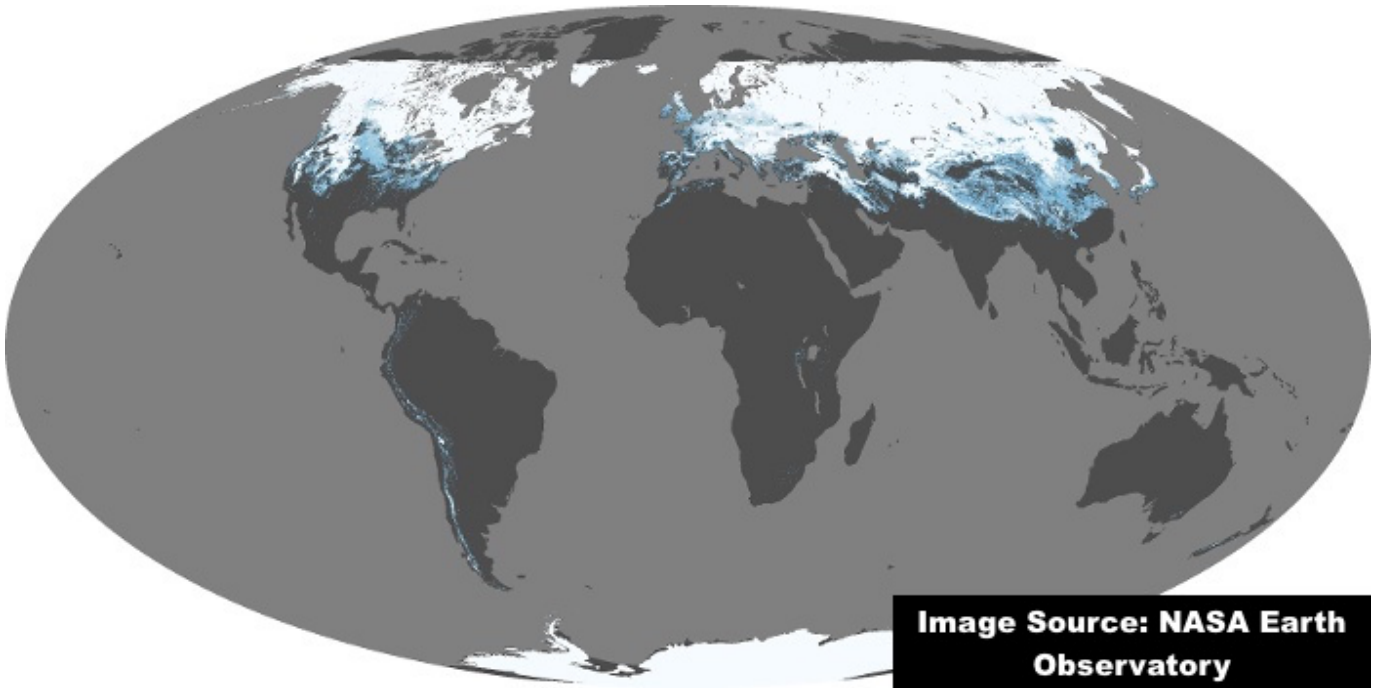
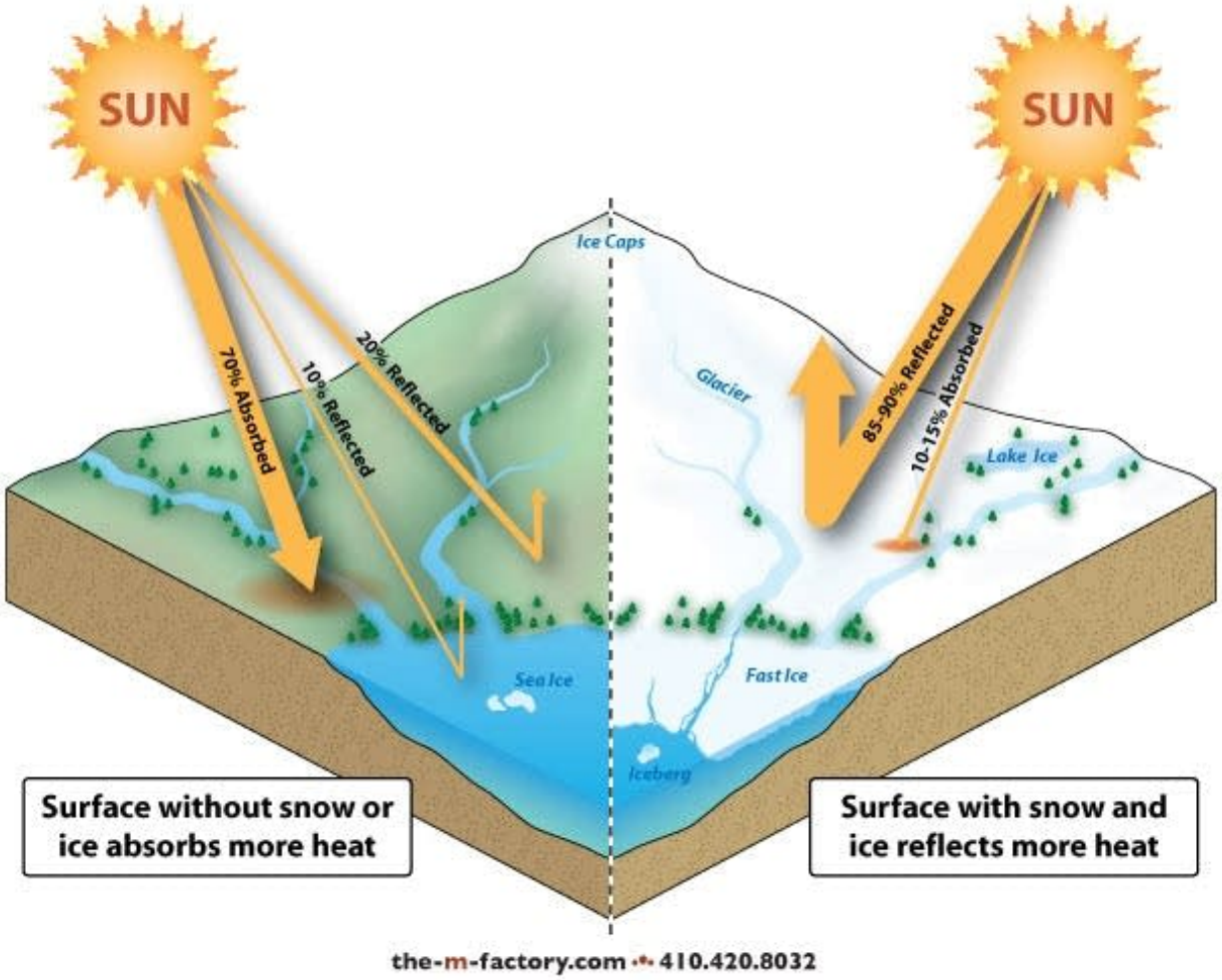
The Linkage Between Fall Snow Cover & Winter Air Temperatures



The atmosphere is linked everywhere across the globe. It's chaotic, yet ceaselessly continues to mesmerize given the unique weather phenomenon it produces. One of, if not the most, awe-inspiring weather wonder revolves around snow. While you watch it fall and accumulate over time with pure bliss, have you ever wondered what its effect ultimately results in that influences surrounding air temperatures? We'll be diving in to understand this effect, what this may mean for continents across the Northern Hemisphere, and how can snow cover predict what air temperatures thousands of miles away?

A meteorologist quite well versed in this study is Judah Cohen. He has documented literature and years' worth of research surrounding this snow connection to predict winter temperatures, along with the polar vortex. In this article, we'll be presenting his information and findings to help understand this linkage.

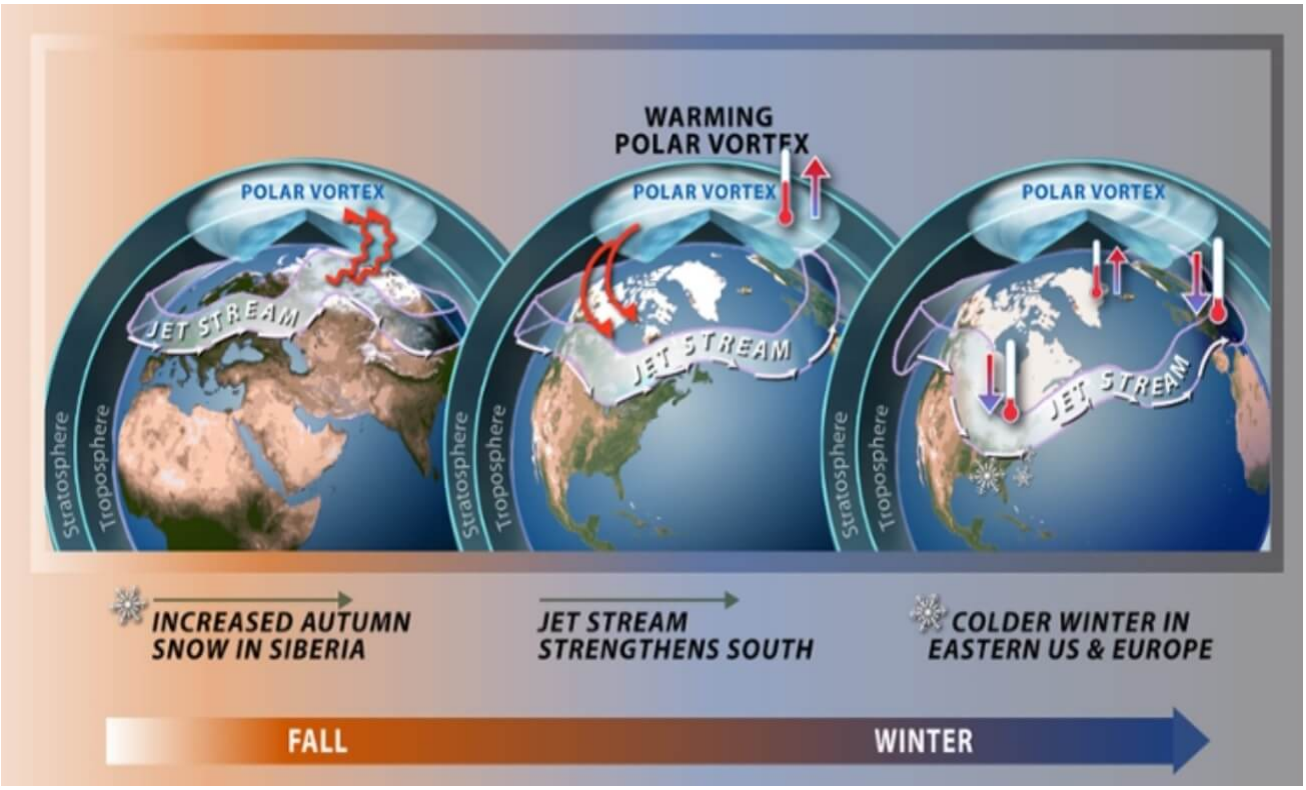
First, let's discuss the science behind the effect of snow regarding reflection. If you've not heard or ever seen the term "Albedo", it's simply the amount of reflected light or radiation that a surface possesses. In this case, ice and snow have the highest albedo on the entire Earth. Statistically-speaking, snow reflects upwards of 90% of the sun's radiation back to space. Contrast this with bare landscape that only reflects about 20%. This renders a significant difference in terms of the transport of heat on a molecular level.



It's primarily across Siberia, amongst other regions of the polar latitudes, where we focus our attention in terms of snowfall accumulation through autumn, especially from Dr. Cohen's research. This reflection ends up playing a robust role when it comes to its ultimate influence like on the stratospheric polar vortex, and within the troposphere (where our weather happens). This reflected energy, as it heads toward Space, allows for a net

energy loss within the lower portion of the atmosphere. In other words, above the deep snow cover, a cold high-pressure system – coined the Siberian High - develops and strengthens due to this process.

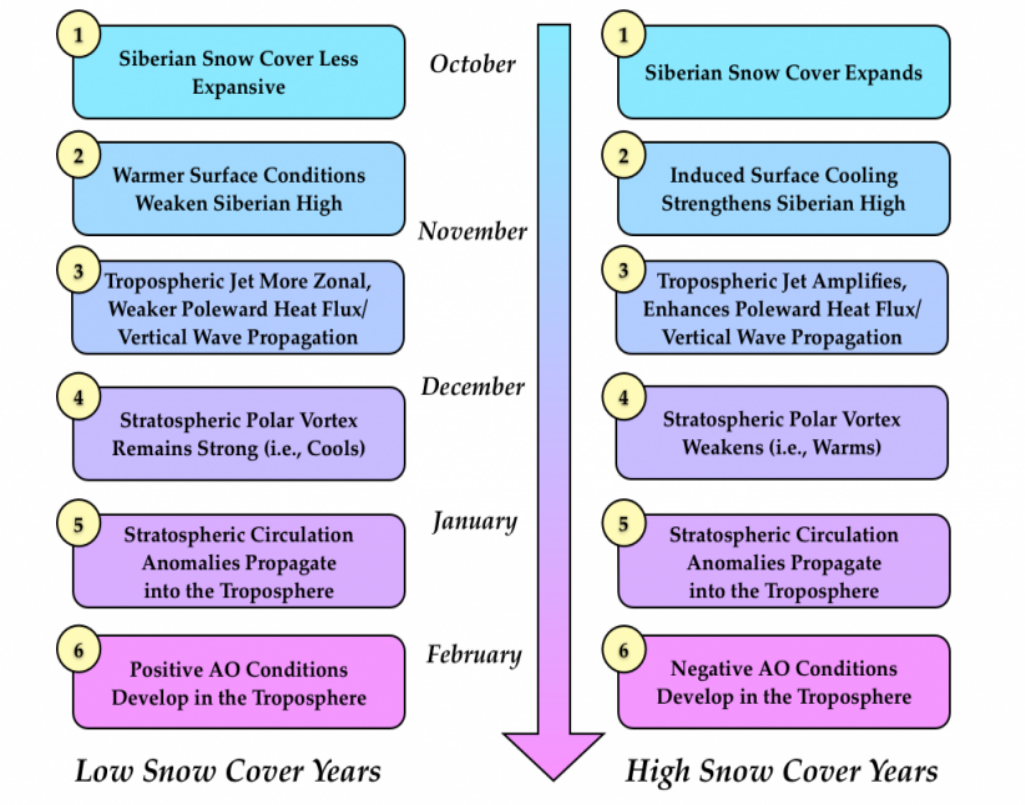
This process is two-fold. Under that dome of high pressure is dense, cold air. The stronger the high-pressure system is during the winter, the colder the air masses can be as they reach regions across the higher and middle latitudes. The jet stream becomes more unstable given the temperature gradient clashes that result in from the cold, arctic air with the warmer, milder to the south. This contrast between the two opposing air masses results in stronger cyclones, and the stronger they can get, the more energy can be dispersed. That energy, in conjunction with the reflected sun radiation from the snow, together produces a net warming effect in the stratosphere. That layer at the top of the atmosphere happens to be where the polar vortex resides. Putting it all together, like in the wonderful graphic below (credit: National Science Foundation), this is how fall snow cover can ultimately lead to arctic outbreaks and cold air masses into North America, Asia, and Europe.



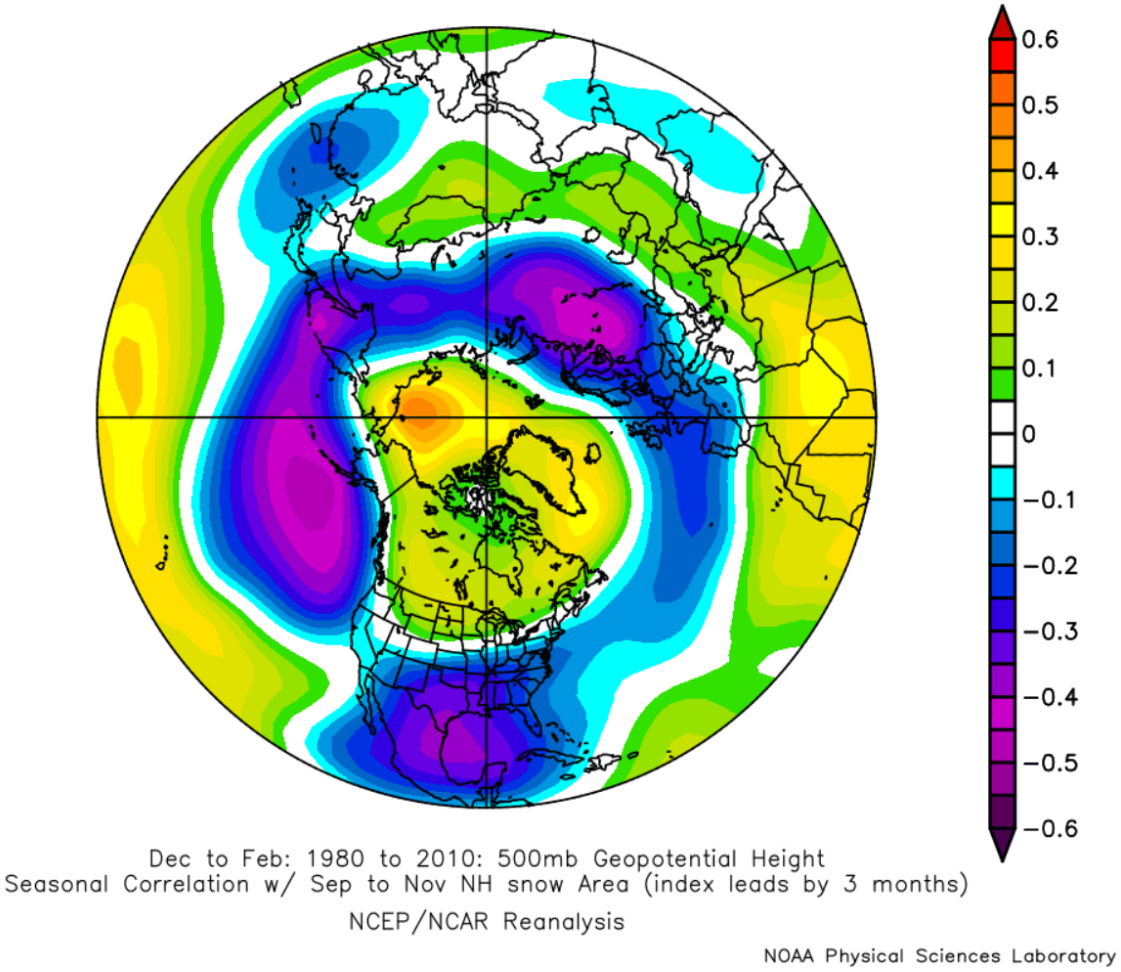
When the polar vortex becomes disrupted, like in the case of a known phenomenon “Sudden Stratospheric Warming”, a weakening commences. Since the stratosphere connects to the tropopause (level just below the

Stratosphere), there is a much greater chance of arctic outbreaks because those frigid arctic winds can work their way downward. This also implies high-latitude blocking, where now larger areas of higher-than-normal pressure can build across the broad arctic region since the once-stable polar vortex is off kilter and weakened. Are you seeing the linkage now? This area also coincides with the famous teleconnections of the North Atlantic Oscillation and Arctic Oscillation.

Circling back to Meteorologist Judah Cohen, he developed a snow forecast, six-step model to try to make seasonal winter predictions. It's deciphered simplistically as it follows a chronological order from fall to winter and sums up the science that was discussed above in a nutshell. The greater the depth and spatial accumulation of snow during autumn and into winter, the greater the risk of a disrupted polar vortex and response of colder air masses during the winter. The lesser extent of snow cover, the lesser the chance of frigid outbreaks and bad winters.

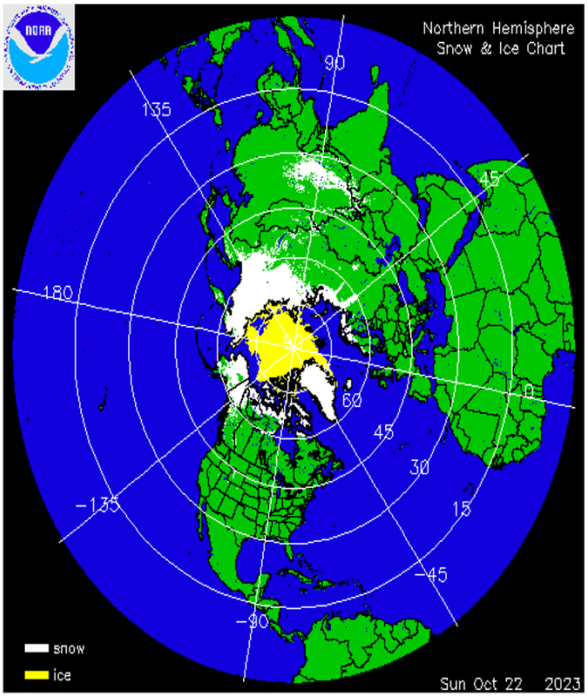


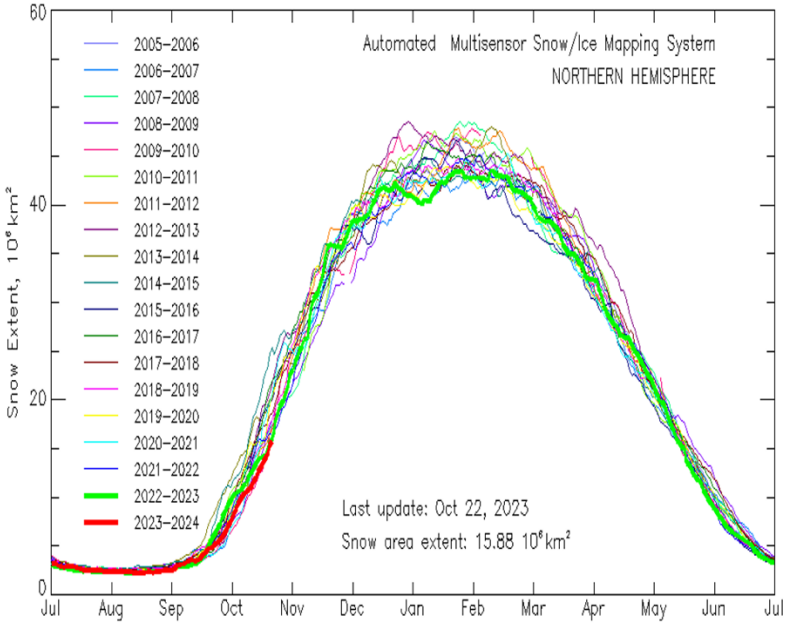
To further show how strong this entire linkage is, shown below (severe-weather.eu) reveals a correlation between Northern Hemisphere snow cover and polar blocking across the high latitudes. Verbatim, this reveals a weak tropospheric polar vortex, and cooler, stormier weather in the mid latitudes.



So, you may be wondering, great this is awesome information and now you know the science behind what snow can really end up producing other than its blissfulness. However, you're unsure of where to look to see if curious on the state of snow cover across the Northern Hemisphere. Look no further, as graphics below reveal different visualizations of snow cover across the Northern Hemisphere. It can be accessed at the Cryosphere page from the World Meteorological Organization. In this case for this year, snow cover is below average across the Northern Hemisphere and in Siberia. While this at first glance may appear as a detriment if you're a big

winter fan, I'd caution to not jump to any conclusions. Winter weather patterns can change dramatically for snow to fall across these regions, and there are years past where snowfall increased significantly leading up to December. There is still quite a way to go, and it should be emphasized that the atmosphere is full of chaos and uncertainty. While this has a strong linkage and correlation, sometimes it fails and ends up causing questions after-the-fact because the atmosphere behaves the way it wants to.





It's quite fascinating that whatever happens in one area of the world, can directly or indirectly affect another area. This all happens through the atmosphere and by the weather it produces, Seasonal forecasts have come a long way, and its well-esteemed researchers such as Dr. Cohen that make breakthroughs and discover findings that can help to try to predict a disorderly "system". Sometimes it's a success, but more times than not it's not; however, scientists continuously will find ways to improve an imperfect science.