Figure 12. Measured and simulated power at an ambient wind speed of 8 m/s and an ambient turbulence intensity of 10% when WTG 2 is exposed to the wake of WTG 1 (a), WTG 5 is exposed to the wake of WTG 2 (b), and WTG 5 is exposed to the wake of WTG 1 (c). The number of measured 10-min time series in each wind direction bin is illustrated on the secondary axis.

The predicted results of all models agree very well with the measurements. The DWM-Egmond model overestimates the deficit, especially at the largest distance of 4.71D. The results of the flapwise and edgewise blade root moments as well as the tower bottom bending moments are shown in Figure 13. The results of the recalibrated and original DWM-Keck models agree very well with the measurements over all distances. The DWM-Egmond model on the other hand overestimates the loads mostly, particularly at the highest distance of 4.71D. The reason is that the degradation of the wake over the downstream distance is underestimated by this model. The eddy-viscosity definition in the DWM-Keck-c model has been recalibrated by lidar measurements from the site. As a result, a higher and more suitable degradation of the wake could be achieved.

The bias of accumulated DELs over all wind directions as well as the RMSE are depicted in Figure 14. The recalibrated DWM-Keck model delivers the lowest deviation and RMSE over all distances for the flapwise moment and the tower bottom bending moment, whereas the edgewise blade root bending moment is not improved by the recalibration. However, as mentioned in the previous section, the difference between the results of the single variations of the DWM model is very low for this load component, so that all models agree very well with the measurements of the edgewise moment with the exception of the Frandsen wake added turbulence model. The reason for this is probably that no wind speed deficit is considered in Frandsen’s model, so that the alternating load at the flapwise moment is higher due to the higher wind speed and the rotational speed of the rotor. The DWM-Egmond model overestimates the loads over all downstream distances. Towards greater downstream distances, the improvement due to the recalibration increases. Lastly, the Frandsen model overestimates the loads over all distances, in particular for close spacings.