South East European Virtual Climate Change Center

Introduction to LRF and products for end-users

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WMO RA VI-Europe RCC functions

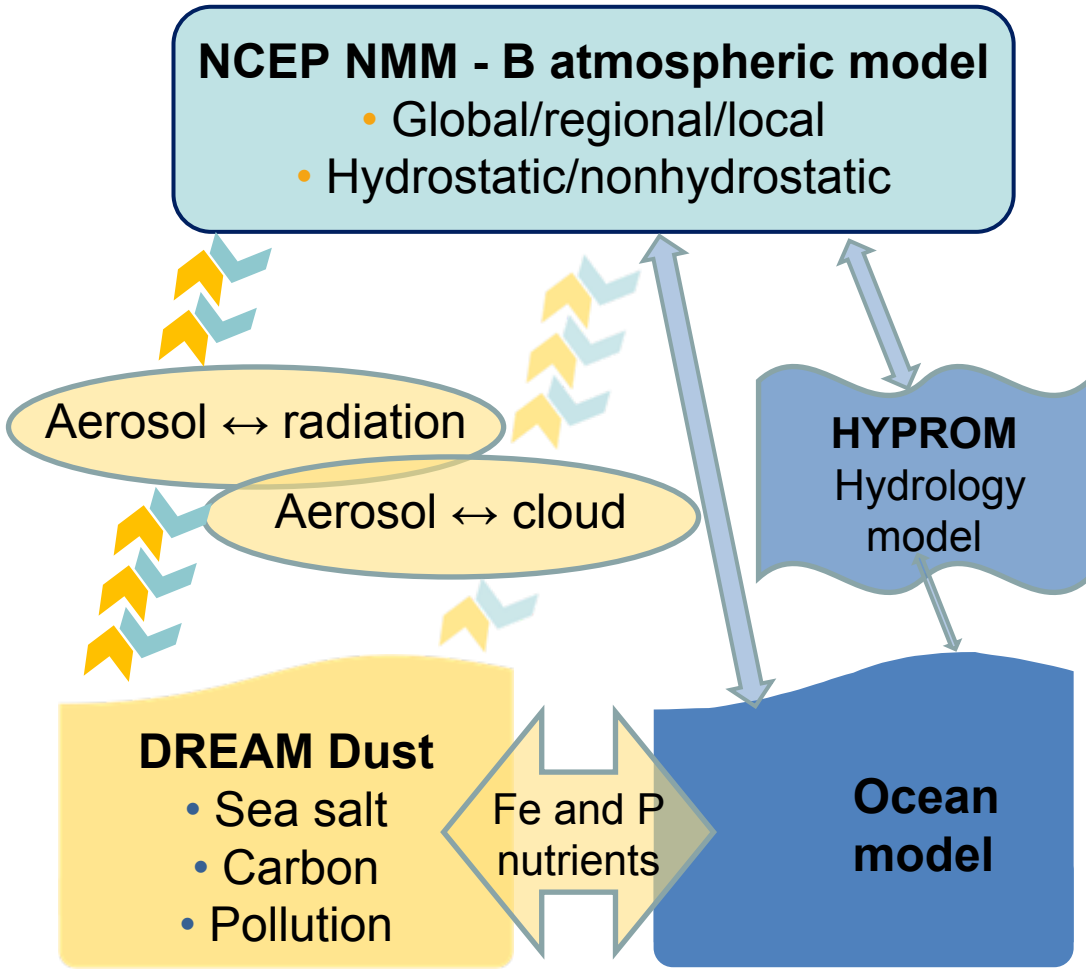
WMO RA VI RCC-Network
Implementation Plan
Pilot RA VI RCC Network Nodes

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

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

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

RCC Highly recommended functions (example):
SEEVCCC
Earth Modeling System



Long Range Forecast / Seasonal 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.

Probabilistic forecast

- **Seasonal forecast is NOT a weather forecast!**
- Provides statistical summary of the atmosphere and ocean state in forecoming season.

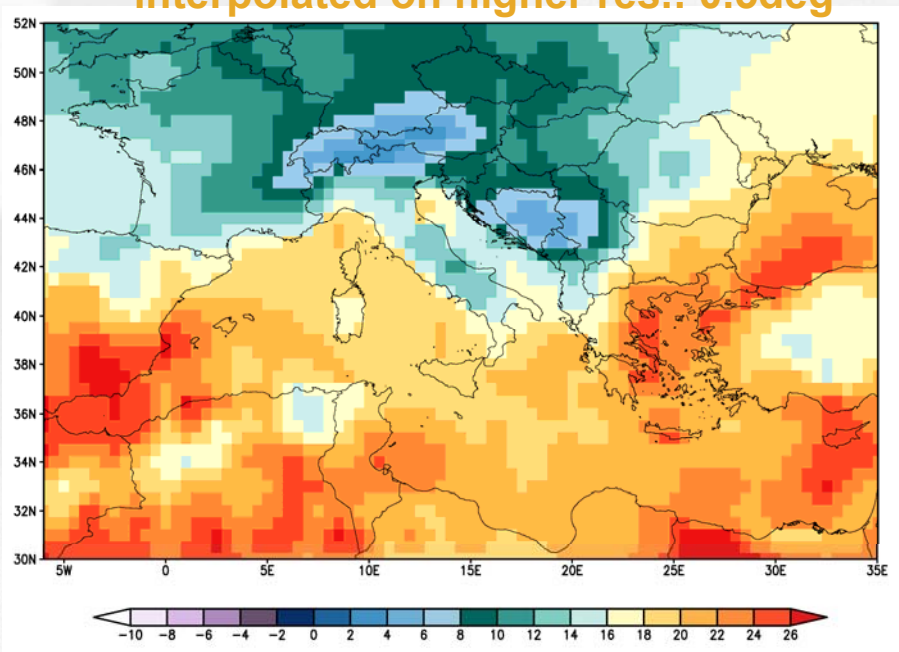
RCM-SEEVCCC LRF (Long Range Forecast – Seasonal Forecast)

- **regional dynamical downscaling using fully coupled atmosphere-ocean RCM**
- model start: 16th of each month ; forecast duration: 7 months (~215 days)
- model resolution: ~35km atmosphere ; ~20km ocean
- model domain: Euro - Mediterranean region extended toward Caspian Sea
- **41 ensemble members!**
- initial and boundary conditions: ECMWF, resolution:125km
- results prepared for South East European region in form of:
  - **mean ensemble maps** (mean 2m temperature, precipitation accumulation, temperature anomaly and precipitation anomaly with respect to CRU data 1961-1990) for month and three months (season)
  - **diagrams** (probabilistic forecast of mean monthly temperature and monthly precipitation accumulation for specific place)

Benefit Of Using Regional Climate Models

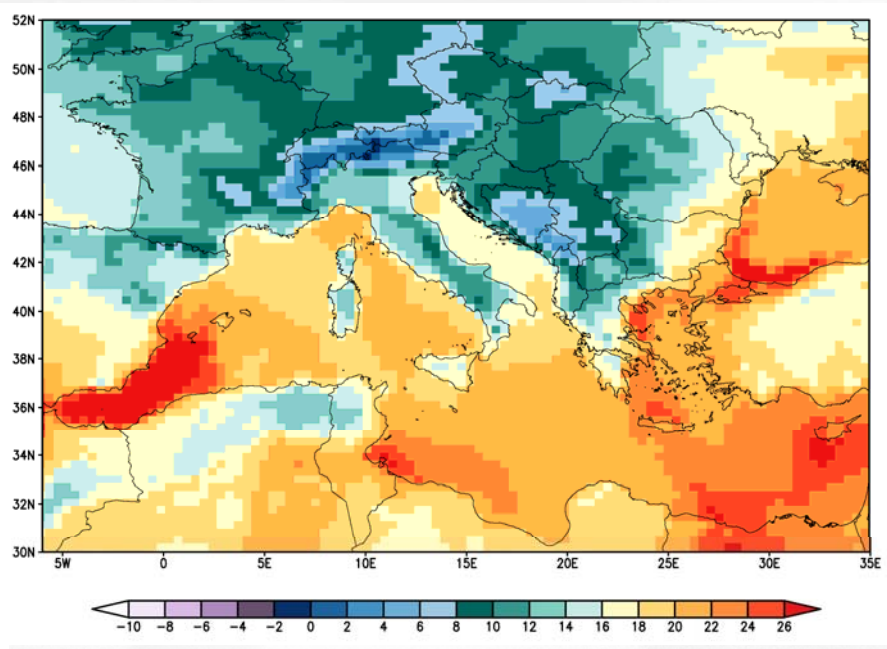
- DYNAMICAL DOWNSCALING FOR SEASONAL FORECAST

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



resolution:125km

2m temperature RCM-SEEVCCC

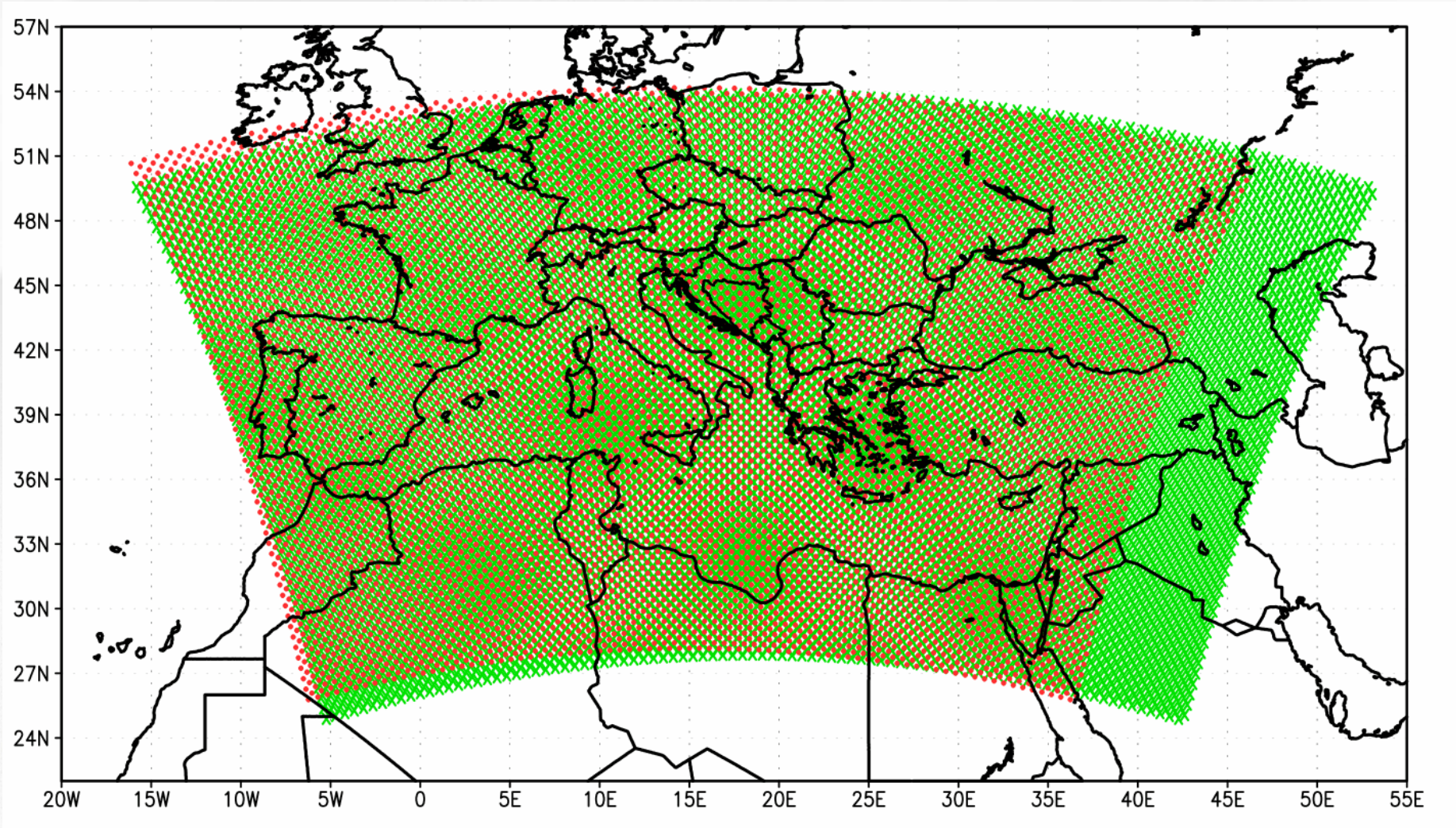


resolution: 35km atmosphere
20km ocean

More detailed temperature field using regional model!

RCM-SEEVCCC LRF: domain

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



Available data from LRF

- Data available for each ensemble member :
  on every 6h (atmospheric) and average over 5 days (ocean)

- **Using these data further downscaling can be performed for smaller domains oh higher resolutions**
- **Calculation of LRF for different parameters depending on end-user's specific needs**

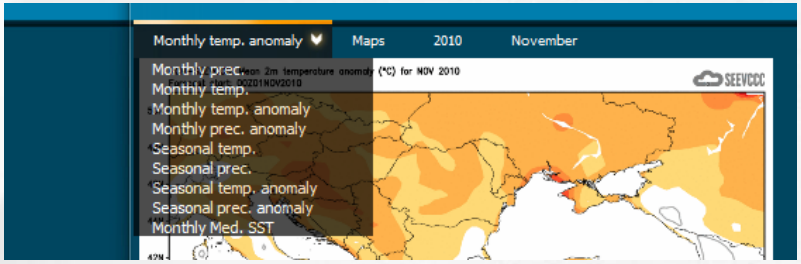
Atmospheric output variables:	Ocean output variables:
● Geopotential of surface/topography, m ● Sea/land mask, 1/0 ● U wind (standard pressure levels), m/s ● V wind (standard pressure levels), m/s ● Temperature (standard pressure levels), K ● Specific humidity (standard pressure levels), kg/kg ● Cloud water mixing ratio (standard pressure levels), kg/kg ● Surface temperature, K ● Temperature on 2m, K ● Specific humidity on 2 m, kg/kg ● U 10m wind, m/s ● V 10m wind, m/s ● Temperature on 10m, K ● Specific humidity on 10m, kg/kg ● Accumulated precipitation total (6h accumulation), m/m^2 ● Accumulated snow (6h accumulation), m ● Accumulated convective precipitation (6h accumulation), m/m^2 ● Soil moister content, m^3/m^3 ● Latent heat flux on surface, W/m^2 ● Short wave incoming on surface, W/m^2 ● Long wave incoming on surface, W/m^2 ● Sensible heat flux on surface, W/m^2	● Elevation, m ● U barotropic vel., m/s ● V barotropic vel., m/s ● U surf. momentum flux, m/s ● V surf. momentum flux, m/s ● Surf heat flux, W/m^2 ● Surf short wave flux, W/m^2 ● U bot. momentum flux, m/s ● V bot. momentum flux , m/s ● Temp. on sigma levs, °C ● Salinity on sigma levs, psu ● U vel. on sigma levs, m/s ● V vel. on sigma levs, m/s

LRF (Seasonal forecast) products

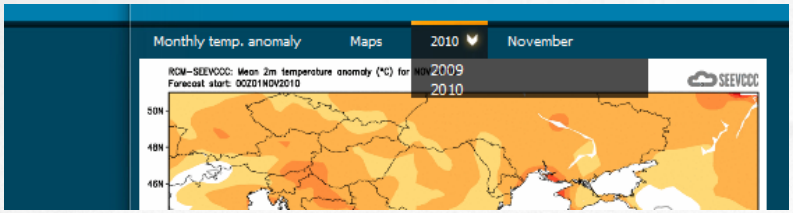
WWW.SEEVCCC.RS

Available products at present!

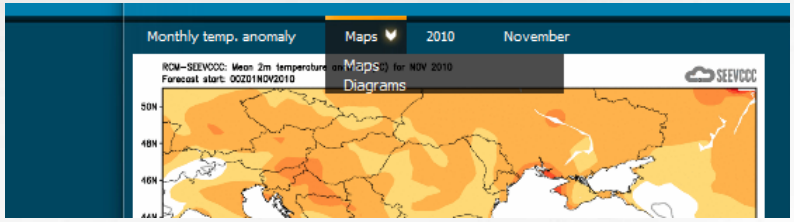
Choose parameter



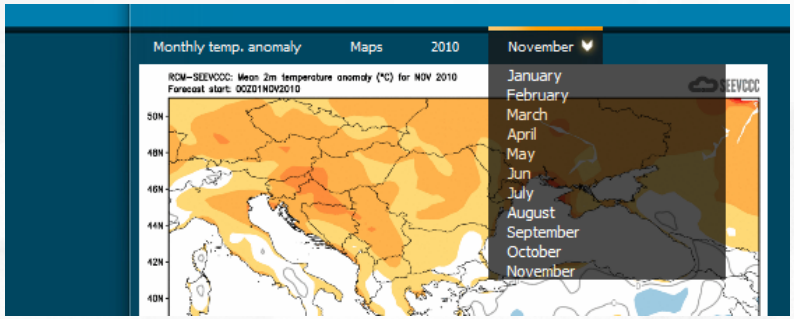
Choose year



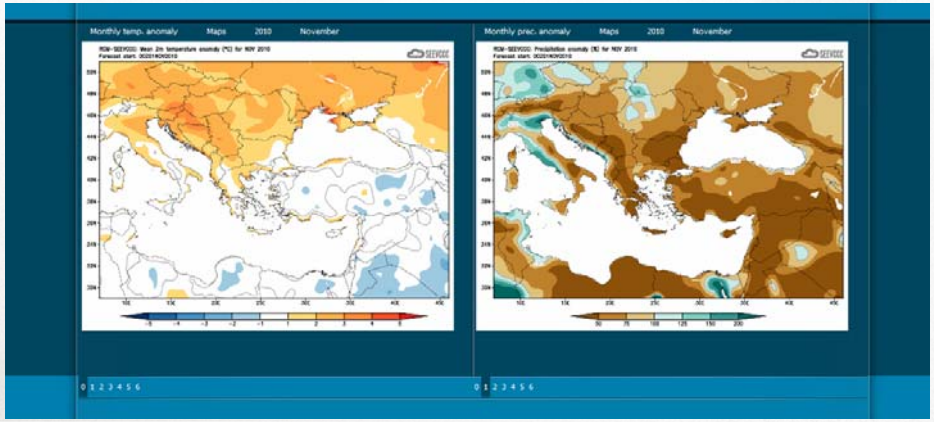
Choose map or diagram



Choose lead month



Option for results comparison of different parameters or selected forecast



How to understand and use LRF products?

• LRF (Seasonal forecast) is not weather forecast! It can not be used for prediction of weather/ocean variables for specific date. It can only give evaluation of atmosphere and ocean in forecoming period not shorter then one month.

• Since it is ensemble forecast it can be used for statistical evaluation: what is the probability some of the next months to be warmer/colder or with more/less precipitation than climate normal and probability of magnitude of deviation from normal value.

• RCM-SEEVCCC LRF anomalies are given as difference from CRU data (1961-1990). This is important to keep in mind in comparing obtained values for anomalies with anomalies obtained with other seasonal ensemble forecasts (global models). Usual method for calculation of anomalies is with respect to model climatology for the period 1985 – 2000 (warmer than 1961-1990). So, if other models, for example, give negative anomaly, it is possible that RCM-SEEVCCC gives positive anomaly.

• From atmospheric/ocean variables obtained from LRF it is possible to calculate probabilistic forecast for parameters needed for end-users (heat units, start/end of growing season,…..).

What RCM-SEEVCCC LRF need in future?

- Advantages of regional ensemble seasonal forecast

  • Indisputable advantage is higher resolution that can produce much more detail dynamics inside model domain and thereby much better results, especially near sea and in mountain regions. (RCM res:~30km, GCM: ~125km)

  • RCM-SEEVCCC is coupled atmosphere-ocean model. Ocean part have big influence on SEE region forecast. (it is tried at first only with atmosphere model and results were not satisfactory)

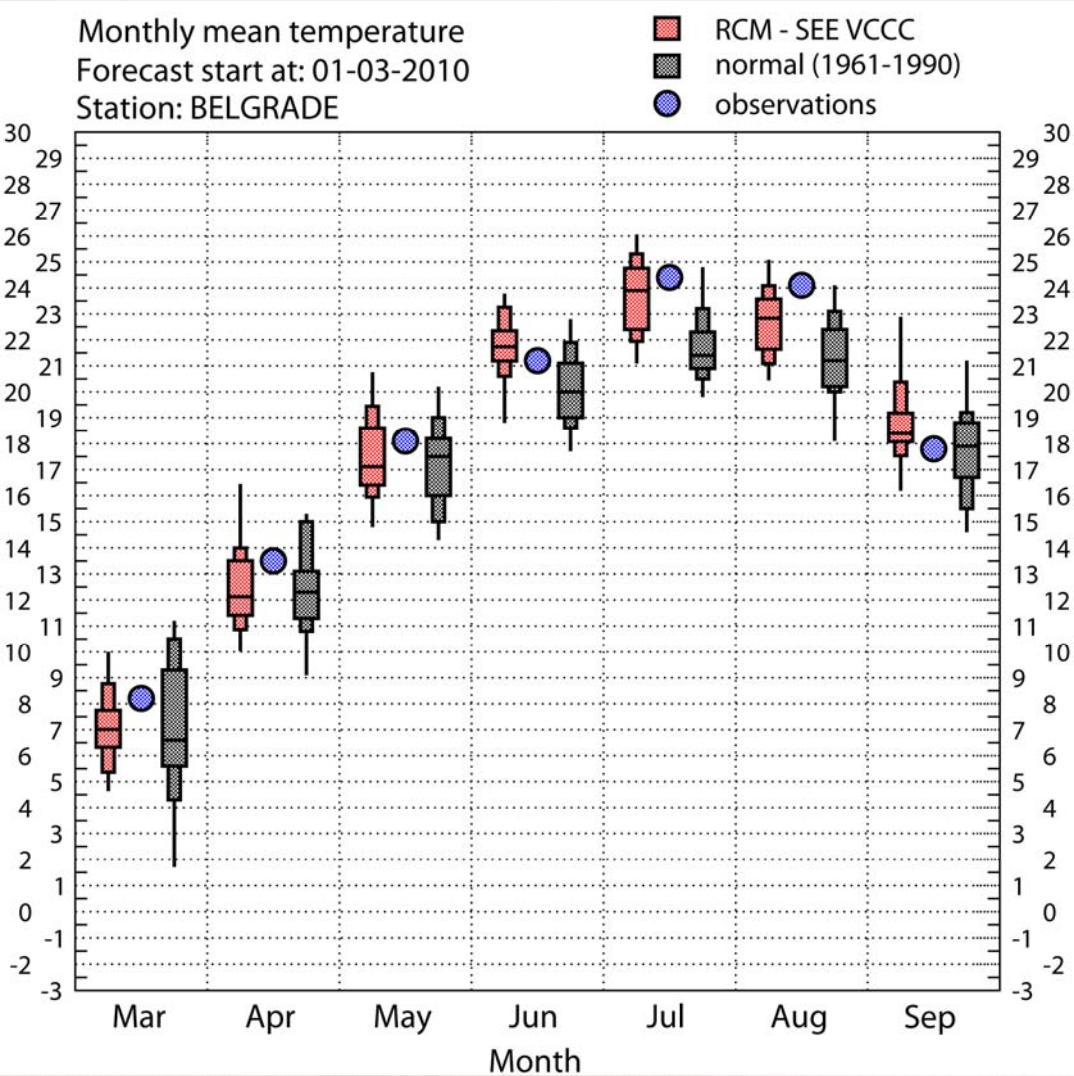
- Further improvements of RCM-SEEVCCC LRF

  • To satisfy unavoidable rule of LRF management, model climatology must be performed. Results should be presented as difference from model climatology. Every model has BIAS (systematic error), but for results that are difference of two model simulations (future minus model climatology) can be assumed that BIAS is reduced to minimum.

  • To present results as probabilistic diagrams as much as possible, rather than in form of maps for mean ensemble values in order to fully use advantage of ensemble forecast. Interested parties can submit request for which place they are interested to have probabilistic diagrams of LRF.

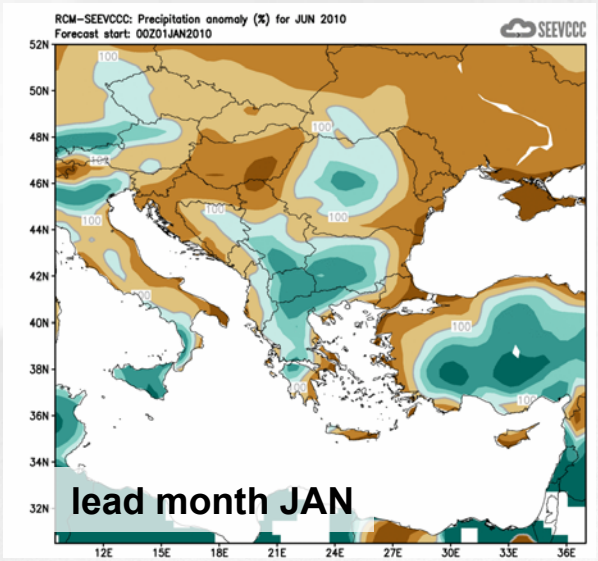
Examples of RCM-SEEVCCC LRF products

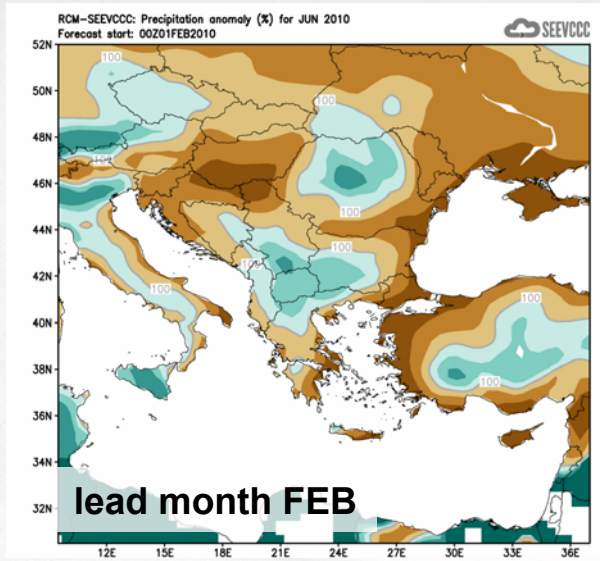
- Example of probabilistic diagrams: March 2010 LRF with climatology and observations

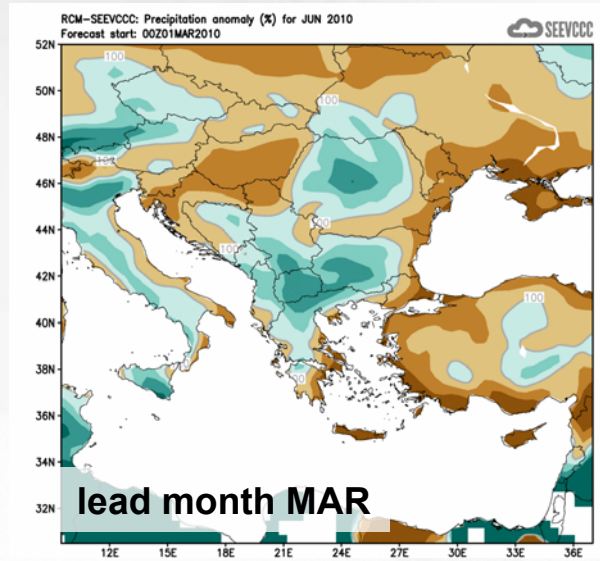


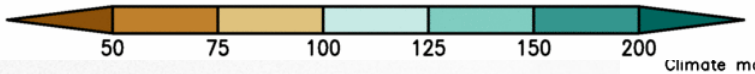
Examples of RCM-SEEVCCC LRF products

- Example of maps for mean ensemble values: precipitation anomalies for June 2010

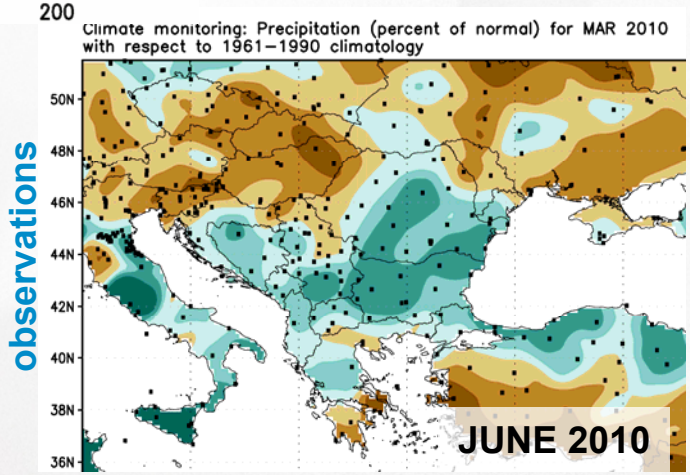






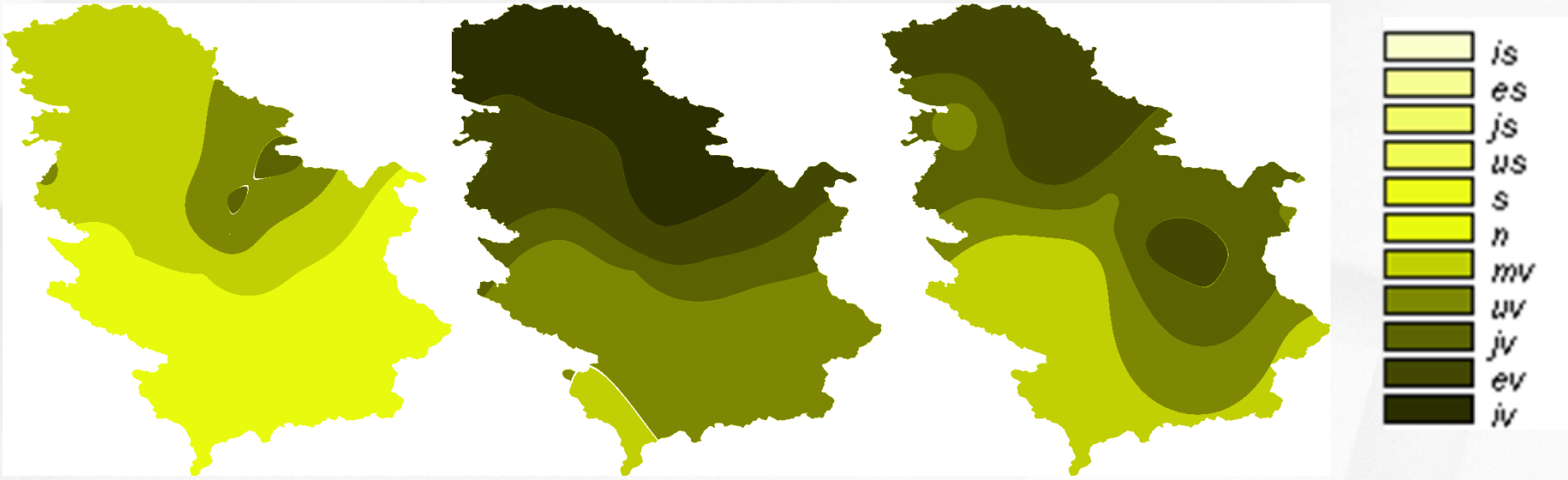


- Three LRF for June 2010 are presented:
  January, February and March LRF
  - model keeps consistency in LRF
    (all three gave similar for June)
  - very good coincidence with observations



Examples of RCM-SEEVCCC LRF products

- Example of special use of LRF precipitation results: SPI2 for February 2010 using January 2010 LRF



RCM-SEEVCCC ensemble forecast

corrected LRF RCM-SEEVCCC ensemble forecast

observed

Since large part of the SEE region is place of “Summer Drying Problem” and no model climatology is available, for some special use of LRF products (obtained from precipitation data), such is SPI2 forecast, **Statistical BIAS Correction based on daily climatology** is applied on ensemble LRF.

Further R&D and application of LRF

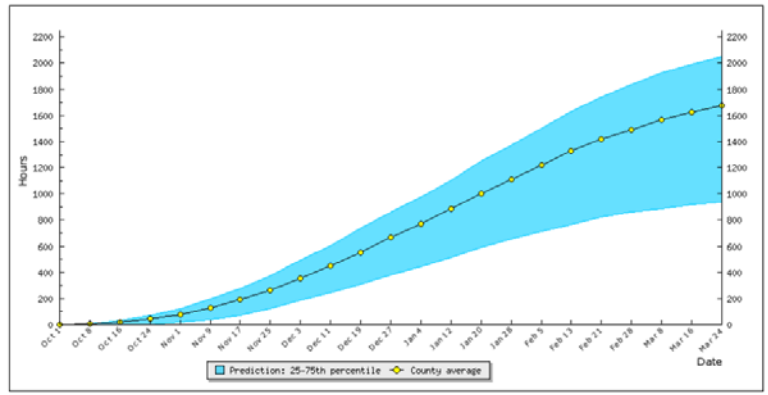
- Model climatology
  - in December 2010 new128 CPU will be available
  - estimated time for model climatology simulations is ~2 months
  - results presented using model climatology available from first half of 2011

- Corporation with end-users
  - produce special forecast needed for end-users
  - present results of any desirable parameter in user-friendly form (idea from http://agroclimate.org/tools/ChillAccum)

AgroClimate — print page

AUTAUGA (AL): Chill Accumulation, Predicted and Accumulated, La Niña Years

Date	Oct 1	Oct 8	Oct 16	Oct 24	Nov 1	Nov 9	Nov 17	Nov 25	Dec 3	Dec 11	Dec 19	Dec 27	Jan 4	Jan 12	Jan 20	Jan 28	Feb 5	Feb 13	Feb 21	Feb 28	Mar 8	Mar 16	Mar 24
Prediction: 25-75th percentile																							
25th CH	0	0	0	2	17	38	69	121	184	242	310	380	440	516	592	657	710	767	820	860	889	917	936
75th CH	0	8	31	70	125	200	278	374	495	605	736	859	974	1107	1252	1371	1501	1633	1738	1834	1929	1991	2047
County average																							
CH	0	8	20	44	77	130	194	265	352	448	554	665	771	886	1002	1113	1221	1331	1418	1488	1565	1624	1675



- Developing a new RCM coupled model
  - NCEP/NMMB coupled with ocean model
  - can work in non-hydrostatic mode → can perform simulations below 10km resolution
  - coupling with hydrological model