between global temperature anomaly and two main factors: geomagnetic activity (aa index) of Earth external factor and CO2 of Earth internal factor. For this, we used NOAA Global Surface Temperature anomaly (Ta) data from 1868 to 2015. The aa index indicates the geomagnetic activity measured at two anti-podal subauroral stations (Canberra Australia and Hartland England) and the CO2 data come from historical ice core records and NOAA/ESRL data. From the comparison between (Ta) and aa index, we found several interesting things, First, the linear correlation coefficient between two parameters increases until 1985 and then decreases rapidly. Second, the scattered plot between two parameters shows a boundary of the correlation tendency (positive and negative correlation) near 1985. A partial correlation of (Ta) and two main factors (aa index, CO2) also shows that the geomagnetic effect (aa index) is dominant until about 1985 and the CO2 effect becomes much more important after then. These results indicate that the CO2 effect become very an important factor since at least 1985. For a further analysis, we simply assume that Ta = Ta(aa)+Ta(CO2) and made a linear regression between (Ta) and aa index from 1868 to 2015. A linear model is then made from the linear regression between energy consumption (a proxy of CO2 effect) and Ta-Ta(aa) since 1985. Our results will be discussed in view of the prediction of global warming.

[포 SS-02] Evaluation of a Solar Flare Forecast Model with Value Score

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There are probabilistic forecast models for solar flare occurrence, which can be evaluated by various skill scores (e.g. accuracy, critical success index, heidek skill score, and true skill score). Since these skill scores assume that two types of forecast errors (i.e. false alarm and miss) are equal or constant, which does not take into account different situations of users, they may be unrealistic. In this study, we make an evaluation of a probabilistic flare forecast model [Lee et al., 2012] which use sunspot groups and its area changes as a proxy of flux emergence. We calculate daily solar flare probabilities from 2011 to 2014 using this model. The skill scores are computed through contingency tables as a function of forecast probability, which corresponds to the maximum skill score depending on flare class and type of a skill score. We use a value score with cost/loss ratio, relative importance between the two types of forecast errors. The forecast probability (y) is linearly changed with the cost/loss ratio (x) in the form of y=ax+b: a=0.88; b=0 (C), a=1.2; b=-0.05(M), a=1.29; b=-0.02(X). We find that the forecast model has an effective range of cost/loss ratio for each class flare: 0.536-0.853(C), 0.147-0.334(M), and 0.023-0.072(X). We expect that this study would provide a guideline to determine the probability threshold and the cost/loss ratio for space weather forecast.

[포 SS-03] Dependence of solar proton events on their associated activities: solar and interplanetary type II radio burst, flare, and CME

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We investigate the dependence of solar proton events (SPEs) on solar and interplanetary type II bursts associated with solar flares and/or CME-driven shocks. For this we consider NOAA solar proton events from 1997 to 2012 and their associated flare, CME, and type II radio burst data with the following subgroups: metric, decameter-hectometric (DH), and meter-to-kilometric (m-to-km) type II bursts. The primary findings of this study are as follows. First, about half (52%) of the m-to-km type II bursts are associated with SPEs and its occurrence rate is higher than those of DH type II bursts (45%) and metric type II bursts (19%). Second, the SPE occurrence rate strongly depends on flare strength and source longitude, especially for X-class flare associated ones; it is the highest in the central region for metric (46%), DH (54%), and m-to-km (75%) subgroups. Third, the SPE occurrence rate is also dependent on CME linear speed and angular width. The highest rates are found in the m-to-km subgroup associated with CME speed 1500 kms−1: partial halo CME (67%) and halo CME (55%). Fourth, in the relationships between SPE peak fluxes and solar eruption parameters (CME linear speed, flare flux, and longitude), SPE peak flux is mostly dependent on SPE peak flux for all three type II bursts (metric, DH, m-to-km). It is noted that the dependence of SPE peak flux on flare peak flux decreases from metric to m-to-km type II

burst.

[포 SS-04] 2016 Total Solar Eclipse Expedition

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A total solar eclipse occurs on March 9 along the path through Indonesia and the Pacific. KASI organized an expedition team for total solar eclipse observation. The main purpose of this observation is to test the coronal temperature and outflow velocity diagnostics based on filter observation, which is proposed for the next generation coronagraph. In addition, various white light observations including automatic programmed observation, manual observation, linear polarization, and time-lapse movie will be tried. We report the preliminary result of the expedition.

[포 SS-05] Detrended fluctuation analysis of magnetic parameters of solar active regions

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Many signals in the nature have power-law behaviors, namely they are "scale-free".
The method of detrended fluctuation analysis (DFA), as one of the popular methods (e.g., Rescaled range analysis and Spectral analysis) for determining scale-free nature of time series, has a very important advantage that the DFA can be applied to both stationary and non-stationary signals. The analysis of time series using the DFA has been broadly used in physiology, finance, hydrology, meteorology, geology, and so on. We performed the DFA of 16 Spaceweather HMI Active Region Patch (SHARP) parameters for 38 HMI Active Region Patches (HARPs) obtained by Solar Dynamics Observatory (SDO) from May 2010 to June 2014. The main results from this study are as follows. (1) The most of the time series data are non-stationary. (2) The DFA scaling exponents of "mean vertical current density" for 38 HARPs have a negative correlation coefficient (-0.41) with flare index. (3) The DFA scaling exponents of parameters such as "Sum of the absolute value of net currents per polarity", "Absolute value of the net current helicity", and "Mean photospheric excess magnetic energy density" for the most active HARPs having more than 10 major flares, have positive correlation coefficients (0.64, 0.59, and 0.53, respectively) with the ratio of "the number of CMEs associated with major flares" to "the number of major flares". Physical interpretations on our results will be discussed.

[포 SS-06] Comparison between observation and theory for the stand-off distance ratios of CMEs and their associated ICMEs

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We examine whether the observational stand-off distance ratios of CMEs and their associated ICMEs could be explained by theoretical model or not. For this, we select 16 CME-ICME pairs from September 2009 to October 2012 with the following conditions: (1) limb CMEs by SOHO and their associated ICMEs by twin STEREO spacecraft and vice versa when both spacecraft were roughly in quadrature; (2) the faint structure ahead of a limb CME is well identified; and (3) its associated ICME clearly has a sheath structure. We determine the observational stand-off distance ratios of the CMEs by using brightness profiles from LASCO-C2 (or SECCHI-COR2) observations and those of the ICMEs by solar wind data from STEREO-IMPACT/PLASTIC (or OMNI database) observations. We also determine the theoretical stand-off distance ratios of the CME-ICME pairs using semi-empirical relationship based on the bow shock theory. We find the following results. (1) Observational CME stand-off distance ratio decreases with increasing Mach number at the Mach numbers between 2 and 6. This tendency is consistent with the results from the semi-empirical relationship. (2) The observational stand-off distance ratios of several ICMEs can be explained by the relationship.

태양계

[포 SS-07] Thermal Modeling of Comet-Like Asteroids

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