to the different mechanisms governing the acceleration pattern and interval, and different condition such as the acceleration location.

[구 SS-10] Dependence of solar proton peak flux on 3-dimensional CME parameter

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In the present study, we examine the dependence of solar proton peak flux at SOHO and STEREO on 3-D CME parameters (radial speed, angular width, and longitudinal angular separation between its source region and the magnetic footpoints of spacecraft). For this we consider 38 proton enhancements of 16 SEP events observed by SOHO, STEREO-A, and/or B from 2010 August to 2013 June. As a result, we find that the enhancements are strongly dependent on these three parameters. The correlation coefficient between proton peak flux and CME speed is about 0.42 for the cases the footpoints are located inside the lateral boundaries of angular widths, while

there is no correlation for the events outside the boundaries. The correlation coefficient between peak flux and angular separation is −0.51. We find that most of strong proton events occur when their angular separations are closer to zero, supporting that most of the proton fluxes are generated near the CME noses rather than their flanks.

[구 SS-11] Stereoscopic observations of front-side halo CMEs by SOHO and STEREO from 2009 to 2013

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We present a comprehensive catalog of 307 front-side halo (partial and full) CMEs during 2009 and 2013 observed by both SOHO and STEREO. This catalog includes 2D CME properties from single spacecraft (SOHO) as well as 3D ones from multi-spacecraft. To determine the 3D CME properties (speed, angular width, and source location), we use the STEREO CME analysis tool based on a triangulation method. In this paper, we compare between 2D and 3D CME properties, which is the first statistical comparison between them. As a result, we find that 2D speeds tend to be about 20% underestimated when compared to 3D ones. The 3D angular width ranges from 15° to 109°, which are much smaller than the 2D angular widths with the mean value of 225°. We also find that a ratio between 2D and 3D angular width decreases with central meridian distance. The 3D source locations from the triangulation method are similar to the flare locations. The angular width-speed relationship in 3D is much stronger than that in 2D.

[구 SS-12] Development of daily solar flare peak flux forecast models for strong flares

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We have developed a set of daily solar flare peak flux forecast models for strong flares using multiple linear regression and artificial neural network methods. We consider input parameters as solar activity data from January 1996 to December 2013 such as sunspot area, X-ray flare peak flux and weighted total flux of previous day, and mean flare rates of McIntosh sunspot group (Zpc) and Mount Wilson magnetic classification. For a training data set, we use the same number of 61 events for each C-, M-, and X-class from Jan. 1996 to Dec. 2004, while other previous models use all flares. For a testing data set, we use all flares from Jan. 2005 to Nov. 2013. The best three parameters related to the observed flare peak flux are weighted total flare flux of previous day ($r = 0.51$), X-ray flare peak flux ($r = 0.48$), and Mount Wilson magnetic classification ($r = 0.47$). A comparison between our neural network models and the previous models based on Heidke Skill Score (HSS) shows that our model for X-class flare is much better than the models and that for M-class flares is similar to them. Since all input parameters for our models are easily available, the models can be operated steadily and automatically in near-real time for space weather service.

[초 SS-13] KASI's contributions to Space Weather over the past 10 years

Kyungsuk Cho, Young-Deuk Park, and Solar and Space Weather Group
Korea Astronomy and Space Science Institute

For the past decade, supported by the Korean

government, the solar and space weather group of Korea Astronomy and Space Science Institute (KASI) has been researching towards the prevention of hazardous effects on Korean satellites, the stability of wireless telecommunications, and the safety of polar route aviation. So far, we have expanded the ground observation system, made space data more accessible, developed more advanced models for space weather forecasting, from which we have been providing forecasting services to a satisfied domestic clientele. Alongside that, we have continued our research on solar activities and the Sun-Earth connection. In this talk, I will summarize our contributions to space weather over the past 10 years and discuss future plans for next decade.

[구 SS-14] 우주환경 예보를 위한 VAP 데이터 처리 시스템 및 실시간 데이터 표출

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근지구 우주환경 예측을 위해서는 태양의 주기, 흑점, 그리고 코로나의 방출과 함께 Van Allen Belt에 붙잡힌 고에너지 입자의 상태 변화가 우주 환경의 예보를 위한 중요 요소가 된다. 이런 고에너지 입자를 측정하기 위해서는 Van Allen Belt를 통과하는 VAP 위성의 데이터를 살펴보는 것이 매우 중요하다. 이 연구에서는 한국천문연구원에서 APL과 공동으로 VAP 위성의 실시간 데이터를 송수신하는 시스템을 구축하고, 그 실시간 데이터를 우주환경감시실에서 표출하여 Van Allen Belt의 변화를 바로 알아보는 과정을 기술 하였다. 이를 통해 데이터의 경향성을 바로 파악하여 특정 이벤트의 발생을 알아 낼 수 있을 뿐만 아니라 과거의 데이터를 손쉽게 찾아볼 수 있었다. 별도의 프로그램을 개발하여 데이터의 표출 비교를 가능하게 함으로써 다른 위성의 데이터나 태양 이미지를 보지 않아도 자체 비교를 통해 이벤트의 발생을 찾아 볼 수 있게 되었다.

[구 SS-15] Development of three-dimensional global MHD model for an interplanetary coronal mass ejection

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We developed a three-dimensional magnetohydrodynamic (MHD) code to reproduce the structure of a solar wind, the properties of a coronal mass ejection (CME) and the interaction between them. This MHD code is based on the finite volume method incorporating total variation diminishing (TVD) scheme with an unstructured grid system. In particular, this grid system can avoid the singularity at the north and south poles and relax tight CFL conditions around the poles, both of which would arise in a spherical coordinate system (Tanaka 1994). In this model, we first apply an MHD tomographic method (Hayashi et al. 2003) to interplanetary scintillation (IPS) observational data and derive a solar wind from the physical values obtained at 50 solar radii away from the Sun. By comparing the properties of this solar wind to observational data obtained near the Earth orbit, we confirmed that our model captures the velocity, temperature and density profiles of a solar wind near the Earth orbit. We then insert a spheromak-type CME (Kataoka et al. 2009) into the solar wind to reproduce an actual CME event. This has been done by introducing a time-dependent boundary condition to the inner boundary of our simulation domain. On the basis of a comparison between a simulated CME and observations near the Earth, we discuss the physics involved in an ICME interacting with a solar wind.

[구 SS-16] Full ice-cream cone model for halo coronal mass ejections

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The determination of three dimensional parameters (e.g., radial speed, angular width, source location) of Coronal Mass Ejections (CMEs) is very important for space weather forecast. To estimate these parameters, several cone models based on a flat cone or a shallow ice-cream cone with spherical front have been suggested. In this study, we investigate which cone model is proper for halo CME morphology using 33 CMEs which are identified as halo CMEs by one spacecraft (SOHO or STEREO-A or B) and as limb CMEs by the other ones. From geometrical parameters of these CMEs such as their front curvature, we find that near full ice-cream cone CMEs (28 events) are dominant over shallow ice-cream cone CMEs (5 events). So we develop a new full ice-cream cone model by assuming that a full ice-cream cone consists of many flat cones with different heights and angular widths. This model is carried out by the following steps: (1) construct a cone for given height and angular width, (2) project the cone onto the sky plane, (3) select points comprising the outer