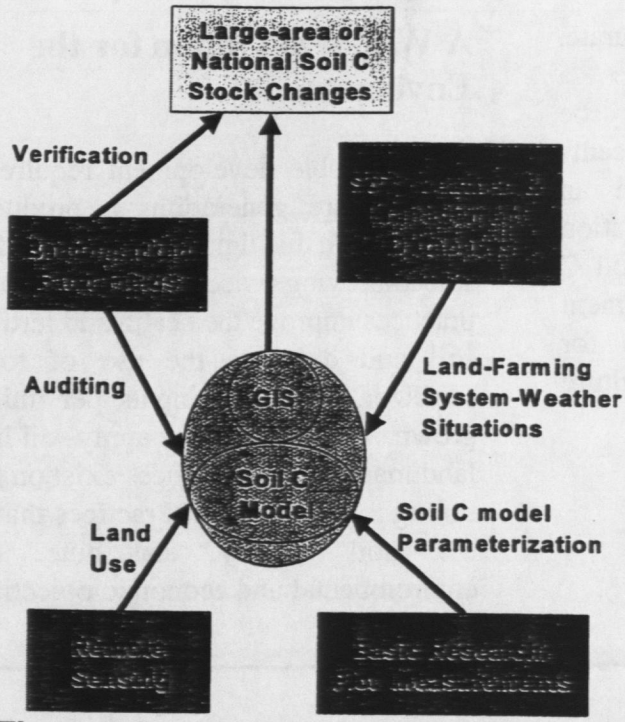

Figure 4 System for quantifying and verifying changes in soil carbon stocks.

System Description

The core of the system is the model of soil C dynamics. This science of soil C dynamics is relatively well developed and several soil C models (e.g. CENTURY) have been used successfully to predict changes in soil C in a wide range of environments. The basic system involves:

1. Model Refinement: appropriate C model parameters are derived and the soil C model is thoroughly tested using a large set of soil C research experiments and data.
2. Define Situations: From databases of soils, landform, weather, and farm management, important situations that result from a combination of the farming system, land, and regional weather are identified. Remote sensing supplements database information on no-tillage extent. (Remote sensing will be more important when the system is expanded to include soil C changes due to changes in management of pastures, farm wood lots, and other land use changes involving perennial vegetation).
3. Scaling Up: Soil C changes for these situations are predicted with the soil C model. These are integrated to make large-area or national estimates using a Geographical Information System (GIS).
4. Verification: The accuracy of the soil C model predictions are audited by comparing the predictions with the rich set of carefully measured C changes in the benchmark situations. Further, if sufficient benchmarks are available so that all important land-farming system situations are represented, an independent estimate of soil C changes is available by scaling up the benchmark soil C changes directly.

A Closer Look at Verification Benchmarks

In the Canadian pilot project, a network of 150 benchmarked fields were established, covering the agriculturally developed portion of the province of Saskatchewan (see Figure 5). The benchmarked fields include every important combination of soil type, texture, and regional climate. The benchmarks were established just before cooperating farmers converted these fields to no-tillage in 1997. On these fields, 2x5m benchmarks were located with Global Positioning System (GPS) and with a buried electromagnetic markers. These benchmarks were carefully sampled according to exacting protocol to minimize variability. The farmers were instructed to manage their fields normally without regard to the benchmark (there is no visible marking of the benchmarks). Soil carbon on the benchmarks will be measured again three years after the initial soil sampling.

Uncertainty of Soil C Changes Low

A well-designed network of passive benchmarks on farm fields is a cost-effective and powerful method of confirming that