

**Assessing tree vitality and sensitivity to growing conditions in semi-arid pine forest using remote sensing techniques at the leaf to ecosystem scales**

Accumulating evidence show increased tree mortality and threats to forest survival in Israel and around the world. Higher temperature, reduced rainfall and changes in its patterns are likely the main causes. Warmer climate around the Earth desert belts will increase the atmospheric water demands, and will intensify the effects of decreasing precipitations, resulting in extended periods of drought. This, in turn, triggers mortality by severe damage the trees’ water transporting systems, and by depleting the carbohydrate reserve leading to carbon starvation. These effects lead, in turn, to increased tree vulnerability to pests’ attacks. The Earth dryland forest, coveting area larger than that of the boreal forests, provide important ecological services in the dry regions. Proper management and suitable afforestation activities, which consider adjusting ecosystem foliage density to conditions, using drought adapted species and ecotypes, must be developed as key management tools to help protect forests survivals. Forest trees ‘stress level’ as indicator of the tree ‘vitality’ is seldom monitored. Management steps are often taken either following large scale collapse. Monitoring forest trees ‘vitality’ using remote sensing (RS) techniques are emerging as powerful management tools that provide early warning for tree stress development on large spatial scales.

This research center on the development of RS-based early warning system to identify early stages of decrease tree ‘vitality’ in the pine forests in Israel. It will provide new insights to the early stages of stress development and powerful means for forest management in the face of climate change. A comprehensive research approach will combine measurements of tree activities from leaf to canopy scales, of carbon and water exchange, chlorophyll content, leaf and tree growth rates. Simultaneous RS measurements, will start also at the leaf and canopy scales, but will be extended using a drone and satellite measurements, and using wide range of wavelengths. This will be used to develop RS-based tree ‘vitality index’, that will be correlated to forest foliage density and the annual rainfall amount and patterns, to help assess the forest sensitivity to changes in growing conditions. Satellite and climatic data will offer extending the study to previous years.

The research will be based on the long-term activities at the Yatir forest research site, and will combine the ongoing gas exchange measurements with new RS measurements at different scales (tower, drone, and satellite), and forest conditions (including also the summer-irrigated plot, and the four thinning levels at the LTER plots).