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Airborne observations of mesoscale airflow induced by soil moisture: a case study from the AMMA Special Observing Period

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The atmospheric impact of mesoscale variations in the surface sensible heat flux over land has been a subject of interest for two decades. Numerical and theoretical models show that at certain length scales, and under weak synoptic forcing, sea-breeze type circulations can develop in response to strongly contrasting surface features. However, observations to validate these models are sparse. This may in part reflect the lack of contrasting mesoscale surface features in well-observed regions of the world. In the Sahel, rainfall events frequently produce substantial perturbations to surface fluxes at the mesoscale. For one or two days after rain, when near surface soil moisture suppresses the sensible heat flux, the planetary boundary layer (PBL) is markedly cooler and moister than in adjacent regions unaffected by the rain event. One of the aims of the UK BAe 146 aircraft during the AMMA deployment in Niamey was to fly over recent storm tracks to explore whether PBL circulations develop in response to surface moisture variability.

Unique observations are presented of an atmospheric cross-section above mesoscale soil moisture features on the afternoon of 1 August 2006. Wet surface features were accurately located in near real time using land surface temperature data from Meteosat Second Generation and processed by the LandSAF. A leg flown close to the surface illustrates the sharp changes in PBL properties when flying across surface moisture patches. The cross-sectional picture emerges from a series of drop sondes on a return leg flown well above the PBL. Both legs provide clear evidence of low level divergence over the wet soil and convergence above warmer surfaces. Given the ubiquity of mesoscale moisture features during the Sahelian rainy season, it seems plausible

that this land surface – atmosphere process may influence subsequent rain events, thus feeding back on the surface.