Dust maps of the MY 25 planet-encircling dust storm

Comparison of MY 25 MOC-observed dust storms and FFSM eddies

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Outline

- Motivation
- Map Development
  - New dust characterization scheme
- Comparison of dust storms and eddies
- Results

Motivation

- Previous comparison of MOC-observed dust storms and FFSM eddies was imprecise latitudinally ->

  ➡ better delimit the areal extent MOC-observed dust storms for eddy/storm comparison

- Provide improved input to GCM

Dust characterization scheme

									Convective structure Dust storms, category 1	Opacity, qualitative (apparent visual obscuration) Dust storms, category 1	Opacity, quantitative τ_d (9-μm) approximation Dust storms, category 1
Category:	**1) Dust storms** • near major lifting sites (Hellas, Claritas)			**2) Category 2** [working characterization] • Different morphology from category 1 (except struc 0) • more spatially intermittent: surface often visible among clouds • more 'cloud'-like, 'puffy' (certain cases)			**3) Gravity waves**					
struc = 3	**63, 0, 0 3F0000 113**	123	133	255, 153, 0 FF9900 213	223	233	**0, 63, 0 003F00 313**	323	333	convective structure = high • large kanoobs • strong shadows/contrast	visually opaque • surface features completely obscured	$\tau_d \geq 1.0$
struc = 2	159, 0, 0 9F0000 112	**79, 31, 79 4F1F4F 122**	132	255, 204, 0 FFCC00 212	222	232	0, 159, 0 009F00 312	0, 127, 79 007F4F 322	332	convective structure = medium • medium kanoobs • medium shadows/contrast • dust spatially intermittent (minimal) •	visually opaque • surface features obscured (or partially) • ..	$\tau_d \geq 1.0$ $\tau_d \geq 0.5$
struc = 1	255, 0, 0 FF0000 111	127, 51, 127 7F337F 121	**0, 102, 255 0066FF 131**	255, 255, 0 FFFF00 211	127, 127, 127 7F7F7F 221	**0, 0, 255 0000FF 231**	0, 255, 0 00FF00 311	0, 204, 127 00CC7F 321	0, 153, 255 0099FF 331	convective structure = low • [small kanoobs] • small shadows/contrast (but present) • dust spatially intermittent • plumes ('small' plumes in craters)	visually diffuse • surface features visible (or partially) • ..	
struc = 0	255, 191, 191 FFBFBF 110	120	130	255, 255, 204 FFFFCC 210	220	230	N/A	N/A	N/A	Convective structure = 0 => Range of possibilities, from: • optically thin haze • optically visible/thick thick dust field • no shadows/contrast • optically thin haze	Full range possible: • surface features visible (optically thin haze) • surface features obscured (optically thick dust)	$\tau_d \leq 0.35$ (optically $\tau_d \geq 1.0$ (optically thick dust)
Structure ↑ / / →	τ_{ice} **low**	τ_{ice} **medium**	τ_{ice} **high**	τ_{ice} **low**	τ_{ice} **medium**	τ_{ice} **high**	τ_{ice} **low**	τ_{ice} **medium**	τ_{ice} **high**			

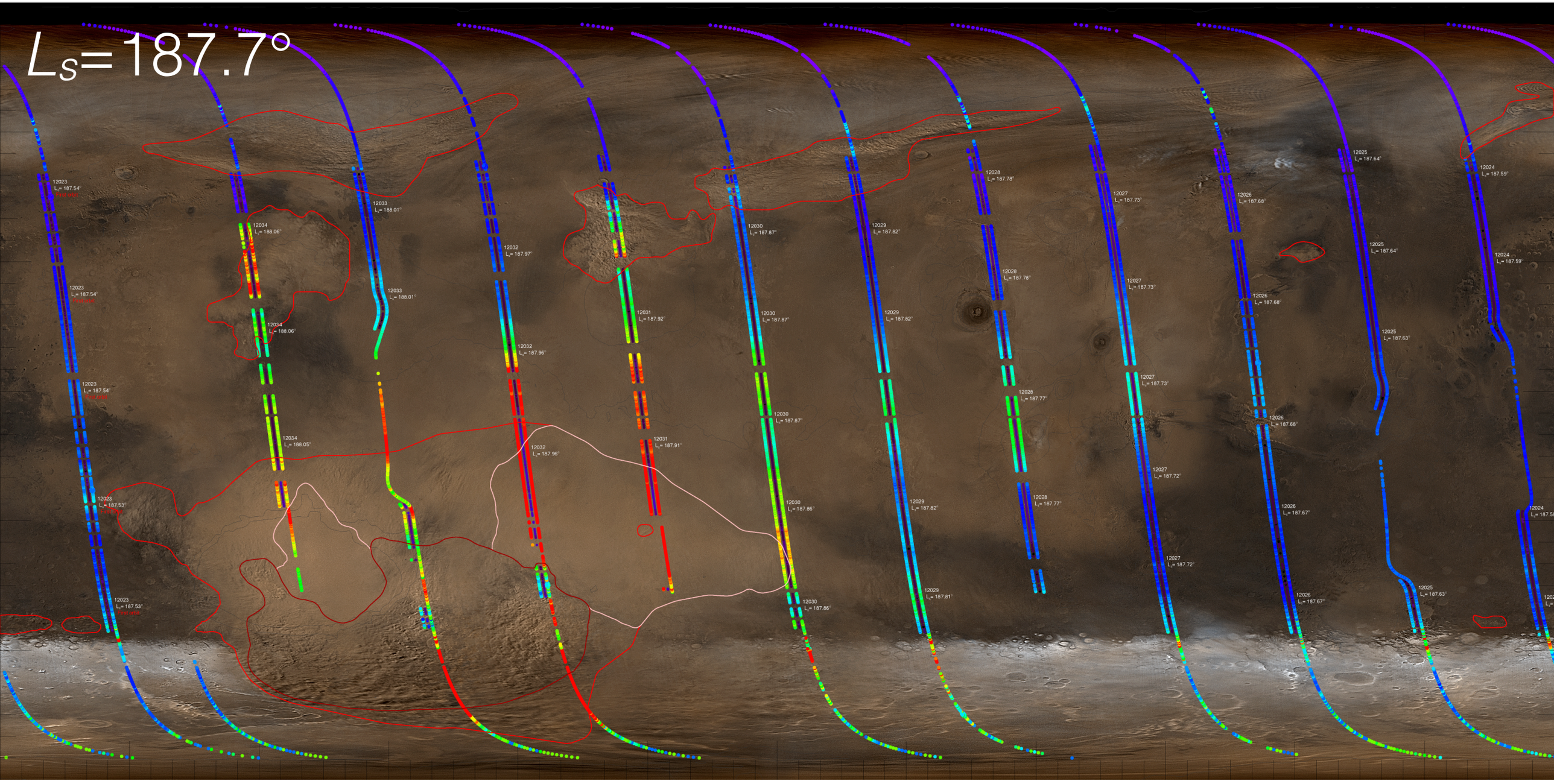
Gravity waves

- Included for completeness - not used in FFSM analysis
- May indicate dust transport

Water ice clouds

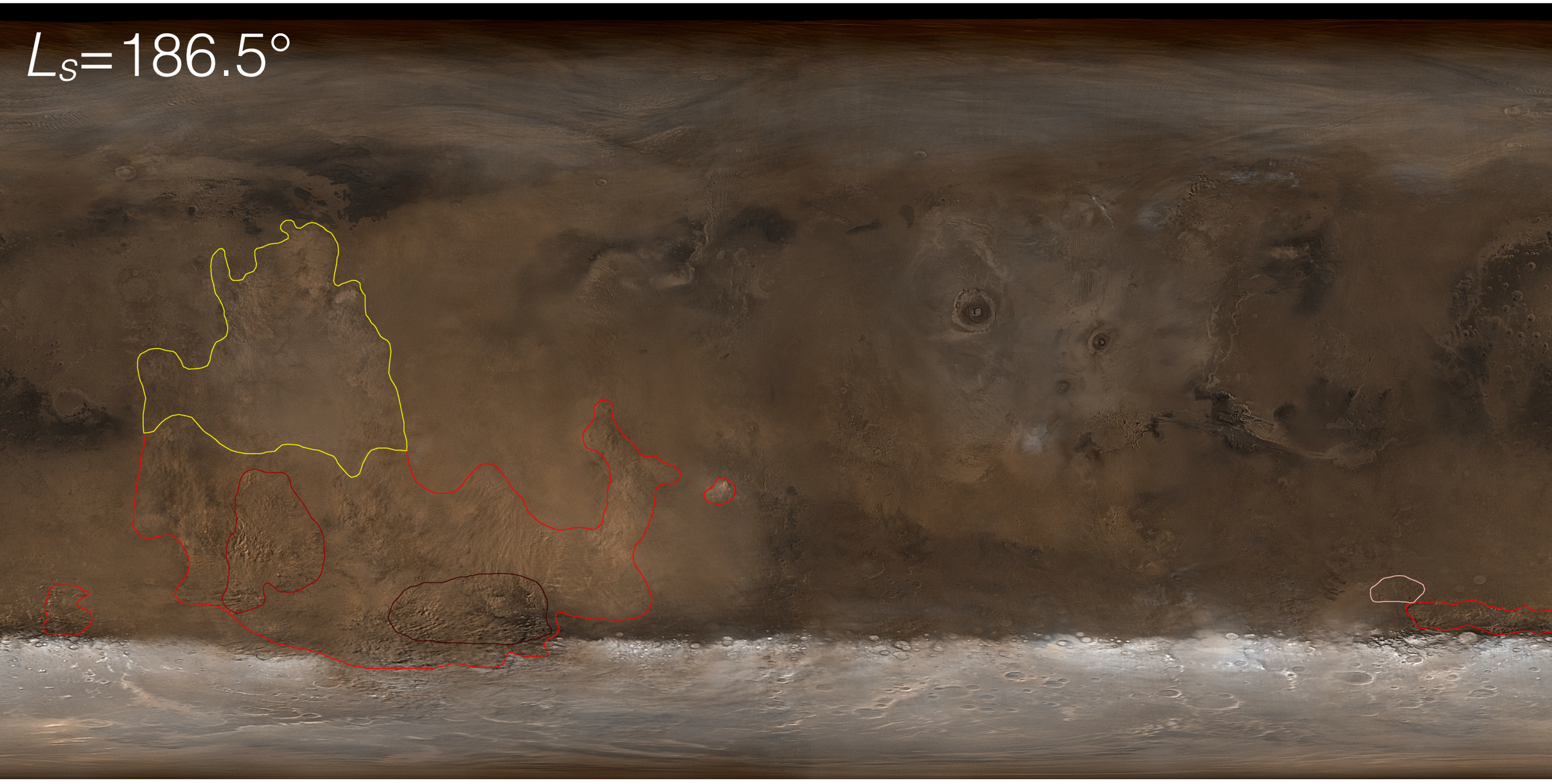
- Included for completeness
- Obscure dust storm structure below => increase uncertainty of dust storm structure

Map development



- Groundtracks: 1) TES 9-μm dust opacity
  2) TES water ice opacity
  3) GCM-derived dust opacity (Wilson *et al.* 2011)

Storm Catalog

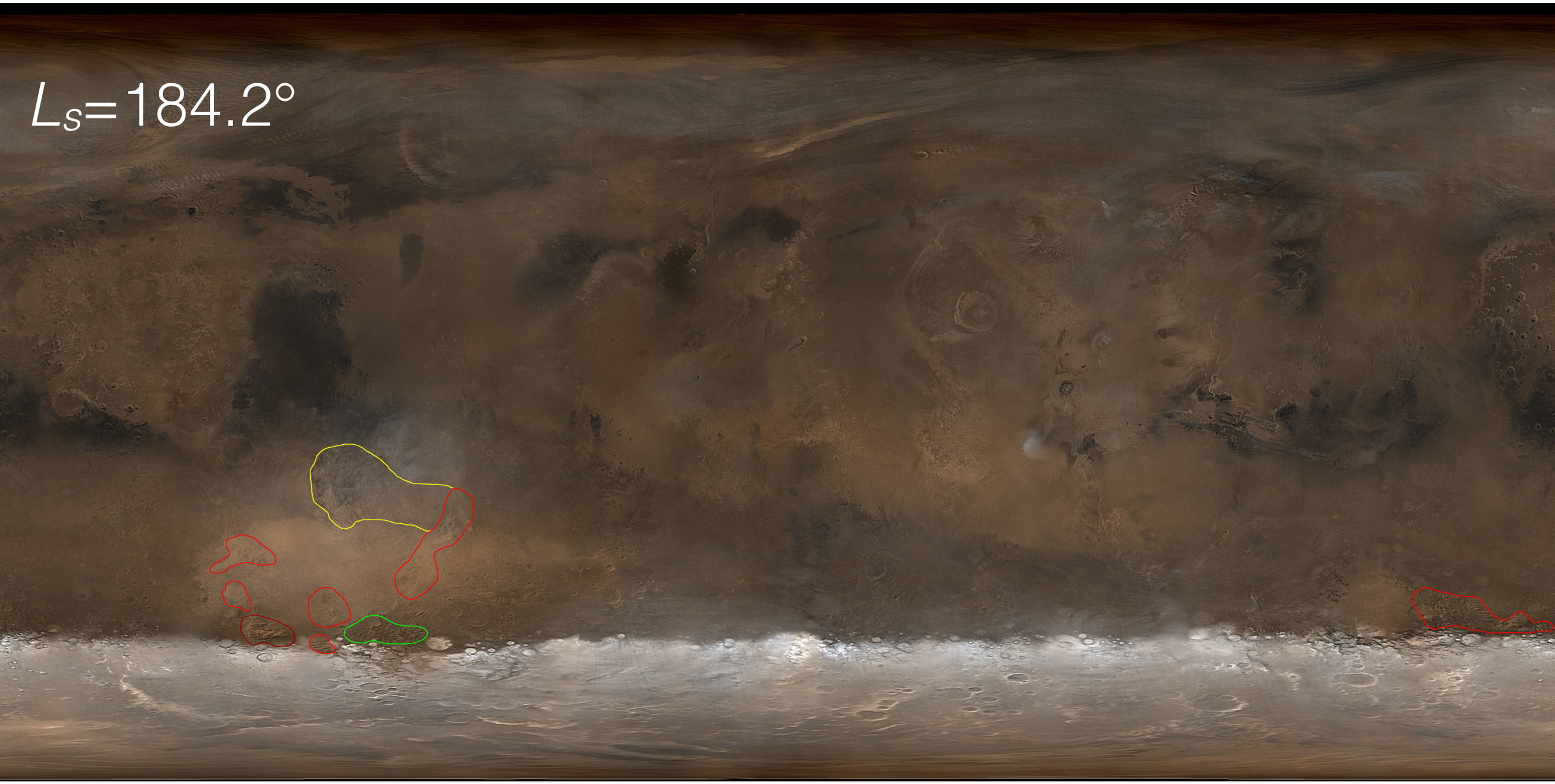


- Identifies storms by lat/lon coordinates, and MOC ID
- Catalogs duplicate storms (in MOC imagery)

MOC dust storm and FFSM baroclinic eddy analysis, MY 25

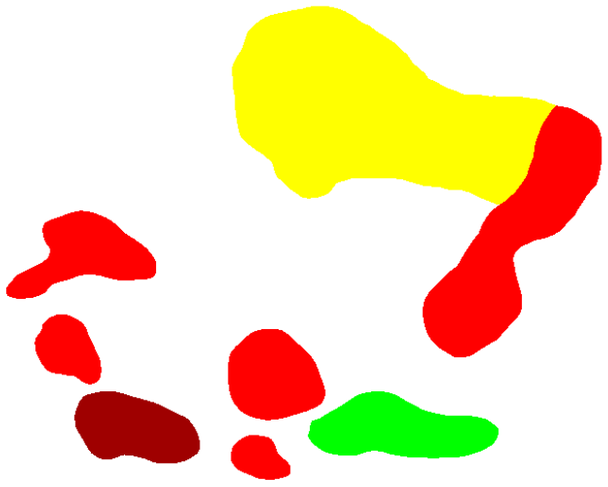
ts	sclk	orb.v7	H	Ls(orb).v7 @ ~45S	Ls [1]	Sol [1]	Date	DOY	Storm coordinates	Storm images duplicated	MOC ID	*c.f.* previous sols: (craters, sfc features..)	Notes	Storms near first and last orbits: storm Ls	Synthesized dust maps
0	674939952	11531	H	165.11			5.21	141	s7: 12-35E,55S		s7: E04-01675, Ls=165.18				
1	674984340	11537	T	165.37			5.22	142					`		
2	675028724	11544	H	165.68			5.22	142							
3	675073112	11550	T	165.95			5.23	143	s1: 349-358E, 47S	s1: 144	E04-01870 (144)		s1 appears on DGM 143 @ 353E, 47S, Ls=165.81; s1 is from E04-01870 (144), Ls=166.33; Q: Is there a dust storm @ 292E, 40S? mixture of dust & ice?		
4	675117498	11556	H	166.21			5.23	143	s2: 22-29E, 45S s3: 20-25E, 50S		s2: E0401853 s3: E0401853			s2: Ls=166.30 s3: Ls=166.30	
5	675161886	11562	T	166.48			5.24	144	s1: 349-358E, 47S s2: 133E, 50S	s1: 143	s1: E04-01870 s2: E04-01931			s1: Ls=166.34	
6	675206250	11569	H	166.78			5.24	144	s4: 32-42E, 50S		s4: E04-01949			s4: Ls=166.83	
7	675250660	11575	T	167.05			5.25	145	s1: 12-25E, 50S	s1: 144	s1: E04-01953			s1: Ls=166.86	
8	675295048	11581	H	167.31			5.25	145	s5: 60E, 40S				Q: ice at 97E, 52S? Q: Is s5 a dust storm? There appears to be some structure.		
9	675339436	11588	T	167.63			5.26	146							
10	675382912	11594	H	167.89			5.26	146	s7: 96-111E, 50S s8: 81-88E, 53S		s7: E04-02127		Q: s8: dust storm? Q: dust event in NE Hellas? in E Hellas? Q: Missing data at ock 11594 (confirm)		
11	675428208	11600	T	168.16			5.27	147							
12	675472594	11607	H	168.47			5.28	148	s1:20-35E, 47S s2: 355-15E, 50S	s1: 147 & 149 s2: 147 & 149	s1: E04-02215 s2: E04-02219				
13	675516982	11613	T	168.74			5.28	148					Dust @ 175-180E,32S apears to come from 149 (E04-02334)		
14	675561370	11619	H	169.01			5.29	149	s1: 40-50E, 50S	s1: 147 & 148	s1: E04-02285				
15	675605758	11625	T	169.27			5.29	149	s2:175-190E, 30-50S	s2: 148	s2: E04-02334				
16	675650142	11632	H	169.59			5.30	150	s1: 28-40E, 50S	s1: 151	s1: E04-02380	139 (sfc feature @ 48E,48S	Water ice clouds west of Hellas [2]		
17	675694652	11638	T	169.85			5.30	150							
18	675738916	11644	H	170.12			5.31	151	s1: 18-27E				s1=plumes over crater; s2=dust entrained in gravity wave clouds; s3a=dust; [2], Water ice clouds west of Hellas [2]		
19	675783304	11650	T	170.39			5.31	151							
20	675827692	11657	H	170.70			6.01	152							
21	675872078	11663	T	170.97			6.01	152							
22	675916466	11669	H	171.24			6.02	153							
23	675960854	11676	T	171.56			6.02	153							
24	676005238	11682	H	171.82			6.03	154	s1: 99-107E, 50-55S	s1: 153	s1: E05-00205				
25	676049626	11688	T	172.09			6.03	154	s8: 192-205E, 33-43S	s8: 153	s8: E05-00268				
26	676094015	11694	H	172.36			6.04	155							
27	676138405	11701	T	172.68			6.04	155							
28	676182786	11707	H	172.95			6.05	156					Q: how to delimit storms in SW Hellas? Q: is that dust storm structure between the 2 outlines in W Hellas?		
29	676227174	11713	T	173.22			6.05	156							
30	676271540	11720	H	173.54			6.06	157							
31	676315948	11726	T	173.81			6.06	157							
32	676360340	11732	H	174.08			6.07	158							
33	676404724	11738	T	174.35			6.07	158							

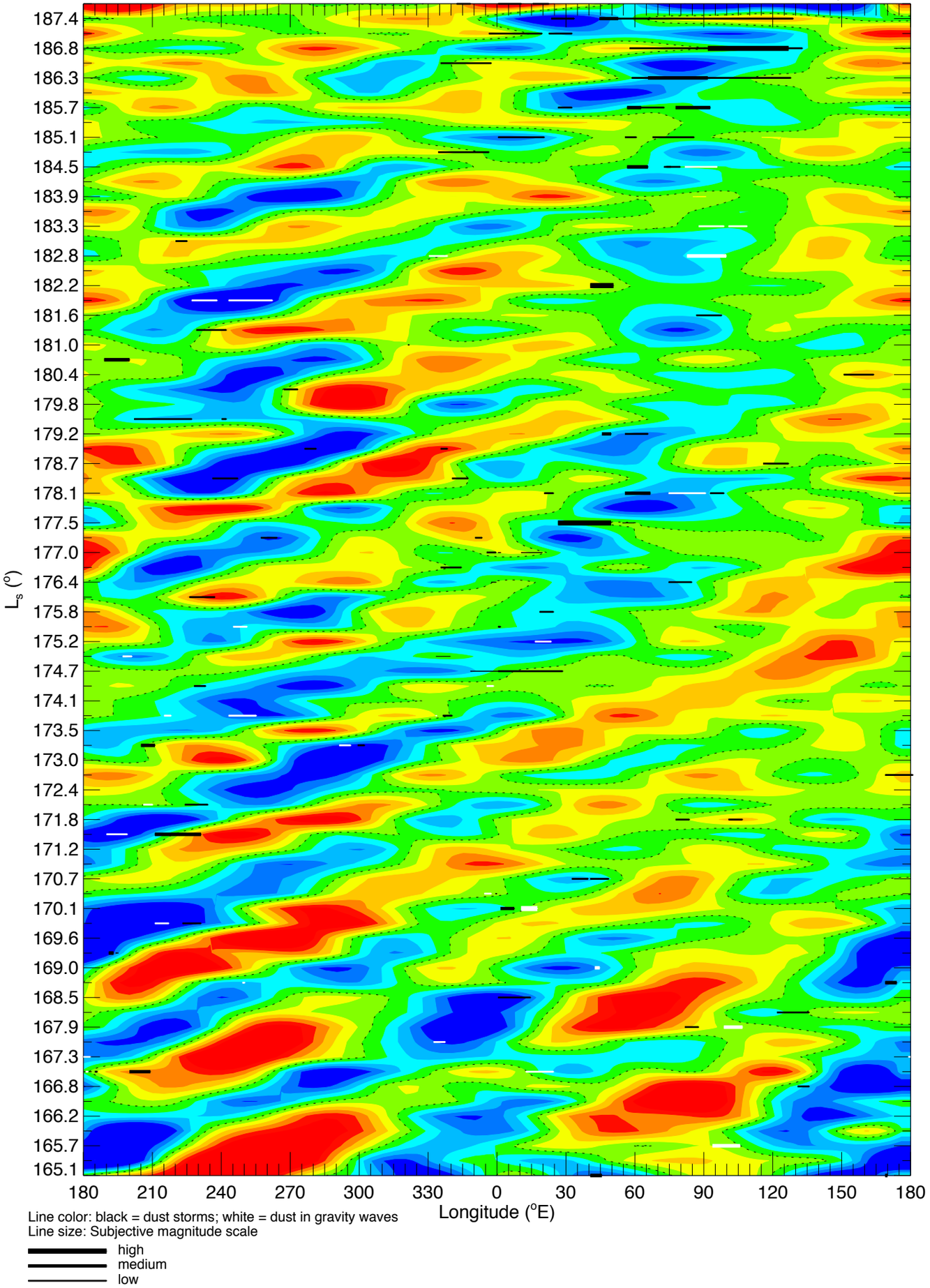
Map Development



Map Development

L_s=184.2°

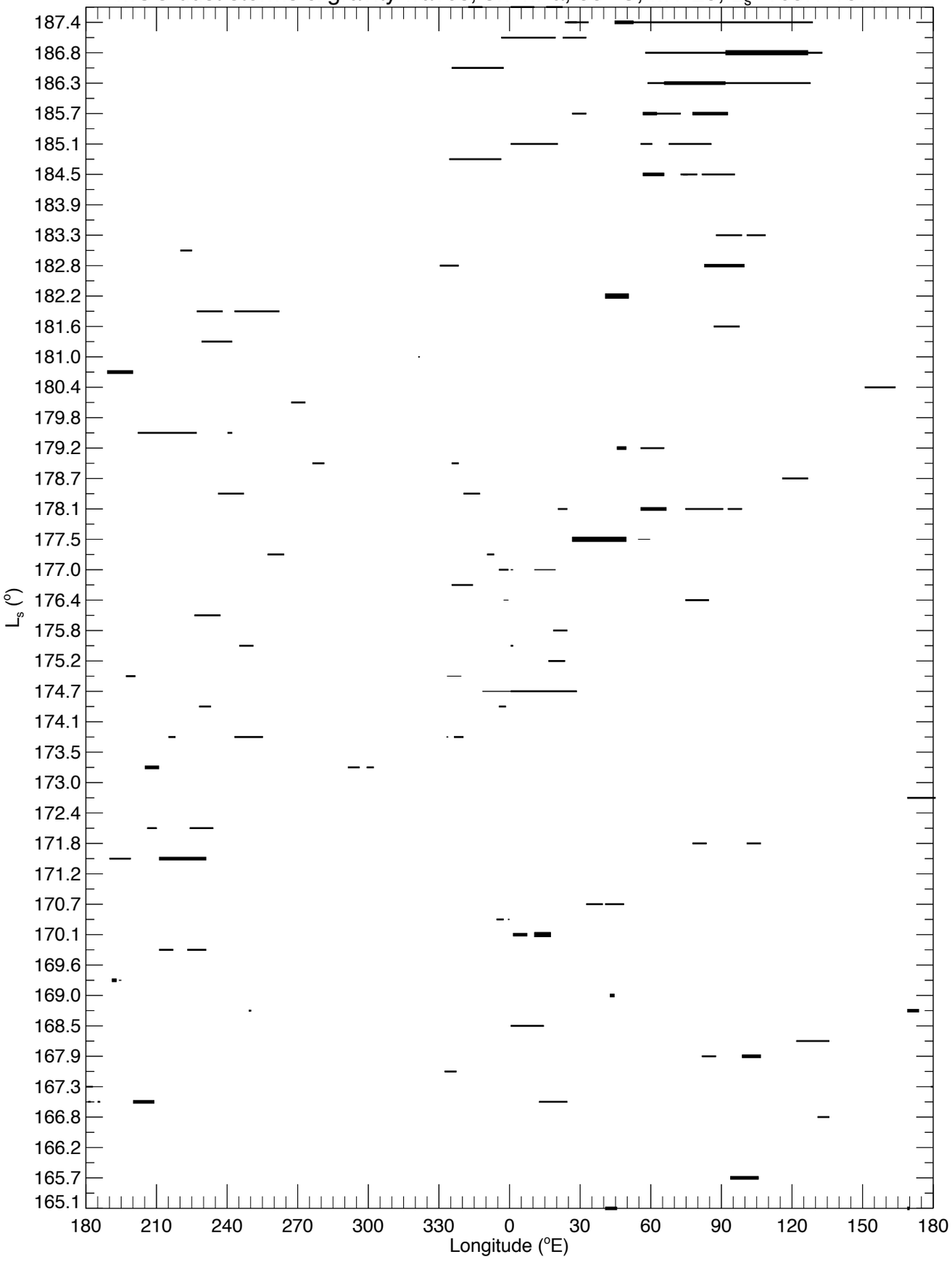




Comparison of dust storms & eddies

- Storm data read from maps
- Concurrent eastward migration

MOC dust storms & gravity waves, 3.7 hPa, 55° S, MY 25, L_s=165.1-187.7°



high
medium
low
minimal

Summary

- 42 maps created
- Integration of MOC-observed dust storms and FFSM eddies suggests concurrent eastward migration of dust storms and eddies
- Six eastward-traveling baroclinic eddies triggered the precursor storms due to the enhanced dust lifting associated with their low-level wind and stress fields.
- Subsequent eddies contributed to storm expansion on Ls=186.3 and beyond