106-4 Using a Large Ensemble of Crop Models to Simulate the Climate Sensitivity of Wheat Yields Across a European Transect.

Reimund P. Roetter[1], Nina K Pirttioja[2], Stefan K Fronzek[2], Timothy R Carter[2], Marco Bindi[3], Roberto Ferrise[3], Taru I Palosuo[1], Fulu Tao[1], Holger Hoffmann[4], Frank Ewert[5], Margarita Ruiz-Ramos[6], Alfredo Rodriguez[6], Maria Ines Minguez Tudela[7], Miroslav Trnka[8], Petr Hlavinka[9], Marco Acutis[10], Senthold Asseng[11], Piotr Baranow[12], Bruno Basso[13], Per Bodin[14], Samuel Buis[15], Davide Cammarano[16], Paola Deligios[17], Marie-France Destain[18], Benjamin Dumont[19], Louis Francois[20], Ingrid Jacquemin[20], Chris Kollas[21], Kurt C. Kersebaum[21], Jaromir Kryszczak[12], Ignacio J Lorite[22], Julien Minet[23], Manuel Montesino[24], Marco Moriondo[25], Christoph Müller[26], Claas Nendel[27], Isik Ozturk[28], Alessia Peregio[29], Sanna Mattia[30], Mikhail Semenov[31], Czesary Slawinski[32], Pierre Stratonovitch[31], Iwan Supit[33], Alex Ruane[34], Francoise Ruget[35], Katharina Waha[26], Enli Wang[36], Lianhai Wu[37] and Zhigan Zhao[38], (1)Climate Impacts Group, Natural Resources Institute Finland (Luke), Helsinki, Finland
(2)Climate Change Programme, Finnish Environment Institute (SYKE), Helsinki, Finland
(3)University of Florence, Florence, Italy
(4)Institute of Crop Science and Resource Conservation (INRES), University of Bonn, Bonn, Germany
(5)Institute of Crop Science and Resource Conservation (INRES), University of Bonn, Bonn, GERMANY
(6)Universidad Politecnica de Madrid, Madrid, Spain
(7)Polytechnic University of Madrid, Madrid, Spain
(8)Mendel University Brno, Brno, Czech Republic
(9)Institute of Agrosystems and Bioclimatology, Mendel University in Brno, Brno, Czech Republic
(10)University of Milan, Milano, Italy
(11)Agricultural and Biological Engineering, University of Florida, Gainesville, FL
(12)Institute of Agrophysics, Polish Academy of Sciences, Lublin, Poland
(13)Michigan State University, Michigan State University, East Lansing, MI
(14)Environmental Sciences, Lund University, Lund, Sweden
(15)INRA, Avignon, France
(16)Invergowrie, James Hutton Institute, Dundee, Scotland
(17)Agriculture, University of Sassari, Sassari, Italy
(18)Dpt AgroBioChem and BioSE, ULg - Gembloux Agro-Bio Tech, Gembloux, Belgium
(19)Geological Sciences, Michigan State University, East Lansing, MI
(20)Agro, Université de Liège, Liège, Belgium
(21)Leibniz Centre for Agricultural Landscape Research, Muencheberg, Germany
(22)IFAPA, IFAPA Junta de Andalucia, Córdoba, Spain
(23)Université de Liège, Liège, Belgium
(24)Agriculture, University of Copenhagen, Taastrup, Denmark
(25)CNR-IBIMET, University of Florence, Florence, Poland
(26)Potsdam Institute for Climate Impact Research, Potsdam, Germany
(27)ZALF - Leibniz Centre for Agricultural Landscape Research, Muencheberg, Germany
(28)Aarhus University, Tjele, (Non U.S.), DENMARK
(29)Agricultura, University of Milan, Milan, Italy
(30)University of Milan, Milan, Italy
(31)Rothamsted Research, Harpenden, England
(32)Polish Academy of Sciences, Lublin, Poland
(33)Wageningen University, Wageningen, Netherlands
(34)NASA Goddard Institute for Space Studies, New York, NY
(35)UAPV, UMR1114 EMMAH, Avignon, France
(36)CSIRO, Canberra, ACT 2601, Australia
(37)Rothamsted Research, Okehampton, United Kingdom
(38)Agriculture, China Agricultural University, Beijing, China

We studied the sensitivity of a 26-member ensemble of process-based wheat models to perturbations in baseline temperature and precipitation along a transect in Europe to construct impact response surfaces (IRSs) of simulated wheat yields.

Resultant IRSs show the simulated yield response to systematic changes to the 1981-2010 baseline in temperature (ranging from -2 to +9°C) and precipitation (-50 to +50%). IRSs were calculated for spring and winter wheat cultivated at four contrasting sites: in southwestern Finland, Germany (winter wheat in the west; spring wheat in the east) and north-eastern Spain. Simplified assumptions were made on CO_2 level, management and soils with the aim to distinguish differences in model response attributable to climate.

Results show that simulated absolute yield levels vary considerably between models under baseline and perturbed conditions. Across the ensemble, there is general agreement among models that the dominant sensitivity changes along the transect. Wheat yields are more sensitive to temperature changes at the Finnish site, sensitive to a combination of temperature and precipitation at the German sites, and more sensitive to precipitation at the Spanish site. Yields benefit from cooling at the Spanish and German sites, while temperatures are close to optimal for the baseline in Finland. Reasons for these site-specific patterns of response can partly be attributed to differences in baseline climate, local cultivars and management practices. Standardized anomalies of simulated yield series match observed regional yield anomalies more closely for spring wheat in Germany than at other sites, mainly due to better resolved observations.

The IRS approach appears suitable for illustrating model behaviour under changing climate, as well as for comparing results from multi-model ensemble simulations.