



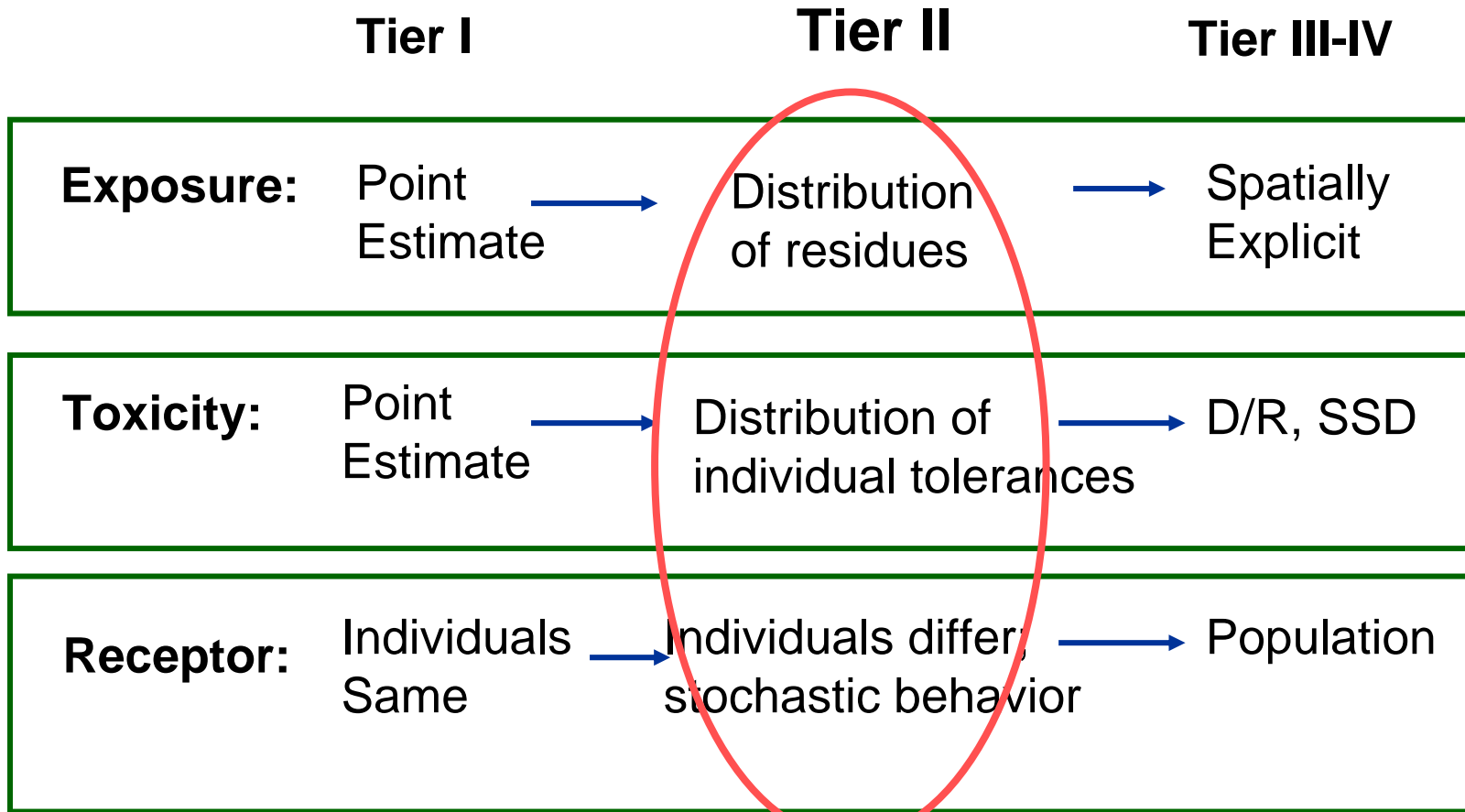
The EPA's Avian Probabilistic Model; Terrestrial Investigation Model (TIM)

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Exposure Modeling Public Meeting
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ERA Framework



Data: Less → More
ERA: Generic → Site Specific
Pop.: Ecological Context → Prediction



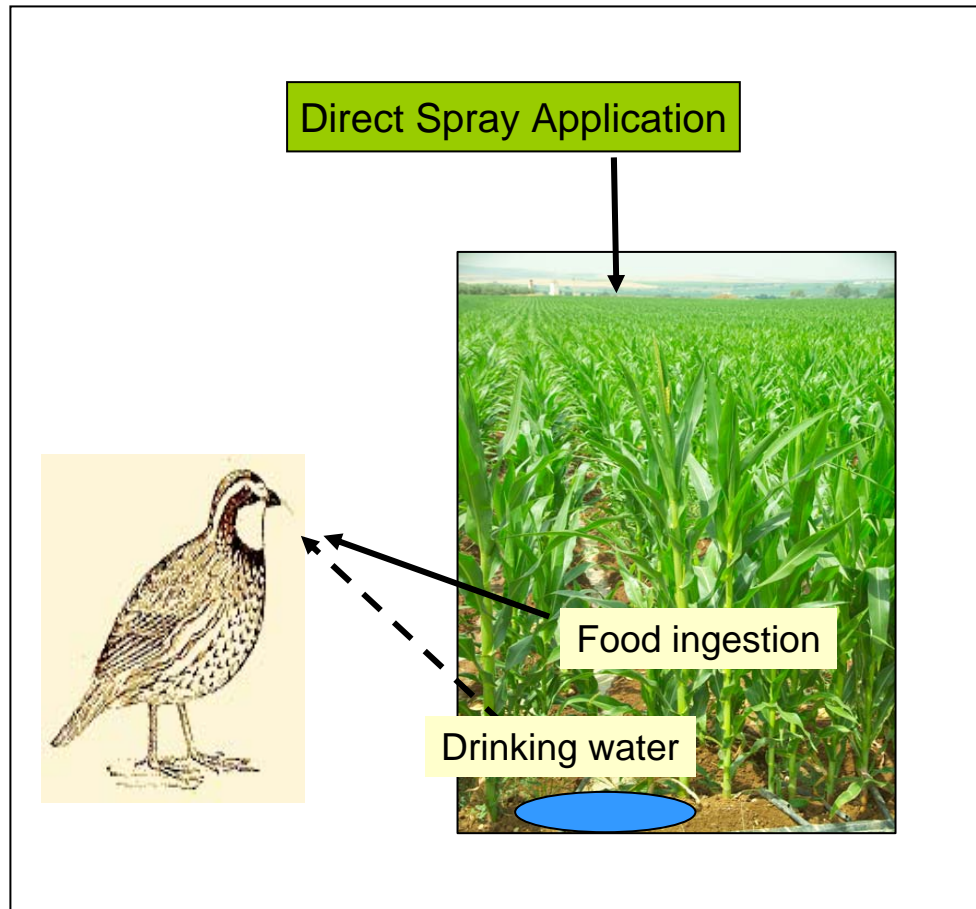
Exposures Estimates in Screening-Level ERA for Terrestrial Receptors

- Discussed previously (T-Rex)
- Incorporates a number of assumptions:
 - 100% of diet is treated with upper-bound residues
 - 100% of diet is obtained from treated field
 - Receptors spend 100% of time on treated field
 - Exposure estimates based on size and food categories
 - Currently*, exposure occurs via DIET only



Screening-Level Exposure Estimation

Modeled Exposure Routes





Terrestrial Investigation Model (TIM)

- Probabilistic modeling construct
 - Address variability and uncertainty
 - Add elements of realism to exposure estimates
- Represents a Tier II Method for estimating risks to Avian Species

- Produces estimate of the probability and magnitude of effects to birds



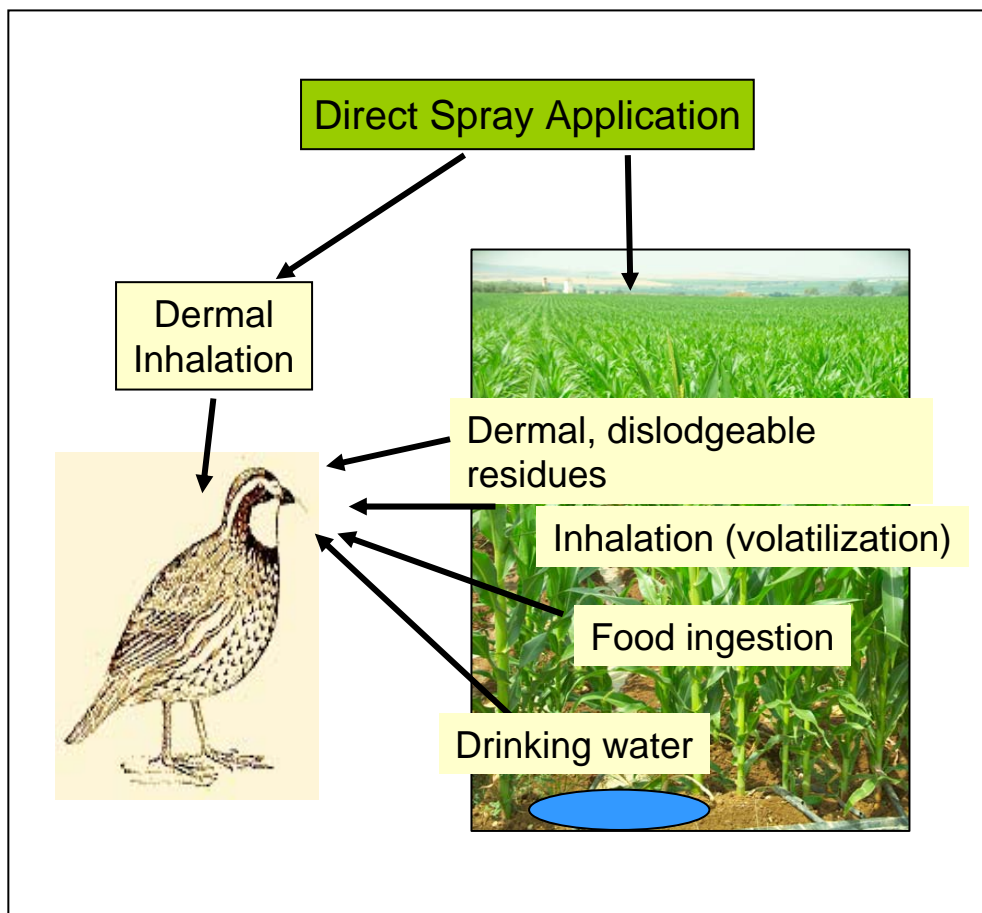
Tier II TIM Model: Some Features

- Pesticide residues vary on food items
- At a given time, a bird may or may not be on the treated field
- Body weight varies
- Diet can be mixed (insects, seeds, forage, etc.)
- Exposure estimates for:
 - Dietary
 - Drinking water
 - Dermal
 - Inhalation



TIM Exposure Estimation

Modeled Exposure Routes

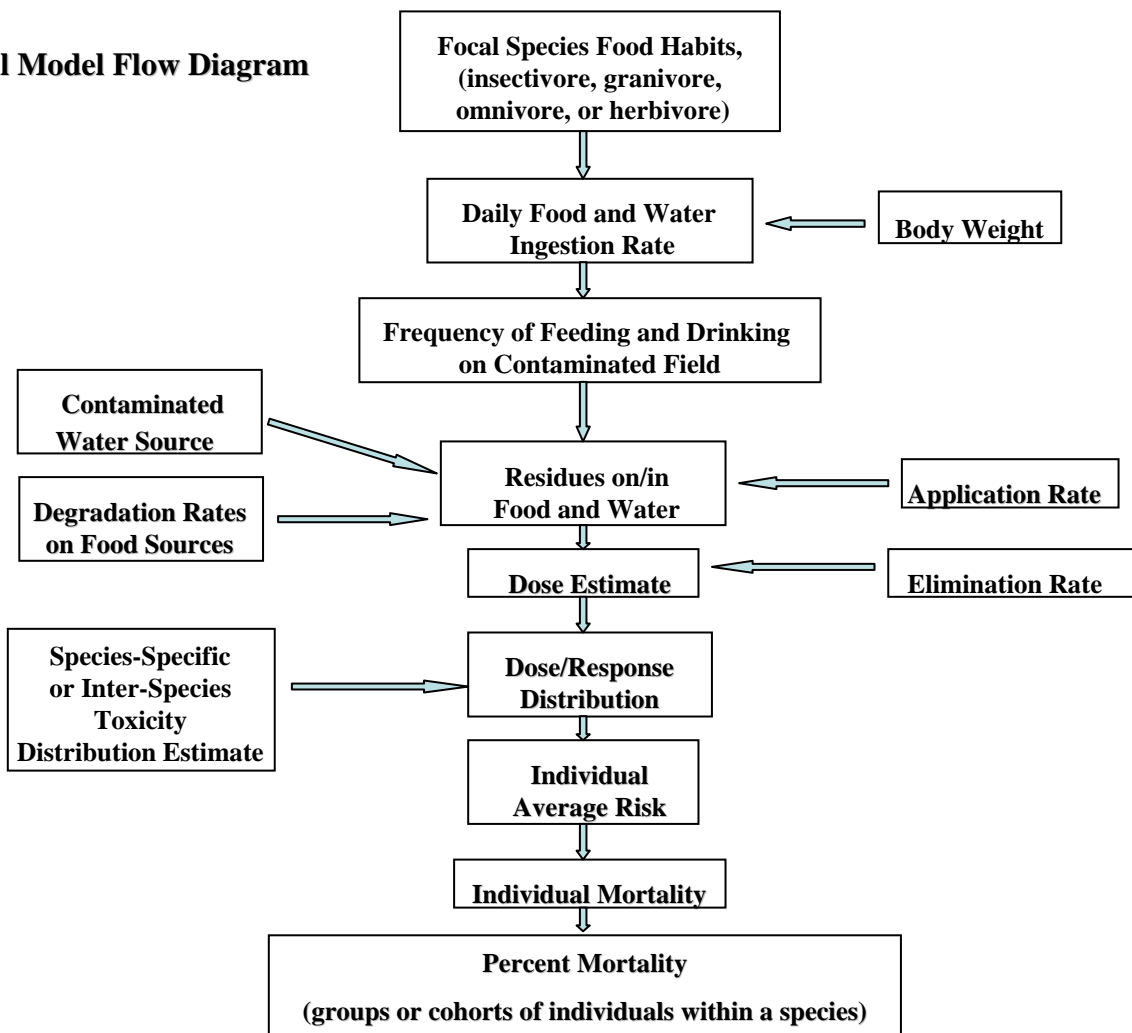


- TIM can estimate exposure via multiple routes
- Selectable
- Each component varies



TIM Flow Chart

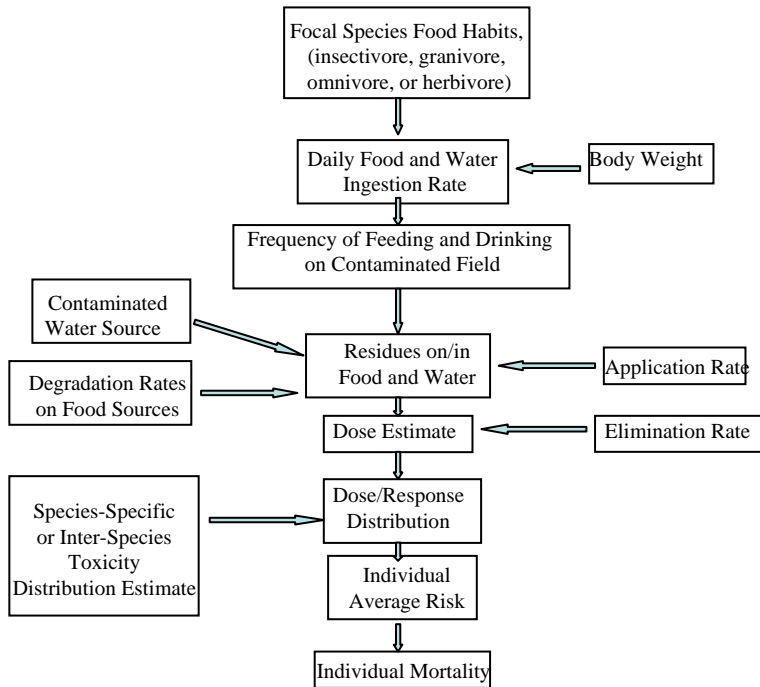
Conceptual Model Flow Diagram



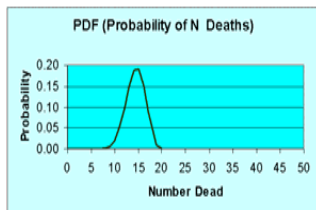


TIM Basic Construct

Conceptual Model Flow Diagram



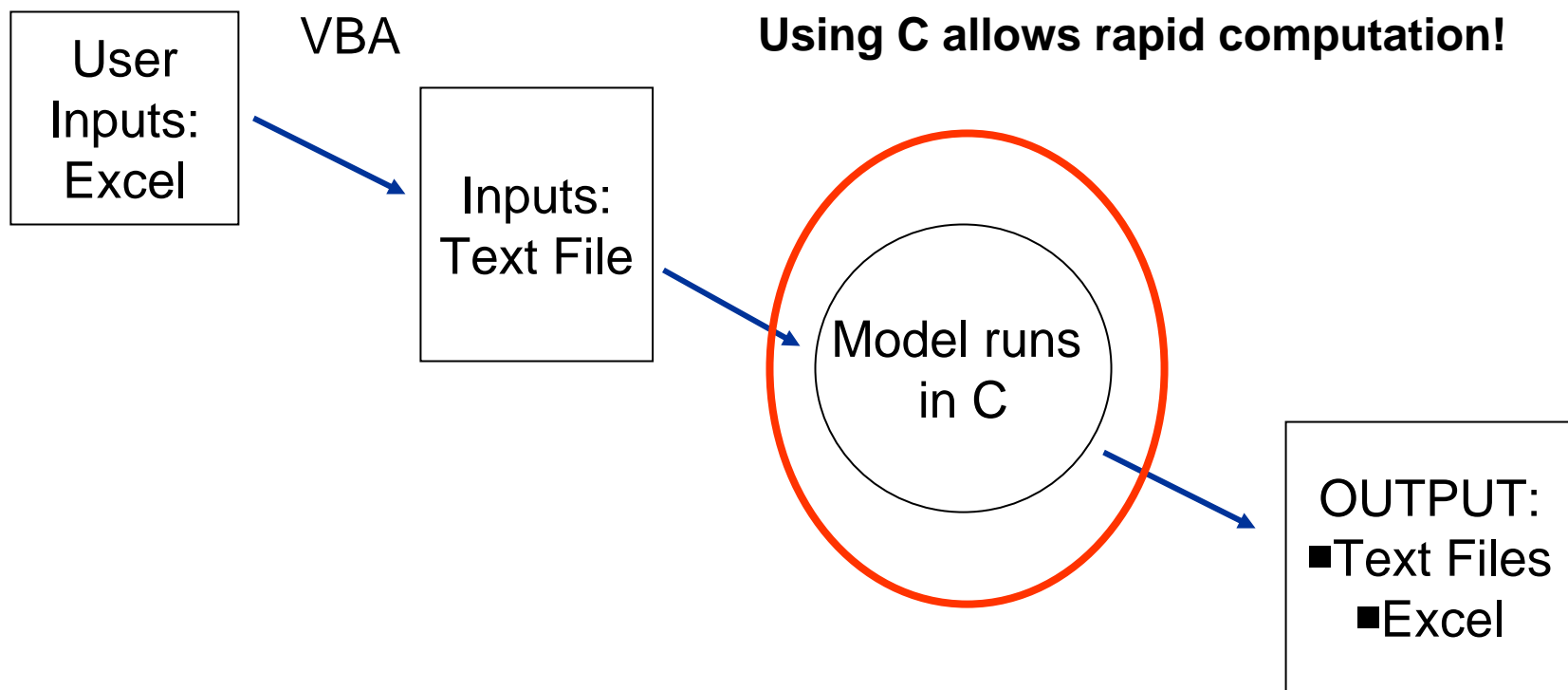
- Run for each bird
- Each hour
- Each day (of sim duration)
- 10,000 Birds*



Percent Mortality
(groups or cohorts of individuals within a species)



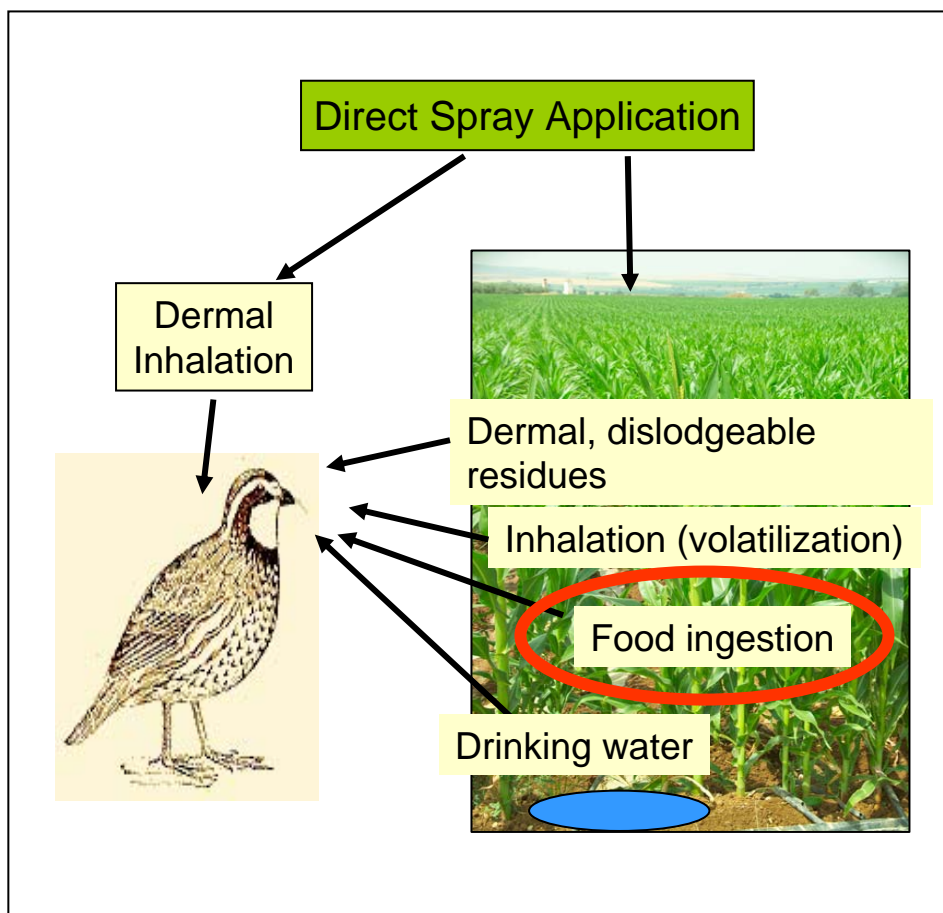
TIM Model: Collection of Linked Programs and Files





More Detailed Look at Food Ingestion Pathway

Modeled Exposure Routes

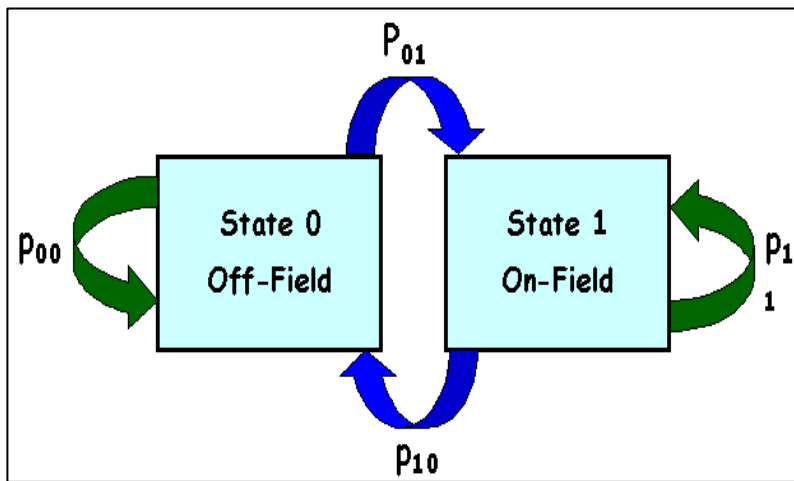


- Food ingestion based on energy requirements
- More accurate estimate of food intake
- Food item residues vary
- Time on field varies
- On/off field at time step



Is the Bird on the Field at Given Time Step?

On-Field Probability

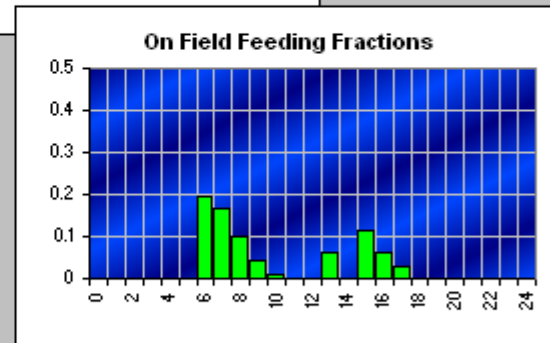
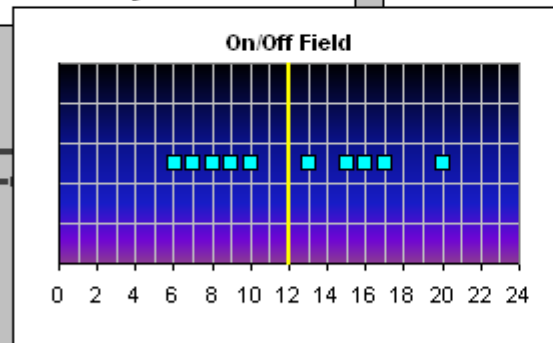
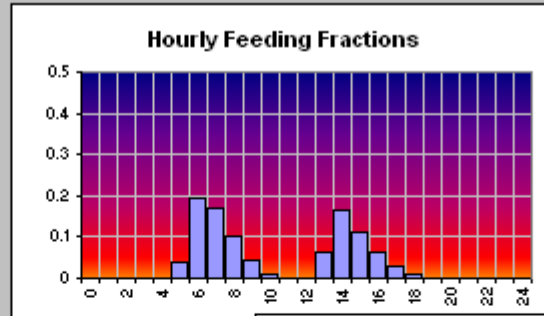
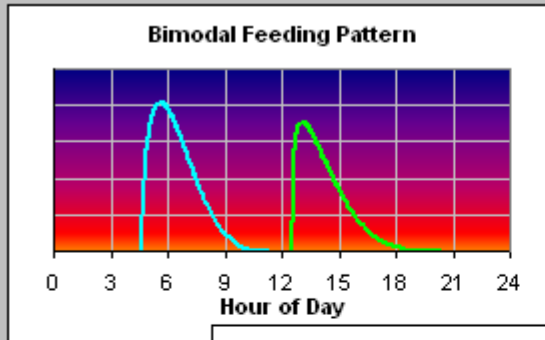


- Time on field varies
- Two state Markov Chain
- Frequency on field from Census data
- Bimodal Feeding pattern



Simulated Time on Field

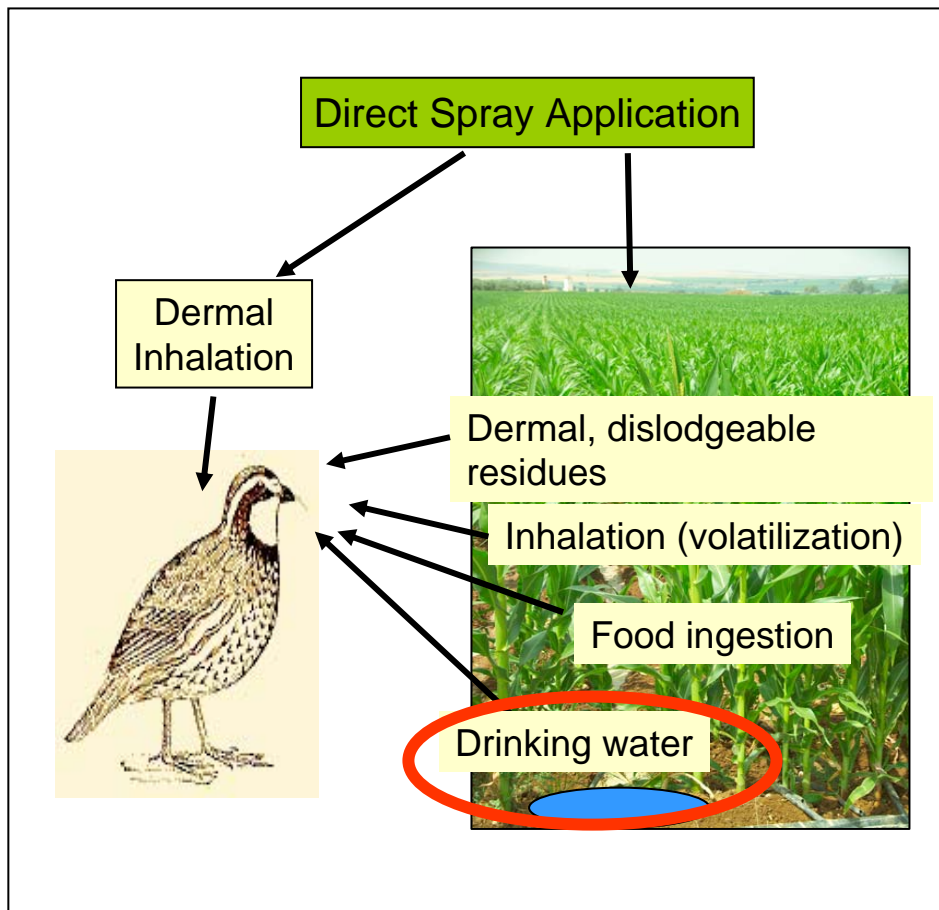
INSTRUCTIONS: Press F9 to cycle through different random realizations for a given set of inputs





More Detailed Look at Drinking Water Exposure

Modeled Exposure Routes

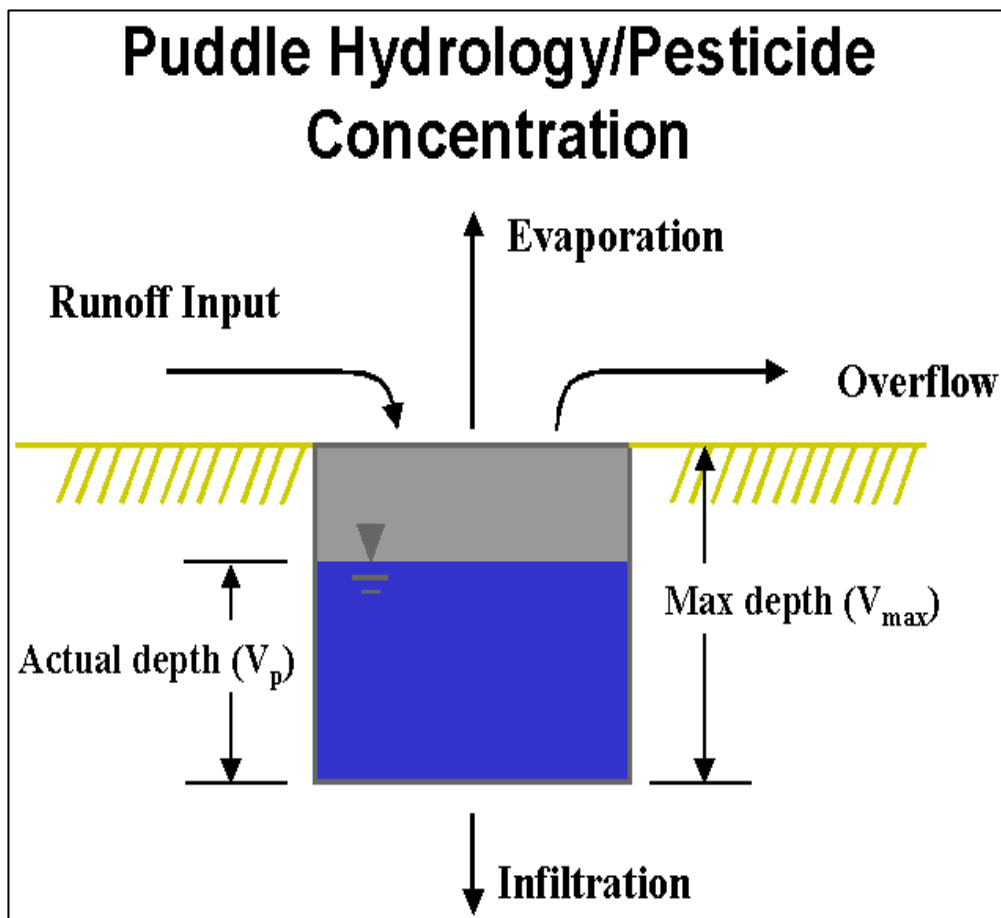


- Exposure via dew
- Exposure via puddles
 - Pre- or post- rain
- Water requirements based on allometric equation
- Water content of food items “counts”



TIM Puddle Model Accounts for Loss

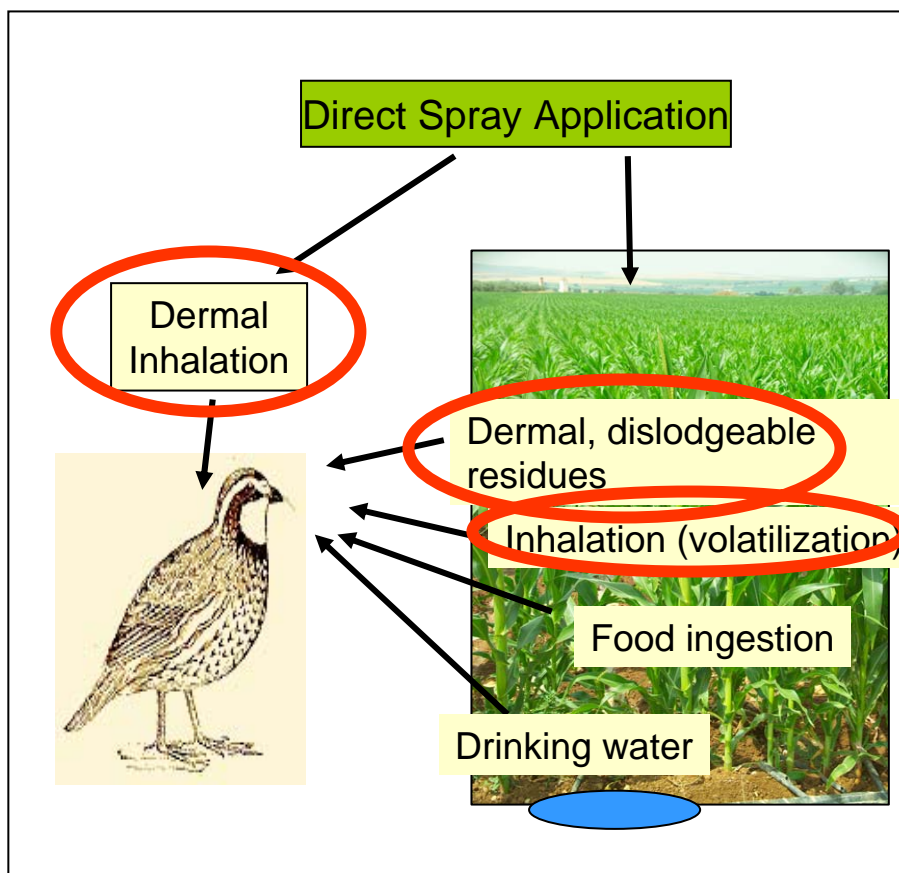
Varying Volume Puddle Model





Other Modeled Exposure Routes

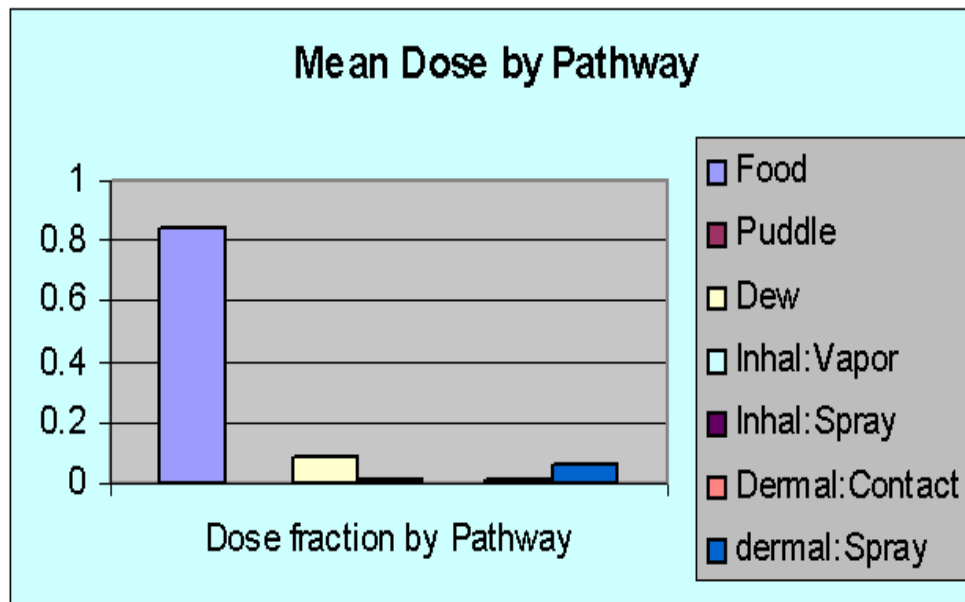
Modeled Exposure Routes



- Inhalation
 - Direct Spray
 - Vapor phase
 - Allometric respiration rate
- Dermal
 - Direct deposition
 - Incidental contact
 - Contact rate, transfer coefficient

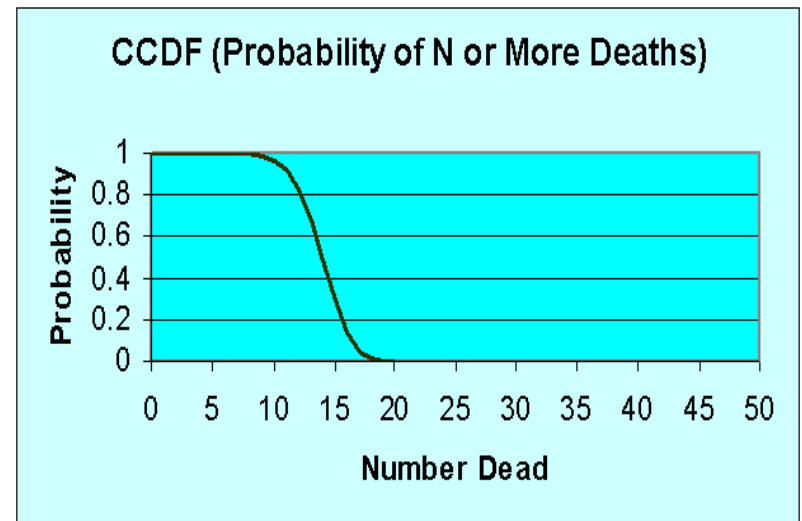
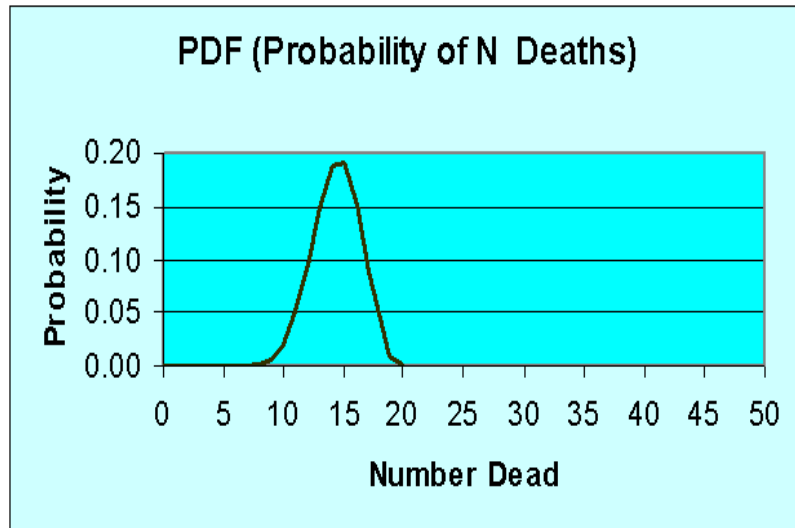


Results: Exposure by Pathway



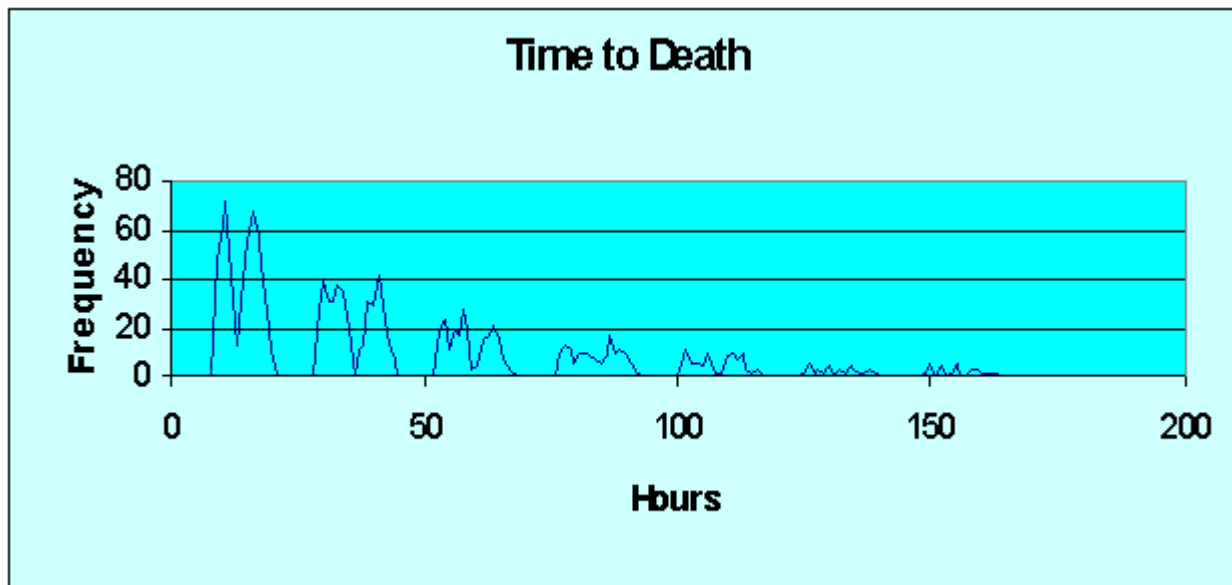


Results: Probability of Mortality





Results: Time of Mortality





TIM Summary

- More “realistic” estimates of exposure because:
 - Variability is incorporated
 - Time on field
 - Body weight
 - Residue levels
 - Can be used to quantify impact of uncertainty
 - Multiple exposure routes *can* be considered
 - Still many uncertainties
- TIM 2.1 is currently undergoing QA/QC
- Future efforts may include simplifying puddle model



More Information

- http://www.epa.gov/scipoly/sap/meetings/2001/031301_mtg.htm
- http://www.epa.gov/scipoly/sap/meetings/2004/033004_mtg.htm

Questions?