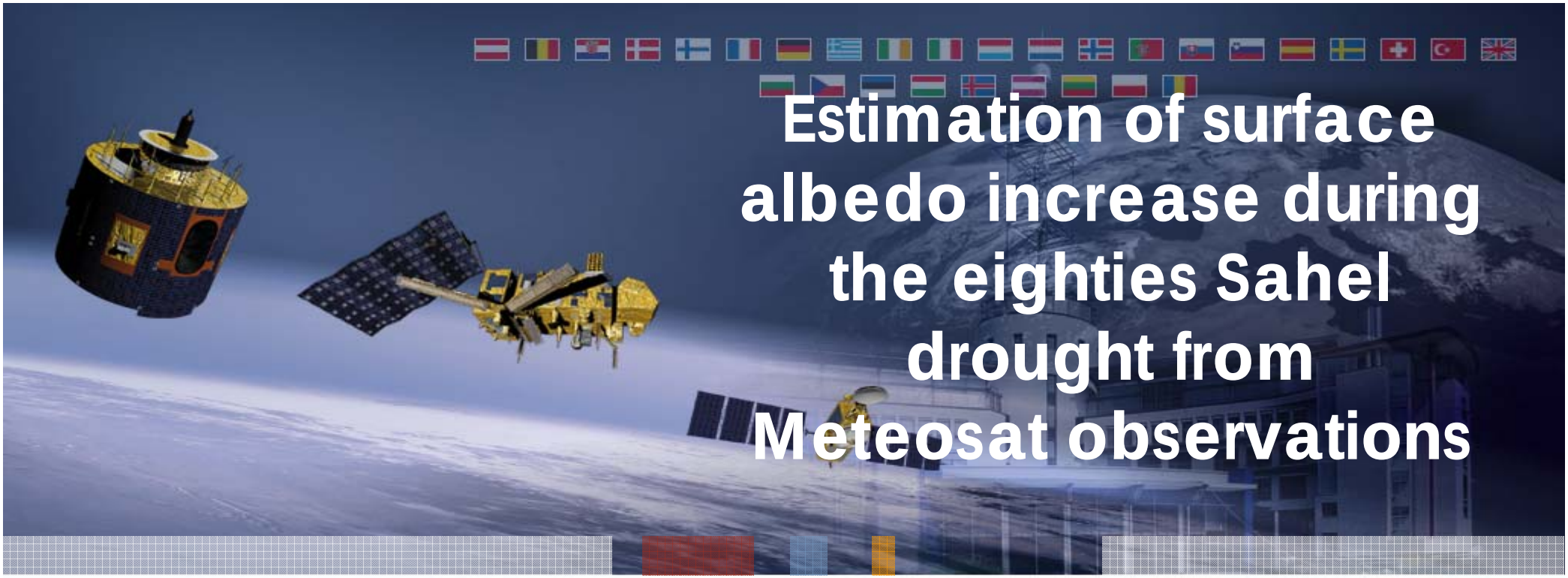
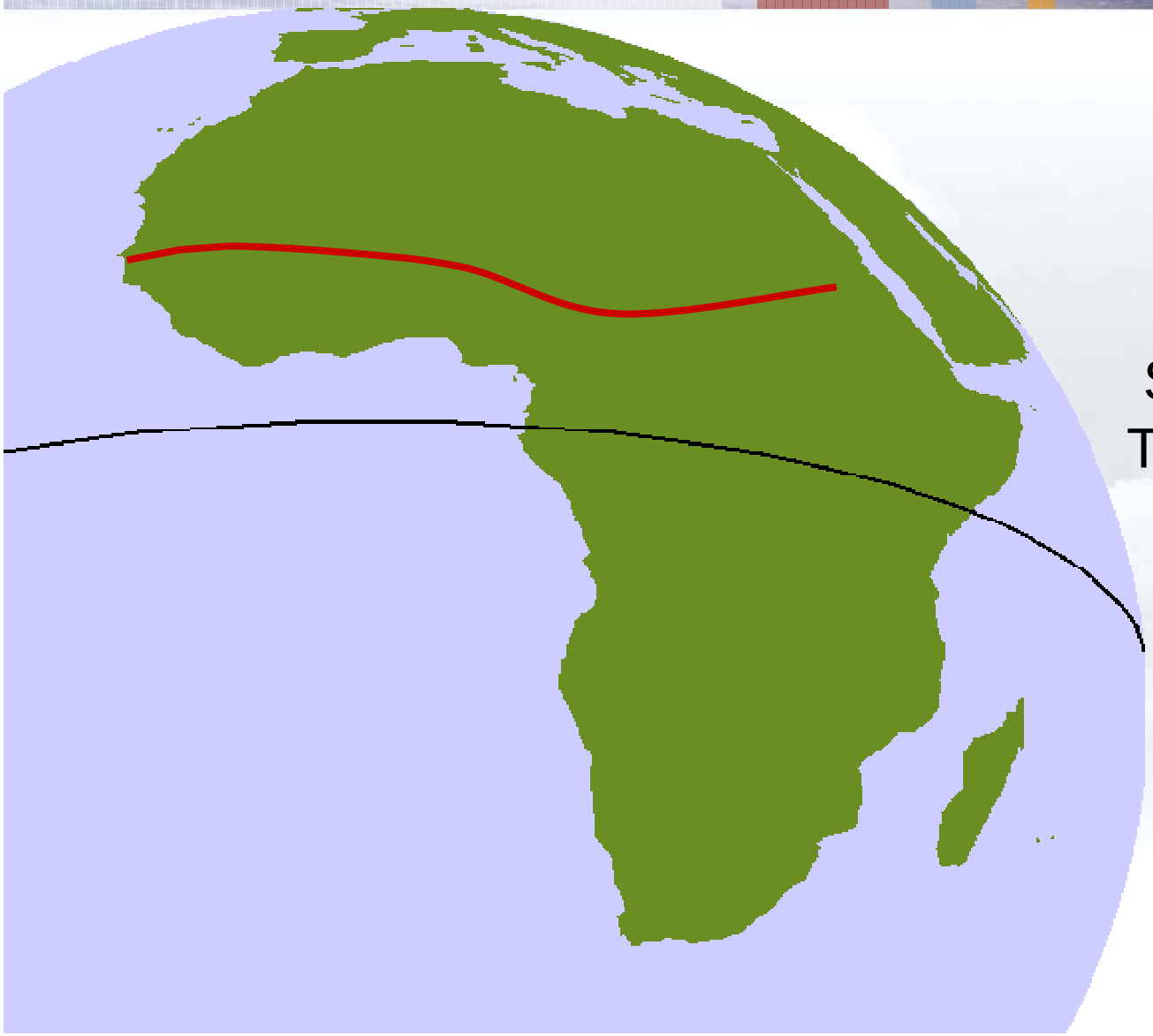


Estimation of surface albedo increase during the eighties Sahel drought from Meteosat observations

Yves Govaerts, EUMETSAT
yves.govaerts@eumetsat.int

Alessio Lattanzio, Makalumedia

Sahel climate : the West African Monsoon



The climate of the Sahel region is controlled by monsoon-induced meteorological processes corresponding to a North-South migration of the Inter Tropical Convergence Zone (ITCZ).

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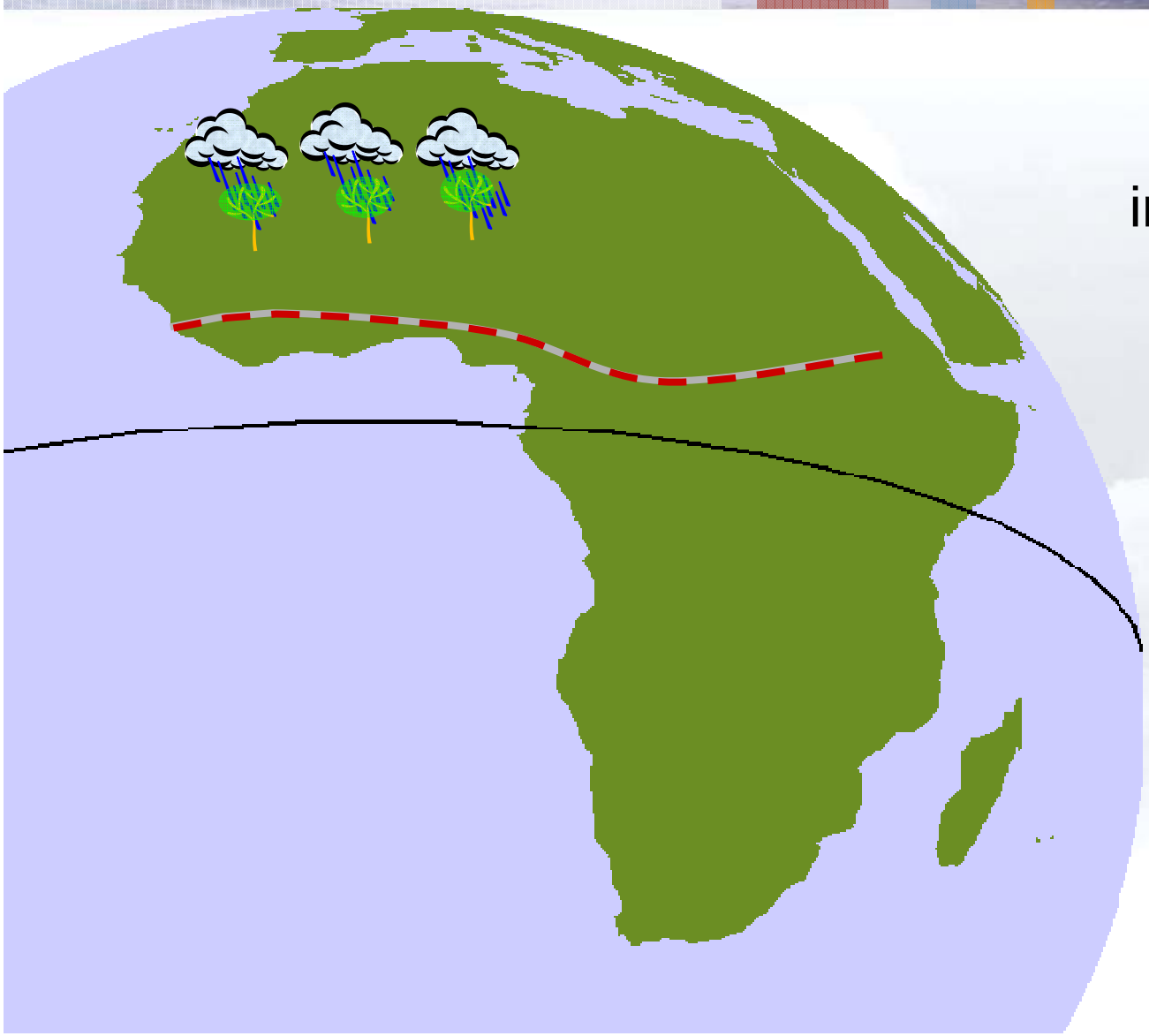
Sahel climate : the West African Monsoon



The northward shift of the ITCZ is associated with intense rainfall responsible for vegetation growth.

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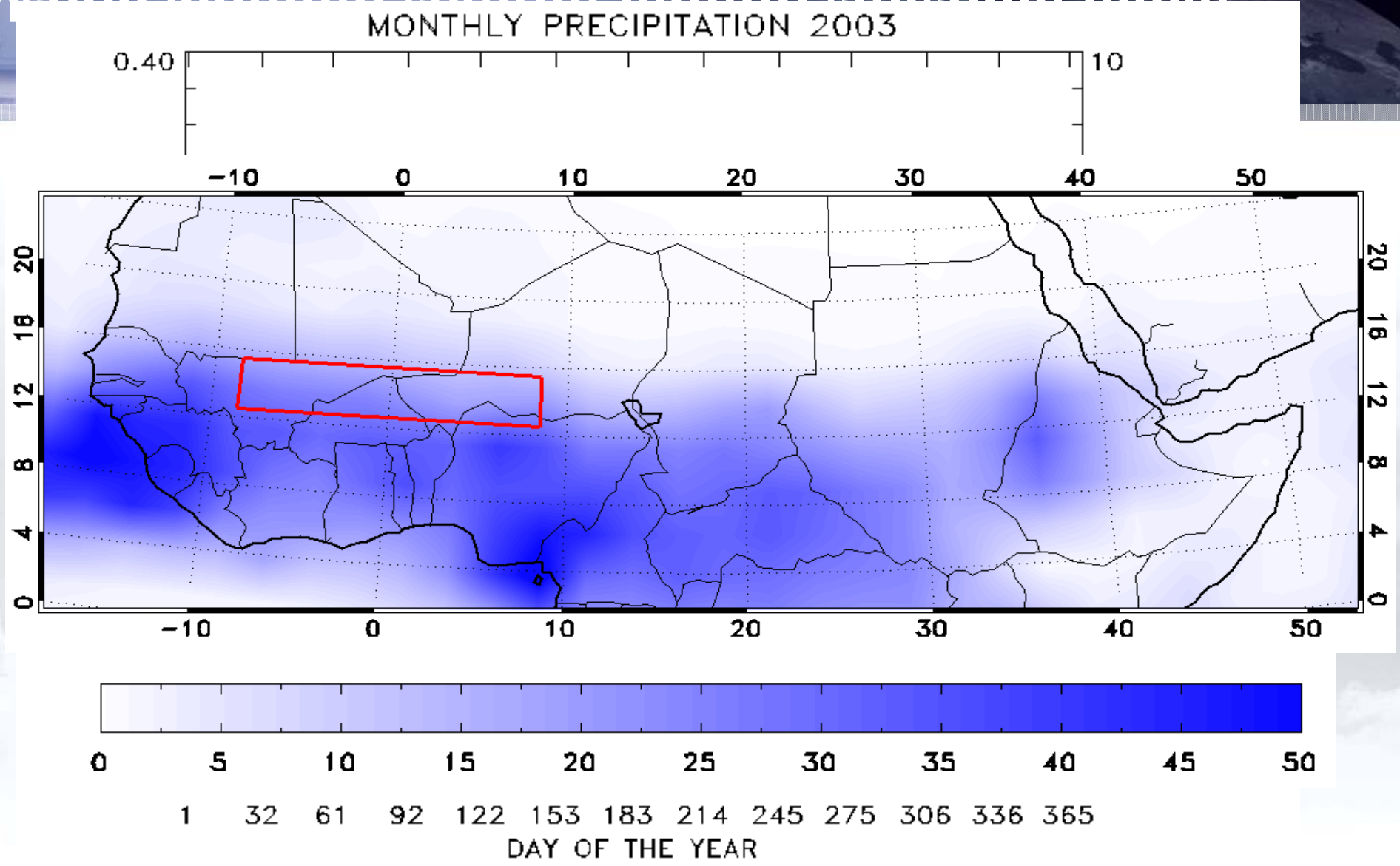
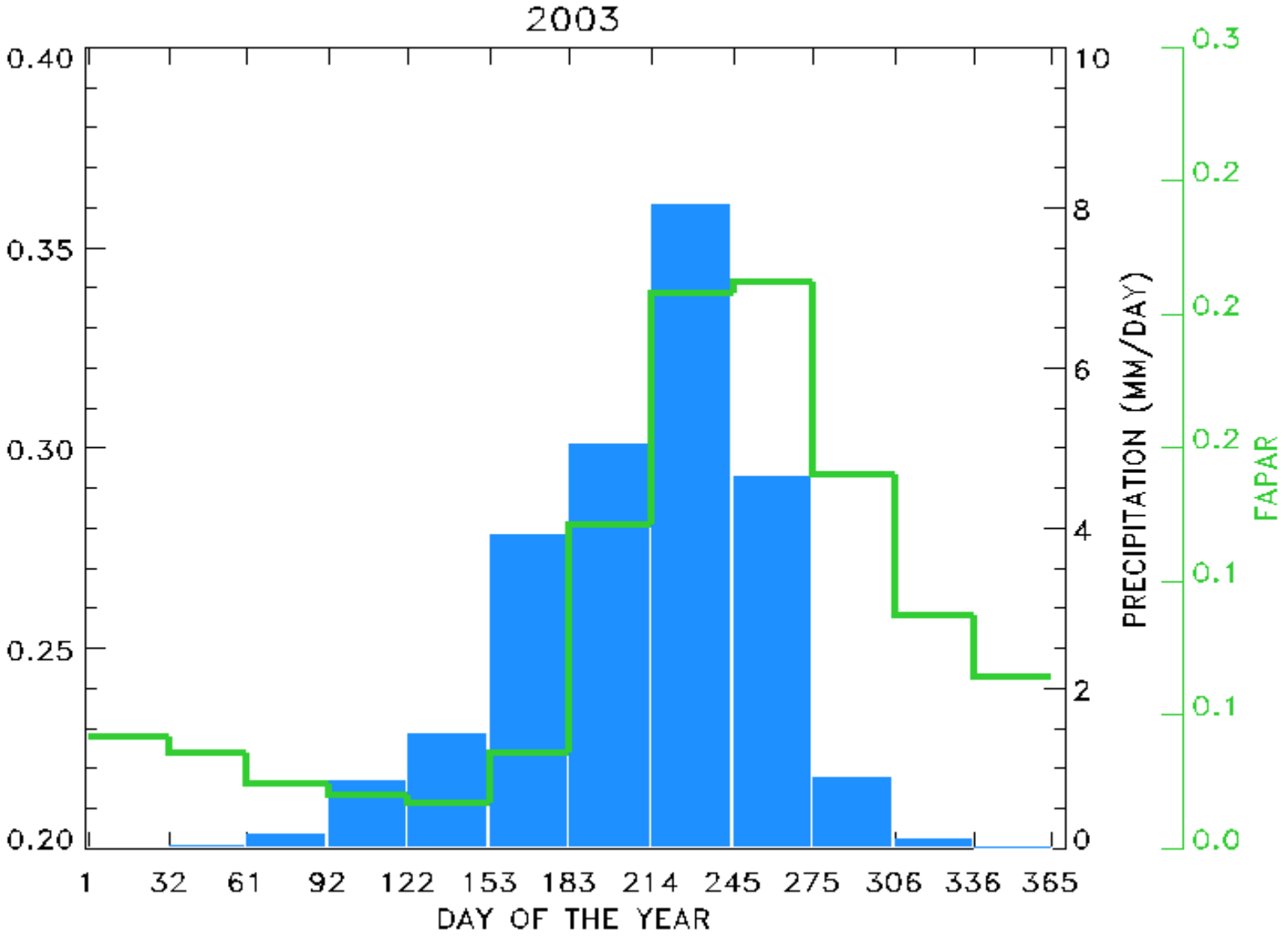
Monsoon induced surface albedo seasonal cycle



GPCP precipitation

Monsoon induced surface albedo seasonal cycle



Gobron N., et al. (2008), **Sea Wide Field-of-View Sensor (SeaWiFS) An Optimized FAPAR Algorithm - Theoretical Basis Document**, **Institute for Environment and Sustainability**, EUR Report No. 20148 EN, 20 pp.

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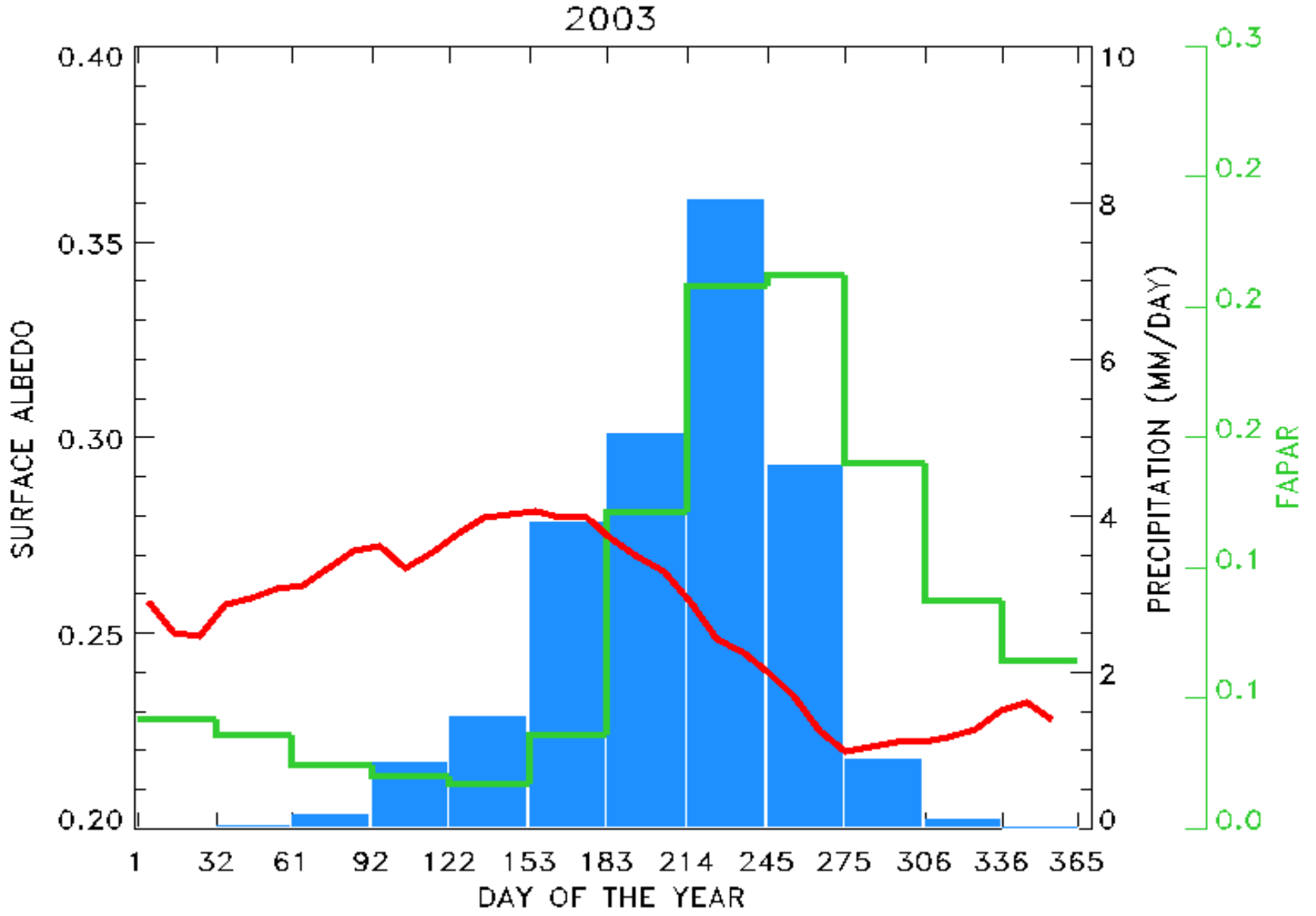
Monsoon induced surface albedo seasonal cycle

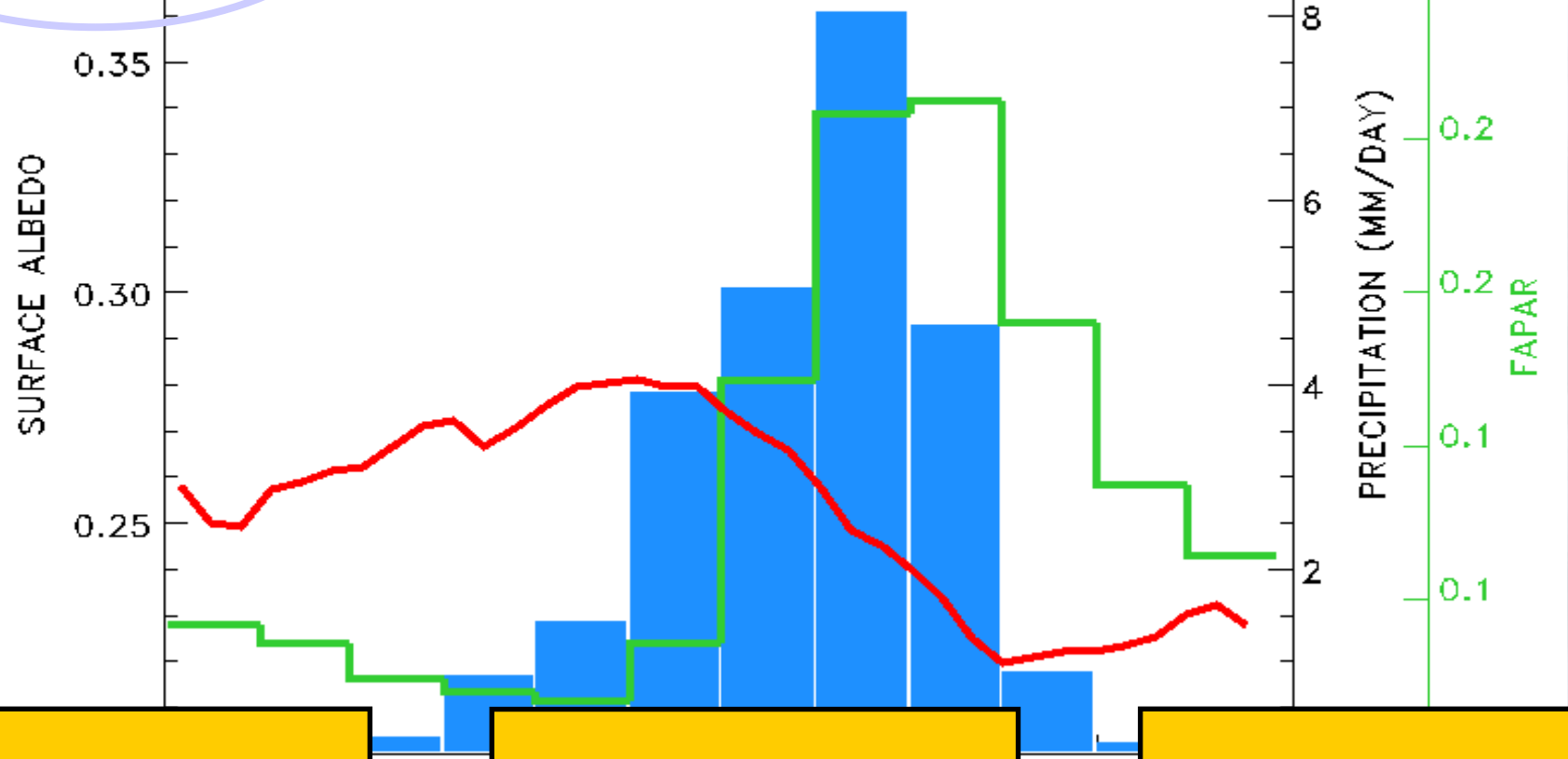


Broadband surface albedo seasonal trend derived from Meteosat

PRECIPITATION ?

VEGETATION GROWS

BB ALBEDO DECREASES

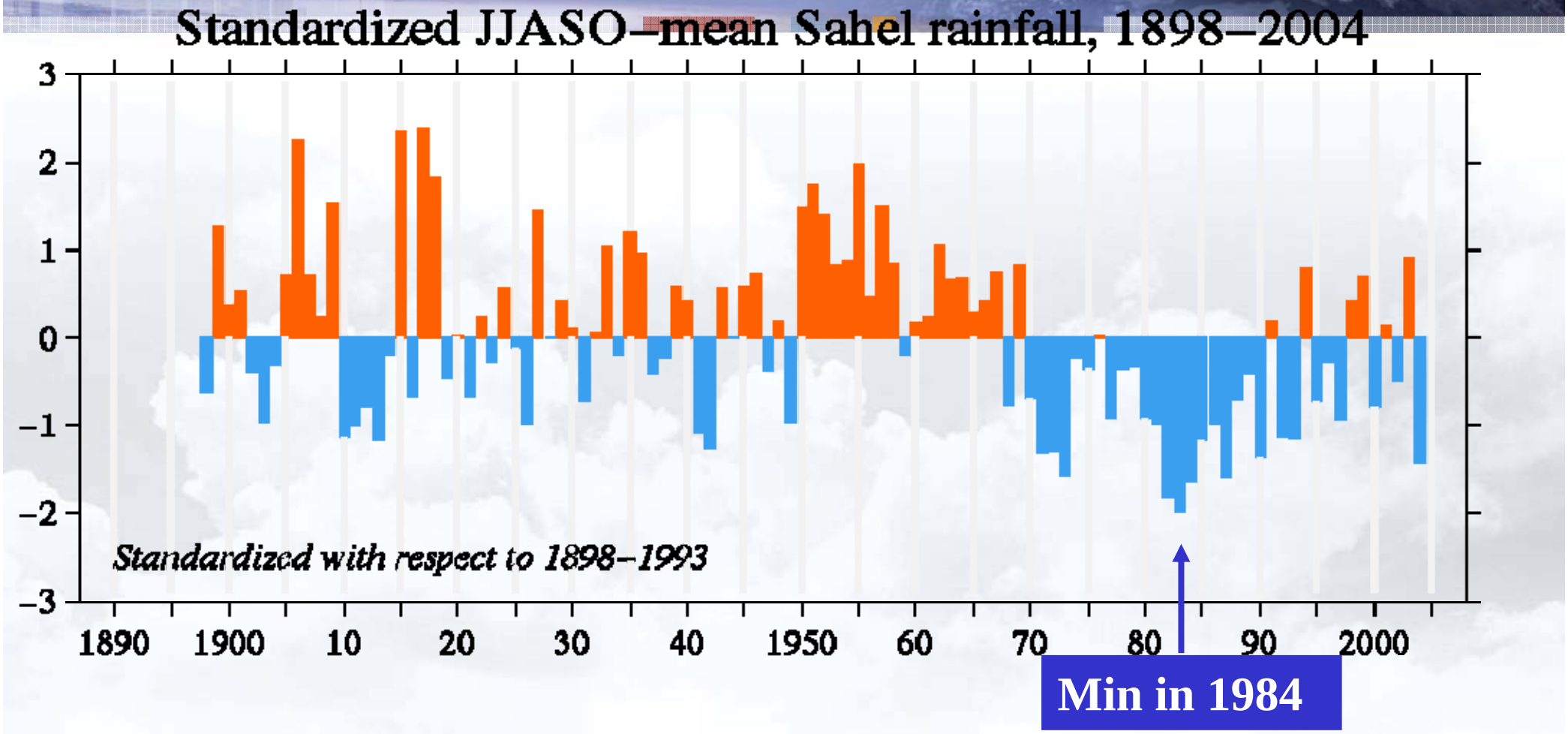


DRY

VEGETATION DEPLETION

BB ALBEDO INCREASES

Sahel rainfall index (20-10N, 20W-10E), 1898 - 2004



http://www.jisao.washington.edu/data_sets/sahel/

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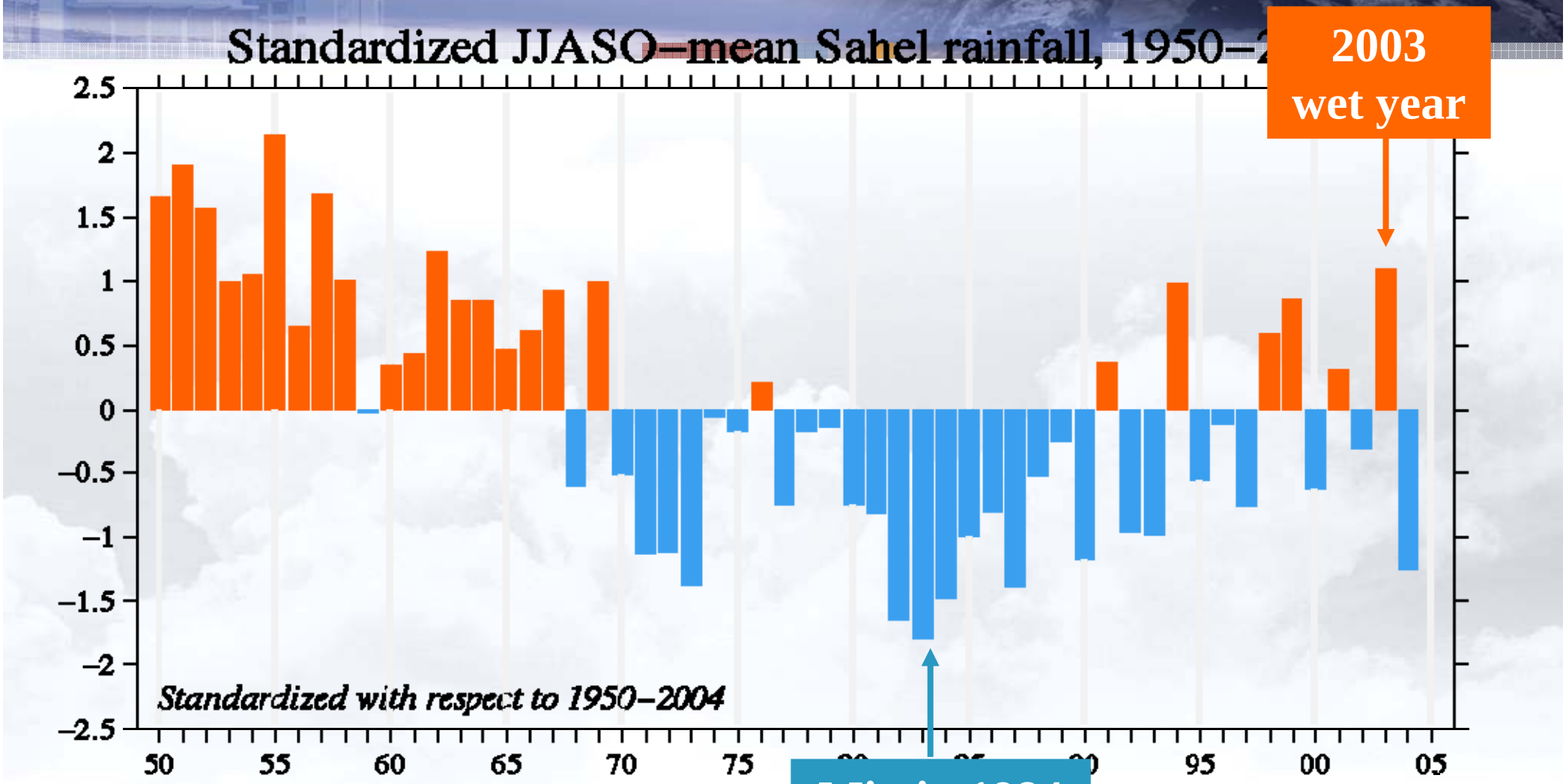
Sahel rainfall index (20-10N, 20W-10E), 1950 - 2004



http://www.jisao.washington.edu/data_sets/sahel/

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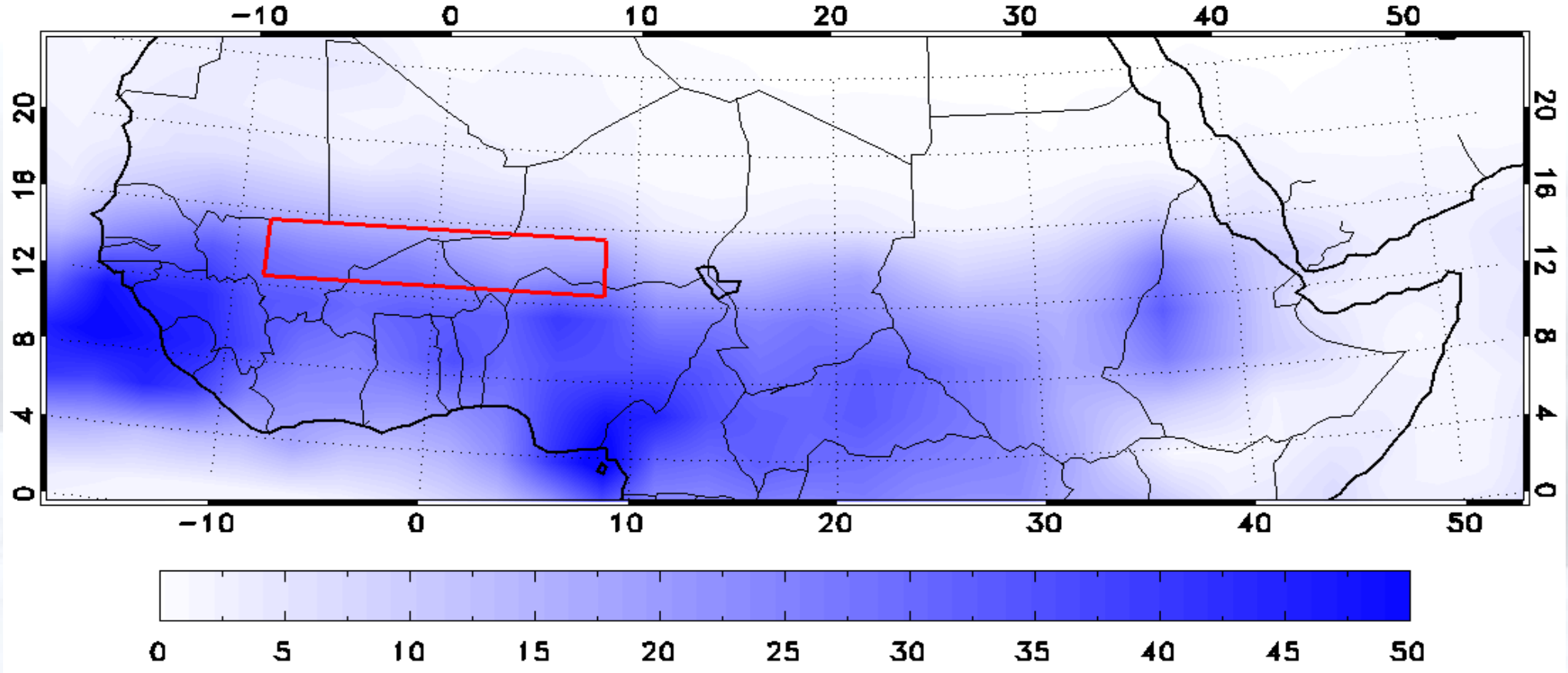
Precipitation change

Total JJASO precipitation in mm (2003)



Global Precipitation Climatology Project (GPCP)

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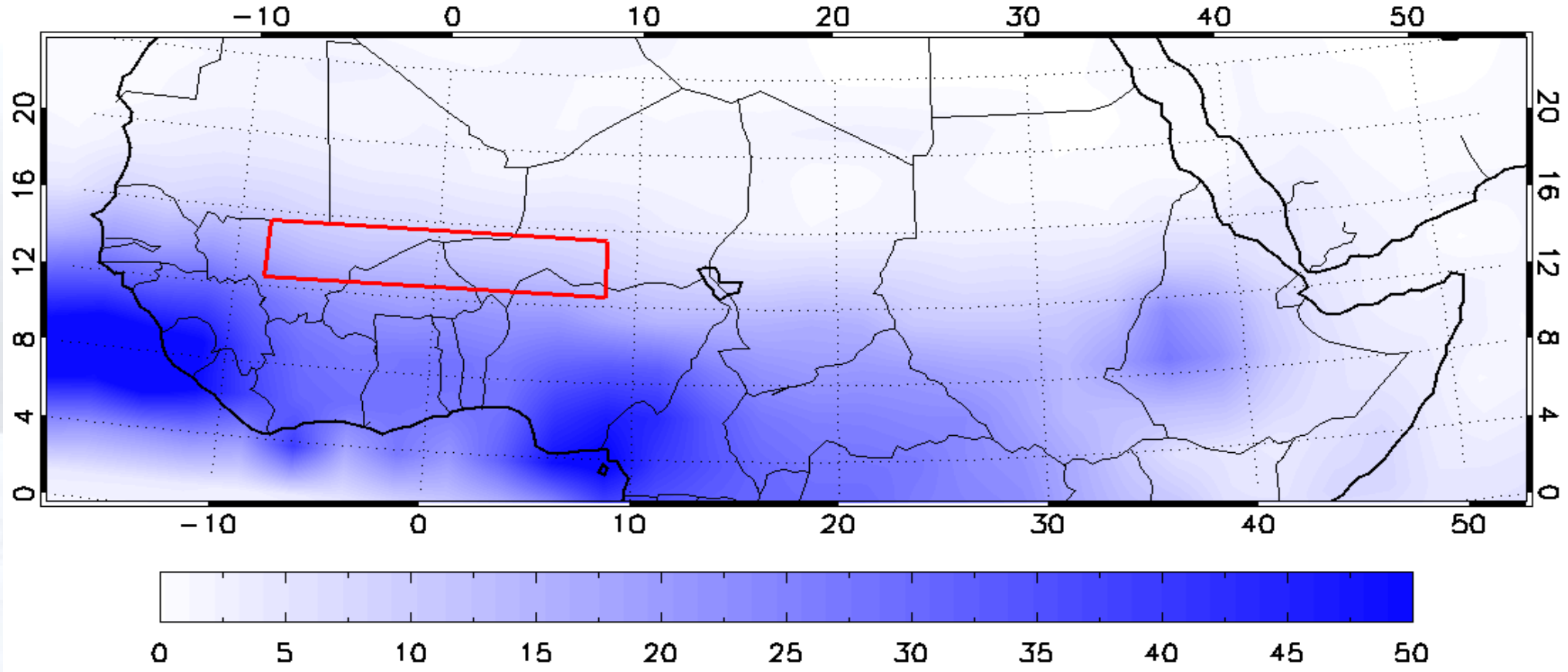
Precipitation change

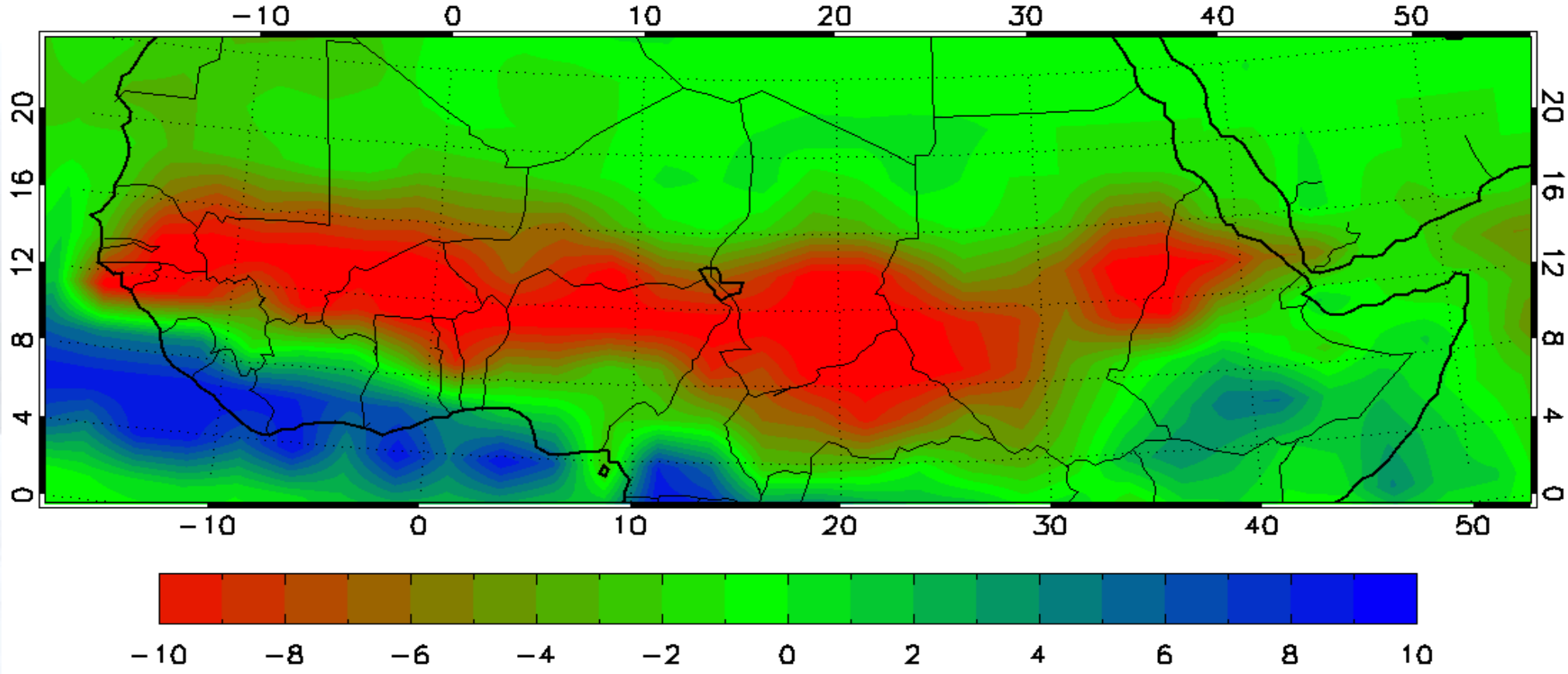
Total JJASO precipitation in mm (1984)



Global Precipitation Climatology Project (GPCP)

Precipitation change

1984 – 2003 JJASO precipitation relative difference



Global Precipitation Climatology Project (GPCP)

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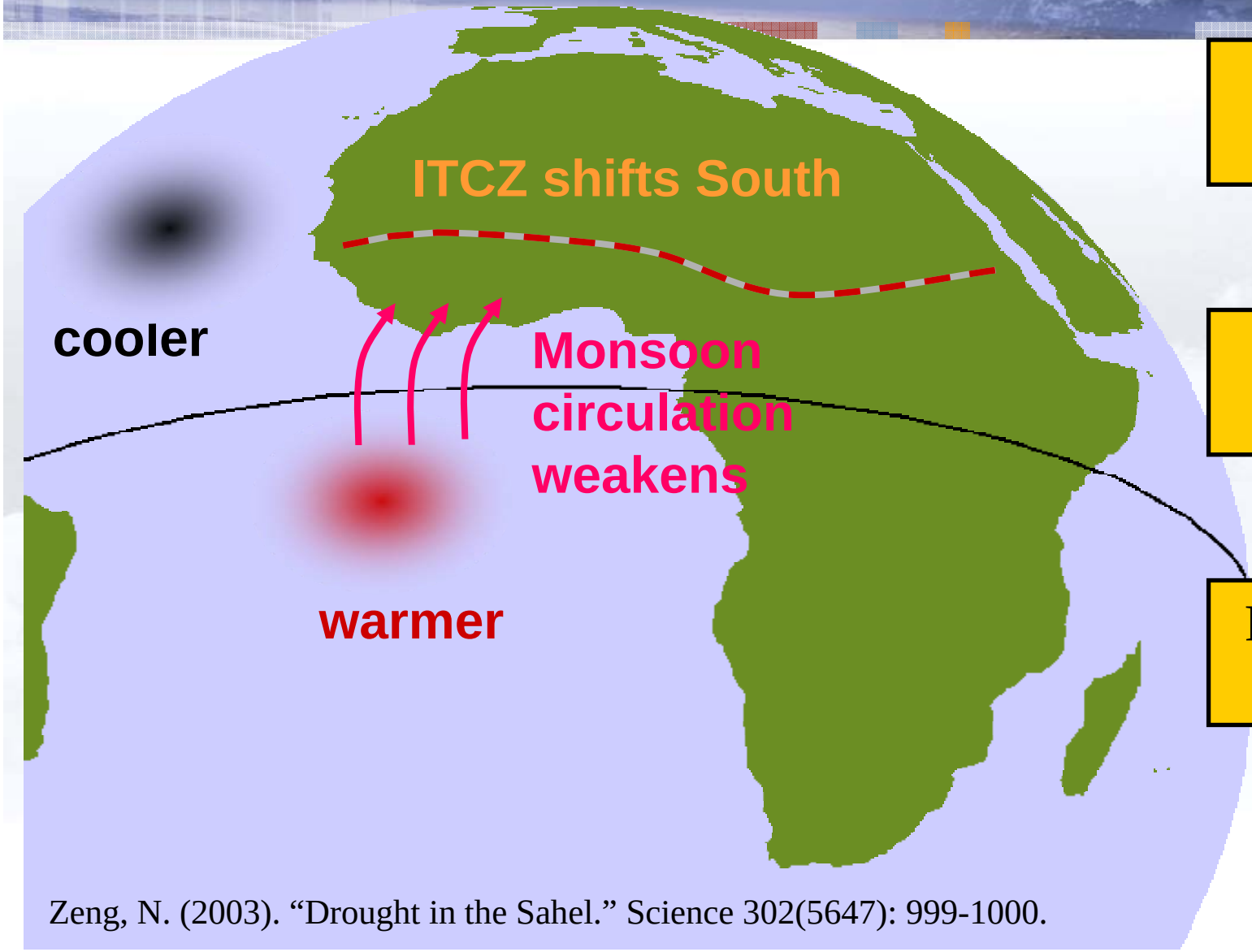
Monsoon SST Feedback over the Sahel Region



SST PATTERN CHANGES

↓

MONSOON WEAKENS

↓

PRECIPITATION DECREASES

Zeng, N. (2003). “Drought in the Sahel.” Science 302(5647): 999-1000.

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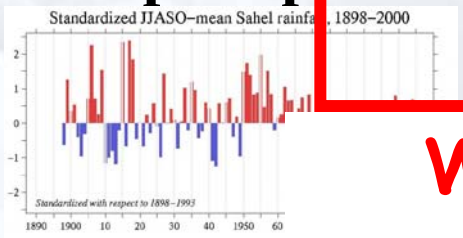
Sea-land-atmosphere feedback mechanisms

SST change

Weaker monsoon circulation

Less precipitation



decreased vegetation cover

albedo increases

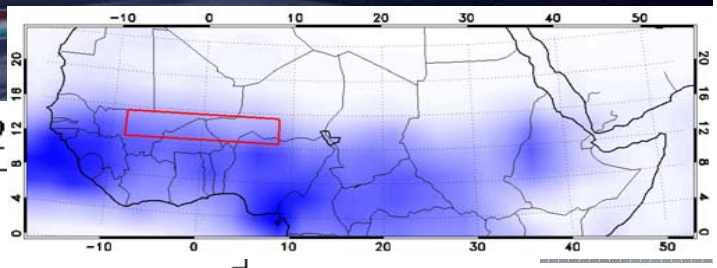
Well recognized but could be better quantified

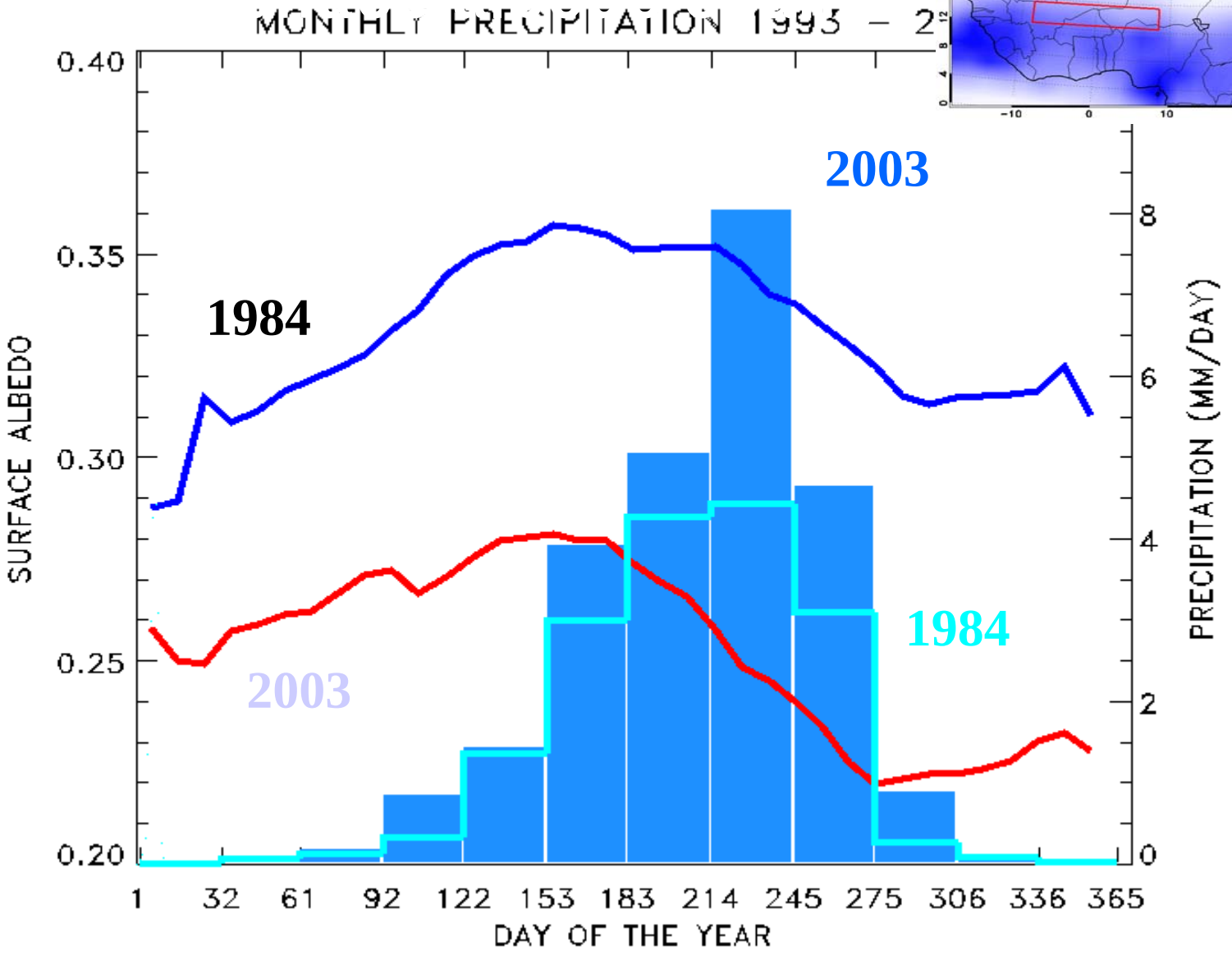
decreased cumulus convection

surface air cools and contracts

reinforced sinking motion

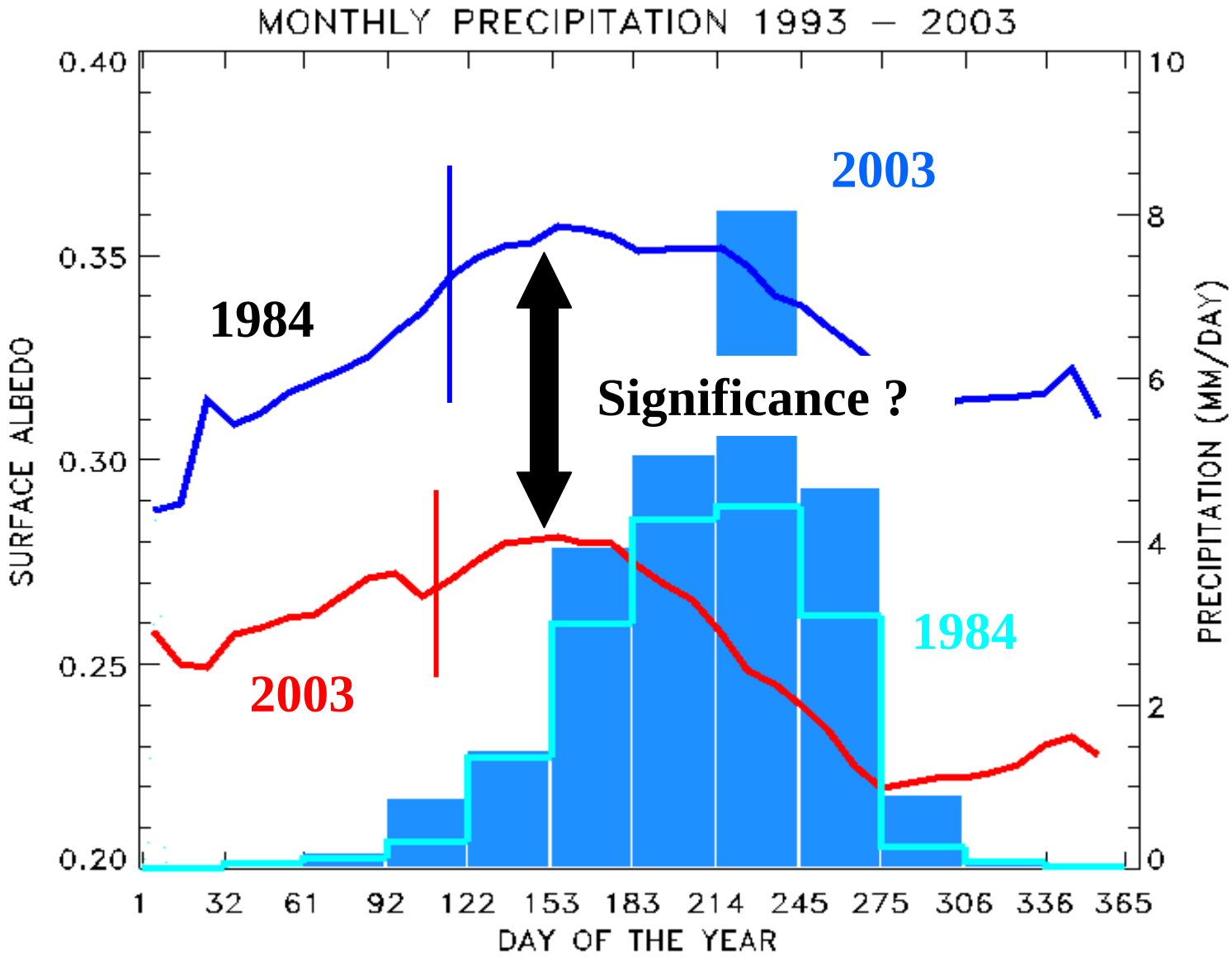
Estimation of surface albedo change





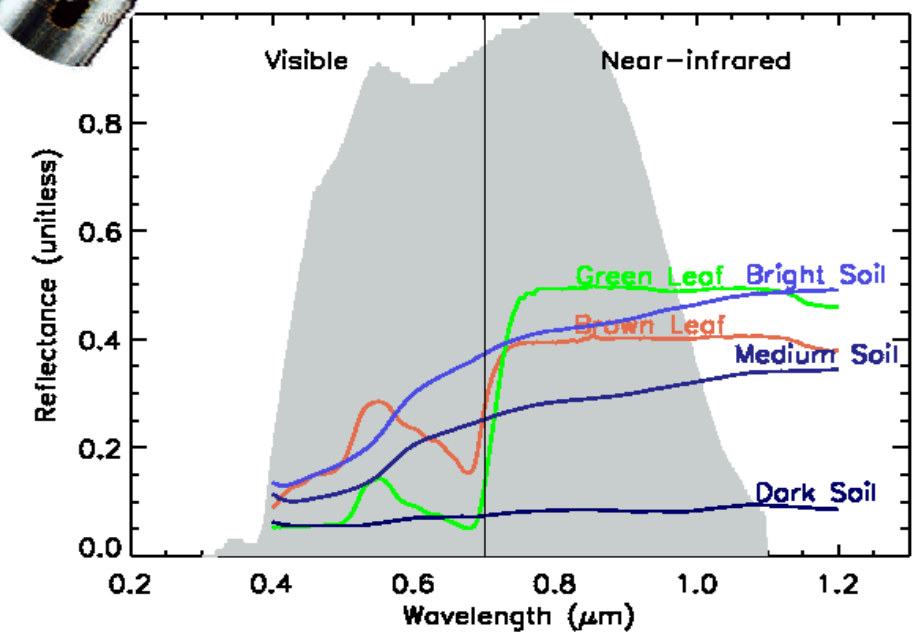
Broadband surface albedo seasonal trend derived from Meteosat

Estimation of surface albedo change



Surface albedo retrieval

- Daily accumulation to characterize surface anisotropy and aerosol load
- Inversion of a coupled srf-atm model
- Retrieval error estimation
- 10Day composite to minimize cloud effects



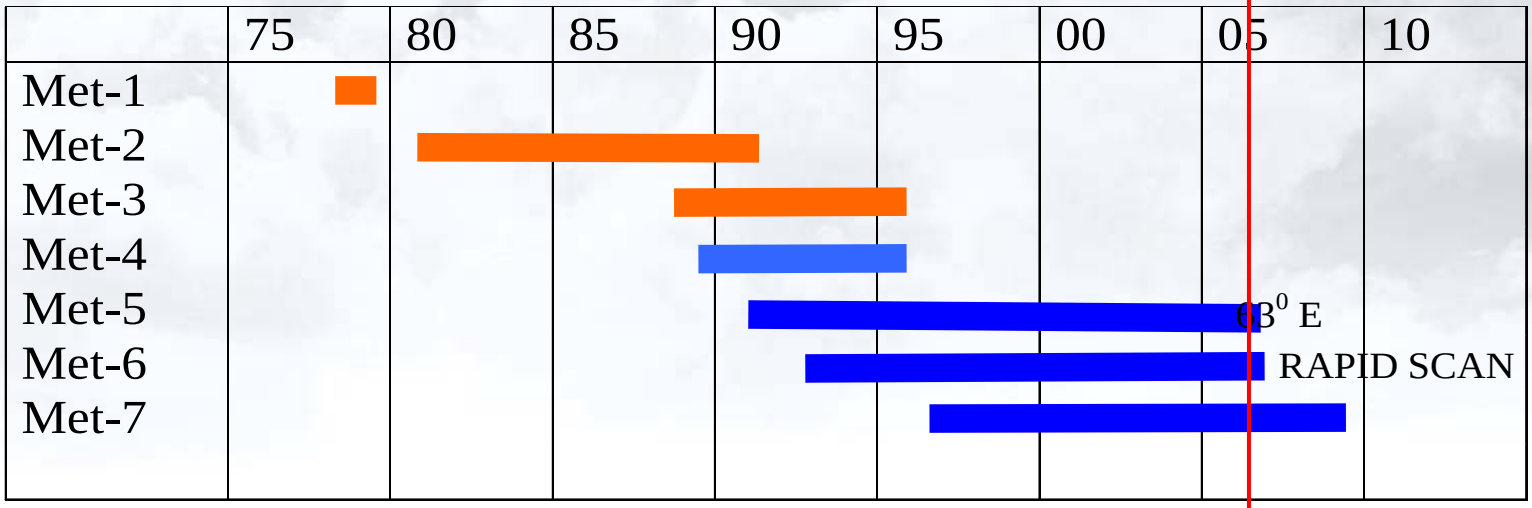
Source of errors

- calibration, radiometric noise
- retrieval (algorithm assumptions)
- spectral conversion (BB)

Pinty, B., ey. Al.. (2000) Surface albedo retrieval from Meteosat: Part 1: Theory, *JGR*,.

Pre-operational
VIS 6 bits

Operational
VIS 8 bits



Int. 18 **Every 30min, 2.5km @ SSP**

Slide: 17

25 years of archive

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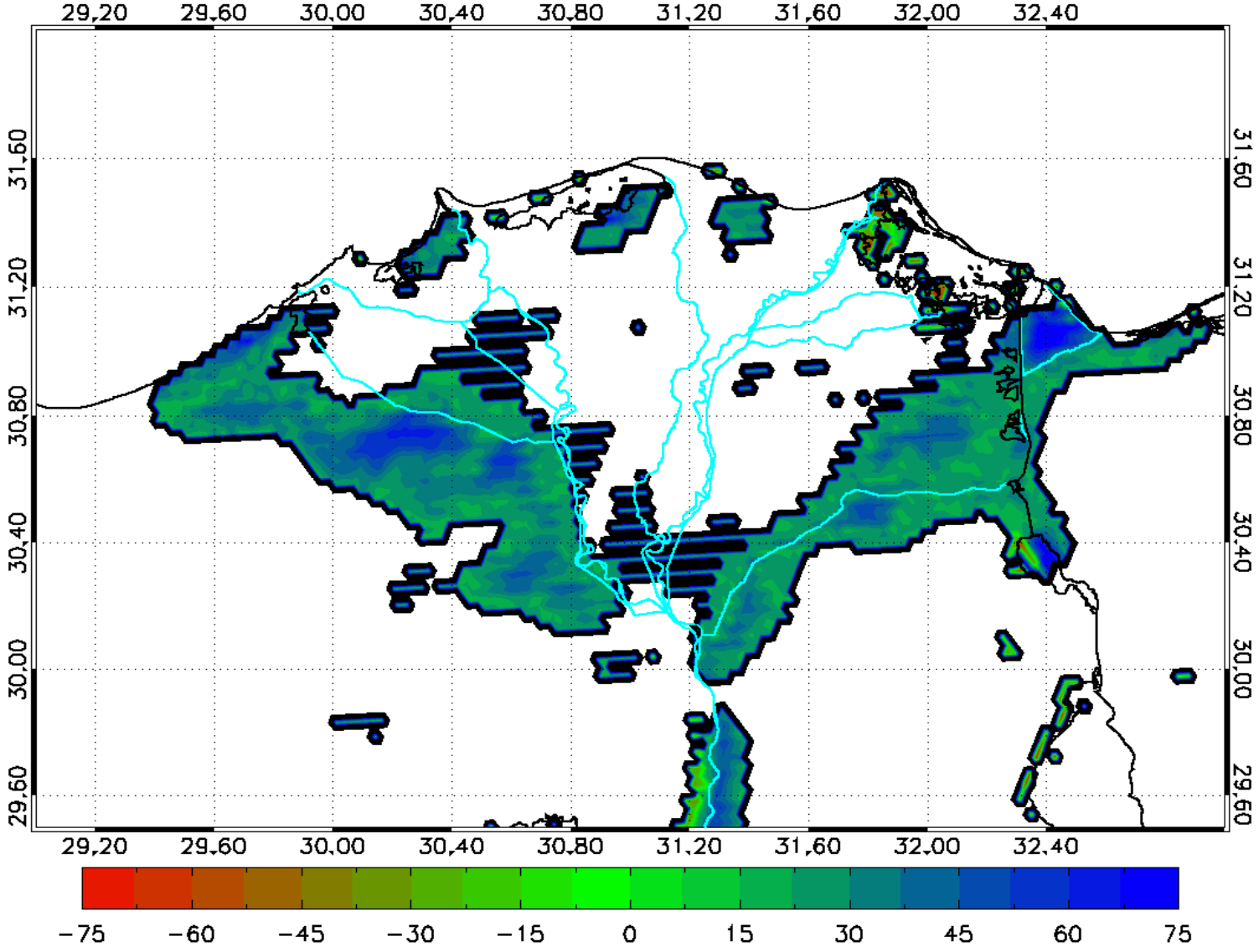
Estimation of significant surface albedo change : Nile delta

Mean annual surface albedo relative changes :
200(1984 – 2003) /(1984 + 2003)



Keep only Significant changes

$$\frac{\sqrt{\left(\sigma^2(1984)+\sigma^2(2003)\right)}}{\left|A(1984)-A(2003)\right|} \leq 1$$

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Estimation of significant surface albedo change: Nile delta

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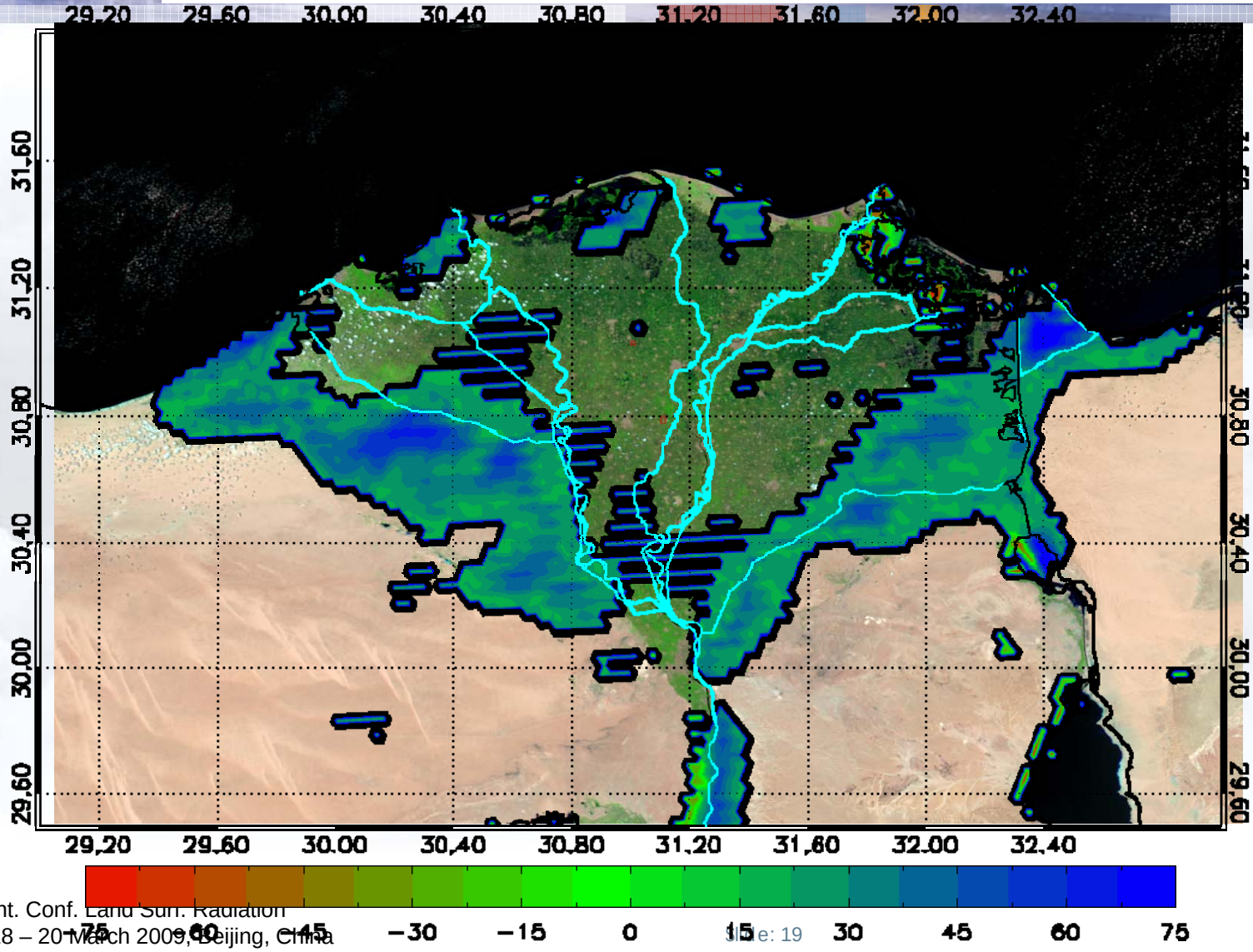

Keep only Significant changes

$$\frac{\sqrt{\left(\sigma^2(1984)+\sigma^2(2003)\right)}}{\left|A(1984)-A(2003)\right|} \leq 1$$

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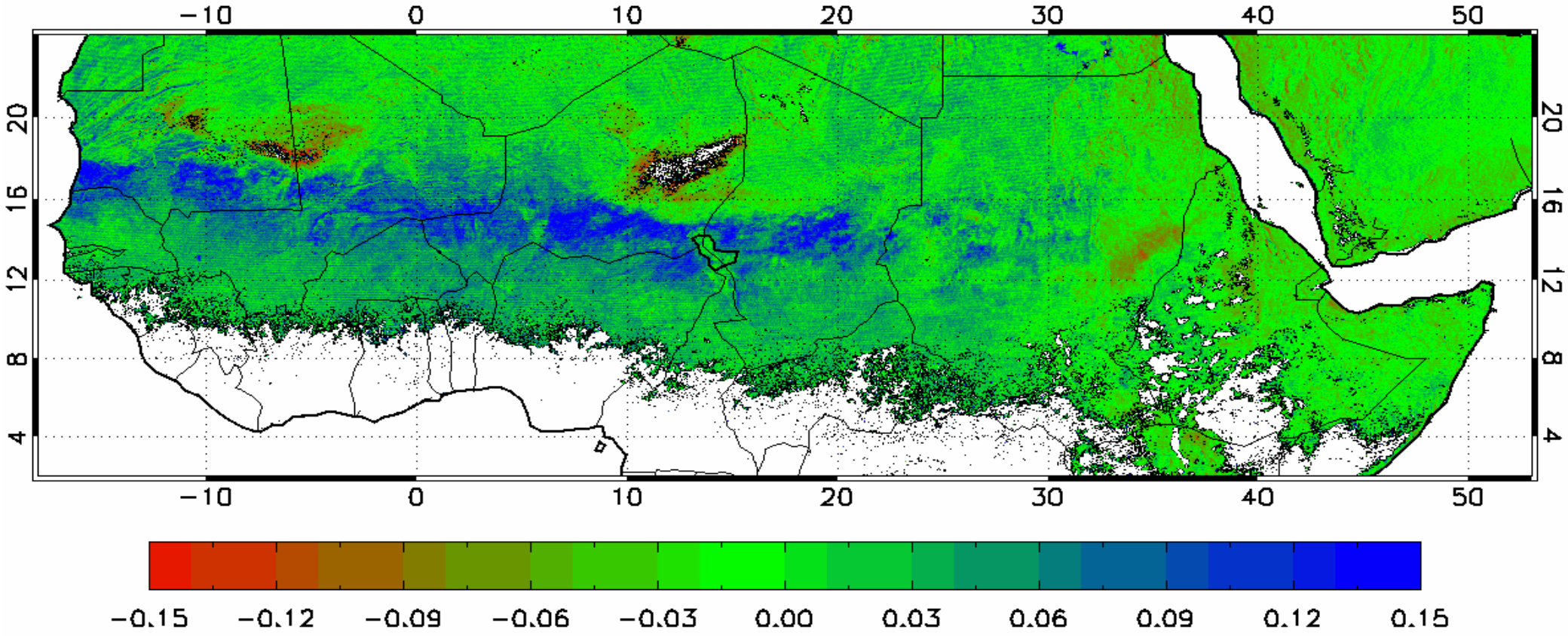
Estimation of surface albedo change



Mean **ASO** surface albedo changes: 1984 – 2003

Govaerts, Y. M. and A. Lattanzio (2008) Estimation of surface albedo increase during the eighties Sahel drought from Meteosat observations, Global and Planetary Change, 64

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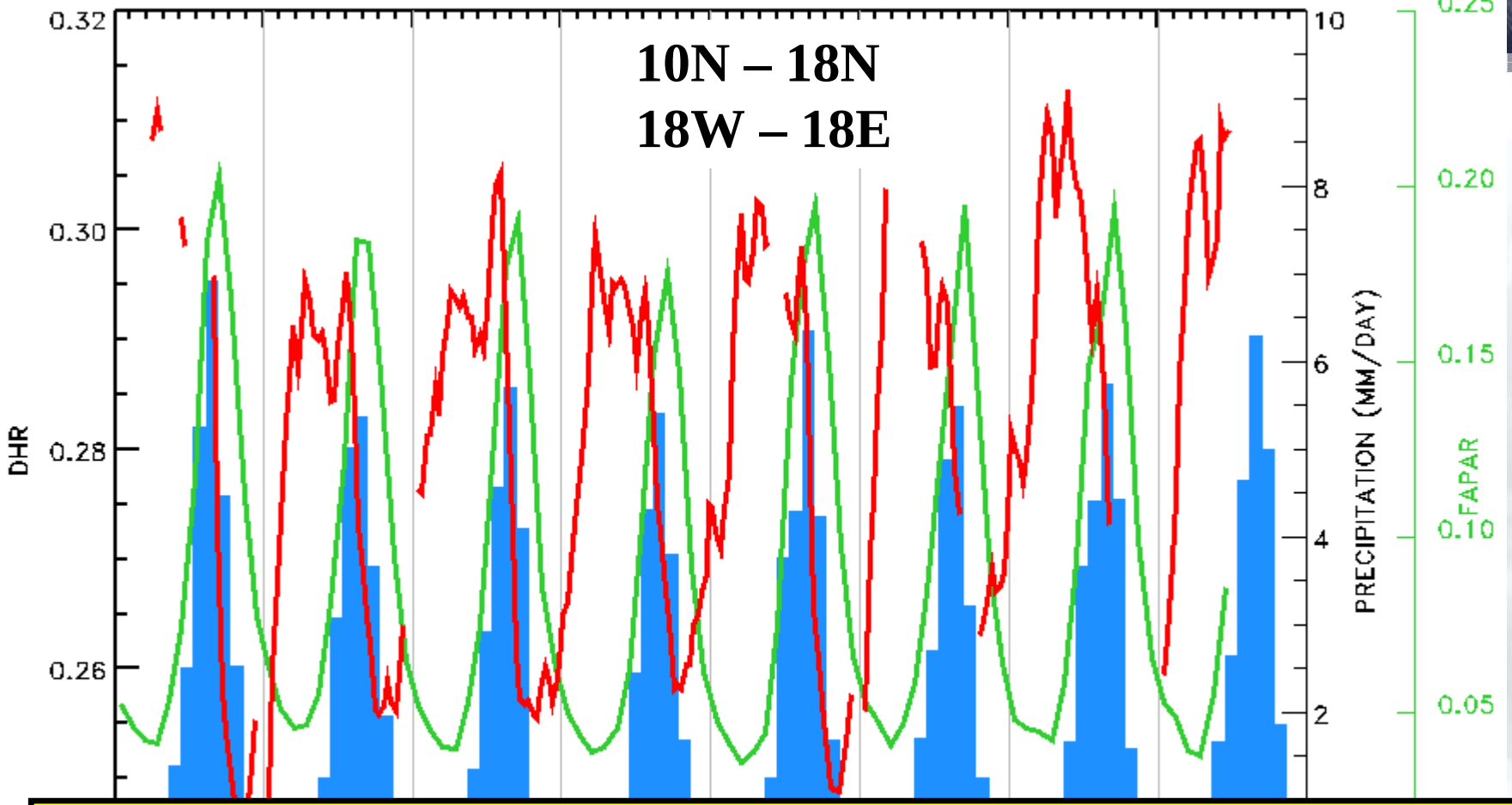
Conclusions

- Estimation of the surface albedo changes in the Sahel region during the ’80s drought
- Within the 10N-18N area, the total JJASO precipitation drops by 28% between 2003 and 1984.
- Surface albedo seasonal cycle less pronounced during dry years
- The mean ASO BB albedo increases from 0.22±0.03 in 2003 to 0.31±0.04 in 1984 (i.e., 0.09±0.05 difference) as a result of the ’80s drought.

10N – 18N	1894	2003	DIFF.	REL. DIFF.
Total annual precipitation (mm)	16.2	19.4	-3.2	-18%
Total JJASO precipitation (mm)	12.6	16.7	-4.0	-28%
Mean annual BB surface albedo(1)	0.31 ± 0.04	0.23 ± 0.03	0.08 ± 0.05	29% ± 18%
Mean ASO BB surface albedo(1)	0.31 ± 0.04	0.22 ± 0.03	0.09 ± 0.05	34% ± 19%

The Meteosat Surface Albedo data set



The Meteosat Surface Albedo data set (1983 - 2006) is available at archive.eumetsat.org

yves.govaerts@eumetsat.int