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Thermal imaging for cold air flow visualisation and analysis

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In this work we present first applications of a thermal imaging system for animated visualization and analysis of cold air flow in field studies.
The development of mobile thermal imaging systems advanced very fast in the last decades. The surface temperature of objects, which is detected with long-wave infrared radiation, affords conclusions in different problems of research. Modern thermal imaging systems allow infrared picture-sequences and a following data analysis; the systems are not exclusive imaging methods like in the past. Thus, the monitoring and analysing of dynamic processes became possible.
We measured the cold air flow on a sloping grassland area with standard methods (sonic anemometers and temperature loggers) plus a thermal imaging system measuring in the range from 7.5 to 14μm. To analyse the cold air with the thermal measurements, we collected the surface infrared temperatures at a projection screen, which was located in cold air flow direction, opposite the infrared (IR) camera. The intention of using a thermal imaging system for our work was:
1. to get a general idea of practicability in our problem,
2. to assess the value of the extensive and more detailed data sets and
3. to optimise visualisation.
The results were very promising. Through the possibility of generating time-lapse movies of the image sequences in time scaling, processes of cold air flow, like flow waves, turbulence and general flow speed, can be directly identified. Vertical temperature gradients and near-ground inversions can be visualised very well. Time-lapse movies will be presented. The extensive data collection permits a higher spatial resolution of the data than standard methods, so that cold air flow attributes can be explored in much more detail. Time series are extracted from the IR data series, analysed statistically, and compared to data obtained using traditional systems.
Finally, we assess the usefulness of the additional measurement of cold air flow with thermal imaging systems.