Supplementary Information

Influence of Northern Hemispheric Winter Warming on the Pacific Storm Track

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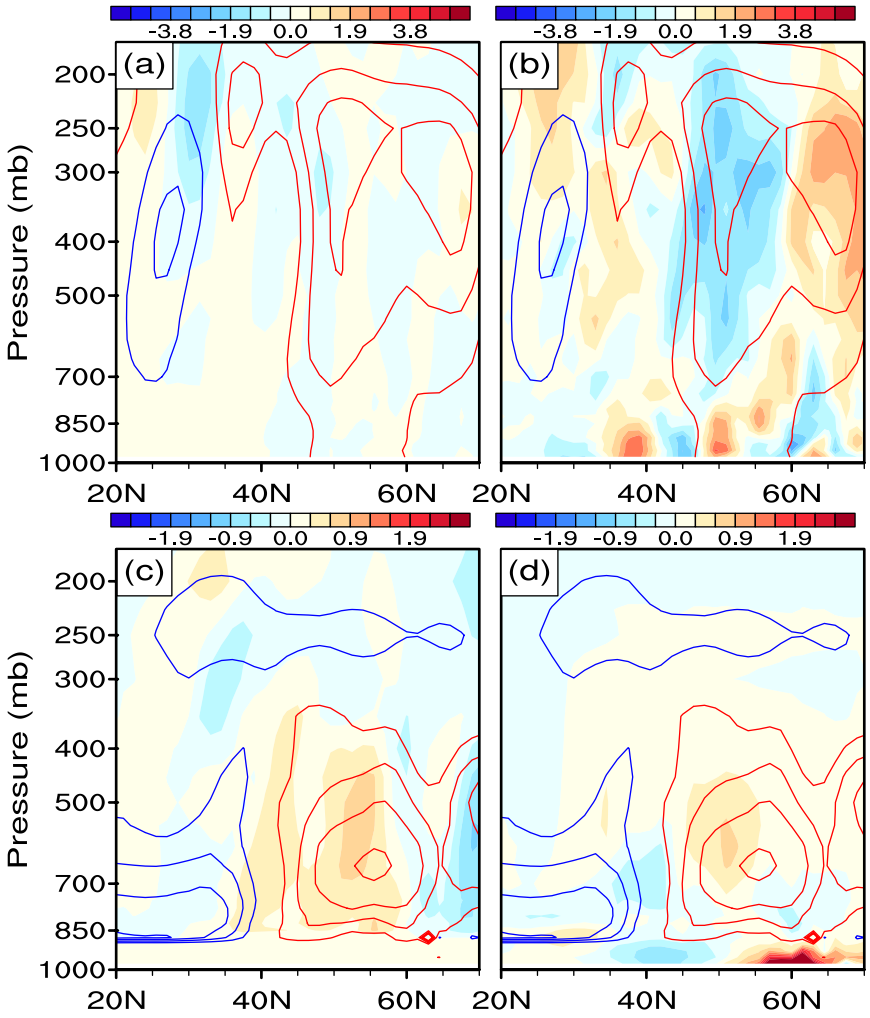

Figure S1. The zonally (150°E–120°W) averaged pattern of (a) advection of EKE′, (b) convergence of geopotential flux, (c) advection of EAPE′, and (d) diabatic EAPE′ generation (DEC) associated with the warming mode (shading; 10^{-5} W m^{-3}). The color contours in the upper panels represent EKE′ (contour interval of 1 m^2 s^{-2}) and in the lower panels EAPE′ (contour interval of 0.5 m^2 s^{-2}) regressed to the warming mode.

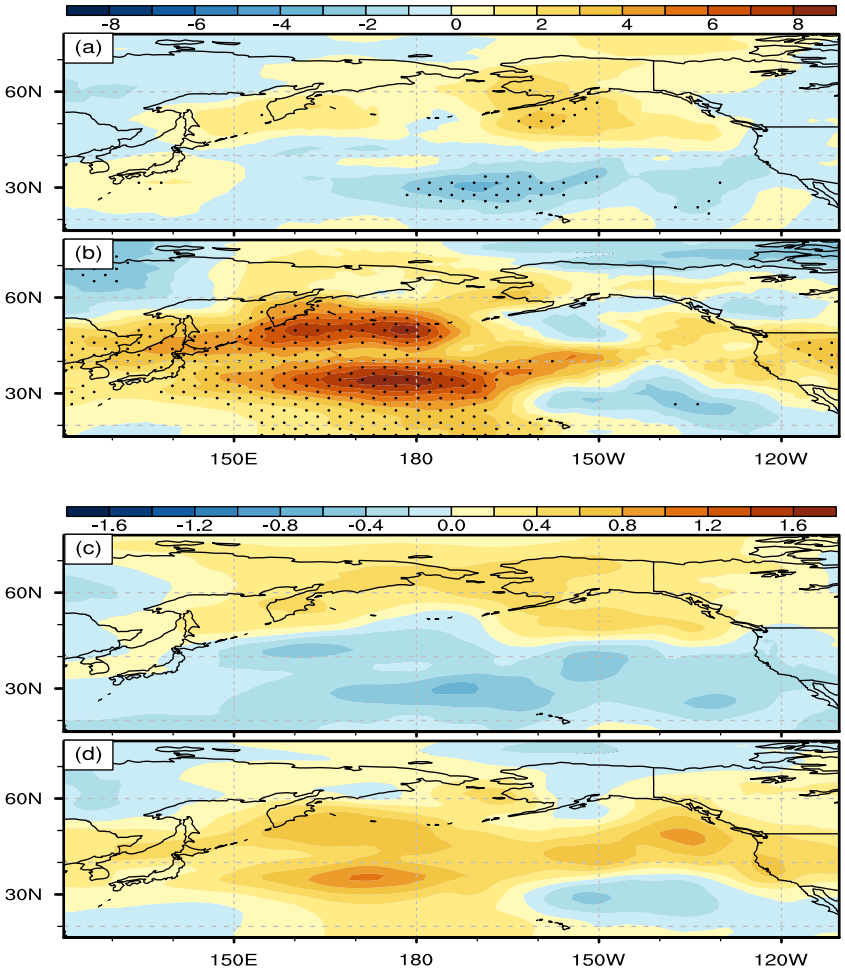

Figure S2. Linear trend of VTEE for the 39 winters during (a) NDJ and (b) FM in comparison with the CSEOF loading vectors in (c) NDJ and (d) FM. Before calculating the trend, seasonal cycle is removed. The unit is $m^2\ s^{-2}\ yr^{-1}$. The dotted area indicates that the trend exceeds 90% significance level.

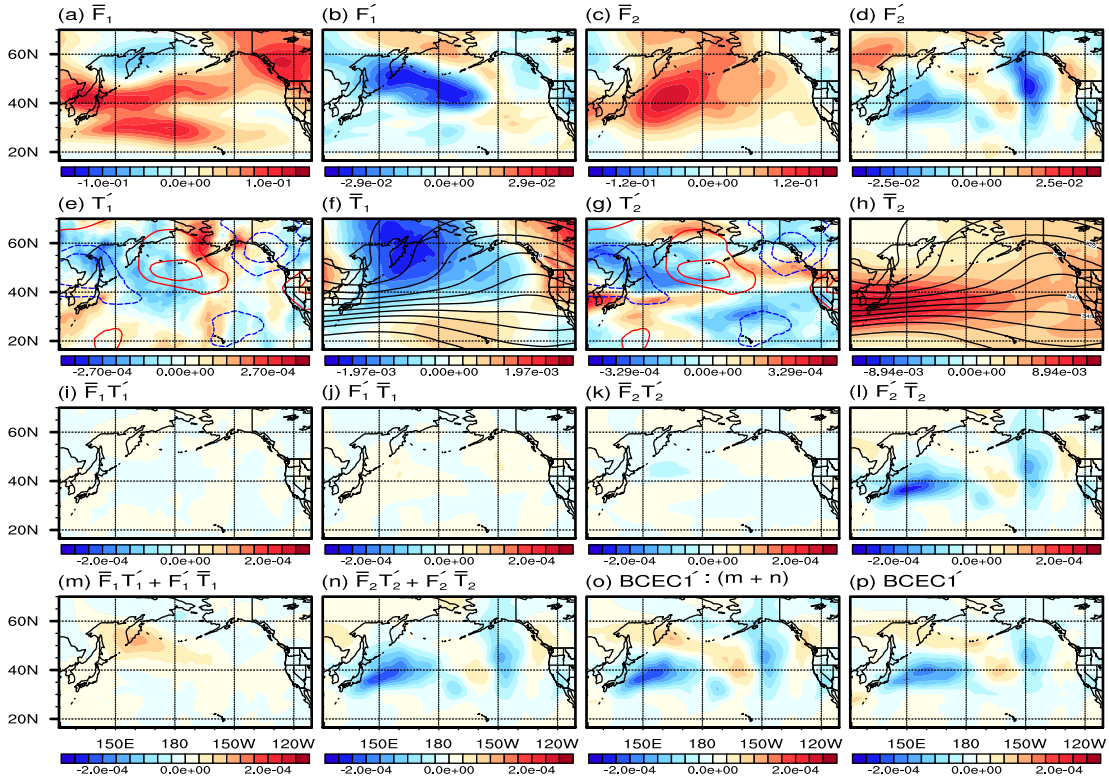

Figure S3. The 400-hPa BCEC1′ components averaged during NDJ. The description on heat flux ($\mathbf{F} = \overline{\mathbf{F}} + \mathbf{F}'$; W m kg^{-1} Pa^{-1}) and mean temperature gradient ($\mathbf{T} = \overline{\mathbf{T}} + \mathbf{T}'$; Pa m^{-1}), where the overbar denotes climatological mean and the prime change due to warming, can be found in Eq. (5). The panel (o) represents the summation of all the terms constituting BCEC1′, $\mathbf{F}'_h \cdot \overline{\mathbf{T}}_h + \overline{\mathbf{F}} \cdot \mathbf{T}'_h$, without the nonlinear term, whereas the panel (p) denotes the regressed pattern of BCEC1′, $(\mathbf{F}_h \cdot \mathbf{T}_h)'$, for the warming mode. The color contours in (e) and (g) represent the regressed temperature pattern at the same vertical level (blue < 0 < red contours at the interval of 0.25 K). The black contours in (f) and (h) represent the climatological average of temperature (contour interval is 5 K). Details of calculation can be found in the main text (see Eq. 18).

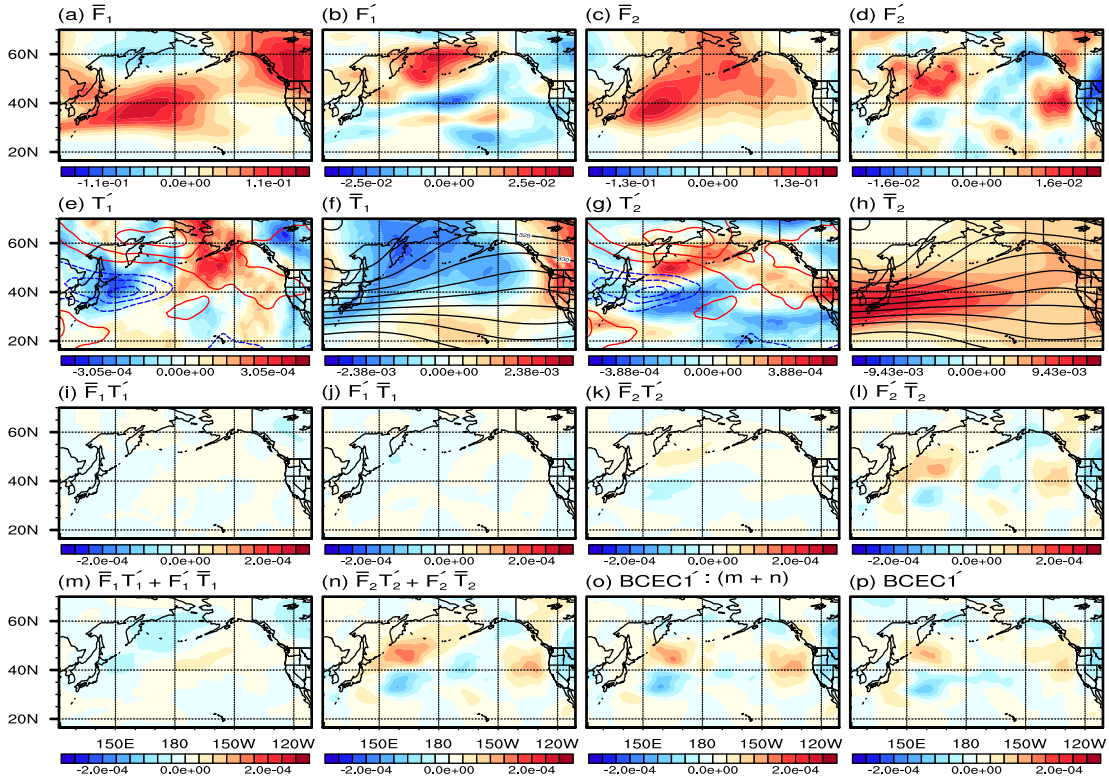

Figure S4. Same as Fig. S3 except for the FM averages.

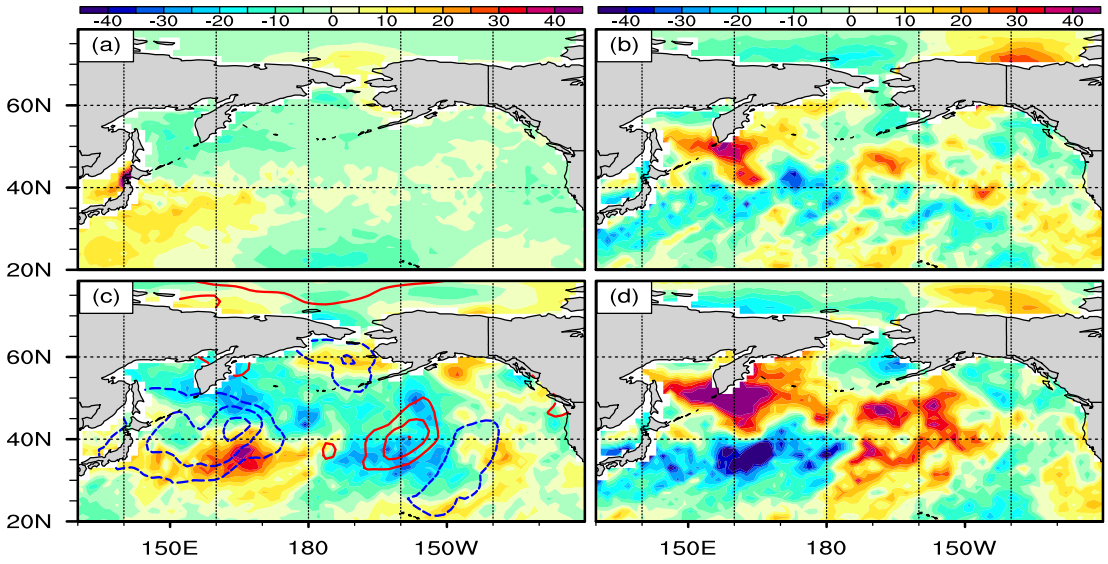

Figure S5. The NDJ averaged pattern of (a) boundary heating, vertically integrated MSE advection by (b) all component, (c) eddy component, and (d) stationary component in units of W m^{-2} for the warming mode. Boundary heating consists of short- and long-wave radiative forcing (radiation accumulated in the atmospheric column) and sensible and latent heat flux from the surface. Contours in (c) represent the vertically averaged meridional MSE′ flux by the eddy component scaled by the specific heat at constant pressure (c_p) (blue < 0 < red contours at the interval of 1 K m s^{-1}).

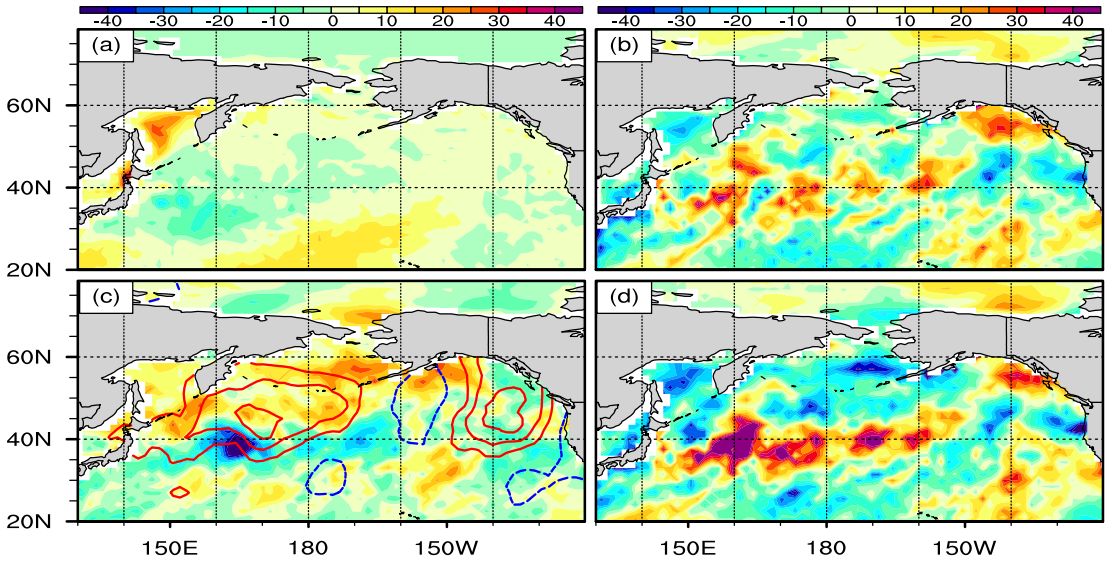

Figure S6. Same as Fig. S5, except for the FM averages.

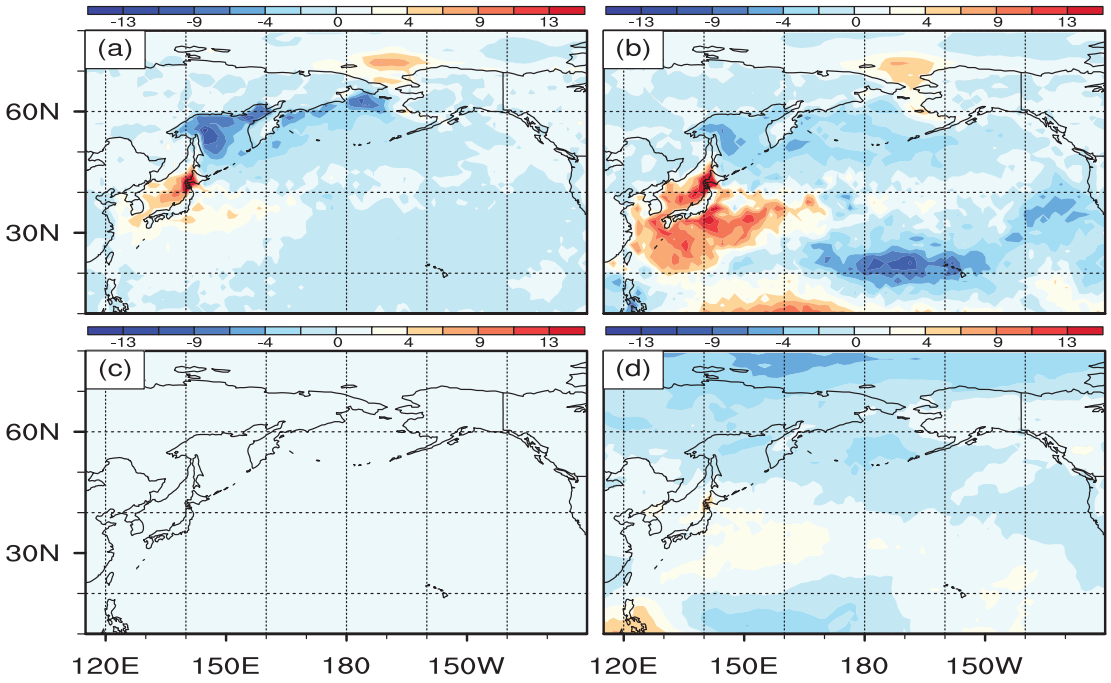

Figure S7. Change in boundary heating components during NDJ associated with the warming mode: (a) sensible heat flux, (b) latent heat flux, (c) net shortwave forcing, and (d) net longwave forcing. The unit is W m^{-2}.

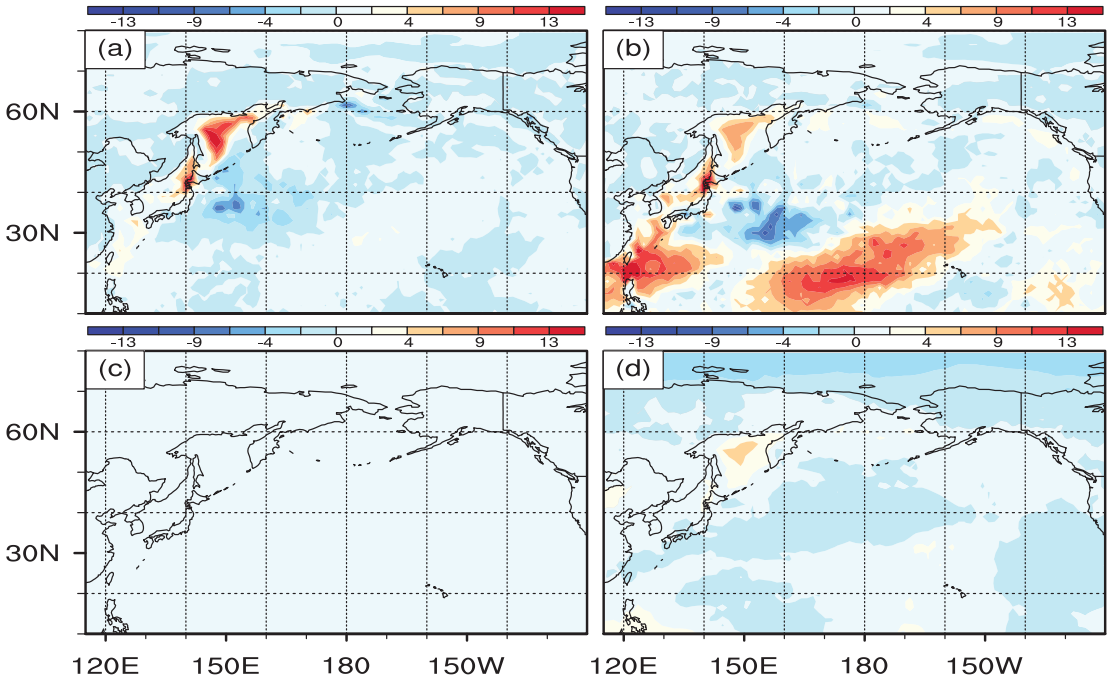

Figure S8. Same as Fig. S7 except for the FM averages.

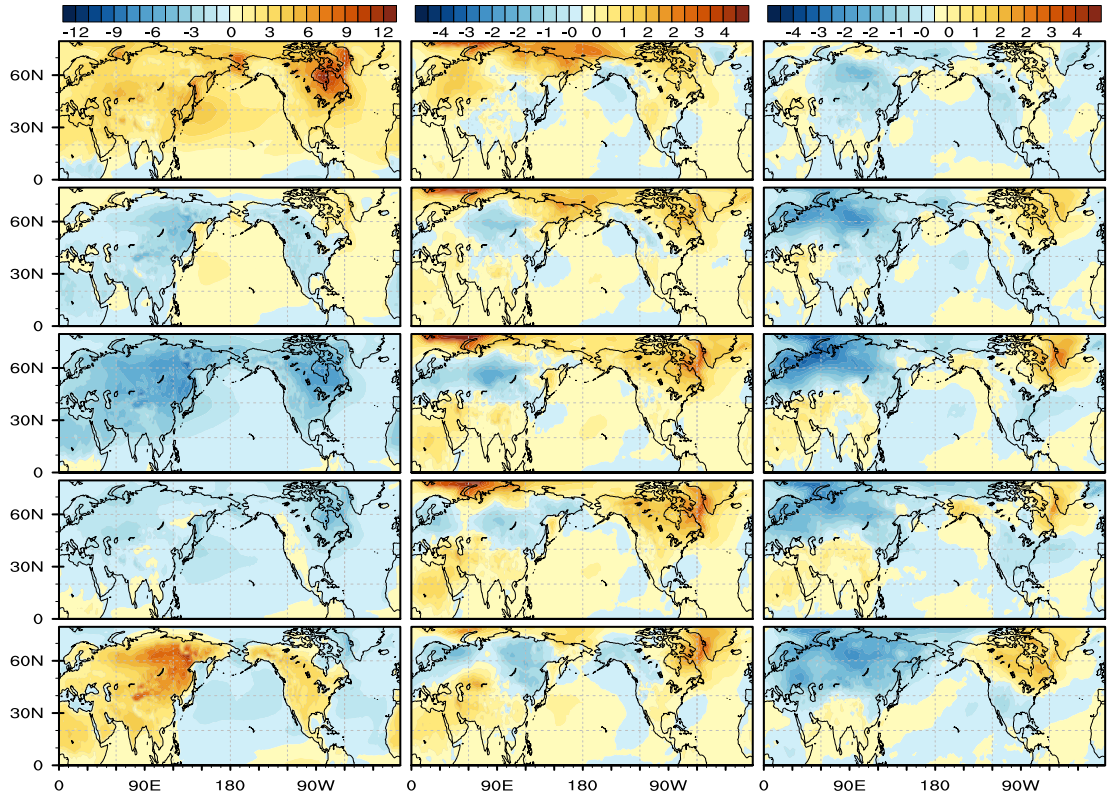

Figure S9. The monthly (NDJFM) patterns of the first three CSEOF modes of surface air temperature: (a) the seasonal cycle, (b) the warming mode, and (c) the third CSEOF mode.