Drought risk monitoring research program in Romanian forests

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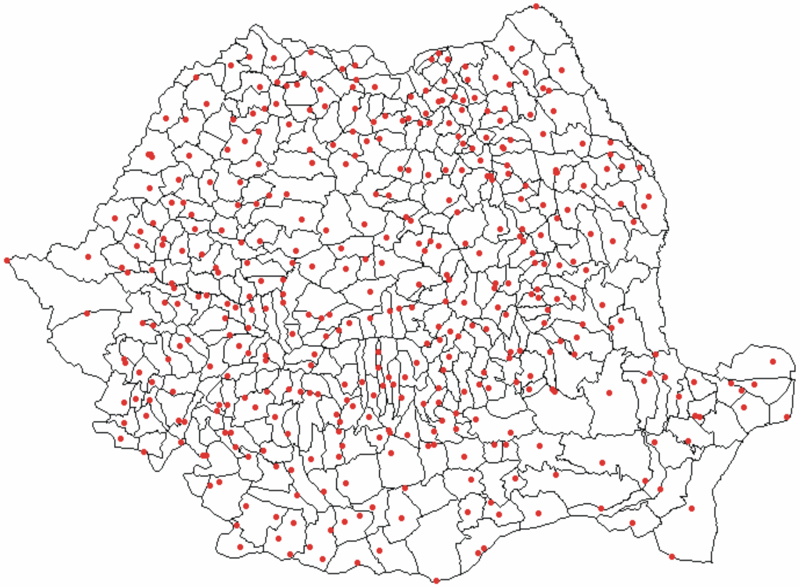
Introduction

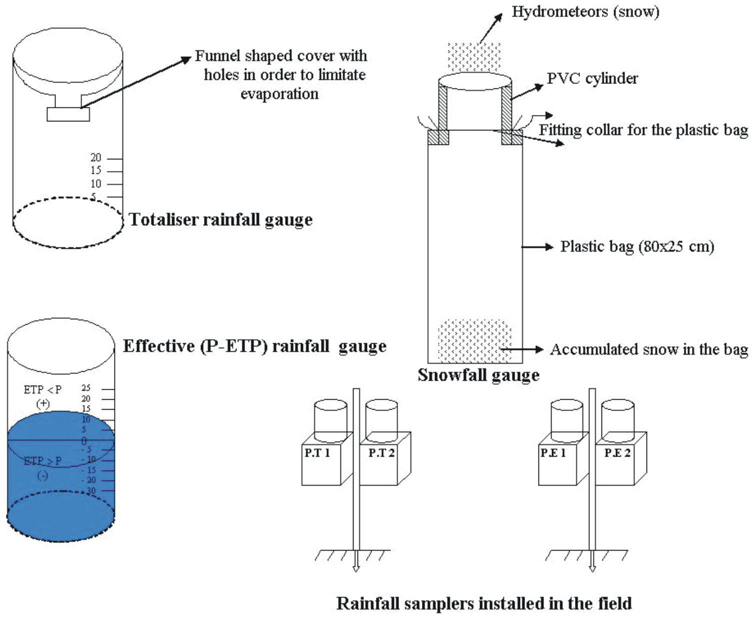
The complex problem of climate changes and their impact to the ecosystems represents an important challenge for the decision-makers involved in the management of the natural ecosystems, but also for the evaluation of socio-economic impacts at different time scales. In the frame of the Forest Monitoring Program (I.C.P. Forests), the impact of drought on the health state and the increment of the trees plays an important role. In the last three years, Romanian Forest Research Institute (ICAS) has developed, in the frame ofthe National Research Program MENER (Environment-Energy-Resources) the research project “Drought Risk Monitoring in Romanian Forests”, which tries to estimate in real time the risk of drought occurrence.



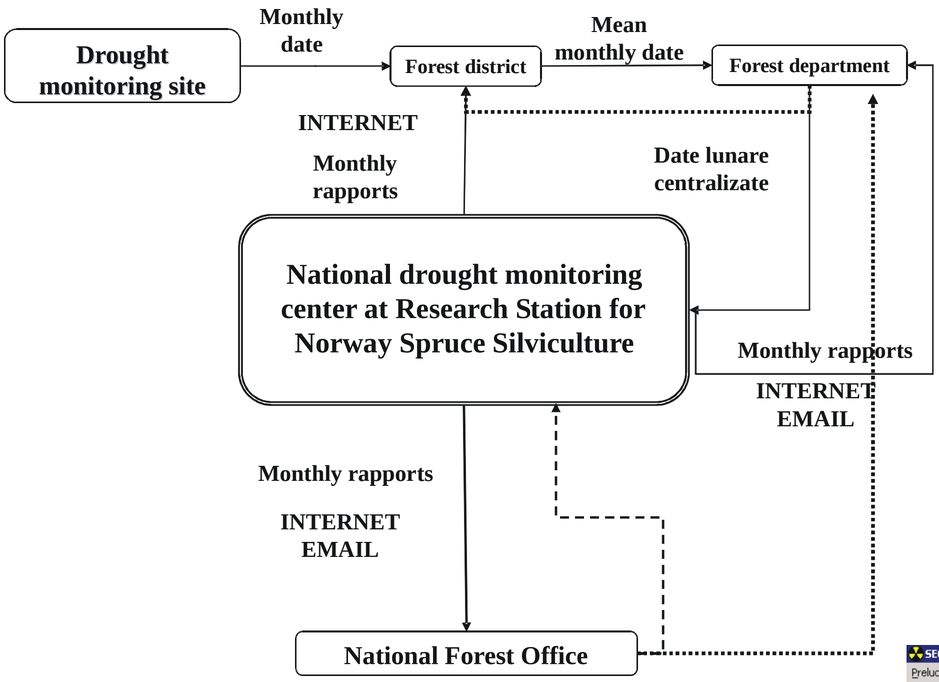
Network of measurement points for total and effective precipitations in the Romanian forests (red dots are permanent plots; each subdivision is a Forest District)

Methods

The measurements are performed in a network of permanent plots, ranged on the entire forested area, in about 400 forest districts. For a better estimation of the drought risk (which is higher at low altitudes), the plots were installed in representative zones, located in the lower part of each forest district. The deficit/excess of rainfall, in relation with the multiannual mean of precipitations are storaged in databases, computed and mapped using modern tools (geostatistics, GIS). On the basis of manuals and training programs, the forester observers from forest districts made measurements and send the data of the total and effective rainfall (precipitation minus evaporation) to the coordinators of the project at each Department Brach of National Forest Administration (RNP). The data are faxed or e-mailed in the first three days of the each month and introduced in the database of the ICAS Experiment Station Câmpulung Moldovenesc. Raw data are checked, validated and processed in the first seven days of the each month. The results are presented in an e-mail report (4-6 pages) with 8-16 maps, showing the rainfall indices for the last 1-12 months, and also is available on Web, at the address http://www.icassv.ro/seceta/.

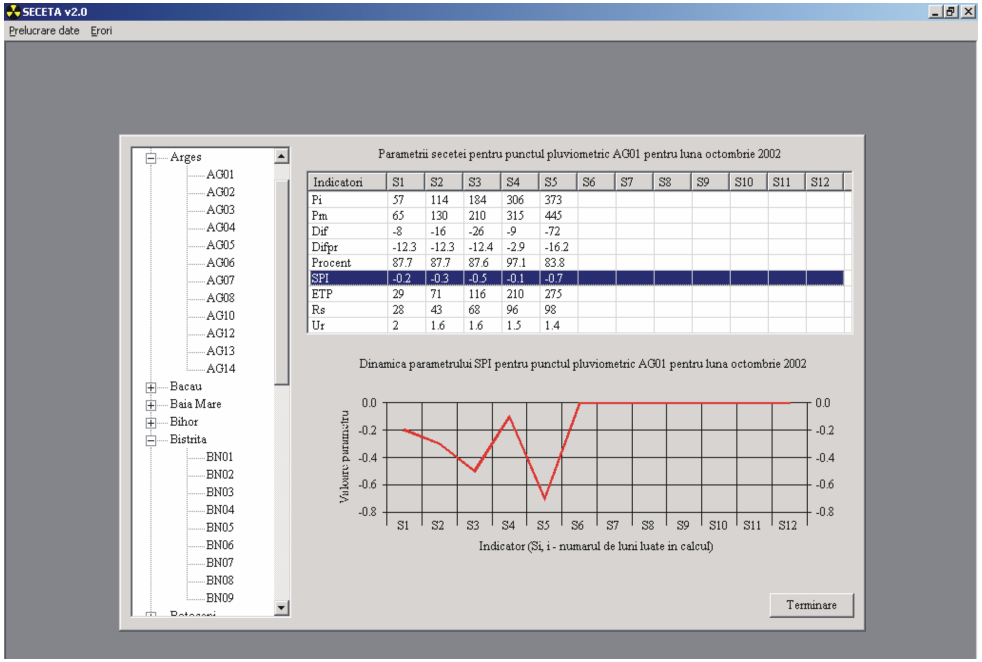


Equipments used for the measurement of the rainfall in the field



Flux of the data in the frame of the project "Drought Risk Monitoring in Romanian forests"

Screenshot of the database structure



Results

For the evaluation of the deficit/excess of precipitations, we have used the standardised precipitation index (SPI), proposed by Doessen & McKee (1991), computed for each point of the network. This index measures how much the real rainfall (for the last 1 to 12 month) is far from the mean value (of the same period), in standard deviation units (SD). Assuming the normal distribution of precipitations (Barbu & Popa, 2003), for the computation of SPI we have used the relation:

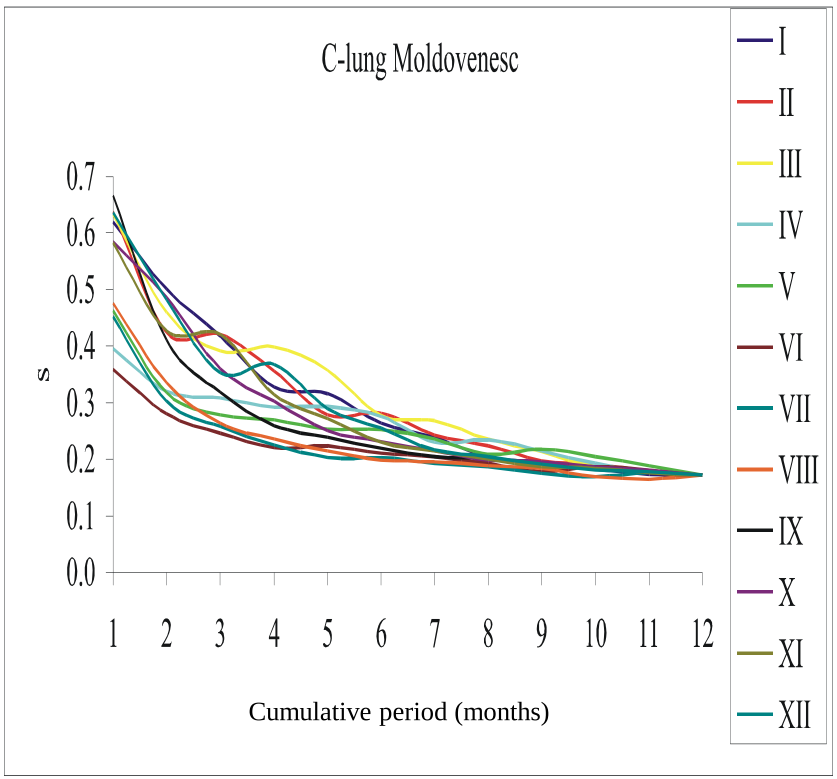
$$SPI = \frac{P_i - P_m}{SD_i}$$

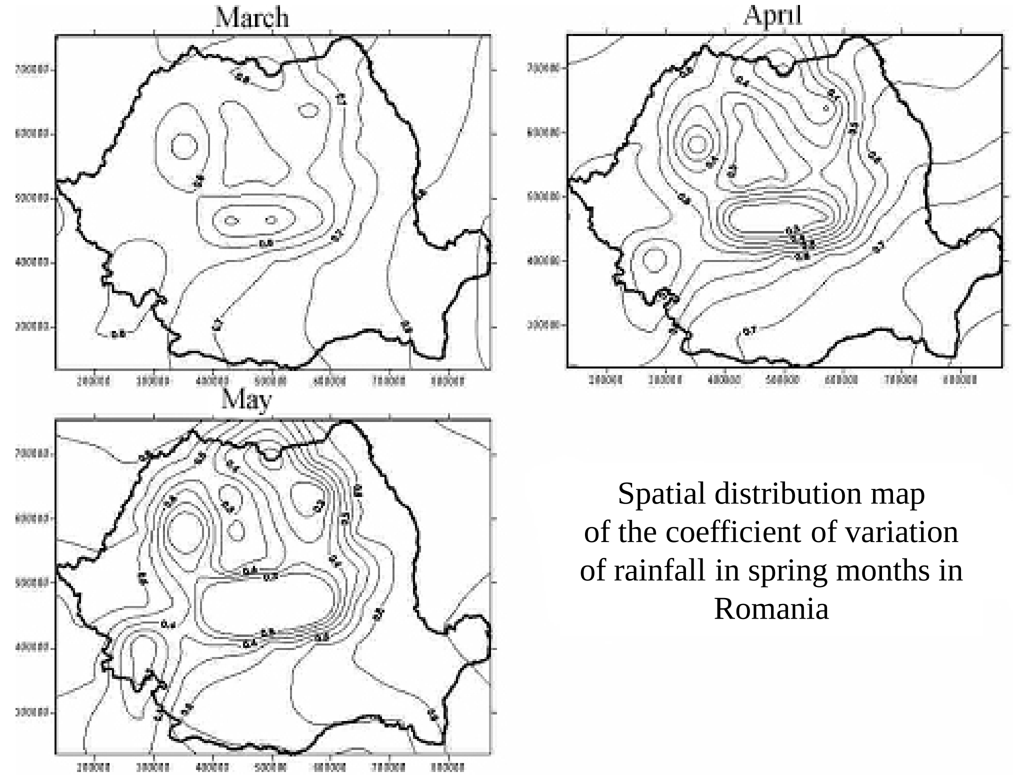
in which:
Pi = precipitations registered in the period i (1 to 12 months)
Pm = mean of the precipitations in the period i
SDi = standard deviation of the mean precipitations in the period i
Transforming the SD in coefficient of variation (s), the SPI can be computed with formula:

$$SPI = \frac{\frac{P_i - P_{mi}}{P_{mi}}}{s_i}$$

Values were estimated for the territory and mapped for different periods (Barbu & Popa, 2003), on the basis of the measured precipitations in the period i, of the multianual mean values of the precipitations (Pmi) and of the coefficient of variation (si). Thus is possible to estimate the SPI for each point of the network. Using geostatistics and GIS, could be generated maps for the distribution of different parameters of rainfall regime.

Coefficient of variation (s) of cumulated rainfall registered in the last 1-12 months from January to December (I-XII) for the meteorological station Câmpulung Moldovenesc





Spatial distribution map of the coefficient of variation of rainfall in spring months in Romania

National Research Program MENER

Project: **MONITORING OF DROUGHT RISK IN THE ROMANIAN FORESTS**

National Forest Administration
Forest Research and Management Institute
Campulung Moldovenesc
www.icassv.ro

Director of Project: Dr. **Ion BARBU** – senior researcher

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About the project

The project is a part of The National Research Program MENER – Environment – Energy – Resources – which tries to evaluate in real time the risk of drought in the Romanian forests on the basis of rain measurements and analysis of indices derived from monthly rain dynamics.
The project started in 2001, after many years of test for equipments and computer programs.
The sustainable forest management in Romania is confronting with great difficulties because of the action of disturbing factors with continuous or quasi-continuous action, among which drought is a determinating aggravating factor (forest fires, insect attacks, overgrazing etc). More often in the last decades, the dying away of many forest has been increased or maintained by prolonged drought conditions.
The making of a national network for measuring total or effective rainfall in the Romanian forests in 2002 has allowed through the mean of very modern computing and viewing systems (GIS, geoststistics), the real evaluation of drought risk for each forest district and the correct foundation of management decisions for each area. The project is directed by Ion Barbu, Ph.D., senior researcher, has been involved in the last 25 years in specific problems concerning the abiotic disturbing factors (snow damages, windthrow, dying away of resinous forests etc.) and has proposed many methods for estimation of natural and antropic risk of forests.

REPORT
OF DROUGHT RISK NR 12

January 2003

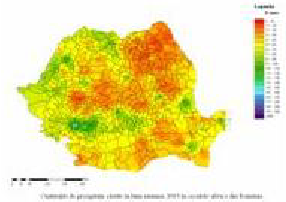
Inside this issue

- **Drought-risk monitoring report for 01.2003**
- **First yearly report 2002**

Synopsis of climatic conditions in 2002.

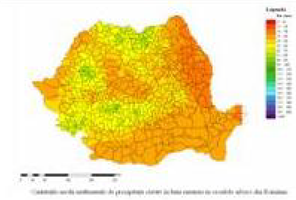
On the ground of rainfall measurements in the monitoring network (400 plots located in each forests district) there has been made an analysis of conditions for each month and season of 2002.
Rain characteristics (in % of mean) of winter 2001-2002 are summarised as follows:
-extremely dry (less than 20% mean rain) in west and south – west Romania
-very dry (25 – 50% of mean rain) in south – east and Transylvania
-moderate dry (50 – 80% of rain) in Dobrogea and Danube plain (south)
-near normal (80 – 125% of mean rain) in the rest of territory
The spring 2002 have continued to be very dry in the same regions as in winter. Rainfall regime was characterised as follows:
-excessive – extreme dry in the hilly regions of southern Carpathians, southern Moldavia, Danube Plain (Bărăgan) and western plain
-very dry – moderate dry in the rest of the country Most part of weed culture and generally agriculture and living stock were affected
The Summer 2002 change totally the rainfall regime and from the end of Mai in southern regions heavy rainfall were registered. The regime of rainfall in summer were:
-very wet – extremely wet in Moldavia and south Romania (except Bărăganul)
-moderate dry – very dry in the south – east
-near normal in mountainous area and Transilvania
The Autumn 2002 reach also huge quantities of rain in all the regions of Romania especially in the extra – Carpathian area.
The rainfall regime were characterised as:
-very wet – excessive wet: in the Danube Plains south of Moldavia, Dobrogea and the north – west region
-moderate wet: in the south – western regions and central Transilvania
-near normal – in the others regions of Romania
The growing year 2002 were characterised by heavy drought in the first part and heavy wet in the second part. In the statistics this situations is very rare. At the beginning of winter season 2002/2003 in all the regions (except south – east) the water supply of soils is estimated good – very good and a good start in the growing season 2003 is forecasted.

Summary of rainfall regime in 2002



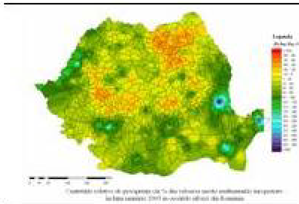
←Map of rainfall (Pi) registered in January 2003

The areas with the lowest rainfalls registered in January 2003 are the NW and S of Transylvania. The rainiest regions are the NW of the Country and in the Southern Carpathians. Rain fall which is greater than the mean in the area has been registered in the S of Moldavia and in the Danube Delta. Areas with rainfall lower than the mean for the area are located in the Romanian Plain. In the Eastern Carpathians, the rainfall was much lower than the mean, especially in the middle and north.



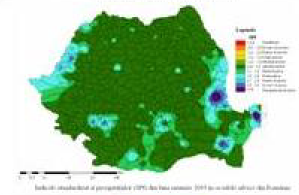
←Map of mean rainfall (Pm) registered in January

Throughout Romania, the month of January is a very dry month. From this rule are excepted the mountainous regions in the SW and NW of Romania, areas which benefit from more precipitations, brought along by the depressional areas caused by the masses of warm and humid air from the Mediterranean and Baltic, which can not break the masses of cool air deriving form the Siberian Anticyclone.
Normally, the driest areas are situated in Moldavia and in the Danube Delta. The area with the most precipitations is the Western part of the Carpathians. The mean value of precipitation in the country is of about 30-40 mm.



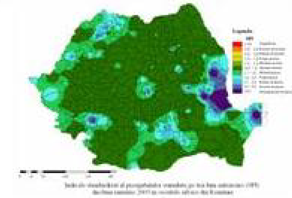
←Map of percent (Pi/Pm) of rainfall registered in January 2003

Map of relative rainfall (Pi/Pm) in January 2003 shows that in the North of Moldavia and in S Transylvania have been registered 10-60% of the mean of January. In the West Plain, South Moldavia and Muntenia, the rainfall exceeded the mean with 20-200%.



←Standardized Index of Precipitation registered in January 2003 (SPI 1)

Although the relative excess/shortage of precipitations are important, the variation coefficient (s%) of rainfall in January throughout Romania is a very high one (more than 50%), which causes the Standardized Precipitation Index to take low values, making January a month with a normal rainfall regime. The only areas with excessive precipitations are a few forest districts in the S of Moldavia and a few forest districts in the W of Romania.



←Standardized Index of Precipitation registered in the last three months Jan-Dec-Nov (SPI 3)

The Standardized Precipitation Index for the last three months also shows a normal precipitation regime, excepting the S of Moldavia, N of Dobrogea, N Romanian Plain and West Plain, where rainfall exceeds normal. These areas have been affected with great intensity by drought in 2002, and an excess of precipitations from the end of 2002 and the beginning of 2003 guarantees optimal conditions for the aforestation campaign in spring 2003 and the beginning of the growing period.

English version of the Monthly Drought Risk Monitoring Report (example)

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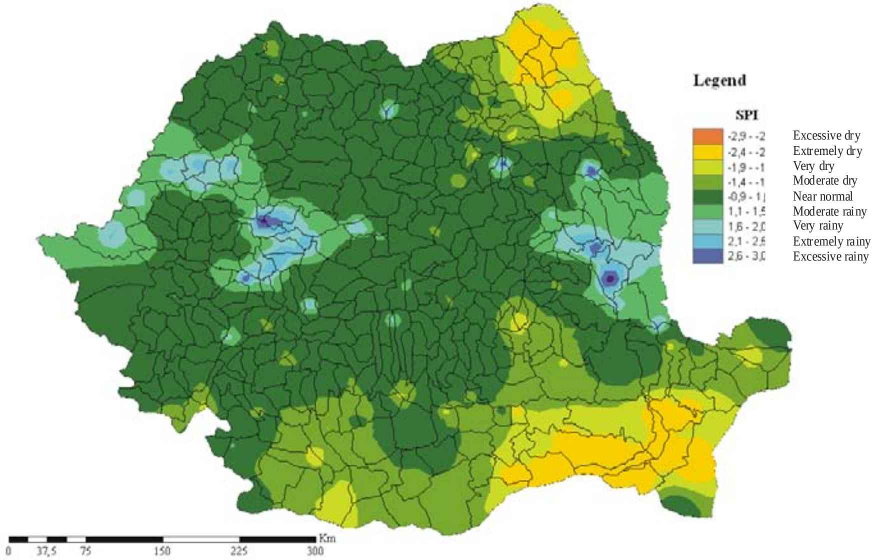
Discussions

The access of our users (decision makers) to real data, in real time, allows a better foundation of the forest anagement decisions (i.e. reforestation). Data from this monitoring project are useful also for other different purposses: the evaluation of the pollution effects, the estimation of the rainfall deficit impact on the health state of trees and on the incidence of other disturbances on the forest (fires, insects, pests, grazing etc.).



Distribution of Standardised Precipitation Index (SPI) in April 2004 in Romanian forest districts

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