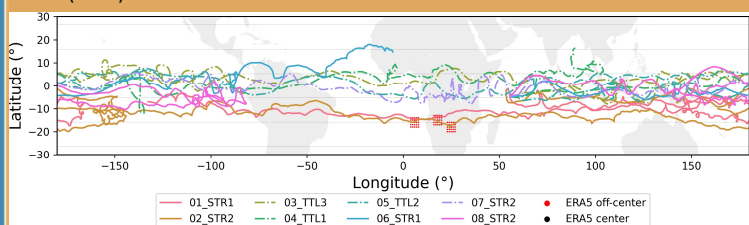


Introduction and background

- Observations from superpressure balloons of Strateole 2 first campaign provide accurate estimates of Gravity Wave Momentum Fluxes (GWMF), see Corcos et al. (2021).



- Related studies:
 - Lott et al. (2023) compared several GW parameterizations against the observations.
 - Has et al. (2024) applied tree-based ensemble ML to probe the relationship between ERA5 large-scale flow and the observed GWMFs.

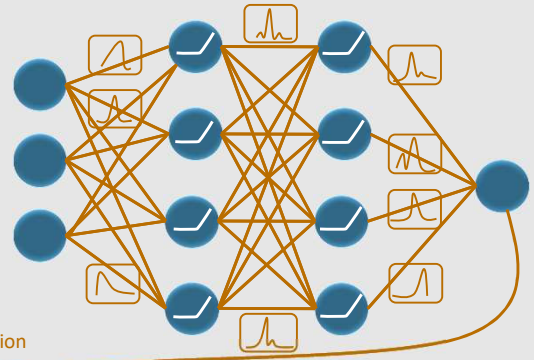
Objective

- With more observations from the 2nd campaign of Strateole 2:
 - Can we improve the reconstruction of GWMF using ERA5 large-scale flow?
 - How certain are we in the reconstruction, knowing that uncertainty exists in both the inputs and the observations?

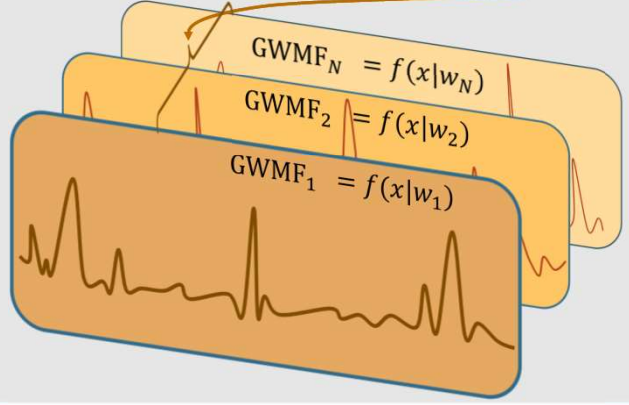
Methodology

- Bayesian Neural Network (BNN):
 - The weights are random variables
 - Prior: $w \sim \mathcal{N}(0, \sigma^2), \sigma^2 \sim \Gamma(a, b)$
 - Training BNN \Leftrightarrow estimating posterior $p(w|D)$ (MCMC method)
 - Prediction: $\hat{y}(x) = \frac{1}{N} \sum_{i=1}^N f(x|w_i)$ with $w_i \sim p(w|D)$.
- BNN was trained on the 2nd campaign (2021) then retrained on 7 balloons of the 1st campaign (2019) to predict the remaining one.

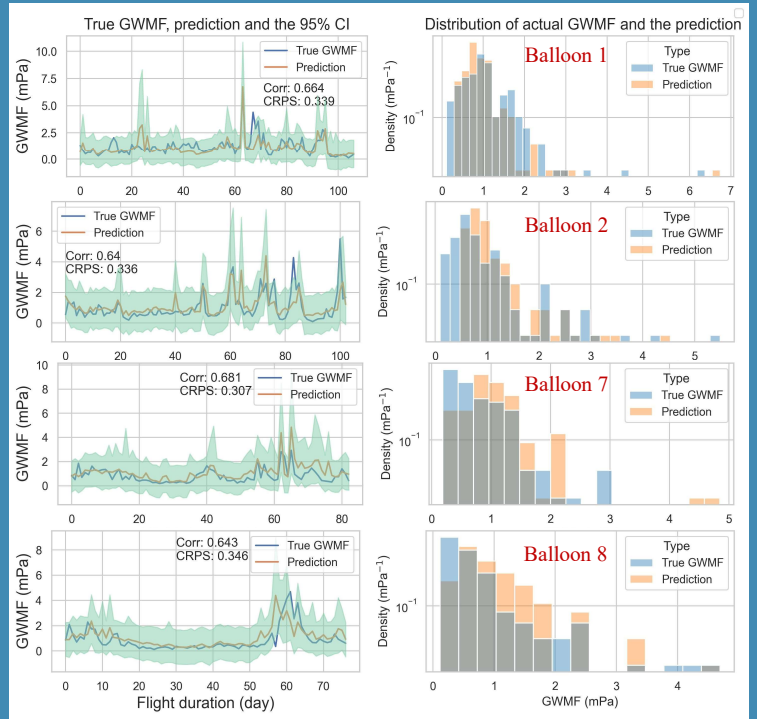
ERA5
 u, v
 Precipitation
 Temperature
 Surface pressure



ReLU activation
 Weight distribution



Numerical Results



Conclusion

- Huge Improvement in capturing high-peak events; however, this comes with a slight degradation in correlation.
- Average correlation ≈ 0.51 and average CRPS ≈ 0.39 .
- The 95% confidence intervals cover majority of the peaks.
- The performance remains variable from one balloon to another due to the limitation of observations and the intermittent nature of GWMFs.
- Training BNN on the whole observations is not stable. Retraining a small part of the pretrained network produces more realistic GWMFs.
- More observations or inputs, such as satellite images, are expected to improve the prediction performance.

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