Seasonal and Interannual Variations of Atmospheric Water Cycle in Siberia and Polar Regions

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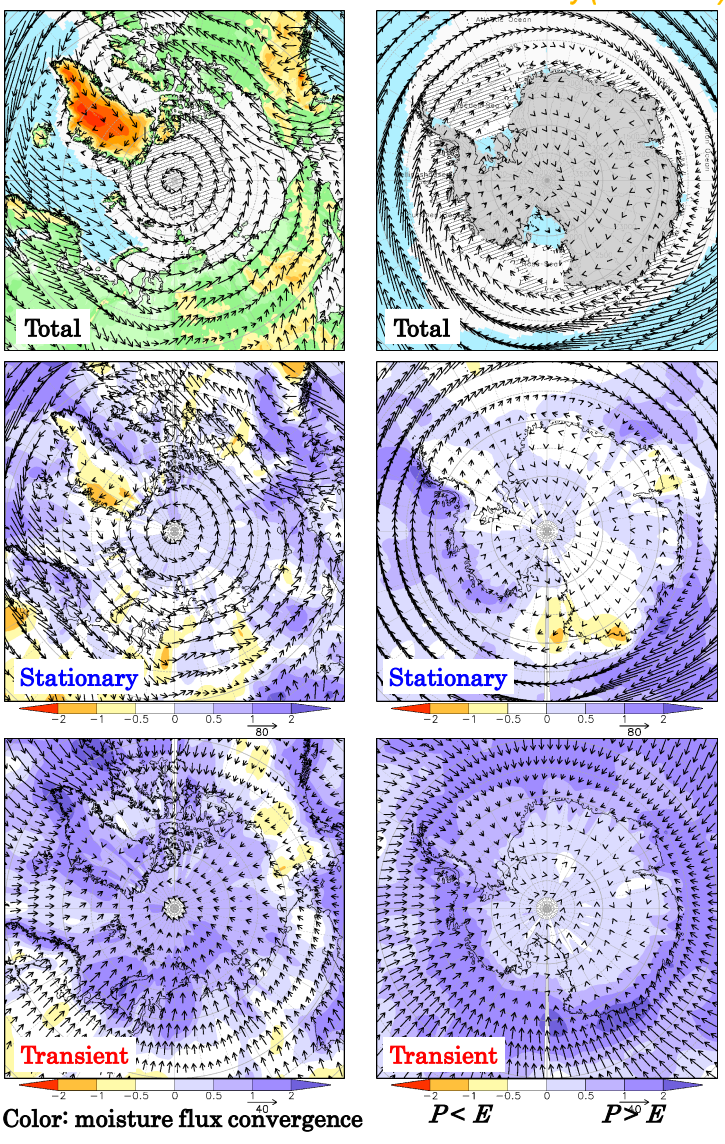
Seasonal and interannual variations of water cycles in Siberia, the Arctic and Antarctic have been investigated based on vertically integrated moisture flux and net precipitation (precipitation minus evaporation, *P–E*) . There were some similarities and dissimilarities in those water cycles.

The Arctic and Antarctic are regions of moisture flux convergence through the year, where *P* exceeds *E*, and then *P–E* is positive. Therefore, the atmospheric moisture transport is a primary input of water into the polar regions. While over Siberia, moisture flux convergence areas are also seen throughout the year, there are some areas of divergence and *P–E* is negative during summer due to large evapotranspiration. The *P–E* over Siberia affects the river discharges.

Moisture flux over the Arctic and the Antarctic in July (1981-2010)



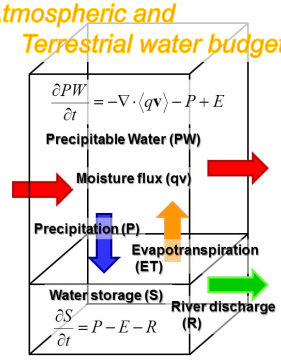
P-E can be estimated only from meteorological variables

$$P - E = -\nabla\langle qv\rangle - \frac{\partial PW}{\partial t}$$

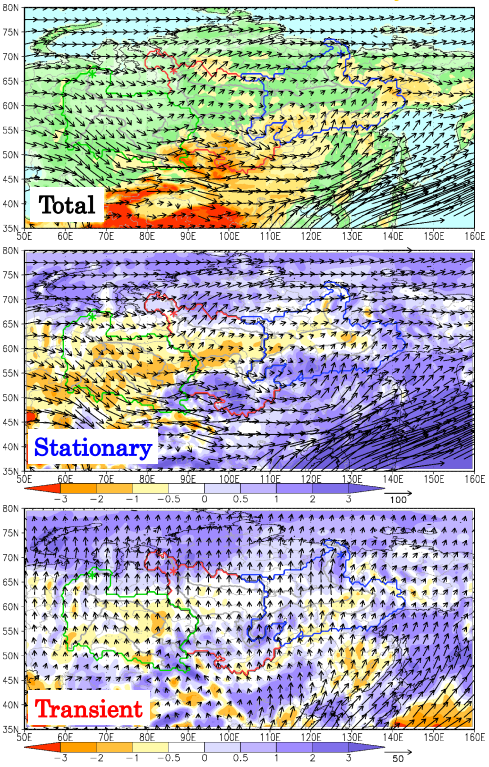
Total moisture flux can be divided into two components;
Stationary: moisture transported by seasonal mean wind
Transient: moisture transported by cyclone activity

$$\overline{q\,\mathbf{v}} = \overline{q}\,\overline{\mathbf{v}} + \overline{q'\mathbf{v}'}$$

Atmospheric and Terrestrial water budget



Moisture flux over Siberia in July



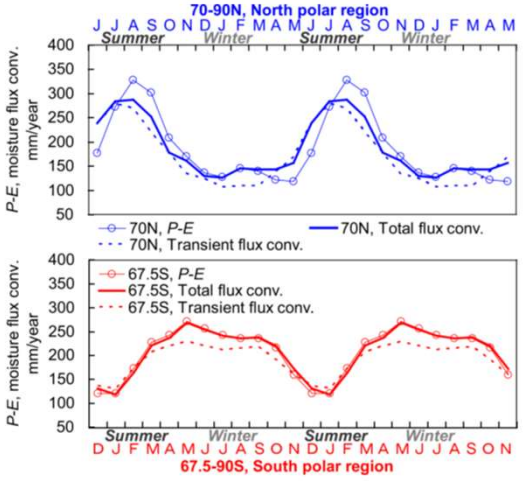
Poleward transient moisture flux associated with cyclone activity plays an important role in the climatological seasonal cycle of *P-E*.

The poleward transient flux dominates over the Arctic and Antarctic (Oshima and Yamazaki, 2004, 2006).

The transient component of moisture flux also dominates over eastern Siberia (Lena), while stationary component associated with seasonal mean wind dominates over western Siberia (Ob). The both components affect over central Siberia (Yenisei).

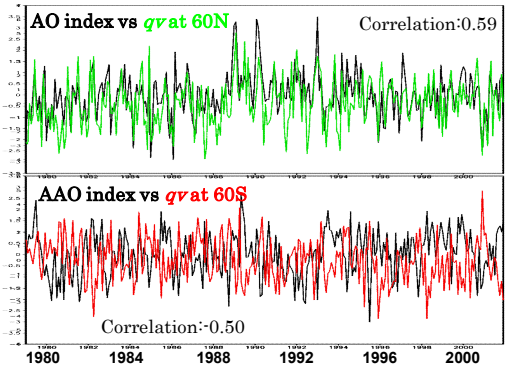
As a result, there is a regional difference in moisture transport processes over Siberia (Oshima et al. 2015).

Seasonal cycles of P-E and moisture flux conv.

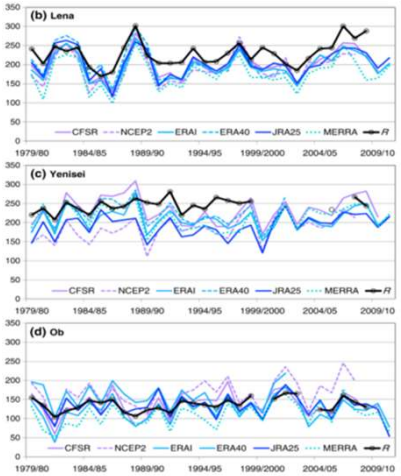


The stationary moisture flux is important for the interannual variations. The Arctic Oscillation (AO) and Antarctic Oscillation (AAO) as an atmospheric internal variability in the Northern and Southern Hemispheres, are related to not only large-scale atmospheric circulation, but also moisture transport over the Arctic and Antarctic (Oshima and Yamazaki, 2004).

Zonal mean poleward moisture flux <qv> at 60N and 60S



P-E and R for the three great Siberian rivers



Summer moisture flux convergence over Siberia dominates *P* and *P-E* over each river basin. Then they affect the interannual variation of the river discharge (Oshima et al. 2015).

Oshima, K. and K. Yamazaki: Seasonal Variation of Moisture Transport in the Polar Regions and the Relation with Annular Modes. Polar meteorology and glaciology, **2004**.
Oshima, K. and K. Yamazaki: Difference in seasonal variation of net precipitation between the Arctic and Antarctic regions. Geophysical Research Letters, **2006**.
Oshima, K., Y. Tachibana and T. Hiyama: Climate and year-to-year variability of atmospheric and terrestrial water cycles in the three great Siberian rivers. Journal of Geophysical Research: Atmospheres, **2015**.