

Application of CROPWAT Model to Estimate and Predict the Main Components of Soil Moisture Balance Based on Seasonal Climate Forecasting

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Aim:

- demonstrate how seasonal climate forecast combined with simulation capabilities of CROPWAT model can estimate and predict the dynamics of the main components of soil water balance

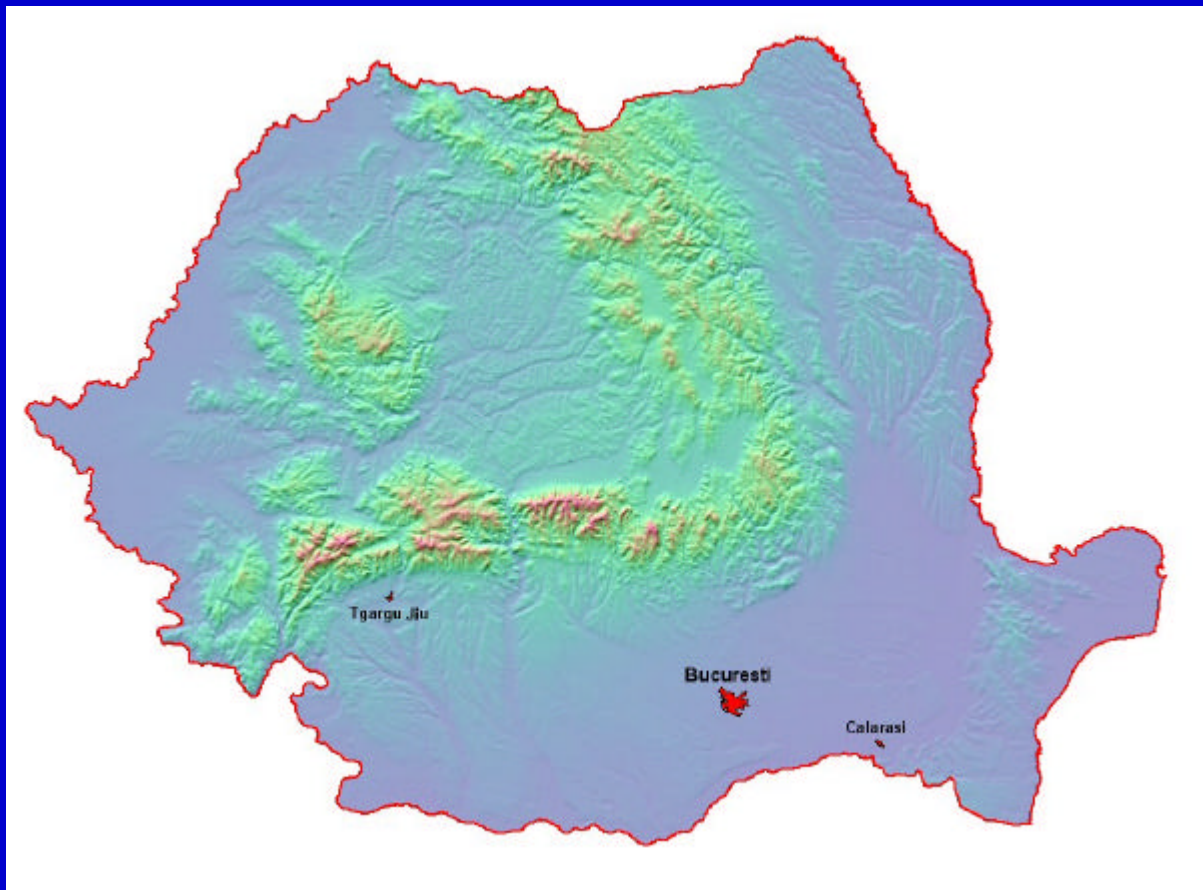
Objectives:

- ? create climate input data according to seasonal forecast for the interval June-September 2003;
- ? assess reference vapotranspiration, crop water requirements and soil water deficit during maize growing season in the forecasted and real weather conditions;
- ? compare the model results and analyze the skill level of seasonal forecast;
- ? estimate yield reduction due to crop stress in the rainfed conditions.

CROPWAT for Windows model

- Is a method to support decision making for irrigation planning and management
- Calculates reference evapotranspiration, crop water requirements and irrigation requirements
- Develop irrigation schedules based on a daily soil-moisture balance using various options for water supply and irrigation management conditions
- Allows the development of recommendations for improved irrigation practices, the planning of irrigation schedules and the assessment of production under rainfed conditions or deficit irrigation

Test-sites used



Input data used

Climatic data:

? Monthly means of:

- minimum temperature (°C)
- maximum temperature (°C)
- air relative humidity (%)
- sunshine duration (hours)
- wind speed at 2m high (m/s)

? Monthly Rainfall

Crop data:

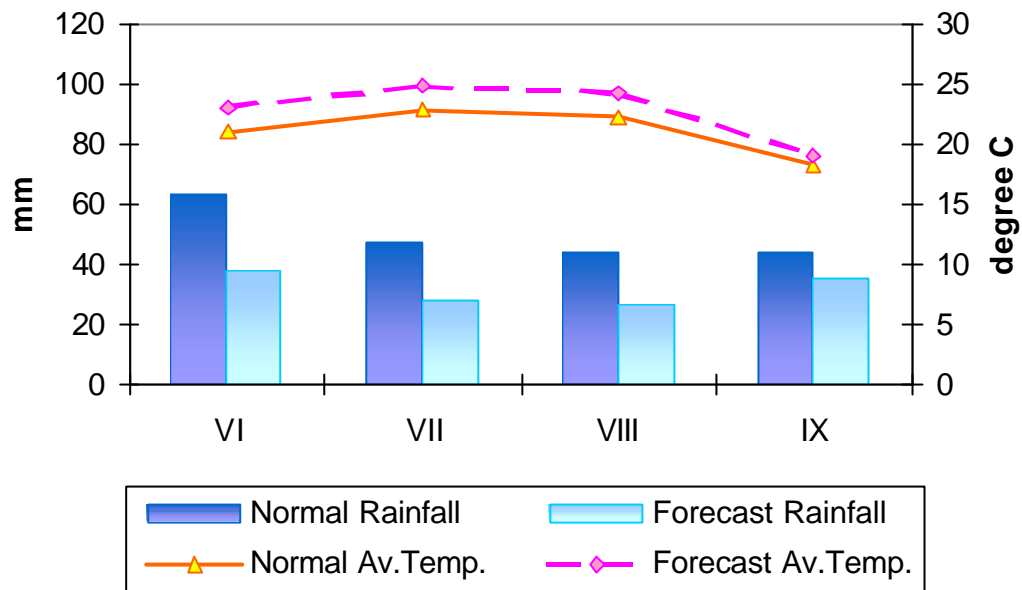
- sowing date: 20 April / 5 May 2003
- crop coefficient (Kc): standard
- crop yield data (Ky): standard
- depletion fraction (P): standard

Soil data:

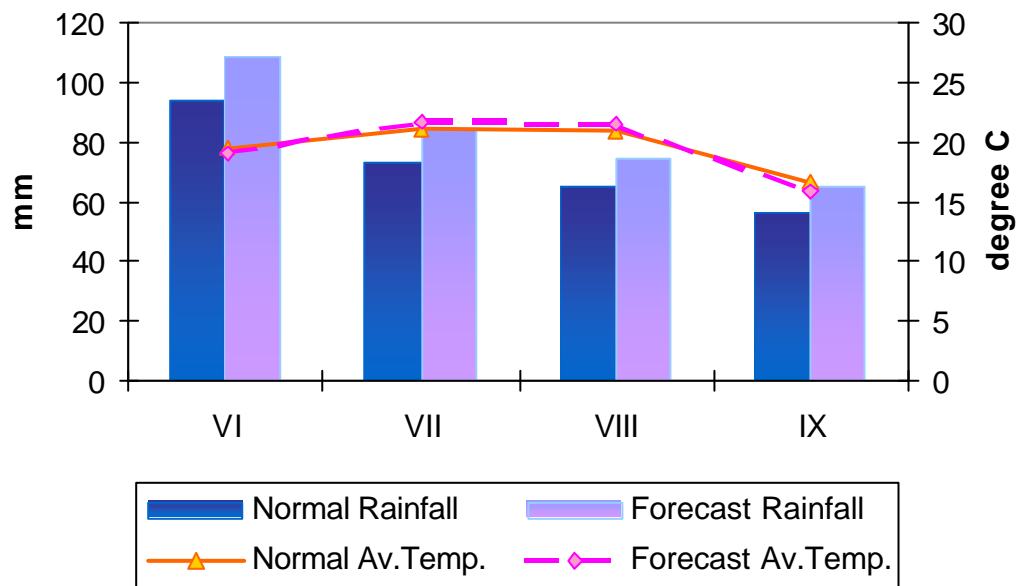
- total available moisture: 227/191 mm
- initial available soil moisture: 170/163 mm
- maximum root infiltration rate: 40 mm/day
- maximum rooting depth: 1m

Scheduling criteria: rainfed conditions

CALARASI 2003



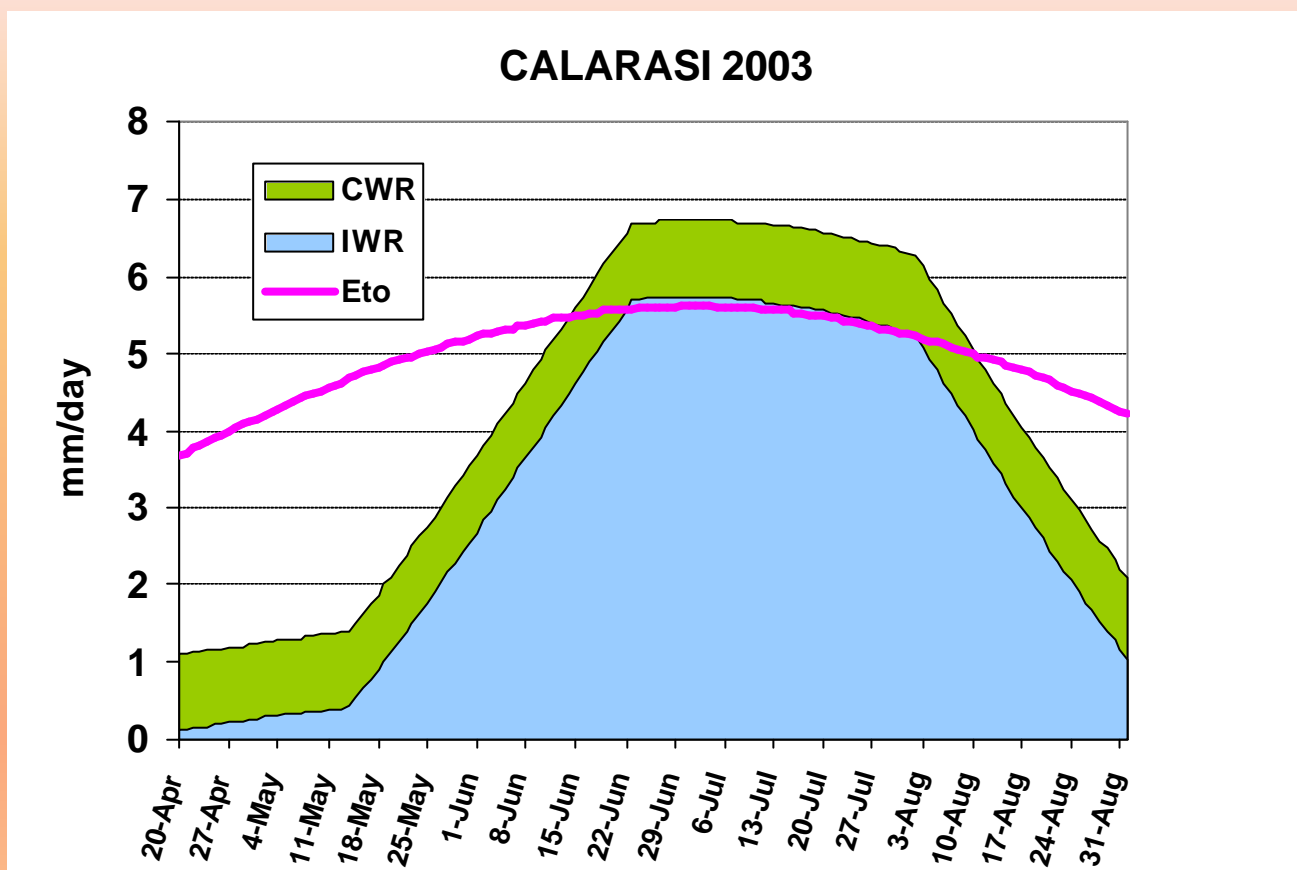
TARGU JIU 2003



The monthly means values of temperature and rainfall estimated by seasonal forecast for the interval June-September 2003

Results

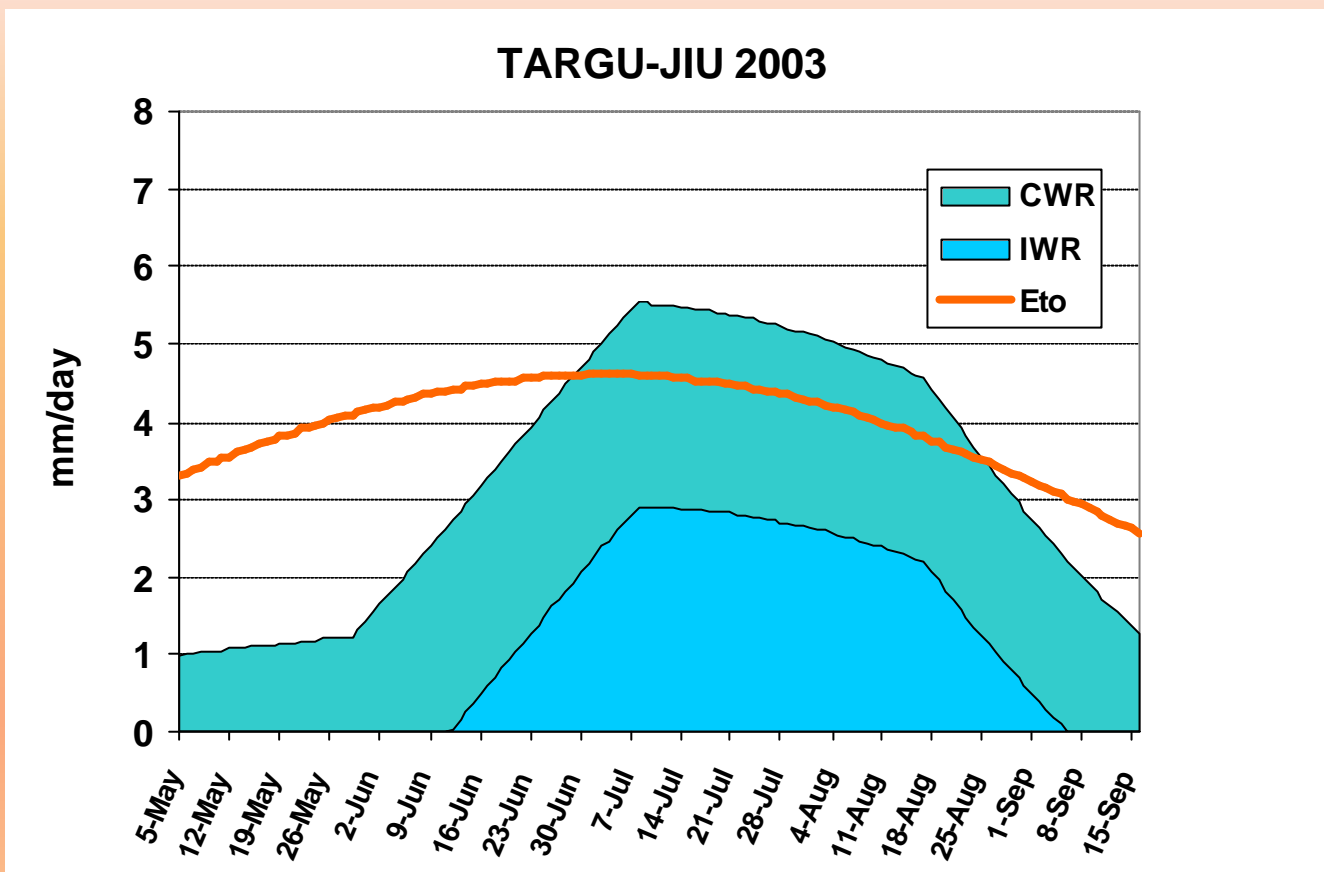
Evapotranspiration dynamic



Daily evolution of the reference evapotranspiration (Eto), crop water requirements (CWR) and irrigation water requirements (IWR) simulated with CROPWAT model during maize growing season at Calarasi site

Results

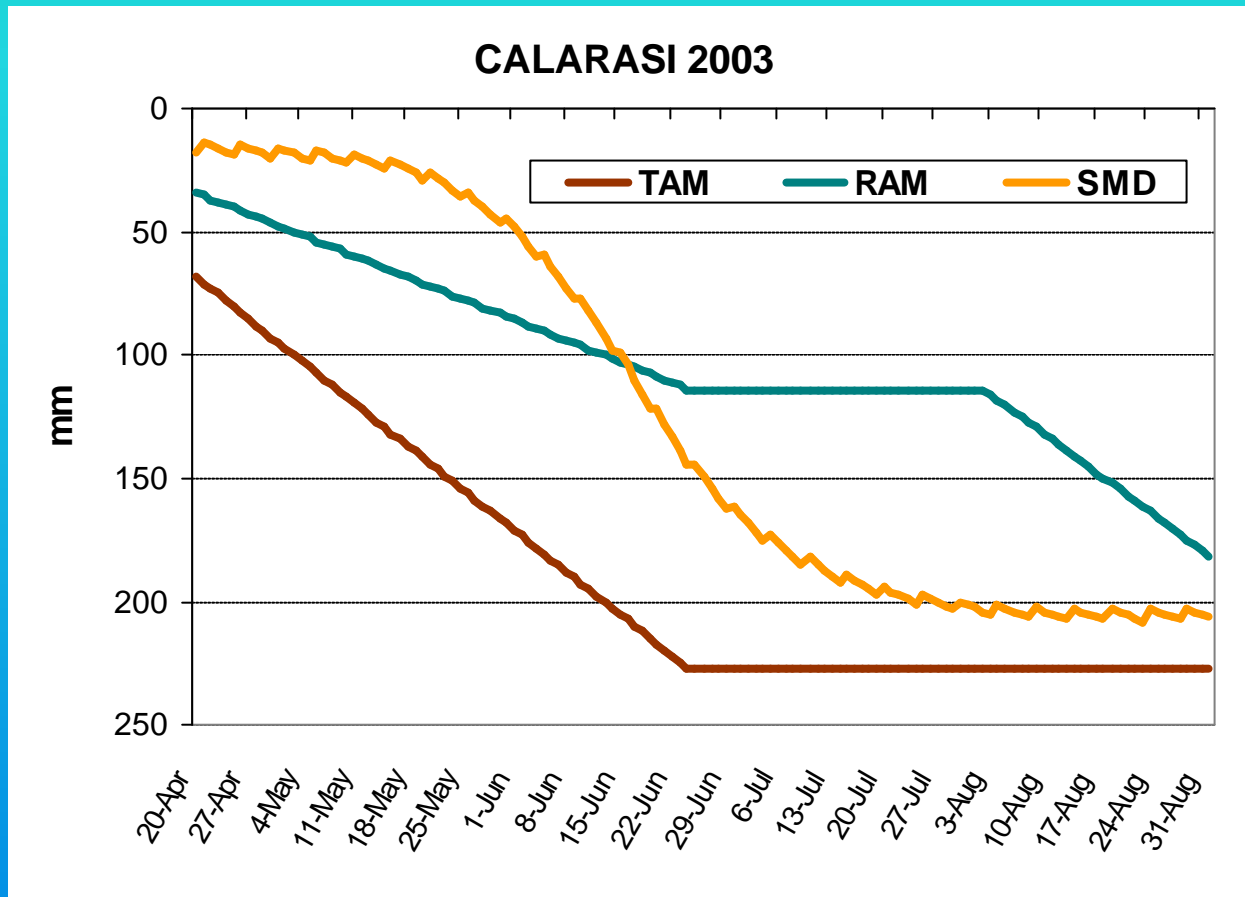
Evapotranspiration dynamic



Daily evolution of the reference evapotranspiration (Eto), crop water requirements (CWR) and irrigation water requirements (IWR) simulated with CROPWAT model during maize growing season at Targu Jiu site

Results

Daily soil moisture balance

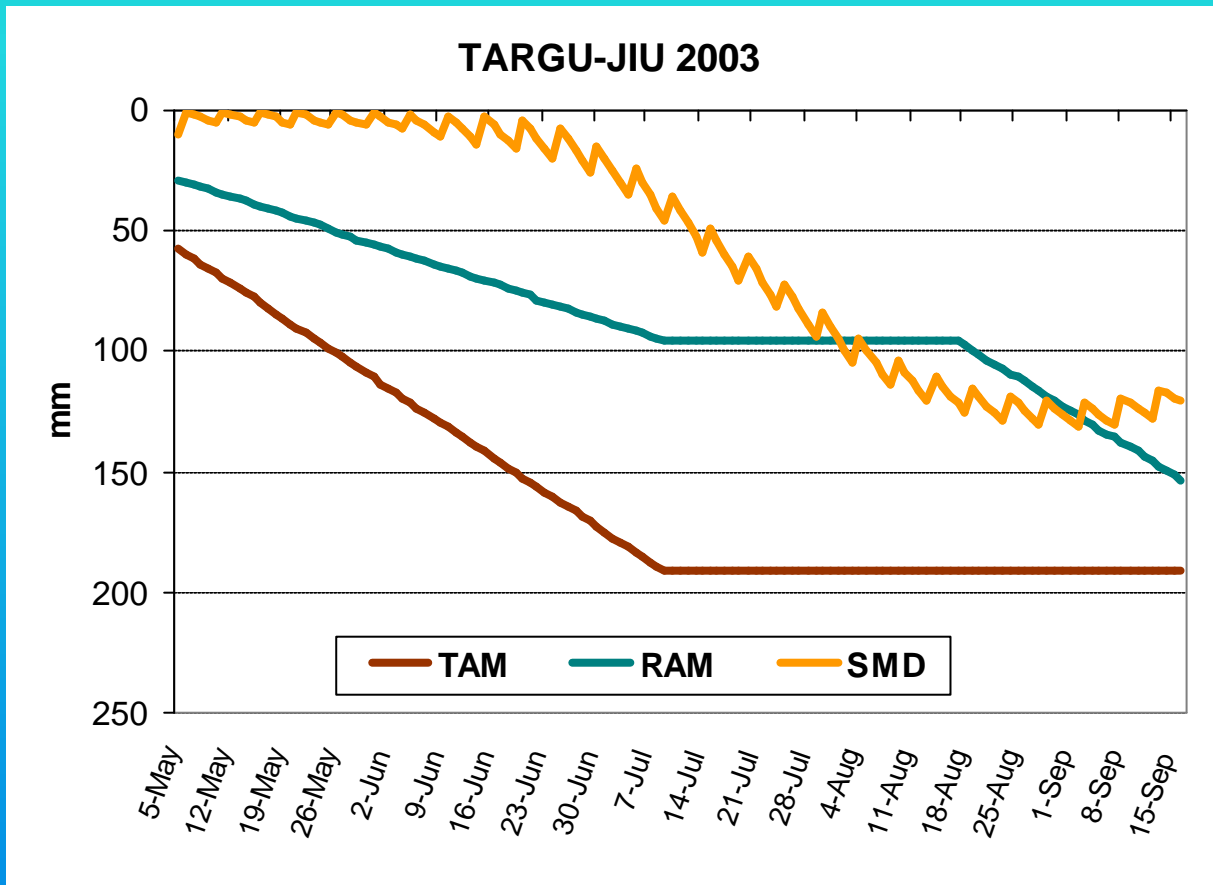


Soil moisture deficit simulated with CROPWAT model during maize growing season at Calarasi site, in the weather forecast conditions for summer 2003;

TAM: total available moisture, RAM: ready available moisture and SMD: soil moisture deficit

Results

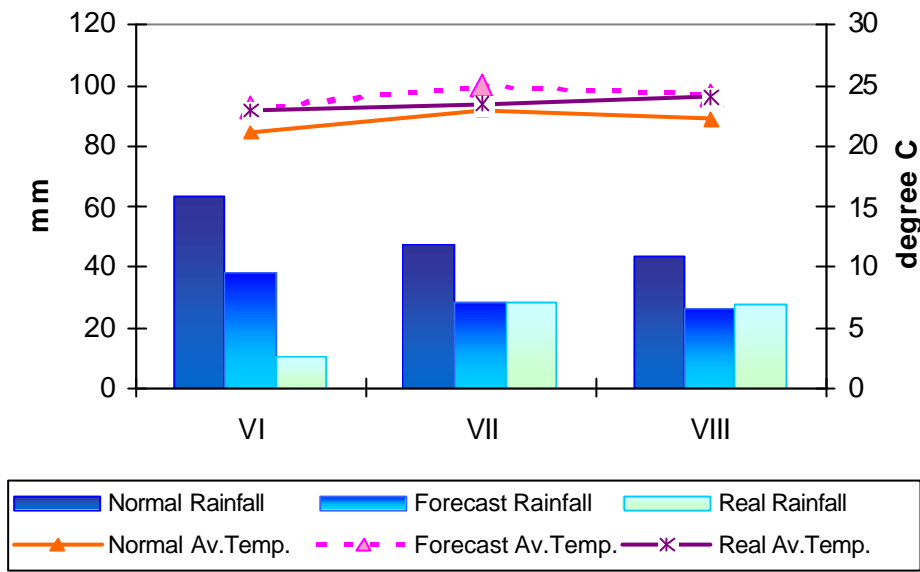
Daily soil moisture balance



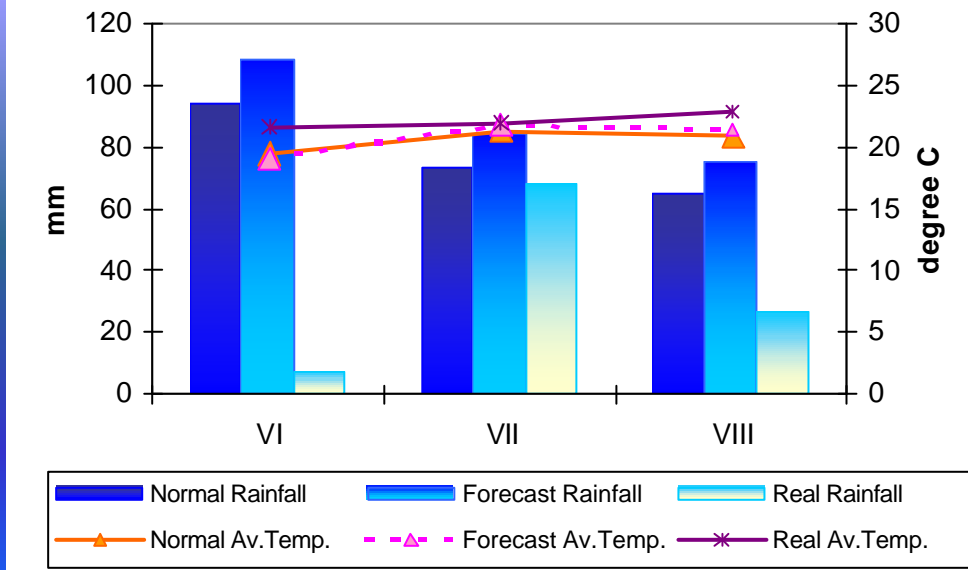
Soil moisture deficit simulated with CROPWAT model during maize growing season at Targu Jiu site, in the weather forecast conditions for summer 2003;

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CALARASI 2003



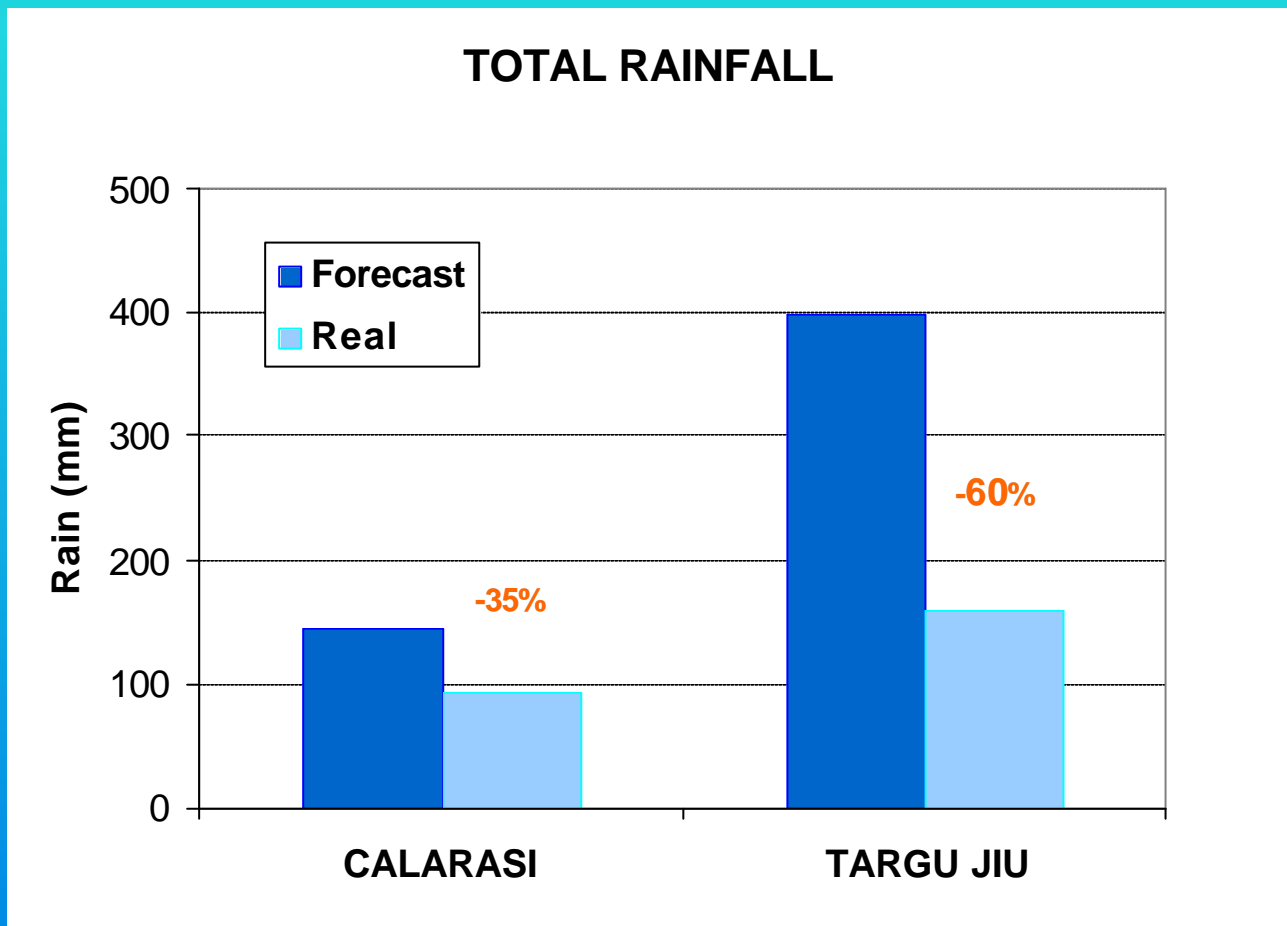
TARGU JIU 2003



The monthly means values of temperature and rainfall in the real weather conditions for the interval June-August 2003

Results

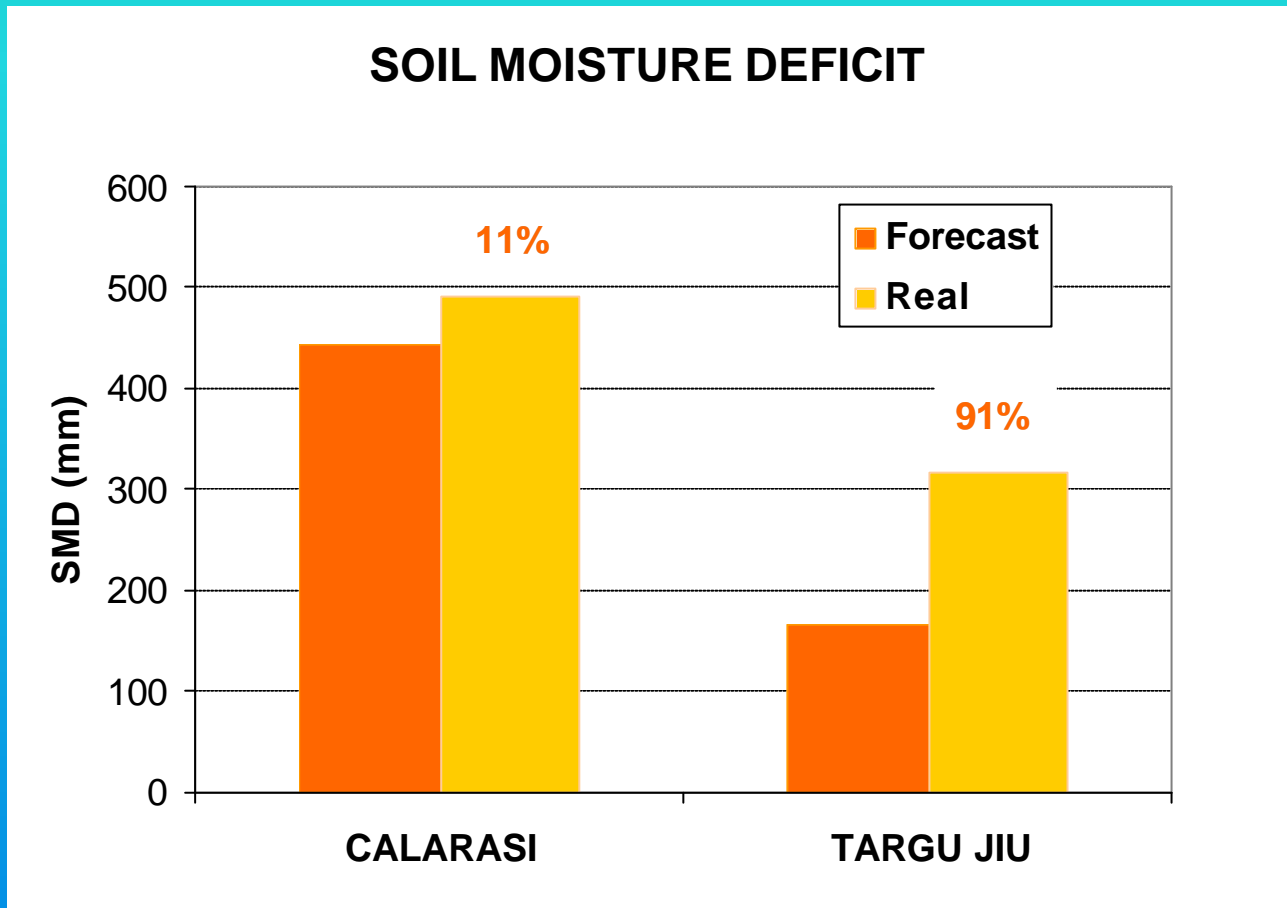
Skill level of seasonal forecast



Changes in growing season rainfall at Calarasi and Targu Jiu sites, under real weather conditions of the year 2003, as compared with the seasonal forecast

Results

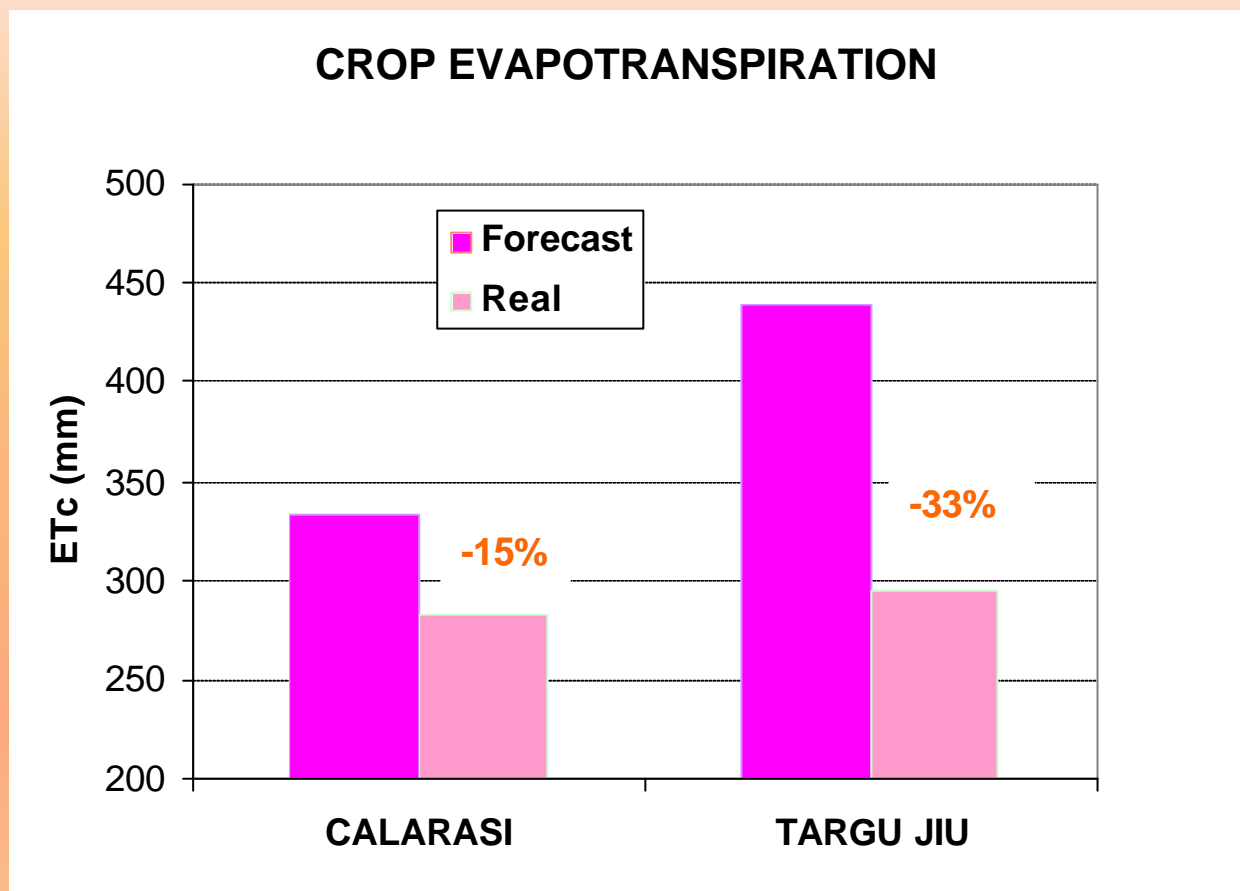
Skill level of seasonal forecast



Changes in growing season soil moisture deficit at both sites, under real weather conditions of the year 2003, as compared with the seasonal forecast

Results

Skill level of seasonal forecast



Changes in growing season actual evapotranspiration at both sites under real weather conditions of the year 2003, as compared with the seasonal forecast

Cumulative values of the main variables simulated with CROPWAT model on the whole maize vegetation period, in the estimated and real weather conditions of 2003

Site	Weather cond.	ETo mm	ETm mm	ETc mm	Total rain mm	SMD mm	Yield red. %
Calarasi	Forecast	676	578	333	144	443	53%
	Real	679	580	283	93	491	64%
	Diff. %	0.4	0.3	-15	-35	11	11
Tg. Jiu	Forecast	539	454	439	398	165	4%
	Real	531	441	295	159	316	41%
	Diff. %	-2	-3	-33	-60	91	37

Conclusions:

- ? According to the seasonal forecast for summer 2003 and the first month of autumn, in Targu Jiu the maize crop would not be affected by the soil water deficit, while in Calarasi the high soil moisture deficit would lead to yield reduction up to 53% from the productive potential;
- ? In the real weather conditions, the maize crop was affected by drought at both sites, the yield reduction percentage being 64% in Calarasi and 41% in Targu Jiu, respectively;
- ? The comparative analysis of the simulated results has emphasized a higher skill level of seasonal forecast for Calarasi site than for Targu Jiu site;

Conclusions:

? The precision level of forecast information for temperature was higher than for rainfall at both sites;

? The application of seasonal weather forecast combined with CROPWAT model allows the estimation of soil water supply conditions with 3-4 months in advance and in case a skillful forecast (such as for Calarasi site) can provides information necessary to make decisions on irrigation planning and management in a dry season, avoiding yield reduction.