PROMISE (Predictability and variability of monsoons, and the agricultural and hydrological impacts of climate change)

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PROMISE

Predictability and variability of monsoons and the agricultural and hydrological impacts of climate change

A 3 year research project funded under Framework 5 of the European Union (grant number EVK2-CT-1999-00022)

For more information see **http://ugamp.nerc.ac.uk/promise**

PROMISE Partners

1 UREADMY (Department of Meteorology, University of Reading)
2 CIRAD (Centre de cooperation Internationale en recherche Agronomique pour le Developpment)
3 CNRM (Meteo France)
4 DMI (Danish Meteorological Institute)
5 ICTP (International Centre for Theoretical Physics)
6 CEH (Centre for Ecology and Hydrology)
7 LMD (Laboratoire de Meteorologie Dynamique
8 MPI (Max Planck Institute)
9 Met Office (Hadley Centre for Climate Prediction and Research)
10 UREADAG (Department of Agriculture, University of Reading)
11 ECMWF (European Centre for Medium Range Weather Forecasting)
12 CRC (Centre de Recerches de Climatologie)
13 CINECA

Goals of PROMISE

PROMISE aims to improve understanding of:

- The potential for seasonal prediction and the benefits that would accrue in terms of the management of water resources and agriculture

- The impacts of climate change on tropical countries, in particular on the availability of water resources for human use and on the productivity of crops and the potential changes in natural vegetation

PROMISE Research and Support

Natural variability and predictability of current monsoon climates

Assessment of anthropogenic climate changes for monsoon climates

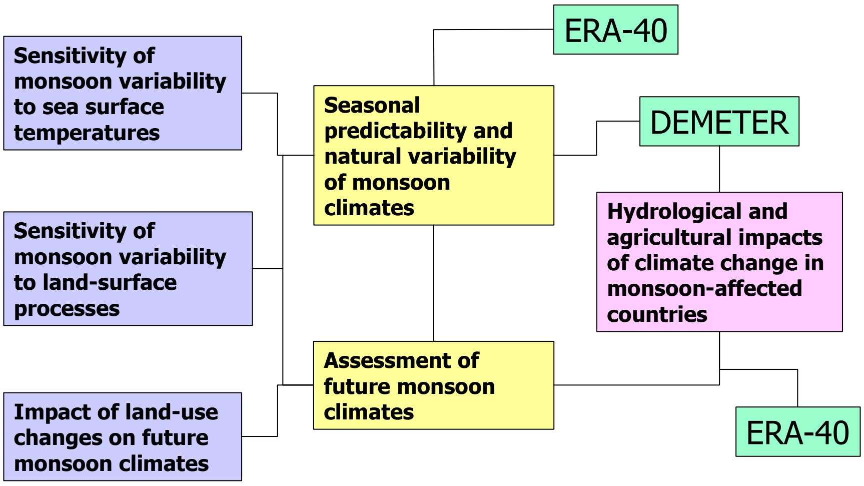
Impact of climate change on ground hydrology and agriculture

+

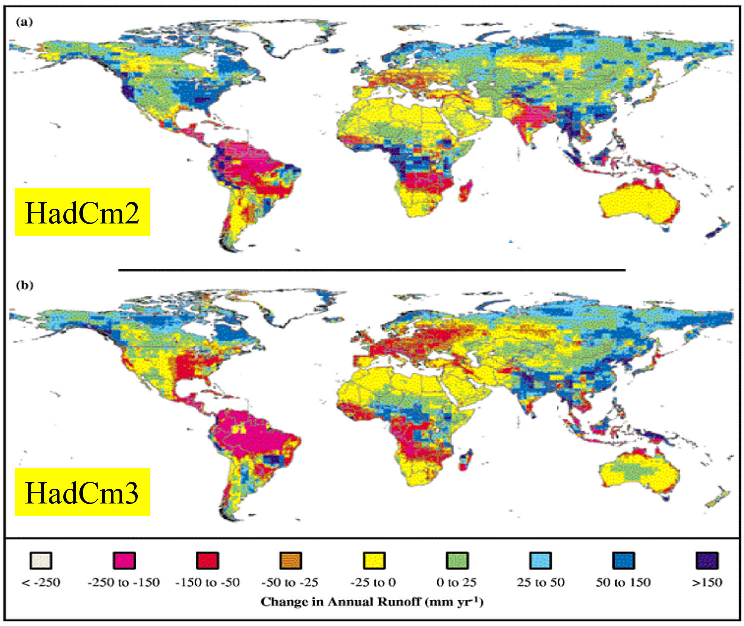
Development of a database of observed and simulated data on meteorology, hydrology and agriculture

Establishment of active links with climate scientists in monsoon affected countries

Main areas of PROMISE research

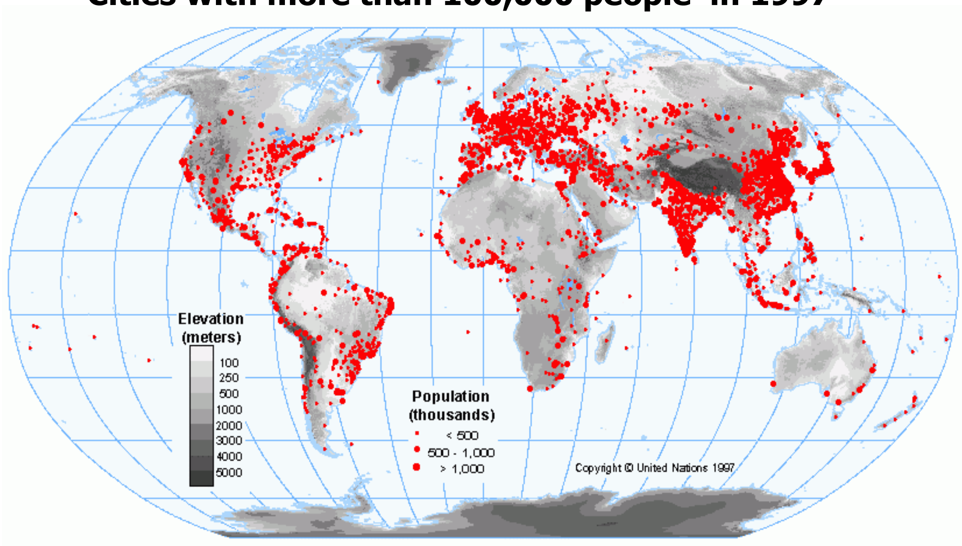


Predicted runoff change by 2050



Predicted change in runoff in 2050 compared to 1990-1996 with CO2 forcing (IPCC 2001).

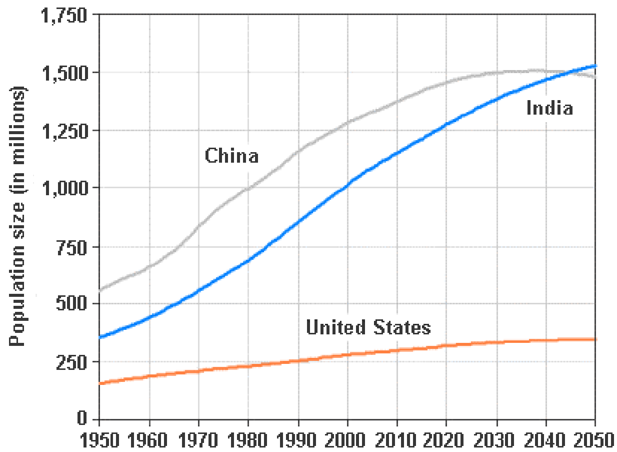
Cities with more than 100,000 people in 1997



Source: United Nations Statistics Division

→ More than 50% of the world population lives in Asia

World population prospects …



Source: United Nations Population Division 1998

→ India predicted to be the most populated country by 2050

GWAVA

Global **W**ater **AV**ailability **A**ssessment

Jeremy Meigh
Centre for Ecology & Hydrology
(Institute of Hydrology)
Wallingford, UK
in conjunction with
British Geological Survey

GWAVA Detailed Objectives

- Consistent methodology at the global scale
- Representation of spatial variability in water availability and demands
- Representation of seasonal and year-to-year variability in water resources
- Accounting for the real properties of water resources systems
- Tackling problems of international basins
- Combined treatment of surface and groundwater
- Ability to take into account scenarios of population growth, urbanisation, economic development and climate change

General approach - 1

- 0.5 by 0.5 degree grid for both water availability and demands
- Rainfall-runoff model for surface water
- Long series of climate inputs to estimate actual availability
- Linking grid cells to simulate river network
- Models to account for effects of:
    - lakes, reservoirs and wetlands
    - abstractions and return flows
    - inter-basin transfers

General approach - 2

- Groundwater availability based on aquifer properties and recharge estimates
- Water demands based on current and projected population and livestock numbers, information on irrigation and industrial use
- Indices of water availability versus demand derived at the grid cell scale

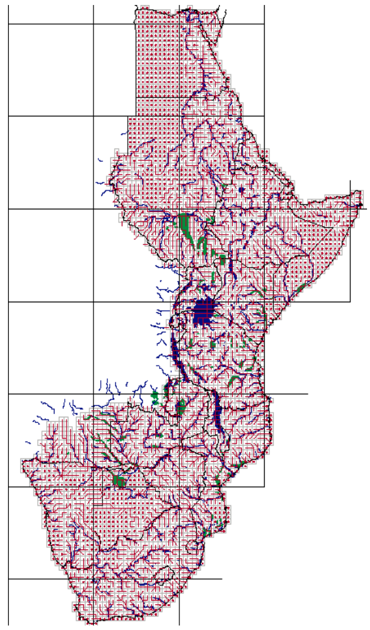
Inputs and data sources

- Physical and water resources data
  - Elevation, River network
  - Vegetation, Soil type
  - Lakes, Reservoirs and Wetlands
  - Aquifer properties
- Climate
  - Rainfall - 30 year time series, Evaporation
- Demand related information
  - Population, Livestock numbers, Industrial and Irrigation demands

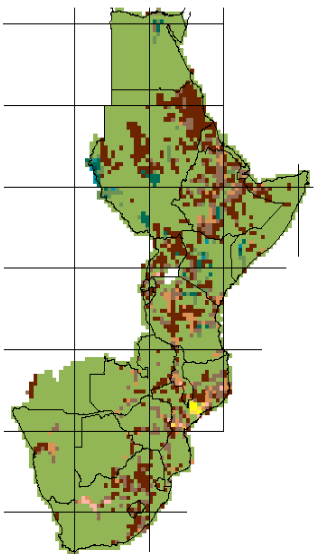
GWAVA and PROMISE

- GWAVA model has been developed for South and East Africa where it has been calibrated and used to produce scenarios of future water availability.
- GWAVA model is being extended to West Africa, using the land use scenarios currently under development for climate change studies within PROMISE.

River network and cell linkages

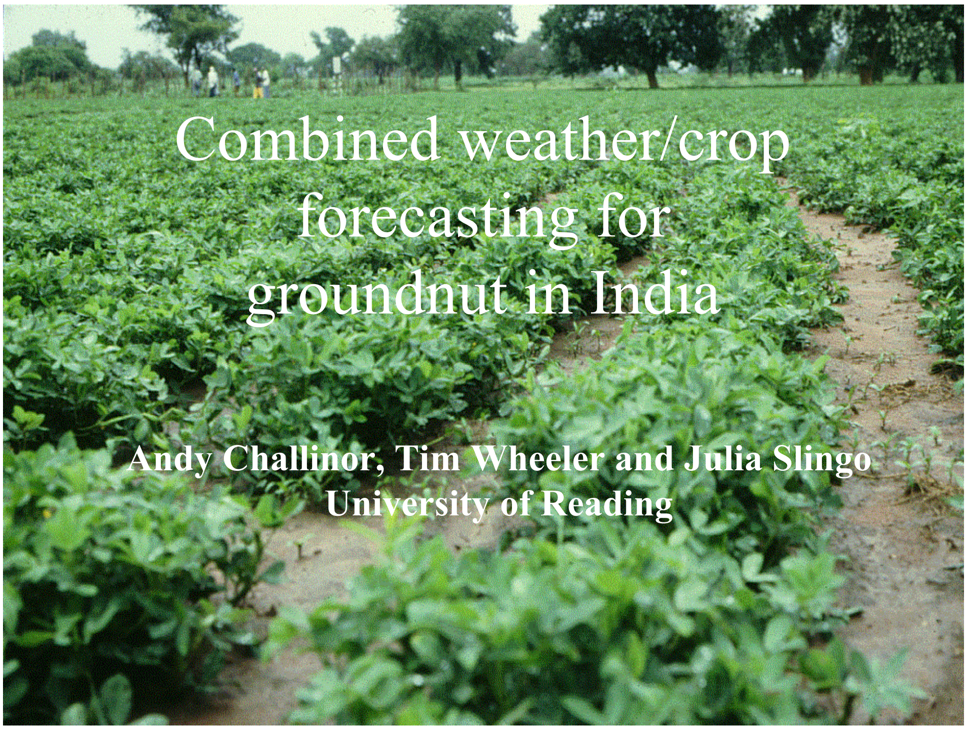


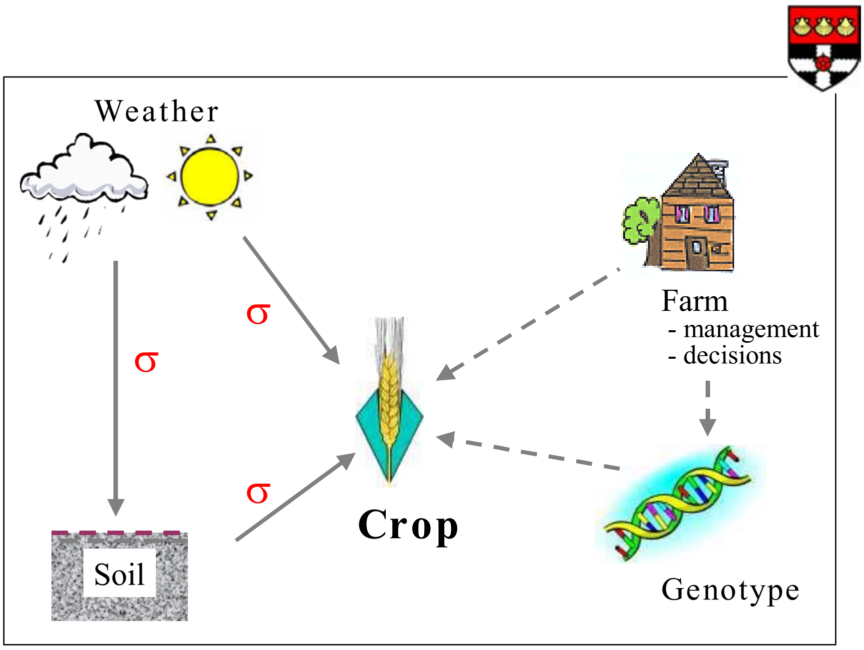
Change in water availability index

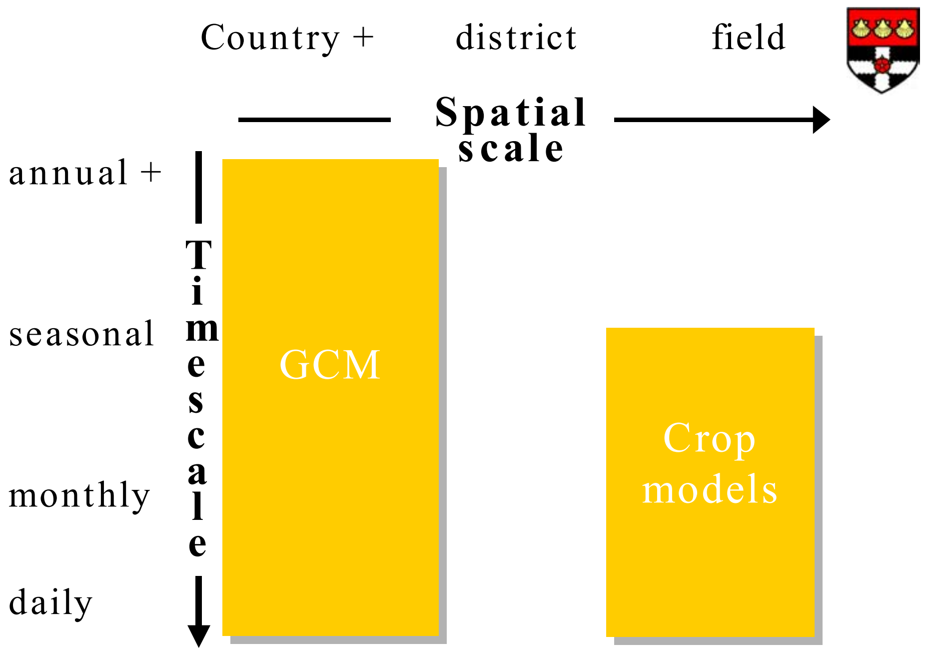


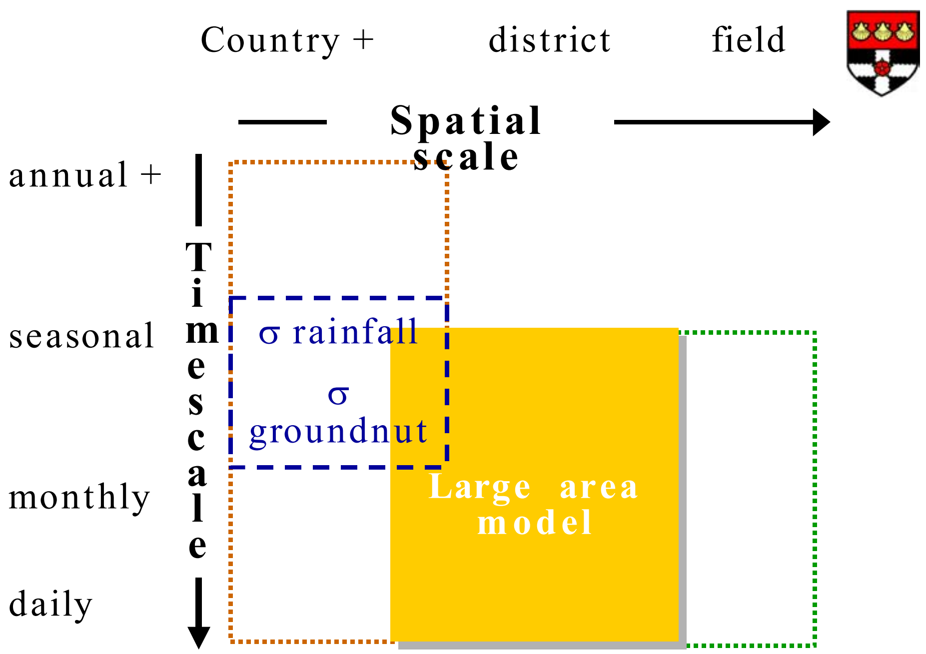
2050, taking in to account:

- **Supply** changes due to climate change
- **Demand** changes due to:
  - increasing population
  - population distribution
  - increasing per capita demands (improved living standards and industrialisation)

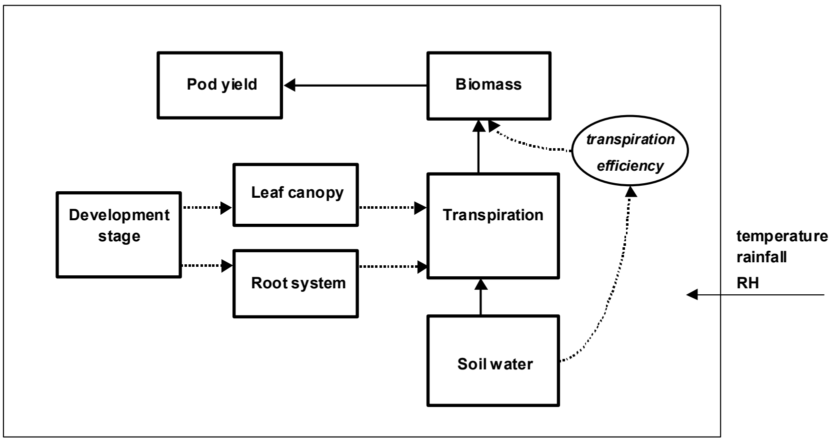

Combined weather/crop
forecasting for
groundnut in India
Andy Challinor, Tim Wheeler and Julia Slingo
University of Reading


Weather
σ
σ
σ
Crop
Soil
Farm
- management
- decisions
Genotype


Country +
district
field
Spatial scale
annual +
seasonal
monthly
daily
Timescale
GCM
Crop models

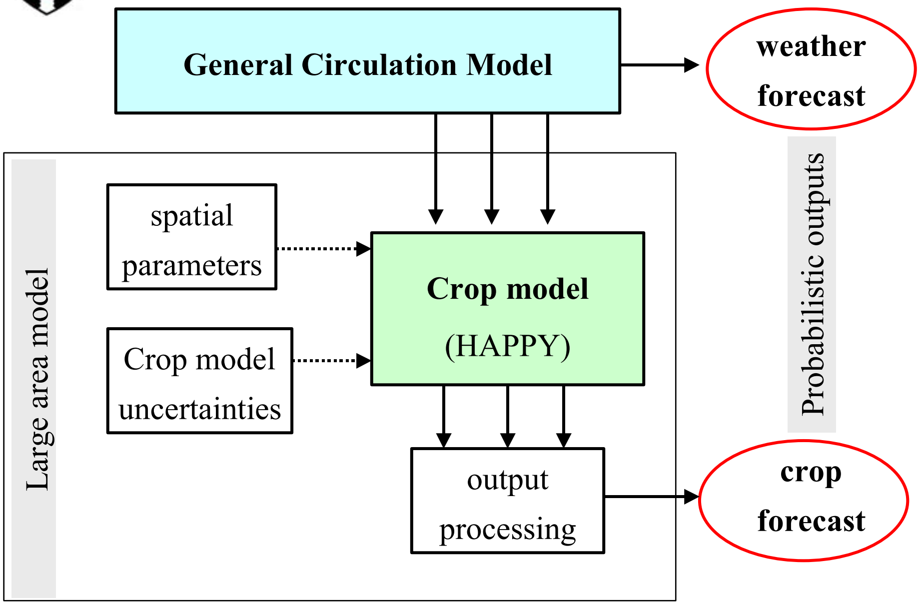

Country +
district
field
Spatial scale
annual +
seasonal
monthly
daily
Timescale
σ rainfall
σ groundnut
Large area model

Huge Area Potential Peanut Yield (HAPPY!!) model



Calibrating and testing HAPPY

- Calibrate using field/district data.
- Test in hindcast mode using ERA-40 data to drive HAPPY.
- Compare predicted crop yields with observed crop yields.
- Re-calibrate HAPPY?


General Circulation Model
weather forecast
Probabilistic outputs
Large area model
spatial parameters
Crop model uncertainties
Crop model (HAPPY)
output processing
crop forecast

DHC_CP

Diagnostic Hydrique des Cultures

Champs Pluviométriques

Crop Water Balance Calculation Using Satellite based Rainfall Estimates

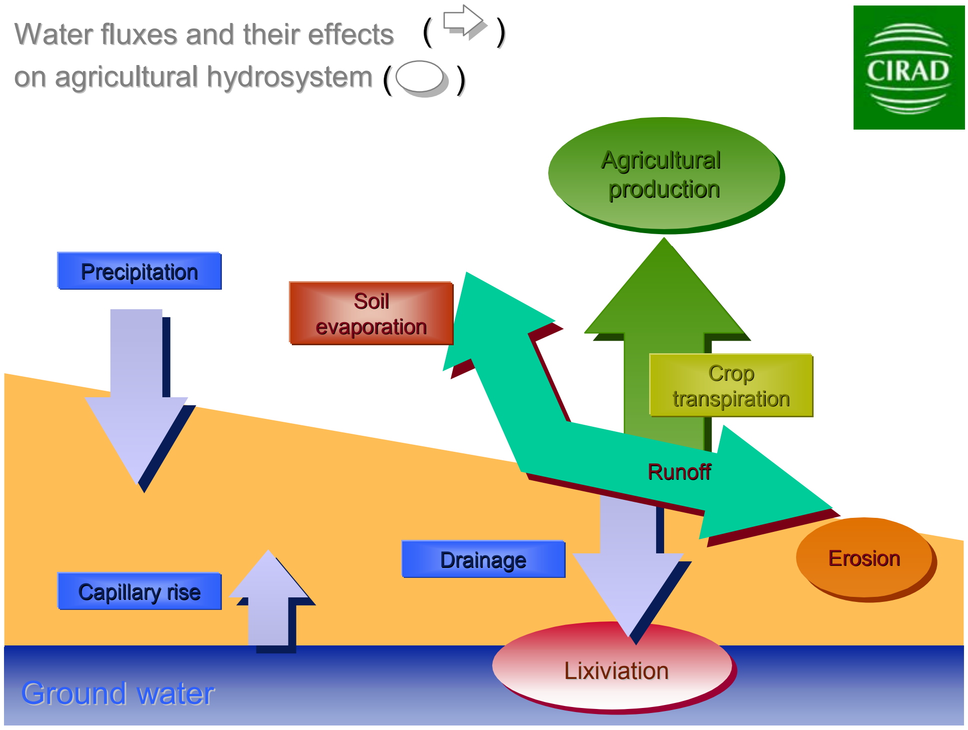
***Presented** by :*
Abdallah SAMBA, Agrometeorologist
AGRHYMET Regional Centre at Niamey, NIGER
Trieste, June 2001

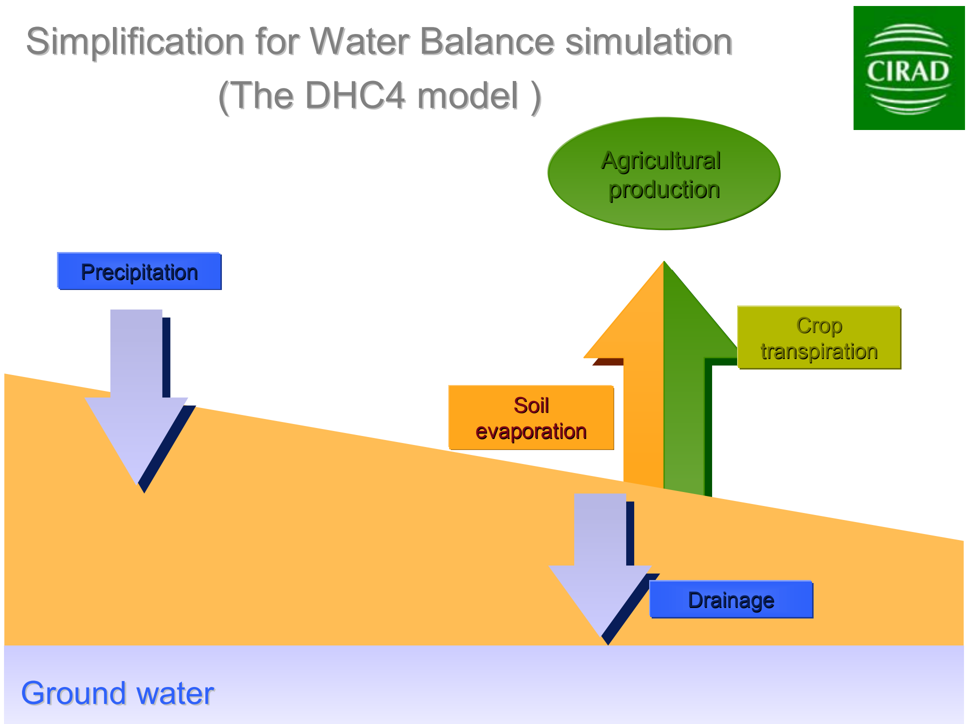
AGRHYMET

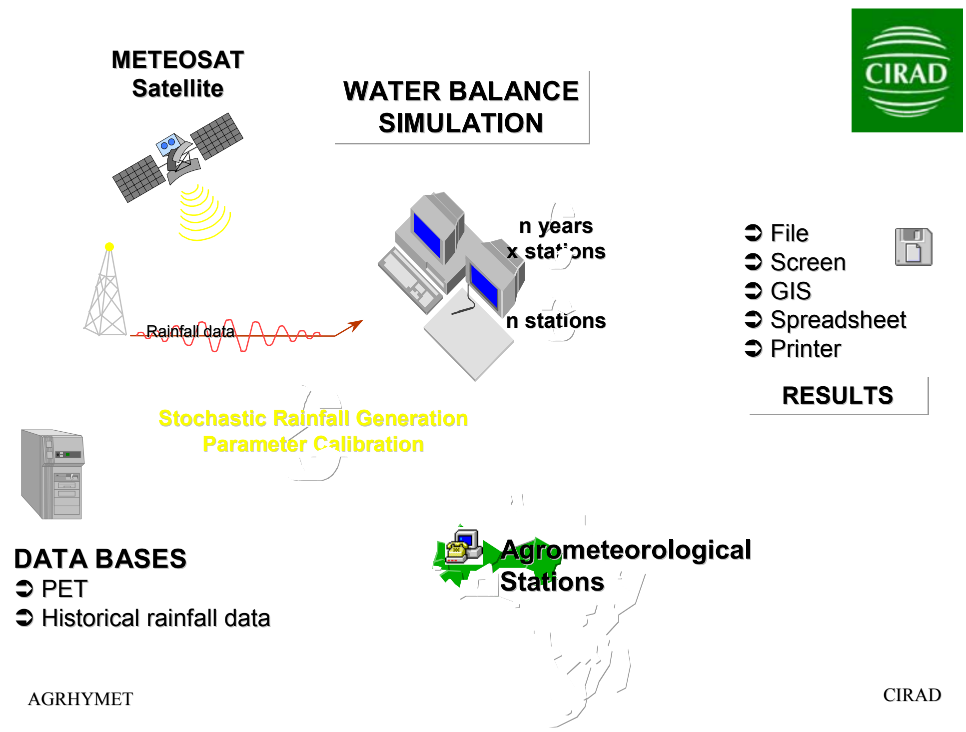
CIRAD

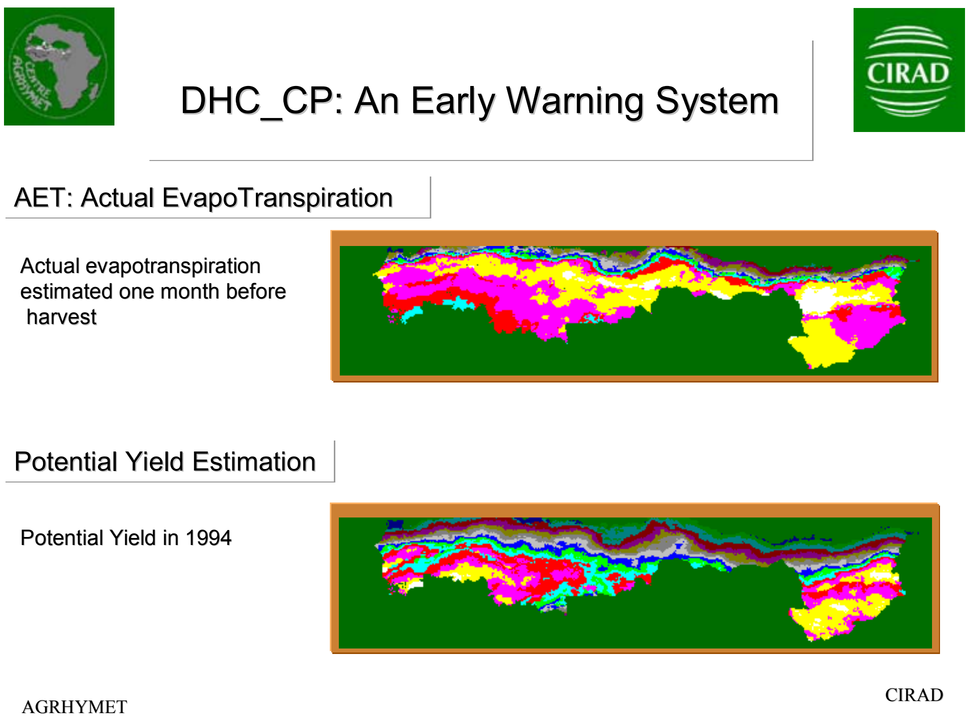
Introduction

- Need to forecast the yields of food crops in order to :
  - best manage the cereal stocks
  - control the distribution of food
  - start food aid in time
- Sophistication of the techniques based on the statistical investigations
- Using water balance simulation to obtain parameters which enable estimation of yields.


Water fluxes and their effects ( )
on agricultural hydrosystem ( )
CIRAD
Agricultural production
Precipitation
Soil evaporation
Crop transpiration
Runoff
Drainage
Erosion
Capillary rise
Lixiviation
Ground water


Simplification for Water Balance simulation
(The DHC4 model)
CIRAD
Agricultural production
Precipitation
Crop transpiration
Soil evaporation
Drainage
Ground water


METEOSAT
Satellite
WATER BALANCE
SIMULATION
n years
x stations
n stations
Rainfall data
File
Screen
GIS
Spreadsheet
Printer
RESULTS
Stochastic Rainfall Generation
Parameter Calibration
DATA BASES
PET
Historical rainfall data
Agrometeorological
Stations
AGRHYMET
CIRAD


DHC_CP: An Early Warning System
AET: Actual EvapoTranspiration
Actual evapotranspiration
estimated one month before
harvest
Potential Yield Estimation
Potential Yield in 1994
AGRHYMET
CIRAD