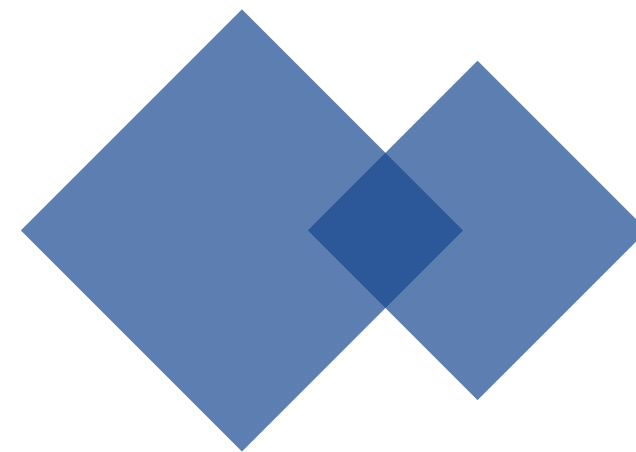


RPMixer

Shaking Up Time Series
Forecasting with **R**andom
Projections
for **Large Spatial-Temporal Data**



24.9.10

Presented by Yyyq



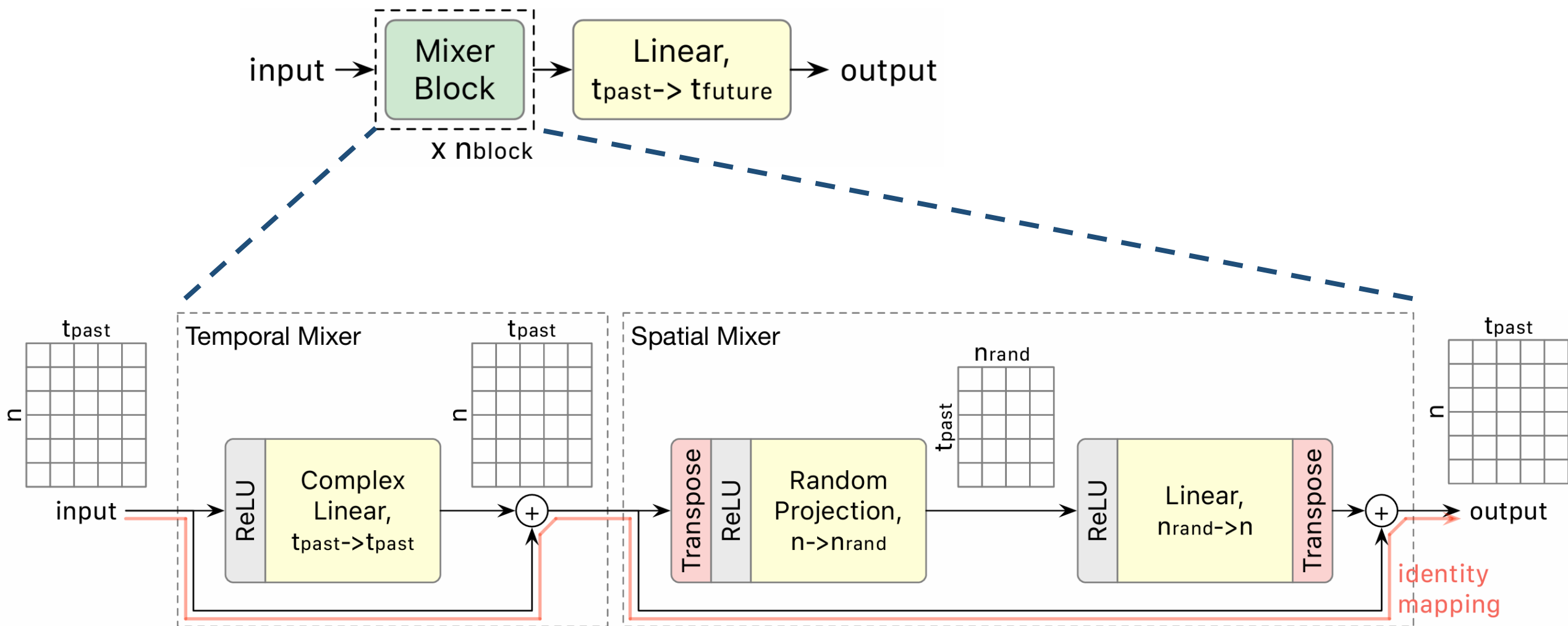
- **大规模时空数据集**上进行交通流预测
- **仅依赖于输入时间序列**：绕过输入图，从时间序列中推断空间关系
 - 在大规模数据集上，在图上进行空间关系学习，面临计算挑战
 - 在没有输入图的情况下，时空预测可以看作是一个**多维时间序列预测问题**



- **RPMixer**: All-MLP, 不依赖输入图, 加入了随机投影层, 提高空间建模能力。
- 在**频域处理时间序列**: 利用**固有周期性**, 增强时间建模能力。
- **大规模时空预测数据集**上证明方法的有效性

03

整体结构

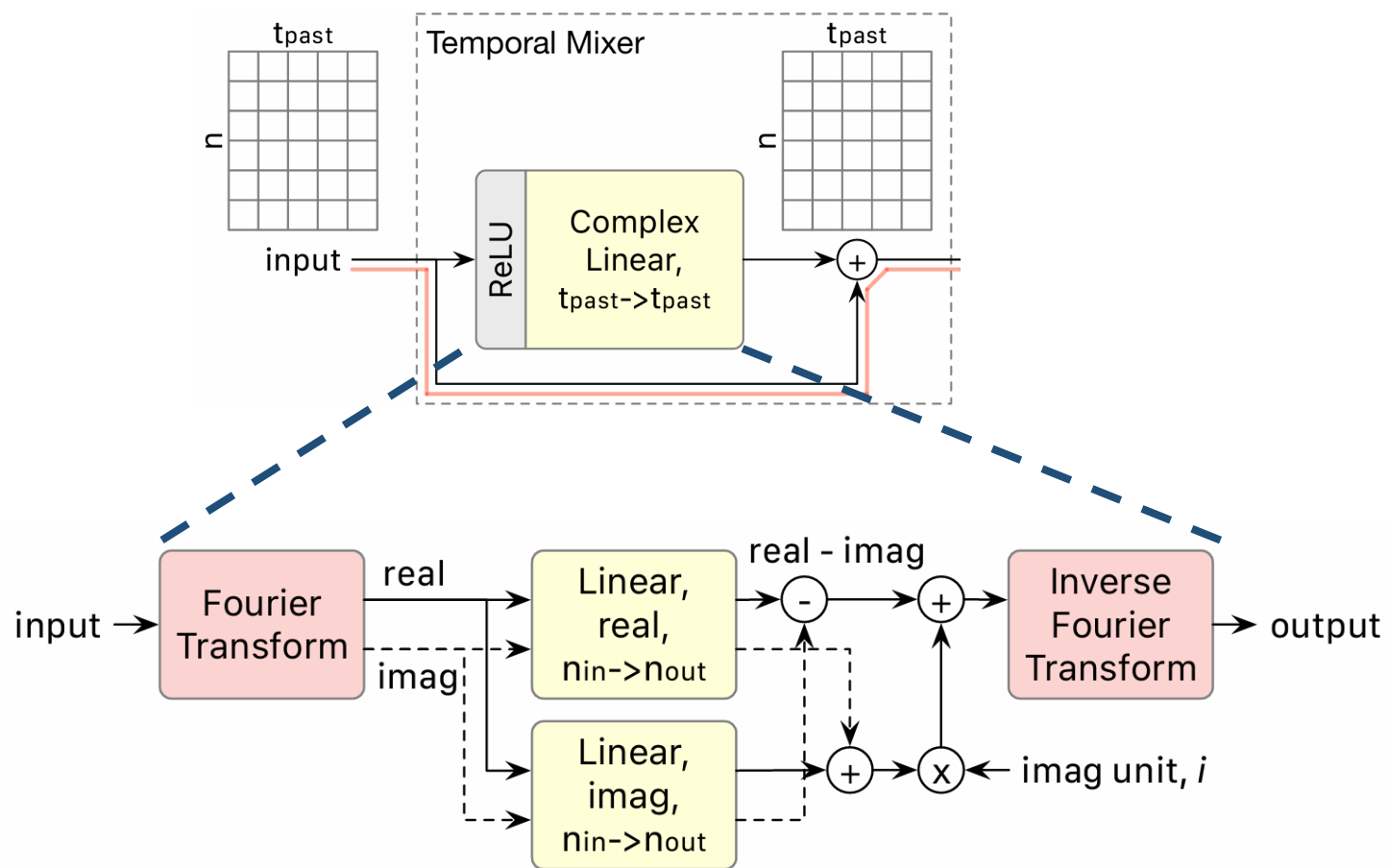


04



算法设计：复线性层（复数的复）→ 时间相关

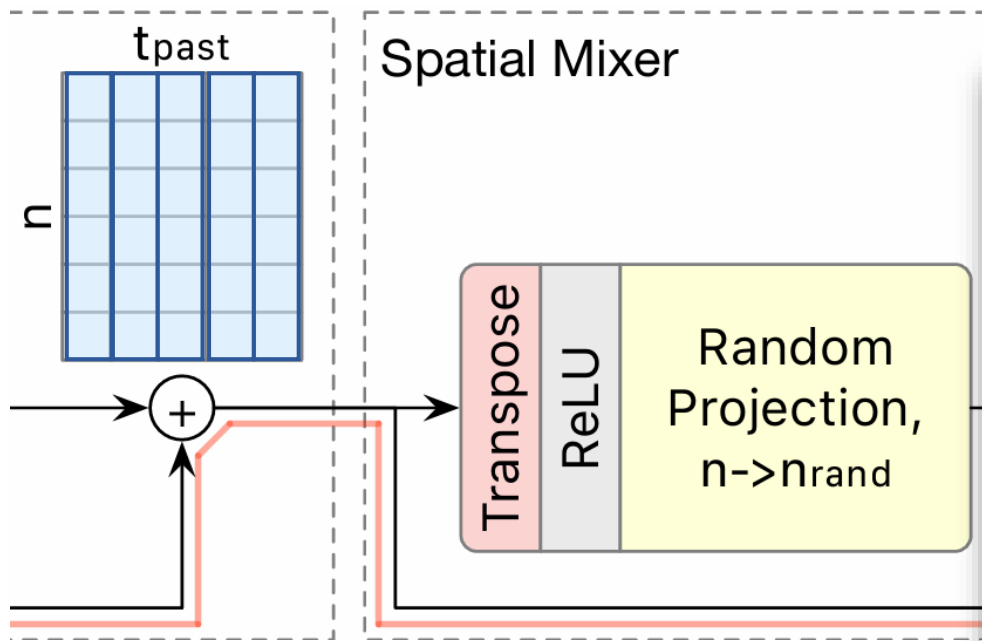
FFT → 将实部和虚部分别用两个线性层进行处理 → 逆FFT





随机投影层：增加不同混频器块输出之间的**多样性**

- 多Mixer堆叠 \approx 集成器（利用不同模型的多样性和互补性，获得更稳健、更准确的结果）
- $t_{past} \times n \rightarrow t_{past} \times n_{rand} \rightarrow t_{past} \times n; (n_{rand} \ll n)$



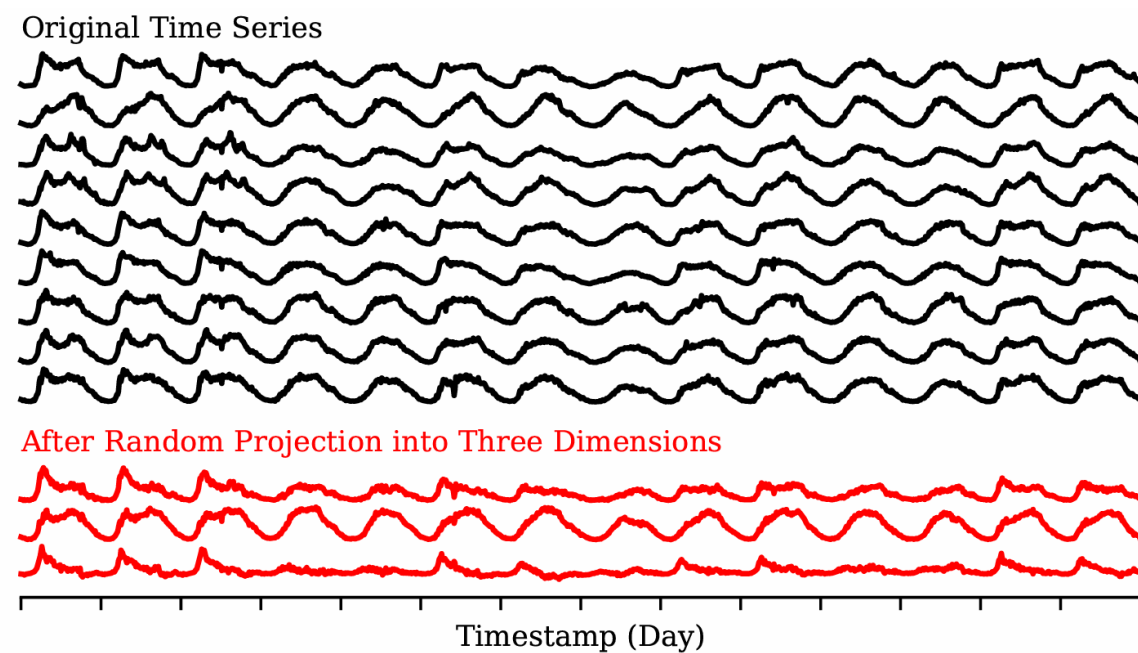
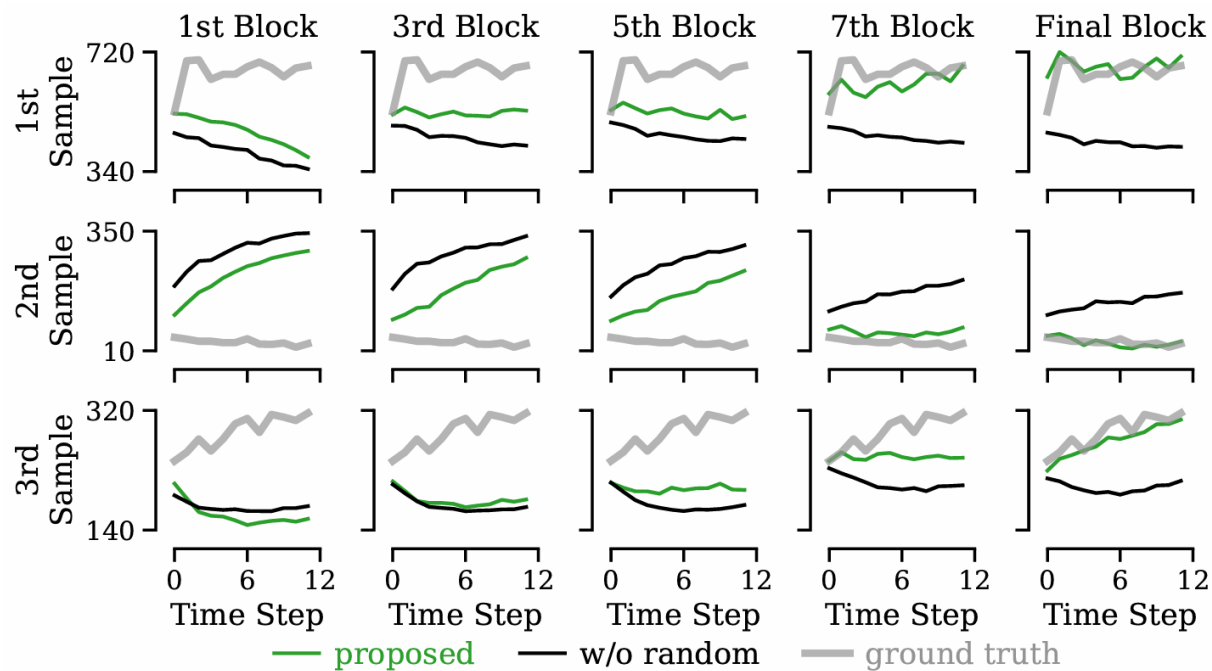
```
class RPLayer(nn.Module):
    def __init__(self, in_dim, out_dim, seed):
        super(RPLayer, self).__init__()
        torch.manual_seed(seed=seed)
        weight = torch.randn(
            out_dim, in_dim, requires_grad=False)
        self.register_buffer(
            'weight', weight, persistent=True)
        self.register_buffer(
            'bias', None)

    def forward(self, x):
        return F.linear(x, self.weight, self.bias)
```



随机投影层：增加不同混频器块输出之间的**多样性**

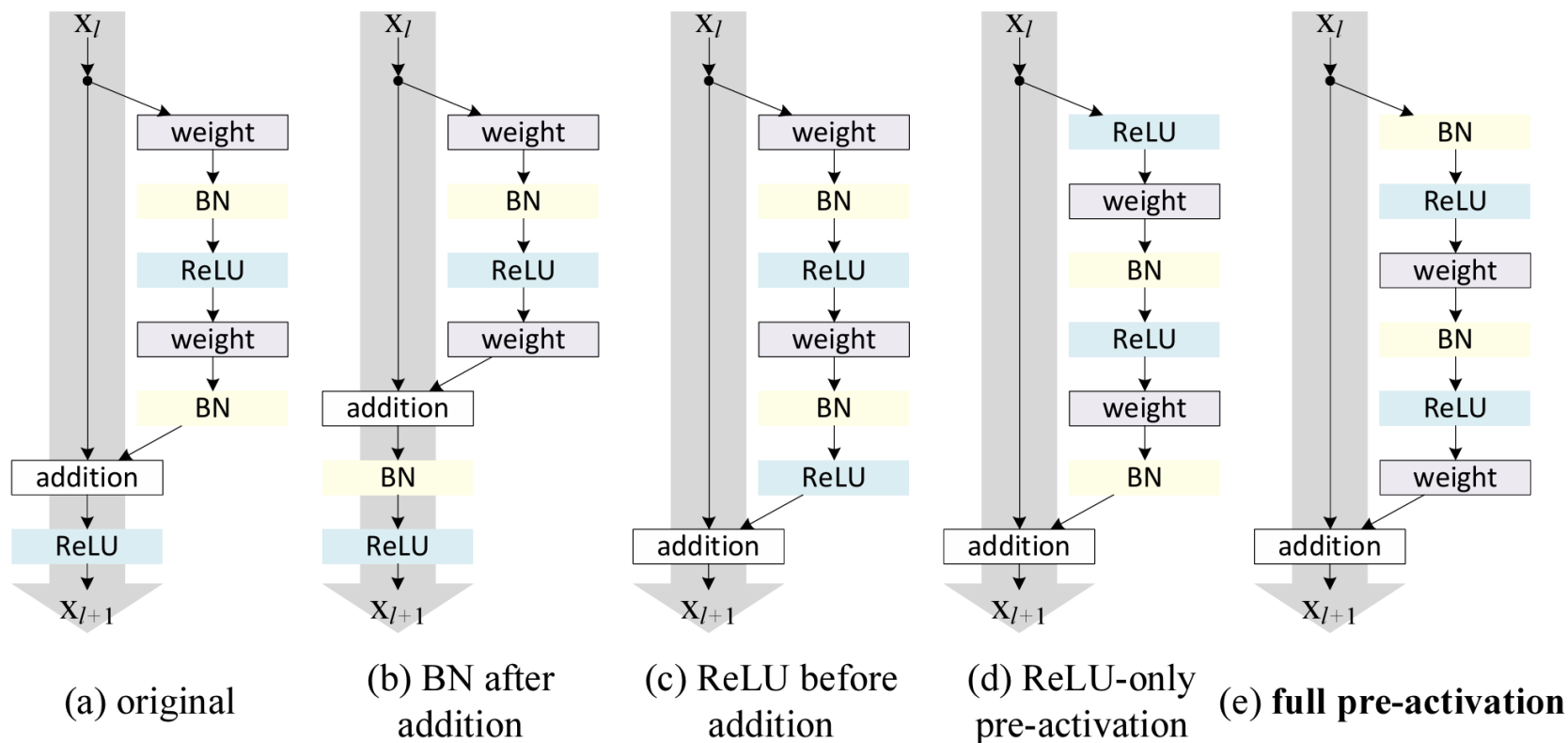
- 多Mixer堆叠 \approx 集成器（利用不同模型的多样性和互补性，获得更稳健、更准确的结果）





促进RPMixer中类似集成的行为

- *"Identity Mappings in Deep Residual Networks"*, Kaiming He, 2016 ECCV, Microsoft Research

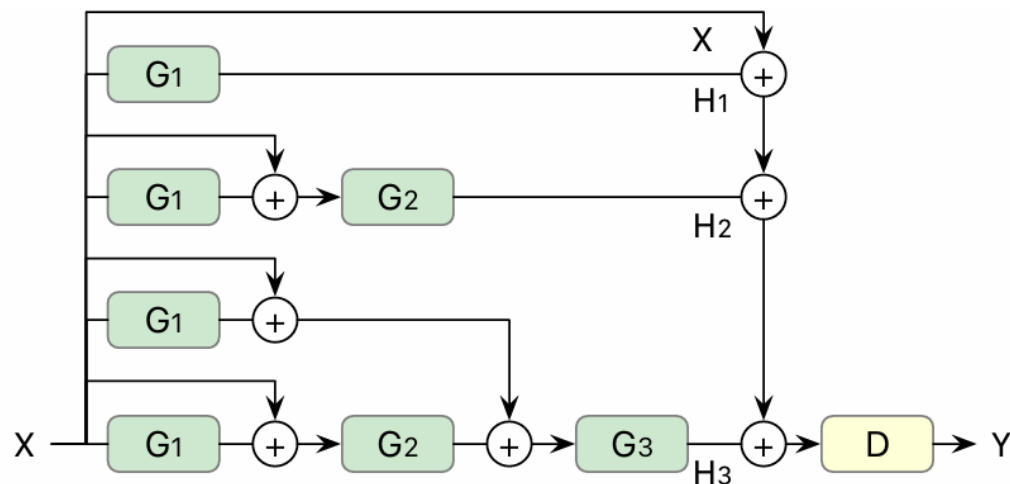
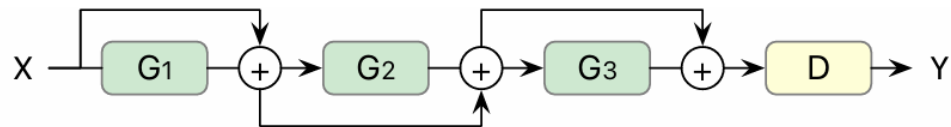
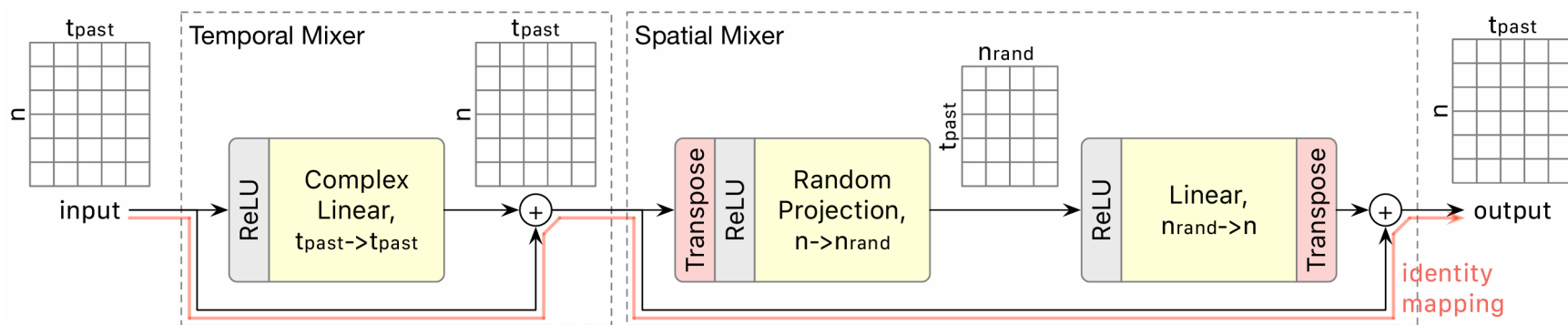


04



算法设计：具有预激活的身份映射 Identity Mapping with Pre-Activation

促进RPMixer中类似集成的行为





只使用19年的流量数据，15分钟的数据窗口，1天 = 96个窗口

Data	# of nodes	# of time steps	time range
SD	716	35,040	[1/1/2019, 1/1/2020)
GBA	2,352	35,040	[1/1/2019, 1/1/2020)
GLA	3,834	35,040	[1/1/2019, 1/1/2020)
CA	8,600	35,040	[1/1/2019, 1/1/2020)

Data	Method	Param	Horizon 3			Horizon 6			Horizon 12			Average		
			MAE	RMSE	MAPE	MAE	RMSE	MAPE	MAE	RMSE	MAPE	MAE	RMSE	MAPE
SD	HL	–	33.61	50.97	20.77%	57.80	84.92	37.73%	101.74	140.14	76.84%	60.79	87.40	41.88%
	LSTM	98K	19.17	30.75	11.85%	26.11	41.28	16.53%	38.06	59.63	25.07%	26.73	42.14	17.17%
	ASTGCN	2.2M	20.09	32.13	13.61%	25.58	40.41	17.44%	32.86	52.05	26.00%	25.10	39.91	18.05%
	DCRNN	373K	17.01	27.33	10.96%	20.80	33.03	13.72%	26.77	42.49	18.57%	20.86	33.13	13.94%
	AGCRN	761K	16.05	28.78	11.74%	18.37	32.44	13.37%	22.12	40.37	16.63%	18.43	32.97	13.51%
	STGCN	508K	18.23	30.60	13.75%	20.34	34.42	15.10%	23.56	41.70	17.08%	20.35	34.70	15.13%
	GWNET	311K	15.49	25.45	9.90%	18.17	30.16	11.98%	22.18	37.82	15.41%	18.12	30.21	12.08%
	STGODE	729K	16.76	27.26	10.95%	19.79	32.91	13.18%	23.60	41.32	16.60%	19.52	32.76	13.22%
	DSTAGNN	3.9M	17.83	28.60	11.08%	21.95	35.37	14.55%	26.83	46.39	19.62%	21.52	35.67	14.52%
	DGCRN	243K	15.24	25.46	10.09%	17.66	29.65	11.77%	21.38	36.67	14.75%	17.65	29.70	11.89%
	D ² STGNN	406K	14.85	24.95	9.91%	17.28	29.05	12.17%	21.59	35.55	16.88%	17.38	28.92	12.43%
	1NN	–	21.79	35.15	13.79%	25.64	41.59	17.05%	30.77	50.59	22.38%	25.47	41.36	17.25%
GBA	Linear	3.5K	20.58	33.30	12.98%	27.00	43.87	18.20%	32.35	53.51	22.38%	25.85	42.35	17.10%
	TSMixer	815K	17.13	27.42	11.35%	19.30	31.07	12.50%	22.03	35.70	14.26%	19.06	30.66	12.55%
	RPMixer	1.5M	15.12	24.83	9.97%	17.04	28.24	10.98%	19.60	32.96	13.12%	16.90	27.97	11.07%
	HL	–	32.57	48.42	22.78%	53.79	77.08	43.01%	92.64	126.22	92.85%	56.44	79.82	48.87%
	LSTM	98K	20.41	33.47	15.60%	27.50	43.64	23.25%	38.85	60.46	37.47%	27.88	44.23	24.31%
	ASTGCN	22.3M	21.40	33.61	17.65%	26.70	40.75	24.02%	33.64	51.21	31.15%	26.15	40.25	23.29%
	DCRNN	373K	18.25	29.73	14.37%	22.25	35.04	19.82%	28.68	44.39	28.69%	22.35	35.26	20.15%
	AGCRN	777K	18.11	30.19	13.64%	20.86	34.42	16.24%	24.06	39.47	19.29%	20.55	33.91	16.06%
	STGCN	1.3M	20.62	33.81	15.84%	23.19	37.96	18.09%	26.53	43.88	21.77%	23.03	37.82	18.20%
	GWNET	344K	17.74	28.92	14.37%	20.98	33.50	17.77%	25.39	40.30	22.99%	20.78	33.32	17.76%
	STGODE	788K	18.80	30.53	15.67%	22.19	35.91	18.54%	26.27	43.07	22.71%	21.86	35.57	18.33%
	DSTAGNN	26.9M	19.87	31.54	16.85%	23.89	38.11	19.53%	28.48	44.65	24.65%	23.39	37.07	19.58%
	DGCRN	374K	18.09	29.27	15.32%	21.18	33.78	18.59%	25.73	40.88	23.67%	21.10	33.76	18.58%
	D ² STGNN	446K	17.20	28.50	12.22%	20.80	33.53	15.32%	25.72	40.90	19.90%	20.71	33.44	15.23%
	1NN	–	24.84	41.30	17.70%	29.31	48.56	22.92%	35.22	58.44	31.07%	29.10	48.23	23.14%
	Linear	3.5K	21.55	34.79	17.94%	27.24	43.36	23.66%	31.50	51.56	26.18%	26.12	42.14	22.10%
	TSMixer	3.1M	17.57	29.22	14.14%	19.85	32.64	16.95%	22.27	37.60	18.63%	19.58	32.56	16.58%
	RPMixer	2.3M	17.35	28.69	13.42%	19.44	32.04	15.61%	21.65	36.20	17.42%	19.06	31.54	15.09%

Data	Method	Param	Horizon 3			Horizon 6			Horizon 12			Average		
			MAE	RMSE	MAPE	MAE	RMSE	MAPE	MAE	RMSE	MAPE	MAE	RMSE	MAPE
GLA	HL	–	33.66	50.91	19.16%	56.88	83.54	34.85%	98.45	137.52	71.14%	59.58	86.19	38.76%
	LSTM	98K	20.09	32.41	11.82%	27.80	44.10	16.52%	39.61	61.57	25.63%	28.12	44.40	17.31%
	ASTGCN	59.1M	21.11	34.04	12.29%	28.65	44.67	17.79%	39.39	59.31	28.03%	28.44	44.13	18.62%
	DCRNN	373K	18.33	29.13	10.78%	22.70	35.55	13.74%	29.45	45.88	18.87%	22.73	35.65	13.97%
	AGCRN	792K	17.57	30.83	10.86%	20.79	36.09	13.11%	25.01	44.82	16.11%	20.61	36.23	12.99%
	STGCN	2.1M	19.87	34.01	12.58%	22.54	38.57	13.94%	26.48	45.61	16.92%	22.48	38.55	14.15%
	GWNET	374K	17.30	27.72	10.69%	21.22	33.64	13.48%	27.25	43.03	18.49%	21.23	33.68	13.72%
	STGODE	841K	18.46	30.05	11.94%	22.24	36.68	14.67%	27.14	45.38	19.12%	22.02	36.34	14.93%
	DSTAGNN	66.3M	19.35	30.55	11.33%	24.22	38.19	15.90%	30.32	48.37	23.51%	23.87	37.88	15.36%
	1NN	-	23.23	38.69	13.44%	27.75	45.92	17.07%	33.49	55.51	22.86%	27.49	45.57	17.28%
	Linear	3.5K	21.32	34.48	13.35%	27.45	43.83	17.79%	32.50	52.69	21.76%	26.40	42.56	17.16%
CA	TSMixer	4.6M	20.38	224.82	13.62%	22.90	229.86	15.51%	23.63	135.09	15.56%	22.12	207.68	14.87%
	RPMixer	3.2M	16.49	26.75	9.75%	18.82	30.56	11.58%	21.18	35.10	13.46%	18.46	30.13	11.34%
	HL	–	30.72	46.96	20.43%	51.56	76.48	37.22%	89.31	125.71	76.80%	54.10	78.97	41.61%
	LSTM	98K	19.01	31.21	13.57%	26.49	42.54	20.62%	38.41	60.42	31.03%	26.95	43.07	21.18%
	DCRNN	373K	17.52	28.18	12.55%	21.72	34.19	16.56%	28.45	44.23	23.57%	21.81	34.35	16.92%
	STGCN	4.5M	19.14	32.64	14.23%	21.65	36.94	16.09%	24.86	42.61	19.14%	21.48	36.69	16.16%
	GWNET	469K	16.93	27.53	13.14%	21.08	33.52	16.73%	27.37	42.65	22.50%	21.08	33.43	16.86%
	STGODE	1.0M	17.59	31.04	13.28%	20.92	36.65	16.23%	25.34	45.10	20.56%	20.72	36.65	16.19%
	1NN	-	21.88	36.67	15.19%	25.94	43.36	19.19%	31.29	52.52	25.65%	25.76	43.10	19.43%
	Linear	3.5K	19.82	32.39	14.73%	25.20	40.97	19.24%	29.80	49.34	23.09%	24.32	39.88	18.52%
	TSMixer	9.5M	18.40	106.28	14.30%	19.77	73.98	15.30%	22.56	87.56	17.80%	19.86	90.20	15.79%
	RPMixer	7.8M	15.90	26.08	11.69%	17.79	29.37	13.23%	19.93	33.18	15.11%	17.50	28.90	13.03%

Data	Method	Param	Horizon 3			Horizon 6			Horizon 12			Average		
			MAE	RMSE	MAPE	MAE	RMSE	MAPE	MAE	RMSE	MAPE	MAE	RMSE	MAPE
SD	HL	-	33.61	50.97	20.77%	57.80	84.92	37.73%	101.74	140.14	76.84%	60.79	87.40	41.88%
	LSTM	98K	19.17	30.75	11.85%	26.11	41.28	16.53%	38.06	59.63	25.07%	26.73	42.14	17.17%
	ASTGCN	2.2M	20.09	32.13	13.61%	25.58	40.41	17.44%	32.86	52.05	26.00%	25.10	39.91	18.05%
	DCRNN	373K	17.01	27.33	10.96%	20.80	33.03	13.72%	26.77	42.49	18.57%	20.86	33.13	13.94%
	AGCRN	761K	16.05	28.78	11.74%	18.37	32.44	13.37%	22.12	40.37	16.63%	18.43	32.97	13.51%
	STGCN	508K	18.23	30.60	13.75%	20.34	34.42	15.10%	23.56	41.70	17.08%	20.35	34.70	15.13%
	GWNET	311K	15.49	25.45	9.90%	18.17	30.16	11.98%	22.18	37.82	15.41%	18.12	30.21	12.08%
	STGODE	729K	16.76	27.26	10.95%	19.79	32.91	13.18%	23.60	41.32	16.60%	19.52	32.76	13.22%
	DSTAGNN	3.9M	17.83	28.60	11.08%	21.95	35.37	14.55%	26.83	46.39	19.62%	21.52	35.67	14.52%
	DGCRN	243K	15.24	25.46	10.09%	17.66	29.65	11.77%	21.38	36.67	14.75%	17.65	29.70	11.89%
	D ² STGNN	406K	14.85	24.95	9.91%	17.28	29.05	12.17%	21.59	35.55	16.88%	17.38	28.92	12.43%
	1NN	-	21.79	35.15	13.79%	25.64	41.59	17.05%	30.77	50.59	22.38%	25.47	41.36	17.25%
	Linear	3.5K	20.58	33.30	12.98%	27.00	43.87	18.20%	32.35	53.51	22.38%	25.85	42.35	17.10%
	TSMixer	815K	17.13	27.42	11.35%	19.30	31.07	12.50%	22.03	35.70	14.26%	19.06	30.66	12.55%
GBA	RPMixer	1.5M	15.12	24.83	9.97%	17.04	28.24	10.98%	19.60	32.96	13.12%	16.90	27.97	11.07%
	HL	-	32.57	48.42	22.78%	53.79	77.08	43.01%	92.64	126.22	92.85%	56.44	79.82	48.87%
	LSTM	98K	20.41	33.47	15.60%	27.50	43.64	23.25%	38.85	60.46	37.47%	27.88	44.23	24.31%
	ASTGCN	22.3M	21.40	33.61	17.65%	26.70	40.75	24.02%	33.64	51.21	31.15%	26.15	40.25	23.29%
	DCRNN	373K	18.25	29.73	14.37%	22.25	35.04	19.82%	28.68	44.39	28.69%	22.35	35.26	20.15%
	AGCRN	777K	18.11	30.19	13.64%	20.86	34.42	16.24%	24.06	39.47	19.29%	20.55	33.91	16.06%
	STGCN	1.3M	20.62	33.81	15.84%	23.19	37.96	18.09%	26.53	43.88	21.77%	23.03	37.82	18.20%
	GWNET	344K	17.74	28.92	14.37%	20.98	33.50	17.77%	25.39	40.30	22.99%	20.78	33.32	17.76%
	STGODE	788K	18.80	30.53	15.67%	22.19	35.91	18.54%	26.27	43.07	22.71%	21.86	35.57	18.33%
	DSTAGNN	26.9M	19.87	31.54	16.85%	23.89	38.11	19.53%	28.48	44.65	24.65%	23.39	37.07	19.58%
	DGCRN	374K	18.09	29.27	15.32%	21.18	33.78	18.59%	25.73	40.88	23.67%	21.10	33.76	18.58%
	D ² STGNN	446K	17.20	28.50	12.22%	20.80	33.53	15.32%	25.72	40.90	19.90%	20.71	33.44	15.23%
	1NN	-	24.84	41.30	17.70%	29.31	48.56	22.92%	35.22	58.44	31.07%	29.10	48.23	23.14%
	Linear	3.5K	21.55	34.79	17.94%	27.24	43.36	23.66%	31.50	51.56	26.18%	26.12	42.14	22.10%
	TSMixer	3.1M	17.57	29.22	14.14%	19.85	32.64	16.95%	22.27	37.60	18.63%	19.58	32.56	16.58%
	RPMixer	2.3M	17.35	28.69	13.42%	19.44	32.04	15.61%	21.65	36.20	17.42%	19.06	31.54	15.09%

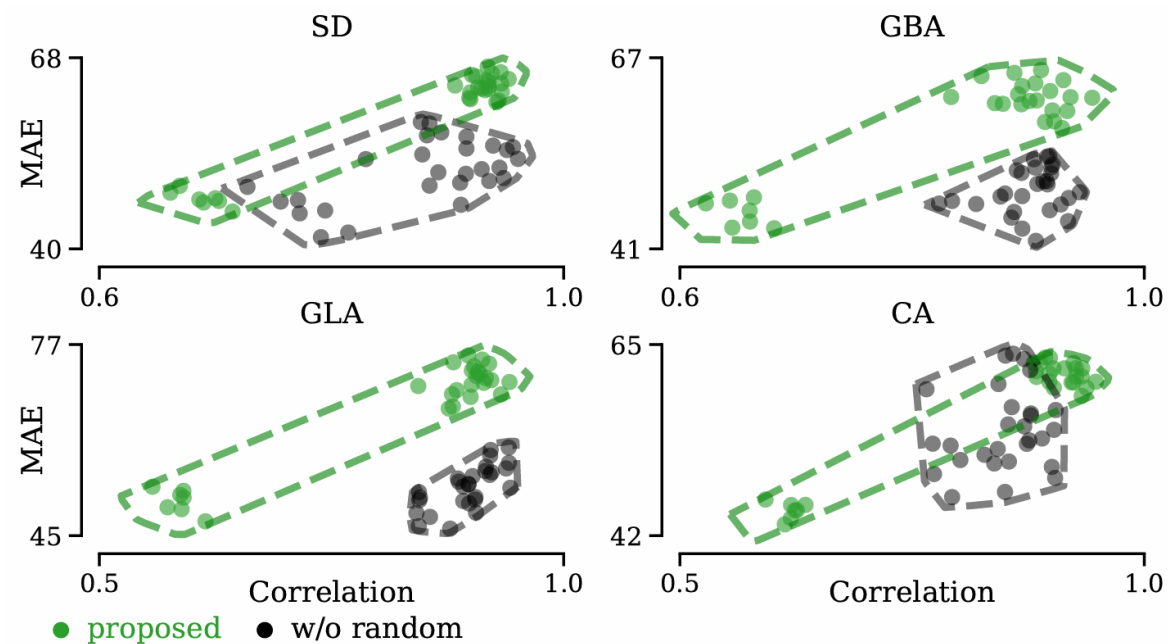
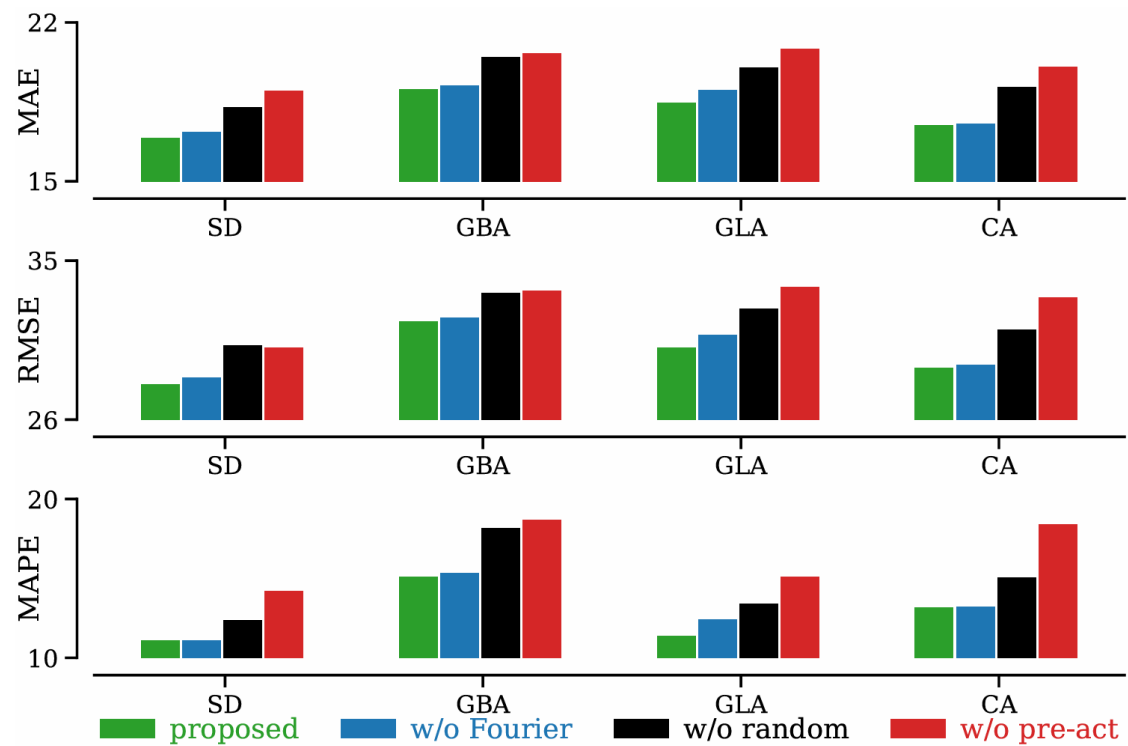
Data	Method	Param	Horizon 3			Horizon 6			Horizon 12			Average		
			MAE	RMSE	MAPE	MAE	RMSE	MAPE	MAE	RMSE	MAPE	MAE	RMSE	MAPE
GLA	HL	–	33.66	50.91	19.16%	56.88	83.54	34.85%	98.45	137.52	71.14%	59.58	86.19	38.76%
	LSTM	98K	20.09	32.41	11.82%	27.80	44.10	16.52%	39.61	61.57	25.63%	28.12	44.40	17.31%
	ASTGCN	59.1M	21.11	34.04	12.29%	28.65	44.67	17.79%	39.39	59.31	28.03%	28.44	44.13	18.62%
	DCRNN	373K	18.33	29.13	10.78%	22.70	35.55	13.74%	29.45	45.88	18.87%	22.73	35.65	13.97%
	AGCRN	792K	17.57	30.83	10.86%	20.79	36.09	13.11%	25.01	44.82	16.11%	20.61	36.23	12.99%
	STGCN	2.1M	19.87	34.01	12.58%	22.54	38.57	13.94%	26.48	45.61	16.92%	22.48	38.55	14.15%
	GWNET	374K	17.30	27.72	10.69%	21.22	33.64	13.48%	27.25	43.03	18.49%	21.23	33.68	13.72%
	STGODE	841K	18.46	30.05	11.94%	22.24	36.68	14.67%	27.14	45.38	19.12%	22.02	36.34	14.93%
	DSTAGNN	66.3M	19.35	30.55	11.33%	24.22	38.19	15.90%	30.32	48.37	23.51%	23.87	37.88	15.36%
	1NN	-	23.23	38.69	13.44%	27.75	45.92	17.07%	33.49	55.51	22.86%	27.49	45.57	17.28%
	Linear	3.5K	21.32	34.48	13.35%	27.45	43.83	17.79%	32.50	52.69	21.76%	26.40	42.56	17.16%
	TSMixer	4.6M	20.38	224.82	13.62%	22.90	229.86	15.51%	23.63	135.09	15.56%	22.12	207.68	14.87%
CA	RPMixer	3.2M	16.49	26.75	9.75%	18.82	30.56	11.58%	21.18	35.10	13.46%	18.46	30.13	11.34%
	HL	–	30.72	46.96	20.43%	51.56	76.48	37.22%	89.31	125.71	76.80%	54.10	78.97	41.61%
	LSTM	98K	19.01	31.21	13.57%	26.49	42.54	20.62%	38.41	60.42	31.03%	26.95	43.07	21.18%
	DCRNN	373K	17.52	28.18	12.55%	21.72	34.19	16.56%	28.45	44.23	23.57%	21.81	34.35	16.92%
	STGCN	4.5M	19.14	32.64	14.23%	21.65	36.94	16.09%	24.86	42.61	19.14%	21.48	36.69	16.16%
	GWNET	469K	16.93	27.53	13.14%	21.08	33.52	16.73%	27.37	42.65	22.50%	21.08	33.43	16.86%
	STGODE	1.0M	17.59	31.04	13.28%	20.92	36.65	16.23%	25.34	45.10	20.56%	20.72	36.65	16.19%
	1NN	-	21.88	36.67	15.19%	25.94	43.36	19.19%	31.29	52.52	25.65%	25.76	43.10	19.43%
	Linear	3.5K	19.82	32.39	14.73%	25.20	40.97	19.24%	29.80	49.34	23.09%	24.32	39.88	18.52%
	TSMixer	9.5M	18.40	106.28	14.30%	19.77	73.98	15.30%	22.56	87.56	17.80%	19.86	90.20	15.79%
	RPMixer	7.8M	15.90	26.08	11.69%	17.79	29.37	13.23%	19.93	33.18	15.11%	17.50	28.90	13.03%

Data	Method	Param	Horizon 3			Horizon 6			Horizon 12			Average		
			MAE	RMSE	MAPE	MAE	RMSE	MAPE	MAE	RMSE	MAPE	MAE	RMSE	MAPE
SD	HL	-	33.61	50.97	20.77%	57.80	84.92	37.73%	101.74	140.14	76.84%	60.79	87.40	41.88%
	LSTM	98K	19.17	30.75	11.85%	26.11	41.28	16.53%	38.06	59.63	25.07%	26.73	42.14	17.17%
	ASTGCN	2.2M	20.09	32.13	13.61%	25.58	40.41	17.44%	32.86	52.05	26.00%	25.10	39.91	18.05%
	DCRNN	373K	17.01	27.33	10.96%	20.80	33.03	13.72%	26.77	42.49	18.57%	20.86	33.13	13.94%
	AGCRN	761K	16.05	28.78	11.74%	18.37	32.44	13.37%	22.12	40.37	16.63%	18.43	32.97	13.51%
	STGCN	508K	18.23	30.60	13.75%	20.34	34.42	15.10%	23.56	41.70	17.08%	20.35	34.70	15.13%
	GWNET	311K	15.49	25.45	9.90%	18.17	30.16	11.98%	22.18	37.82	15.41%	18.12	30.21	12.08%
	STGODE	729K	16.76	27.26	10.95%	19.79	32.91	13.18%	23.60	41.32	16.60%	19.52	32.76	13.22%
	DSTAGNN	3.9M	17.83	28.60	11.08%	21.95	35.37	14.55%	26.83	46.39	19.62%	21.52	35.67	14.52%
	DGCRN	243K	15.24	25.46	10.09%	17.66	29.65	11.77%	21.38	36.67	14.75%	17.65	29.70	11.89%
	D ² STGNN	406K	14.85	24.95	9.91%	17.28	29.05	12.17%	21.59	35.55	16.88%	17.38	28.92	12.43%
	1NN	-	21.79	35.15	13.79%	25.64	41.59	17.05%	30.77	50.59	22.38%	25.47	41.36	17.25%
	Linear	3.5K	20.58	33.30	12.98%	27.00	43.87	18.20%	32.35	53.51	22.38%	25.85	42.35	17.10%
GBA	TSMixer	815K	17.13	27.42	11.35%	19.30	31.07	12.50%	22.03	35.70	14.26%	19.06	30.66	12.55%
	RPMixer	1.5M	15.12	24.83	9.97%	17.04	28.24	10.98%	19.60	32.96	13.12%	16.90	27.97	11.07%
	HL	-	32.57	48.42	22.78%	53.79	77.08	43.01%	92.64	126.22	92.85%	56.44	79.82	48.87%
	LSTM	98K	20.41	33.47	15.60%	27.50	43.64	23.25%	38.85	60.46	37.47%	27.88	44.23	24.31%
	ASTGCN	22.3M	21.40	33.61	17.65%	26.70	40.75	24.02%	33.64	51.21	31.15%	26.15	40.25	23.29%
	DCRNN	373K	18.25	29.73	14.37%	22.25	35.04	19.82%	28.68	44.39	28.69%	22.35	35.26	20.15%
	AGCRN	777K	18.11	30.19	13.64%	20.86	34.42	16.24%	24.06	39.47	19.29%	20.55	33.91	16.06%
	STGCN	1.3M	20.62	33.81	15.84%	23.19	37.96	18.09%	26.53	43.88	21.77%	23.03	37.82	18.20%
	GWNET	344K	17.74	28.92	14.37%	20.98	33.50	17.77%	25.39	40.30	22.99%	20.78	33.32	17.76%
	STGODE	788K	18.80	30.53	15.67%	22.19	35.91	18.54%	26.27	43.07	22.71%	21.86	35.57	18.33%
	DSTAGNN	26.9M	19.87	31.54	16.85%	23.89	38.11	19.53%	28.48	44.65	24.65%	23.39	37.07	19.58%
	DGCRN	374K	18.09	29.27	15.32%	21.18	33.78	18.59%	25.73	40.88	23.67%	21.10	33.76	18.58%
	D ² STGNN	446K	17.20	28.50	12.22%	20.80	33.53	15.32%	25.72	40.90	19.90%	20.71	33.44	15.23%
	1NN	-	24.84	41.30	17.70%	29.31	48.56	22.92%	35.22	58.44	31.07%	29.10	48.23	23.14%
	Linear	3.5K	21.55	34.79	17.94%	27.24	43.36	23.66%	31.50	51.56	26.18%	26.12	42.14	22.10%
	TSMixer	3.1M	17.57	29.22	14.14%	19.85	32.64	16.95%	22.27	37.60	18.63%	19.58	32.56	16.58%
	RPMixer	2.3M	17.35	28.69	13.42%	19.44	32.04	15.61%	21.65	36.20	17.42%	19.06	31.54	15.09%

Data	Method	Param	Horizon 3			Horizon 6			Horizon 12			Average		
			MAE	RMSE	MAPE	MAE	RMSE	MAPE	MAE	RMSE	MAPE	MAE	RMSE	MAPE
GLA	HL	—	33.66	50.91	19.16%	56.88	83.54	34.85%	98.45	137.52	71.14%	59.58	86.19	38.76%
	LSTM	98K	20.09	32.41	11.82%	27.80	44.10	16.52%	39.61	61.57	25.63%	28.12	44.40	17.31%
	ASTGCN	59.1M	21.11	34.04	12.29%	28.65	44.67	17.79%	39.39	59.31	28.03%	28.44	44.13	18.62%
	DCRNN	373K	18.33	29.13	10.78%	22.70	35.55	13.74%	29.45	45.88	18.87%	22.73	35.65	13.97%
	AGCRN	792K	17.57	30.83	10.86%	20.79	36.09	13.11%	25.01	44.82	16.11%	20.61	36.23	12.99%
	STGCN	2.1M	19.87	34.01	12.58%	22.54	38.57	13.94%	26.48	45.61	16.92%	22.48	38.55	14.15%
	GWNET	374K	17.30	27.72	10.69%	21.22	33.64	13.48%	27.25	43.03	18.49%	21.23	33.68	13.72%
	STGODE	841K	18.46	30.05	11.94%	22.24	36.68	14.67%	27.14	45.38	19.12%	22.02	36.34	14.93%
	DSTAGNN	66.3M	19.35	30.55	11.33%	24.22	38.19	15.90%	30.32	48.37	23.51%	23.87	37.88	15.36%
	1NN	-	23.23	38.69	13.44%	27.75	45.92	17.07%	33.49	55.51	22.86%	27.49	45.57	17.28%
	Linear	3.5K	21.32	34.48	13.35%	27.45	43.83	17.79%	32.50	52.69	21.76%	26.40	42.56	17.16%
	TSMixer	4.6M	20.38	224.82	13.62%	22.90	229.86	15.51%	23.63	135.09	15.56%	22.12	207.68	14.87%
CA	RPMixer	3.2M	16.49	26.75	9.75%	18.82	30.56	11.58%	21.18	35.10	13.46%	18.46	30.13	11.34%
	HL	—	30.72	46.96	20.43%	51.56	76.48	37.22%	89.31	125.71	76.80%	54.10	78.97	41.61%
	LSTM	98K	19.01	31.21	13.57%	26.49	42.54	20.62%	38.41	60.42	31.03%	26.95	43.07	21.18%
	DCRNN	373K	17.52	28.18	12.55%	21.72	34.19	16.56%	28.45	44.23	23.57%	21.81	34.35	16.92%
	STGCN	4.5M	19.14	32.64	14.23%	21.65	36.94	16.09%	24.86	42.61	19.14%	21.48	36.69	16.16%
	GWNET	469K	16.93	27.53	13.14%	21.08	33.52	16.73%	27.37	42.65	22.50%	21.08	33.43	16.86%
	STGODE	1.0M	17.59	31.04	13.28%	20.92	36.65	16.23%	25.34	45.10	20.56%	20.72	36.65	16.19%
	1NN	-	21.88	36.67	15.19%	25.94	43.36	19.19%	31.29	52.52	25.65%	25.76	43.10	19.43%
	Linear	3.5K	19.82	32.39	14.73%	25.20	40.97	19.24%	29.80	49.34	23.09%	24.32	39.88	18.52%
	TSMixer	9.5M	18.40	106.28	14.30%	19.77	73.98	15.30%	22.56	87.56	17.80%	19.86	90.20	15.79%
	RPMixer	7.8M	15.90	26.08	11.69%	17.79	29.37	13.23%	19.93	33.18	15.11%	17.50	28.90	13.03%

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实验：消融实验





谢谢观看

MANY THANKS !

24.9.10

