Understanding the response of mountain glaciers to climate variability is crucial for any prediction of sea level rise, the management of water resources, and assessing the risk of natural hazards triggered by glacier retreat. The Southern Alps are important to our understanding of climate change because their location in the southwest Pacific means that they are ideally placed to detect changes in Southern Hemisphere atmospheric circulation. The key to developing present knowledge of the climatic controls on glacier behaviour in the Southern Alps is to find new pathways to establish the linkages between local and large scale atmospheric processes. To do this we have initiated a programme to achieve the following objectives: (1) obtain high quality atmospheric and glaciological data from a New Zealand glacier, (2) reduce uncertainties inherent in modelling local atmospheric processes that control glacier mass loss or gain and (3) generate a detailed understanding of air mass characteristics that control glacier behaviour using regional atmospheric modelling and the latest regional and global climate data products. By carefully examining atmospheric processes at a range of spatial scales (multi-scale approach) using high quality and long term data and atmospheric modelling on the Brewster Glacier, a more detailed understanding of its response to atmospheric forcing and climate change will be achieved. The outcomes of this research are important as there is an increasing urgency within the climate change community to see research on mountain glaciers from the Southern Hemisphere, as there has been a consistent bias towards Northern Hemisphere research.