The quantification of development processes of explosive cyclones over Northwestern Pacific and Atlantic in boreal winter

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A method utilizing a prognostic potential vorticity (PV) inversion is designed and applied to quantify the processes that contribute to the explosive cyclone (EC) development over Northwestern Pacific and Atlantic in boreal winter. The ECs deepening in the two remarked regions are identified and tracked, by using the automated tracking method on ERA-Interim reanalysis data over the period of 1979–2017. The quantification process first involves time differentiation of linearized potential vorticity (PV), which results in a linear function of geopotential height tendency. It is then equated with the PV tendency equation that consists of mean and transient advection terms to represent dynamical processes that contribute to EC development. The quantification, finally, is performed through the inversion of PV tendency budgets, which yields corresponding geopotential height tendency. The results indicate that EC development is primarily caused by zonal advection of PV anomalies by mean flow (~65%) and diabatic production of PV (~40%), with some negative factors in both regions. The former contributes more for ECs deepening over Northwestern Atlantic (~71%) than Northwestern Pacific (~60%), whereas the latter contributes to a similar extent.