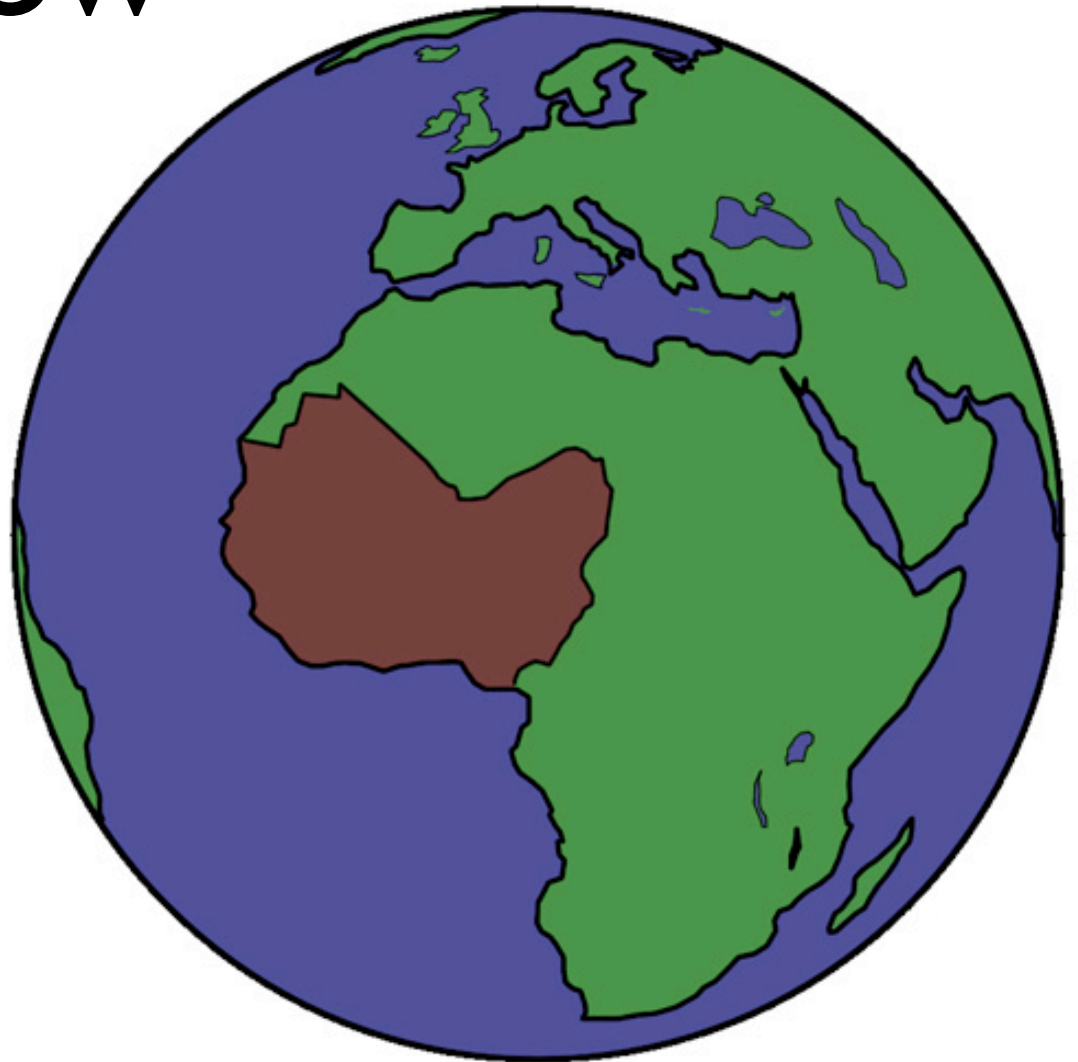
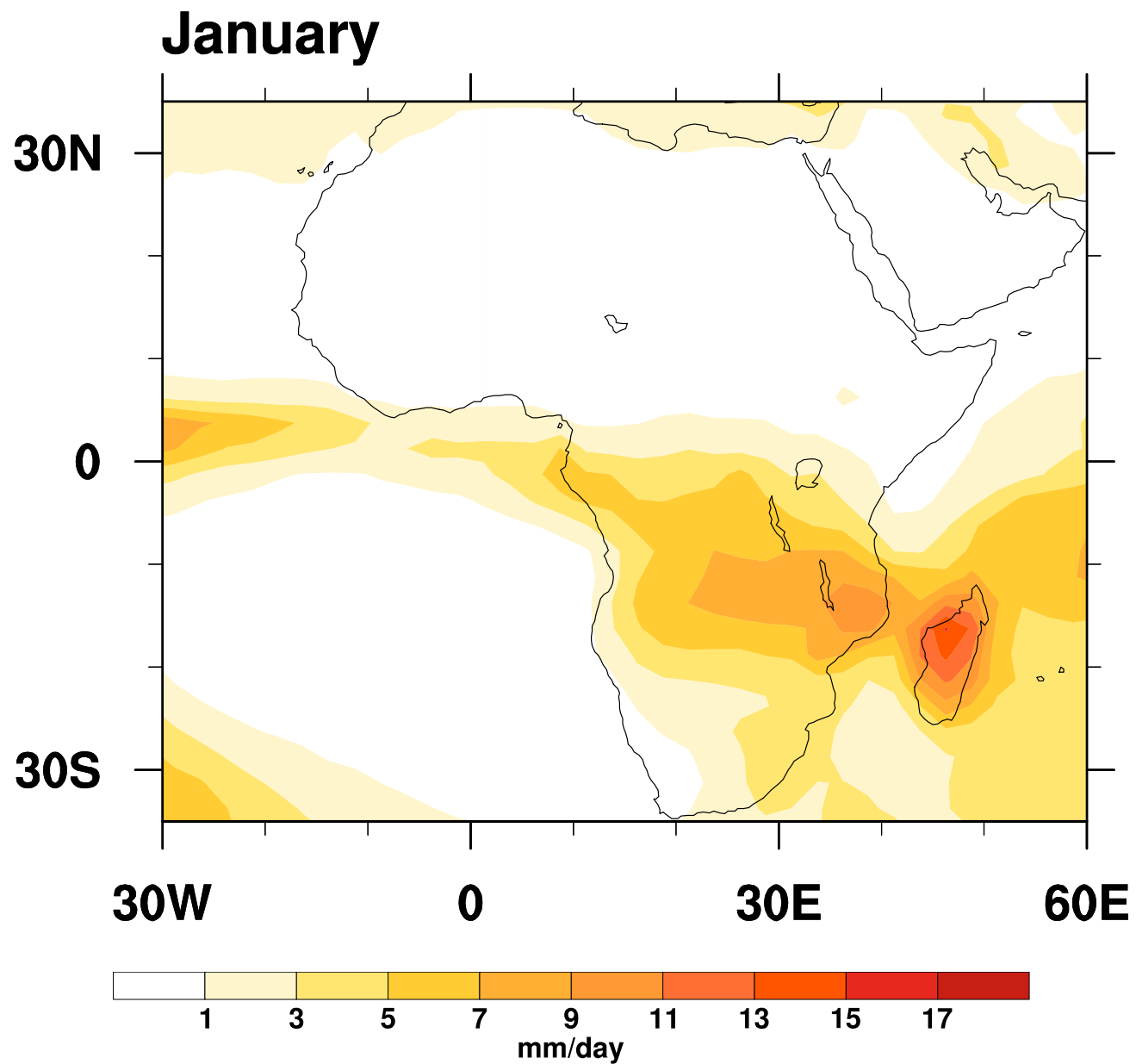


West African Nocturnal Low Level Jet

Rachel McCrary
CMMAP Team Meeting
August 2011
Multiscale Land Surface
Processes Breakout

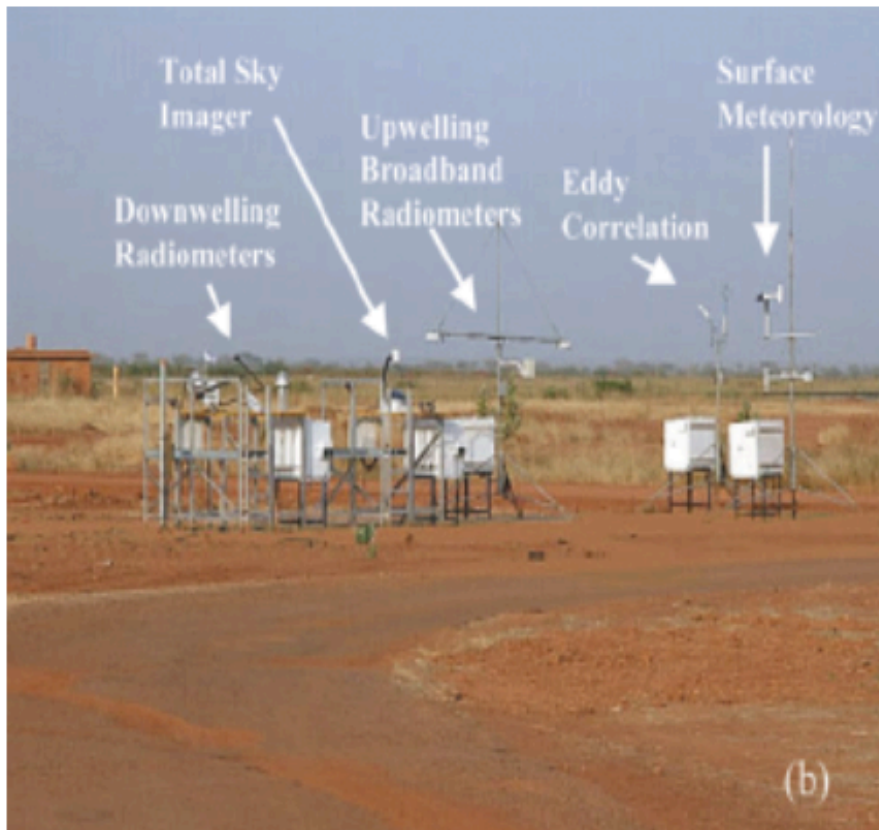


GPCP Rain - Seasonal progression



Niamey, Niger - AMMA ARM site

Before Rain



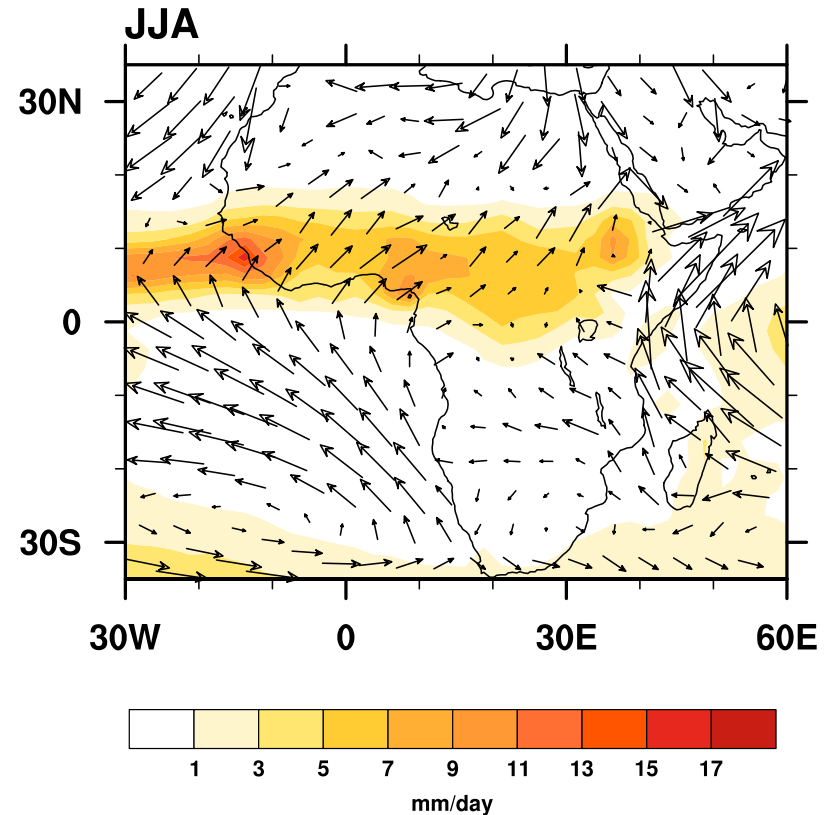
After Rain



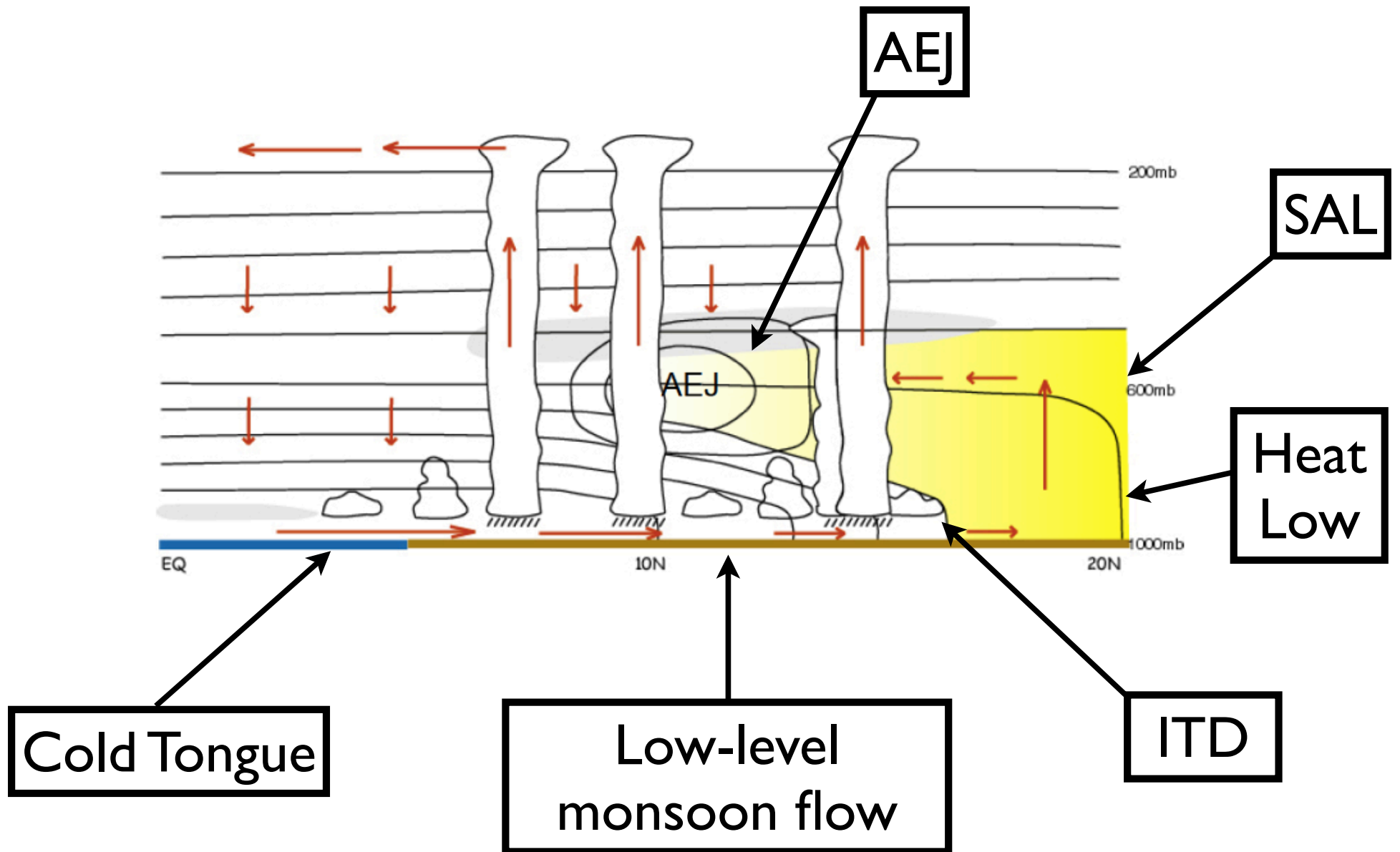
Courtesy of Peter Lamb

Monsoon Dynamics

- West Africa depends on the moisture transported inland from the Gulf of Guinea by the West African Monsoon system.
- Low level monsoon flux controlled by differential heating between the ocean and continent.
- On diurnal time scales the low-level monsoon flow manifests itself as a nocturnal low level jet.
- This NLLJ is important for the monsoon:
 - transports humidity into the region
 - related to numerous processes including turbulence and synoptic disturbances.



Monsoon Dynamics



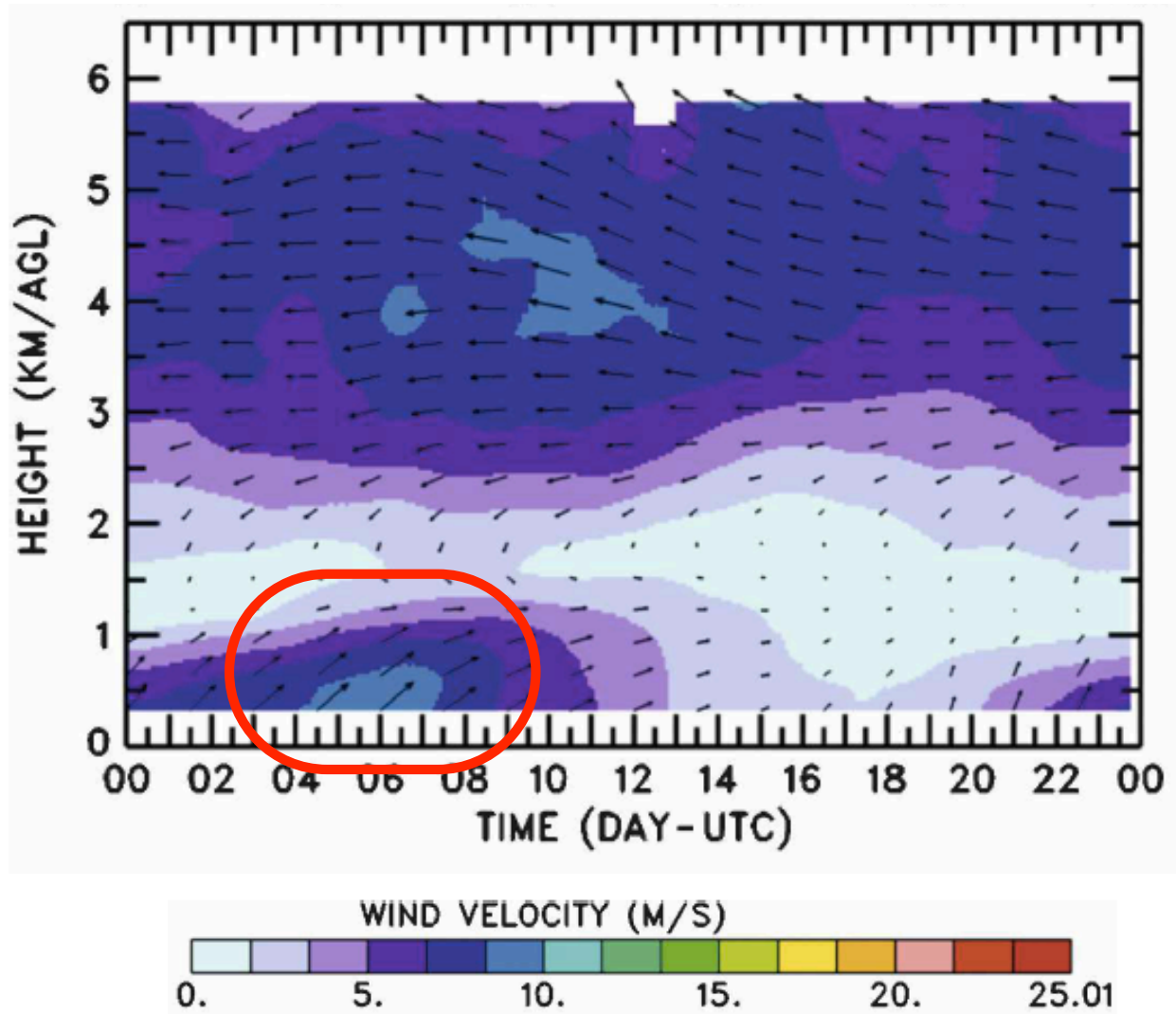
Courtesy of Chris Thorcroft

Nocturnal Low Level Jet (NLLJ)

- Work on low-level jets pioneered by Blackadar (1957),
- Large scale pressure gradient force develops between the Gulf of Guinea and the Saharan heat low.
- During the day, surface turbulent heat fluxes (sensible and latent heating) increase the frictional force of the surface and damps low-level winds.
- After sunset, in the absence of the turbulent frictional force at the surface winds accelerate.
- Coriolis force is weak at low latitudes, the wind acceleration during the night is proportional and parallel to the horizontal pressure gradient force which is linked itself to the temperature contrast and in particular the Saharan heat low.

Composite May Diurnal Winds: Niamey, Niger

Wind Profiler



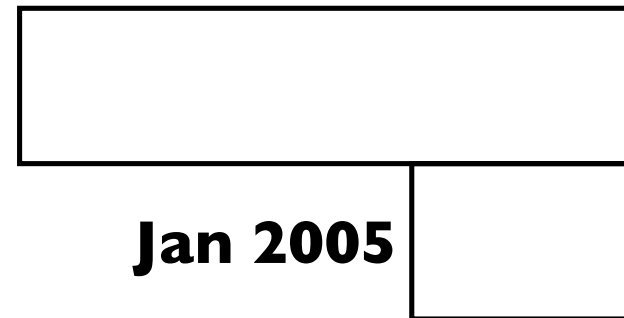
- From Lothon et al. 2008
- Southerly wind component peaks at 0600 UTC.
- Vertical extent of the jet - 1200-m

Model Runs

- Two AMIP style runs forced with observed SSTs from the HadISST dataset for the period 1997-2006.
- Host GCM - CAM 3.5, finite volume dynamical core
- $1.9^{\circ}\text{lat} \times 2.5^{\circ}\text{lon}$, 30 levels
- CRMs oriented in the N-S direction, 4km resolution

Jan 1997

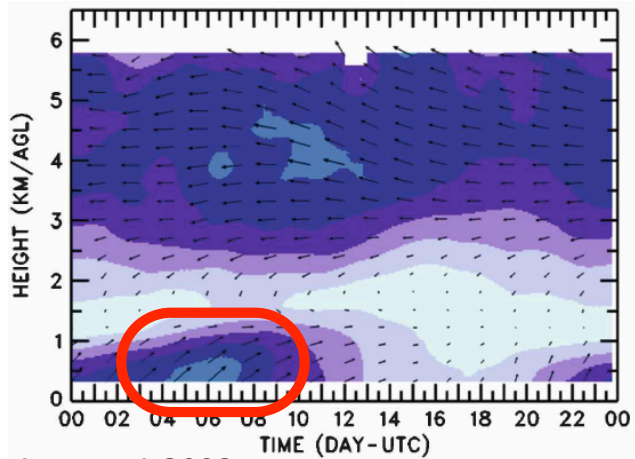
Monthly and daily fields



**hourly fields
and CRM output**

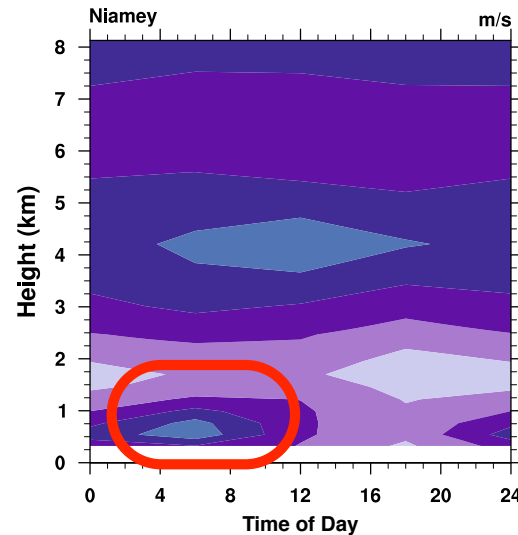
Composite May Diurnal Winds: Niamey, Niger

Wind Profiler

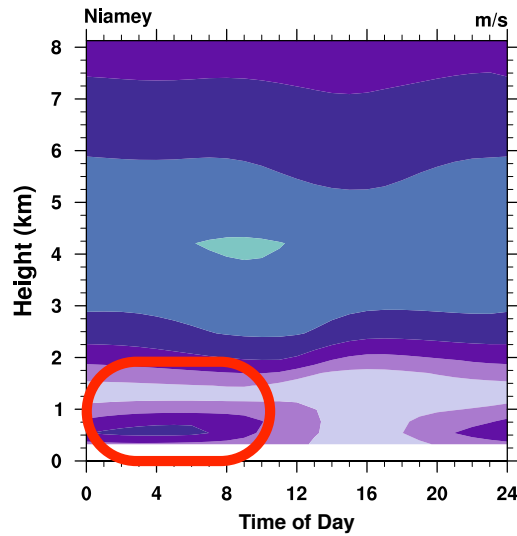


Lothon et al. 2008

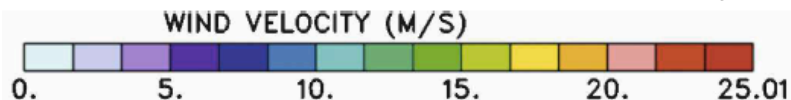
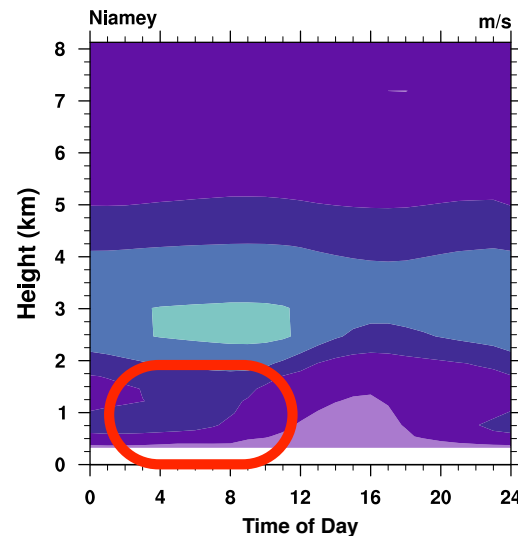
ERA-I



CAM



SPCAM

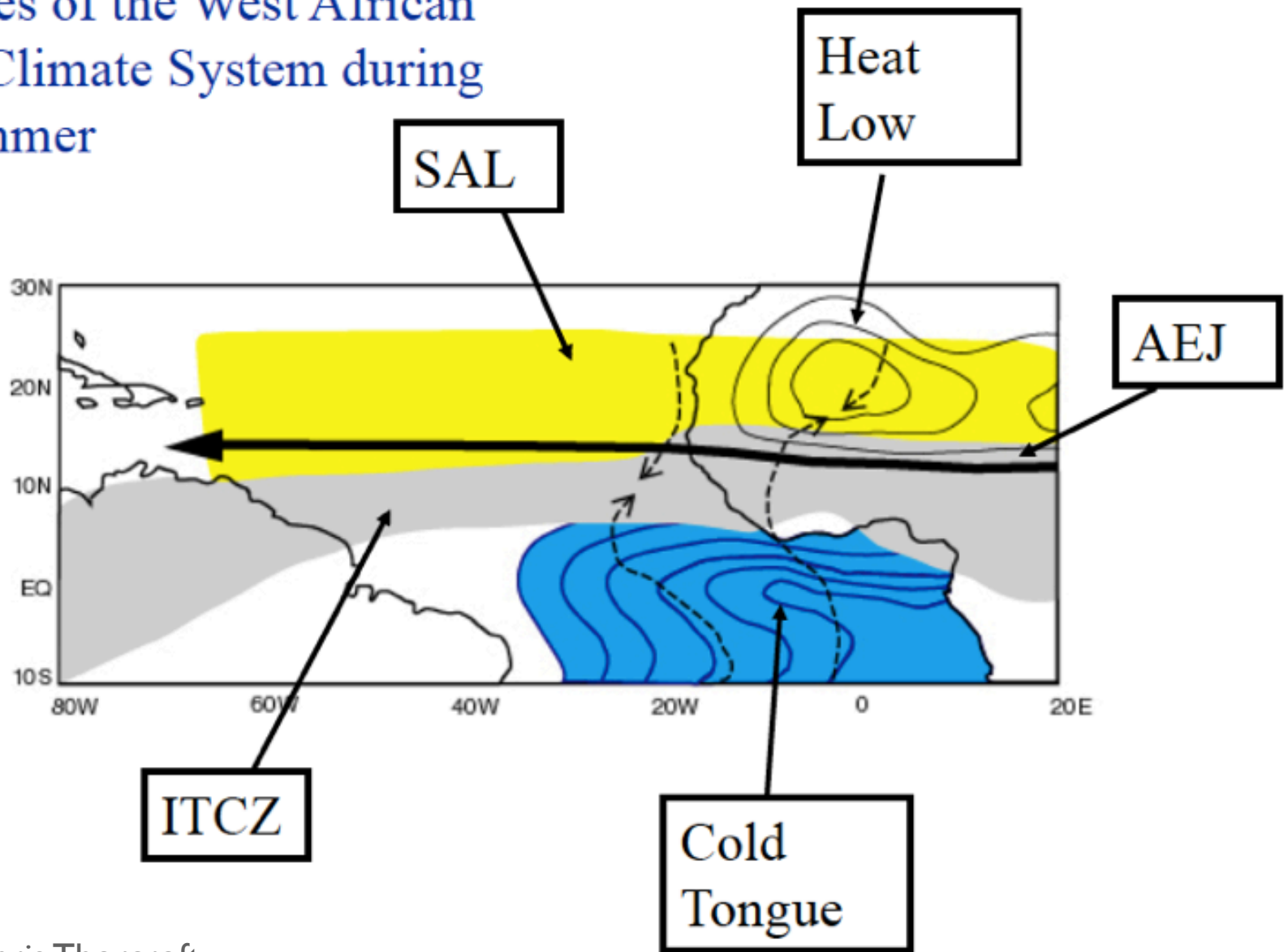


- Southerly wind component peaks at 0600 UTC.
- Vertical extent of the jet - 1200-m
- Jet found in ERA-I and CAM.
- No jet found in SPCAM - whats going on?
- Boundary layer mixing???

No Jet???

Monsoon Dynamics

Key features of the West African Monsoon Climate System during Boreal summer



Courtesy of Chris Thorcroft