Whole Plant Physiology Modelling Project (WPM) May 2005 – May 2008

Agropolis CIRAD
Agropolis INRA
CSIRO/UQ
EMBRAPA

Delphine Luquet (CIRAD, Montpellier, France) – WPM project PI
Ex - PI: Marcel de Raissac (CIRAD) until May 2006

Introduction

WPM project

- Genesis

- Objectives

- Adjustments…

- Workshop programme

Phenotyping within the Generation Challenge Programme (GCP)

- **GCP objectives**

  – Take advantage of plant diversity and new technologies
  – To improve crops with traits of interest in drought prone environments
  – Several crops (12), in particular cereals (maize, rice, sorghum…)

⇒ **Relate targeted plant traits to gene action**

⇔ **Have appropriate PHENOTYPING methods**

(plant characterization in given environment)

Phenotyping challenges

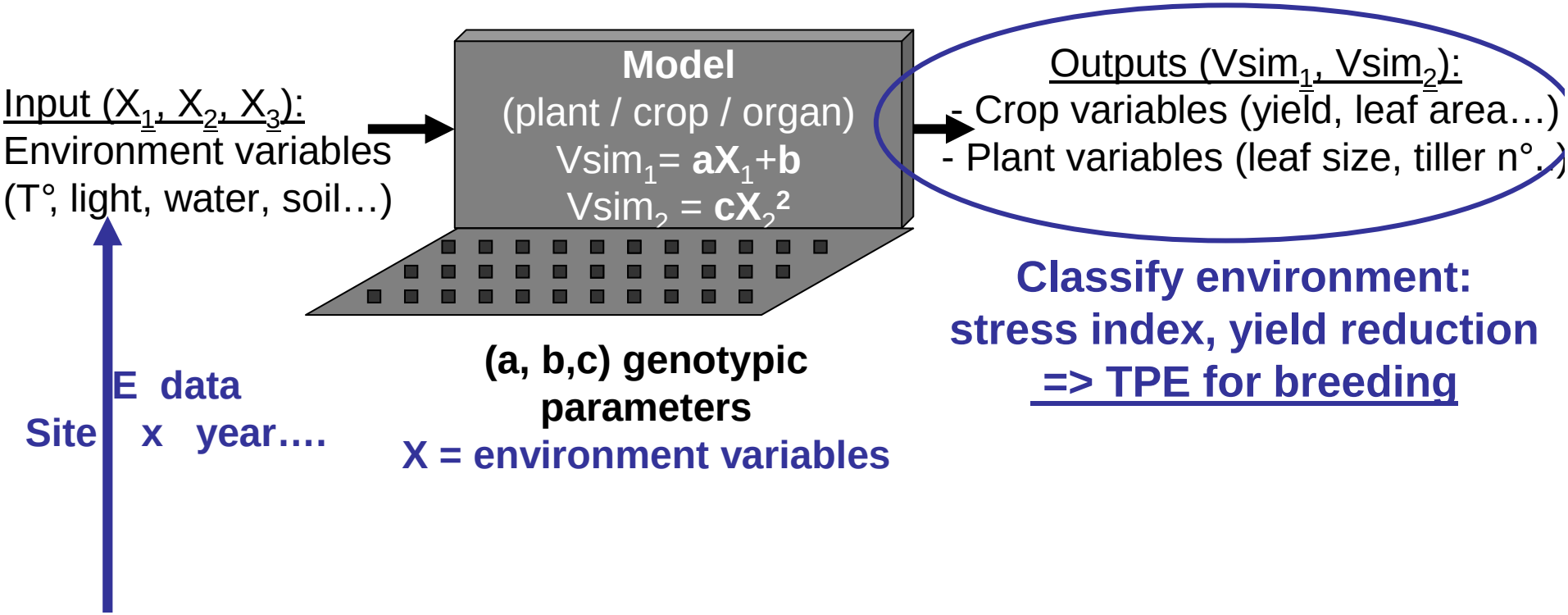
- **Need to adapt phenotyping methodologies and tools to:**
  - Address **process based traits** related to a reduced number of genes
  - Be able to deal with a **large number of genotypes**
  - Be not too expensive…
  - Be combined with a rigorous **environment (E) characterization**

⇒ **Role for plant/crop modeling:**

- Integrate biological and environmental processes => phenotype (crop, plant)
- *In silico* data analyzer of G or E and GxE in phenotype expression

- APSIM model for sorghum TPE in Australia (Chapman, Hammer et al. 2002-03)
- Leaf expansion model for maize under drought (Tardieu, Raymond, et al. 2004-05)
- Rice phenotypic plasticity model under abiotic stress (Luquet, Dingkuhn et al. 2005-06)
...

How models can assist plant phenotyping and environment characterization?



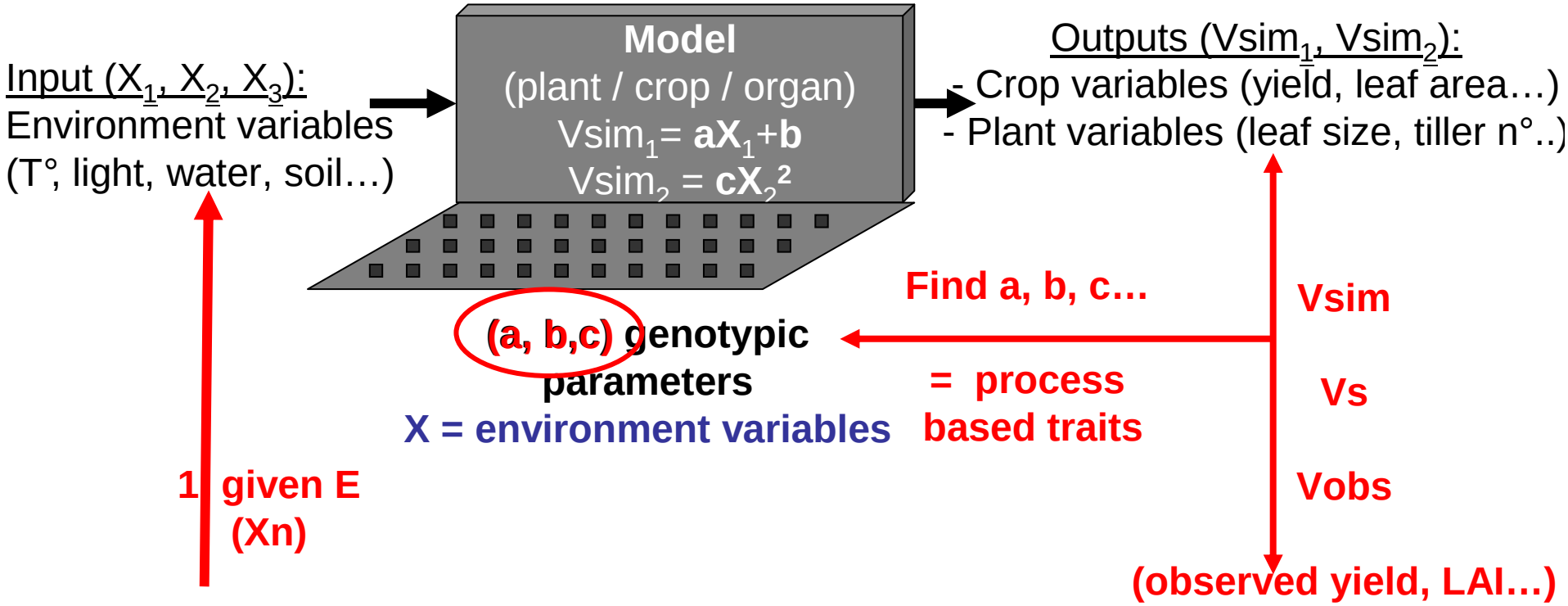
Potentialities

⇒ **1- Target Population of Environment**

⇒ **2- Process base trait phenotyping**

⇒ **3- Sensitivity analysis (combine a,b,c, and E…) => define ideotypes…**

How models can assist plant phenotyping and environment characterization?



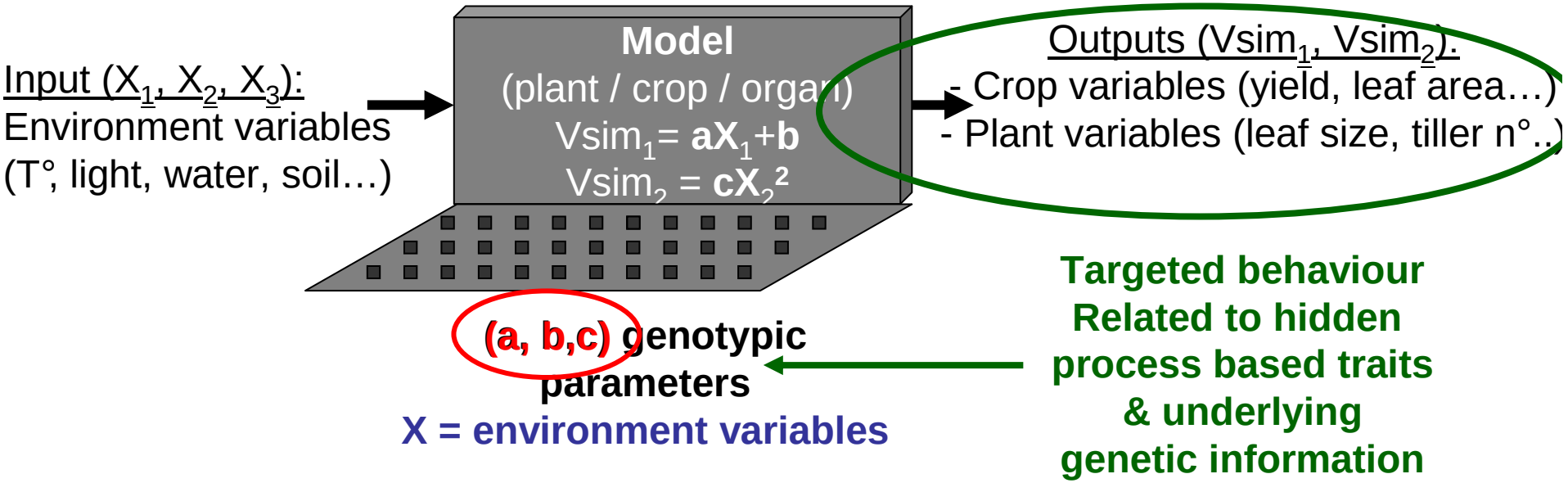
Potentialities

⇒ **1- Target Population of Environment**

⇒ **2- Process based trait phenotyping**

⇒ **3- Sensitivity analysis (combine a,b,c, and E…) => define ideotypes…**

How models can assist plant phenotyping and environment characterization?



Potentialities

⇒ **1- Target Population of Environment (TPE)**

⇒ **2- Process based trait phenotyping**

⇒ **3- Sensitivity analysis (combine a,b,c, and E) => define ideotypes**

⇒ **How to take advantage & improve these potentialities within the GCP?**

⇒ **Whole Plant Physiology Modelling (WPM)**

Commissioned research project initiated in May 2005

In subprogram 1 (headed by JC Glazmann)

WPM: initial framework

2 year project (May 2005- May 2007)

- Collaboration between
  - CIRAD (France)
  - INRA (France)
  - Embrapa (Brazil)
  - University of Queensland/CSIRO (Australia)

- Objective: prove and improve crop/plant modeling contribution for:

(1) TPE characterization and (2) phenotyping

Focus on Brazil (Cerrados)

- Drought prone environment typology
- 6 Experiment sites (from DPN project)
- Cereals: rice, sorghum, maize

WPM project components

	C1 'TPE' characterization	C2 'multi-site trial Model assisted phenotyping'	C3 Model implementation & parameter connection to genetic information
Crops & sites	Rice, Maize, Sorghum (Brazil weather data)	Rice, Maize, Sorghum (Brazil, 3 seasons, 6 sites)	Rice, Maize, sorghum (controlled & field E)
Model	Crop model (Field)	Plant & Crop models	Organ to crop model
Actors	CIRAD Embrapa CSIRO	Embrapa CIRAD INRA - UQ/CSIRO	INRA UQ/CSIRO CIRAD

& associated training activities (2006):
~25 Embrapa scientists trained to crop model ECOTROP (Sete Lagoas, May 2006)
+ link with Phenotyping training - F. Tardieu et al. (July 2006, Montpellier)

Mid-term project adjustments…

- C1
  - ⇒ Only maize and rice TPE in Brazilian Cerrados (not sorghum)
  - ⇒ + West African sorghum TPE (photoperiod X drought environment)

- C2 (Experiment issues)
  - ⇒ Difficulties to have data appropriate for modelling (& with drought)
  - ⇒ Project extension until May 2008 (last exp. season until October 07)
  - ⇒ Results limited to rice (day2) and maize (study still underway…)
  - ⇒ Only crop model assisted ideotype definition (vs. TPE)
  - ⇒ + model assisted field phenotyping of sorghum photosensitivity (v)

- C3 (same goals)
  - ⇒ Model parameter connection to physiological & genetic information
  - ⇒ Challenge of dealing with large number of genotypes
  - ⇒ But not only for drought case studies…

Here we are!
WPM final meeting programme

Hosted by Pioneer

- Thank you to Mark Cooper, Stephen Smith, Leslie Lorenc
- 2 talks (Charlie Messina in C1 & Mark Cooper in C2)
- Pioneer visit tour (Thursday)
- A great pleasure and opportunity to share ideas

& to better know Pioneer

WPM final meeting programme

~ half / one day per project component

- One keynote per component - Thanks to :
  - David Jordan, DPI, Australia (C1)
  - José Luis Araus, Cimmyt, Mexico (C2)
  - Yves Gibon, Max Planck Institute (C3)
- Enough time for discussions (each component + final)
- Privileging result analyses, lessons learned
- Preparing future projects within GCP…


Thanks to be here
Enjoy this meeting!
DRY SEASON EXP'06 IN PORANGATU
(C. Guimaraes, Embrapa CNPAF)