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Postprocessing of gridded precipitation forecasts using cGAN and quantile regression

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Motivation

- cGAN postprocessing for hourly **cloud cover works**[1]
  - reference forecasts: gEMOS or dense NN + ECC or Schaake shuffle
  - 2D GAN
  - temporal dependence not considered
- Apply similar cGAN approach to **precipitation**
  - ideally: hourly 3D GAN in order to sample spatio-temporal scenarios
  - goal: improve univariate and multivariate forecast skill compared to high-resolution COSMO-E DMO
  - reality check: work on daily **cGAN still in progress** due to poor skill

[1]Dai, Y., & Hemri, S. (2021). Spatially coherent postprocessing of cloud cover ensemble forecasts. Monthly Weather Review, 149(12).

Sharing is encouraged

Data and methods I

- Features: COSMO-E 21 member high-resolution (2 km) DMO
- Labels: CombiPrecip gridded precipitation data
  - 1 km resolution
  - blend of gauge observations with radar data
- Focus on JJAs
  - training set: 2014-2018
  - validation set: 2019
  - test set: 2020
- Work in progress, hence results shown only for validation set

Sharing is encouraged

Data and methods II

- **Reference forecasts:**
  - spatial pooling
  - quantile regression
- **cGAN:**
  - separated[1] 3D convolutions in generator and discriminator
  - split discriminator architecture along lead times/days in order to allow for lead time/day dependent weights

[1] Castro, R., Souto, Y. M., Ogasawara, E., Porto, F., & Bezerra, E. (2021). STconvS2S: Spatiotemporal convolutional sequence to sequence network for weather forecasting. Neurocomputing, 426, 285-298.
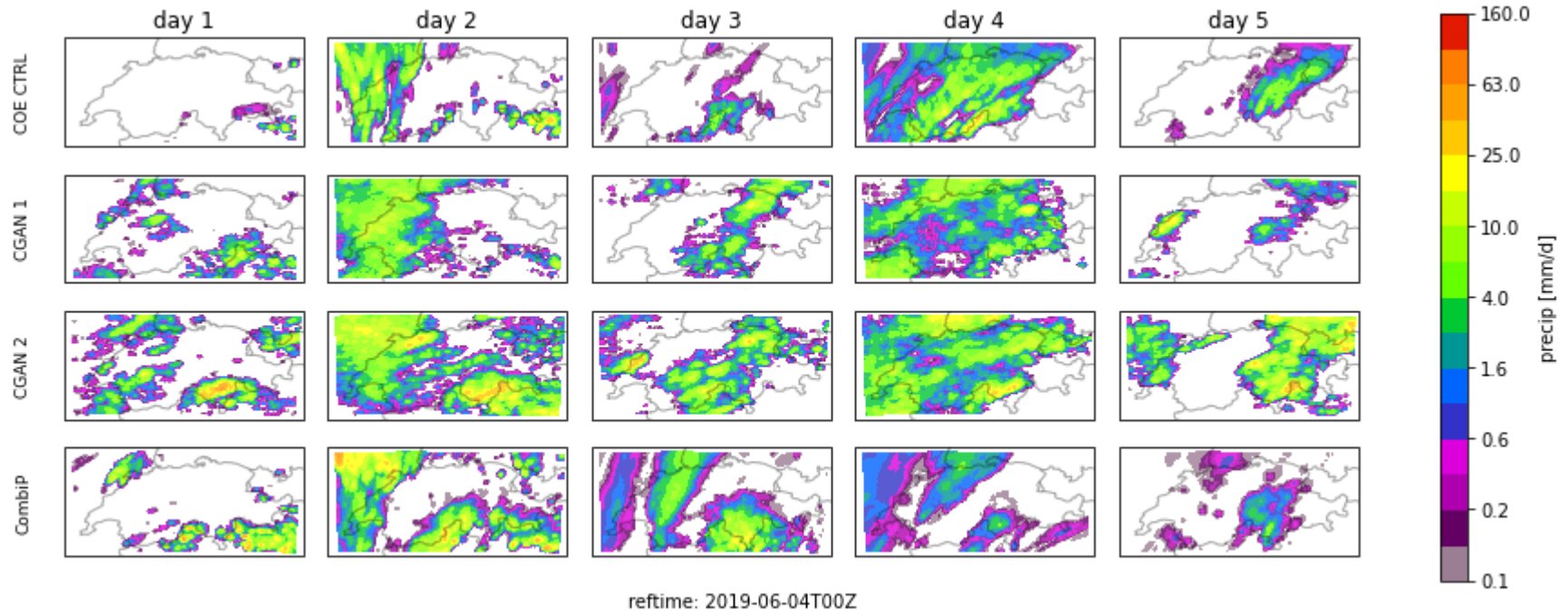
GAN architecture (discriminator)
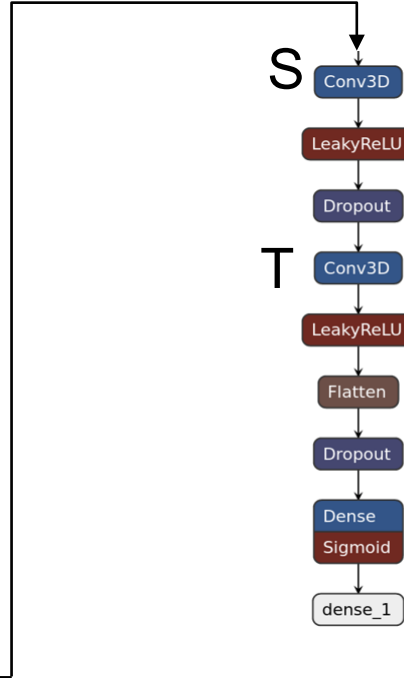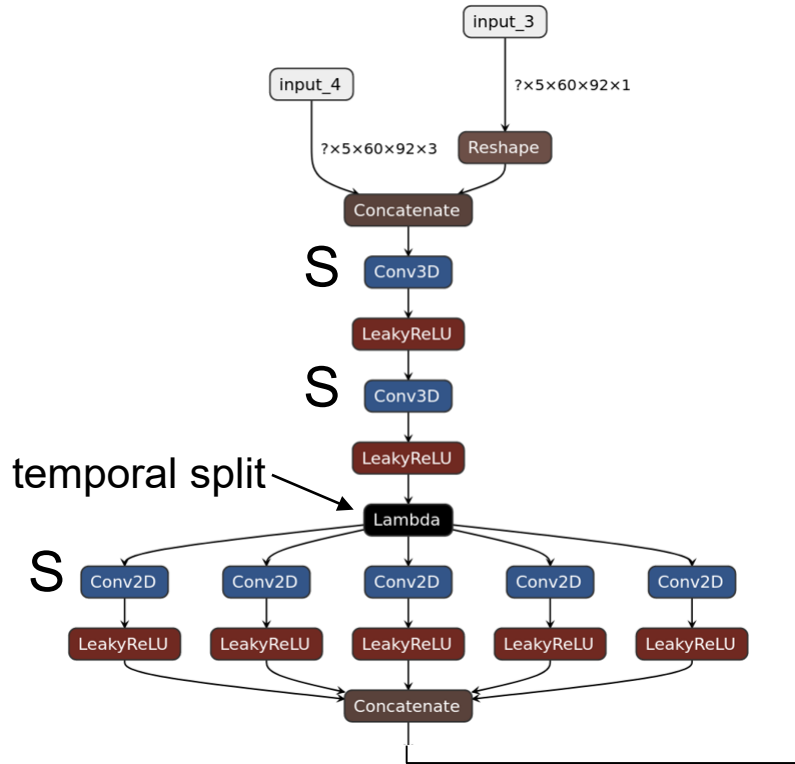
S: spatial convolution
T: temporal convolution
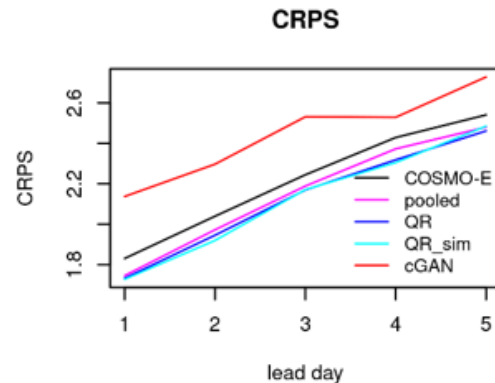
Graph generated using Netron
https://github.com/lutzroeder/Netron

Example forecasts

reftime: 2019-06-04T00Z

Issues and outlook

- Poor cGAN skill
- Using content loss[1] in generator did improve our model
- Still a lot of room for improvement

[1]Harris, L., McRae, A. T., Chantry, M., Dueben, P. D., & Palmer, T. N. (2022). A Generative Deep Learning Approach to Stochastic Downscaling of Precipitation Forecasts. arXiv:2204.02028.