→ ATMOS 2015

Advances in Atmospheric Science and Applications

Saharan desert dust sources: new insights based on aerosol vertical profiles retrieved from thermal infrared measurements by IASI

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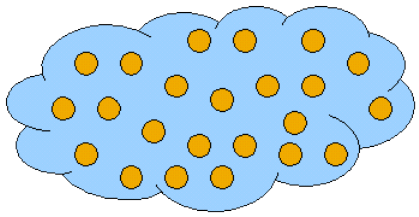
European Space Agency

Desert dust…

- Most important aerosol in annual mass burden
- Major actor in the climate system
  - Direct effect: absorption, scattering, emission
  - Indirect effect: clouds



Modify number of clouds
Modify radiative properties
Modify microphysical properties
(→ e.g. more/less rain)

- Causes health issues when close to the surface

Main source mechanisms

Nocturnal Low Level Jet: Breakdown at sunrise

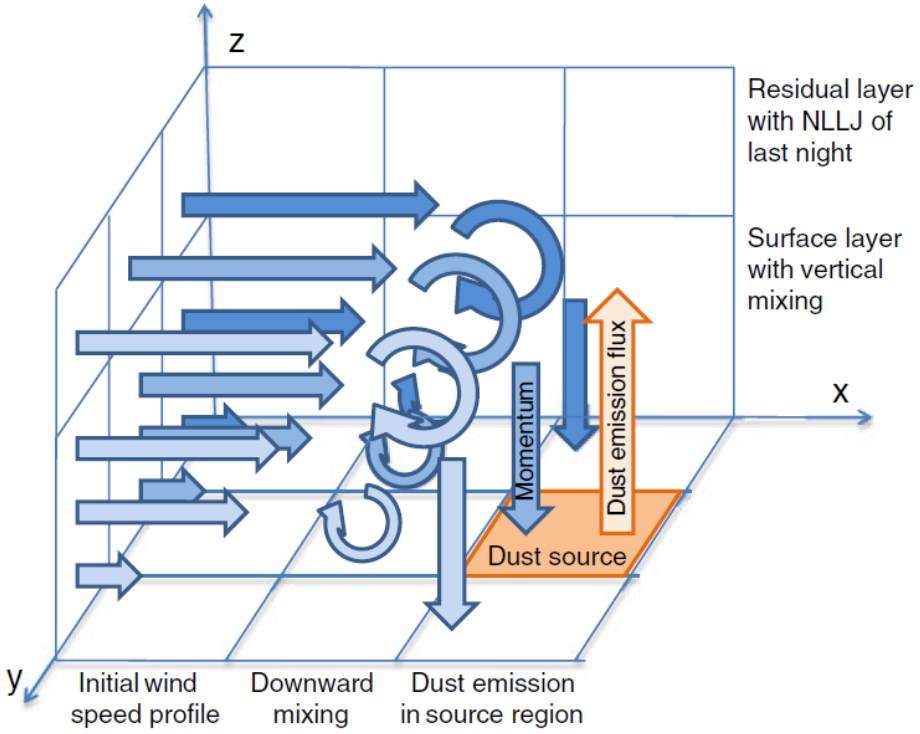


Figure 1 from Fiedler et al, JGR 2013

Main source mechanisms

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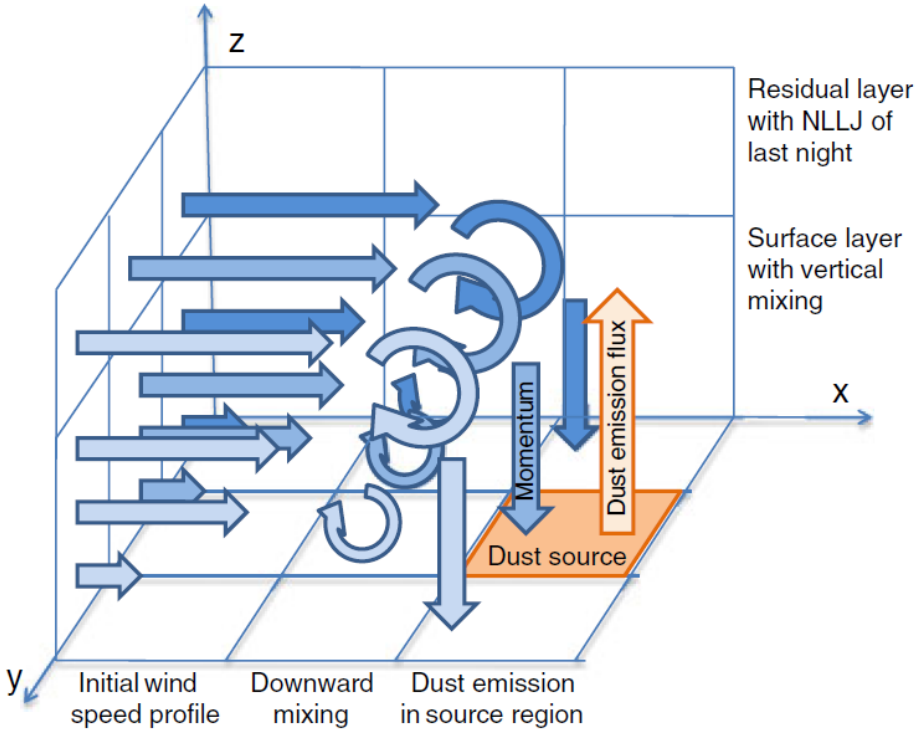


Figure 1 from Fiedler et al, JGR 2013

Convective mechanisms: Mostly afternoon & evening

Cold pools outflow - haboobs (moist convection)

Khartoum, Sudan, 2007
Photograph P.Currion on Flickr

Main source mechanisms

Nocturnal Low Level Jet: Breakdown at sunrise

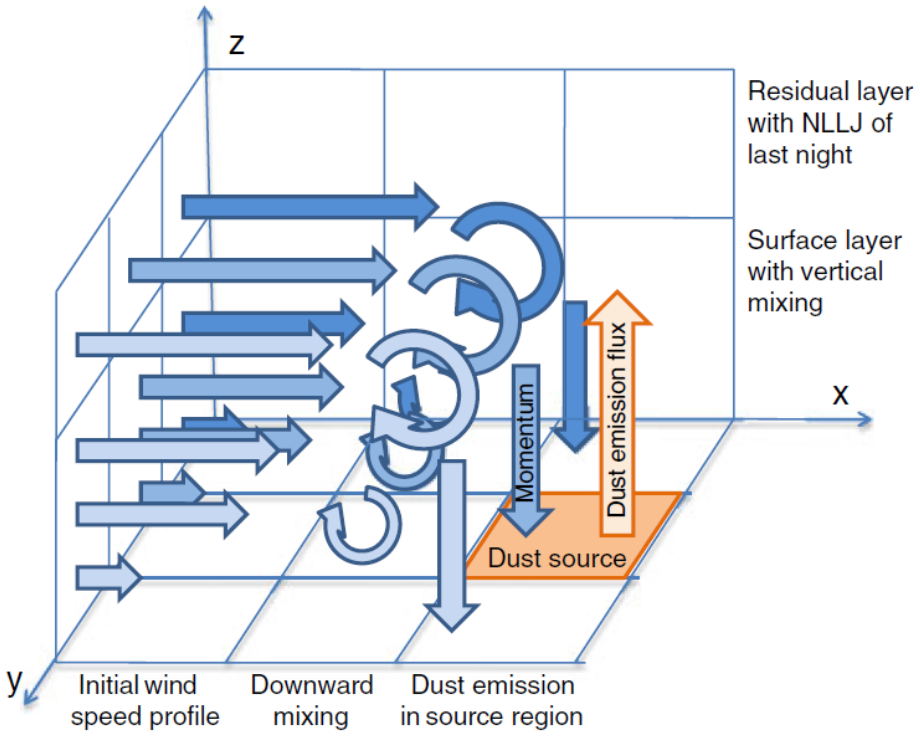


Figure 1 from Fiedler et al, JGR 2013

Convective mechanisms: Mostly afternoon & evening

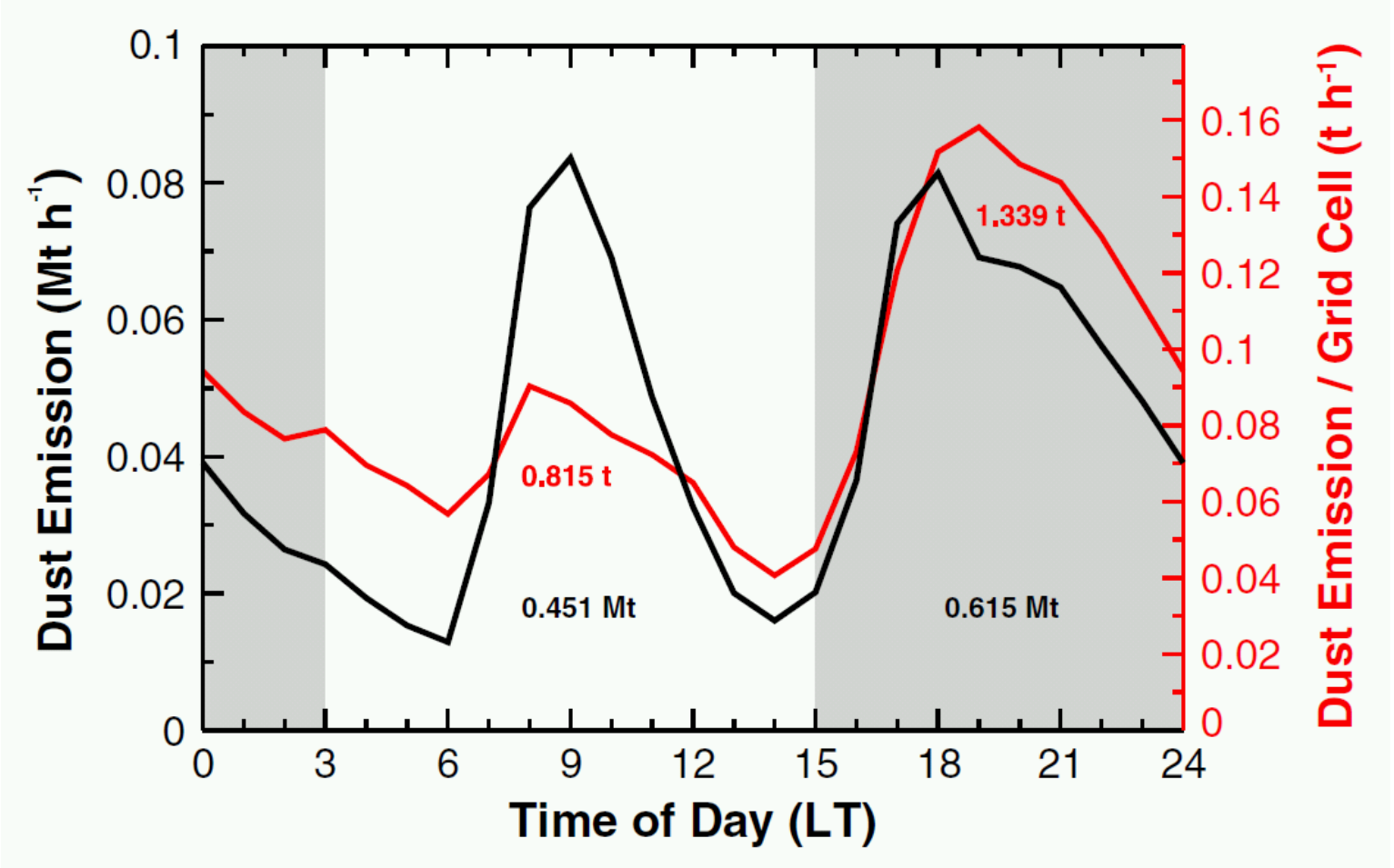
Dry convection
(dust devils…)

Auscape / UIG/
Universal Images Group/Getty Images

Daily cycle

Fig. 3 from **Heinold et al, JGR 2013**

- Model: DES S07 (dust emission scheme)
- 26 Jul -> 2 Sept 2006



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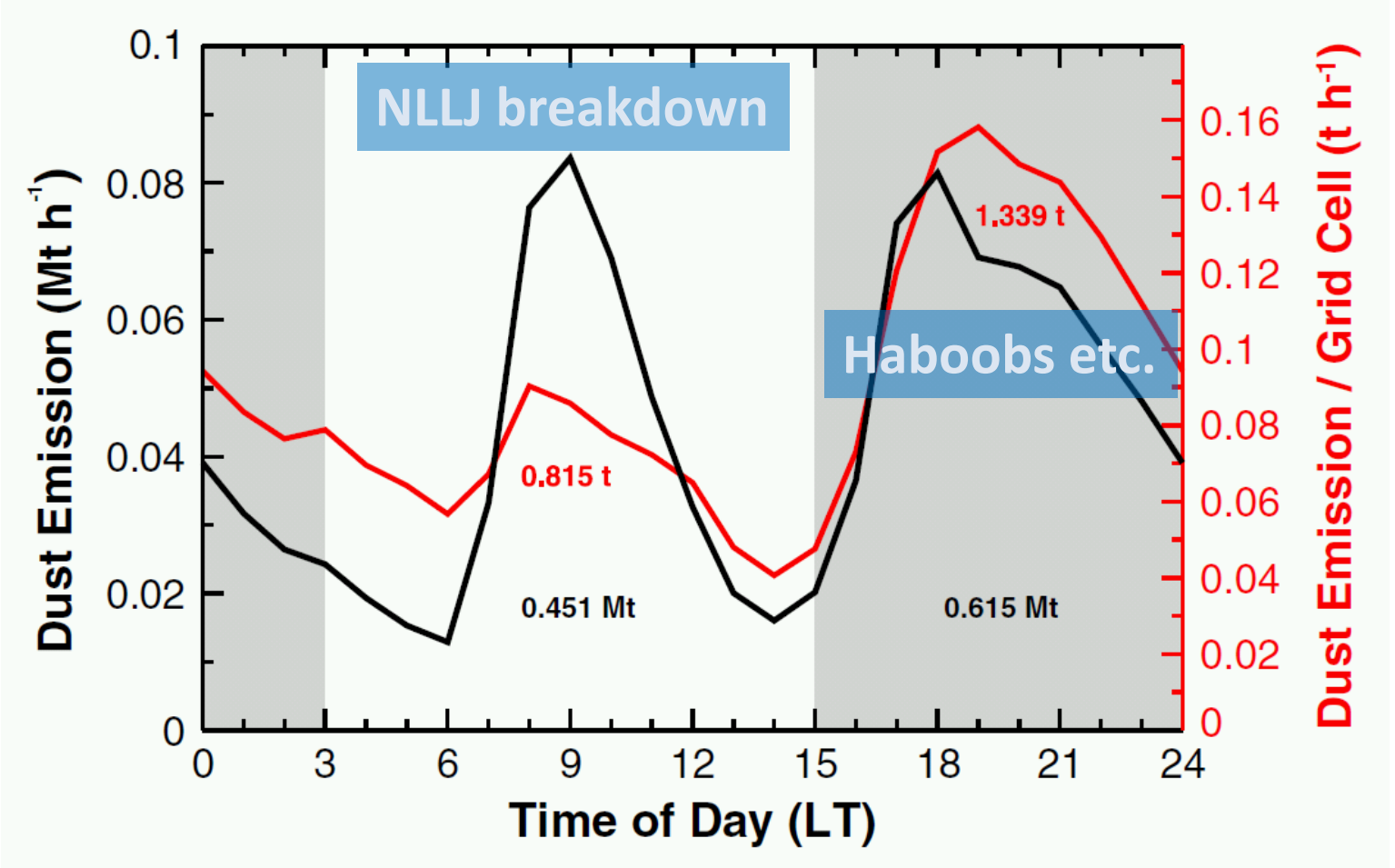

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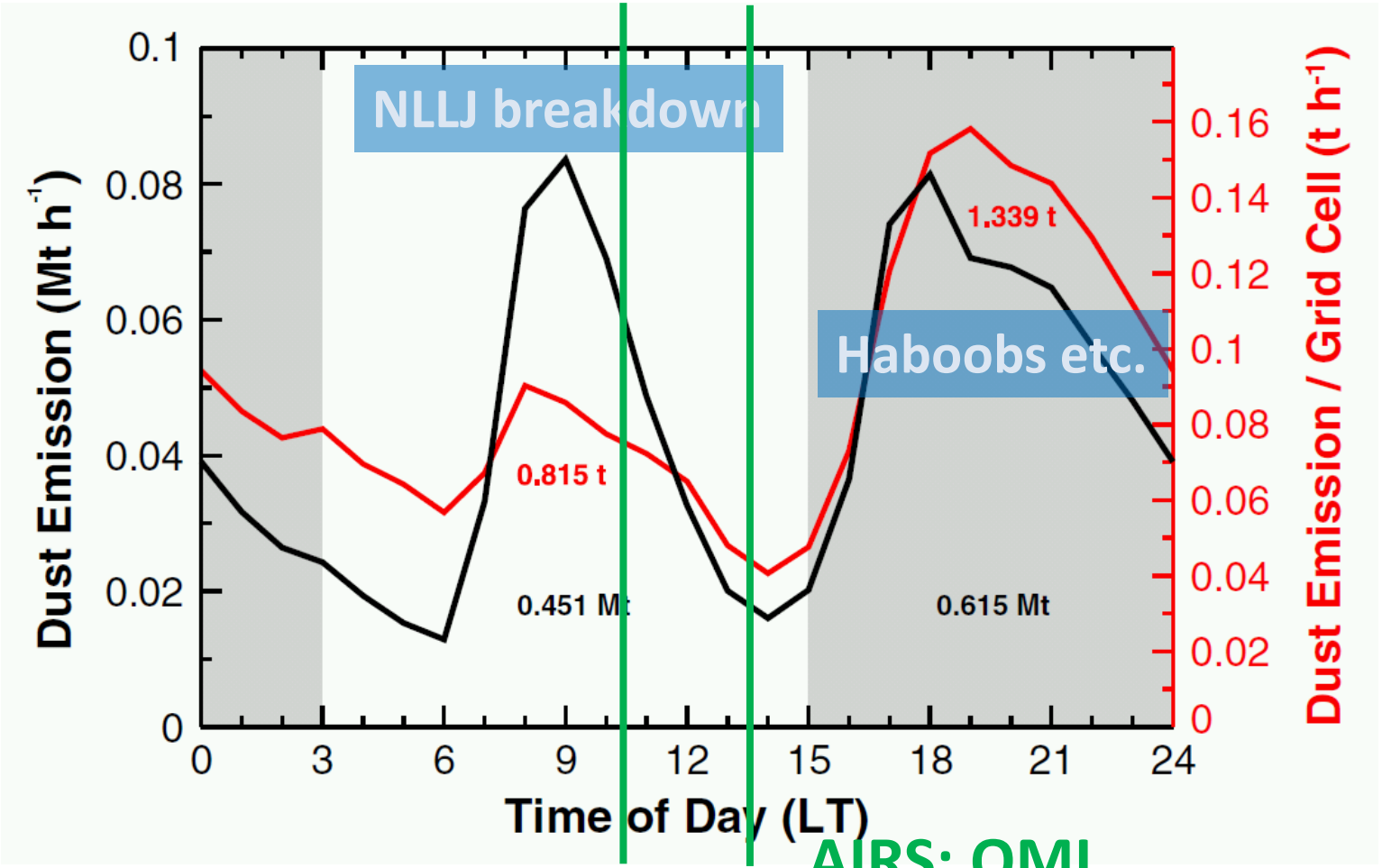

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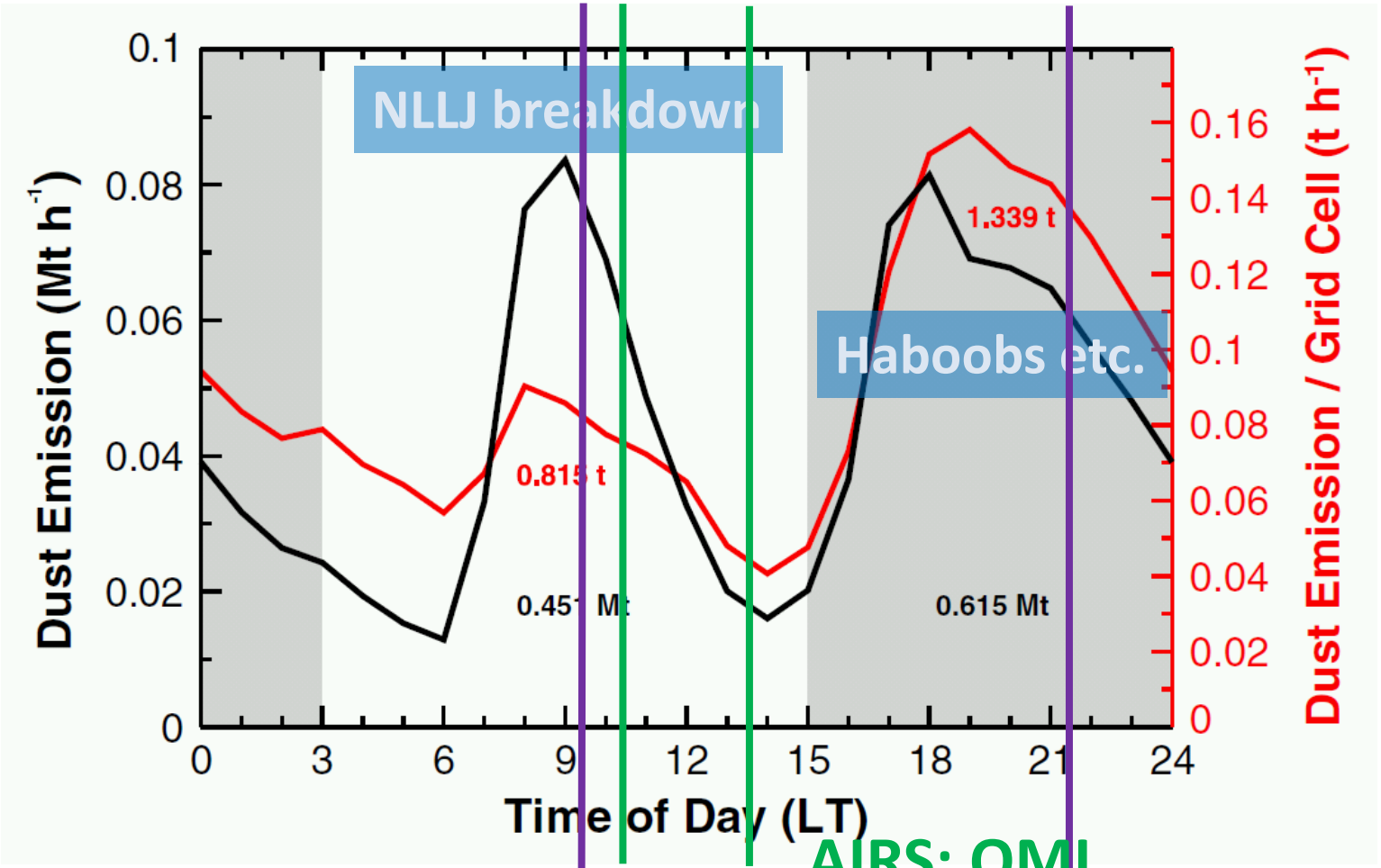


Objectives

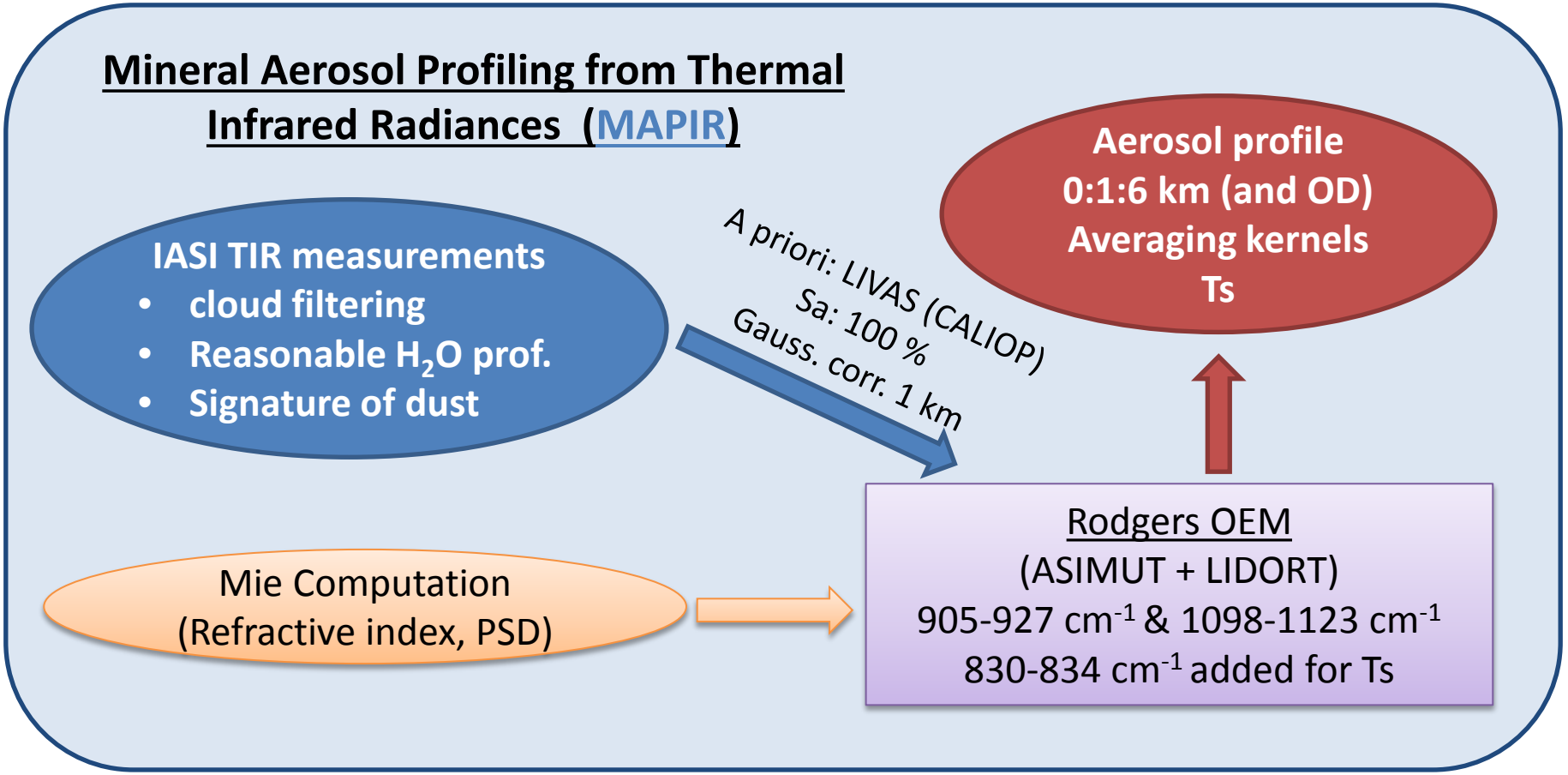
- Provide dust vertical profiles

  -> better separate source and transport

- Provide data when the « usual » sensors can't measure…

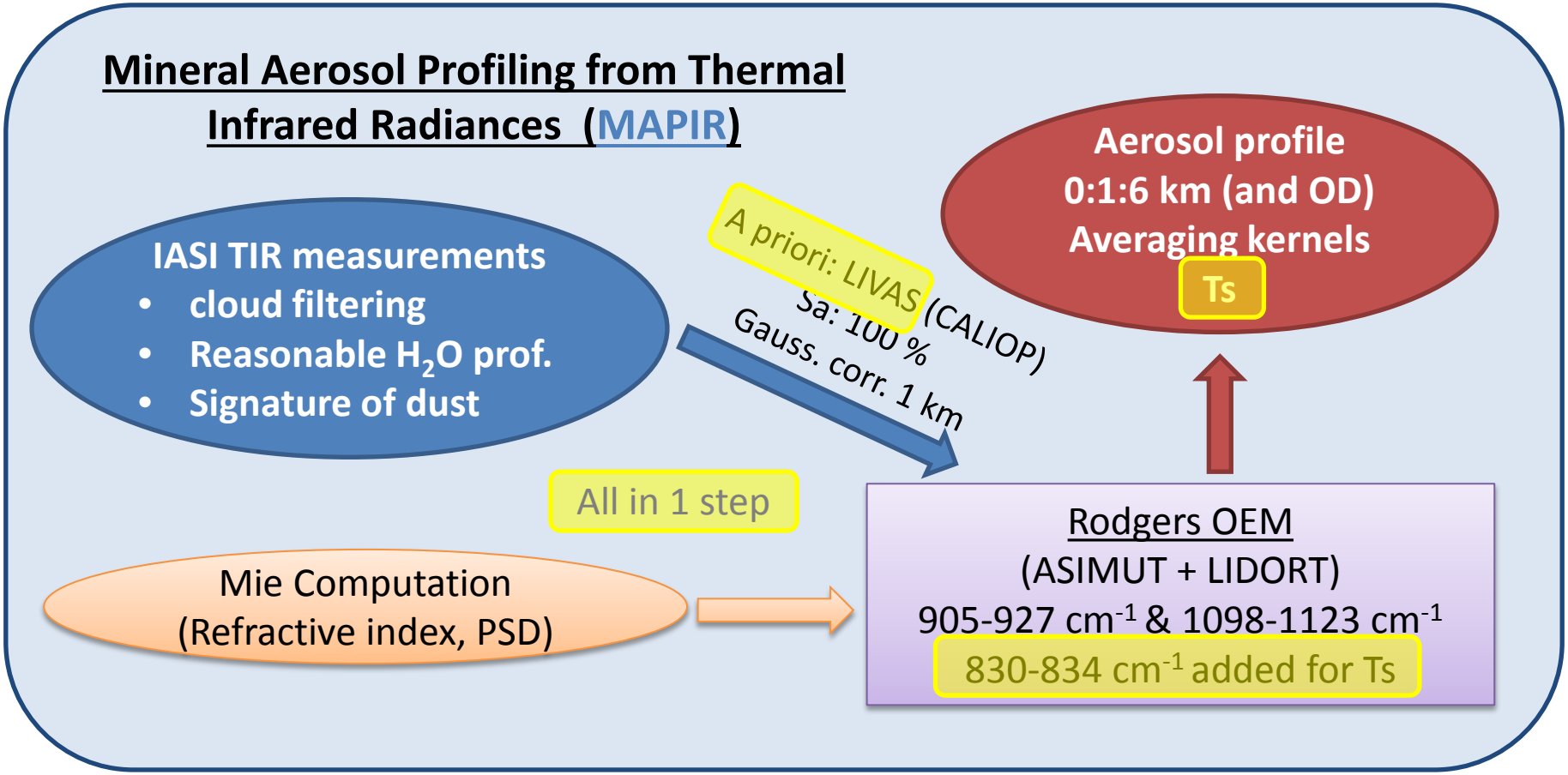
-> Improve the appreciation of dust sources, the knowledge of the diurnal cycle, …

Retrieval strategy



LIVAS: Amiridis et al, ACP 2013 (improved version)

Retrieval strategy



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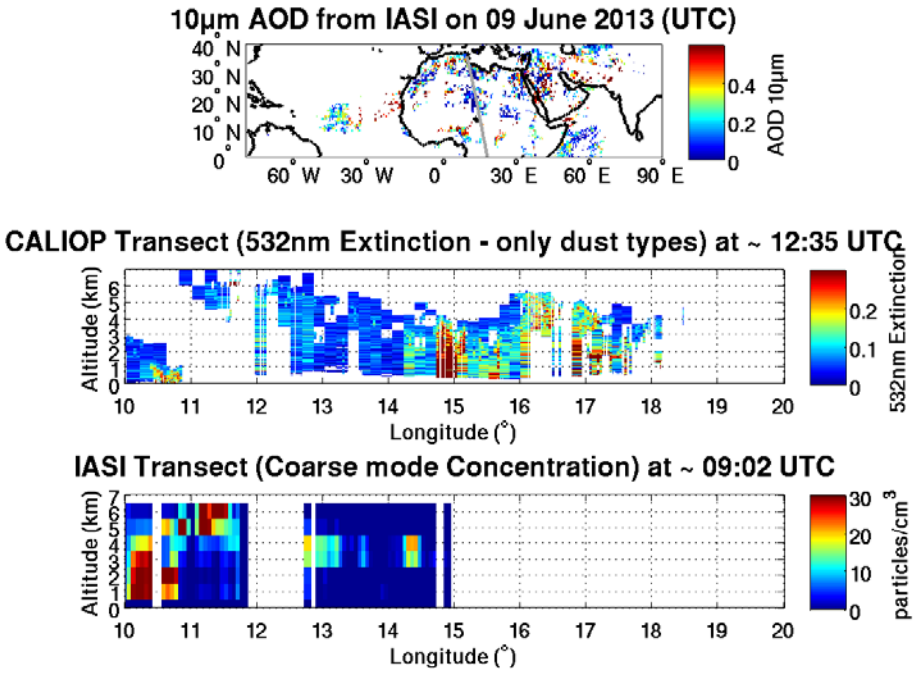
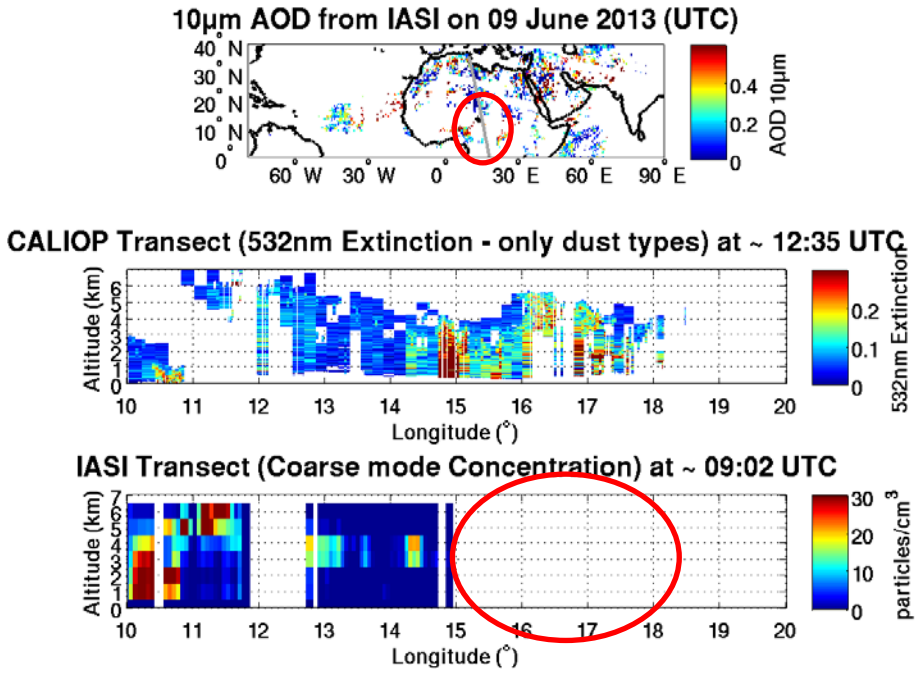
Some CALIOP comparisons



- Quite a nice match both geographically and vertically…

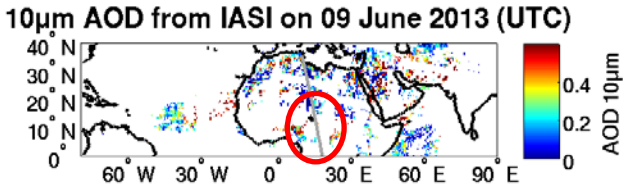
Some CALIOP comparisons



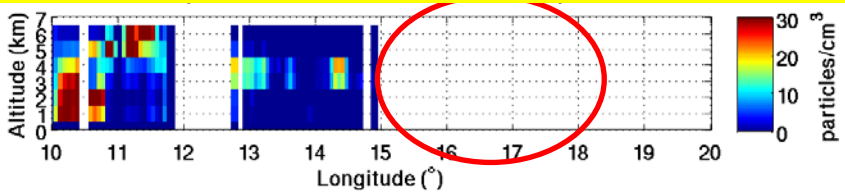
IASI l2 cloud fraction>100% -> ??

- Quite a nice match both geographically and vertically…
- We miss some of the dusty spots… for now…

Some CALIOP comparisons



Validation undergoing within the Aerosol CCI project
- OD in baseline
- vertical profiles in an option



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- Quite a nice match both geographically and vertically…
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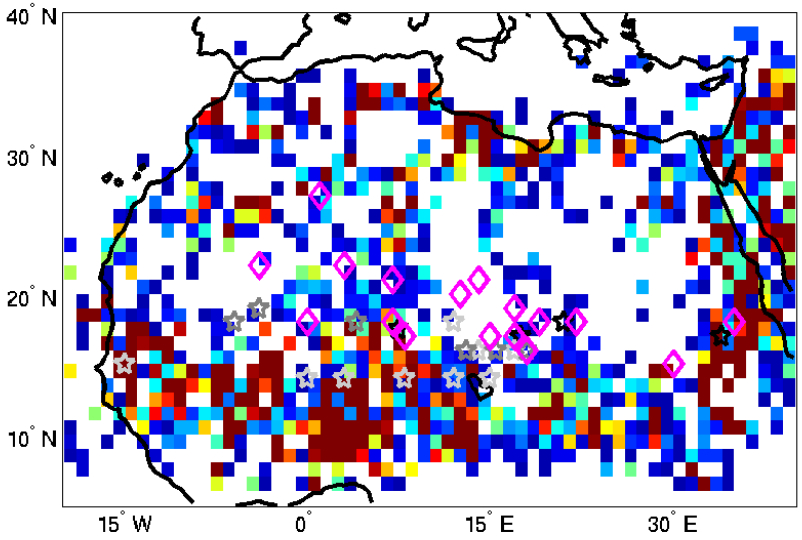
Sources: Methodology

- Year 2013
- Until now: One month in each season
- L3 gridded data
- Average number of dust detections with min OD of 0.2 in the lowest layer or in the total column
- Not showing any OD here!!
- Compare with literature

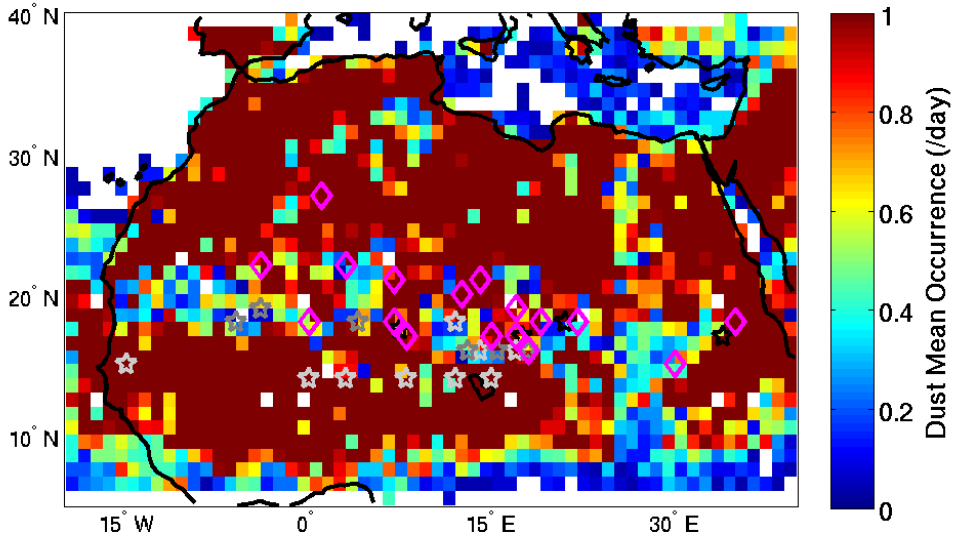
Yearly average

Day

Min OD of 0.2 in **surface layer**



Min OD of 0.2 in **total column**



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Yearly average

Day

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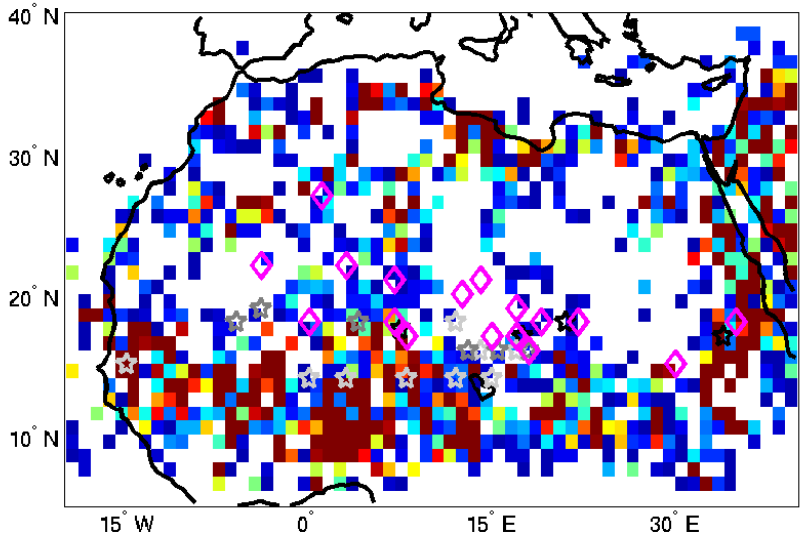

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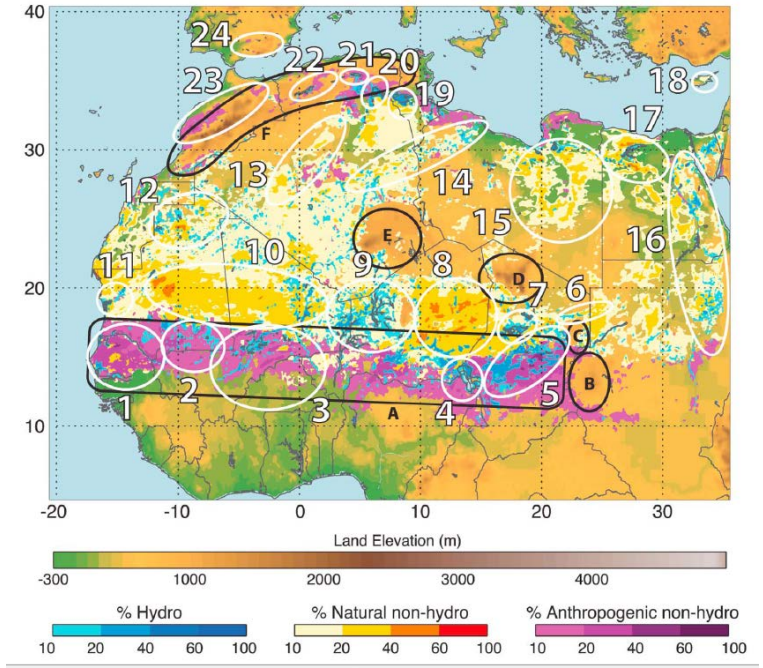
Fig 7 from Ginoux et al, RG 2012

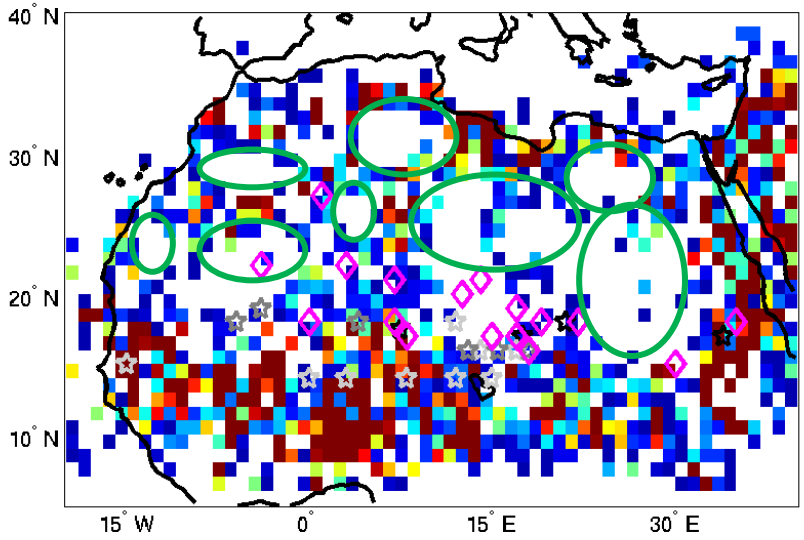


Source area highlighted in white
Data from MODIS DB OD >0.2

Yearly average

Day

Min OD of 0.2 in **surface layer**



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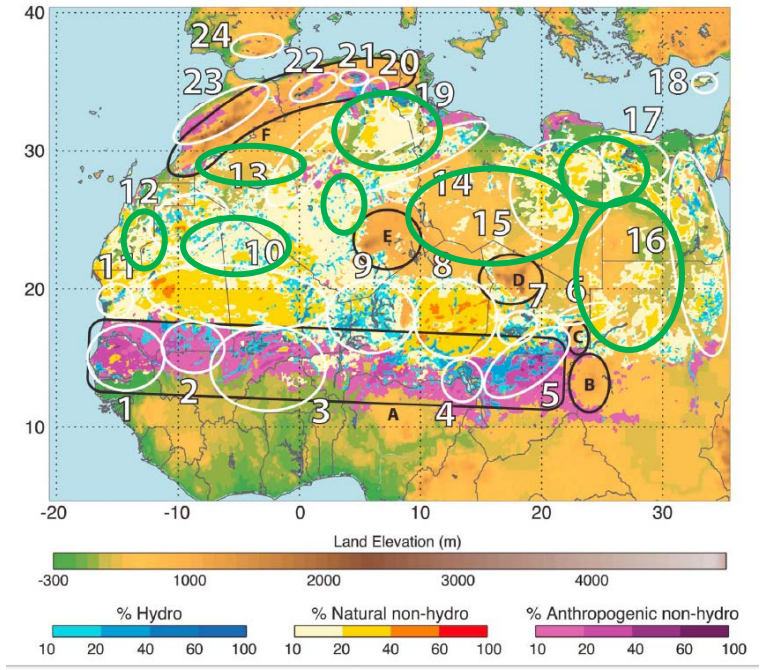

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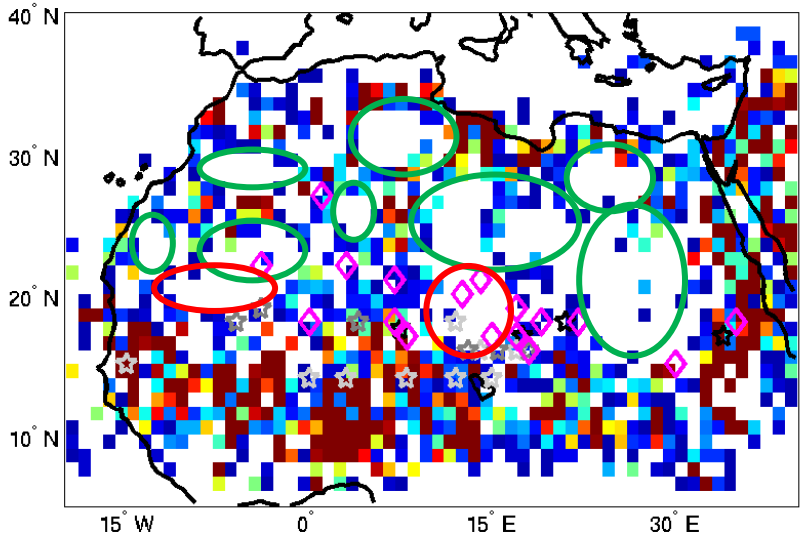

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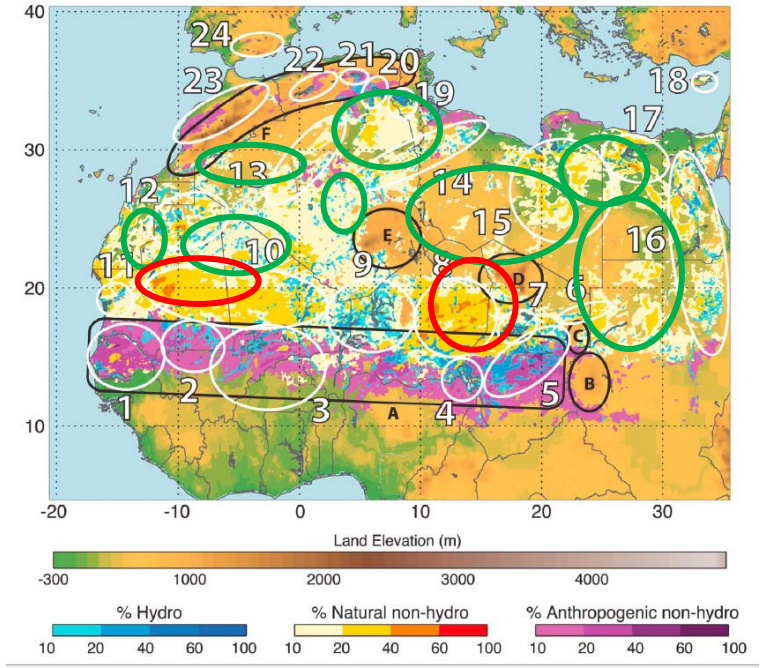

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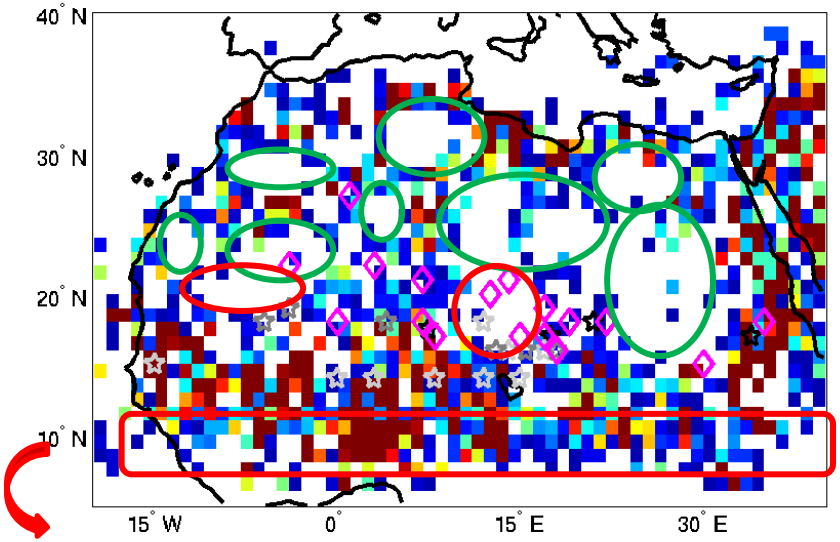

artefact? deposition? unknown sources?

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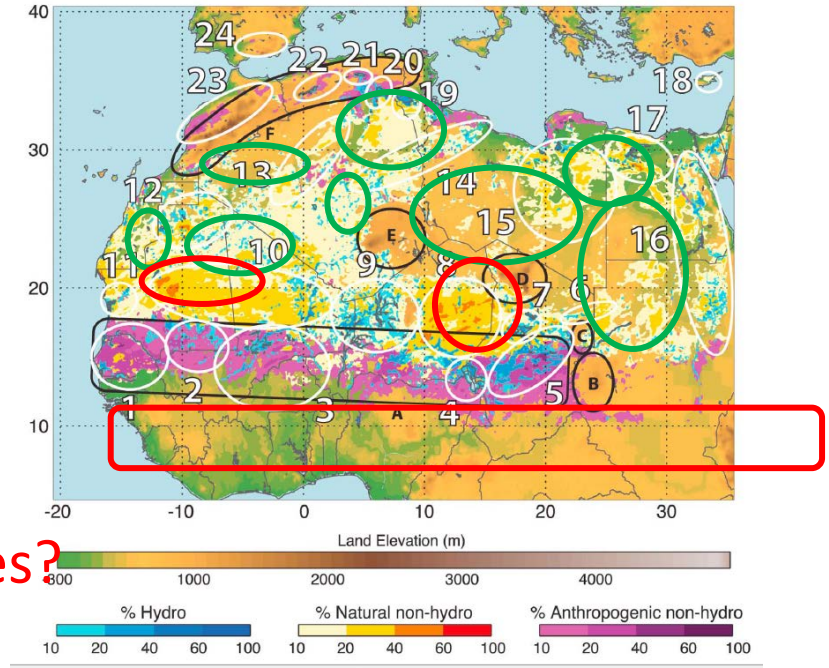
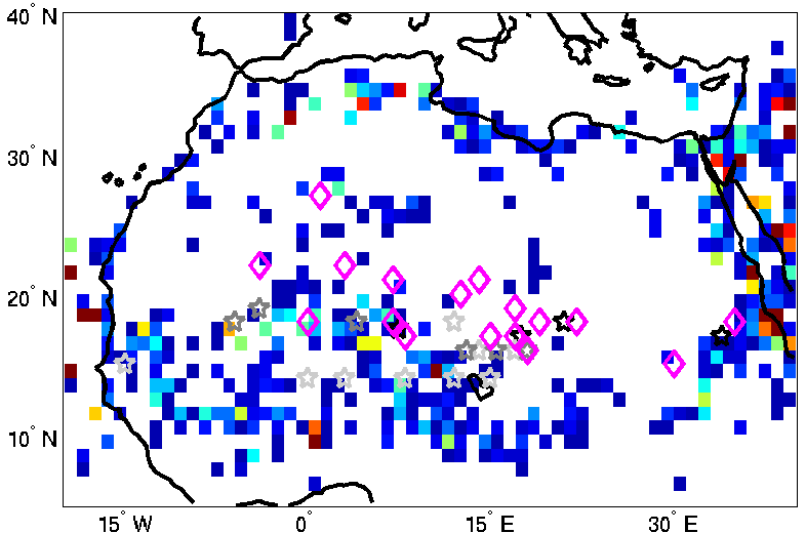


Source area highlighted in white
Data from MODIS DB OD >0.2

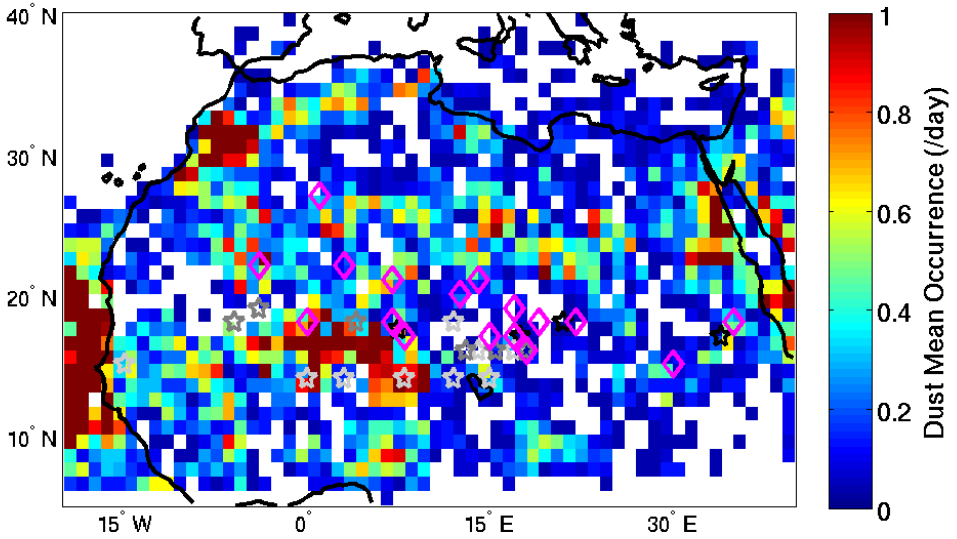
Yearly average

Night

Min OD of 0.2 in **surface layer**



Min OD of 0.2 in **total column**



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Monthly averages

Day

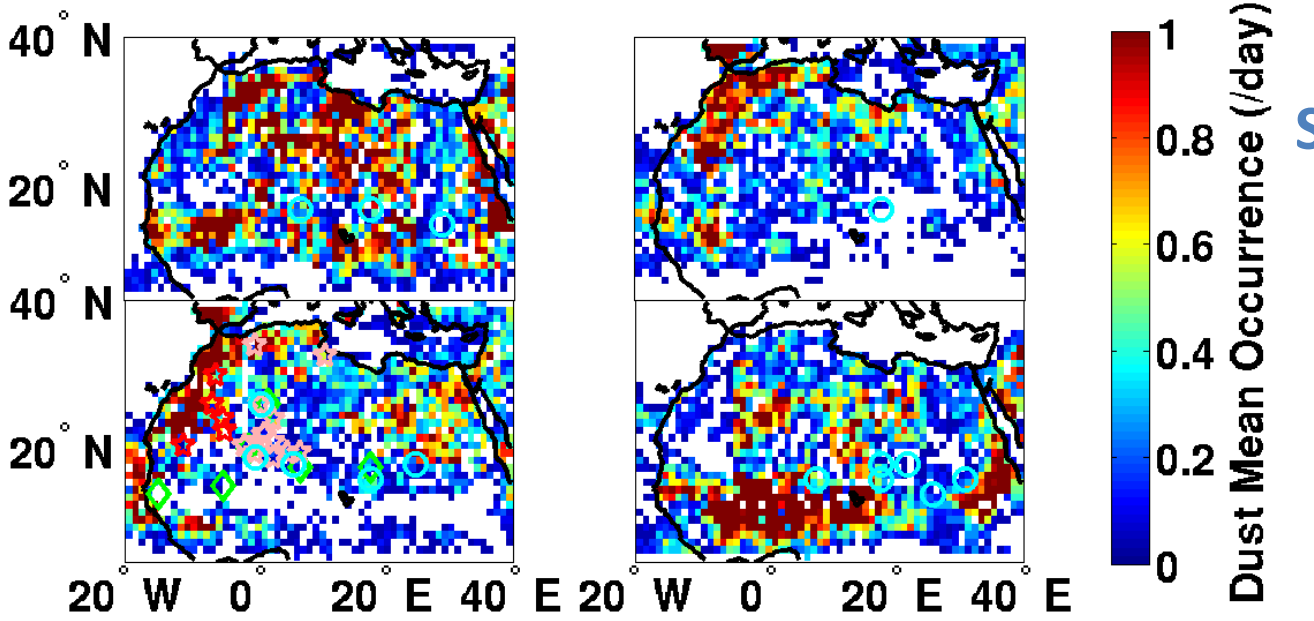
Min OD of 0.2 in **total column**

March

June

September

December



◇ Kocha et al, GRL 2013 - data from MODIS DB Aqua and Terra 06 2006

☆ Ashpole et al, JGR 2013 - NW Africa, data from SEVIRI 06-08 2004-2010; mainly NLLJs

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Monthly averages

Day

Min OD of 0.2 in **total column**

Atlas Mountains ???

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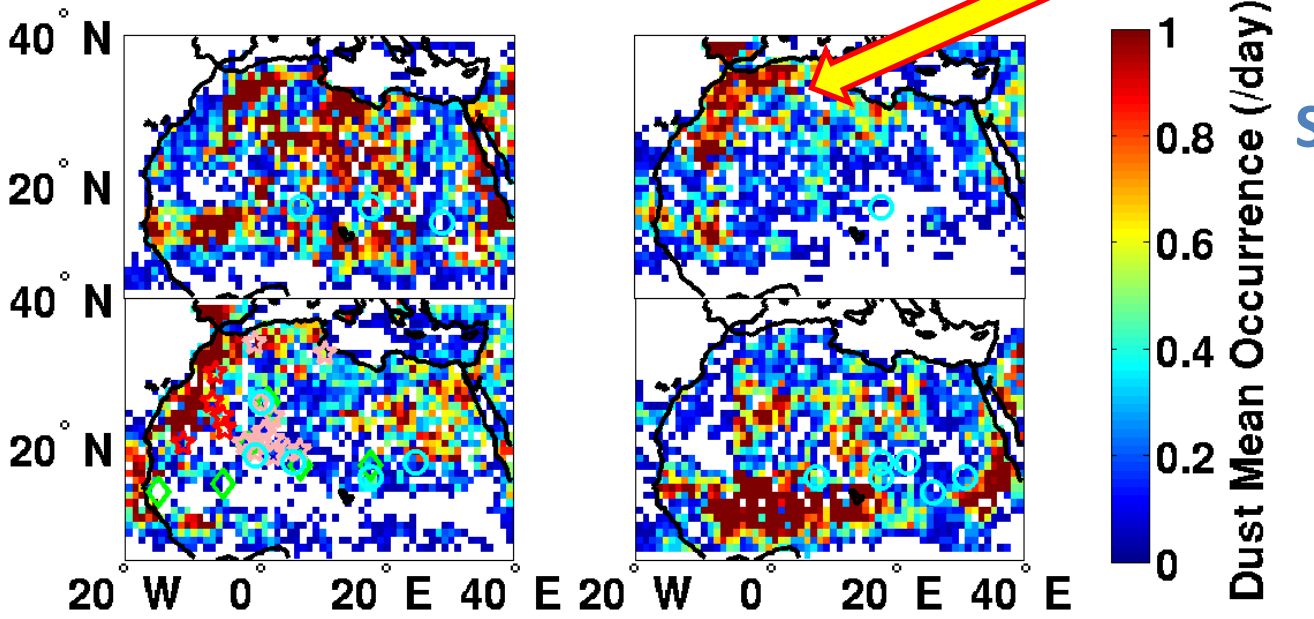
June

September

December



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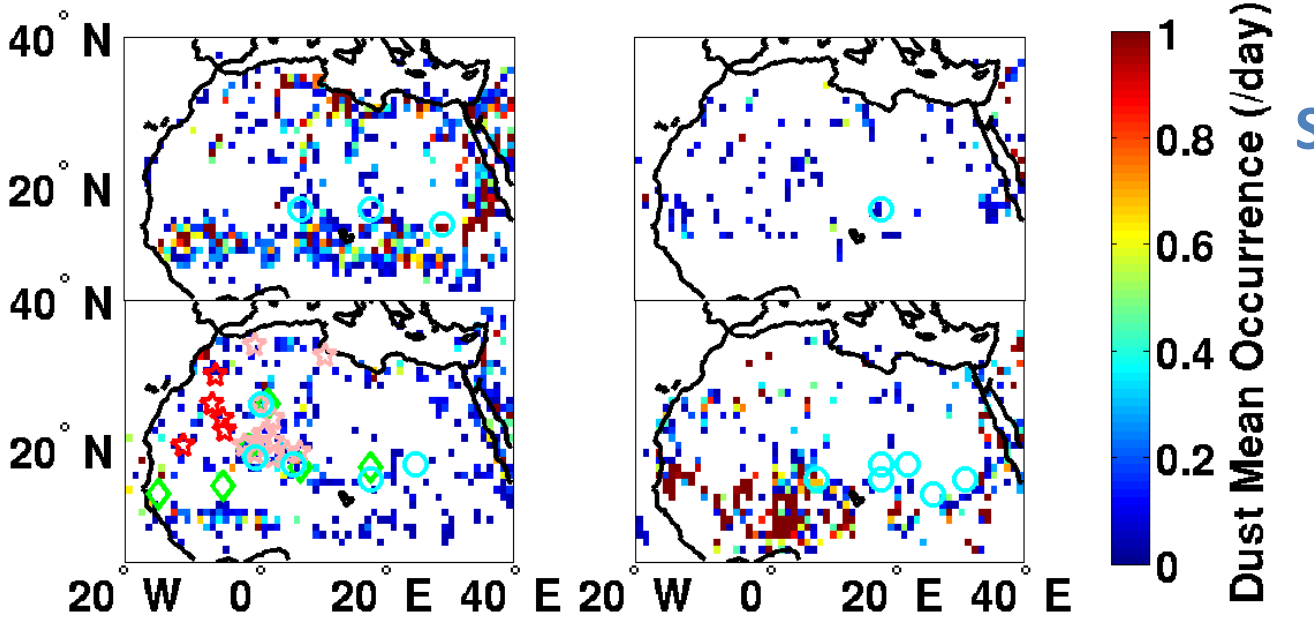

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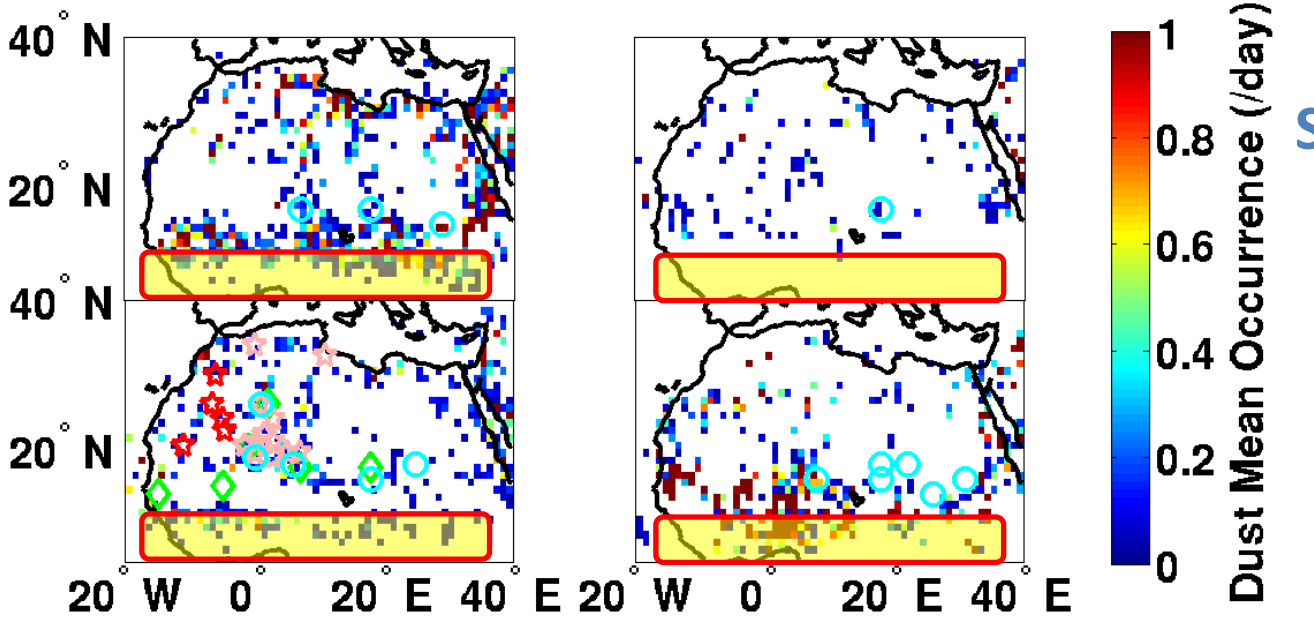

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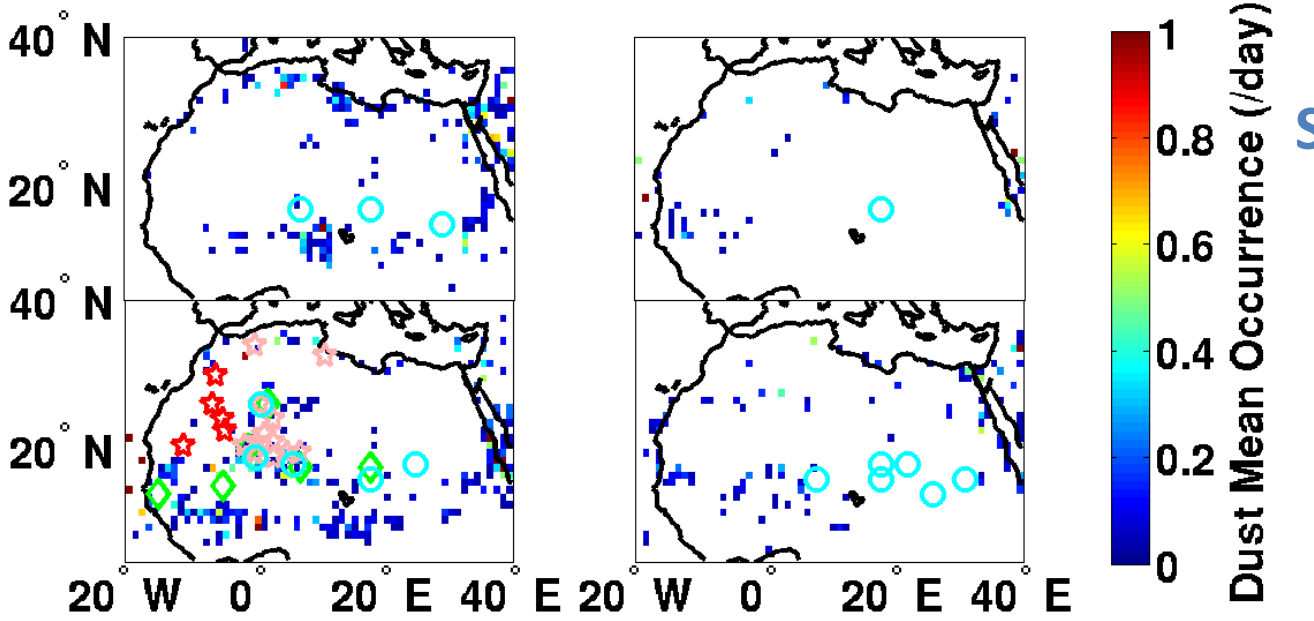

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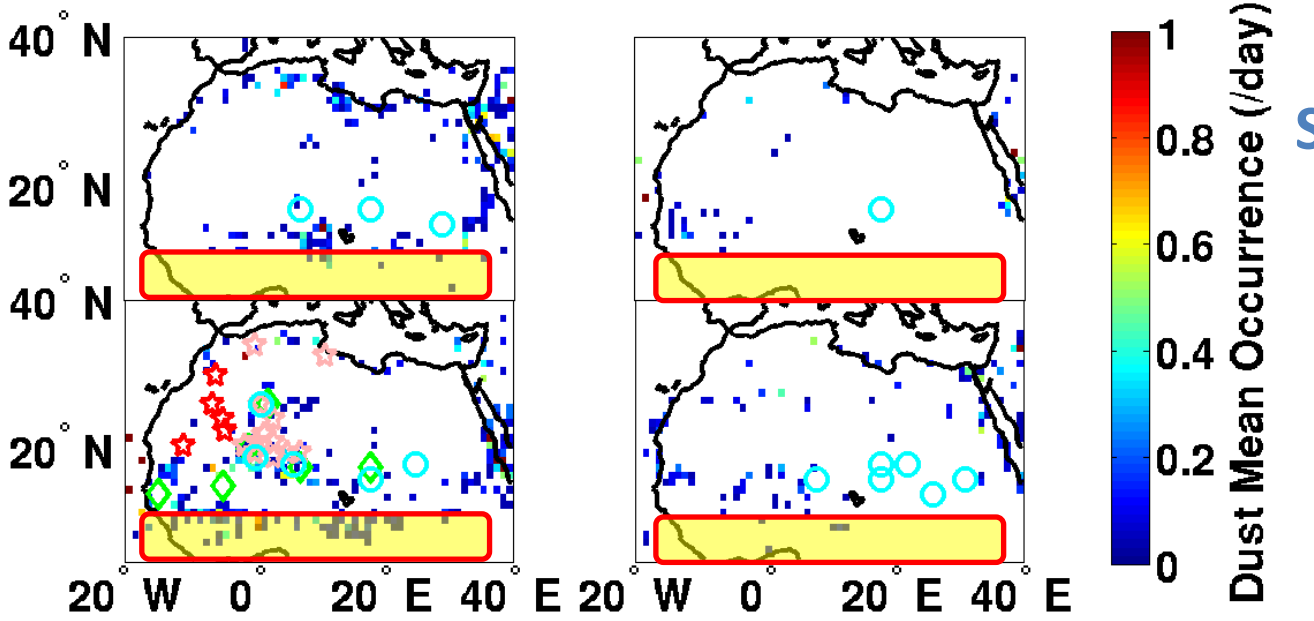

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Wrap up…

- Vertical profiles of desert dust are succesfully retrieved from IASI TIR measurements
- New way to look at sources: surface dust detection vs total column
- Day and night
- Detected source area mainly match the dust source area mentioned in literature
- One « new » source area: sub-sahel winter/spring daytime???

Some issues…

- « Missing data » because of the strange cloud mask in some cases (being resolved!)
- Relies on a lot of « a priori » knowledge of the atmospheric and surface state, and on dust
- Some underestimation at night?

… and great perspectives!

- Soon: 10 years of IASI data will be processed!
- Future is already « ensured »… ☺

- Transport and deposition may also be studied using this dataset

Thank you!!!

CCI_Aerosols