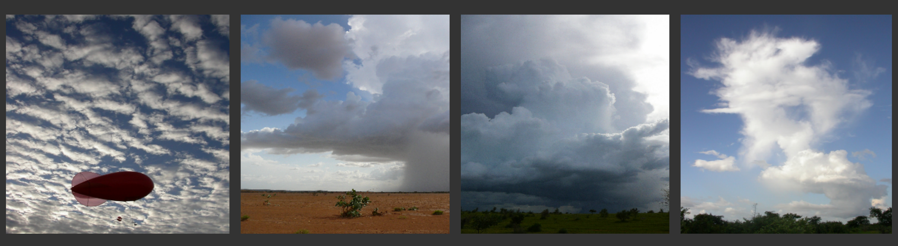
ANNUAL CYCLE OF CLOUD AND AEROSOL RADIATIVE EFFECTS OVER WEST AFRICA
OBSERVATIONALLY - BASED ESTIMATIONS



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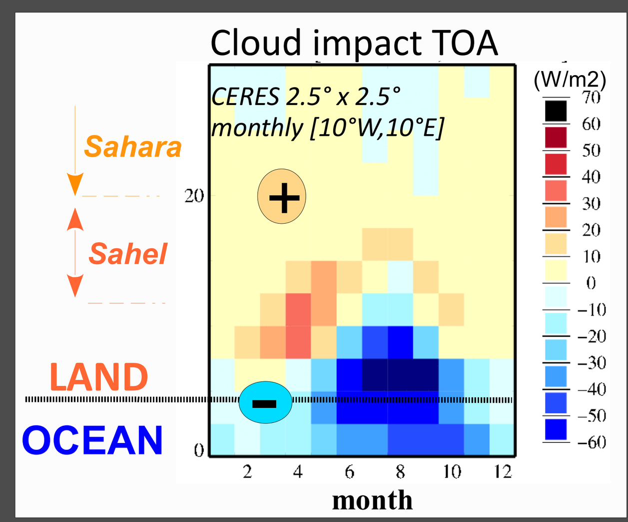
CONTEXT AND OBJECTIVES

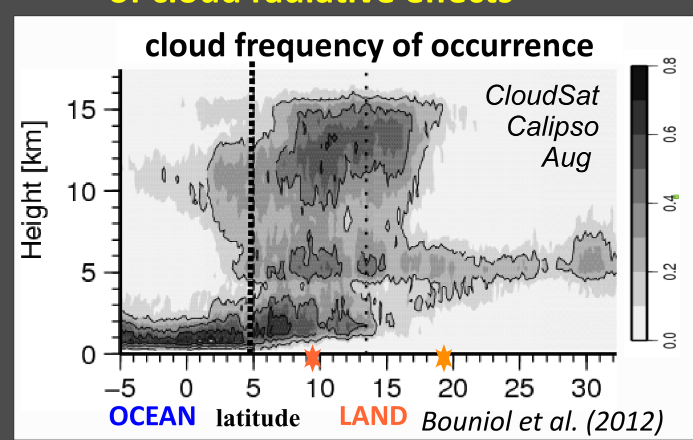
Major errors in the modelling of radiative fluxes in West Africa, in CMIP5 simulations (Roehrig et al. 2013) and (re)analyses

These errors are linked to surface, aerosols, and cloud processes. and they largely affect the energetics and dynamics of the monsoon

Objectives : estimate and analyse cloud radiative impact throughout the year in West Africa based on observations ; further aim to provide ground-based references for models



well defined latitudinal structure of cloud radiative effects



Linked to distinct observed cloud types

DATA AND METHOD

Radiative fluxes data

ARM & GERB (*Slingo et al., 2009*)
AMMA-CATCH (*J. Hydrol Spec. Iss. 2009*)
Surface : Δt = 1, 15 or 30 min
TOA : Δt = 15 min

Radiative transfert model

RRTM (*Iacono et al, 2008*) **Inputs**
- Greenhouse gazes : RRTM climatology
- **Water vapour** & **temperature profiles**:
  radiosondes & ECMWF analysis
  radiosondes: 4 to 8 per day
  ECMWF analysis : 4 per day
- **Aerosols** : Aeronet, AOD,SSA, AP Δt < 1h
- **Albedo** : surface data & LSA-SAF
- **Surface temperature** from LW surface flux

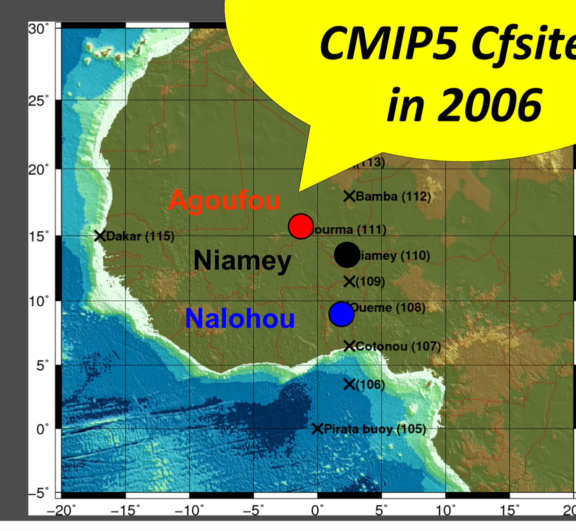
data from AMMA , ARM , AMMA-CATCH

Radiatives fluxes estimates
Clear sky and Clean sky
LW and SW TOA and Surface

Cloud Radiative Effect (CRE)
CRE : RAD (obs) – Rad_clear (computed)
+ estimate of **aerosol radiative effect**
LW and SW Δt ~ 30 min

OTHER DATASETS: ***cloud masks***, *AMF radar, lidar* ***precipitable water*** *GPS,* ***precipitation*** *local data*

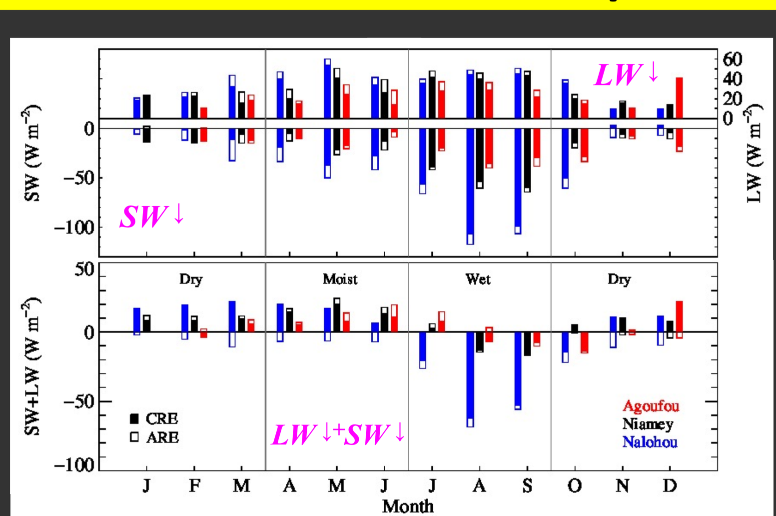
Focus on 3 contrasted sites *CMIP5 Cfsites in 2006*



Agoufou: Central Sahel, annual precipitation ~ 350 mm (*Guichard et al. 2009*)
Niamey: Southern Sahel, annual rainfall ~ 600 mm (*Slingo et al. 2009*)
Nalohou: Soudanian zone, annual rainfall ~ 1100 mm (*Mamadou et al. 2014*)

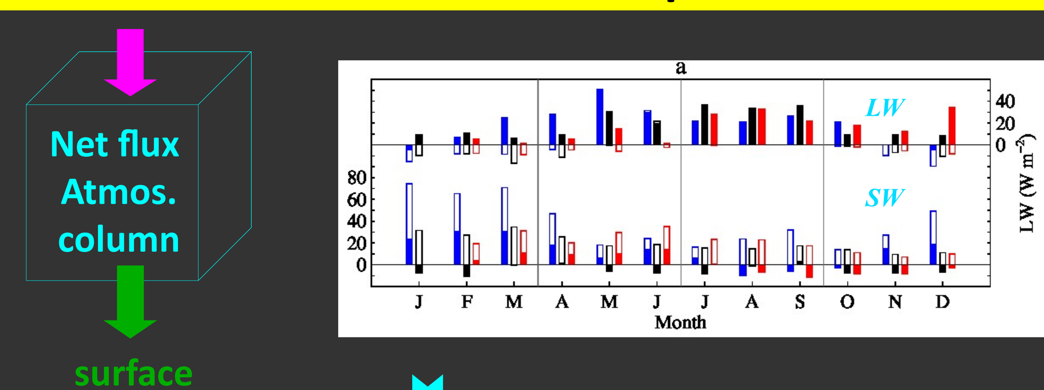
OBSERVATIONALLY-BASED RESULTS *Geoffroy et al. (2015)*

Cloud & aerosol radiative impacts: TOA



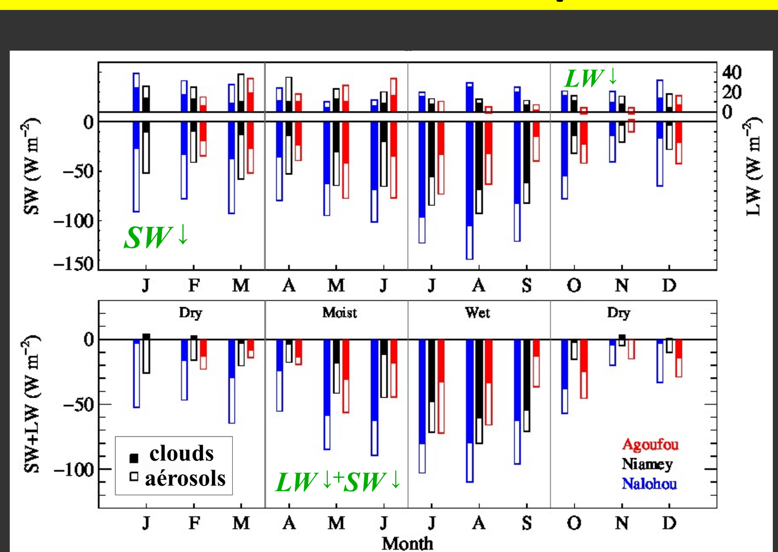
- compensations LW-SW, but major LW effect in the Sahel
- consistency with latitudinal gradient at regional scale: negative in the South, positive in the North

Cloud & aerosol radiative impacts: ATMOSPHERE



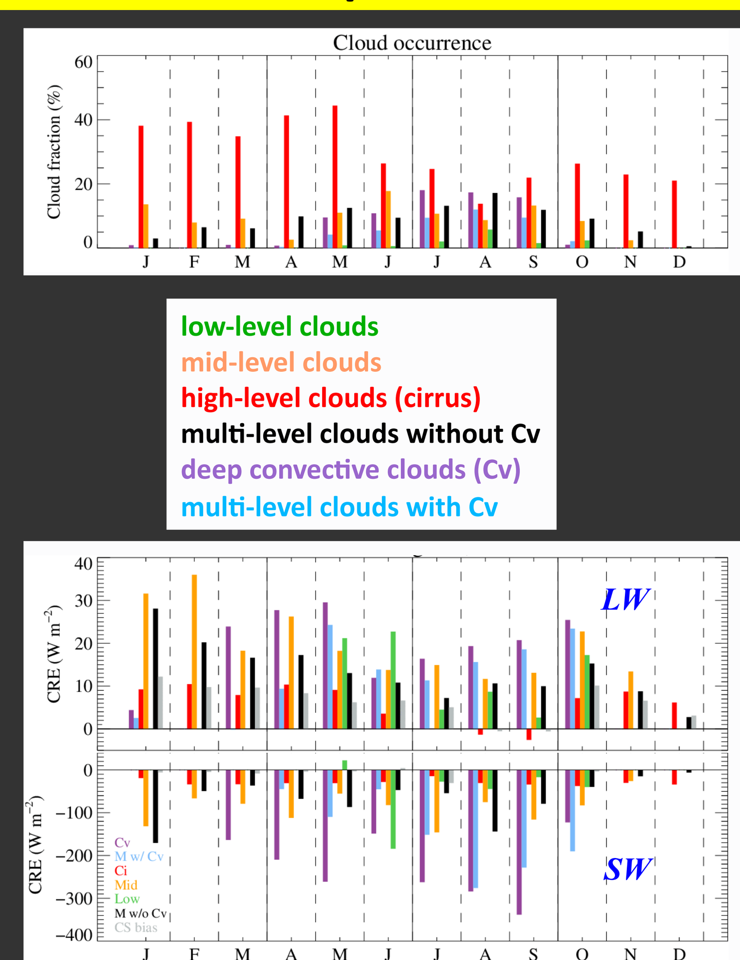
- cloud impact mostly in the LW
- aerosol impact mostly in the SW
- Consistent with, and extend, the results of Slingo et al. (2009)

Cloud & aerosol radiative impacts: SURFACE



- SW dominates, but LW important during dry season
- SW+LW: cloud impact dominates during the monsoon, Aerosols impact dominates during the dry season

Cloud radiative impact: BY CLOUD TYPE



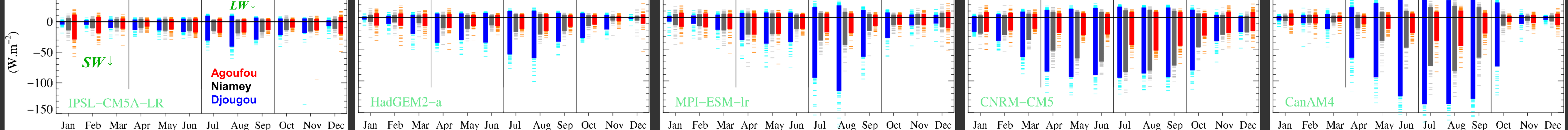
- occurrence of cirrus and mid-level clouds all year long
- SW surface: impact of deep convective clouds dominates
- LW surface: large impact of mid-level clouds

RESULTS FROM CMIP5 AMIP runs

AMIP runs, AMIP5 cfSites outputs

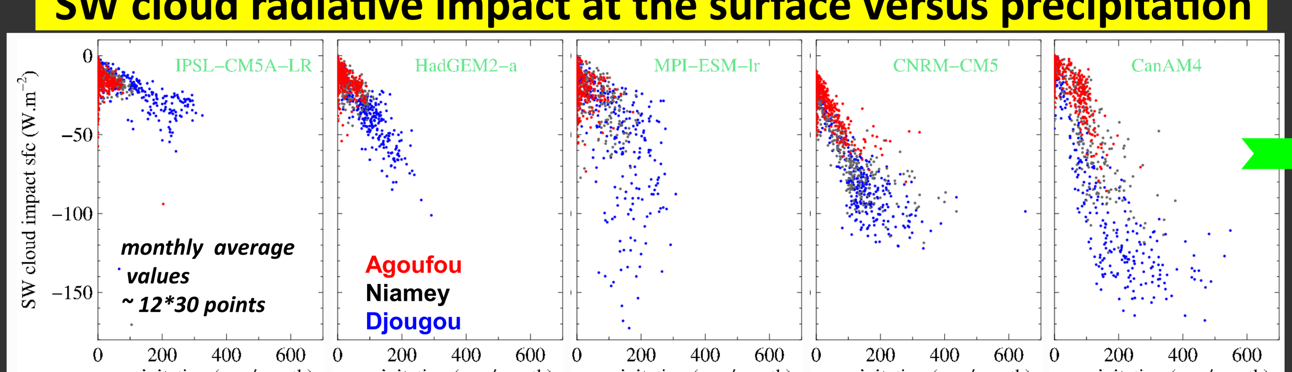
Thick bars: monthly-mean values averaged over ~30 years
Thin horizontal lines: monthly-mean values

Cloud radiative impact: SURFACE



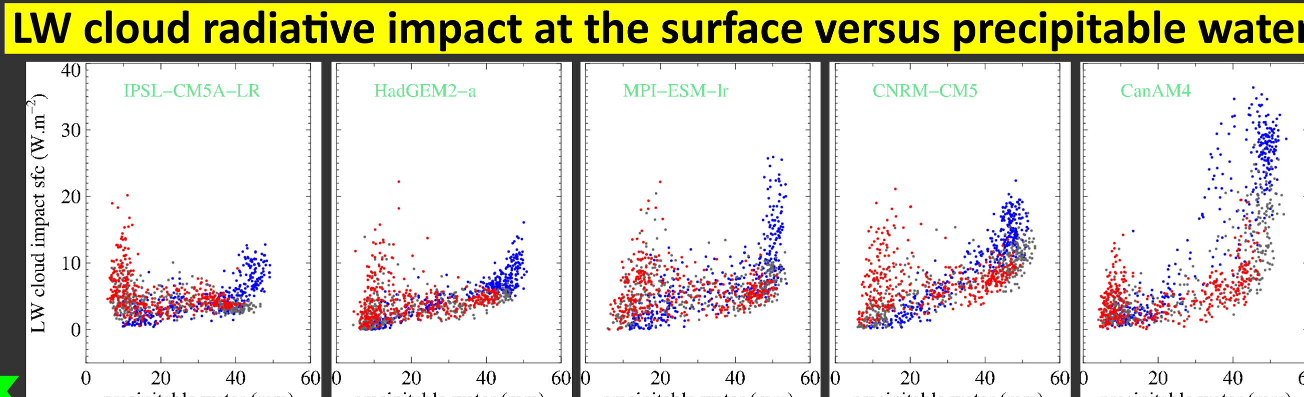
very large spread, with relative errors ~ 100 %

SW cloud radiative impact at the surface versus precipitation



precipitation only partly accounts for differences in SW

LW cloud radiative impact at the surface versus precipitable water



distinct coupling of cloud LW radiative impact with atmospheric water possibly related to differences in aerosols and diurnal cycle of cloud cover

NEXT STEP

more analyses of cloud radiative impact as a function of cloud type in observations and climate runs, design of physically-based diagnostics

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Acknowledgements
We thank our AMMA and AMMA-CATCH colleagues, and ARM for the data, CMIP5, CFMIP and EUCLIPSE for climate model outputs