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Multiscaling of vegetation and moisture indices from MODIS satellite data.

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Scaling processes are increasingly understood to be the result of nonlinear dynamical mechanisms repeating scale after scale over a large range of scales leading to non-classical resolution dependencies. Statistical properties consequently vary in power law ways with the spatial resolution. When classical (single scale) remote sensing algorithms are applied to surrogates derived from such fields, they can at most be correct at the unique (and subjective) calibration resolution.
Scaling analysis and modeling techniques are applied to MODIS TERRA bands 1-7 satellite data and the standard derived vegetation and soil moisture indices in order to quantitatively characterize the wide range scaling of these fields. The scaling exponents we find are not so large; however, they act over wide scale ranges and imply large effects. For example for statistics near the mean, the MODIS (500 m) resolution would be biased by a factor $\approx$1.52 when compared to similar results from an "ideal" sensor at 1 mm resolution. Applying the standard index algorithms on lower and lower resolution satellite data we obtain indices with significantly different statistical properties than if the same algorithm was used at finer resolution and then degraded to an intermediate value (a difference of a factor $\sim$1.54). Our results demonstrate that these commonly used algorithms can at best be accurate at the unique calibration scale and point to the urgent need to develop resolution independent algorithms based on the scaling exponents.