Precipitation Associated with Cyclogenetic Hotspot Regions in the Extratropical Southern Hemisphere: CORDEX-CORE Projections

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1 Introduction

Cyclones play a fundamental role in driving precipitation variability at mid-latitudes (Reboita et al. 2018; Kodama et al., 2019), and flooding in coastal regions (Pfahl and Wernli 2012; Hawcroft et al. 2018, Lionello et al., 2019). In warming scenarios, the increase of atmospheric water vapor can contribute to the increase of precipitation associated with cyclones. In this context, projections of precipitation associated with cyclones in the main cyclogenetic regions of the Extratropical Southern Hemisphere domains (Africa - AFR, Australia - AUS and South America - SAM) are analyzed during the winter season (JJA). Projections were performed with Regional Climate Model version 4 (RegCM4) nested in 3 global climate models output (HadGEM2-ES, MPI-ESM-MR and NOrESM-1M).

2 Methodology

2.1 RegCM4 Projections

Horizontal resolution of 22 km; 23 sigma vertical levels; Community Land Model (CLM4.5) scheme for land surface processes; scenario RCP8.5. RegCM The domains of simulations are shown in **Figure 1**.

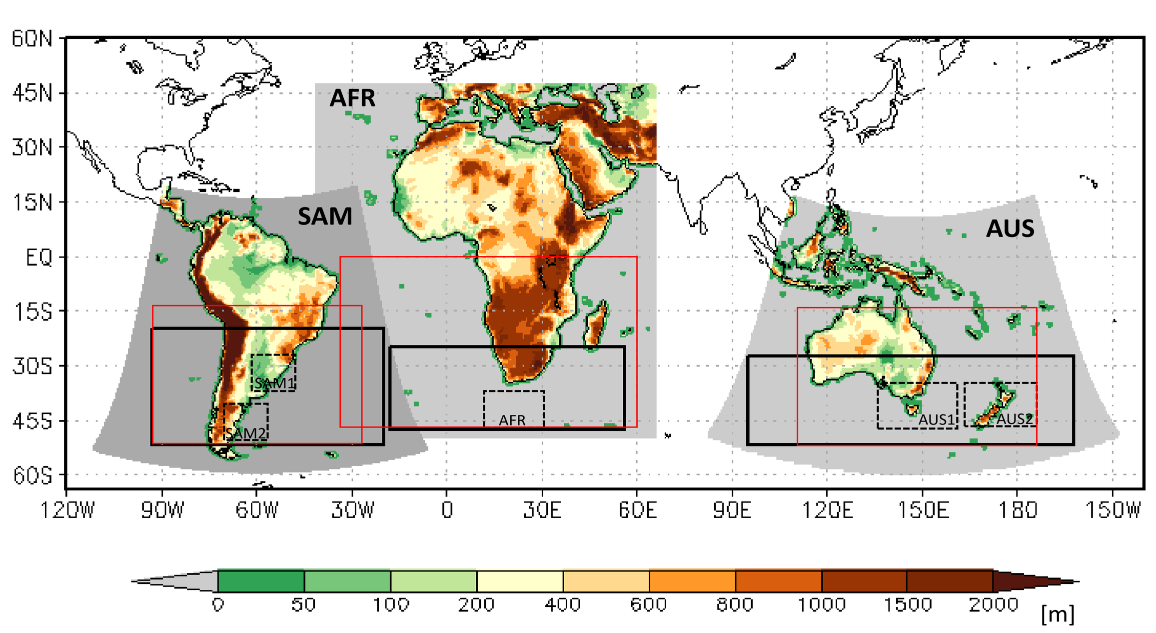

Figure 1 Southern Hemisphere CORDEX domains, topography (meters), areas used in the tracking analysis (black boxes), and areas hotspots of cyclogenesis (dot boxes). See Reboita et al. (2020) for more details such as the Eulerian analysis (red boxes).

2.2 Cyclone Detection and Tracking Method

Objective procedure based on a nearest-neighbor approach applied mean sea level pressure gridded fields (Lionello et al.,2002; Reale and Lionello, 2013). The tracking area is shown in **Figure 1**. Only cyclones with a maximum depth ≥ 10 hPa in some period of their lifecycles are retained. The analyzed periods are: historical (1995-2014) and future (2080-2099).

2.3 Precipitation Analysis

Average precipitation associated with cyclones is calculated over a three-day period (pre-cyclogenesis, cyclogenesis and post-cyclogenesis). The future climate change signals are calculated as the difference of future minus present statistics based on the RegCM4 and GCMs ensembles.

3 Results and Conclusions

Figures 2-6a,d depict the difference of the 3-day mean precipitation associated with cyclogenesis in the hotspot regions in relation to the total winter climatology for GCMs and RegCM4 ensembles in the present climate, while **Figures 2-6b,e** show the same information but for the future climate. The intensity of precipitation is higher during the cyclogenetic events than for the winter total climatology. In terms of the climate change signal **(Figures 2-6c,f)**, in all hotspot regions, we find a predominant increase in the mean intensity of the cyclogenetic precipitation in the future climate. For example, **Figure 5c,f** shows more intense precipitation over southern Brazil and between Uruguay and Argentina with an increase greater than 30% in the future.

In summary, as precipitation associated with cyclones in the future as the total winter precipitation climatology (not only due to cyclones) over the hotspot regions can increase compared to the present climate.

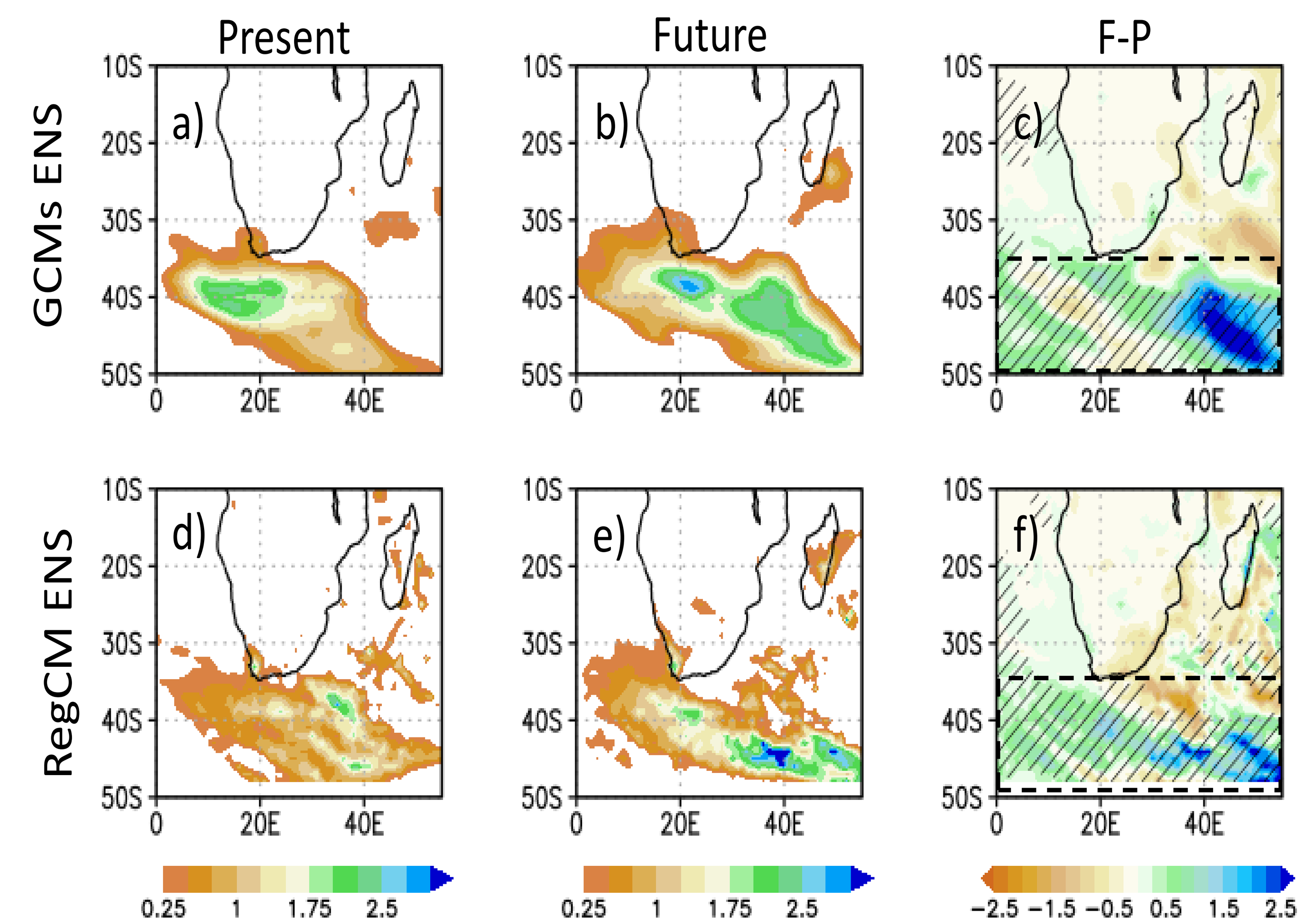

Figure 2 Precipitation associated with the cyclones in AFR hotspot region: **a**, **b**, **d** and **e** are the 3-day mean precipitation (from the pre to post-cyclogenesis) minus the total winter climatology (mm day^{-1}; only positive differences are shown) and **c** and **f**, in colors, are the difference of the precipitation (mm day^{-1}) associated with the cyclones (3-days) in the future minus the present (F-P) and in black lines the places where the total winter precipitation climatology will increase in the future compared to the present. Top: GCMs ensemble and bottom: RegCM4 ensemble.

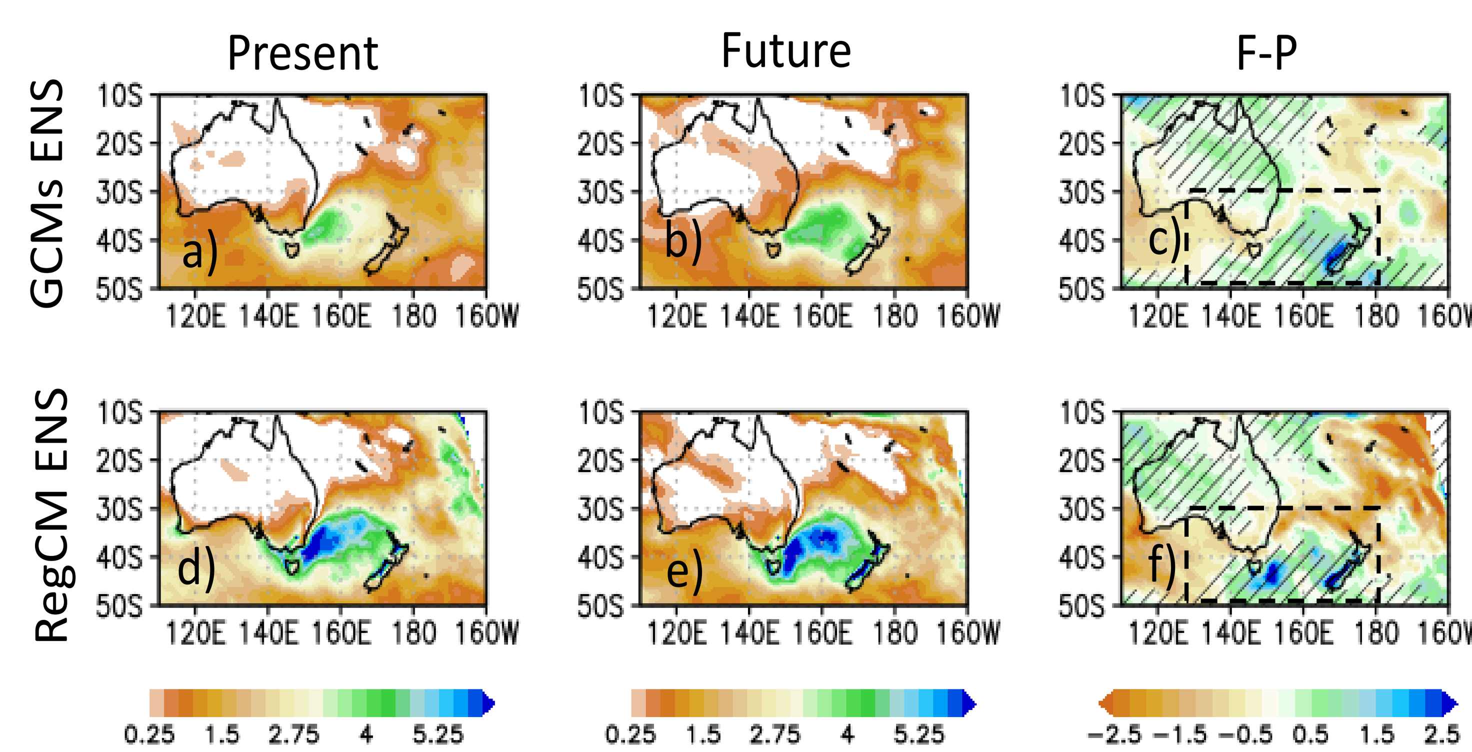

Figure 3 Similar to Figure 2 but to AUS1.

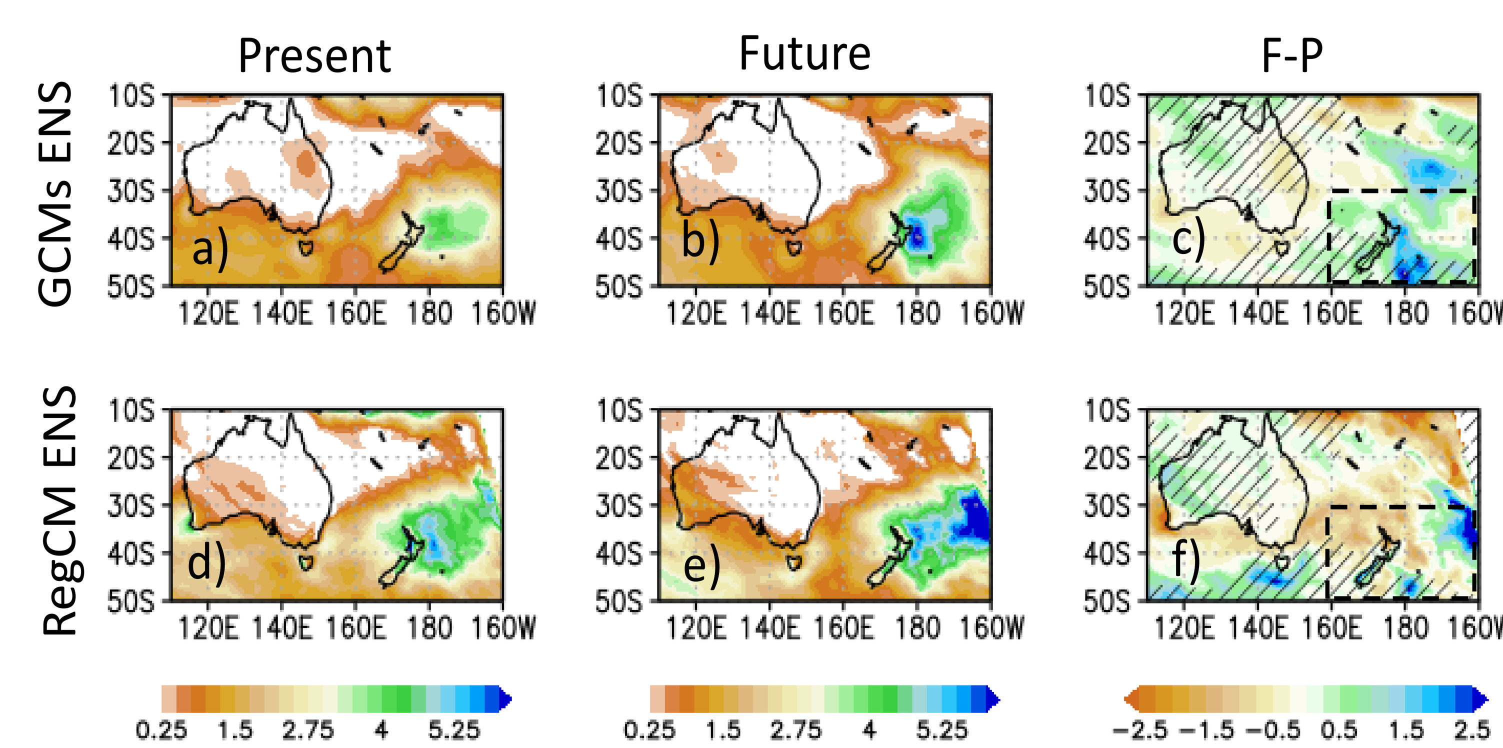

Figure 4 Similar to Figure 2 but to AUS2.

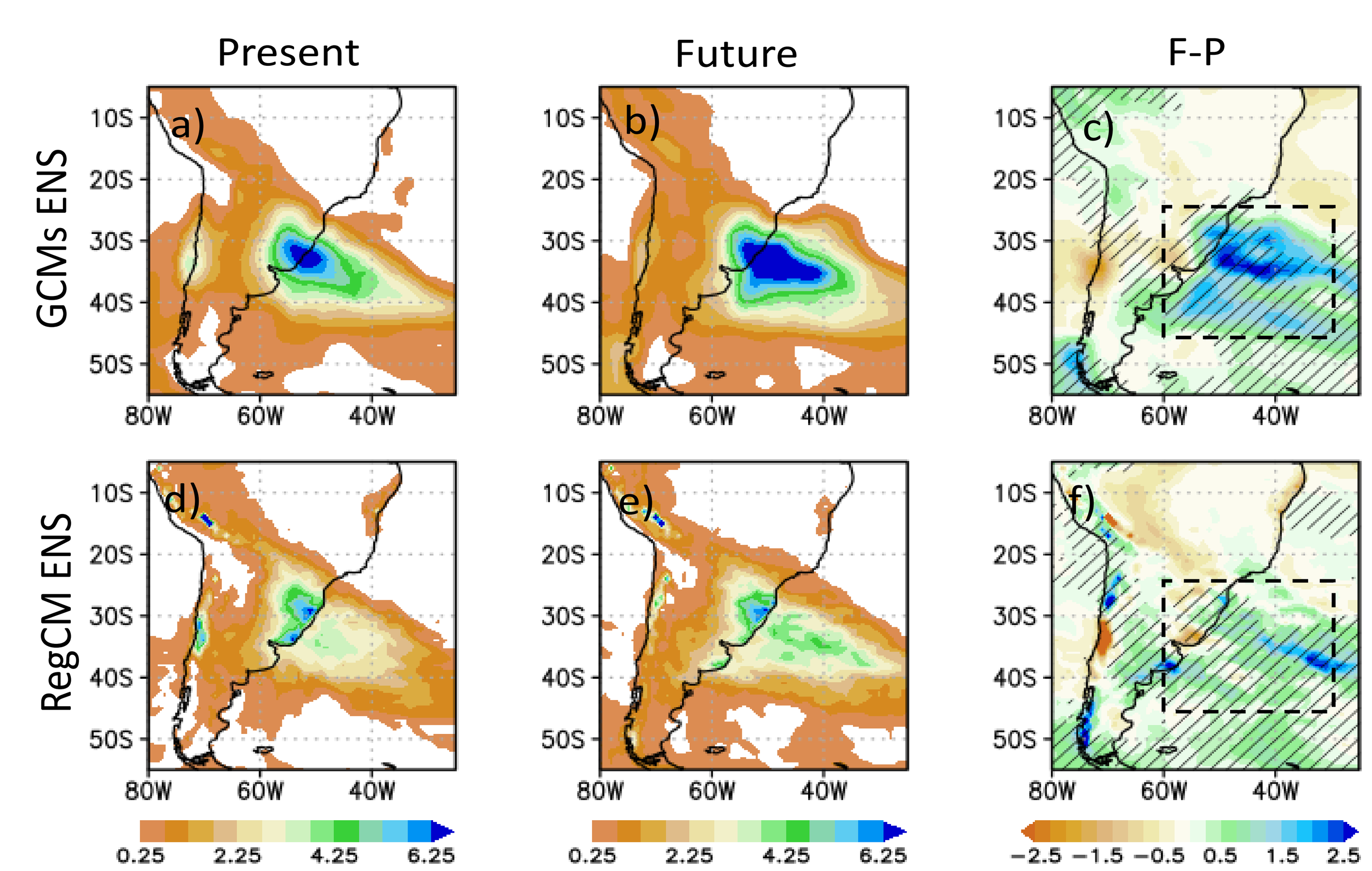

Figure 5 Similar to Figure 2 but to SAM1.

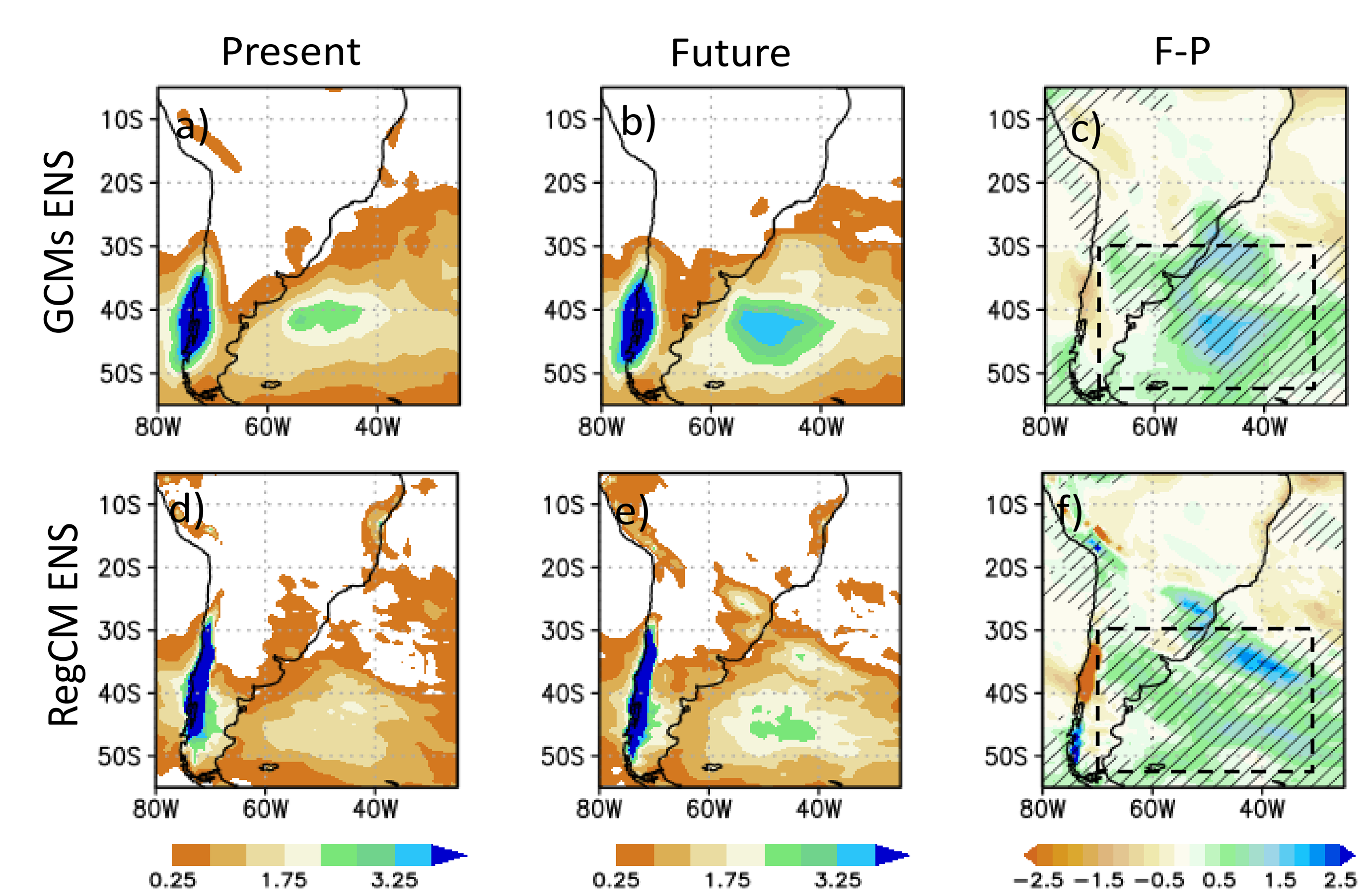

Figure 6 Similar to Figure 2 but to SAM2.

4 Acknowledgment:

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5. References

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