**The cloud classification**

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# Abstract

Keywords: South West Indian Ocean, cloud cover,

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# Introduction

Previous studies:

Cloud Type product issued from retrievals of the Spinning Enhanced Visible and InfraRed Imager onboard MeteoSat Second Generation (MSG-SEVIRI) offers a classification of clouds at 3 km spatial resolution and 15 min time resolution over the period 2010–2014. This cloud type classification was used for a diurnal and seasonal analysis to exam its role on the annual forests greenness in central Africa (between 0 and 5°N and 12–19°E). In this study [Philippon et al. (2016)](#_ENREF_6) redefined 7 cloud type according to cloud altitude and their optical properties; then

The climatological distribution of low-cloud fraction (LCF) over south Indian Ocean and its seasonality is presented by using satellite data, and lined to the storm-track activity and subtropical high. ([Miyamoto et al., 2018](#_ENREF_5)).

[Li et al. (2014)](#_ENREF_4) have shown some evidence of linkage between the cloud vertical structure and large-scale climate by exploring large-scale atmospheric dynamics, meteorological processes, and tropospheric cloudiness.

Using the DARDAR mask product based on Cloud–Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) and CloudSat measurements (between 2007 and 2010), the characterization of the spatial, seasonal and vertical variability of clouds over the whole southwest Indian Ocean is investigated in the latitudinal band between 10 and 30◦S ([Vérèmes et al., 2019](#_ENREF_7)).

In the southwest Indian Ocean, vertical distribution of tropical clouds and their temporal variability of at the diurnal and seasonal scales are investigated in the northern part of Reunion Island (55.5°E; 21.1°S) using data from a 95 GHz cloud radar during 2016–2018 ([Durand et al., 2021](#_ENREF_2)).

[Kahn et al., 2008](#_ENREF_3)

[Chen et al., 2000](#_ENREF_1)

This paper is organized as follows: Section 2 presents the data used in this study and the methods to XXX. The results are shown in section 3. Then conclusions are made in section 4 followed by a brief discussion.

# Data and Methods

## SAFNWC/GEO cloud type product

Reference of this data (to confirmed):

<https://www.nwcsaf.org/web/guest/scientificdocumentation#NWC/GEO%20v2018>

Graphical user interface, chart

Description automatically generated

Fig. 1 spatial coverage of downloaded SAF\_NWC cloud product in general projection.

A picture containing map

Description automatically generated

Fig. 2 Spatial coverage of SAF\_NWC cloud product over Reunion Island.

# cloud variability and

monthly and diurnal:

Chart, bar chart

Description automatically generatedChart, histogram

Description automatically generated

Fig. 3 examples of monthly and diurnal cloud type, from [Philippon et al. (2016)](#_ENREF_6" \o "Philippon, 2016 #60).

## SSR classification

### SSR climatology over Reunion

# Discussion and Conclusion

Summary:

climate change impacts:

Perspective:

This study focusses on the SSR variability due to climate variabilities, where the analysis is at regional scale, over Reunion area. However, more detailed variation at local scale is still missing. Uniformly distributed anomalous SSR (see the classification of SSR anomaly in section 3.1) implies an investigating at smaller scales, such as the cloud process and topography lifting, etc, which is a perspective of this study.

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# Appendix

# References

Engeland K, Borga M, Creutin J-D, François B, Ramos M-H, Vidal J-P (2017) Space-time variability of climate variables and intermittent renewable electricity production – A review Renewable and Sustainable Energy Reviews 79:600-617 doi:<https://doi.org/10.1016/j.rser.2017.05.046>

Fauchereau N, Pohl B, Reason C, Rouault M, Richard Y (2009) Recurrent daily OLR patterns in the Southern Africa/Southwest Indian Ocean region, implications for South African rainfall and teleconnections Climate Dynamics 32:575-591

Hersbach H et al. (2020) The ERA5 global reanalysis Quarterly Journal of the Royal Meteorological Society 146:1999-2049 doi:<https://doi.org/10.1002/qj.3803>

IEA (2021) World Energy Outlook 2021

Ineichen P (2008) A broadband simplified version of the Solis clear sky model Solar Energy 82:758-762 doi:<https://doi.org/10.1016/j.solener.2008.02.009>

Ineichen P (2016) Validation of models that estimate the clear sky global and beam solar irradiance Solar Energy 132:332-344 doi:<https://doi.org/10.1016/j.solener.2016.03.017>

Jäger-Waldau A (2021) Overview of the Global PV Industry☆. In: Reference Module in Earth Systems and Environmental Sciences. Elsevier. doi:<https://doi.org/10.1016/B978-0-12-819727-1.00054-6>

Liu L et al. (2020) Optimizing wind/solar combinations at finer scales to mitigate renewable energy variability in China Renewable and Sustainable Energy Reviews 132:110151 doi:<https://doi.org/10.1016/j.rser.2020.110151>

Macron C, Pohl B, Richard Y, Bessafi M (2014) How do Tropical Temperate Troughs Form and Develop over Southern Africa? Journal of Climate 27:1633-1647 doi:10.1175/jcli-d-13-00175.1

Pohl B, Dieppois B, Crétat J, Lawler D, Rouault M (2018) From synoptic to interdecadal variability in Southern African rainfall: toward a unified view across time scales Journal of Climate 31:5845-5872

Vigaud N, Pohl B, Crétat J (2012) Tropical-temperate interactions over Southern Africa simulated by a regional climate model Climate Dynamics 39:2895-2916 doi:10.1007/s00382-012-1314-3

Yin J, Molini A, Porporato A (2020) Impacts of solar intermittency on future photovoltaic reliability Nature Communications 11:4781 doi:10.1038/s41467-020-18602-6

Chen, T., Rossow, W.B., Zhang, Y., 2000. Radiative Effects of Cloud-Type Variations. Journal of Climate 13(1), 264-286.

Durand, J., Lees, E., Bousquet, O., Delanoë, J., Bonnardot, F., 2021. Cloud Radar Observations of Diurnal and Seasonal Cloudiness over Reunion Island. Atmosphere 12(7), 868.

Kahn, B.H., Chahine, M.T., Stephens, G.L., Mace, G.G., Marchand, R.T., Wang, Z., Barnet, C.D., Eldering, A., Holz, R.E., Kuehn, R.E., Vane, D.G., 2008. Cloud type comparisons of AIRS, CloudSat, and CALIPSO cloud height and amount. Atmos. Chem. Phys. 8(5), 1231-1248.

Li, Y., Thompson, D.W.J., Stephens, G.L., Bony, S., 2014. A global survey of the instantaneous linkages between cloud vertical structure and large-scale climate. Journal of Geophysical Research: Atmospheres 119(7), 3770-3792.

Miyamoto, A., Nakamura, H., Miyasaka, T., 2018. Influence of the Subtropical High and Storm Track on Low-Cloud Fraction and Its Seasonality over the South Indian Ocean. Journal of Climate 31(10), 4017-4039.

Philippon, N., de Lapparent, B., Gond, V., Sèze, G., Martiny, N., Camberlin, P., Cornu, G., Morel, B., Moron, V., Bigot, S., Brou, T., Dubreuil, V., 2016. Analysis of the diurnal cycles for a better understanding of the mean annual cycle of forests greenness in Central Africa. Agricultural and Forest Meteorology 223, 81-94.

Vérèmes, H., Listowski, C., Delanoë, J., Barthe, C., Tulet, P., Bonnardot, F., Roy, D., 2019. Spatial and seasonal variability of clouds over the southwest Indian Ocean based on the DARDAR mask product. Quarterly Journal of the Royal Meteorological Society 145(725), 3561-3576.