Frank Freedman, PhD, CCM

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Synopsis

25+ years of experience as a researcher and consulting meteorologist and air pollution modeler. Extensive experience in modeling using WRF, AERMOD and other models. Expertise in atmospheric boundary layers and turbulence.

Education & Certifications

Certified Consulting Meteorologist (CCM), American Meteorological Society, 2010

PhD (2003): Stanford University, Civil and Environmental Engineering
(Thesis: Development of two-equation turbulence model for atmospheric boundary layers)

MS (1996): San Jose State University, Meteorology
BS (1992): San Jose State University, Meteorology

Career

Senior Scientist, EnviroComp Consulting Inc. (2005 – current)
Lecturer / Researcher, San Jose State University (SJSU, 2005 – current)
Principal Investigator / Project Lead, Health and Air Quality Applied Science Team (NASA, 2016 – 2020)
Postdoctoral Researcher, National Center for Environmental Prediction (NCEP, 2003 – 2004)

Projects (Consulting, EnviroComp)

- Modeling of airborne particulates and air toxics released from an accidental oil tank facility fire.
- Air quality impacts of methane and air toxics released from a natural gas storage facility rupture.
- Review of air quality permits and emissions of Ethylene Oxide from a sterilization facility.
- Review of health risk assessment and fenceline air quality measurements from a refinery.
- Review of air toxic emissions and health risk assessment from a lead recycling facility.
- Cr-VI emissions and dispersion modeling from remediation of a water treatment plant.
- Carcinogenic air pollution impacts from long-term exposure to oil and gas field emissions.
- Assessment of airborne odors from waste management facilities and refineries.
- Estimation of cumulative downwind metal deposition from past emissions from a copper smelter.
- Review of permitted emissions and dispersion modeling from cement foundries.

Projects (Research)

(NASA) Developed spatial fields of air pollution concentrations across various regions of California for exposure assessment. Fields captured pollution due to ambient urban air, agricultural sources, windblown dust, and wildfire smoke. Data inputs included in-situ station measurements from routine and specialized air quality networks, satellite measurements, and geospatial land-use fields.

(NASA) Deployed and evaluated air particulate measurements from a network of low-cost air particulate samplers. Samplers deployed at various locations in the SF Bay Area, Boston and New York City.

(SJSU) Applied the WRF HYSPLIT-STILT Lagrangian particle air pollution dispersion model to estimate hourly urban CO2 concentration enhancements (above background) at a downtown San Jose site.

(NCEP) Worked with an international team of scientists to improve national weather and climate prediction models to improve model representations of stable atmospheric boundary layers.

University Instructor

I have taught several graduate and upper-division courses in air pollution, computational methods and advanced physics at San Jose State University:

CME177 – Air Pollution Engineering
METR131 – Air Pollution Meteorology
METR/ENVS113 – Atmospheric Pollution
METR112 – Global Climate Changes
METR241 – Mesoscale Numerical Modeling & Parameterizations
METR240 – Numerical Methods in Meteorology
METR136 – Statistical Methods in Meteorology
METR130 – Boundary Layer Meteorology
METR121 – Atmospheric Dynamics

Publications

Journals

Freedman, F. R., P. English, J. Wagner, Y. Liu, A. Venkatram, D. Q. Tong, M. Z. Al-Hamdan, M. Sorek-Hamer, R. Chatfield, A. Rivera, and P. L. Kinney, 2020: Spatial Particulate Fields during High Winds in the Imperial Valley, California. Atmosphere., 11, https://www.mdpi.com/2073-4433/11/1/88.

Freedman, F. R., K. L. Pitts, and A.F.C. Bridger, 2014: Evaluation of CMIP climate model hydrological output for the Mississippi River Basin using GRACE satellite observations. J. Hydrol., 519, https://www.sciencedirect.com/science/article/pii/S0022169414008312.

Freedman, F. R., and M. Z. Jacobson, 2003: Modification of the standard ε-equation for the stable ABL through enforced consistency with Monin-Obukhov similarity theory, Bound. Layer Meteor., 106, http://www.sjsu.edu/people/frank.freedman/docs/FJ2003_stable.pdf.

Freedman, F. R., and M. Z. Jacobson, 2002: Transport-dissipation analytical solutions to the E-ε turbulence model and their role in predictions of the neutral ABL, Bound. Layer Meteor., 102, http://www.sjsu.edu/people/frank.freedman/docs/FJ2002_neutral.pdf.

O'Neill, S.O, M. Diao, S. Raffuse, M. Z. Al-Hamdan, M Barik, Y, Jia, S. Reid, Y. Zou, D. Tong, J. West, J. Wilkins, A. Marsh, F. Freedman, J. Vargo, N. K. Larkin, E. Alvarado, and P. Loesch, 2021: A multi-analysis approach for estimating regional health impacts from the 2017 Northern California wildfires, J. Air Waste Manage. Assoc., 71, 791 – 814. https://www.tandfonline.com/doi/full/10.1080/10962247.2021.1891994.

Y. Ding, I. Cruz, F. Freedman, and A. Venkatram, 2021: Improving spatial resolution of PM2.5 measurements during wildfires, Atmos. Pollution Res., 12, https://www.sciencedirect.com/science/article/abs/pii/S1309104221001070

McRae I., F. Freedman, A. Rivera, X. Li, J. Dou, I. Cruz, C. Ren, I. Dronova, H. Fraker, and R. Bornstein, 2020: Integration of the WUDAPT, WRF, and ENVI-met models to simulate extreme daytime temperature mitigation strategies in San Jose, California, Build. Env., 184, https://doi.org/10.1016/j.buildenv.2020.107180.

Stowell J, Bi J, Al-Hamdan M, Lee H, Lee S, Freedman F, Kinney P, Liu Y. 2020. Estimating PM2.5 in Southern California using satellite data: factors that affect model performance. Environ Res Let. 15, https://iopscience.iop.org/article/10.1088/1748-9326/ab9334.

Bi J, Stowell J, Seto E, English P, Al-Hamdan M, Kinney P, Freedman F, Liu Y. 2020. Contribution of Low-Cost Sensor Measurements to the Prediction of PM2.5 Levels: A Case Study in Imperial County, California, USA. Environ Res. 180, https://doi.org/10.1016/j.envres.2019.108810.

Castillo M., J. Wagner, G. S. Casuccio, R. R. West, F. R. Freedman, H. M. Eisle, Z. Wang, J. P. Yip, P. L. Kinney, 2019: Field testing a low-cost passive aerosol sampler for long-term measurement of ambient PM2.5 concentrations and particle composition, Atmos. Environ., 216, https://doi.org/10.1016/j.atmosenv.2019.116905.

Ahangar, F.E., F. R. Freedman, and A. Venkatram, 2019: Using Low-Cost Air Quality Sensor Networks to Improve the Spatial and Temporal Resolution of Concentration Maps, Int. J. Environ. Res. Pub. Health, 16, https://www.mdpi.com/1660-4601/16/7/1252.

Zannetti, P., A. D. Daly, and F. R. Freedman, 2015: Dispersion modeling of particulate matter containing hexavalent chromium during high winds in southern Iraq, *J. Air Waste Manage. Assoc.,* **65**, https://www.tandfonline.com/doi/full/10.1080/10962247.2014.981317.

Svensson G. and co-authors, 2011: Evaluation of the diurnal cycle in the atmospheric boundary layer over land as represented by a variety of single column models – the second GABLS experiment, *Bound. Layer Meteor.*, **140**, 177 – 206, https://link.springer.com/article/10.1007/s10546-011-9611-7.

Cuxart and co-authors, 2005: Single-column model intercomparison for a stably-stratified atmospheric boundary layer, *Bound. Layer Meteor.,* **118***,* 273-303, https://link.springer.com/article/10.1007/s10546-005-3780-1

Gopalakrishnan, S. G., F. R. Freedman, M. Sharan, and T.V.B.P.S. Rama Krishna, 2005: A Model Study of the Strong and Weak Wind, Stably Stratified Nocturnal Boundary Layer: Influence of Gentle Slopes, *Pure and Applied Geophys.,* **162***,* 1795-1809, https://link.springer.com/article/10.1007/s00024-005-2693-8

Sistla, G., N. Zhou, W. Hao, J. Y. Ku, S. T. Rao, R. Bornstein, F. Freedman, and P. Thunis, 1996: Effects of uncertainties in meteorological inputs on Urban Airshed Model predictions and ozone control strategies, *Atmos. Environ.*, 30, 2011-2025, https://doi.org/10.1016/1352-2310(95)00268-5.

Conferences

A satellite-dispersion modeling system to generate high-resolution downscaled PM2.5 fields, CMAS 2017 Bi-Annual Conference, October 23-25, 2017, UNC Chapel Hill, Chapel Hill, NC. Abstract available at: https://www.cmascenter.org/conference//2017/abstracts/freedman_satellite-dispersion_2017.pdf

WUDAPT, uWRF, ENVI-MET Coupling for Site-Specific Urban Heat Island Analysis in San Jose, CA, CMAS 2017 Bi-Annual Conference, October 23-25, 2017, UNC Chapel Hill, Chapel Hill, NC, w co-authors.

HYSPLIT-STILT Simulations of Urban Background Concentrations Affecting Central San Jose, CA: Applications for CO2 and PM2.5, MAC-MAQ, Meteorology and Climate – Modeling for Air Quality (MAC-MAQ) Conference 2017, UC Davis (Davis, CA).

Atmospheric Residual Layers: WRF/HYSPLIT Modeling for Better Understanding in Complex Terrain, AGU Fall Meeting, San Francisco, CA, 19 December 2014

Assessment of Water Storage Trends and Distributions in the Mississippi River Basin as Simulated by IPCC Models and Compared to GRACE Satellite Data, 2013 Workshop on the use of GRACE Data for Water Cycle Analysis and Climate Modeling, NASA Jet Propulsion Laboratory / California Institute of Technology, July 15 – 17, 2013, Pasadena, CA.

Development of AERMOD-ready Meteorological Input Files for the South Coast Air Quality Management District", 2009 Annual Conference and Exhibit, Air & Waste Management Association, Detroit (MI), 2009.