

Development of a web-based interface for simulating alternative conservation practices using APEX

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Overview

APEX Model Background

Existing APEX Interfaces

NRCS Systematic Tool for Analyzing Resources (STAR)

STAR Walkthrough

APEX Model Background

Farm/small watershed scale

Developed by USDA in Temple, TX
and Texas A&M University

Simulates:

- Water, sediment, nutrients, pesticide transport from fields
- Crop growth, biomass, yields



APEX Model Background

Agronomic management:

- Irrigation, Drainage, Furrow dikes
- Buffer strips, Grass Waterways
- Fertilization, Pesticide applications
- Manure management
- Crop rotations

Review paper Gassman et al. (2010).
Trans. ASABE Vol. 53(3): 711-740.



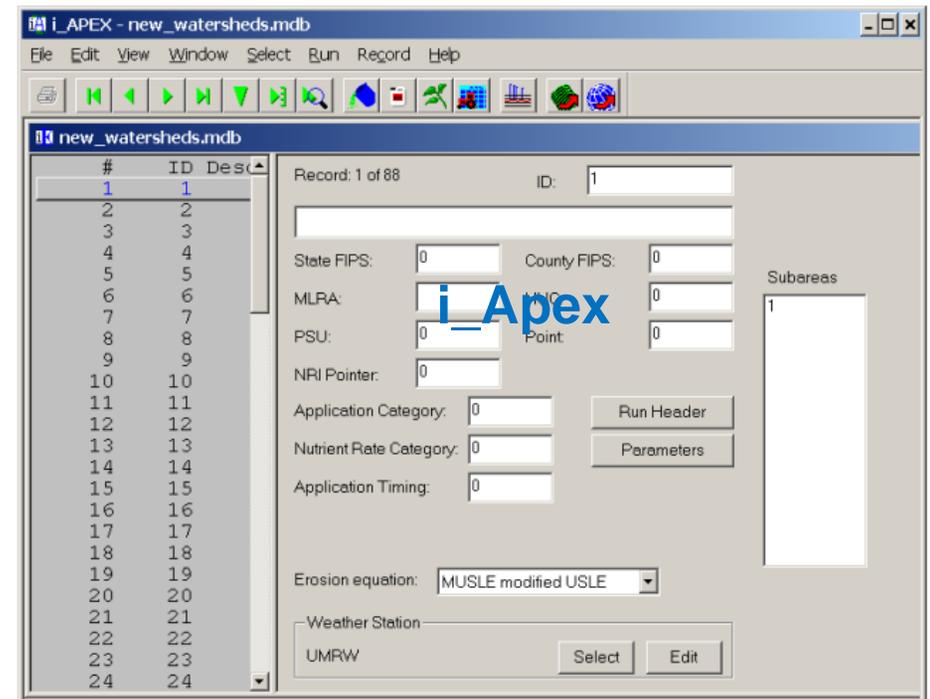
Existing APEX Interface

ArcApex, i_Apex, WinApex

Useful for detailed site-specific analysis

Intensive input data requirement

Involves significant learning curve and model understanding



Why use a web-based interface for APEX?

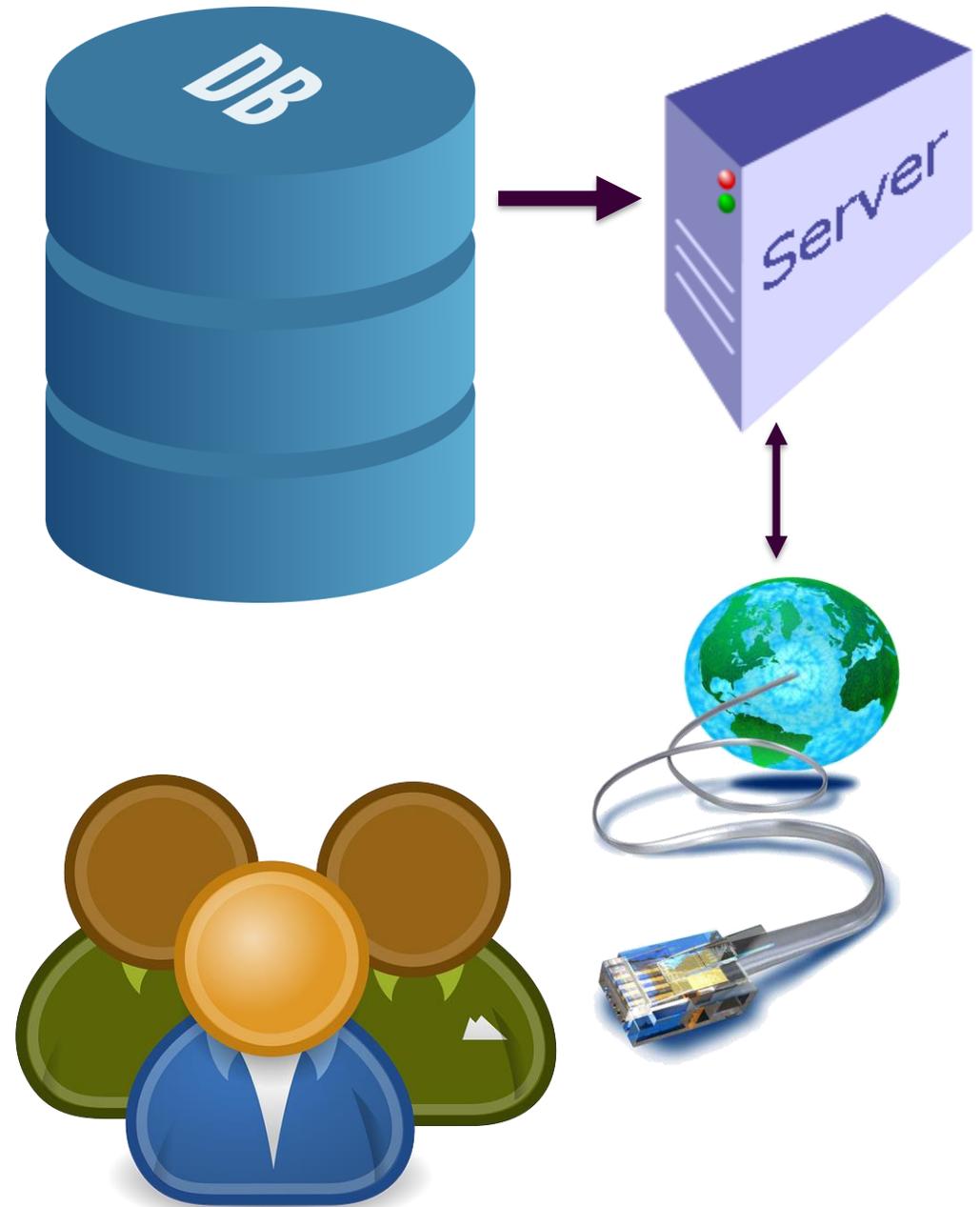
Easier to use

No software dependencies (e.g. ArcGIS license)

Can be accessed through any internet-enabled computer

Databases can be updated as new data or information becomes available

Seamless workflow between running a complex mathematical model and interpreting nutrient management planning results



Web-Based APEX, NRCS STAR

Stone has been working with Texas A&M University and the NRCS in TX and VT to develop a tool for running APEX on the web.

The tool features:

- Ability to run a complex water quality model (APEX) through a streamlined, user interface.
- Databases with built in local topography, soils, and weather to populate model inputs.
- Simulation of multiple types of best management practices and field operations schedules specific to the Northeast.
- Reporting capabilities that generate comparisons between “baseline” and alternative management practices.
- Web-based access, run remotely on cloud computers.

Farm specific field conditions, historical and current agronomic practices, and BMPs can be assessed.

Web-Based APEX, NRCS STAR: Vermont Example Walkthrough

USDA APEX NRCS - Farm Scale Water Quality Modeling Tool

Choose Basemap Imagery Legend Find Address

Plan: MikePlan \ Mike Assessment:

[0] Start Menu

Welcome to STAR!

Please proceed by choosing an option below...

Begin Conservation Plan Assessments	Use an existing conservation plan to define assessments, fields, and schedules that can then be analyzed by APEX.
Create New Conservation Plans	Import or create new conservation plans.
Manage User Preferences	Manage your application options and preferences.
Administration & User Management	Manage your application options and preferences.
About STAR	History and vision of the STAR tool.

- > [1] Choose Plan
- > [2] Assessment Definition
- > [3] Practices
- > [4] Operations
- > [5] Soils
- > [6] Run Apex
- > [7] Reports

NRCS STAR: VT Example Walkthrough

Create a New Conservation Plan

The screenshot displays the USDA APEX NRCS Farm Scale Water Quality Modeling Tool interface. The main window shows an aerial view of a farm field with a red location pin. Three callout boxes provide instructions:

- 1. Use the "Find Address" Tool to locate the farm field.** This points to the "Enter Address Information" dialog box on the right, which contains fields for Address (Lake Rd), City (St. Albans), State (Vermont), and Zip, along with a "Find" button.
- 2. Choose Create New Conservation Plan** This points to the "Create New Conservation Plans" button in the left sidebar.
- 3. Create a new plan and give it a new name** This points to the "New Conservation Plan" dialog box at the bottom, which has fields for "New Plan Name" (Demo VT Plan) and "Land Owner Name" (Test User), and a "Create & Define PLUs >>" button.

The interface also includes a "Welcome to STAR!" sidebar with a "Start Menu" and a "Conversation Plan Editor" window at the bottom.

NRCS STAR: VT Example Walkthrough

Draw or Import Field Boundaries

The screenshot displays the USDA APEX NRCS Farm Scale Water Quality Modeling Tool interface. The main window shows a satellite map of a rural area with a large field boundary highlighted in light brown. A red location pin is visible on a road below the field. A 'Conversation Plan Editor' dialog box is open on the left side of the map, titled 'New Conservation Plan'. The dialog box contains the following text:

Conversation Plan Editor

New Conservation Plan [?]

Create New Plan Without Toolkit Data

New Plan Name: **Demo VT Plan**

Land Owner Name: **Test User**

Conservation Plan ID:

There are two options for creating PLUs:

1. Upload a PLU Shapefile

Hit upload, and select the .SHP and .DBF files for the shapefile you want to upload. To select multiple files, hold down "Ctrl" or "Shift" key. Preview the uploaded PLUs on the map and either hit the "Save Uploaded SHP to Plan" button or click cancel to start over.

NOTE: Your shapefile must be in a Web Mercator projection. Once imported, confirm its correct location by using the Find Address tool and comparing the fields to the satellite imagery.

Upload Save Uploaded SHP to Plan Cancel

AND/OR

2. Draw PLUs

Hit New PLU and use the mouse to draw the PLU on the screen. Double click to finish drawing. Select Save to complete the PLU, Edit to make changes, or Cancel to start over. You can create multiple PLUs by reselecting the New PLU button.

New PLU Save Edit Cancel

Cancel

Three callout boxes provide instructions:

- 1. Select New PLU (points to the 'New PLU' button)
- 2. Trace the field boundary and double click to finish (points to the field boundary)
- 3. Choose Save (points to the 'Save' button)

The top of the interface shows the title 'USDA APEX NRCS - Farm Scale Water Quality Modeling Tool', a 'Choose Basemap Imagery' dropdown menu, and 'Legend Find Address' links. Below the title bar, it says 'Plan: -not set-' and 'Assessment: -not set-'.

NRCS STAR: VT Example Walkthrough

Select an Operation Schedule

USDA APEX NRCS - Farm Scale Water Quality Modeling Tool

Plan: Demo VT Plan \ Test User Assessment: Demo Baseline

Choose Basemap Imagery Legend Find Address

> [0] Start Menu
> [1] Choose Plan
> [2] Assessment Definition
> [3] Practices
▼ [4] Operations

4. Field Operations Definition

Double-Click A Field's Name To View or Edit The Operations Schedule For That Field

Field Name	Operations Status
Corn Field	Incomplete
Practices: No Practices	

Define Soils >>

1. Double click the field name to open the operation schedule editor

Operations Schedule Editor

Auto Irrigation: No
Auto Fertilization: No

1. Select an Operation Schedule:

Select a default operation schedule
 Select a previously defined operation schedule

To filter the op. schedule list, enter a search term:

2. Filter the list of operation schedules with a key word

3. Review the operations then move onto customizing

Apply Prev. Defined to Field Customize Op. Schedule

Crop	Year	Month	Day	Tillage Op.	Tillage Equip.	Rate	Units	PHU	Edited
Corn grain	1	5	15	Fertilize	Fertilizer App - Truck spreader	3569.608667	lbs/acre	NA	No
Corn grain	1	5	15	Fertilize	Fertilizer app In furrow or with seed or band 1	99.92406166	lbs/acre	NA	No
Corn grain	1	5	16	Plant in rows	Planter, 40 inch	0	plants/acre	3827.606400	No
Corn grain	1	7	1	Fertilize	Fertilizer app Surface Broadcast no incorp 2	199.8481233	lbs/acre	NA	No
Corn grain	1	10	20	Harvest without kill.	COMBINE SELF-PROP 4WD	0	NA	NA	No
Corn grain	1	10	21	Kill crop	KILL	0	NA	NA	No

NRCS STAR: VT Example Walkthrough

Edit Operations

- Modify any of the listed operations by double clicking
- Add new operations by selecting the appropriate tab

Operations Schedule Editor ✕

Auto Irrigation: No Copy Ops to Other Years Complete Operation Schedule

Auto Fertilization: No

Tillage **Irrigation** Fertilizer Pesticide Planting Harvest/Kill Grazing

Add a Tillage Operation ?

Year (1-6): Month (1-12): Day (1-31):

Tillage Type:

Crop: Limit To Op. Sched. Crops

Equipment:

(+ Add Tillage Op)

	Crop	Year	Month	Day	Tillage Op.	Tillage Equip.	Rate	Units	PHU	Edited
<input checked="" type="checkbox"/>	Corn grain	1	5	15	Fertilize\VTManure	Fertilizer App - Truck spreader	3569.608667	lbs/acre	NA	No
<input checked="" type="checkbox"/>	Corn grain	1	5	15	Fertilize\10-10-10	Fertilizer app In furrow or with seed or band 1	99.92406166	lbs/acre	NA	No
<input checked="" type="checkbox"/>	Corn grain	1	5	16	Plant in rows	Planter, 40 inch	0	plants/acre	3827.60	Yes
<input checked="" type="checkbox"/>	Corn grain	1	7	1	Fertilize\32-06-00	Fertilizer app Surface Broadcast no incorp 2	199.8481233	lbs/acre	NA	No
<input checked="" type="checkbox"/>	Corn grain	1	10	20	Harvest without kill.	COMBINE SELF-PROP 4WD	0	NA	NA	No
<input checked="" type="checkbox"/>	Corn grain	1	10	21	Kill crop	KILL	0	NA	NA	No

NRCS STAR: VT Example Walkthrough

Soils Processing and Editing

- The predominant soil on the field is determined and soil parameters can be edited by double clicking the field name on the soil panel

5. Field Soil Parameter Editing

Double-Click A Field's Name To View or Edit The Soil Parameters For That Field

Field Name	Soil Name
Corn Field	Copake

Run Apex >>>

To execute APEX select Run APEX after completing soils editing

Field Soils Editor

Edit Soil Parameters

Soil Name: Copake

Apply to all layers: WTMN: 0 WTMX: 0 HSG: 2

Select Layer #: 1

Initial Soil P from Field Tests: [Dropdown]

Soil P Value: 0 PH: 5.9

Z: 0.6561679 BD: 1.25 SAN: 67.7 SIL: 21.3

WOC: 2.0301624 CNDS: 0 SSF: 0

CEC: 0 SATC: 3.2999952

(+) Update Soil

Default Soil Values

WTMN: 0 WTMX: 0 HSG: 2 PH: 5.9

Z: 0.6561679 BD: 1.25 SAN: 67.7 SIL: 21.3

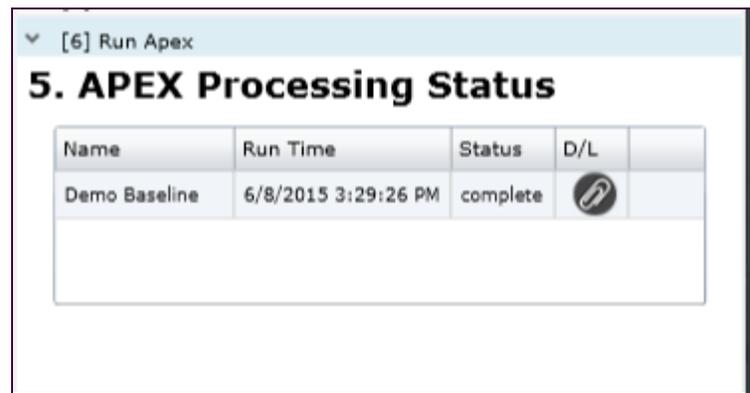
WOC: 2.0301624 CNDS: 0 SSF: 0

CEC: 0 SATC: 3.2999952

NRCS STAR: VT Example Walkthrough

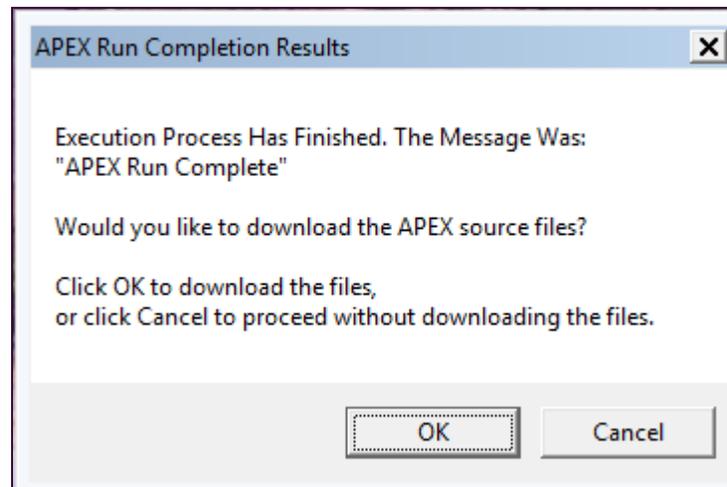
Executing APEX

- While the data is being prepared for the APEX run and APEX is executing the status will be updated.



Name	Run Time	Status	D/L	
Demo Baseline	6/8/2015 3:29:26 PM	complete		

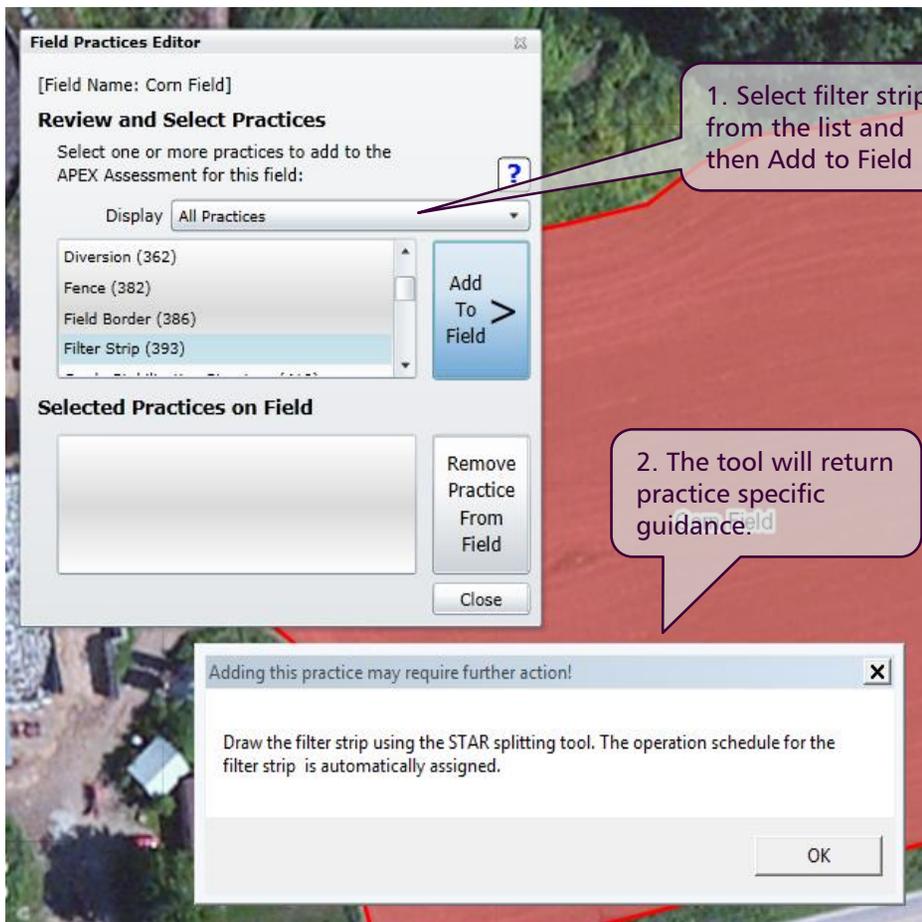
- Once APEX finishes executing, you have the option of downloading the source files



NRCS STAR: VT Example Walkthrough

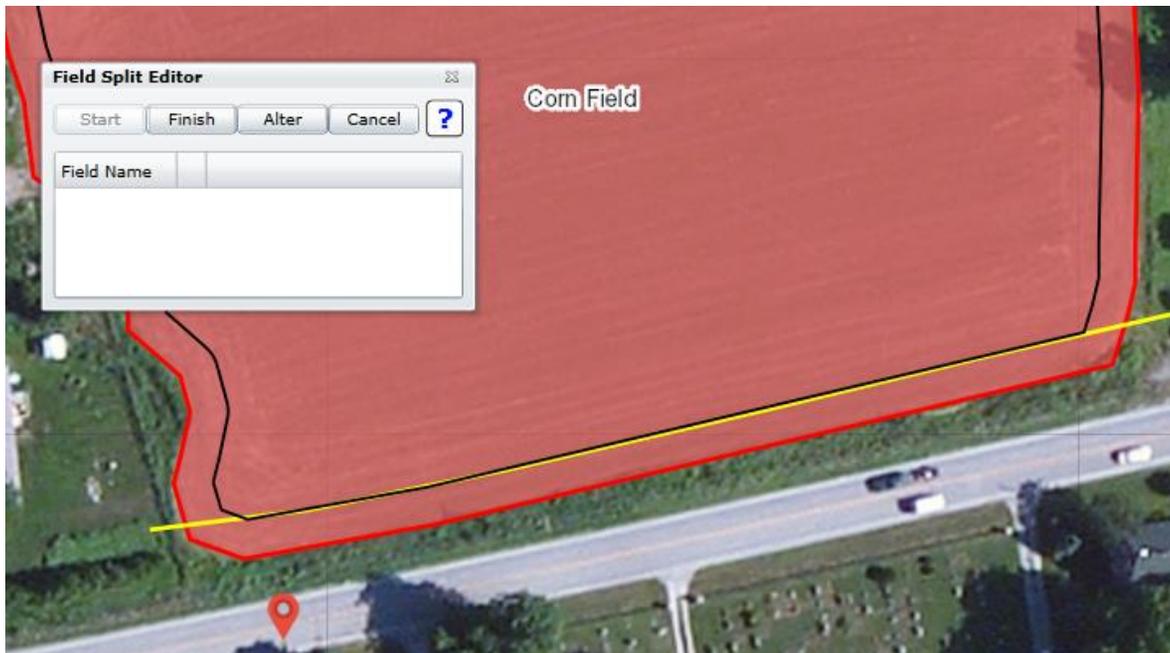
Add a Filter Strip for an Alternative Assessment

- To add a BMP, double click the field name on the Field Practice Definition panel



NRCS STAR: VT Example Walkthrough

Draw the Filter Strip



- A line is displayed based on the width entered. Trace the line at the desired location to create the filter strip.

- The filter is split from the corn field as a new polygon. Specify the drainage for the field and the filter strip.

