

Leveraging Pretrained Deep Learning Models to Extract Similarities for the Analog Ensemble Method Applied to Convection Satellite Imagery

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Computer Vision, Ensemble and Convection

Context:

Convective activity is the most impactful and destructive weather phenomena. In literature none of analog ensemble method applications assessed convection. Additionally, most of application is 1D grid-point selected locations.

What:

A new system for estimating convective precipitation using analog ensemble method and deep learning pretrained algorithms for similarity assessment, bridging gap between satellite observations and ground-truth reanalysis.

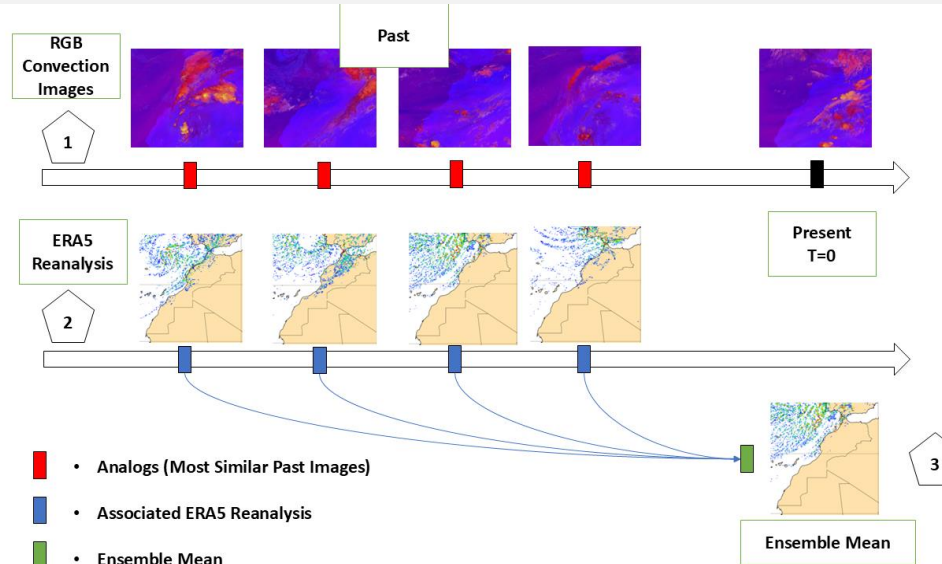
Data:

- 5 Years (2020-2024), Daily EUMETSAT RGB Convection Images at 12H,15H and 18H.
- 5 Years (2020-2024), Daily ERA5 Data for convection indicators (CAPE, K Index, Total Cloud Water Vapor, Convective Precipitation) at 12H, 15H and 18H.
- Domain covers 40N, 20S, -20W, 3E.
- Training period: 2020-2023
- Test period: 2024

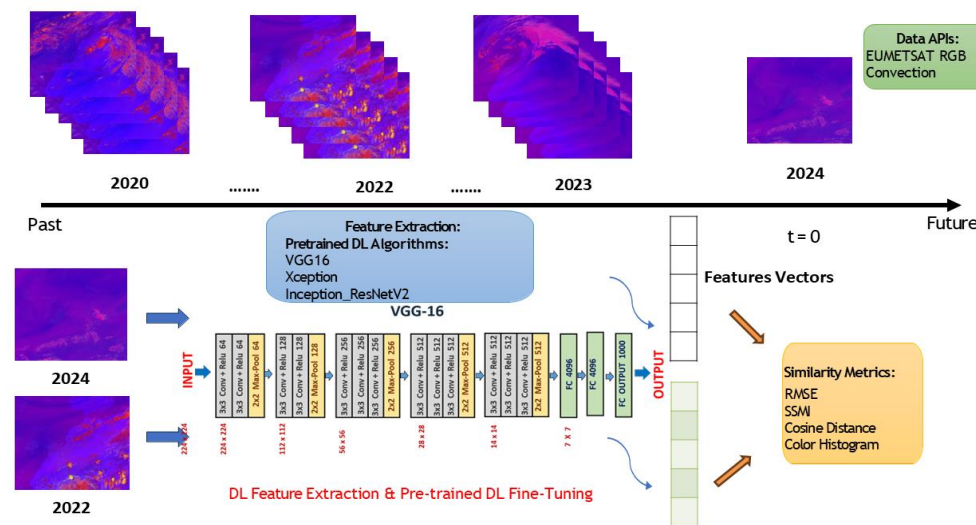
How:

- Along training period, 3 pretrained DL algorithms (VGG16, Xception and Inception_ResNetV2) are finetuned to perform feature extraction from convection satellite images.
- During testing period, each day feature extraction is performed for present and all past satellite images, and similarity between present and past features vectors is assessed using different metrics (SSMI, RMSE, Cosine..)
- All analog past images are ranked according to their similarity to present image
- Top 10 most similar past images ERA5 data is then used as ground-truth to form analog ensemble members.

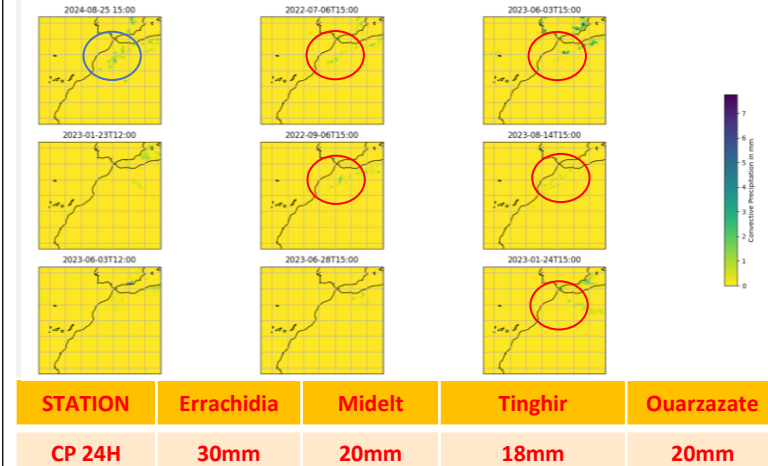
Analog Ensemble Method Adapted to Satellite Imagery



Evaluating RGB Convection Images Similarity with Pretrained DL

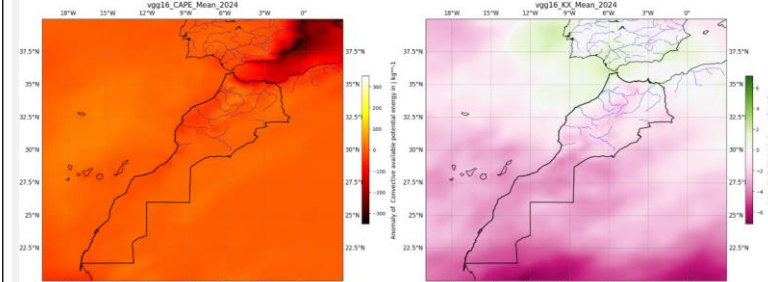


Use Case 25-08-2024



Most of members captures convective activity with fair estimation of precipitation, compared to ground observations and target reanalysis.

Perspective: Assessing Convection Ingredients



The system can be used to assess convection indicators with acceptable bias compared to literature (Ensemble Mean Bias along 2024 of 300J/Kg**2 and 4 Kg m**2 s**-2 for CAPE and K-Index respectively)

References:

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- Alaoui, B., Bari, D., & Ghabbar, Y. (2022, November). Space Analog's Searching to Improve Deterministic Forecasting Using Analog Ensemble Method Over Morocco. (MedGu 2022)
- Mascarenhas, S., & Agarwal, M. (2021, November). A comparison between VGG16, VGG19 and ResNet50 architecture frameworks for Image Classification. (CENTCON). IEEE, 2021. p. 96-99

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(a) Abstract

(b) Full Poster

(a)



(b)

