Nowformer : A Locally Enhanced Temporal Learner for Precipitation Nowcasting

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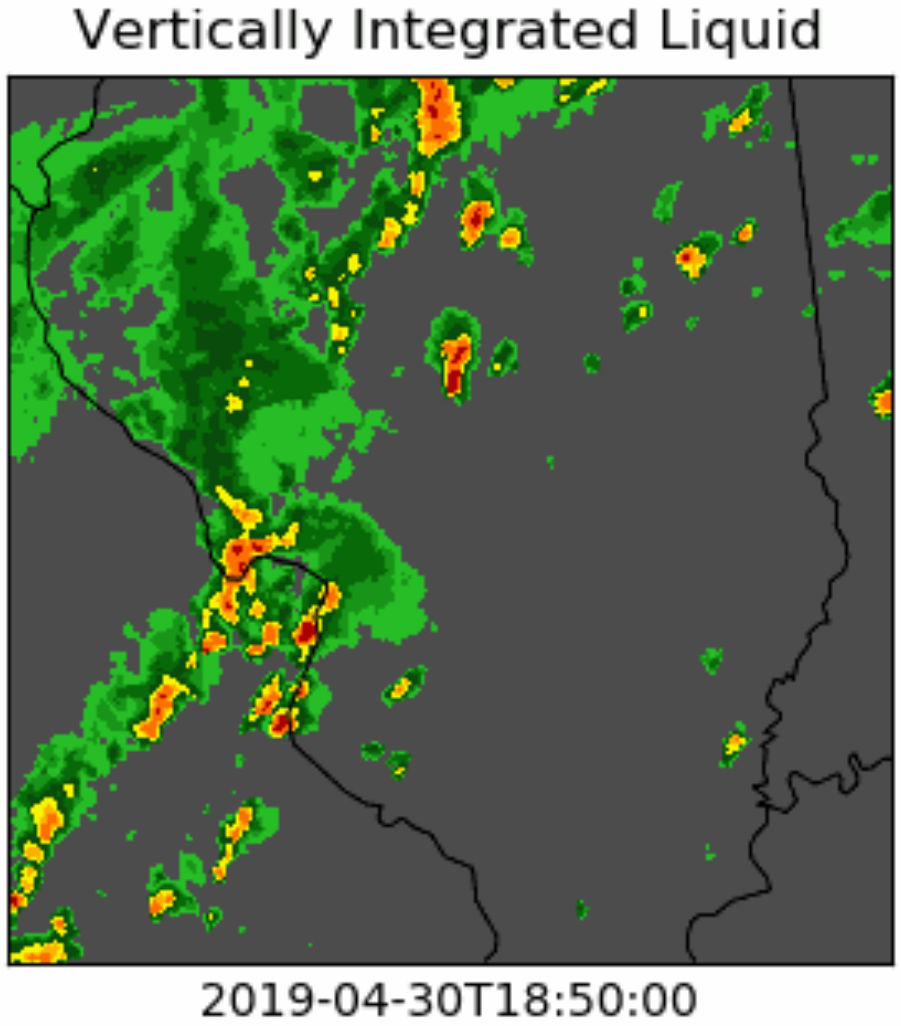
Precipitation Nowcasting

- Climate change has induced heavy downpours in many parts of the globe, causing significant damage to human society. [1,2]

- Precipitation nowcasting
  - Predicts precipitation changes within 6 hours

[1] Mark Veillette, Siddharth Samsi, and Chris Mattioli. Sevir: A storm event imagery dataset for deep learning applications in radar and satellite meteorology. Advances in Neural Information Processing Systems, 33:22009–22019, 2020
[2] Cong Bai, Feng Sun, Jinglin Zhang, Yi Song, and Shengyong Chen. Rainformer: Features extraction balanced network for radar-based precipitation nowcasting. IEEE Geoscience and Remote Sensing Letters, 19:1–5, 2022.

Motivation



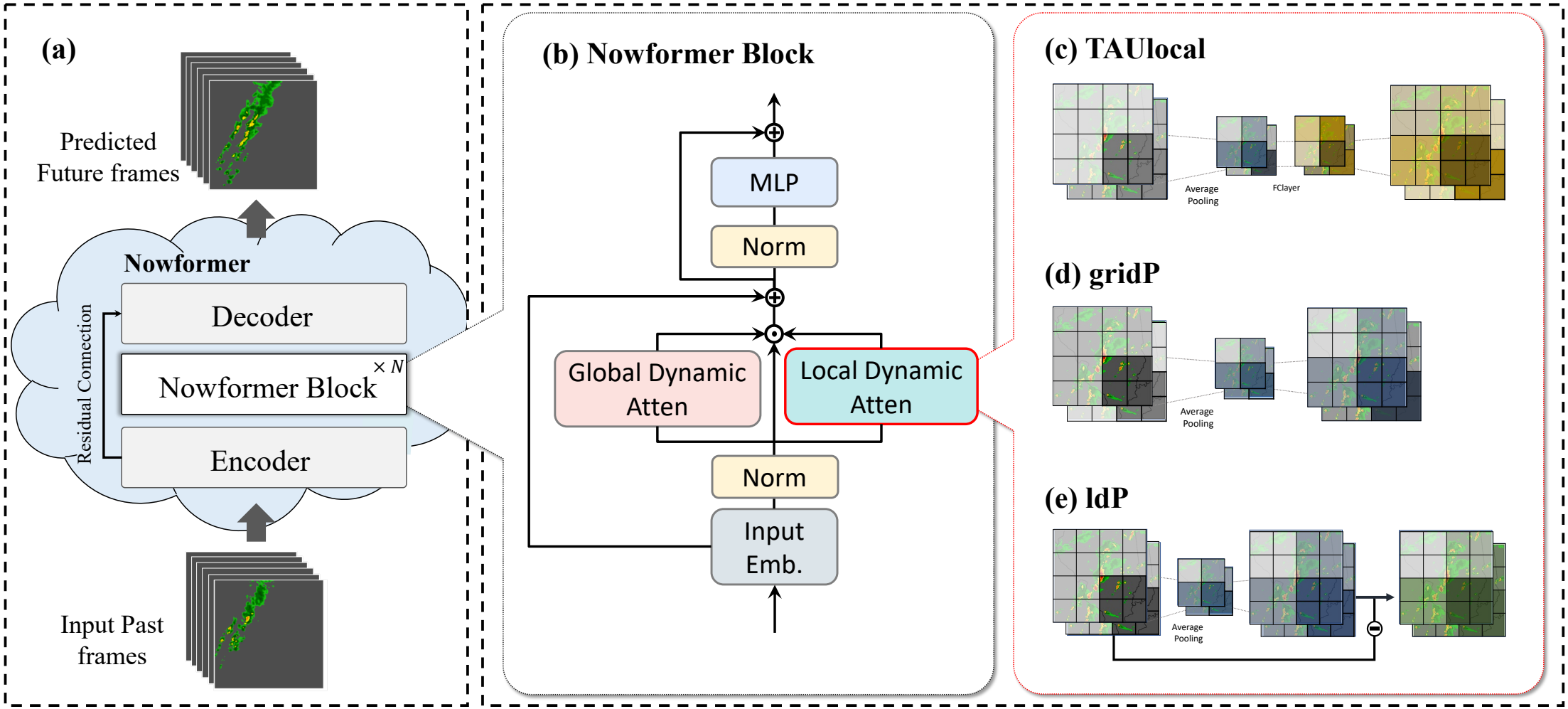
Precipitation data has unique pattern.

- ✓ fluid mass spreading (Global Dynamics)
- ✓ each part of fluid has an individual life-cycle (Local Dynamics)

*Propose a transformer-based nowcasting model that extract **global and local dynamics reflecting meteorological characteristics.***

Our Method

Nowformer



Experimental Results

- Results on Sevir strorm
  - Quantitative results

Table 1: Comparison of our methods with baselines on several metrics.

Model	Param. (M)	GFLOPs	Metrics					
			CSI-74	CSI-133	POD-74	POD-133	MAE↓	MSE(10^{-2}) ↓
Persistence	–	–	0.4766	0.4500	0.6072	0.5814	23.60	35.81
UNet [22]	4.14	4.79	0.6201	0.5820	0.7013	0.6547	21.67	24.48
Rainformer [5]	212.40	50.89	0.6340	0.6055	0.7559	0.7209	20.57	23.79
SimVP [14]	14.03	74.01	0.6507	0.6207	0.7583	0.7231	19.65	23.67
TAU [13]	11.25	55.55	0.6453	0.6152	0.7543	0.7180	19.32	22.20
Nowformer w/ TAUlocal	10.78	55.56	0.6457	0.6183	0.7861	0.7461	19.95	21.30
Nowformer w/ gridP.	10.53	55.56	0.6551	0.6309	**0.8091**	**0.7786**	20.37	22.51
Nowformer w/ ldP.	10.53	55.56	**0.6592**	**0.6331**	0.7881	0.7567	**18.91**	**21.22**

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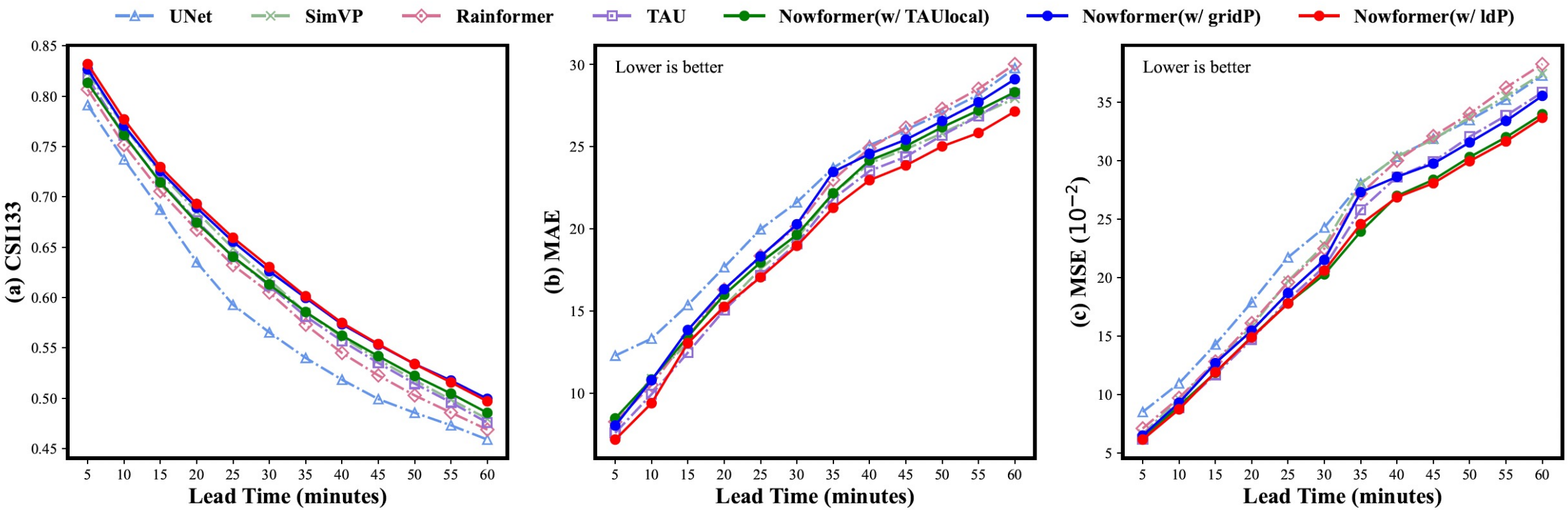

Figure 2: Performance over lead times.

Application context

- ✓ Easy to apply wherever data exists
  - Do not utilize complex physical formulas or dynamic models

- ✓ Scalability
  - Our methods can utilize data from satellites, various sensors, weather stations, etc.
  - it could solve more various tasks related to climate change

Thank you

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