Environmental Policy Integrated Climate

EPIC

EPIC

A Crop and Soil Productivity Simulation Model

Environmental Policy Integrated Climate (EPIC) model is a cropping systems model that was developed to estimate soil productivity as affected by erosion as part of the Soil and Water Resources Conservation Act analysis for 1985. EPIC simulates approximately eighty crops with one crop growth model using unique parameter values for each crop. It predicts effects of management decisions on soil, water, nutrient and pesticide movements, and their combined impact on soil loss, water quality, and crop yields for areas with homogeneous soils and management.

Capabilities

EPIC functions on a daily time step and can simulate hundreds of years. Since the initial development, EPIC has been continually improving through the additions of algorithms to simulate water quality, nutrient cycling, climate change, and the effects of atmospheric carbon dioxide. It can be configured for a wide range of crop rotations and other vegetative systems, tillage systems, and other management practices. The model can also assess the cost of erosion for determining optimal management strategies.

EPIC Components

Weather Simulation Inputs

- precipitation, air temperature, solar radiation, relative humidity, and wind speed

Hydrology

- determines surface runoff and subsurface flow volumes, peak runoff rates, and water table dynamics

Erosion

- calculates erosion caused by rainfall, runoff, and irrigation as well as wind/dust distribution from feedlots

Nutrient Cycling

- estimates nitrogen and phosphorous loss in runoff; nitrogen leaching; organic nitrogen and phosphorous transport by sediment; nitrogen and phosphorous mineralization, immobilization, and uptake; denitrification; mineral phosphorous cycling; nitrogen fixation; pesticide fate and transport

Soil Inputs

- soil strength, texture, bulk density, conductivity, pH, carbon, and water content by layer

Waste Management

- estimates manure erosion from feedlots, grazing fields, and dairies with or without lagoons

Plant Growth

- simulates crop interception of solar radiation; conversion of intercepted light to biomass; division of biomass into roots, above-ground biomass, and economic yield; root growth; water use; and nutrient uptake
- estimates the severity of stresses caused by water, nutrients, temperature, aeration, and radiation

Plant Environment Control

- simulates a drainage system
- provides mechanisms for applying irrigation, fertilizer, furrow diking, lime, and pesticides

Tillage

- measures the change in bulk density, ridge height, and surface roughness
- converts standing residue to flat residue

Economic Budgets

- compares net returns and/or other economic indicators versus erosion, nutrient loss, or other environmental indicators predicted by EPIC in response to alternative cropping systems, management practices, and other scenarios

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Various EPIC Applications:

Examples of EPIC applications include assessments of:

- relative comparisons between different erosion class soils
- erosion losses and erosion impacts on crop productivity
- effects of different nutrient treatments
- surface runoff and leaching of nitrogen and phosphorous losses from fertilizer and manure applications
- leaching and runoff from pesticide applications
- soil erosion losses from wind erosion
- climate change and drought impacts on crop yield and soil erosion
- development of agricultural management practices that are effective at sequestering soil carbon
- sediment and nutrient losses as a function of different tillage systems, crop rotations, and fertilizer rates
- impacts of different irrigation amounts and timings
- economic-environmental analyses in response to alternative cropping systems, management practices, and other scenarios
- nutrient and pesticide movement estimates for alternative farming systems for water quality analysis

EPIC Interfaces:

Several interfaces and other tools have been developed to support EPIC applications since the first versions of the model were released:

Crop Production and Management Model (CroPMan)

- Simulates fertilization of nitrogen and phosphorous (mineral, manure); planting date; crop maturity; crop type and rotation sequence; cover crop and double cropping systems; irrigation (sprinkler, furrow, flood, buried, and surface drip); plant population; row spacing; tillage/residue management; and pesticide economics and fate. Includes a comprehensive economic analyses with share cropping and government payments.

Windows Interface EPIC (WinEpic)

- Designed to be a research-oriented and comprehensive simulation model for analyses of cultural practices and cropping systems on production, soil quality, water and wind erosion, and profits as well as focus on research applications in which multiple runs need to be made efficiently.

Interactive EPIC (i_Epic)

- Used to support large EPIC simulation sets that will facilitate analysis of variations in management, cropping systems, and climate conditions for major agricultural production regions across the globe.

Ground Water Loading Effects of Agricultural Management Systems (GLEAMS)

- Application for pesticide, water, sediment, and plant nutrient losses and movement.

EPIC - Water Table (EPIC-WT)

- Provides a tile drainage component that simulates the effects of subsurface drainage systems on surface and subsurface drained volumes and the fluctuations of field water table depth.

Spatial Epic

- Links geographical information systems (GIS) input for large regional studies and includes an adaptation loop to temporarily evaluate management practices.

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