

## Supporting information: S1 Text

### Explaining the oscillations in final cell diameters

We showed that the final diameters of xylem cells obtained with a morphogenetic gradient display oscillations between cells. In the steady state, these oscillations are very regular. It is not trivial to understand the emergence of the oscillations since it is essentially a kinematic effect, which can only be perceived by closely following in time and space the transformations undergone by the cells. Here, we perform such monitorings, always in the steady state and for a fast-diffusing signal. Note, however, that the principle of the explanation also holds for a slow-diffusing signal and for a polarly transported signal. We first consider the case of two cells per oscillation period (Fig. 1, 2 and 3), then the case of three cells per oscillation period (Fig. 4 and 5). The transition from two to three cells per oscillation period is done by increasing the characteristic length  $\lambda_d$  of the concentration profile.

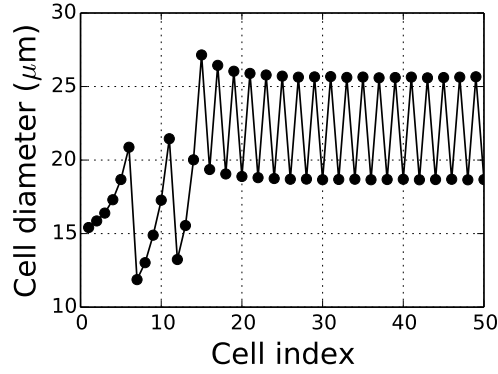
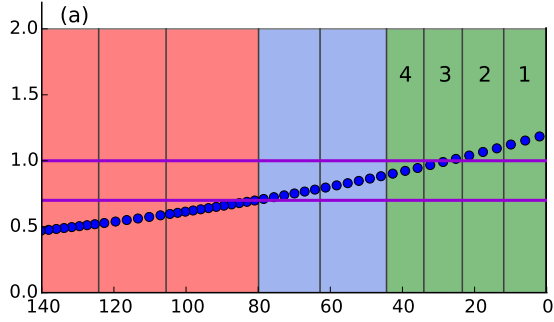
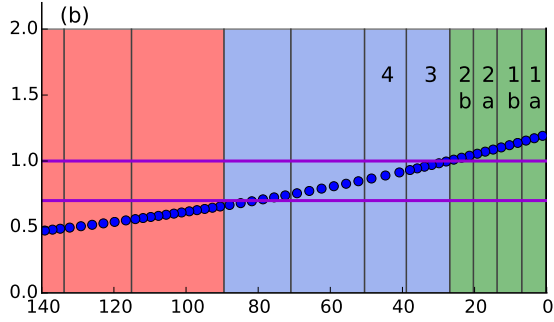


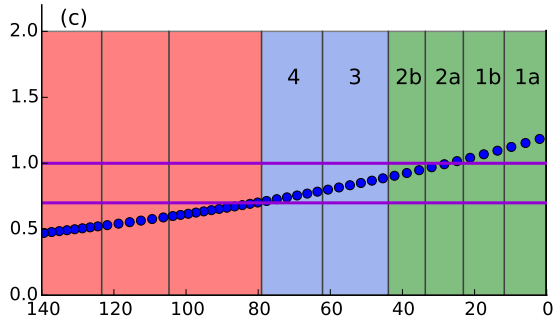
Figure 1: Final cell diameters with oscillations between two values. Oscillations stabilise after a transient state.



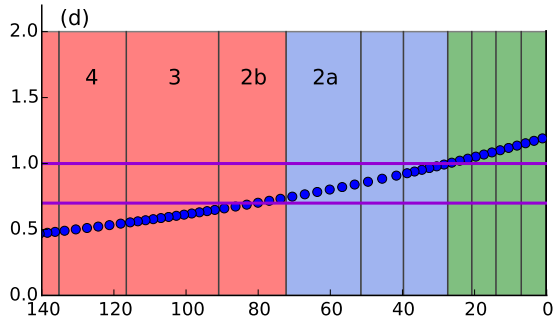
- a. There are four cells in the cambial zone. All of them are close to the critical size at which division can occur, but only cells 1 and 2 will reach it with a signal concentration allowing them to divide.



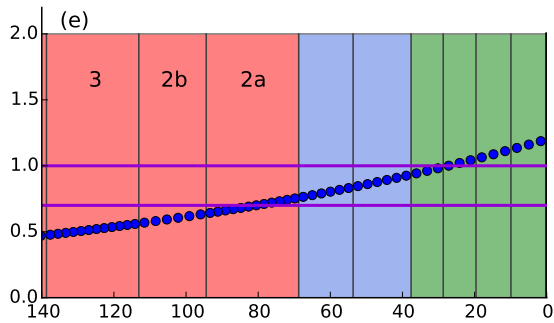
- b. Cells 1 and 2 divided, giving rise to, respectively, cells 1a, 1b and 2a, 2b. Cells 3 and 4 reached the critical size without having been able to divide.



- c. Cell enlargement pushed away cells 2a and 2b where the signal concentration is below the division threshold. They were sharing the same size just after cell 2 divided, but they immediately begin to enlarge and diverge. Indeed, since 2a is closer to the source, it enlarges faster than 2b. The difference, still tiny, is going to increase.



- d. 2b just left the enlargement zone. While going through this zone, 2a has enlarged faster than 2b, and is thus larger. Moreover, it will leave the enlargement zone later, which will increase the discrepancy.



- e. Both 2a and 2b left the enlargement zone. The diameter discrepancy will not change anymore. The largest cell, 2a, is  $26\mu\text{m}$  large, and the narrowest one, 2b, is  $18\mu\text{m}$  large.

Figure 2: Succession of snapshots describing the emergence of two-values oscillations

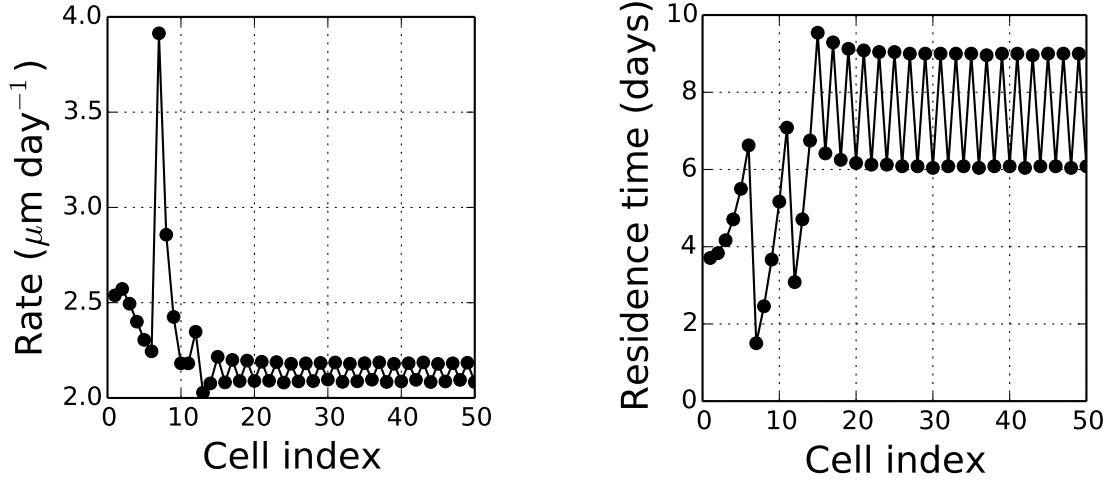


Figure 3: Mean enlargement rates and residence time in the enlargement zone for two-values oscillations. Cells with with larges mean enlargement rates are also these one which spend the longest time in the enlargement zone.

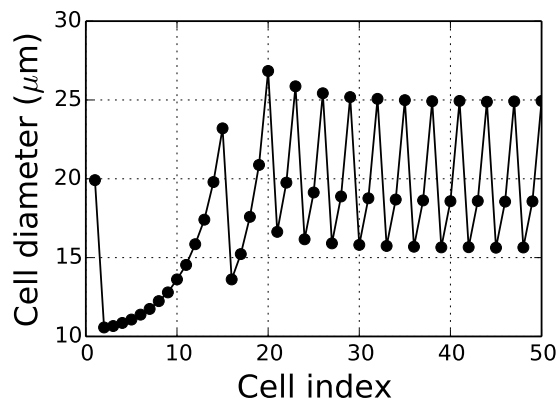


Figure 4: Final cell diameters with oscillations between two values.

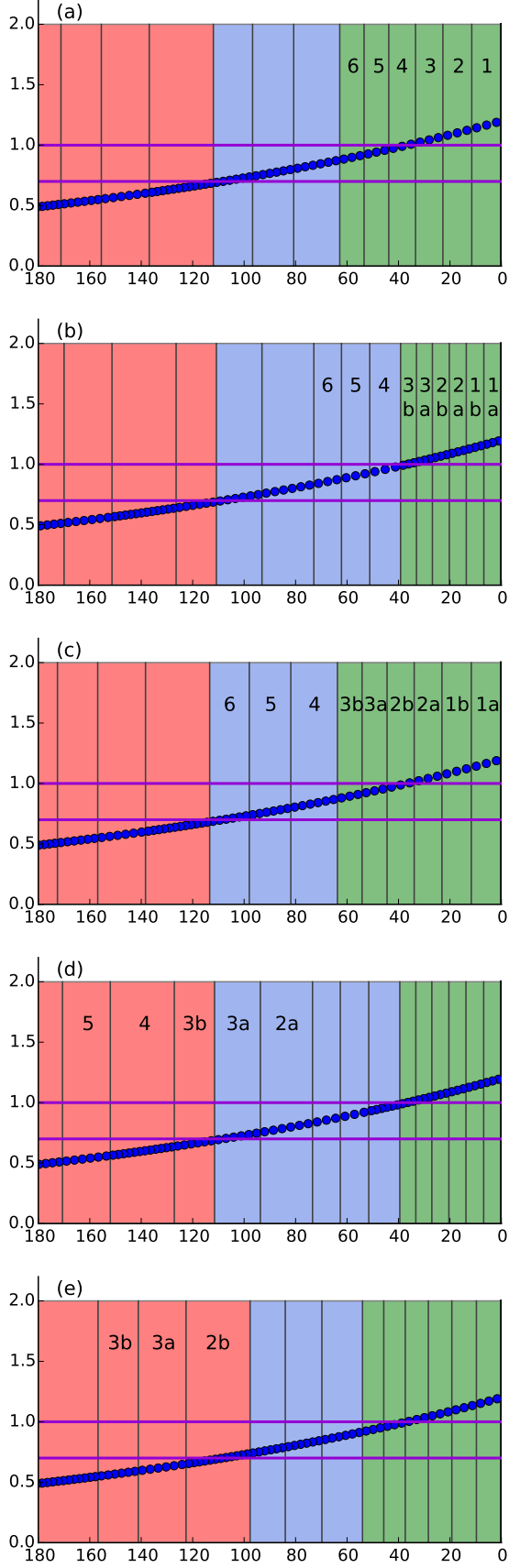


Figure 5: Succession of snapshots describing the emergence of two-values oscillations

Three cells (1, 2, and 3) divide at very close times. Half of the six resulting cells (cells 2b, 3a, and 3b) are pushed away where the signal concentration is below the division threshold before having been able to divide again. For these three cells, the closest the source is, the faster and the longer the enlargement is. Thus they will end with three different final diameters, which constitutes a period of oscillation. These diameters are, respectively,  $15.5\mu\text{m}$ ,  $18.5\mu\text{m}$  et  $25\mu\text{m}$  (figure 4).