Connections and Key Scientific Issues: A Terrestrial Perspective
How do we get from Point A to Point B?
Timing is everything

• Trajectories of change
• Sequence and linkages
Timescale of change in terrestrial biogeochemistry and energy balance is longer than timescale of major climatic oscillations.

Spatial scales are generally finer.
Major need: Study systems that are clearly changing, focus on linkages not single processes
Scaling up: How can we make broad regional predictions from fine-scale measurements?
**Fig. 5** The relationship between mean total vascular plant foliar N (± 1 SE) and mean leaf area index (± 1 SE) for sites along the transect. Also plotted is the linear regression ($r^2 = 0.93, y = 0.31 + 1.29x$).

**Fig. 6** The modelled response surface of GPP of vascular plants (contour lines, g C m$^{-2}$ day$^{-1}$) to combined variations in LAI (L; m$^2$ leaf area m$^{-2}$ ground area) and total foliar N (N; g N m$^{-2}$ ground area). Also shown (symbols) are the LAI–N relationships for the sites along the transect, and the line that connects points on the surface where $\partial P/\partial N = 1.48 \partial P/\partial L$, where $P = GPP$. 
\[ y = 1.89x \]
\[ R^2 = 0.95 \]

\[ y = -0.44x^2 + 2.16x \]
\[ R^2 = 0.92 \]
A. Control plots

B. Fertilized plots

Apical growth, g/m²/y

Forb apical
Evergreen apical
Deciduous apical
Graminoid apical
New elements: e.g., Winter C turnover
“Development” of prev. observed changes: e.g., Shrub abundance

Identification of feedbacks:
- Surface Energy balance
- C cycling/GH gases
- Water
- Nutrients

Scales of change: longer time scale, coarser space scale than climate oscillations.
A. Control plots

Apical growth, g/m²/y

Forb apical
Evergreen apical
Deciduous apical
Graminoid apical
Fig. 2. Relationships between aboveground net primary production (g/m²) and annual precipitation (mm) for a regional model (Sala et al. 1988) for the Central Grassland Region of the U.S. and for the long-term model from this work for the Central Plains Experimental Range. Shaded areas represent 95% confidence intervals. Regional model ANPP = −34 + 0.60(Ann. Precipitation). Long-term model ANPP = 56 + 0.13(Ann. Precipitation).
**Figure 4.** Aboveground net primary production versus biomass, leaf mass, and leaf area in the long-term fertilizer experiment at Toolik Lake, Alaska. Open symbols represent data from control plots; filled symbols represent fertilized plots. For the fertilized plots, the year of harvest is indicated for each data point. Data from 1983-1995 are from Shaver et al. 2001; data from 2000 are unpublished.