Supplement of: Co-Variability, Not Causality, Drives Inverted-V Sensitivity Between Liquid Water Path and Droplet Concentrations

Tom Goren[1,2], Goutam Chourdhury[1], Jan Kretzschmar[2], and Isabel McCoy[3,4]

[1]Department of Environment, Planning and Sustainability, Bar-Ilan University, Israel
[2]Institute for Meteorology, Leipzig University, Leipzig, Germany
[3]Cooperative Institute for Research in Environmental Sciences, Boulder, CO, USA
[4]NOAA Chemical Sciences Laboratory, Boulder, CO, USA

Correspondence: Tom Goren (tom.goren@biu.ac.il)

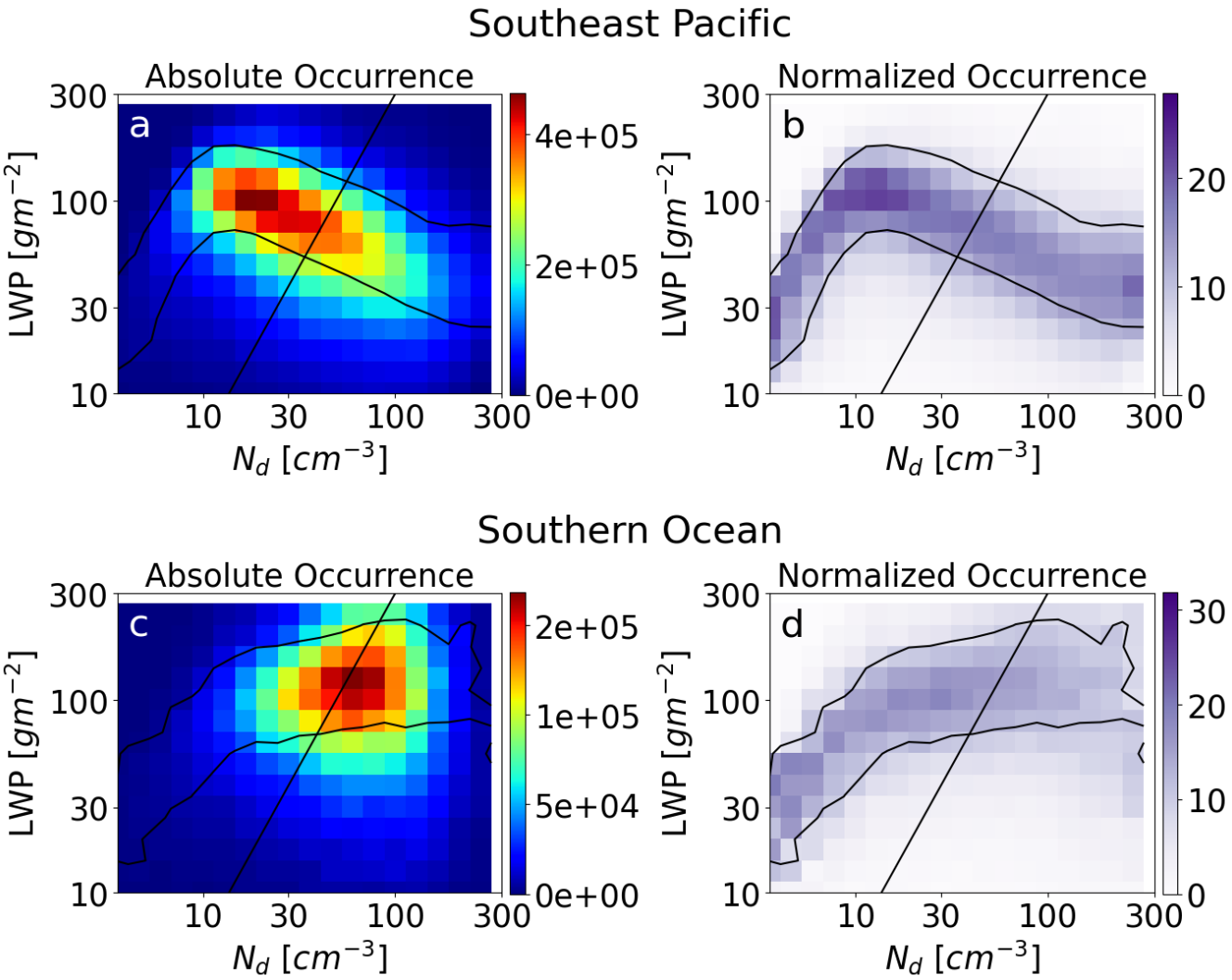

Figure S1. Joint histograms of LWP and N_{d}. Panels (a) and (b) are for the entire SEP region and panels (c) and (d) are for a small domain in the Southern Ocean (see Table A1 for region limits). Panels (a) and (c) display the absolute occurrence while panels (b) and (d) display the normalized occurrence relative to each N_{d} bin. The black curves bound the bins with at least 10% of the column-normalized observations. The diagonal line represents an effective radius of 15 μm (assuming adiabatic clouds), serving as an approximate indicator of precipitation, with precipitating clouds located to the left of the line.

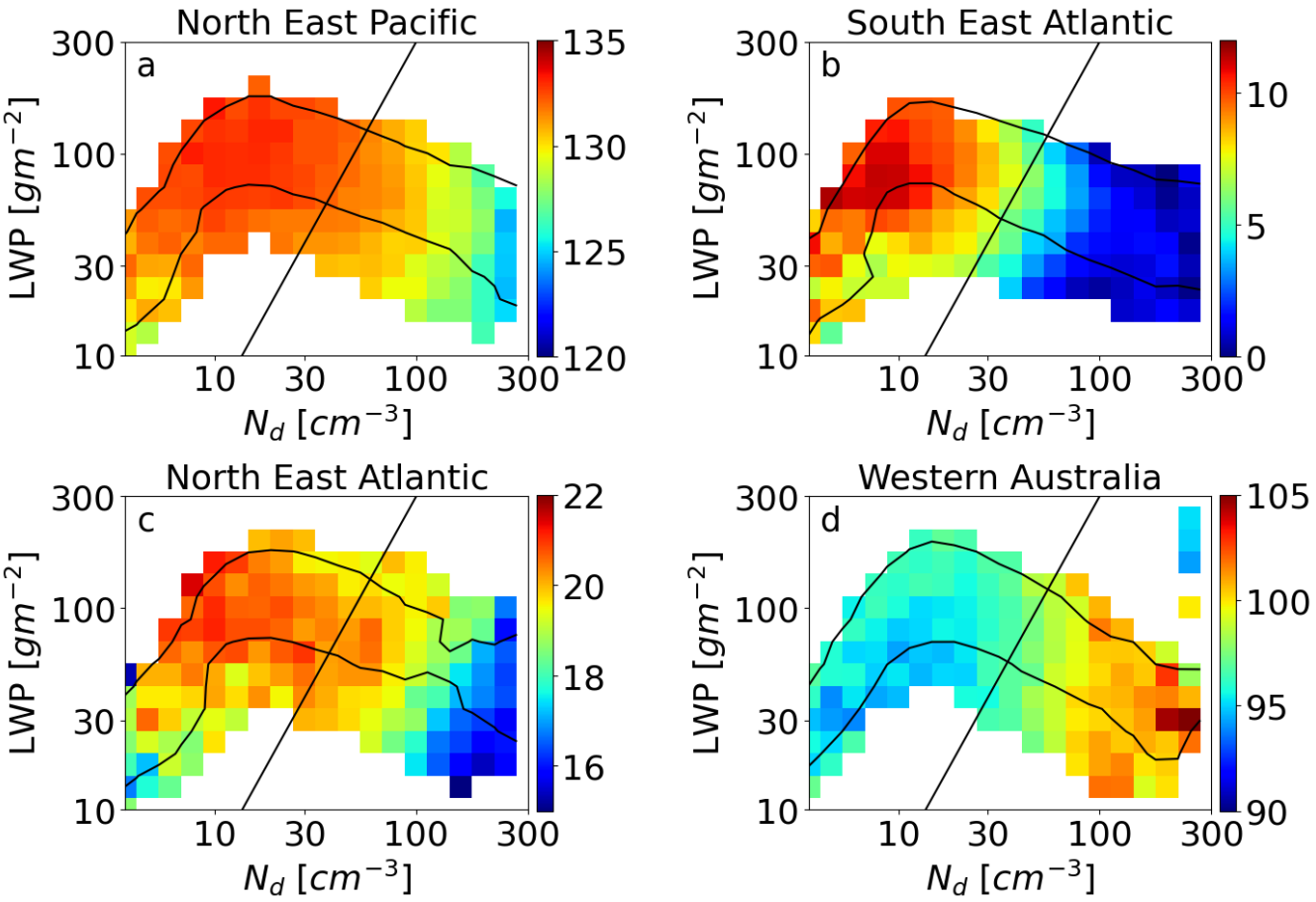

Figure S2. Joint histograms of LWP and N_{d} with mean longitude represented by color in each bin for four additional Sc regions. Note that for Western Australia, the longitude is longitude east, whereas for the other regions, it is longitude west. The *inverted-V* pattern emerges from the joint histograms of N_{d} and LWP, where each column is normalized to sum to 1. The black curves indicate the range where at least 10% of the normalized observations occur within each bin. The diagonal line represents an effective radius of 15 μm (assuming adiabatic clouds), serving as an approximate indicator of precipitation, with precipitating clouds located to the left of the line.

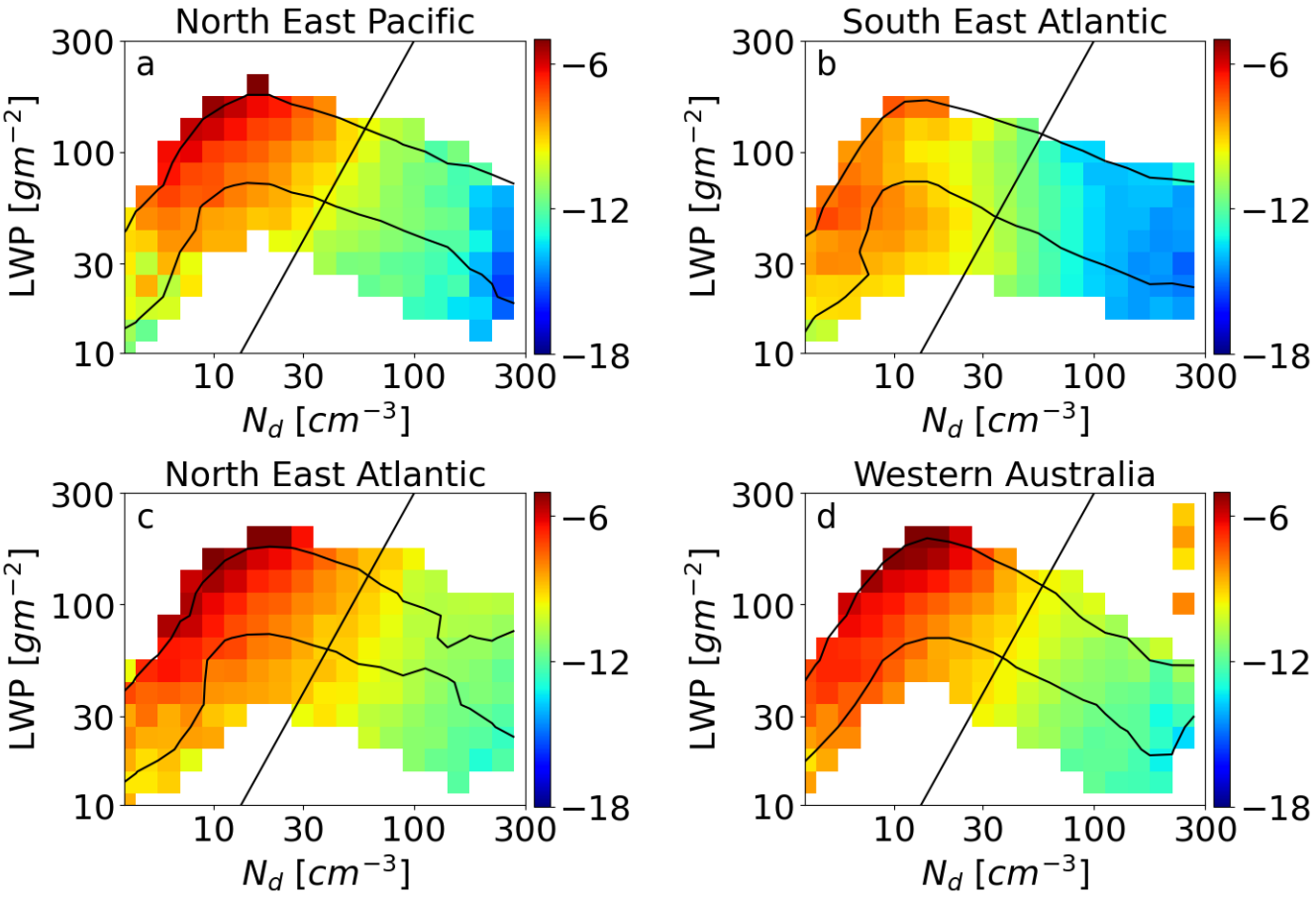

Figure S3. Same as S2 but for M. A more negative M indicates a shallower MBL, while a less negative M indicates a deeper MBL.

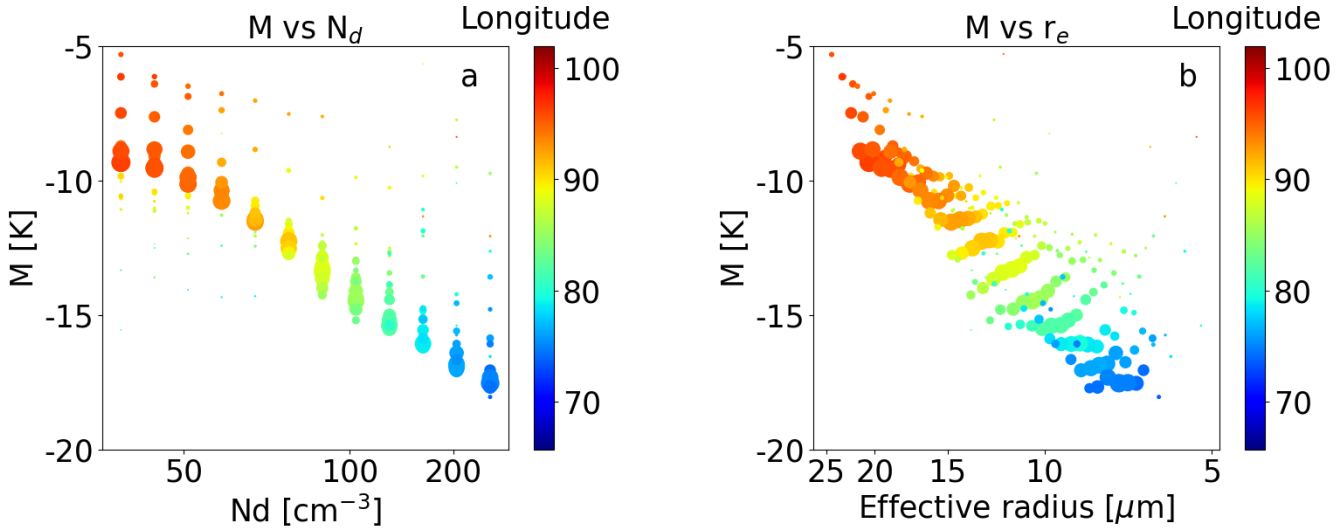

Figure S4. Correlations derived from the LWP-N_{d} joint histogram bins of the SEP. (a) M, a proxy for the MBL depth, against N_{d}. A more negative M indicates a shallower MBL, while a less negative M indicates a deeper MBL. Note the robust relationship between M and longitude (in color) with N_{d}. (b) r_{e} versus M. The increase in r_{e} with M as derived from the climatology, can be interpreted as representing temporal cloud vertical development. The color represents the mean longitude of each bin, and the size of the circles represents the relative number of scenes in each N_{d} bin.

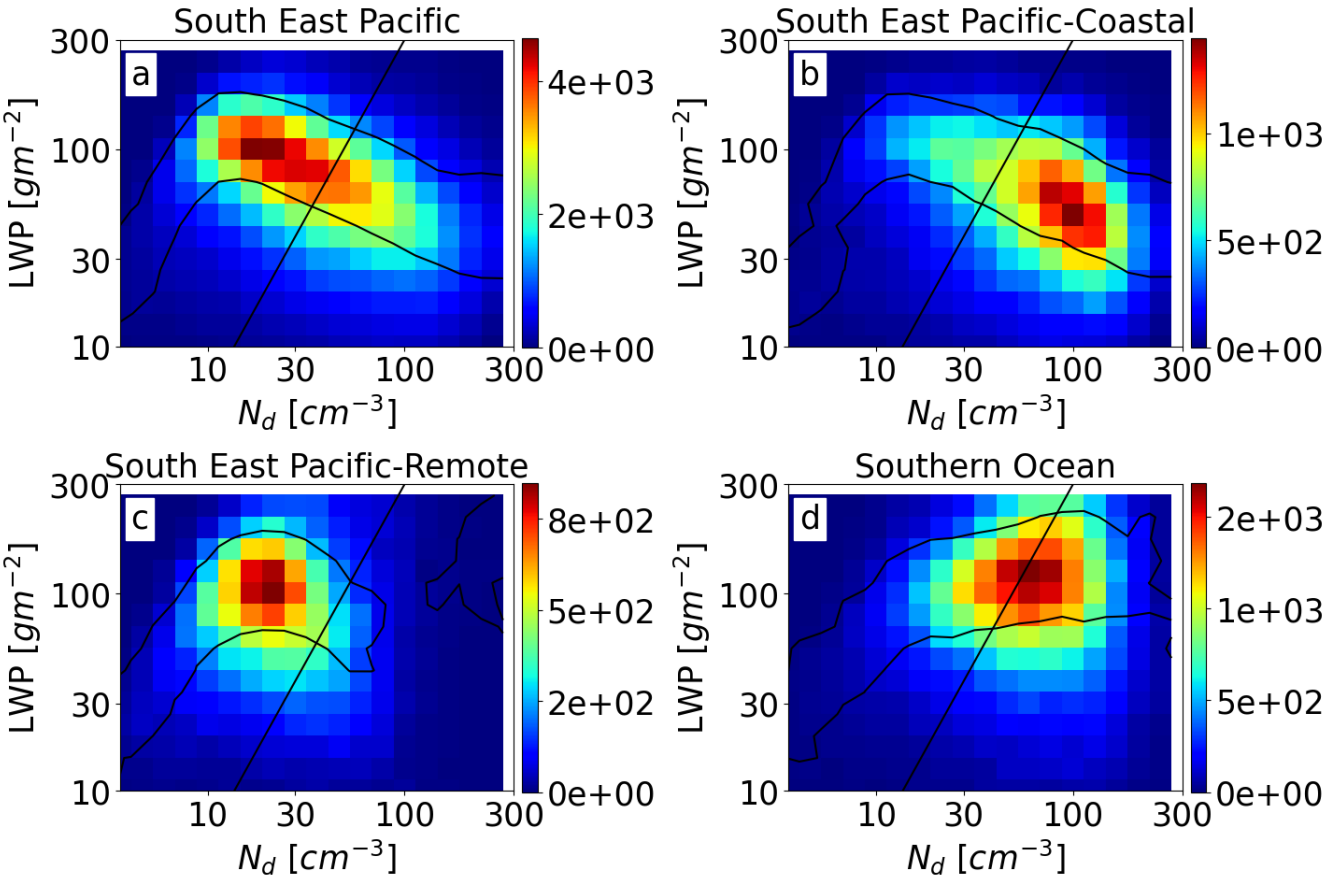

Figure S5. Joint histogram of LWP and N_{d} showing the absolute occurrence of scenes in each bin for different regions. It can be seen that low N_{d} observations in the SEP coastal region are scarce (b), whereas in the remote SEP, the opposite is true with scarce high N_{d} observations (c). Panel (a) is for the entire SEP domain. Also note the absence of co-variability between LWP and N_{d} in the Southern Ocean (d). Refer to Table 1 in the paper for the boundaries of the regions.

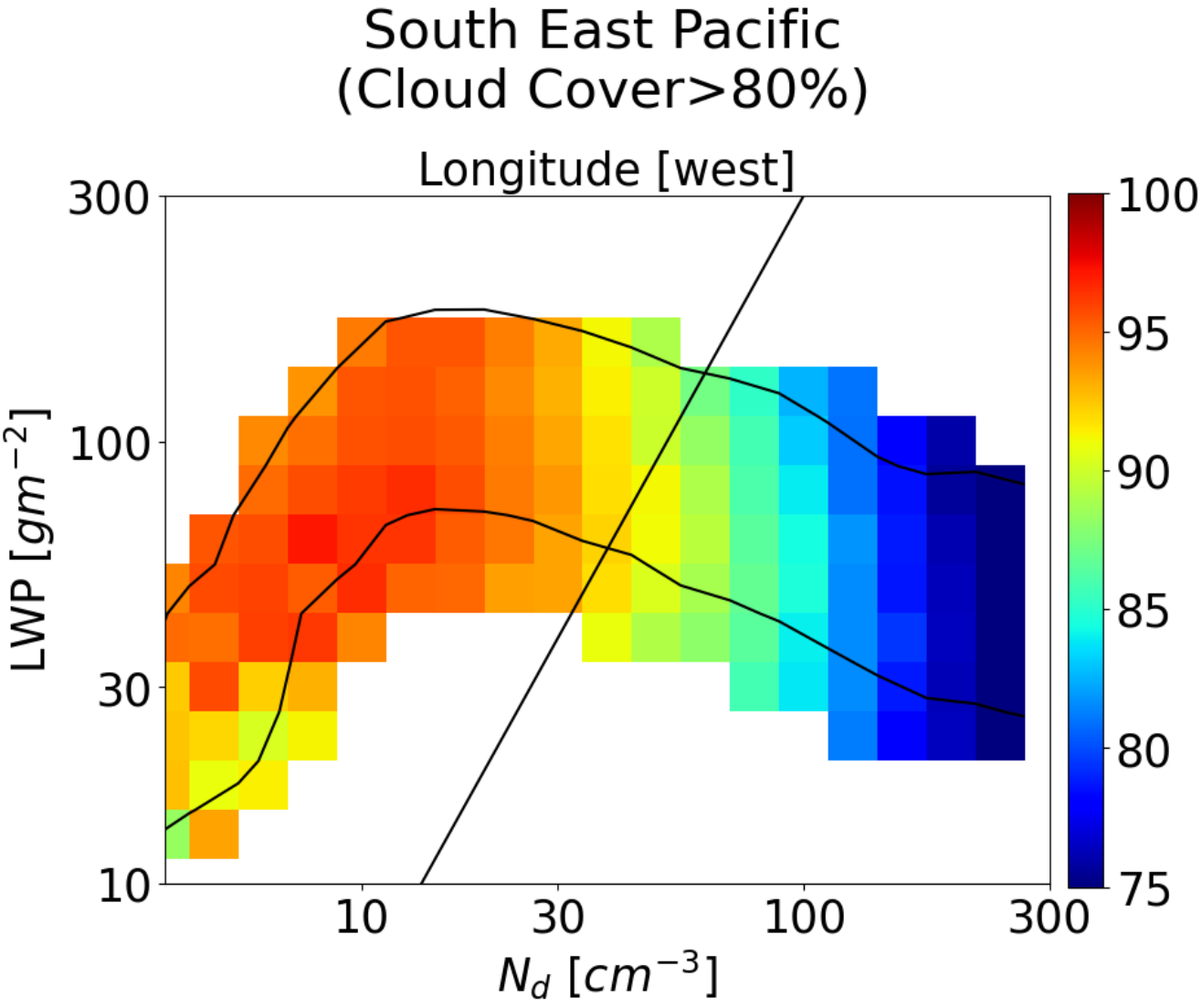

Figure S6. Same as S2 but for the SEP region and for cloud cover $>$ 80%.