

FRANK MITLOEHNER, PHD
Professor and Cooperative Extension Air Quality Specialist
Director, CLEAR Center
Department of Animal Science
University of California, Davis
Davis, CA 95616

EDUCATION

MS, University of Leipzig, Germany, Animal Science & Ag Engineering, 1996
PhD, Texas Tech University, TX, Animal Science, 2000
Postdoctoral Fellow at Texas Tech University from Aug 2000 - Dec 2001.

APPOINTMENT

- Professor & Cooperative Extension Specialist; Dept Animal Science, UC Davis; since 2012
- Adjunct Professor; College of Animal Science; North West Agriculture and Forestry University (NWAUFU), Yangling, China; since 2016
- Associate Professor & Extension Specialist; Dept Animal Science, UC Davis Oct '07- '12
- Assistant Extension Specialist for Air Quality; Dept Animal Science, UC Davis; '02 – '06

PROFESSIONAL EXPERIENCE

- Director, UC Davis CLEAR Center
- Chairman, United Nations Food and Agriculture Organization (UN FAO), Partnership Project for the Benchmarking of Environmental Impacts of the Global Livestock Supply Chains; LEAP (2012 - 15)
- Member, National Academy of Science, Institute of Medicine, Committee on Assessment of the Environmental and Health Effects of the Food System (March 2013-15)
- Workgroup Member, President's Council of Advisors on Science and Technology, PCAST (June 2012-15)

AWARDS

- 2005 *Outstanding Paper Award – Journal: 'Measurement, Science and Technology'*
- 2006 *Academic Federation Excellence in Research Award - University of California, Davis*
- 2007 *Environmental Award - Environmental Protection Agency*
- 2009 *Distinguished Service Award for Outstanding Research - University of California*
- 2011 *Outstanding Dairy Industry Researcher Award*
- 2014 *ASUCD Excellence in Education Award for the College of Agricultural and Environmental Science*
- 2016 *Distinguished Alumni Award, Texas Tech University, Lubbock, TX*
- 2019 *Distinguished Teaching Award for Undergraduate Instruction – University of California, Davis*
- 2019 *CAST Borlaug Communication Award*
- 2019 *George Strathearn Memorial Research Award – California Beef Council*
- 2021 *Sacramento Magazine - 100 Most Notable Business Leaders*

PROFESSIONAL SOCIETIES

- American Geophysical Union (AGU)
- American Chemistry Society (ACS)
- American Society of Animal Science (ASAS)
- American Society of Agricultural and Biological Engineers (ASABE)

Teaching

- Zool 4409 – Comparative Zoology. 130 student enrollment, senior level class in comparative physiology for pre-veterinary and zoology students in the Zoology Department at Texas Tech University.
- ANS41 – Domestic Livestock Production. 280 student enrollment, sophomore level class for animal science students in the Department of Animal Science at UC Davis
- ANS41L- Domestic Livestock Production Laboratory. 120 student enrollment, 2 unit, sophomore level laboratory to teach students in the Department of Animal Science hands-on husbandry of livestock and to expose them to real world farms and ranches.
- ABG 202 – Grant Procurement and Administration. 20 PhD graduate student enrollment in the Animal Biology Graduate Group.

Publications (2001-2021)

1. Mitloehner, F.M., J.L. Morrow-Tesch, S.C. Wilson, J.W. Dailey, and J.J. McGlone. 2001. Behavioral and sampling techniques for feedlot cattle. *J. Anim. Sci.* 79:1189-1193.
2. Mitloehner, F.M., J.L. Morrow-Tesch, S.C. Wilson, J.W. Dailey, M. Galyean, M. Miller, and J.J. McGlone. 2001. Shade and water misting effects on behavior physiology, performance and carcass traits of heat stressed feedlot cattle. *J. Anim. Sci.* 79:2327-2335.
3. Mitloehner, F.M., M.L. Galyean, and J.J. McGlone. 2002. Shade effects on performance, carcass traits, physiology, and behavior of heat-stressed feedlot heifers. *J. Anim. Sci.* 80:2043-2050.
4. Wilson, S.C., F.M. Mitloehner, J.L. Morrow-Tesch, J.L. Dailey, and J.J. McGlone. 2002. An assessment of several potential enrichment devices for feedlot cattle. *Appl. Anim. Beh. Sci.* 76:259-265.
5. Wilson, S.C., J. Morrow-Tesch, D.C. Straus, J.D. Cooley, W.C. Wong, F.M. Mitloehner, and J.J. McGlone. 2002. Airborne microbial flora in a cattle feedlot. *Appl. Environm. Microbiol.* 68:3238-3242.
6. Mitloehner, F.M., T. Grandin, M. Galyean, J. Swanson, B. Smith, and D. Sehnert. 2003. Federation of Animal Science Societies (FASS) Beef Training Module (<http://www.fass.org/video/beef.asp>).

7. Mitloehner, F.M., and R.B. Laube. 2003. Chronobiological indicators of heat stress in *Bos indicus* cattle in the Tropics. *J. Anim. Vet. Advances* 2: 654-659.
8. Oltjen, J.W., and F. Mitloehner. 2004. An overview of current beef welfare concerns. In: Information Resources on the Care and Welfare of Beef Cattle (C.P. Smith, Ed.) pp. vii-xiii. AWIC Resource Series No. 24. U.S. Dept. of Agriculture, National Agricultural Library, Animal Welfare Information Center. Beltsville, MD.
9. Morrow, J.L., F.M. Mitloehner, A.K. Johnson, M.L. Galyean, J.W. Dailey, T.S. Edrington, R.C. Anderson, K.J. Genovese, T.L. Poole, S.E. Duke, and T.R. Callaway. 2005. Effect of sprinkling cattle on incidence of zoonotic pathogens. *J. Anim. Sci.* 83:1959-1966.
10. Mitloehner, F.M. 2005. Effects of insufficient data on air quality regulatory policy in animal agriculture. *J. Appl. Poultry Sci.* 14:373-377.
11. Webber, M.T. MacDonald, M.B. Pushkarsky, C.K.N. Patel, Y. Zhao, N. Marcillac, and F.M. Mitloehner. 2005. Agricultural ammonia sensor using diode lasers and photoacoustic spectroscopy. *Meas. Sci. Technol.* 16:1547-1553.
12. Silvis, J., G. Shaver, F.M. Mitloehner, D. Niemeier. 2006. Interaction among air quality, climate change and California agriculture. Chapter 4. In: Cavagnaro, T.R., Jackson, L.E., and Scow, K.M., eds. *Climate Change: Challenges and Solutions for California Agricultural Landscapes*. California. CEC-500-2005-189-SF. http://www.climatechange.ca.gov/climate_action_team/reports/index.html. California Climate Change Center, Sacramento CA.
13. Chang, A., T. Harter, J. Letey, D. Meyer, R. Meyer, M. Cambell, F. Mitloehner, S. Pettygrove, P. Robinson, and R. Zhang. 2006. Managing dairy manure in the central valley of California. Oakland: University of California *ANR publication 9004*.
14. Von Borell, E., A. Özpınar, K.M. Eslinger, A.L. Schnitz, Y. Zhao, and F.M. Mitloehner. 2007. Acute and prolonged effects of ammonia on hematological variables, stress responses, performance, and behavior of nursery pigs. *J. Swine Health Prod.* 15:137-145.
15. Shaw, S.L., F.M. Mitloehner, W.A. Jackson, E. DePeters, R. Holzinger, J. Fadel, P. Robinson, and A.H. Goldstein. 2007. Volatile organic compound emissions from dairy cows and their waste as measured by proton transfer reaction - mass spectrometry. *Env. Sci. & Technol.* 41:1310-1316.
16. McGarvey, J., W.G. Miller, R. Zhang, Y. Ma, and F.M. Mitloehner. 2007. Bacterial population dynamics in dairy waste during aerobic and anaerobic treatment and subsequent storage. *Appl. Environm. Microbiol.* 73:193-202.
17. Mitloehner, F.M., and M. Schenker. 2007. Environmental Exposure and Health Effects

of Concentrated Animal Feeding Operations. *Epidemiology* 18:309-311.

18. Zhang, R.H., H. Sun, C. Collar, and F.M. Mitloehner. 2007. Aerator performance for wastewater lagoon application. *ASABE publication 701Po907*.
19. Stull, C., S. Barry, W. Jensen, D. Drake, L. Forero, J. Guerro, J. Maas, F. Mitloehner, G. Nader, and J. Oltjen. 2007. Beef Care Practices. Oakland: University of California *ANR publication 8257*.
20. Trabue, S., K. Scoggin, F.M. Mitloehner, R. Burns, and H. Xin. 2007. Volatile sulfur compounds associated with animal feeding operations. *Atmospheric Environment* 42:3332-3341.
21. Sun, H., S. Trabue, K. Scoggin, W. Jackson, Y. Pan, Y. Zhao, I.L. Malkina, J.A. Koziel, and F.M. Mitloehner. 2008. Alcohol, volatile fatty acid, phenol, and methane emissions from dairy cows and fresh waste. *J. Environm. Qual.* 36: 615-622.
22. Sun, H., Y. Pan, Y. Zhao, W. Jackson, L. Nuckles, V. Arteaga, and F.M. Mitloehner. 2008. Effects of sodium bisulfate on alcohol, amine, and ammonia emissions from dairy slurry. *J. Environm. Qual.* 37: 608-614.
23. Mitloehner, F. M. and M. S. Calvo. 2008. Worker health and safety in concentrated animal feeding operations. *J. Agri. Health Safety.*14; 163-187.
24. Howard, C., W. Yang, P. Green, F.M. Mitloehner, I. Malkina, R.G. Flocchini, M.J. Kleeman. 2008. Direct measurements of the ozone forming potential from dairy cattle emissions using a transportable smog chamber. *Atmospheric Environment.* 42: 5269-5277.
25. Zhang, R., J.A. McGarvey, F.M. Mitloehner. 2008. Effects of anaerobic digestion and aerobic treatment on gaseous emissions from dairy manure storages. *Int. J. Agr. & Biol. Eng.* 1:15-20.
26. Johnson, A. K., F. M. Mitloehner, J. L. Morrow, and J. J. McGlone. 2008. Effects of shaded versus unshaded wallows on behavior, performance, and physiology of the outdoor lactating sow. *J. Anim. Sci.* 86:3628–3634.
27. Marcillac-Embertson, N.M., P.H. Robinson, J.G. Fadel, and F.M. Mitloehner. 2009. Effects of shade and sprinklers on performance, behavior, physiology, and the environment of heifers. *J. Dairy Sci.* 92: 509-517.
28. Mitloehner, F.M., H. Sun, and J. Karlik. 2009. Environmental chamber studies improve greenhouse gas emission estimates and suggest mitigation strategies for livestock facilities. *California Agriculture.* 63: 79-83.

29. Hamilton, S. W., E. J. DePeters, J. A. McGarvey, J. Lathrop, and F. M. Mitloehner. 2010. Greenhouse Gas, Animal Performance, and Bacterial Population Structure Responses to Dietary Monensin Fed to Dairy Cows. *J. Environm. Qual.* 39: 106-114.
30. Mitloehner, F.M., J. Swearingen, L. Jacobson, C. Gooch, P. Ndegwa. 2009. Chapter 3: Husbandry, Housing, and Biosecurity. In: Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching, Federation of Animal Science Societies, 14-28.
31. Pitesky, M., K. Stackhouse, and F.M. Mitloehner. 2009. Clearing the Air: Livestock's Contributions to Climate Change. *Adv. Agronomy*, 103: 1-40.
32. Plummer, L.E., K. E. Pinkerton, S. Reynolds, S. Meschke, F.M. Mitloehner, D. Bennett, S. Smiley-Jewell, and M.B. Schenker. 2009. Aerosols in the Agricultural Setting. *J. Agromed.* 14: 413-6.
33. McGarvey, J. A., S. W. Hamilton, J. R. Lathrop, and F. M. Mitloehner. 2010. Effects of Dietary Monensin on the Bacterial Population Structure of Dairy Cattle Colonic Contents. *Appl. Microb. & Biotechn.* 85: 1947-1952.
34. Wegesser, T.C., L.M. Franzi, F.M. Mitloehner, A. Eiguren-Fernandez , and J.A. Last. 2010. Lung Antioxidant and Cytokine Responses to Coarse and Fine Particulate Matter from the Great California Wildfires of 2008. *Inhalation Toxicology.* 22: 561-570.
35. Howard C. J., A. Kumar, F. M. Mitloehner, K. R. Stackhouse, P. G. Green, R. G. Flocchini, and M. J. Kleeman. 2010. Direct Measurements of the Ozone Formation Potential from Livestock and Poultry Waste Emissions. *Env. Sci. & Technol.* 44: 2292-2298.
36. Calvo M. S., A. C. Gerry, J. A. McGarvey, T. L. Armitage, and F. M. Mitloehner. 2010. Acidification of calf bedding reduces fly development and bacterial abundance. *J. Dairy Sci.* 93:1059-1064.
37. Burgos S. A., N. M. Embertson, Y. Zhao, F. M. Mitloehner, E. J. DePeters, and J. G. Fadel. 2010. Prediction of Ammonia Emission from Dairy Cattle Manure Based on Milk Urea Nitrogen: Relation of Milk Urea Nitrogen to Ammonia Emissions. *J. Dairy Sci.* 93:2377-2386.
38. Howard, C. J., A. Kumar, I. A. Malkina, F. M. Mitloehner, P. G. Green, R. Flocchini, and M. Kleeman. 2010. Reactive Organic Gas Emissions from Livestock Feed Contribute Significantly to Ozone Production in Central California. *Env. Sci. & Technol.* 44: 2309-2314.
39. Montes, F., S. D. Hafner, C. A. Rotz, and F. M. Mitloehner. 2010. Temperature and air

velocity effects on ethanol emission from corn silage with the characteristics of an exposed silo face. *Atmospheric Environment*. 44:1989-1995.

40. Place S.E., and F.M. Mitloehner. 2010. Contemporary Environmental Issues: A Review of the Dairy Industry's Role in Climate Change and Air Quality and the Potential of Mitigation through Improved Production Efficiency. *J. Dairy Sci.* 93:3407-3416.
41. Hafner S. D., Montes, F., C. A. Rotz, and F. M. Mitloehner. 2010. Ethanol emission from loose corn silage and exposed silage particles. *Atmospheric Environment*. 44: 4172-4180.
42. Eastman C., D. C. Mitchell, D. H. Bennett, D. J. Tancredi, F. M. Mitloehner, and M. B. Schenker. 2010. Respiratory symptoms of California's dairy workers. *Field Actions Science Report*. 2: 1-6.
43. Kumar A., C. J. Howard, D. Derrick, I. L. Malkina, F. M. Mitloehner, M. J. Kleeman, C. P. Alaimo, R. G. Flocchini and P. G. Green. 2010. Determination of volatile organic compound emissions and ozone formation from spraying solvent-based pesticides. *J. Environ. Qual.* 40: 1423-1431.
44. Mitloehner, F. M. 2010. Is the rising demand for animal protein fueling climate change? *J. Anim. Breed. Genet.* 127: 421-422 (Editorial).
45. El-Mashad, H. M., R. Zhang, T. Rumsey, S. Hafner, F. Montes, C. A. Rotz, V. Arteaga, Y. Zhao, F. M. Mitloehner. 2011. A mass transfer model of ethanol emission from thin layers of corn silage. *Trans. ASABE*. 53: 1-7.
46. Xin H., R. S. Gates, A. R. Green, F. M. Mitloehner, P. A. Moore Jr., and C. M. Wathes. 2011. Environmental impacts and sustainability of egg production systems. *Poultry Science*. 90:263-277.
47. Malkina I.L., A. Kumar, P. G. Green, and F. M. Mitloehner. 2011. Identification and quantitation of volatile organic compounds emitted from dairy silages and other feedstuffs. *J. Environ. Qual.* 40:1-9.
48. Coopriider K.L., F. M. Mitloehner, Y. Zhao, T. R. Famula, E. Kebreab, and A. L. Van Eenennaam. 2011. Feedlot efficiency implications on greenhouse gas emissions and sustainability. *J. Anim. Sci.* 89: 2643-2656.
49. Stackhouse K. R, Y. Pan, Y. Zhao, and F.M. Mitloehner. 2011. Greenhouse gas and alcohol emissions from feedlot steers and calves. *J. Environ. Qual.* 40:899-906.
50. Kumar, A., C. P. Alaimo, R. Horowitz, F. M. Mitloehner, M. J. Kleeman, and P. G. Green. 2011. Volatile organic compound emissions from green waste composting: characterization and ozone formation. *Atmospheric Environment*. 45:1841-1848.

51. Jacobson, L. D., B. W. Auvermann, R. Massey, F. M. Mitloehner, A. L. Sutton, H. Xin. 2011. Air issues associated with animal agriculture: a North American perspective. *Council for Agricultural & Science Technology* 47: 1-23.
52. McGarvey, J. A., K. R. Stackhouse, W.G. Miller, L.H. Stanker, R. Hnasko and F.M. Mitloehner. 2011. The effects of sodium bisulfate on the bacterial population structure of dairy cow waste. *J. Appl. Microbiol.* 111: 319-328.
53. Stackhouse, K.R., S.E. Place, M.S. Calvo, Q. Wang, and F. M. Mitloehner. 2011. Greenhouse gas emission sources from US beef and dairy production systems. In: *Understanding Greenhouse Gas Emissions from Agricultural Management. Ch. 21*, pp 407-417. American Chemical Society.
54. Place S.E., K.R. Stackhouse, M. Calvo, Q. Wang, and F.M. Mitloehner. 2011. Mitigation of greenhouse gas emissions from US beef and dairy production systems. In: *Understanding Greenhouse Gas Emissions from Agricultural Management. Ch. 23*, pp 443-457. American Chemical Society.
55. El-Mashad, H. M., R. Zhang, V. Arteaga, T. Rumsey, F. M. Mitloehner. 2011. Generation and emissions of volatile fatty acids and alcohols during anaerobic storage of dairy manure. *Trans. ASABE* 54: 1-9.
56. Place, S., Y. Pan, Y. Zhao, and F. M. Mitloehner. 2011. Construction and Operation of a Head Chamber System for Measuring Eructated Greenhouse Gas and Volatile Organic Compound Emissions from Cattle. *Animals, 1*: 433-446.
57. Vogel, C. F. A, J. Garzia, D. Wu, D. Mitchell, Y. Zhang, N. Y. Kado, P. Wong, D. A. Trujillo, A. Lollies, D. Bennett, M. B. Schenker and F.M. Mitloehner. 2012. Activation of inflammatory responses in human U937 macrophages by particulate matter collected from dairy farms: an in vitro expression analysis of pro-inflammatory markers. *Environmental Health.* 11:17-26.
58. Hu, J., C. J. Howard, F. M. Mitloehner, P. G. Green, and M. J. Kleeman. 2012. Mobile Source and Livestock Feed Contributions to Regional Ozone Formation in Central California. *Env. Sci. & Technol.* 46: 2781-2789.
59. Place, S. E., and F. M. Mitloehner. 2012. Beef production in balance: considerations for life cycle analyses. *Meat Science.* 92: 179-181.
60. Mitloehner, F. M. and S. Place. 2012. Perspectives of the impacts of livestock production on climate change. *Advances in Animal Biosciences.* 2: 608-610.
61. Li C., W. Salas, R. Zhang, C. Krauter, A. Rotz, and F. M Mitloehner. 2012. Manure-

- DNDC: a Biogeochemical Process Model for Quantifying Greenhouse Gas and Ammonia Emissions from Livestock Manure Systems. *Nutrient Cycling in Agroecosystems*. 93: 163-200.
62. Zhao, Y, Y. Pan, J. Rutherford, F.M. Mitloehner. 2012. Estimation of the Interference in multi-gas measurements using the infrared photoacoustic Innova analyzer. *Atmosphere*. 3: 246-265.
 63. Garcia, J., D. Bennett, M. Schenker, F.M. Mitloehner. 2012. Occupational exposure to particulate matter and endotoxin for California dairy workers. *International Journal of Hygiene and Environmental Health* 216: 56-62.
 64. Garcia, J., D. H. Bennett, D. Tancredi, M. B. Schenker, D. Mitchell, S. J. Reynolds, R. Silva, G. P. Dooley, J. Mehaffy, and F. M. Mitloehner. 2012. Characterization of endotoxin collected on California dairies using personal and area based sampling methods. *Journal of Occupational and Environmental Hygiene*. 9: 580-591.
 65. Stackhouse-Lawson, K.R., C.A. Rotz, J.W. Oltjen, F.M. Mitloehner. 2012. Growth promoting technologies reduce the carbon footprint, ammonia emissions, and costs of California beef production systems. *J. Anim. Sci.* 90: 4656-4665.
 66. Stackhouse-Lawson, K.R., C.A. Rotz, J.W. Oltjen, F.M. Mitloehner. 2012. Carbon footprint and ammonia emissions of California beef production systems. *J Anim. Sci.* 90: 4641-4655.
 67. Clay, S., J. Dangl, J., D. Fischhoff, M. Jahn, D. Latham, F.M. Mitloehner, T. Sinclair, and C. Somerville. 2012. Agricultural Preparedness and the Agricultural Research Enterprise. *President's Council of Advisors on Science and Technology (PCAST)*. Washington DC. pp 1-55
 68. Garcia, J., D. H. Bennett, D. Tancredi, M.B. Schenker, D. Mitchell, and F.M. Mitloehner. 2013. A survey of particulate matter on California dairy. *J. Environm. Qual.* 42(1):40-7.
 69. McGarvey, J.A, R.B. Franco, J.D. Palumbo, R. Hnasko, L. Stanker and F.M. Mitloehner. 2013. Bacterial Population Dynamics and Chemical Transformations During the Ensiling of *Medicago sativa* (Alfalfa) and Subsequent Exposure to Air. *Journal of Applied Microbiology*. 114, 1661-1670.
 70. Hafner, S, Cody Howard, Richard E. Muck, Roberta B. Franco, Felipe Montes, Peter G. Green, Frank Mitloehner, Steven L. Trabue, C. Alan Rotz. 2013. Emission of Volatile Organic Compounds from Silage: Compounds, Sources, and Implications. *Atmospheric Environment*. 77: 827-839.
 71. Neumeier, C.J. and F.M. Mitloehner. 2013. Cattle biotechnologies reduce environmental impact and help feed a growing planet. *Anim. Front.* 3:36-41.

72. Stackhouse-Lawson, K., C.A. Rotz, J.W. Oltjen, F.M. Mitloehner. 2013. Growth promoting technologies reduce greenhouse gas, alcohol, and ammonia emissions from feedlot cattle. *J. Anim. Sci.* 90:4656-4665.
73. Wang, Q., M. Burger, T. A. Doane, W. R. Horwath, A. R. Castillo, and F. M. Mitloehner. 2013. Effects of inorganic versus organic copper on denitrification in peat soil. *Adv. Anim. Biosciences.* 4: 42-49.
74. Place S.E. and Mitloehner F.M. 2013. Air quality issues in sustainability: Greenhouse gases and volatile organic compounds. In: *Sustainable Animal Agriculture*, E. Kebreab (ed). pp124-136.
75. Place, S., and F. M. Mitloehner. 2014. The Nexus of Environmental Quality and Livestock Welfare. *Annual Review of Animal Biosciences.* 2: 555-569.
76. Pitesky, M., A. Gunasekara, C. Cook, F. M. Mitloehner. 2014. Adaptation of Agricultural and Food Systems to a Changing Climate and Increasing Urbanization. *Current Sustainable Renewable Energy Reports* 1: 43-50.
77. Zhao, Y., S. Cliff, A. Wexler, W. Javed, K. Perry, Y. Pan, and F.M. Mitloehner. 2014. Measurements of Size- and Time-resolved Elemental Concentrations at a California Dairy Farm. *Atmospheric Environment* 94: 773-781.
78. Werth S.J., E.G. Schusterman, C.B. Peterson, and F.M. Mitloehner. 2014. Concentrated Animal Facilities and Air Quality Issues. *Encyclopedia of Agriculture and Food Systems.* 1: 283-290.
79. Hafner, S.D., R. B. Franco, L. Kung Jr, C.A. Rotz, and F.M. Mitloehner. 2014. Potassium sorbate reduces production of ethanol and 2 esters in corn silage. *Journal of Dairy Science.* 97:7870-8.
80. Mitchell, D.C., T.L. Armitage, M.B. Schenker, D.H. Bennett, D. Tancredi C. Eastman Langer, S.J. Reynolds, G. Dooley, J. Mehaffy, F.M. Mitloehner. 2015. Particulate Matter, Endotoxin, and Worker Respiratory Health on Large Californian Dairies. *Journal of Occupational and Environmental Medicine.* 57:79-87.
81. Stackhouse-Lawson, K. R., C.B. Tucker, M.S. Calvo-Lorenzo, F.M. Mitloehner. 2015. Effects of growth-promoting technology on feedlot cattle behavior in the 21 days before slaughter. *Applied Animal Behaviour Science.* 162: 1-8.
82. Nesheim, M.C, K. Clancy, J.K. Hammitt, R.A. Hammond, D. Haver, D. Jackson-Smith, R. S. Johnson, J.D. Kinsey, S.M. Krebs-Smith, M. Liebman, F.M. Mitloehner, K.M. Pollack, P.J. Stover, K.M. Swanson, and S.M. Swinton. 2015. A Framework for

Assessing Effects of the Food System. *National Academies Press*. Washington DC. pp 1-500.

83. Arteaga V., D. Mitchell, T. Armitage, D. Tancredi, M. Schenker, and F.M. Mitloehner. 2015. Cage versus non-cage laying hen housing: Worker respiratory exposures. *Journal of Agromedicine*. 20:245-255.
84. Mitchell D., V. Arteaga, T. Armitage, F.M. Mitloehner, D. Tancredi, N. Kenyon, and M. Schenker. 2015. Cage versus non-cage laying hen housing: Worker respiratory health. *Journal of Agromedicine*. 20:256-264.
85. Arteaga V., D. Mitchell, G.E. Matt, P. Quintana, J. Schaeffer, S. Reynolds, M.B. Schenker, and F.M. Mitloehner. 2015. Occupational Exposure to Endotoxin in PM2.5 and Pre-and Post-Shift Lung Function in California Dairy Workers. *Journal of Environmental Protection*. 6, 552-565.
86. Ledgard, S., B. Henry, M. Benoit, C. Devendra, J. Dollé, A. Gac, , C. Lloyd, H. Zerfas, F. M. Mitloehner. 2015. Greenhouse gas emissions and fossil energy use from small ruminant supply chains, guidelines for assessments. Food and Agricultural Organization of the United Nations, Livestock Environmental Assessment and Performance Partnership. Pg. 1-81.
87. Thoma, G., S. Wiedemann, J. C. P. Palhares, M. A. Saleque, M. Kanzaki, A. Missohou, I. Kyriazakis, J. Gittins, J. Burr, F. M. Mitloehner. 2015. Greenhouse gas emissions and fossil energy use from poultry supply chains, guidelines for assessments. Food and Agricultural Organization of the United Nations, Livestock Environmental Assessment and Performance Partnership. Pg. 1-107.
88. Vellinga, T., S. Bertrand, N Martin, H. Luttikholt, B. Caputi , H. van der Werf, L. Yue, R. Bhatta, S. Arora, B. Lukuyu, P. P. Crosson, H. Meissner, A. Flysjo, H. Blonk, F. M. Mitloener. 2015. Environmental performance of animal feeds supply chains, guidelines for assessments. Food and Agricultural Organization of the United Nations, Livestock Environmental Assessment and Performance Partnership. Pg. 1-157
89. Lin, X., R. Zhang, H. Elmashed, S. Jiang, and F.M. Mitloehner. 2016. Nutrient Flow and Distribution in Conventional Cage, Enriched Colony and Aviary Layer Houses. *Poultry Science*. 95, 213-224.
90. Calvo-Lorenzo, M.S., L.E. Hulbert, A.L. Fowler, A. Louie, L.J. Gershwin, K.E. Pinkerton, M.A. Ballou, K.C. Klasing, and F.M. Mitloehner. 2016. Wooden hutch space allowance influences male Holstein calf health, performance, daily lying time, and respiratory immunity. *Journal of Dairy Science*. DOI: 10.3168/jds.2016-10888
91. Caro, D., E. Kebreab, and F. M. Mitloehner. Mitigation of enteric methane emissions from global livestock systems through nutrition strategies. 2016. *Climatic Change*. 137, 467-480. DOI: 10.1007/s10584-016-1686-1

92. Zhao, Y., A S. Wexler, F. Hase, Y. Pan, F.M. Mitloehner. 2016. Detecting Nitrous Oxide in Complex Mixtures using FTIR Spectroscopy: Silage Gas. *Journal of Environmental Protection*. 7, 1719-1729
93. Bonifacio, H.F., C.A. Rotz · S.D. Hafner, and F.M. Mitloehner. 2016. A process-based emission model of volatile organic compounds from silage sources on farms. *Atmospheric Environment*. 152, 85–97
94. Sainz, R.D., Dykier, K.C., Mitloehner, F.M., Oltjen J.W. 2016. Performance and body composition in high and low RFI beef cattle. EAAP, (137) 101-103.
95. Sainz, R.D., Dykier, K.C., Mitloehner, F.M., Oltjen, J.M. 2016. Energy metabolism in high and low RFI beef cattle. EAAP, (137) 103-105.
96. Calvo-Lorenzo, M.S., L. E. Hulbert, M. A. Ballou, A. L. Fowler, Y. Luo, K. C. Klasing, and F.M. Mitloehner. 2017. Space allowance influences individually housed Holstein bull calf innate immune measures and standing behaviors after castration at 3 weeks of age. *Journal of Dairy Science*. 100: 2157-2169.
97. Mitloehner, F., J. Dailey, J. Morrow, and J. McGlone. 2017. Impact of feed delivery pattern on aerial particulate matter and behavior of feedlot cattle. *Animals*. 7, 1-11.
98. Mitloehner, F.M., and M. Cohen. Impacts and mitigation of emissions from dairy feeds on air quality. 2017. *Large Dairy Herd Management* 3rd ed. (editor: D. Beede), ADSA, Champaign, IL. Pp: 47-59.
99. Byrnes, R., V. Eviner, E. Kebreab, W. R. Horwath, L. Jackson, B. M. Jenkins, S. Kaffka, A. Kerr, J. Lewis, F. M. Mitloehner, J. P. Mitchell, and K. M. Scow. 2017. Review of research to inform California’s climate scoping plan: Agriculture & working land. *California Agriculture*. 71:160-167.
100. Davidson, M., J. Schaeffer, M.L. Clark, S. Magzamen, E.J. Brooks, T.J. Keefe, M. Bradford, N. Roman-Muniz, J. Mehaffy, G. Dooley, J. Poole, F.M. Mitloehner, S. Reed, M.B. Schenker, and S.J. Reynolds. 2018. Personal Exposure of Dairy Workers to Dust, Endotoxin, Muramic Acid, Ergosterol and Ammonia on Large-Scale Dairies in the High Plains Western United States. *Journal of Occupational and Environmental Hygiene*.15: 1-12.

101. Drewnowski, A., A. Havelaar, C. Sere, C. de Fraiture, F. Mitloehner, H. Steinfeld; H. Melgar-Quinonez, J. Ingram, M. Heller, P. van 't Veer, R. Clemens, S. Fan, T. Garnett, T. Marsden, and T. Griffin. 2018. The Chicago Consensus on Sustainable Food Systems. *Frontiers in Nutrition*. 4: 1-6.
102. Caro, D., S.J. Davis, E. Kebreab, F.M. Mitloehner. 2018. Land-use change emissions from soybean feed embodied in Brazilian pork and poultry meat. *Journal of Cleaner Production*. 172:2646-2654.
103. Mitloehner, F.M. 2018. Addressing the 2050 Food Challenge – a Sustainable Solution Must Include Livestock. *International Animal Health Journal*. 5: 56-59.
104. Xiao-Shi Wei, Chuan-Jiang Cai, Jia-Jun He, Chao Yu, F.M. Mitloehner, Bao-Long Liu, Jun-Hu Yao, and Yang-Chun Cao. 2018. Effects of biotin and nicotinamide supplementation on glucose and lipid metabolism and milk production of transition dairy cows. *Animal Feed Science and Technology* 237:106-117.
105. Lai, E., M. Hess, and F.M. Mitloehner. 2018. Profiling of the Microbiome Associated With Nitrogen Removal During Vermifiltration of Wastewater From a Commercial Dairy. *Frontiers in Microbiology*. DOI: 10.3389/fmicb.2018.01964
106. Dougherty, H.C., J.W. Oltjen, F.M. Mitloehner, E.J. DePeters, L.A. Pettey, D. Macon, J. Finzel, K. Rodrigues, and E. Kebreab. 2018. Carbon and blue water footprints of California sheep production. *Journal of Animal Science*. DOI: 10.1093/jas/sky442
107. McGarvey, J.A., S. Place, J. Palumbo, R. Hnasko, and F.M. Mitloehner. 2018. Dosage Dependent Effects of Monensin on the Rumen Microbiota of Lactating Dairy Cattle. *Microbiology Open*. DOI: 10.1002/mbo3.783
108. Hulbert, L.E, M.S. Calvo-Lorenzo, M.A. Ballou, K.C. Klasing, and F.M. Mitloehner. 2019. Space allowance influences individually housed Holstein male calves' age at feed consumption, standing behaviors, and measures of immune resilience, before and after step-down weaning. *Journal of Dairy Science*.;102: 4506-4521. doi: 10.3168/jds.2018-15368.
109. Dougherty, H.C., A. Ahmadi, J.W. Oltjen, F. M. Mitloehner, and E. Kebreab. 2019. Modeling production and environmental impacts of small ruminants– Incorporation of existing ruminant modeling techniques, and future directions for research and extension. *Professional Animal Scientist*. 35, 114-129
<https://doi.org/10.15232/aas.2018-01753>
110. Mitloehner, F.M. 2019. The Welfare of Cattle. *Livestock and Climate Change: Facts and Fiction*. In: Eds: T. Engle, D. Klingborg, B. Rollin. CRC Press. Chapter 4. Pp 27-30. *CRC Press*.

111. Pitesky, M., J. James, P. Pandey, F.M. Mitloehner, M. Cadena and S.Aly. 2019. Regional effects of climate change on California animal agriculture and options for farmers to respond through husbandry adaptation and greenhouse gas mitigation. *CAB Reviews* 14, DOI [10.1079/PAVSNNR201914002](https://doi.org/10.1079/PAVSNNR201914002)
112. Peterson, C., H. El Mashad, Y. Zhao, Y. Pan and F.M. Mitloehner. 2020. Effects of SOP Lagoon Additive on Gaseous Emissions from Stored Liquid Dairy Manure. *Sustainability*. 12, 1393; <https://doi.org/10.3390/su12041393>
113. Drwencke, A., T. Grazyne, M. Stevens, V. Narayanan, A. Carrazco, F.M. Mitloehner, T. Pistochini, and C. Tucker. 2020. Innovative cooling strategies: dairy cow responses, water and energy use. *J Dairy Science*. <https://doi.org/10.3168/jds.2019-17351>
114. Raiten, Dan. J., L. H Allen, J. L Slavin, F.M Mitloehner, G.J. Thoma, P.A Haggerty, and J.W Finley. Understanding the Intersection of Climate/Environmental Change, Health, Agriculture and Improved Nutrition: A Case Study on Micronutrient Nutrition and Animal Source Foods. *Current Developments in Nutrition*, 1-8.
115. Karcher, D., M. Endres, R. Grant, F.M. Mitloehner, M. Estienne, and K. Koelk. 2020. Chapter 3: Husbandry, Housing, and Biosecurity. In: Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching, Federation of Animal Science Societies. https://www.adsa.org/Portals/0/SiteContent/docs/AgGuide4th/Ag_Guide_4th_ed.pdf
116. Carrazco, A.V., C.B. Peterson, Y. Zhao, Y. Pan, J.J. McGlone, E.J. DePeters, F.M. Mitloehner. 2020. The impact of essential oil feed supplementation on enteric gas emissions and production parameters from dairy cattle. *Sustainability* 12, 10347; doi:10.3390/su122410347
117. Ross, E.G., C.B. Peterson, A.V. Carrazco, S.J. Werth, Y. Zhao, Y. Pan, E.J. DePeters, J.G. Fadel, M.E. Chiodini, L. Poggianella and F.M. Mitloehner. 2020. Effect of SOP “STAR COW” on Enteric Gaseous Emissions and Dairy Cattle Performance. *Sustainability* 12, 10250; doi:10.3390/su122410250
118. Haiden Britt, J, R.A. Cushman, C.D. Dechow, H. Dobson; P. Humblot; M.F. Hutjens, G.A. Jones, F.M. Mitloehner, P.L. Ruegg, I.M. Sheldon, J.S. Stevenson. 2021. Review Perspectives on Future Sustainability of High Performing Dairy Cows. *J Dairy Science*. *In press*.
119. Ross G.E, C.B Peterson, Y. Zhao, Y. Pan, F.M. Mitloehner. 2021. Manure Flushing versus Scraping in Dairy Freestall Lanes Reduces Gaseous Emissions. *Sustainability*. *In press*.

120. Ross, E.G., J.J. Ball, S.J. Werth, S.E. Mejia-Turcios, Y. Zhao, Y. Pan, P.C. Taube, T. R. Meinert, N.K. Van Engen, F. M. Mitloehner. 2021. Effect of ractopamine hydrochloride on environmental gas emissions, growth performance, and carcass characteristics in feedlot steers. *Journal of Animal Science*. In press

GRANTS (2002-2021; total extramural funding = \$12,200,000)

Air Emission Mitigation Techniques and Technologies for California Dairies

Agency: State Water Resources Control Board (SWRCB) & UC matching
Amount: \$600,000
P.I.: F. Mitloehner,
Co-PIs: J. Fadel, P. Robinson, T. Harter, and R. Zhang
Period: Jan 03 – Dec 06

UC Equipment Matching Funds Program

Agency: UC Davis, Vice Chancellor for Research
Amount: \$140,000
P.I.: F. Mitloehner
Period: Jan 03 – Dec 06

Development of an Air Module Curriculum for the California Dairy Quality Assurance Program

Agency: Environmental Protection Agency (EPA)
Amount: \$50,000
P.I.: F. Mitloehner,
Co-PIs: D. Meyer, and M. Payne
Period: Mar 03 – Mar 05

Laser-based Sensors for Monitoring Ammonia Emissions

Agency: USDA-SBIR I
Amount: \$79,000 (\$20,000 for Mitloehner portion)
P.I.: C. Patel (Pranalytica) and F. Mitloehner
Period: Jul 03 – Dec 05

Laser-based Sensors for Monitoring Ammonia Emissions

Agency: USDA-SBIR II
Amount: \$350,000 (\$75,000 for Mitloehner portion)
P.I.: C. Patel (Pranalytica) and F. Mitloehner
Period: Jul 05 – Dec 06

Effect of Atmospheric Ammonia on Pig Welfare

Agency: National Pork Board (NPB)

Amount: \$40,000
P.I.: F. Mitloehner
Period: Dec 03 – Jul 05

Volatile Organic Compound Emissions from Cows Fed Typical California Rations

Agency: Environmental Protection Agency (EPA)
Amount: \$75,000
P.I.: F. Mitloehner,
Co-PIs: B. Flocchini, P. Robinson, J. Fadel, and E. DePeters
Period: Dec 03 – Jun 05

Developing a Process-based Model for Greenhouse Gases for California Dairies

Agency: California Energy Commission
Amount: \$500,000 (\$119,000 for Mitloehner portion)
P.I.: B. Salas and F. Mitloehner,
Period: May 03 – Jun 07

Volatile Fatty Acids, Amine, and Phenol Emissions from Cows and their waste

Agency: California Air Resources Board (CARB)
Amount: \$200,000
P.I.: F. Mitloehner,
Co-PIs: S. Trabue (USDA-ARS) and J. Koziel (ISU)
Period: Oct 05 – Sep 06

National Air Emissions Monitoring Project- Air Emissions from California Dairies

Agency: Ag Air Research Council (AARC)
Amount: \$250,000
P.I.: F. Mitloehner,
Period: Jan 07 – May 10

Characterization of Dairy Waste Management Strategies with Regard to Pathogens and Air quality

Agency: US Dept of Agriculture – Agricultural Research Service (USDA-ARS)
Amount: \$30,300
P.I.: F. Mitloehner
Co-PIs: R. Zhang
Period: Mar 05 – Dec 06

Process-Based Farm Emission Model for Estimating Volatile Organic Compound Emissions from California Dairies

Agency: California Air Resources Board (CARB)
Amount: \$300,000
P.I.: R. Zhang
Co-PIs: F. Mitloehner, Allen Goldstein (UC Berkeley)
Period: Jun 06 – Jun 09

Estimating and Reducing Air Emissions from Dairy Feeding Operations

Agency: USDA/CSREES
Amount: \$278,000
P.I.: F. Mitloehner
Co-PIs: R. Zhang, J. McGarvey, E. DePeters, C. Krauter
Period: June 06 – Sep 09

Respiratory Exposures and Health of Workers on California Dairies

Agency: National Institute of Occupational Health and Safety (NIOSH)
Amount: \$1,700,000
P.I.: F. Mitloehner
Co-PI: M. Schenker, D. Bennett, C. Vogel
Period: Sep 06- Sep 2011

Effects of Dietary Rumensin on Greenhouse Gas and Volatile Organic Compounds Emissions from Lactating Dairy Cows

Agency: Ely Lilly - ELANCO
Amount: \$230,000
P.I.: F. Mitloehner
Co-PI: J. McGarvey
Period: Jan 2010 - Dec 2012

National Air Emissions Monitoring Project- Air Emissions from California Dairies

Agency: California Department Food and Agriculture (CDFA)
Amount: \$150,000
P.I.: F. Mitloehner,
Period: Sep 09 – Feb 10

Alcohol Emissions from California Dairies

Agency: California State University (CSU Foundation)
Amount: \$138,000
P.I.: F. Mitloehner,
Period: Sep 08 – Feb 11

Monitoring and modeling gaseous emissions from swine production systems

Agency: Applied Geosolutions
Amount: \$292,000
P.I.: F. Mitloehner
Period: Oct 10 – Oct 12

Coalition for Sustainable Egg Supply - Exposure and Health

Agency: Center for Food Integrity
Amount: \$454,000
P.I.: F. Mitloehner
Period: Sep 10 – Sep 14

Evaluation of volatile organic compounds, nitrogen oxide, carbon dioxide, ammonia and dry matter losses in alfalfa silage treated with inoculant blends

Agency: DeLaval
Amount: \$40,000
P.I.: F. Mitloehner
Period: May 11 – Dec 11

Effects of Micromineral Additives in Dairy Feed on Greenhouse Gas Emissions from Cow Manure

Agency: AllTech
Amount: \$50,000
P.I.: F. Mitloehner,
Period: Mar 11 – Mar 12

Combined Heat and Power Research on Commercial Dairy Farm

Agency: California Energy Commission
Amount: \$848,000
P.I.: F. Mitloehner
Period: Jun 12 – Nov 14

Effects of Nutritional Additives on Greenhouse Gas Emissions from Cattle

Agency: Novus International, Inc.
Amount: \$72,000
P.I.: F. Mitloehner
Period: Dec 11 – Dec 12

Reducing Greenhouse Gas Emissions from Cattle Nutritional Management

Agency: Alltech
Amount: \$45,000
P.I.: F. Mitloehner
Period: Jul 12 – May 13

Reducing Dairy Silage Emissions for Improved Air Quality and Productivity

Agency: California Air Resources Board (CARB)
Amount: \$400,000
P.I.: F. Mitloehner
Period: Jul 12 – Jun 16

Veterinary Good Clinical Study (vGCP): Effect of Feeding LY488756 on Environmental Emissions when fed to Finishing Beef Cattle for 91 Days

Agency: Ely Lilly
Amount: \$4,000,000
P.I.: F. Mitloehner
Period: Oct 12 - Dec 17

Benchmarking of pre-AMMP dairy emissions

Agency: California Department of Food and Agriculture (CDFA)
Amount: \$580,000
P.I.: F. Mitloehner
Period: Jul 17 – Jun 19

Benchmarking of post-AMMP dairy emissions I

Agency: California Air Resources Board (CARB)
Amount: \$400,000
P.I.: F. Mitloehner/ M. Kleeman
Period: Jul 17 – Jun 19

Benchmarking of post-AMMP dairy emissions II

Agency: California Air Resources Board (CARB)
Amount: \$290,000
P.I.: F. Mitloehner
Period: Jul 18 – Jun 20

Emissions of Greenhouse Gas and Criteria pollutants from Dairy Manure Pre- and Post Anaerobic Digestion

Agency: California Energy Commission (CEC)
Amount: \$250,000
P.I.: F. Mitloehner
Period: Feb 21 – Jun 23