Surface and upper air recent developments in MeteoSwiss

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MeteoSwiss is currently renewing a large fraction of its current systems of observation both for surface and upper air measurements. This effort was initiated in 2004 with the renewal of the surface Automatic Weather Station network, the project SwissMetNet. MeteoSwiss re-builds a state-of-the-art unified and secured network composed of 130 automatic weather stations. By the end of 2008, 70 stations will be renewed. The project SwissMetNet will end in 2012.

This renewal of the AWS network in Switzerland is completed without any data interrupt for the clients by either re-building a new SwissMetNet station nearby the old one (thus ensuring the switch from the old to the new SMN station within one sampling rate, resp. 10 minute for most of the stations, 1 minute for special one) or by using an additional mobile station at the site where the new station is build exactly where the old one was located.

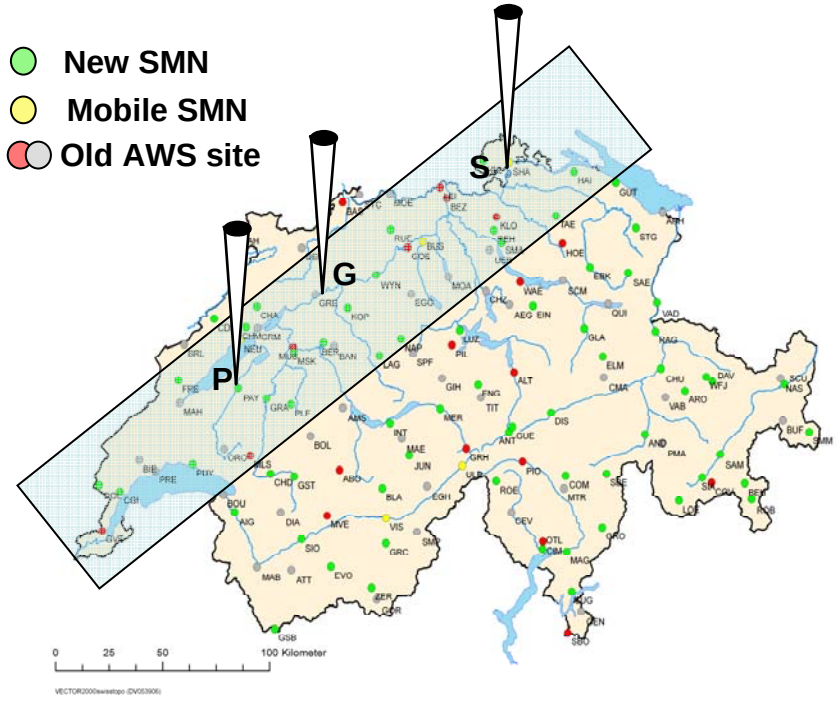

Figure 1: *SwissMetNet renewal state as per September 2008. The green dots indicate the already renewed AWS site (New SMN). The blue area indicates the Swiss Plateau located between the Jura Mountains (NW) and the Alps (SE). The three Remote sensing sites in Payerne (P), Granges (G) and Schaffhausen (S) are also indicated.*

This SwissMetNet network is now integrating on the same platform the latest upper air remote sensing instruments operationally in use at MeteoSwiss: three new sites as indicated in Figure 1 are equipped with a passive microwave Temperature profiler, and an active low troposphere Wind profiler. Schaffhausen and Payerne are fully operational, and Granges will be by the end of 2008. At each remote sensing site the continuous observation of the temperature and the wind field at different altitude, and up to an altitude of ca. 5'000 masl, gives the ideal set of observation for a measure of the dynamic of the atmosphere over the Swiss Plateau. Figure 2 gives an example of a time series of 24 hours.

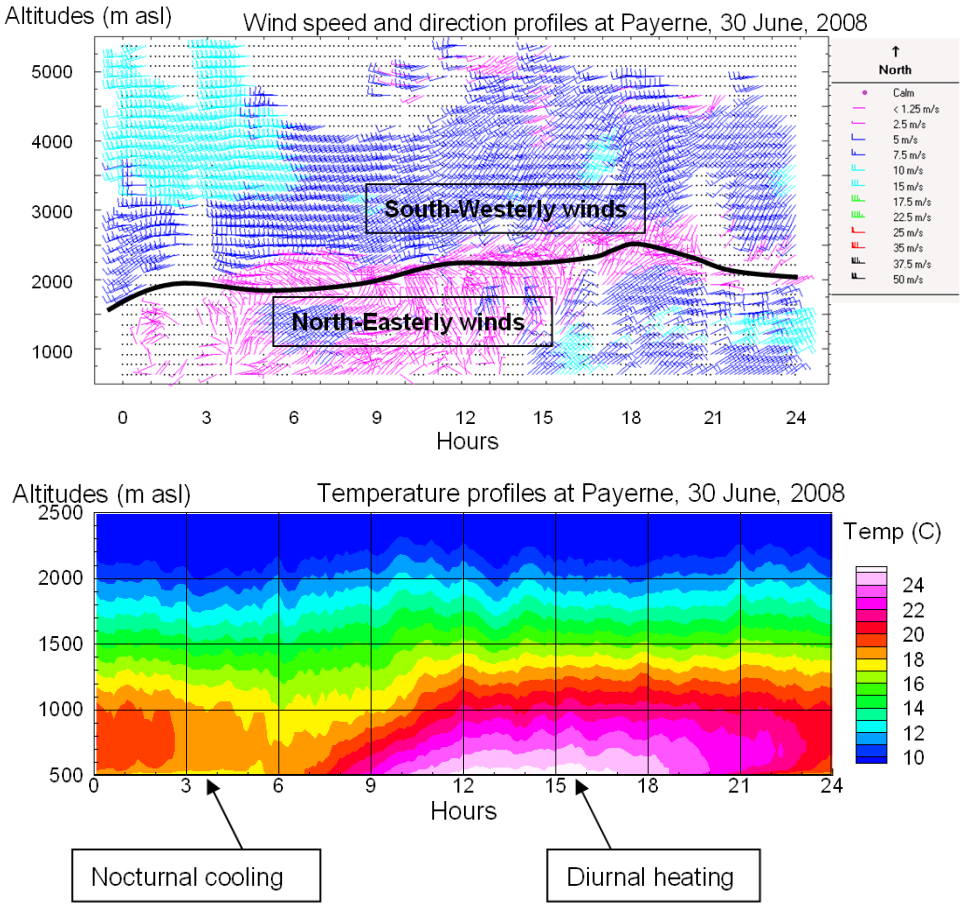

Figure 2: *Time series of wind speed and direction (upper panel) and temperature (lower panel) over 24 hours on June 30th, 2008 in Payerne. The black line on the upper panel indicates the transition between the wind field (NE) at low altitude on the Swiss Plateau, and the synoptic wind fields (SW) at higher altitude. This dynamic is reflected again using the temperature profiles as shown in the lower panel.*

One of the goals of this surface and upper air measurements, and in particular of the remote sensing sites indicated in Fuigure 1, is a real time data assimilation input into the fine grid MeteoSwiss COSMO2 numerical weather forecast model. Every 3 hours (8 times a day) a new COSMO2 forecast is run over the next 24 hours. This NWP with a horizontal grid resolution of 2.2 km, and 60 layers from the ground up to ca. the tropopause, gives the ideal picture of the atmospheric dynamic over the Swiss Plateau. It is in particular designed as an ideal tool in order to forecast the development of a polluted plume emitted on the Swiss Plateau (eg. the case of a nuclear power plant release) , and its forecasted evolution in time and space over the next hours. Figure 3 gives 2 examples of COSMO2 outputs.

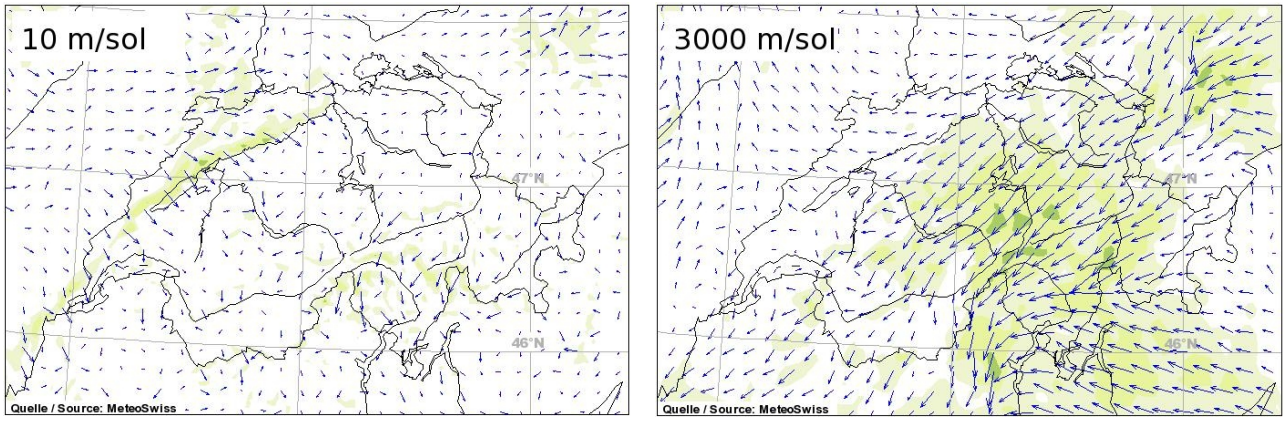

Figure 3: *Wind field forecasted by COSMO2 with direct data assimilation of the network as illustrated in Figure 1 and 2. At 10m above ground level the wind fields on the Swiss Plateau are NW winds of the order or less than 10m/s. At 3'000 m agl winds from E-NE are forecasted at wind speeds higher than 20m/s. Such wind stratification over the Swiss Plateau is very common: it can ideally be forecasted using this combination of 3D surface and upper air observations with the COSMO2 output.*

Currently COSMO2 does assimilate relative humidity profiles derived from the every 12 hours radiosonde data. The lack of relative humidity observation in the upper atmosphere is one of the major drawbacks for the quality of the weather forecast provided by the numerical weather model. After more than 1 year of installation at the Aerological Station Payerne, a Raman lidar for day and nighttime measurements of tropospheric water vapor is in full operation since August 2008. The system is developed as an eye safe automated instrument. A multi-telescope receiver with a "near range" fiber is used having narrow field-of-view and a grating polychromator is used for narrow-band detection. This system shall initially prove its stability and sustainable operation over the next months, prior to being fully incorporated on the SwissMetNet platform. Additional range resolved information of the extinction and backscattering properties of the aerosol in the atmosphere are also measured. By the end of 2009 the system will allow for temperature profiling using the rotational Raman lines of N2/O2.

This lidar unit will be used for the validation against other collocated systems in MeteoSwiss Payerne, in particular the recent development of the new humidity sensor on the Swiss radiosonde, and also the comparison with passive microwave water vapor profiling. It will complement additional state of the art radiosonde techniques (flash sondes, snow white, ..) in the case of the WMO GRUAN (Global Reference Upper Air Network) program. Figure 4 shows two results obtained by the Raman lidar MeteoSwiss Payerne

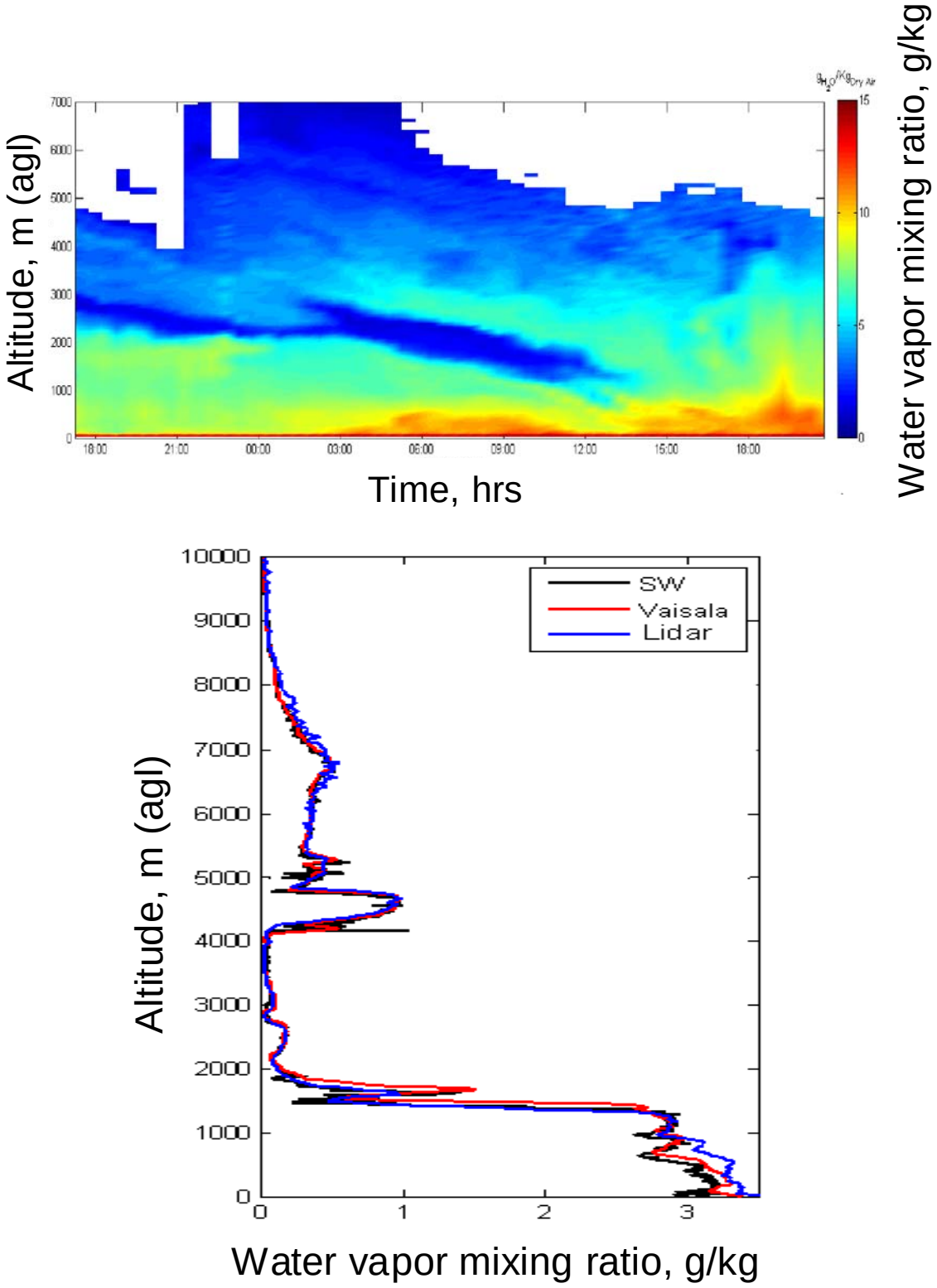

Figure 4: *Water vapor Raman lidar results: the upper panel is a typical time series of 24 hours of water vapor measurement. Under daytime conditions the effective range of measurements is limited to ca. 5'000 m agl due to the increase of the sunlight background intensity on the water vapor Raman return. At night a typical altitude range of 8'000 magl is reached. The lower pannel is a direct comparison of the lidar profile against 2 radiosondes profile using the Vaisala RS92 and Meteolabor Snow White relative humidity sensor.*