Putting It All Together – Sediment Model (CBP RHM)

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Phase 6 (Nutrients/Sediment) Model Structure

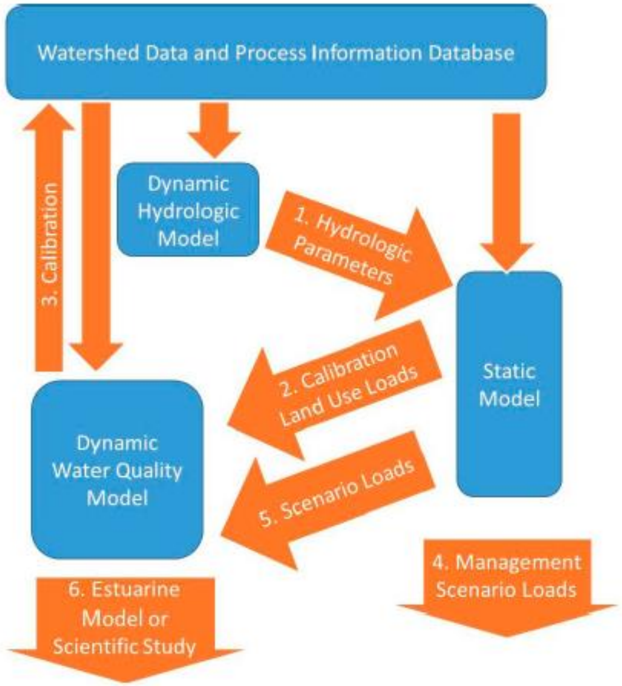


Figure 1-4: Relationship between the time-averaged and dynamic models

Table 9-1: Transport Processes Represented in the Phase 6 Watershed Model

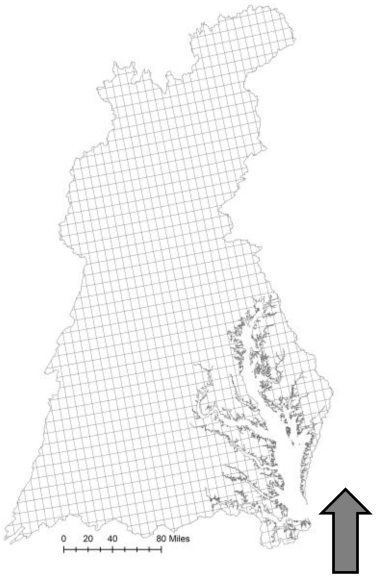
Process	Phase 6 Nutrients	Phase 6 Sediment
Edge-of-Field	Average loads + input load variability + land-to-water factors	RUSLE estimates
Hillslope		Interconnectivity factors
Groundwater		NA
Small Stream	SPARROW stream-to-river factors Average Streambank Erosion and Floodplain Deposition	SPARROW stream-to-river factors Average Streambank Erosion and Floodplain Deposition Streambank Erosion Due to Impervious Cover
Large River	HSPF River simulation	HPSF River simulation

Static (time-averaged) Models were developed/sourced and linked with the Dynamic Model in Phase 6.

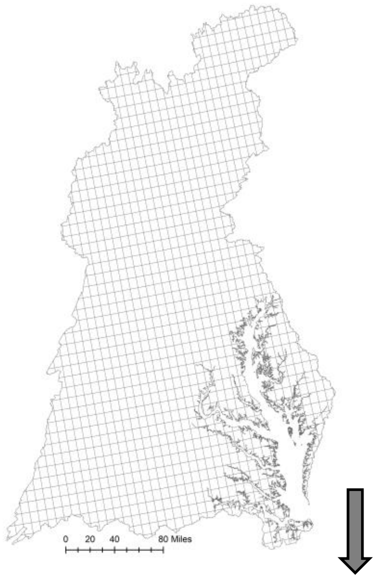
The static model consisted of elements from multiple models of different scales.

Static (Time-Averaged) Sediment Model

- Development, calibration, and verification of the Static Model
  - A mass balance approach at the RIM-shed scale was use for the sediment model.

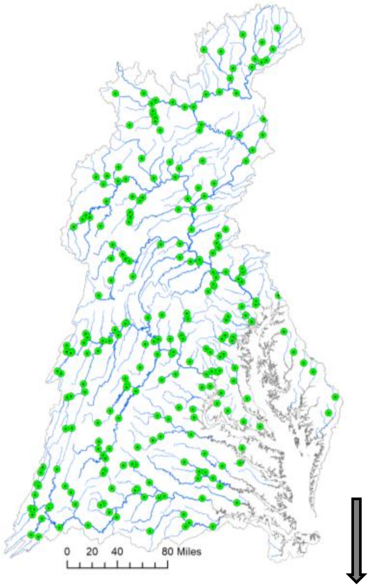


RUSLE Loading Rates (10-m Raster)

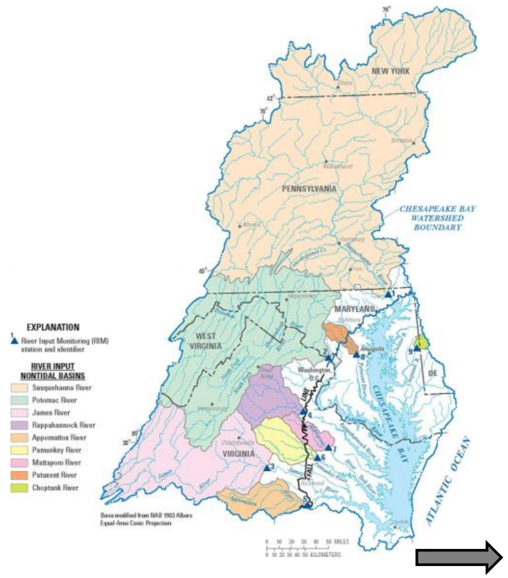


Sediment Delivery Ratio (10-m Raster)

SPARROW Stream to River Delivery Factors (NHDPlus Streams)



P532 HSPF River to Bay Delivery Factors (P532 River Segments)



WRTDS Average Annual RIM Load [1]

[1] Moyer et al. (2012) Comparison of two regress ion-based approaches for determining nutrient and sediment fluxes and trends in the Chesapeake Bay watershed. U.S. Geological Survey Scientific Investigations Report 2012-5244

Dynamic Sediment Model

- Dynamic Model performs temporal disaggregation for some of the elements of the static model.
  - Temporal disaggregation of RUSLE land use loading rates were performed using HSPF and split into sand and fines.
  - Sediment delivery ratios and SPARROW stream to river factors were used as average annual factors.
  - River simulation was performed using HSPF (settling/scour processing for storage/discharge) and calibrated to daily monitoring samples at 164 stations.
  - Additional verifications were performed using monthly and annual USGS WRTDS loads at 57 stations.

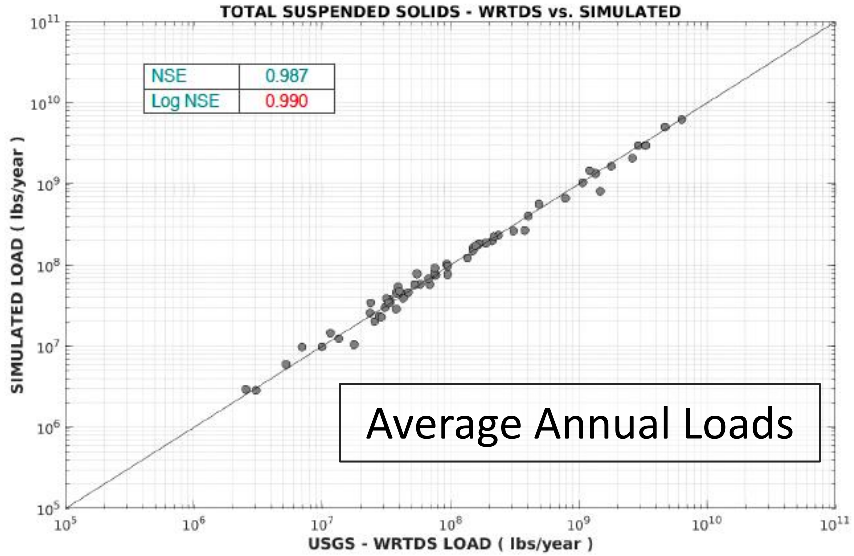


Figure 10-68. WRTDS and Watershed Model average annual sediment loads are shown for 60 monitoring sites. The figure shows a good agreement between the two estimates across different spatial scales.

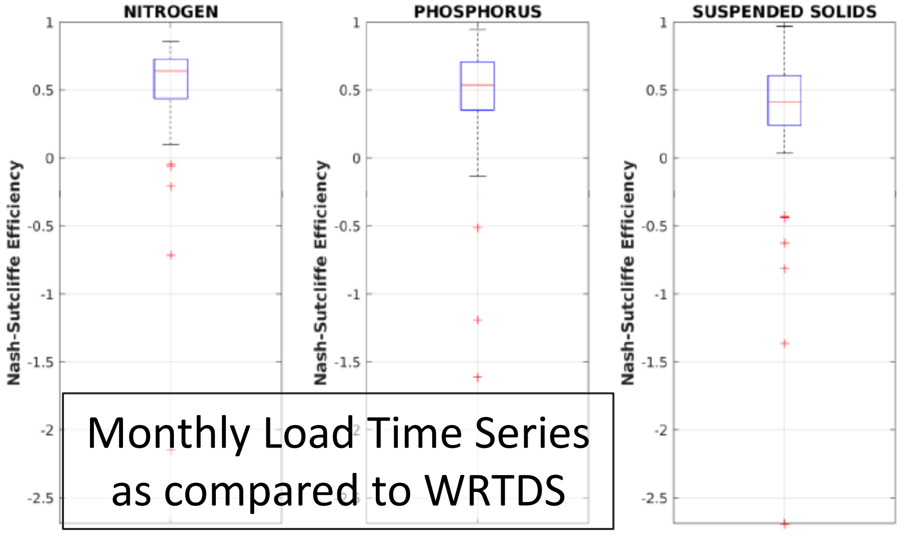


Figure 10-84: Nash-Sutcliffe Efficiencies (NSEs) showing the agreement between simulated and USGS-WRTDS monthly nitrogen, phosphorus, and sediment loads. The distribution includes 72, 58 and 57 monitoring sites for nitrogen, phosphorus and sediment respectively. *NSE of 1 for a monitoring site indicates a perfect match in loads for every month.*

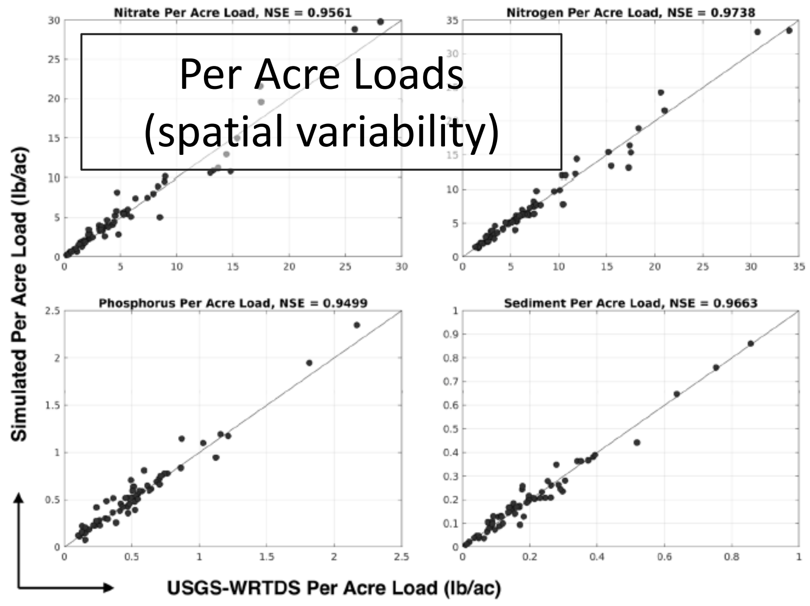


Figure 10-85: Geographic efficiencies for nitrate, nitrogen, phosphorus, and sediment. Geographic efficiencies

Linked static-dynamic model performed well on various model performance evaluation / verification metrics.

RHM – Static (time-averaged) Models

- Static (time-averaged) hydrology model
  - Claggett and Easton have been thinking about it
  - Multiple objectives include providing a foundation for P7 hydrology simulation (parameters for the dynamic model, data for the other modeling efforts (e.g., sediment and nutrient models), and development of hydrologic response units
  - Goal is to link fine scale geospatial datasets (both climatic and watershed properties) with some of the critical hydrograph characteristics of observed data at more than 400 streamflow stations using statistical models
    - Average flow (e.g., P6 10-m sediment model used an empirical model)
    - Separation of surface and sub-surface flow components, which can be used for the characterization of critical source areas (e.g. using topographic index and soil properties)

RHM – Static & Dynamic Models

- Calibration of Static (time-averaged) models
  - Different versions of static models with linked with the dynamic model for selecting best data, e.g., SPARROW factor associated with enhanced vegetation index was not used as part of the nitrogen model.
  - Should static model be calibrated at smaller scales (NTN stations)?
- Calibration of the Dynamic models
  - Finer scale simulation of NHDplus streams could be done using HSPF.
  - Should the dynamic model response of a NHDplus stream be calibrated to additional/new datasets, e.g., predictions of CDFN/SPARROW estimates for estimating the model parameters or temporal disaggregation?

Summary

- We are in very early stages of ”putting it all together” but good progress have been made on some of the critical data and building blocks that are needed for the sediment model.
- Going forward main tasks would be to
  - Develop static (time-averaged) models of hydrology and sediment
    - considerations such as how the static model be calibrated
  - Linking them in the Dynamic Model
    - considerations such as how to combine static models with other datasets (e.g., CDFN, SPARROW)