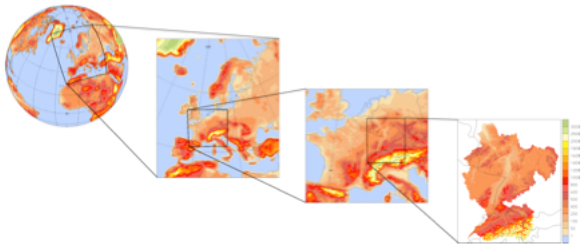
Workshop on Climate Change Scenarios
30. Sep. 2005, ETH Zurich



Experiences at the Interface between Climate and Climate Impact Research

D. Gyalistras
Systems Ecology ETHZ
http://www.climate-impacts.ch

Acknowledgements:
A. Fischlin, M. Christenson, H. Manz, E. Schüpbach, M. Rohrer, C. Wahrenberger, D. Lorenzi, M. Schwarb

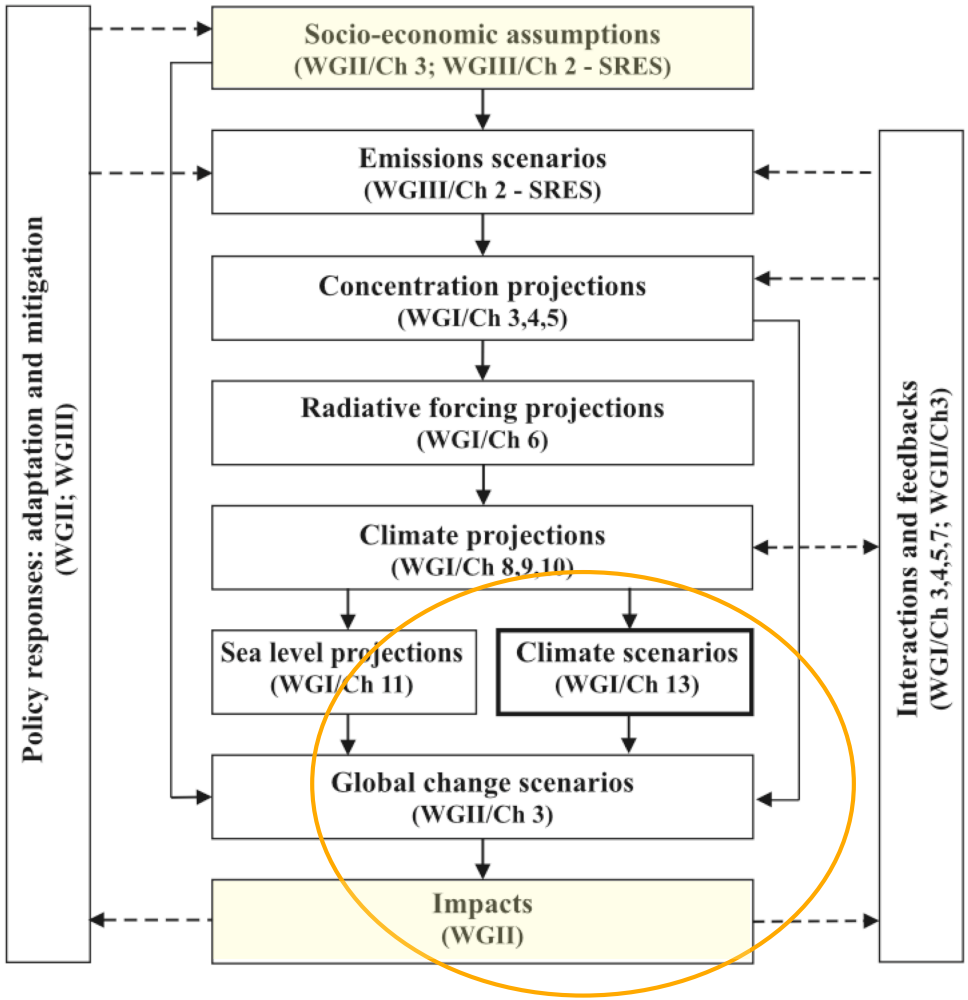
Overview

I. Introduction

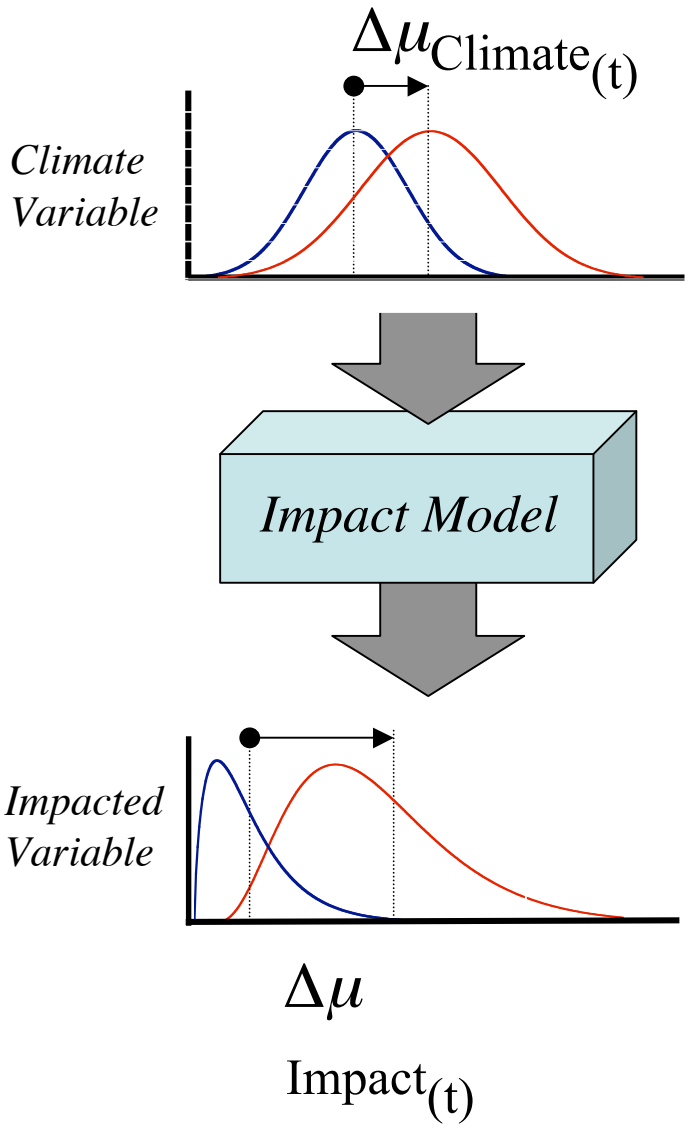
II. Climate Scenarios for Impact Studies: Problems & Solutions

III. Conclusions

Typical Approach Used In Impact Studies



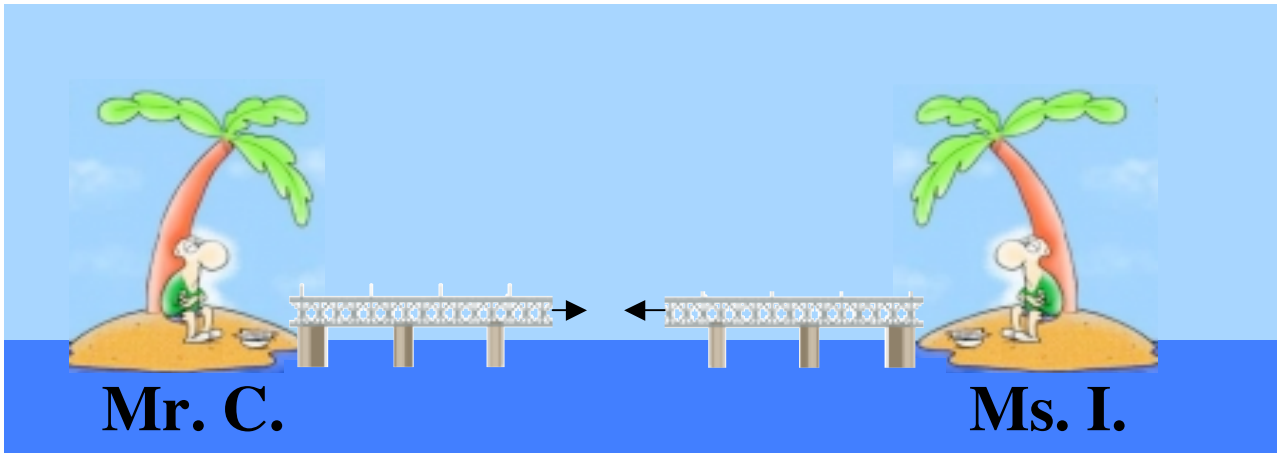
Mearns *et al.* (2001), IPCC TAR



Flow of information is…

"Climate" → *"Impacts"*

but research situation often is…



So, what is the problem?

Mr. C's Problem: "Impact Models Are Too Detailed"

Example: Heating energy demand of buildings

$$Q_h = k_{tot} \cdot HDD - \eta\, Q_s$$

$$HDD = \sum_{d=1}^{365} IF(T_{(d)} \le \theta_o, 1, 0) \cdot (\theta_i - T_{(d)})$$

Possible solution: Reduce input requirements

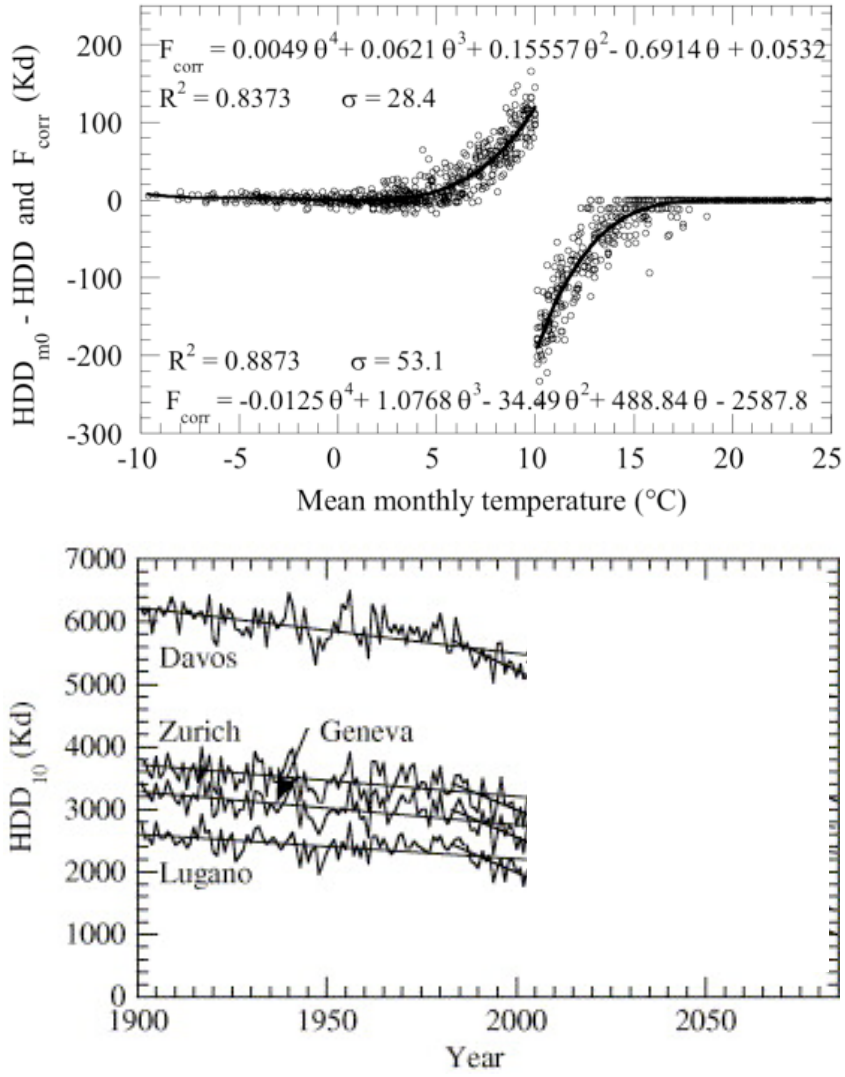
$$HDD = 30 \cdot \sum_{m=1}^{12} IF(T_{(m)} \le \theta_o, 1, 0) \cdot (\theta_i - T_{(m)}) \quad + \quad f_{corr}(\theta_i, \theta_o, T_{(m)})$$

Heating energy demand of buildings (cont.)

f_{corr} for Switzerland

$\theta_o = 10$ °C
$\theta_i = 20$ °C

Energy demand based on monthly T data



Christenson *et al.* (2005), *Energy Convers. Manage.*

Ms. I's Problem: "Scenarios Are Too Coarse"

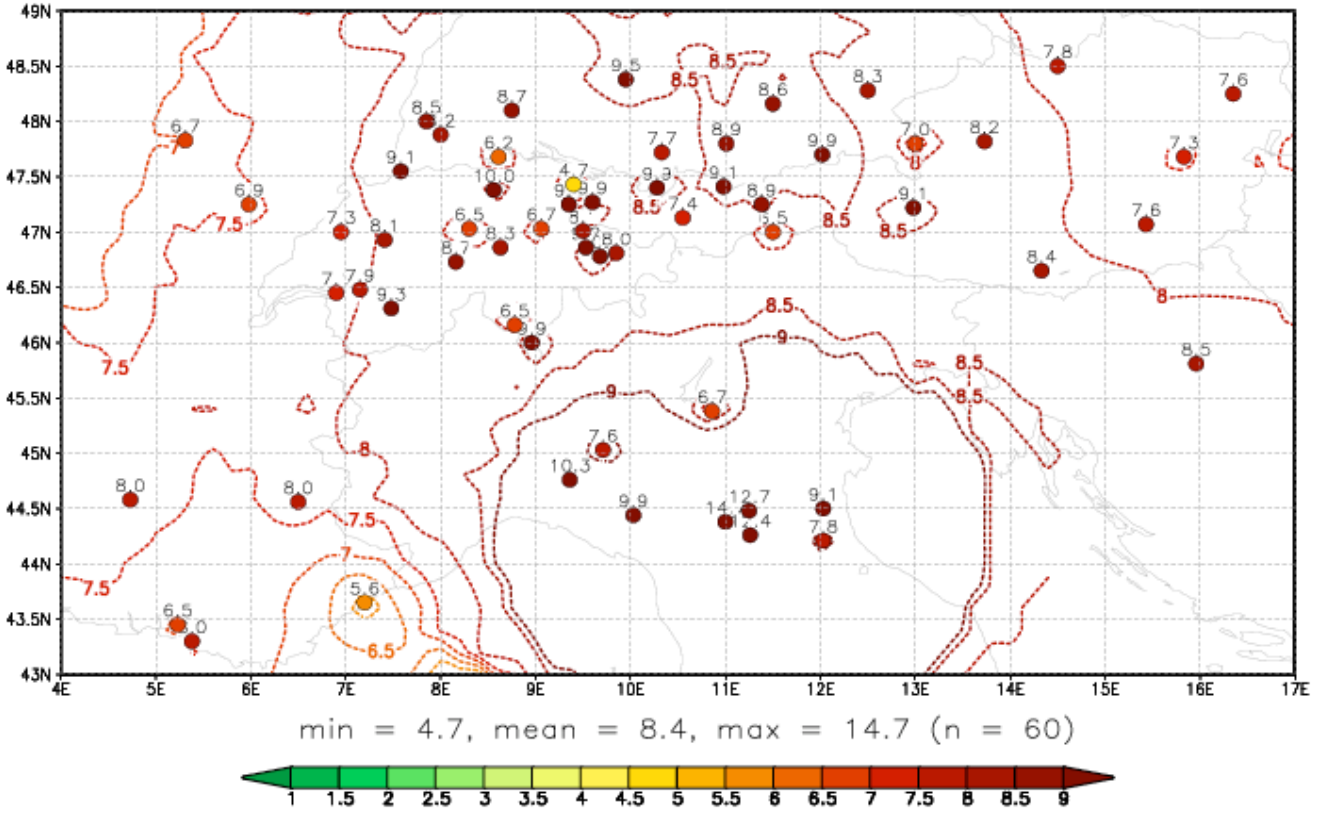
The available scenarios may have…

- only a limited set of **variables** (radiation?, wind?, …)
  → e.g., incremental scenarios, statistical downscaling
- insufficient **spatial resolution** (catchment … site)
  → e.g., RegCMs, statistical downscaling ⬅
- insufficient **temporal resolution** (monthly… hourly)
  → e.g., temporal downscaling ⬅
- insufficient **temporal extent** (decades … millenia)
  → e.g., pattern scaling techniques

Site-Specific Statistical Downscaling

Example: Scenario for summer T_{max} in the Alpine region

HadAM3, Scenario A2, $\Delta\mu$ 2070-2100 rel. to 1961-1990

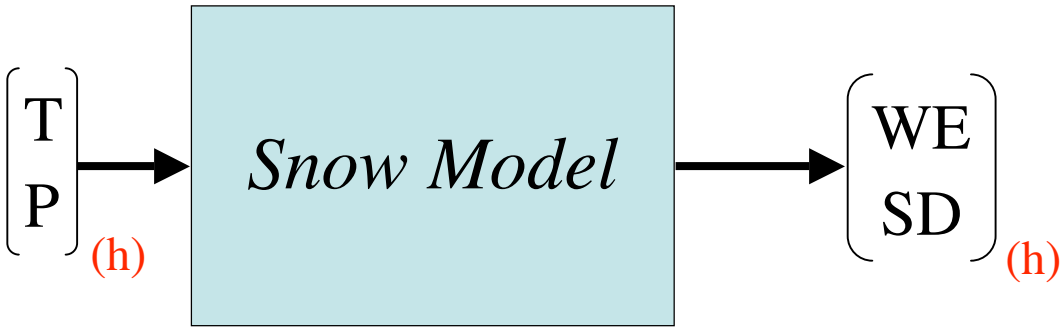


Gyalistras & Schüpbach, in prep.

Temporal Downscaling (1)

Example problem: Simulation of local snow cover

Inputs:
- Hourly mean temperature
- Hourly total precipitation

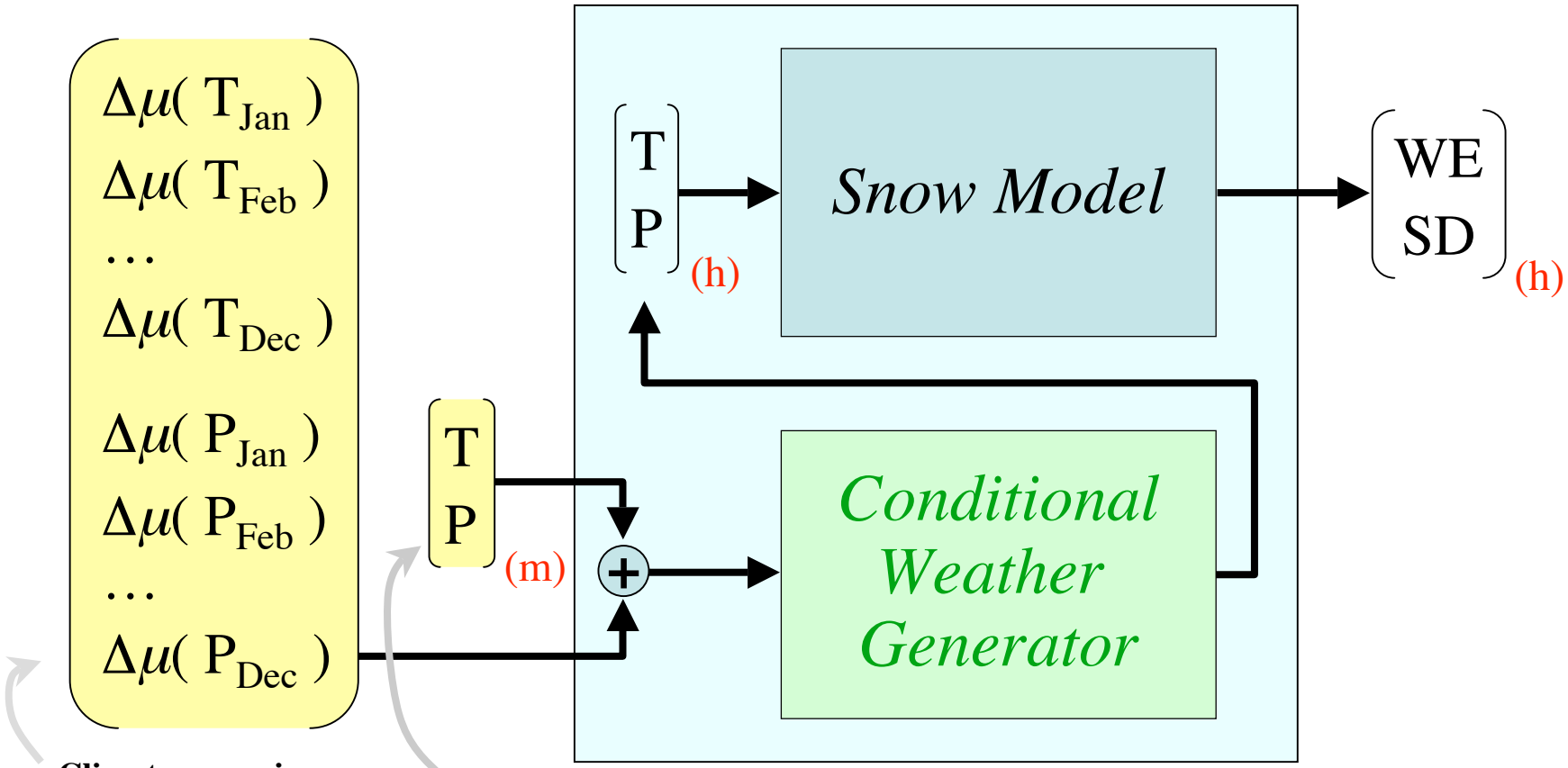


Outputs:
- Hourly snow water equivalent
- Hourly snow depth

How to get optimally consistent scenarios of hourly weather under possible future climatic conditions?

Temporal Downscaling (2)

Solution: Derive hourly weather data conditional on monthly weather inputs & scenarios



Climate scenario
(consisting of shifts in the expected values of monthly weather variables, derived e.g. from a climate model simulation)

Measured monthly weather data
(or monthly data derived from a hourly reference data set)

Temporal Downscaling (3)

Case study site: Davos, Switzerland (1590 m a.s.l.)

Target statistic: # days with snow depth exceeding 30 cm (good for downhill skiing)

Historical simulation

SIM: snow depth statistics from hourly snow model simulation using inputs from temporal downscaling

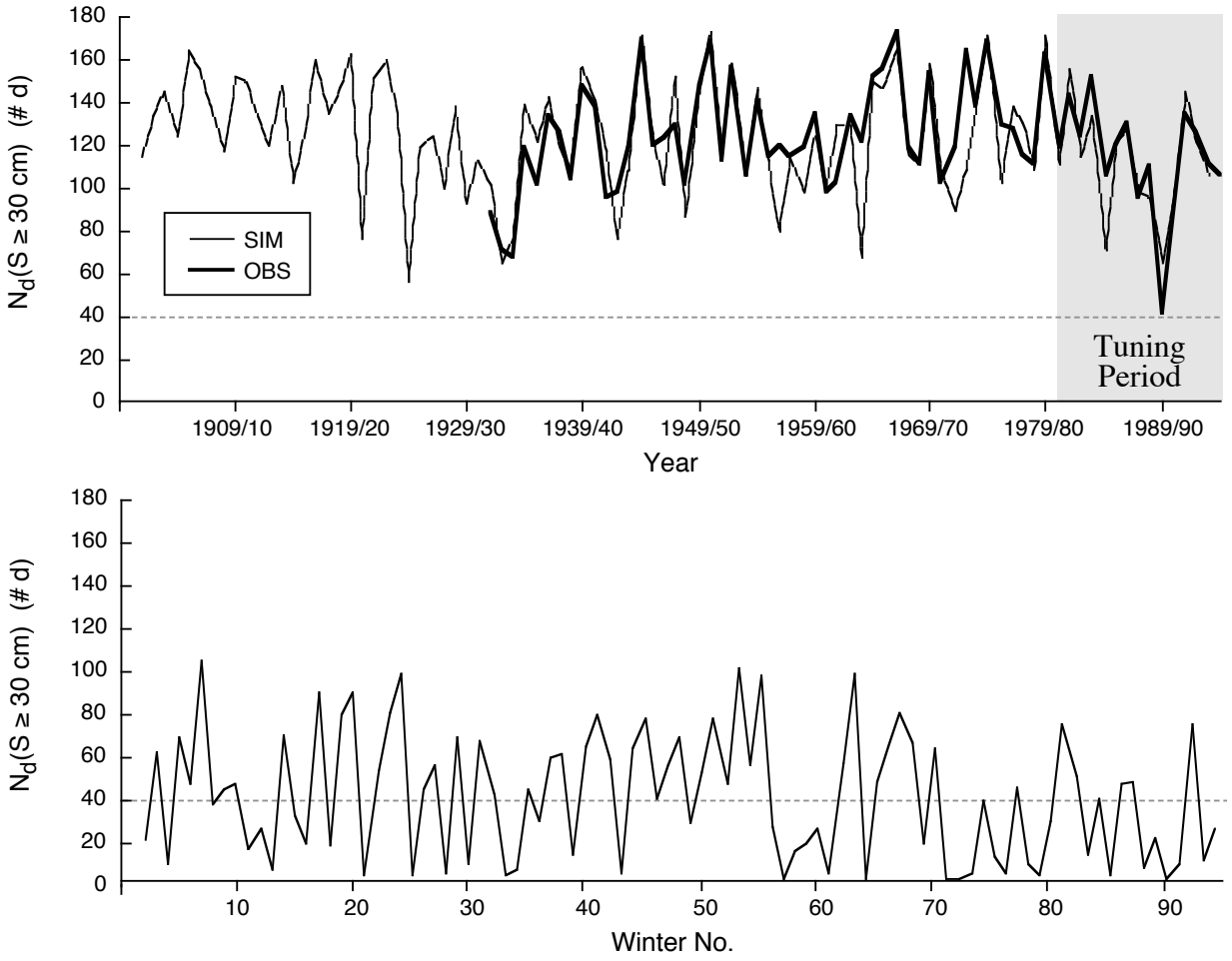
OBS: snow depth statistics from daily field measurements

Scenario simulation

Average changes:

$\Delta\mu(T_{mon}) = +5\ ^{\circ}C$

$\Delta\mu(P_{mon}) = +20\%$



Gyalistras *et al.*, submitted to *Clim. Dyn.*

Conclusions

- Typically there is a **mismatch** between the available scenario information and the actual scenario needs
- A **wide range of methods** (and data sets) are now available to bridge this gap