We thank the reviewer for their thorough evaluation of and constructive feedback on our manuscript. We propose several changes below that we believe address the reviewer's commentary and improve the manuscript. These changes are summarized in this letter, along with specific responses to the reviewer's comments. Below the reviewer's comments our response is shown in **bold**. Proposed modifications and/or additions to the manuscript are shown in *italics*.

Reviewer #2 Evaluation

In this paper, entitled "How well can we forecast local magnetic ground perturbations with existing space weather monitoring resources?" the authors use data from a ground-based observatory located in Norway, along with solar wind and interplanetary magnetic field data to train and validate the long short-term memory (LSTM) models. For some cases, they also use CME arrival times. I find their study to be an interesting contribution to space weather forecasting and recommend publication after minor revisions.

- **Thank you! We appreciate the reviewer's very careful reading of our manuscript and their feedback. Except where explicitly indicated below with bold text, we propose to make the modifications recommended by the reviewer in the revised manuscript.**

Below, I provide my suggestions regarding minor issues:

line 9: consider deleting "simultaneously" - accompanied already implies something occurring together

- **Agreed, will be removed in the revised manuscript**

line 16: "solar wind speed" --> "solar wind speed v" (I suggest defining solar wind speed at this point - first mention - and use only the abbreviation "v" to the rest of the manuscript

- **Agreed, we will remove instances of "solar wind speed" in the revised manuscript except where it seems necessary to maintain search functionality and/or clarity.**

line 43: coronal mass ejection (CME) --> CME (already defined in line 18)

- **Thank your catching this, will be corrected.**

line 52: interplanetary magnetic field --> IMF (already defined in line 17)

- **Thank your catching this, will be corrected.**

lines 62-63: (Advanced Composition Explorer (ACE), 2025) --> Is there a reference or link missing here?

- **Sorry for the confusion; there is a reference to "Advanced Composition Explorer (ACE), 2025" in the bibliography. We included this reference so that each dataset mentioned in this paragraph has a reference pointing the reader to its web address.**

line 66: after "Statnett" add something like "system operator of the Norwegian power system", as the reader might not be aware of who Statnett is

- **Thank you, we will revise the sentence in question to read as follows:**

  Our choice to focus on Rørvik magnetometer measurements is based on information from Norway's transmission grid operator, Statnett, that ground-based conducting infrastructure close to the area was responsive to elevated levels of geomagnetic activity in 2021 (Statnett, private communication, 2025).

line 68: "Viljanen et al. (2021)" --> "(Viljanen et al., 2021)"

lines 71-72: please consider clarifying a little bit on "first-order backward differencing" - this term is not familiar to all readers

- **Good point, we will state the formula for first-order backward differencing in the revised manuscript.**

line 81: "the power in other in contributions" --> "the contributions"

- **Will be corrected.**

line 95: "dipole tilt ψ" --> "dipole tilt angle ψ"

- **Will be corrected.**

line 95 and Figure 2: in text it reads as "By and Bz". In panel b it is "Bz" and in panel c "By". In the caption it reads that By is in panel (b) and Bz in panel (c). Please check if it is "By" and "Bz" or the other way around and revise accordingly so that everywhere (text, panels, caption) they appear in the same (correct) order.

- **Thank you for catching this, we will correct the text in the revised manuscript so that it reads "Bz and By", corresponding to the order shown in the Figure.**

line 97: "with a standard deviation of ~5–6 h around the time of CME impact" --> how was this time interval chosen?

- **Excellent question, thank you for pointing out that we failed to state this. This time interval was chosen based on typical width of arrival time distributions seen in the HUXt model. We propose to include this information in the revised manuscript, as also indicated in our response to the first reviewer.**

line 101: "blue lines and orange lines" --> "blue and orange lines"

- **Will be corrected.**

line 128: "(In this..." --> "(in this..."

- **Will be corrected.**

line 144: "Akiba et al. (2019)" --> "(Akiba et al., 2019)"

- **Will be corrected.**

line 145: Please consider clarifying the term "patience value" for a broader scientific audience

- **This is a good idea, thank you. In accordance with this comment and a comment from Reviewer 1, we propose to modify the description of hyperparameters selected via Optuna in the revised manuscript so that it reads:**

  "The tuned parameters had a batch size of 70, a look-back window Δt_b = 34 h (or N_b = 204 as previously mentioned), an optimizer with a learning rate of 5.4e-05, early stopping at a patience value of 8, and a dropout probability of zero. (The patience value is a hyperparameter used with the early stopping technique; it is the number of epochs the training process must wait for an improvement in the model's performance on the validation set before stopping the training. The dropout probability is the probability of ignoring a random neuron and its connections; it is part of a commonly used strategy for avoiding overfitting that is known as the dropout method (Srivastava et al, 2014).)"

line 150: "Kingma (2014)" --> "(Kingma, 2014)"

- **Will be corrected.**

line 161: "Girosi et al. (1995)" --> "(Girosi et al., 1995)"

- **Will be corrected.**

line 164: "dropout method" --> Please add reference

- **Will be corrected as shown in our response to the reviewer's comment on Line 145, thank you.**

line 185: "Given that h = w & n = 0,1,2, ...,w and h" --> "Given that h = w, n = 0,1,2, ...,w and h"

- **We propose to revise both the equation preceding this text and the text itself; please see our response to the first reviewer about this same portion of the text.**

lines 190-192: Please consider rephrasing/ splitting into shorter and more concise sentences, as it is pretty hard to follow.

- **We propose to revise this sentence as follows in the revised manuscript:**
  "To obtain a climatology model prediction for a specific timestamp, we use the month of the timestamp in question to first select a group of 24 coefficients. We then convert the timestamp of the observation to fractional hours and perform a linear interpolation between the two nearest hourly averages."

line 205: "Here we are however interested in dynamic learning" --> "Here, however, we are interested in dynamic learning"

- **We agree, thank you for the suggestion.**

lines 213-217: Please revise for clarity (e.g. "fixed" appears multiple times) - Also, the last sentence seems to be redundant

- **We propose to revise this sentence so that it reads as follows in the revised manuscript:**
  Finally, all the transformed data were sequenced using the sliding window method. With this method, a sliding window is created by taking a time series data sample of length T and creating individual subsamples of length n. The last m samples are to be forecasted, and m < n < T. The next subsample is generated by sliding the window forward to the next subsample of length n, such that the total number of subsamples is T-n+1. This process is illustrated in Figure 4.

line 222: "Hyperopt(Bergstra et al., 2015)" --> "Hyperopt (Bergstra et al., 2015)"

- **Will be corrected.**

lines 223-226: Please revise for clarity (and grammar)

- **We propose to revise the sentences on these lines as follows in the revised manuscript:**

  "We chose to use Optuna, as it dynamically constructs the search space, is easy to set up, provides efficient sampling and pruning algorithms, and recently has been reported to be robust in optimizing model hyperparameters (Conde et al., 2023). For this work, we used Optuna to examine sequence window size, number of layers, LSTM hidden units, batch size, patience, learning rate, fold number, and dropout probability."

line 233: "Sampler" --> "sampler"

- **Will be corrected.**

line 243: Please add reference for "Gini importance"

- **We will add a reference to Nembrini et al ([2018](#)), which gives a good overview of the Gini importance.**

line 249" Please clarify "watching capability"

- **Thank you for pointing out that this was unclear. Watching capability was not meant as a technical term; we simply meant that the method is capable of monitoring the values of variables during computation. In the revised manuscript we propose to rewrite "watching capability" → "the capability of this method to monitor variables during computation".**

line 259: "November 3-4" --> "November 3-4, 2021"

- **Will be corrected.**

line 259: "measured values of P0" --> Is P0 actually measured or derived from magnetometer measurements of the geomagnetic field? The same question also applies to line 271 "observed P0"

- **Fair point, P_0 is of course calculated from magnetometer measurements. We propose to use the word "calculated" in the revised manuscript.**

line 309: "dominate" --> "dominates"

- **Will be corrected.**

line 311: "lesser but nevertheless" --> "smaller, yet still"

- **Will be corrected.**

lines 312, 361, 363, 401: "solar wind speed v" --> "v"

- **Will be corrected except where we feel it increases clarity to retain "solar wind speed". Thank you for your careful reading!**

line 320: Please define here MCC, which is now defined later in line 330

- **Thanks for pointing this out, we will correct this in the revised manuscript.**

line 333: Please revise this: "forecasting ?e.g.,>[]Hu2024,Baily2021SW"

- **Will be corrected.**

Caption of Table 3: Please make sure to include also TP, TN, FP and FN

- **Will be corrected.**

line 360: "shows" --> "show"

- **Will be corrected.**

line 358: Please consider making this sentence more clear and precise

- **We propose to shorten this sentence in the revised manuscript so that it reads:**

The feature importance shown in Figure 9 was calculated for each model and forecasting horizon h.

Caption of Figure 5: "...In each panel The observed..." --> "...In each panel the observed..."

- **Will be corrected.**

Captions of Figures 6 and 7: "Measured dH/dt" --> Is it actually measured or calculated? (see also previous comment for line 259)

- **In line with our response above, we propose to correct this in the revised manuscript so that it reads "Estimated *dH/dt* power over 0–0.01 Hz (thick, gray line) derived from Rørvik magnetometer measurements" or similar.**