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We investigate a relative contribution from short to long-term flaring rate to predicting M and X-class flare probabilities. In this study, we consider magnetic parameters summarizing distribution and non-potentiality by Solar Dynamics Observatory/Helioseimic and Magnetic Imager and flare list by Geostationary Operational Environmental Satellites. A short-term rate is the number of major flares that occurred in an given active region (AR) within one day before the prediction time. A mid-term rate is a mean flaring rate from the AR appearance day to one day before the prediction time. A long-term rate is a rate determined from a relationship between magnetic parameter values of ARs and their flaring rates from 2010 May to 2015 April. In our model, the predicted rate is given by the combination of weighted three rates satisfying that their sum of the weights is 1. We calculate Brier skill scores (BSSs) for investigating weights of three terms giving the best prediction performance using ARs from 2015 April to 2018 April. The BSS (0.22) of the model with only long-term is higher than that with only short-term or mid-term. When short or mid-term are considered additionally, the BSSs are improved. Our model has the best performance (BSS = 0.29) when all three terms are considered, and their relative contribution from short to long-term rate are 19%, 23%, and 58%, respectively. This model seems to be more effective when predicting active solar ARs having several major flares.

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[구 SS-12] Application of a non-equilibrium ionization model to rapidly heated solar plasmas

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We apply a non-equilibrium ionization (NEI) model to a supra-arcade plasma sheet, shocked plasma, and current sheet. The model assumes that the plasma is initially in ionization equilibrium at low temperature, and it is heated rapidly by a shock or magnetic reconnection. The model presents the temperature and characteristic timescale responses of the Atmospheric Imaging Assembly (AIA) on board Solar Dynamic Observatory and X-ray Telescope (XRT) on board Hinode. We compare the model ratios of the responses between different passbands with the observed ratios of a supra-arcade plasma sheet on 2012 January 27. We find that most of observations are able to be described by using a combination of temperatures in equilibrium and the plasma closer to the arcade may be close to equilibrium ionization. We also utilize the set of responses to estimate the temperature and density for shocked plasma associated with a coronal mass ejection on 2010 June 13. The temperature, density, and the line of sight depth ranges we obtain are in reasonable agreement with previous works. However, a detailed model of the spherical shock is needed to fit the observations. We also compare the model ratios with the observations of a current sheet feature on 2017 September 10. The long extended current sheet above the solar limb makes it easy to analyze the sheet without background corona. We find that the sheet feature is far from equilibrium ionization while the background plasma is close to equilibrium. We discuss our results with the previous studies assuming equilibrium ionization.

[구 SS-13] Oscillation of a Small Hα Surge in a Polar Coronal Hole

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Hα surges (i.e. cool/dense collimated plasma ejections) may act as a guide for a propagation of magnetohydrodynamic waves. We report a high-resolution observation of a surge observed with 1.6m Goody Solar Telescope (GST) on 2009 August 26, from 18:20~UT to 18:45UT.

Characteristics of plasma motions in the surge are determined with the normalizing radial gradient filter and the Fourier motion filter. The shape of the surge is found to change from a `C' shape to an inverse `C' shape after a formation of a cusp, a signature of reconnection. There are apparent upflows seen above the cusp top and downflows below it. The upflows show rising and rotational motions in the right-hand direction, with the rotational speed decreasing with height.

Near the cusp top, we find a transverse oscillation of the surge, with the period of ~2 min. There is no change of the oscillation phase below the cusp top, but above the top a phase change is identified, giving a vertical phase speed about 86kms-1. As the height increases, the initial amplitude of the oscillation increases, and the oscillation damping time decreases from 5.13 to 1.18min. We conclude that the oscillation is a propagating kink wave that is possibly excited by an x-point oscillation.

[구 SS-14] A Comprehensive Study of Interaction of Magnetic Flux Ropes Leading to Solar Eruption

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Solar observations often show that interaction of more than one flux rope is involved in solar eruptions. In this regard, Lau and Finn (1996) intensively studied the interaction of two flux ropes, which reside in between two parallel planes each mimicking one polarity region of the solar photosphere. However, this geometry is quite far from the real solar situation, in which all feet of flux tubes are rooted in one surface only. In this paper, we study the interaction of two flux ropes in a semi-infinite region above a plane representing the solar photosphere. Four cases of the flux rope interaction are investigated in our MHD simulation study: (1) parallel axial fields and parallel axial currents (co-helicity), (2) antiparallel axial fields and parallel axial currents (counter-helicity), (3) parallel axial fields and antiparallel axial currents (counter-helicity), and (4) antiparallel axial fields and antiparallel axial currents (co-helicity). Each case consists of four or six subcases according to the background field direction relative to the flux ropes and the relative positions of the flux rope footpoints. In our simulations, all the cases eventually show eruptive behaviors, but their degree of explosiveness and field topological evolutions are quite different. We construct artificial emission measure maps based on the simulations and compare them with images of CME observations, which provides us with information on what field configurations may generate certain eruption features.

[구 SS-15] Denoise of Astronomical Images with Deep Learning

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Removing noise which occurs inevitably when taking image data has been a big concern. There is a way to raise signal-to-noise ratio and it is regarded as the only way, image stacking. Image stacking is averaging or just adding all pixel values of multiple pictures taken of a specific area. Its performance and reliability are unquestioned, but its weaknesses are also evident. Object with fast proper motion can be vanished, and most of all, it takes too long time. So if we can handle single shot image well and achieve similar performance, we can overcome those weaknesses.

Recent developments in deep learning have enabled things that were not possible with former algorithm-based programming. One of the things is generating data with more information from data with less information. As a part of that, we reproduced stacked image from single shot image using a kind of deep learning, conditional generative adversarial network (cGAN). r-band camcol2 south data were used from SDSS Stripe 82 data. From all fields, image data which is stacked with only 22 individual images and, as a pair of stacked image, single pass data which were included in all stacked image were used. All used fields are cut in 128x128 pixel size, so total number of image is 17930. 14234 pairs of all images were used for training cGAN and 3696 pairs were used for verify the result.

As a result, RMS error of pixel values between generated data from the best condition and target data were 7.67×10^{-4} compared to original input data, 1.24×10^{-3}. We also applied to a few test galaxy images and generated images were similar to stacked images qualitatively compared to other de-noising methods. In addition, with photometry, The number count of stacked-cGAN matched sources is larger than that of single pass-stacked one, especially for fainter objects. Also, magnitude completeness became better in fainter objects. With this work, it is possible to observe reliably 1