



Climate Change scaled down to the Alpine Region

University of Natural Resources and Applied Life Sciences, Vienna
Department of Water, Atmosphere and Environment
Institute of Meteorology

Helga Kromp-Kolb

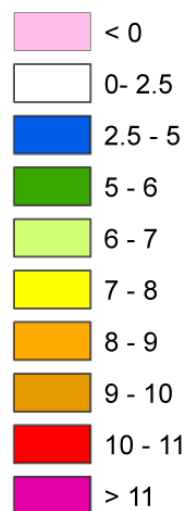




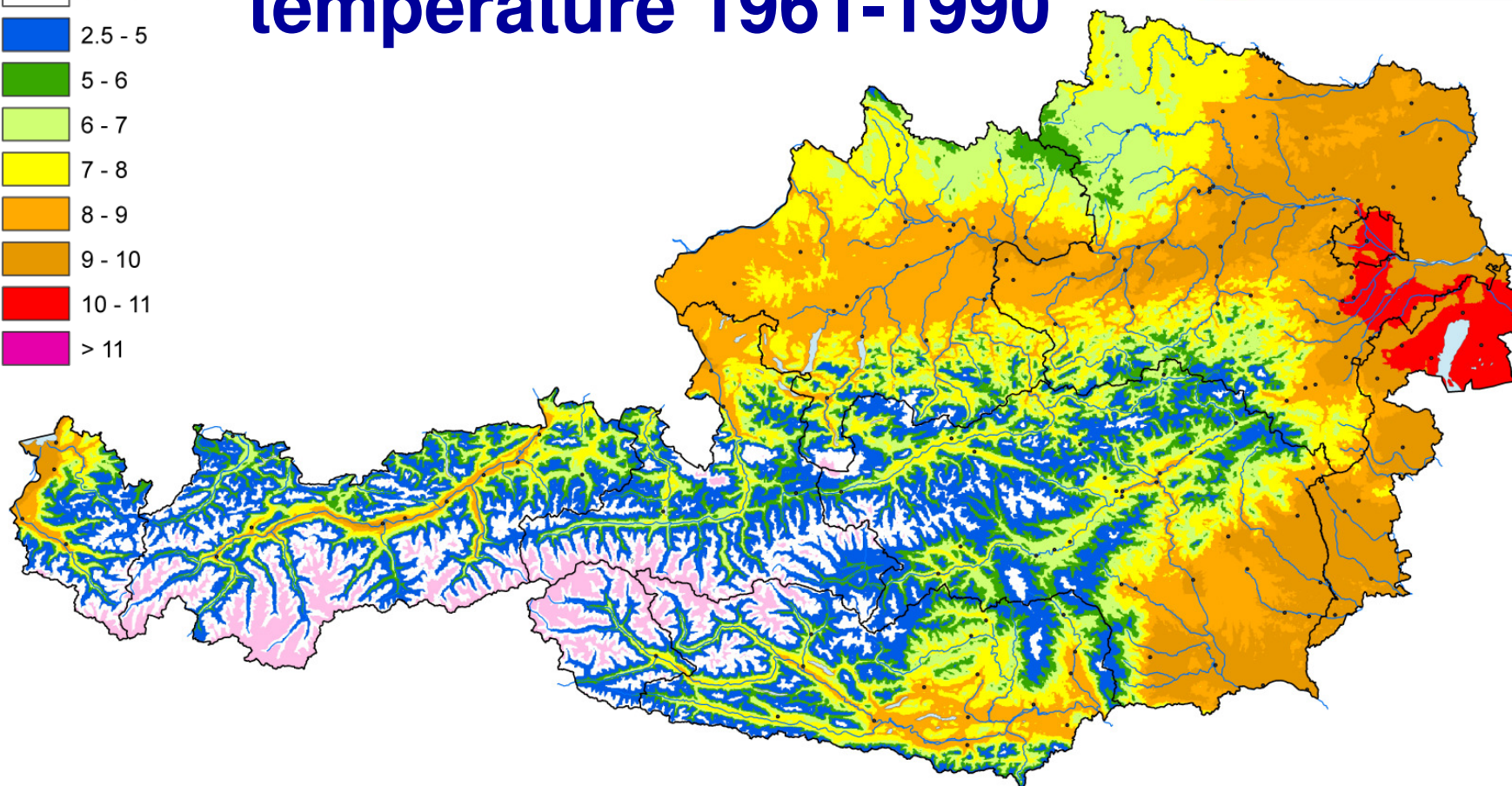
Topographic Map of Austria



1961-1990



Annual average temperature 1961-1990

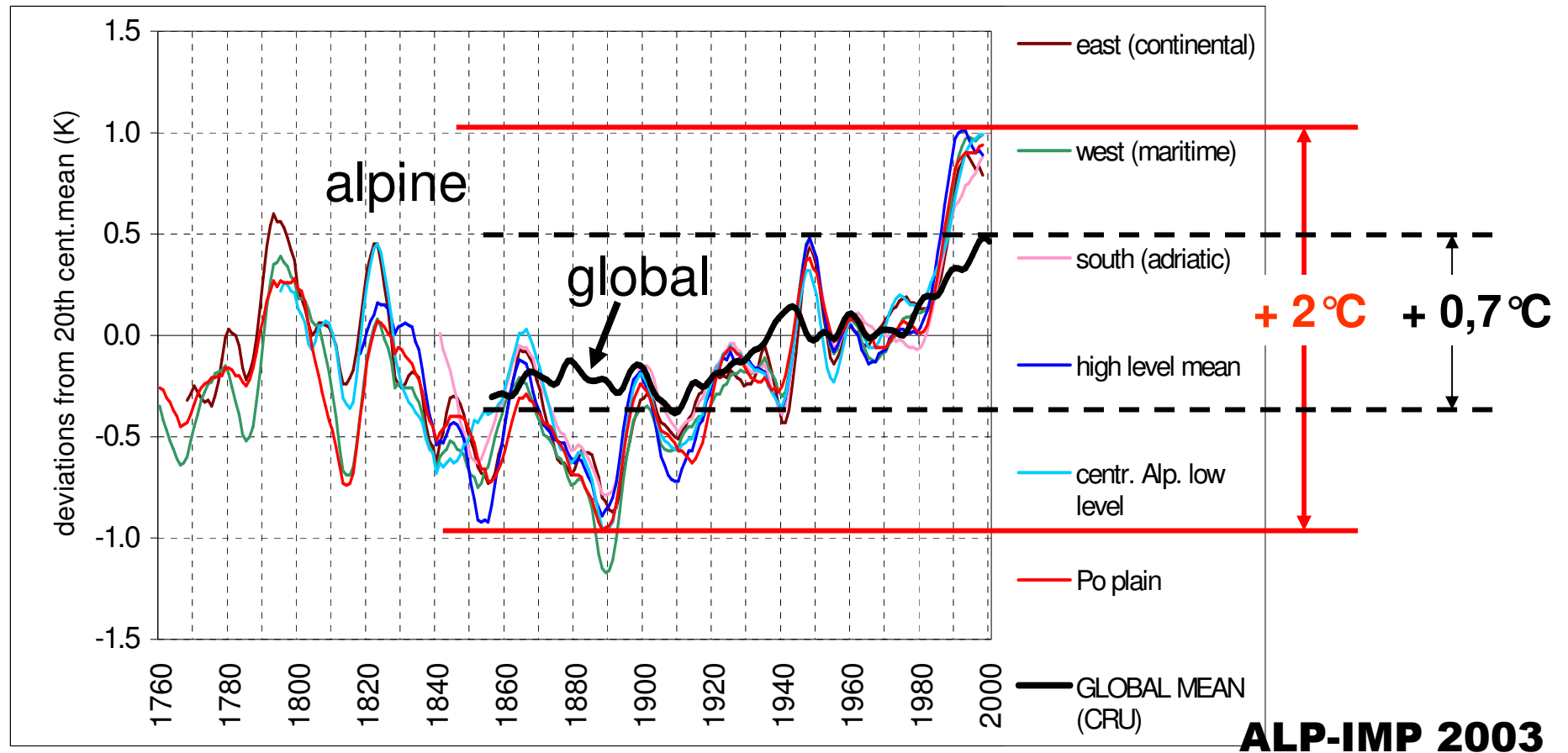


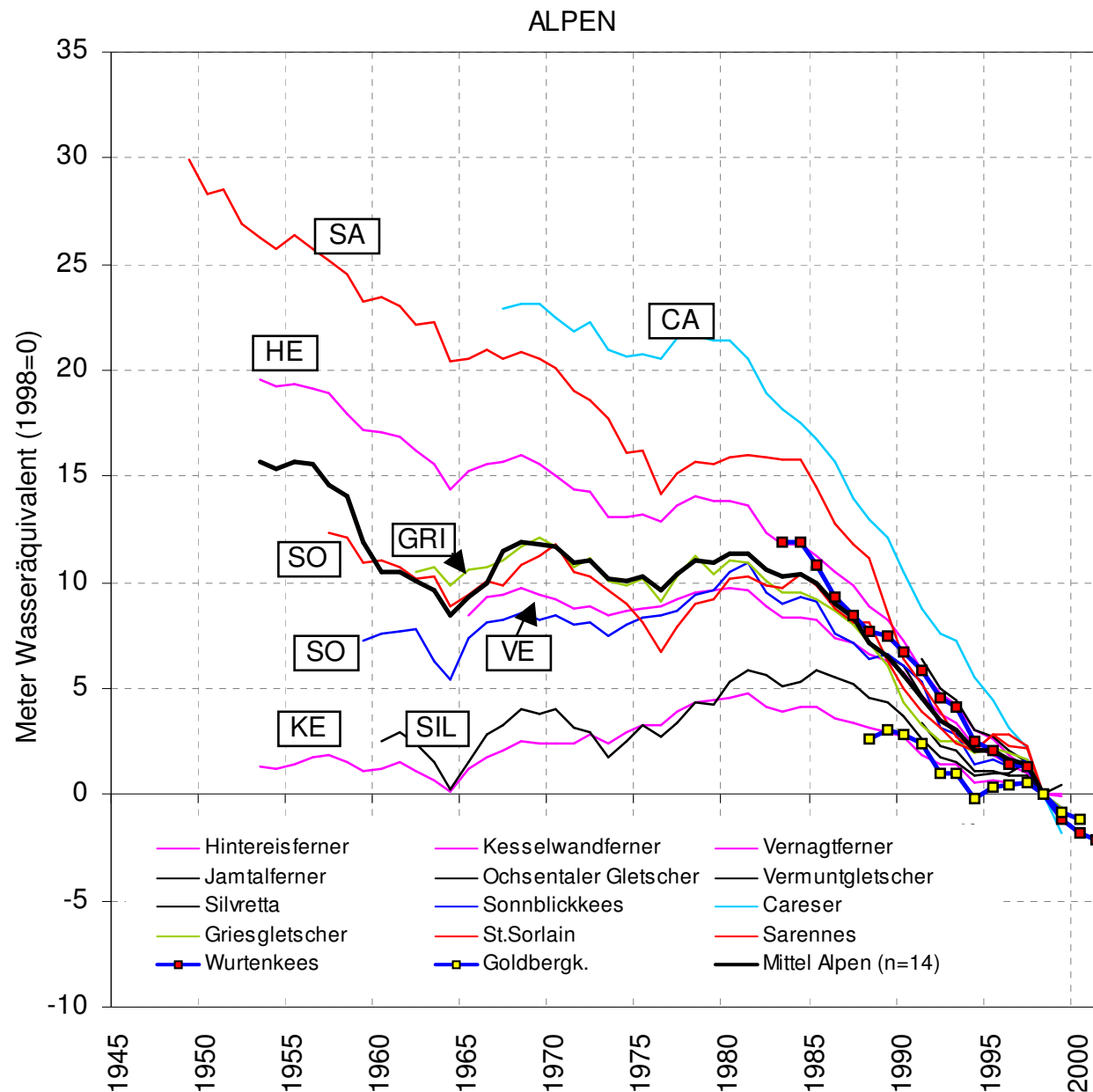
Paltental



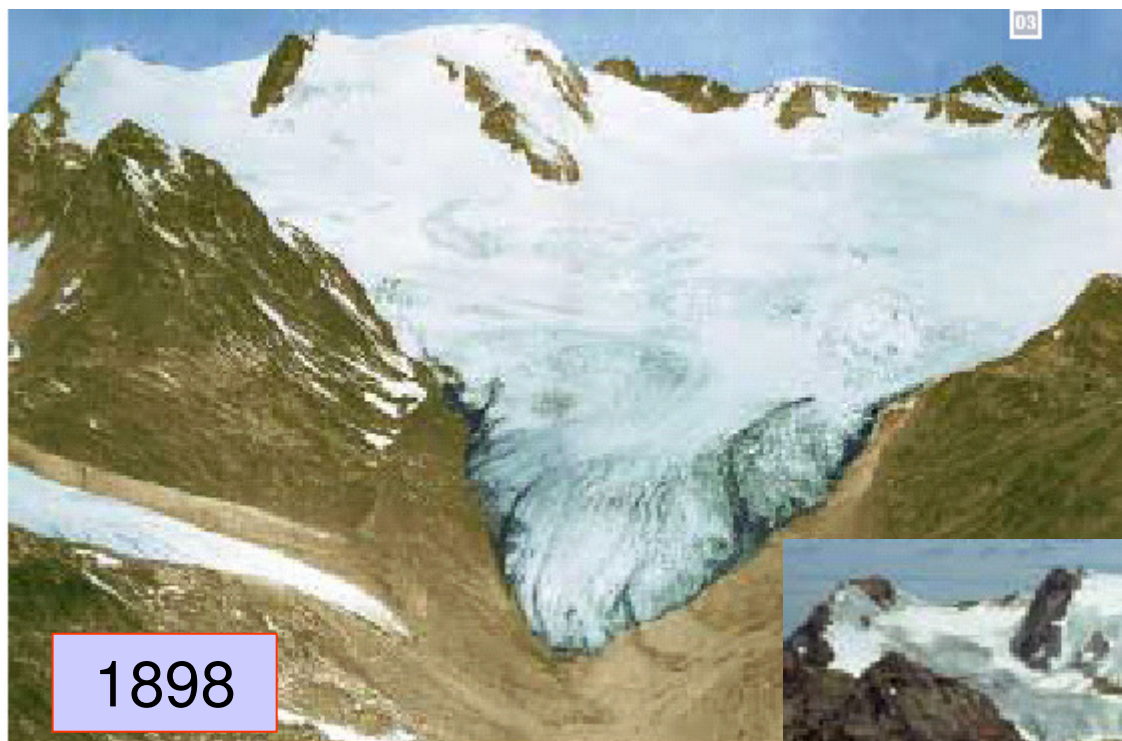


Alpine Area 1760 - 2000





Retreat of Alpine Glaciers 1950 - 2000



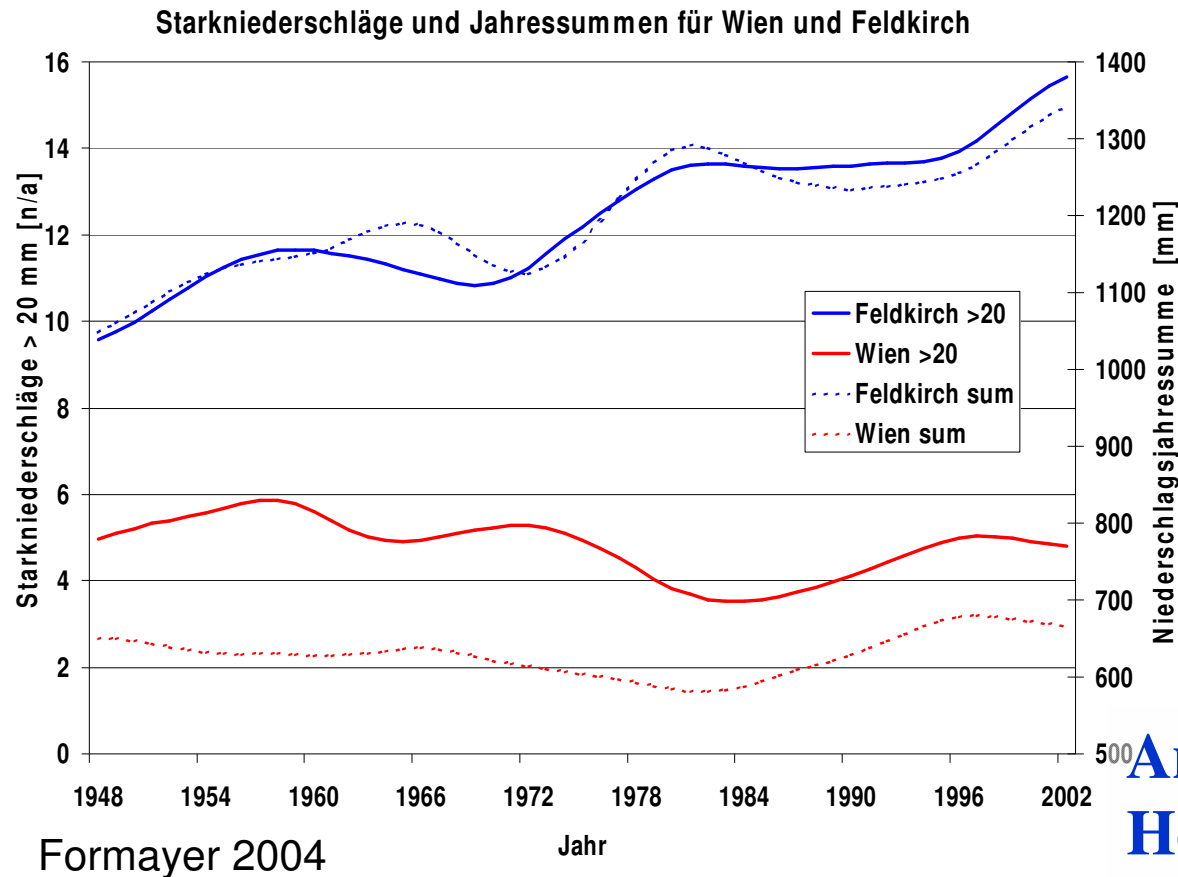
Würthle & Sohn, August 1898

Vernagt Glacier

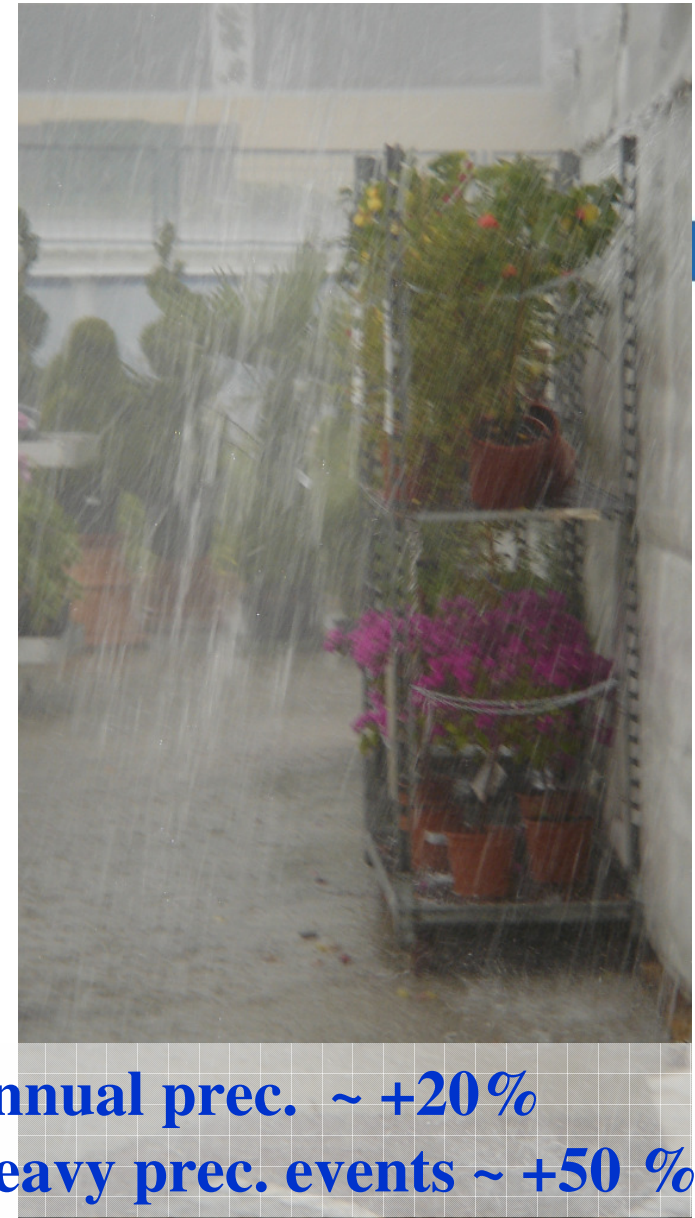
[http://files.alpenverein.at/download/
1076670171156_18_gletscherberichte
2003.pdf](http://files.alpenverein.at/download/1076670171156_18_gletscherberichte2003.pdf)



Frequency of precipitation events > 20 mm/d (-----) & annual sums (- - -) in Feldkirch, Vbg., and **Vienna**



Annual prec. ~ +20 %
Heavy prec. events ~ +50 %





Caveats of Climate Models

- Uncertainties
 - Gaps in understanding, in data
 - limits to spatial resolution, ...
- Feed backs
 - Aerosols, atm. chemistry, vegetation, ...
 - Underestimation of climate change
- Uncoupling of economic growth and energy demand / GHG-Emissions
 - Underestimation of climate change

Processes included / resolved in state-of-the-art GCMs (1)



Atmosphere

Large scale “synoptic” circulation

Radiative forcing of the atmosphere

Poorly resolved: orographic effects

Clouds

Convection – Turbulence

resolved

parametrised

Ocean

Large scale “thermohaline circulation”

resolved

Processes included / resolved in state-of-the-art GCMs (2)



Cryosphere

Large scale sea ice and snow cover

Polar ice sheets (but no ice dynamics)

} resolved

Vegetation

Parameterised in standard GCMs

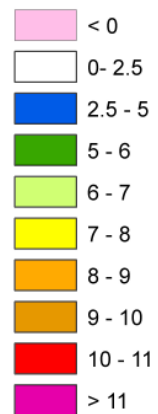
Some feedback mechanism included in
experimental runs

Annual average temperature 1961-1990

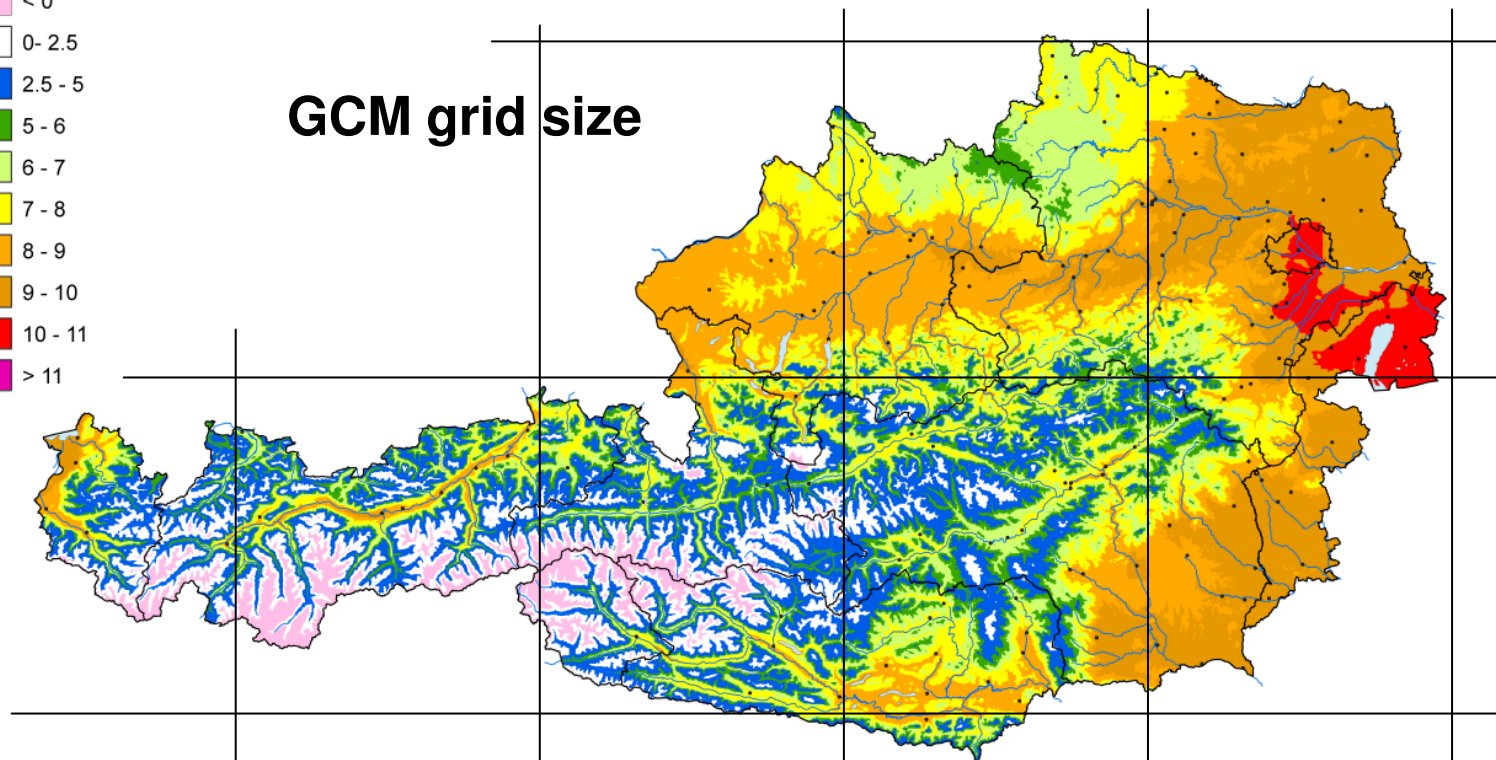


Beobachtete Jahresmitteltemperatur [1961-1990] in Österreich

1961-1990



GCM grid size

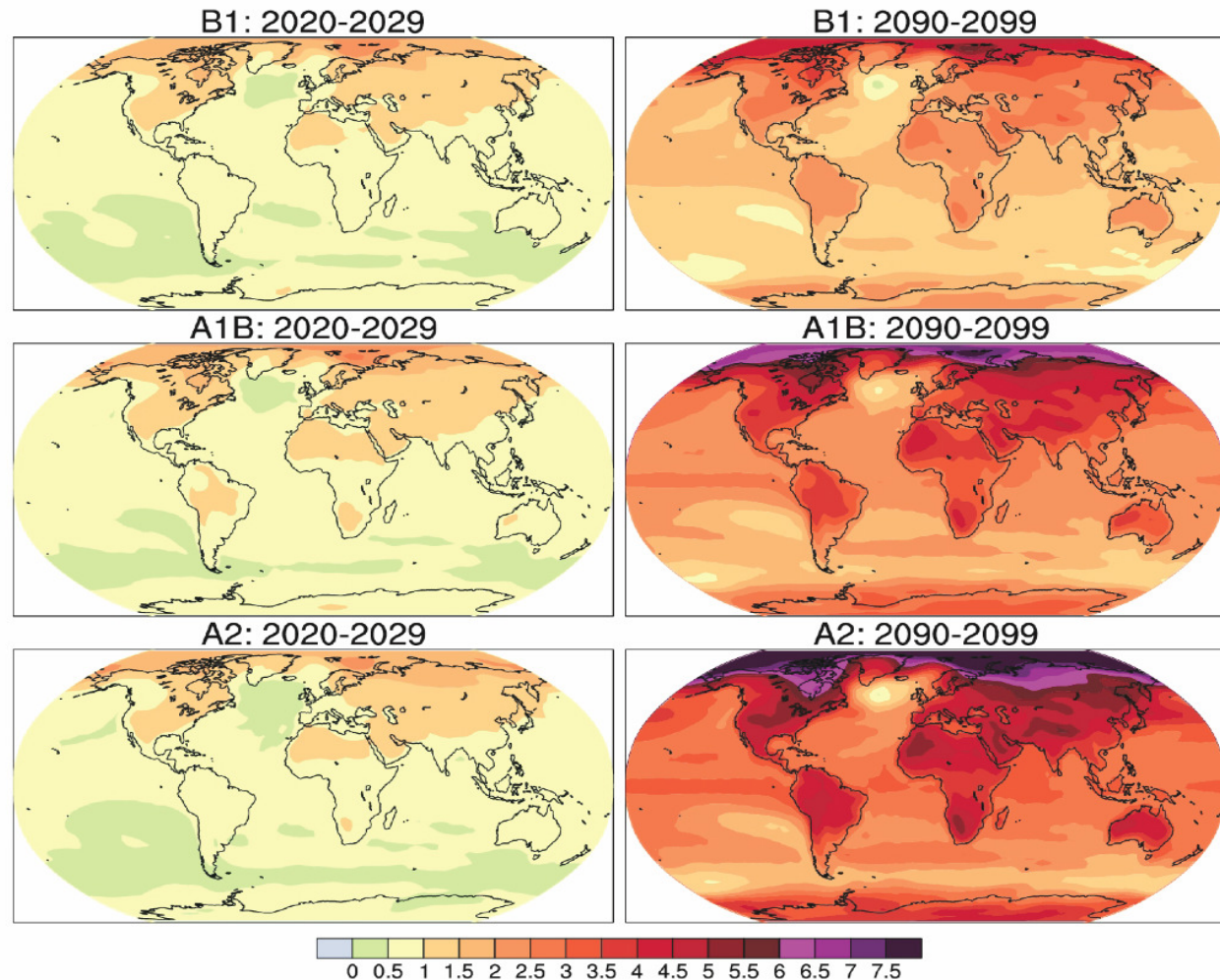


Projections of Future Changes

Projected warming
in 21st century
expected to be

greatest over land
and at most high
northern latitudes

and least over the
Southern Ocean
and parts of the
North Atlantic
Ocean



2020-2029

2090-2099

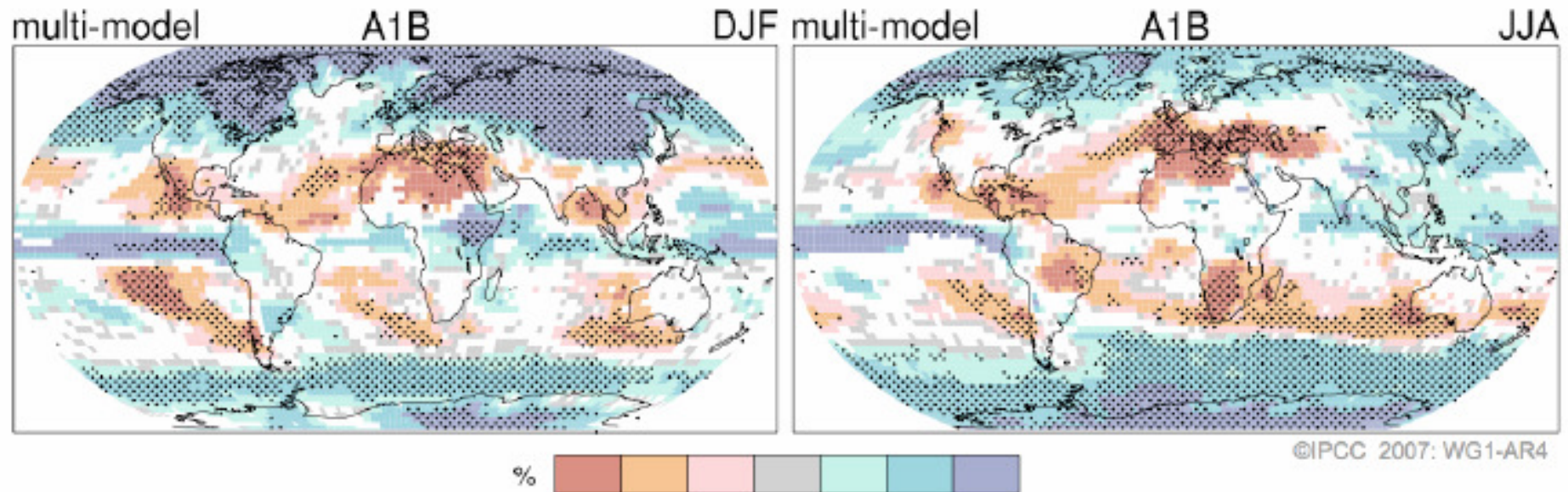
IPCC 2007, courtesy Pachauri and Jallow

Patterns of Precipitation Changes 2090/99 – 1980/99



winter

summer



White: <2/3 of models agree on *sign* of change (+ or -)

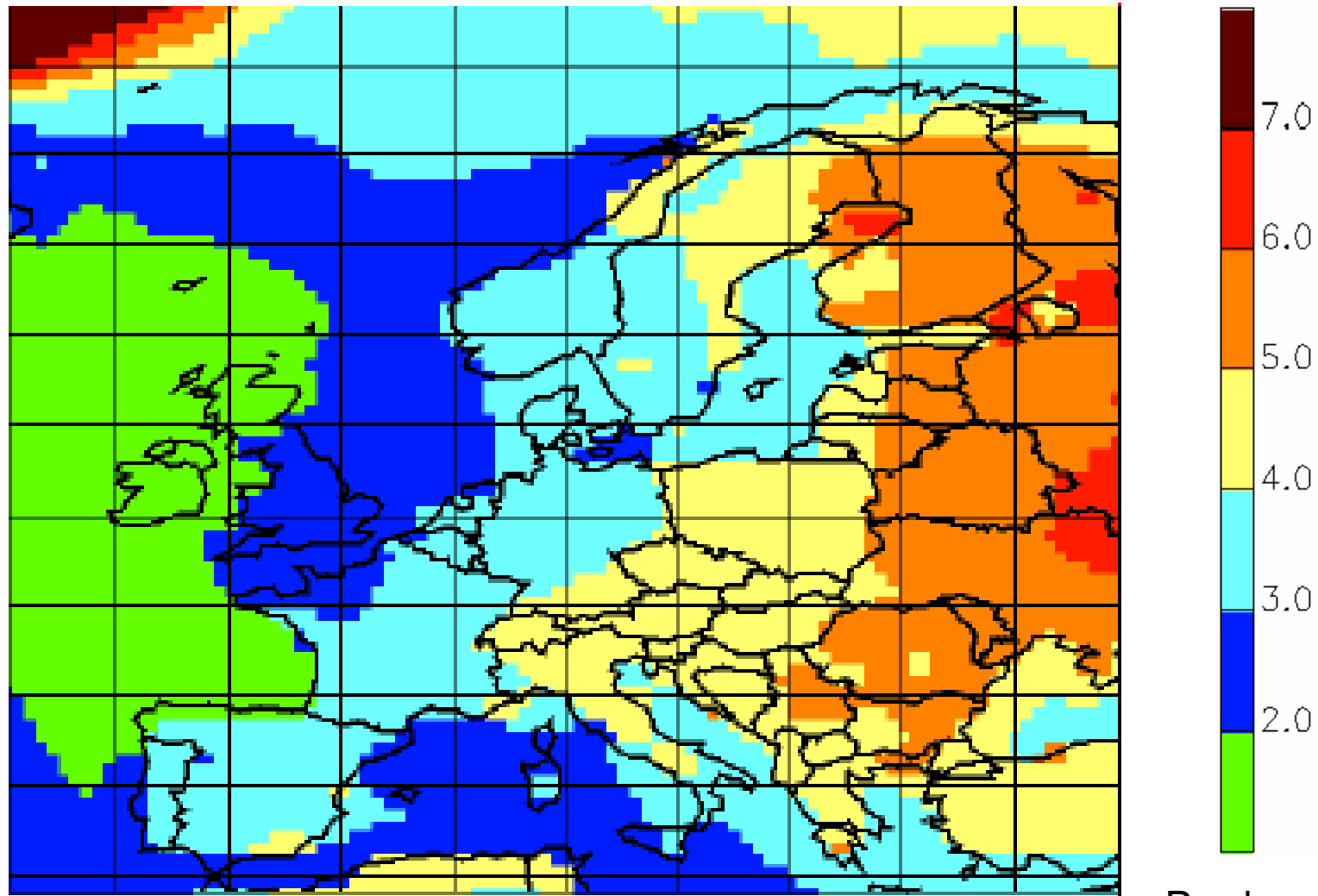
Stippled: >90% of models agree on *sign* of change

Precipitation increases *very likely* in high latitudes

Decreases *likely* in most subtropical land regions

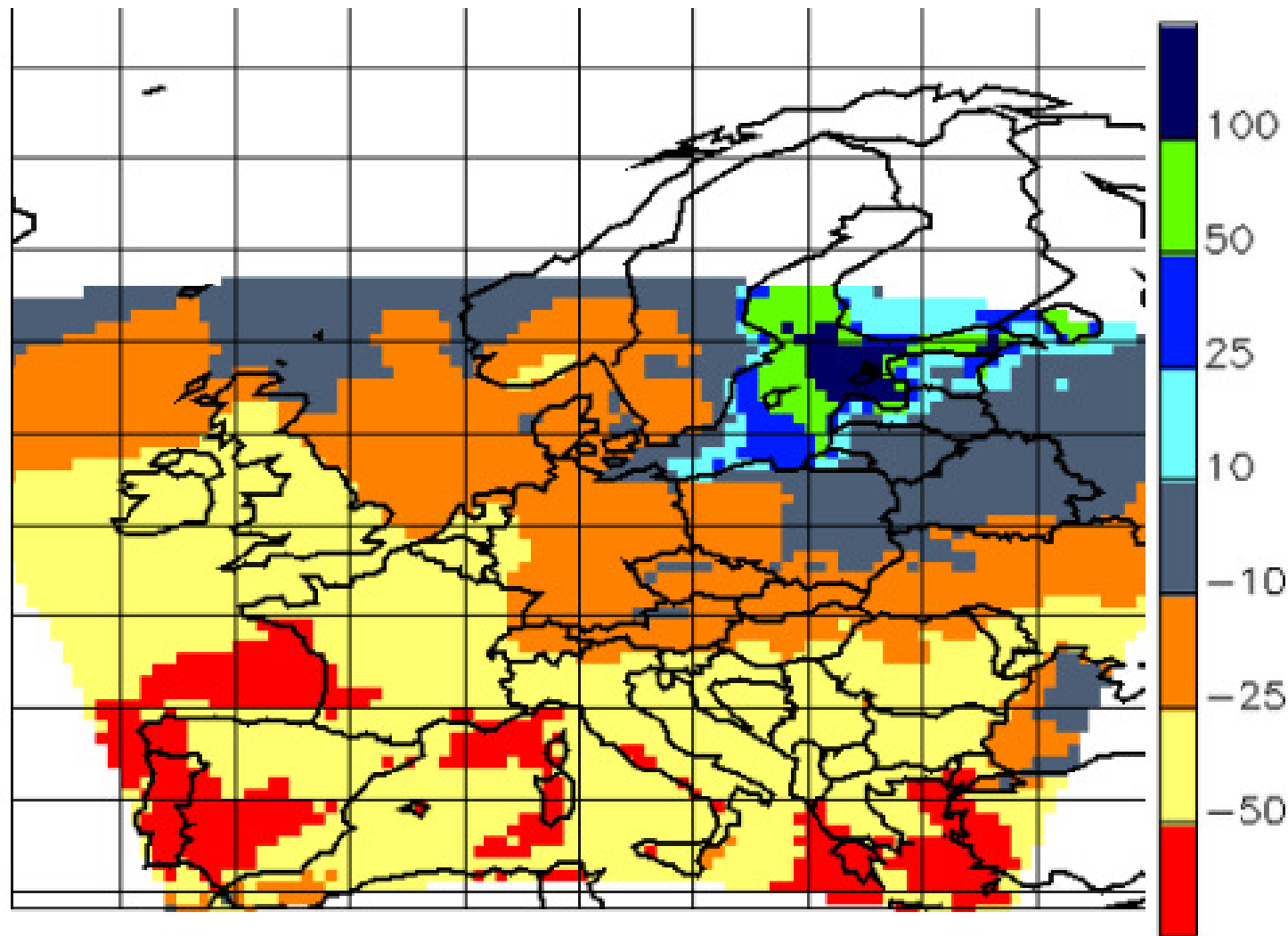
IPCC 2007

Temperature projection for Europe (Su 2070-2100)



Prudence 2003

Precipitation Projection for Europe (Su 2070-2100)



Prudence 2003

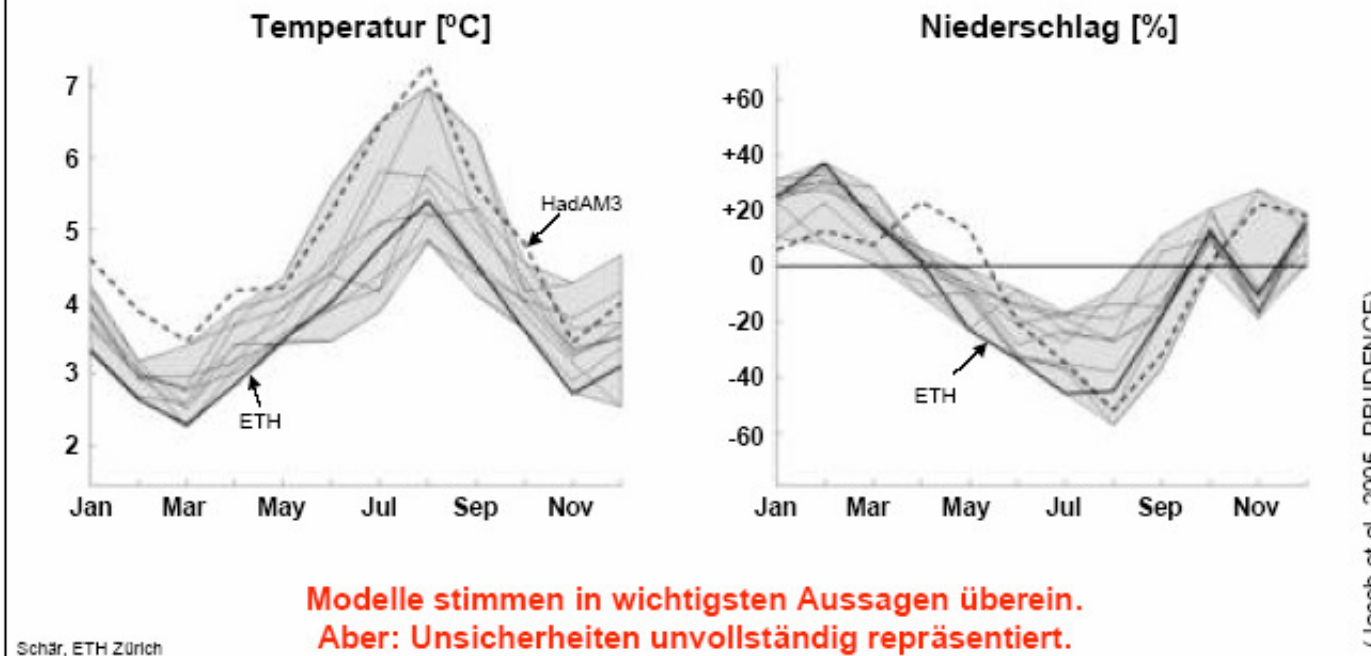
Temperature and precipitation scenarios – Alpine Area 2071/2100 vs. 1961/1990



Winter:
+15 - 40%

Summer:
-10 - 50%

Increase in
heavy
precipitation
events



Graph by
Schär 2005



Output localization

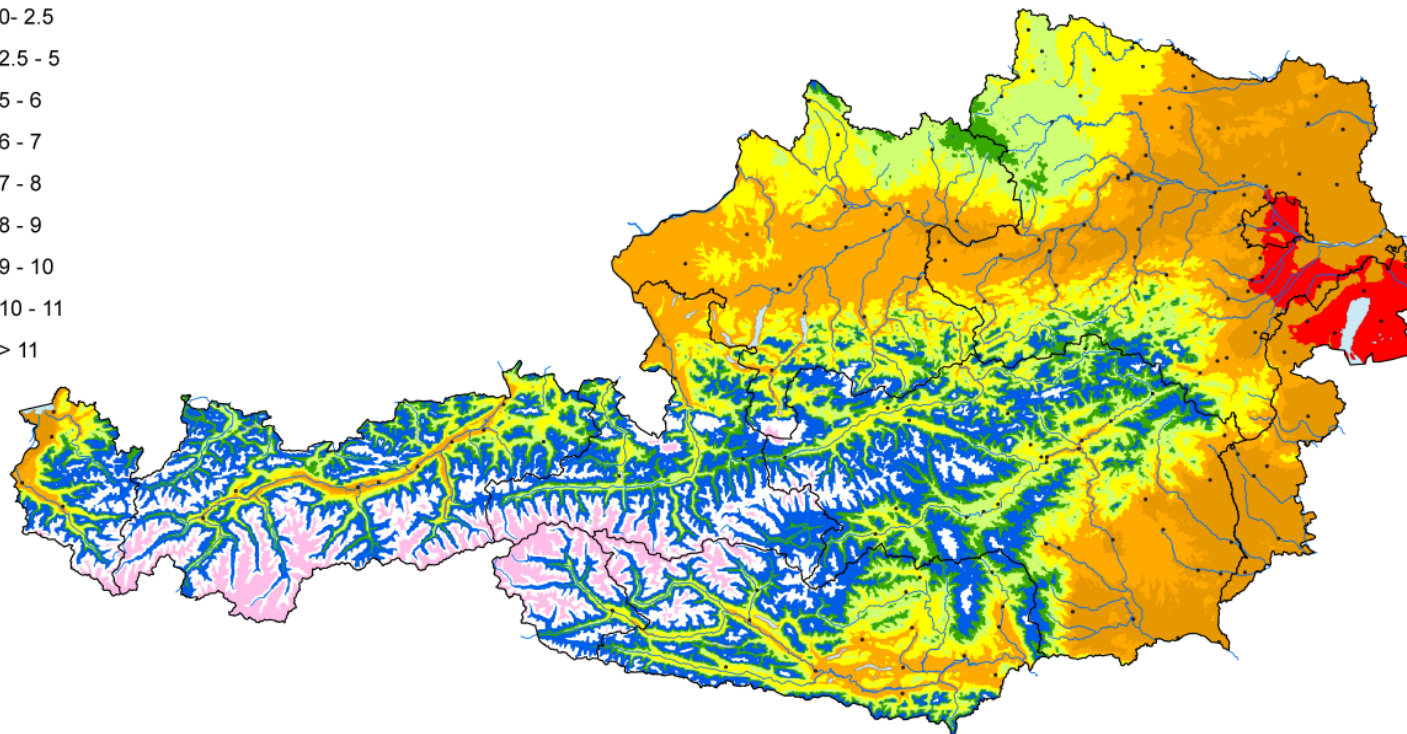
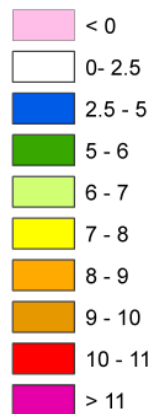
- **Even RCM with 10 km resolution do not resolve complex mountain regions**
- **Diurnal range of temperature in valleys underestimated**
→ **effect on heat waves or frost days**
- **Local wind systems and channeling not resolved**
→ **bias in evapo-transpiration and storm intensity**

Annual average temperature 1961-1990



Beobachtete Jahresmitteltemperatur [1961-1990] in Österreich

1961-1990

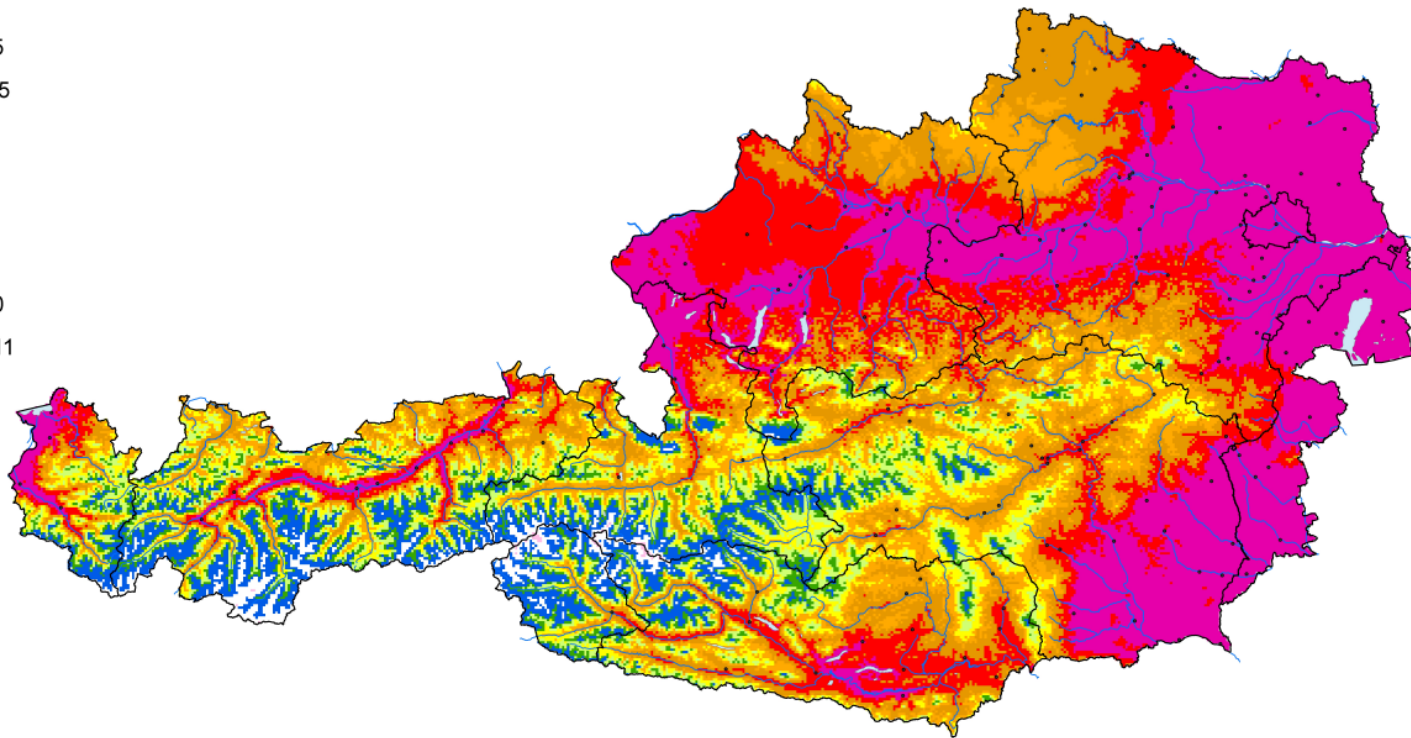
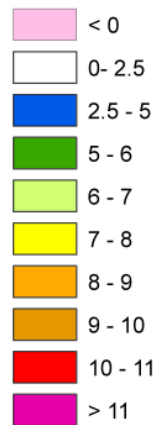


Annual average temperature 2025-2050



Analogszenario der Jahresmitteltemperatur [2020 -2050] in Österreich (Basis: ECHAM4)

Szenario



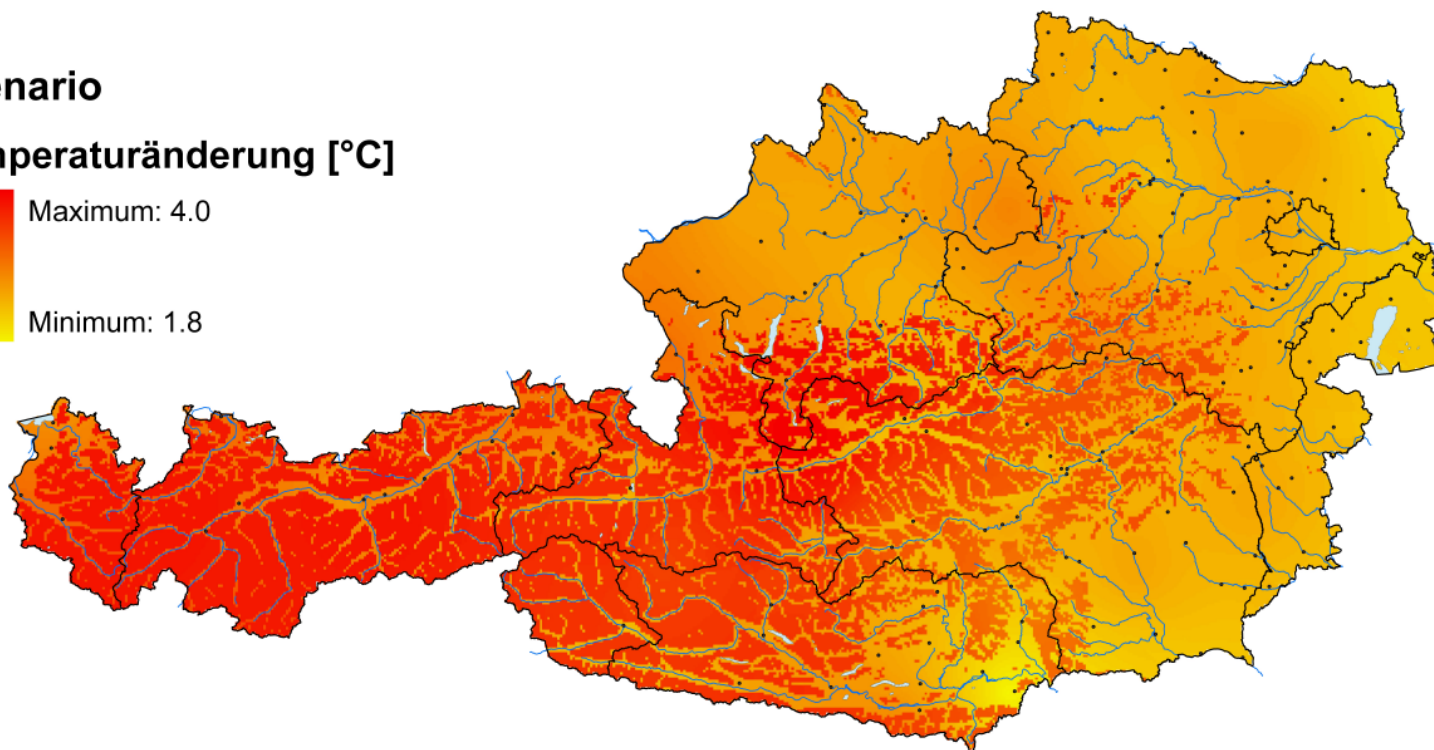
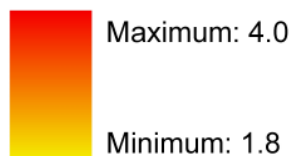
Temperature change 2020/50 vs. 1961/90



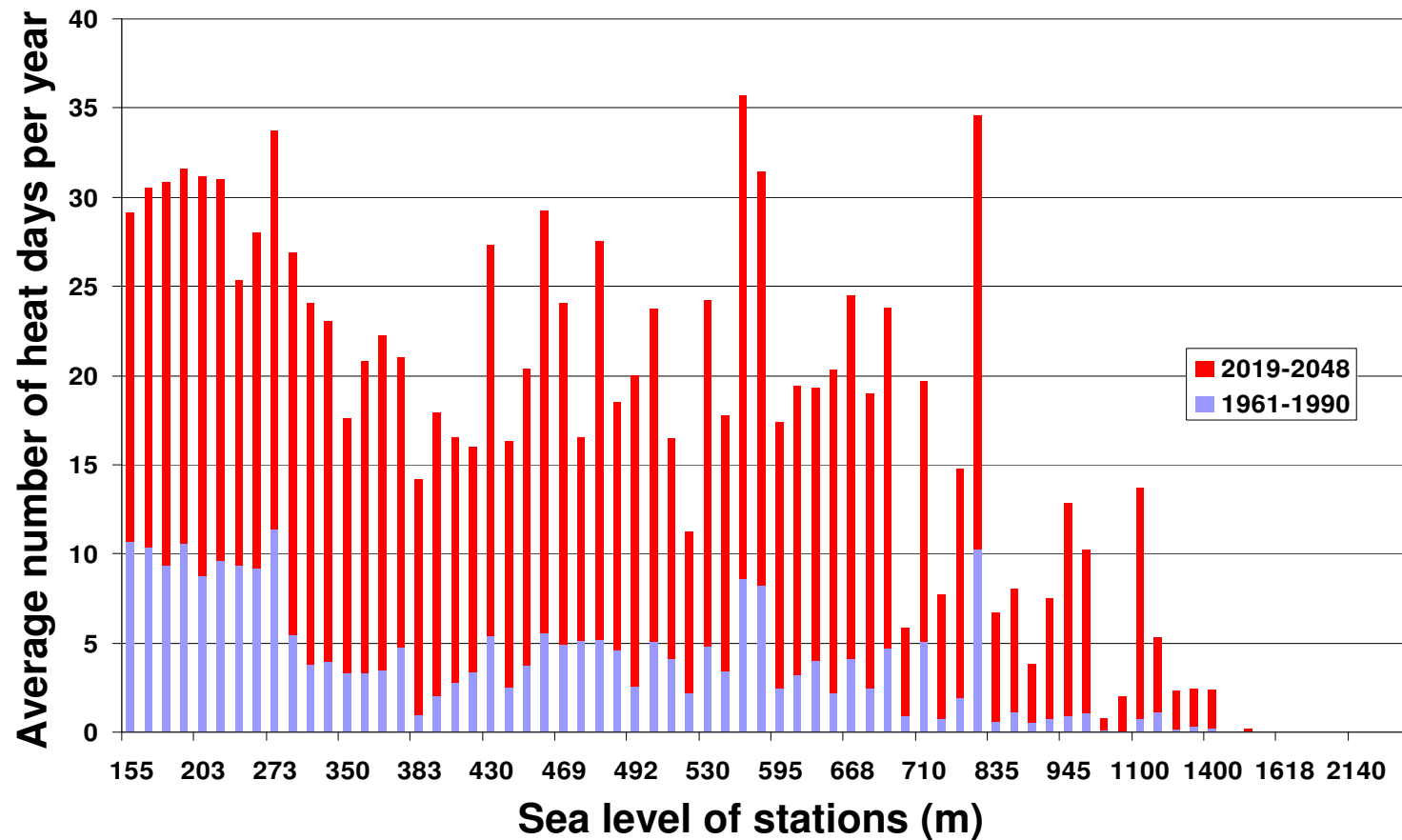
Analogszenario der Änderung der Jahresmitteltemperatur
[2020 -2050 versus 1961-1990] in Österreich (Basis: ECHAM4)

Szenario

Temperaturänderung [°C]

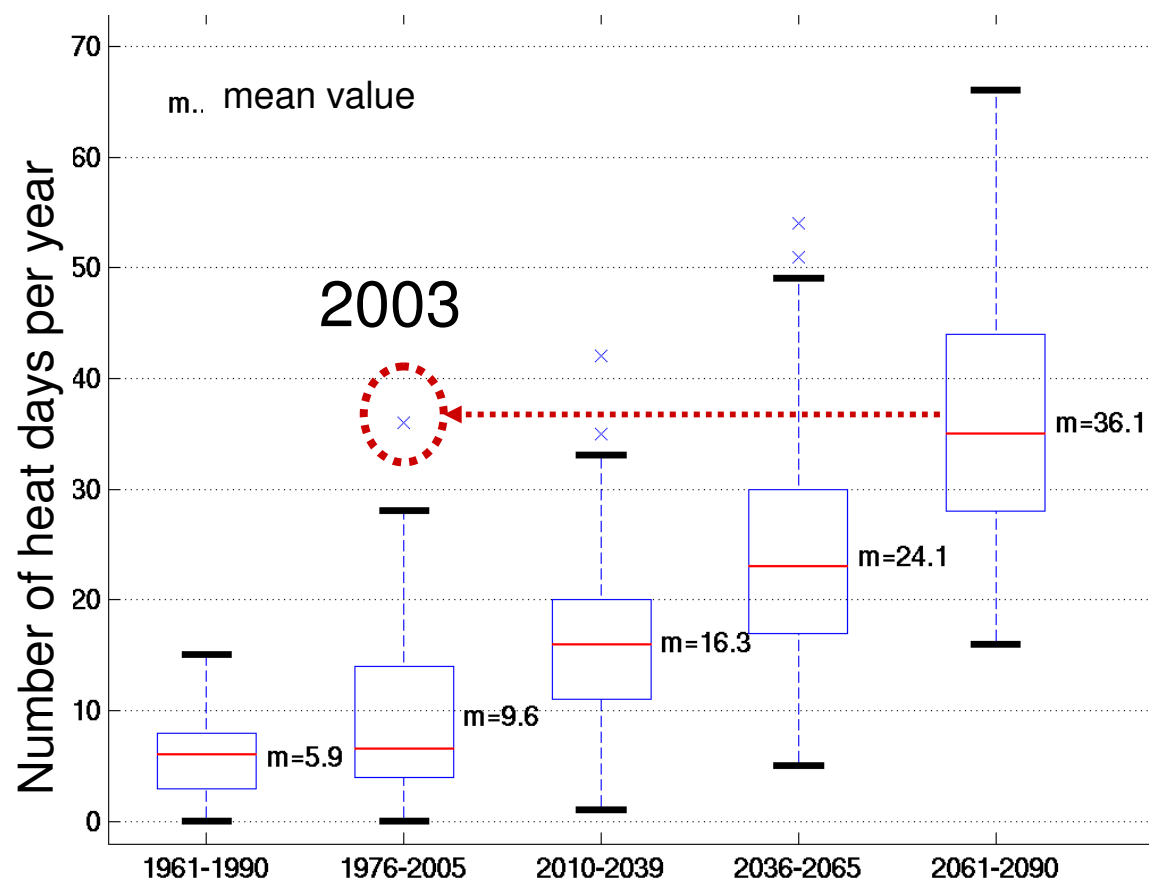


Heat days per year for StartClim Stations 1961/90 and 2019/48



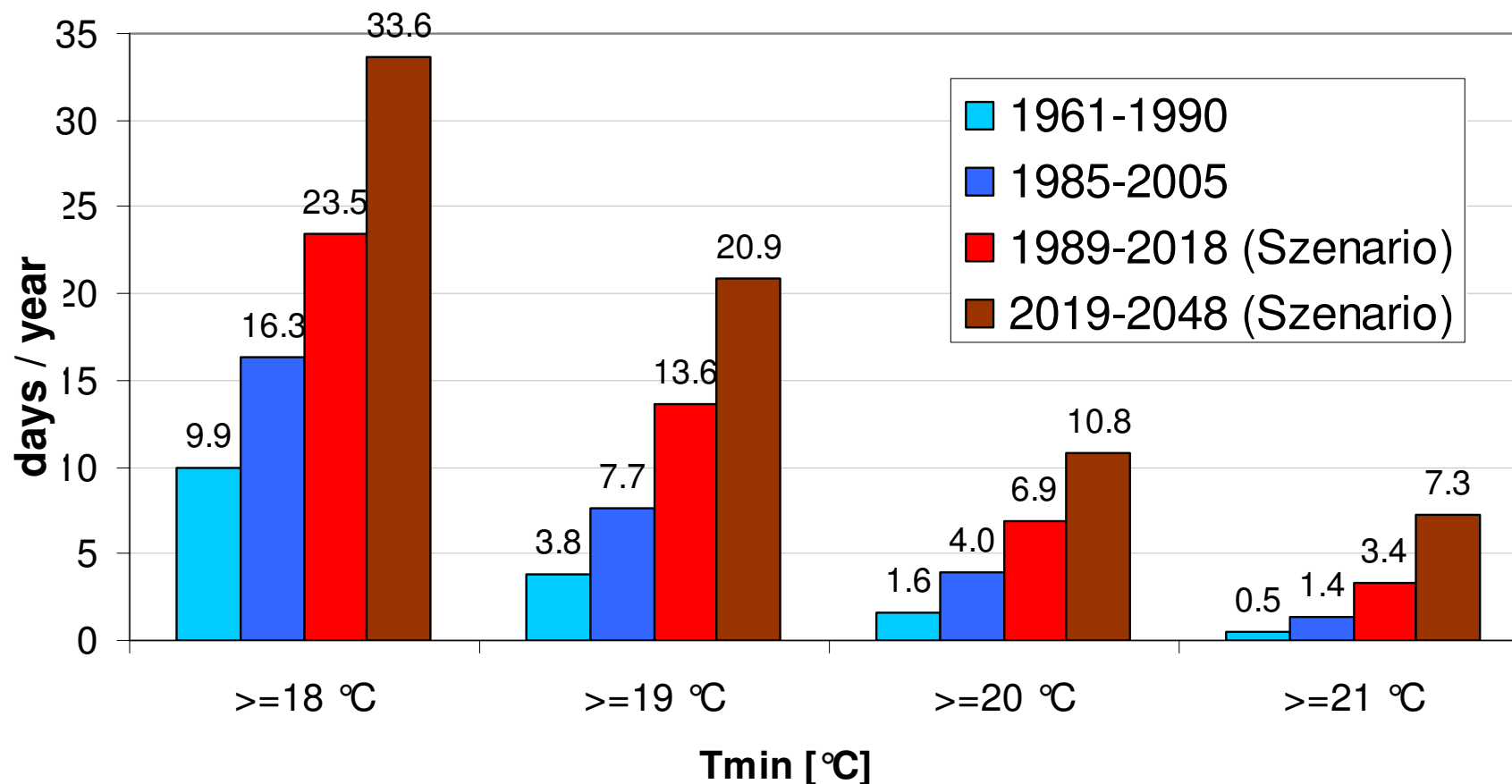
StartClim /
Formayer
et al. 2004

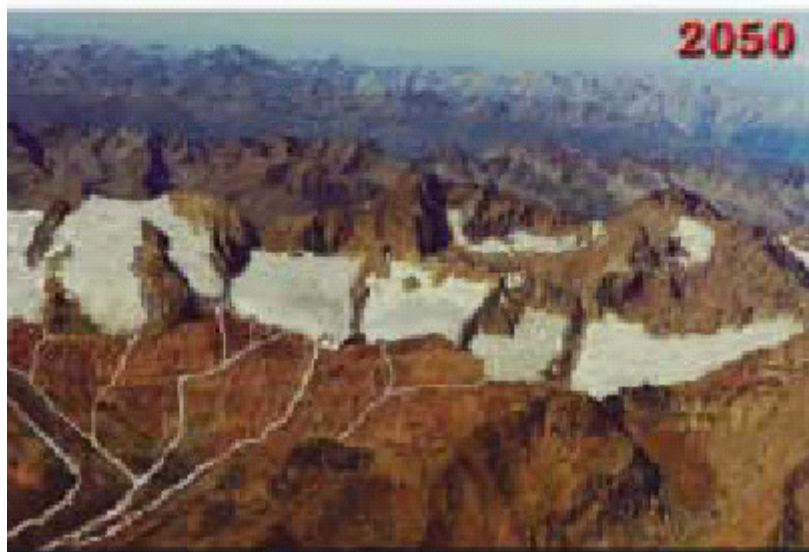
Heat days in Linz/Hörsching



Formayer et al. 2007

No. of days with temperatures at night above given values





Projections for the Vernagt Glacier



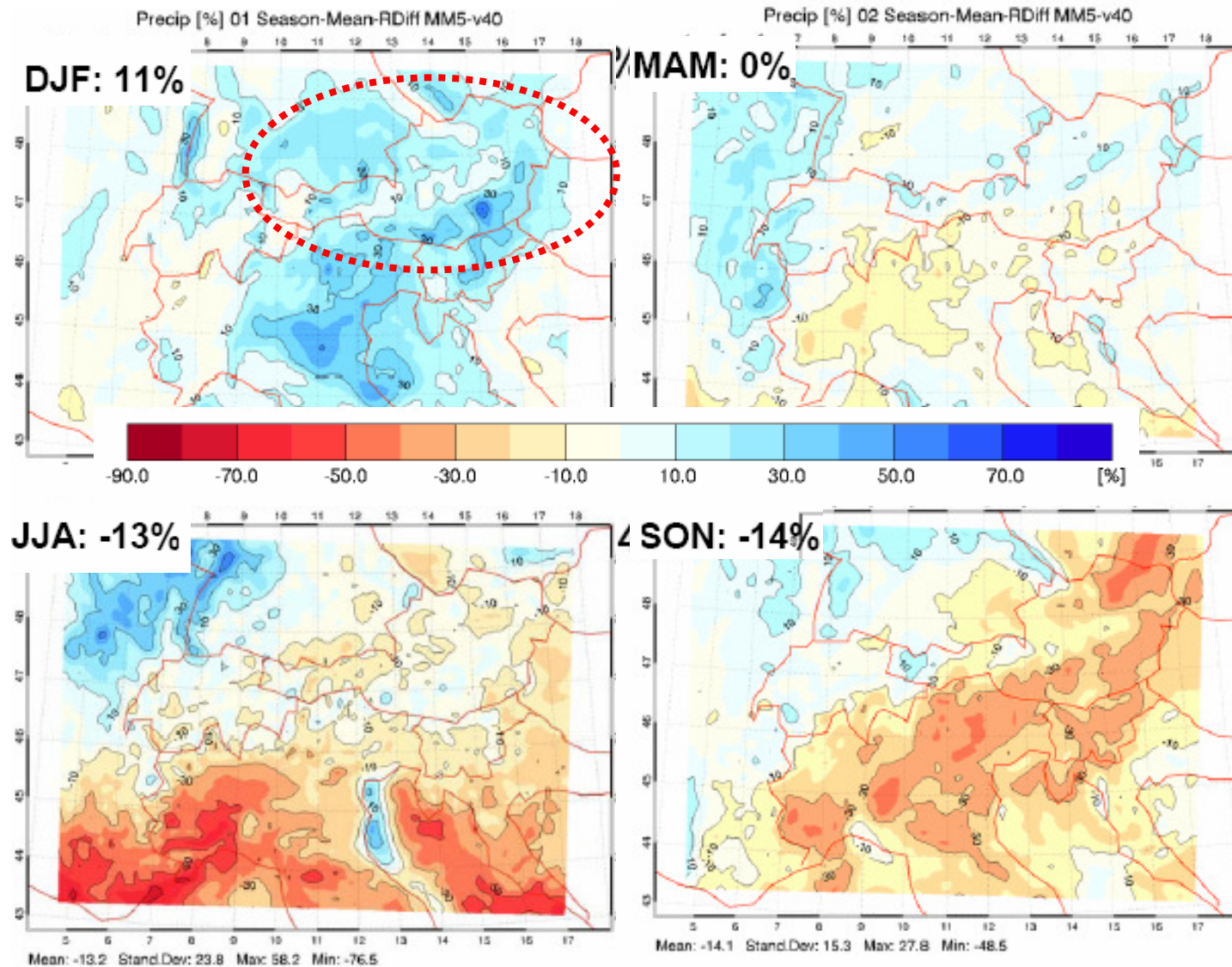
http://files.alpenverein.at/download/1076670171156_18_gletscherberichte2003.pdf



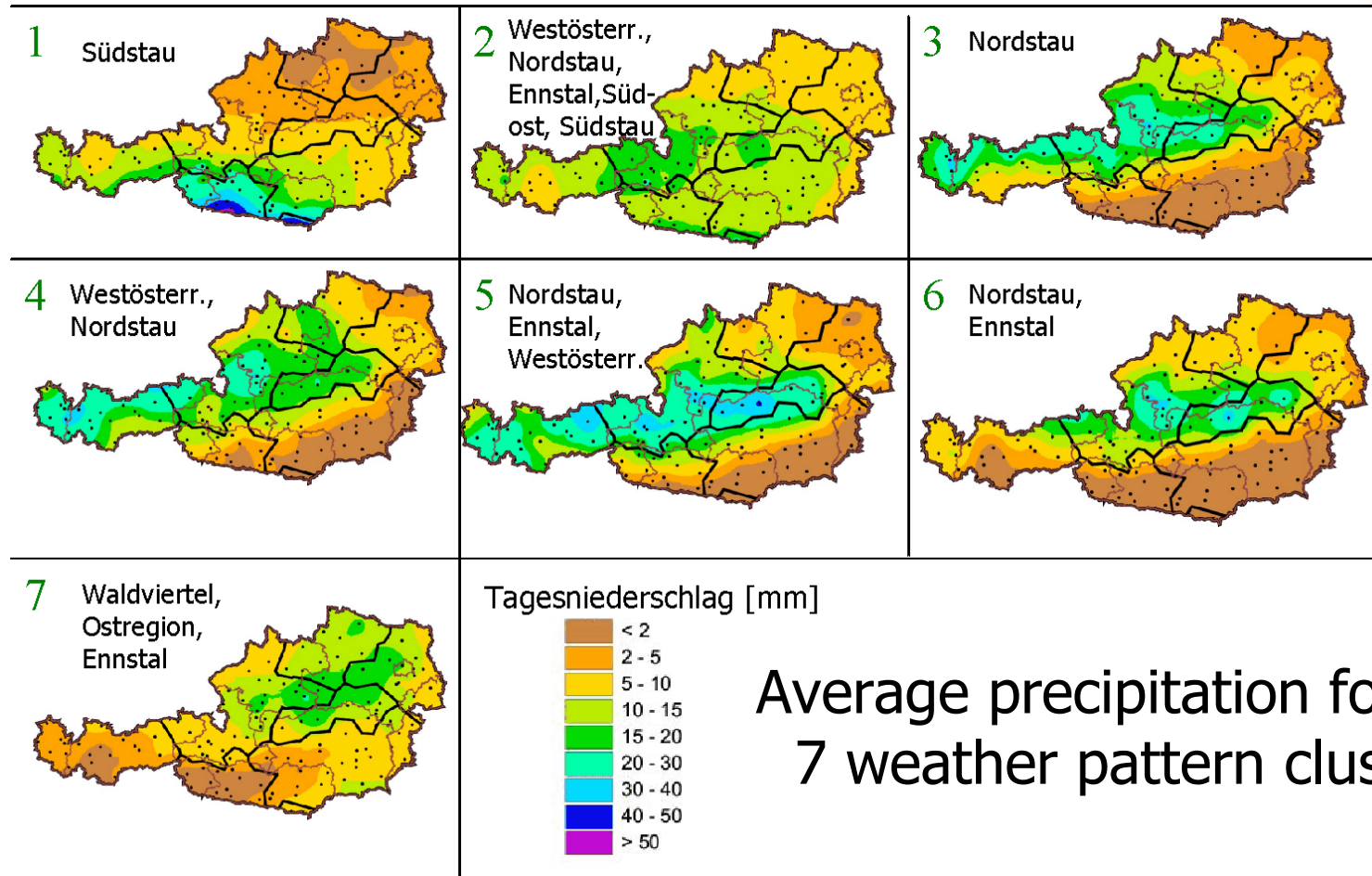
Changes in precipitation

**2040 vs.
1960/90**

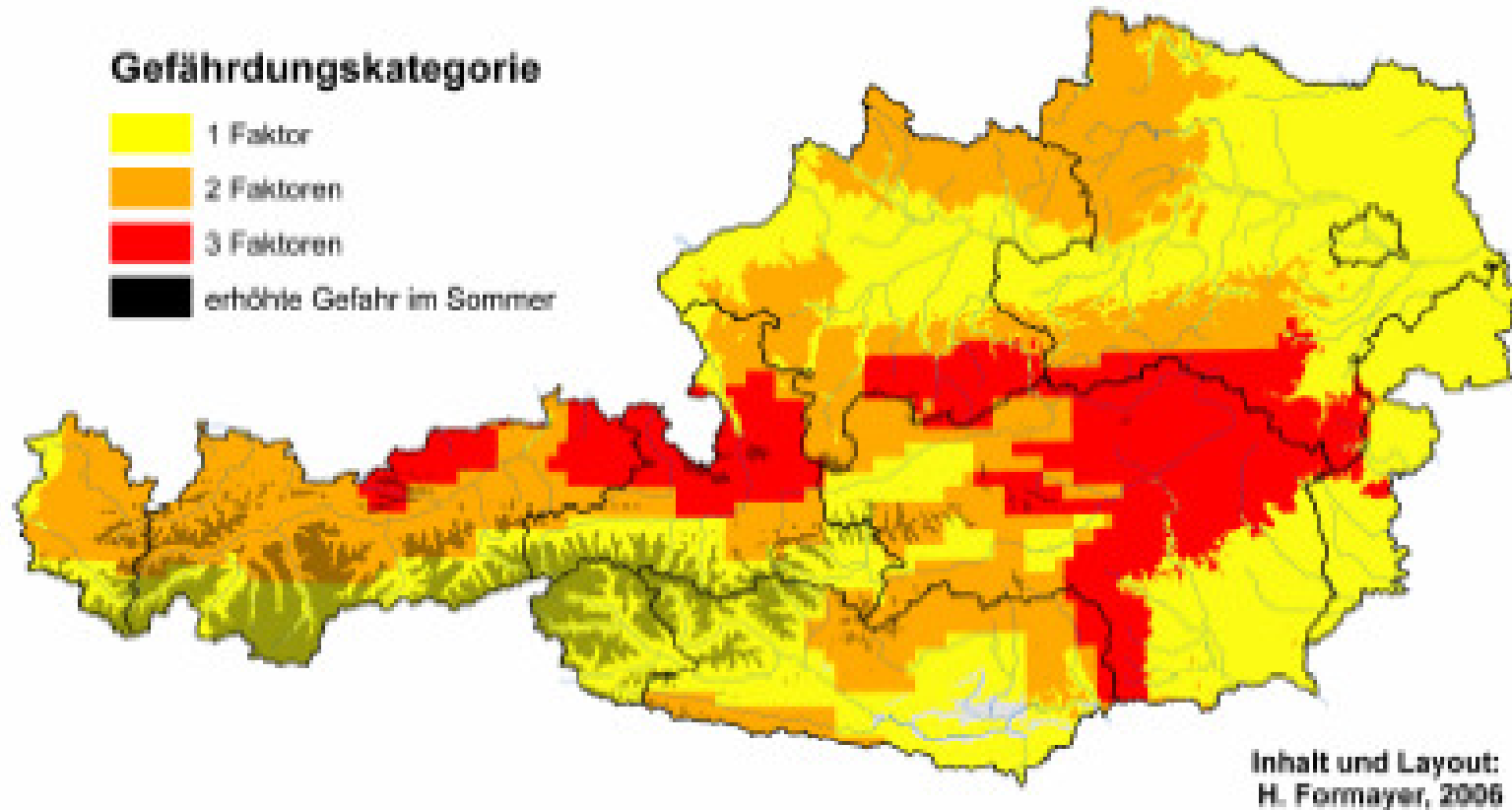
Reclip:more



Weather patterns with heavy precipitation



Regional risk of climate change induced flooding





**University of Natural Resources and Applied Life Sciences,
Vienna**

Department of Water, Atmosphere and Environment
Institute of Meteorology

Univ. Prof. Dr. Helga Kromp-Kolb

Peter Jordanstraße 82, A-1190 Wien
Tel.: +43 1 47654 - 5600, Fax: +43 1 47654 - 5610
meteorologie@boku.ac.at , www.boku.ac.at

Thank you for your attention!

