SEEVCCC

# South East European Virtual Climate Change Center

## functions related to climate change, vulnerability and adaption

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# WMO RA VI-Europe RCC functions:

# RCC Highly recommended functions (example):

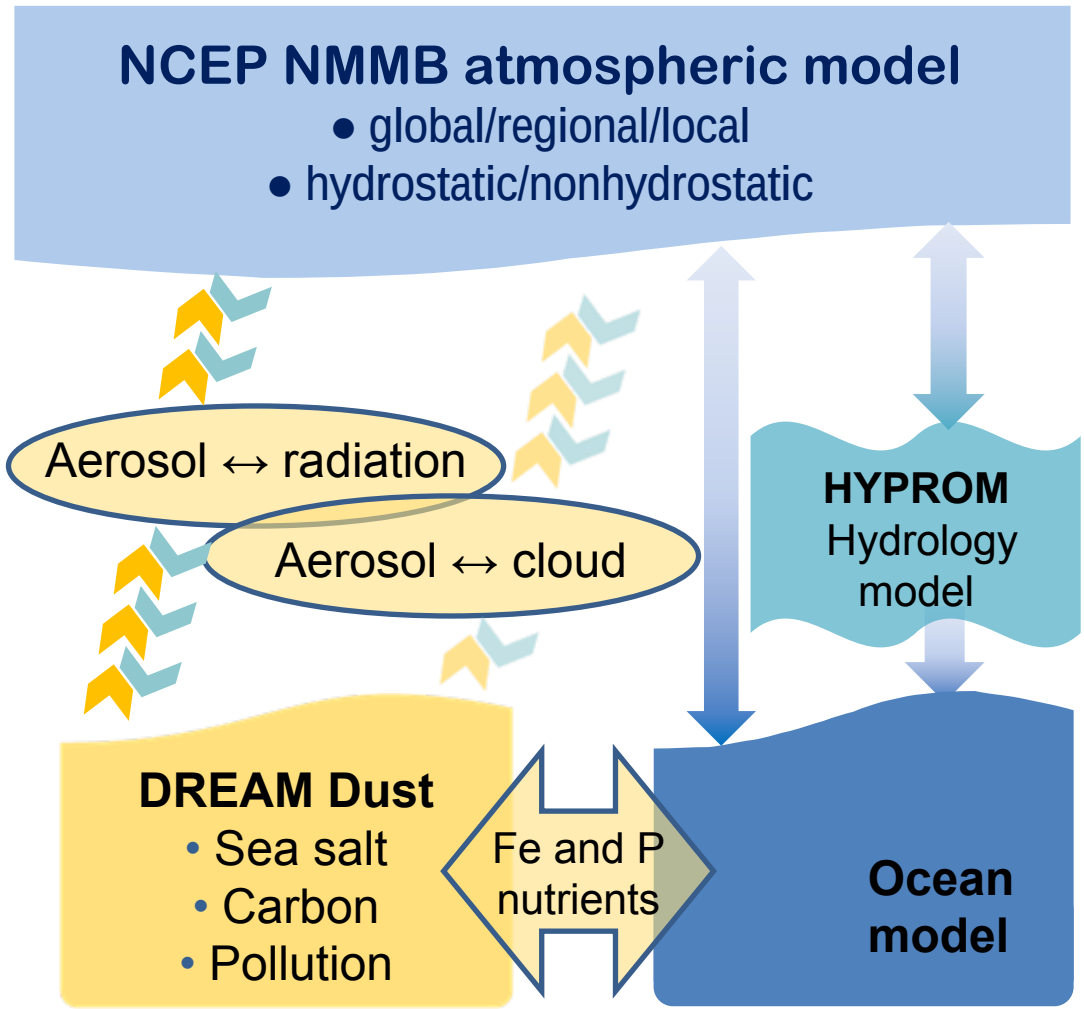
**WMO RA VI RCC-Network**
Implementation Plan
Pilot RA VI RCC Network Nodes

**Climate Data**
Lead: KNMI/Netherlands
(SEEVCCC/RHMS-Serbia)

**Climate Monitoring**
Lead: DWD/Germany
(SEEVCCC/RHMS-Serbia)

**LRF**
Lead: Météo-France & ROSHYDROMET
(SEEVCCC/RHMS-Serbia)

**SEEVCCC Earth Modeling System**



# Operational functions in SEEVCCC

## Climate monitoring

Every month collecting data from the stations (400-500 stations ;
main source for data KNMI-ECA&D, other – climate bulletins) and making:

- mean temperature and precipitation fields,
- temperature anomaly and precipitation percent of normal fields

for last month and last three months periods

necessary: direct corporation with countries from the region in exchanging data!

## Seasonal forecast

Every month regional long range forecast for 7 months
dynamical scaling ECMWF 41 ensemble with RCM-SEEVCCC:

- mean ensemble temperature and precipitation fields,
- probability diagrams for specific places

available in the middle of the month

## Dust forecast

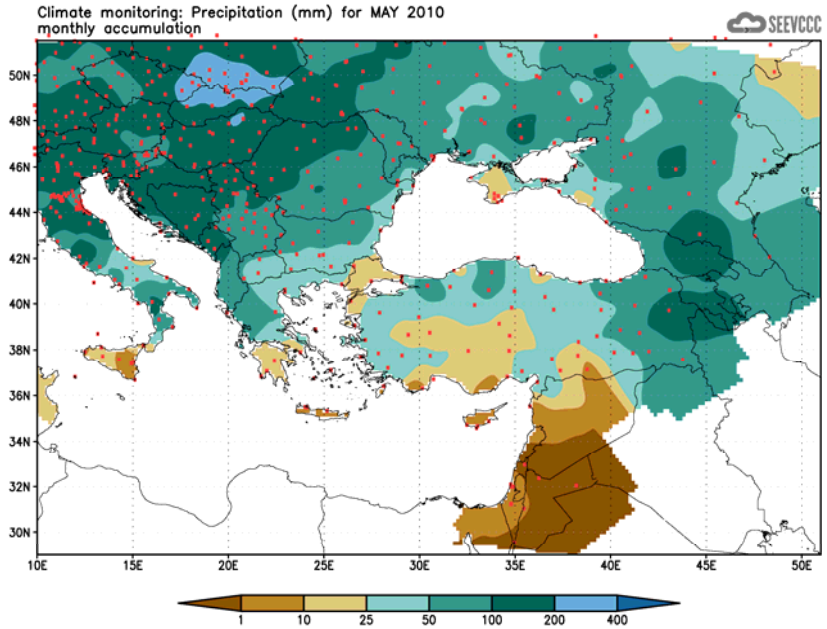
Every day three day forecast:

- Dust Regional Atmospheric Model (DREAM),
- DREAM with assimilation using ECMWF analysis of dust concentration

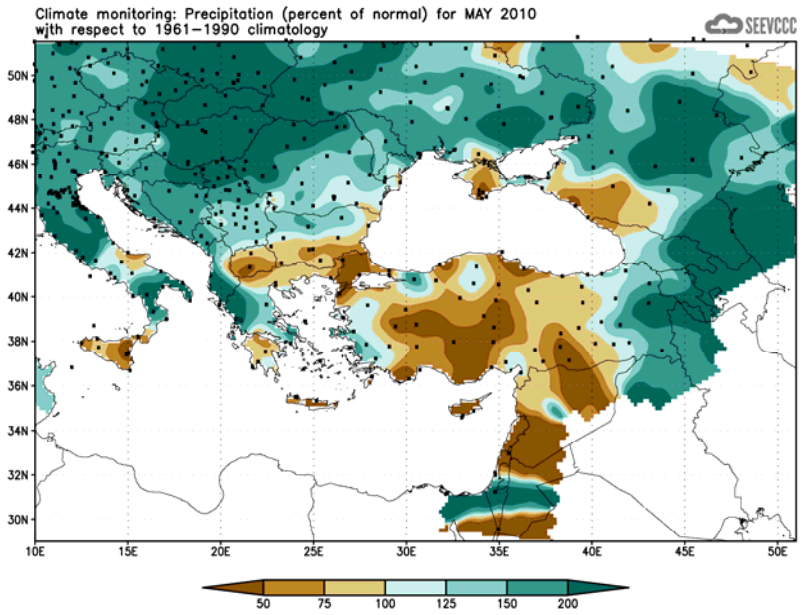
# Climate monitoring: precipitation data

**May 2010**

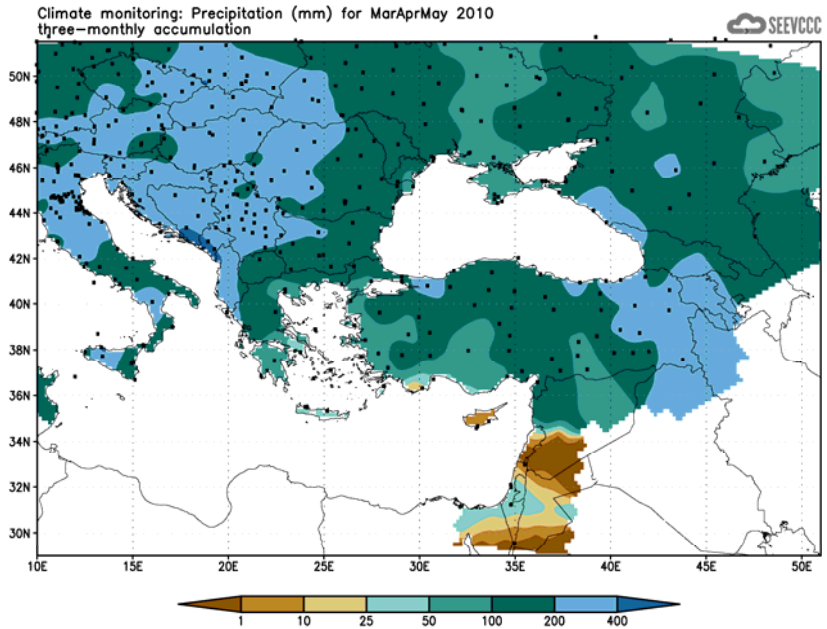
monthly accumulation



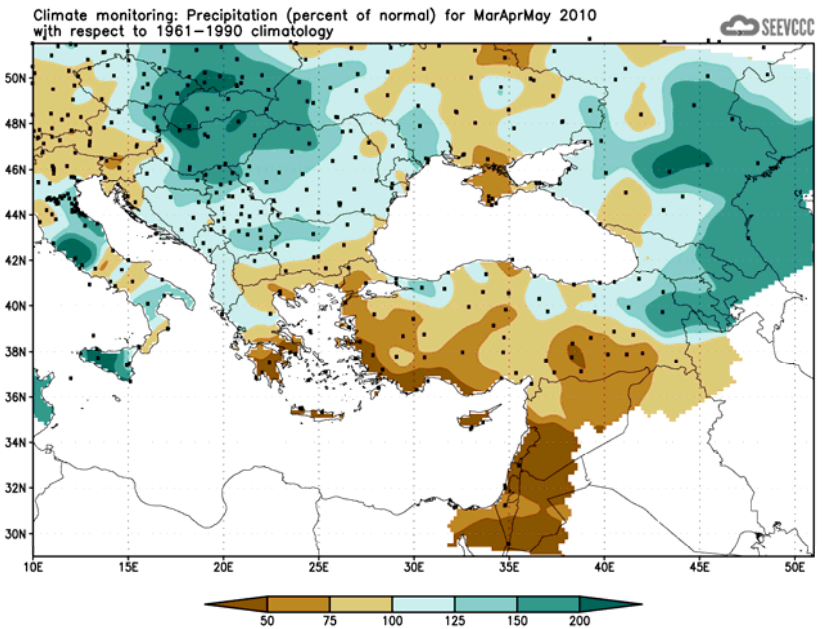

percent of normal for one month




three-months accumulation



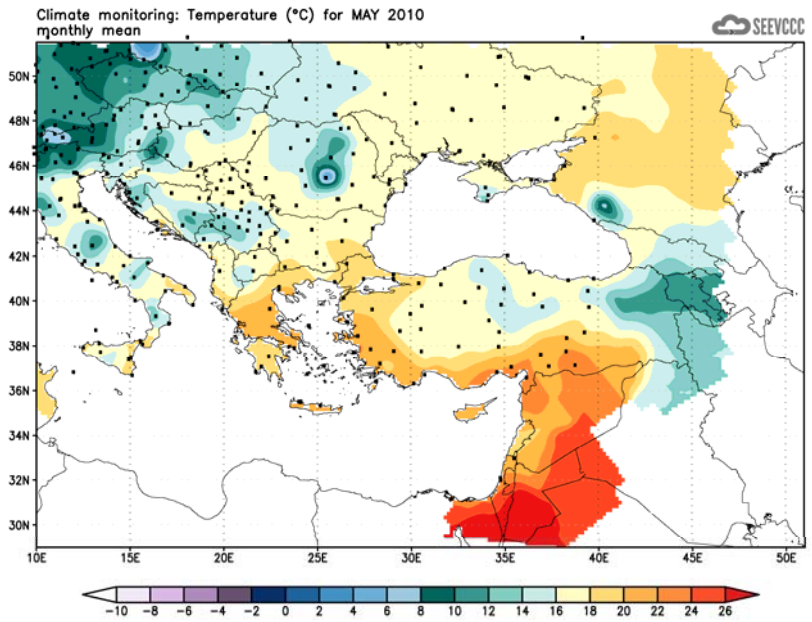

percent of normal for three months



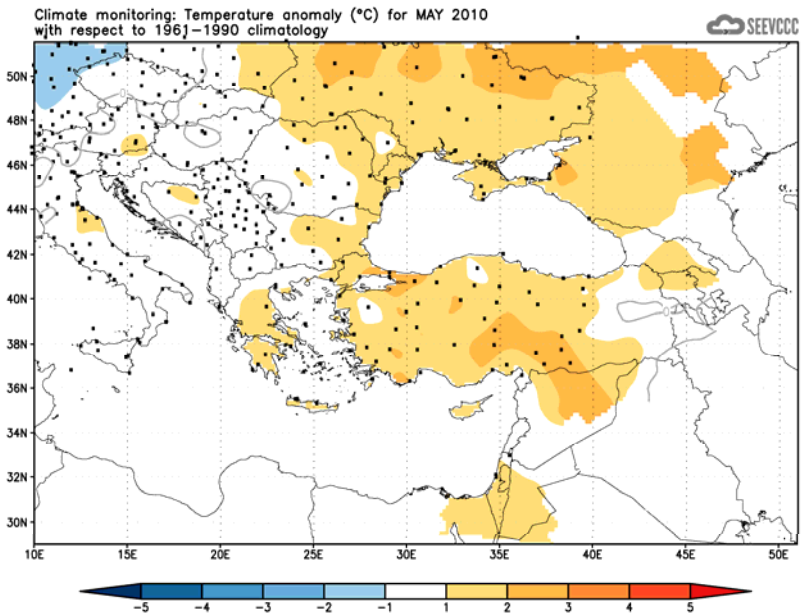
# Climate monitoring: temperature data

**May 2010**

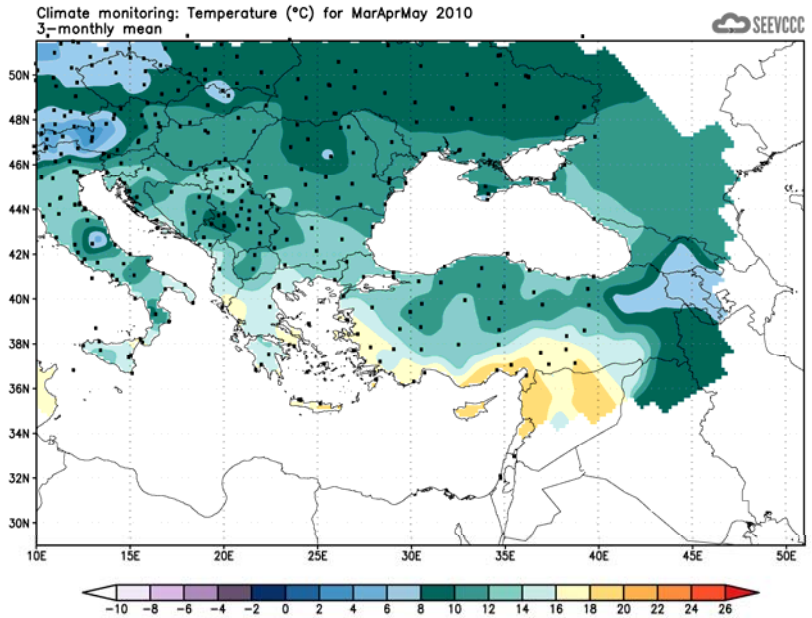
mean monthly temperature



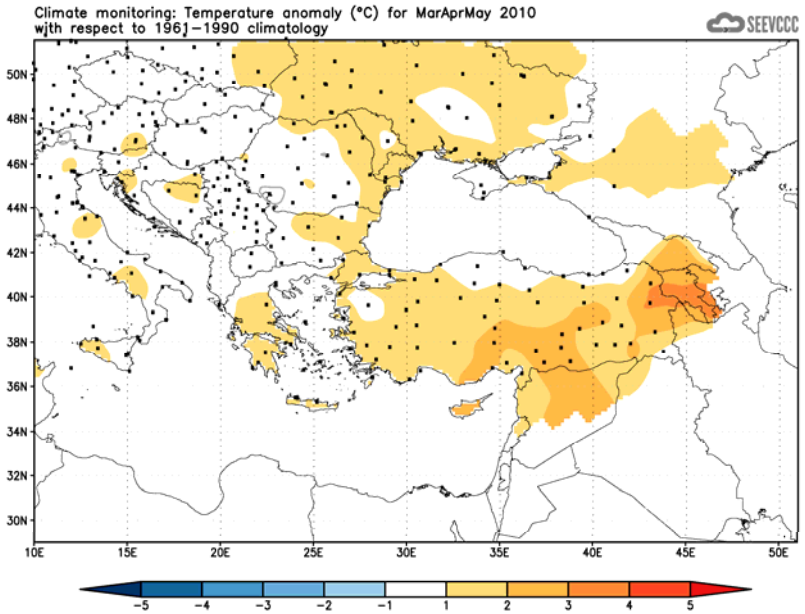

temperature anomaly for one month




mean temp. for three months




temperature anomaly for three months



# About seasonal ensemble forecast

- **ECMWF recommendations**

- Seasonal forecast strongly depends on the initial state of the climate system whose representation in numerical models has uncertainties.
  Atmospheric and oceanic numerical models are affected by errors, observations are sparse which limits a seasonal forecast skill.
  In order to overcome this problem, large number of separate simulations have to be made.
  This is called ENSEMBLE forecast.

- **Seasonal forecast is NOT a weather forecast!**

Provides statistical summary of the atmosphere and ocean state in forecoming season. → **probabilistic forecast**

- **RCM-SEEVCCC LRF** (**L**ong **R**ange **F**orecast **–** seasonal forecast)
  regional dynamical downscaling

- coupled atmosphere-ocean model

**model start**: 16th of each month
**forecast duration**: 7 months (~215 days)
**model resolution**: ~35km atmosphere ; ~20km ocean
**41 ensemble members!**
**initial and boundary conditions**: ECMWF, res.:125km

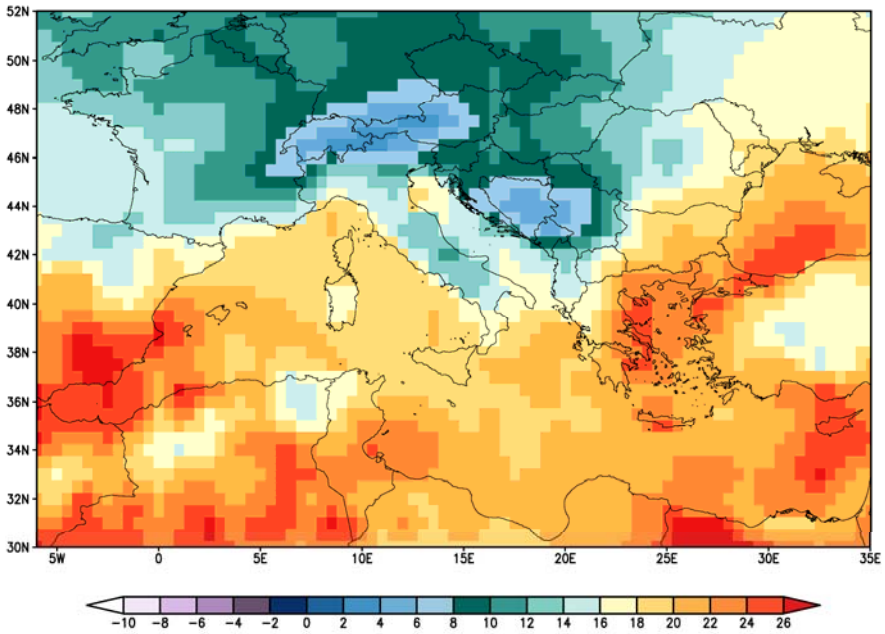
- computer availability & efficiency

**hardware**: HPXC cluster 3000 BL
16 nodes – 128 cores ; 3 GHz cpu
**seas.forecast**: 1 ens. member – 1 cpu
**wall time**: 23h for 7 months forecast

# Benefit Of Using Regional Climate Models

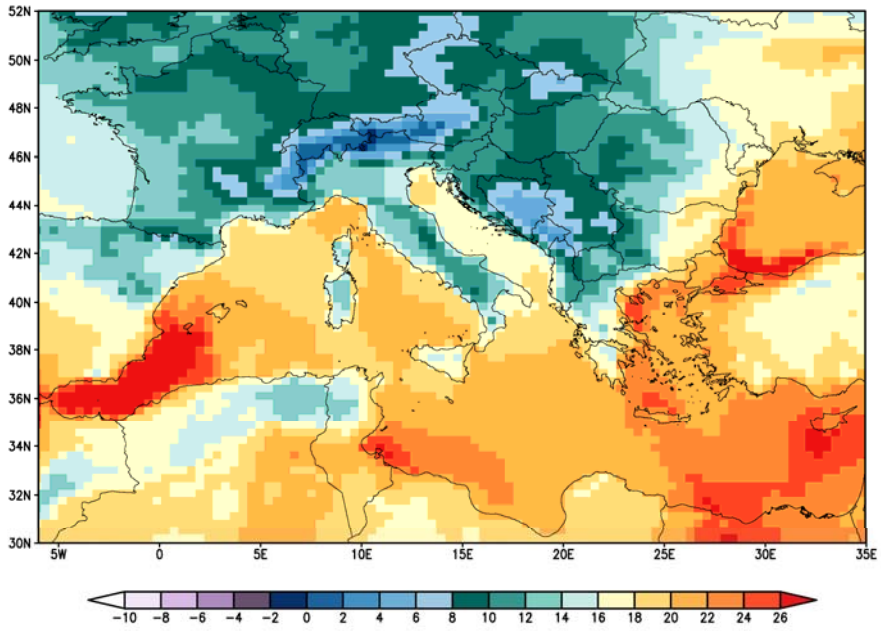
## DYNAMICAL DOWNSCALING FOR SEASONAL FORECAST

2m temperature ECMWF
interpolated on higher res.: 0.5deg




resolution:125km

2m temperature RCM-SEEVCCC




resolution: 35km atmosphere
20km ocean

**More detailed temperature field using regional model!**

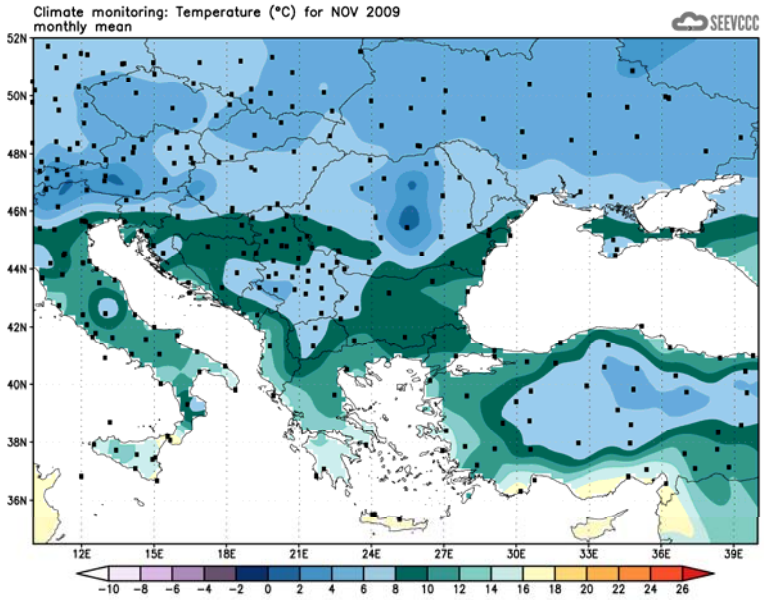
# Example from first LRF run: issued in June 2009

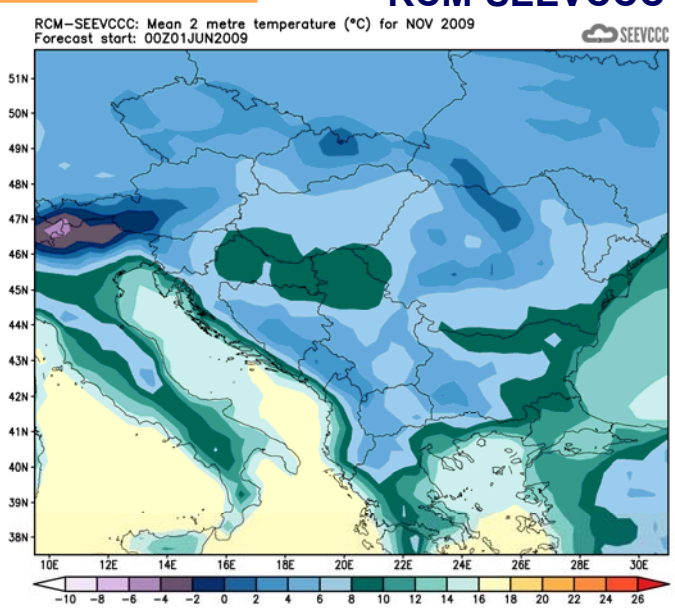
**results for: November 2009**

**OBSERVATIONS**

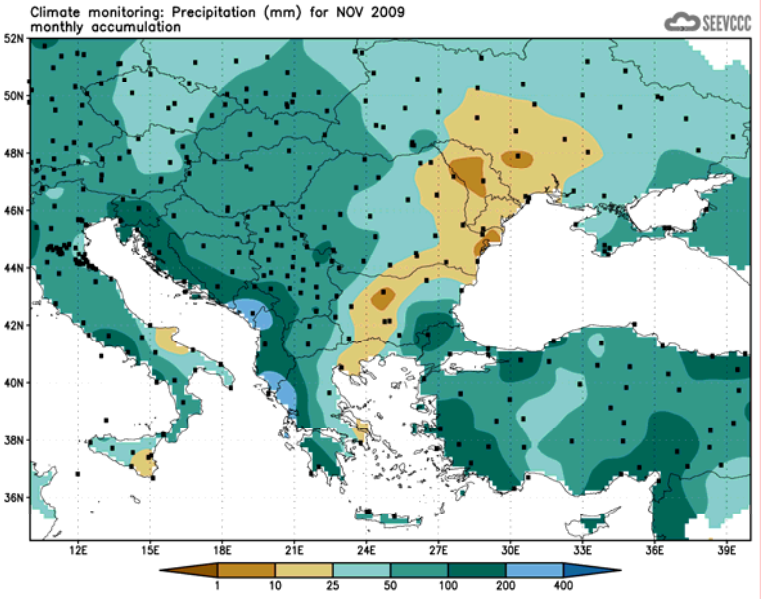
**RCM-SEEVCCC**

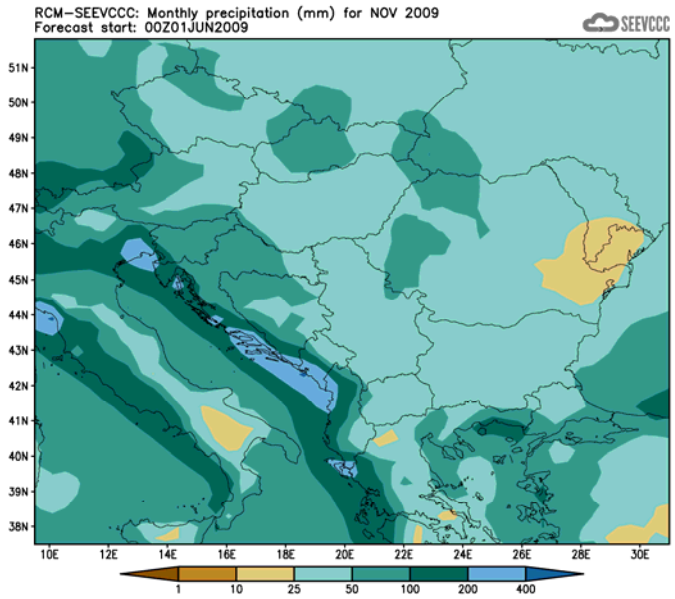
**monthly mean 2m temperature**



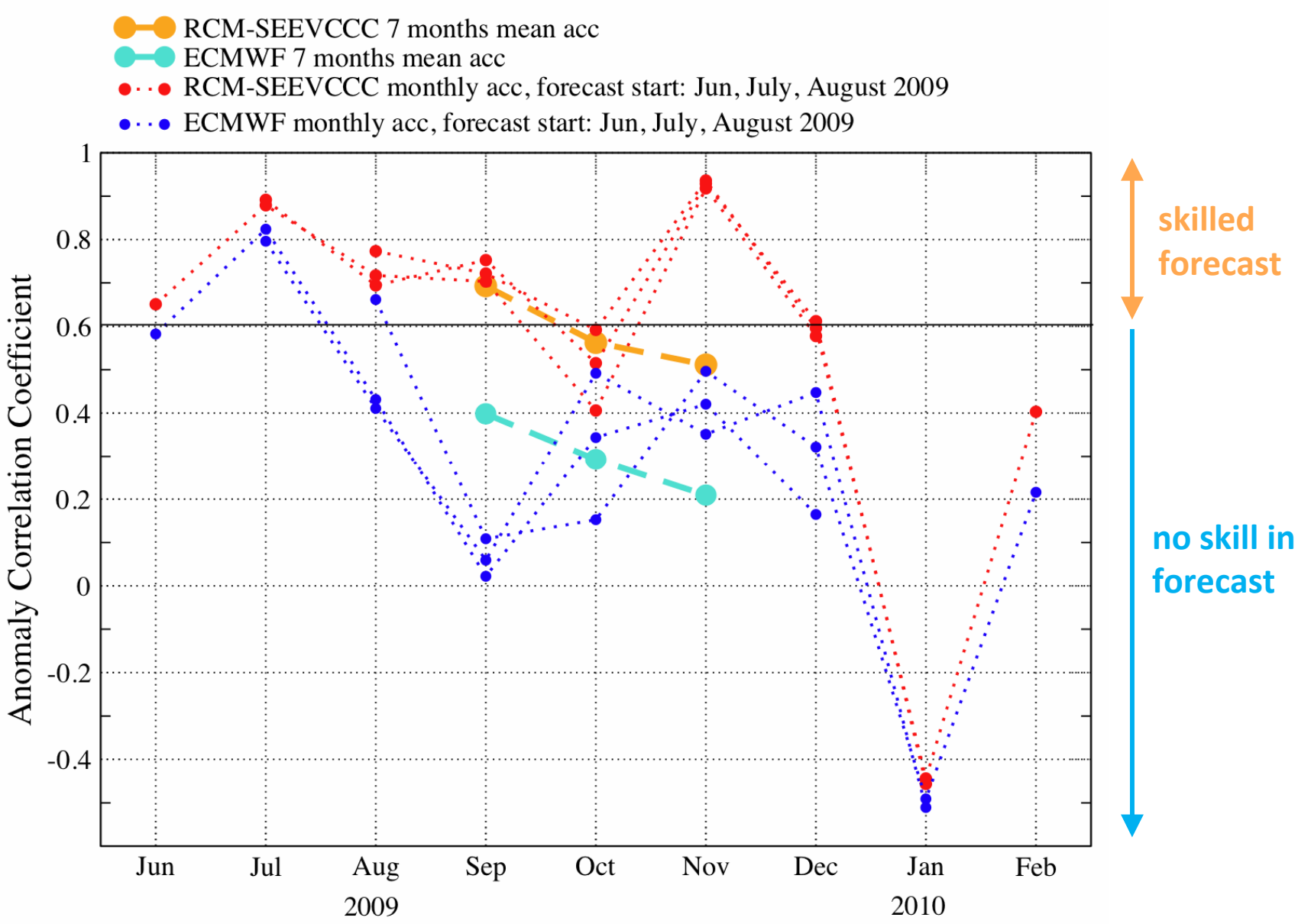




**total monthly precipitation**



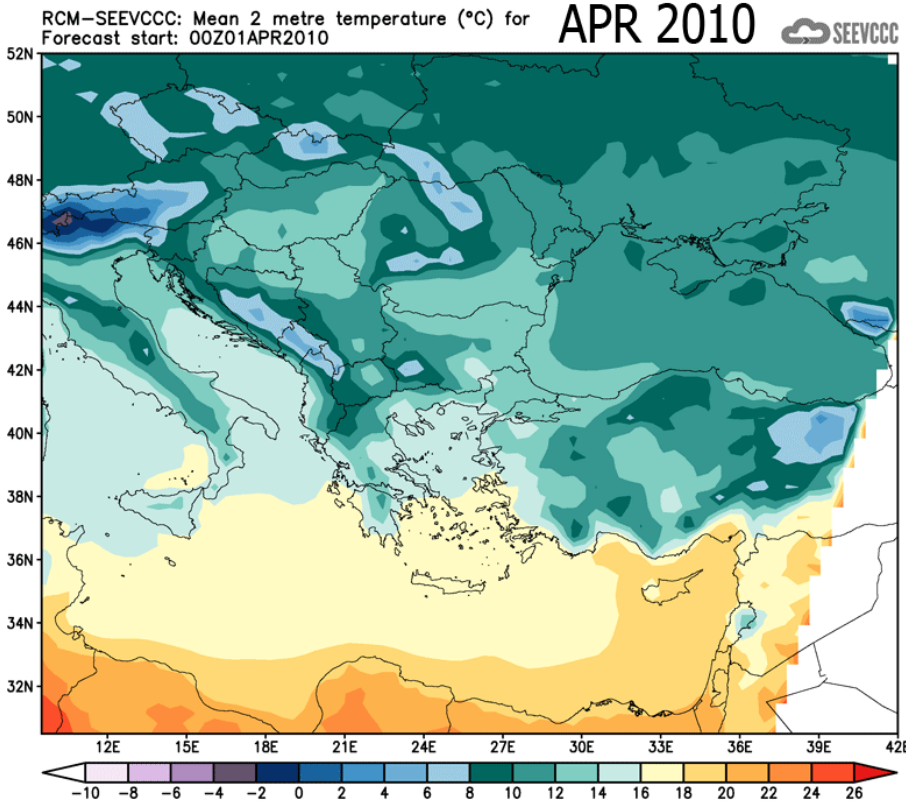



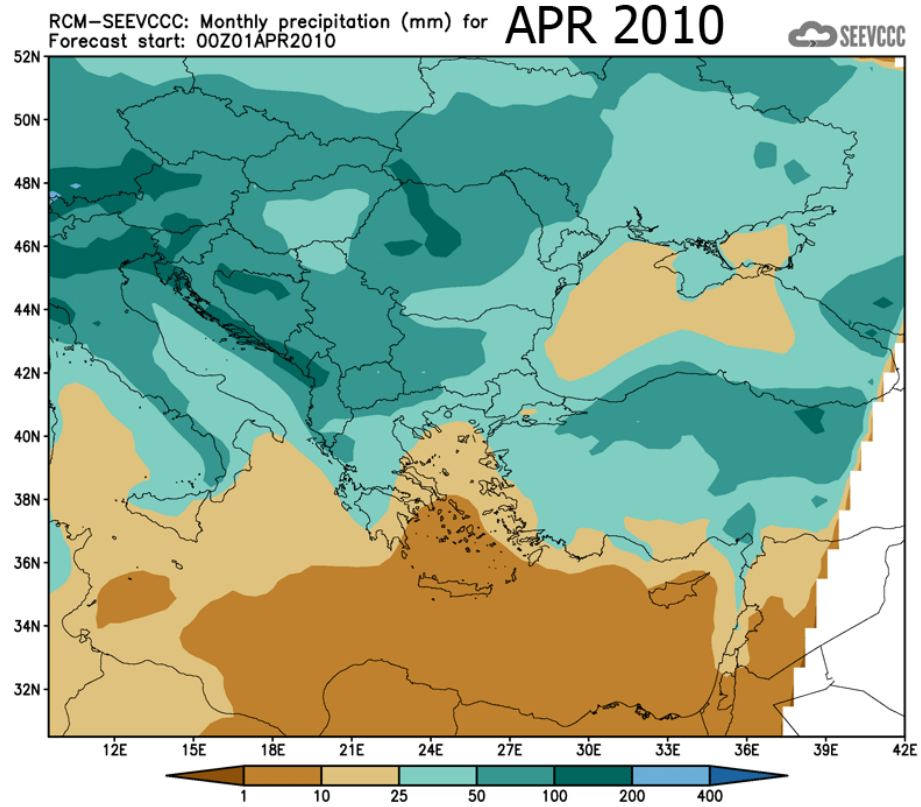
# RCM-SEEVCCC LRF: ACC SCORE



# RCM-SEEVCCC LRF: precipitation & temperature

- **MAPS:** mean ensemble values



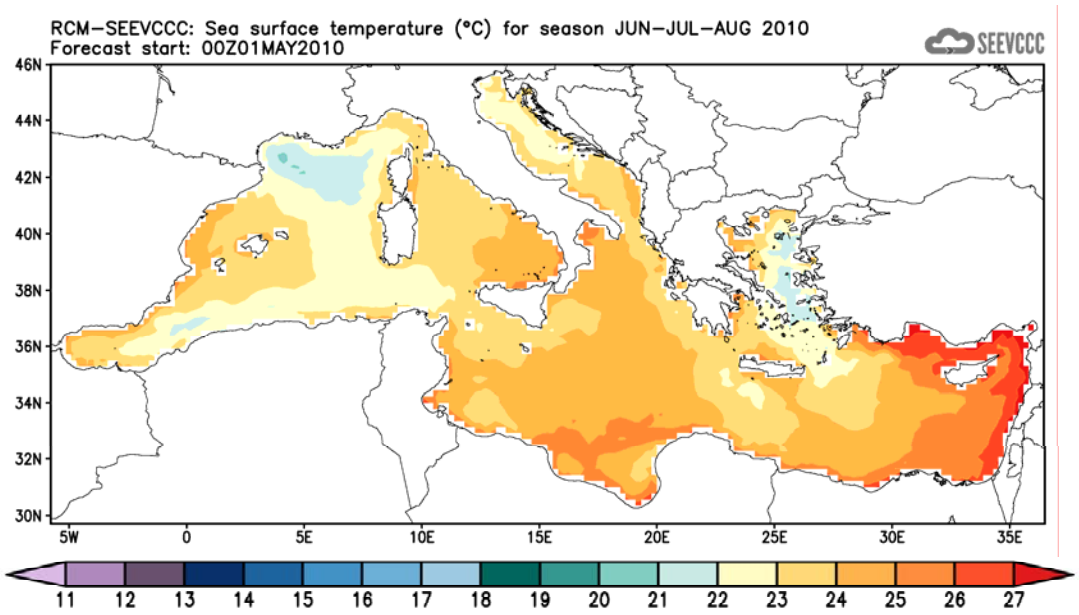




- available maps:
  for each month and for 3 months
  - mean 2m temperature, acc. precipitation,
    temperature anomaly, precipitation percent of normal (with respect to 1961-1990)
    (no model climatology/hindcast available → data for normals are from observations)

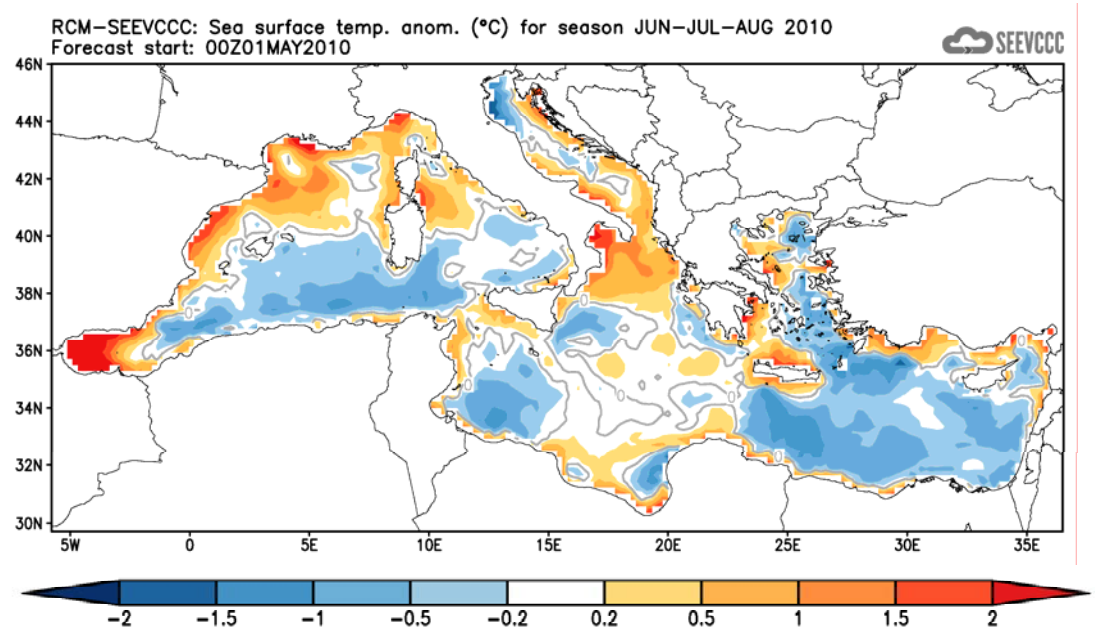
# RCM-SEEVCCC LRF: sea surface temperature

- SST results example:

SST mean value for JJA 2010




SST anomaly for JJA 2010



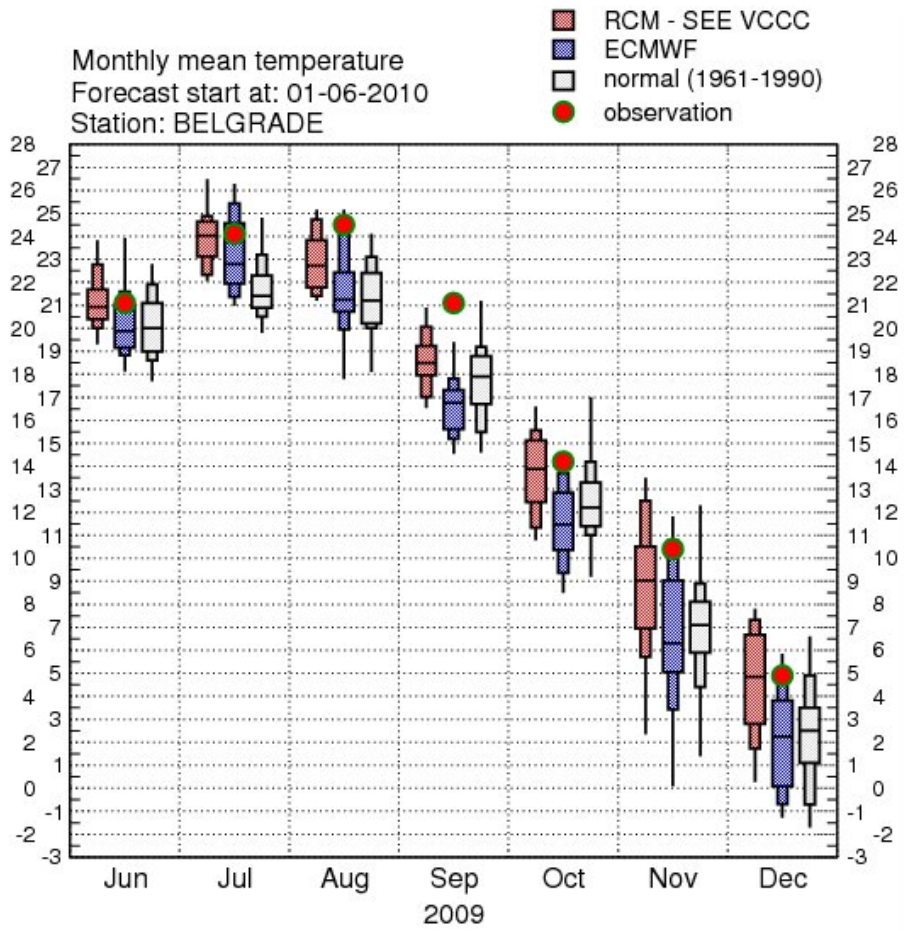
# RCM-SEEVCCC LRF: diagrams

- **DIAGRAMS**: example of LRF issued in June 2009

Future plan: to make diagrams, like one presented for Belgrade, for as many places as possible

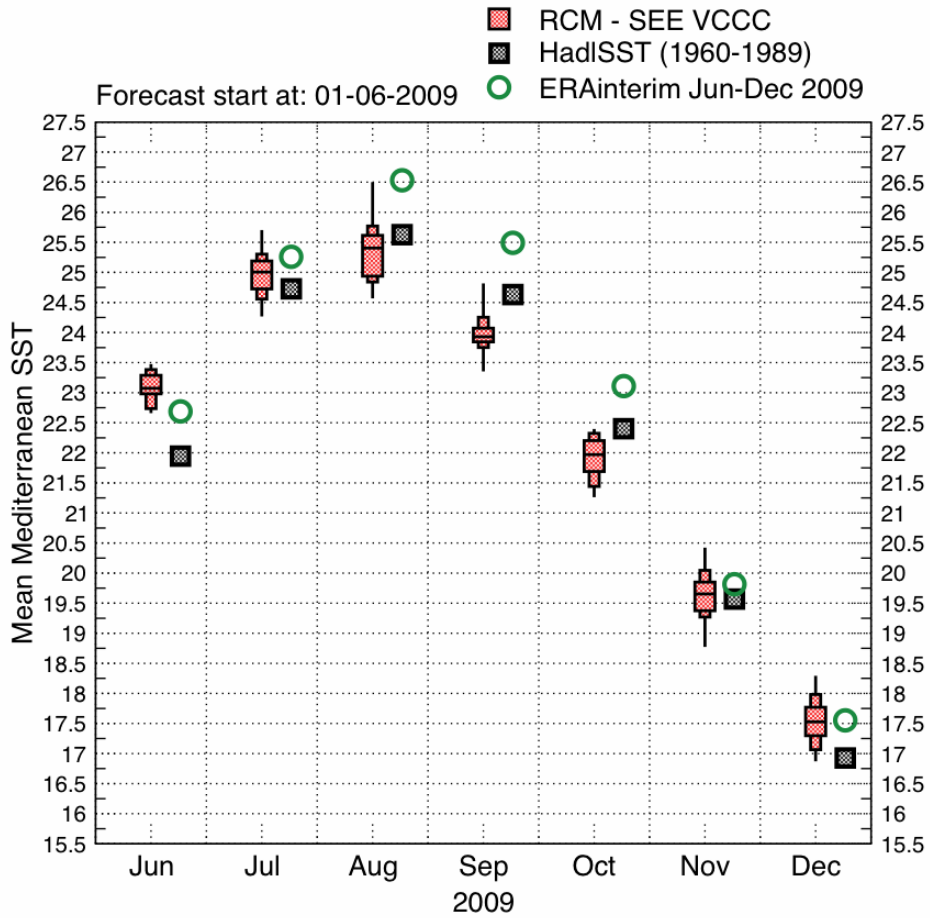
**Monthly mean 2m temperature, Belgrade**

**RCM-SEEVCCC, ECMWF, climatology, observations**



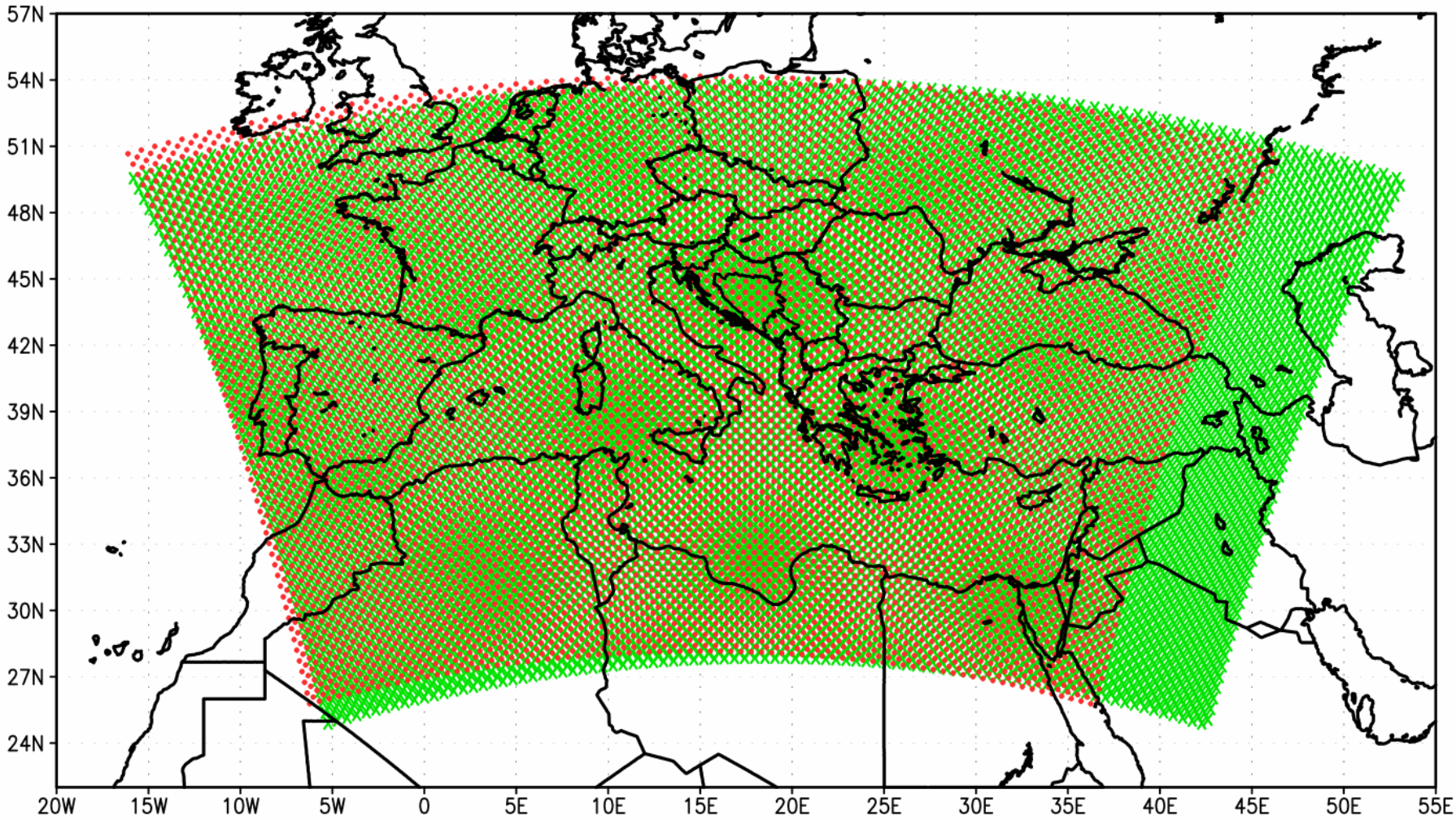

**Monthly mean Mediterranean SST**

**RCM-SEEVCCC, Hadley obs , ERAinterim reanalysis**



# RCM-SEEVCCC LRF: domain

- from June 2010 domain is expanded to the east (green)



**RCM-SEEVCCC seasonal forecast was used for Southern Europe Climate Outlook Forum – III**
**(SEECOF – III)**

**report can be found on the web-site:**

**http://www.seevccc.rs/SEECOF-III/**

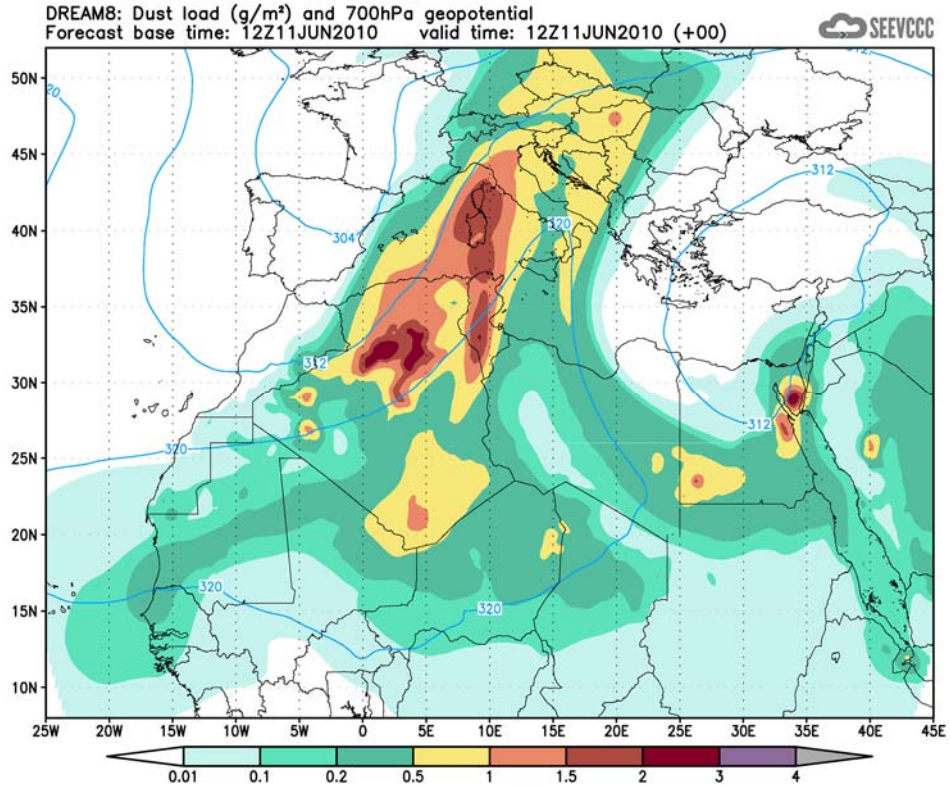
# Dust forecast: DREAM

**DREAM8**: **D**ust **R**egional **A**tmospheric **M**odel with 8 categories for particle sizes

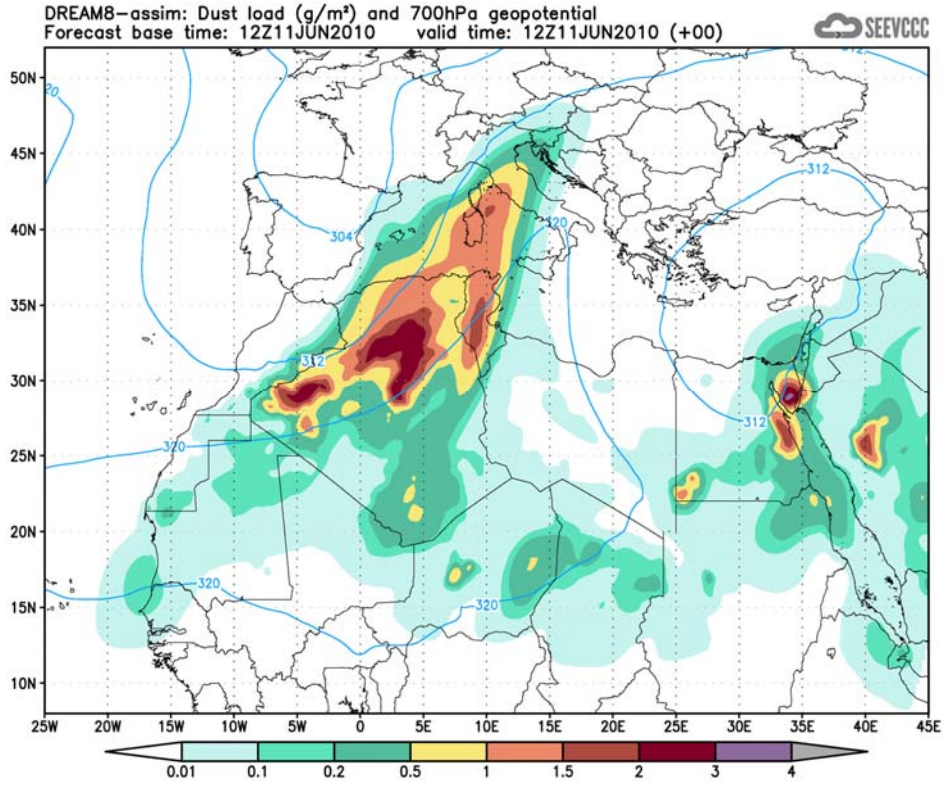
- **model runs:** 12UTC start ; +72h forecast
- **model resolution:** 1/3 degrees (~35km)
- **models:** DREAM8 and DREAM8-assim (with assimilation using ECMWF dust aerosol analysis)

presented: model run from June 11th 2010 12UTC

## DREAM8




## DREAM8 – assim



# Climate change

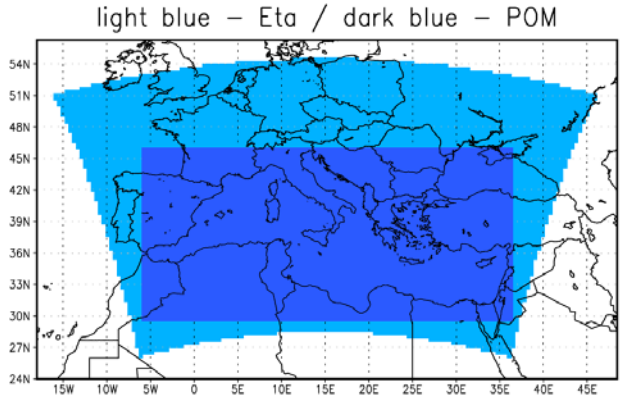
## Climate projections

**Regional Climate Model (RCM) – SEEVCCC:**

- **coupled atmosphere – ocean model**
- **Euro-Mediterranean region**
- **resolution:** ~35km atmosphere ; ~20km ocean
- **simulations:**

| Experiment | Time slice |
|---|---|
| 20c3m (**present climate**) | **1961-1990** |
| **A1B SRES** | **2001-2030, 2071-2100** |
| **A2 SRES** | **2071-2100** |

**model domain**




## Climate change studies

- developing methodology for climate projection verification and correction
- studies about impact of climate change on agriculture, water resources,…

## Future plans

- climate projections with different RCM → ensemble of models
- gathering history data from more stations possible inside the region

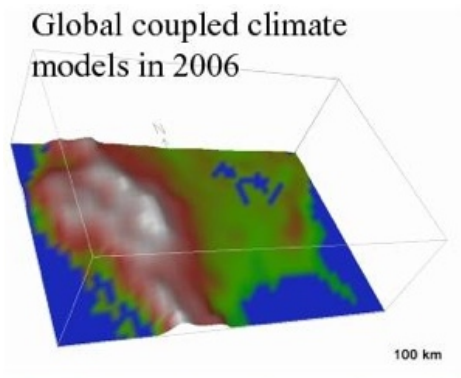
# Benefit Of Using Regional Climate Models

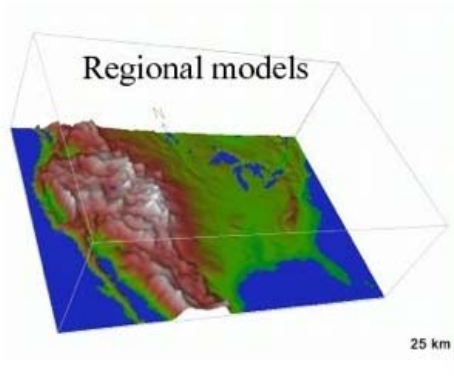
## DYNAMICAL DOWNSCALING FOR CLIMATE PROJECTIONS

Regional dynamical downscaling provide us **information with more details** about present climate and future climate changes.

**Important for different impact studies** specially on regional level:

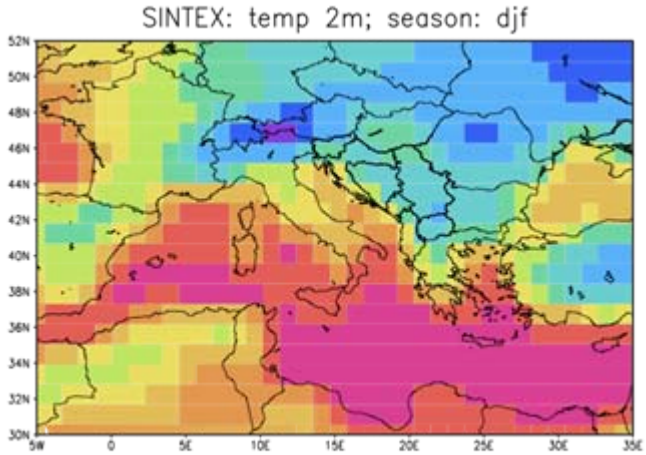
- energy
- hydrology
- agriculture
- environmental protection
- industry ...



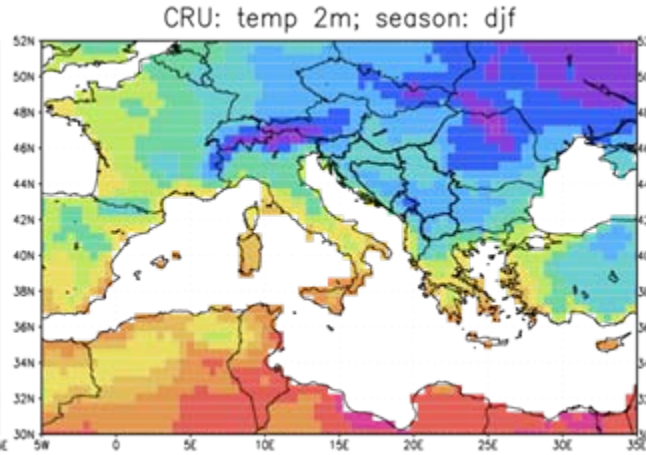




## 1961-1990: MEAN SURFACE TEMPERATURE FOR WINTER SEASON

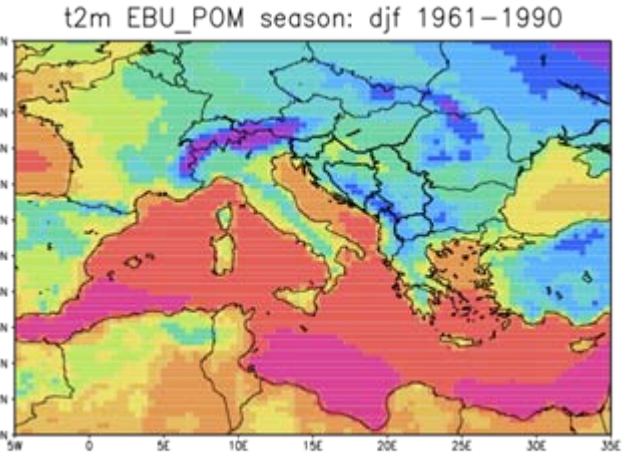
**GLOBAL MODEL**




**OBSERVATIONS**




**REGIONAL MODEL**

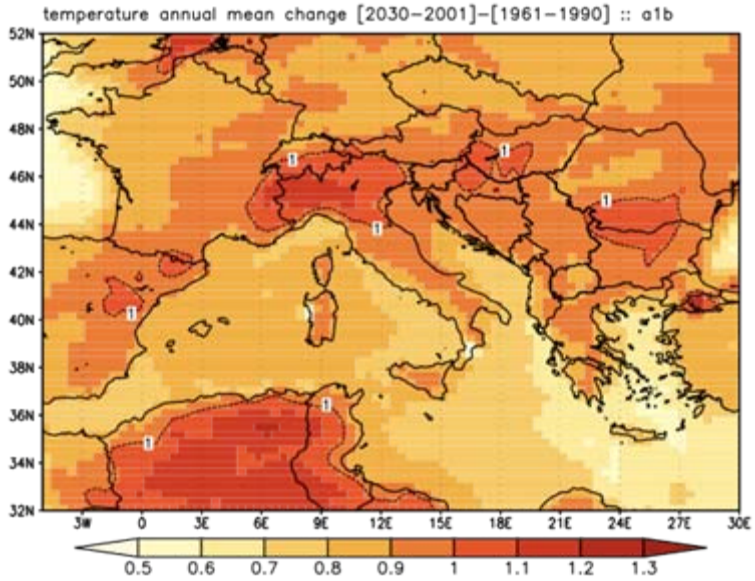


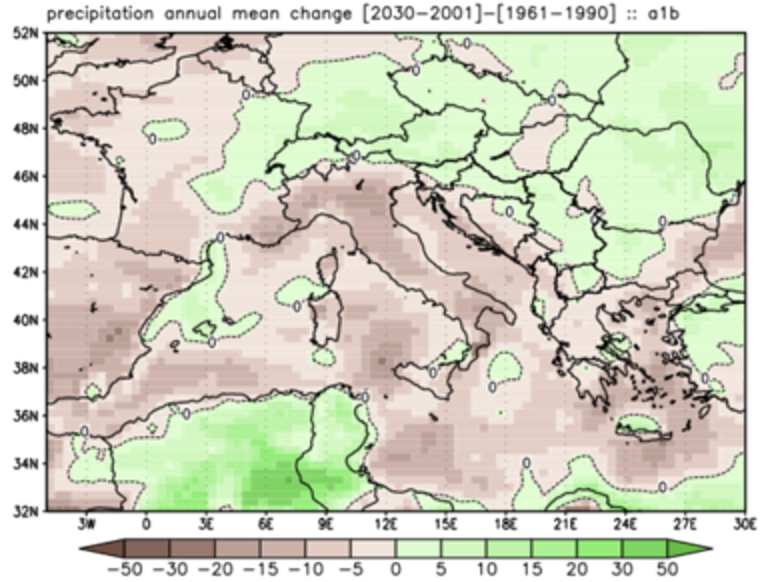

# Climate projections

## Annual temperature change

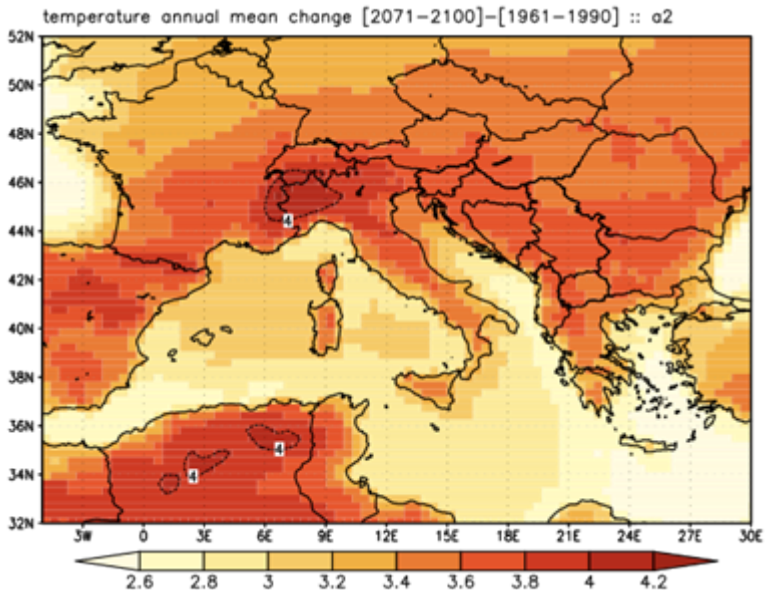
## Annual precipitation change

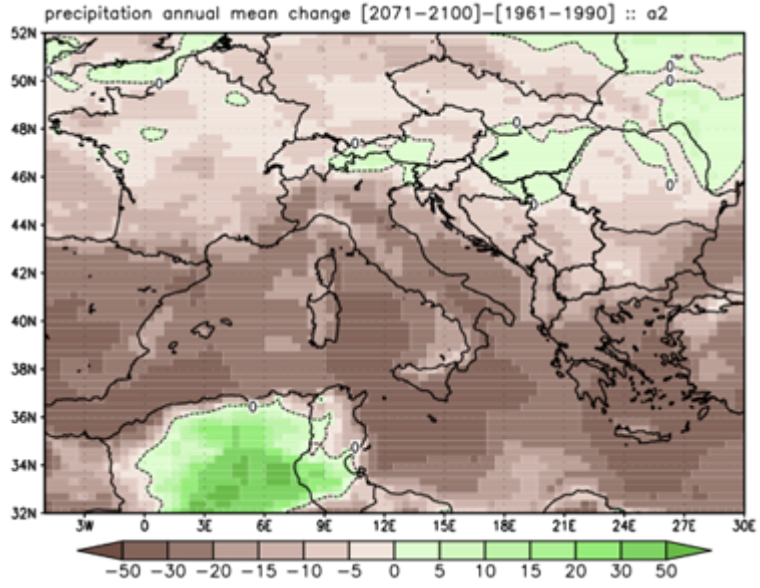
A1B SCENARIO (MODERATE)
[2001-2030] - [1961-1990]



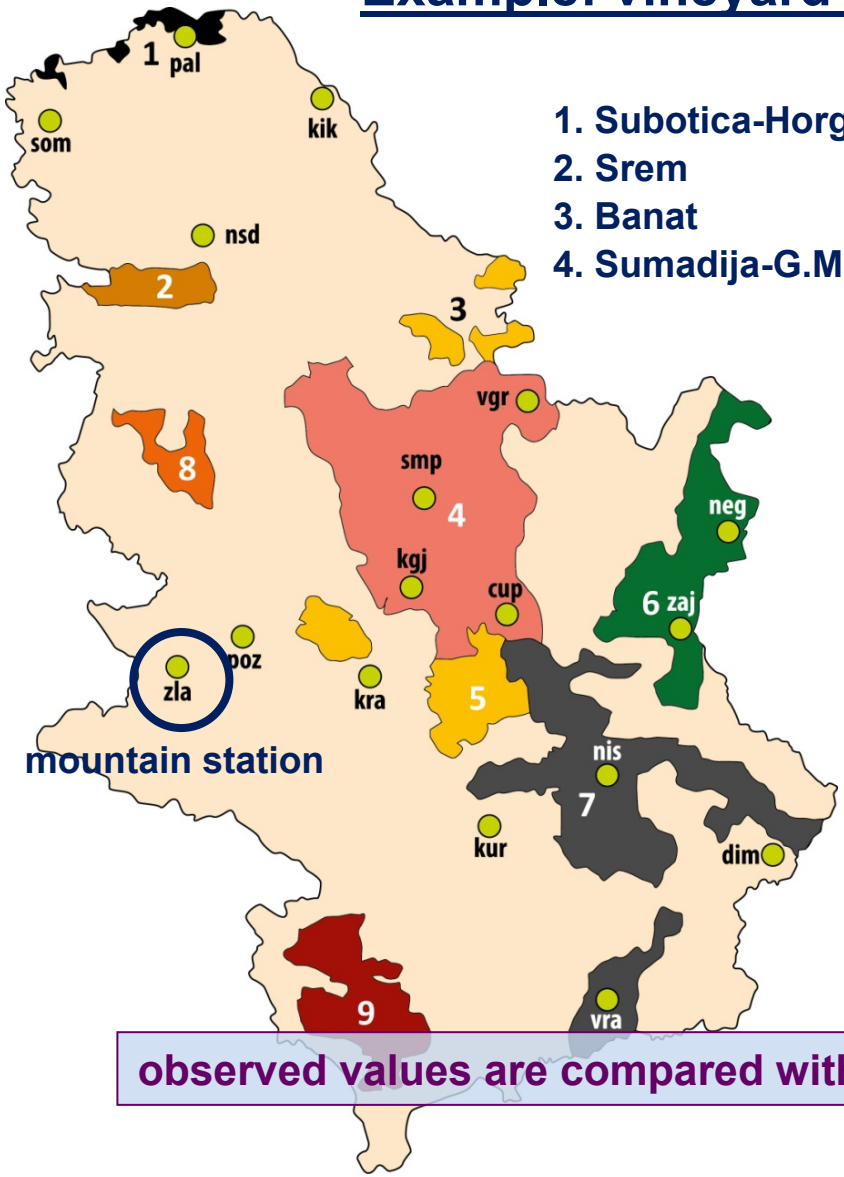

A2 SCENARIO (STRONG)
[2071-2100] - [1961-1990]



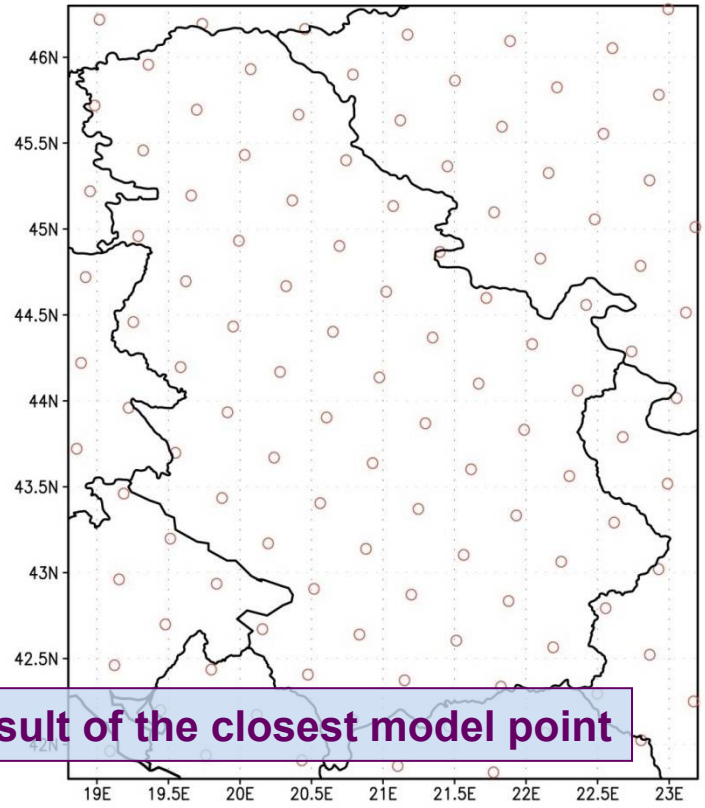



# Climate change studies

## Example: vineyard regions in Serbia




1. Subotica-Horgos
2. Srem
3. Banat
4. Sumadija-G.Morava
5. W.Morava
6. Timok
7. Nisava-S.Morava
8. Pocerac
9. Kosovo


observed values are compared with model result of the closest model point

Models have BIAS!
Be careful using climate projection results !

- **Simple BIAS correction**

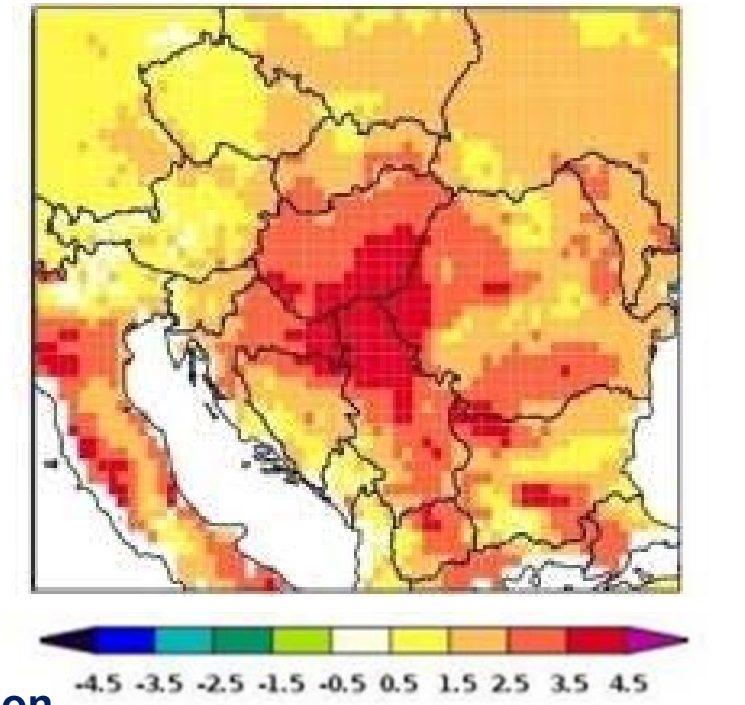
***future value of the variable*** **=**
**= observation + (m. future value – m. present value)**

- **Statistical BIAS correction**

***assumption*****: daily data for temperature during one month follow Normal distribution ; daily data for precipitation during growing season follow Gamma distribution**

***idea*****: model results and observed values have the same probability density function**

**Image from CLAVIER-WP1: Climate**




**2mTemp. diff. between simulation and observations (summer 1981-2000)**

**Make correction functions for each station and apply on model results!**

- **correction was performed for: daily precipitation**
  **daily mean, max and min temperature**

# Results obtained for 17 selected stations using statistical BIAS correction

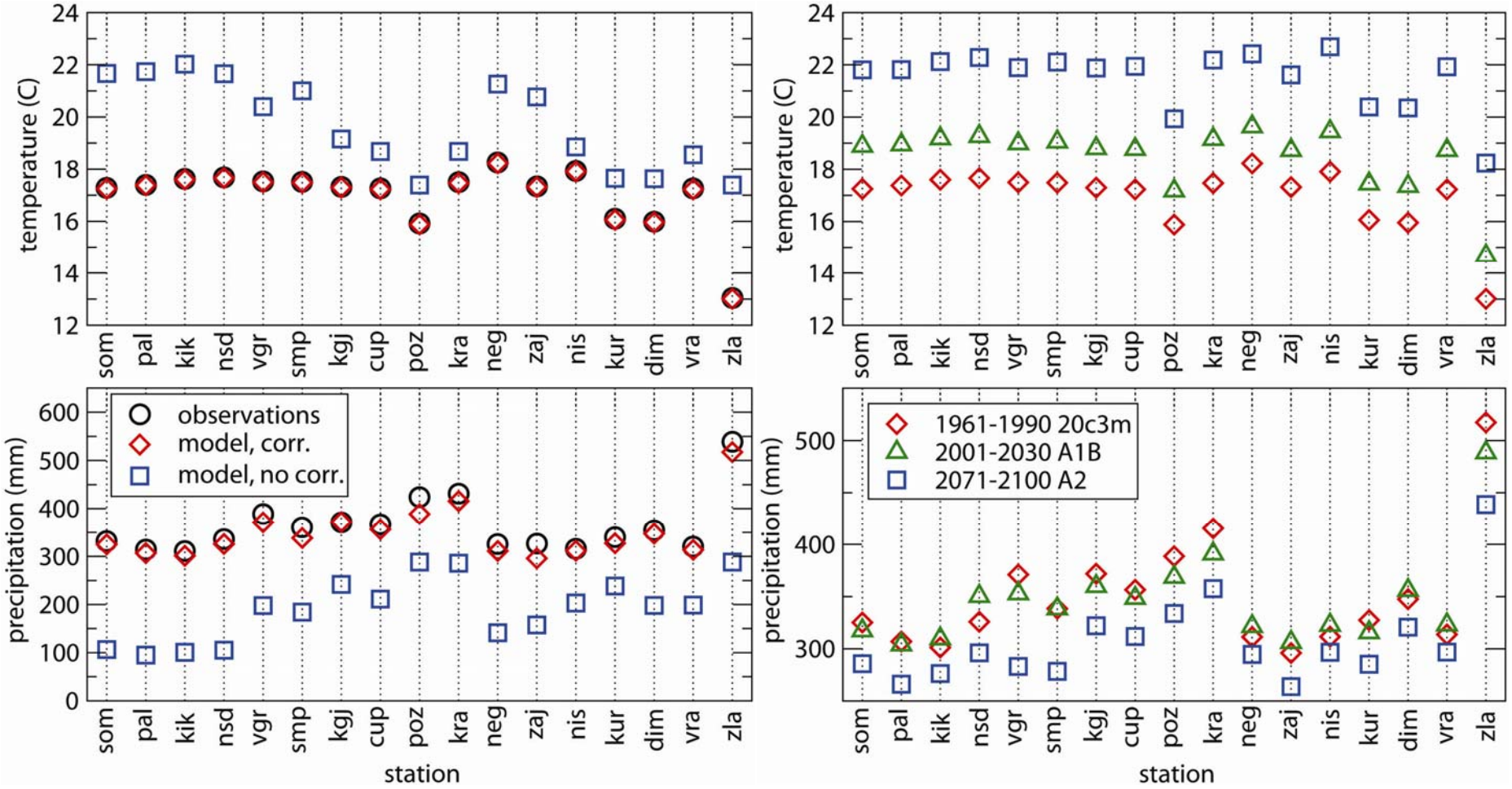
## For vegetation period April-September

**present climate:**

**observations, model results & corrected model results**

**climate projections:**

**corrected model results**



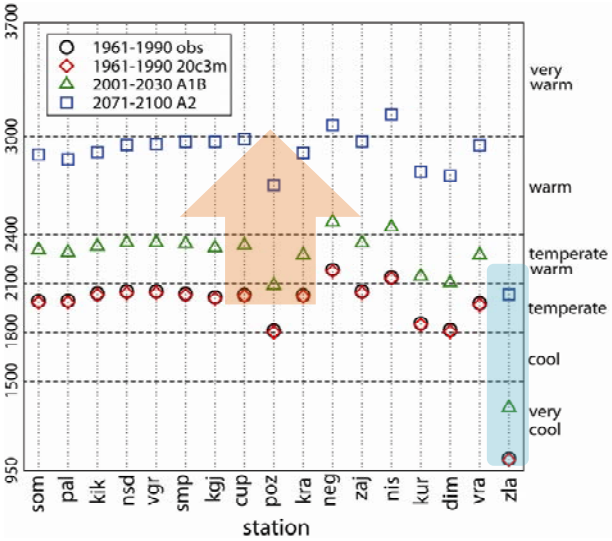
# Multicriteria Climatic Classification System (Géoviticulture MCC System)

Heliothermal Index (*HI*), Dryness Index (*DI*) and Cool Night Index (*CI*) define a Multicriteria Climatic Classification System (Géoviticulture MCC System) for grape growing regions worldwide.

## Indices are calculated for vegetation period as mean values for 30 years

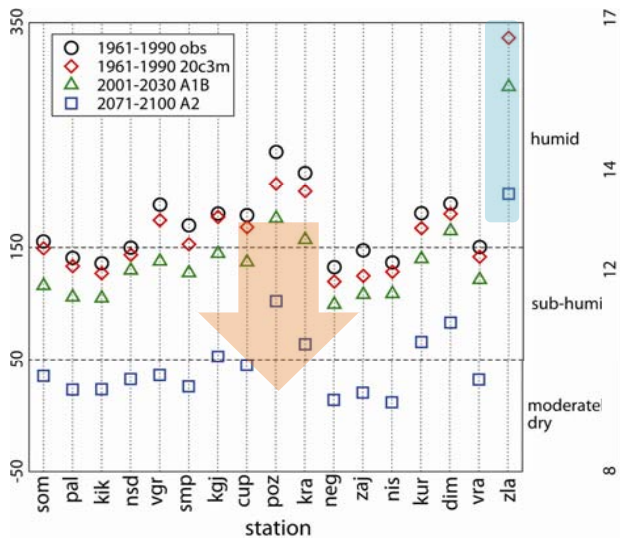
### 1. *Heliothermal index*

$$HI = \sum_{1.04.}^{30.09.} \frac{(T - T_b) + (T_x - T_b)}{2} d$$



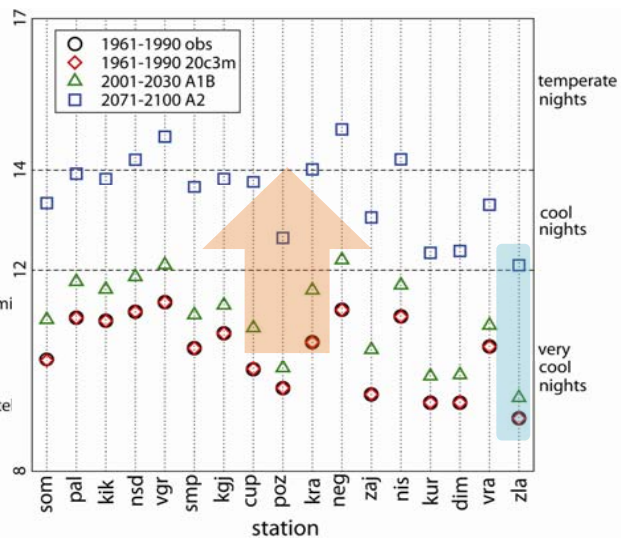

### 2. *Dryness index*

$$DI = W_o + \sum_{Apr.}^{Sep.} P - (E_t + E_s)$$



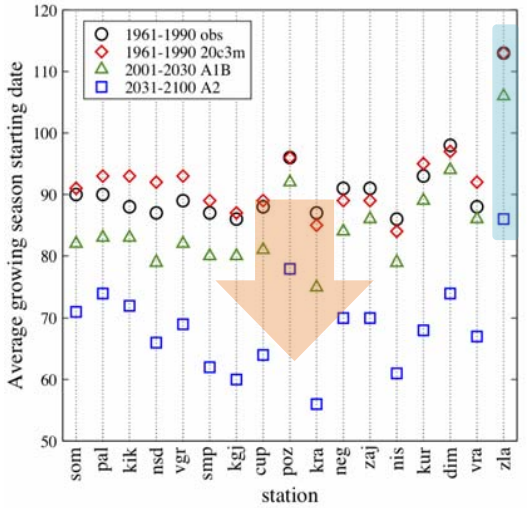

### 3. *Cool night index*

$$CI = \frac{1}{N} \sum_{1.09.}^{30.09.} T_{\min}$$



# Some selected results…

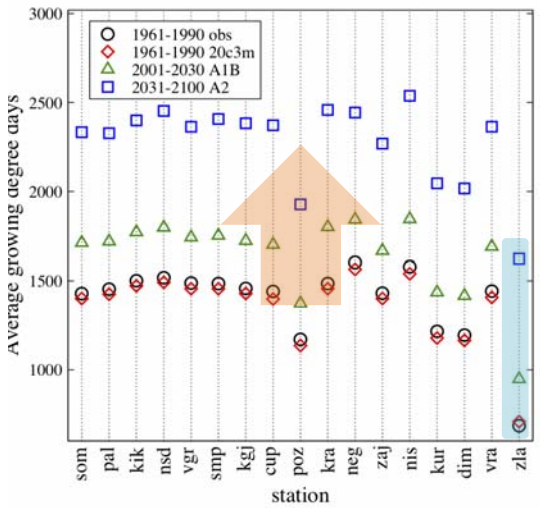
## growing season start date




April

March

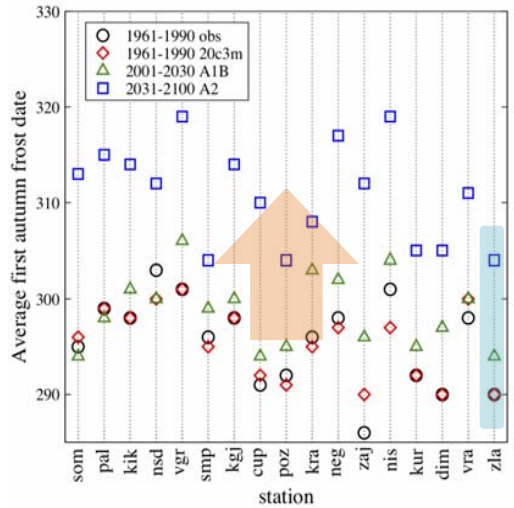
## growing degree days




2400

1400

## first autumn frost date




1.Nov.

## Summary


duration: 200 → 240 days

growing degree days: 1400 → 2400

warmer, dryer!

number of frost days:
90 → 50

num. of days Tmin<-15C:
3 → 0

**Mountain station ~1000m altitude enters the climate regime of present vineyard regions!**

# Research & Development

## SEEVCCC Earth Modeling System

**NMMB** – **N**onhydrostatic **M**ultiscale **M**odel (developed & operational in NCEP)

- Numerical Weather Prediction Model (NWPM)
- works on global, regional (res. ~10km) and local scales (res.~100m)
- valuable tool for perform simulations on any desirable resolutions

### Atmospheric particles

Include dust, seasalt, minerals and other atmospheric particles:

- transport and their interactions with atmosphere and ocean (influence on cloud formation, radiation, ocean flora and fauna,…)
- for now dust component (DREAM) is prepared

### Hydrology

Dynamical hydrology model id developed - HYPROM

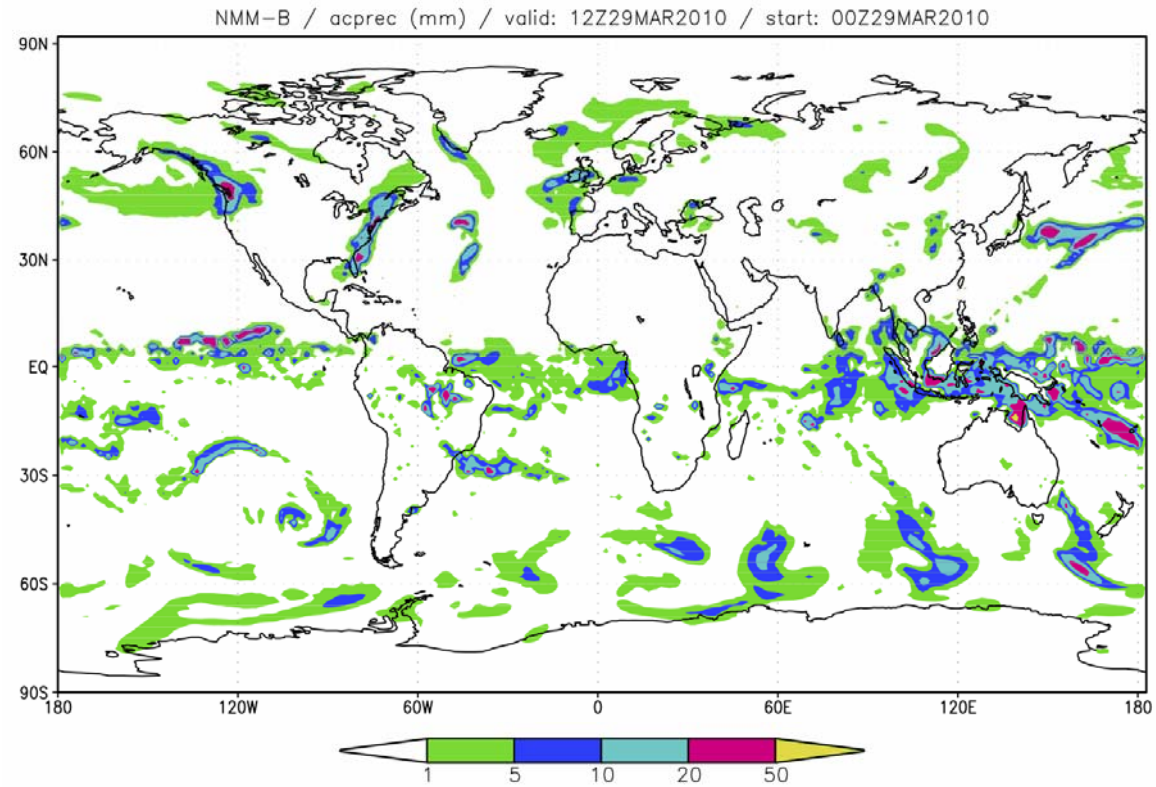
- simulation of hydrology cycle
- ready to be included into atmospheric driver

### Ocean

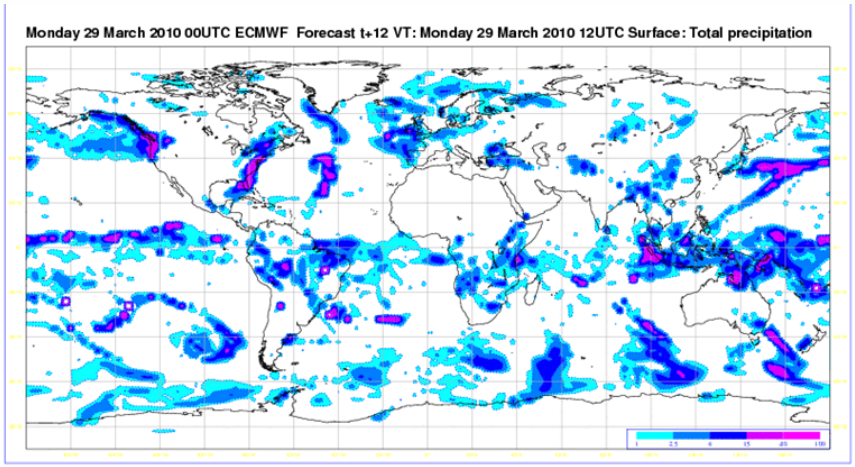
- couple NMMB with ocean model

# SEEVCCC Earth Modeling System: NMMB

**First results obtained with NMMB in SEEVCCC: global forecast**




**ECMWF analysis**



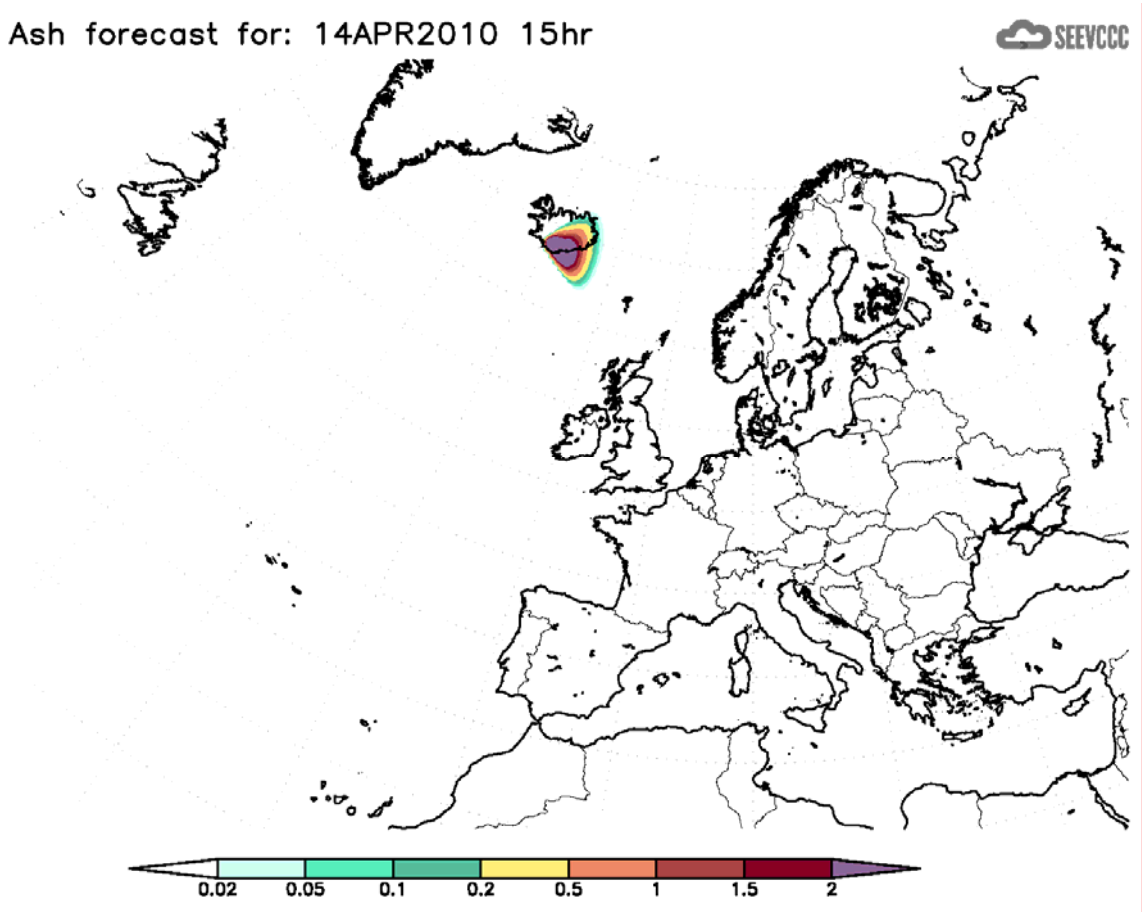

## Future plans:

- SEEVCCC will perform 10 days (global) forecast
- testing model on regional and local scales
- coupling with ocean, aerosols, hydrology
- perform seasonal forecast
- climate projections
- ……

# Atmospheric particles: DREAM

## DREAM4 modified – experimental forecast of volcanic ash

### Eyjafjallajokull eruption (starting date: April 14th 2010)




- beside dust forecast DREAM can be modified for transport of different sorts of atmospheric particles
- in future: mineral transport, sea salt, pollen,….

# Hydrology: HYdrology PROgnostic Model

**tests were done using models:**

- **for atmosphere:**
  **NMME**
  (Non-hydrostatic Mesoscale Model)
- **for land:**
  **NOAH** land surface model
- **for hydrology:**

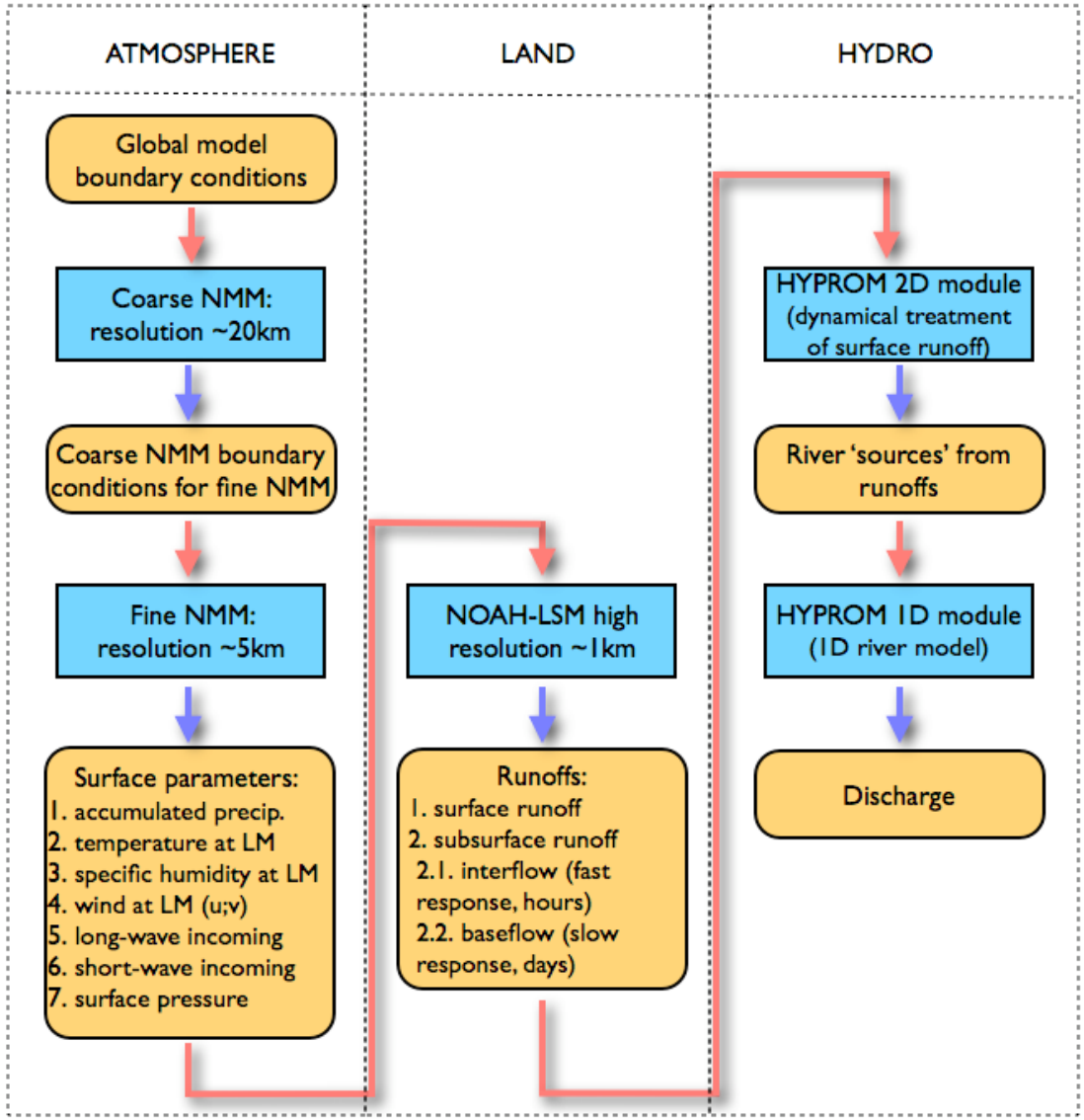
**HYPROM 2D** – surface runoff
**HYPROM 1D** – river routing

**Prognostic water velocity !**

**datasets:**

- HYDRO1k USGS topography
- FAO soil texture data
- USGS land use data

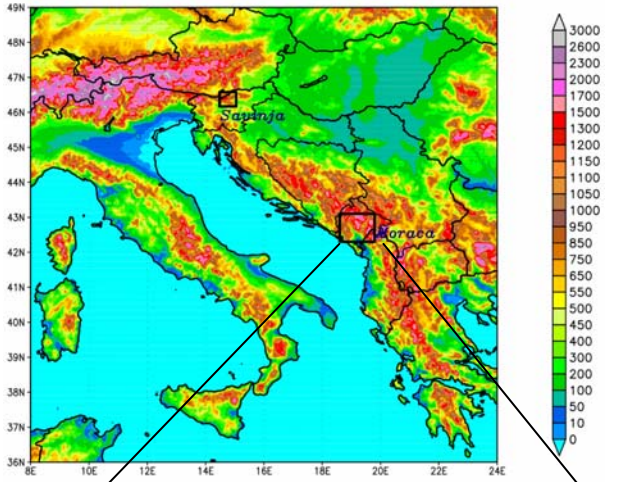
**Future plan:**
**couple HYPROM with NMMB**



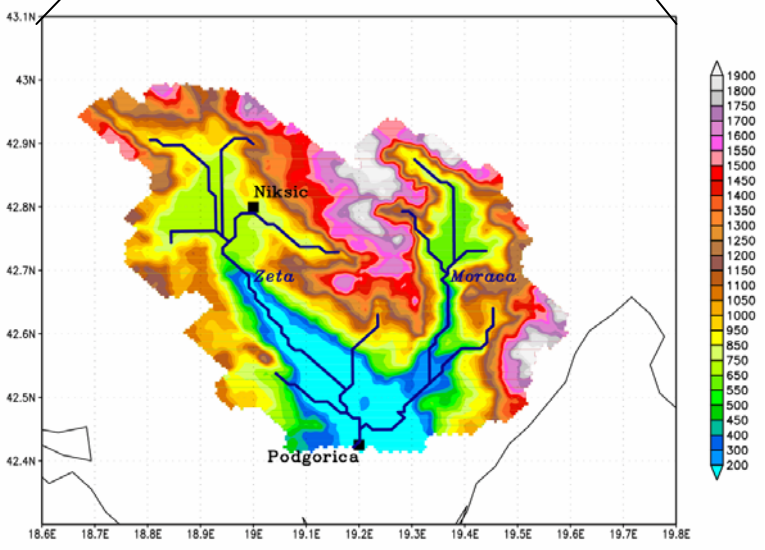

LM - lowest atmospheric model level

# HYPROM runs example: The Moraca river (Montenegro)

**Moraca basin:** 3200 km$^2$
**Podgorica sub-basin:** 2600 km$^2$

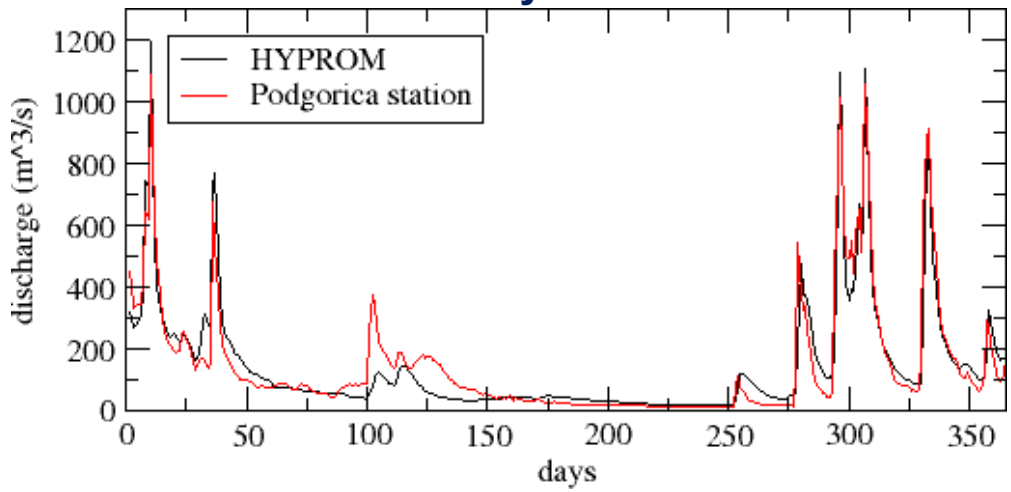



HYPROM orography with river bed and meteo and hydro stations position

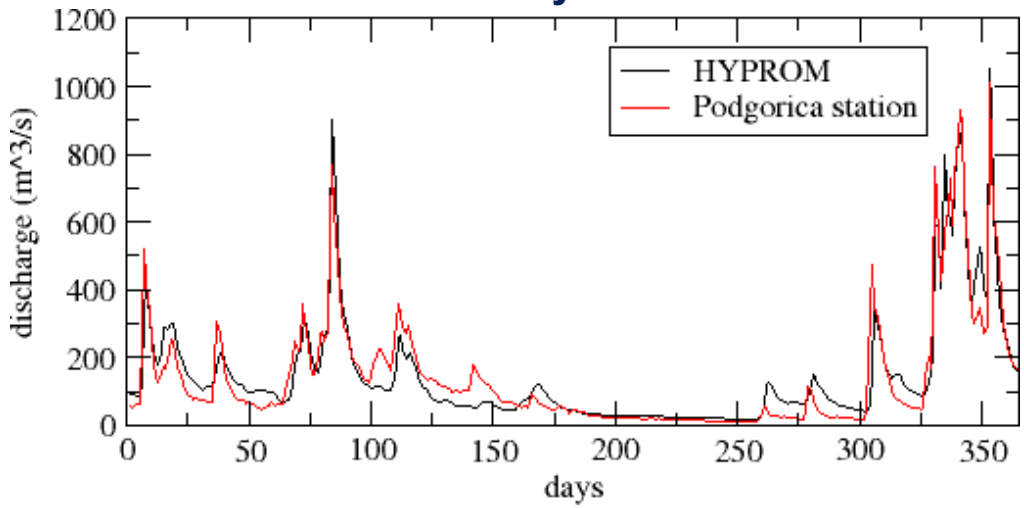



## *The Moraca river discharge – Podgorica sub-basin*

**case: year 2003**




**case: year 2008**



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