What Causes the Low-Level Cloud Increase from April to May Over the Arctic?

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Introduction

- The influence of Arctic clouds on the atmosphere's temperature varies based on cloud type, latitude, and season. Knowing how Arctic clouds change throughout the year is crucial for understanding their impact on Arctic amplification.
- Understanding the spatial and vertical extent of Arctic clouds in May is very important, as May marks the onset of the melt season.

Methods

- Arctic cloud data from 2006 to 2019 was collected from the 3S-GEOPROF-COMB product created by Bertrand et al. (2023). This globally gridded data product contains cloud vertical structure data from the CloudSat radar and CALIPSO lidar. Together, this monthly dataset provides a comprehensive climatology that is perfect for visualizing patterns in Arctic clouds that emerge throughout the year.
- Arctic sea ice data (Figure 3a) is from the National Snow and Ice Data Center (Meier et al., 2021).
- Vertical potential temperature data (Figure 3b) is from NOAA Physical Sciences Laboratory, website at https://psl.noaa.gov.

Acknowledgements

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Results

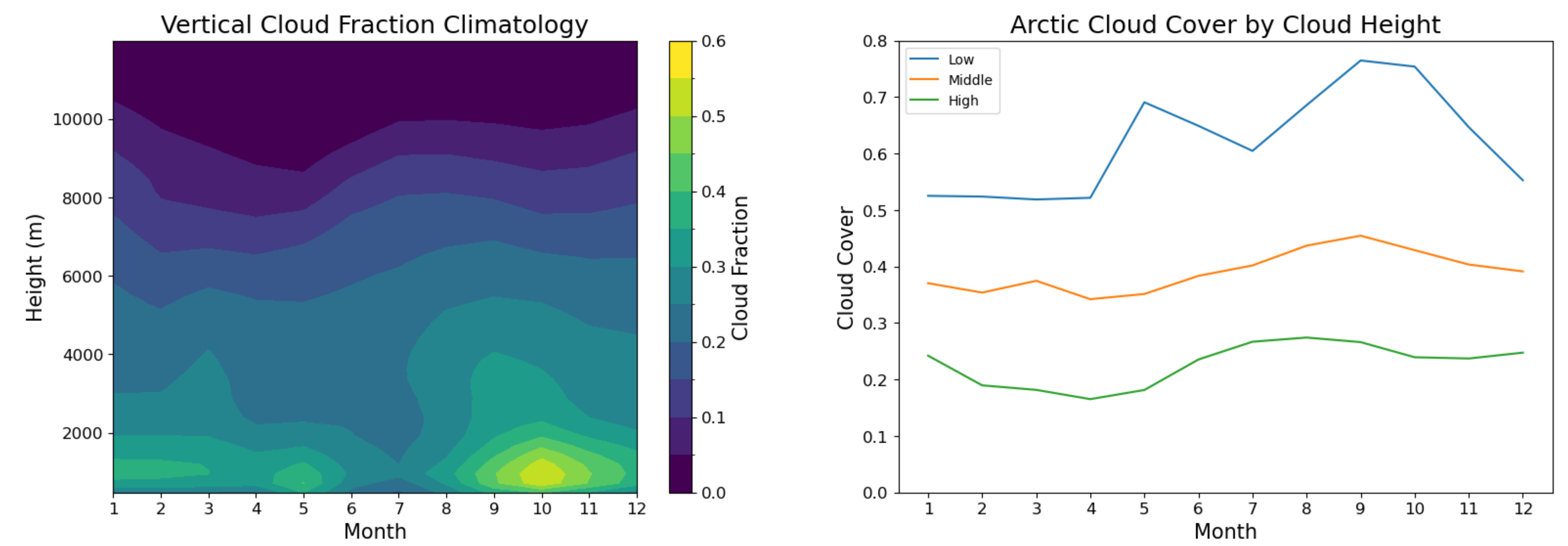


Figure 1: The figure on the left shows a vertical profile of the cloud fraction throughout the year from 360m to 12km over the Arctic (70-90N). The figure on the right shows the Arctic cloud cover throughout the year as a function of cloud height, where 'low' indicates a cloud base below 3.2km, 'middle' indicates a cloud base between 3.2km and 6.6km, and 'high' indicates a base above 6.6km.

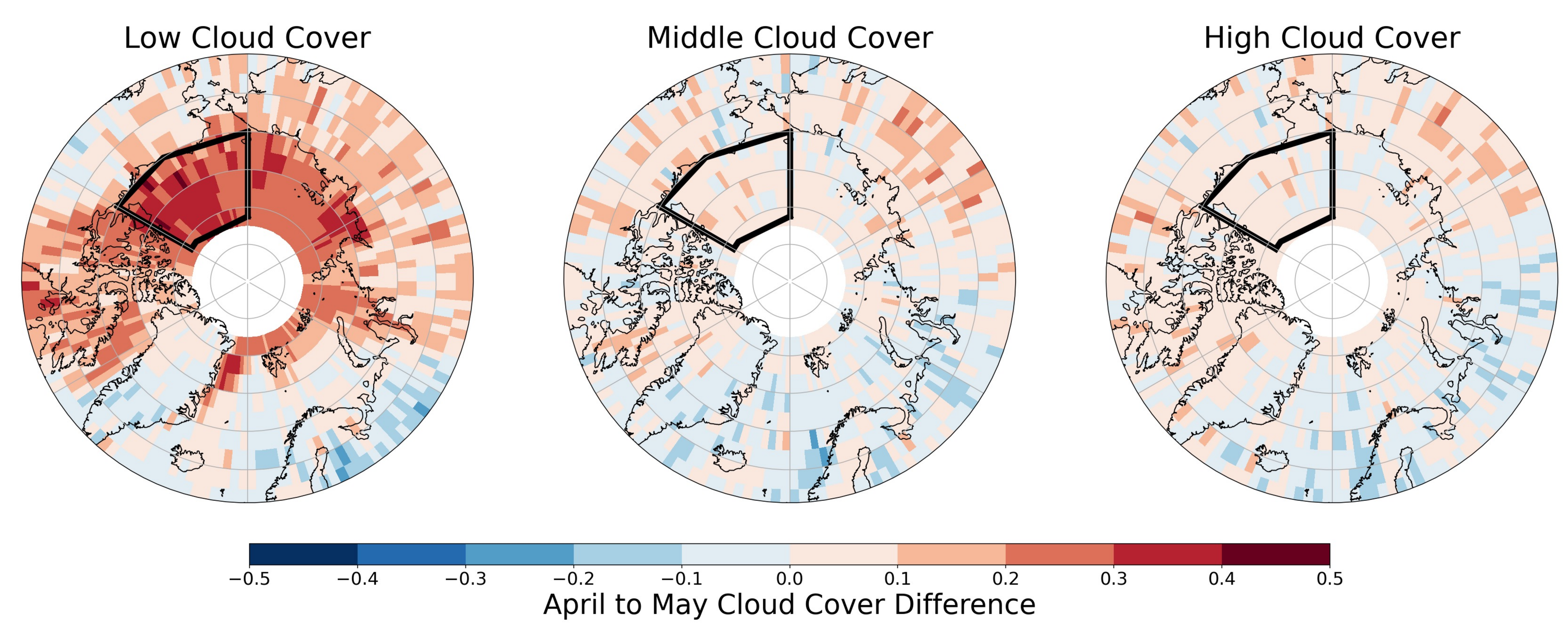
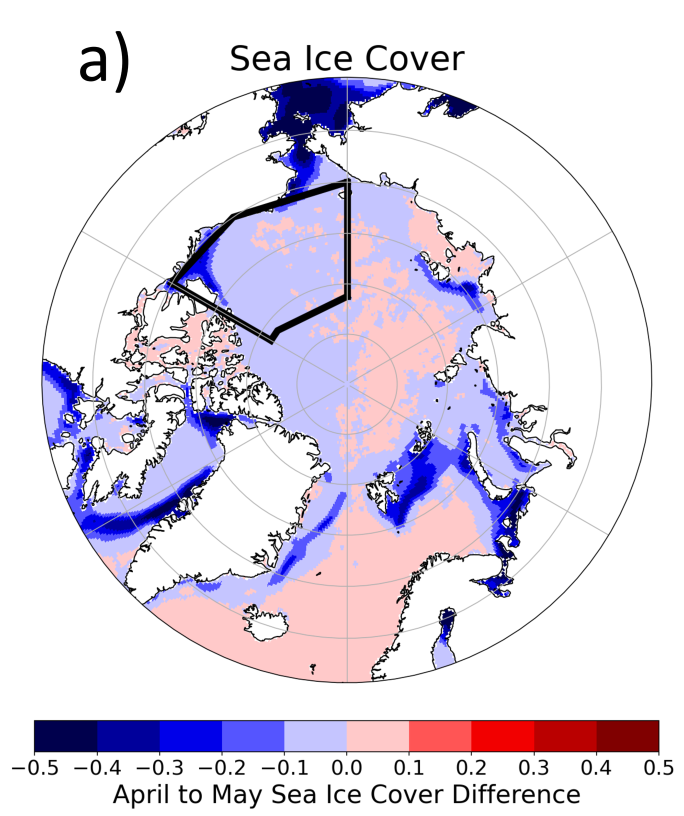


Figure 2: The map on the left shows the difference in low cloud cover between April and May, while the central and right figures show the differences in middle cloud cover and high cloud cover, respectively. Positive values represent an increase in cloud cover from April to May, while negative values represent a decrease. The black box outlines the area with the most significant low-level cloud increase.

Figure 3a: May minus April difference in sea ice cover. The black box outlines the area with the most significant low-level cloud increase.



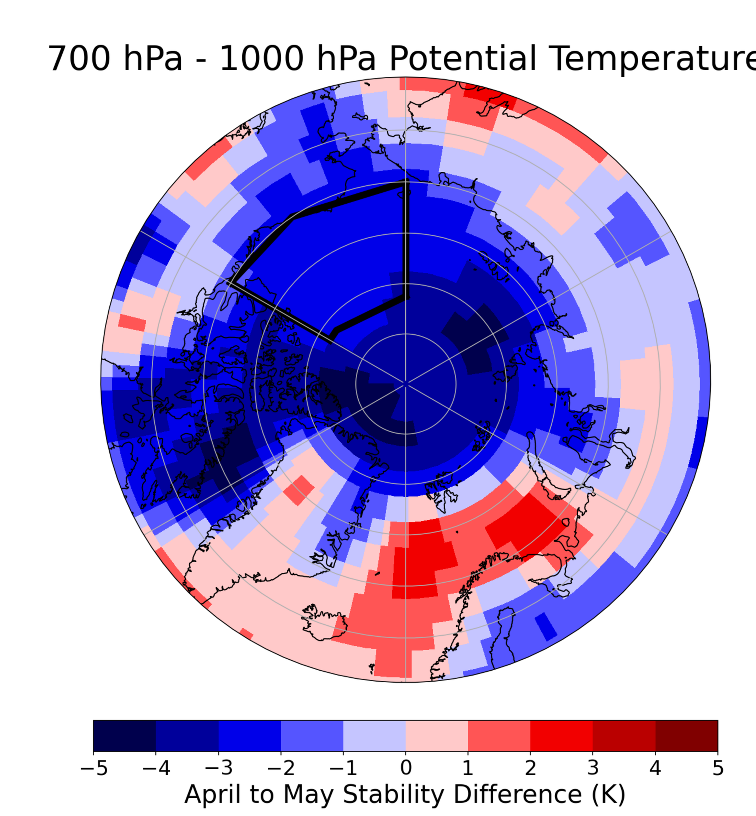


Figure 3b: May minus April difference in low-level stability, which is represented by the potential temperature difference between 700 hPa and 1000 hPa. Negative values represent a stability decrease, while positive values portray an increase.

Conclusion

- There is a notable increase in low-level cloud cover from April to May throughout the Arctic Ocean and particularly the Beaufort Sea, which coincides with a decrease in low-level stability. There is a consistent negative correlation between low-level cloud cover and low-level stability over the Arctic throughout the year.
- **Future Work: Determine Mechanism Behind Increase**
  - Surface moisture change: Snow melt? Ice Leads? Moisture Advection?
  - Atmosphere-only stability change: Inversion trapping moisture to create clouds?

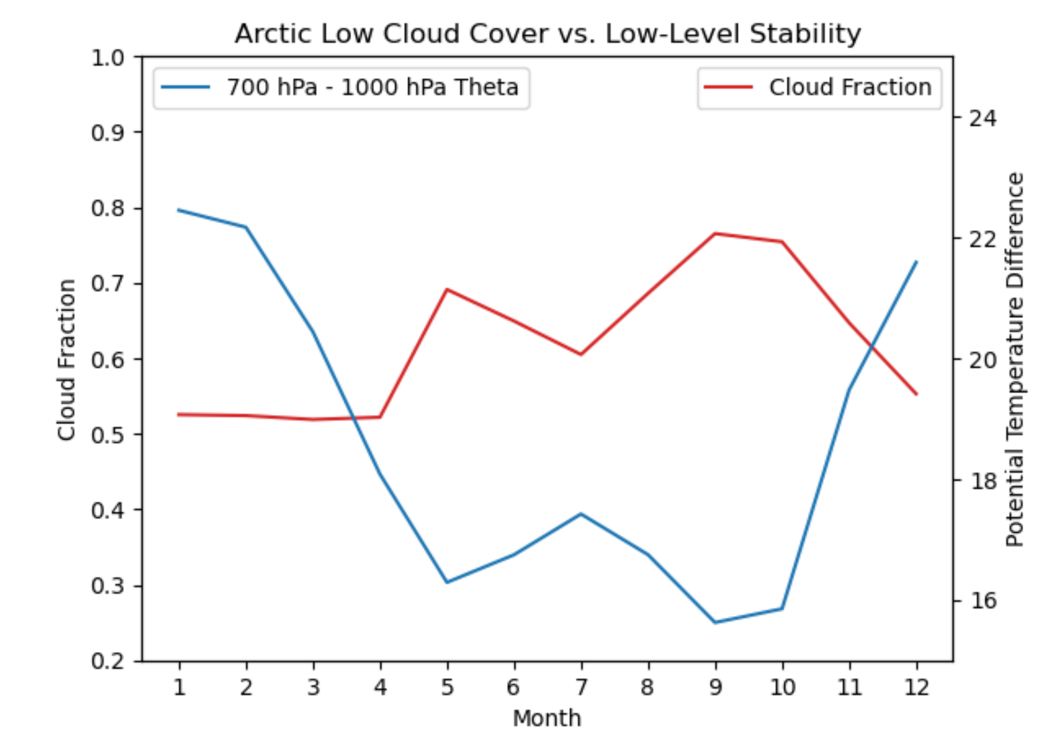


Figure 4: The figure illustrates the variation in low cloud cover and low-level stability throughout the year across the Arctic.

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