

Dynamic Infrared Land Surface Emissivity Atlas based on IASI Retrievals

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Contents

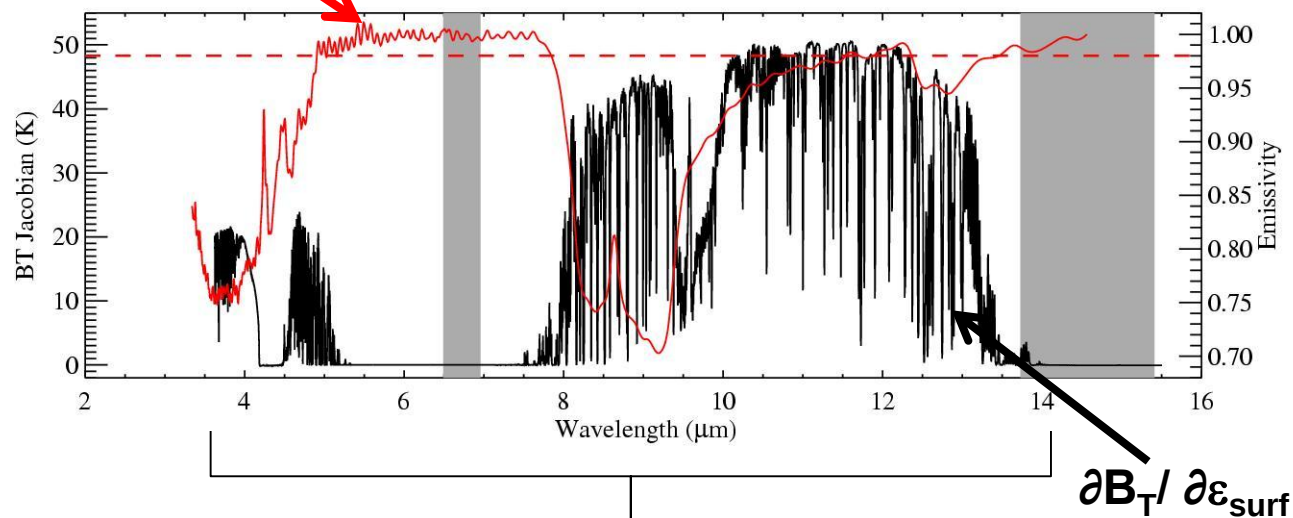
- Background and Motivation
- Atlas Construction
- Preliminary Runs
- Comparison with UWIREMIS atlas
- Status

Motivation

NRT atlas

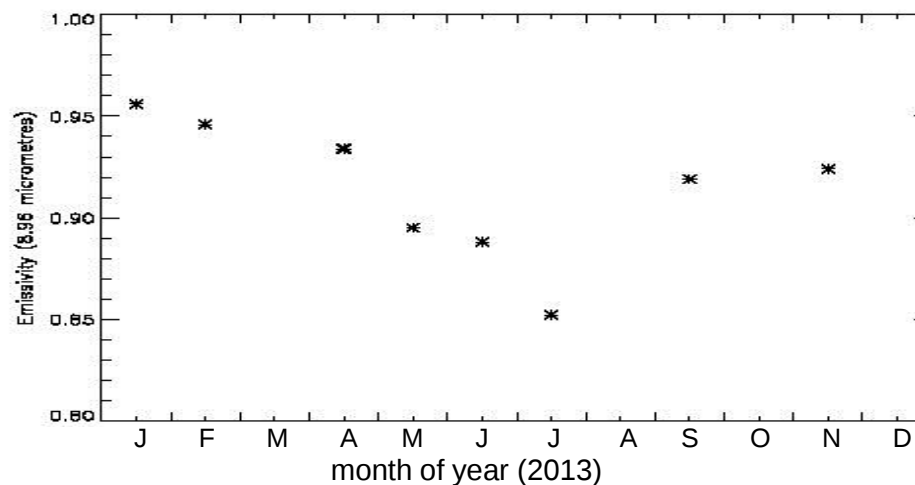
- up-to-date information
 - short term variability
-
- assimilation surface sensitive IR channels over land for NWP (FG for 1dvar)
 - apply to other IR instruments such as SEVIRI
 - improve Tskin accuracy

ϵ of sand (lab spectral analysis)



surface emissivity sensitive IR wavelengths

Retrieved Emissivity at $[\text{lon}, \text{lat}] = [-0.50, 12.50]$ at $8.96 \mu\text{m}$ 2013



IASI (Infrared Atmospheric Sounder Interferometer)

- CNES/EUMETSAT
- MetOp-A (2006), MetOp-B (2013)
- Hyperspectral IR Sounder (8461 channels)
- Spectral Range 3.62 – 15.5 μm
- Mid-morning orbit 09:30 (desc) / 21:30 (asc)

1dvar Retrieval of Emissivity

- $\varepsilon(\lambda)$ retrievals from estimation of PC coefficients in 1dvar
- high dimensional data set reconstructed from PC set of reduced dimensionality
- skin temperature, cloud top pressure and cloud fraction also retrieved

Atlas Construction

- Gridded dataset 0.5 deg x 0.5 deg
- emissivity spectral estimate for each gridbox
- NRT updates from 1dvar IASI emissivity retrievals
- data driven Kalman Filter

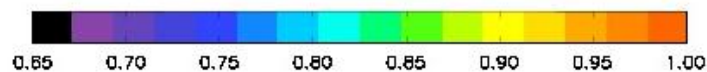
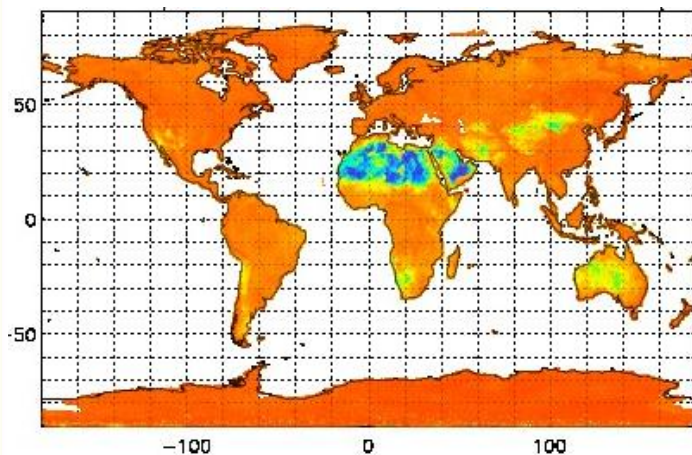
Kalman Filter Implementation

- Initial $\underline{\varepsilon}$ over each gridbox
- persistence model for each $\varepsilon(\lambda)$ in each gridbox
- 1dvar retrievals as measurement updates
- measurement noise from 1dvar analysis covariance matrix

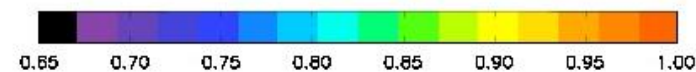
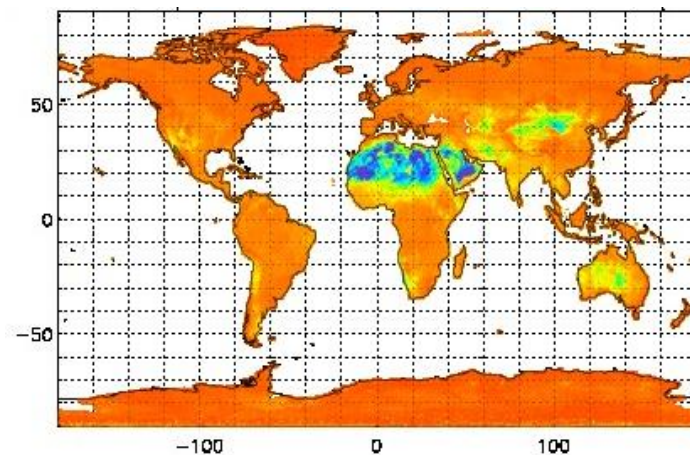
$$A = [B^{-1} + H^T R^{-1} H]^{-1}$$

- system noise from UWIREMIS atlas
- update $\underline{\varepsilon}$ for each relevant gridbox
- covariance matrix estimate

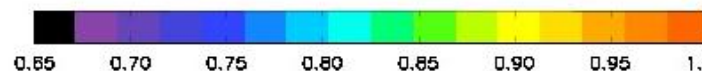
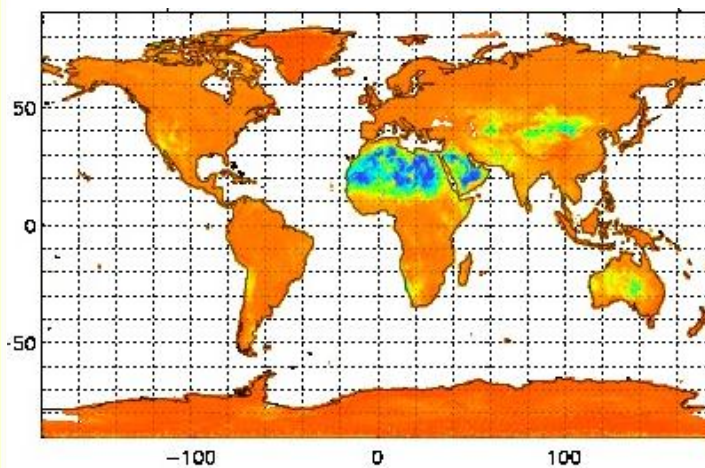
KF emissivity ch:1884 (8.96 μ m) seasonal variation



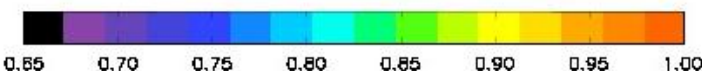
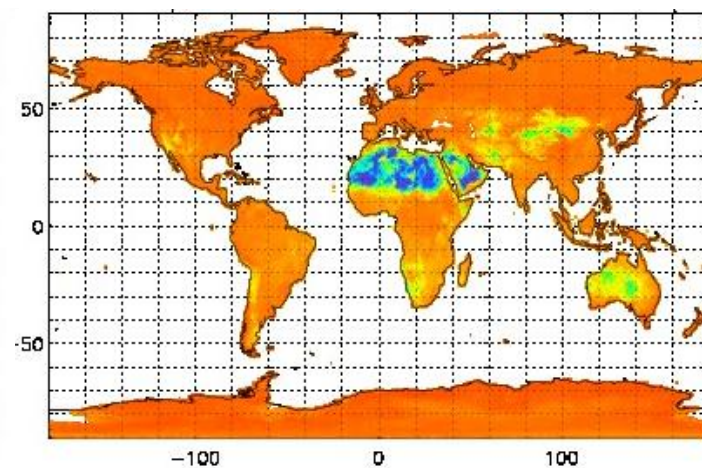
Jan 2014



Apr 2014

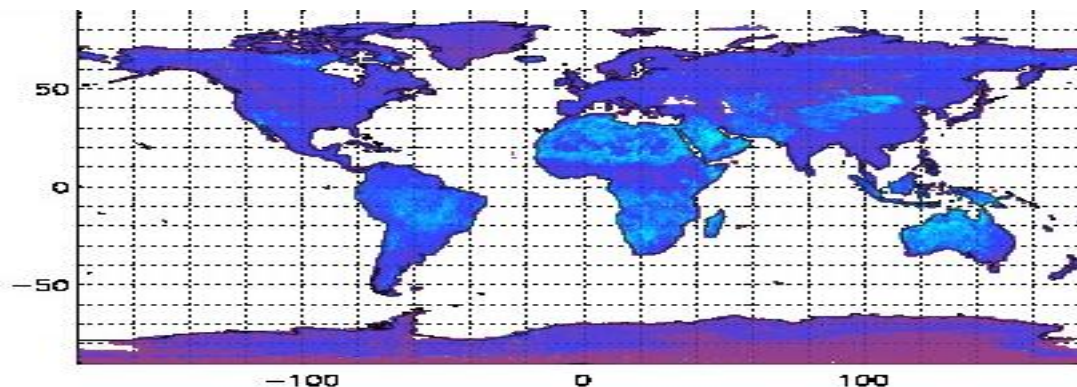


Jul 2014

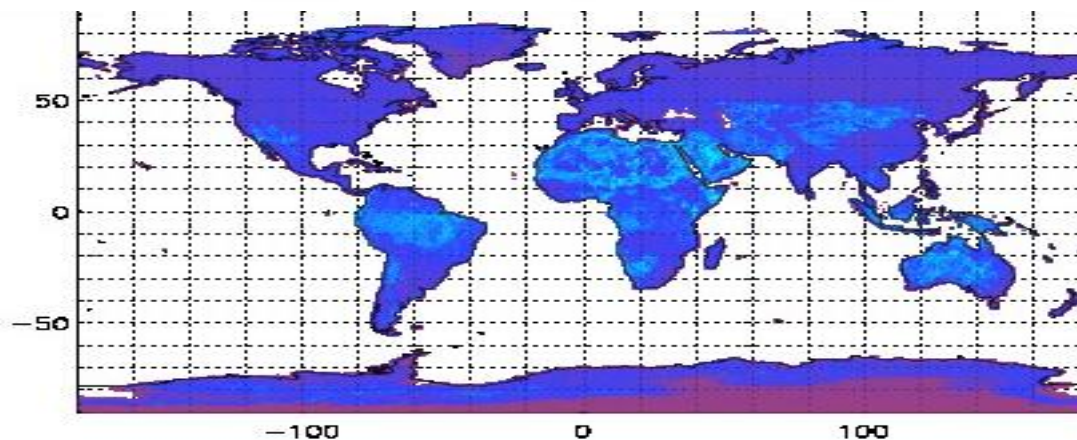


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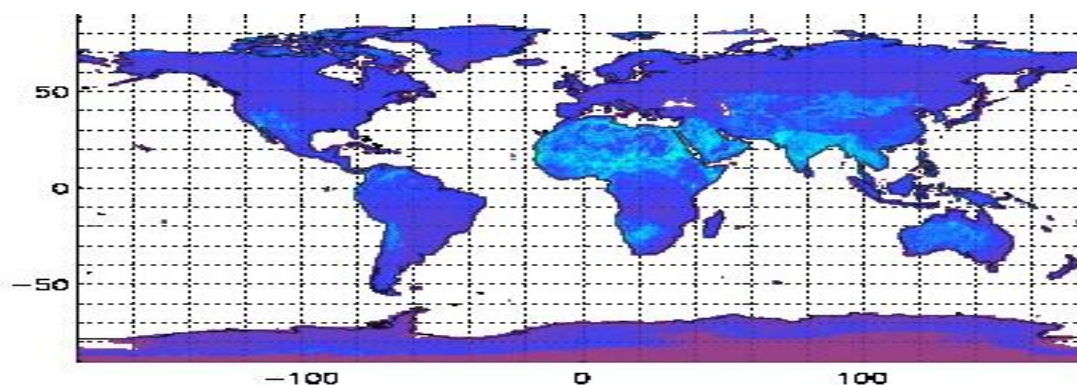
KF emissivity stdev ch:1884 (8.96 μ m)



Jan 2014



Apr 2014



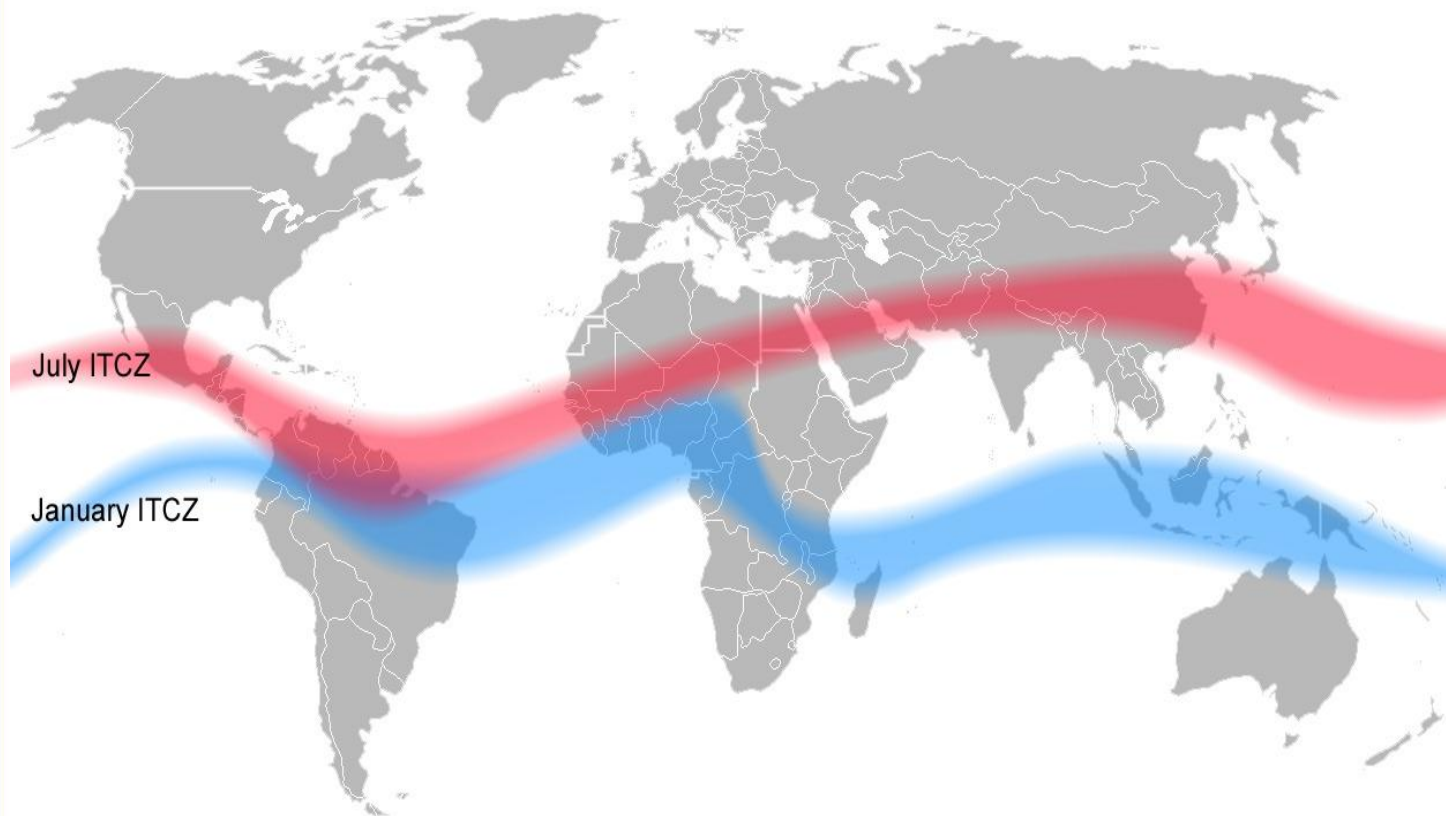
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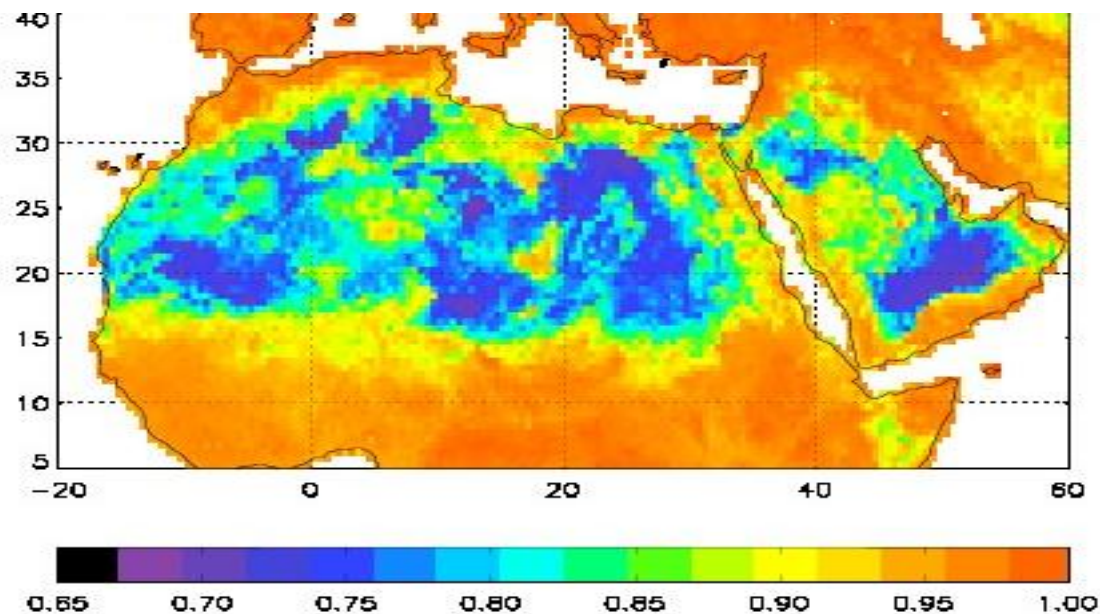


Met Office

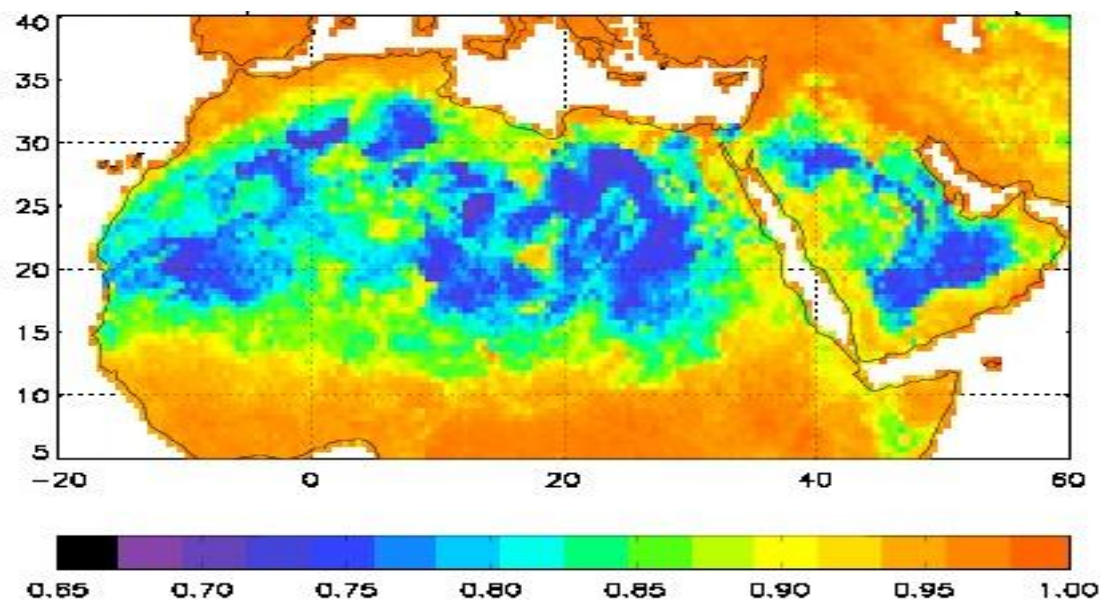
ITCZ January-July



KF emissivity ch:1884 (8.96 μ m)

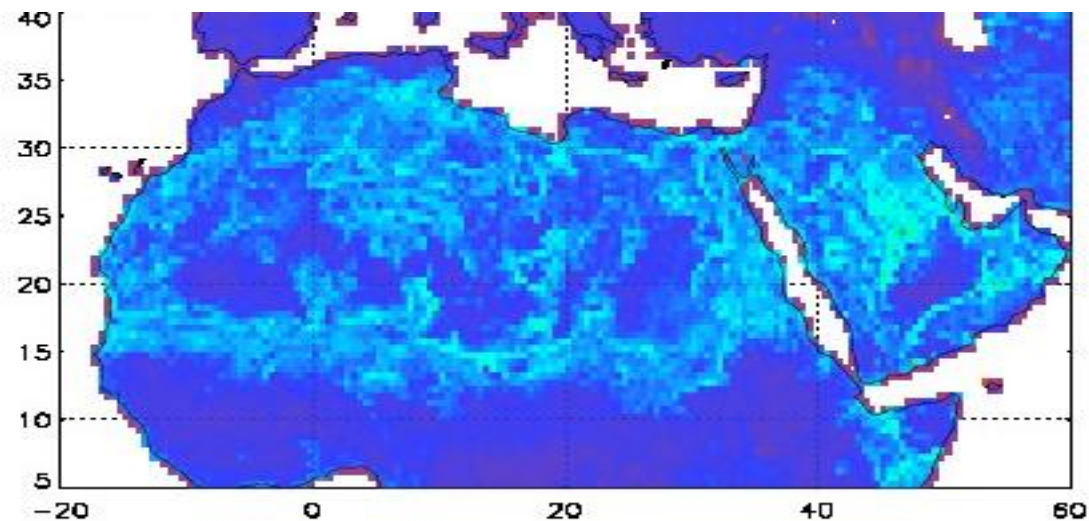


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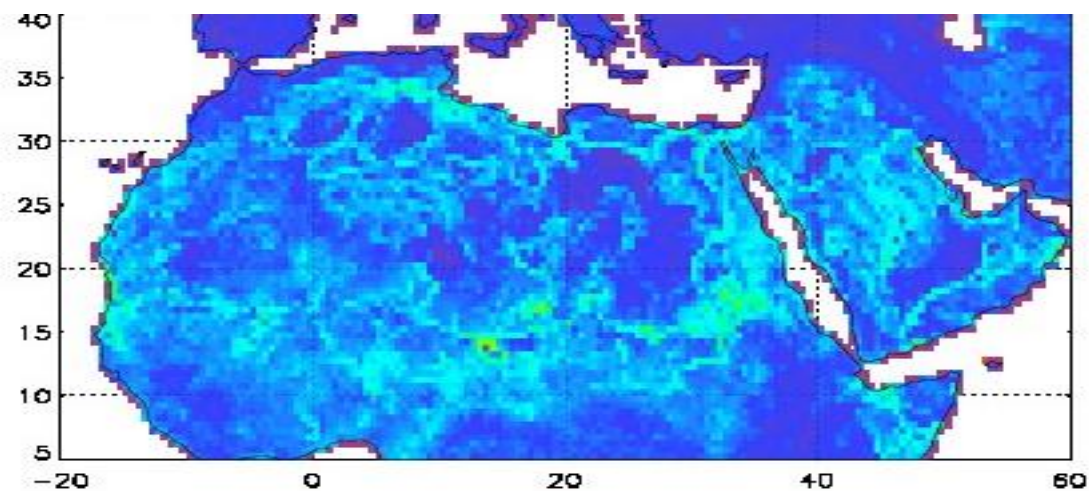


Jul 2014

KF emissivity stdev ch:1884 (8.96 μ m)



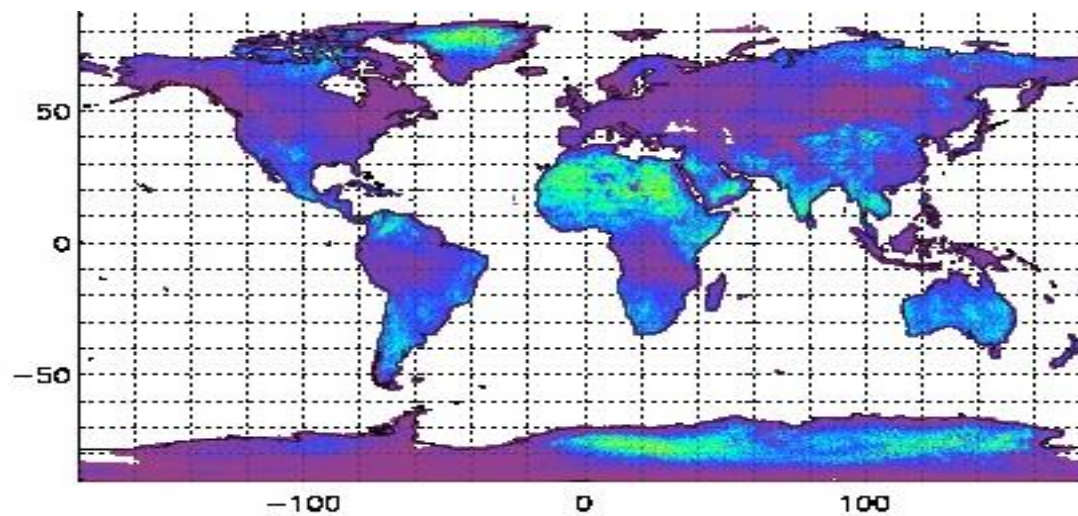
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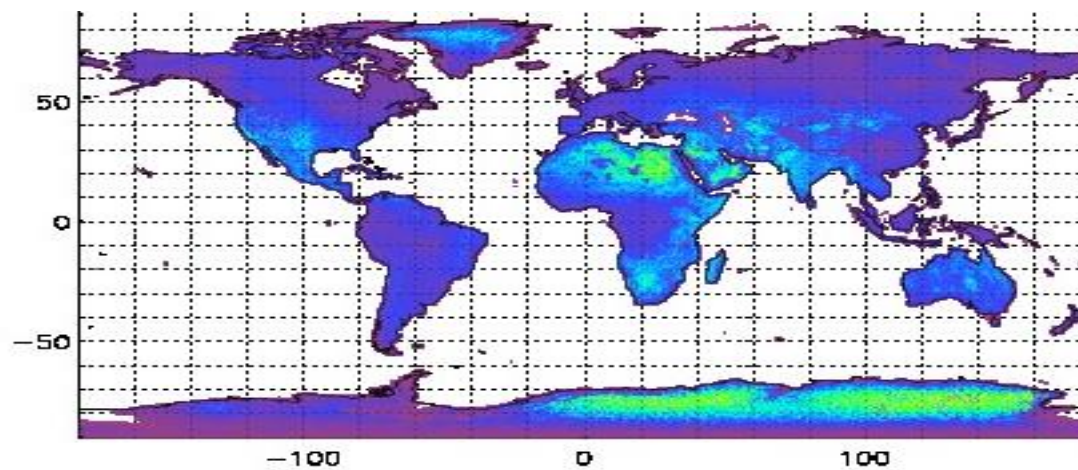
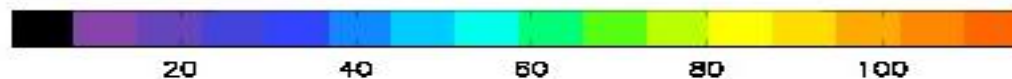
Jul 2014



No of retrievals per gridbox ch:1884 (8.96 μ m)



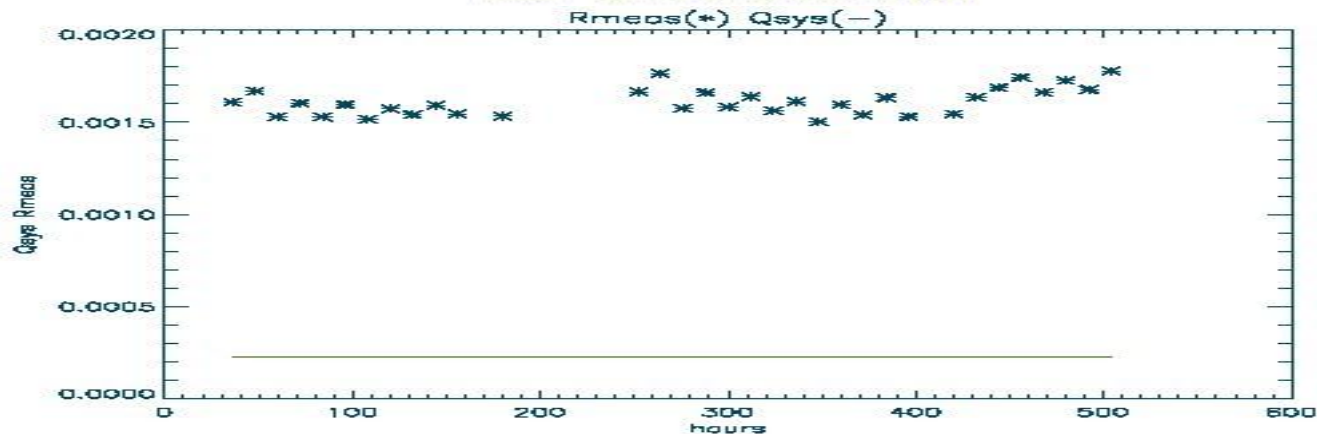
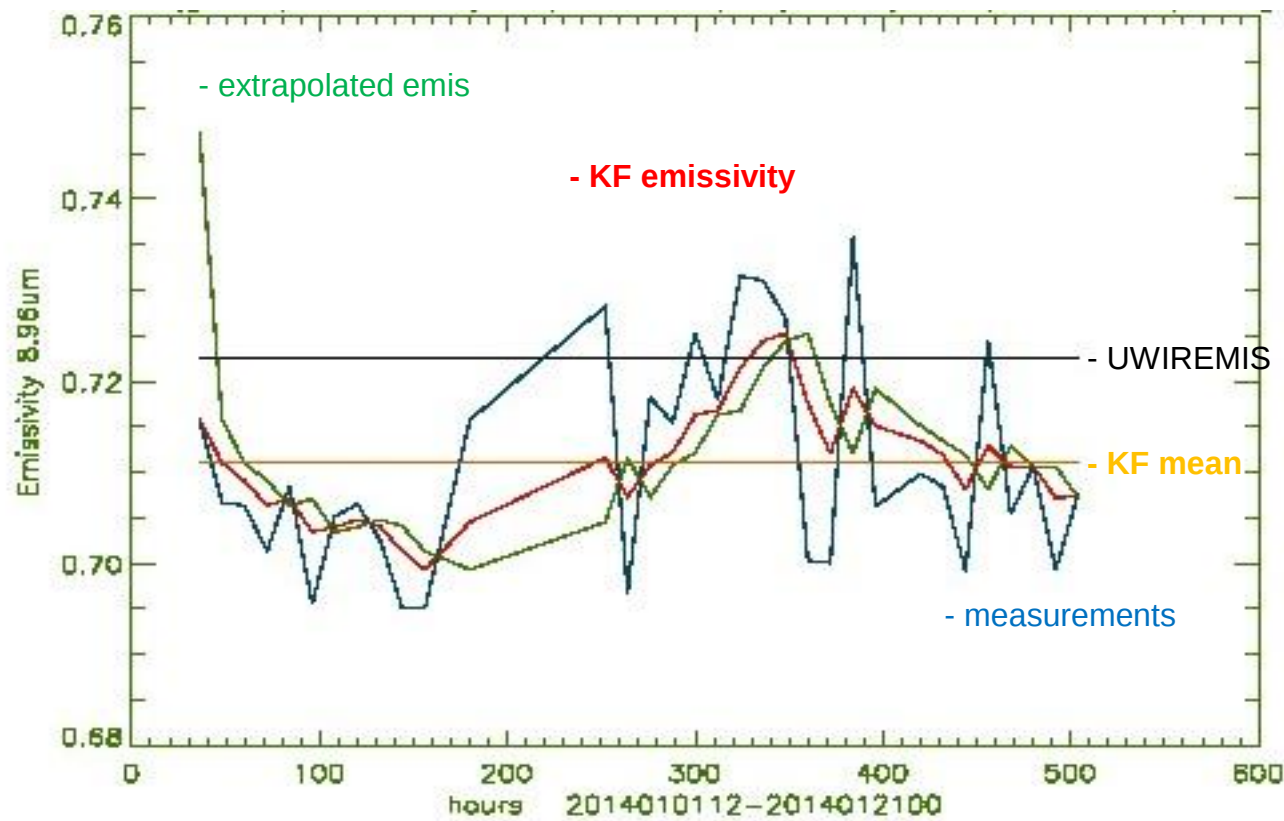
1 month
Jan 2014



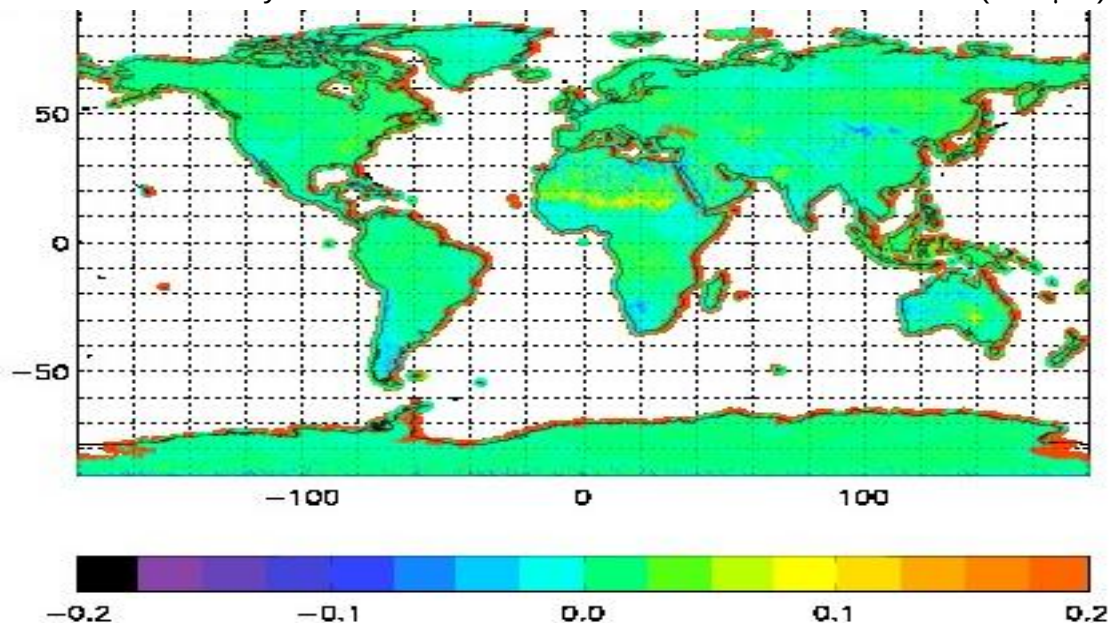
1 year
2014



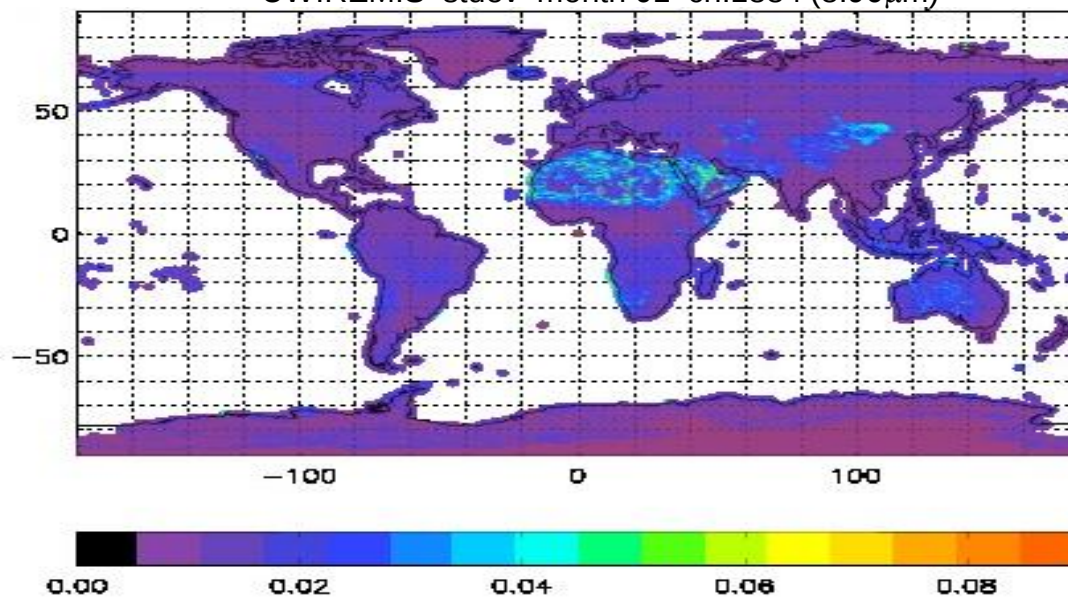
KF emissivity $8.96\mu\text{m}$ (lon,lat) = (-7.5,21.5)



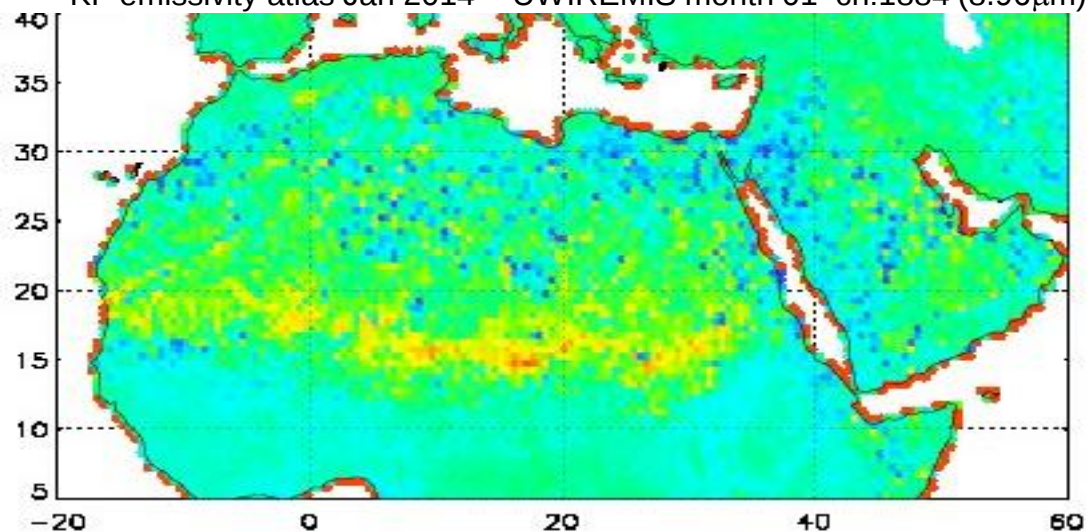
KF emissivity atlas Jan 2014 - UWIREMIS month 01 ch:1884 (8.96 μ m)



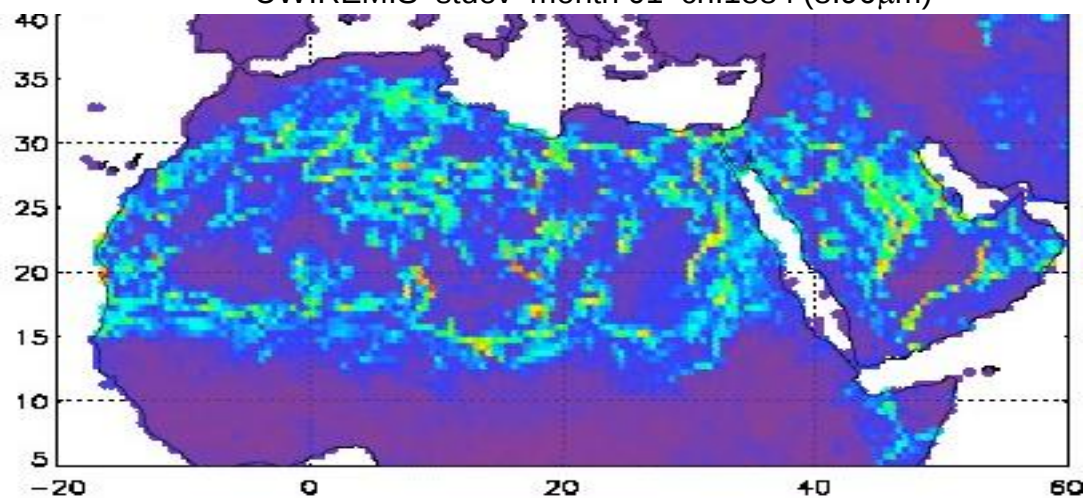
UWIREMIS stdev month 01 ch:1884 (8.96 μ m)

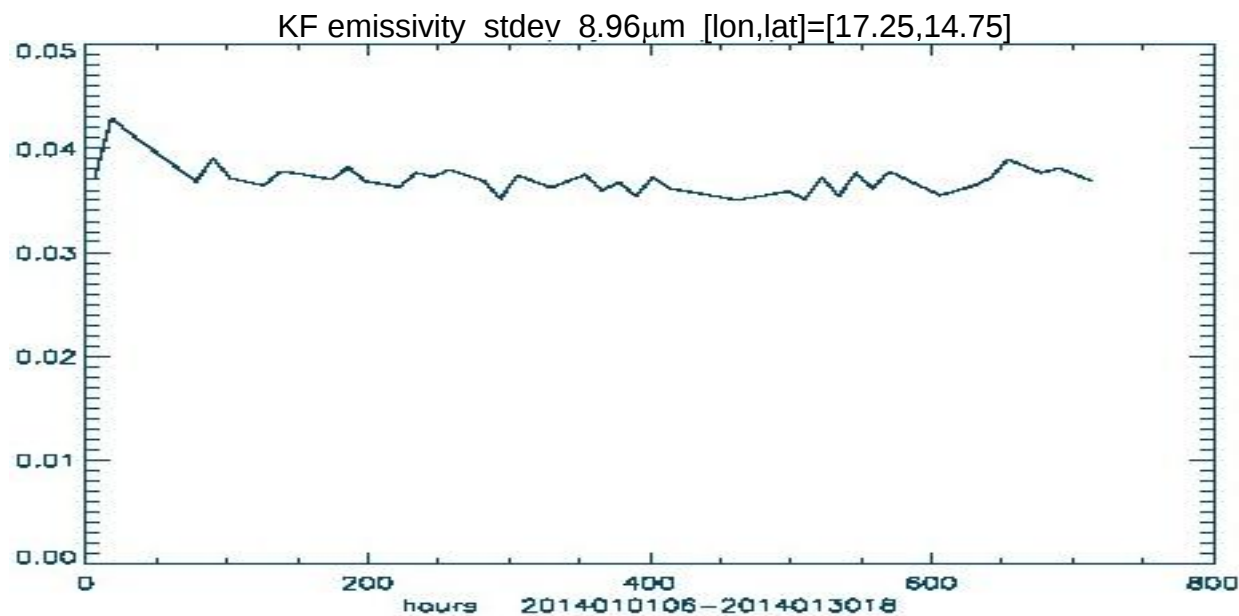
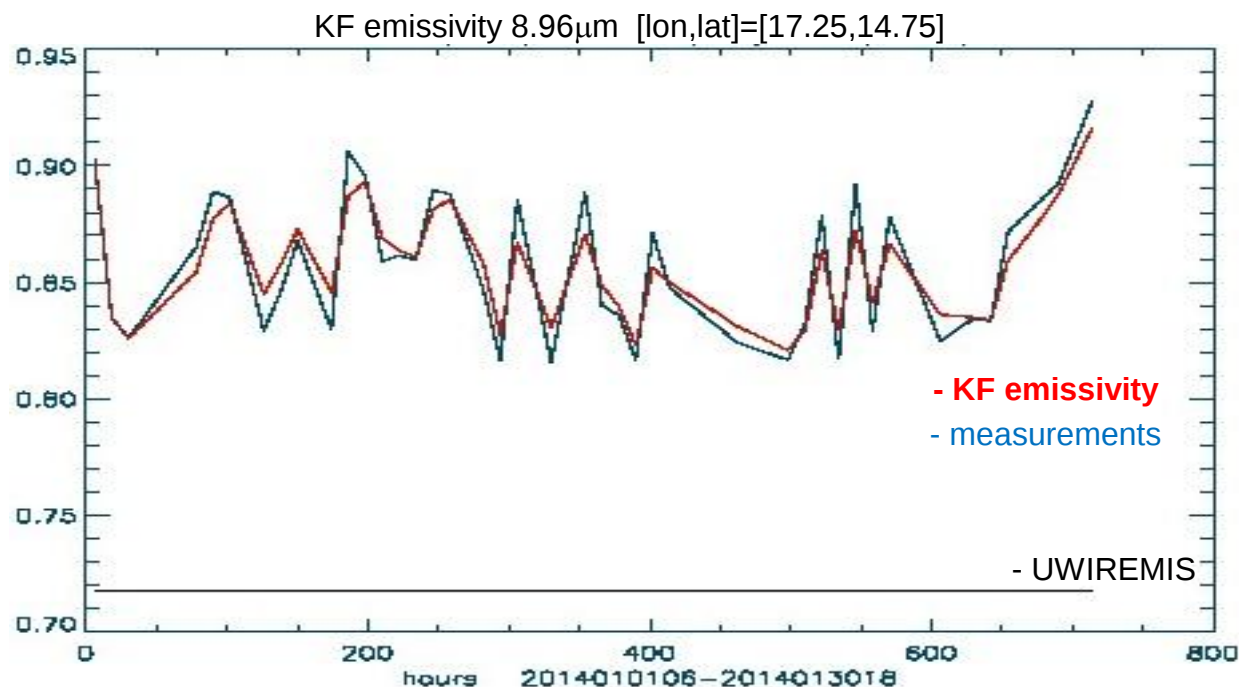


KF emissivity atlas Jan 2014 - UWIREMIS month 01 ch:1884 ($8.96\mu\text{m}$)

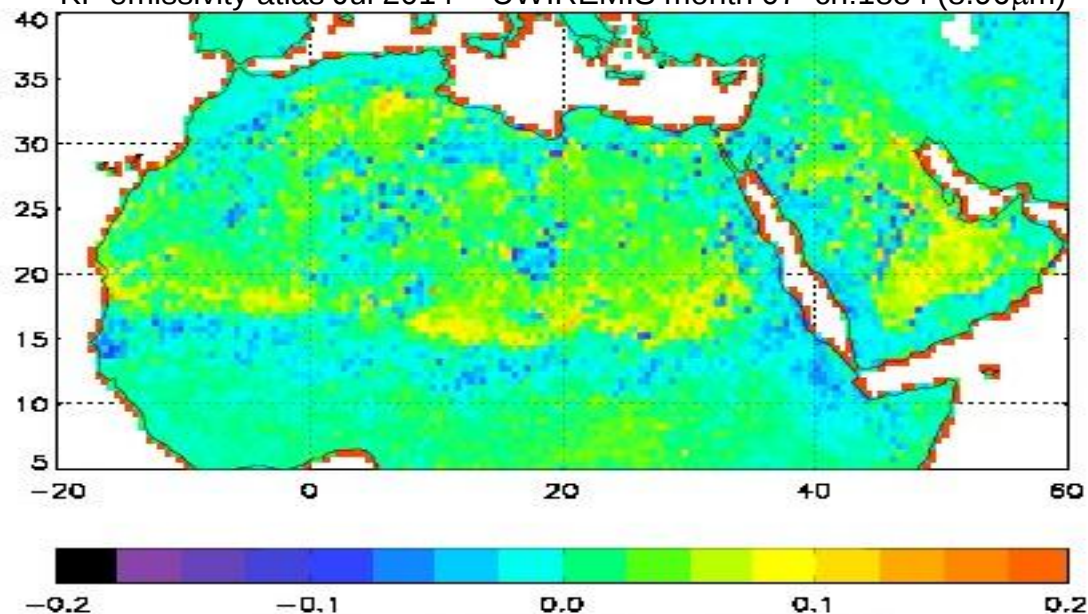


UWIREMIS stdev month 01 ch:1884 ($8.96\mu\text{m}$)

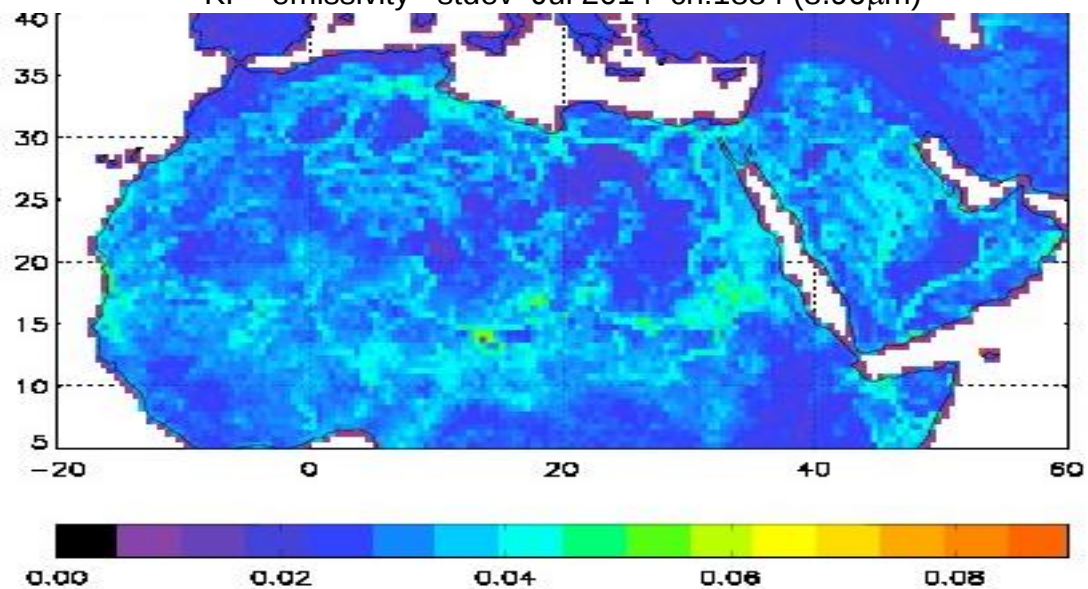


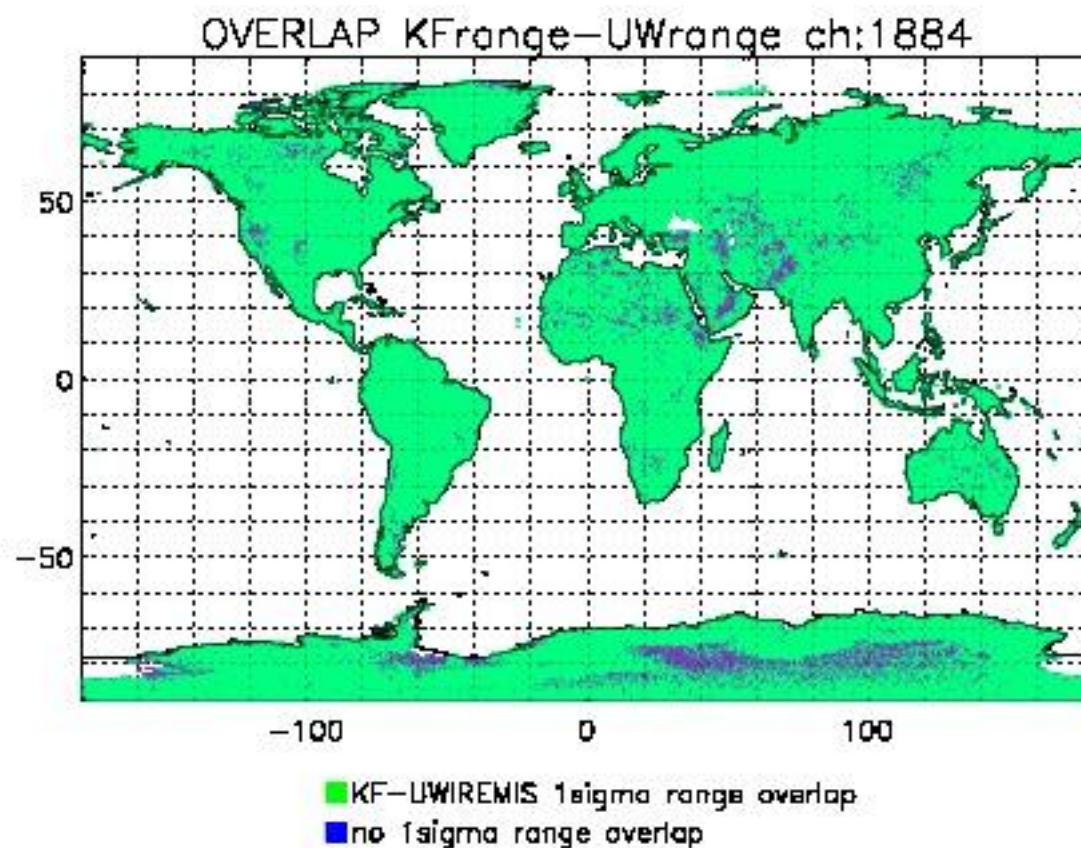


KF emissivity atlas Jul 2014 - UWIREMIS month 07 ch:1884 (8.96 μ m)

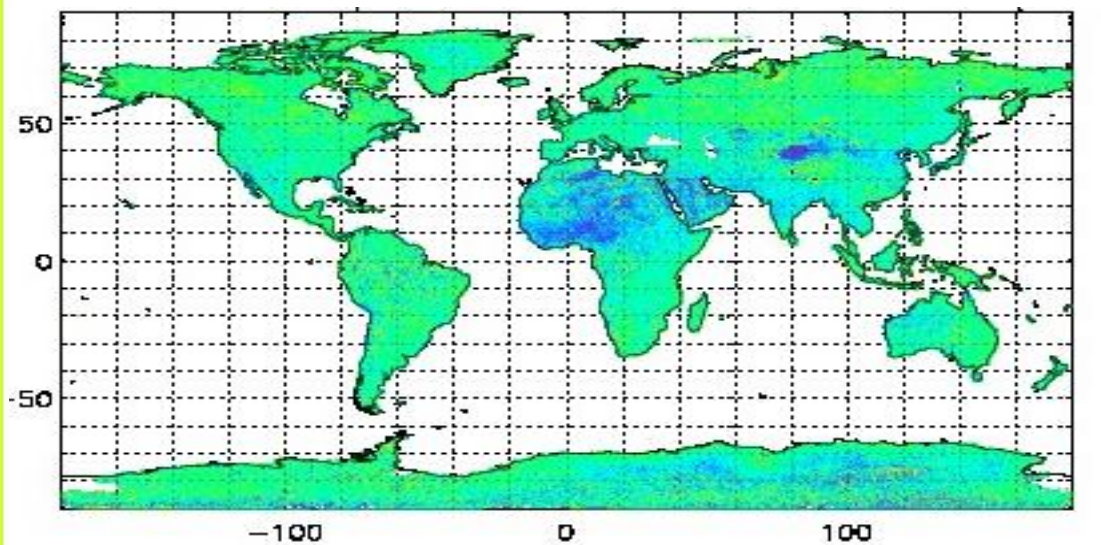


KF emissivity stdev Jul 2014 ch:1884 (8.96 μ m)

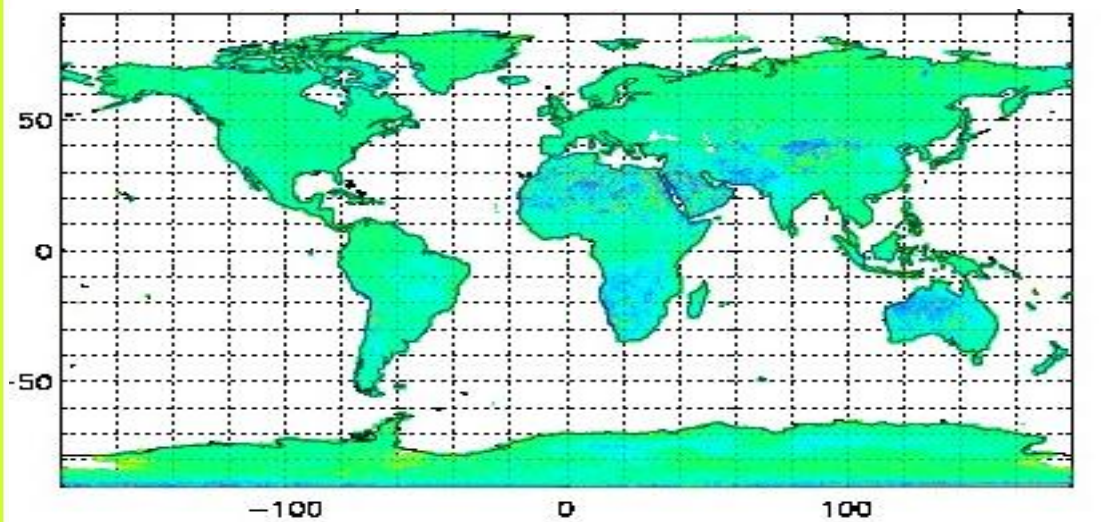
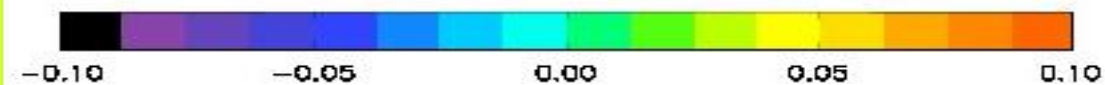




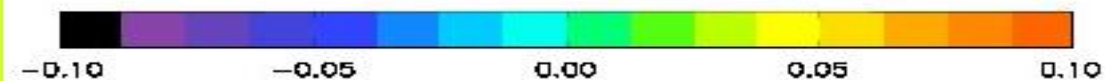
atlas_data_upd_2014073118.nc-UWIREMIS_07 82373/89595(91.9393%) range overlaps



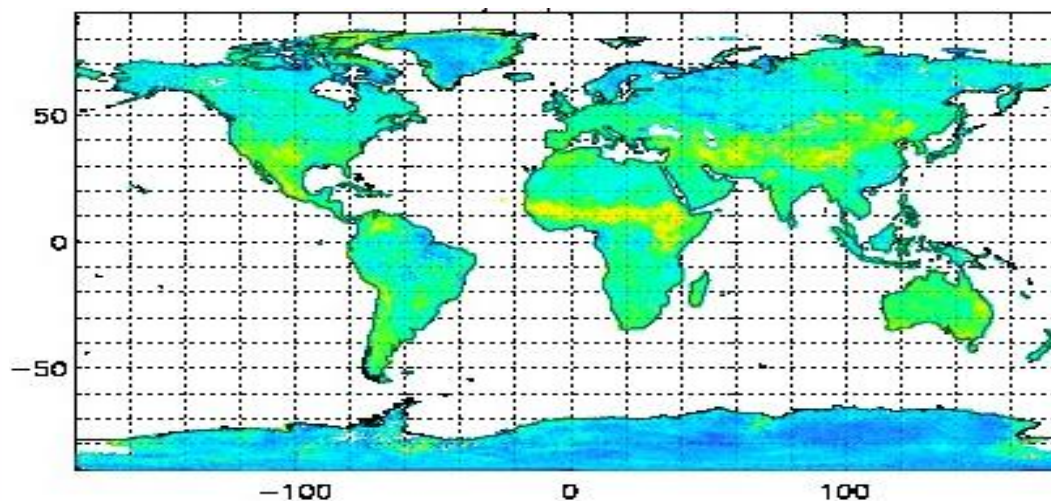
Mar 2014



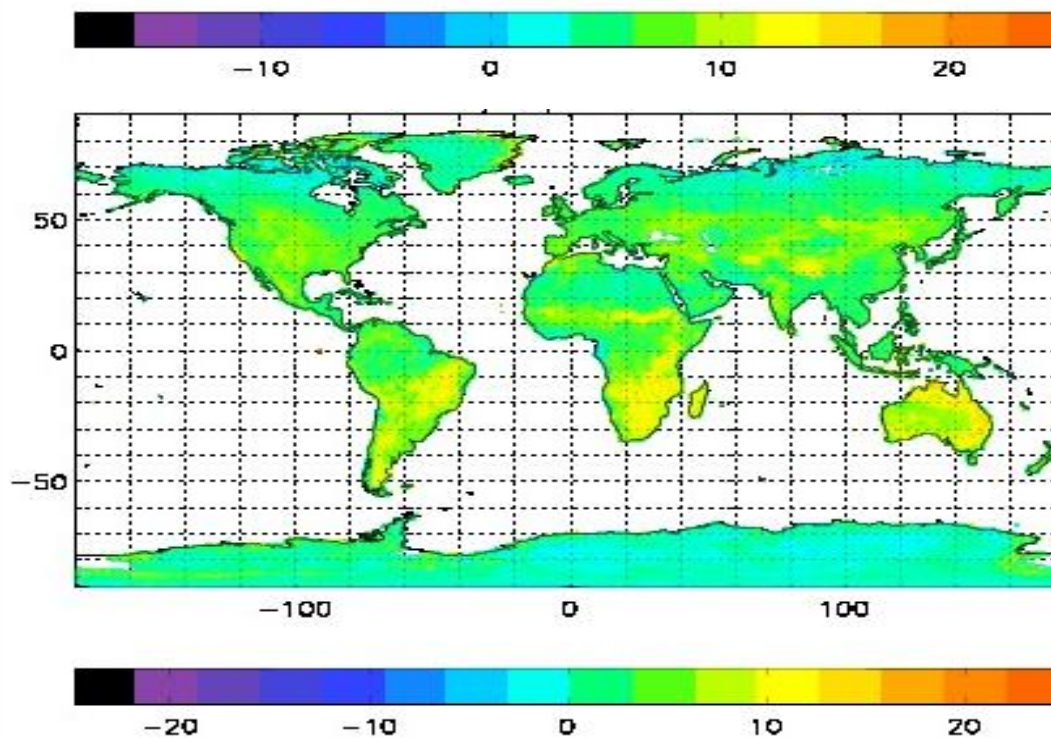
Oct 2014



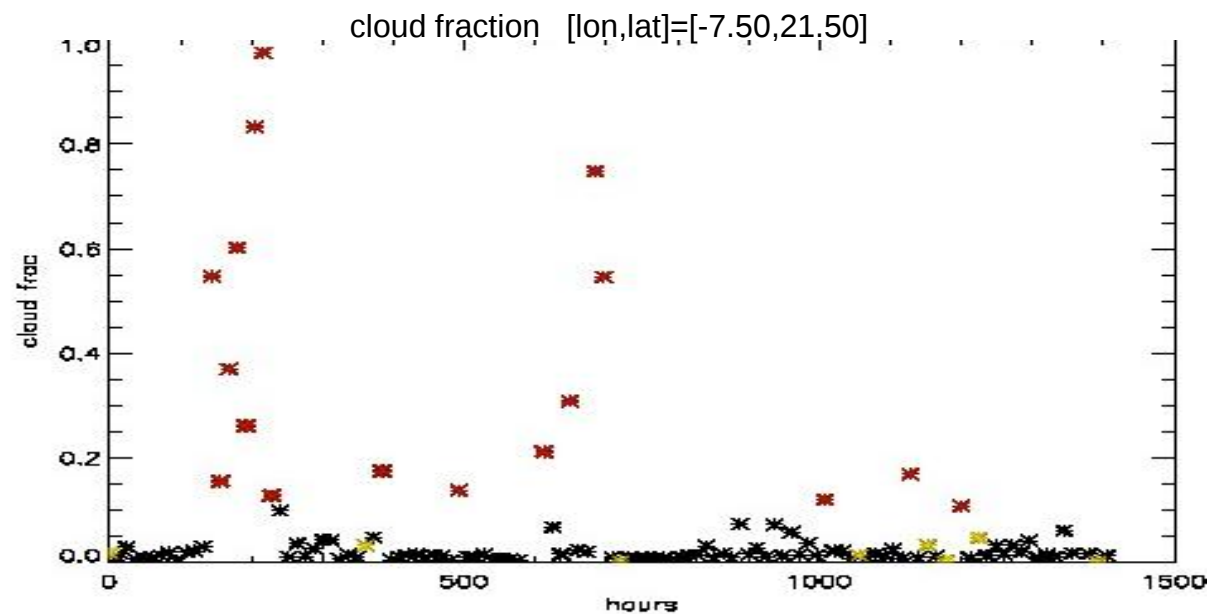
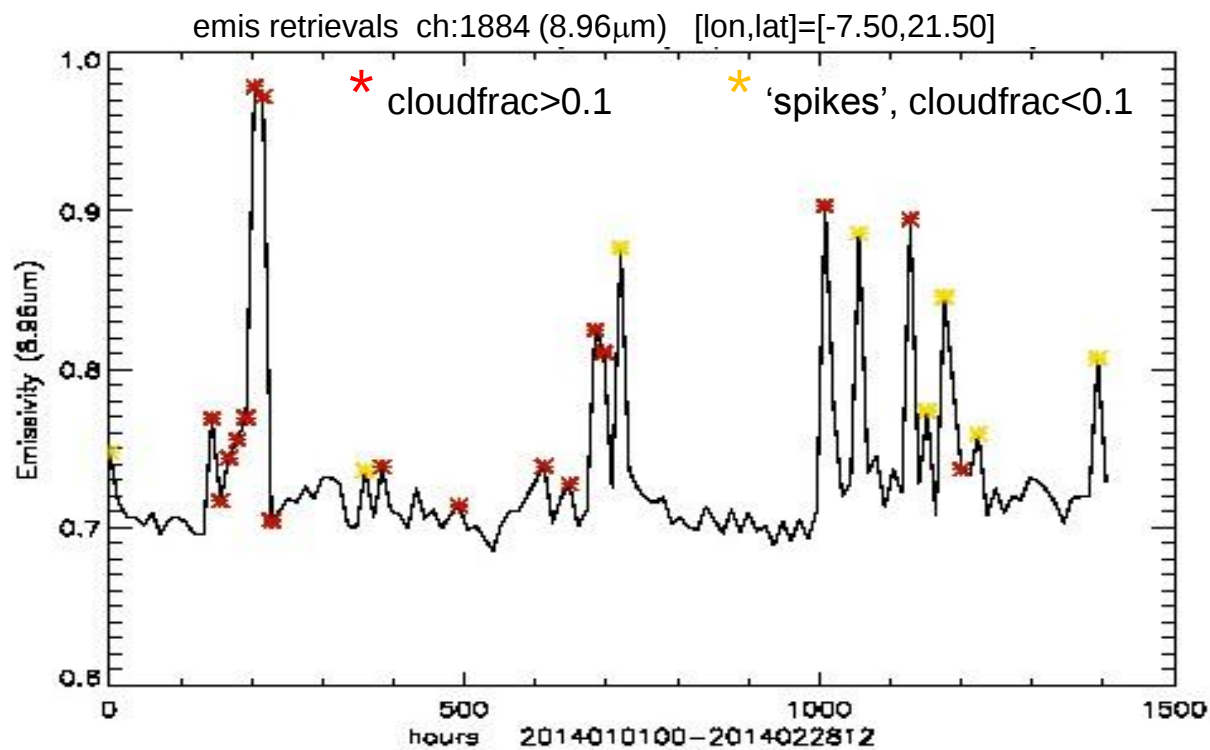
Daytime Tskin increments

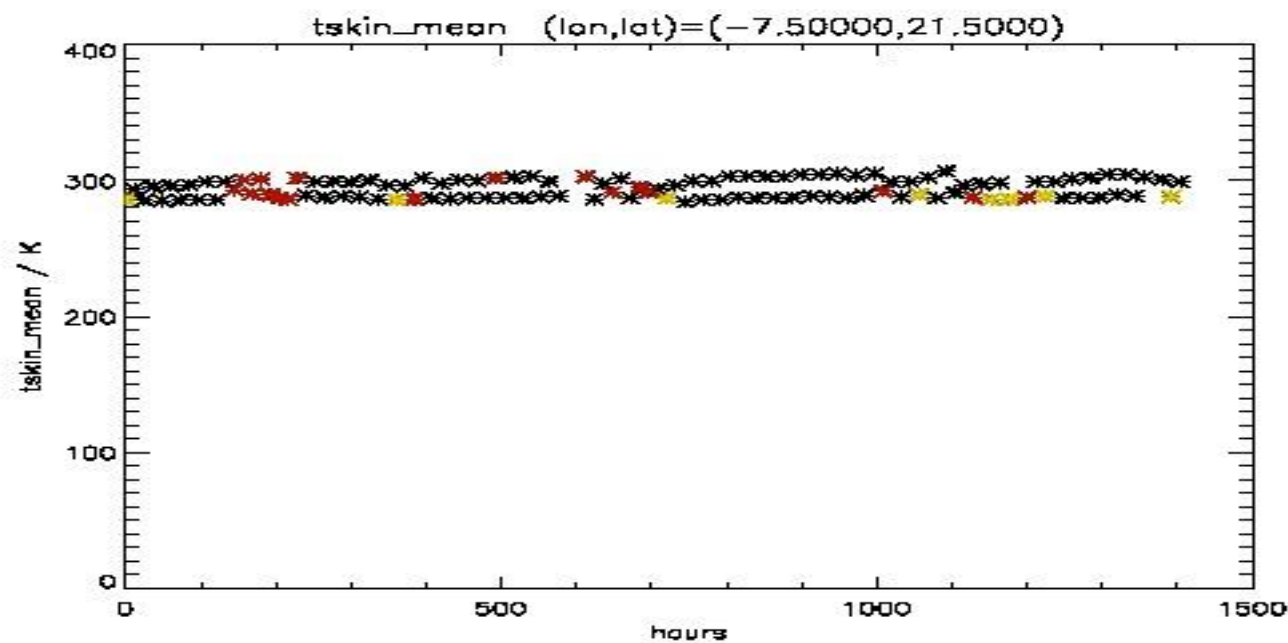
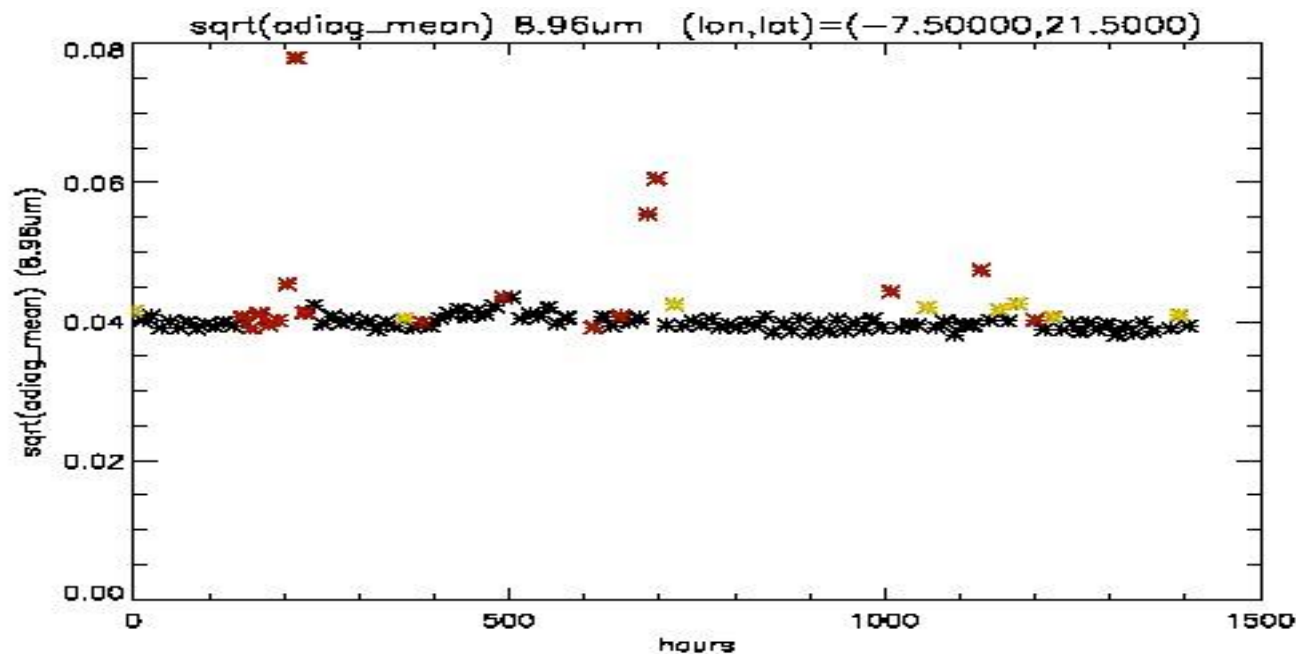


Mar 2014

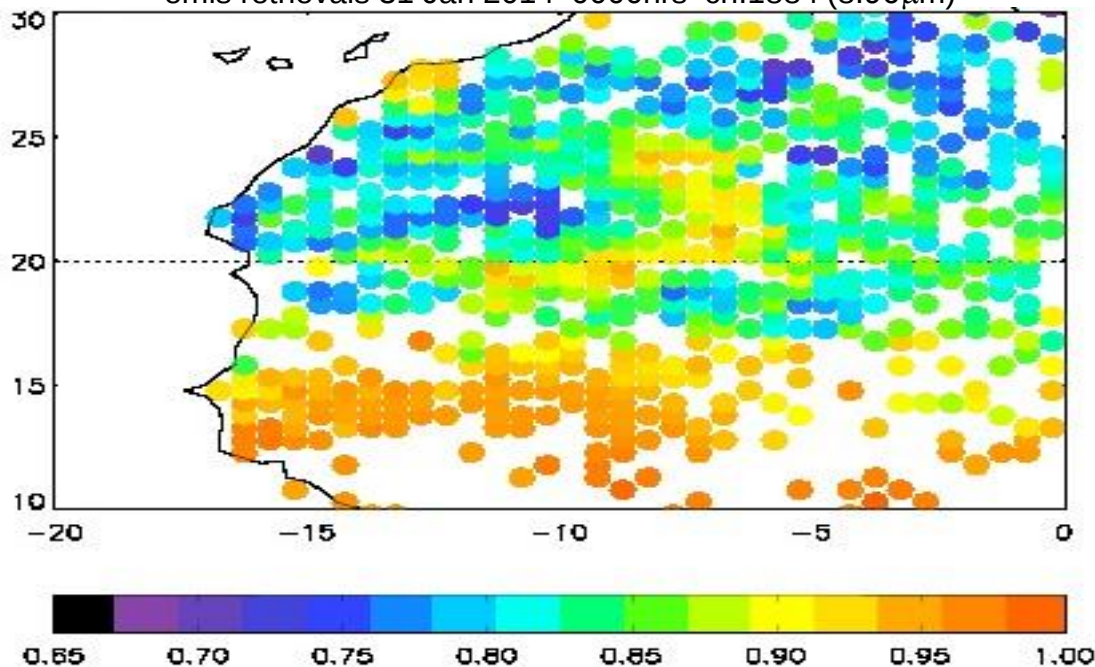


Oct 2014

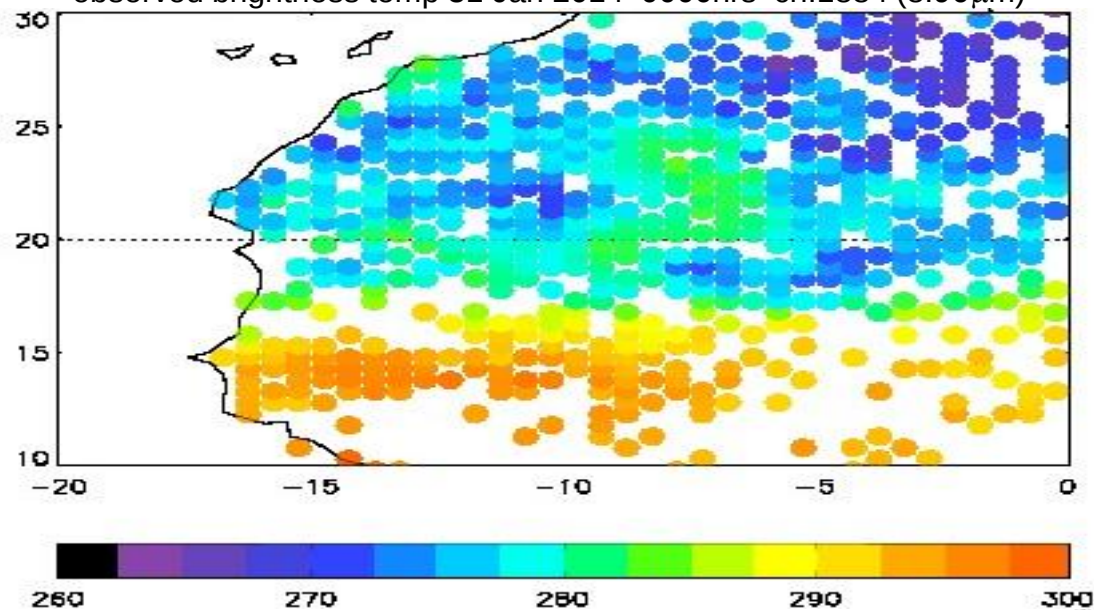




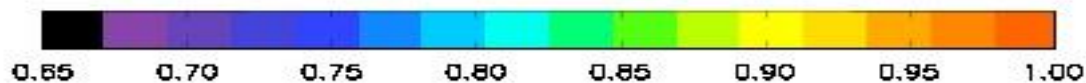
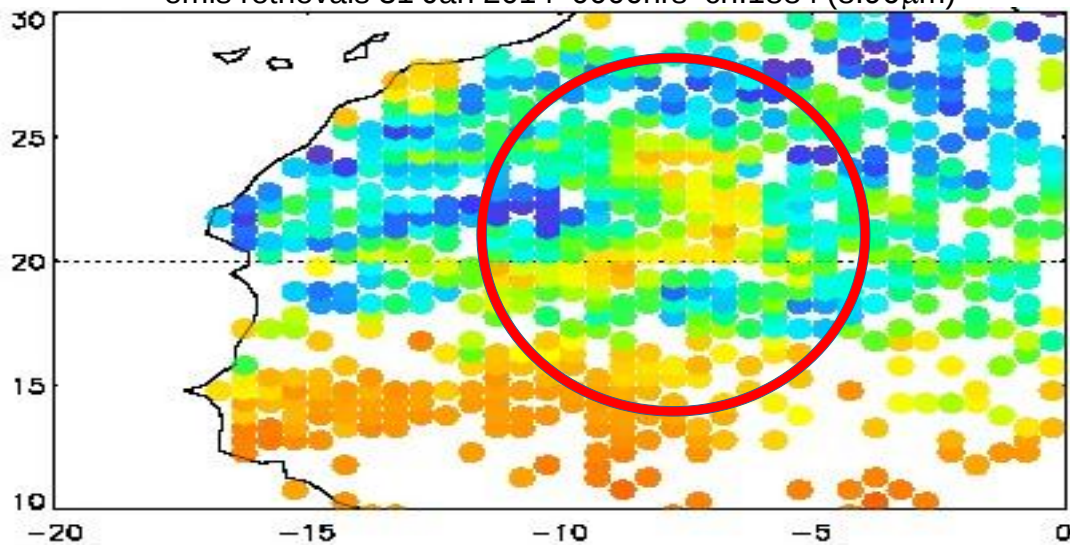
emis retrievals 31 Jan 2014 0000hrs ch:1884 (8.96 μ m)



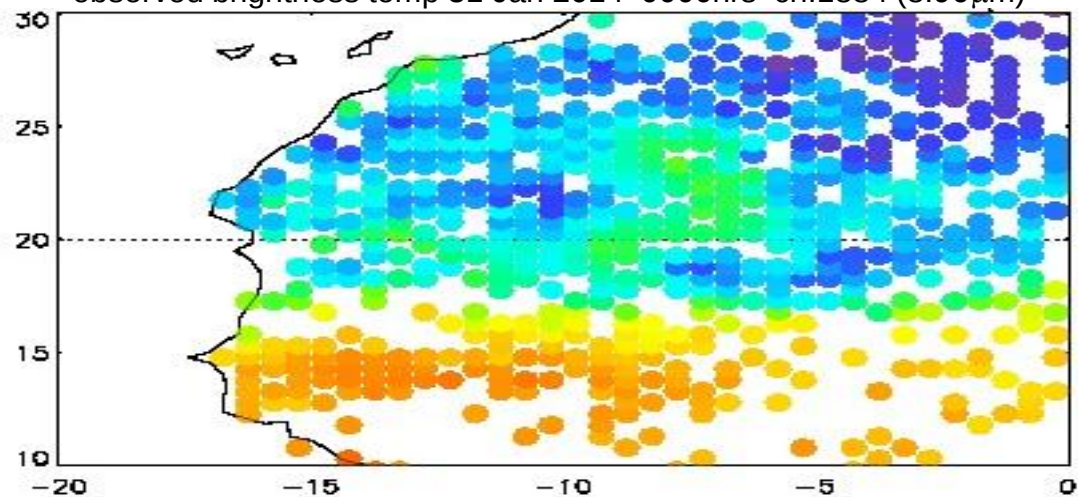
observed brightness temp 31 Jan 2014 0000hrs ch:1884 (8.96 μ m)



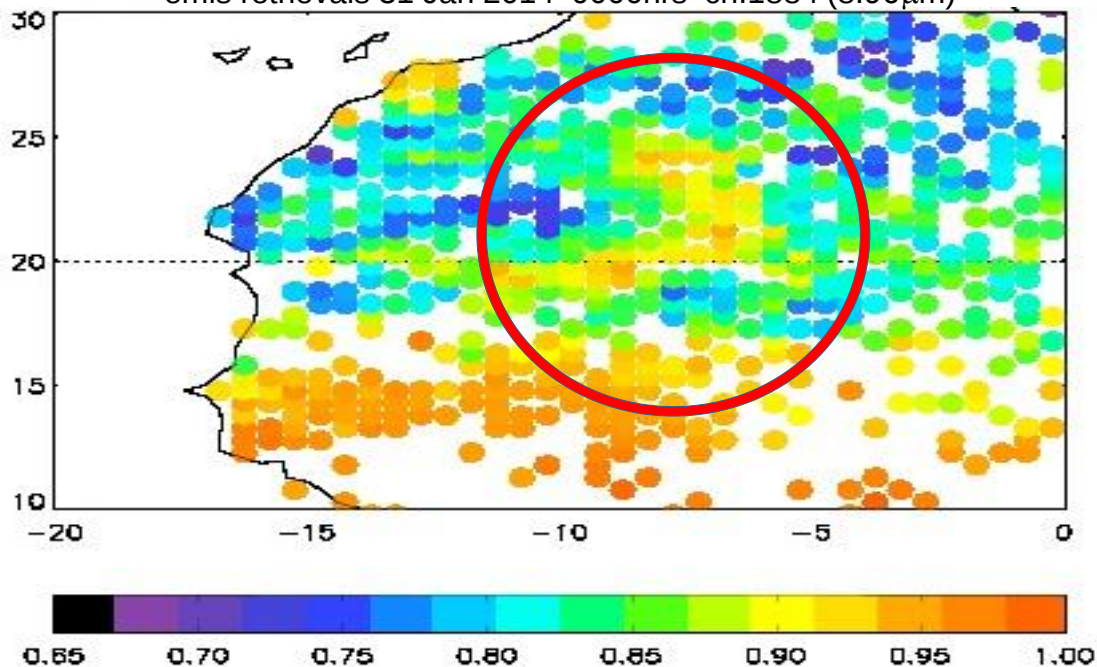
emis retrievals 31 Jan 2014 0000hrs ch:1884 (8.96 μ m)



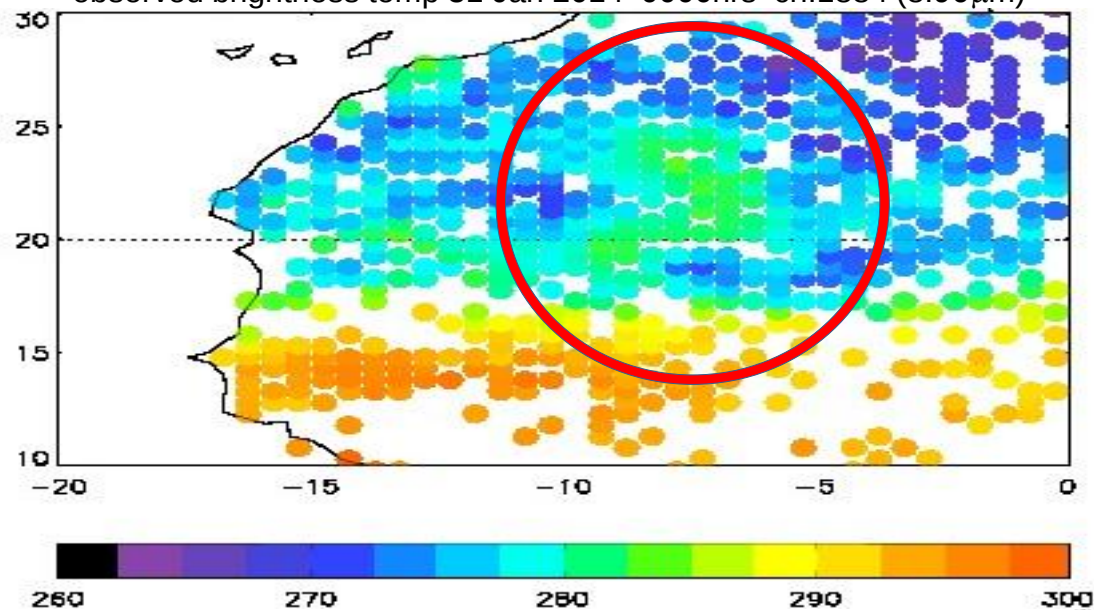
observed brightness temp 31 Jan 2014 0000hrs ch:1884 (8.96 μ m)



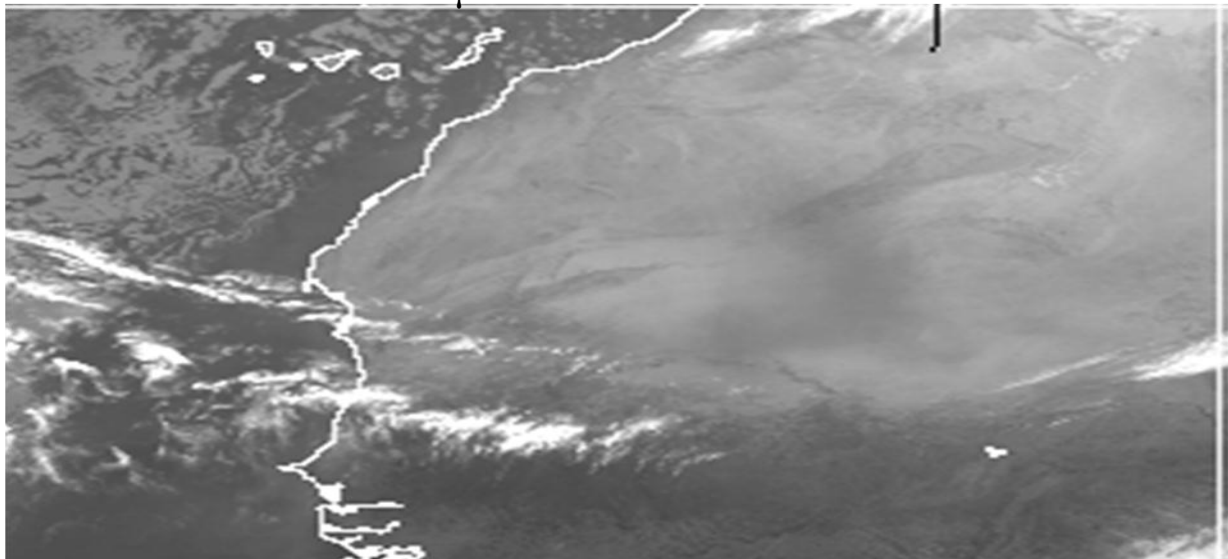
emis retrievals 31 Jan 2014 0000hrs ch:1884 (8.96 μ m)



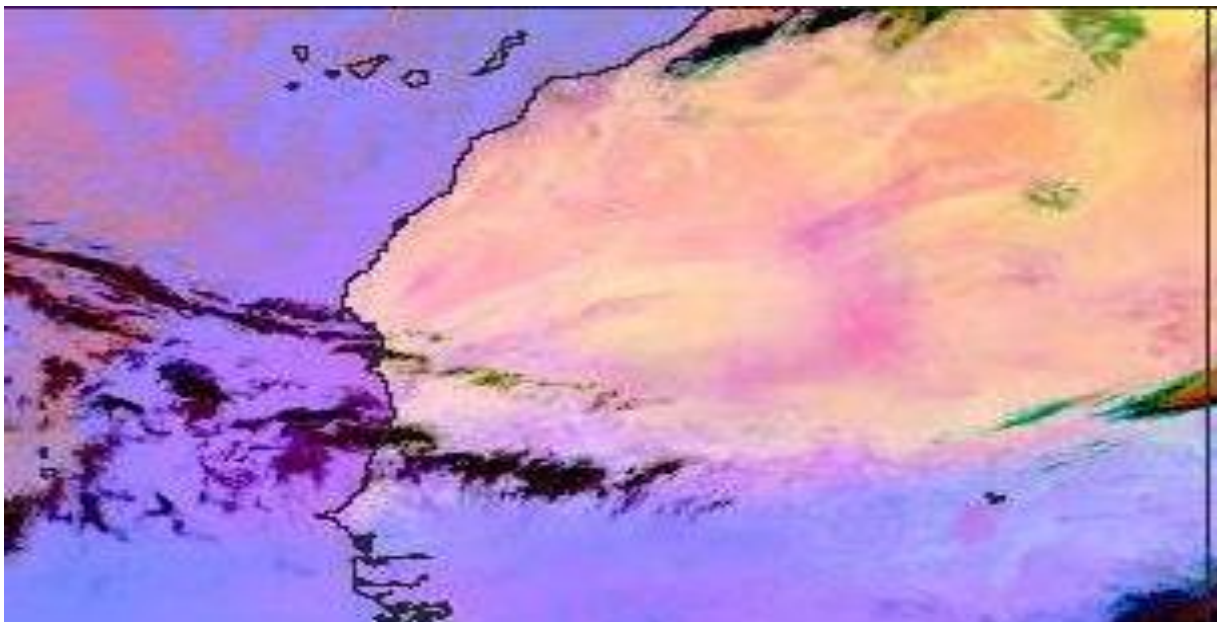
observed brightness temp 31 Jan 2014 0000hrs ch:1884 (8.96 μ m)



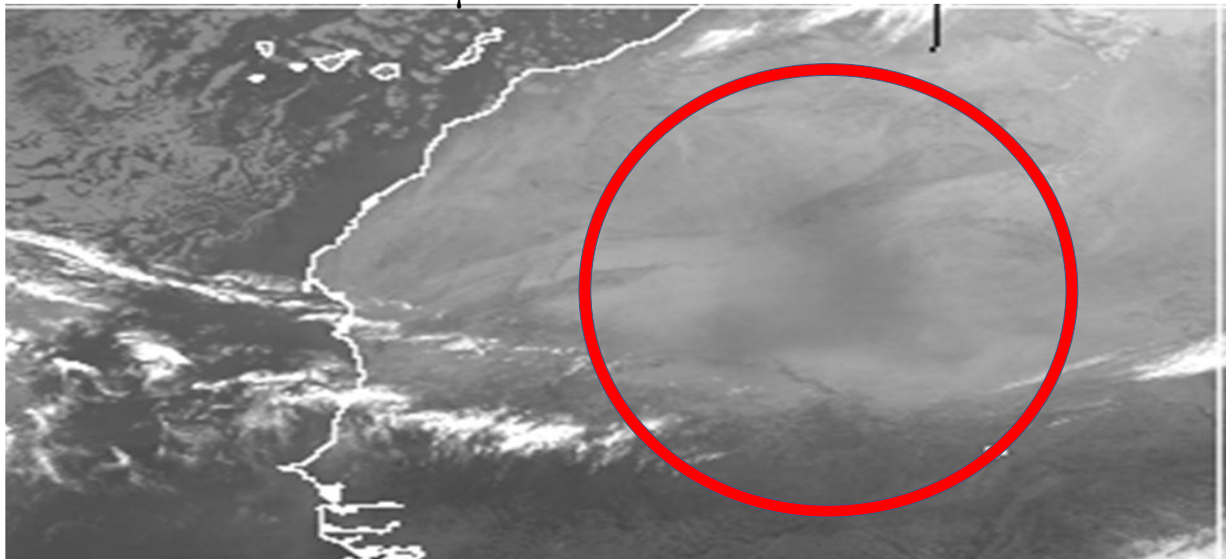
MSG 8.7 μ m 31 Jan 2014 0000hrs



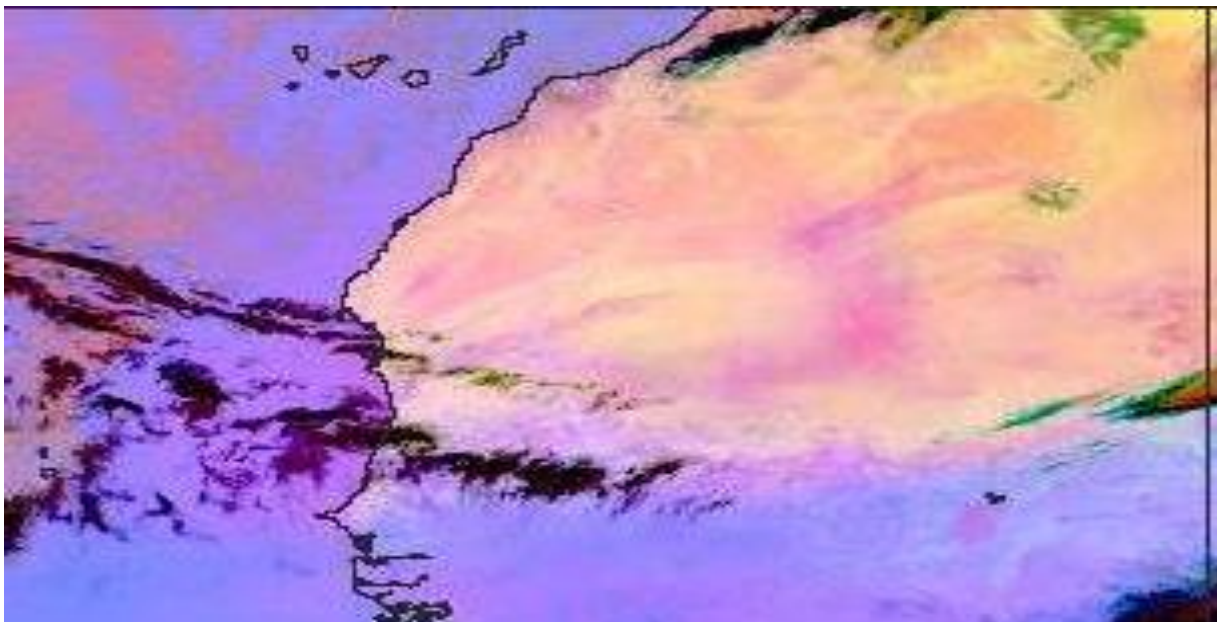
MSG DUST RGB (12.0 μ m,10.8 μ m,8.7 μ m) 31 Jan 2014 0000hrs



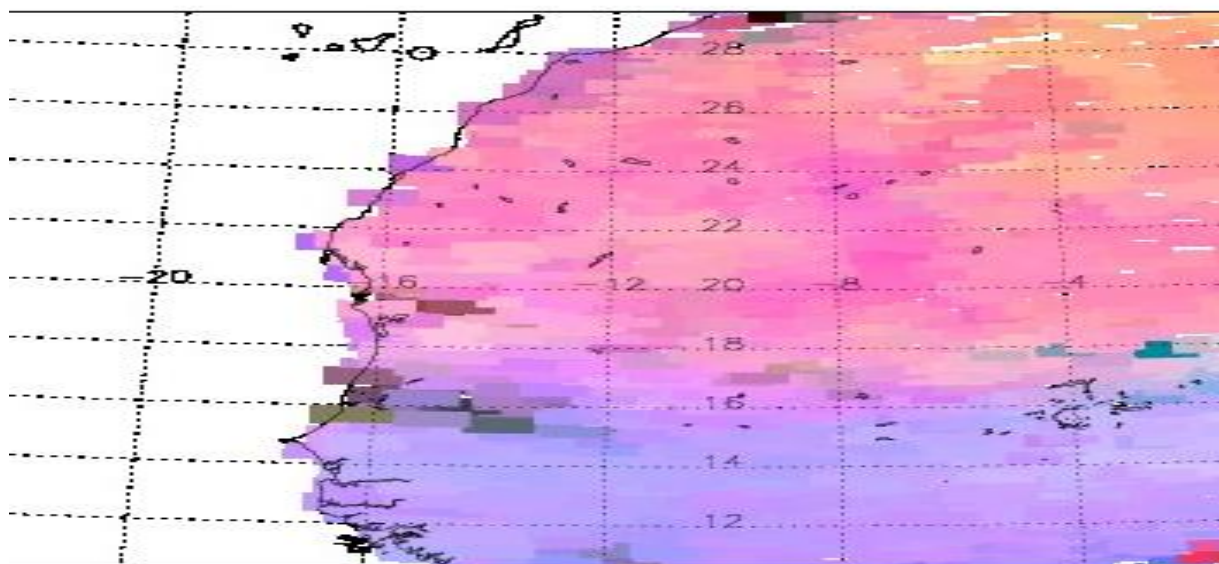
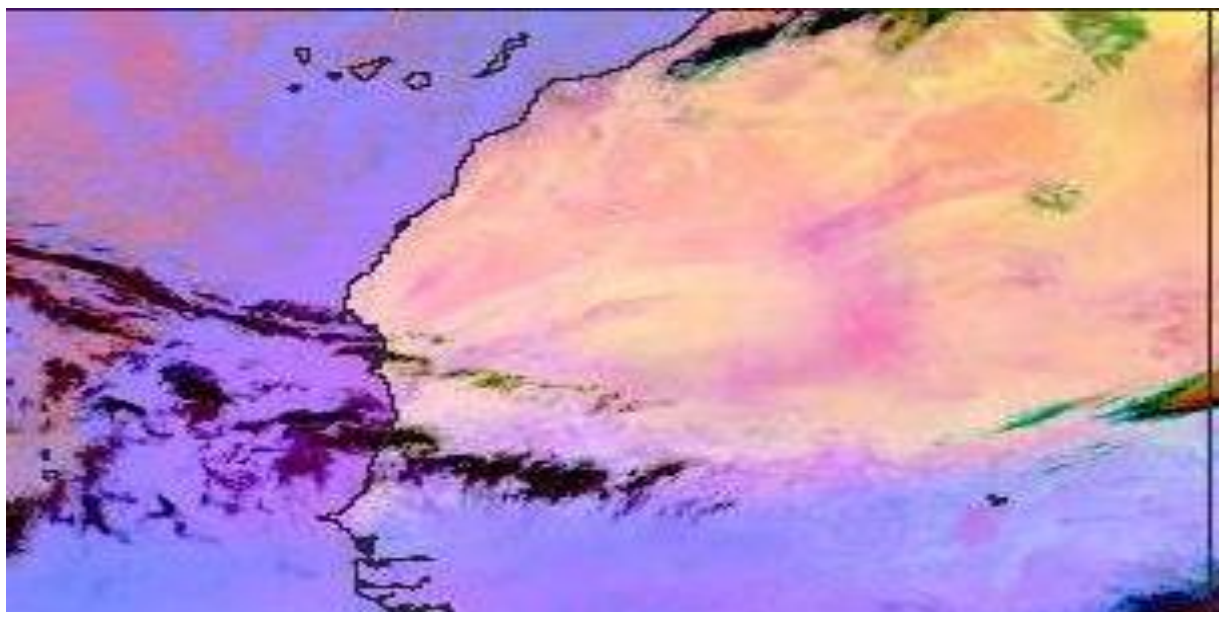
MSG 8.7 μ m 31 Jan 2014 0000hrs



MSG DUST RGB (12.0 μ m,10.8 μ m,8.7 μ m) 31 Jan 2014 0000hrs

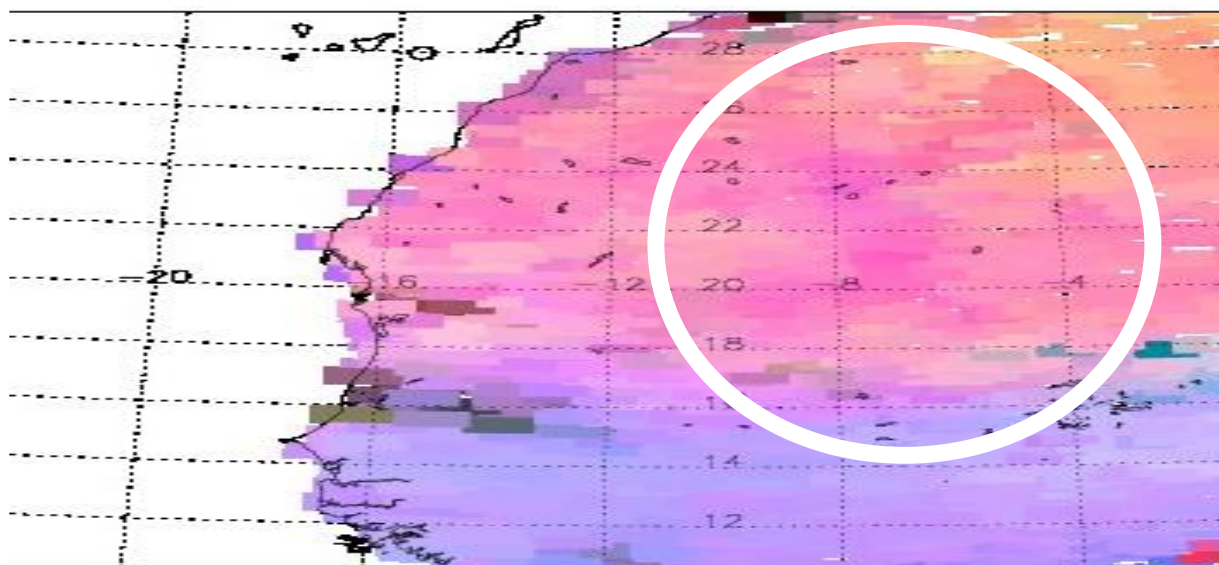
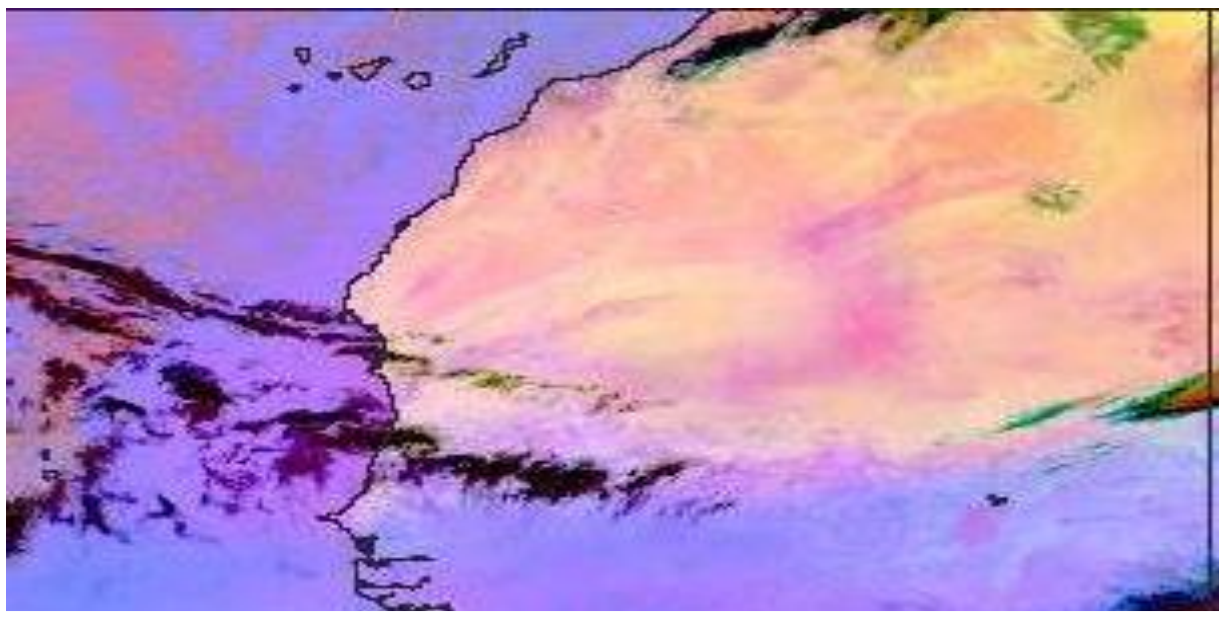


MSG DUST RGB (10-9,9-7,9) (12.0 μ m,10.8 μ m,8.7 μ m)



SIMULATED MSG DUST RGB (10-9, 9-7, 9) from IASI
31 Jan 2014 0000hrs

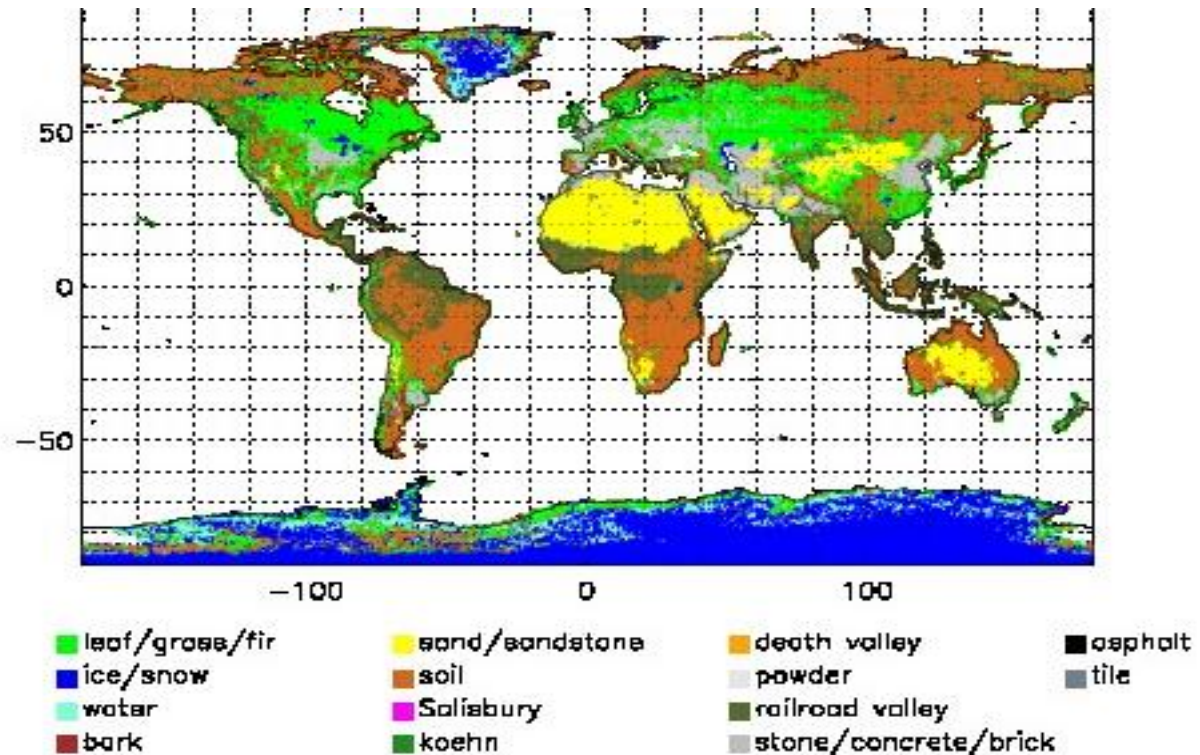
MSG DUST RGB (10-9,9-7,9) (12.0 μ m,10.8 μ m,8.7 μ m)



SIMULATED MSG DUST RGB (10-9, 9-7, 9) from IASI
31 Jan 2014 0000hrs

Surface Type from Analysed PC Scores

surf type category 2014032618



- categorise lab spectra by surf type
- project mean PC score in each gridbox onto lab spectra pcs
- highest projection indicates most influential lab spectrum
- category of most influential lab spectrum indicates surf type

Summary

- Kalman Filter Atlas version developed
- Run over one year period
- dust aerosol issue detected
- possible ITCZ related cloud contamination
- Initial comparisons against UWIREMIS monthly atlas
 - > 90% '1-sigma overlap'

Next Steps

- Test and Validation against other sources and instruments
 - UWIREMIS atlas
 - EUMETSAT IASI LSE operational/experimental products
 - FAAM research aircraft campaign data
- QC flag for dust aerosol
- Snow consideration
- Diurnal variation
- Scan angle dependence
- Application to other current and future IR instruments
 - SEVIRI, HIRS, MTG-IRS, IASI-NG
- Use in Met Office Data Assimilation system
- Available to all centres with full documentation