

Deepak K. Ray, Ph.D.

Senior Scientist

Institute on the Environment (IonE)

University of Minnesota, Twin Cities

<http://gli.environment.umn.edu/about/team/deepak-ray/drak@umn.edu>

Tel: 612-626-4029

Professional Experience and Education

Ph.D., *Atmospheric Science*, University of Alabama, Huntsville, USA, 2005

M.S., *Atmospheric Science*, University of Alabama, Huntsville, USA, 2002

M.Sc., *Environmental Science*, Jawaharlal Nehru University, New Delhi, India, 1999

B.Sc., *Geology (distinction in Physics and Mathematics)*, Jadavpur University, Calcutta, India, 1997

University of Minnesota, Twin Cities

- January 2015 – current: Senior Scientist
- August 2009 – December 2014: Research Associate

Purdue University, West Lafayette

- August 2005-July 2009: Postdoctoral Research Associate

University of Alabama, Huntsville

- August 1999-July 2005: Graduate Research Assistant

Research Focus

My overall research interests and expertise intersects the disciplines of climate, agriculture and ecosystems. I build global agricultural datasets and conduct model simulations to answer questions on the impact of land use / land cover change and global climate change on food security and sustainability. I work with stakeholders of agriculture: industry, farmers, academia and environmental NGOs, to work for food security, and sustainability of our environment and farming community.

Peer-reviewed Publications (published)

2019

35. **Ray D. K.**, P. C. West, M. Clark, J. S. Gerber, A. V. Prishchepov, S. Chatterjee (2019) Climate change has likely already affected global food production. *PLoS ONE* 14(5): e0217148. <https://doi.org/10.1371/journal.pone.0217148>

34. Vogel E., M. G. Donat, L. V. Alexander, M. Meinshausen, **D. K. Ray**, D. Karoly, N. Meinshausen, K. Frieler (2019) The effects of climate extremes on global agricultural yields. *Environmental Research Letters* 14 054010, doi: 10.1088/1748-9326/ab154b

2018

33. Tigchelaar, M., Battisti, D. S., Naylor, R. L. and **Ray, D. K.** (2018) Future warming increases probability of globally synchronized maize production shocks, *Proceedings of the National Academy of Sciences*, doi:10.1073/pnas.1718031115

2017

32. Zscheischler, J., et al. Reviews and syntheses: An empirical spatiotemporal description of the global surface–atmosphere carbon fluxes: opportunities and data limitations, *Biogeosciences* 14, 3685-3703
31. Mueller, N. D., Rhines, A., Butler, E. E., **Ray, D. K.**, Siebert S., Holbrook, M., Huybers, P. Global Relationships between Cropland Intensification and Summer Temperature Extremes over the Last 50 Years, *Journal of Climate* 30, 7505-7528
30. Müller, C., et al. Global Gridded Crop Model evaluation: benchmarking, skills, deficiencies and implications, *Geosci. Model Dev.*, 10, 1403-1422, doi: 10.5194/gmd-10-1403-2017
29. Porwollik, V., et al. Spatial and temporal uncertainty of crop yield aggregations, *European Journal of Agronomy*, doi: 10.1016/j.eja.2016.08.006

2015

28. Elliott, J., et al. (2015), The Global Gridded Crop Model Intercomparison: data and modeling protocols for Phase 1 (v1.0), *Geosci. Model Dev.*, 8, 261-277, doi:10.5194/gmd-8-261-2015
27. **Ray, D. K.**, J. S. Gerber, G. K. MacDonald, P. C. West (2015), Climate variation explains a third of global crop yield variability, *Nature Communications* 6:5989 doi:10.1038/ncomms6989

2014

26. Gray, J. M., S. Frolking, E. A. Kort, **D. K. Ray**, C. J. Kucharik, N. Ramankutty, M. A. Friedl (2014), Direct human influence on atmospheric CO₂ seasonality from increased cropland productivity, *Nature*, 515, 398-401, doi:10.1038/nature13957
25. West, P. C., J. S. Gerber, P. M. Engstrom, N. D. Mueller, K. A. Brauman, K. M. Carlson, E. S. Cassidy, M. Johnston, G. K. MacDonald, **D. K. Ray**, S. Siebert (2014), Leverage points for improving global food security and the environment, *Science*, 345, 325-328, DOI: 10.1126/science.1246067

2013

24. **Ray, D. K.**, J. A. Foley (2013), Increasing global crop harvest frequency: recent trends and future directions, *Environmental Research Letters*, 8 044041, doi:10.1088/1748-9326/8/4/044041
23. **Ray, D.K.**, N. D. Mueller, P. C. West, and J. A. Foley (2013), Yield trends are insufficient to double global crop production by 2050, *PLOS ONE*, 8(6): e66428, doi: 10.1371/journal.pone.0066428
22. **Ray, D. K.** (2013), Dry season precipitation over the Mesoamerican Biological Corridor is more sensitive to deforestation than to greenhouse gas driven climate change, *Climatic Change*, DOI: 10.1007/s10584-013-0753-0
21. **Ray, D. K.** (2013), Tropical Montane Cloud Forests. In Climate Vulnerability: Understanding and Addressing Threats to Essential Resources. *Elsevier Inc., Academic Press*, 79–85 pp

2012

20. **Ray, D.K.**, N. Ramankutty, N. D. Mueller, P. C. West, and J. A. Foley (2012), Recent patterns of crop yield growth and stagnation. *Nature Communications* 3:1293 doi: 10.1038/ncomms2296
19. Mueller, N., J. S. Gerber, M. Johnston, **D. K. Ray**, N. Ramankutty and J. A. Foley (2012), Closing yield gaps through nutrient and water management, *Nature*, 490, 254-257, doi:10.1038/nature11420
18. **Ray, D. K.**, B. C. Pijanowski, A. D. Kendall and D. W. Hyndman (2012), Coupling land use and groundwater models to map land use legacies: Using GIS to assess model uncertainties relevant to land use planning, *Applied Geography*, 34, 356-370, doi:10.1016/j.apgeog.2012.01.002

2011

17. Foley, J. A., N. Ramankutty, K. A. Brauman, E. S. Cassidy, J. S. Gerber, M. Johnston, N. D. Mueller, C. O'Connell, **D. K. Ray**, P. C. West, C. Balzer, E. M. Bennett, S. R. Carpenter, J. Hill, C. Monfreda, S. Polasky, J. Rockström, J. Sheehan, S. Siebert, D. Tilman, and D. P. M. Zaks (2011), Solutions for a Cultivated Planet, *Nature*, 478(7369): 337-342, doi:10.1038/nature10452
16. **Ray, D. K.**, V. S. Manoharan, R. M. Welch (2011), Cloud Cover Conditions And Stability Of The Western Ghats Montane Wet Forests, *J. Geophys. Res.*, 116, D12104, doi:10.1029/2010JD015245
15. Lawton, R. O., U. S. Nair, **D. K. Ray**, A. Regmi, A. Pounds, and R. M. Welch (2011), Quantitative measures of immersion in cloud and the biogeography of cloud forest, 217-227, In: Tropical Montane Cloud Forests, L. A. Bruijnzeel, F. N. Scatena and L. S. Hamilton (eds), *Cambridge University Press*, 750 (p)
14. Nair, U. S., **D. K. Ray**, R. O. Lawton, R. M. Welch and R. Pielke (2011), The impact of deforestation on orographic cloud formation in a complex tropical environment, 538-548, In: Tropical Montane Cloud Forests, L. A. Bruijnzeel, F. N. Scatena and L. S. Hamilton (eds), *Cambridge University Press*, 750 (p)

2010

13. **Ray, D. K.**, J. M. Duckles and B. C. Pijanowski (2010), The Impact of Future Land Use Scenarios on Runoff Volumes in the Muskegon River Watershed, *Environmental Management*, 46: 3, 351-366, DOI: 10.1007/s00267-010-9533-z
12. Mishra, V., K. A. Cherkauer, D. Niyogi, M. Lei, B. C. Pijanowski, **D. K. Ray**, L. C. Bowling and G. Yang (2010), A regional scale assessment of land use/land cover and climatic changes on water and energy cycle in the upper Midwest United States, *International Journal of Climatology*, 30: 2025-2044, DOI: 10.1002/joc.2095
11. **Ray, D. K.**, R. A. Pielke, Sr., U. S. Nair, and D. Niyogi (2010), Roles of atmospheric and land surface data in dynamic regional downscaling, *J. Geophys. Res.*, 115, D05102, doi:10.1029/2009JD012218

10. **Ray, D. K.** and B. C. Pijanowski (2010), A Backcast Land Use Change Model to Generate Past Land Use Maps for the Muskegon River Watershed of Michigan, USA, *Journal of Land Use Science*, 5: 1, 1-29, doi: 10.1080/17474230903150799

9. **Ray, D. K.**, J. S. Gerber, N. D. Mueller, N. Ramankutty and J. A. Foley (2010), Recent trends in closing the yield gaps of major global crops, *Agro 2010, the XI ESA Congress*, Montpellier, J. Wery, I. Shili-Touzi, A. Perrin (eds), ISBN: 978-2-909613-01-7, 329-330

2009

8. **Ray, D. K.**, R. A. Pielke, Sr., U. S. Nair, R. M. Welch, and R. O. Lawton (2009), Importance of land use versus atmospheric information verified from cloud simulations from a frontier region in Costa Rica, *J. Geophys. Res.*, 114, D08113, doi:10.1029/2007JD009565

2008

7. Nair, U.S., S. Asefi, R.M. Welch, **D.K. Ray**, R.O. Lawton, V.S. Manoharan, M. Mulligan, T.L. Sever, D. Irwin, A. Pounds (2008), Biogeography of Tropical Montane Cloud Forests, 2: Mapping of Orographic Cloud Immersion, *Journal of Applied Meteorology and Climatology*, DOI: 10.1175/2007JAMC1819.1

6. Welch, R. M., S. Asefi, J. Zeng, U. S. Nair, Q. Han, R. O. Lawton, **D. K. Ray**, and V. S. Manoharan (2008), Biogeography of Tropical Montane Cloud Forests, 1: Remote Sensing of Cloud Base Heights, *Journal of Applied Meteorology and Climatology*, DOI: 10.1175/2007JAMC1668.1

2007

5. Pijanowski, B. C., **D. K. Ray**, A. J. Kendall, J. M. Duckles, D. W. Hyndman (2007), Using Backcast Land Change and Groundwater Travel-time Models to Generate Land Use Legacy Maps for Watershed Management, *Ecology and Society*, Vol 12, 2

4. Nair, U. S., **D. K. Ray**, J. Wang, S. A. Christopher, T. J. Lyons, R. M. Welch, and R. A. Pielke Sr. (2007), Observational estimates of radiative forcing due to land use change in southwest Australia, *J. Geophys. Res.*, 112, D09117, doi:10.1029/2006JD007505

2006

3. **Ray, D. K.**, U. S. Nair, R. O. Lawton, R. M. Welch, and R. A. Pielke Sr. (2006), Impact of land use on Costa Rican tropical montane cloud forests: Sensitivity of orographic cloud formation to deforestation in the plains, *J. Geophys. Res.*, 111, D02108, doi:10.1029/2005JD006096

2. **Ray, D. K.**, R. M. Welch, R. O. Lawton, and U. S. Nair (2006), Dry Season Clouds and Rainfall in Northern Central America: Implications for the Mesoamerican Biological Corridor, *Global and Planetary Change*, 54, 150–162, doi:10.1016/j.gloplacha.2005.09.004

2003

1. **Ray, D. K.**, U. S. Nair, R. M. Welch, Q. Han, J. Zeng, W. Su, T. Kikuchi, and T. J. Lyons (2003), Effects of land use in Southwest Australia: 1. Observations of cumulus cloudiness and energy fluxes, *J. Geophys. Res.*, 108(D14), 4414, doi:10.1029/2002JD002654

Link to Google Scholar Profile for full list of publications:

<http://scholar.google.com/citations?user=DkNhZnEAAA&hl=en>

Funding

Funding Agency: Meridian Institute

Co-PI, with Paul West as PI

Project Title: Improving the broader effectiveness of zero-deforestation commitments and commodity standards

Budget Period: 07/01/2019 – 03/31/2020

Total Budget granted: 149,962 (US\$)

Funding Agency: Swiss national Science Foundation

PI: Markus Stoffel

External partner: Deepak Ray

Project Title: CALDERA – EffeCts of lArge voLcanic eruptions on climate and societies: UnDerstand the impacts of past Events and related subsidence cRises to evAluate potential risks in the future

Budget Period: 03/01/2019 – 02/27/2023

Total Budget granted: 2,792,035 Swiss Francs (CHF)

Popular Press Writing

[Crop Crisis: Why Global Grain Demand Will Outstrip Supply - The Conversation – Australia \(6/21/2013\)](#) – 212 comments, 61 tweets, 74 Facebook shares

Service

Journal Reviewer (42 reviews)

Agricultural and Forest Meteorology (2), Atmospheric Environment (2), Climatic Change (2), Earth's Future (1), Earth Interactions (1), Environmental Research Letters (3), Environmental Sciences (1), Environmental Science and Technology (1), Geophysical Research Letters (1), Journal of Climate (1), J. Environmental Planning and Management (1), Journal of Hydrometeorology (1), International Journal of Climate (1), International Journal of Remote Sensing (5), Nature Communications (6), Nature Geoscience (1), Nature Sustainability (1), PLOS ONE (3), Proceedings of the National Academy of Sciences, USA (1), Proceedings of the Royal Society B (1), Remote Sensing (1), Remote Sensing of the Environment (1), Scientific Reports (3), Solutions (1)

Proposal Reviewer (7 reviews)

NASA (3), NSF (2), Netherlands Organisation for Scientific Research (1), External PhD proposal review, WIMEK, Wageningen, The Netherlands (1)

Proposal Panel (1)

NASA INCA Panel Review (November 2015)

Conference Sessions

Ecological Society of America 2013 – session chair COSI – Agriculture I

Ecological Society of America 2013 – co-convener COS 64-5 Viewing agricultural trade networks in terms of land and water resource sustainability

Deepak Ray, Insitute on the Environment, University of Minnesota

American Geophysical Union Annual Meeting 2012 – convener of oral and poster sessions: in Global Environmental Change: GC025. Hotspots on a Cultivated Planet: Reducing Water, Nitrogen and Carbon Footprints While Increasing Food Production

American Geophysical Union Annual Meeting 2011 – convener of oral and poster sessions in Biogeosciences: B23. Feeding the World While Sustaining the Planet: Building Sustainable Agriculture Within the Earth System

Outstanding student paper judge: American Geophysical Union Annual Meeting 2010

Advising

2003 summer: advising 2 undergraduate visiting students from University of Puerto Rico

2006 fall: advising PhD student from University of Alabama, Huntsville

2005-2009: co-advising PhD student at Purdue University

2019 summer: co-advising 3 PhD students from the School of Statistics, U. of Minnesota