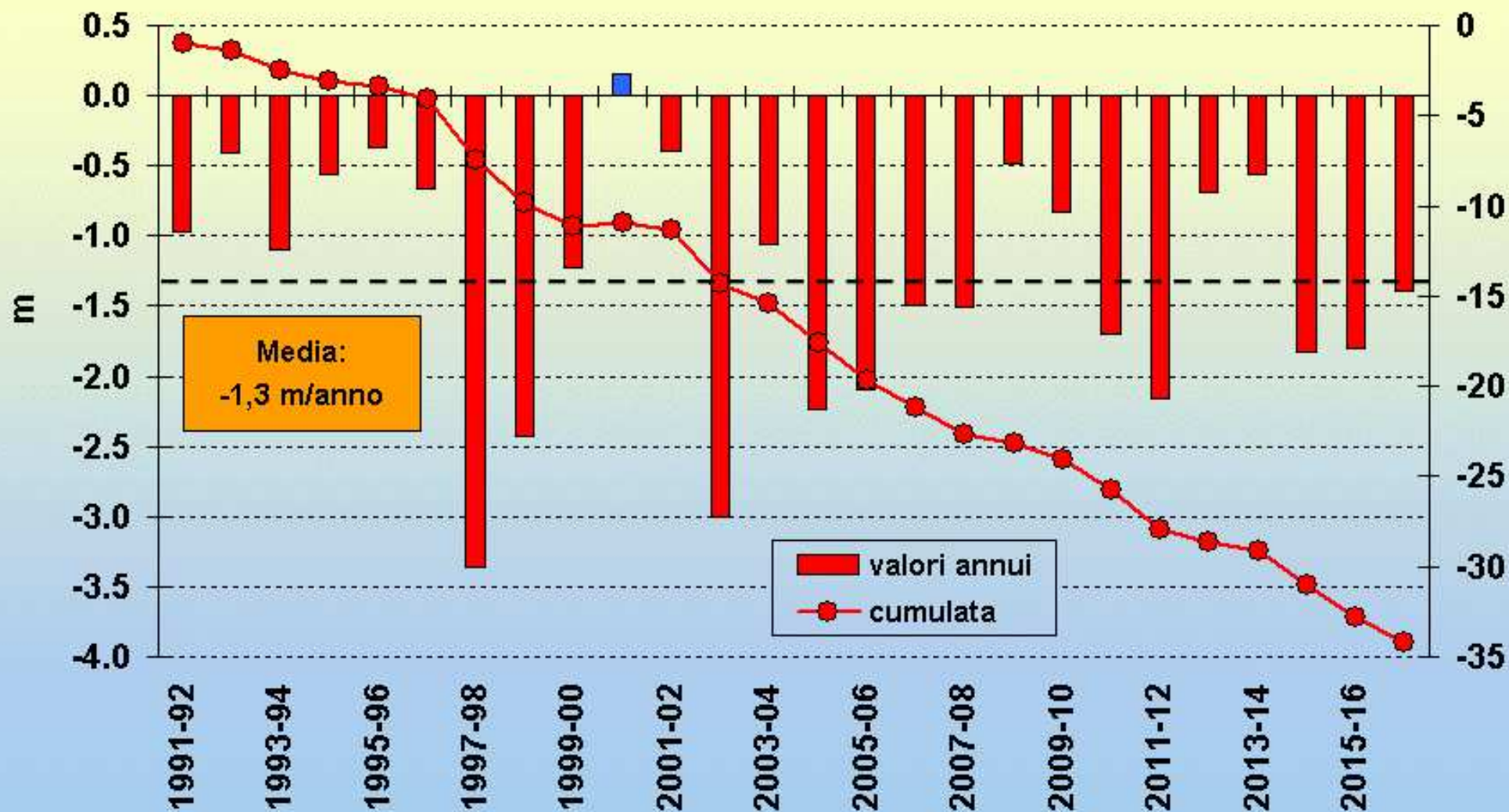
Rete di 6 paline ablatometriche per determinare le perdite annue di spessore glaciale.



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!)

Ghiacciaio Ciardoney (Gran Paradiso) - Bilancio di massa annuo e cumulato tra le stagioni 1991-92 e 2016-17



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

Sopravvivenza prevista: 20-30 anni.



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

M. Huss^{1,*}

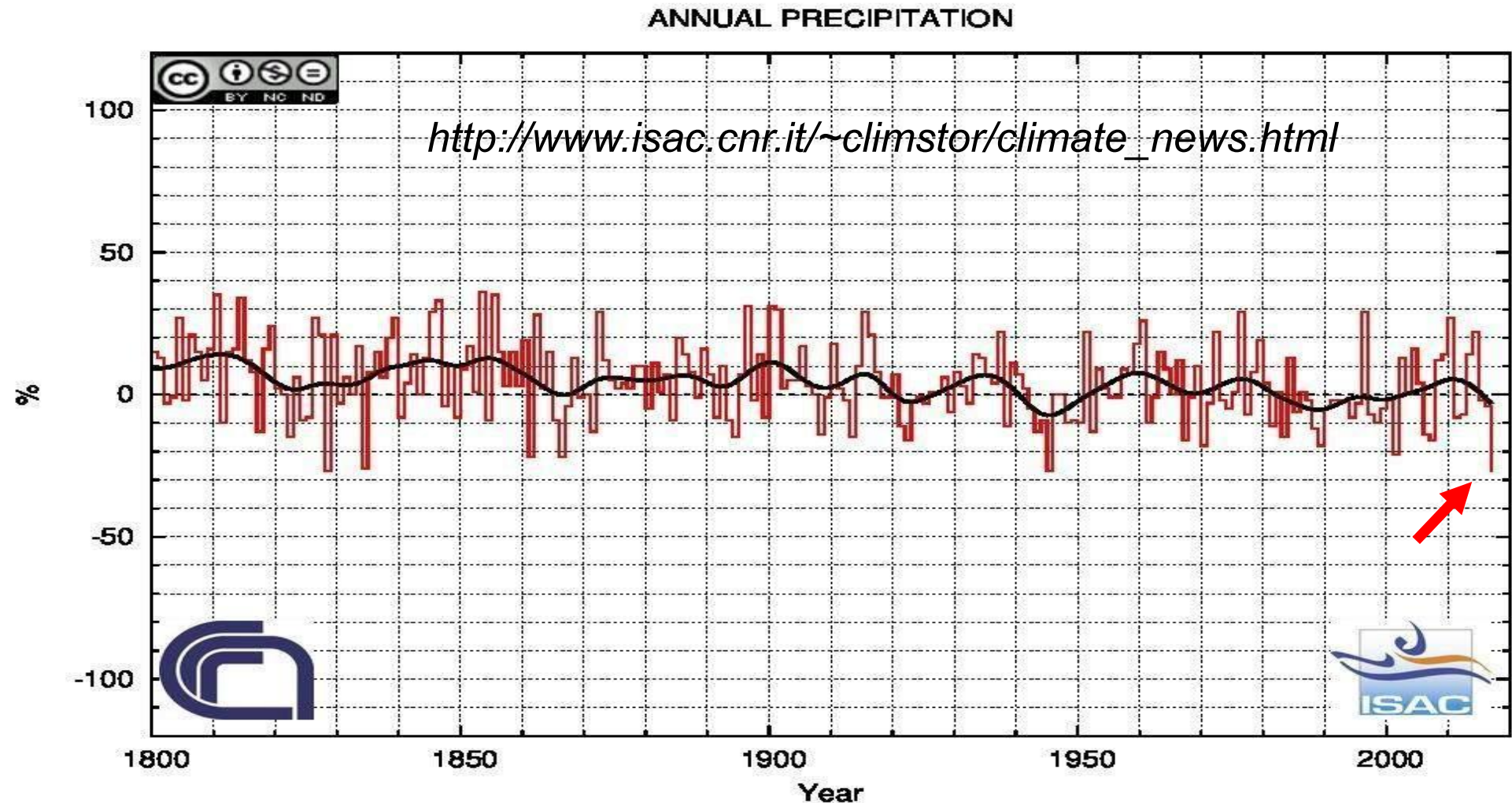
¹Department of Geosciences, University of Fribourg, 1700 Fribourg, Switzerland

^{*}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 $+3.9 \text{ km}^3$ (1977). Mean mass balances are expected to be around $-1.3 \text{ m w.e. a}^{-1}$ 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

Val Susa,
ottobre 2017

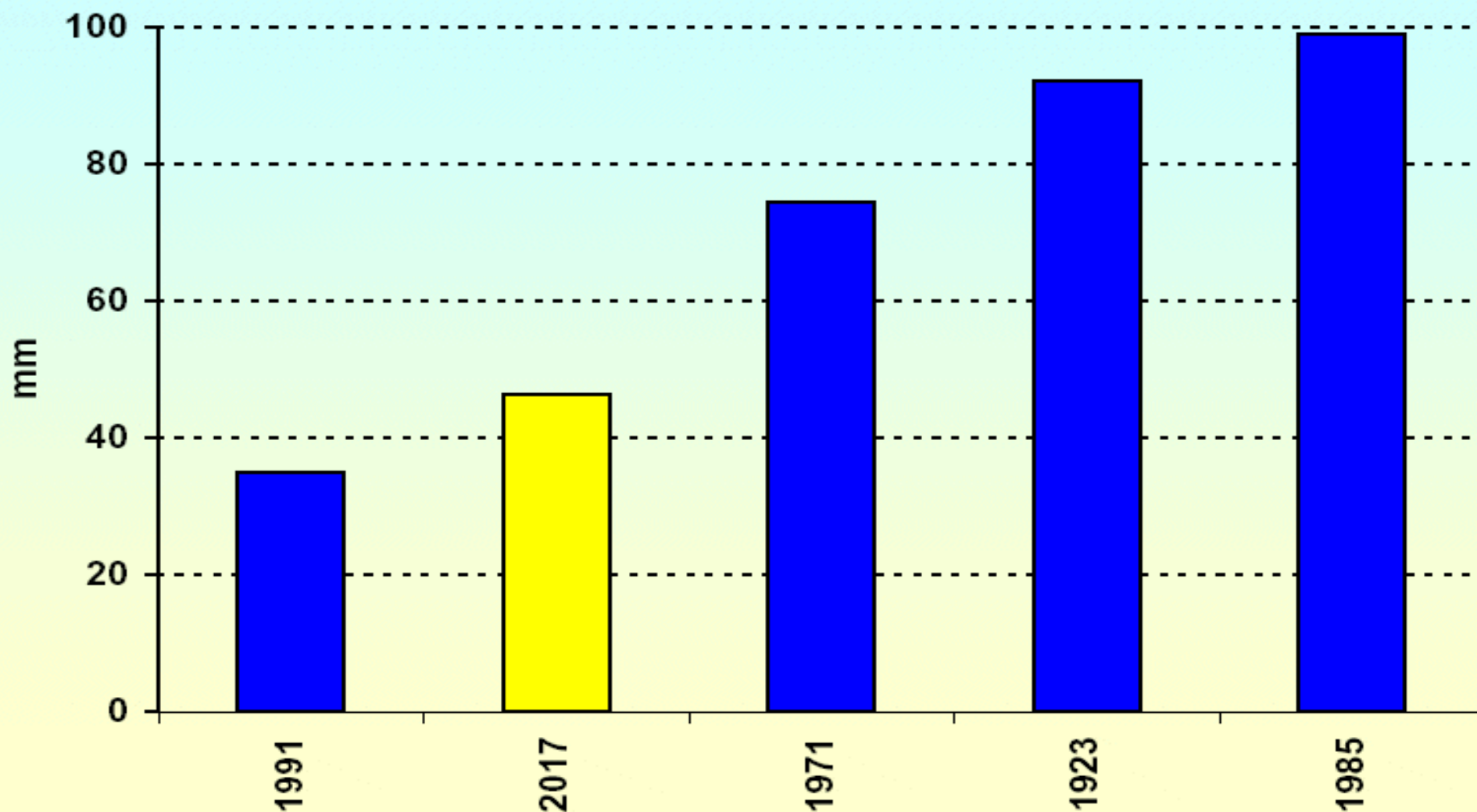
Siccità estrema 2017
in Piemonte
(-40% precipitazioni).

Colpa dei cambiamenti
climatici? In parte sì.

Effetti aggravati
dal caldo anomalo.

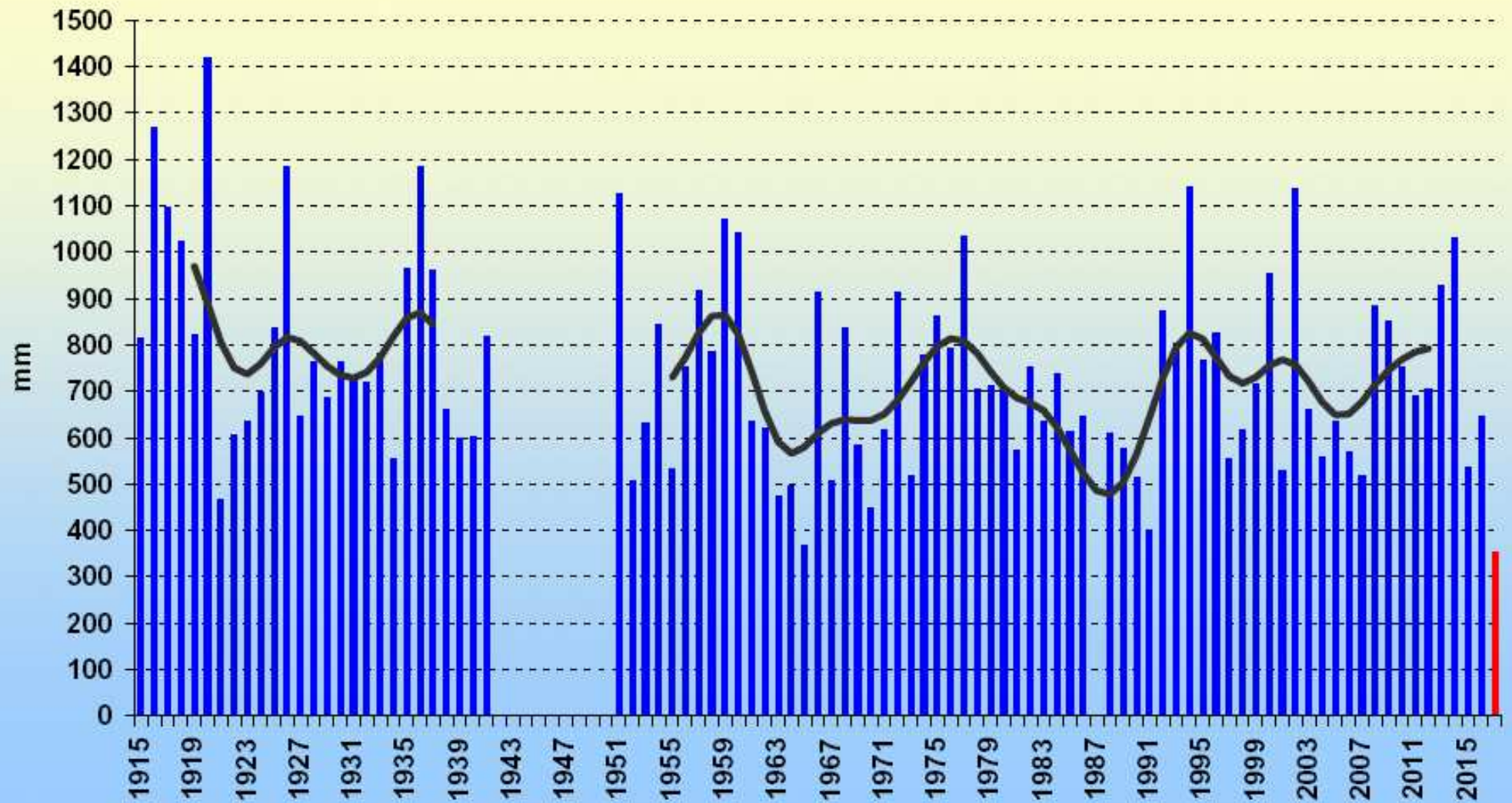


Acqui Terme - I 5 periodi giugno-ottobre più secchi dal 1915



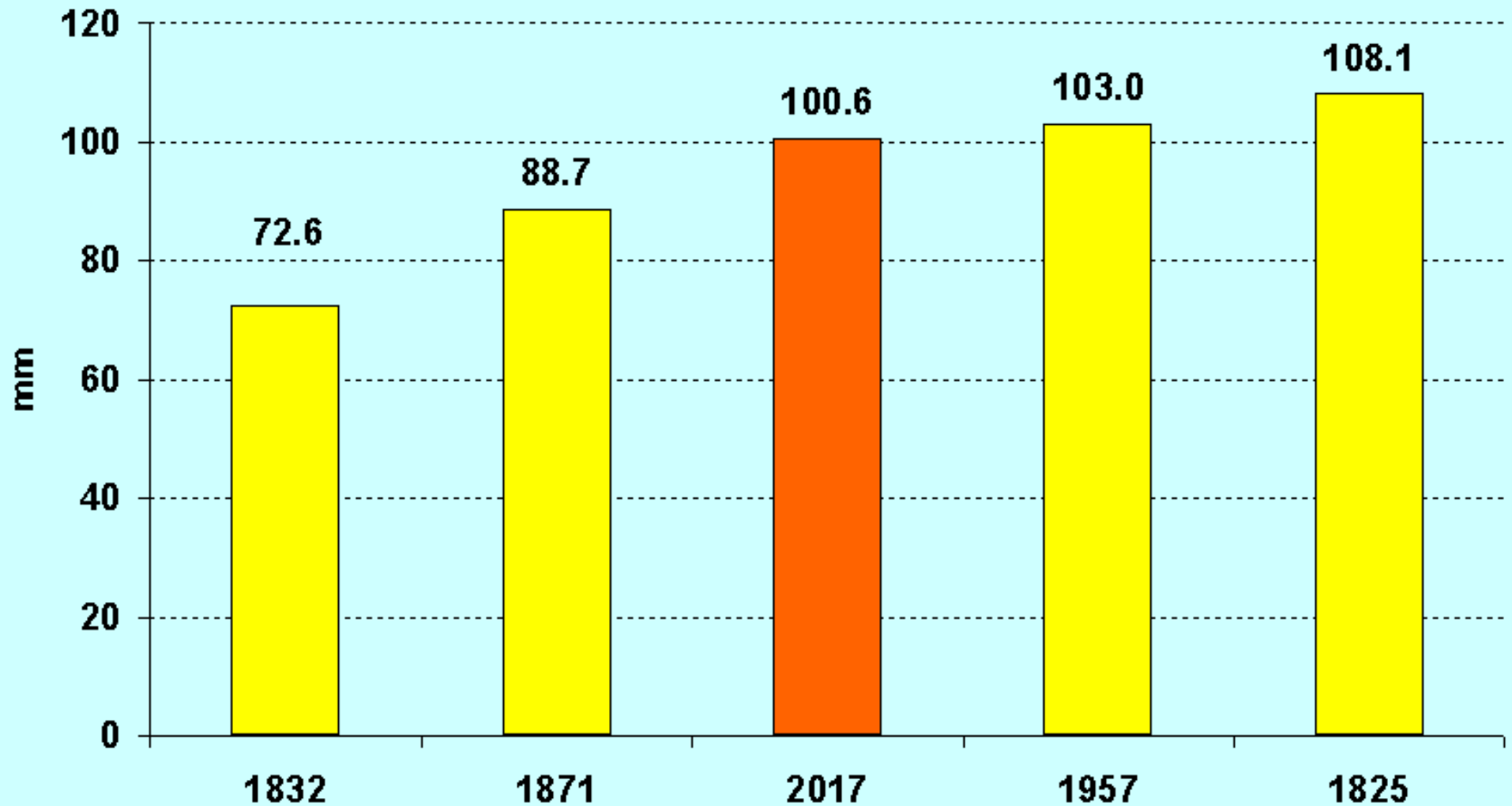
Straordinaria siccità estiva-autunnale nel Piemonte meridionale: peggio di così ad Acqui solo nel 1991. 46 mm (ARPA Piemonte), 16% del normale.

Acqui Terme - Precipitazioni annue dal 1915 al 2017 (mm di pioggia e neve fusa)
(elaborazione dati: SMI - www.nimbus.it)



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

I 5 periodi luglio-ottobre più secchi dal 1802 a Torino



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

Susa, 27 ottobre 2017



Oltre 7000 ettari bruciati sulle Alpi piemontesi

Maggior consumo di acqua durante ondate di caldo estivo

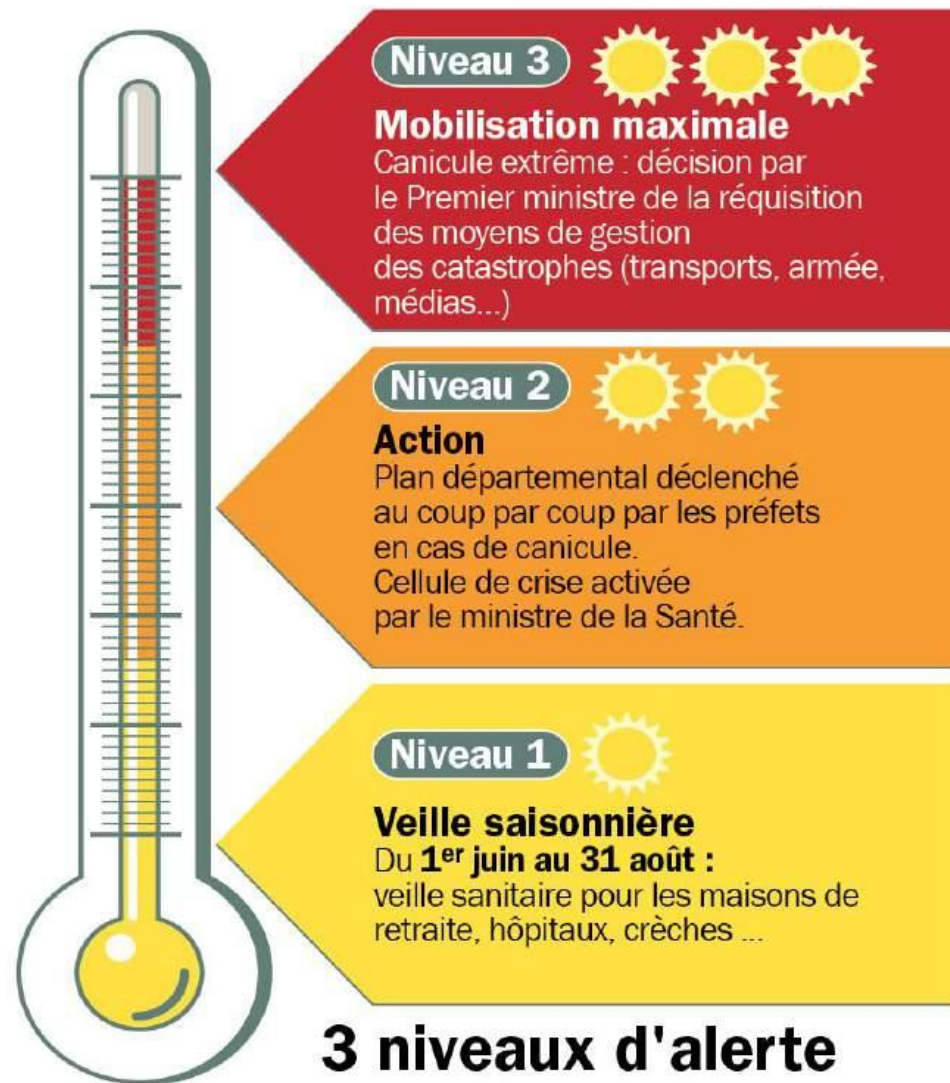
Canicule

5 conseils pour prévenir les risques

- 1 Buvez fréquemment et abondamment**
(au moins 1,5 litre d'eau par jour même si vous n'avez pas soif)
- 2 Évitez de sortir aux heures les plus chaudes et de pratiquer une activité physique, maintenez votre logement frais**
(fermez fenêtres et volets la journée, ouvrez-les le soir et la nuit s'il fait plus frais)
- 3 Rafraîchissez-vous et mouillez-vous le corps plusieurs fois par jour**
(douches, bains, brumisateurs ou gant de toilette mouillé, sans vous sécher)
- 4 Passez si possible 2 à 3 heures par jour dans un endroit frais**
(cinémas, bibliothèques municipales, supermarchés...)
- 5 Aidez les personnes les plus fragiles et demandez de l'aide**
(notamment auprès de votre mairie)

Le plan canicule



Pour plus d'information :
0821 22 23 00 (0,12 €/minute)

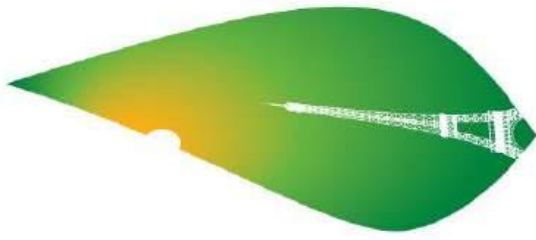
www.sante.gouv.fr/canicule/



Numéro vert du ministère
de la Santé : **0 800 06 66 66**

Source : ministère de la Santé





PARIS2015
UN CLIMATE CHANGE CONFERENCE
COP21•CMP11

30 NOVEMBRE - 11 DÉCEMBRE 2015

21^E 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



The screenshot shows the IPCC website homepage. At the top, there is a blue header with the IPCC logo (WMO and UNEP) and the text "INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE". Below the header, there is a navigation menu on the left with links: Home, About IPCC, Meetings and Communication, IPCC Reports, Guided Publications & Services, Information for the Media, IPCC Glossary, and Links. The main content area features a large banner for the "20 years IPCC" anniversary, dated 31st August 2008, with a photo of a building. To the right of the banner, there is a "NEWS" section with two items: "1 December 2009: Speech by Mr. Rajendra Pachauri, IPCC Chairman, at the Opening Ceremony of the UNFCCC COP14, Poznan" and "2 December 2009: IPCC side event: 'The IPCC scientific perspective'". Below the news section, there is a link to "IPCC Technical Paper on Climate Change and Water". At the bottom right, there is a red box for the "IPCC 20th Anniversary Series & IPCC 20th Anniversary Geneva Symposium".

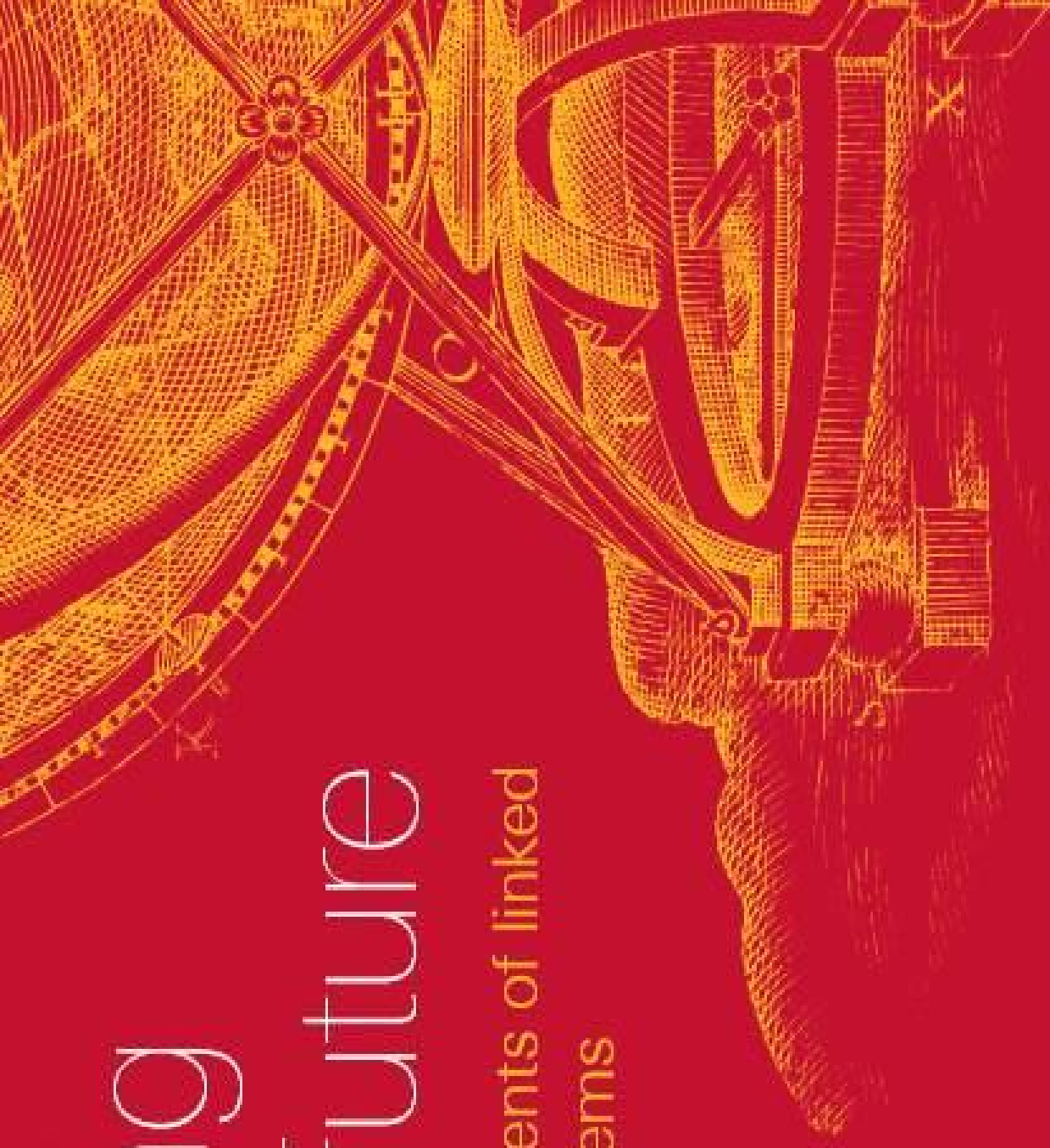
Modeling Earth's future

Integrated assessments of linked
human-natural systems

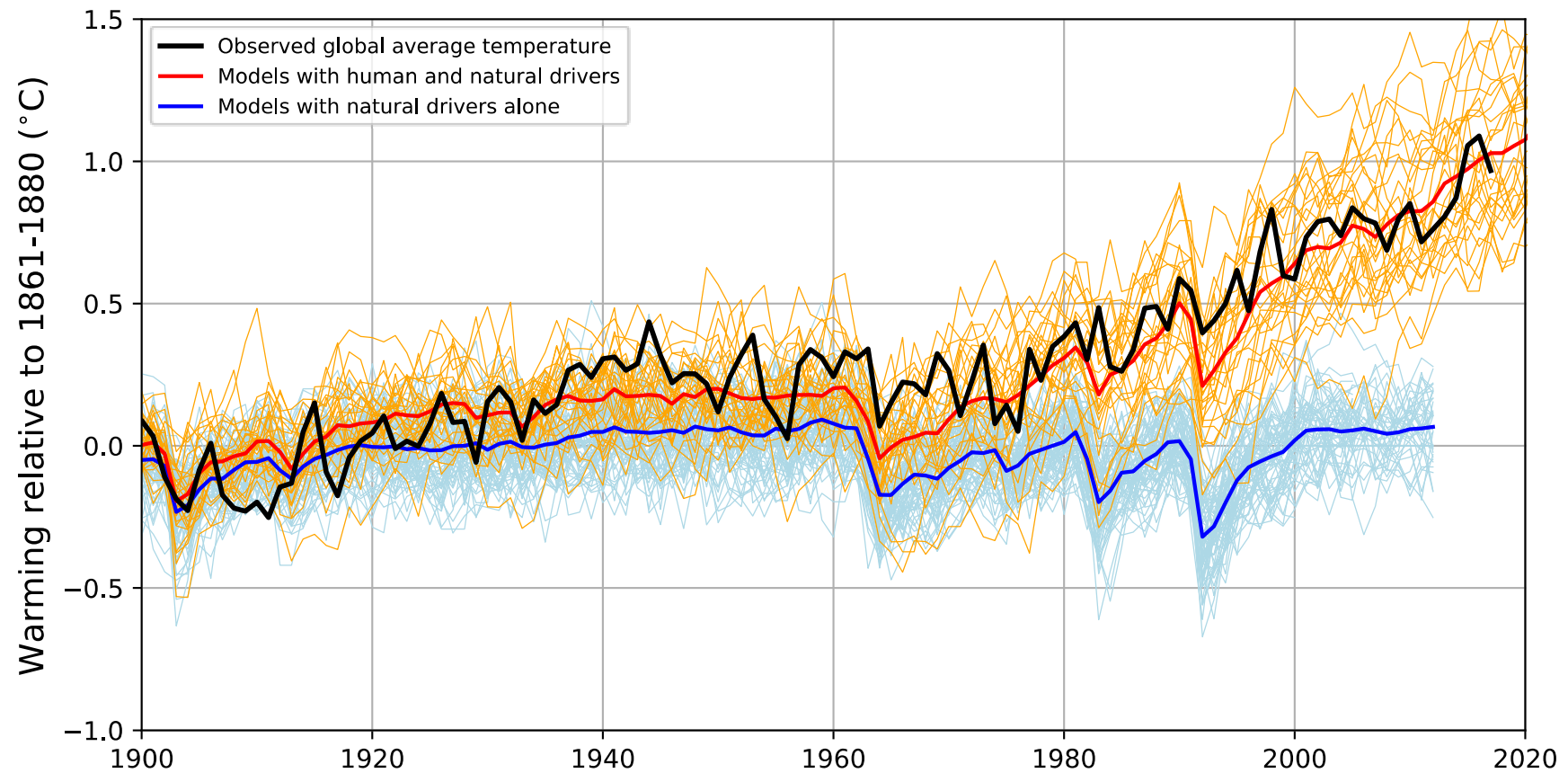
THE
ROYAL
SOCIETY



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



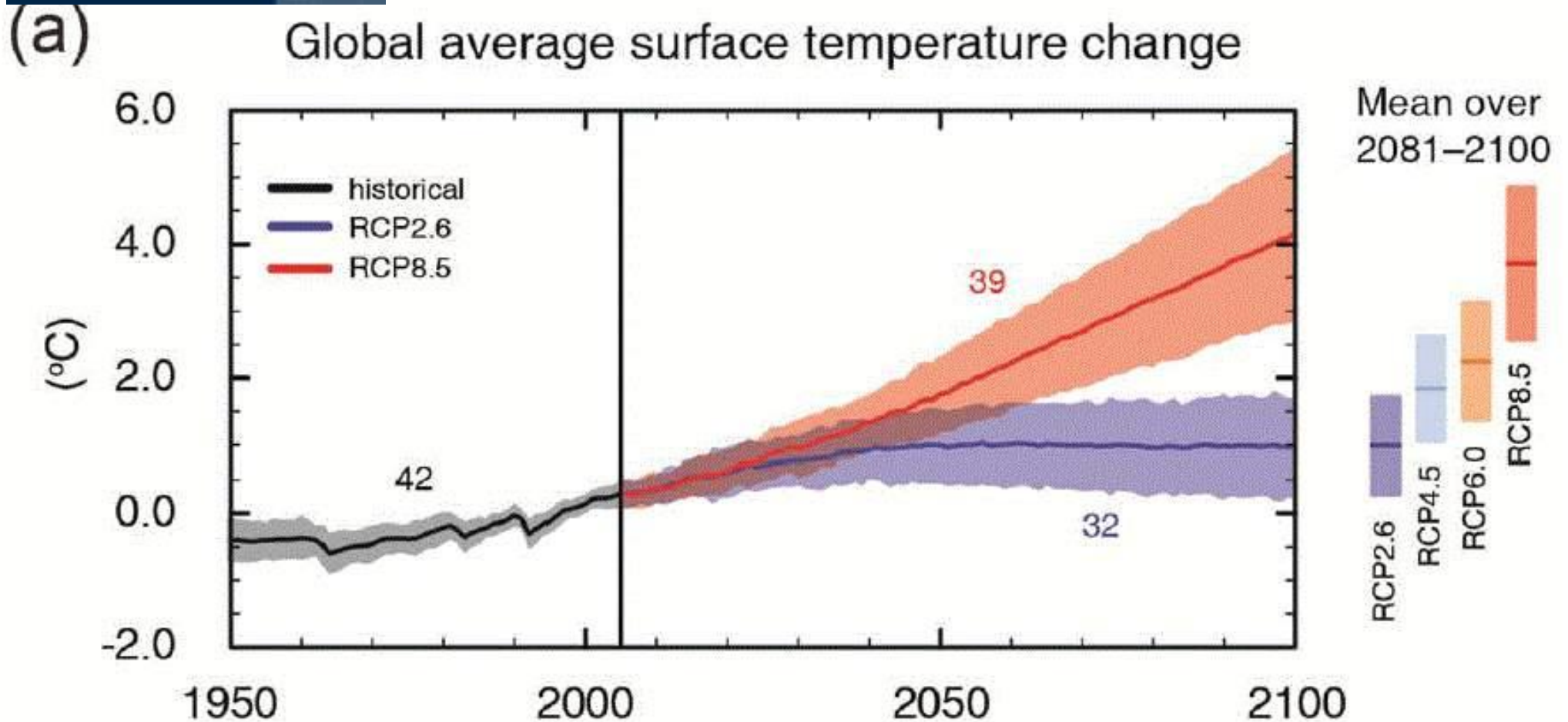
Climate models reproduce observed warming only when human influences are included



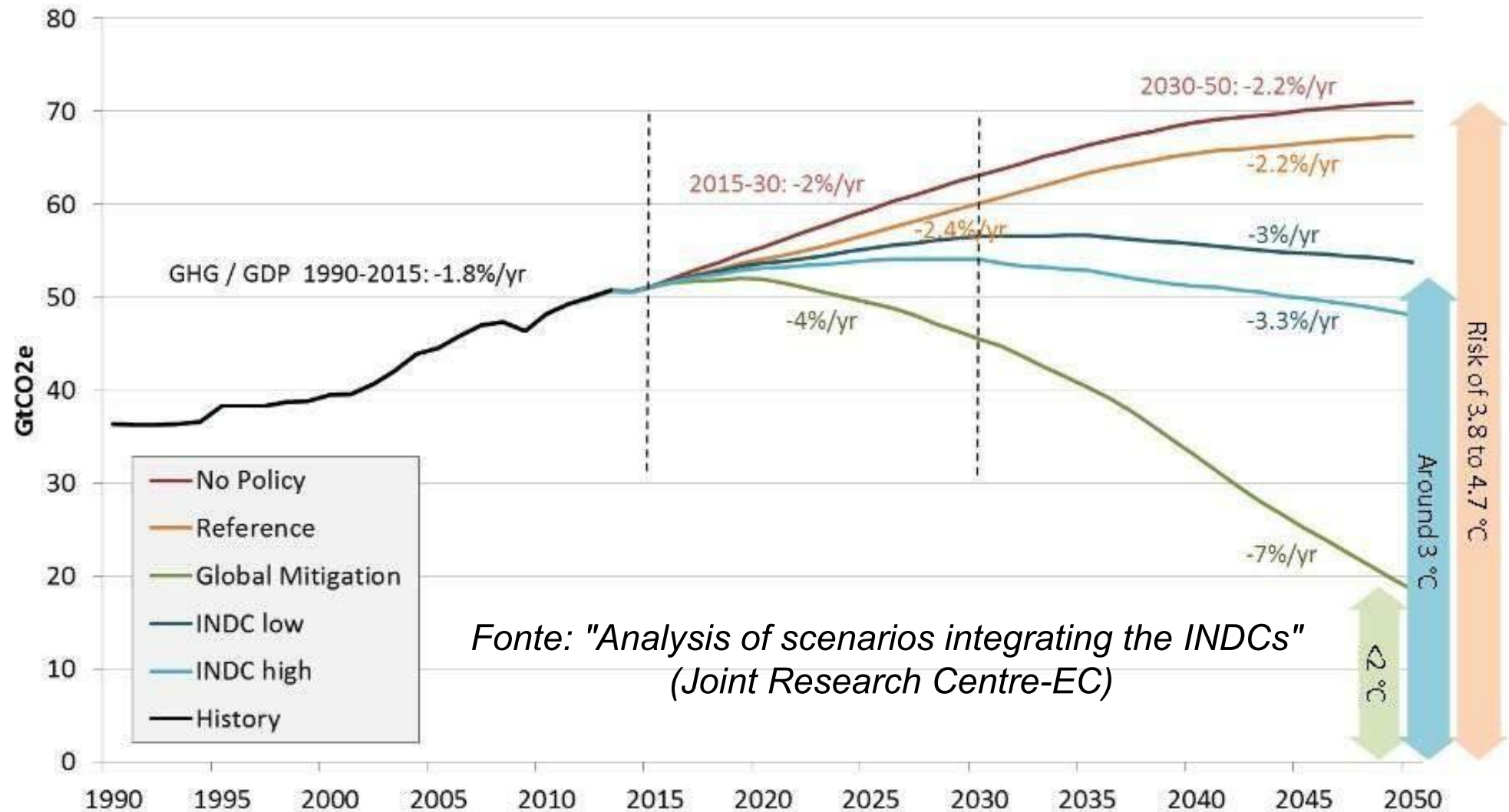
Richardson et al, 2017



Il futuro della temperatura globale secondo IPCC AR5 (2013): +2 o +5°C?



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



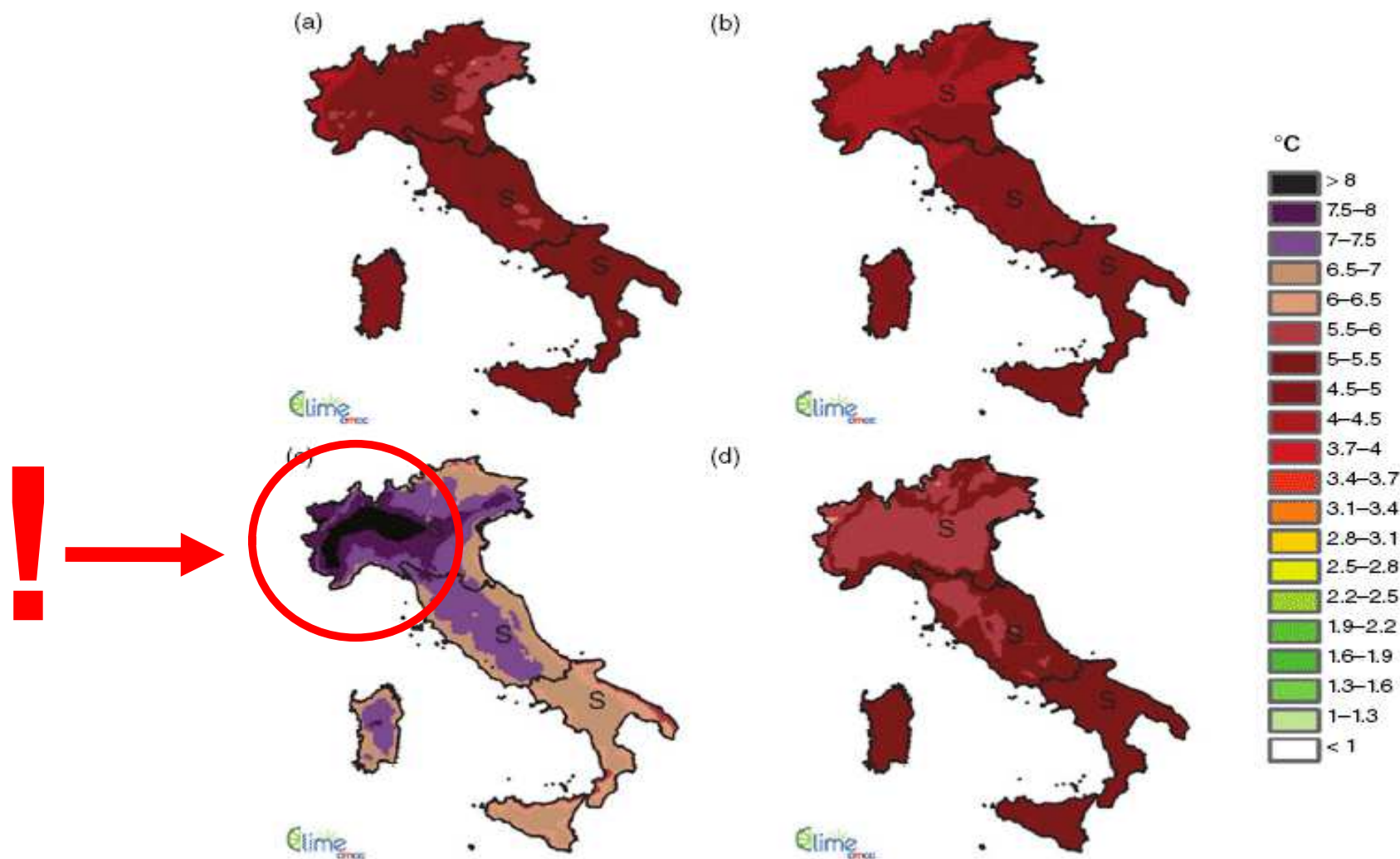


Figure 9. Temperature climate projections, RCP8.5: seasonal differences (°C), between the average value over 2071–2100 and 1971–2000 for (a) DJF, (b) MAM, (c) JJA and (d) SON (S, significant; NS, not significant).

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.

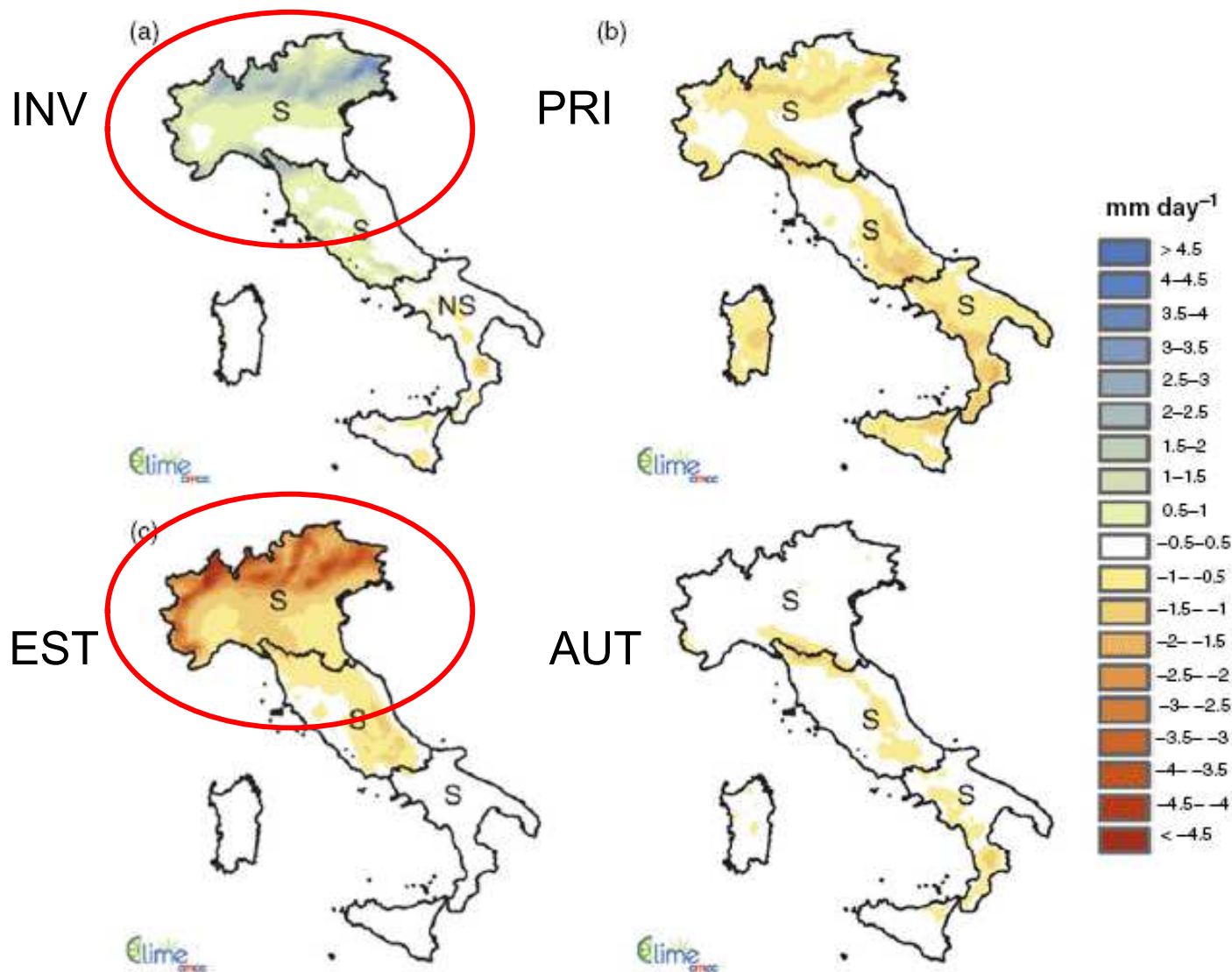


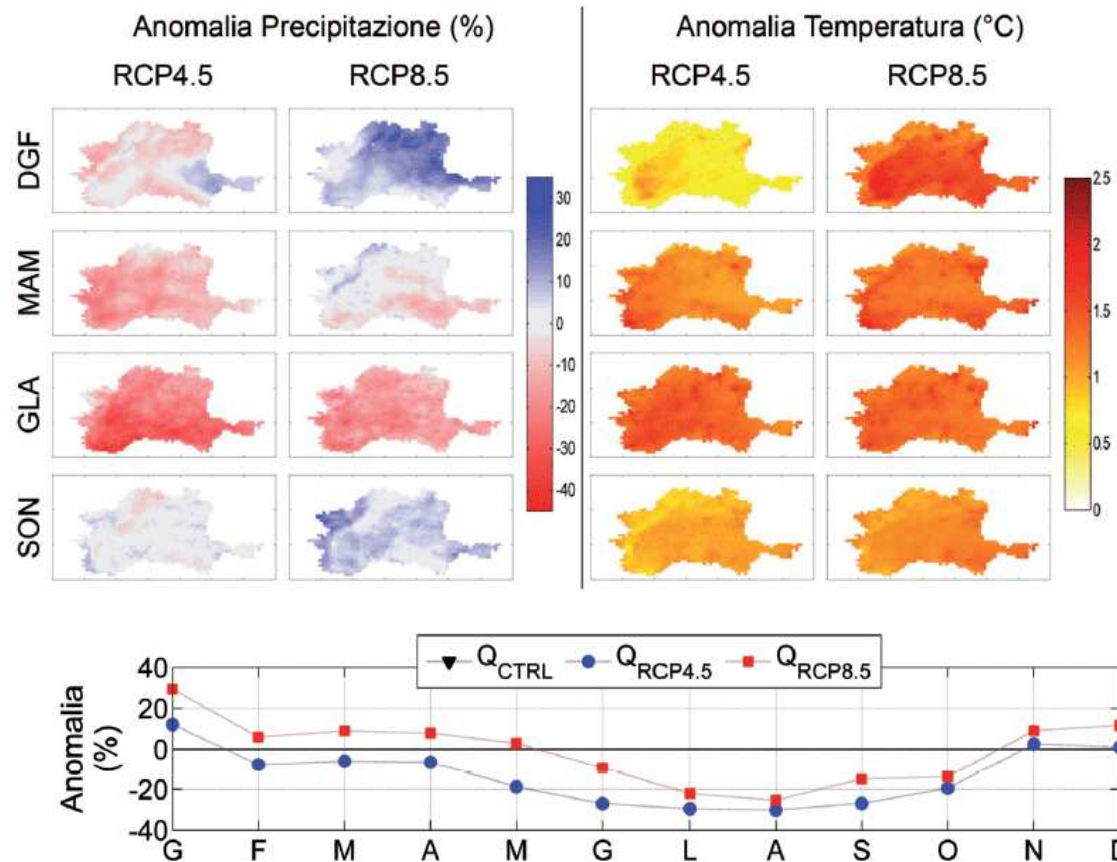
Figure 12. Precipitation climate projections, RCP8.5: seasonal differences (mm day^{-1}), between the average value over 2071–2100 and 1971–2000 for (a) DJF, (b) MAM, (c) JJA and (d) SON (S, significant; NS, not significant).

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)

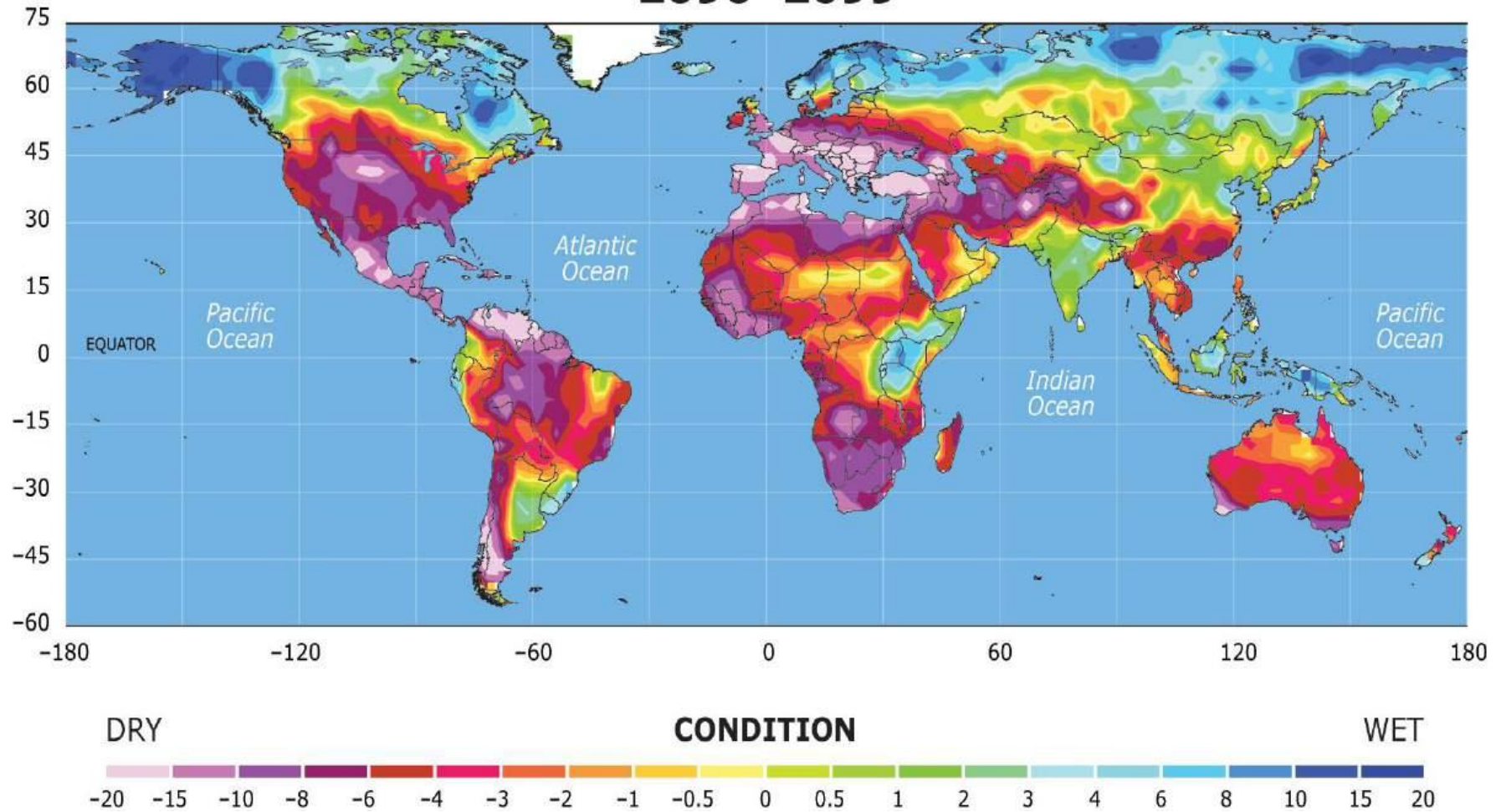
**In futuro più siccità
estive e minore
portata di Po e
affluenti
(fino a -30%
verso il 2050)**



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?

2090–2099 NCAR, Boulder (2010)



Indice di severità potenziale delle siccità future nel mondo
 < -4 = siccità estrema

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

MANAGING THE RISKS OF EXTREME
EVENTS AND DISASTERS TO ADVANCE
CLIMATE CHANGE ADAPTATION



SPECIAL REPORT OF THE
INTERGOVERNMENTAL PANEL
ON CLIMATE CHANGE



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)



Polesine - 1951



Firenze - 1966



Alpi occidentali - 2000

Nubifragi localizzati > flash-flood (talora meno prevedibili)



Sestri Ponente - 2010



5 Terre e Lunigiana - 2011



Genova - 2011



Vipiteno - 2012



Torino - 2012

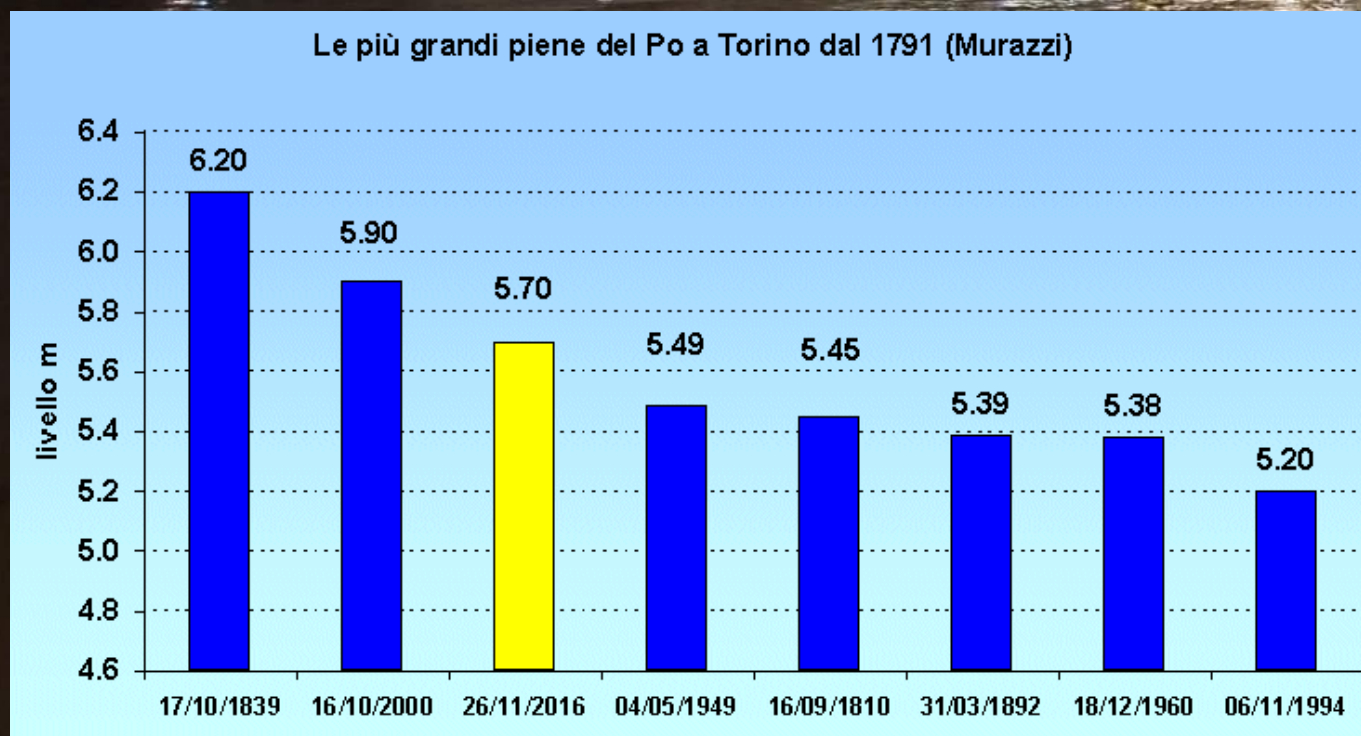


Lipari - 2012



Napoli - 2012

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



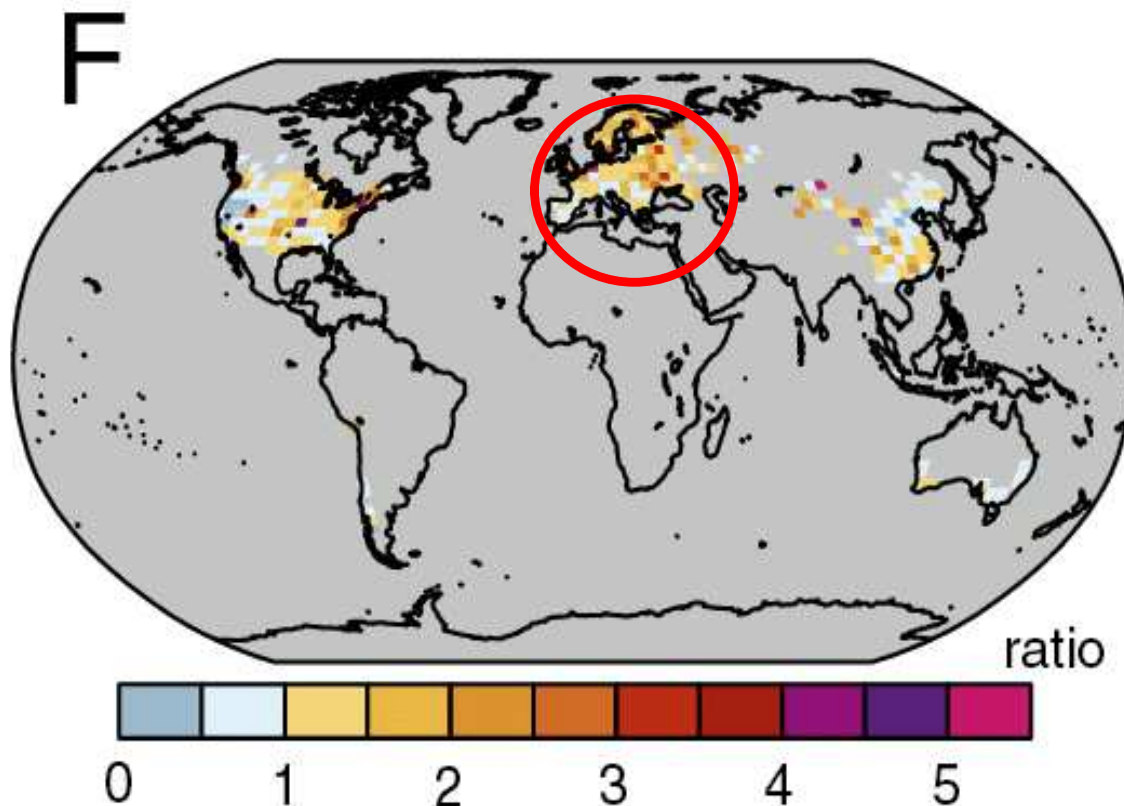
Torino-Murazzi,
25 novembre 2016
(f. L. Mercalli)

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}

^aDepartment of Earth System Science, Stanford University, Stanford, CA 94305; ^bWoods Institute for the Environment, Stanford University, Stanford, CA 94305; ^cLamont-Doherty Earth Observatory, Columbia University, Palisades, NY 10964; ^dEmmett Interdisciplinary Program in Environment and Resources, Stanford University, Stanford, CA 94305; ^eNASA Goddard Institute for Space Studies, New York, NY 10025; ^fDepartment of Earth and Planetary Sciences, Northwestern University, Evanston, IL 60208; ^gInstitute of the Environment and Sustainability, University of California, Los Angeles, CA 90095; ^hDepartment of Statistics, University of California, Los Angeles, CA 90095; and ⁱDepartment 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)



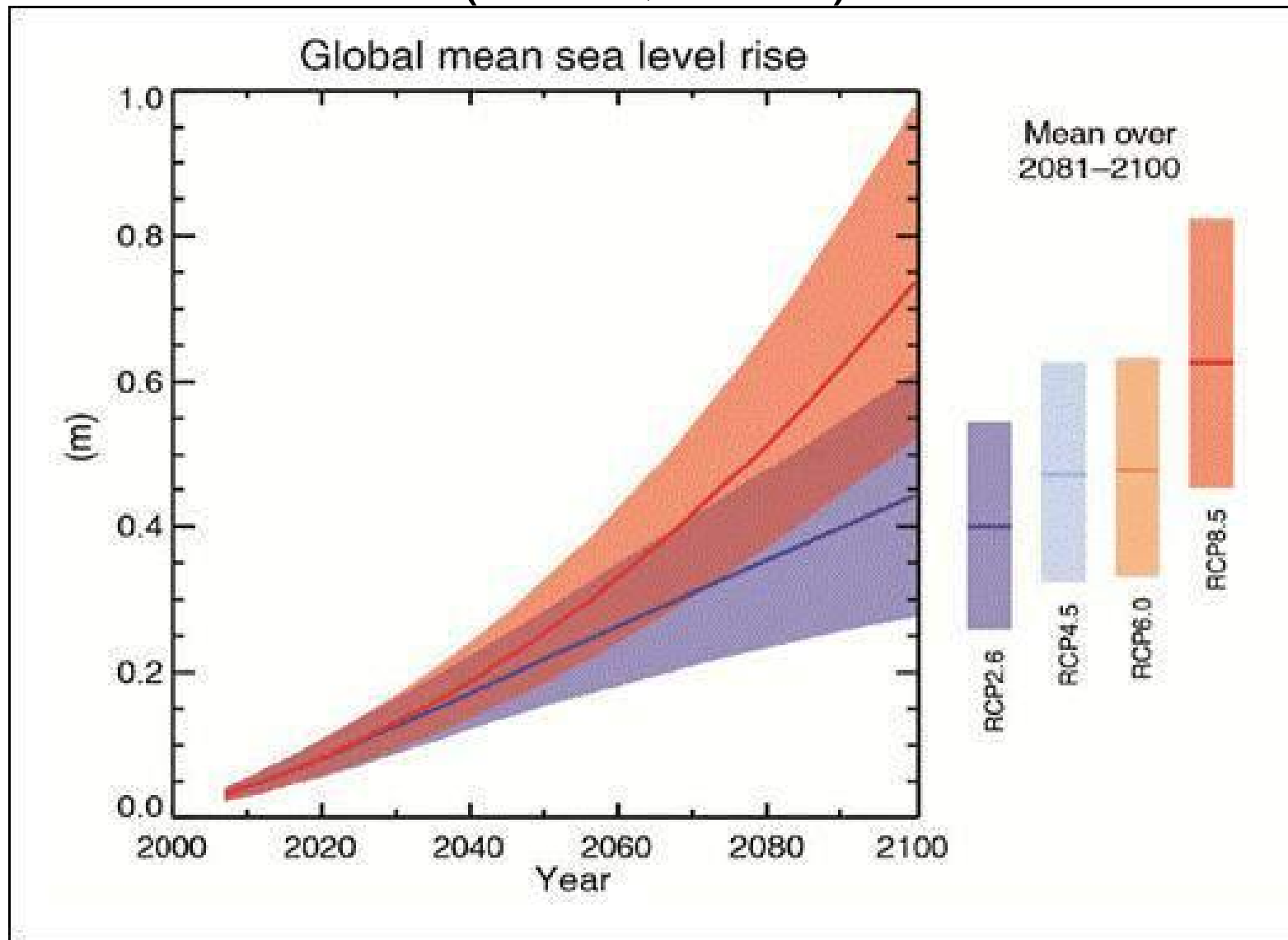
Primi segnali da altri studi

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



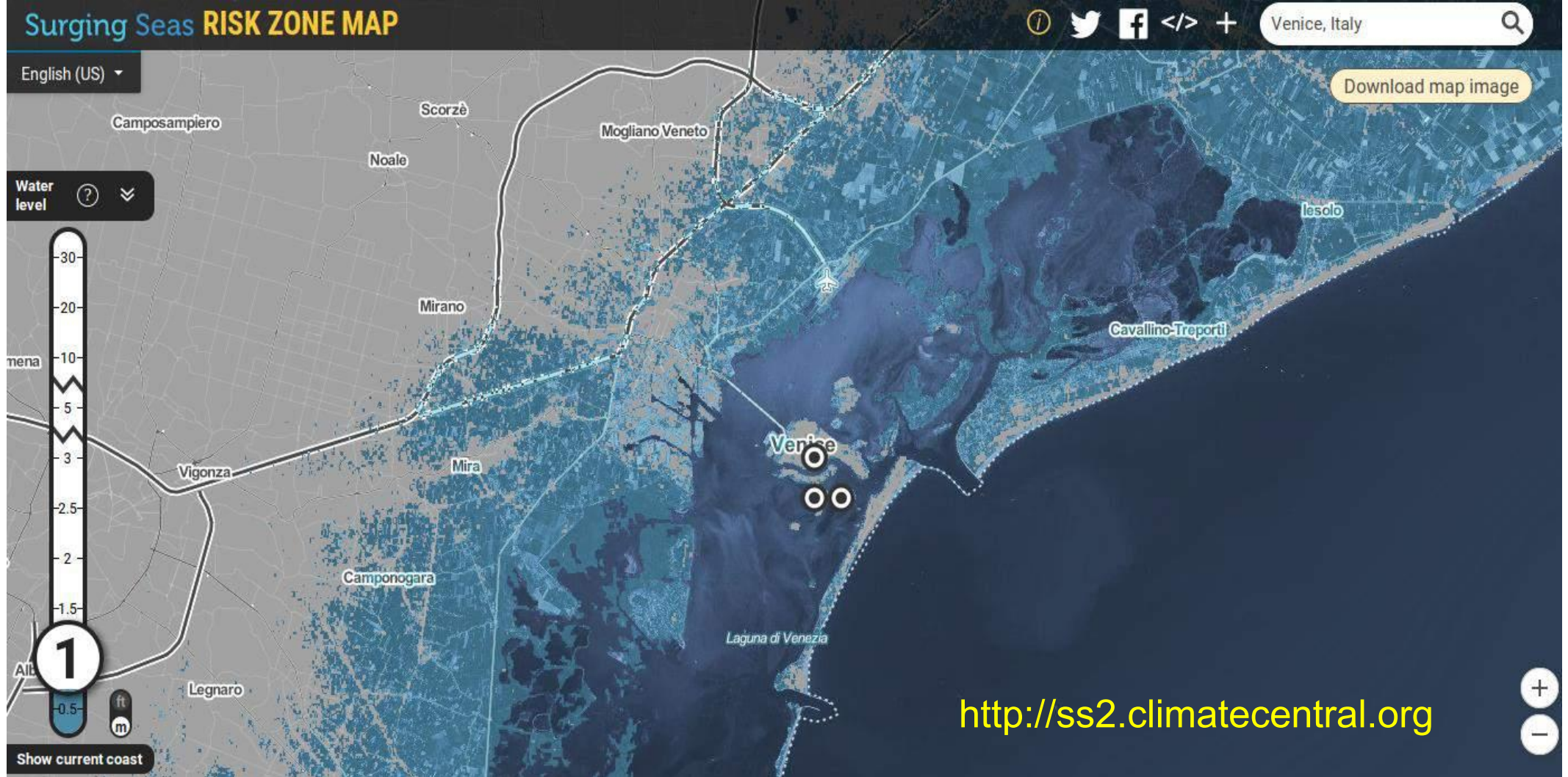
Aumento livello marino

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



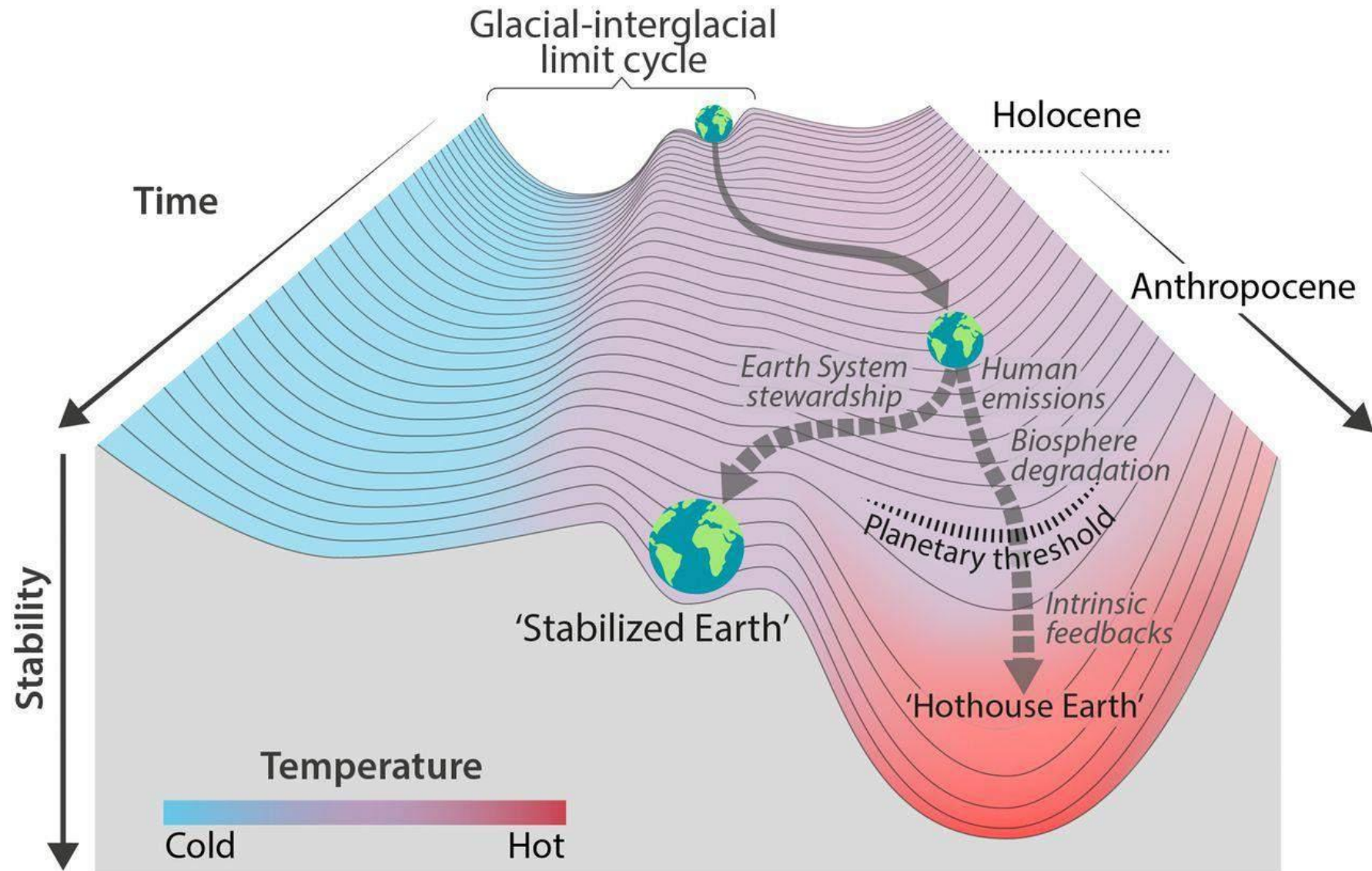
Nuovi studi indicano anche 2 metri in più!

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

Stability landscape showing the pathway of the Earth System out of the Holocene and thus, out of the glacial–interglacial limit cycle to its present position in the hotter Anthropocene.



Will Steffen et al. PNAS doi:10.1073/pnas.1810141115

PNAS

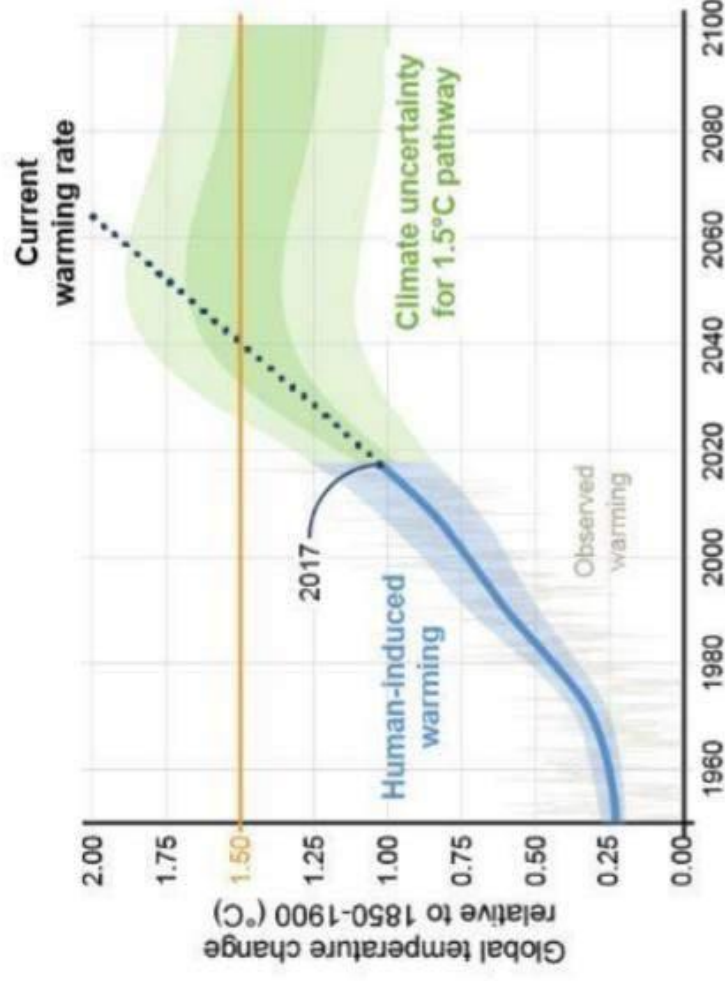
Global Warming of 1.5°C

An IPCC special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.



FAQ1.2: How close are we to 1.5°C?

Human-induced warming reached approximately 1°C above pre-industrial levels in 2017



FAQ1.2, Figure 1: Human-induced warming reached approximately 1°C above pre-industrial levels in 2017. At the present rate, global temperatures would reach 1.5°C around 2040.

The IPCC logo, consisting of the lowercase letters 'ipcc' in a blue, sans-serif font.

INTERGOVERNMENTAL PANEL ON climate change

CLIMATE CHANGE 2014

Mitigation of Climate Change

WG III

WORKING GROUP III CONTRIBUTION TO THE
FIFTH ASSESSMENT REPORT OF THE
INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE



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

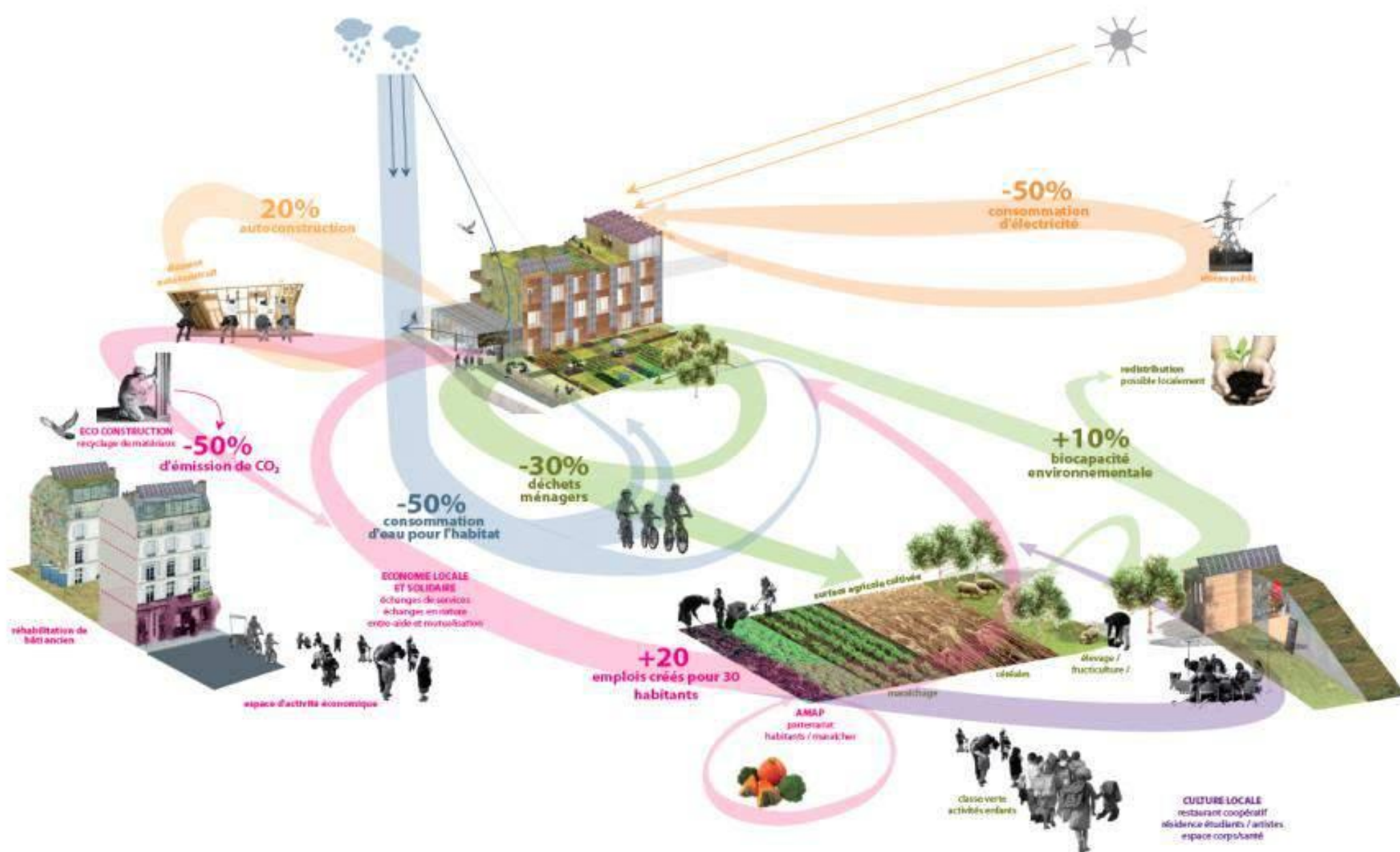
Uso plurimo:
agricoltura, potabile

*Diga AEM del Serrù
(Valle Orco)*

Raccolta domestica acqua piovana



Sostenibilità e resilienza

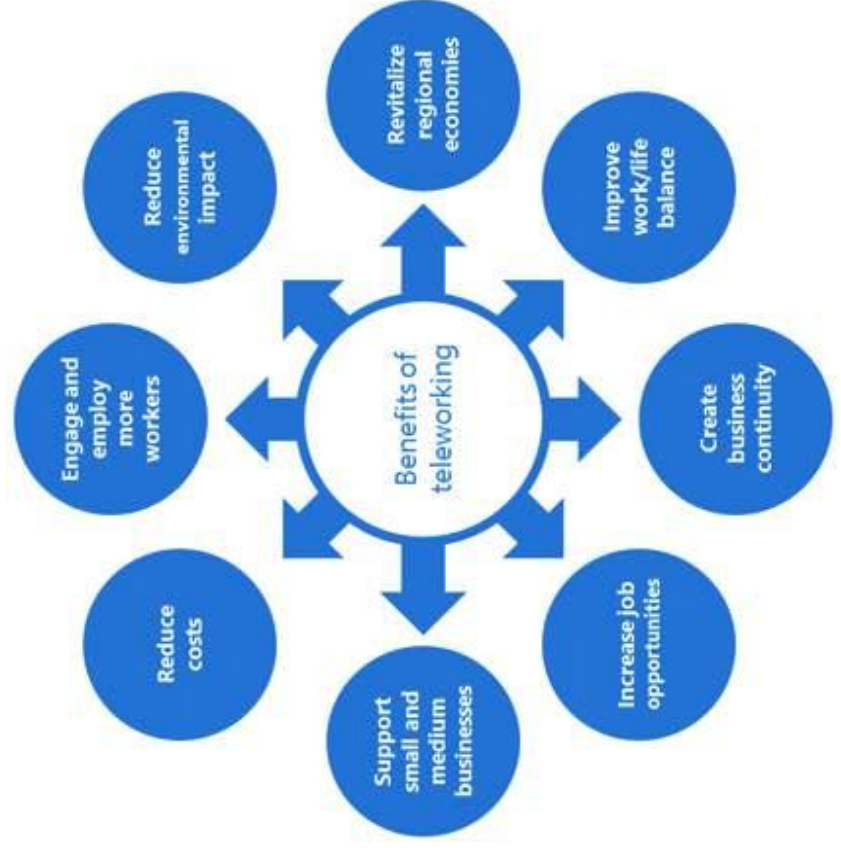


A high-angle photograph of a residential roof covered in red tiles. A large, rectangular array of dark blue solar panels is mounted on the roof, covering a significant portion of the surface. The panels are arranged in several rows. In the background, a mountain range is visible under a clear blue sky. Some of the mountain peaks are covered in snow. A few bare trees and a small satellite dish are also visible on the roof and in the distance.

**Energie rinnovabili ed efficienza
energetica abitazioni**



TELEWORK is the Future?





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



A RACE WE CAN WIN

“Climate change is the defining issue of our time – and we are at a defining moment.”



António Guterres,
United Nations Secretary-General,
10 September, 2018

“Climate change is moving faster than we are.”

“If we do not change course by 2020, we risk missing the point where we can avoid runaway climate change, with disastrous consequences for people and all the natural systems that sustain us.”

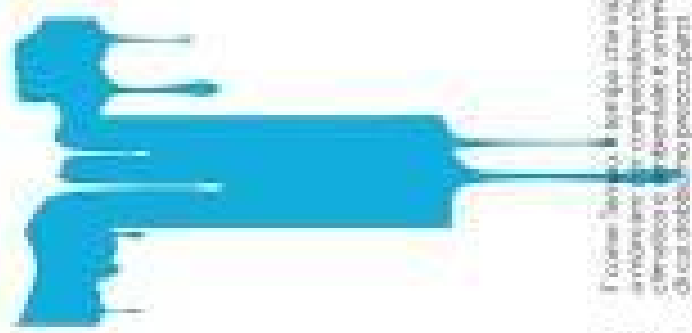
The only question is how to communicate the gravity of our situation to the non-scientific public. In the words of Kaisa Kosonen, an observer at the negotiations, “Scientists might want to write in capital letters, ‘ACT NOW, IDIOTS,’ but they need to say that with facts and numbers.”



LUCA MERCALLI

NON C'È PIÙ TEMPO

COME REAGIRE AGLI ALLARMI AMBIENTALI



Il nostro futuro è quello che inizia
arrivando per comprendere che quella
che è la nostra vita è un'esperienza
di cui dobbiamo preoccuparci.



UN PIANO PER SALVARCI

PREPARIAMOCI

A VIVERE IN UN MONDO CON MENO RISORSE,
MENO ENERGIA, MENO ABBONDANZA...
E FORSE PIÙ FELICITÀ

Luca Mercalli

chiarelettere