method. We plan to investigate variation of tidal parameters with seasons that could be related to interaction between tides and gravity wave from lower atmosphere since the interaction might cause the variability of tidal amplitudes and energies. The obtained tidal characteristics over the KSS are expected to be very unique when compared with other Antarctic sites, because gravity waves in the lower atmosphere are very active near the Antarctic peninsula.

■ Session : 태양 및 우주환경 II
4월 29일(수) 16:25 - 17:55 제2발표장

[SE-07] Prospects of empirical space weather forecast based on solar information

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In this talk I will review our recent progress of space weather forecast based on solar information. Major findings can be summarized as follows. First, we presented a concept of storm probability map depending on CME parameters. Second, we suggested a CME earthward direction parameter and demonstrated its importance in terms of the forecast of geomagnetic storms. Third, the importance of solar magnetic field orientation for storm occurrence in terms of ICME classification was examined. Fourth, the relationship among coronal hole-CIR-storm relationship has been investigated. Fifth, the storm forecast based on coronal hole information is in progress but challenging. Sixth, a new proton event forecast method including helio-longitudinal dependence has been suggested. We are attempting to apply machine learning technology to space weather forecast. I will discuss the importance of these works and their future prospects.

[SE-08]Forecast of Geomagnetic Storm based on CME and Interplanetary Condition

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In our previous studies, we already examined the CME properties that control the CME geoeffectiveness and suggested the geomagnetic storm prediction formula based on only initially-observed CME parameters. However, there are some limitations for the forecast using only CME parameters, since geomagnetic storms are directly affected not only by solar source events but also by near Earth interplanetary conditions. In addition to this, the initially-observed CME characteristics can be changed during its transit to the Earth. For this reason, we have to consider real time solar and interplanetary conditions together to improve the forecast capability of geomagnetic storms. In this study, we examine near Earth interplanetary conditions for 64 CME-Dst pairs from 1997 to 2003, which were associated with M and X class solar flares and whose source regions were clearly identified. We ensure that the peak Bz and Ey prior to Dst minimum value are strongly related with Dst index. By carefully investigating the interplanetary condition for moderate geomagnetic storms (Dst $\leq$ 50 nT), we suggest an empirical criteria: Bz = -5 nT or Ey = 3 mV/m for t = 2 hr. As a result, most of the storms (90 %) satisfy the interplanetary criteria. Among 20 exceptional eventsunsatisfying the CME-storm forecast, 15 misses can be explained by the interplanetary condition, but we couldn't find the cause of 5 false alarms. By considering both conditions, all geomagnetic storms (Dst $\leq$ 50 nT) are found to occur when the CME conditions or interplanetary conditions (Bz $\leq$ -5 nT or Ey $\geq$ 3 mV/m for t $\geq$ 2 h) are satisfied.

[SE-09] Application of Support Vector Machine to Space Weather Prediction: Geo-effectiveness of CMEs

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Support vector machine is a powerful machine learning method in classification and regression. Generally machine learning has been greatly applied in image processing, data classification, and data mining. It is very helpful to automatically produce models from data which are not clearly understood. Very recently, researchers started to apply it to space weather forecast. In this study, we apply it to the forecast of geo-effective CMEs using 488 CME-Dst pairs that Kim et al. (2008) used. Here we assume that the occurrence of a geomagnetic storm is governed by CME speed, longitude, and earthward direction parameter. We

made a model by training 348 front-side halo CMEs from 1997 to 2001, and predicted geo-effectiveness of 140 CMEs from 2001 to 2003. Finally we could achieve 72.1% accuracy in prediction by using SVM. In the future, we will apply machine learning technology to various space weather predictions to achieve more accurate predictions.

[SE-10] Statistical comparison of interplanetary conditions causing intense geomagnetic storms

Eun-Young Ji, Yong-Jae Moon, Dong-Hun Lee
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The southward IMF Bz field and convective electric field Ey component are well known interplanetary parameters which control the occurrence of intense geomagnetic storms (Dst ≤ -100 nT). In this study we have made a statistical comparison of interplanetary conditions of these parameters causing intense geomagnetic storms. By investigating the conditions of 82 intense geomagnetic storms from 1998 to 2006, we considered 8 different criteria of interplanetary conditions for the occurrence of gemagnetic storms including what Gonzalez and Tsurutani (1987) suggested - Bz < -10 nT or Ey > 5 mV/m for interval > 3h. Then we applied these criteria to whole interplanetary data during the same period. As a result, we present contingency tables between prediction and observation, and obtain their statistical parameters for forecast evaluation such as probability of detection yes (PODy), false alarm ratio (FAR), Bias and critical success index (CSI). A comparison of these statistical parameters for 8 criteria shows that the best criteria for intense geomagnetic storms is Bz ≤ -8 nT or Ey ≥ 5 mV/m for 2h. In this case, the PODy, FAR, Bias and CSI are estimated to be 0.85 0.41 1.45 0.53, respectively.

[SE-11] Empirical forecast of corotating interacting regions based on coronal hole information

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In this study, we suggest an empirical forecast of CIRs (Corotating interaction regions) based on the information of coronal holes (CHs). For this we used CH data obtained from He I 10830 Å maps at National Solar Observatory-Kitt Peak from 1996 to 2003 and the CIR data that Choi et al. (2009) identified. Considering the relationship among coronal holes, CIRs, and geomagnetic storms (Choi et al. 2009), we propose the criteria for geoeffective coronal holes ; the center of CH is located between N30 and S30 and between E40 and W20, and its area in percentage of solar hemispheric area is larger than the following areas: (1) case 1 : 0.36%, (2) case 2 : 0.66%, (3) case 3 : 0.36 % for 1996-2000, and 0.66 % for 2001-2003. Then we present contingency tables for three cases and their dependence on solar cycle phase. From the contingency tables, we determined several statistical parameters for forecast evaluation such as PODy (the probability of detection yes) , FAR (the false alarm ratio), Bias (the ratio of "yes" predictions to "yes" observations) and CSI (critical success index). Considering the importance of PODy and CSI, we found that the best criterion is case 3 ; PODy=0.78, FAR=0.66, Bias=2.26, and CSI=0.31. It is also found that the parameters near solar minimum are much better than those near solar maximum. As a next step, we are developing a forecast method of geomagnetic storms based on coronal hole information.

[SE-12] Source identification of back side solar proton events

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Solar proton events, whose fluxes are larger than 10 particles cm-2 sec-1 ster-1 for >10 MeV protons, have been oserved since 1976. NOAA proton event list from 1997 to 2006 shows that most of the events are related to both flares and CMEs but a few fraction of events (5/93) are only related with CMEs. In this study, we carefully identified the sources of these events. For this, we used LASCO CME catalog and SOHO MDI data. First, we examined the property of CMEs related with the events. The CMEs are found to eject from the western hemisphere and their velocities are all above 1200Km/s. Second, we searched a major active region in the front solar disk for several days before the proton events occurred by taking into account two facts : (1) The location of the active region is consistent with the position angle of a given CME and (2) there were several flares in the active region or the active region is the largest among several candidates. As a result, we were able to determine active regions which are likely to produce proton events without ambiguity as well as their longitudes at the time of proton events by considering solar rotation rate, 13.2° per day. From this study, we found that the longitudes of five active regions are all between 90°W and 120°W. When the flare peak time is assume to be the CME event time, we confirmed that the dependence of their rise times (proton peak time - flare peak time) on longitude are consistent with the previous empirical formula. These