

## **Conversations with the DSM Focus Team**

### **Q) Digital Soil Mapping is different than soil mapping**

A) There is no stereoscope mapping, plane table mapping, sharpshooter mapping, bucket auger mapping, there is only mapping. Projecting our knowledge from an observation point to an area, which represents a landform segment unique from adjacent segments, is making a soil map. “Projecting our knowledge” is another way of saying “making a prediction”, or mapping, which is the same thing as modeling. Making a soil map using nothing but an aerial photo and auger is a modeling effort. Using hardware, software, data and the numerous methods for modeling is only different by the means used to help model the soil landscape.

### **Q) DSM precludes field work**

A) This is a misconception. DSM has been used for initial soil surveys and updates at typical and accelerated production rates. For “typical” production rates, the resulting DSM product is more consistent, precise, documented and spatially explicit compared to a traditionally produced product, with no loss in field time and better directed field time. At accelerated production rates, conventional survey methods offer no/little feasibility for producing a consistent, precise, documented or defensible survey.

### **Q) All DSM products I’ve seen stink, why should we devote resources to an inferior product?**

A) Every place a DSM product was deemed rubbish, an eventual soil map was produced. A product produced conventionally, at some level, would have been able to utilize DSM techniques. It is possible some projects deemed failures may have been the product of circumstance, inadequate covariate data, gaps in knowledge or an unwillingness to change or incorporate new procedures among other reasons.

### **Q) What’s wrong with STATSGO?**

A) Nothing, but who here was involved with creating STATSGO? The product is close to 40 years old, are we willing to let STATSGO be the small-scale representation of our soils knowledge today?

### **Q) What’s wrong with SSURGO for doing projects of large spatial extent?**

A) Biggest factors are it is incomplete, inconsistent and not current. Managing and manipulating attribute data is burdensome for most users. What does NRCS gain by putting this high burden on users?

### **Q) What’s wrong with SSURGO, period?**

A) SSURGO is and has been a fine product and it can stay as-is. No effort related to DSM abandons SSURGO. However, it is possible NRCS could have more than ONE product line. In addition, pointing out the limitations of SSURGO provides opportunities to address the limits.

### **Q) SSURGO is as good as it gets, name one limitation?**

A) The polygon data model has its limitations. There are many cases when the map unit designs are consociations or associations where we have the knowledge and ability to spatially represent the extent of components (major and minor) using raster data. If we can map it, we should map it.

**Q) Raster data looks like junk, what's good about it?**

A) When using DSM techniques, the data inputs are in raster form and represent the soil forming environment. Provided the resolution is adequate, small bodies of soil classes may be spatially represented with raster data that are not possible in the polygon world. In addition, modeling soil property distributions (horizontal and vertical) is possible with raster inputs. Mapping properties is different than what we are used to, but is a product that offers many advantages.

**Q) What else is good about the raster world?**

A) Precision will increase using raster data. This is lacking with traditional soil survey methods. Also, much of the raster data to be used is developed, maintained and distributed by other respected agencies. We could utilize much of this from the raster source, rather than maintaining it in database form (MAAT, GDD, slope gradient, slope aspect, etc...).

A database is inadequate for recording and representing many spatial variables. Think about slope aspect and how it is populated in the database. A lo-rv-hi is inadequate to represent aspect for many of the map units in USA. Trying to maintain these things in a database creates extra work and often leads to some of the disjointed cartographic representations that plague SSURGO.

**Q) Can we convert raster to vector?**

A) Yes, and it has been done for a number of surveys, but it is a time-consuming retrofit. If there is a goal of a complete vector dataset, this will need to be pursued, but adopting the raster products as end-points and developing tools that utilize raster data for desktop and web-based GIS applications would be more appropriate efforts.

**Q) We don't have a standard or delivery mechanism for raster data**

A) During the early stages of adoption of GIS by NRCS, the idea of SSURGO was developed. The first standard for SSURGO took about 5 years to develop with the first version finalized in 1995. There were several modifications to the version from 1995-2005. There was no delivery mechanism other than ftp, disk or tape. Web Soil Survey was not available until 2005. There was no wringing of hands or gnashing of teeth regarding delivery methods in 1995. GIS-based web services were not even a dream discussed in public in 1995. There was a substantial investment of time, people and money devoted to development of Web Soil Survey. Developing web based services for a raster product will require a corresponding effort, but the lack of a web based delivery system for raster data should not preclude initiation of DSM projects and products. The delivery mechanism can catch-up with the available data in time.

**Q) What are these products you speak of?**

A) NRCS/NCSS has focused on mapping soil classes, i.e. soil series, components..... via soil map units from the beginning. By proxy of the soil classes, we develop spatial representations of soil properties. Soil properties could be mapped directly. This would be a separate but related product of our traditional soil maps.

**Q) What are the benefits of soil property maps?**

A) Since all ratings and interpretations are derived from properties, it would be beneficial to have a product that is a direct representation of the suite of properties needed to generate ratings and interpretations. It is a big task to get the particular properties at particular depths for all of the components by using the database tables. Again, this presents a burden to users of our data.

**Q) I can get what I need for any property I want, what's the big deal?**

A) Do it for the Missouri River Basin or the Colorado River Basin north of Bullheads City, AZ. Then do it for multiple scenarios so someone can look at changes, and do it fast, everyone wants fast. More than likely, SSURGO does not exist for all areas of either watershed. How do we deal with incomplete data? How do our users deal with incomplete data?

Consider a raster dataset that includes all of the significant physical and chemical soil properties at standardized depths and assume it is seamless across the USA. There is no database required, the data is implicit in the raster layers. Non-soil attributes such as climate, elevation derivatives, land cover, land use, etc are also in raster form. The rules for countless interpretations and ratings are already defined. Applying them to a standardized dataset would certainly be more direct than current methods.

Having data available like this would make an analysis of the Missouri River Basin readily accessible. This is something NRCS and other land management agencies do frequently, it not the sole domain of global modelers.

**Q) Hasn't someone already done this, e.g. STATSGO-SSURGO blend/Polaris/SoilGrid/SoilGRID+, why do it again?**

A) Yes, and some of these projects have received funding from NRCS. With the exception of the STATSGO and STATSGO-SSURGO blended GlobalSoilMap products, these have all fallen in the realm of research projects and had limited or no input from a wide range of NRCS/NCSS soil scientists. Enough of these preliminary investigations have been completed that we could proceed in production mode, improving upon the limitations of previous efforts while utilizing the expertise of the many soil scientists within NCSS.

This would proceed as versioned products or approximations. Version 2 will be an improvement on version 1; informed by version 1 and additional data, knowledge or technique.

**Q) So what, everything I need is in the component table in NASIS**

A) Information related to "what" is in NASIS, but not much related to "where" is in a form useful to users. The database is of limited use without a good corresponding map.

**Q) SSURGO has slope phases, isn't that useful?**

A) Compare slope class to slope class representations of SSURGO vs high resolution DEMs, then decide. Random observations in several Midwest counties shows an agreement of 45-50%. That is for slope gradient, which is easily defined, produced and compared by anyone familiar with GIS and basic raster processing skills. Soil scientists are good, but they are no match for high resolution DEMs. Polygon lines have gone through so many edits, their relation to the landscape is not as good as we think and fitting landforms into preconceived slope classes results in misrepresentations of the landform or slope class.

**Q) The slope phases are critical for interpretations, isn't that useful?**

A) Consider a soil map without slope phases, just soil/component names. All of the physical and chemical properties required for interpretations are available. Wouldn't it be more useful, precise and accurate to use the slope gradient from an approved DEM for the slope gradient dependent rules, rather than the slope gradient as defined by the RV of the SSURGO components?

**Q) Why don't we just adjust polygons to better fit landscape?**

A) Adjusting 30-40 million polygons is a huge task. Would the prospect of editing vectors for the next 15 years be an effective recruiting tool for new soil scientists? Is this what we want mid-career soil scientists to do with their time?

**Q) Wouldn't we have a better product if we adjusted the lines?**

A) We would have a product with vector lines with an improved match to the landscape, which would be an improvement. But, we still have the limitations of the polygon model. Our contention is to leave SSURGO as-is. Future work should adopt the raster data model and geospatial methods and be offered *in addition to, not instead* of SSURGO.

**Q) DSM will put soil scientists out of a job**

A) Our numbers are shrinking without DSM. We have 1/3 to 1/4 of the staff we had in the mid-1980s, is the trend going to change? Exclusively offering the same product is a better recipe for reducing our numbers than DSM.

**Q) Consider the following scenario; you have been told that your acreage goals for the coming year will be increased 5x or 10x, what are your options?**

A) You like to eat and provide for your responsibilities, you will produce at a rate 5-10x of what you are accustomed. Several recent projects (Boundary Waters Canoe Area and MLRA 55A) were faced with this very challenge. The goals of Soils2026 are personified with this scenario.

**Q) But that product will stink compared to what I typically do**

A) The assignment was/is to create a map at 5-10x the typical rate, not at your typical rate. The best available data about soil survey will be developed within the given constraints.

**Q) Yes, but it would be better to do nothing than to do it poorly**

A) The only thing worse than a poor prediction is no prediction. Those that hesitate to make a prediction will be ignored for those willing to take the challenge. NRCS/NCSS has the expertise, staff and infrastructure, we just need to start doing it. The following quote is applicable:

*"Every year, if not every day, we have to wager our salvation upon some prophecy based upon imperfect knowledge"* Oliver Wendell Holmes

**Q) OK, we do something and it is junky, then what?**

A) We perpetuate the human endeavor, keep learning and continually improve upon the product:

No information = terrible < poor information < fair < pretty good < good < very good information

It is old news in soil survey as noted by this 90 year old statement: *"... I cannot conceive of the time when knowledge of soils will be complete. Our expectation is that our successors will build on what has been done, as we are building on the work of our predecessors."* - R.S. Smith, Director of the Illinois Soil Survey, 1928.