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Improvement in efficiency of auroral 3D analysis

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Generalized-auroral computed tomography (G-ACT) is a method to reconstruct three-dimensional (3D) distribution of auroral emission from multi-instrument data, such as monochromatic images taken at multi-point imager network and ionospheric electron density from radars. This method is expected to be useful for auroral 3D research by combining multiple auroral images with the electron density data obtained by the EISCAT_3D radar, which is planned to be operated in the near future. On the other hand, the 3D analysis of aurora has been limited to case studies because it takes a long time to process data and solve the inverse problem. In this study, therefore, we examine how to make this G-ACT calculation more efficient and faster. In particular, hyper-parameters associated with the weights between different data types and the regularization cannot be fixed because they depend on observation conditions such as auroral shape, position, and noise level, and also they are time consuming to calculate. Thus, hyper-parameters are pre-calculated under various conditions using model simulations and compiled into a database to automatically determine the appropriate hyper-parameters for the observed data. The simulations also enable us to estimate errors in the analysis results.