Influence of grid resolution on the NOAA historical satellite snow product

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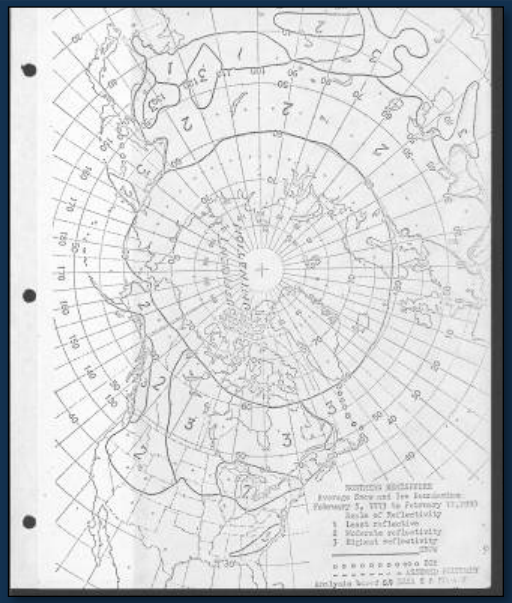
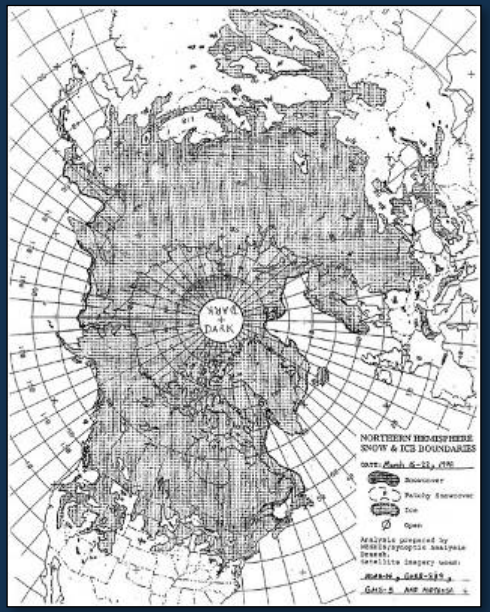
Outline

- Overview of NOAA historical snow product
- Overview of NASA MEaSUREs snow product
- Implications of grid resolution & land mask changes
  - Spatial
  - Temporal
- Complementary & future work

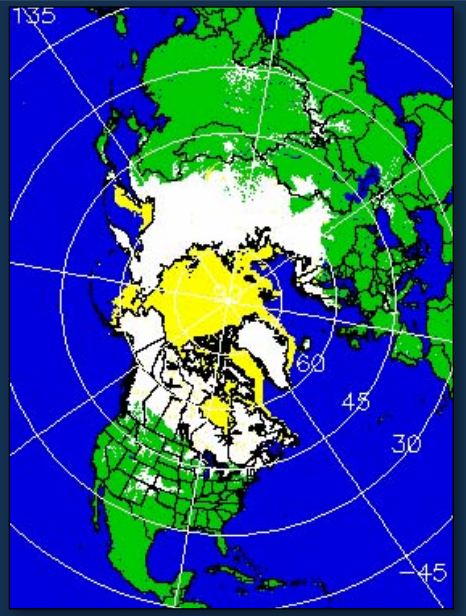
Upgrading the NOAA visible:
Environmental data record (EDR) → to CDR



1973



1998



2007

Nov 1966 | Oct 1972 | May 1975 | 1980-81 | | | 1990s | May 1999

ESSA, NOAA, GOES Series

Weekly 190 km digitized

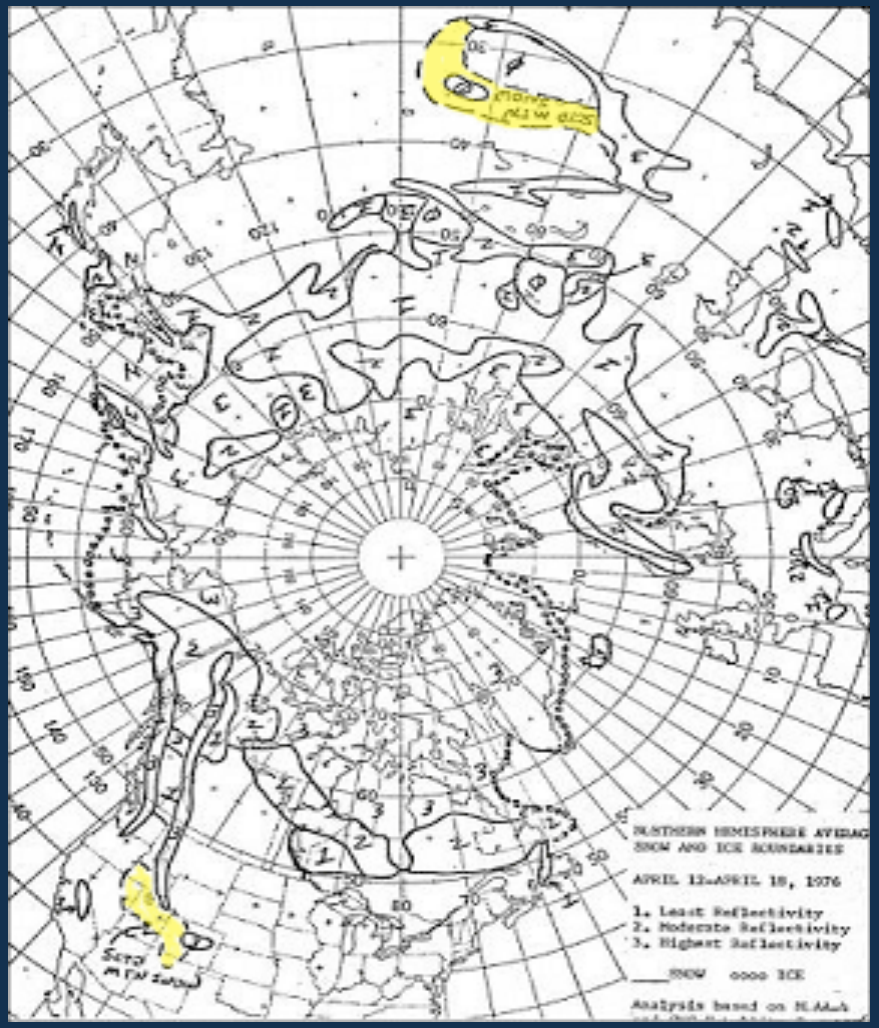
METEOSAT & GMS added

Reanalysis of 1966-71

Feb 1997 | Feb 2004

IMS 24 km | IMS 4 km

Upgrading the NOAA visible:
Scattered snow reanalysis



- Match the past mapping to current knowledge
- Correct errors to match IMS era
- Examine each digitized NOAA map cell

Scattered mountain snow or patchy snow

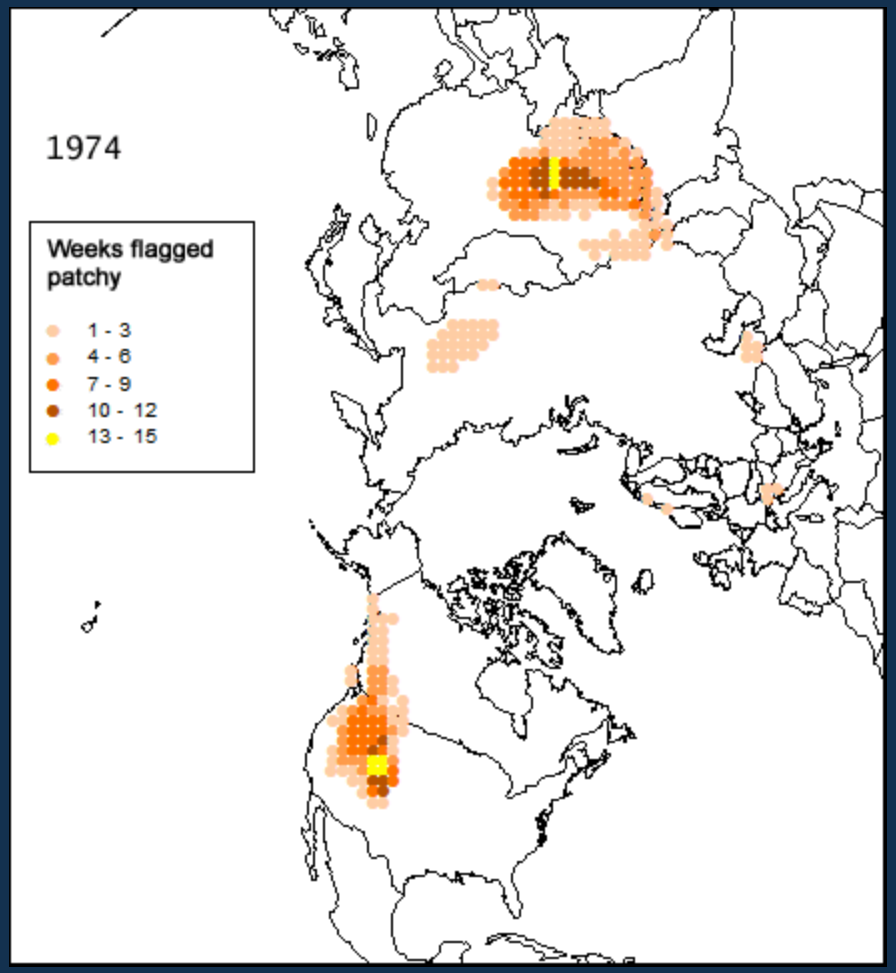
↓

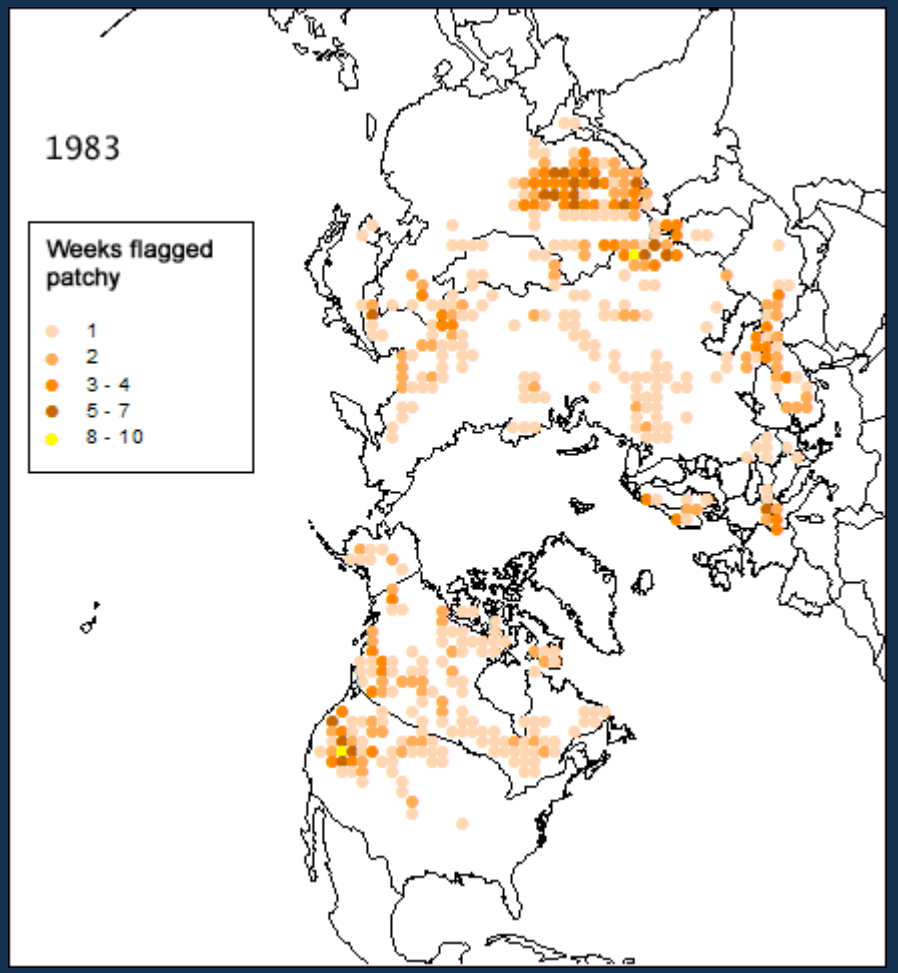
Digitized as snow covered

↓

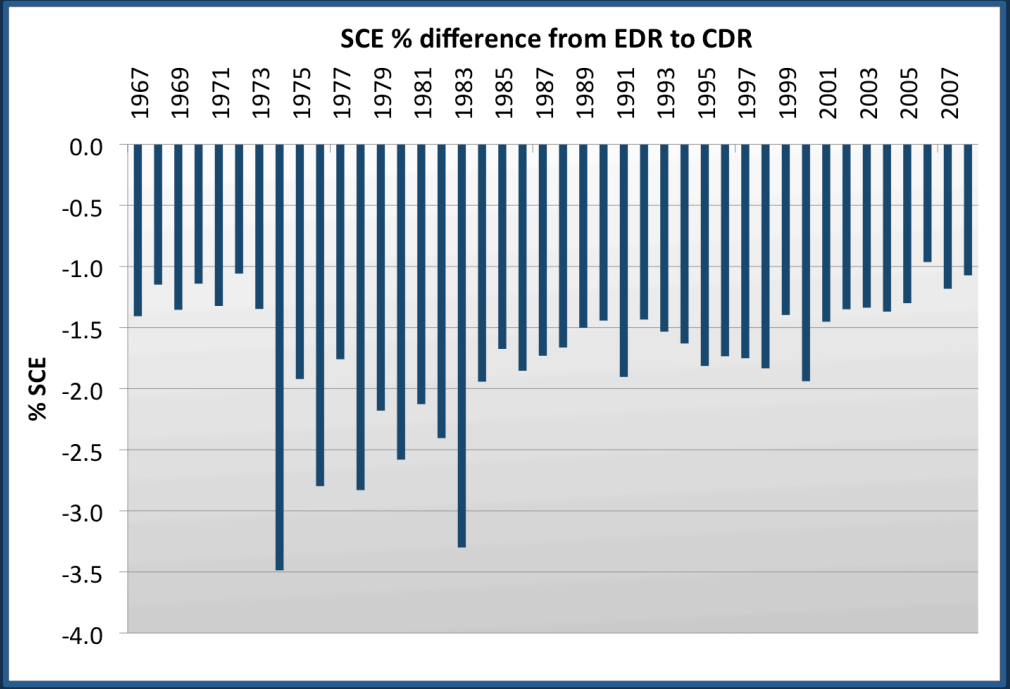
Remove

Upgrading the NOAA visible:
Scattered snow reanalysis





Upgrading the NOAA visible: Reanalysis to produce new CDR



- Match past record to current knowledge and consistency
- Correct errors in the past to match what has been learned within the IMS era

- Examine each digitized NOAA map cell
- 42% found to be “best match” to convert IMS cells to the larger NOAA grid

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National Aeronautics and
Space Administration
Development of Northern Hemisphere Snow and Ice Climate Data Records
MEaSUREs Making Earth Science Data Records for Use in Research Environments
www.snowcover.org

Project goals for snow MEaSUREs:

- Assess compliance of current NH snow cover products over land, sea ice and the Greenland ice sheet with NRC Climate Data Record (Earth System Data Record) characteristics

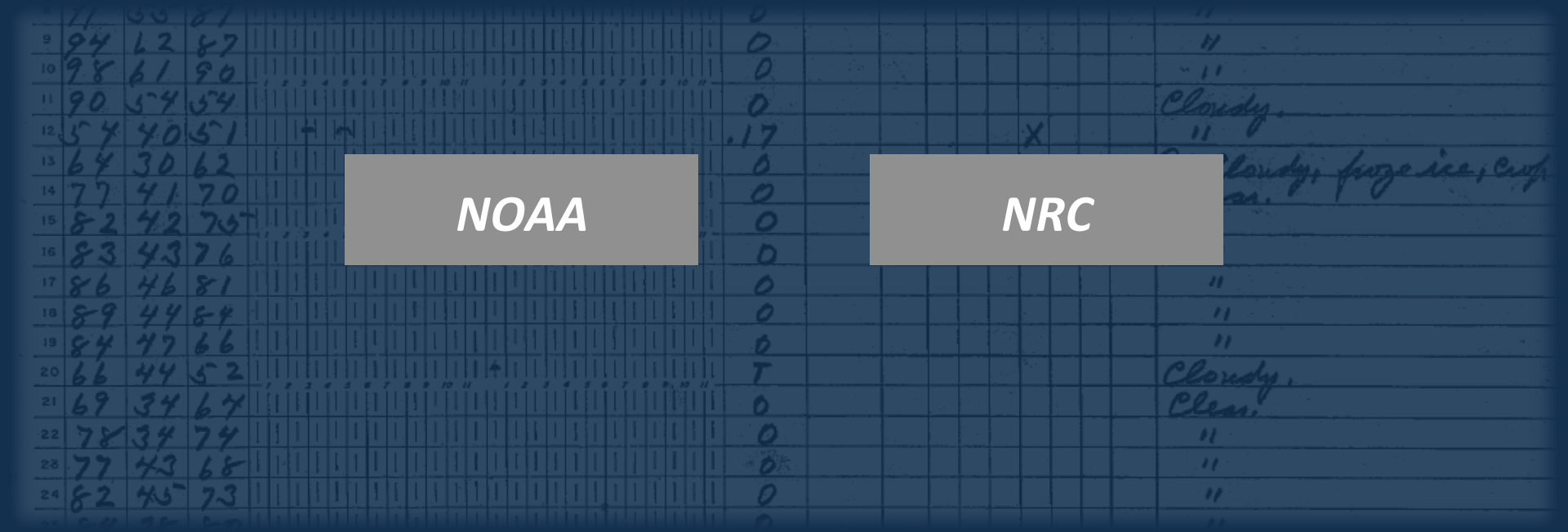
- Fuse data records to develop enhanced ESDRs of NH snow conditions

- Make the ESDRs and associated products available to the user community via the NASA Distributed Active Archive Center (DAAC) at NSIDC

Climate Data Record Attributes

- Length
- Consistency
- Continuity
- Documentation

National Research Council (NRC), 2004: Climate Data Records from Environmental Satellites. National Academies Press, Washington, DC.



NOAA ***NRC***

MEaSUREs terrestrial snow products

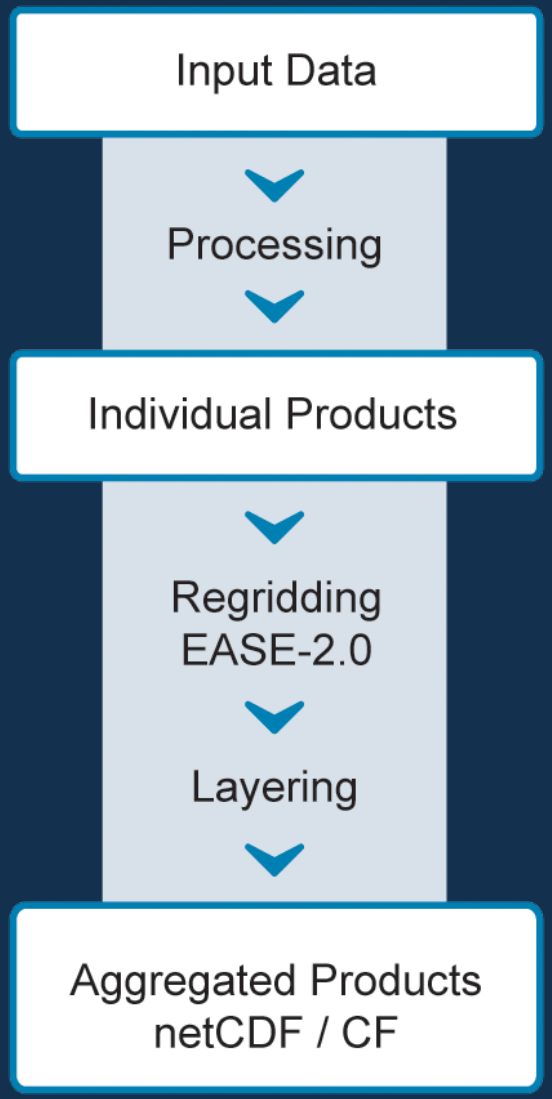
Product	Category	Temporal Resolution
Visible Satellite SCE	Snow extent on land	Daily / Weekly
MODIS CGF	Snow extent on land	Daily
Passive Microwave	Snow extent on land	Daily
Ice Extent	Arctic sea ice	Daily
Melt Onset	Arctic sea ice	Daily
Ice Age	Arctic sea ice	Weekly
Greenland Surface Melt	Greenland	Daily

MEaSUREs fused products

Title	Years	Spatial Resolution	Temporal Resolution	Components
NH Terrestrial Snow Daily	1999-2012	25km	Daily	IMS, Passive Microwave, MODIS CGF
NH Terrestrial Snow Weekly	1967-2012	100km	Weekly	NOAA Weekly, Passive Microwave
Arctic Sea Ice Characterization	1979-2012	25km	Daily	Sea Ice Extent, Ice Age, Melt Onset
Greenland Surface Melt	1979-2012	25km	Daily	Passive Microwave
NH State of Cryosphere Daily	1999-2012	25km	Daily	Snow and Ice Extent, State of Melt
NH State of Cryosphere Weekly	1967-2012	100km	Weekly	Snow and Ice Extent, State of Melt

Methodology

- Individual snow sectors (continental, sea ice, and Greenland) are produced, then fused into hemispheric products
- Aggregated products are output in EASE-Grid version 2.0 at 25km and 100km resolutions
- Output in netCDF files conform to Climatological Forecasting (CF) conventions



Motivation:

- What impact does changing grid resolution have on snow cover extent area estimates?
- How sensitive are potential grid resolution effects spatially and temporally? Does the magnitude of this effect vary throughout the record?

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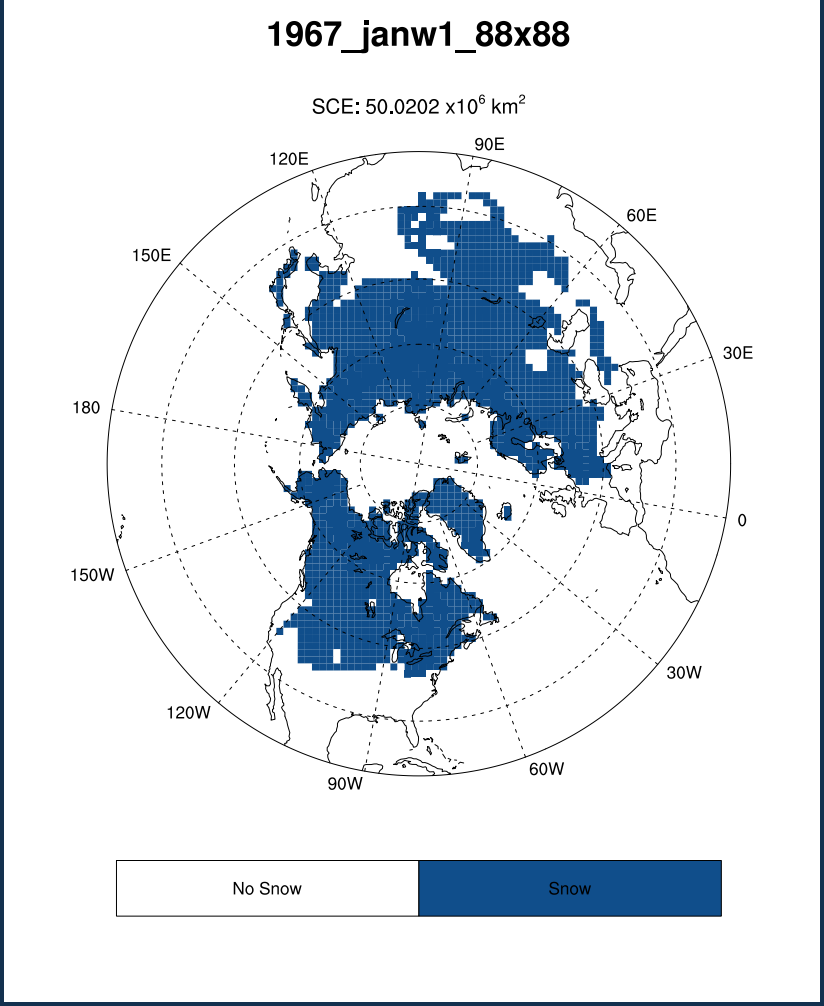
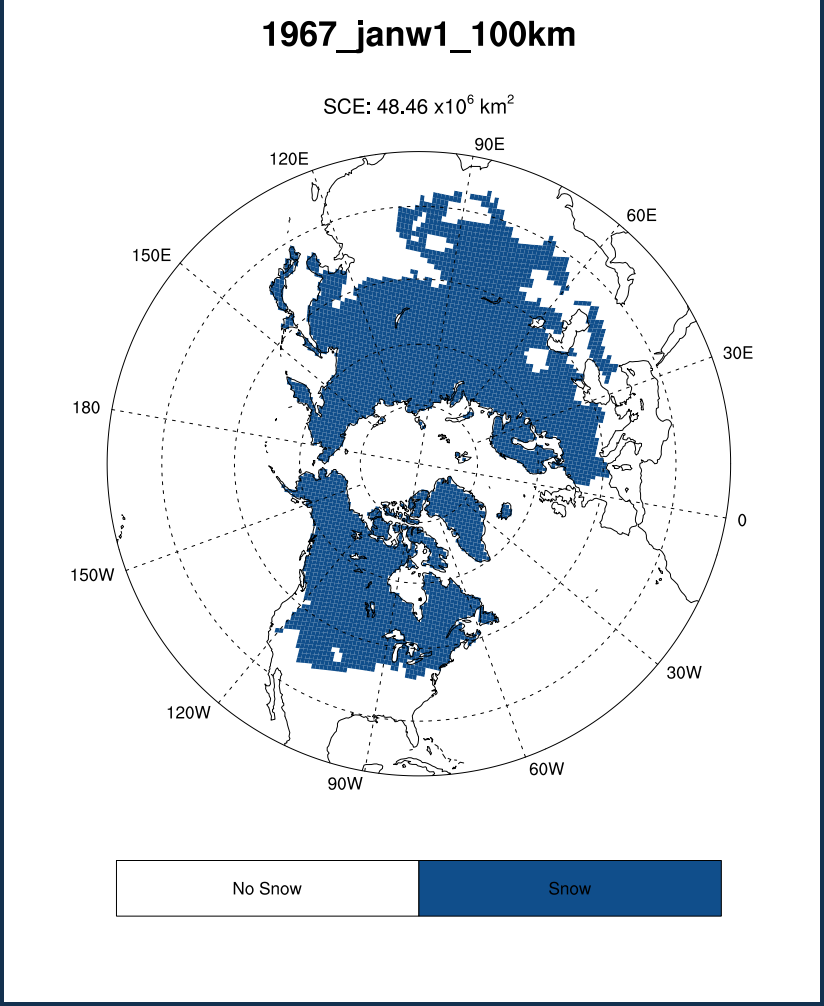
NOAA SCE, spatial comparison:
88x88 versus 100km EASE2 grid





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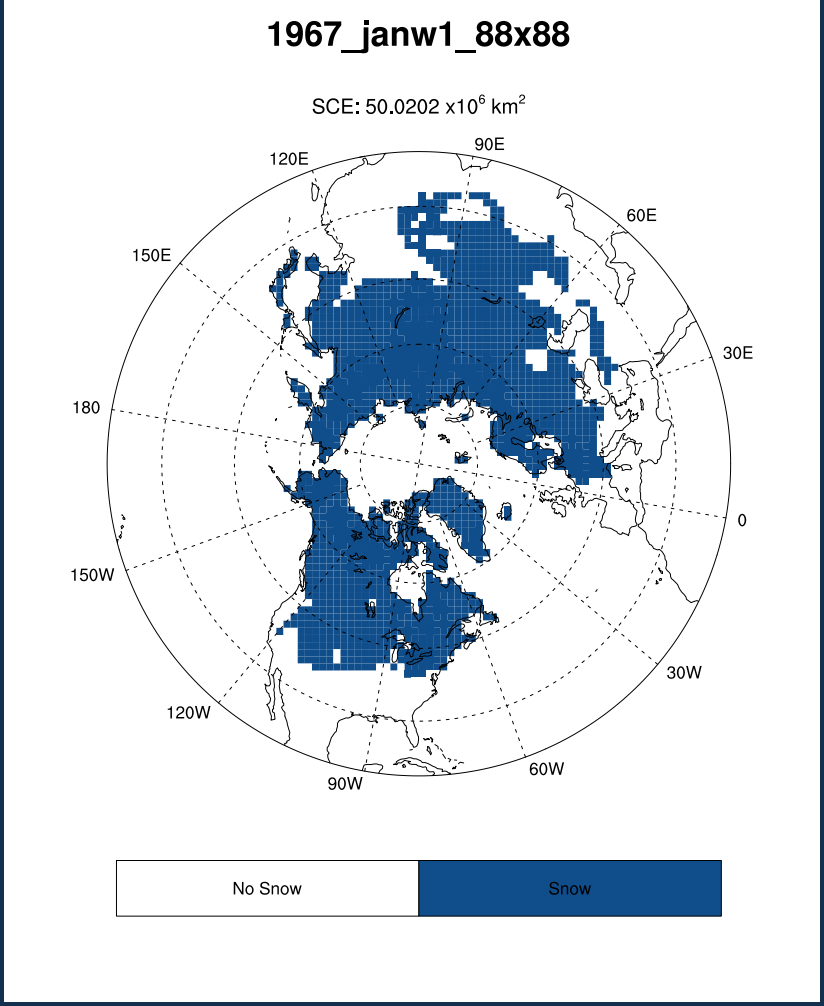

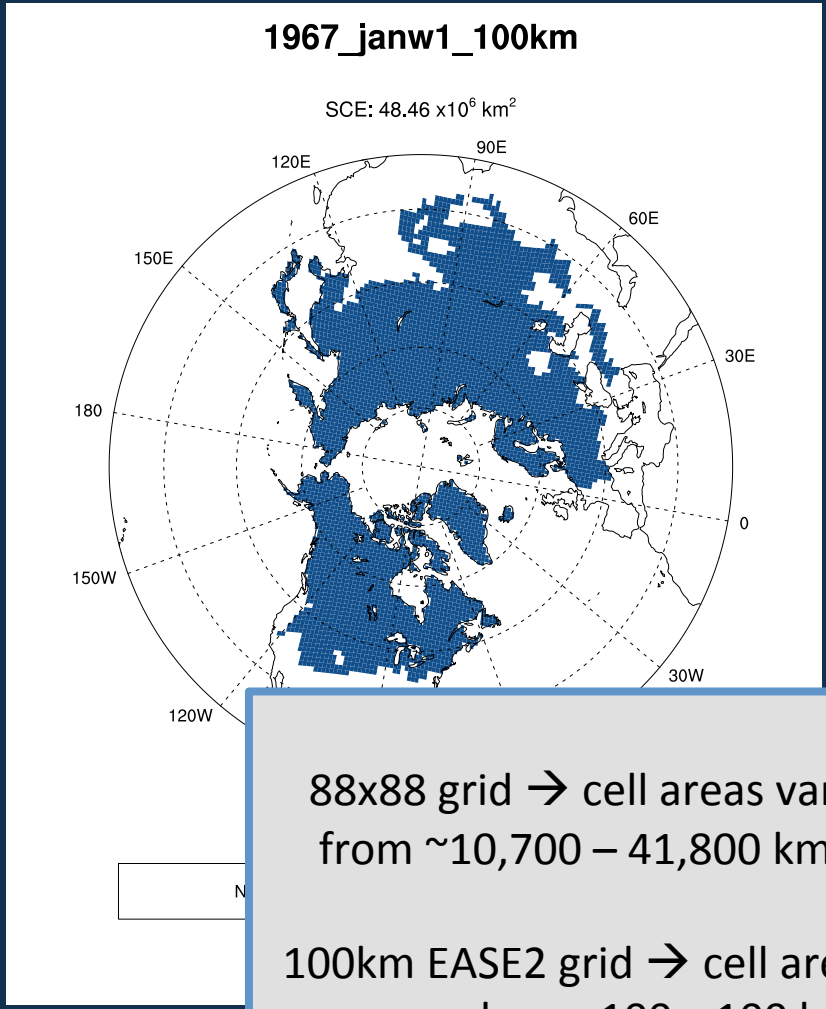

88x88 grid → cell areas vary from ~10,700 – 41,800 km^2

100km EASE2 grid → cell areas are equal area 100 x 100 km

NOAA SCE, spatial comparison:
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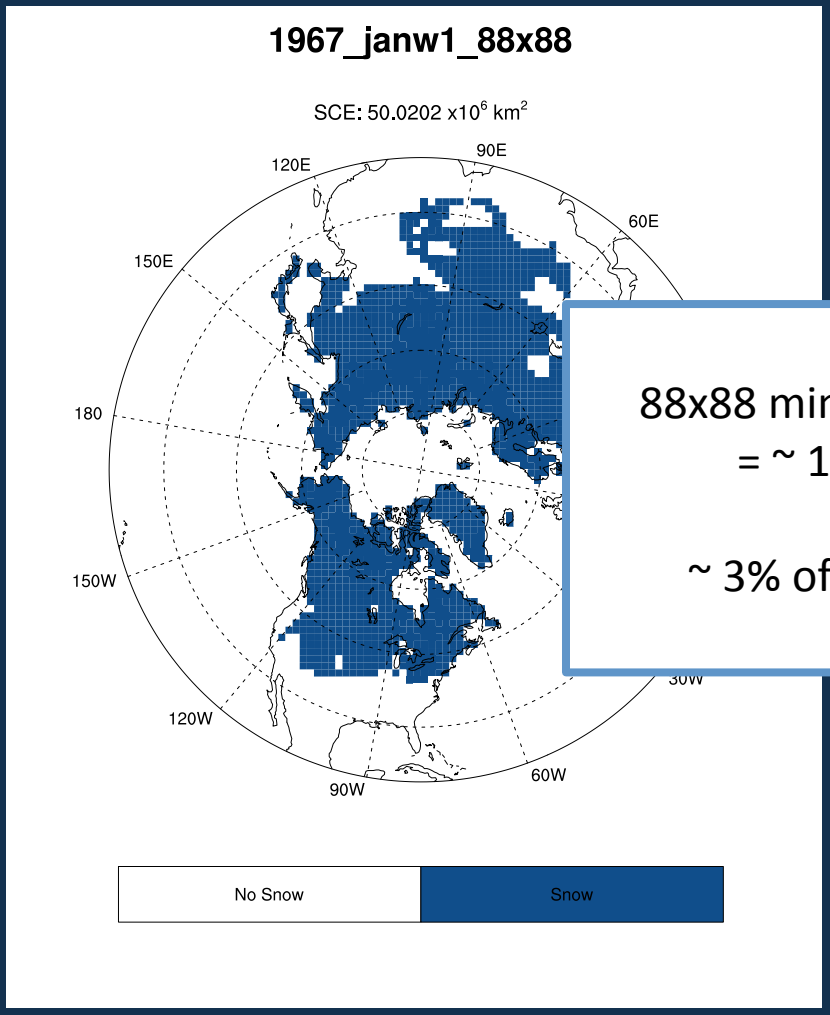
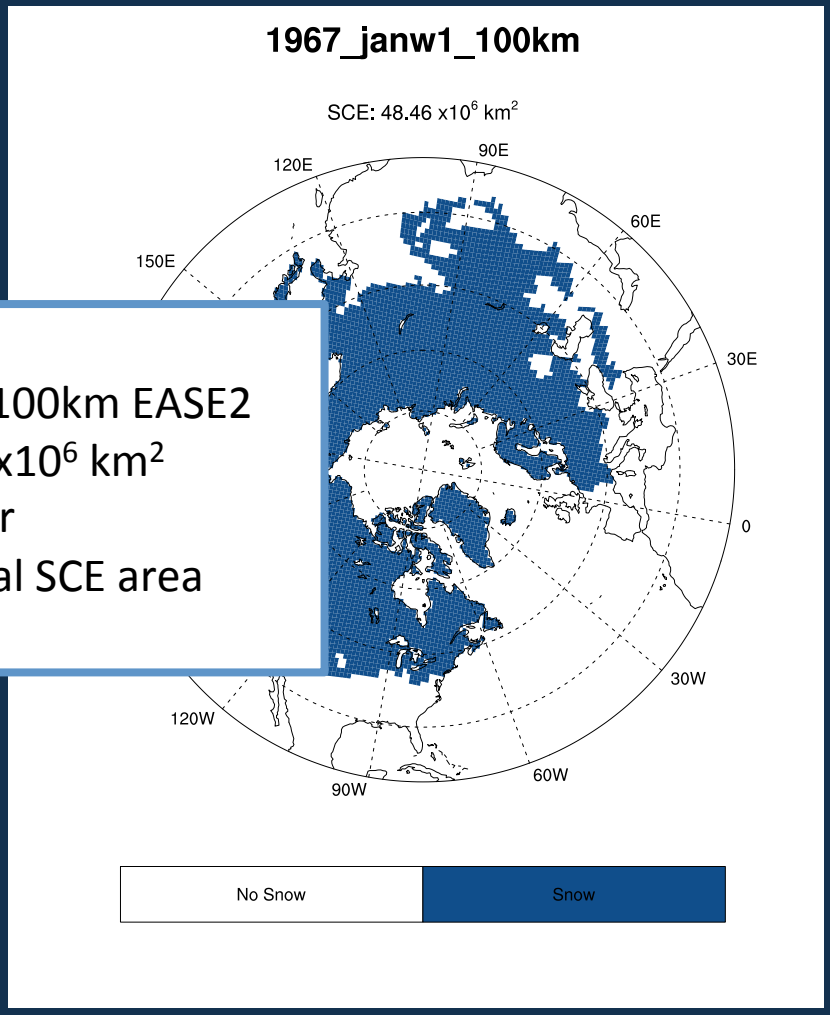


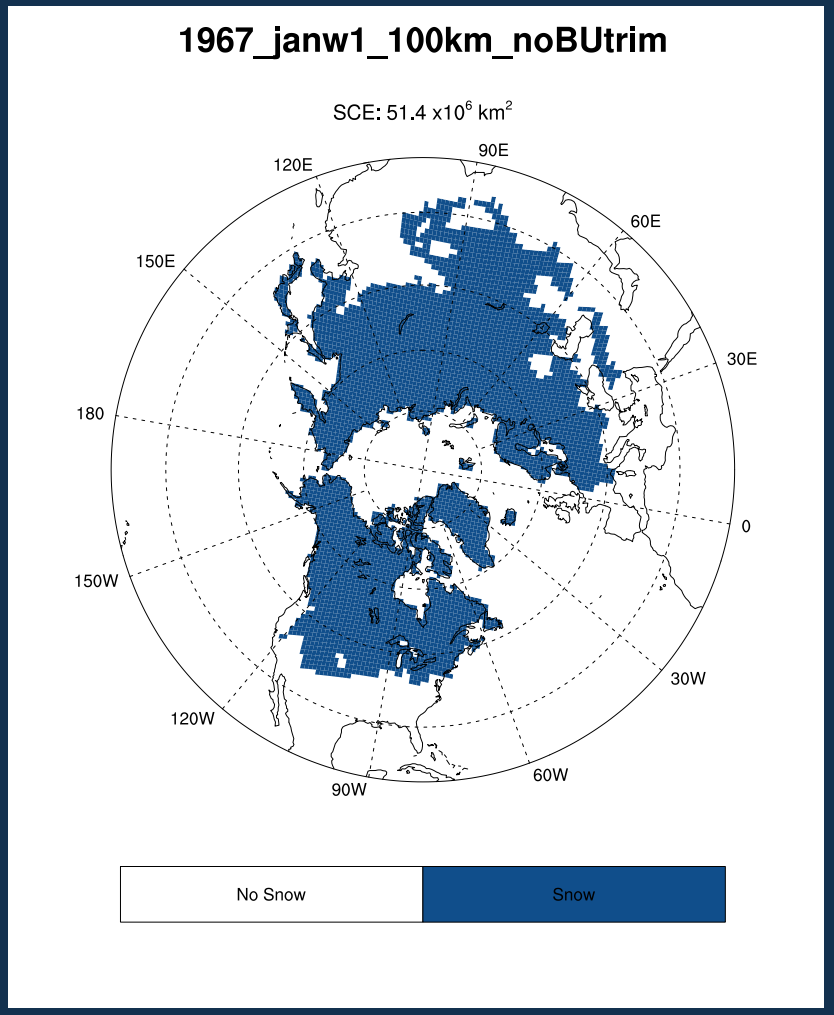
88x88 minus 100km EASE2
= ~ 1.56 x10^6 km^2
Or
~ 3% of total SCE area



NOAA SCE, spatial comparison:
88x88 versus 100km EASE2 grid

- 88x88 minus 100km E2:
  = ~ 1.56 x10^6 km^2

- Without using the BU MODIS landmask, 88x88 minus 100km E2:
  = ~ -1.38 x10^6 km^2



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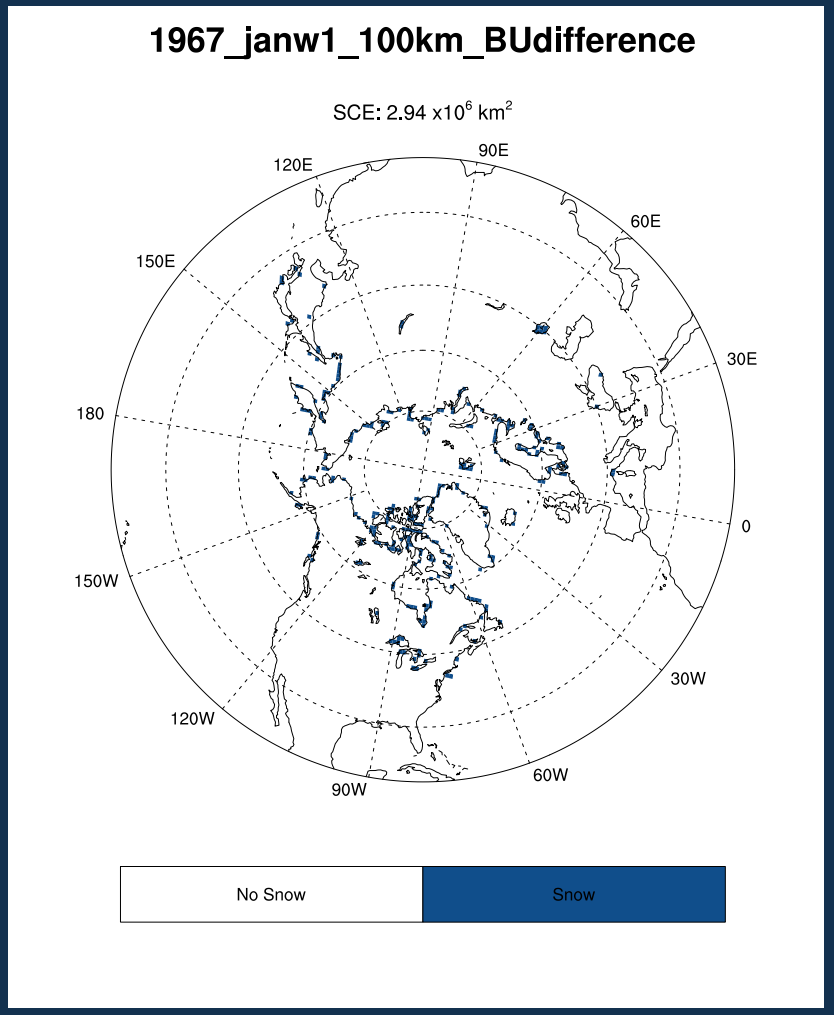
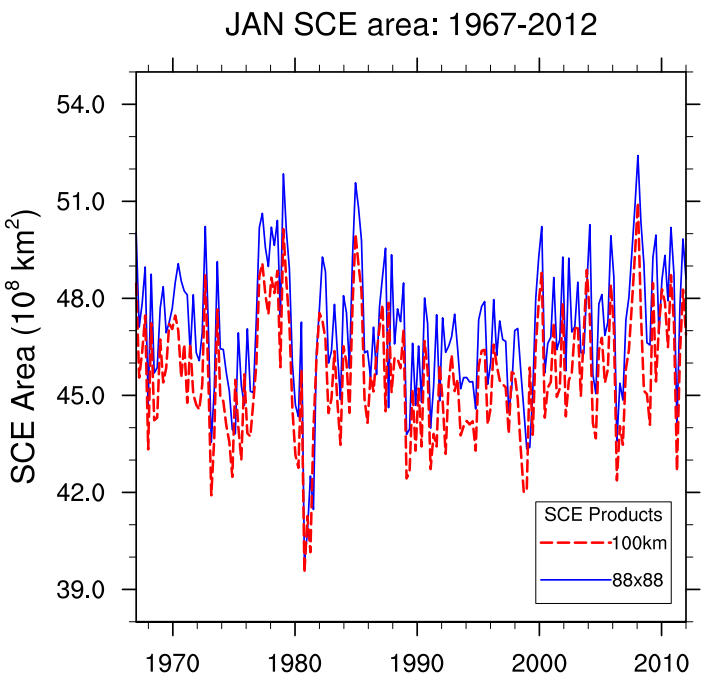


NOAA SCE: January wk1-wk4, 1967-2012
88x88 versus 100km EASE2 grid

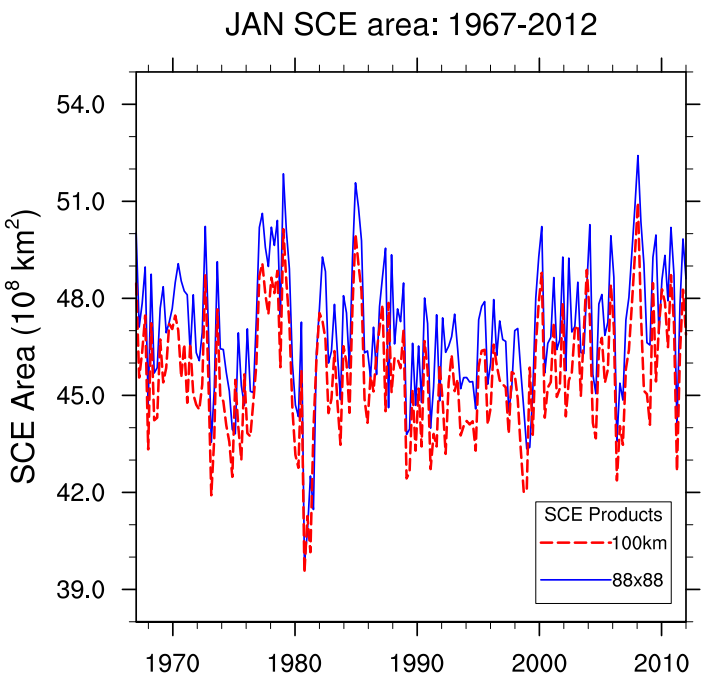


Cross correlation = 0.865

- 88x88 NOAA SCE consistently greater than 100km EASE2 version
- CC value of 0.865 between the two series
- 100km EASE2 product trimmed using BU MODIS landmask

NOAA SCE: January wk1-wk4, 1967-2012

88x88 versus 100km EASE2 grid



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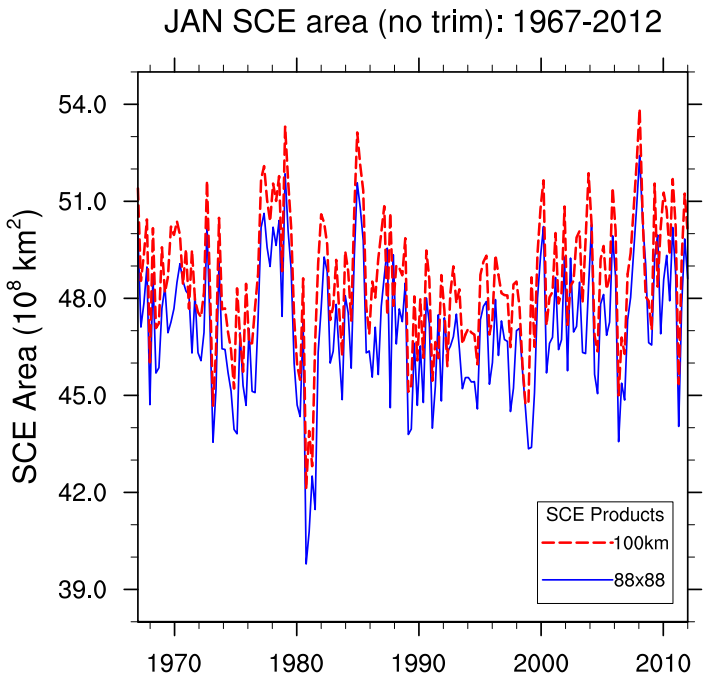
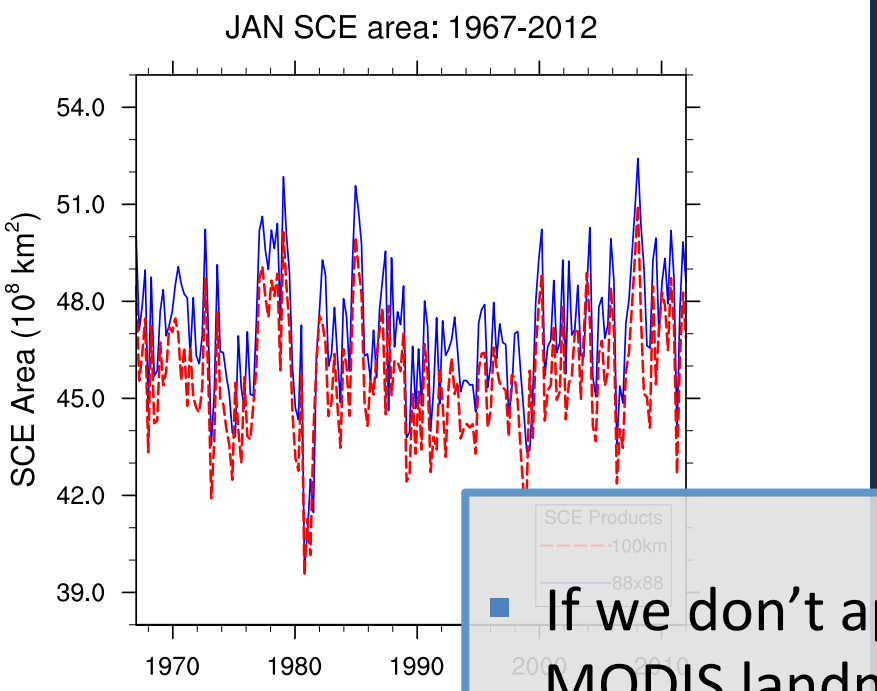


Cross correlation = 0.868

NOAA SCE: January wk1-wk4, 1967-2012

88x88 versus 100km EASE2 grid



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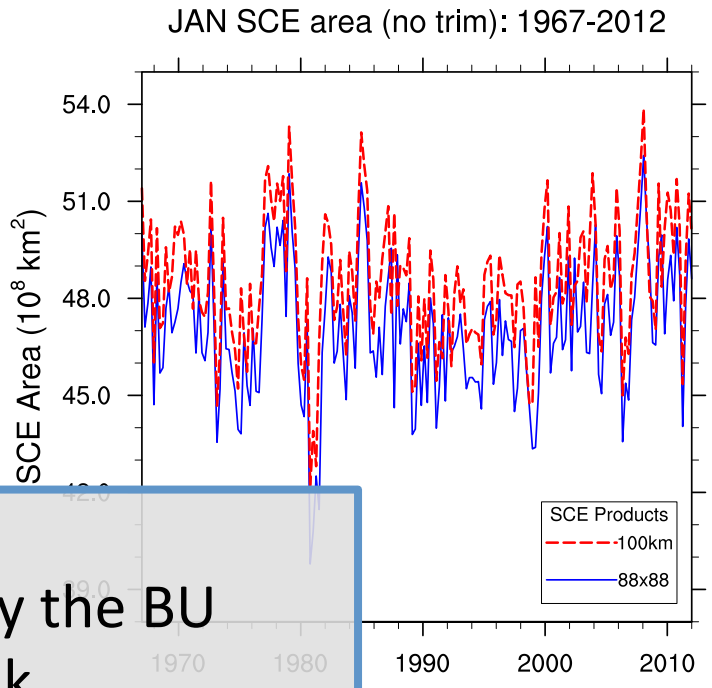


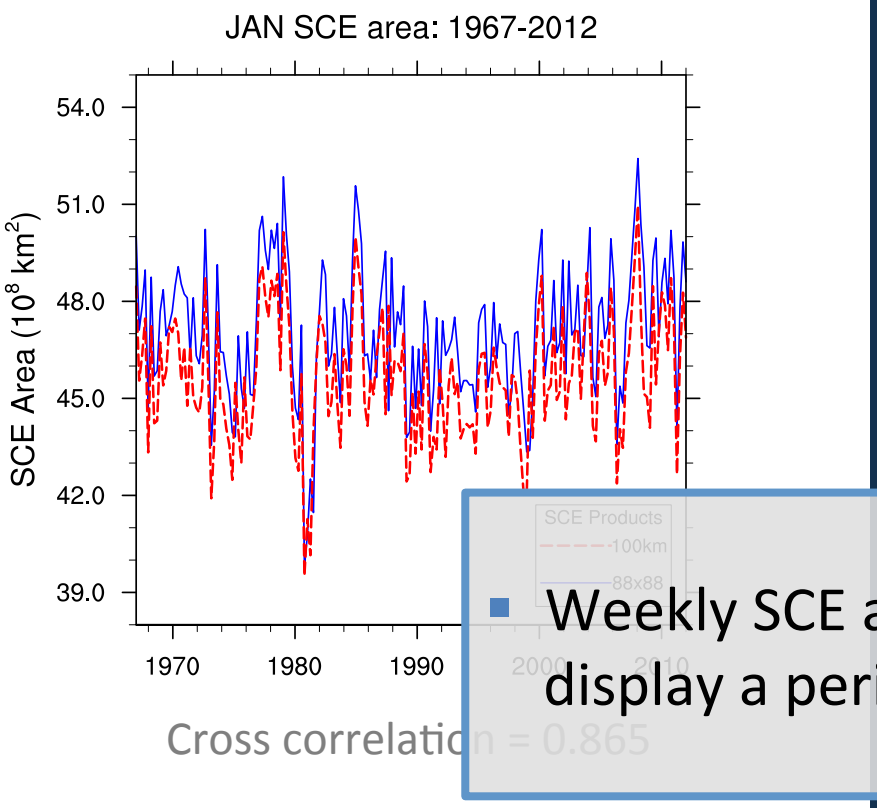
Cross correlation = 0.868

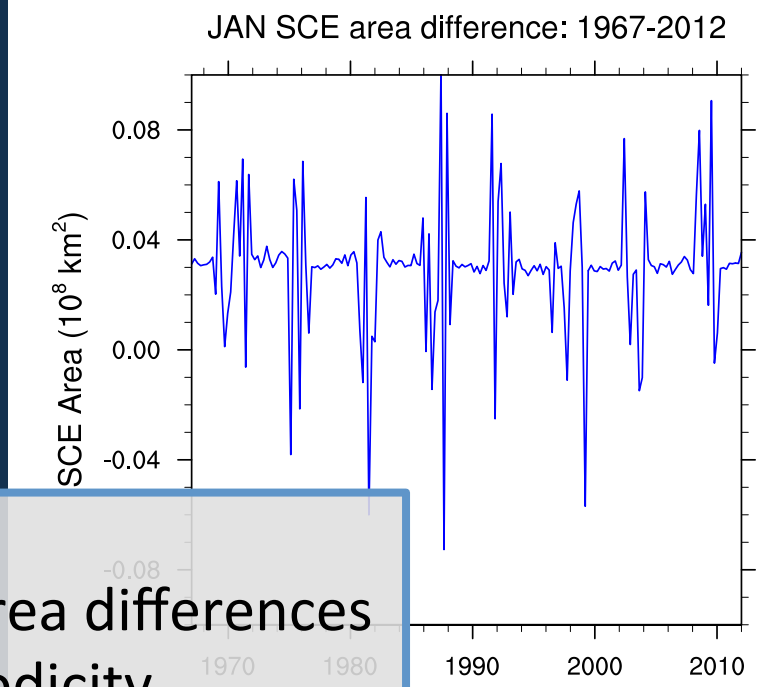
- If we don't apply the BU MODIS landmask

  88x88 < 100km EASE2 SCE

NOAA SCE: January wk1-wk4, 1967-2012

88x88 versus 100km EASE2 grid

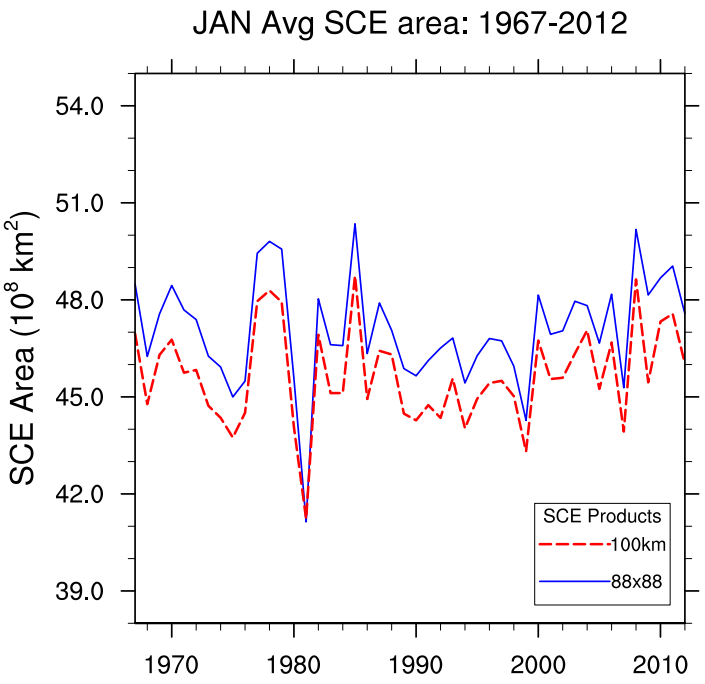




- Weekly SCE area differences display a periodicity

NOAA SCE: January Average, 1967-2012

88x88 versus 100km EASE2 grid



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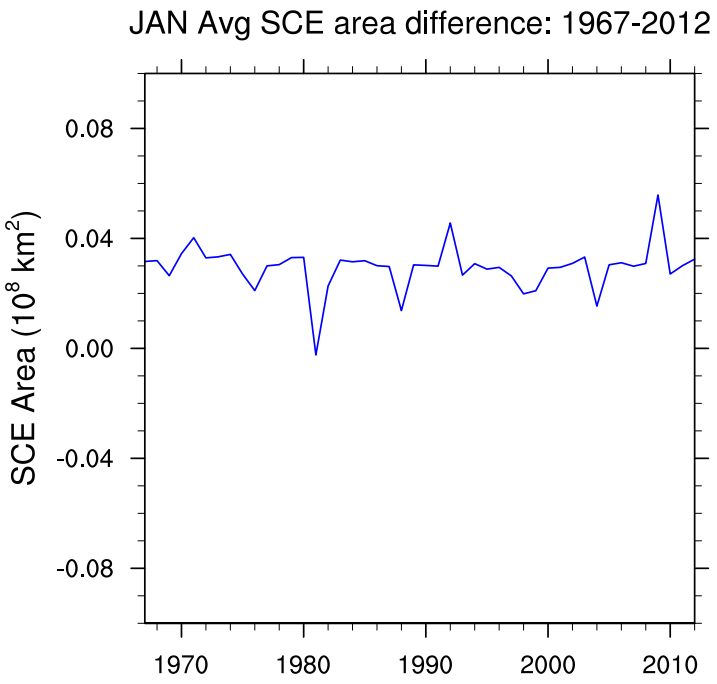
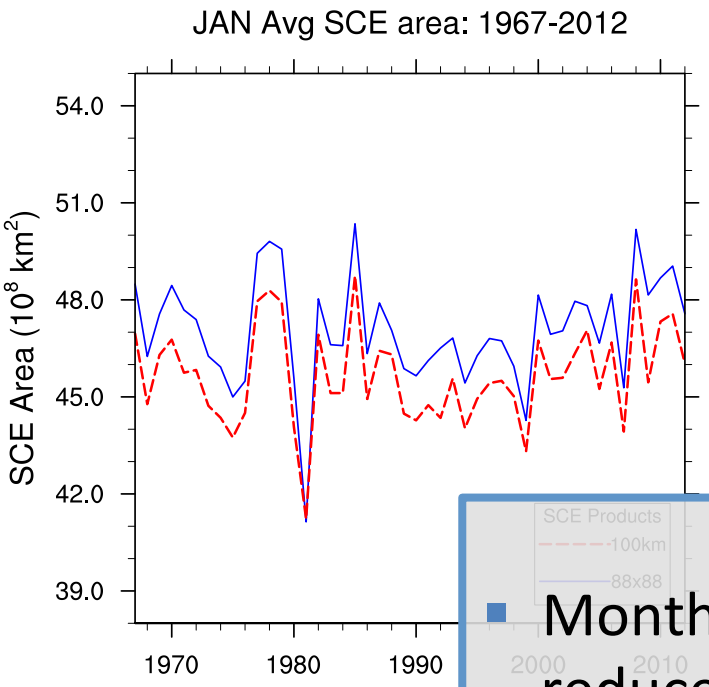
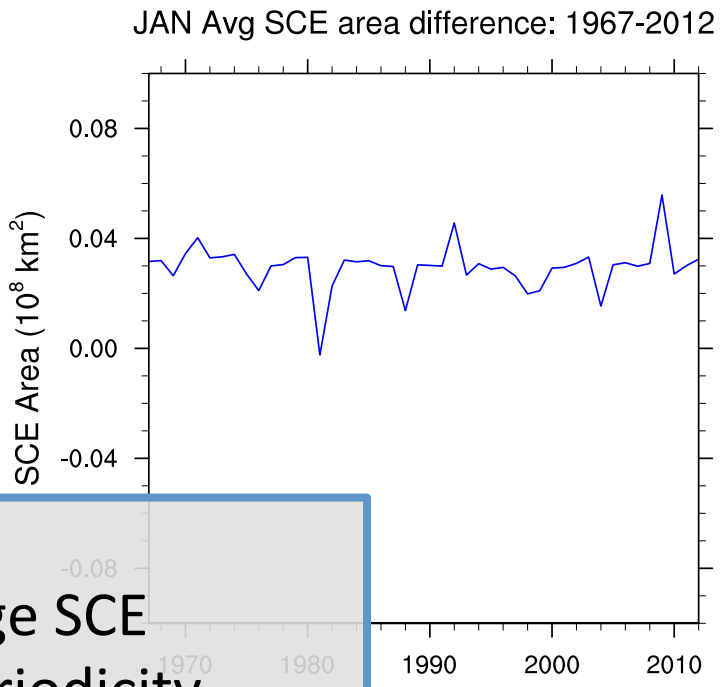


NOAA SCE: January Average, 1967-2012

88x88 versus 100km EASE2 grid





- Monthly average SCE reduces this periodicity

Future work:

- Extend spatial and temporal SCE resolution comparisons between the 88x88 versus the 100km EASE2 grid to other months within the snow season

- Repeat analysis for the daily IMS 24km versus the 25km EASE2 products

Complementary work: Tom Mote, U of Georgia

Assessment of the Stability of a Satellite Snow Extent CDR from Station Snow Depth Observations

- → Gridded North American snow depth record compared to the visible satellite record (88x88 product) for different epochs (1965-1980, 1981-1998, 1999-2000) within the satellite CDR

- → CDR tends to detect more snow (5.28%) later in the record in the most recent epoch (post IMS)

- → Cells with a smaller fraction of stations reporting snow, and with lower mean snow depth, are more likely to be shown as snow covered in the most recent epoch than in earlier epochs

Comments, suggestions, questions very welcome!

Gina Henderson

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