Estimation of Forage Biomass and Nitrogen Using MERIS Data

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The quantification of biophysical and biochemical parameters of grassland is vital as they act as indicators of the productivity, stress, growth and nutrient status. The two main objectives of this study were to (a) evaluate the predictive performance of vegetation indices (NDVI, SAVI and TSAVI) and band depth analysis parameters (BD, BDR, BNA and NBDI) for green biomass estimation and (b) to evaluate the predictive performance of MTCI, REP and band depth analysis parameters for foliar nitrogen (nitrogen concentration and nitrogen density) using MERIS data. Simple linear regression was used to relate vegetation indices (NDVI, SAVI and TSAVI) with green biomass and stepwise multiple linear regression was used to predict green biomass from band depth analysis parameters (BD, BDR, BNA and NBDI). For estimating foliar nitrogen from MTCI and REP, simple linear regression was used while for estimating foliar nitrogen from band depth analysis parameters stepwise multiple linear regressions was used. Using calibration dataset, all band depth analysis parameters except BD resulted in higher coefficient of determination ($R^2 = 0.73$) compared to vegetation indices ($R^2 = 0.54$ for SAVI, $R^2 = 0.52$ for TSAVI and $R^2 = 0.51$ for NDVI). Using independent validation dataset, band depth analysis (NBDI) predicted green biomass with a higher accuracy (136.2 g/m2, 47 % of the mean) compared to SAVI (444.6 g/m2, 154 % of the mean). For the estimation of nitrogen concentration, band depth showed very low coefficient of determination ($R^2 = 0.21$) and the results of MTCI and REP were statistically non-significant ($P > 0.05$). Using calibration dataset for the estimation of nitrogen density, band depth analysis parameters resulted in a moderate coefficient of determination ($R^2 = 0.51$ for NBDI, $R^2 = 0.52$ for BNA, $R^2 = 0.52$ for BDR and $R^2 = 0.30$ for BD) compared to MTCI ($R^2 = 0.29$) and REP ($R^2 = 0.24$). Using independent validation dataset, band depth analysis (NBDI) predicted nitrogen density with a higher accuracy (4.2 g/m2, 39 % of the mean) compared to MTCI (6.6 g/m2, 61 % of the mean). Band depth analysis parameters predicted biomass more accurately than vegetation indices (SAVI, TSAVI, and NDVI). The prediction performance of band depth analysis parameters for nitrogen density was more accurate than MTCI and REP. The prediction of nitrogen concentration was poor ($R^2 < 0.25$).