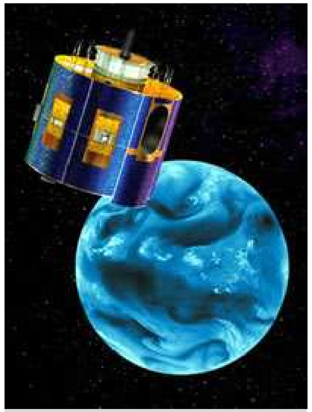


Analysis of OLR in short timescales over Africa

-K.Chan supervised by
Prof J.Harries
Advised by J.Russell

Outline:

- Motivation
- Data product & method
- Different Modes of Variability
- Diurnal timescale
- Semi diurnal
- Longer timescale variability
- Summary

Motivation

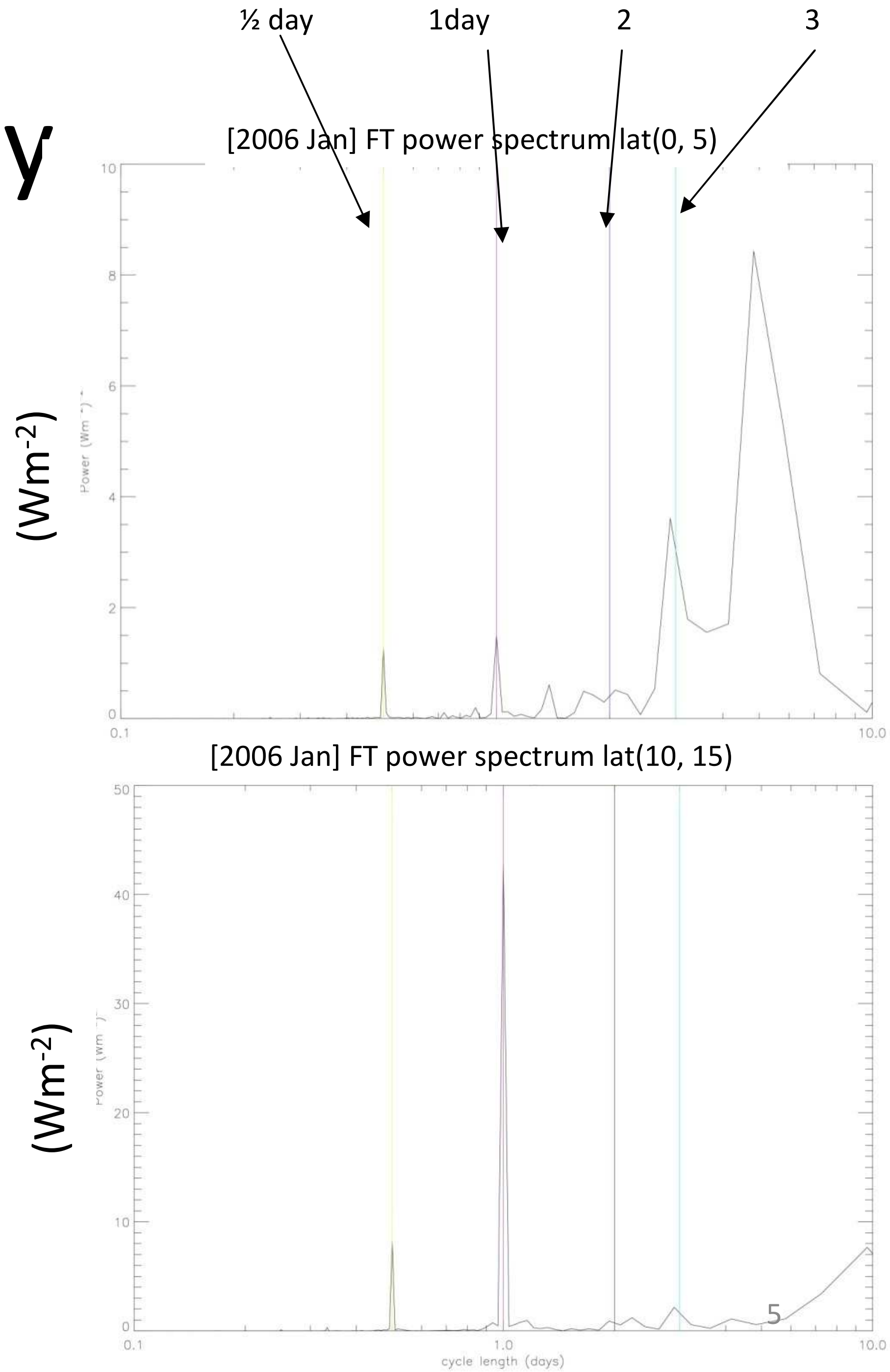
- Characterise short term OLR variability
- Identify different cycles
- Investigate shorter cycles using GERB
- Understand the climate processes associated with the cycles
- Gain better understanding of African meteorology

Data product & method

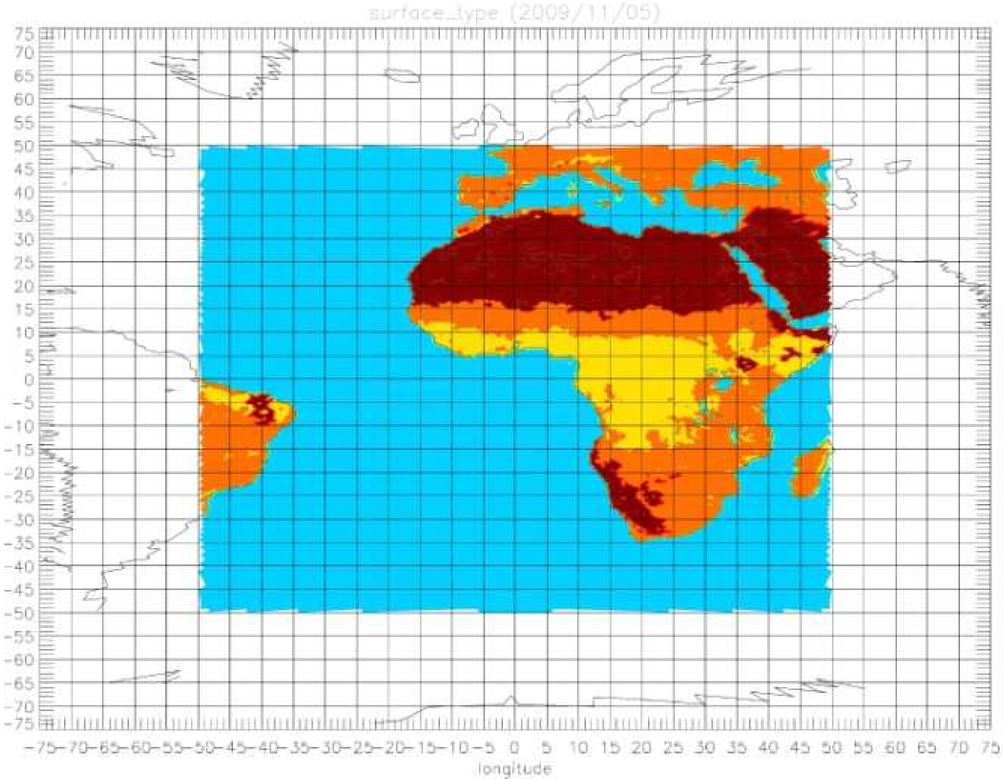
- GERB LW flux product (L2 ARG)
- Fourier Analysis
  - Latitude -50:50, longitude -50:50
  - Over 2006/01,07
- Principal Component Analysis
  - Latitude -30:30, longitude -30:40
  - 2006/01,07, averaged

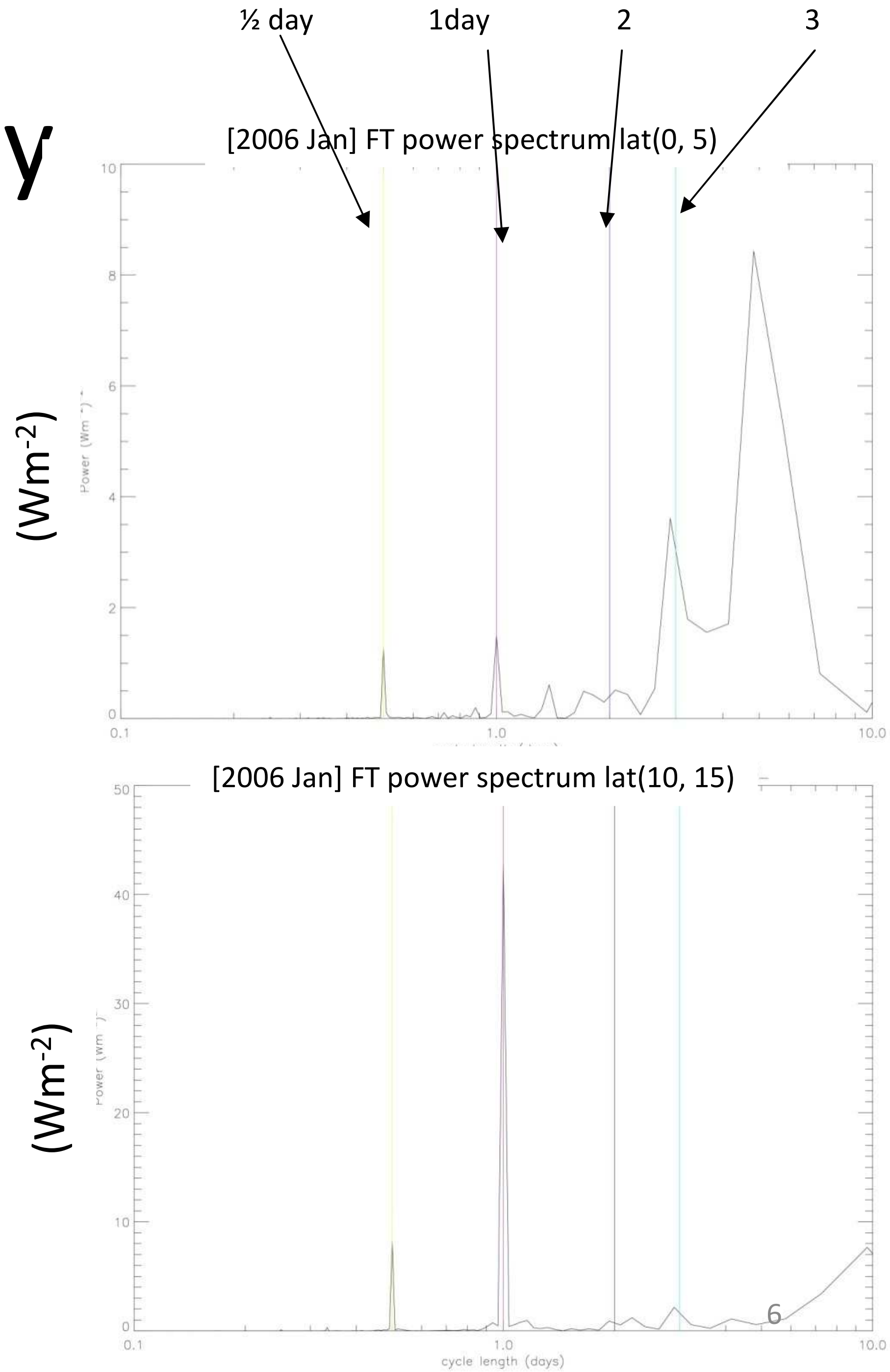
Modes of variability

- Averaged ‘zonally’
- Along the ITCZ
- Small diurnal, large part of ocean
- Peaks in high cycle length, i.e 3 & 5, further investigation
  - Outside ITCZ
  - High diurnal cycle strength, region along Sahara
  - Relatively weak in longer cycle lengths



Modes of variability

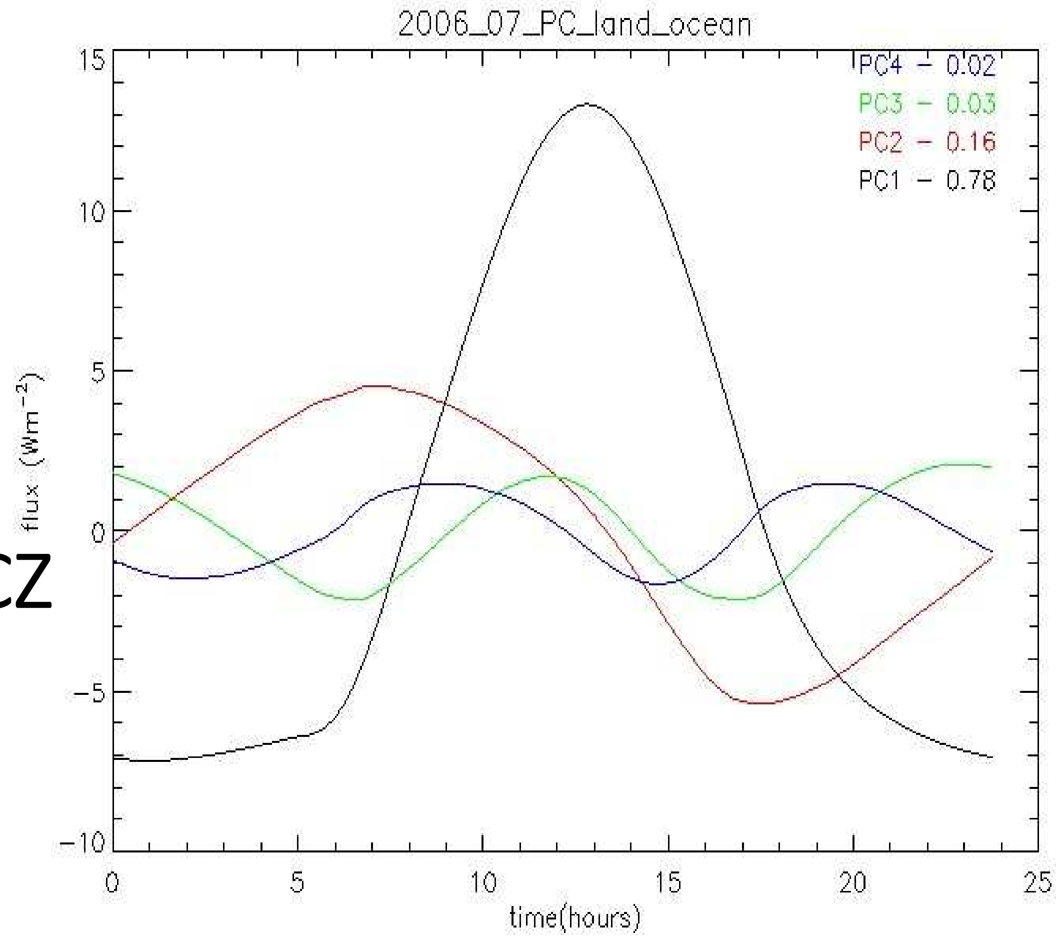




- Relatively weak in longer cycle lengths

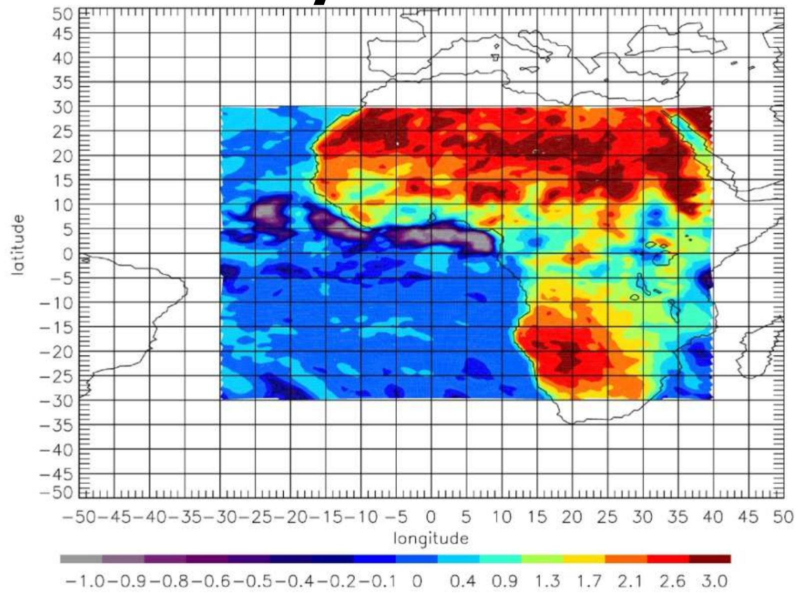
Diurnal timescale analysis

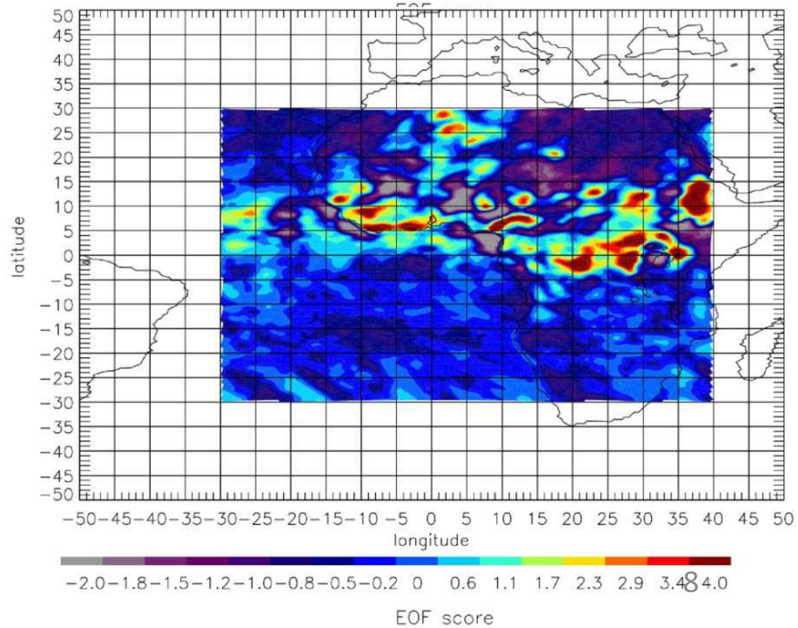
- PC analysis – 2006/07/01-30
- PC1- surface heat response
- PC2- clouds associated with ITCZ
- Comer et al. 2007



Diurnal timescale analysis

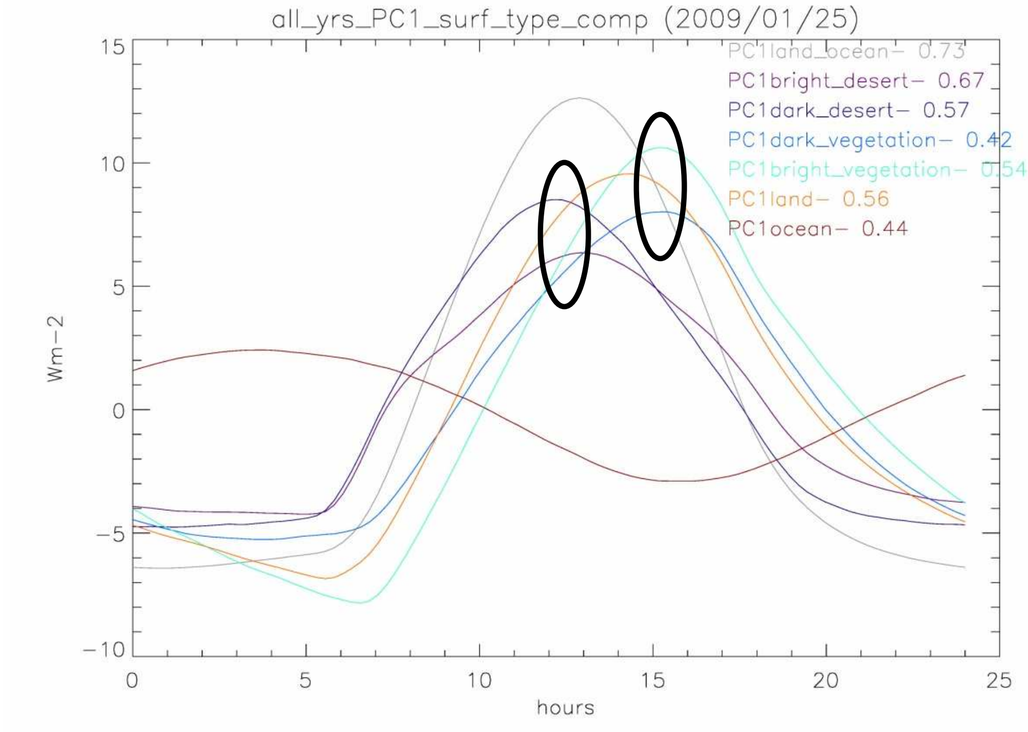
- EOF – 2006/07/01-30
- EOF1 – dominant signal over land
- EOF2 – most of the strong signals along ITCZ





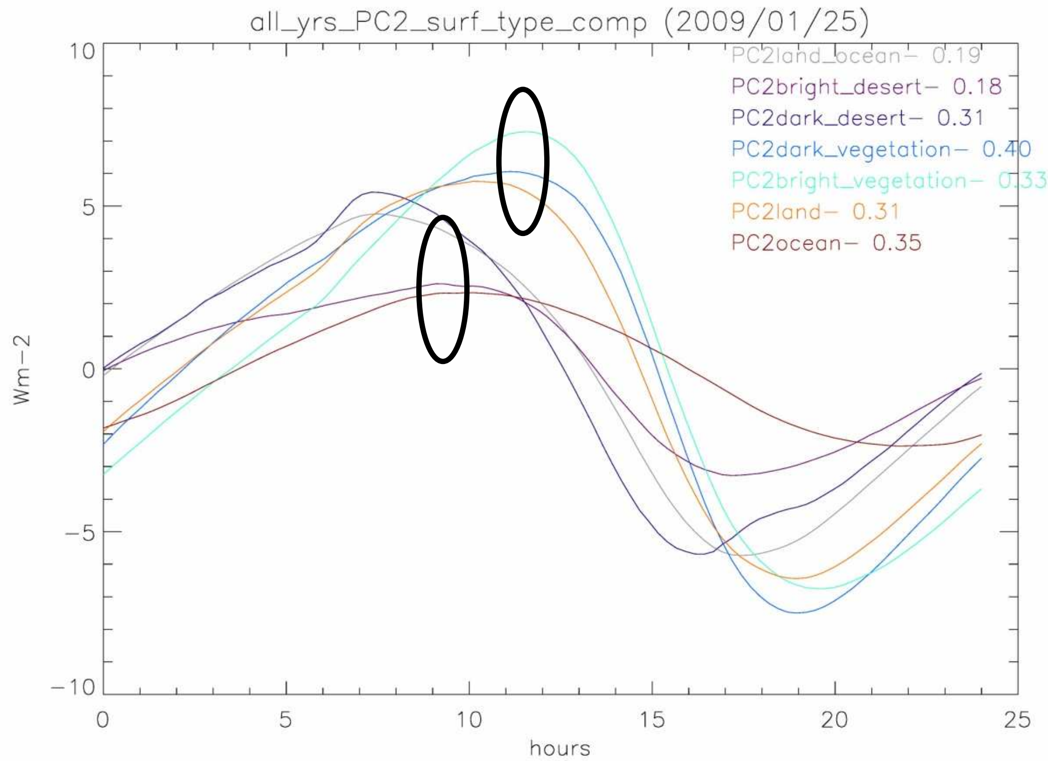
Diurnal timescale analysis

- First order PCs over different surface types
- Desert OLR peaks before vegetation
- Ocean has a different heating cycle



Diurnal timescale analysis

- 2nd order PC
- Inversely related to cloud cycle
- Different peak times with surface type
- Similar phase lag between veg. and desert

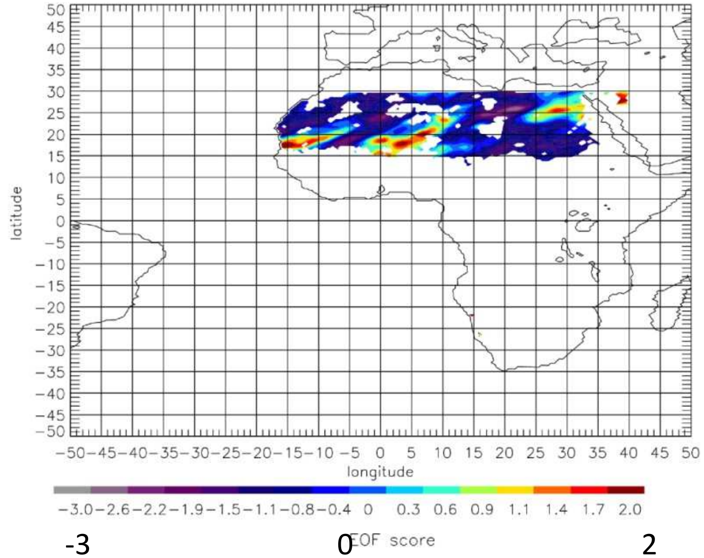


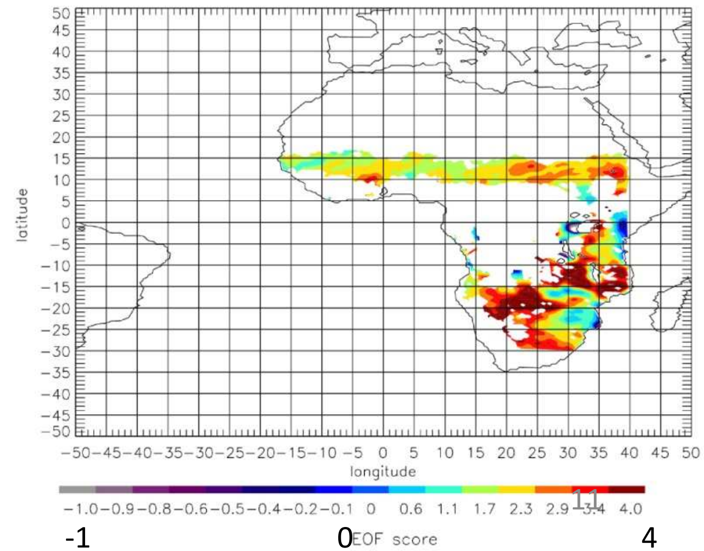
Diurnal timescale analysis

- Desert EOF 2 (2006/01)
  - 0 to low magnitude in

most regions

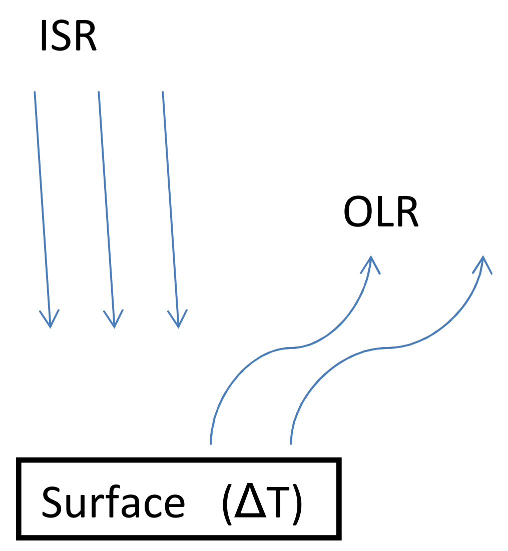
  - Some positive signal
  - Region out of ITCZ
- Vegetation EOF 2 (2006/01)
  - Strong EOF 2 signal occurs where EOF 1 is weak
  - suggests different overall diurnal cycle along ITCZ





Semi-diurnal cycle

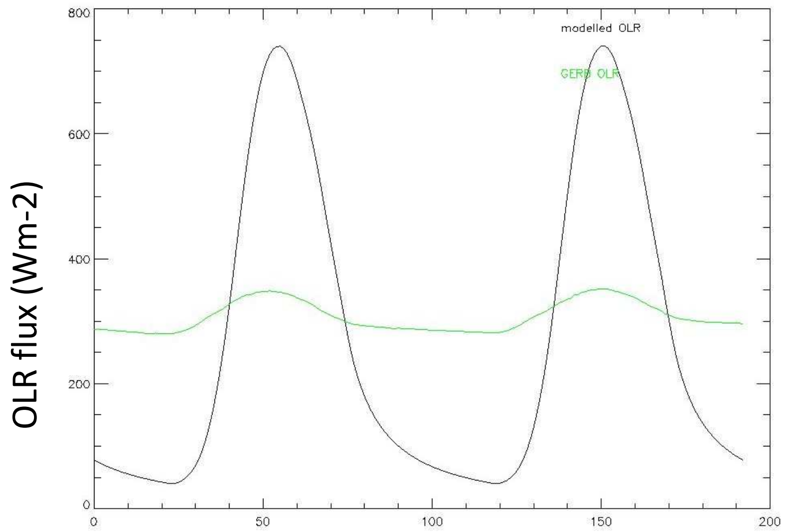
- Modelling OLR using only incoming solar radiation and surface
- Average albedo
- 7 surface categories:
  - Heat capacities
  - Effective surface depth
- All ISR is absorbed by the surface
- Surface radiates as a black body
- 15 minutes time step



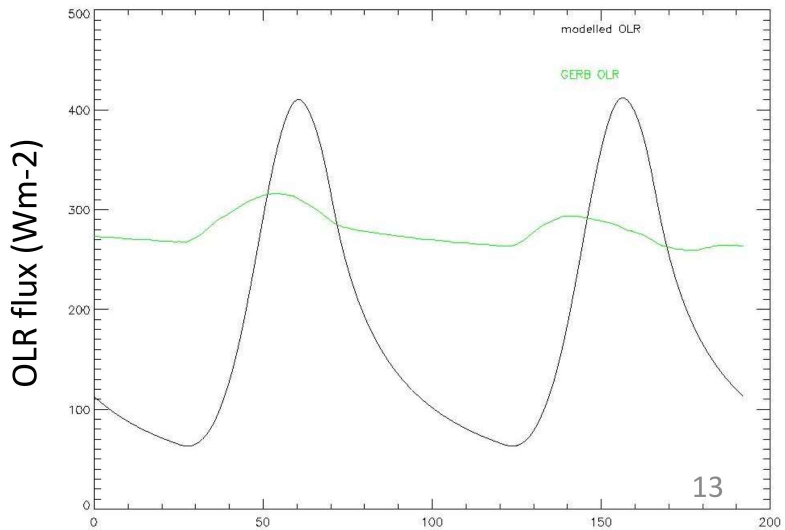
Semi-diurnal cycle

- Modelled OLR is only dependent on ISR and heat capacity
- Absolute magnitude between modelled and DATA is large
- The peaks are roughly in phase
- Vegetation more difficult to model

2006/07 Desert OLR cycle



2006/07 Vegetation OLR cycle



Semi-diurnal cycle

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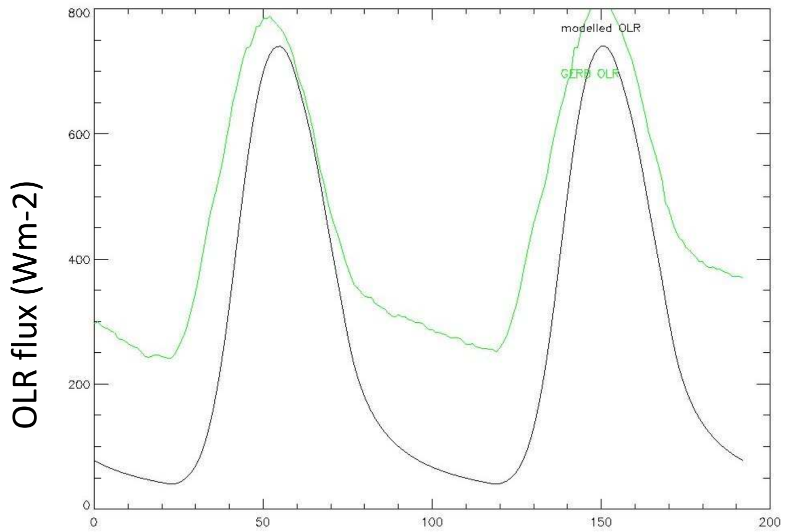
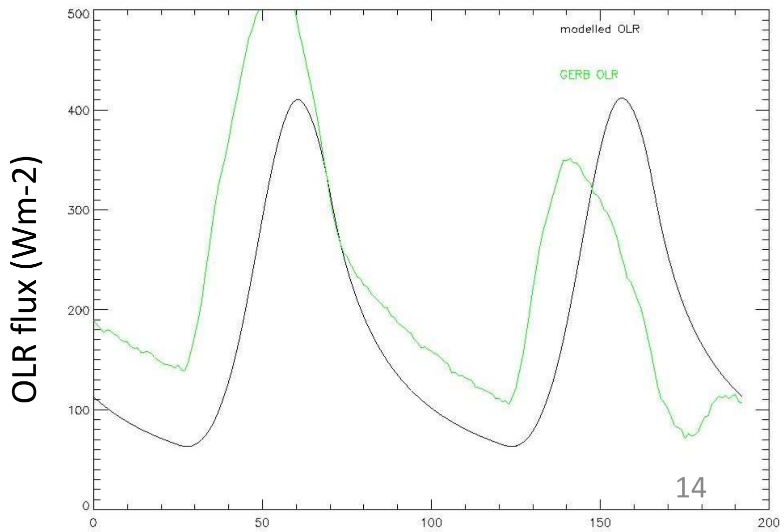
2006/07 Desert OLR cycle

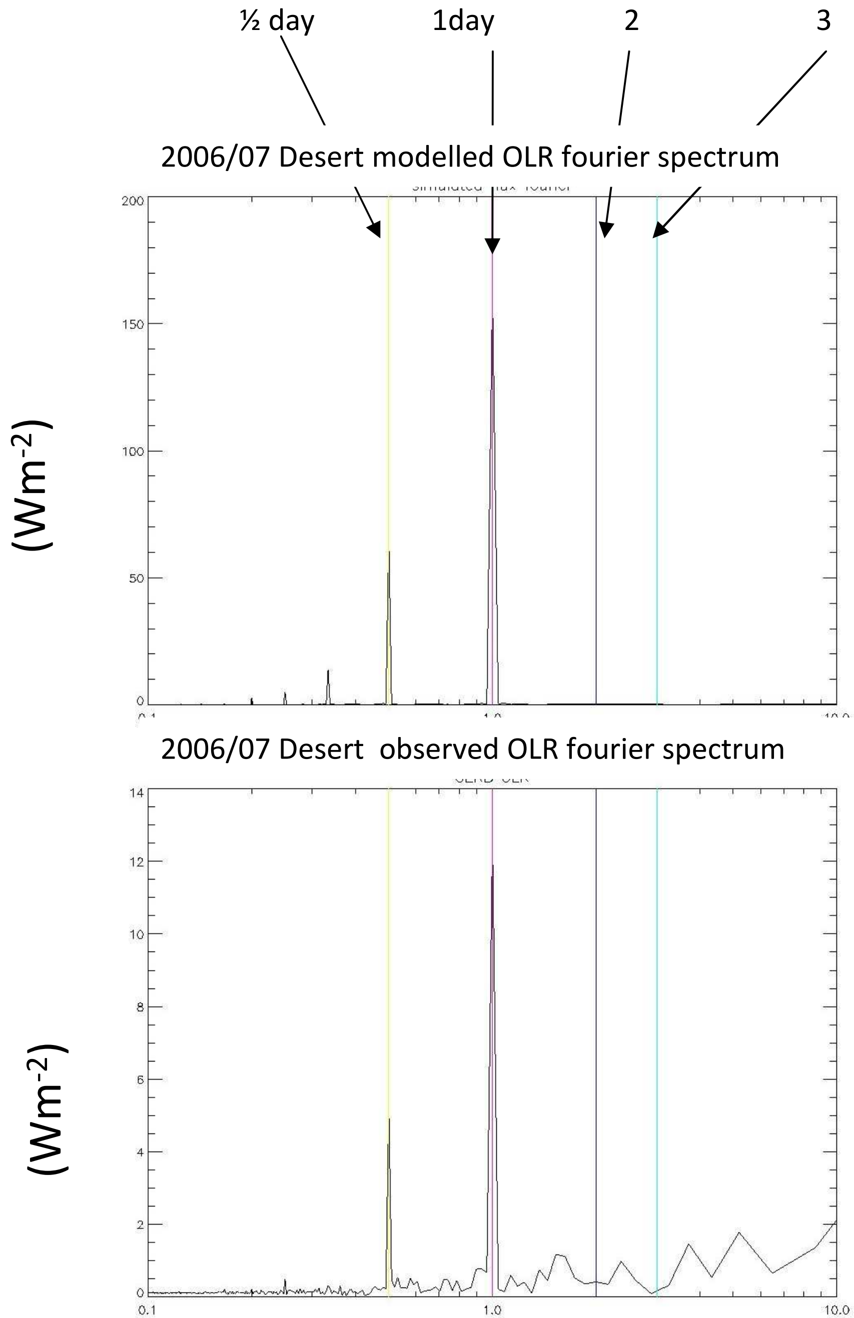


2006/07 Vegetation OLR cycle



Semi-diurnal cycle

- Fourier power spectrum (Desert – avoid ITCZ)
- Both modelled and simulated OLR showed diurnal and semi-diurnal peaks
- Relatively magnitudes are similar



Modes of variability

- Averaged 'zonally'
- Along the ITCZ
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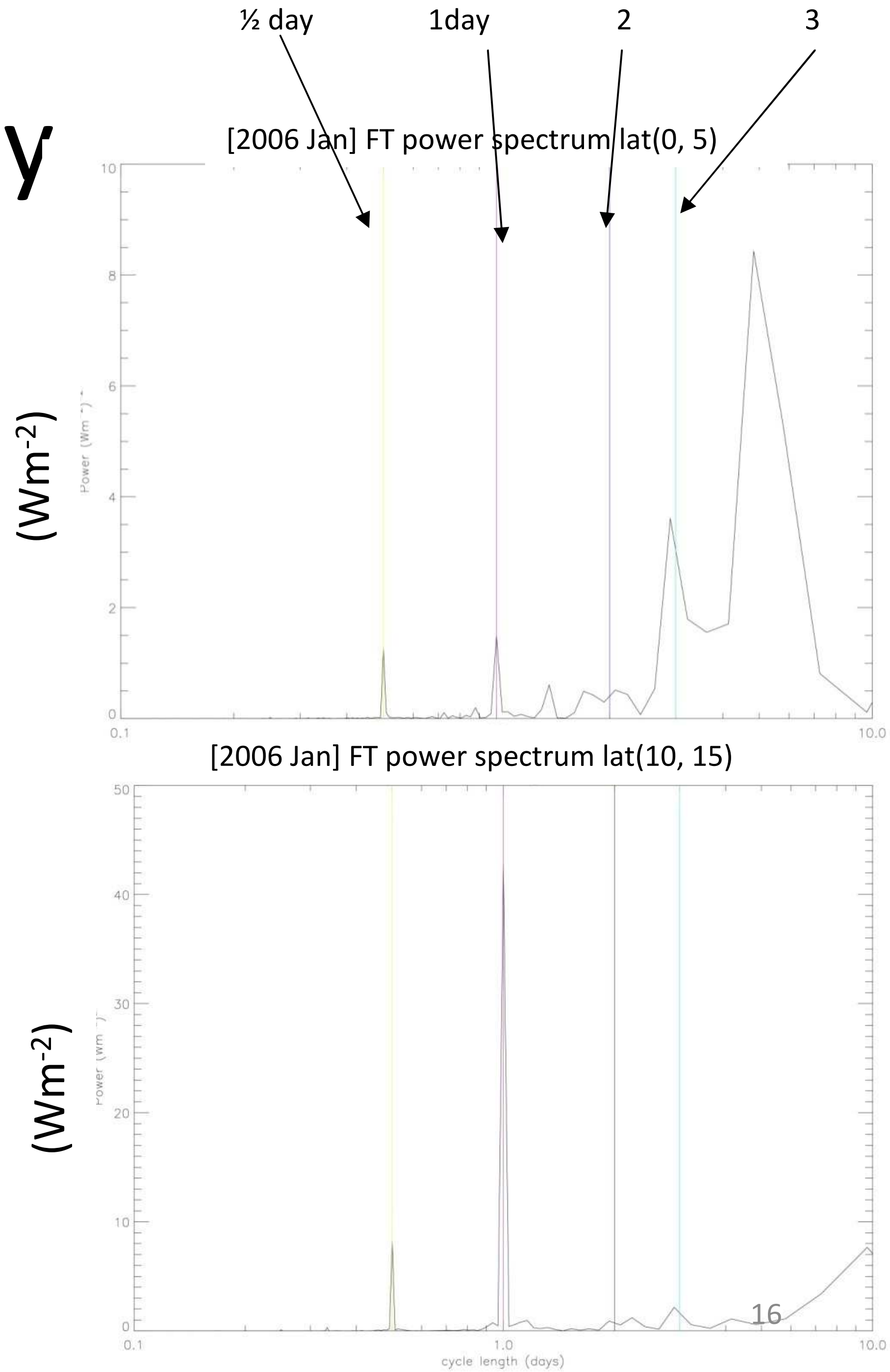
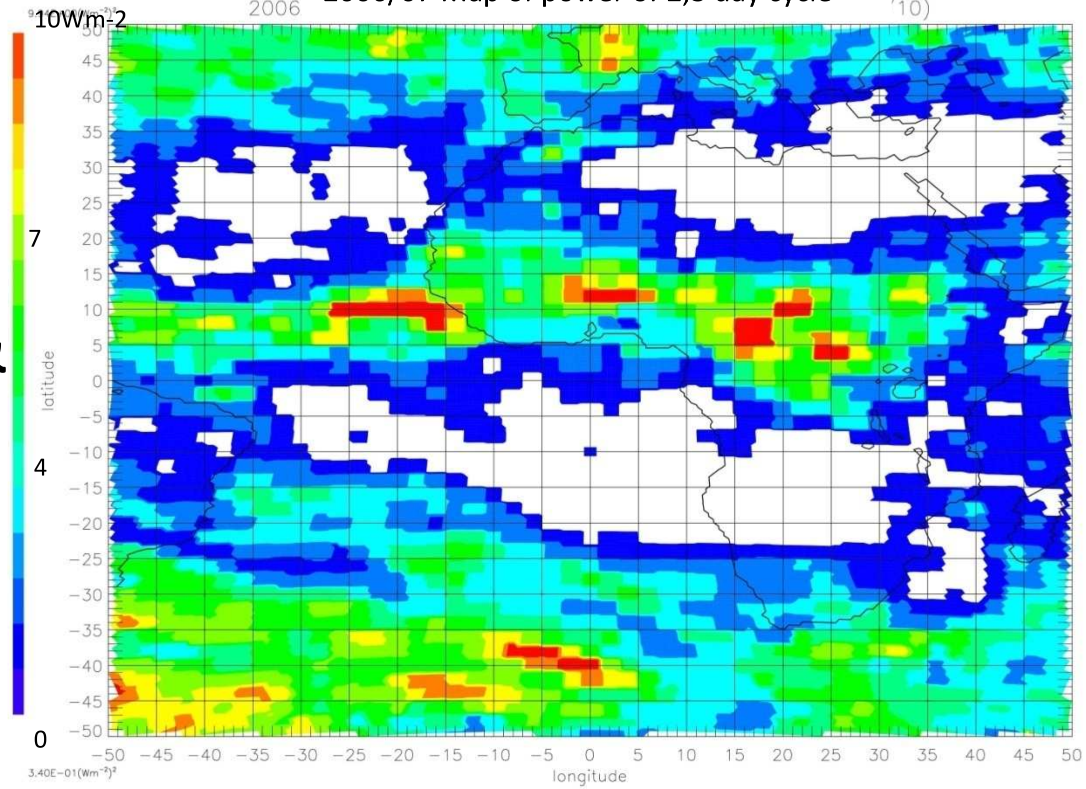
- Peaks in high cycle length, i.e 3 & 5, further investigation
  - Outside ITCZ
  - High diurnal cycle strength, region along Sahara
  - Relatively weak in longer cycle lengths



Fourier power map

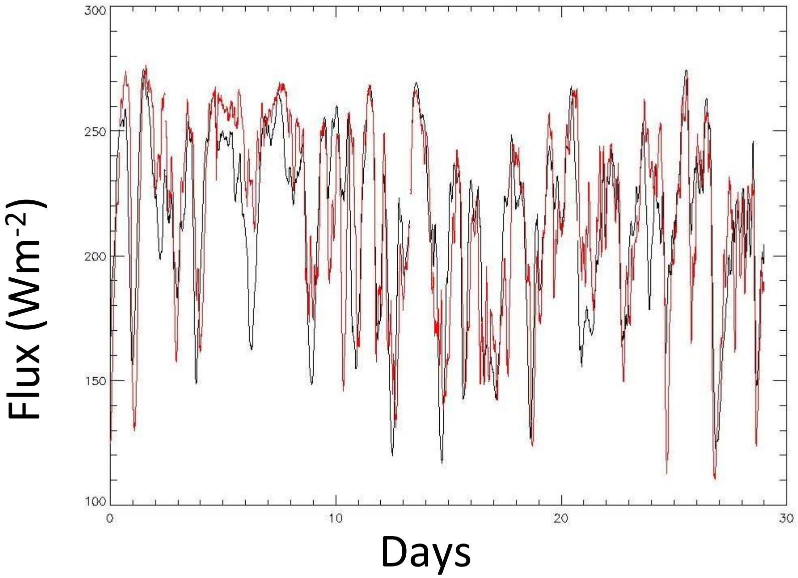
- Power of 2-3 days cycle length
- Found over ITCZ & mid latitude
- Strongest signal found in ITCZ
- 2-3 days convective variability

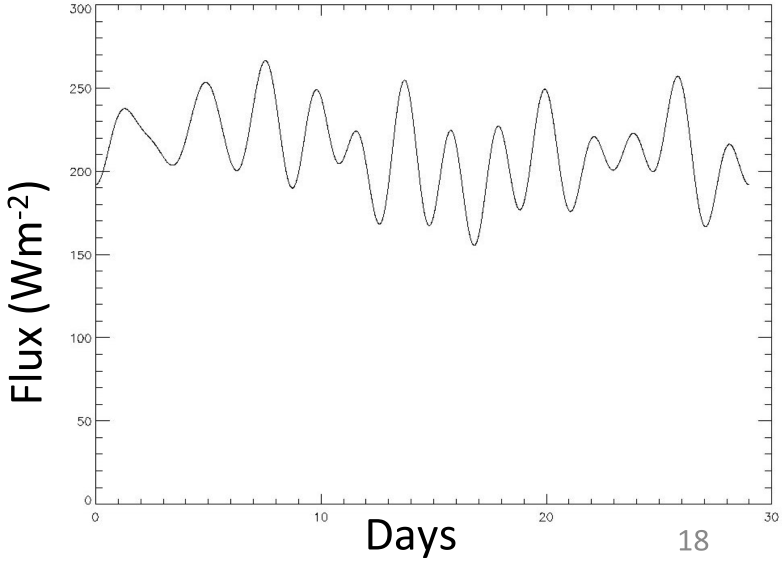
2006/07 Map of power of 2,3 day cycle



2 days filter

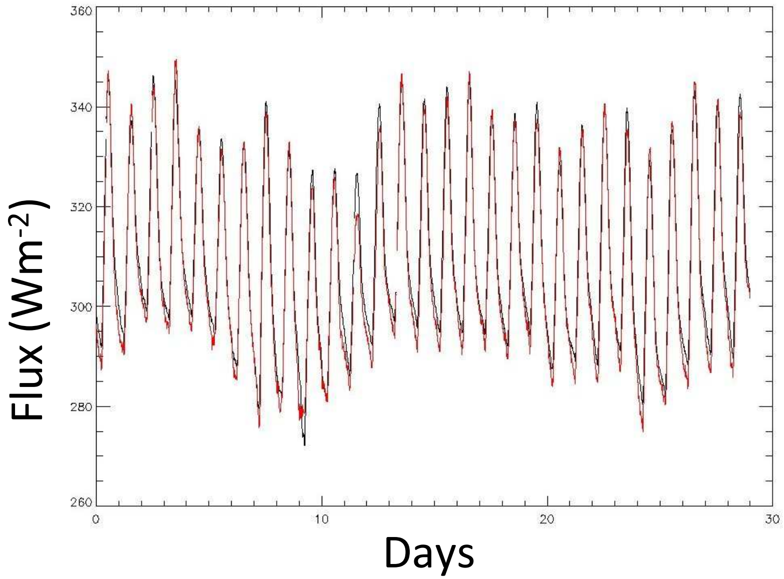
- Niger (15N, 5E)
- Low pass filter
- 2 -4 days cycle in this region
- Amplitude varies over 1 month
- Time scale of wave changes, might need to use another technique

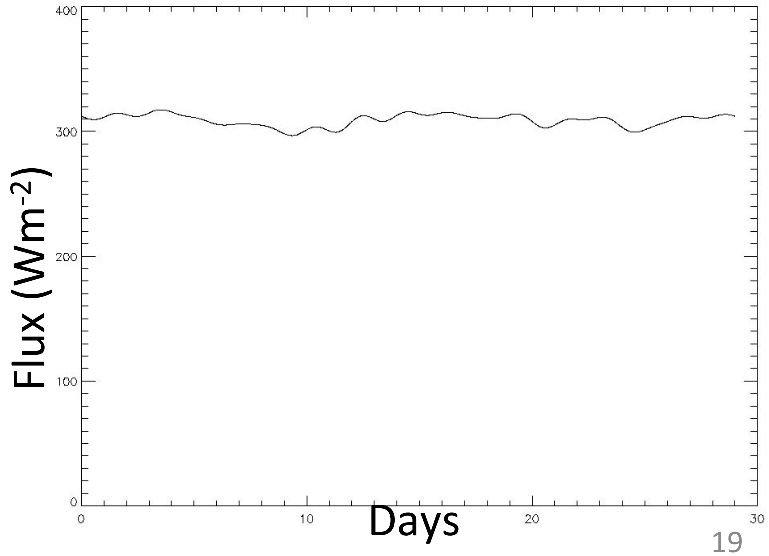




2 days filter

- Sahara desert (25N, 20E)
- Almost no variation beyond 1 day cycle
- Suggests a fairly consistent diurnal cycle over the month





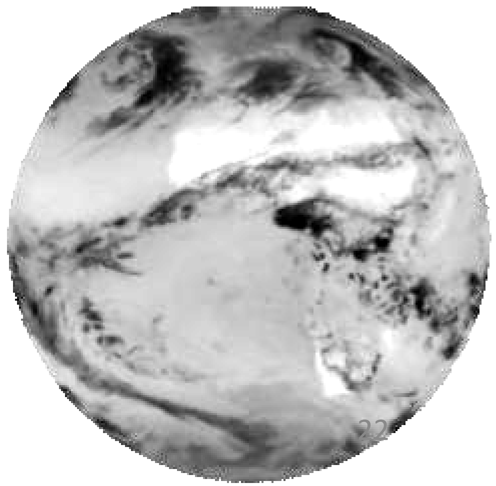
Summary

- Semi-diurnal & diurnal cycle strongest over land
- Modelled OLR using surface properties & ISR
- Semi-diurnal could be explained by heat capacity of surface, in terms of fourier power
- 2-3 days cycle possibly caused by convective variability
- Peaks in high cycle length, i.e. 3 & 5
- AEWs
- Longer cycles were observed in low pass OLR over central Africa

End

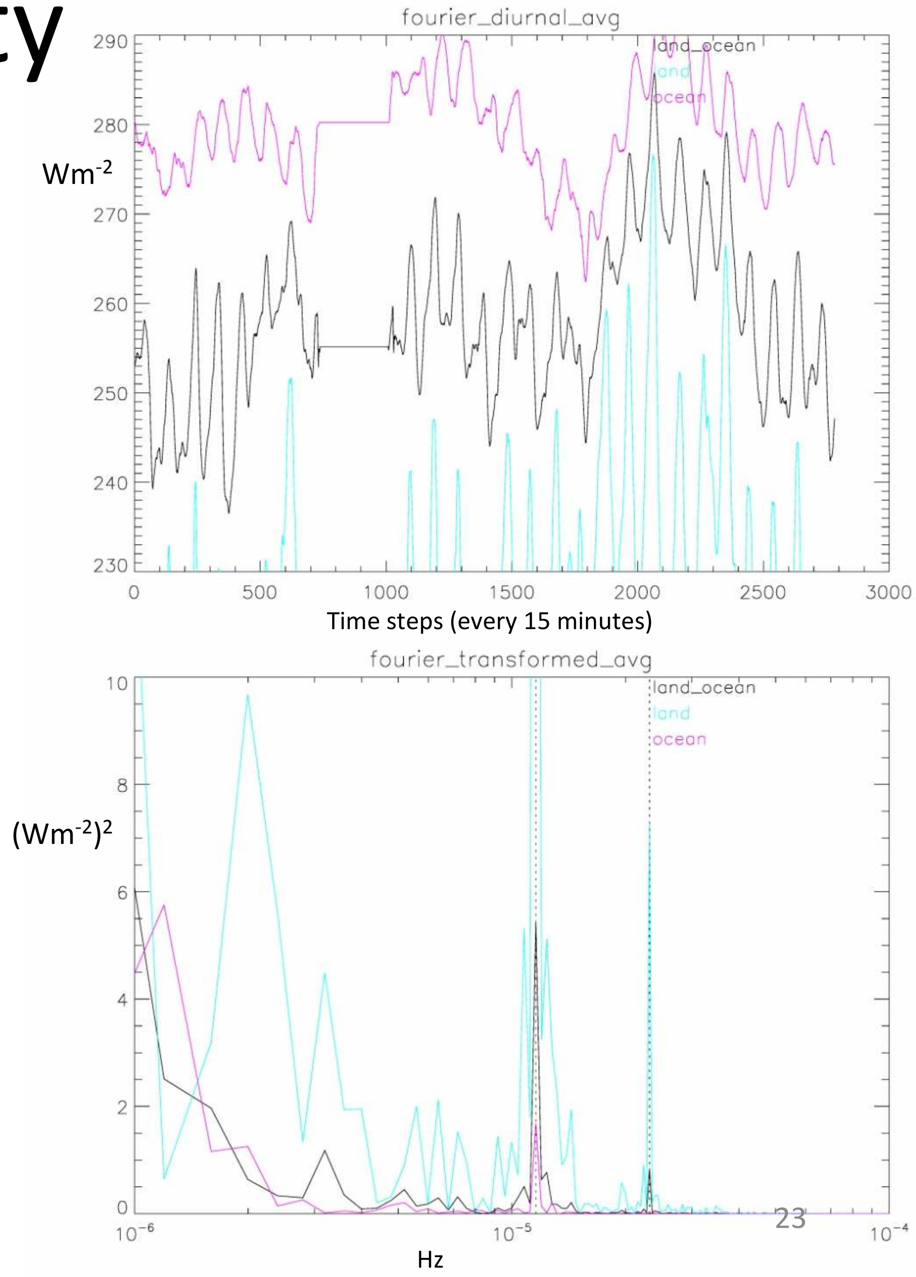
Background - GERB

- Geostationary satellite
- Broadband instrument (0.32-100 μm)
- 2 channels:
  - Total
  - SW measured through quartz filter
- High temporal resolution (17 minutes)
- 2 products:
  - SW : 0.32-4.0 μm
  - LW : 4.0-100 μm (by subtraction)



Modes of variability

- Averaged 'zonally'
- Three surface types
- Strongest mode is diurnal variation
- Larger amplitude over land



Semi-diurnal