Seasonal Variability of Aerosol Composition in Switzerland: A Modelling Study


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Project

characterization of aerosol composition in summer and winter in Switzerland

Periods:
- January-February 2006
- June 2006

Air Quality Model: CAMx

Met- Model: MM5 (initialized by COSMO)

IC and BC: global model MOZART for similar periods
CAMx Nested Model Domains

- **Domain 1**: 27 km x 27 km
- **Domain 2**: 9 km x 9 km
- **Domain 3**: 3 km x 3 km
- **14 vertical layers**
AMS Measurements in 2006

Zurich
urban background
6-25 Jan.

Reiden
motorway
28 Jan-10 Feb

Payerne
rural
1-30 June
Winter

Zurich

wind speed
1-6 Jan. moderate 6-17 Jan. low 17-23 Jan. high 23 Jan-5 Feb variable 5-10 Feb high
Vertical profiles of potential temperature
Payerne, January 2006

low wind
9 Jan.

high wind
18 Jan.
Zurich (urban background)

PM

Wind speed:
- moderate
- low
- high
- variable
Inorganic Aerosols

Zurich (urban background)

- PNO₃
- PSO₄
- PNH₄

Reiden (motorway)

- model
- measurements

Wind speed:
- low
- high
- variable
- variable
- high
Organic Aerosols

Zurich (urban background)

- Underestimation especially in low-wind periods
- Model OA is mainly POA
- Model SOA is mainly BSOA

Reiden (motorway)
Elemental Carbon

Zurich (urban background)

Slight overestimation

Reiden (motorway)

underestimation
Predicted versus Observed

wind speed

Period II: low
Period III: high
Period IV: variable
Predicted Total Aerosols (µg/m³)

19 Jan. 2006
Relative contributions

January 2006 (Zurich)

Measurements

- Main components are particulate nitrate and organic aerosols
- 60% of total aerosol mass is inorganic
- Organic aerosols are underestimated, EC is overestimated

Model
Summer

Payerne

wind speed

1-12 June moderate-high
12-17 June low
17-30 June variable
Payerne (rural)

- moderate-high
- low-wind
- variable
Inorganic Aerosols

Payerne (rural)

Wind: moderate-high  low  variable
Organic Aerosols

Payerne (rural)

- Underestimation especially under low-wind conditions
- Model OA is mainly SOA
- Model SOA is mainly BSOA
Elemental Carbon

Payerne (rural)

Wind: moderate-high    low    variable
Predicted versus Observed

Wind speed

Period I: moderate-high
Period II: low
Period III: variable
Relative contributions

June 2006 (Payerne)

Measurements

- Main components are organic aerosols
- Organic aerosols are underestimated
- Particulate nitrate is overestimated

Model

- Main components are organic aerosols
- Organic aerosols are underestimated
- Particulate nitrate is overestimated
Conclusions

In general, model-measurement agreement gets worse under low-wind conditions.

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<th>Winter</th>
<th>Summer</th>
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<tr>
<td></td>
<td>Zurich (urban background)</td>
<td>Payerne (rural)</td>
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<tr>
<td><strong>Main components</strong></td>
<td>organic aerosols</td>
<td>organic aerosols</td>
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<td>particulate nitrate</td>
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<td><strong>Organic aerosols (model)</strong></td>
<td>mainly POA</td>
<td>mainly SOA</td>
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<td><strong>Performance</strong></td>
<td>OA underestimated</td>
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- Improvement of meteorological parameterization.
- Implementation of wood burning and sesquiterpene emissions in the emission inventory.
- CAMx simulations with an enhanced SOA module including:
  - oligomerization processes
  - SOA formation from isoprene, sesquiterpenes
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