

Machine Learning cloud top height; an opportunity or challenge for the wind community?

Nina Håkansson¹, Javier García-Pereda², Anke Thoss¹

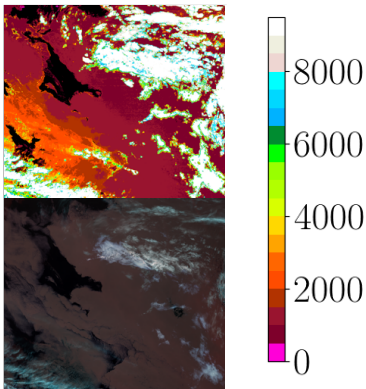
²Agencia Estatal de Meteorología

Presentation at IWW15 (Online)

NWCSAF PPS Package

- Software for cloud products from polar orbiting satellites
- Instruments:
 - AVHRR
 - MODIS
 - VIIRS
 - MERSI2
 - SLSTR (comming)
 - MetImage (comming)
- Nowcasting & Climate data record production (CLARA-A3, CLAAS2)
- Next release planned for 2021
- Products (ex)
 - CTTH Cloud top temperature and height
 - HRW High Resolution Winds (beta release 2021)

PPS CTTH



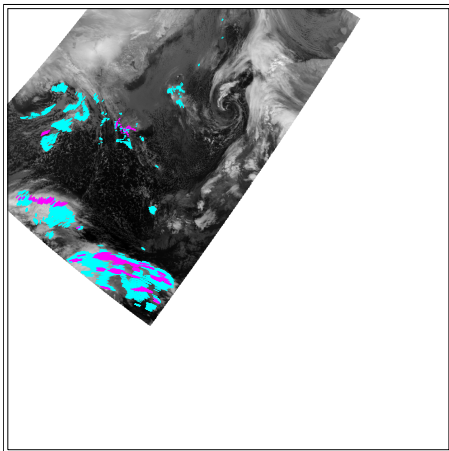
S-NPP 8th March 2015, at 10:57UTC

NWCSAF PPS new HRW product

- The HRW software developed in NWCSAF-GEO have been updated to run also for polar satellites
 - See presentation:
NWCSAF/High Resolution Winds: AMV Software for Geostationary and Polar Satellites – Status in 2021
- Products and imager data remapped to common area before retrieval



PPS HRW



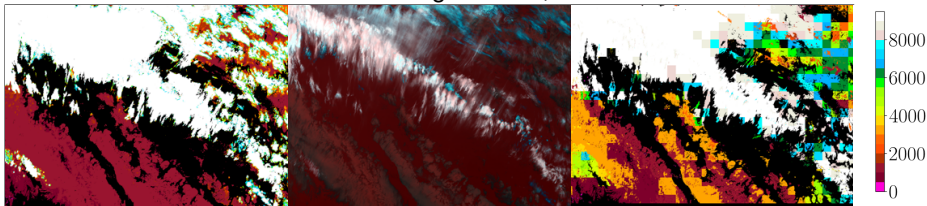
Metop-C 1st February 2020, at 11:40UTC

Neural Network Cloud Top Height

NN-CTTH:

<https://www.atmos-meas-tech.net/11/3177/2018/amt-11-3177-2018.html>

Suomi-NPP 8th August 2015, at 20:25UTC



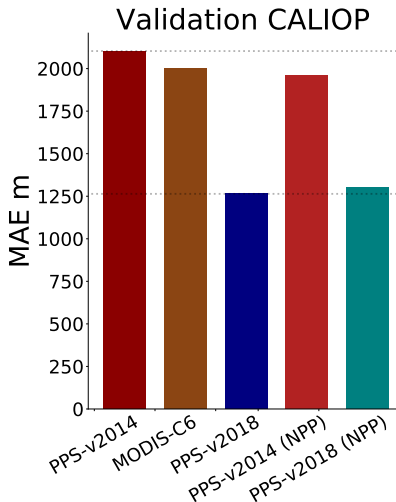
PPS-v2018 CTTH
(MAE scene:0.9km)

PPS-v2014 CTTH
(MAE scene:1.7km)

- New improved CTTH in PPS-v2018
- MAE: Mean absolut error compared to CALIOP.

NN-CTTH Validation

- NN-CTTH is trained with MODIS 2010
- Applied to VIIRS 2015 and MODIS 2010:
 - S-NPP VIIRS data: 15 orbits
 - Eos-Aqua MOIDS data: 6 days
- The blue bars are the Neural Network Metod
- Robust performance and low errors



Effect on HRW

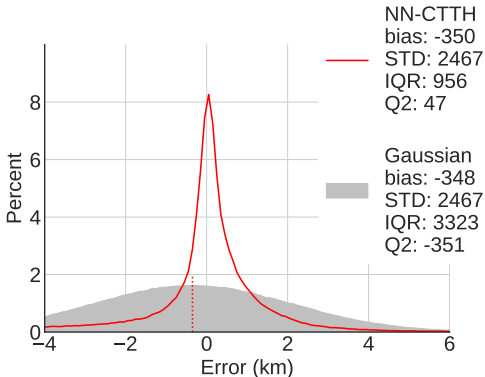
- We thought that HRW might benefit from a CTTH aiming to retrieve the height 1.0 optical depth into the cloud and not the actual cloud top.
- Similar results for winds from polar satellites compared to from geostationary show that the neural network CTTH works OK also for HRW.
- Validation performed by Javier García-Pereda.



package year of data	MSG-GEO (2010)	PPS (2020)
NC	10979907	644756
SPD [m/s]	17.3	23.02
NBIAS	-0.07	-0.06
NMVD	0.32	0.32
NRMSVD	0.39	0.39

Non-Gaussian error distributions

- NN-CTTH and corresponding Gaussian distribution
 - Same bias & STD
 - Distributions are different
 - ⇒ bias & STD not enough to describe the error distribution!
- Bias: not most common error
- Note: some large errors expected due to sensor and FOV differences.



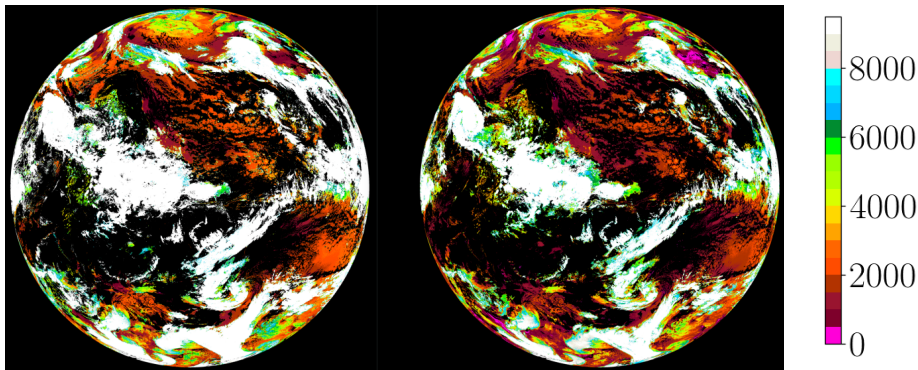
Error estimates for CTTH

Upper and lower threshold with quantile regression neural networks, Simon Pfreunds Schuh et al. (2018):

<https://www.atmos-meas-tech.net/11/4627/2018/amt-11-4627-2018.html>

Upper limit

Lower limit



- Method not restricted to AVHRR/MODIS/VIIRS although PPS-software package is.

Summary and future

Summary :

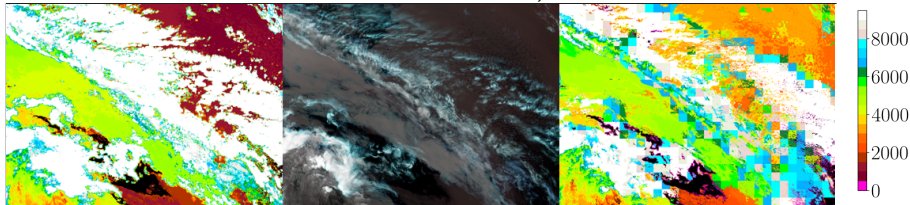
- New beta release of PPS-HRW for polar satellites 2021
- Neural network height is ok for HRW retrievals

Future :

- How to use the cloud top error estimates?
- Explore effect on HRW of cloud top NN trained for different optical depths

Thank you for listening!

Suomi-NPP 8th March 2015, at 10:58UTC



PPS-v2018 CTTH
(MAE:1.4km)

PPS-v2014 CTTH
(MAE:3.1km)