Regional climate models as data source for hydrological modelling

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1. Background
2. Choice of Regional Climate Model
3. Hydrological modelling
4. Conclusions

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1. Background

Goal: development of reliable information flows to predict the impact of climate change on the hydrological regime of the river basin

Calibration / validation	Choice of RCM	Predicting hydrological regime
Meteorological observations	Present global conditions	Global climate change scenario
Hydrological model	Regional climate model	Regional climate model
Modelled run-off	Modelled present climate	Modelled future climate
Run-off observations	Meteorological observations	Hydrological model
		Modelled future run-off

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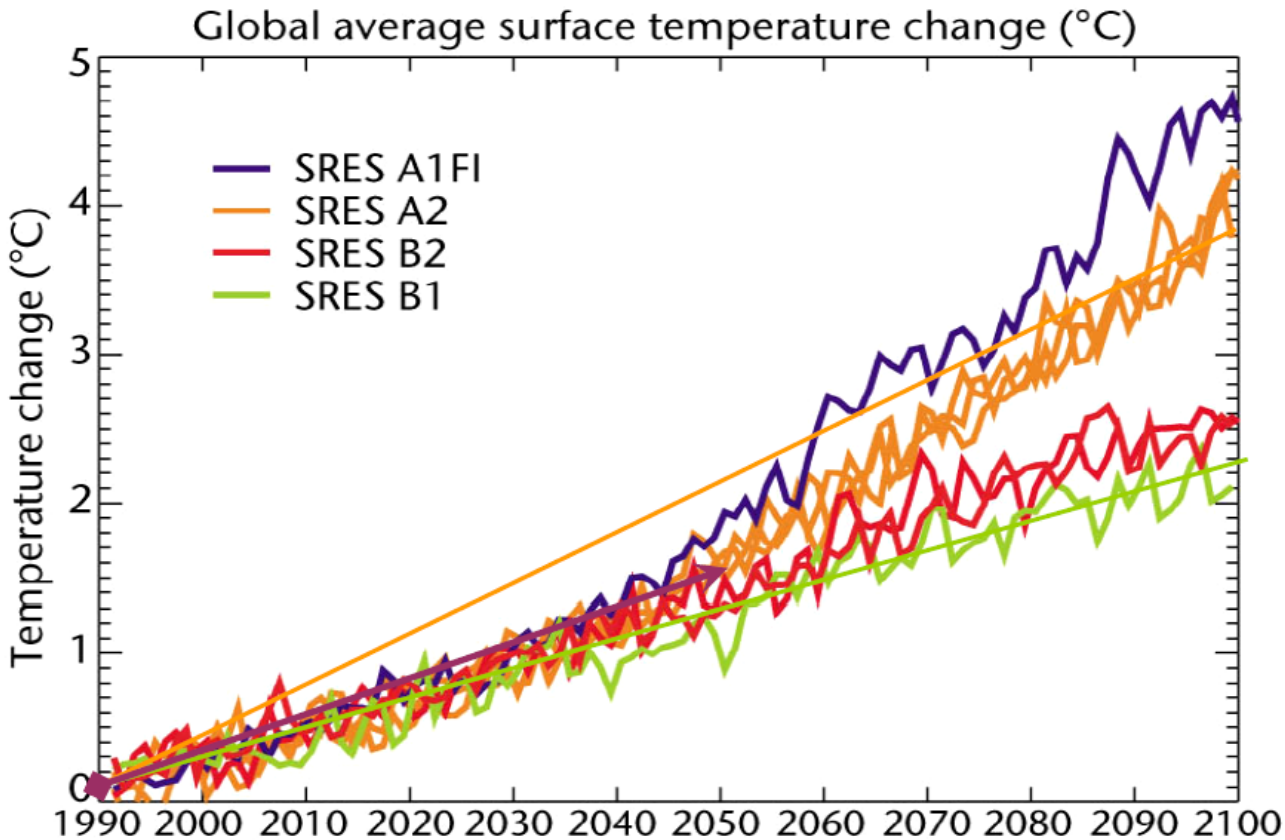
2. Choice of RCM / SRES

Intergovernmental Panel on Climate Change (IPCC) by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP)

IPCC Special Report on Emissions Scenarios

A1, A2, B1 and B2 scenario families

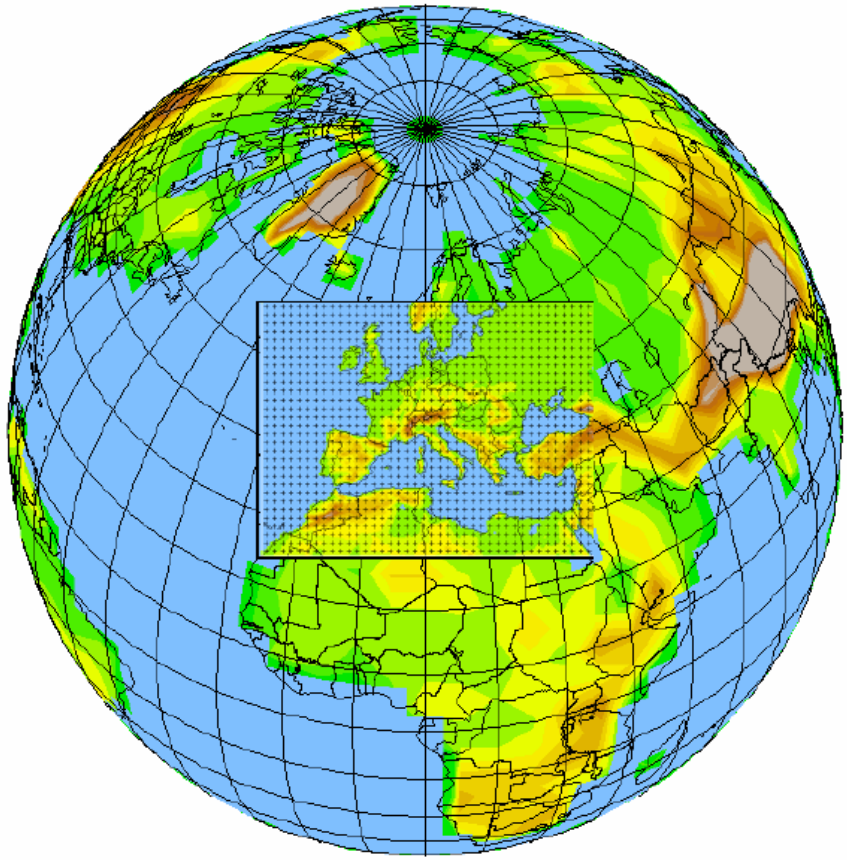


2. Choice of RCM: RCM

Global climate change scenario

Global climate model

Regional climate model



PRUDENCE is a European FP5 scientific project to quantify confidence and the uncertainties in predictions of future climate and its impacts, using an array of climate models.

PRUDENCE will provide a series of high-resolution climate change scenarios for 2071-2100 for Europe

2. Choice of RCM / models

21 model / forcing considered for control period 1961-1990:

CHRM HC_CTL,
CLM CTL,
CLM CTLsn,
HadRM3P adeha,
HadRM3P adehb,
HadRM3P adehc,
HIRHAM HC1,
HIRHAM HC2,
HIRHAM HC3,
HIRHAM ecctrl,
HIRHAM ECC,
HIRHAM Xtra hi res. F12,
HIRHAM high res. F25, HIRHAM HADCN, PROMES control,
RACMO HC1,
RCAO HCCTL,
RCAO hi res. HCCTL_22,
RCAO MPICTL,
RegCM ref,
REMO 3003

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2. Choice of RCM / approach

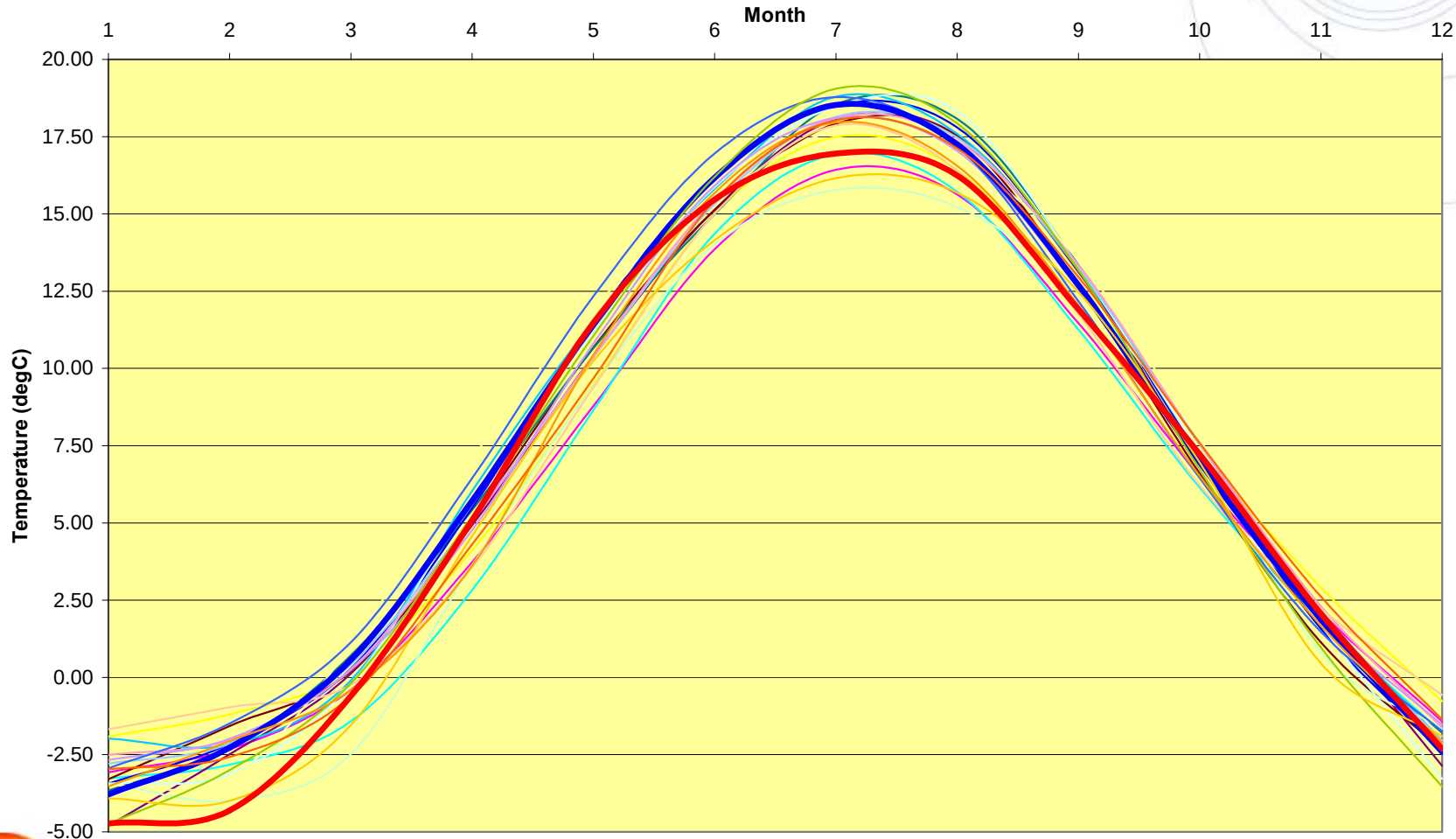
- 21 model (GCM) is considered for control period 1961-1990.
- 9 observations locations are considered for time period 1961-1990 (observation by USSR Hydrometeorological Agency)
- Monthly average precipitation, monthly average temperature, standard deviation of monthly precipitation and standard deviation of monthly temperature is calculated for each observation location from the 1 observation data series and 21 model data series:

(4 parameters x 12 months x 9 locations x (1 obs + 21 mod))

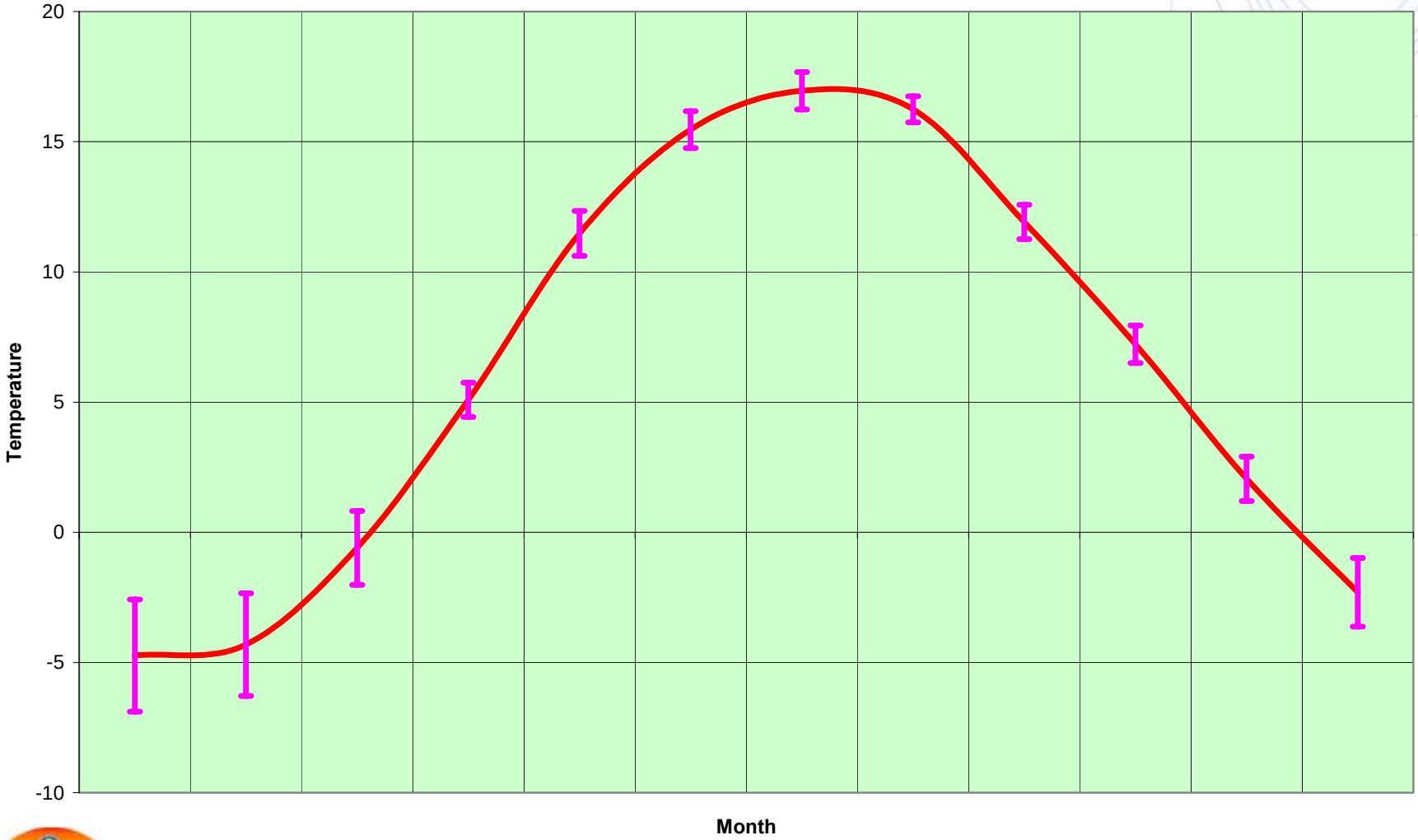
- 432 deviations between the model results and observations are calculated for each of 21 models
- Deviations are normalised to give equal weight for each of 4 parameters
- Penalty function is constructed from normalised deviations to quantify the difference between the model climate and the observed climate

2. Choice of RCM / temperature@Riga

Monthly temperature (OBS = 6.2 degC, MOD = 6.9 degC)

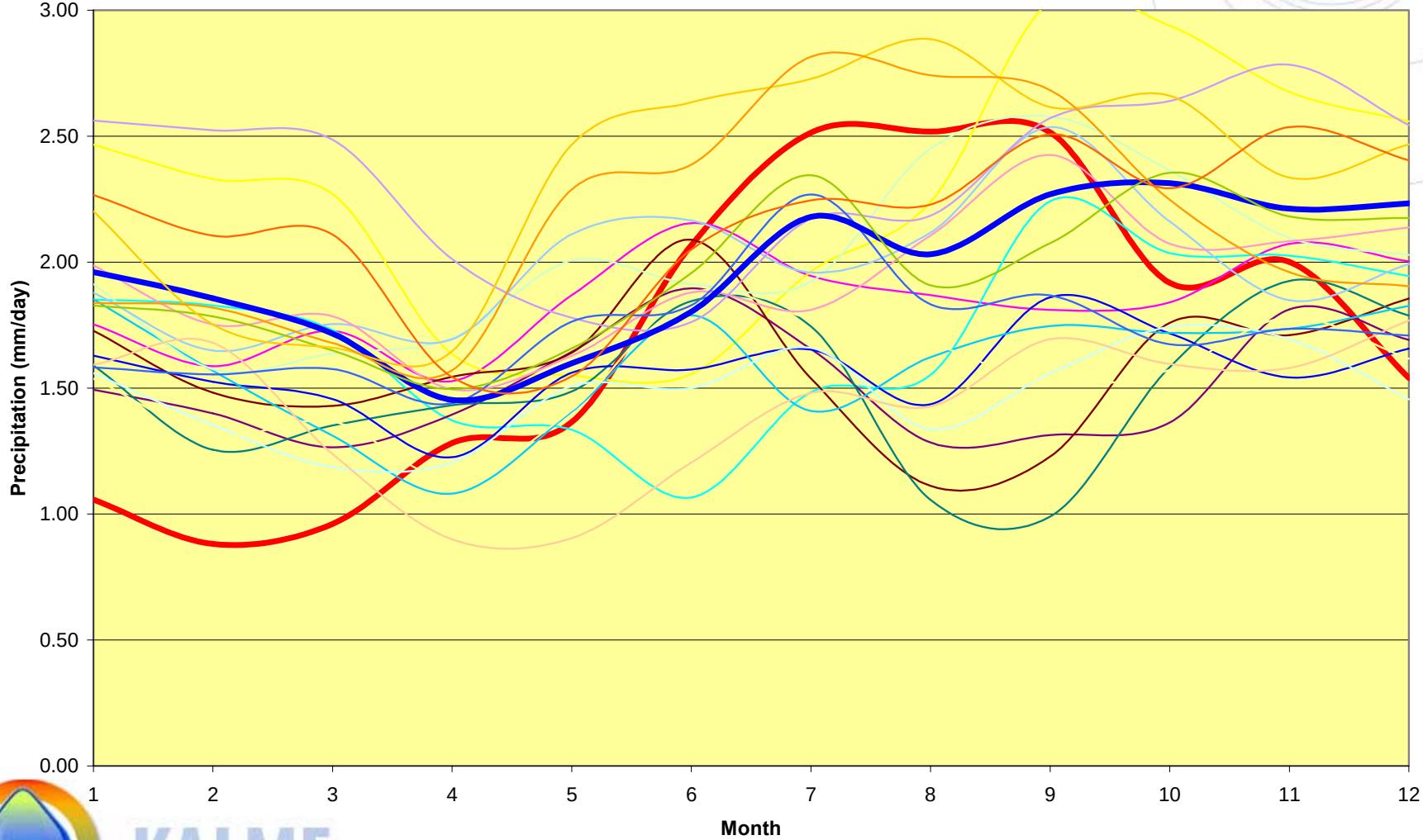


2. Choice of RCM / temperature STD @ Riga



2. Choice of RCM / precipitation@Riga

Monthly precipitation (OBS = 620 mm, MOD = 708 mm i.e. +14%)



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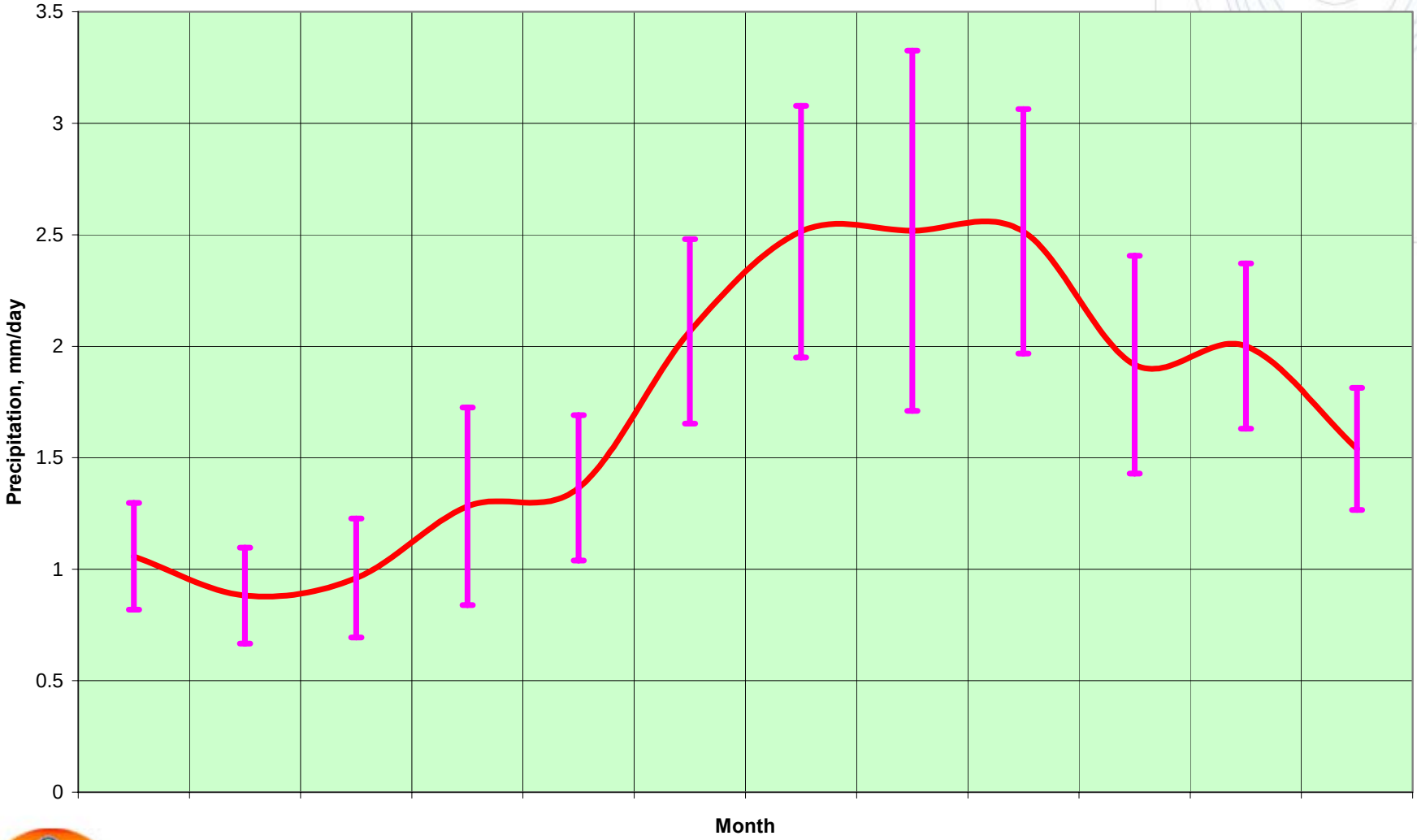
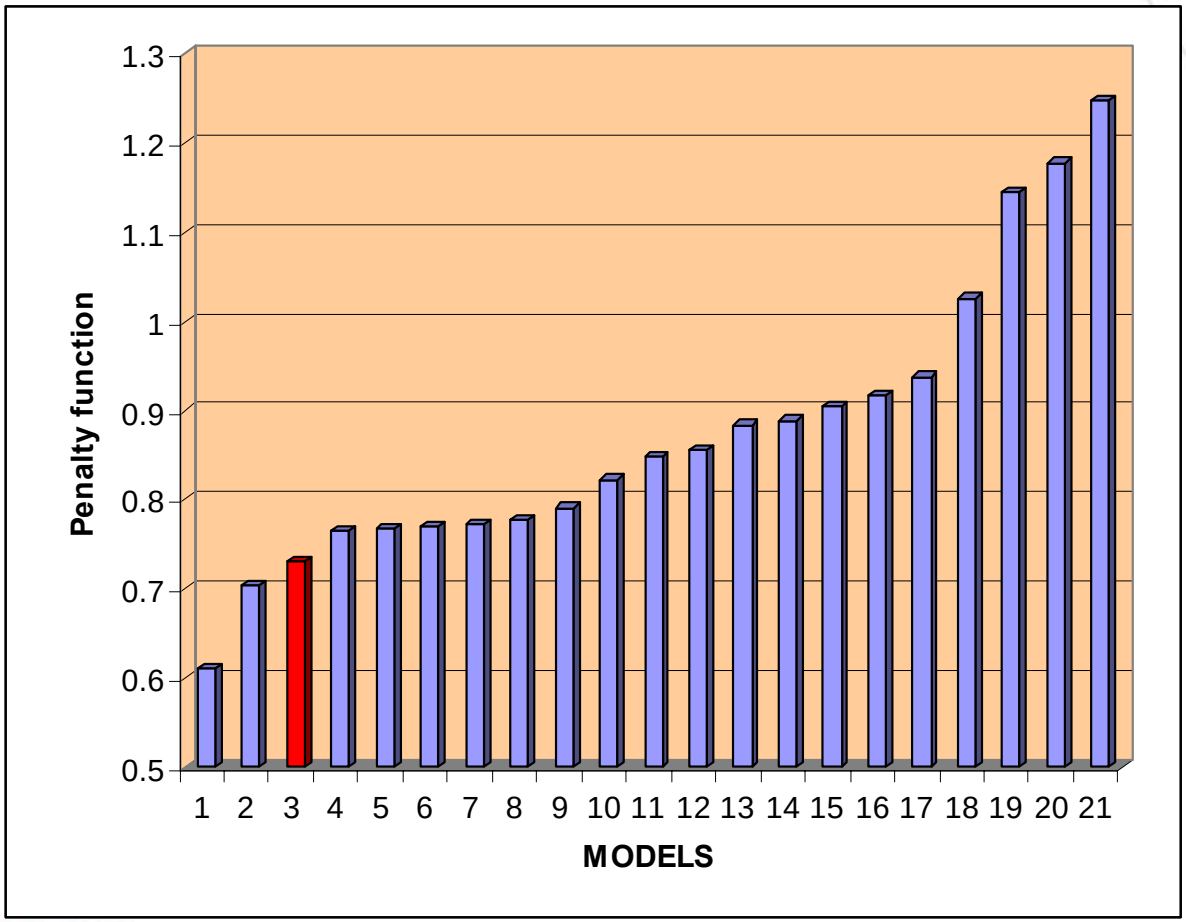
2. Choice of RCM / precipitation STD @ Riga

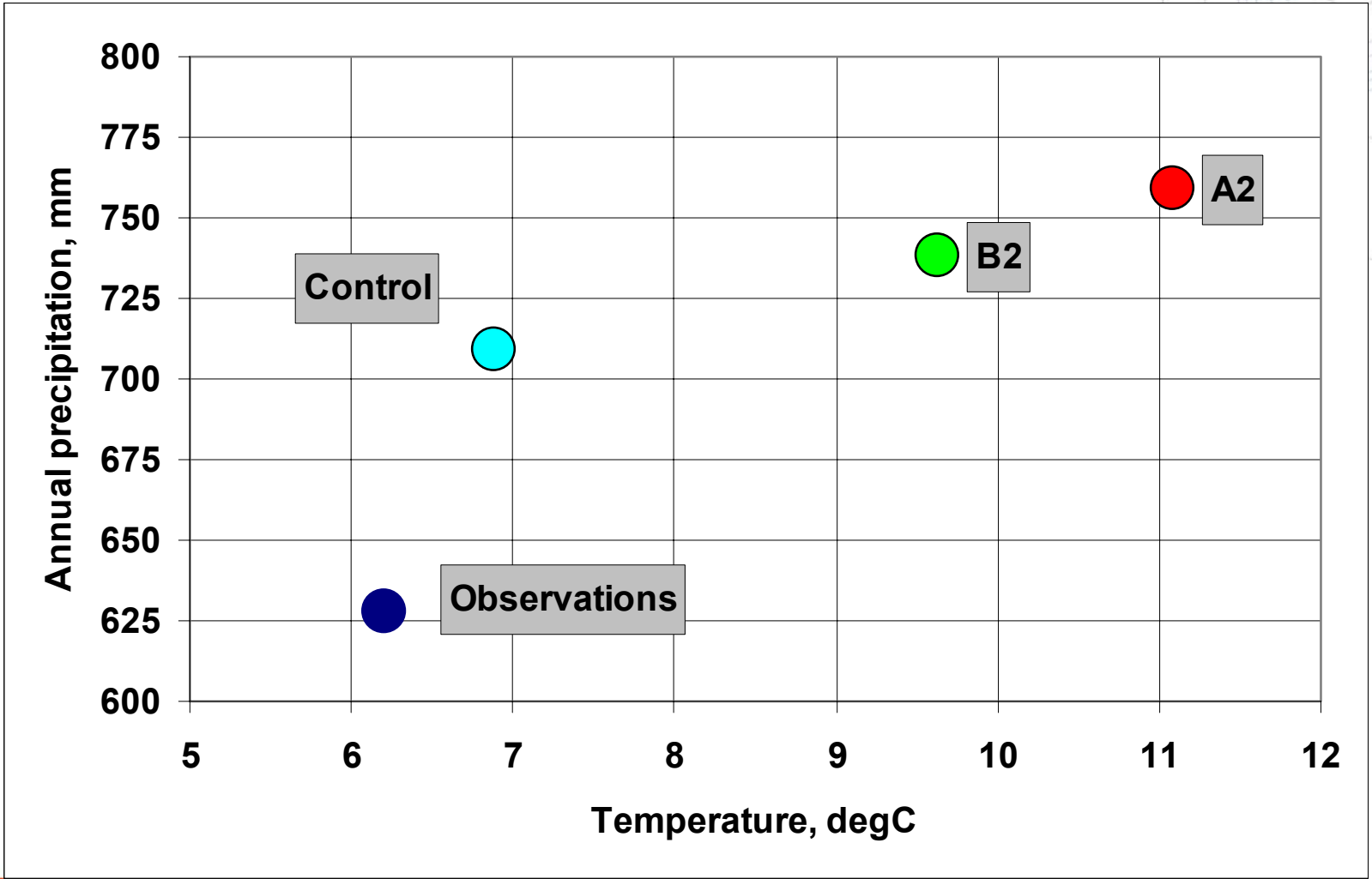


2. Choice of RCM / summary

SMHI (SE) RCAO HadAM3H (HCCTL) model used further

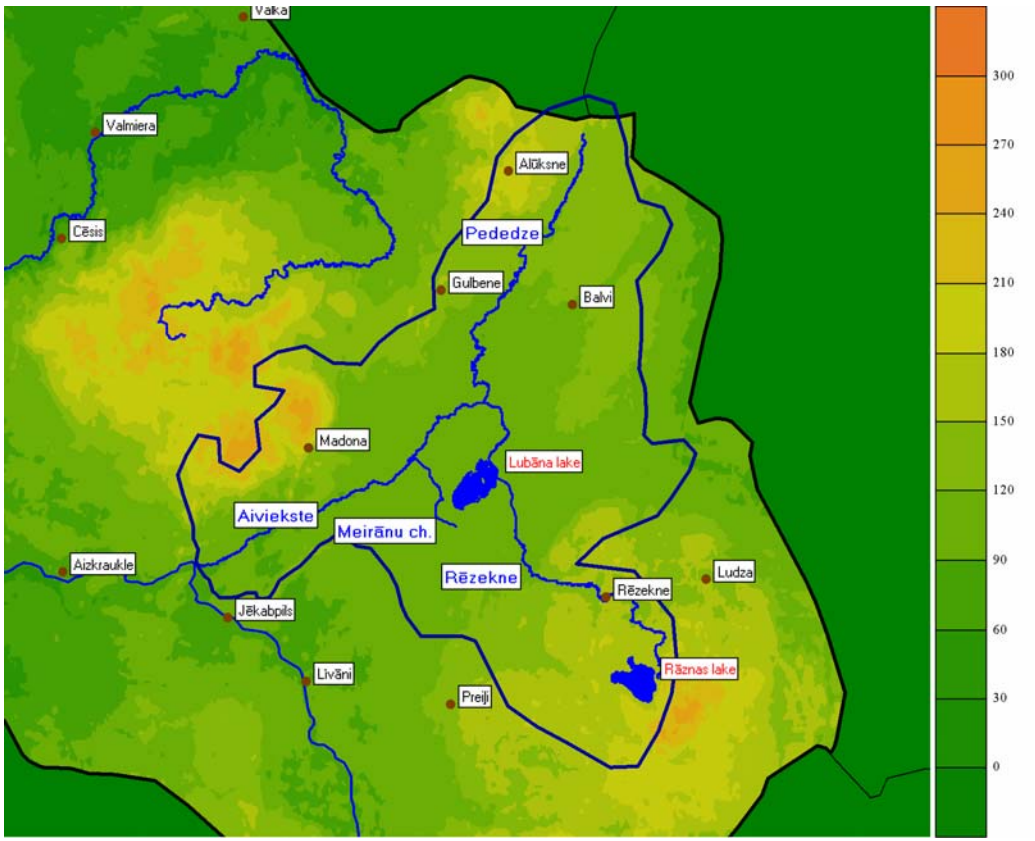


2. Choice of RCM / summary



3. Hydrological modelling: model & domain

In-house model of hydrological processes FiBasin.
Aiviekste basin in Latvia.



Calibration for 1976-1979

Hydrometric observations Zīverts (2000)

Meteorological observations LEGMA

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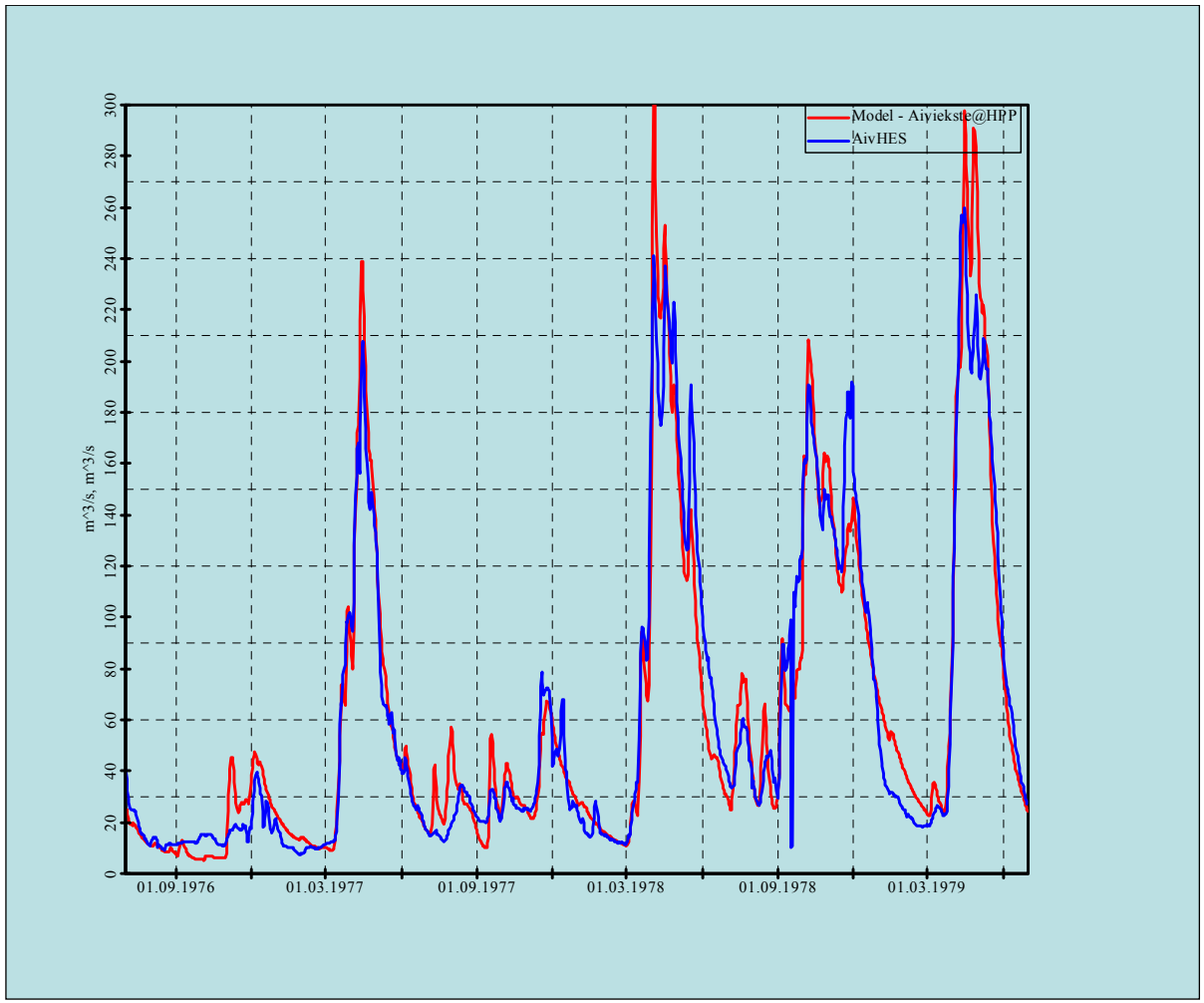
3. Hydrological modelling: calibration



Comparison of observed Q / modelled Q (forcing by observed T, p)

3 years, starting in June

Average runoff
OBS 61.6 m^3/s
MOD 62.5 m^3/s

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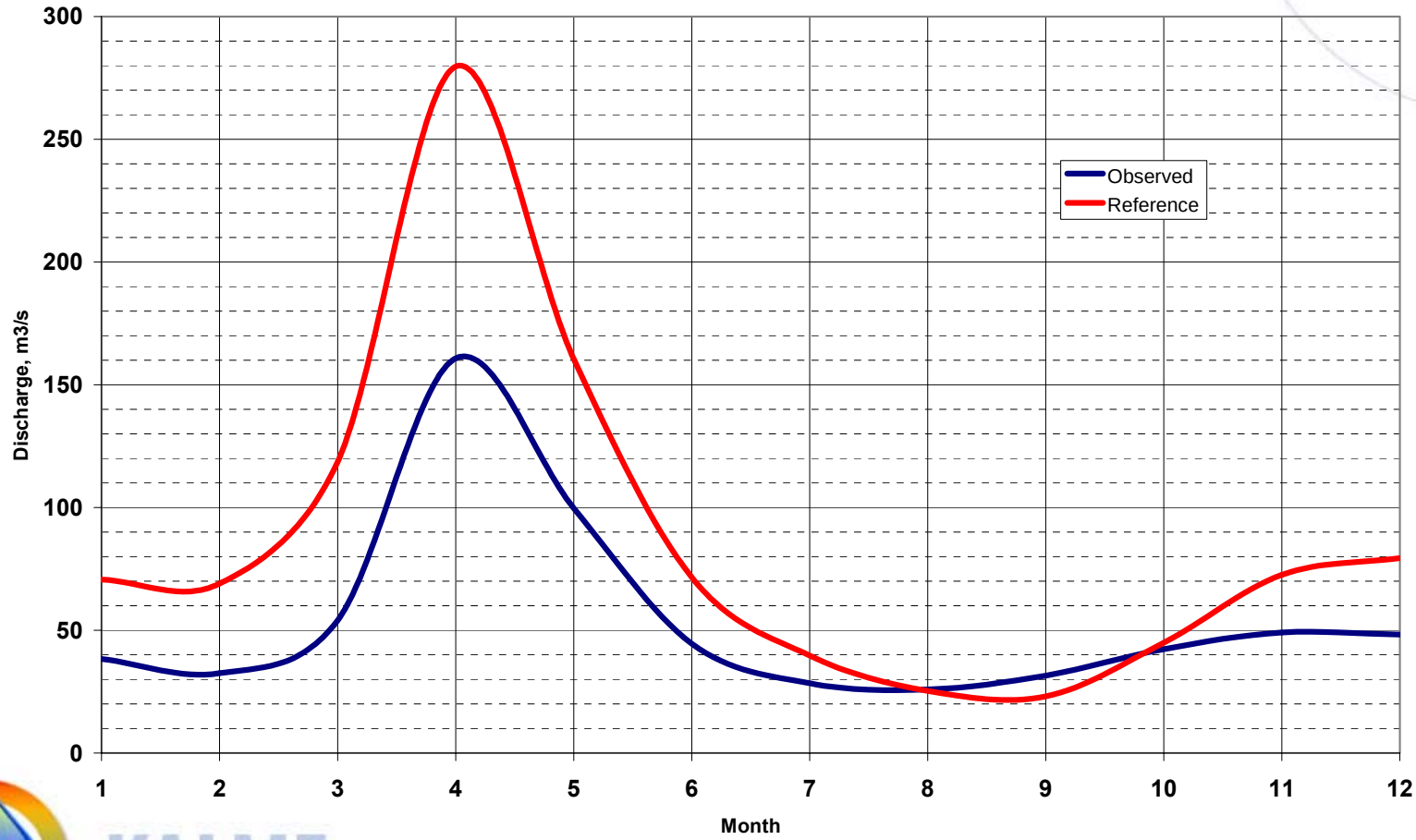
3. Hydrological modelling: control period

Comparison of observed Q / modelled Q (RCM forcing) 1961-1990
Average runoff: OBS 54.6 m^3/s MOD 88.1 m^3/s (+61% !!!)



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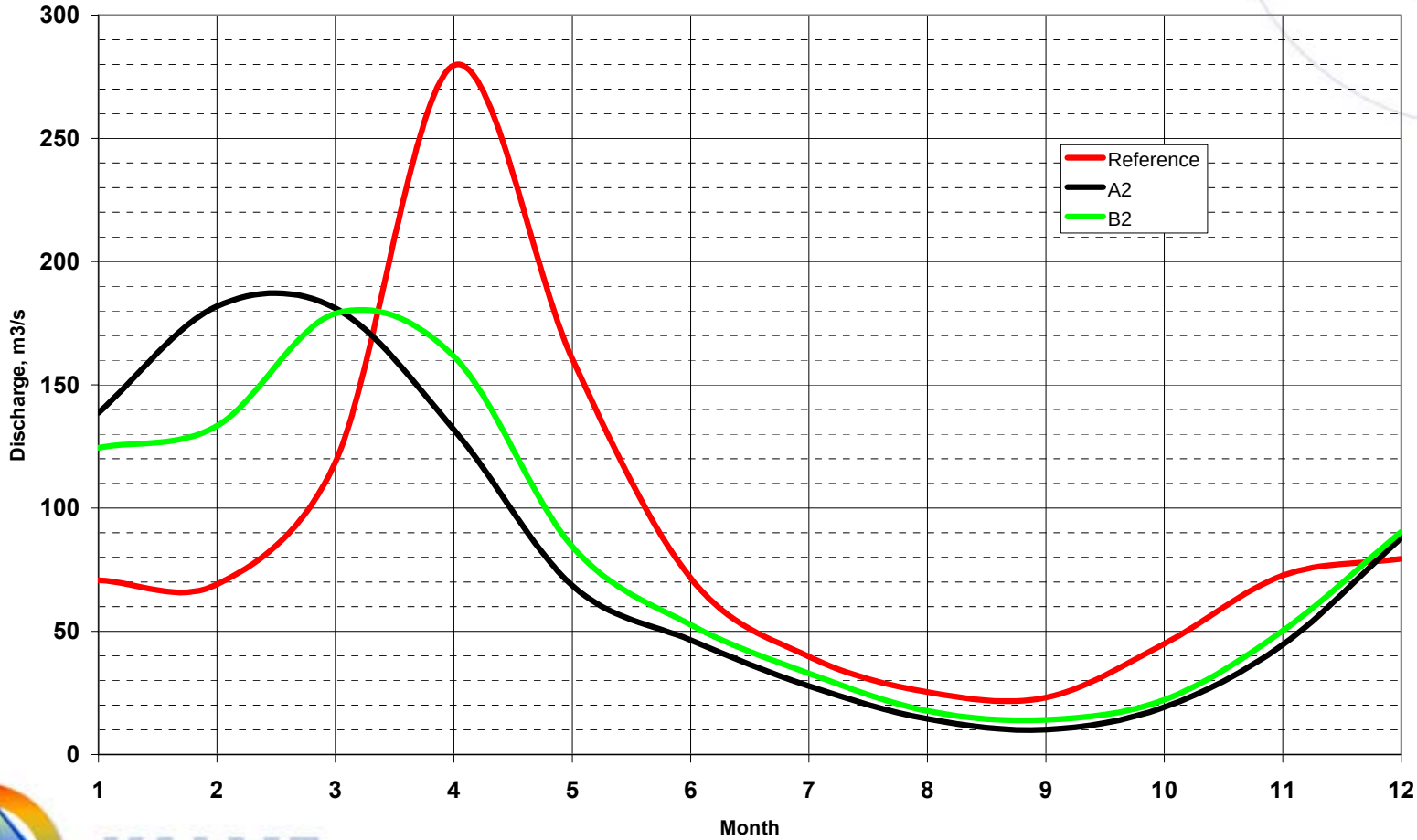
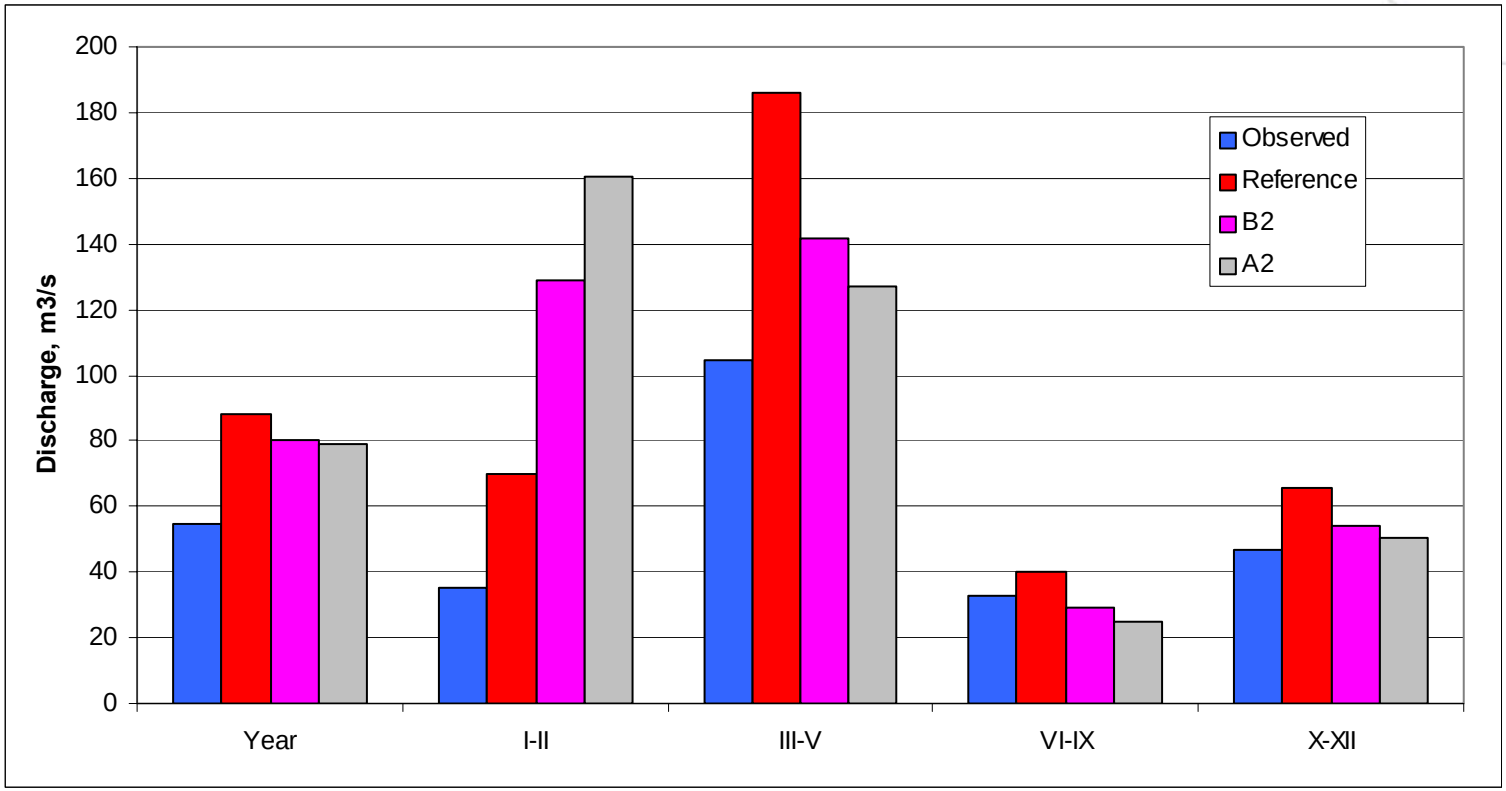
3. Hydrological modelling: scenarios

Modelled Q. Forcing by RCM data (T, p).
Comparison of control period (1961-90) and scenarios A2, B2 (2071-2100)



3. Hydrological modelling: summary

Disagreement in OBS/MOD for control period
Are the forecasts reliable? Yes & No ☺



4. CONCLUSIONS

GENERAL

- Employing the RCM as forcing data source for models of hydrological processes is promising and challenging
- There exist pitfalls along the way
- The “best” RCMs are not neccessarily those which match the observations of modelled meteorological parameters better
- Small changes in the forcing may produce reasonable quantitative and qualitative changes in response of a non-linear system

PARTICULAR

- The accurate winter temperature/precipitation regime is crucial for using RCM data in hydrological modelling
- Summer precipitation is rather irrelevant