AMS Abstract

STRATIFIED FLOW PAST A HILL: APPLICATION OF THE DIVIDING STREAMLINE CONCEPT

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As part of the MATERHORN field campaign on atmospheric flow in mountainous terrain, the dividing streamline concept for stratified flow over obstacles was investigated using smoke flow visualization and meteorological measurements. At small Froude numbers ($Fr < 1$), a stratified flow approaching a mountain either possesses enough kinetic energy to pass over the summit or else flow around the sides, with the a streamline separating the two scenarios. Applying a logarithmic velocity profile to Sheppard's formula, an explicit representation for the dividing streamline height was derived and a new set of parameters were identified to determine the dividing streamline height. It is shown that there will always be a dividing streamline for real atmospheric stratified shear flows. In the experimental program, an isolated northwestern peak (hill) of the Granite Mountain, approximately 60m in height, was used. Incoming flow velocities and temperature profiles were measured upstream using sonic anemometers mounted on a 32m tower, while onsite measurements were taken with portable weather stations. During the first visualization experiment, sufficiently strong stratification was developed around 3:00AM GMT, with Froude numbers in the (classical) theoretical range for a dividing streamlines to exist. In the first trial, suitably placed red smoke releases were used while in another trial white smoke was released from a 25m crane. Well-defined dividing streamlines were observed in both cases, and its vertical location was at a height about half of the mountain height, which is consistent with theoretical results based on Sheppard's formula. The second visualization experiment was conducted under neutral atmospheric conditions, serving as a control case with no dividing streamline. This latter case was signified by clear vortex shedding and flow separation at the top of the hill.