

Diurnal and spatial variation of xylem flow and xylem dielectric constant in conifers

Kyle C. McDonald⁽¹⁾, Reiner Zimmermann⁽²⁾, Ernst-Detlef Schulze⁽³⁾, JoBea Way⁽¹⁾

(1) Jet Propulsion Laboratory
California Institute of Technology
Mail Stop 300-233
4800 Oak Grove Drive, Pasadena, California 91109
Phone: 818-354-32.63, Fax: 818-354-9476, email: kyle.mcdonald@jpl.nasa.gov

(2) BITOIK
Plantkology 11
Dr. H. Frisch Str. 1
D-95448 Bayreuth, Germany

(3) University of Bayreuth
Plant Ecology 1
Universitaetsstrasse 30
D-95440 Bayreuth, Germany

It is known that temporal variation of the dielectric constant in woody plant tissue may occur due to a change of water status (e.g. water content) and chemical composition, albeit to varying degrees of sensitivity. Continuous in situ observations of the dielectric constant properties of woody plant tissue, during previous experiments indicated varying degrees of correlation between the dielectric constant of a tree's hydroactive xylem tissue and the hydraulic status of the vegetation. We had observed distinctly different tree to tree responses in the diurnal behavior of xylem dielectric constant for individual trees exposed to identical microclimatic conditions. The aspect of temporal and spatial variation of dielectric constant in the same woody tissue type, within a individual tree however was not yet addressed.

In order to develop a more clear understanding of the relationship between the dielectric and hydraulic properties of xylem tissue and the role of the xylem sap chemical composition in individual trees, we performed detailed observations of these parameters in stems of Norway Spruce, *Picea abies* Karst. (L.), in the Fichtelgebirge, Germany. As part of a larger ecophysiological experiment, we continuously monitored dielectric constant in the xylem tissue as a function of height in two trees.

Dielectric constant measurements were made over several weeks during the summer of 1995 with two dielectric monitoring systems recently designed at JPL. Probes were implanted in the xylem tissue of 43 year old trees at approximately one meter intervals extending from the ground to the base of the canopy. Dielectric constant was measured approximately every 40 minutes at each implanted probe.

The measurements demonstrate that the temporal response of xylem tissue dielectric constant may vary dramatically with location within individual trees. The observed within tree variability in the dielectric properties will be presented. Coincident observations of xylem sap flow and chemical composition will be compared with the trends observed in the dielectric properties. Implications for the use of dielectric measurements as an indicator of changes in xylem chemical composition and xylem water status will be discussed.