# Overview of Agricultural Production Systems

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# A Difficult Task…

- Provide overview of relevant issues in agricultural production systems

BUT…

- Quite diverse audience:
  - Climate variability and predictability
  - Land use change, ecosystem services, sustainability
  - Biofuels

# What I will try to do…

- Provide overview of agricultural ecosystems (for the various audiences)
- Present a few ideas to foster discussion

# Agricultural Ecosystems

- Complex natural/human systems
- Have characteristics of natural ecosystems
  - Non-linearities, feedbacks, multiplicity of scales
- PLUS complexities of human decision-making under uncertainty
- Understanding agroecosystems requires integrated approach

# Agricultural Ecosystems - 2

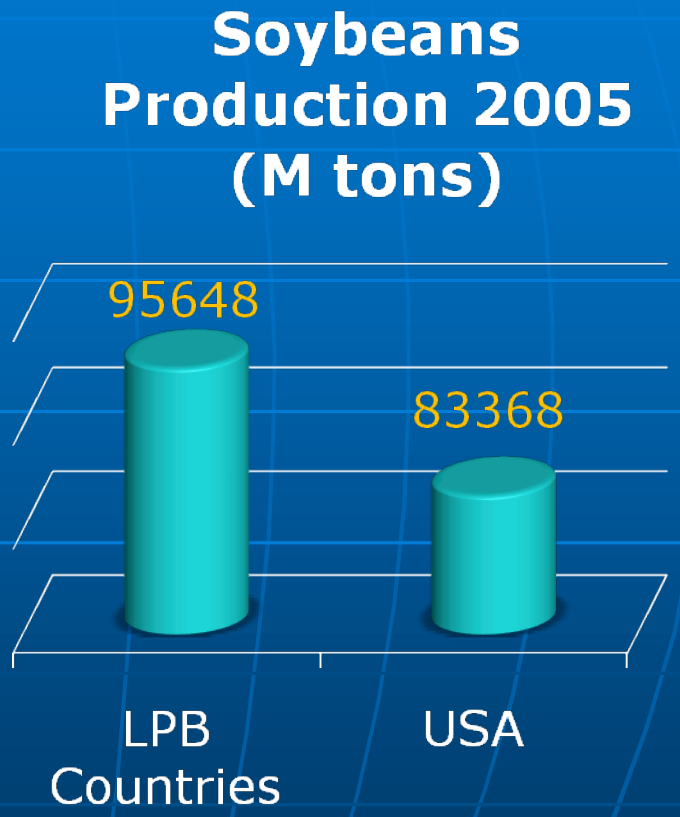
- Production decisions mostly made by individuals, embedded in a social context
  - Multiple objectives, often conflicting
- Individual characteristics
  - Risk tolerance, loss aversion
- Social interactions
  - Social networks: learning, technology diffusion

# Agricultural Ecosystems - 3

- Related global change issues:
  - Land use changes
  - Irrigation is main user of scarce freshwater
  - Deforestation, desertification
  - Global food security
  - Biodiversity, GMOs

# Agricultural Ecosystems - 4

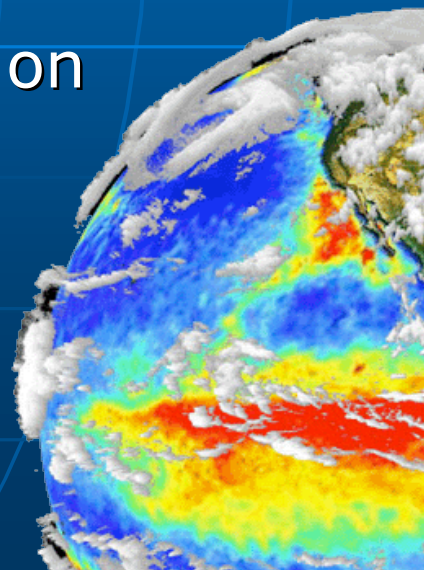
- Huge economic importance
- Globalized trade




Source: FAO Statistics

# Agriculture and Climate

- Human sector most sensitive to climate variability/change
- Confluence of events:
  - Enhanced technological capabilities
  - Better understanding of climate system
  - Higher awareness of climate influence on human activities
- RESULT: Increased demand for climate information in agriculture



# Climate Information Systems

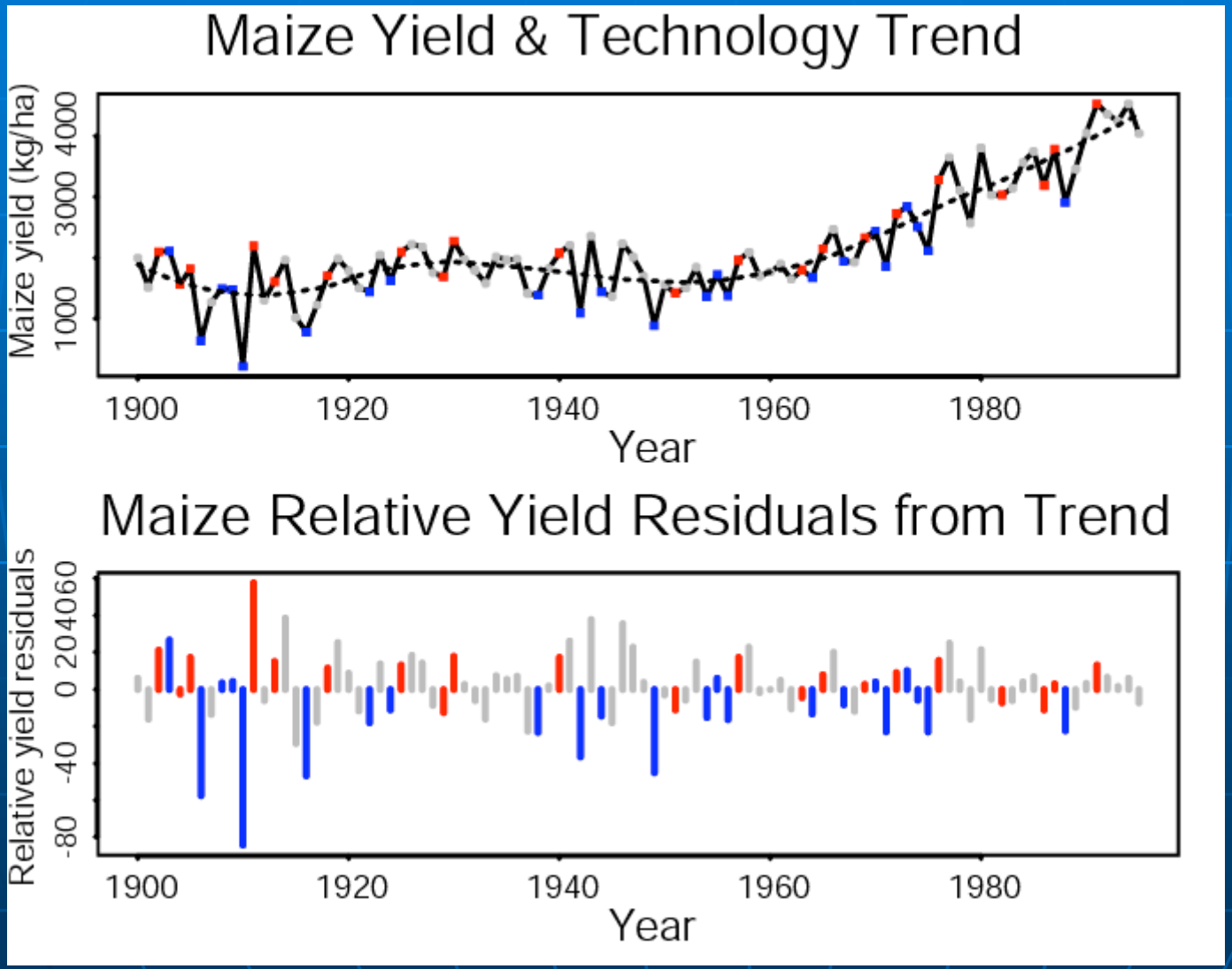
- An effective climate information system (or climate service) will *not* develop spontaneously
- A climate information system has to be informed and supported by an appropriate research program *throughout* its initial phase
- Research supporting climate information systems must evolve:

  Exploratory → Pilot → (Semi)operational

# Research Stages - Exploratory


- Associations between climate and agriculture?
  - Statistical analyses of historical data
  - Simple modeling
  - Issue scoping: surveys, focus groups
- *Partners:* academic institutions or governmental research agencies

# Historical Maize Yields & ENSO




# Research Stages - Pilot


- More sophisticated, realistic modeling
- Risk management studies
  - Can we react to climate info? How? Why not?
- Economic, social, institutional dimensions
  - Understanding decision-making process
  - Value of climate information
  - Best institutional structures?

# Mapping Realistic Decisions

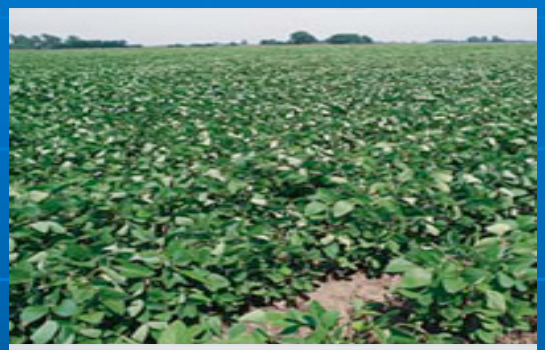
**Owned Land**

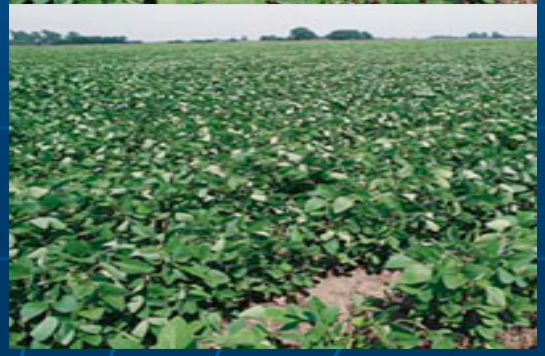



Land Allocation Decisions

Over 50% of agriculture in the Pampas is done on rented land

**Rented Land**

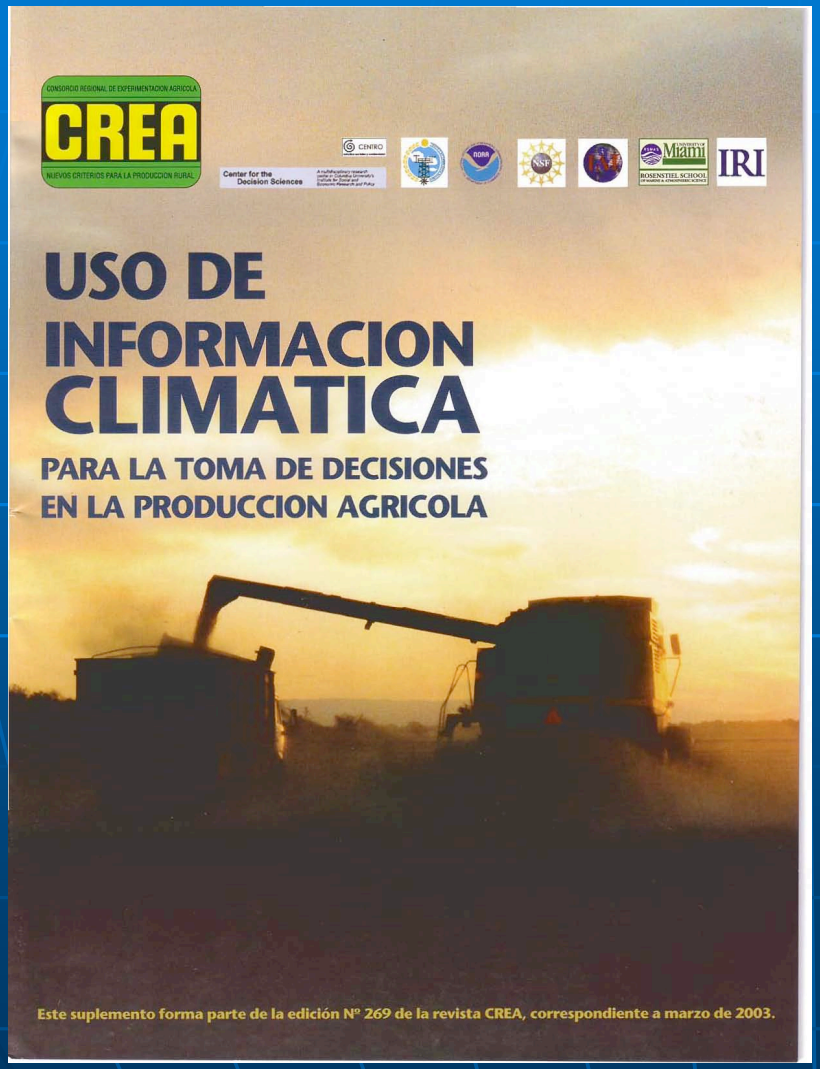


# Research Stages – Operational (?)


- Research topics: broad spectrum, but highly specific issues
  - Continuous assessment
- Strategic partnerships crucial: with BOTH operational agencies AND stakeholder groups

# Commitment to Outreach

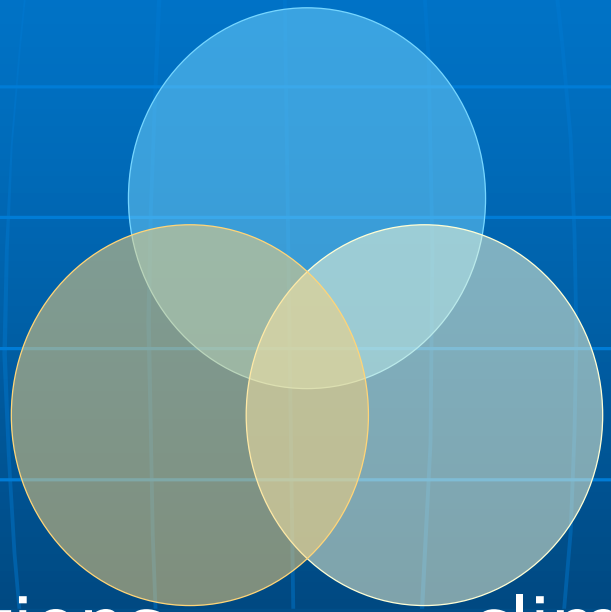



# Relevant Climate Scales

| Scale | Issues |
|---|---|
| Weather | Tactical decisions |
| Intra-seasonal | Crop stresses;<br>Yield prediction |
| Interannual | Yield and income variability;<br>Use of seasonal forecasts |
| Interdecadal | Infrastructure planning;<br>Land use change |

# Climate Information Components

Historical data
and statistics



Recent
climate conditions

Seasonal
climate forecasts

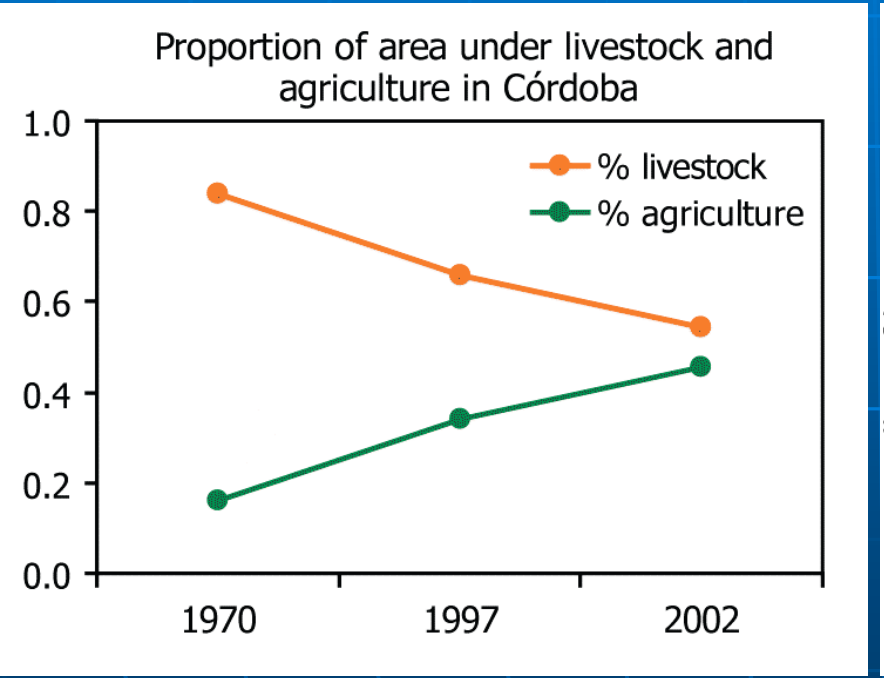
Also: “plausible” decadal scenarios, longer scales?

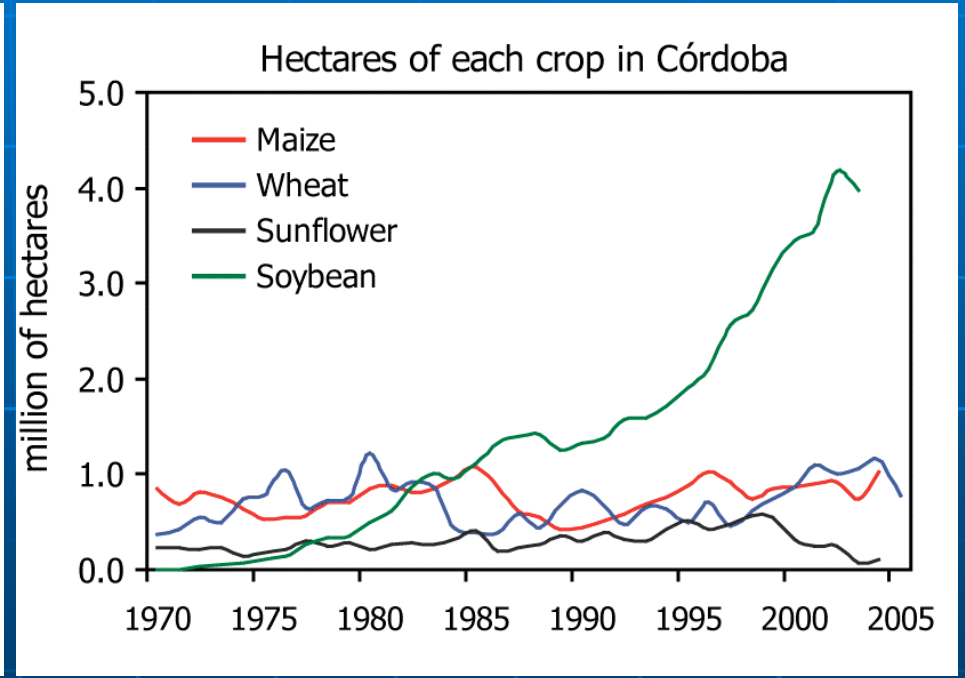
# Decadal Climate Variability

- Drastic changes in agricultural production systems in the Pampas in recent decades
- Partly due to climate variability, but also other factors:
  - Increased global demand for commodities
  - Macroeconomic changes
  - New technologies
  - New institutions (e.g, INTA, AACREA, AAPRESID)

# Changes in Production Systems

## Northern Cordoba: climatically marginal region

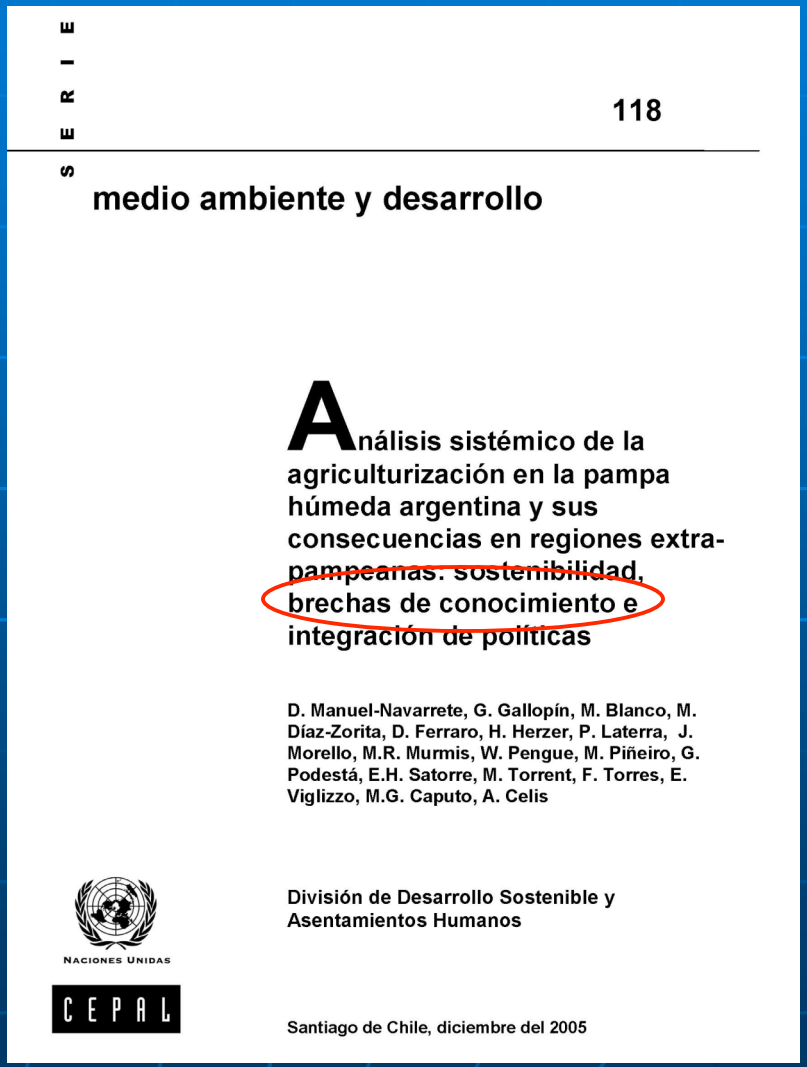



Courtesy Ing. Federico Bert

# Key Questions - 1

- What will be the consequences of "transplanting" production systems from the Pampas to marginal regions?



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medio ambiente y desarrollo

Análisis sistémico de la agriculturización en la pampa húmeda argentina y sus consecuencias en regiones extra-pampeanas: sostenibilidad, brechas de conocimiento e integración de políticas

D. Manuel-Navarrete, G. Gallopín, M. Blanco, M. Díaz-Zorita, D. Ferraro, H. Herzer, P. Laterra, J. Morello, M.R. Murmis, W. Pengue, M. Piñeiro, G. Podestá, E.H. Satorre, M. Torrent, F. Torres, E. Viglizzo, M.G. Caputo, A. Celis

NACIONES UNIDAS

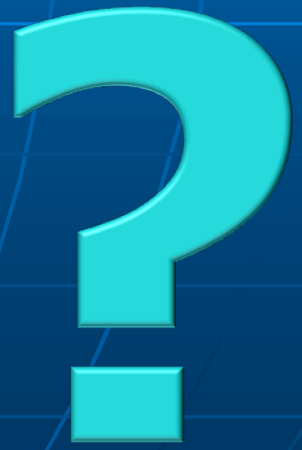
CEPAL

División de Desarrollo Sostenible y Asentamientos Humanos

Santiago de Chile, diciembre del 2005

# Key Questions - 2

- How will production systems that evolved partly in response to enhanced climate respond if conditions revert to drier epochs or change permanently?



# Smooth link to biofuels…

- Can agricultural area be sustained or expanded if climate gets drier?

# Two Main Biofuels

**Bioethanol**

**Biodiesel**

# Contentious/Uncertain Issues

- Food security vs. fuel security
- Biofuel balances
  - Economic ($$)
  - Energetic
  - Greenhouse gases
- Small farmers vs. large operators
- Intensive (costly?) technologies

# Summary

- Agricultural ecosystems are complex natural/human systems
  - Real-world decisions of economic importance
  - High relevance to many global change issues
- Climate is an important source of risk to agriculture, but not the only one...
- There is an increasing demand for climate information to support agricultural decisions

# Summary - 2

- An effective climate information system (or climate service) will *not* develop spontaneously
- A climate information system has to be informed by an appropriate research program

# A proposal for discussion…

- IAI / CLIVAR / IDRC may sponsor development of a series of "white papers" :
  - Opportunities and impediments for use of new climate knowledge
  - Perspectives for biofuel production in the Americas
  - Future agricultural production in the Americas (global demand, land use, sustainability, technological innovations)

# Content of “white papers”

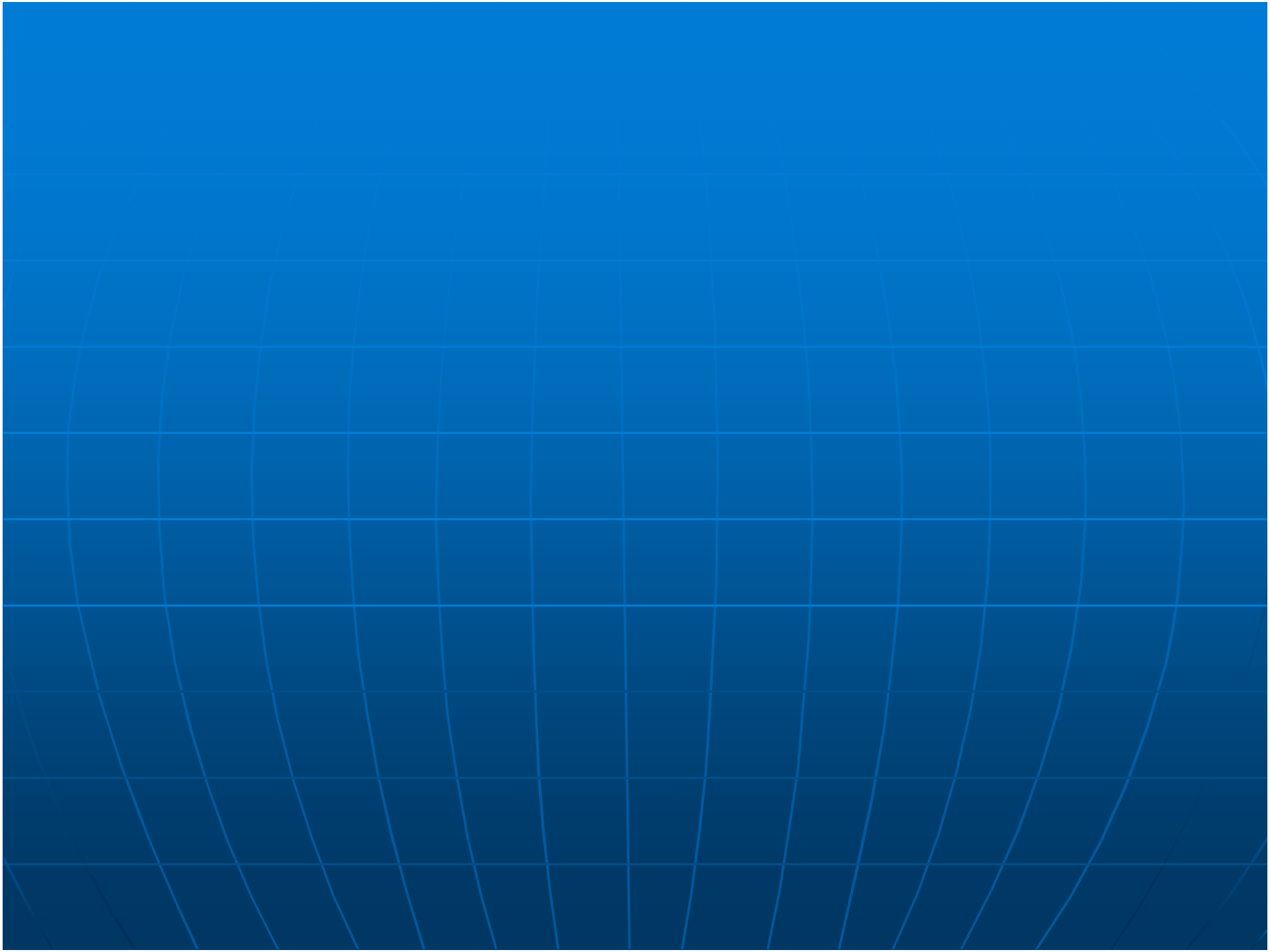
- Survey/integrate current knowledge
- Clearly identify knowledge gaps
- Acknowledge multiple perspectives (often value-laden) about an issue
- Address topics from an “integrative science” perspective
- Provide policy guidance based on “best available science”

# Funding Gratefully Acknowledged!

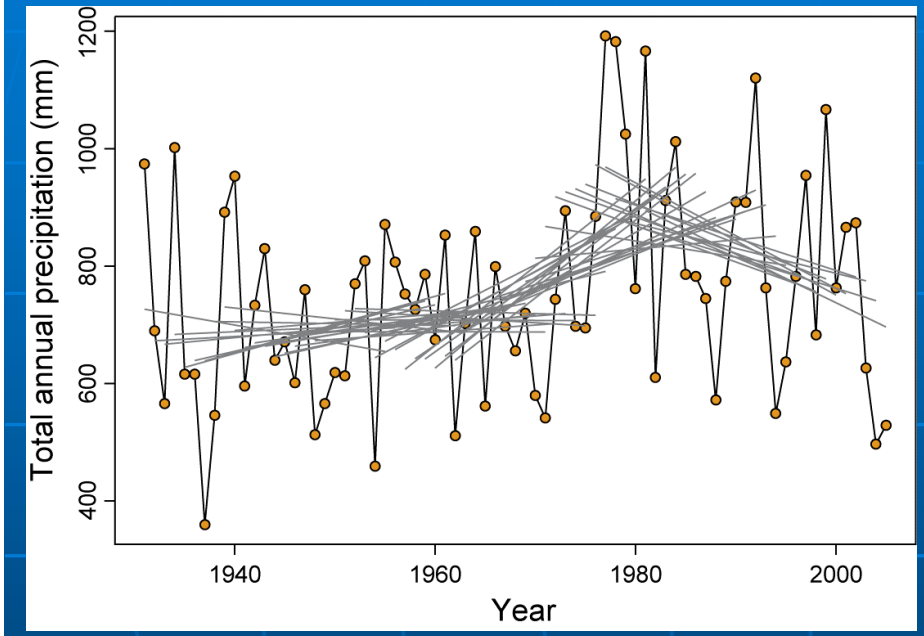

- Methods & Models for Integrated Assessment
- Biocomplexity in the Environment: Dynamics of Coupled Natural & Human Systems

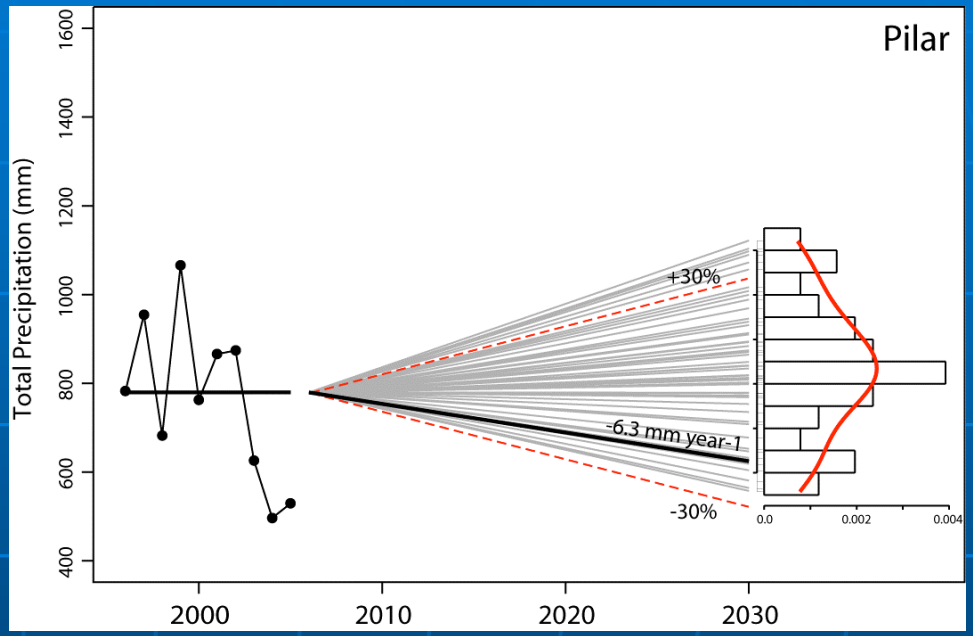

- Environment and Sustainable Development
- Human Dimensions of Global Change
- Regional Integrated Science & Assessments


- Initial Science Program – Phase 2
- CRN Program – Phase 2



# Plausible scenarios – Cordoba

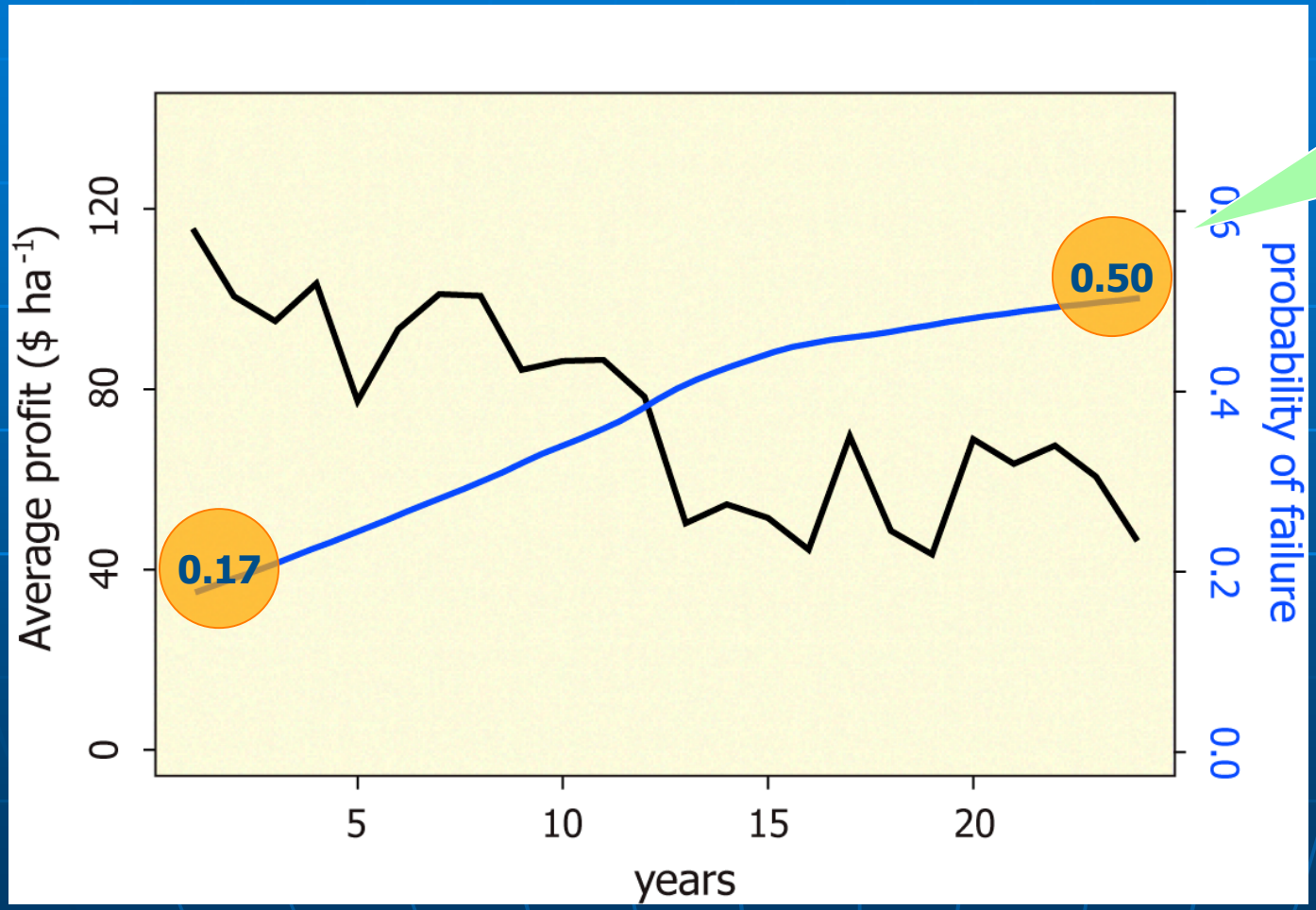



Linear trends fitted to moving25-year windows

Fitted trends projected (starting from median of last 10 yrs)

# Risk to Soybean Profits

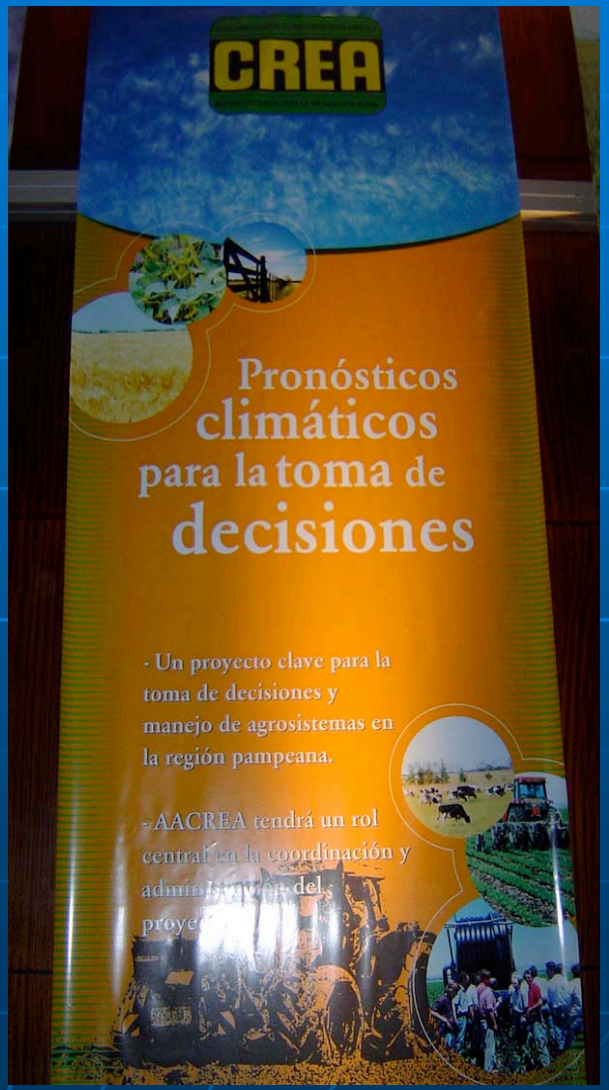



Probability of negative profits

NOTE:
No adaptation!

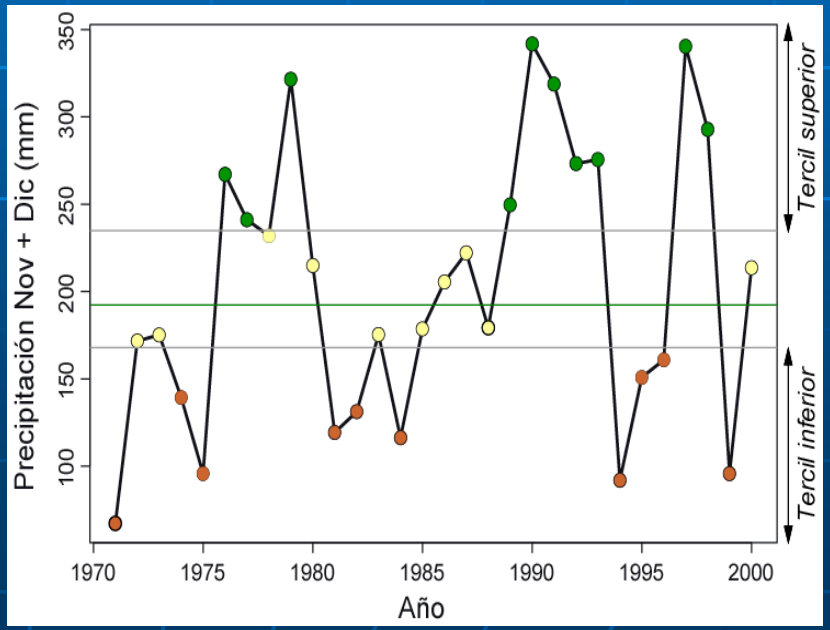
# Strategic Partnerships

- AACREA: non-profit farmers' organization
- Groups of 8-12 farmers
- About 150 groups in Argentina
- "Early adopters"
- "De facto" extension functions
- Large multiplicative effect



# Why historical information?

- Lack of knowledge about local climatology
  - What is "normal"?
  - Recent arrivals to agriculture
  - Greater memory of recent events
- How to interpret seasonal forecasts
  - Boundaries between terciles?



# Why diagnostic information?

- Provides context for decision-making
  - Refine previously-made decisions
  - Helps interpret forecasts
- Relevant span is sector-dependent