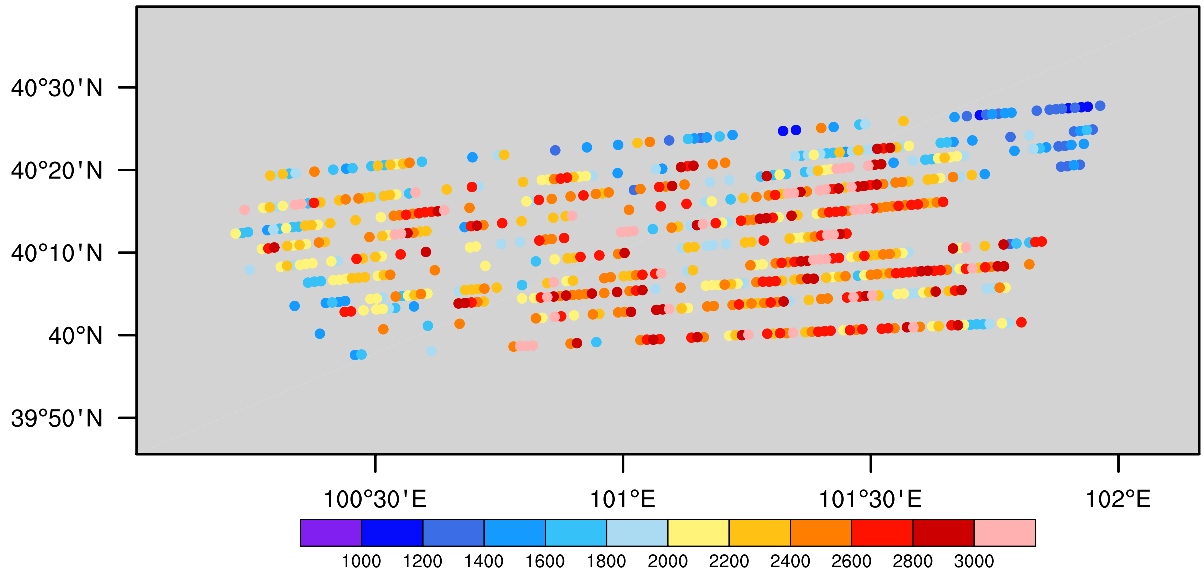

Figure S1 MINX retrieval of dust injection height (m ASL) in a dust event on 30 April, 2001 in the Gobi Desert. Trajectories are initiated from each of these points with the observed height, thus constituting a natural ensemble of dust trajectories from this particular dust plume.

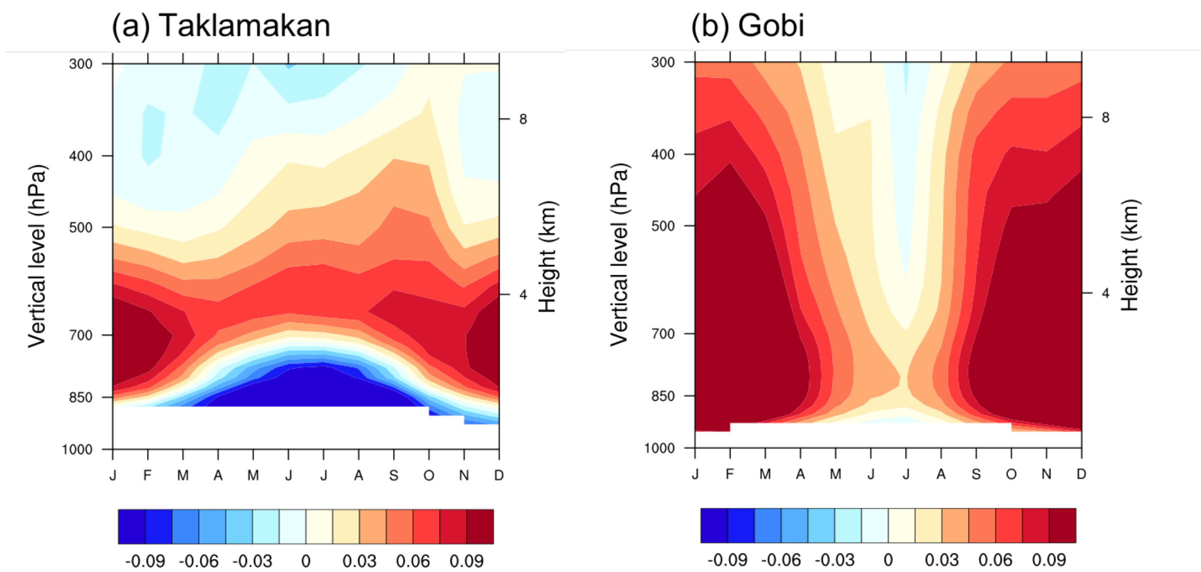

Figure S2 Climatological seasonal cycle of vertical motion (Pa s^{-1}) averaged over the (a) Taklamakan and (b) Gobi Deserts during 2000-2017. The vertical motion data is from MERRA-2 reanalysis.

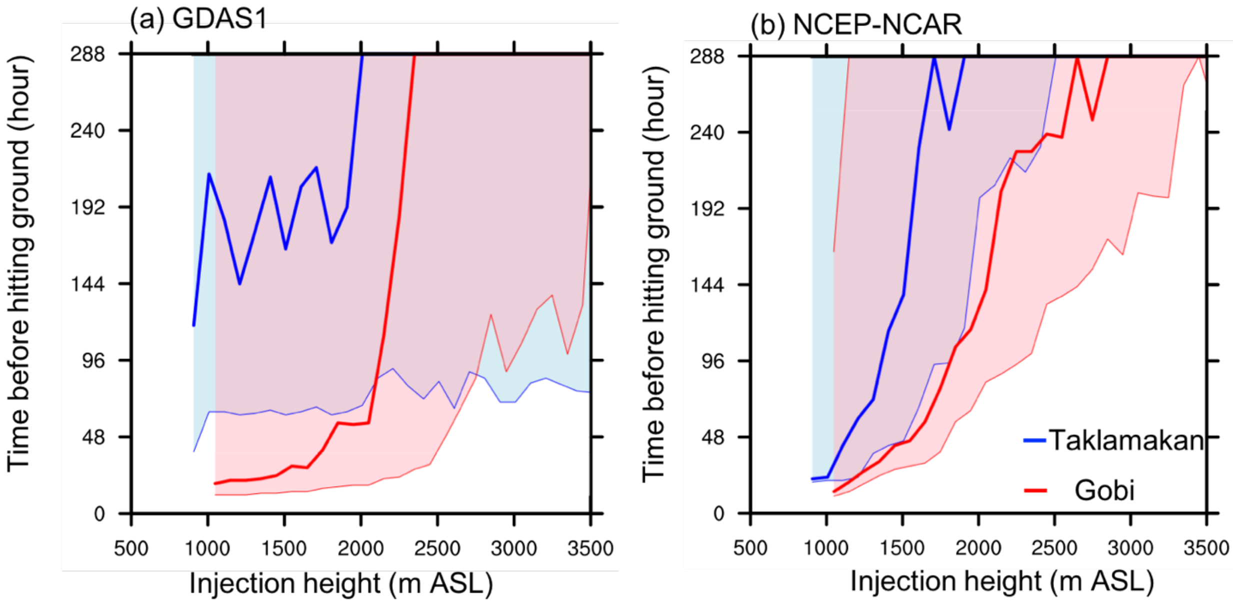

Figure S3 Atmospheric suspension time (hours) of dust particles emitted from the Taklamakan (40˚N, 89˚E, elevation = 805 m) (blue) and Gobi (43.5˚N, 130˚E, elevation = 954 m) (red) Deserts as a function of injection height (m ASL), based on trajectories in March-May of 2006-2008, driven by (a) GDAS1 and (b) NCEP-NCAR Reanalysis. The thick lines (shading) represent the median (10^{th} to 90^{th} percentiles) of suspension time among 276 trajectories for each injection height. The trajectories driven by GDAS1 confirm the NCEP-NCAR-based conclusions: (1) dust particles emitted from the Taklamakan Desert generally stay longer in the atmosphere than dust from Gobi; and (2) dust particles injected to above 2 km ASL from both deserts are likely to stay in the atmosphere for longer than 10 days, thus enabling long-range transport.

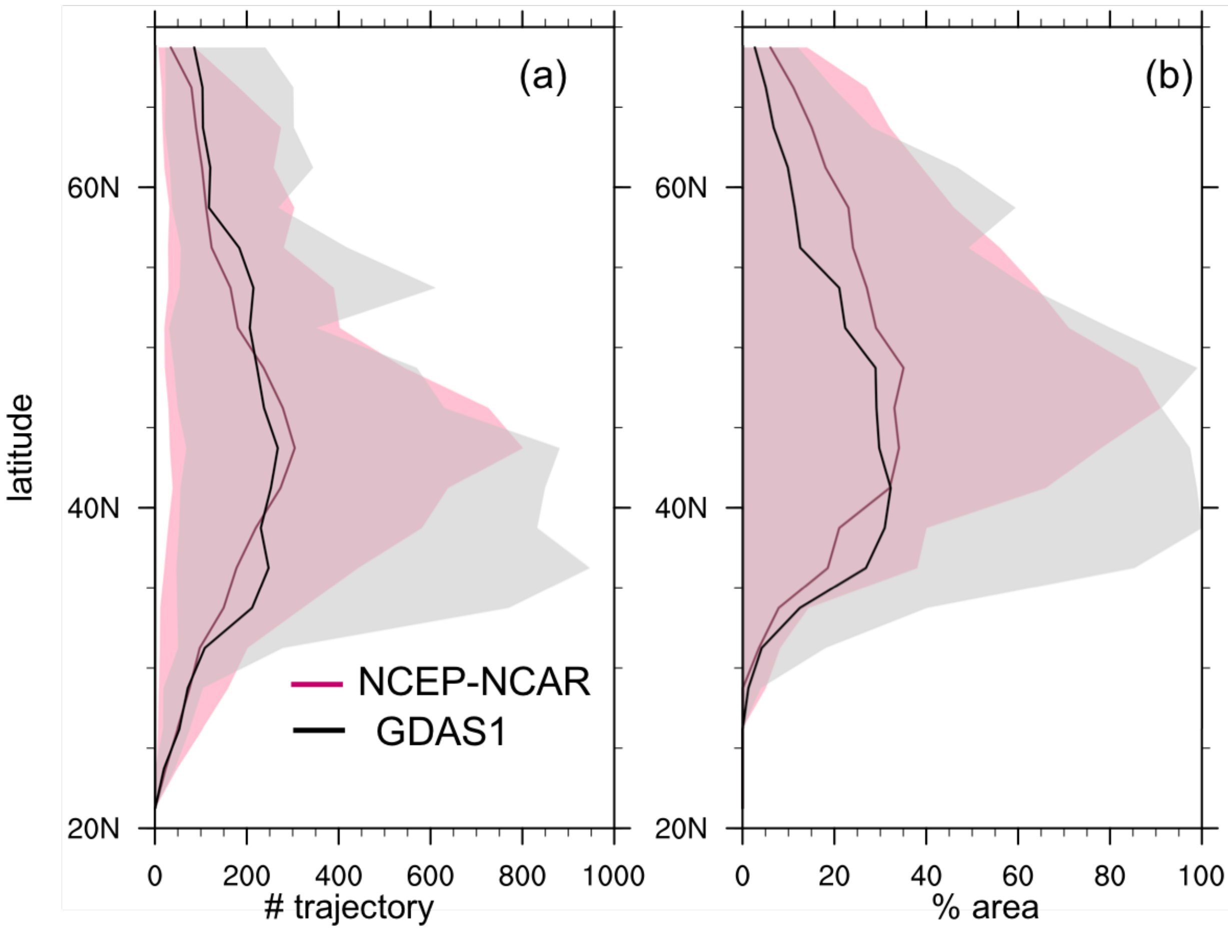

Figure S4 Influence of Taklamakan dust on North America by latitude, represented by trajectory passage during 2006-2011, driven by GDAS1 (black) and NCEP-NCAR (purple) Reanalysis. (a) Number of trajectories per year from Taklamakan that pass over each 2.5˚ latitude band. (b) Percentage of area in each 2.5˚ latitude band influenced by more than 100 trajectories per year from the Taklamakan Desert. The shadings represent maximum and minimum values during 2006-2011. The additional trajectories driven by GDAS1 conform the NCEP-NCAR-based finding regarding the latitudinal spread of dust from the Taklamakan Desert that peak around 40˚N-45˚N over North America.