

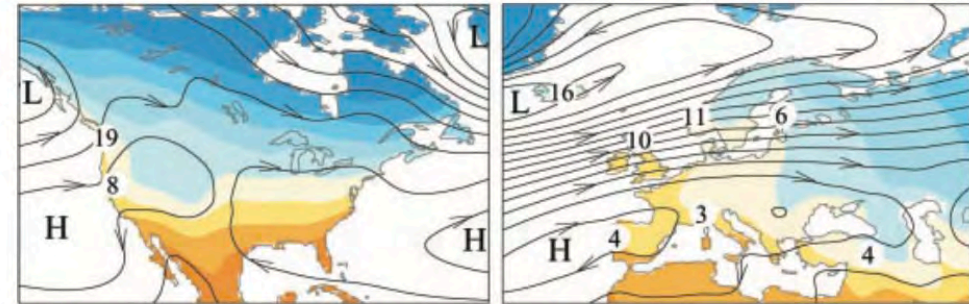
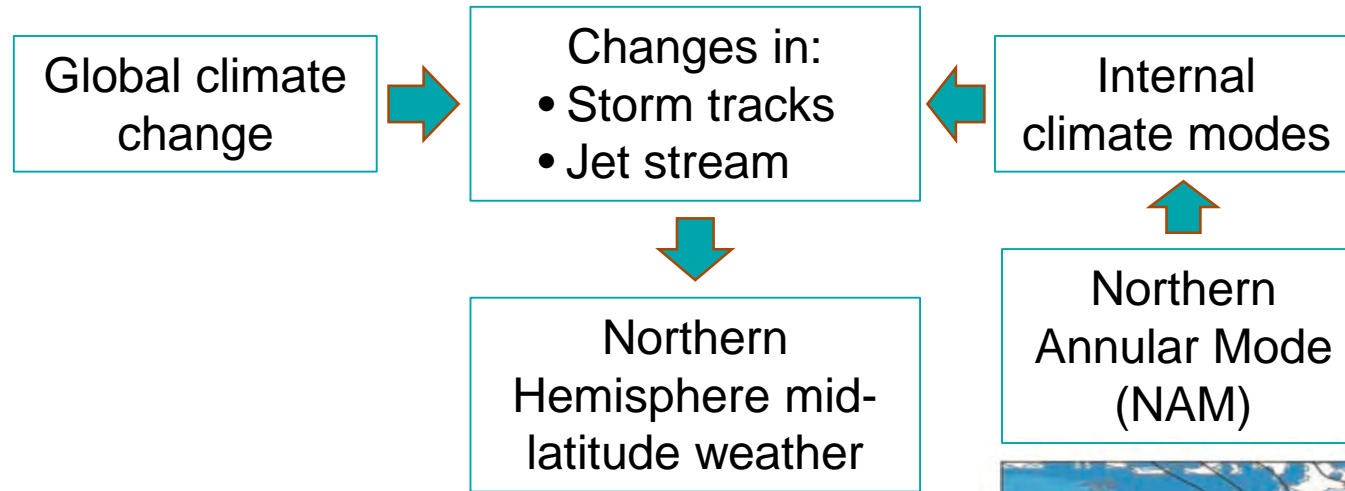
Changes in the North American Temperature Extremes Associated with the Shift in the Northern Annular Mode (NAM)

I Gusti Ayu **Diah** Valentina

Xiaoming Shi, Elizabeth A. Maroon

Primary influences on mid-latitude weather:

Cohen et al., 2014

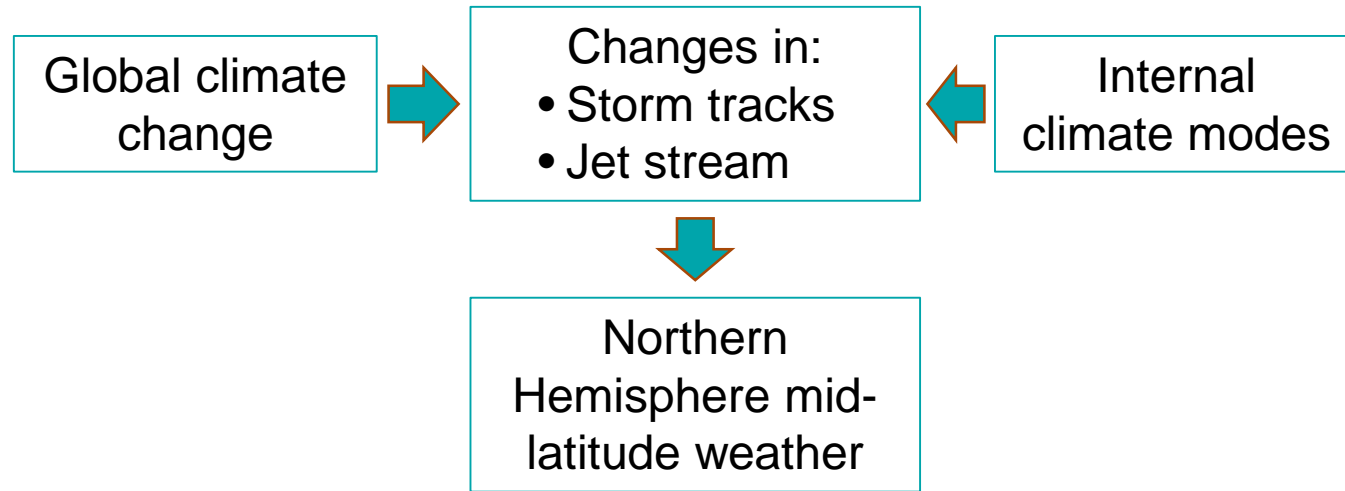


Shading: **surface temperature**
Contour: **sea level pressure**

Thompson & Wallace, 2001

Primary influences on mid-latitude weather:

Cohen et al., 2014



Research Question:

❖ How much is the Northern Annular Mode (NAM) influences the winter NH extreme temperature?

In this study we use:

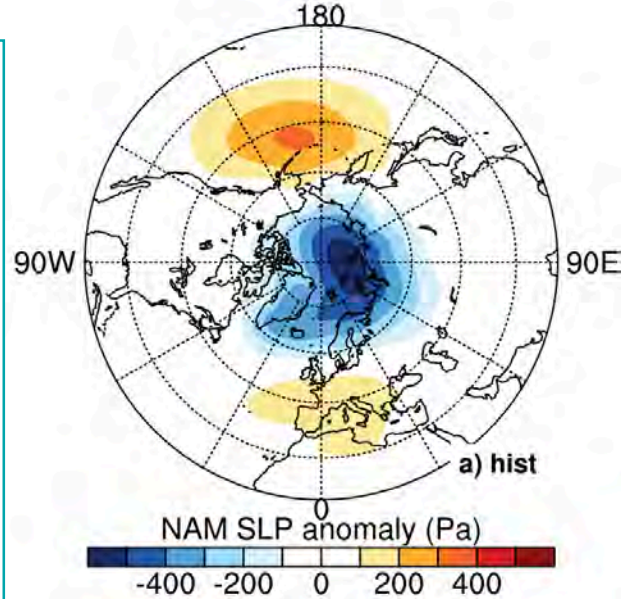
- ❖ 40 ensemble members of CESM1 Large Ensemble (LENS)
to analyse the mean pattern considering the internal climate variability over the Northern Hemisphere

1. NAM pattern in historical and future RCP 8.5 scenario

2

Notes:

1. Winter season (JFM)
2. Daily NAM index from monthly EOF1 SLP anomaly
3. ± 1 std daily NAM index to define NAM phases

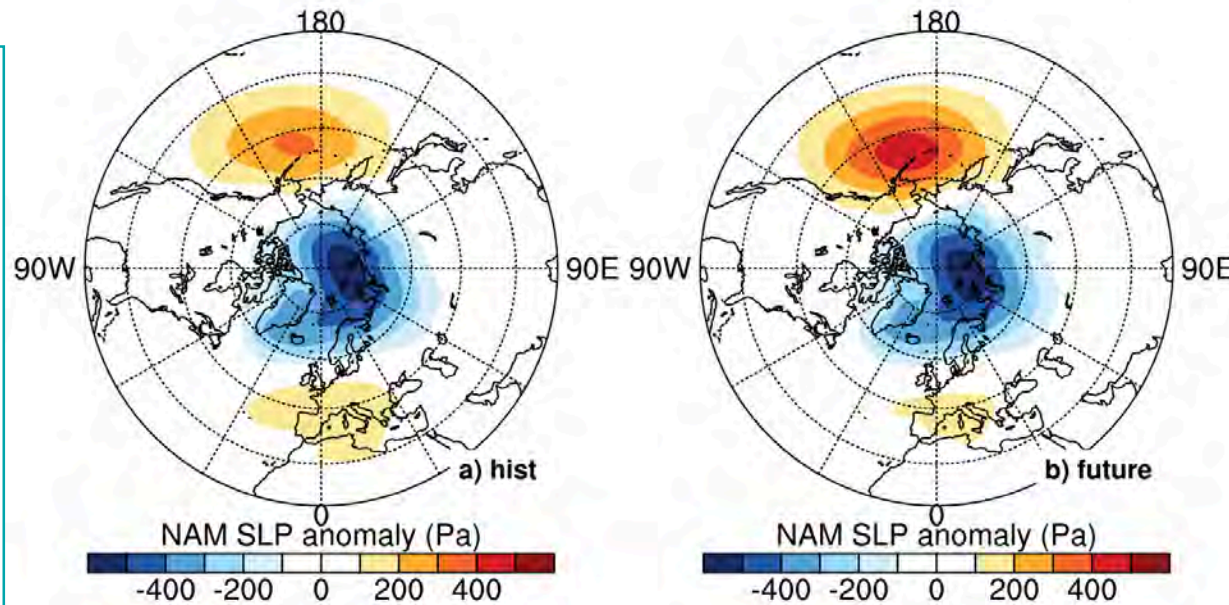


1. NAM pattern in historical and future RCP 8.5 scenario

2

Notes:

1. Winter season (JFM)
2. Daily NAM index from monthly EOF1 SLP anomaly
3. ± 1 std daily NAM index to define NAM phases



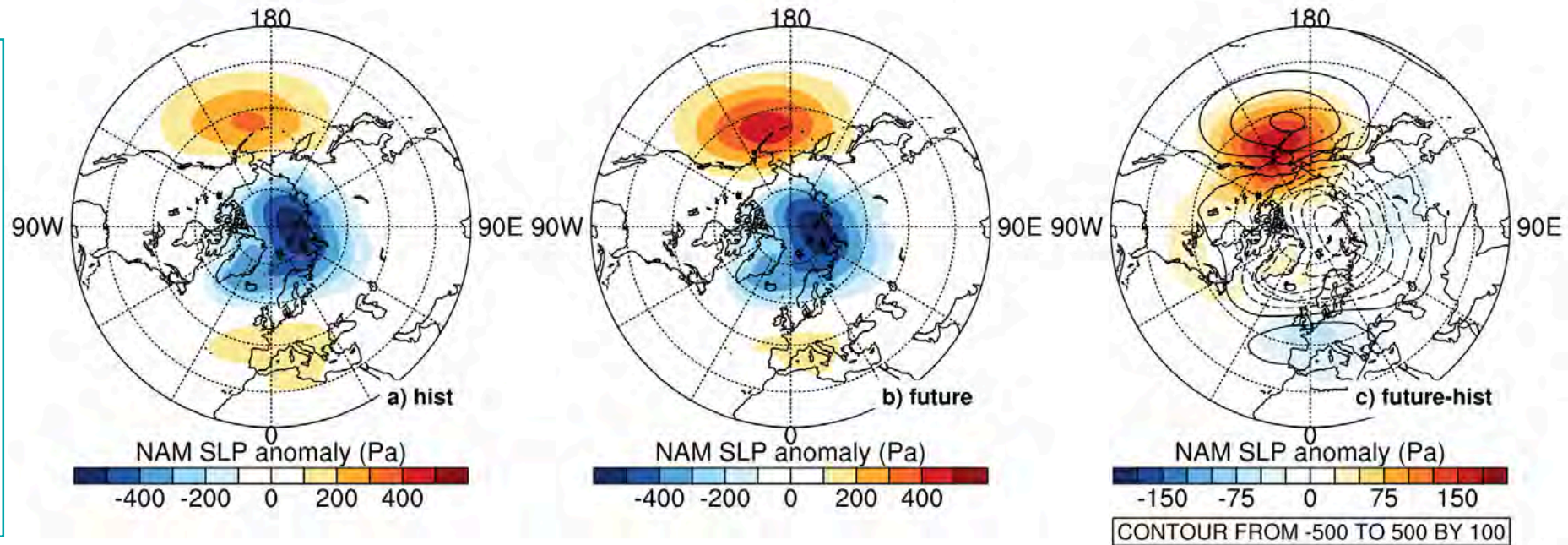
- ❖ **Positive NAM phase** dipole pattern
- ❖ Stronger Pacific center + poleward/northeastward shift
- ❖ Weakened Atlantic center

1. NAM pattern in historical and future RCP 8.5 scenario

2

Notes:

1. Winter season (JFM)
2. Daily NAM index from monthly EOF1 SLP anomaly
3. ± 1 std daily NAM index to define NAM phases

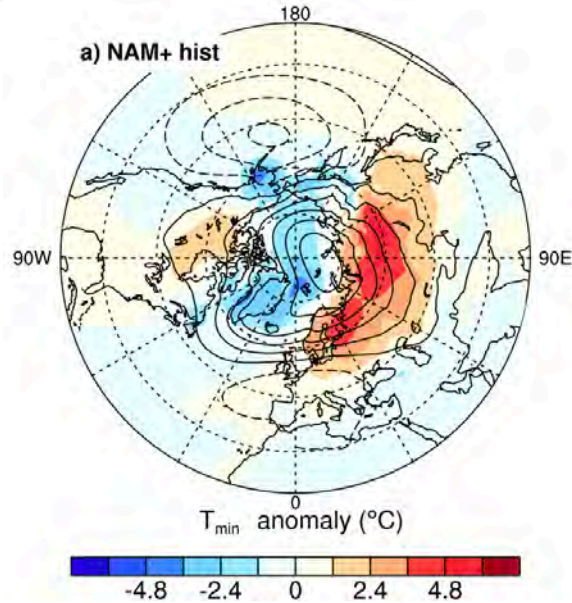


- ❖ **Positive NAM phase** dipole pattern
- ❖ Stronger Pacific center + poleward/northeastward shift
- ❖ Weakened Atlantic center
- ❖ 15 CMIP6 model mean also indicates a stronger Pacific center and poleward shift of the NAM pattern

2. NAM Teleconnection in a Warming Climate

**Extreme
Temperature
(T_{\min})
Composite**

**Contours:
NAM**



Historical (1951-2000)

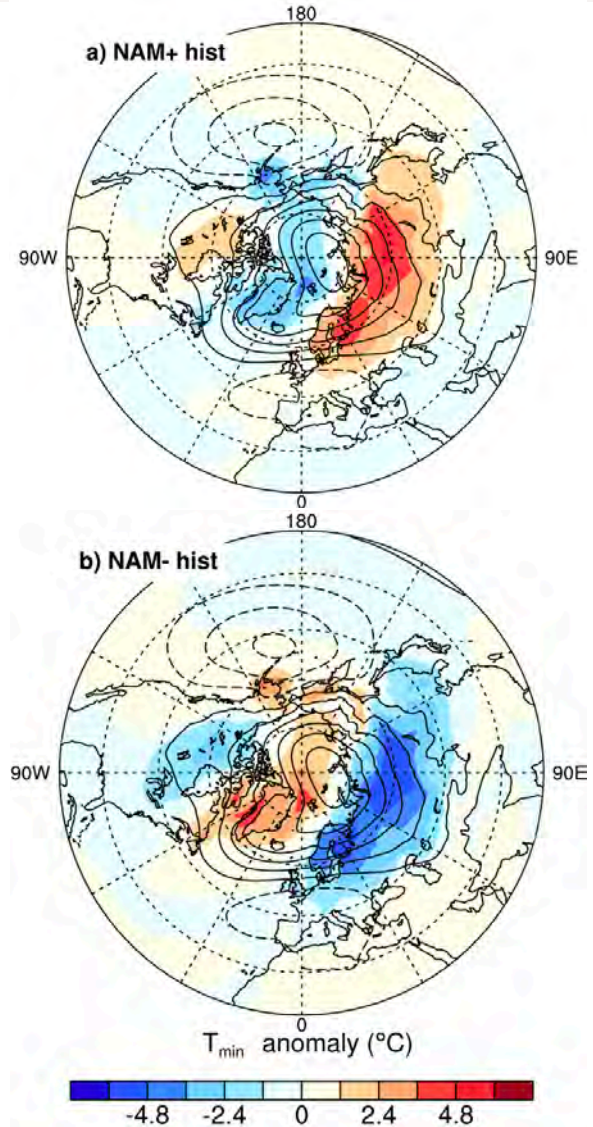
NAM⁺

- ❖ Stronger westerlies
- ❖ Central Northern America
→ Anomalous warm
- ❖ Western Northern America
→ colder

2. NAM Teleconnection in a Warming Climate

Extreme
Temperature
(T_{\min})
Composite

Contours:
NAM



Historical (1951-2000)

NAM⁺

- ❖ Stronger westerlies
- ❖ Central Northern America
→ Anomalous warm
- ❖ Western Northern America
→ colder

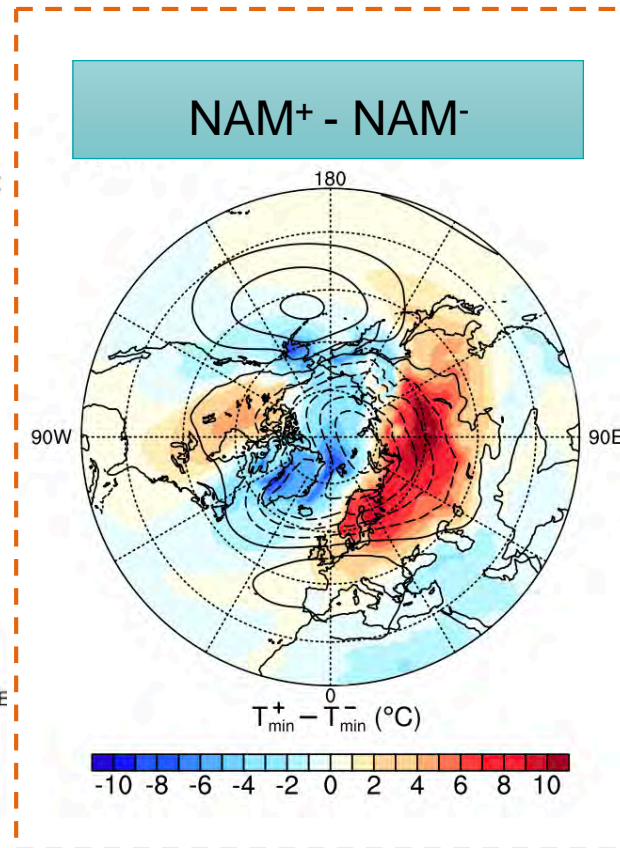
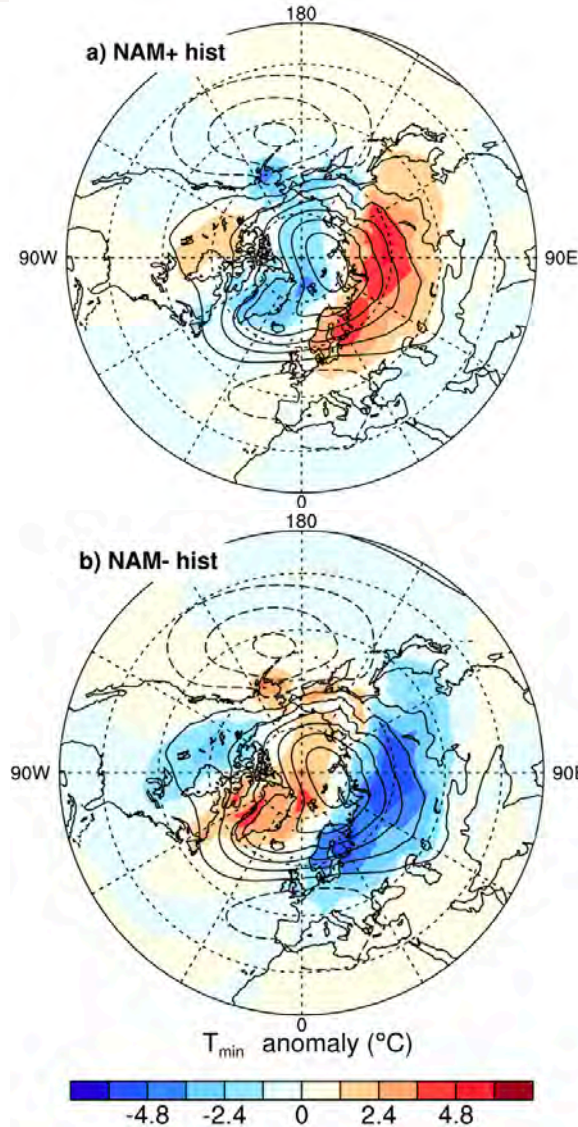
NAM⁻

- ❖ Anomalous easterly
- ❖ Central Northern America
→ Anomalous cold
- ❖ Western Northern America
→ warmer

2. NAM Teleconnection in a Warming Climate

Extreme
Temperature
(T_{\min})
Composite

Contours:
NAM



Historical (1951-2000)

NAM+

- ❖ Stronger westerlies
- ❖ Central Northern America
→ Anomalous warm
- ❖ Western Northern America
→ colder

NAM-

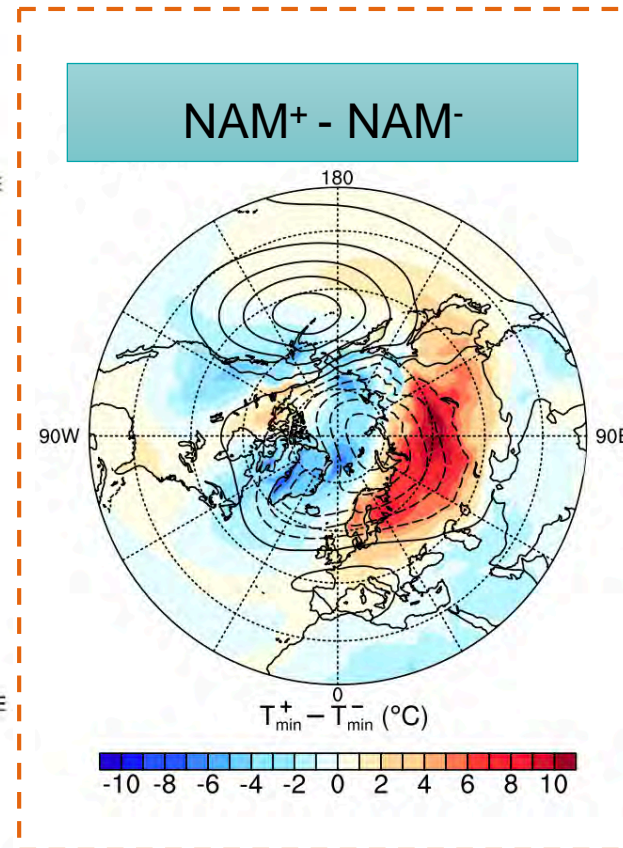
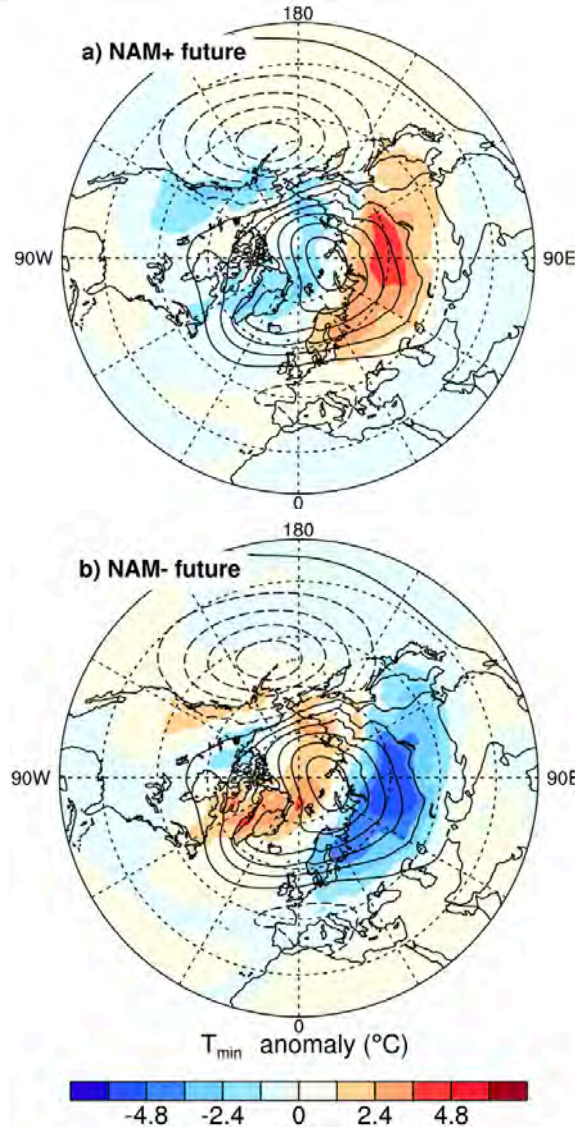
- ❖ Anomalous easterly
- ❖ Central Northern America
→ Anomalous cold
- ❖ Western Northern America
→ warmer

2. NAM Teleconnection in a Warming Climate

4

Extreme
Temperature
(T_{\min})
Composite

Contours:
NAM



How to analyse the change in T_{\min}
response given the change in NAM
phase?

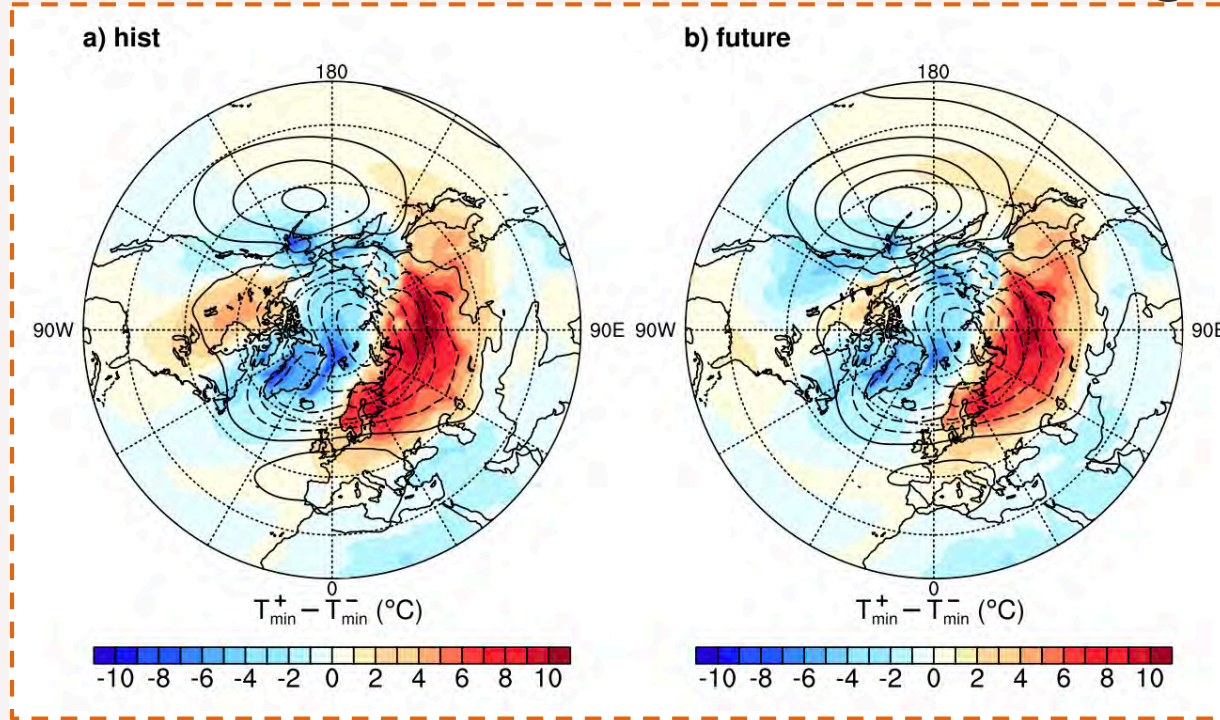
Difference between **dashed box**

2. NAM Teleconnection in a Warming Climate

5

T_{\min}
Composite
Difference
Between
Phases

Contours:
NAM

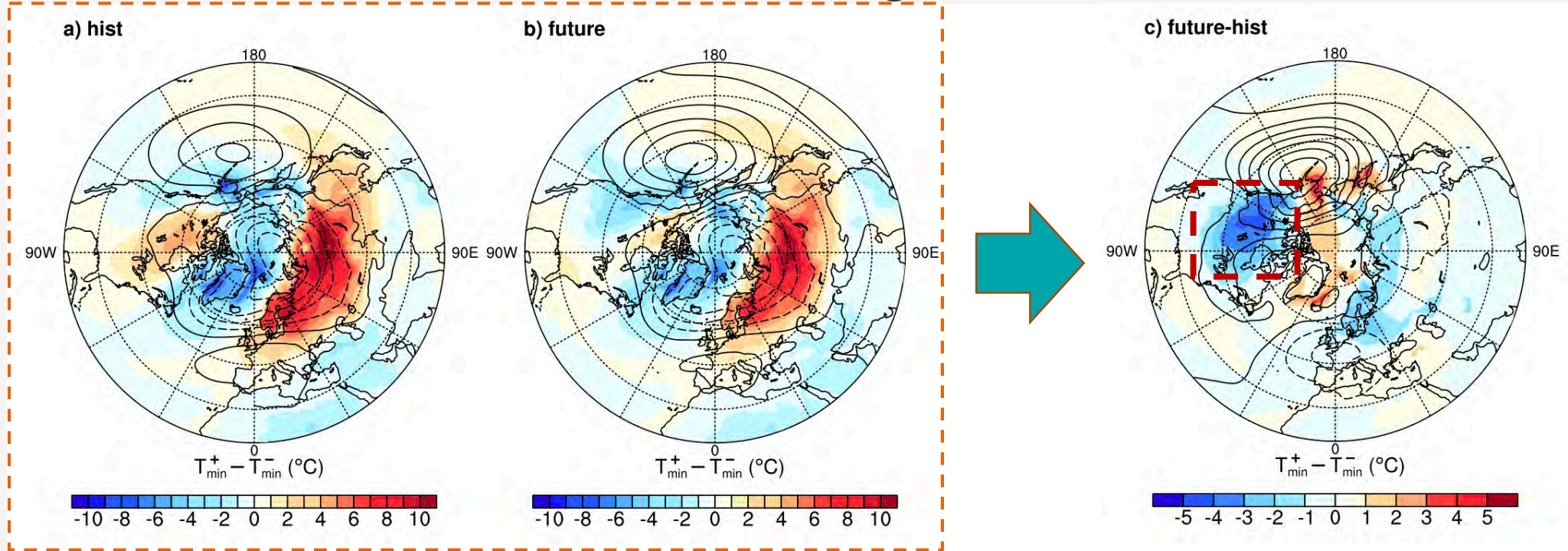


2. NAM Teleconnection in a Warming Climate

5

T_{\min}
Composite
Difference
Between
Phases

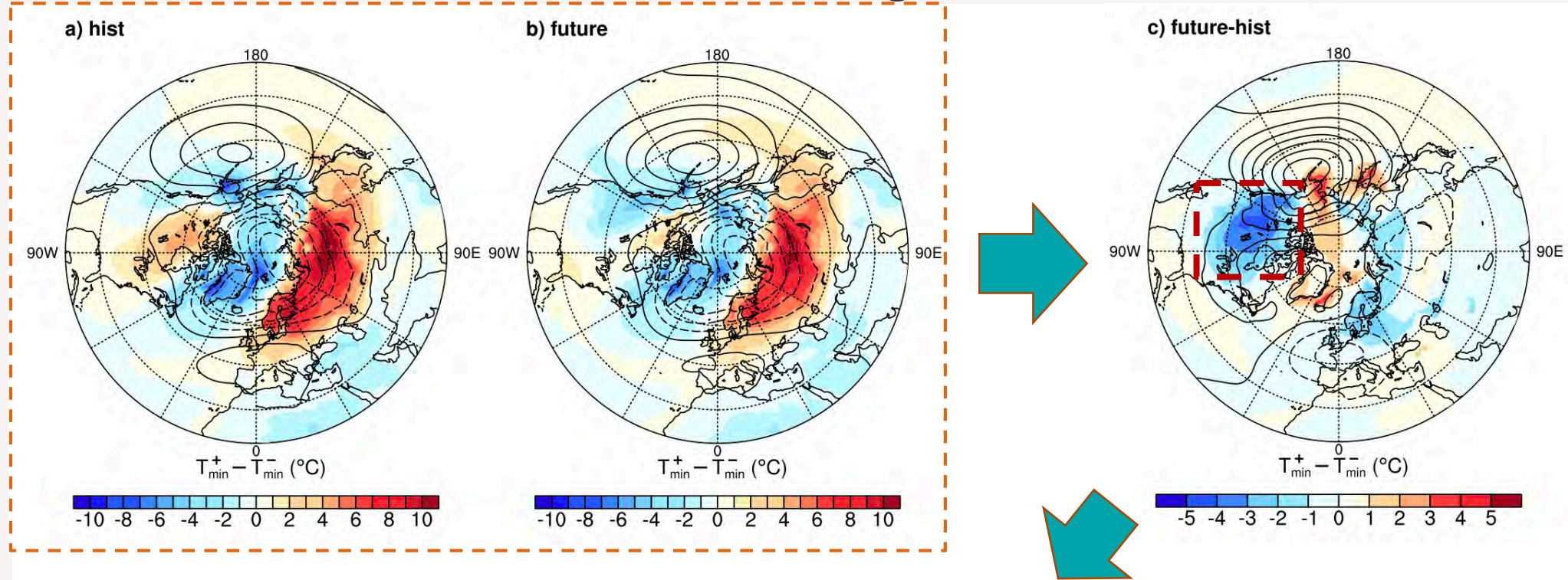
Contours:
NAM



2. NAM Teleconnection in a Warming Climate

T_{\min}
Composite
Difference
Between
Phases

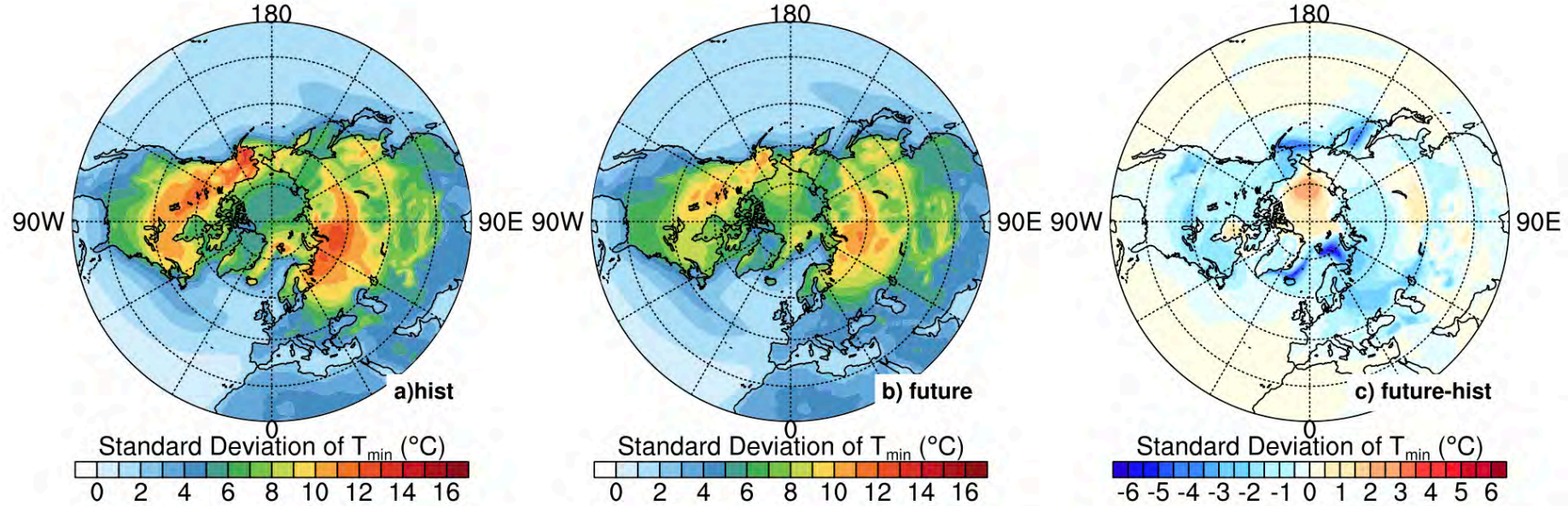
Contours:
NAM



- ❖ Western Northern America → colder in NAM⁺ & **intensified** in the future
- ❖ Central Northern America → colder in NAM⁻ & **weakened** in the future
- ❖ **Temperature advection** with a poleward/northeastward shift of Pacific center
- ❖ Similar result for 15 CMIP6 model mean analysis

2. NAM Teleconnection in a Warming Climate

T_{\min}
Standard
Deviation



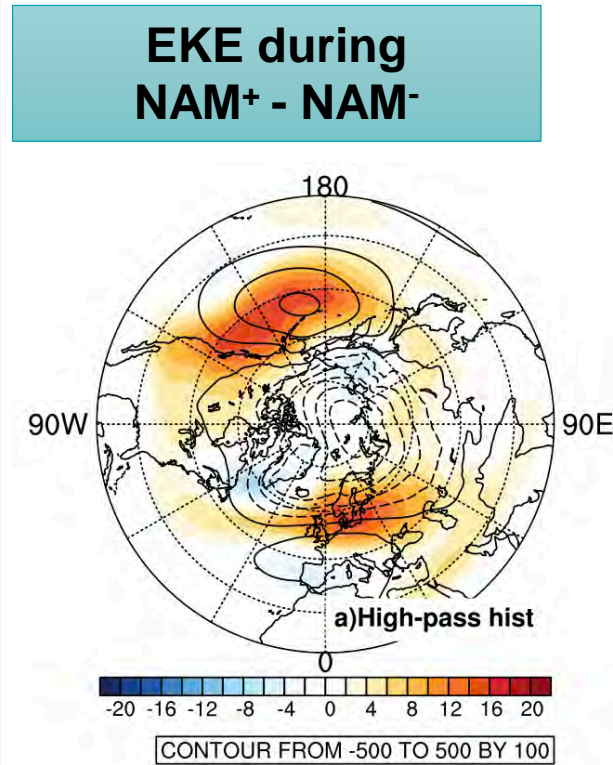
- ❖ Varies more over the mid-latitude (40°-70°N) regions.
- ❖ Overall **weakened** in the future, except for the polar region.
- ❖ **NAM possibly contributes** to the T_{\min} weakening in the future, especially for the central North American continent

3. Changes of the Pacific storm track in relation to NAM

7

Eddy
Kinetic
Energy
Composite
(500hPa)

Contours:
NAM



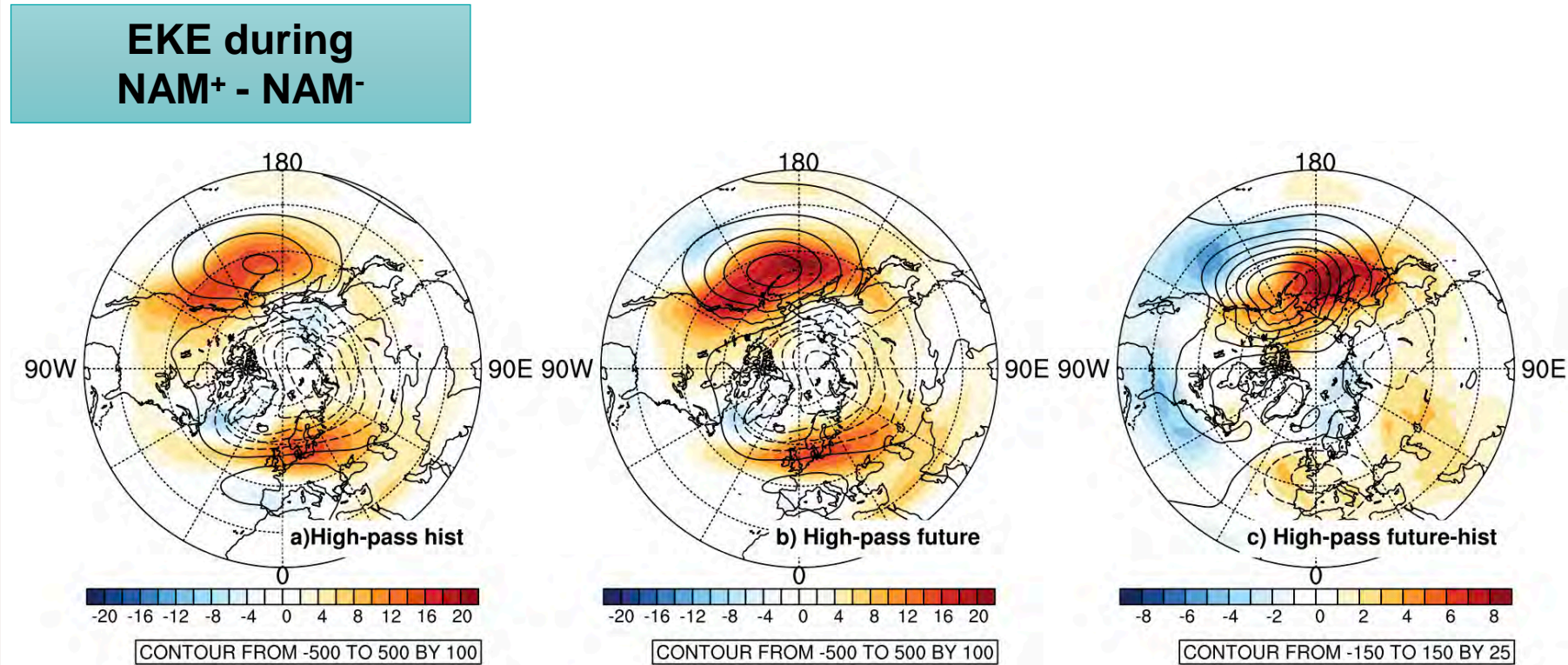
- ❖ More storm track activity (orange shading) in NAM⁺ compared to NAM⁻
- ❖ Location match the NAM Pacific center

3. Changes of the Pacific storm track in relation to NAM

7

Eddy
Kinetic
Energy
Composite
(500hPa)

Contours:
NAM



- ❖ Pacific storm track activity:
→ Intensified and poleward shifted in NAM⁺
- ❖ Same location as maximum change in NAM Pacific center in the future (panel c)

Summary

40 ensemble members mean of CESM1 LENS suggests:

1. NAM and teleconnection pattern:

- ❖ Intensified and poleward/northeastward shifted of the NAM Pacific center.
- ❖ Less extreme temperature variabilities in the future
 - coincides with a weakening in winter anomalous cold over central North America NAM⁻.
- ❖ The cold advection associated with the poleward shift of NAM Pacific center
 - results in a colder winter over the west coast/western North America NAM⁺.

2. Storm Track

- ❖ Intensified & poleward shifted in Pacific storm track during NAM⁺.

Thank You

I Gusti Ayu **Diah** Valentina

Email: igadv@connect.ust.hk

