Biophysical products from Landsat

Ramakrishna Nemani

NASA Ames Research Center

Ranga Myneni

Boston University

Jennifer Dungan

NASA Ames Research Center

LANDSAT Science Team Meeting

June 12-14, 2007

Planned Contribution

- Develop an operational capability to produce vegetation green leaf area index (LAI) from Landsat data by adapting a physically based approach conceived and implemented by the MODIS Science team.

- LAI- Leaf Area Index is defined as one-sided green leaf area per unit ground area in broadleaf canopies and as the projected needle leaf area in coniferous forests.

- LAI is an important variable for quantifying the cycling of water, carbon and nutrients through ecosystems.

Good practice on reporting predictions

“When reporting the estimated value and uncertainty of such a measurand, one should always make clear that the measurand is defined by a particular method of measurement and indicate what that method is. One should also give the measurand a name which indicates that it is defined by a measurement method, for example, by adding a modifier such as `conventional.’”

-Taylor and Kuyatt (1994)

NIST standard concepts and terminology
Taylor and Kuyatt (1994)

- **Accuracy** – a qualitative statement about the closeness of the measurement to the value of the variable of interest (the measurand)
- **Precision** – a qualitative statement about the repeatability and/or reproducibility of the measurement
- **Repeatability** – the closeness of the agreement between the results of successive measurements of the same measurand carried out under the same conditions of measurement
- **Reproducibility** - closeness of the agreement between the results of measurements of the same measurand carried out under changed conditions of measurement
- **Random error** - result of a measurement minus the mean that would result from an infinite number of measurements of the same measurand carried out under repeatability conditions
- **Systematic error** (sometimes called bias) - mean that would result from an infinite number of measurements of the same measurand carried out under repeatability conditions minus the value of the measurand

NIST standard concepts and terminology (continued)

- **Standard uncertainty** – a quantitative statement expressed as the standard deviation of repeated or reproduced measurements obtained using statistical or other methods. The suggested symbol is u_i
- **Combined standard uncertainty** – the standard uncertainty obtained by combining the individual standard uncertainties using the law of propagation of uncertainty. The suggested symbol is u_c
- **Expanded uncertainty** – the measure of uncertainty that defines an interval about the measurement result y within which the value of the measurand Y is confidently believed to lie. The suggested symbol is U; $U = ku_c(y)$ and it is confidently believed that $Y-U \leq Y \leq y+U$, which is commonly written as $Y = y \pm U$. The conventional coverage factor k is 2; this should be specified.

OLI Requirements

- **5.6.1 Absolute Radiometric Uncertainty**

OLI-792 The OLI absolute radiometric uncertainty shall be as given in Table 5.6-1 for the range of Ltypical to 0.9 Lmax (Table 5.6-2).

OLI-1420 At any other radiance across the range of 0.3 Ltypical to Ltypical the absolute uncertainty shall not exceed the values in Table 5.6-1 by more than 0.5%. This requirement applies to extended, spatially uniform, unpolarized targets with a known spectral shape.

OLI-793 Pre-launch radiance uncertainties shall be established relative to National Institute for Standards and Technology (NIST) standards.

OLI-794 Uncertainty estimates shall include the NIST standard uncertainties.

Parameter	**Requirement (1-sigma)**
Radiance	5%
Top of Atmosphere (TOA) Reflectance	3% of actual TOA

Questions

- Radiometric specifications are required to be standard uncertainties. How were these determined?
- What are the implications of the specifications for OLI for standard uncertainties of surface spectral reflectance?
- How will reflectance uncertainties influence the uncertainty of leaf area index predictions?
- What influences LAI accuracy more -- assumptions in the model or propagation of input error sources?