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Supplementary material

Fig. S1 - Cross-sections and photos of stems of a *Tilia cordata* tree wth infra-red images of the heat field around and along a linear heater. The multi-point HFD sensor was installed perpendicular (a) or in parallel (b) to the smoothed stem surface. Yellow areas in both stem cross-sections correspond to cut-off parts of stems. Frontal and radial infra-red images of the heat field under conditions of zero-flow are symmetrical concerning the end or axis of the heater (c and e, respectively), whereas they are highly deformed by moving sap, both in tangential and radial directions (d and f, respectively). Modified from Nadezhdina et al. (2004).

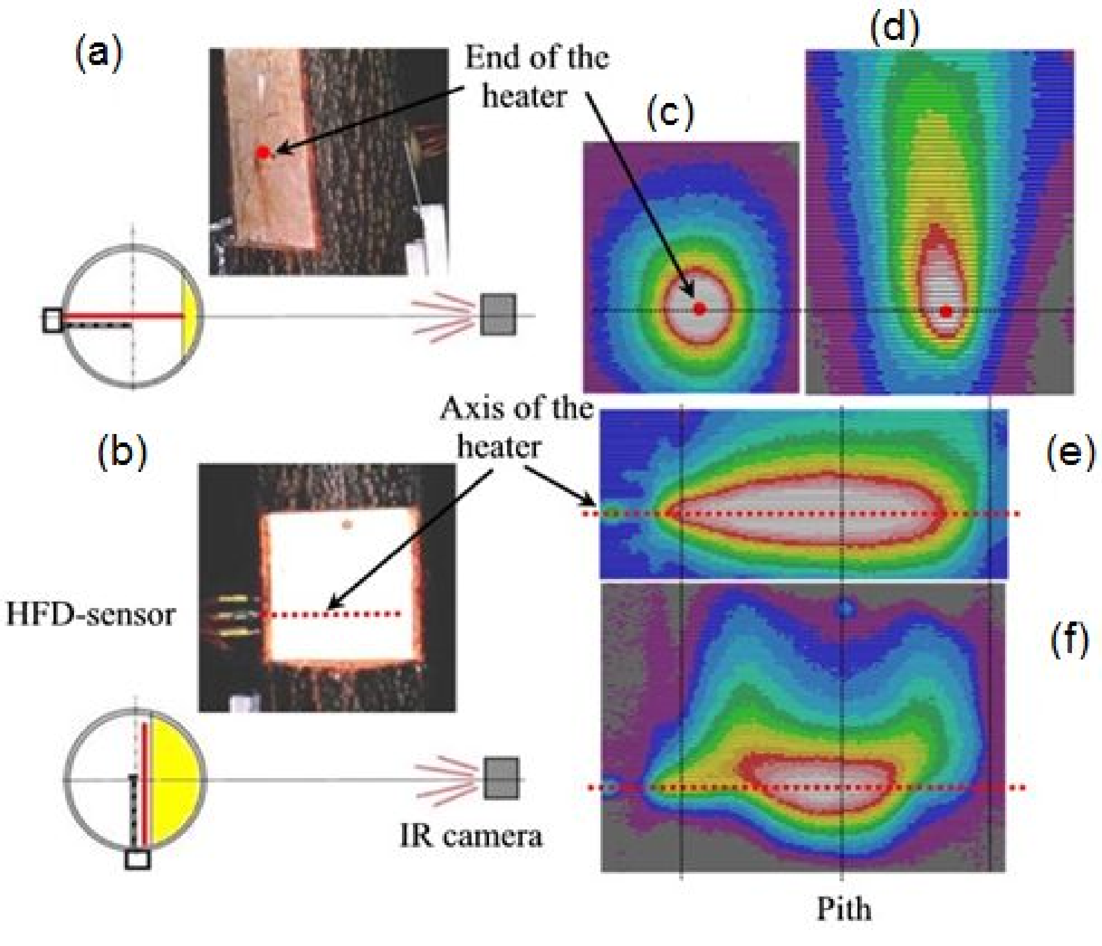

Fig. S2 - Tangential (a) and radial (b) IR images of a heat field in stem of a *Tilia cordata* tree with schemes of sensor displacement. IR images demonstrate 3D dimension of the HFD method which can register deformation of a heat field by moving sap (blue arrows) in two directions (axial and tangential) in stem (tangential sections 1 and 2) as well as in radial direction in sapwood. Heat field has right elliptical form in heartwood (tangential section 3) and it is also symmetrical in radial direction there. As many sections with thermo recorders may exist in a stem along xylem radius to measure unique radial profile of heat field created by a heater and deformed by corresponding flow rates.

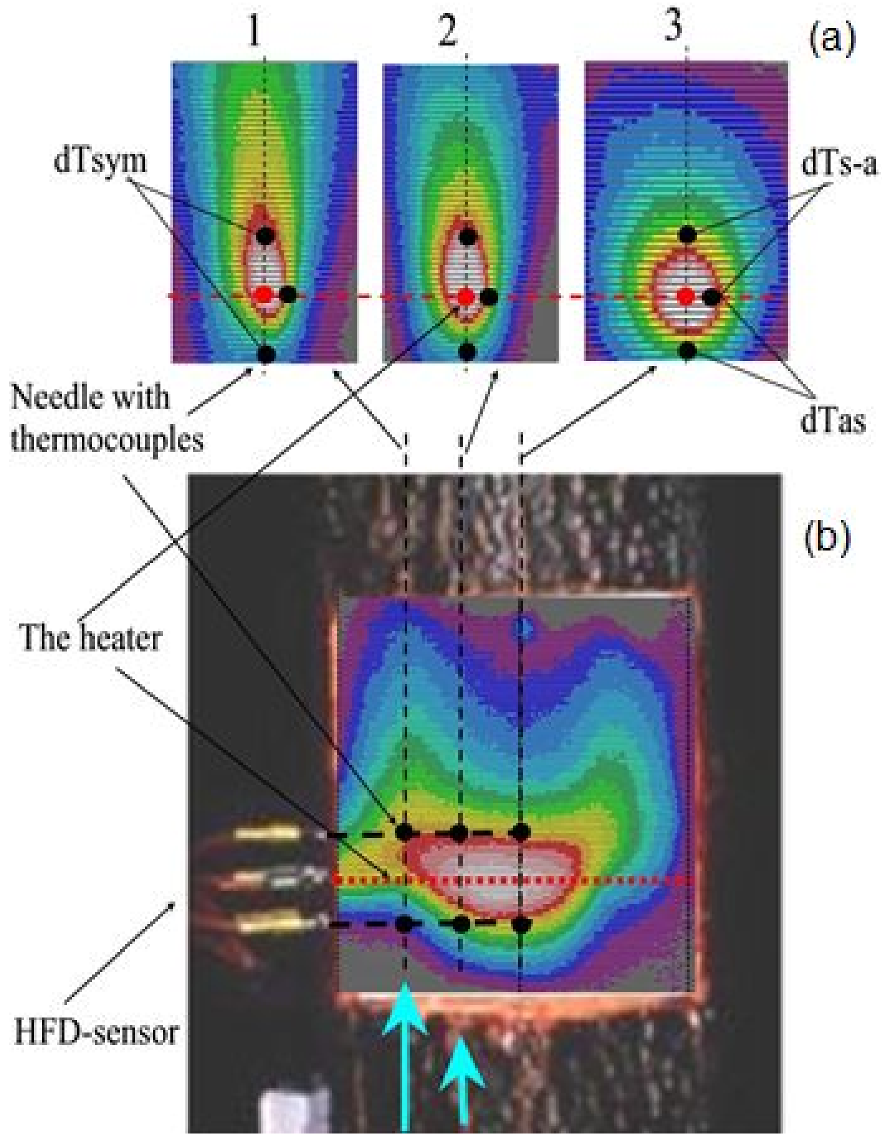

Fig. S3 - Dynamics of symmetrical temperature difference, dT_{sym}, and sap flux density in a lateral root of a Quercus suber tree, measured at the end of dry and the beginning of wet periods. Rain events of different intensity are marked by arrows of different thickness. Sap flow density is calculated by two formulas: with (red) and without (black) correction for flow direction for negative values of $dT_{sym.}$

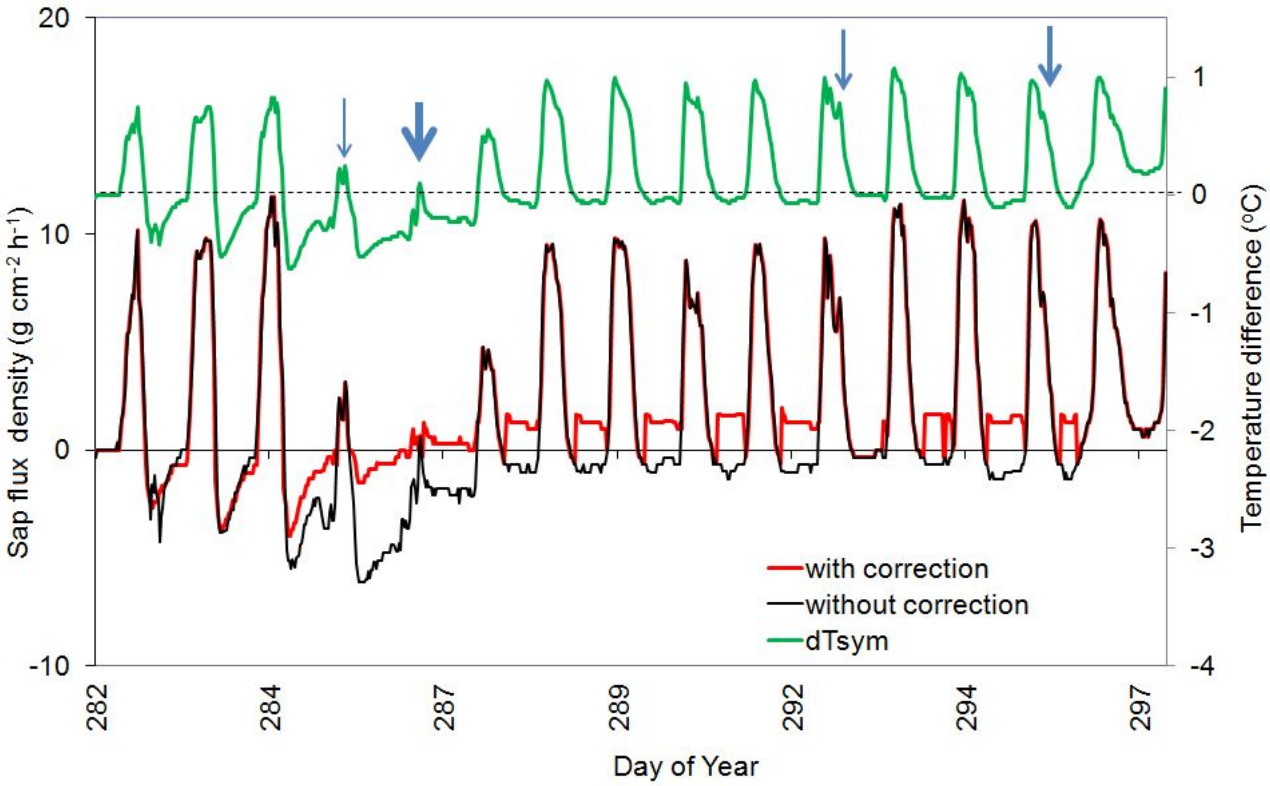

Fig. S4 - Dynamics of dTas (a) and SFS (b) in pear tree before and after corrections of K-values (c) altered due to changes length of the heater in a stem as a result of moving the heater out at 1 cm (dashed vertical line).

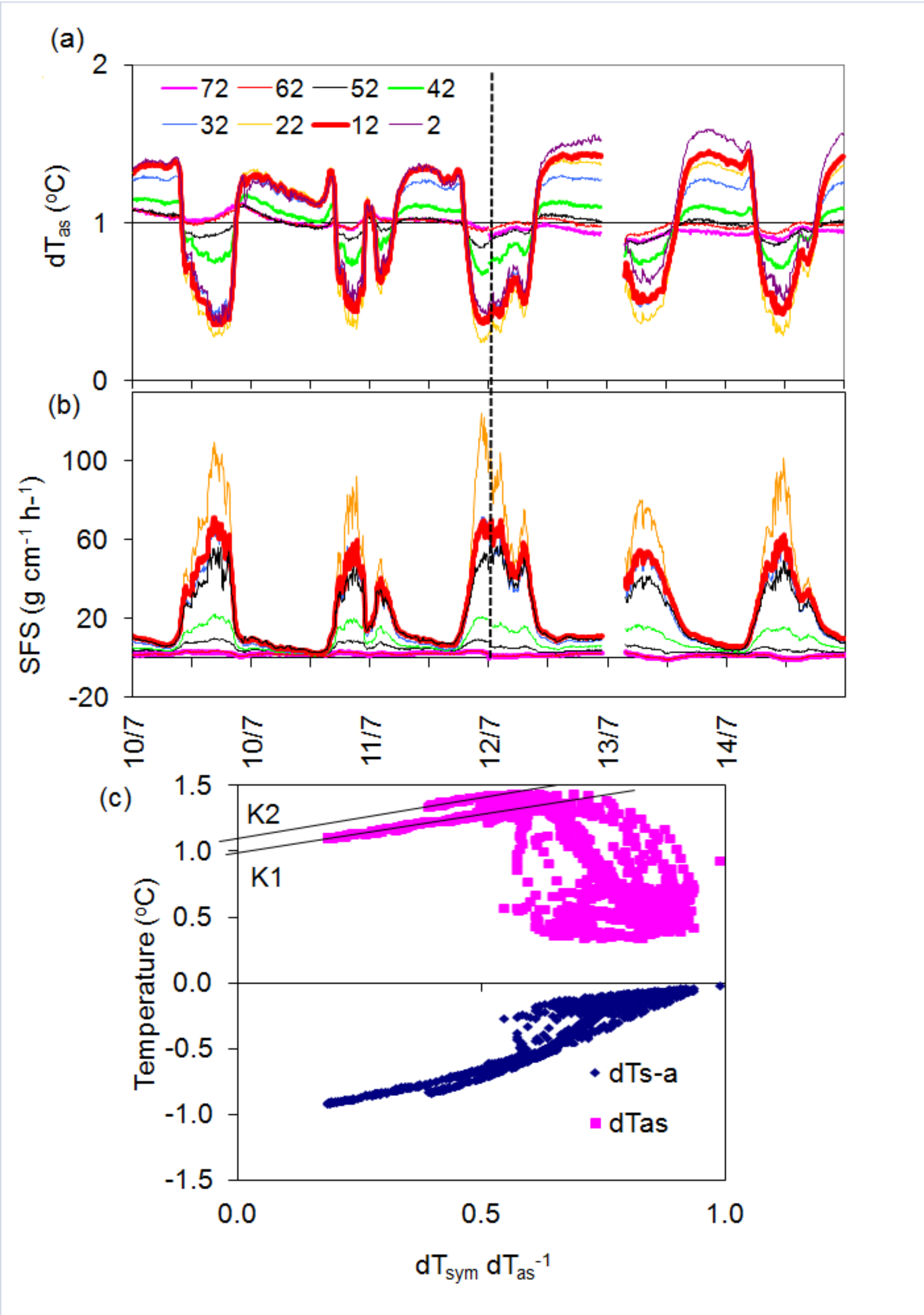

Fig. S5 - Sap flow dynamics measured by the same multi-point HFD sensor in the stem of a *Quercus suber* tree from four different stem sides. Records between tree sides are divided by vertical lines. Numbers in legend indicate depth of thermometer below the cambium in mm. The outermost (6 mm) and the inner (56 mm) sap flow per section are marked by thick curves. (Data shown with permission of Teresa David).

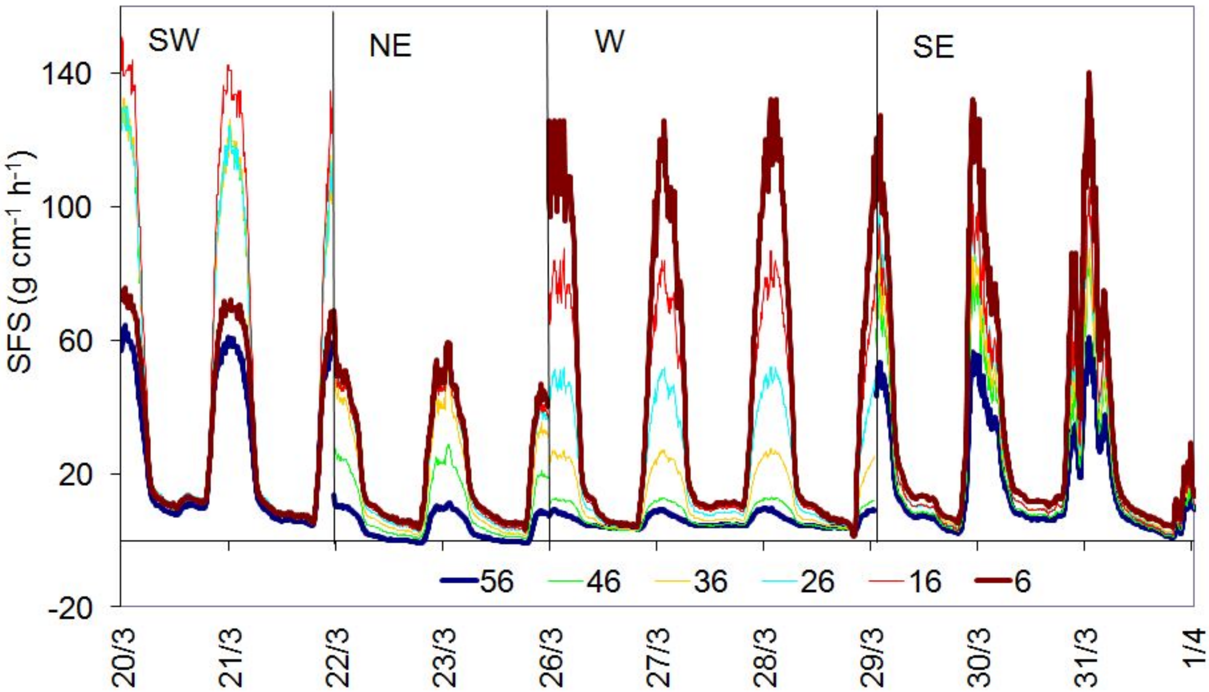

Fig. S6 - Dependences of R and K-values from depth of measurement in sapwood of seven spruce trees.

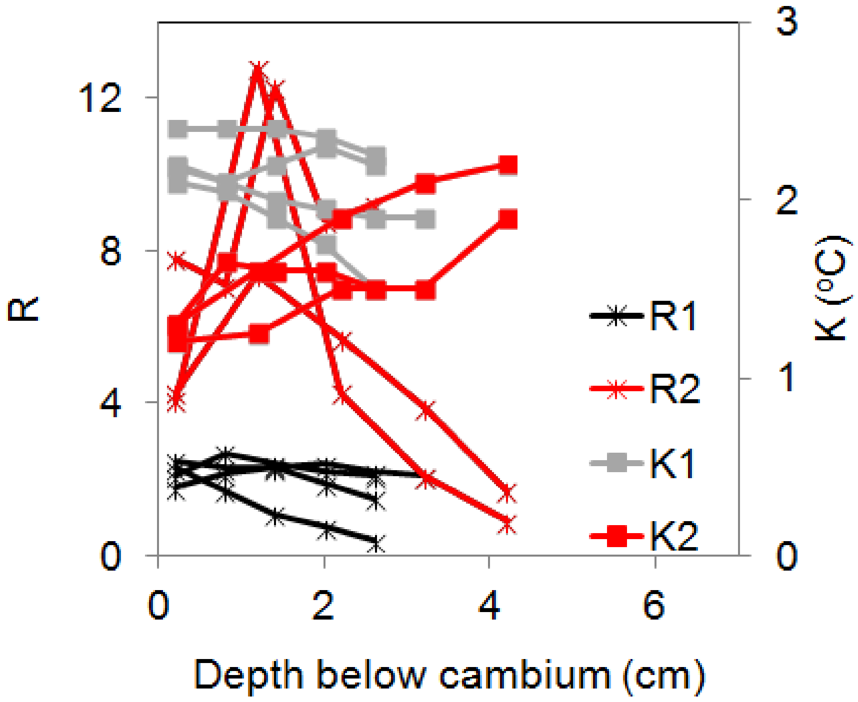

Fig. S7 - K-diagrams constructed for a Douglas-fir tree before (a) and after (b) application of localized irrigation. The latter was utilized from the tree side, opposite to sap flow measurements conducted during dry hot period. Due to high flows at nights it was difficult to determine K-value correctly by using interpolation line (a). Application of localized irrigation exactly indicates correct direction of the interpolation line (b).

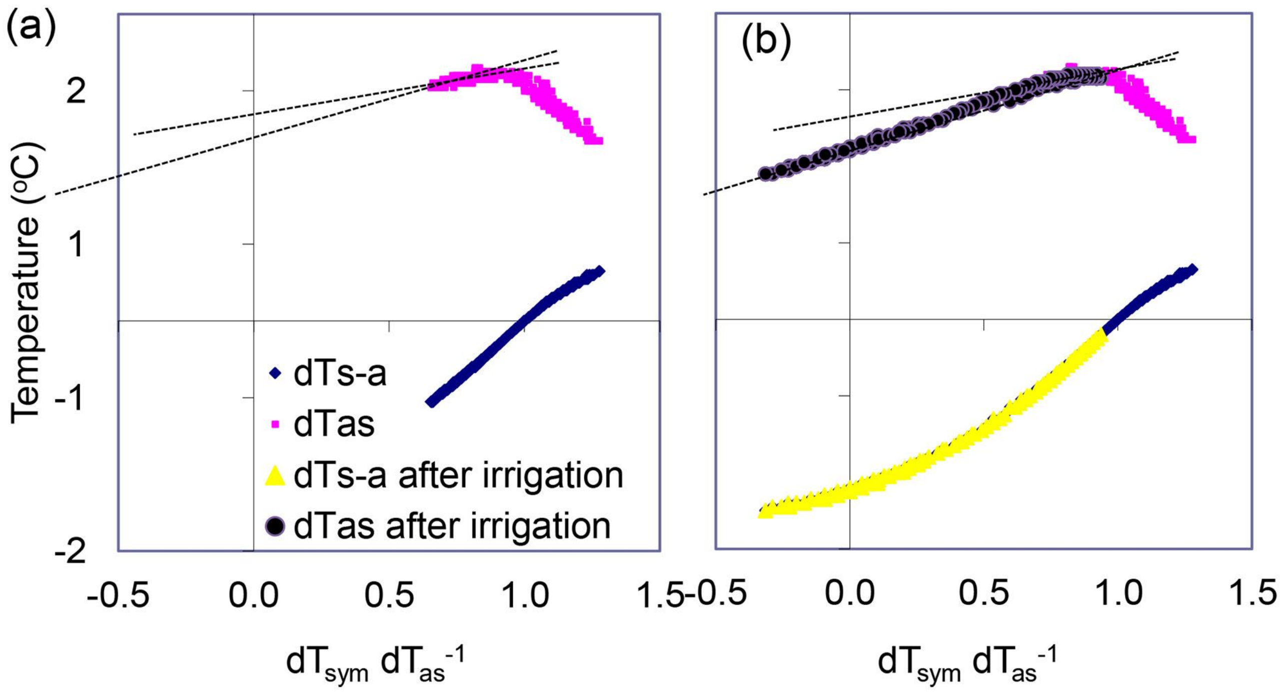

Fig. S8 - *K/R*-diagrams for a *Quercus suber* large sinker root (a) and spruce stem (b) measured during 7 months at xylem depth of 3 cm from the cambium. *K*-value was very stable for a *Quercus suber* root which always had success to deep underground water (a). *K*-value changed for spruce stem from 2.5 to 2.9ºC during the measured period due to gradual tissue desiccation caused by drought (b).

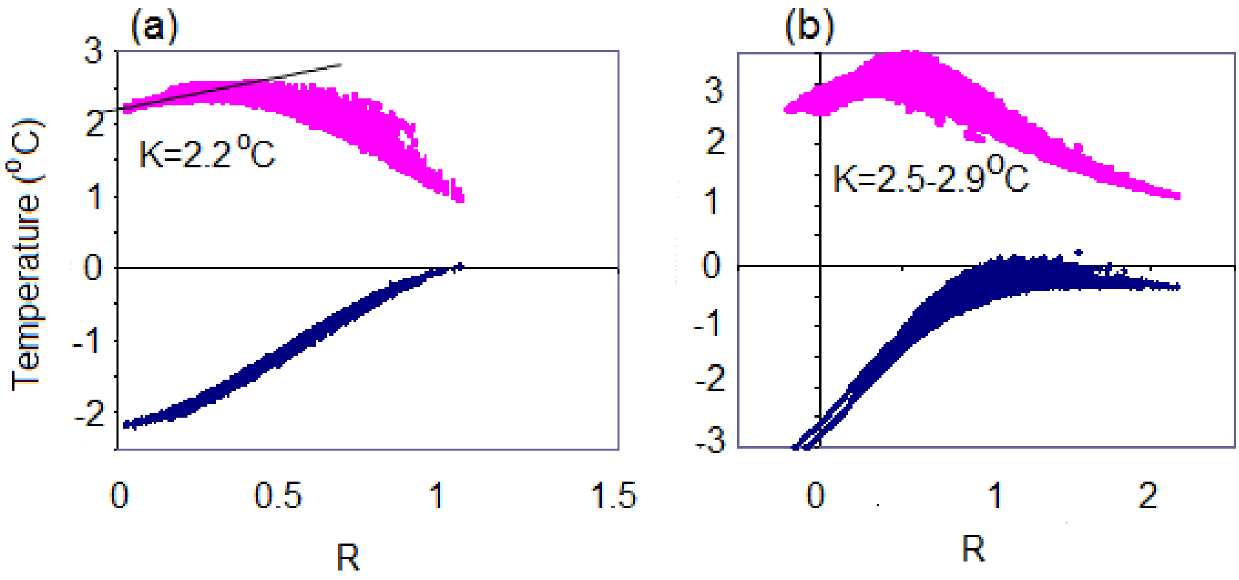

Fig. S9 - Sap flow dynamics measured in stem of a spruce tree in two xylem depths calculated without (a) and with (b) correction of K-value. *K*-value was stable in depth of 5 mm (red) but gradually increased in depth of 45 mm (black).

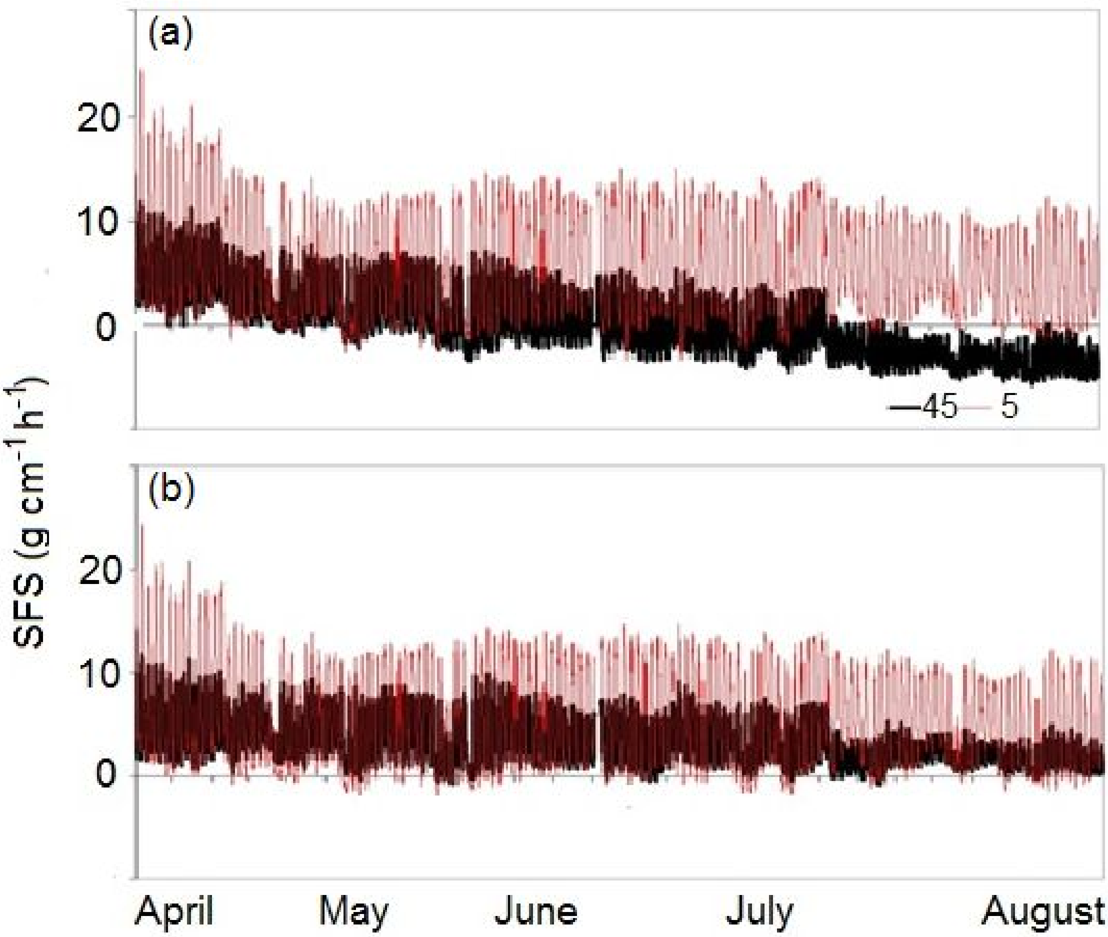

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Fig. S10 - Dynamics of temperature differences (a), sap flow (b) and K-diagram (c) for a spruce tree measured in a dry period. Results are shown for the outer xylem at depth of 5 mm below the cambium. *K*-value was stable and equal to 1.5 °C. Pink arrows indicate decrease of sap flow with drought progressing (b) and changes of *K*-value type (from type 1 to type 2) starting from the beginning of records (c).