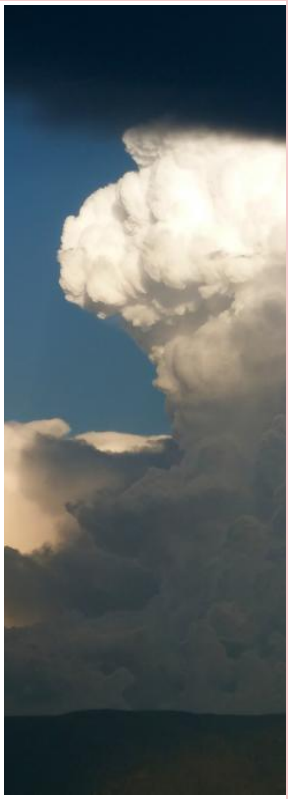
RELAMPAGO

Remote sensing of Electrification, Lightning, And Mesoscale/microscale Processes with Adaptive Ground Observations – translates to *lightning flash* in Spanish and Portuguese

What is RELAMPAGO?

RELAMPAGO is to observe convective storms in the lee of the Andes Mountains in central Argentina that are poorly represented by weather and climate models and produce high impact weather in the lee of the Andes mountains in Argentina. It is a 45 day project from 1 November - 15 December 2018, occurring concurrently with the 9-month US Department of Energy CACTI project. The project is recommended for funding by the US National Science Foundation (and is in the facility request/PI proposal stage) and is proposed to NASA and NOAA to bring US resources to the field It will also involve significant contributions from Argentina (CONICET), Brazil (CNPq and FAPESP), and Chile (CONICYT), as well as universities across the region, Argentina's national meteorological service (Servicio Meteorológico Nacional, SMN) and Brazil (INPE and CPTEC).



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01 INTERNATIONAL ENDORSEMENTS

Flooding forecast demonstration project for the WMO HIWEATHER project

Research and Forecasting Demonstration Project for WWRP

Endorsed by:

Nowcasting and Mesoscale Weather Forecasting Group of the WWRP

Joint Scientific Committee-WWRP

Scientific Steering Committee-WWRP

CLIVAR/GEWEX Hydroclimatology Panel

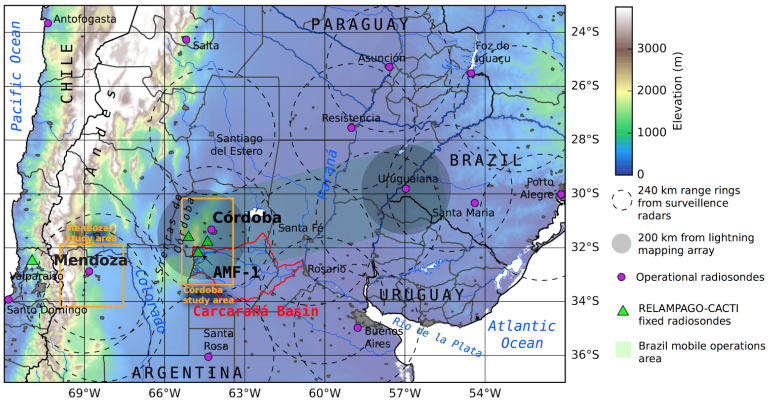
02 WHY ARGENTINA?

Argentina has amongst the strongest thunder-storms on earth, known to produce hazardous weather:

• Flash flooding
• Riverine flooding
• Hail
• Damaging winds
• Tornadoes
• Lightning

This region arguably has among the most intense convective systems in the world with respect to the frequency of large hail, high storm tops, and extreme lightning activity according to satellite proxy data, yet much remains unknown about the scarcely observed intense convection in this region. RELAMPAGO, leveraging the repeatability of storms in the region, aims to address science questions related to the pre-initiation to initiation, initial organization/severe-weather generation, and growth/ backbuildingstages of storm development, which are poorly understood. New insights into connections between the extreme hydroclimate, high impact weather, and atmospheric dynamical processes in meteorological and geographical settings unique to the these regions can be obtained by bringing together NSF facilities with new operational dual-polarization radars in Argentina significant contributions from Argentina, Brazil, Chile, NOAA, and NASA, and (3) a complementary funded climate-process focused U.S. Department of Energy major field campaign called Clouds, Aerosols, and Complex Terrain Interactions (CACTI).

The meteorological-geographical setting in the lee of the Andes Cordillera, including multi-scale interactions of synoptic disturbances, the South American Low Level Jet (SALLJ), and the complex terrain characteristics produce unique kinematic, thermodynamic, and aerosol environments that serve as controlling mechanisms for convective initiation, intensification, and upscale



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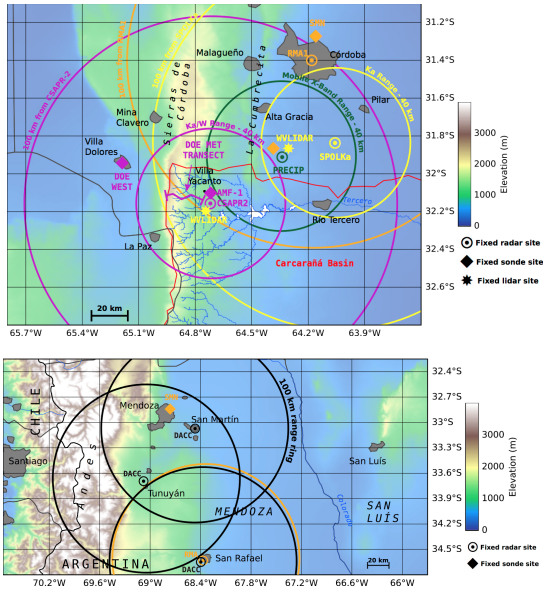
growth. These factors contribute to a unique convective spectrum that governs high impact weather in South America. Intensive field observations and characterization of these physical mechanisms will yield new understanding of relationships between convective systems and the environment, and therefore improve the prediction of convection globally.

03 RELAMPAGO OBJECTIVES

RELAMPAGO will partner with DOE-CACTI, which is a 9-month deployment of the AMF-1, CSAPR-2 radar, MAOS aerosol facility. The DOE G-1 microphysics/ radiation/ aerosol aircraft is proposed to participate during the RELAMPAGO IOP.

To address these objectives, the field campaign will obtain targeted, multi-platform observations from the subsurface through the depth of the troposphere throughout the region to characterize the synoptic scale, mesoscale, and convective scale thermodynamic and kinematic environmental evolution during convective events with varying morphologies, evolutions of cloud and precipitation properties, and severe weather characteristics. An adaptive ground-based and aircraft-based network, including mobile mesonets, Lightning Mapping Arrays and other lightning instruments, soundings, fixed and mobile Doppler/polarization radars (from W- to S-Band), lidars, microwave profilers, and surface flux measurements, will be used to (1) characterize the pre-convective and convective environments, (2) characterize kinematic and microphysical properties of clouds and precipitation, convective outflows, atmospheric electrification, and hydrometeor size distributions and (3) observe hydrometeorological interactions with convective systems in a region of repeatable observations. RELAMPAGO will provide unique observations of atmospheric and surface conditions in a region with substantial terrain and explore a regime of convection not observed comprehensively.

RELAMPAGO will form a key part of an observation network that will elucidate the tight connections between the land surface, complex terrain, convective development, and the production of severe weather, role of terrain processes in initiating and developing organized convective systems and altering flows within and above the convective boundary layer, and roles of environmental moisture, aerosols, and instability on the resultant intensity, organization, precipitation, and high impact weather production of deep convective systems. Through its unique configuration of atmospheric profiling and remote sensing capabilities, understanding of processes that impact prediction of societal hazards will be improved.



Adaptive ground observations will observe storms in two environments: Near the Sierras de Córdoba (SDC), where flooding, hail, and wind damage is prevalent, and MCSs initiate that impact the greater La Plata Basin, and near Mendoza, in the Andes foothills where legendary hail storms produce widespread damage in this key wine-producing region.

Experimental design for the RELAMPAGO fixed observatories in the SDC (top) and Mendoza (bottom) regions.

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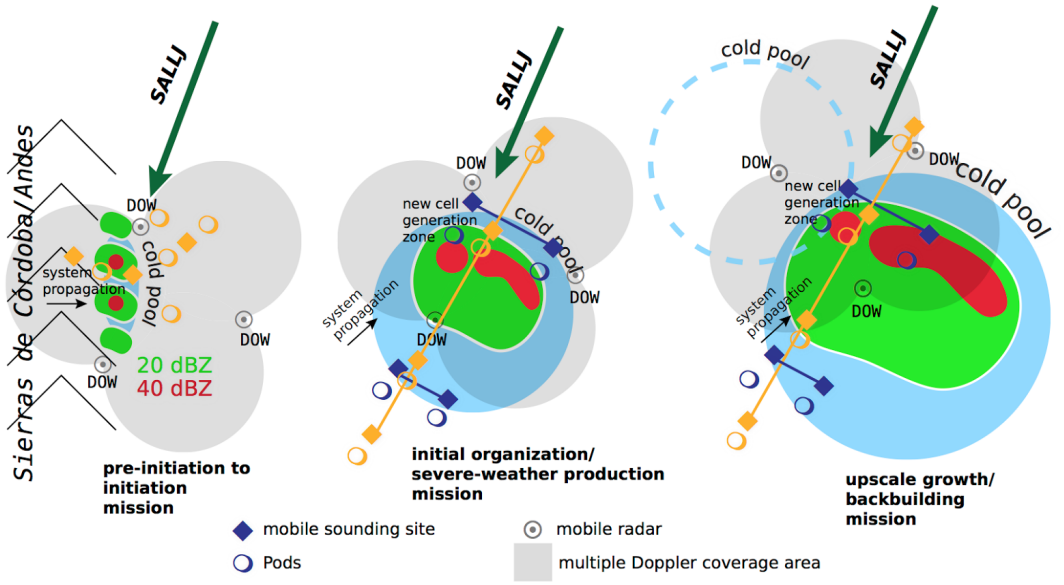
Adaptive ground sampling

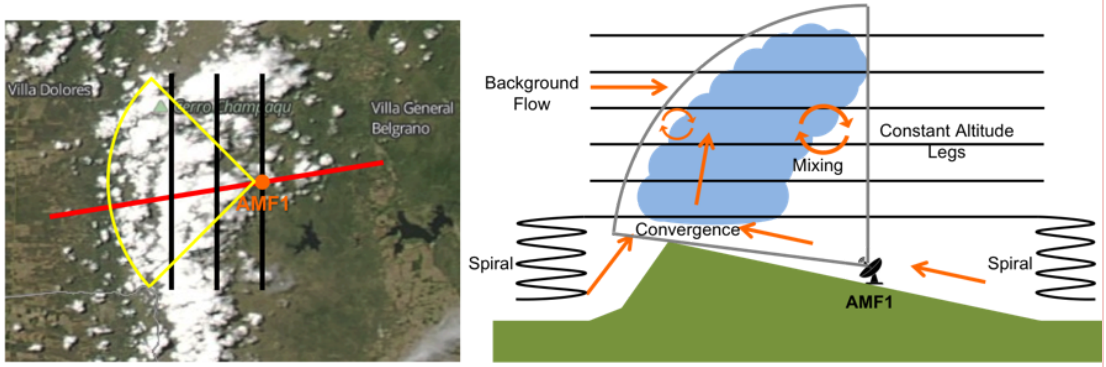
3 sampling modules (pictured below), adaptable to both study regions, will address hypotheses for *initiation, organization and severe weather production*, and *upscale growth/backbuilding*.



Design of initiation (left), initial organization (center), and upscale growth/backbuilding (right) missions for RELAMPAGO mobile assets. Initially, separate sampling missions will be called for each case, based on forecasts. Pre-organized sites and missions will be carefully designed to avoid safety, communication and coordination issues. As experience grows during the campaign, we will attempt to coordinate missions with more complex objectives given the infrastructure and communications.

Coordinated atmospheric sampling

Soundings, surface obs, mobile radars, and aircraft will focus on sampling pre-, during- (with updraft sonde sampling) and post-convective environments, including cold pools, before and during events:



The DOE G-1 aircraft flight strategy for orographic cumulus events in horizontal and vertical plan views. Meridional, RHI (~zonal), and spiral flight legs are shown in black. The vertical plan view is shown in red in the horizontal plan view. Typical circulations for these events are shown in orange, and AMF-1 location with radar scans are also shown.

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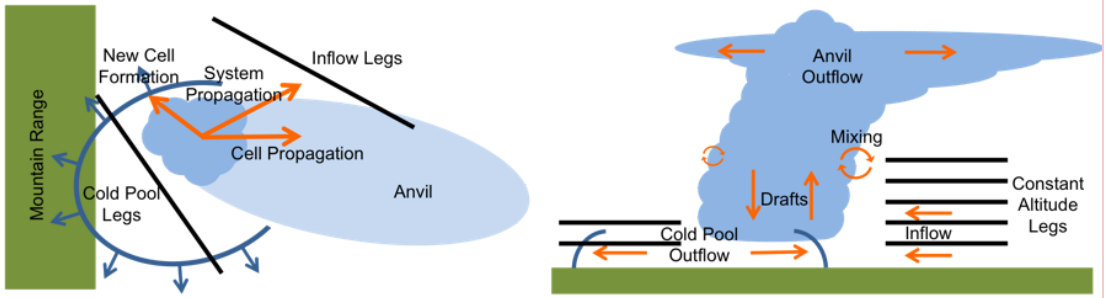
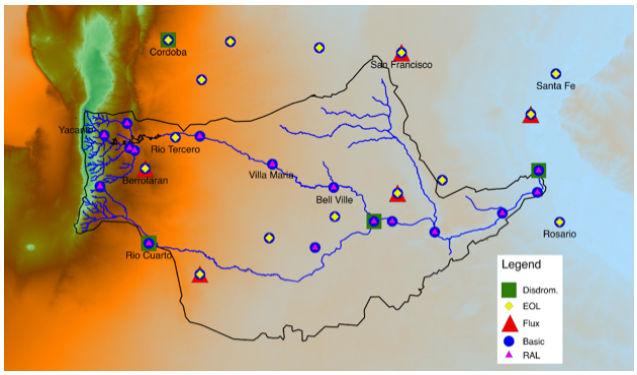


The DOE G-1 flight strategy for deep convection in horizontal and vertical plan views. Convective inflow and outflow flight legs are shown in black and are flexible to changing depending on the evolution of each event.

Hydro-meteorology and land-surface interaction

A comprehensive hydrometeorological project will quantify land surface forcing and flooding impacts (over 9 month period, with intensive streamflow sampling during 45-day RELAMPAGO IOP)



Proposed locations of the NSF hydrometeorological network that will operate for the RELAMPAGO-EOP across the Carcarañá River basin.

04 BROADER IMPACTS

Our experimental design, focusing on the contrasting factors controlling the initiation and growth of these systems with the global population of convective storms, particularly in the US Great Plains, will improve understanding of, and the ability to predict, severe convective storms worldwide. The extensive set of observations and research conducted will aid current efforts to install new weather radars and regional lightning networks, and modernize the weather and climate prediction infrastructure in South America, in the development of conceptual models of extreme weather events for use by forecasters in South America and globally, and in combination with improved prediction of weather- and hydrological-related hazards, will lead to reductions in future loss of life and property. Education and outreach in several universities and schools in subtropical South America and the US, extensive international student and scientist cooperation and involvement in the observation campaign, and a large internet presence through social media and webinars will enhance collaboration and awareness across the Americas as well as train the next generation of scientists and engineers in the Americas.

05 CONTACT

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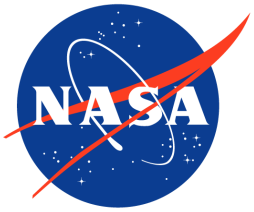
06 ANTICIPATED SPONSORS



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