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An Alumina Plant at Wagerup, Western Australia, has been observed to produce effluent from various stages of its operation and various locations on the Plant Site. The question of whether this effluent is likely to be affecting local residents in townships and homesteads in the vicinity of the Plant is investigated in a study reported by Dr. Ron Calhoun et al. (31 August 2007). This study used a scanning Doppler lidar system in coordination with other instrumentation to reveal the behavior of aerosol plumes emanating from the Plant. An important aspect of this problem is that the terrain a few kilometers to the east of the Plant rises abruptly by ~300 m as a north-south-oriented escarpment, generating complex-terrain flow effects especially for wind directions with an easterly component. As a scientist who has studied these kinds of flow for more than three decades—and using Doppler lidar for two decades—I was asked for my assessment of this study. I have read this report and studied the evidence presented, and I concur with its findings. Some more specific comments follow.

Key points made in the report were:

- **Airborne plumes of material were being detected and tracked by the lidar.** The primary scattering targets for lidar wavelengths are aerosol particles, which here act as tracers for the plume. The fall speeds of such particles are negligible, so they are excellent tracers of atmospheric motion. Other emissions not detected by the lidar, such as gaseous species, would be collocated with the aerosol within the plume, as pointed out in the text. Lidar has a long history (more than two decades) of being used for tracking of plumes, including particulates, oil fogs, and forest-fire smoke, so it is the appropriate tool for this application. The measurement resolution in time and space is more than adequate for the issues addressed here.

- **Plumes originate as Plant effluent.** This was repeatedly and convincingly demonstrated over many cases, and the source locations were associated with the Calciner 4, Multiflue and RDA locations, as described.

- **Plumes aloft mix down to the surface.** This was also convincingly demonstrated using several different instruments. Under stronger wind conditions the plumes at times remained in contact with the surface. But at other times, transport occurred aloft and was decoupled from the ground surface. In these cases the vertical mixing to the surface could occur through downward bursts of turbulence at night, as evidenced by the increases in turbulent momentum fluxes observed, or by “fumigation,” or downward mixing of layers aloft during morning hours as the earth surface begins to heat up.

- **Plumes originating at the Plant and mixing to the surface in populated areas are the most likely explanation for complaints by the local population.** Several cases convincingly illustrate direct transport from the plant to areas where complaints
were received, including the well documented 27 August 2004 case, when many complaints were registered.

Two kinds of transport and diffusion were noted in the case studies of this report. The first is simple, steady "classic" advection of relatively straight plumes by steady moderate to strong winds. The other is transport in more complex and variable winds, either because the flow is light and variable, or because of complex-terrain effects on the flow—or both. These types of flow were observed during the Wagerup operations and described in the report. These flow observations, including the flow reversals shown downwind of the escarpment on 27 August, are consistent with similar flows documented in other studies in other complex-terrain areas of the world. The consistency in the behavior of the winds and resulting aerosol distributions reinforces the interpretation that plumes originate at the Plant and are distributed over the local countryside at concentrations high enough to be detected and to result in complaints.

Some other points made in the report are worth re-emphasizing:

- aerosol as observed by the lidar serve as a tracer for the effluent plume; other chemical species not detected by the lidar need to be measured and documented.
- Most cases where the plume remains at high concentration occur at night or during other stable atmospheric conditions when diffusion, especially in the vertical, is restricted. This underscores the importance of the temperature soundings, which are a way to gain further insight into the suppression of vertical mixing near the surface
- The role of moisture needs further study, such as, does deliquescence (swelling of aerosol by absorption of water vapor), for example, lead to chemical transformation or to enhanced removal?

In summary, the many cases documented over the three-month period of operation provide strong, compelling evidence for these points. The instrumentation used—scanning lidar—is uniquely capable of making these connections. Lidar has been used for at least two decades to track various kinds of aerosol plume and to study complex-terrain flows. Therefore, I find that the conclusions of the study are supported by the evidence and valid.