2nd NOAA AI Workshop on Leveraging AI in Environmental Science

Development of machine learning based downscaling methods for wildfire risk

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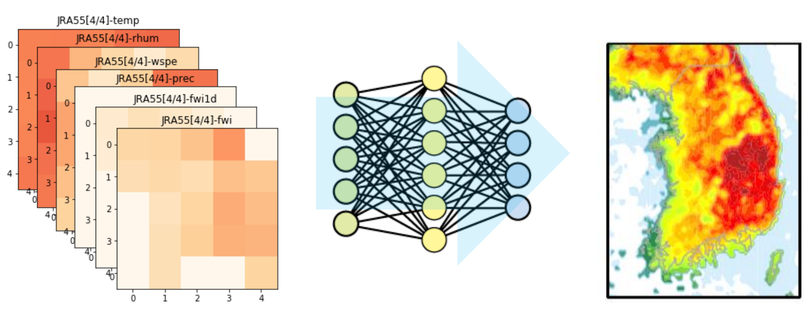
Key points

- Machine learning successfully enhances resolution of fire weather conditions (5x5 -> 100x100).
- Only a few minutes are required to produce scaled up product, which is significantly efficient in time and computing cost.
- In general, SISR algorithms with more training parameters show better performance.
- Remarkable performance in Korea suggests its potential to apply in any place and data.

Data

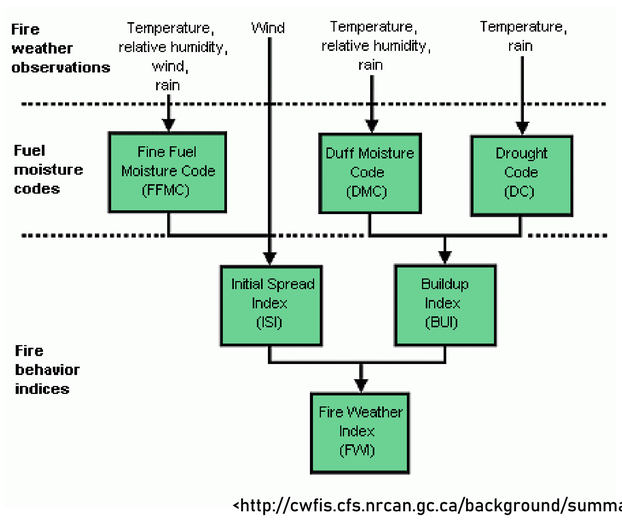
	Input	Algorithm	Output
Variable	FWI(t, t-1) T, Q, W, P	SISR algorithms	FWI
Size	5x5		100x100
Source	JRA55		DSJRA
Period	Train: 1959~95 , Test: 1996~2012 (only MAMJ)		



Methods

➢ Fire Weather Index (FWI)

- FWI is a numerical rating for fire danger based on the Canadian Forest Service Fire weather Index Rating System, indicating fire intensity and behavior.



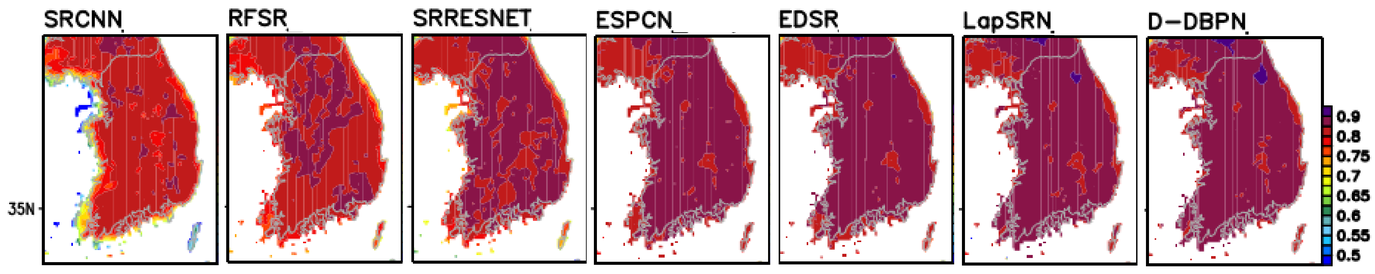
<http://cwfis.cfs.nrcan.gc.ca/background/summary/fwi>

➢ Single Image Super Resolution

- The SISR is an ill-posed inverse problem without a unique solution in that numerous HR (high-resolution) images can be converted into the same LR image.
- The first deep neural network based algorithm is called Super-Resolution Convolutional Neural Network (**SRCNN**)
- There has been remarkable progress for the recent few years with the deeper and wider network structures, such as Efficient Sub-Pixel Convolutional Neural Network (**ESPCN**), Enhanced Deep Residual Network (**EDSR**), Residual Dense Network (**RDN**) and Deep Back-Projection Network (**DBPN**).
- In this study, Fire Weather Index (FWI) is scaled up more than 15 times from 1.25 degree (150km) to 0.05 degree (6km) over the Korean peninsula.

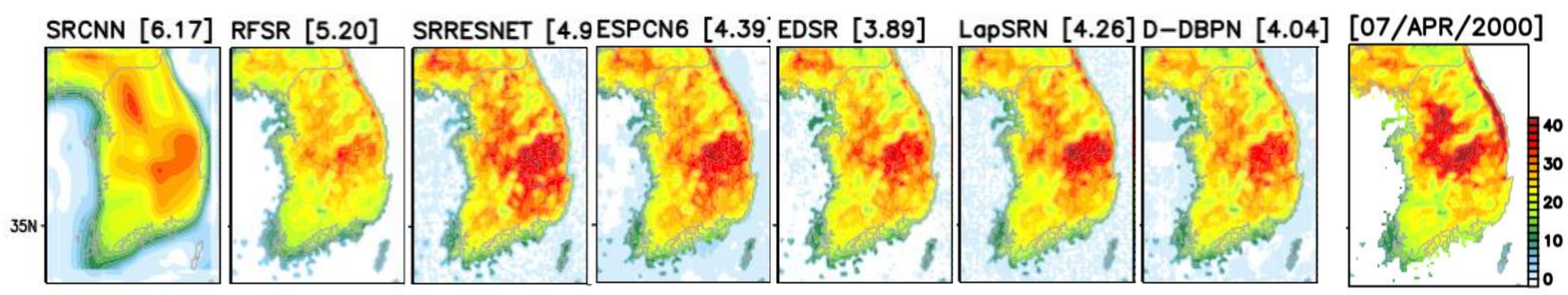
Results

❖ Correlation for the test period



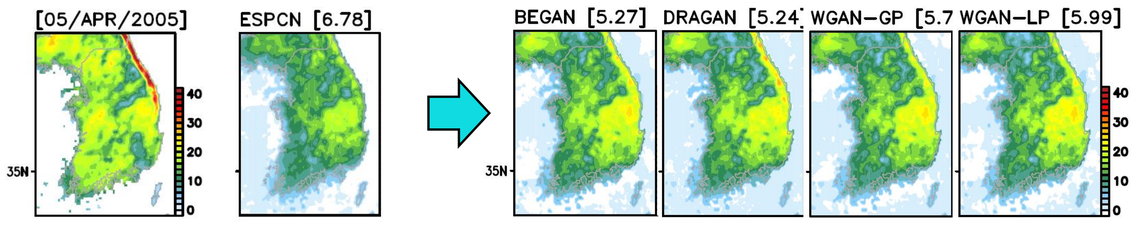
➢ Higher than 0.8 correlation is shown for the most of algorithms.

❖ Extreme case

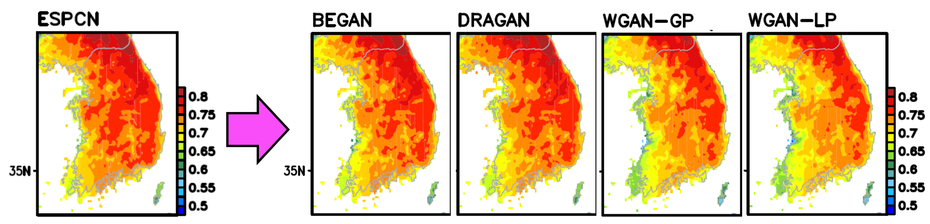


➢ High values of FWI is well produced along the eastern coast of Korea, where one of the biggest wildfire occurred on the year 2000.

❖ Apply Generative Adversarial Network (GAN)



➢ In some extreme cases, merging with GAN shows improved results



➢ However, general performance (correlation) is not improved or even a bit worse.

Reference

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Acknowledgement

This research is results of a study on the “HPC Support Project, supported by the Ministry of Science and ICT in Korea and NIPA.

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