**Table S1**. Spatial and temporal input datasets used in the study.

| Data Type | Description |
|---|---|
| Digital Elevation Model (DEM) | Source: USGS National Map (https://apps.nationalmap.gov/viewer/) Resolution: 10 m |
| Land Use/Land Cover | Source: National Land Cover Database (NLCD) (https://www.mrlc.gov/data) Resolution: 10 m |
| Soil | Source: NRCS Web Soil Survey (https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx) Resolution: 10 m |
| Crop Information | Source: USDA NASS Resolution: 30 m |
| Climate | Source: gridMet (http://www.climatologylab.org/gridmet.html) Resolution: Daily |
| Flow Discharge | Source: USGS, Station 0557200 (https://waterdata.usgs.gov/nwis) Resolution: Daily |
| Riverine Nitrate | Source: Illinois State Water Survey Resolution: Daily |
| Crop Yield | Source: USDA NASS Resolution: Annual |

**Table S2**. Final calibrated SWAT+ parameters for hydrology, nutrient dynamics, and crop yield.

| Parameters | Description | Change Type | Value |
|---|---|---|---|
| **Hydrology** | | | |
| cn2 | Partitions precipitation to surface flow and subsurface infiltration | pctchg[1] | 1.275 |
| cn3_swf | Pothole evaporation coefficient | pctchg | -10.638 |
| esco | Soil evaporation compensation factor | absval | 0.021 |
| epco | Plant uptake compensation factor | absval | 0.313 |
| ovn | Manning's "n" value for overland flow | pctchg | 2.150 |
| awc | Available water capacity of the soil layer (mm H2O/mm soil) | pctchg | 4.954 |
| bd | Moist bulk density (Mg/m3 or g/cm3) | pctchg | -15.338 |
| z | Depth from soil surface to bottom of layer (mm) | pctchg | 31.720 |
| k | Saturated hydraulic conductivity (mm/hr) | pctchg | 45.154 |
| latq_co | Lateral flow coefficient | absval[2] | 0.815 |
| lat_ttime | Lateral flow travel time (days) | absval | 5.456 |
| perco | Percolation coefficient - adjusts soil moisture for percolation to occur | absval | 0.899 |
| biomix | Biological mixing efficiency | absval | 0.897 |
| canmx | Maximum canopy storage (mm H2O) | absval | 0.110 |
| snofall_tmp | Temperature at which precipitation converts to snow | absval | 1.849 |
| snomelt_tmp | Temperature required for snowmelt | absval | 2.172 |
| tile_latk | Multiplication factor to determine lateral Ksat from SWAT Ksat input value | absval | 3.143 |

| | | | |
|---|---|---|---|
| tile_lag | Drain tile lag time | absval | 20.369 |
| alpha | Baseflow alpha factor (1/days) | absval | 0.737 |
| revap_min | Threshold depth of water in the shallow aquifer for revap or percolation to the deep aquifer to occur | absval | 42.384 |
| surlag | Surface runoff lag coefficient | absval | 7.205 |
| **$NO_3$-N & Crop Yield** | | | |
| cmn | Rate factor for humus mineralization of active organic nutrients (N and P) | absval | 0.0026 |
| cdn | Denitrification exponential rate coefficient | absval | 0.965 |
| sdnco | Denitrification threshold water content | absval | 0.781 |
| nperco | Nitrate percolation coeficient | absval | 0.996 |
| n_updis* | Nitrogen uptake distribution parameter | absval | 48.398 |
| harv_idx* | Potential harvest index for the plant at maturity under ideal growing condition | absval | 0.50 (corn), 0.32 (soyb) |
| lai_pot* | Maximum potential leaf area index | absval | 5.5 (corn), 5.0 (soyb) |

[1] pctchg = percentage change; [2] absval = absolute value.

**Table S3**. Model simulated hydrologic components for calibration period 1994-2000 and validation period 2001-2007.

| Components | Calibration (1994-2000) | Validation (2001-2007) |
|---|---|---|
| Precipitation (mm) | 1007.72 | 1046.09 |
| Snowfall (mm) | 98.72 | 91.94 |
| Actual ET (mm) | 654.57 | 674.77 |
| Water Yield (mm) | 190.60 | 211.82 |
| Surface Runoff (mm) | 9.03 | 12.86 |
| Lateral Flow (mm) | 1.06 | 1.06 |
| Tile Flow (mm) | 180.51 | 197.90 |