Response to Reviewers

Dear Reviewer,

We appreciate the time and effort that you have dedicated and are grateful for your insightful comments which have improved the manuscript. We have incorporated the constructive suggestions, and have highlighted the changes within the manuscript and marked them in blue color. Here is a point-by-point response to your comments and concerns.

Reviewer 2

The manuscript proposes a new deep-learning picker that leverages dynamic convolutional neural networks for detecting and picking seismic phases from windowed or continuous waveform data. The authors then combined the previously published CREIME model for magnitude estimations of waveform windows that have high P-wave probabilities. The authors have evaluated the performance of their picker and their combined workflow on open-source seismic datasets and aftershocks following the Turkey earthquake. The technical part of the manuscript is overall solid. However, I have vital concerns about the 'real-time' claim. It seems to me that the authors have confused the concept of processing continuous data with the concept of real-time earthquake monitoring. I suggest the authors modify their claim from 'Real-time' to 'efficient' and emphasize more on the performance of the proposed deep-learning picker. Aside from the 'real-time' claim, the study seems good overall. Below are my detailed comments:

Response: We appreciate the reviewer's suggestion to modify our claim from 'real-time' to 'efficient'. We understand that 'real-time' can have different interpretations, and we agree that emphasizing the efficiency of our proposed deep-learning picker is essential. We made this adjustment in the revised manuscript avoiding the strict interpretation of 'real-time'.

1.How is the term 'Real-time' defined? What is the time cost between the time of data recorded at the seismometer and the time of output produced? Please note that there are several important steps for real-time earthquake monitoring besides the time cost of the phase-picking model. For example, how is the time cost of the data transmitted from the seismometer to the data center? Is the data processed at the seismometer end with edge-computing (which would be important in areas with poor internet access), or is the data transmitted to the data center first and processed later there? The data packages in the real-time seismic data flow can contain errors due to transmission issues. How is that addressed?

Response: We acknowledge that the term 'real-time' to describe our model's performance was a misnomer. Our model does not operate in real-time, and therefore, we did not perform any analysis on the time cost of real-time data flow. We apologize

for any confusion caused by the incorrect terminology and thank the reviewer for pointing this out. Instead, our proposed model provides timely results from continuous waveform recordings. We revised the manuscript to accurately reflect this and ensure that our terminology aligns with the actual capabilities of our model.

2.What is the inference time cost of the model? What is the key advantage of the proposed method over conventional and lightweight convolutional deep-learning pickers in terms of real-time monitoring? The authors claim, "However, most of the prevalent CNN-based models perform inference using static convolution kernels, which may limit their representation power, efficiency, and ability for interpretation." However, to my acknowledgment, the current CNN-based models, especially lightweight ones, are sufficient for millisecond-level inference. One key claim of the manuscript is that the proposed method is much faster and, therefore, more suitable for real-time earthquake monitoring. However, I didn't find any quantitative comparisons on the inference speed in this paper.

Response: In the introduction section of the manuscript, we claim that "However, most of the prevalent CNN-based models perform inference using static convolution kernels, which may limit their representation power, efficiency, and ability for interpretation." To clarify, our primary focus in this work is the utilization of the dynamic networks to enhance the performance of the seismic phase classification performance and, consequently reduce the errors in the phase arrival-time estimation. As a result, we have not quantified the time comparison of the inference speed in this paper. However, following the reviewer's suggestion, we will explore such a relative comparison in our follow-up work.

3.The event's location is one key information in earthquake monitoring and yet not resolved by the current workflow. The lack of event location information would decrease the significance of the proposed monitoring method.

Response: Event location is indeed a crucial component of seismic analysis, but its inclusion in our current model was beyond the scope of this work. We understand the importance of this aspect and recognize it as an essential feature for a comprehensive seismic monitoring system. However, getting an accurate phase arrival is crucial for a correct event location determination. We plan to address event location information and upgrade the current model in future research.

4.Why is being adaptive to different input lengths important? Is that because in the real-time earthquake monitoring scenario that the authors are dealing with, the input lengths of data chunks can be significantly different? And what are the advantages of the proposed method over the RNN-based pickers, which can also adapt to different input lengths?

Response:

- The proposed method is adaptive to different input lengths, as it can accommodate the continuous data of different durations. We have edited the text in line 40 to highlight this.
- We are currently working on a RNN-based model for event detection which will be a follow-up of this work.

5. Section 5.5 ‘Real-time earthquake detection’, how is the ‘real-time’ here different from ‘continuous data’? Section 6.2 ‘the live data of the Turkey earthquake’, what does the ‘live data’ mean, do authors have access to the real-time data packages from the Earthquake Data Center System of Turkey, or do they use the downloaded continuous waveform data?

Response: We incorrectly used the term ‘real-time’ when referring to our data source. we apologize again for the inconvenience. To accurately describe our data source, we now use the term ‘continuous seismic recordings’ throughout the revised manuscript. This term better reflects the downloaded continuous waveform data that we are utilizing.