# Mapping leaf area index in Finnish boreal forests

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The realization of the full potential of remote sensing for mapping land surface biophysical variables, such as leaf area index (LAI), requires methods that can generalize in space and time. Physical models have become well-established in the retrieval of biophysical variables from moderate to coarse resolution satellite data at global-scale, but empirical regressions based on vegetation indices are usually applied for mapping biophysical variables at finer spatial resolution.

We compared two different approaches for LAI mapping from Landsat ETM+ and SPOT HRVIR images. First, we used an extensive database of LAI measurements from five conifer-dominated boreal forest sites in Finland and reduced simple ratio (RSR) vegetation index to calibrate empirical regressions for predicting effective LAI ($L_e$). Next, we applied forest reflectance model PARAS to simulate RSR-$L_e$ relationships and training data for neural networks. The PARAS was parameterized using empirical data on canopy structure, leaf albedo estimated from images over dense forest stands, and mixtures of field-measured forest understory spectra. Finally, we tested the best methods for LAI mapping across Finland using IMAGE2000 and IMAGE2006 datasets.

According to the results, the empirical RSR-$L_e$ regression performed best when assessed at an independent test site in southern Finland. However, the difference to the best PARAS based retrievals was only marginal. The advantage of forest reflectance model PARAS is that it can directly use field measurements to parameterize the canopy structure (LAI-2000 plant canopy analyzer, hemispherical photographs) and optical properties of foliage and understory.