

## Annex eleven: Climate Change Scenarios

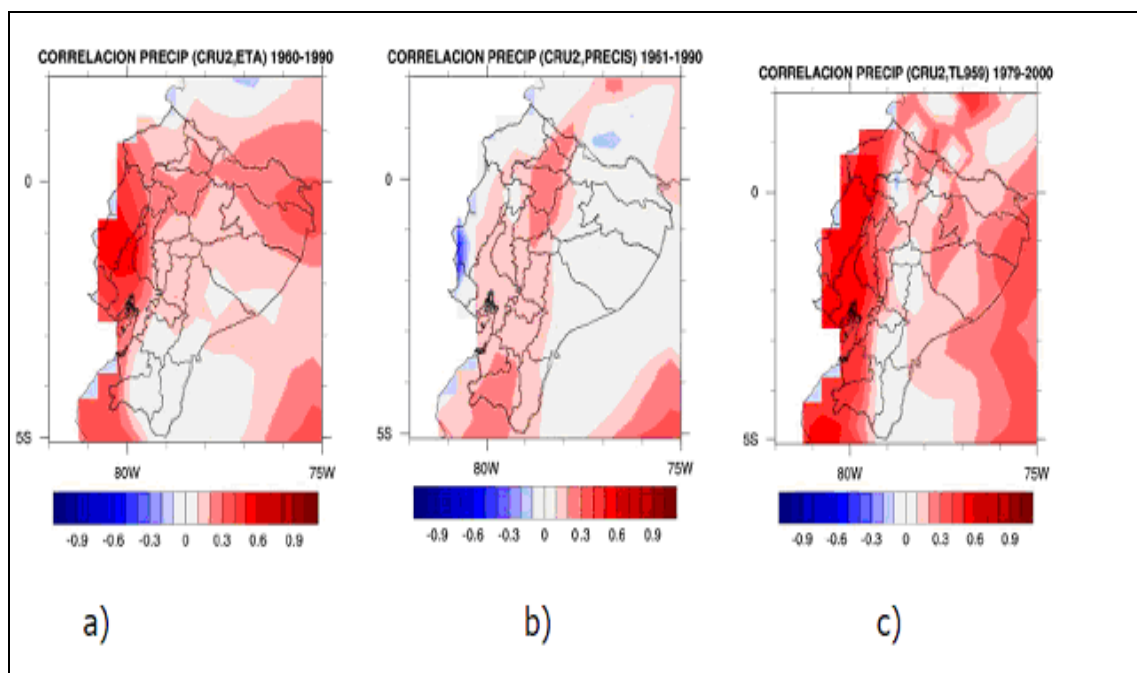
### 1. SCENARIOS OF CLIMATE CHANGE – SECOND NATIONAL COMMUNICATION

#### Rainfall:

Maps 9 (a, b and c) show the relationship between present and future status. The red colour indicates positive analogies, blue colour negative ones and white close to zero.

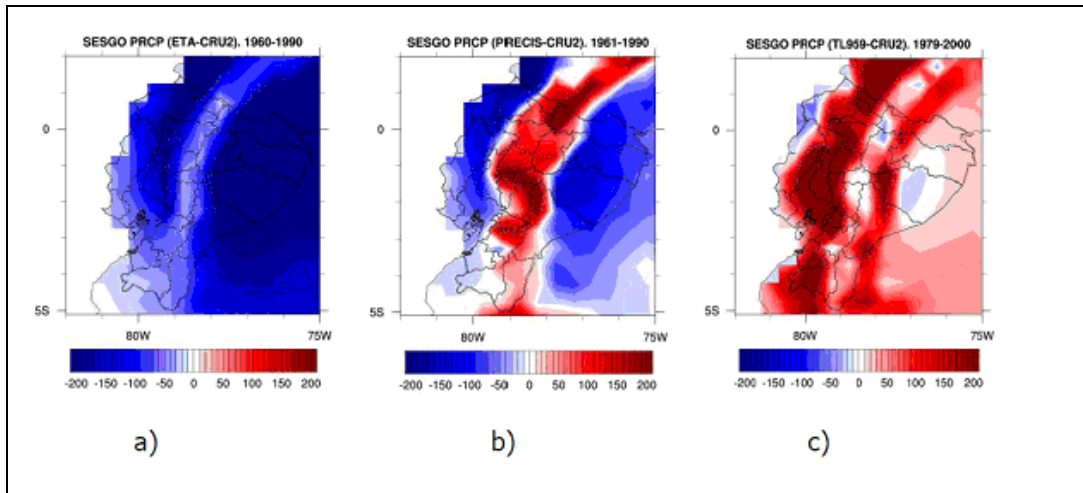
The higher analogies at national level have been obtained with ETA pattern and the lower with PRECIS. The patterns ETA and TL959 show important positive analogies, mainly in the Pacific Coast and some areas of the Amazon.

**Map. 9 Correlation Between Future Time vs. Present Time**



Maps 10 (a, b and c) show the **deviation** by calculating the difference between the rainfalls at present and the foreseen rainfalls in the future. The areas in red show the increase and those in blue show the decrease of rainfalls. With exception of the Highlands, the **ETA pattern** underestimates the rainfalls in the Pacific coast and the Amazon. The PRECIS pattern over values the rainfall in the Highlands and South of the Amazon and underestimates the rainfall in the rest of the country. The pattern TL959 overestimates the rainfalls in the **continental** area of the Pacific Coast and the West and East hillside of the Andes; while in the Northern central areas of the Pacific coast the values are neutral or underestimated.

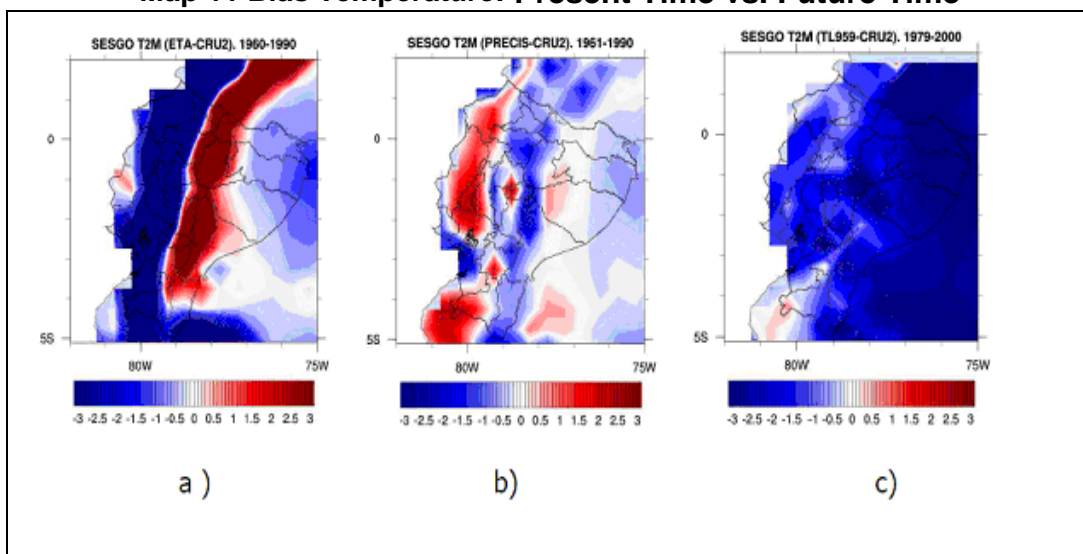
## Map 10 Bias Present Time vs. Future Time



### Temperature:

In the case of temperature "... the best analogies are provided by TL959, which foresees a cold deviation for the majority of the country. ETA pattern indicates a cold deviation for the Pacific Coast and the Western Andean watersheds (Pacific) (equal to or higher than 3 Centigrade degrees) while there is a warm deviation (equal to or higher than 3 Centigrade degrees) for the Amazonian areas close to the hillsides and the Easter Andean watershed (Amazon). For the rest of the Amazon it has been foreseen a lower cold deviation, approximately 1.5°C). The PRECIS pattern show high analogies for temperature, with the exception of certain areas in the Province of Loja, in the South of Ecuador. On the other hand, show a warm deviation for most of the Pacific Coast and cold deviations for the Highlands. In general terms, the temperature in the Amazonian **is well described**, with the exception of the regions in the Eastern side. Maps 11 (a, b and c) show the over and under estimations of future temperature in comparison with present temperature.

## Map 11 Bias Temperature: Present Time vs. Future Time



### **General Consent Analysis:**

In accordance with the climate change scenarios described above, “The results of the general consent analysis suggest, at a long term, an increase in the rainfalls, mainly for the Highlands, while it is foreseen a decrease of rainfalls for the Amazonian region (particularly the Eastern region of the Amazon) and for the Pacific Coast (Santa Elena, Manabí and Esmeraldas) particularly for Esmeraldas”.

“In the short term, TL959 pattern foresee an increase of the rainfalls for the Pacific Coast, particularly for some areas of Province El Oro, Southern region of province of Guayas and the majority of Manabí. In the Highlands it is foreseen both, increase and decrease of rainfalls, depending on the area. In the Amazon, in the areas close to the Andean hillsides, there are many zones that show an increase of the rainfalls, while in the Eastern region, a decrease or minimum increase of rainfalls is foreseen”.

“All the patterns indicate an unequivocal warming of the climate system in all the regions of the country. The foreseen climate change is consistent with world-wide patterns, although Harrison & Carson (2007) foresee areas of cold weather in South American Pacific Coast”.

## **2. ANALYSIS OF HISTORIC EVIDENCE AND SCENARIOS OF CLIMATE CHANGE**

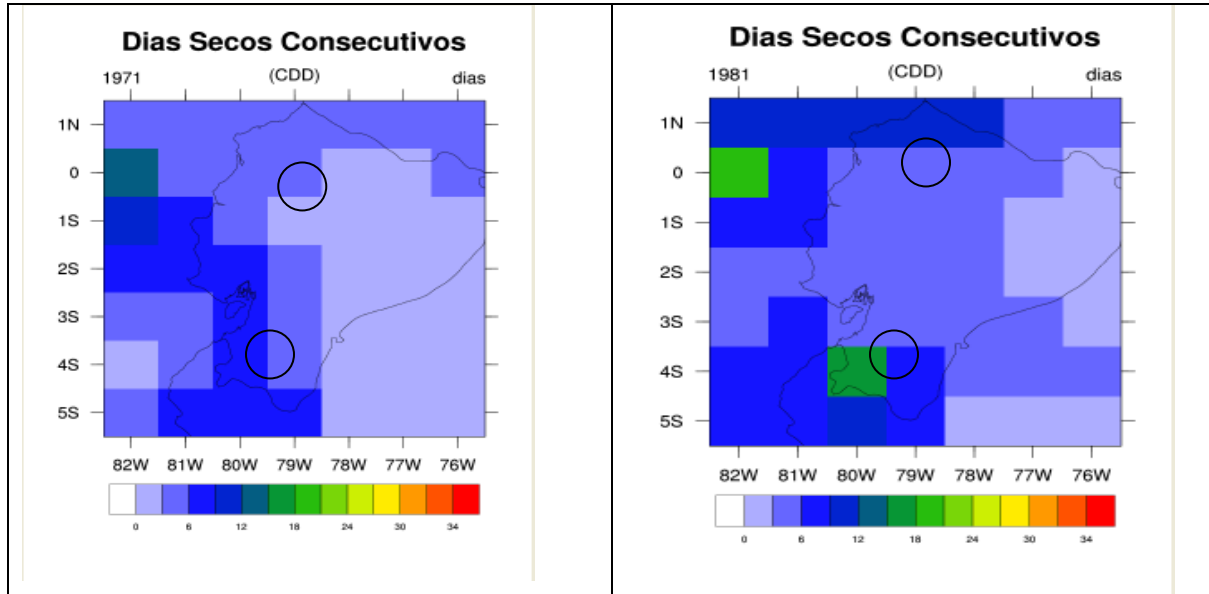
Following is an analysis based on the historical evidence and application of PRECIS pattern for 2010-2020:

- Historical climate changes in the period 1971 – 2009 based on statistical and historical information in Ecuador (source INAMIH)
- Estimation of future climate change elements 2010 – 2020, as per information provided by programme PRECIS-Echam, which allows forecasting climate change in certain periods.

### **Historic Evidence of Climate Change:**

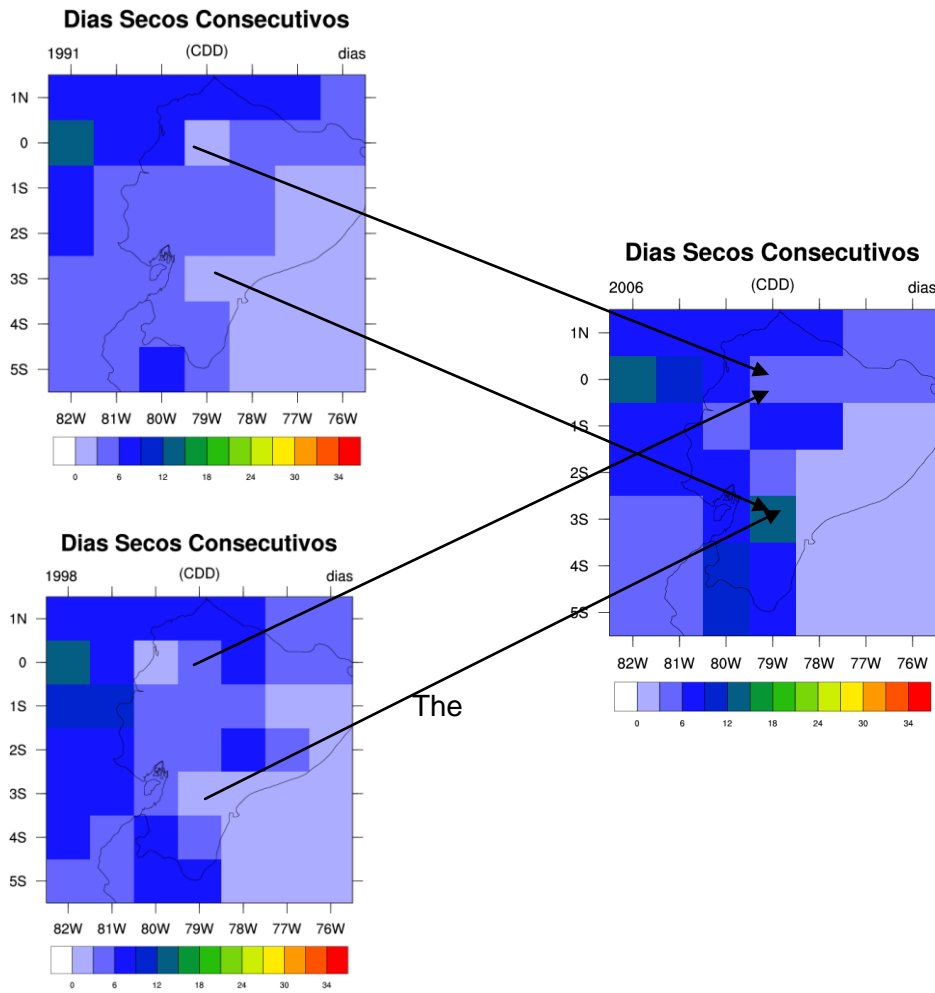
The analysis on climate index, applying FCLINDEX (numeric - historic data – 1971 – 2009) give clear evidence of the climate change. For instance, if the index of consecutive non-rainy days (CND) for the period 1971 – 1981, the increase of non-rainy days is clear. This index is higher in the areas of the project (Pichincha-Cayambe and Jubones River Basin), where the number of non-rainy consecutive days has increased from 3-6 to 15-18.

## Consecutive Dry Days

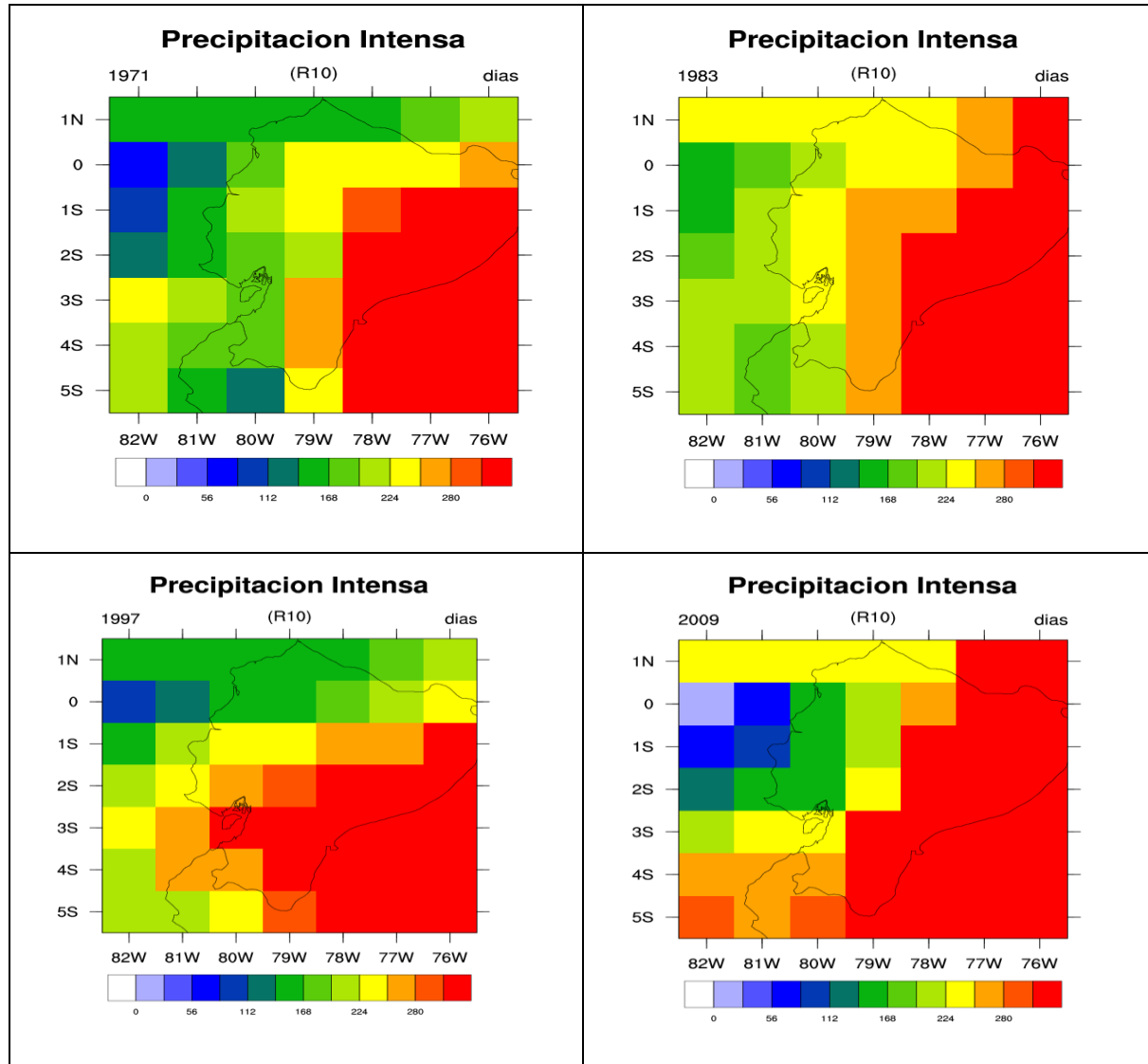


These scenarios are shown in the following graphics. The number of consecutive non-rainy days has increased in 1, 5 consecutive non-rainy days for the period 2001- 2006.

Example: 1991 – 2006 / 1998 -2006: increase of consecutive non-rainy days in the area of Jubones Basin for the period 1991 - 2006, is 12 days.

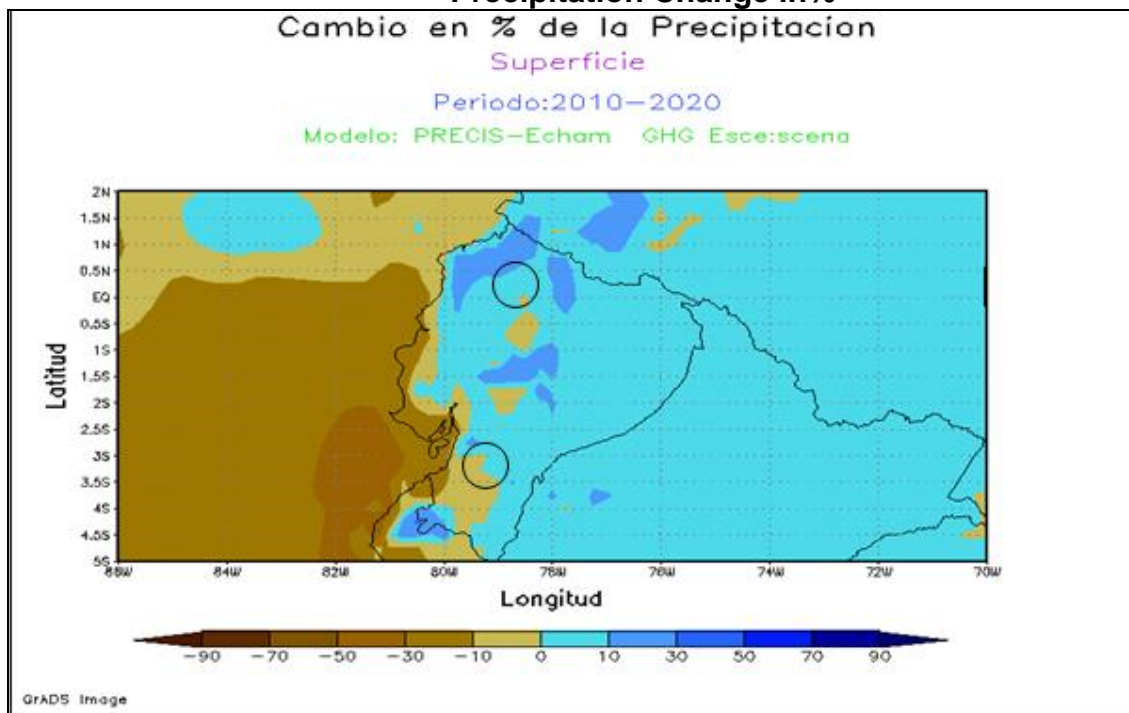


## Number of days with heavy precipitation (R10)



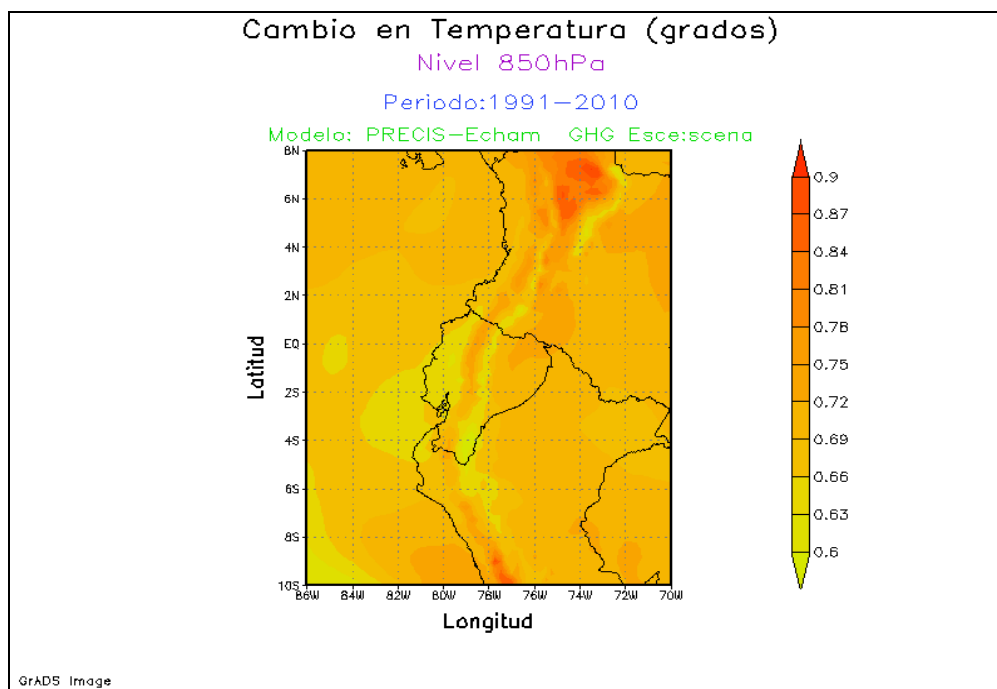
The change in temperature directly affects rainfall patterns. As it can be seen in the following graphics, there are intense rainfalls in short periods of time. If the climate change scenario foreseen for 2010 – 2020 is analyzed, 10% decrease of the rainfalls is foreseen, mainly for the lower region of Jubones River Basin while there is 10% increase of the rainfalls in the districts of Cayambe and Pedro Moncayo in the Province of Prichincha, during this period.

### Precipitation Change in%



The change of temperature is clear. If the information obtained for the period 1991 – 2010 is compared with the scenario 2010 – 2020, an increase in the average temperature of approximately 0.9 and 1° C is foreseen for the areas of the project.

### % Change in Temperature 1991-2010



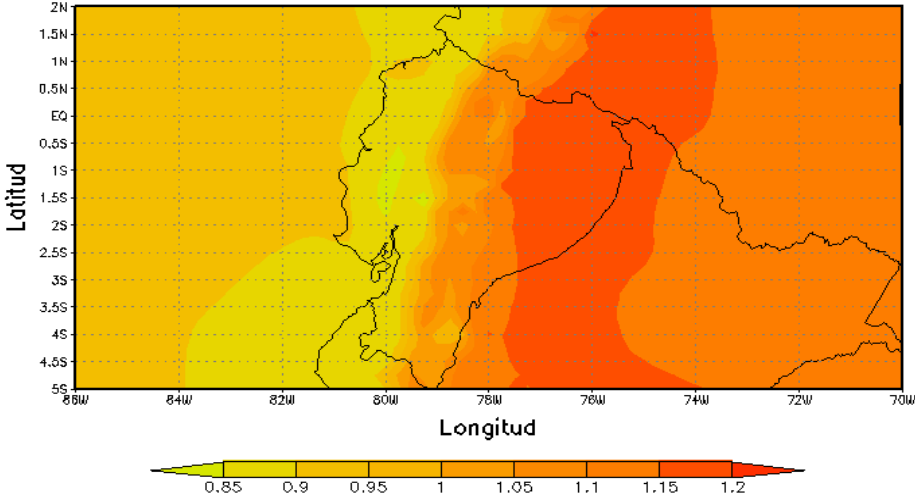
# % Change in Temperature 2010-2020

Cambio en Temperatura (grados)

Nivel 850hPa

Periodo:2010-2020

Modelo: PRECIS-Echam GHG Esce:scena



GrADS Image