Assessment of Air Pollution in Alpine Environments

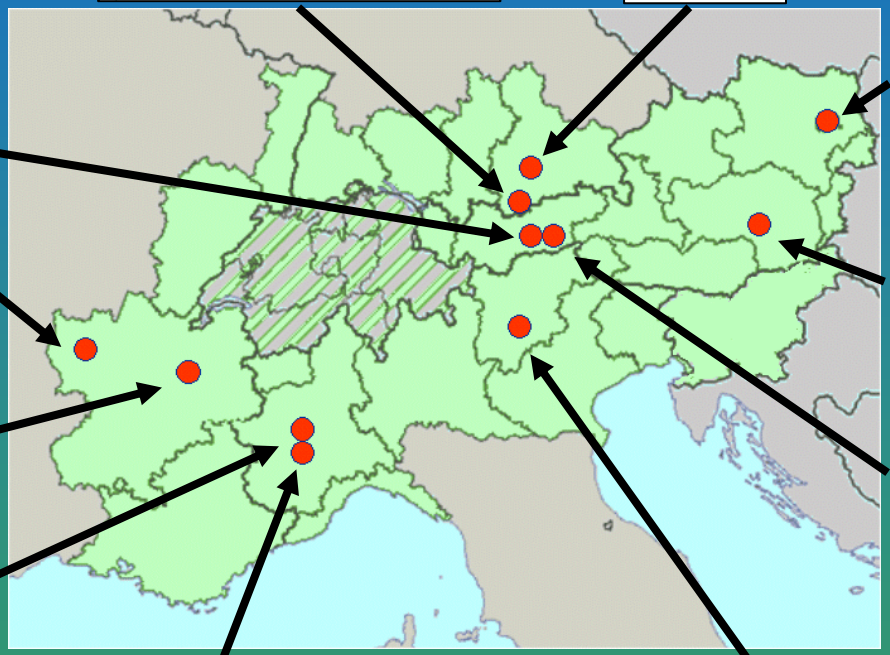
Peter Suppan[1], Klaus Schäfer[1], Stefan Emeis[1],
Renate Forkel[1], Markus Mast[1],
Johannes Vergeiner[2], Esther Griesser[2]

[1]Institute for Meteorology and Climate Research
Environmental Atmospheric Research (IMK-IFU)
Garmisch-Partenkirchen / Germany

[2]Department of Meteorology and Geophysics
Innsbruck University / Austria

peter.suppan@imk.fzk.de

11 partners form an Alpine network of experts ..



Forschungszentrum Karlsruhe
in der Helmholtz-Gemeinschaft
Institute for Meteorology and Climate Research
Atmospheric Environmental Research (IMK-IFU)

DLR

universität innsbruck

BOKU

CETE de Lyon centre d'Études techniques de l'Équipement

TUG

CSTB le futur en construction

Medizinische Universität Innsbruck

ISAC

PIEMONTE Arpa Agenzia Regionale per la Protezione Ambientale

unitn.it trento

KIT Karlsruhe Institute of Technology

ALPNAP

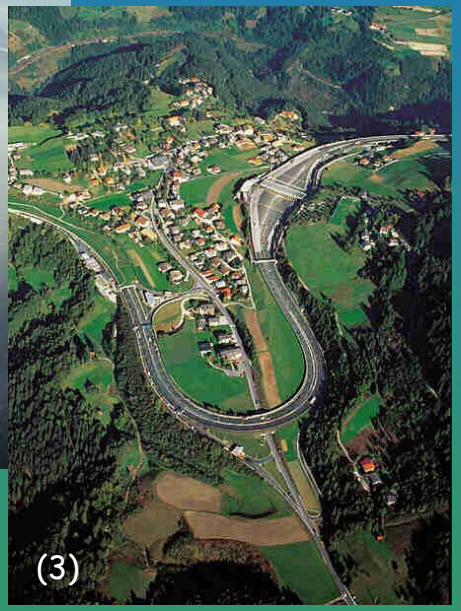
This project has received European Regional Development Funding through the INTERREG IIIB Community Initiative

Alpine Space Interreg III B

... in meteorology, air pollution, noise, and health

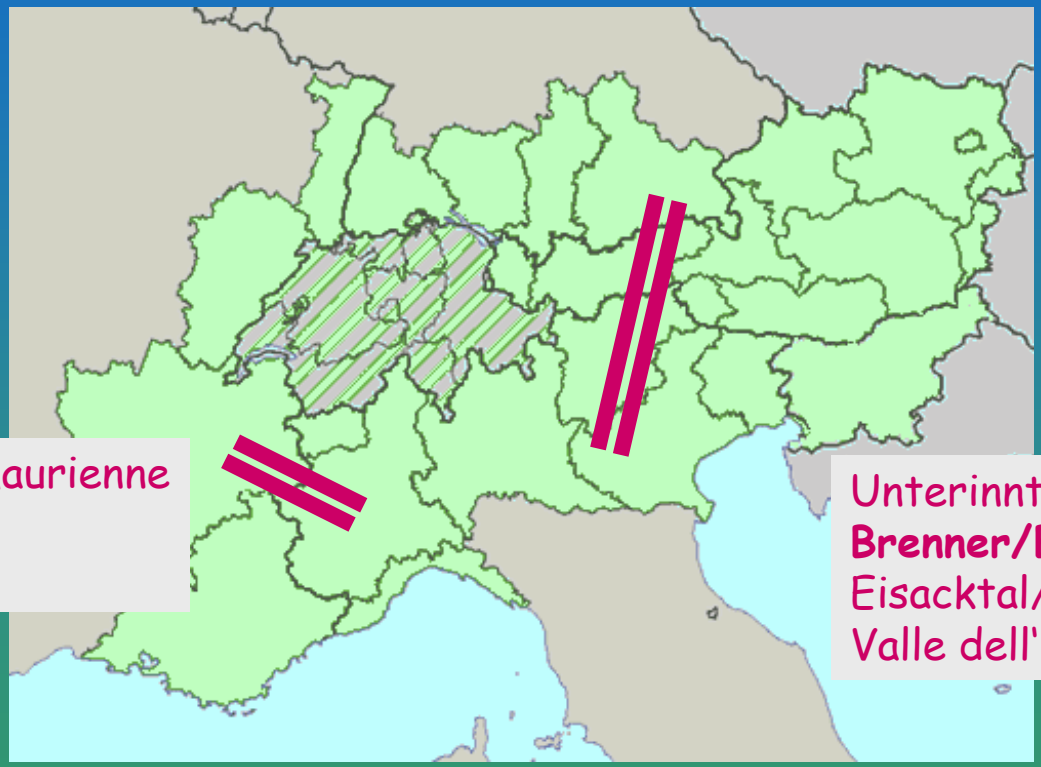

(1)


(2)


(3)

Photos:
(1) FZK-IMK-IFU Garmisch
(2) Amt der Tiroler Landesregierung, Innsbruck
(3) http://www.asg.co.at/index.htm

... focusing on two major road and rail transit routes



Vallée de la Maurienne
Frejus
Val Susa

Unterinntal
Brenner/Brennero
Eisacktal/Valle Isarco
Valle dell' Adige

... implemented the project ALPNAP

Monitoring and Minimisation of Traffic-Induced Noise and Air Pollution Along Major Alpine Transport Routes

Objectives

- to assess the distribution of emissions in valleys, with the focus on traffic and domestic heating
- to assess the impact of air pollution and noise on the environment, quality of life, and health in a integrated approach
- to assess designed traffic regulations to meet noise and air quality standards
- to introduce sustainable Alpine-wide network of experts and authorities

Questions

- new results and experiences from health rise the question on a further reduction of thresholds on PM (is less the mass concentration than the number of ultra fine particles a valid value for health impact??)
- what about the new limits in 2010 for PM_{10} and NO_2 (can we really decrease the NO_2 levels much more than now?)
- NO_2 – more efficient burning technique in cars, new types of catalysts cause higher NO_2; increasing number of diesel cars

Methodology

Measurements

- to assess, simulate and validate the emissions
- to assess the transport conditions and effects
- to determine the mixing height layer
- to find a common methodology for noise and air pollution measurements
  - on specific and typical sides in the valley and on the slopes
  - in Winter 2005/2006

Modelling

- to simulate specific regions for different periods (short / long term)
- to link different scales
- introducing forecast systems, air pollution control systems

09:45

15:05

15:55

17:35

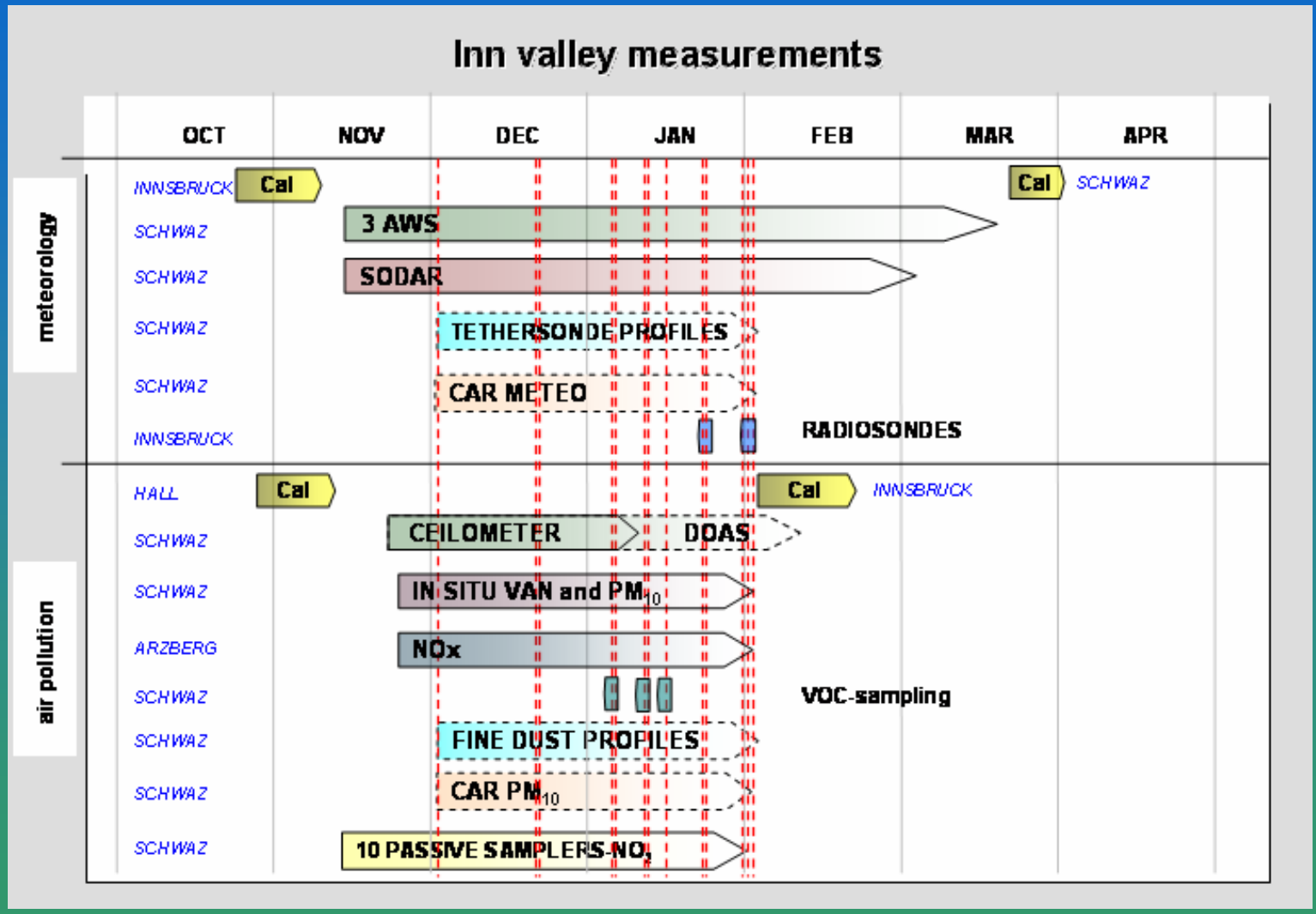
Peter Suppan, Institute for
Meteorology and Climate Research (IMK-IFU)

January 29, 2006

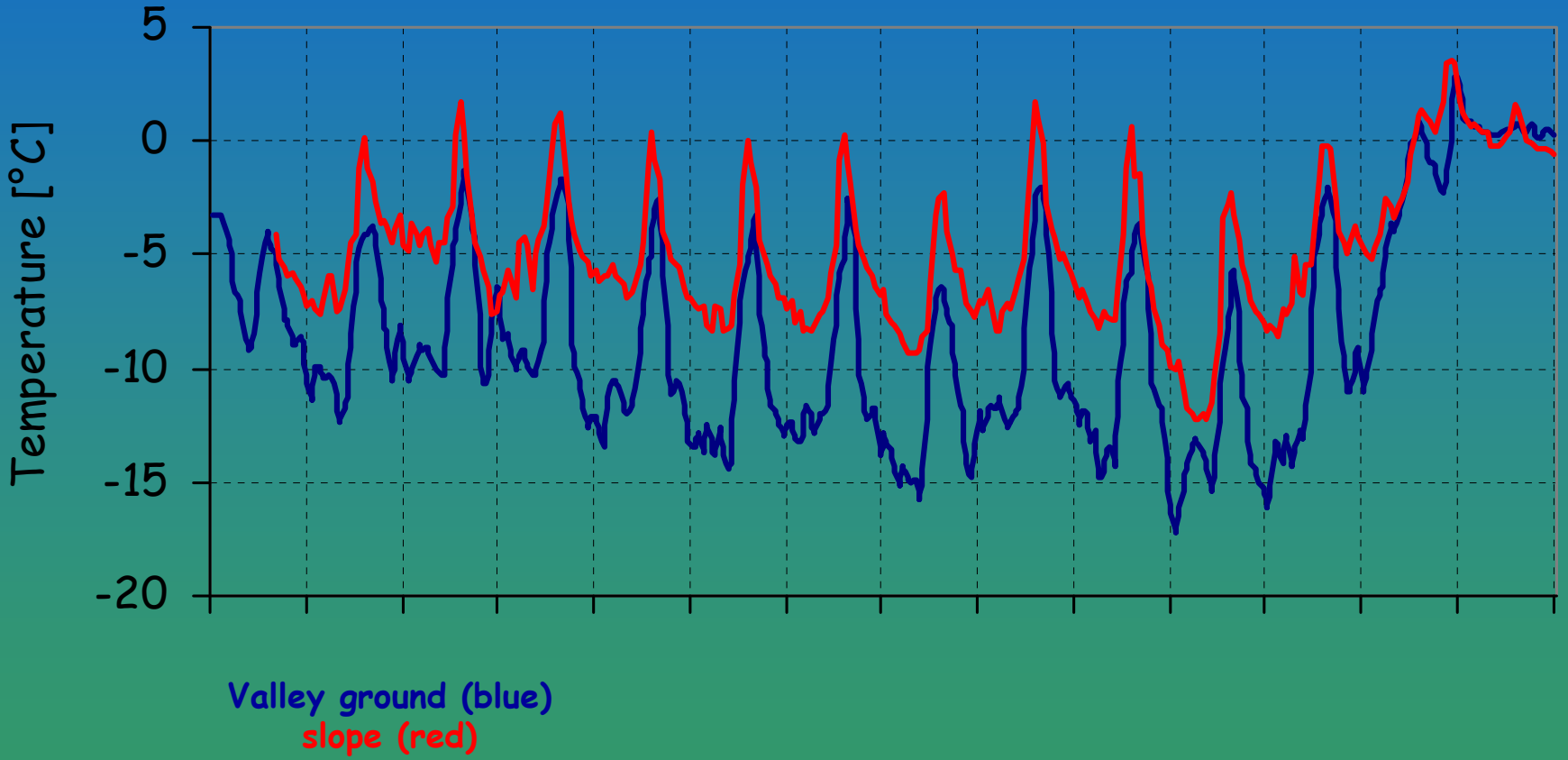
11th Harmonisation Conference
2-5 July 2007, Cambridge, UK

Measurements

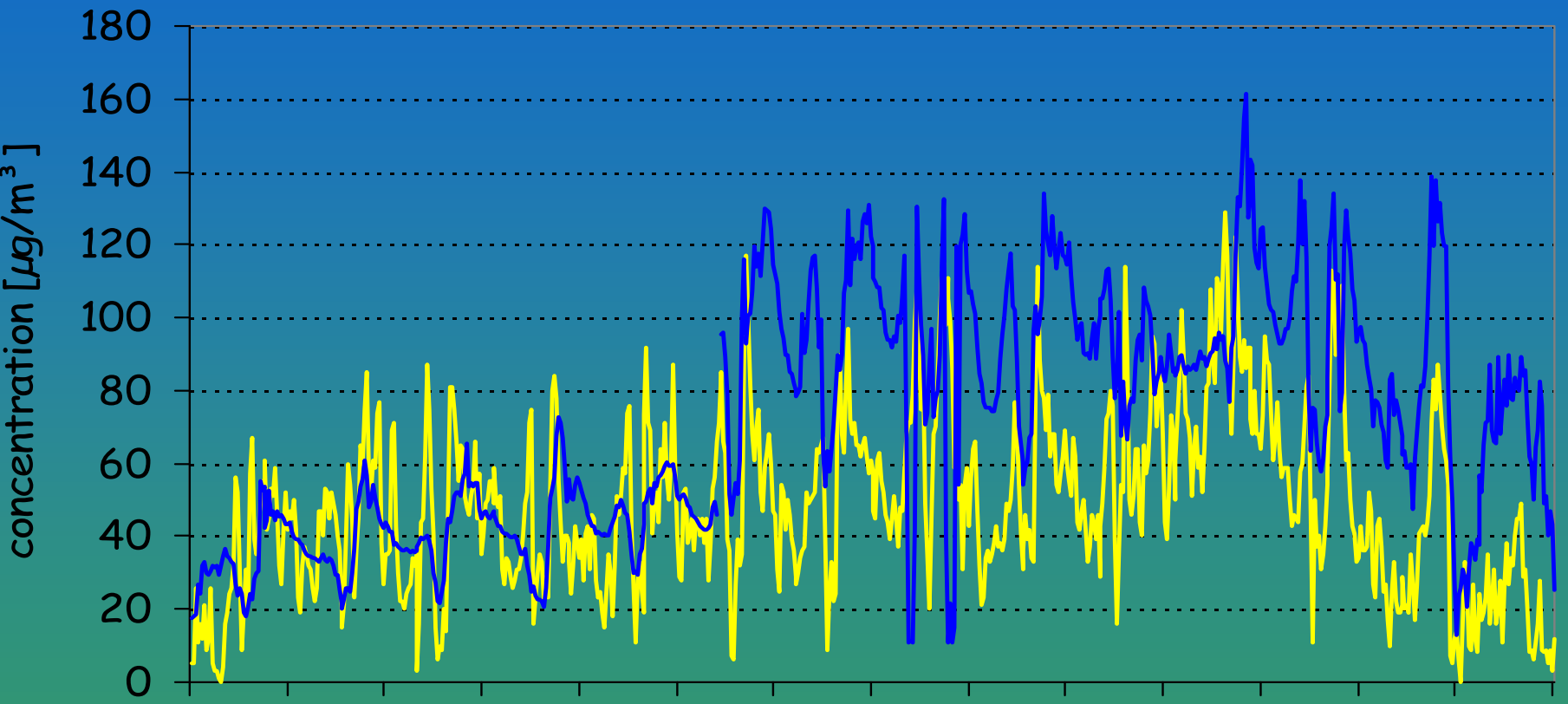

3
4
2
1
2
5
1
3
4
5
6
NOx
6


Inn valley measurements
OCT
NOV
DEC
JAN
FEB
MAR
APR
meteorology
air pollution
INNSBRUCK
Cal
Cal
SCHWAZ
SCHWAZ
3 AWS
SCHWAZ
SODAR
SCHWAZ
TETHERSONDE PROFILES
SCHWAZ
CAR METEO
INNSBRUCK
RADIOSONDES
HALL
Cal
Cal
INNSBRUCK
SCHWAZ
CEILOMETER
DOAS
SCHWAZ
IN SITU VAN and PM10
ARZBERG
NOx
SCHWAZ
VOC-sampling
SCHWAZ
FINE DUST PROFILES
SCHWAZ
CAR PM10
SCHWAZ
10 PASSIVE SAMPLERS-NO2

High-pressure period: 5–19 January 2006

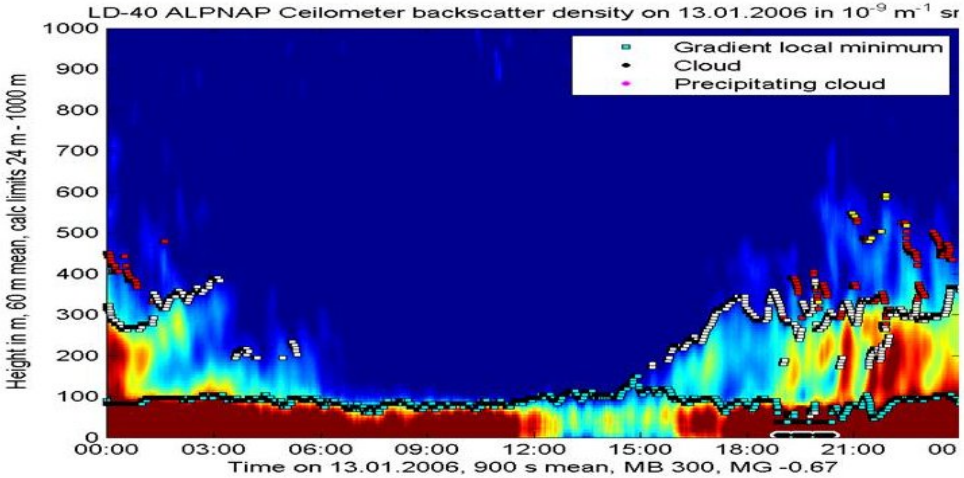


NO_2 and PM_{10} at the valley ground

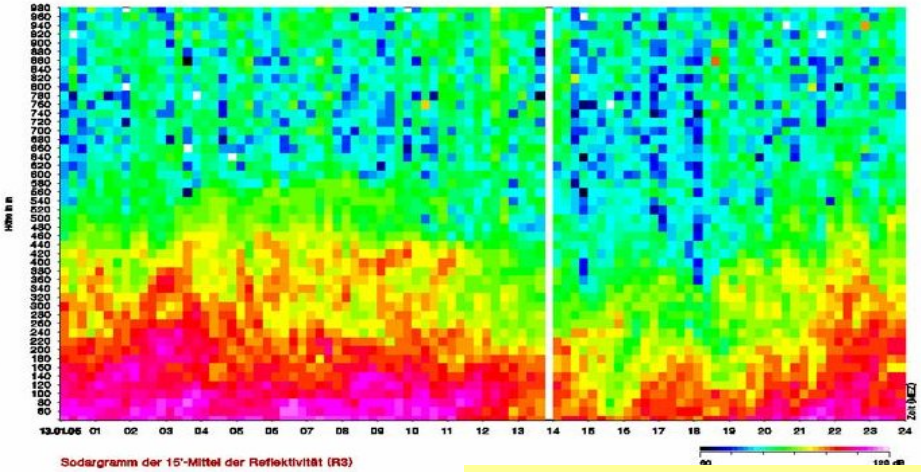


5-19 January 2006; 30 min mean values
NO_2 (blue) and PM_{10} (yellow)

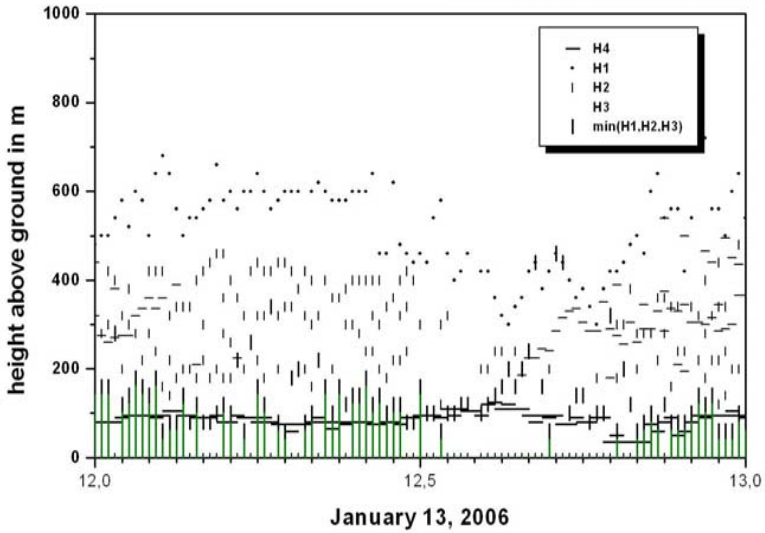
Determination of MLH from Ceilometer and SODAR measurements



optical backscatter intensity plus analysed MLH



acoustic backscatter intensity



analysed MLH from acoustic (vertical bars) and optical (horizontal bars) information in green: stable surface layer

Modelling

Online coupled meso scale climate chemistry model - MM5chem

Meteorological part

- Based on MM5
- Non-hydrostatic
- Nesting capability
- Soil and snow model

Chemistry part

- RADM2 / RACM chemistry
- KPP preprocessor for chemical mechanisms
- Photolysis model
- Aerosol module (MADE/SORGAM)
- Biogenic emission module

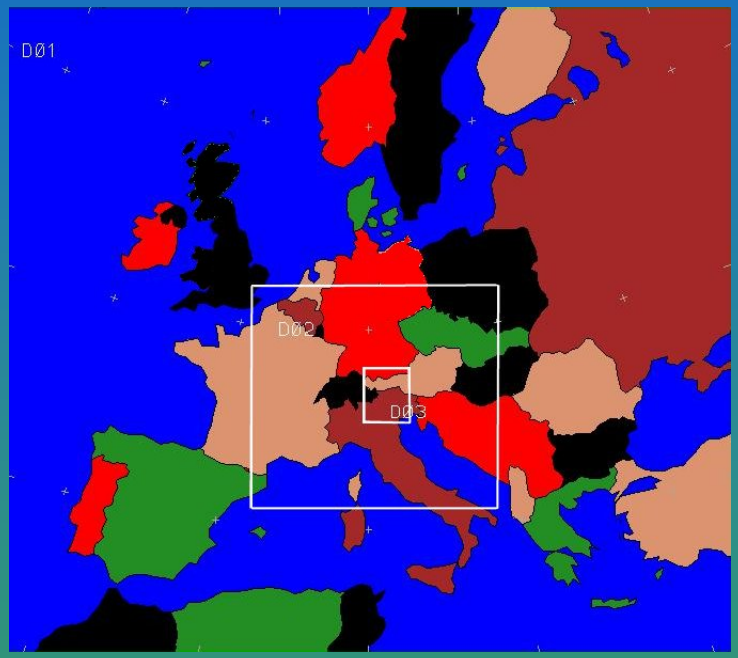
Output:
Fields of temperature, humidity, cloud water and ice, rain water, snow, photolysis frequencies, concentrations of chemical compounds in the gas and particle phase, snow height …

General Setup

- Online coupled meteorology-chemistry simulation with MCCM
  39 gaseous compounds, secondary and primary PM
- 3 nested model domains
- Domain Resolution Grid points

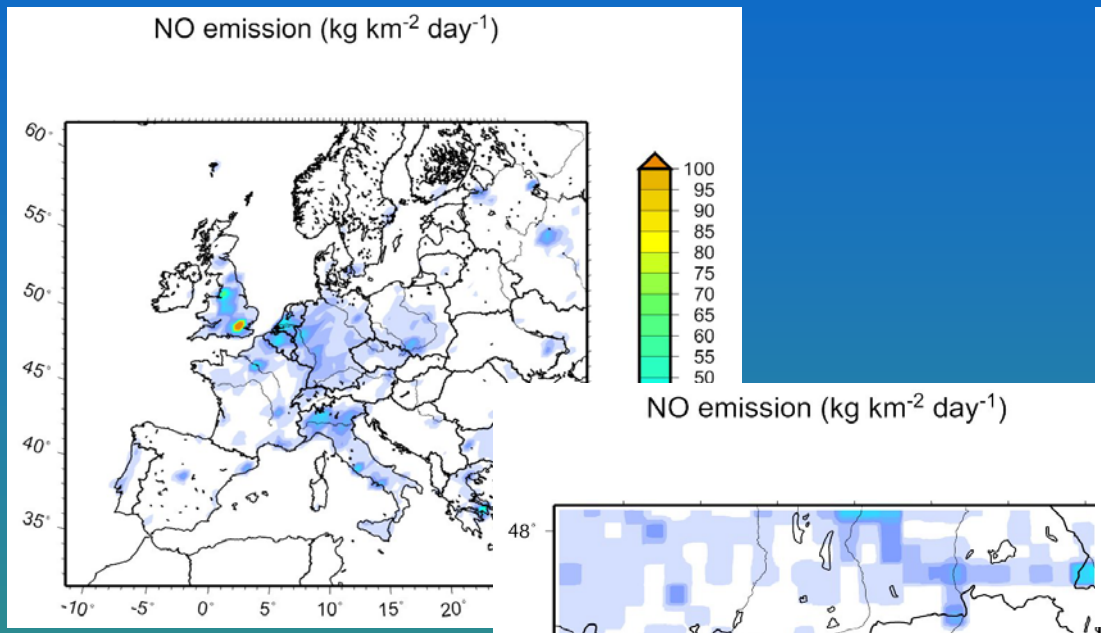
D1	Dx=60km	59 x 66
D2	Dx=12km	101 x 111
D3	Dx=2.4km	126 x 106

- **Continuous simulation**
  1.10.2003 – 31.3.2005
- **High computer requirements**
  CPU time: ca. 90 days (with 16 nodes)
  Disk storage: ca. 250 GB long term plus
  ca. 2000 GB intermediate storage

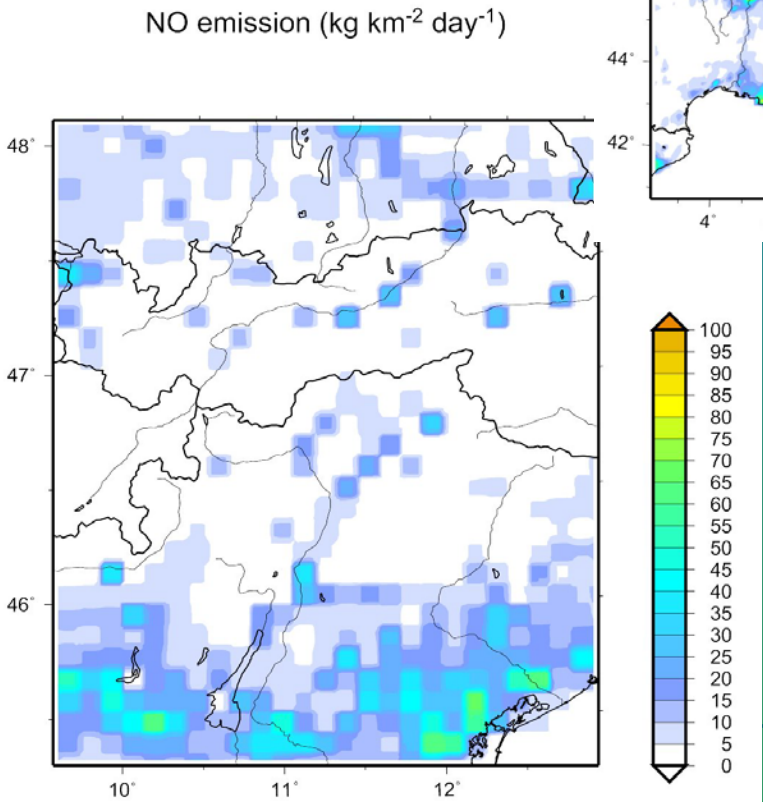


Long Term Air Quality Modelling

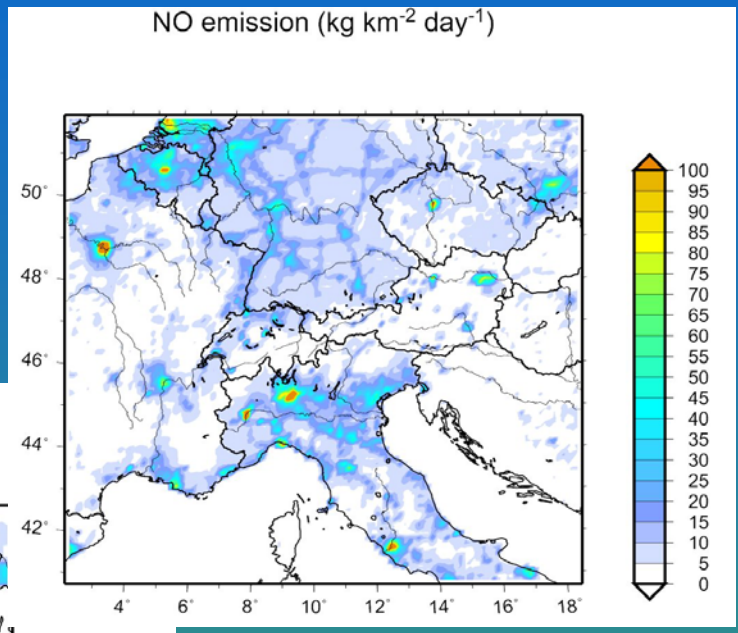
Emissions



60x60 km²



2.4x2.4 km²

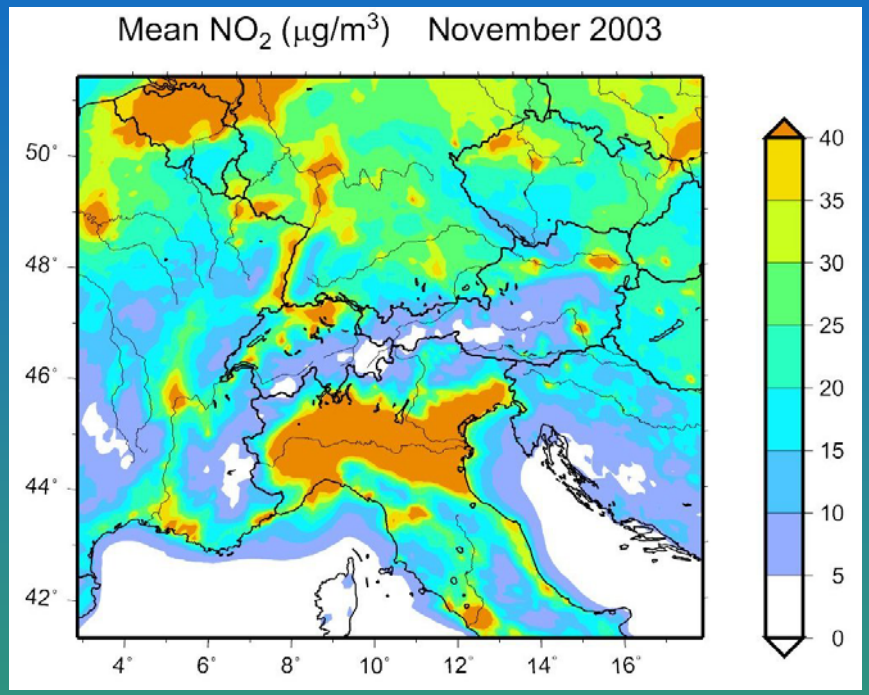


12x12 km²

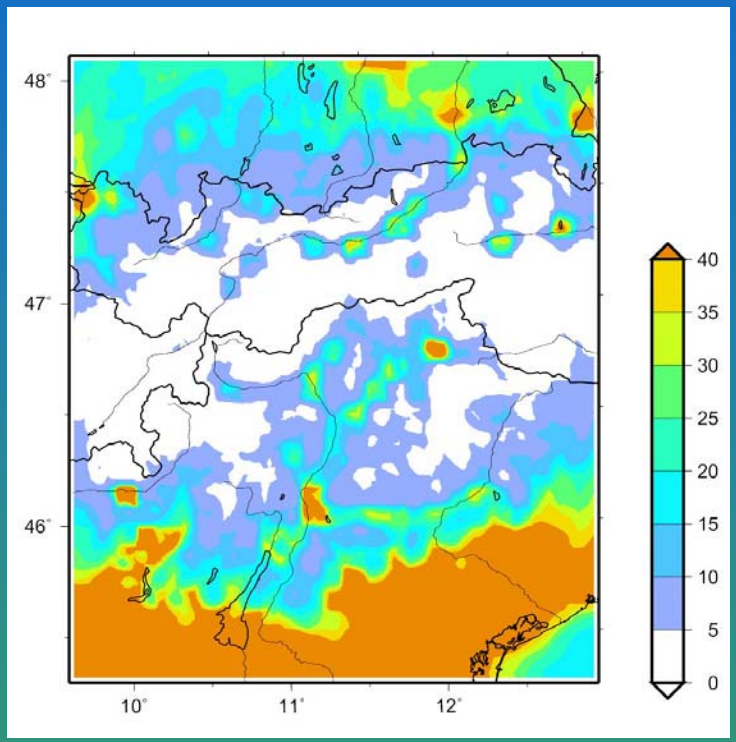
Emission inventory is a combination of:

TNO
IER
EMEP

Simulations

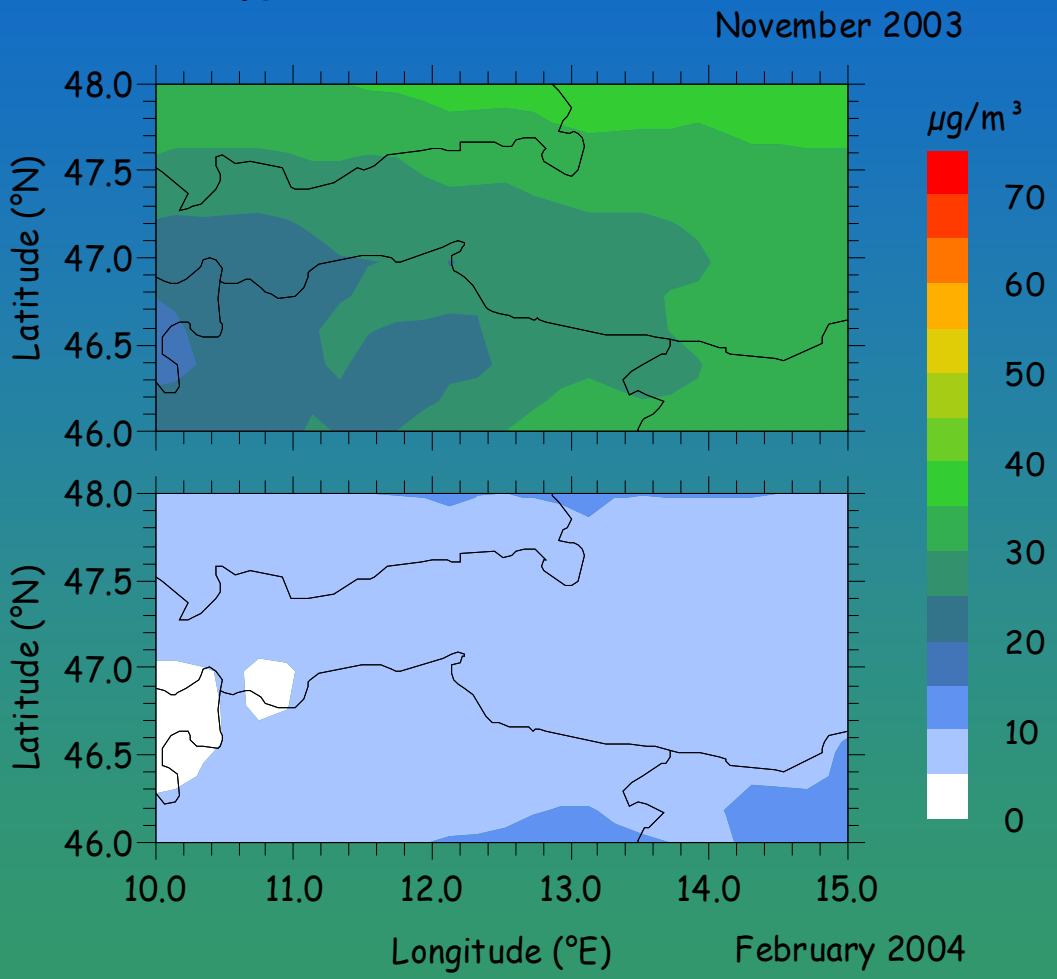


Domain D1



Domain D2

Simulations: $PM_{2.5}$



Domain D2
12 km resolution

Conclusions

- Meteorological conditions play a significant role within valleys
- Measuring data show a high variability within the valley
- Traffic emissions have major impact on air quality in summer
- Domestic heating is a main source during winter time
- Even by a future emission reduction of 30 to 60 % of all emission categories, target values will be exceeded
- Recently by PM_{10}, much more by NO_2 in 2010
- Introduction of technical measures e.g.
  - Multimodal traffic management
  - Innovative traffic technologies
  - New forms of mobility services

Outlook

- Excellent database for modelling validation
- Database will be used for forecast models as well as for health impact studies
- Future activities shall also include the term of climate change

Thank you for your attention

This work is funded by the EU-"Interreg III B Alpine Space" program