La Plata Basin (LPB)
Regional Hydroclimate Project

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Scientific and Implementation Steering Group (SISG)

CPTEC
Centro de Previsão de Tempo e Estudos Climáticos

Ministerio de Defensa
Secretaría de Planeamiento
Servicio Meteorológico Nacional

Climate Prediction Center

WCRP World Climate Research Programme
Global Energy and Water Cycle Experiment GEWEX WCRP
CLIVAR Climate Variability & Predictability World Climate Research Programme

Outline

1. Motivations for LPB

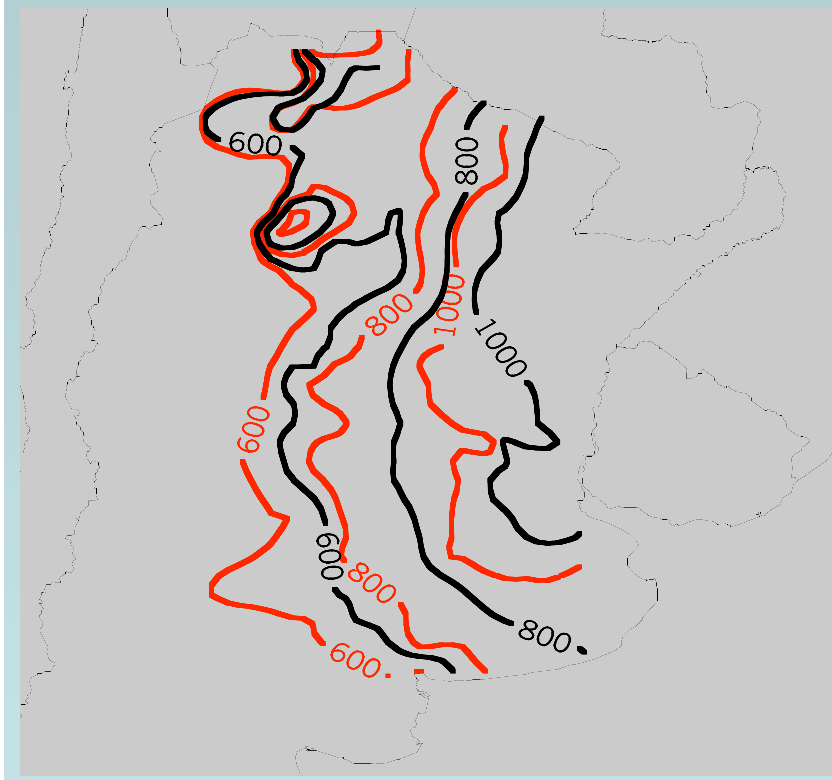
2. Implementation of activities
    - Data collection
    - Monitoring/Field Experiment

3. LPB support

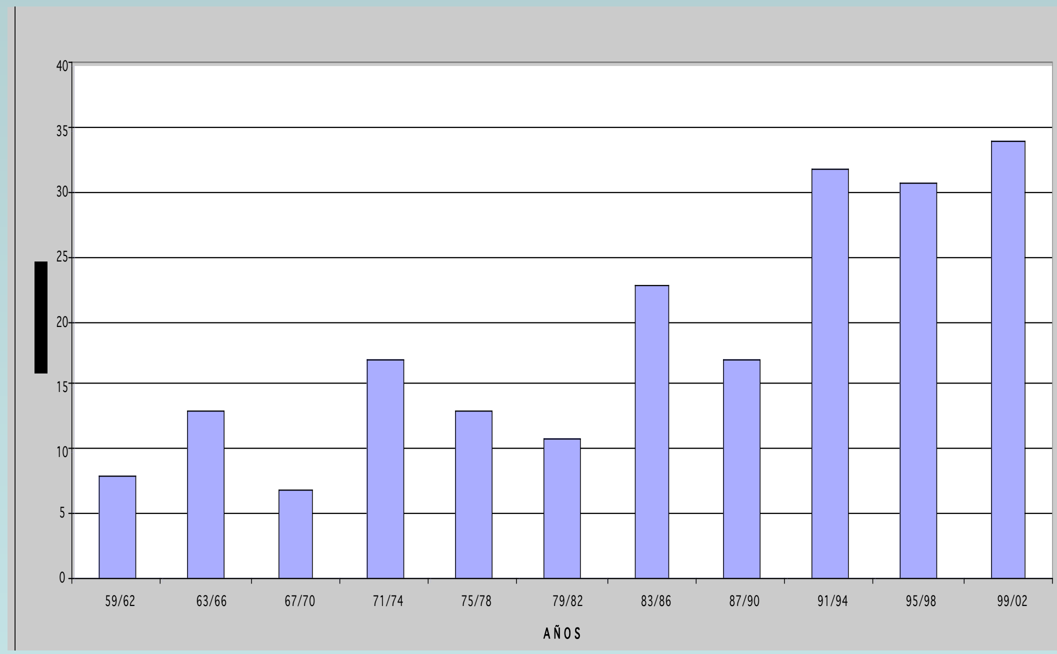
4. Future steps

1. Motivation: Trends in precipitation

Black 1950-1969
Red 1980-1999



Number of cases with P> 100 mm/(2 days) for 16 gauging stations over central and northeastern Argentina



Source: Barros et al

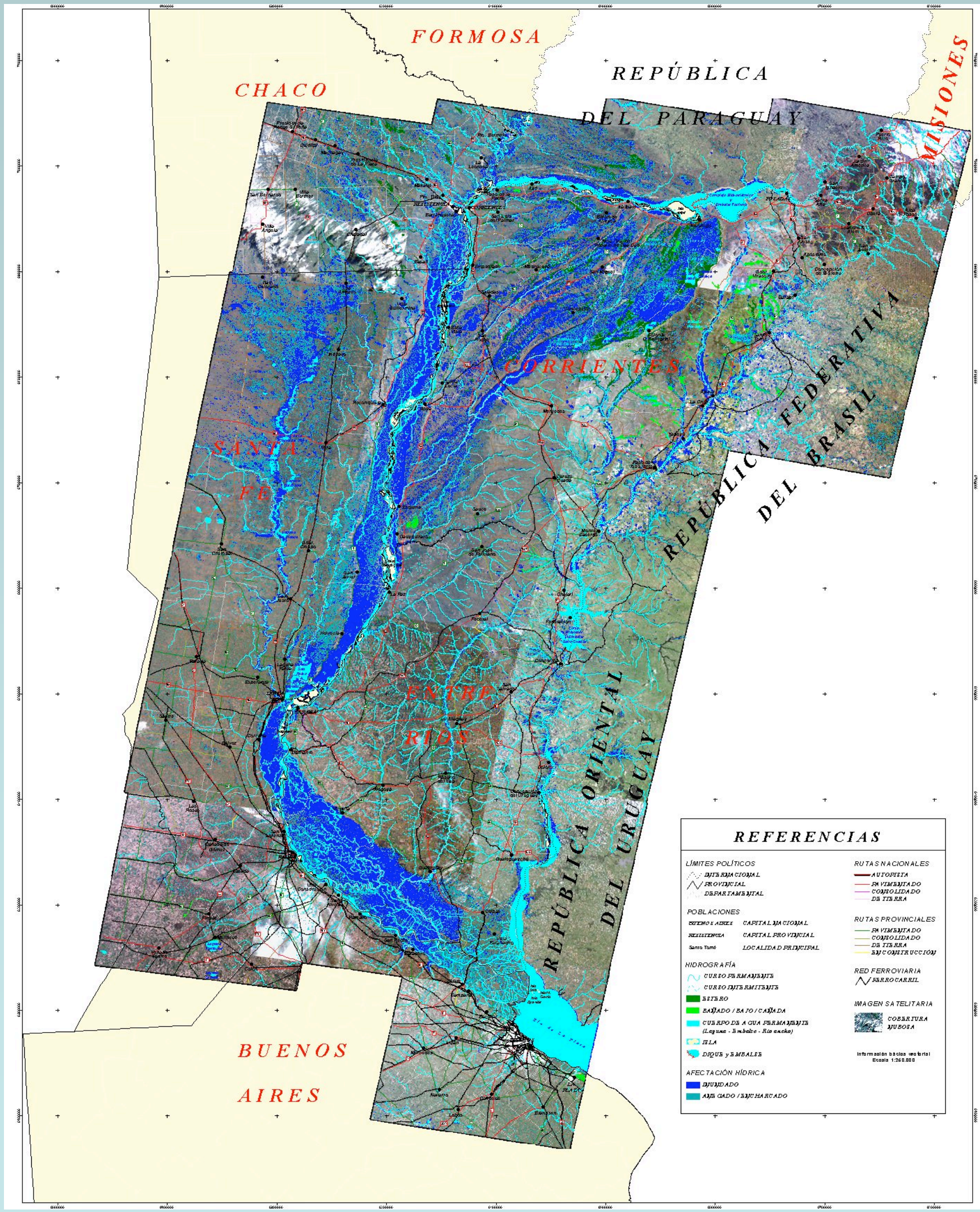
Amplification of the precipitation signal in the streamflow

	Rainfall rate over La Plata Basin ($m^3\ s^{-1}$)	Streamflow ($m^3\ s^{-1}$)	Evaporation + Infiltration ($m^3\ s^{-1}$)
1998	107,000	36,600	70,400
1999	81,600	20,440	61,600
Difference	*23 %*	*44 %*	*13 %*
El Niño	76,000	25,250	50,750
La Niña	71,000	21,640	49,360
Difference	*7 %*	*17 %*	*3 %*
1951-1970	72,000	19,300	52,700
1980-1999	83,500	26,000	56,500
Difference	*16 %*	*35 %*	*9 %*

Berbery and Barros (2002)

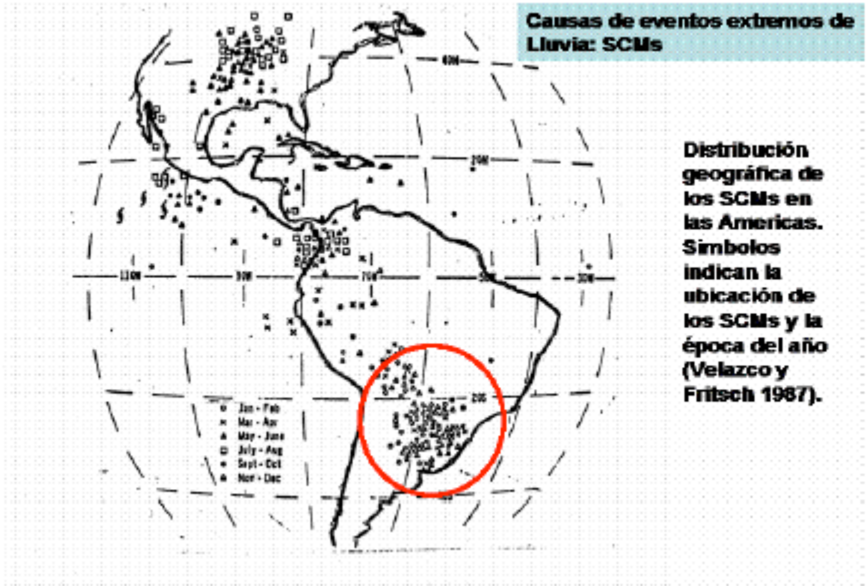
Normal conditions

1997/98 Flood of the Paraná River (Satellite images from CONAE)

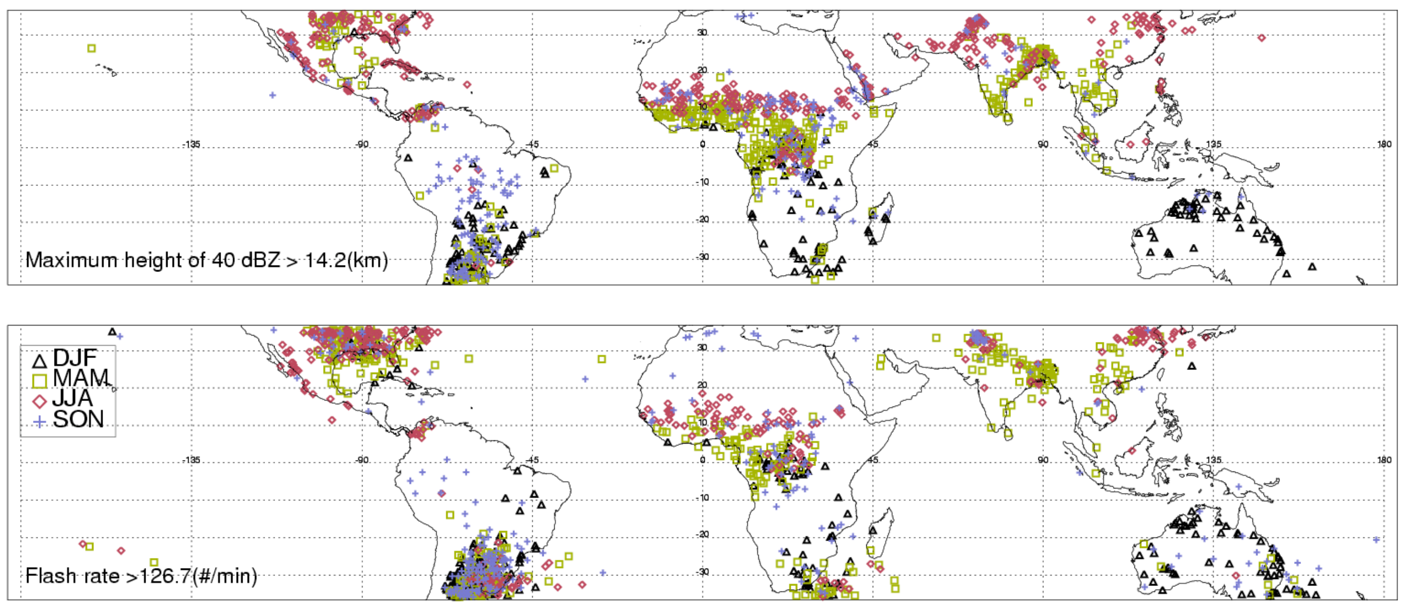


2. Motivation

Mesoscale Convective Systems (MCSs)



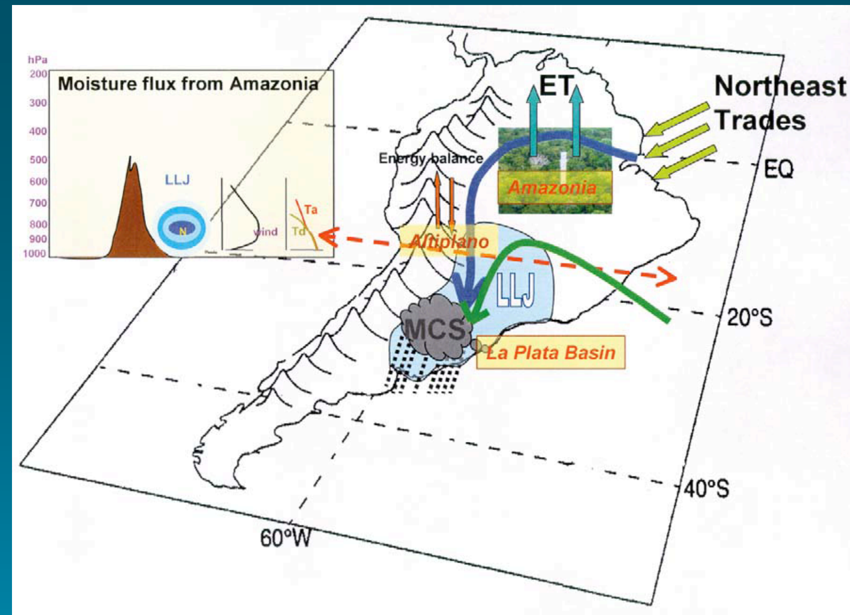
Velasco and Fritsch 1987

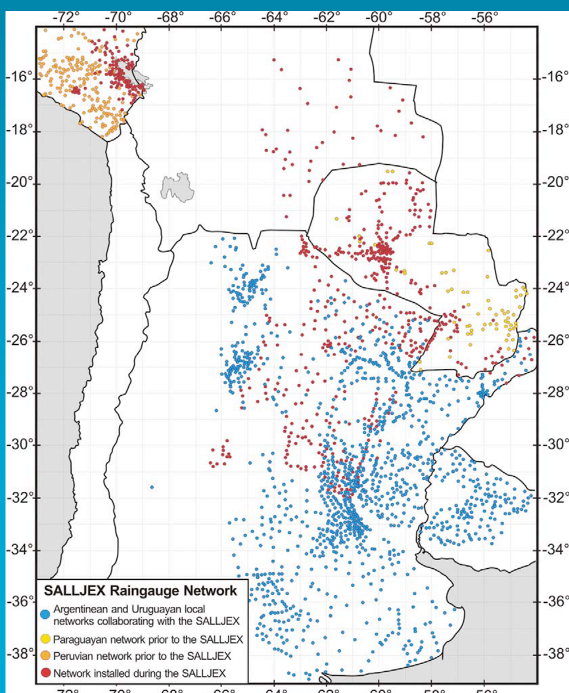


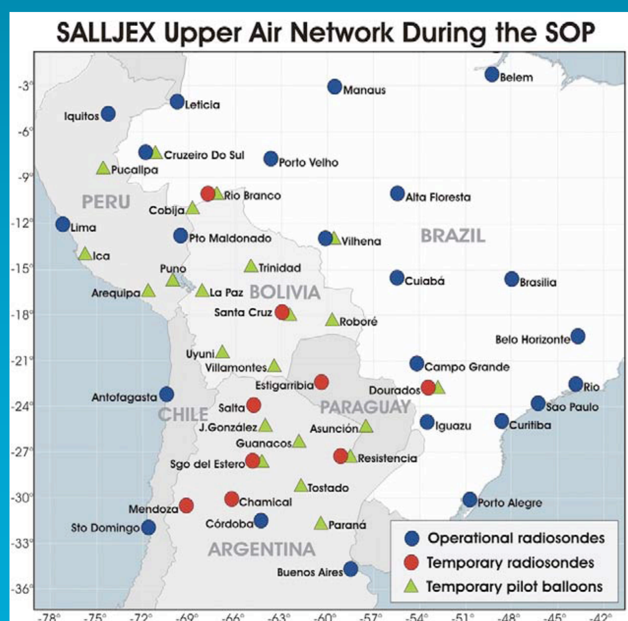
Courtesy of Zipser

SALLJEX

WCRP
CLIVAR / VAMOS-GEWEX
Field Campaign

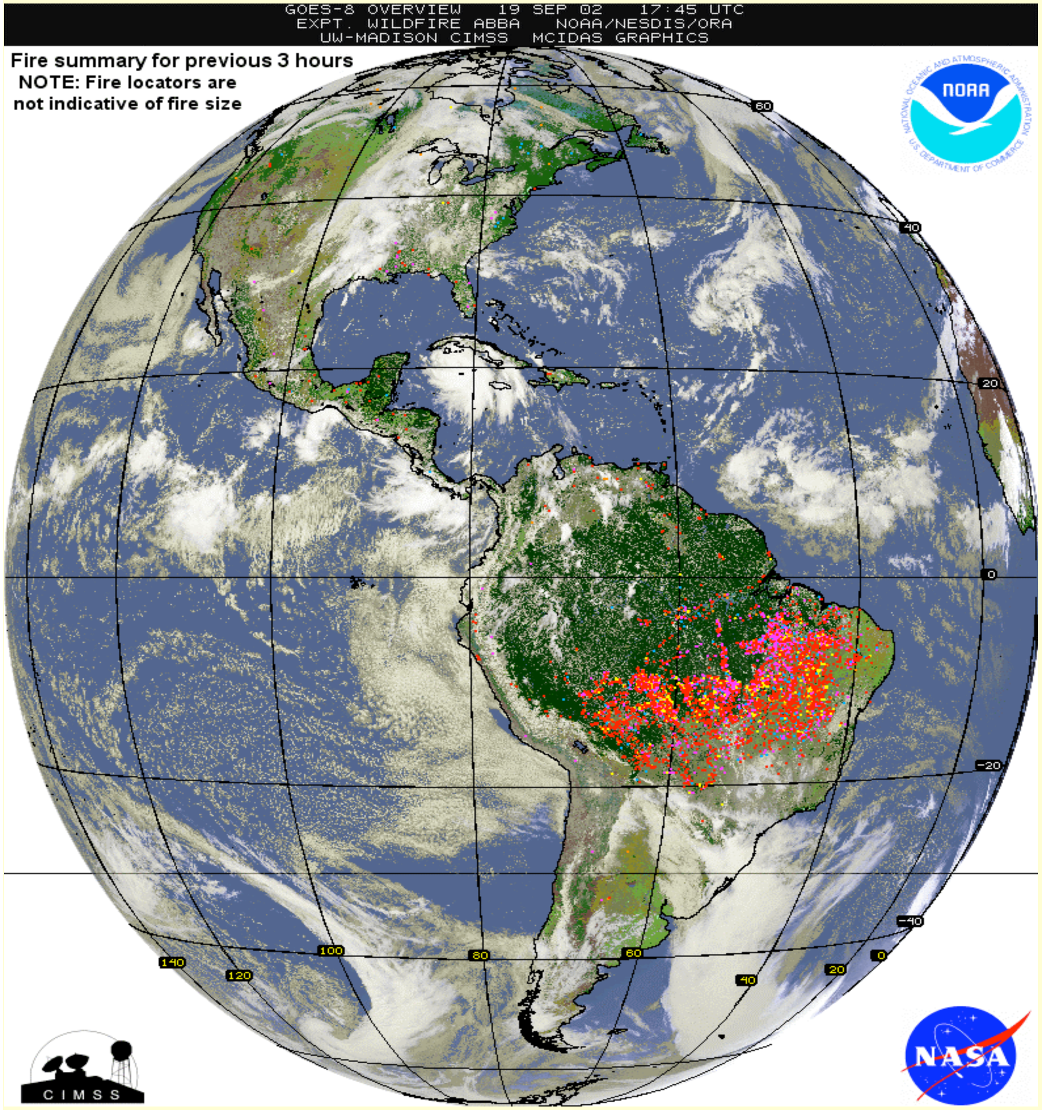






Flight dates	Flight type
Jan 11	LLJ-Test aircraft operating procedures
Jan 15	LLJ-Successful in obtaining many profiles of a weak jet
Jan 17	LLJ-Jet details near the topography NW of Santa Cruz
Jan 18	LLJ-Cold Front-MCS
Jan 21	LLJ-No significant deep convection along flight track
Jan 22	LLJ-MCS genesis
Jan 24	Cold Surge
Jan 28	Altiplano-South Pacific diurnal variations of the ML
Feb 1	Northwestern Argentina heat low
Feb 4	LLJ-Northern Argentina. Samples of Convective cells.
Feb 6	LLJ-Southern Bolivia and Western Paraguay.
Feb 7	LLJ–Observed jet with “classical” distribution
Feb 8	LLJ-MCS.

GOES-8 ABBA FIRE PRODUCT
1745Z 19 SEP 2002

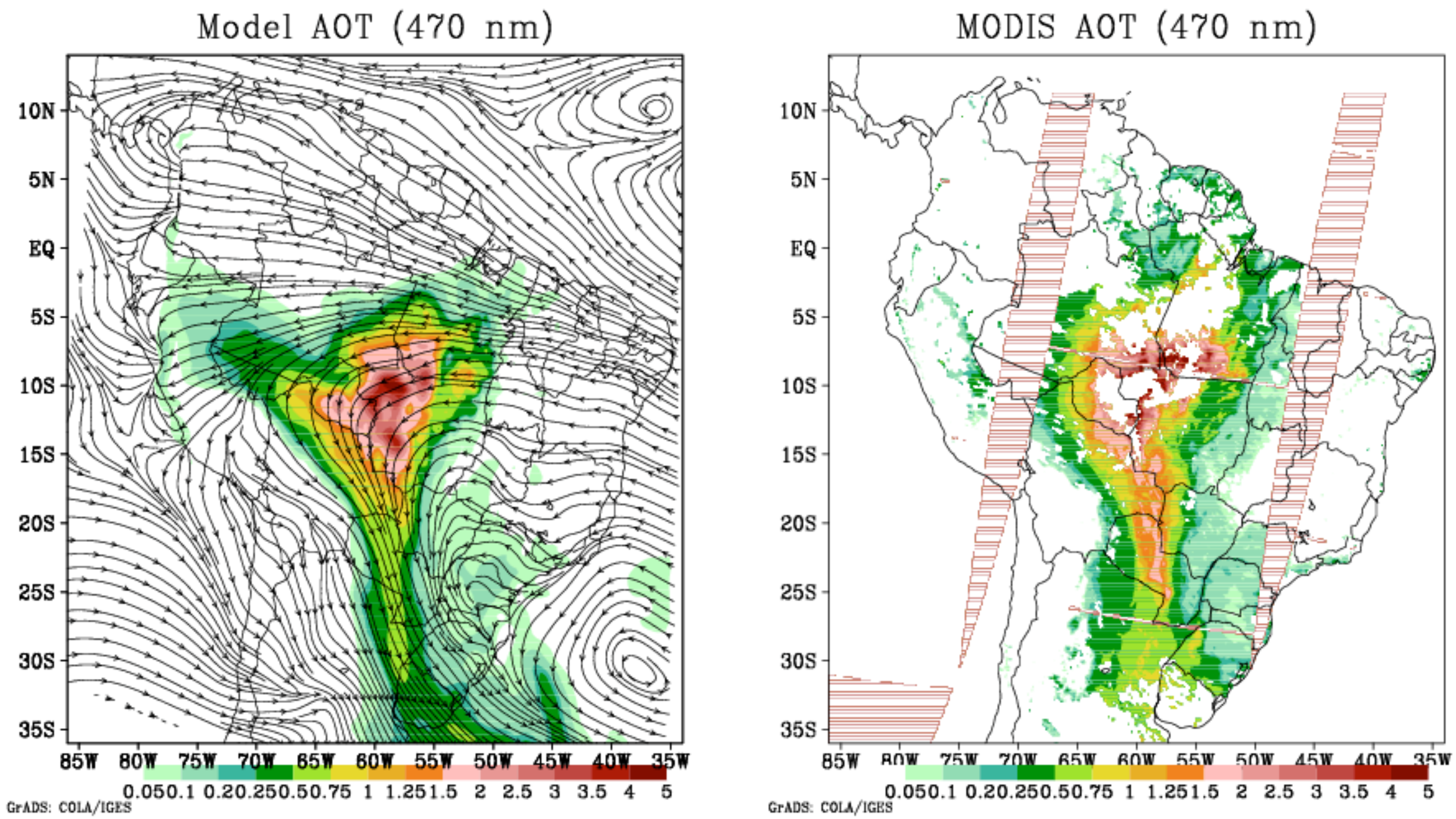


- How do aerosols contribute to cloud processes?

- What is the impact of advected aerosol on the surface heat and moisture budgets?

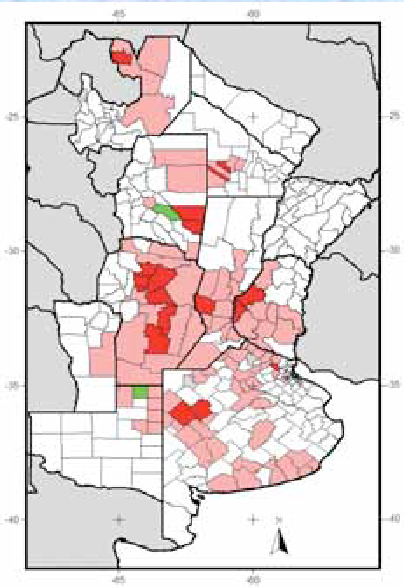
- What is the radiative effect in the precipitation processes?

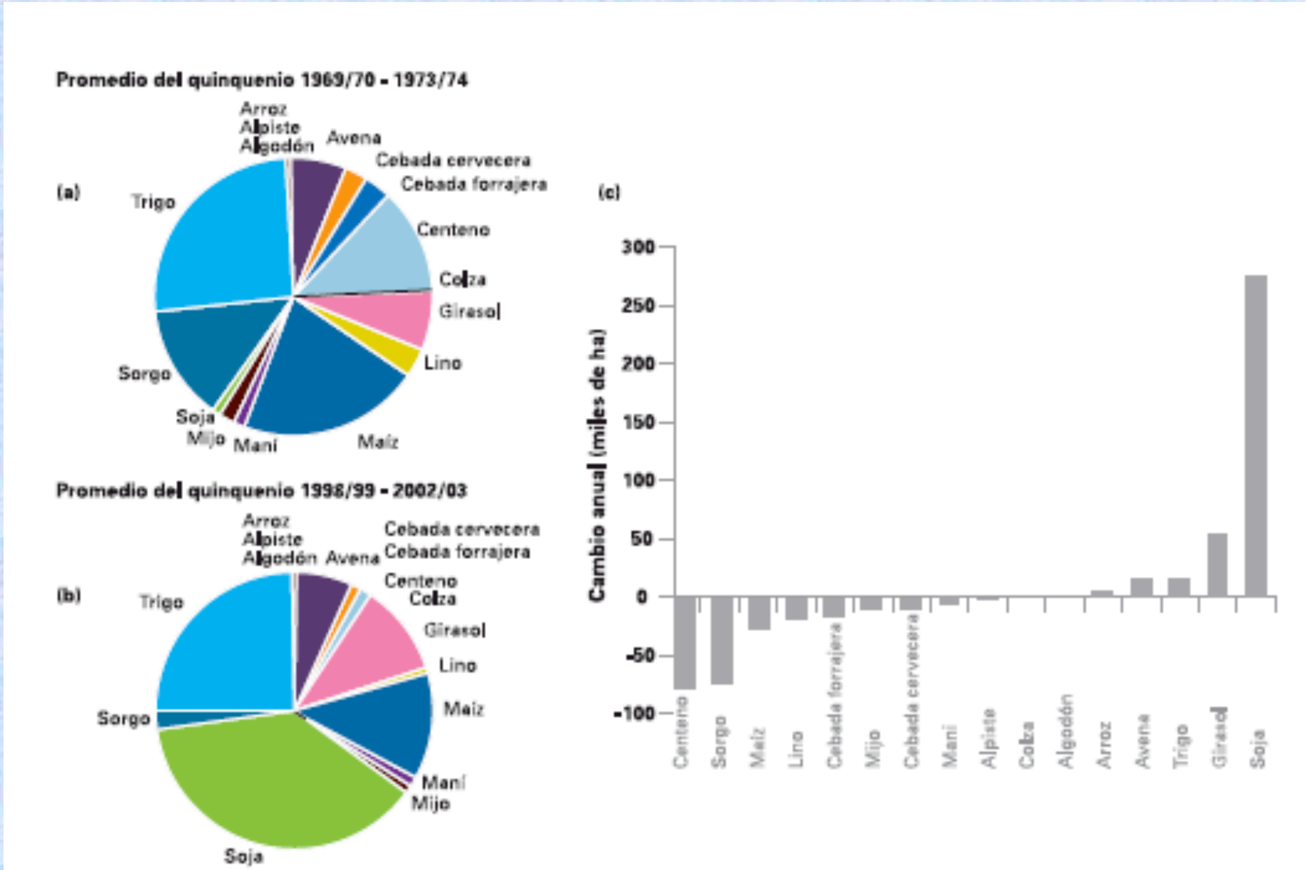
Aerosol effects



Numerical simulation and validation with MODIS of aerosol optical thickness. Freitas et al (2005)

3. Motivation for Land cover/Land use studies

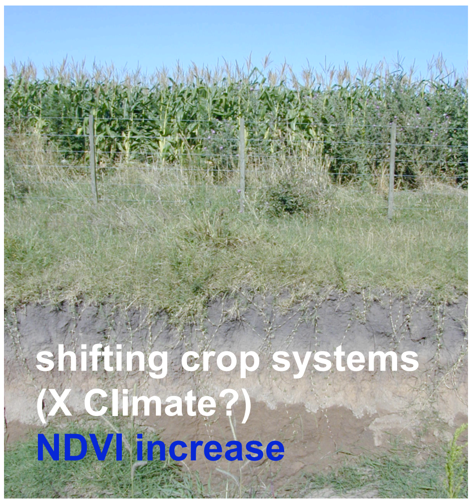


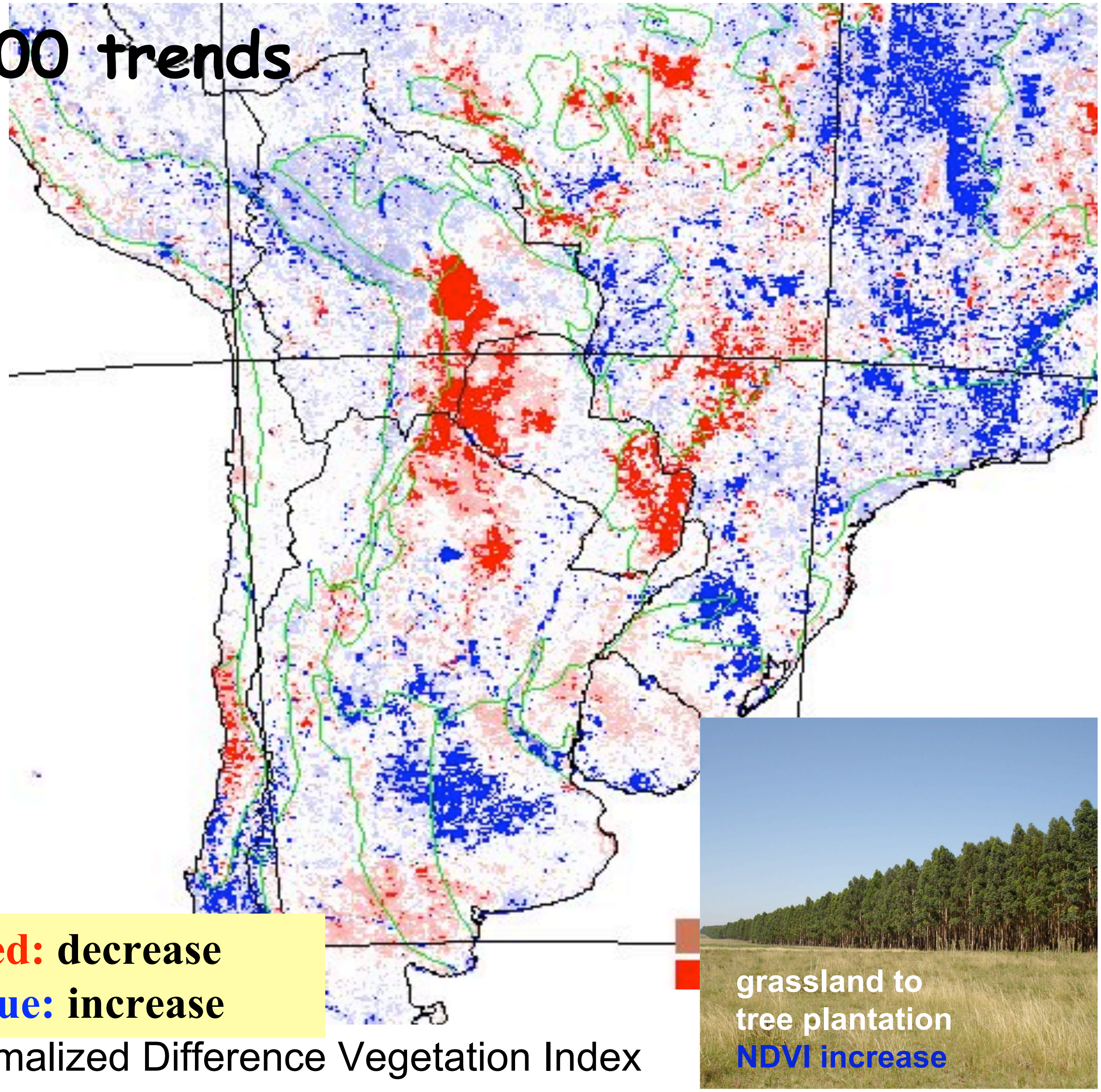


Characterization of land use changes using remotely sensed biophysical variables

NDVI 1981-2000 trends

surrogate for primary production from NOAA-AVHRR images





Red: decrease
Blue: increase

Normalized Difference Vegetation Index

Depending on their physiological properties, crops have different evapotranspiration properties, and they reflect and/or absorb radiation differently (changes in albedo), thus affecting the processes that produce precipitation.

Likewise, their roots absorb water differently, thus impacting the soil moisture, deep runoff and ultimately river flows.

Scientific Motivations for the LPB Regional Hydroclimate Project

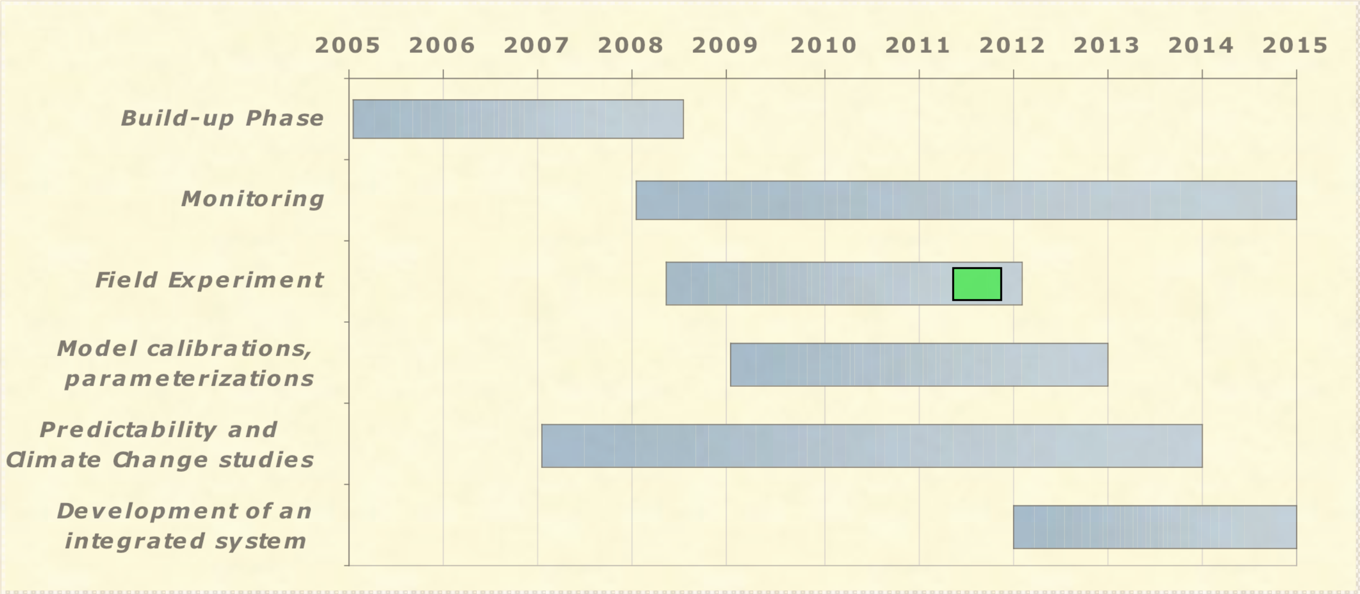
- Strong interannual and interdecadal climate and streamflow variations and trends
- Confounding effects of land use change: deforestation, intensive agriculture trends and urbanization
- Unknown effect of aerosols advection from biomas burning from tropical areas
- Strong role of MCS in total precipitation
- Vulnerability to climate change
- Potential for better predictability

Main science questions:

- What climatological and hydrological factors determine the frequency and spatial extent of **floods and droughts**?
- How **predictable** is the regional weather and climate variability and how predictable are their impacts on the hydrological, agricultural and social systems of the basin?
- What are the impacts of global **climate change and land use change** on regional weather, climate, hydrology and agriculture? To what extent can their impacts be predicted?

Structure of the LPB Implementation Plan

- *Data rescue efforts* - *Hydroclimatic monitoring* - *Field Experiment (PLATEX)*	- *Hydroclimate Modeling and Predictability activities* - *Climate change assessments* a. *Climate change scenarios and regional downscaling* b. *Land cover/Land use* c. *Aerosol effects*
Capacity Building and Outreach	



LPB Monitoring/Field experiment issues

1. Survey of existing data
Collect existing met/hydro information through the region in preparation for the field experiment (Precipitation, Streamflow, Soil Moisture…)

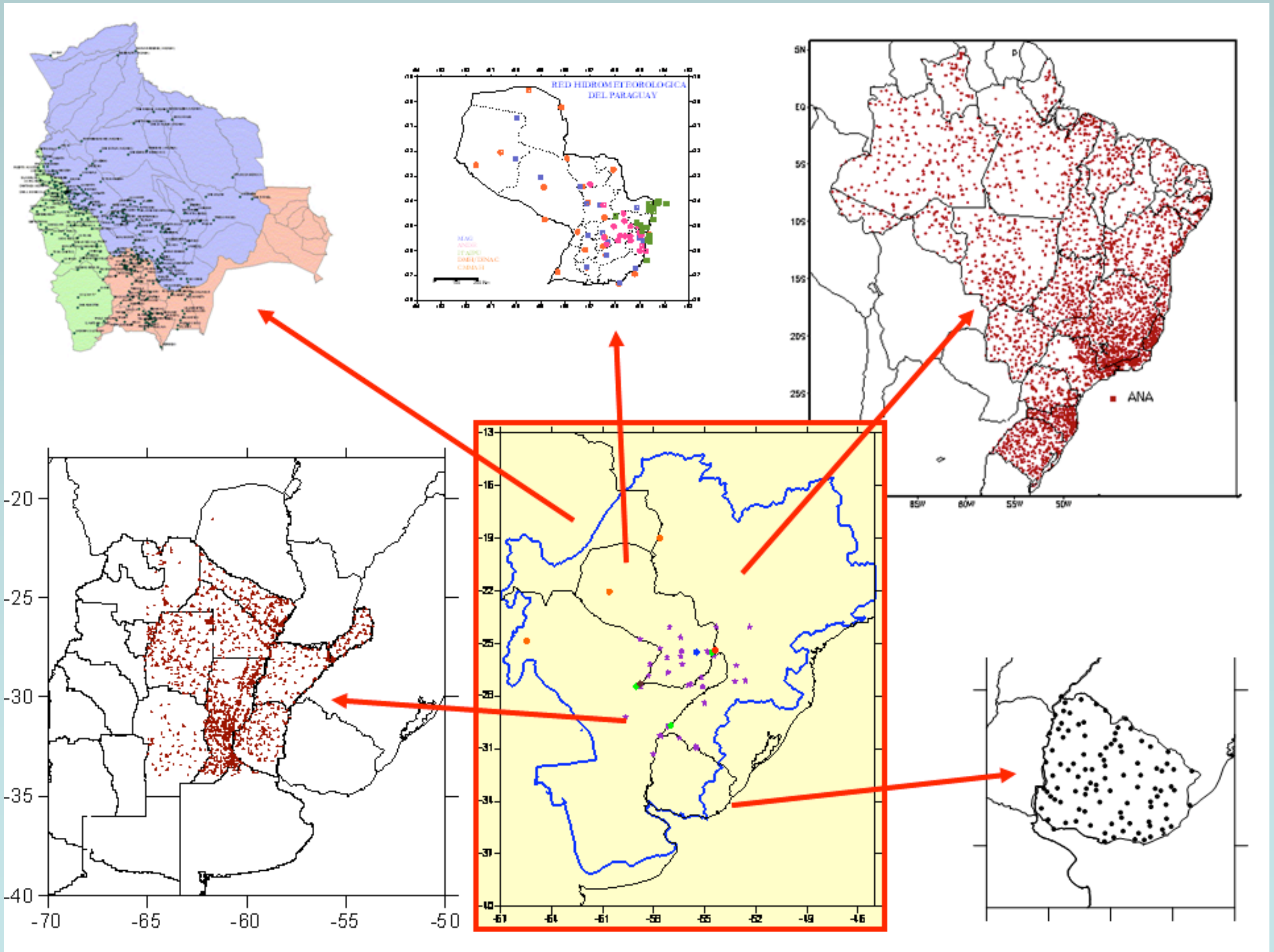
2. Soil moisture measurements
To obtain soil moisture observations for model calibration and other agricultural purposes.

3. Flux Towers
- Define/Identify locations of flux towers that can be employed during LPB.
  Cruz Alta (BR), San Luis (AR) [Other opportunities]

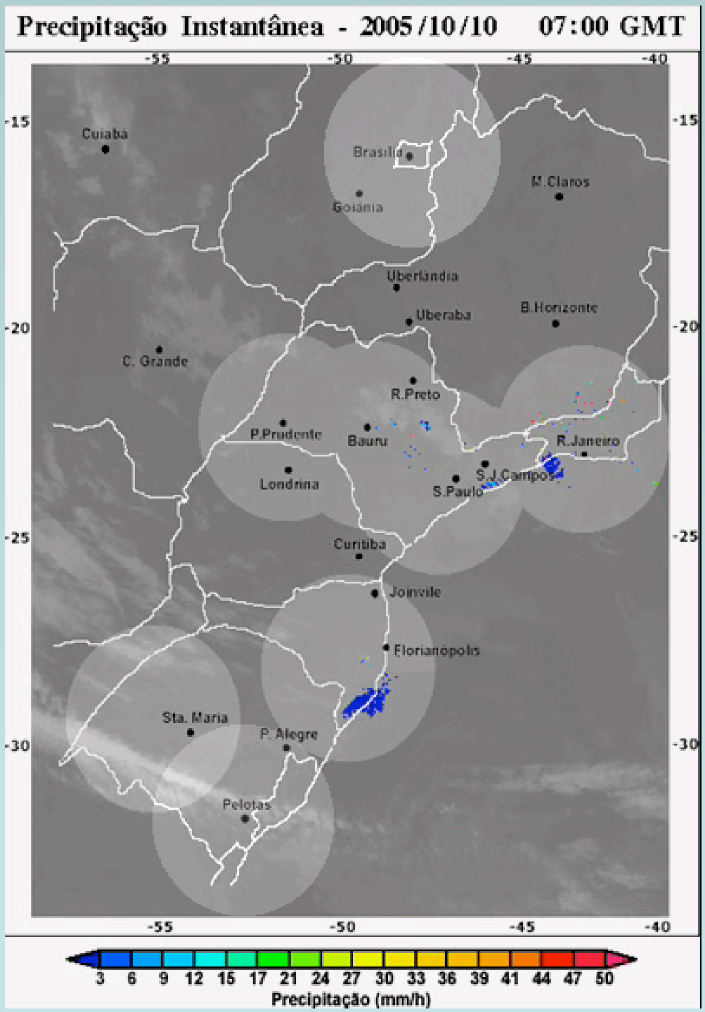
4. Radar facilities
- A network of radar systems is being integrated in South-eastern Brazil.
- Two radars in Argentina BA and Pergamino (north of BA) + *two other radars will soon become available (La Pampa and Entre Rios)*

5. Aerosols
- What radiation observations are currently available?
- Can we get quantitative estimates of aerosols for LPB with the Lidars already available?

Data survey: Precipitation networks



Data survey: Radar and lightning networks



LPB-3
Itaipu Hydropower Plant
Feb 2008

Field Campaign Planning

WG-1: Data collection and data recovery

WG-2: Radar, satellite and lightning measurements

WG-3: Radiation, aerosols, and trace gases

WG-4: Flux Towers and soil moisture measurements

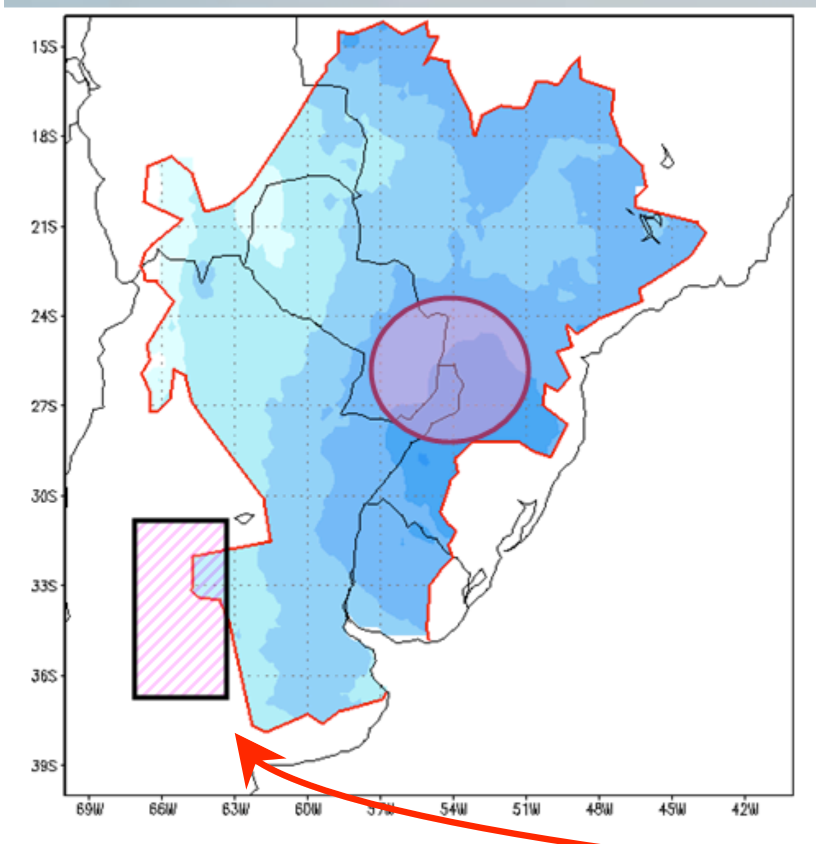
LPB-3

LPB/WCRP-Itaipu Framework Agreement
(being drafted)

Itaipu → LPB: allow the use of their secured areas to install instruments; use of their facilities for workshops and conferences; train students (and provide support!)

LPB → Itaipu: LPB will provide forecasts and other products for the sub-basins of interest (through CPTEC)

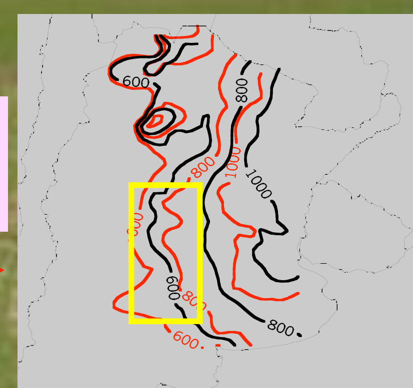
Selected regions for the LPB field campaign and monitoring activities



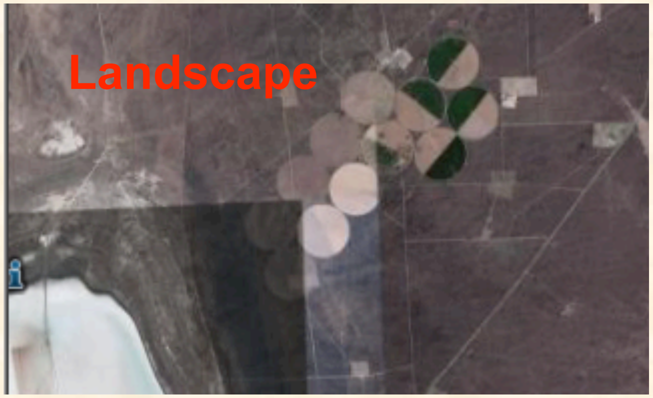
The **circle** represents the primary region of study where precipitation is largest.

The **box** represents a transition region where Land-Atmosphere interactions are important. Significant LCLU changes have occurred due to changes in agricultural practices.

Black: 1950-1969
Red: 1980-1999



KEY TO METHODS: linkage of 3 scales



Remote Sensing: MODIS surface temperature, NDVI

Light aircraft -*SkyArrow 650:*
radiation and vapor + temperature profiles

Micrometeorology: vapor +temperature profiles

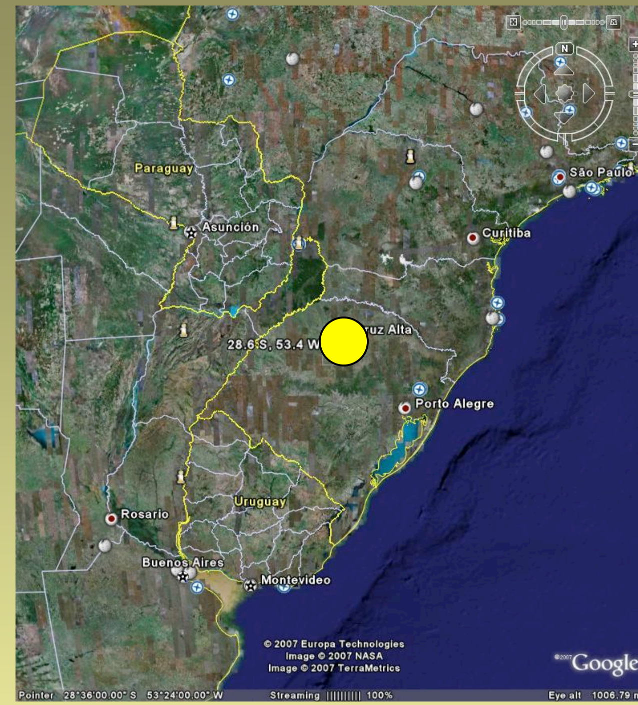
Water Balance modelling: Hydrus + Dinaqua + PALS

Field measurements:
grass + tree transpiration, evaporation, deep seepage

Cruz Alta (approx 28.6S, 53.4W)

(Courtesy of Osvaldo Moraes)

Soy bean field



sensible heat,
latent heat,
CO2,
momentum fluxes,
soil moisture,
soil temperature

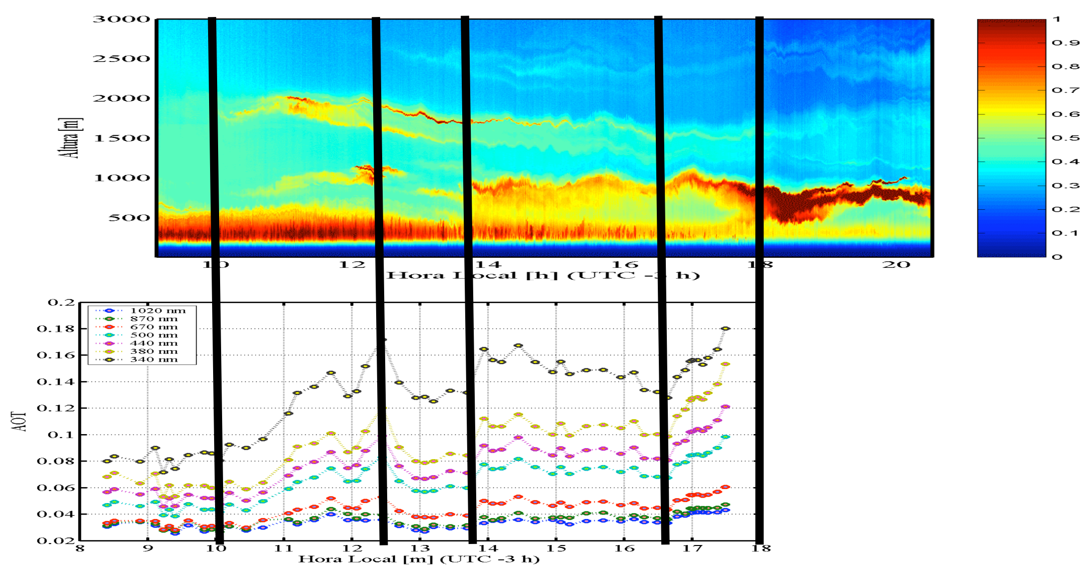
Multi-wavelength Lidar System in Buenos Aires

(Courtesy of Eduardo Quel)

- *Study the height dependent aerosol optical properties at different wavelengths, the boundary layer evolution and the water vapour vertical distribution.*
- Aerosol extinction coefficient using nitrogen Raman channels (387 nm and 607 nm).
- Total to molecular backscatter and backscatter to extinction ratio.
- Water vapour mixing ratio profile using the Raman water vapour (408 nm) and nitrogen channels (387 nm).

Aerosol Optical Thickness AERONET

Buenos Aires 26 August 2004



EOL/UCAR Facilities
Field experiment only

ISFF: Flux Towers/Soil Moisture
SPOL: Radar *[one option is to propose upgrades to local radars, as was done during NAME]*
ISS: Radiosondes/Profiler
RAF: Aircraft (Soil moisture? Aerosols?)
Lidar

LPB Funding – (update Mar '08)

LPB
La Plata Basin

Many Regional Projects
-Mesonet, Flux Towers in San Luis, AR
-Flux Tower in Cruz Alta, BR;
-Several other projects (including regional collaborations)

CLARIS - LPB
A Europe-South America Network for Climate Change Assessment and Impact Studies - € ~3.3M

NASA
Remote Sensing/Data assimilation - Capacity Building

IAI
Ecosystems, Biodiversity, Land Use and Cover, and Water Resources

CIC-GEF
Framework Program for the sustainable management of the La Plata Basin water resources, in relation to climate variability and change $ 10.7 M (~0.9 M)

NCAR (NSF)
Collaborations during Field Experiment

ARM (DOE)
Collaborations during Field Experiment

Objective: "*Assist the regional governments in the integrated management of the water resources of the La Plata Basin in relation to variability and climate change effects, aiming at the economic development of the region with a sustainable environment*"

Objective: "*Understand and quantify the impact of anthropogenic activities on the La Plata Basin hydroclimate*"

Objective: "*Incorporate high quality observations of surface conditions from NASA satellites and other observing systems into numerical models of La Plata basin to improve predictability of the region's hydrology, weather and climate*"

Area of interest: *Investigate the impact of changing land use and land cover conditions on the regional hydroclimate and extreme events of the La Plata Basin*
"Landuse change, biofuels and rural development in the La Plata Basin"

Final comments

LPB continues to grow in terms of science, regional participation, and visibility at agencies. There are increased collaborations with operational centers (CPTEC, SMN, CPC).

Planning of the monitoring and field campaign activities is advancing slowly but steadily. (Need to achieve critical mass and secure funds for this component.)

A Framework Agreement is being discussed with the Itaipu Hydroelectric Plant. LPB will provide elaborated hydroclimate products, and Itaipu will provide support to the monitoring and field campaign activities.