Development of NHDPlus Inputs for the Fine-Scale Chesapeake Regional Hydrology Model (CRHM)

Modeling Workgroup Quarterly Call
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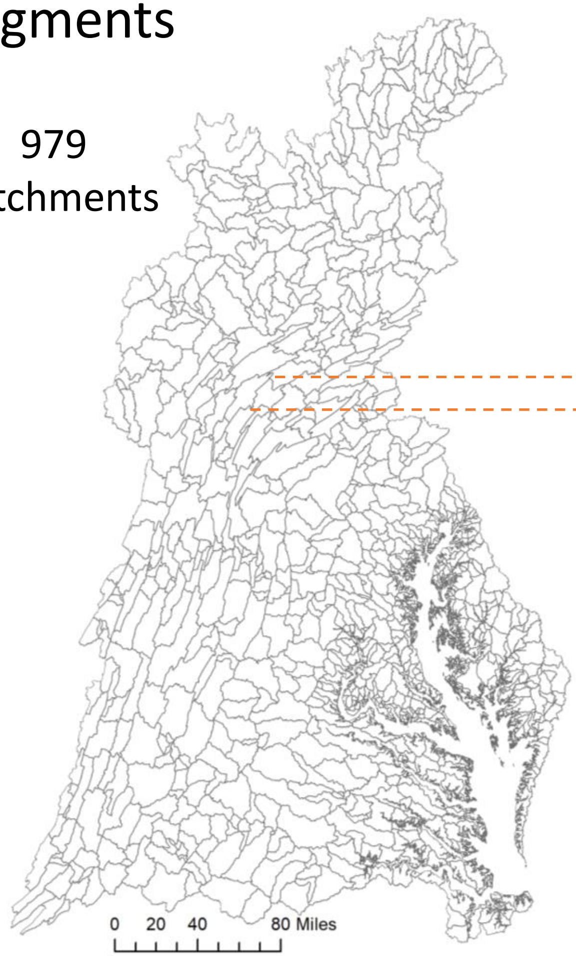
From Phase 6 scale to NHDPlus scale

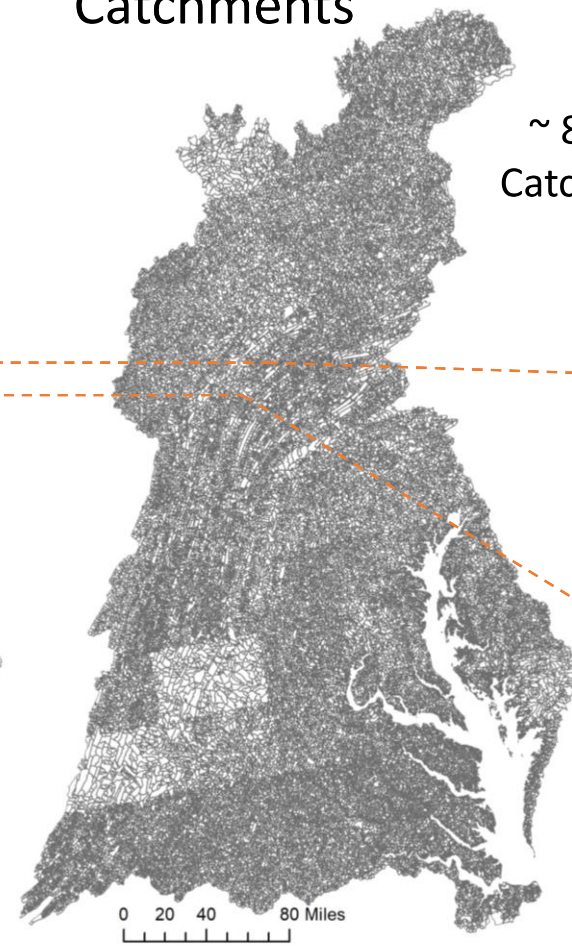
Phase 6 (P6) river segments

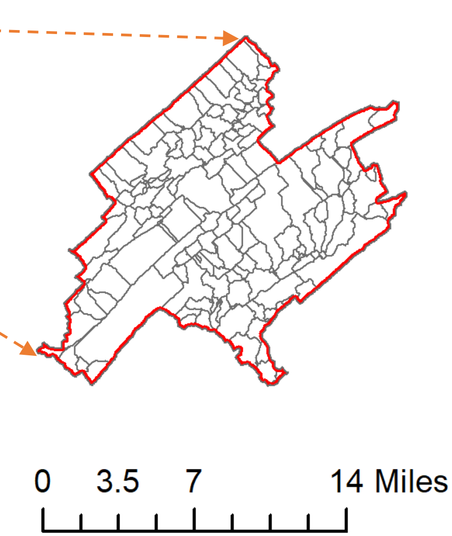
979 Catchments



NHDPlus Catchments

~ 80,000 Catchments

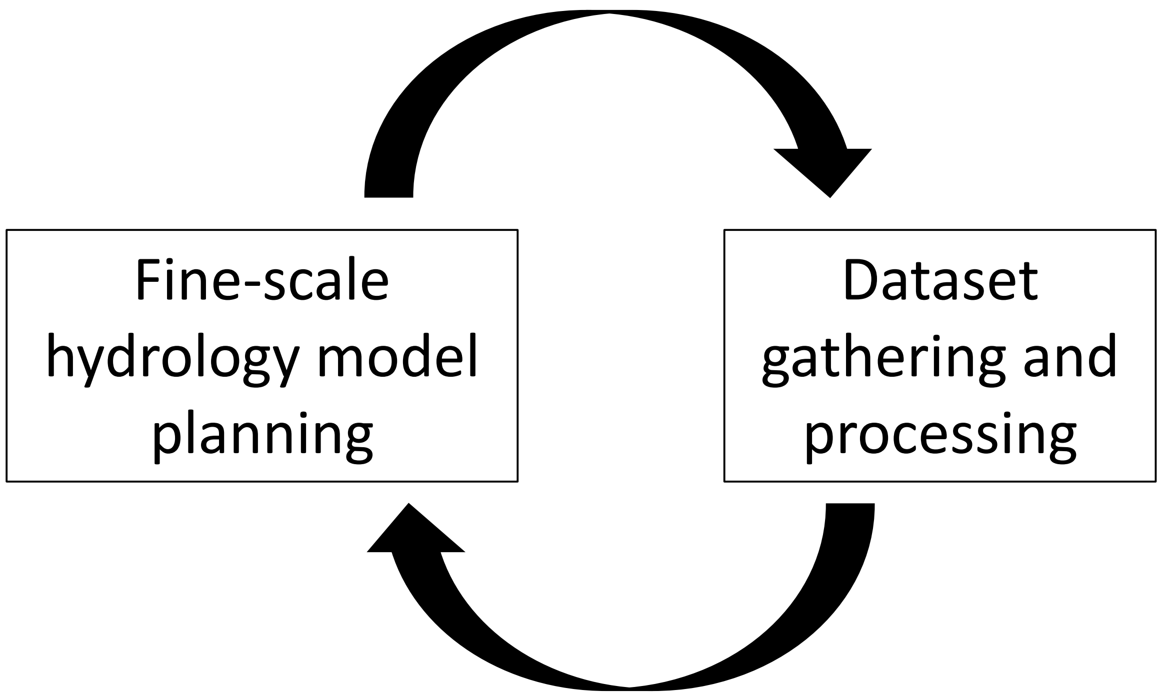




From Gopal`s presentation at Modeling Workgroup April 2020 Quarterly

From Phase 6 scale to NHDPlus scale

Need for finer scale datasets



Two main tasks ahead:

1. Revise/Augment existing P6 datasets

2. Process/acquire new datasets

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Example: Water Diversions

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    - low flow conditions
    - extreme droughts
    - ecological flow metrics
    - living resource-relevant variables (e.g., temperature)

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    - living resource-relevant variables (e.g., temperature)
  - Better characterizing and accounting for fine-scale water withdrawals and consumptive use will be crucial

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- P6 assumptions to downscale monthly/annual data to daily relatively simple (e.g., estimation of seasonal cycles for irrigation)

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Next steps to improve diversion dataset

- NHDPlus enhancements (Lead: **John Brakebill**)

  Daily water use estimates for thermoelectric, irrigation and larger public supplies at the **HUC12** level for **2015**

  Hydroelectric uses not included in recent enhancements but data may be available

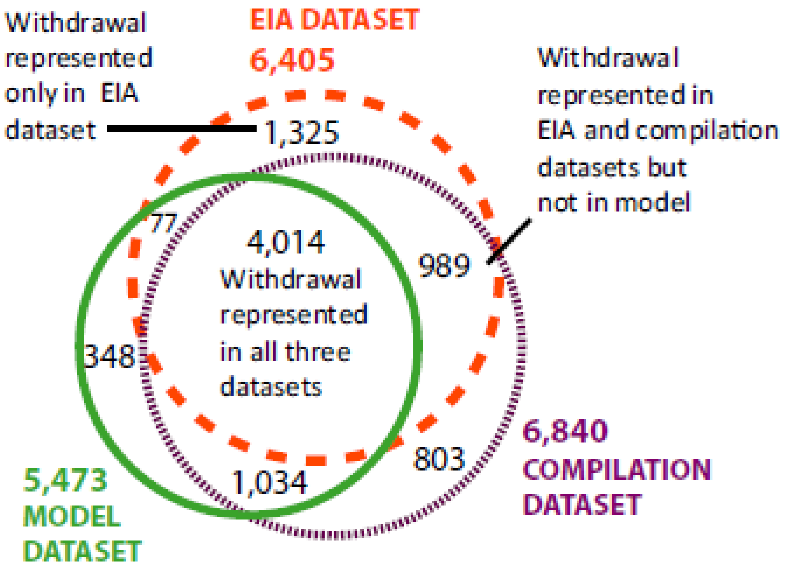
- Work with John to hindcast use estimates back to 1985

- Downscale/disaggregate HUC12 data to scale we need

1. Revise/Augment existing P6 datasets
Example: Water Diversions

- **If needed**, integrate information from NHDPlus enhancements with other sources, e.g.:
  - P5.3.2 thermoelectric water use data provided by individual states
  - USGS water use reports and thermoelectric model estimates for years other than 2015
  - EIA data (includes data on discharge temperature)
  - Other?

Not all data in all datasets



Harris & Diehl, 2017

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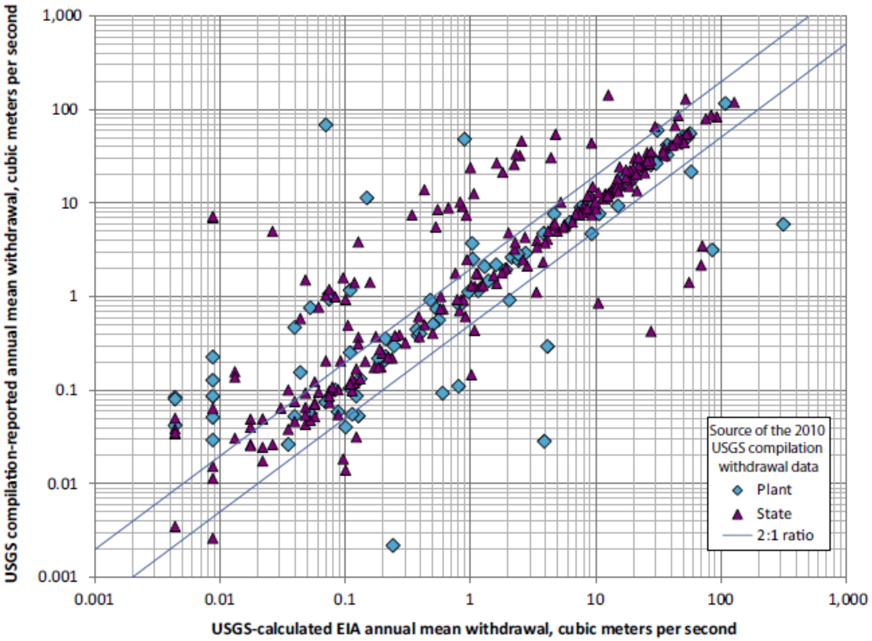
Some disagreement across datasets



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1. Revise/Augment existing P6 datasets
Example: Reservoir Operation Rules

- P6 reservoir management simulation based on relatively simple stage-volume-area-discharge relationships (simple/varying “ftables”).

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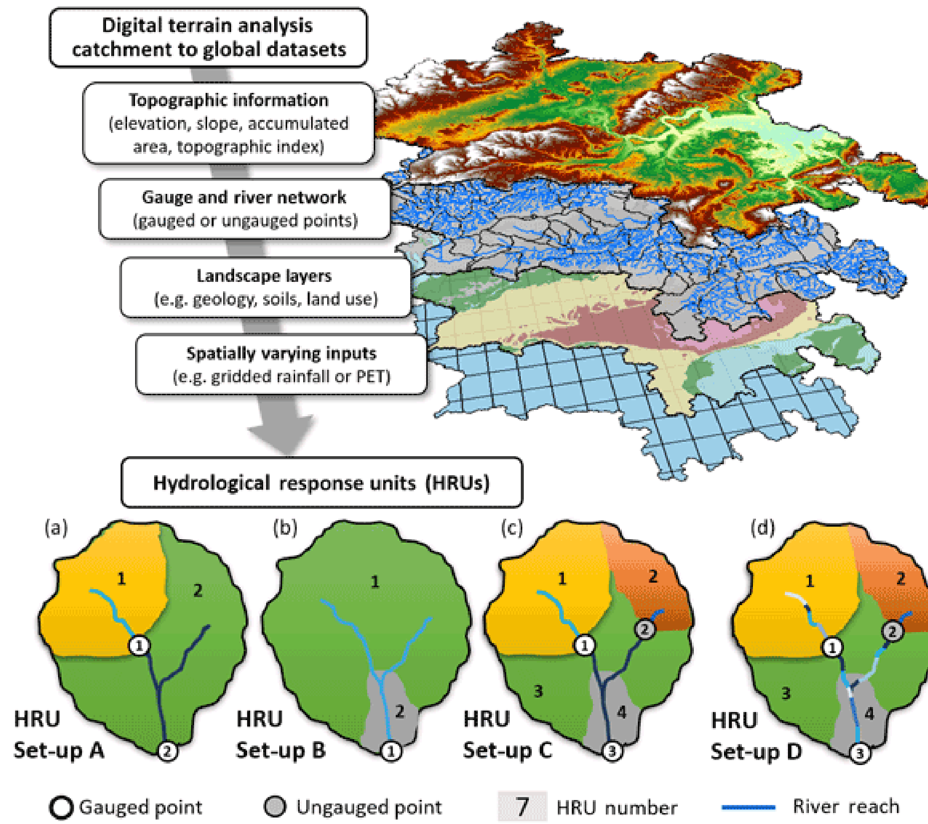
- Started conversation with **ICPRB** (**Sarah Ahmed, Cheri Schulz**), **VA DEQ** (**Rob Burgholzer**) and **SRBC** (**John Balay, Can Liu**) to:

  - Assess performance of P6 reservoir rules in capturing reservoir dynamics compared to rules modeled by water supply partners

  - Develop method to either translate refined operation rules provided by water supply partners into ftables format or set up a new, more flexible framework to incorporate complex operation rules that are not easily captured by ftables into CRHM.

2. Process/acquire new datasets
Example: Watershed properties

Eventually, land simulation **likely** based on some type of hydrologic response unit (HRU) framework that characterizes fine-scale landscape response by integrating high-res hydrography, land cover and land use (**Peter Clagget`s team**) with watershed characteristics (e.g., soil properties, climate, geology...).



Coxon et al. 2019

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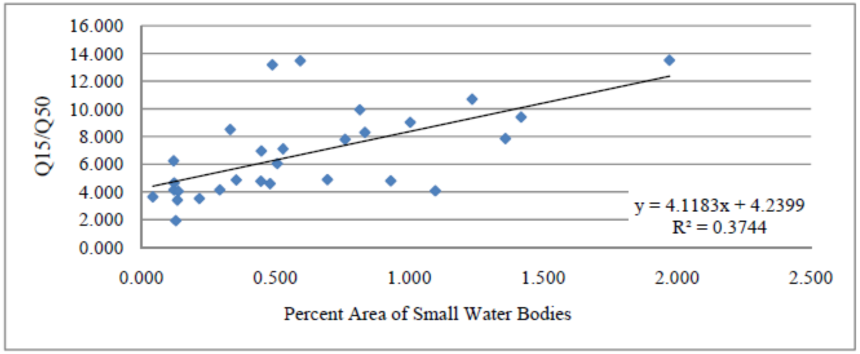
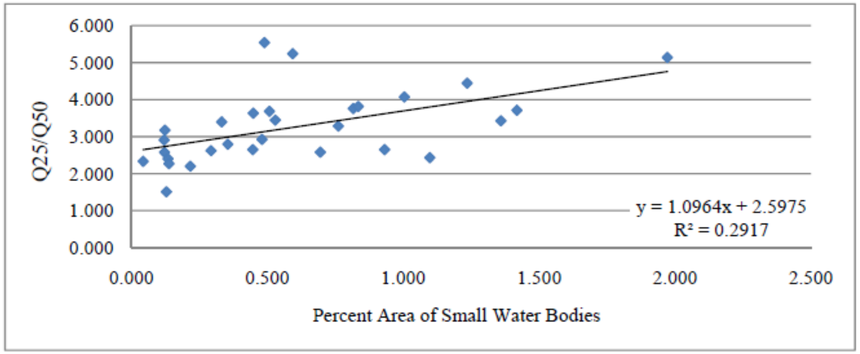
Example: Watershed properties

Fine-scale datasets on watershed properties needed:

- as direct inputs to the model to resolve spatial variability in hydrologic response
- to develop statistical models that relate small-scale watershed properties to hydrograph features and can help inform and improve the model`s ability to explain and predict spatial variability in hydrologic response

Relationship between % watershed area occupied by small ponds vs. high flow metrics





Longbucco et al. 2010

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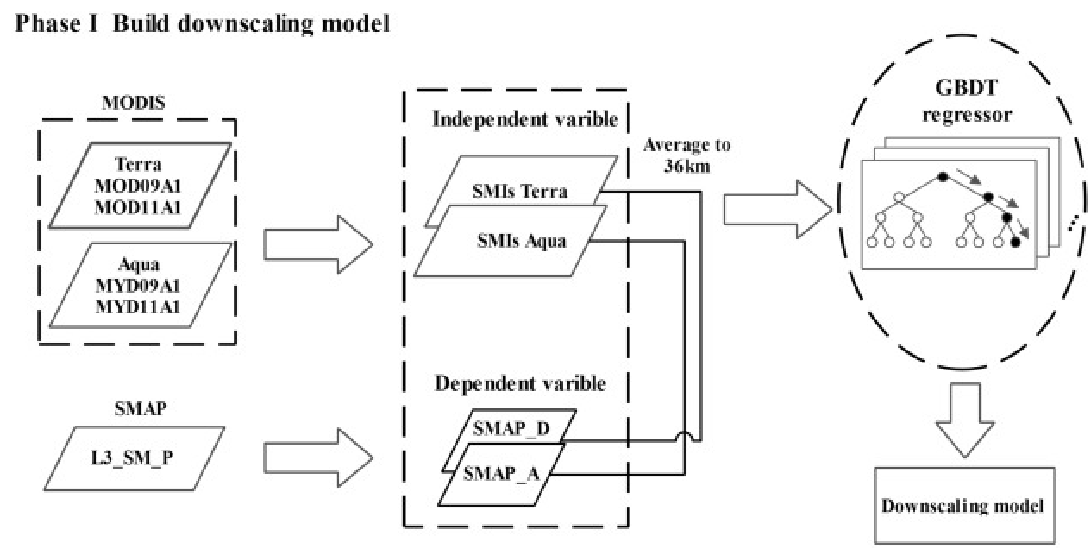
Example: Watershed properties

Example: Leveraging remote sensing products to obtain time-varying soil moisture maps

- Retrieve data from soil moisture dedicated satellite missions (e.g., SMOS, SMAP)
- Build statistical model to downscale satellite products (geostatistical and machine learning techniques often work well)



Wei et al. 2019

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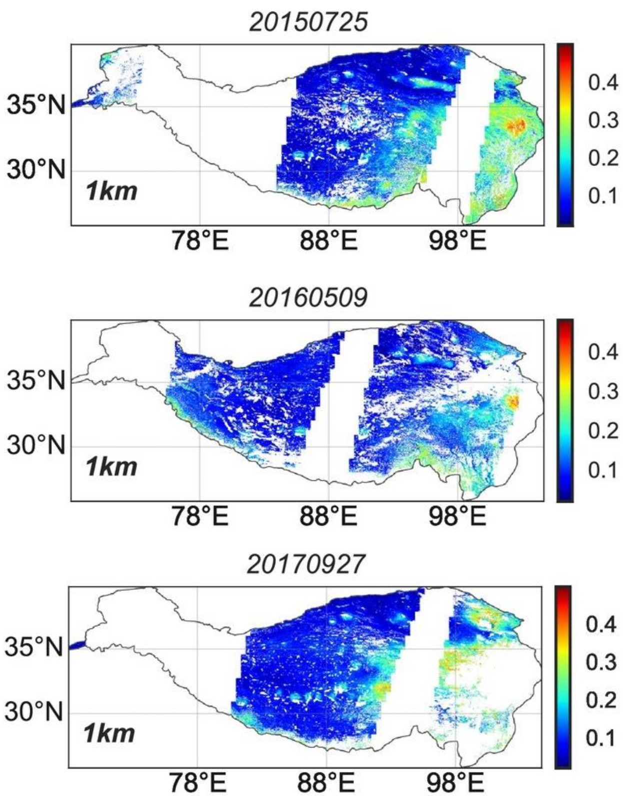
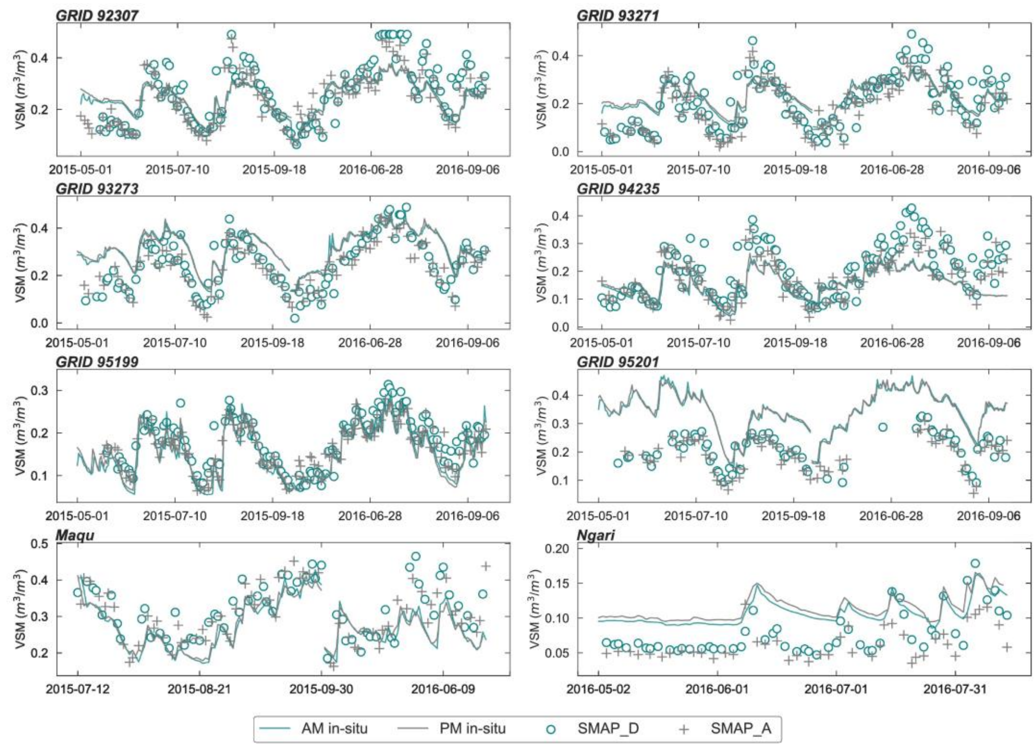
<u>Example: Watershed properties</u>

Example: Leveraging remote sensing products to obtain time-varying soil moisture maps

Soil moisture maps



Soil moisture time series: obs vs. predicted



Wei et al. 2019

Some expected challenges

- Integrate datasets from disparate sources, formats, spatio-temporal resolution
- Reconcile discrepancies across different data sources
- Develop framework to hindcast and/or fill in information where needed
- Develop framework to downscale/upscale data in space and time as needed
- Automate QAQC procedures as much as possible