

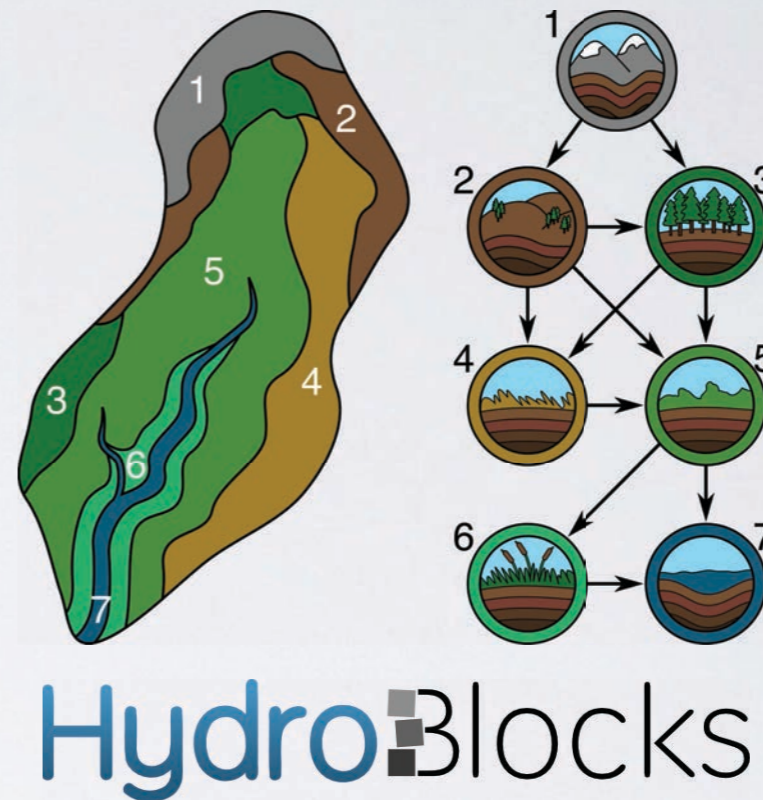
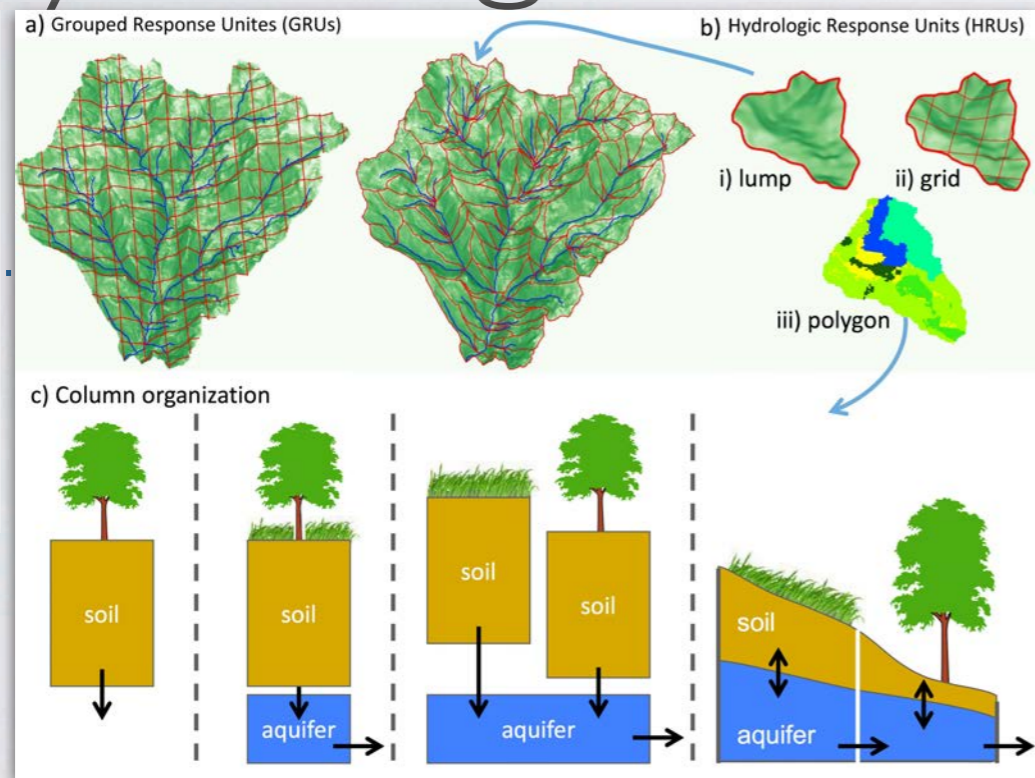
POLARIS: 30-meter soil properties over the contiguous United States for use in land surface modeling

Nathaniel W. Chaney

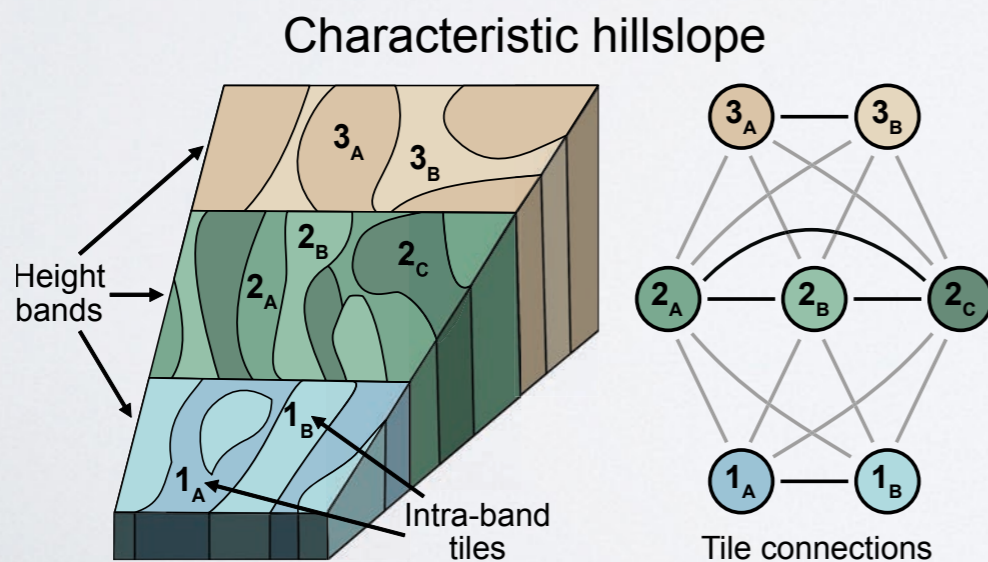
June 5th, 2018



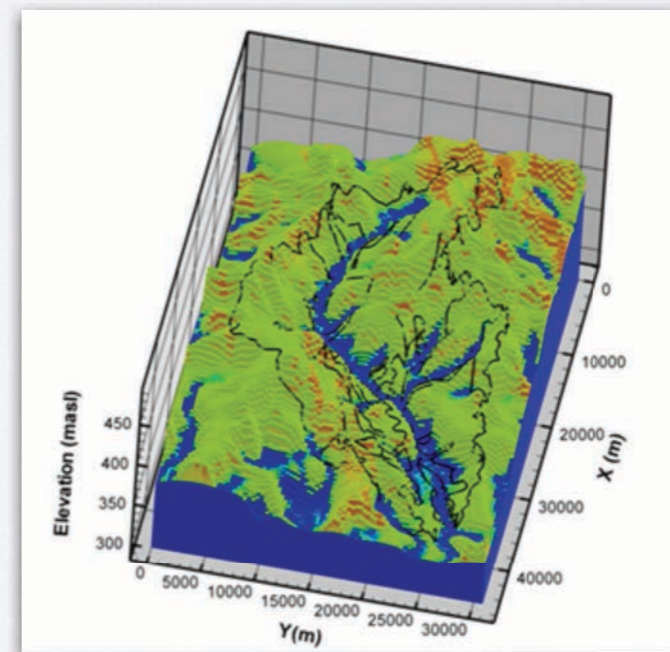
Motivation: Field-scale resolving hydrologic and land surface models



SUMMA

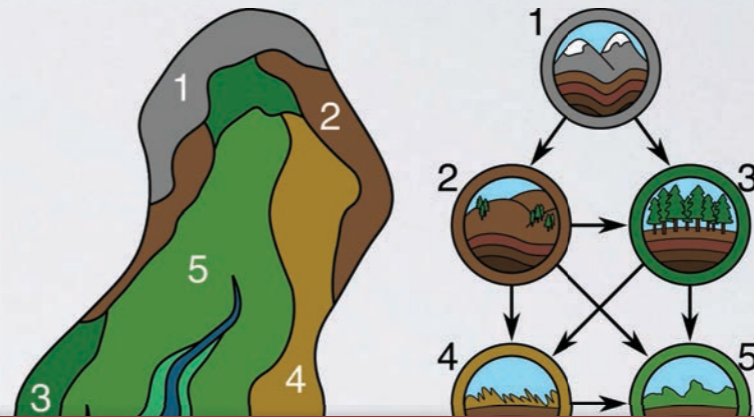
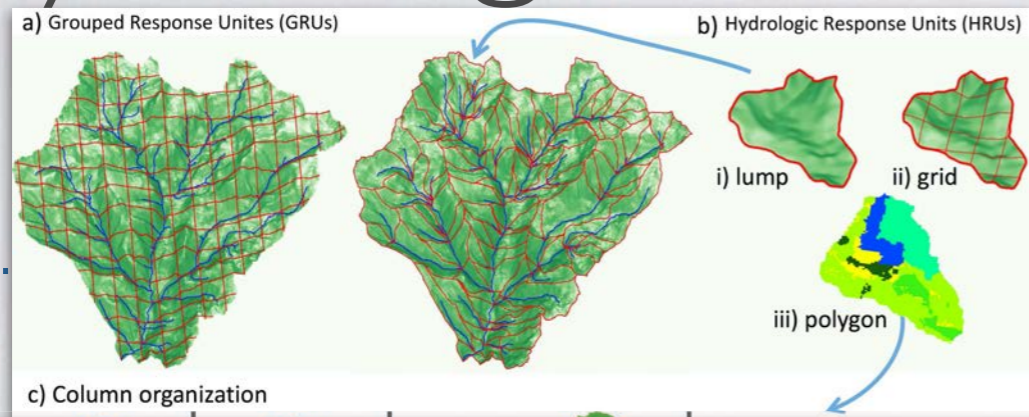


GFDL LM4-HB



PARFLOW-CLM

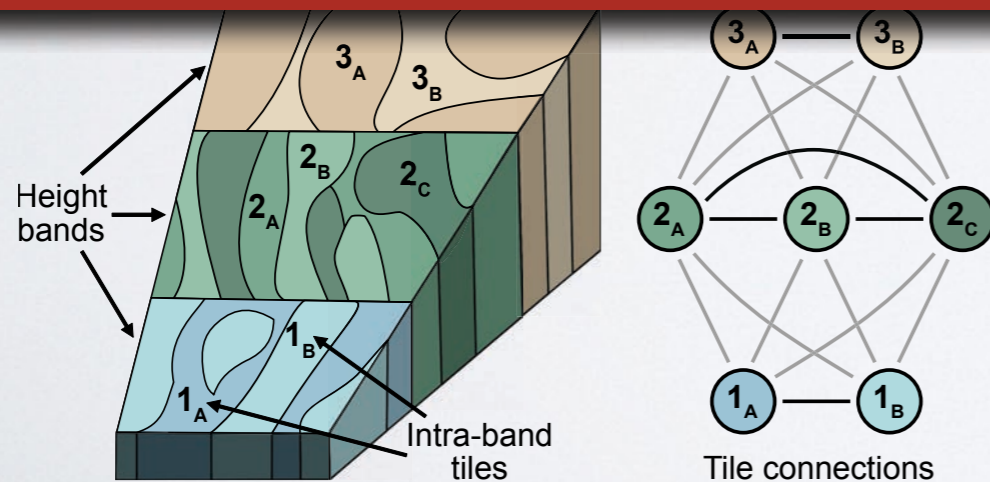
Motivation: Field-scale resolving hydrologic and land surface models



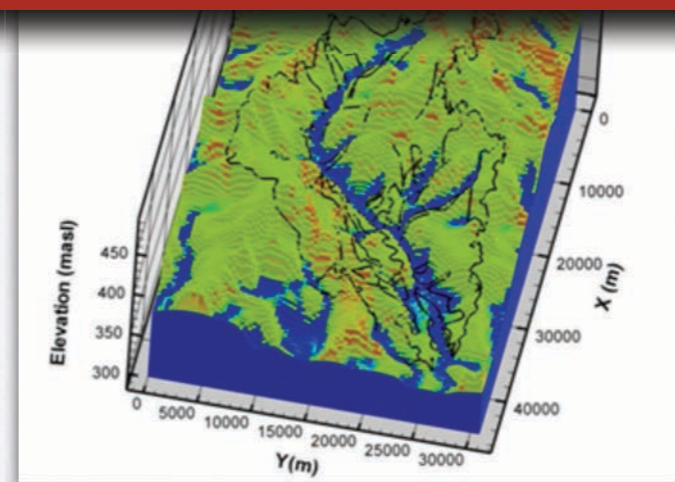
Emerging new paradigm



Land surface models that resolve processes explicitly at scales between 10 - 100 meters

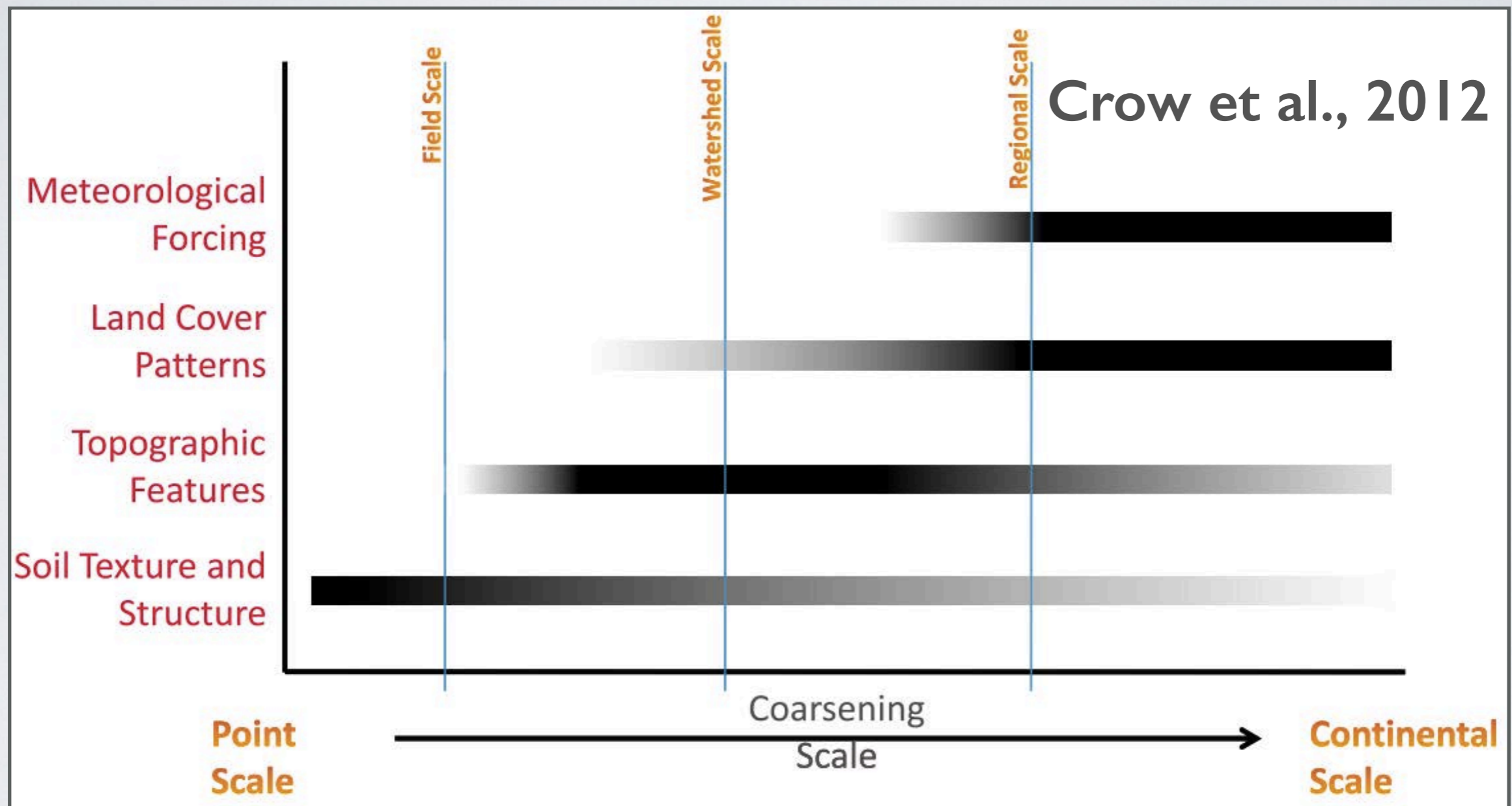


GFDL LM4-HB

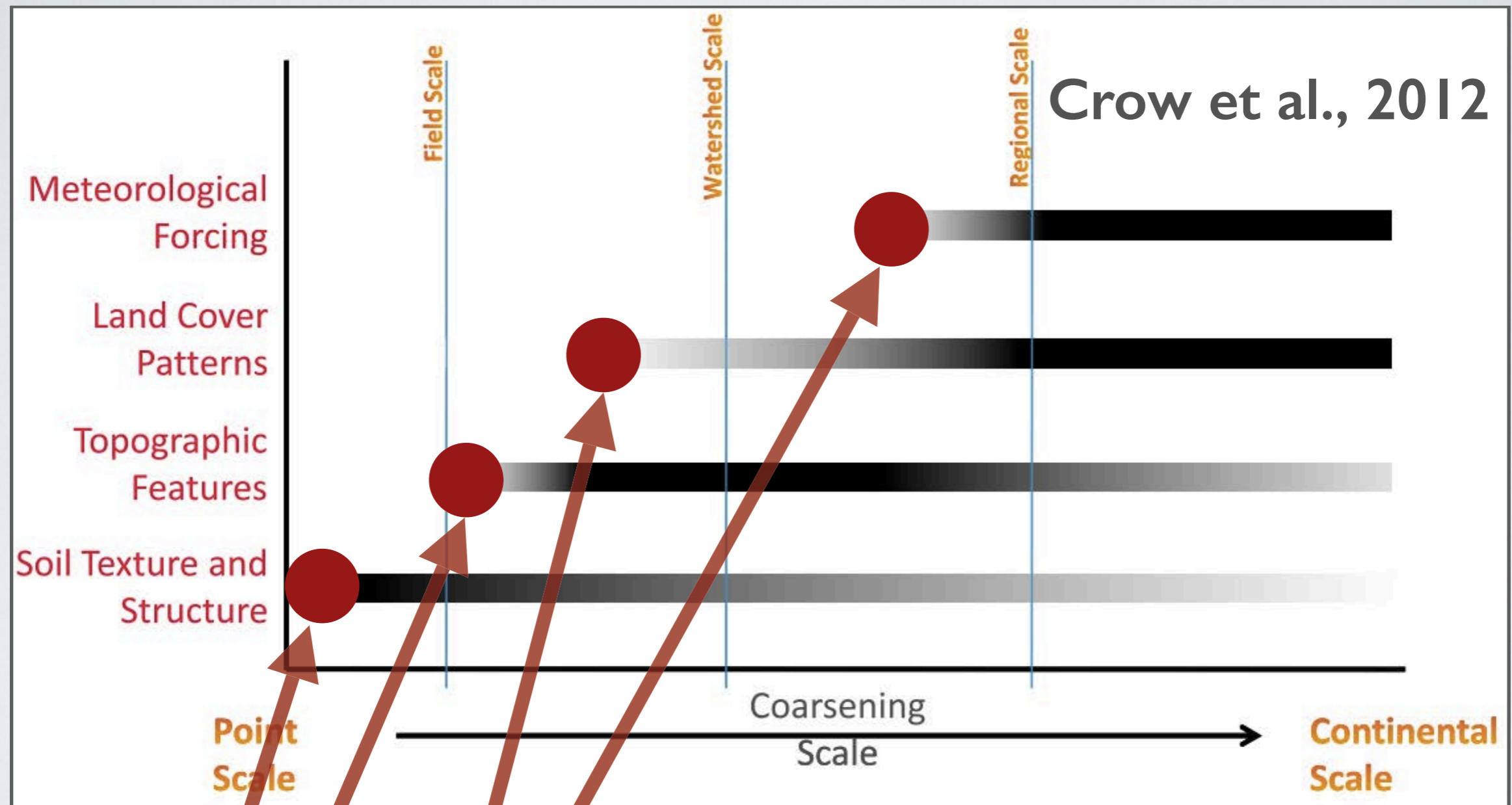


PARFLOW-CLM

Data requirements for these models: Multi-scale heterogeneity of soil moisture

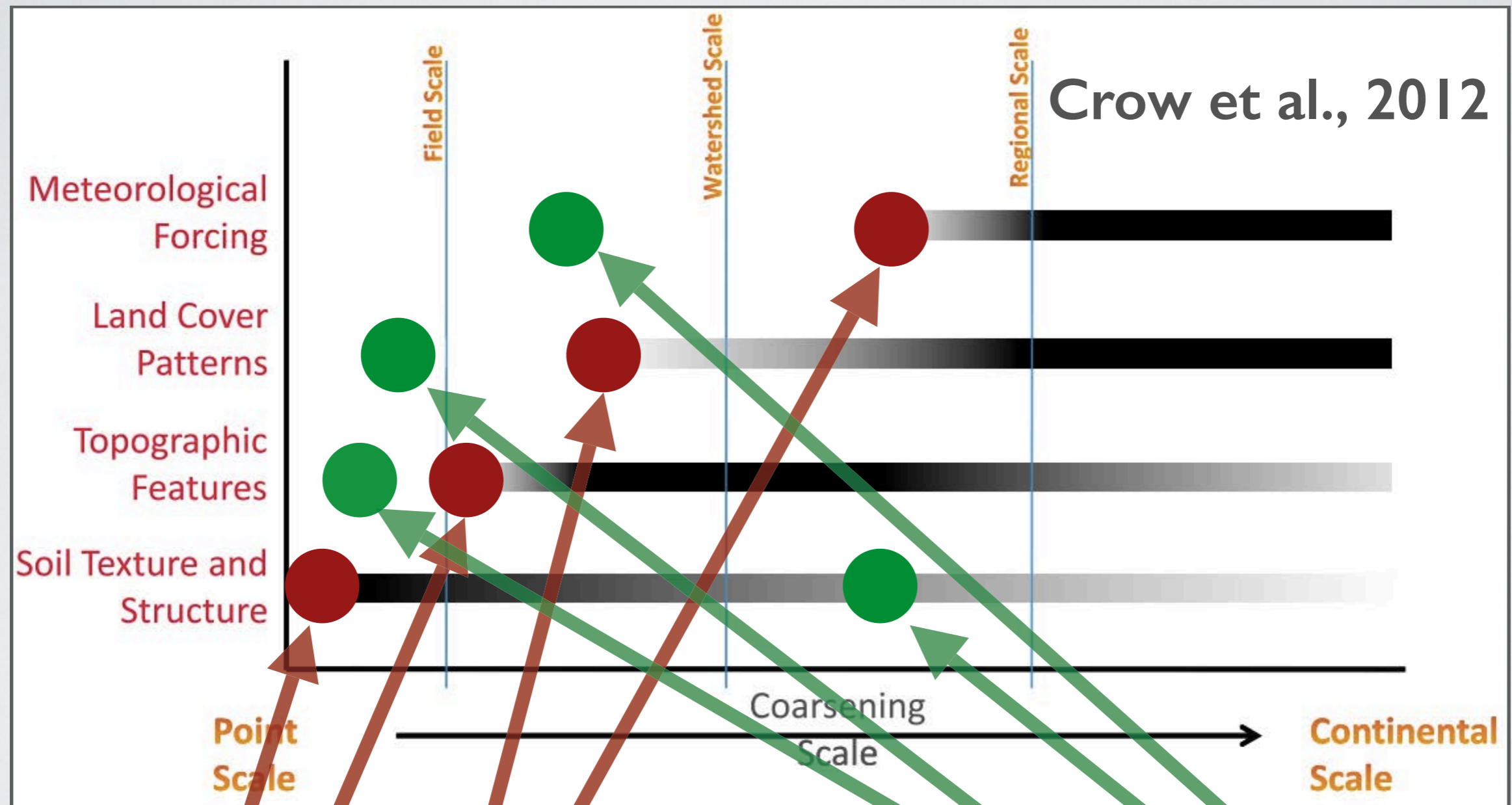


Data requirements for these models: Multi-scale heterogeneity of soil moisture



What we need

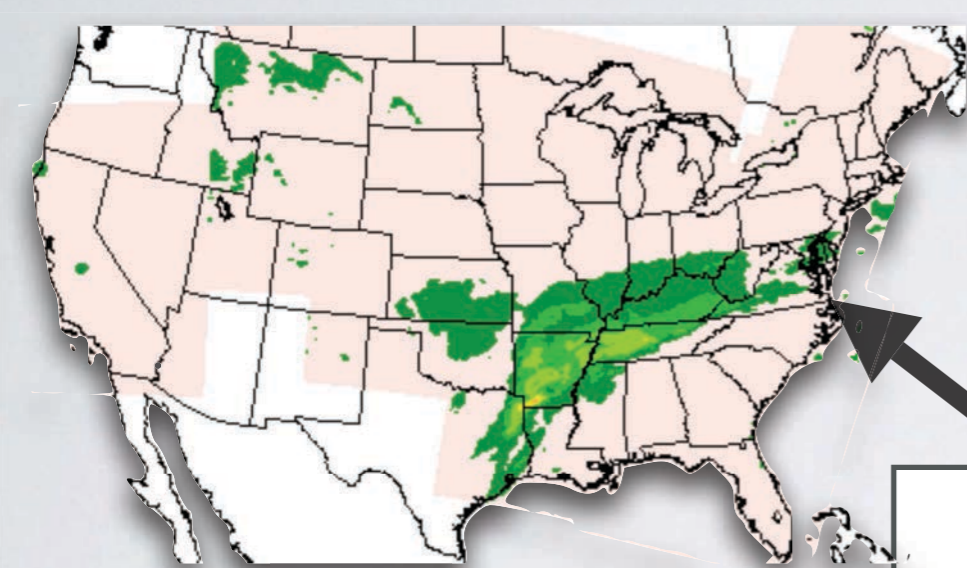
Data requirements for these models: Multi-scale heterogeneity of soil moisture



What we need

What we have

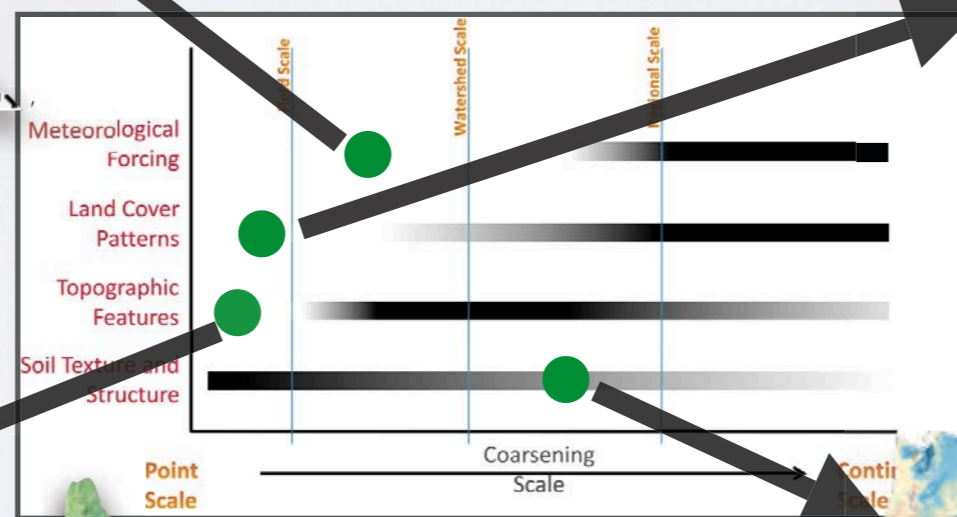
Motivation: What data do we have?



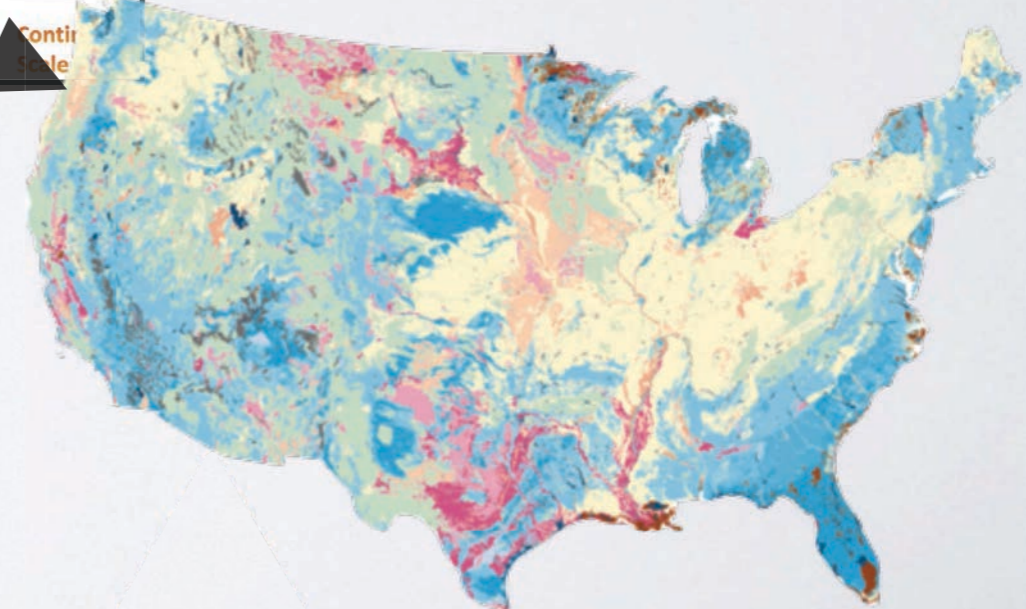
Stage IV - 4 km



NLCD- 30 m

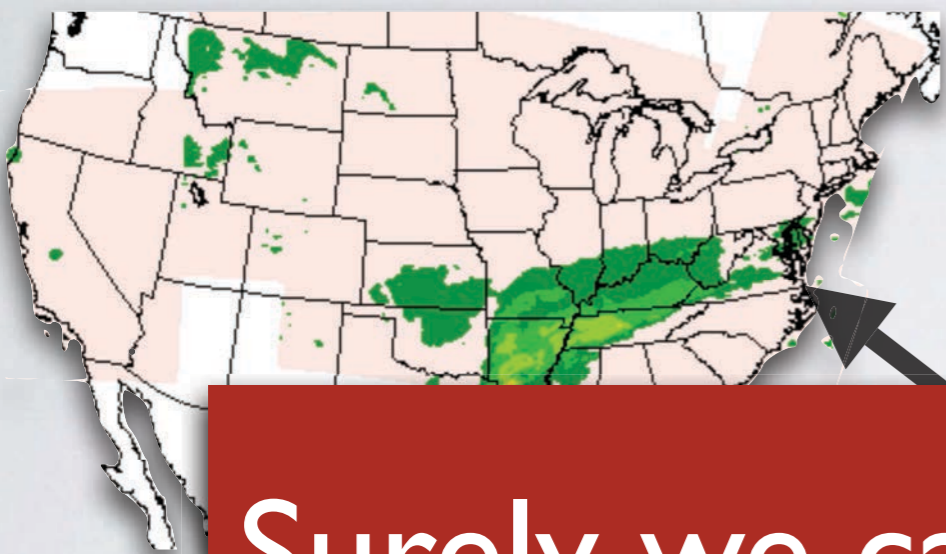


NED - 10 m



CONUS-Soil - ~25 km

Motivation: What data do we have?



Sta

Surely we can do better in 2018 than
CONUS-Soil (made in 1999), right?

Scale

Scale

Scale

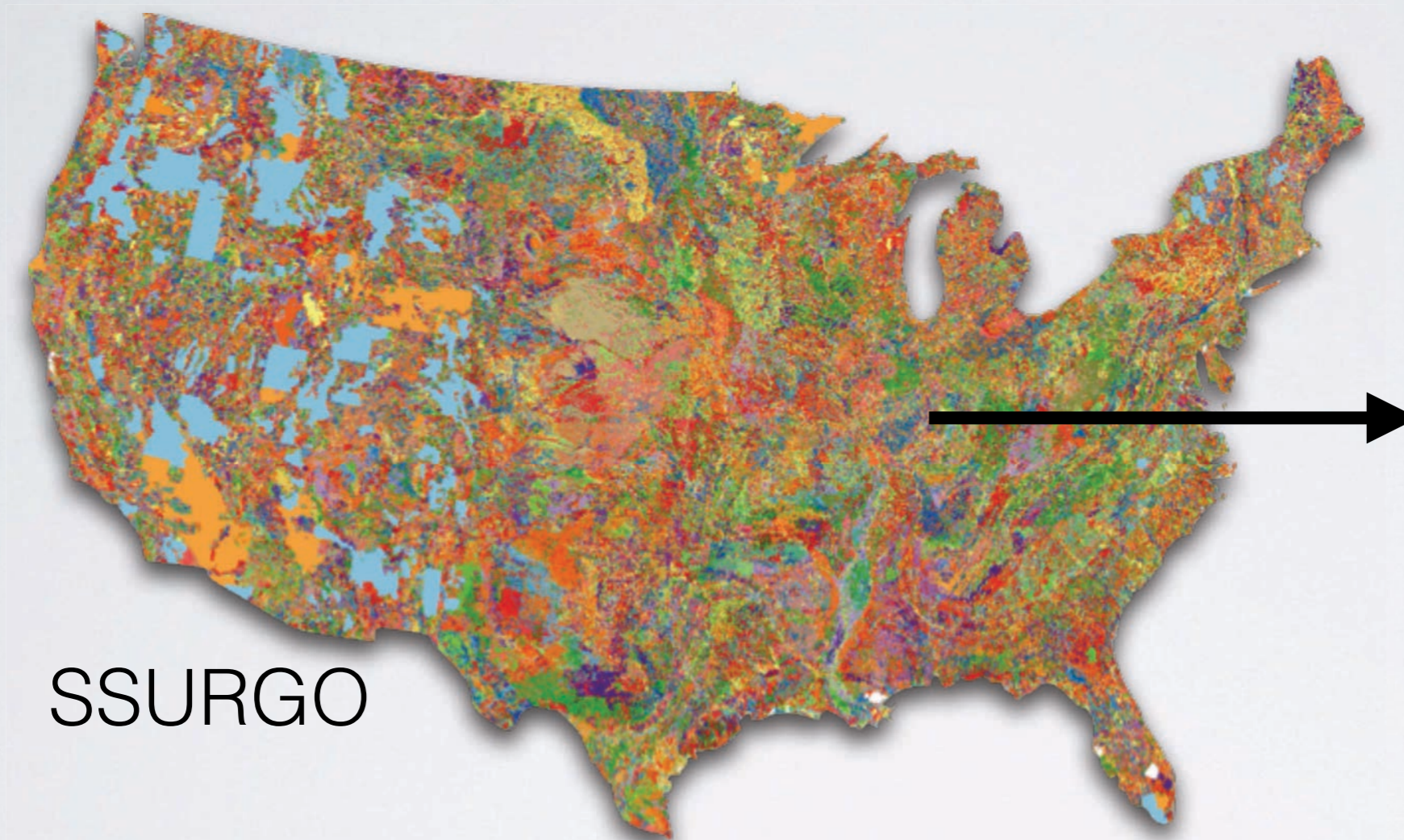


NED - 10 m



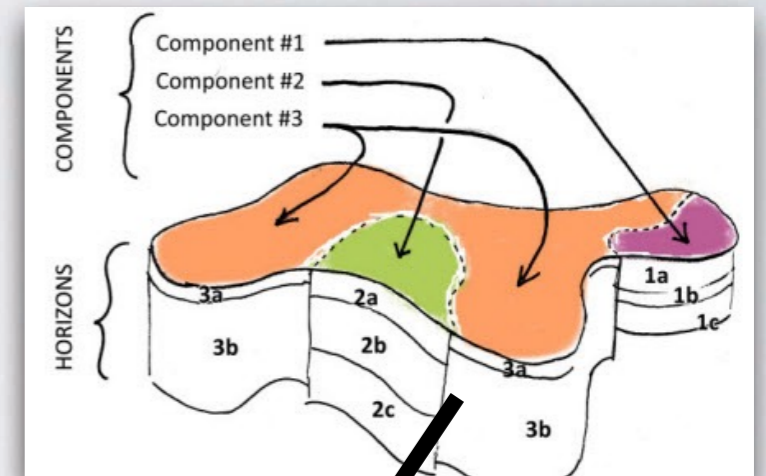
CONUS-Soil - ~25 km

POLARIS: Harnessing the wealth of soil surveys over CONUS (SSURGO) to improve soil information for environmental models



SSURGO

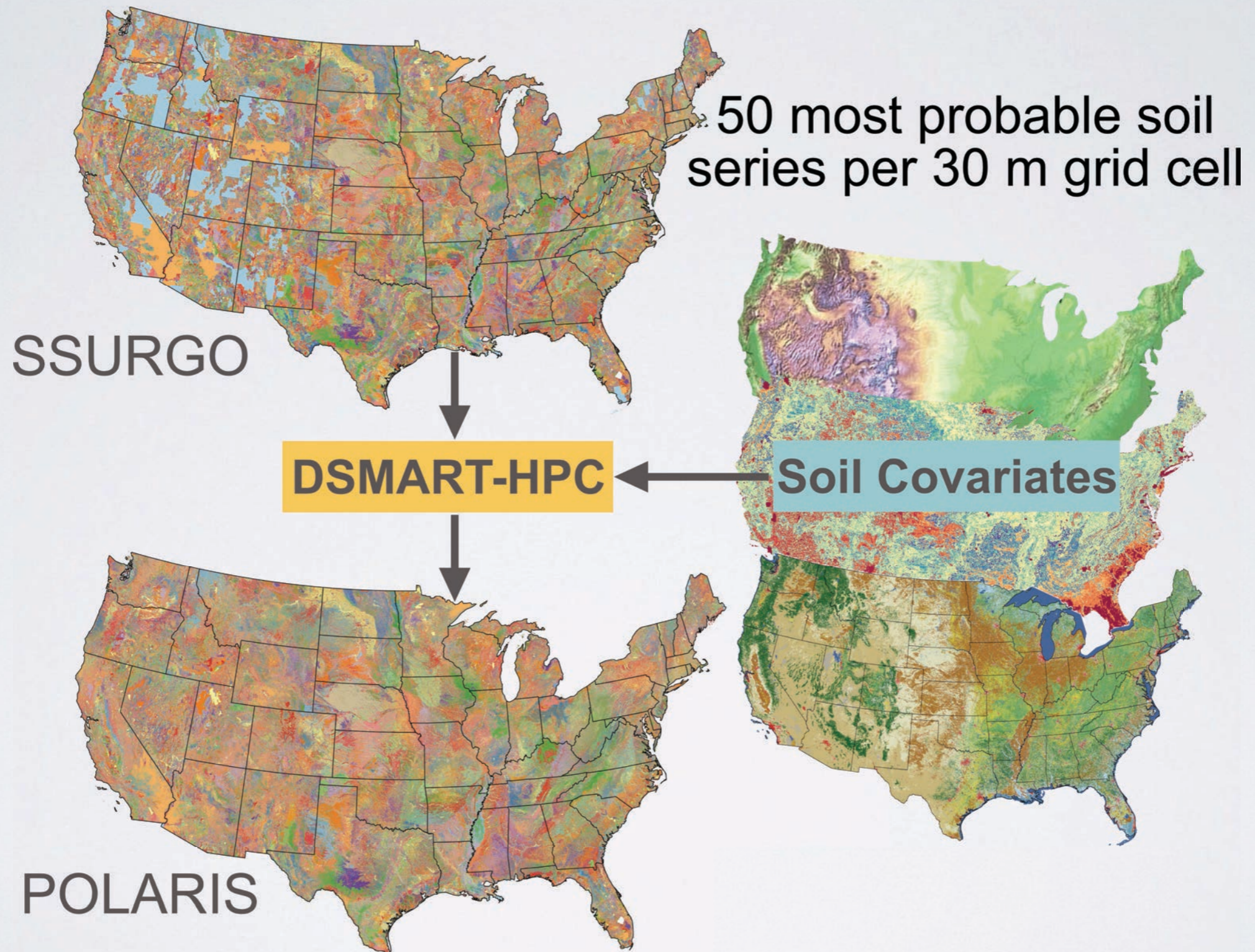
- 100+ years of soil surveys
- Effective spatial resolution of ~1000 m
- 20,000+ soil series over CONUS



Example: Cerini

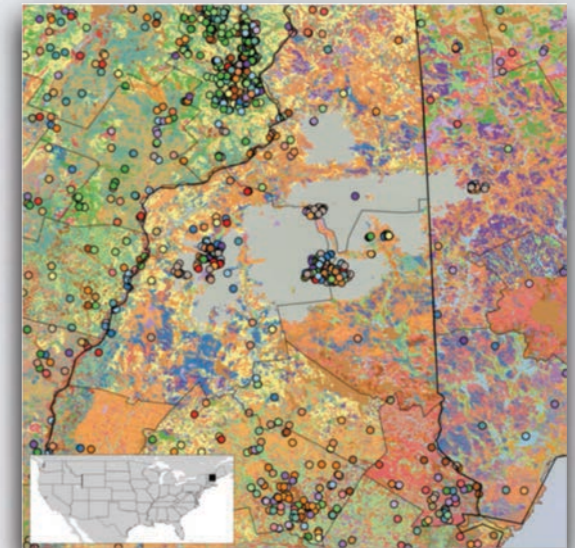
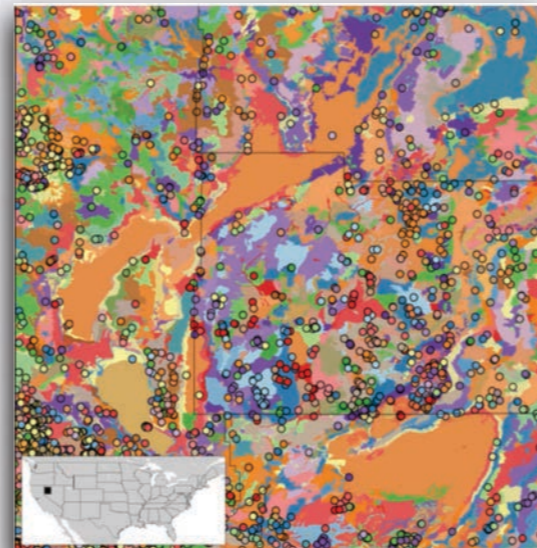
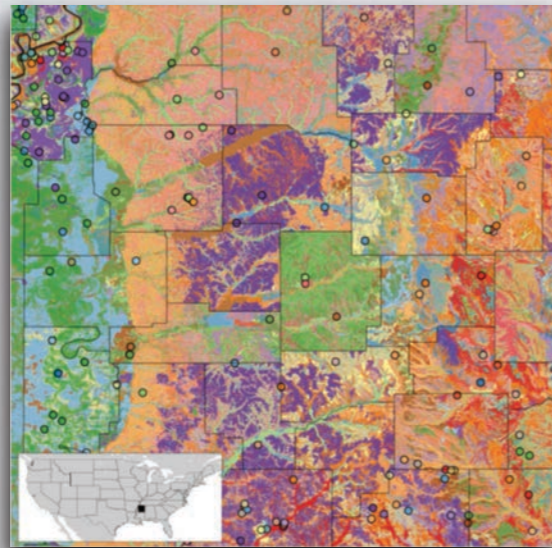
Organic Matter (%)		Percent Clay		Percent Sand	
0.3	0.8	21	31	23	44
0cm		0cm		0cm	
39cm		39cm		39cm	
79cm		79cm		79cm	
118cm		118cm		118cm	
157cm		157cm		157cm	
EC (dS/m)		SAR		CaCO ₃ (%)	
1	2	5	2	1	2
0cm		0cm		0cm	
39cm		39cm		39cm	
79cm		79cm		79cm	
118cm		118cm		118cm	
157cm		157cm		157cm	

Step 1: POLARIS soil series

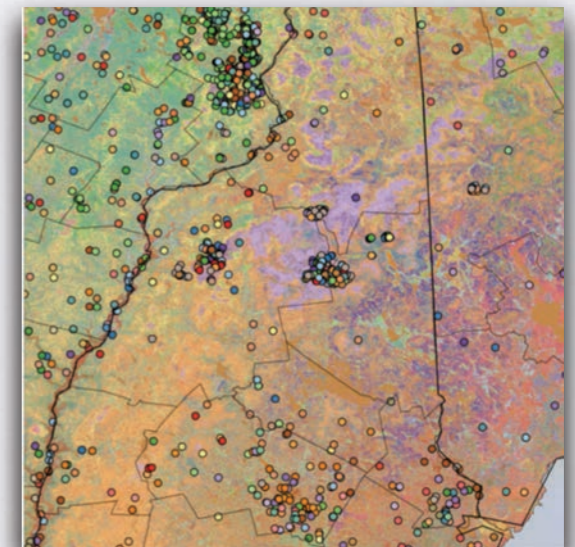
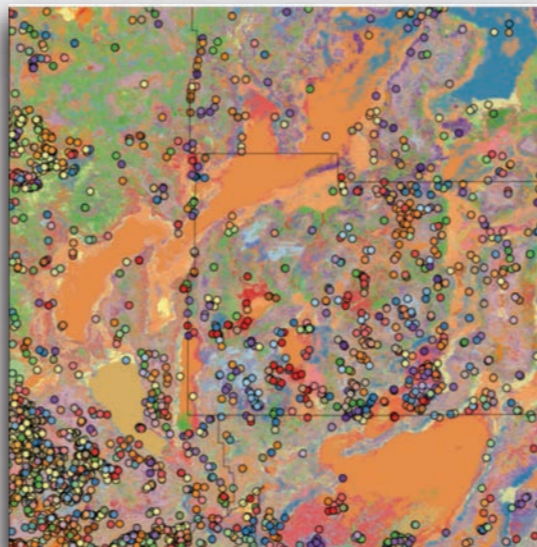
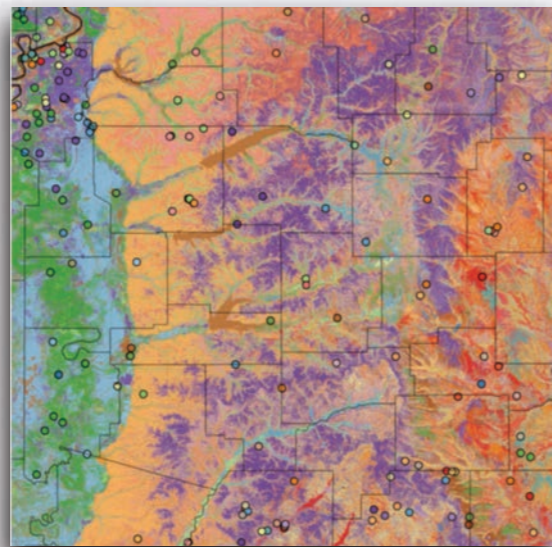


Addressing the challenges in SSURGO

SSURGO

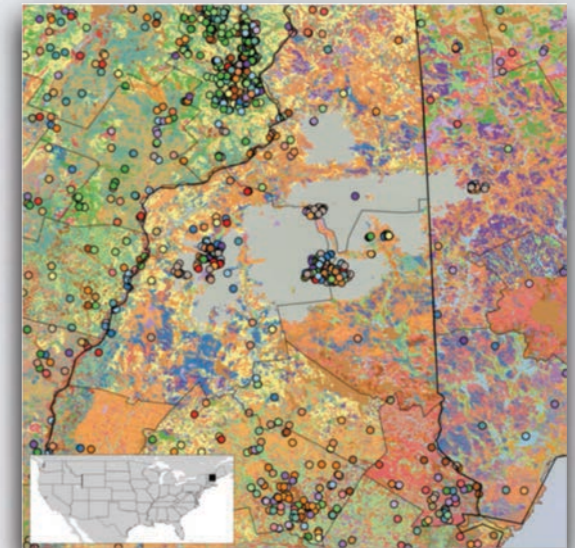
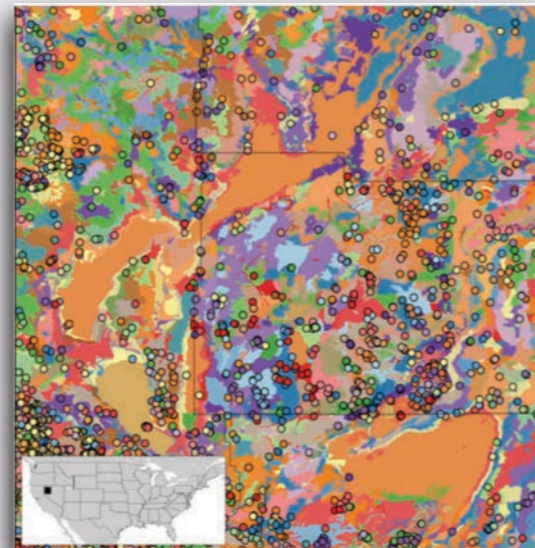
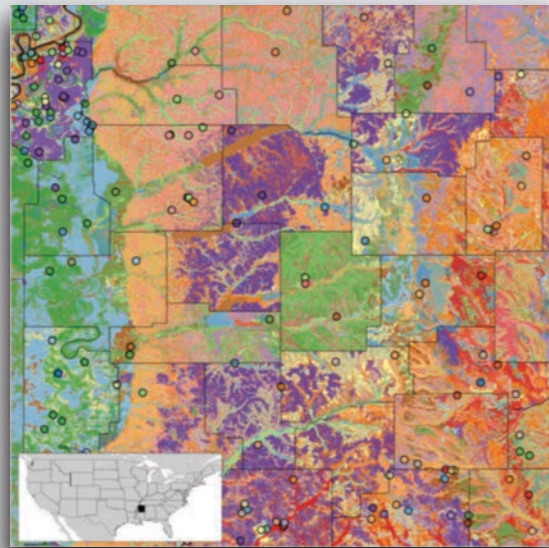


POLARIS



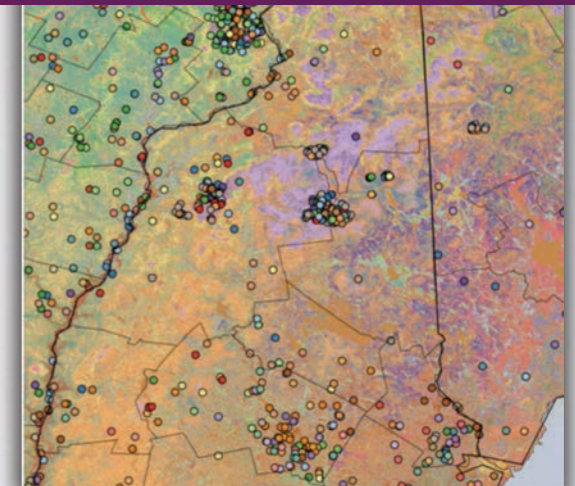
Addressing the challenges in SSURGO

SSURGO

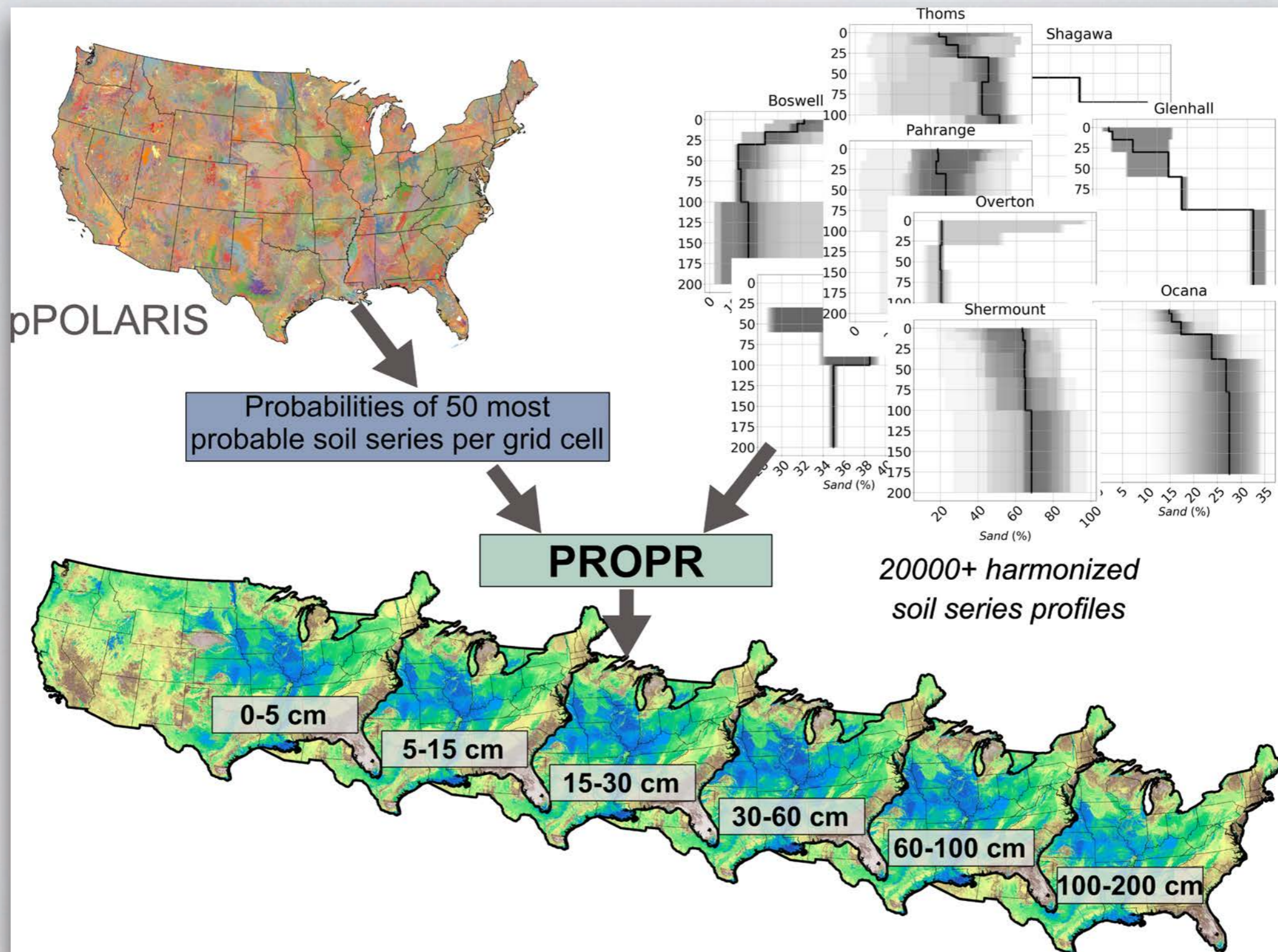


Use POLARIS in land surface models?
Challenge: Land surface models need property maps

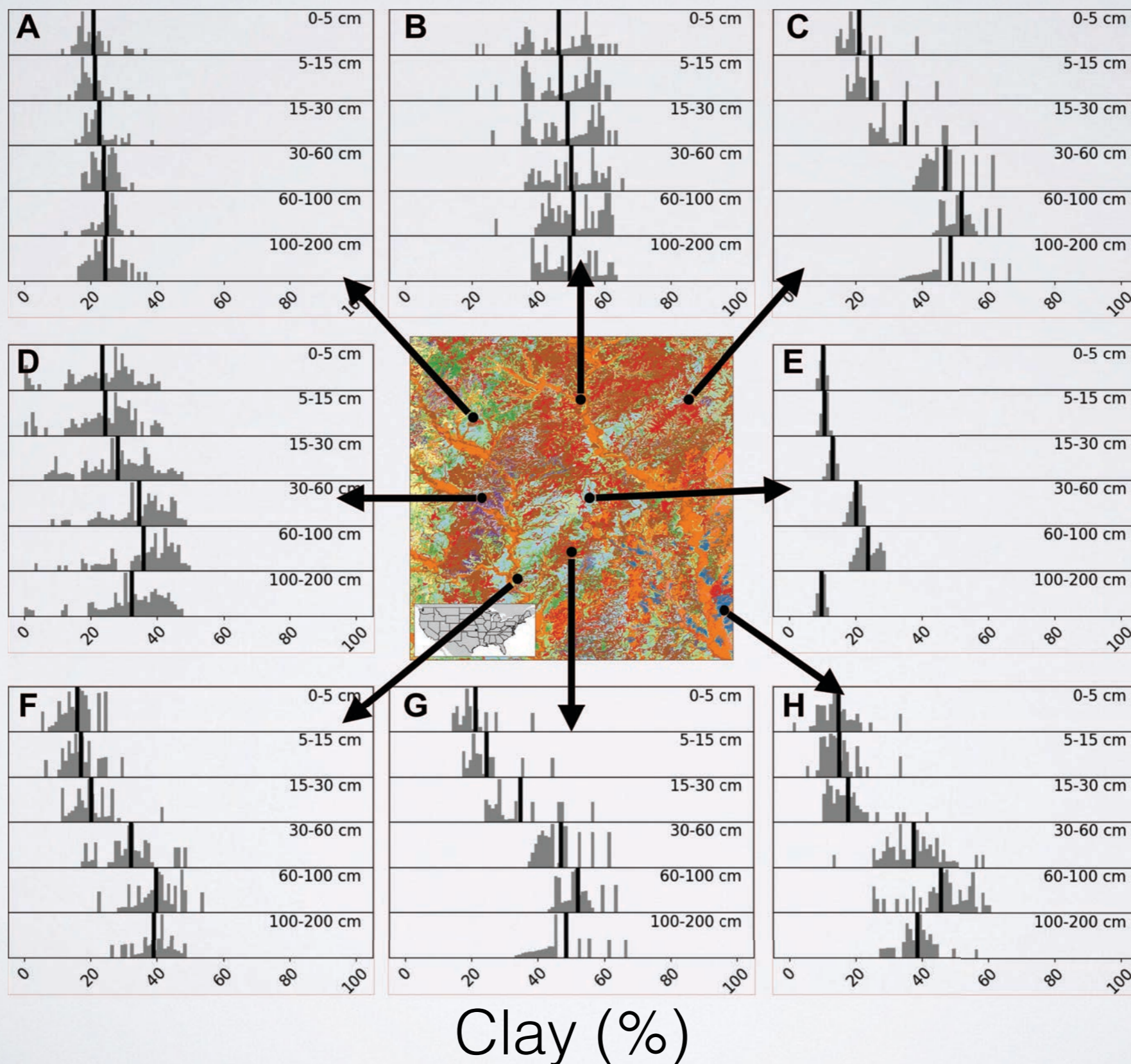
POLARIS



Step II: POLARIS properties



POLARIS properties: For each 30 m grid cell, 100 bin histogram per property and layer



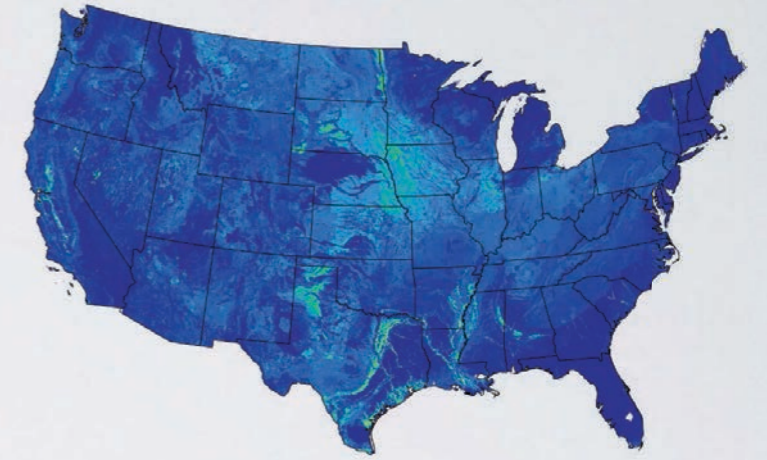
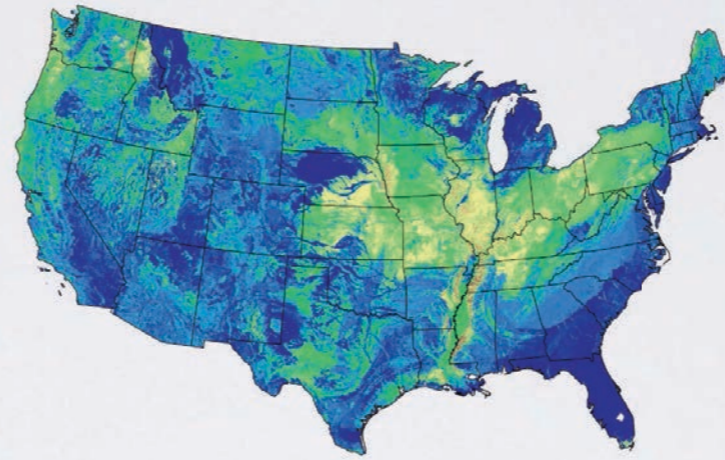
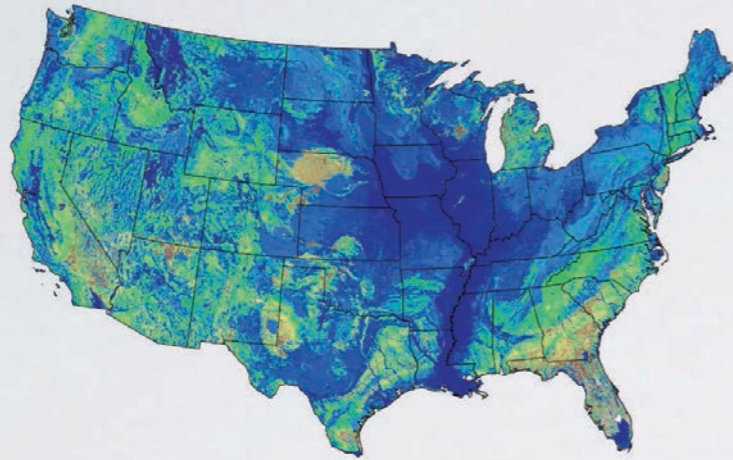
POLARIS properties: Summarizing the histograms

Sand

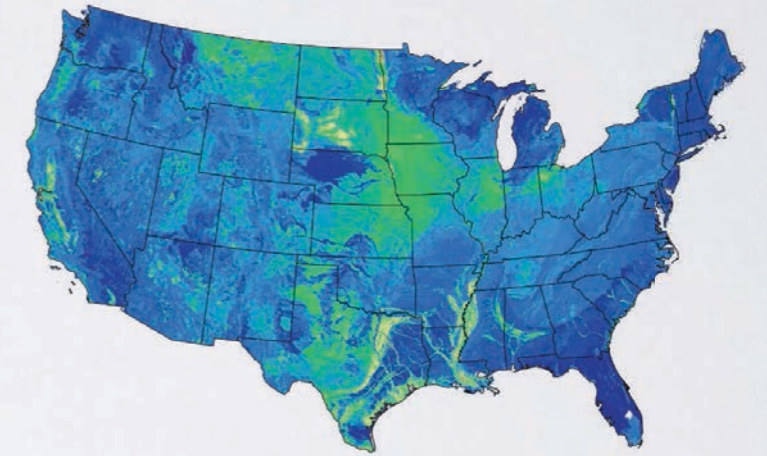
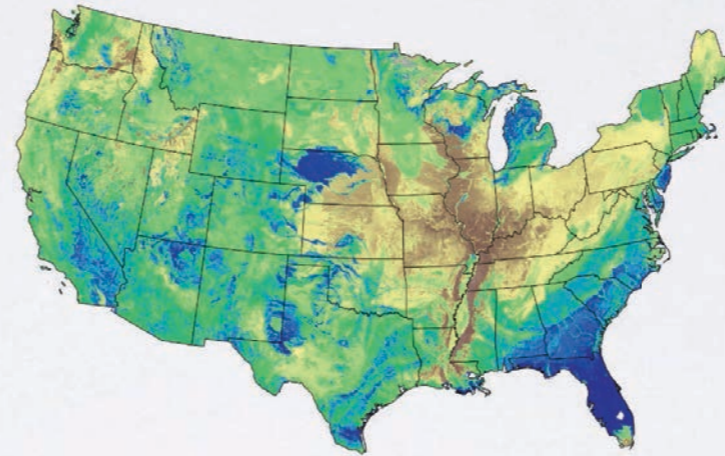
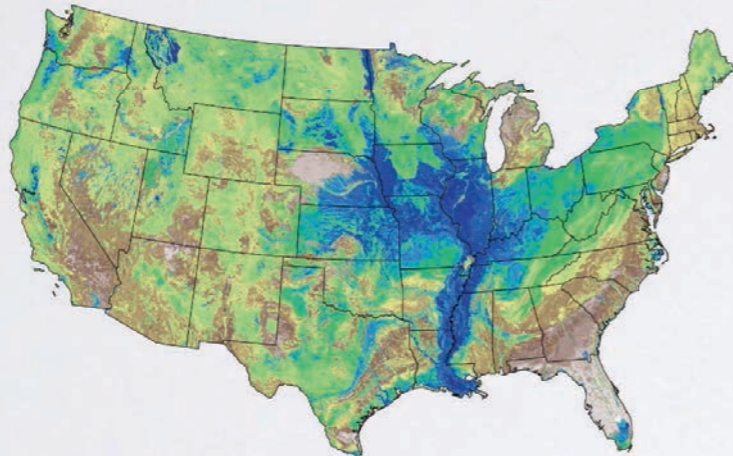
Silt

Clay

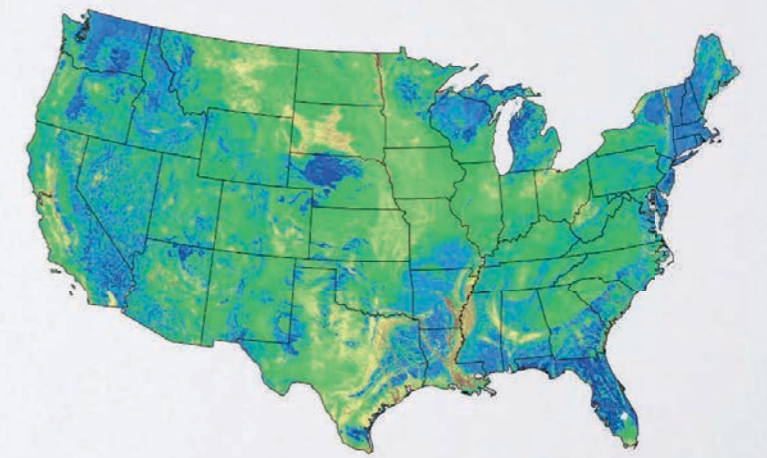
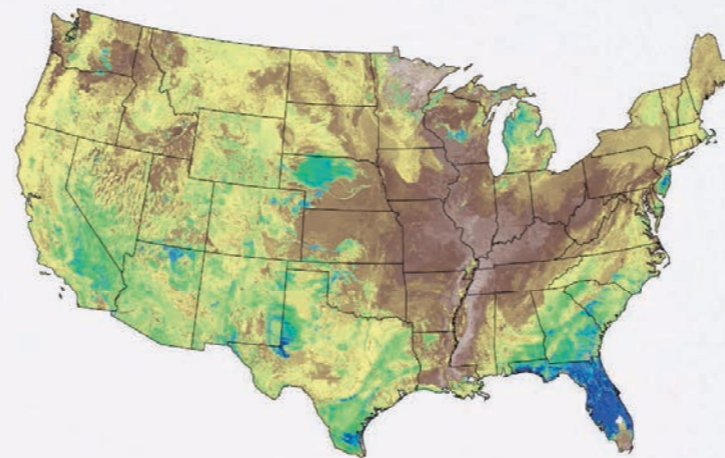
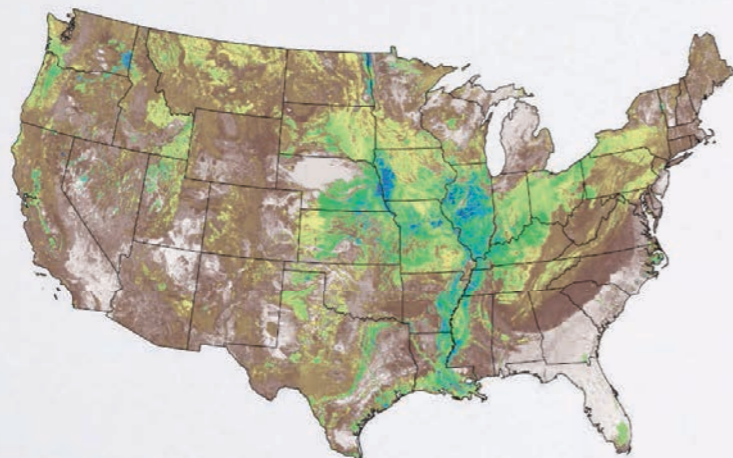
5th



50th



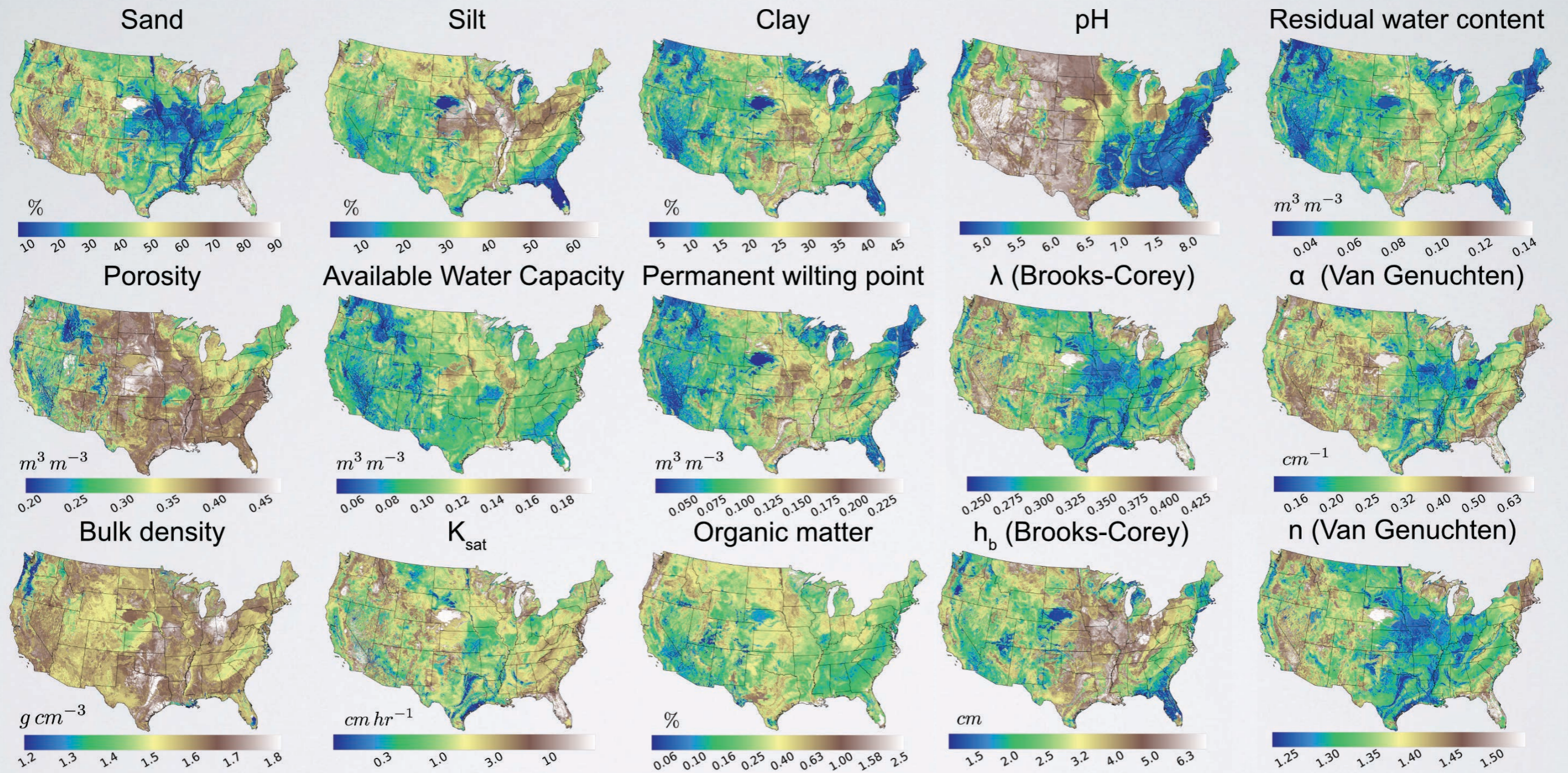
95th



*depth-weighted average

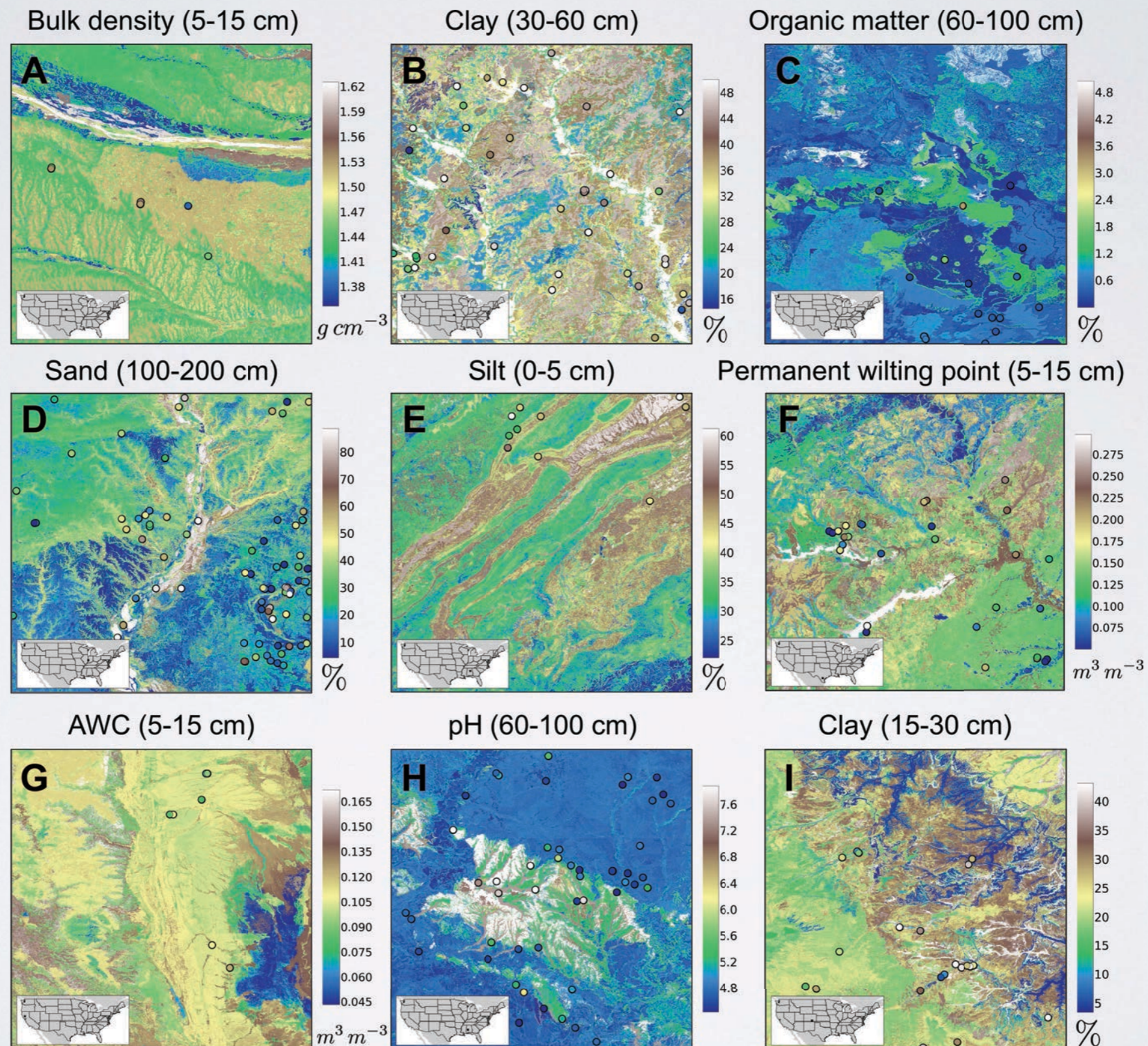


POLARIS properties: Summarizing the histograms (II)

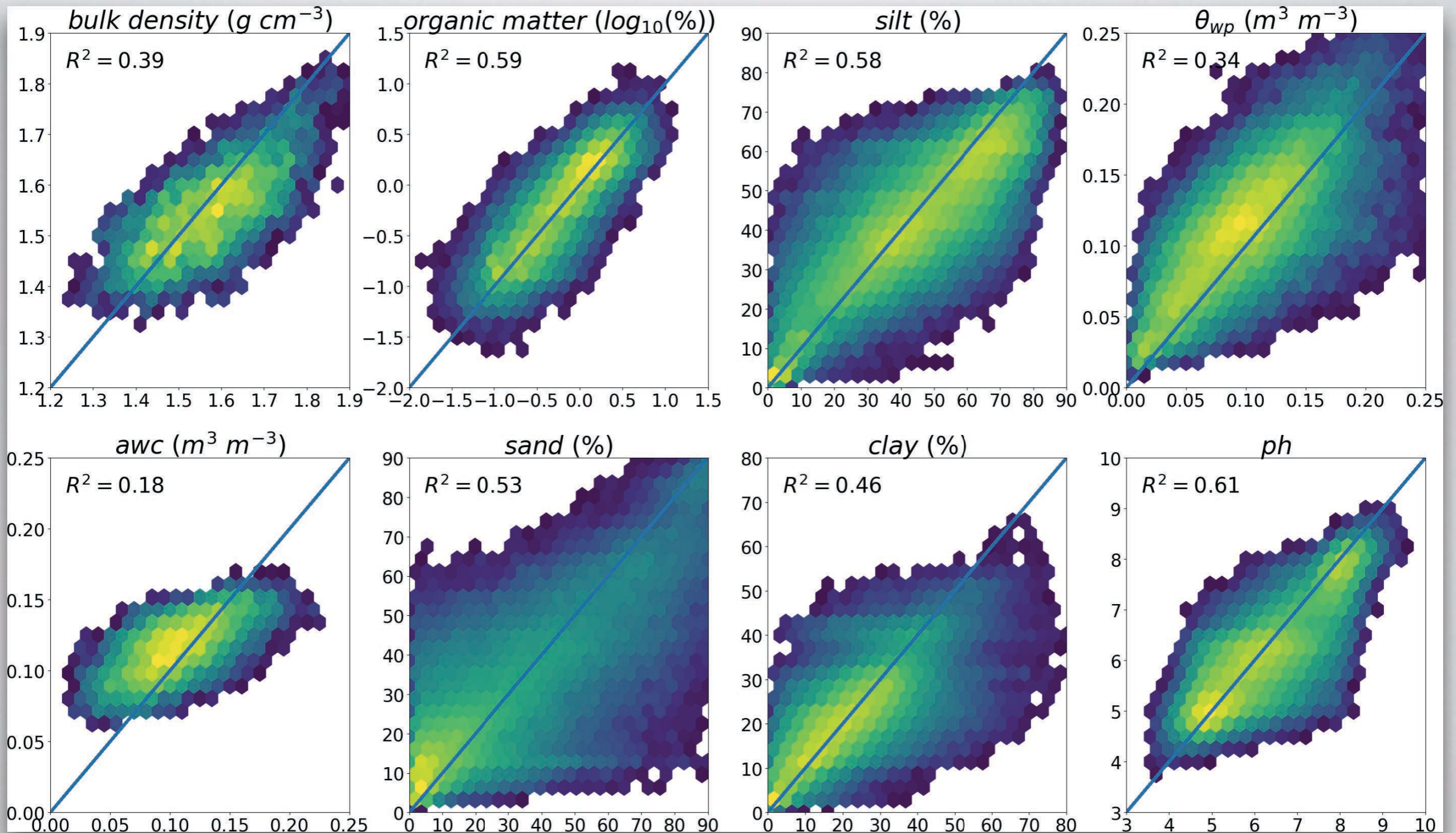


*depth-weighted average mean

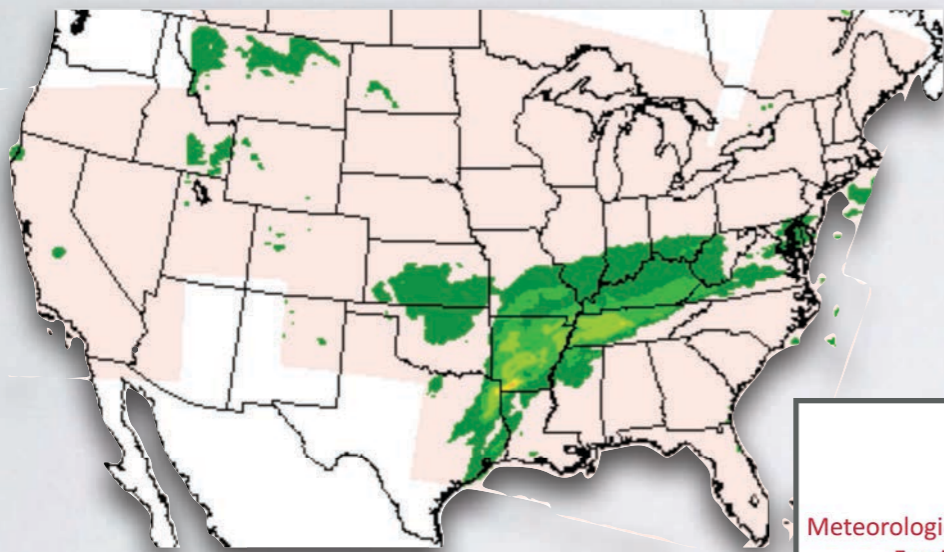
POLARIS properties: Evaluation examples



POLARIS properties: Evaluation



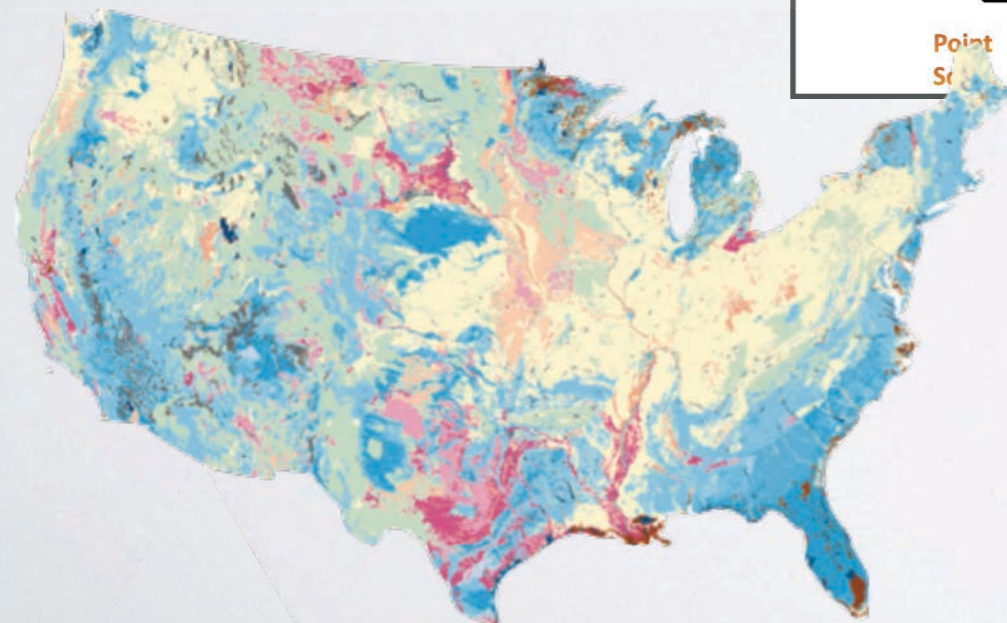
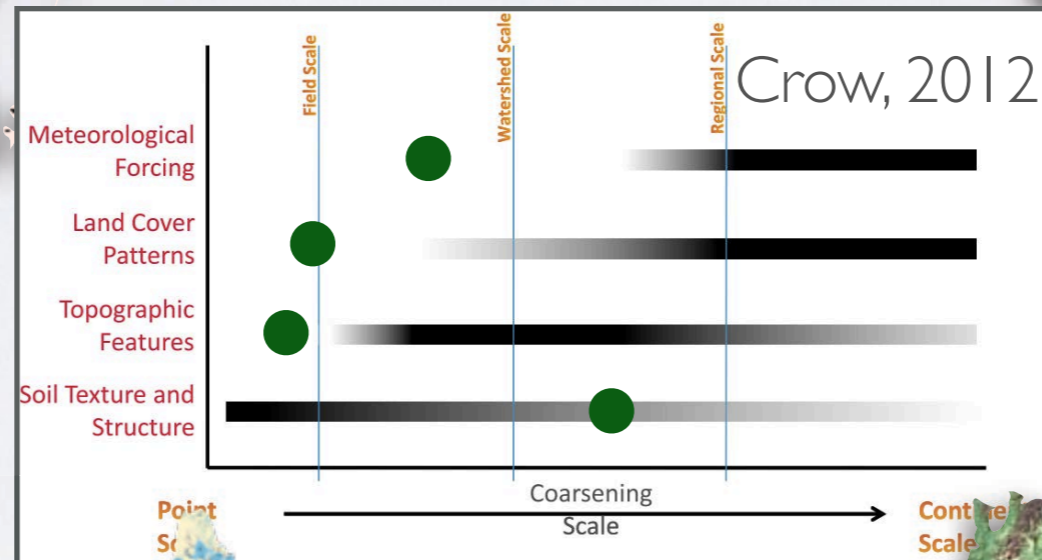
Motivation: What data do we have?



Stage IV - 4 km



NLCD - 30 m

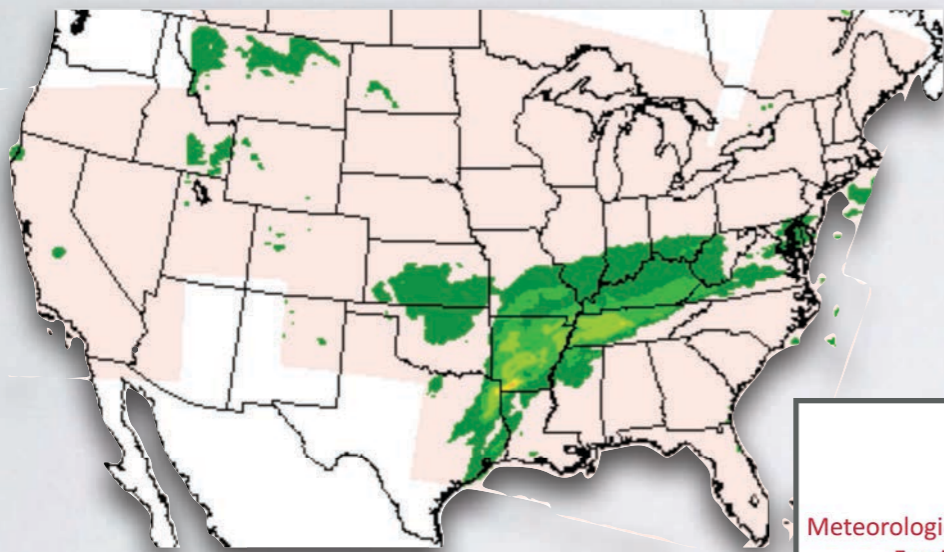


CONUS-Soil - ~25 km



NED - 30 m

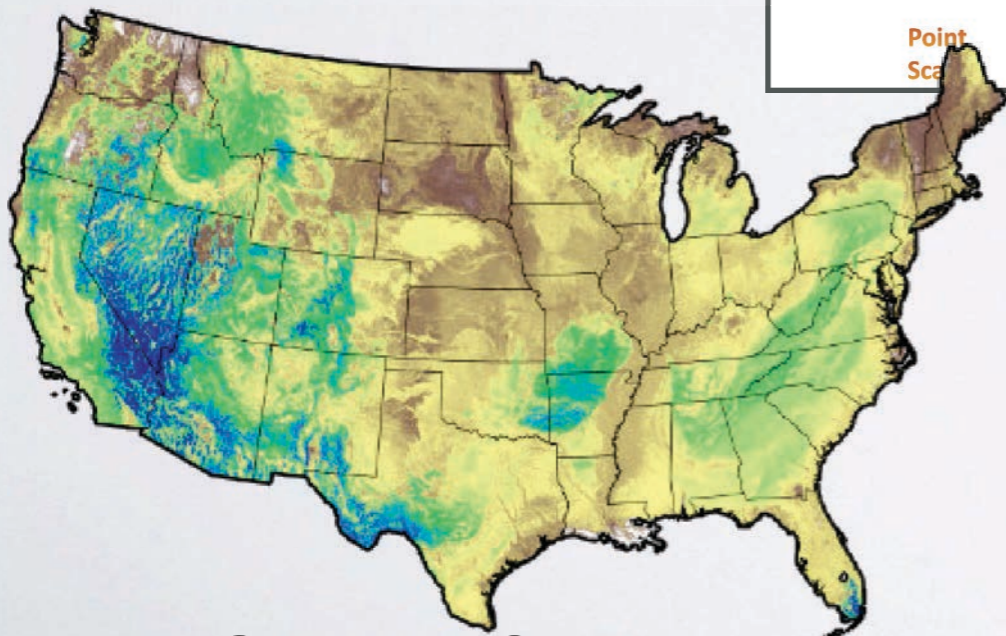
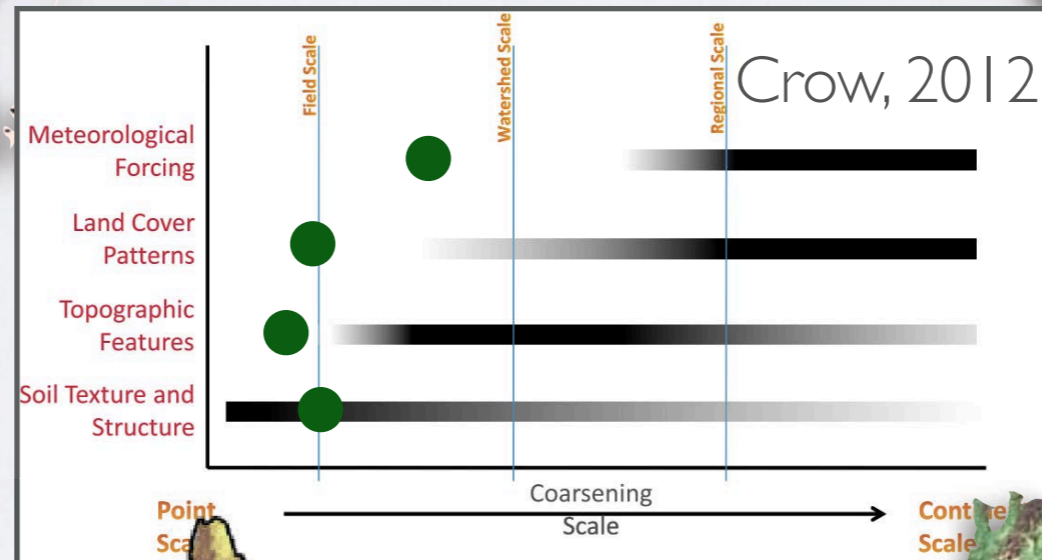
Motivation: What data do we have?



Stage IV - 4 km



NLCD - 30 m



POLARIS - 30 m



NED - 30 m

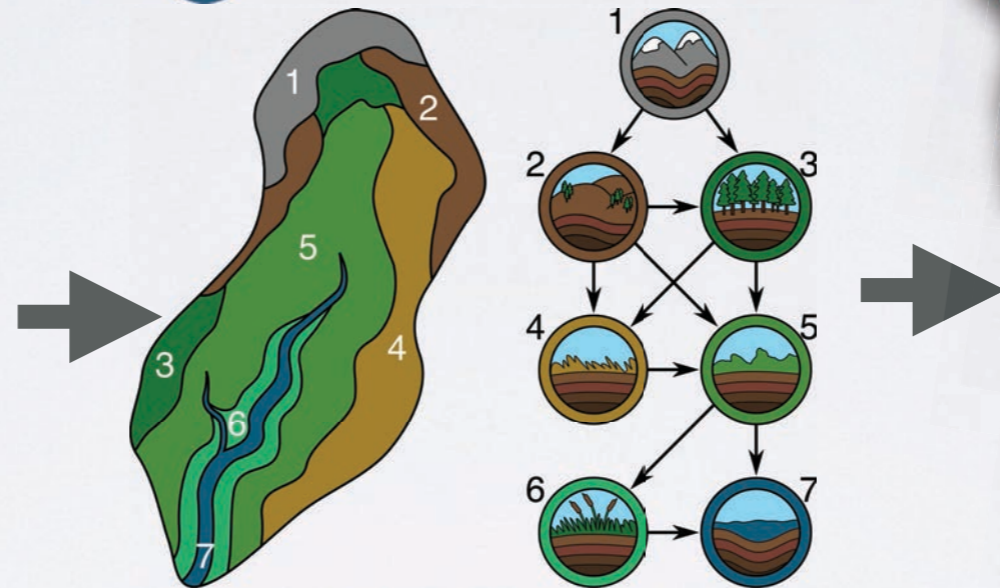
Using POLARIS in the new generation of hydrologic and land surface models

Environmental data

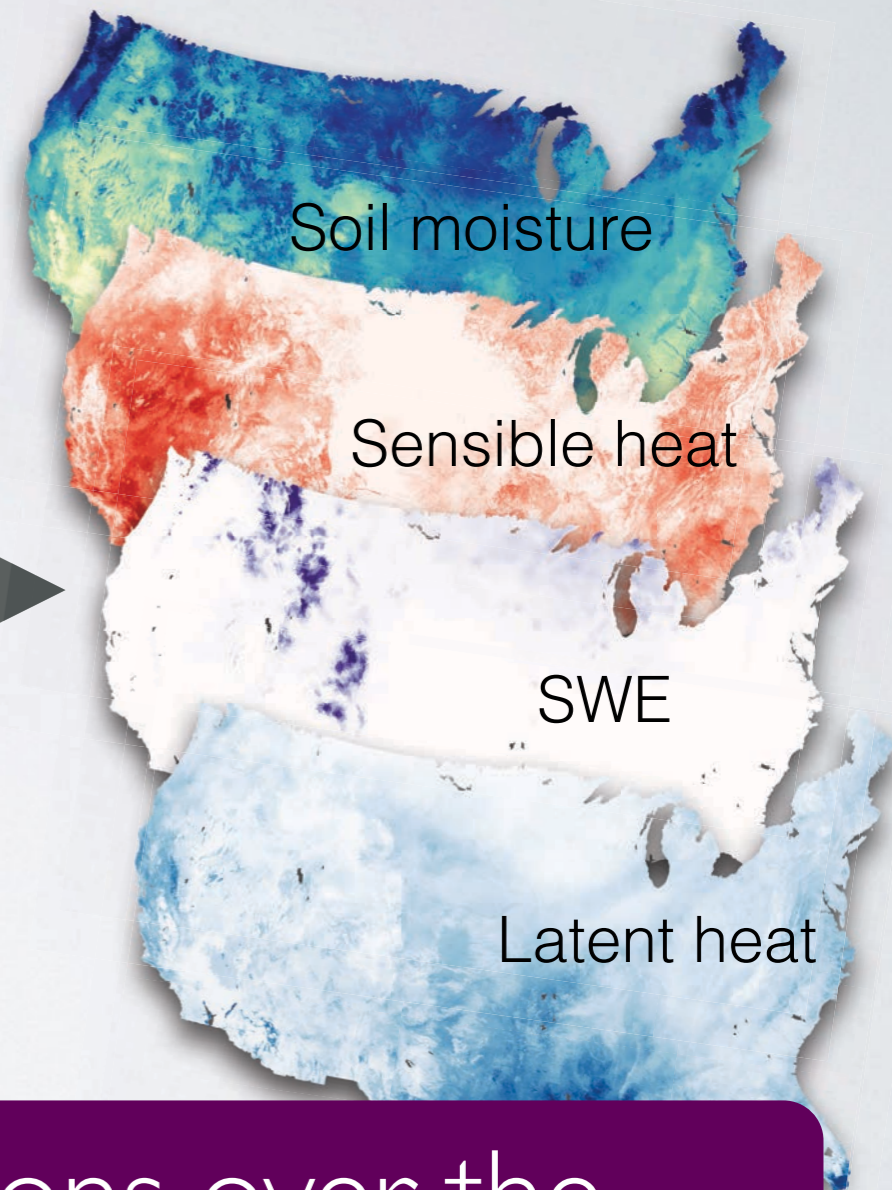


Land Surface Model

HydroBlocks

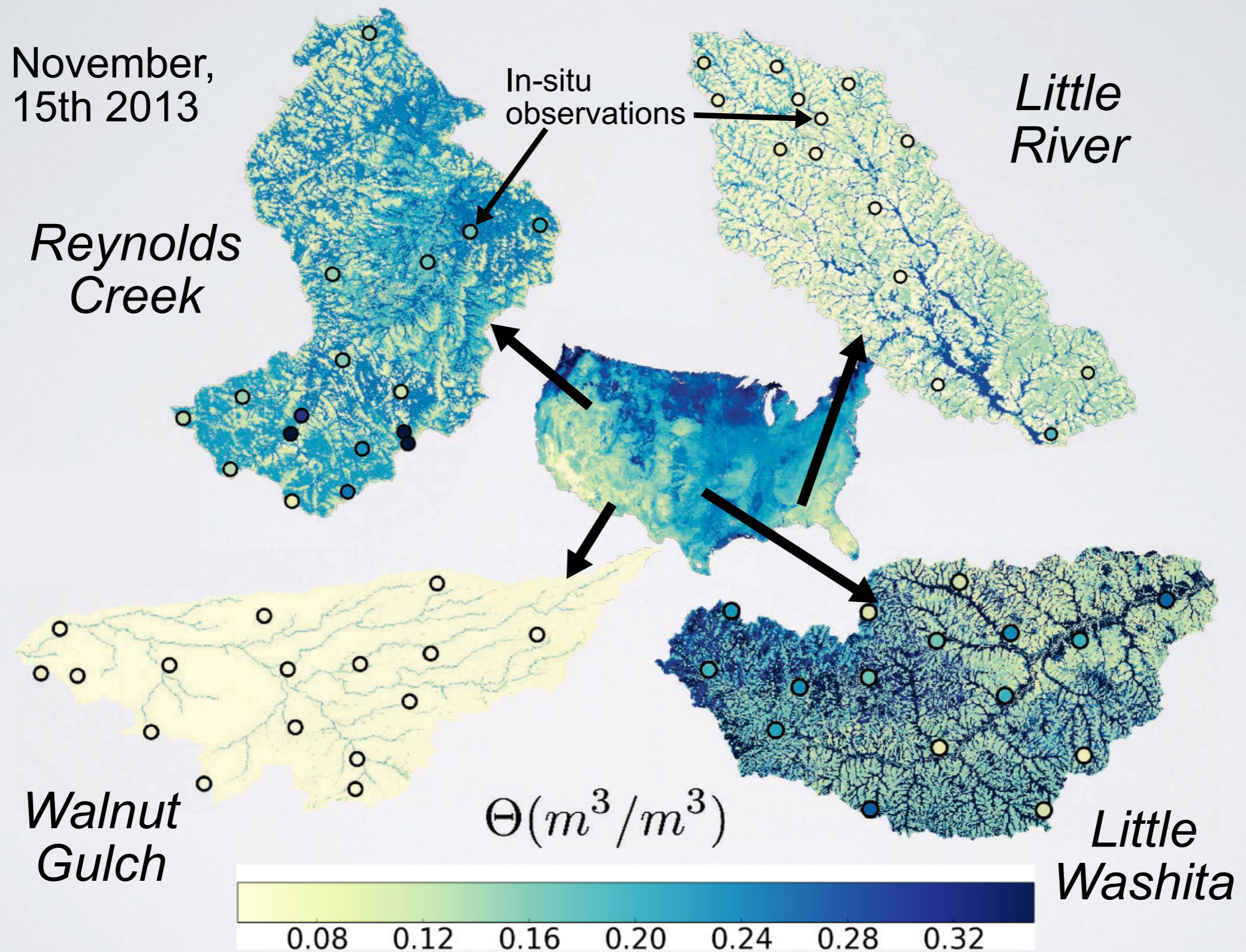


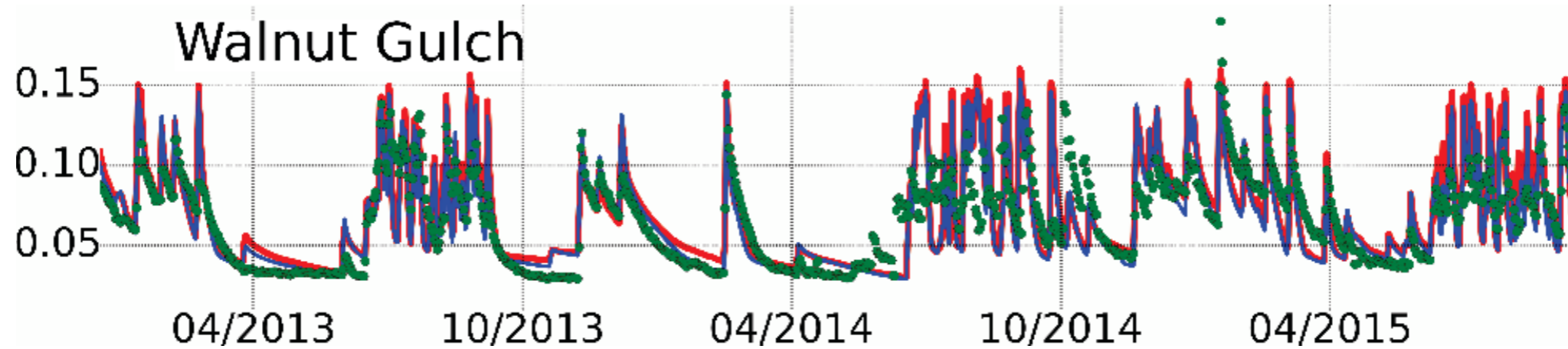
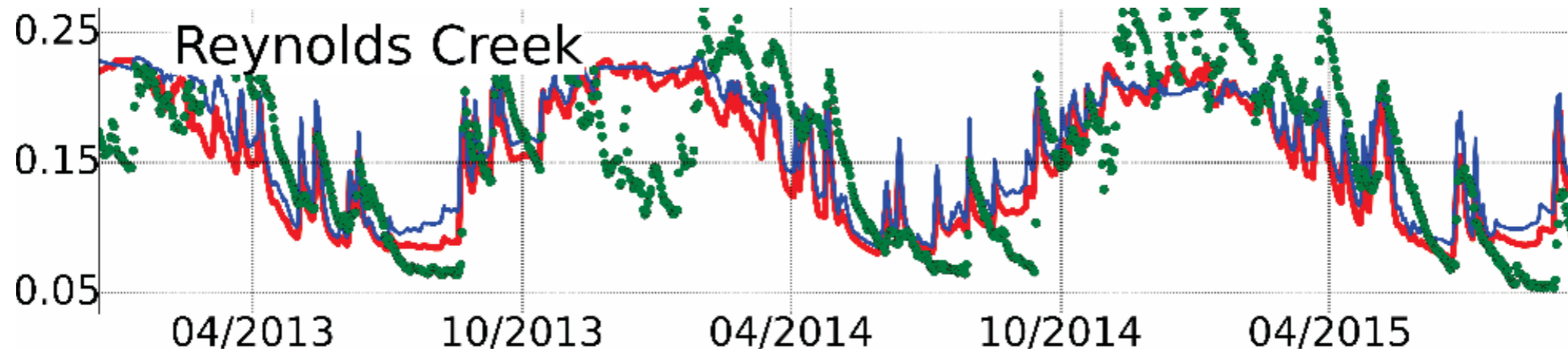
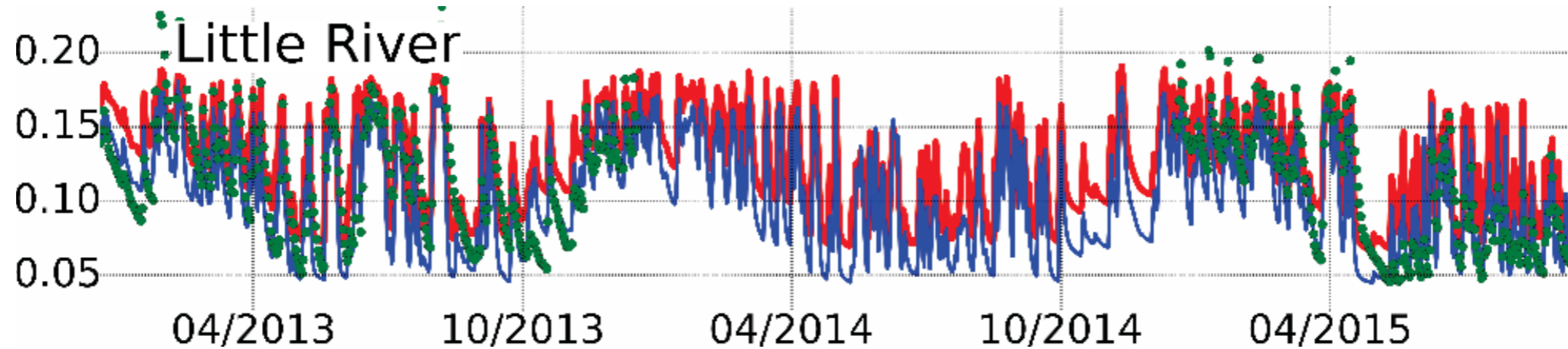
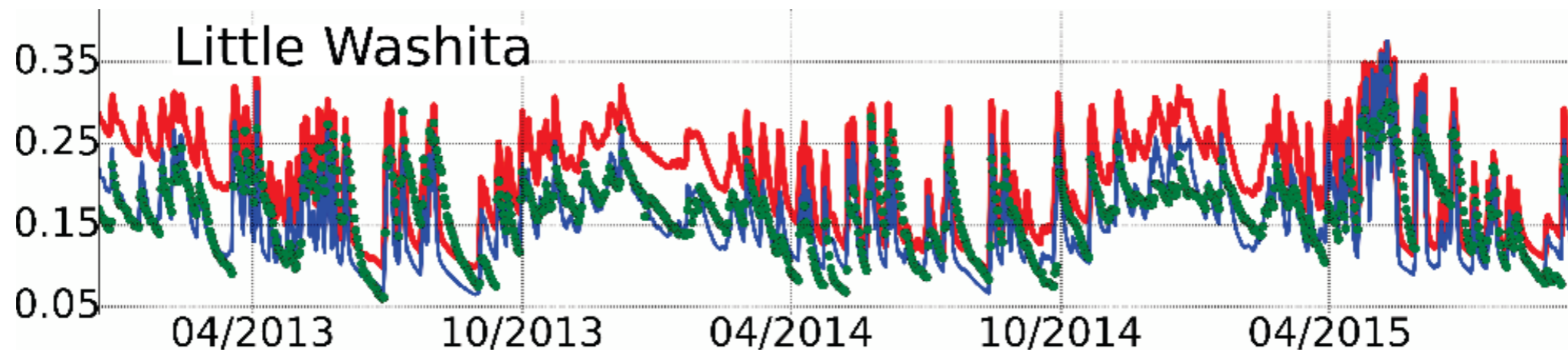
Simulations



Proof of concept: 30 m simulations over the Contiguous United States between 2004 and 2014

POLARIS application: Simulating soil moisture



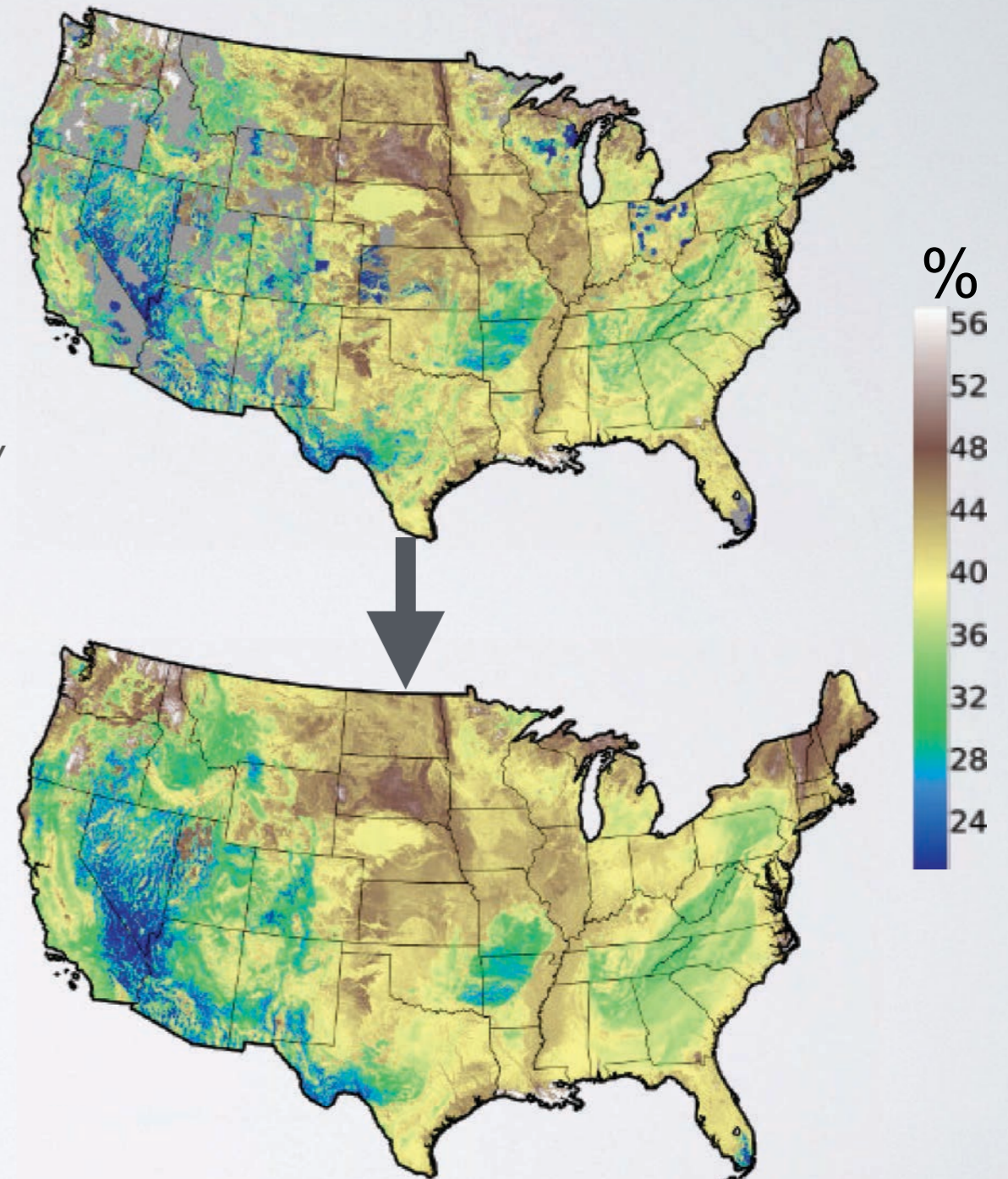


■ Simulated catchment mean ■ Simulated network mean ■ Observed network mean

POLARIS: Summary and Conclusions

- Soil properties over CONUS at 30m
- Mapped soil properties with uncertainties (multiple vertical layers)
- Derived data products: Brooks-Corey and Van Genuchten parameters
- **Result:** Field-scale soil information for use in land surface and hydrologic models

www.polaris.earth



Porosity (0-5 cm)

