Remote sensing of the thermal layering of a valley atmosphere

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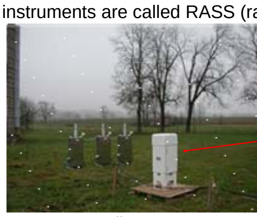
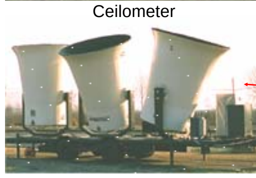
Motivation

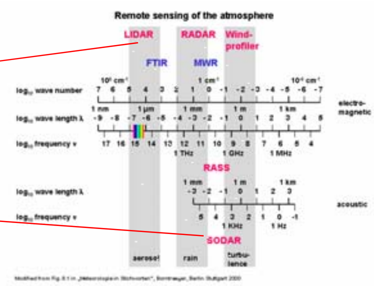
- Dispersion conditions for air pollutants and noise in the Alpine space are coined by the special features of mountain meteorology (channeling, foehn, stagnant flows, low inversions, etc.)
- Inversions prevent vertical exchange of air pollutants. Noise beams are bended downwards at inversions.
- Traffic emissions and aerosols below inversions accumulate. Under unfavourable conditions such accumulations can last over many days.

Remote Sensing

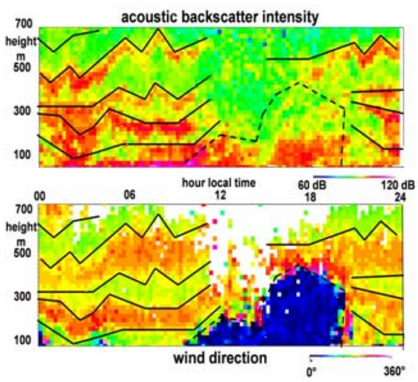
- Inversions cannot be detected by surface in situ measurements of classical meteorological parameters such as temperature, humidity, wind speed, etc.
- Active remote sensing of the vertical layering of the atmosphere can be made with electro-magnetic, optical or acoustic pulses.
- Acoustic remote sensing detects temperature fluctuations and vertical temperature gradients (such as inversions). The instrument for acoustic remote sounding is called SODAR.
- Optical remote sensing detects aerosol concentrations. Instruments for optical remote sensing are LIDAR and ceilometer (a small LIDAR).
- Electro-magnetic remote sensing can be combined together with acoustic remote sensing for the detection of vertical temperature profiles. Such instruments are called RASS (radio-acoustic sounding systems).


Ceilometer


SODAR



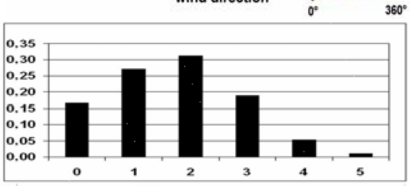
Results of SODAR measurements



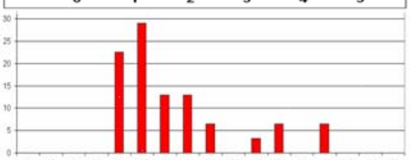
Inversions in the Inn valley near Schwaz detected with a SODAR.

red: high acoustic backscatter
green: low acoustic backscatter

red: southwesterly winds
green: southerly winds
blue: northeasterly winds

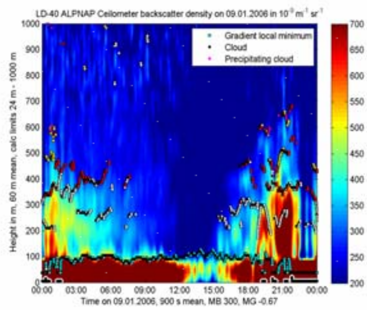


Frequency of multiple inversions in the Inn valley in January 2006



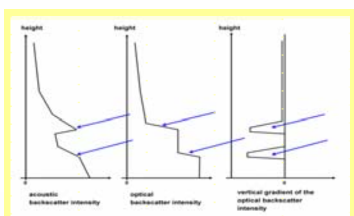
Frequency of the height of the lowest inversion in the Inn valley in January 2006

Results of ceilometer measurements

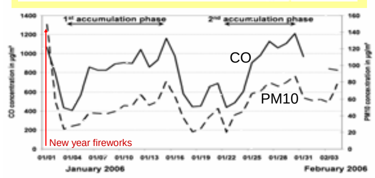


Inversions in the Inn valley near Schwaz detected with a ceilometer.

red: high optical backscatter
blue: low optical backscatter



Analysis schemes for the detection of inversions from SODAR (left) and ceilometer (middle and right) data.



Effect of persisting inversions on air quality: Increase of CO and PM10 concentrations during two calm periods with high air pressure and no clouds in the Inn valley in January 2006.

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