The Role of the HC_3N and C_2N_2 Atmosphere of Titan in the Saturnian System

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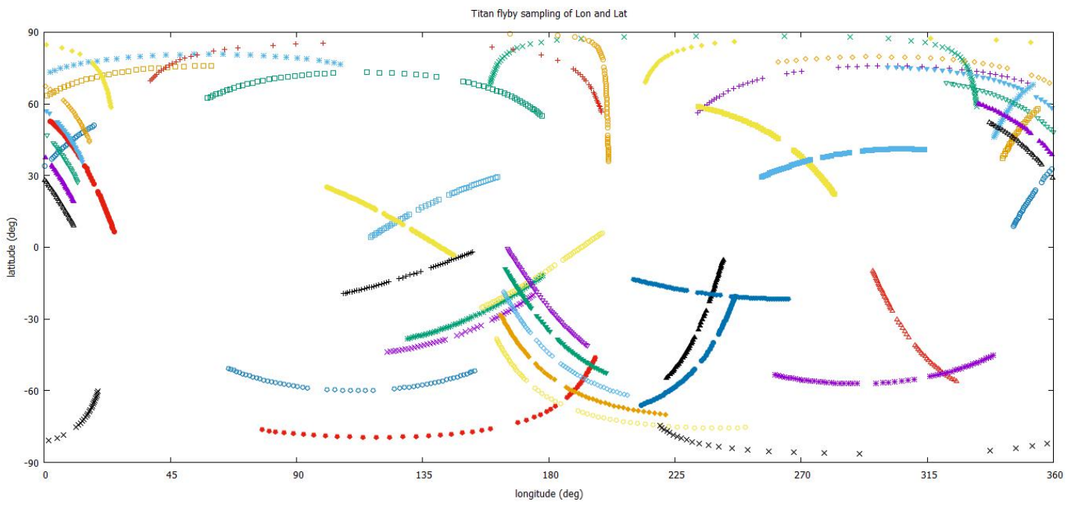
Introduction

According to the study before,the main components in the atmosphere of Titan was known to be Nitrogen. In 2004, the Cassini spacecraft entered into the orbit of Saturn and has successfully completed several flyby missions for Titan.What's more, Cassini discovered the evidence that the atmosphere of Titan also contained various gases like Methane, Hydrogen and Acetylene. And the researches before also pointed out that a double-lobed structures for HC_3N between north and south poles. From 2005 to 2012, Cassini/INMS (Ion Neutral Mass Spectrometer) measurements in CSN (Closed Source Neutral) have completed 36 flyby missions of the Titan about 950~1500km above the ground. In this article,we use the new specific data observed by Cassini during the 36 flyby missions , especially aimed at the region from 950~1000km. We discovered that the volume contents of C_2N_2 and HC_3N only one millions of the atmosphere density. We also analysed the number denisity of C_2N_2 and HC_3N, and try to find the key factors that influence the denisty.

Materials



The figure above show the orbiting path of Cassini in 36 flyby missions. It present the deficient of the detection region as there remain blank area which Cassini didn't detect. Almost half of the data remain misfits due to the wall effect, this article has excluded this error.

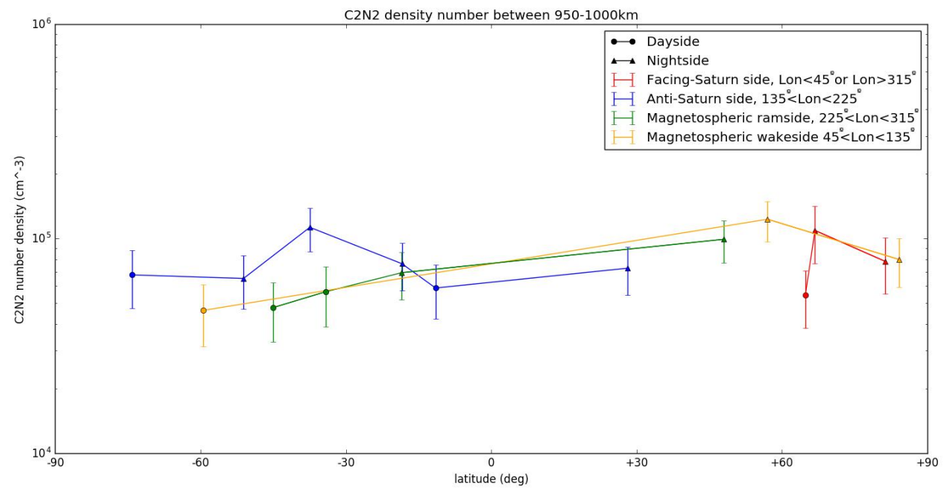
Table.1

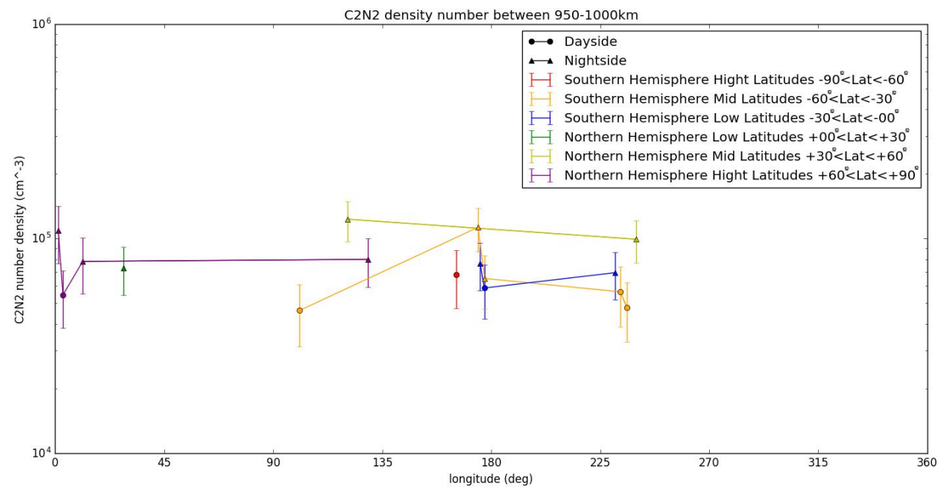
The Details of the Flybys Consided in This Study

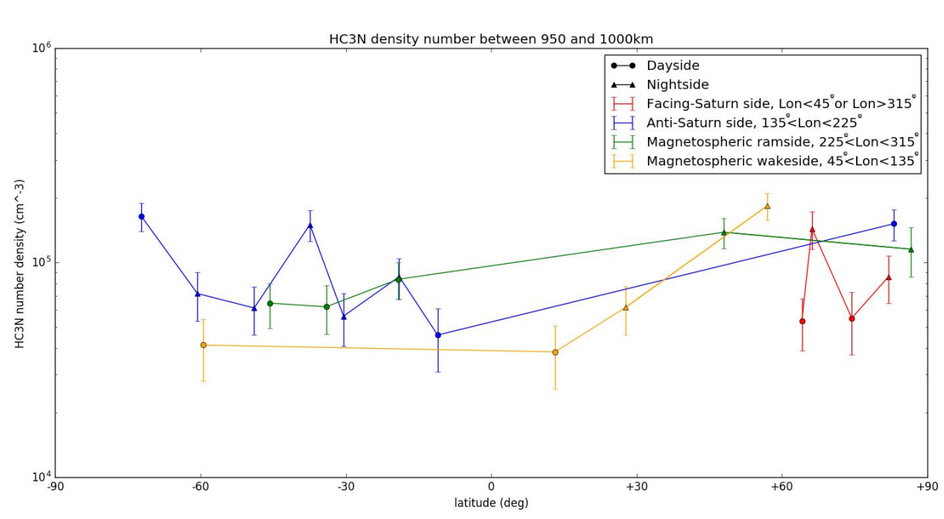
Flyby	Data	SLT(h)	Alt(km)	Φ(°)	λ(°)	SZA(°)	LST(h)	F10.7	Plasma Classification
T5	2005/4/16	5.3	1025	74.0	272.0	127.5	23.3	77	PS
T16	2006/7/22	2.4	950	85.1	316.3	105.4	17.4	74	—
T18	2006/9/23	2.3	962	70.9	357.0	89.8	14.4	71	Lobe
T19	2006/10/9	2.2	980	60.9	357.5	81.0	14.3	75	PS
T21	2006/12/12	2.1	1000	43.1	264.7	125.2	20.3	102	—
T23	2007/1/13	2.0	1000	30.6	357.9	53.3	14.0	79	PS
T25	2007/2/22	13.9	1000	30.4	17.3	161.2	0.6	76	—
T26	2007/3/10	13.8	981	31.7	357.9	149.5	1.8	70	BM
T27	2007/3/26	—	1010	40.9	358.0	144.1	1.7	74	—
T28	2007/4/10	13.7	991	50.4	358.1	137.2	1.7	69	—
T29	2007/4/26	13.7	981	59.4	358.4	129.8	1.6	81	PS
T30	2007/5/12	13.6	960	68.6	358.9	121.7	1.5	71	—
T32	2007/6/13	13.6	975	84.5	1.5	106.9	0.3	71	MS
T36	2007/10/2	11.5	973	-59.9	108.9	67.3	16.1	66	PS
T39	2007/12/20	11.4	970	-70.2	176.6	61.2	11.5	73	PS
T40	2008/1/5	11.3	1010	-11.7	130.4	37.6	14.5	80	BM
T41	2008/2/22	11.2	1000	-34.9	151.8	30.2	13.0	72	Lobe
T42	2008/3/25	11.1	1000	-27.2	156.4	21.3	12.6	89	MS
T43	2008/5/12	11.0	1000	20.7	142.0	35.9	13.8	68	Lobe
T48	2008/12/5	10.4	960	-10.4	178.7	25.0	10.4	69	—
T49	2008/12/21	10.3	970	-44.1	236.8	82.6	6.5	68	PS
T50	2009/2/7	10.2	960	-33.8	306.5	136.7	1.8	71	—
T51	2009/3/27	10.1	960	-30.6	234.8	84.1	6.4	67	PS
T55	2009/5/21	22.0	965	-21.9	177.9	141.4	21.9	72	PS
T56	2009/6/6	21.9	965	-32.0	178.1	135.0	21.8	69	Lobe*
T57	2009/6/22	21.9	955	-42.0	178.4	127.8	21.8	68	PS*
T58	2009/7/8	21.8	965	-52.1	178.8	120.2	21.7	71	PS*
T59	2009/7/24	21.8	955	-62.2	179.6	112.2	21.6	68	PS*
T61	2009/8/25	21.7	970	-19.2	237.1	85.9	17.7	67	Lobe*
T64	2009/12/27	17.0	955	77.6	185.5	82.3	16.4	—	—
T65	2010/1/12	17.0	1073	-82.3	358.8	95.2	4.7	—	—
T71	2010/7/7	16.0	1010	-56.1	303.5	82.2	7.5	—	—
T83	2012/5/22	13.6	955	72.6	128.4	70.9	16.8	—	—
T84	2012/6/7	—	959	39.1	284.0	75.7	6.8	—	—
T86	2012/9/26	—	956	62.6	200.6	46.6	11.8	—	—
T87	2012/11/13	—	973	11.7	124.7	68.2	16.7	—	—

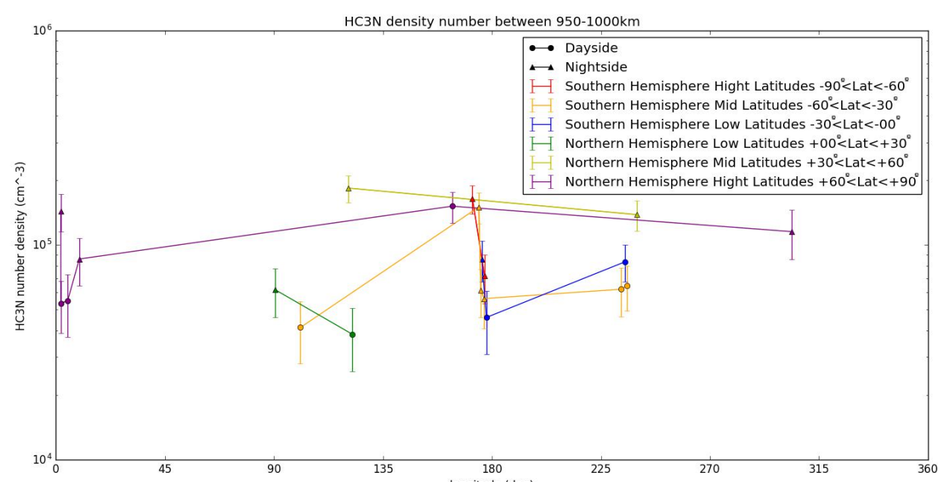
Note: The alitude, latitude, west longitude, and solar zenith angle is given at the closest approach to Titan.The F10.7 cm solar flux refers to that observed at 1 AU and is given in solar flux units (sfu). The plasma classifications are the following: plasma sheet (PS), bimodal (BM), lobe, and magnetosheath (MS).

Methods









The format above show the avareage of the data collected ranging from 950km to 1000km's atmosphere. The each point in one picture is detected by Cassini in one flyby mission. We illustrate the data results according to different latitude, plasma orientation and local time.

Conclusions

Even though Cassini has been operated for serveral years to complete the flyby missions and collect more new data, we didn't gain the data with high confidence due to the concentration of C_2N_2 and HC_3N in the atmosphere stay too low.Based on the extant data, we dicovered that, (1) there is no great variance in the concentration of C_2N_2 and HC_3N in the different magnetospheric sides or opposite hemispheres. (2) We didn't find the double-lobed structures for HC_3N between north and south poles, and (3) we conclued that the concentration of C_2N_2 and HC_3N will approximately correspond to positive corrlation. (4) We discovered that in different time or spaces, the desity of C_2N_2 and HC_3N will be changing variably, for example, during the flyby mission in T28, T29, T30, the concentration of C_2N_2 and HC_3N were as twice as global average.

Nonetheless, to confim our conclusion above still require long time and more specific observation. We are looking forward for Cassini to send back more inspiring new data.

Reference

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