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ABSTRACT: Five atmospheric transport models were evaluated for use in Phase II of the Historical Public Exposures Studies at the Rocky Flats Plant. Models included a simple straight-line Gaussian plume model (ISCST2), several integrated puff models (RATCHET, TRIAD, and INPUFF2), and a complex terrain model (TRAC). Evaluations were based on how well model predictions compared with sulfur hexafluoride tracer measurements taken in the vicinity of Rocky Flats in February 1991. Twelve separate tracer experiments were conducted, each lasting 9 hr and measured at 140 samplers in arcs 8 and 16 km from the release point at Rocky Flats. Four modeling objectives were defined based on the endpoints of the overall study: (1) the unpaired maximum hourly average concentration, (2) paired time-averaged concentration, (3) unpaired time-averaged concentration, and (4) arc-integrated concentration. Performance measures were used to evaluate models and focused on the geometric mean and standard deviation of the predicted-to-observed ratio and the correlation coefficient between predicted and observed concentrations. No one model consistently outperformed the others in all modeling objectives and performance measures. About 75% of the maximum hourly concentration predictions were within a factor of 5 of the observations. About 64% of the paired and 80% of the unpaired time-averaged model predictions were within a factor of 5 of the observations. The overall performance of the RATCHET model was somewhat better than the other models. All models appeared to experience difficulty defining plume trajectories, which was attributed to the influence of multilayered flow initiated by terrain complexities and the diurnal flow patterns characteristic of the Colorado Front Range.