論 文 内 容 の 要 旨

This dissertation is about the data analysis and processing based on the active-passive radar and infrasound observations. Obviously, the terms between two of them are absolutely different set of instruments, however the combination of two of them may give a possibility to study a wide range of atmospheric phenomena. In this dissertation, three different observations, such as the allSKy interferometric METeor (SKiYMET) radar as an active remote sensing technique and the Kochi Forward Scatter Meteor Radar (KFSMR), as well as the Infrasound network observation systems as a passive remote sensing technique for the upper atmosphere. The SKiYMET radar and the KFSMR radar systems were used to investigate the changes in meteor peak height according to solar activity, represented by the solar radio index F10.7, and the number of solar sunspots, R, compared with the empirical results of the Mass Spectrometer Incoherent Scatter Extending (MSISE) and Committee on Space Research International Reference Atmosphere models as well as the orbital parameters of the meteor. The infrasound observation from the infrasound sensor network of KUT was used to infer the source signal detection, e.g., the arrival direction and the apparent speed based on the implementation of the method of Doppler Radar Beam Swinging. Therefore we have chosen to split up the scenario of the study in two parts. One is in the field of radar system as the radio remote sensing, and the second part is in the field of infrasound system as the sound wave remote sensing. While the primary targets of this dissertation are the audience working with ground based observations to study the atmosphere, and also aimed to make it accessible and useful to a wider user.

It was found that (i) the daily meteor count rates at above the meteor radar sites in the period from 2003 to 2016 could be used to determine the dynamics in the upper atmosphere, where peak conditions occurred in the middle of the year; (ii) through a statistical approach using the normal distribution function, the variation in meteor peak height showed a positive correlation with the trend in solar activity; and (iii) comparison between the two empirical models and our observations showed two points where annual air density seemed to have a clear relationship with peak meteor height. In addition, the annual neutral density pattern of the model was related to the daily meteor count every year, although it showed a pattern opposite to the solar activity trends. From the meteor observation with the three-receiver interferometer system, the average speed of the Geminid meteor shower observations shows a peak speed of around 35 km/s which confirms the results of similar observations previously.

In different part of this dissertation, low frequency signals from the Mt. Shinmoedake in Japan are used to estimate the horizontal atmospheric wind velocity at certain altitude. Depending on the background atmospheric condition at low-mid altitude, the arrival signals are observed during sequence of explosive volcanic activities. It was also found that the comparison of the atmospheric wind speed between the infrasound observation and the radiosonde observation are relatively in good agreement, whereas the wind at above the radiosonde altitude still remain works for validations and comparisons.

Additionally, the implementation of the Doppler Radar Beam Swinging into the infrasound sensor array system gives a possible way to detect the source waves for further atmospheric wind estimation, even though it still meets several limitation during the processing. However, these results suggest the utilities of both radio and infrasound techniques could be used for atmospheric study.