Abstract

In weak wind regimes, the wind starts to oscillate, and it is not easy to define a mean wind direction. These low-frequency horizontal wind oscillations are called meandering and have been observed regardless of any meteorological conditions in different environments. Though, until now, no research has been conducted in highly complex terrain, like the Lower Inn Valley. The aim of this thesis is thus to investigate meandering occurrence and properties during low wind speed (LWS) events in this complex setting. In particular, it is analysed how both LWS and meandering flows respond to different topographic features, seasons, time of the day and stability conditions. Besides, meandering depth, meandering in the vertical, temperature meandering and the interaction of meandering with turbulence are briefly investigated.

The analyses are based on several months of turbulence observations collected at five measurement sites on the valley floor, north and south-facing slopes and mountain top. LWS events are defined as periods longer than half an hour with mean wind speed below 1.5 m s^{-1} and meandering is researched during these events with the Eulerian Autocorrelation Function (ACF), which shows in case of meandering distinct negative lobes and large loop parameters ($m \geq 1$). The size of these lobes and the period of the oscillating motions serve as indicators of the nature of meandering.

The results show that LWS is common at all sites in the Lower Inn Valley, especially in the circumstances less exposed to strong valley winds. LWS could take place both during the day or the night, and it does not depend much on stability. It is quite rare only in neutral conditions.

LWS proved to be a necessary but not a sufficient condition for meandering, which however is not exclusively associated with particular environmental conditions or topographic features. Indeed, it could happen in all circumstances, even though it shows a slight preference for stable and weakly turbulent states. In almost all cases observed, meandering exhibits similar meandering periods and ACF lobe sizes to those shown in flat terrain. Still even if comparable, the recorded meandering periods are generally slightly shorter in these complex settings and are even shorter in unstable, daytime cases, due to the superimposition of well-developed turbulence.

Meandering could develop homogeneously in a deep layer above the ground. Meandering-like motions were observed in the temperature field, connected to stable stratifications, and infrequently in the vertical wind component. Complex topography appears to have a major role in triggering this phenomenon in the vertical, that otherwise is absent. Meandering periods in these last two cases are shorter than in the horizontal, suggesting, therefore, a different underlying nature.

In conclusion, meandering proved to be more an inherent property of flows than a local phenomenon susceptible to environmental characteristics. Indeed, it takes place also in highly complex terrain, when the wind is weak.