ROBERT J. YAMARTINO, PH.D.

SENIOR ADVISOR, ENVIROCOMP CONSULTING, INC.

EDUCATION

Ph.D. (Physics) Stanford University
B.S. (Physics/Math) Tufts University

PROFESSIONAL HISTORY

Chief Scientist, Integrals Unlimited: 2000 to present
Earth Tech / Sigma Research Corporation: 1985 to 2000
Environmental Research & Technology, Inc., (ERT): 1981 to 1985
Geomet G.m.b.H. (West Berlin): 1980 to 1981
Argonne National Laboratory: 1974 to 1980

PROFESSIONAL SUMMARY

Dr. Yamartino is an internationally recognized expert on the development of specialized air quality models. During his 33 years of professional experience, he has developed and evaluated plume, puff, Lagrangian particle, and Eulerian grid models applicable to a wide range of spatial and temporal scales. He has made modeling contributions on such diverse topics as reactive plumes, surface depletion of plumes, urban ozone, acidic deposition, high-fidelity numerical advection, low wind speed dispersion, concentration fluctuations, hybrid source-receptor analyses, street canyon and garage ventilation, airport air quality, and turbulence statistics.

On the micro-scale, he was the principal developer of the Canyon-Plume-Box (CPB) series of urban street canyon models under programs sponsored by the German EPA (UBA) and subsequently by the U.S. DOT's FHWA and FAA. In 2002, FHWA released his fully-documented CPB-3 model. He recently co-developed the Micro-CALGRID model, which resolves the impact of vehicle emissions on ozone and NO_2 concentrations in complex urban environments at spatial resolutions of a few meters. He recently adapted the TKE-based, vehicle turbulence module he developed for Micro-CALGRID to a simple equation for vehicle-induced mixing, applicable to traditional plume-based, mobile-source dispersion models.

On the scale of airports, he refined models for plume rise and dispersion of engine exhaust from military and commercial jet aircraft. These model refinements were based on extensive analyses of high-time resolution monitoring experiments at Washington National and Dulles Airports were implemented into the Airport Vicinity Air Pollution (AVAP-II) model and are now used in the FAA/USAF's Emissions and Dispersion Modeling System (EDMS) for Civilian Airports and Air Force Bases. He has also compared certain aspects of the EDMS with AVAP-II model and various EPA Guideline models.

On the urban through meso-scale, he has developed: a reactive plume model for large TVA power plant plumes; a refined stratified flow computational algorithm for the EPA's Complex Terrain Dispersion Model (CTDM-PLUS); and the Kinematic-Simulation Particle (KSP) model, a synthetic-turbulence-based dispersion model capable of predicting concentration fields for times as short as a second and on spatial scales from meters to a thousand kilometers. He also developed the integrated puff, or slug, algorithm for the CALPUFF and AUSPUFF models, refined integration methods for MESOPUFF and CALPUFF/AUSPUFF, and has contributed to development of the CALMET/AUSMET models.

In the meso-/regional-scale photochemical modeling arena, Dr. Yamartino managed the development of the CALGRID photochemical model for the California ARB, designed and coded all of the model's transport and diffusion modules, and subsequently directed a SCAQMD/ARB funded effort to evaluate the model using the SCAQS data base. He later developed a high-fidelity, nested grid algorithm for the North Carolina team (NCSC) developing the MODELS-3 photochemical modeling system for U.S. EPA and, more recently, has developed a refined horizontal diffusivity formulation and computational module for use in the ARB's SARMAP Air Quality Model (SAQM). For the last several years, he has been involved in a European Community driven, and German EPA (UBA) sponsored, effort to upgrade the capabilities of the merged REM3 and CALGRID models to yield a PC-based system capable of assessing compliance and control strategy effectiveness relative to the EC's growing-season and annual average oxidant and particulate standards.

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PROJECT EXPERIENCE

Plume-, Puff-, and Particle-Modeling of Atmospheric Transport and Dispersion

- **Cambridge Environmental, Inc.:** Reviewed CALMET and CALPUFF modeling approach and input files used in the Levy et al. (2000) report on the "Estimated Public Health Impacts of Criteria Pollutant Air Emissions from Nine Fossil-Fueled Power Plants in Illinois". This analysis involved evaluation of the contributions of specific CALMET/CALPUFF algorithms to the overall biases and uncertainties of that modeling study.

- **Egan Environmental, Inc**.: Refined interfaces between the prognostic meteorological model, MM-5, and CALMET and applied the CALMET/CALPUFF modeling system to a high-resolution study of atmospheric flow and dispersion over the tri-coastal, upper Cape Cod region. Analysis of the model results highlight the strengths of this modeling system in dealing with complex, 3-d, sea- and land-breeze circulations, and will serve as the basis for several model refinement recommendations.

- **Umweltbundesamt (German EPA):** Developed and evaluated an atmospheric transport and dispersion model based on the kinematic simulation of turbulence. The Kinematic-Simulation Particle (KSP) modeling system incorporates near-source plume dynamics, pollutant chemistry and aerosol formation, deposition processes, and is designed to operate on domains ranging from tens of meters to over 1000 km.

- **Pacific Air and Environment, Pty Ltd.:** Provided assistance on refined deposition modeling to Moreton Bay using the AUSMET/AUSPUFF model combination. This effort involved assistance on preparation of input files as well as the development of some customized modeling subroutines.

- **California Air Resources Board (ARB):** Formulated, coded and tested the integrated-puff or "slug" algorithm that is a principal component of the CALPUFF model. Also, contributed a number of scientific algorithms as co-developer of the CALMET/CALPUFF modeling system during this ARB funded, and subsequent U.S. EPA funded, model system development and refinement efforts.

- **U.S. Army Atmospheric Sciences Laboratory:** Developed and tested model components for a high-time-resolution, mesoscale, multispectral smoke dispersion model. Individual particle trajectories were developed using the mean grid-scale winds, a kinematic simulation (KS) representation of long wavelength, sub-grid-scale turbulent eddies, plus Langevin equation modeling of the short wavelength turbulent eddies.

- **U.S. Environmental Protection Agency:** Evaluated a variety of approaches for estimating stable flow properties over two-dimensional ridges and three-dimensional hills. The resulting stratified/shear flow module was incorporated into the EPA's Complex Terrain Dispersion Model (CTDM) for regulatory applications.

- **Umweltbundesamt:** Developed an AIRSHED postprocessor, reactive plume model to estimate NO, NO_2, and O_3, concentrations in the near vicinity of major roadways. The reactive plume chemistry accounts for alternative pathways for NO oxidation to NO_2, such as peroxy radical reactions, in addition to the more routinely modeled ozone oxidation pathway.

- **U.S. DOT:** Analyzed an extensive base of wind tunnel flow, turbulence, and concentration data and developed an advanced, street canyon/highway cut-section, pollutant dispersion model for the Federal Highway Administration. Additional Federal Aviation Administration support enabled extension of this CPB-3 model to encompass airport terminal geometries including curved access roads and semi-open parking garages.

- **U.S. DOT/Federal Aviation Administration:** Refined models for the plume rise and dispersion of emissions from military and commercial jet aircraft. The model refinements were based on extensive analyses of high-time resolution monitoring experiments at Washington National and Dulles Airports.

- **U.S. Air Force:** Developed a comprehensive model for dispersion from point, line, and area sources under calm and low wind conditions.

- **Umweltbundesamt:** Provided guidance on algorithm selection and design for Germany's regulatory model. Developed a selectable-accuracy, adaptive algorithm for the evaluation of line and area source impacts as well as a module for dry deposition removal.

Eulerian Oxidant and Deposition Modeling

- **Umweltbundesamt (German EPA):** Developed a new, generalized-coordinate transport scheme for the model REM3/CALGRID. This transport scheme totally eliminates operator-splitting errors, conserves mass, ensures correct transport fluxes, and preserves the constancy of a uniform mixing ratio field -- all to a machine accuracy of about one part in a million.

- **California Air Resources Board (ARB):** Managed a research project for the development of a more realistic horizontal diffusivity approach for the ARB's SARMAP Air Quality Model (SAQM). This new formalism considers wavenumber-dependent numerical diffusion, off-diagonal diffusivity flux terms, and the ability of the prognostic meteorological model to reproduce wind shears.

- **U.S. Environmental Protection Agency:** Under subcontract to the North Carolina Supercomputer Center, a very low numerical diffusion, advection scheme was generalized to yield a mass-conserving, nested grid algorithm that can accommodate high mesh resolution ratios. This scheme was intended for use in the EPA's Models-3 System.

- **California Air Resources Board (ARB):** Managed development of the next-generation, photochemical grid model, CALGRID. This flexible model includes the most recent advances in atmospheric chemistry, dry deposition, and planetary boundary layer simulation. Also designed and tested the accurate, low numerical diffusion, transport algorithms for this model. This model will be used by the ARB for air resources management planning, including estimation of the effects of various control scenarios on ozone concentrations.

- **Ontario Ministry of the Environment:** Directed tasks associated with the structure and numerical methods of a 12 layer, acid rain grid model. Developed a new numerical advection scheme that uses results of spectral theory to reduce the numerical diffusion of cubic spline algorithms. Refined an adaptive Crank-Nicolson/fully-implicit scheme for vertical transport and diffusion.

- **Umweltbundesamt:** Developed an advection scheme for nested and telescoping grids that exhibits low dispersion and mesh interface reflectivity for local/global mesh ratios as high as ten.

- **Ontario Ministry of the Environment:** Designed and supervised the development of a dry deposition algorithm appropriate for dozens of trace atmospheric species under a wide range of atmospheric conditions, seasons and surface canopy types.

- **Empire State Electric Energy Research Corporation:** Managed the integration of a trajectory generator (ARL-ATAD) with a statistical model for chemical conversion and deposition of acidic sulfur and nitrogen species, and followed by a lake acidification module. This model provided planners with tool for evaluating the impact of various emissions scenarios on the CO_2 acidity and alkalinity of specific lakes in the Adirondacks and elsewhere in the Northeastern U.S. and Canada.

PUBLICATIONS

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Yamartino, R.J., D.G. Strimaitis, and T.A. Messier, 2002. Modification of Highway Air Pollution Models for Complex Site Geometries, Volumes 1: Data Analyses and Model Development. U.S. DOT/FHWA Final Report FHWA-RD-02-036, 233pp.

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Stern, R. and R.J. Yamartino, 2002. Development and first results of a new photochemical model for simulating ozone and PM-10 over extended periods. Proceedings of the 12th AMS/AWMA Conf. on the Applications of Air Pollution Meteorology, Norfolk, Virginia, May 20-24, AMS, Boston, MA.

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Yamartino, R. and D. Strimaitis, 1998. Refinement and Evaluation of the Kinematic Simulation Particle Model. EARTH TECH Final Report to the German Umweltbundesamt, Sept.

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