Evaluation of critical atmospheric patterns for the occurrence of forest fires in a climate change context in the northwest of argentine Patagonia.

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Objective

Analyze the possible influence of **climate change** on some **atmospheric patterns** related to **fire danger** in **northwestern argentine Patagonia**.

Data

- CMIP5 GCMs: **CSIRO-Mk3-6-0 / GFDL-ESM2G / CMIP5 multimodel ensemble**
- **Historical experiment / RCP2.6 / RCP8.5**

- **Main atmospheric fire drivers**: sea surface temperature in the region of the index EN3.4 (**SST EN3.4**), sea level pressure anomalies (**SLP**), surface air temperature anomalies (**TAS**), the Antarctic Oscillation Index (**AOI**) and monthly accumulated precipitation (**PR**).

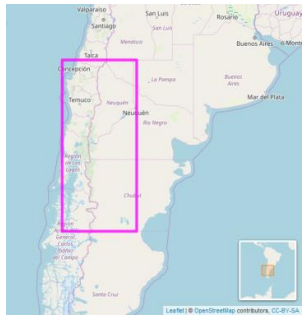

Figure 1. *Study region.*

Introduction

- **Forest fires** are a **global phenomenon** and result from **complex interactions** between **weather** and **climate conditions, ignition sources**, and **humans** (de Torres Curth et al., 2008). Understanding these relationships will contribute to the development of management strategies for their **mitigation and adaptation** (Bedia et al., 2014).
- In a **climate change** context, fire hazard conditions are expected to increase in many regions of the world due to projected changes in climate, which include an **increase in temperatures and** the occurrence of more intense **droughts** (IPCC, 2012; Westerling, 2008).
- In Argentina, **northwestern Patagonia** is an area very sensitive to these changes (de Torres Curth et al., 2008) because of its climate, vegetation, the urbanizations highly exposed to fires, and the proximity of two of the largest and oldest National Parks in the country.
- The **Fire Weather Index (FWI)** is used as a proxy for the mean **fire season (FS)** danger of the study region (Marcuzzi, 2014).

Periods

Historical 1986-2005

Near Future (NF) 2021-2040

Medium Future (MF) 2041-2060

Far Future (FF) 2061-2080

Very Far Future (VFF) 2081-2100

Region's fire season (FS): September to April

Metodology

- **Means and Variances:** of each period and difference of each future period and the historical one → **Student's test and Bartlett's test (p<0,05; p<0,1)**
- **Boxplots**: represent the changes in the distribution
- **Partial Correlation Coefficient:** determine the independent contribution of each atmospheric variable to the FWI.

Results

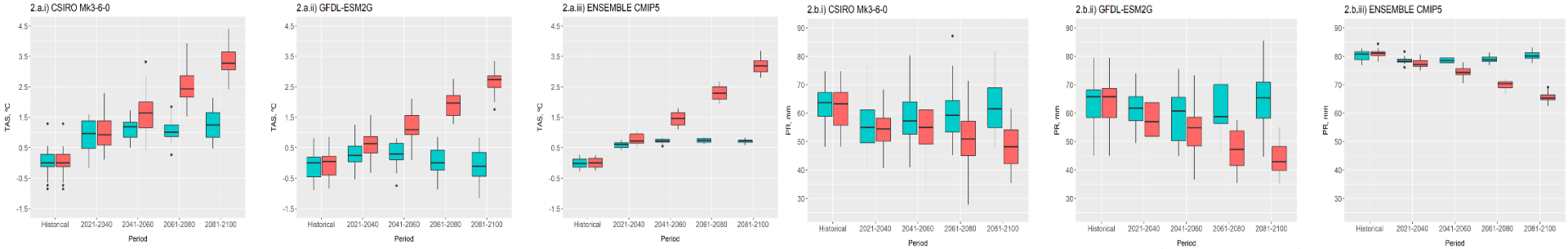

Figure 2. *Boxplots of mean **a.** TAS, ºC and **b.** PR, mm during the FS of the historical period and future projections with RCP2.6 (green) and RCP8.5 (pink) with **i)** CSIRO-Mk3-6-0, **ii)** GFDL-ESM2G and **iii)** multimodel ensemble .*

- **Means (95% confidence):**
- **TAS (Figure 2. a.)** above the historical mean in all cases. Significant: CSIRO-Mk3-6-0 and Ensemble: in all periods of the two RCPs. GFDL-ESM2G: NF and MF of RCP2.6 and all of RCP8.5. **Values (+) and increasing**
- Strong consensus in projecting a **decrease** in **PR (Figure 2. b.)** for all future periods of RCP8.5

Increase in FWI in NW Patagonia

- Significant differences in **Means at 90%** confidence (and not at 95%): Uncertainty between models. Same sense as at 95% confidence, reinforces what was found.

- **Variances (95 and 90% confidence)**: Most of the differences are **NOT significant**. **IQR small variations**. It reinforces the increases / decreases found in the means. Significant cases: Uncertainty between models.
- **Partial correlation coefficients ~0** and **NOT significant** (95% confidence).

Conclusions

- **SST EN3.4** is the only one that could indicate a **reduction in fire danger** in the future, although **no variable presented a significant contribution to the FWI with respect to the others**.
- In the **RCP8.5** scenario, **greater fire danger** is projected by the **TAS**, the **PR**, the **SLP**, and relative by the **AOI**
- In the **RCP2.6** scenario, **only the TAS** shows **influence** leading **to an increase**, which would be offset by the **opposite influence of SST EN3.4** for the same periods in this scenario.

In **RCP8.5** it could be assumed that there is a trend towards an **increase in fire danger** given the influence in this sense of most of the variables analyzed, but not **in RCP2.6** where there would be **no significant changes**.

References

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Display materials

Results

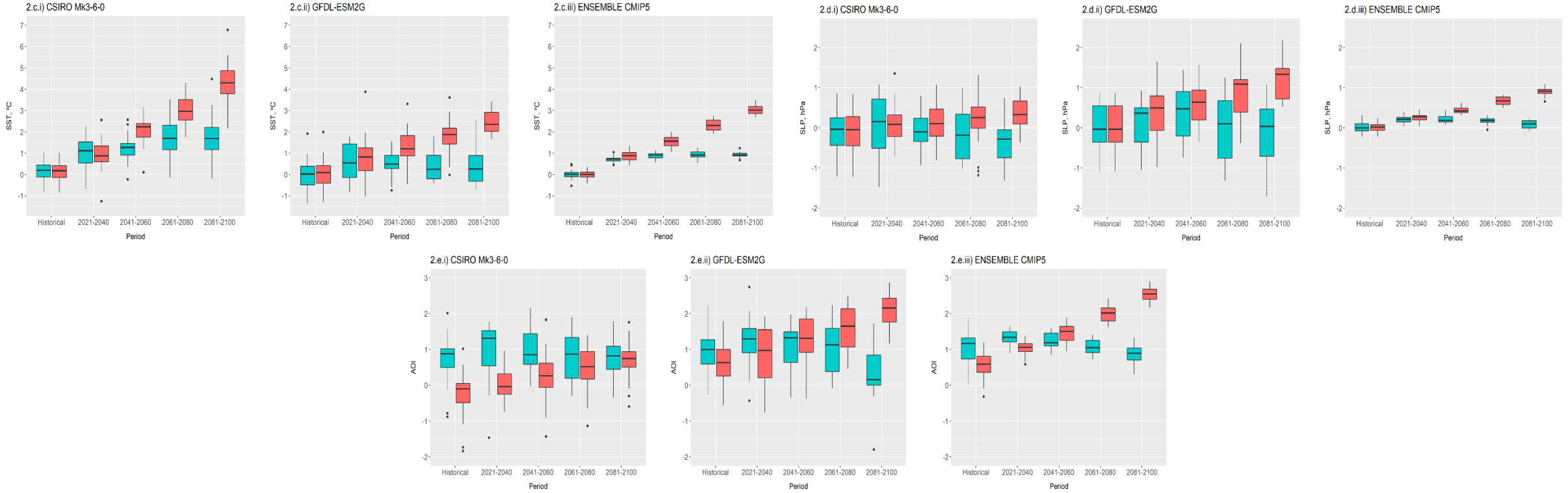

Figure 2. *Boxplots of mean* ***c.*** *SST EN3.4, ºC;* ***d.*** *SLP, hPa and* ***e.*** *SST, ºC during the FS of the historical period and future projections with RCP2.6 (green) and RCP8.5 (pink) with* ***i)*** *CSIRO-Mk3-6-0,* ***ii)*** *GFDL-ESM2G and* ***iii)*** *multimodel ensemble .*

➢ **Means (95% confidence):**

• **SST EN3.4 (Figure 2. c.):** above the historical mean in all cases. Significant: CSIRO-Mk3-6-0 and Ensemble: in all periods of the two RCPs. GFDL-ESM2G: NF and MF of RCP2.6 and all of RCP8.5. **Values (+) and increasing** → greater occurrence of El Niño events in the future → **lower FWI index in NW Patagonia.**

• **SLP (Figure 2. d.): (+) differences in all cases**. Significant: CSIRO-Mk3.6.0 only in the VFF of RCP8.5; GFDL-ESM2G in the MF, FF and VFF of RCP8.5. Ensemble on all except the FML of RCP2.6. Not significant: other cases → **Coincidence between models: VFF of RCP8.5** → would favor a **higher FWI in NW Patagonia**

• **AOI (Figure 2. e.):** Discrepancies between GCMs. Only coincided: **GFDL-ESM2G and ensemble for FF and VFF of RCP8.5 of an increase in AOI** (CSIRO-Mk3-6-0 values (+) but NOT significant) → **higher FWI** associated with SAM (+) (weakening of westerlies in mid-latitudes and displacement of the systems towards high latitudes, with a decrease in precipitation in Patagonia).