2-D Photosynthesis Model

We model leaf photosynthesis using a two-dimensional porous medium approximation. The model is solved using a finite element method (FEM) in the *R* package **deSolve** (Soetaert, Petzoldt, and Setzer 2010). Table 1 is a glossary model terms and symbols. Here we describe the model and associated *R* code.

## Leaf anatomy

We assume that the leaf is a homogenous 2-D medium. In the final version, we will incorporate differences in spongy and palisade porosity, gradients in light absorption, electron transport capacity, and Rubisco concentration. The mesophyll is thick and the stomata are regularly spaced apart by distance on both ab- and adaxial surfaces. In this scenario, we assume that the stomata on each surface are precisely offset from each other by distance . This minimizes the average distance between any point in the mesophyll and its nearest stomate. Because of the regular spacing, we only need to model the region between a stomate on surface and the next stomate on the other surface (fig. 1). The rest of the mesophyll will be the same because of symmetry.

|  |
| --- |
| Figure 1: Example leaf anatomy analyzed by the 2-D FEM. |

The mesophyll is symmetric with distanceRunning Code

When you click the **Render** button a document will be generated that includes both content and the output of embedded code. You can embed code like this:

1 + 1

[1] 2

You can add options to executable code like this

[1] 4

The echo: false option disables the printing of code (only output is displayed).

Soetaert, Karline, Thomas Petzoldt, and R. Woodrow Setzer. 2010. “Solving Differential Equations in *R* : Package **deSolve**.” *Journal of Statistical Software* 33 (9). <https://doi.org/10.18637/jss.v033.i09>.