Modeling the Fate and Transport of Nutrients in the Lower Salinas River Watershed:

Where do we start?

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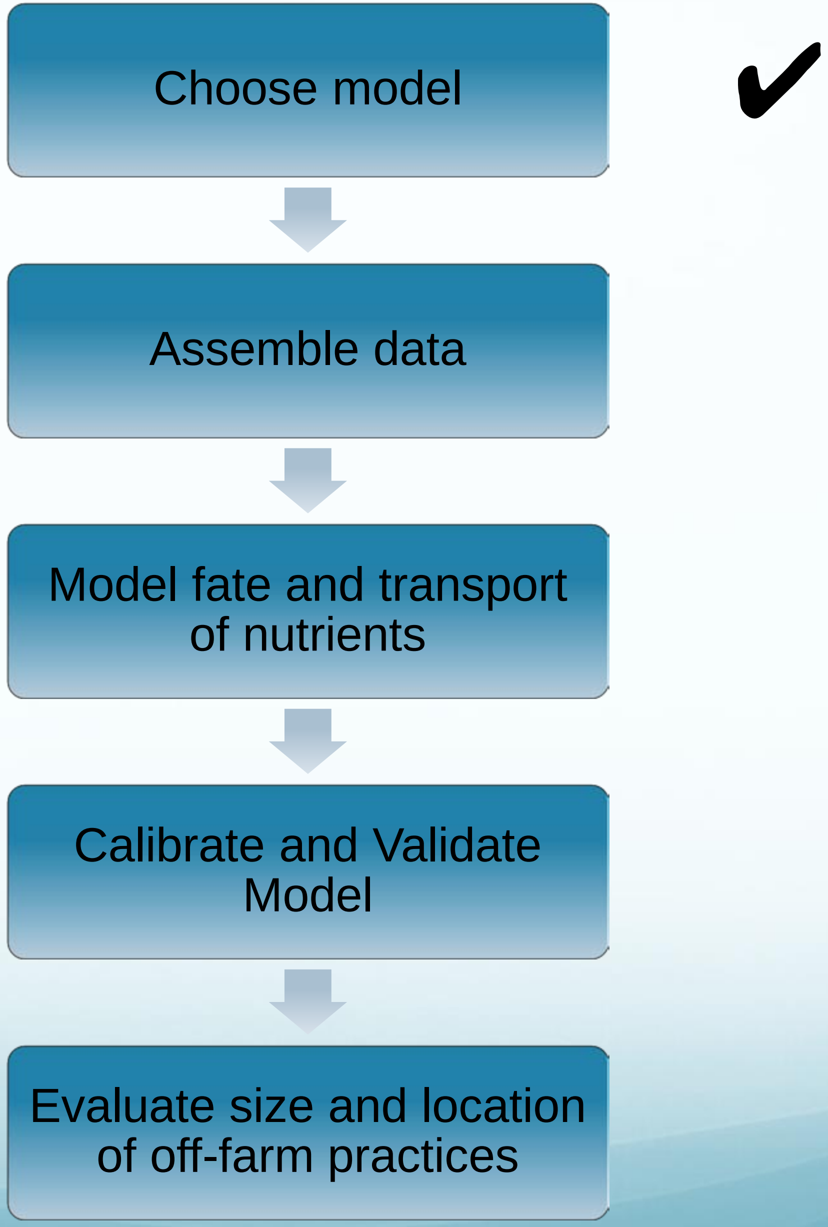
Project Objectives

1. Model the fate and transport of nutrients in the lower Salinas R. watershed
2. Evaluate the location and size of different natural solutions to demonstrate the potential effectiveness of off-farm treatment wetlands and cooperative management to reduce nutrient loading
3. Inform stakeholders and growers of the results so together with off- and on-farm practices, help cooperatives meet the regulatory obligations

Project Significance

- Surface water nitrate concentrations exceed 200 mg/L at times in some locations within the watershed
- Current practices are unable to meet regulatory compliance
- Salinas Valley growers have a strong incentive under the current Agricultural Order to find solutions to water quality impairments

Steps


Choose model
✔
Assemble data
Model fate and transport of nutrients
Calibrate and Validate Model
Evaluate size and location of off-farm practices

Study Location

Elkhorn Slough Foundation

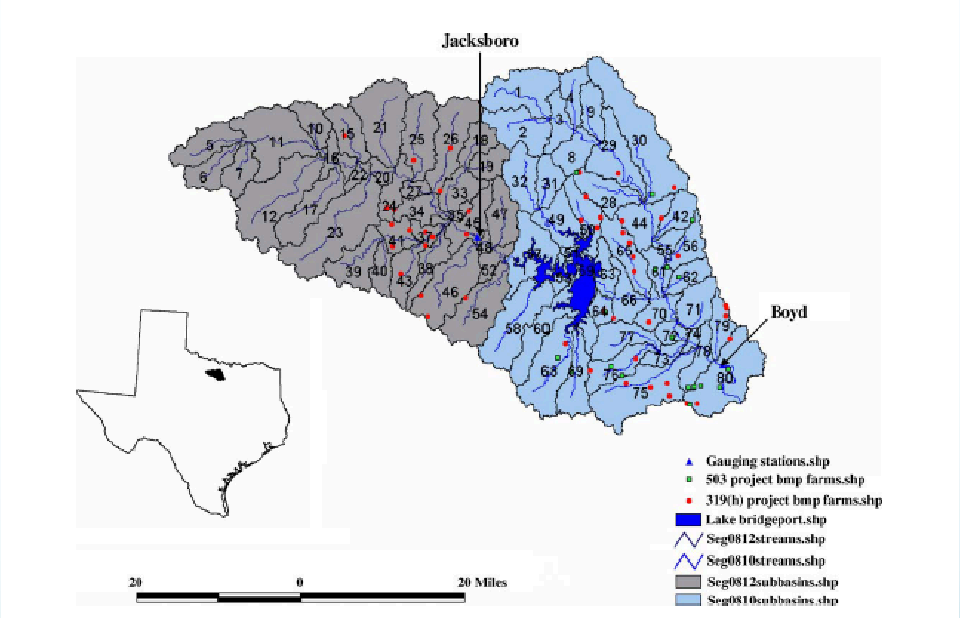
SWAT: Soil and Water Assessment Tool

- USDA Agricultural Research Service and Texas A&M scientists
- Model the quality and quantity of surface and groundwater and predict the environmental impact of land use, land management practices, and climate change
- Help water resource managers evaluate the impact of agriculture on water and diffuse pollution in medium and large river catchments
- Sensitivity analysis and calibration tool

SWAT: Soil and Water Assessment Tool

- Semi-distributed model – watershed can be divided into smaller subcatchments and hydrological response units (HRUs) with unique properties. Can input unique properties in HRUs that allows the modeler to see responses of the catchment on different spatial and temporal scales.

Example:



Santhi et al. 2006

Major Points for Model Selection

- International acceptance – widely used in various countries and adopted for different environments and scales
- Used to support TMDL analyses, investigate the effectiveness of conservation practices, and perform macro-scale assessments for large regions
- Can consider a wide variety of management scenarios

Main Model Components

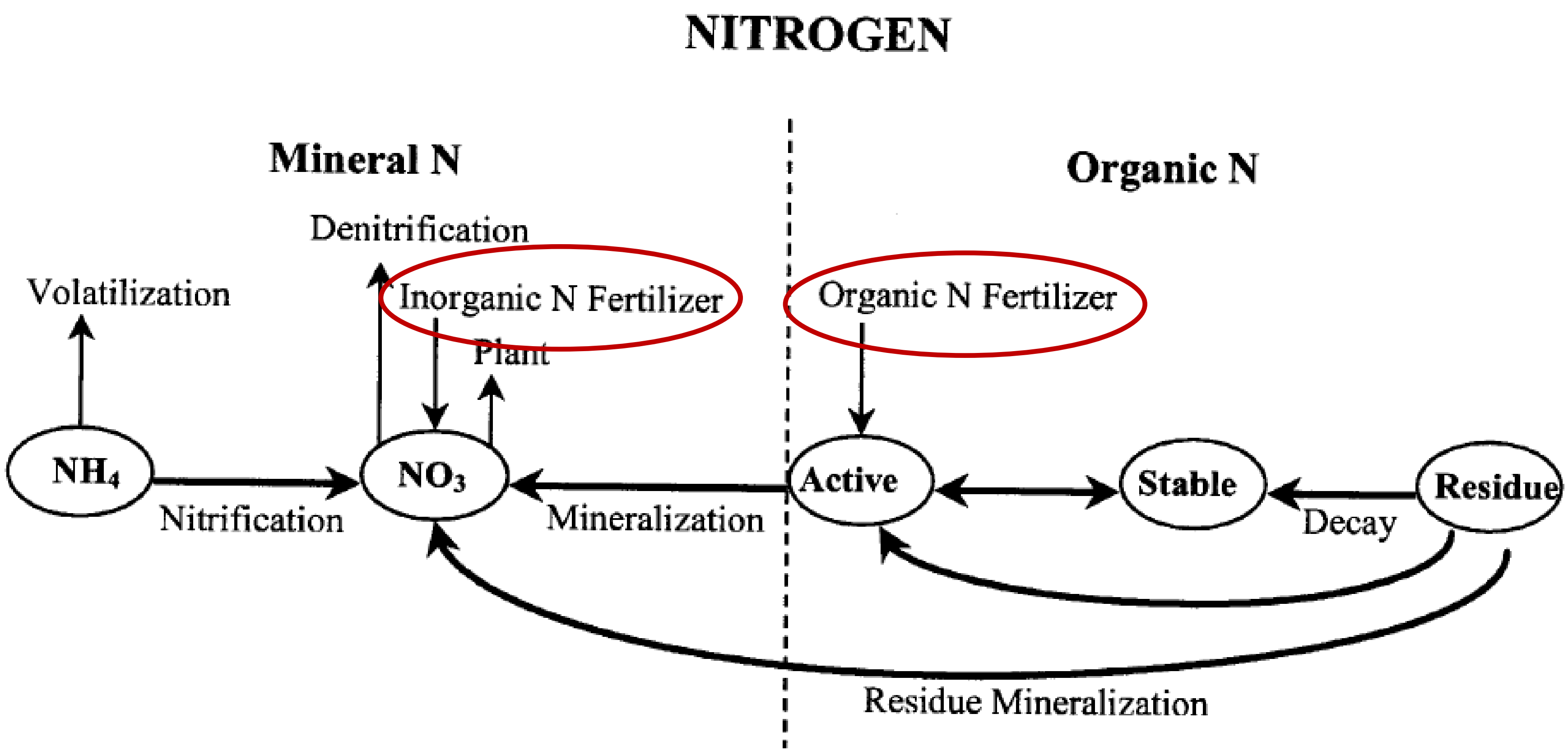
- Elevation – USGS (http://seamless.usgs.gov) ; also some LiDAR
- Land use – USGS (seamless.usgs.gov)
- Soils – STATSGO and SSURGO

These 3 components are used to delineate the watershed into smaller subbasins

Data Inputs

- Weather – National Climatic Data Center
- Stream flow data – USGS
- **Tillage**
- **Fertilizer**
- **Crop growth**
- **Irrigation**
- Pound/wetlands
- **Water use**
- **Groundwater flow (including tile drain)**
- Reach characteristics
- Surface runoff
- Percolation
- Evapotranspiration
- Reservoir storage
- Point sources
- Septic

Nitrogen Processes Modeled in Swat



Santhi et al. 2001

Model Outputs

- Generates daily, monthly, and annual data of how hydrologic and nutrient loading changes based on input parameters

MORE DATA	**=**	**BETTER CALIBRATED RESULTS**

Case Studies

Example 1: Estuary on coast of France

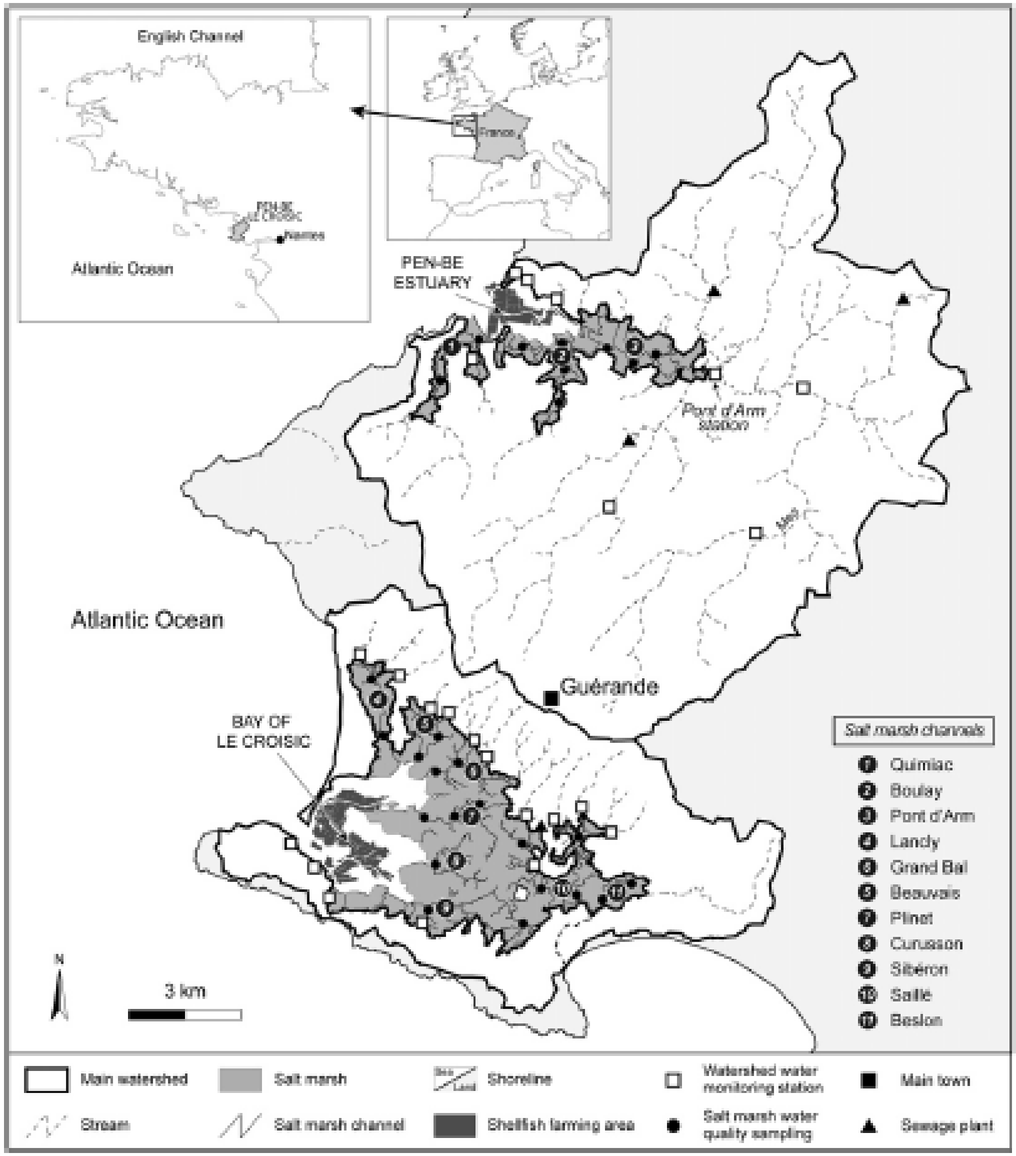


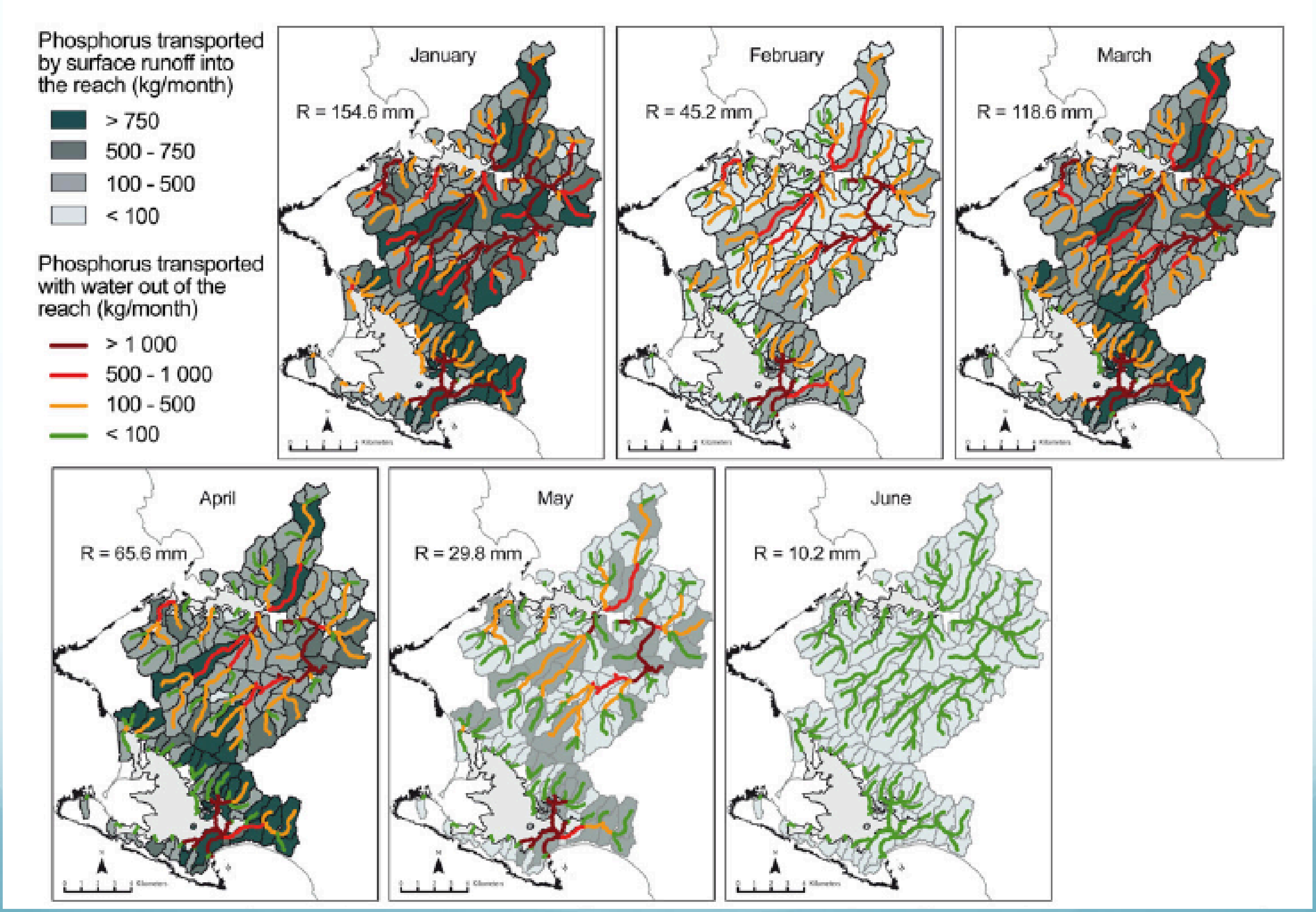
Fig. 1. Location of the study area and configuration of Pen-Bé estuary and Le Croisic bay watersheds.

Bay and estuary on the coast of France

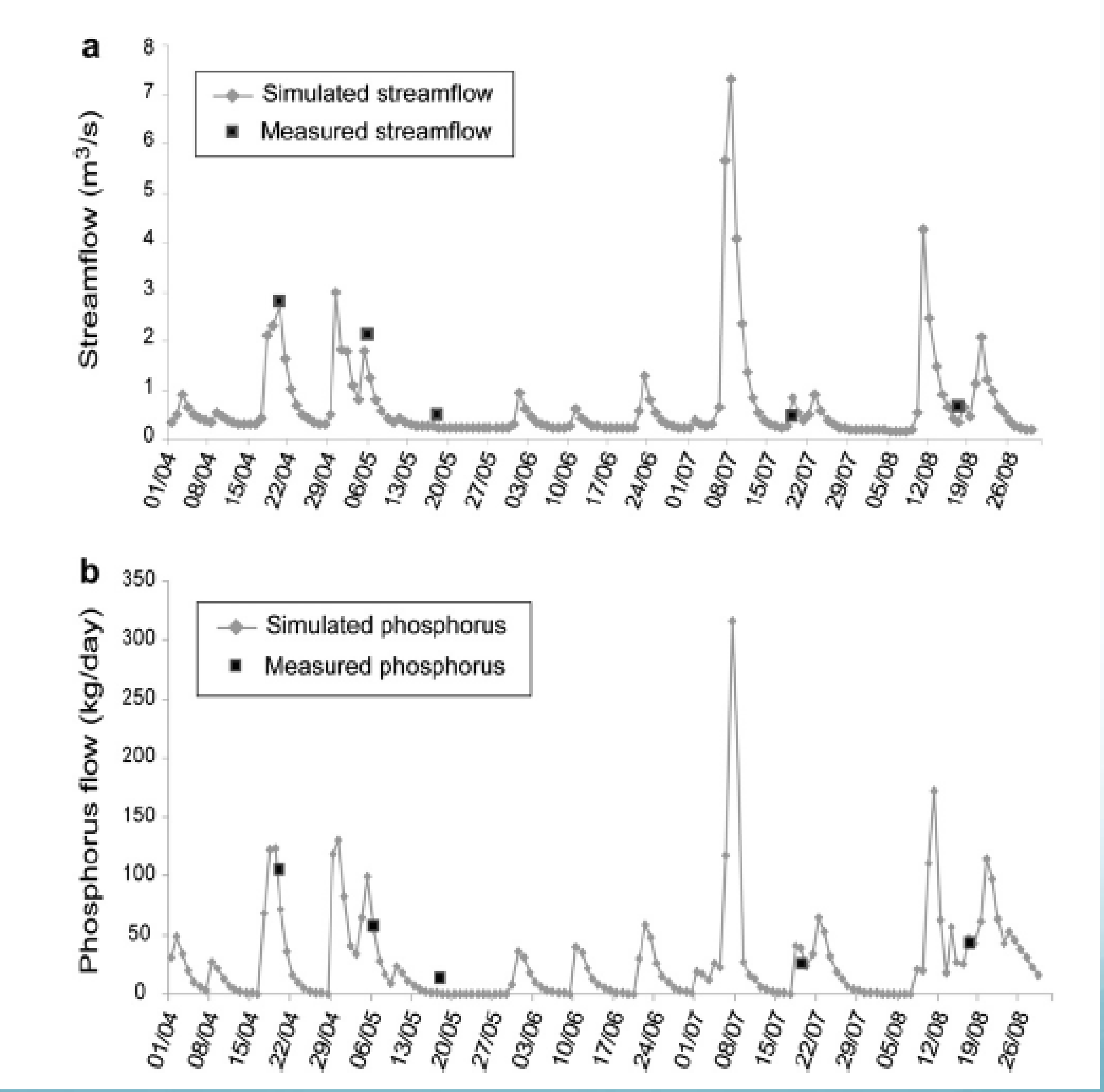
- Experienced decreased shellfish production and water quality

Rollo et al. 2010

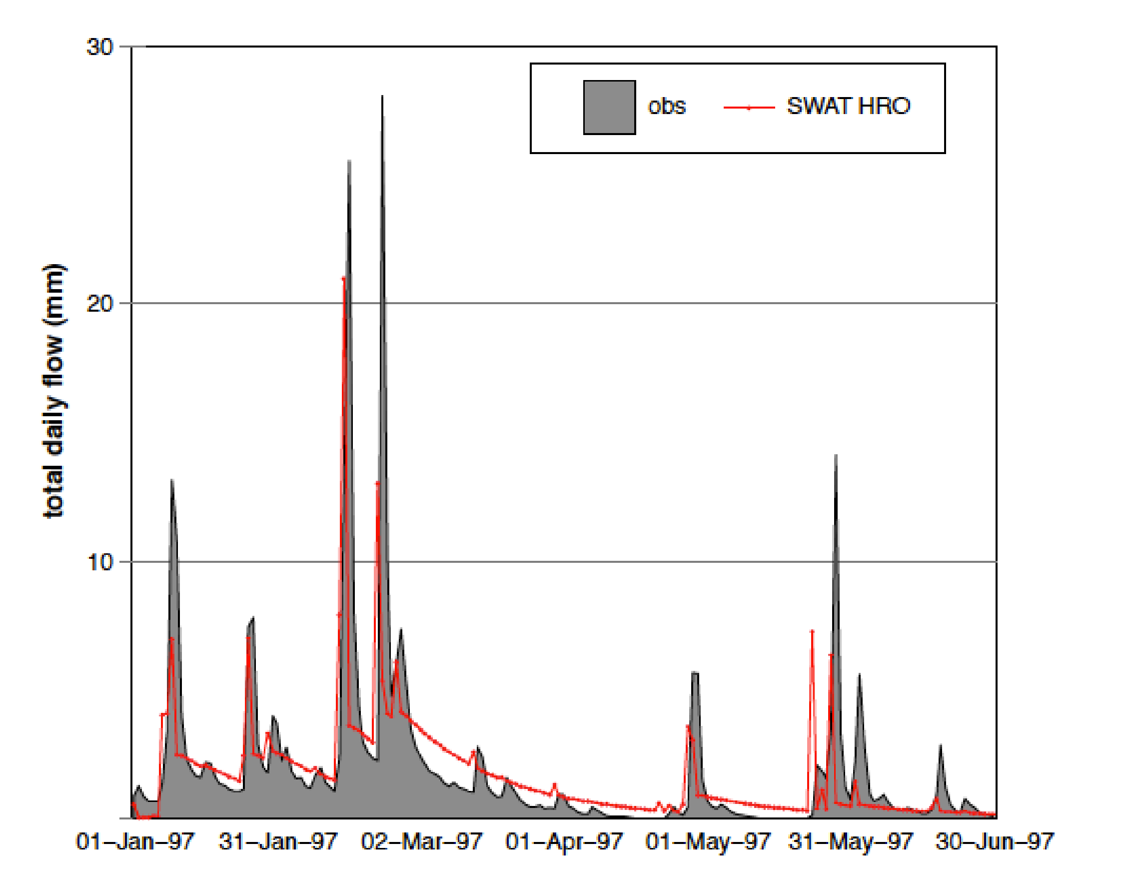
Identifying P transport in subbasins



Observed vs. Model Simulated



Example 2: Coastal Plain Watershed



Observed and simulated total daily flows

- Minimal adjustments required in the SWAT model to obtain accurate results
- High resolution data produces simulated results closer to observed data

Bosch et al. 2004

Example 3: BMPs

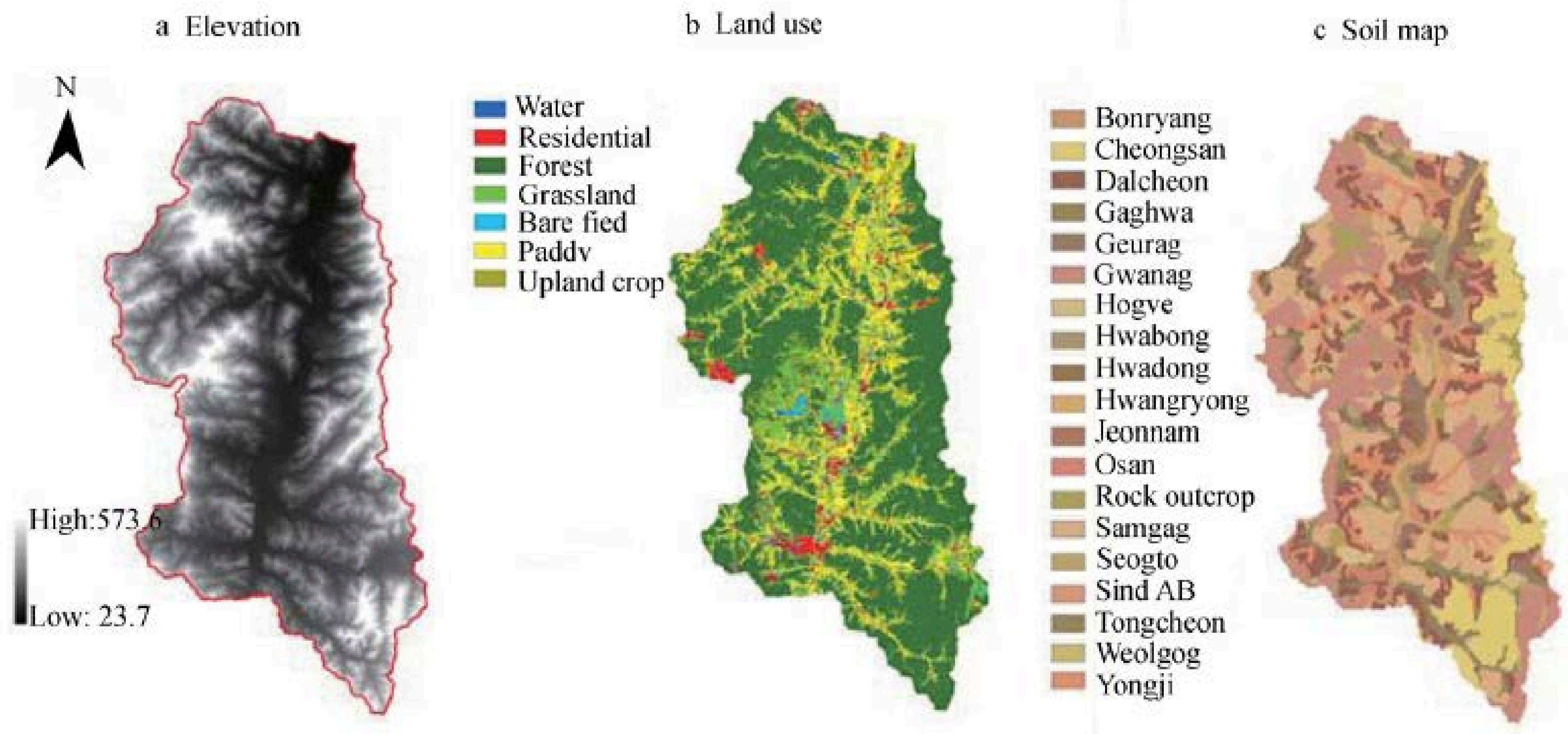


Fig. 2 GIS data of 30 m resolution. (a) elevation; (b) land use; (c) soil map.

Lee et al. 2010

Example 3

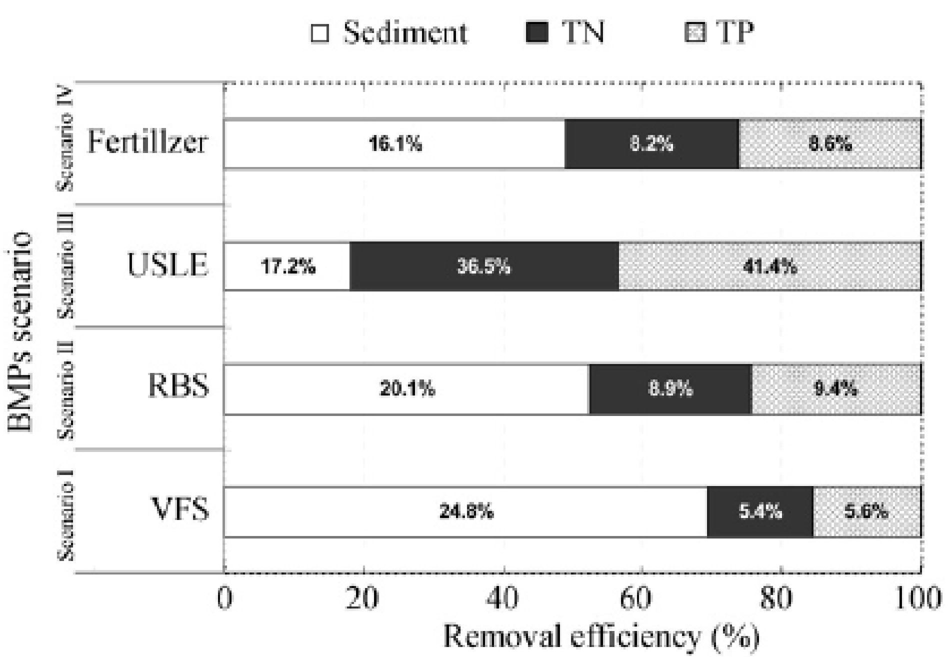


Fig. 6 NPS pollution removal efficiency with BMP scenarios.

- Investigated four land-management practices with SWAT:

1) Vegetative filter strip

2) Riparian buffer system

3) Regulation of the Universal Soil Loss Equation P factor (nutrient transport by soil erosion)

4) Fertilizer application (amount, type, timing)

Lee et al. 2010

Summary

- SWAT model is a watershed approach, not targeting specific locations
- Our ultimate goal is to identify the ideal location and size of off-farm treatment wetlands
- With off- and on-farm practices, help cooperatives meet regulatory obligations

Photo credit: Keith Ellenbogen

Suggestions?

- Data availability? **Tillage, Fertilizer application, Crop growth, Irrigation, Tile drains (nutrient concentrations)**

  - some data will require sampling

- What other results from the model would stakeholders be interested in?

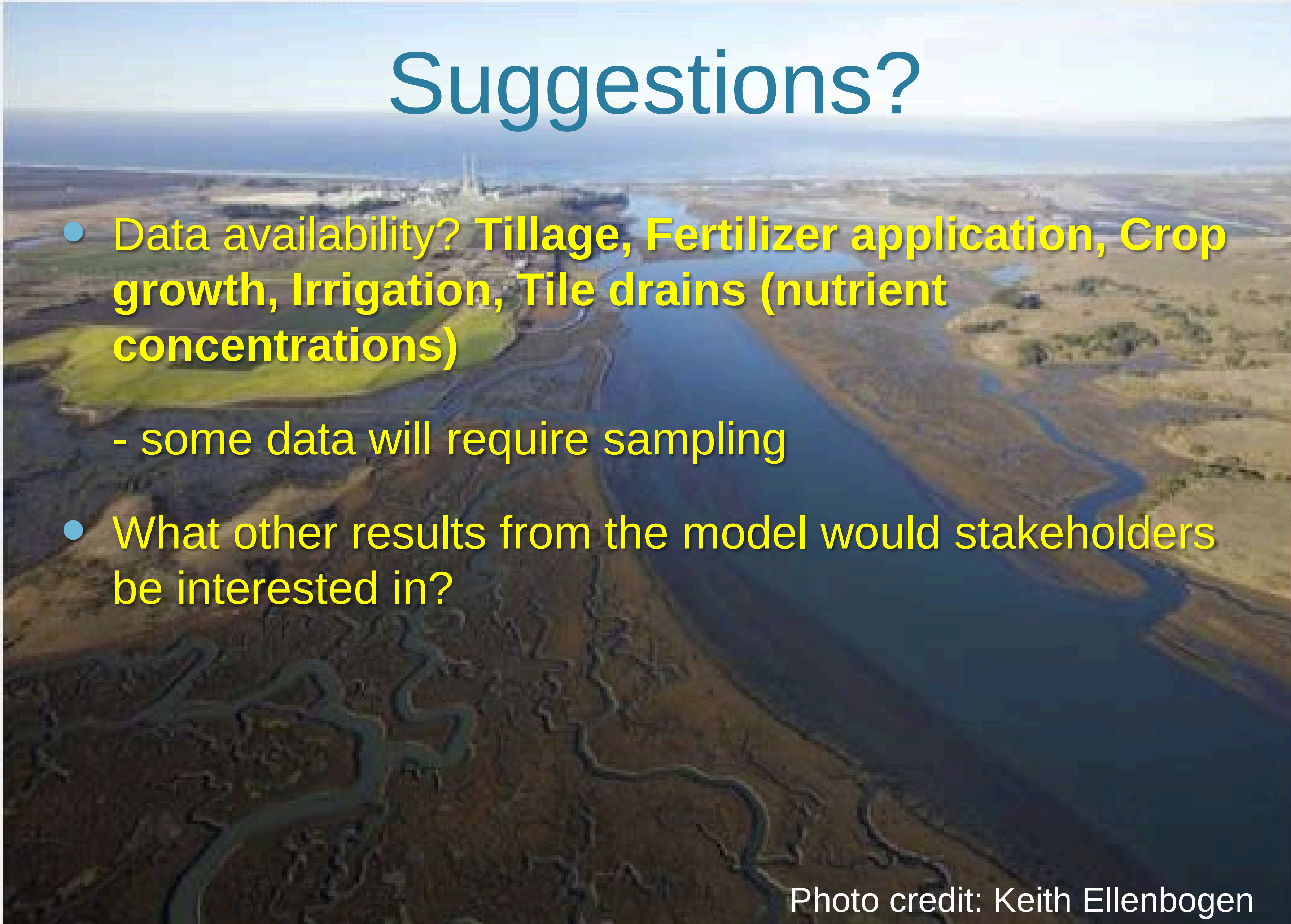


Photo credit: Keith Ellenbogen