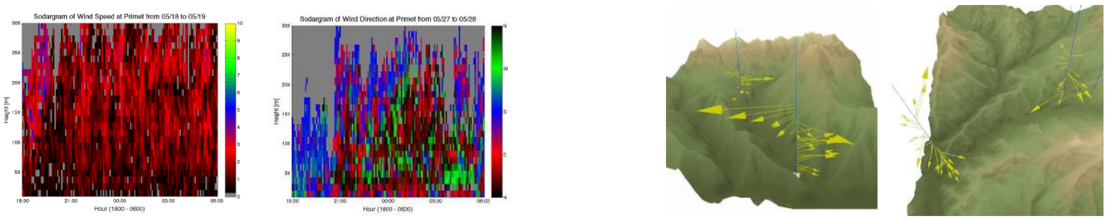
Visualizing Valley Wind Flow

Kendra A. Schmal, Christoph Thomas, Judy Cushing*, Genevieve Orr
Willamette University, University of Bayreuth, Evergreen State College, Willamette University



(a) (b) (c) (d)

Figure 1: *(a) and (b) show the previous visualizations of wind speed and direction which are generated by the SoDAR. (c) and (d) show the new visualization we created.*

1 Introduction

The field of micrometeorology is primarily concerned with smaller-scale meteorological phenomena, specifically those which occur within the lowest atmospheric layer called the Atmospheric Boundary Layer (ABL). The primary defining characteristic of the ABL is that wind dynamics within this layer are influenced by the Earth's topography, as well as time-dependent temperature changes in the Earth's surface. In forests and connected valleys, weak-wind flows transport moisture, heat, gases and potential contaminants, directly impacting adjacent ecosystems [Thomas et al. 2012].

Although weak-wind transport is a known phenomenon, it is also poorly understood. We created animations and visualizations of data collected in the ABL at H. J. Andrews. These visualizations improve upon the previous available visualizations (which were produced by the data collection equipment), by placing the data spatially, allowing for a more intuitive understanding of the data.

2 Implementation

Data representing wind speed, direction, and additional data were observed by a pair of ground-based acoustic remote sounders (SoDAR) located at H. J. Andrews (HJA) Long Term Ecological Research Forest, situated in Oregon near the Cascades. Measurements were taken at two stations in adjoining valleys with a horizontal separation distance of approximately 6 kilometers: Primet station in Lookout Valley, and McRae station in McRae. Measurements were available every 5 minutes for the nocturnal hours from 6pm to 6am over a 3 month period.

*e-mail: kschmal@willamette.edu, christoph.thomas@uni-bayreuth.de, judyc@evergreen.edu, gorr@willamette.edu

Measurements of wind speed and direction were provided for each 10m height increment for the vertical column extending from 15m and 395m above ground. If the equipment could not produce a physically meaningful reading, data were flagged. We represent these 5-minute wind measurements as a vector (magnitude and direction) for each height interval. A digital elevation map (DEM) of the valleys was created using LiDAR data provided by HJA. Daily observation files were read into a WebGL program for visualization.

Visualizing the wind measurements in the context of the local topography was critical in identifying and interpreting typical flow patterns, which are strongly influenced by the position in the deeply incised, narrow valleys. Being able to display observations from both stations in the same visualization domain provided non-quantitative, but very intuitive information about spatiotemporal correlation between the two stations. The latter is instrumental in diagnosing the connectivity through atmospheric transport in the adjoining valleys with implications for the exchange of heat, water, particulates, and carbon dioxide and thus the ‘breathing’ of the mountainous landscape.

While visualizing wind speed and direction was the first step, we intend to add other variables available from the acoustic sounders that also provide valuable information about the state of the atmosphere and its transport, including signal reflectivity and variability of wind speed components. These additional variables have not been implemented yet in the visualization.

Acknowledgements

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References

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