Challenges to potato-based systems under climate variability/change conditions

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On behalf of the
Production Systems and The Environment Division

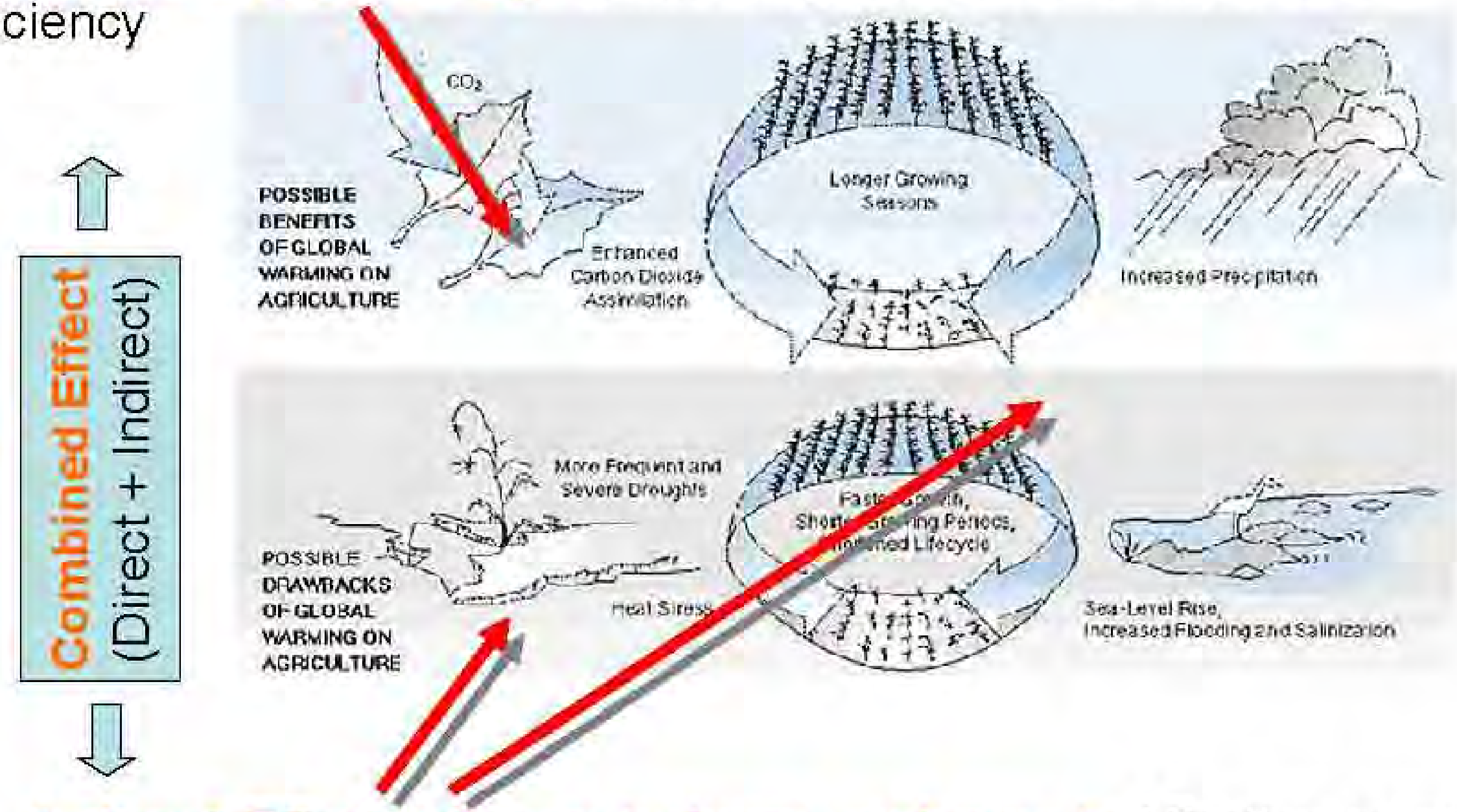
INTERNATIONAL
POTATO
CENTER (CIP)

September 2009

Climate & potato-based systems

Effects of climate change on agric. crops

Direct Effect (higher CO_2): Stimulating radiation and water use efficiency



Indirect Effect (change in temp. and prec.): Affecting growing seasons, suitable cultivation area, etc.

Bindi 2008

Effects of the climate change

- Land and soil health: Soil organic matter will decline as temperatures are elevated.

- As a result of decline in OM, soils will become more acidic, nutrients will become depleted, microbiological diversity will diminish and a decline in soil structure will result in less WHC (Barnard et al., 2005, Schulze, 2005 and Molope, 2006).

Effects of the climate change

- *Biodiversity*: Climate change, in the medium to long term, will affect biodiversity.
- *Pests and diseases*: Plant and animal diseases and insect distributions are likely to change.

Climate & potato-based systems

Knowledge gaps and research priorities:

- **Experimental analyses and model simulation to quantify:**
  - effect of increasing CO_2 on crops other than cereals, including those of importance to the rural poor (e.g. local potato cultivars)
  - interaction between crop yields and other factors of production (pests, diseases, weeds, etc.) under climate change conditions
  - impact of climate extreme events on crop yields
- **Reduce and quantify uncertainties of future prediction** (for climate change and their impacts)
- **Develop tools** (e.g. farm and cropping system models) **to evaluate adaptation strategies at different spatial levels** (cropping, farm, region)
- **Evaluate actual applicability of adaptation strategies:**
  - Cost and benefits (economic, social, environmental)
  - Role of new technology (e.g. biotechnologies, fertilizers, etc.)
  - Interaction with mitigation strategies

from Chapter 5 - WGII FAR-IPCC, 2007

Source: Bindi, 2008

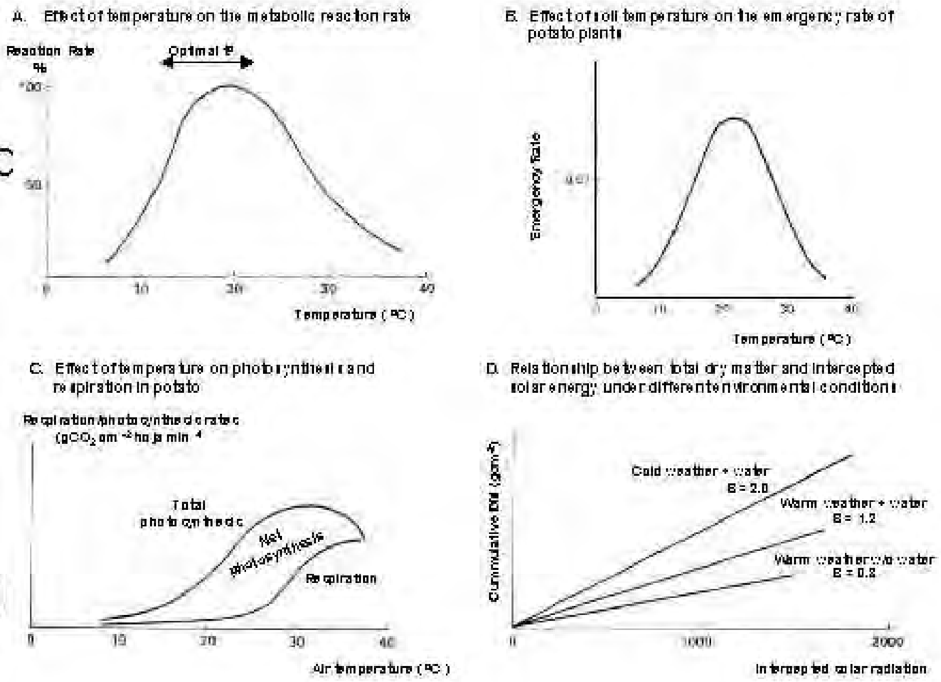
Potato climate requirements

Temperature Requirements:

mean daily temperatures 18 to 20°C

night temperature below 15°C (requirec
for tuber initiation)

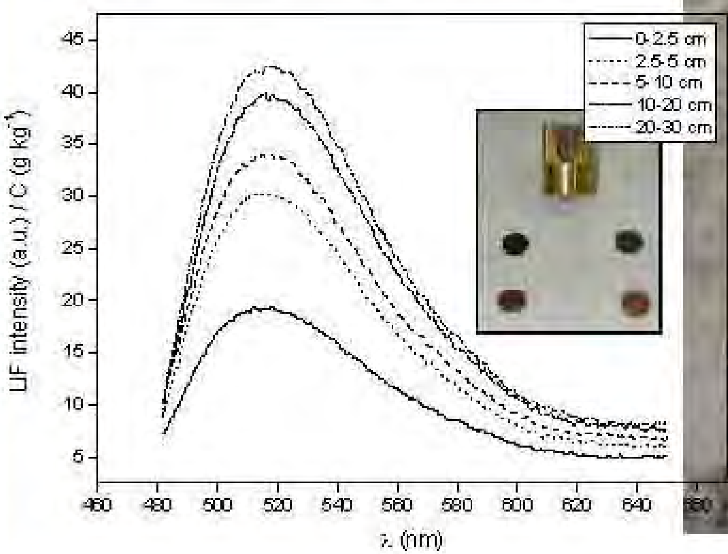
temperatures below 10°C and above 30°C inhibit tuber growth

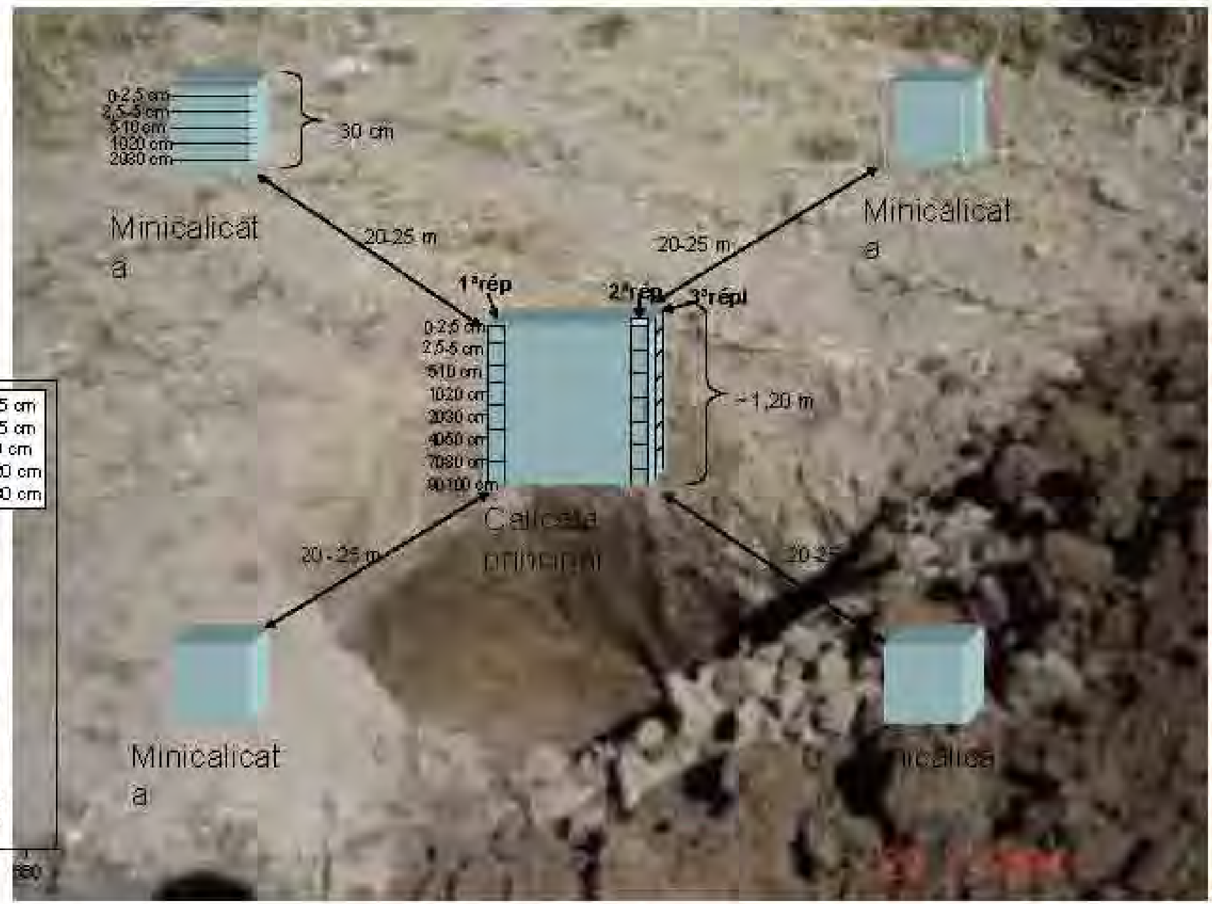


- **Water Requirements:**
  - 500 to 700 mm for a 120 to 150 d
    growing season

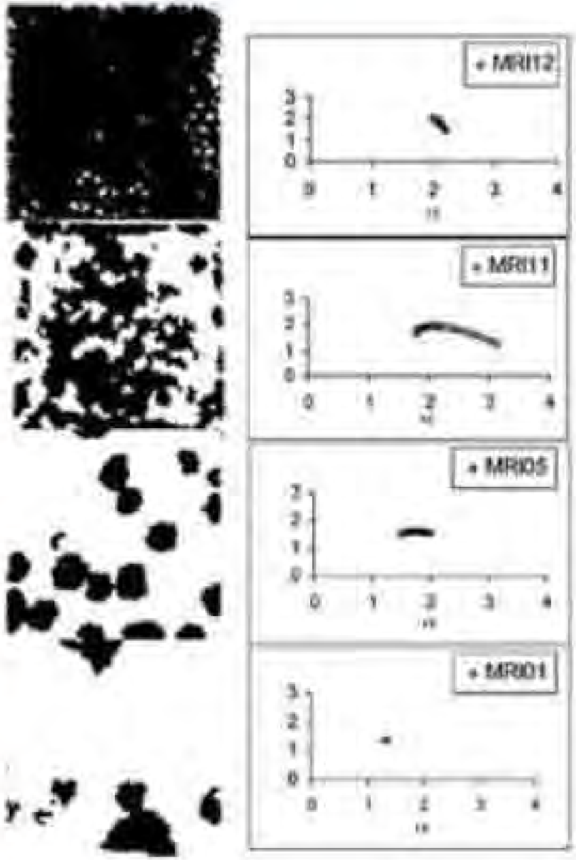
Climate & potato-based systems

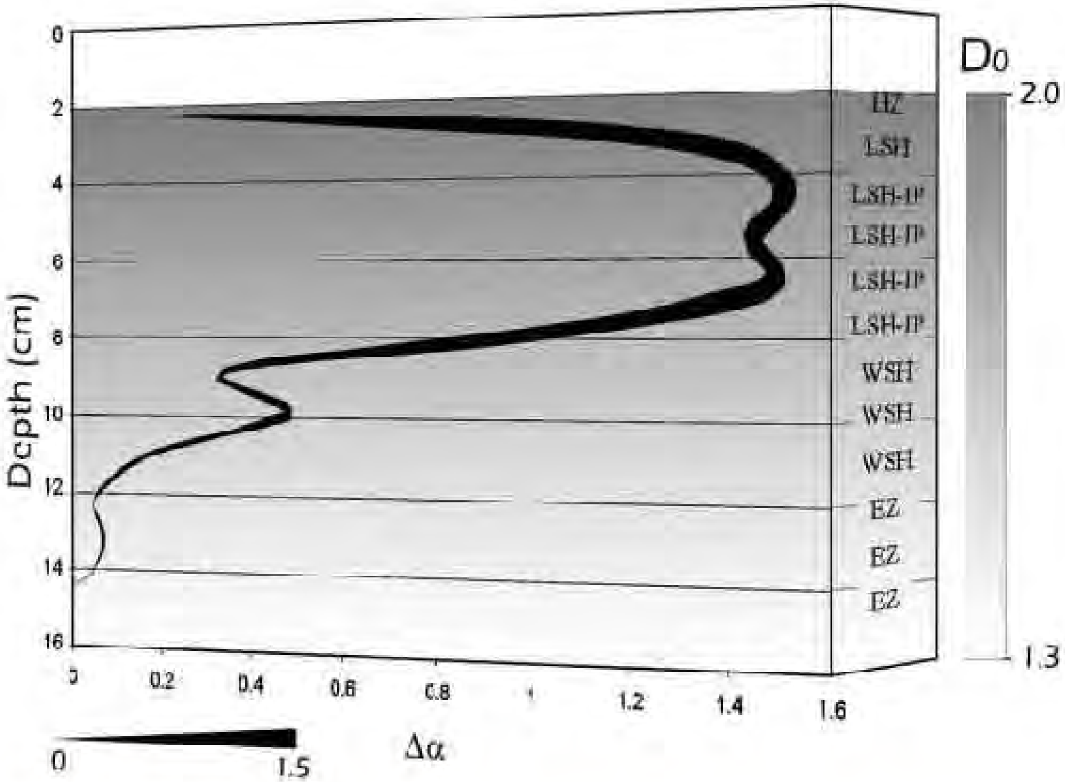
Soil carbon stocks and quality in potato systems



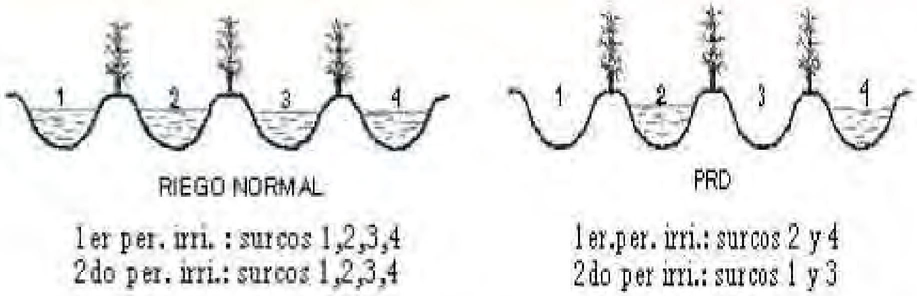


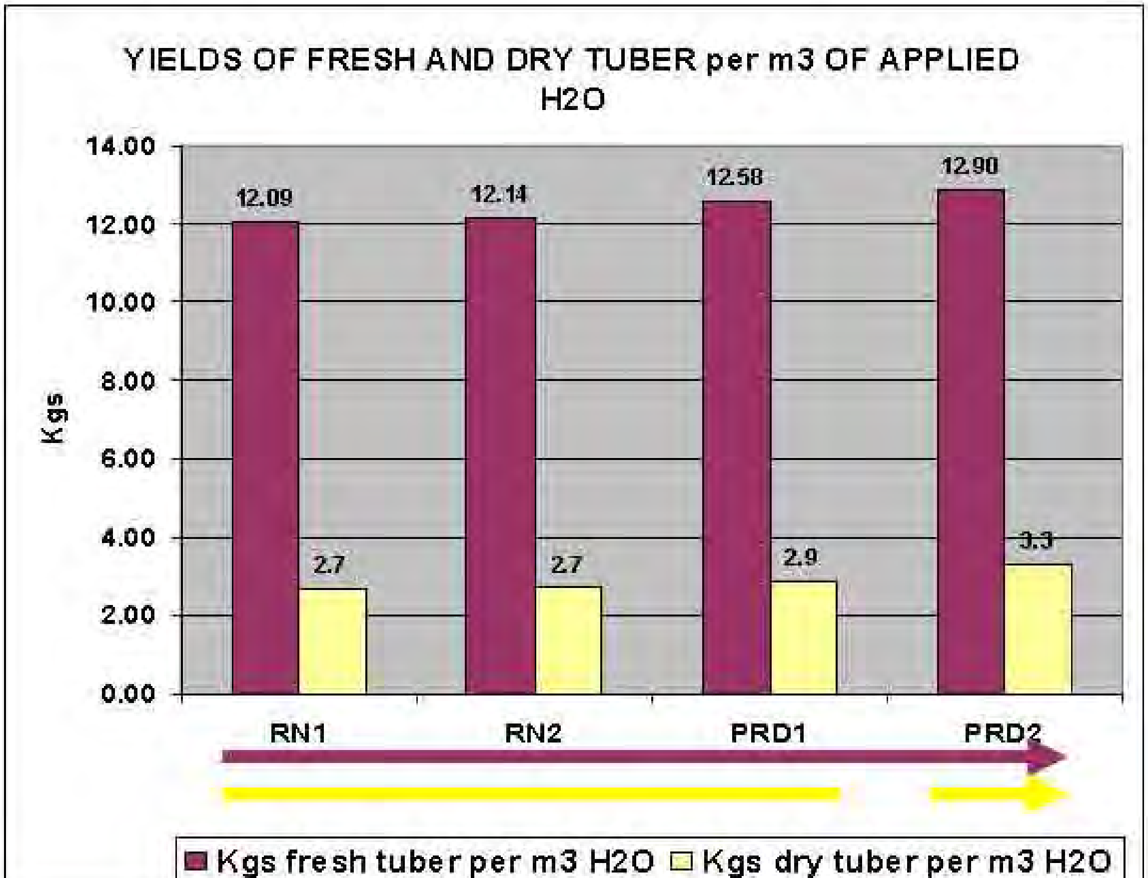
Understanding water relations in potato systems





Partial Root Drying

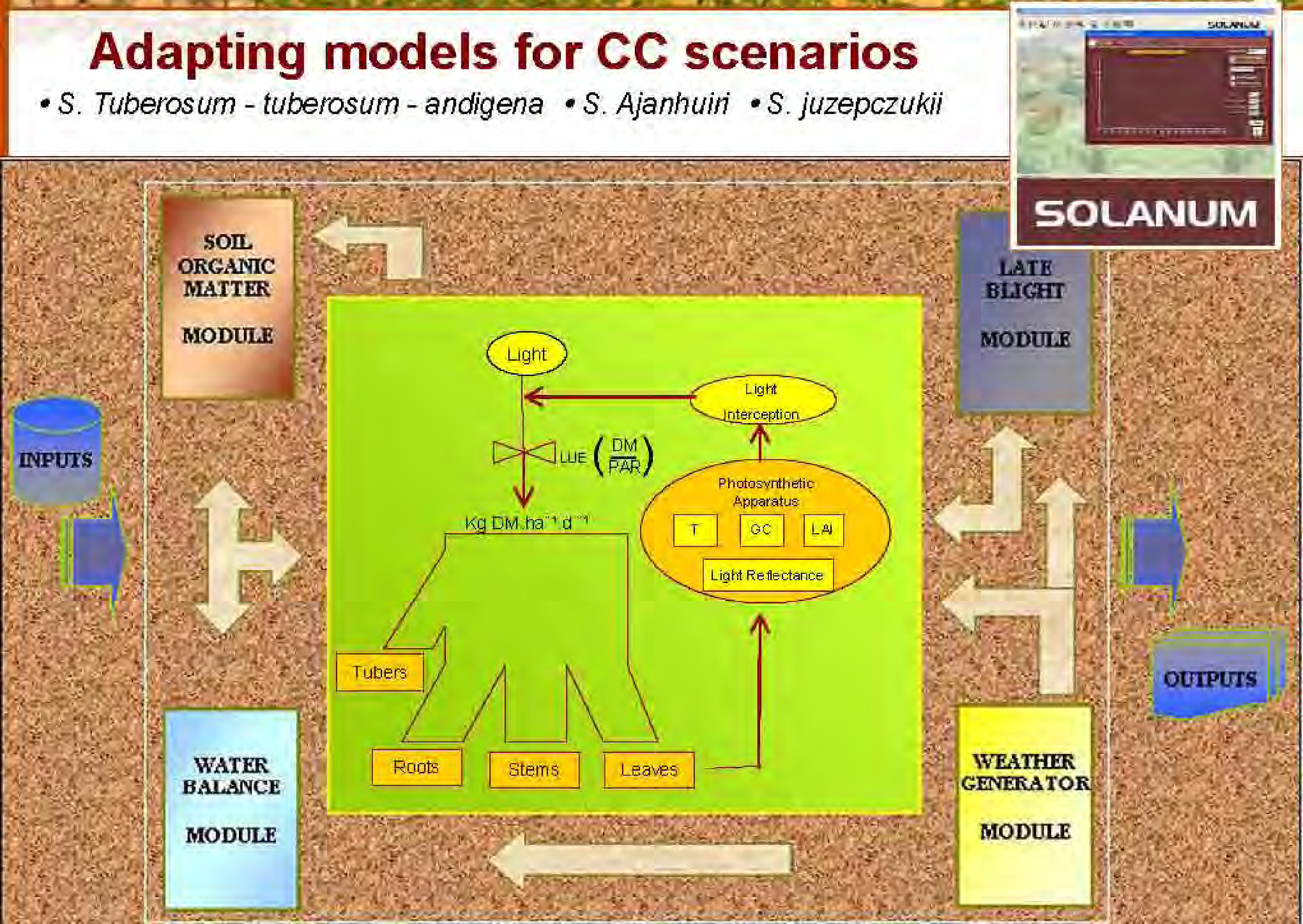




Understanding root architecture, growth, and H_2O transport with non-destructive non- invasive tools

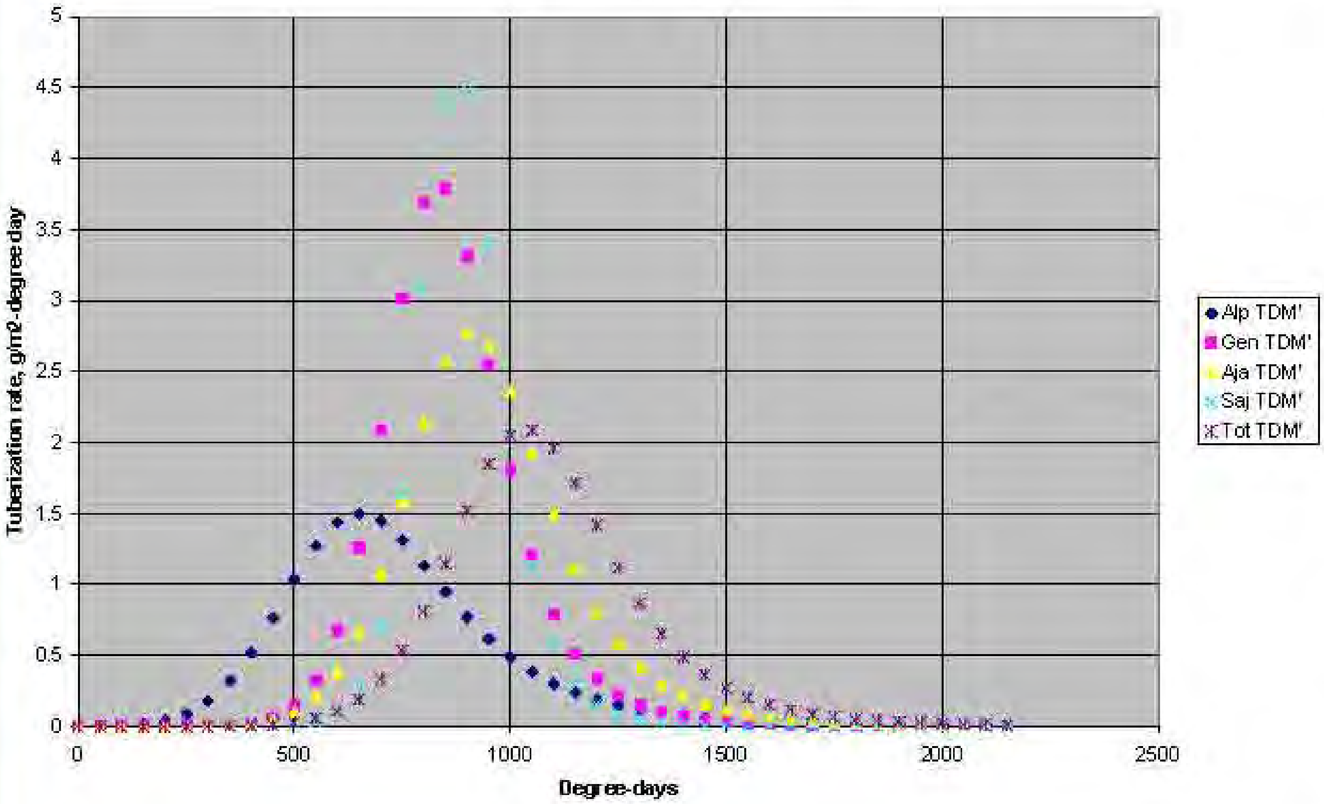
Adapting models for CC scenarios

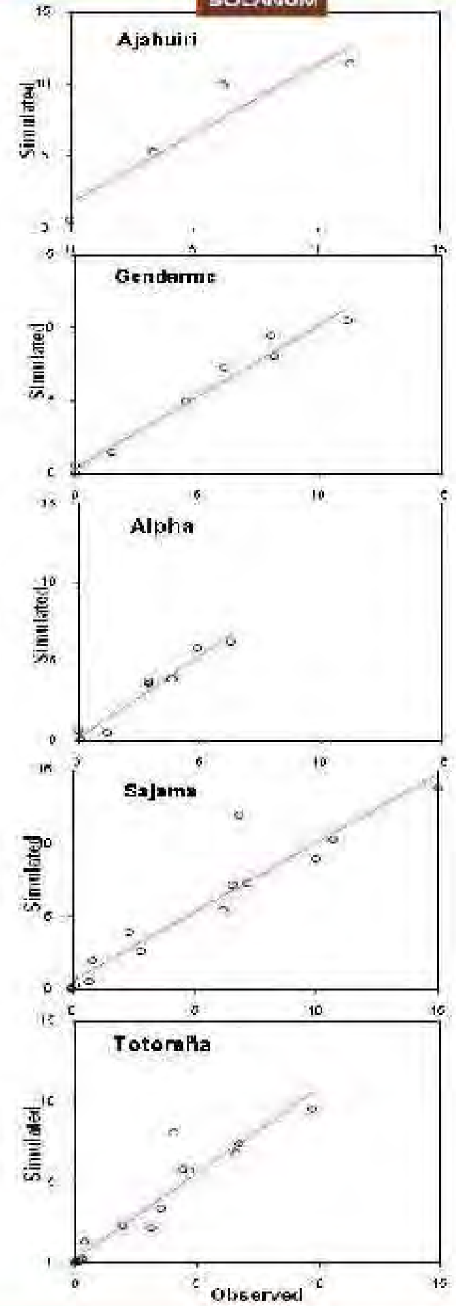
- S. Tuberosum - tuberosum - andigena
- S. Ajanhuiri
- S. juzepczukii

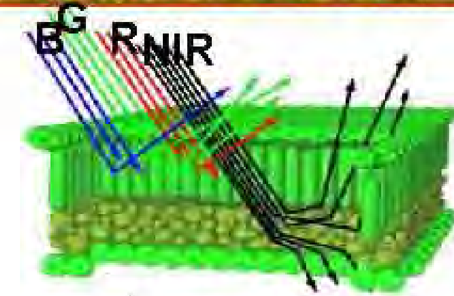


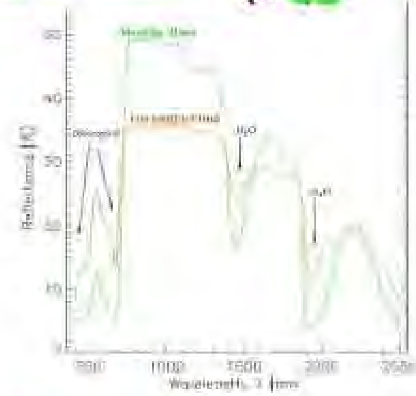
Top down modeling approach

Figure 1. Tuberization dynamics in the high Andes

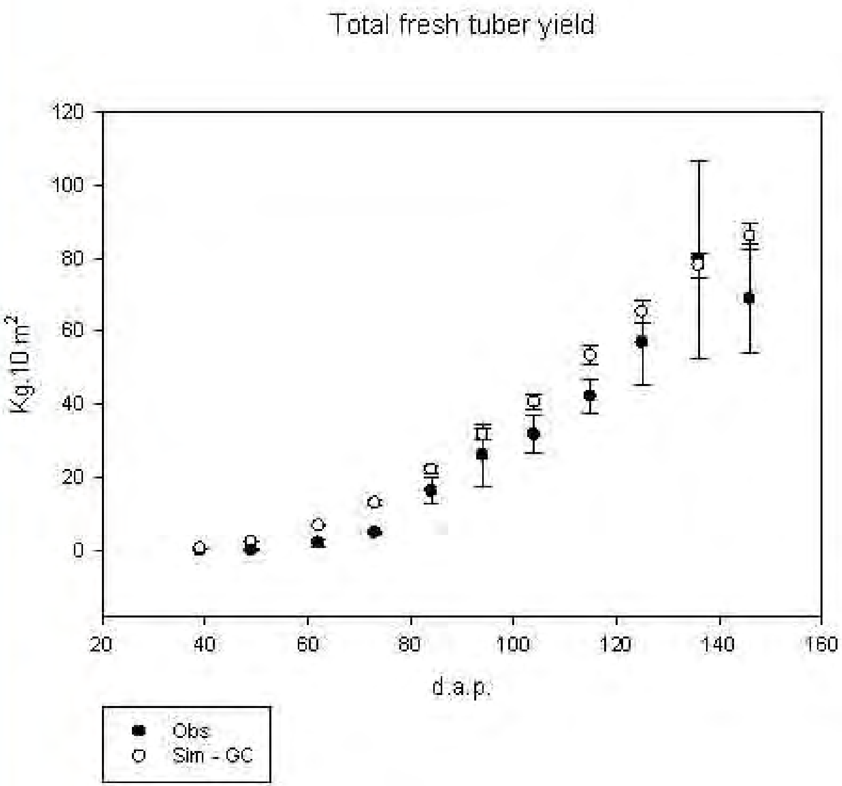


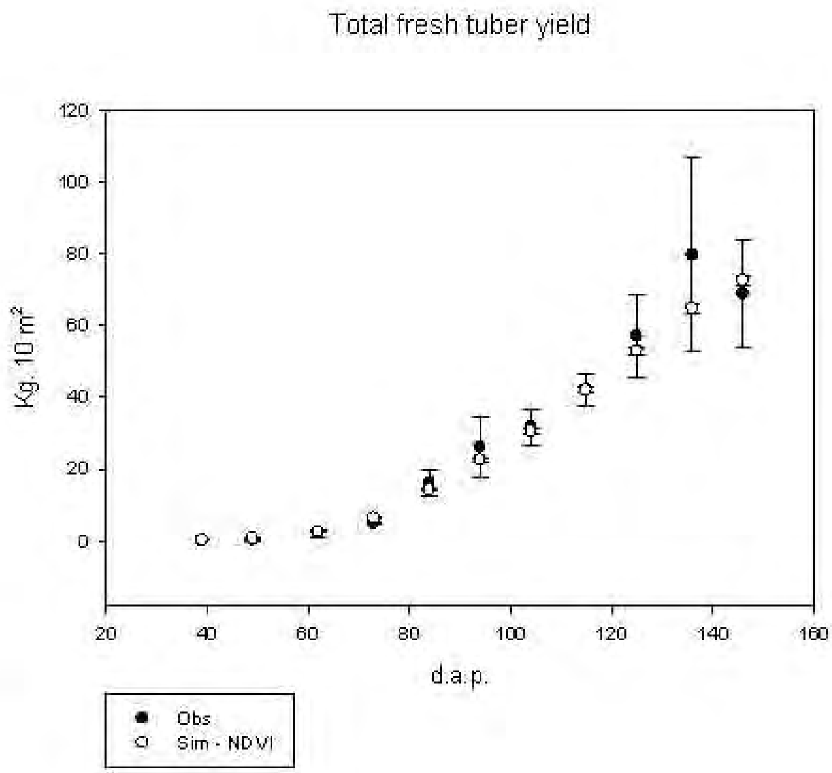


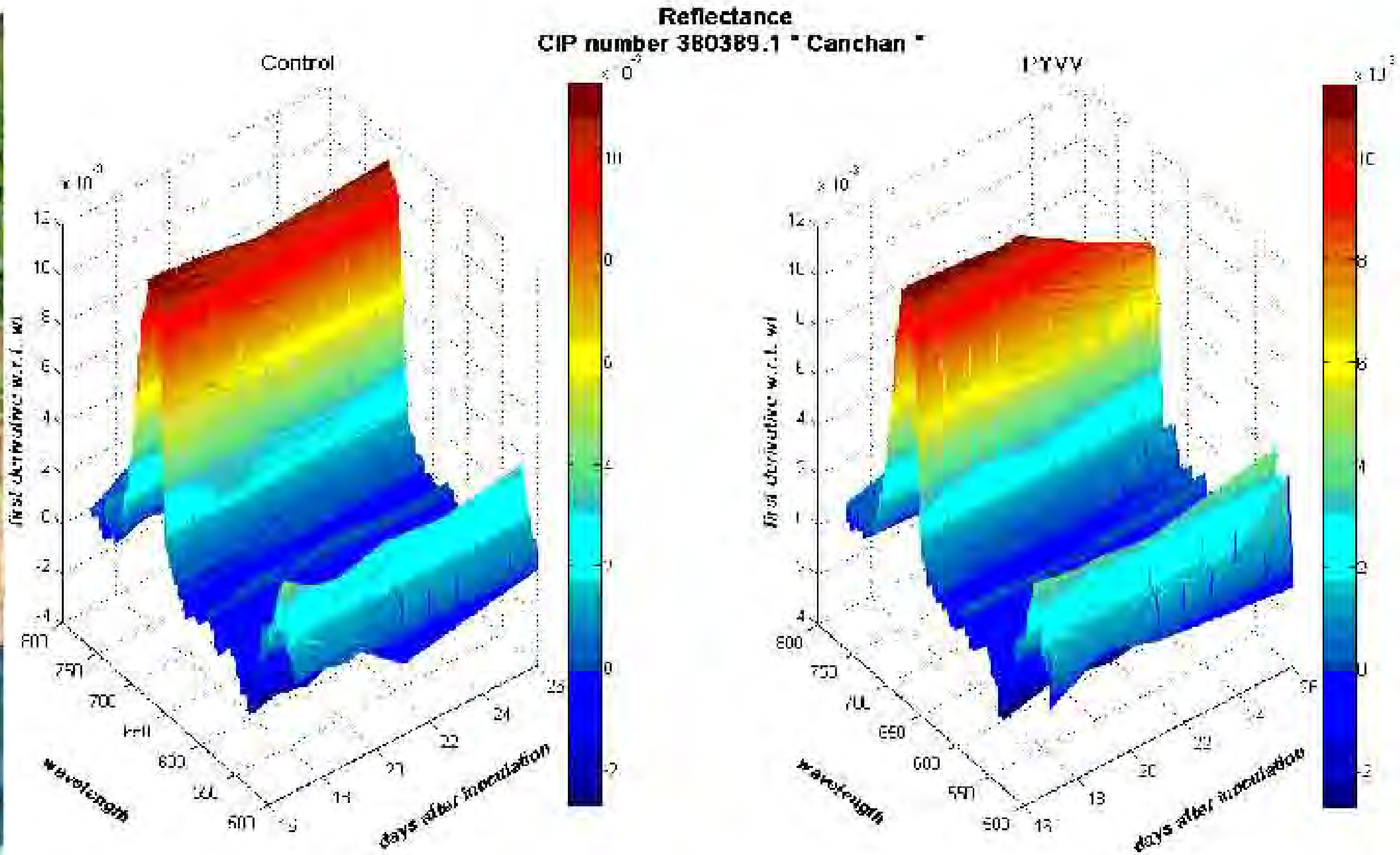




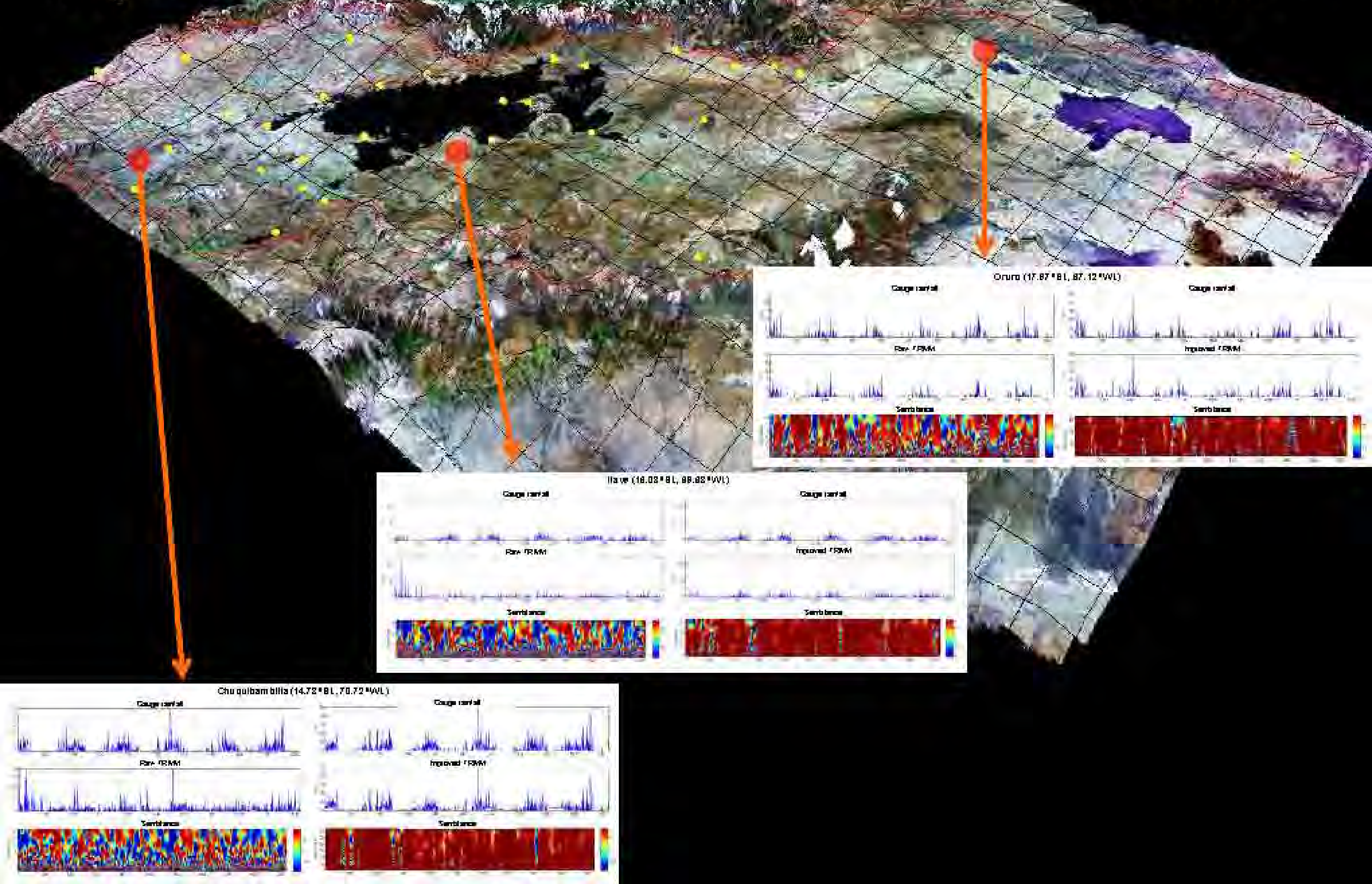
Improving model predictions with low-cost Hi-res RS


Total fresh tuber yield
Kg.10 m^2
d.a.p.
Obs
Sim - GC

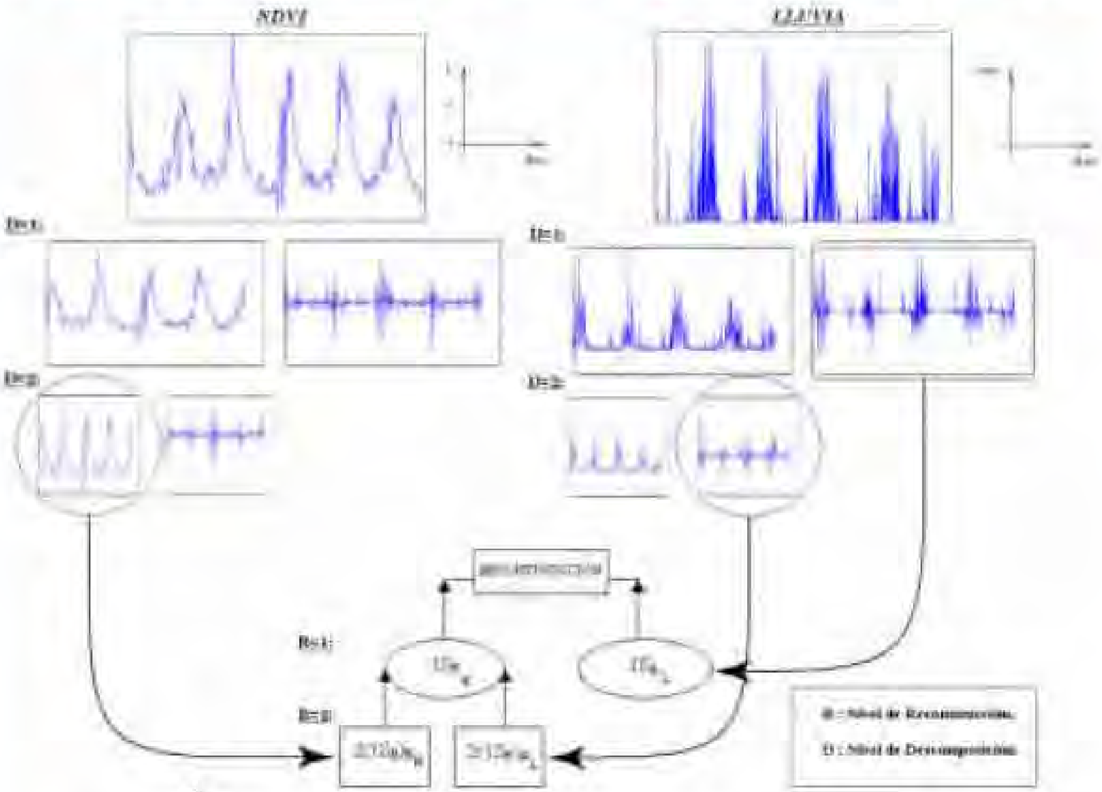

Total fresh tuber yield
Kg. 10 m^2
d.a.p.
Obs
Sim - NDVI

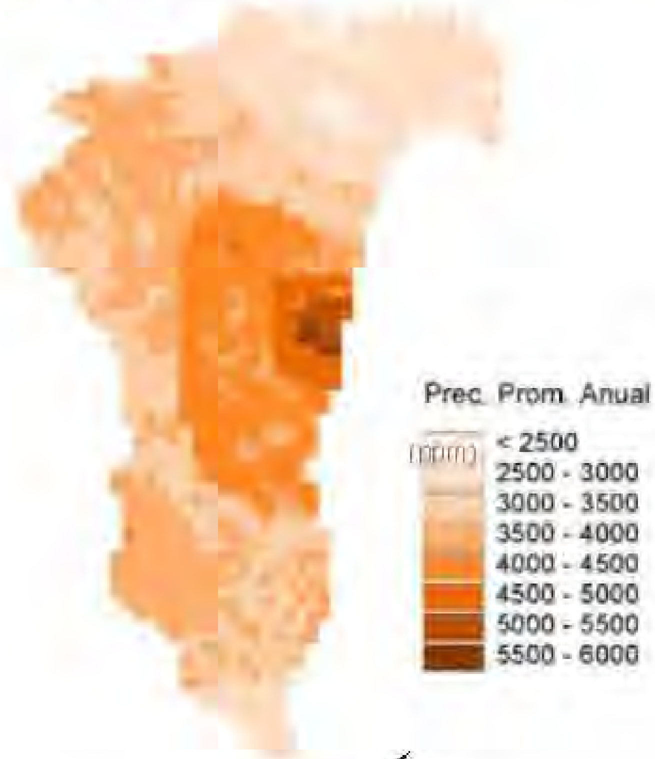

Reflectance
CIP number 380389.1 " Canchan "
Control
PYVV
first derivative w.r.t. wl
wavelength
days after inoculation

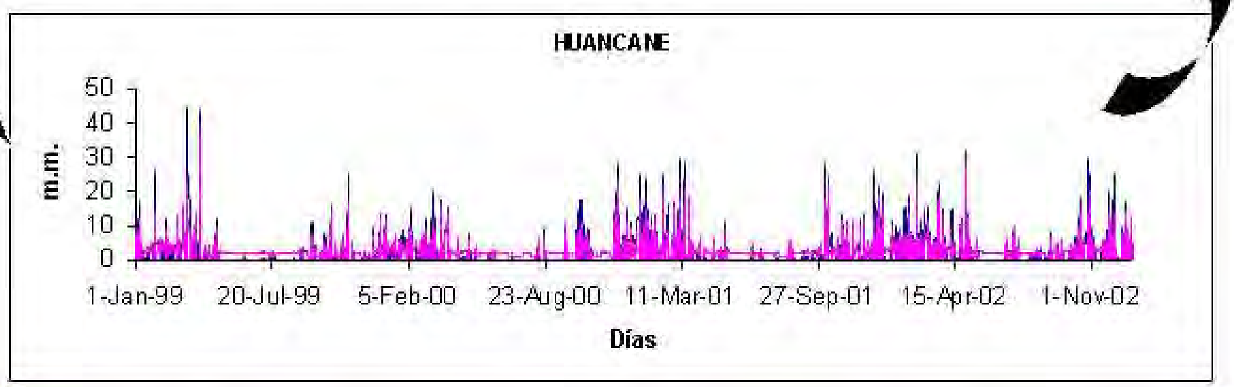
Improving TRMM rainfall estimates in mountains



Space-time scaling weather/climate data







Climate & potato-based systems

Selection of contrasting drought & heat tolerance genotypes

Native Andean potato

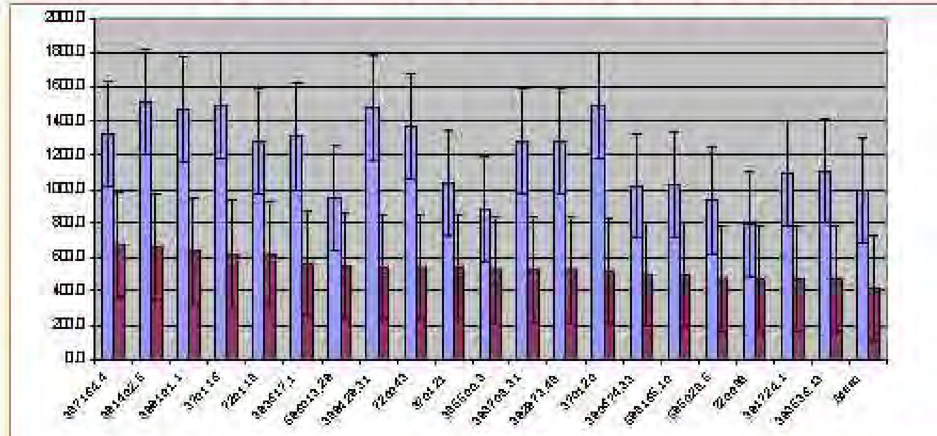
- *S. tuberosum* Andigenum cultivar group
- *S. ajanhuiri*
- *S. juzepczukii*
- *S. curtilobum*

Source: Division 3

Potato Drought Tolerance Screening

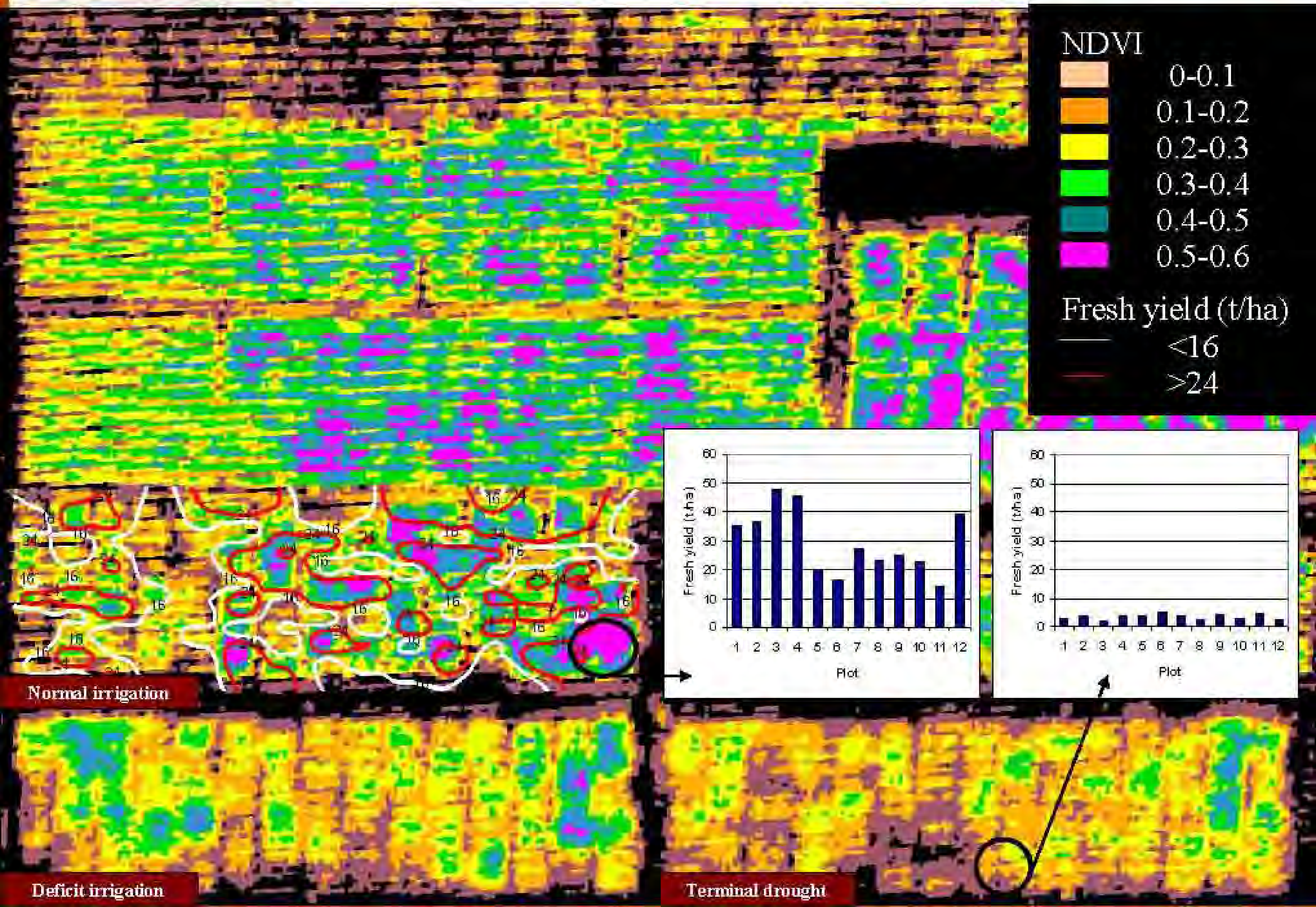
- Materials: breeding clones & landraces from CGS
- Methods:
  - Replicated plots in La Molina
  - Irrigation suspended 5-6 weeks after planting
  - Harvest 90-110 days
- Results: collection of 192 drought-tolerant breeding clones and landraces

Best 20 – Irrigated vs. Drought



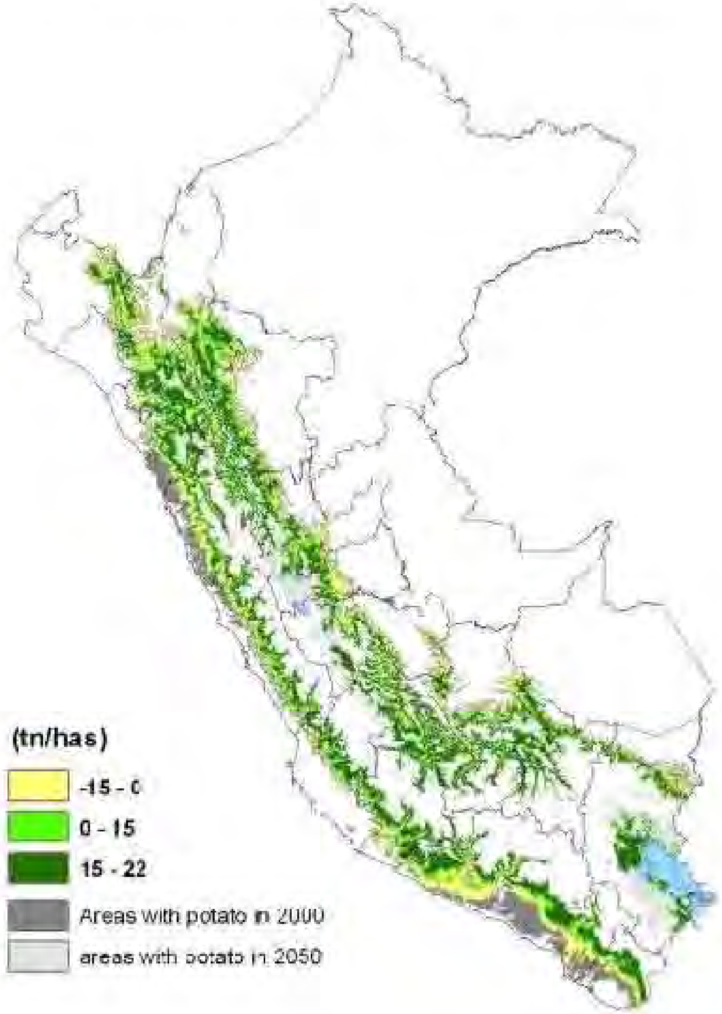
Drought tolerance screening in CIP potato CGS R. Cabello, E. Chujoy

RS data for helping select tolerant potato cultivars



Climate & potato-based systems

Changes in potential potato production 2000 -2050



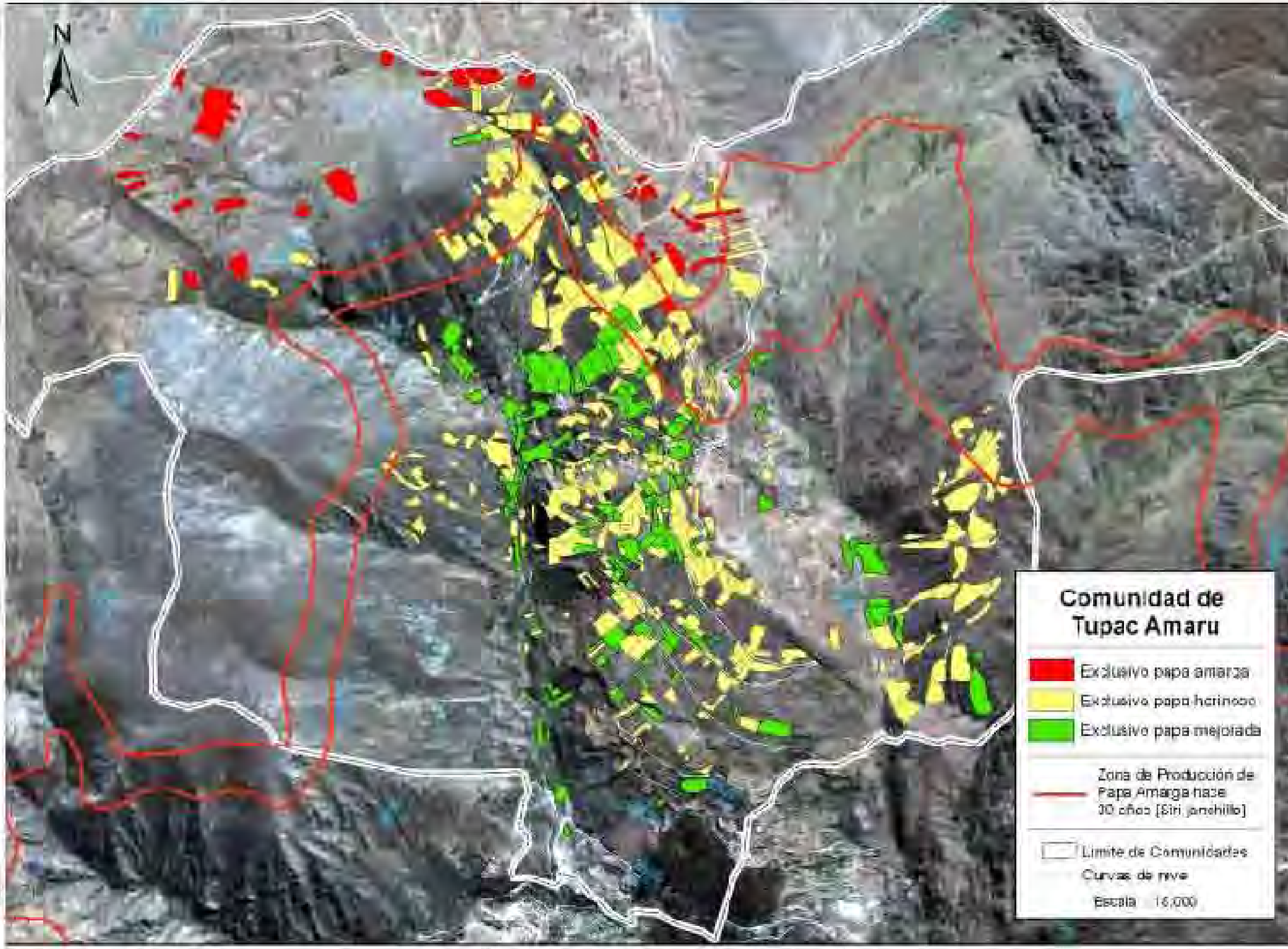
Bitter Potato: long-term adaptation

1975:

(4000-4150msnm)

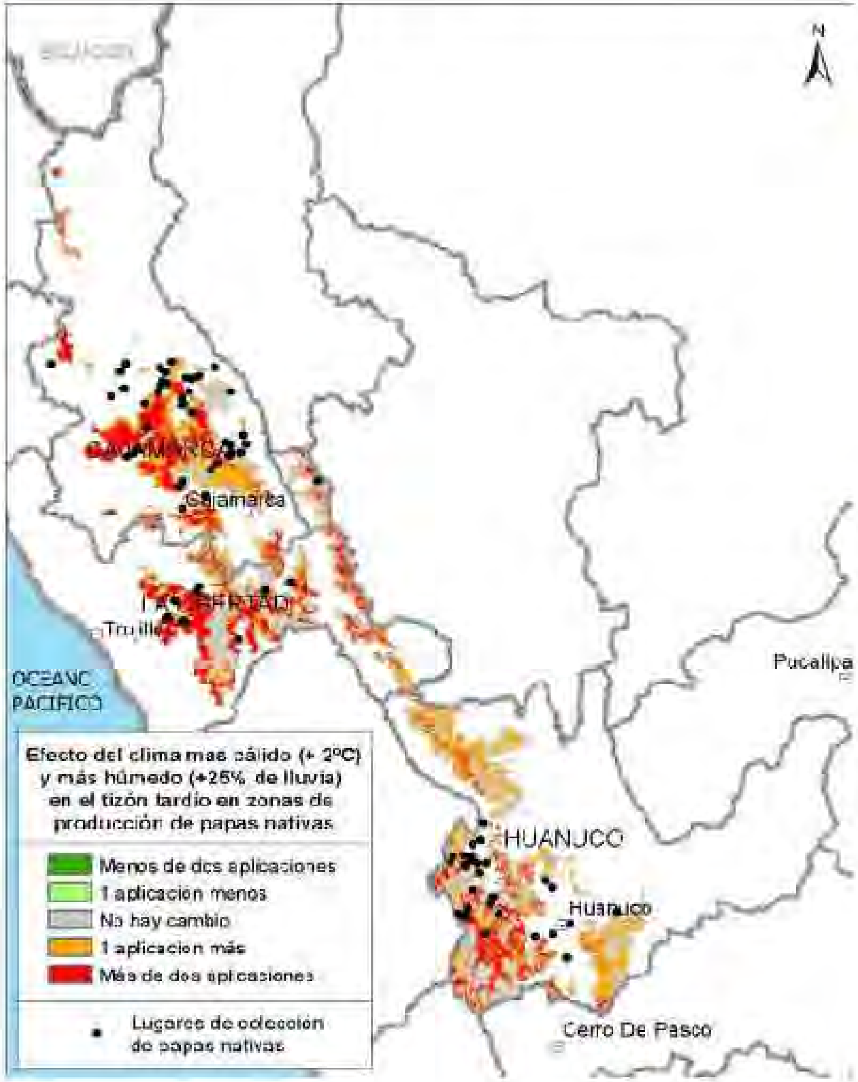
2005:

(4150-4300msnm)



S. De Haan & H. Juarez, CIP (2008)

Late blight



- Zonas de producción de papa.

Naturaleza del gasto	2000	2050	Gasto adicional
Fungicida (tm)	966.9	1034.8	67.8
Gasto en fungicidas (millones de USD)	21.9	23.4	1.5
Gasto en mano de obra (millones USD)	7.5	8.1	0.5
Gasto total (millón USD)	29.4	31.5	**2.1**

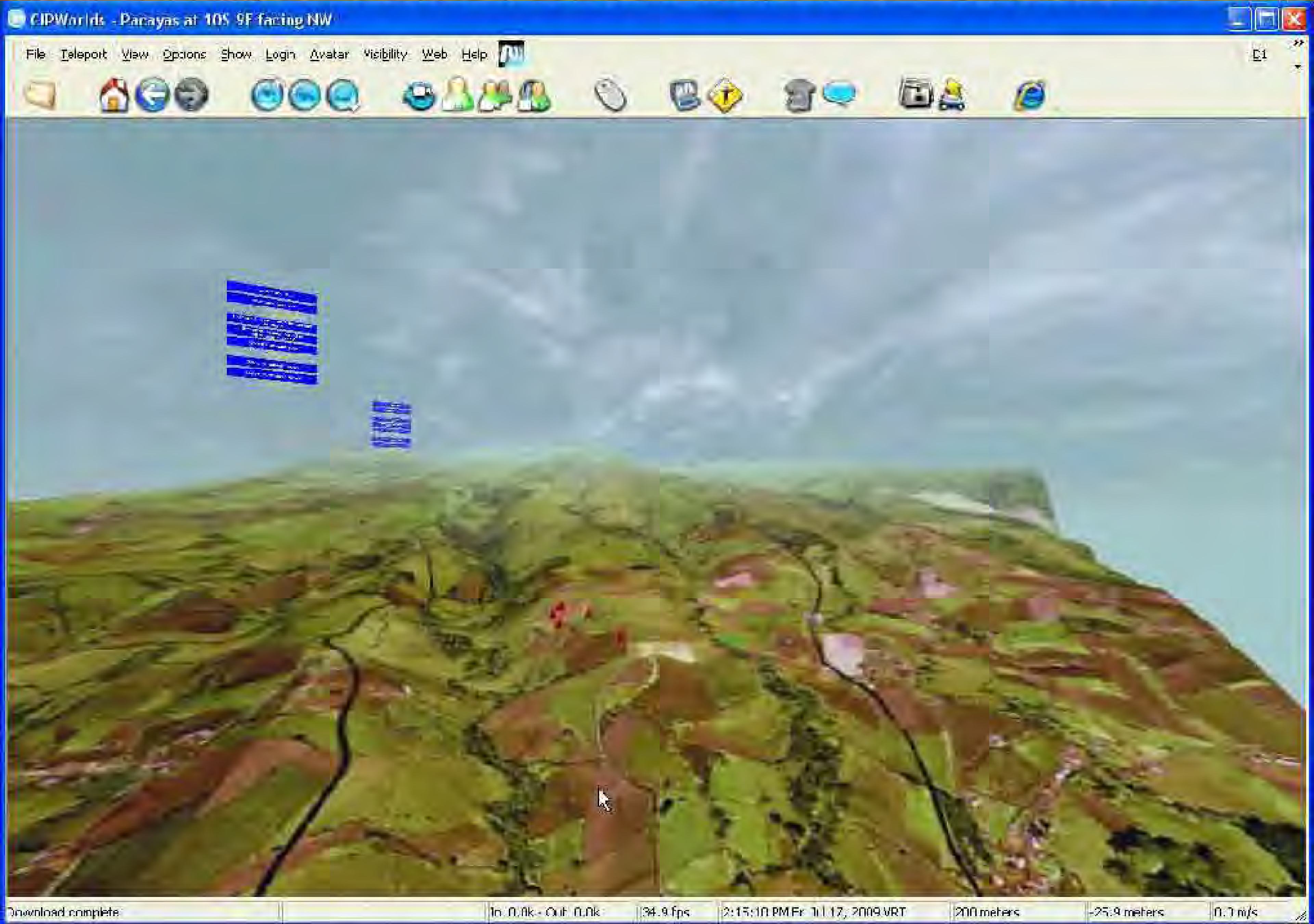
- Zonas de producción de papa nativa (>3,000 msnm).
  - ✓ Se estima que más del 60% de los gastos adicionales para controlar la enfermedad de TT por cambio climático van a tener que ser asumidos por los agricultores ubicados en las zonas de producción de papas nativas (1.3 millón USD).

Potato tuber moth

- La polilla de la papa generalmente es reportada en la costa y valles interandinos cálidos. Se estima que en la actualidad 120,398 ha de papa son afectados por la polilla (45% del área total sembrado).

- Se espera que por efecto de cambio climático, la polilla va a subir a zonas mas altas de producción de papa ubicadas principalmente en los valles interandinos que podrían incrementarse a 179,178 ha afectadas (67% del área total sembrado) por efecto del cambio climático.

Improved visualization of scenarios



Thank you

Production Systems and
The Environment Division

http://inrm.cip.cgiar.org