

Annual report 2021 for Flagship Pilot Study in Southeastern South America (FPS-SESA)

Status and progress during the year including scientific highlights, end to end perspective and participants engaged in the project

With focus on extreme rainfall events in Southeastern South America (SESA), the FPS-SESA initiative seeks to promote inter-institutional collaboration and further networking to tackle the following specific scientific objectives:

- 1) to study multi-scale processes and interactions that result in extreme precipitation events;
- 2) to develop actionable climate information from statistical and dynamical downscaling based on co-production with the impact and user community.

The activities and deliverables of the FPS-SESA are in progress to achieve the objectives proposed. However, as the project progressed, new ideas emerged to complement the originally planned tasks and to be able to address the objectives in a more comprehensive way. From these discussions, the need for new RCM and/or ESD longer-term simulations became evident, which should consider different important aspects for impact modeling (such as interannual variability, larger domains, and additional surface output variables). These simulations are essential as input data for crop yield and hydrological models to study the impact of extreme precipitation events on two main productive systems in SESA and will require a new tailored protocol. Additionally, due to different constraints, specifically related to computing resources, financial support and the world pandemic situation, some delays in the original tasks have arisen. Therefore, to fully accomplish the objectives of the FPS an extension of the FPS-SESA of 2 years was requested and granted in 2021.

The focus for this extension is the evaluation of the impacts of heavy precipitation events in different sectors (hydrology and agriculture). Thus, a new protocol for RCM and ESD simulations is being developed in order to design an experimental setup to produce simulations as input data for crop and hydrological models. This protocol will be available soon at the FPS website (<http://cordexfpssesa.at.fcen.uba.ar/index.php>).

A series of virtual meetings has been carried out since October 2021 with all contributors to the FPS-SESA. From this dialog with impact modelers, the spatial domain has been extended to include the full hydrological catchments and crop areas to be analyzed (the Uruguay river basin and southern Brazil). The seasons considered have also been extended to cover all growing seasons and not only the purely meteorological rainy season. Additionally, different variables to include in the RCM/ESD model outputs (precipitation, Tx, Tn, solar radiation, wind speed, hail and relative humidity) are being evaluated. Bias Adjustment methods for RCM simulations are also being considered in the new phase of the FPS-SESA. In addition, other WRF simulations at convection-permitting resolutions covering all South America are available through the NCAR South America Affinity Group (<https://ral.ucar.edu/projects/south-america>), of which many researchers of the FPS-SESA are also part. Therefore, these simulations will be considered in the analysis of RCM simulations in the FPS-SESA framework.

Some preliminary tests with the Variable Infiltration Capacity (VIC) hydrological model forced with both ESD and convection-permitting simulations for the Uruguay river were also performed in 2021. The results of these simulations are being evaluated.

Manuscripts on the analysis of diurnal cycle of precipitation for the 2009-2010 season with extreme events and sensitivity of RCMs simulations to resolution and physics; and on ESD methods sensitivity to dataset choice and predictors choice are under preparation.

During 2021, different applications for funding were submitted mainly to cover the expenses of the FPS-SESA Conference and Capacity building activity planned for November 2022 in Buenos Aires, Argentina and scientific stays.

Summary of each workshop/activity held during the year

Title, date, short description, location, website, links	Responsible person/-s	Funder

Related publications during the year

Title, journal and link to publication	Author/-s	Date
The CORDEX Flagship Pilot Study in Southeastern South America: A comparative study of statistical and dynamical downscaling models in simulating daily extreme precipitation events. <i>Climate Dynamics</i> , DOI : 10.1007/s00382-020-05549-z	Bettolli ML, Solman SA, da Rocha RP, Llopart M, Gutierrez JM, Fernández J, Olmo ME, Lavín-Gullón A, Chou SC, Carneiro Rodrigues D, Coppola E, Balmaceda Huarte R, Barreiro M, Blázquez J, Doyle M, Feijó M, Huth R, Machado L, Vianna Cuadra S.	04 January 2021
Synoptic forcing associated with extreme precipitation events over Southeastern South America as depicted by a CORDEX FPS set of convection-permitting RCMs. <i>Climate Dynamics</i> volume 56, pages3187–3203 (2021), https://doi.org/10.1007/s00382-021-05637-8	A. Lavin-Gullon, M. Feijoo, S. Solman, J. Fernandez, R. P. da Rocha, ML Bettolli	26 January 2021
Evaluation of multiple downscaling tools for simulating extreme precipitation events over Southeastern South America: a case study approach. <i>Climate Dynamics</i> volume 57, pages1241–1264 (2021), https://doi.org/10.1007/s00382-021-05770-4	S Solman, ML Bettolli, ME Doyle, ME Olmo, M Feijoo, D Martinez, J Blázquez & R Balmaceda Huarte	23 April 2021
Statistical downscaling of daily precipitation over southeastern South America: assessing the performance in extreme events. <i>International Journal of Climatology</i> , DOI: 10.1002/joc.7303.	Olmo, M, Bettolli ML.	30 July 2021
Influence of Madden–Julian Oscillation on extreme rainfall events in Spring in southern Uruguay. <i>International Journal of Climatology</i> . https://doi.org/10.1002/joc.7022	Ungerovich M, Barreiro M, Masoller C.	24 Jan 2021

Planned activities for next year

Planned scientific activities for 2022:

To build a repository for sharing data and simulations.

To finalize ESD and RCM simulations for impact studies.

To model streamflow of the Uruguay river and crop yield in Southern Brazil.

To summarize results in manuscripts.

Conference and capacity building activity: To organize the FPS-SESA Conference and Capacity building activity in November 2022 in Buenos Aires, Argentina:

Title: Conference on Regional Climate Modeling and Extreme Events over South America: Results from the CORDEX-Flagship Pilot Study. Activity: FPS-SESA conference. Venue: University of Buenos Aires, Buenos Aires, Argentina

Side-Activity: Conference and Capacity building activity for CORDEX SAM and CAM. Title: Lab training activity on how to use, interpret and compare the GCM/RCMs/ESD simulations. Venue: University of Buenos Aires, Buenos Aires, Argentina

Scientific Stays: a scientific stay at the Institute of Physics/University of Cantabria (IFCA/UCAN) for a PhD student is planned.

Additional relevant information

The 6th edition of the Convection-Permitting Climate Modeling Workshop will be held in Buenos Aires city, Argentina on September 7-9th 2022.

The workshop is an open forum to discuss the benefits and added value of using the regional and global convection-permitting resolution for weather and climate studies using multiple approaches and its topic is closely related to the FPS-SESA. Workshop Organizers: Lluís Fita, Maria Laura Bettolli, Roy Rasmussen and Andreas Prein.

The workshop will also feature the '1st Convection-Permitting Climate Modeling Winter School' (<http://www.cima.fcen.uba.ar/cpCMSchool2022>) on Saturday, September 10th (after the end of Workshop). School Director: Marta Llopart.

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If more space is needed just add rows in the table.

The report is due the 15th of February each year and should be sent to ipoc@cordex.org.