AppDates Tool: Automated Label-Compliant Application Date Assignment and Parameterization of Pesticide in Water Calculator (PWC) Batch Input Files

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Background
- Endangered species risk assessments for pesticides use models to simulate exposure and aquatic environmental fate
- **USEPA's Pesticide in Water Calculator (PWC)[1] simulates pesticide applications** to land surfaces using the Pesticide Root Zone Model (PRZM) and the subsequent transport to and fate in surface water bodies using the Variable Volume Water Model (VVWM)
- Pesticides typically have diverse uses and restrictions that vary based on the use site, region, and time of year

Problem
- **Manual parameterization of numerous PWC model runs is time-prohibitive and prone to human error** due to label restrictions unique to each use site and region
- Ensuring conservatism (*e.g.*, simulation of applications during wettest months of the year) further complicates date assignment logic

Solution: AppDates Tool
- **Automates PWC batch file preparation** (efficient, transparent, reproducible)
- **Generates label-compliant application dates and rates** for variety of use sites within the United States
- Facilitates PWC runs with landscape scale refinements (alternate distances, drift factors, transport mechanisms)
- Ensures conservativism is maximized (prioritize applications during wettest months with maximum application rates at minimum reoccurrence intervals)
- Intuitive graphical user interface (GUI) and input tables

AppDates Tool
1. Iterate through each row (use) in the agronomic practices table (APT)
2. Get ag. practices info (*e.g.*, restrictions, hydrologic units to process, application method, emergence & harvest dates, etc.)
3. For each run to be created…
   - Apply date assignment algorithm
   - Finalize PWC run and add to batch file

AppDates Tool Use Cases
1. **Generate new a PWC batch file**
2. Quality check (QC) an existing batch file
3. Quality check an existing batch file and update application information

PWC Batch File

I want to create a new PWC batch input file. I'll start by setting up the input tables, then use the GUI for the rest.

AppDates Tool GUI

Application Date Assignment Algorithm

Algorithm Logic
1. Iterate through each day (date) in the year, from wettest to driest month
2. Prepare the first application in a series:
   - Get the application rate
   - Get the starting application date*
   - Get the minimum reapplication interval (MRI)
3. Make applications if the…
   - date is valid**
   - annual limits are not exceeded
   - interval limits are not exceeded
   - rate max number of apps are not exceeded
4. Prepare for next application in a series
   a) get the next app rate
   b) get the next app date***

* If the random start dates parameter is disabled, then the start date is the date from the iteration. If the random start dates is enabled, the start date is a random date in the month of the date from the iteration.

** A date is valid if it…
- is in a valid interval (pre- or post-emergence) for that rate
- meets the rate instructions constraints (if applicable)
- is not within the minimum reapplication interval (MRI)
- is not within the preharvest interval (PHI)

*** Default is to forward assign the number of days equal to the MRI. However, if the next forward date is not valid, then start reverse assigning from the series starting date.

Example

Agronomic restrictions (Row in APT)

Run Descriptor	Demo
Labeled Use	Demo
Application Method	Ground
Scenario	VegetableESA
State	OR
Drift-Profile	G-HB-VF-F
Max. Annual Amount (lbs/acre)	9
Max. Annual Number of Apps	5
Pre-Harvest Interval (PHI) (days)	3
Pre-Emergence Max. Amount (lbs/acre)	
Pre-Emergence Max. Number of Apps	
Post-Emergence Max. Amount (lbs/acre)	
Post-Emergence Max. Number of Apps	
Rate 1 Max. App Rate (lbs/acre)	2
Rate 1 Max. Number of Apps	
Rate 1 Pre-Emergence MRI (days)	
Rate 1 Post-Emergence MRI (days)	10
Rate 1 Instructions	
Rate 2 Max. App Rate (lbs/acre)	
Rate 2 Max. Number of Apps	
Rate 2 Pre-Emergence MRI (days)	
Rate 2 Post-Emergence MRI (days)	
Rate 2 Instructions	
… up to 4 unique rates can be parameterized	

Annual Limits / Interval Limits / Rate Limits

Derive From Ag. Restrictions

HUC2	17b
Emergence Date	4/15
Harvest Date	8/15

Wettest Month Rankings for HUC2

Rank	Month
1st	Dec
2nd	Nov
3rd	Jan
4th	Feb
5th	Mar
6th	Oct
7th	Apr
8th	May
9th	Sep
10th	Jun
11th	Aug
12th	Jul

User Options
Conservatism Prioritization — **Use Random Dates?**

Wettest Months [X] — Yes [ ] No [X]

Application Rate [ ] — Random Seed = [ ]

- First valid date (series start date) is 4/15 (first date within the post-emergence interval)
- Remaining dates are forward assigned based on the MRI for the use
- The max. annual number of apps and max. annual amount are reached after the 5th application
- Last application rate is reduced to 1 lb/acre to ensure annual max. amount is not exceeded

App	Date	Rate (lbs/acre)
1	4/15	2
2	4/25	2
3	5/05	2
4	5/15	2
5	5/25	1

Jan Feb Mar Apr (E) May Jun Jul Aug (H) Sep Oct Nov Dec

Pre-Emergence | Post-Emergence | Pre-Emergence

Input Tables

Ag Practices Table (APT)	Label instructions for each use and application method
Drift Profile Values	Drift fraction values dependent on application method, waterbody scenario (bin), and distance from waterbody
Chemical Fate Parameters	Fate and transport parameters for the active ingredient
Landscape Parameters	Landscape parameters for each waterbody scenario (bin)

Implementation and Distribution
- Written in Python
  - Extensively used and cross-platform programming language
  - Readable code facilitates collaboration and long-term maintenance
- Open Source
  - Available via GitHub[2]
  - Released under GNU General Public License v3.0 (GPLv3)[3]

Planned Enhancements
- Allow probabilistic application parameters for Monte Carlo analysis
- Incorporate precision application dates to avoid modeling applications on days with rain if disallowed by label

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PWC - Pesticide in Water Calculator
GUI - Graphical User Interface
HUC - Hydraulic Unit Code
QC - Quality Check

APT - Agronomic Practices Table
MRI - Minimum Reapplication Interval
PHI - Pre-Harvest interval

References
[1] https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment#PWC
[2] https://github.com/GESTF-ESA/PWC-AppDate-Tool
[3] https://www.gnu.org/licenses/gpl-3.0.en.html

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