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In the context of climatic change, species area may move and so, a study of forest species vulnerability is on interest. In Mediterranean regions, trees can suffer of water stress due to drought during summer. Responses to environmental constraints are delayed in forest so it is necessary to anticipate risks in order to adapt management. It would be therefore interesting to localize areas where trees might be vulnerable to water stress. To detect such areas, the idea developed in this study is to map the severity of water stress, which may be linked to soil. Because vegetation surface temperature is linked to transpiration and so to water stress, the relevance of thermal infrared as a tool to detect water stress was explored. Past studies about surface temperature of forests at the planting scale did not lead to conclusive results. At this scale, important spatial and temporal variations of surface temperature, with a magnitude of about 10°C, can be registered but there is possibly a sizeable contribution of the undergrowth (Duchemin, 1998a, 1998b). In the other hand, important stress are not detectable, probably due to meteorological conditions (Pierce et al., 1990). During spring and summer 2008, an experimentation was carried out on the silver fir (Abies alba) forest of Mont Ventoux (south of France) to evaluate temporal variations at tree scale of the surface temperature in relation to water stress and climatic conditions. Two sites and three trees were chosen for measurements of surface temperature with a view to have different levels of water stress. Transpiration deficit is characterised by the ratio of actual transpiration to potential transpiration which is computed by the ISBA model (Noilhan et al., 1989) implemented by climatic observations made at the top of tree canopy. Sap flow measurements needed to calculate this ratio were completed on different trees of the sites. Climatic datas also allows building reference temperature and then surface temperature indices. Throughout the experimentation, there were only short dry periods, 2008 being a wet year. During these periods, temperature indices increased while transpiration ratios decreased showing that an observable increase in surface temperature is induced by water stress. To assess the exploitable signal magnitude, a declining tree having negligible transpiration but a canopy structure, which was still comparable to a healthy tree, was monitored. A difference in surface temperature between the healthy tree and the declining tree get to an average of 4 °C. This gives keys of interpretation of thermal infrared measurements (sensitivity, magnitude) in case of silver fir forest. If encouraging results were obtained, the study showed that the range of magnitude remains modest. Therefore, the influence of climatic conditions, which also influence surface temperature, must be accounted very carefully. To reach operational results spatial study at the forest scale is now required.

Keywords: Fir, Abies alba, thermal infrared, water stress, transpiration, surface temperature, remote sensing

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