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The Impact of Aeolus wind observations on the West African Monsoon

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Tropical Africa is characterized by the world-wide largest degree of mesoscale convective organisation. During boreal summer, the wet phase of the West African Monsoon (WAM), the midlevel African easterly jet (AEJ) over the Sahel allows for the formation of synoptic-scale African easterly waves (AEWs) with a maximum intensity close to the West African coast. AEWs interact with convection and its mesoscale organization through modifications in humidity, temperature and vertical wind shear, and often serve as initial disturbances for tropical cyclogenesis. In addition, rainfall can be modulated by other types of tropical waves such as Kelvin or mixed Rossby gravity waves. Upper-tropospheric conditions are dominated by the Tropical Easterly Jet (TEJ), whose variability appears to be connected to convective activity. Overall, our quantitative understanding of the WAM system is still limited. The observational network over the region is sparse and rainfall forecasts with current Numerical Weather Prediction models are hardly better than climatology.

The Aeolus satellite launched in 2018 offers a great opportunity to further investigate the WAM with an unprecedented density of free-tropospheric wind data. Assimilating Aeolus wind observations in denial experiments using the current operational system of the European Centre for Medium-Range Weather Forecasts (ECMWF) shows that the main circulation features of the WAM are greatly impacted: the AEJ and the TEJ are systematically weaker and stronger respectively by~1m/s in the analysis fields including Aeolus data. As a consequence AEWs also show a weakening in the propagation amplitude. We are currently investigating the contributions of the HLOS (horizontal line-of-sight) Rayleigh and Mie wind observations to these observed differences. Mie observations (i.e., those related to backscatter from hydrometeors and aerosol particles) seems to contribute strongly to the difference in the AEJ, which lies within a convectively active region with a high aerosol load. On the other hand, the difference seen in the TEJ appears to originate mostly in the Rayleigh (i.e., clear air) observations. Surprisingly, the ascending and descending HLOS observations contribute differently to the data impact, possibly revealing a remaining bias or model problems with the diurnal cycle. Future work will include systematic comparisons between the operational systems of DWD and ECMWF to understand the influence of

different data assimilation approaches as well as the impact on forecasts.