Engineers model the threat of avalanches

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(Phys.org) -- Snow avalanches, a real threat in countries from Switzerland to Afghanistan, are fundamentally a physics problem: What are the physical laws that govern how they start, grow and move, and can theoretical modeling help predict them?

Cornell researchers have uncovered some clues. Graduate student Cian Carroll was lead author on a paper published in the journal Physics of Fluids in June that details a dynamic model for the acceleration and growth of what the researchers call the avalanching "cloud." They hope their model can predict avalanche size, speed, density and other parameters to help in planning in high-risk areas, Carroll said.

Prior research on snow avalanches shows that a significant amount of mass is picked up at the "head" of a gravity current. The mass distributes into the rest of the current, or cloud, and this mass travels at the front of the cloud as it densifies, accelerates and grows -- leading to natural disasters.

The researchers first looked at the mechanism responsible for the rapid pickup of snow that occurs within the first few meters of the current. They determined that a mechanism driven by pressure gradients penetrating within the snow pack destabilized and broke apart the snow particles.

They then looked at the area just above the snow pack to see the effect the snow pickup had on the overlying cloud and its associated pressure waves. They observed that varying densities changed how the internal velocity took shape in the cloud, which they checked with experiments performed in a water flume. Further simulations allowed them to look into greater details of the effects that viscosity has on current and how this changes the cloud's swelling.

The paper was co-authored by Michel Louge, professor of mechanical and aerospace engineering, and Carroll's adviser; as well as Barbara Turnbull of the University of Nottingham.

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