# **Table S 1.** Details of in-situ measured data of crop field sites.

|  |  |
| --- | --- |
| **Site Name** | **Availability of in-situ data** |
| **Ames** | Initial soil water and nitrate condition, Soil profile, Weather data, measured soil physical and hydraulic properties, Residue amount, Tillage information, Seeding rate and plant density, Planting date, Fertilizer rate, Phenology dates, LAI, Soil water content, eta, Biomass, and Grain yield. |
| **Bushland** | Initial soil water and nitrate condition, Soil profile, Weather data, measured soil physical and hydraulic properties, Residue amount, Tillage information, Seeding rate and plant density, Planting date, Fertilizer rate, Phenology dates, LAI, Soil water content, ETa, Irrigation amount with the scheduled date, Biomass, and Grain yield. |
| **Ithaca** | Calibrated initial soil water content, Soil profile, Weather data, Tillage date, Planting and harvesting date, Irrigation amount with the scheduled date, Planting density, fertilizer rate, Top surface soil moisture content, Biomass, and Grain yield. |
| **Glenlea** | Weather data, Soil profile, Tillage date, Planting and harvesting date, Soil water content, Planting density, Fertilizer rate, Biomass, and Grain yield. |
| **Greeley** | Actual initial soil water condition, Soil profile, Weather data, Measured soil physical and hydraulic properties, Residue amount, Tillage information, Seeding rate and plant density, Planting and harvesting date, Fertilizer rate, Phenology dates, LAI, Soil water content, ETa, Irrigation amount, Biomass and Grain yield. |
| **Gilmore** | Weather data, Soil profile, Tillage date, Planting and harvesting date, Soil water content, Planting density, Fertilizer rate, Soil water content, Biomass and grain yield. |
| **Harrow** | Soil profile, Tillage date, Planting and harvesting date, Planting density, Fertilizer rate, Biomass, and grain yield. |
| **Mead** | Initial soil water and nitrate condition, Soil profile, Weather data, Measured soil physical and hydraulic properties, Residue amount, Tillage information, Seeding rate and plant density, Planting and harvesting date, Fertilizer rate, Phenology dates, LAI, Irrigation amount with scheduled date, Soil water content, ETa, Biomass, and Grain yield. |
| **Ottawa** | Initial soil water and nitrate condition, Soil profile, Weather data, measured soil physical and hydraulic properties, Residue amount, Tillage information, Seeding rate and plant density, Planting date, Fertilizer rate, Phenology dates, LAI, Soil water content, ETa, Biomass, and Grain yield. |
| **St. Emmanuel** | Weather data, Soil profile, measured soil physical and hydraulic properties, Residue amount, Tillage information, Seeding rate, plant density, Planting and harvesting date, Fertilizer rate, Phenology dates, LAI, Soil water content, Biomass, and Grain yield. |
| **Ste.-Anne-de- Bellevue** | Soil profile, Tillage date, Planting and harvesting date, Planting density, Fertilizer rate, Biomass and Grain yield. |

**Table S 2.** A description of Maize Models of Group A sites and their abbreviations.

|  |  |  |
| --- | --- | --- |
| Model | Acronym | References |
| **All Maize Models** | | |
| DSSAT-CERES-Maize FAO- PM | DCFR | Jones and Kiniry, 1986; Ritchie, 1972; Allen et al., 1998 |
| DSSAT-CERES-Maize -  Priestley-Taylor | DCPR | Jones and Kiniry, 1986; Ritchie, 1972; Priestly and Taylor, 1972. |
| APSIM-Maize SOILWAT | ASW | Probert et al., 1998; Keating et al., 2003; Priestly and Taylor, 1972 |
| APSIM-Maize SWIM | AMSA | Holzwoth et al., 2014;  Campbell, 1985; Priestly and Taylor, 1972. |
| Root Zone Water Quality Model-2 | RZWQM-2 | Ahuja et al., 2000; Farahani and DeCoursey, 2000; Shuttleworth and Wallace, 1985; Ma et al.,2012 |
| **Group Maize Models** | | |
| DSSAT-CERES-Maize -  Priestley-Taylor | DCPR | Jones and Kiniry, 1986; Ritchie, 1972; Priestly and Taylor, 1972. |
| APSIM-Maize SWIM | AMSA | Holzwoth et al., 2014;  Campbell, 1985; Priestly and Taylor, 1972. |
| Root Zone Water Quality Model-2 | RZWQM-2 | Ahuja et al., 2000; Farahani and DeCoursey, 2000; Shuttleworth and Wallace, 1985; Ma et al.,2012 |

**Table S 3.** List of Maize Models of Group B sites and their abbreviations (Source Kimball et al., 2023)

|  |  |  |
| --- | --- | --- |
| **Acronym** | **Model Name** | **Reference** |
| All Maize Models | | |
| AHC | Agro-Hydrological & chemical & Crop sys. simulator | Xu et al., 2018 |
| AMSW | APSIM-SOILWAT | Keating et al., 2003 |
| AQCP | AquaCrop | Allen et al., 1998 |
| AQY | Aqyield | Constantin et al., 2015 |
| ARMO | ARMOSA | Perego et al., 2013 |
| BIOM | Biome-BGCMuSo 6.0.2 | Hidy et al., 2016 |
| CS | CropSyst4 | Stöckle et al., 2003 |
| DACT | DayCent-CABBI | Moore et al., 2020 |
| DCAR | DSSAT CSM-CERES-Maize ASCE-Alfalfa | Ritchie |
| DCAS | DSSAT CSM-CERES-Maize ASCE-Alfalfa Suleiman | DeJonge and Thorp, 2017 |
| DCFH | DSSAT CSM-CERES-Maize FAO-56 Hydrus | Shelia et al.,2018 |
| DCFR | DSSAT CSM-CERES Maize FAO-56 Ritchie | Sau et al., 2004 |
| DCFS | DSSAT CSM-CERES-Maize FAO-56 Suleiman | Sau et al., 2004 |
| DCGR | DSSAT CSM-CERES-Maize ASCE-Grass Ritchie | Ritchie |
| DCGS | DSSAT CSM-CERES-Maize ASCE-Grass Suleiman | DeJonge and Thorp, 2017 |
| DCPH | DSSAT CSM-CERES-Maize Priestley-Taylor Hydrus | Shelia et al.,2018 |
| DCPR | DSSAT CSM-CERES-Maize Priestley-Taylor Ritchie | Sau et al., 2004 |
| DCPS | DSSAT CSM-CERES-Maize Priestley-Taylor Suleiman | Sau et al., 2004 |
| DIAR | DSSAT CSM-IXIM-Maize ASCE-Alfalfa Ritchie | DeJonge and Thorp, 2017 |
| DIAS | DSSAT CSM-IXIM-Maize ASCE-Alfalfa Suleiman | DeJonge and Thorp, 2017 |
| DIFR | DSSAT CSM-IXIM-Maize FAO-56 Ritchie | Sau et al., 2004 |
| DIFS | DSSAT CSM-IXIM-Maize FAO-56 Suleiman | Sau et al., 2004 |
| DIGR | DSSAT CSM-IXIM-Maize ASCE-Grass Ritchie | DeJonge and Thorp, 2017 |
| DIGS | DSSAT CSM-IXIM-Maize ASCE-Grass Suleiman | DeJonge and Thorp, 2017 |
| DIPR | DSSAT CSM-IXIM-Maize Priestley-Taylor Ritchie | Sau et al., 2004 |
| DIPS | DSSAT CSM-IXIM-Maize Priestley-Taylor Suleiman | Sau et al., 2004 |
| ECOS | ecosys | Grant and Flanagan, 2007 |
| JUL | JULES | Best et al., 2011 |
| L5SH | L5-SLIM-H | Wolf, 2012 |
| MZD | MAIZSIM Daily | Yang et al., 2009 |
| MZH | MAIZSIM Hourly | Yang et al., 2009 |
| SLUS | SALUS | Basso and Ritchie, 2015 |
| SLFT | SIMPLACE LINTUL5 FAO56 SLIM3 CanopyT | Wolf, 2012 |
| SMET | SIMETAW# | Mancosu et al., 2016 |
| SSMi | SSM-iCROP | Soltani and Sinclair, 2012 |
| STCK | STICS\_KETP | Brisson et al., 2003 |
| STSW | STICS\_ETP\_SW | Brisson et al., 2003 |
| SWB | SWB | Annandale et al., 1999 |
| TMOD | Test Model | - |
| XNGM | Expert-N - GECROS | Priesack et al., 2006 |
| XNSM | Expert-N - SPASS | Priesack et al., 2006 |
| **Group Maize Models** | | |
| AHC | Agro-Hydrological & chemical & Crop sys. simulator | Xu et al., 2018 |
| AMSW | APSIM-SOILWAT | Keating et al., 2003 |
| AQCP | AquaCrop | Allen et al., 1998 |
| AQY | Aqyield | Constantin et al., 2015 |
| ARMO | ARMOSA | Perego et al., 2013 |
| BIOM | Biome-BGCMuSo 6.0.2 | Hidy et al., 2016 |
| CS | CropSyst4 | Stöckle et al., 2003 |
| DACT | DayCent-CABBI | Moore et al., 2020 |
| DCGR | DSSAT CSM-CERES-Maize ASCE-Grass Ritchie | Ritchie |
| DCPS | DSSAT CSM-CERES-Maize Priestley-Taylor Suleiman | Sau et al., 2004 |
| ECOS | ecosys | Grant and Flanagan, 2007 |
| JUL | JULES | Best et al., 2011 |
| L5SH | L5-SLIM-H | Wolf, 2012 |
| MZD | MAIZSIM Daily | Yang et al., 2009 |
| SLUS | SALUS | Basso and Ritchie, 2015 |
| SLFT | SIMPLACE LINTUL5 FAO56 SLIM3 CanopyT | Wolf, 2012 |
| SMET | SIMETAW# | Mancosu et al., 2016 |
| SSMi | SSM-iCROP | Soltani and Sinclair, 2012 |
| STCK | STICS\_KETP | Brisson et al., 2003 |
| SWB | SWB | Annandale et al., 1999 |
| TMOD | Test Model | - |
| XNGM | Expert-N - GECROS | Priesack et al., 2006 |

**Table S 4.** Basic characteristics of the five multi-model averaging techniques used in this study.

|  |  |  |  |
| --- | --- | --- | --- |
| **Multimodal**  **Averaging Approach** | **Acronym** | **Method Description** | **Sources** |
| Simple Model Averaging | SMA | Equal weights averaging | Shamseldin et al. (1997) |
| Median |  |  | Armstrong (1989) |
| Inverse Rank | IR | Inverse Rank Approach | Aiolfi and Timmermann (2006) |
| Bates and Granger Averaging | BGA | Minimizing the Root Mean Square Error | Bates and Granger (1969) |
| Granger  Ramanathan A | GRA | Based on ordinary least  squares (OLS) algorithm | Granger and Ramanathan (1984) |
| Granger  Ramanathan B | GRB | Weights based on ordinary least squares (OLS) algorithm and sum constrained to unity | Granger and Ramanathan (1984) |
| Granger  Ramanathan C | GRC | Based on ordinary least  squares (OLS) algorithm  and bias-corrected the  results | Granger and Ramanathan (1984) |

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