

SDSim: A Novel Simulator for Solar Drying Processes

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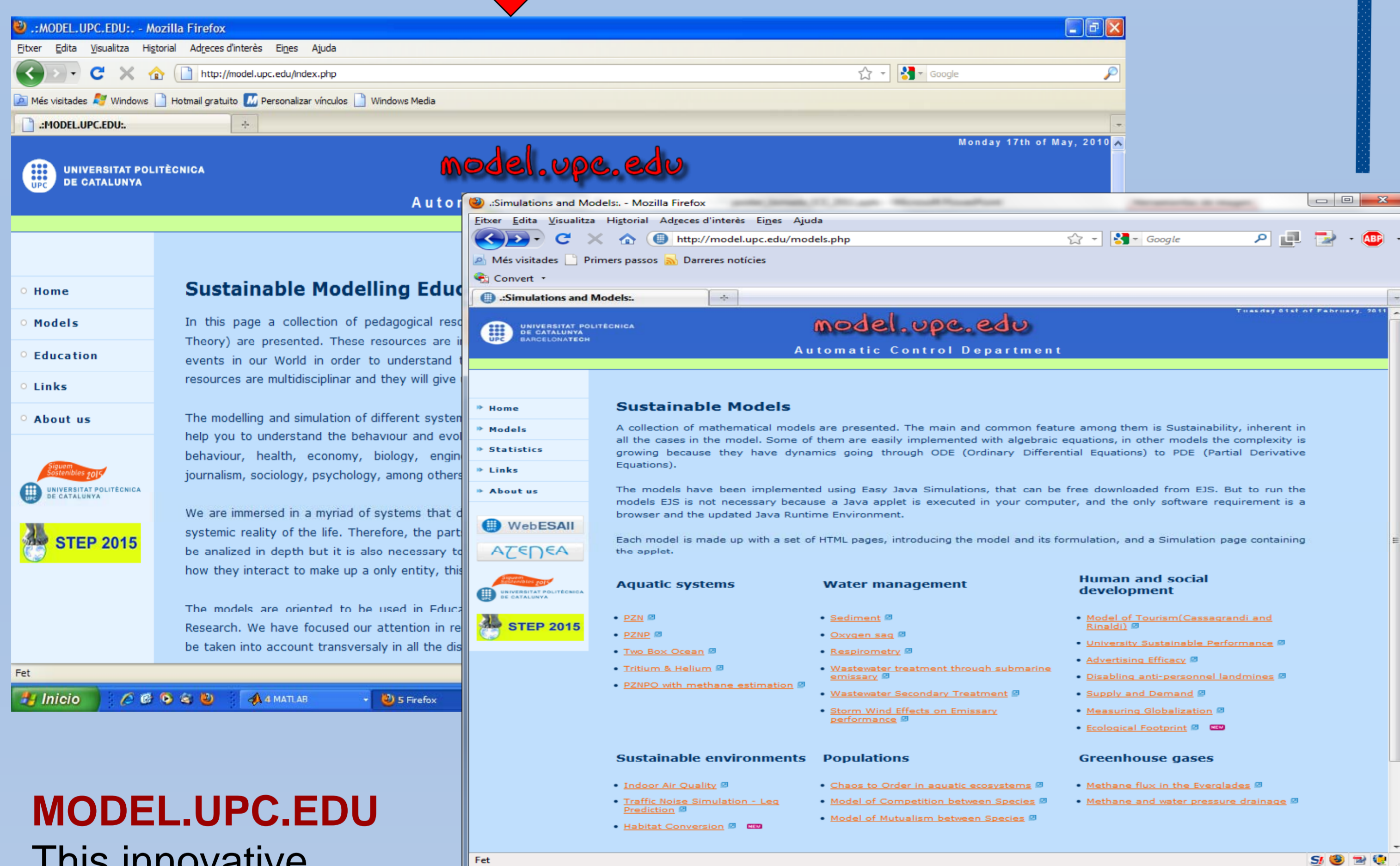
ABSTRACT and OBJECTIVE- SDSim is a novel solar dryer simulator based in a multi-crop, inclined multi-pass solar air heater with in-built thermal storage mathematical model. This model has been developed as a designing and developing tool used to study and forecast the behavior of the system model in order to improve its drying efficiency and achieving a return on the dryer investment. The main feature of this simulator is that most of the parameters are permitted to be changed during the simulation process allowing finding the more suitable system for any specific situation with a user-friendly environment. The model has been evaluated in a real solar dryer system by comparing model estimates to collected data. This mathematical model is included in a set of laboratory practices, specifically in the energy area, that integrates the 'Sustainability and Social Commitment' competence. The interest in simulation of this kind of systems is focused to forecast their behavior in order to control and actuate over them wasting the less natural resources as possible. In this work, the use of a didactic material for laboratory practices is explained. This pedagogical resource is published in a web platform (<http://model.upc.edu>) where the student can find laboratory practices, the instructor explanations and the software to develop new dynamical models. We have the strong belief that undergraduate students must receive an Education for the Sustainability independently of their career together and transversally with the basic and specifically concepts of the own subject.

Motivation

Greening Education: In the last years society has become aware of that the pattern of current development affects our Planet in a noxious way. In order to not increase the use of nuclear energy generation neither the primary energy production coming from burning fossil fuels, there is the necessity of shifting to the generation of renewable energy to help meet increased energy needs. Education and Training play an important role in the sustainable production of renewable energy (solar, wind...) as well as in a rational use of this energy (consumption reduction...).

Distance Education: In our modern society, distance education has become a viable solution for students who require more flexible, accessible, and adaptive teaching systems, without spatial and temporal restrictions.

Innovative Web-based Pedagogical Tool Environment



MODEL.UPC.EDU

This innovative didactic tool, the MODEL web, is a compilation of sustainable modeling education resources, specifically a virtual laboratory. The virtual laboratory is made up of models in the following typology:

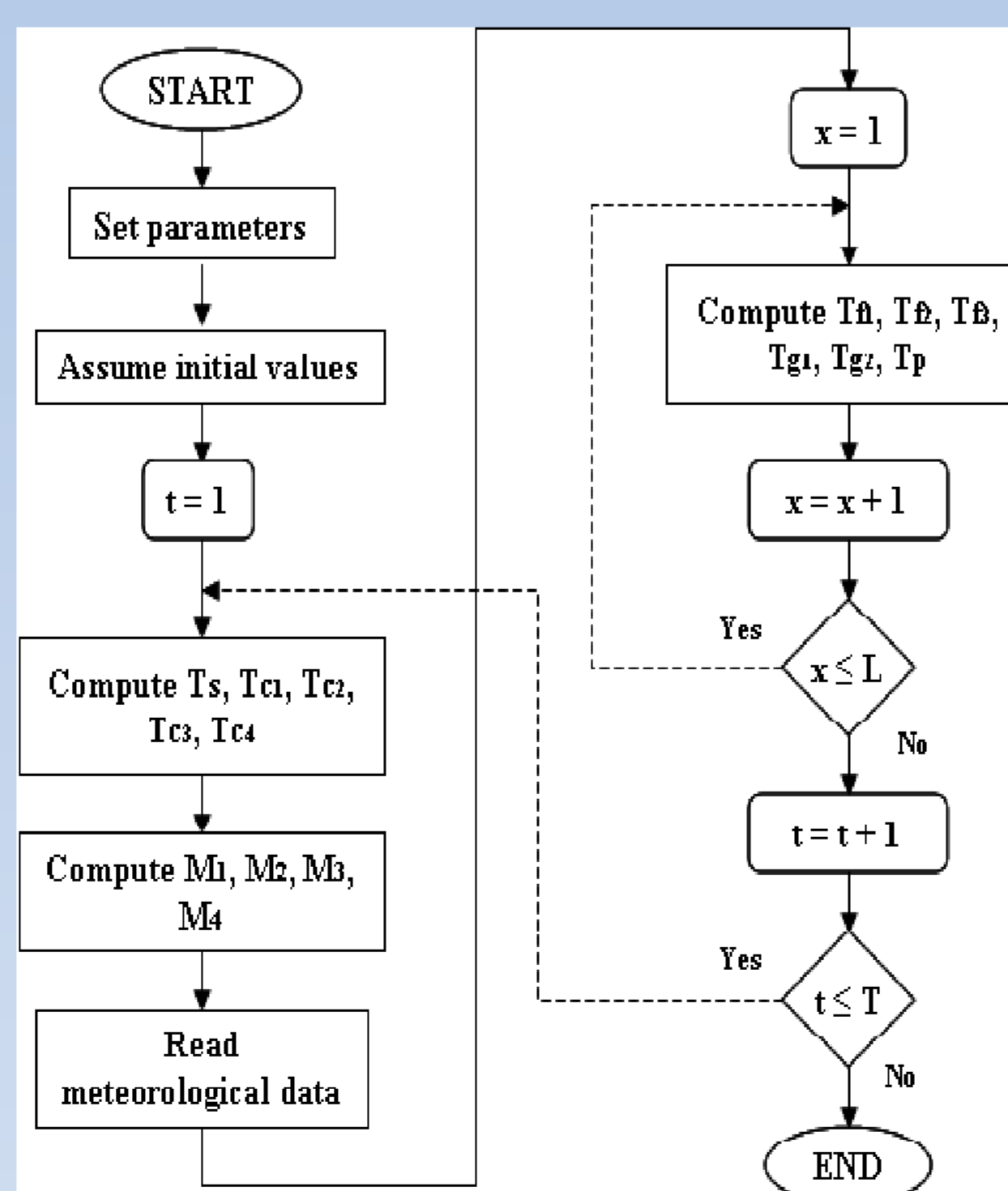
- Aquatic systems
- Water management
- Human and social development
- Sustainable environments and populations
- Greenhouse gases
- Renewable energies

Teaching staff have an initial task of preparing the contents of the practice, and it consists on the following steps:

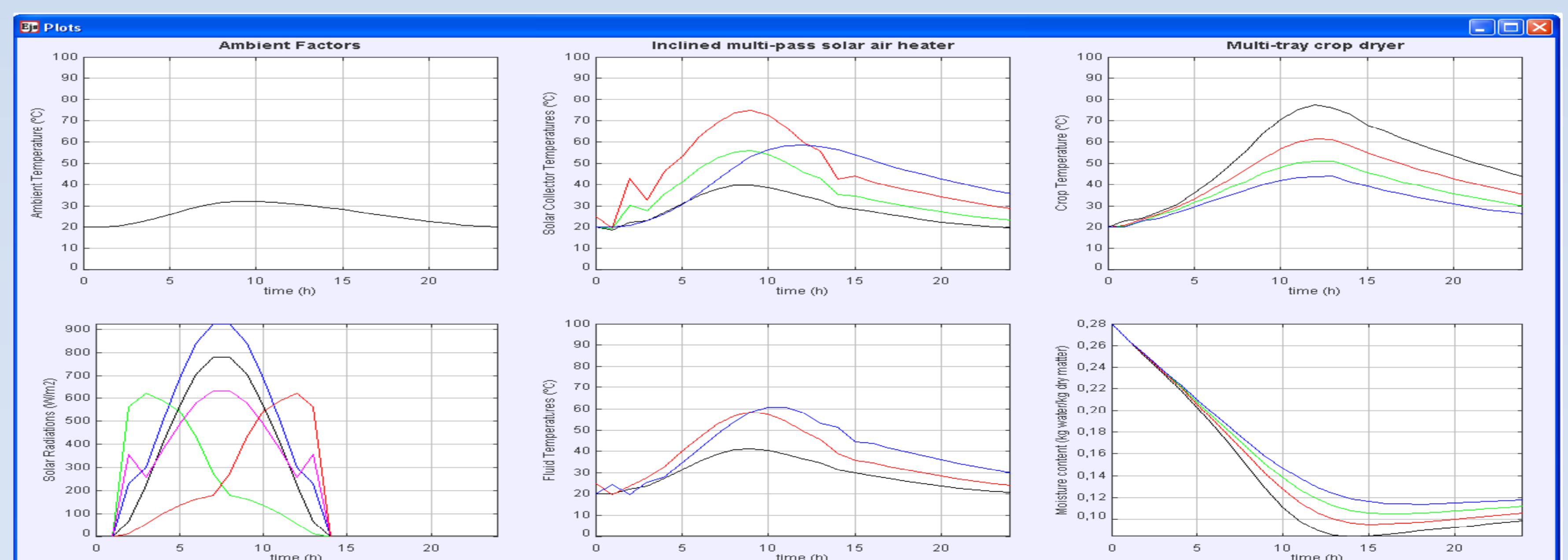
- To develop the model of the real system by physical or empirical equations.

- To implement the model with the E_j s in order to verify the equations, and propose a specific view.

- When the above steps are perfectly done and the view is attractive enough, it is necessary to create a web page with the output of E_j s.



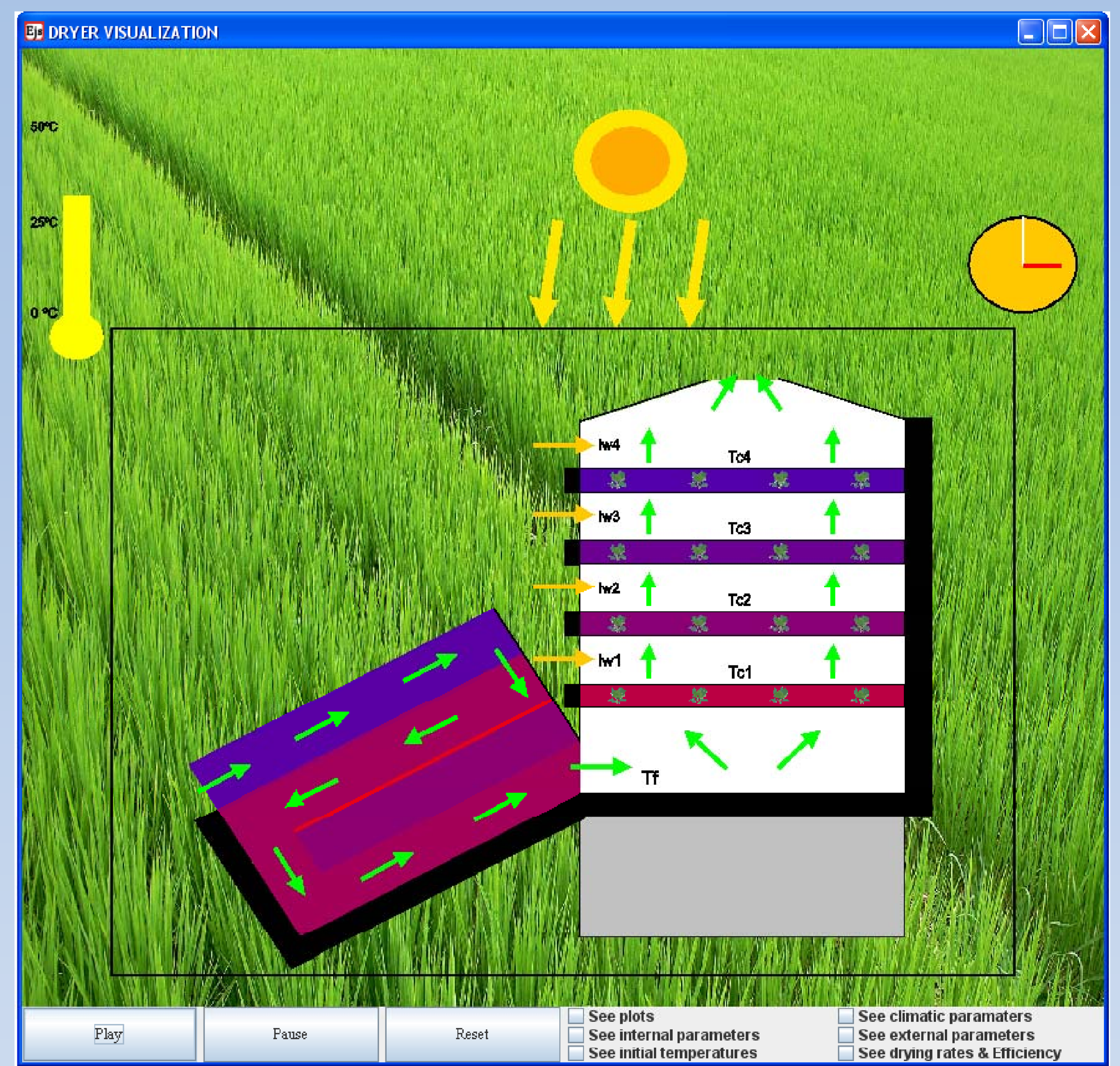
Simulation Results



SDSim

Due to the current trends towards higher cost of fossil fuels and uncertainty regarding future cost and availability, use of solar energy in food processing will be a necessity and become more economically feasible in the near future.

- Using the SDSim simulator the temperatures of the different trays, the moisture evaporation and the drying rate for each produce are predicted.
- This software allows to make easier the task of simulating the systems with changing parameters or specifications by user.
- The implemented equations in the simulator are generic, and for this reason the user can reproduce the behavior of any multi-tray crop drying system with inclined multi-pass solar air heater with in-built thermal storage simply varying its geometry and features.
- The mathematical models are based on:
 - Energy balance on solar air heater
 - Fluid entrance during the i-th glass cover (for each air stream)
 - Useful energy from solar air heater
 - Energy balance on different trays in the drying chamber



Simulator View

The objective of the simulator is to find the most efficient design for new solar driers

Visit the Pedagogical Web: MODEL.UPC.EDU