United States Department of Agriculture
Natural Resources Conservation Service

GlobalSoilMap.net and the North American Node

National Cooperative Soil Conference
La Cruces, NM
May 12, 2009

Jon Hempel
Co-Director/NA Node Leader
National Geospatial Development Center
Natural Resources Conservation Service
Morgantown, West Virginia

United States Department of Agriculture
Natural Resources Conservation Service

USDA NRCS

GlobalSoilMap.net

A New Digital Soil Property (functions) Map of the World

Digital Soil Map of the World (DSM) - Vision

Build a global 90m raster based soil information system by 2015.

-Freely available and web-accessible for large areas of the globe (80%).

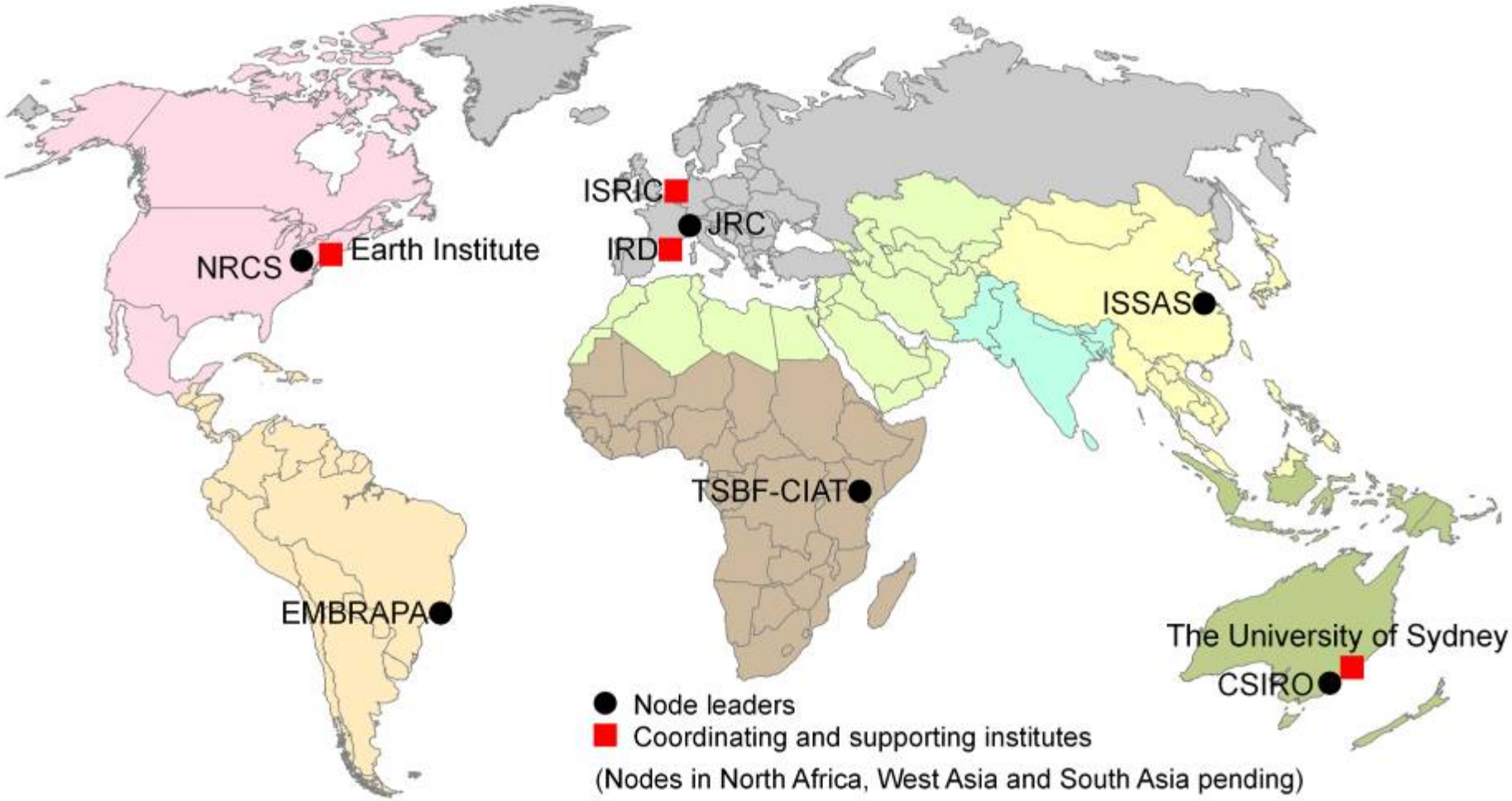
-Easily registered and combined with other environmental grid data.

-Improved natural resource assessments for food production, adaptation to climate change, and land degradation (erosion, desertification, urban, flooding, acidification, salanization).

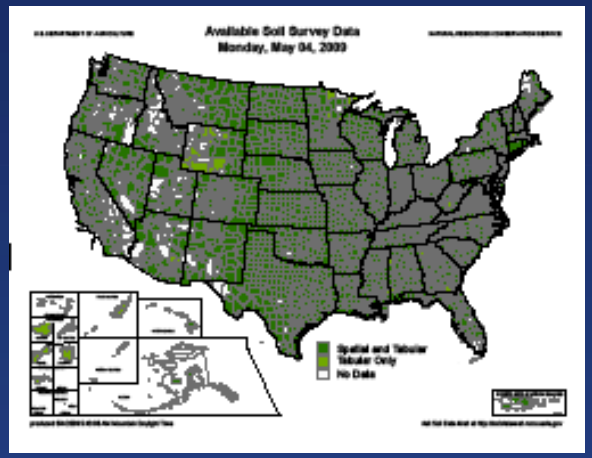
-Better decisions on land management and planning.

Critical step to solve the chronic lack of global soil resource information

Information Update-Current Global Leadership



Why Global Soil Information?

United States	Canada	Mexico
		32 percent of Mexico has detailed soil maps of 1:50000 or greater

Node Leadership

JRC-Joint Research Centre, Ispra, Italy

ICRAF-International Center for Research in Agroforestry, Nairobi, Kenya

EMBRAPRA-Brazilian Agricultural Research Corp, Rio de Janeiro, Brazil

CSIRO-Australia Commonwealth Scientific and Research Organization, Canberra, Australia

ISSAS-Institute of Soil Science, Chinese Academy of Science, Nanjing, China

NRCS-NGDC National Geospatial Development Centre, Morgantown,West Virginia USA

(AAFC-Agriculture and Agri-Food Canada)

North Africa/West Asia (leadership not decided)

South Asia (leadership not decided)

Project Leadership

-Alfred Hartemink-ISRIC- World Soil Resources Data Centre Wageningen, Netherlands

-Pedro Sanchez-Earth Institute at Columbia University, New York, New York

Scientific Leadership

-Alex McBratney et.al.-University of Sydney, Sydney Australia

Information Technology Leadership-CIESIN (Gates)

-Sonya Ahamed/Marc Levy-Center for International Earth Information Network-Columbia University

GlobalSoilMap.net Milestones

- November 2008-Bill and Melinda Gates Foundation provide funding for the African node, sub-sharan Africa-$18.4 M (USD)

United States Department of Agriculture
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The African launch 13th Jan 2009

BILL & MELINDA GATES foundation

Alliance for a Green Revolution in Africa

United States Department of Agriculture
Natural Resources Conservation Service

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BBC NEWS | Science & Environment | New soil map for African farmers - Windows Internet Explorer

BBC NEWS

New soil map for African farmers

By James Morgan
Science reporter, BBC News

Access : Digital soil map for Africa launched : Nature News - Windows Internet Explorer

nature news

Access
This article is part of Nature's premium content.

Published online 13 January 2009 | Nature | doi:10.1038/news.2009.17

Digital soil map for Africa launched

Map will help farmers to improve crop production.

Natasha Gilbert

Soil scientists are developing the first ever digital soil map of Africa, covering 42 countries south of the Sahara. The map will provide up-to-date information on the health and properties of the soil, helping farmers and policymakers to improve degraded soils and increase crop production.

To read this story in full you will need to login or make a payment (see right).

Comments

Africa's soils to be digitally mapped - SciDev.Net - Windows Internet Explorer

SciDev Net

Africa's soils to be digitally mapped

A digital map of the state of Africa's soils is to be put together in an initiative launched today (13 January).

The African Soil Information Service, launched in Nairobi, Kenya, will produce a digital map of 42 African countries revealing soil type and its component nutrients.

This information will guide farmers and policymakers on efforts to improve the fertility of Africa's soils, some of which are the most depleted in the world. The project will be coordinated by the International Center for Tropical Agriculture.

Agronomists to map Africa's soils to increase crops | Environment | Reuters - Windows Internet Explorer

REUTERS

REUTERS DEALS
THE GLOBAL DESTINATION FOR DEAL-MAKERS AND INNOVATORS

Agronomists to map Africa's soils to increase crops

NAIROBI (Reuters) - International agronomists plan to map different soil types across Africa to improve agricultural methods, increase harvests and help farmers earn a better living from their land, scientists said Tuesday.

The four-year project will combine on-the-ground soil sampling and remote satellite imagery to produce a detailed digital map of sub-Saharan Africa, the Center for Tropical Agriculture (CIAT) said.

"Soil management in sub-Saharan Africa must be improved dramatically if we are to reduce poverty, feed growing populations and cope with the

GlobalSoilMap.net Inauguration New York City-Columbia University February 17, 2009

Jeffrey Sachs-GlobalSoilMap.net Inauguration

"On the current trajectory we will not meet our Millennium Development Goal to cut hunger by half by 2015," said Jeffrey Sachs, director of the Earth Institute at Columbia University. "We need to speed up, and fortunately can do so if we mobilize much greater global cooperation. Today's meeting speaks to the MDG hunger challenge and many others as well, including climate change, agriculture deficiency, nutrition, and water availability. Soil mapping is one of the pillars to the challenge of sustainable development and the Earth Institute is proud to be a founding partner in this undertaking."

Gates Foundation Support to GlobalSoilMap.net Project (7%, 1.3M)

- Consortium funding for technical and operational meetings
- ISRIC positions
  - Fund Raising Officer (global effort)
  - Science Officer-support aggregation of technical data for all nodes (Bob McMillian)
  - Legacy Data officer-coordinate collection of data for AfSIS/coordinate with other nodes (Johan Leenaars)

Science Officer responsibilities

- Scientific coordination, management and planning
- Project management, monitoring the completion of the various program/components on time, on budget, and up to specifications
- Liaison with all scientists in the nodes of *GlobalSoilMap.net* and with the sister project developing an *African Soil Information Service*, to ensure compatibility of methods and approaches
- Scientific leadership in technical developments necessary to achieve the mapping goals
- Coordinate the writing of technical manuals

Technical Manuals to be Developed (Science Officer)

- Computing and Infrastructure
- Decision Tree and Spatial Methods
- Covariates and Terrain Analysis
- Soil Properties/Pedo-Transfer Functions and Inference Methodologies

Technical Background/Information

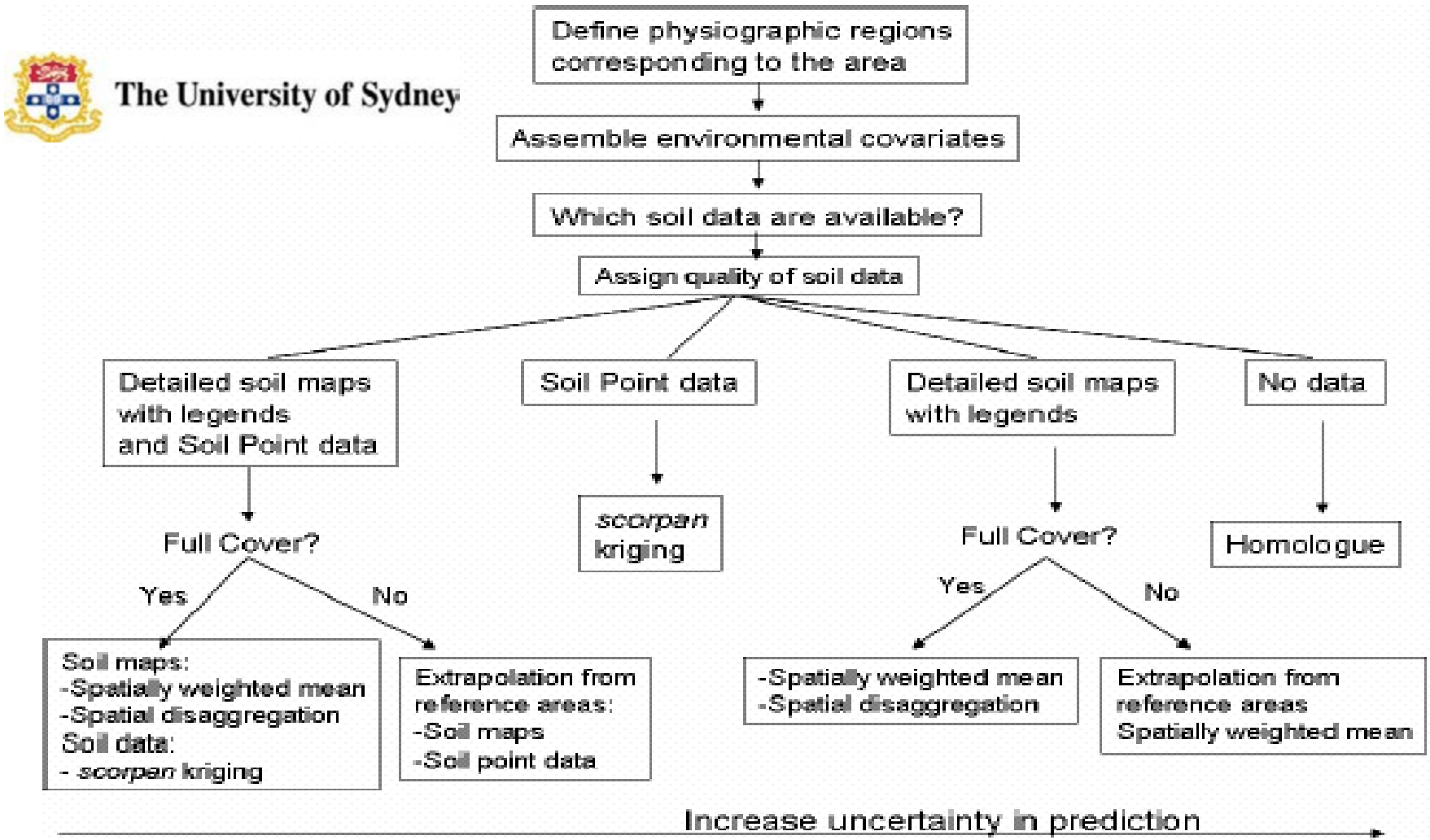
Model for Digital Soil Mapping

S=f(s,c,o,r,p,a,n) (McBratney et. al. 2003)

S=f(c,o,r,p,t) (Jenny)

- S-soil properties of interest
- s-soil and other properties of soil at a point
- c-climatic properties of the environment at a point
- o-organisms
- r-relief or topography
- p-parent material
- a-age or time factor
- n-space, spatial position

Digital Soil Mapping Workflow



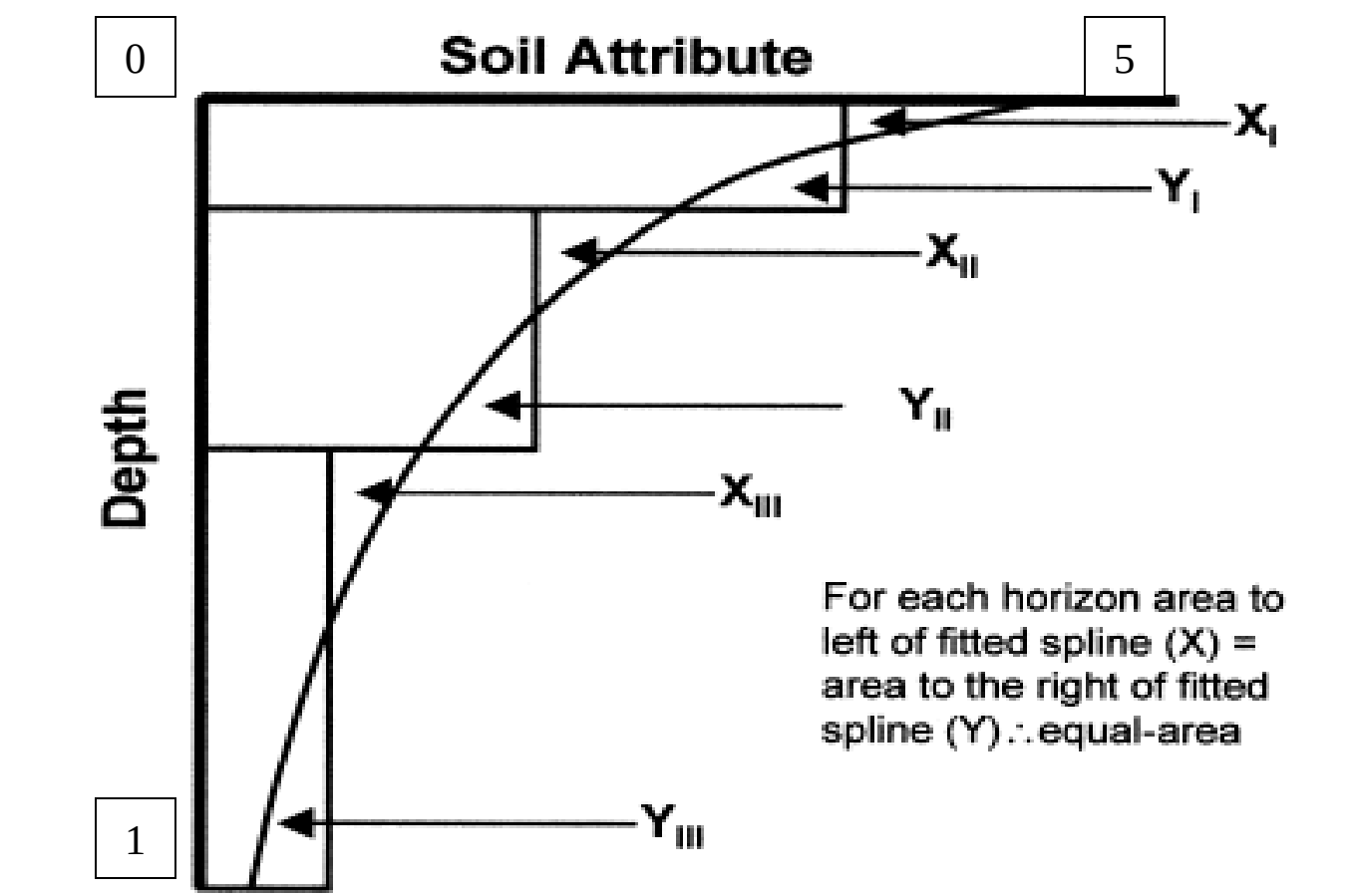
Properties to be mapped

- Texture-Clay (1 meter)
- Organic Carbon-(near surface)
- pH (near surface)
- Bulk Density (1 meter)
- Depth Classes-depth to restrictive layer

Properties to be inferred (pedo-transfer functions)

- Nutrient supply capacity-CEC, exchangeable bases, available P
- Plant Available Water Capacity
- Infiltration
- Ksat (permeability)

Soil Depth Attribute functions



T.F.A. Bishop et al. Geoderma 91 1999 27–45

North American Node Progress and Advancement

GlobalSoilMap.net
North American Node

- Support the Global Consortium approach to producing soil property information
- Information to be built on “Legacy” data (existing information)
- North America has a long history of collecting, producing and archiving soil survey data
  - Point data: validation
  - Aggregate data (polygons): disaggregation techniques
  - Ancillary Data

North American Node

GlobalSoilMap.net: CANADA-UNITED STATES DIGITAL SOIL MAPPING CASE STUDY

S. DeGloria[1], W. Fraser[2], X. Geng[3], J. Hempel[4], A. Moore[5], S. Smith[6], J. Thompson[7], A. Waddell[8]

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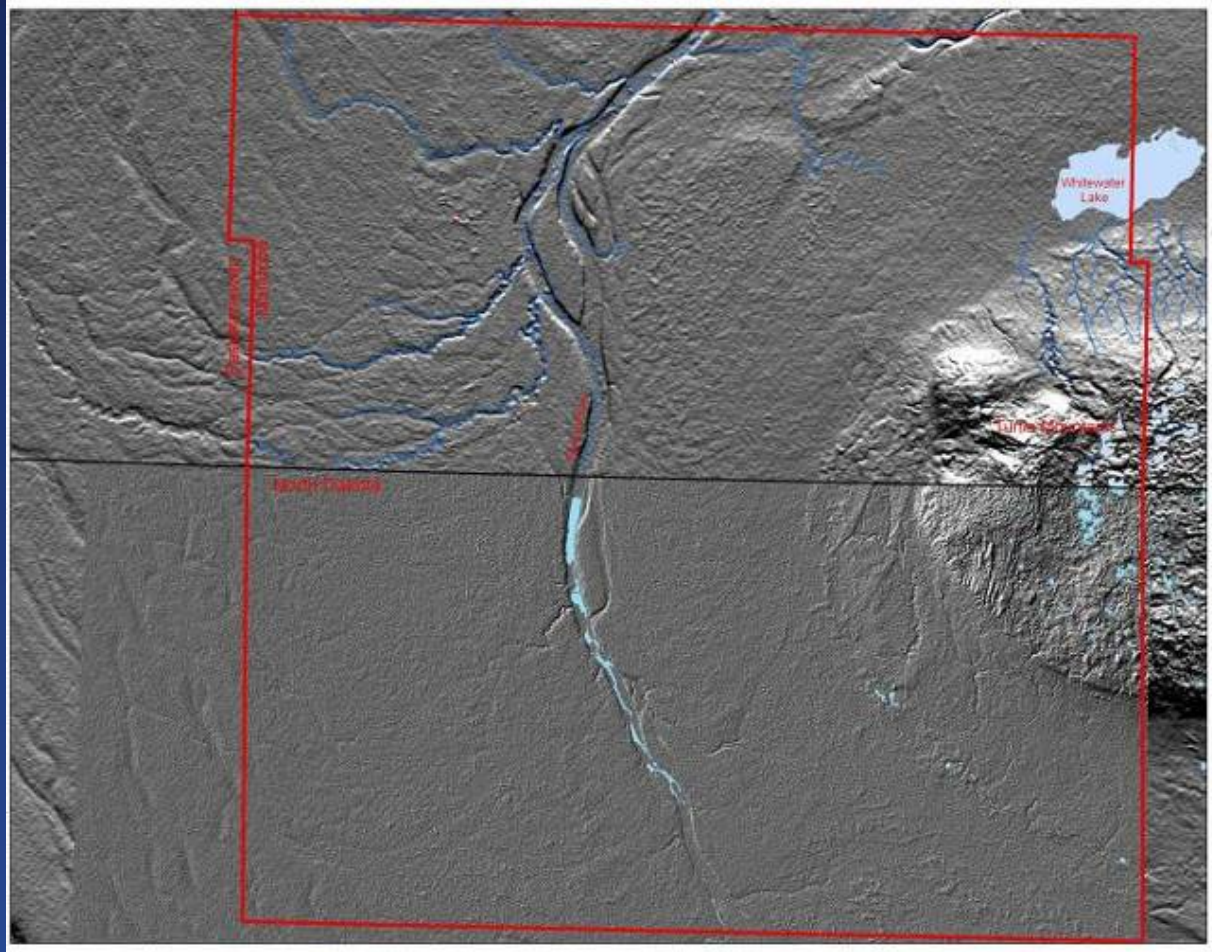
[8]Agriculture and Agri-Food Canada, Winnipeg, MB, waddella@agr.gc.ca

Canada-United States DSM Project: Northern Glaciated Plains Case Study

Objectives:

- Map selected soil properties based on detailed soil mapping in Canada and USA using digital soil mapping methods and spatial data of high spatial resolution.
- Map selected soil properties based on generalized soil mapping in Canada and USA, and compare to soil property maps developed from spatial data of high spatial resolution.
- Map selected soil properties based on detailed mapping using spatial data at highest spatial resolution available (>= 30 m), and compare to soil property maps based on spatial data of lower spatial resolution (>= 90m).

Canada-US Case Study Area
SW Manitoba–NC North Dakota



Canada - Aspen Parkland and Southwest Manitoba Uplands Ecoregions

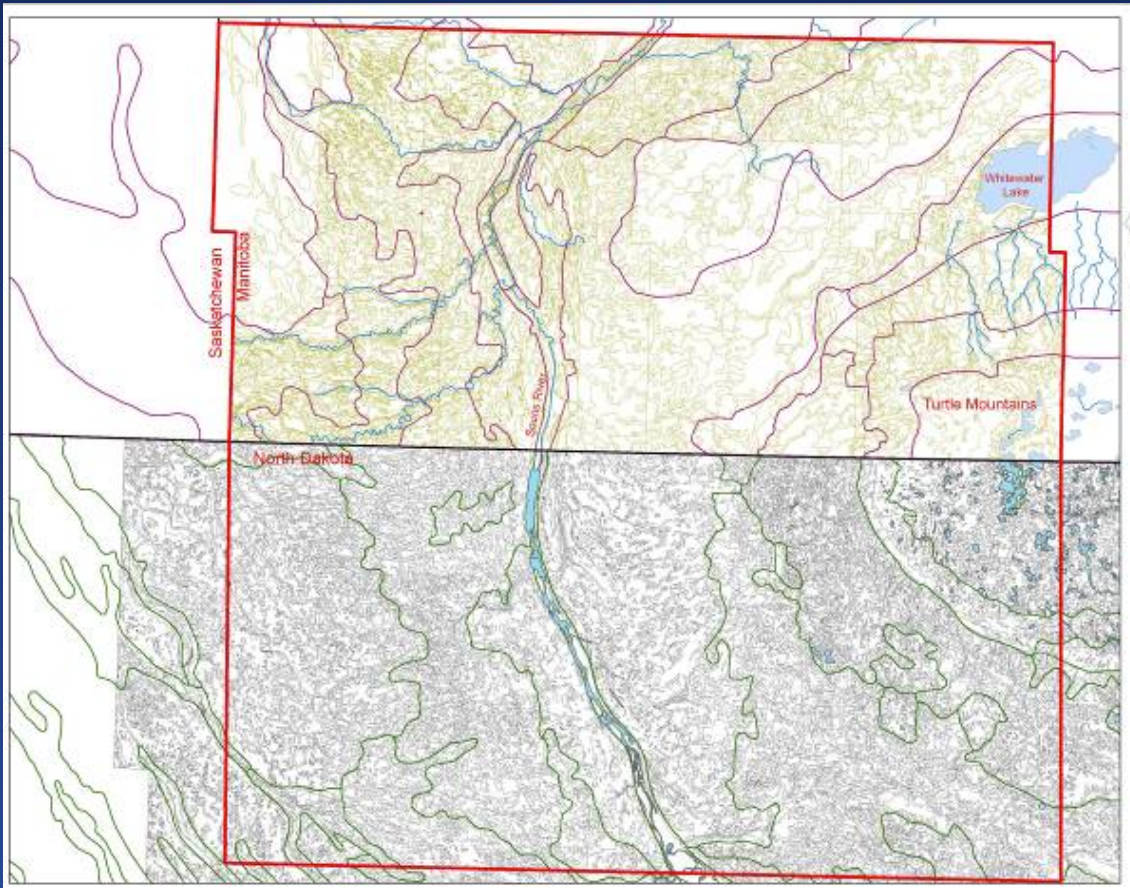
USA - Northern Black Glaciated Plains Major Land Resource Area (MLRA 55A)

Area: approx. 6,225 km^2 (622,400 hectares)

Proposed Study Area
Study Area Boundary

Soil survey data from:

- ***Detailed soil survey (DSS)*** **of the rural municipalities of Edward, Arthur, Brenda and Winchester (Manitoba) at *1:20,000 and 1:40,000* scale.**
- ***SSURGO* at *1:12,000 and 1:24,000* scale from the Soil Survey of Bottineau County (North Dakota).**
- **Soil Landscapes of Canada (SLC) at 1:1m scale**
- **U.S. General Soil Map (STATSGO2) at 1:250,000 scale**

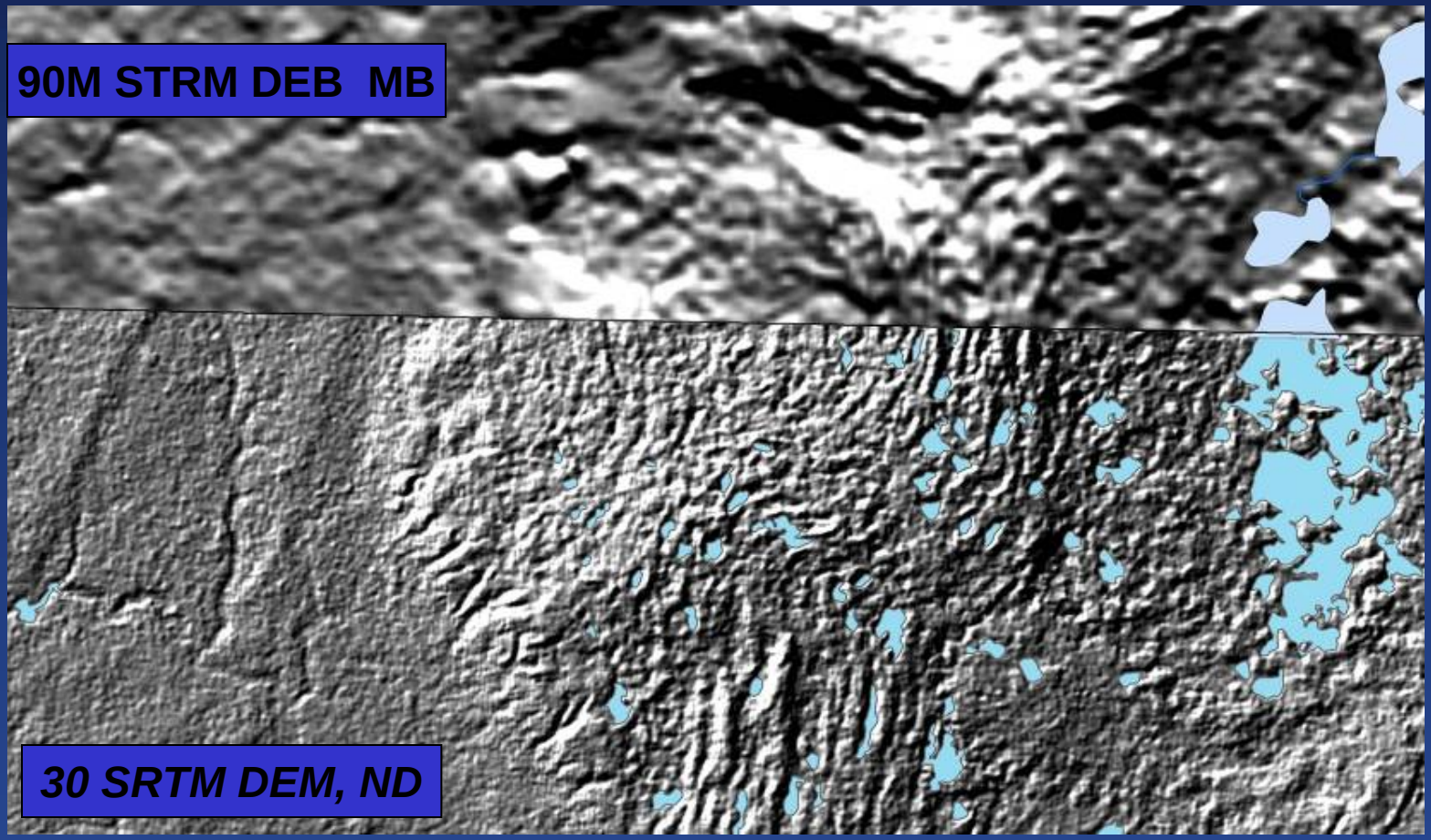


General soil map unit boundaries are overlaid on detailed soil map unit boundaries (courtesy Soil Resources Group, AAFC).

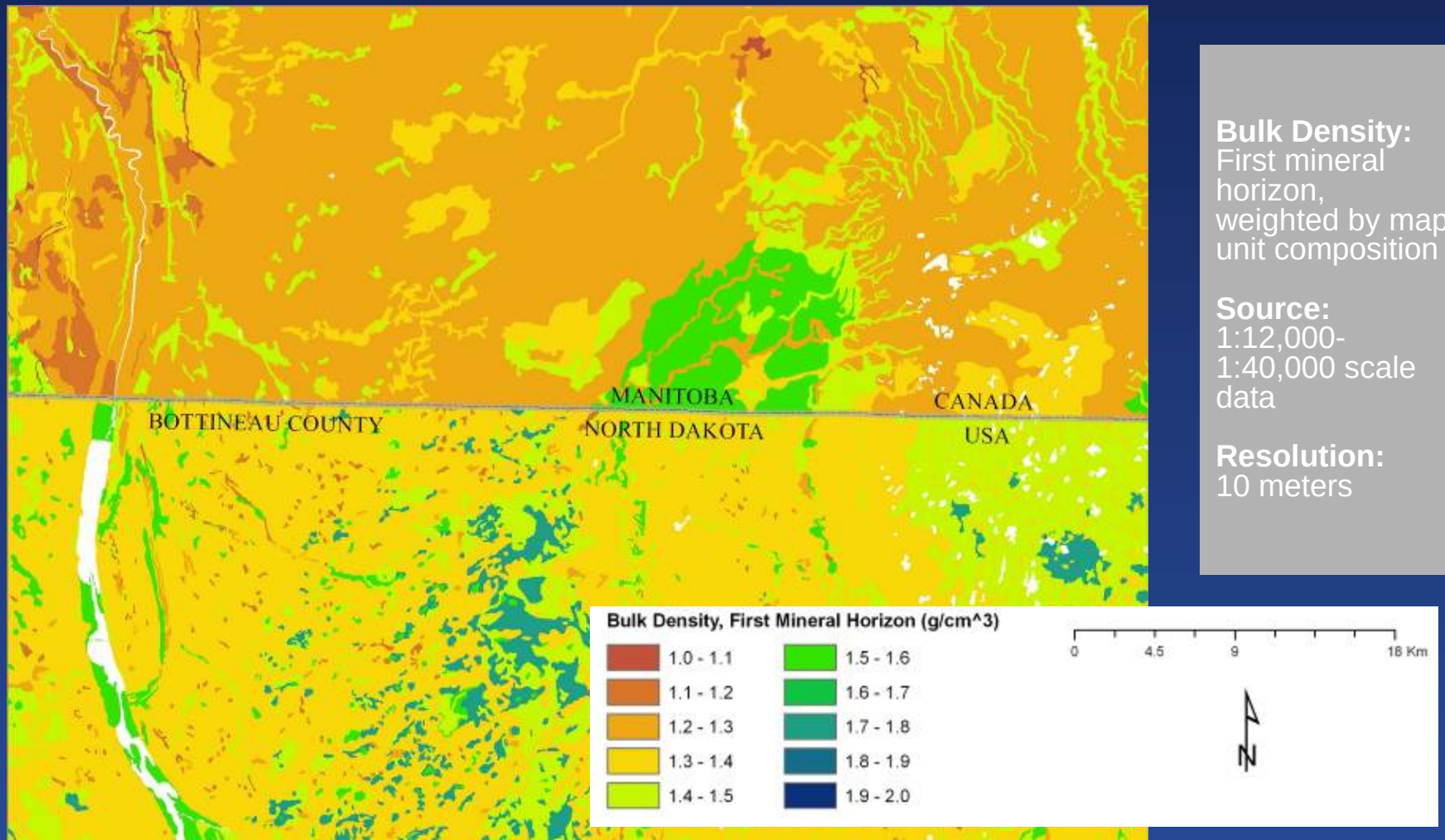
Proposed Study Area

- Study Area Boundary
- Canada - Generalized Soils
- MB -Soils Detailed
- US - Generalized Soil
- ND - Soils Detailed

Northern Glaciated Plains Study Area



Digital map of soil bulk density derived from legacy data

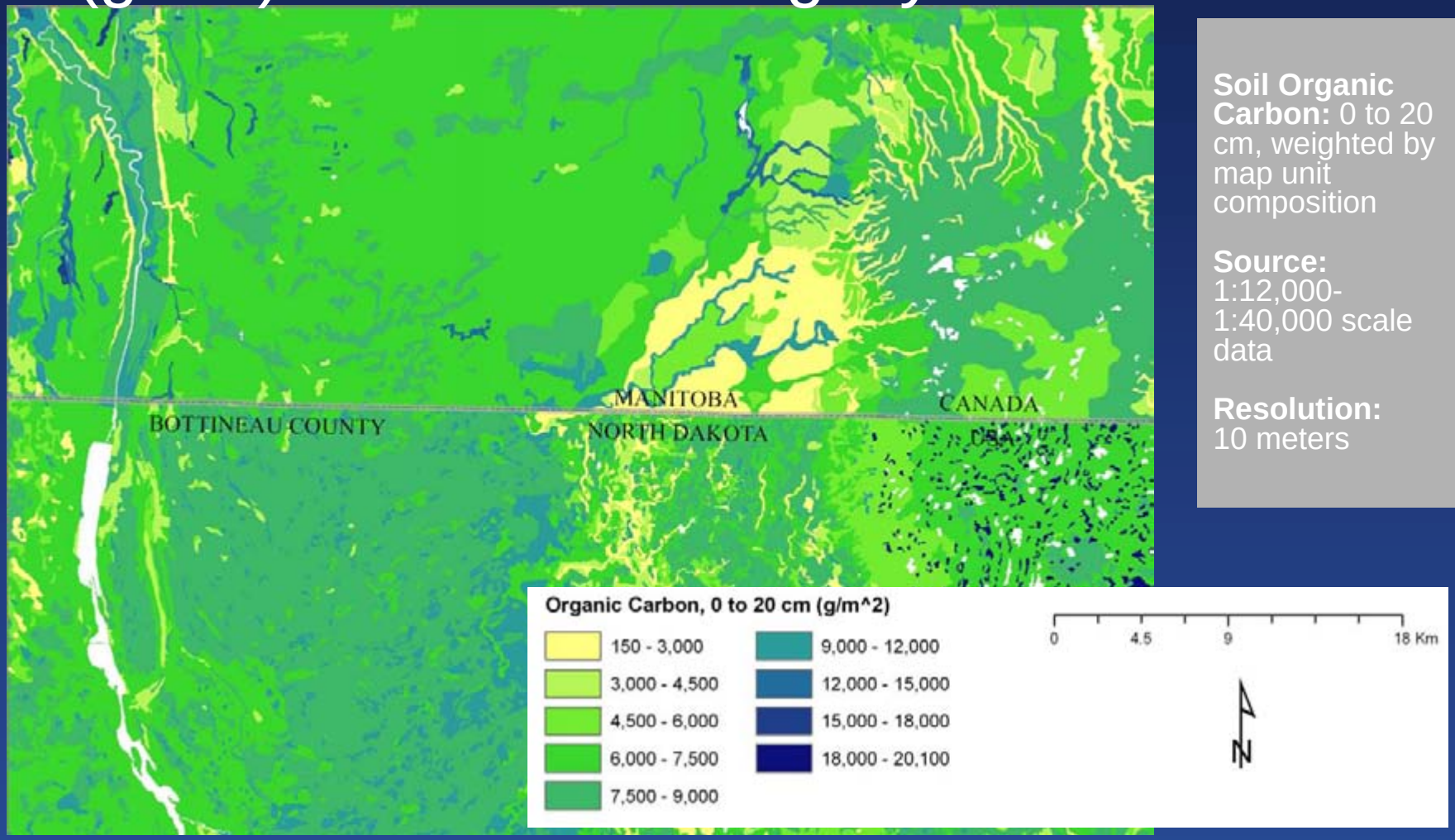


Bulk Density:
First mineral horizon, weighted by map unit composition

Source:
1:12,000-1:40,000 scale data

Resolution:
10 meters

Digital map of soil organic carbon ($g\ m^{-2}$) derived from legacy data



Soil Organic Carbon: 0 to 20 cm, weighted by map unit composition

Source: 1:12,000-1:40,000 scale data

Resolution: 10 meters

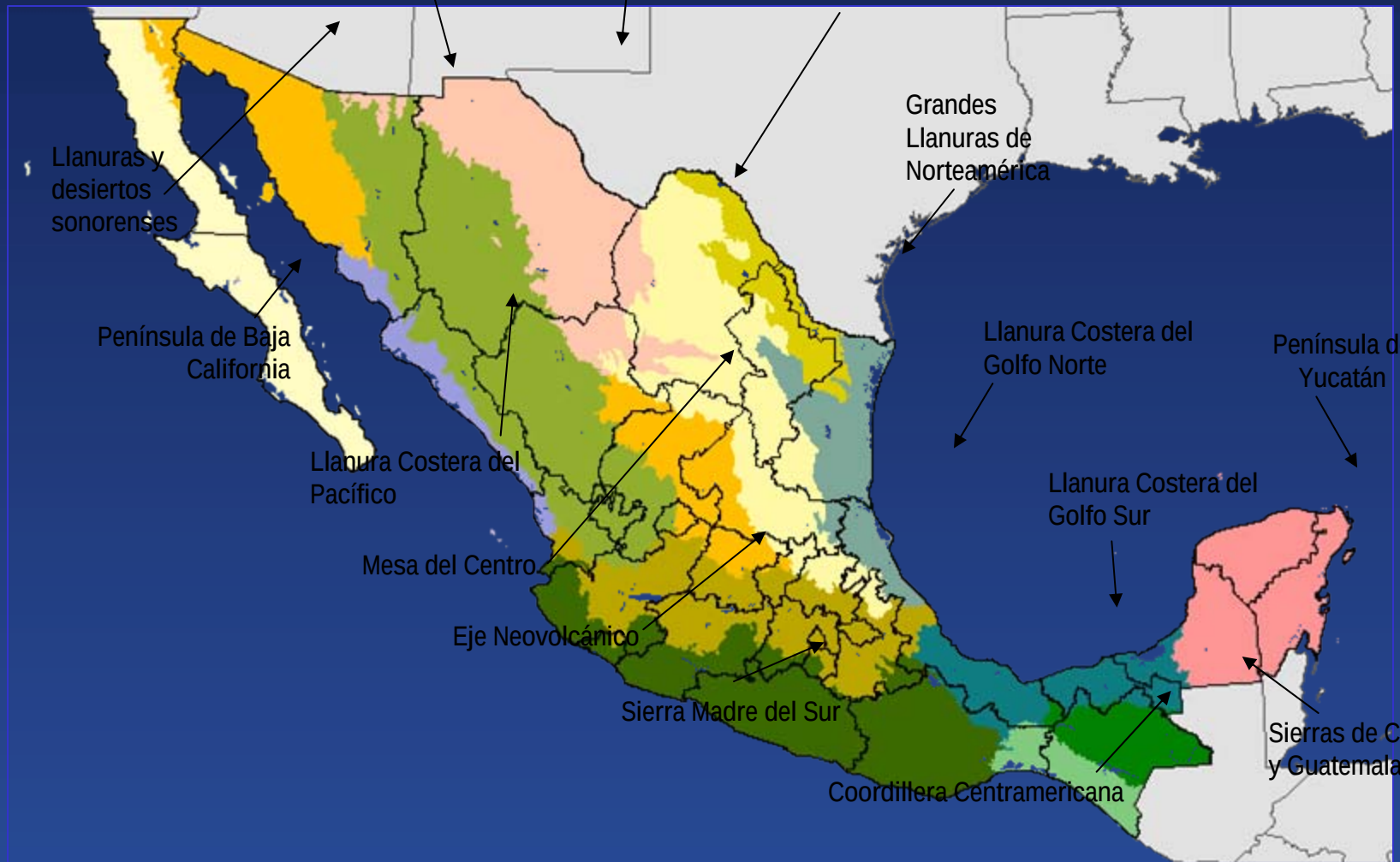
Issues

- SRTM data availability and alternatives (no data)
- DSM methods less reliant on terrain model derivatives (90M too coarse?)
- Data harmonization
  - Cartographic and taxonomic
- Mapping inconsistencies
  - Within country and between countries
- Soil properties with depth (layers)
  - Taxonomic horizons vs. layers
- Consistency of node DSM methodologies (McBratney to NA)
- Future trans-national collaborations of NA GSM node:
  - Mexico, Central America, Caribbean
- Consortium-wide DSM training and mapping activities

Mexico Soil Survey

- The National Institute of Statistics, Geography and Informatics (INEGI)
  - responsible for soil survey information in Mexico

LAND RESOURCE REGIONS - 15



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MAJOR LAND RESOURCE AREAS - 84

Available Lab Data

54,000 studied pedons

23,000 pedons with lab data

AVAILABLE SOIL MAPS

Scale at 1:1,000,000

Scale at 1:250,000

Scale at 1:50,000 (32% of the territory)

Uses of GlobalSoilMap.net information in North America

- Provide high resolution soil information to unmapped (and mapped) areas in North America
- Used by policy makers and land managers for important environment issues
  - Carbon sequestration (Global Climate change)
  - Define areas of soil (environmental) degradation-erosion, desertification, urban
  - Identify Best Management Practices

Uses of GlobalSoilMap.net information in North America

- Soil attributes are critical inputs for ecosystem services
- Provide a consistent set of data that is geographically continuous
- Provide scalable soil information for users at a field level to modelers needing regional or continental information
- Provide uncertainty values for all predictions
  - Guide priorities for future investigations

Where next?

- Continue moving forward
- Technical Workshop with Dr. McBratney (May 18)
- Collection of Covariate data/information (ISRIC Science Officer)
- Continue Canada-US case study work
  - NGDC positions
- Continue to engage with Mexico
- Continue to search for funding

GlobalSoilMap.net - a new digital soil map of the world - Windows Internet Explorer

http://globalsoilmap.net/

www.globalsoilmap.net

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News

The project will be officially launched in 2009:
17th February, New York USA

Download the flyer

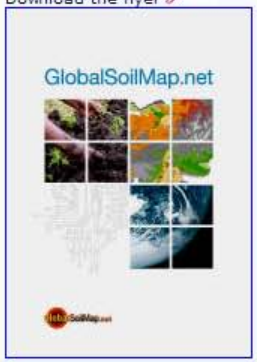
The African part of *GlobalSoilMap.net* was launched on 13th January 2009 in Nairobi. Read here the press coverage.

AfricaSoils.net

We have formed a consortium that aims to make a new digital soil map of the world using state-of-the-art and emerging technologies for soil mapping and predicting soil properties at fine resolution. This new global soil map will be supplemented by interpretation and functionality options that aim to assist better decisions in a range of global issues like food production and hunger eradication, climate change, and environmental degradation. This is an initiative of the Digital Soil Mapping Working Group of the International Union of Soil Sciences (IUSS).

In November 2008, an $18 million grant has been obtained from the Bill & Melinda Gates foundation and the Alliance for a Green Revolution in Africa (AGRA) to map most parts in Sub-Sahara Africa, and make all Sub-Saharan Africa data available. From this grant there are also funds for coordinating global efforts and for the establishment of a global consortium. Several institutions have assumed a leading role in this effort but no funding has been obtained yet to make a digital soil map of the entirel global land area.

Download the flyer



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