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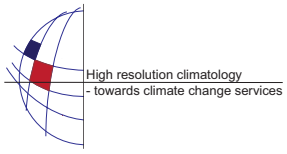

The cold air drainage model KLAM_21

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A brief description of the physics and numerical techniques of the cold air drainage model KLAM_21 is presented. The model has been developed by the Deutscher Wetterdienst (Sievers, 2005) for simulations of nocturnal airflow in hilly and mountainous terrain under dry fair weather conditions. The model has been widely used as an environmental consultancy tool. Typical model applications include frost protection (cold air ponding) and air quality (nocturnal ventilation).

The single-layer model calculates the depth and the mean wind of a surface based stable layer that evolves from a neutrally stratified atmosphere during nighttime. The prediction of the velocity and direction of the cold air drainage is based on vertically averaged momentum tendency equations. Temporal changes in the total heat deficit in the cold air layer are calculated from a prescribed local heat loss rate (describing turbulent and radiative cooling) and advection (donor-cell algorithm). The depth of the cold air layer (depth of the surface based temperature inversion) is calculated diagnostically from the total heat loss deficit. The model is initialised with neutral stratification at sunset (onset time of nocturnal cooling). Optionally, effects of an ambient (regional) wind and/or the dispersion of a passive tracer can be simulated.

Integration over time is carried out on a regular Arakawa C grid using dynamically calculated time steps. Spatial gradients are discretised using centred differential quotients. The standard size of the computational domains can reach up to 1500 x 1500 grid cells. Grid resolutions usually range between 10 m and 500 m. High resolution simulation can be limited to a nested inner grid domain, while the courser outer domain is covering the entire airshed of interest.

A friendly user interface allows easy setup, control, and evaluation of model simulations. Some selected examples of KLAM_21 applications are shown to illustrate the features and capabilities of the model.

Sievers, U., 2005: Das Kaltluft-Abfluss-Modell KLAM_21. Theoretische Grundlagen, Anwendungen und Handhabung des PC-Modells. Berichte des Deutschen Wetterdienstes 227.