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Abteilung Wald

State and Development of Drought in Swiss Forests or Why we need Forest Monitoring

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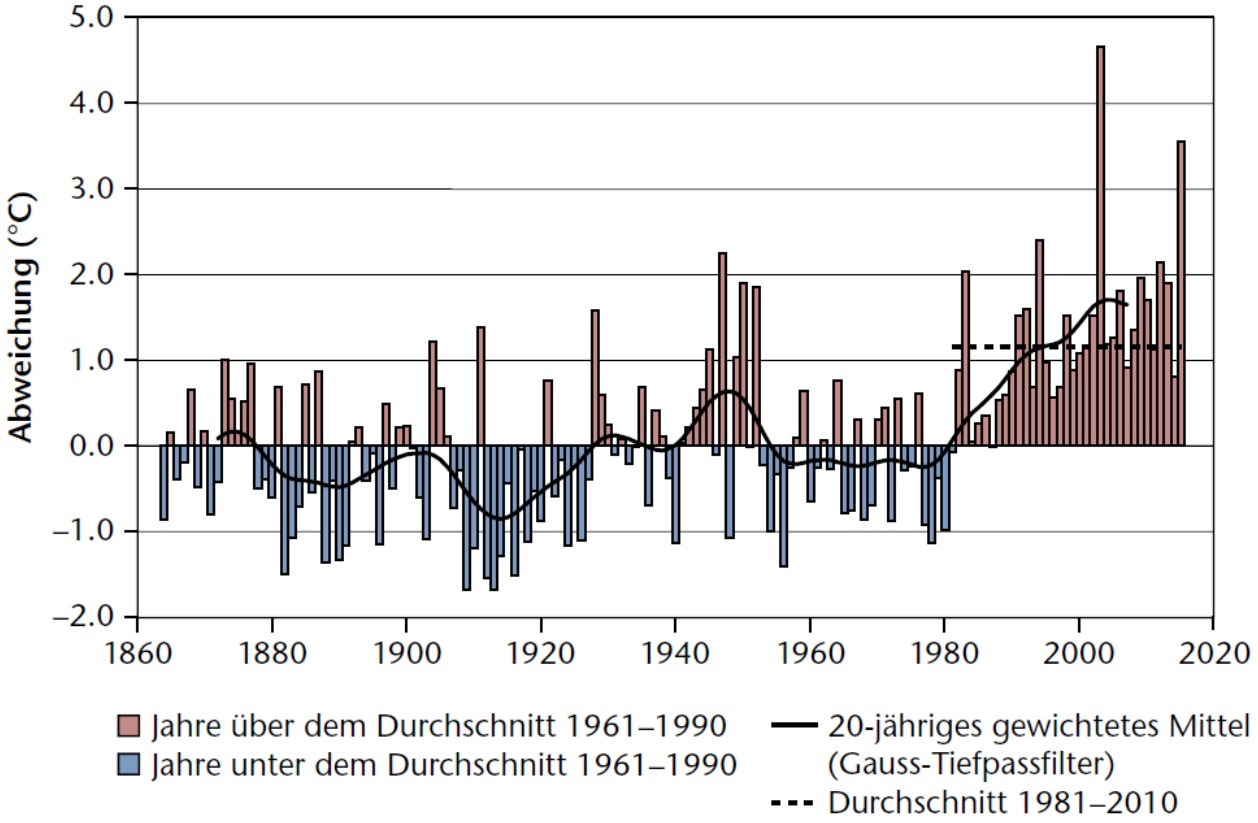
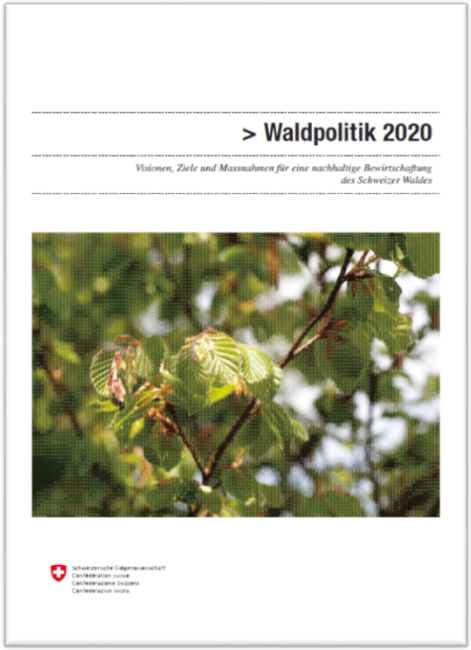
METEOTEST

Introduction

Climate change is a matter of concern



Introduction



Forst Policy 2020

„The impact of climate change (…, drought etc.) on the forest shall be studied …. «

The Swiss Adaptation strategy

Focus on „climate sensitive forest stands»

In Genearl: The Confederation clarifies the kind and the extend of the threat for forests

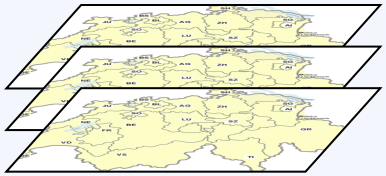
Kind : Description and assessment of potential threats with feasible indicators (with relation to eco-physiology).

Extent : Spatial scale = Switzerland, regions. An estimate of the intensity of the potential threat should also be possible

→ Risk assessment on the large scale

Methods – what do we need?

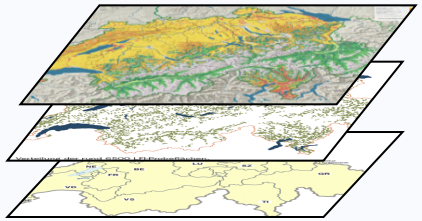
Basic Information



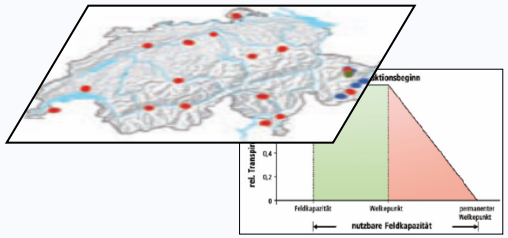
- Climate & Scenarios
- Forest information: tree spec., areal stats., …
- Soil: WHC, …
- Deposition
- …..

Regionalization

1. Simple: Merging of basic information

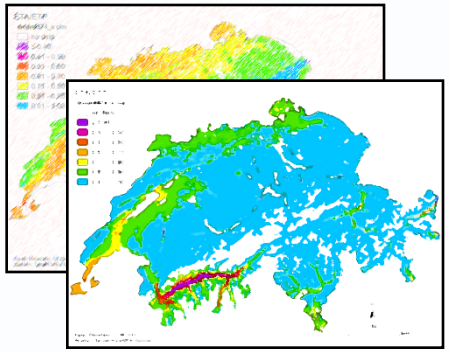


2. Advanced: Transfer evaluation results, experiments, models



Results

- Kind: various indicators
- Extend: endangered regions, ha
- Intensity: evaluation with a scale



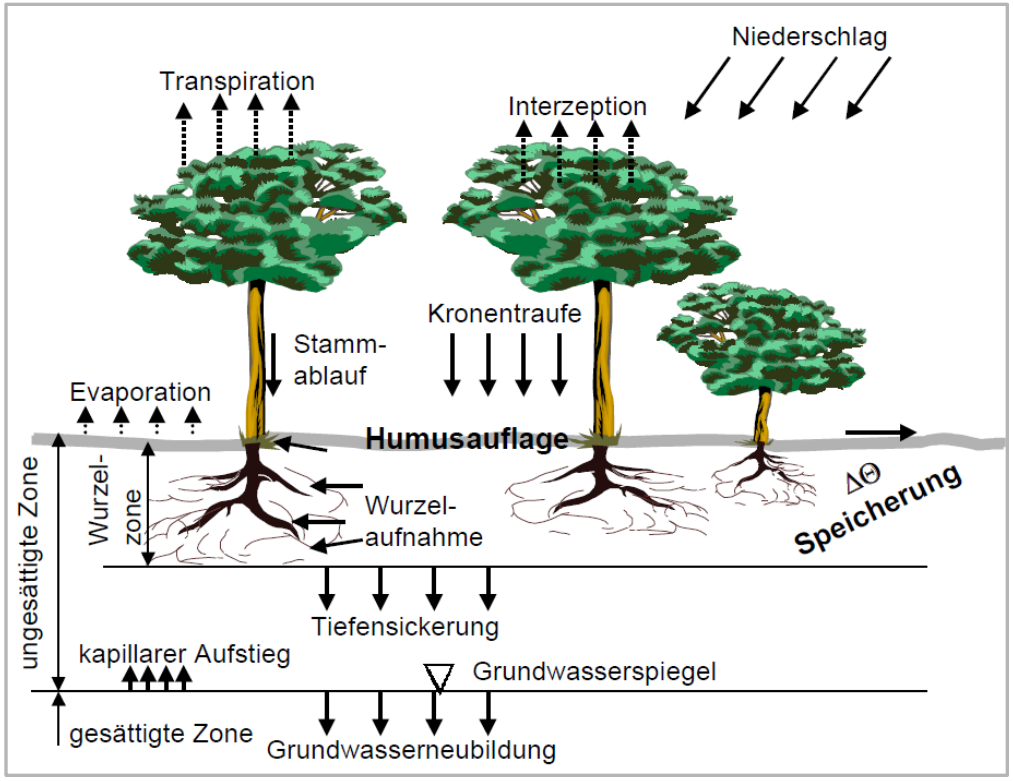
Methods - Climate data

- Stations of MeteoSchweiz: 1931–2013
  - 30-300 Sites (according to year and parameter)
- «CRU» Data: Grid Europe: 1901–2000 [2]
- Interpolation of temperatur, precipitation, wind, global radiation as basis for the calculation of the potential evapotranspiration
  - Interpolation with «change factor method»
  - ETp-Model (Romanenko, 1961)
- Interpolation:
  - Site data (for the simulation of sites), days
  - Grid 250 x 250 m, month

[2]: http://www.cru.uea.ac.uk/data

Methods – forest information

From Climate to climate evaluation : drought yes / no ?



Source:
Hörmann et al. 2003

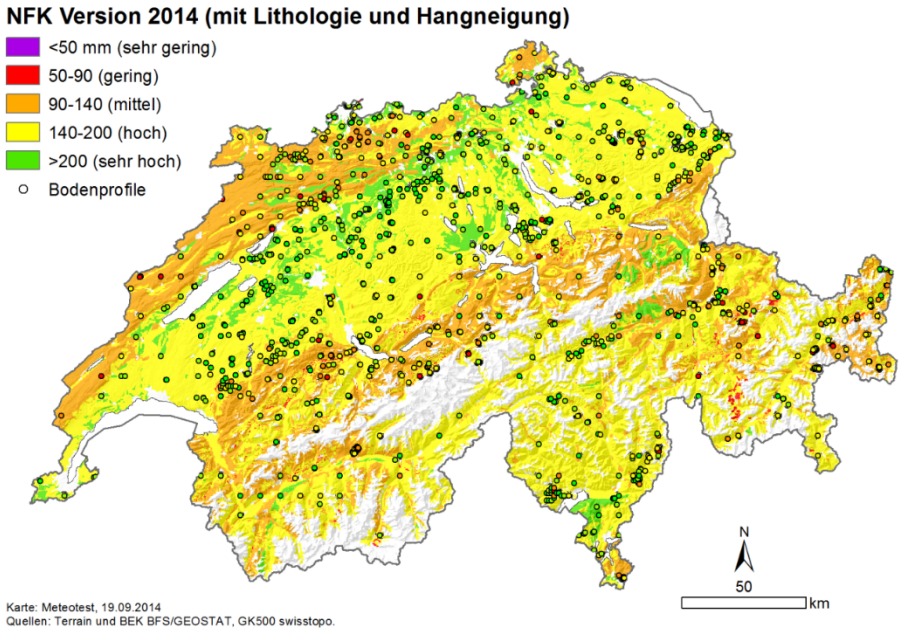
Aim: simplified description of the water budget, landscape scale

Shortcomming: no soil information on this scale available

Methods – Soil characteristic

Water Holding Capacity of Soils (WHC, germ.: nFK) for large scale applicatons. Estimate on an empirical basis:

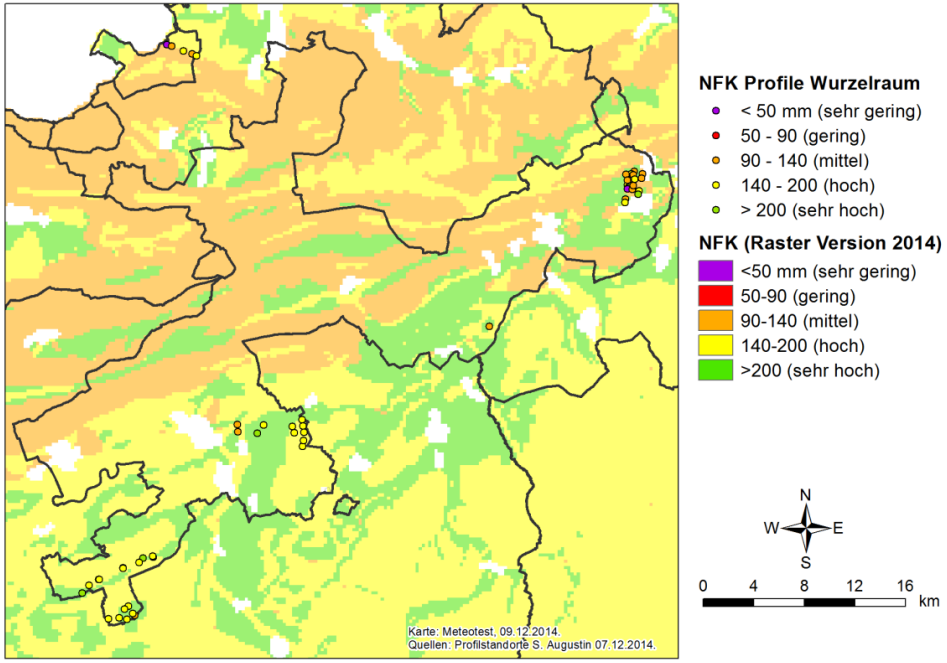
- 1234 soil pits, Lithologie map of Switzerland
- Relation between Lithologie and weathering (C/S/S) [6]
- Grouping of lithology according to weathering characteristics
- Assignment of the 1234 pits to litho-groups
- All WHC classification accord. to KA5 [7]



[7]: Bodenkundliche Kartieranleitung KA5
[6]: Ergebnisse und Vorschläge der DBG-Arbeitsgruppe „Kennwerte des Bodengefüges“ zur Schätzung bodenphysikalischer Kennwerte. http://www.boden.tu-berlin.de/fileadmin/fg77/_pdf/publikationen/bodenphysikalischeKennwerte.pdf

Method – Plausibility check (1)

1. Soil pits (52 independent pits) from the canton Solothurn



2. Data from the German Forest Soil Survey (Rheinland-Pfalz)

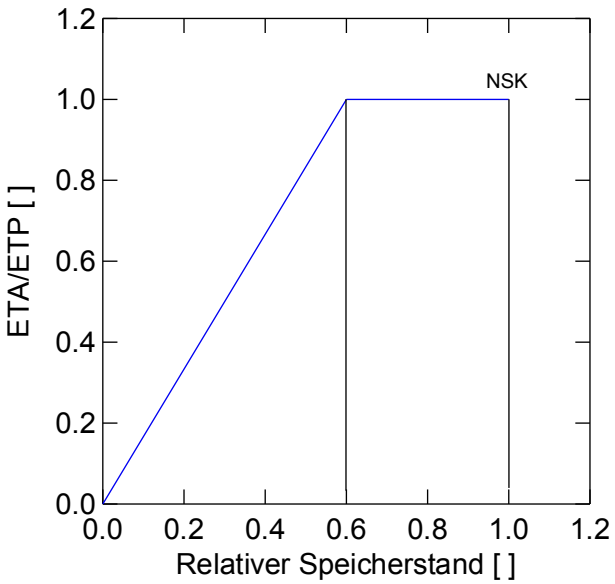
- To test the general approach «lithology – resulting texture»

Methods - Indicators

Based on a pre study [3], an evaluation of intercantonal forest monitoring plots and some literature, two indicator «families» were successful in describing drought:

- Site Water Balance (SWB), [3, 4]
  - Monthly
  - Simple Model, many options
- Ratio between the actual and the potential evapotranspiration: ETa/ETp (Monthly and daily data)

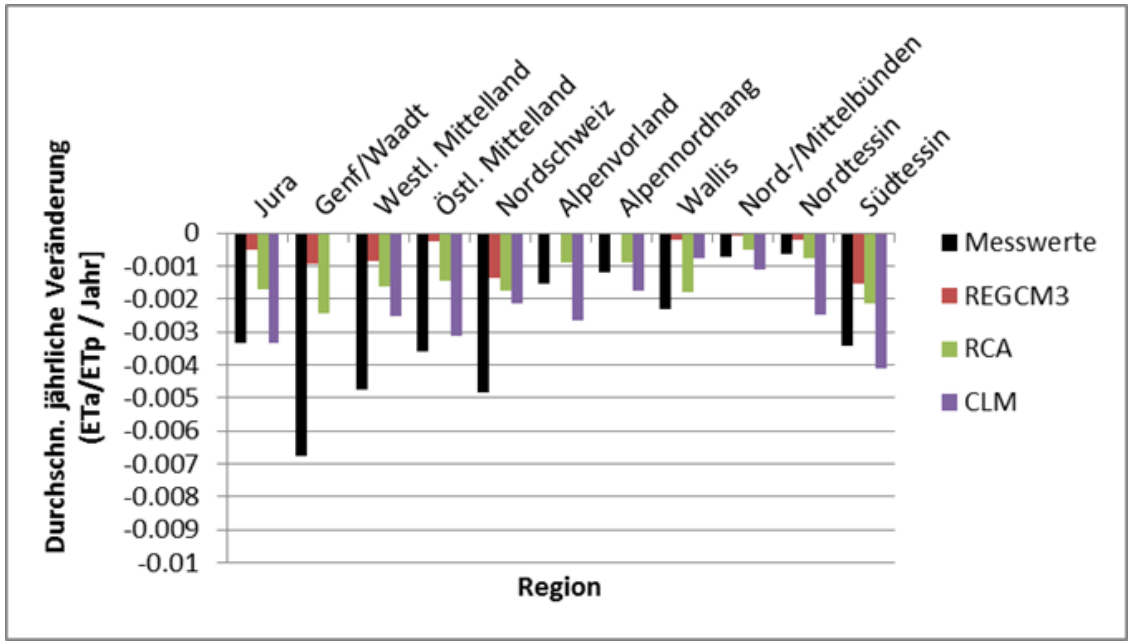
→ For both indices data on the water holding capacity are needed

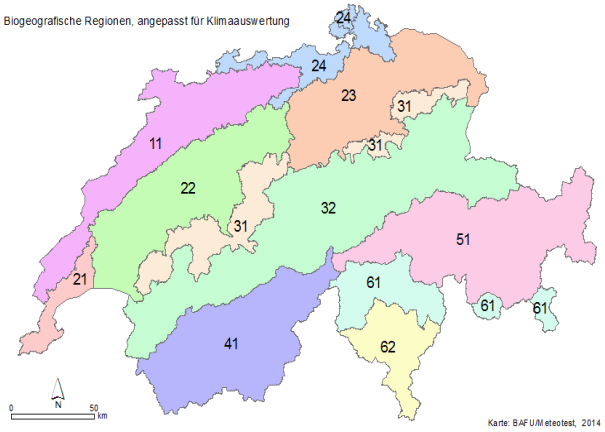


[3]: http://www.wm.ethz.ch/publications/mf/ts11
[4]: Spellmann, H. et al. (2007): Risikovorsorge im Zeichen des Klimawandels. AFZ – Der Wald 23: S. 1246-1249.

Results – Historic Trends

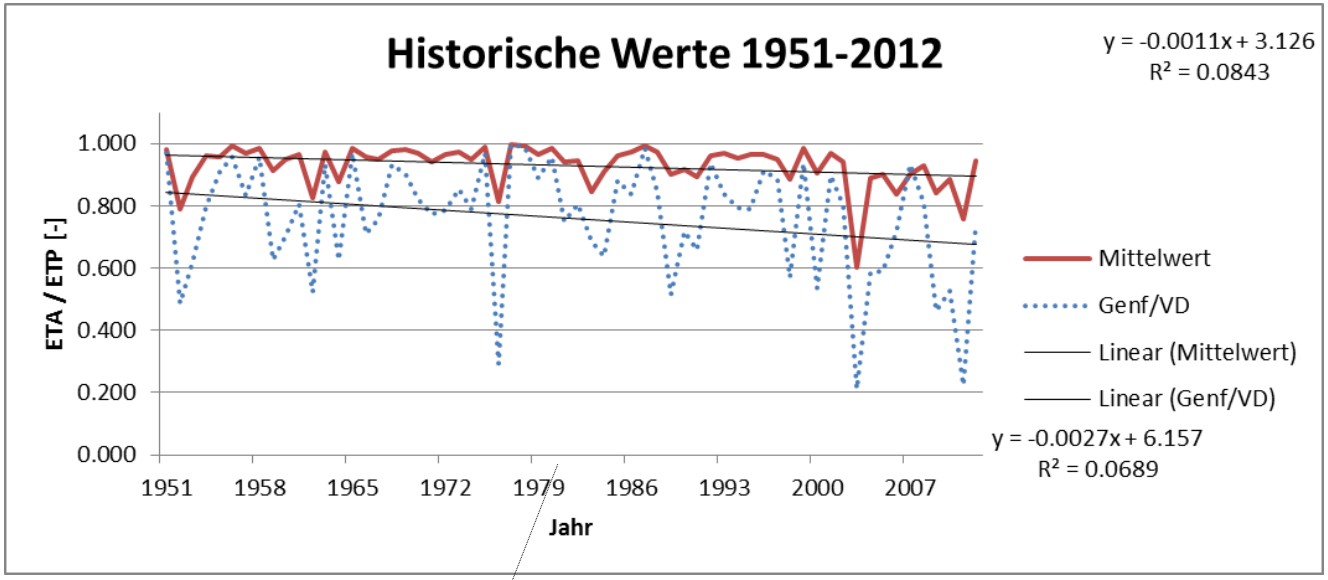
ETa/ETp 1981-2010, (Vegetation period)



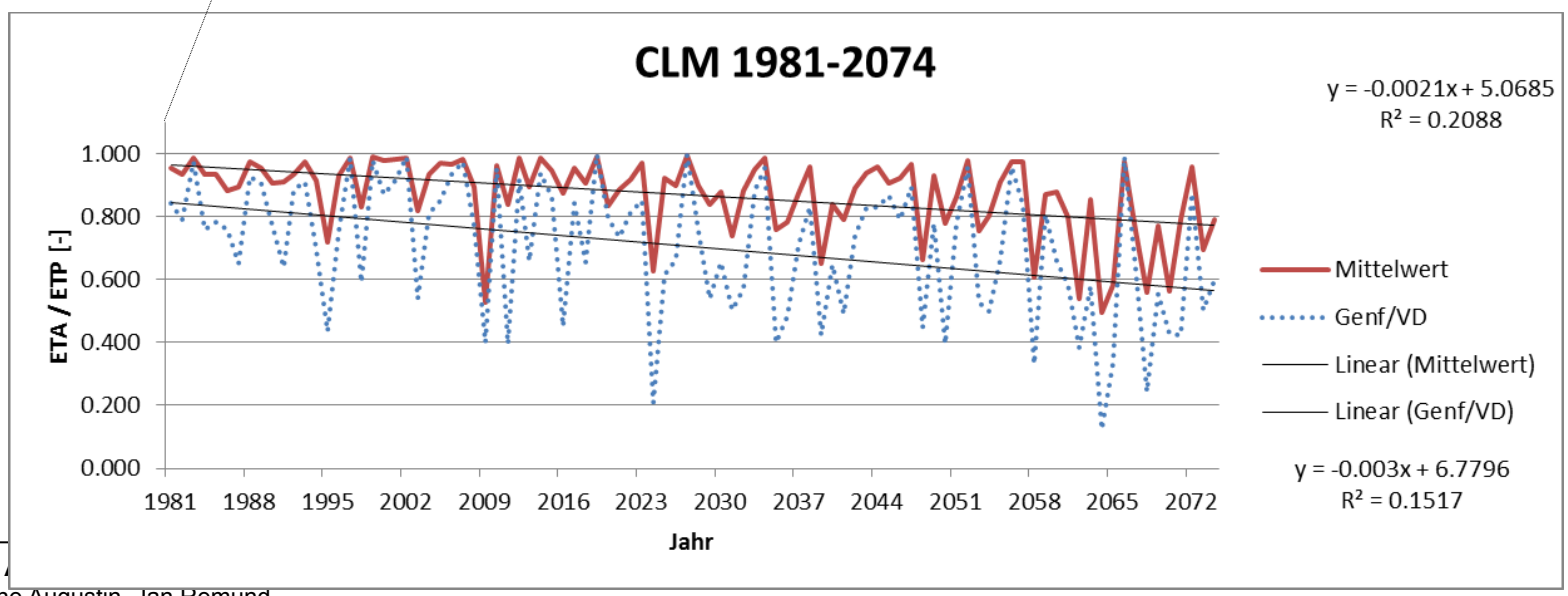


- Strong decrease in the western midlands and the north
- Models underestimate the trends in these regions
- CLM model estimates the trend – on average – best
- CLM model overestimates the trend in the south (Ticino). There the RCA model fits better
- The REGCM3 is in any case «too wet»

Results – Historical trends

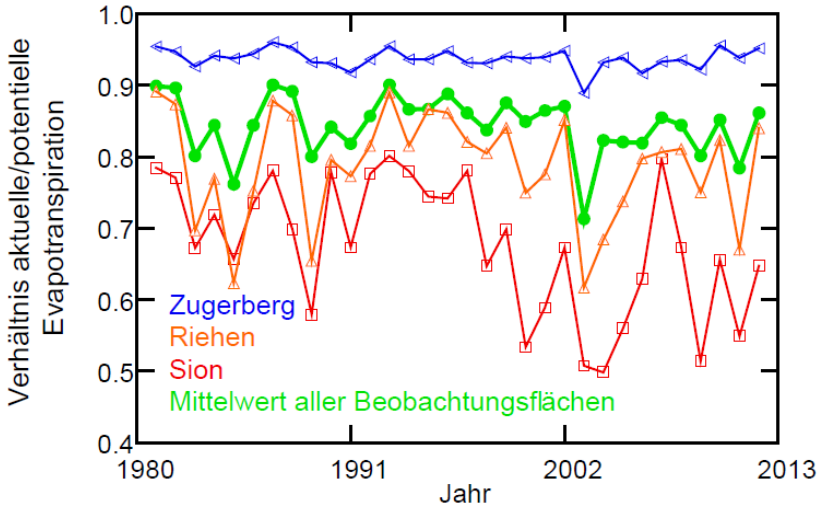


- Trend: increase since 2000 (-0.2 / 100 years)
- Variability increasing (3-fold)



Method – Plausibility check (2)

1. **Trends of ETa/ETp, calculated with WaSim-ETH for the Intercantonal Forest Monitoring plots, 1981 - 2012**

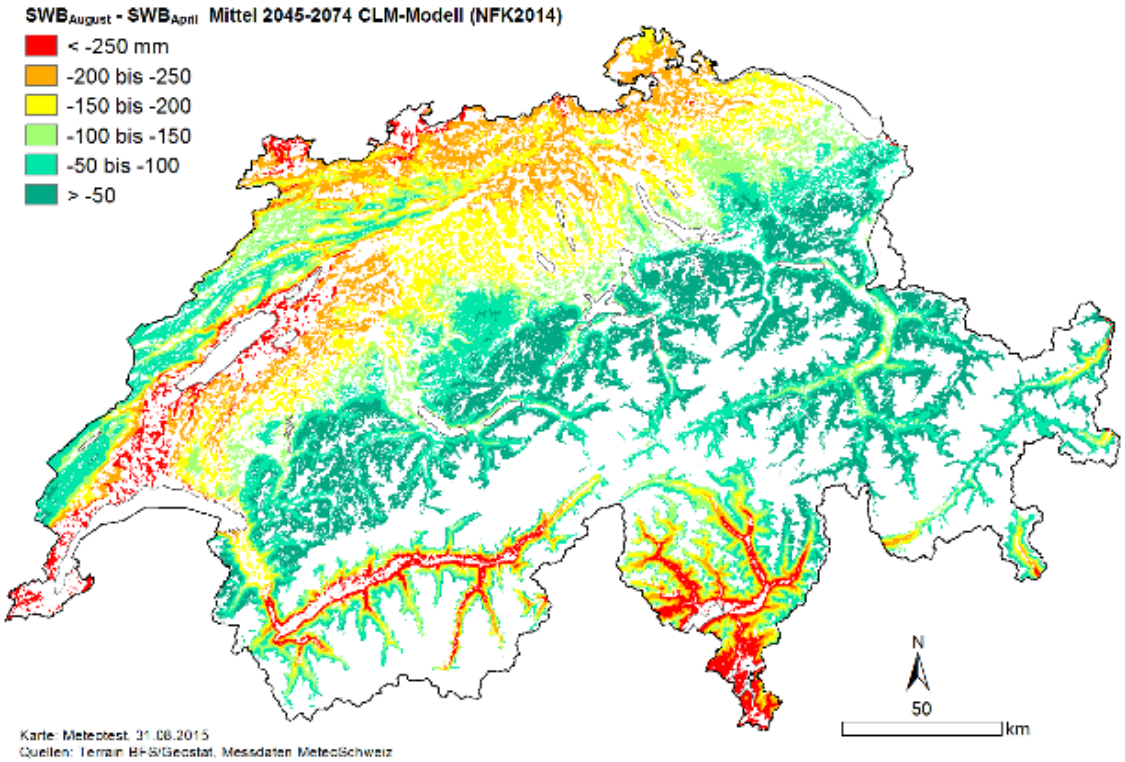


Source:
Braun et al. 2014

2. **Transpiration data for Switzerland from MeteoSchweiz**
   Increasing transpiration in the 20th century (but no data for forests available)

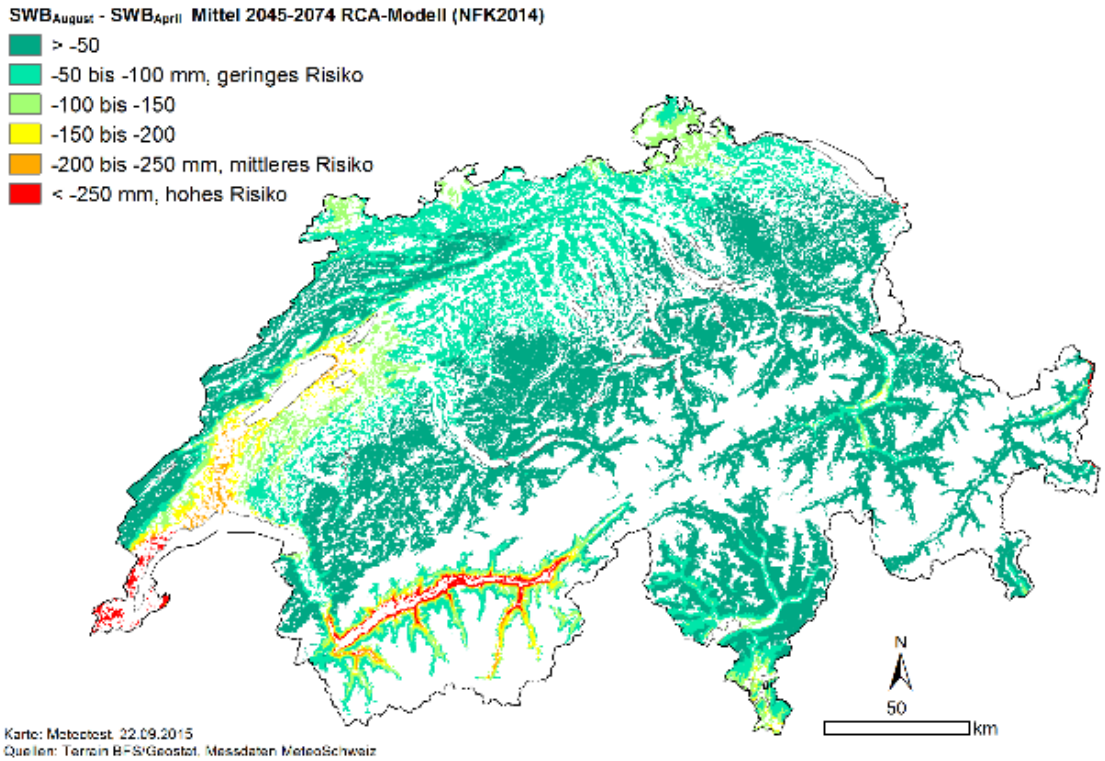
Results – Site Water Balance

August-April, CLM, 2045-2074



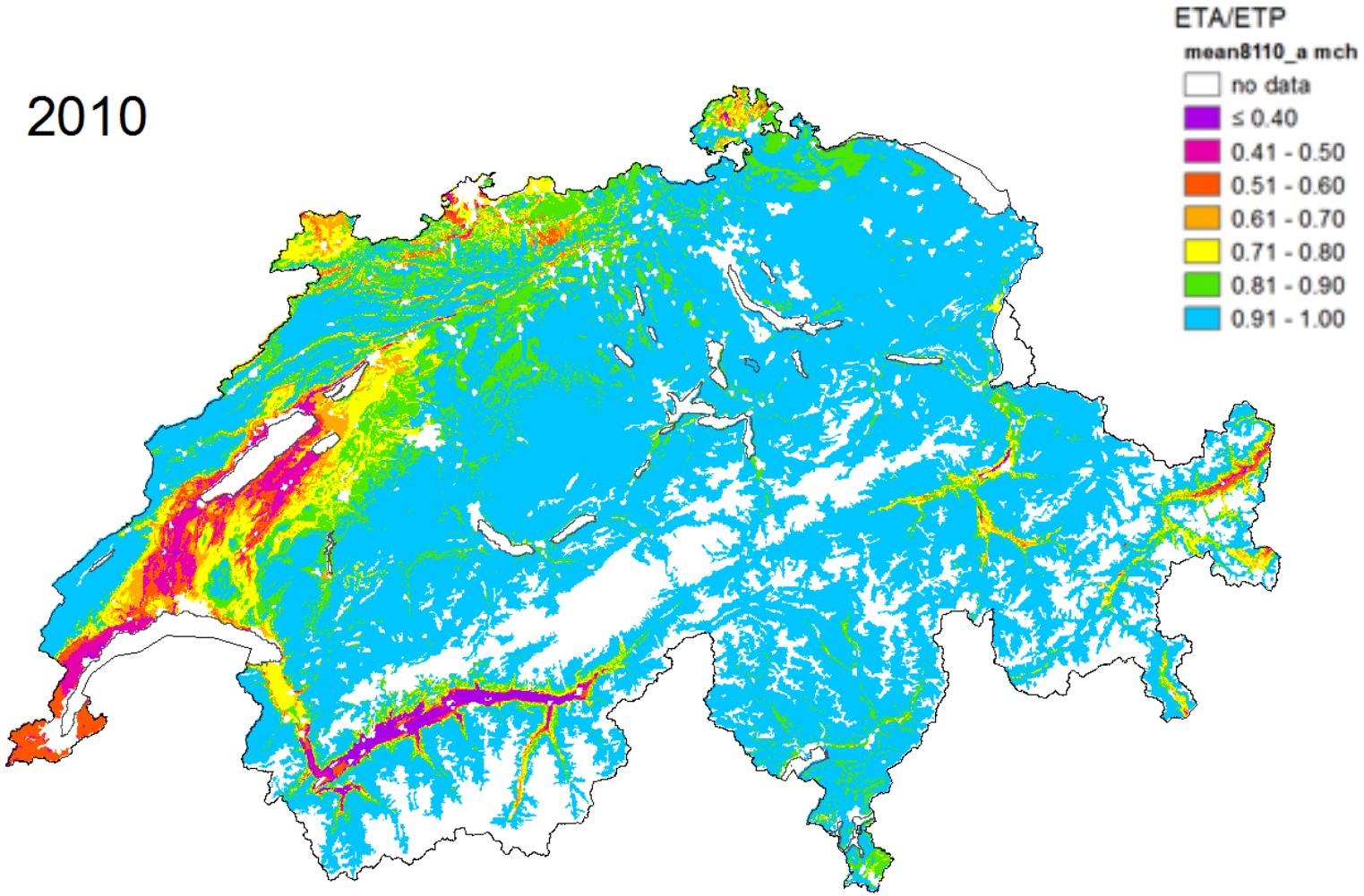
Results – Site Water Balance

August-April, RCA, 2045-2074



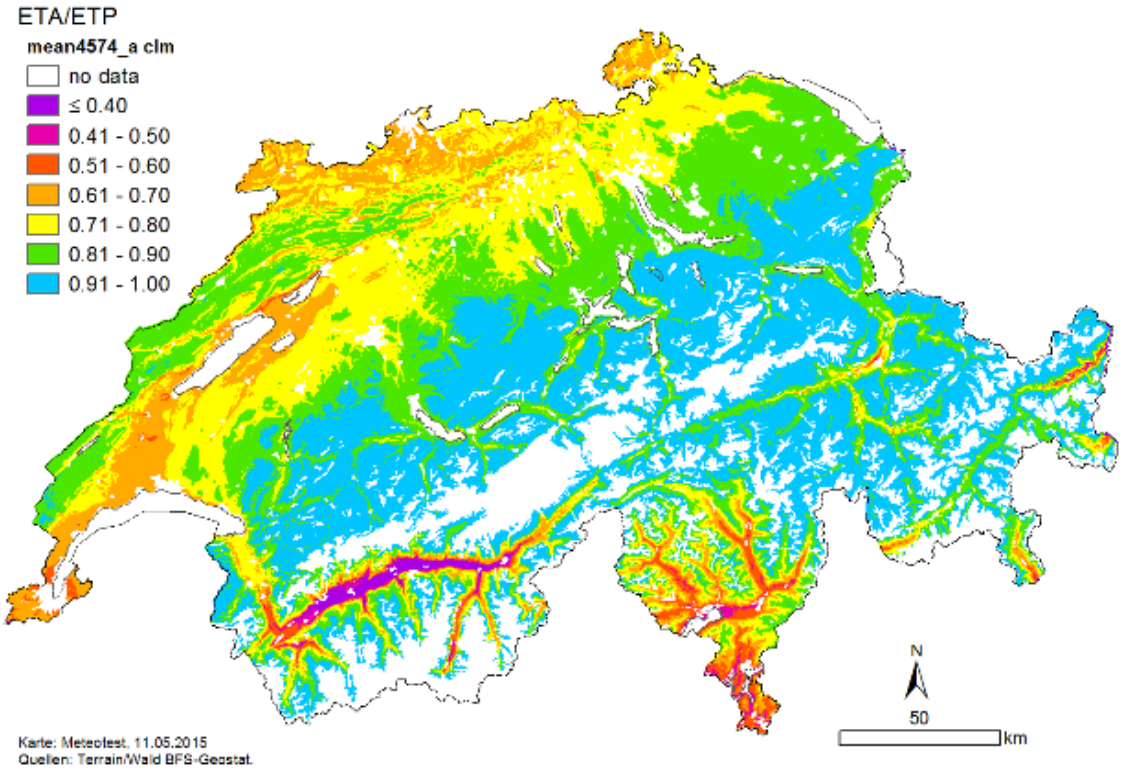
Results – ETa/ETp

1981-2010 (April – August)



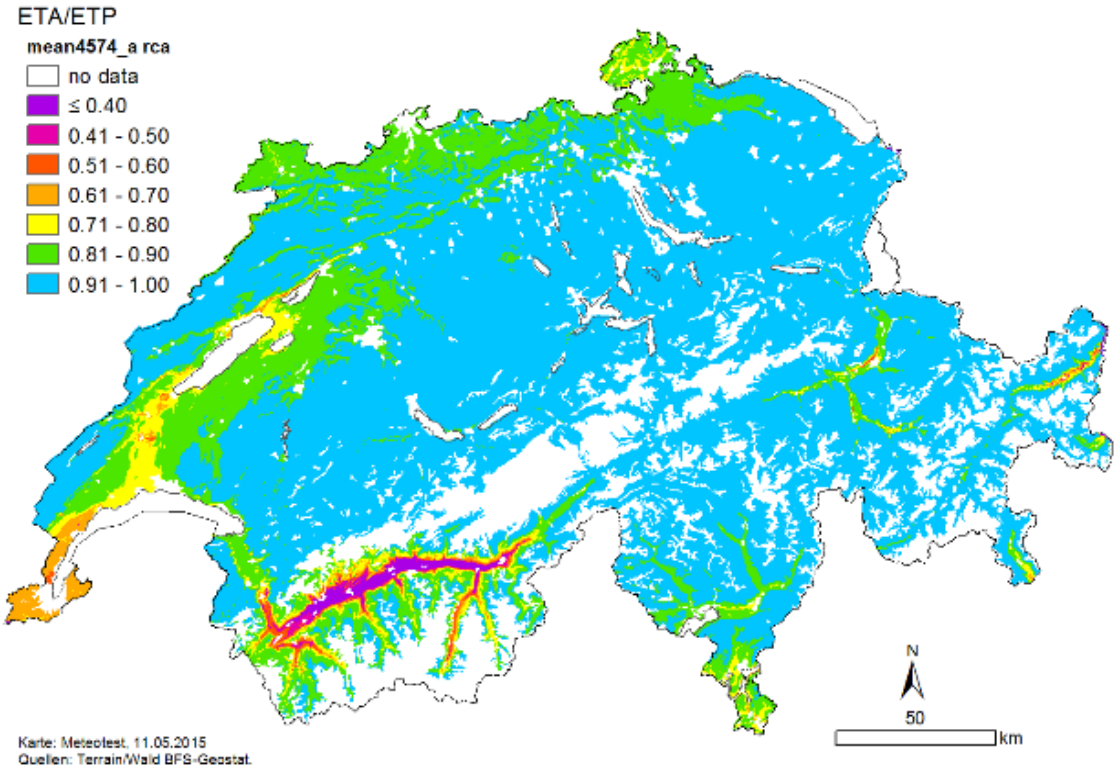
Results – ETa/ETp, CLM

2045-2075 (April – August)



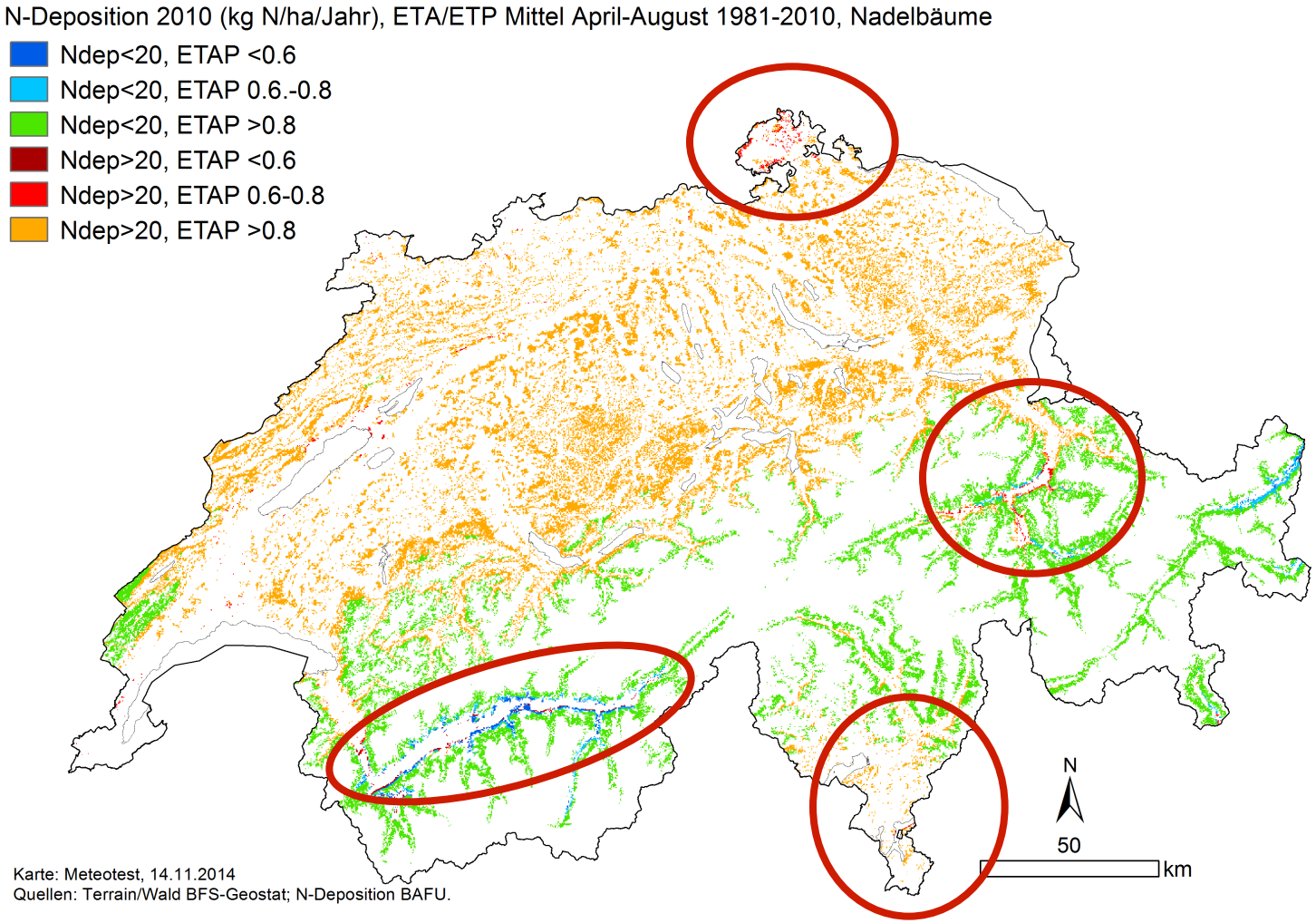
Results – ETa/ETp, RCA

2045-2075 (April – August)



Results – Drought and N Deposition

Drought and N deposition will intensify their effects



Fazit - I

Climate is changing:

- Drought increases in the last 60 years stat. significantly, esp. outside the alps
- In many regions the observed trends are more pronounced than the calculated development (Genf/VD, N-CH, W-Midlands, Wallis)
- The CLM-Model (realisation of A1B) is obviously the most relevant model in many regions
- The climate variability is increasing
- Great uncertainties exist in the development of the precipitation.

Fazit - II

Forst Monitoring is needed for:

- the detection of cause-effect-relations
- the transfer of data and evaluation results to the large scale
- the verification / plausibility check of regionalisation results

Regionalisation is as good as the available data.

There is room for good ideas to improve the results.

Thanks to (in alphabetical Order)

- **Beat Achermann**, BAFU, for deposition data
- **Joachim Block**, Rheinland-Pfalz, for data and valuable hints
- **Sabine Braun**, Swiss Intercantonal Forest Monitoring, for data and evaluations
- **Beat Rihm**, Meteotest, for the mapping
- **Gaby von Rohr**, Soil Protection Service, Canton Solothurn, for soil data
- **Stephan Zimmermann**, WSL, for soil data

  and **Meteoschweiz** for climate data