Surface jets and internal mixing during the coalescence of impacting and sessile droplets

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S1. SESSILE DROPLET EVAPORATION

As noted in Sec. II B, the sessile droplet is deposited 16 s to 24 s before coalescence. During this time, the droplet will begin to evaporate and therefore loose mass. To quantify the evaporation rates, the size of a sessile droplet for each fluid mixture was monitored over 50 s following deposition using a tensiometer. From this data, the percentage volume loss in time was determined and is displayed in Fig. S1. Only the evaporation until the point of coalescence (up to 24 s) is of interest, where the vertical dashed lines in Fig. S1 demarcate the time from deposition of the sessile droplet to coalescence.

Figure S1 shows a pure water droplet looses less than 1% of its mass before coalescence due to evaporation over the period of interest. However, the evaporation rate for the droplet mixtures increase with ethanol content since the volatility of ethanol is higher than that of water. Note that the volume (rather than mass) loss is measured and reported in Fig. S1 whilst ethanol is approx-

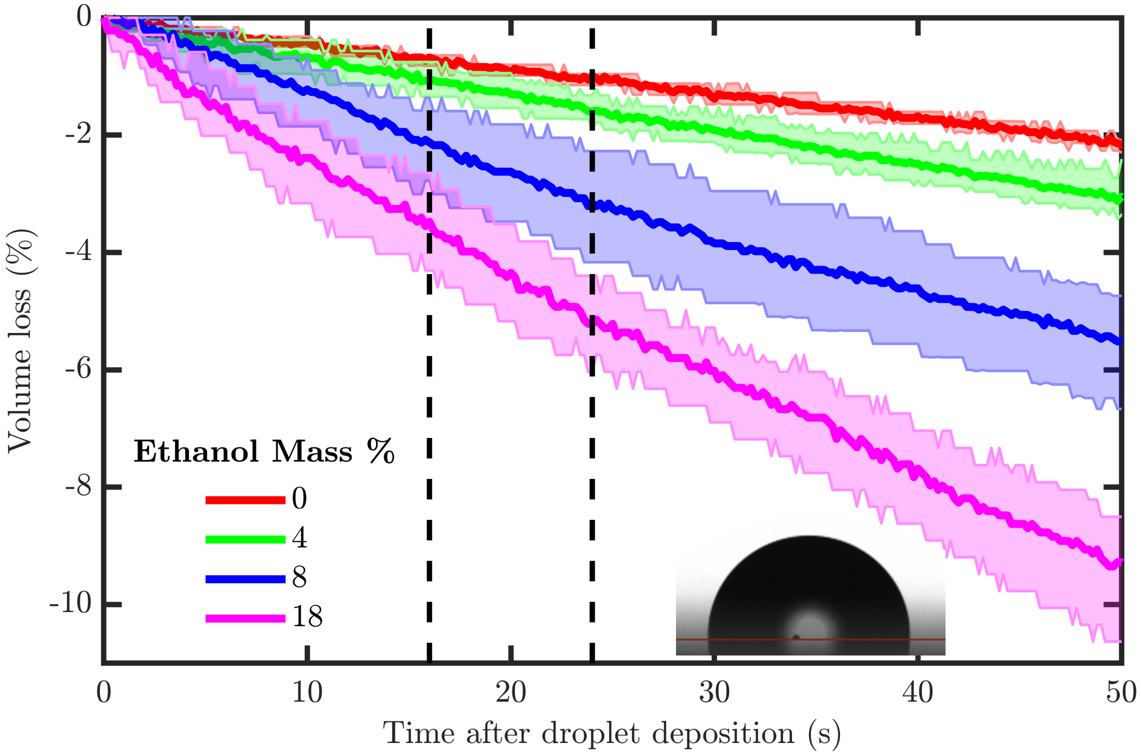

FIG. S1: Volume loss for sessile droplet of four ethanol-water mixtures in time. The precursor sessile droplet was deposited on the substrate 16 s to 24 s before the impacting droplet in the coalescence experiments (demarcated by the dashed vertical lines).

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imately 20% less dense than water, which amplifies the decrease seen. Nevertheless, evaporation does decrease the ethanol content of the sessile droplet for the larger ethanol mass percentages. However, for the smallest non-zero ethanol mass content (4%) the *mass* loss is almost identical to that of water (within experimental error) up to 24 s, indicating the relative ethanol content of the droplet does not change significantly on the time scale of interest. This case corresponds to the surface jet discussed in detail in the main text, which provides confirmation that the formation of the surface jet is not influenced by evaporation.

Figure S1 indicates a greater evaporation for the two mixtures with the largest ethanol content (8% and 18%). The change is surface tension of a pendant droplet of these fluid mixtures was measured in time, where a surface tension increase of less than 1% was observed (i.e. at most $0.4\,\mathrm{mN\,m^{-1}}$ for the 18% ethanol mixture) over the period of interest. Whilst the rate of evaporation is faster for a sessile droplet than a pendant droplet due to increased evaporation at the contact line, the minimum surface tension difference between fluid mixtures used in this work is $8\,\mathrm{mN\,m^{-1}}$. Hence sessile droplet evaporation does not affect the trends identified.

S2. VIDEO DESCRIPTIONS

AVI videos for each frame montage (Figs. 2, 7 and 9) are provided, with the descriptions of each video given below. The videos were compressed to improve download speeds and playback performance, with some resulting loss of quality. The full resolution videos and constituent frames can be obtained by emailing the authors indicated. In cases where both the side and bottom views are provided, it is recommended to add each to a PowerPoint slide and animate them such that they both play on a single click in order to view them – the frame rates are set such that the times are matched when played simultaneously. The frame rates indicate the speed of playback, but are not necessarily the individual video frame rates since some frames are skipped in certain videos to reduce their file size. The video file names are in the form `iA_sB_C_D.avi`, where `A` is the impacting droplet fluid number, `B` is the sessile droplet fluid number, `C` is the view (bottom or side) and `D` is additional identifying information.

A. Figure 2 (lateral separation)

File Name	Start Time	End Time	Frame Rate	Figure
`i2_s2_side_lat1.avi`	−10 ms	150 ms	93.75	2a
`i2_s2_bottom_lat1.avi`	−10 ms	150 ms	27	2a
`i2_s2_side_lat2.avi`	−10 ms	150 ms	93.75	2b
`i2_s2_bottom_lat2.avi`	−10 ms	150 ms	27	2b
`i2_s2_side_lat3.avi`	−10 ms	150 ms	93.75	2c
`i2_s2_bottom_lat3.avi`	−10 ms	150 ms	27	2c

B. Figure 7 (change surface jet)

File Name	Start Time	End Time	Frame Rate	Figure
`i2_s2_side_alter.avi`	−10 ms	200 ms	125	7a
`i2_s2_bottom_alter.avi`	−10 ms	200 ms	36	7a
`i3_s2_side_alter.avi`	−10 ms	200 ms	125	7b
`i3_s2_bottom_alter.avi`	−10 ms	200 ms	36	7b
`i2_s3_side_alter.avi`	−10 ms	200 ms	125	7c
`i2_s3_bottom_alter.avi`	−10 ms	200 ms	36	7c

C. Figure 9 (long term mixing)

File Name	Start Time	End Time	Frame Rate	Figure
`i3_s1_bottom_mix.avi`	−20 ms	800 ms	120	9a
`i1_s3_side_mix.avi`	−15 ms	600 ms	375	9b
`i1_s3_bottom_mix.avi`	−15 ms	600 ms	108	9b
`i2_s3_bottom_mix.avi`	−20 ms	800 ms	160	9c
`i3_s3_bottom_mix.avi`	−20 ms	400 ms	90	9d
`i4_s3_bottom_mix.avi`	−20 ms	800 ms	120	9e

S3. RAW DATA

Tables of values are provided as `.txt` files for the data points included in the following figures: vertical position (Fig. 5); horizontal position (Fig. 6); regime map (Fig. 8). Note that these files contain headers which include the command to import them into `MATLAB`.