Simulation of rainfall for hydropower calculation with RegCM5

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Abstract

Uruguay is one of the leading countries in the world in terms of renewable energy production, together with Denmark, Ireland, and Germany, with more than a third of its electricity coming from wind farms. In the last decade, efforts have been put into the energy sector, and nowadays, 97% of the country's energy generation is renewable [2]. Although renewable energy has a lot of advantages, it has to be considered that it is highly variable, depending on atmospheric conditions. Then, it is vital to get precise forecasts.

Nowadays our energy forecasting model is run with GFS forecasts as boundary conditions. In this research we investigate the posibility to susbtitute GFS with RegCM5 forecasts.

Introduction

- For the optimal operation of the electrical power generation system, Uruguay uses SimSEE [3] (electricity system simulator). Based on atmospheric forecasts, this model is able to forecast energy generation and energy demand
- To get a more precise energy generation and demand forecast, we are investigating the posibility to initialize SimSEE with RegCM's output
- The first step is to validate rainfall forecast in Río Negro Basin, where the most important hydraulic dams are located (Fig. 1, smaller pannel)
- **Then, the objective is to compare RegCM5 and GFS rainfall simulations in Río Negro Basin**

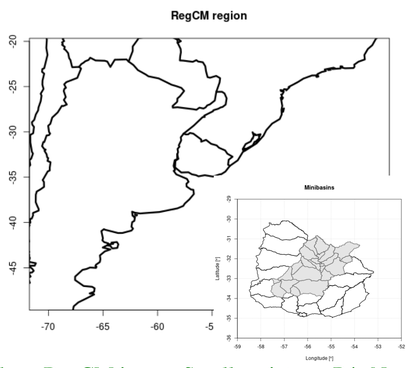

Figure 1: Bigger picture: Region where RegCM is run. Smaller picture: Río Negro Basin divided into 25 minibasins

Methodology

1. Run RegCM5 in the region of figure 1 (big) as follows:
   - Boundary and initial conditions: ERA 5
   - Period: 2018-2021
   - Lead time: from 1 to 10 days
   - Parameterizations: similar to CORDEX DOMAIN SouthAmerica
2. Interpolate 24 hours accumulated rainfall in 25 minibasins
3. Calculate root mean squared error and correlations with observations
4. Compare with GFS root mean squared error and correlations

Results - RMSE

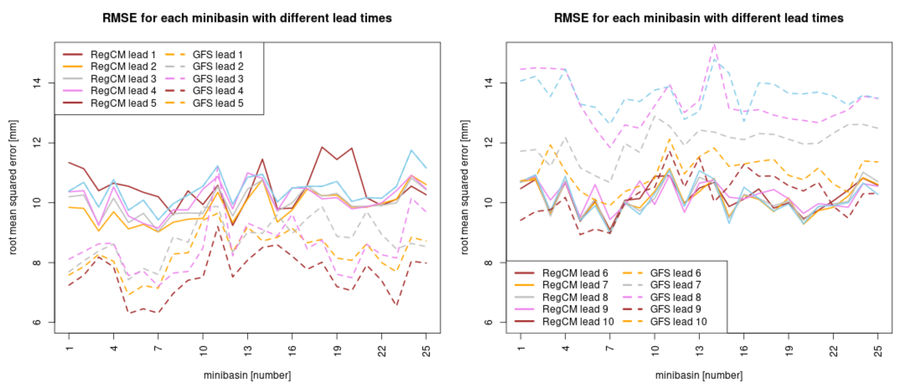

Figure 2: RMSE for each minibasin for leads 1 to 5 (left) and 6 to 10 (right)

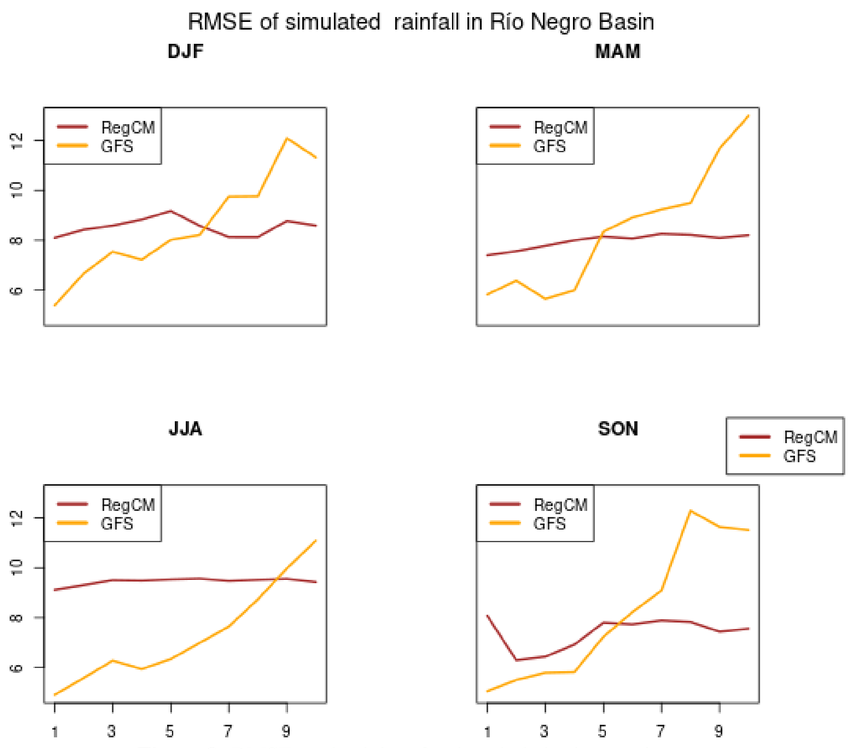

Figure 3: RMSE vs. lead time for the whole basin per trimester

Results - Correlations

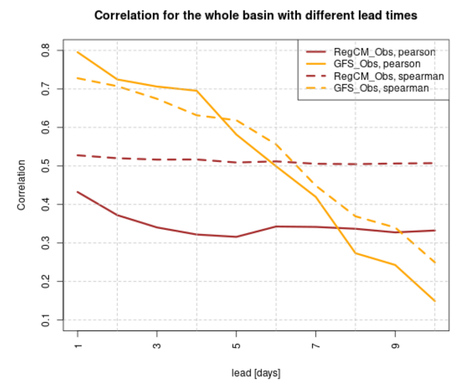

Figure 4: Correlation vs. lead time for the whole basin

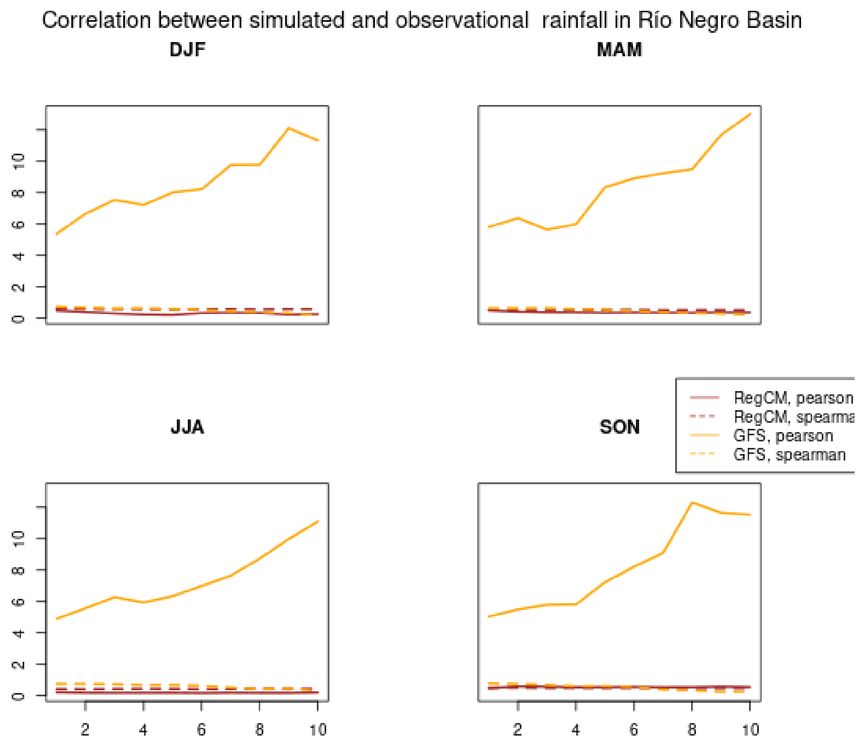

Figure 5: Correlation vs. lead time for the whole basin per trimester

Conclusions

- For each minibasin RegCM (GFS) has lower (higher) skill for smaller leads
- RegCM's skill stays stable with lead time while GFS's is reduced
- RegCM's skill is worst in winter (JJA), when rainfall systems are bigger in space and time scales
- In RegCM, Spearman correlation (robust) is higher than Pearson correlation (least robust)

Forthcoming Research

- Is it possible to get better RegCM skill by changing some parameters?
- Does it make any sense to repeat the analysis for other atmospheric variables?
- Are there some specific situations where RegCM is much better than GFS?
- Would we get better results with another regional model?

Disclaimer: The content of this article is entirely the responsibility of its authors, and does not necessarily reflect the position of the institutions of which they are part of.

References

[1] Reto Bertoni, Pablo Messina, and Luis Bértola. La "revolución eólica" en uruguay. *Diálogo Político*, 35(2):84–89, 2019.

[2] Gonzalo Casaravilla and Ruben Chaer. Energy transition of uruguay. In *IAEE Energy Forum, Fourth Quarter 2021, pp, 11-14*. International Association for Energy Economics, 2021.

[3] Ruben Chaer, Diego Sebastián Beledo Franco, Lorena DiChiara, Fernando Fontana, Pablo Soubes, and Enzo Coppes. Optimización en simsee de agendas gnl. In *IntegraCIER 2014: Congreso Iberoamericano de Energía, 10-12 nov. 2014, Punta del Este, Uruguay, pp. 1-12*. CIER, 2014.