渦熱フラックスの変調からみた北極気候変動

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The eddy heat flux as a key for better understanding of the Arctic climate system

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The meridional eddy heat flux, which is defined as a product of northward component of wind velocity and temperature where each represents deviation from its respective zonal average, is a major component in the global energy balance, thus essential to the global climate system. In this presentation, I will provide evidence that it also plays critical roles in the context of Arctic polar amplification and Arctic-midlatitudes climate linkage. Our results based on a set of carefully designed sensitivity experiments using a fully stratosphere resolving AGCM show that atmospheric circulation in winter is to a large extent modulated in response to Arctic sea-ice reduction. In particular, the residual mean meridional circulation, induced by a modified eddy heat flux field, is enhanced as a result of Arctic sea-ice reduction. This leads to a significant column-wise heating, equivalent to about 60% of an increase in the air-sea heat exchange due to a reduced state of the Arctic sea-ice cover, thus contributing to Arctic polar amplification through a positive feedback mechanism. The same modified eddy heat flux field supports upward propagation of planetary-scale wave in a manner specific to weaken the stratospheric polar vortex, with downward propagation of signals to the surface level in winter. The results clearly demonstrate an integrating role of the eddy heat flux in the Arctic energy balance, polar amplification, and Arctic-midlatitudes climate linkage.

References

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