
THE BAO TALL TOWER SITE IS THE FIRST TO BE LOCATED NEAR COMPLEX TERRAIN AND A LARGE URBAN AREA. HOWEVER, EXTENSIVE PAST STUDIES OF THE METEOROLOGY AND AIR QUALITY ALONG THE COLORADO FRONT RANGE WILL AID IN THE ANALYSES OF THE COMPLEX DATA EXPECTED AT THIS SITE.

THE BAO

METEOROLOGY OF THE SITE AND URBAN INFLUENCES

FOUR REGIMES DOMINATE AIR QUALITY ALONG THE EASTERN SLOPES OF THE ROCKY MOUNTAINS:

• Nocturnal drainage flows that follow the South Platte River from the southwest to the northeast through Denver. The nocturnal drainage jet structure (Neil et al., 1995), because of a nearly laminar layer that forms between 100m and 300m, may result in the trapping of urban surface emissions in a thin layer below the jet and may isolate elevated emissions from point sources in the air flow above the wind maximum. This drainage system extends well into northeastern Colorado during summer (Tooth and Johnson, 1985), including regions with significant ammonia sources.

• Thermally and/or dynamically driven northeasterly upslope winds (upslope, toward the foothills), often associated with a shallow front or a surge structure only a few hundred meters deep, that can transport cool air from the lowlands of the South Platte, northeast of Denver, southeast into the foothills. During the Brown Cloud Study, these winds were most likely to occur during the afternoon but were also observed at many other times of the day and night (Cook, 1973; Neff, 1990; Neff et al., 1995) and sometimes as a result of mesoscale eddies that form along the Front Range (e.g. Levinson and Banta, 1995). These upslope and recirculating flows enable aged aerosol and/or precursor gases such as ammonia to return to Denver and may contribute to a rapid deposition into the shallow boundary layer (Bosane et al., 1995). The stability of the shallow air mass limits vertical mixing and allows further buildup of pollution. When alternating with a nocturnal drainage wind, they may lead to a day-to-day recycling of the same air mass.

• Moist, cool northeasterly upslope winds, usually in response to lee cyclogenesis southeast of Denver and/or cold, surface high pressure developing over the Great Plains to the northeast. With sunrise, the wind shifts back to a northerly direction and by 1600 GMT in the early morning whereas lower levels increase in relative value. This increase in concentrations of CO2 at lower levels coincides with a wind shift from northerly to westerly at 0900 GMT. The detailed figure (below, left) shows opposing trends in CO2 and CO between 22 m and 100 m suggesting a surface source for CO2 that is not combustive.

The CO2 Tall Tower Program

THE NOAA ESRL/GMD TALL TOWER NETWORK PROVIDES REGIONAL REPRESENTATIVE MEASUREMENTS OF CARBON DIOXIDE (CO2) AND RELATED GASES IN THE CONTINENTAL BOUNDARY LAYER. RECENTLY WE HAVE ALSO BEGUN SAMPLING GASES THAT ARE RELEVANT FOR AIR QUALITY STUDIES. WE COLLECT METEOROLOGICAL DATA THAT CAN BE USED TO STUDY BOUNDARY LAYER DYNAMICS. THE TALL TOWER SITES ARE PART OF THE NORTH AMERICAN CARBON PROGRAM AND ARE A PRIMARY DATA SOURCE FOR IRIS’s CARBON TRACKER CO2 DATA ASSIMILATION SYSTEM.