

Results from the Cumberland Powerplant Plume Case study of 12 July 1999

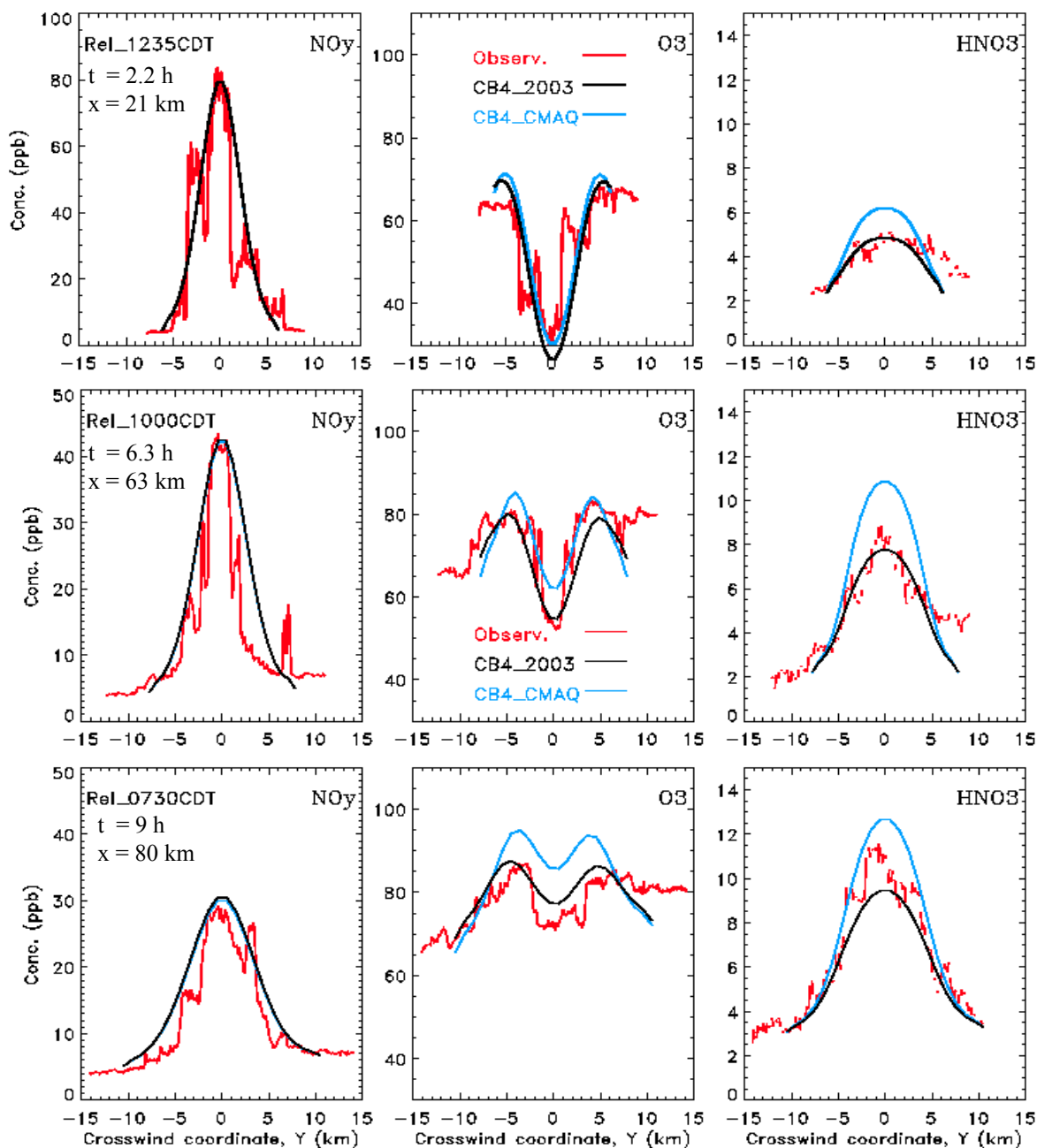


Figure 3.1. Comparison of observed (red traces) and simulated (black and blue) traces of the crosswind plume profiles (at 500 m height in the CBL) of NO_y, O₃ and HNO₃ for three selected traverses of the TVA Cumberland powerplant plume sampled by the NOAA-WP3 aircraft on 12 July 1999. The three traverses are for different plume releases, and hence not of the same Lagrangian air parcel. For each traverse (one row of panels), the plume release time is shown in the upper left corner of the leftmost panel, along with plume age (t) and downwind distance (x) from the source at sampling. The blue and black traces in each panel correspond to LRPM simulations based on CB4-CMAQ (blue) and CB4-2003 (black) chemical mechanisms.

Cumberland Powerplant Plume, 12 July 1999, 1000 release, plume age = 2h

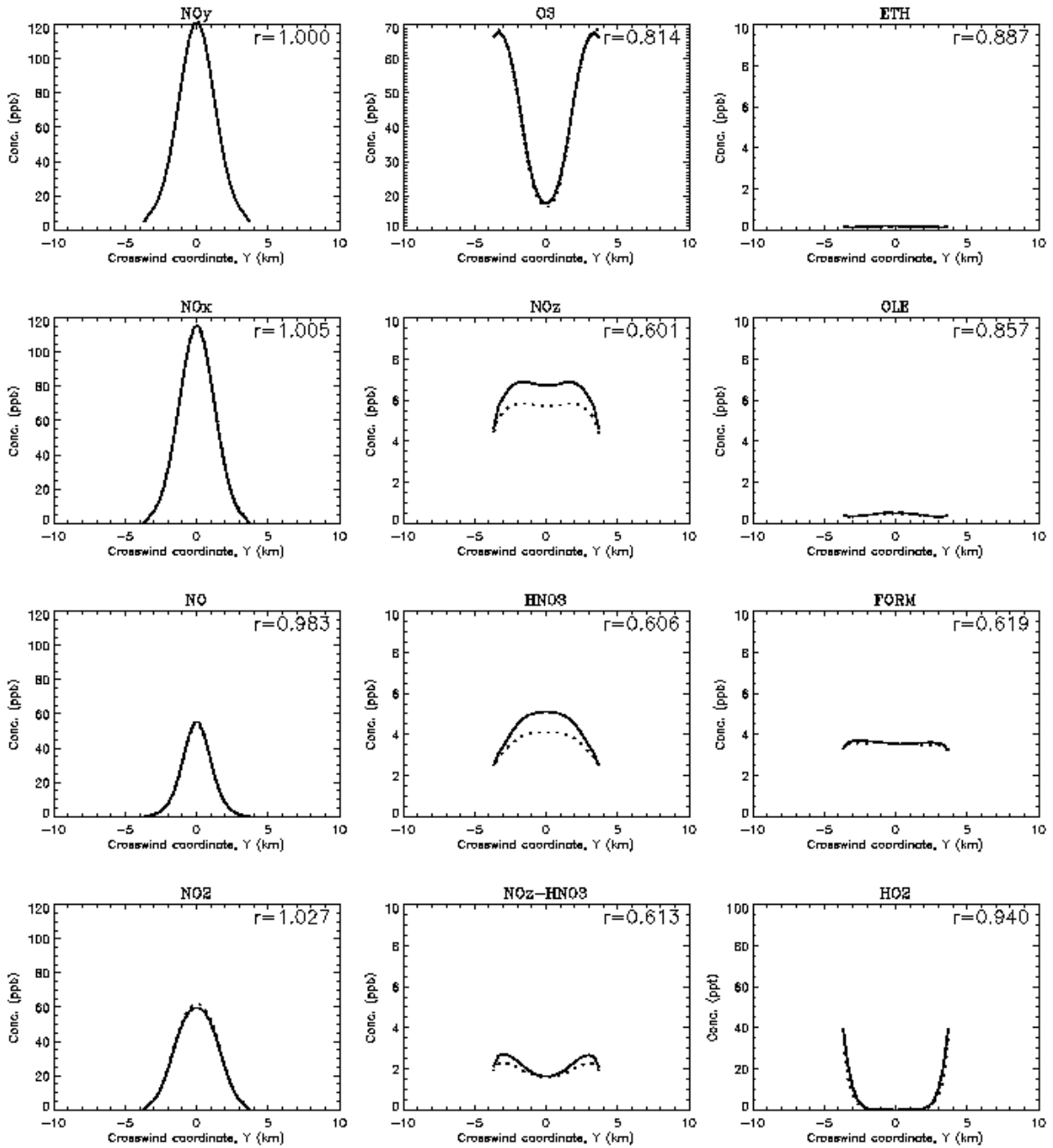


Figure 3.2 Simulated crosswind plume concentrations of selected species in the Cumberland powerplant plume in TN for plume release at 1000 on 12 July 1999, at plume age = 2h: CB4-CMAQ (solid traces) v. CB4-2003 (dotted traces). $Q(\text{NO}_x) \sim 266 \text{ kmol/h}$, $Q(\text{RVOC}) = 0$.

Cumberland Power Plant Plume, 12 July 1999, 1000 release, plume age = 6h

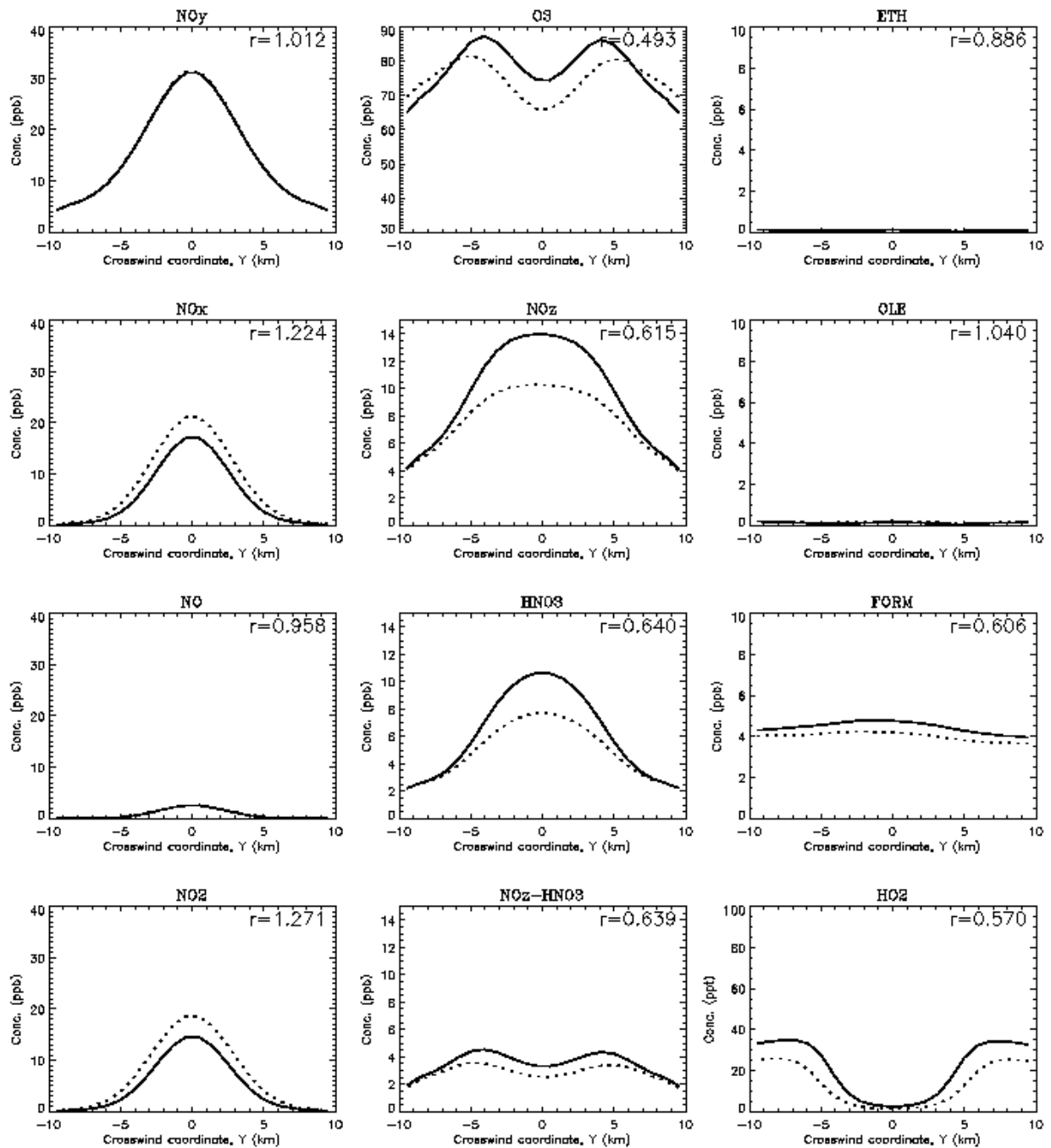


Figure 3.3 Simulated crosswind plume concentrations of selected species in the Cumberland powerplant plume in TN for plume release at 1000 on 12 July 1999, at plume age = 6h: CB4-CMAQ (solid traces) v. CB4-2003 (dotted traces). $Q(\text{NO}_x) \sim 266 \text{ kmol/h}$, $Q(\text{RVOC}) = 0$.

Cumberland Power Plant Plume, 12 July 1999, 1000 release, plume age = 8h

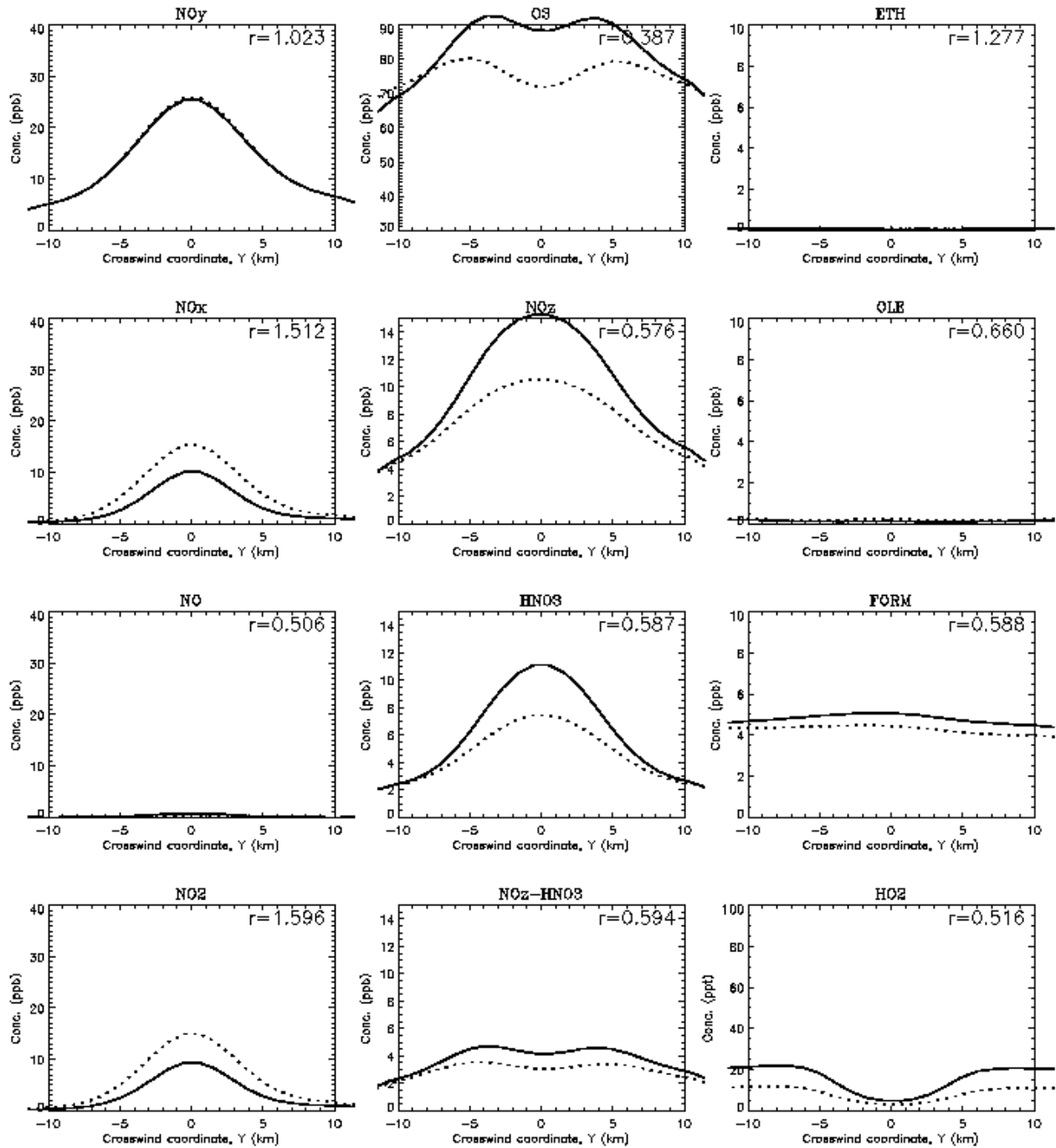


Figure 3.4 Simulated crosswind plume concentrations of selected species in the Cumberland powerplant plume in TN for plume release at 1000 on 12 July 1999, at plume age = 8h: CB4-CMAQ (solid traces) v. CB4-2003 (dotted traces). $Q(\text{NO}_x) \sim 266 \text{ kmol/h}$, $Q(\text{RVOC}) = 0$.

Sweeny TX T1 (~23km, 1.7h)

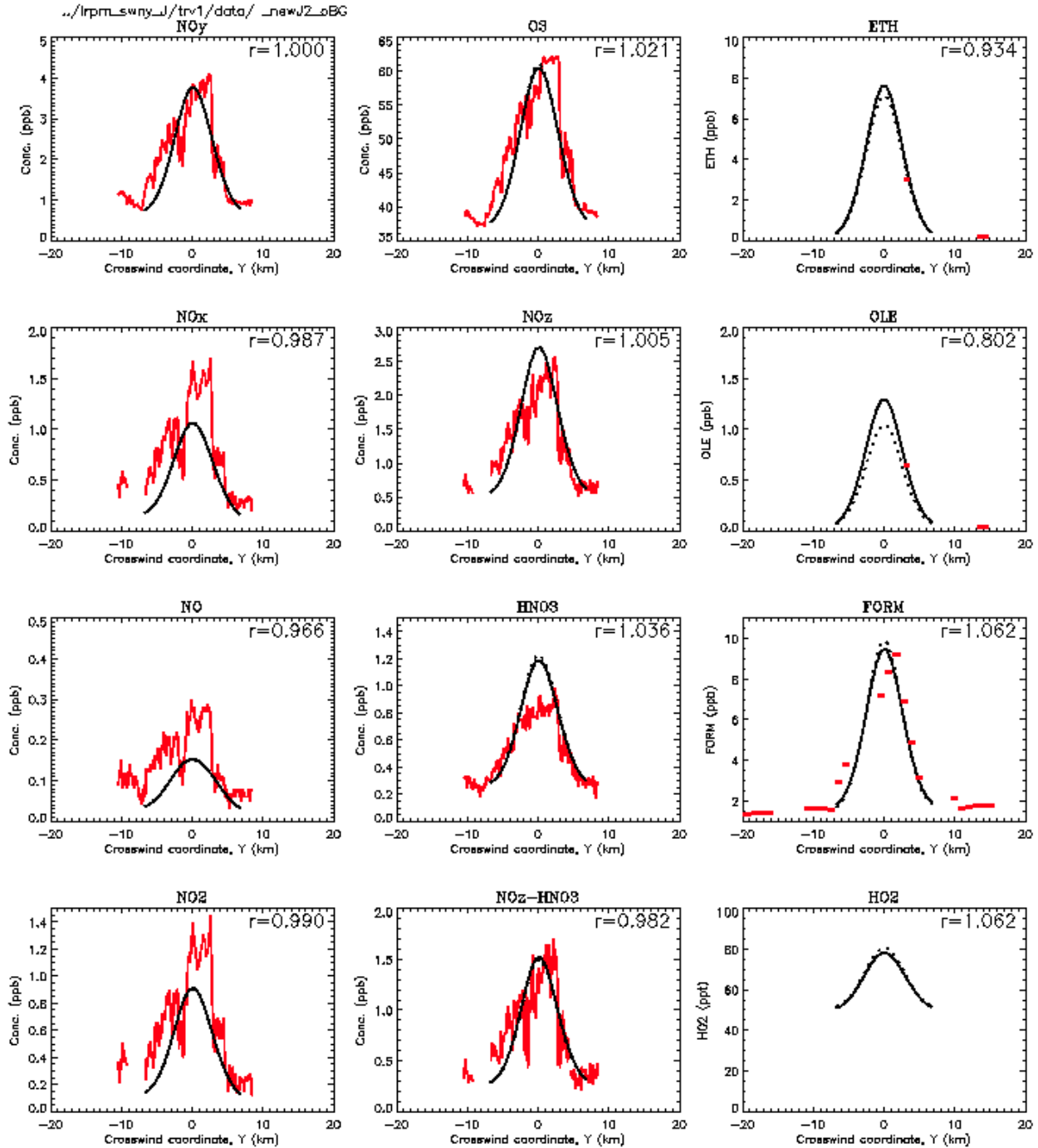


Figure 3.5 Data-model (LRPM) comparison of crosswind plume concentrations of selected species in the Sweeny plume sampled in traverse T1 at a downwind distance of ~23km and plume age of ~1.7h (plume release at ~1130 and plume sampling at ~1310), for the following plant emission rates: $Q(\text{NO}_x) = 24.6 \text{ kmol/h}$, $Q(\text{ETH}) = 3.6 Q(\text{NO}_x)$ and $Q(\text{OLE}) = 2.0 Q(\text{NO}_x)$. The red trace is based on aircraft data, the black traces are based on LRPM simulations using CB4-CMAQ (solid) and CB4-2003 (dotted). The r-value shown in the upper right corner of each panel is the ratio of the peak plume concentrations in excess of the background value (average of left and right backgrounds) as calculated using CB4-2003 as compared to that using CB4-CMAQ.

Sweeny TX RunT1 continued to t = 3h

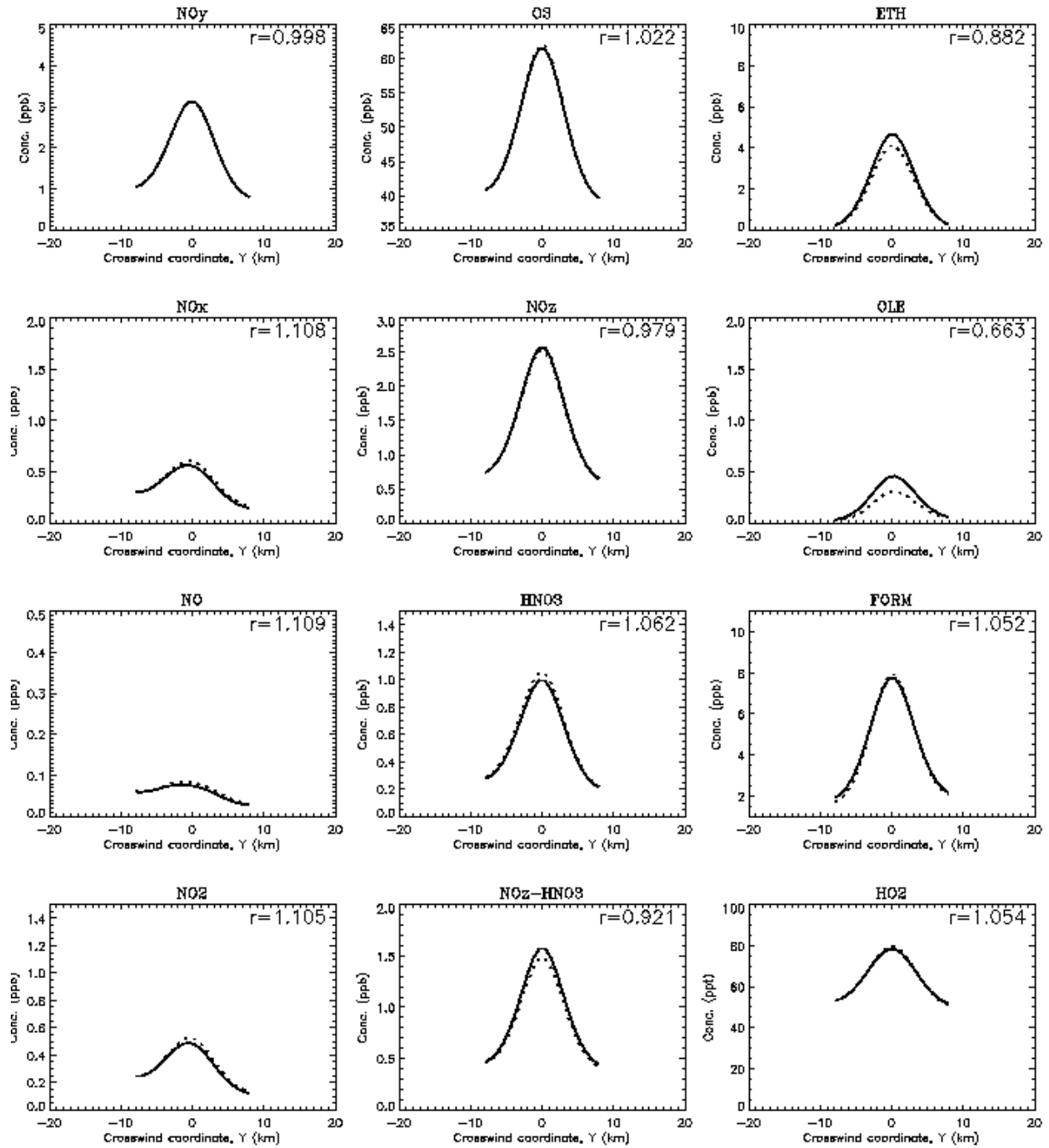


Figure 3.6 Crosswind plume concentrations of selected species in the Sweeny plume at plume age of 3h in the same Lagrangian model run as shown in Figure 3.1.

Sweeny TX T2 (~50km, 3.75h)

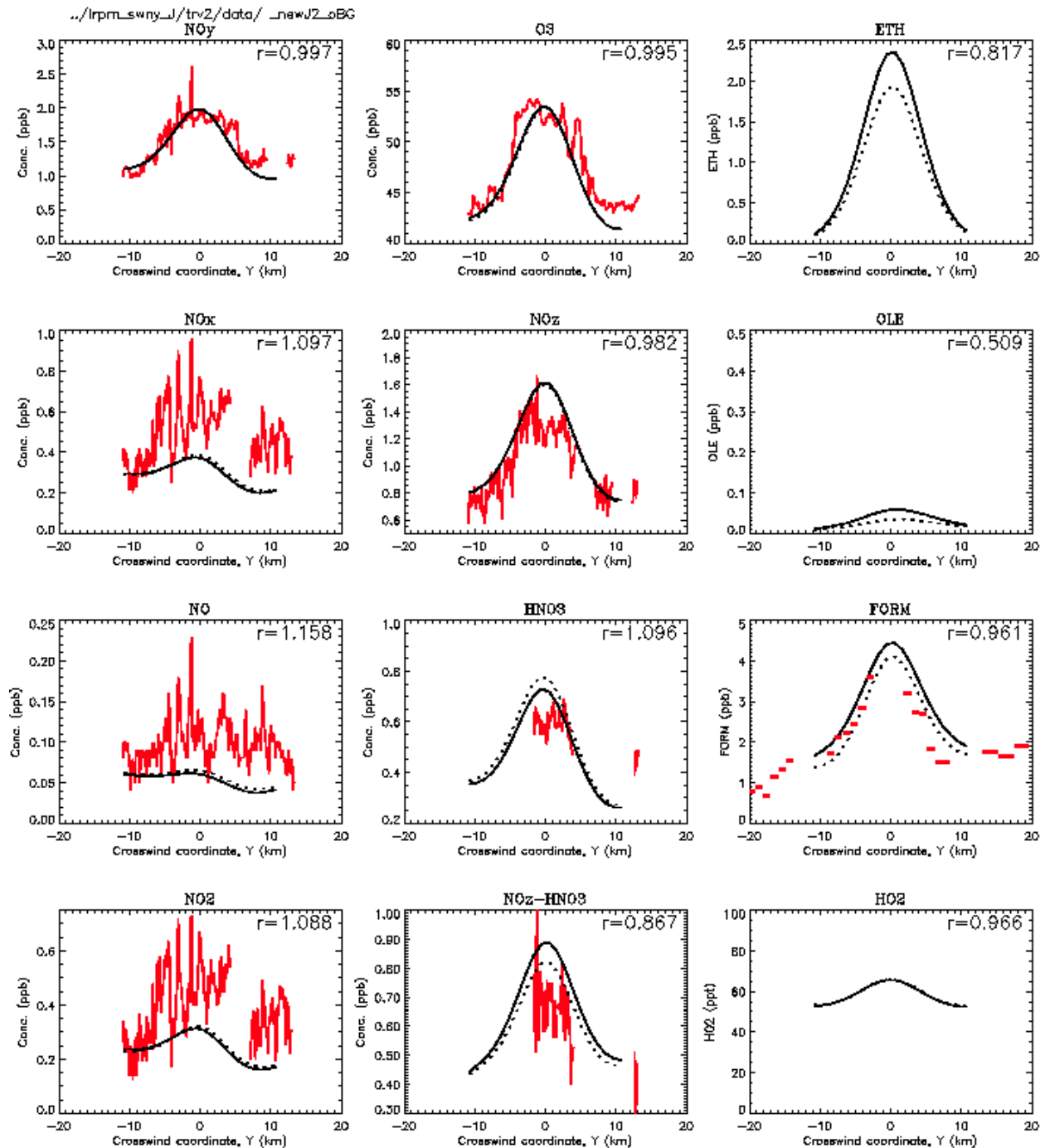


Figure 3.7 Data-model (LRPM) comparison of crosswind plume concentrations of selected species in the Sweeny plume sampled in traverse T2 at a downwind distance of ~50km and plume age of ~3.7h (plume release at ~1010 and plume sampling at ~1355), for the following plant emission rates: $Q(\text{NO}_x) = 24.6 \text{ kmol/h}$, $Q(\text{ETH}) = 3.6 Q(\text{NO}_x)$ and $Q(\text{OLE}) = 2.0 Q(\text{NO}_x)$. The red trace is based on aircraft data, the black traces are based on LRPM simulations using CB4-CMAQ (solid) and CB4-2003 (dotted). The r-value shown in the upper right corner of each panel is the ratio of the peak plume concentrations in excess of the background value (average of left and right backgrounds) as calculated using CB4-2003 as compared to that using CB4-CMAQ.

Sweeny (ppp) TX T2

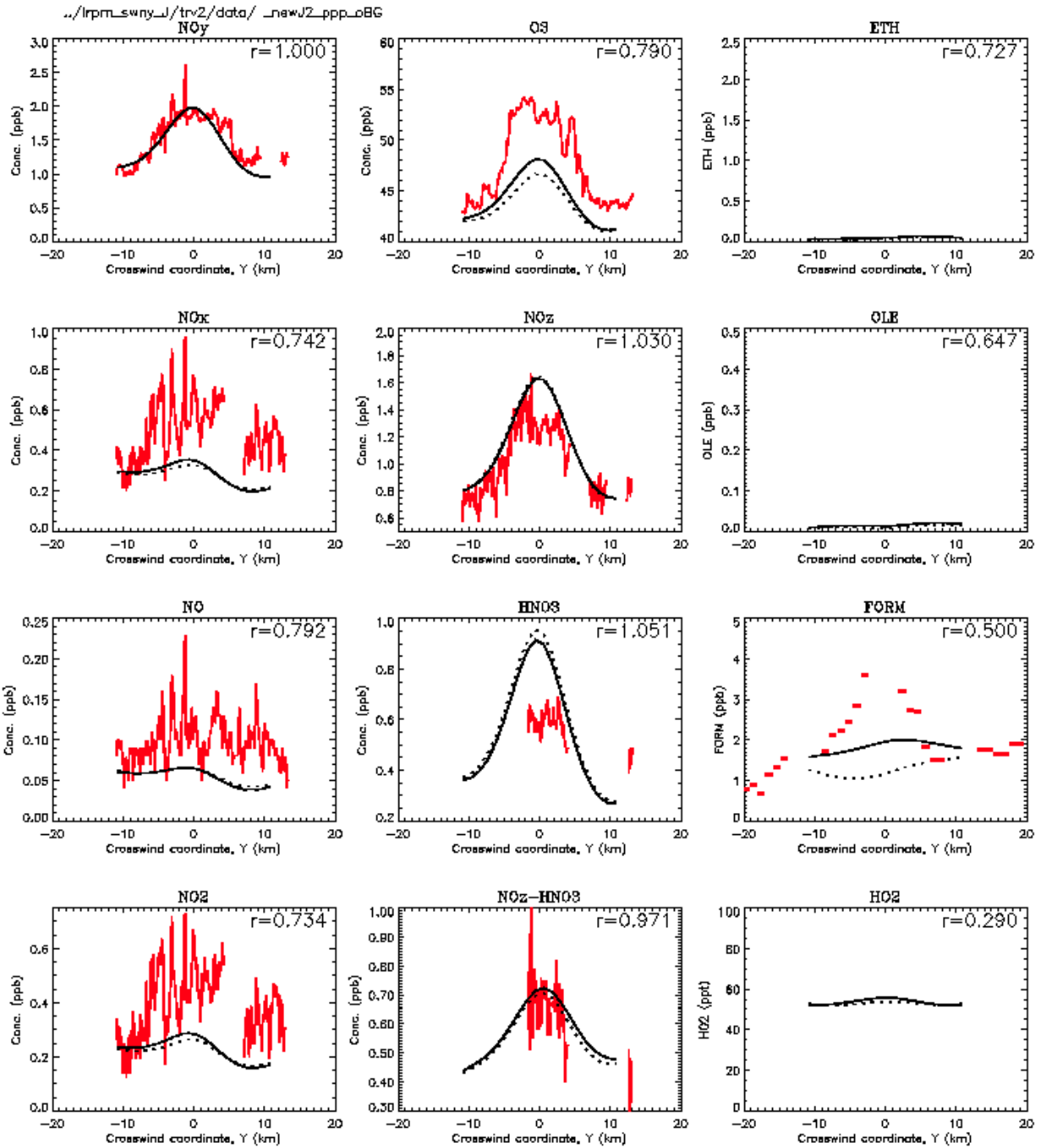


Figure 3.8 Lagrangian simulation of the Sweeny “powerplant” plume of 8/28/2000 for $Q(\text{ETH}) = 0 = Q(\text{OLE})$: comparison with CB4-CMAQ and CB4-2003.

Sweeny TX, 1000 release

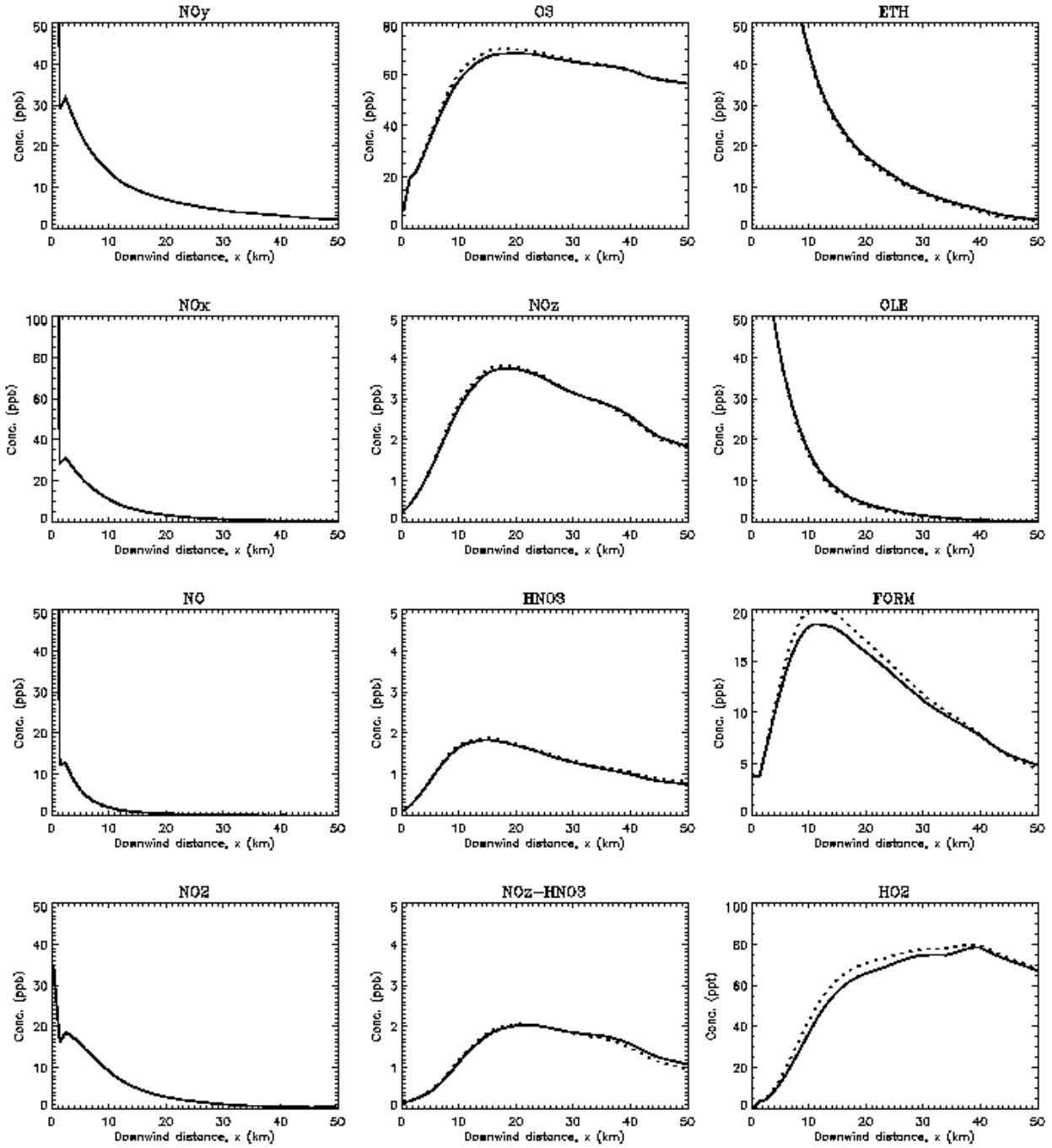


Figure 3.9 Simulated plume-centerline concentrations as a function of downwind distance for a hypothetical Sweeny plume release at 1000 on 8/28/2000 based on CB4-CMAQ (solid) and CB4-2003 (dotted).

Sweeny (PPP) TX, 1000 release

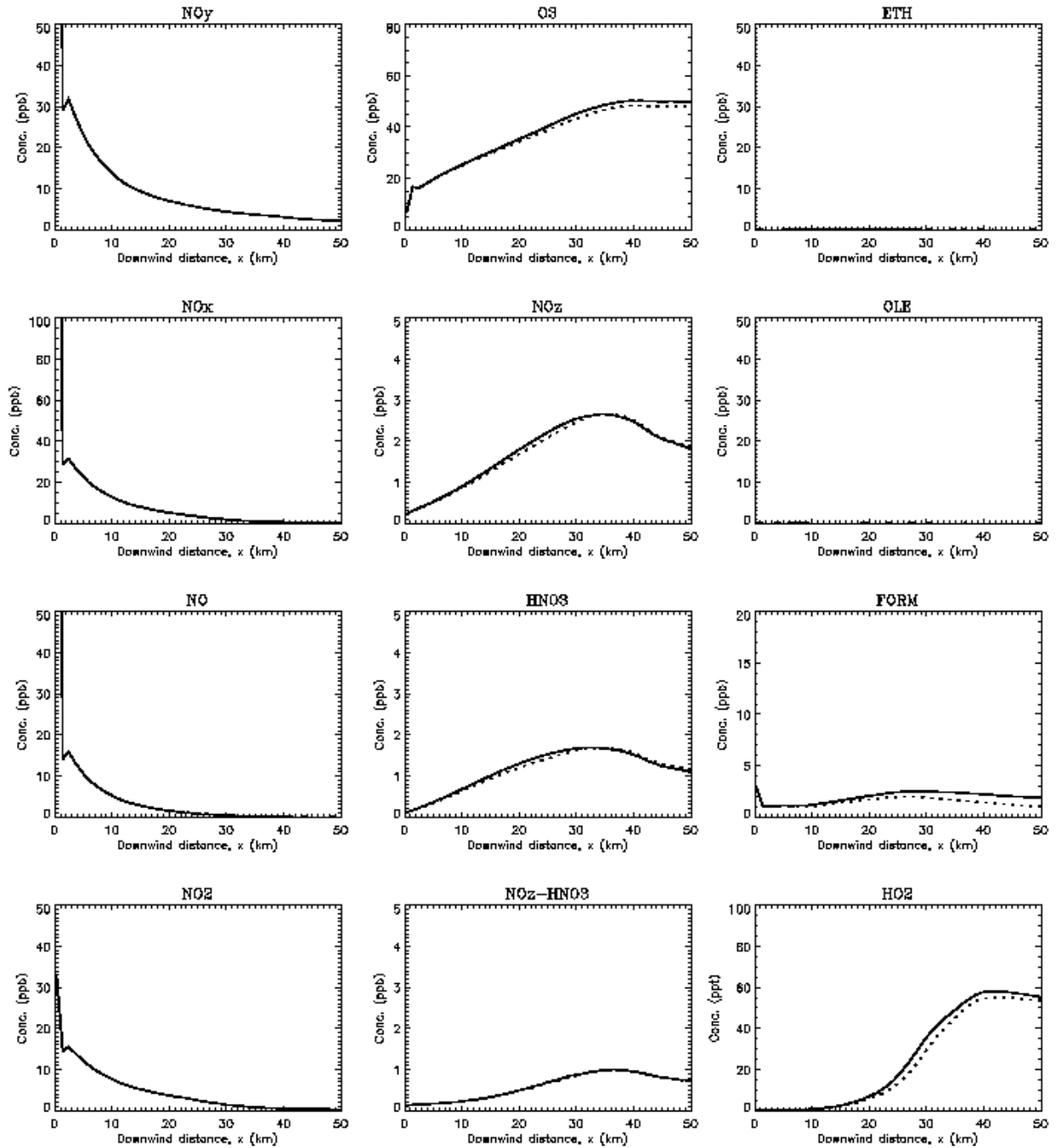


Figure 3.10 Simulated plume-centerline concentrations as a function of downwind distance for a hypothetical Sweeny “powerplant” plume release ($Q(\text{RVOC}) = 0$) at 1000 on 8/28/2000 based on CB4-CMAQ (solid) and CB4-2003 (dotted).

Sweeny emissions in TN, t = 3h

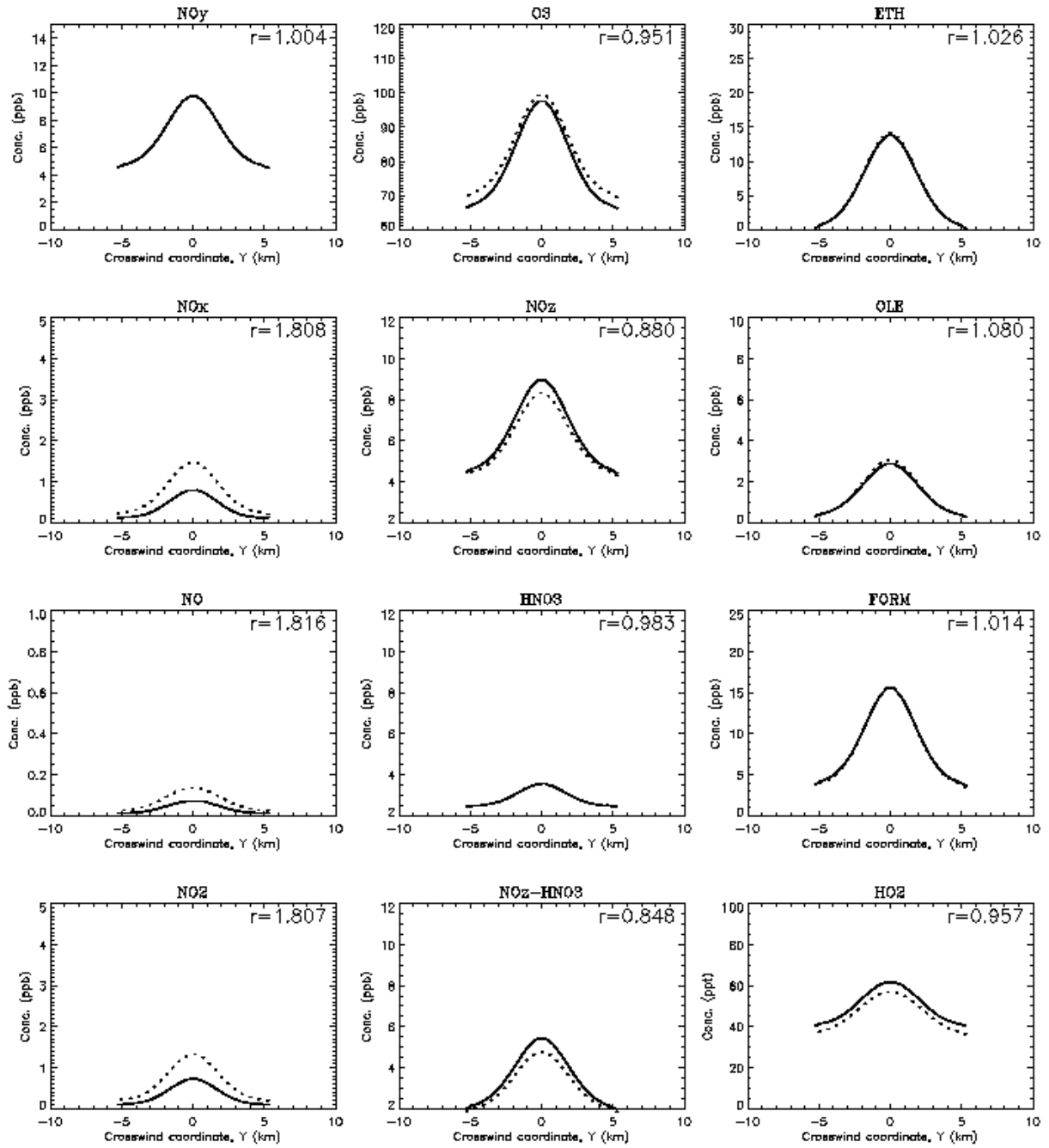


Figure 3.11 Lagrangian simulations of crosswind plume concentrations in the “Sweeny” plume released from the Tennessee site of the Cumberland Steam Plant, at plume age of 3h, for the meteorological and chemical background conditions of 7/12/99 in Tennessee.

Sweeny PPP emissions in TN, t = 3h

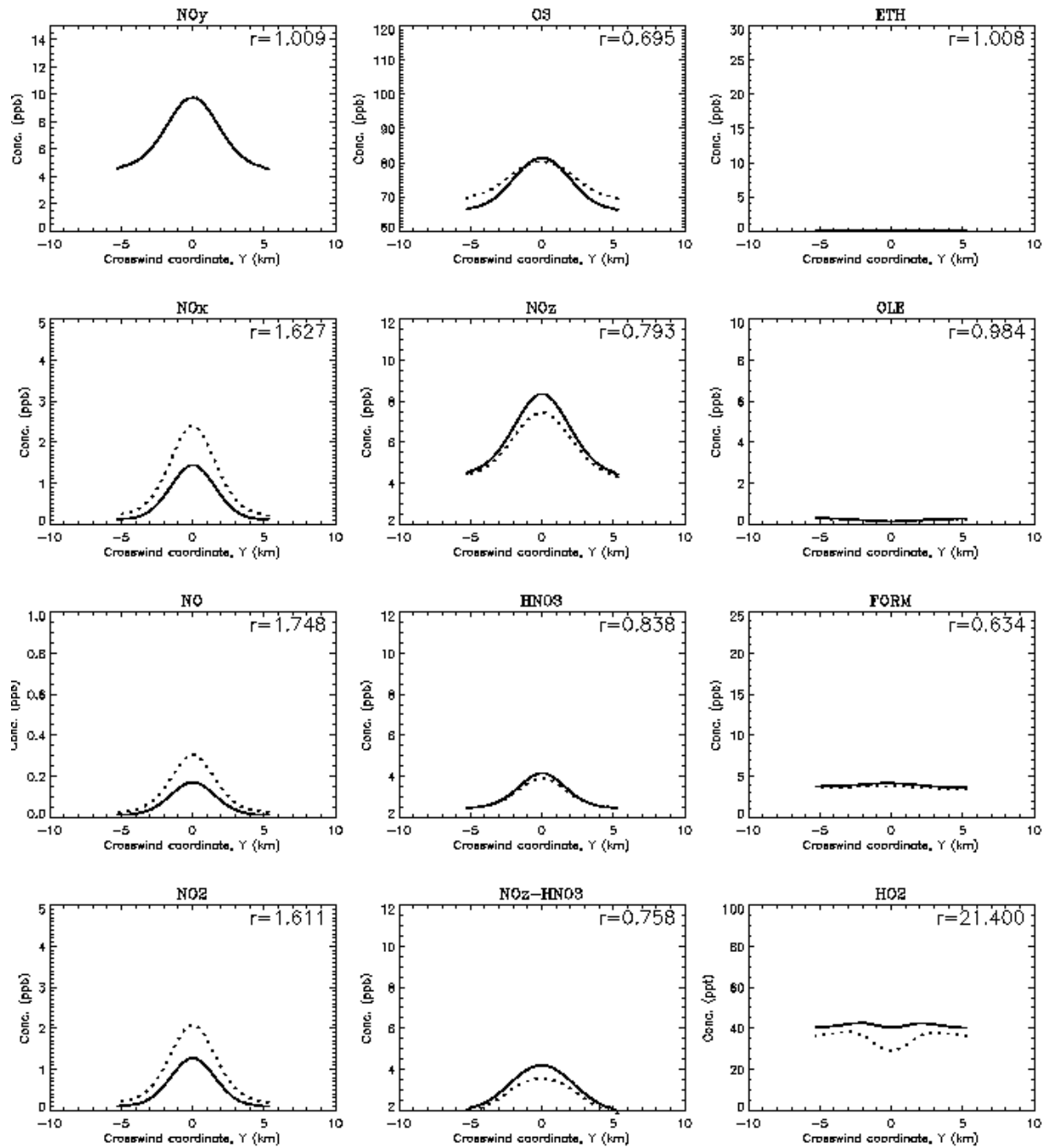


Figure 3.12 Lagrangian simulations of crosswind plume concentrations in the “Sweeny powerplant” plume ($Q(\text{RVOC}) = 0$) released from the Tennessee site of the Cumberland Steam Plant, at plume age of 3h, for the meteorological and chemical background conditions of 7/12/99 in Tennessee.