Impact of climate change on Latvian water environment

WP1: Impact of the climate change on runoff, nutrient fluxes and regime of Gulf of Riga

Uldis Bethers

Laboratory for mathematical modelling of environmental and technological processes
Faculty of Physics and mathematics,
University of Latvia

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WP1. GOAL

Modelling of several scenarious of the change of water environment using the existing climate change scenarious for Baltic Sea region

WP1. TASKS

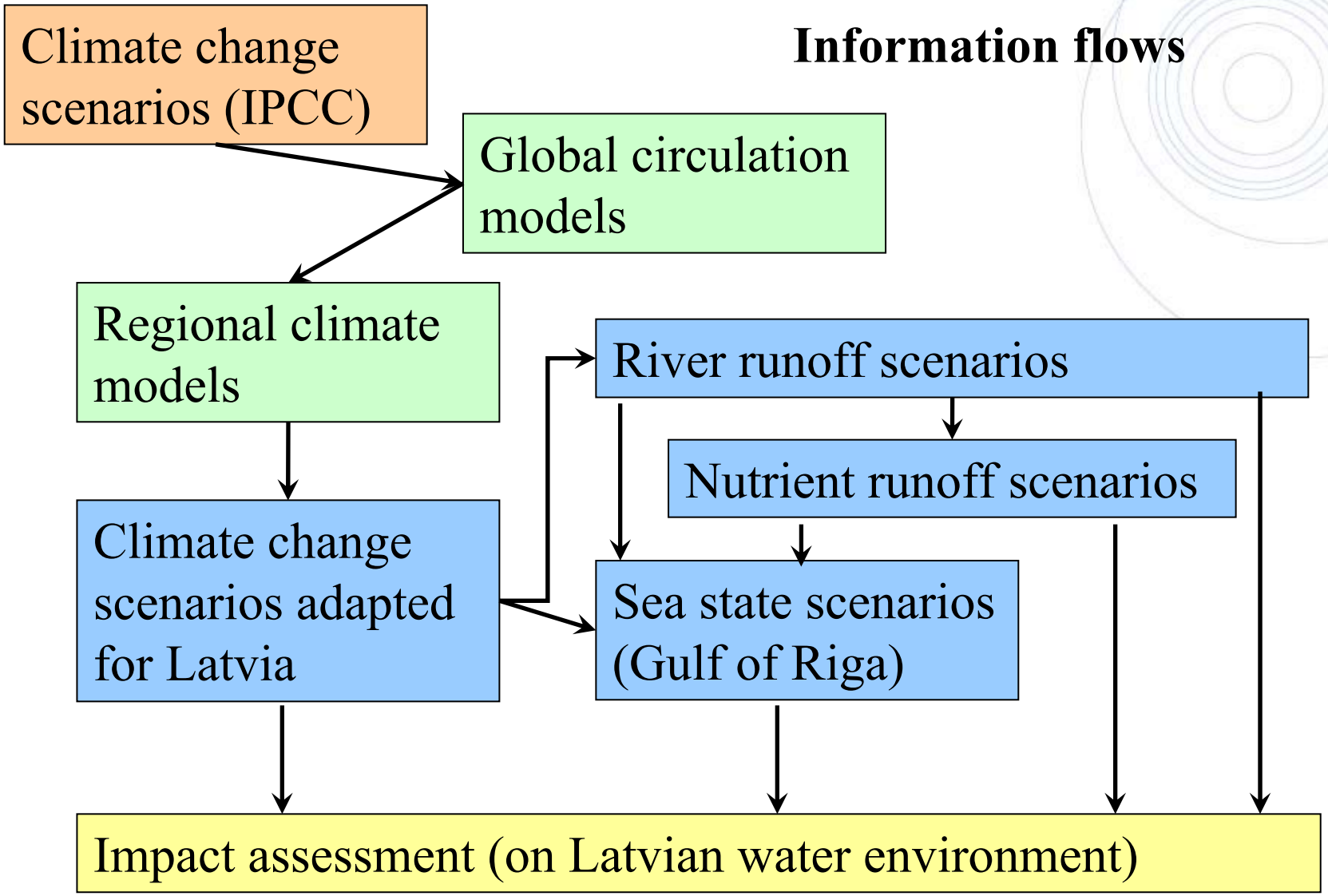
WP1a. Evaluate and adapt the results from the regional climate models, and design the series of data which form the state of the water objects. Scenarios

WP1b. Modeling of surface water and nutrients runoff for Latvia. Preparation of data series of river runoff for climate change scenarios

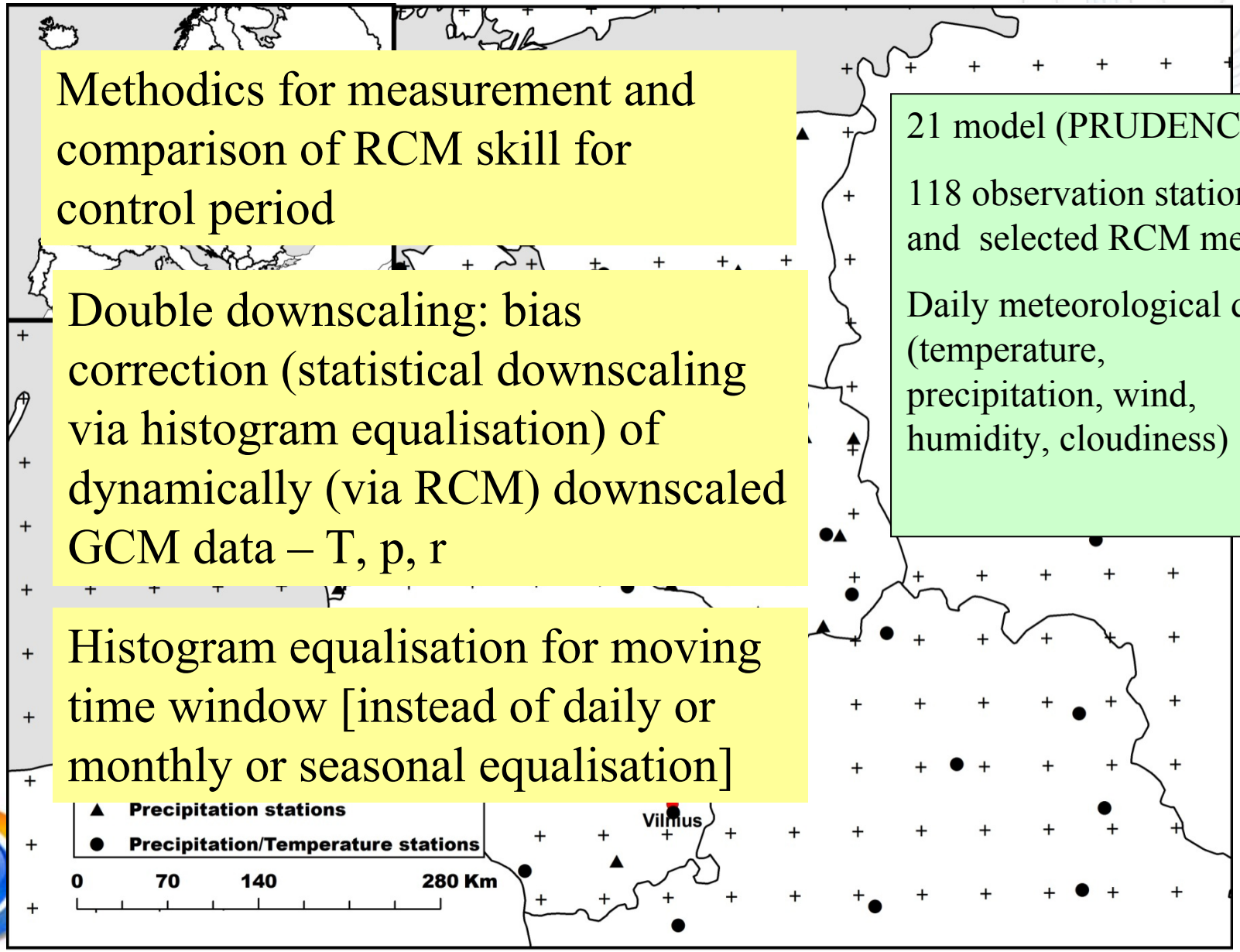
Calculation of data series of nutrient runoff to the Gulf of Riga

WP1c. Adapt 3D sea state models to produce the data series for the forecast of biogeochemical processes and sea ecosystem evolution.
Oceanographic modelling
WP1d. Provide modelling and data analysis support for other WPs. Support

Information flows



Climate scenarios 1A



Methodics for measurement and comparison of RCM skill for control period

Double downscaling: bias correction (statistical downscaling via histogram equalisation) of dynamically (via RCM) downscaled GCM data – T, p, r

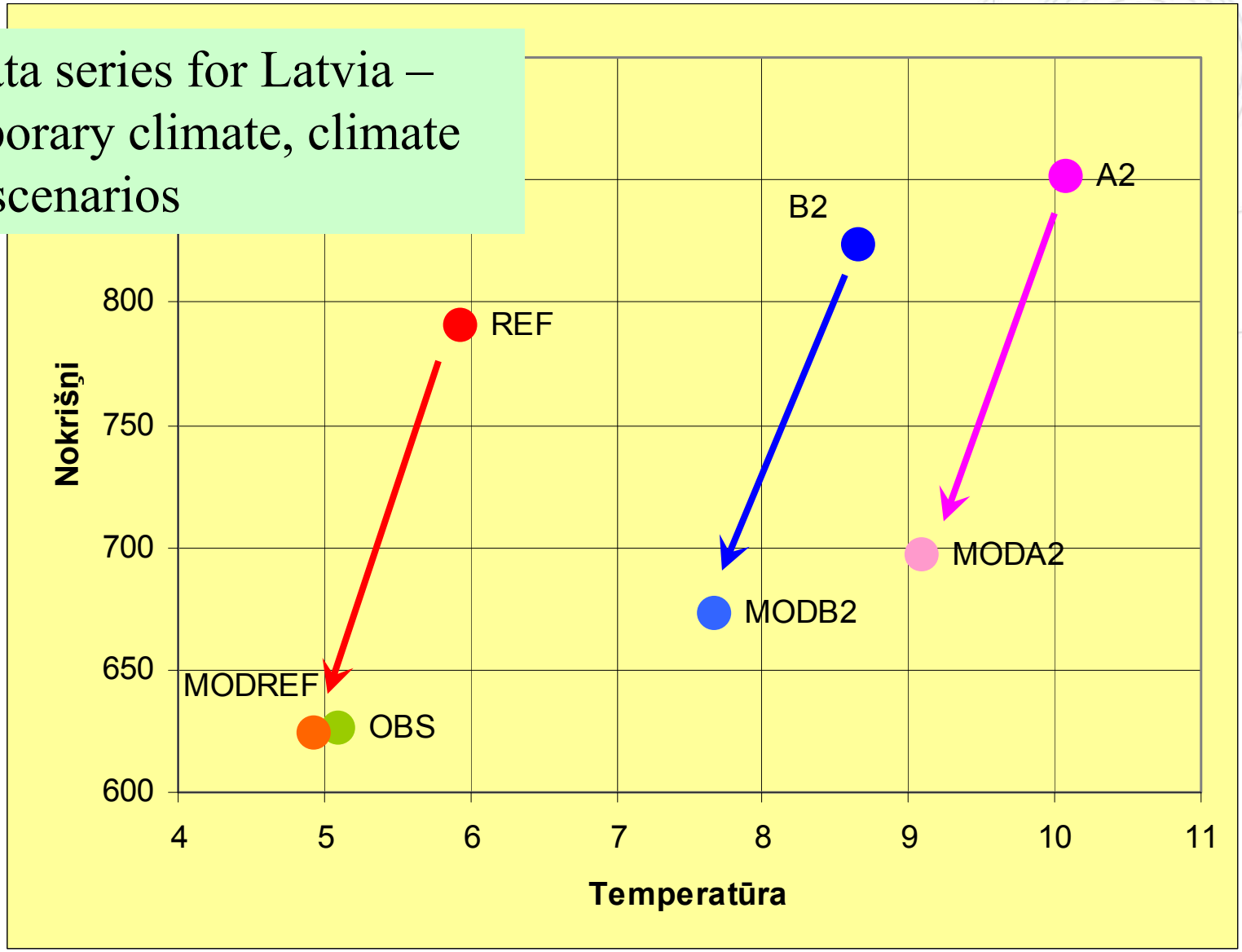
Histogram equalisation for moving time window [instead of daily or monthly or seasonal equalisation]

21 model (PRUDENCE)

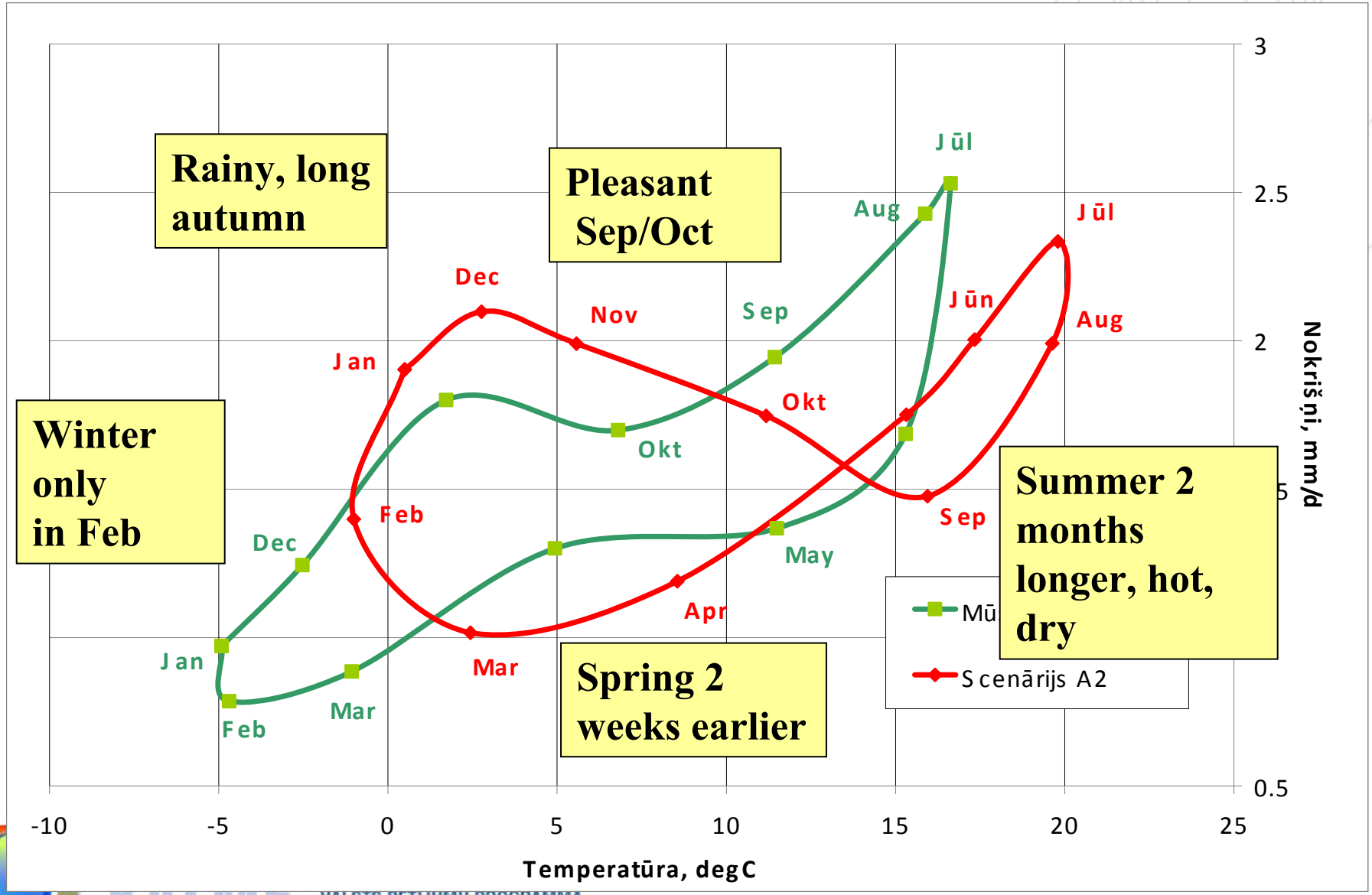
118 observation stations and selected RCM mesh

Daily meteorological data (temperature, precipitation, wind, humidity, cloudiness)

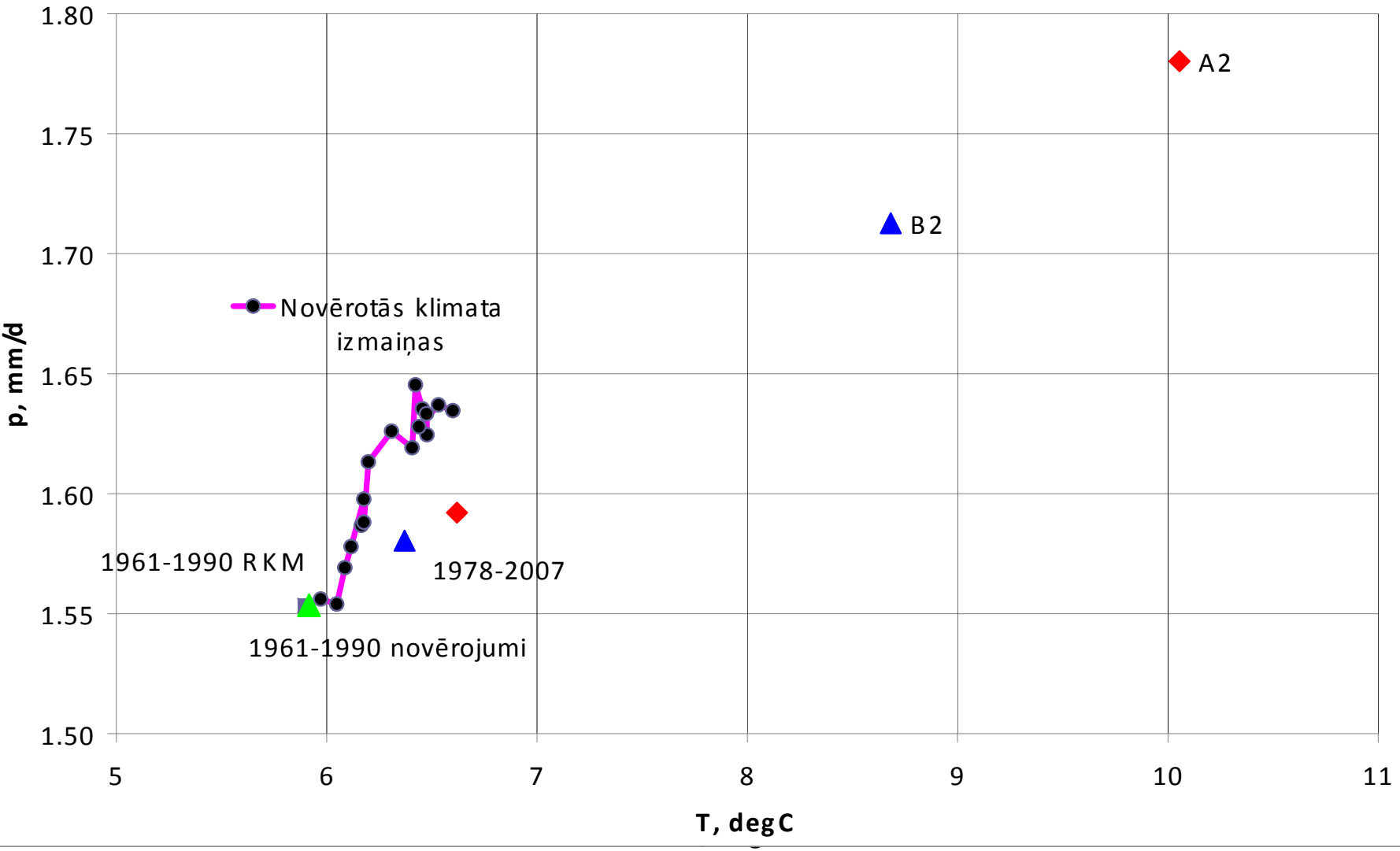
Daily data series for Latvia – contemporary climate, climate change scenarios



Insight : T-p diagram for Dobele, contemporary climate and A2 scenario



Dobele: comparison scenarios vs. observations



Noteces modelēšana 1B

- Hidroloģisko modeļu ansambļa pieeja 2008
- Noteces kalibrācija / verifikācija ūdensobjektiem
- Upju noteces scenāriji

Atziņa 2008 – upju notece RJL sateces baseinā samazināsies vismaz par 5-10%

- **Reģionālā upju noteces izmaiņu analīze Latvijai 2009**
- **UBA noteces scenāriji 2009**
- **Biogēnu noteces scenāriji 2009 (paldies Bārbelei ☺)**

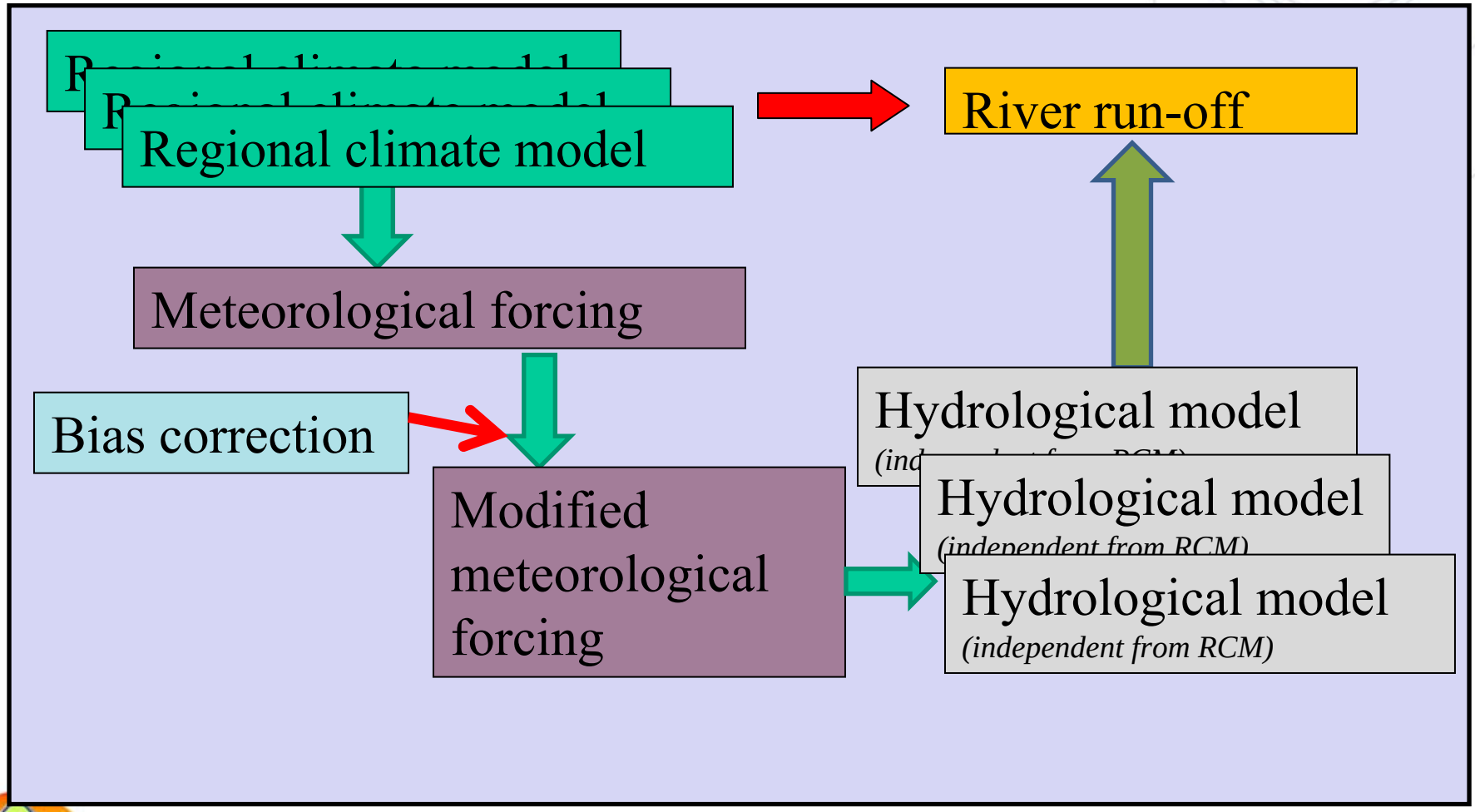
Atziņa – hidroloģiskā režīma daudzveidība Latvijā samazināsies

NOVITĀTE PASAULĒ

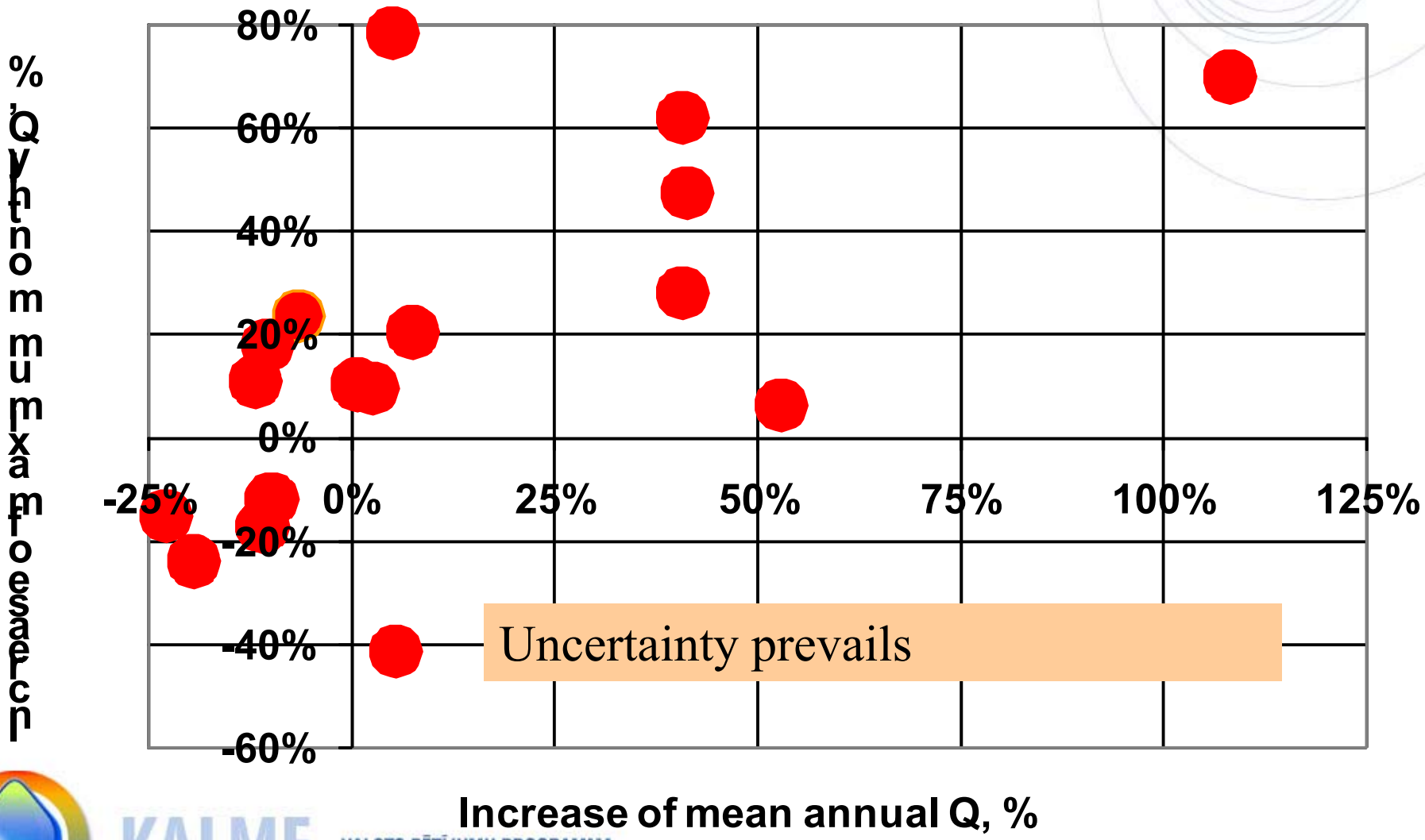
“Double ensemble forecast: ensemble of RCM vs. ensemble of hydrological models”

River runoff 1B

Double ensemble approach



Impact assessment by RCM ensemble (Bērze)



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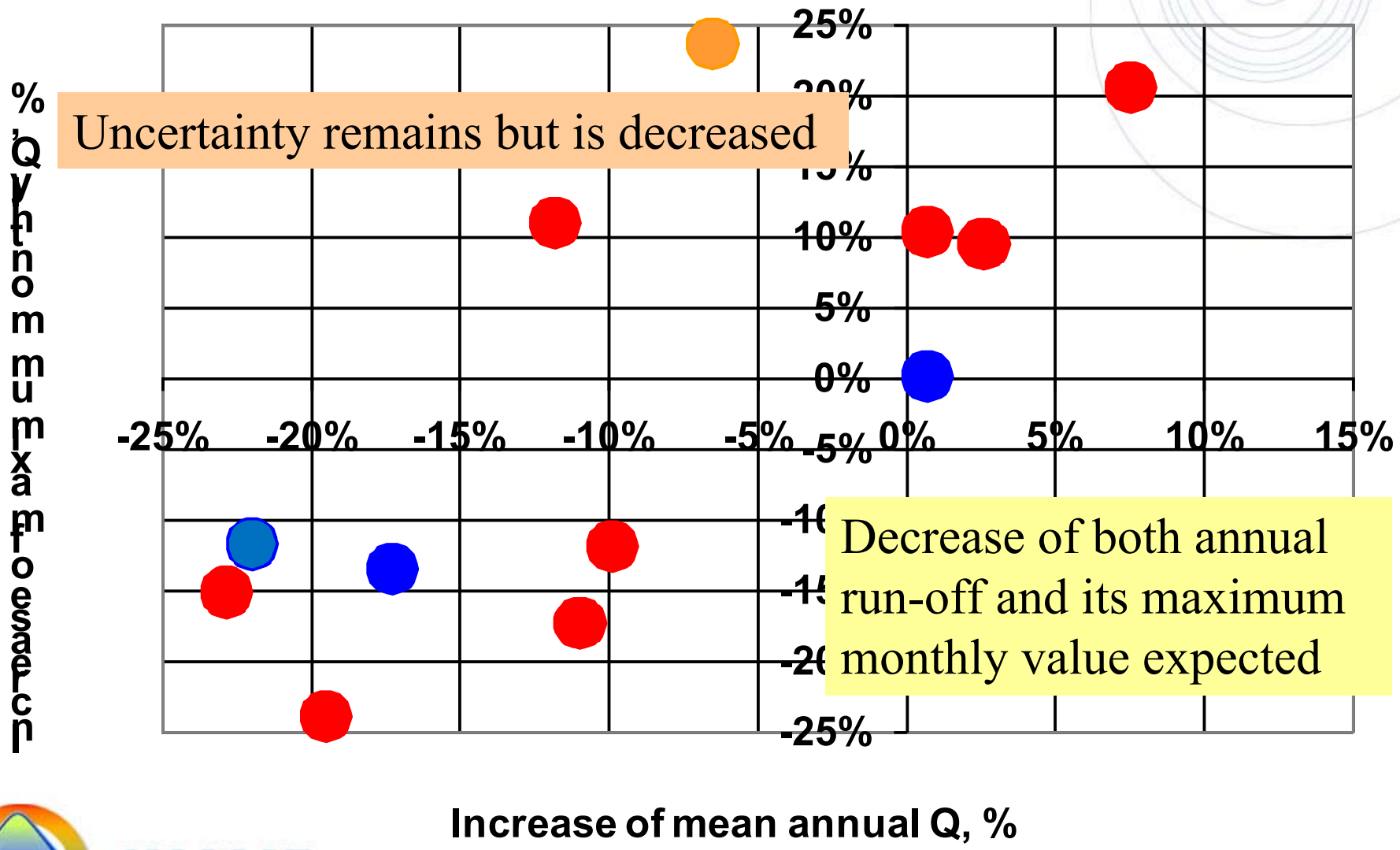
Impact assessment by hydrological model ensemble



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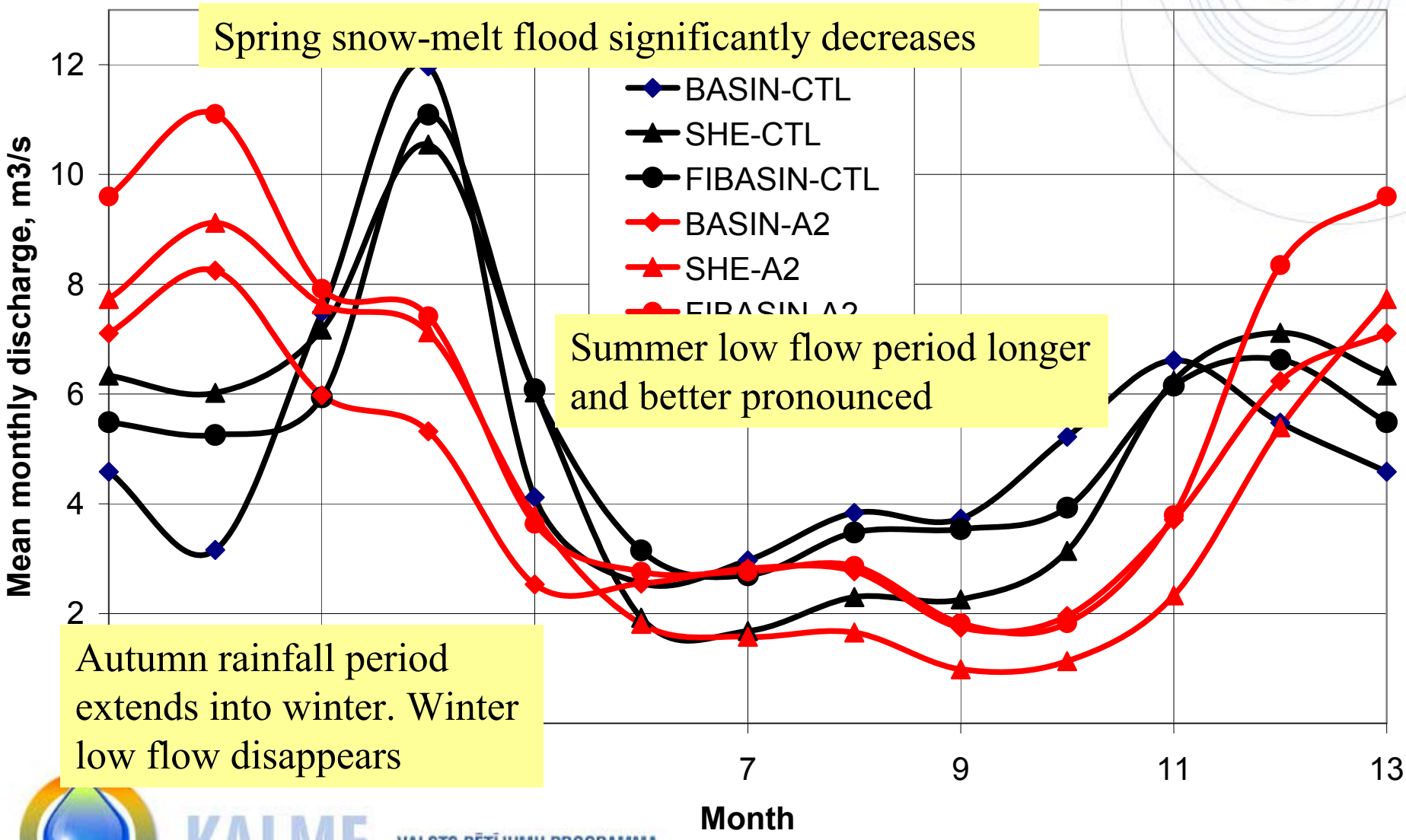
Seasonal analysis by hydrological model ensemble



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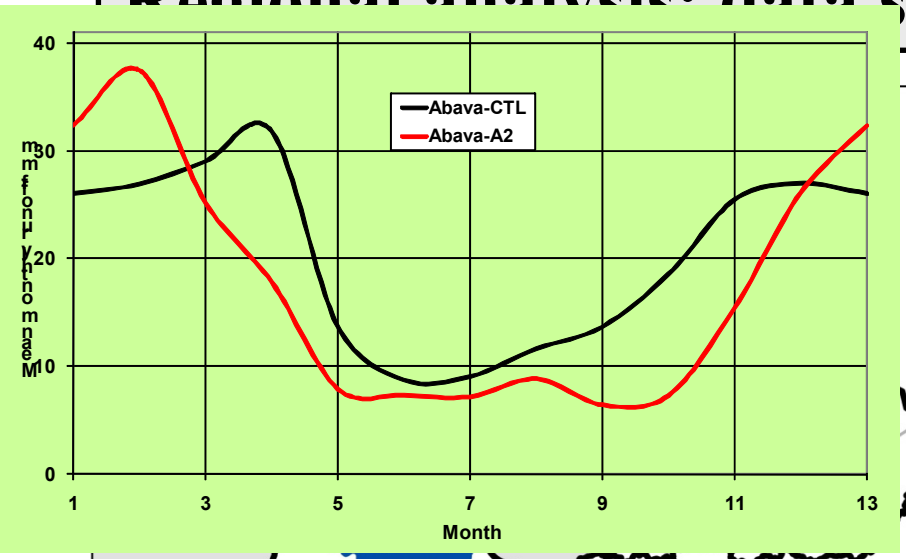
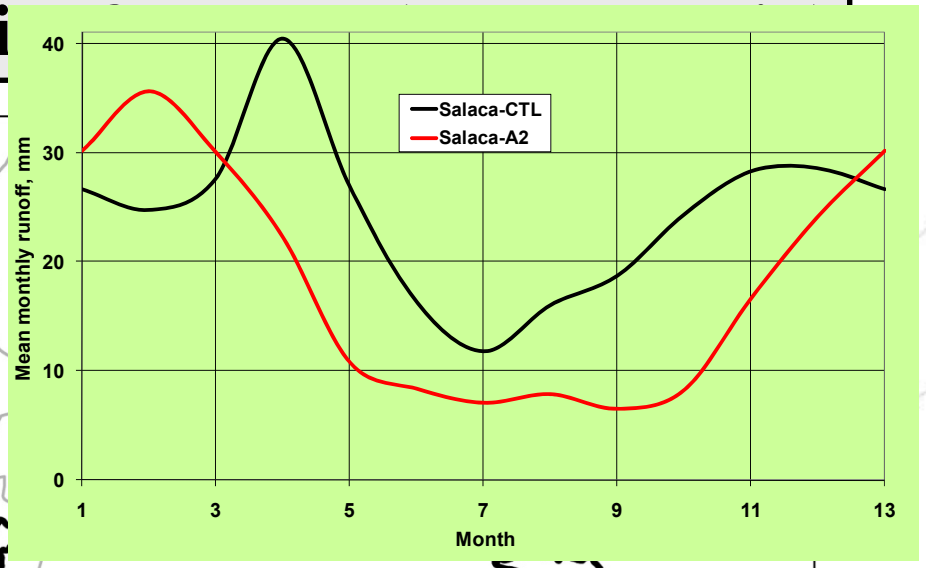
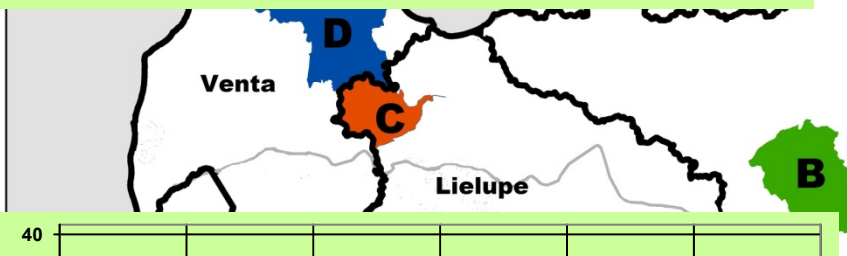
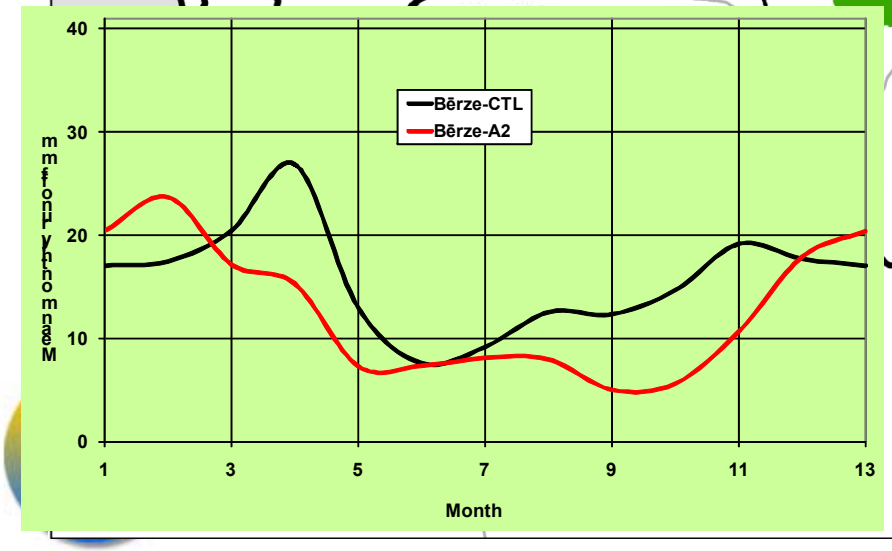
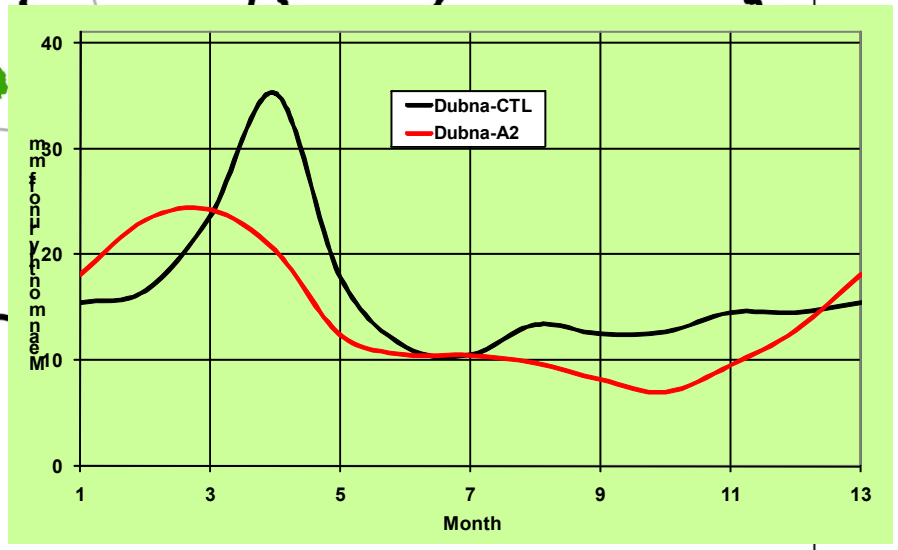
Regional analysis: data seri



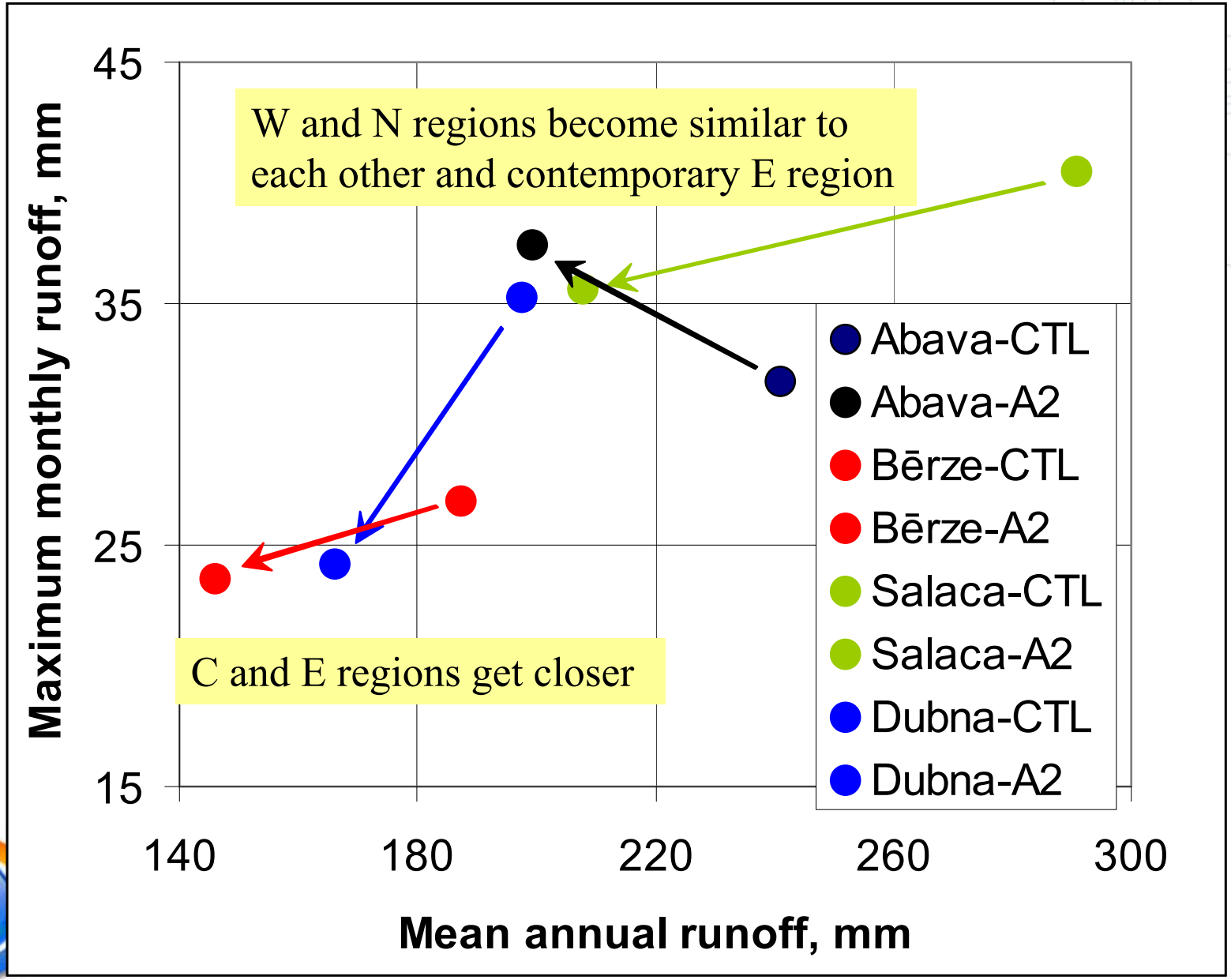








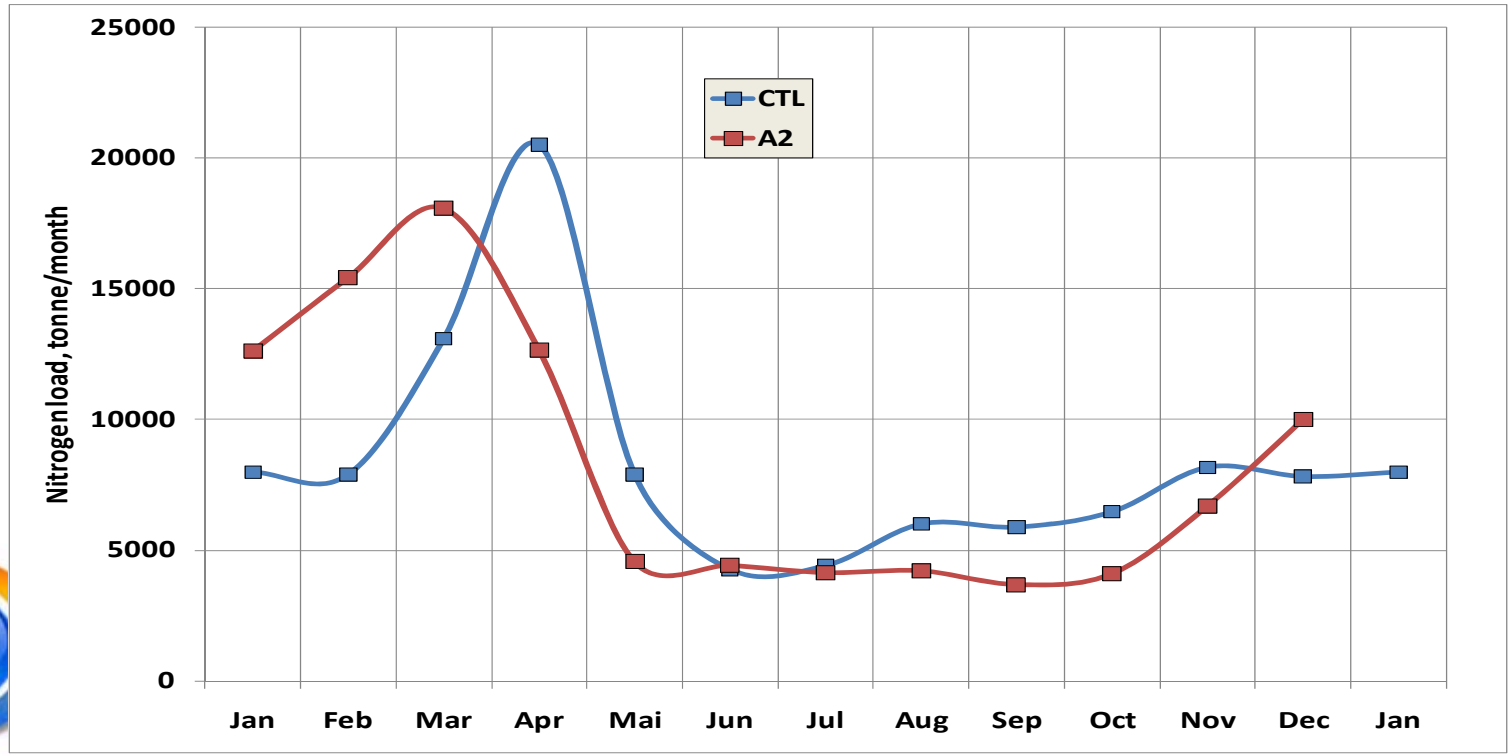
Regional analysis (MIKE BASIN)



Nutrient run-off 1B*

River run-off was calculated for control period and A2 scenario by MIKE BASIN hydrological model with daily time-step. Model was set-up for the drainage basin of the Gulf of Riga, dividing it into 42 subbasins.

Yearly average nutrient loads are assumed to remain the same in the A2 scenario, while their seasonal distribution have been changed. Loads of Norg, N-NH4, N-NO3, Porg, P-PO4 with monthly time-step are used as the input for the nutrient model of the Gulf of Riga.



Sea state modeling 1C

ORIGINAL PLAN – 3D climatic modeling failed

Gulf of Riga: vertical temperature distribution

General Ocean Turbulence Model (GOTM)

Coefficients of second order model: Cheng (2002)

Dynamic equation (k-ε style) for TKE

Dynamic dissipation rate equation

Model forcing

Climate data from PRUDENCE. Control: 1961-1990, Scenario A2: 2070-2100

Institute	Model	Driving data	Acronym	Experiment
SMHI	RCAO high res.	HadAM3H A2	HCCTL_22	control
SMHI	RCAO high res.	HadAM3H A2	HCA2_22	scenario

Extra downscaling of RCM data (bias correction via histogram equalisation):

relative humidity (used variable **td2m**)

air temperature (used variable **t2m**)

Original RCM data:

sea level pressure (used variable **MSLP**)

cloudiness (used variable **clcov**)

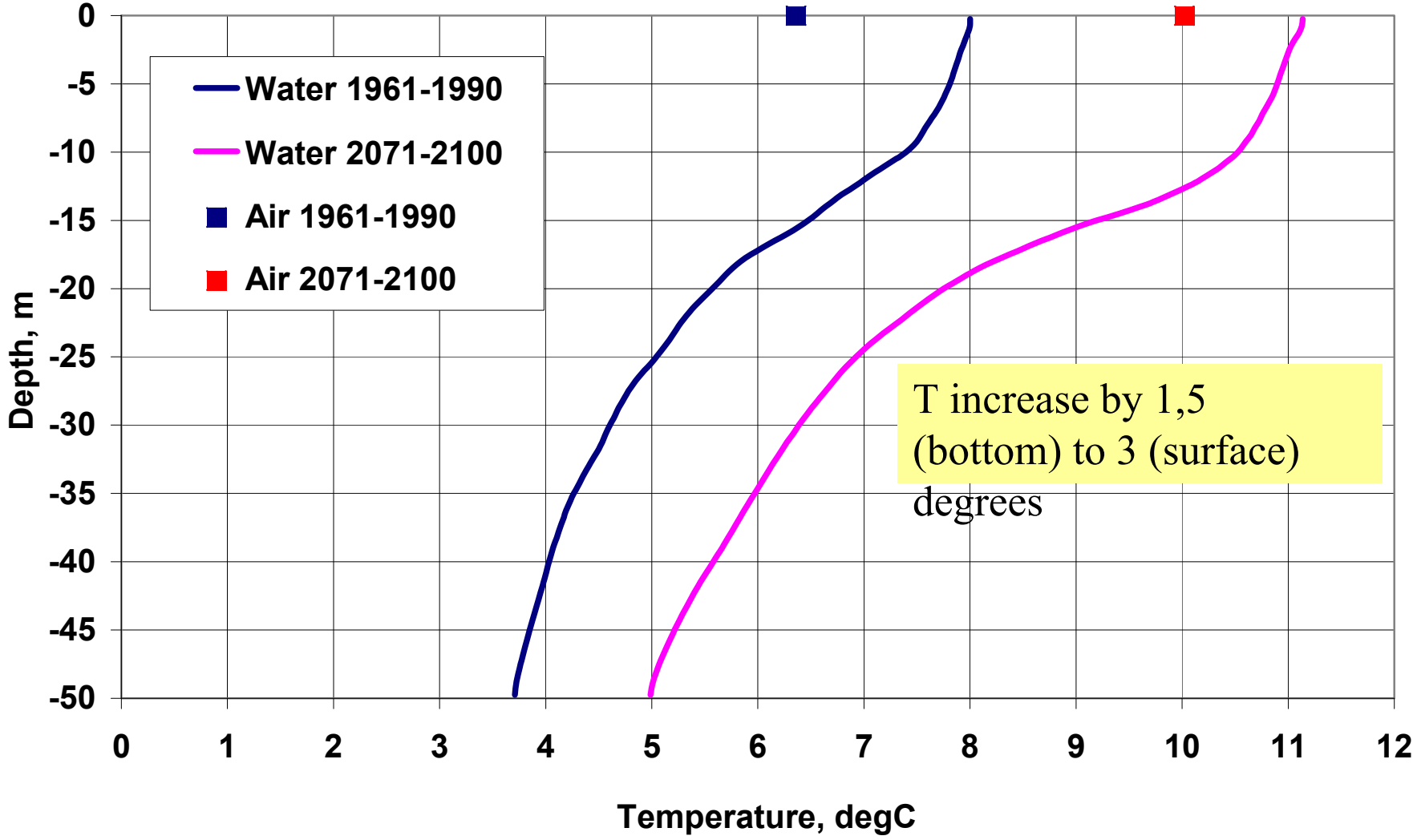
wind speed (used variable **w10m**)

wind direction (used variable **w10dir**)

Calculations made for Gulf of Riga (50 m), 30 year period, daily output data – water temperature

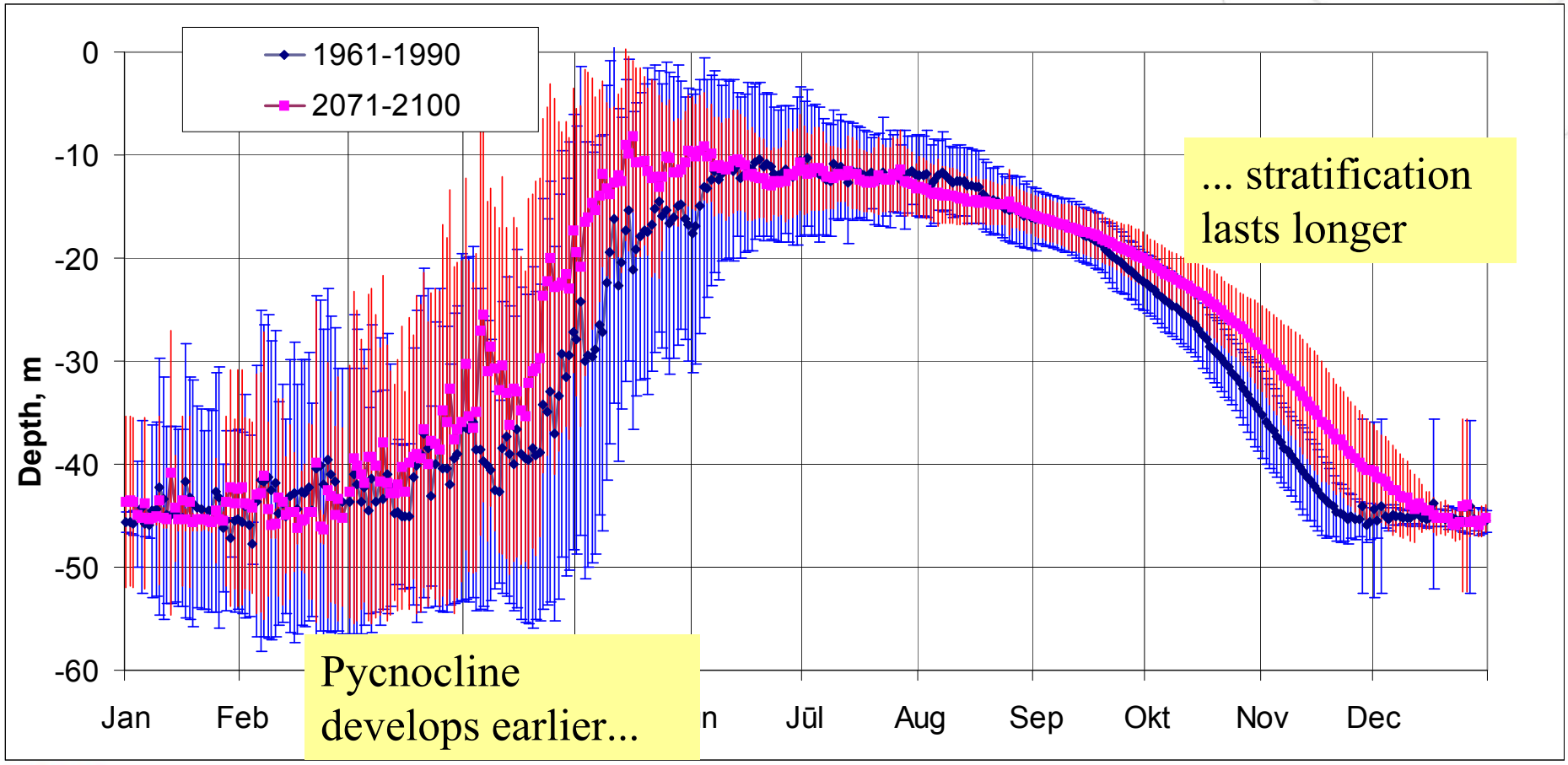
Physical model results – I
(mean temperature distribution over depth)

Surface T increase close to air T increase



T increase by 1,5 (bottom) to 3 (surface) degrees

Physical model results – II
(mean daily pycnocline depth and its variation)



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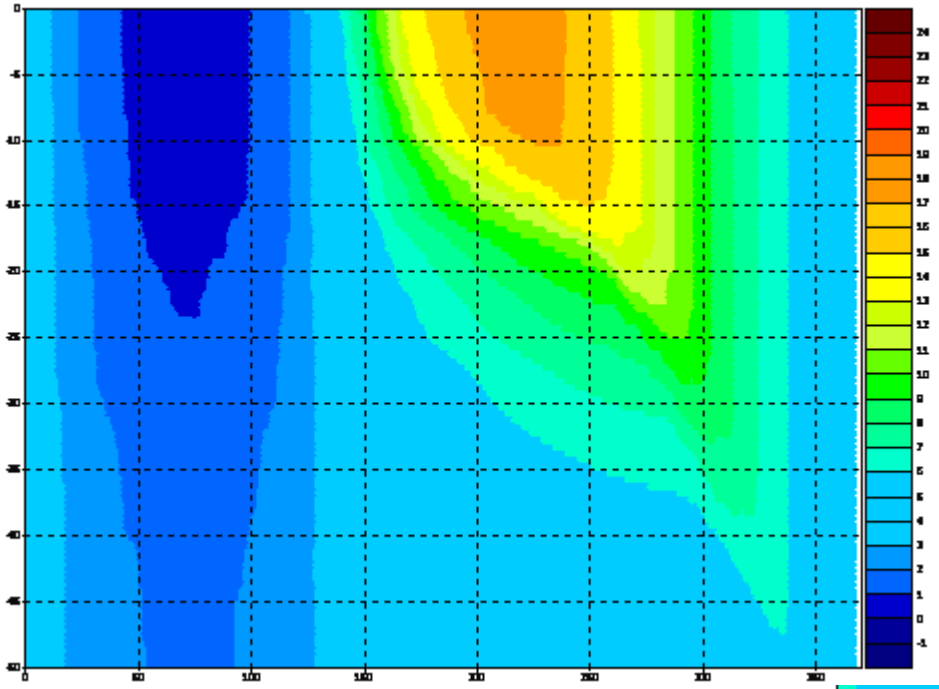
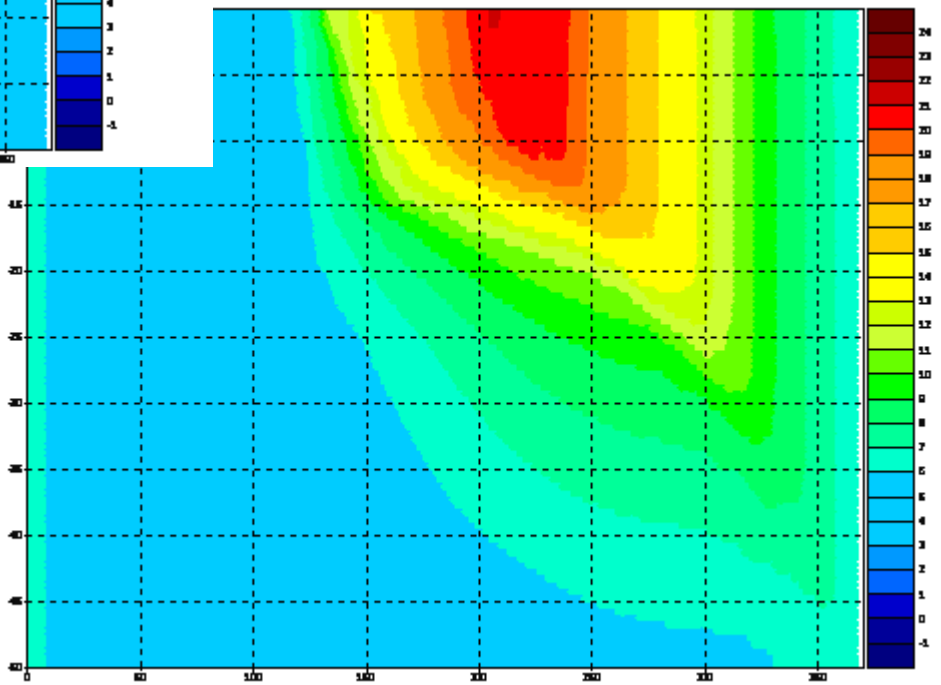
Physical model results – III
(mean time-depth plots of temperature)



Contemporary climate

Climate change scanario A2



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