

#### Modelling spatial and temporal leaf temperature dynamics at leaf and canopy scales

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Workshop HETEROCLIM – 10 -14 June 2014, Loches, France

### SPATIAL AND TEMPORAL MODELLING LEAF **TEMPERATURE DYNAMICS AT LEAF AND CANOPY SCALES**

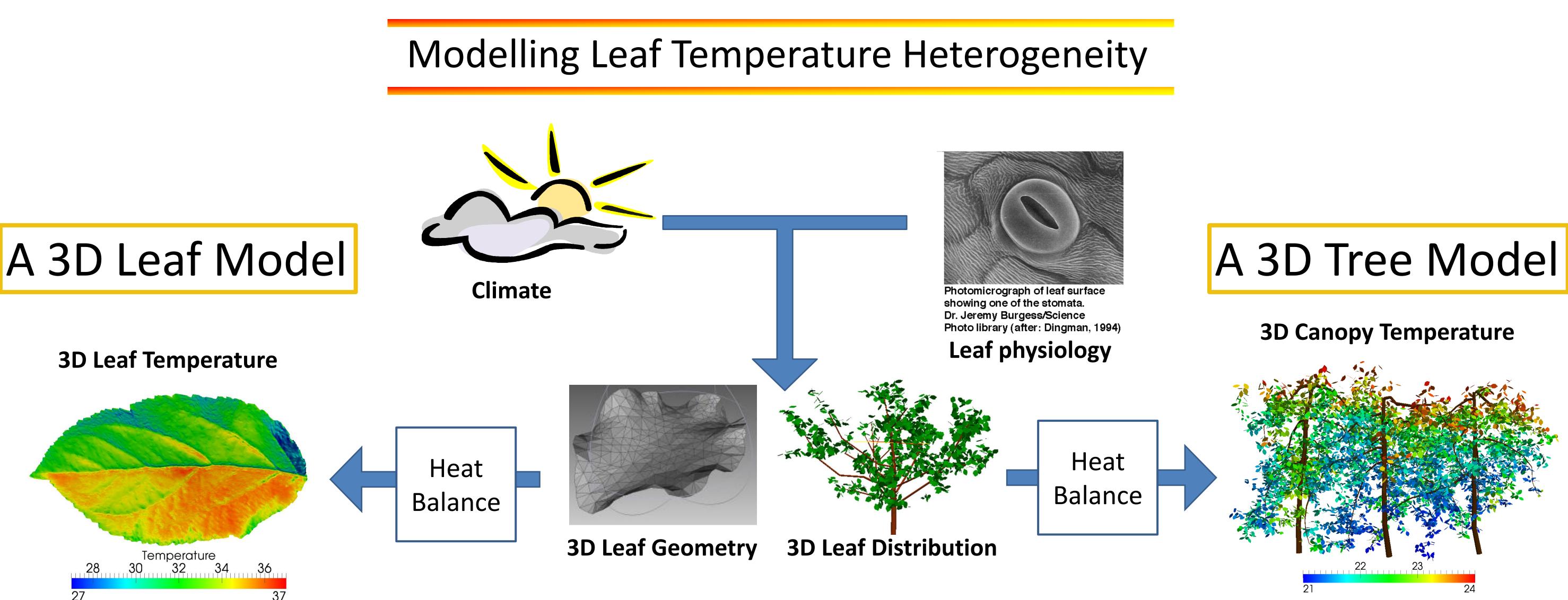
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# Thermal Heterogeneity in Tree Canopies

Leaf temperature is an important factor involved in many biological processes such as leaf transpiration and photosynthesis, leaf pathogen interactions or insect development. A high spatial variability in leaf temperature dynamics (frequency, amplitude, spatial gradients) at canopy scale (shaded leaf versus sunlit leaf) and at leaf scale (leaf geometry, edge effect, boundary layer) is observed. Such variability results from changes in energy exchanges between the leaf and its local environment.

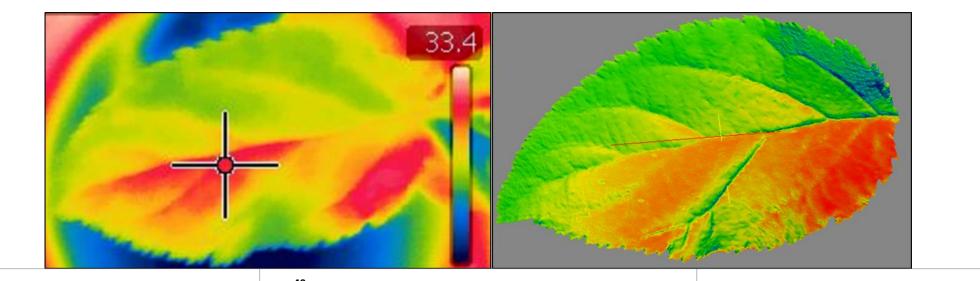
A modelling work was developed by IRBI and PIAF labs to predict leaf temperature heterogeneity and insect development at the leaf scale (a 3D leaf model) and at the canopy scale (a 3D tree model).

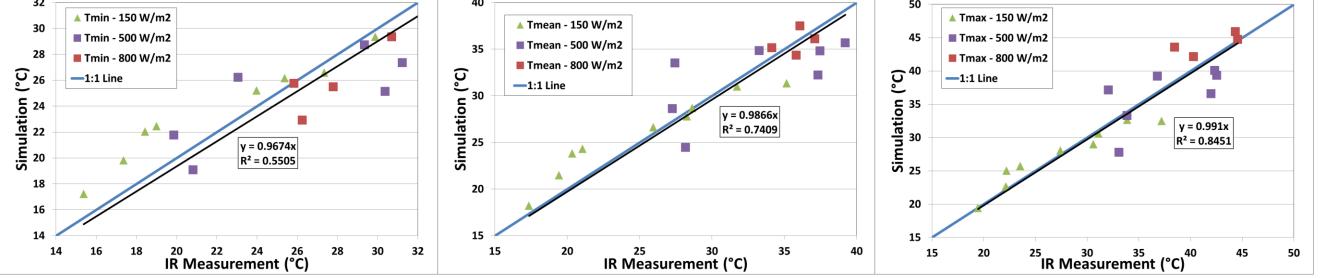


Schematic view of the main features of the 3D leaf model and the 3D tree model

# Simulating Leaf Temperature Heterogeneity

### **Temperature measurement vs Simulation**





# Tree Scale

### **Temperature measurement vs Simulation**

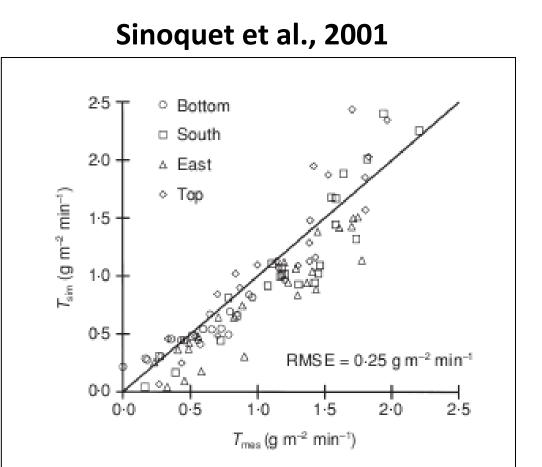


Figure 7. Relationship between transpiration rates at branch scale measured in the field  $(T_{mes})$  and simulated by the RATP model (Tsim) on 24 August 1996. Results are presented for four branches in different locations in the tree crown. Each point corresponds to measured and simulated values for a 30 min period.

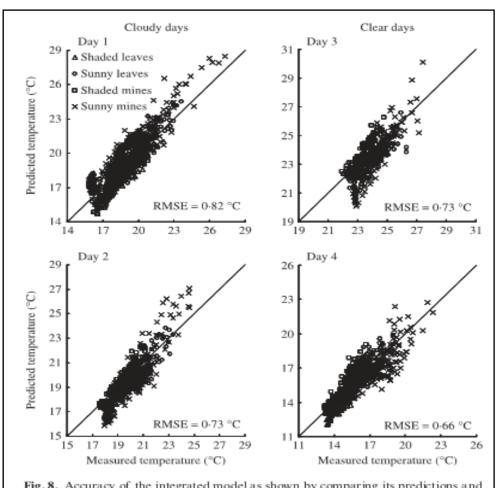


Fig. 8. Accuracy of the integrated model as shown by comparing its predictions and actual records of leaf and mine temperatures, made at several positions within the tree canopy and during moderate climatic conditions. This comparison was done for both cloudy conditions (left column) and sunny conditions (right column). Lines show the x = y relationship and the root mean square error of predictions (RMSE) is given for the whole data set of each day

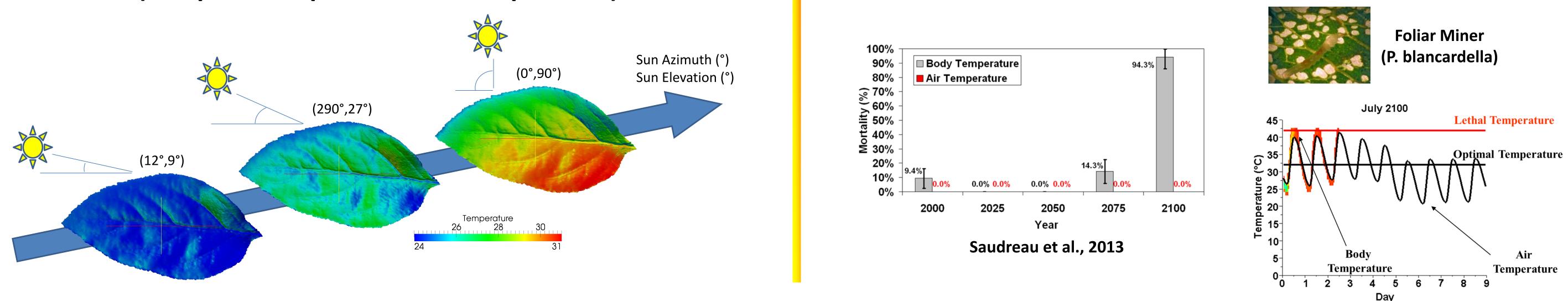
#### Pincebourde et al., 2007

#### **Climate change and insect mortality**



## (Temperature pattern and sun position)

# (Air temperature vs Body temperature)



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