Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

AEM002-P01 Room:Convention Hall Time:May 27 10:30-13:00

The use of cloud classification and rainfall radar data to improve geostationary satellite based rainfall estimation

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The use of geostationary satellite dataset for rainfall estimation has several advantages that it has a hemisphere coverage and high temporal resolution. However, we can only use Visible/Infra Red (VIS/IR) sensor that carried by geostationary satellite. Because of the cloud is opaque in VIS/IR spectral band, an indirect approach is used for rainfall estimation, i.e. according to several top surface cloud characteristics such as shape, brightness, temperature etc. Another rainfall estimation approach is by using Passive Micro Wave (PMW) sensor. The microwave spectral band has characteristic that can penetrate the cloud and interact with the hydrometeor. Those of characteristics make the PMW method more direct in term of rainfall estimation. PMW sensor usually mounted on polar orbit satellite, so it has limitation on temporal resolution and coverage. This study combines the advantage of geostationary satellite and PMW satellite images for rainfall estimation. We use MTSAT datasets that is blended with TRMM 2A12 to estimate the rainfall over Japan. We make a statistical relationship between cloud top temperature from MTSAT and rainfall rate from TRMM 2A12, according to assumption that on the convective cloud situation lower cloud top temperature is associated with higher rain rate. In the actual situation such assumption sometimes cannot be fulfilled. The cloud top temperature of the cirrus cloud i.e.: cold but not produces rain and the nimbostratus cloud i.e.: produces rain but warm have disturbed such relationship. The cloud classification according to the cloud type and cloud height will be performed. We use several cloud classification methods such as segmentation method, split-window method and maximum likelihood method to classify the cloud type. We investigate the statistical relationship among cloud classes and height to the rain rate. A calibration with the C-band rainfall radar data will also be conducted. The estimation result will be validated with the measured rainfall (Automated Meteorological Data Acquisition System/AMeDAS System). We expected that cloud classification based on cloud type and height as well as C-band rainfall radar calibration will improve the rainfall estimation accuracy.

Keywords: geostationary satellite, rainfall estimation, MTSAT, TRMM 2A12, cloud classification

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A warm season climatology of convective precipitation over the Korean Peninsula

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The goal of this study is to investigate the variations in the spatial and temporal patterns of lightning activity over the Koran Peninsula in relation to precipitation during the summer monsoon months during 10 years (2000-2009) and to develop a better understanding of these two meteorological phenomena. In this study, we present the results of an analysis of lightning activity and associated monsoon rainfall over Korea. We obtained precipitation data from 98 synoptic stations and the lightning data were collected from a lightning detection network installed by the Korean Meteorological Administration (KMA).

This study will be of use in understanding the role of convective rain in the extreme precipitation over Korea, and this could eventually enhance skills for understanding the relationship between climate change and extreme precipitation.

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Keywords: extreme precipitation, Korean Peninsula, lightning activity, climate change

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Global map of thunderstorm activity based on GEON and its relationship to the solar activity

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Hokkaido University developed a global ELF observation network, named GEON, which provides very unique information of each cloud-to-ground lightning discharge (CG), as well as Schumann resonance (SR) power, a proxy of global energy proxy of lightning discharge. From the standpoint of the relationship between the effect of solar activity to the climate of Earth, lightning activity estimated by data obtained by GEON and the outgoing longwave Radiation (OLR), an indicator of cloud amount, are examined for their periodicity and phase in the periodic range of about one month. SR power shows about 27-day periodicity in solar maximum years and it becomes elongated toward solar minimum. On the other hand, OLR shows same kind of 27-day periodicity in solar maximum years, but only in the Western Pacific Warm Pool area. Both the spectra of SR and OLR have a peak around 35-day in solar minimum years. The average spectrum of OLR in solar maximum years also shows an enhancement in the range of 50-60 days corresponding to the main MJO period. In this presentation the relationship between the thunderstorm activity inferred from global lightning distribution observed by GEON and OLR are discussed in detail, comparing the solar activity.

Keywords: lightning, thunderstorm, OLR, solar activity, GEON

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Periodic Changes of Global Lightning Activities and Their Regional Dependences

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In order to study the periodic changes of global lightning activity and their regional dependences, we have analyzed ELF magnetic field waveform data obtained at Syowa station in Antarctica, Onagawa observatory in Japan and Esrange in Sweden for the period between February 2000 and December 2009. We have estimated day-to-day amplitude variation of the global lightning activity derived from Schumann resonance (SR) spectral power. As a next step, we have calculated power spectrum of the SR spectral amplitude variation to estimate periodicities using MEM, FFT, and wavelet method. It is found that the periodgram showed steep spectral peak at ˜28-day in 2000-2001 which is the solar maximum period. On the other hand, a peaked period of the SR spectral amplitude variation gradually increased and showed a steep spectral peak over 30-days after 2002. Using the transient SR waveform data and newly developed geolocation method, we have also estimated the occurrence locations of intense lightning discharges for the period between September 2003 and August 2003. We will discuss the relationship between the periodic changes of regional lightning occurrence numbers and periodic changes of the regional lightning activity.

Keywords: lightning, Schumann resonance, periodic change

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Initial Results of Sprite Observation from Aircraft Using High-speed II-CCD camera and High-Vision Camera

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In order to study spatial and time evolution of Transient Luminous Events (TLEs), such as sprites, elves, and blue jets, we have carry out TLE observations from a jet-aircraft using high-speed Image-Intensified (II) CCD camera, Watec CCD camera, EM-CCD camera and high-vision camera. On November 28, we have carried out a first try of the observation and captured about 30 TLE events successfully. At the presentation, we will show the initial results of the spatial and time evolution of sprites measured by high-speed and high-vision cameras.

Keywords: lightning, sprite, high-speed camera, high-vision camera

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AEM002-P06 Room:Convention Hall Time:May 27 10:30-13:00

Global Lightning and Sprite Measurements (GLIMS) from International Space Station

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The Global Lightning and sprIte MeasurementS (GLIMS) on the International Space Station (ISS) is a mission to detect and locate optical transient luminous events (TLEs) and its associated lightning simultaneously from the non-sun synchronous orbit, and is scheduled to be launch from Japan in January, 2012 as part of the multi-mission consolidated equipment on Japanese Exposure Module (JEM). Our mission goals are (1) to detect and locate lightning and sprite within storm scale resolution over a large region of the Earth's surface along the orbital track of the ISS without any bias, (2) to clarify the generation mechanism of sprite, and (3) to identify the occurrence conditions of TLEs. To achieve these goals, two CMOS cameras, six Photometers, VLF receiver, and VHF interferometer with two antennas, are installed at the bottom of the module to observe the TLEs as well as causative lighting discharges at nadir direction during day and night time. Though the luminous events so-called sprite, elves and jets have been investigated by numerous researchers all over the world based mainly on the ground observations, some important problems have not been fully understood yet such as generation mechanisms of columniform fine structure and horizontal offset of some sprites from the parent lightning discharges. In the JEM-GLIMS mission, observations from our synchronized sensors are going to shed light on above-mentioned unsolved problems regarding TLEs as well as causative lighting discharges. In this presentation, the scientific background, instrumentation, project summaries are given.

Keywords: Lightning, Sprite, ISS

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3D mapping of winter lightning discharges observed in the Shonai area

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The Shonai area railroad weather project has investigated fine-scale structure of wind gust using two X-band Doppler radars and the network of 26 surface weather stations since 2007, in order to develop an automatic strong gust detection system for railroad. In 2009, the project was expanded and started lightning observation to investigate the mechanism of winter lightning and the application to strong gust prediction. Lightning discharge is known to be related to microphysical and dynamical processes within storms. Many scientists have indicated that lightning activity is associated with severe weather. Therefore, integration of continuous three-dimensional (3D) lightning monitoring (intracloud and cloud-to-ground lightning) and comprehensive high-density meteorological observation can provide useful index for predicting strong gust.

We developed a lightning observation system. The azimuth and elevation of VHF radiation sources originated from lightning flashes are computed using arrival time difference of three VHF pulses. After operation test at Meteorological Research Institute (MRI), we installed this system in the north of Shonai area (Ohama, Sakata) in October 2009. Moreover, we constructed three lightning observation sites in the Shonai area in September 2010, in order to visualize lightning discharges in 3D.

Our sensors detected lightning discharges at 01:13:32 JST on 4 December 2010. Using the VHF waveform data, we conduct 3D lightning mapping. The duration of discharge is about 60 ms and divided into two stages. The locations of discharges are compared with the radar echo data observed with two X-band Doppler radars in the Shonai area. As a result, the distribution of lightning discharges is consistent with the strong echo region. The lightning flash was also recorded with the network cameras at each site. In this presentation, we will show the lightning discharge process in detail.

Keywords: Winter lightning, 3D mapping, VHF observation, X-band radar, Shonai area