

conducting area-specific assessments. However, as noted above, a few commenters expressed the view that since EPA conducted area-specific quantitative assessments for the inhalation exposure and respiratory effects risk assessments discussed above (section II.A.2), it necessarily has sufficient information about these same factors to conduct such exposure and risk assessments of the potential UV-B radiation-related consequences of a more stringent O<sub>3</sub> NAAQS. These commenters also expressed the view that to the extent that EPA has incorporated these factors in quantitative area-specific assessments of respiratory effects, it should be possible to use the same information on these factors to conduct similar assessments of UV-B radiation-related effects.

While EPA clearly recognizes that the factors that are important in the inhalation exposure and respiratory effects risk assessments are analogous to the factors that would be important to conducting similar assessments of the UV-B radiation-related effects, as discussed above, EPA believes that these commenters are ignoring the important differences between these sets of factors. Although substantial information has been gathered over time regarding factors related to respiratory effects, no such similar research has as yet been done that would provide comparable information related to dermal exposure factors. For the reasons discussed above, EPA rejects the notion advanced by these commenters that simply because there is sufficient information to conduct area-specific quantitative assessments for the inhalation exposure and respiratory effects risk assessment, that such information would be sufficient to conduct exposure and risk assessments of the UV-B radiation-related effects of a more stringent O<sub>3</sub> NAAQS.

Based on the discussion of factors above and consideration of the comments received, EPA continues to believe that more information is needed before credible area-specific quantitative analyses of potential UV-B radiation-related consequences of a more stringent O<sub>3</sub> NAAQS could be conducted.

### 3. Evaluation of UV-B Radiation-Related Risk Estimates for Ground-level O<sub>3</sub> Changes

As should be clear from the discussion above, a full risk assessment of UV-B radiation-related effects resulting from a moderate change in ground-level O<sub>3</sub> would be an extremely challenging enterprise that appears to be beyond current data and modeling capabilities. Nevertheless, three

analyses (Cupitt, 1994; U.S. DOE, 1995; Lutter and Wolz, 1997) have developed estimates that attempt to bound the potential indirect UV-B radiation related effects associated with replacing the former 1-hour O<sub>3</sub> NAAQS with an 8-hour O<sub>3</sub> standard. All three analyses essentially reflect a static comparison of two separate O<sub>3</sub> concentrations on a national basis, and include, either explicitly or implicitly, numerous assumptions needed while excluding the important area-specific issues and factors outlined above.

The most thoroughly documented calculations are those provided in Cupitt (1994), an EPA white paper developed as an initial scoping analysis of the issues, in preparation for potential consideration in the Regulatory Impact Analysis (RIA) that would accompany the O<sub>3</sub> NAAQS regulatory package. This paper discusses many of the important factors and uncertainties outlined above, summarizes key background information to provide perspective, and includes a discussion and table summarizing the many simplifying assumptions that were needed to permit the development of quantitative estimates. Cupitt's analysis evaluates changes resulting from cumulative exposures under two scenarios, including one that compares estimates of NMSC incidence associated with an assumed reduction of daytime summer O<sub>3</sub> of 10 ppb that would occur uniformly throughout 30 eastern States and the District of Columbia and within an assumed atmospheric mixing layer that ranged up to 2 km in altitude. Assuming no other relevant factors changed over the several decade exposure period that would be required, the resulting increase in NMSC incidence for this extreme scenario was estimated eventually to reach "between 0.6% and 1%." While these percentages are small—indeed too small to be measurable (Cupitt, 1994)—if taken at face value, they would not necessarily be judged as trivial because of the large baseline of NMSC. For reasons outlined below, however, even these small percentage estimates appear to be substantially overstated and cannot be considered reliable.

The Cupitt paper was never formally published, but it was subjected to internal agency peer review and commentary by experts at EPA's Office of Research and Development (ORD) (Childs, 1994; Altschuller, 1994). While finding the exposition, including recognition of the difficulties in such an approach, to be "very acceptable," the reviewers noted substantial uncertainties in basic data and

expressed concerns about the numerous simplifying assumptions that called the numerical results into significant question. Examples of data uncertainties noted by the reviewers include: (1) The accuracy of column O<sub>3</sub> (in Dobson units) and UV measurements used; (2) the fact, recognized in Cupitt (1994), that the predicted UV-B radiation flux changes are at the "noise" level and could not be reliably detected statistically or attributed to the change in ground-level O<sub>3</sub> concentration; (3) data on effects of aerosols are limited, yet ignoring such effects in estimating the O<sub>3</sub>—UV-B radiation relationship was "erroneous;" and (4) data to permit dynamic assessment of the feedback between increased UV radiation and increased O<sub>3</sub> is limited to uncertain models, and this potential feedback mechanism was ignored in the analysis (Childs, 1994).

Reviewers also questioned a number of the simplifying assumptions that could have "substantial impact" on the resulting risk estimates. Among these were: (1) The assumed mixing height of 2 km, which reviewers considered too high on average, especially for the eastern United States—by overstating the thickness of the pollution-related layer of the atmosphere that is the focus of the control strategies designed to attain the NAAQS, this factor would bias the estimates upwards by as much as a factor of 2; (2) the assumption that the O<sub>3</sub> mixing ratio is the same at the earth's surface as it is at 2 km, when the vertical profile varies through the diurnal cycle—because vertical mixing increases through the day, this assumption would be most important in the earlier portion of daylight hours; (3) the assumption that neither aerosols nor O<sub>3</sub> production cycles themselves exert either positive or negative feedback on UV-B penetration—as noted in the previous section, a dynamic consideration of these factors could change the direction of the result in particular areas; (4) the assumption that NMSC might result from episodic exposures, when, in fact, NMSC results from cumulative doses—this assumption affects only separate and far smaller estimates Cupitt made for episodic changes, essentially invalidating those results; (5) the assumption that all people would be susceptible to NMSC based on assumed exposure factors; and (6) the assumption that behavioral patterns, demographic patterns, and meteorological factors and other factors related to actual exposures remain constant over time (Childs, 1994; Altschuller, 1994).

These reviewers capsulized their conclusions regarding the quantitative results of this analysis as follows: