Short introduction to WP1:
“Climate variability and seasonal prediction”

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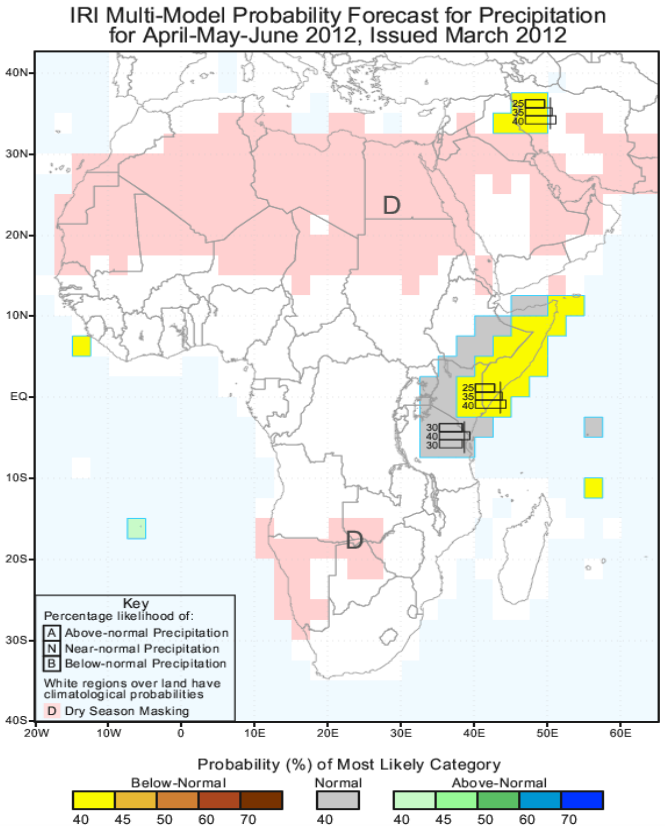
Overview of envisaged working tasks

WT1.1: Quantification and predictability of climatic parameters affecting rice growth at sensitive development stages

WT1.2: Long term regional climate simulations to study the impact of LUC/LCC on climate

WT1.3: Quantification of climate induced uncertainties for future rice production in EA

Seasonal climate predictions: State-of-the-art



Problems for end-users:

- Sensitivity of crops to climatic variability is modulated at intraseasonal time scale and farmers mostly depend on local-scale climatic variability

- Tercile information not sufficient and no answers to intraseasonal issues

- Limited predictive skill:
almost no skill for JFM/AMJ, and moderate skill for OND
seasonal resolution may mask predictability if intraseasonal rainfall not matched the modulation of predictability

WT 1.1: *Specific Objectives*

- To analyze the intraseasonal modulation of predictable signals of rainfall jointly with the spatial coherency of the predictable signal (prerequisite for seasonal prediction)

- To quantify the predictability of extreme events which severely affect rice growth

- To analyze the predictability crucial intraseasonal features for different rice varieties at different spatiotemporal scales
  - Start of wet season to determine suitable planting windows for rice
  - Intraseasonal probabilities of dry spells
  - etc.

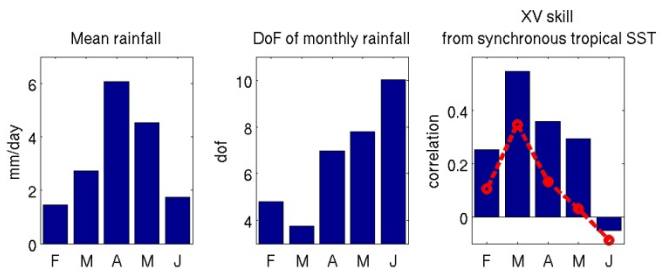
Methods

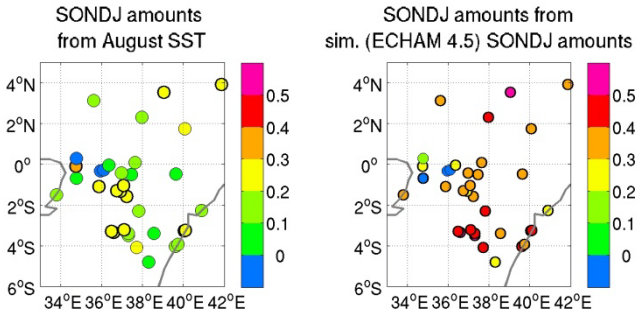
- 2-tiered forecast system (at IRI):
  - Forecasts of global tropical SSTs
  - Application for the suite of atmospheric models that respond to SST forcing

  → surface temperature and precipitation anomaly patterns

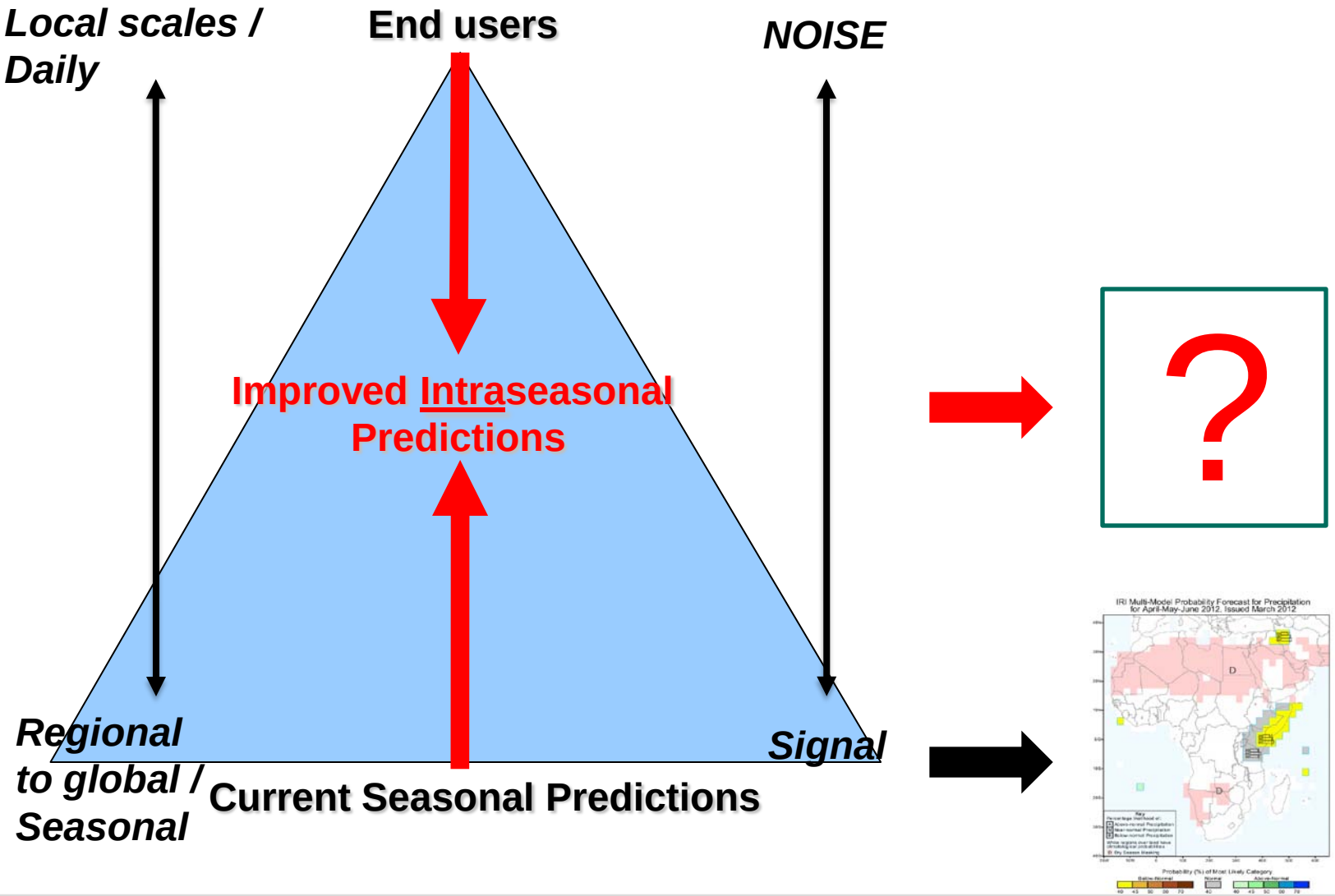
- Predictor screening (other than SST) for model improvement

- Statistical analysis to assess the level of predictability of predictand (jointly with coherency of the predictand)





Milestone: A prediction system …



Milestone: … accounting for vulnerability of rice (varieties) during development

Critical temperatures for the development of rice plant at different growth stages

Growth stages	Critical temperature (°C)		
	Low	High	Optimum
Germination	16–19	45	18–40
Rooting	16	35	25–28
Leaf elongation	7–12	45	31
Tillering	9–16	33	25–31
Initiation of panicle primordia	15	-	-
Panicle differentiation	15–20	30	-
Anthesis	22	35–36	30–33
Ripening	12–18	> 30	20–29

Overall objectives:

Optimize planting dates of rice (varieties) to avoid crop failure & stabilize food security!

Vulnerability:
1-2 hours of high T at anthesis result in large fraction of grain sterility!

Yoshida, 1978

Assessing vulnerability also for water availability, radiation, …

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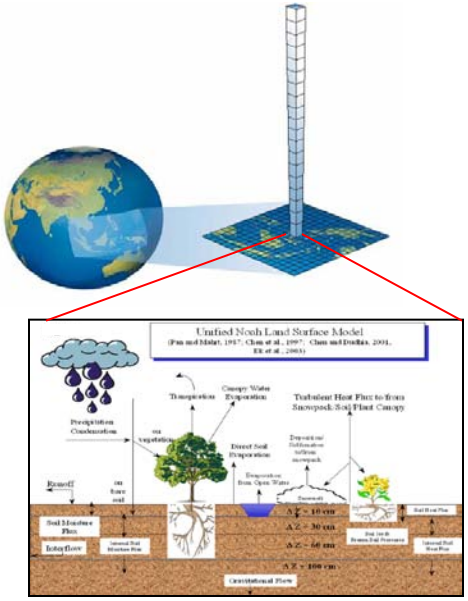
Regional climate predictions: State-of-the-art

Rationale: High spatiotemporal resolution climate information required for agricultural impact studies (e.g. future rice productivity, future suitability areas for rice growing)



Problems for CC impact modelers:

• Description of the land surface not sufficient usually time-invariant, i.e. static LU maps

• Poor representation of lateral (subsurface and overland) fluxes: the process formulations of land surface schemes describe the vertical exchange of energy and water fluxes but no lateral transport is possible

Purely scientifically issue: RCMs do not explicitly account for the effects of the mixing ratios of greenhouse gases (GHGs) other than CO_2

WT 1.2: *Specific Objectives*

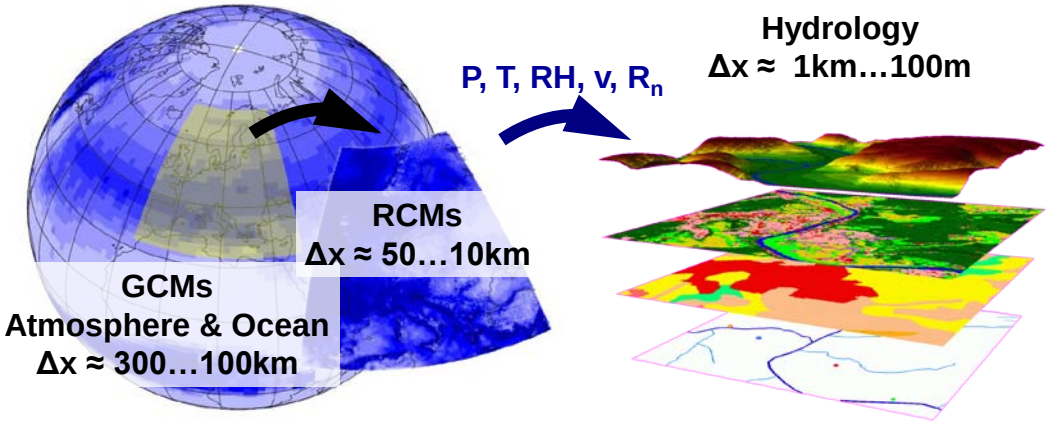
- To identify the spatial “target” resolution, i.e. to which resolution is DSS giving additional information for impact studies?

- To analyze the impact of GHG induced changes, separately for different greenhouse gases, and the impacts induced by LUC/LCC on climate

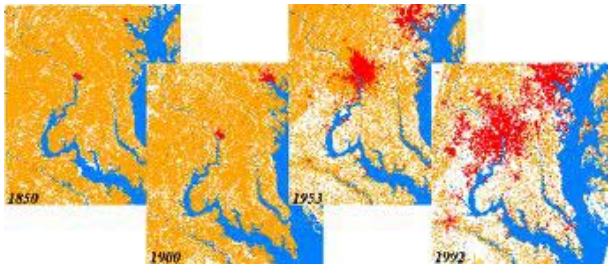
- To analyze the impacts of small scale lateral water fluxes at surface and subsurface on atmosphere, and thus, to analyze the feedback of LUC/LCC on precipitation patterns

Methods

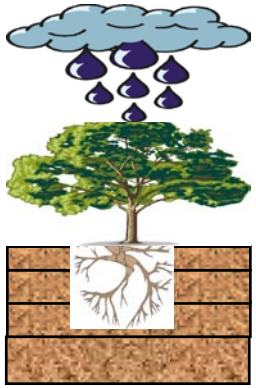
1.) Regional Climate Modeling (WRF) to provide input e.g. for hydrological and agricultural impact studies



3.) Implementation dynamic LUC/LCC

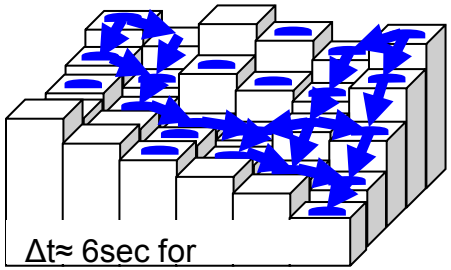


2.) Model improvement (lateral water and energy fluxes)

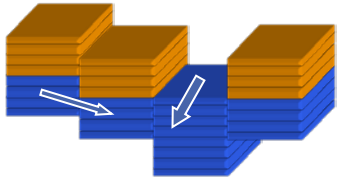


Soil-Vegetation Atmos-phereTransfer Model

Explicit diffusive wave overland flow



Explicit saturated subsurface flow



- Supervised/unsupervised classification of RS imagery
- LUC/LCC scenarios

Milestone:

RCM simulations for EA with improved model compartments

30-year time slice from 1971-2000 (baseline) & two future periods (2021-2050, 2071-2100)

→ using identified target resolution

→ accounting for LUC/LCC & GHG induced changes

→ accounting for lateral water and energy fluxes

Overall objectives:

Improved high resolution climate data for EA to provide more accurate data for RICE-EA impact modelers (hydrological and crop yield modelers)

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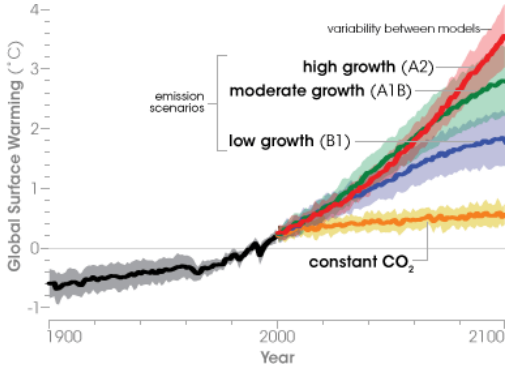
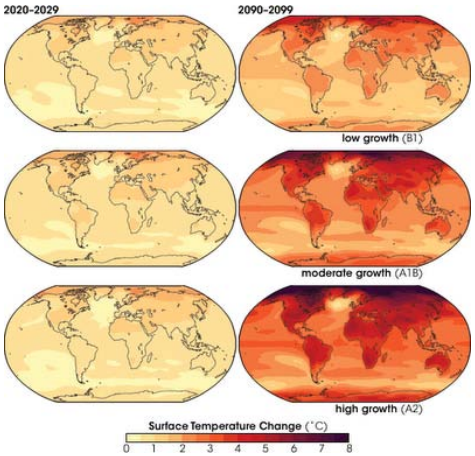
CC/CV uncertainty estimation: State-of-the-art

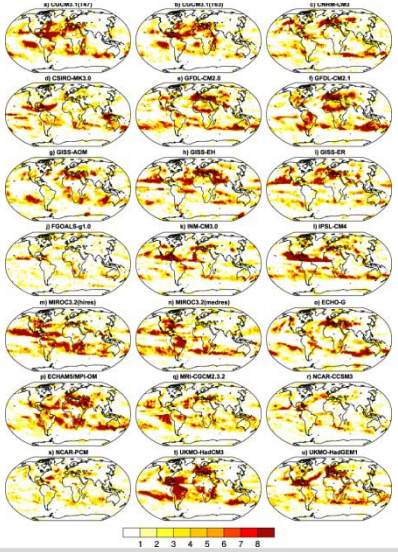
Problems for end-users:

- DDS very expensive (computing resources)
  → Usually: 1 GHG scenario, 1 GCMs, 1 RCM

- Uncertainties increase with increasing modeling chain (GHG scenario, GCM, RCM, etc.)







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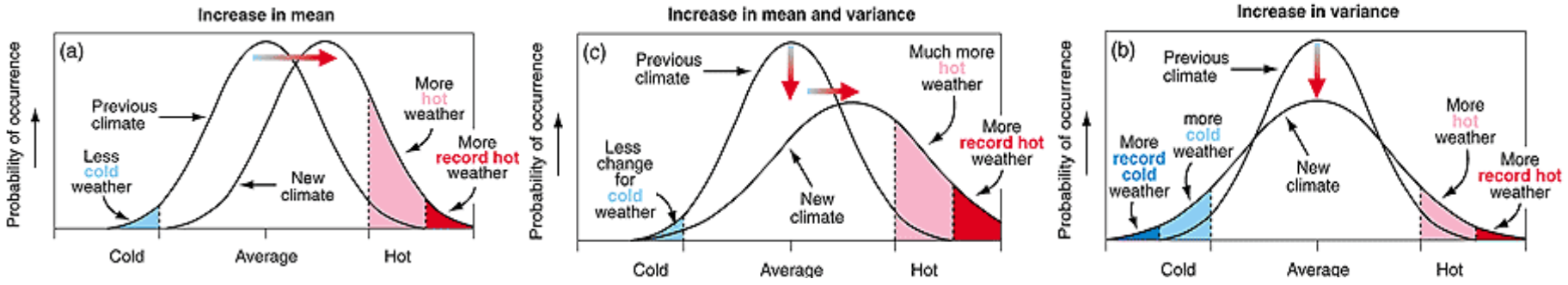
WT 1.3: *Specific Objectives*

- Statistically downscale meteorological variables (P, T, R) using a *multi-model & multi scenario* approach
- To quantify uncertainties in deriving hydrometeorological variables important for rice production in EA arising from different GCMs, emission scenarios, and ESDS approaches
- To judge the probability of the RCM projection derived in WT1.2

Methods

- Different ESDS methods:
  - *Expanded Downscaling* (XDS, e.g. Bürger 1996, 2002)
  - *Multi-Objective Fuzzy Rule-Based Classification* (MOFRBC, Bárdossy, 1995)
- Statistical analysis of the ESDS results to derive PDFs of crucial variables for rice growth in EA for the past and future time slices
- EV Theory to assess probability (change) of rare events



Milestone:

Derive & provide RICE-EA partners with PDFs of crucial variables for rice growing in EA to be used for CC impact analysis

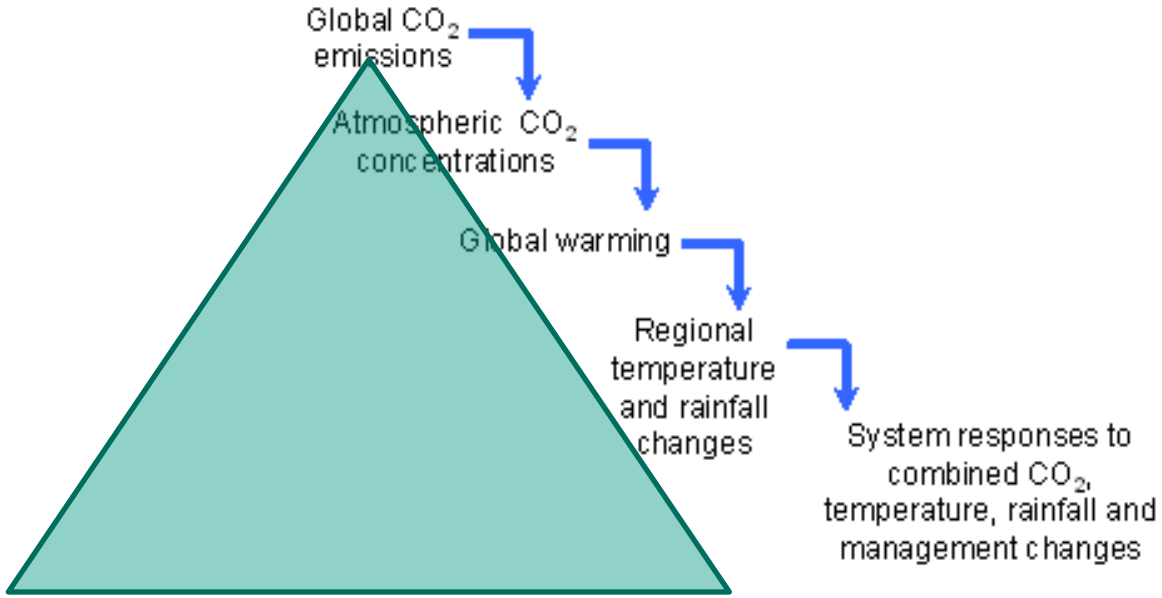
Overall objectives:

Quantification of uncertainties for future rice production in EA related to the climate drivers

To be discussed

- Centralized Database for RICE-EA consortium
- Missing partner for supervised/unsupervised classification of RS imagery to derive LUC/LCC scenarios
- Suggestions for RCM simulations (GCM, GHG scenario, which time slices, etc.?)


THANK YOU
FOR YOUR ATTENTION


Global CO_2 emissions
Atmospheric CO_2 concentrations
Global warming
Regional temperature and rainfall changes
System responses to combined CO_2, temperature, rainfall and management changes