Introduction, general aim of project, and purpose of poster

The use of a complex Chemistry-Transport-Model (CTM) like KAMM/DRAIS in studies related to regional long-term air quality requires the classification of meteorological conditions of at least ten years, because the continuous application of such a model over a time period of 10 years or even longer would be too time consuming and too expensive. Therefore, the general aim of the project is the examination of two different classification methodologies with respect to their practical applicability in the field of long-term air quality studies.

The two techniques chosen are “classical” cluster analyses, and Kohonen’s Self-Organizing-Maps (SOM). Criteria of judgement will be

- the efficiency of a method (handling, computation time, interpretation of classification results),
- and whether the resulting classes are good representatives of the whole spectrum of meteorological conditions.

The last aspect is related to the question whether statistical measures and air quality indicators calculated from detailed simulations over a period agree with those derived from the classification. Such indicators characterizing air quality are, for example, AOT40 and SOMO35. In order to achieve the goal of the project it is not necessary to consider the meteorological conditions over a very long period, it is sufficient to take into account a shorter one, for example one whole year.

Therefore, KAMM/DRAIS simulations for the Federal State of Baden-Württemberg (FRG) have been performed for one year (2000), calculating hourly concentrations of all 41 RADM2 species. Statistical measures and air quality indicators have been derived from the results of these simulations.

The poster describes these simulations. The results are compared statistically with corresponding measurements. The focus is on ozone.

The complete project and the model system KAMM/DRAIS are illustrated in Fig. 1, and Fig. 2, respectively, the model area is shown in Fig. 3.

Model setup, initial- and boundary conditions, emissions

- Horizontal resolution:
  - NX = 59, NY = 59, ΔX = 5km, ΔY = 5km
- Vertical resolution:
  - NZ = 35, ΔZ = 10m, ΔZtop = 250m
- Model level: 5000m ASL
- Start of simulation: January 1, 00:00 UTC
- Storage of results: Δt = 1 h
- Numerical time step: ≤ 20 sec
- Initial- and boundary values: EURAD results (Fig. 4): Re-initialization: every second day
- Boundary values: every hour
  - flux method for T, G, and C: advective transport over lateral inflow boundaries
  - for u and v Ornskold radiation conditions
- Basic state, derived from EURAD results:
  - every three hours new u0, v0, and T0, linear interpolation
- Nudging, derived from EURAD results:
  - every three hours, only u and v, linear interpolation
- Nudging coefficient: 3.06-4 constant

Fig. 1: Flow diagram of the project
Fig. 2: Illustration of the model system
Fig. 3: Model domain located in south-west Germany

Necessary extensions of model system KAMM/DRAIS

I. Dependence of parameters on Julian day

Vegetation parameter P:
- Leaf Area Index (LAI)
- Vegetation coverage of soil

Aerodynamic parameters P:
- Roughness length
- Displacement height
- Profile parameter of wind speed inside vegetation

Parameterization of dependence

\[ P = P_{min} + (P_{max} - P_{min}) \cdot X_{veg}(J) \]

P: Parameter
J: Julian day
X_{veg}(J): vegetation function (see, below)

Problem:

KAMM is a “fair weather” model (no clouds, no rain) but clouds affect the pollutant distribution by accounting for

- upward mixing out of the PBL with subsequent transport in the free troposphere
- entrainment of clean air into the PBL
- aqueous chemical conversion
- removal by rainout and washout
- Effects on the photolysis rate

How clouds and rain are considered

- EURAD and KAMM/DRAIS both use the chemistry module RAMD2, thus, adaption of EURAD cloud module
- General procedure (see Hass, 1991)
- Cloud parameters like fraction, height, thickness, rainy clouds or fair weather clouds influencing pollutant transport and transformation are calculated in the chemistry module based on specific humidity, temperature, pressure, and precipitation rate that are all derived in the meteorology module and transferred to the chemistry part
- All meteorological parameters, except precipitation rate, are available from KAMM
- Precipitation rate has been taken from EURAD results

Fig. 4: Nested domains of EURAD model and areas for which data have been provided for use in KAMM/DRAIS
Fig. 5: Total NOX emissions, June, 14, 2000, 06:00 UTC (Kühlwein et al., 2002)