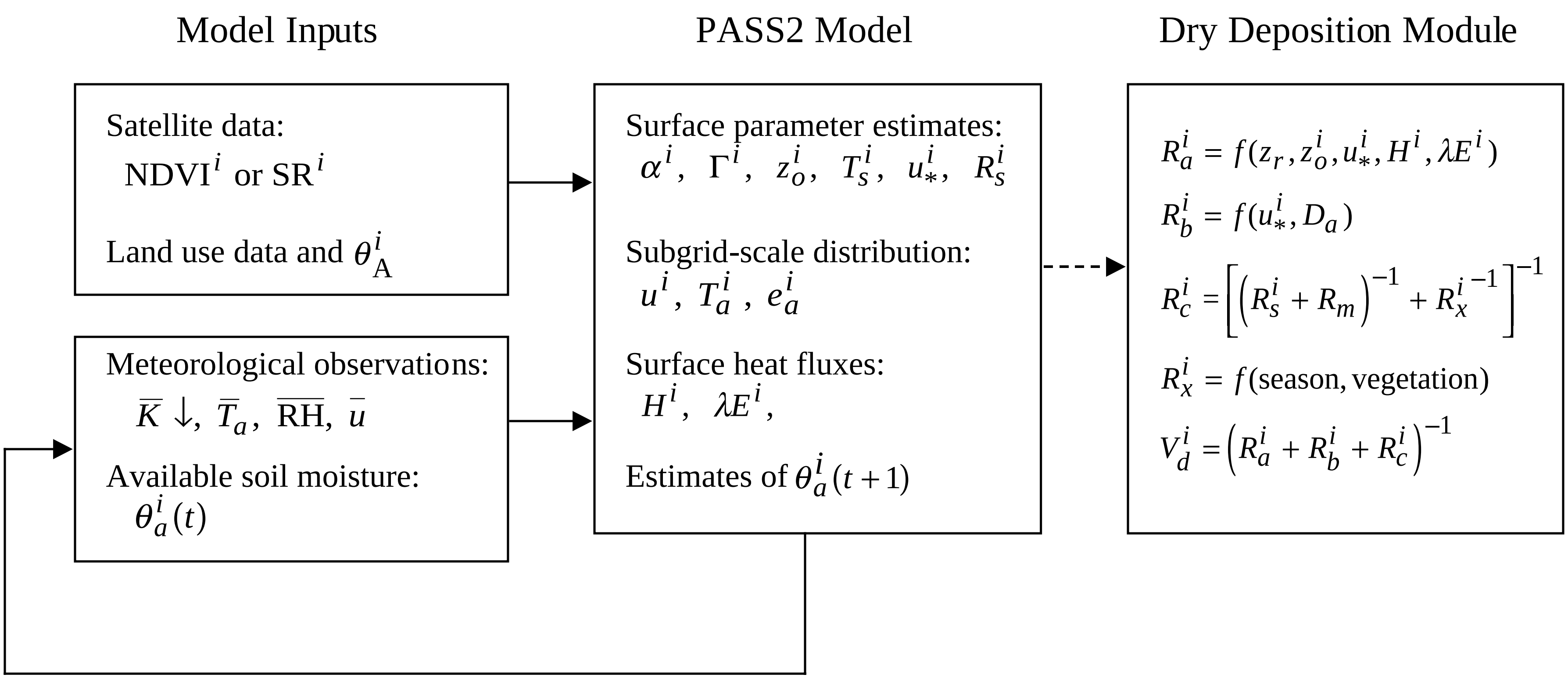
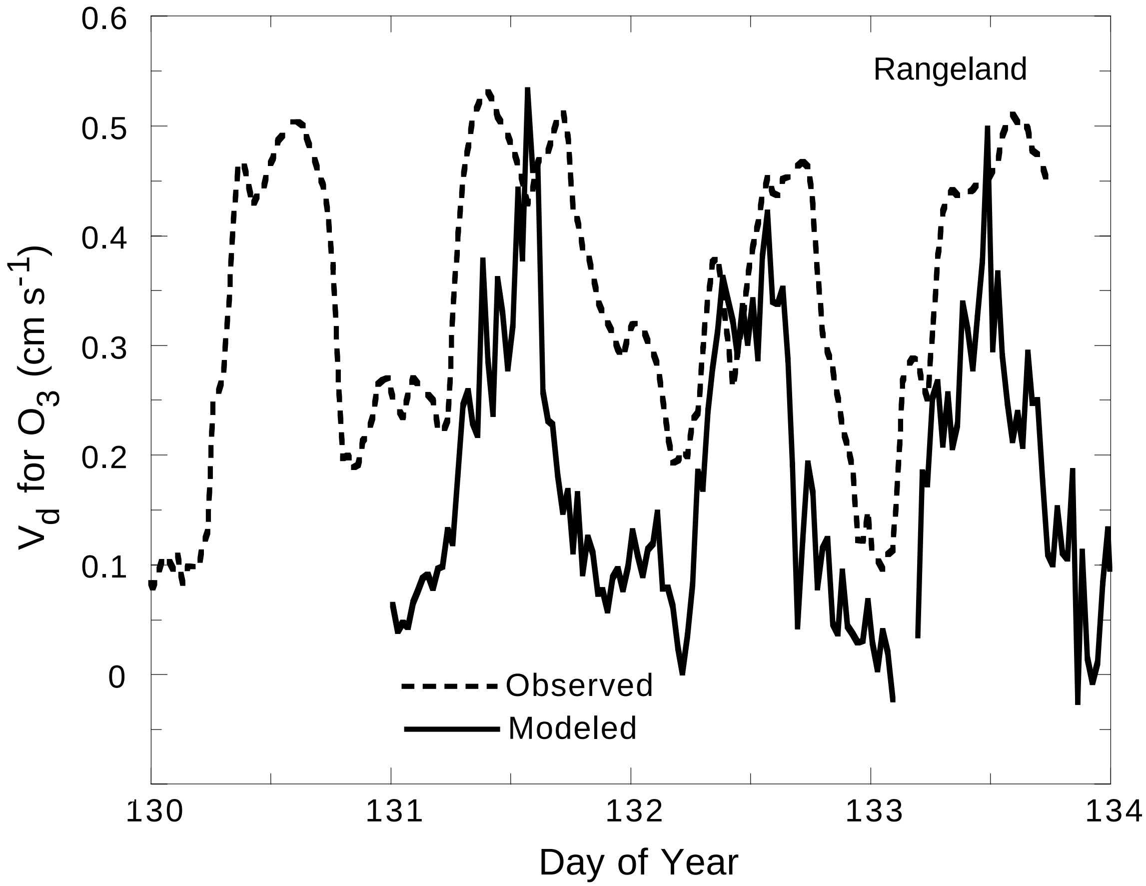
Effects of Soil Moisture Variations on Deposition Velocities Above Vegetation

Marvin L. Wesely, Argonne National Laboratory
Jie Song, Northern Illinois University
Robert T. McMillen, NOAA/ATDD
Tilden P. Meyers, NOAA,ATDD

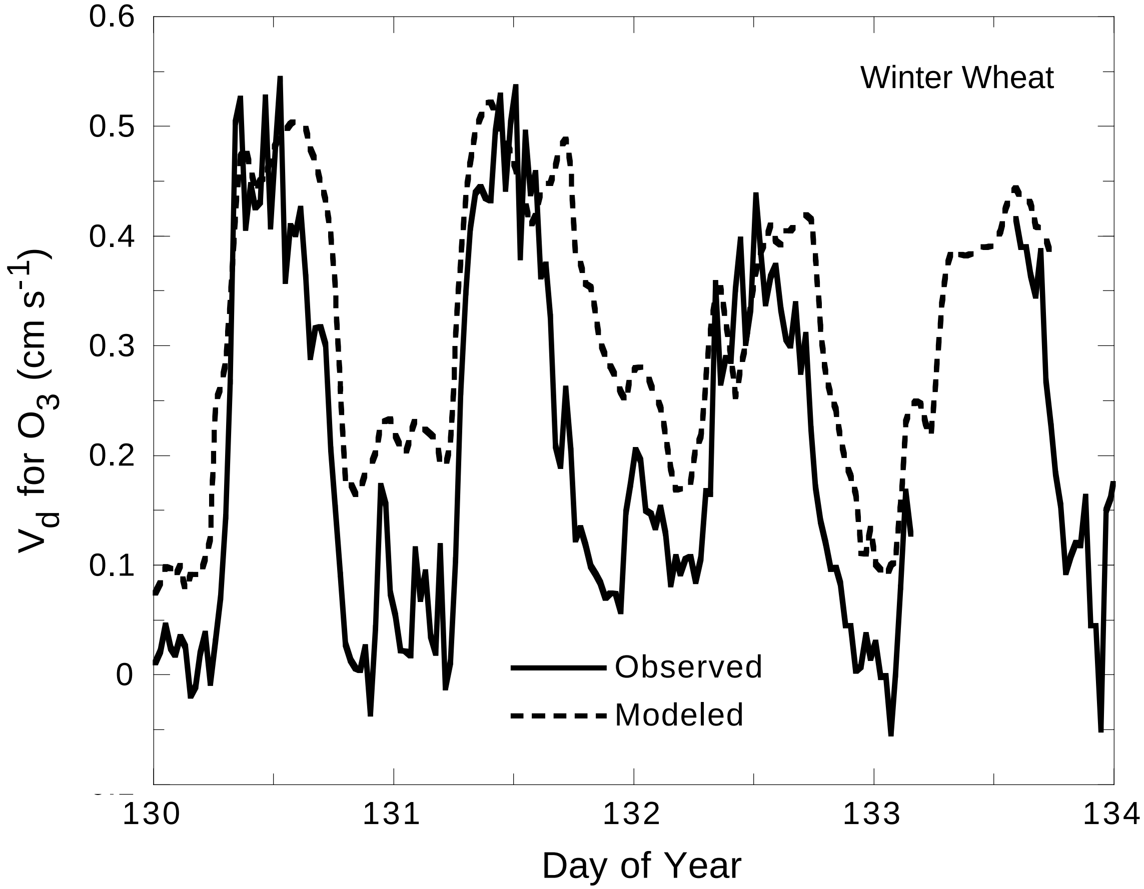
Schematic Diagram of Calculations and Variables Used by the Second-Phase Parameterized Subgrid-Scale (PASS2) Model and the Dry Deposition Module



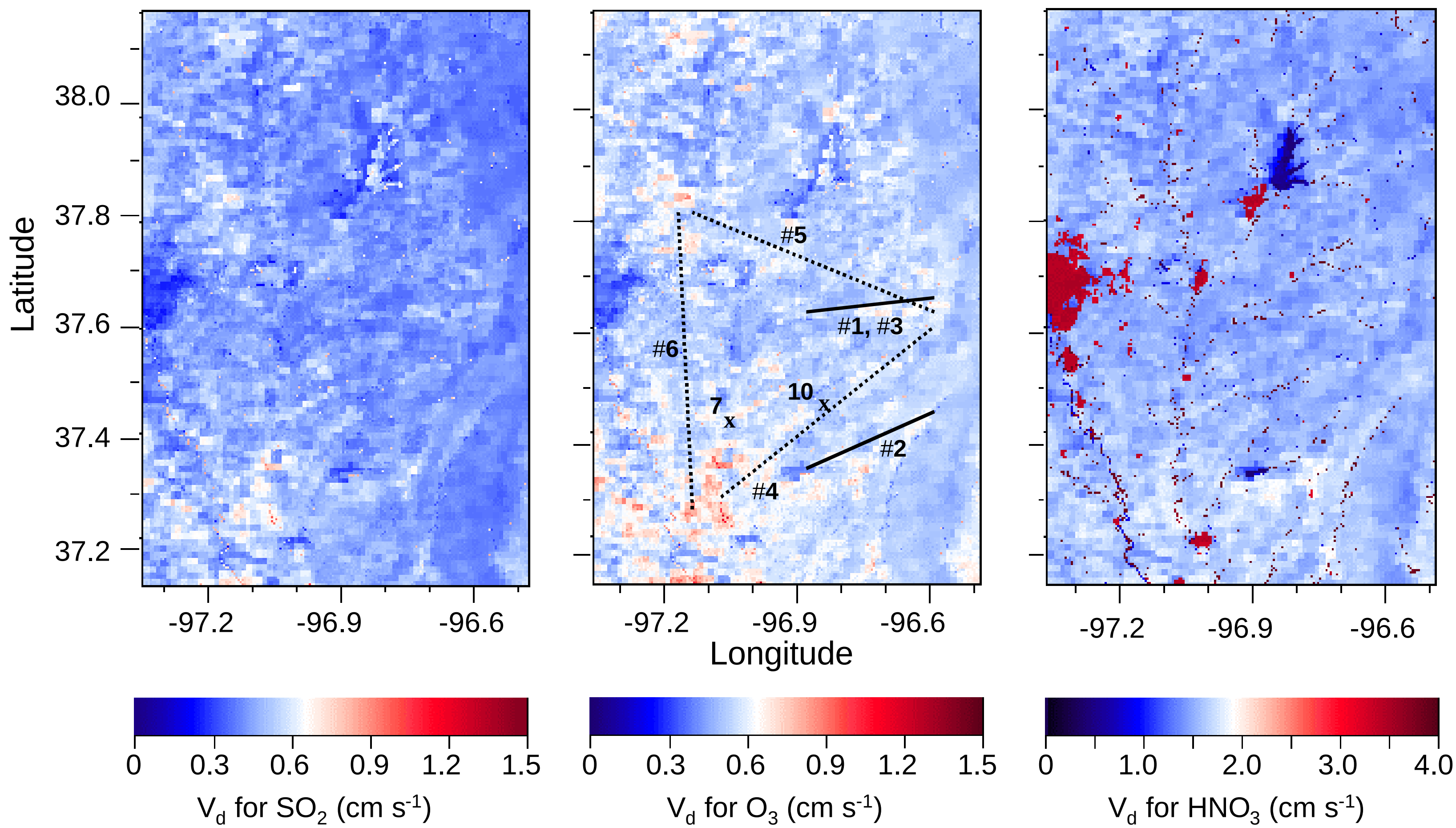
Observations by Eddy Covariance and Model Estimates of Ozone Deposition Velocity at a Rangeland Site in Kansas

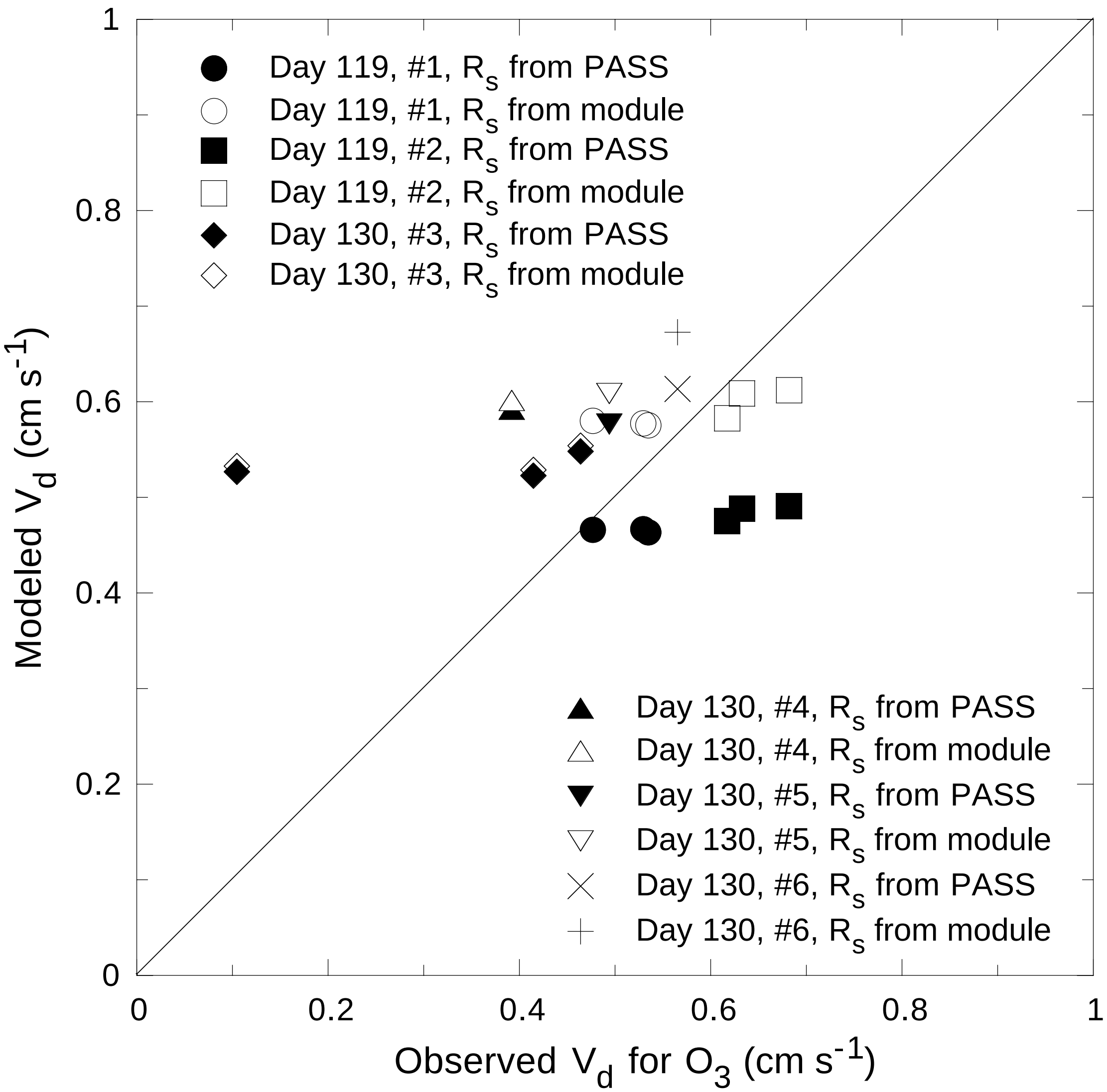


Observations by Eddy Covariance and Model Estimates of Ozone Deposition Velocity at a Winter Wheat Site in Kansas

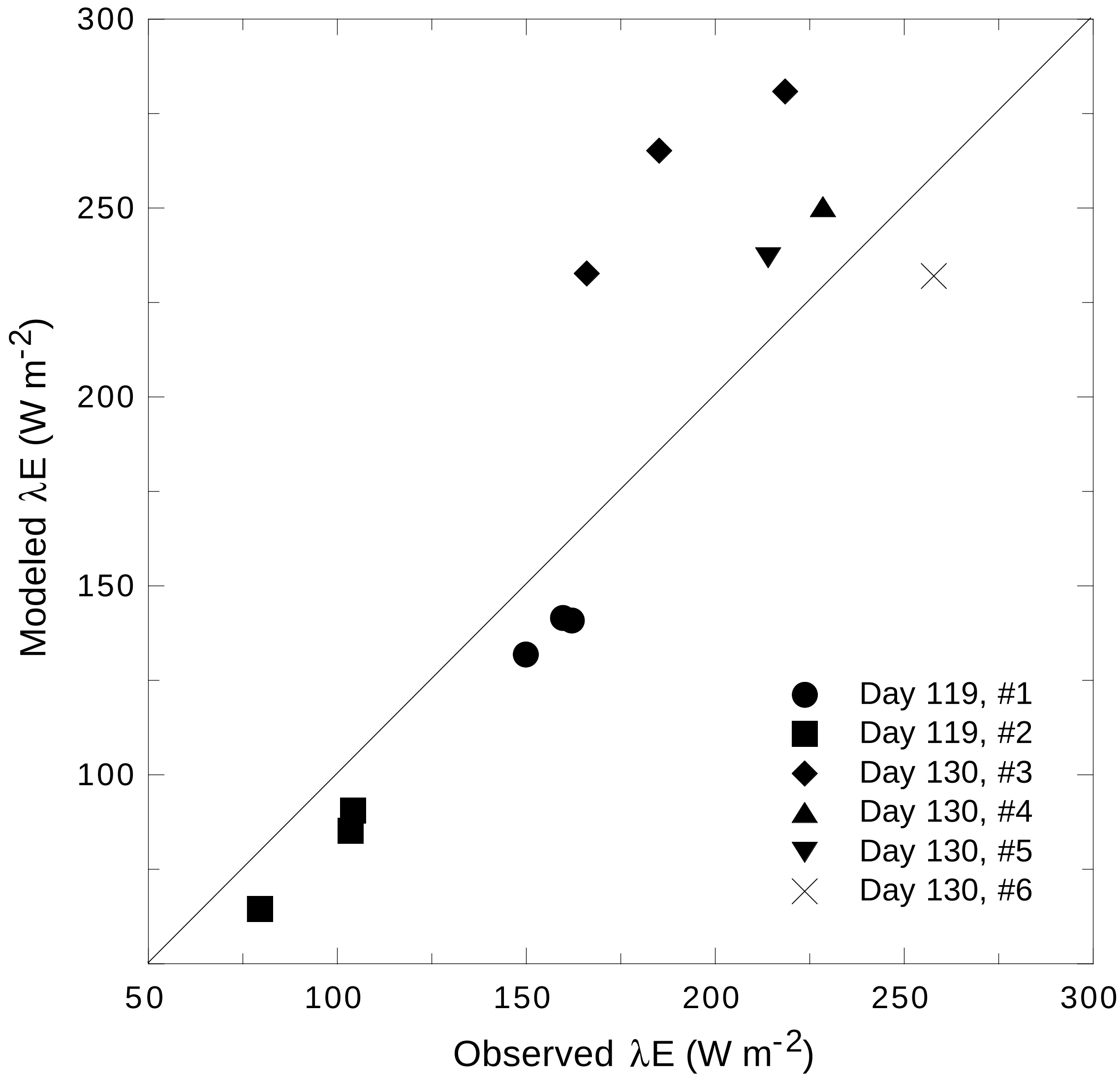


Modeled horizontal distribution of deposition velocities for the Walnut River Watershed at noon on May 10. The straight line segments indicate aircraft flight paths and the x's mark the locations of the two surface sites.



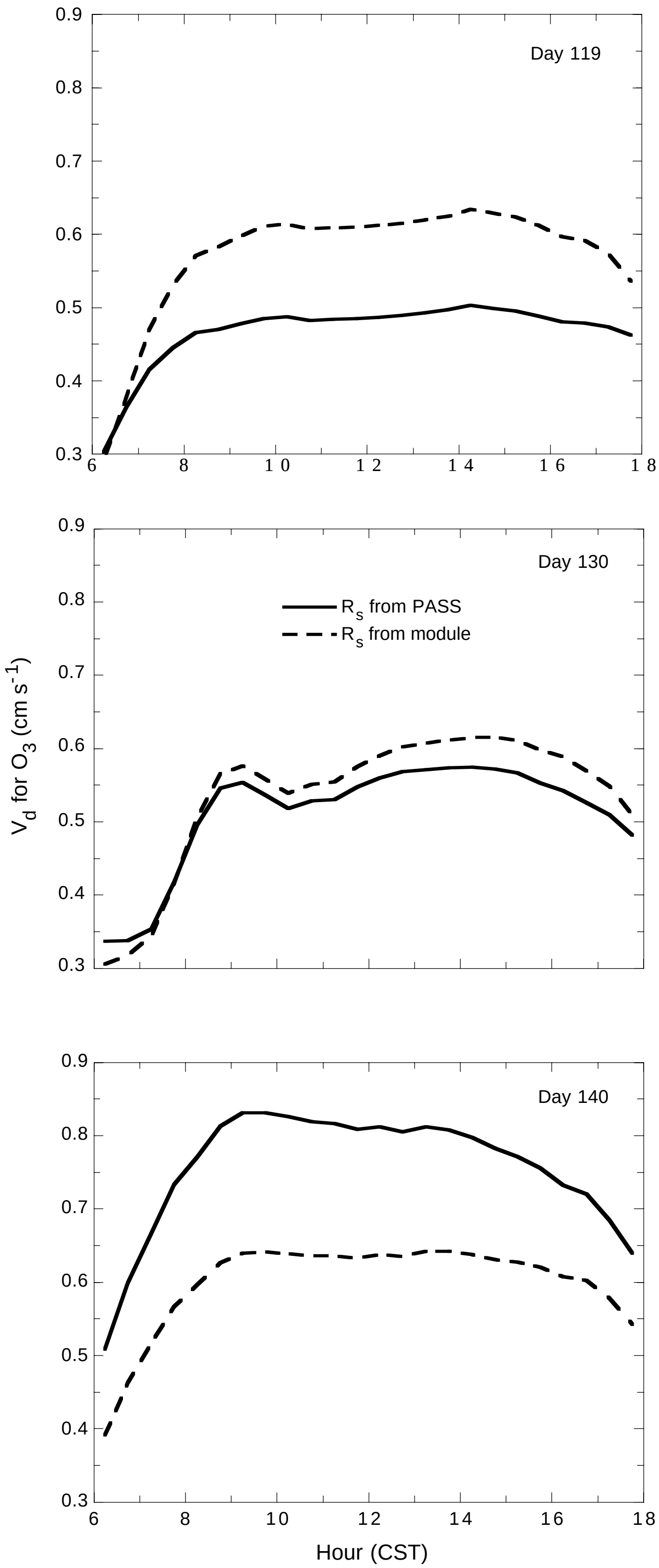


Day 119, #1, R_s from PASS
Day 119, #1, R_s from module
Day 119, #2, R_s from PASS
Day 119, #2, R_s from module
Day 130, #3, R_s from PASS
Day 130, #3, R_s from module
Day 130, #4, R_s from PASS
Day 130, #4, R_s from module
Day 130, #5, R_s from PASS
Day 130, #5, R_s from module
Day 130, #6, R_s from PASS
Day 130, #6, R_s from module
Modeled V_d ($cm\ s^{-1}$)
Observed V_d for O_3 ($cm\ s^{-1}$)
0
0.2
0.4
0.6
0.8
1



300
250
200
150
100
50
100
150
200
250
300
Modeled λE (W m-2)
Observed λE (W m-2)
Day 119, #1
Day 119, #2
Day 130, #3
Day 130, #4
Day 130, #5
Day 130, #6

Modeled Ozone Deposition Velocity Averaged over the Entire Watershed With and Without Consideration of the Effects of Soil Moisture Variations



Conclusions

- Changes in deposition velocities for substances strongly controlled by stomatal resistance can be as large as 30% when the effects of soil moisture are taken into account.
- Adequate description of surface properties is difficult to achieve over extended areas.
- Use of PASS provides a method to find fairly detailed information on the effects of surface conditions on deposition velocities, e.g., for air pollution studies over distances of 100km to 1000 km.
- Description of nonstomatal canopy resistances in terms of NDVI or SR might improve module performance.