GLASS Global LAnd Surface Satellite

产品用户大会（2022）

New Insights into Regional Climate Change: Coupled Land Albedo Change Estimation in Greenland from 1981 to 2017

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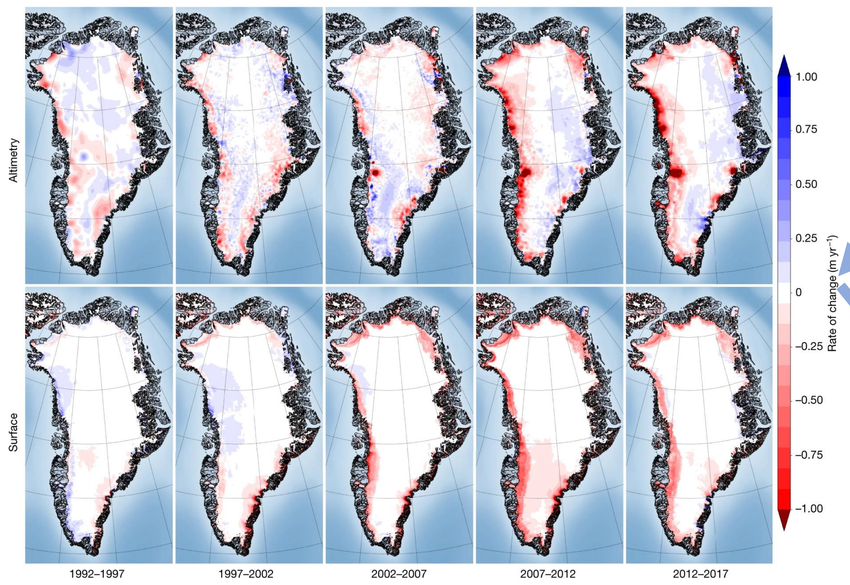
Introduction

- **Greenland Ice Sheet has been a major contributor to global sea-level rise in recent decades.**
- **Land albedo is a crucial variable in land surface energy balance and climate change.**
- **Increasing Ice melts and surface-runoff in response to global warming.**
- **Natural and Anthropogenic forcing, Detection & Attribution.**



(1)

Anthropogenic activity

(2)

Sea-level rise

Materials

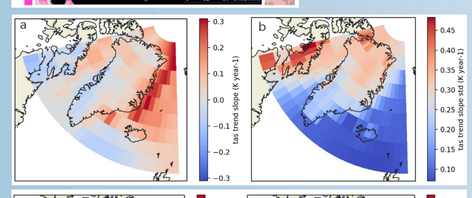
- **GLASS**: surface albedo products (0.5-1km)
- **ERA5:** monthly reanalysis: 0.25°x0.25°
- **GCMs:** CMIP5(*https*://esgf-node.llnl.gov/projects/cmip5/

Name	Affiliation/Country	Resolution
bcc-csm1-1	CN	64×128
bcc-csm1-m	CN	160×320
BNU-ESM	CN	64×128
GFDL-ESM2G	USA	90×144
GFDL-ESM2M	USA	90×144
GISS-E2-H	USA	90×144
GISS-E2-H-CC	USA	90×144
ipsl-cm5a-lr	FRA	96×96

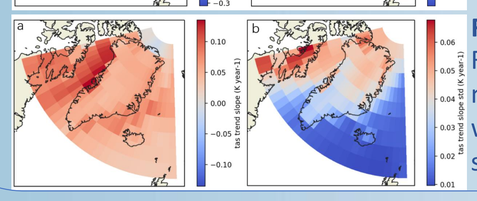
- **M-K** (Mann-Kendall & Test)
- **(D/A):** Optimal Fingerprint (including downscaling)

Coupled Model Inter-comparison(ERA5)

Inter-annual trend of albedo(37ys) Overall net decrease (-0.013±0.001 decade^{-1}, p<0.01), nearly 40 years, based on GLASS.

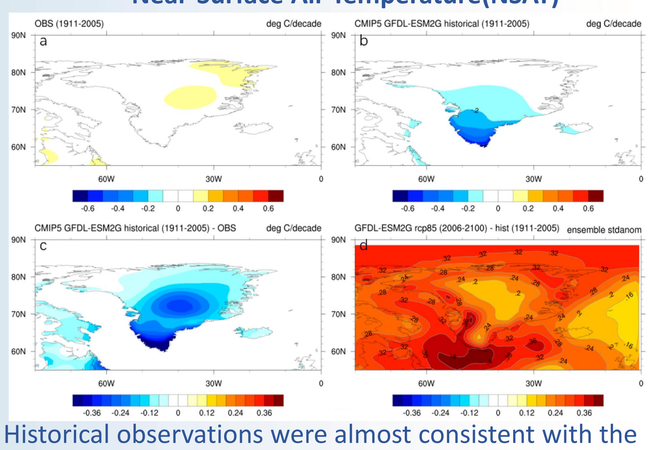


From 2008 to 2017(NSAT) Eastern (SE) part of the study area belonged to the stable zone in temperature.



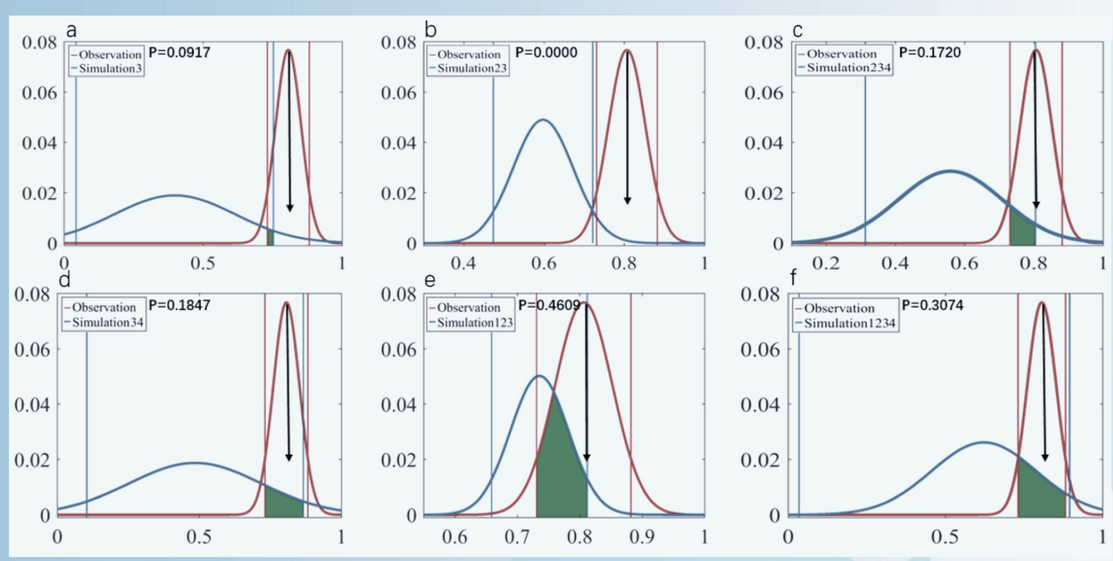
From 1981 to 2017(NSAT) Rising temperature is more significant in the west & southeast of the study area.

Near-Surface Air Temperature(NSAT)



Historical observations were almost consistent with the results of the climate model simulations regarding albedo-temperature. (OBS-Historical-ERA5 under RCP8.5)

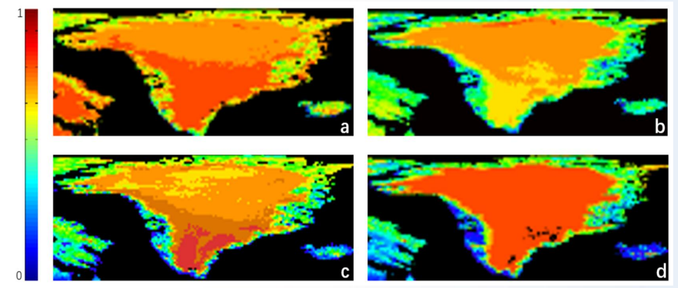
D&A: detections and attributions



- **Main Considerations:** OBS(GLASS), Aerosol forcing, Greenhouse forcing, Natural forcing, and Historical Total Simulations.
- Greenhouse gasses forcing (carbon emissions) and aerosol forcing were the key forcings (probability coefficient: 0.46; p<0.05) regarding albedo trend(37yrs).
- **Overall effects**: decreasing albedo.

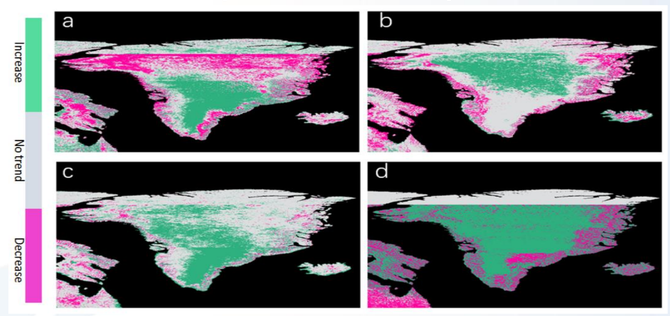
Averages and Trends

Seasonal averaged albedo dynamics (1981- 2017; GLASS)

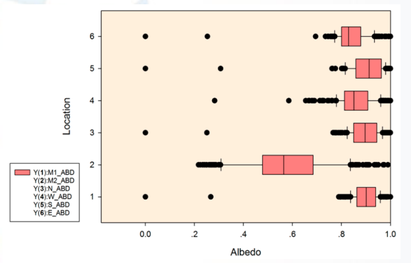


coastal zone: low albedo; **middle Greenland**: high albedo;
Spring: south of the study area was much higher than that in the north of the study area. **But!!!...**
Summer: switched spatial distribution.

Seasonal trends (1981- 2017; GLASS)



Middle region: increase; **coastal regions:** decrease
Significant increase in the south of the study area except summer(linked with the interactions of land-ocean).



Different sampling Areas
- ✓ middle
- ✓ Northern
- ✓ Western
- ✓ Southern
- ✓ Eastern

Stronger spatial & temporal heterogeneity

Inter-annual variation of albedo from 1981 to 2017 (GLASS Dataset)

Remarking Conclusions

- Albedo generally showed a decreasing trend in the past 37 years (-0.013±0.001 decade-1, p<0.01), in particular, the albedo showed a significant increasing trend in the middle part of the study area but a decreasing trend in the coastal area. The inter-annual and seasonal variations of albedo showed strong spatial-temporal heterogeneity.
- Both the greenhouse gas forcing and aerosol forcing induced by anthropogenic activities during the past 37 *yrs* were likely to be the main contributors (46.1%) to the decrease of surface albedo in Greenland. Greenland might experience local warming effect in the following years, and thus trigger sea level rising further, globally.

Refs: 1) *The IMBIE Team.* Mass balance of the Greenland Ice Sheet from 1992 to 2018. ***Nature*** 579, 233–239 (2020). https://doi.org/10.1038/s41586-019-1855-2
2) *Vitousek, S., Barnard, P., Fletcher, C. et al*. Doubling of coastal flooding frequency within decades due to sea-level rise. ***Sci Rep*** 7, 1399 (2017). https://doi.org/10.1038/s41598- 017-01362-7

Acknowledgements

This study was funded by China Association for Science and Technology, "Youth Project of High Scientific and Technological Innovation"; Grant No: DXB-2KQN-2016-028. We here thank National Key Laboratory of Lawrence, USA, China National Meteorological Administration, and Beijing Normal University. More here thanks Pro.Aurélien Ribes from the University of Toulouse (National Centre for Meteorological Research), France.

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