Trift glacier at Weissmies in Saas valley in summer 2015
From “Werkstattgespräch” with Prof. Martin Funk
(vimeo.com/142795405)

Trift glacier at Weissmies in Saas valley after breaking off on 10 September 2017

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Simulation of climate change and scenarios for Switzerland

Christina Schnadt Poberaj

and the CH2018 team:
David Bresch, Mischa Croci-Maspoli, Andreas Fischer, Michiko Hama, Reto Knutti, Sven Kotlarski, Mark Liniger, Christoph Schär, Christoph Raible, Simon Scherrer, Cornelia Schwierz, Silje Sørland, Kuno Strassmann

and many more

SCCER-School: Shaping the Energy Transition, Engelberg, 18 October 2017

Structure

Has climate changed in Switzerland?

Global and regional climate modelling

Swiss climate change scenarios

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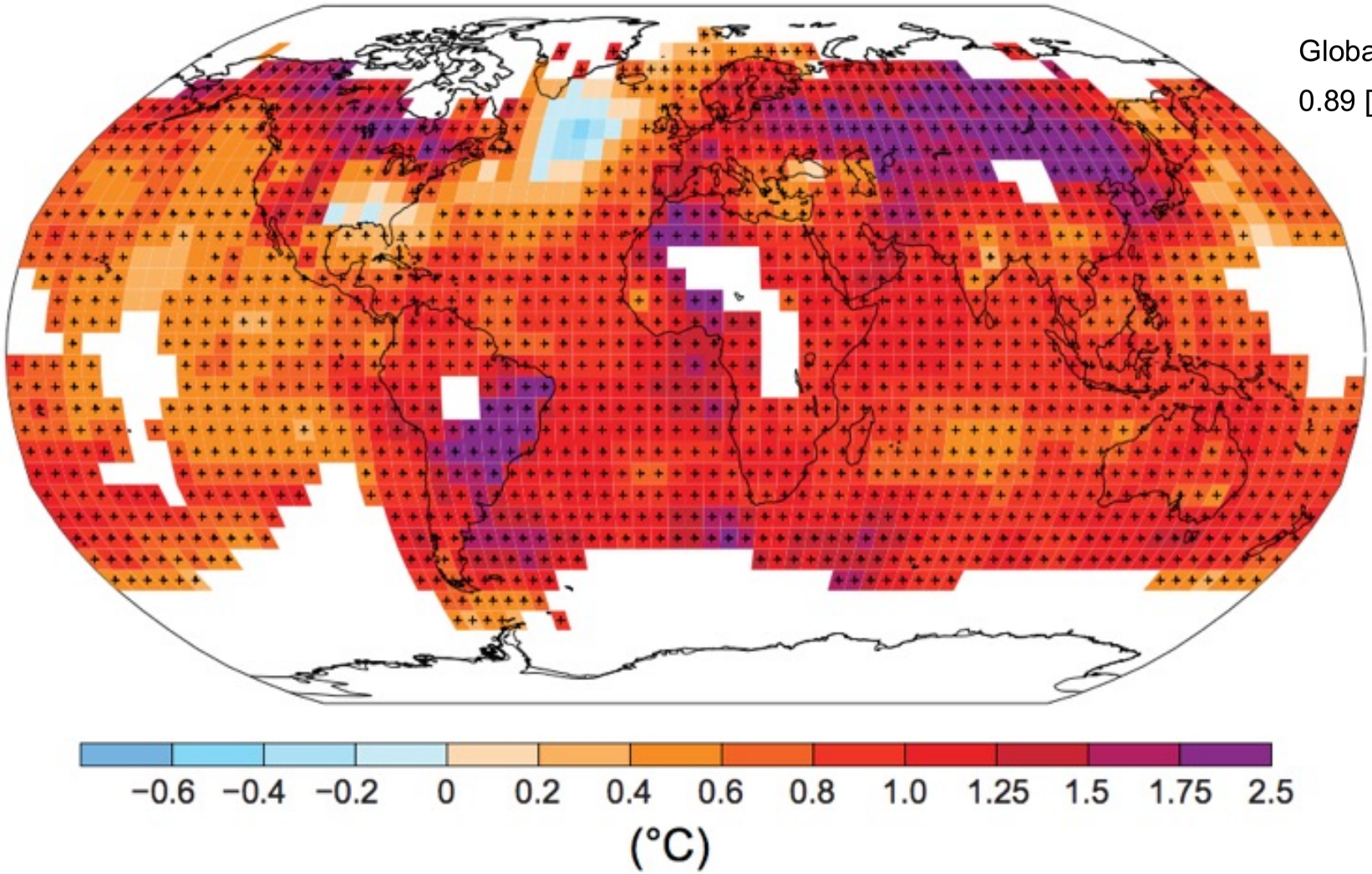
Global surface temperature changes 1901 - 2012



IPCC AR5, Figure SPM1.b

Data set: National Climatic Data Center, National Merged Land-Ocean Surface Temperature Analysis

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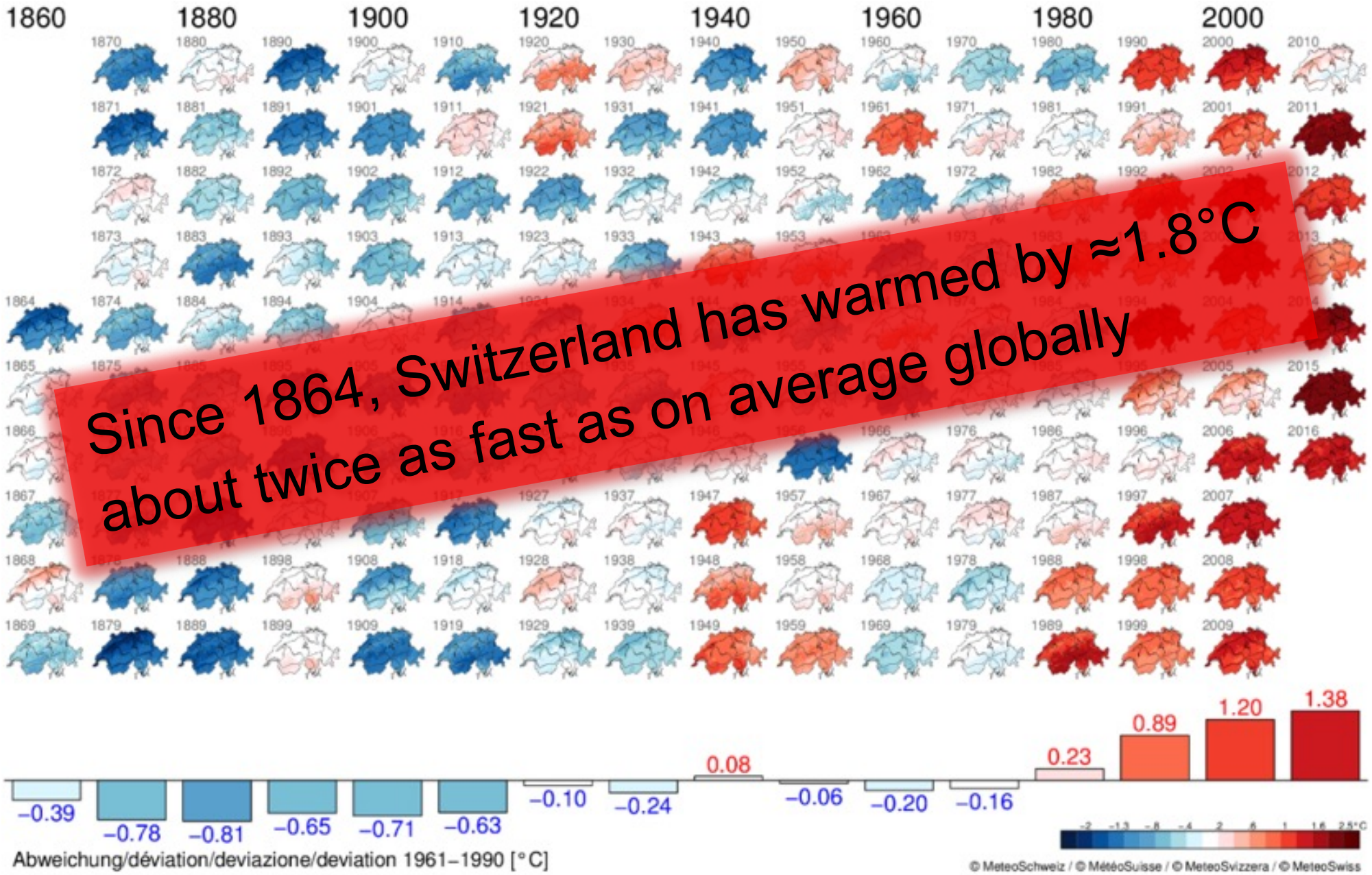
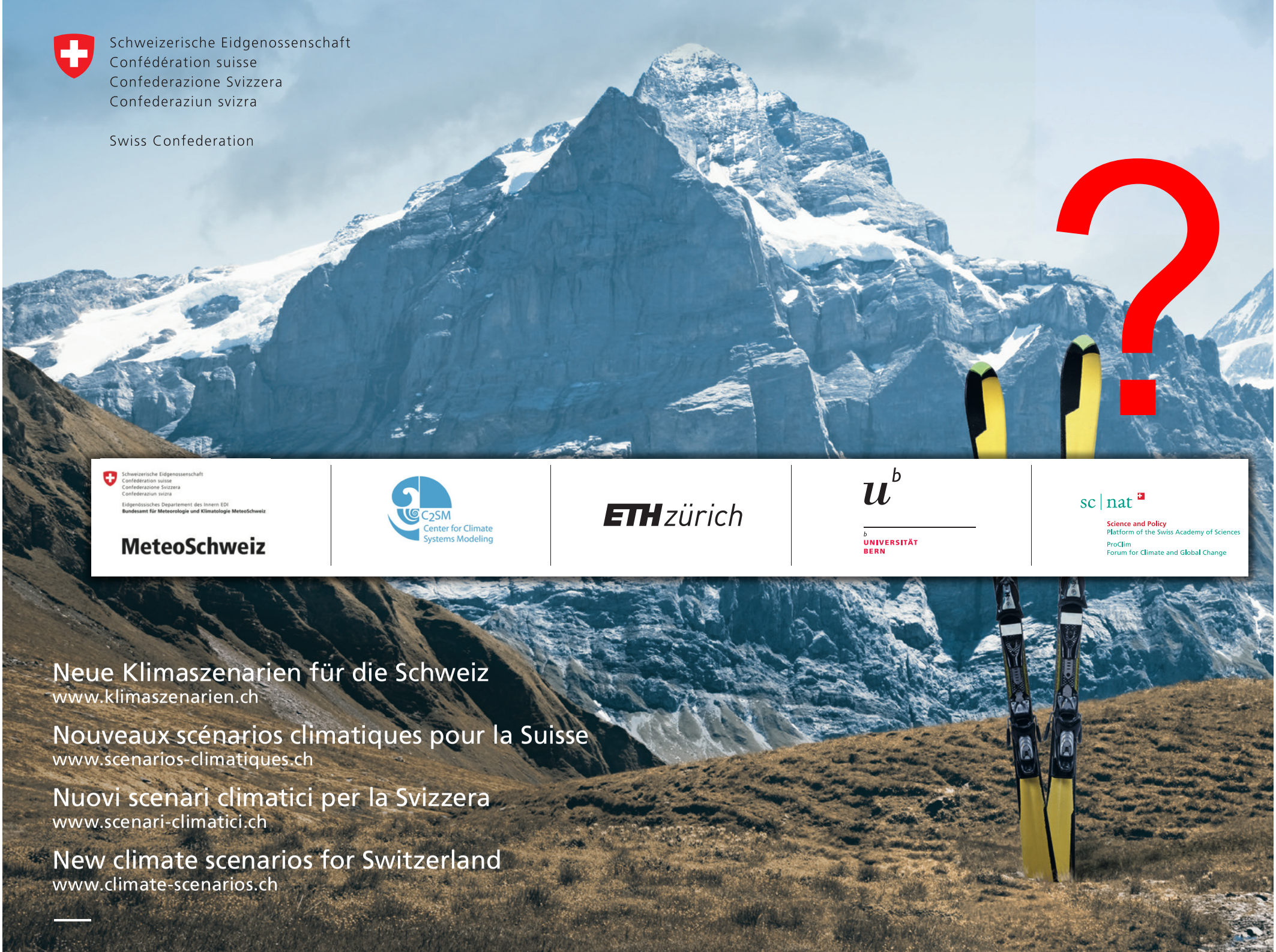
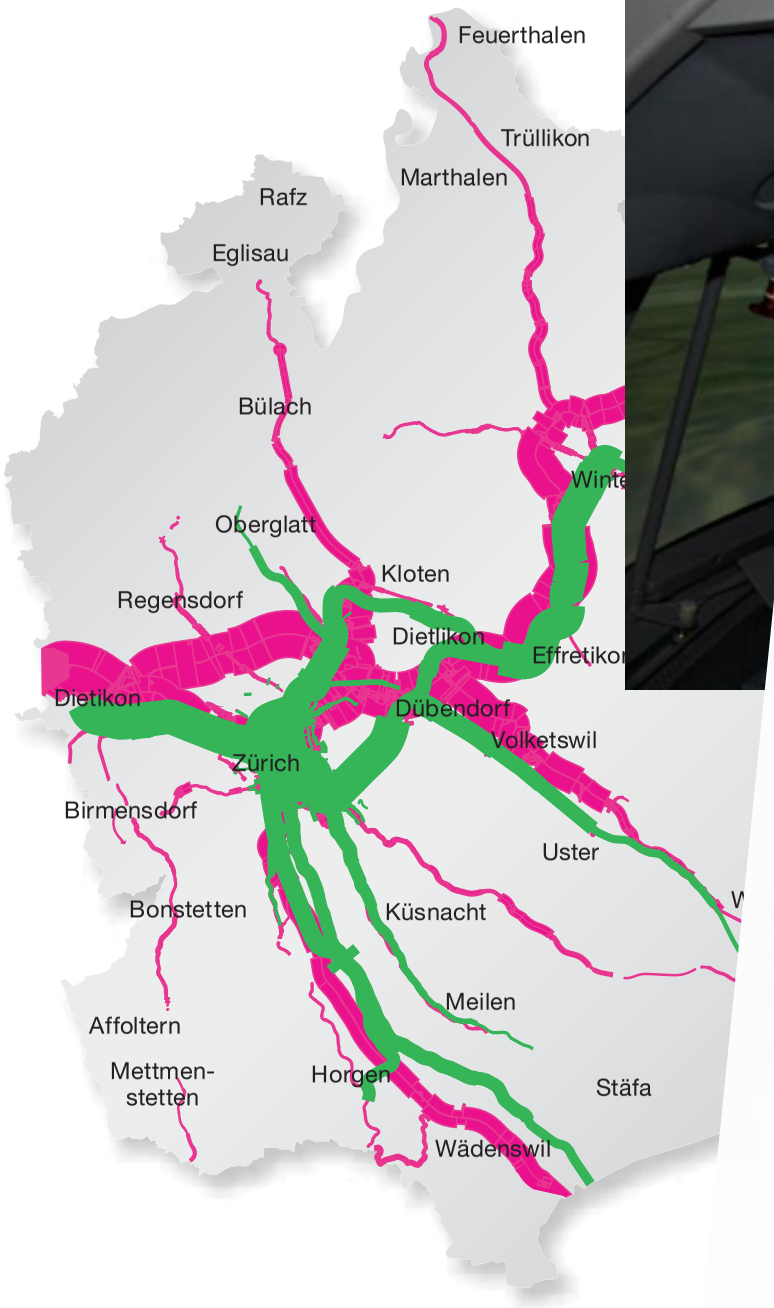


CH2018 draft, do not cite


Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra
Swiss Confederation
Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra
Eidgenössisches Departement des Innern EDI
Bundesamt für Meteorologie und Klimatologie MeteoSchweiz
MeteoSchweiz
C2SM
Center for Climate
Systems Modeling
ETH zürich
b
UNIVERSITÄT
BERN
sc | nat
Science and Policy
Platform of the Swiss Academy of Sciences
ProClim
Forum for Climate and Global Change
Neue Klimaszenarien für die Schweiz
www.klimaszenarien.ch
Nouveaux scénarios climatiques pour la Suisse
www.scenarios-climatiques.ch
Nuovi scenari climatici per la Svizzera
www.scenari-climatici.ch
New climate scenarios for Switzerland
www.climate-scenarios.ch



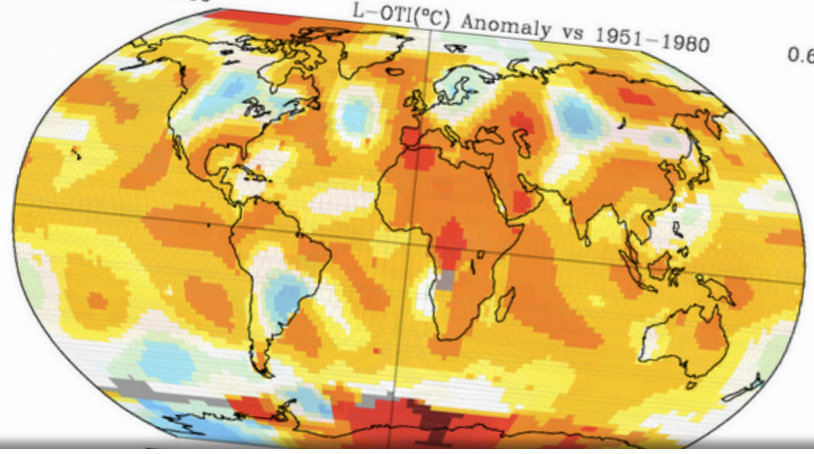
Tages-Anzeiger

Front Zürich Schweiz International Wirtschaft Börse Sport Kultur Reisen **Wissen** Auto Blogs Panorama Mehr

Medizin & Psychologie Natur Technik Geschichte Weiterbildung Bildstrecken

Ein Indiz mehr für den Klimawandel

Die momentan herrschende Hitze wird als Extremereignis angesehen. Sie gilt als weiterer Hinweis auf den durch den Menschen verursachten Klimawandel.



Artikel zum Thema

Die Sonne schwächelt, aber der Klimawandel ist stärker

…h werden wie …szeit». Doch die …g. Mehr…

…chen Kaffee …gelwald sterben

Models simulating Earth's climate help scientists to understand past climate and project future climate

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Global climate models (GCMs)

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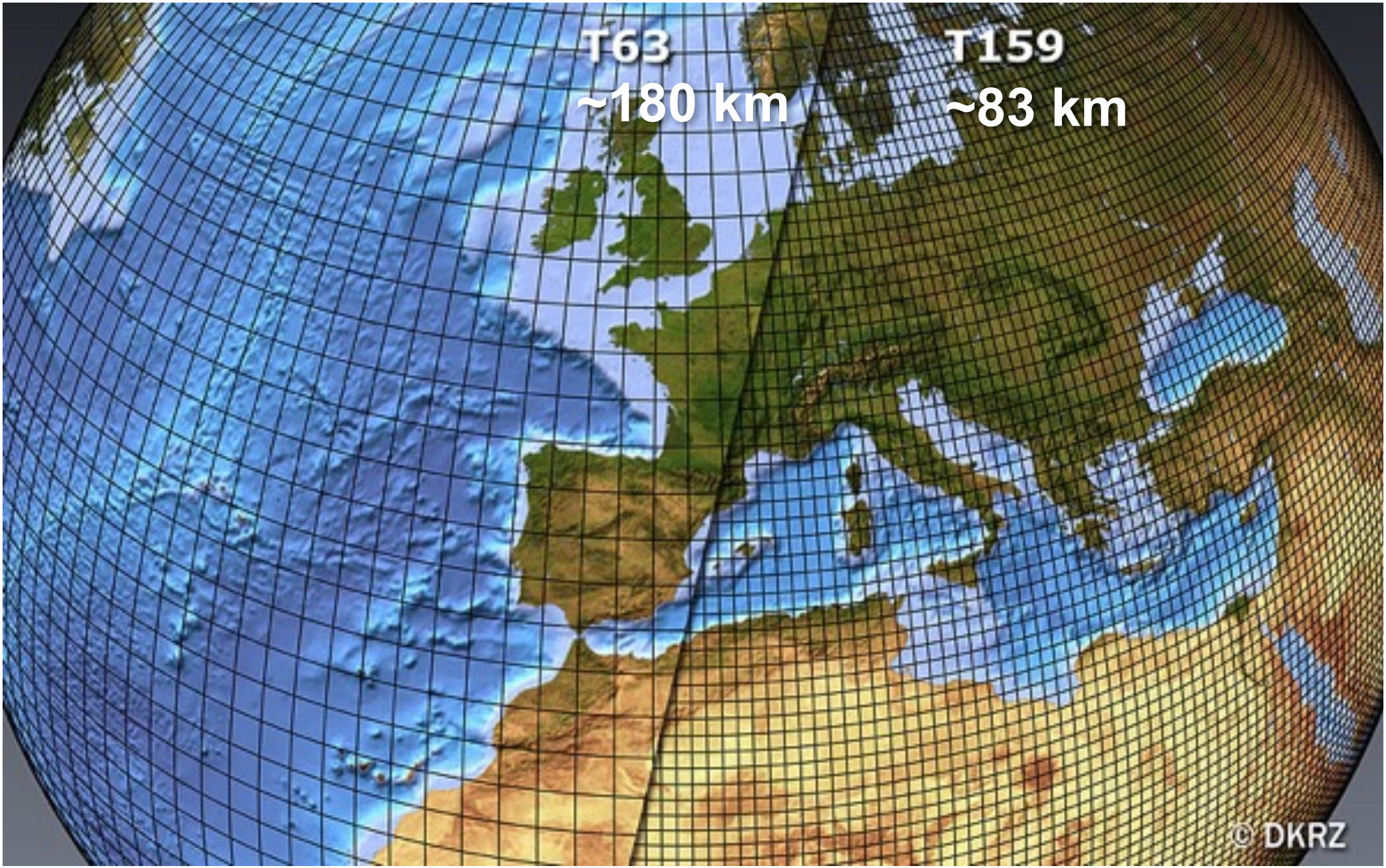
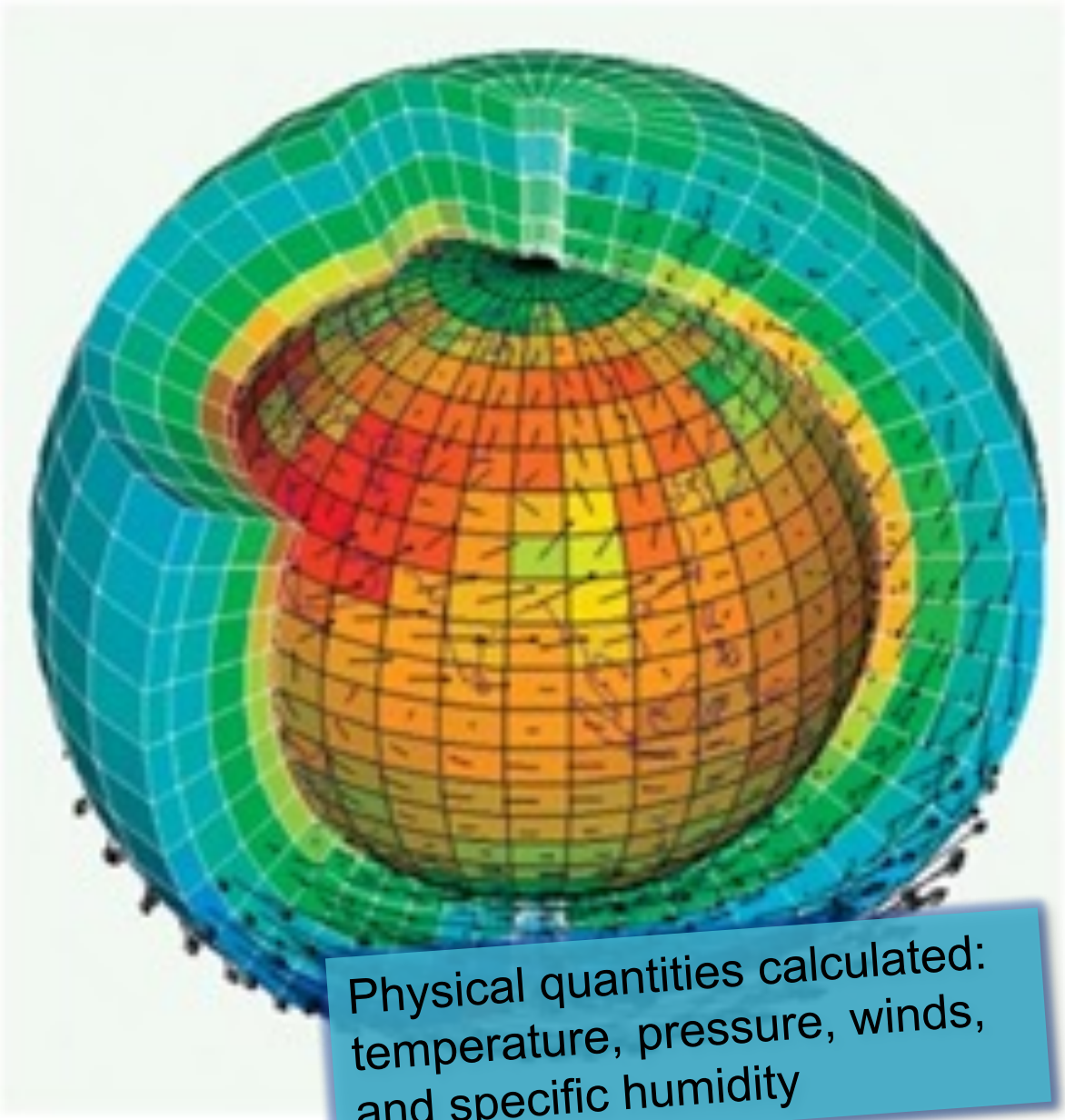


Global climate models (GCMs)



Physical quantities calculated: temperature, pressure, winds, and specific humidity

Governing Equations

$$\frac{d\mathbf{V}}{dt} = -\nabla\Phi - f\mathbf{k} \times \mathbf{V} + \mathbf{F}$$

Horizontal equation of motion

$$\frac{\partial\Phi}{\partial p} = \frac{-RT}{p}$$

Hydrostatic/Hypsometric equation

$$\frac{dT}{dt} = \frac{\kappa T}{p}\omega + \frac{J}{c_p}$$

Thermodynamic energy equation

$$\frac{\partial\omega}{\partial p} = -\nabla \cdot \mathbf{V}$$

Continuity equation

From Wallace & Hobbs (2006)

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Physical processes too small to be resolved

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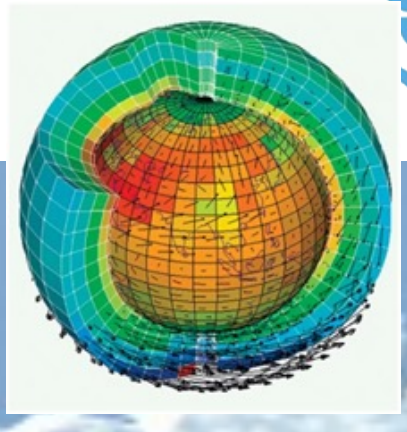

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World's largest supercomputers to run climate model codes

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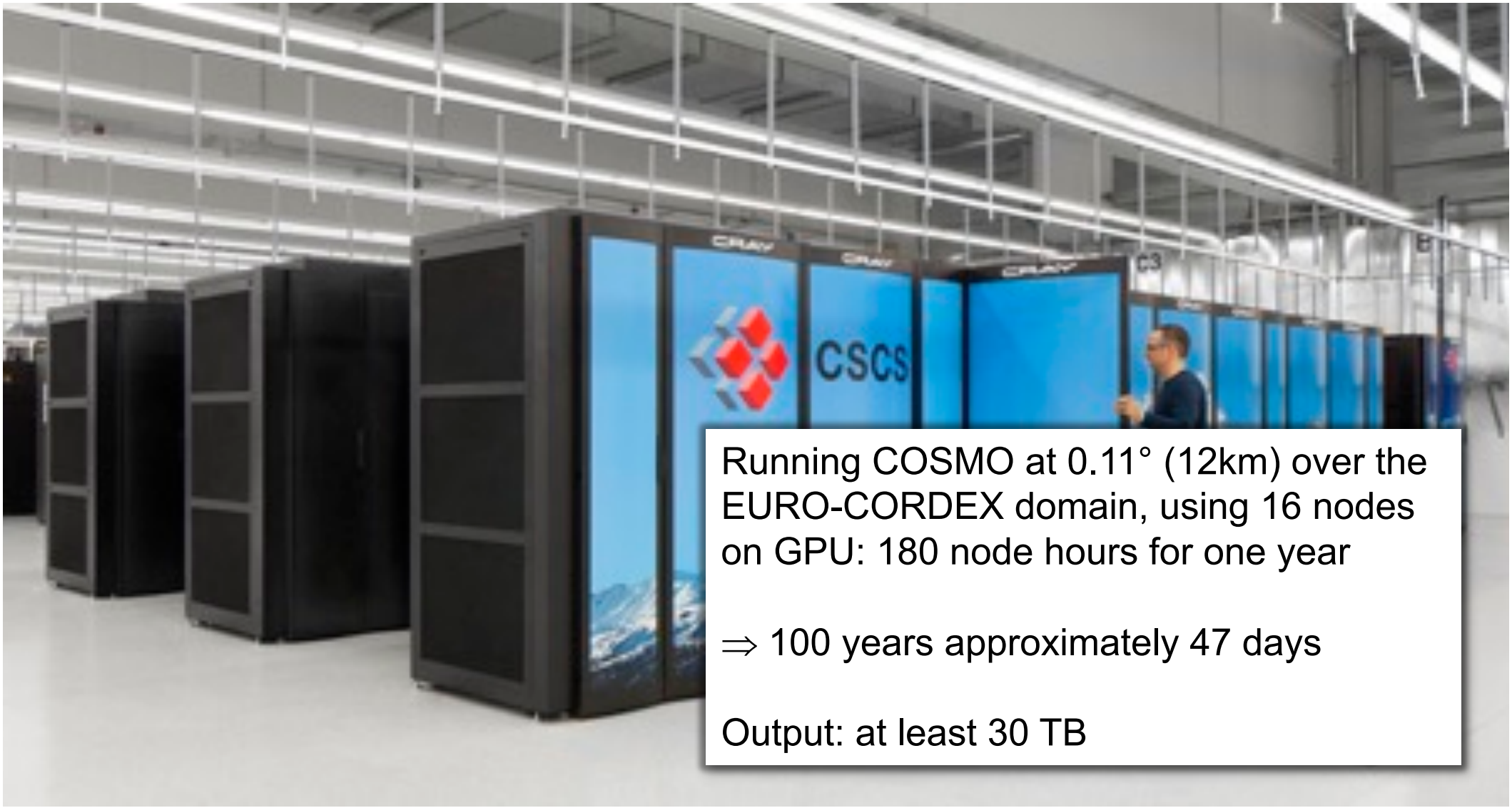


Running COSMO at 0.11° (12km) over the EURO-CORDEX domain, using 16 nodes on GPU: 180 node hours for one year

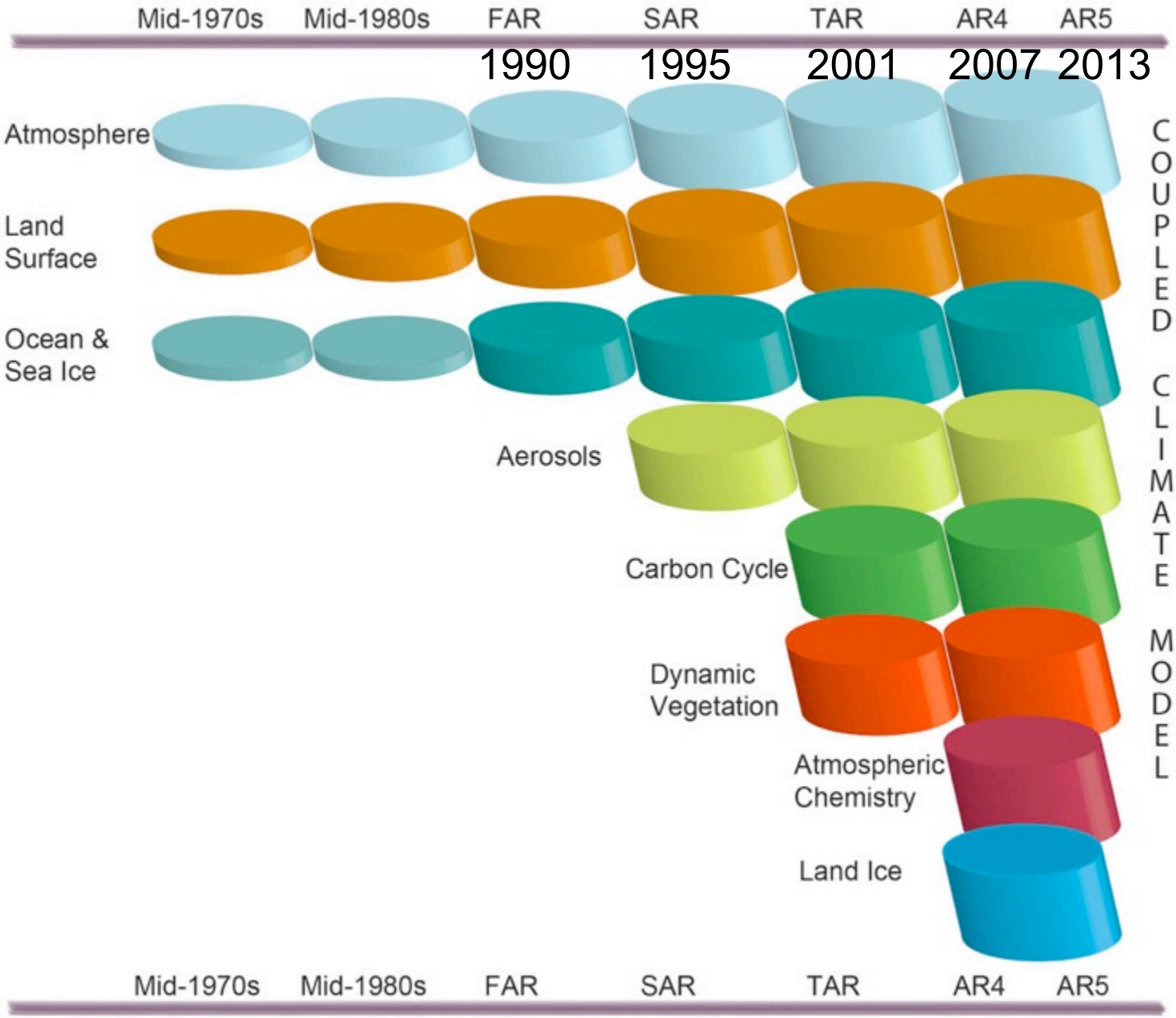
⇒ 100 years approximately 47 days

Output: at least 30 TB

Named after Piz Daint, a prominent peak in Grisons, this supercomputer at CSCS is the flagship system for national HPC Service

Global climate models:

The basis for our scenarios of the future



IPCC AR5 WG1 Fig. 1.13

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Global climate models:

The basis for our scenarios of the future

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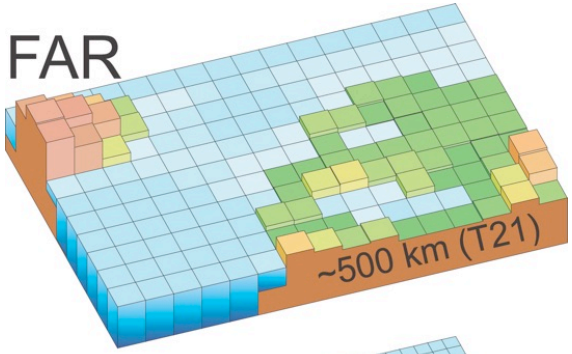
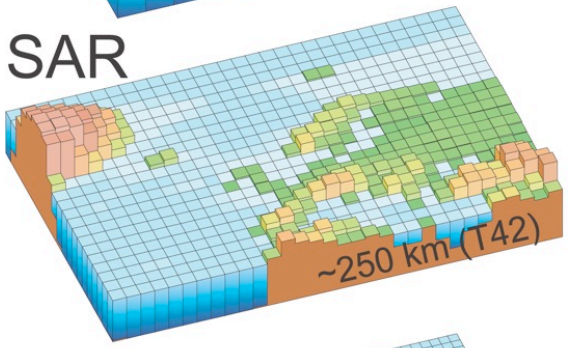
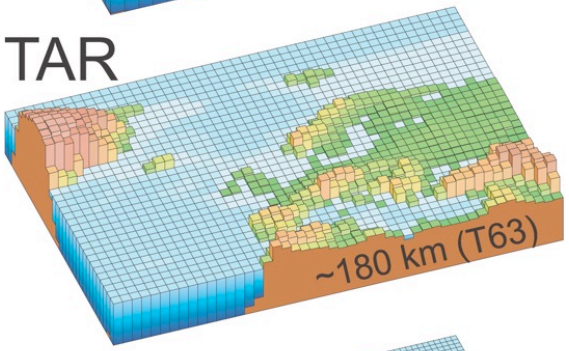


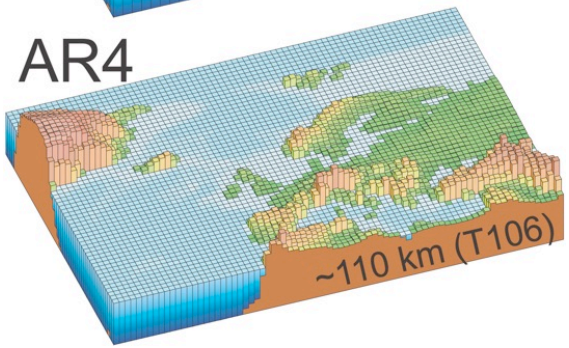
1990



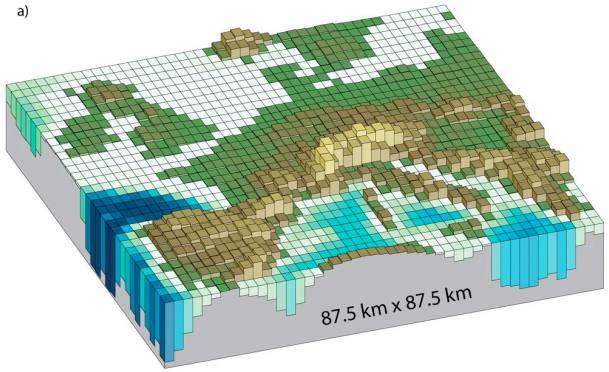
1995



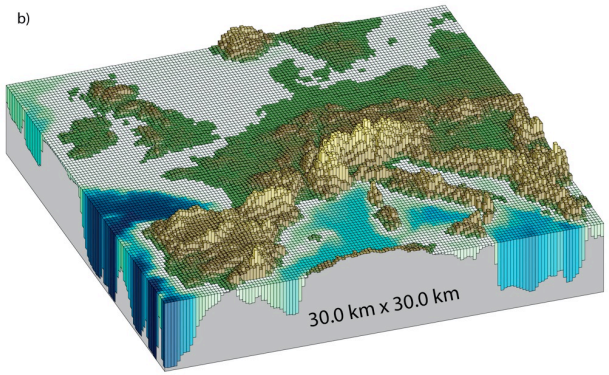
2001



2007



2013



Source:
IPCC AR5, Fig. 1.15

Source:
IPCC AR4, Fig. 1.4

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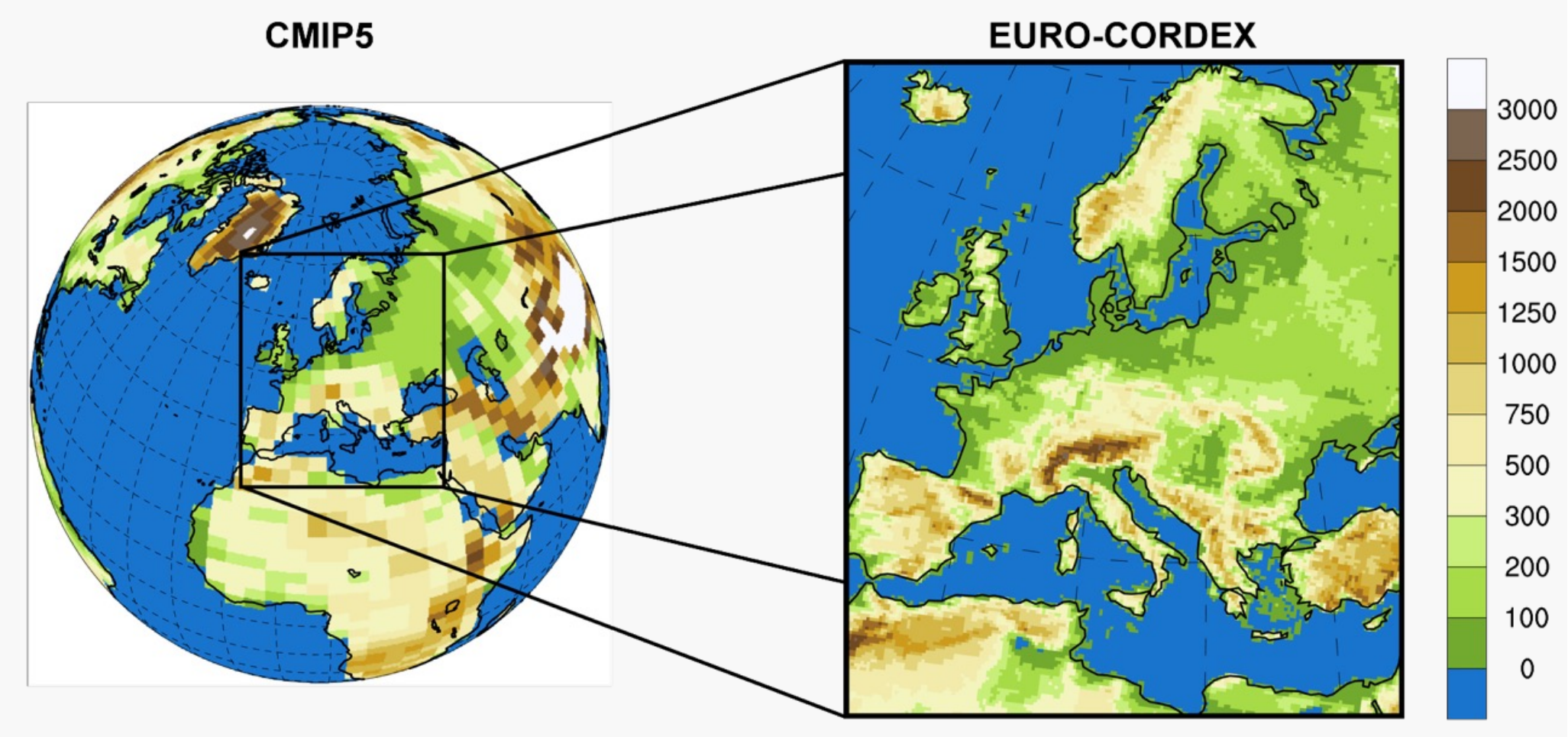
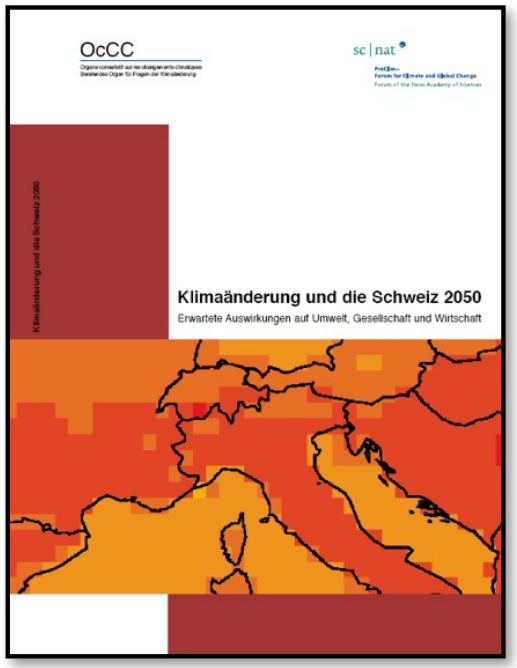
WCRP CORDEX Coordinated Regional Climate Downscaling Experiment

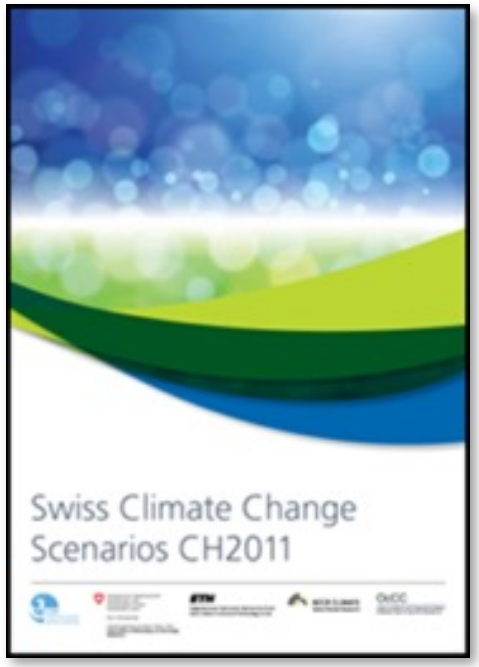
Coupled Model Intercomparison Project Phase 5



CH2018 draft, do not cite

Short history of national scenario assessments





CH2007 **CH2011** **CH2018**

www.ch2011.ch

www.climate-scenarios.ch

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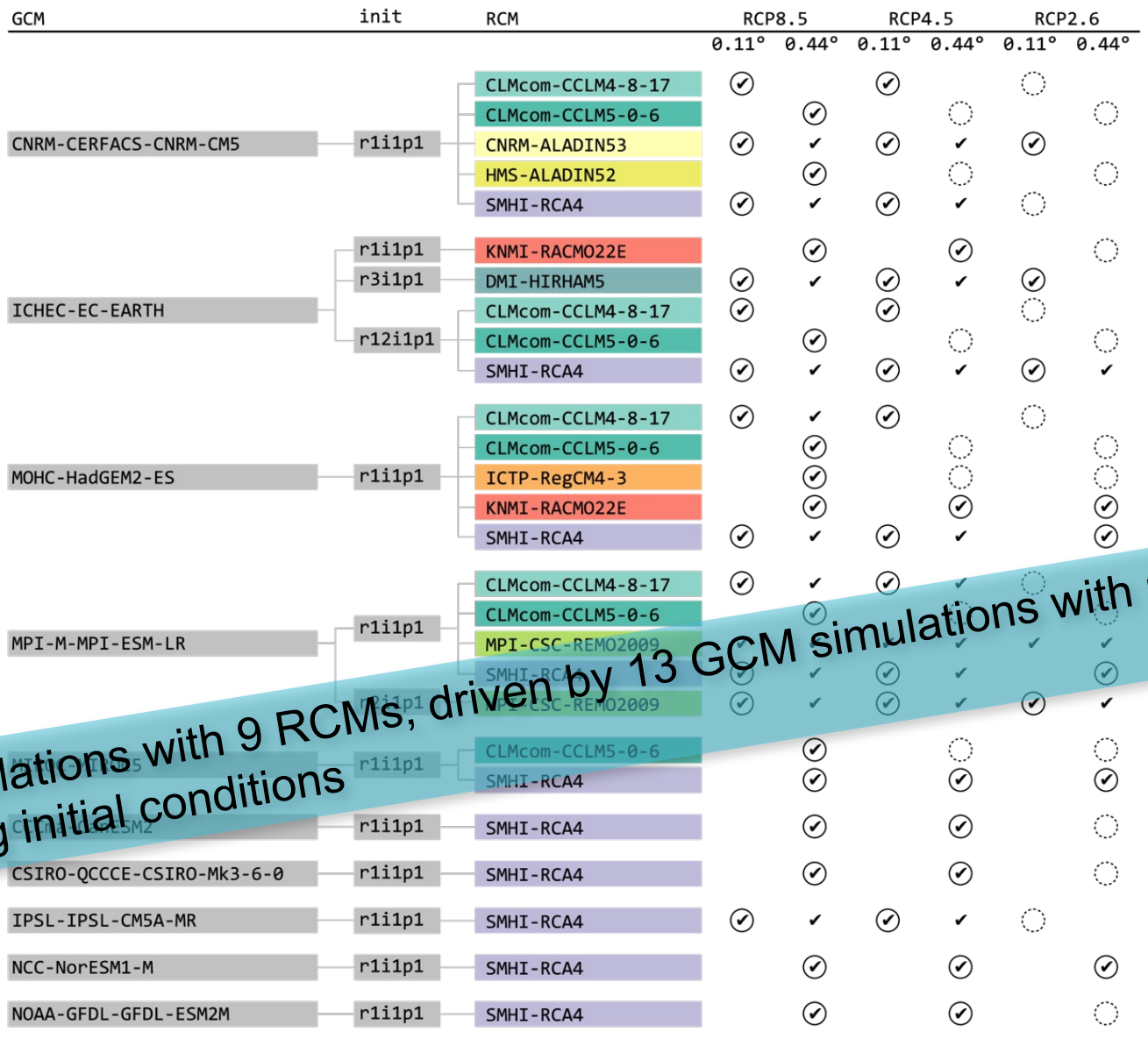
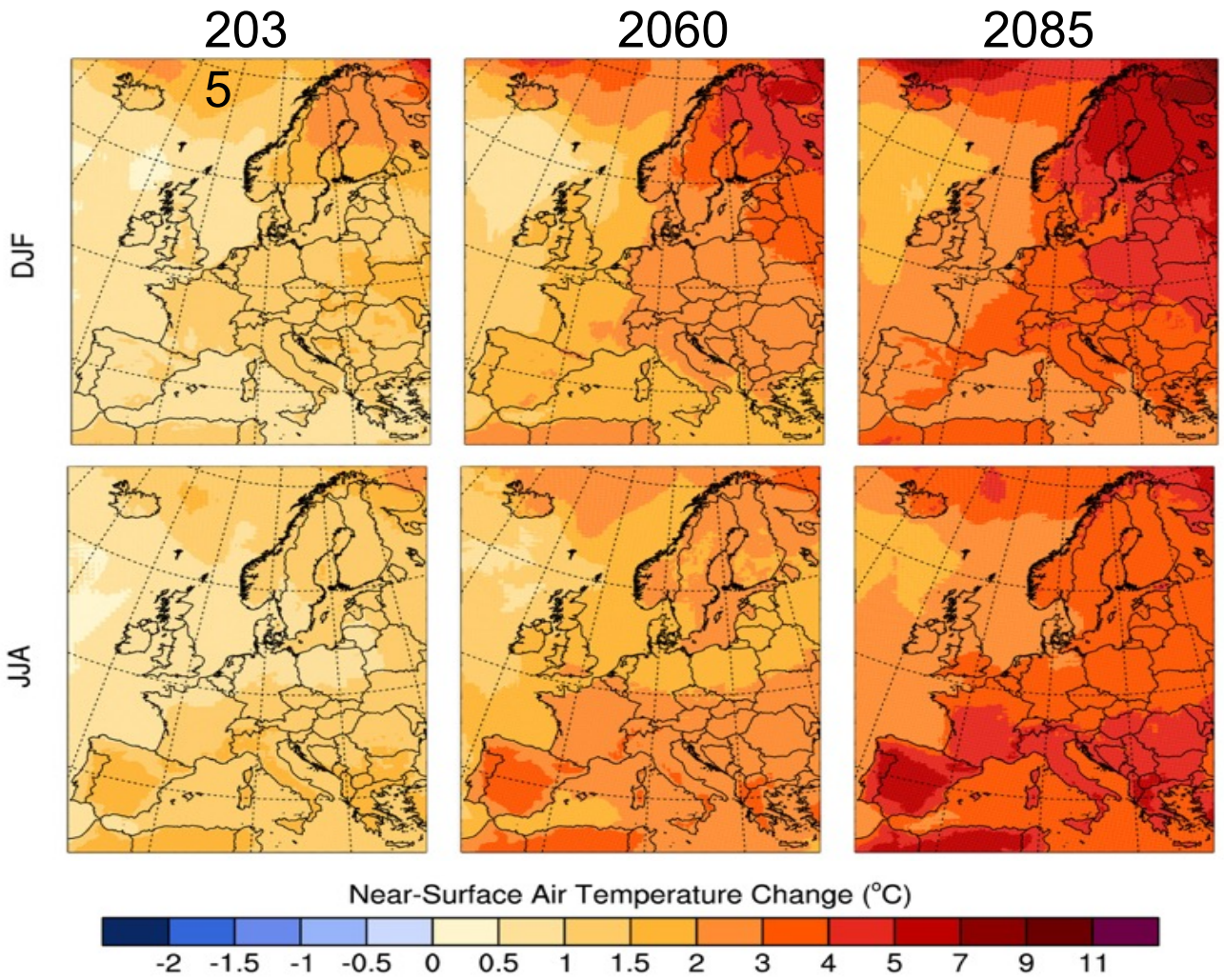


GCM	init	RCM	RCP8.5		RCP4.5		RCP2.6	
			0.11°	0.44°	0.11°	0.44°	0.11°	0.44°
CNRM-CERFACS-CNRM-CM5	r1i1p1	CLMcom-CCLM4-8-17	✓		✓		○	
		CLMcom-CCLM5-0-6		✓		○		○
		CNRM-ALADIN53	✓	✓	✓	✓	✓	
		HMS-ALADIN52		✓		○		○
		SMHI-RCA4	✓	✓	✓	✓	○	
ICHEC-EC-EARTH	r1i1p1	KNMI-RACMO22E		✓		✓		○
	r3i1p1	DMI-HIRHAM5	✓	✓	✓	✓	✓	
	r12i1p1	CLMcom-CCLM4-8-17	✓		✓		○	
		CLMcom-CCLM5-0-6		✓		○		○
		SMHI-RCA4	✓	✓	✓	✓	✓	✓
MOHC-HadGEM2-ES	r1i1p1	CLMcom-CCLM4-8-17	✓	✓	✓		○	
		CLMcom-CCLM5-0-6		✓		○		○
		ICTP-RegCM4-3		✓		○		○
		KNMI-RACMO22E		✓		✓		✓
		SMHI-RCA4	✓	✓	✓	✓		✓
MPI-M-MPI-ESM-LR	r1i1p1	CLMcom-CCLM4-8-17	✓	✓	✓		○	
		CLMcom-CCLM5-0-6		✓		○		○
		MPI-CSC-REMO2009		✓		✓	✓	✓
		SMHI-RCA4	✓	✓	✓	✓		✓
	r2i1p1	MPI-CSC-REMO2009	✓	✓	✓	✓	✓	✓
[illegible]	r1i1p1	CLMcom-CCLM5-0-6		✓		○		○
		SMHI-RCA4		✓		✓		✓
[illegible]ESM2	r1i1p1	SMHI-RCA4		✓		✓		○
CSIRO-QCCCE-CSIRO-Mk3-6-0	r1i1p1	SMHI-RCA4		✓		✓		○
IPSL-IPSL-CM5A-MR	r1i1p1	SMHI-RCA4	✓	✓	✓	✓	○	
NCC-NorESM1-M	r1i1p1	SMHI-RCA4		✓		✓		✓
NOAA-GFDL-GFDL-ESM2M	r1i1p1	SMHI-RCA4		✓		✓		○

81 simulations with 9 RCMs, driven by 13 GCM simulations with partly differing initial conditions

Median temperature change in Europe

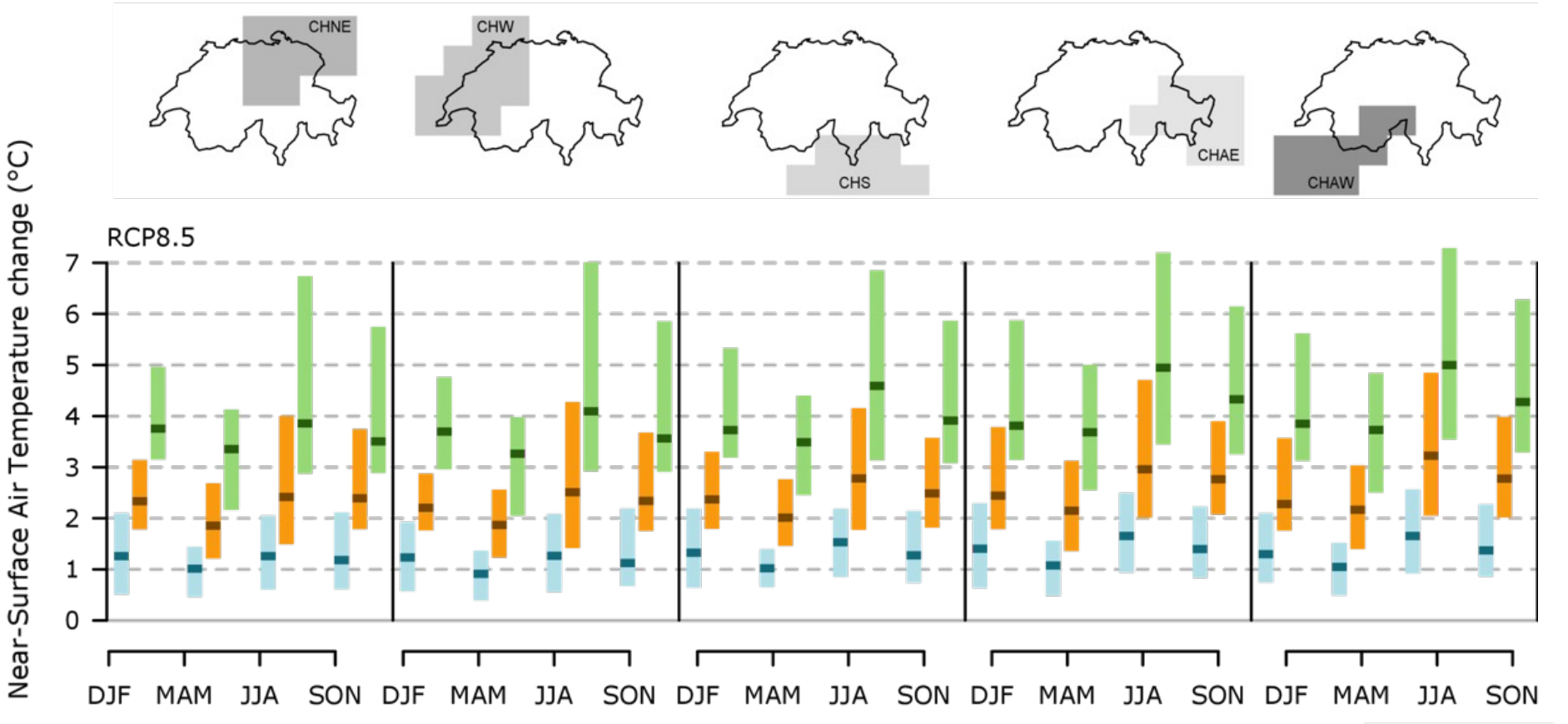


RCP8.5 Scenario

- Temperature changes amplify over 21st century
- Polar amplification: Larger increase in northern Europe in winter
- Mediterranean amplification: Larger increase in southern Europe in summer

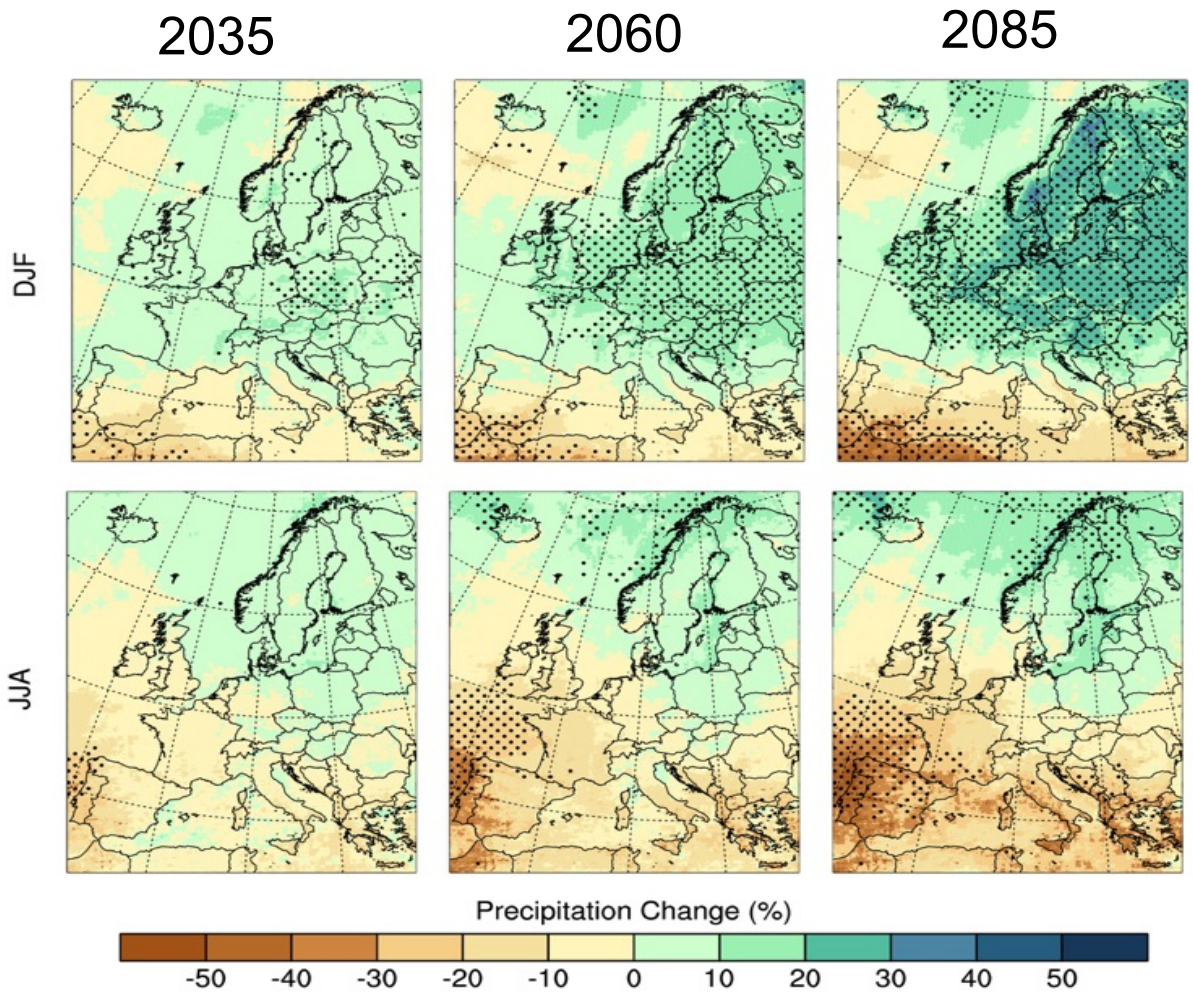
CH2018 draft, do not cite

Median temperature change in Switzerland



- Switzerland affected by Mediterranean amplification
- Increase in temperature in all regions and seasons
- Assuming RCP8.5, median temperature increase in 2085: 3.2-5°C to 4.0-7.3°C

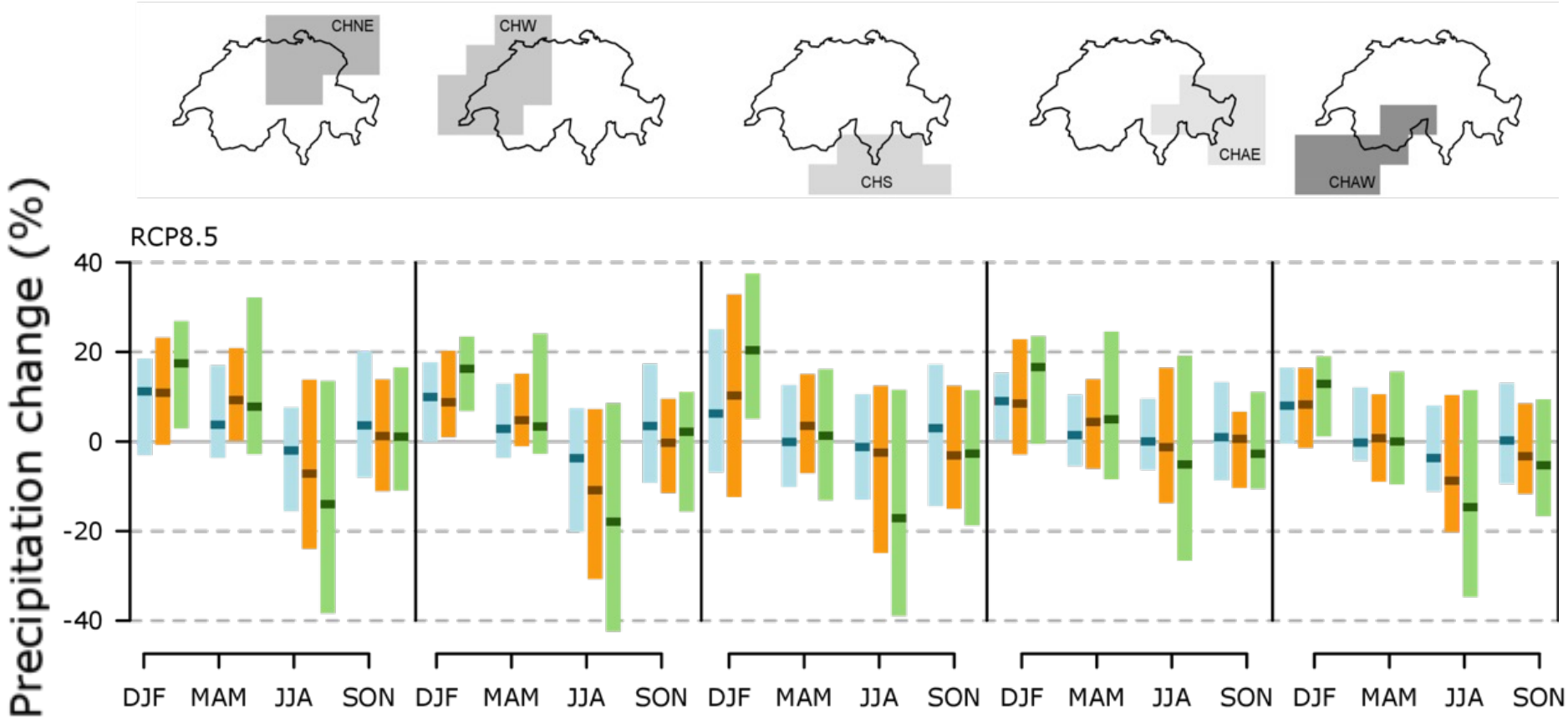
Precipitation changes in Europe



RCP8.5 Scenario

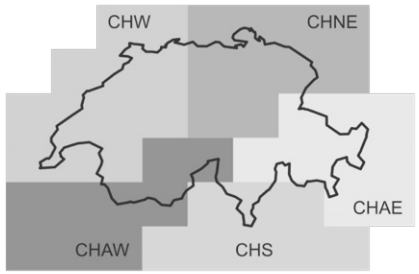
- Large-scale geographic variations towards the end of the century
- Increase in precipitation across northern Europe
- Decrease in precipitation across southern Europe

Precipitation change in Europe



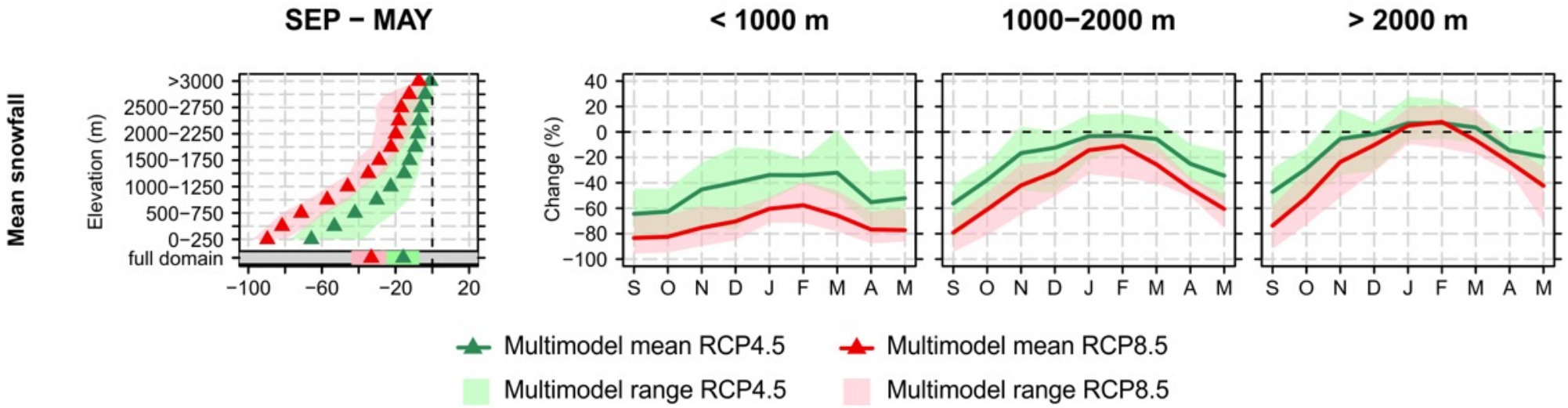
- Significant wintertime increase in precipitation in all regions
- Other seasons: no significant change due to large spread between single model estimates


Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra
Swiss Confederation
Neue Klimaszenarien für die Schweiz
www.klimaszenarien.ch
Nouveaux scénarios climatiques pour la Suisse
www.scenarios-climatiques.ch
Nuovi scenari climatici per la Svizzera
www.scenari-climatici.ch
New climate scenarios for Switzerland
www.climate-scenarios.ch



Change in snowfall in Switzerland

C2SM Center for Climate Systems Modeling



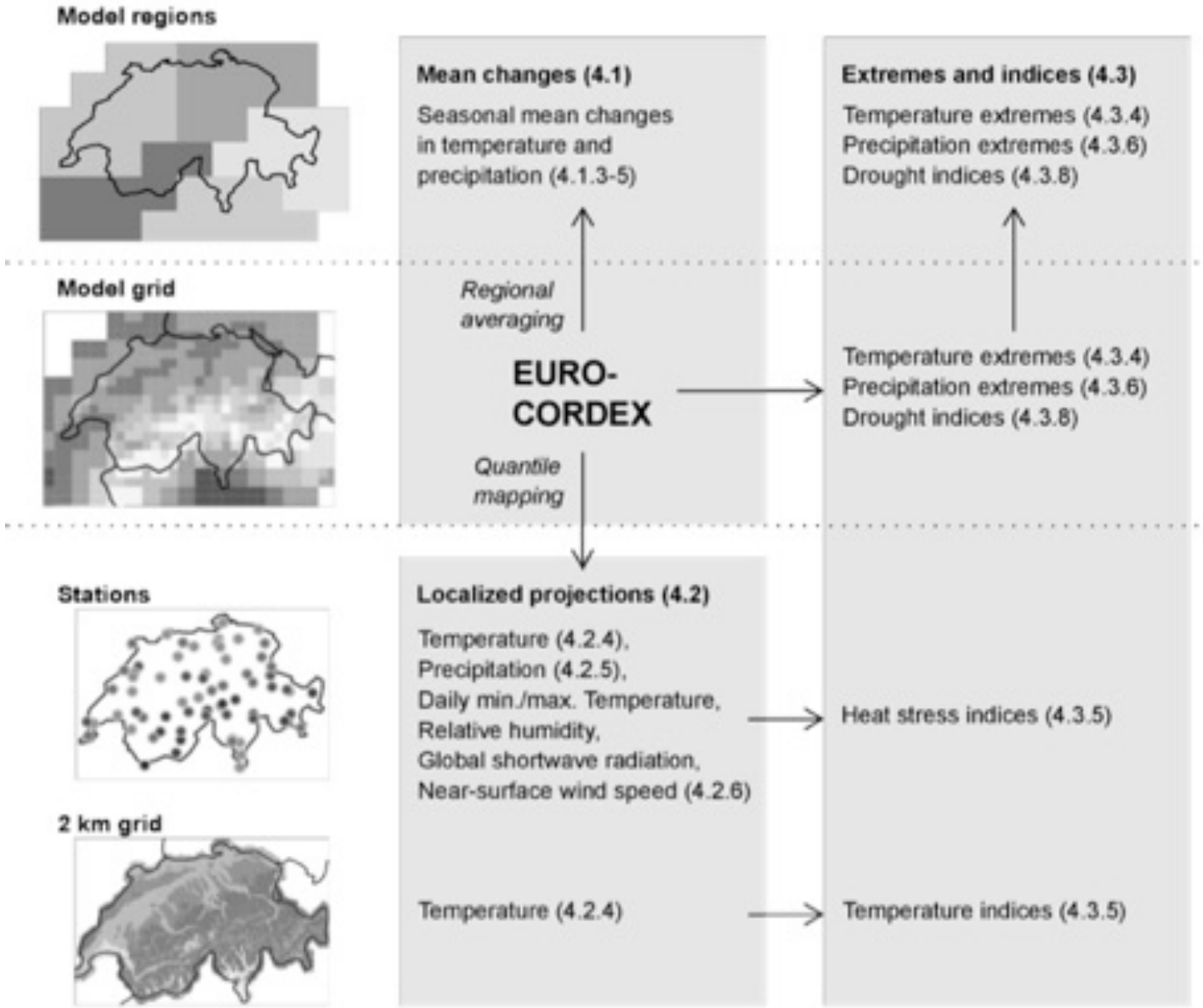
- Mean snowfall sums decrease at all elevations and over entire winter except for elevations higher than 2000m in mid-winter
- Below 750 m (RCP4.5) and 1250 m (RCP8.5) reduction of more than 50% of today's mean winter snowfall
- Stable/slightly increasing snowfall sums in mid-winter at high elevations due to increasing winter precipitation

Summary

- Climate is changing
- Global climate models serve as basis for climate scenarios
- Global climate models have largely grown in complexity and resolution
- Downscaling techniques allow scenarios at the regional and local scale
- Swiss climate will significantly change

New Swiss climate change scenarios to be launched in autumn 2018! Check our website www.climate-scenarios.ch

Overview Products Swiss Climate Change Scenarios 2018



CH2018 draft, do not cite

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ETH-Klimarunde

Stadt- und Klimawandel: Wie stellen wir uns den Herausforderungen?

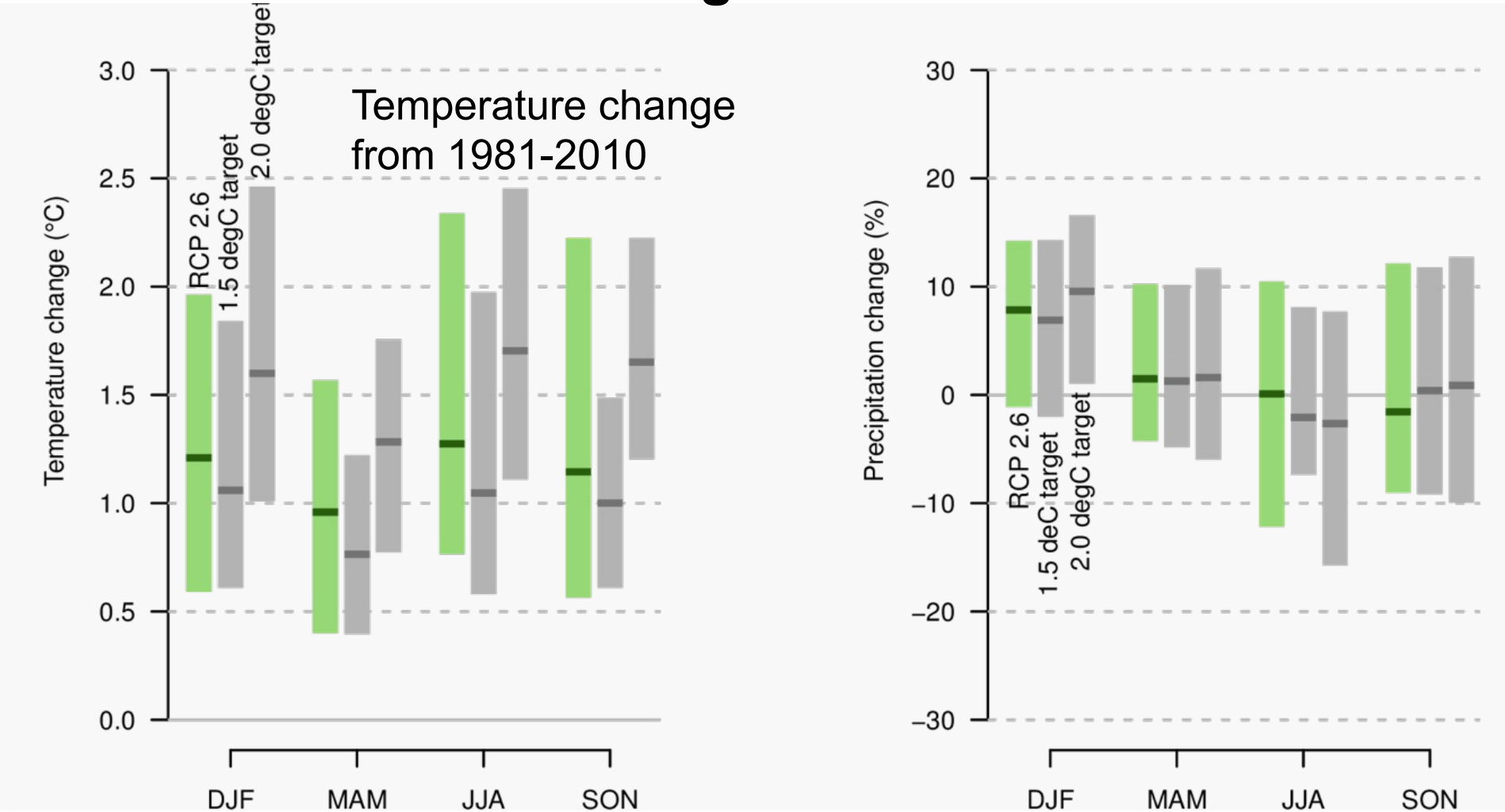
Mittwoch, 8. November 2017, 15.00 – 19.30 Uhr
ETH Zürich, Hauptgebäude

Informationen und Anmeldung:
http://www.c2sm.ethz.ch/events/eth-klimarunde-2017.html

C2SM Center for Climate Systems Modeling

Energy Science Center

How would climate in Switzerland change if the Paris agreement was met?



- If Paris agreement was met, Switzerland may experience another 0.5-1.7°C temperature increase until the end of the century