

Einfluss schwindenden arktischen Meereises auf das Klima der nördlichen mittleren Breiten

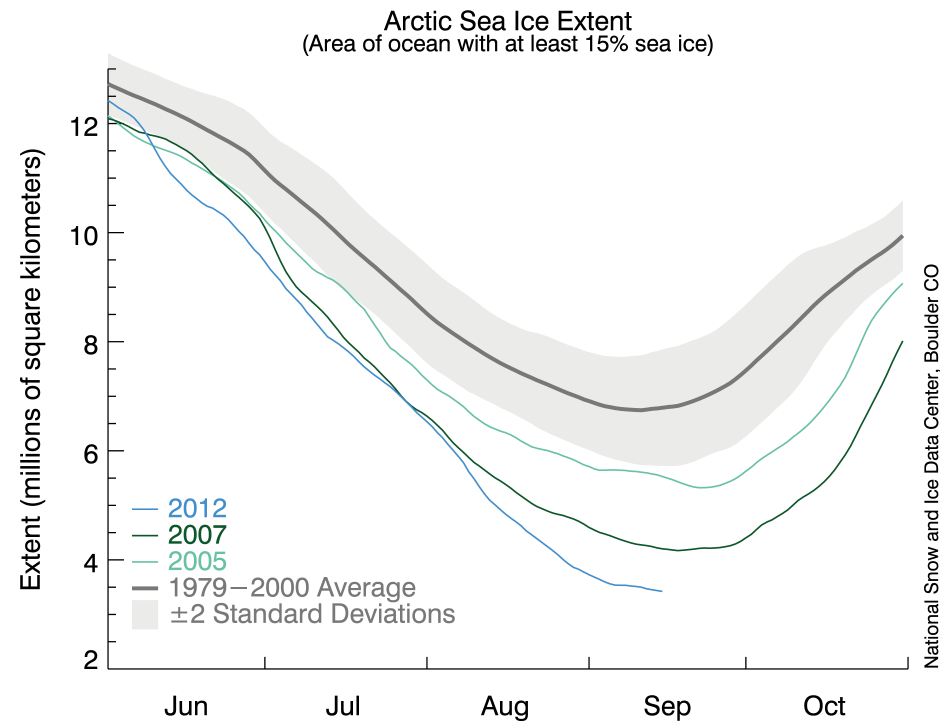
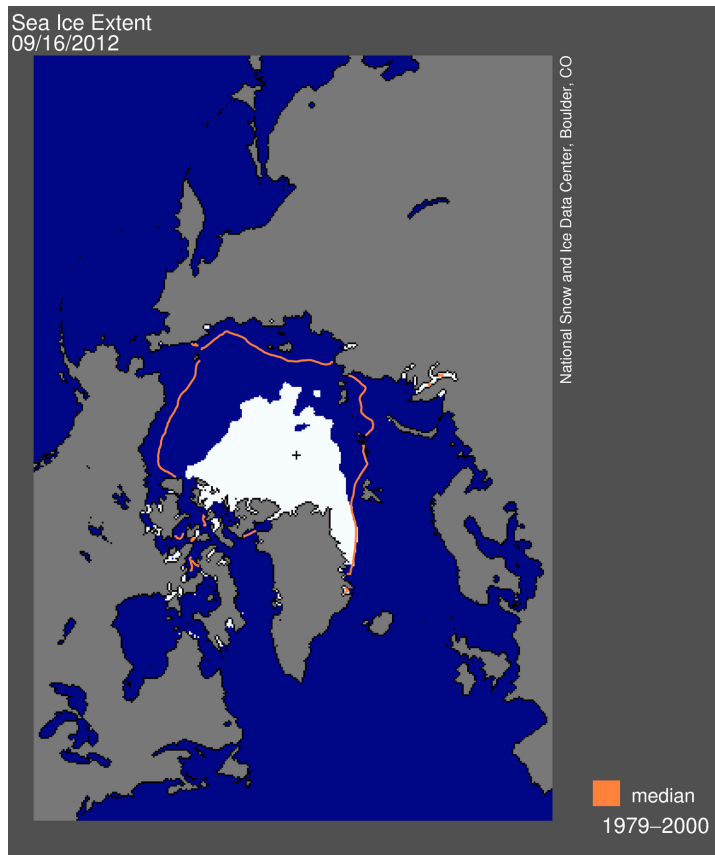
Tido Semmler, Emily Gleeson, Shiyu Wang, Ray
McGrath, Thomas Jung

Alfred-Wegener-Institut für Polar- and
Meeresforschung,
Met Éireann, Schwedisches Meteorologisches und
Hydrologisches Institut

1. Motivation
2. Experimente
3. Ergebnisse
4. Zusammenfassung

1. Motivation

- Arktisches Meereis schneller geschrumpft als von Klimamodellen vorhergesagt
- Wie beeinflusst eine stark geschrumpfte oder verschwundene arktische Meereisbedeckung das Klima?



Idealisierte Sensitivitätsexperimente: EC-EARTH-IFS in T255L62 (79 km horizontale Auflösung mit 62 vertikalen Schichten bis 5 hPa) angetrieben mit ERA-40 SSTs und Meereiskonzentrationen

Standard, reduziertes Meereis, meereisfrei

Reduziertes Meereis:

$SIST \leq T_{freeze} - 10 \text{ }^\circ\text{C} \rightarrow SIST = SIST + 10 \text{ }^\circ\text{C}, SIC = SIC$

$SIST > T_{freeze} - 10 \text{ }^\circ\text{C} \rightarrow SST = \text{Max}(T_{freeze}, SIST), SIC = 0$

SIST: Meereisoberflächentemperatur

SST: Meeresoberflächentemperatur

SIC: Meereiskonzentration

T_{freeze} : Gefriertemperatur von Meerwasser (-1.7 °C)

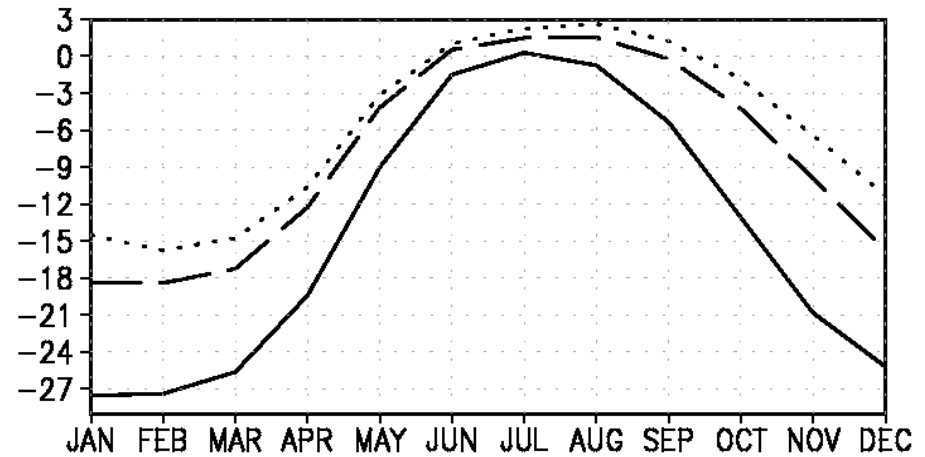
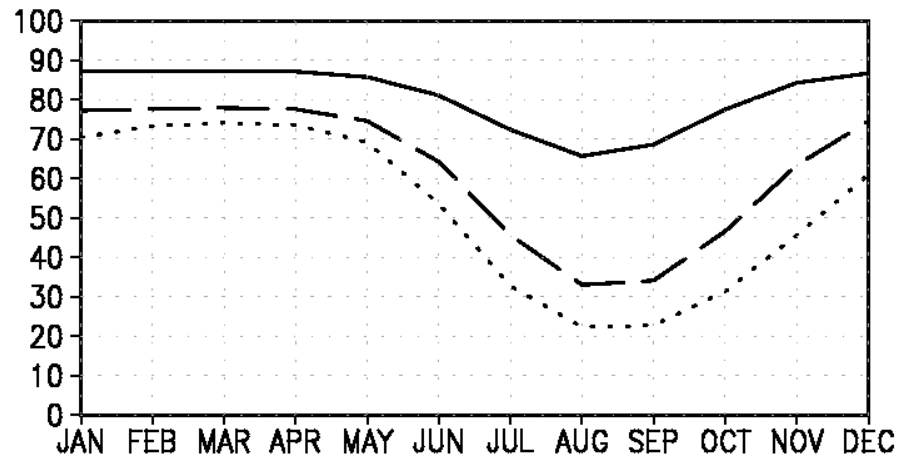
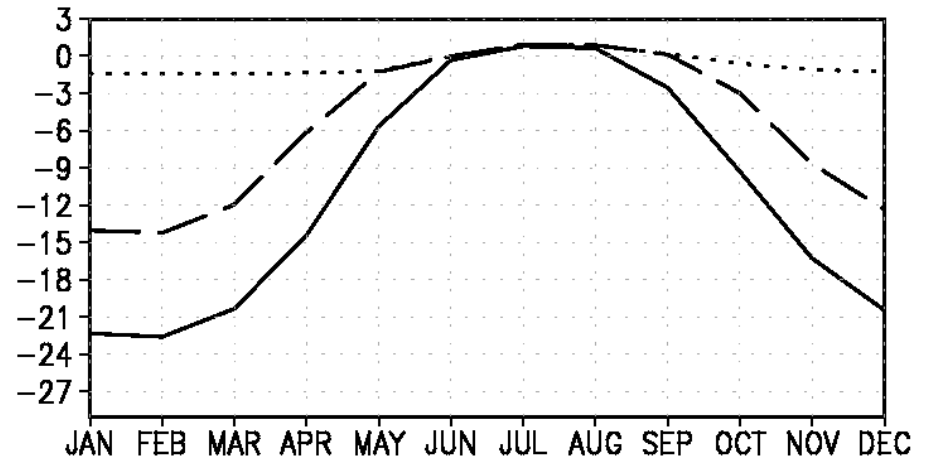
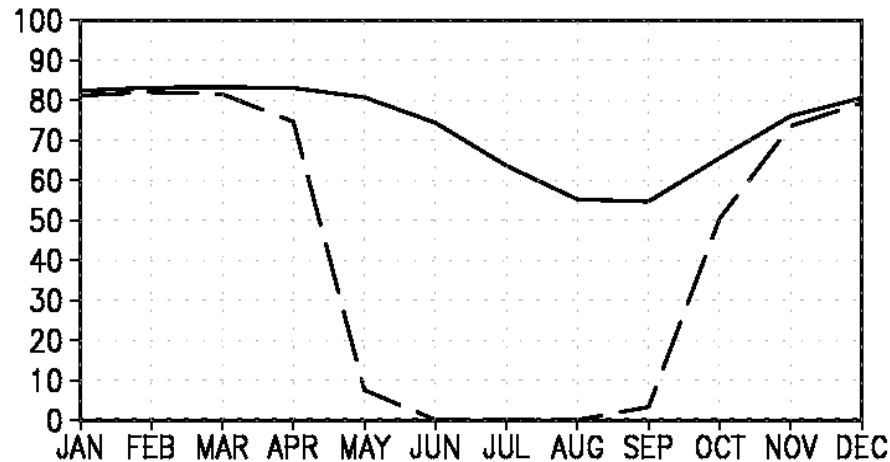
Gekoppelte Experimente: EC-EARTH IFS-NEMO-LIM in T159L62 ORCA1 (Atmosphäre: 125 km horizontal, 62 vertikale Schichten, Ozean 1° horizontal, 42 vertikale Schichten)

1850-2005: Beobachtete Treibhausgas- und Aerosolkonzentrationen

2006-2100: Zwei verschiedene Emissionsszenarien für Treibhausgase und Aerosole: RCP 4.5, RCP 8.5 (Strahlungsantrieb in 2100 verglichen mit 1850: 4.5 und 8.5 W/m²)

Verglichen werden in dieser Studie die Zeiträume 1851-1950 und 2001-2100

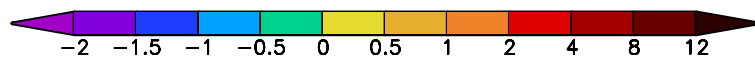
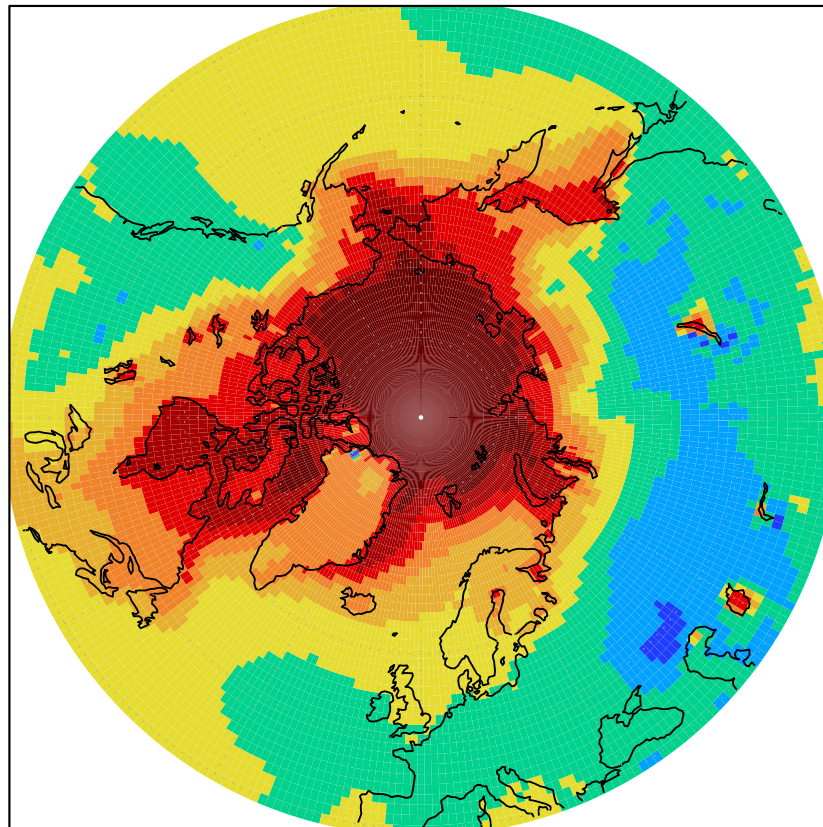
2. Experimente



Meereiskonzentration [%] und SIST/SST [C] als Mittel über Meergitterpunkte nördlich von 70 N. Durchgezogen: REF (oben), hist (unten), gestrichelt: IR (oben), RCP 4.5 (unten), gepunktet: IF (oben), RCP 8.5 (unten).

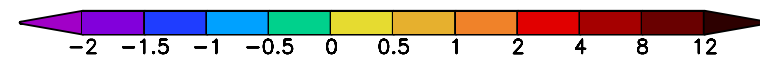
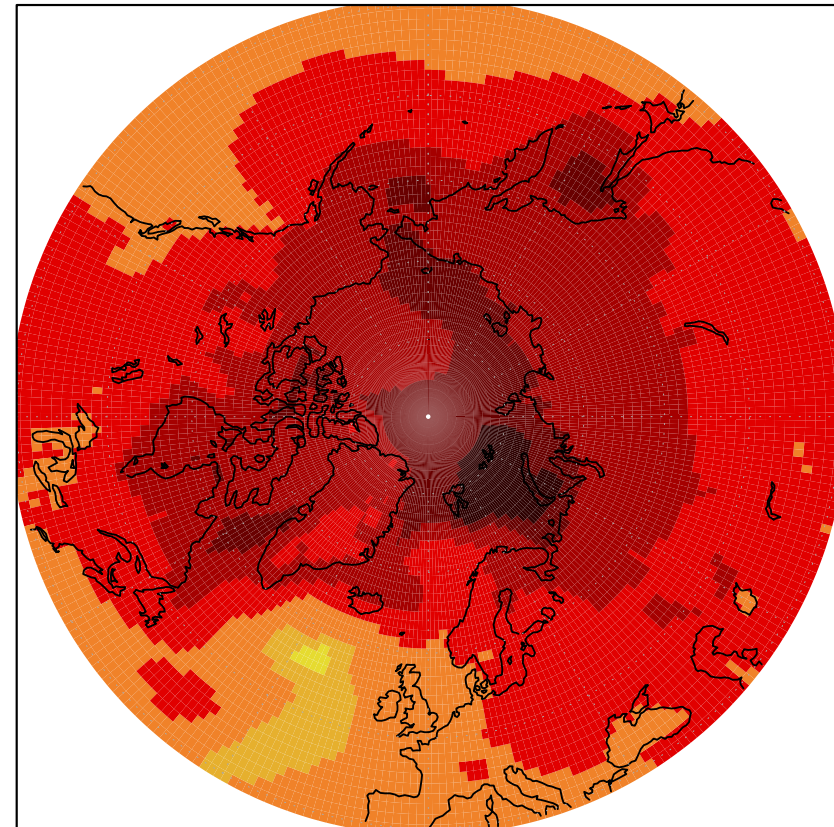
3. Ergebnisse

EC-EARTH-IFS T255L62 icereduced – standard
Change in 2m temperature [C]



DJF 1960–2000

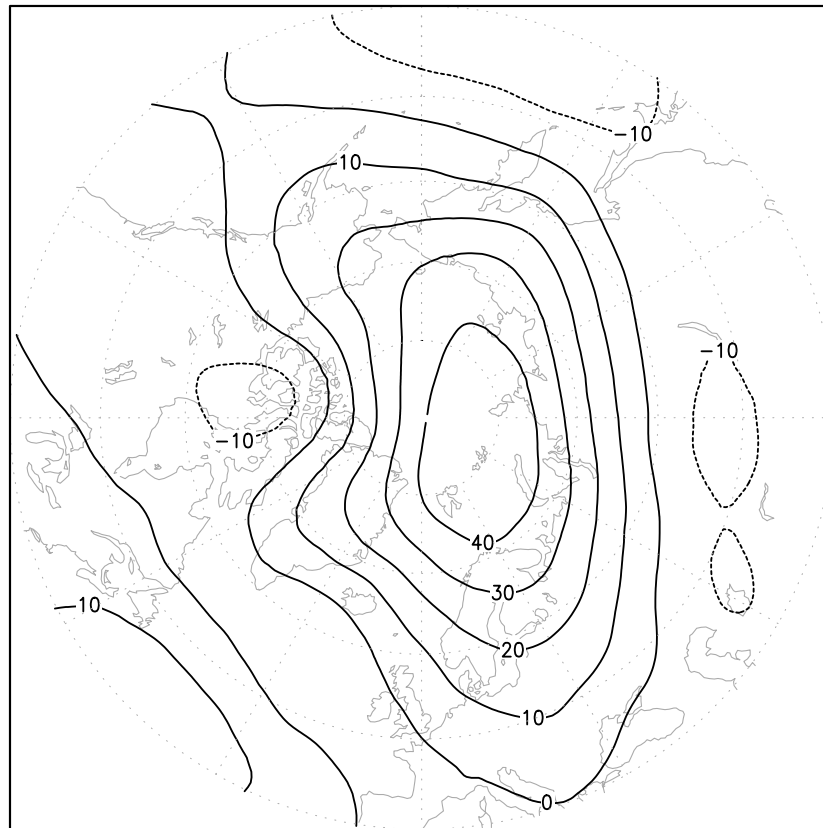
EC-EARTH-IFS T159L62 me41
2m temperature anomaly [C]



DJF 2001–2100 minus 1851–1950

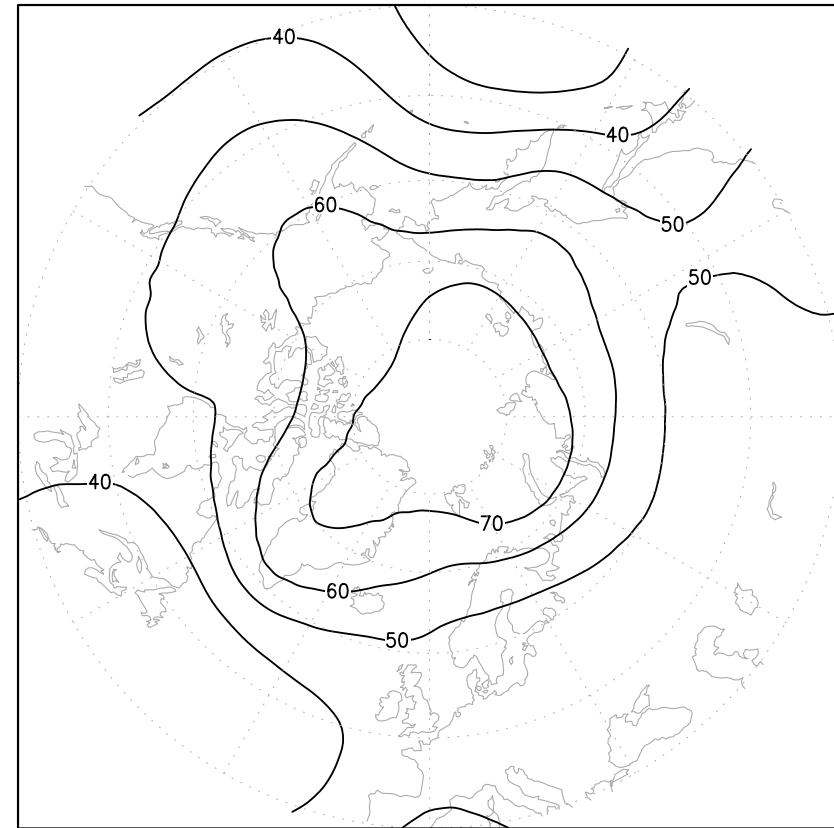
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EC-EARTH-IFS T255L62 icereduced – standard
Change in 500 hPa geopotential [m]



DJF 1960–2000

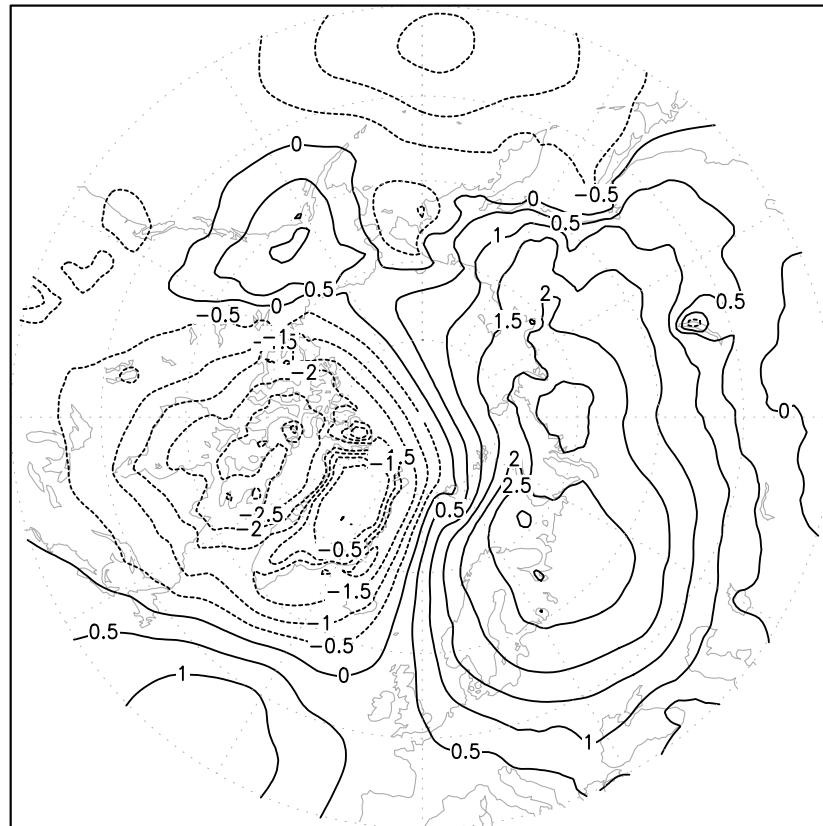
EC-EARTH-IFS T159L62 me41
500 hPa geopotential anomaly [m]



DJF 2001–2100 minus 1851–1950

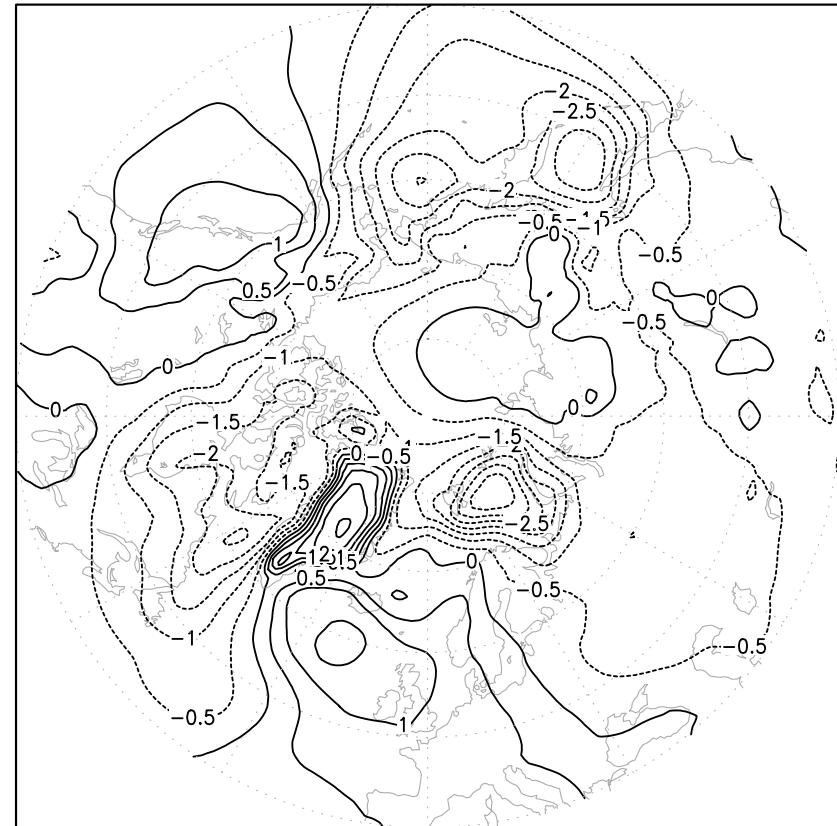
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EC-EARTH-IFS T255L62 icereduced – standard
Change in MSLP [hPa]



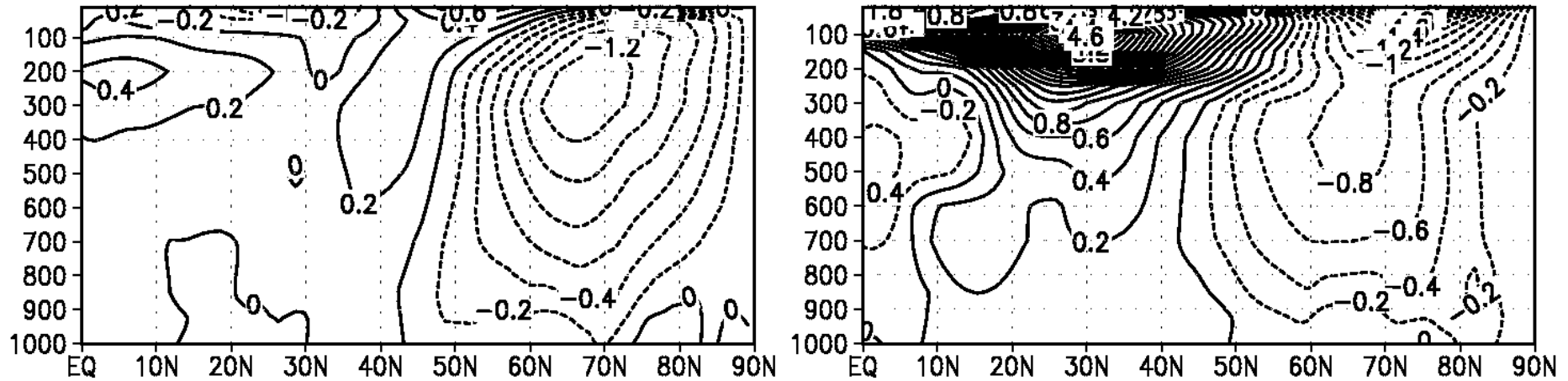
DJF 1960–2000

EC-EARTH-IFS T159L62 me41
MSLP anomaly [hPa]



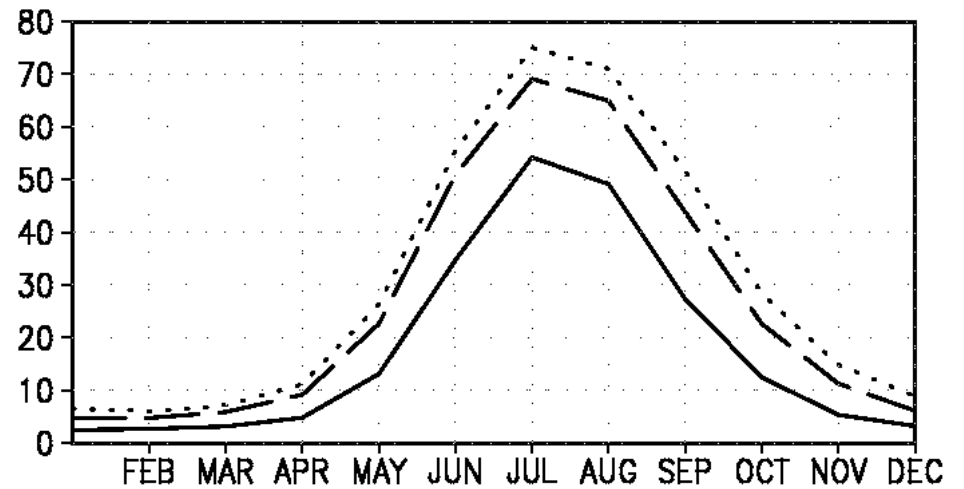
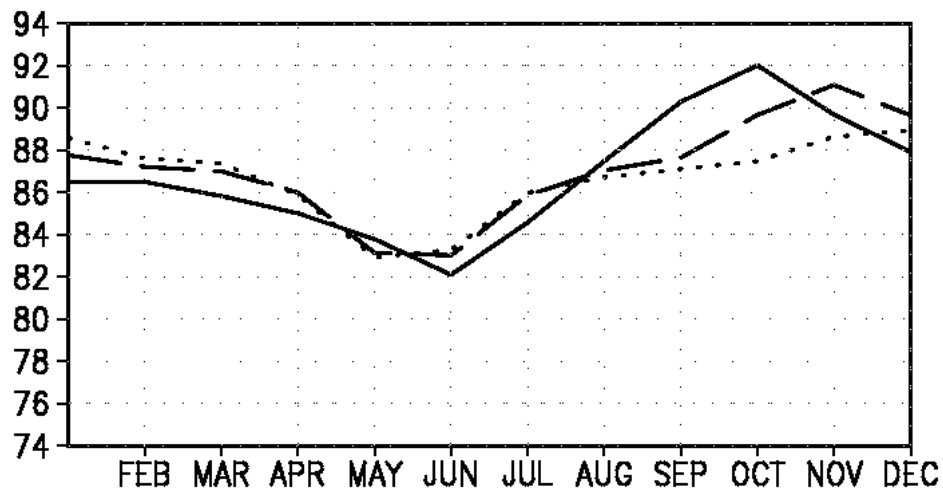
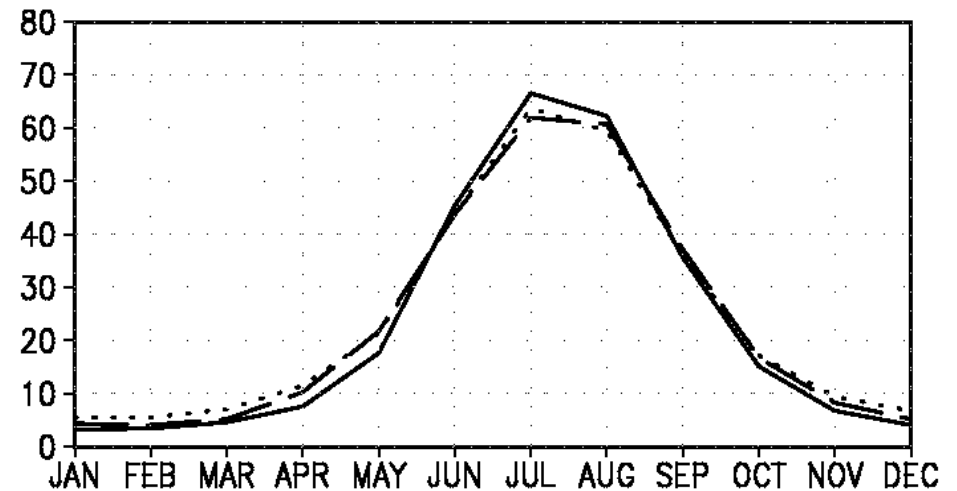
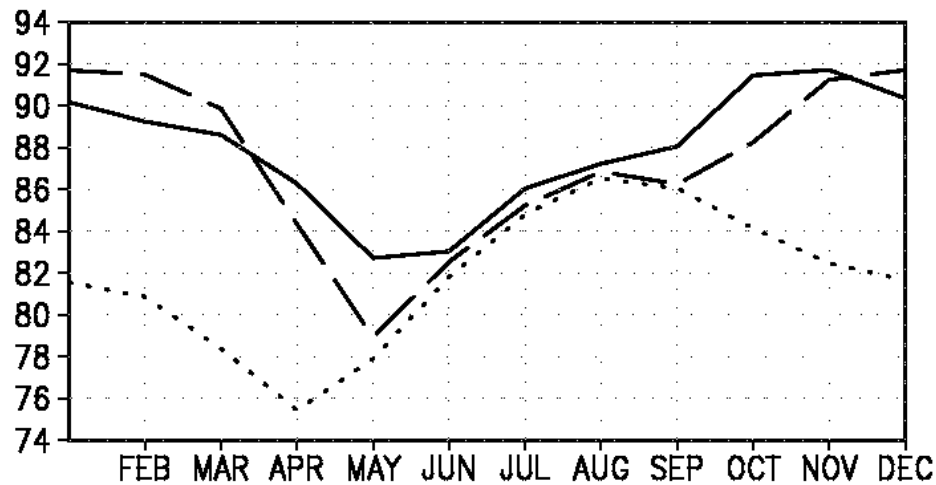
DJF 2001–2100 minus 1851–1950

3. Ergebnisse



Änderung der u-Komponente [m/s] zonal gemittelt (links) in IR verglichen mit REF und (rechts) RCP 4.5 verglichen mit hist.

3. Ergebnisse



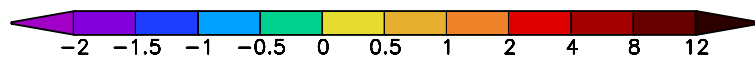
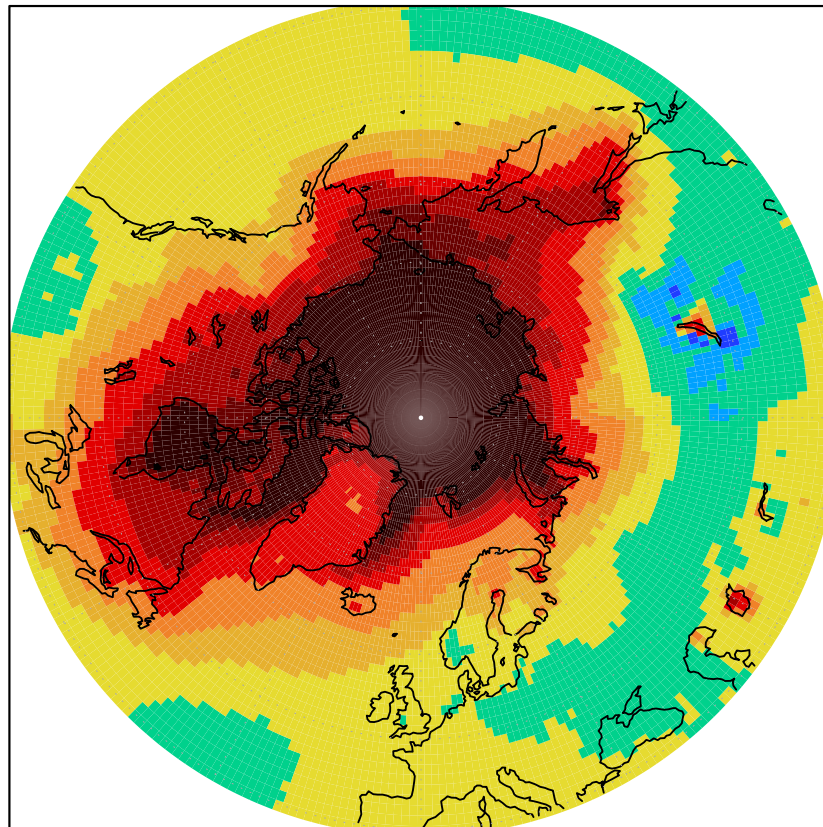
Wolkenbedeckung [%] und vertikal integrierter Flüssigwassergehalt [g/m²] als Mittel über alle Gitterpunkte nördlich von 70 N. Durchgezogen: REF (oben), hist (unten), gestrichelt: IR (oben), RCP 4.5 (unten), gepunktet: IF (oben), RCP 8.5 (unten).

- Übertreibung des Kontrastes der Erwärmung in der Arktis und den mittleren Breiten sowie zwischen Winter- und Sommererwärmung in idealisierten Experimenten → Einfluss auf Klima
- In Sommer und Winter starke Änderung des Energiehaushaltes
- Barokline Anomalien im Winter in der zentralen Arktis in beiden Experimenten. Barotrope Anomalien unterschiedlich.
- Im Sommer schwache Zirkulationsanomalien in idealisierten und gekoppelten Experimenten.
- Generell große Unsicherheit in arktischer Wolkenbedeckung und arktischen Wolkeneigenschaften in Klimasimulationen.
- Einfluss der zukünftigen Entwicklung der arktischen Wolken auf das Abschmelzen des arktischen Meereises

Mehr Ergebnisse in: [Semmler, T., McGrath, R., and Wang, S. \(2012\): The impact of Arctic sea ice on the Arctic energy budget and on the climate of the Northern mid-latitudes. Climate Dynamics \(EC-Earth Special Issue\), DOI 10.1007/s00382-012-1353-9](#)

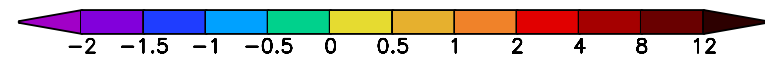
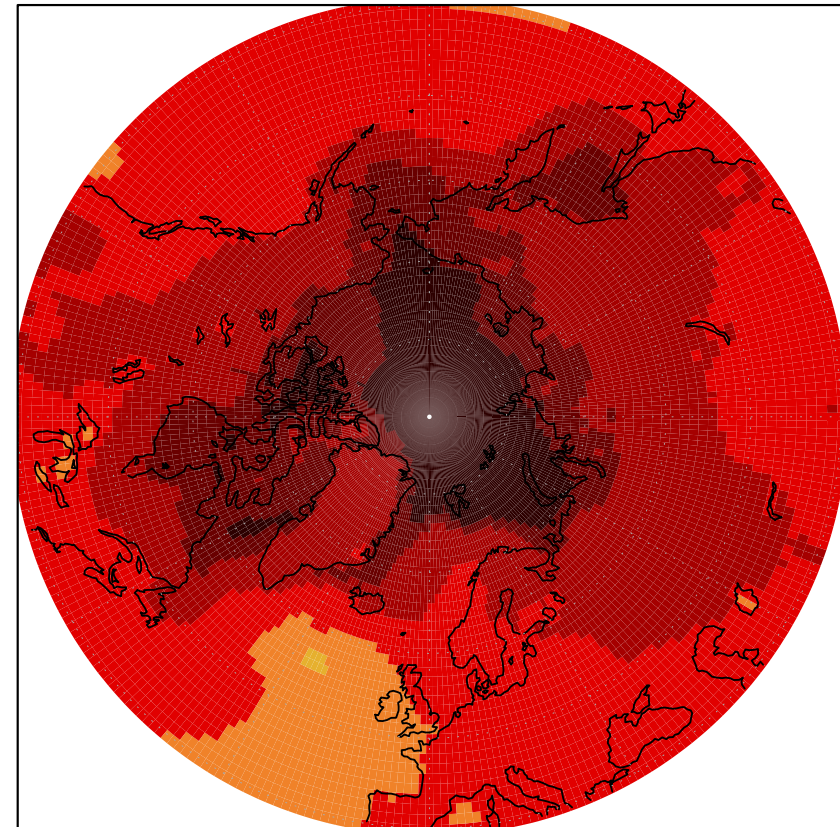
3. Ergebnisse

EC-EARTH-IFS T25L62 icefree – standard
Change in 2m temperature [C]



DJF 1960–2000

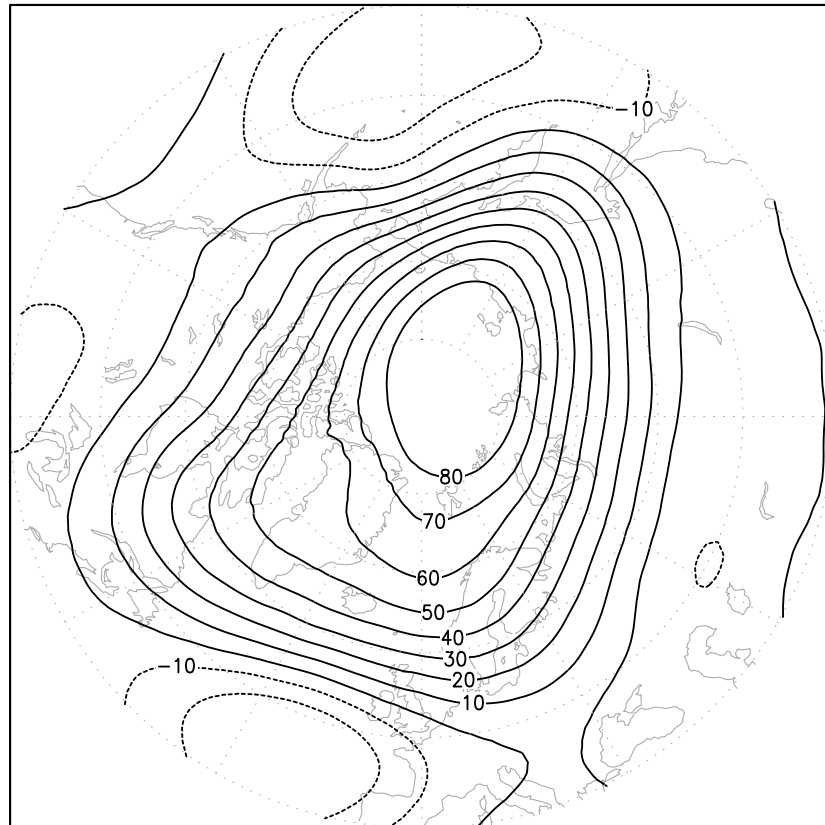
EC-EARTH-IFS T159L62 me81
2m temperature anomaly [C]



DJF 2001–2100 minus 1851–1950

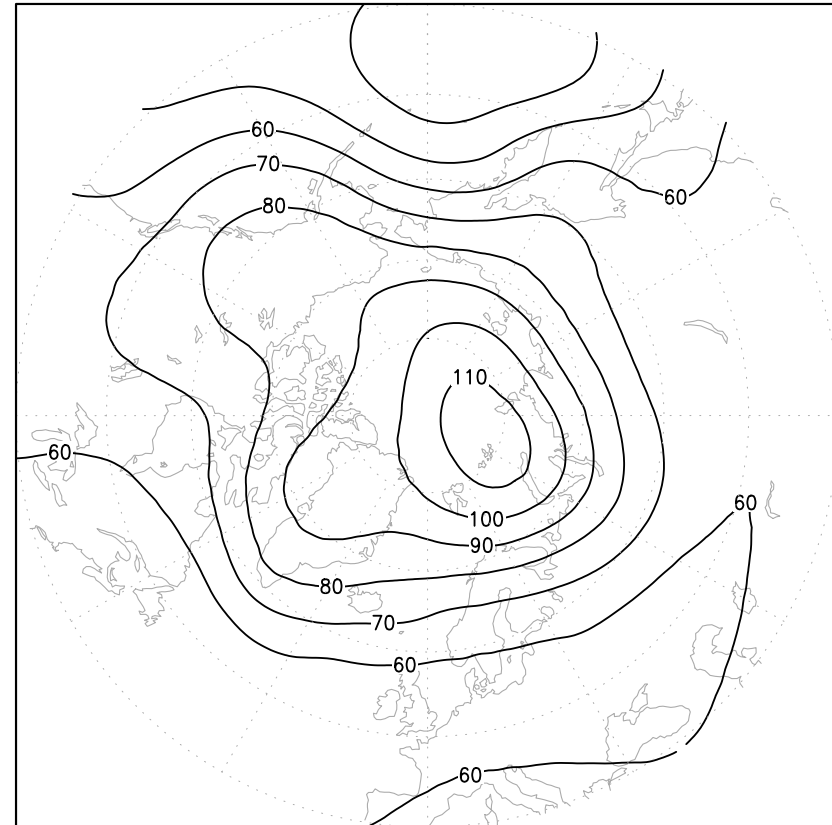
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EC-EARTH-IFS T255L62 icefree – standard
Change in 500 hPa geopotential [m]



DJF 1960–2000

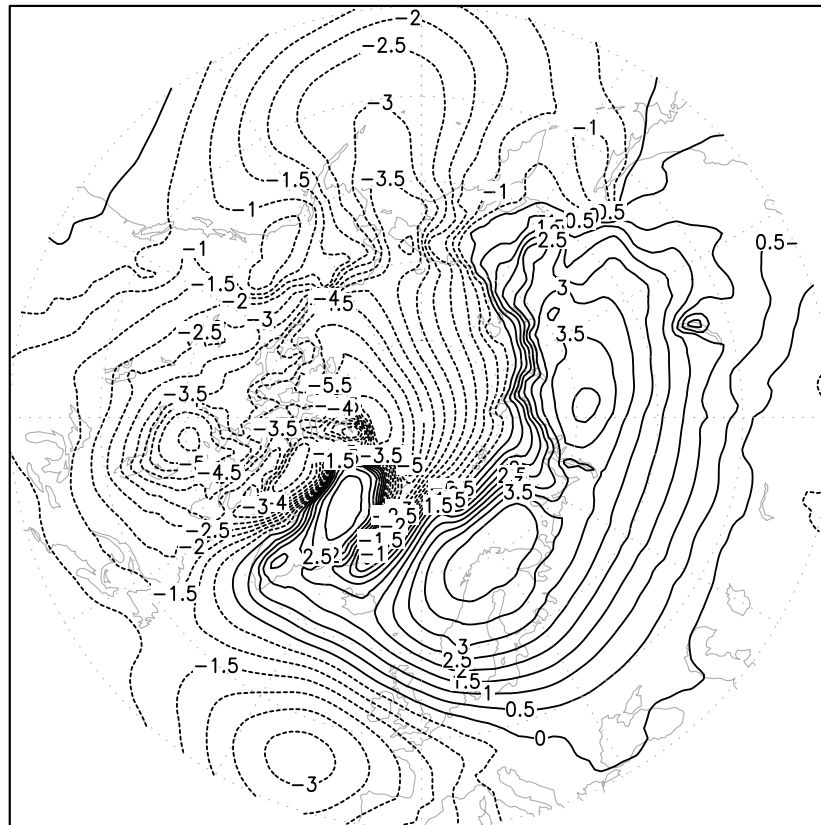
EC-EARTH-IFS T159L62 me81
500 hPa geopotential anomaly [m]



DJF 2001–2100 minus 1851–1950

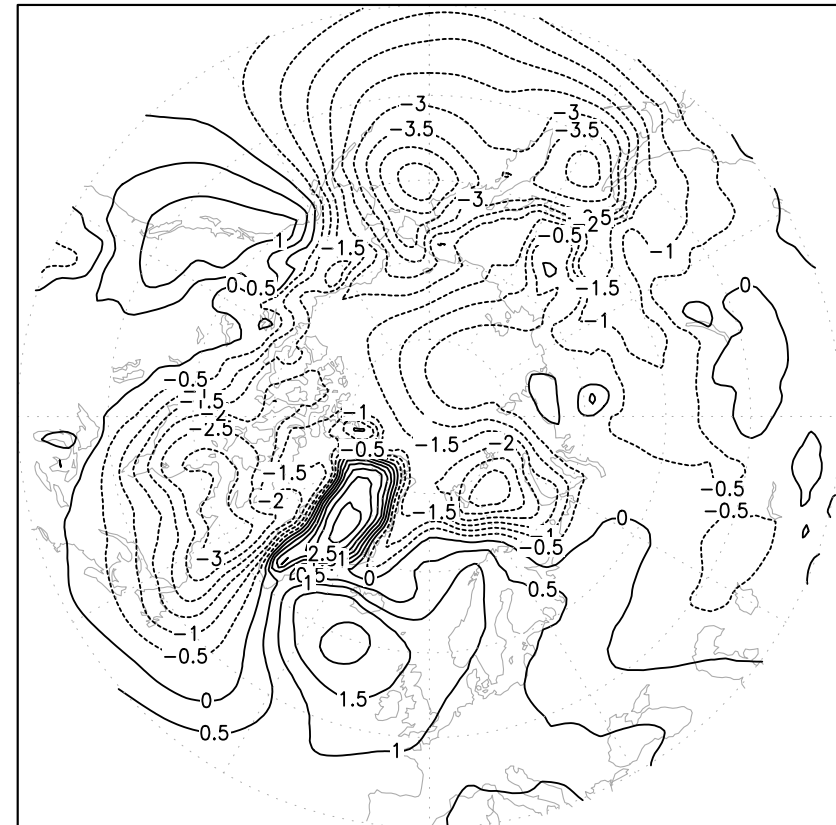
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EC-EARTH-IFS T255L62 icefree – standard
Change in MSLP [hPa]



DJF 1960–2000

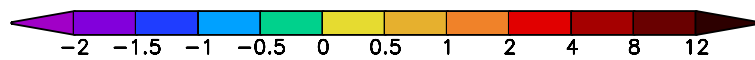
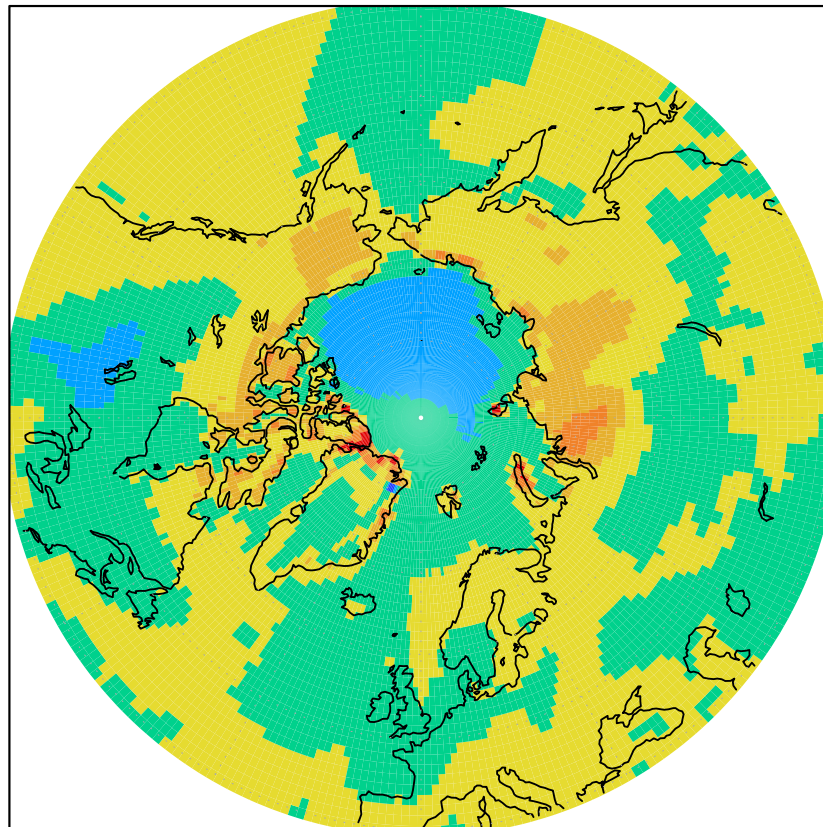
EC-EARTH-IFS T159L62 me81
MSLP anomaly [hPa]



DJF 2001–2100 minus 1851–1950

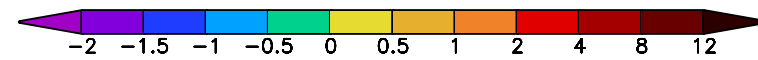
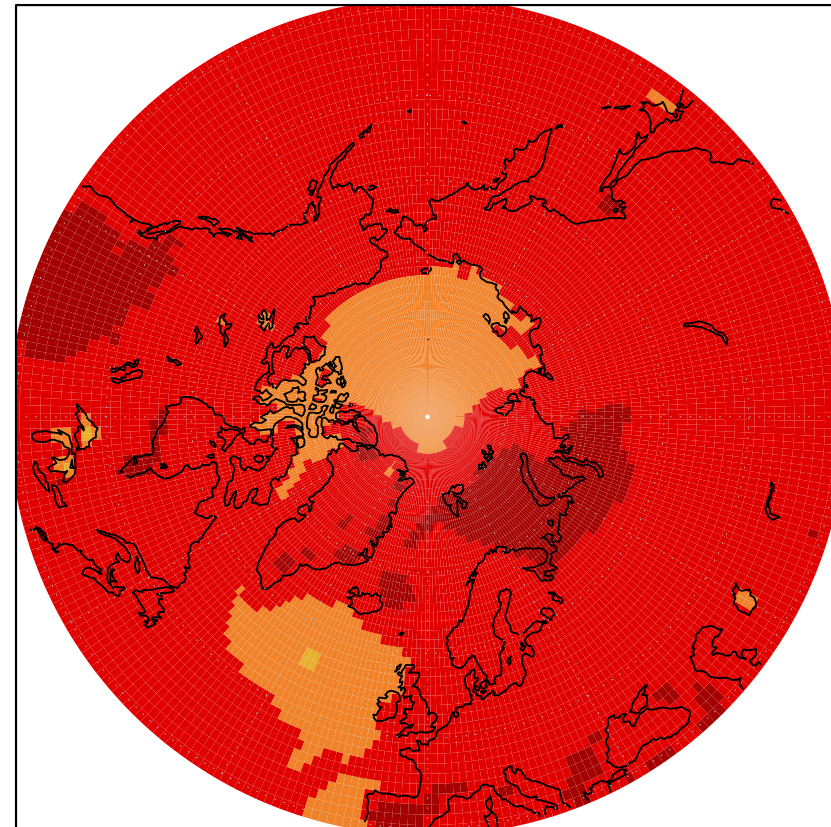
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EC-EARTH-IFS T25L62 icefree – standard
Change in 2m temperature [C]



JJA 1960–2000

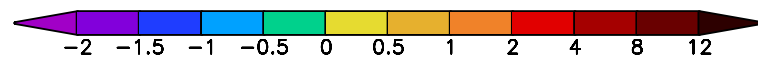
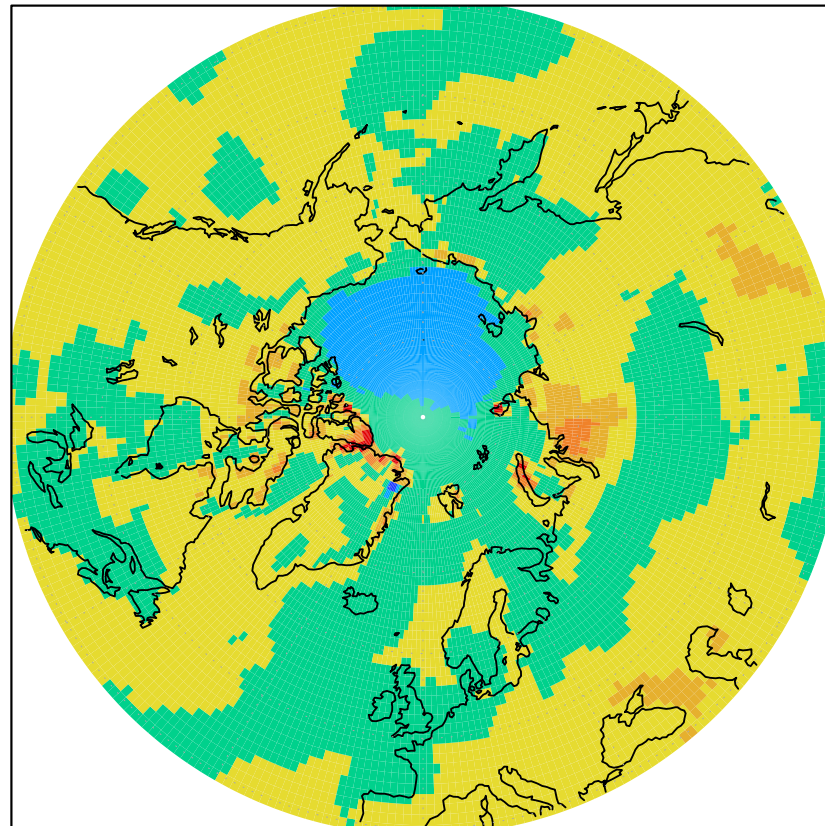
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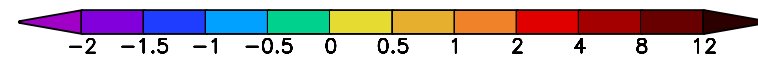
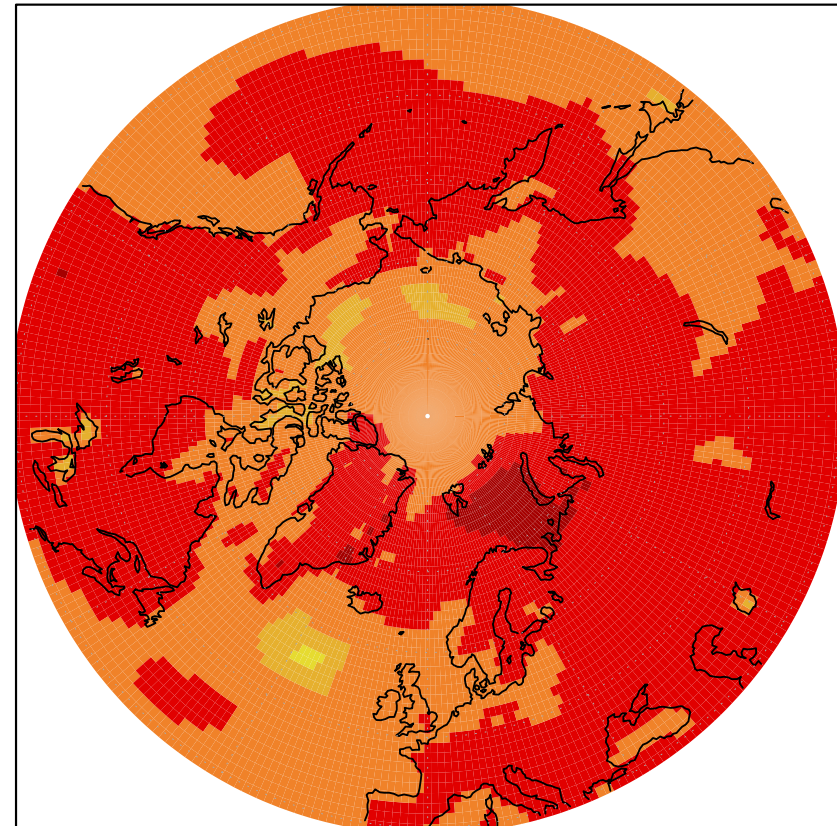
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Change in 2m temperature [C]



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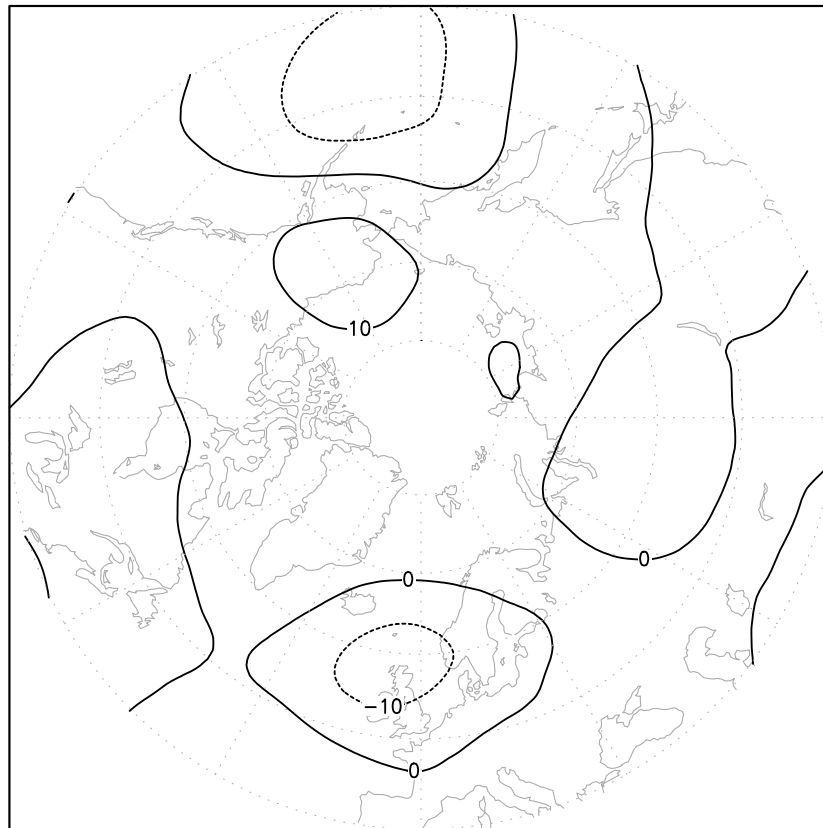
EC-EARTH-IFS T159L62 me41
2m temperature anomaly [C]



JJA 2001–2100 minus 1851–1950

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EC-EARTH-IFS T255L62 icefree – standard
Change in 500 hPa geopotential [m]



JJA 1960–2000

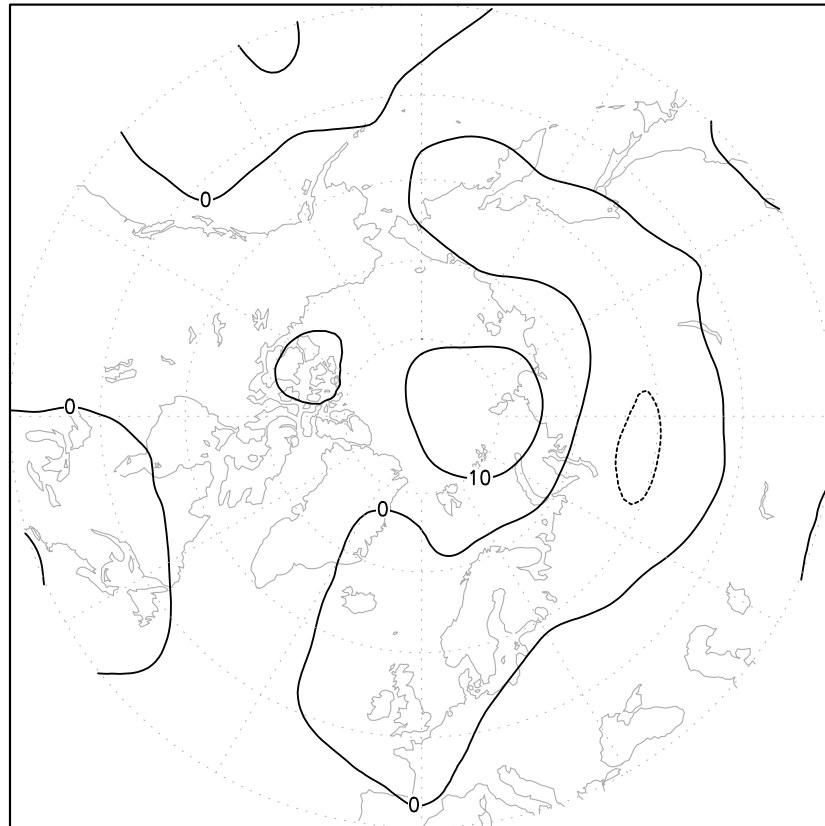
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JJA 2001–2100 minus 1851–1950

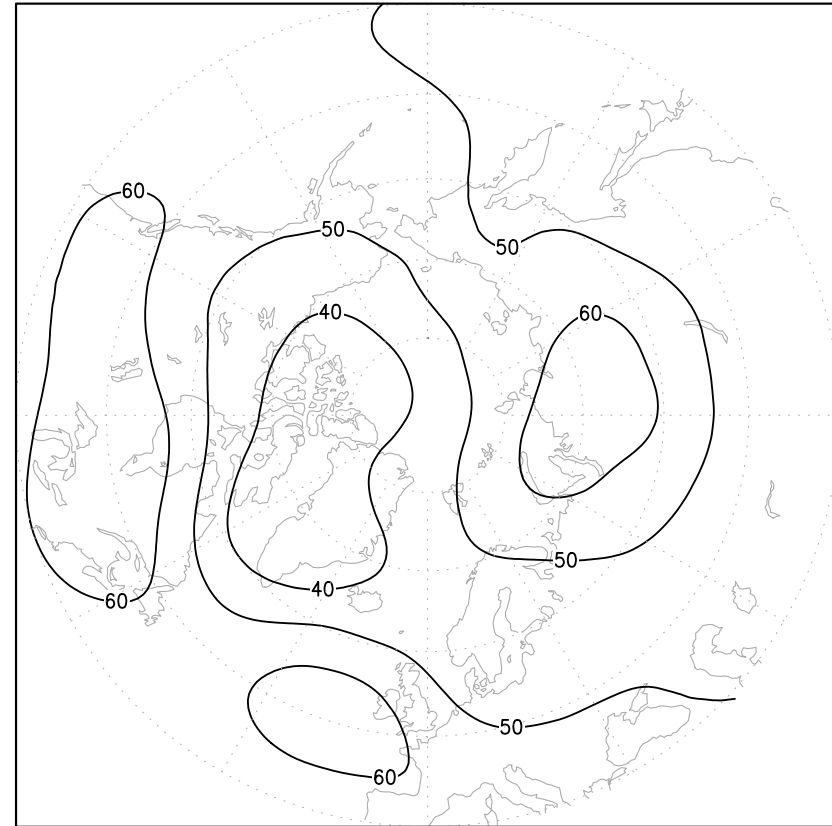
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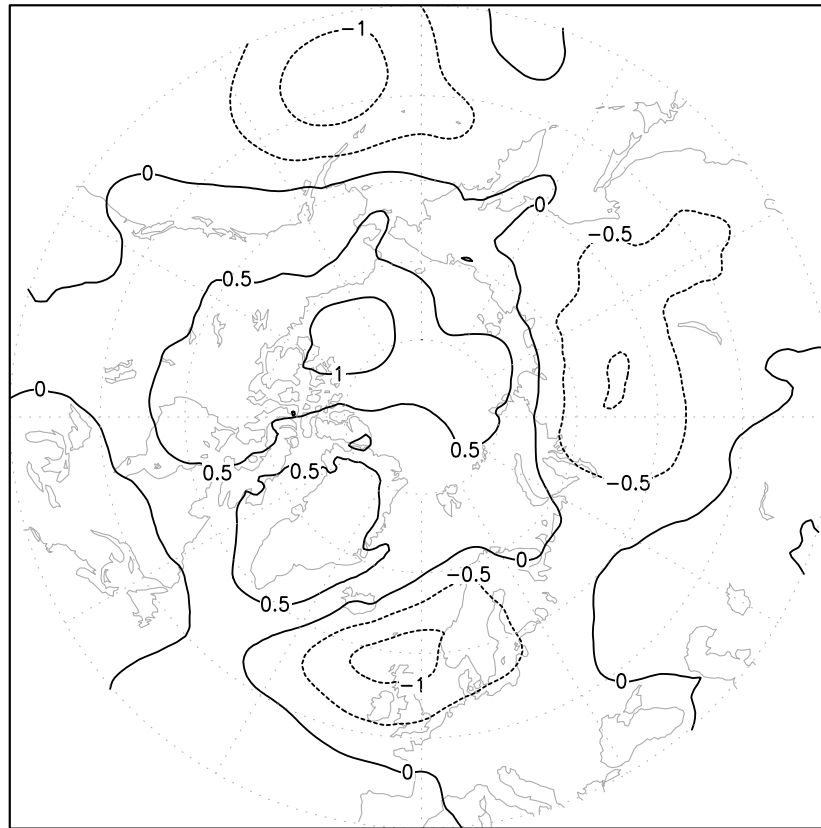
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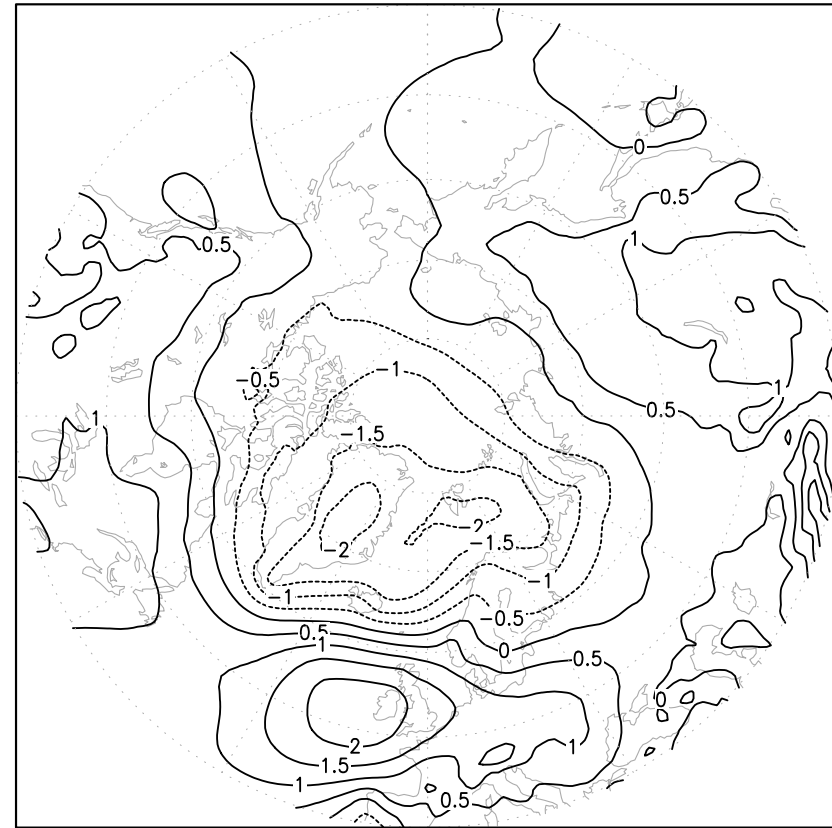
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Change in MSLP [hPa]



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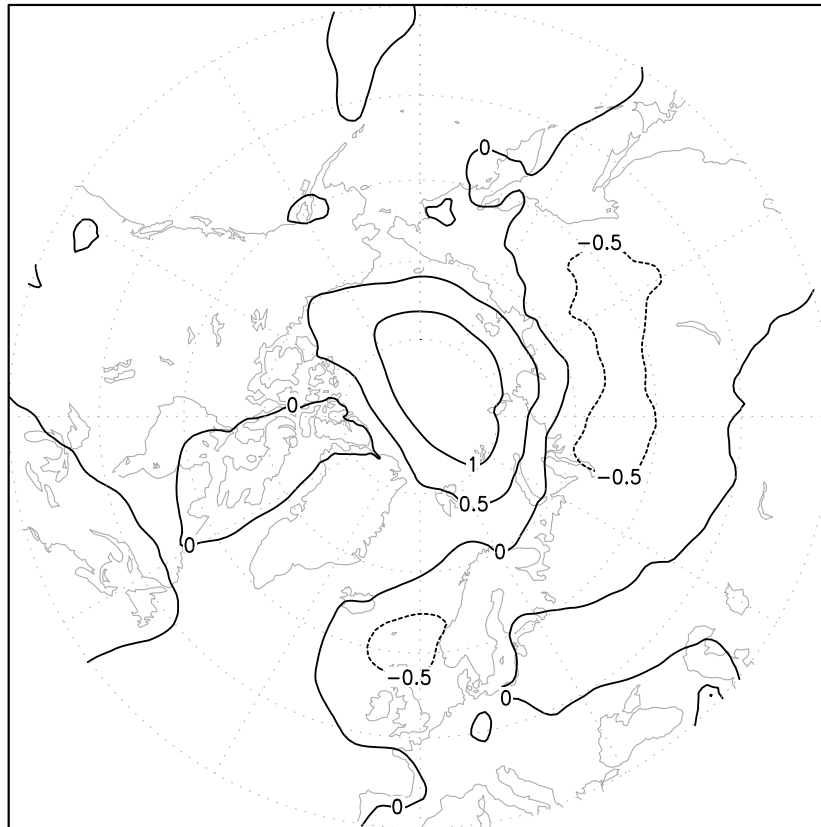
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MSLP anomaly [hPa]



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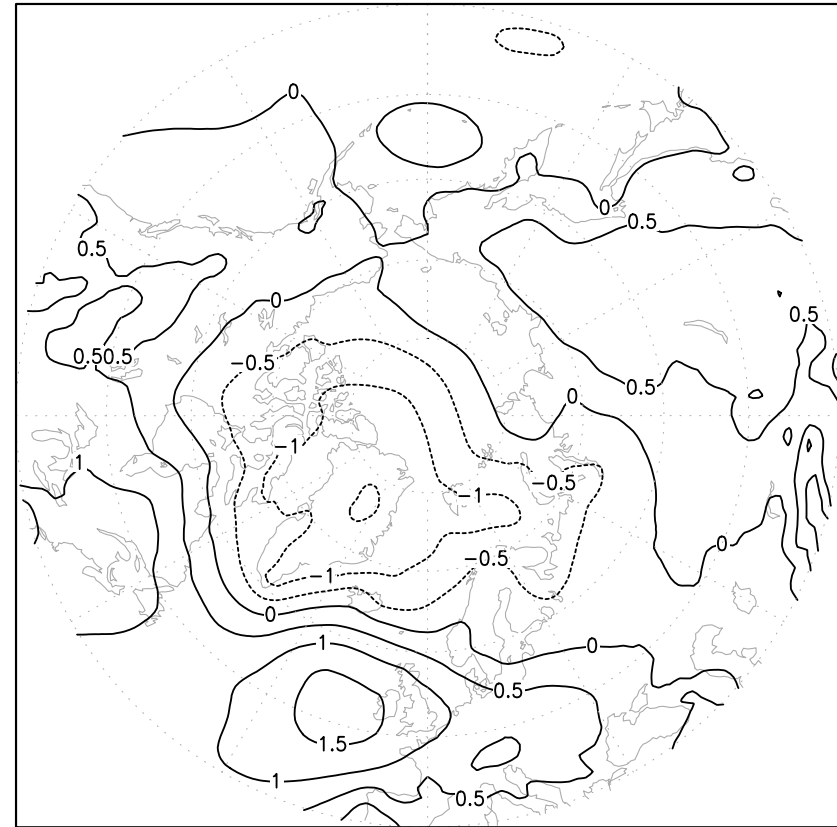
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