**Plant thermodynamics:** leaf shape and margin morphology affects evapotranspiration

"The functional significance of leaf shape lies more often in water relations than directly in leaf thermoregulation" (Nicotra et al. 2011)

- Plants are good candidates for studying structural thermal adaptations
- Evapotranspiration is still seen as a necessary "cost" for photosynthesis
- It has a cooling effect but its thermoregulatory role is still unclear

**Abstracting geometry principles:** from leaf morphometrics to parametric design

- Models laser-cut from commercial paper towel (leaf-scaled designs)
- Uniform wetting with cold water followed by free convection drying
- Water loss temps. recorded with analytical scale / thermal camera
- Models keep a uniform cooler temp. until paper finally starts dewetting
- A delayed dewetting hints to slow water loss = lower evaporation rate

**Qualitative and quantitative results:** geometry-driven divergences in evaporation rate

- Primary "teeth"-acted as dewetting nucleators
- Dewetting propagates inward from boundaries
- Significant differences in drying times [15-75 min differences between designs]
- Extreme cases (dissipative vs retaining design) were resilient to wetting inconsistencies

**Biomimetic application space:** heat transfer systems assisted by phase-changing fluids

- How to translate findings from 2D into 3D? How to transfer findings to technical devices?

**Ongoing research areas:** conceptual / empirical botany and thermal investigation

- Leaves and morphometric data collection, with Elliptic Fourier shape analysis.
- Observation of leaf tissues and transpiration-related microstructures (stomata, water pores).
- Measuring local humidity/temp. over leaves and plants (3D), for boundary layer and scale studies.
- Theoretical framework for heat/mass transport models and computational simulations.
- Fabrication of leaf analogues with nonwovens and hydrogels, to explore applications.
- Materials research for models with differentiated marginal properties / active evaporation