A proposal to the energy budget in the auroral ionosphere: Challenge from thermospheric winds in the pulsating aurora

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Pulsating aurora is a typical phenomenon of the recovery phase of magnetic substorm and is frequently observed in the morning sector. The widely accepted generation mechanism of pulsations in precipitating electrons is related to wave-particle interactions around the equatorial plane in the magnetospheric tail. This mechanism is completely different from the discrete-arc case, which generates high-energy auroral electrons by the inverted-V type potential structure in the magnetospheric acceleration region. This potential structure induces the perpendicular electric field. The electric field is mapped down to the ionosphere, and enhances the Pedersen current as the ionospheric closure current. Since the perpendicular electric field directly relates to the Joule heating rate and the Lorentz force, thermal and kinetic energies in the thermosphere are locally increased in the vicinity of the arc rather than the inside, resulting in wind variations in the thermosphere. However, this scenario cannot be simply applied to the pulsating-auroral case because of the completely different mechanism of the auroral-electron generation, and we have believed that large energies are not dissipated in the pulsating aurora and there should be no obvious wind variations in the thermosphere. However, we found thermospheric-wind variations in the pulsating aurora during simultaneous observations with a Fabry-Perot Interferometer (557.7 nm), several cameras, and incoherent-scatter radars. This is a significantly important finding in evaluating our understanding of the energy budget in the substorm recovery phase. As mentioned above, the Joule heating process and the Lorentz force play important roles for thermospheric-wind variations. While the both cases need enhancements of the perpendicular electric field, we well know that a typical level of the convection electric field is too low to generate the wind variations in a same level as the observed in the pulsating aurora. Thus the observed wind variation is a clear evidence that our estimation of the dissipated energy in the recovery phase has been underestimated. This presentation will summarize our measurements showing several events of the pulsating aurora, in particular focusing on the energy budget in the magnetosphere-ionosphere-thermosphere coupled system.