Increasing the accuracy and resolution of precipitation forecasts using deep generative models

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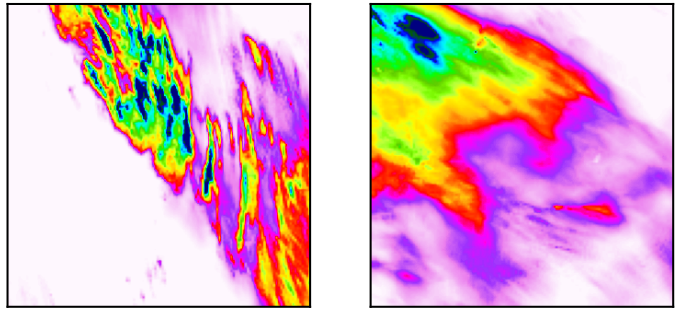
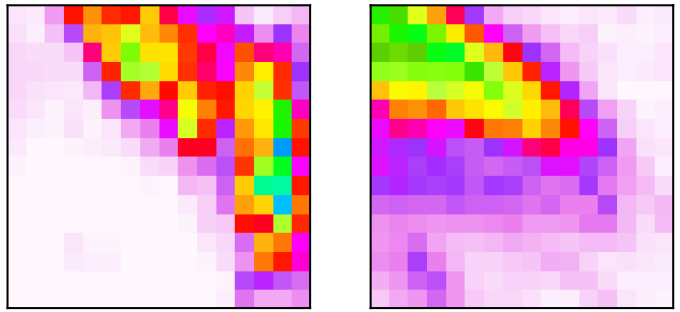
Problem: high resolution rain forecasts extremely expensive

- Precipitation forecasts produced by numerical weather models (NWMs)
- **High resolution = prohibitively expensive** for most of the world
- Global NWMs run at low resolution
  - miss the **variation of rainfall at fine scales**
  - Smooth out **extreme values**



High Res Ground truth



Low Res NWM

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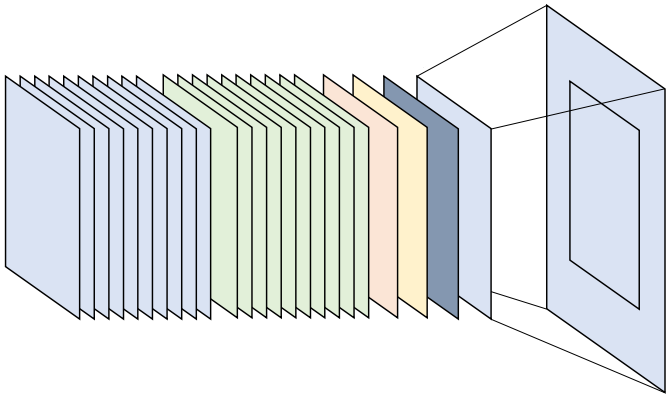
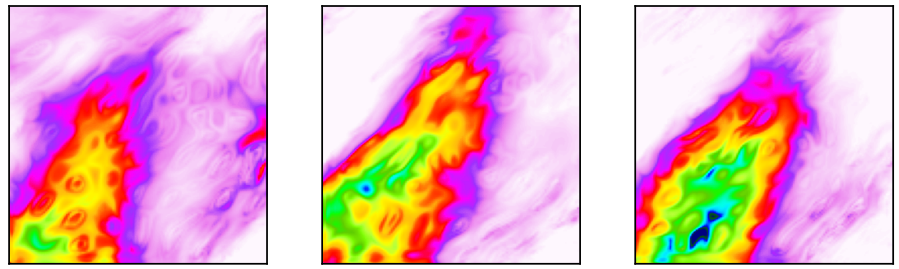
Proposal: CorrectorGAN for high-res ensemble forecasts

Low-resolution numerical weather model ensemble forecasts

cGAN →

Distributions of plausible, high resolution precipitation forecasts.





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Model Goals

1. Correct biases and errors
2. Super-resolve into plausible high-resolution fields
3. Replicate the variability in the underlying true distribution.

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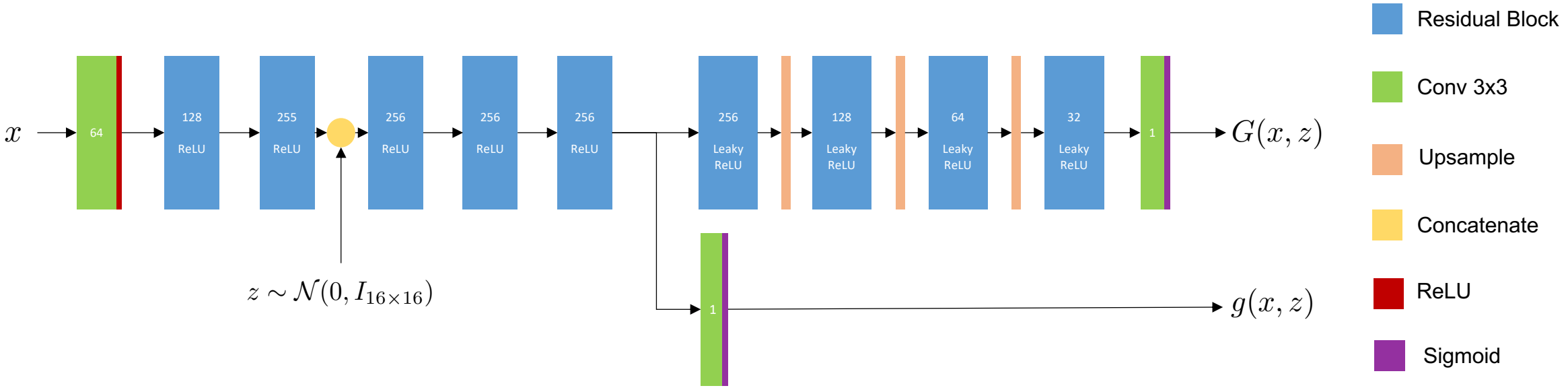
Generator Architecture



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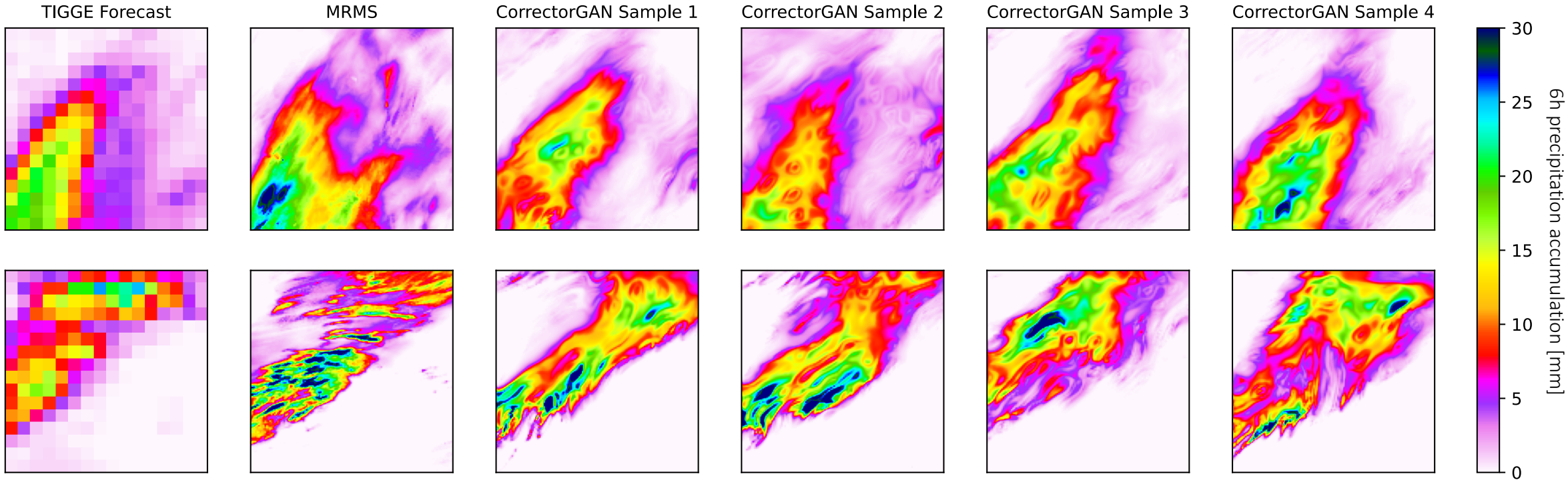
Sample Forecasts



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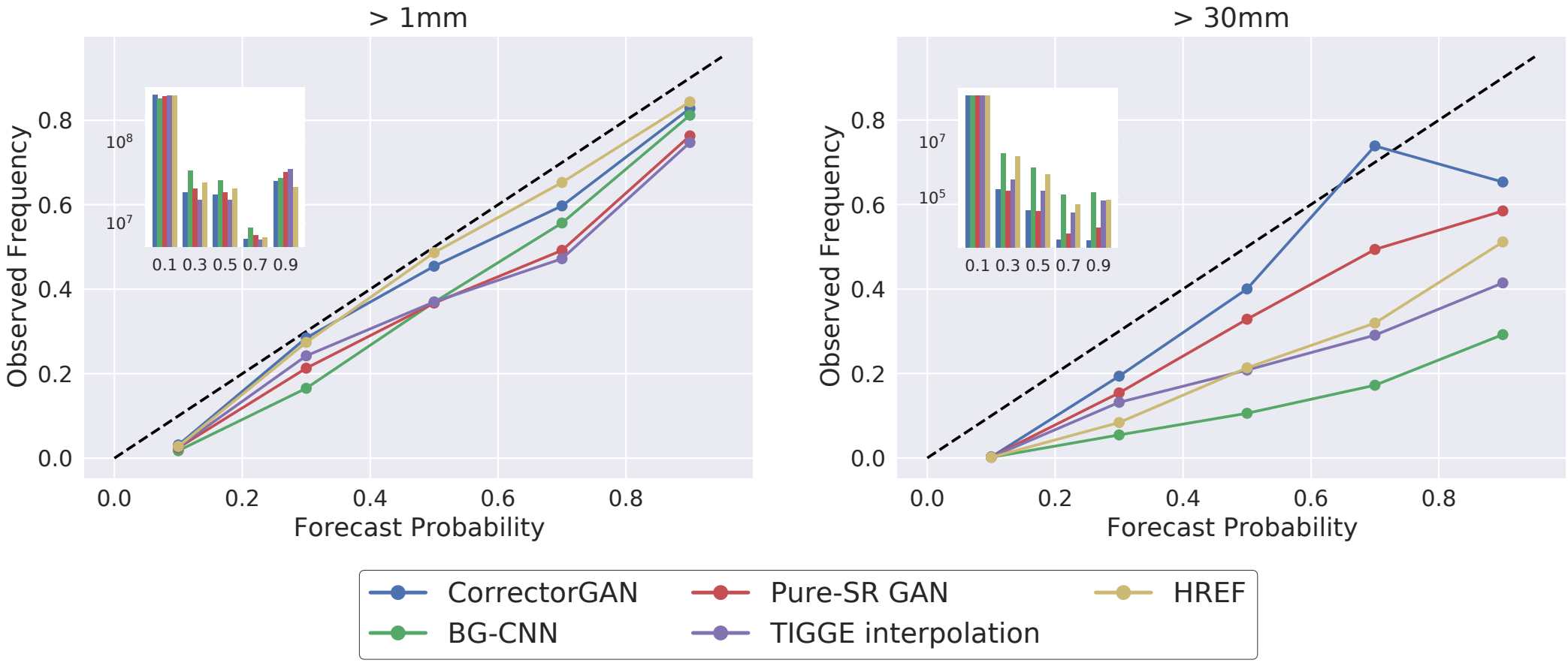
Evaluation

Model	CRPS	Brier Score			
		1mm	5mm	10mm	30mm
CorrectorGAN	0.574	0.06	0.034	0.02	0.0024
HREF	0.562	0.059	0.032	0.019	0.0026
TIGGE Interp.	0.605	0.064	0.035	0.021	0.0025
Pure-SR GAN	0.61	0.063	0.036	0.021	0.0024
BG-CNN	0.62	0.06	0.035	0.021	0.0032

Evaluation



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Conclusions

- Overall, a promising advance towards high resolution precipitation forecasting using only data

- Still room to improve
  - Forecasts unrealistically “wavy”
  - Often cannot correct large-scale bias

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