I. Preliminary OP Cumulative Risk Assessment

F. Cumulative Assessment

1. Introduction

The previous four sections of this document have described the development of the major components of the risk assessment. They describe a highly complex process of combining multiple data sets to develop a description of the possible risks from OP pesticides by each of the pathways described. OPP has had to develop new methods for each component of the assessment in order to produce an assessment which presents as realistically as possible the potential exposure to OP pesticides. The purpose of this section is to explain the concepts used to accumulate risk from each pathway into a total risk estimate, and to provide a basis for understanding the graphical presentations that are provided in Section III for each of the regional assessments.

2. Basic Concepts

The definition of cumulative risk developed as a result of the passage of FQPA requires OPP to conduct a risk assessment for a group of pesticides with a common mechanism of toxicity that is multi-pathway, multi-route, and multi-chemical in scope. As described is section I.B above, the RPF method was used to address the issue of combining toxic responses from OPs with varying propensities to inhibit acetylcholinesterase. Exposure to each OP was normalized to equivalent exposure to the index compound, methamidophos. The toxicity data currently available for conducting this analysis are estimates of response by route-specific dosing, and do not support estimating delivered dose to the target tissue. OPP decided to address this problem by comparing route-specific exposures to route-specific points of departure to produce unitless margins of exposure for each route. In this case, the POD was a BMD_{10}. MOEs were combined by taking the inverse for each route, adding them together, and then taking the inverse of that sum. This process was used to produce a distribution of daily estimates for the subpopulation of concern that reflects regional and seasonal variation in the patterns of exposure that are likely to occur throughout the US across the year. OPP used a probabilistic assessment to capture the full range of exposure possibilities from all sources analyzed. The intent was to produce an estimate of risk that is as realistic as possible. The OP cumulative risk assessment is not a high end risk assessment. It attempts to reflect the full range of likely exposures for consideration in a regulatory context. However, at the same time it is designed to avoid developing extreme exposure estimates based upon the combination of exposure scenarios and assumptions that are not reasonable.

3. Framing the Population-Based Assessment

OPP focuses its risk assessment on exposure and resulting risk to the population, not to risk to an individual. This distinction is an important one with regard to defining how the components of the assessment will be combined. The current assessment focuses on highlighting inter-individual patterns of exposure instead of attempting to define intra-individual patterns of exposure. OPP made this choice because of the lack of acceptable longitudinal data defining intra-individual behavior for any component of the risk assessment. This issue has been repeatedly discussed at SAP meetings reviewing the conduct of dietary risk assessment methodology. Longitudinal data permitting modeling of the consumption of food and water by the US population is not available. The data describing the use of pesticides in a residential setting is even more uncertain. Although ranges of use parameters are available and have been used in this assessment, they are only adequate to define the behavior of the population across time, and cannot accurately reflect the day to day variability in behavior of an individual. Therefore, OPP decided to develop a series of daily exposure distributions and array them as a distribution across time.

The distribution of daily exposures and resulting MOEs are developed such that the exposures from OPs in foods, drinking water and from residential uses are all calculated simultaneously for each hypothetical individual in the subpopulation. OPP uses the Calendex software to develop the distributions and resulting MOEs. Calendex permits incorporation of time course information with regard to residential uses of pesticides, but does not permit specific allowance for regional variability. OPP addressed this issue by running separate risk assessments for each of twelve regions of the US. The regions correspond to agronomic cropping areas and reflect climatic and soil conditions that are likely to affect pest pressure and resulting pesticide use. Regional differences in pesticide use are major considerations in appropriately estimating exposure from pesticides in drinking water and residential uses.

To generate a daily distribution of exposure for the subpopulation of interest, a consumption record is selected from the CSFII that corresponds to the age group of interest. Calendex uses this consumption record to estimate OP exposure from food by randomly assigning a residue value for each food included. After multiplying each amount of food consumed by its selected residue value, the total exposure for this individual from food is summed. At the same time, all appropriate residential scenarios that may be encountered for the calendar day 1 (January 1) are reviewed. A probability-based decision is made as to whether or not that scenario will be encountered (e.g., a lawn treatment; probably not in January). If the scenario is assigned a "yes" answer, then the appropriate values defining the exposure are selected from the many distributions of input parameters for residential exposure scenarios. The exposures for dermal, oral and inhalation exposures are calculated for all selected residential scenarios. A drinking water value taken from the PRZM/EXAMS output for January 1 is selected and paired with the water consumption reported in the CSFII consumption record. These values are used to calculated exposure from drinking water for that date. All of the exposures are converted to route-specific MOEs to define the total exposure to the hypothetical individual on January 1. The process is repeated for each consumption record for the age group in the CSFII ten times to build a distribution of exposures for January 1. This process is repeated for January 2, January 3 and so forth across the year.

The 365 daily exposure distributions are arrayed together in order to provide a profile of possible exposures by each route and in total as MOEs. An example of such a distribution of distributions is presented in Figure I.F.1. In this figure, each daily distribution is arrayed on the yz plane of the plot. Day 365 can be clearly seen on the right side of the plot. This distribution of total risk is expressed as a cumulative distribution function of MOEs versus percentile of exposure. Percentile of exposure refers to that portion of the population that has less than or equal exposure. For example, at the 80^{th} percentile of exposure, 20% of the population has an MOE lower than the one at the 80^{th} percentile point on the distribution.

The distribution of daily distributions is used to estimate the potential population, with accompanying distributions generated for each pathway and route. OPP acknowledges that this approach does not describe intra-individual risk. In all likelihood, the variability in an individual exposure would be much greater than in a population-based approach because of the limited likelihood of repetitive events such as residential pesticide applications. However, the population at large will experience some degree of exposure each day. This factor is a likely source of conservatism in the current assessment.

4. Interpreting the Outputs

The results of the final assessment are presented in graphical form in the appendices. The reflect year-long slices across the 3-dimensional plot in Figure I.F.1. In that plot, dark lines can be seen across the total MOE surface. For instance, the top line in the 3-dimensional plot represents the 99.9th of exposure for the population. A slice through the surface parallel to the xy plane at the 99th percentile would look like the plot presented in Figure I.F.2. This plot presents the potential total MOE for the population exposed to OPs by the exposure scenarios included in this assessment. In addition, the contributions from various pathways and routes of exposure are arrayed separately to assist the risk manager in identifying contributors to risk for further evaluation. Other percentiles of exposure may also be of interest. For example, Figure I.F.3 presents the results of the assessment at the 97.5th percentile of exposure. At this percentile, the MOEs for all routes and pathways are lower than at the 99th percentile. The risk manager can also note from these two figures that the dominant inhalation exposure that was a major risk contributor at the 99th percentile is not a major risk contributor at the 97.5th percentile, suggesting that only a small proportion of the population is being impacted by this route of exposure.

OPP will use the changes in graphical presentations of data such as these to evaluate the significance of various sources of exposure, considering the percentile at which the exposure becomes significant and the duration over which the exposure route and source remain dominant in the risk assessment results.

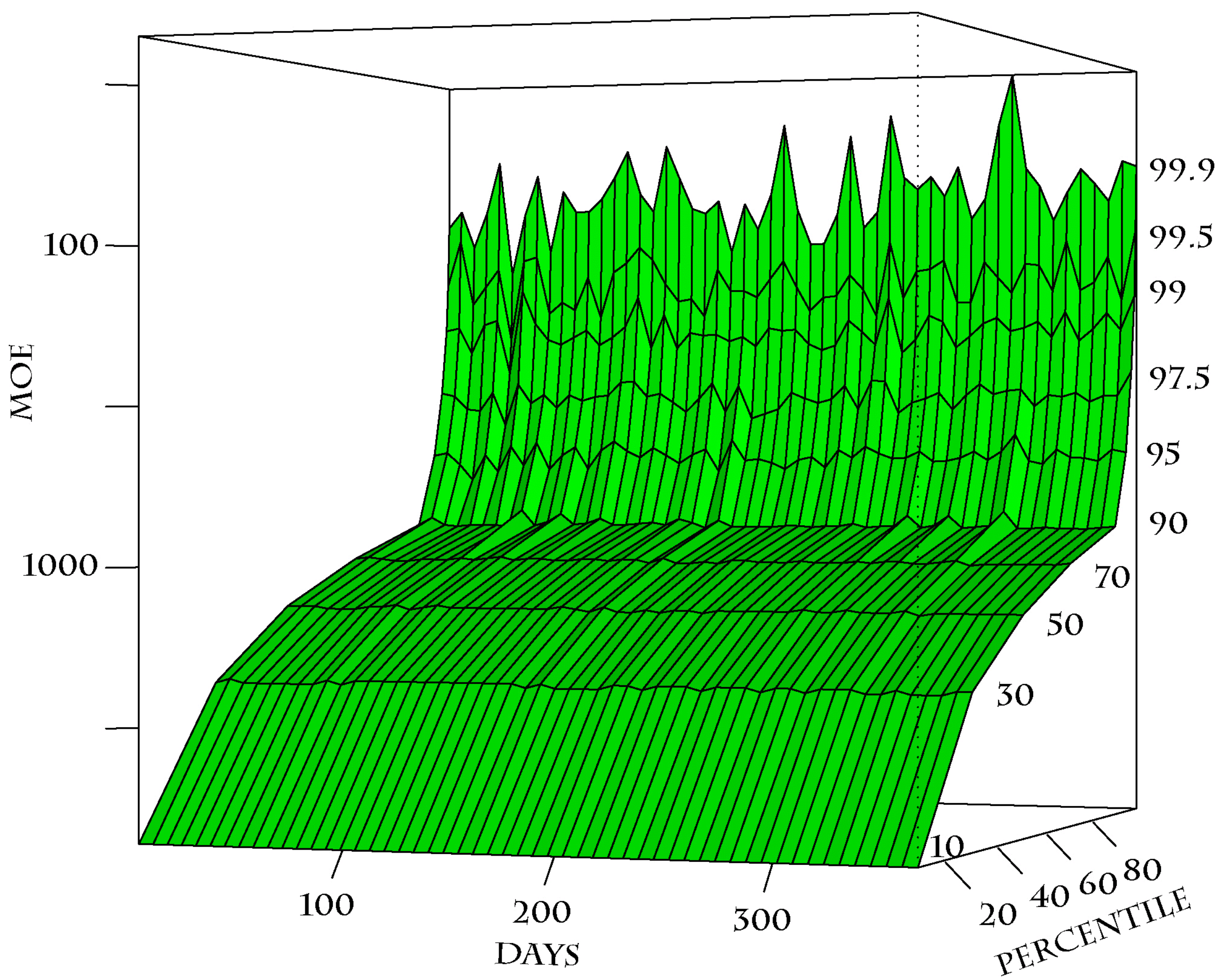

Figure I.F-1. Three-dimensional plot of the total MOE by day of the year and percentile of exposure

Figure I.F-2. Cumulative Assessment - Annualized 99th Percentile Estimate for Children Ages 3 -5 Years for All Routes and Pathways

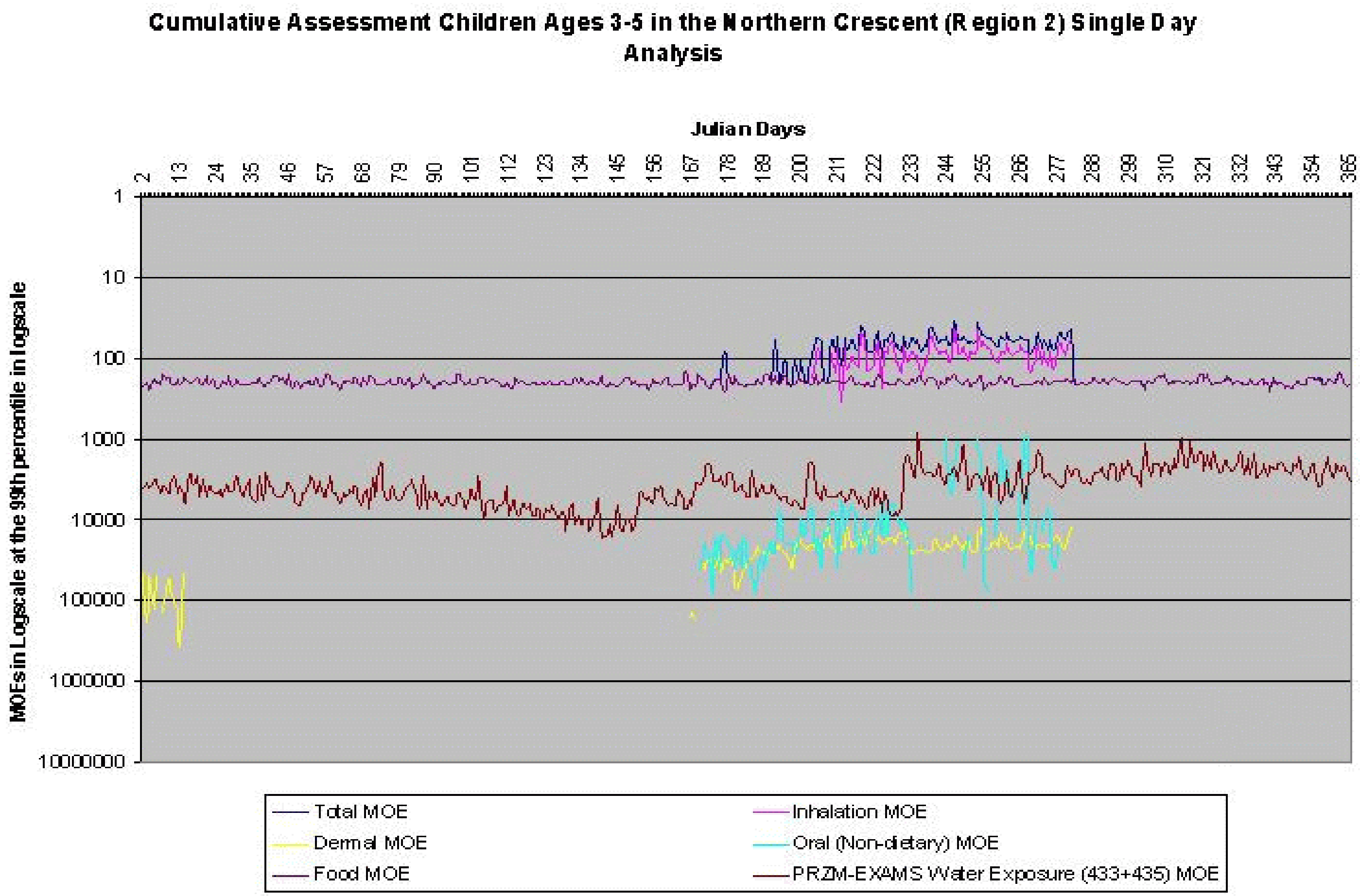

Figure I.F-3. Cumulative Assessment - Annualized 97.5th Percentile Estimate for Children Ages 3 -5 Years for All Routes and Pathways