X5.80: Multilayer Retrieval of Cloud Top heights from MODIS over the Southern Ocean (SO)

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Why are SO clouds so important?



Frequency of multiple cloud layer coverage (Mace et al. 2009)



Cloud Top Heights (CTH) retrieval of multilayer cloud by CALIOP and

- Multilayer clouds are more frequent over the SO
- Schuddeboom and McDonald (2021) identified substantial discrepancies in the representation of clouds between satellite data and climate models which leads to CRE biases over the SO
- L'Ecuyer et al., (2019) found that multilayer clouds contribute to enhancing LW radiation and reducing SW leading to global cloud radiate effects (CRE)
- Existing retrieval algorithms of Passive Satellites commonly assume clouds as single layer instead of multilayer
- ✤ We have compared different passive sensors over the SO and found biases in cloud properties retrieval (Fig 1)

Data used for Neural Network (NN)

- Moderate Resolution Imaging Spectroradiometer (MODIS)-AQUA (MYD06 and MYD02SSH data)
- CLOUDSAT/Cloud Profiling Radar (CPR) and Cloud-Aerosol Lidar with Orthogonal Polarisation (CALIOP) merged dataset (CC)
- Fifth generation ECMWF atmospheric reanalysis (ERA5)









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Summary of Results

Table 3: Mean values and Standard Deviation for NN(Predicted) CTHs data, NASA MODIS CTH and CloudSat-CALIOP CTHS.

		NN CTH		NASA MODIS CTH		CloudSat- CALIOP	
		Top layer	Second layer	Top layer	Secon d layer	Top layer	Second layer
Mean [km]	Single-layer cases	3.47	-	3.12	-	3.56	-
	Multi-layer cases	8.04	3.45	5.25	-	8.26	3.42
Standard Deviation [km]	Single-layer cases	3.05	-	2.98	-	3.25	-
	Multi-layer cases	2.67	2.24	3.48	-	2.84	2.73

Table 4: Error Statistics for NN(Predicted) CTHs data and NASA MODIS CTH against CloudSat-CALIOP CTHS.

CloudSat-CALIOP (CTH) vs		NN MOI	DIS CTH	NASA MODIS CTH		
		Top layer	Second layer	Top layer	Second layer	
Mean Bias Error [km]	Single-layer cases	0.09	-	0.44	-	
	Multi-layer cases	0.22	-0.02	3.00	-	
Mean Absolute Error [km]	Single-layer cases	0.70	-	1.05	-	
	Multi-layer cases	0.78	1.09	3.24	-	
Root Mean square error [km]	Single-layer cases	1.03	-	1.76	-	
	Multi-layer cases	1.10	1.63	4.30	-	
Correlation	Single-layer cases	0.95	-	0.85	-	
	Multi-layer cases	0.93	0.80	0.54	-	

Retrieval Comparison



Fig 4: Probability distribution of CTHs used for validation of the NN training for the inputs, a) single-layer training and b) for multilayer training Probability Distribution of Cloud top height for Multilayer pixels



• Extend the NN to other passive sensors in the SO

CMIP6 models, Journal of Geophysical Research: Atmospheres, 126, e2021JD035 310, 2021.

b)

• Modify algorithm to retrieve two-layer Cloud base height

References

Future work

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