

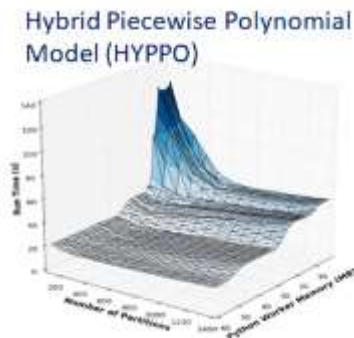
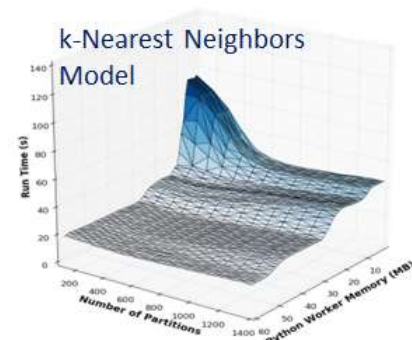
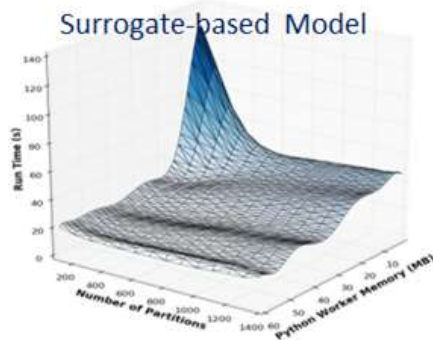
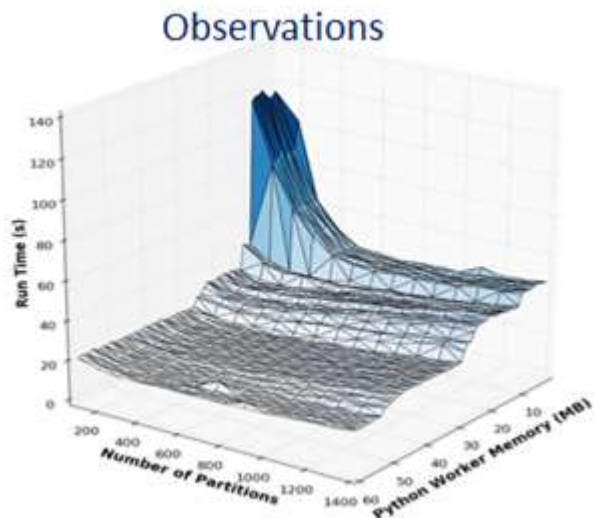
Adopting and Adapting High Performance Computing Tools for Soil Moisture Modelling

Leobardo Valera, Ricardo Llamas, Rodrigo Vargas, and Michela Taufer



Modeling HPC Performance

Model of runtime for Hadoop runs for different parameter values

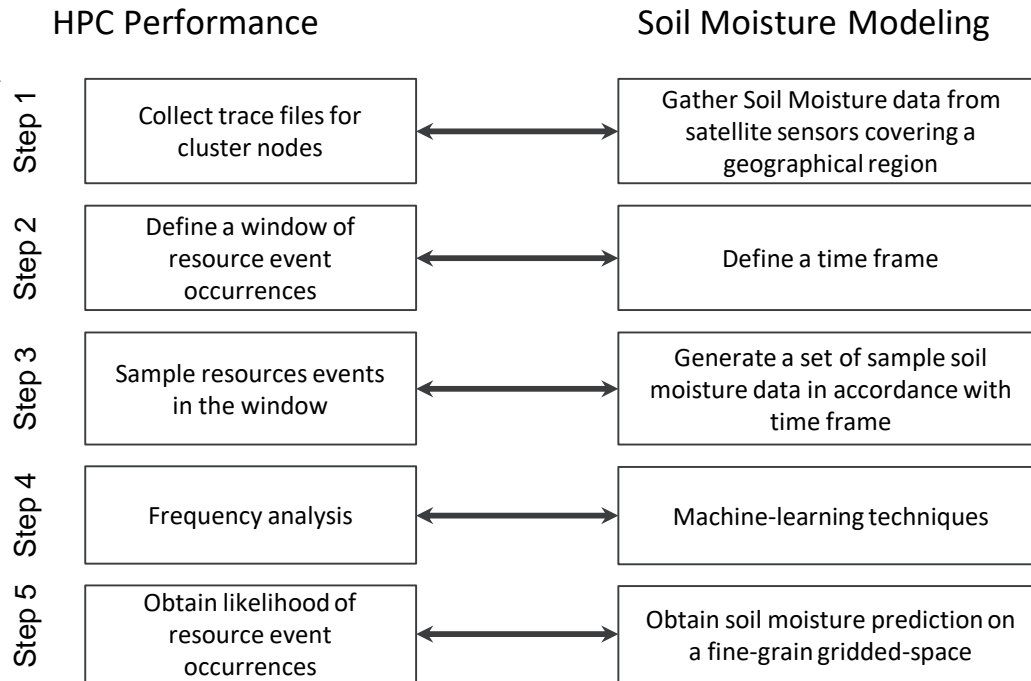


Modeling Performance vs. Soil Moisture

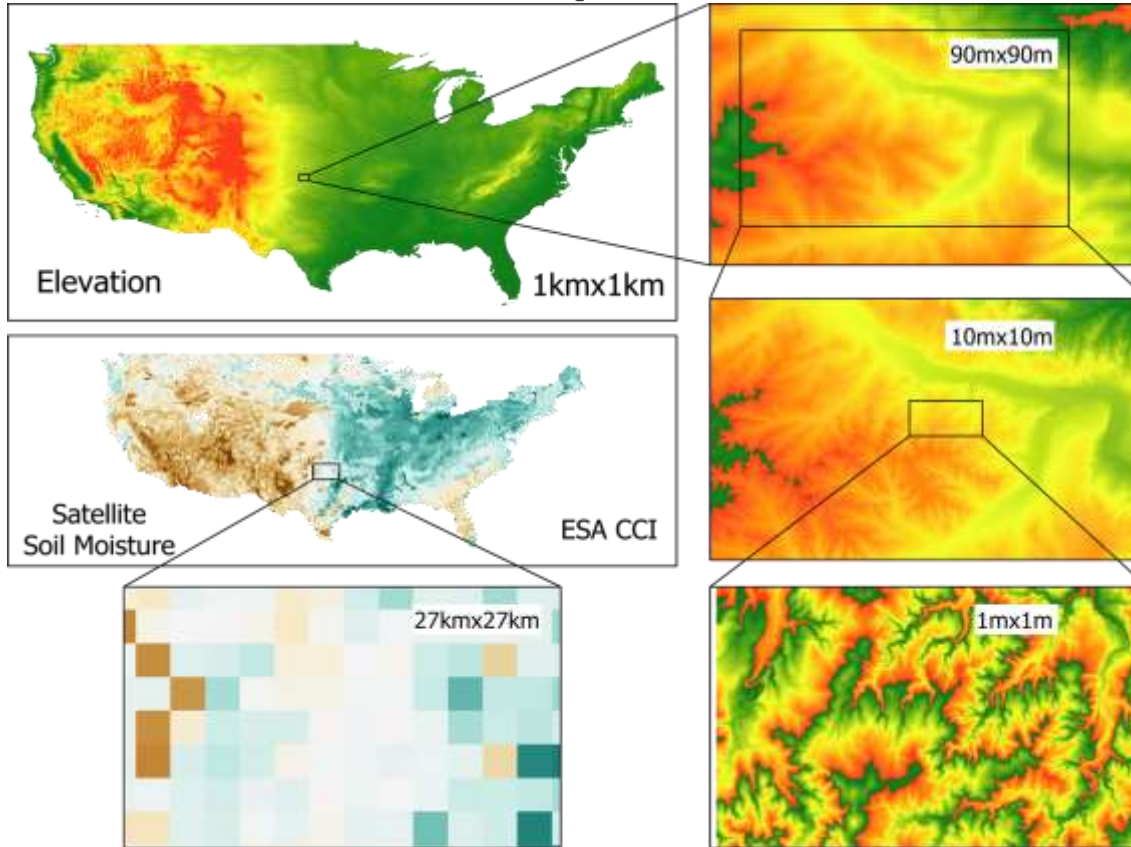
Step-by-step analogy between prediction of idle times in HPC systems and soil moisture modeling over fine-grain gridded spaces

Hypothesis: we can adopt and adapt HPC tools used for performance predictions and modeling to predict and model soil moisture patterns

Performance data and the soil moisture data are both multi-dimensional spatial data

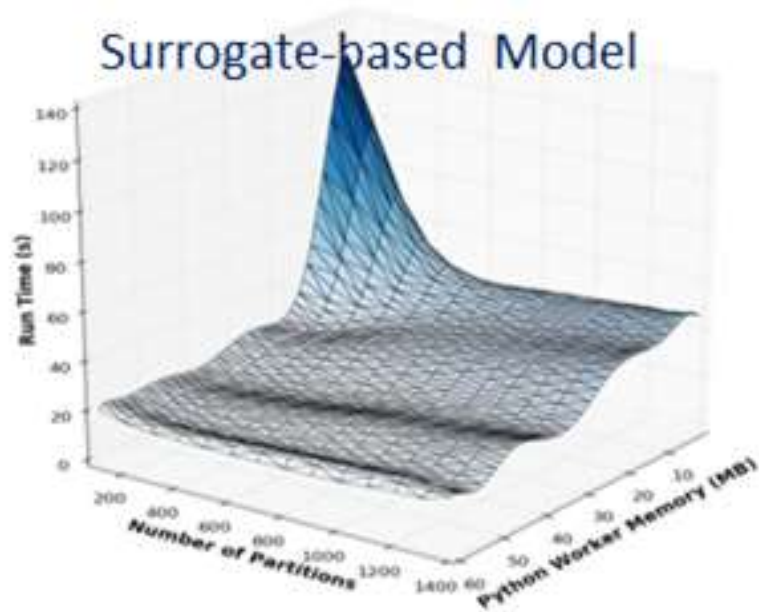


Multi-resolution Spatial Data

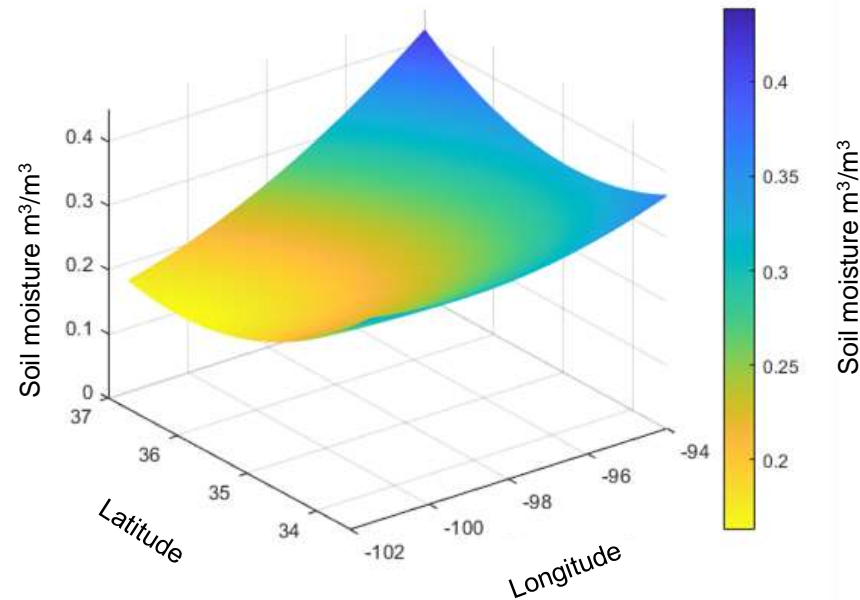
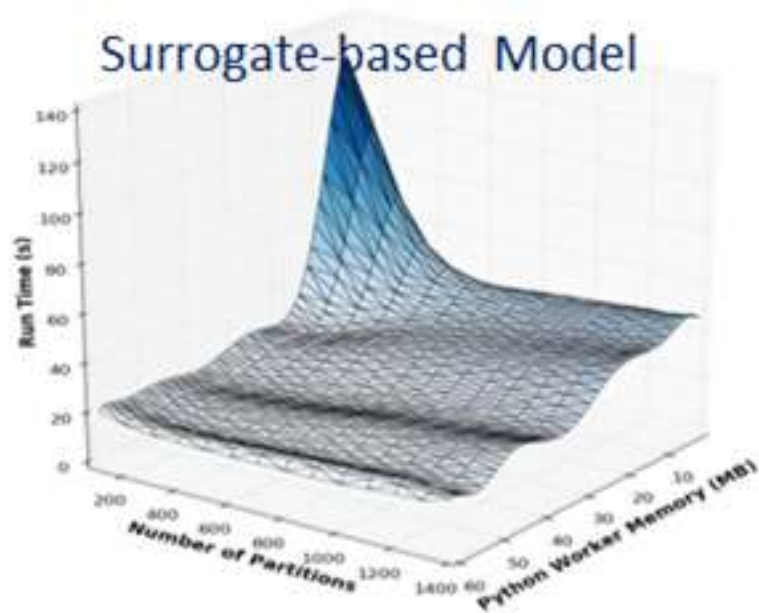


Dataset	Source	Resolution / Scale
ESA-CCI	European Space Agency Climate Change Initiative	Space: 0.25 arc-degrees (~27 km) Time: 24 hours
DEM	Hydroshare (1-km) [4], United States Digital Elevation Model (90-m, 10-m, 1-m)	1 km, 3 arc-second (~90 m), 1/3 arc-second (~10 m), 1 m
Terrestrial Ecoregions	Commission for Environmental Cooperation	1:10,000,000
NSMN	National Soil Moisture Network	Space: point based Time: daily

Question: Can we **directly adopt** the HPC techniques?

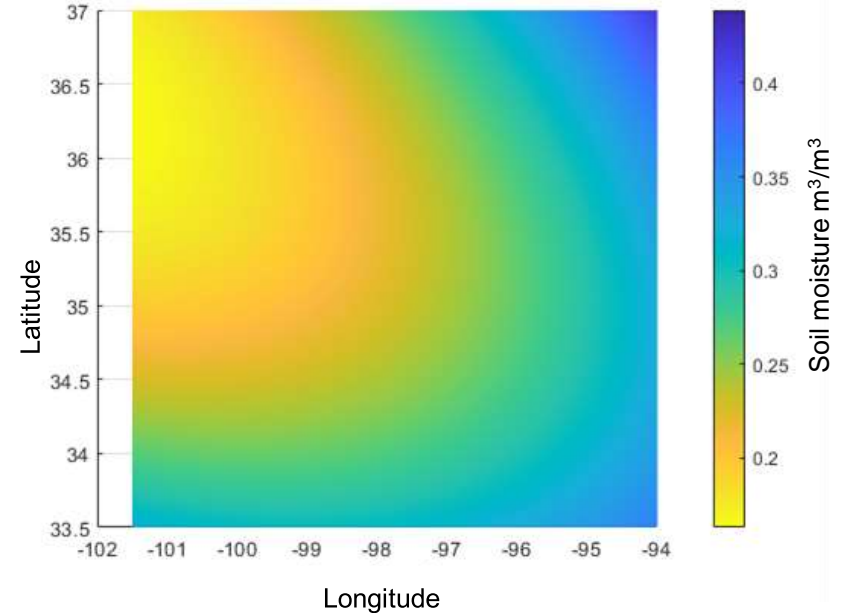
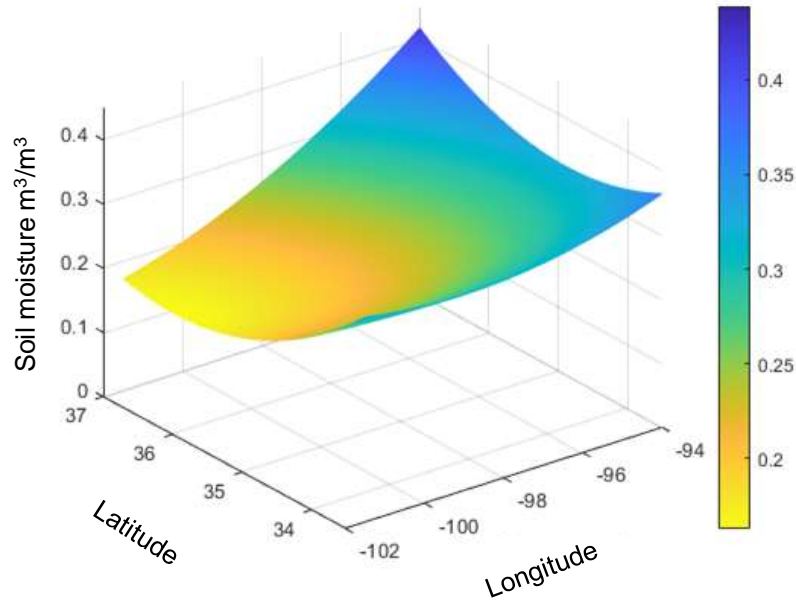


Question: Can we **directly adopt** the HPC techniques?



Naive application of SBM to SM data modeling

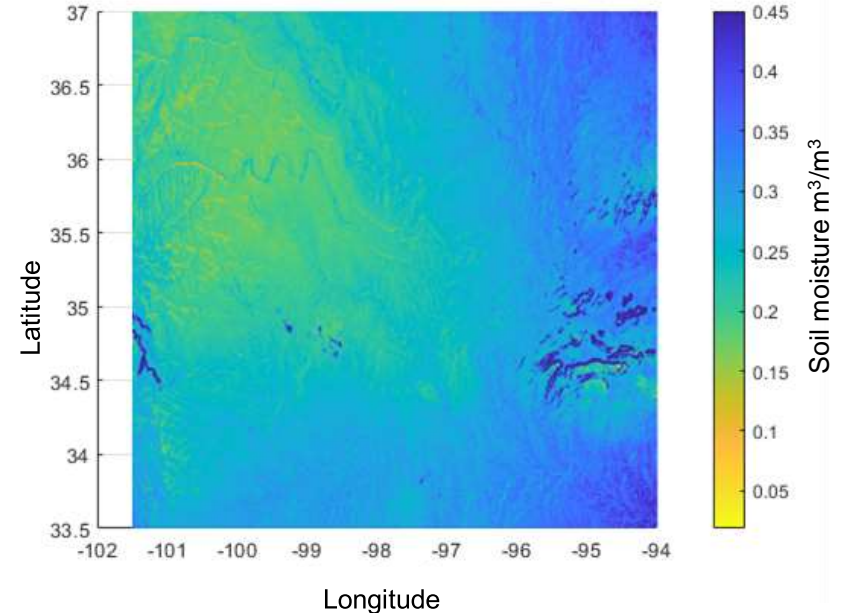
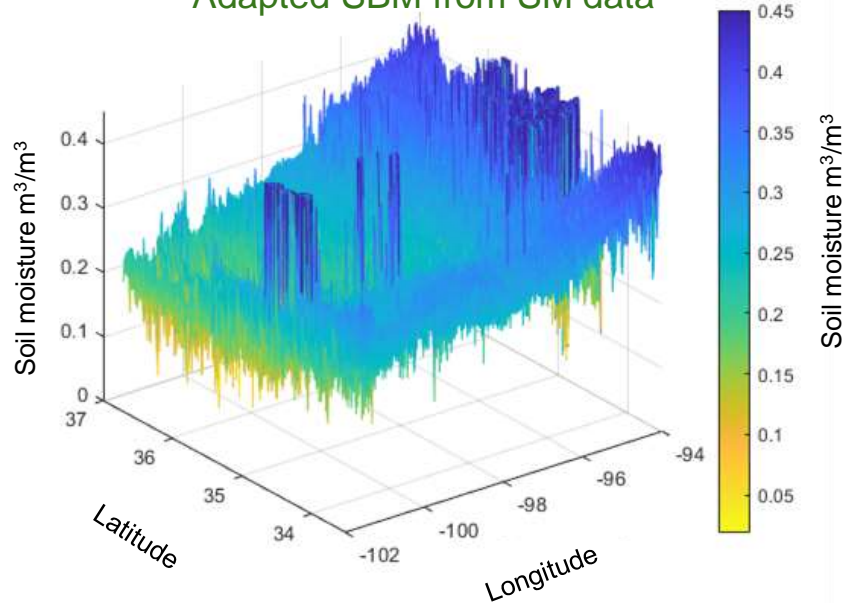
Answer: **No**, we **need to adapt** the techniques to our data



This modeled SM pattern is **not realistic!**

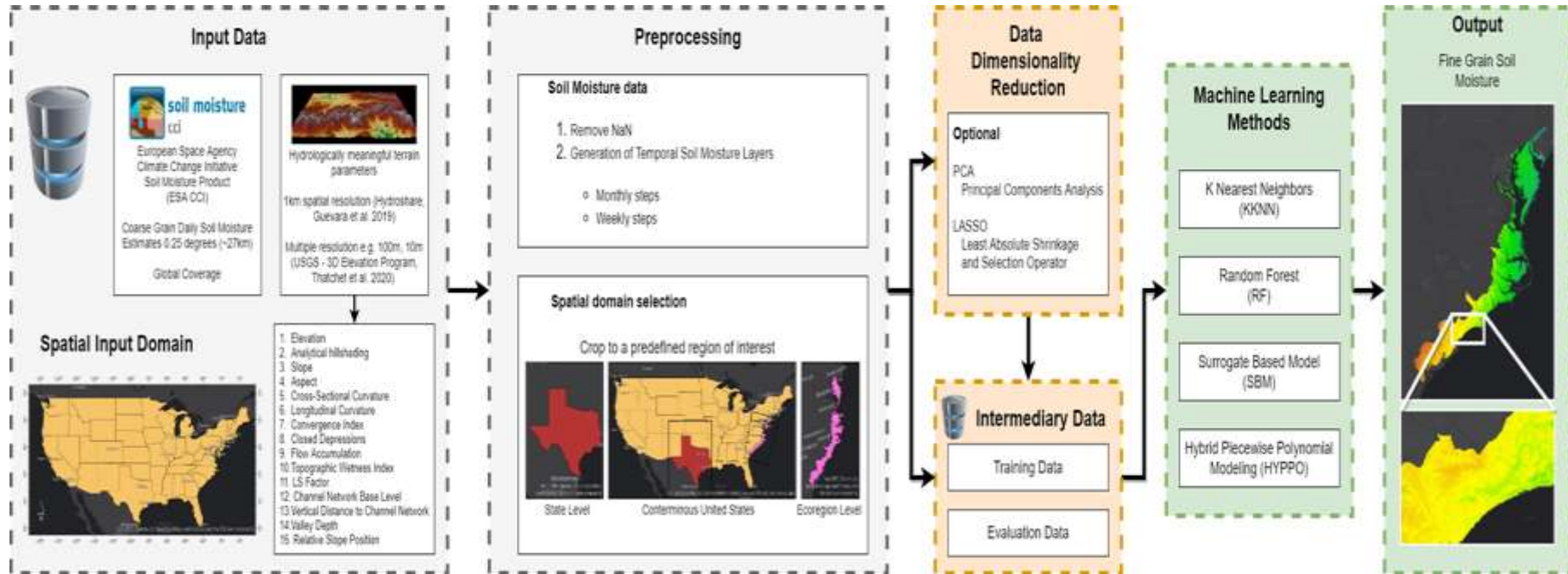
Answer: **No**, we **need to adapt** the techniques to our data

Adapted SBM from SM data



This modeled SM pattern is **realistic**!

SOMOSPIE Workflow



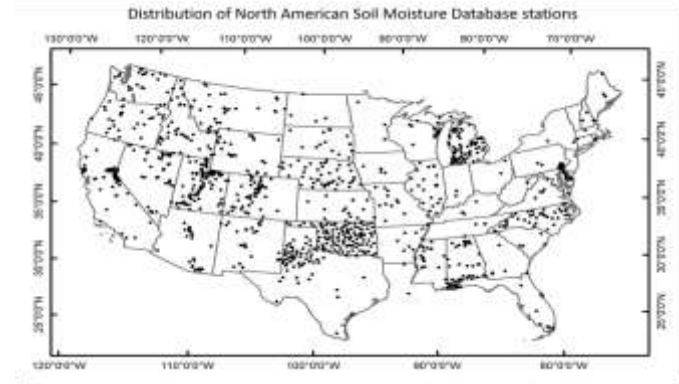
Use Case I: Models from Sensor Data vs. Satellite Data

Point Field Measurements

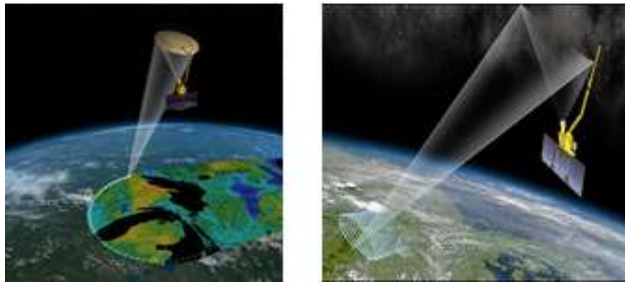


Point-Scale

Upscaling



Remotely sensed estimations



Grid-Scale

Downscaling



Use Case I: Models from Sensor Data vs. Satellite Data



Upscaling Point to 1 km

Ground-Truth data

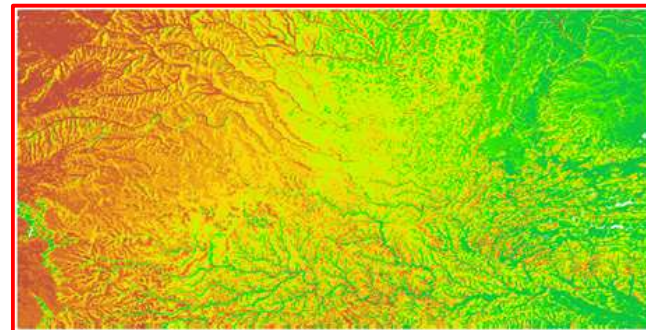
Coordinates, Elevation, Aspect, Slope, Soil moisture
TWI (6 parameters)

Samples: 162

SBM, degree 2

Soil moisture
 m^3/m^3

- 0 - 0.195917
- 0.192915 - 0.225028
- 0.225028 - 0.247507
- 0.247507 - 0.268680
- 0.268680 - 0.288680
- 0.288680 - 0.304608
- 0.304608 - 0.317842
- 0.317842 - 0.500000



Downscaling 27 km to 1 km

Satellite-Derived data

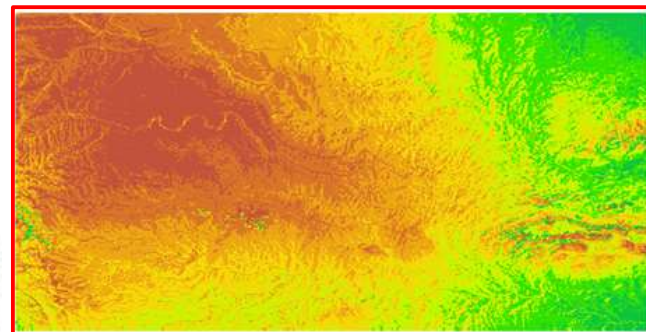
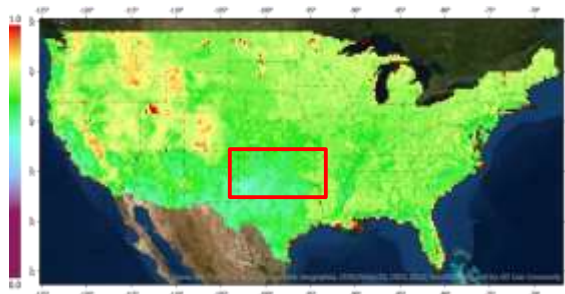
Coordinates, Elevation, Aspect,
Slope, TWI (6 parameters)

Samples: 162

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Soil moisture
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- 0.268680 - 0.288680
- 0.288680 - 0.304608
- 0.304608 - 0.317842
- 0.317842 - 0.500000



Use Case II: Wildfire Simulations Integrating Soil Moisture Models

Replication of the Gatlinburg wildfire using FDS simulator and augmented model of the region (including impact of soil moisture)

Soil moisture m^3/m^3

- 0.209 - 0.210
- 0.210 - 0.211
- 0.211 - 0.212
- 0.212 - 0.214
- 0.214 - 0.216
- 0.216 - 0.218
- 0.218 - 0.221
- 0.222 - 0.225
- 0.225 - 0.230
- 0.230 - 0.234
- 0.234 - 0.238
- 0.238 - 0.243
- 0.243 - 0.249
- 0.249 - 0.256
- 0.256 - 0.264
- 0.264 - 0.274
- 0.274 - 0.286
- 0.286 - 0.297
- 0.297 - 0.307
- 0.307 - 0.347

