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AIR QUALITY DECISION SUPPORT SYSTEMS

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ABSTRACT

The past forty years have produced a multitude of deterministic and statistical modelling tools for predicting the temporal and spatial distribution of air pollutants around a variety of source structures. Long-memory time series analysis and pattern recognition techniques are now an attractive alternative or supplement to numerical modelling for identifying significant trends in long-term air quality and providing short-term air quality forecasts.

Recent statistical analysis of Australian capital city air quality information has demonstrated the relative importance of different source types, the role of bushfires in ozone production and the changing environment of monitoring locations in a rapidly expanding metropolis. The same techniques form the basis of user-friendly decision-support systems for local/regional air quality. With realistic forecasts of regional meteorological states now available up to 7 days in advance, predictive and reactive control philosophies can be integrated. Particular applications are discussed for providing a 4-48 hour forecast of regional photo-oxidant and PM_{10} distributions in the Brisbane urban area and the predictive/reactive control strategies for a major inland industry.

INTRODUCTION

Air quality management has to encompass a variety of time and spatial scales, allow for evolving systems and facilitate decision-making under many types of uncertainty. It necessarily requires a good appreciation of risks, an evaluation of alternative options and scenarios and a recognition of the value of known similar situations and system characteristics. There are several planning horizons, each with a degree of predictability and a variety of possible analysis tools. It is unlikely that any one modelling and prediction scheme can provide adequate guidance for a given situation - a more realistic approach may be to adopt a platform of techniques of quite different types and origins. This paper reviews the utility of statistical and expert system approaches to establish existing air quality states and trends over a multi-decade period and, at the other end of the time spectrum, to produce short-term predictions of air quality from 2-7 day predictions of regional meteorology.

The assessment and anticipation of extremes both in emissions, meteorology and dispersion require a quantitative evaluation of the possible outcomes for consequent concentration dosages and medical endpoints. Management also requires communication and consensus of ideas and results for people with quite different levels of technical skills. Decision-support systems are software-based integrators of historical information, user objectives and knowledge that facilitate the presentation and evaluation of alternative options. They are often needed for air quality management of individual industries, urban conurbations or, indeed, regional and national airsheds. This paper addresses three current areas of interest in Australia and illustrates how statistical and information management techniques can form a very fruitful adjunct to deterministic tools such as numerical airshed models.

The three examples are the subject of recent work by a company specialising in forecasting technologies for the environmental and energy industries. The theoretical tools include:-