MONITORING SOIL WATER CONTENT STATUS IN NATURAL PASTURES AREAS IN URUGUAY USING A SOIL WATER BALANCE MODEL

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SUMMARY

Cattle beef production in areas with natural pastures is very important in Uruguay. Monitoring water soil content status in natural pastures areas is a key issue for planning and decision making at farm and government level, to prevent production losses.
The Climate and Information Systems Unit (GRAS) of the National Agricultural Research Institute (INIA) of Uruguay, jointly with other national and international Institutions (MGAP, DNM, IRI), has been developing an Information and Decision Support System (IDSS) for monitoring soil water availability status using a Soil Water Balance Model.
Data and maps including soil water availability estimated values are monthly published by GRAS in the web page www.inia.org.uy/gras/ visited by more than 2,000 users per day, and a written bulletin is sent by email each month to more than 25,000 users.

Key Words: soil water balance, natural pastures, soil water content monitoring.

INTRODUCTION

Cattle beef production in natural grasslands is one of the more relevant agriculture production in Uruguay. Monitoring and information about the current status of natural pastures is very important for planning and decision making at farm and government level, to prevent cattle beef production losses. Soil water availability is the main factor determining natural grass species production during the growth season.

The Climate and Information Systems Unit (GRAS) of the National Agricultural Research Institute (INIA) of Uruguay, jointly with other national and international Institutions such as the Ministry of Agriculture (MGAP), the National Direction of Meteorology (DNM), the Argentinean Agriculture Research Institute (INTA), and the International Research Institute for Climate and Society (IRI), has been developing an Information and Decision Support System (IDSS) for monitoring natural pastures status in Uruguay. That IDSS is based in tools like Remote Sensing, Geographic Information Systems (GIS) and Water Balance Models.

OBJECTIVES

The main objective of the IDSS is to develop and offer almost real time information about natural grasslands areas production status, to support Government and cattle beef producers planning and decision making. Soil water availability is the main factor determining natural grass species growth.

One of the most important components of the IDSS is the estimation of the soil water content based on a Soil Water Balance Model for Uruguayan soils.

METHODOLOGY

The “Water Balance Model for Soils of Uruguay” (http://www.inia.org.uy/disciplinas/agroclima/bh), developed by the INIA – GRAS Unit jointly with the Water and Soils Department of the MGAP, and the National Direction of Meteorology of Uruguay, estimates the soil water content integrating the water precipitation data from 85 climate stations, the atmosphere water potential demand, the vegetation transpiration, and the water holding capacity of each soil type. This model runs daily and generates ten days and monthly means outputs in map format of soil water content (mm and %) and water runoff (mm).

Model inputs are:

- Effective precipitation (PRE) calculated with the current registered precipitation from 85 climate stations minus a surface runoff value estimated with precipitation values from 5 days before.

- Potential Evapotranspiration (ETP) or water pasture demand from the soil estimated with the Penman-Monteith physical model (FAO, 1998), using daily values of: temperature, air humidity, wind velocity and solar radiation.

- Soil Water Holding Capacity (CR) for each soil unit defined in the “Carta de Reconocimiento de Suelos de Uruguay escala 1:1.000.000” (MGAP, 1982). Changes of estimated soil water content are calculated daily using a logarithmic model adapted from the Thornthwaite C.W. y Mather J.R method.

RESULTS

The main soil water balance model outputs are:
1) Soil Water Content in mm (AD) and % (PAD), 2) Water Vegetation Stress Index (IBH) based on RET/PET, and 3) Surface Water Runoff (ANR), (Fig 1).

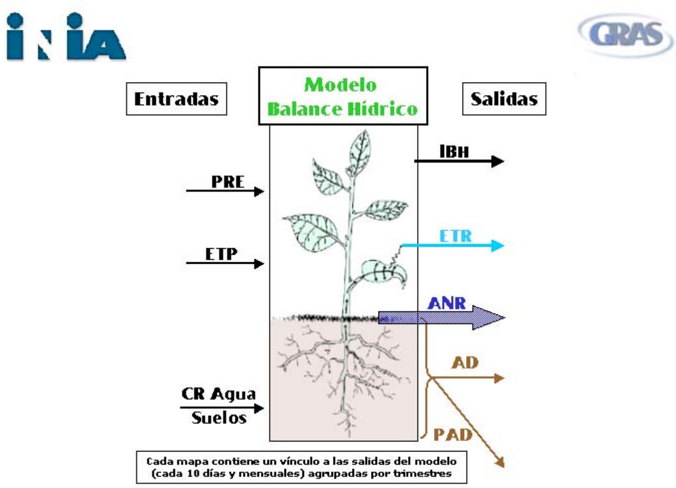
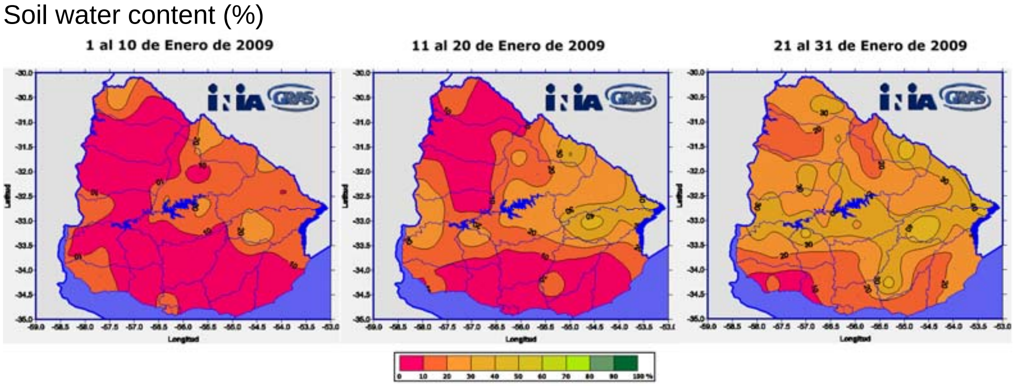


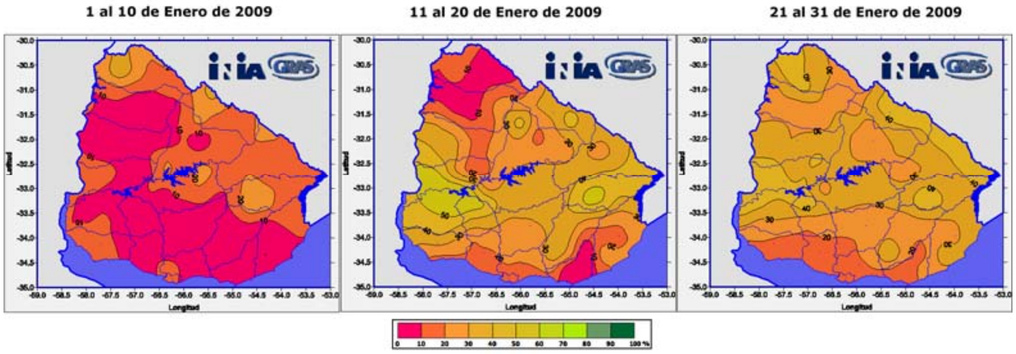
Figure 1: Soil water balance representation in the web site

Data application example: Monitoring “La Niña” drought (Summer 2009).

Soil water content (%)



Vegetation Stress Index (%, RET/PET)



Surface Water Runoff (mm)

Soil Water Balance data and maps are located and continuously updated (every 10 days) in the GRAS Unit web site http://www.inia.org.uy/online/site/148070I1.php , visited by 2,000 users per day.

A monthly agro - climate report, including Soil Water Balance information, is also published in the GRAS Unit web site and sent by email each month to more than 20,000 users.

CONCLUSIONS

Soil Water Balance components have demonstrated to be a powerful tool to monitor soil water content and vegetation status in natural pasture areas, mainly alerting and helping in drought situations.

Government and private decision makers use that information for planning and climate risk management in agriculture production in Uruguay.

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