Summary of SpecNet North Meeting, September, 2007.

About 40 people met at the University of Alberta for the "SpecNet North" meeting in Edmonton from 10-14 September, 2007, to consider the scientific and technical issues related to northern-latitude sampling. Many attendees were using (or interested in using) some form of spectral reflectance to study northern latitude (arctic and boreal) ecosystems, although other ecosystems were also represented. A few summary points from the meeting are presented here.

Scientific Issues

Much of the discussion centered on changing surface cover in northern latitudes. This included changing vegetation functional types (e.g. strub and treeline movement, and the potential replacement of moss with vascular plants, associated with warming, surface drying, and increasing active layer depth. We noted the limited history of interpreting spectral reflectance largely in terms of greenness (NDVI) and carbon uptake, and noted that there were other uses for reflectance that were less studied. For example, we noted that more emphasis needed to be placed on linking spectral measurements to changing phenology, albedo, respiration and methane fluxes, and that finer assessment of functional types (e.g. moss vs. vascular plant cover) could be useful.

Standardization

There continues to be discussion of how much and what kind of "standardization" is needed within the SpecNet community. While everyone recognized the value of standard protocols, we recognized that too much restriction (overly strict standards) would stifle innovation and creativity. Also, not all participants can afford the same level or type of technology or methodology (SpecNet is a voluntary cooperative, not a funded effort, limiting our ability to enforce standards). In the absence of enforced standards, we can establish a series of recommendations or "best practices" and make these available through publications and the SpecNet website.

We recognized that within the group as a whole, there are three levels of technology:

• simple two-band radiometers (e.g. Skye Sensors and "NDVI meters" defined by Huemmrich et al. 1999),

• hyperspectral field spectrometers, sometimes automated (e.g., Gamon et al. 2006, Leuning et al. 2006, and Hilker et al. 2008)

• imaging spectrometry (e.g. AVIRIS, Headwall Photonics, etc.)

Most of our discussion centered on levels one and two (what most people can afford). However, there has been insufficient comparative testing of brands or assessment of issues like sensor longevity or calibration drift, particularly under field conditions. Consequently, inter-brand comparison and standardization or cross-calibration is needed,

and this will be a focus of our next SpecNet meeting (scheduled for Italy in June-July, 2008, spearheaded by Loris Vescovo).

The second level (hyperspectral sensors) provides very rich and complex datasets, but the meaning of these spectra varies with the context, which includes spatial, temporal, spectral and angular (geometric) aspects. For example, the shape and appearance of a plant spectrum depends upon sampling scale (leaf – canopy – stand), season, time of day, sun angle, look angle, sky conditions, in addition to the type and physiological state of the plant (for recently published examples, see papers by Sims et al. 2006, Hilker et al. 2008, and Hall et al. 2008). A well-designed measurement campaign should explicitly take this complexity into account. In part because of this complexity of measurement context, we decided that much of the "standardization" at this level needed to focus on good documentation (metadata) that can properly record the sampling conditions.

One conclusion was that we would try to develop a sample spectral library for northern latitude vegetation based on spectra that had already been collected. Several sample data sets already exist, but have not been adequately documented, or the documentation has not been adequately standardized, so these spectra are of limited use beyond their original purpose. Thus any attempt to develop a library should largely focus on tools for documenting the context (e.g. metadata tools). Several examples of emerging metadata efforts and related databases exist within the SpecNet community and could be the starting point for this effort.

Once adequate metadata standards had been developed, we could add in additional datasets or join efforts with other similar groups (e.g. TropiDry, USGS) who also are developing or have developed spectral libraries of vegetation. Thus, a primary role of SpecNet can be to clarify the metadata needs, to provide metadata tools for the larger community. Development and provision of software tools (e.g. processing tools, medatada editors, databases, etc.) needs to be an ongoing focus, but is currently unfunded. Since there is no direct funding for this effort, we would either need to seek new funding, or work with other funded efforts (e.g. Canarie, NCEAS and Oak Ridge DAAC).

SpecNet Website

The group felt that the website was a valuable part of SpecNet that could be far better developed, and much discussion centered on what products or tools might be placed on the website. A long list of potential additions was discussed, and several people volunteered to contribute (see "SpecNet Wrap-up Discussion – Sept 13, 2007). We noted that since the website itself was an unfunded volunteer effort, it may take time to implement many of the suggested improvements, and that further volunteers would be welcome in developing individual pages, and that J. Gamon would continue to coordinate this effort in the foreseeable future.

Organizational efforts

The SpecNet efforts overlap considerably with other scientific efforts and organizations, yet our focus on spectral reflectance as "proxies" for many ecological variables provide a unique role for SpecNet. Considerable discussion centered on how to continue outreach efforts that might enable us to better link our work to that of other groups. In addition to our long-standing interest in carbon fluxes, there were several other communities identified for outreach. For example, the interest in defining cover and surface energy balance suggests that we should be working more closely climatologists. The emerging interest in phenology, particularly in northern latitudes, suggested we should be contacting existing phenological monitoring groups and defining our own unique (e.g. automated optical sampling approach) to the problem of changing phenology. Finally, the need for a better cyberinfrastructure requires that we work closely with computer scientists or data archiving communities (e.g. Canarie, NCEAS and Oak Ridge DAAC). We also discussed the possibility of incorporating SpecNet as a nonprofit group and the value of establishing a steering committee or advisory board to help guide SpecNet.

Future meetings

Two potential meetings are planned for the next year. One would be a small meeting at NCEAS (organized by J. Gamon) to continue working on data/metadata needs, perhaps focused on developing a sample spectral library (date to be determined). A second meeting, to be held in Italy (led by Loris Vescovo and European colleagues) would address the simple sensor technology and related calibration and standardization needs.

References Cited:

Gamon JA, Cheng Y, Claudio H, MacKinney L, Sims D (2006b) A mobile tram system for systematic sampling ecosystem optical properties. Remote Sensing of Environment . 103:246-254

Hall FG, Hilker T, Coops NC, Lyapustin A, Huemmrich KF, Middleton EM, Drolet GG, Margolis HA, Black A (2008) Multi-angle remote sensing of forest light use efficiency by observing PRI variation with canopy shadow fraction Remote Sensing of Environment , in press.

Hilker T, Coops NC, Hall FG, Black TA, Wulder MA Nesic Z, and Krishnan P (2008) Separating Physiologically and Directionally Induced Changes in PRI using BRDF Models. Remote Sensing of Environment , in press.

Huemmrich KF, Black TA, Jarvis PG, McCaughey JH, Hall FG (1999) High temporal resolution NDVI phenology from micrometeorological radiation sensors. Journal of Geophysical Research . 104(D22):27,935-27,944.

Leuning R, Hughes D, Daniel P, Coops NC, Newnham G (2006) A multi-angle spectrometer for automatic measurement of plant canopy reflectance spectra. Remote Sensing of Environment . 103:236-246.

Sims DA, Luo H, Hastings S, Oechel WC, Rahman AF, and Gamon JA (2006) Parallel adjustments in vegetation greenness and ecosystem CO 2 exchange in response to drought in a Southern California chaparral ecosystem. Remote Sensing of Environment . 103:289-303.