Qeios

Peer Review

Review of: "3D Cloud Reconstruction Through Geospatially-Aware Masked Autoencoders"

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This paper presents a 3D cloud reconstruction method based on SEVIRI satellite images. A data-driven approach is proposed in which the correspondence between images from 11 SEVIRI channels and Cloudsat vertical profiles is learned using a two-step SSL approach: image encoding based on a masked auto-encoder (MAE) and learning of a 3D decoder generating the vertical distribution of clouds. Validation shows that the method provides a statistically significant improvement over the state-of-the-art U-Net algorithm.

The approach is very interesting and motivating, with a definite level of innovation! The description of the work is very clear and well-structured. The evaluation of different configurations of the approach (size of the VAE, temporal and/or spatial encoding) demonstrates the relevance of the architecture chosen and represents potential added value for future work.

I suggest adding a discussion on the positive effect of taking time and coordinates into account in the encoder. The reflectance measured by the satellite is highly dependent on the relative position of the satellite and the sun. The use of time and coordinates in the MAE implicitly encodes this geometric aspect. This could explain the added value illustrated in Figure 6, but also the fact that 3D reconstruction can be carried out independently of geometric considerations.

If possible, an analysis of the sensitivity of the model uncertainty to important factors influencing cloud reflectance, such as sun position, surface reflectance, cloud optical depth, total column water vapour, and aerosol optical depth, would help to increase confidence in the proposed methodology. It would also be interesting to assess how the model's performance evolves as the angular distance to the satellite's nadir increases.

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Minor comments:

Label of Figure 7: typo

Figures 4 and 6: replace “MSG’s field-of-view » by validation domain

Figures 4 and 6: you mention limiting the validation to ±45°. This is not consistent with the maps (±~40°).

Declarations

Potential competing interests: No potential competing interests to declare.