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Optimization of long-term air quality modelling for Baden-Württemberg (FRG): Part II, calculation of air quality indicators based on classified meteorological conditions[1]

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A methodology to classify atmospheric conditions has been provided which can be applied efficiently with respect to the determination of long-term air quality for the Federal State of Baden-Württemberg, FRG. For this purpose two different classification techniques have been analysed with respect to their applicability in long-term air quality studies. These were "classical" cluster analyses, using the WARD and K-MEANS methods, and Kohonen's "Self Organizing Maps" (SOM). These techniques have been judged by their efficiency and the aspect whether the resulting classes represent the whole spectrum of possible meteorological conditions.

The second point has not been studied from the meteorological point of view but by answering the question whether statistical quantities, which describe air quality and which have been derived from the results of the meteorological classification, do agree with those statistical values that have been calculated from the results of a detailed simulation of trace gas concentration distributions. Such statistical quantities are average and maximum concentrations of air pollutants, percentiles, and, with respect to ozone, indicators like AOT40 and SOMO35.

As preliminary stage to actual long-term air quality studies the aim of the project was the development of an efficient classification and analysis tool. For this purpose it was not necessary to consider the atmospheric conditions over a long time of 10 to 20

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years. It was sufficient to take into account a shorter period, e.g. one year. Therefore, simulations with the CTM KAMM/DRAIS have been carried for the year 2000 and for the area of Baden-Württemberg. For the whole year, three dimensional hourly concentration distributions have been calculated for all 41 RADM2 species. The statistical air quality measures have been calculated based on the results of this detailed annual simulation. For the classification of the three-dimensional large-scale meteorological conditions the results of the EURAD model have been used. For each class obtained, one day has been chosen objectively, representing the classified atmospheric condition. The concentration distributions for this representative day were already known from the annual simulation.

Based on these results and taking into account the frequency of each class, the statistical air quality measures could be recalculated with sufficient accuracy. Essentially, the classes obtained can be considered representative of the atmospheric conditions taken into account, because the difference between the statistical values derived from the classification results and those based on the annual simulation are in general less than 10%.

With respect to the judging criteria, the K-MEANS method seems to be the most suitable because the air quality indicators resulting from the detailed simulation could be best reproduced by those based on the results of the K-MEANS classification