GlobalSoilMap.net North America (NA) Node Meeting-Fargo, North Dakota
October 25-26, 2011

GlobalSoilMap.net North America (NA) Node Meeting was hosted by Dr. David Hopkins at NDSU Soil Science Department in Fargo, North Dakota from October 25-26, 2011. Participants representing Canada, Mexico, USA and other cooperators participated with presentations and discussions. The list of participants is shown in Table 1.

Table 1. Participants of the GlobalSoilMap.net North America (NA) Node Meeting

Name	Organization	Email
Jerome Schaar	USDA-NRCS	jerome.schaar@nd.usda.gov
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Norman Bliss	ARTS at USGS/EROS	bliss@usgs.gov
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Jim Thompson	WVU	james.thompson@mail.wvu.edu
David Hopkins	NDSU	david.hopkins@ndsu.edu

Day 1 – October 25, 2011

Introductory remarks were given by Dr. David Hopkins the host of the meeting at North Dakota State University-Department of Plant Sciences; Jerome Schaar the MO 7 Leader; Jon Hempel the North America Node leader for the Globalsoilmap.net project from the USDA-NRCS, National Soil Survey Center; Scott Smith from Agriculture and Agri-Food Canada and Eliseo Guerrero from Instituto Nacional De Estadistica Y Geografia, Mexico.

Jon Hempel: North America Node leader

Meeting Expectations:

Uncertainty – how to move forward?
Memorandum of understanding (MOU) with Mexico;
MLRA 55A Harmonization followed by disaggregation;
USA-Canada Harmonization
Identify a Pilot Area for USA-Mexico:
Generate the current gridded STATSGO/SSURGO2 with GSM.net specifications for the US, similar efforts for Canada and Mexico;

Users of the data (Norm Bliss)

GlobalSoilMap.net updates,

Staff Changes:

Bob MacMillan retired as the scientific coordinator. Position is still vacant. There are two candidates from France considered. One may be funded by their respective institution which increases the likelihood of receiving the appointment.

Alfred Hartemink retired as the Director of the GlobalSoilmap.net project.

Dr. Neil McKenzie, current Chief of CSRIO, Australia is now the new director of the GlobalSoilMap.net project and fully funded by CSRIO.

Jon Hempel volunteered for the Acting Executive Secretary position which at this point is not funded.

Scott Smith: Scientific Coordinator for Canada:

GEOS has been signed by Canada and it can be fitted to the GSM.net frame to increase support and funding. Linking GSM.net with GEOS will score very high with Agriculture and Agri Food Canada and may provide additional funding.

Jon Hempel: North America Node leader

We need support to participate to the GEOS meeting.

There is a Fund Raiser position that may move to university of Columbia based on Dr. Pedro Sanchez proposal. The position may require $150,000.year salary and Gates Foundation may help fund the position.

Current GSM.net maps for NA Node and versioning.

The three GSM.net specifications (grid, Spline and uncertainty) must be met in order to publish the property maps. NA Node has the best chance of being the first to deliver the V0.1 that meets the GSM.net specifications. There is pressure to deliver the V0.1 as a proof of concept and to attract funding. There is progress made but funding is still a problem and this requires a lot of commitment for everybody.

Global Soil Partnership

UN-FAO has initiated the Global Soil Partnership similar to the Global Water Partnership based on 5 pillars (produce, deliver, use, ….). At this point there is no funding as previously expected.

James Thompson – North America Node Scientific Coordinator

The post doc position recently filled has become vacant again as the candidate has accepted another position. We are looking to fill this position and sooner than later.

Work has been continued on disaggregation for MLRA 127 and 55A.

Property maps for GSM.net are finished for half of the properties (organic carbon, texture silt, sand, clay and coarse fragments). The pH pedotransfer function for converting measured pH 1:1 Water to 1:5 Water as required by GSM.net has been identified and to be applied for generating the pH map.

Bulk Density (BD) approach – apply pedotransfer functions first, followed by equal area spline.

Data structure is not exactly defined. Each node maintains its own structure then when delivering the product to the GSM.net consortium conditioned it to meet GSM.net specifications and requirements.

PDFs – Develop pdf for each country within the NA Node. Run a cross fashion pdf:

USA pdf applied to Canada and Mexico;
Canada pdf applied to Mexico and USA
Mexico pdf applied to Canada and USA
Evaluate via regression and RMSE.

Zamir Libohova - North America node USA USDA-NRCS-NSSC

Presented **Digital Raster Grid Property Maps Versioning for North America** to address the inherited issues related to legacy data (scale, methods, classifications, formats, temporal scales, etc).

Scott Smith: Scientific Coordinator for Canada:

Are the current scale of maps adequate for the modelers? If yes this does not necessitates the production of GSM.net maps at coarser scales for modelers!

Zamir Libohova - North America node USA USDA-NRCS-NSSC.

The current gridded polygons from legacy data may satisfy modeling world in general however the GSM.net initiative started with the focus on generating high resolution soil property maps needed for Africa thus placing things in perspective the delivery of the high resolution property maps is a MUST.

Jon Hempel - North America Node leader

Are the “Spatially Weighted Means” maps different from “Gridded”? Should we call them “Spatially Weighed Means”?

Zamir Libohova – North America node USA USDA-NRCS-NSSC.

The “gridded” term is used to emphasize the fact that at this point the maps are not truly continuous. Whether the gridded maps are based on the spatially weighted means or some other method, the fact remains that all the pixels for a soil map units will have the same property value. The pixels will take different values when soil map units will be disaggregated into components.

Jon Hempel - North America Node leader

As part of the versioning approach we should generate Version0.1 with what we have so far to demonstrate the proof of concept, identify gaps and possible attract funding.

Scott Smith: Scientific Coordinator for Canada:

GSM.net update for Canada:

Glenn Lelyk has generated the GSM.net property maps for some of the properties based on SLC using spatially weighted means and equal area spline.

There is a lot of data collected by consultants. There is no mechanism in place to collect these data due to proprietary issues and fees to acquire them when possible.

We are in the middle of reorganizations and staff reduction and movement has become an issue.

Given the amount of data from this source why not use LIDAR to make higher resolution maps?

Zamir Libohova - North America node USA USDA-NRCS-NSSC

SRTM is available worldwide contrary to LIDAR.

Eliseo Guerrero – Mexico, INEGI

Provided updates on the Mexico soil data base and information status:

1:50,000 scale soil maps, 1968-1980 edition based on UNESCO-FAO coveting 30% of the country. All digitized. There are no gaps. There are 22,864 georeferenced soil profiles and 10,442 of them have analytical laboratory data. The laboratory data are currently being validated.

1:1,000,000 General National Soil Map 1979-1983 edition based on UNESCO-FAO covering the entire country. All digitized.

1:250,000 Series I scale digital soil map, 1980-1996 edition Series I based on UNESCO-FAO covering the entire country. All digitized. There are 9,549 georeferenced soil profiles and 2,808 have analytical laboratory data.

1:250,000 Series II scale digital soil map 1998-2007 edition based on the World Resource Base (WRB-1999) classification covering the entire country. All digitized. There are 2,940 soil profiles all with laboratory data.

Total number of soil profiles 35,353 and only 16,190 with laboratory data.

There is a system or database for capturing the attributes that has general soil descriptions with soil profile data and laboratory data. There are no data for Bulk Density and AWC. Also there are no lower and higher values for the properties in the attribute tables.

Nathan Odgers – West Virginia University – Geospatial Research Unit

Presented the work on **Application of the equal-area spline function to legacy soil data.**

Uncertainty approach was discussed. The idea of adjusting the uncertainty based on the percent map unit composition can be limited due to the fact that there is a discrepancy between point data and which component it represents when more than 1 component is present and the spatial distribution of the components within the map units is not known.

Larry West – National Leader USDA-NRCS-NSSC

Suggested that the uncertainty should also be done for certain properties such as %clay, AWC that relate to drought stress. Quantifying the uncertainty this way may convince people to provide funding.

Norm Bliss – USGS-EROS

The fact that there may not be enough point pedons for the uncertainty can be addressed also by grouping certain soil map units based on some similarity to create a population of map units from which then we can extract property values on pixel basis (1 point/pixel or

many points within a pixel). The sample of extracted points will serve for calculating mean, StDev and probability distribution functions that would give us the 95% confidence limits.

David Hopkins – North Dakota State University

NASIS and other data sources from transects can also be used. However they are estimates.

Norm Bliss – USGS-EROS

Presented the work on gridding SSURGO and STASGO2. The gridded SSURGO filled in with STASGO2 can be still problematic for certain models during simulations. A discussion about long baseline slope using D8 algorithm was shortly discussed.

Glenn Lelyk and Scott Smith - Agriculture and Agri-Food Canada

Presented the work on generating soil property maps for Canada based on GSM.net specifications. The question about the use of just spatially weighted means (if available) instead of spline was discussed in term of bias that the spatially weighed means introduces. For example if a pixel has many components only the most dominant is considered. Also when more than one component is present the weighted mean does not represent neither component, so if one component is very saline and the other is saline then the weighted mean falls between saline-very saline. This is where the uncertainty comes into play. Terrain based mapping may unlock the spatial information provided on the legacy data and may provide the spatial distribution of the components on the landscape that would alleviate the weighted mean bias.

Nathan Odgers - West Virginia University – Geospatial Research Unit

Discussed approaches to the spline when abrupt or discontinuous horizons are present. For such profiles the entire horizon can be sliced into 1cm or equal thicknesses. This however may lead to over fitting of the spline which may not be much different from the current representation of the soil property change with depth. The other option is to slice the bottom of the above horizon and top of the below where the abrupt change is into 1 cm think horizons in order to force the spline through the additional horizons. The over fitting can also lead to negative values for property values close to 0. In such cases the negative values can be set to either 0 or close to 0 for example 0.01.

Zamir Libohova - North America node USA USDA-NRCS-NSSC

The threshold for such cases can be set equal to the accuracy or error associated with the property. For example, if % clay is estimated based on field tests then the negative values can be set at 5%. For pH this may be based on the errors associated with the analytical methods for example 0.3 pH units.

Nathan Odgers - West Virginia University – Geospatial Research Unit

The weighted means for soil map units with bedrock (for example 50:50). In this case one approach is to use weight based units (for example g kg^{-1}) instead of volume based units (for example %). So the value to be reported is g kg^{-1} soil, which would exclude rock by default since it is only reported for the soil portion of the map units. If however, the units

are on per volume basis (%) then it should not be up scaled to the soil map units. For example, if one map unit has 50% rock for one component and the other component is 50% and has 20% clay then the 20% clay should be reported only.

Day 2 – October 26, 2011

Eliseo Guerrero – Mexico, INEGI

Provided further information on other auxiliary soil data available from Mexico. There is a geology map at 1:250,000 scale. As far as soil maps, the polygon soil maps do not have attribute tables. Only the point pedon data do have attribute tables. Also not all the polygon maps have point pedon data. Pedons and polygon soil maps are not linked.

Norm Bliss – USGS-EROS

The soil map units can be grouped based on Taxonomy like the Alaska example he has worked. This would provide more than one pedon for map unit. The pedon and polygon data can be related, especially for WBR maps since both have a common WRB legend.

Mike Ulmer – USDA-NRCS Senior Regional Soil Scientist Northern Great Plains Region

Presented some of the results for the Re-correlation and Update of the MLRA 55A Northern Black Glaciated Plains. The process was based on the landscape model, tacit knowledge, and driven by interpretations.

Zamir Libohova - North America node USA USDA-NRCS-NSSC

Questioned the fact that due to interpretation driven correlation certain features that are repeatable and predictable on the landscape were erased. The maps are harmonized based on the least detailed map units at the cost of losing detailed information confirmed by the tacit knowledge. Despite the fact that the documentation is still available in case changes need to be made, the removal of features that are predictable should be avoided during the harmonization.

Mike Ulmer – USDA-NRCS Senior Regional Soil Scientist Northern Great Plains Region

The time and personnel it took is not evaluated. It is uncertain. However the entire staff has been heavily involved with this. At least 2 years have been invested in this process.

Zamir Libohova - North America node USA USDA-NRCS-NSSC

Presented the results on Converting pH 1:1 H_2O and/or 1:2 $CaCl_2$ to 1:5 H_2O for the North America node of GlobalSoilMap.net project. Discussions followed about the possibility of using the pedotransfer function from this work to convert the pH values for Canada and Mexico.

Scott Smith: Scientific Coordinator for Canada:

Presented results from the work on the **"Use of Data-Driven and Knowledge-Driven Methods In Disaggregating Soil Survey Maps, Okanagan Basin, Southern British Columbia".** Following the presentation several issues related to validation were raised by Scott Smith. The first issue was about the number of points needed for validating the disaggregated maps based on digital soil mapping techniques - how many? The second issue was about the validating attributes and not the series. The third issue was about the

validation based on expert knowledge rather than pure statistics as the legacy data themselves are not always collected based on statistical approaches.

James Thompson – North America Node Scientific Coordinator

Presented results from the work on **"Disaggregation of Soil Class Polygon Maps to Produce Continuous Soil Property Raster Maps using Digital Soil Mapping Techniques".** Suggestions were made about the disaggregation approach. Jim has used "relative slope position" algorithm in aml script that can generate the slope positions that in turn can then be used to tie soils to slope positions to be used for the generation of property maps. Hewitt and Schmidt landform classification can also be used as a way to associate each soil/component with the slope position. If the final product is not harden then a fuzzy membership for each slope position will be created that can be used to generate the soil property maps.

Jay Sagin – Private Consultant from Canada

Presented some opportunities for projects in Kazakhstan including training. Discussed the idea of creating a separate node for the Kazakhstan region and the neighboring countries around Caspian Sea as part of the GSM.net project. The region is unique with regards to geology, climate and soils. Also suggested the increase in the number of soil property maps beyond the GSM.net project.

Discussions/Future Work and Plans

Uncertainty – is the priority. However, due to the different data base structures and data collected each country may have to develop methods for the uncertainty suitable for their conditions. GSM.net does provide some guidance for estimating the uncertainty semi-qualitatively.

USA would use min/max values as the 95% CI for reporting the uncertainty for versions 0.1-0.4.

Canada and Mexico do not provide min/max values so other approaches need to be considered:

Variance within soil map units with more than 2 components can be used as a measure of uncertainty.

Another approach is to group soil map units based on some similarity index (taxonomic or other). Use each smu as an observation and calculate the variance as a measure of uncertainty, and/or calculate the variance, StDev and 95% CI based on the point pedon data falling within grouped smu.

Mexico work on versions 0.1-0.4

The pedon data need to be linked to the polygon data. There is common WRB legend for the pedon and polygon that can be used to relate them. The use of other data like geology, lancover, and climate can also be used to group the soil map units for the uncertainty and stratify the pedon data.

The smu with more than 1 component do not have % composition. One of the approaches is to use disaggregation techniques presented by Scott Smith, James Thompson and others.

Norm Bliss will conduct some preliminary data analysis. Once the preliminary work is finished then a meeting with INEGI will be arranged.
A pilot project that is data rich like Sonora can be used as an example for the joining and disaggregation of soil data between Mexico and USA.

Canada continued work on versions 0.1-0.4.

Will continue to do some data mining from the old SLC to extract information for the gaps (areas with no data). Pedons that relates to components will be searched in order to populate the attributes for the soil polygon maps. Scott committed to informing the node leader within 3 months of a plan.
Glenn Lelyk and Nathan Odgers to collaborate on a summary report on the weighted mean and spline functions in preparation of v0.1 and v0.5 for possible publication and/or submission to the GSM Science committee for their information and perusal.
Glenn Lelyk and Joe Brennan to look at the correlation of hydrological soil groups along the Canada-US border in the Red River Valley to view if any significant differences.
Possible preparation of a poster for the Red River Commission annual meetings in January.

USA

Continuing work on generating the maps for the remaining soil properties (ECEC, EC, AWC, Soil Depth, Bulk Density and pH).
For the BD use two approaches: (i) the current attributes from the polygon map units the same way as used for the other properties, and (ii) develop pedotransfer functions (pdf) based on pedon data using clay, silt, sand, and organic matter as predictors to predict BD. The BD derived from pdf and the attributes of polygon data to be compared with the measured ones from the pedon for QC/QA.
Version 0.1 – Generate the property maps based on STATSGO2 by Spring 2012. The data to be used as is. Document the procedures used for V 0.1 and post it on the USDANRCS- GSM.net web site.
Version 0.5 – (SSURGO +STATSGO) and (SSURGO + No Dada from STASGO) by midd-summer. These versions will be at 30m pixel then re-sampled to 90m per GSM.net specifications.
Version 1+ will be developed based on digital soil mapping techniques and the pilot projects can be used as test beds.
Develop a protocol for reviewing the maps by experts and soil scientists.
Tom Reinsch to work on the USA-Mexico MOU designed similar to the one between USA-Canada.
At this point it was agreed that there is no need for a CANDA-USA-Mexico MOU. Pilot projects will not be emphasized in the MOUs. Instead, the pilot projects will be started after within country harmonization have been completed.
Mike Ulmer indicated that the harmonized MLRA55A will be soon available and can be used for future harmonization efforts between USA and Canada.

It was agreed to have another meeting of the North America Node at a location yet to be determined.

Possible site visit to Aguascalientes, Mexico by node representatives to further establish working relationships and work plans was suggested.