Assessment of Climate change impacts on grain crops for the Southern Brazil – projections from SA CORDEX

CORDEX abstract

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Many studies have highlighted the potential impact of climate change on agriculture and food security (e.g., Challinor et al., 2007; Haim et al., 2008; Tubiello et al., 2007), particularly in developing regions (Easterling et al., 2007). In this work we evaluate the value added by the Regional Climate Model 4 (RegCM4) in representing the climate over the Rio Grande do Sul state (southern Brazilian state), as well as the climate change projections in an ensemble of four 21st century projections (1970-2100, RCP8.5 scenario) with the RegCM4 driven by the HadGEM, GFDL and MPI global climate models (GCMs) – SA CORDEX domain. Specifically, we focus our analyses for the austral summer season, when most of grain crops are cultivated over the state. In general RegCM4 improves precipitation annual cycle for the GFDL and HadGEM, particularly for the former, and presents higher (then the driver MPI) bias for the MPI simulation. More consistency climatology is found between RegCM4 simulations, global models diverge significantly during the austral spring season (e.g., MPI and HadGEM simulate 0.3 and 4.5 mm/day for September, respectively). All RegCM4 realizations suggest a precipitation increase during the summer season, particularly for January and February – months where grain crops are in the critical phases (reproductive and grain formation). At sub-state level the three GCM present different climate change projections for precipitation; HadGEM projects major increase (between 25-50%) over the west half of state and an increase lower than 25% over the east half, MPI presents the inverse pattern as

shown by HadGEM, and GFDL projects a south to north gradient (ranging from +25% to -5%). RegCM4 projections are more consistent throughout the three simulations, suggesting a precipitation increase over all state – increasing from west to east.

Evaluate the models projections at sub-state level is particularly important for the Rio do Grande do Sul state because the state has two sub-regions considerably different. The north half (high land area, mountainous plateau) and south half (low land area) have very different edafoclimatic characteristics; the south half is composed by predominant flat terrain and hydromorphic soils bad drained, and the north half (over the mountainous plateau) has soils well drained but predominantly shallow. In general the projections of precipitation increase over the south half may result in less frequent droughts – which has major impacts for soybean and maize. However, the precipitation increase may be also associated with more frequent and intense floods events that may result in soil anoxy, impacting rainffed grain crops. Another important question, usually less addressed, is that the precipitation increase may result in incident solar radiation decrease, which may decrease the rice yield (paddy rice system) – the main crop of the region. For the north half, where soils are in general well drained, the increase of precipitation may be mostly related with grain crops yield increase. Therefore, the uncertainties in the spatial pattern projects by the GCMs may result in lack of confidence in the crops evaluations and assessments impacts over the state. RegCM4 simulations increase ensemble agreement, however to a some extend by decreasing the physical parameterizations diversity.

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