

# DROUGHT FORECASTING USING A HYBRID NEURAL ARCHITECTURE FOR INTEGRATING TIME SERIES AND STATIC DATA

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## How bad can the drought be ?

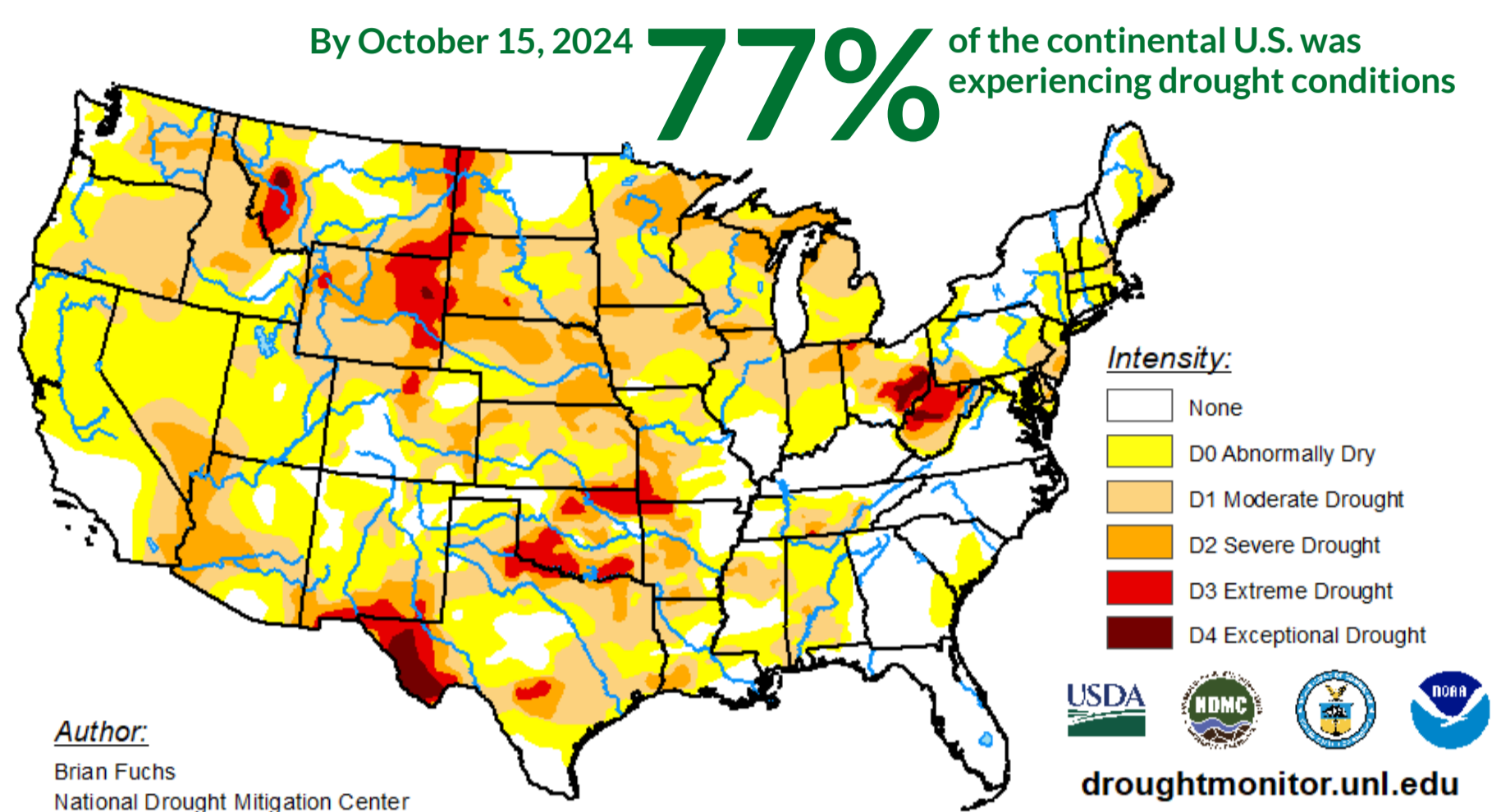


Figure 1. USDM (US Drought Monitor) map by 15/10/2024.

## Motivations

- ▶ Developing **better forecasting models enables early drought detection**, allowing timely intervention and **mitigating effects** on water resources, agriculture, and communities.
- ▶ Most previous deep learning approaches target homogeneous regions and use single-modality data.
- ▶ **DroughtED [1]: public dataset featuring an expert-informed metric for drought evaluation.**

## Contributions

1. A neural architecture integrating time series and static data through **FFNNs, LSTMs, categorical embeddings, and an attention mechanism.**
2. An ablation study to assess the contribution of each component within the proposed model.
3. Model introspection through visualization techniques over latent states.

## Data

For each local target (county  $c$ , timestamp  $t$ ):

- ▶ **Time Series:** Meteorological records  $\mathbf{x} \in \mathbb{R}^{T \times M'}$ .
- ▶ **Static features:** Soil characteristics  $\mathbf{s} \in \mathbb{R}^{f_d + f_n}$ .
- ▶ **Target:** Drought intensity categories  $y \in \mathbb{R}^6$ .

$T$  : Number of days before  $t$  (180).

$f_d$  : Number of static categorical features.

$f_n$  : Number of static numerical features.

$M'$  : Meteorological features plus previous year's corresponding features.

## The proposed model

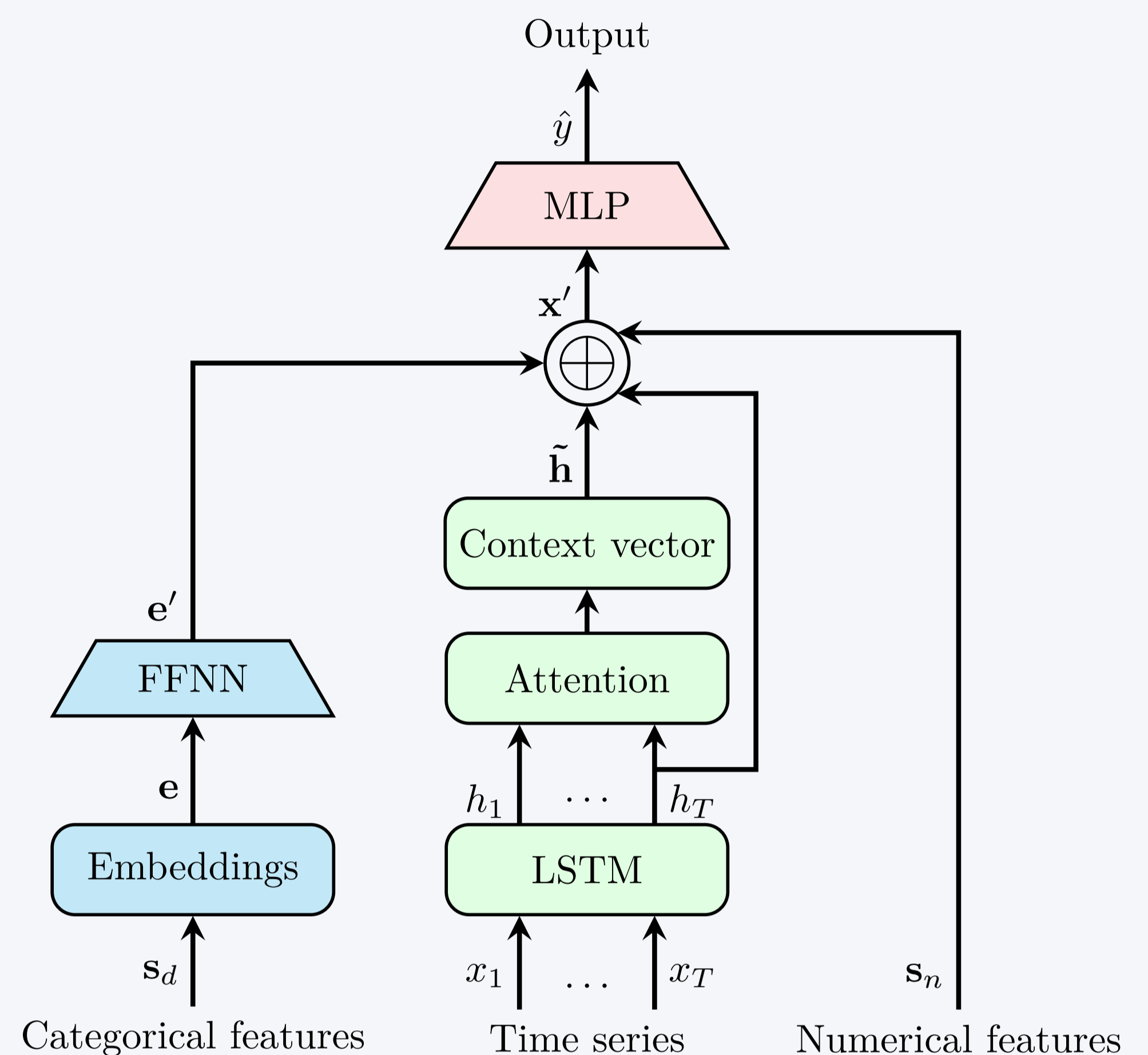


Figure 2. Schematic view of the proposed model.

## Results

Predictive performance vs the best baseline [1]:

- ▶ MAE  $\downarrow$  30%.
- ▶ F1  $\uparrow$  9%.
- ▶ Multi-class weighted ROC-AUC  $\uparrow$  7%.

Observations from the ablation study:

- ▶ Most of the knowledge is derived from meteorological data.
- ▶ The incorporation of the attention mechanism systematically improves performances.

## References

- [1] Christoph D Minixhofer, Mark Swan, Calum McMeekin, and Pavlos Andreadis. Droughted: A dataset and methodology for drought forecasting spanning multiple climate zones. In *ICML 2021 Workshop on Tackling Climate Change with Machine Learning*, 2021.



QR code to the paper

