The National Soil Carbon Network:

Advancing carbon cycle science through data synthesis

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Motivation and Goals

- Soil is a tremendous C pool: soils store 3x as much C as is held in global vegetation (soil C = 2x atmospheric C)
- Soil C storage is dynamic: net accumulation vs. loss is a quantitatively small balance between very large input and output fluxes
- Mechanistic knowledge and modeling of soils lags other components of the global C cycle

➢ Quantify the amount and spatial variation of C storage in U.S. soils (*e.g.*, across sites or within profiles)

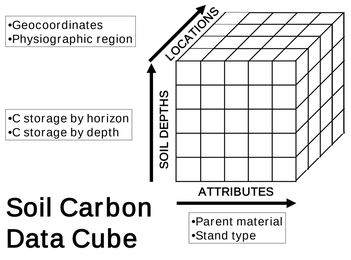
➢ Constrain turnover times of distinct soil C pools (*e.g.*, horizons, physical or chemical fractions)

➢ Identify sources of soil C vulnerability and determine how much soil C can be lost due to these factors

➢ Enhance the availability of scientific resources for advancing soil C science (*e.g.,* data, sample archives, analytical infrastructure)

Website structure and data

- Access to database is provided at the FLUXNET site: http://fluxdata.org/nscn
- The NSCN page has general network information, member sign-up, capacity for online data contribution, information about availability and types of data, and download- or browser-based data exploration
- Data contributions are fit to a template, then ingested in batches into a multidimensional data cube (soil depths x locations x attributes)



Visualization of the soil C data cube. The cube describes the spatial position of each soil C observation in 3-D, along with other continuously varying and categorical attributes.

- New spreadsheet-based reports are generated from the cube each time more data are added
- Reports are slices of the date cube arranged in useful ways (*e.g.*, soil C stocks by horizon and soil type, soil C to 1 m depth across major landform types)

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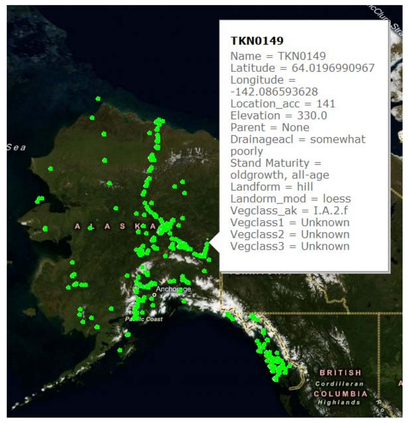
Prototype: AK Deep Soil C database



Above: Map of site locations providing soil C data for the AK Deep Soil C database.

- The NSCN collaborated on the Alaska Deep Soil Carbon Project, which synthesized soil C data from 15 agency and academic scientists
- Goals included community building, data gap identification, and creation of a new research tool (the database)
- Data originate from nearly 800 sites (>1,400 profiles, >48,000 individual soil layers)
- Site map available on the NSCN website, self-updating from data cube

Below: Online view of a report from the AK data cube w/soil C by horizon and ecoregion.

Data Browsing › CarbonByHorizon

Home | Dataset Information | Data Browsing | Search this site...

Excel Web Access - CarbonByHorizon

File | Open in Excel | Data | Find

Profile Carbon by Horizon

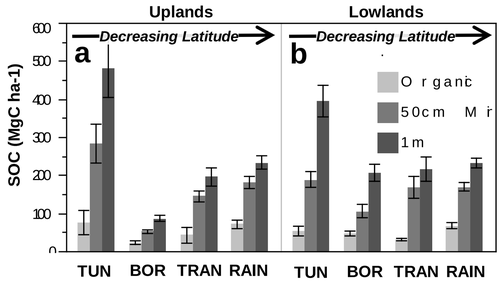
Download latest spreadsheet

Generated:12/10/2010 9:00:43 PM

Data as of 02/25/2010; Processed 04/11/2010; Profiles with contiguous samples only

Site Name	Latitude	Longitude	Eco-Region	Profile Name	Measure Date	Horizon	SOC	Layer Thickness	Sample Count
00AK068001	63.48355484	-150.1499023	Alaska Range	00AK068001	8/2/2000 12:00:00 AM	A	0.2444	3	1
00AK068001	63.48355484	-150.1499023	Alaska Range	00AK068001	8/2/2000 12:00:00 AM	C	2.2949	68	4
00AK068001	63.48355484	-150.1499023	Alaska Range	00AK068001	8/2/2000 12:00:00 AM	O	0.9579	29	4
00AK068001	63.48355484	-150.1499023	Alaska Range	00AK068001	8/2/2000 12:00:00 AM	Total	3.4972	100	9
00AK068002	63.43358231	-150.7666931	Alaska Range	00AK068002	8/2/2000 12:00:00 AM	B	1.9133	68	3
00AK068002	63.43358231	-150.7666931	Alaska Range	00AK068002	8/2/2000 12:00:00 AM	C	0.1047	16	1
00AK068002	63.43358231	-150.7666931	Alaska Range	00AK068002	8/2/2000 12:00:00 AM	E	0.4308	3	1
00AK068002	63.43358231	-150.7666931	Alaska Range	00AK068002	8/2/2000 12:00:00 AM	O	0.3012	9	4
00AK068002	63.43358231	-150.7666931	Alaska Range	00AK068002	8/2/2000 12:00:00 AM	Total	2.75	96	9

- Site, profile, and layer-level data are contained within the data cube
- Most basic data are site coordinates, layer thicknesses, bulk densities, and C concentrations (cube computes C stocks from these statistics)
- Additional continuous data include soil pH, %N, $\delta^{13}C$, particle size dist.
- Other categorical data include soil series and taxonomic info, sampling/ analytical methods, landform and ecoregion classes, disturbance hist.
- Data cube automatically derives geographic, soil taxonomic and ecoregion data from site coordinates, facilitating spatial analyses
- Nested design of data cube (site, profile, layer) allows users to quantify soil C variability across spatial scales
- Comprehensive metadata enable numerous custom analyses



Soil C storage by ecoregion and profile depth, computed from AK database by K. Johnson et al..

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Continued Expansion

- USDA-NRCS-NCSS pedon-level soil characterization database provides soil C for >200,000 sampled layers
- Other agency data anticipated (*e.g.,* NRCS-NCSS Rapid Soil C Assessment, USGS Global Change Program, USDA-FS FIA)
- Many investigators have assured or provided datasets
- NSCN will solicit data from other networks (*e.g.,* LTSE, LTSP, LTER, NERC, SMC)
- Additional soil C response metrics will be incorporated (*e.g.,* chem. & phys. fractions, NMR, NIR, MIR spectra)
- Large ^{14}C datasets are being added; designated staff at NIACS and LLNL-CAMS will enhance NSCN member access to soil ^{14}C analysis
- As database size grows, FLUXNET site functionalities will allow creation of working groups for geographic regions, topics of investigation, types of soil C data
- Synergy with FLUXNET: website provides terrestrial C data from the parent material up to the boundary layer

Access and Use

- Any user can browse information about availability and types of data, but only NSCN members can access data
- NSCN membership requires providing data, access to samples, field sites, or labs, or using the database to develop a synthesis product (*e.g.,* map, model, paper)
- Data contributions can feed database but remain hidden from view until contributor approves release
- Access and fair use policies are adapted from FLUXNET and posted on the database webpage
- NSCN will encourage specific researchers to use the database (*e.g.,* ^{14}C researchers, climate/C cycle modelers, grad students working on review projects)
- The NSCN database will enhance access to and use of existing data resources by compiling them in one place
- As it develops, the NSCN database will provide data resources enabling advances in many areas of C cycle research, such as: mechanisms of soil C stabilization vs. loss, feedbacks with climate change, management effects on soil C stocks, and patterns of spatial and temporal variation in soil C in unmanaged lands.

Acknowledgments

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