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