Ice cloud altitudes with ATLID and MTG-FCI-OCA

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1. Context

Objective

- Objective: improve ice clouds retrieval for FCI.
- Further goal: Characterization of contrails.
- Our focus here: Cloud Top Height (**CTH**) for ice clouds.

Products

- Meteosat Tird Generation - FCI Optimal Cloud Analysis product (**OCA**): reference EUMETSAT cloud retrieval for Meteosat. [1, 2].
  One full disk image every 10 minutes.
- EarthCARE - ATLID CTH product **ATL_CTH_2A** [3]. Four months Global along track data, baseline BA.

2. Machine Learning-based retrieval

Model characteristics

- We use the Multi Layer Perceptron (**MLP**) model from scikit-learn [4].
- Land and ocean are split in separate models.
- 2 hidden layers of 128 neurons

A similar approach can also be found in Meijer et al [5].

Input features

- All thermal bands
- Skin Temperature (ECMWF)
- Time of day / day of year
- Latitude / Solar zenith angle

Training methodology

1. Selection of data:
   (a) Start from a ATLID ice cloud entry in ATL_CTH_2A .
   (b) Keep only clouds above 7km.
   (c) Find corresponding MTG-FCI pixel and correct for parallax.
2. Split into training (70%), testing (15%) and validation (15%).

Preliminary results

- See figures.
- Land model: MAE 0.95km / R-score 0.73
- Ocean model: MAE 0.87km / R-score 0.80

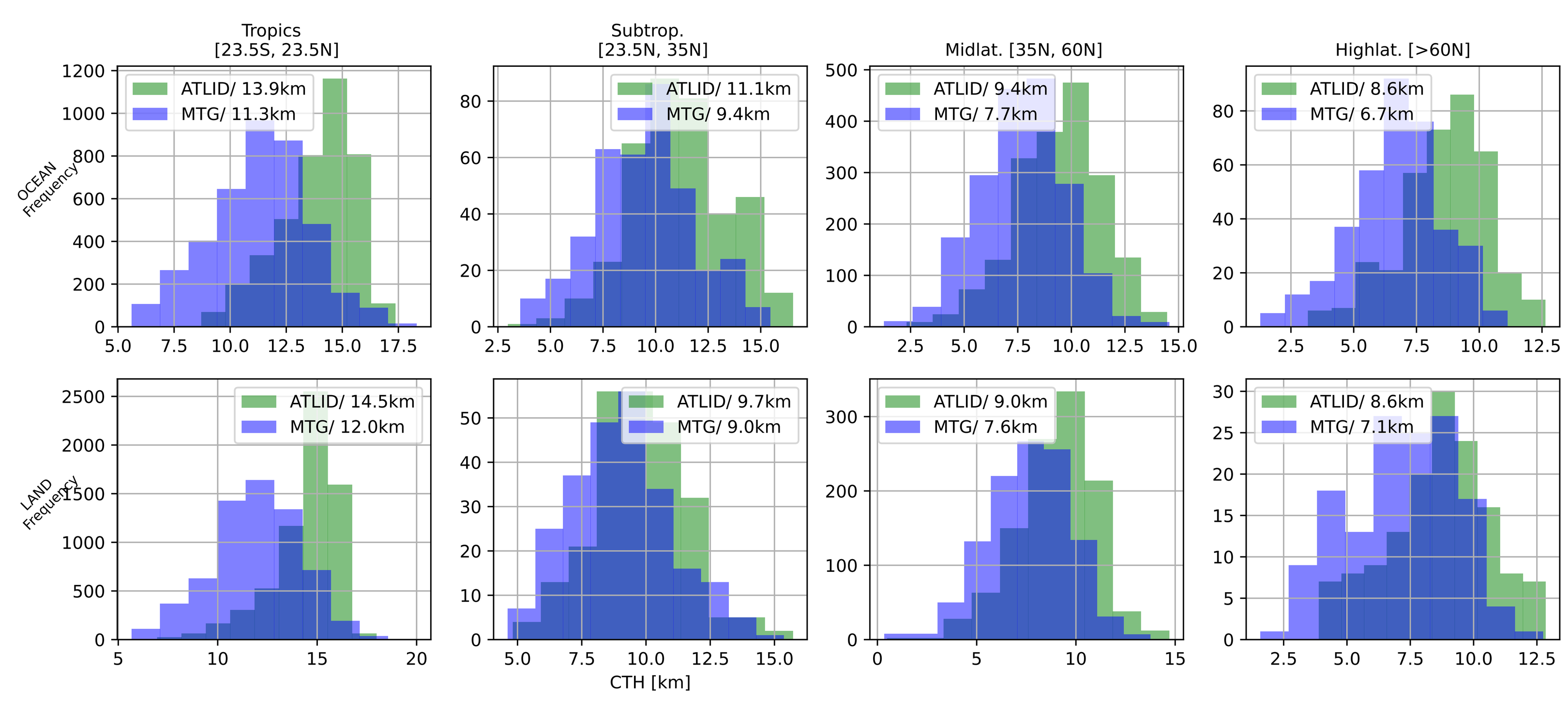

Figure 1: *Histogram of CTH from OCA/ATL_CTH_2A for ocean (top) and land (bottom), for different latitude bands, for colocated measurements.*

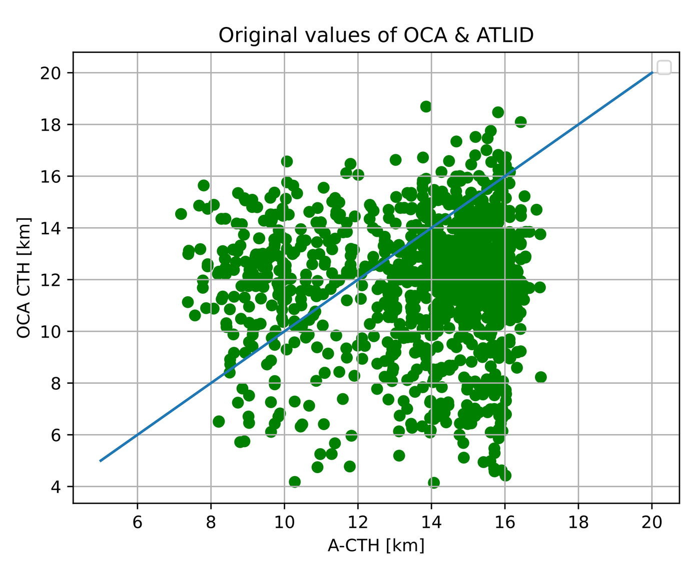

Figure 2: *OCA vs ATL_CTH_2A over land*

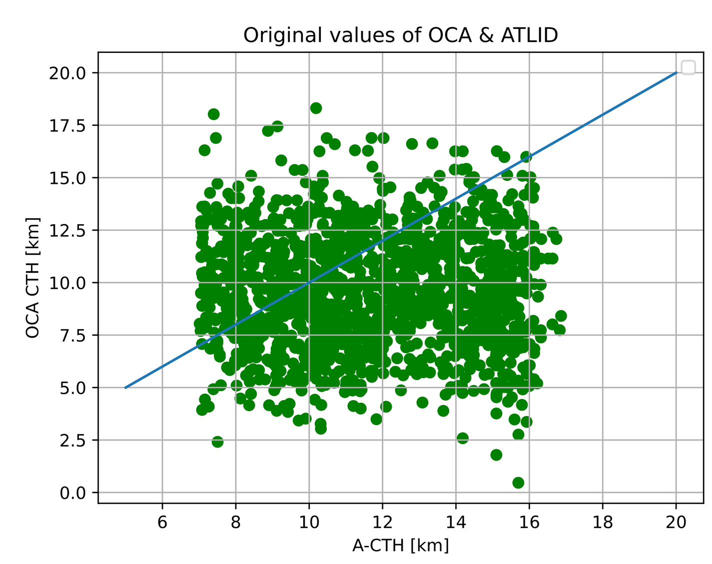

Figure 4: *OCA vs ATL_CTH_2A over ocean*

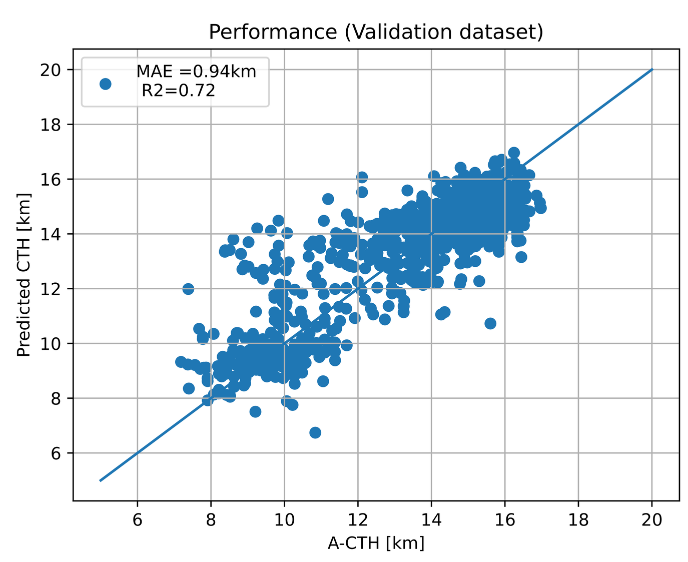

Figure 3: *MLP prediction vs ATL_CTH_2A over land*

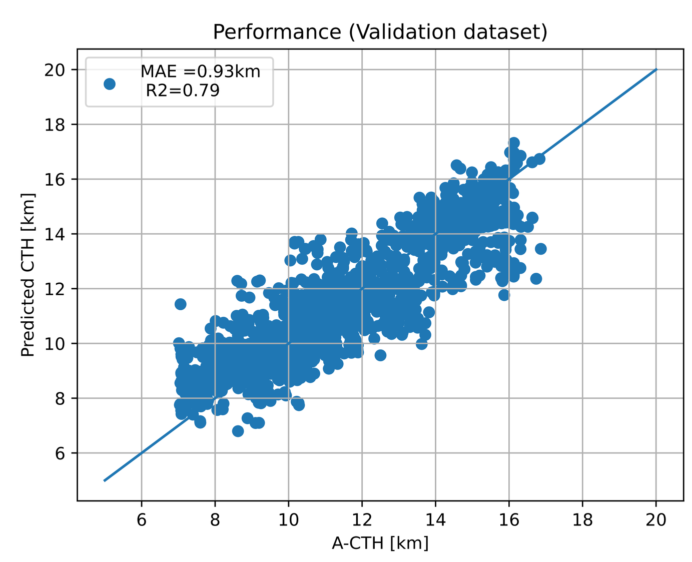

Figure 5: *MLP prediction vs ATL_CTH_2A over ocean*

3. Summary & future work

Summary of results

- Systematic underestimation of CTH for ice clouds in OCA, known issue which is here highlighted with ATLID.
- MLP as retrieval alternative for cloud physical properties, with conclusive results for CTH.

Future work

- Test for the inclusion of other features (land surface information).
- Lift 7km filter.
- Consider Cloud Optical Depth (COD) and Cloud Effective Radius (CER).
- Extend over longer time spans.
- Consider image-based data processing [5].
- Combine the retrieval model with contrail detection to study the climate impact of contrails.

References

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