<u>Recent Advancements in Ambient Monitoring Methods to Support Buffer Zone Assessments for Agricultural Fumigants</u>

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Field studies are important components of buffer zone assessments for agricultural fumigants. The collection of high quality field data, coupled with model-based assessment, provides data to characterize both the best estimate of emission rates as a function of time, and also the distributions of emission rates as a function of time. Over the past year, 8 field studies were conducted by Sullivan Environmental based on upgraded meteorological monitoring capability, and refined air quality monitoring methods using ambient-based and on-field flux methods. Five of these studies included both on-field measurements to support the on-field flux method as well as ambient data collection for the more standard emission fitting approach. This paper describes the benefits of improved meteorological documentation to estimate emission rates from both ambient and on-field flux methods.

In addition, a modified field study design for the ambient method, based on a forecast-based approach, is described. This method has been shown to produce comparable results to study designs that analyze data from nearly twice as many monitoring stations. Overall, these modifications have made the greatest degree of refinement during the most critical periods for most buffer zone assessments, i.e. nighttime periods with low to calm wind speeds.

<u>Improved Meteorological Monitoring For Ambient Networks</u>– During the EPA Science Advisory Panel (SAP) hearings on modeling of agricultural fumigants that were held in August and September 2004, recommendations were made to upgrade the sensitivity of the equipment use for meteorological monitoring during fumigant field studies. The primary benefit of the improved sensitivity is the effective removal of ”calm” periods, i.e. periods with wind speeds below the wind speed threshold for the monitoring equipment. This improvement, coupled with another SAP recommendation to refine the modeling during low wind speed conditions, such as through the use of the CALPUFF model, substantially reduces the uncertainty in fitting emission rates during critical low wind speed, nocturnal periods, and ultimately supports the modeling of buffer zones. The benefit to regulatory agencies, agricultural interests, and the public is that buffer zones can be established based on state-of-the-art science, which provides a sounder basis for regulation.

During data collection over the past year, more than four months of minute-by-minute data have been collected during specific field studies, there have been only several minutes with non-quantifiable wind data based on the threshold of 0.003 mph for the 3D sonic anemometer system that is being used (Campbell Scientific CSAT-3 system).

Figure 1
CSAT-3
Sonic Anemometer

<u>Improved Meteorological Monitoring for On-Field Flux Monitoring Profiles</u> – On-field flux monitoring systems based on profile monitoring of fumigant air concentrations and wind speed provides an alternative method of estimating flux from fumigation applications. Although dispersion modeling is not required to estimate emission rates, the profile method is critically dependent on identifying the wind speed profile. During the most critical periods for fumigant exposures, i.e. typically low wind speed nocturnal conditions, wind speed can often be less than threshold wind speeds of typical anemometers, which often is approximately 0.5 m/sec. By using 2D sonic anemometers at three levels along a profile with starting thresholds of 0.02 mph, the most critical periods can be evaluated without data loss and / or increased uncertainty caused by loss of quantifiable wind speed at one or more levels of the profile. The 2D sonic anemometers are used in conjunction with fine-wire thermocouples to measured the profile of temperature, and measurements of relative humidity along the profile to support the Bowen ratio correction to computed Richardson numbers that are used to support data interpretation via the gradient method.

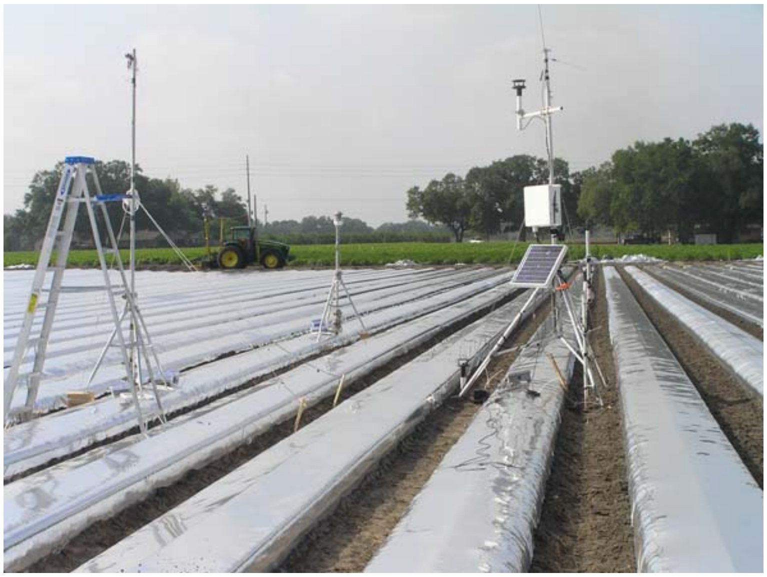

Figure 2: Example of on-field flux sampling array

<u>More Efficient Design of Ambient Method Emission Fitting Approach</u> – Through the completion of more than 20 field studies for fumigants since 1999, it has been determined that a minimum of 8 monitoring sites generally are needed to produce consistently sound results. To minimize the standard error in emission fitting and to produce refined results, it has been determined that approximately 8 sites with quantifiable measured data is preferred. Since the wind blows in various directions during a field study, a monitoring network of approximately 20 stations generally would be needed to reach this goal. The operation of a network of this size requires multiple staff members each time tubes are changed, and a great deal extra expense for laboratory analysis, which in many cases would be to document non-detected concentrations for the upwind stations.   The operation of a 12-site network, on the other hand can readily be changed out by one staff member, which allows for reduced labor costs and nearly half the analytical costs. Two test studies have been completed to date where 20 or more air quality monitors were in place around the field and real-time forecasts were documented at the time of the study to evaluate the forecast method. For each 4-hour monitoring period, a recommendation was made based on an experienced weather forecaster regarding which additional four sites should be added to the core network of 8 sites, i.e. the selection of 4 sites among the 12 supplementary sites to improve the probability of measuring detectable concentrations. Figures 3 and 4 below show the normalized results of these tests:

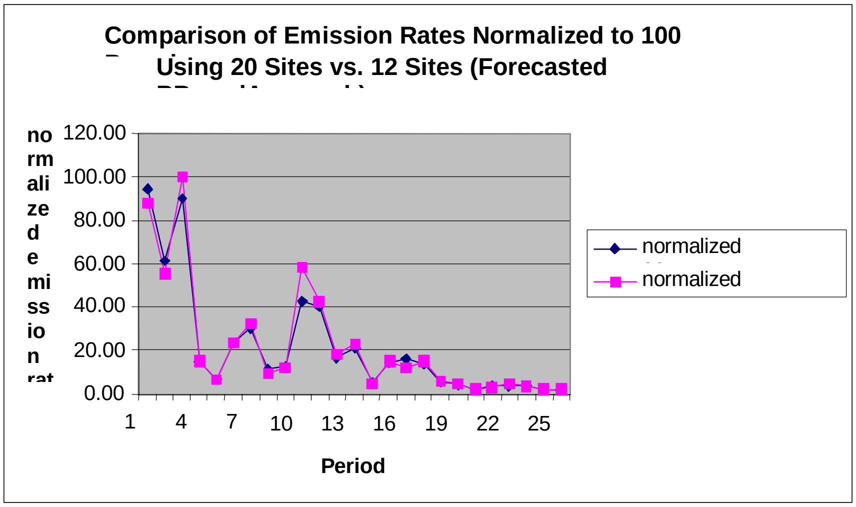

Figure 3: Comparison of normalized emissions based on 20 sites vs. 12 sites (chemigation application) based on ISCST3 modeling

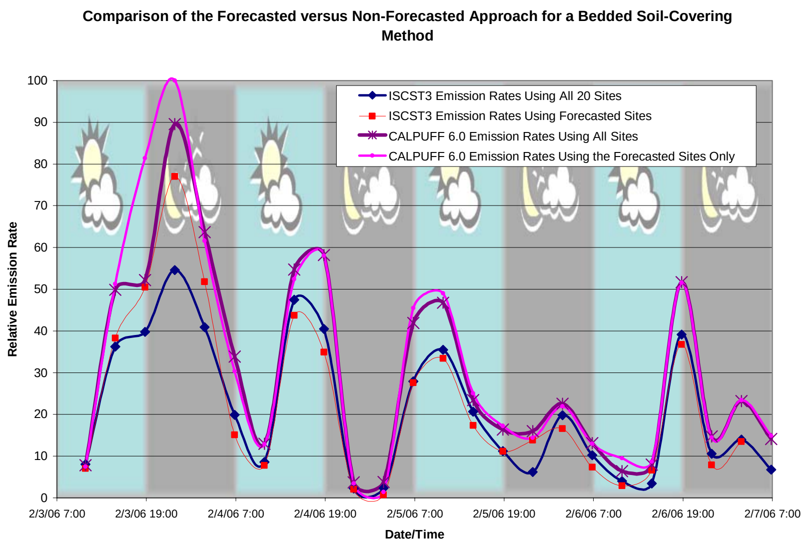

Figure 4: Comparison of normalized emissions based on 20 sites vs. 12 sites (shank injection / soil covering method) based on ISCST3 and CALPUFF 6 modeling

As shown above, there is minimal benefit from using all 20 sites versus using the forecasted sites. Through proper management of field records, sample labels (e.g. crossing out portions of field sheets and eliminating sample labels for unused site / period combinations) clarity can be maintained during sample collection. This approach improves the efficiency of the emission fitting process, without sacrificing data quality, especially with the use of the CALPUFF 6 model.