GLI processing and products

NASDA/EORC ADEOS-II GLI Land
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What is ADEOS-II GLI?

- ADEOS-II has been launched on Dec. 14, 2002.
- GLI is an optical sensor for global observation.
- GLI has 1km and 250m resolution channels.
- GLI has 23 channels in VNIR, 6 channels in SWIR, and 7 channels in MTIR (36 channels).

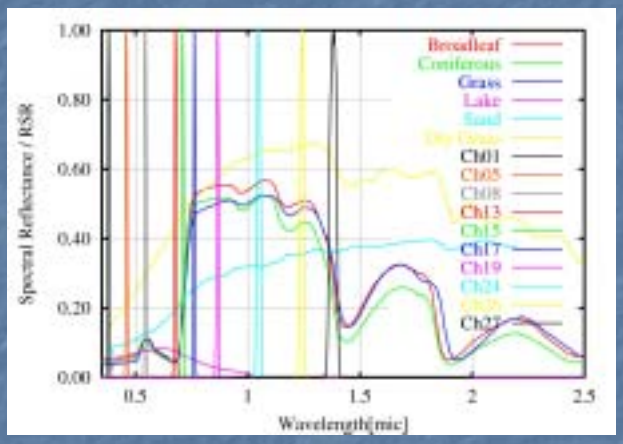
Specification

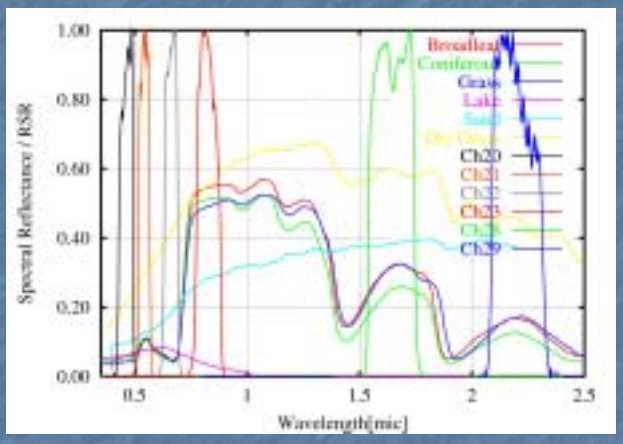
Spectral Range	0.375-12.5um
Channels	36
Swath	±45° (1600km)
Tilting	0°, ±20°
Recurrent Period	4 days
Path (Orbit) Period	101 min
Number of Path (orbit) per recurrent period	57path/4day (14.25path/day)
Number of Scene	26 Scene/path (1scene=138scan,

GLI Ch.	Wavelength Range[nm]	Resolution [m]	Radiance[W/m^2/st/mic]	[W/m2/sr/mic]	S/N
Ch1	375-385	1000	365	59	600
Ch2	395-405	1000	139	70	800
Ch3	407-417	1000	130	65	800
Ch4	438-448	1000	109/560#	54	800
Ch5	455-465	1000	108/624#	54	800
Ch6	485-495	1000	86	43	800
Ch7	515-525	1000	64/539#	31	600
Ch8	540-550	1000	56/549#	28	600
Ch9	560-570	1000	47	23	800
Ch10	620-630	1000	33	17	800
Ch11	661-671	1000	26	13	800
Ch12	675-685	1000	24	12	800
Ch13	673-683	1000	438	12	200
Ch14	705-715	1000	18	10	700
Ch15	705-715	1000	311	10	250
Ch16	744-754	1000	14	7	550
Ch17	759-767	1000	350	6	130
Ch18	855-875	1000	9	5	450
Ch19	860-870	1000	304	5	130
Ch20	425-495	250	624	36	200
Ch21	520-570	250	549	25	150
Ch22	630-690	250	150	14	100
Ch23	770-880	250	257	21	140
Ch24	1040-1060	1000	203	8	300
Ch25	1100-1170	1000	200	8	350
Ch26	1230-1250	1000	138	5.4	70
Ch27	1360-1400	1000	94	1.5	120
Ch28	1540-1740	250	69	5	109
Ch29	2100-2320	250	30	1.3	105
	#: piecewise linear		1km Land	250m Land	

Ch30	3.715	345	H: 300 L: 250	0.07/0.07 0.71/0.78	1000
Ch31	6.7	307	285 200	0.02/0.03 0.27/0.32	1000
Ch32	7.3	322	300 200	0.02/0.03 0.24/0.27	1000
Ch33	7.5	324	300 200	0.02/0.02 0.21/0.24	1000
Ch34	8.6	350	300 190	0.03/0.05 0.47/0.49	1000
Ch35	10.8	354	300 190	0.04/0.05 0.24/0.30	1000
Ch36	12	358	300 190	0.04/0.06 0.23/0.27	1000
		1km land			

Relative Spectral Response of GLI 1km and 250m land channels



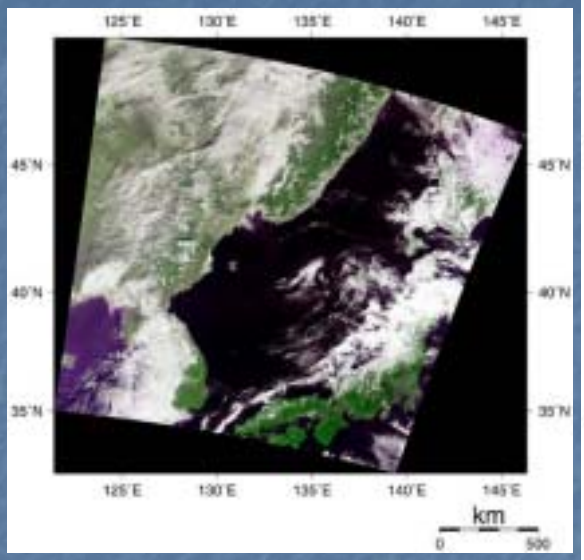


RSR of 1km land channels
With typical spectral reflectance

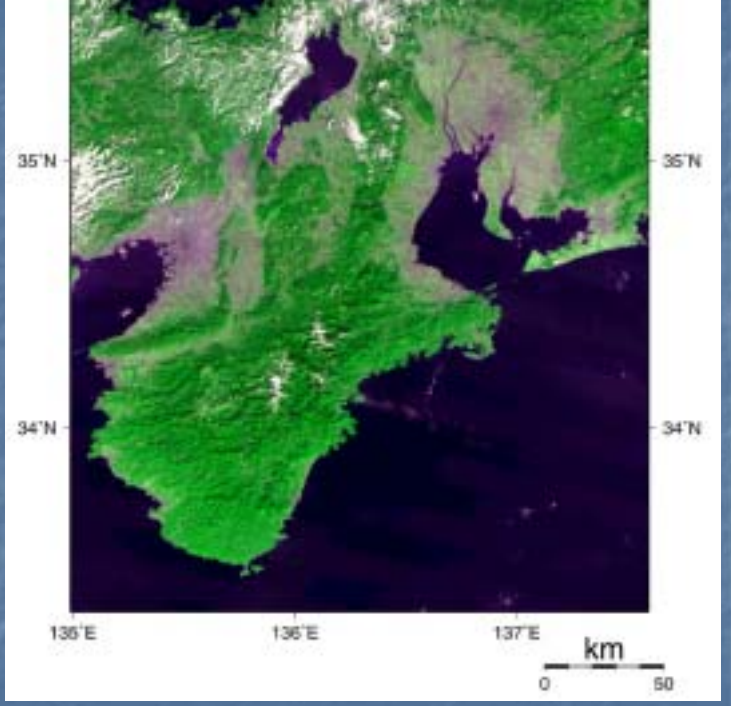
➔ Narrow band

RSR of 250m land channels
With typical spectral reflectance

➔ Broad band



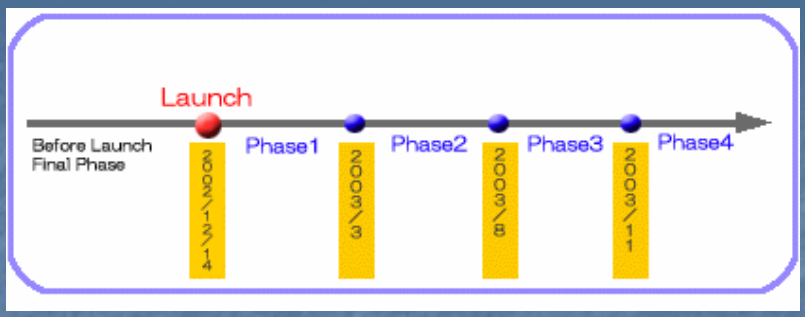
Example of GLI 1km image captured on Feb. 7, 2003 (RGB=ch.13,19,8)



Example of GLI 250m image captured on Feb. 7, 2003 (RGB=ch.22,23,21)

→1km data is useful for **global** monitoring, and 250m data is useful for **more detailed** monitoring.

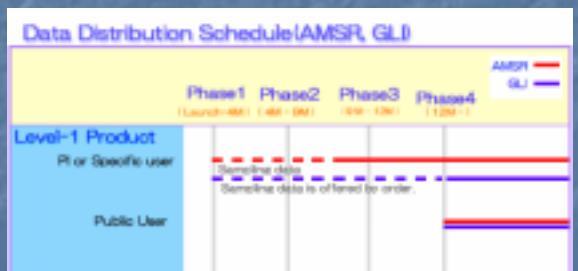
ADEOS-II schedule



Phase1(2002/12/14 - 2003/4/14)
Initial Checkout of the satellite and system adjustment and processing of L0 etc.

Phase2(2003/4/15 - 2003/12)
Adjustment of level 1 GLI product and calibration/validation phase

Now!



L1B is possible to be provided to CAL/VAL PIs.
CAL/VAL PIs can process Level 1 data after Apr. 15 (CAL/VAL phase).

Raw data

Level 1A(GLI 1km,250m):
Reformatted L0
- Bit string(13bits) of L0 is transformed into byte unit(16bits).
- Radiometric and Geometric correction coefficients are attached.

Level 1B(GLI 1km,250m):
Radiometric corrections and Geometric corrections are applied.
- Band registrations are done.
- Projection coefficients attached.
- Ocean/Land flags attached.
- Image data are grouped to 3, VNIR, SWIR, MTIR

Level 2A(GLI 1km):
-precise geometric correction parameter(PGCP)
-16 days composite data(L2A_LC)

Level 2(GLI 1km):
-Atmospheric corrected reflectance (ACLC)
-Vegetation Index (VGI;NDVI,EVI)

Most land users may use L1B, L2A or L2.

GLI land higher algorithm (L2A or L2)

1. Precise Geometric Correction

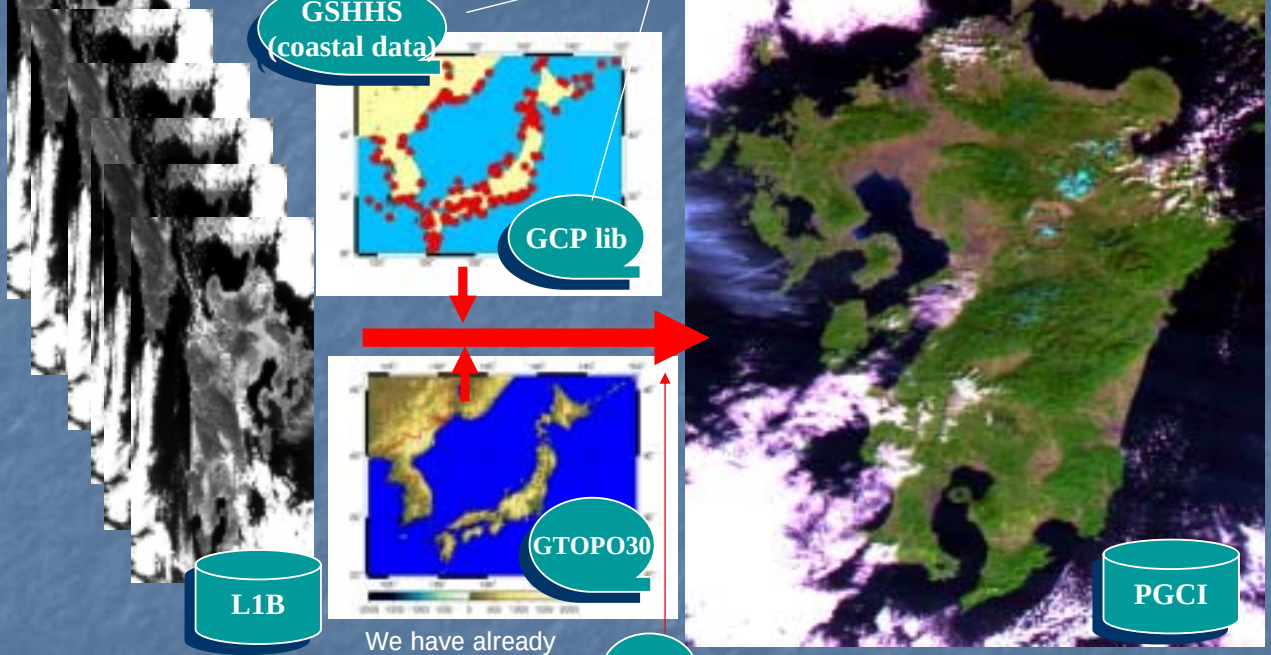
2. 16days Composite

3. Atmospheric correction (after validation)

4. Vegetation Index (NDVI,EVI)

But

GLI 1km algorithm has prepared, but there is no higher algorithm for 250m data



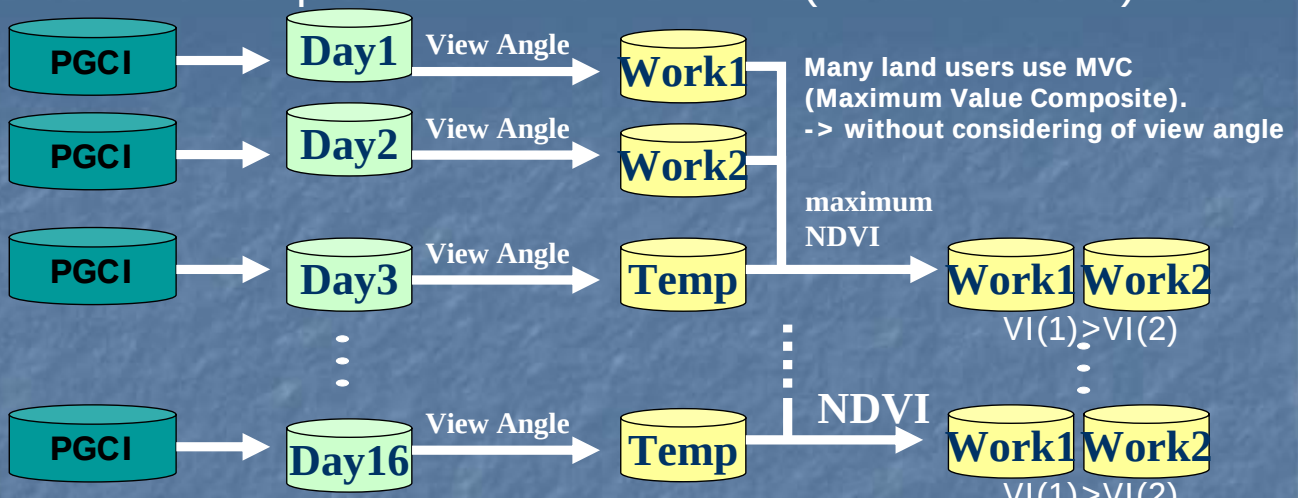
We have already prepared GTOPO30.

※GLI sensor scans from east to west.

250 m can be almost same algorithm.

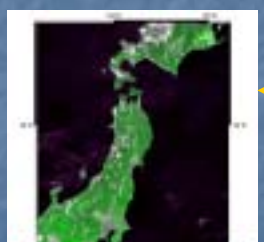
→ NASDA calibration group is now verifying the geometric error.

GLI 1km Composite for cloud free data (CVMVC method)



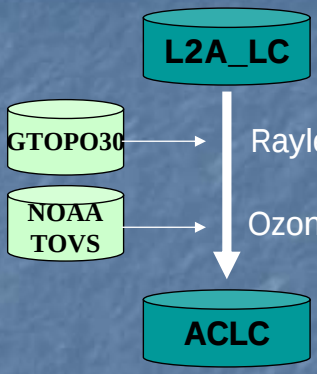
Reason of using CVMVC is …

1. Maximum NDVI can detect cloud free pixels
2. Maximum NDVI can detect higher satellite angle pixels, which is effected by surface BRDF.
3. Selected pixel should be satisfied with both of lower satellite zenith angle and



16day composite
Days: 1 to 16

$$\rho_{obs} = \frac{\pi L_{sat}}{F_0 \cos(\theta_s)}$$



This algorithm will be applied after calibration and validation.

250m can be same algorithm ??

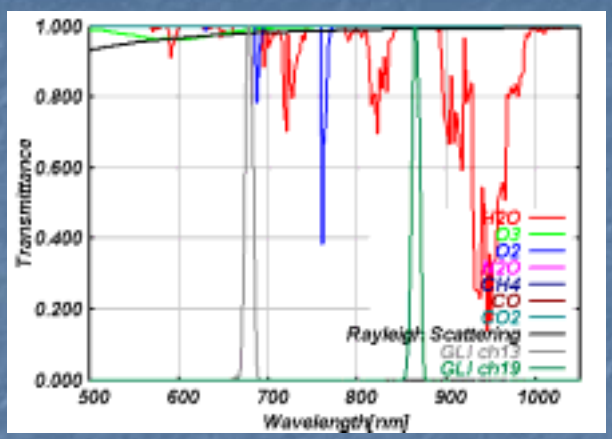
Much of the computation during atmospheric correction requires intensive CPU time due to floating point processing.

Solution 1. **L2A_LC** leaves the STSG (Sun-Target-Sensor Geometry) data.

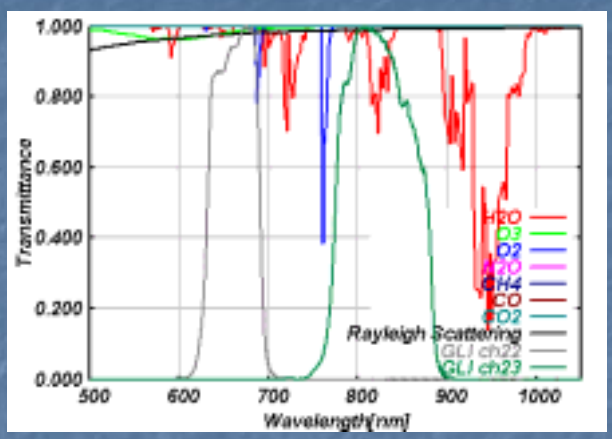
Atmospheric corrected reflectance can be **applied after composite**.

Solution 2. Optical depth of molecular scattering and STSG conditions can be expressed **by LUT (Look-Up table)** using standard atmospheric model and elevation (depends on temperature and pressure).

Relative Spectral Response and gaseous transmittance



1km channel with gaseous transmittance (Red and Near Infra-red)



250m channel with gaseous transmittance (Red and Near Infra-red)

→ Red and NIR 250m channels have SENSITIVITY OF ATMOSPHERIC COMPENSATION

$$NDVI = \frac{\rho_{NIR} - \rho_{RED}}{\rho_{NIR} + \rho_{RED}}$$

$$EVI = G \times \frac{\rho_{NIR} - \rho_{RED}}{L + \rho_{NIR} + C1 \times \rho_{RED} - C2 \times \rho_{BLUE}}$$

VGI
(NDVI,EVI)

Normalized Difference Vegetation Index (NDVI):

-> "continuity index"

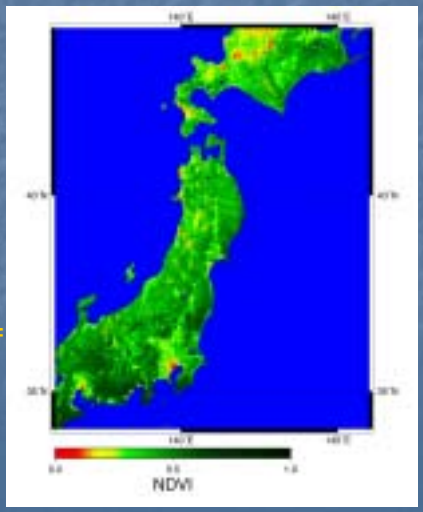
This index could be extended to provide a longer term data for use in operational monitoring studies.

Enhanced Vegetation Index (EVI):

-> “optimized index”

This index can enhance the vegetation signal with improved sensitivity in high biomass regions and improved vegetation monitoring through a decoupling of the canopy background signal and a reduction in atmosphere influences

250m can be same algorithm



--- GLI 250m land algorithm (idea) ---

product

Precise geometric correction	→	Almost same as 1km algorithm. It should use both of elevation data and GCPs data.
Composite	→	same as 1km algorithm
Atmospheric correction	→	Characteristics of 250m channels (center of wavelength, band width and so on) are different from 1km channels. Especially, 250m channels may have sensitivity of atmospheric compensation.
Vegetation Index (NDVI,EVI)	→	same as 1km algorithm

1. CAL/VAL phase starts from Apr. 15, 2003. And verification is now ongoing.

2. GLI 250m land algorithm should be developed as soon as possible.

3. 250m algorithm will be almost same as 1km algorithm,
   but 250m channels may have sensitivity of atmospheric compensation.

4. Collaborate with Prof. Tateishi and Dr. Ake.
   - The GLI Acquisition Strategy (250m) -> Dr. Ake (NASDA/EORC)
   - Precise Geometric Correction (1km,250m)
     -> Dr. Hashimoto (NASDA/EORC)
   - Composite & Atmospheric Correction & VIs (1km,250m)
     -> Dr. Yamamoto(NASDA/EORC)
   - Land classification (250m) -> Prof. Tateishi (Chiba Univ.)

If you are interested in ADEOS-II/GLI, please contact to me
(**kath@eorc.nasda.go.jp**).

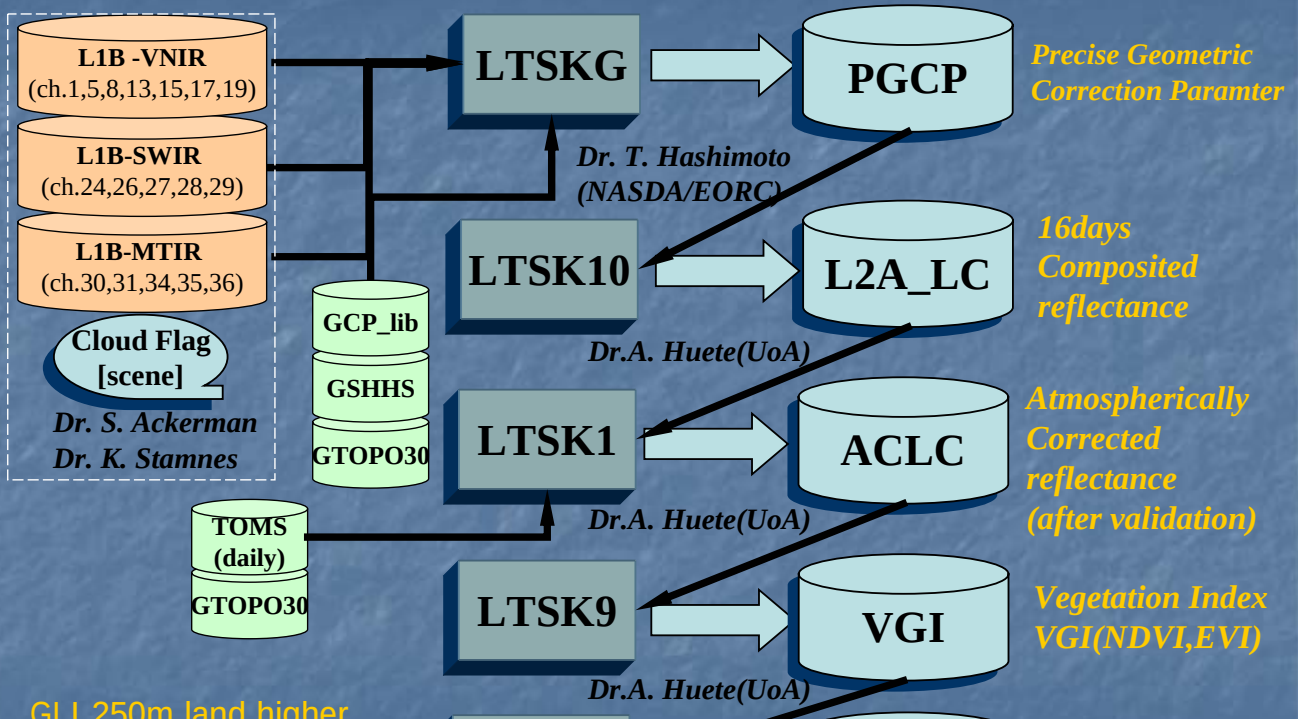
Appendix.

1. Increased channels for land and ocean observations compared to previous optical sensors, which leads to a higher observation capability.

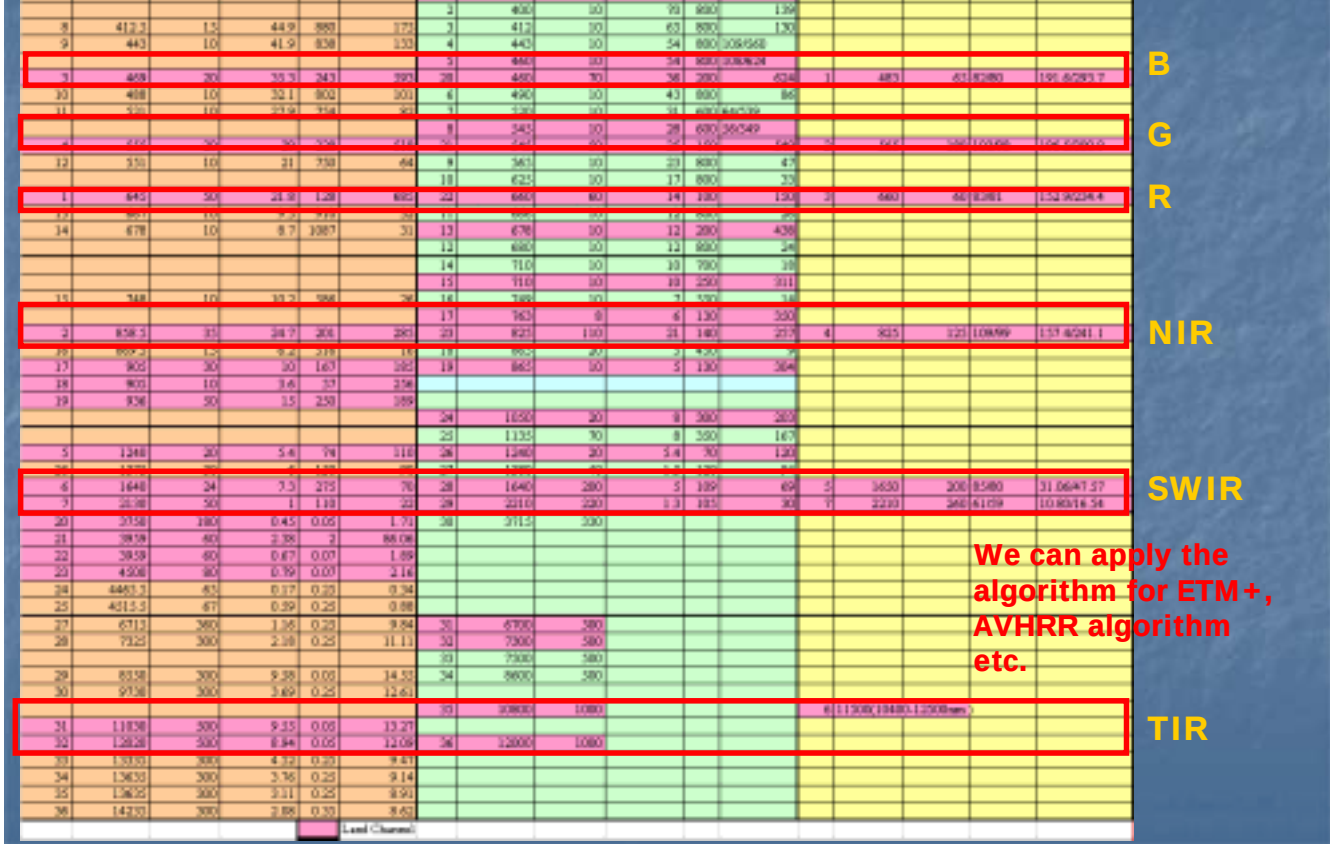
2. More channels of 250 m level high resolution (ch.20,21,22,23,28,29) than the most advanced U.S. satellite sensor, MODIS.

3. Better aerosol observation over land by the near-ultraviolet channels(ch.1;380nm), which will be done for the first time by 1 km level resolution sensors.

GLI **1km** land algorithm on higher processing and products



GLI 250m land higher

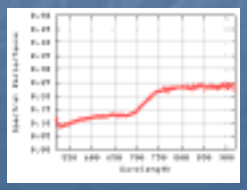
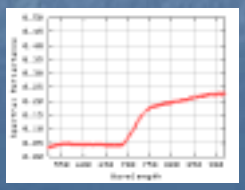
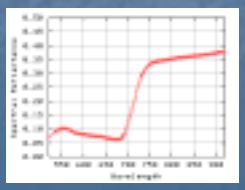


Comparison of GLI sensor and Other Sensor's Specification

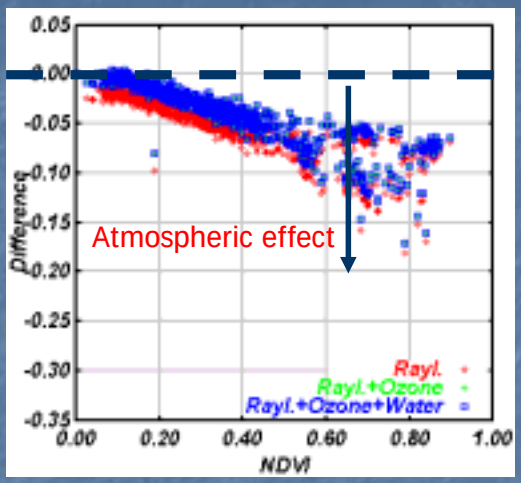
ADEOS-II GLI band	band22	band13	band23	band19
ADEOS-II GLI center wavelength(nm)	660	678	825	865
ADEOS-II GLI resolution(m)	250	1000	250	1000
Landsat7 ETM+ band	band3	band3	band4	band4
Landsat7 ETM+ wavelength(nm)	630-690	630-690	775-900	775-900
Landsat7 ETM+ resolution (m)	30	30	30	30
NOAA AVHRR band	band1	band1	band2	band2
NOAA AVHRR wavelength(nm)	580-680	580-680	725-1100	725-1100
NOAA AVHRR resolution(m)	1100	1100	1100	1100
Terra MODIS band	band1	band1	band2	band2
Terra MODIS center				

Site	Mandalgovi (Mongolia)	Brazilia National Park (Brazil)	Konza (U.S.)
Date	1998/08/09 ~1998/08/11	2000/05/05	2000/06/15
organization	Chiba Univ.	Uinv. Of Arizona	Uinv. Of Arizona
Spectrometer	S2320 (Soma Optics Inc.)	FieldSpec HH	FieldSpec HH
Range	350nm-1050nm	269.2nm-1068nm	269.2nm-1068nm
Number of Channels	512ch	512ch	512ch
Method	Mobile Measurement System	MQUAL (MODLAND Quick Airborne Looks)	"Yoke"
Sensor Height	about 2m	about 200m	about 2m

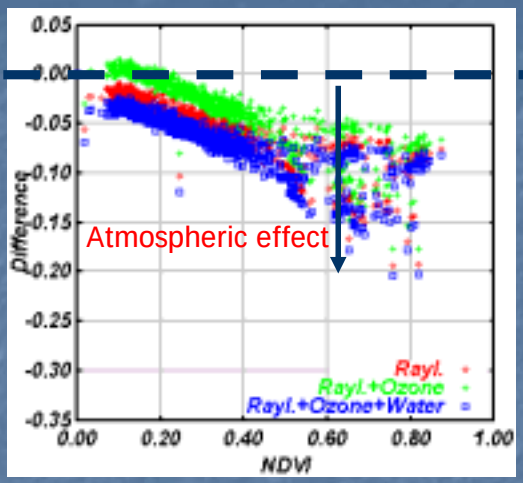


Example of simulation results



GLI 1km NDVI



GLI 250m NDVI

No atmospheric corrected

Item	Condition
Date	23, June
Solar Zenith Angle	45[deg]
Satellite Zenith Angle	45[deg]
Relative Azimuth Angle	20[deg]
Target Height	0[m]