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Observing entrainment mixing, photochemical ozone production, and regional methane emissions by aircraft using a simple mixed-layer framework

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	dzi/dt (cm s ⁻¹)	Sfc-P Tend (cm s ⁻¹)	Omega (cm s ⁻¹)	W (cm s ⁻¹)	z_i advection (cm s ⁻¹)	w_e (cm s ⁻¹)
1/16/13	1.10(0.29)	-0.16 (0.01)	0.8(0.5)	-1.0(0.5)	0.08(0.12)	2.08(0.59)
1/18/13	1.10(0.60)	-0.16(0.01)	0.4(0.5)	-0.6(0.5)	0.05(0.42)	1.69(0.89)
1/20/13	0.60(0.63)	-0.16(0.01)	0.8(0.5)	-1.0(0.5)	0.04(0.20)	1.56(0.83)
1/21/13	0.70(0.22)	-0.11(0.01)	-0.9(0.5)	0.9(0.5)	0.07(0.06)	-0.21(0.55)
1/22/13	1.9(0.49)	-0.16(0.01)	-0.1(0.5)	1.1(0.5)	-0.21(0.95)	0.96(1.18)
1/30/13	3.6(0.58)	-0.05(0.01)	-1.7(0.5)	1.6(0.5)	-0.44(0.14)	2.39(0.77)
2/4/13	1.4(0.60)	-0.21(0.01)	0.5(0.5)	-0.8(0.5)	0.06(0.10)	2.13(0.80)
Averages	1.5(0.49)	-0.14(0.01)	-0.0(0.5)	-0.0(0.5)	-0.05(0.14)	1.51(0.80)
Std Dev of avg	1.0	0	0.11	1.14	0.2	0.89
6/26/13	1.20(0.39)	-0.12(0.01)	0.3(0.5)	-0.4(0.5)	0.75(1.20)	0.86(1.36)
6/27/13	3.8(0.72)	-0.12(0.01)	-2.7(0.5)	2.5(0.5)	-0.20(1.32)	1.51(1.59)
6/28/13	4(1.2)	-0.18(0.01)	-1.5(0.5)	1.3(0.5)	-1.67(3.28)	4.69(3.52)
8/13/13	4.10(0.35)	-0.17(0.01)	-0.8(0.5)	0.6(0.5)	-1.47(1.50)	4.98(1.62)
8/14/13	2.40(0.79)	-0.12(0.01)	-1.7(0.5)	1.5(0.5)	-4.24(2.64)	5.14(2.80)
8/15/13	2.50(0.75)	-0.11(0.01)	-2.6(0.5)	2.5(0.5)	-1.03(0.70)	1.10(1.14)
9/28/13	1.20(0.02)	-0.17(0.01)	0.1(0.5)	-0.3(0.5)	0.00(0.02)	1.45(0.50)
9/29/13	2.8(0.47)	-0.17(0.01)	-1.9(0.5)	1.7(0.5)	-0.02(0.10)	1.05(0.69)
9/30/13	3.0(0.46)	-0.17(0.01)	-1.1(0.5)	0.9(0.5)	0.81(2.51)	1.23(2.60)
6/8/14	5.0(0.85)	-0.12(0.01)	-1.4(0.5)	1.2(0.5)	-0.70(0.34)	4.41(1.05)
6/9/14	3.0(1.00)	-0.21(0.01)	-1.5(0.5)	1.2(0.5)	-4.84(5.84)	6.52(5.95)
Averages	3.00(0.63)	0.15(0.01)	1.3(0.5)	1.2(0.5)	2.30(1.77)	2.99(2.07)
Std Dev of avg	1.2	0.01	0.1	0.93	1.9	2.1

Table S1: Entrainment rate table for both studies (DISCOVER-AQ in the winter of 2013 near Fresno, and the Arvin O3 study in the summers of 2013/14 near Bakersfield), z_i budget terms, the surface pressure tendency, omega at the level nearest the observed ABL height (from the NARR data set), and subsidence. The surface pressure tendency and omega values are corrected to linear speeds via the hydrostatic approximation for the sake of comparison. Values in parentheses represent estimates of each term's 1 σ uncertainty.

	dO3/dt (ppb h⁻¹)	O3 Advec (ppb h⁻¹)	Dep O3 (ppb h⁻¹)	Ent O3 (ppb h⁻¹)	Δ O3 (ppb)	Photo Prod. (ppb h⁻¹)	Avg O3 ABL (ppb)
1/16/13	0.70(0.002)	-0.02(0.01)	-0.9(0.59)	-0.8(0.32)	-5(1.0)	2.3(0.92)	38(1.5)
1/18/13	1.09(0.003)	-0.05(0.05)	-1.0(0.75)	-0.5(0.28)	-4(1.0)	2.6(1.1)	42(1.5)
1/20/13	0.72(0.002)	0.25(0.09)	-1.0(0.76)	-0.60(0.34)	-6(1.0)	2(1.2)	46(1.5)
1/21/13	1.15(0.003)	0.25(0.05)	-1.31(4.08)	0.1(0.37)	-8(1.0)	2.(4.5)	52(1.5)
1/22/13	0.97(0.005)	-0.37(0.03)	-1.0(1.2)	-0.2(0.27)	-5(1.0)	3(1.5)	53(1.5)
1/30/13	2.21(0.001)	0.11(0.02)	-0.70(0.44)	-0.1(0.26)	-5(1.0)	3.4(0.72)	40(1.5)
2/4/13	2.19(0.003)	0.02(0.03)	-0.9(0.59)	-0.8(0.36)	-7(1.0)	3.9(0.98)	46(1.5)
Averages	1.29(0.003)	0.03(0.04)	-1.0(1.20)	-0.4(0.31)	-6(1.0)	3(1.6)	45(1.5)
Std Dev of Avg	0.64	0.21	0.21	0.35	1.4	0.68	5.7
6/26/13	2.48(0.002)	-2.20(0.16)	-0.80(0.75)	-6.6(0.73)	-40(1)	12(1.7)	60(1.5)
6/27/13	3.72(0.002)	-1.0(0.12)	-0.80(0.68)	-1.8(0.57)	-20(1)	7(1.4)	57(1.5)
6/28/13	3.12(0.002)	-1.50(0.13)	-1.0(0.60)	-1.2(0.66)	-16(1)	7(1.4)	73(1.5)
8/13/13	1.18(0.001)	-9.9(0.22)	-1.2(0.64)	-1.9(0.28)	-8(1)	14(1.1)	72(1.5)
8/14/13	2.35(0.002)	-2.5(0.23)	-1.3(0.71)	-1.0(0.40)	-10(1)	7(1.3)	79(1.5)
8/15/13	2.68(0.002)	-5.0(0.30)	-1.0(1.5)	-2.3(0.50)	-13(1)	12(2.4)	77(1.5)
9/28/13	3.71(0.001)	-0.66(0.06)	-1.3(0.82)	-2.3(0.24)	-10(1)	8(1.1)	61(1.5)
9/29/13	2.14(0.001)	0.23(0.03)	-2.0(1.6)	-1.8(0.26)	-6(1)	5(1.9)	66(1.5)
9/30/13	4.77(0.001)	-0.29(0.03)	-0.7(0.60)	-1.3(0.17)	-5(1)	7(0.80)	37(1.5)
6/8/14	2.73(0.002)	1.6(0.11)	-1.2(0.69)	-1.8(0.41)	-10(1)	4(1.2)	77(1.5)
6/9/14	1.65(0.002)	-0.34(0.07)	-1.5(0.81)	-2.8(0.51)	-10(1)	6(1.4)	92(1.5)
Averages	2.78(0.002)	-2.0(0.13)	-1.2(0.86)	-2.2(0.43)	-14(1)	8(1.4)	68(1.5)
Std Dev of Avg	1.0	2.1	0.3	1.5	9.8	3.1	15

Table S2: Ozone Budgets for the DISCOVER–AQ mission (top) and the ArvinO3 mission (below). Values in parentheses represent estimates of 1 σ uncertainties in each measurement.

	dCH₄/dt (ppb h⁻¹)	CH₄ advec (ppb h⁻¹)	CH₄Ent Flux (ppb h⁻¹)	Δ CH₄ (ppb)	CH₄ Emission (Ggrams y⁻¹)	Avg CH₄ ABL (ppb)
1/16/13	23(6)	0(0.4)	-56(46)	-400(50)	240(140)	2130(20)
1/18/13	26(1.3)	4(1.6)	-24(24)	-200(50)	130(80)	2230(20)
1/20/13	-2.9(0.9)	8(1.4)	-30(31)	-300(50)	58(103)	2210(20)
1/21/13	-10(9)	6(4.3)	0.0(21)	-400(50)	-58(74)	2310(20)
1/22/13	-139(1.8)	-10(10)	-20(24)	-300(50)	53(110)	2290(20)
1/30/13	25.4(0.8)	-1(1.3)	-20(21)	-200(50)	200(97)	2020(20)
2/4/13	-0.3(0.5)	4(2.1)	-24(21)	-200(50)	70(87)	2070(20)
Averages	-11(1)	1(3)	-24(22)	-290(50)	100(99)	2180(20)
Std Dev of Avg	60	10	20	90	100	110
6/26/13	0.4(0.1)	-6(9.1)	-4(5)	-160(50)	250(96)	1900(20)
6/27/13	-1.4(0.1)	-5(4.7)	-7(8)	-150(50)	260(79)	1870(20)
6/28/13	-14.0(0.4)	-13(4.9)	-13(12)	-100(50)	280(120)	1920(20)
8/13/13						
8/14/13						
8/15/13						
9/28/13	-10.5(0.4)	-5.0(8.6)	-13(11)	-210(50)	120(89)	2080(20)
9/29/13	-1.9(0.3)	10(12)	-10(12)	-190(50)	16(91)	2070(20)
9/30/13	-6.6(0.3)	5(14)	-11(10)	-220(50)	-25(120)	1940(20)
6/8/14	-25.0(0.6)	-11(2.2)	-21(14)	-150(50)	150(97)	2080(20)
6/9/14	-15.0(0.4)	-4.0(3.0)	-25(18)	-120(50)	300(110)	2080(20)
Averages	-9.2(0.3)	-4.0(7.0)	13(11)	-160(50)	170(100)	1990(20)
Std Dev of Avg	10	10	10	40	125	90

Table 3: Methane Budgets for the DISCOVER–AQ mission (top) and the ArvinO3 mission (below). Values in parentheses represent estimates of 1 σ uncertainties in each measurement.