

Reforestation impacts on local climate and ecosystemic services, simulated with a land-surface model

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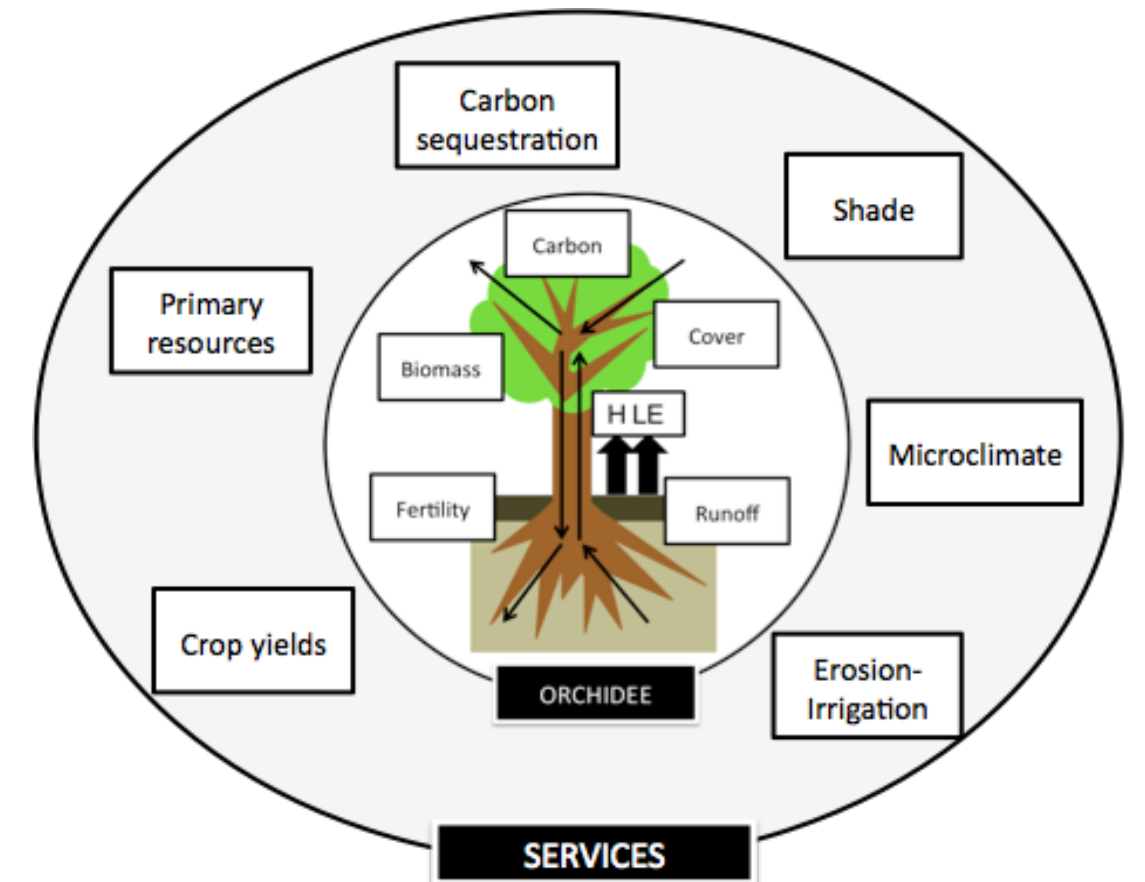


Climate modeling research in partnership with social enterprise KINOME, focusing on reforestation development projects in tropical semi-arid areas

Kinome manages reforestation projects, mainly through assisted natural regeneration, with the goal of improving the quality of life. The projects are at village-scale, built as a solution to ecologic and socioeconomic issues.

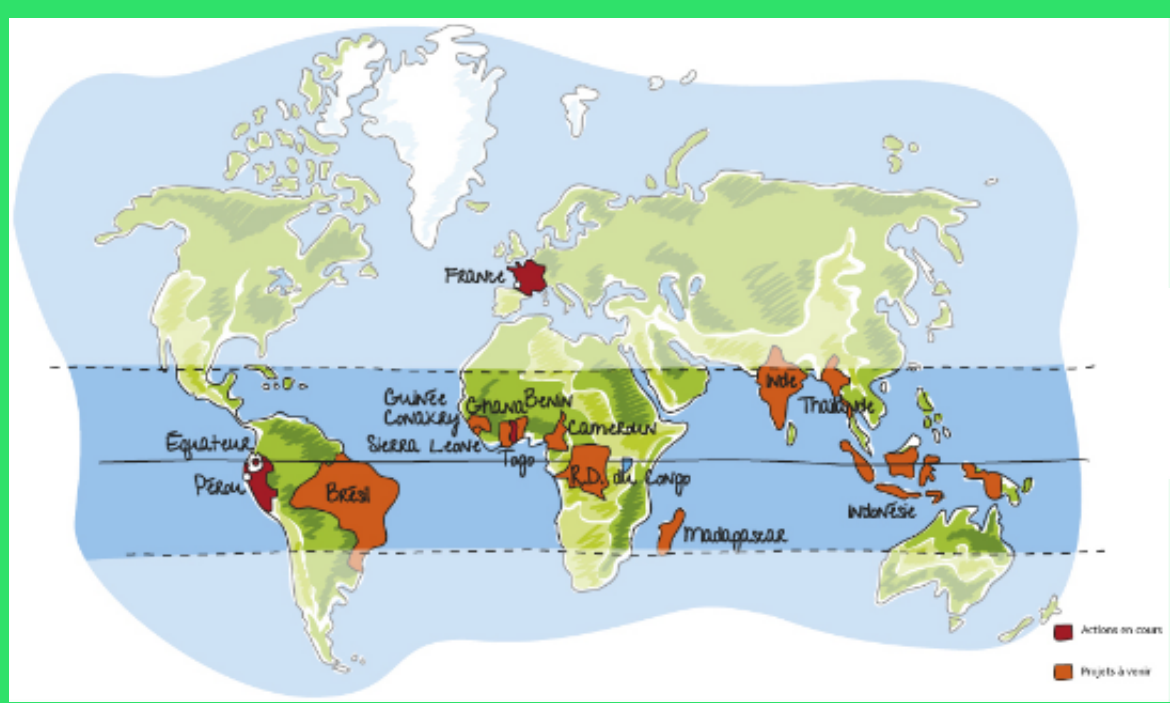
Key points

- Projects are implemented either as a network of local initiatives or as a large-scale top-down strategy
 - Rural development projects are meant to improve people's living conditions
 - In deforested areas, reforestation can provide local economical resources
 - Climate impacts of reforestation in tropical semi-arid areas remain uncertain
 - Land-surface models simulate effects of vegetation and land-use changes on surface variables
- > Using the land-surface model, what answer to the question of potential impacts of reforestation projects can scientists provide? At local scale? At regional scale?
- > Are local scenarios a good unit for evaluating reforestation impacts on climates?
- > How to build impact indicators out of model surface variables?

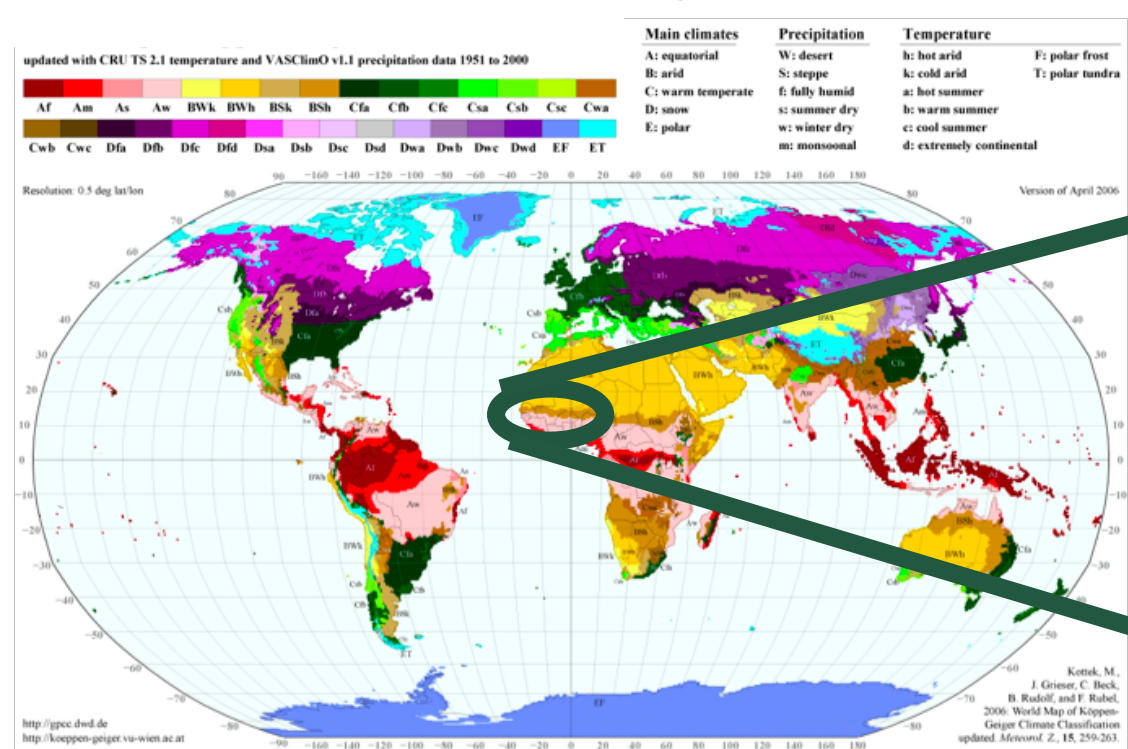


1- Reforestation potential of tropical semi-arid areas

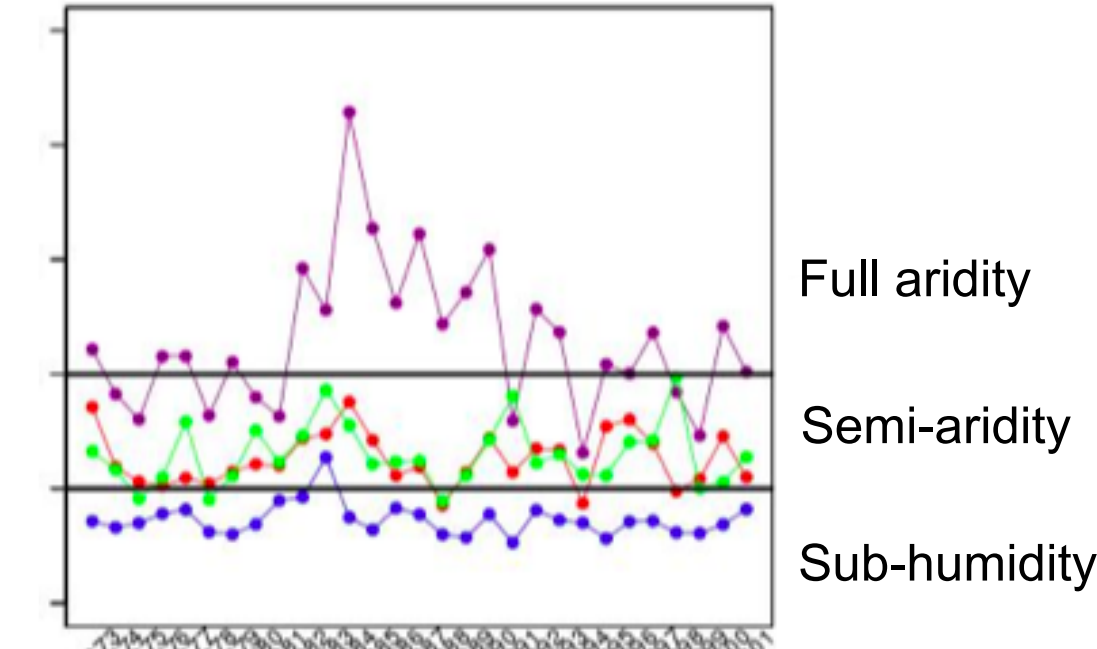
Map of Kinome reforestation projects



World Map of Koppen-Geiger Classification



For 4 sites in the sahelian zone, fluctuation of Koppen aridity from 1979 to 2003, with running 15-year-averages



Warm, tropical semi-arid areas (BSh in Koppen-Geiger climate classification) are frontier regions between humid savannas or rainforests, and deserts. The Koppen-Geiger classification is built on climatological means of temperature and precipitation data. However, interannual variability (seasonal) is not (limitedly) accounted for. Moreover, other factors trigger field observed "aridity".

At site scale, the application of Koppen classification shows interannual variability, mainly due to the precipitation variability. >> Such variability is relevant for designing reforestation strategies in water-limited conditions.

Presence of trees

- Precipitations are the limiting growth factor in semi-arid areas
- Anthropic deforestation: deliberate deforestation for cropping purposes + unsustainable use of wood resources
- Other deforestation triggering factors: fires, droughts

Limit climate conditions may allow tree regrowing in deforested semi-arid areas.

Climate Change: Climate shifts are expected in semi-arid areas - Some current semi-arid areas are likely to become wetter - New regions may become more arid

Reforestation may be considered as an adaptation tool to climate change.

2- ORCHIDEE land-surface model: surface variables impacts of land-use changes

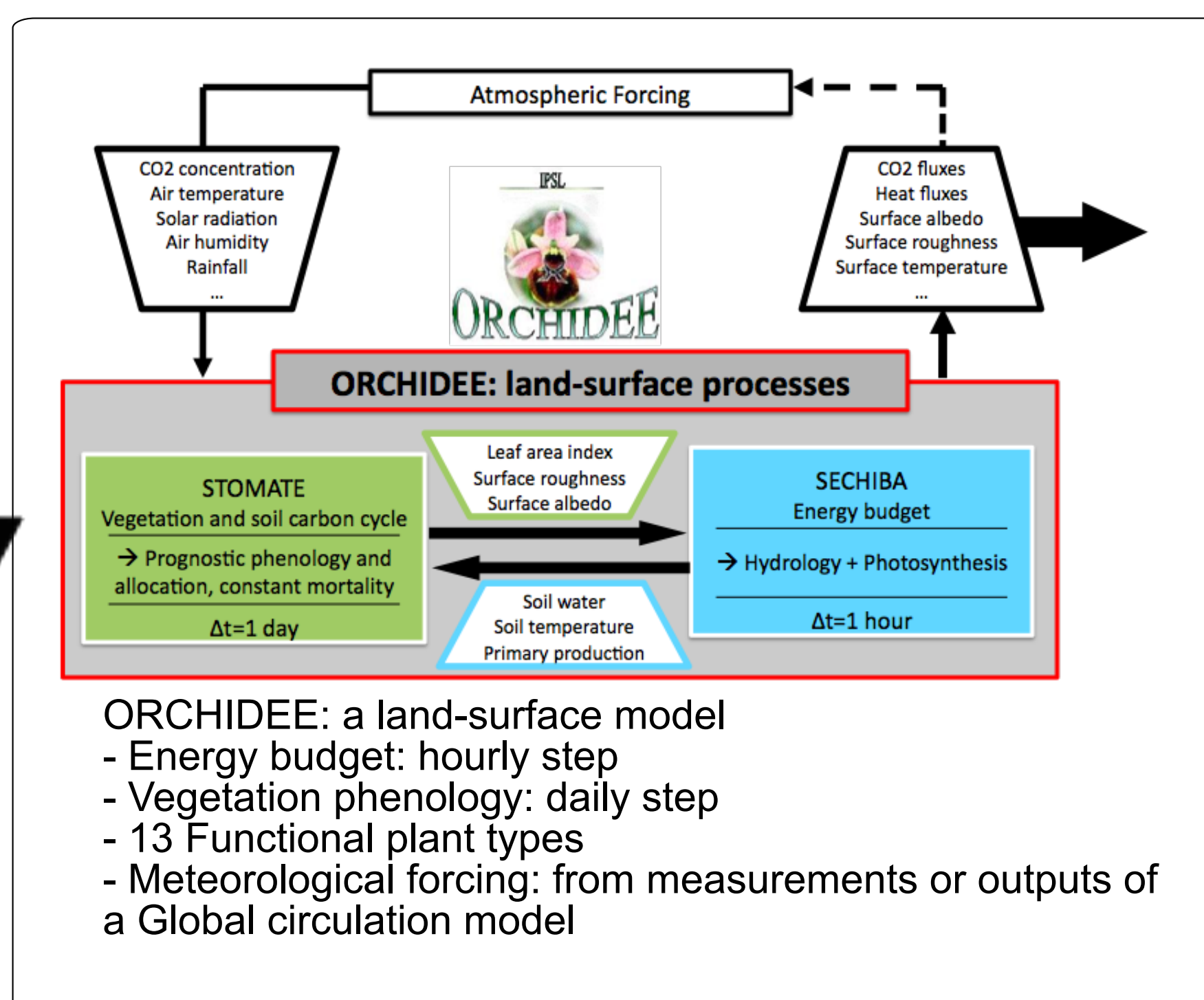
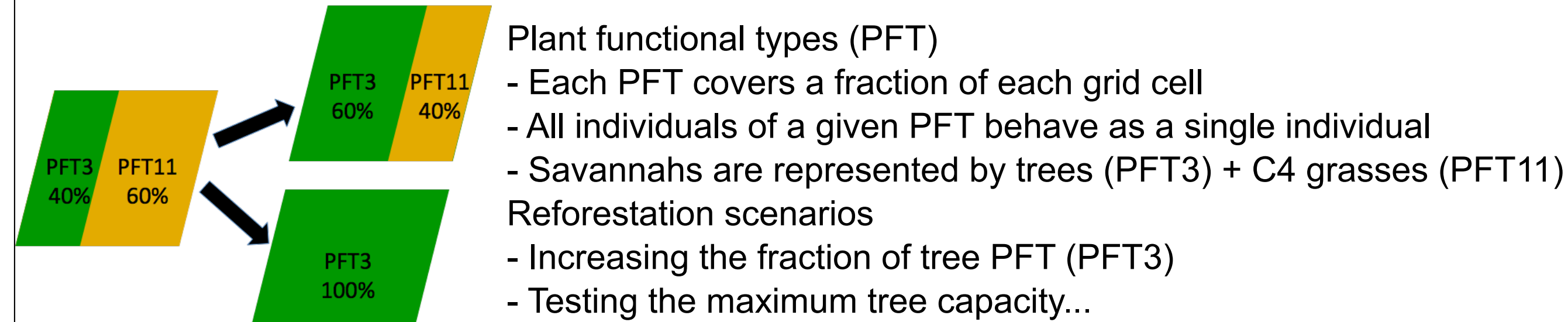
Field scale action

- Trees are protected one by one
- Projects are implemented at community scale



Field expertise

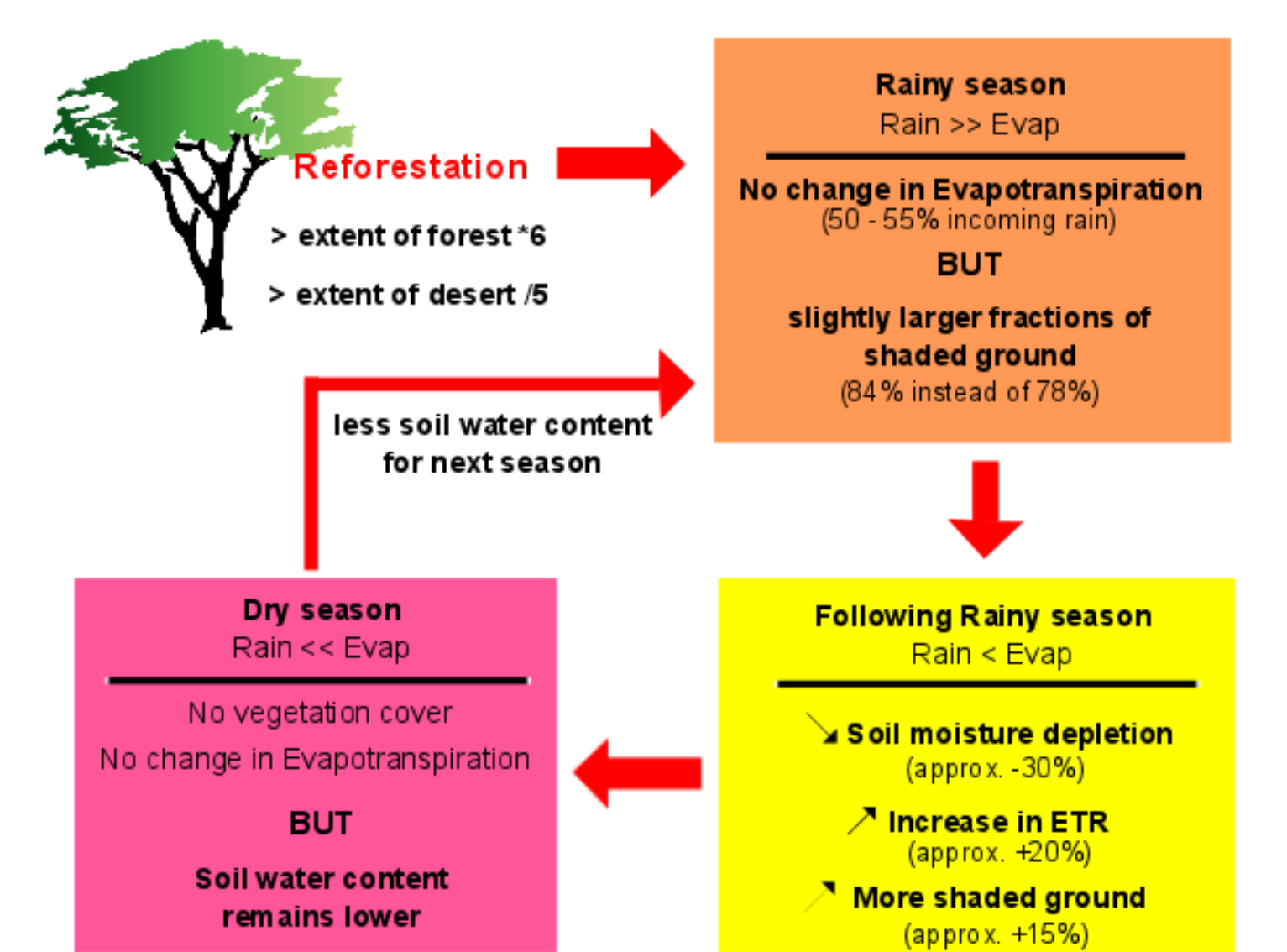
- Trees and grasses properties
- Vegetation repartition
- Anticipated changes in vegetation cover



ORCHIDEE: a land-surface model

- Energy budget: hourly step
- Vegetation phenology: daily step
- 13 Functional plant types
- Meteorological forcing: from measurements or outputs of a Global circulation model

First results in Senegal (V. Haeflinger, 2012)



-- Regional scale (GGW Senegal)

-- Virtual reforestation experiment

Mixed results of reforestation over bare soil + The reforested area benefits from more shaded ground during the growing (rainy) season -- The soil water content decreases due to trees' consumption

Following steps

- > Evaluate the value of the model for tropical semi-arid areas
- > Make necessary (feasible) adjustments
- > Test a range of reforestation scenarios

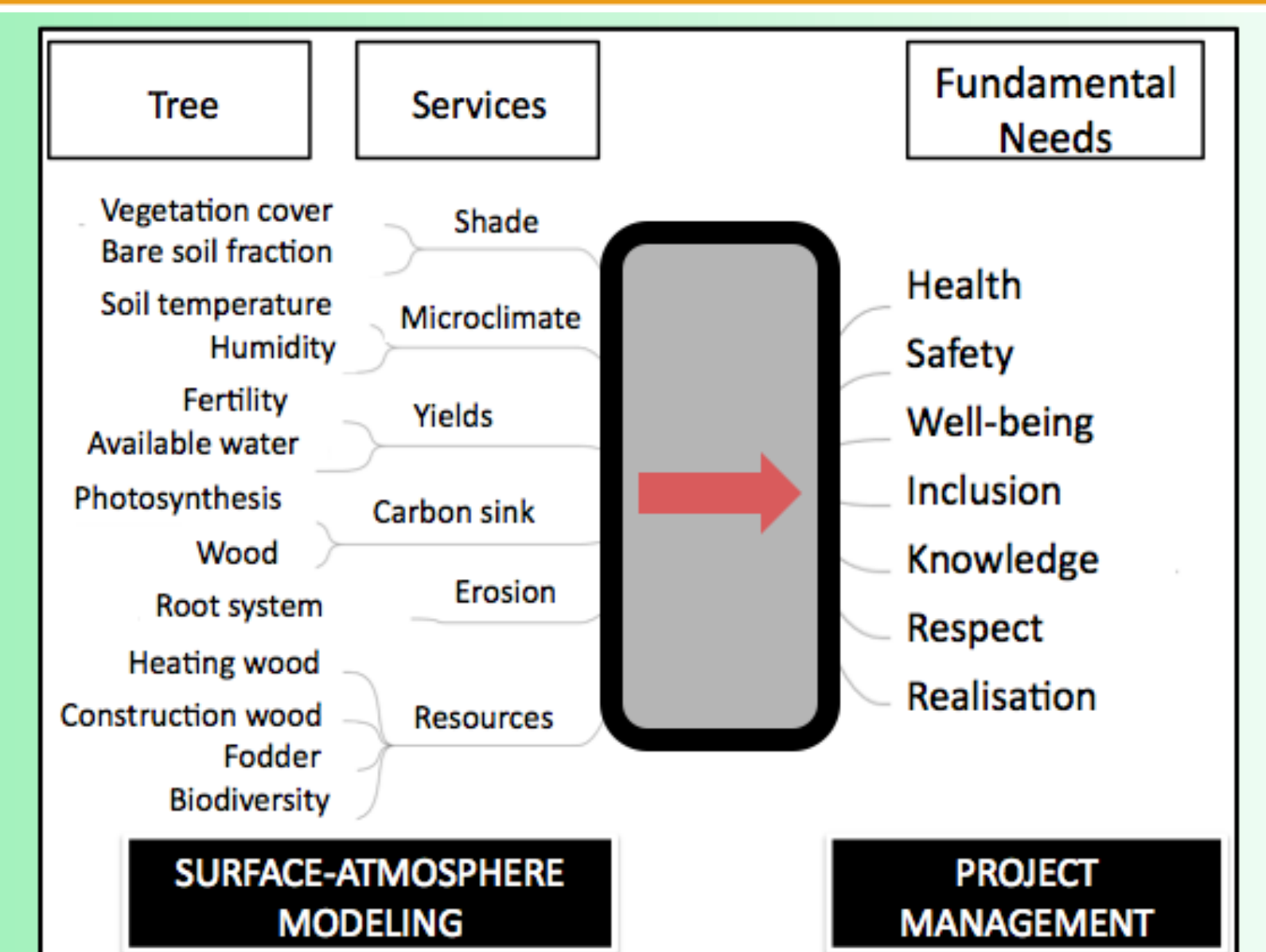
3- From simulated surface variables to indices of climate and ecosystemic services

Concertation with stakeholders

- > Field visits
- > Stakeholder interviews
- > Participative workshops

- >> Build field-relevant scenarios for simulations
- >> Use project-relevant variables as simulation outputs

Kinome develops its own multicriteria evaluation tool, focusing on human fundamental needs. The goal is to provide potential climate impact results that will eventually be included in the global reforestation project evaluation tool.



References

Kottek M. et al. (2006), "World map of the Koppen-Geiger climate classification updated", Meteorologische Zeitschrift, Vol. 15, No. 3, 259-263
 Krinner G. et al. (2005), "A dynamic global vegetation model for studies of the coupled atmosphere-biosphere system", Global Biogeochemical Cycles, Volume 19, Issue 1