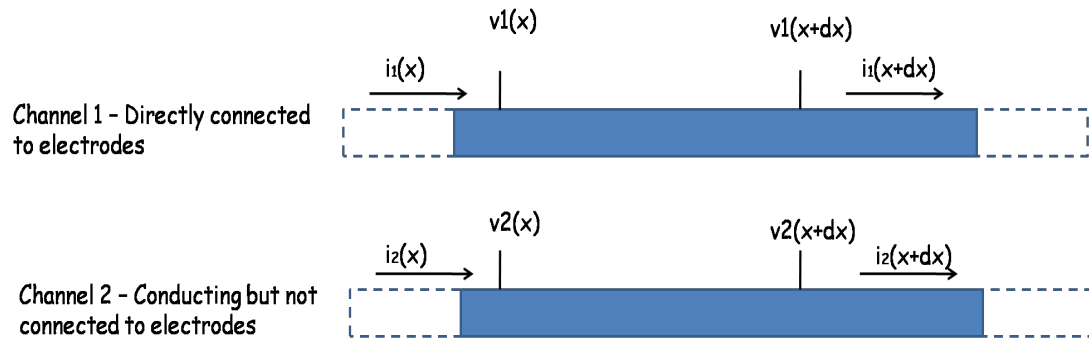


Supplementary Material

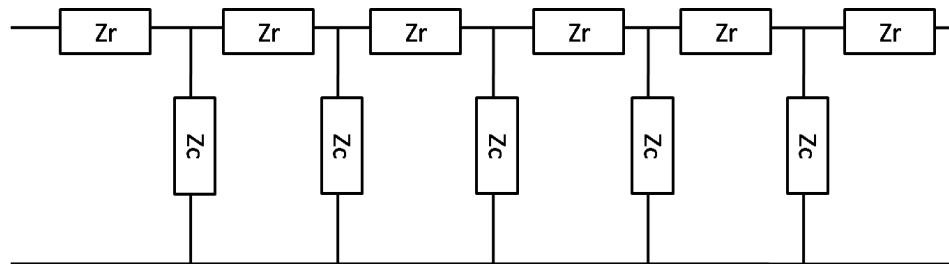
1 Supplementary Data

The appendix includes the figures for the theoretical derivation of the lumped model.

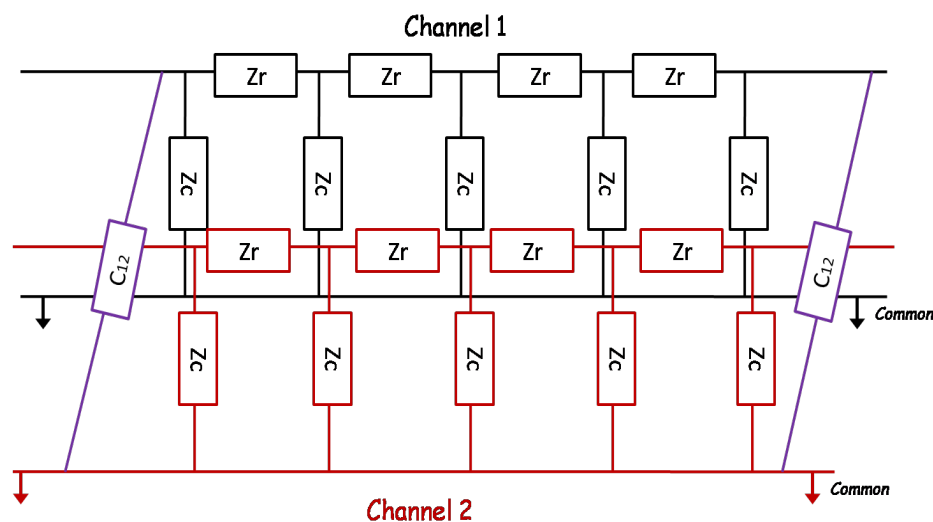
2 Supplementary Figures



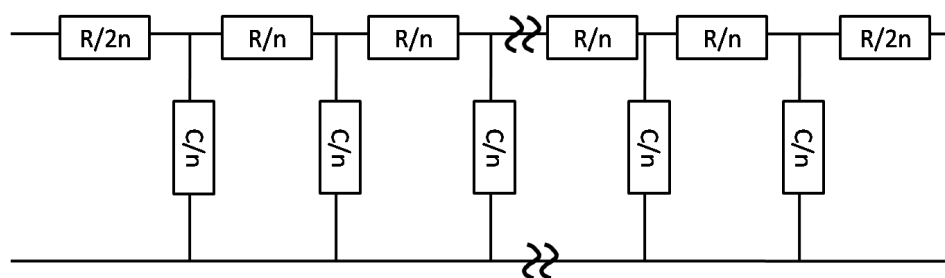
Supplementary Figure S1. Schematic description of two conduction channels behavior



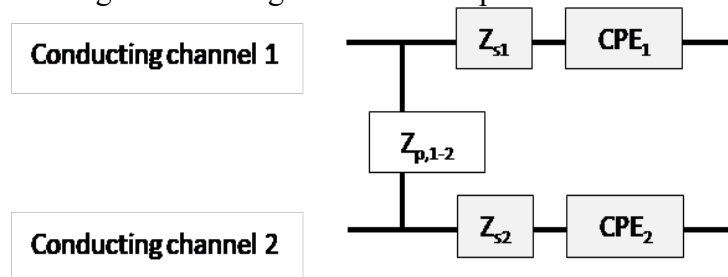
Supplementary Figure S2. Lumped circuit model for a transmission line representation of a single segmented vessel using capacitive and resistive elements.



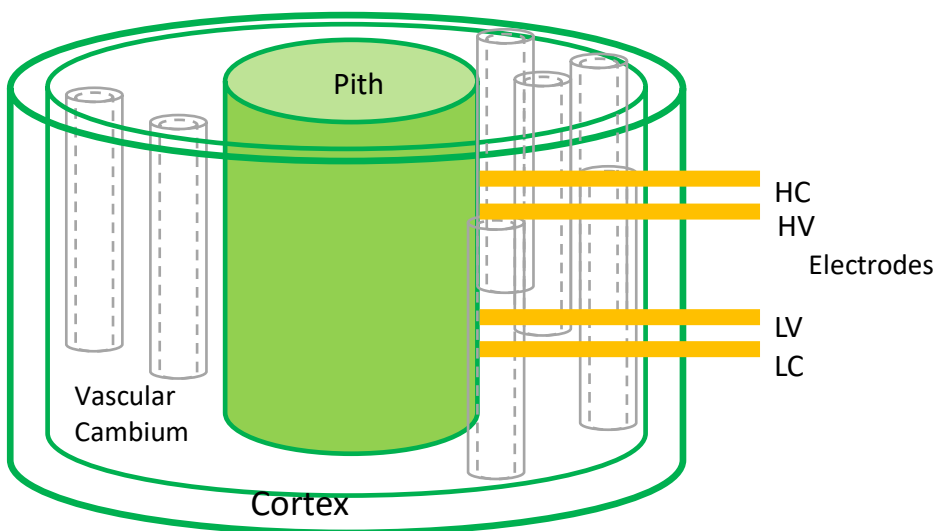
Supplementary Figure S3. Two transmission line channels cross coupled via C_{12} , taking into account only nearest neighbours' interaction



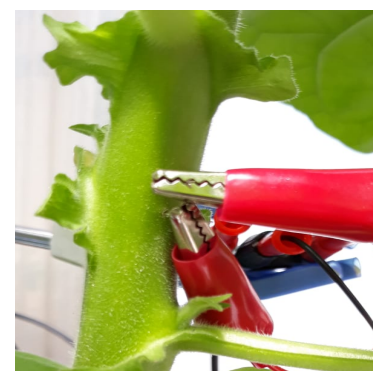
Supplementary Figure S4. A transmission line composed of n resistors with a total resistance of R and n capacitors with an overall capacitance of C , that can be represented using the Π or T lumped element models for describing a conducting channel in the plant.



Supplementary Figure S5. A simplified equivalent circuit describing the impedance of a cambium vascular bundle where a conduction path is represented by a resistive element and a constant phase



a



b

Supplementary Figure S6. A) schematic illustration of the plant stem showing the three different areas of the stem and specifically the vessels in the vascular cambium where a double layer is created under an induced electric field. B) Example image of two electrodes coupled to the plant stem.

Table S1 Model components and functions

Color	Branch	Elements	Representative equation	Example values order of magnitude	Values in the literature [19]
Red	Resistive path	R	R	$10K\Omega$	$10K\Omega$
Green	Both ends in contact	$R1+Z1$	$R + 1/j\omega Q^n$	$1K\Omega$	$1K\Omega$
Blue	One end in contact	$C2+R2+Z2$	$j\omega C + R + 1/j\omega Q^n$	$R \propto 100\Omega$, $C \propto nF$, $n = 0.5$, $CPE \propto a \text{ few } K\Omega^{-1}$	$R \propto 5K\Omega$ $R \propto 500\Omega$ $C \propto nF$ CPE not available
Brown	No ends in contact	$C3+R3+Z3$	$j\omega C + R + 1/j\omega Q^n$		

Table S2 Comparison of available plant monitoring methods

Example Methods	Soil Moisture	Drones	Stomatal conductance	Electrochemical chip	Leaf temperature	Gravimetric measurements	This method & model
Parameter Monitored	Soil water potential	Visual inspection of the plant	An indication of photosynthesis activity	Electrochemical reaction result created in the plant as a response to a stress factor	Leaf temperature	Plant weight	Stem impedance
Direct plant measurement\ Surrounding environment	Surrounding environment	Direct	Direct	Direct	Direct	Direct	Direct
Destructive to the plant	No	No	No	No	No	No	No
Can provide early detection of stress	Yes	Once visible stress is apparent	Yes	Yes	Somewhat	Somewhat	Yes
Allows ongoing monitoring	Yes	Somewhat	Short duration periods	Yes	Short duration periods	Yes	Yes
Field deployable	Yes	Yes	Yes	Yes	Yes	No	Yes
References	see review in [43]	[8]	[see review in [43]	[12]	[43]	see review in [43]	[44]