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Meteorological influences upon air quality in a deep Alpine valley

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Motivation

- **Air quality** is mainly determined by traffic, industrial and urban emissions as well as by specific meteorological and topographic conditions
- **Mitigation and adaptation strategies** (e.g. traffic regulations, threshold exceedances corresponding daughter directives 1999/30/EU and 2000/69/EU) need solid scientific background
- **High air pollution episodes** associated with meteorological conditions like calm winds and low inversion layers were studied near major Alpine traffic routes
- Alpine valleys as **sensitive regions** with direct consequences for public health (Samoli et al., 2006)
- **Future:** New infrastructures, traffic control measures, modal shift in freight transport – What are the consequences?

INTERREG IIIB Project ALPNAP - Monitoring and Minimisation of Traffic-Induced Noise and Air Pollution along Major Alpine Transport Routes

Duration: 01/2005 – 12/2007

Activities

- Evaluating monitoring data from stations along the traverses in collaboration with regional authorities and other INTERREG IIIB projects (e.g. MONITRAF)
- Performing field campaign in the Inn valley between November 2005 and February 2006
- Studying the spatial variation and distribution of air pollution induced by inner Alpine traffic
- Investigating the dependence of the observed air pollution patterns on meteorological parameters like wind, stability and mixing layer height as well as on emissions of air pollutants

Methodology

During the measurement campaign a dense network of meteorological and air pollution monitoring sites including remote sensing instruments together with in situ devices were operated.

Only those instruments are described, whose results are discussed here.

Target area Schwaz / Vomp and instrumentation.
Images of the measurement devices: (1) DOAS receiver/emitter unit, (2) SODAR, (3) ceilometer and (4) in situ instruments for NO, NO_x, CO, O_3 and PM_{10} as well as meteorological parameters.
Their location is shown on the map with a circle and the corresponding number.
The red square shows the location of the LT station Vomp Raststätte.
In the upper left corner a close up in the vicinity of the highway with DOAS and the LT station is given.
Note the river Inn and the A12 highway (closer to the northern slopes).

General conditions

From meteorological and air pollution point of view it is essential to figure out how "typical" the winter 2005 / 2006 was.

Parameter \ Month	November	December	January
Mean temperature 2005 / 2006 (degC)	2.9	-1.9	-5.4
10 yr mean temperature (degC)	4.0	-0.2	-1.0
Days with snow deck 2005 / 2006	12	31	31
10 yr mean days with snow deck	5.8	16.7	17.1
Precipitation 2005 / 2006 (mm)	35	120	59
10yr mean precipitation (mm)	94	62	60

Comparison of 10 year long term mean values to the winter 2005 / 2006 at the station Jenbach of the Land Tirol in the lower Inn valley (source: www.zamg.ac.at).

Comparison of relevant air pollution parameters for the 5 year period 2000 to 2004 to last winter values 2005 / 2006 at the permanent LT station Vomp Raststätte. For PM_{10} the period starts in 2001.

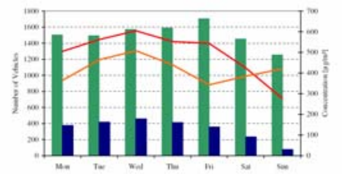
Parameter \ Month	November	December	January
Mean NOx, 2005 / 2006 (µg/m³)	357.5	392.7	562.8
Relative to 5yr mean NOx (%)	+2.1	-0.6	+35.7
Mean NO, 2005 / 2006 (µg/m³)	222.1	224.6	321.8
Relative to 5yr mean NO (%)	-6.1	-12.4	+35.7
Mean NO_2, 2005 / 2006 (µg/m³)	70.8	87.9	126.0
Relative to 5yr mean NO_2 (%)	+18.2	+21.2	+50.4
# threshold exceedances NO_2 daily mean, 2005 / 2006	6	21	28
5 yr mean # threshold exceedances NO_2 daily mean	2.2	8.8	14.4
# threshold exceedances NO_2 HMW, 2005 / 2006	3	0	126
5 yr mean # threshold exceedances NO_2 HMW	0	0.6	1
Mean PM_{10}, 2005 / 2006 (µg/m³)	35	43	66
Relative to 4 yr mean PM_{10} (%)	+5.1	+8.3	+53.8
# threshold exceedances PM_{10} daily mean, 2005 / 2006	2	10	23
4 yr mean # threshold exceedances PM_{10} daily mean	4	9.3	10.8

Results (I)

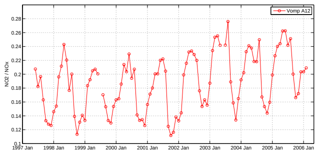
Mean diurnal variation of light vehicles (green bars), heavy vehicles (blue bars), NO_x concentration (red line) and PM_{10} concentration of LT station (orange line, diagrammed with factor 10) from 1 November 2005 until 6 February 2006 of the LT station Vomp Raststätte in 5 m distance to the highway A12.

Results (II)

Weekly means of light vehicles (green bars), heavy vehicles (blue bars), NO_x concentration (red line) and PM_{10} concentration of LT station (orange line, diagrammed with factor 10) from 1 November 2005 until 6 February 2006.



Monthly mean of the NO_2/NOx concentration ratio measured at the LT station Vomp Raststätte in 5 m distance to the highway A12 between June 1997 and Feb 2006.



Conclusions

- Pronounced air pollution levels during persistent high pressure episodes
- NO and NO_2 concentrations dominated by the traffic volume
- Daily differences in air pollution due to temporal variations of highway emissions
- Domestic heating emissions increase during low temperatures
- Air quality is determined by weather conditions and the mountainous effects
- Increased NO_2/NO_x ratios may be caused by high amount of heavy duty vehicles (Carslaw, 2005)

Literatur

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