

**BRF/albedo inversion constrained by temporal smoothness.**P. Lewis<sup>1\*</sup>, T. Quaife<sup>1</sup>, C. B. Schaaf<sup>2</sup><sup>1</sup>Remote Sensing, University College London<sup>2</sup>Department of Geography and Environment, Boston University

Estimating (spectral) albedo and related shortwave energy budget measures from moderate spatial resolution wide field of view satellite sensors such as MODIS inevitably involves temporal compositing of angular samples of the bidirectional reflectance factor (BRF) to allow for angular integration. Early attempts used simple block moving windows (e.g. compositing over a 16 day window, every 16 days for MODIS). An appreciation that a higher frequency moving window provides more opportunities for sufficient samples to be able to invert the BRF model has led to the current version of the MODIS BRDF/albedo product still compositing over 16 day windows, but now stepping every 8 days. The fundamental assumption behind such compositing is that the surface properties remain constant over the compositing period. The temporal width of the moving window then controls the degree of (temporal) smoothness of the resulting product. That said, many areas still suffer from having insufficient observations within the prescribed temporal window to robustly invert the BRF/albedo model.

In this paper, we apply the concepts of Twomey (1977) to the problem of linear BRF model inversion for albedo estimation. The method has previously been widely applied to atmospheric inversion problems. In essence, rather than having e.g. a solution every 8 days assuming conditions constant over 16 days, as with the MODIS product, we obtain an estimate of model kernel parameters for every day in a time series, with the condition that the kernel parameters change smoothly in time. The degree of smoothness is controlled by a Lagrange multiplier that constrains first-order differences. The resultant temporal trajectories of model parameters are less noisy than those obtained with the moving window approach, and appear to be much better constrained in regions of sparse sampling than current 'backup algorithm' methods used in the MODIS product. Results are shown for a range of conditions and comparisons made with the MODIS BRDF/albedo product. An equivalence between this method and the Kalman smoother approach is noted.

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