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Comparison of MetOp AVHRR Cloud Products from the CLAVR-x, PPS and MAIA Systems

Introduction:

MetOp-A provides, for the first time, global AVHRR data at full resolution (1 km). This poster presents an initial comparison of three operational AVHRR cloud products from NOAA and EUMETSAT's Nowcasting SAF Project. This work focuses on the cloud detection performance. The products compared are taken from:

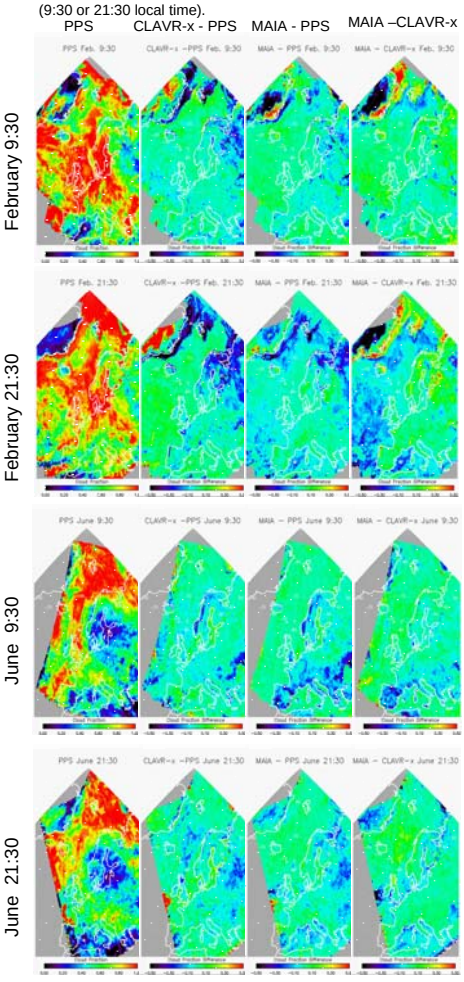
PPS – SMHI's Polar Processing System. Provides cloud products and imagery for nowcasting. Also being developed for climate applications within the CM-SAF.

•**CLAVR-x**: NOAA's system that provides a cloud mask in Level-1b data and full suite of cloud products. Also serves as the basis for the PATMOS-x climate data-set.

•**MAIA**: Meteo' France's system for cloud clearing IASI data and for generating a global SST product.

Cloud Fraction Comparison

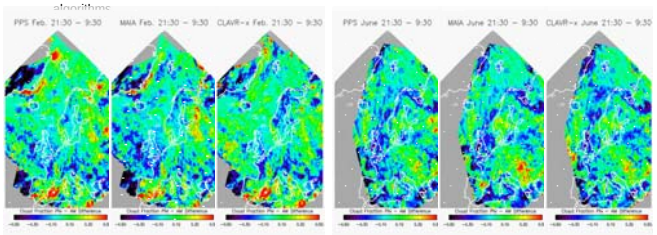
To compare the performance of cloud detection schemes, cloud amounts were computed in 0.5 degree cells over the region observed by the Norrköping HRPT receiving station. We analyzed two periods of data from February 1-142007 and from June 1-14 2007. The results were also separated by node (9:30 or 21:30 local time).



- Most regions exhibit difference less than 10%
- Differences do appear more often over land.
- Significant differences over Greenland in February and on sea ice boundaries.

Day-Night Differences

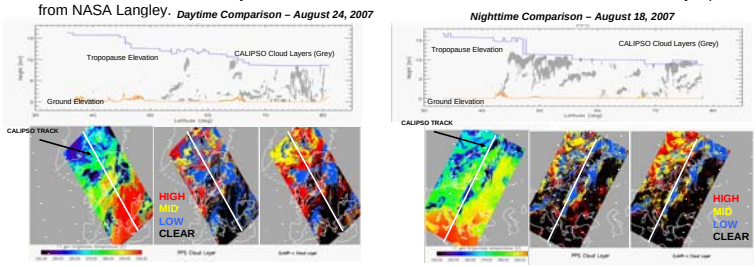
The following images show the differences between the 21:30 and 9:30 results for both periods. Large differences between day and night may be indicative of inconsistencies in the day and night algorithms.



- Most of patterns are common to all three data-sets
- Large day-night differences over Greenland and its surrounding points to potential algorithm issues.
- Not enough data for the true diurnal cycle to emerge.

Comparisons to CALIPSO (NOAA-18)

To provide a more quantitative comparison, we analyzed several HRPT scenes received by Norrköping. Because CALIPSO flies in the EOS A-train, only NOAA-18 data provided simultaneous, co-located data with CALIPSO. The algorithms run on NOAA-18 are the same as on METOP data (though channel 3b is used during the day). The images below show the CALIPSO cloud layer cross sections and the corresponding PPS and CLAVR cloud layers. Because the definitions of the PPS and CLAVR-x cloud types differ, the types were converted to a uniform cloud layer definition shown below. The CALIPSO data is the 1 km Cloud Layer product from NASA Langley.



Statistics of Cloud Detection Relative to CALIPSO

The following numbers give the fraction of clear and cloudy pixels that were correctly detected relative to CALIPSO. A clear result from CALIPSO meant that cloud fraction based on the three closest CALIPSO pixels was less than or equal to 0.33. A cloudy result from CALIPSO meant the cloud fraction based on the three closest pixels was greater than or equal to 0.66. The closest three CALIPSO pixels were used as opposed to the closest to account for the difference in spatial sampling.

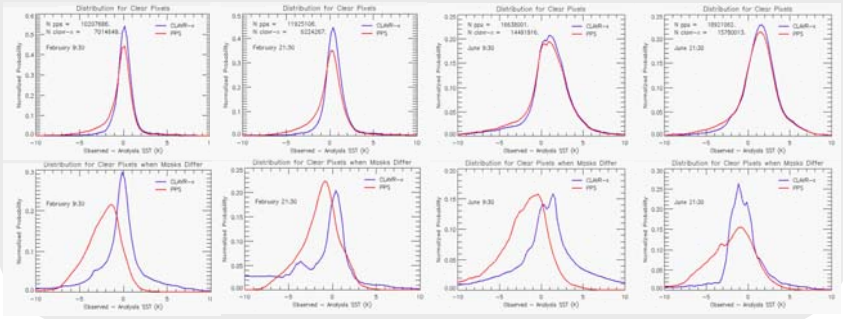
	Nighttime Scene		*Daytime Scene*	
	PPS	**CLAVR-x**	**PPS**	**CLAVR-x**
Clear	0.78	0.76	0.90	0.92
Cloudy	0.98	0.99	0.84	0.90

- The nighttime results indicate both PPS and CLAVR-x clear pixels are cloudy 20% of the time. This number drops to about 10% during the day.
- Both PPS and CLAVR-x show little indication of false detection of cloud during the nighttime scene.
- During the day 16% of the PPS and 10% of the CLAVR-x cloudy pixels were not called cloudy by CALIPSO.

Comparison of Derived Sea Surface Temperatures

A cloud mask can also be validated by analyzing the quality of the clear radiances. For example, comparisons of derived Sea Surface Temperatures (SST) from the clear 11 and 12 μm radiances to SST analysis fields can be used to validate the cloud detection. In this analysis, the SST's from the February and June clear data over ice-free oceans are compared to NCEP Real Time Global (RTG) SST. The top row pf figures shows the distribution of the difference in the observed SST and the analysis. Areas of sea-ice were excluded. Cloud contamination would act to shift the distribution towards negative values. The second row of images shows the distribution for clear pixels where the other cloud mask did not produce a clear value. If the distribution of clear pixels not called clear by the other mask exhibits the characteristics of clear pixels, it indicates that the other mask may be missing cloud. A standard MCSST equation was used and no attempt was made to remove biases.

- CLAVR-x SST distributions indicate that its clear pixels over ocean suffer from less cloud contamination than PPS
- However, CLAVR-x produces roughly 10-20% less clear pixels than PPS
- Pixels classified as clear in CLAVR-x but not in PPS do not show much evidence of cloud contamination.



Future Work

- Extend this analysis globally once PPS begins processing global MetOp data on a routine basis.
- Extend this analysis to include cloud height once PPS begins processing also this parameter in satellite projection and globally
- Study the resulting long-term climatologies generated from PPS within the CM-SAF to the CLAVR-x driven climate data-set (PATMOS-x).