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Blocking, gap flow and mountain waves along the coastal escarpment of South Africa

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A fatal crash of a light aircraft occurred in the complex coastal mountainous terrain along the South African South Cape in December 2015. An investigation of the meteorological conditions on that day revealed the interaction between mountain waves, gap flow and blocking near a cold front and terrain. The crash made it clear that it is necessary to provide forecasters with knowledge of the turbulence that will arise under these circumstances. Against this background, experiments were carried out near the crash site, with automatic weather stations and radio stations to answer this question. Turbulence has been successfully characterized by the Froude number, Froude altitude scale and thermal wind equation. The Bernoulli equation, which classifies the gap flow, was not helpful due to the effect of the upwind blocking area. Phenomena in descending order of the generated wind force were, compression effect above the peak (44.7 ms^{-1}), blocking (26 ms^{-1}) and finally gap flow. The gap flow had a negative impact on the strength of the barrier jet. Phenomena in descending order of the turbulence intensity were; gap flow, mountain wave/rotors and finally blocking. Gap flow generated higher vertical speeds than mountain waves. These mountain waves generated the highest vertical speeds measured in South Africa to date, combined with the waves of the shortest wavelength. A blocking jet with a depth of 600 m and a width of 80 km changed the formation of mountain waves significantly. The blocking jet was so strong, that it extended up to 30 km beyond the end of the mountain range. Most likely, a combination of mountain waves, gap flow and blocking contributed to the crash, which shows that these three features cannot be seen as separate processes.