Studying the Impact of Climate Changes on Some Environmental Pollution Levels by Advanced Mathematical Tools

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Large-scale environmental models can successfully be used in different important for the modern society studies as, for example, in the investigation of the influence of the future climatic changes on pollution levels in different European countries, [4] and [6]-[9]. Such models are described mathematically by non-linear systems of partial differential equations, which are defined on very large spatial domains and have to be solved numerically on very long time intervals (running over many consecutive years). The discretization of the spatial derivatives leads to huge systems of ordinary differential equations that have to be handled numerically by using the Newton method at each time-step. Moreover, very often many different scenarios have also to be developed and used systematically in the investigations. Therefore, both the storage requirements and the computational work are enormous. The following four tasks have to be resolved successfully in order to be able to handle this difficult problem:

(a) numerical methods, which are both sufficiently accurate and very fast, are to be selected,

(b) efficient and reliable splitting procedures are to be applied,

(c) the cache memories of the available high-speed computers are to be efficiently exploited

and

(d) the codes are to be parallelized.

The **Unified Danish Eulerian Model** (UNI-DEM), [1]-[3] and [5], was used in the actual computations with sixteen scenarios and over a time-period of sixteen years (from 1989 to 2004). It will be explained how the above four computational tasks **(a)**-**(d)** were resolved and some recent results obtained during the runs will be reported and explained.

References

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