

A HISTORICAL PERSPECTIVE ON THE STUDY OF KATABATIC FLOWS AND FUTURE RESEARCH AVENUES

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Abstract: Herein, the history of katabatic flow study is presented, along with a summary of the current status of katabatic flow research and prospective research avenues.

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1. SUMMARY

Katabatic flows, and their related brethren, have been the subject of written fascination by scientists since the decade of the 1840's, and have been observed far longer by naturalists. In Aristotle's *Meteorologica* published in 397 BC, we find perhaps the first oblique reference to katabatic flows or their valley flow brethren, which at that time were unnamed, '...perhaps a local wind called by the inhabitants Phoenicias. ... westerly winds are counted as northerly because they blow from the sunset; ... while those [winds] from the sunset are reached by the sun later and it soon leaves them.' Aristotle's observations and his statements therefrom regarding meteorology and winds are riddled with errors, and even seem laughable in comparison with the knowledge we have gained to date.

The word 'katabatic' being of Hellenic origin ('kata' downward, 'batos' moving beyond) and meaning 'downward moving', is applied to complex terrain winds that arise from negative bouyancy forces on a parcel of air. These winds are often called 'local', 'mountain', 'valley', 'drainage' or 'downslope' winds by different authors in different disciplines, are ubiquitous over land and ice covered surfaces, particularly at night. These omnipresent flows effect the entire land surface of the Earth, requiring merely a cool source (or heat sink) at the lower boundary. Theory of their vertical structure, turbulence quantities and fundamental dynamics have been proposed, some of which have received more attention than others. Despite being prevalent, and in particular despite their significant role in determining the sensible weather experienced by human beings because of their near-surface region of influence, these flows are relatively poorly understood and are seldom well represented in numerical simulations of daily weather or climate.

Observations of these flows are wherefrom the interest in them began (e.g. Fournet 1840), however, and to this day, a comprehensive understanding of katabatic flow, its interaction with other flows and its role in our climate system does not exist despite a variety of field studies. This review will emphasize an understanding of the historical work on katabatic flows and the more recent work on causes of variation in such flows. Other reviews of slope and valley flows can be found, for example, in Defant (1951), Geiger (1975) and Whiteman (1990). The most thorough analysis and interpretation of the first century (1800's through 1945) of katabatic flow investigation can be found in Hawkes (1947).

Future research avenues are discussed as related to emerging interdisciplinary scientific questions and in fundamental observational and numerical modeling of the roughness sublayer within which katabatic flows form.

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