Validation of the Climate, using WRF in the Northern Patagonia Icefield: Preliminary results

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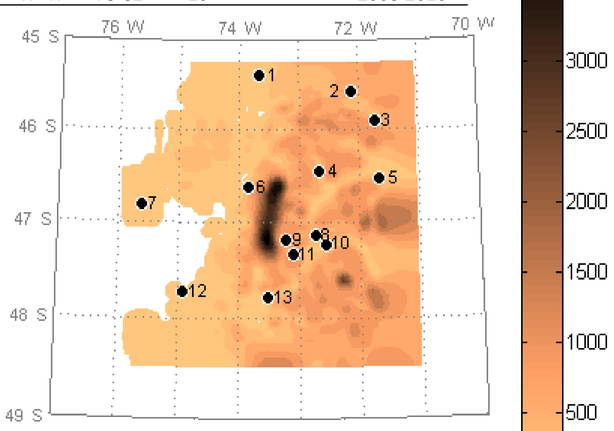
Abstract

The climate version of the regional Weather and Research Forecast Model (WRF) has been run for the 2000-2006 period over the Northern Patagonia Icefield (NPI) with a 5 km resolution, which is nested within a 15 km resolution subregional domain and a 45 km resolution regional domain. The regional model is initialized using the NCEP/NCAR Reanalysis database. Regional simulations from the different domains, mainly over the NPI, are tested against the observed surface stations to validate the improvement of the model results with respect to the lower resolution simulations from GCMs. Interest in the NPI is due to the scarce availability of observed meteorological and glaciological information in this large and remote icefield, and the need to validate the model behavior in simulating the current climate and its variability in complex terrain. The results will shed light on the degree of confidence in simulating future climate scenarios in the region and also in similar geographical settings. Based on this study subsequent model runs will allow to model future climate changes in Patagonia, which is basic information for estimating glacier variations to be expected during the next 2 centuries. The final objective of this work is to assess the future sea level rise contribution from the melting and possible ice collapse in Patagonia. This study is part of the ice2sea project funded by the EU 7 FP.

Location of weather stations

N°	Station	Source	Lat	Lon	High	Data Period T°	Data Period Precip.
1	Puerto Aysen (Aeródromo)	DMC	45º24'	73º40'	11	2000-2005	
2	Coyhaique (Te. Vidal)	DMC	45º35'	72º07'	310	2000-2010	2000-2010
3	Balmaceda (Aeropuerto)	DMC	45º54'	71º43'	520	2000-2010	2000-2010
4	Bahia Murta (Río Baker)	DGA	46º27'	72º40'	240		2000-2010
5	Chile Chico (Aeródromo)	DMC	46º32'	71º41'	327	2000-2006	2000-2005
6	Glaciar San Rafael	DGA	46º38'	73º51'	8		
7	Cabo Raper	SERVIMET	46º49'	75º37'	46	2000-2010	2010
8	Rio Baker en Ang. Chacabuco	DGA	47º08'	72º43'	160		2003-2010*
9	Lago Cachet 2	DGA	47º11	73º14	427		
10	Lord Cochrane (Aeródromo)	DMC	47º14'	72º33'	182	2000-2006	2000-2005
11	Colonia	DGA	47º20	73º06'	146		2010
12	San Pedro	SERVIMET	47°43	74°55		2000-2010	
13	Caleta Tortel (Río Baker)	DGA	47º47'	73º32'	10		2003-2010

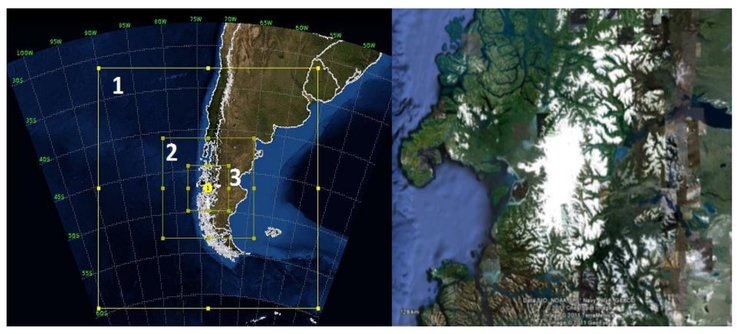
(*): Series con más de 30% de datos faltantes



Location of the weather stations used in this study and orography of domain 3.

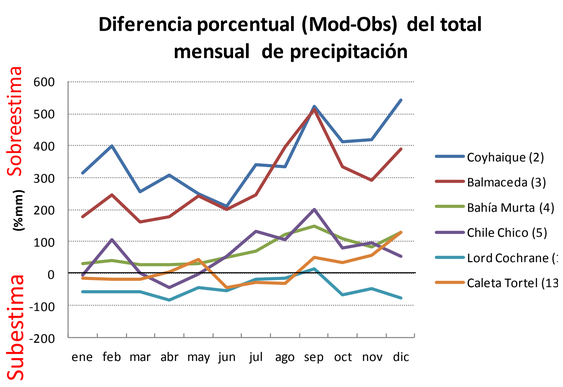
Domains and parametrizations

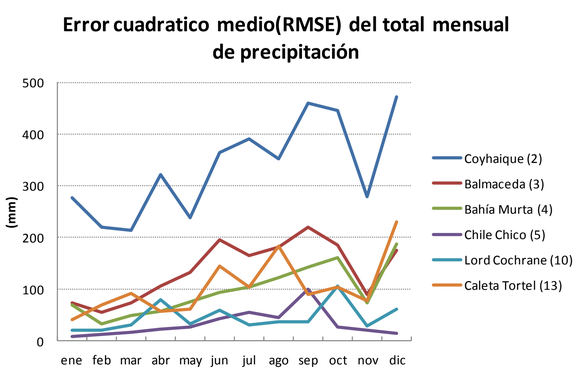
The downscaling was done using the dynamic WRF model for three nested domains: the first one at 45 km, the second at 15 km and the third at 5 km resolution. This later domain was centered in the Northern Ice Cap. Numerical simulation was carried out for the 2000-2006 period. The regional model was nested using the NCEP/NCAR Reanalysis data. Some parameterizations were: physical scheme of Thompson et al (2008), RRTM longwave and shortwave radiation of Budhia (1989), QNSE surface layer, QNSE boundary layer, 5 layer thermal diffusion for land surface, Betts-Miller (1986)-Janjic (1994) for cumulus, and the ETA operational scheme.



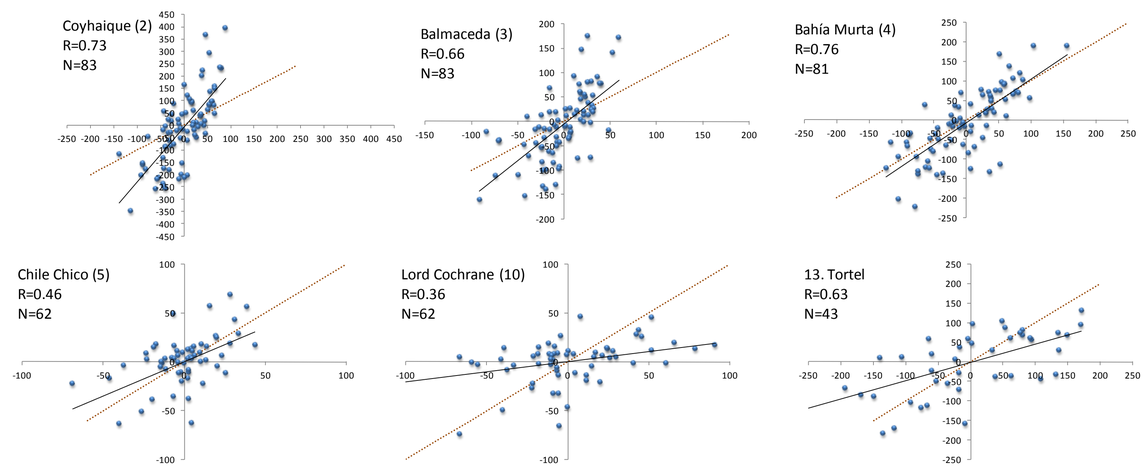
Validation of the precipitation and temperature

Precipitation: simulation over estimate for about 200% at Coyhaique (2) and Balmaceda (3) stations, while it was only about 20-80% at Lord Cochrane (10) y Caleta Tortel (13) stations. The RMSE analysis indicates that largest errors are found at Coyhaique, while in the other stations these errors are significant in summer and autumn.

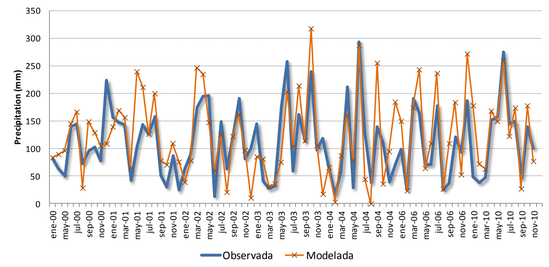




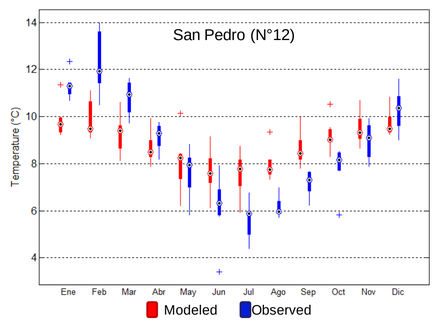
Despite of the important differences in the monthly precipitation, the variability is well simulated by the model. The correlation coefficient of the precipitation anomalies varies between 0.72 in Bahia Murta and 0.36 in Lord Cochrane.

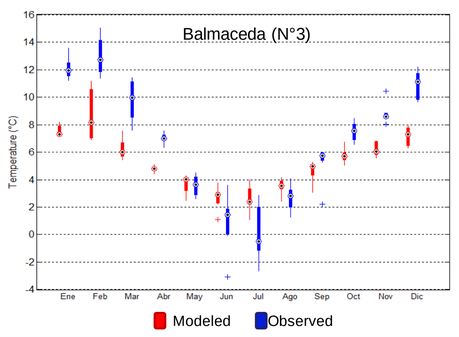


Monthly precipitation as simulated by the model domain 3 in Bahia Muta and the observed precipitation registered in the same place. The simulated curve was corrected for differences grater than 100 mm.



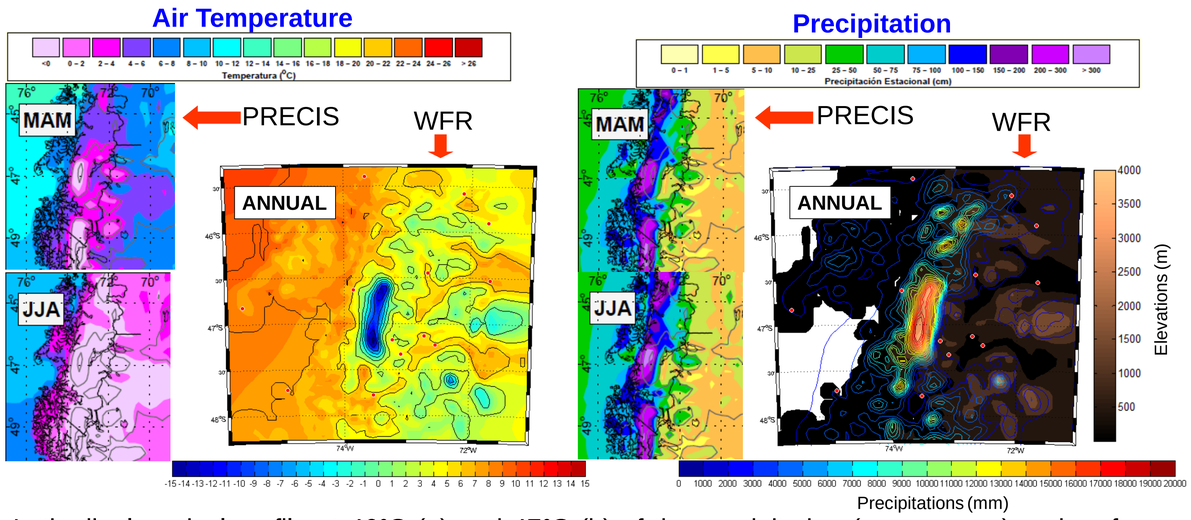
Temperature: the model in general simulates colder (warmer) temperatures for summer (winter) months. The seasonal behavior simulated by the model is smoother that the observed behav





Spatial simulations

Spatial distribution of the simulated mean annual temperature and annual mean precipitation accumulation for 2000-2006 period. For comparison are the PRECIS model (20 km resolution) results (CONAMA, 2006) to visualize the improved results of the WRF model at 5 km resolution.



Latitudinal vertical profile at 46°S (a) and 47°S (b) of the precipitation (green curve) and surface elevation (light blue shaded area). Model simulation results show the effect of the orographic with more precipitation in the western side of the mountain much less precipitation in the eastern side.

References

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