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Objective high Resolution Analysis over Complex Terrain with VERA

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VERA (Vienna Enhanced Resolution Analysis) is a model independent, high resolution objective analysis of meteorological fields over complex terrain. This system consists of a special developed quality control procedure and a combination of an interpolation and a downscaling technique. Whereas the so called VERA-QC is presented at this conference in the contribution titled "VERA-QC, an approved Data Quality Control based on Self-Consistency" by Andrea Steiner, this presentation will focus on the method and the characteristics of the VERA interpolation scheme which enables one to compute grid point values of a meteorological field based on irregularly distributed observations and topography related aprior knowledge.

Over a complex topography meteorological fields are not smooth in general. The roughness which is induced by the topography can be explained physically. The knowledge about this behavior is used to define the so called Fingerprints (e.g. a thermal Fingerprint reproducing heating or cooling over mountainous terrain or a dynamical Fingerprint reproducing positive pressure perturbation on the windward side of a ridge) under idealized conditions. If the VERA algorithm recognizes patterns of one or more Fingerprints at a few observation points, the corresponding patterns are used to downscale the meteorological information in a greater surrounding. This technique allows to achieve an analysis with a resolution much higher than the one of the observational network.

The interpolation of irregularly distributed stations to a regular grid (in space and time) is based on a variational principle applied to first and second order spatial and temporal derivatives. Mathematically, this can be formulated as a cost function that is equivalent to the penalty function of a thin plate smoothing spline. After the analysis field has been divided into the Fingerprint components and the unexplained part respectively, the requirement of a smooth distribution is applied to the latter component only (the Fingerprint field is rough by definition). In order to obtain the final analysis field, the unexplained component has to be combined with the weighted Fingerprint patterns.

Operationally, VERA is carried out at our Department on an hourly basis analyzing temperature measurements, pressure, wind and precipitation observations for several domains of the whole world. VERA analyses are used for nowcasting purposes, for establishing climate databases and model verification. Furthermore, VERA can be interesting for everyone who possesses a PC but does not have access to a complex data assimilation system which is in general only available at numerical weather prediction centers.