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Leaf area index (LAI) is a very important variable required in many hydrological processes. It controls evapotranspiration in several ways, rain interception and run-off. However, because LAI may change rapidly with space and time, estimates derived from remote sensing data could be used as input to spatially distributed hydrological models running at a range of scales.

The derivation of LAI from remote sensing data is not straightforward since several factors may confound LAI effect on reflectance. We propose to use radiative transfer model inversion to estimate LAI from top of canopy reflectance measurements. Several inversion approaches are compared, with emphasis put on the regularisation of the inverse process by introducing prior information on the variables.

Applications of this approach is made over several agricultural data sets at high spatial resolution (few 10th meters) thanks to hyperspectral (CASI, HYMAP) and BRDF (POLDER) airborne sensors. It includes the ReSeDA experiment on the Alpilles site in 1997 based on POLDER sensor, the Blue Earth experiment based on CASI in 1997, the DAISEX experiment in 1999 with POLDER and HYMAP and the Laon experiment based on CASI data in 2000 and 2001.

The limitations of these approaches are discussed, with due attention on the way to derive prior information, inverse techniques, uncertainties on measurements and models, and scaling effects.