

35 years of cloud observations based on HIRS measurements

(HECTOR_{beta}: HIRS basEd Climate daTa recORd - beta)

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Deutscher Wetterdienst
Wetter und Klima aus einer Hand



EUMETSAT

CM SAF

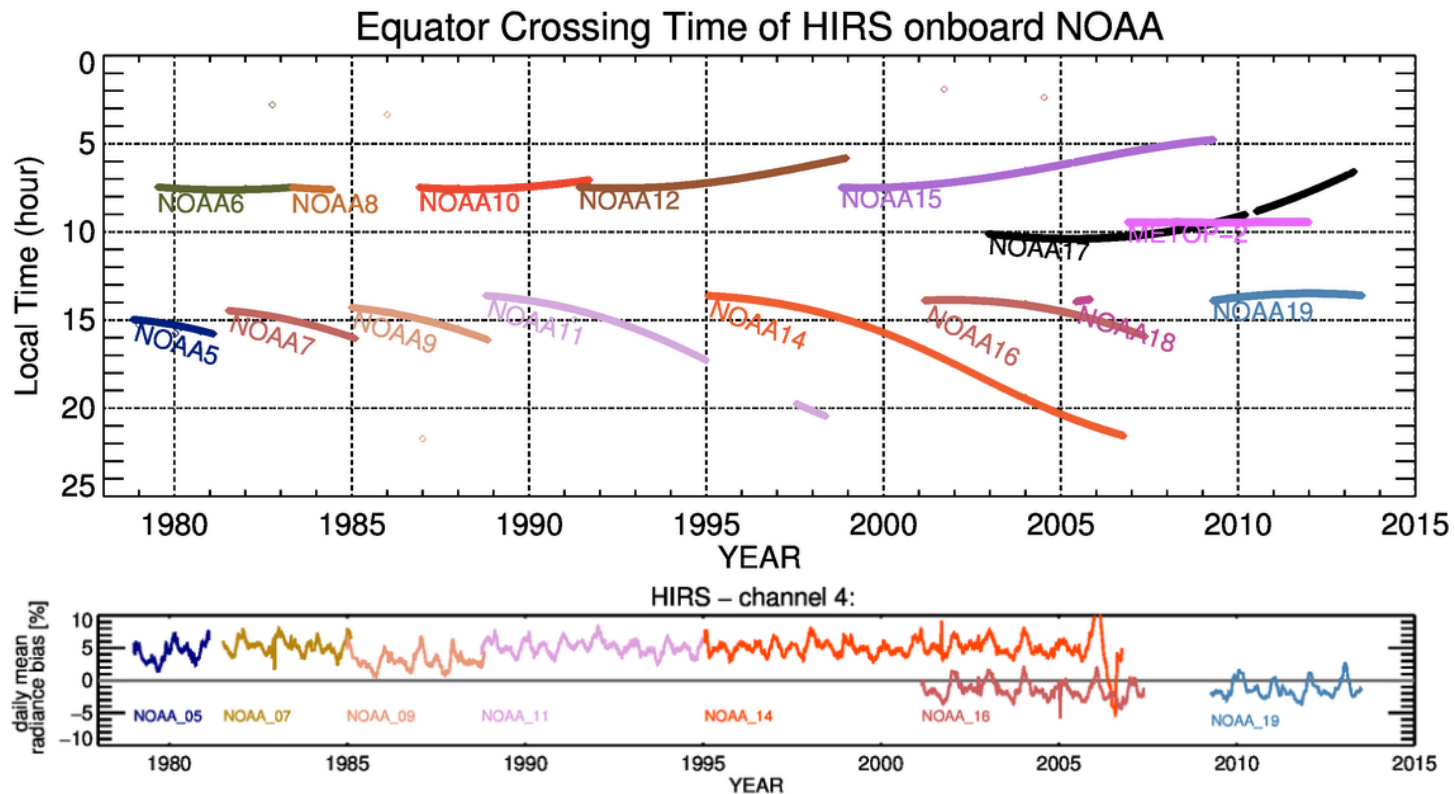
CLIMATE MONITORING



EUMETSAT

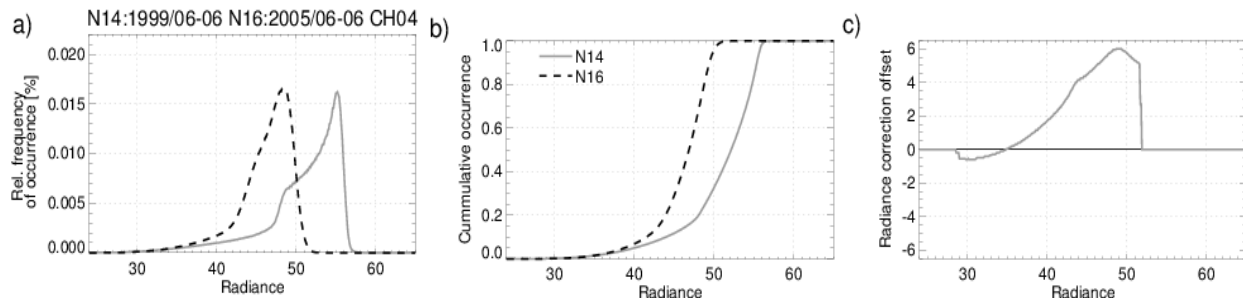
Available HIRS Level-1 data

Received from EUMETSAT (not inter-calibrated yet)



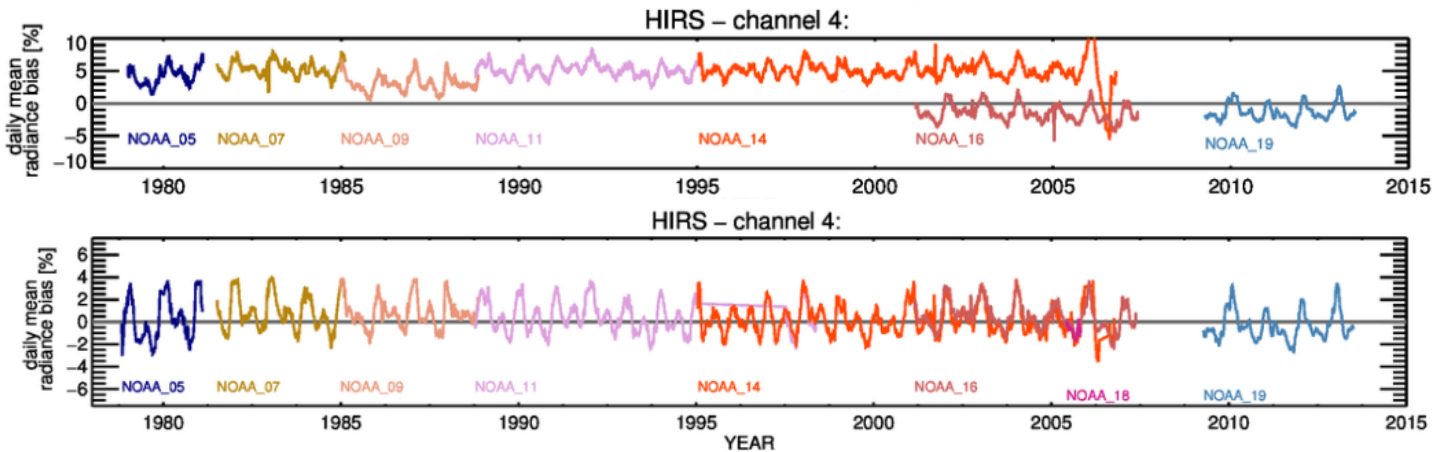
Level-1 Homogenization

Mimicking NOAA-17 HIRS by matching histograms of global observations



Alternatively use synthetic HIRS observations based on IASI spectra or RT simulations

Figure Globally aggregated histograms of HIRS ch4 for NOAA-14 and NOAA-16 (a), also shown as cumulative histograms (b). Panel (c) shows the radiance dependent correction offset which is to be applied to NOAA-14 channel 4 to mimic NOAA16.



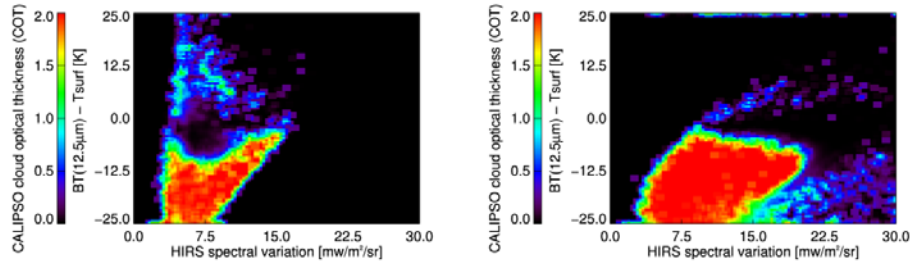
Cloud detection and CTP retrieval

Cloud detection

Two threshold tests are applied to

(1) Standard deviation over all used channel radiances (the more homogeneous all radiances are, the more likely a cloud is observed.)

(2) Difference Tb between 12.5μm thermal window and surface temperature (the larger this difference, the more likely a cloud is observed)



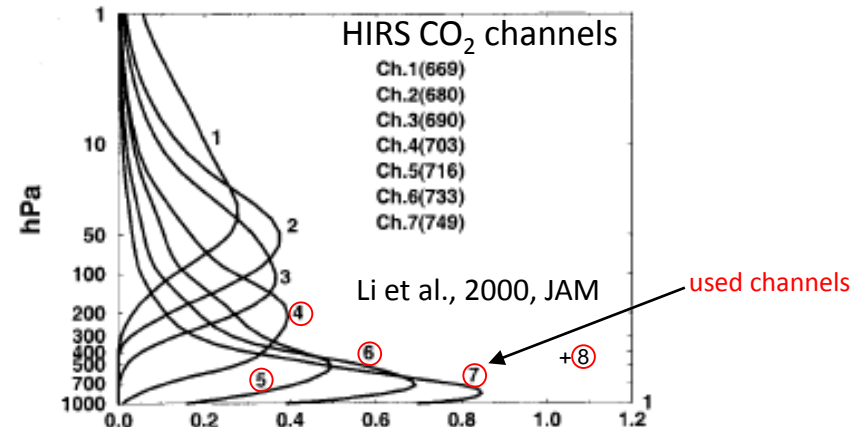
The thresholds were determined based on median CALIPSO COD for all combinations of (1) and (2) which are stored in LUTs separately for warm and cold atmospheres (Figure 6, panels a and b).

Cloud top pressure/height/temperature

Employing the retrieval Clouds from InfraRed Sounders (CIRS, Feofilov and Stubenrauch; 2017) incl. adaptations made for HIRS. Searching for MIN(CH²) in CH² profile with CH² being defined:

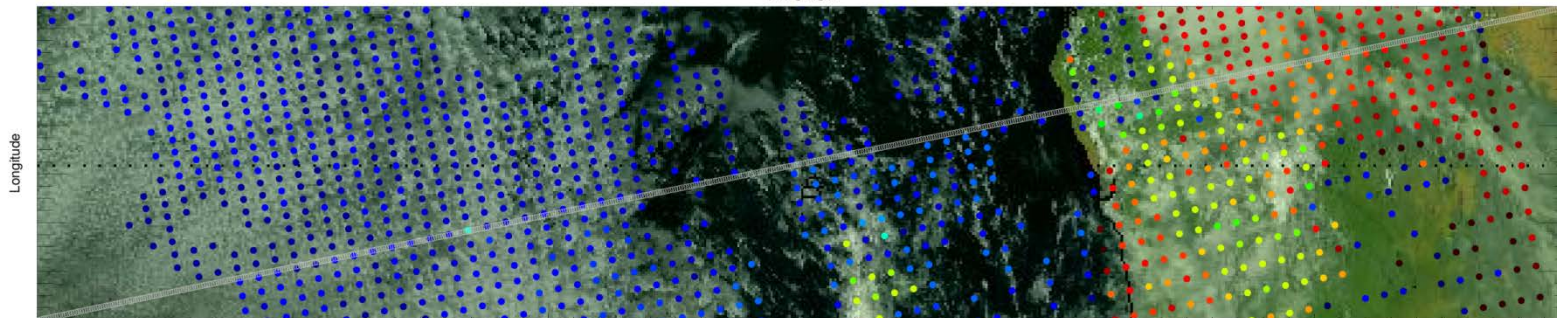
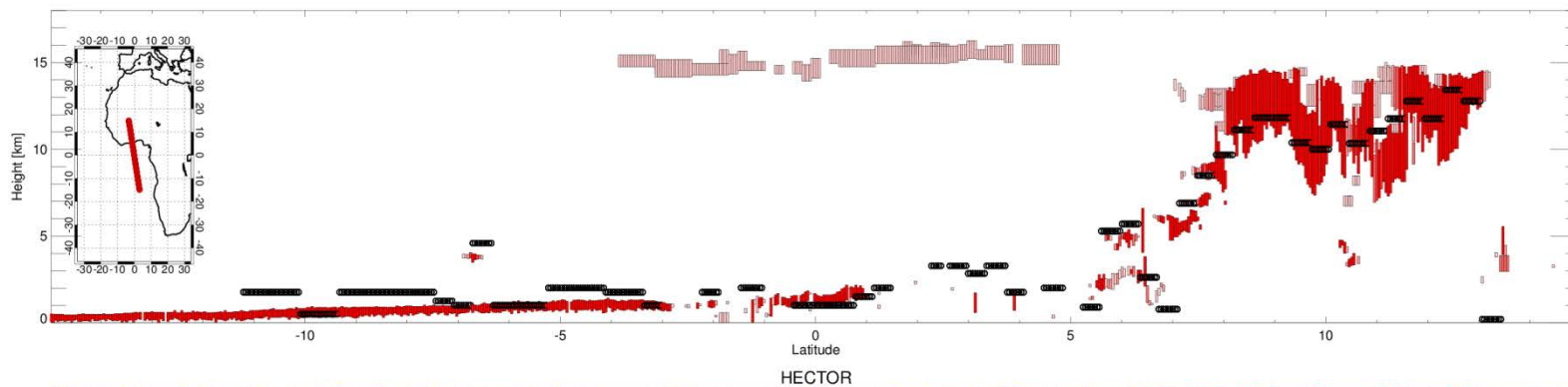
$$CH^2(p_k) = \sum_i \frac{(I_{opaque}(p_k, v_i) - I_{clear}(v_i)) \varepsilon(p_k) * (I_{measure}(v_i) - I_{clear}(v_i))^2}{\sigma^2}$$

CTP at the level for which the CH² minimum if found is the retrieval value, which is further converted to CTT and CTH using NWP profiles.



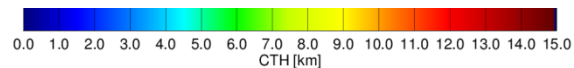
Validation

CTH vs. CALIOP (three uppermost layers)



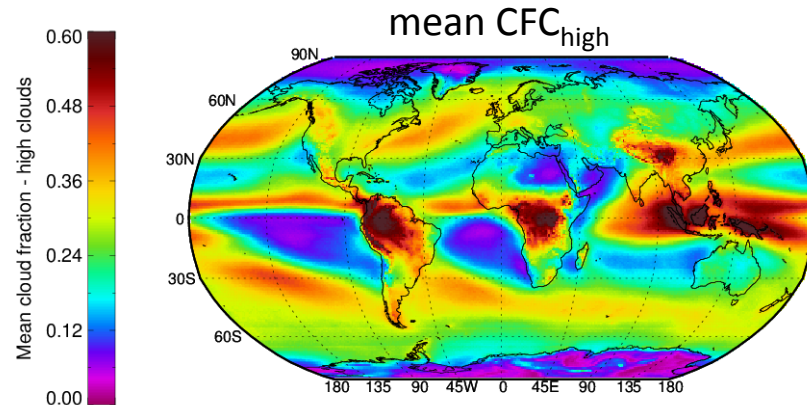
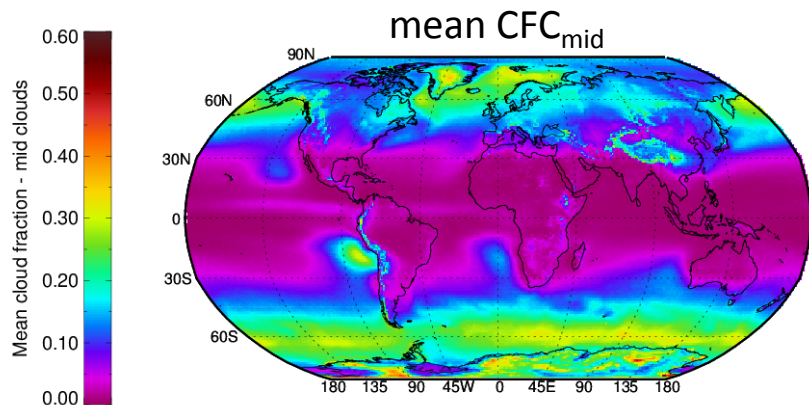
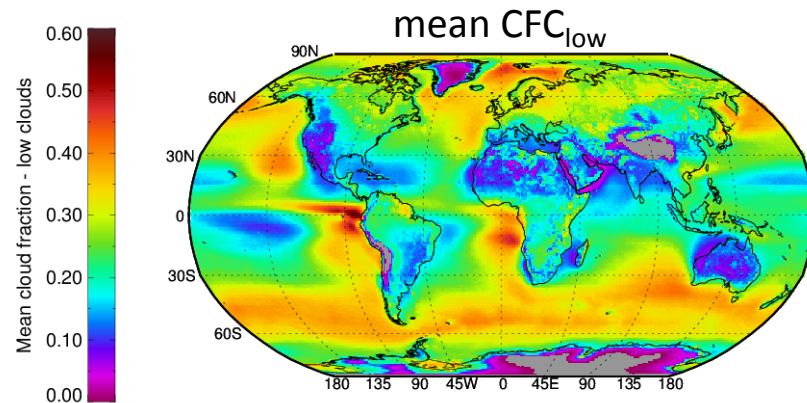
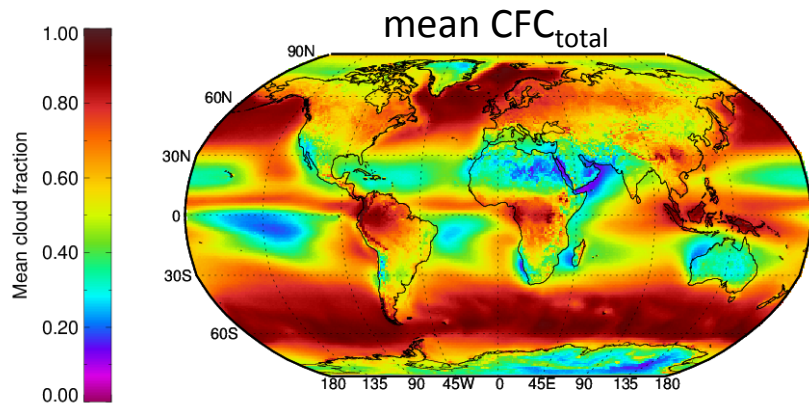
NOAA-19 HIRS, 2009/10/24, 12:43 asc

Latitude



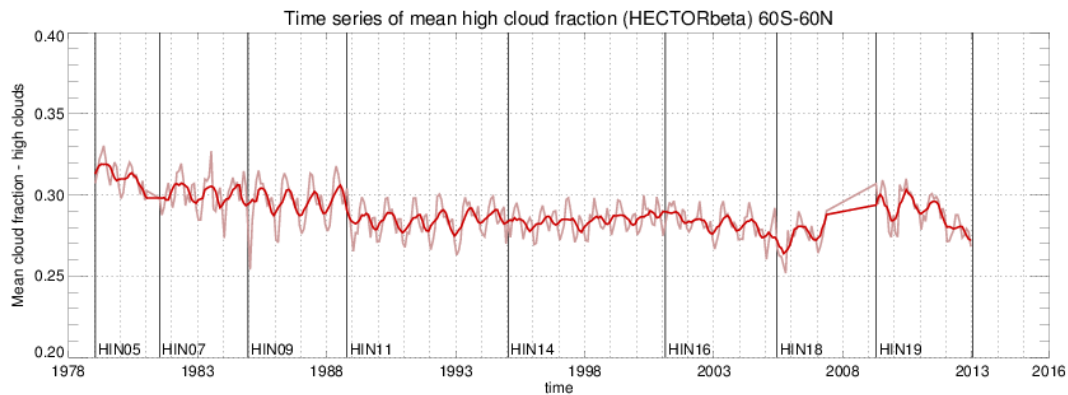
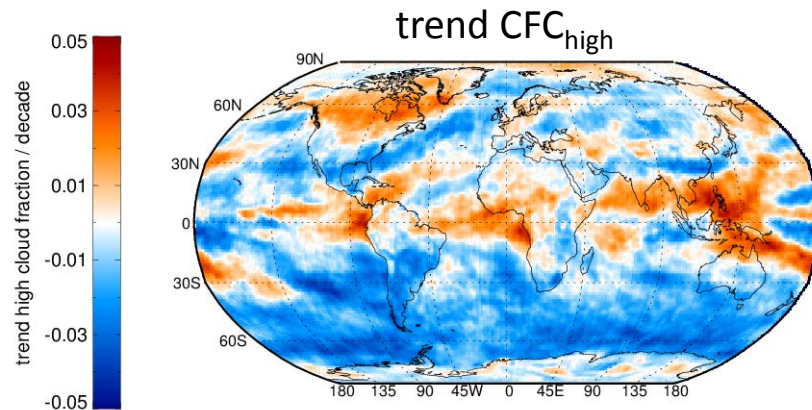
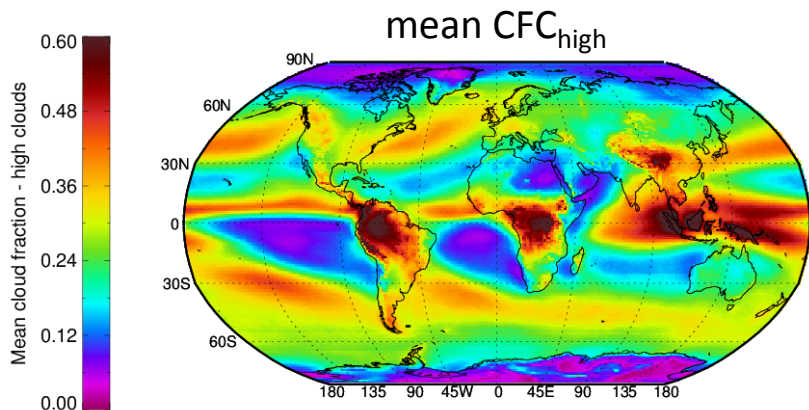
Cloud climatologies (1979-2012)

HECTOR_{beta} Multi-annual mean cloud fraction (total/low/mid/high)



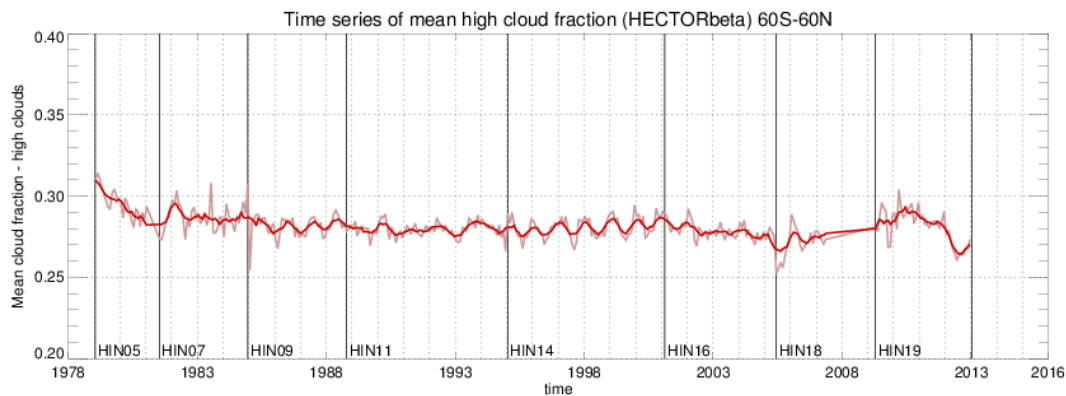
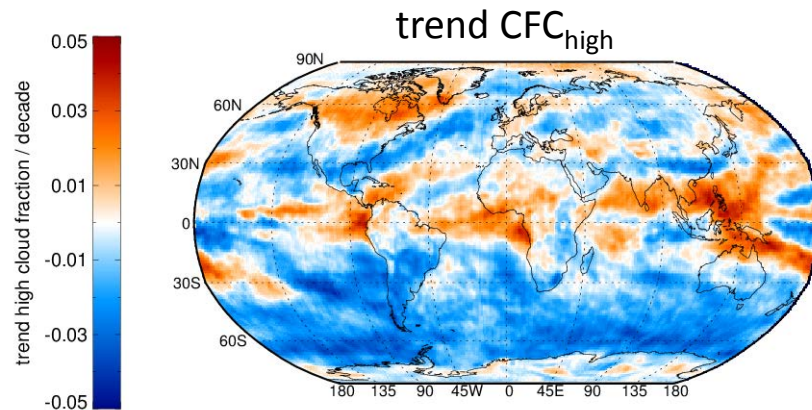
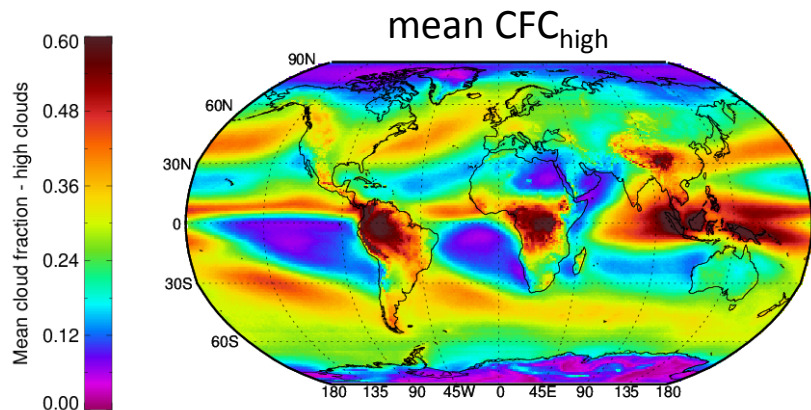
Cloud climatologies (1979-2012)

High clouds - stability/trends



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High clouds - stability/trends

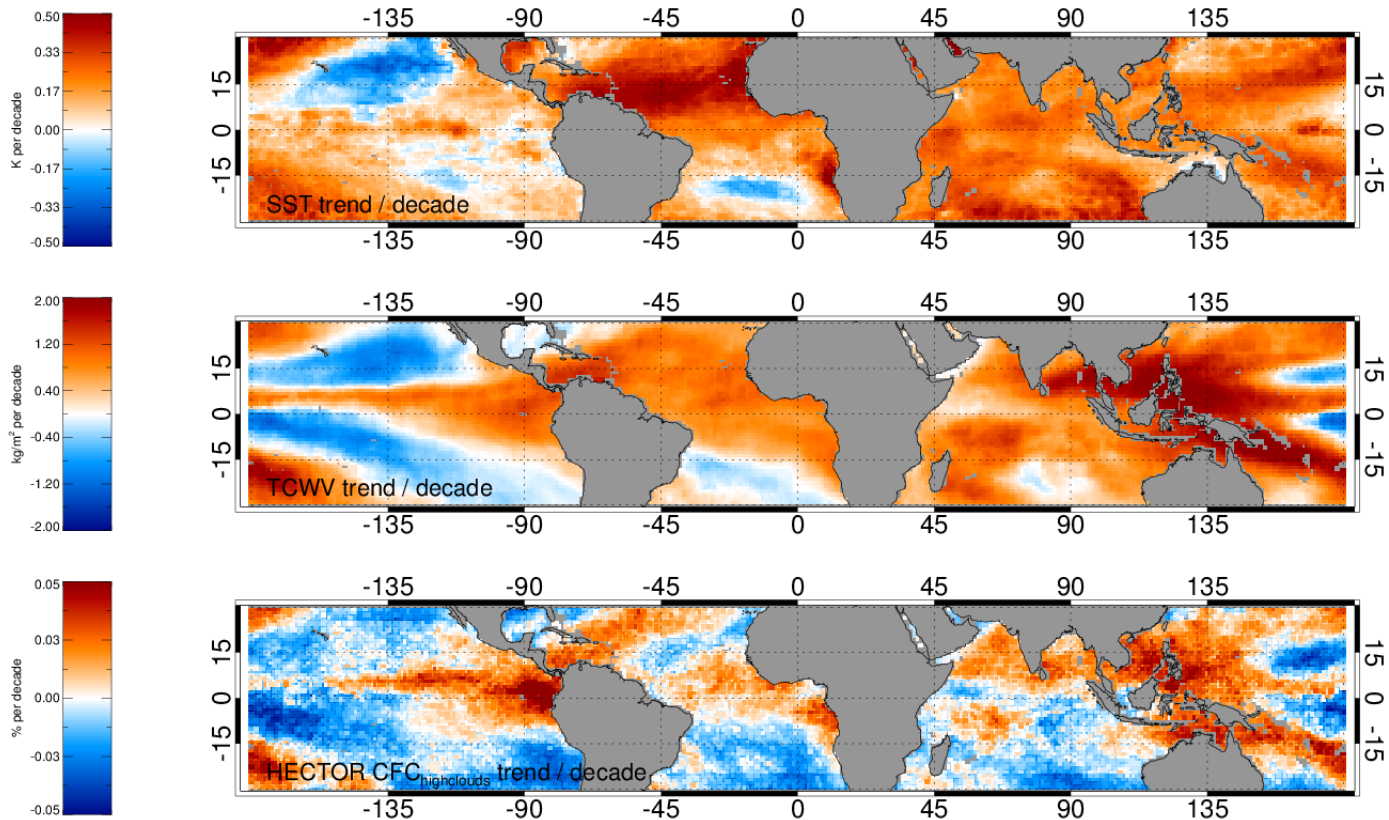


after deseasonalizing and
diurnal cycle correction (1:30PM)

Analysis (1988-2012)

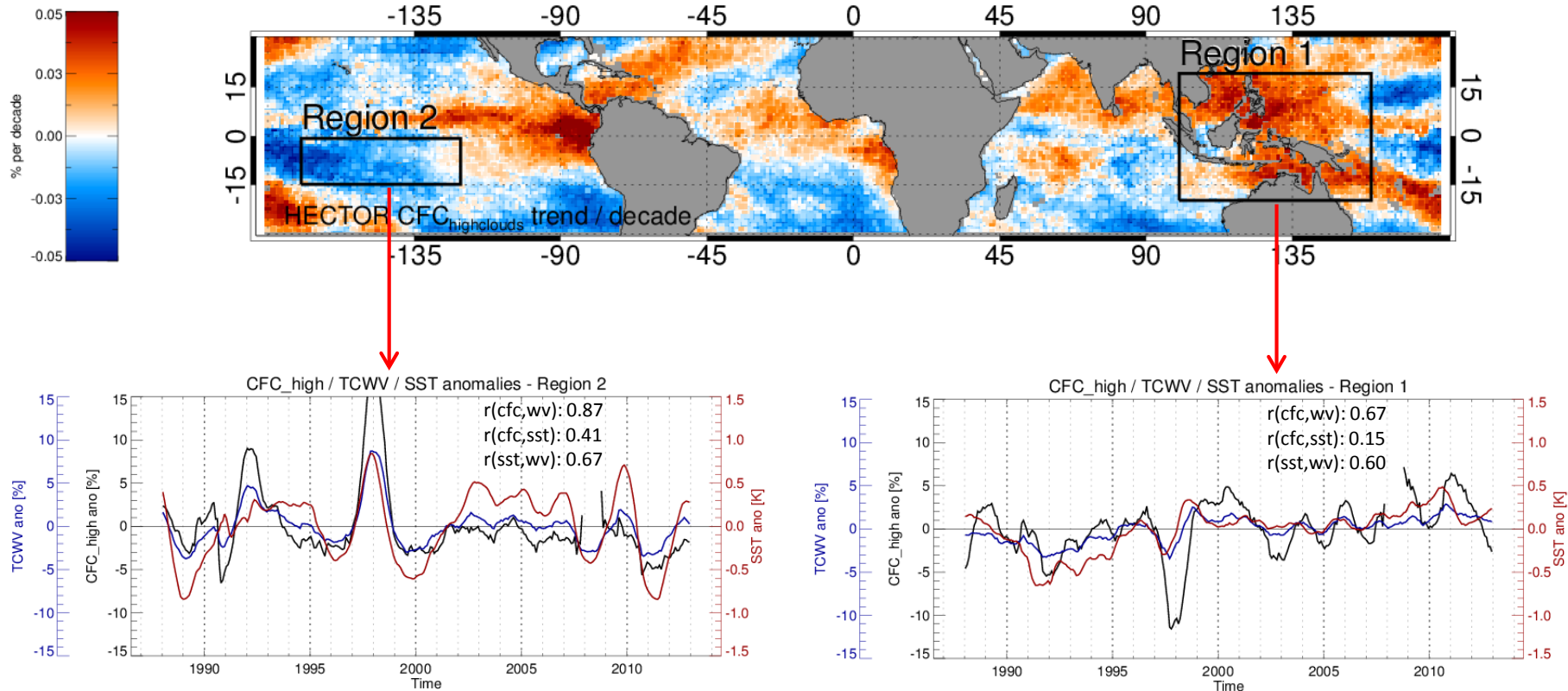
High clouds in the Tropics

SST: AVHRR Pathfinder Version 5.2; Casey et al. (2010)
TCWV: HOAPS-3.3; Kinzel et al. (2017)
HECTOR_{beta}: CM SAF HIRS-based cloud properties



Analysis (1988-2012)

High clouds in the tropics



Summary/Outlook

- Implemented and tested 2 schemes for cloud detection and cloud top pressure retrieval
- Cloud detection and height assignment are of good quality. Some problems remain for low-level clouds and thus for total clouds fraction as well
- High clouds time series demonstrates already a good stability of the data
- Allowing to start doing climate analysis, e.g. analysing trend patterns and der correspondence to other atmospheric and surface properties
- New HIRS FCDR released soon by FIDUCEO
- Maybe redo homogenization using synthetic HIRS obs. based on IASI spectra using HIRS SRF (+shifts)
- Generation and release of HECTORv1.0 in Spring/Summer 2018

