

# Multi-sensor remote sensing for computing actual evapotranspiration and its application for irrigation performance assessment in the Roxo irrigation command area, Portugal

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## ABSTRACT:

A remote sensing technique, Surface Energy Balance Algorithm for Land (SEBAL), was applied to calculate actual evapotranspiration (ETa) over the Roxo irrigation command area (Portugal) by using fifteen satellite imageries produced from two sensors: four Thematic Mapper imageries (resolution: 30 m at visible bands and 60 m at thermal infrared bands) and eleven MODIS imageries (resolution: 250 m at visible bands and 1000 m at thermal infrared bands). Since the resolution of the Thematic Mapper imageries was higher than that of the MODIS imageries, ETa values of various landcovers computed from the MODIS imageries belonging to same or close dates were calibrated based on the four Thematic Mapper data to compute the monthly values of ETa. SEBAL is an algorithm that estimates ETa and other energy fluxes using remotely sensed data (satellite imageries) of different dates together with little ground data. Estimation of ETa from the SEBAL algorithm is the most crucial part in the assessment of irrigation performance as it can map the spatial and temporal structure of ETa. One-point value of ETa for a specific location cannot map the spatial and temporal structure of ETa over the entire irrigation command area because ETa varies for one type of crop to another due to different root zones, heights and densities, and differs from one month to another due to different environmental conditions such as soil moisture, precipitation and temperature. Spatial and temporal structure of ETa is a must to calculate irrigation performance indicators like Depleted Fraction (DF) and Relative Evapotranspiration (RET). Beside these two remote sensing-based indicators, the study also calculates other two ground-based indicators: Relative Water Supply (SWF) and Overall Consumed Ratio (OCR). The study combined remote sensing-based results with ground-based results for better assessment of the irrigation performance.

Depleted fraction during May-September in 2003, which was the core irrigation season in the Roxo irrigation command area, was around or higher than 1. This indicates the short supply of irrigation to the crops. Other three irrigation performance indicators: relative water supply, overall consumption ratio and relative evapotranspiration also described that none of the major crops in the irrigation command area had a sufficient supply of water. However, it was worth-mentioning that the crops like maize and sugar beet had not gone through adverse effects of production as they both showed higher values of relative evapotranspiration (0.75 and 0.72) despite that they were attributed to lower relative water supply values (0.65 and 0.64 respectively). This indicated that the soil in these crop fields was sufficiently wet to maintain evapotranspiration rate at high level. In overall, the study revealed that the combined approach of remote sensing and ground data could be employed for the study of irrigation performance assessment with a high reliability.

*Keywords:* SEBAL, irrigation performance assessment, actual evapotranspiration

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