



Radiometric Normalizationradiometric normalization

Remote sensing applications often use image time series or mosaics of various images or image parts. *Radiometric normalization* generally refers to empirically reducing the differences between images in time series or mosaics related to differences in the image acquisition time or date. These differences can affect the accuracy of image interpretation. In satellite-based optical remote sensing, these differences include differing atmospheric conditions, target illumination, sensor calibration, or surface phenology. Radiometric normalization is applied both to images that have undergone atmospheric correction and to those that have not.

Image radiometric normalization is warranted when

1. the spectral signatures from one image will classify other images without other normalization,
2. the particular approach to time-series analysis requires that the radiometric differences between images be minimal, or
3. a single linear model that does not account for image date will classify an image mosaic.

Radiometric normalization is mathematically superfluous when change detection consists of stacking images through time and then simultaneously classifying them empirically, as with a maximum-likelihood classification. Radiometric normalization may also be unnecessary when using machine-learning models, to classify an image mosaic, if the reference data for the classification model represent all image dates.

To radiometrically normalize images to a reference image or to each other, calibration models are estimated from pixels in the images and then applied to the imagery. Normalization models estimated from linear regression between manually selected, spectrally stable features, such as human-made structures, are unreliable if the goal is to normalize differences in surface phenology. Models estimated from all overlapping pixels, with linear regression, histogram matching, or regression tree normalization, are more stable. When pixels that have not undergone real change dominate images, removing changed pixels before estimating the model is statistically unnecessary. Regression tree normalization matches vegetation phenology more closely than histogram matching, and histogram matching may yield better results than linear regression. Localized approaches estimate a separate model for each pixel based on overlapping pixels within a surrounding window. Of all these approaches, only regression tree normalization and localized approaches can normalize nonlinear image differences in vegetation phenology, but these approaches can also result in some loss of image detail.

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Further Readings

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