ETH zürich

Climate Change Uncertainty and Risk: from Probabilistic Forecasts to Economics of Climate Adaptation

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This recording is provided as replacement for the oral lecture, which cannot take place due to the Corona virus. The recording is meant for the students and should not be spread beyond its intended use. Thanks!

Schedule

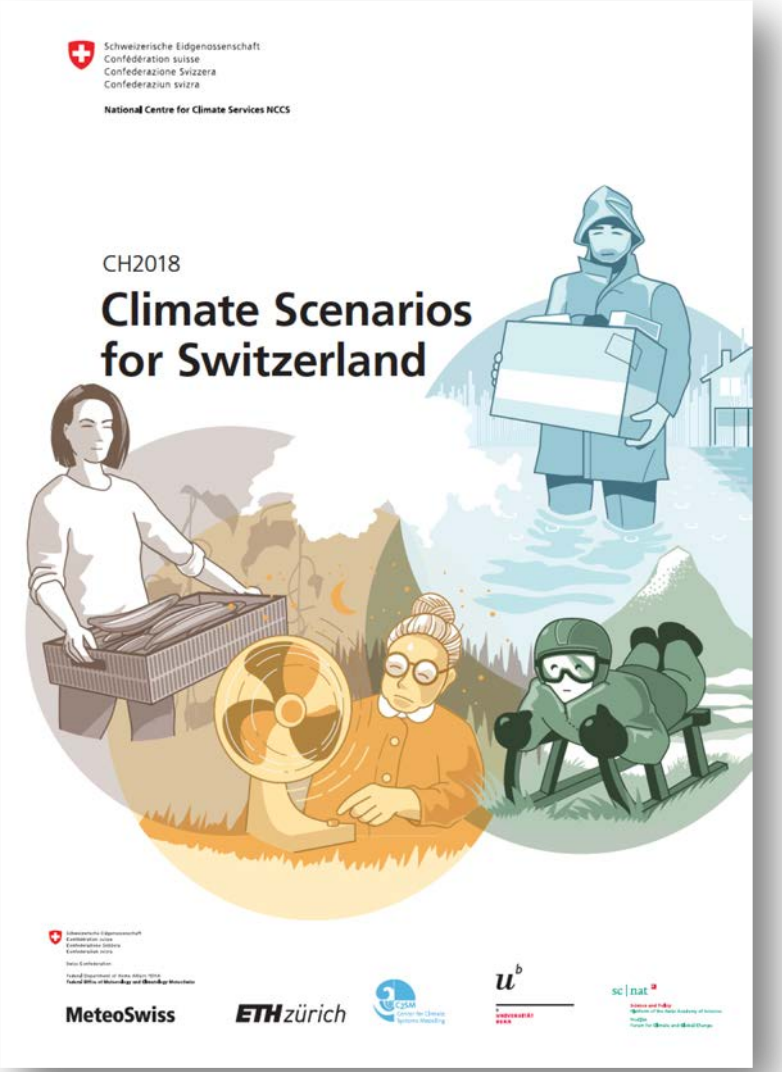
24.02.2020	(1)	Logistics, Introduction to probability, uncertainty and risk management (RK, DB)
02.03.2020	(2)	Predictability of weather and climate (RK) Exercise 1 (toy model)
09.03.2020	(3)	Detection/attribution (RK)
16.03.2020	(4)	Model evaluation & calibration (RK) Exercise 2 (toy model)
23.03.2020	(5)	2°C target and adaptation in UNFCCC (RK, DB)
30.03.2020	(6)	Climate change and impacts, use of scenarios (RK, DB) Exercise 3 (toy model), preparation of presentation
06.04.2020	(7)	Probabilistic risk assessment model and some insurance basics (DB) Exercise 4 (introduction to CLIMADA)
13.04.2020	Ostermontag (no course)	
20.04.2020	(8)	Interactive scenario creation (DB) → shorturl.at/kuwWZ

Schedule

27.04.2020	(9)	Basics of economic evaluation and economic decision making (DB) Exercise 5 (impacts)
04.05.2020	(10)	The cost of adaptation - in developing and developed regions (DB)
11.05.2020	(11)	Shaping climate-resilient development – valuation of a basket of adaptation options (DB) Exercise 6 (adaptation measures, preparation of your own *small extension*[1])
18.05.2020	**(12)**	**Climate services and adaptation in Switzerland** **Exercise 7 (Swiss climate scenarios CH2018 for adaptation)**
25.05.2020	(13)	Final discussion (DB, RK)

[1] See Syllabus https://ethz.ch/content/dam/ethz/special-interest/usys/iac/iac-dam/documents/edu/courses/climate_risk/FS2020/Uncertainty_and_Risk_Syllabus_V2.pdf

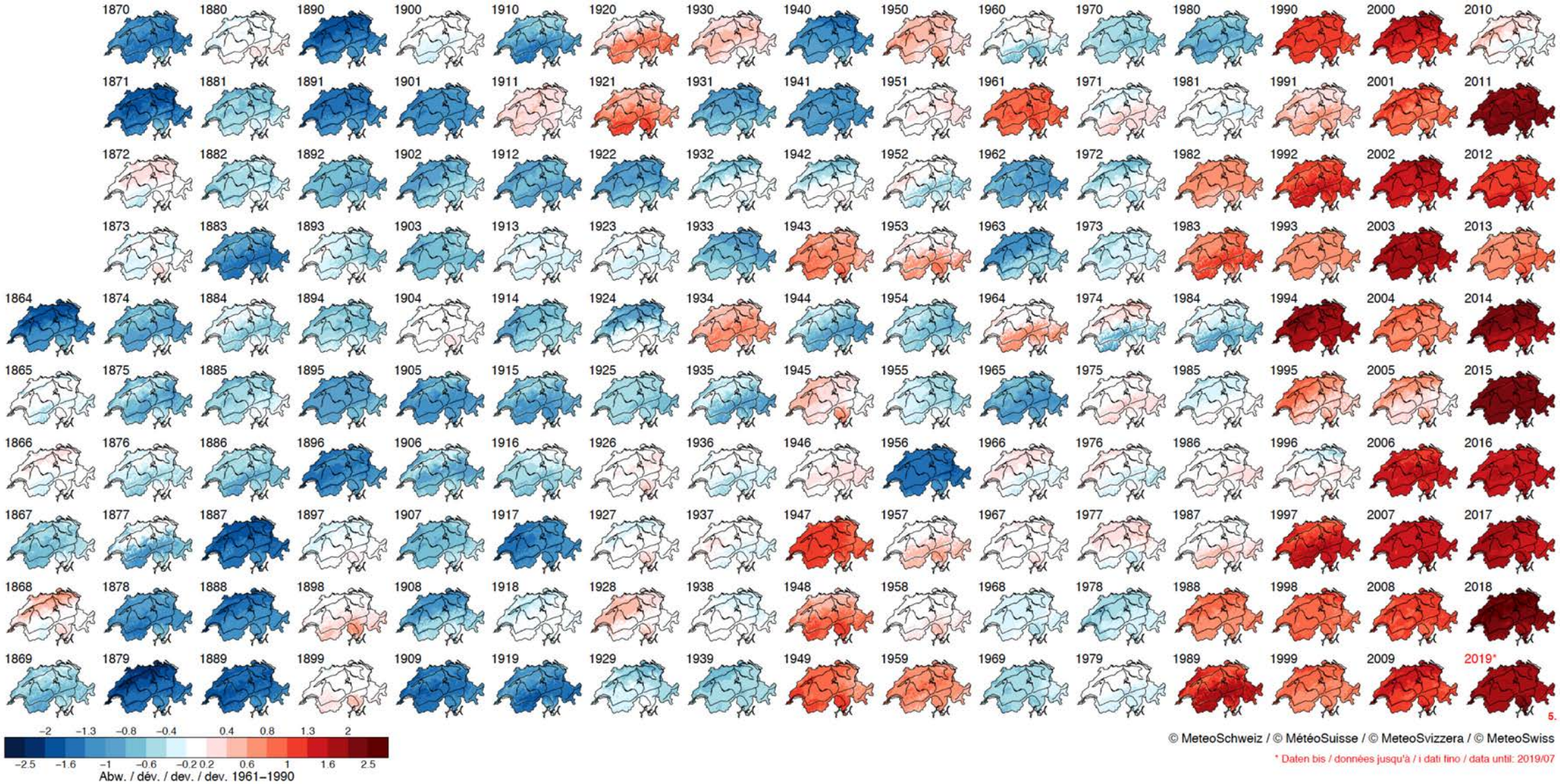
Pre-read for today



CH2018 - Climate Scenarios for Switzerland (PDF, 6 MB)

https://www.nccs.admin.ch/dam/nccs/en/dokumente/website/klima/CH2018_broschure.pdf.download.pdf/CH2018_broschure.pdf

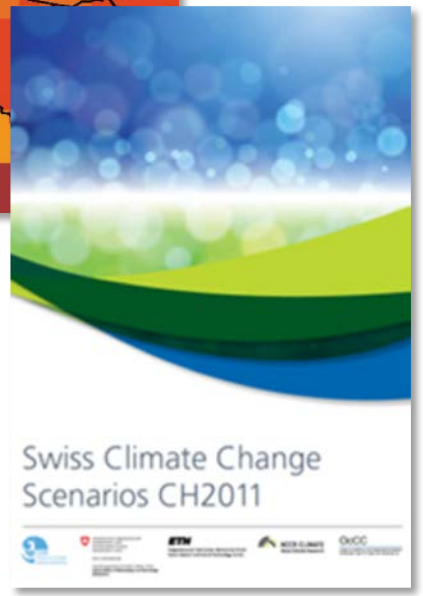
It is getting warmer in Switzerland



New Swiss Climate Scenarios CH2018

CH2007

CH2011



Switzerland 2060 (business as usual)

Dry
Summers

Heavy
Precipitation

More
Hot Days

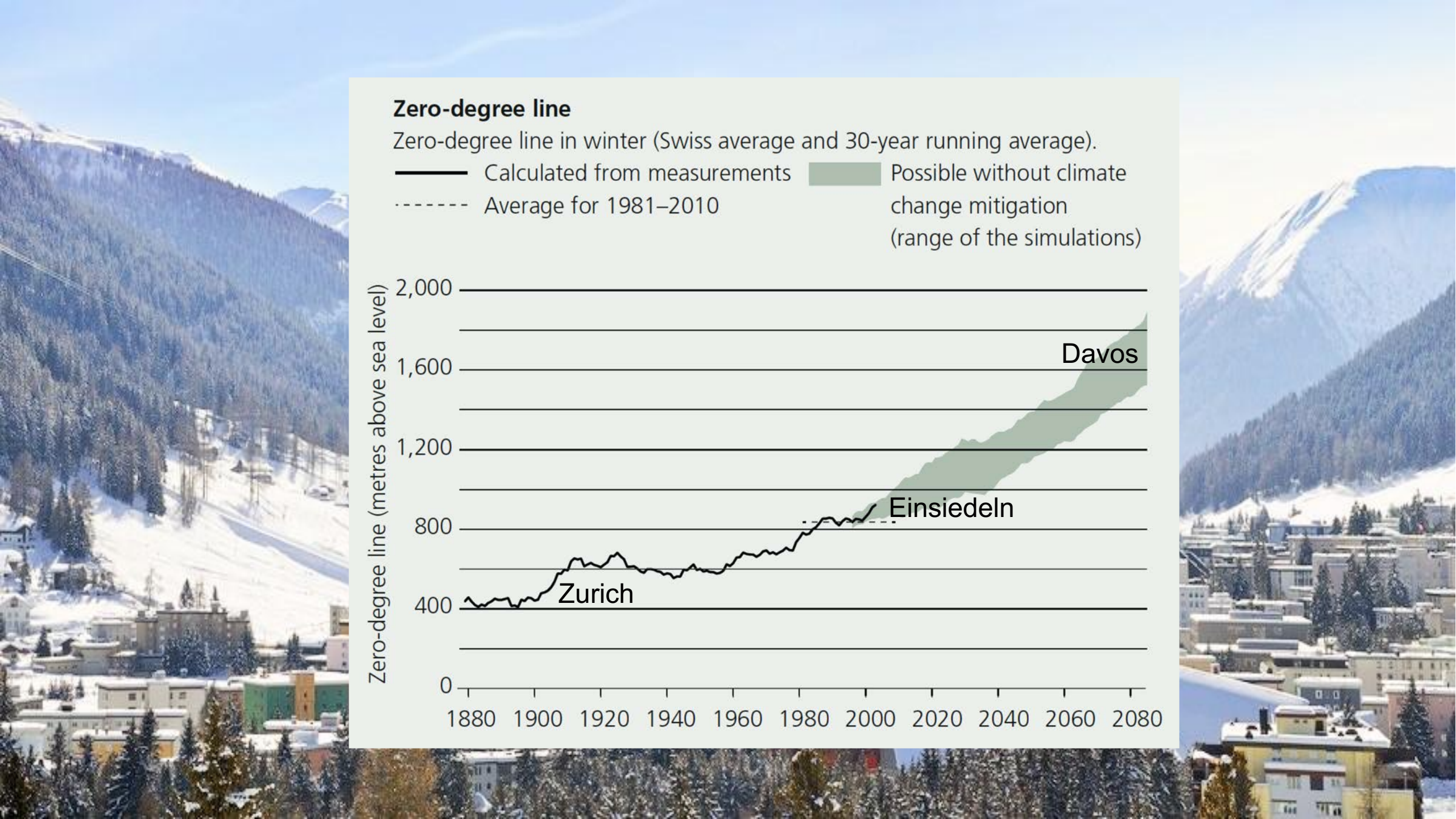
Snow-scarce
Winters

Snow-scarce Winters

Increase in elevation of zero-degree line

Snow becomes a rarity

Snow-scarce Winters

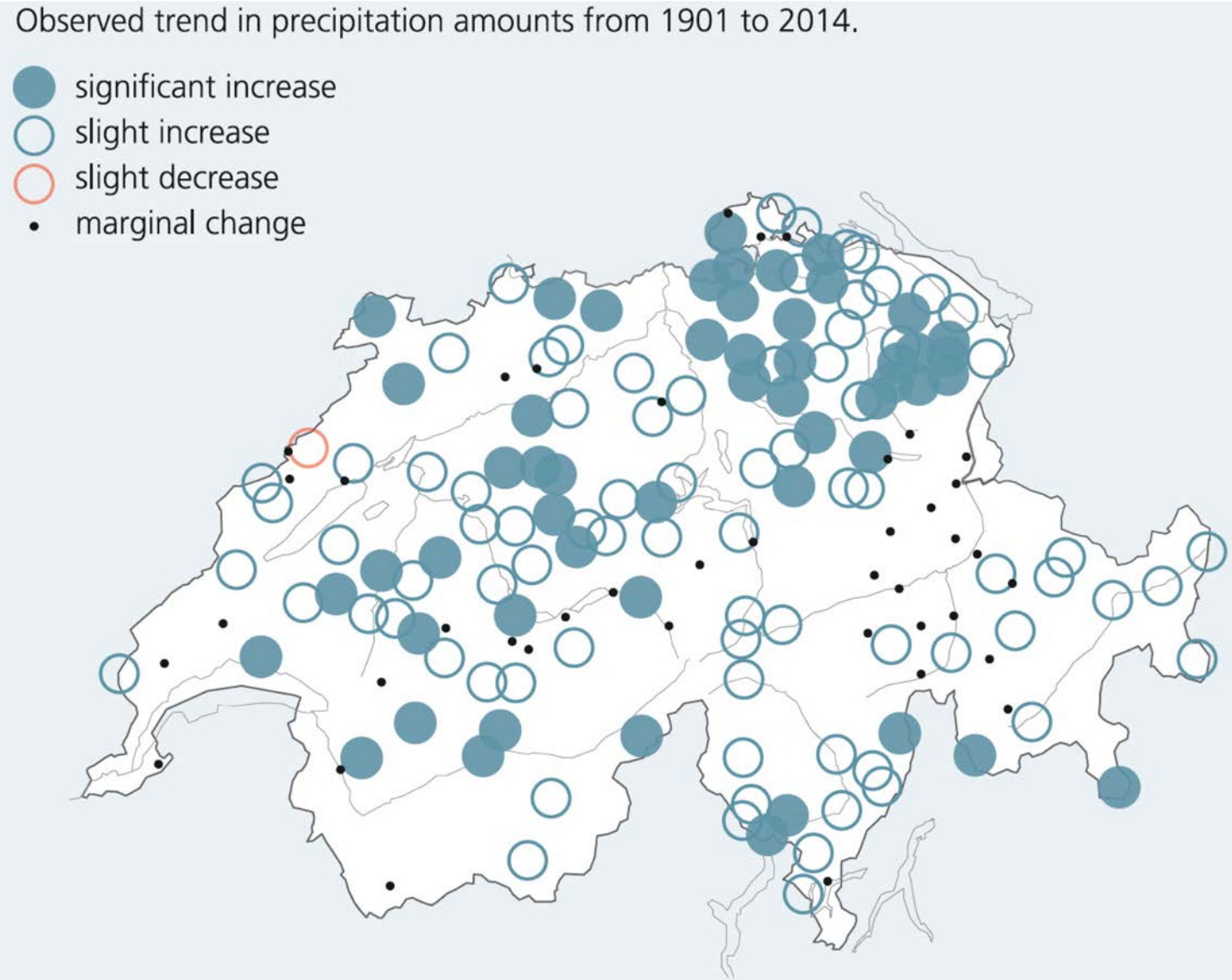

Zero-degree line
Zero-degree line in winter (Swiss average and 30-year running average).
Calculated from measurements
Average for 1981–2010
Possible without climate change mitigation (range of the simulations)
Zero-degree line (metres above sea level)
2,000
1,600
1,200
800
400
0
1880
1900
1920
1940
1960
1980
2000
2020
2040
2060
2080
Davos
Einsiedeln
Zurich

Heavy Precipitation

Heavy Precipitation

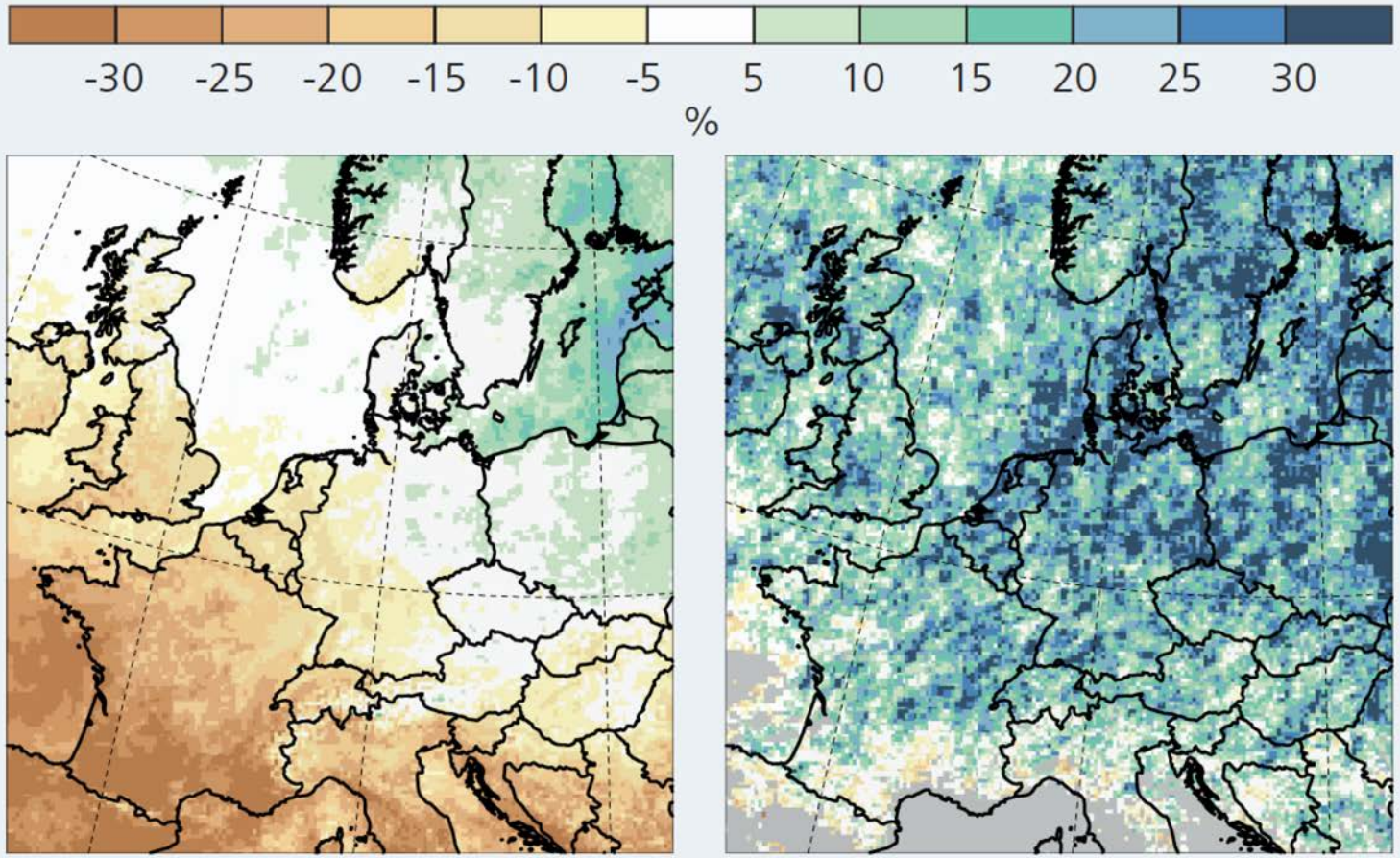
Extremes intensify

31 to 0 for Trend in Heaviest Single-day Precipitation



Change in average and extreme precipitation in summer

Change around 2060 without climate change mitigation,
in comparison to 1981–2010 (30-year averages).



Average summer precipitation

100-year single-day precipitation event

Dry Summers

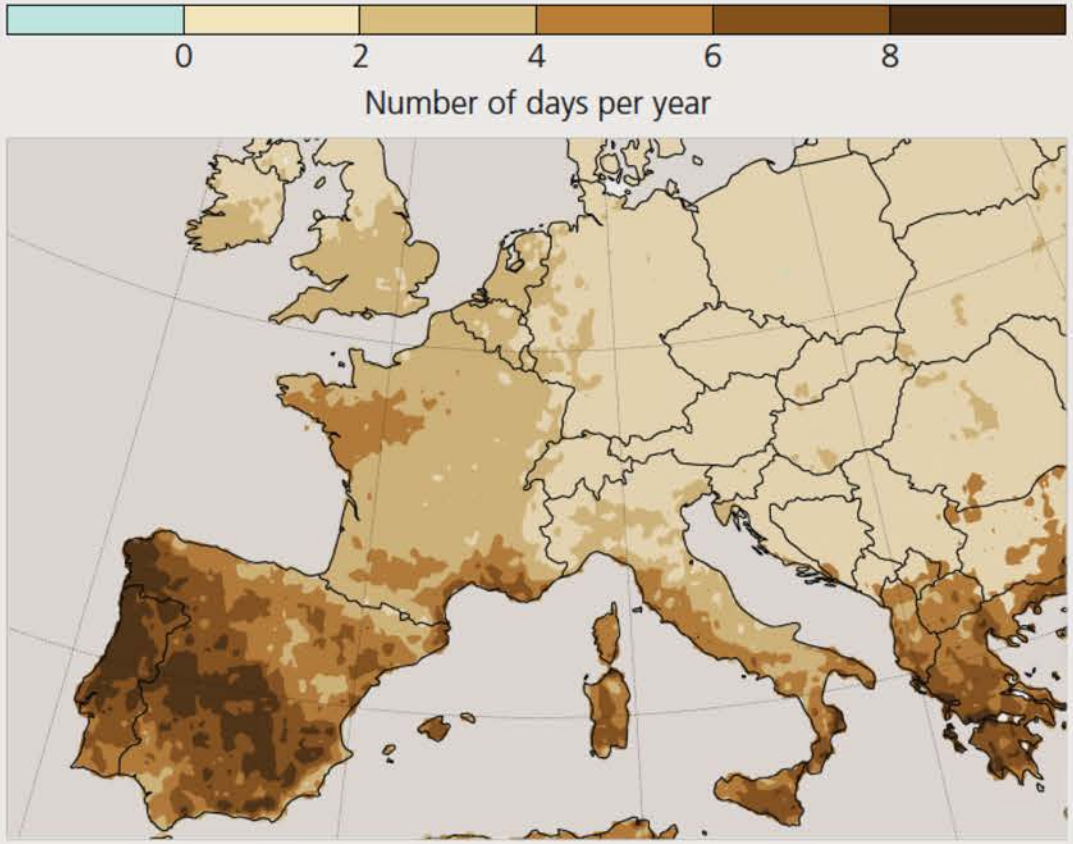
Dry
Summers

Less Precipitation –
More Evapotranspiration –
Dryer Soils

Less Precipitation in Summer

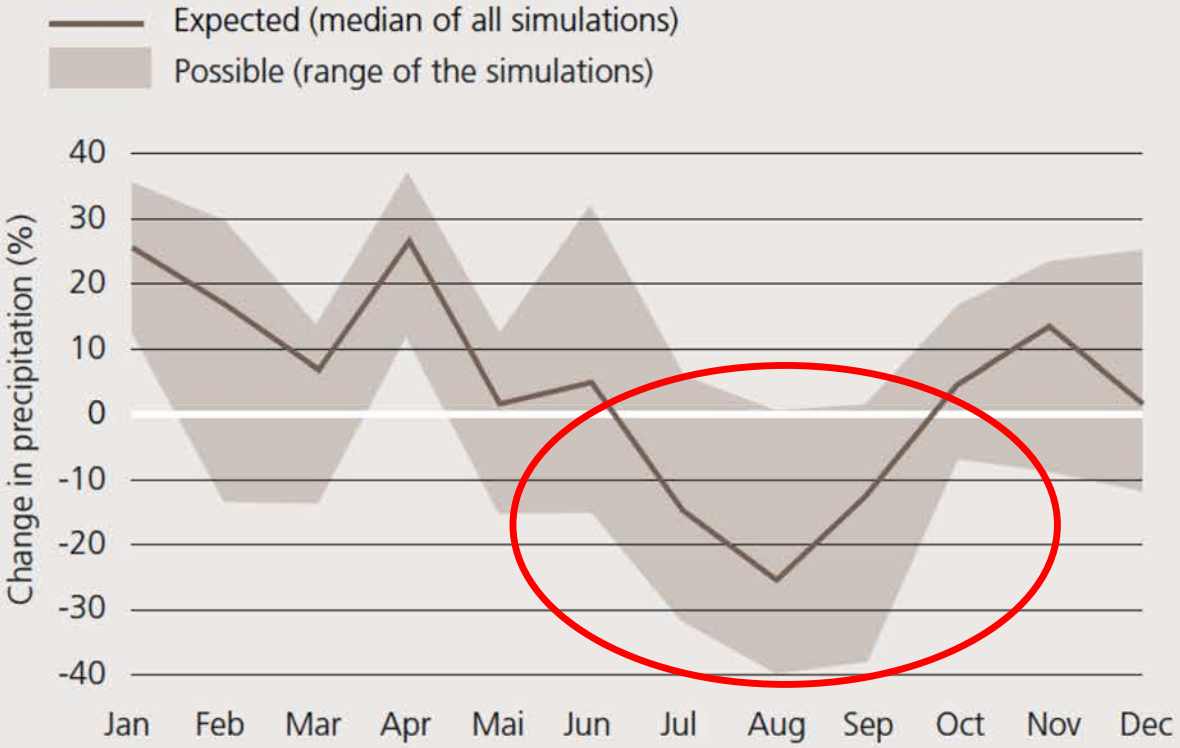
Change in the longest dry period in summer

Expected change around 2060 without climate change mitigation, in comparison to 1981–2010 (30-year averages).



Change in precipitation in La Chaux-de-Fonds

Change over the course of the year around 2060 without climate change mitigation, in comparison to 1981–2010 (30-year average).



More Hot Days

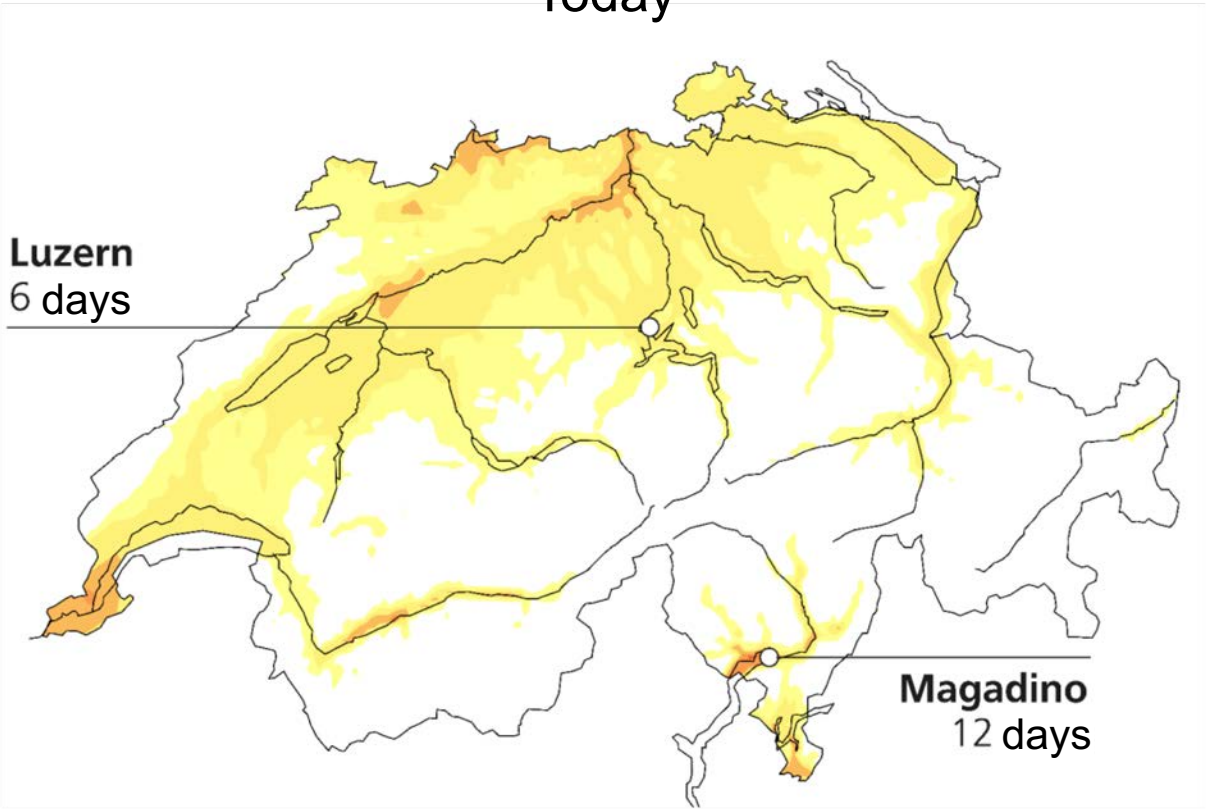
More intense Heat Waves

3-5 times more Hot Days

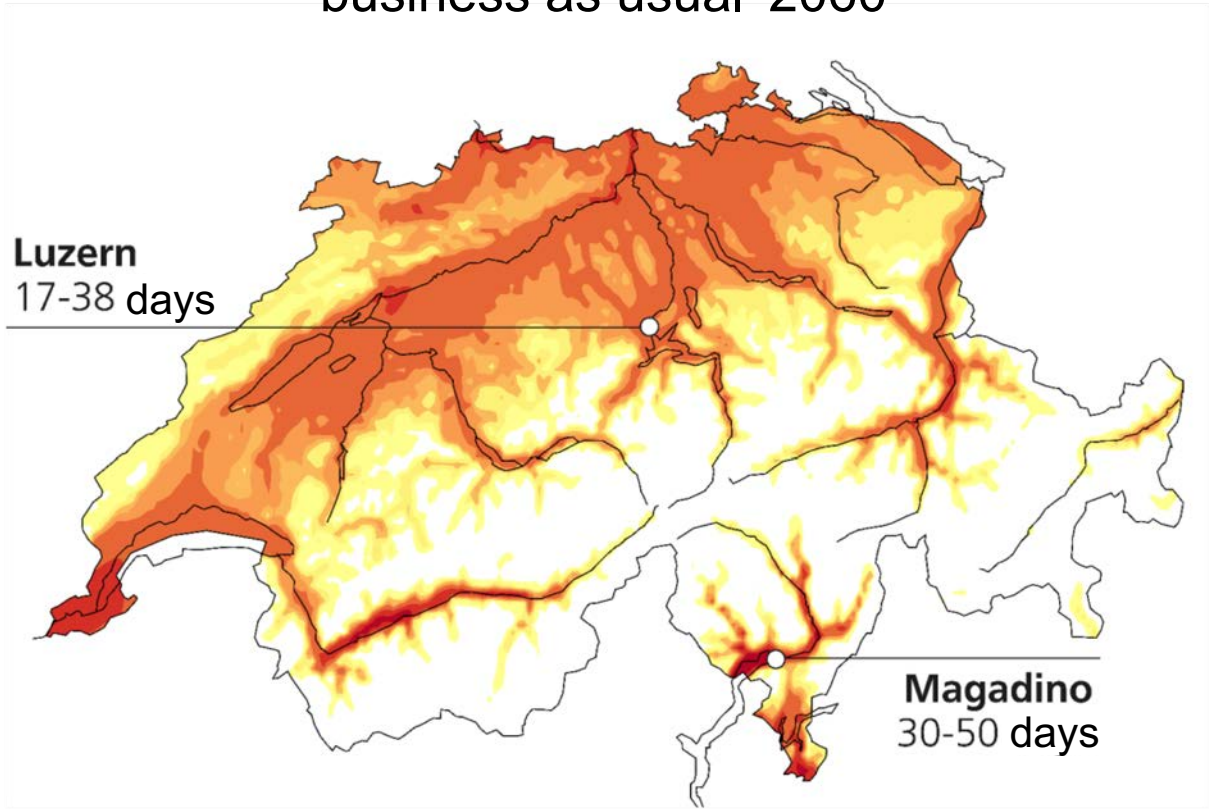
More
Hot Days

Subsantially more Hot Days

Today



‘business as usual’ 2060



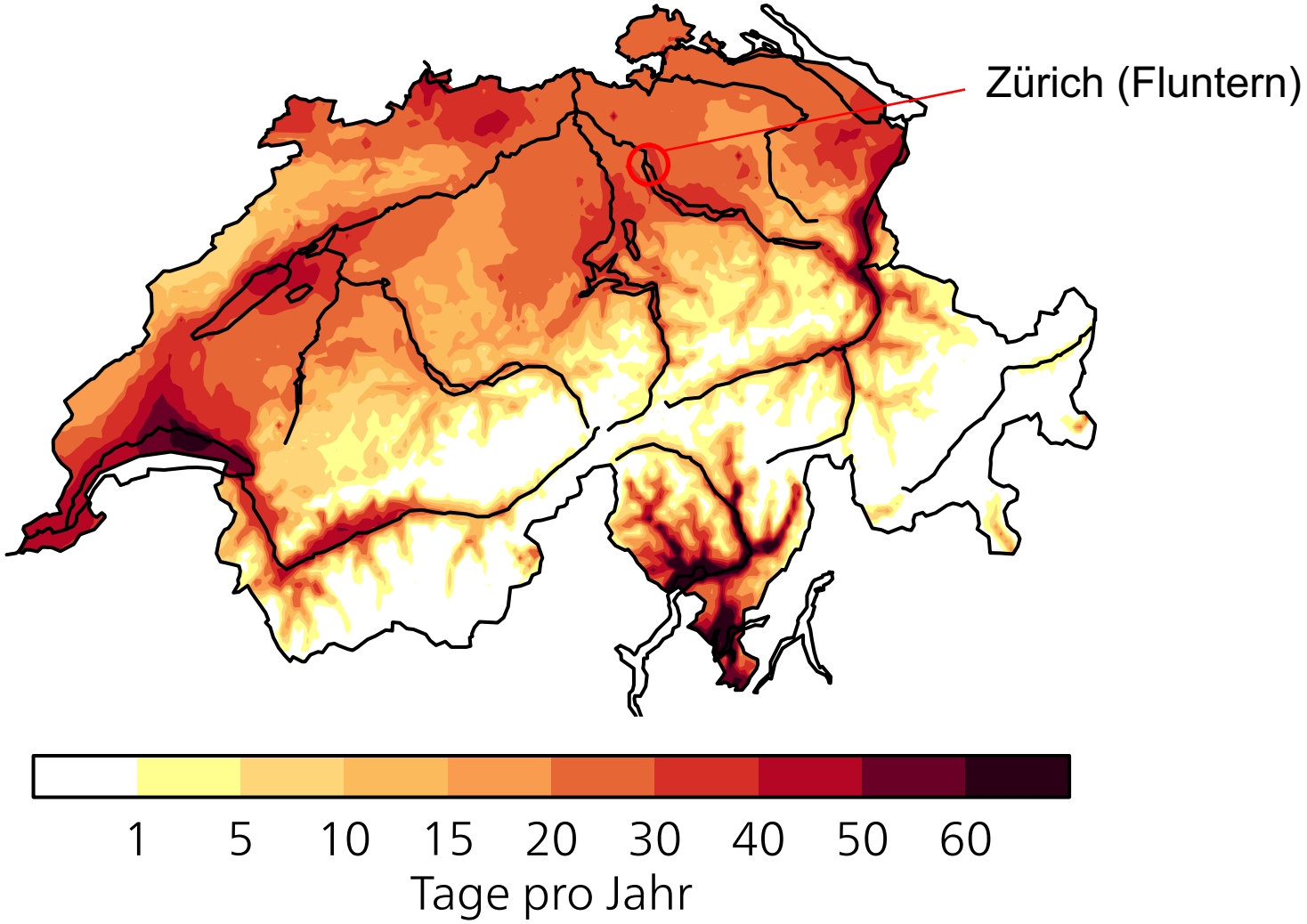
Heat wave 2018

Heat wave 2060?

Tropennächte

2085 RCP8.5

Jahresmittel Obere Schätzung



Measures to deal with tropical nights (**100** elderly in the home)

Air conditioning (per unit, i.e. per person)	2’799.-
Life expectancy of air conditioning unit	5 years
Unit cost per year thus	**560.-** per affected person
Electricity and maintenance per day	**12.-** per tropical night day

Cost of insulation of elderly home	2'200’000.-
Life expectancy of insulation	50 years
Cost of insulation per year	**44’000.-**

Question: Which measure is more cost effective? → Excel

	inhabitants	100			
tropical nights	% affected	affected inhabitants	air conditioners	*aircon all*	insulation
2	0.1%	-	-	*58'380*	44'000
4	0.6%	1	608	*60'780*	44'000
10	5.3%	5	3'399	*67'980*	44'000
25	37.9%	38	32'672	*85'980*	44'000
30	55.3%	55	50'589	*91'980*	44'000
40	100.0%	100	103'980	*103'980*	44'000
air conditioning unit		2'799			
life expectancy air conditioner		5	years		
power and maintenance per day		12			
cost of aircon unit per year		560			
safety margin additional units		0%			
cost insulation multi-family		220'000			
cost insulation elderly home		2'200'000			
life expectancy insulation		50	years		
cost of insulation per year		44'000			

Additional measure

Day in the Alps per person per day	100.-
Transport costs	25.-

(When) is this measure more effective ? → Excel (add)

	inhabitants	100					
tropical nights	% affected	affected inhabitants	air conditioners	*aircon all*	insulation	mountain stay affected	mountain stay all
2	0.1%	-	-	*58'380*	44'000	-	22'500
4	0.6%	1	608	*60'780*	44'000	425	42'500
10	5.3%	5	3'399	*67'980*	44'000	5'125	102'500
25	37.9%	38	32'672	*85'980*	44'000	95'950	252'500
30	55.3%	55	50'589	*91'980*	44'000	166'375	302'500
40	100.0%	100	103'980	*103'980*	44'000	402'500	402'500
air conditioning unit		2'799					
life expectancy air conditioner		5	years				
power and maintenance per day		12					
cost of aircon unit per year		560					
safety margin additional units		0%					
cost insulation multi-family		220'000					
cost insulation elderly home		2'200'000					
life expectancy insulation		50	years				
cost of insulation per year		44'000					
mountain stay per person per day		100					
transport forth & back		25					

Forming groups and how to proceed

Four groups of *n* students each in zoom breakout rooms, each group assigned to one ‘story’ (Dry Summers, Heavy Precipitation, More Hot Days, Snow-scarce Winters).

Proceed along Economics of Climate Adaptation (ECA) in a back of the envelope fashion (milchbüchleinartig), i.e., quantify risk today, estimate effect of (economic) development and impact of climate change by 2060, informed by 2018 data and a relationship between hazard intensity and impacts(s), likely informed by a recent event. Figure effect of your choice of an adaptation option(s) to reduce impact... and if time remains, also guesstimate the cost of your option(s). Assume a linear development over time and choose a reasonable discount rate to bring it to a net present value.

Preparation until 10h. In the first five minutes: Share view on assigned theme (Dry Summers, Heavy Precipitation, More Hot Days, Snow-scarce Winters), second five minutes: select a sector (agro, urban productivity, insured property, artificial snow, …), then get going (organize breaks yourself). 10:15-10:30h prepare one slide (Schaubild), starting 10:30h with presentations, 2 min/group, followed by discussion per theme (Dry Summers, Heavy Precipitation, More Hot Days, Snow-scarce Winters)

Some resources you might start from on the next slide.

Potential sources

Heat - work productivity
https://link.springer.com/article/10.1007/s00484-018-1530-6
https://www.nature.com/articles/nclimate2623?proof=true&draft=journal
https://www.nature.com/articles/nclimate1827

Drought - agriculture
https://de.wikipedia.org/wiki/D%C3%BCrre_und_Hitze_in_Europa_2018#Landwirtschaft

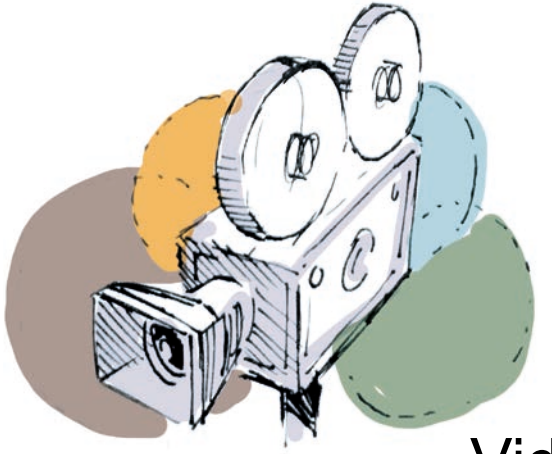
Snow – and lack thereof
https://www.researchgate.net/profile/Christian_Rixen/publication/228663378_Klimawandel_und_Wintertourismus_Okonomische_und_okologische_Auswirkungen_von_technischer_Beschneiung/links/0fcfd50804153a5981000000.pdf

Flood
http://www.planat.ch/de/wissen/statistik/
https://www.wsl.ch/de/naturgefahren/hochwasser-und-ueberschwemmung/unwetterschadens-datenbank.html
Global: https://www.nature.com/articles/nclimate2617
Europa: http://assets.climatecentral.org/pdfs/EuropeanFloods_WWA_RapidAttribution_June2016.pdf

CH2018 products www.nccs.ch

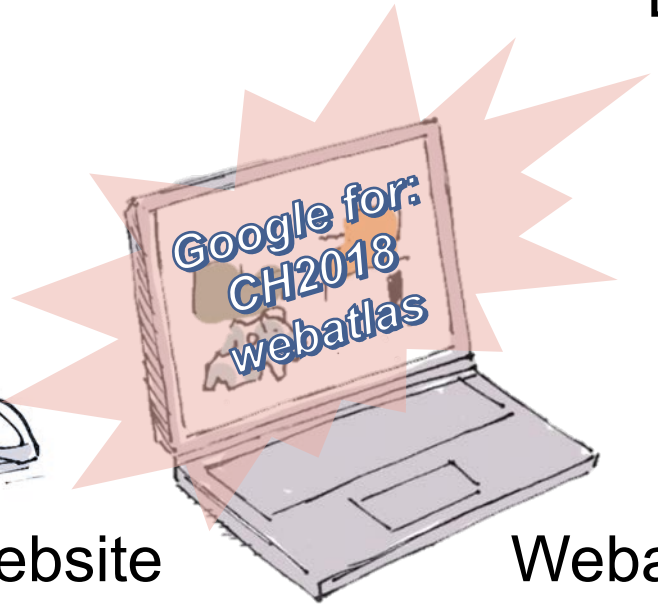
Technical report

Brochure



Videos

Website

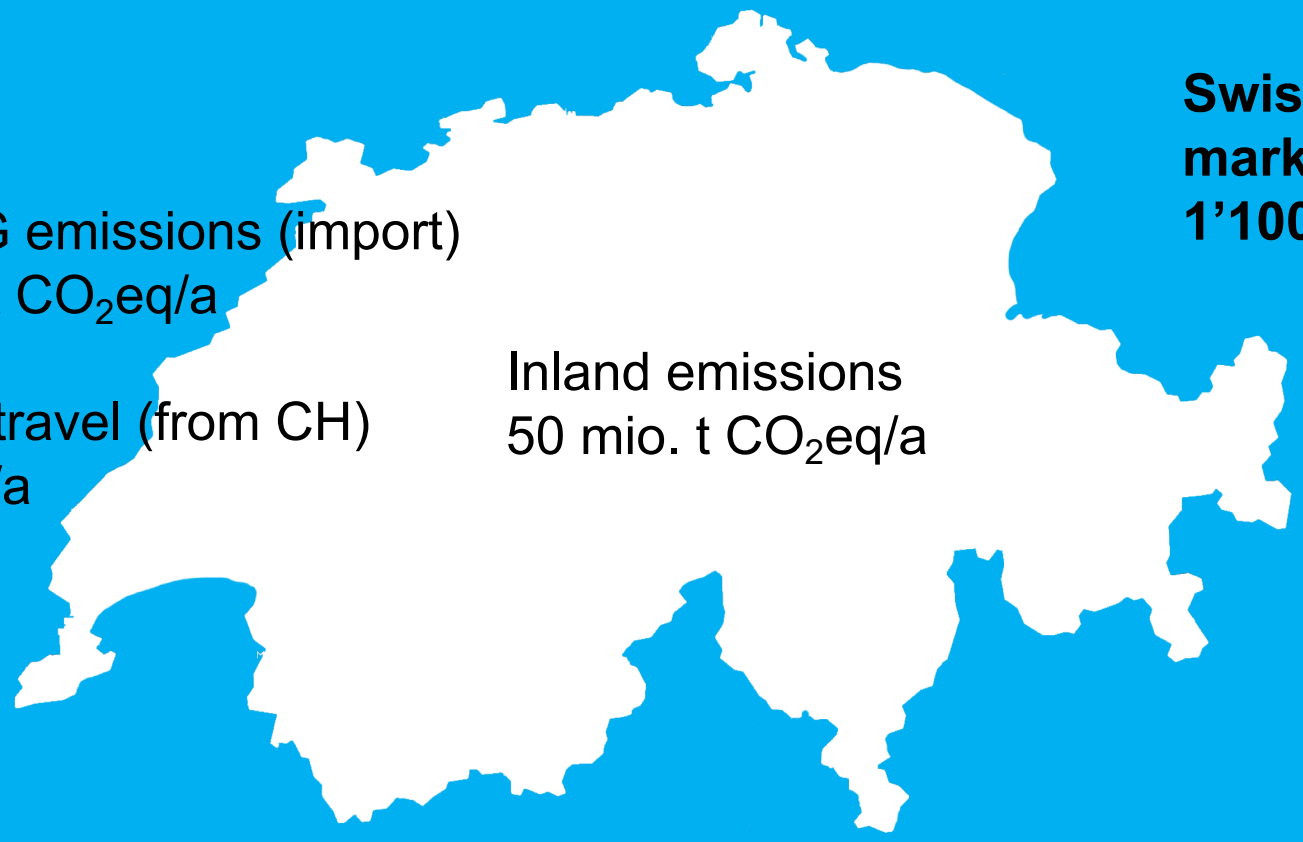


Webatlas

Data

Scribbles by zeichenfabrik.ch

Swiss greenhouse gas (GHG) emissions[1]



grey GHG emissions (import)
110 mio. t CO_2eq/a

International air travel (from CH)
10 mio. t CO_2eq/a

Inland emissions
50 mio. t CO_2eq/a

Swiss financial marketplace[2]
1'100 Mio. t CO_2eq/a

direct investments
270 mio. t CO_2eq/a

portfolio investments
(incl. pension funds)
230 mio. t CO_2eq/a

grey GHG emissions (export)
55 mio. t CO_2eq/a

operations of CH export goods
?? (machinery only: 12 mio. t CO_2eq/a)

[1] Source: Klima-Masterplan Schweiz, Umweltallianz, https://www.wwf.ch/sites/default/files/doc-2017-09/2016-05-Studie-Klima-Masterplan-Klima-Allianz.pdf
[2] Would the Swiss financial market place be a country, it would rank 6th largest global emitter (after China [10'354], USA [5'414], India [2'274], Russia [1'617] and Japan [1'237])