## Ozonesonde launches from the University of Houston and Smith Point in support of DISCOVER-AQ

Gary A. Morris

Assoc. Dean of Arts & Sciences
Professor of Physics & Astronomy

AQRP Workshop
Pickle Research Campus
University of Texas
Austin, Texas
Thursday, 14 November 2013

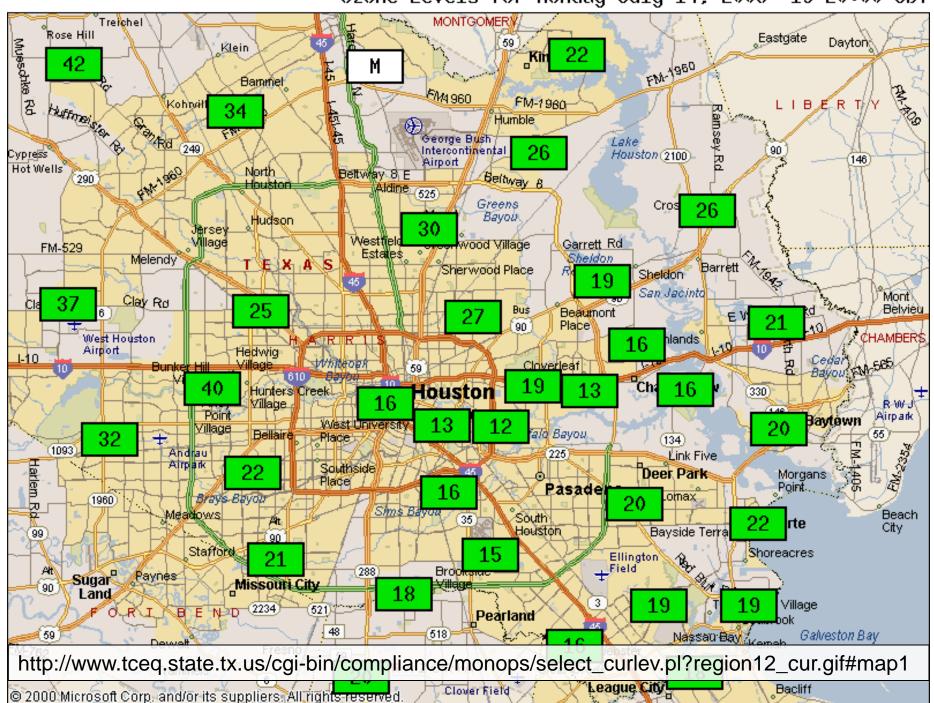




# **Project Outline**

- Funded for 30 ozonesonde launches from Smith Point and/or the University of Houston
- Calculate HYSPLIT back trajectories for each flight from 0.5, 1.0, 1.5, 2.0, 2.5, and 3.0 km.
- Provide links to supporting met data.
- Provide balloon trajectory info.
- Provide ascii text files with all data
- Develop an understanding of the context of the last decade to interpret and understand 2013

Ozone Levels for Monday July 14, 2008 19-20:00 CDT

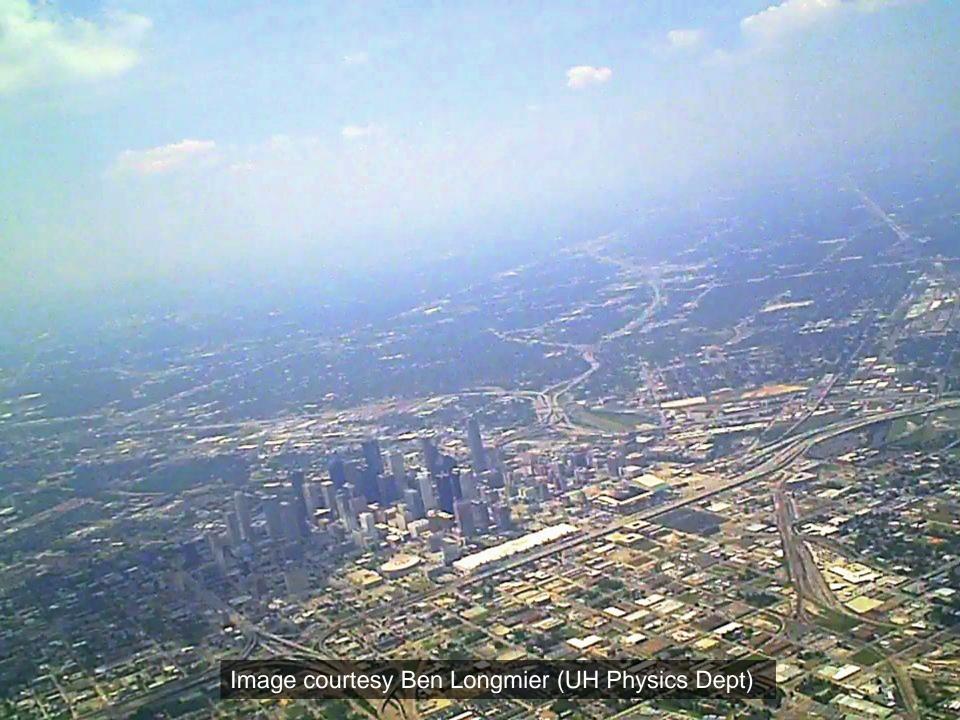




# Launch from the University of Houston

Courtesy H. Selkirk (NASA GSFC)

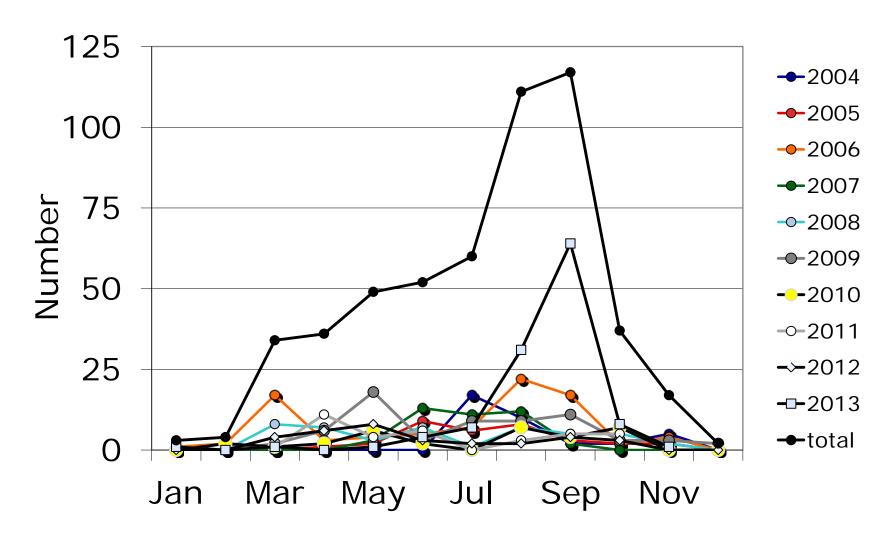








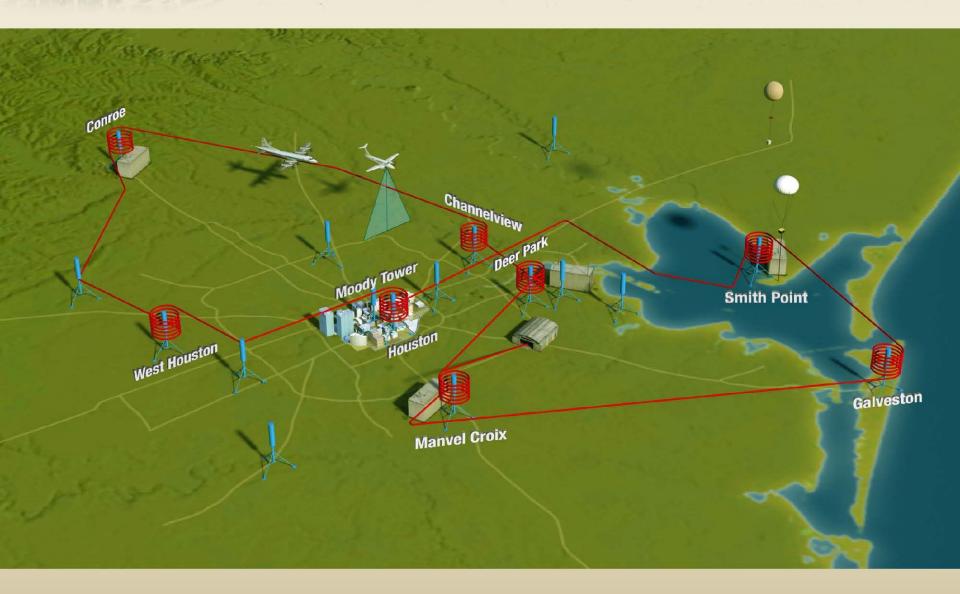
#### **Houston Launches**



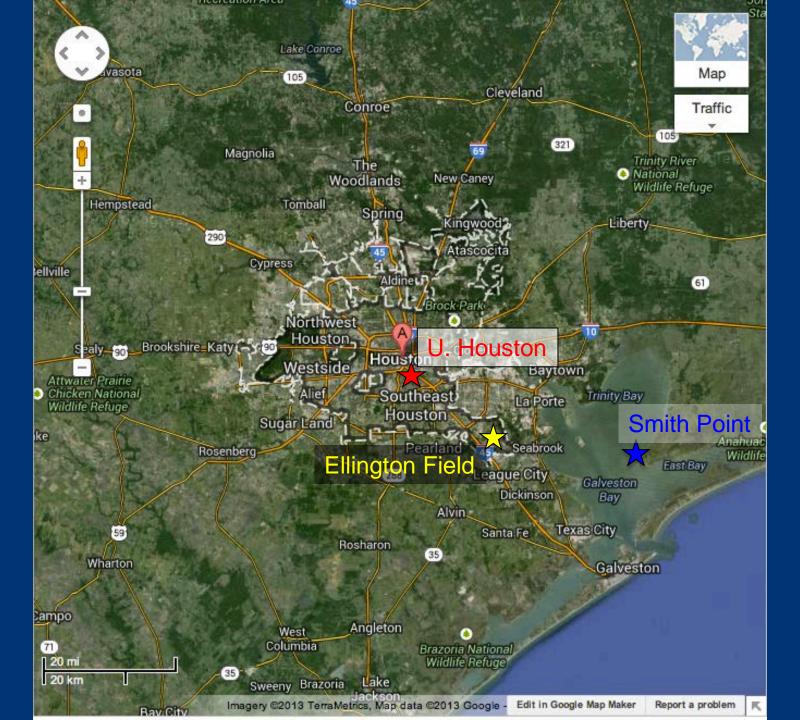


### **Observing Strategy for Houston**



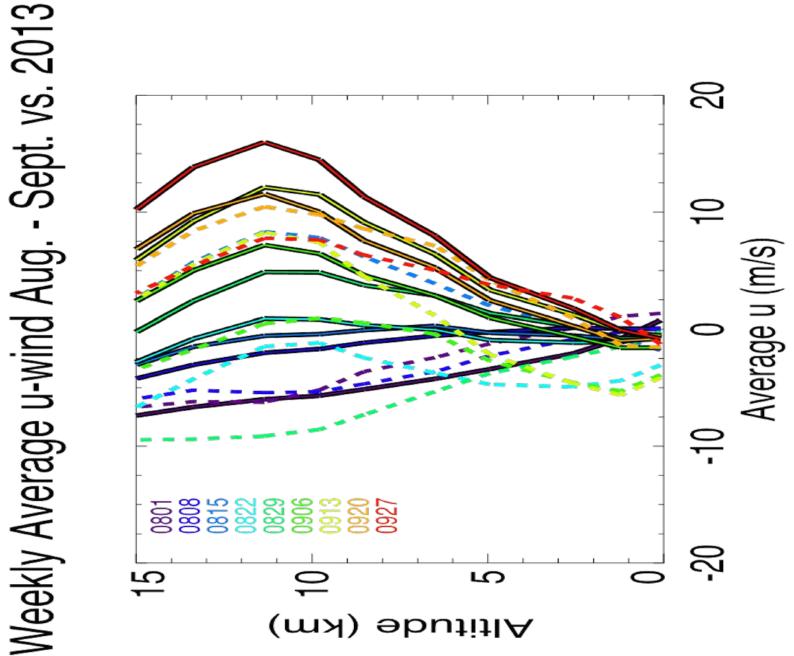


Courtesy James Crawford, NASA LARC

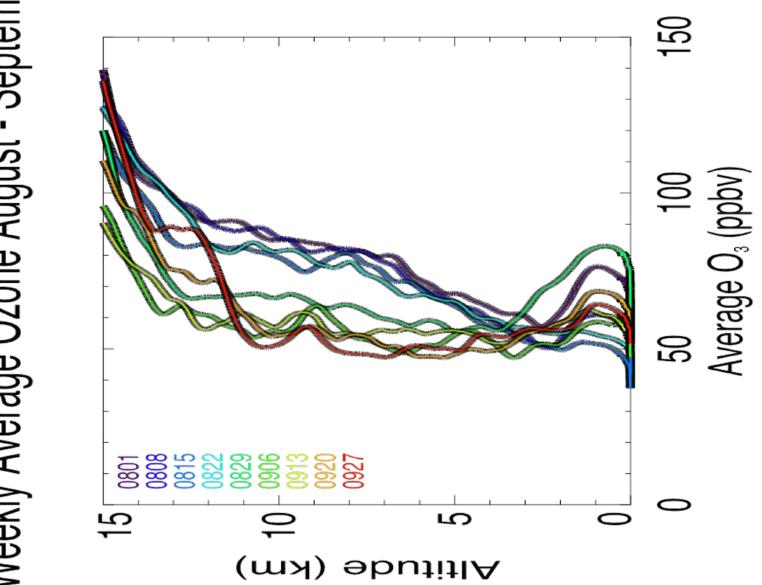


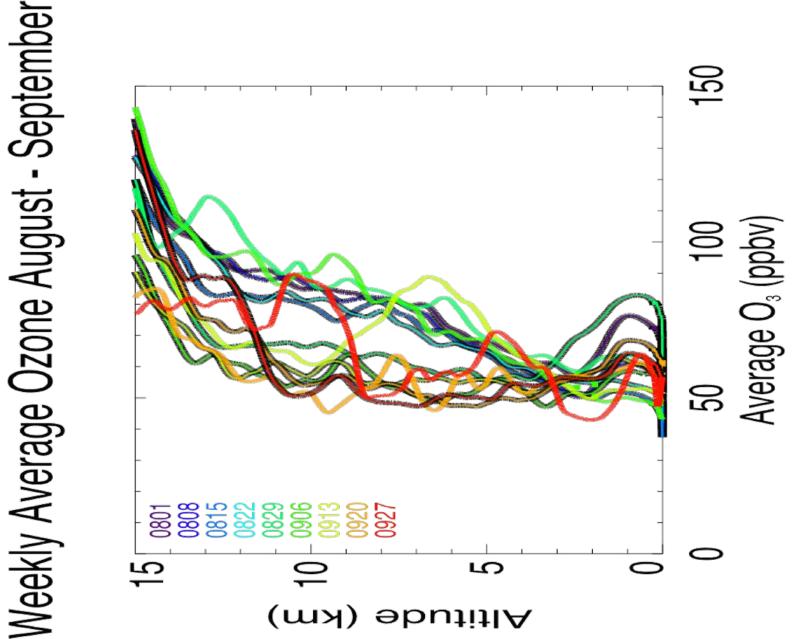
September 2013						◀   Today   ▶
Sun 1  Smith Point - 9 pm	Mon 2  NASA Aircraft arrive  Smith Point - 1 pm  UH Sonde - 2 pm	Tue 3  Smith Point - 2 pm  UH Sonde - 2 pm	Wed 4  NASA Aircraft Flight Day  Smith Point - 9 am Smith Point - 1 pm UH Sonde - 2 pm EFD sonde - 4 pm EFD sonde - 7 pm	Thu 5  Smith Point - 1 pm  UH Sonde - 2 pm	Fri 6  NASA Aircraft Flight Day  Smith Point - 10 am  UH Sonde - 12 pm  Smith Point - 2 pm  EFD sonde - 8 pm	Sat 7  Smith Point - 2 pm
Smith Point - 2 pm	OUH Sonde - 2 pm Smith Point - 2 pm EFD sonde - 6 pm	• UH Sonde - 2 pm	NASA Aircraft Flight Day Smith Point - 9 am UH Sonde - 1 pm Smith Point -3 pm EFD sonde - 6 pm	NASA Aircraft Flight Day Smith Point - 9 am UH Sonde - 1 pm Smith Point -3 pm	NASA Aircraft Flight Day Smith Point - 9 am UH Sonde - 1 pm Smith Point - 2 pm EFD sonde - 5 pm	NASA Aircraft Flight Day UH Sonde - 2 pm Smith Point - 2 pm
UH Sonde - 1 pm Smith Point - 2 pm	© Smith Point - 2 pm	Smith Point - 1 pm     UH Sonde - 2 pm	NASA Aircraft Flt Day - Abort     Smith Point - 9 am     Smith Point - 2 pm     UH Sonde - 2 pm	● Smith Point - 2 pm	20	• UH Sonde - 2 pm
UH Sonde - 1 pm Smith Point - 2 pm	UH Sonde - 1 pm     Smith Point - 1 pm	O NASA Aircraft Flight Day Smith Point - 9 am Smith Point - 2 pm UH Sonde - 2 pm	NASA Aircraft Flight Day     Smith Point - 9 am     Smith Point - 2 pm     UH Sonde - 2 pm	O NASA Aircraft Flight Day UH Sonde - 7 am Smith Point - 9 am Smith Point - 12 pm UH Sonde - 2 pm Smith Point - 3 pm	© Smith Point - 9 am UH Sonde - 12 pm Smith Point - 2 pm	28

Weekly Average u-wind Aug. - Sept. 2 0801 0808 0815 0822 0823 0906 0913 0920 0927 2 5 S Altitude (km)

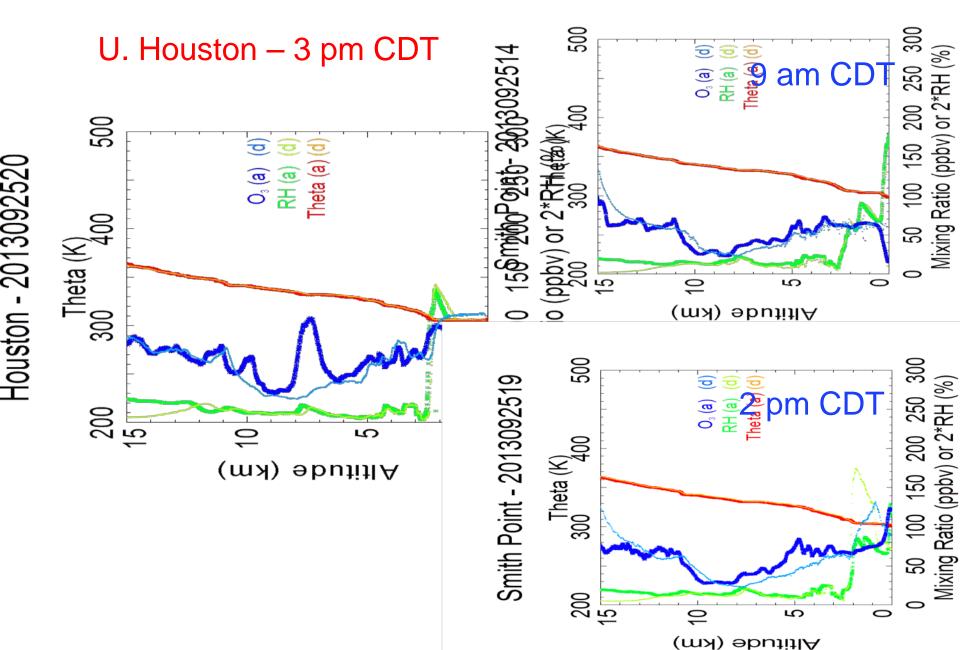


Weekly Average Ozone August - September





#### **Smith Point**



	Manitoning Site	POC												Se	pte	mb	er 2	201	3										POC	Monitoring Site
а	Monitoring Site	PUC	1	2	3	4	5 6	7	8	9	10	11	12	13 1	41	5 1 6	6 17	118	19	20 2	1 22	23	24	25	26	27 2	8 2	9 30	PUL	Monitoring Site
_	ton-Galveston-Brazoria		_	_		_		_	_	_	_	_	_		_	_	_	_			_		_				_	_		
-	Houston East C1/G316	2	43	54	69 6	51	46 32	2 3	9 42	42	40	55	56	61 5	7 2	9 3	5 37	45	27	20 2	4 35	55	35	97	78	58 4	9 29	9 38	2	Houston East C1/G316
- 1	Houston Aldine C8/AF108/X150	2	49	46	72 7	77	40 47	7 2	8 43	47	42	57	54	58 5	57 3	2 29	9 38	49	28	15 2	7 39	40	37	81	82	54 4	5 2	5 46	2	Houston Aldine C8/AF108/X150
	Channelview C15/AH115	3	42	46	77 3	31	28 23	3 2	5 32	37	34	51	52	52 5	4 2	6 34	4 34	140	20	17 2	7 39	54	46	93	72	57 5	7 3	2 27	3	Channelview C15/AH115
-	Northwest Harris Co.		$\overline{}$	$\overline{}$	$\overline{}$	$\overline{}$	46 52	$\neg$	$\neg$	$\overline{}$	$\overline{}$	$\overline{}$		$\neg$	$\neg$	$\neg$	$\neg$	$\overline{}$	$\overline{}$	-	$\neg$	$\overline{}$					$\neg$	-		Northwest Harris Co.
(	C26/A110/X154	2	42	38	48 8	5/	46 54	2 3	/ 55	54	55	61	54	60 6	0 3	8 3.	1 43	3 55	33	14 3.	2 41	42	50	72	/8	58 4	6 2	5 3/	2	C26/A110/X154
	lou.DeerPrk2	1	39	34	49 1	NΑ	28 37	7 2	9 37	41	39	44	57	62 6	4 2	8 36	6 37	38	3 30	18 2	4 38	56	41	103	72	58 5	1 2	9 34	1	Hou.DeerPrk2
	235/235/1001/AFH139FP239		ш	ш	ш.	_		_∟		_	ш	ш														$\vdash$	╫	+		C35/235/1001/AFH139FP2: Seabrook Friendship Park
(	Seabrook Friendship P <mark>Site inf</mark> 245	orma	tion	for	Seat	oroc	k Frie	ndsh	nip P	ark	C45	43	54	61 5	9 4	2 40	0 39	9 39	33	21 2	2 38	59	42	133	69	63 6	3 34	4 30	1	C45
	Houston Bayland Park	1	39	37	50 5	56	56 42	, 3	2 37	45	40	50	73	76 7	18 2	8 46	5 36	142	26	19 3	0 44	58	56	87	62	59 4	9 2	8 29	1	Houston Bayland Park
Н	C53/A146											-					_						_							C53/A146
-	Conroe Relocated C78/A321	1	58	44	57 :	6	54 46 39 38	3	1 43	51	50	50	49	58 5	4 3	8 3	5 50	148	332	21 3	9 45	39	55			57 5				Conroe Relocated C78/A32
Н	Manvel Croix Park C84 Clinton C403/C304/AH113						49 37																			54 5 51 4				Manvel Croix Park C84 Clinton C403/C304/AH113
۰	Houston North Wayside	$\overline{}$	$\overline{}$	$\overline{}$	$\overline{}$	$\overline{}$	-	$\neg$	$\neg$	$\overline{}$	$\overline{}$	$\overline{}$		$\neg$	$\neg \vdash$	$\neg$	$\neg$	$\overline{}$	$\overline{}$	$\neg \vdash$	$\neg$	$\overline{}$				$\neg$	$\neg$	$\neg$	$\overline{}$	Houston North Wayside
	2405	1	46	54	67 6	57	47 41	L  34	4 43	42	39	49	49	58 5	3 3	1 30	0 36	45	5 23	15 29	9 38	49	41	83	79	49 4	6 21	6 29	1	C405
H	louston Monroe C406	1	35	36	45 4	15	40 36	5 3:	3 37	43	39	44	59	63 6	3 2	3 34	4 36	38	3 27	19 2	4 36	67	41	95	64	55 5	1 30	0 32	1	Houston Monroe C406
L	ang C408	2	44	46	58 8	30	56 50	39	9 45	48	42	NΑ	57	56 6	2 3	5 37	7 42	2 53	28	17 3	0 42	48	49			53 5				Lang C408
-	louston Croquet C409						43 44																			53 4				Houston Croquet C409
F	Houston Westhollow C410	1	39	34	43 6	58	65 48	3 3	7 36	45	44	52	66	69 7	77 3:	2 5	5 37	44	1 26	18 3	4 43	55	52	75	59	50 4	7 2	5 40	1	Houston Westhollow C410
П	Houston Texas Avenue	1	41	46	53 4	17	52 40	) 3	8 38	42	37	56	61	57 5	8 3	0 39	9 35	40	24	16 2	7 39	53	42	81	65	50 4	8 29	9 38	1	Houston Texas Avenue C411
-	Park Place C416	1	38	40	51 4	18	48 39	3 3	6 39	43	40	49	67	73 6	3 2	6 34	4 37	143	3 25	20 2	5 37	74	43	93	73	57 5	3 2	8 40	1	Park Place C416
Н	Sheldon C551						37 35																							Sheldon C551
L	Baytown Wetlands Center	_	-	_	-	$\overline{}$		_	_	-	-	$\overline{}$		_	_	_	_	_	$\overline{}$	-	_	-					_	_	-	Baytown Wetlands Center
ı	552	1 N	37	44	57	36	41 33	3  2	5 31	37	36	41	50	50 5	4 2	7 3.	3 30	34	120	16 2	0 30	53	31			54 5				C552
C	Crosby Library C553	1 N	55	47	92 5	57	47 44	1 2	7 35	42	26	NΑ	NΑ	NAN	IA N	A N	A NA	N/	NA	NA N	ANA	NA	NA	NA	80	68 6	5 4:	2 58	1	Crosby Library C553
١	West Houston C554	1 N	40	40	44	73	67 56	5 4	8 43	50	NΑ	NΑ	NΑ	NAN	IA N	A NA	A NA	N/	NΑ	20 3	7 49	57	54	77	71	57 5	4 29	9 47	1	West Houston C554
L	a Porte Sylvan Beach C556	1 N	40	29	45 4	11	40 34	1 3:	1 38	43	39	36	NA	NAN	IA N	A NA	A NA	NA	NΑ	15 2	0 34	50	26	151	53	NA N	AΝ	ANA	1	La Porte Sylvan Beach C5
H	Mercer Arboretum C557	_	_	_	_	_	NA NA	_	_	_	-	-	_	_	_	_	_	_	_	_	_	-	46			60 4				Mercer Arboretum C557
	om Bass C558						37 35																	-		53 4	_	_		Tom Bass C558
H	(aty Park C559						NA NA																	$\overline{}$		52 4	_	_	-	Katy Park C559
H	Atascocita C560	_	_	_		-	NA NA	_		_	_	-	-	_	_	_	_	_	_	-	_	_	_			56 4	_	_	_	Atascocita C560
H		_	_	_		_	NA NA	_			_	_	-		_			_		-			_	-		71 5	_	_	_	
H		-	_	-	_	-	-	_	_	_	_	-	-	_	_	_	_	_	_	_	_	-	_	_		_	_	_	_	Meyer Park C561
H	Bunker Hill Village C562	_	_	_	_	_	69 49	_	_	_	_	-	-	_		_	_	_	_		_	_	60			52 4	_	_	-	Bunker Hill Village C562
H	Huffman Wolf Road C563	1 N	54	48	53 5	58	50 41	1 3	2 36	43	40	63	55	57 4	19 3	4 40	0 40	145	27	15 N	AINA	NA	43	68	81	55 4	7 2:	5 46	1	Huffman Wolf Road C563
	HRM-3 Haden Road C603/A114	1 N	42	56	81 5	50	49 37	7 3	4 39	44	40	53	61	63 5	8 3	0 39	9 37	44	1 24	19 2	8 38	58	39	99	78	57 4	9 3	0 28	1	HRM-3 Haden Road C603/A114
-	Vallisville Road C617	1 N	56	46	82 5	54	49 41	3	1 36	45	42	57	58	63 5	9 2	8 4	1 37	47	7 24	22 2	8 41	64	41	84	74	64 6	6 3	5 40	1	Wallisville Road C617
H	Danciger C618			_		_	34 34				_	_	_										_							Danciger C618
H		_	_	_	_	_	32 30	_	_	_	_	-	_	_	_	_	_	_	_		_	_	_	-		51 5	_			Mustang Bayou C619
Н	Austang Bayou C619	_	_	_	_	-	-	_		_	-	-	$\overline{}$	_	_	_	_	_	_	_		-	_	_		_	_	_	_	
-	exas City 34th St. C620						38 34																			61 6	_	_	_	Texas City 34th St. C620
Н	JH Moody Tower C695																							$\overline{}$						UH Moody Tower C695
-	J of H-Sugarland C696						52 52																							U of H-Sugarland C696
L	JH Coastal Center C697						37 35																			63 6				UH Coastal Center C697
L	JH WG Jones Forest C698						52 44																							UH WG Jones Forest C698
Į	JH West Liberty C699	1 N	53	43	49 5	55	46 38	3 2	5 32	42	38	59	51	51 4	16 3	1 32	2 35	37	7 NA	NA 2	0 33	34	35	52	48	36 3	6 2:	1 41	1	UH West Liberty C699
	ynchburg Ferry	1	38	43	70 4	11	43 30	2	7 34	40	38	42	54	58 5	55 2	5 34	4 34	41	31	19 2	5 31	52	35	84	66	62 6	0 3	3 32	1	Lynchburg Ferry
	C1015/A165																													C1015/A165
	ake Jackson C1016	1	26	22	26 3	12	30 27 41 35	1 2	7 33	36	38	40	43	54 4	5 2	4 3	2 22	31	28	19 2	4 34	47	20	65	59 NA	47 4 NA N	6 2º	9 24 A NA	1	Lake Jackson C1016
-	Baytown Eastpoint C1017  Balveston 99th St.	-	$\overline{}$	-	-	$\overline{}$	$\overline{}$	_		-	$\overline{}$	-		_		_	_	$\overline{}$	$\overline{}$	-		-					$\neg$	$\neg$	$\overline{}$	Baytown Eastpoint C1017 Galveston 99th St.
	21034/A320/X183	1	40	24	22 4	13	33 28	3 2	8 36	44	44	43	45	62 4	16 3	7 37	7 36	5 30	24	20 2	0 36	37	27	70	68	67 6	3 41	0 27	1	C1034/A320/X183

# Ozonesonde Observations Summary

- >500 ozonesonde profiles in Houston since 2004, with August – September season very well sampled
- 36 profiles from Smith Point, 22 from U. Houston, and 6 from Ellington Field in Sept. 2013 as part of DISCOVER-AQ
- U. Houston had 5 additional launches in August in preparation for DISCOVER-AQ and 4 launches in July as part of a training workshop.
- 2013 meteorology was very unusual, with the first frontal passage during Sept. not occurring until the 21<sup>st</sup>.
- Ozone and winds resembled early mid August rather than September conditions.
- High ozone event of 25 26 Sept. well sampled by sondes, with 3 launches from U. Houston and 5 launches from Smith Point.

