



The Influence of Snowcover on Wintertime Nor'easters over the Northeast United States

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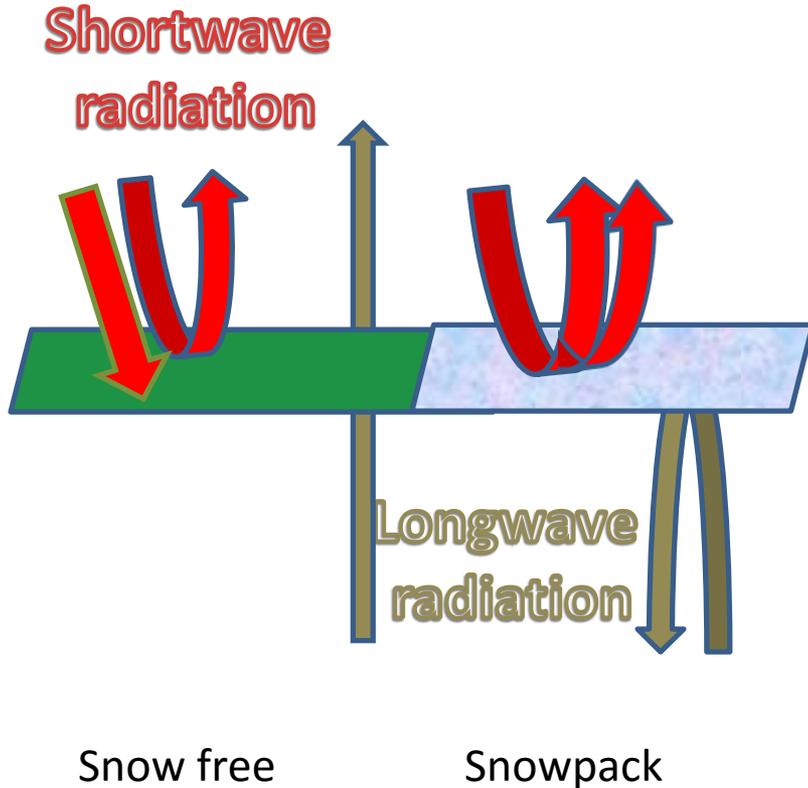
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Introduction

- Hypothesis: **A snowpack over the Northeast United States will alter atmospheric dynamics enough to perturb a wintertime Nor'easter**
 - A snowpack changes the surface energy balance
 - Energy fluxes drive atmospheric conditions therefore if a snowpack can change fluxes significantly it can change the atmospheric dynamics

Background



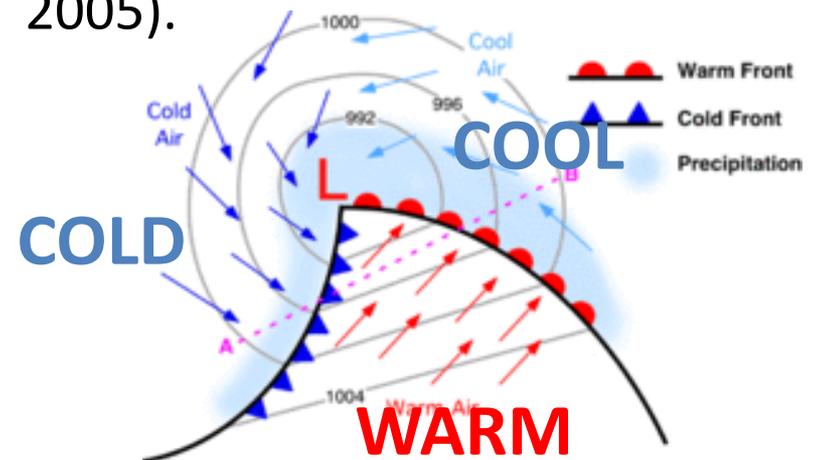
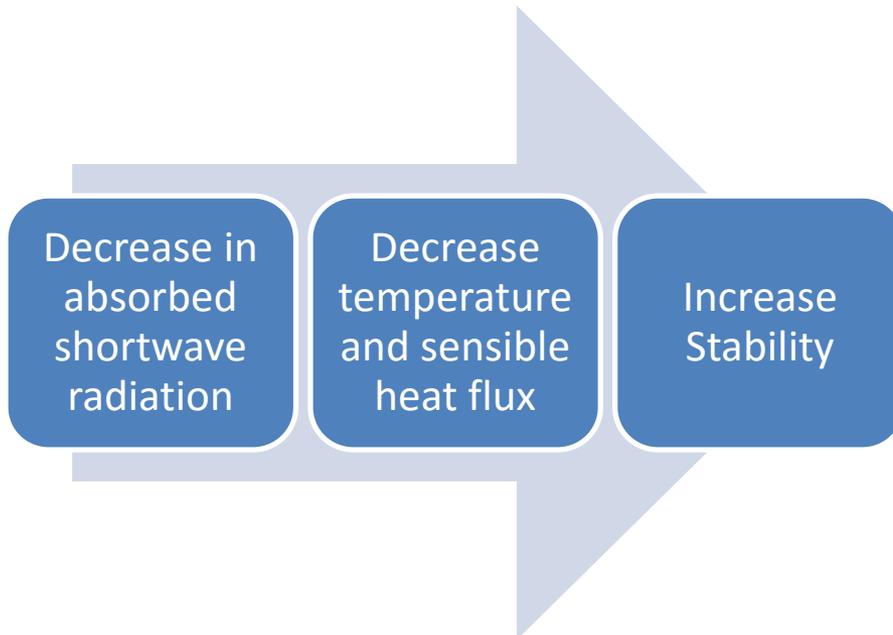
- Snow cover= radiative sink
 - Increased albedo means surface loses shortwave radiation that would have otherwise been absorbed and used to the warm surface
 - Thermal insulator

Background: Previous studies

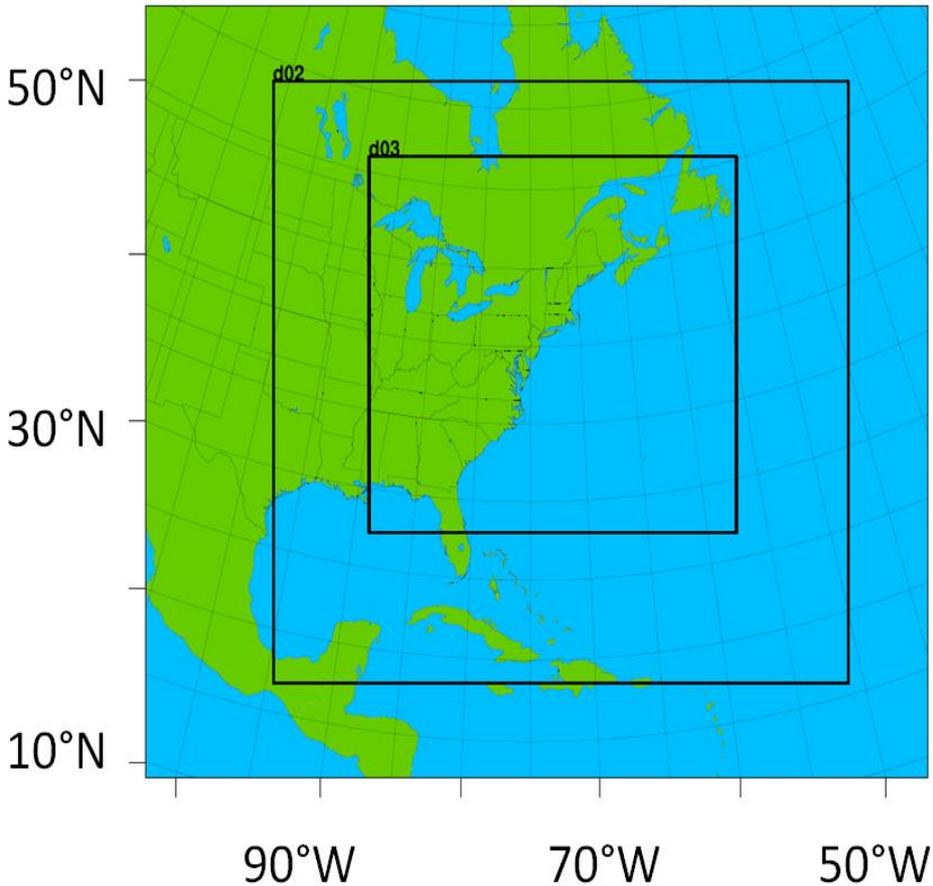
Snow cover inhibits the formation of clouds and precipitation (Namias 1985)

Weakened temperature and moisture gradients across fronts

- Warm sector experiences greater cooling from a snowpack compared with cool and dry sectors where temperature and moisture are already low (Elguindi et al. 2005).



Methods



- WRF-ARW 3.1
- Ten classic Nor'easters with two simulations each
 - Control run with no initial snow cover
 - Perturbed run with 50 cm deep snowpack
- 4.5 day simulations
- Case selection
 - i. No secondary low pressure
 - ii. Significant amount of snow deposited in Northeast US
 - iii. Storm Dates within R1 data
 - iv. Span winter seasons

Results

Decrease in absorbed shortwave radiation

Decrease temperature and sensible heat flux

Increase Stability

On average,

- Albedo is two times higher in snowpack simulation
- Two-meter temperature is 4.4 °C less in snowpack simulation
- Sensible heat is 21.0W m⁻² less in the snowpack simulation
- Convective precipitation is 10% lower in the snowpack simulation

Results and Discussion

Snowpack- Snow free	
Average Surface Pressure	1 mb
Local Maximum Surface	6.1 mb
Central Low Pressure	0.6 mb
Central Low Pressure Max	3.9 mb

- An observational study found pressure differences during cyclonic events between 3 and 5 mb for maximum snow versus minimum snow depth (Spar 1973)

- Midwest study found
 - Average central low pressure 4 mb greater
 - Larger central low pressure differences for larger storms indicating snow cover prevents cyclonic intensification (Elguindi et. al 2005)

Results and Discussion

- Snowpack simulation has less convective precipitation compared to the control

Convective precipitation (% Total precipitation)	
Snowpack	15.9
Snow free	25.5

- A study in the Midwest finds little to no convective precipitation over snowpack because of increased stability and decreased convergence (Elguindi et al. 2005)
- Snowpack simulation has a gain in total precipitation
 - 8.8 % increase in frozen precipitation
 - 2.3 % increase in non-convective liquid precipitation
- No significant changes in frontal strength or integrated cloud depth

Conclusion

Surface Changes

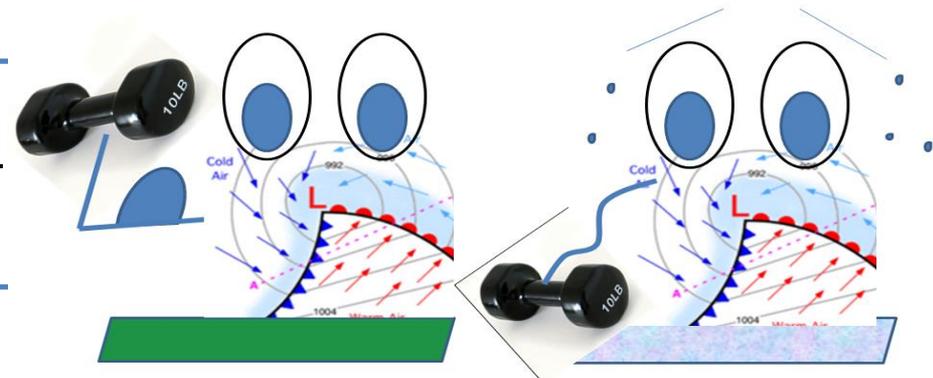
- Snowpack altered surface dynamics by decreasing albedo, sensible heat flux, temperature

Atmospheric Changes

- Leading to increases in pressure and stability and a decrease in convective precipitation

Nor'easter Perturbation!

- Therefore an overall weaker cyclone



Conclusion

- The results are similar to studies in other regions; however
 - No noticeable changes in fronts or cloud cover
 - Increase in total precipitation
- Further investigation is needed!
 - Wider range of case studies
 - Larger number of cases studies
 - Comparison of results in Northeast and Midwest

Thank you!

