**INTRODUCTION**
- Our focus: Snowfall ⇒ Snow distribution on surface ⇒ Melt
- Energy for melt is limited per unit area
- Inaccurate snow distribution will give incorrect melt and runoff and inaccurate timing and magnitude of discharge in hydrographs
- Scarcity of data in remote locations (for ex, Arctic Tundra) is a major problem
- High Resolution Distributed Computational Models are required
  - How much dependence ???
  - High Resolution: ~ 10 - 1 meter

**KEY PLAYER**
- Challenges of snow distribution are different in different topography
- Main Role: Wind
  - Wind driven preferential deposition of snowfall
  - Wind driven rearrangement
  - Wind+Topography+Vegetation interacted snow distribution

**GOALS IN MODELING SNOW**
- Understand Snow-Wind interaction through physical processes
- What are they?
  - Precipitation distribution over varying elevation and vegetation
  - Saltation, Suspension & Sublimation
  - Blowing snow distribution
- Expectations from models
  - Accurate distribution along drifts
  - Accurate depth and SWE over time
  - Model - LiDAR Observation ⇒ 0

**PROBLEMS & CHALLENGES IN MODELING**
- Arctic Tundra
- Alpine Mountain

**COMPLEXITIES OF SNOW-WIND COUPLED DISTRIBUTION MODELS**
- Existing physics motivated approaches
  - Solve linearized momentum equations using Fourier transforms of topography specified by a Digital Elevation Model (DEM)
  - Topographic modification of wind speeds and distribution by an empirical weighting factor
  - Two layer frictional velocity approach for transport
  - Generate wind fields from mesoscale atmospheric models which solve simplified forms of Navier-Stokes equations with Large Eddy Simulations (LES)
  - Transport by solving diffusion equation with finite element method
- Ideal approach
  - Numerically solve FULL Navier-Stokes equations (NOT by LES) for the wind fields
  - Use Lagrange Particle Tracking method to track snow particle trajectories over wind fields
  - For preferential deposition & blowing snow events

**DO WE NEED TO GO THAT FAR ???**
- Computationally Highly Expensive
- Are existing models performing as per expectations?
- Are we fine tuning free model parameters too much to match observations?
- Are the models reliable in different scenarios?
- Can we constrain models? OR limit fine tuning?

**RESULTS**
- Snow accumulation
- Cumulative sublimation
- Cumulative sediment

**DISCUSSIONS**
- Model predictions are different
  - For ex, Essery et al. predicted much more sublimation and transport compared to SM
  - More focus is needed on modeling methodologies
  - Demand for a more unified approach which help constrain many sub models
  - A deeper understanding of snow-wind interaction

**MODEL PERFORMANCE: A COMPARATIVE CASE STUDY**
- Used SnowModel (SM) (Liston et al.) to reproduce the results of Essery et al. (1999) model
- Computed vegetation-wise snow water equivalent (SWE) and sublimation
- Model run: 11⁶ Sept 1996 to 8¹ May 1997

**BASED ON**
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**Figure captions**
- Arctic Tundra
- Alpine Mountain
- Wind driven Snow tower formation
- Wind+Gravitation driven
- Vegetation classes
- Forcing Met. data
- Snow distribution 10 - 1 meter

**REFERENCES**