Impacts of the dust on the West African synoptic components and rainfall in summertime

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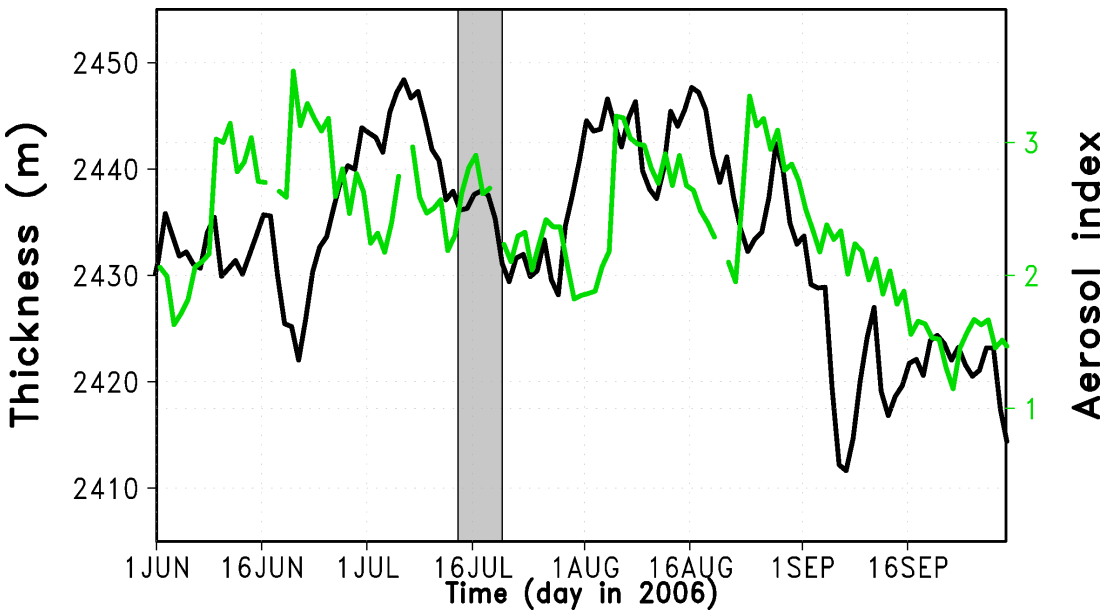
4^{th} AMMA international conference - Toulouse - July 5^{th}, 2012

Objectif of this study

understand the impacts of the dust on the WAM

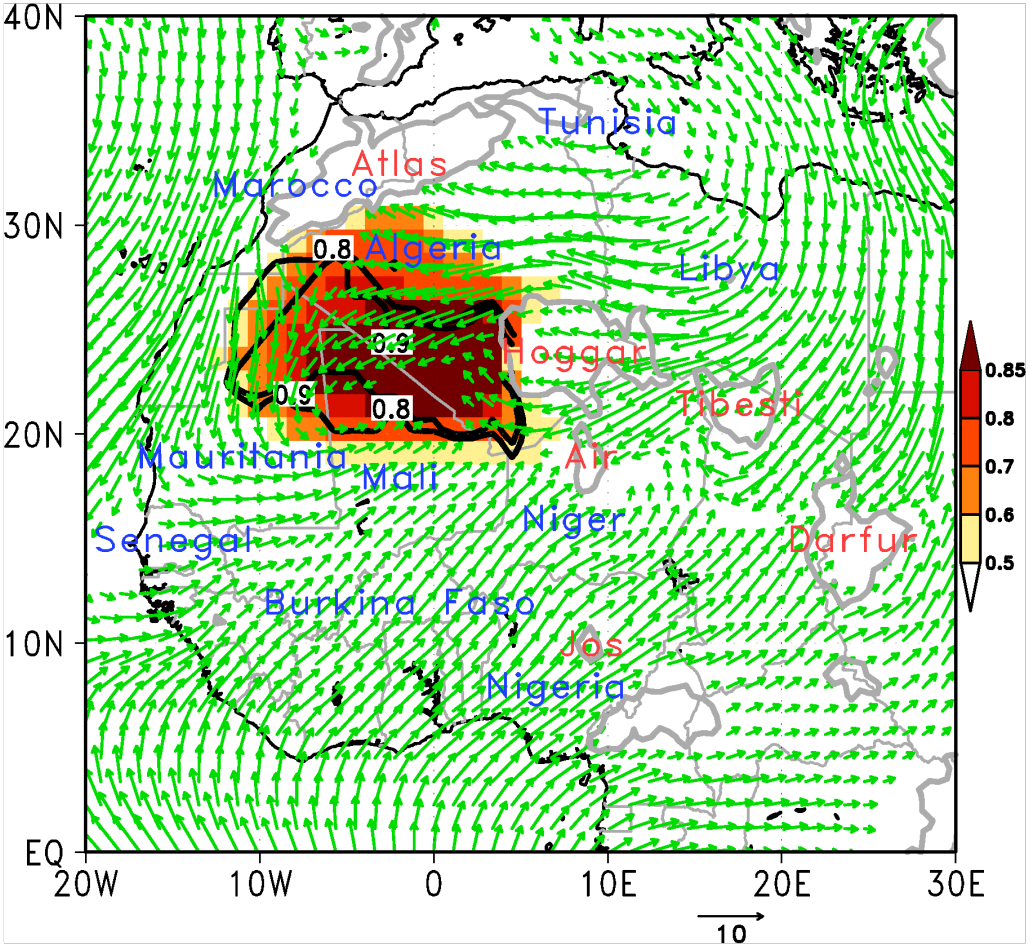
1. identify a specific event
   - strong intra seasonal pulsation of the monsoon
   - dust event (outbreak and transportation)
2. validate the regional model with observation/analysis
3. analyse the impact of the dust using different configuration of the Meso-NH model

Case study in July 2006 : The Heat Low



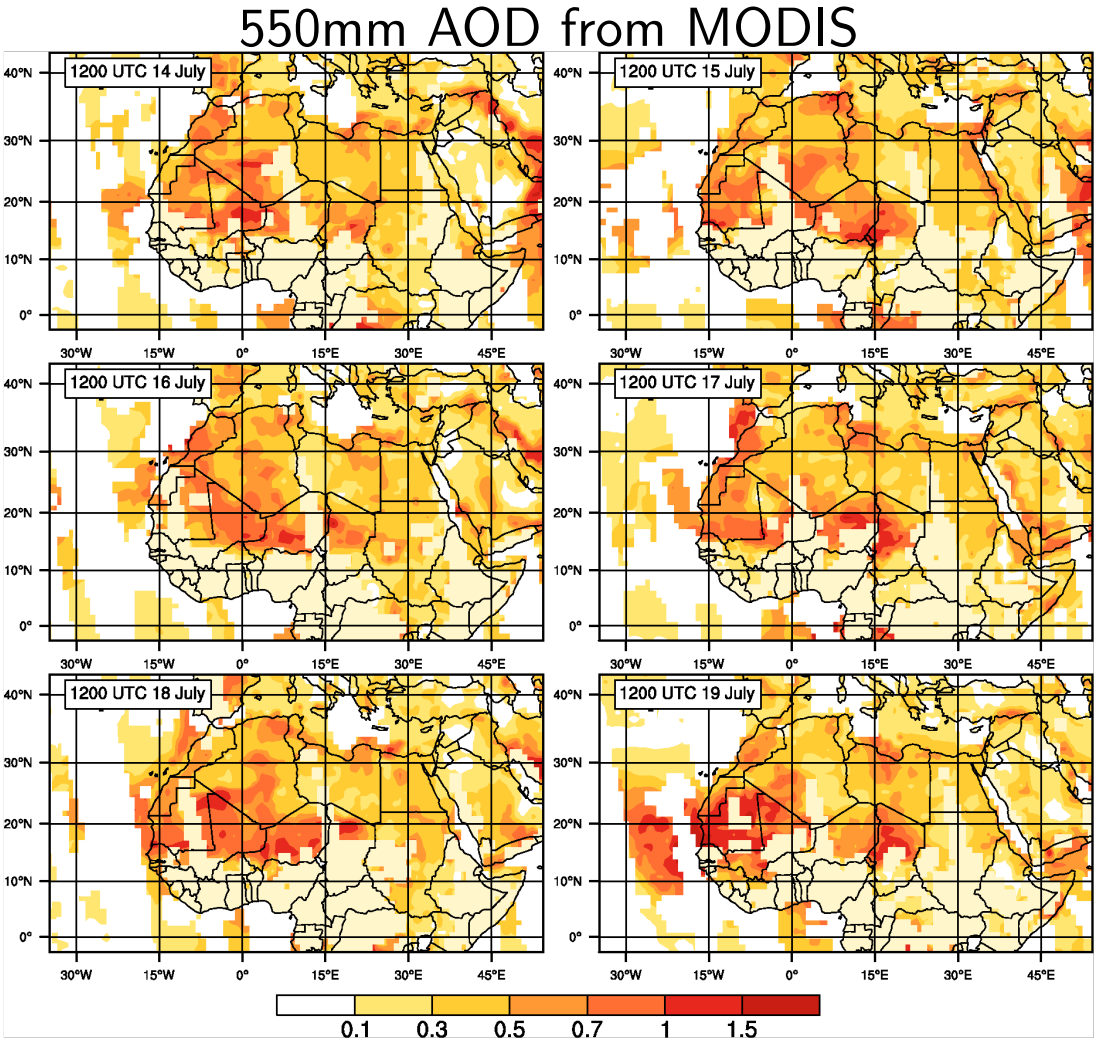
- Increase of the HL intensity then rapid decrease
- Short time variability of the dust load in the WAHL region

Case study in July 2006 : The Heat Low



- from 14 to 19 July
- established monsoon phase
- HL location very stable in latitude, slightly westward displacement

Case study in July 2006 : Dust event



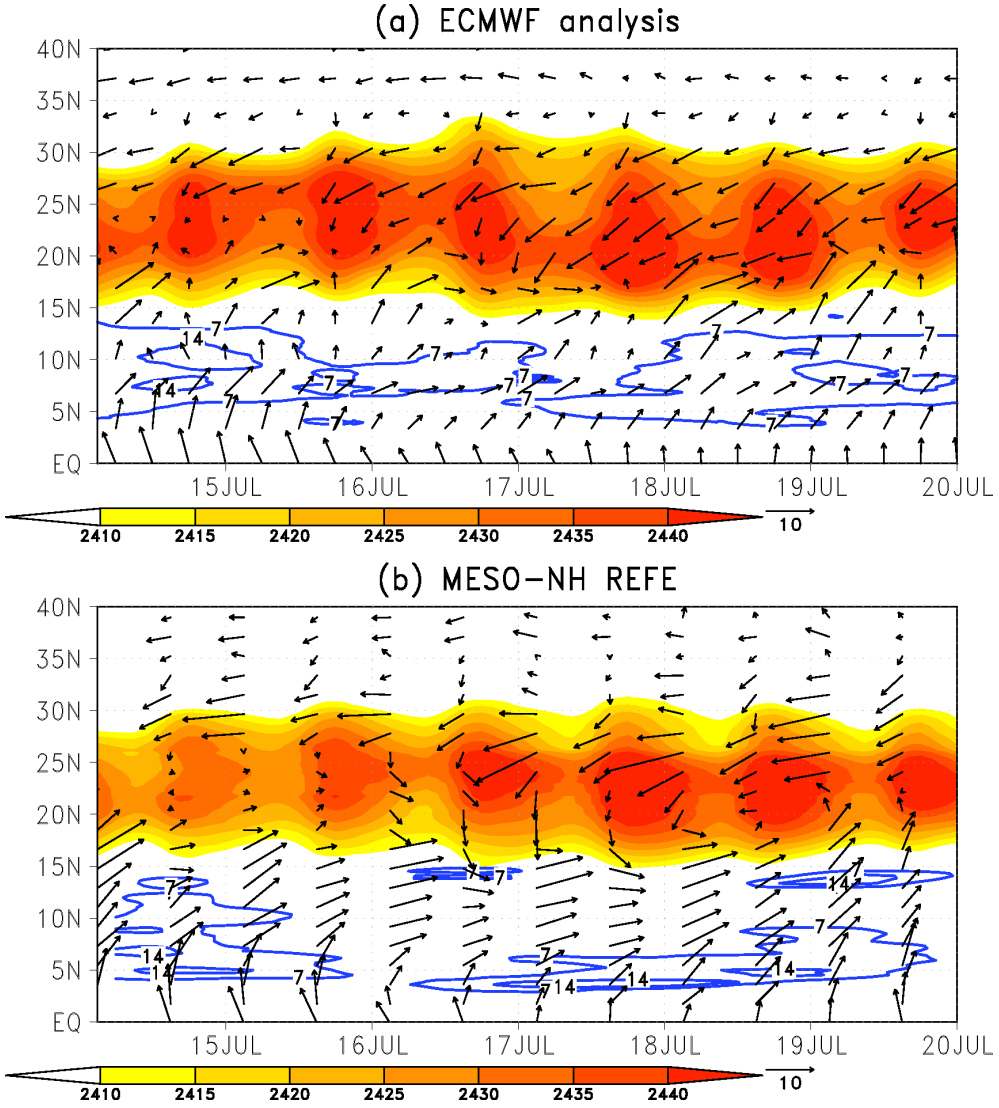
- First dust plume located north to 20degN
- Second event more to the south (from 16 July)
- Westward displacement

Experimental set up

- case study during 6 days (from 14 to 19 July 2006)
- Regional model **Meso-NH** driven by ECMWF operational analysis
  - 3 different configurations of dust scheme
    * REFE $\longrightarrow$ no dust
    * CLIM $\longrightarrow$ climatology of the dust distribution
      Tegen et al. (1997)
    * DUST $\longrightarrow$ prognostic dust plume
      Grini et al. (2006)

Regional simulation of the monsoon circulation

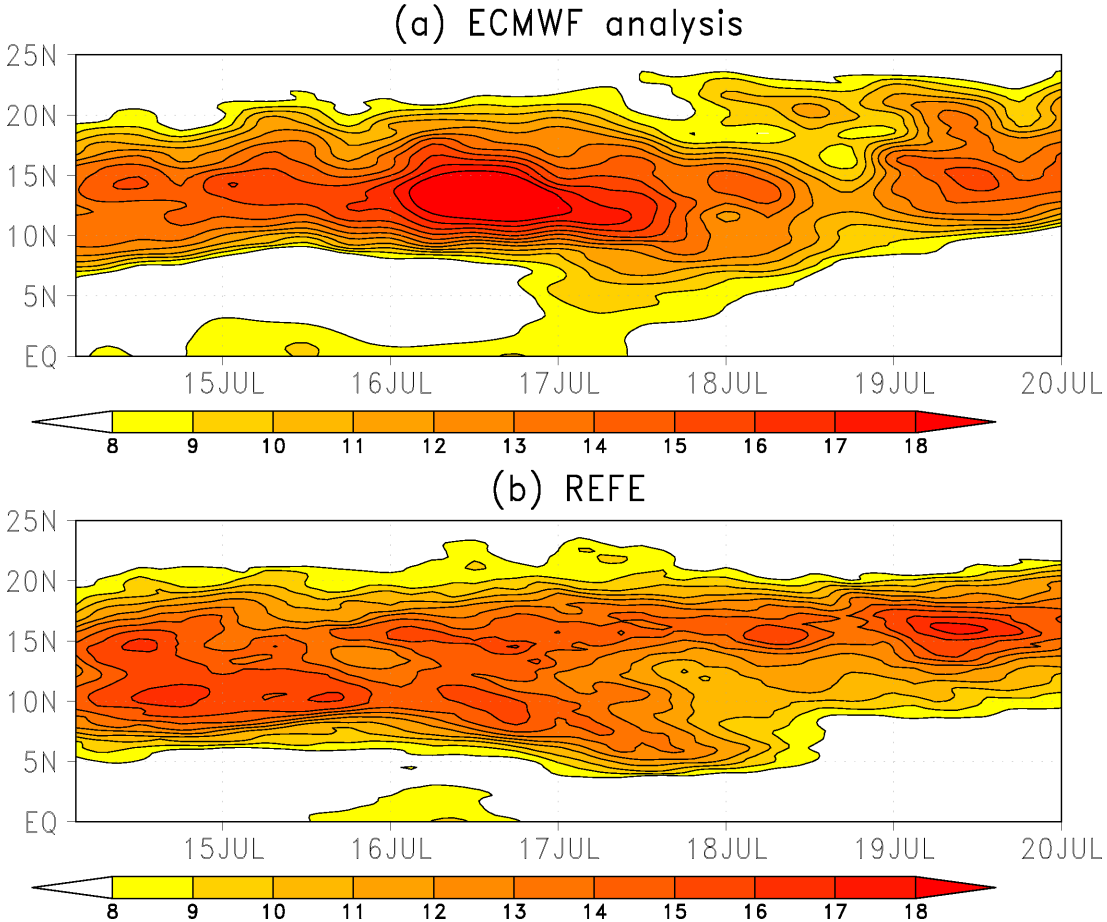
REFE experiment vs. operational analysis
Heat low, 925hPa wind speed and precipitation(EPSAT-SG or model)



- HL : consistent location but cold biais (10m shallower)
- Monsoon flow : strong eastward component of the wind (insufficent vertical mixing)

Regional simulation of the monsoon circulation

REFE experiment vs. operational analysis
African Easterly Jet (intensity of the 600 hPa wind speed)



- African Easterly Jet (intensity of the 600 hPa wind speed)
- Intensification of the wind not well represent in the moddle of the period

Regional simulation of the monsoon circulation

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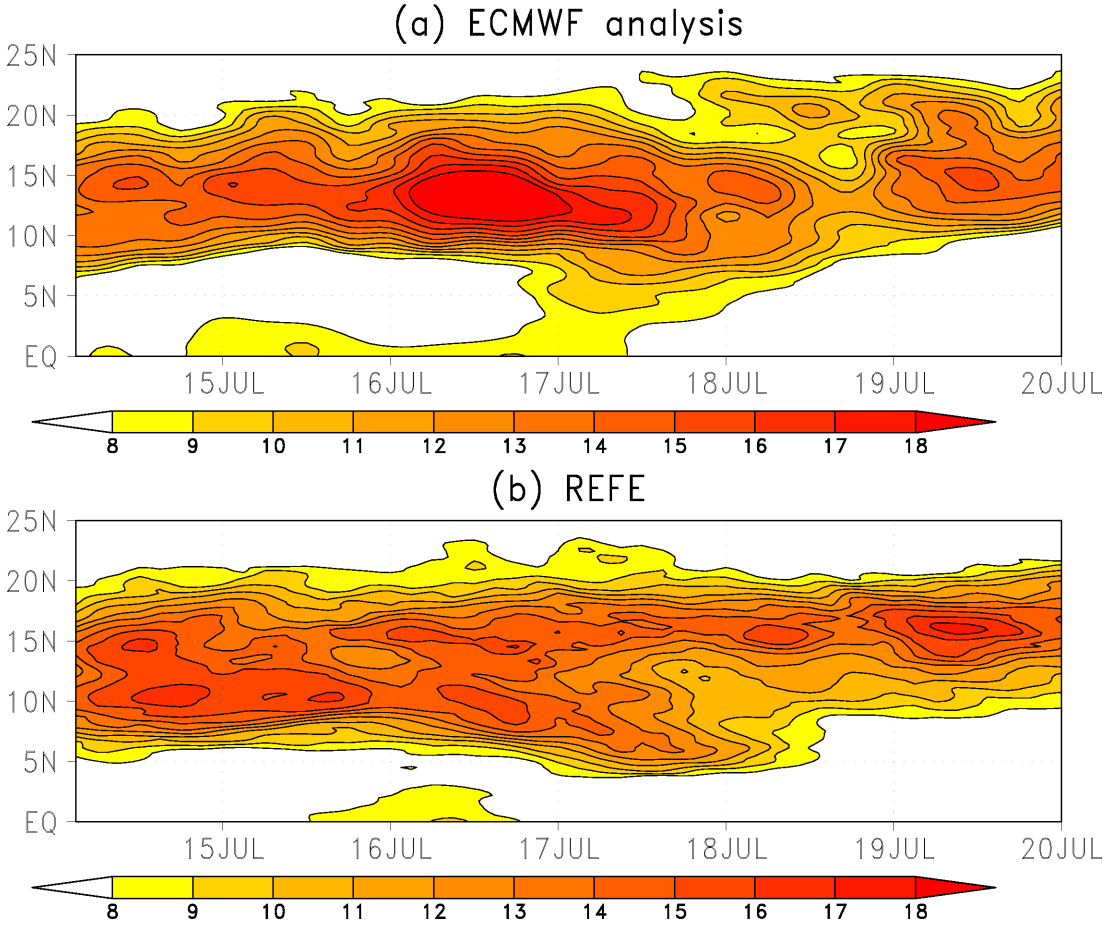
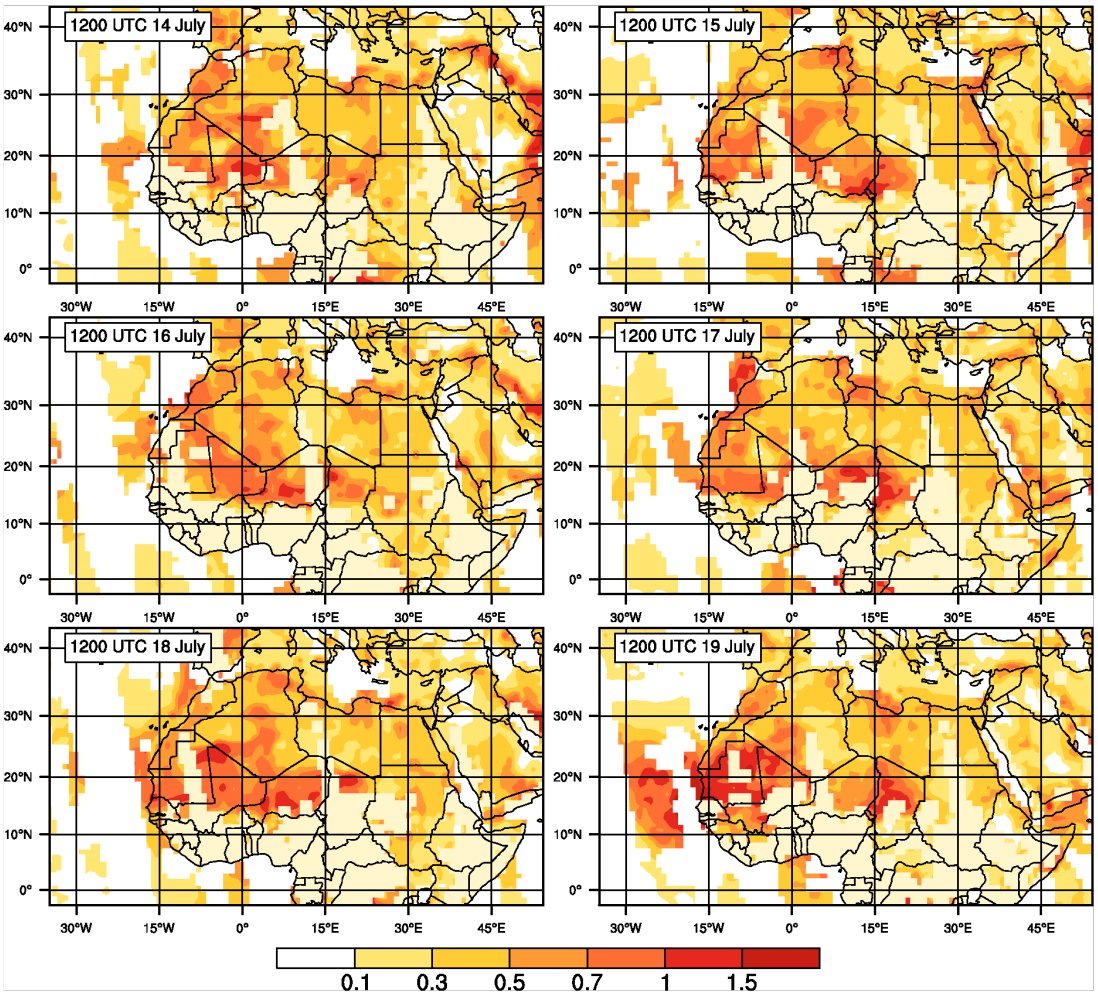


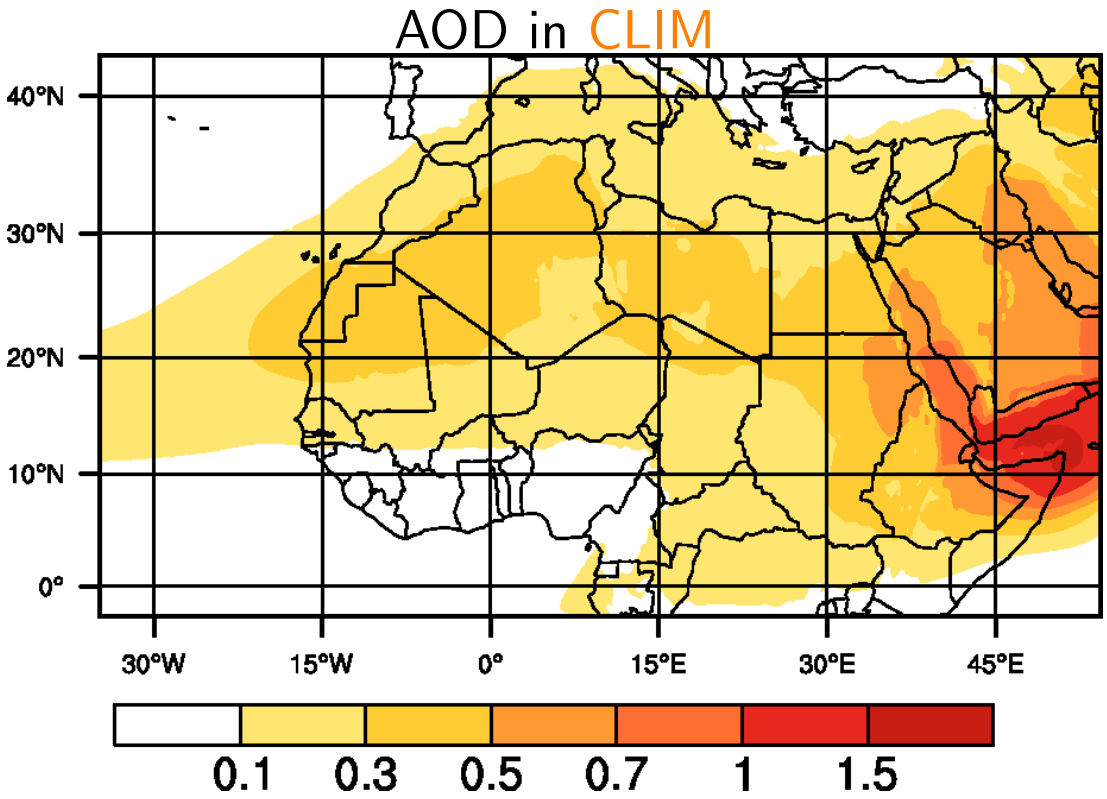
- African Easterly Jet (intensity of the 600 hPa wind speed)
- Intensification of the wind not well represent in the moddle of the period
  $\Rightarrow$ allows to define the reference for the dust impact assessment

Dust simulation

AOD observed (Modis)



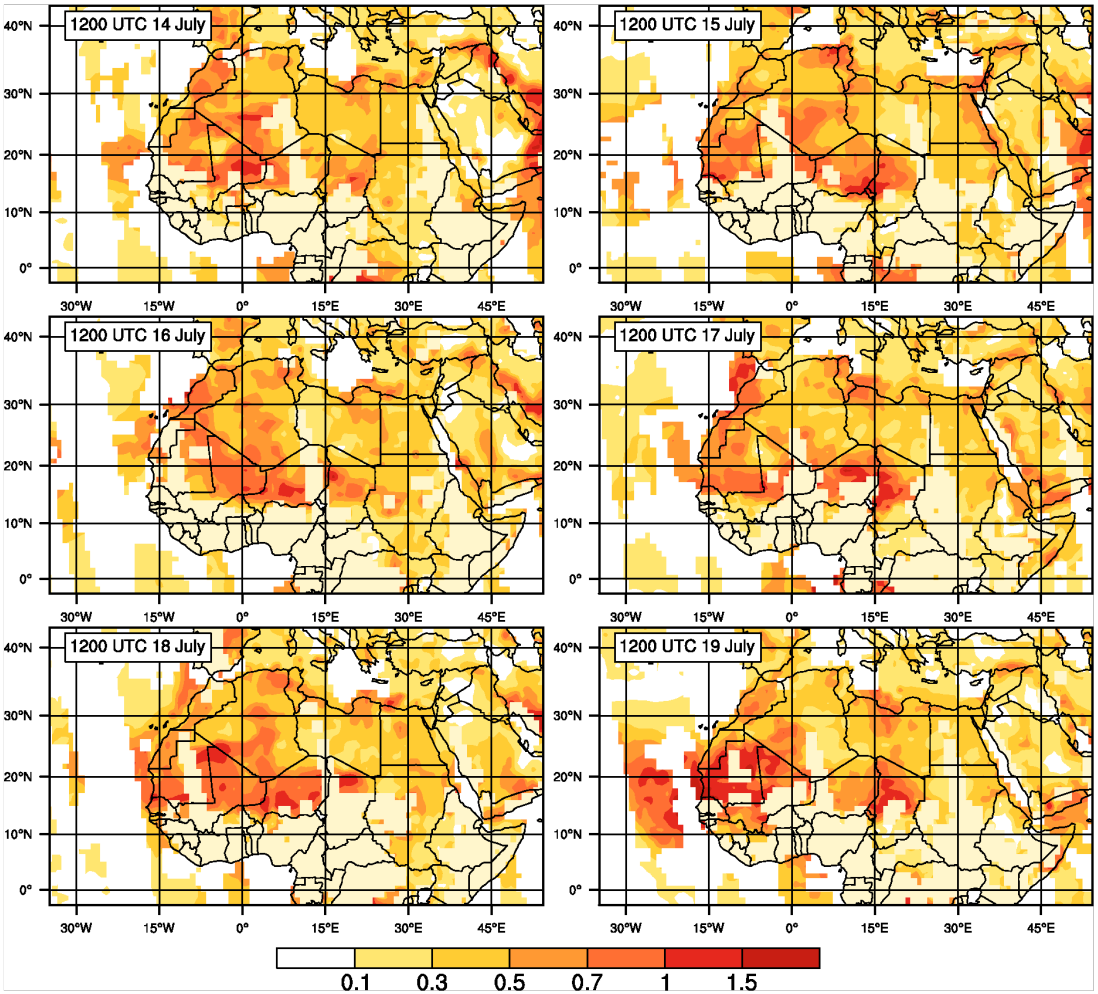
Dust simulation



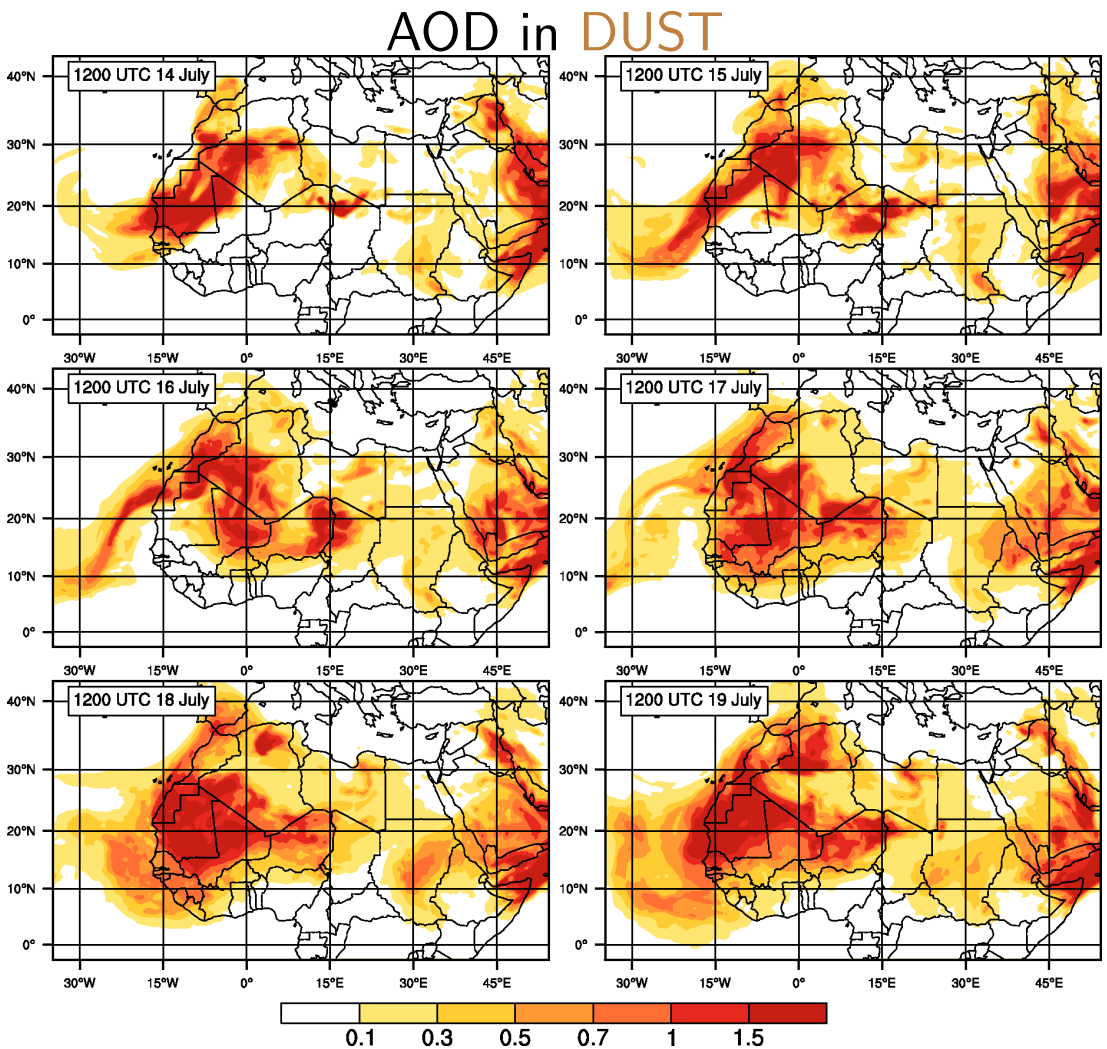
→ large differences of the AOD using the climatology (July 2006 very dry)

Dust simulation

AOD observed (Modis)



Dust simulation

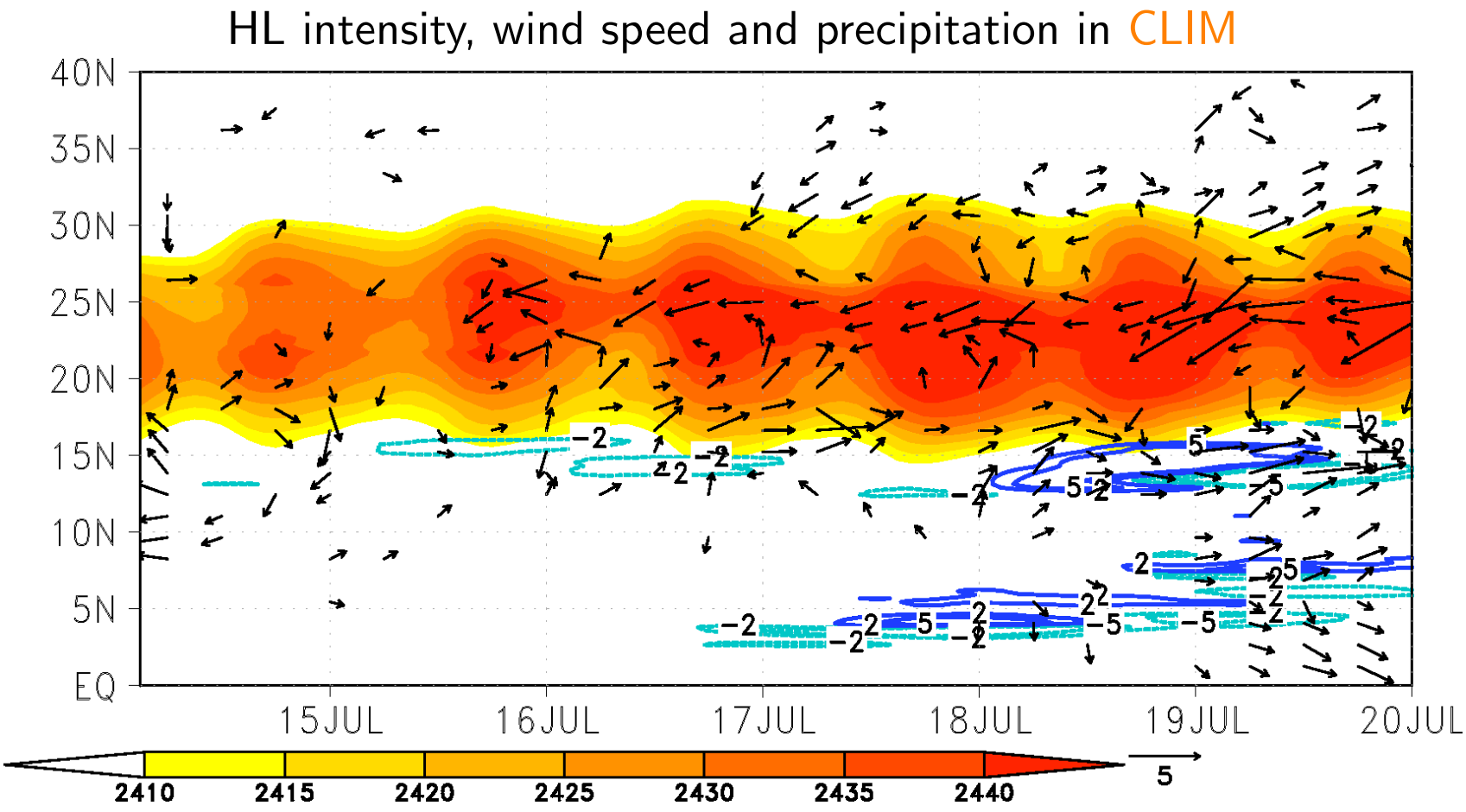


$\longrightarrow$ two intense and wide dust plumes over the West Africa

$\longrightarrow$ locations agree rather well the observations

$\longrightarrow$ underestimation of dust above the boundary layer

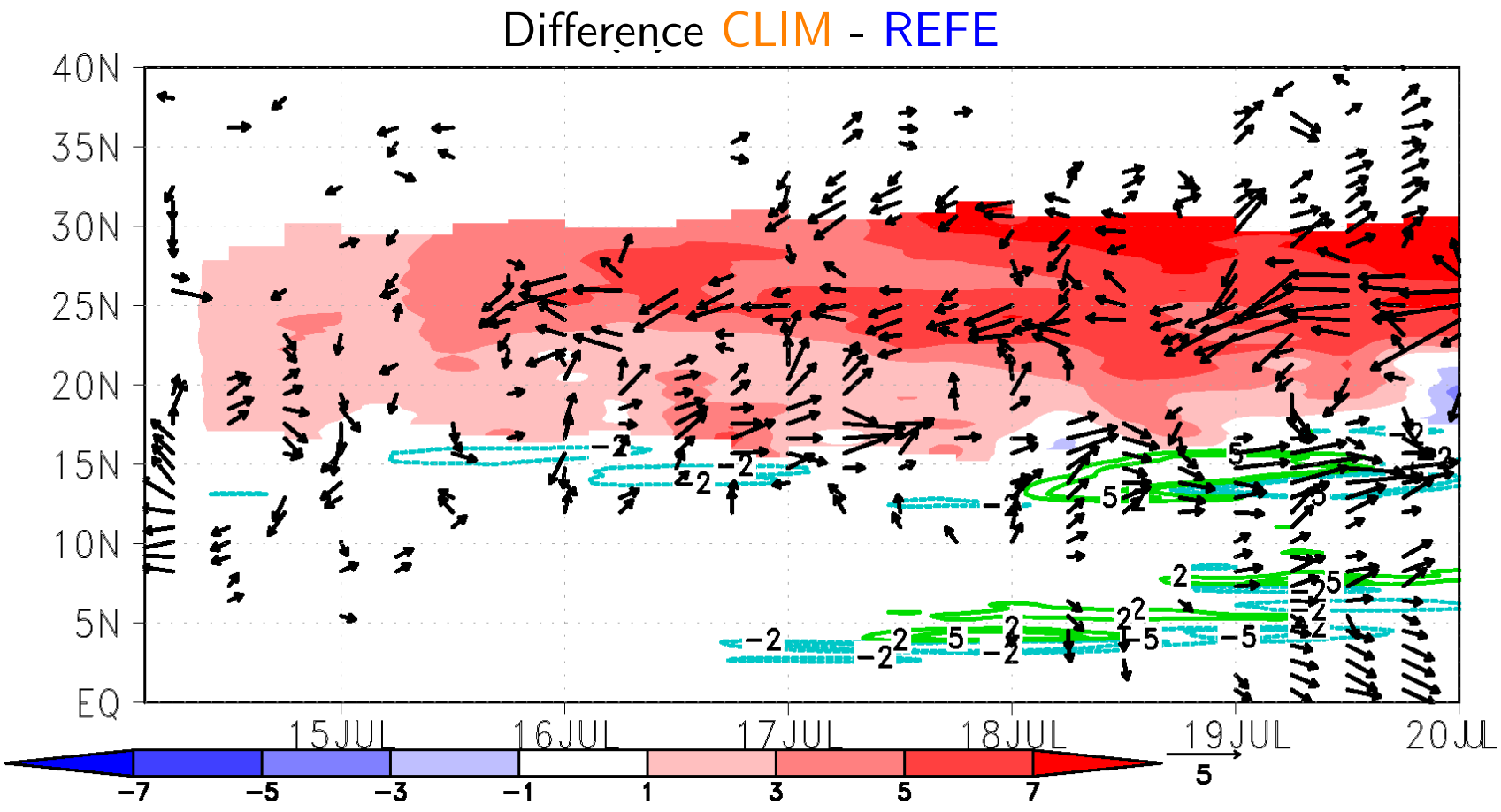
Impact of the climatological dust on the dynamic



$\longrightarrow$ increase of the HL intensity until 18 July

$\longrightarrow$ precipitation after the maximum HL intensity (on 19 July)

Impact of the climatological dust on the dynamic

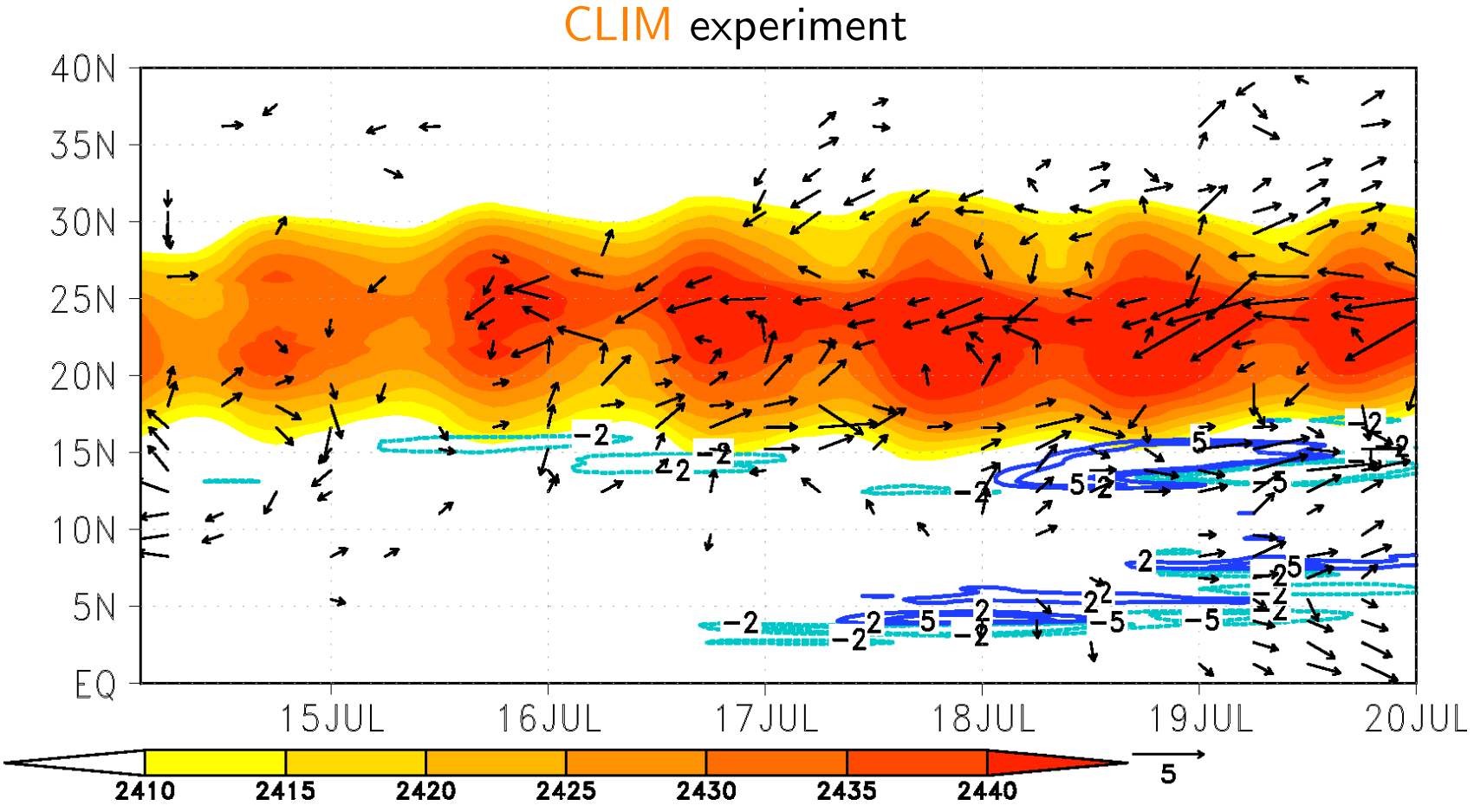


→ increase of the HL intensity until 18 July

→ precipitation after the maximum HL intensity (on 19 July)

→ linear increase of the WAHL intensity in the CLIM experiment (too short simulation ?)

Impact of the prognostic dust on the dynamic



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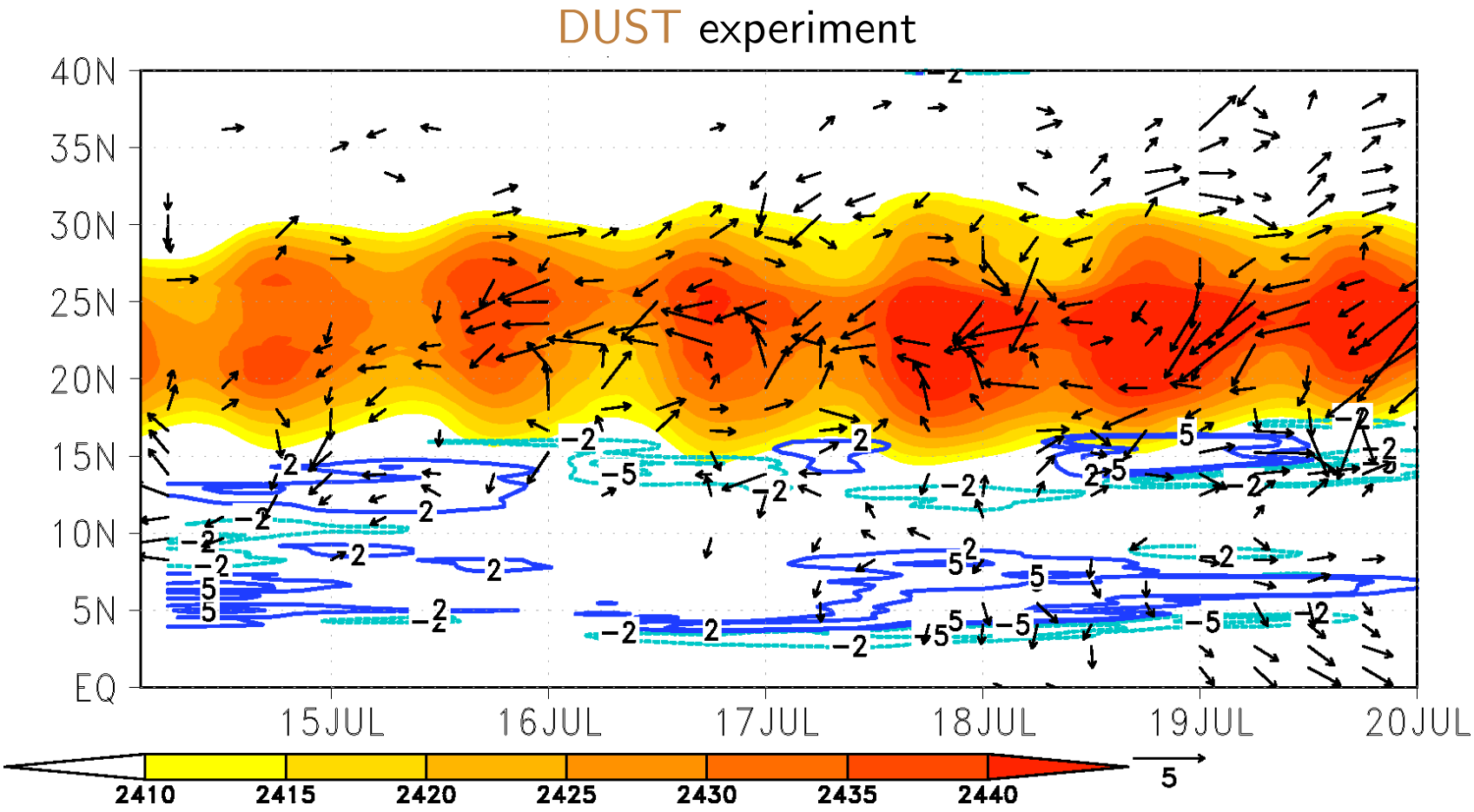
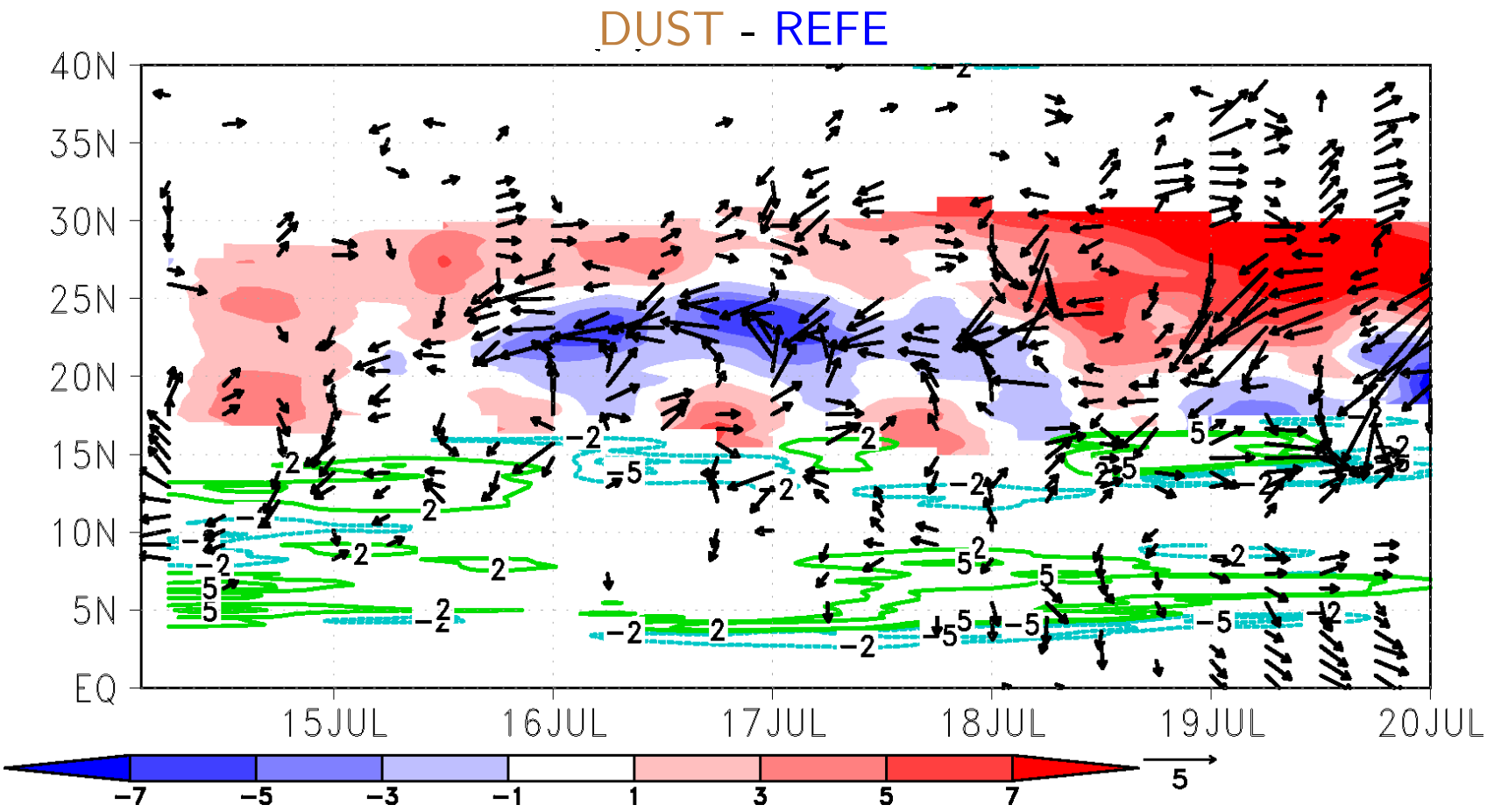


$\longrightarrow$ HL less intense using prognostic dust

$\longrightarrow$ increase of the precipitation more frequent (modification of the atmospheric stability)

Impact of the prognostic dust on the dynamic



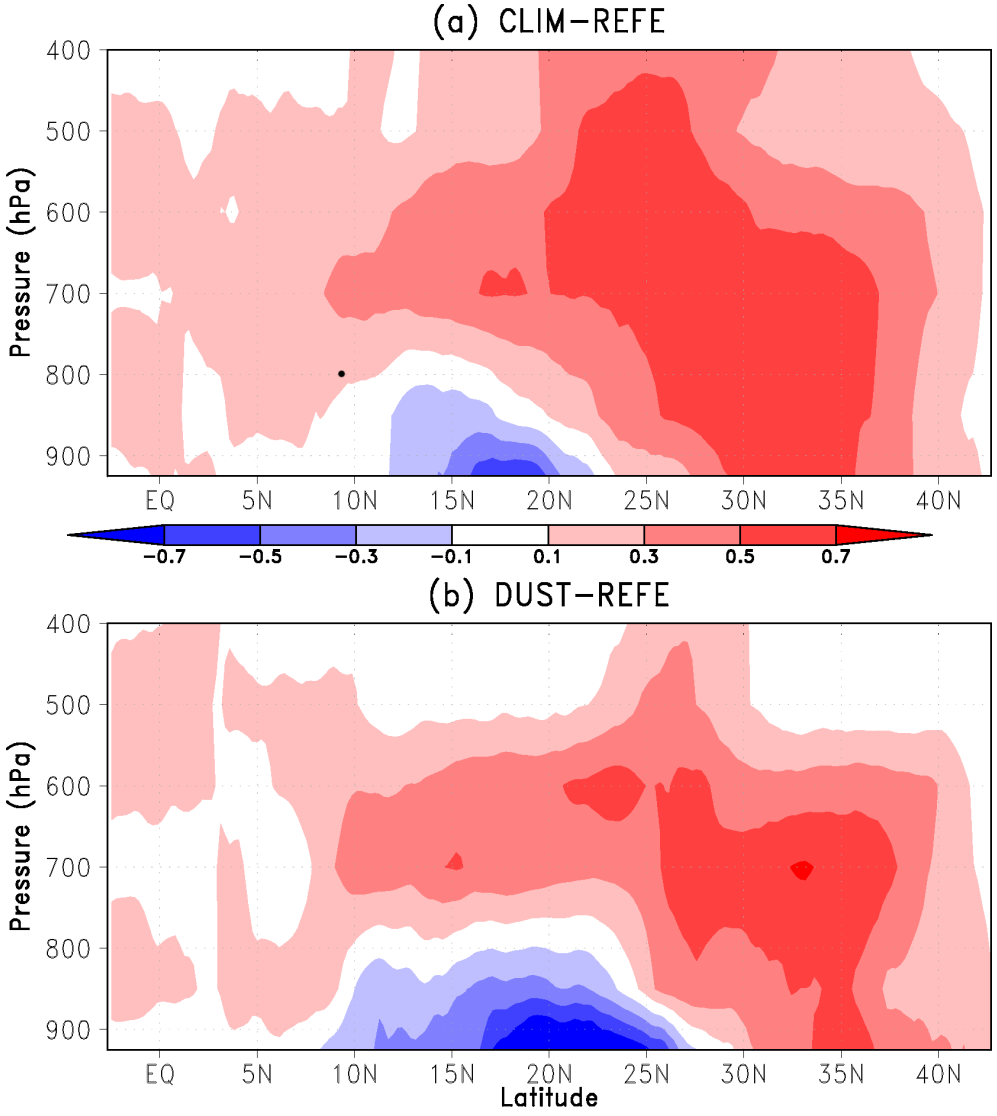
→ HL less intense using prognostic dust

→ increase of the precipitation more frequent (modification of the atmospheric stability)

⇒ negative retroaction of the dust plume (reduction of the solar heating) or modification of the monsoon circulation?

Impact of the dust on the dynamics

Temperature difference averaged along the simulation period



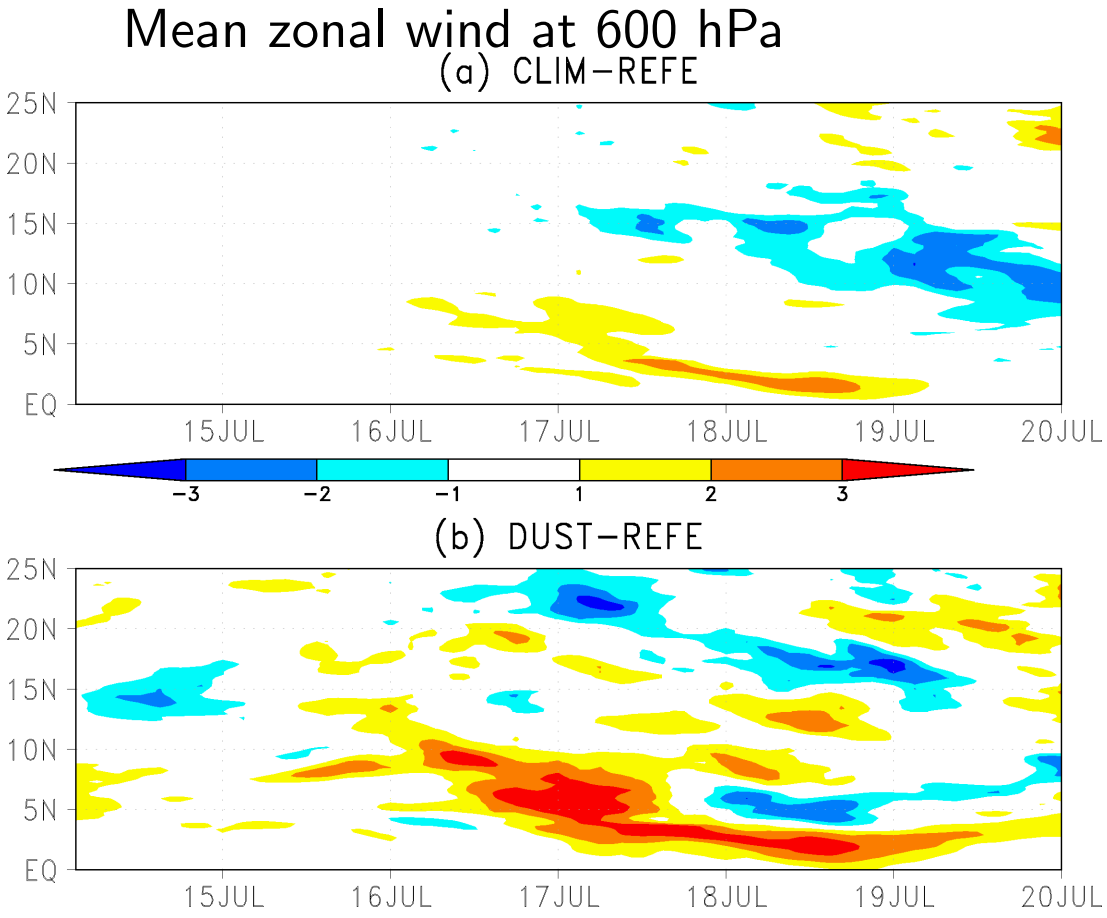
→ heating of the dust stronger in average during CLIM

→ latitudinal gradient larger in DUST

→ negative anomaly in the low layer associated with

- increase of the humidity advection
- decrease of the solar heating (dust plume, clouds)

Impact of the dust on the dynamics

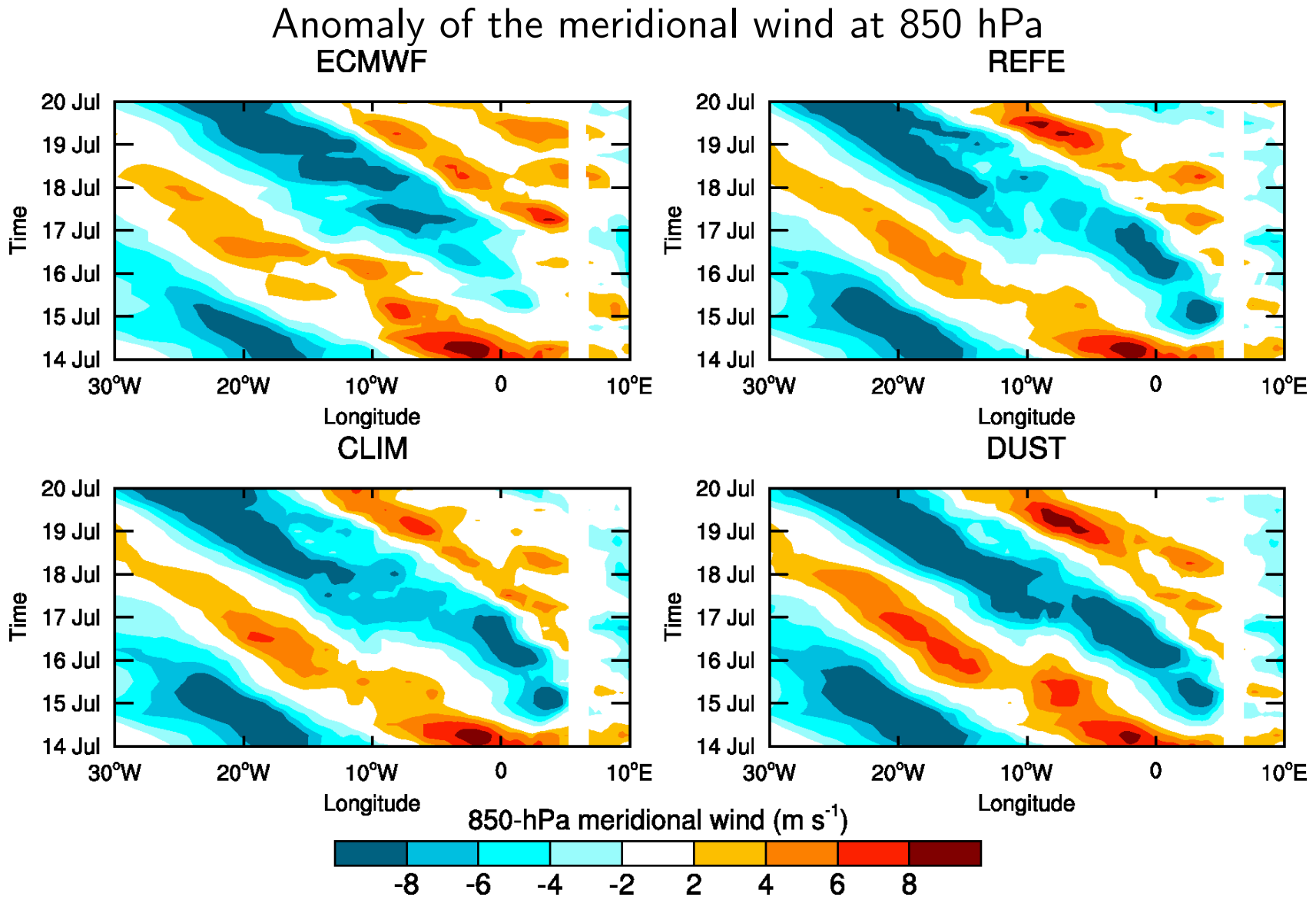


$\longrightarrow$ during the negative anomaly of the HL, increase of the AEJ intensity

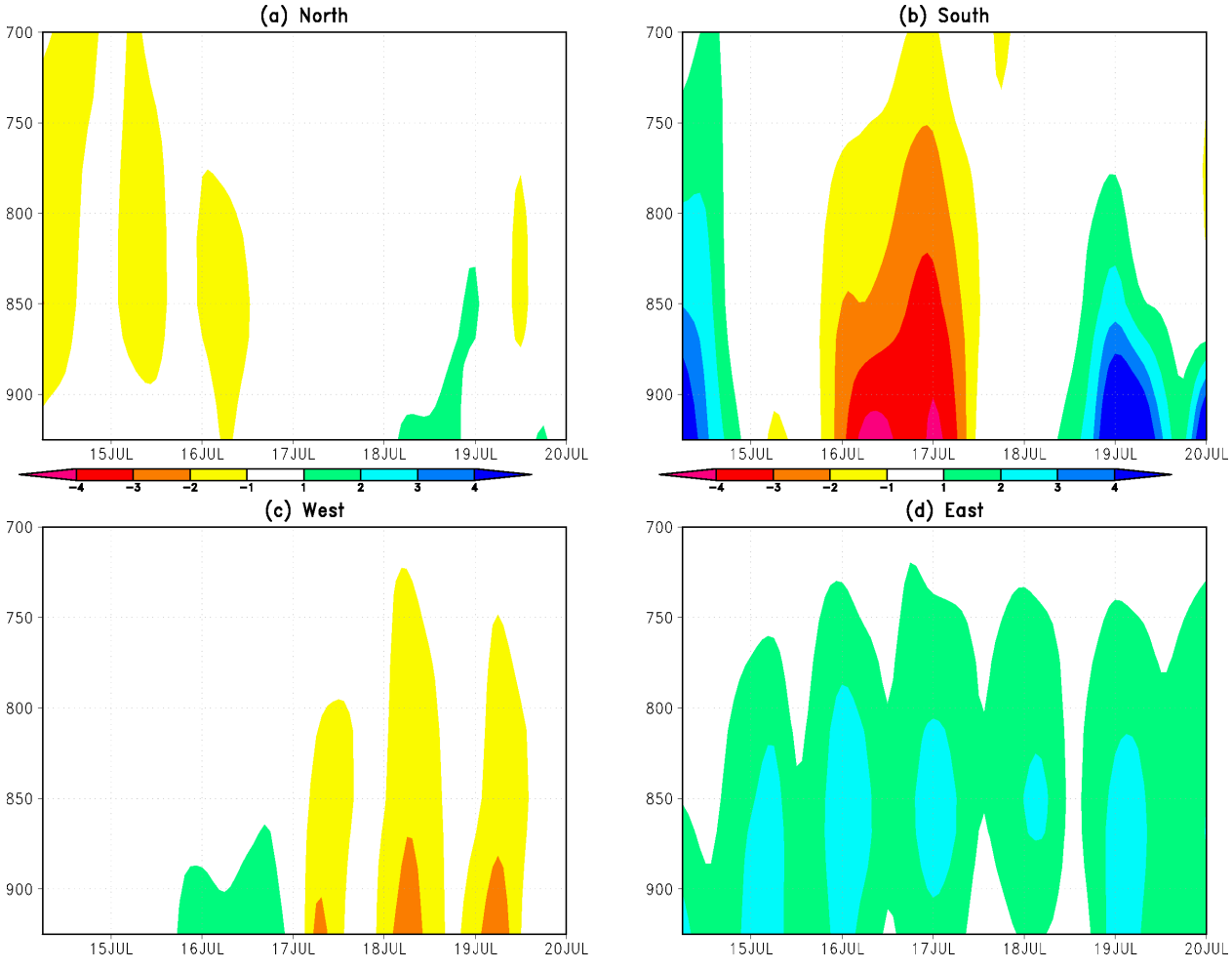
$\longrightarrow$ unexpected relation between the phase of the HL and the wind intensity

$\longrightarrow$ more in agreement with the increase of the temperature gradient

Impact of the dust on the AEWs

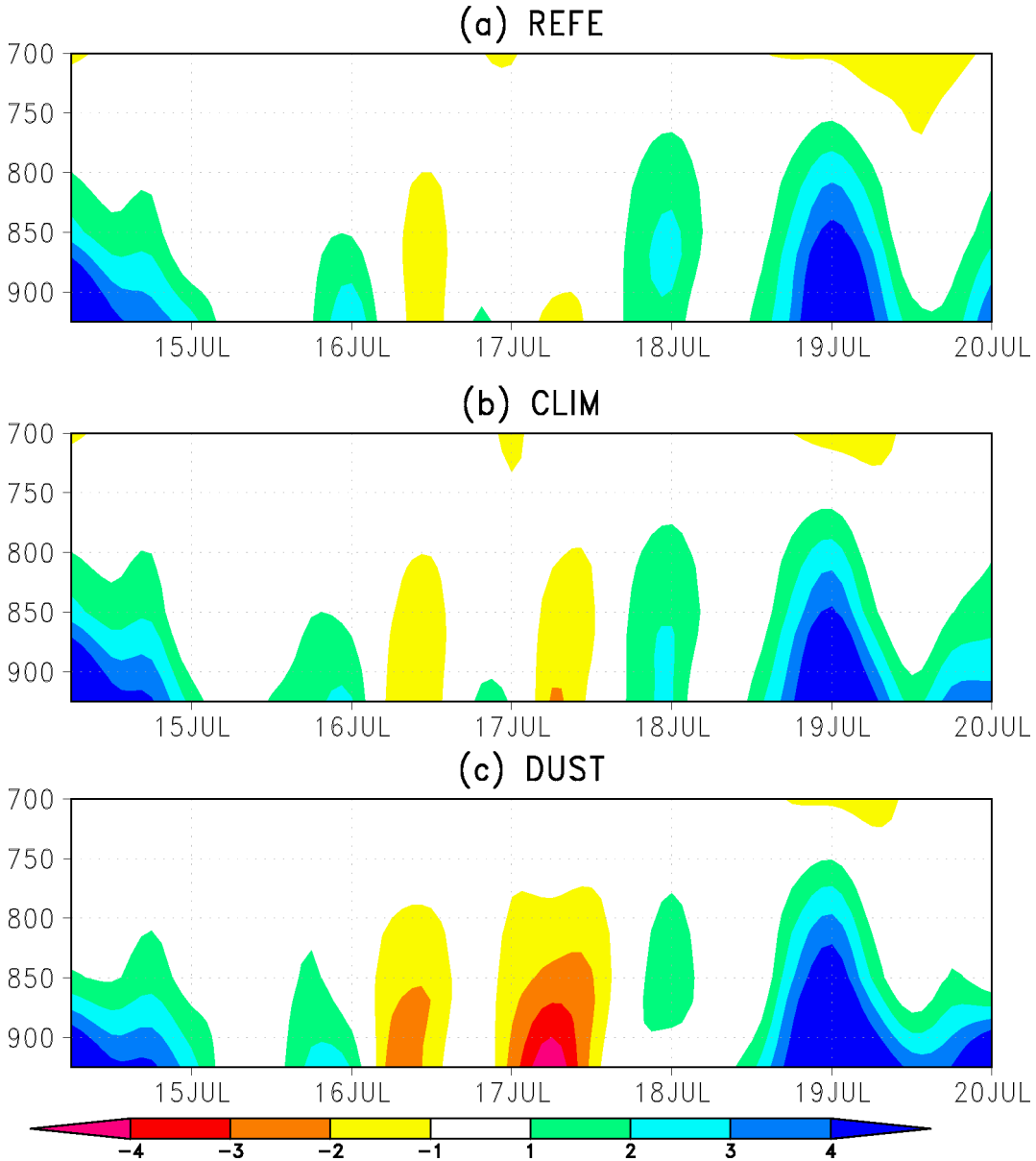


Impact of the dust on the dynamics



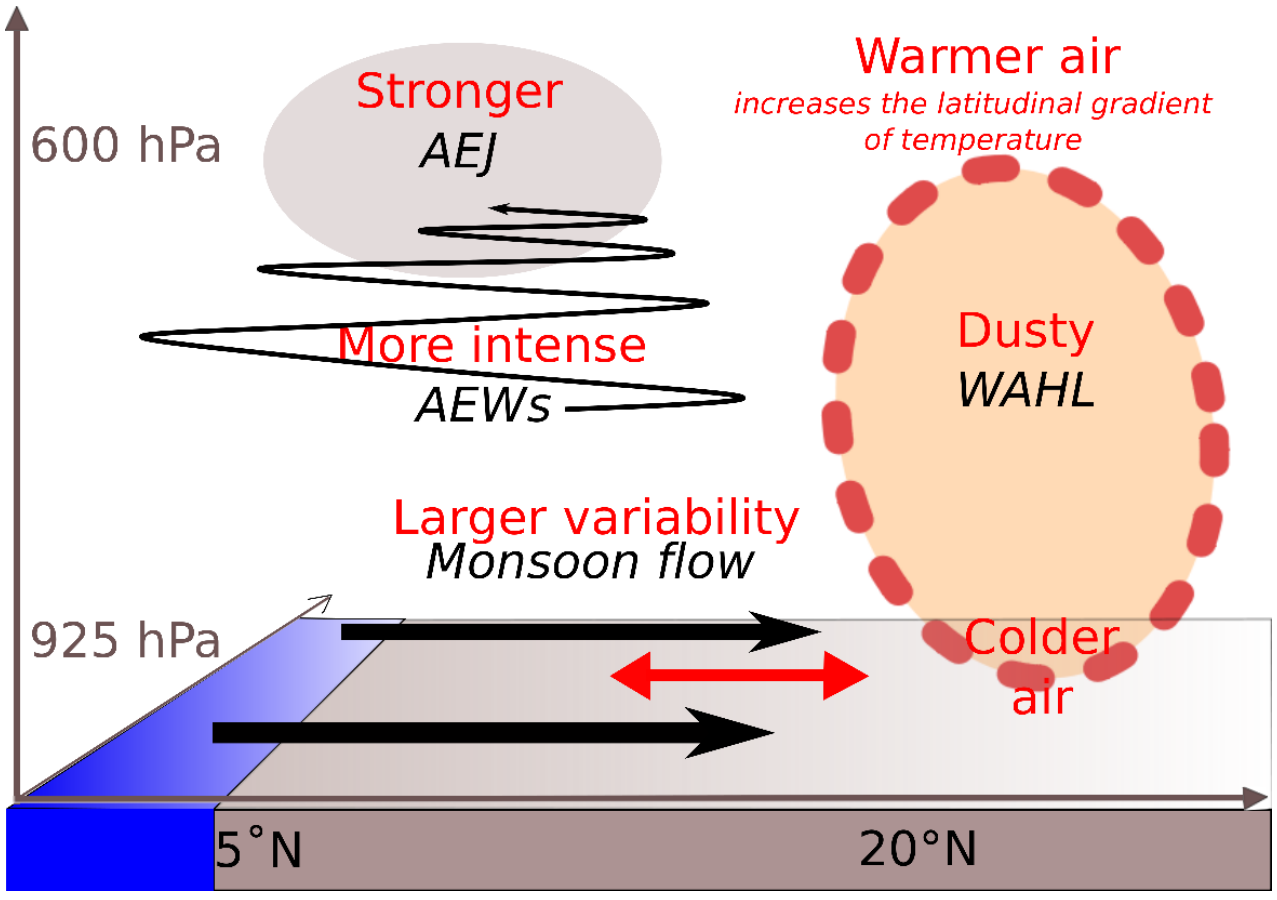
$\longrightarrow$ strong increase of the humidity flux from the southern side of the HL

Impact of the dust on the dynamics



$\longrightarrow$ large difference of the total balance of humidity advection in the HL

Conclusions



⇒ no modification of the monsoon structure

⇒ increase the pulsation intensities (HL, AEWs)

Conclusions

Perspectives

- Need to extend this similation to a long time period (month, summer season)
- Impact during transition period of the monsoon period ?

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