

**Bottom-up modeling
studies for the NACP
Mid-Continent Intensive**

Faith Ann Heinsch
Campaign

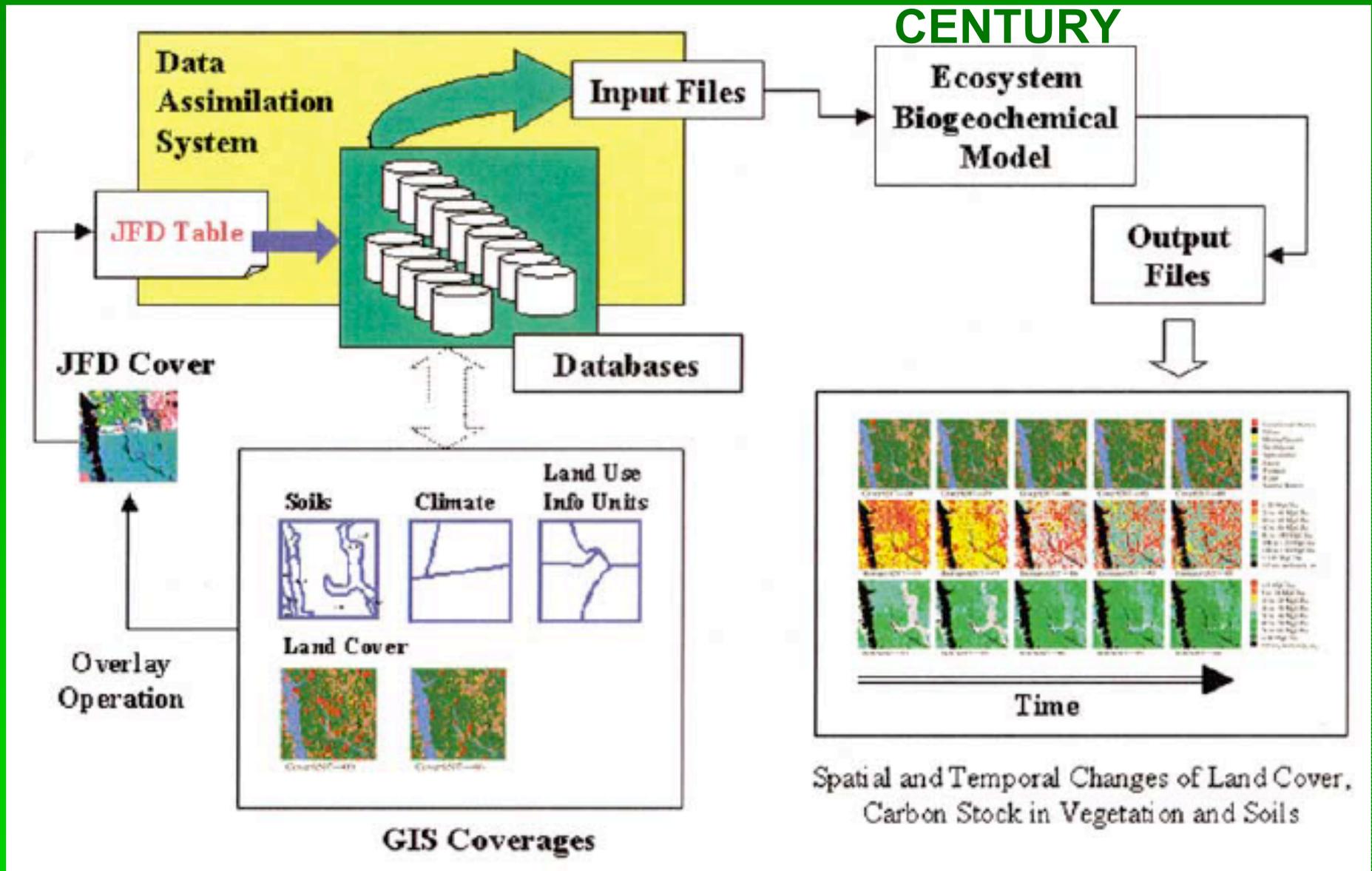
NACP Midcontinental Regional Intensive
Investigators' Workshop

February 21, 2006

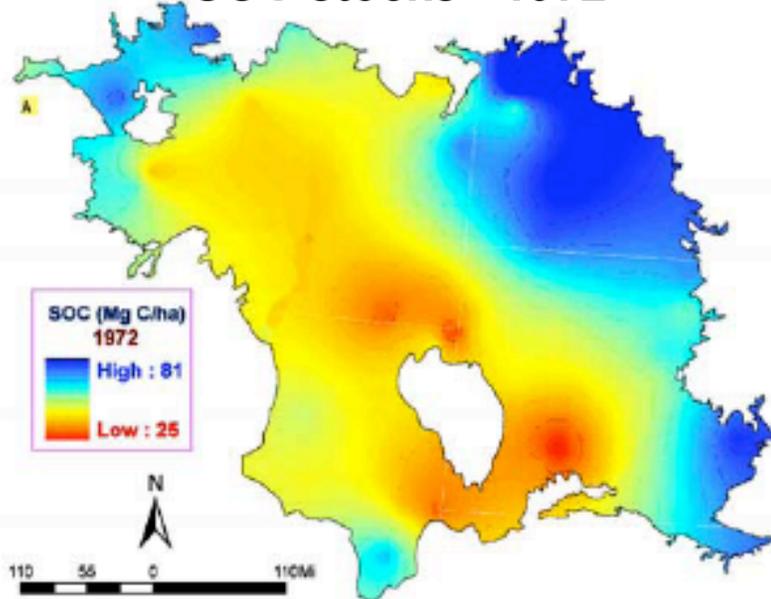
General Ensemble Biogeochemical Modeling System (GEMS)

- Uses sampling blocks rather than a wall-to-wall design
- Land Cover and Land Use Change are detected using multi-year Landsat data
- Carbon dynamics computed with GEMS

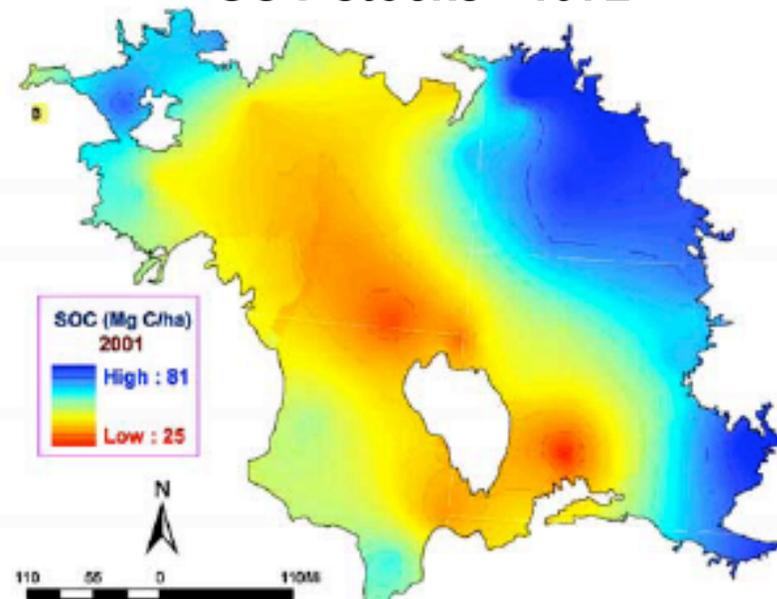
GEMS



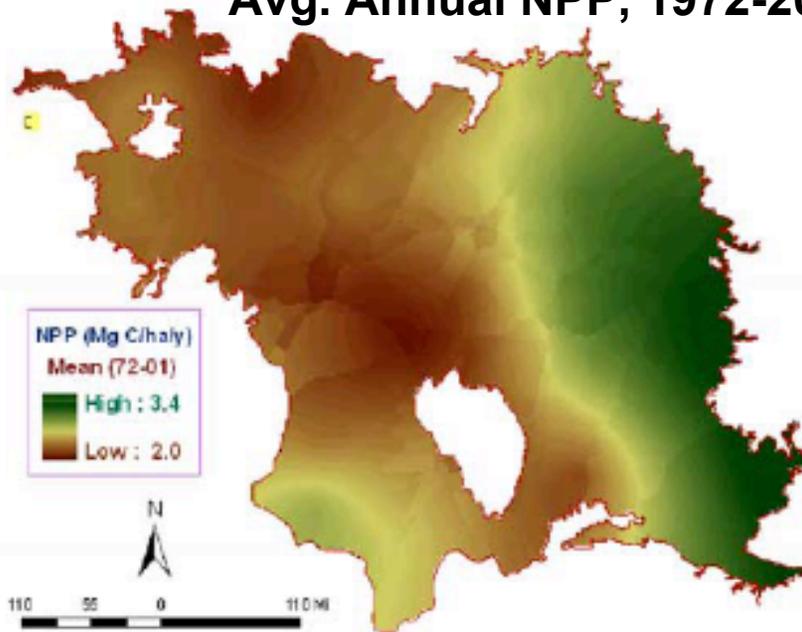
SOC stocks - 1972



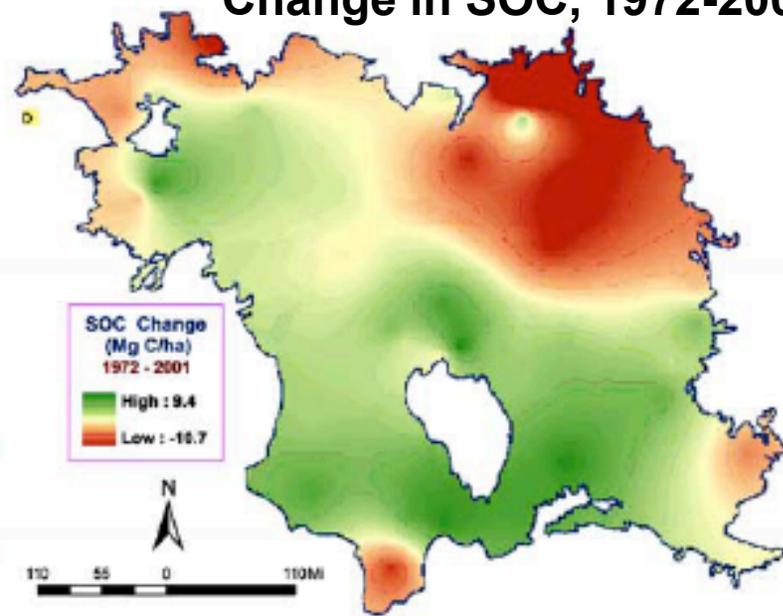
SOC stocks - 1972



Avg. Annual NPP, 1972-2001

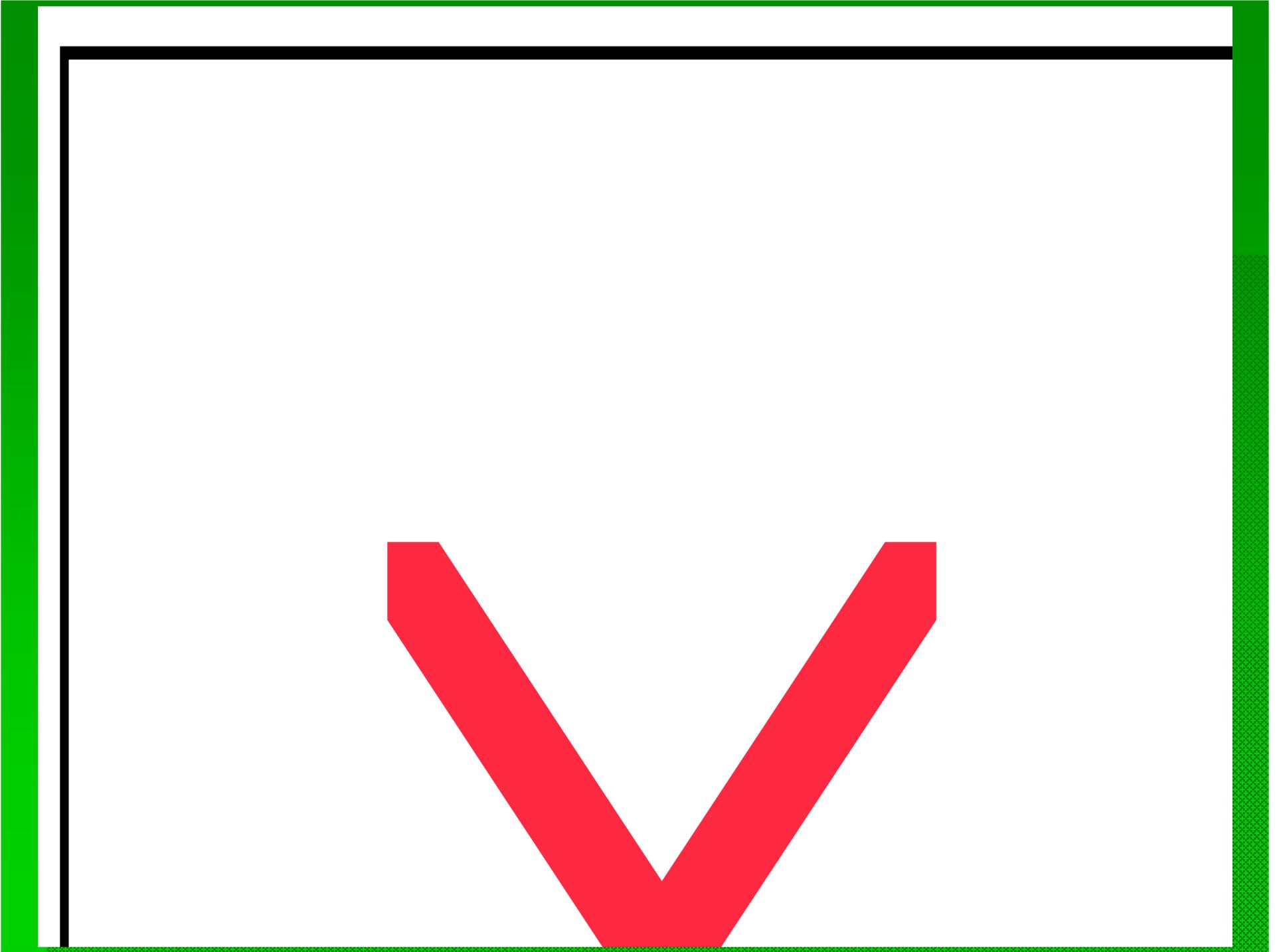


Change in SOC, 1972-2001

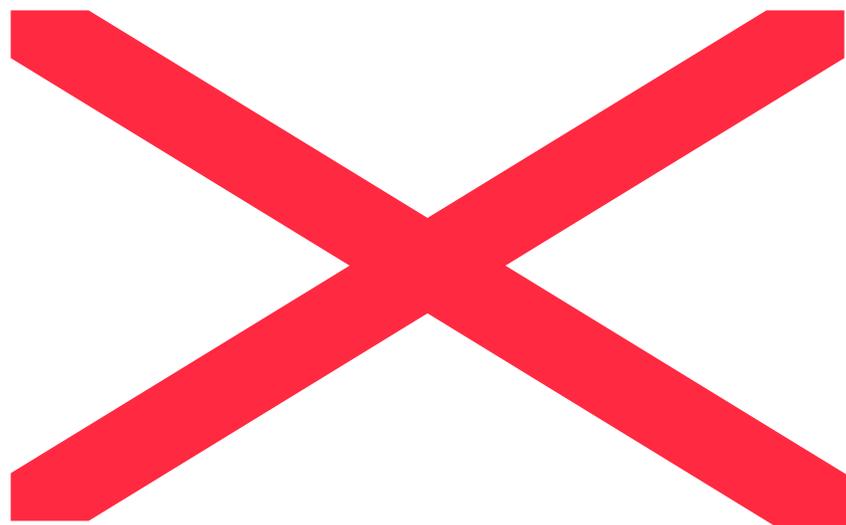


DeNitrification-DeComposition Model (DNDC)

- DNDC
 - Developed for agricultural systems
 - Carbon, nitrogen and trace gas emissions
- Wetland-DNDC
 - Developed for forested wetlands
 - Water, carbon, and nitrogen dynamics
 - Uses PnET
 - forest production, ecosystem C dynamics and emissions of trace gases (CH₄, N₂O, NO, N₂, NH₃)



Inventories of N₂O emissions (2000) and changes in emissions (1990-2000) from European forest soils



FORCARB2

- Forest carbon budget simulation
- Estimates based on inventory data
- Includes projections of future timber resources
 - NAPAP (Ince 1994)
 - TAMM/ATLAS (Mills and Kincaid 1992, Haynes 2003)

Current regional average carbon density for forest ecosystem C pools

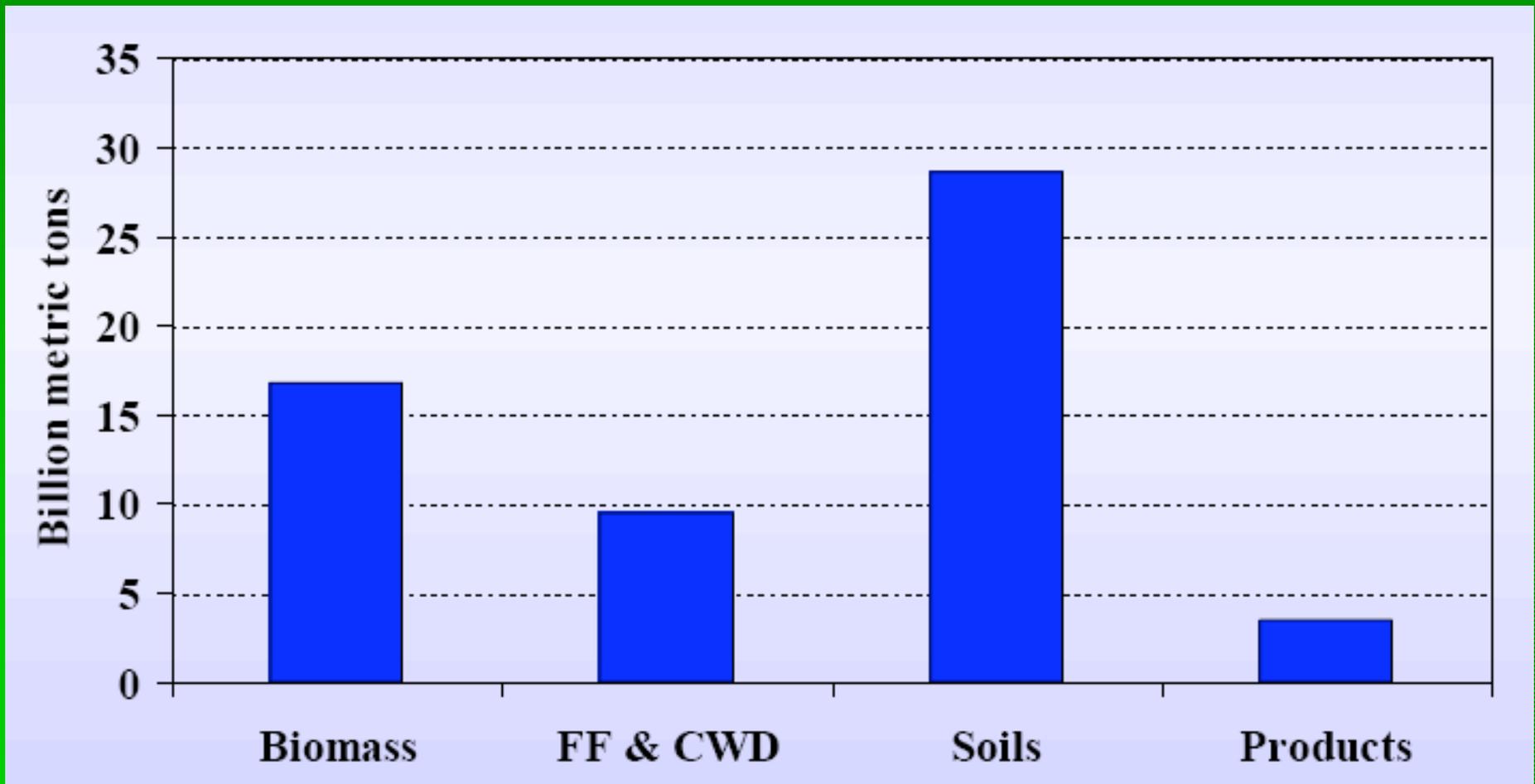
Table 3. Estimates of current regional average carbon density (metric tons carbon per hectare) and area (1000 hectares) for forest ecosystem carbon pools

Region ^a	Carbon pool/area	Carbon (t/ha)			
		National forest timberlands	Other public timberlands	Reserved forestlands	Other forestlands
GP	Biomass	55.7	52.6	58.5	15.0
	Nonliving plant mass	31.7	27.9	29.2	13.3
	Soil organic carbon	86.9	116.6	97.7	97.9
	Area (1000 ha)	413	104	27	77
NC	Biomass	66.2	60.1	63.3	26.3
	Nonliving plant mass	28.4	29.2	28.1	30.4
	Soil organic carbon	158.9	172.9	161.4	176.5
	Area (1000 ha)	3,106	5,984	1,109	344
NE	Biomass	100.3	85.6	43.8	40.1
	Nonliving plant mass	31.7	26.7	24.9	25.7
	Soil organic carbon	132.5	122.9	135.4	135.0
	Area (1000 ha)	876	3,205	1,987	129
SC	Biomass	79.0	79.0	80.9	28.2
	Nonliving plant mass	17.8	17.1	16.7	8.5
	Soil organic carbon	93.5	109.1	93.4	88.0
	Area (1000 ha)	2,645	2,057	530	28
SE	Biomass	81.1	67.0	78.4	31.5
	Nonliving plant mass	17.0	15.7	16.6	8.4
	Soil organic carbon	98.8	114.2	114.1	85.0
	Area (1000 ha)	1,906	1,983	1,274	2

^aThe regions are: Great Plains (GP), North Central (NC), Northeast (NE), South Central (SC), Southeast (SE), Pacific Northwest-Westside (PNWW), Pacific Northwest-Eastside (PNWE), Pacific Southwest (PSW), and Rocky Mountain (RM).

Carbon Stock on Forestland and Wood Products of the U.S., 1997

(Total stock estimate: 57 billion metric tons)



Birdsey and Lewis, 2002, 5th State and Local
Climate Change Partners' Conference

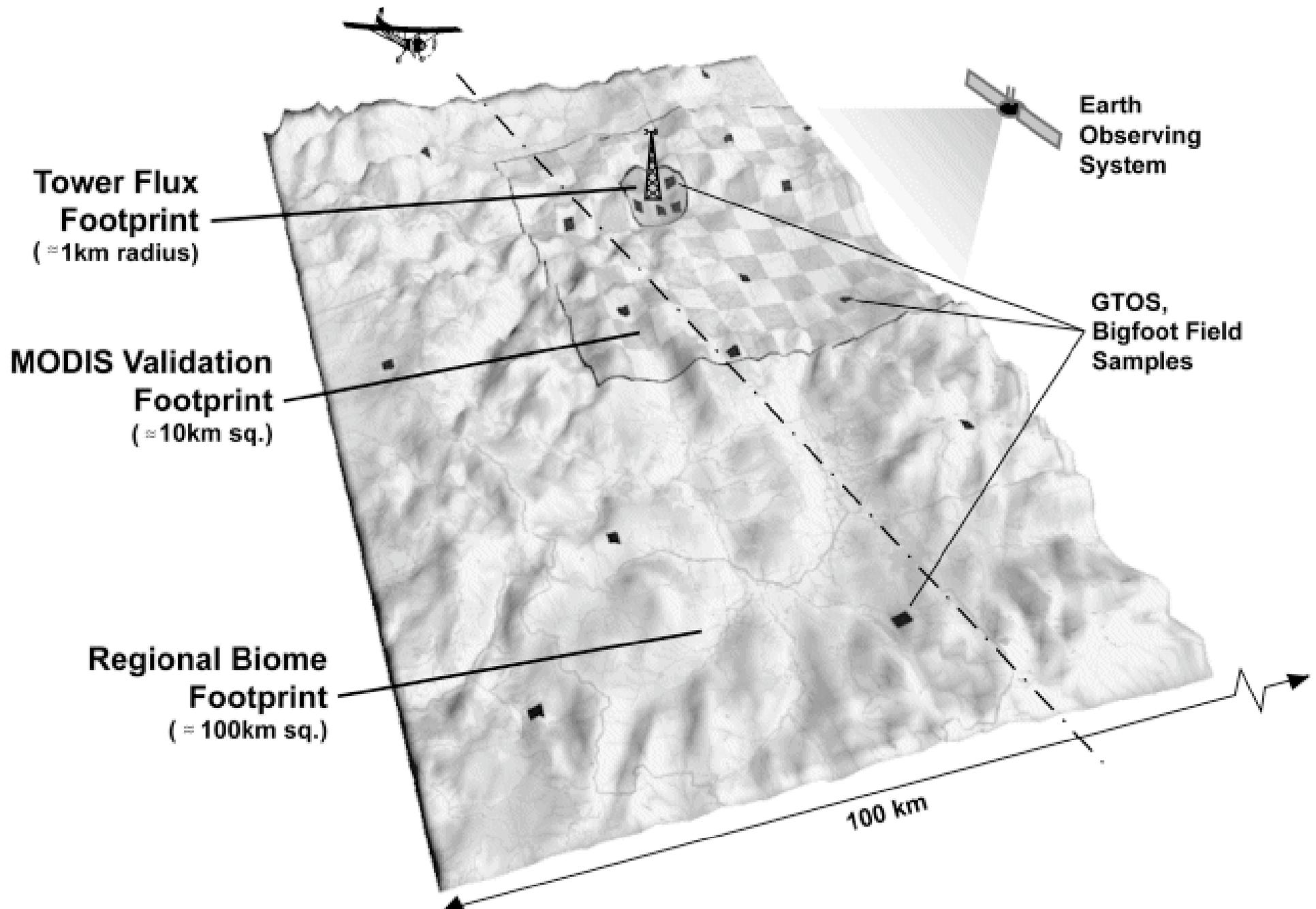
ChEAS plan: Sub-regional modeling

- Validation at multiple scales
 - Stand-level processes
 - Landscape aggregation
 - daily to annual time scales
- Wetlands
 - Underrepresented land cover types
- Harvest/Disturbance

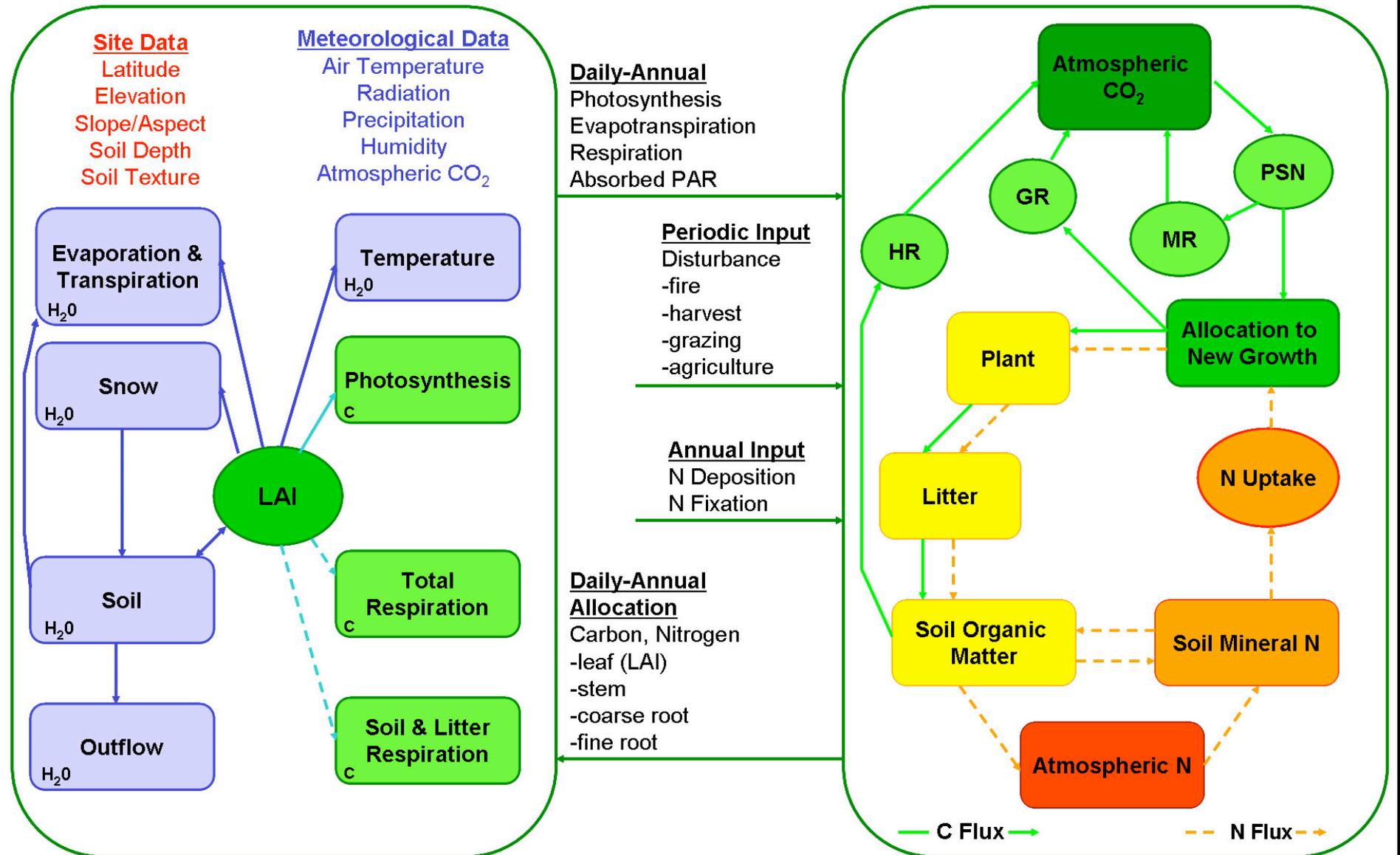
ChEAS plan: Sub-regional modeling

- Sources of differences between models/measurements
 - Mean error
 - Error distribution
- Errors related to grain size
 - 30 m, 250 m, and 1 km

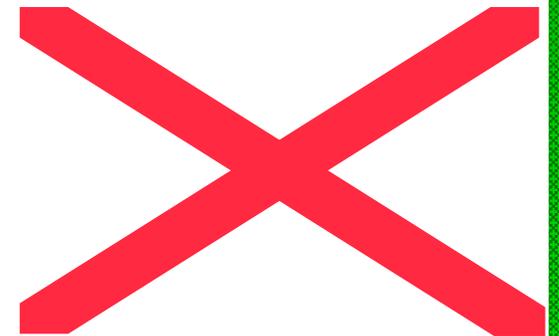
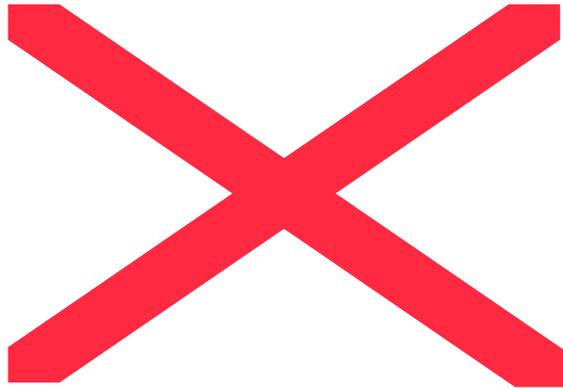
Multi-scale Measurement Strategy



Biome-BGC

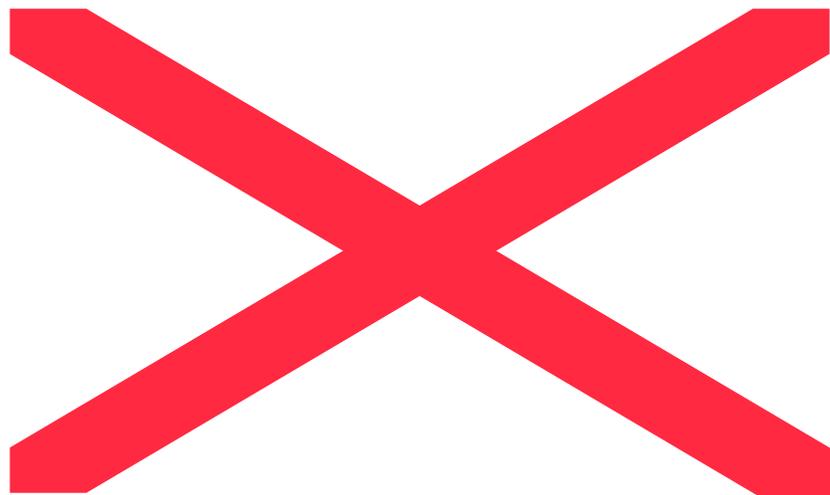


**Biome-
BGC
Results –
Park Falls,
1997-2003**



$$y = 1.1007x - 0.2361$$
$$r^2 = 0.3096$$

Biome-BGC Results, Park Falls, 1997-2003

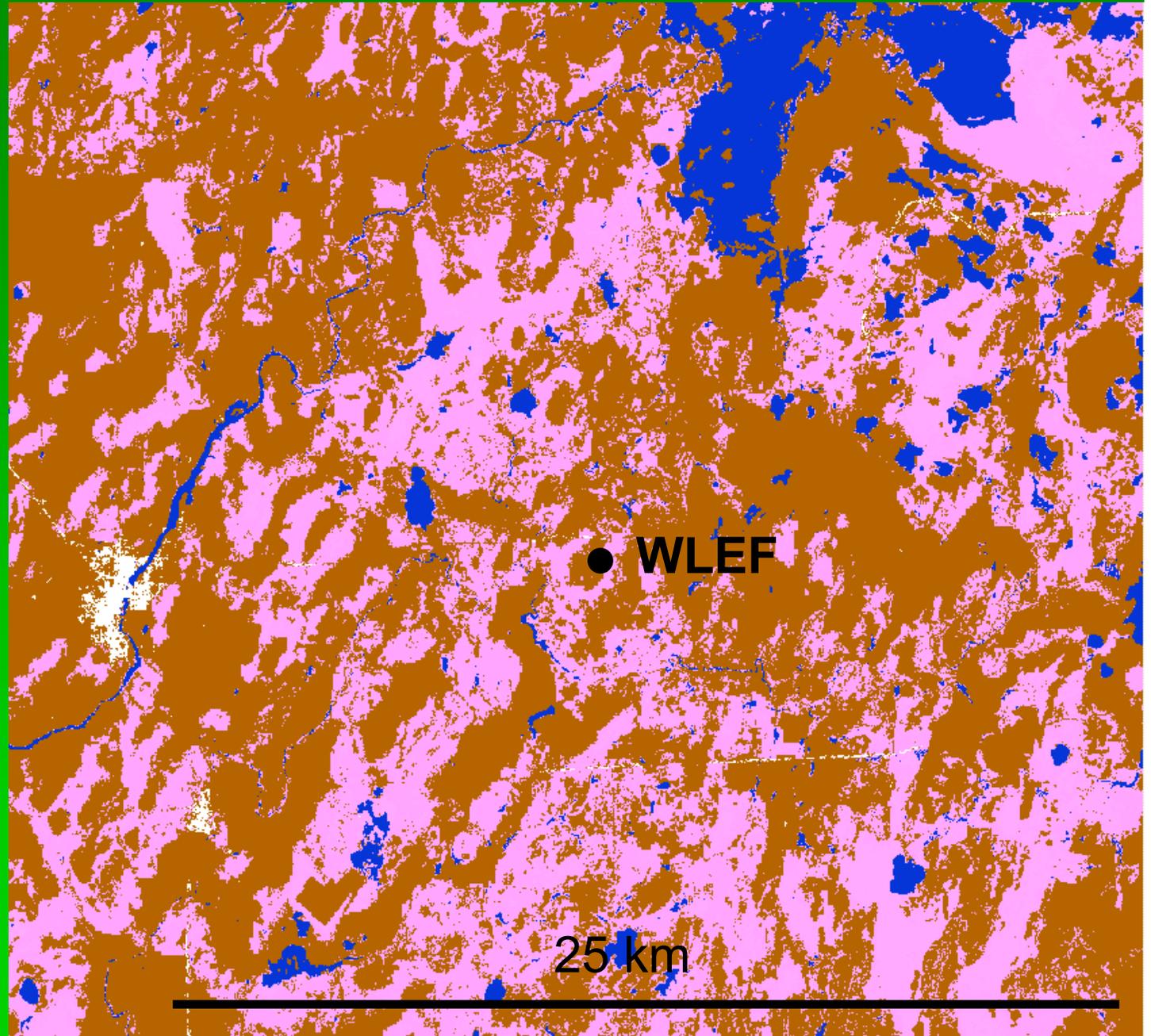
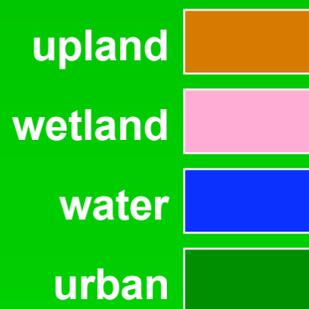


Land Cover around WLEF

Upland
55-70%

Wetland
30 – 42%

Urban
0 – 2%



Wetland-BGC

- Has a 2-layer soil model:
 - Unsaturated & saturated layers
 - Dynamic changes
- Water moves from saturated layer via RHESSys-based capillary rise function
- At present, only affects carbon & water

Things to Consider

- What models should we use in this Intensive?
- What inputs and parameters do these models need?
- Who will collect those data?