MODIS DATA STUDY
TEAM PRESENTATION

September 7, 1990

AGENDA

1. Effects of Reduced Spatial Resolution on MODIS Processing and Storage Requirements

2. Questions and Discussion Areas for Dr. Ed Chang, Information Systems Manager for Interfaces Between EOSDIS Flight and Ground Segments

EFFECTS OF REDUCED SPATIAL RESOLUTION ON MODIS PROCESSING AND STORAGE REQUIREMENTS

In May 1990, we delivered a document entitled "MODIS Processing and Storage Requirements". The document provided these requirements by discipline and processing level, and also included other attributes such as reprocessing, reserved capacity, and future growth. Here we revisit the MODIS processing and storage requirements in response to a modification to the MODIS-N instrument. The modification to the instrument design is a reduction in nadir footprint from 214 m to 250 m, 428 m to 500 m, and 856 m to 1 km. As a result, the MODIS-N scan period increases from 1.02 seconds to 1.19 seconds, the number of on-Earth IFOVs across track decrease from 1582 to 1354, and the radiometric portion of the instrument data rate decreases by a factor of 0.856^2.

As a result of this proposed instrument modification, both the processing and storage requirements are reduced (in addition to a 27% decrease in the data rate of MODIS-N, and 23% for MODIS-N and -T combined). The total daily volume for Level-1A and -1B is found to decrease from 299.3 to 230.9 gigabytes when both MODIS-N and -T data are considered (a reduction of about 23%). The storage requirements for the MODIS standard products (Level-1A, -1B, 2, and 3) decrease from 386.7 to 307.4 gigabytes per day (a reduction of about 21%). When reprocessing, reserve capacity, and other contingencies are considered, the total MODIS CPU requirement for the first year after launch becomes 687 MFLOPS.

In terms of reduced CPU requirements, the processing requirement for all levels is reduced from 177.3 to 144.4 MFLOPS (a reduction of about 19%). Of this, a 23% reduction is realized at Level-1 (roughly proportional to the reduction in the joint data rate). There is only a 14% reduction in the ocean discipline CPU requirements (due to the importance of MODIS-T), but a 25% decrease in CPU requirement is realized for the land and atmosphere disciplines (which depend primarily on MODIS-N).

Appended are processing and storage listings that provide the basic computations summarized above.

MODIS-T Channel Parameters

Ban	Center Wavelength (micron)	Band Pass (micron)	IFOV (m)
1	0.410	0.015	1100
2	0.425	0.015	1100
3	0.440	0.015	1100
4	0.455	0.015	1100
5	0.470	0.015	1100
6	0.485	0.015	1100
7	0.500	0.015	1100
8	0.515	0.015	1100
9	0.530	0.015	1100
10	0.545	0.015	1100
11	0.560	0.015	1100
12	0.575	0.015	1100
13	0.590	0.015	1100
14	0.605	0.015	1100
15	0.620	0.015	1100
16	0.635	0.015	1100
17	0.650	0.015	1100
18	0.665	0.015	1100
19	0.680	0.015	1100
20	0.695	0.015	1100
21	0.710	0.015	1100
22	0.725	0.015	1100
23	0.740	0.015	1100
24	0.755	0.015	1100
25	0.770	0.015	1100
26	0.785	0.015	1100
27	0.800	0.015	1100
28	0.815	0.015	1100
29	0.830	0.015	1100
30	0.845	0.015	1100
31	0.860	0.015	1100
32	0.875	0.015	1100

MODIS-N Channel Parameters

Band	Center Wavelength (micron)	Band Pass (micron)	IFOV (m)
1	0.659	0.020	250
2	0.865	0.050	250
3	0.470	0.020	500
4	0.555	0.020	500
5	1.240	0.020	500
6	1.640	0.020	500
7	2.130	0.050	500
8	0.415	0.015	1000
9	0.443	0.010	1000
10	0.490	0.010	1000
11	0.531	0.010	1000
12	0.565	0.010	1000
13	0.653	0.015	1000
14	0.681	0.010	1000
15	0.745	0.010	1000
16	0.865	0.015	1000
17	0.908	0.030	1000
18	0.936	0.010	1000
19	0.950	0.050	1000
20	3.750	0.180	1000
21	3.750	0.180	1000
22	3.959	0.050	1000
23	4.050	0.050	1000
24	4.465	0.050	1000
25	4.515	0.050	1000
26	4.565	0.050	1000
27	6.715	0.360	1000
28	7.325	0.300	1000
29	8.550	0.300	1000
30	9.730	0.300	1000
31	11.030	0.500	1000
32	12.020	0.500	1000
33	13.335	0.300	1000
34	13.635	0.300	1000
35	13.935	0.300	1000
36	14.235	0.300	1000

MODIS-N and MODIS-T Data Rate and Volume Estimates

Earth Radius (km)	6371		
Satellite Altitude (km)	705		
Orbital Period (min)	98.9		
MODIS-N # 1000 m REF channels	12		
MODIS-N # 500 m REF channels	3		
MODIS-N # 250 m REF channels	2		
MODIS-N # 500 m TIR channels	17		
MODIS-N # 500 m TIR channels	2		
MODIS-T # 1.1 km REF channels	32		
MODIS-N # bits/REF channel	12		
MODIS-N # bits/TIR channel	12		
MODIS-T # bits/REF channel	13		
MODIS-N REF Duty Cycle	50%		
MODIS-N TIR Duty Cycle	100%		
MODIS-T REF Duty Cycle	50%		
MODIS-N # Along-track IFOVs	8		
MODIS-T # Along-track IFOVs	30		
MODIS-N # Detectors	648		
MODIS-T # Along-track detectors	30		
MODIS-N Maximum scan angle (deg)	55		
MODIS-T Maximum scan angle (deg)	45		
MODIS-N IFOV FWHM (deg)	8.13E-02		
MODIS-T IFOV FWHM (deg)	8.94E-02		
MODIS-N # pixels along-scan/on-Earth	1354		
MODIS-T # pixels along-scan/on-Earth	1007		
MODIS-N Scan Period (sec)	1.19		
MODIS-T Scan Period (sec)	4.61		
MODIS-N VIS Data (megabits/scan)	7.3		
MODIS-N TIR Data (megabits/scan)	3.2		
MODIS-N Daytime Data (megabits/scan)	10.5		
MODIS-T Daytime Data (megabits/scan)	12.6	Overhead &	
MODIS-N # Scans/Orbit	5000	Contingency	
MODIS-T # Scans/Orbit	643	10%	Total
MODIS-N Daytime Data Rate (mbps)	8.9	0.9	9.8
MODIS-N Nighttime Data Rate (mbps)	2.7	0.3	3.0
MODIS-T Daytime Data Rate (mbps)	2.7	0.3	3.0
MODIS-N Orbital Ave Data Rate (mbps)	5.8	0.6	6.4
MODIS-T Orbital Ave Data Rate (mbps)	1.4	0.1	1.5
MODIS-N Daily Data Volume (gigabits)	501.3	50.1	551.4
MODIS-T Daily Data Volume (gigabits)	117.6	11.8	129.4
Total Daily Data Volume (gigabits)	618.9	61.9	680.8
MODIS-N Volume (gigabytes) LEVEL-1A	68.9	6.9	75.8
MODIS-T Volume (gigabytes) LEVEL-1A	16.2	1.6	17.8
Total Daily Volume (gigabytes) @1A	85.1	8.5	93.6
MODIS-N Volume (gigabytes) LEVEL-1B	101.1	10.1	111.2
MODIS-T Volume (gigabytes) LEVEL-1B	23.7	2.4	26.1
Total Daily Volume (gigabytes) @1B	124.8	12.5	137.3
Total Daily Volume (gigabytes) @1A&B			230.9

MODIS LONG-TERM ARCHIVE STORAGE REQUIREMENTS

Data Product	Daily Level-1A	Daily Level-1B	Daily MODIS-T Level-2/T	Daily MODIS-N Level-2/N	Equivalent Daily Level-3	Equivalent Daily Level-4	Total/day
Navigation	0.07	18.68	0.00		0.00	0.00	18.8
Calibration	6.84		0.00		0.00	0.00	6.8
Engineering/Housekeeping	4.26	5.67	0.00		0.00	0.00	9.9
At-Satellite Radiances	85.10	113.47	0.00		0.00	0.00	198.6
Water-Leaving Radiances	0.00	0.00	10.14	3.97	6.63	0.00	20.7
Single Scattering Aerosol Radiances	0.00	0.00	8.23	2.65		0.00	10.9
Angstrom Exponents	0.00	0.00	0.32	0.44	0.00	0.00	0.8
Chlorophyll-A Concentrations (Case 1	0.00	0.00	0.32	0.44	0.23		1.0
Chlorophyll-A Concentrations (Case 2	0.00	0.00	0.03	0.04	0.23	0.00	0.3
Chlorophyll-A Fluorescence	0.00	0.00	0.32	0.44	0.23	0.00	1.0
CZCS Pigment Concentrations	0.00	0.00	0.32	0.44	0.23	0.00	1.0
Sea-Surface Temperature	0.00	0.00	0.00	1.10	0.23	0.00	1.3
Sea-Ice Cover	0.00	0.00	0.00	0.13	0.07	0.00	0.2
Attenuation at 490 nm	0.00	0.00	0.32	0.44	0.23	0.00	1.0
Detached Coccolith Concentration	0.00	0.00	0.10	0.13	0.23	0.00	0.5
Phycoerythrin Concentrations	0.00	0.00	0.32		0.23	0.00	0.5
Dissolved Organic Matter	0.00	0.00	0.32	0.44	0.23	0.00	1.0
Seston	0.00	0.00	0.32	0.44	0.23	0.00	1.0
Ocean Cal Data Sets							
Primary Production	0.00	0.00	0.32	0.44	0.23	0.00	1.0
Land-Leaving Radiances	0.00	0.00	2.71	14.42	2.83	0.00	20.0
DEM/DTM	0.00	0.00	0.00		0.00	0.00	0.0
Vegetation Index	0.00	0.00	0.00	3.78	1.73		5.5
Land Surface Temperature	0.00	0.00	0.00	0.47	0.17	0.00	0.6
Thermal Anomalies	0.00	0.00	0.00	0.47	0.00	0.00	0.5
Snow Cover	0.00	0.00	0.00	0.24	0.0009		0.2
Spatial Heterogeneity [Not sized here]							
Land Cover Type	0.00	0.00	0.00		0.0001	0.00	0.0
Bidirectional Reflectance, BRDF	0.00	0.00	0.00		0.0068		0.0
Cloud Mask	0.00	0.00	0.32	1.58	0.0000	0.00	1.9
Cloud Fraction	0.00	0.00	0.00		0.0075	0.00	0.0
Cloud Effective Emissivity	0.00	0.00		0.06	0.0005	0.00	0.1
Cloud-Top Temperature and Pressure	0.00	0.00	0.00	0.25	0.0010	0.00	0.3
Cloud Optical Thickness (0.66 μm)	0.00	0.00	0.00	0.06	0.0003	0.00	0.1
Cloud Particle Effective Radius	0.00	0.00	0.00	0.06	0.0003	0.00	0.1
Cloud Particle Thermodynamic Phase	0.00	0.00	0.00	0.03	0.0003	0.00	0.0
Aerosol Optical Depth (0.41 to 2.13	0.00	0.00	0.00		0.0010	0.00	0.0
Aerosol Size Distribution	0.00	0.00	0.00		0.0010	0.00	0.0
Aerosol Mass Loading	0.00	0.00	0.00		0.0010	0.00	0.0
Atmospheric Stability	0.00	0.00	0.00	0.13	0.0021	0.00	0.1
Total Precipitable Water	0.00	0.00	0.00	1.70	0.0031	0.00	1.7
Total Ozone	0.00	0.00	0.00	0.13	0.0010	0.00	0.1
Browse [Not sized here]	0.00	0.00	0.00		0.0000	0.00	0.0
Metadata [Not sized here]	0.0	0.0	0.0		0.0	0.0	0.0
Ocean Discipline Subtotal (L-2/3/4)	0.0	0.0	21.3	11.6	9.3	0.0	42.2
Land Discipline Subtotal (L-2/3/4)	0.0	0.0	2.7	19.4	4.7	0.0	26.8
Atmosphere Discipline Subtotal (L-2/3/4)		0.0	0.3	4.0	0.019	0.0	4.3
Total	96.3	137.8	24.4	34.9	14.0	0.0	307.4

MODIS STANDAKU PRODUCT GENERATION CPU REQUIREMENTS (September 6, 1990) USING 250/50u/1000 m RESOLUTION FOR MODIS-N

DOMAIN	FRACTION	PROC LEVEL	LOC	MFLOPS		MFLOPS		MFLOPS	
Day only	40%	Level-1A	40000	19.9	Reproc*2	288.8	Subtotal	466.5	
Ocean only	70%	Level-1B	23925	25.2	NearRT	14.4	Cntl/RDBMS	14.4	
Land only	30%	L-2 Ocean	11840	20.0	Browse	2.9	Reserve	206.1	
Cloud only	50%	L-2 Land	42202	5.9	Metadata	1.4	Total	687.0	Year 1
Clear only	50%	L-2 Atmos	19872	38.4	Maint	14.4	Growth@40%:	816.2	Year 2
		Level-2	83914	67.9				996.9	Year 3
SCAN PERIOD	SECONDS	Level-3	12000	31.4				1250.1	Year 4
MODIS-T	4.62	Total	159839	144.4				1604.4	Year 5
MODIS-N	1.19								

		Prototype LOC	Operational LOC	Prototype MFLOP/Scan MODIS-N (as sized)	Prototype MFLOP/Scan MODIS-N (@1 km res)	Prototype MFLOP/Scan MODIS-T	Operational MFLOP/Scan MODIS-N	Operational MFLOP/Scan MODIS-T	Effective MFLOP/Scan MODIS-N	Effective MFLOP/Scan MODIS-T	Resultan MFLOPS MODIS-N&
Level-1A	Bit Error Correction (to be sized)										
Level-1A	Total	16000	20000	17.8	15.2	14.5	19.0	18.1	19.0	18.1	19.9
Level-1B	Navigation	330	513	1.5	1.3	1.5	1.3	1.5	1.3	1.5	1.4
Level-1B	Calibration	500	725	29.7	25.4	24.2	25.4	24.2	14.7	9.7	14.4
Level-1B	Ancillary	500	725	1.3	1.1	3.1	1.1	3.1	1.1128	3.1	1.6
Level-1B	Other	8000	10000	9.0	7.7	6.0	7.7	6.0	7.7	6.0	7.8
Level-1B	Total	9330	11963	41.5	35.5	34.8	35.5	34.8	24.8	20.3	25.2
Level-2	Water-Leaving Radiances	530	1425	16.6	14.2	116.9	29.7	236.8	4.2	33.2	10.7
Level-2	Single Scattering Aerosol Radiances	[INCLUDED]	100				1.3	3.0	0.2	0.4	0.2
Level-2	Angstrom Exponents	[INCLUDED]	100				1.3	3.0	0.2	0.4	0.2
Level-2	Chlorophyll-A Concentrations (Case 1	40	200	0.5	0.4	1.2	2.2	5.4	0.3	0.8	0.4
Level-2	Chlorophyll-A Concentrations (Case 2	37	193	1.7	1.5	3.9	4.2	10.8	0.6	1.5	0.8
Level-2	Chlorophyll-A Fluorescence	100	350	0.4	0.3	1.0	2.0	5.0	0.3	0.7	0.4
Level-2	CZCS Pigment Concentrations	18	145	0.4	0.3	1.0	2.0	5.0	0.3	0.7	0.4
Level-2	Sea-Surface Temperature	600	1300	6.1	5.2		11.7	3.0	4.1	1.1	3.7
Level-2	Sea-Ice Cover	90	280	0.7	0.6		2.5	3.0	0.3	0.4	0.4
Level-2	Attenuation at 490 nm	120	400	0.4	0.3	1.0	2.0	5.0	0.3	0.7	0.4
Level-2	Detached Coccolith Concentration	100	350	0.8	0.7	2.0	2.7	7.0	0.4	1.0	0.5
Level-2	Phycoerythrin Concentrations	150	475	1.1	0.9	2.9	3.2	8.8	0.4	1.2	0.6
Level-2	Dissolved Organic Matter	40	200	0.5	0.4	1.2	2.2	5.4	0.3	0.8	0.4
Level-2	Seston	40	200	0.5	0.4	1.2	2.2	5.4	0.3	0.8	0.4
Level-2	Primary Production	41	203	0.5	0.4	1.2	2.2	5.4	0.3	0.8	0.4
Level-2	Land-Leaving Radiances	8261	8361	50.4	43.1		43.1		2.6		2.2
Level-2	DEM/DTM	500	1100	7.7	6.6		14.5		0.9		0.7
Level-2	Vegetation Index	30	160	4.3	3.7		8.7		0.5		0.4
Level-2	Land Surface Temperature	300	700	9.0	7.7		16.7		2.5		2.1
Level-2	Thermal Anomalies	100	300	0.7	0.6		2.5		0.4		0.3
Level-2	Snow Cover	90	280	0.6	0.5		2.3		0.1		0.1
Level-2	Land Cover Type	5000	5100								
Level-2	Bidirectional Reflectance, BRDF	5000	5100								
Level-2	Cloud Mask	200	900	5.0	4.3		9.9		9.9		8.3
Level-2	Cloud Fractional Area	100	500	0.6	0.5		2.3		2.3		2.0
Level-2	Cloud-Top Temperature and Pressure	424	948	8.6	7.4		16.0		8.0		6.7
Level-2	Cloud Optical Thickness (0.66 μm)	1080	1180	25.0	21.4		21.4		4.3		3.6
Level-2	Cloud Particle Effective Radius	[INCLUDED]	100				1.3		0.3		0.2
Level-2	Cloud Particle Thermodynamic Phase	[INCLUDED]	100				1.3		0.3		0.2
Level-2	Aerosol Optical Depth (0.41 to 2.13	500	1100	3.1	2.7		6.6		1.3		1.1
Level-2	Aerosol Size Distribution	704	1508	29.2	25.0		51.4		10.3		8.6
Level-2	Aerosol Mass Loading	100	300	0.7	0.6		2.5		0.5		0.4
Level-2	Atmospheric Stability	3000	3100	8.6	7.4		7.4		7.4		6.2
Level-2	Total Precipitable Water	[INCLUDED]	100				1.3				
Level-2	Total Ozone	[INCLUDED]	100				1.3		1.3		1.1
Level-2	Other	4000	5000	4.5	3.9	3	3.9	3.0	3.9	1.2	3.5
Level-2	All	31295	41957	188	161	136	286	315	69	46	68
Level-3	Averaging	1000	2000	5.6	5.6		11.2		11.2		11.2
Level-3	Other	2000	4000	10.1	10.1		20.2		20.2		20.2
Level-3	All	3000	6000	15.7	15.7		31.4		31.4		31.4

INDEPENDENT ESTIMATE

Effects of Reduced Spatial Resolution on MODIS Processing and Storage Requirements

In "MODIS Processing and Storage Requirements" by Han et al. (1990), Appendix B presented a spreadsheet summary of these requirements. That analysis was based upon the assumption that the spatial resolution would be 856m, 428m, and 214m for MODIS-N. Recently these resolutions have been reduced to 1000m, 500m, and 250m respectively. An updated spreadsheet with this new assumption is presented here. Using a 0.4 daytime duty cycle, the reduced spatial resolution requires 618 to 652 MFLOPS now vs. 832 to 876 MFLOPS previously or a reduction of 26%. The reduction in processing is nearly uniformly distributed among all levels and disciplines. The storage requirements are reduced from 357 GB/day to 273 GB/day or by 24%. The major savings is in the Level 1 data products.

ESTIMATE OF MODIS PROCESSING REQUIREMENTS
(with new spatial resolutions)

General information:	maximum pix/sec	channels	daytime tot/sec	nighttime tot/sec	Gpixels /day
MODIS-N pixels/sec/lambda (visible 1 km):	9087	12	109047	0	3.77
MODIS-N pixels/sec/lambda (thermal 1 km):	9087	17	154483	154483	13.35
MODIS-N pixels/sec/lambda (0.5 km):	36349	5	181745	0	6.28
MODIS-N pixels/sec/lambda (0.25 km.):	145396	2	290792	0	10.05
MODIS-T pixels/sec/lambda (1.1 km):	7208	32	230656	0	7.97
			966723	154483	41.42
Percent computer usage:	70.0				
Percent downtime:	10.0				
Percent browse overhead:	0.1				
Percent metadata overhead:	0.2				
Percent I/O overhead:	20.0				
Number of reprocessings:	2				
Calculated overhead above Level 2:	3.77				
Assumed day/night duty cycle:	0.4				
Assumed fractional cloud cover:	0.5				
Assumed fractional land cover:	0.3				
Assumed fractional ocean cover:	0.7				

	Mflops:	Ops/pix:	Pix/sec:	no. of products	no. of inputs	Storage (Gp/day)
BASIC LEVEL 1A PROCESSING:						
MODIS-N (visible 1 km):	0.65	15	3635	12	12	3.769
MODIS-N (thermal 1 km):	2.32	15	9087	17	17	13.347
MODIS-N (0.5 km):	1.09	15	14540	5	5	6.281
MODIS-N (0.25 km):	1.74	15	58158	2	2	10.050
MODIS-T (1.1 km):	1.38	15	2883	32	32	7.971
BASIC LEVEL 1B PROCESSING:						
MODIS-N (visible 1 km):	1.52	35	3635	12	12	3.769
MODIS-N (thermal 1 km):	3.71	24	9087	17	17	13.347
MODIS-N (0.5 km):	2.18	30	14540	5	5	6.281
MODIS-N (0.25 km):	4.89	42	58158	2	2	10.050
MODIS-T (1.1 km):	2.26	25	2883	32	32	7.971
LAND LEVEL 2 PROCESSING:						
Land leaving radiances (9 at 1 km):	2.45	500	545	9	9	0.424
Land leaving radiances (5@0.5 km):	5.45	500	2181	5	5	0.942
Land leaving radiances (2@0.25 km):	8.72	500	8724	2	2	1.507
NDVI(1 km):	0.00	0	545	0	2	0.000
NDVI(0.5 km):	0.00	0	2181	0	2	0.000
NDVI(0.25 km):	0.35	20	17448	1	2	1.507
Land surface temperature (LST):	1.91	1400	1363	1	3	0.118
Land cover type (quarterly, L-3):	0.38	44	8724	1	2	0.008
Weekly global snowcover maps:	0.02	44	545	1	3	0.047
Thermal anomalies and fires:	0.47	52	9087	1	4	0.785
Surface spectral albedo maps (8):	0.00	0	545	8	9	0.377
OCEAN LEVEL 2 PROCESSING:						
Water leaving radiances (40):	6.41	126	1272	40	40	4.397
Single scattering aerosol radiance:	0.00	0	1272	5	5	0.550
Angstrom coefficient:	0.00	0	1272	3	3	0.330
Chlorophyll-a conc.(case 1 waters):	0.05	39	1272	1	2	0.110
Chlorophyll-a conc.(case 2 waters):	0.02	130	127	1	2	0.011
Chlorophyll fluorescence:	0.13	100	1272	1	3	0.110
CZCS pigment concentrations:	0.04	34	1272	1	2	0.110
Sea surface temperature:	2.23	700	3181	1	3	0.275
Detached coccolith concentrations:	0.05	40	1272	1	4	0.110
Phycoerythrin pigment concentration	0.07	52	1272	1	2	0.110
Dissolved organic material conc.:	0.05	39	1272	1	2	0.110
Attenuation in oceans at 490 nm:	0.13	100	1272	1	1	0.110
Total seston concentrations:	0.05	39	1272	1	2	0.110
nary productivity (case 1):	0.05	41	1272	1	4	0.110
in situ validation observations:	0.13	100	1272	1	1	0.110

ATMOSPHERIC LEVEL 2 PROCESSING:

ud opt. depth, drop size & phase	9.27	51000	182	3	8	0.047
Cloud properties: Emis., T, and P:	0.55	3000	182	3	8	0.047
Cloud flags:	4.54	500	9087	1	4	0.785
Aerosol optical depth (8):	0.04	63	73	8	8	0.050
Aerosol size distribution (8):	16.60	28549	73	8	12	0.050
Total precipitable water (near-IR):	0.02	100	182	1	3	0.016
Total precipitable water(thermal):	0.00	100	4	1	18	0.000
Total column ozone (thermal):	0.00	100	4	1	18	0.000
Lifted index (thermal):	0.00	100	4	1	18	0.000
Layer mean temperatures (thermal):	3.09	850000	4	4	18	0.001
Layer mean moisture (thermal):	3.09	850000	4	4	18	0.001

Total number of Level 2 products out, in, and stored(Gpix/day): 260 388 96.21

LEVEL 2 TO 3 PROCESSING:

				# rect.
LAND PRODUCTS:				
MODIS-N (visible 1 km):	3.85	372	545	19
MODIS-N (thermal 1 km):	1.52	372	1363	3
MODIS-N (0.5 km):	2.03	372	5452	1
MODIS-N (0.25 km):	8.11	372	21809	1
OCEAN PRODUCTS:				
MODIS-T (1.1 km):	5.63	372	1009	15
ATMOSPHERIC PRODUCTS:				
MODIS-N (visible 1 km):	1.08	372	145	20
MODIS-N (thermal 1 km):	1.62	372	363	12
MODIS-N (0.5 km):	0.00	372	7270	0
MODIS-N (0.25 km):	0.00	372	29079	0

	Mflops	With % use Mflops	Cum. sum Mflops	Data Volume Gpix/day	Cum. sum Volume	Data Volume GB/day
L .l 1A processing (w/o DTM):	7.19	10.27	10.27	41.42	41.42	82.84
Level 1A DTM & geometry overhead:	2.91	4.15	14.43	11.98	53.40	23.96
Level 1B processing:	14.55	20.79	35.22	41.42	94.82	82.84
Land Level 2 processing:	19.77	28.24	63.46	6.46	101.28	25.85
Ocean Level 2 processing:	9.40	13.43	76.88	6.66	107.94	26.64
Atmospheric level 2 processing:	37.20	53.14	130.02	0.98	108.92	3.93
Level 2 to level 3 processing:	23.85	34.07	164.09	5.54	114.46	26.12
Level 3 to level 4 processing:	0	0.00	164.09	0.00	114.46	0.00
Browse processing:	0.11	0.16		0.11	114.58	0.23
Metadata processing:	0.23	0.33		0.23	114.81	0.46
I/O overhead:	23.04	32.92				
Downtime overhead:	13.83	19.75				
Twice reprocessing:	304.15	434.51				
Storage required (Gpix/day and GB/day):				114.81		272.87

Grand total of processing (MFLOPS):	651.76	618.86
Grand total of processing (GFLOPS):	0.65	0.62

		N ops/pix
Grand total as function of N ops/pixel (GFLOPS):	0.96	2000
	1.92	4000
	2.88	6000
	3.84	8000

S ARY ESTIMATE OF MODIS CDHF REQUIREMENTS:

	N	MFLOPS /var. with no overhead	Total	Total + overhead	Data Volume GB/day
Level 0 to 1A:	68	0.15	10.10	19.10	106.80
Level 1A to 1B:	68	0.21	14.55	27.53	82.84
Land variables:	29	0.68	19.77	37.39	25.85
Ocean variables:	60	0.16	9.40	17.77	26.64
Atmospheric vars:	35	1.06	37.20	70.35	3.93
Level 3:	71	0.34	23.85	45.11	26.12
Level 4:	0	0.00	0.00	0.00	0.00
Browse & metadata:					0.69
Post-launch period:					
Land variables:	14	0.52	7.30	13.81	6.60
Ocean variables:	9	0.15	1.36	2.57	3.96
Atmospheric vars:	12	1.26	15.18	28.71	0.75
At launch total (MFLOPS):			114.86	217.25	272.87
At launch re-processing (MFLOPS):				434.51	545.74
At launch grand total (GFLOPS):				0.65	818.60
Post-launch total (MFLOPS):				262.33	284.17
Post-launch re-processing (MFLOPS):				524.66	568.35
Post-launch grand total (GFLOPS):				0.79	852.52

	Mflops:	Ops/pix:	Pix/sec:	no. of products	no. of inputs	Storage (Gp/day)
LAND POST-LAUNCH DATA PRODUCTS:						
Leaf area index (weekly):	0.52	383	1363	1	1	0.118
BRDF (seasonal):	0.52	383	1363	1	1	0.118
Incident PAR (daily):	0.52	383	1363	1	1	0.118
Soil brightness index:	0.52	383	1363	1	1	0.118
Growing season length:	0.52	383	1363	1	1	0.118
Surface emissivity:	0.52	383	1363	1	1	0.118
Primary production (weekly):	0.52	383	1363	1	1	0.118
Surface diffusion resistance (weekl	0.52	383	1363	1	1	0.118
Thermal inertia:	0.52	383	1363	1	1	0.118
Surface roughness:	0.52	383	1363	1	1	0.118
Evapotranspiration (weekly):	0.52	383	1363	1	1	0.118
Carbon dioxide balance:	0.52	383	1363	1	1	0.118
Vegetation decomposition:	0.52	383	1363	1	1	0.118
Polarization:	0.52	383	1363	1	1	0.118
TOTALS =	7.30			14	14	1.649
OCEAN POST-LAUNCH DATA PRODUCTS:						
Primary production averages:	0.15	118	1272	1	1	0.110
High chloro. conc. from fluorescenc	0.15	118	1272	1	1	0.110
Fluorescence efficiency:	0.15	118	1272	1	1	0.110
PP from fluorescence:	0.15	118	1272	1	1	0.110
Incident PAR:	0.15	118	1272	1	1	0.110
Attenuation of PAR:	0.15	118	1272	1	1	0.110
Daily PAR:	0.15	118	1272	1	1	0.110
Beam attenuation at 520 nm:	0.15	118	1272	1	1	0.110
Particulate scattering:	0.15	118	1272	1	1	0.110
TOTALS =	1.36			9	9	0.989
ATMOSPHERIC POST-LAUNCH DATA PRODUCTS:						
Aerosol single scattering albedo:	1.69	9279	182	1	1	0.016
Cloud size and perimeter:	1.69	9279	182	2	2	0.031
Total precipitable water within clo	1.69	9279	182	1	1	0.016
Global aerosol transport processes:	1.69	9279	182	1	1	0.016
Aerosol effects on cloud albedo stu	1.69	9279	182	1	1	0.016
Cloud climatologies:	1.69	9279	182	3	3	0.047
Histograms of daytime cloud optical	1.69	9279	182	1	1	0.016
Hemispheric albedo from albedo mode	1.69	9279	182	1	1	0.016
Atmospherically corrected imagery:	1.69	9279	182	1	1	0.016
TOTALS =	15.18			12	12	0.188

QUESTIONS AND DISCUSSION AREAS FOR DR. ED CHANG, INFORMATION SYSTEMS MANAGER FOR INTERFACES BETWEEN EOSDIS FLIGHT AND GROUND SEGMENTS

- Routine Delivery of MODIS Level-0, Platform Ancillary, and Instrument Control Log Data
  - Scenario for delivery/acquisition of these data sets in the context of Level-1 processing
  - Data packets, transfer frames, virtual channels, TDRSS, CDOS, and us
  - CDOS designation and handling of missing or uncorrectable data blocks
  - What does our CDOS interface look like (and how does it behave)?
  - What will CDOS send us as Level-0 data?
- The Role of Field Support Terminals
- Most Recent Concepts in Direct Broadcast
- Real-Time Instrument Requirements
- Near-Real-Time and/or Quick-Look Data (updated definitions)
- TDRSS, NASCOM, and a 10^{-8} End-to-End System Bit Error Rate
- Possible Impacts of MODIS Data Flows Due to Shuttle and Other Manned Missions
- What are the Expectations of EOSDIS for MODIS Level-1 Data Products?
- Scenarios for Treatment of Data Acquisition Requests (lead times)
  - Routine
  - Targets of Opportunity