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EVALUATION AND COMPARISON OF REGIONAL CLIMATE MODELS OVER THE IBERIAN PENINSULA

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ABSTRACT

Different relations between parameters involved in both water and energy land surface budgets are computed from daily ERA-Interim data for the months of July and November(representative of the dry and wet season) in the period 1989-2008 over an area within the Iberian Península covering most of Tajo and Guadiana basins (from 40.5N to 37.5N, and from 7.0W to 2.0W).
The main objective of this work is to use the obtained relations for the evaluation and comparison of regional climate models (RCMs) participating in the ENSEMBLES project. This approach was first proposed by Betts (2004) for comparing and evaluating global climate models. He proposed the assessment of model surface components as a system with widely connected components. In this way, models are compared among themselves and evaluated against observational data. The work is mainly focused on the goodness of the representation of physical surface processes and their feedbacks. The obtained relationships among different parameters are therefore considered as imposed restrictions by physical processes which can be used to evaluate RCMs.

OBJECTIVES

1) To analyze in an area of the Iberian Peninsula the behavior the ERA-Interim model in terms of daily water and surface energy balances to establish some relationships that should meet the climate models in this area.

2) In a next step we will check if this relations obtained are well represented in the models of the ENSEMBLES project.

3) If these relationships are satisfied in a similar way on the models of the ENSEMBLES project we will obtain a greater robustness for future projections for the SRES A1B scenario for the period 2001-2050.

INTRODUCTION

❑ The climate processes can be represented in mathematical terms based on physical laws.
❑ The climate system of the land surface exerts controls on the amplitudes of the variables in all time scales

❑ The changes in the radiative flux at the Earth's surface affect the surface heat and moisture.

❑ The comparison of predictability and uncertainty of the models indicates that the latter are relatively more important in most of the European region .

❑ It is necessary to know the goodness of the models to reproduce the reference climate in different regions and thus to begin the task of construction of probabilistic scenarios.

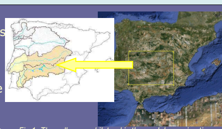


Fig.1.-The yellow quadrilateral is the model aproximation to the Tajo and Guadiana river basin shown in the left (beige-shaded)

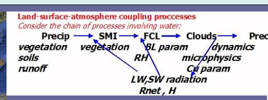
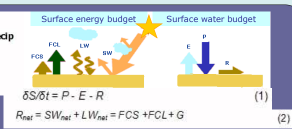


Fig.2.- The parameters and the processes involving water and their feedbacks



$$\delta S/\delta t = P - E - R \quad (1)$$

$$R_{net} = SW_{net} + LW_{net} = FCS + FCL + G \quad (2)$$

Fig.3.- Schematics of surface energy and water fluxes. FCS, FCL, LW and SW stand for surface sensible and latent heat flux, surface longwave and shortwave radiation flux, respectively; E, P, and R stand for evaporation, precipitation and runoff. The surface water balance and the surface energy balance equations.

METHODOLOGY

The methodology used by Alan K. Betts (2004) is followed for the understanding of the linkages and feedbacks between physical processes in the models, so that different models can be compared with each other and with data.
ERA-Interim model data (grid 0.5X0.5) are used for the period 1989-2008, in an inland area of the Iberian Peninsula which covers roughly the Tajo and Guadiana basins for July and November.
Daily data are chose since the surface climate variations can be represented with considerable accuracy by means of the average daily state variables and average daily flows.
The work is maked with the months of July and November as representative of the dry season and wet season respectively in the area of calculation, but sometimes we also use date from May because there is a huge drought in July in this area and this does not allow us to drawn conclusions of the connections between some parameters.
The mean lifting condensation level height is a good approximation to mean cloud base in the daytime (Hnub): Hnub = 122(T-Td)
The index moisture soil SMI is computed for the first 0-7cm soil layer as SMI = (SM-0.171)/(0.323-0.171); SM is the model soil water fraction, 0.171 the model soil permanent wilting point and 0.323 is the model field capacity.
The evaporative fraction (FE) = FCL/(FCL+FCS)

RESULTS

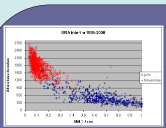


Fig.4.-Scatterplots for the selected area of the Iberian peninsula of H_{nub} as a function of SMI

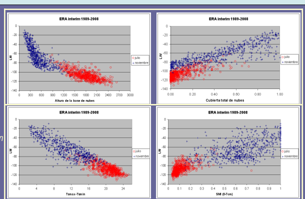


Fig.5.-Surface LW_{net} as a function of cloud base, total cloud cover, the diurnal range of radiometric skin temperature and soil moisture index (0-7cm layer) for Jul and Nov for the selected area of the Iberian peninsula

Hnub ↓	LWnet ↓
Tsmax-Tsmin ↓	LWnet ↓
SMI ↑	LWnet ↓
TCC ↑	LWnet ↓

Table 1.-¿ What happens when LW_{net} decreases?

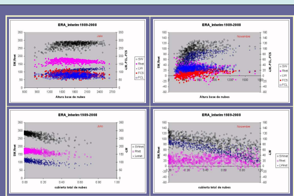


Fig.6.- (top) Surface energy balance terms SW_{net}, R_{net}, LW_{net}, sensible heat FCS, and latent heat FCL as a function of mean cloud-base Hnub for Jul and Nov, and (bottom) radiation fluxes as a function of total cloud cover

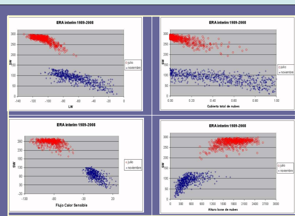


Fig.7.- As in Fig.5, but SW_{net} against LWnet, total cloud cover, sensible heat flux and cloud base

Hnub ↓	SWnet ↓
LWnet ↓	SWnet ↓
FCS ↓	SWnet ↓
TCC ↑	SWnet ↓

Table 2.- ¿What happens when SW_{net} decreases?

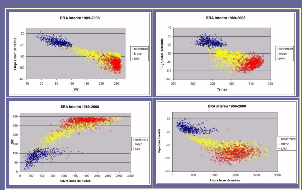


Fig.10.-As Fig.5, but for sensible heat flux against maximum skin temperature and SW_{net} , and mean cloud-base height against SW_{net} and sensible heat flux for May, July and November.

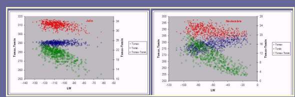


Fig.8.-Maximum and minimum skin temperatures T_{smax} and T_{smin}, respectively, and the diurnal range of skin temperature (right-hand scale) plotted against LW_{net} for Jul (left) and Nov (right)

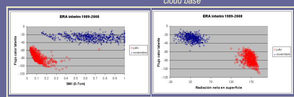


Fig.9.- As in Fig.5, but Latent heat flux,(FCL) against SMI, and net radiation (R_{net})

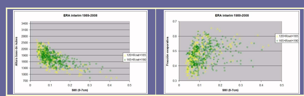


Fig.11.- Scatterplots for de selected area of H_{nub} and evaporative fraction partitioned into two ranges of R_{net}, as a function of SMI

CONCLUSIONS

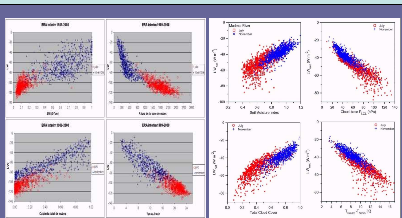


Fig.11.-Surface LW_{net} as a function SMI, H_{nub}, TCC, T_{smax}-T_{smin} for Jul and Nov for the selected area of the Iberian Peninsula for ERA-Interim data(1989-2008) (left-hand) and for the Madeira River basin (right-hand, obtained by Betts 2004) for ERA-40 data(1972-2002)

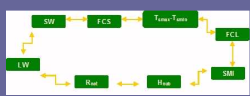


Fig.12.-The coupling of the soil moisture , cloud base, cloud cover, radiation fields, sensible and latent heat fluxes. We can see that there are strong feedbacks on the daily time scale between the cloud field and the surface energy budget. This means that cloud and the land surface components of a model must be evaluated as a tightly coupled system, not as independent components.

Hnub ↑	SWnet ↑
FCS ↑	FCL ↑
Tsmax-Tsmin ↑	Tsmax ↑
Rnet ↑	Fracción Ev ↓
TCC ↓	SMI ↓

Fig.13 .- If we assume that net longwave radiation flux LW_{net} increases the change they will experience the other terms is indicated in the table (increases in red, decreases in blue)

- **We have found out several relationships that meet the ERA-Interim model within the Iberian Peninsula**
- **The conclusions for our work area with ERA-Interim data largely coincide with those obtained by Betts for the Madeira River basin with data from ERA40.**
- **We have verify that the variables and fluxes are indeed interconnected.**

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