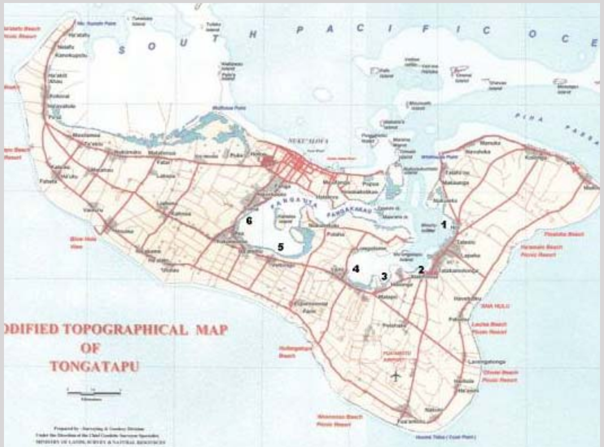


Better agricultural water management on low Pacific islands

Brent Clothier
Sustainable Land Use team

Pacific Economic Cooperation Council
Noumea, 26th May 2008

HortResearch

The Six Forms of Capital

Sustainable economic growth not only depends on financial capital, but also:

- **Economic capital**: Infrastructure, as well as money
- **Human capital**: Knowledge, skills & competencies
- **Institutional capital**: Civic, political & legal arrangements
- **Cultural capital**: Values, histories, traditions & practices binding people together
- **Social capital**: Networks of shared norms, trust & understanding
- **Natural capital**: The renewable & non-renewable stocks of natural resources that support life & economic activities

Adam - in Hebrew **אָדָם** – “Soil"

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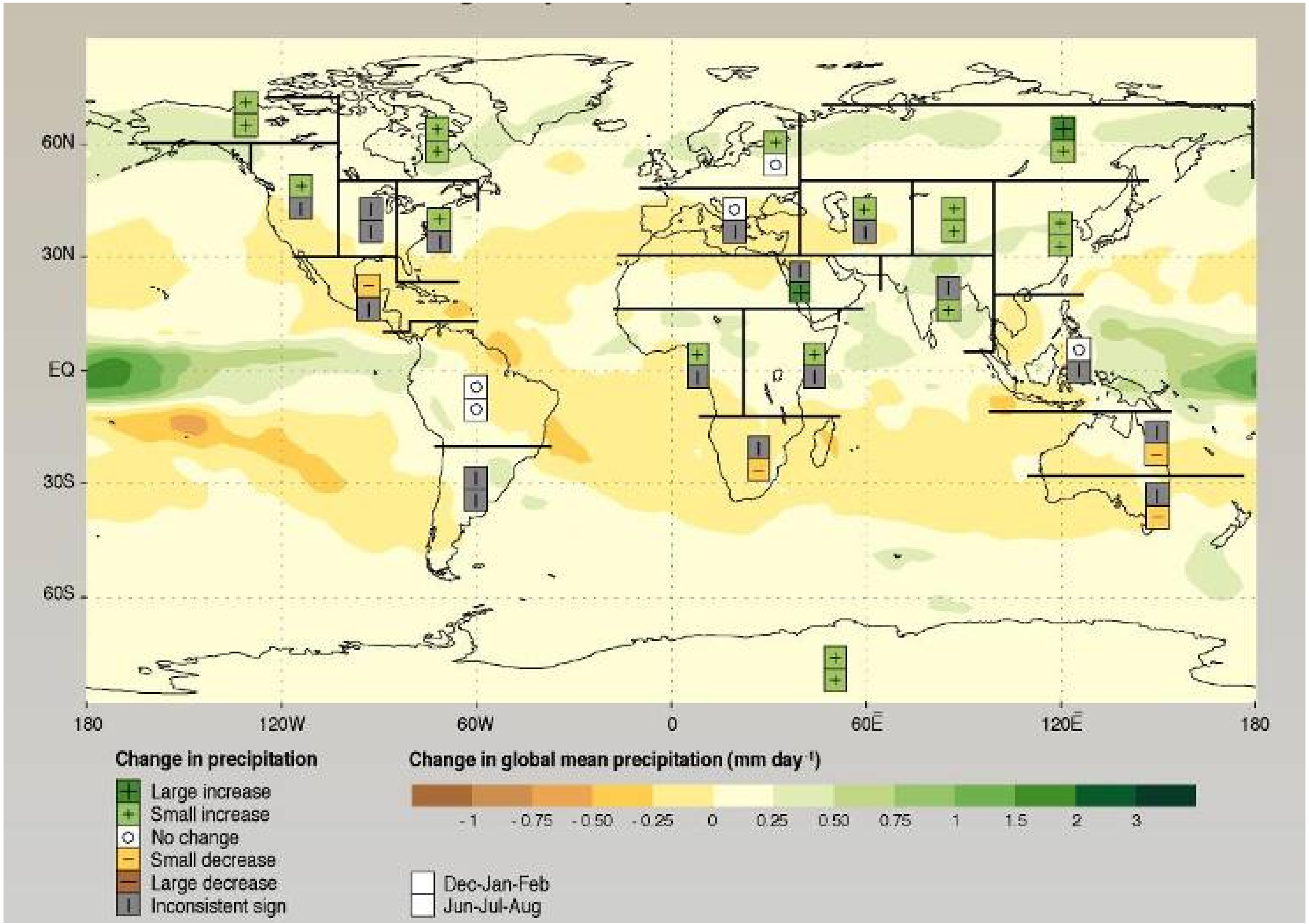
Intensification

"… we can temporarily exceed the carrying capacity of the earth, but put our natural capital into decline"

"… put another way, the ability to accelerate a car that is low on gasoline does not prove the tank is full"

P. Hawken, A. Lovins & L.H Lovins 1999
Natural Capitalism

IPCC Third Assessment (2001): Rainfall Changes (Scenario B2)



Water will be a critical resource worldwide.

.... including many Pacific Islands

Irrigation and Agriculture

Irrigation is being held responsible for

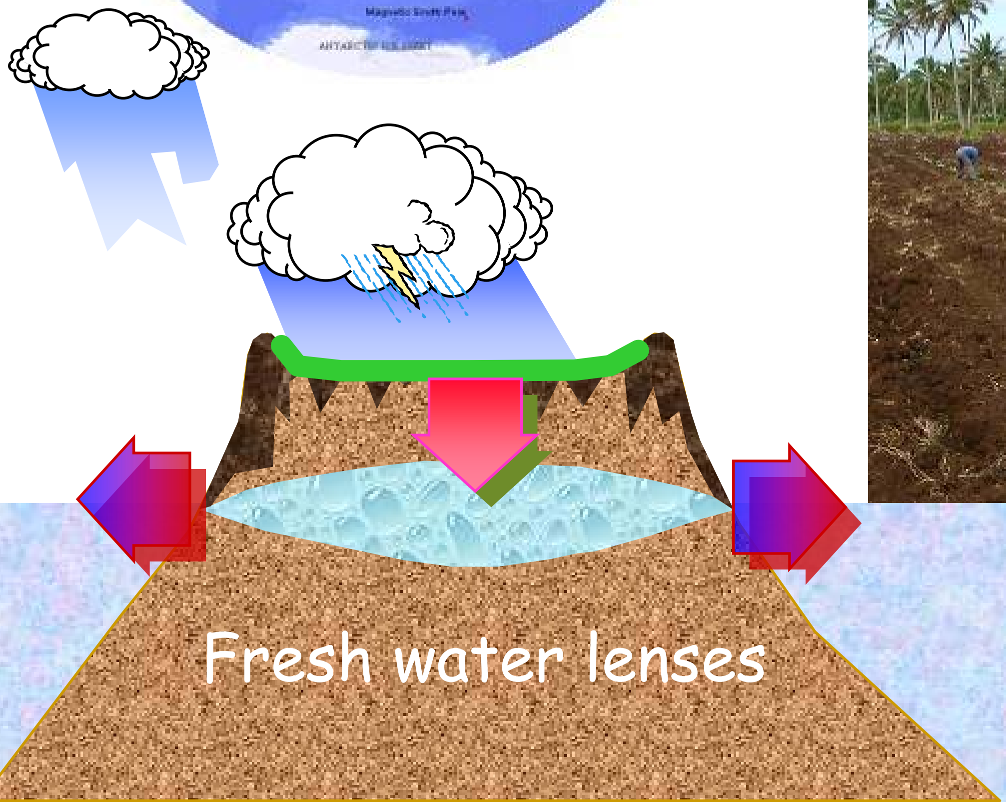
- wasting water
- 'mining' water
- non-point source pollution
- saline intrusion
- groundwater depletion & pollution

Sustainable Use & Wise Stewardship of Water is Imperative

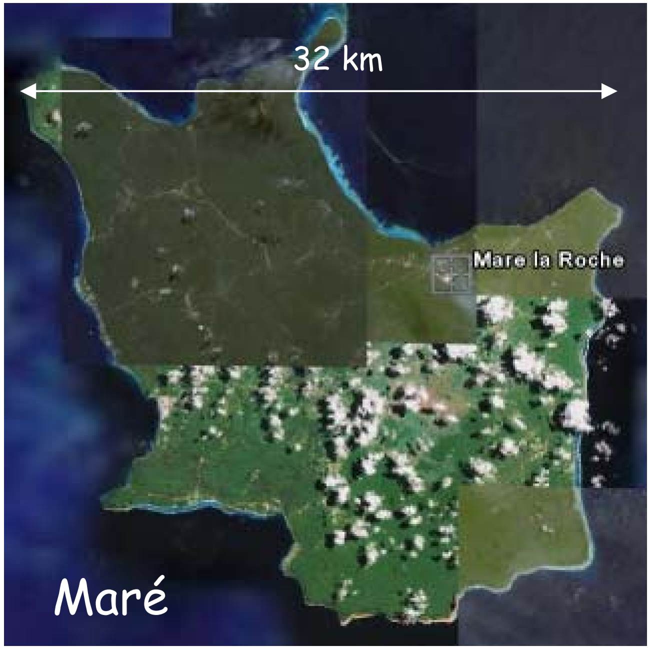
The Agrichemical Problem …

Non-point source pollution: A world-wide concern

Nutrients & pesticides in fragile environments



Case Studies



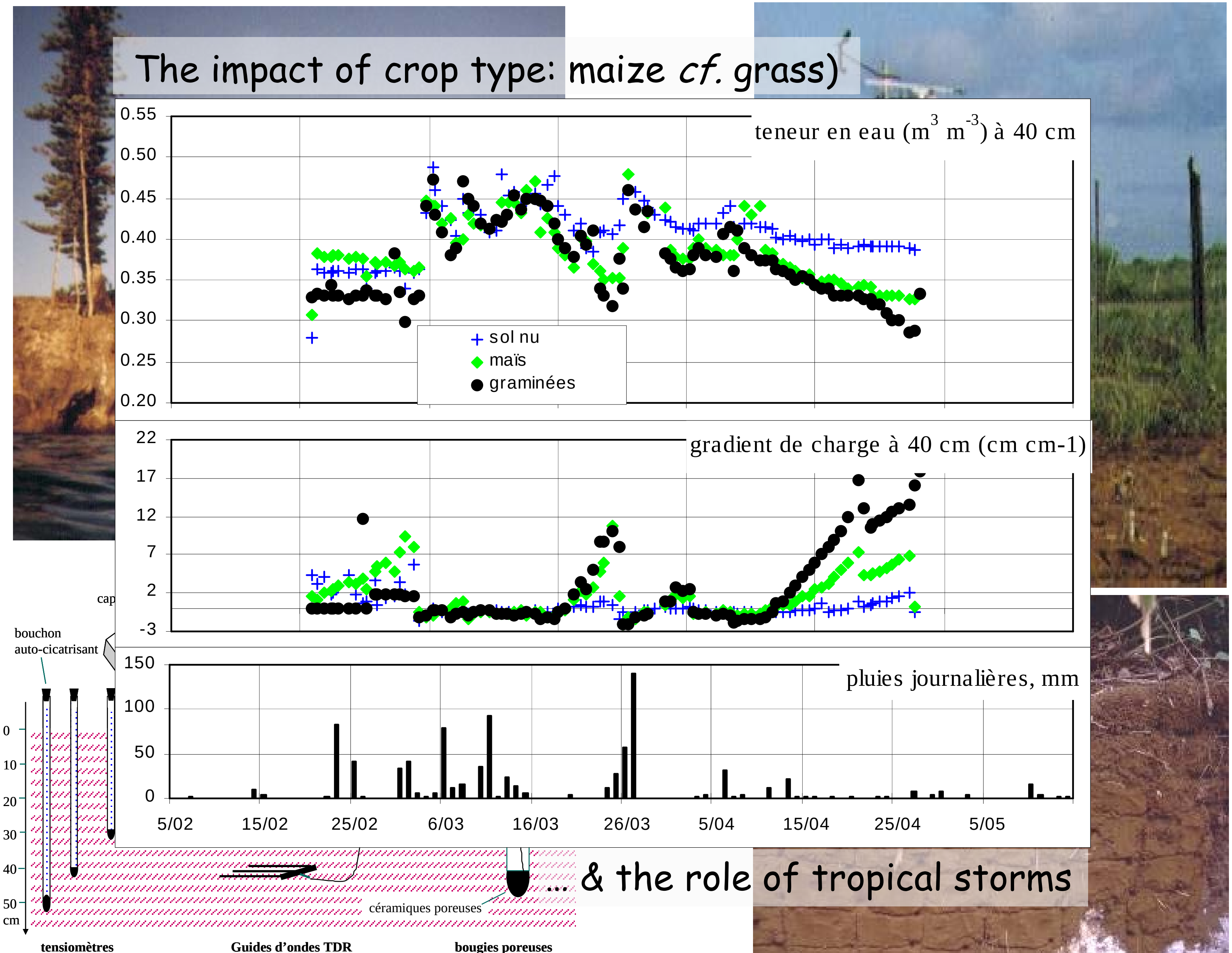
1995-98: IRD
Maize & perennial grasses – N leaching & irrigation

2002-present; IAC
Fruit trees – root dynamics, tree water use & drainage dynamics

2002-2006: EU – INCO-DEV
Squash pumpkin – N and pesticide leaching, plant water use, fresh water lens - impacts & dynamics

Maré: Intensive measurements to understand the “leakiness” of coral soil

The impact of crop type: maize *cf.* grass)



… & the role of tropical storms

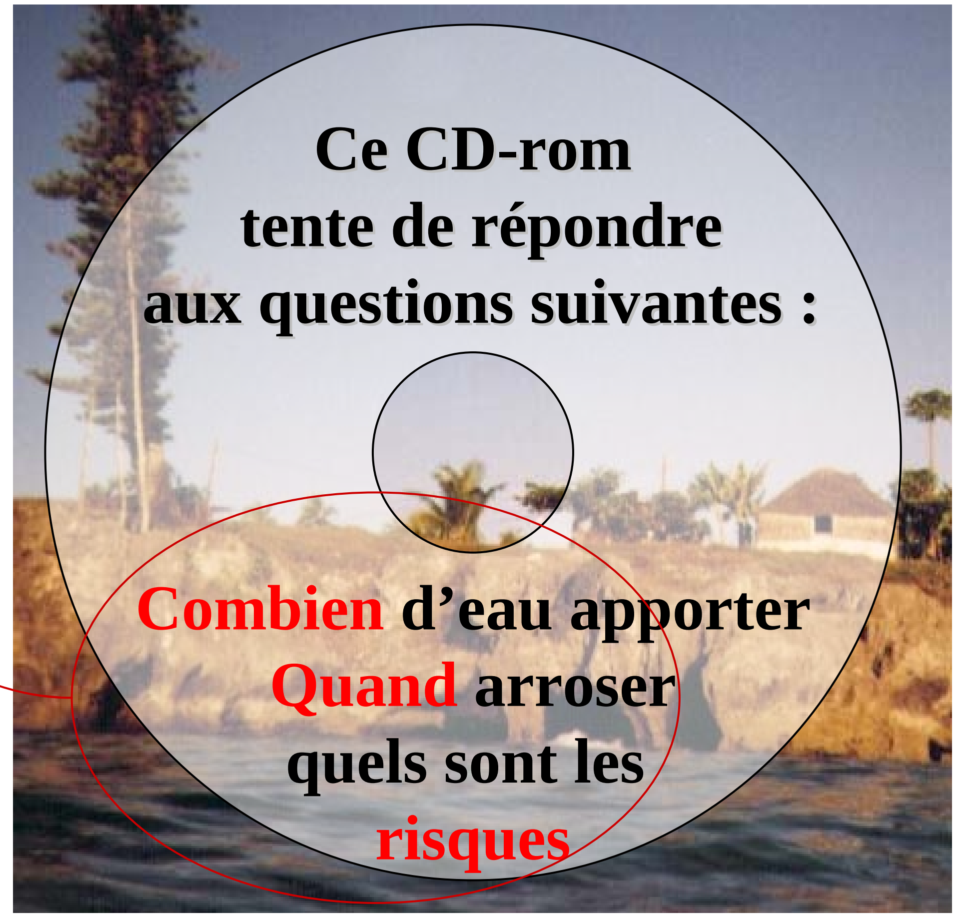
IRD
Institut de recherche pour le développement

HortResearch

Le Resultat: La gestion de l'eau d'irrigation

Présentation du CD-rom, outil d'aide à la gestion de l'irrigation.

How much?
When?
Risks?



Institut de recherche
pour le développement

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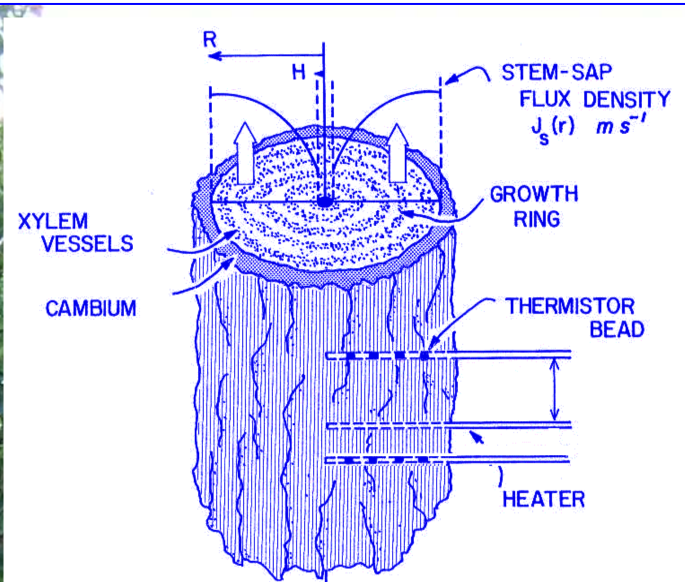
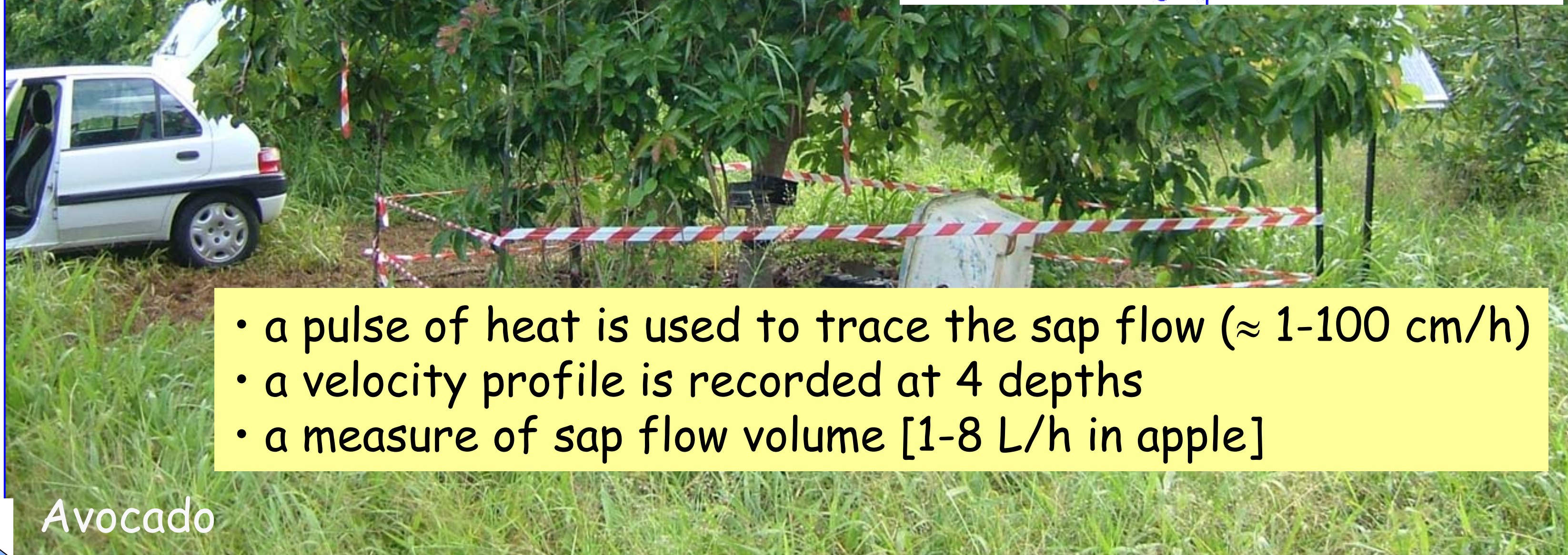
Maré: Measurements to understand better the need for water by trees

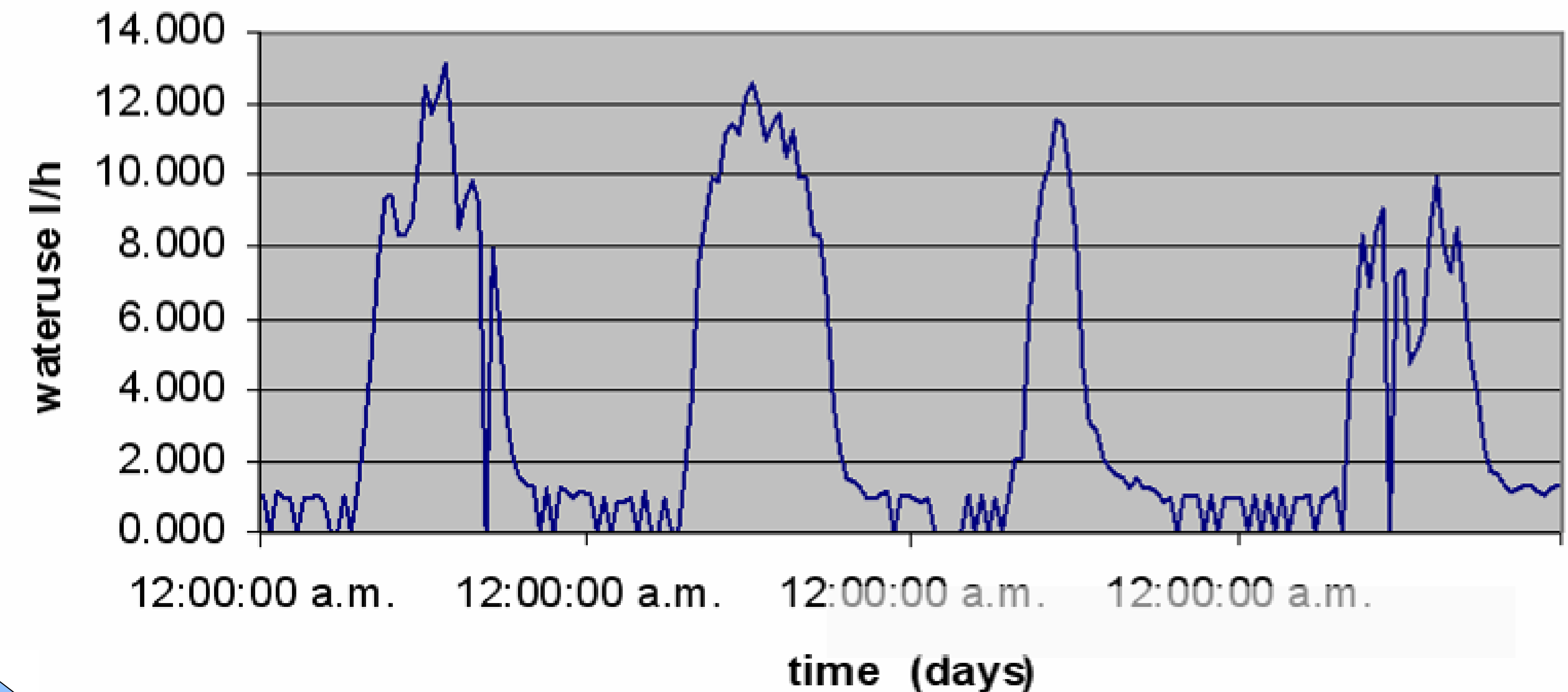




- a pulse of heat is used to trace the sap flow (≈ 1-100 cm/h)
- a velocity profile is recorded at 4 depths
- a measure of sap flow volume [1-8 L/h in apple]

Measurements of tree water –use

- Remote by modem
- Real time



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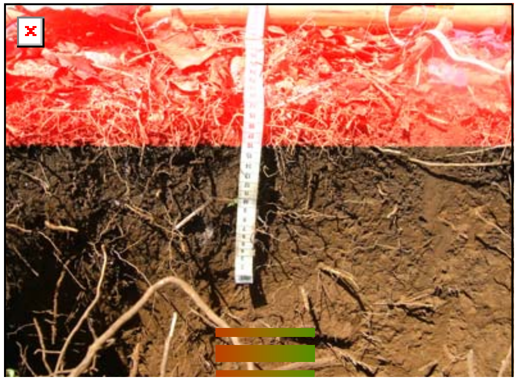
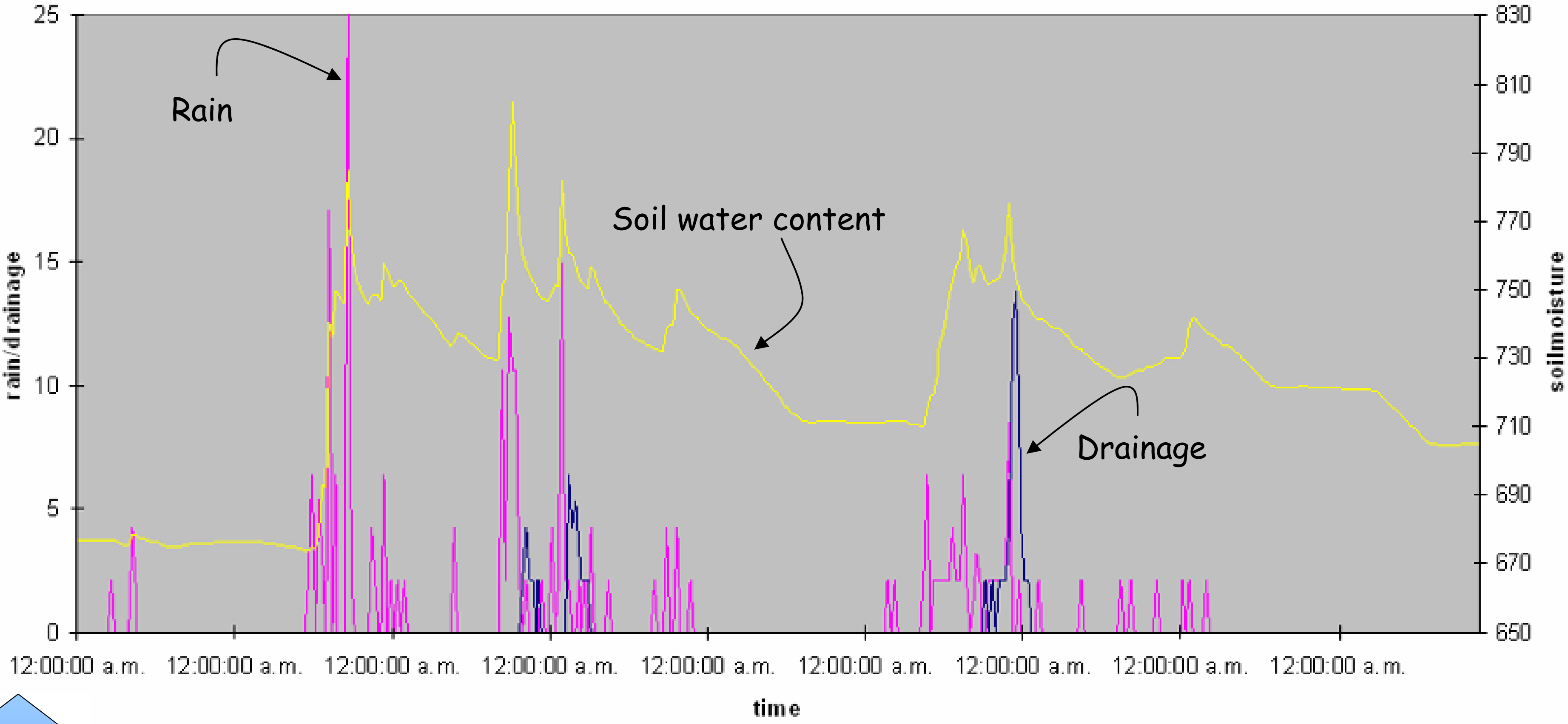
Characterising the hydraulic 'leakiness' of soil

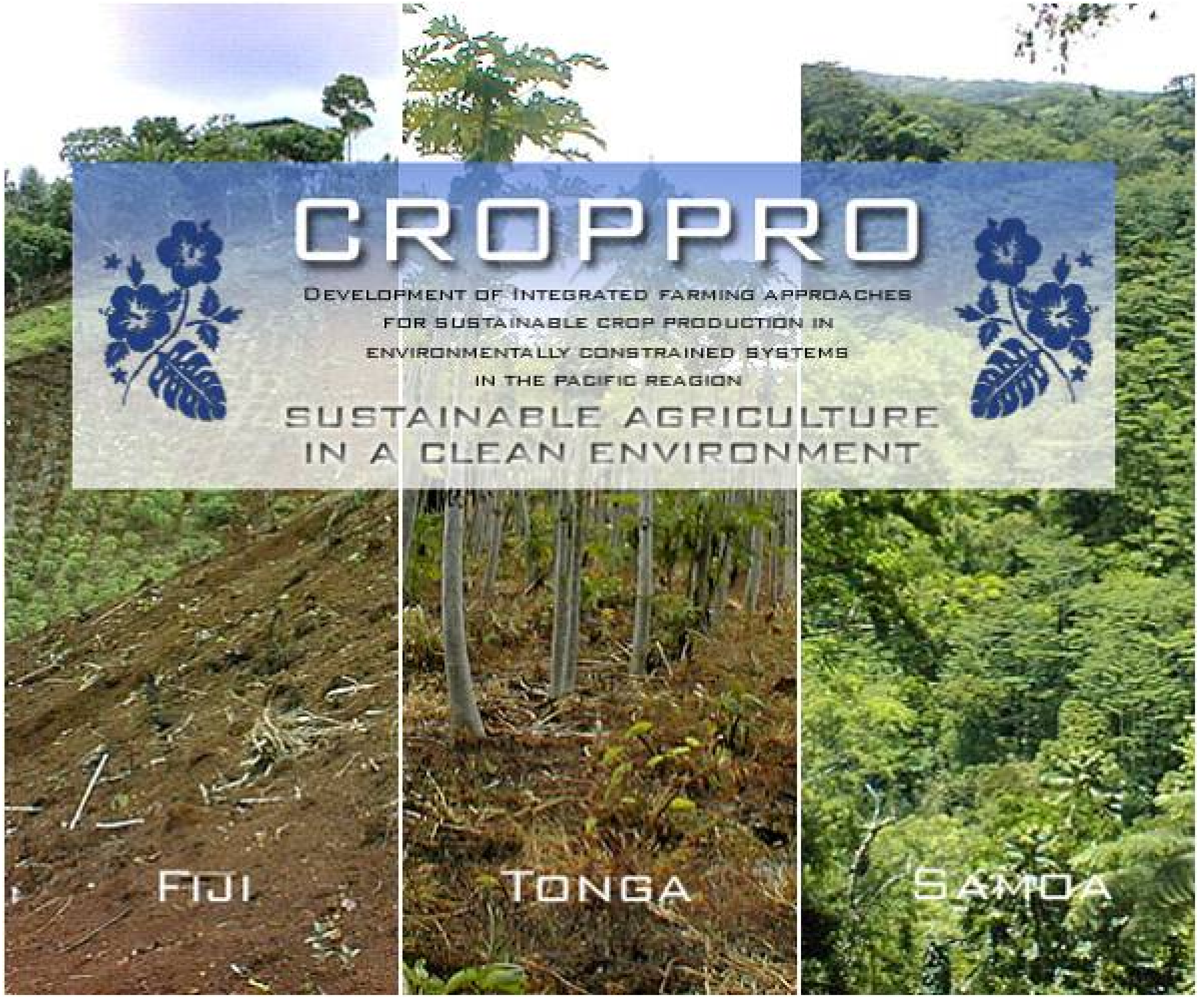
Measurements in the soil of the root-zone

- Remote
- Real-time

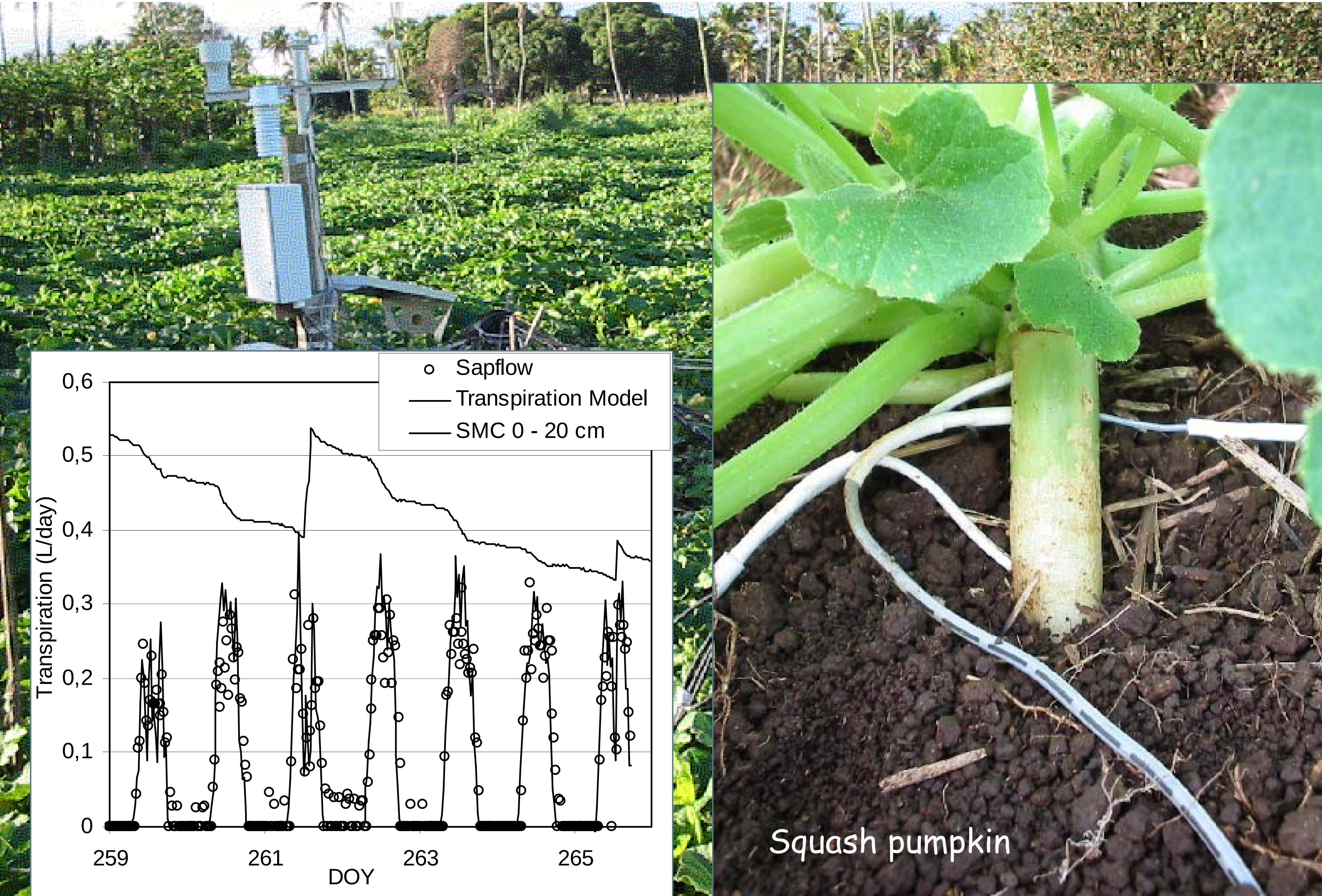


Understanding the water balance of coral soil

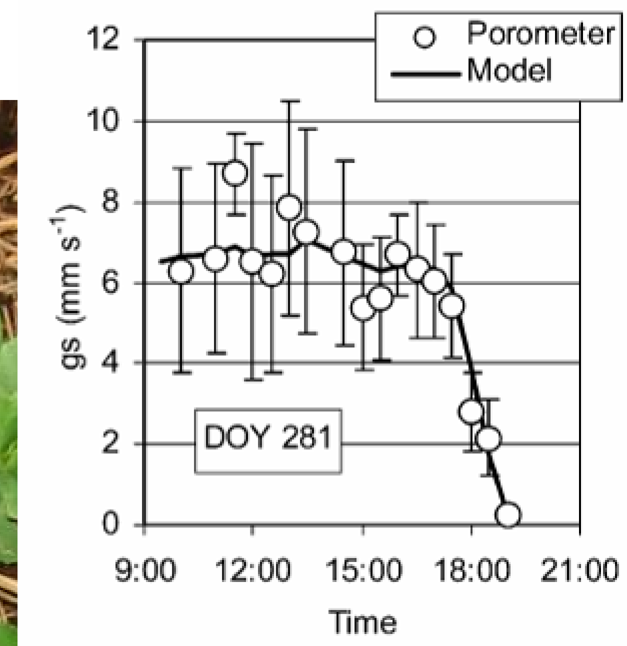


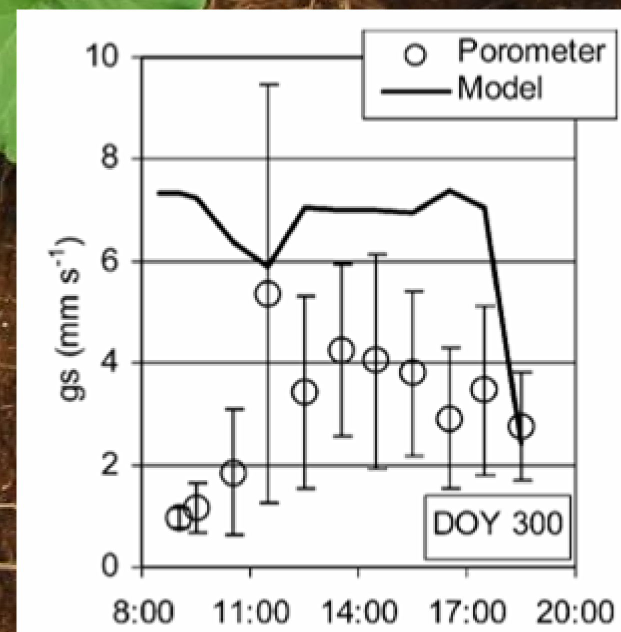

CROPPRO
Development of integrated farming approaches
for sustainable crop production in
environmentally constrained systems
in the Pacific reagion
SUSTAINABLE AGRICULTURE
IN A CLEAN ENVIRONMENT
FIJI
TONGA
SAMOA

Measuring Crop Evapotranspiration – Understanding Water-Use Processes

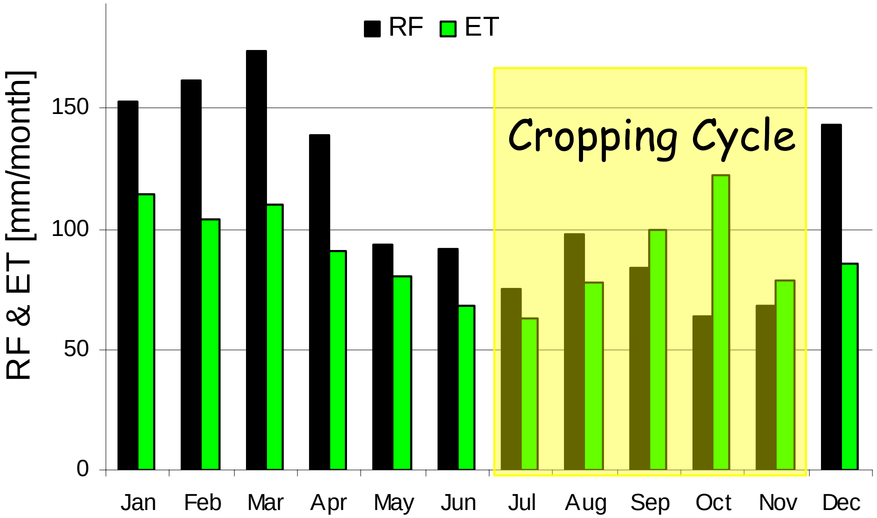


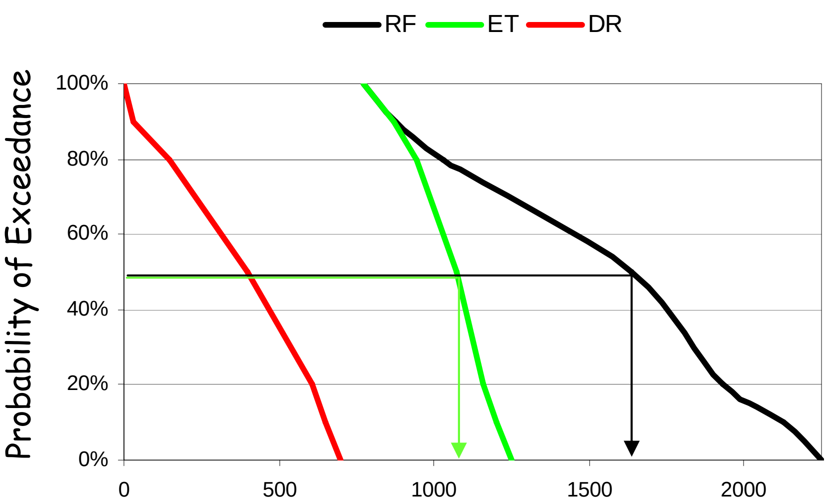
Water Use: Crop Transpiration & Drought

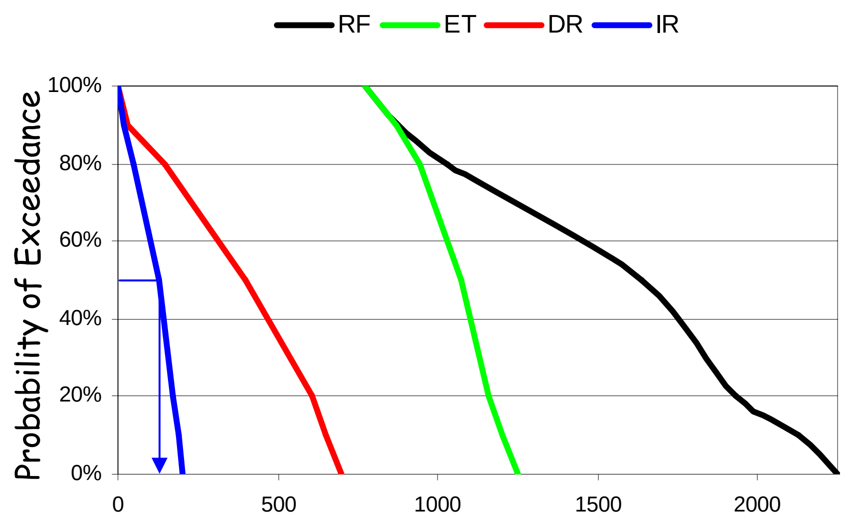




The Water Balance: A Risk Assessment





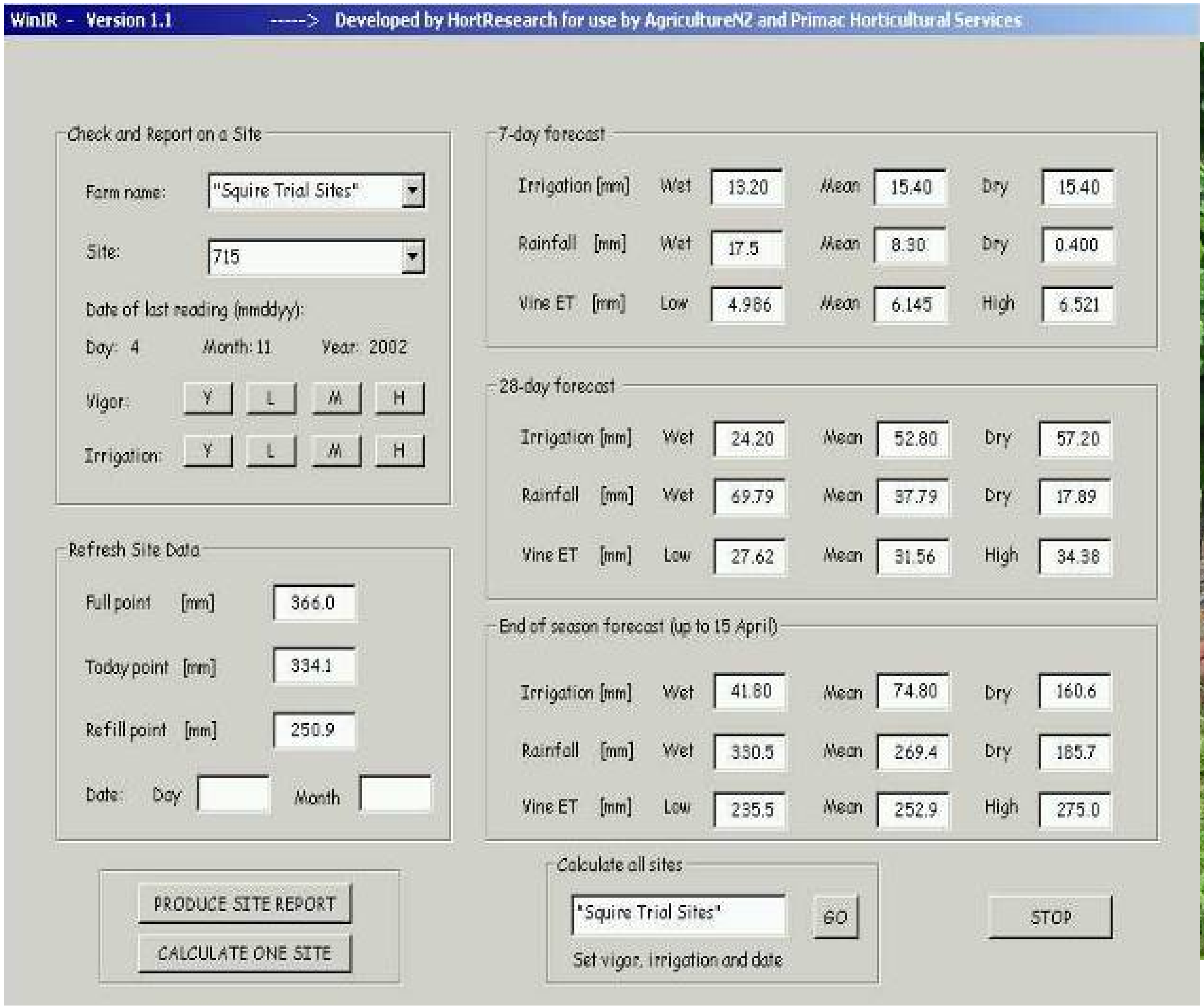


On annual average RF=1600 mm

ET=1100 mm

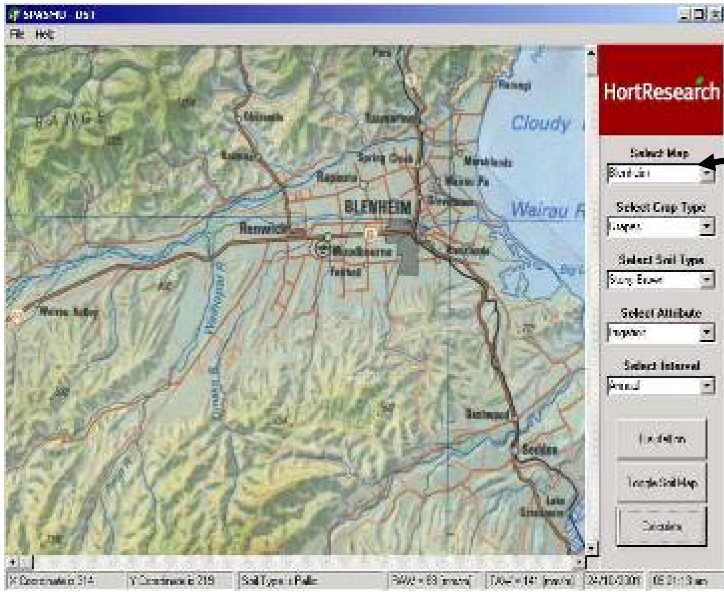
The tactical need for irrigation is on average 100 mm

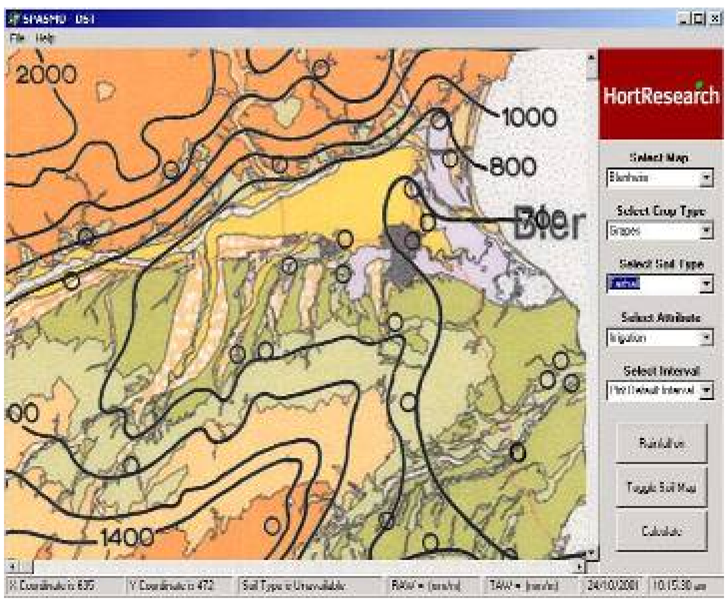
New Zealand Example: A Decision Calculus for Irrigation *Application*



A tool for real-time irrigation management

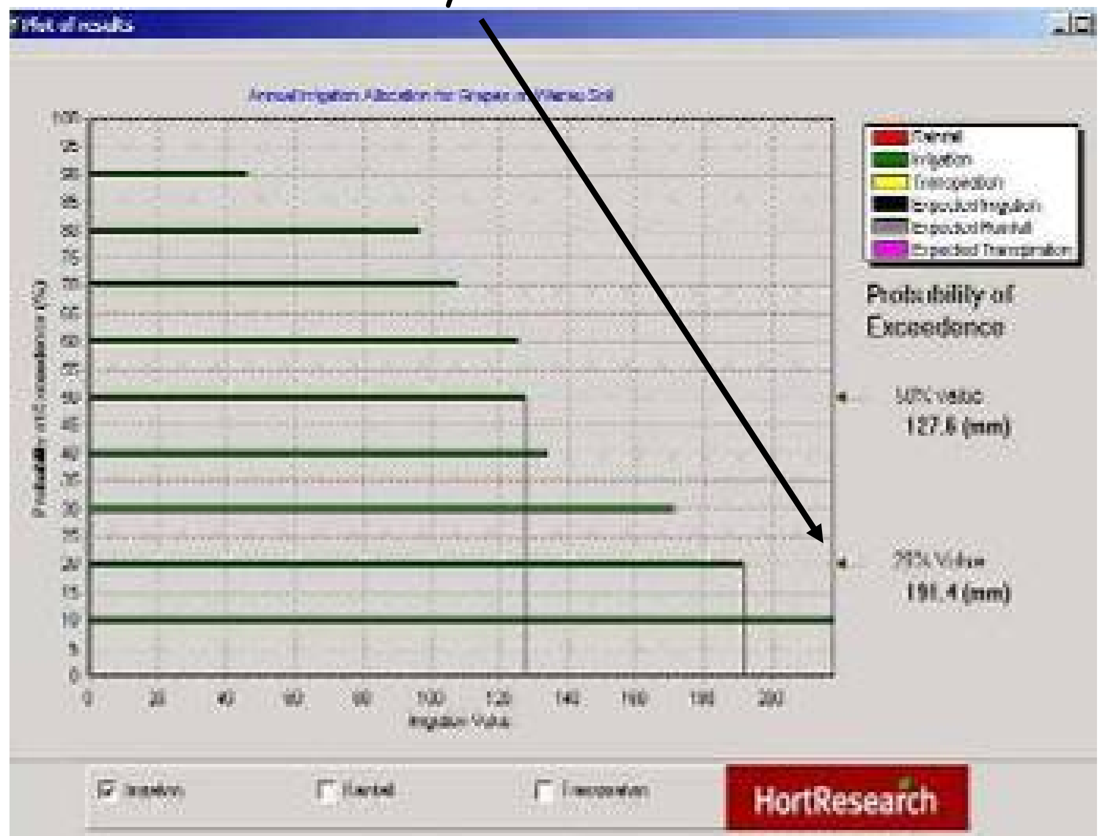
New Zealand Example: A DST for Equitable Irrigation *Allocation*



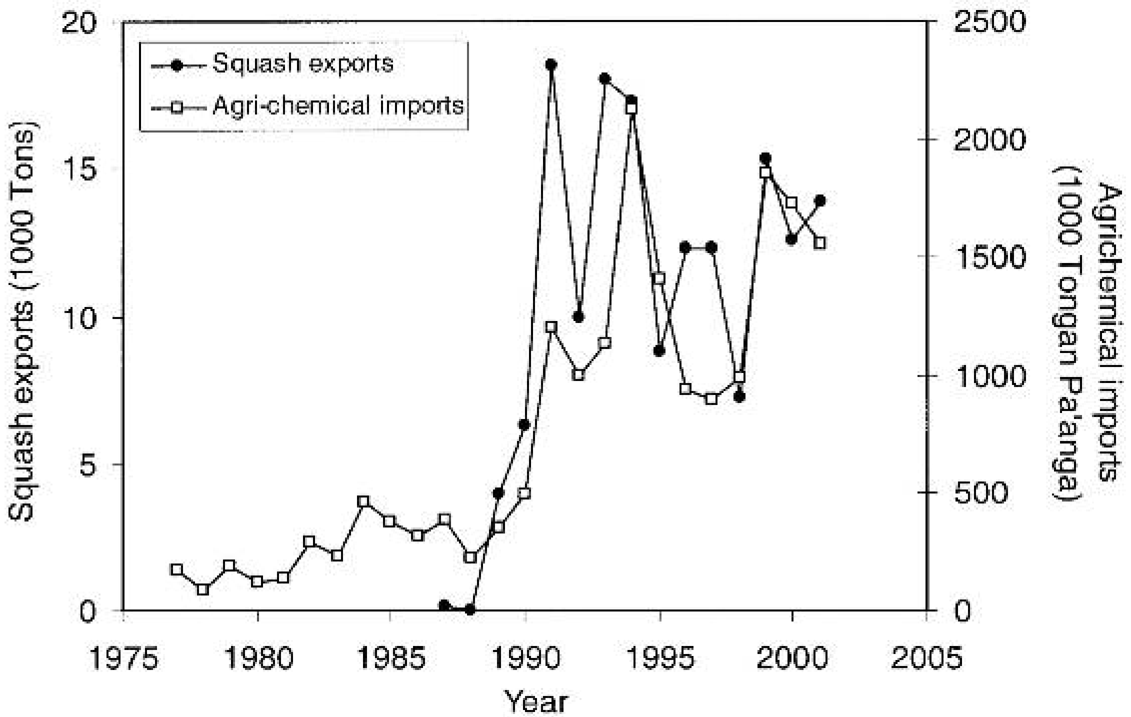


<u>Inputs</u> of
- location & weather
- soil's buffering & crop demands

<u>Outputs</u> of a risk assessment for irrigation - based on 30-years' data



The Future Challenge: Increased production – Sustainable Agrichemical Use



Economic & social benefits, yet risks to the environment & public health

Measuring & Modelling the Fate Underfoot: Leaching & Sustainable Practices

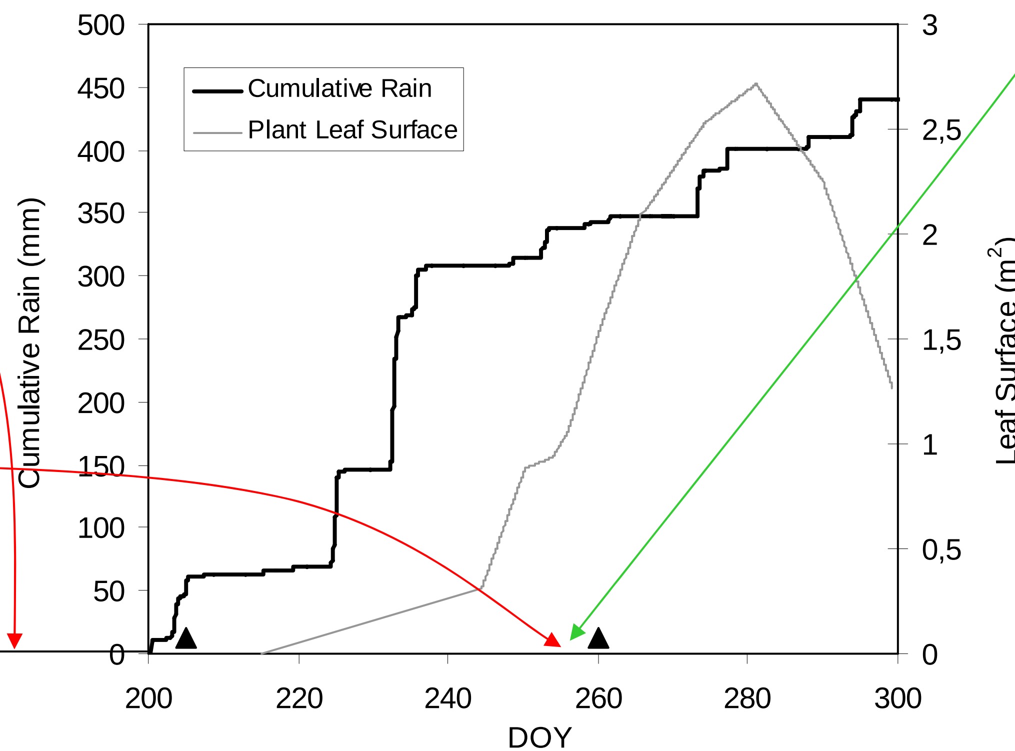
Balancing the Nitrogen Inputs & Leaching Risks

Grass ploughed & mineralises nitrogen (DOY 180)

Some 350 mm of rain, before leaf-area & roots develop

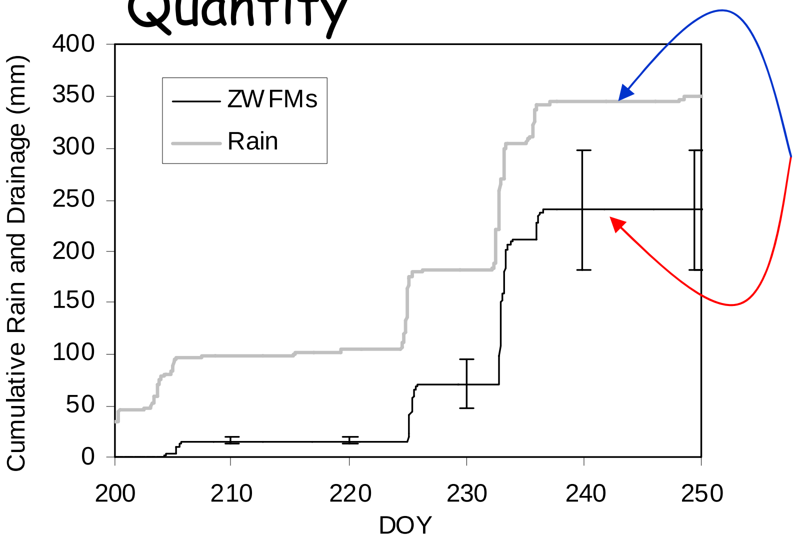
Fertiliser @ 65 kg-N/ha at planting (DOY 185)

Another 80 kg-N/ha @ DOY 255



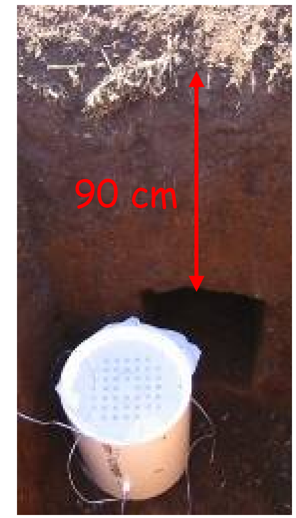
What then happens deeper down?

Quantity

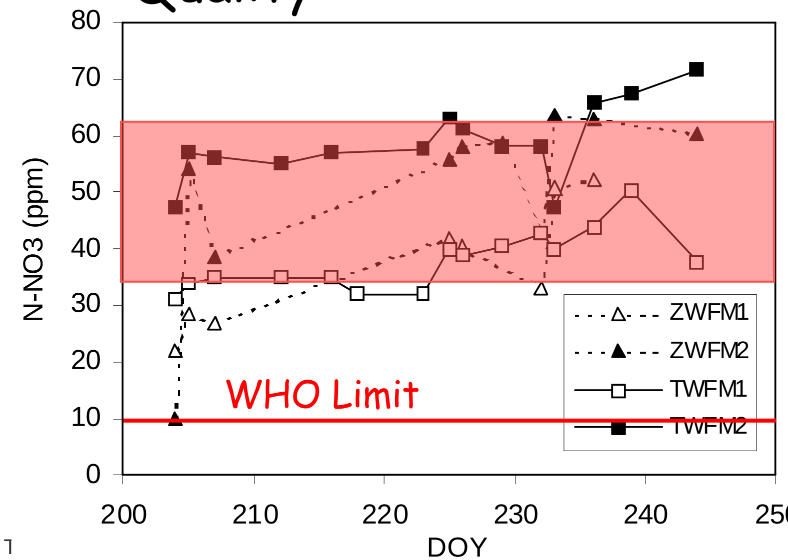


Between DOYs 200 & 245 drainage is 70% of rainfall.

The potential for leaching is great



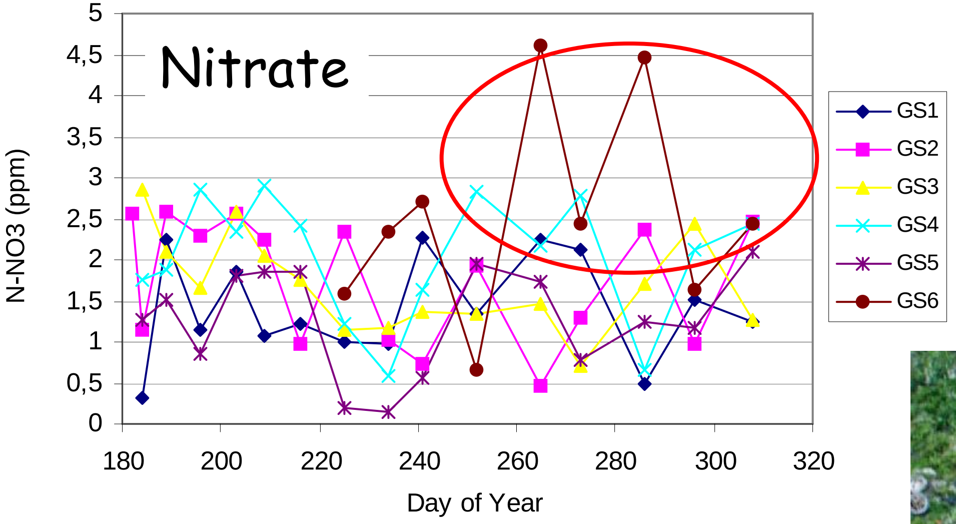
Quality



The NO_3-N content is 35-65 ppm, or, on average, 5 times the NZ drinking water standard

Twice that which was applied has been lost!

Is fertiliser leaking to the lagoon?



Nitrate NZ Drinking Water Standard = 10 ppm
ANZECC Estuarine Trigger Value (QLD) = 0.03 ppm

Fertiliser applied at planting
DOY 185 & again on DOY 255

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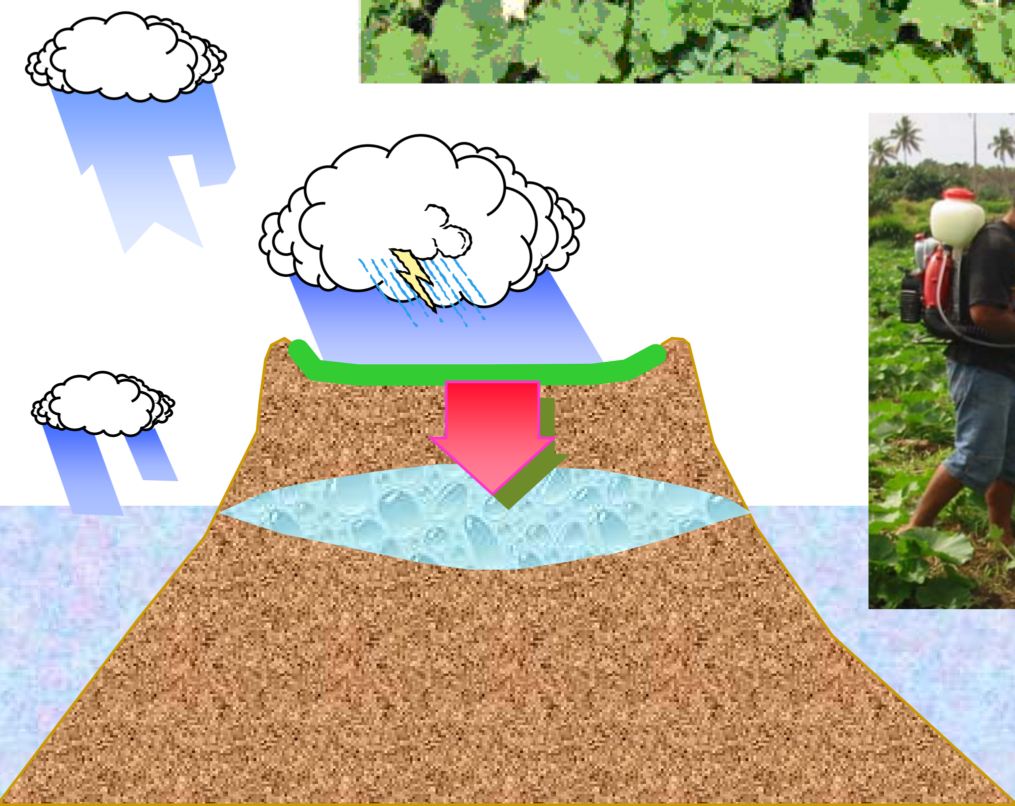
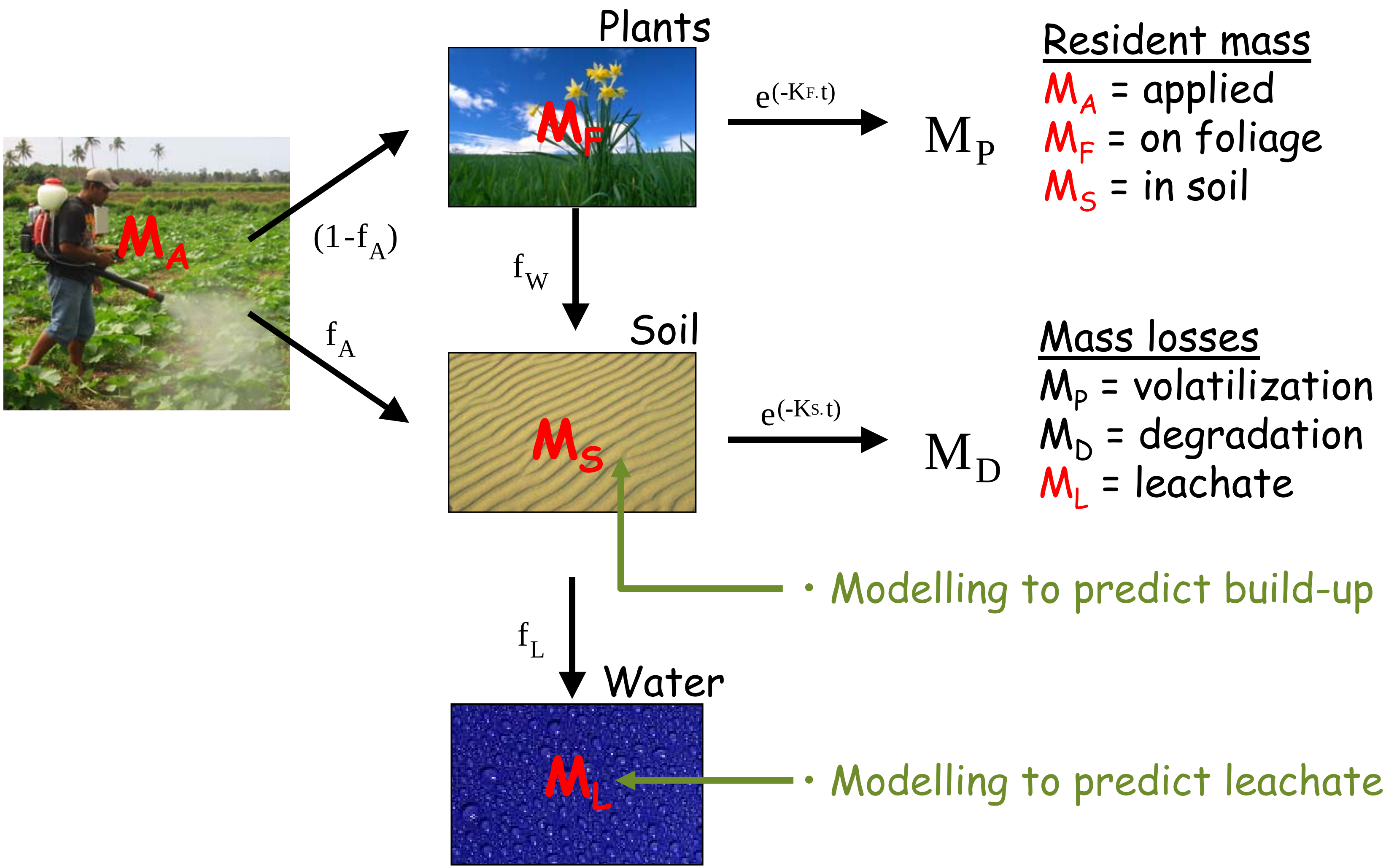
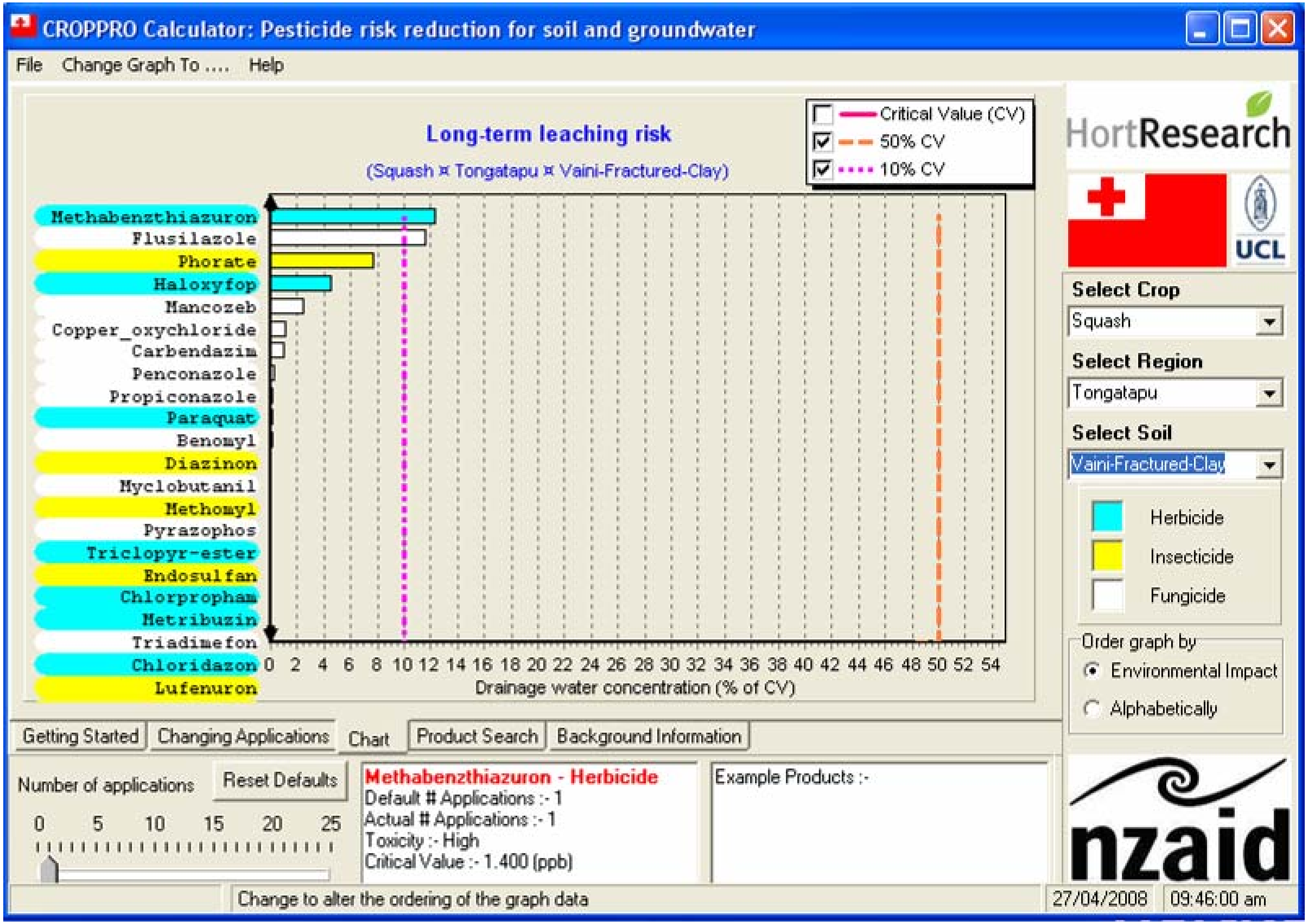
Modelling using SPASMO –our Soil Plant Atmosphere System Model: The Impacts of Pesticide Practices



SPASMO Prediction of Pesticide Fate: Where & How Much?

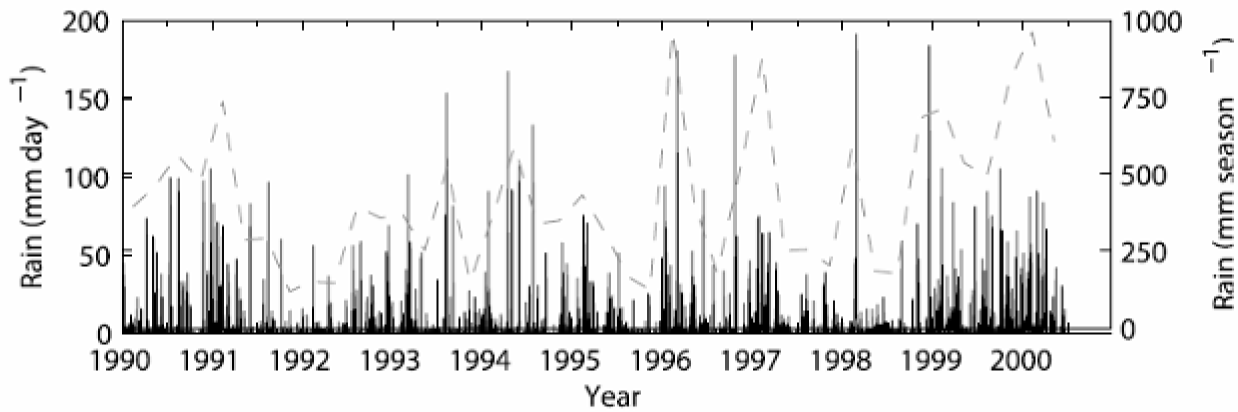


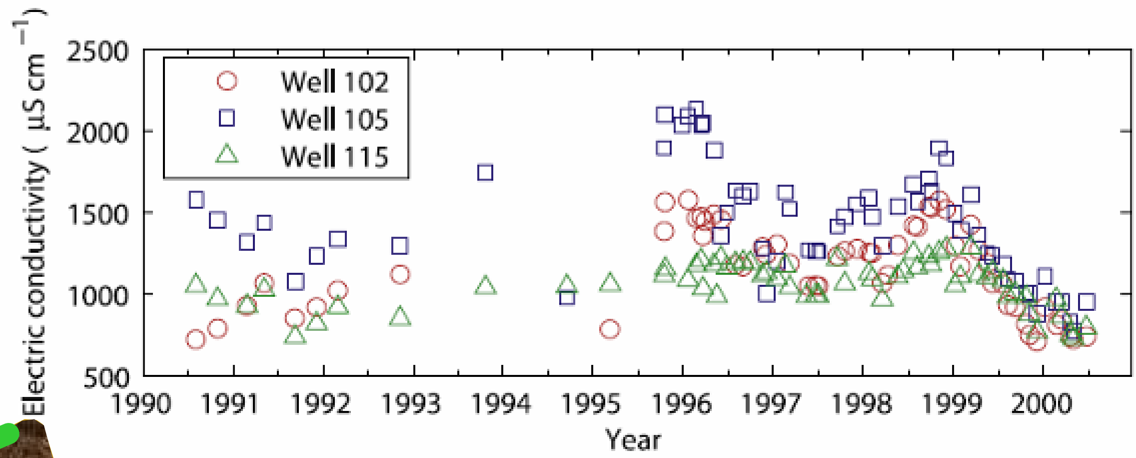
Decision Support Tools for Better Choices & Sustainable Practices

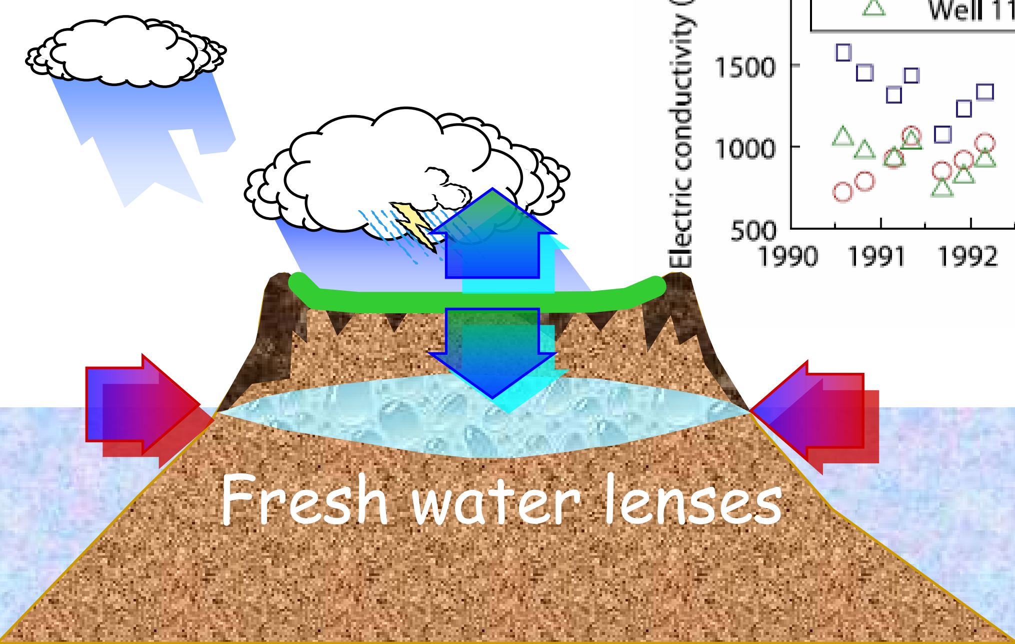


Nature Sucks!   El Niño & La Niña ...

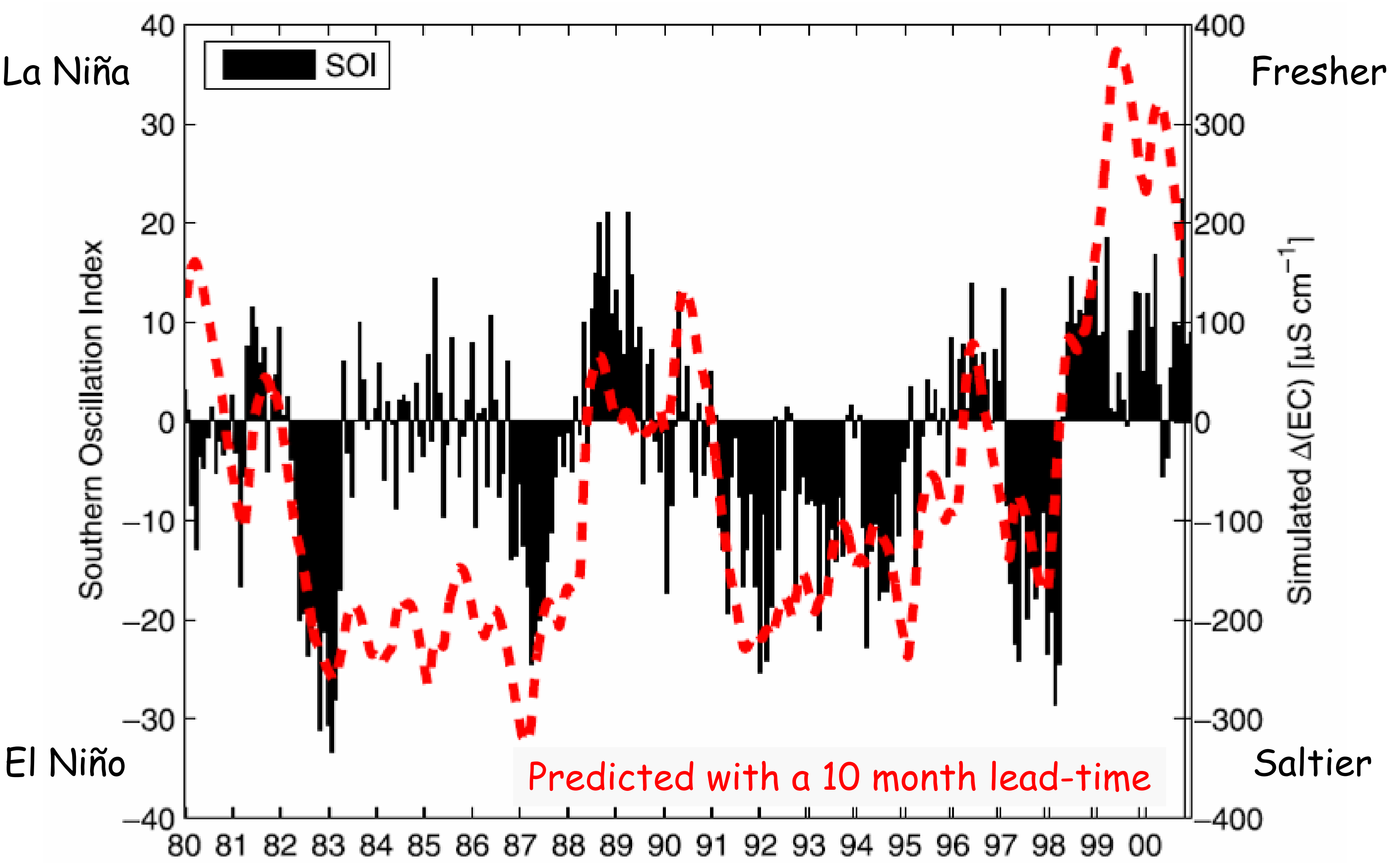
Translating climate patterns to the water-resource status of an atoll







Predicting the Future Using the Southern Oscillation Index





Soil & Water - sustaining wealth-generating capacities & protecting the life-supporting ecosystems in the Pacific

Science - Creating **Decision Support Tools** for policies of sustainable development & protection of natural capital & maintenance of ecosystem services