Evaluation of Collection 5 MODIS Terra, Aqua and Combined LAI Products

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Abstract

Suite of Collection 5 MODIS LAI/FPAR products include 8-day Terra and Aqua products, 8-day Combined Terra and Aqua product, and Daily Combined Terra and Aqua product. In this study we evaluated Collection 5 LAI/FPAR products over the range of spatial scales; North America continent (single composite during the growing season), or scale of MODIS tile (spatial time series for three MODIS tiles). For validation we used Collection 4 Terra and Aqua surface reflectance, Collection 4 Land Cover and Collection 5 LAI/FPAR algorithm. To understand the performance of the algorithm over two data sets, we used combined product. Our results contribute to understanding the satellite algorithms of two products, main (Radiative Transfer based) and back-up (empirical). Comparison of histograms confirms stability of Terra, Aqua and Combined LAI products. In general, histograms are similar for Collection 4 and Collection 5 products. The difference between combined and Terra or Aqua data is due to spatial and temporal variability of the data. The difference between combined and Terra or Aqua data is due to spatial and temporal variability of the data. The difference between combined and Terra or Aqua data is due to spatial and temporal variability of the data. Local LAI retrievals algorithms consists of two parts, main (Radiative Transfer based) and back-up (empirical). Contribution of Terra and Aqua retrievals are equal at the continental scale for all vegetation types. Locally contribution may vary as function of space and time. Single sensor retrievals (Aqua or Terra) have high retrieval rate of 8-day single sensor product, but improve temporal resolution of the product- 4-days product. Based on the above: spatial distribution of LAI from Terra and Combined products is similar; there is no spatial patterns of predominant Terra or Aqua retrievals- essentially random coverage; General retrieval rate of the main algorithms is 80% for Terra and 85% for Combined; Back-up algorithm retrievals are mostly concentrated over woody vegetation and combined product helps to improve retrieval rate over woody vegetation by about 15%.

Results

Continental Scale

Site Scale

Tile Scale

Conclusions

- Suite of Collection 5 MODIS LAI and FPAR products will include the following: a) 8-day Terra (MOD15A2), b) 8-day Aqua (MCD15A3), c) 8-day Combined Terra and Aqua (MOD15A2), and d) 4-day Combined Terra and Aqua (MCD15A3).
- We analyzed preformance of the above products using Collection 4 Aqua and Terra Surface Reflectance products, Collection 4 Land Cover product, and Collection 5 LAI/FPAR algorithm.
- For completeness and generality of results three spatial scales were used in analysis: continental (North America), MODIS tile scale (1200x1200 km), and scale of validation sites (7x7 km).
- Terra has the longest time series. Collection 5 LAI/FPAR algorithm overestimates LAI for all vegetation types, in general we see more noise in Aqua LAI retrievals based on limited case studies. We also found that Aqua NDVI is quite often lower than Terra, which results in similar difference between Aqua and Terra LAI. The difference is within product specifications (0.5 LAI) for both continental and tile scale, however could be large at the local scale of validation sites. We attribute this due to noise in surface reflectances.
- Combined Terra and Aqua product selects best retrievals from two data sets. Contribution of Terra and Aqua retrievals are equal at the continental scale for all vegetation types. Locality contribution may vary as function of space and time. Single sensor retrievals (Aqua or Terra) have high retrieval rate of 8-day single sensor product, but improve temporal resolution of the product- 4-days product.
- Our study suggests that for Collection 5 and future reprocessing of the suite of MODIS land products the algorithm and RT theory, which predicts the relationship between LAI and FPAR, is an important part of the overall algorithm performance. Based on the above, we recommend using Combined LAI product, which combines the strengths of both datasets, and improves the accuracy of atmospheric corrections.

Figure 1. Spatial distribution of 8-day Terra, Aqua and Combined products. Collection 4 MODIS Terra and Aqua Surface Reflectance products for days 101-200, 2000. Collection 4 Terra Land Cover product and Collection 5 LAI/FPAR algorithm were used to retrieve LAI over North America continent: (a) Terra LAI, (b) Terra QC, (c) Combined LAI, (d) Combined QC. Maps show LAI distribution. Aqua retrievals are not shown due to large uncertainties. Generally LAI retrieved from Aqua LAI/FPAR products is lower than Terra LAI. Combined product selects best retrievals from two data sets. Contribution of Terra and Combined product helps to improve retrieval rate over woody vegetation by about 15%.