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A Europe-South America Network for Climate Change Assessment
And Impact studies in La Plata Basin

SEVENTH FRAMEWORK PROGRAMME

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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

D5.3. Ensemble of coordinated high-resolution climate change scenarios in La Plata Basin and their associated uncertainties

Due date of deliverable: Month 24

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

Organisation name of lead contractor for this deliverable: UCLM

Deliverable No	Deliverable title	WP	Lead beneficiary	Estimated indicative person-months (permanent staff)	Nature	Dissemination level	Delivery date
D5.3	Ensemble of coordinated high-resolution climate change scenarios in La Plata Basin and their associated uncertainties	5			O	CO	24

1. Introduction

On the general overview of WP5 objectives, it is stated that climate change scenarios derived from global models (GCMs) can exhibit inaccuracies at regional scales because some forcings cannot be adequately represented at coarse resolutions. La Plata basin is a region where climate change scenarios have not conclusively determined what changes could be expected in the next few decades, despite observational studies that have shown an increase in precipitation in the last past decades. The development of regional climate models (RCMs) nested into GCMs has been broadly accepted as the most adequate tool to improve the representation of the regional climate. RCMs are capable of representing finer-scale details related to thermal contrasts due to complex topography or other surface inhomogeneities. Moreover, due to the fact that RCMs are able to capture more adequately some mesoscale processes, they are expected to simulate more realistically precipitating systems, extreme events and, thus, regional climate. Therefore, one of the central issues of WP5 is to produce a coordinated ensemble of regional climate change scenarios. Task 5.1 indicates that a RCM ensembles of regional climate change scenarios has to be performed, coordinating among the groups to produce the ensemble scenarios. Next table shows which time periods and global climate model (GCM) models are used as boundary conditions for the seven 50km resolution RCMs participating in the project:

RCM	GCM	Present climate (1960—1990)	Near Future (2010-2040)	Distant Future (2070-2100)	Continuous run (1960-2100)
MM5	HadCM3-Q0	X	X	X	
RCA/SMHI	EC5OM-R1				X
	EC5OM-R2				X
	EC5OM-R3				X
RegCM3/USP	HadCM3-Q0	X	X	X	
	EC5OM-R1	X	X	X	
REMO	EC5OM-R3	X	X	X	
PROMES	HadCM3-Q0				X
LMDZ	EC5OM-R3				X
	IPSLA1B				X
Eta	HadCM3-Q0	X	X	X	

Table 1: Matrix of GCM/RCM combinations of regional climate change simulations over South America domain.

The result is an ensemble of 11 RCM simulations, 6 of them being forced with ECHAM5 (EC5OM) GCM (with three realizations), 4 of them with the HadCM3 (Q0 or “unperturbed” version), and 1 with IPSL. The GCM/RCM “matrix” above allow us to consider several degrees of uncertainty (from GCM and RCM formulations), being the emissions scenario A1B for all of them. A brief description of each of the 7 RCMs used in the project are available on the project web server.

At the project database web server more than 100 daily and sub-daily variables (at surface and on pressure levels covering up to 100 hPa) are available. Precipitation, temperature (mean, maximum and minimum), moisture, wind, radiation, pressure and soil magnitudes are among those variables, and geopotential, wind, moisture and temperature for atmospheric levels. Also vertically integrated fields are computed. These variables are stored in netcdf format (http://www.unidata.ucar.edu/software/netcdf/), usually for each decade. Also monthly fields are also computed. Furthermore, interpolated fields to a common 0.5x0.5 degrees grid are available, at least for the main variables. All the RCMs have results for the three 30-year periods: present climate (1960-1990), a near future (2010-2040), and distant future conditions (2070-2100), to allow different impact and climate change studies, depending on the interests and needs. Some of the RCMs model the whole 1960-2100.

Previously to these climate change simulations, the seven RCMs were forced with ERAinterim reanalysis (Simmons et al., 2007) for 1989-2008 period, over the same domain (Solman et al., 2011a, 2011b). These perfect boundary conditions allow to study spread among models not related to GCMs, and so will help to understand the uncertainties on RCM climate change runs forced by them.

2 Results

Deliverable D5.2 (“Uncertainties in regional climate change simulations”) is performing a detailed analysis of these simulations, being focused on the uncertainties obtained from these regional climate projections. A reference for these analysis, although focused over Europe, can be found in Déqué et al (2007). One main reference for this analysis is the European ENSEMBLES project (van der Linden and Mitchell, 2009). Therefore, here just a brief overview of the main results is presented here, with only simple spatial figures to describe the overall description of the ensemble of CLARIS-LPB WP5 RCMs simulating present and future conditions over South America. It must be remembered also that from deliverable D5.1, several metrics are expected to be used as indicators of that uncertainty or spread among models.

2.1. Present climate (1961-1990) validation

Seasonal mean temperature and precipitation are shown for each of the RCM projections, compared over that period with the widely used CRU gridded observational database (New et al., 1999). Figures 2.1 to 2.4 show DJF and JJA mean daily temperature and precipitation, respectively. In these four figures, it can be seen how RCMs are able to reproduce the main spatial characteristics of seasonal temperature both in winter and summer, the conditions over tropical and subtropical areas and their temperature gradient, for example. Other regional features are also reasonably described, both over the LPB region or over the Amazon, among many others. Nevertheless, some deficiencies are also obtained when models are compared with observations, such as, for example, a general overestimation of mean temperature maximum values on DJF over LPB, or over the Amazon, although there is also a relevant spread on model results for some of these features. In relation with precipitation, similar conclusions can be stated, both in terms of the capability to describe the seasonal cycle and spatial patterns related, but also with a spread on how models are able to describe some of the climatic features over the region, as it is the case, for example, of the systematic underestimation of precipitation over the southern part of LPB during June-July-August (JJA) period. It must be taken into account that biases on present climate period simulations here are not only due to the RCM itself (as it is the case in the ERAinterim runs), but also to the GCM used to force each regional model. As they are not the same for all of the RCMs, as shown in table 1, therefore, differences among RCMs and against observations will also be related to the forcing GCM.

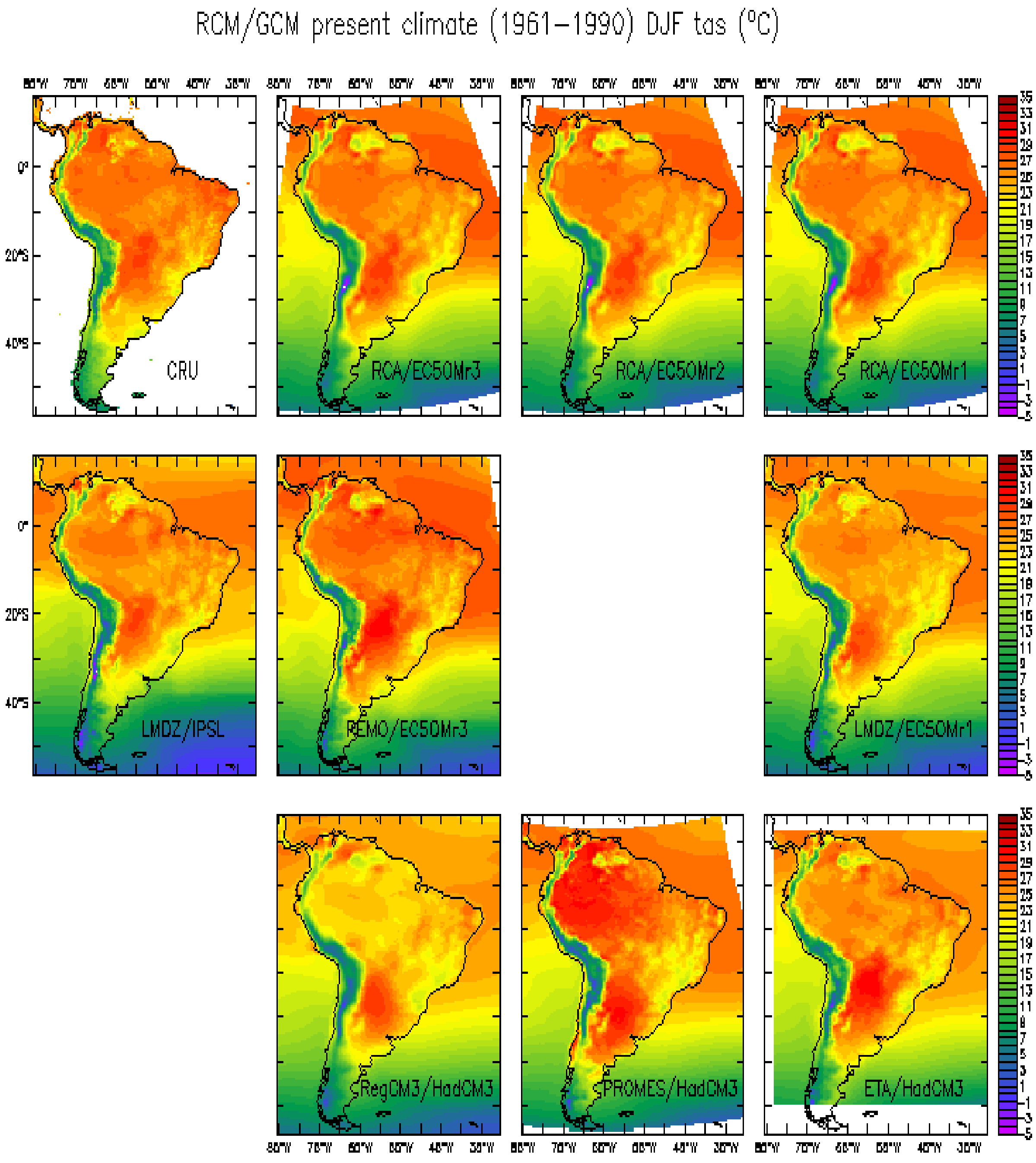

Figure 2.1: Present climate (1961-1990) DJF mean temperature from each of the RCMs

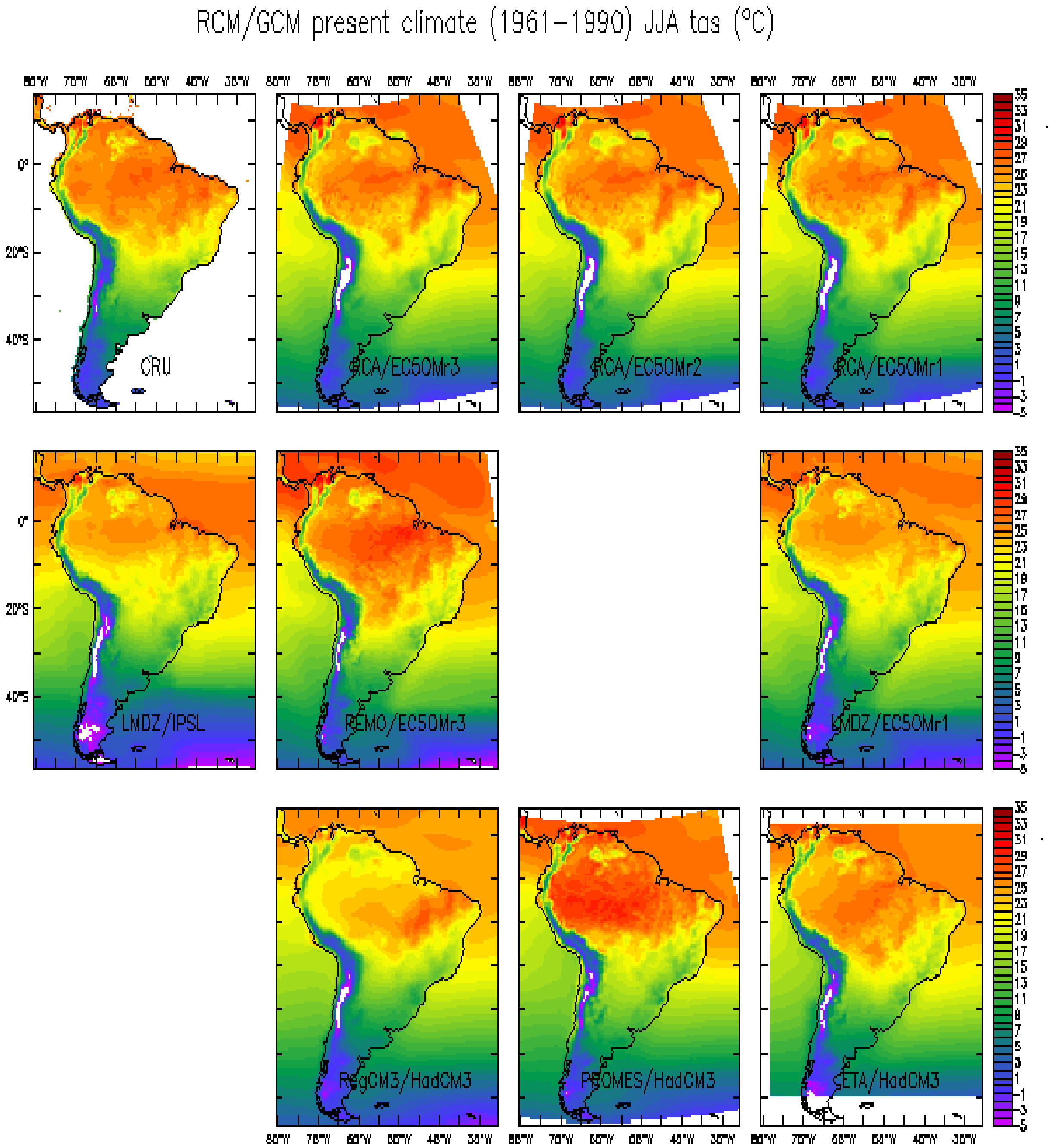

Figure 2.2: Present climate (1961-1990) JJA mean temperature from each of the RCMs

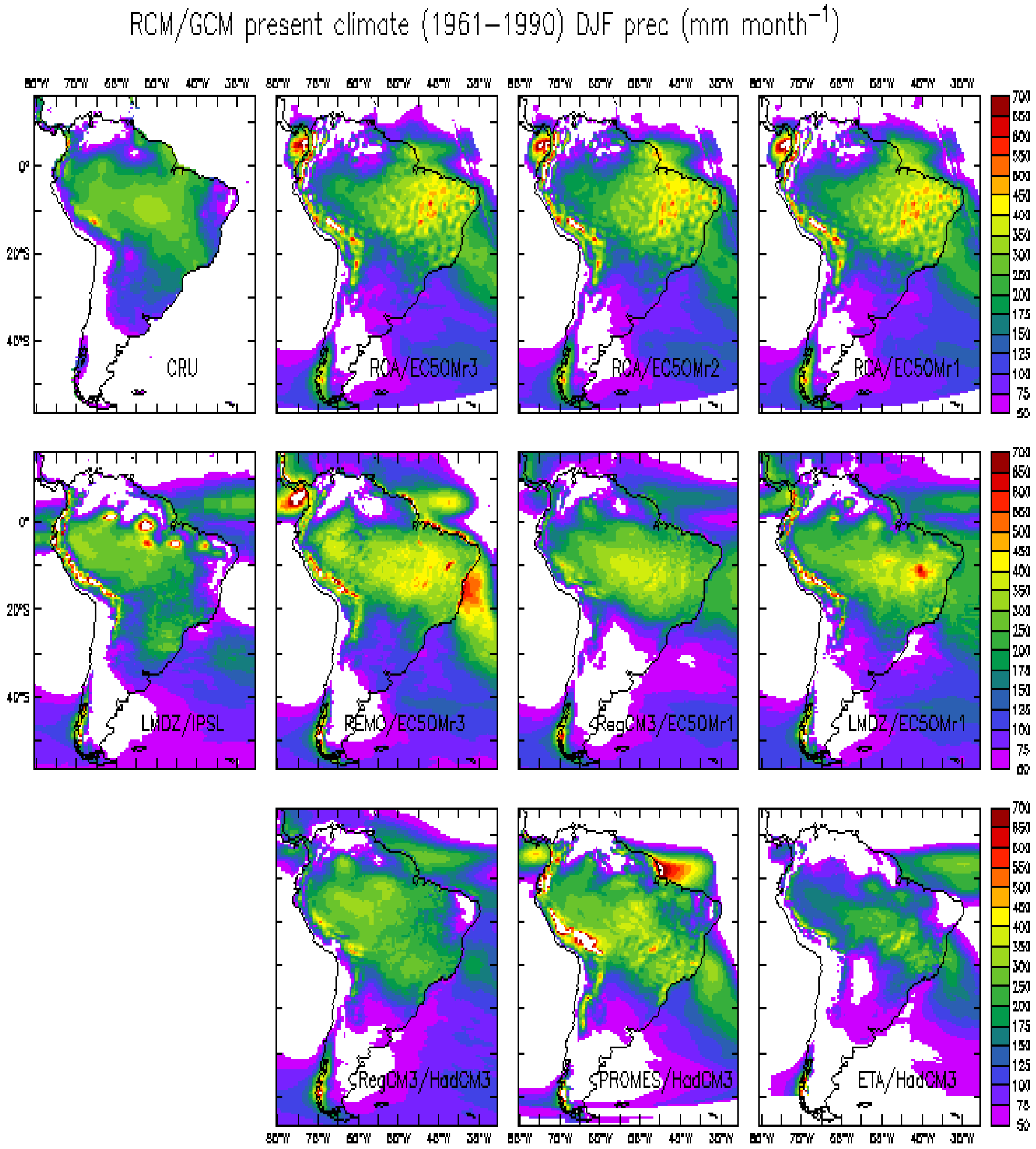

Figure 2.3: Present climate (1961-1990) DJF monthly precipitation from each of the RCMs

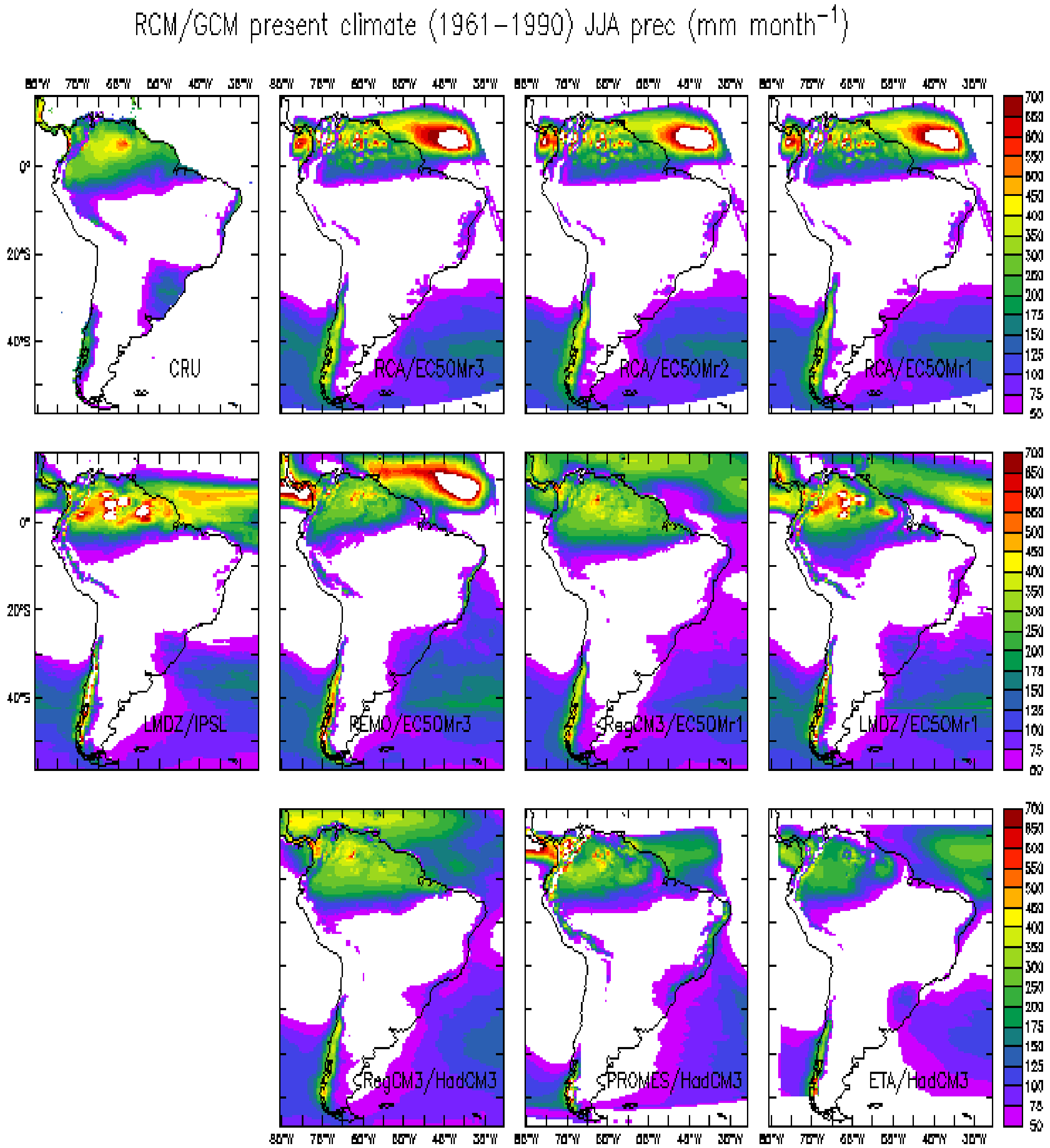

Figure 2.4: Present climate (1961-1990) JJA monthly precipitation from each of the RCMs

2.2. Future climate projections: Near future (2010-2040) and distant future (2070-2100)

Once present climate is modeled by the RCMs, the projections for future conditions from each of the RCMs is also presented in figures 2.5 to 2.8. Each of them show in the upper panel the results for near future conditions (2011-2040), and below for the end of XXIst century (2071-2100).

There is a general agreement on the increase of temperature obtained by any of the regional models, that is increased when the further period is considered. Regional features are obtained that are slightly different from model to model, sometimes even when the same GCM is used to force to different RCMs.

As it was obtained for temperature when simulating present conditions, precipitation results exhibit a larger spread when comparing models for both periods and for both seasons. This is an expected result, as precipitation is known to show a larger uncertainty. Specially during summer (DJF), it seems that there is a trend to increase the changes (positive or negative, depending on the region and model) of change from near to distant future: most of the models show an increase of precipitation compared with present climate conditions over LPB, that is increased when further future period is considered. Over the Amazon, it tends to be the opposite behavior.

Nevertheless, as it is already mentioned in the introduction, here just a very brief description is presented, and a detailed analysis of the spread among models when describing future climatic conditions is done in detail on deliverable D5.2, and the associated uncertainties related to the ensemble of RCMs.

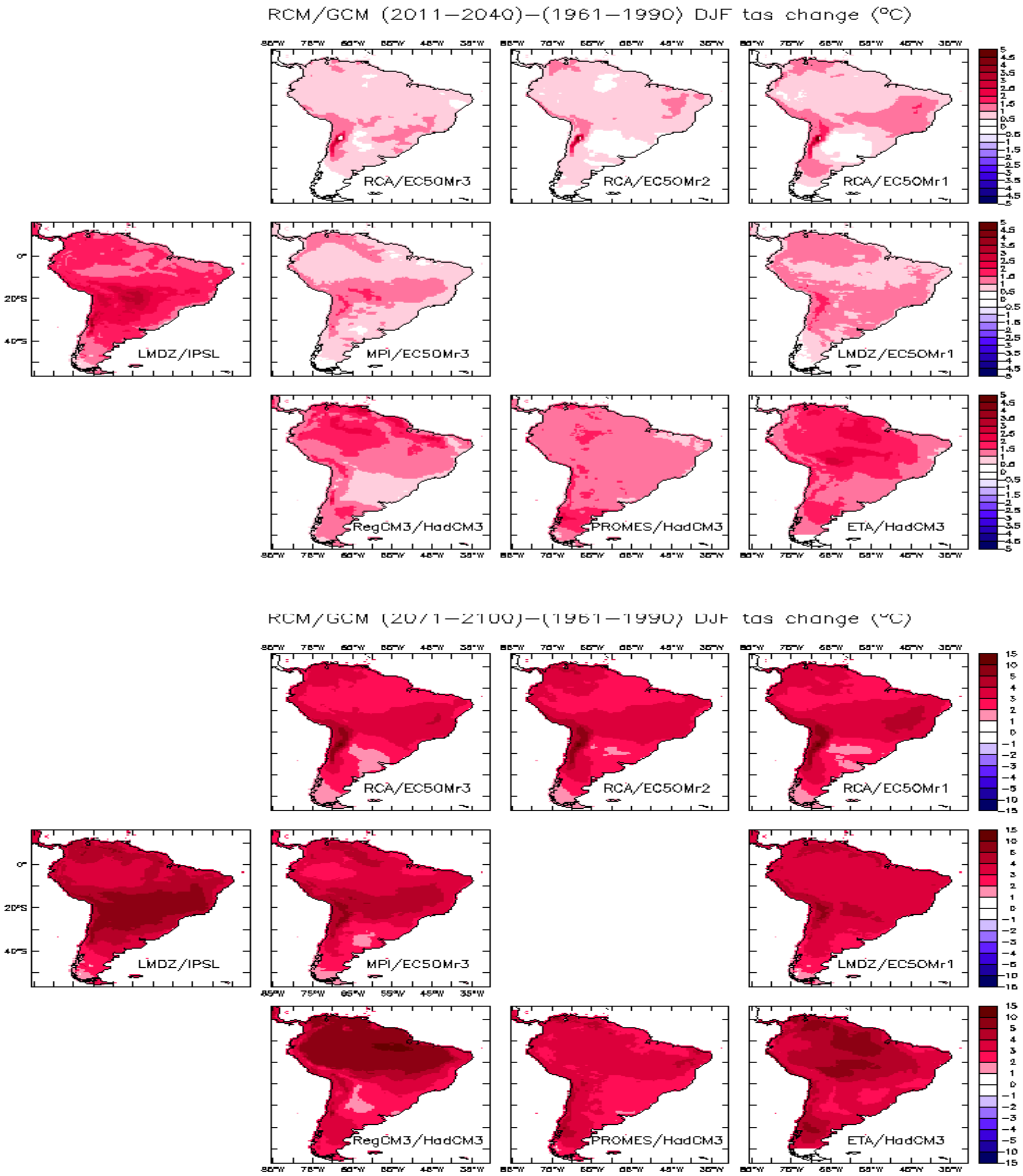

Figure 2.5: Future climate (2011-2040.above, 2071-2011.below) DJF daily temperature change from present climate (1961-1990, figure 2.1) for each of the RCMs.

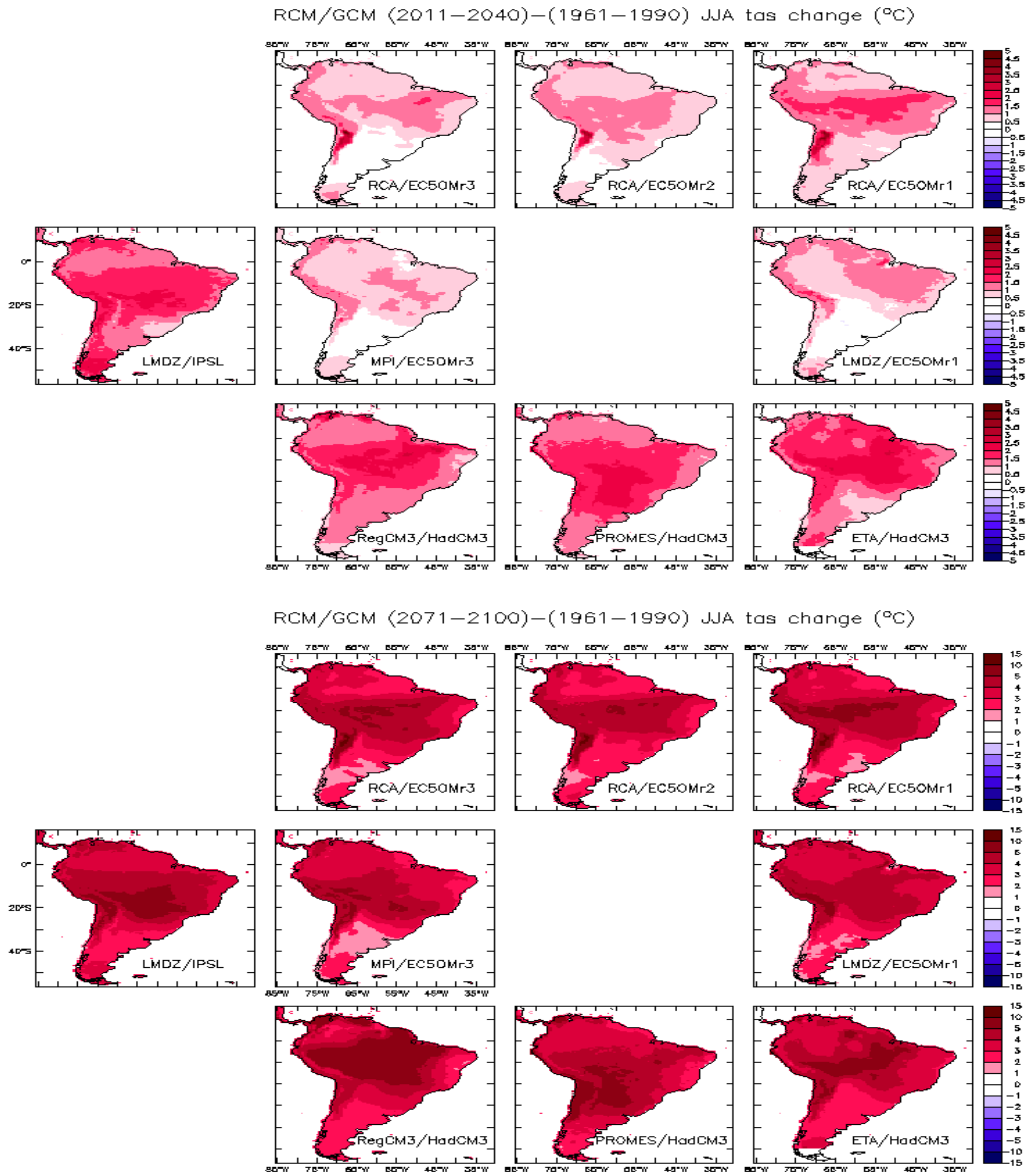

Figure 2.6: Future climate (2011-2040.above, 2071-2011.below) JJA daily temperature change from present climate (1961-1990, figure 2.2) for each of the RCMs.

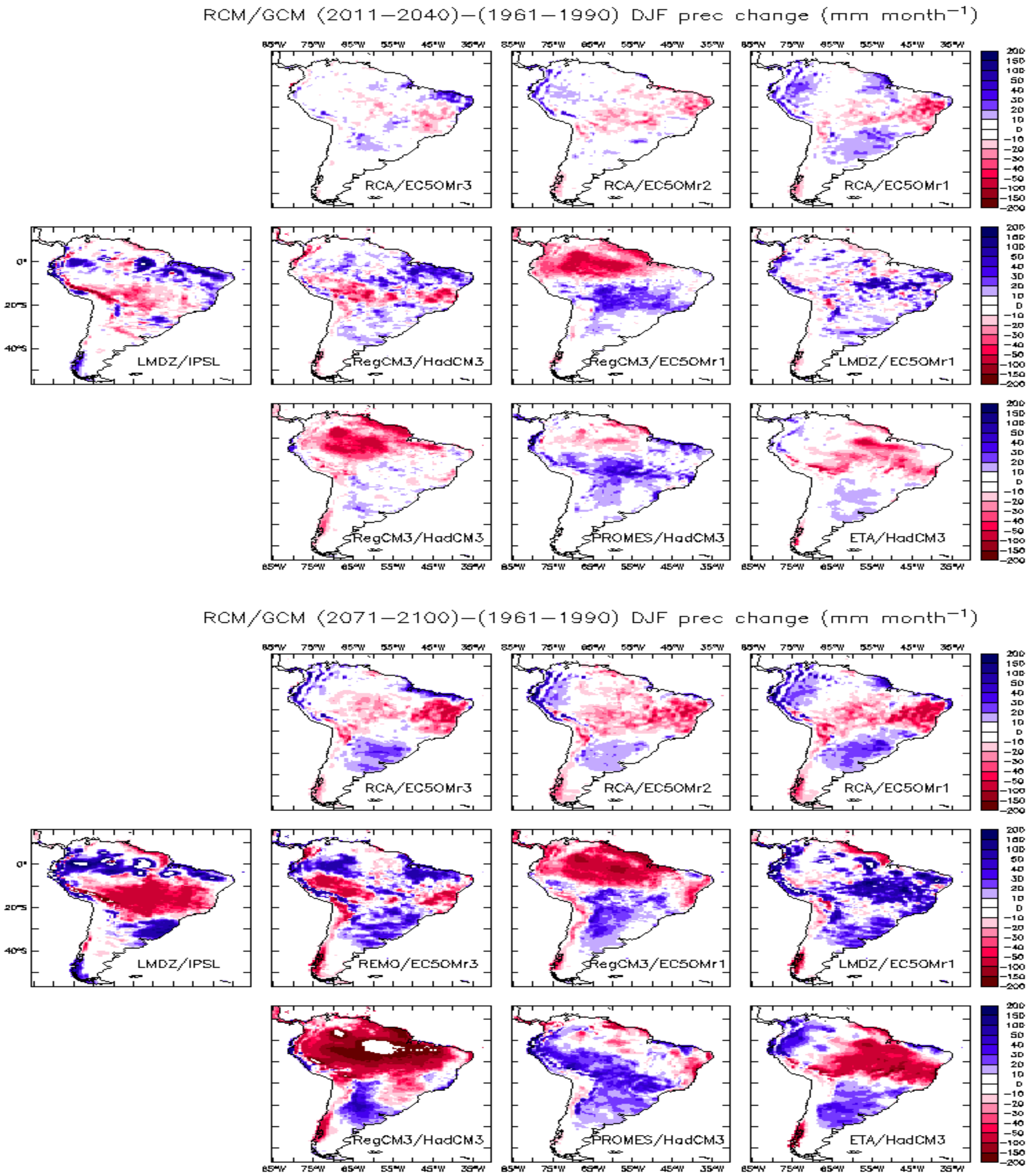

Figure 2.7: Future climate (2011-2040.above, 2071-2011.below) DJF monthly precipitation change from present climate (1961-1990, figure 2.3) for each of the RCMs.

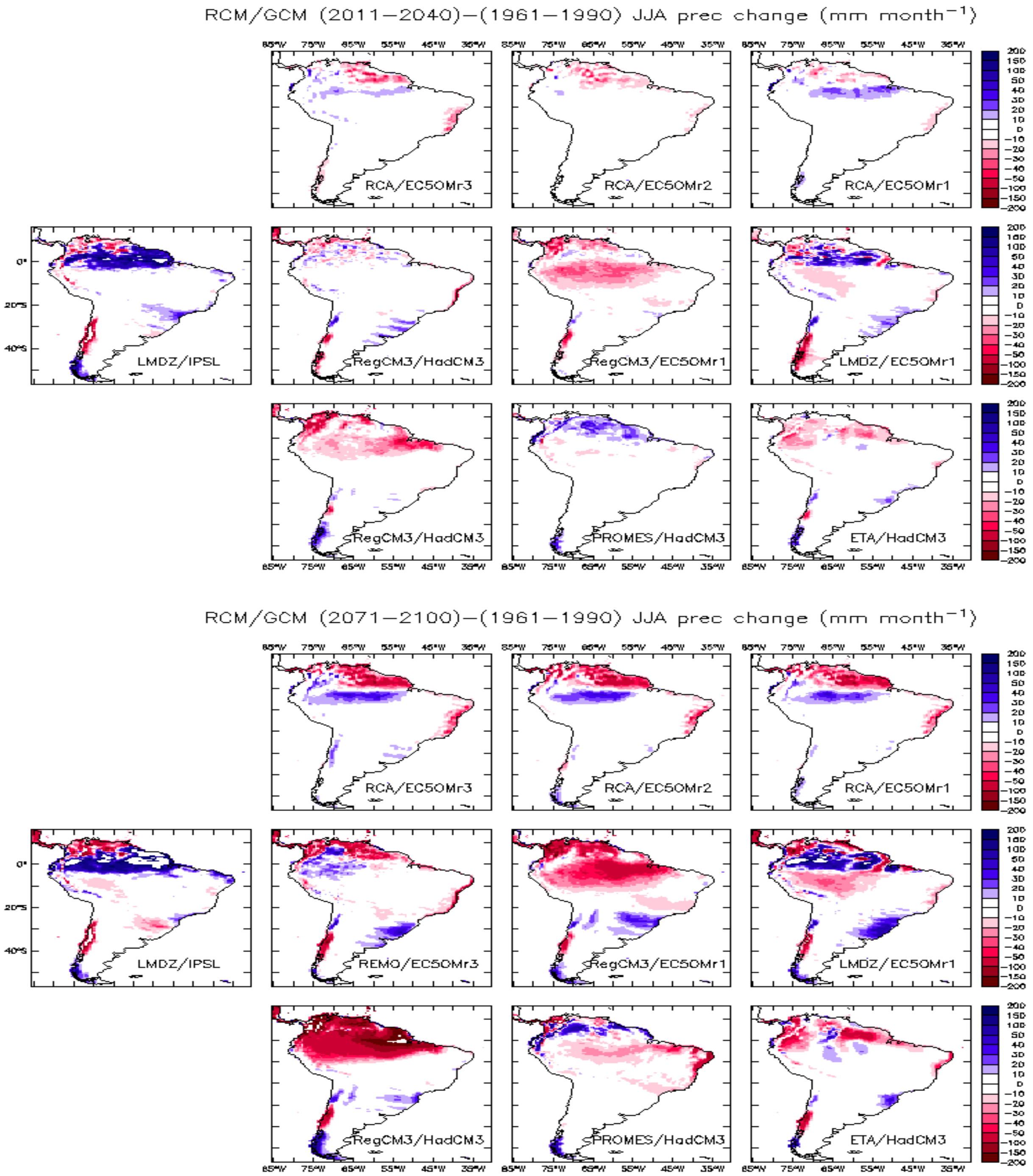

Figure 2.8: Future climate (2011-2040.above, 2071-2011.below) JJA monthly precipitation change from present climate (1961-1990, figure 2.4) for each of the RCMs.

4. Discussion

As it is stated before, a detailed analysis of the uncertainties associated with regional climate model projections over LPB from this ensemble of RCMs will be done in deliverable D5.2. A close interaction with other working groups to analyze extremes (WP6), the relation with the forcing GCMs (WP4), how accurate model results are to observations (WP3), and the procedures and recommendations (WP7) to use these projections when dealing with impacts (WP8, WP9) is being performed. The data portal inside the project is expected to show most of the information, by means of several documents (usage guidelines, model documentations, updates on model output availability), and also through several figures similar to the ones shown here that can be accessed on a link entitled "quick look climate change figures".

5. References

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