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Validation of CMIP5 models by means of representing patterns of mesoscale systems on South America for the summer and winter

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INTRODUCTION

The climate model developers have conducted a new series of climate modeling experiments, which are part of the Couple Models Intercomparison Phase 5 (CMIP5). These show us a new generation of Atmosphere-Ocean couple models, as well as a new generation of sceneries. The performance rate of the models representing the current climate is not uniform. In other words, not every region on the planet is well represented by the same models (Errasti, 2011). Therefore, it is necessary the validation of the General Circulation Models (GCMs) prior to elaborate climate change studies.

The main target of the research is to analyze the performance of the CMIP5 models based on the major atmospheric patterns that determine the climate in Peru. This poster shows the principal results of the studies.

MATERIALS AND METHODS

For the development of this study, some specific data has been used: pressure at sea level, 200hPa geopotential, precipitation and 2m temperature, all of them are monthly data from 48 CMIP5 models. The data is available at http://pcmdi9.llnl.gov/. Simulation r1i1p1 outputs were taken from the "historical" experiment. For the comparisons there were used monthly data from ERA40 reanalysis (Uppala et al. 2005) and ERAinterim reanalysis (Dee et al. 2011). For the first one, climatological period from 1971 – 2000 served as reference as the 1979 – 2005 was the reference for the second one; the resolution for the reanalysis data was 2.5° x 2.5° and 1.5° x 1.5° respectively. Precipitation and temperature data were also used from TS3.0 monthly basis, which is produced by the Climate Research Unit (CRU), with a resolution of 0.5 x 0.5; 1971 – 2005 climatic period was used for this.
The developed validation describes 45 CMIP5 models quantitatively, emphasizing the representation of the climatology in low and high atmospheric circulation over South America. This also considers 7 features related to the cores' location and size of the systems: High Bolivian (HB), the South Pacific Anticyclone (SPA) and the Equatorial Lows (EL). These areas are shown in **Picture n°1.**
First, the difference was calculated for the highest pressure value and its location, according to SPA core between a CMIP5 model and a reanalysis (ERA40 and ERAinterim), for summer and winter, getting the first 4 features. In a similar way, another difference was calculated, this time for the size values and distances from the exact location of the High Bolivian Core, using the 200hPa geopotential, during summer, getting the 5th and 6th features.
The second step was about the assessment of sea pressure level intensity over the northeast of Peru as in the first step was shown. In this case only the size value difference was obtained, getting the last feature.
Afterwards, the location and size values retrieved for the SPA, HB and EL were switched to an absolute value and then standardized, dividing by the highest value of each feature. Finally the 7 features were ordered in columns and the threshold value of 0.33 was used, except for the value of the geopotencial at 200hPa which was 0.66; so the models that obtain 5 features at least with lower values than the threshold (considering both reanalysis) are selected.
Furthermore, Taylor diagrams were made for each of the 9 peruvian regions shown in **Picture n°3**. Diagrams were made using maximum and minimum 2m temperatures and precipitation from 48 CMIP5 available models and observed data from the CRU. In Taylor diagrams, the representation of surface level variables is analyzed by the GCMs.

RESULTS AND CONCLUSIONS

The validated models are shown in **Chart n°1**. To check the validation method, **Picture n°2** shows us the sea level pressure distribution from the selected models and the unselected ones, for summertime. The SPA and the continental lows configuration are steadier in the selected models, submitting better similarity with reanalysis data.
In Taylor diagrams, surface variables have a uniform distribution of the results of the models in relation to observed data, having the same amount of good and bad models. Location is not always optimal in the 7 selected models in relation to of the models. During summertime, precipitation is better represented by the selected models, mainly for the central sierra, northern sierra, central forest and central coast locations. During wintertime the selected models were not very effective representing precipitation. On the other hand, the 7 models represent better the minimum temperature than the maximum, mainly for summertime. Finally the best represented regions are central and northern forest.

Picture 1. Areas used in the validation of the models belonging to CMIP5. SPA: South Pacific Anticyclone, EL: Equatorial lows; BH: The Bolivian High

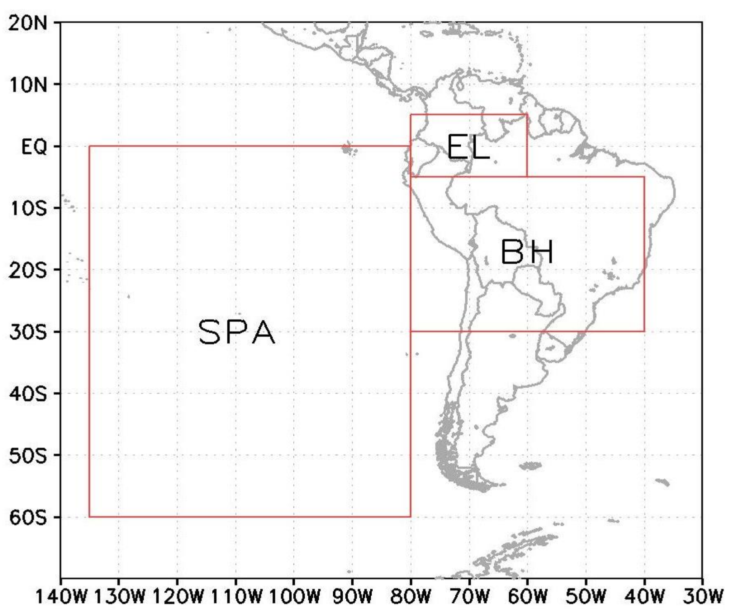
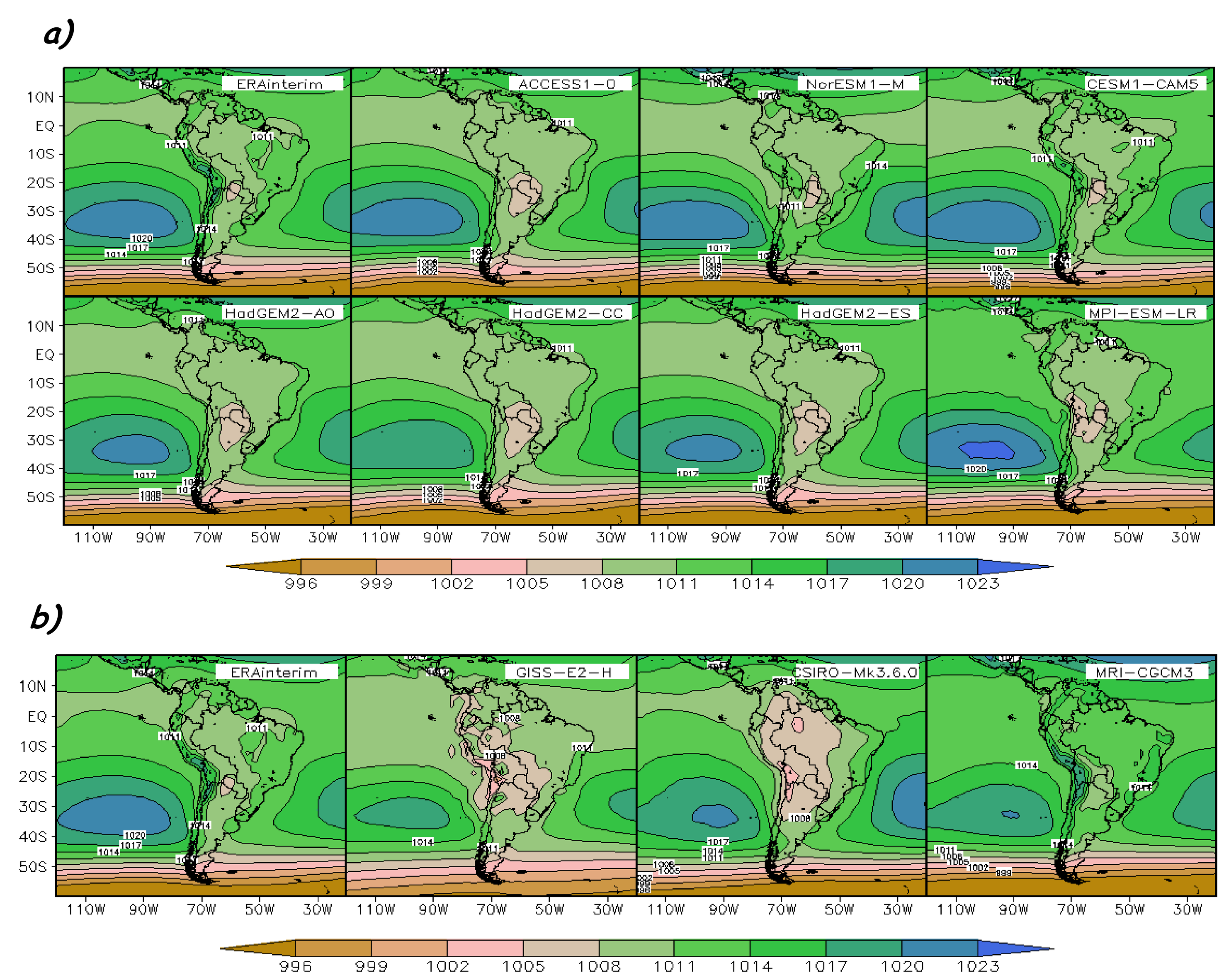


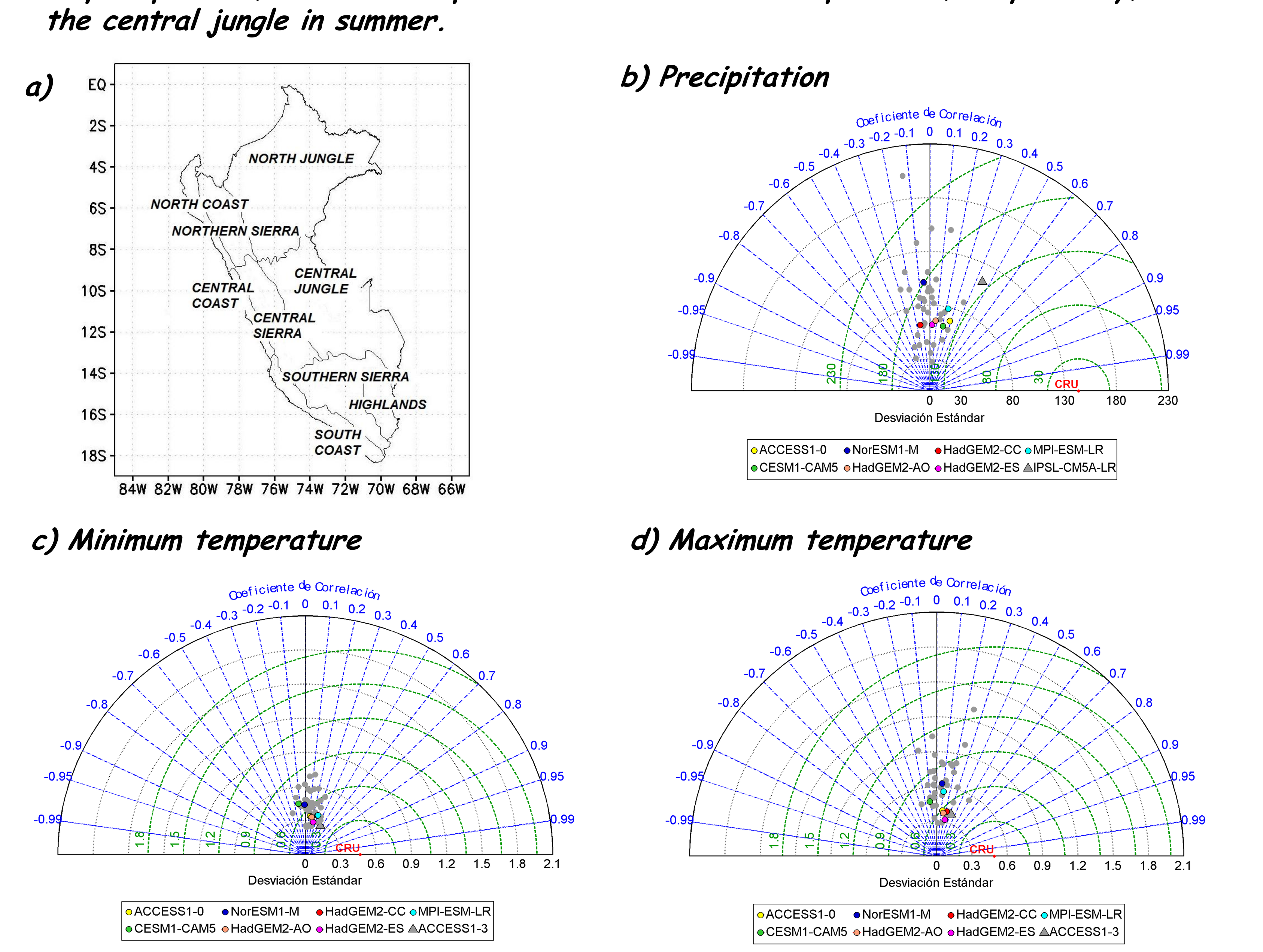
Chart 1. CMIP5 models selected

	MODELOS	RESOLUCION ATMOSFERICA	PAIS
1	ACCESS1-0	192x145 N96	Australia
2	CESM1-CAM5	0.9x1.25 f09	USA
3	NorESM1-M	Finite Volume 1.9 degrees latitude, 2.5 degrees longitude	Norway
4	HadGEM2-CC	1.875 deg in longitude by 1.25 deg in latitude N96	United Kingdom
5	HadGEM2-ES	1.875 deg in longitude by 1.25 deg in latitude N96	United Kingdom
6	HadGEM2-AO	1.875 deg in longitude by 1.25 deg in latitude N96	Korea
7	MPI-ESM-LR	approx 1.8 deg T63	Germany

Picture 2. Maps of sea level pressure for the summer period. a) Models selected b) models that failed validation.



Picture 3. a) Division of Peru in nine study regions. b), c) and d) Taylor diagrams of precipitation, minimum temperature and maximum temperature, respectively, for the central jungle in summer.



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