On the forecasting challenges of the RELAMPAGO observational campaign using an on purpose CRM ensemble with WRF

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[1] *CIMA, CONICET-UBA, CNRS UMI-IFAECI, Argentina* [2] *Serv. Meteo. (SMN), Argentina* [3] *Dept. of Atmos. Scie., U. Illinois, USA* [4] *NOA-IERSD, Greece* [5] *Dpt. of Atmos. Scie.,CSU, USA* [6] *Dpt. of Atmos. Scie., U. Washington, USA*
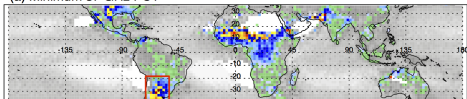
GEWEX Convection-Permitting Climate Modeling Workshop II, Boulder, 4-6th Sept. 2018
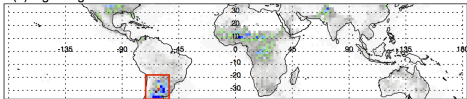
Climatological studies using TRMM data ...

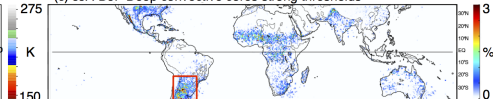# Climatological studies using TRMM data ...

(a) Minimum 37 GHz PCT

(b) Lightning flash rate

(c) JJA-DJF Deep convective cores strong thresholds

(d) JJA-DJF Wide convective cores strong thresholds

[Zipser et al., 2006, BAMS]

[Houze et al., 2015, Rev. Geophys.]

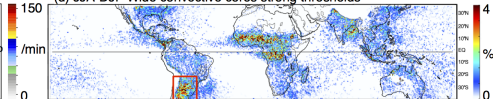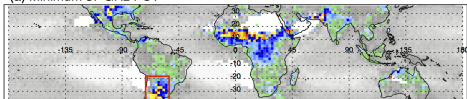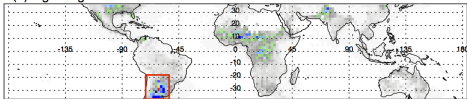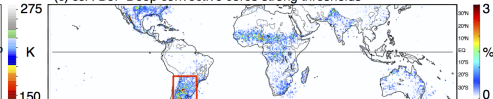Climatological studies using TRMM data ...
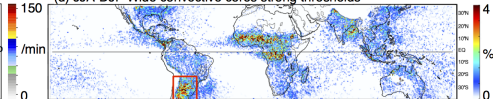

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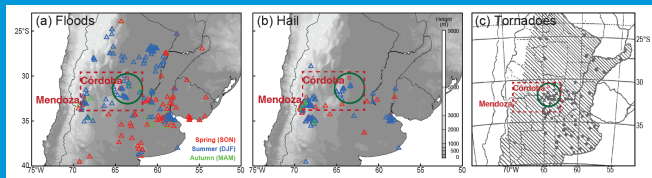... the world **most intense** storms in Argentina !!

RELAMPAGO-CACTI

- USA NFS & Dept. Energy funded intense observation campaign over Mendoza and Córdoba in Argentina

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Remote Sensing of **E**lectrification, **L**ightning **A**nd **M**eso-scale/micro-scale **P**rocesses with **A**dapative **G**round **O**bservations (RELAMPAGO)

Known zones of intense convective phenomena:

[Rasmussen et al., 2014, Geophys. Res. Lett.]

[Schwarzkopf & Rosso, 1982 12th Conf. Severe Local Storms]

RELAMPAGO-CACTI

- USA NFS & Dept. Energy funded intense observation campaign over Mendoza and Córdoba in Argentina
- Questions to be addressed by RELAMPAGO-CACTI:

  - What are the life cycles and environmental characteristics of deep, organized, high-impact weather-producing storms across this region? How does it act to set the stage for hazardous weather and extremes? (kinematic, thermodynamic, aerosol, land surface, topography)

  - What are the physical mechanisms that produce these storms? How do they differ from similar events in the US? What is the predictability of these storms and associated hazards?

- **Institutions**
    - US Universities: UIUC, UT, CSU, CU, UW, PSU
    - US Institutions: DOE (BNL, PNNL, LBNL), NCAR, CSWR, NOAA, NASA
    - AR Universities: Buenos Aires, Córdoba, La Plata, Litoral
    - AR Institutions: SMN, CIMA, SINARAME, MinCyT, CITEDEF, INVAP
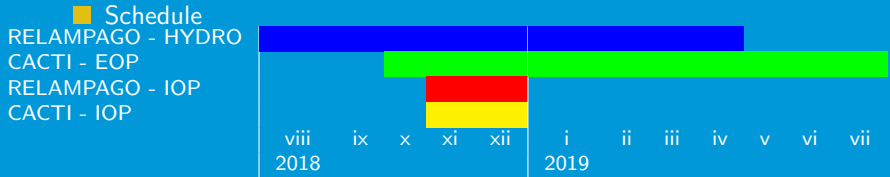   - BR Universities/Institutions: University of Santa María, University of São Paulo, INPE

- **roles in observations**
  - NSF:
    - Deployment pool, S-PolKa, DOWs, Soundings + Expendables, Mesonet/Pods (CSWR), DIAL LIDAR
    - Non-deployment pool, Hydromet measurements (RAL)
  - NASA (US): Disdrometers, Rain gauges, Micro-rain radars, (specital GOES-16 scans?)
  - NOAA (US): Lightning mapping array, Field mills (Proposed)
  - DOE (US): CACTI AMF-1 (cloud/profiling suite, aerosol measurements), C-Band DP Radar, G-I microphysical and aerosol aircraft)
  - SMN (AR): Mobile soundings, Enhancement of operational radiosondes, DSD + rainfall
  - SINARAME (AR): C band Radars DP
  - INPE (BR): Sao Borgia, Mobile X-Band DP radar, Precip/profiling supersite, Lightning mapping array, Stickn S-Band DP radars downstream

■ Schedule

RELAMPAGO - HYDRO											
CACTI - EOP											
RELAMPAGO - IOP											
CACTI - IOP											

viii	ix	x	xi	xii	i	ii	iii	iv	v	vi	vii
2018					2019						

1 Pre-field campaign project design, research, integration
   ■ RELAMPAGO **DryRun 1** (Nov 2017): 2015 Nov.-Dec. cases
     (1st week), real-time (2nd week)
   ■ RELAMPAGO DryRun 2 (2018 Sept. 10th, 1 week real-time)
2 Societal and governmental engagement (2015-)
3 Large multi-agency field campaign + forecasting and
   nowcasting activities (2018-2019)
   ■ RELAMPAGO/CACTI IOP: 2018 Nov. 1st - Dec 15th 20
4 Post-project science (2018 and beyond)

C I M A
CONICET
U B A

Deployment of instruments

RELAMPAGO IOP

■ Instruments

DOE

DOW

CSWR

CSWR pods

CSWR Mobile Meso-Net

soundings

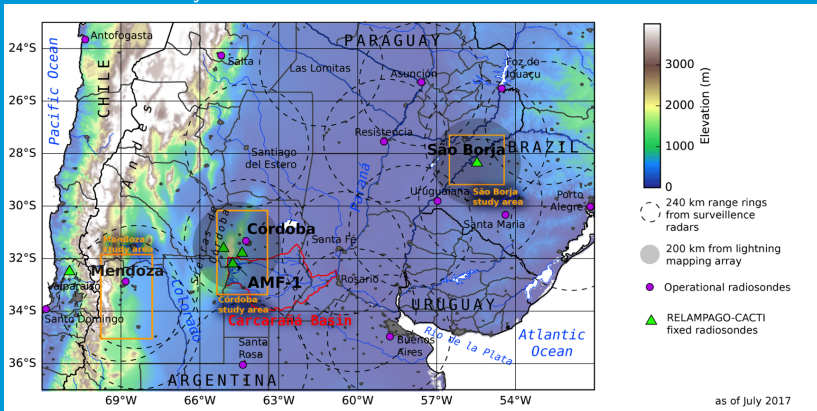**18** containers arrived at Buenos Aires Harbor !!
>**70** people involved in IOPs: in-field, forecasters and scientists

■ Areas under study

as of July 2017

Carlos Paz headquarters: morning/night briefings, observers re
place
Mendoza, **Córdoba** IOPs aeras

- Virtual briefing of a field campaign and instrumental deployment

RELAMAPGO Dry Run

- Virtual briefing of a field campaign and instrumental deployment
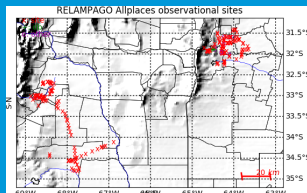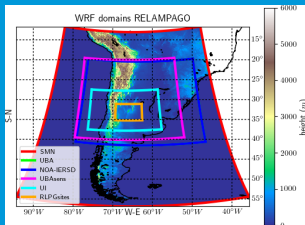- Test of data-sharing and forecast coordination

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- **Main scientific focus:** convection initiation, severe weather, upscale convective growth, backbuilding, hydrometeors

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- Convection permitting WRF ensemble from 6 different institutions: U. Illinois [US] (UI), Servicio Meteorológico Nacional [AR] (Met. Office), Colorado State University [US] (CSU), Centro de Investigaciones del Mar y la Atmósfera [AR] (CIMA 2 runs), National Observatory of Athens [GR] (NOA) - IERSD

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- 4 different domains, 6 different physics configurations, different forcing (GFS, ERA-Interim, ERA5) and model set-up (4 *km*, vertical lev., ...)

- 1st week: 5 old 2015 cases, 2nd week real-time (forced by GFS)

RELAMPAGO Dry Run 1

■ 6 Old cases: 48-hour simulations of past strong events (2015 Nov-Dec)

■ real-time: 48-hour simulations of 2018 Nov 27th-30th
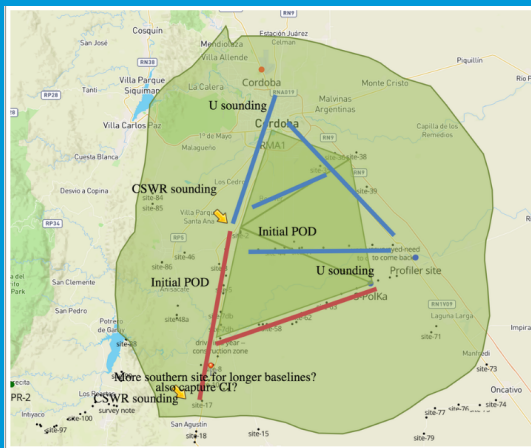
RELAMPAGO Dry Run 1

- e.g. Case1: 2015 Nov. 7-9
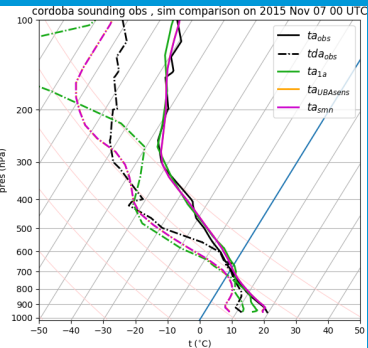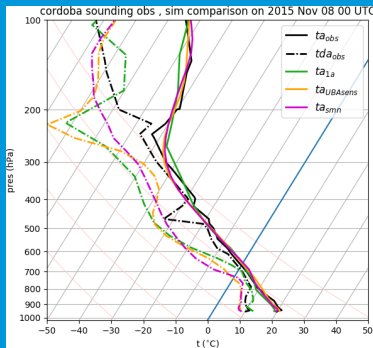
Córdoba radar image on 7th at 20:06:56 UTC

courtesy of SMN - SINARAME
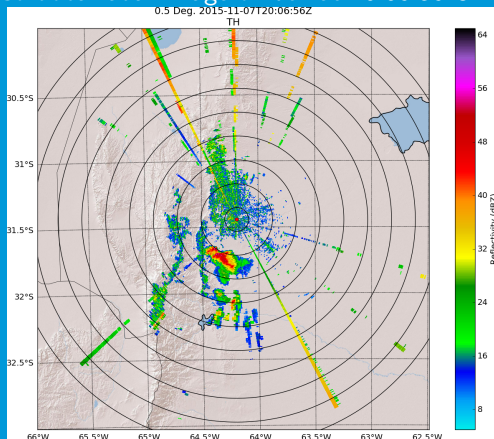
RELAMPAGO Dry Run 1

- e.g. Case1: 2015 Nov. 7-9

Córdoba sounding

initial conditions   24-h forecast   runs

1a: ERA-I, 4km, 40lev

UBAsens: GFS, 3km, 60lev

smn: GFS, 3.3km, 38lev

obs. soundings from U. Wyoming data portal

- ERA-Interim wetter at low levels than GFS
- Large differences after 24-h forecast

RELAMPAGO Dry Run 1

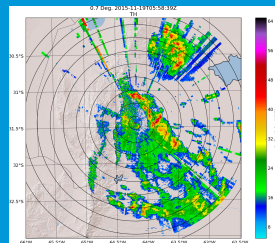■ e.g. Case6: 2015 Nov. 18-20

Córdoba radar images
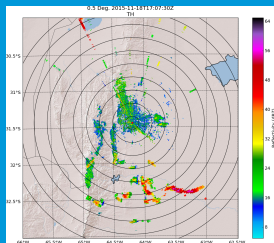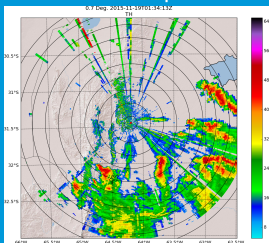
Conv. Init.   Full development   Second series of storms

courtesy of SMN - SINARAME

■ e.g. Case6: 2015 Nov. 18-20

Córdoba sounding

initial conditions 24-h forecast runs

era5-1a: 1a + ERA5

smnphys: 1a + smn
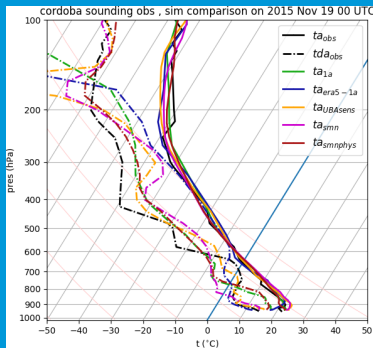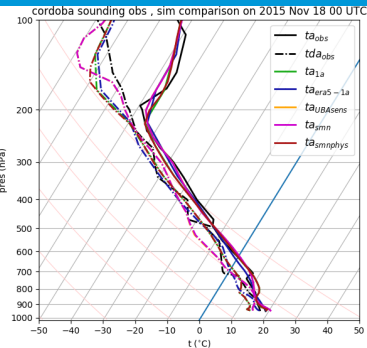
physics

obs. soundings from U. Wyoming data portal

■ Not large differences at initial time-step
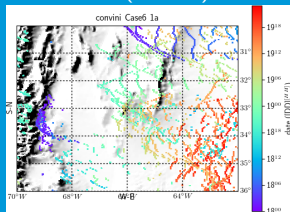
■ Large differences after 24-h forecast
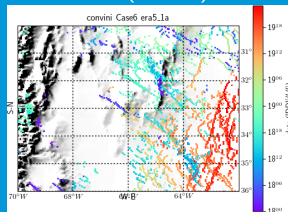
C I M A
CONICET
U   B   A

RELAMPAGO Dry Run 1

- e.g. Case6: 2015 Nov. 18-20

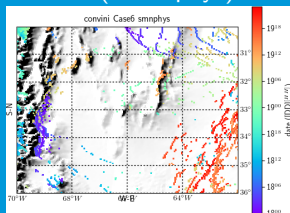 Convective initialization (time at $pr > 0.0001 \ kgm^{-2}s^{-1}$)

1a (ERA-I)

1a (ERA5)

1a (SMN phys)

- Different time & locations
- Orographic influence convection triggering
- Similar NW-SE evolutions
- Lower convection with SMN phys

- Main results:
  - Difficulties to get data on time for briefings (only 1-2 local runs available)
  - Large spread of forecasts, difficulties to determine instrumental distribution and scientific focus

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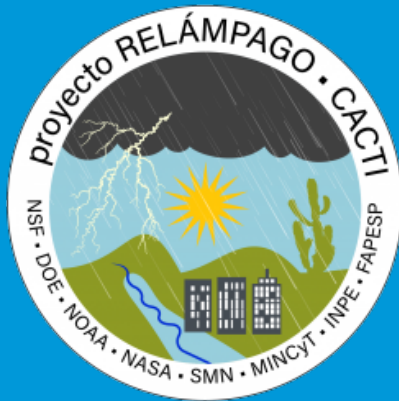
- Further Work
  - WRF set-up forecasts coordination is necessary
  - Optimize data/figures sharing to be on time for briefings
  - Development of an ensemble (60 members with GFS ens.) with data assimilation (CIMA+SMN) during the campaign and to be keep afterwards as regular forecast
  - BAMS article about DryRun exercise currently under preparation
  - **Getting closer to the campaign !!**

Thank you for your attention !!