Seasonal and altitudinal water vapour variations

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The amount of water vapour which the atmosphere can hold increases with temperature. If global temperatures increase due to increasing anthropogenic emissions, a corresponding increase in water vapour could have a strong positive radiation feedback. **Figure 1** shows monthly mean integrated water vapour (IWV) and surface air temperature data calculated from radiosonde ascents at Payerne over the period 1994 to 2001. The temperature and the water vapour measurements show the same seasonal cycle with a maximum in August and a minimum in January/February.

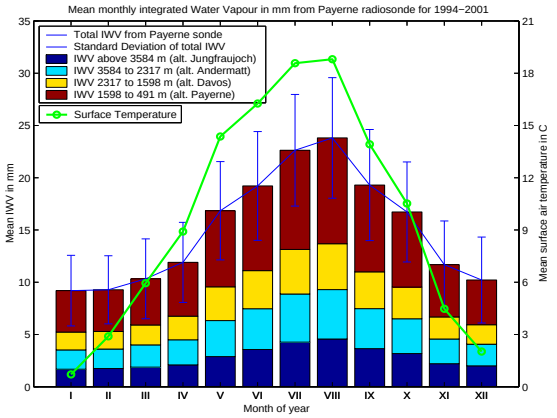

Figure 1 Mean monthly IWV and surface air temperature from Payerne radiosonde data.

The distribution of water vapour in Switzerland is greatly influenced by the mountain geography. Since the amount of water vapour in the atmosphere decreases roughly exponentially with height, total column water vapour is very dependent on altitude. This is also illustrated in **Figure 1** where the IWV for different altitudes has been calculated from the Payerne radiosonde data for the period 1994 to 2001.

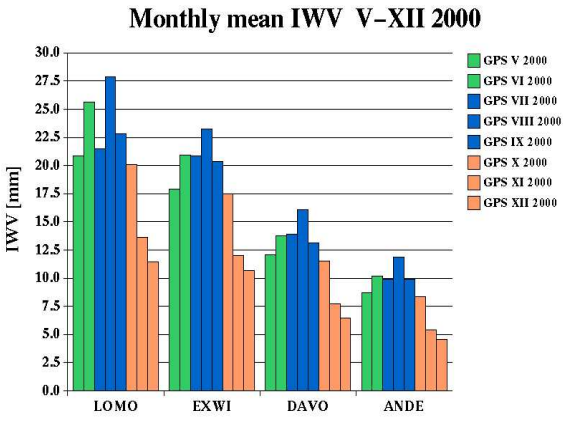

Figure 2 Monthly mean IWV for May to Dec 2000 at the following GPS stations:
LOMO - Locarno at 380 m above sea level, Southern Alps
EXWI - Bern at 580 m above sea level, Swiss Plateau
DAVO- Davos at 1600 m above sea level, Eastern Alps
ANDE - Andermatt at 2300 m above sea level, Central Alps

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Radiosonde relative humidity sensors are the only direct measurement of IWV available to us. However, remotely sensed measurements can be carried out with higher spatial or temporal sampling.
The time delay in the microwave signal emitted by Global Positioning System (GPS) satellites is related to the total amount of water vapour in the troposhere. There are currently 29 GPS receivers in the Swiss AGNES network which can provide hourly information on IWV content. Monthly mean IWV from four of these stations is shown in **Figure 2**. Similar to the Payerne radiosonde data, the highest water vapour amounts occur in August. In **Figure 3**, IWV from seven GPS stations is plotted against altitude. For both August and December 2000, a reduction of around 50 % in water vapour amount occurs between Locarno (380 m) and Andermatt (2300 m).

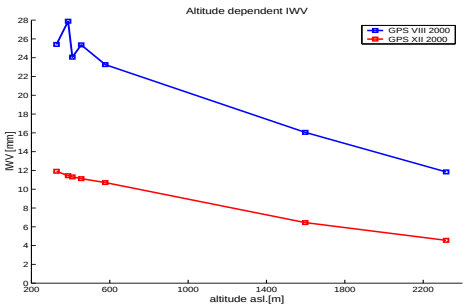

Figure 3 Change in monthly mean IWV with altitude for seven GPS stations

Outlook - This work forms part of the NCCR STARTWAVE (**St**udies in **A**tmospheric **R**adiative **T**ransfer and **Wa**ter **V**apour **E**ffects) project. The goals of the project include developing new techniques for monitoring water vapour and making data from existing techniques available for the purposes of climate monitoring and research. Water vapour measurement techniques contributing to STARTWAVE include:

- Microwave radiometer data(1994 onwards)
- Sun photometer data
- GPS data
- Radiosonde data

An important part of the project will be the contro l of data quality so that climatic trends can be studied. This can be carried out through the comparison of various technniques as shown in Figure 4. This particular day in April illustrates the diurnal IWV cycle.

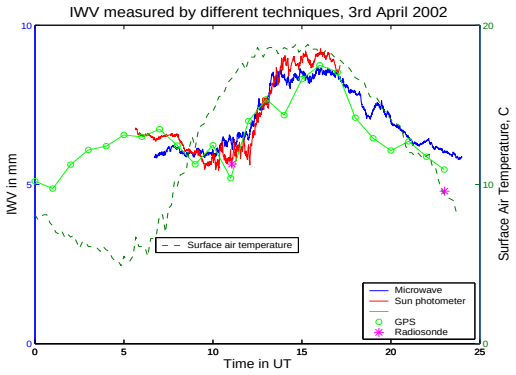

Figure 4 - IWV measured using four different techniques