



Supplement of

Estimating Twomey forcing sensitivity to aerosol plume spreading rates

Lucas A. McMichael et al.

Correspondence to: Lucas A. McMichael (mcmic@uw.edu)

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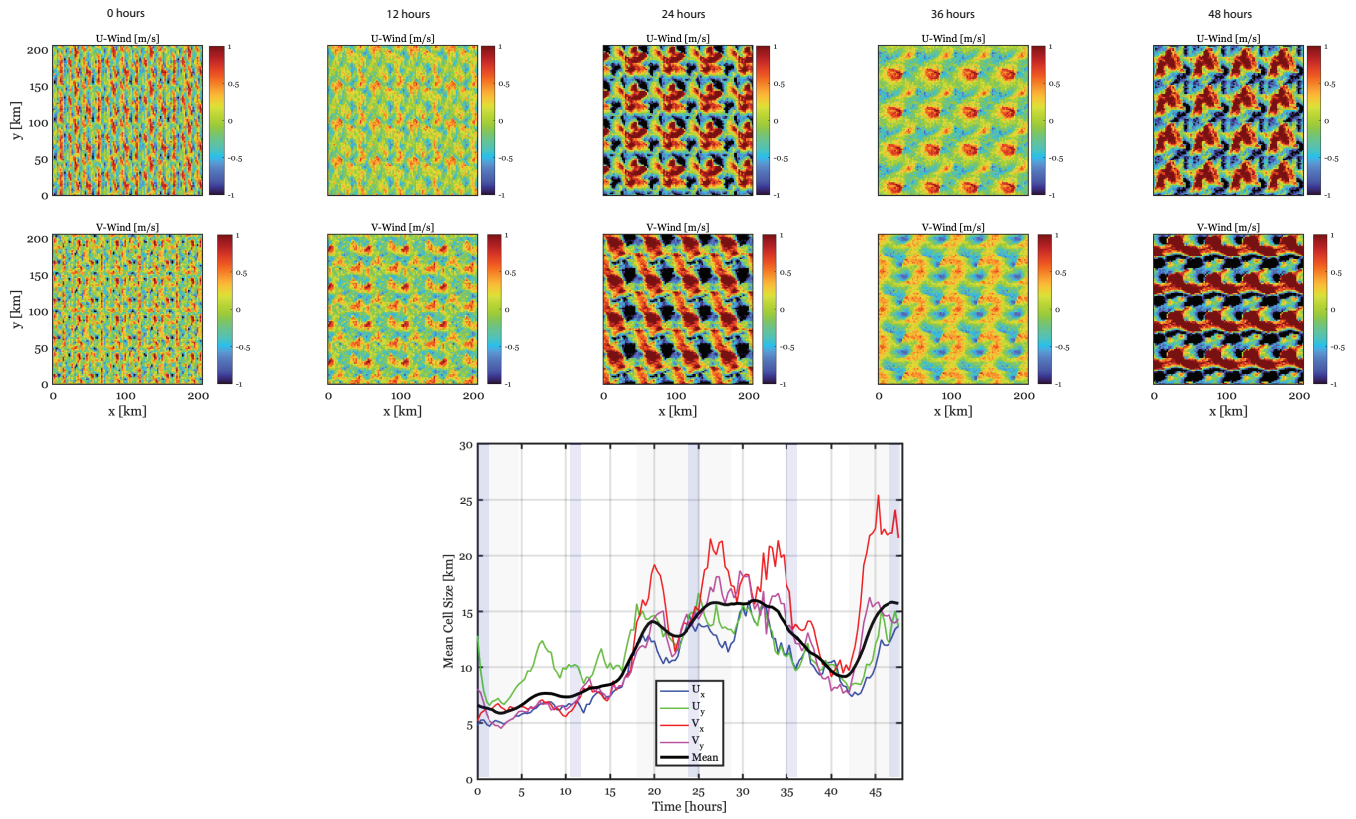


Figure S1: Top panels show U (top row) and V (bottom row) wind fields from a single LES case used to determine mesoscale cell size, starting at 0 hours on the left and increasing by 12 hour increments. The counting operation was performed on the tiled, clipped, and coarse-grained LES wind fields, using a 1 km x1 km bin which was comprised of 100 LES grid columns. The size of the mesoscale cells was determined by counting and storing the number of consecutive coarse-grained bins with a given sign and taking the median value of the consecutive bins array as the characteristic size of the flow field. This operation was performed in the x- and y-dimensions of the U and V velocity fields and the final mesoscale cell size is the average of all four of these components. An example of the characteristic cell sizes along each dimension and the mean cell size is shown in the bottom plot.

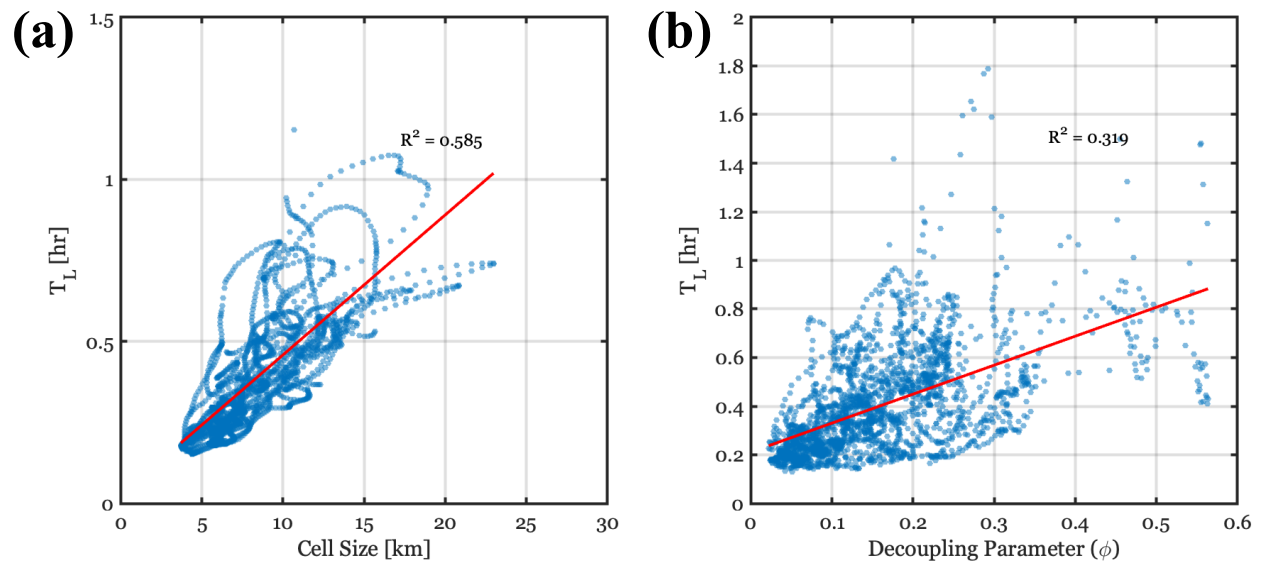


Figure S2: (a) Scatterplot showing the relationship between mesoscale cell size and the relaxation timescale, plotted at 20-minute output frequency for the 17 cases. (b) Scatterplot showing the relationship between the decoupling parameter and the relaxation timescale.

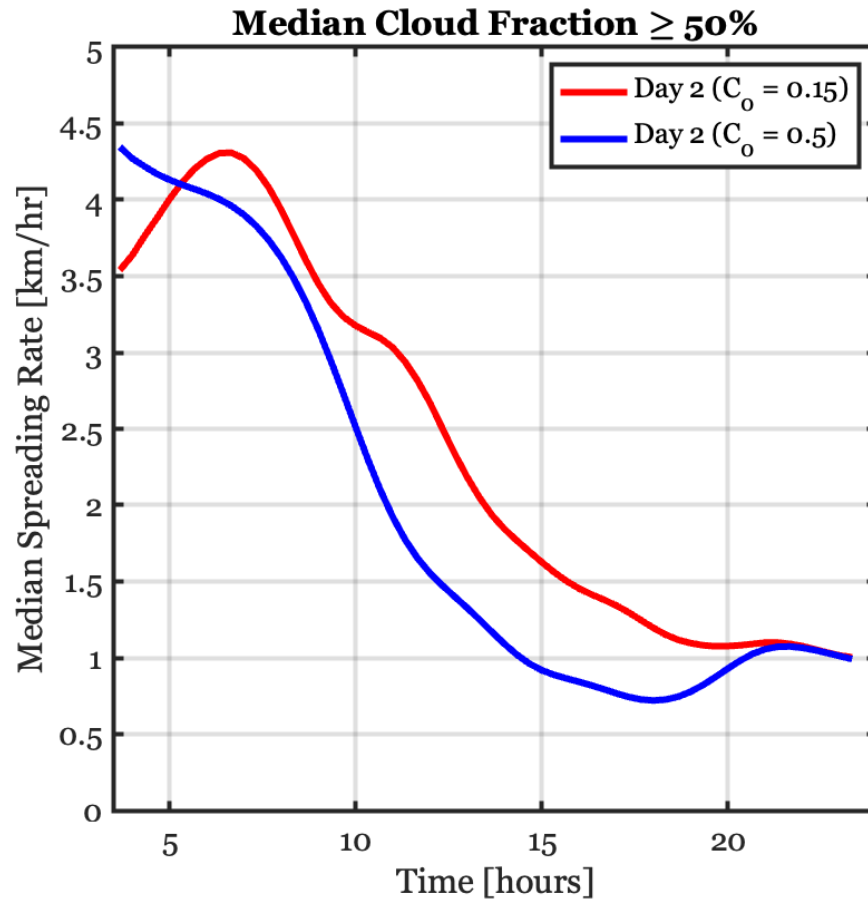


Figure S3: The ensemble median spreading rates for Day 2 simulations with C_0 values that respond to surface precipitation rate (red line) and fixed $C_0 = 0.5$ (blue line).

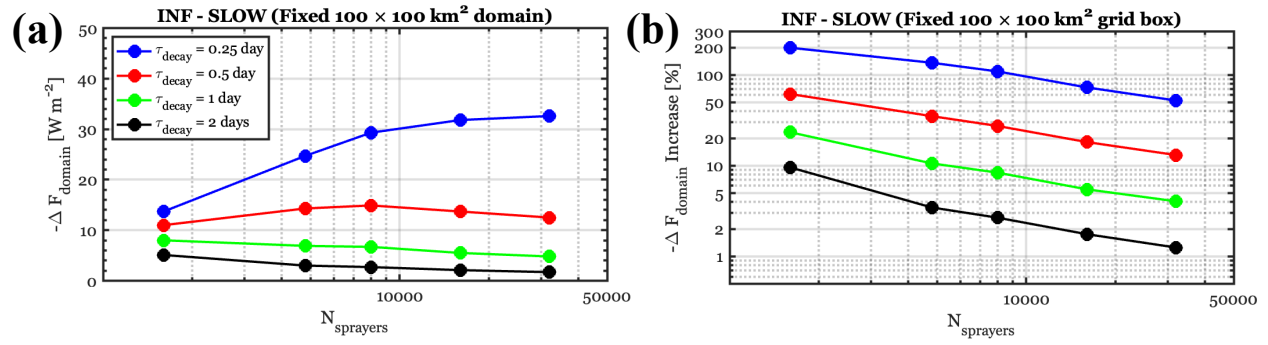


Figure S4: The theoretical maximum importance of spreading rate explored using a fixed domain size (100 x100 km²) with randomly moving point sources. Cloud fraction is assumed to be unity, background aerosol is fixed at 20 #/mg, and boundary layer depth is constant at 1 km. (a) INF-SLOW difference in domain-averaged Twomey forcing and (b) INF-SLOW percentage increase in domain-averaged Twomey forcing.

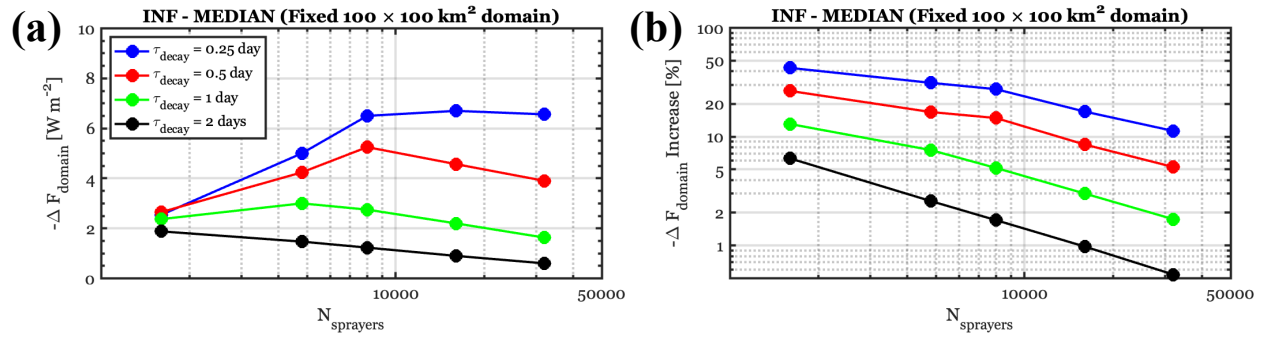


Figure S5: The expected GCM grid column errors driven solely by spreading rate assumptions, explored using a fixed domain size (100 x100 km²) with randomly moving point sources. Cloud fraction is assumed to be unity and the MEDIAN case represents median values of turbulence, precipitation, boundary layer depth, and background aerosol for Day 2 of the LES library. (a) INF-MEDIAN difference in domain-averaged Twomey forcing and (b) INF-MEDIAN percentage increase in domain-averaged Twomey forcing.