



HAL
open science

Prediction of Evapotranspiration and Yields of Maize: An Inter-comparison among 29 Maize Models

Bruce A. Kimball, Kenneth J. Boote, Jerry L. Hatfield, Laj R. Ahuja, Claudio O. Stöckle, Sotiris V. Archontoulis, Christian Baron, Bruno Basso, Patrick Bertuzzi, Julie Constantin, et al.

► **To cite this version:**

Bruce A. Kimball, Kenneth J. Boote, Jerry L. Hatfield, Laj R. Ahuja, Claudio O. Stöckle, et al.. Prediction of Evapotranspiration and Yields of Maize: An Inter-comparison among 29 Maize Models. ASA, CSSA and SSSA International Annual Meetings (2016), Nov 2016, Phoenix, États-Unis. 3p. hal-01608915

HAL Id: hal-01608915

<https://hal.science/hal-01608915>

Submitted on 3 Jun 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Prediction of Evapotranspiration and Yields of Maize: An Inter-comparison among 29 Maize Models

By

Bruce A. Kimball¹, Kenneth J. Boote², Jerry L. Hatfield³, Laj R. Ahuja⁴, Claudio Stockle⁵, Sotirios Archontoulis⁶, Christian Baron⁷, Bruno Basso⁸, Patrick Bertuzzi⁹, Ming Chen¹⁰, Julie Constantin¹¹, Delphine Deryng¹², Benjamin Dumont¹³, Jean-Louis Durand¹⁴, Frank Ewert^{15,16}, Thomas Gaiser¹⁶, Sebastian Gayler¹⁷, Timothy Griffis¹⁰, Munir Hoffman¹⁸, Qianjing Jiang¹⁹, Soo-Hyung Kim²⁰, Jon Lizaso²¹, Sophie Moulin⁹, Claas Nendel¹⁴, Philip Parker¹⁴, Taru Palosuo²², Eckart Priesack²³, Zhiming Qi¹⁹, Amit Srivastava¹⁶, Fulu Tao^{22,24}, Kelly Thorp¹, Dennis Timlin²⁵, Tracy E. Twine¹⁰, Heidi Webber¹⁶, Magali Willaume¹¹, Karina Williams²⁶

¹U.S. Arid-Land Agricultural Research Center, USDA-ARS, Maricopa, AZ 85138
(bruce.kimball@ars.usda.gov; kelly.thorp@ars.usda.gov; 1-520-316-6369)

²University of Florida, Agronomy Department, Gainesville, FL 32611 (kjboote@ufl.edu; 1-352-273-2215)

³National Laboratory for Agriculture and the Environment, USDA-ARS, Ames, IA 50010-3120
(Jerry.Hatfield@ars.usda.gov; 1-515-294-1829)

⁴Agricultural Systems Research Unit, USDA, Agricultural Research Service, 2150 Centre Avenue, Bldg. D., Suite 200, Ft. Collins, 80526 CO, (laj.ahuja@ars.usda.gov, Phone: (970) 492-7315)

⁵Biological Systems Engineering, Washington State University, 1935 E. Grimes Way, PO Box 646120, Washington State University, Pullman WA 99164-6120 (stockle@wsu.edu; 509-335-1578)

⁶Iowa State University, Department of Agronomy, Ames, Iowa 50010 (sarchont@iastate.edu; 1-515-294-7413)

⁷CIRAD UMR TETIS, Maison de la Télédétection, 500 rue Jean François Breton, Montpellier, 34093, France (christian.baron@cirad.fr; |Tel: 33 (0)4 67 54 87 28)

⁸Michigan State University, Dept. Geological Sciences and W.K. Kellogg Biological Station, 288 Farm Ln, 307 Natural Science Bldg., East Lansing, MI, 48824 (basso@msu.edu; 1-517-353-9009)

⁹INRA centre de recherche Provence-Alpes-Côte d'Azur, 228, route de l'Aérodrome, CS 40 509, Domaine Saint Paul, Site Agroparc, 84914 Avignon Cedex 9, France
(patrick.bertuzzi@paca.inra.fr, Tél. : +33 (0)4 32 72 22 25; sophie.moulin@paca.inra.fr, Tél. : +33 (0)4 32 72 23 76)

¹⁰University of Minnesota, Department of Soil, Water, and Climate, 1991 Upper Buford Cir, Falcon Heights, MN 55108 (tgriffis@umn.edu, Tel: 1-612-625-3117; chen1718@umn.edu; twine@umn.edu, 1-612-625-7278)

Kimball, 2016, Prediction of Evapotranspiration and Yields of Maize: An Inter-comparison among 29 Maize Models, *ASA 2016 International Annual Meeting - American Society of Agronomy*, Phoenix, AZ, USA, 6-9 November 2016.

- ¹¹AGIR, Université de Toulouse, INRA, INPT, INP- EI PURPAN, CastanetTolosan, France (julie.constantin@toulouse.inra.fr; Tel: +33 (0)5 61 28 50 26; magali.willaume@ensat.fr; Tel: +33 (0)5 61 28 54 23).
- ¹²University of Chicago, Computation Institute, 5735 S Ellis Ave Chicago, IL 60637 (deryng@uchicago.edu)
- ¹³ULg-GxABT, University of Liege, Gembloux Agro-Bio Tech Faculty, Dpt. Agronomy, Bio-Engineering and Chemistry, Crop Science Unit, Passage des Déportés, 2, 5030, Gembloux, Belgium (Benjamin.Dumont@ulg.ac.be; Tel : +32(0)81.62
- ¹⁴Unité de Recherche Pluridisciplinaire Prairie et Plantes Fourragères, INRA, 86 600 Lusignan, France (jean-louis.durand@lusignan.inra.fr)
- ¹⁵Leibniz Centre for Agricultural Landscape Research, Eberswalder Straße 84, 15374 Müncheberg, Germany (frank.ewert@uni-bonn.de; Parker@zalf.de Tel: +49-33432-32-471)
- ¹⁶Institute of Crop Science and Resource Conservation, University of Bonn, Katzenburgweg 1 D-53115 Bonn, Germany (tgaiser@uni-bonn.de; amit.srivastava@uni-bonn.de; hwebber@uni-bonn.de; Tel: +49 228 73-2876)
- ¹⁷Universität Hohenheim, Institute of Soil Science and Land Evaluation, Biogeophysics, Emil-Wolff-Str. 27, D-70593 Stuttgart, Germany (sebastian.gayler@uni-hohenheim.de, Tel: +49 (0)711-45922323)
- ¹⁸Crop Production Systems in the Tropics, Georg-August-Universität, Grisebachstraße 6, Göttingen, Germany (mhoffma@gwdg.de; TEL: +49 551/39-33790)
- ¹⁹Department of Bioresource Engineering, Macdonald Campus, McGill University, 1-024 Macdonald-Steward Hall, Sanite-Anne-de-Bellevue, QC, Canada H9X 3V9 (qianjing.jiang@mail.mcgill.ca; zhiming.qi@mcgill.ca; 514-398-7983)
- ²⁰University of Washington, Center for Urban Horticulture, Seattle, WA 98105 (soohkim@uw.edu)
- ²¹Technical University of Madrid (UPM), Dept. Producción Agraria-CEIGRAM, Ciudad Universitaria, 28040 Madrid, Spain (jon.lizaso@upm.es)
- ²²Natural Resources Institute Finland (Luke), Vantaa FIN-01370, Finland (taru.palosuo@luke.fi; fulu.tao@luke.fi)
- ²³Helmholtz Center Munich, Institute of Biochemical Plant Pathology, Ingolstaedter Landstr. 1 85764 Neuherberg, Germany (priesack@helmholtz-muenchen.de, Tel: + 49 89 3187 3354)
- ²⁴Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Science, 11A, Datun Road, Chaoyang District, Beijing, 100101, China (taofl@igsnr.ac.cn)
- ²⁵Crop Systems and Global Change Research Unit, USDA-ARS, Beltsville, MD (Dennis.Timlin@ars.usda.gov; 1-301-504-6255)
- ²⁶Climate Adaptation Scientist Meteorological Office, FitzRoy, Road Exeter Devon EX1 3PB, United Kingdom (karina.williams@metoffice.gov.uk; Tel: +44 (0)1392 884857)

Kimball, 2016, Prediction of Evapotranspiration and Yields of Maize: An Inter-comparison among 29 Maize Models, *ASA 2016 International Annual Meeting - American Society of Agronomy*, Phoenix, AZ, USA, 6-9 November 2016.

ABSTRACT

An important aspect that determines the ability of crop growth models to predict growth and yield is their ability to predict the rate of water consumption or evapotranspiration (ET) of the crop, especially for rain-fed crops. If, for example, the predicted ET rate is too high, the simulated crop may exhaust its soil water supply before the next rain event, thereby causing growth and yield predictions that are too low. In a prior inter-comparison among maize growth models, ET predictions varied widely, but no observations of actual ET were available for comparison. Therefore, another study has been initiated under the umbrella of AgMIP (Agricultural Model Inter-Comparison and Improvement Project). This time observations of ET using the eddy covariance technique from an 8-year-long experiment conducted at Ames, IA are being used as the standard. Simulation results from 29 models have been completed. In the first “blind” phase for which only weather, soils, and management information were furnished to the modelers, estimates of seasonal ET varied from about 200 to about 700 mm. A detailed statistical analysis of the daily ET data from 2011, a “typical” rainfall year, showed that, as expected, the median of all the models was more accurate across several criteria (correlation, root mean square error, average difference, regression slope) than any particular model. However, some individual models were better than the median for a particular criteria. Predictions improved somewhat in later stages when the modelers were provided additional leaf area and growth information that allowed them to “calibrate” some of the parameters in their models to account for varietal characteristics, etc.