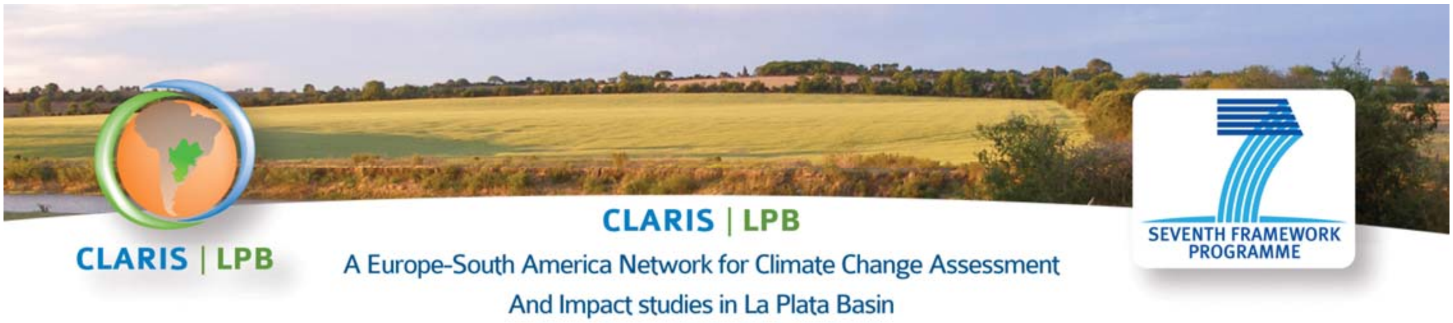

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Deliverables

Instrument: **SP1 Cooperation**

Thematic Priority: **Priority Area 1.1.6.3 "Global Change and Ecosystems"**

FP7 Collaborative Project – Grant Agreement 212492

CLARIS LPB
A Europe-South America Network for Climate Change Assessment and Impact Studies in La Plata Basin

DELIVERABLES

D09.09: Calibration of soil moisture satellite measures in the Lower Parana region

Due date of deliverable: Month 18

Start date of project: **01/10/2008** Duration: 4 **years**

Organisation name of lead contractor for this deliverable: CONICET

Deliverable No	Deliverable title	WP	Lead beneficiary	Estimated indicative person-months (permanent staff)	Nature	Dissemination level	Delivery date
D9.9	Calibration of soil moisture satellite measures in the Lower Paraná region	WP9	CONICET	4,00	O	PU	18

Report of Deliverable 9.9

Introduction

One of the activities included in WP9 was the calibration of soil moisture satellite measures in the Lower Paraná region. This task was to be lead by a French scientist expert in this area and scientists from CONICET would work in collaboration. However, at the moment of the kick off meeting of CLARIS LPB this scientist was not incorporated into the project, therefore a new strategy was adopted in order to fulfill the need of soil moisture information in the La Plata basin necessary for other studies in this project.

This deliverable is now focused on understanding how soil moisture interacts with different atmospheric processes and the impact it has on the development of floods in the area of La Plata Basin. Given the scarce information available, since no regular and continuous measurements of soil moisture are performed in the area, soil moisture will be estimated for La Plata basin through a soil moisture model, CLASS U3M-1D. Once the model is calibrated for different locations soil moisture scenarios will be generated and used to study the impact on precipitation in particular situations which lead to flood conditions.

Fortunately, soil moisture data is measured continuously at some locations, some of them are in the Province of Entre Rios. Therefore, work is being carried out in collaboration with the National University of Entre Rios, who measure soil moisture at several points in the province using automatic meteorological stations. Their soil moisture measurements had not yet been callibrated at the beginning of this project but are now in process of completing this process. Different soil data, such as texture and hydraulic parameters will be available soon and the model callibration shall be completed for the province.

Model Description

The model chosen is CLASS U3M-1D developed by the Cooperative Research Center for catchment hydrology – Australia. The CLASS modelling framework (Tuteja et al 2004) consists of a suite of tools that can be used for physically based distributed eco-hydrological modelling. The framework is designed for investigation of the effects of landuse and climate variability on both paddock scale as well as the catchment scale. The framework includes several tools that are used as building blocks in the catchment model, CLASS U3M-1D is one them.

CLASS Unsaturated Moisture Movement Model U3M-1D (Vaze et al 2004) can be used for partitioning water balance using Richards' equation in the unsaturated zone for any combination of climate conditions, land-use and soil type. Non-reactive solute balance across the soil profile can also be performed using advective transport. A balance is conducted for each soil material and evaporative, drainage and solute fluxes are simulated over time. Water balance error associated with the numerical approximation is quantified for each soil material. The model uses an adaptable sub-daily time step based on transient climate conditions.

Data

Climate data necessary for running the model consists of precipitation and evaporation. Rainfall is meausured daily at different meteorological stations in the La Plata basin, however this is not the case of evaporation therefore it must be estimated through equations. CLASS U3M-1D converts the evaporation data into potential evapotranspiration using a PAN coeficient, therefore the process followed was to estimate potential evapotranspiration using the FAO Penman-Monteith equation (FAO, 1998) and then convert it into evaporation using the PAN coeficient. Maximum and minimum temperature, wind, relative humidity and radiation data are used in the calculation of potential evapotranspiration. The daily data necessary for these estimations, as well as precipitation data were available from de National University of Entre Rios automatic station. The station also estimates hourly potential evaporation and then integrates it to obtain the daily value.

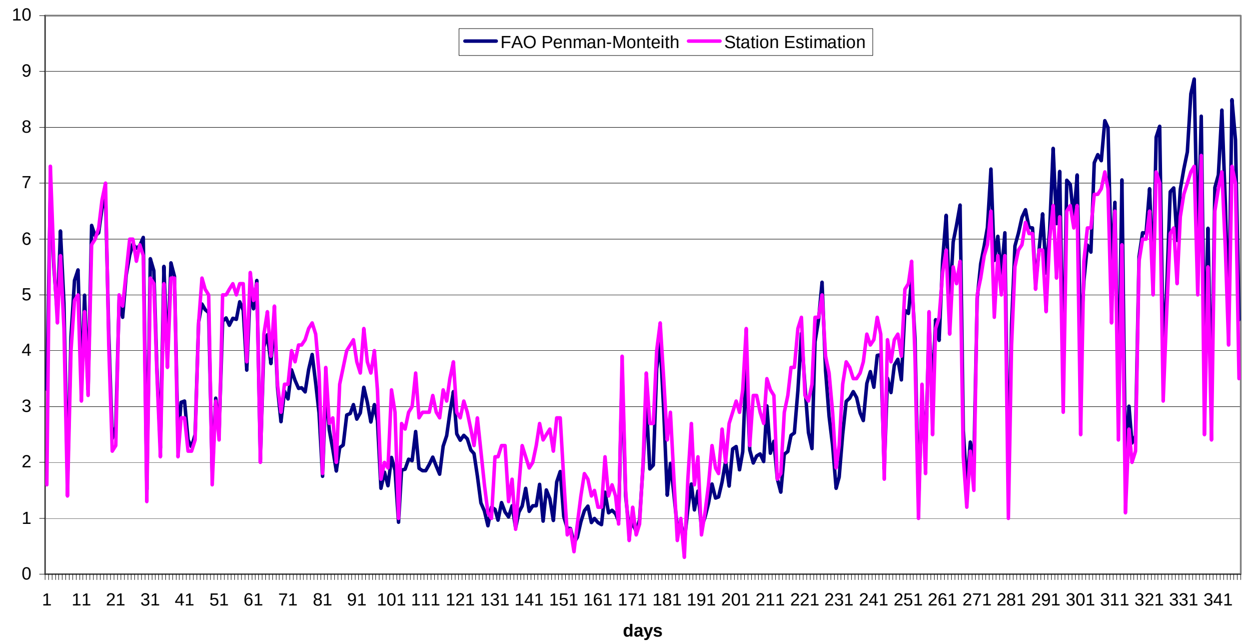

Figure 1: Daily potential evapotranspiration estimated using the FAO Penman-Monteith equation and estimated by the automatic meteorological station.

Figure 1 presents the daily potential evapotranspiration for Diamante station, Entre Rios, for the period January 2008 – December 2008. Blue lines correspond to values estimated applying the Fao Penman-Monteith potential evapotranspiration equation to daily information. Pink lines represent the daily integrated potential evapotranspiration estimated by the meteorological station. Both curves are in good agreement as confirmed by the high significant correlation coefficient (0.95). Differences are probably due to the fact that in one case the estimation is based on daily data while in the other potential evapotranspiration is estimated using daily information and then a daily value is attained. Since the potential evaporation equation is not linear the mean daily value will not coincide with the daily value estimated using mean daily variables.

As a first approach to calibrate the model for the selected site in Entre Rios, soil layers and soil materials were obtained from Diamante soil map elaborated by INTA. Once the callibration of the automatic station is concluded soil information will be update to better represent the area of interest. The maximum number of soil materials that CLASS U3M-1D can model is fixed to 4, however the depth of these materials is variable. In our case the lowest layer is set to *silt loam,* both intermediate layers correspond to *silt clay loam* textures, and the upper layer is *silt loam.* The total soil depth modeled is 60cm, which agrees with the depth within which measurements are available. Land use type selected is *pasture* and monthly mean values of leaf area index (LAI) are used.

There are 3 alternative soil hydraulic models setup in CLASS U3M-1D: *van Genuchten* (van Genuchten, 1980), *Vogel and Cislerova* (Vogel and Cislerova, 1988) and *Brooks and Corey* (Brooks and Corey, 1966). Default hydraulic parameters, for each of the three hydraulic models, have been used to the moment, but experiments will be run using the new parameters obtained during the station calibration process.

Results

Several tests were run to analyze the sensibility of the model. Using the Diamante station information for the year 2008 soil water content was estimated using CLASS U3M-1D for each of the hydraulic models. Results of the different experiments run have always been identical in the case of *van Genuchten* and *Vogel and Cislerova* as it can be seen in figures 2 to 5*. Brooks and Corey* captures best the decrease in soil moisture at surface level when compared to observations, while *van Genuchten* represents better the highest content of moisture in the soil. Data from Diamante station are on a different scale (right hand side) since they have not yet been callibrated. A value of 200 indicates the driest conditions while for saturated soils a cero value would be read. With the purpose of showing increased water content with higher measured values the scale has been modified, i.e., now 200 indicates staturated soils and dry conditions correspond to cero value.

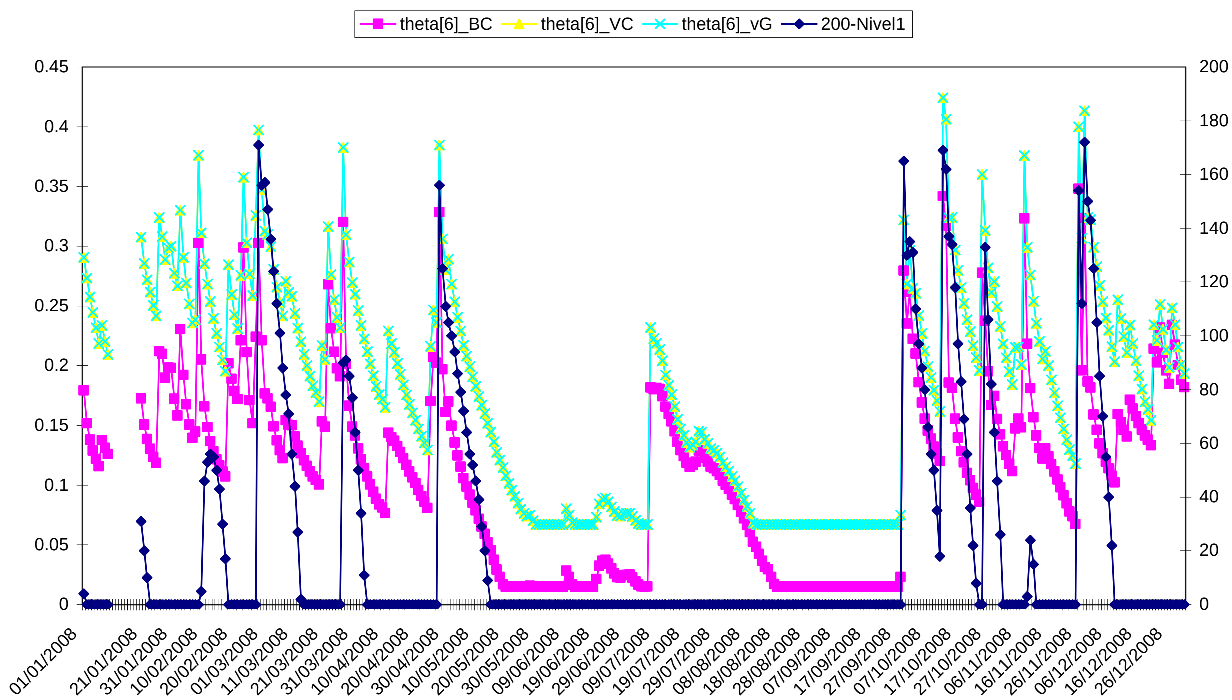

Figure 2: Surface level soil moisture modeled by CLASS U3M-1D using the alternative soil hydraulic models: *van Genuchten* (light blue), *Vogel and Cislerova* (yellow) and *Brooks and Corey* (pink), and soil moisture data measured at Diamante Station (Entre Rios) (blue).

Similar results are seen when looking at soil moisture at the second modeled level, 22cm (figure 3). However at deeper levels modeled water content does not seem to represent reality. At 35 and 55 cm (figures 4 and 5) no daily variation is observed in the soil water content at Diamante station, on the other hand modeled results with each of the hydraulic models, capture some variability. An interesting point is that upto 35cm minimum water values were lower in the case of Brooks and Corey model, but at the lowest level this behavior changes. Both van Genuchten (and Vogel and Cislerova) presents lower soil moisture values throught the whole period than those from Brooks and Corey model.

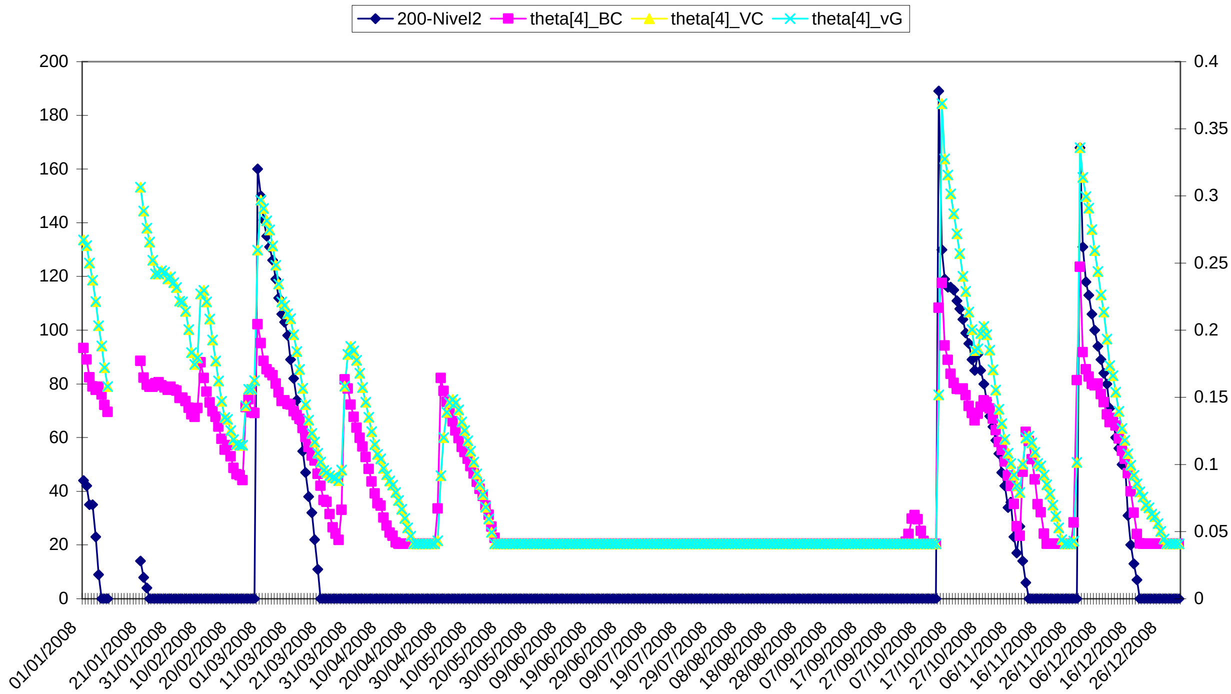

Figure 3: 20cm level soil moisture modeled by CLASS U3M-1D using the alternative soil hydraulic models: *van Genuchten* (light blue), *Vogel and Cislerova* (yellow) and *Brooks and Corey* (pink), and soil moisture data measured at Diamante Station (Entre Rios) (blue).

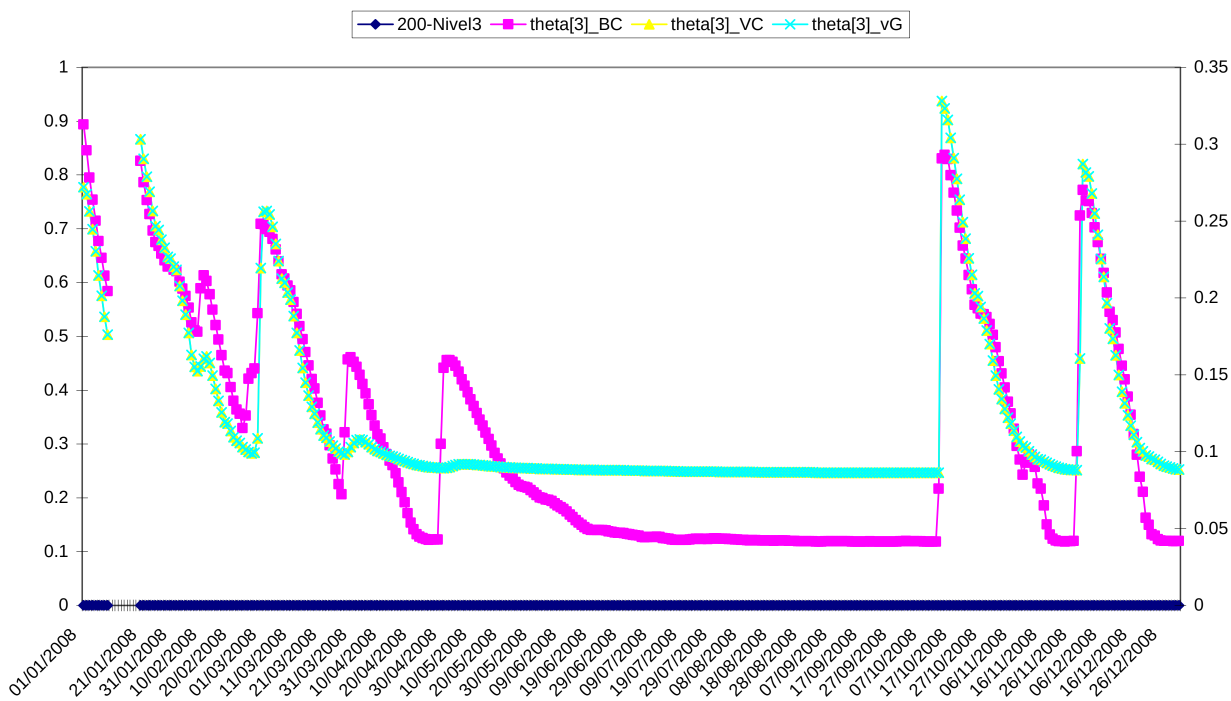

Figure 4: 35cm level soil moisture modeled by CLASS U3M-1D using the alternative soil hydraulic models: *van Genuchten* (light blue), *Vogel and Cislerova* (yellow) and *Brooks and Corey* (pink), and soil moisture data measured at Diamante Station (Entre Rios) (blue).

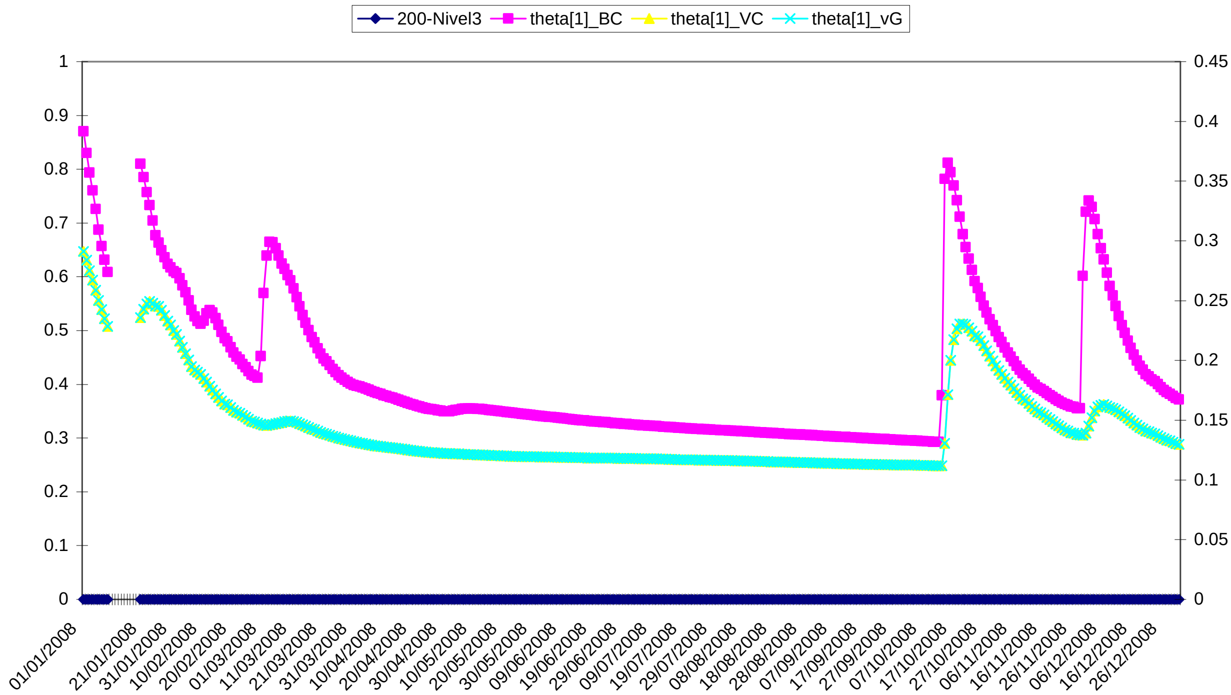

Figure 5: 55cm level soil moisture modeled by CLASS U3M-1D using the alternative soil hydraulic models: *van Genuchten* (light blue), *Vogel and Cislerova* (yellow) and *Brooks and Corey* (pink), and soil moisture data measured at Diamante Station (Entre Rios) (blue).

More tests are necessary to adequately callibrate the soil moisture model, and they will be run using the new soil parameters obtained from the callibration of the soil moisture sensors of the automatic meteorological station which is been carried out by the University of Entre Rios

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