# Estimate of dust emissions in the intertropical discontinuity region of the West African Monsoon


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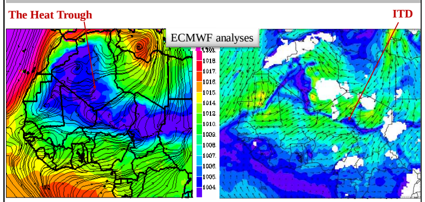
## Characteristics of the ITD

- ✓ Embedded in a region of low pressure (i.e. The Heat Trough),
- ✓ Strong convergence,
- ✓ Very weak wind speeds,
- ✓ Strong horizontal shear between the harmattan and the monsoon flow,
- ✓ Well marked diurnal cycle (latitudinal variation of 100-200 km/day).

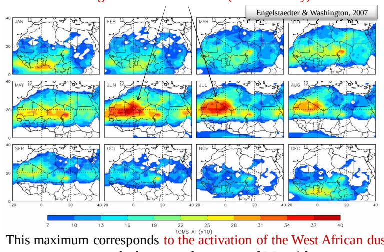



Mean Sea Level Pressure (hPa) Wind speed and direction at 925 hPa

## Dust activity over North and West Africa

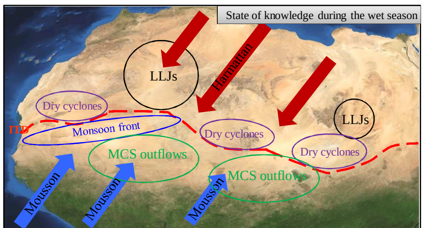
### Annual cycle of dust emission

The maximum in dust emissions over North and West Africa is observed during the monsoon season (June and July).




This maximum corresponds to the activation of the West African dust sources which cover a large area of West Africa.

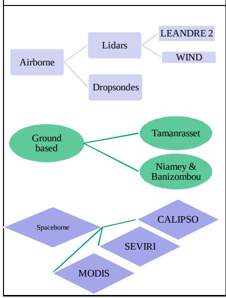
### Mechanisms involved in dust emission




- ✓ Dust emission associated with the LLJs (Todd et al. 2008; Knippertz, 2008),
- ✓ Dust emission associated with the monsoon leading edge (Bou Karam et al. 2008; 2009b),
- ✓ Dust emission associated with the MCS outflows (Flamant et al., 2007; Marsham et al., 2008),
- ✓ Dust emission associated with dry cyclones in the ITD (Bou Karam et al., 2009a).

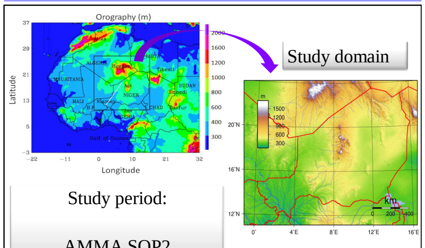
## Dust emission and transport in the ITD: Synergy between observations & mesoscale modelling

### Data sources

| Observations | Analysis | Mesoscale modelling |
| --- | --- | --- |
|  | ECMWF | MesoNH (Lafore et al., 1998) + Dust scheme (Tulet et al., 2005) (Grini et al., 2006) |



### Study period & domain

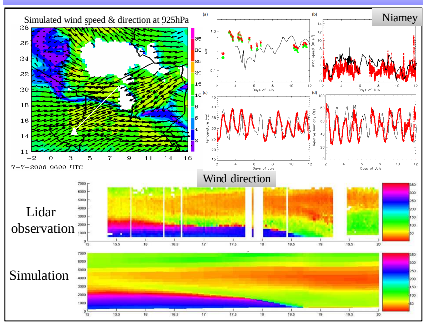



Study period:

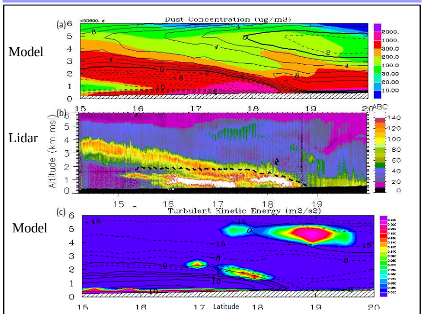
AMMA SOP2

➔ 2-13 Juillet 2006

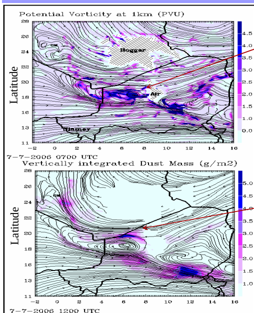
### Model Validation




### Dust emission at the leading edge




### Dust emission associated with vortices




Cyclone characterized by:

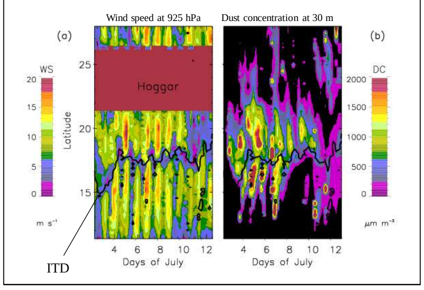
- ✓ Potential Vorticity: 4.5 PVU
- ✓ Diameter = ~400km
- ✓ Lifespan = 6 hours
- ✓ Quite stationary.

Dust emission by cyclonic winds:

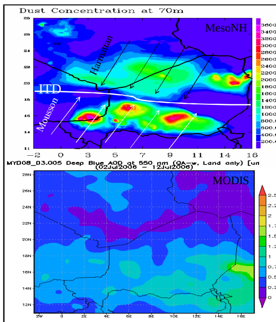
- ✓ Dust flux < 3 μg/m²/s
- ✓ Dust Mass < 4.5 g/m²

### Diurnal cycle of dust emission in the ITD

Hovmoller diagram at 6°E over 12-28°N




### Estimate of dust loads

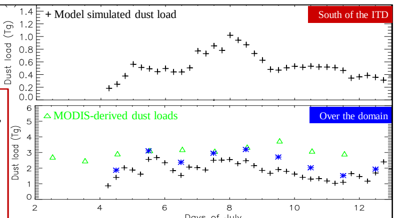



Koren et al., (2006); Todd et al., (2007)

⇩

Dust load (Tg) = 1.9 (g/m²) x AOD x S (m²)

S= Surface of the domain of interest.




| Dust load (Tg) | MODIS-derived AODs | MesoNH |
| --- | --- | --- |
| Over the domain | 3 Tg | 2.5 Tg |
| South of the ITD | 1.5 Tg | 0.7 Tg |

## Discussion & Conclusions

➢ The daily mean dust load related to strong surface winds on both side of the ITD is estimated to be in the order of **3 Tg** over the study domain.

➢ The daily mean dust load associated with strong surface winds south of the ITD is evaluated to **0.7 Tg.**

➢ Dust emissions driven by strong surface winds occuring on both side of the ITD while lying across the Sahel may contribute significantly to the total dust load observed annually over West and North Africa.

**Contribution of the different mechanisms**

| | LLJs (Bodélé) Todd et al., *2007; 2008* | MCS outflows Bou Karam et al., *in preparation* | ITD dry cyclone Bou Karam et al., *2009a* | Leading edge of the monsoon Bou Karam et al., *2009b* |
| --- | --- | --- | --- | --- |
| **Daily mean dust load (Tg)** | 0.7 | 1.5 | 0.4 | 0.7 |

## Related References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