

IMAP/VISIによる大気光とオーロラの観測： 初期結果報告

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20130225 大気圏シンポジウム @ ISAS



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Scientific Targets of VISI

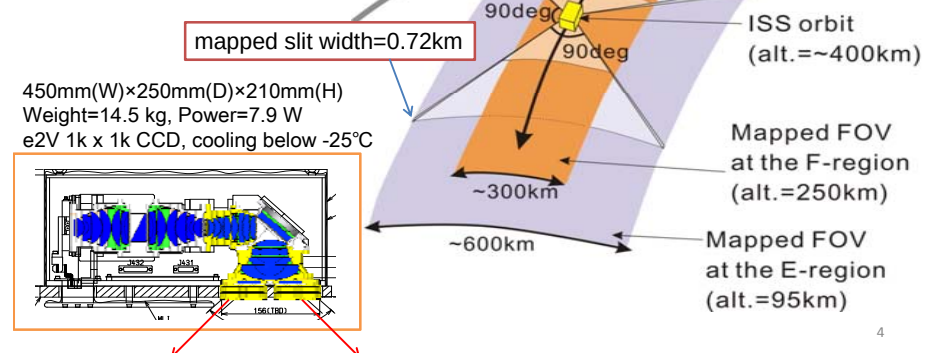
Table Summary of VISI.

Airglow	Region	Target	Required Plate scale	Intensity at mid.-lat.	Expected S/N for airglow variation	Aurora
O2 (0-0) (762nm)	lower-thermosphere (95km alt.)	gravity wave	16 x 16 km	>1000R	1.6 for 50R variation	O2 aurora, >10 kR, ~120 km alt.
OH Meinel (730nm)	mesopause (85 km alt.)	gravity wave, temp.	16 x 16 km	400R/nm	4.2 for 20R/nm variation	N2 aurora, >10 kR ~110 km alt.
O (630nm)	upper-thermosphere (250km alt.)	bubble, gravity wave, TID	25 x 25 km	100R	1.8 for 10R variation	O red aurora, >1kR 250 km alt.

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Field-of-view of VISI: two-line scanning

- altitude: 400 ± 50 km
- period: 90 min
- inclination: 52 deg
- latitude range: ± 51 glat.
- speed: 7.6 km/s

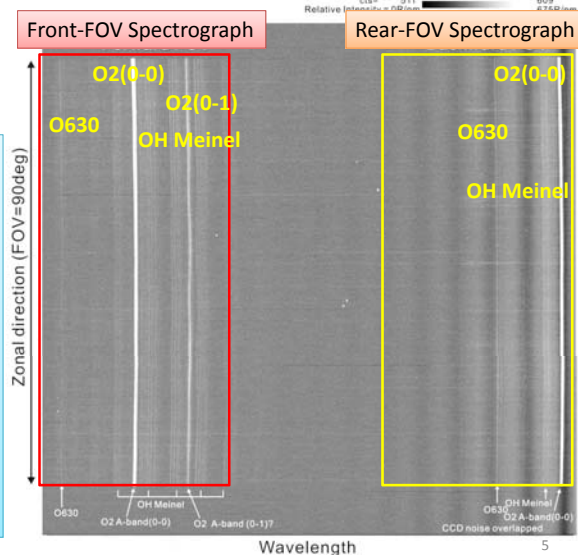


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Characteristics of VISI data

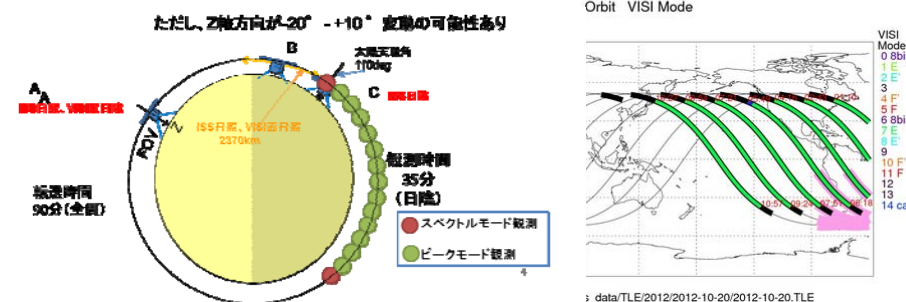
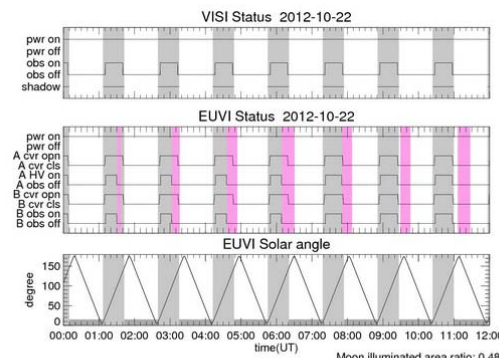
Initial test in Aug. 2012, we confirmed checked the following issues.

- VISI electronics works correctly.
- Optical alignment was not degraded due to the launch.
- Peltier electric cooling works good. The CCD temperature is cooled down to -30 degC with 10 sec after turning on of the Peltier.
- Prominent O2 emission lines.



Operation

- VISI, EUVI turn on only in the nightside (~35min)
- VISI is mainly operated with the peak mode, and at each of the start and end of operation VISI takes 1 exposure with the spectral mode.



Observation mode

Calibration mode

With 1x1 pixel read-out (no-binning), 1 full-frame data (1072x1048) are recorded.

Exposure time=2-4 sec.

Spectral mode

Data at 6 ROIs are recorded. The ROIs are determined for 3 emissions in the front FOV and 3 emission in the back FOV. Bining: 8pix, 16pix, 32pix

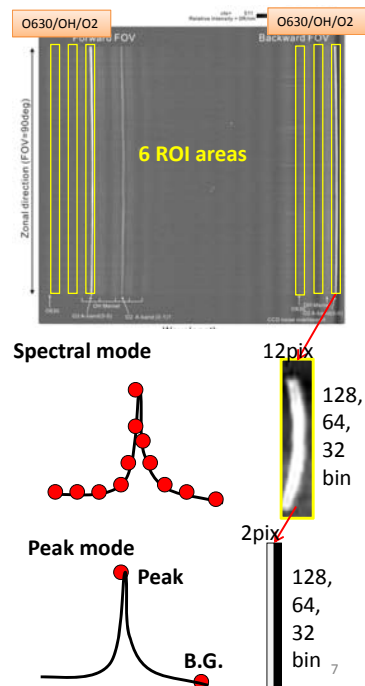
Exposure time=1-6sec, cycle=1.9-6.6 sec.

Peak mode

On each spectrum in the ROI, the peak and background are determined and recorded.

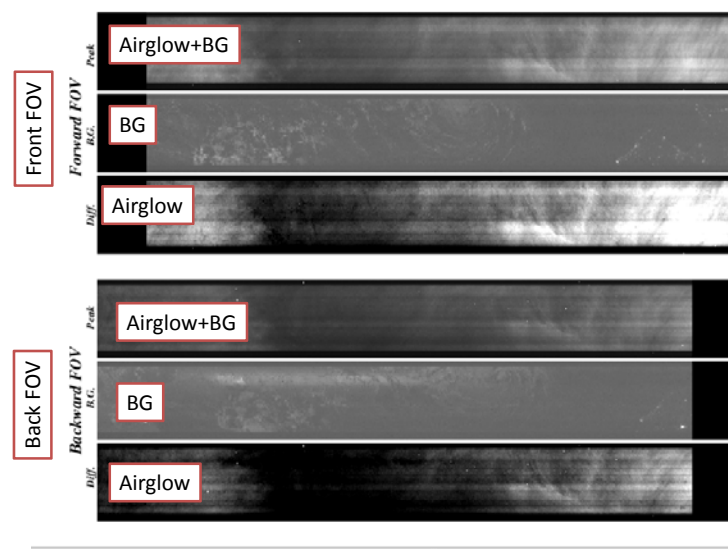
Bining: 8pix, 16pix, 32pix

Exposure time=1-6sec, cycle=1.9-6.6 sec.

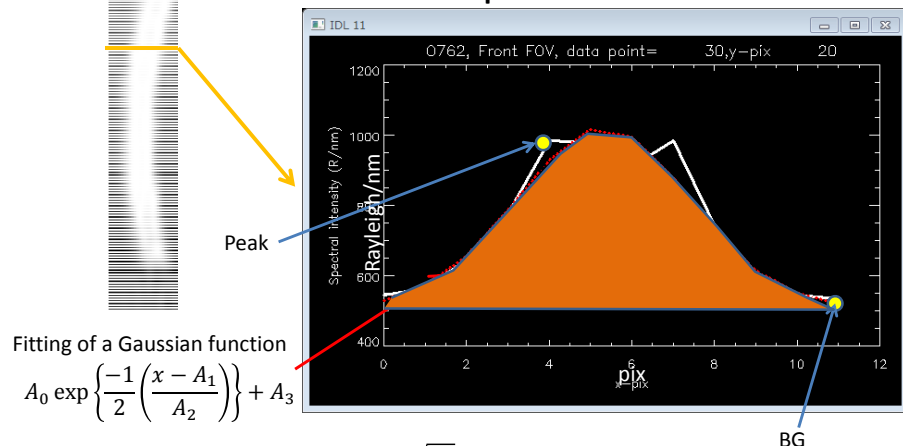


E-region airglow O₂ 762nm

20120925 0207UT, mapping alt=95km



On-orbit calibration: Gaussian fitting to emission profile with the spectral mode

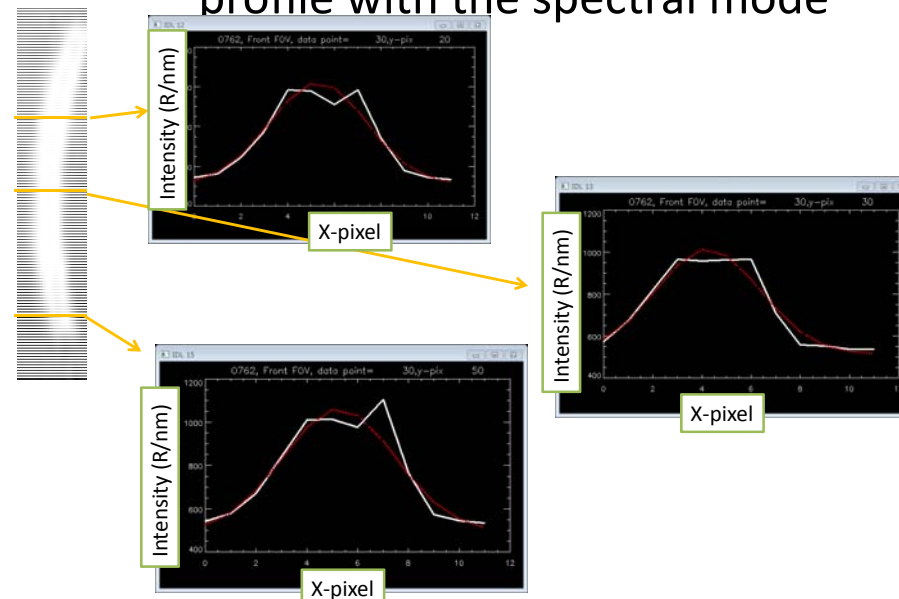


Fitting of a Gaussian function

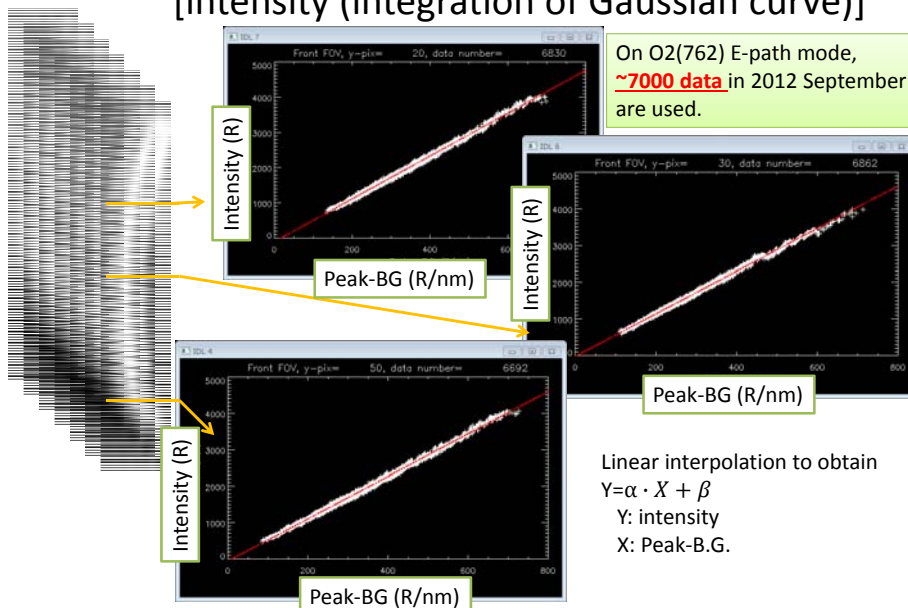
$$A_0 \exp\left\{\frac{-1}{2}\left(\frac{x - A_1}{A_2}\right)^2\right\} + A_3$$

Thus, we have an integration value of $\sqrt{2\pi}A_0A_2$
which is intensity of O2 (0-0) emission line.

Gaussian fitting to emission profile with the spectral mode

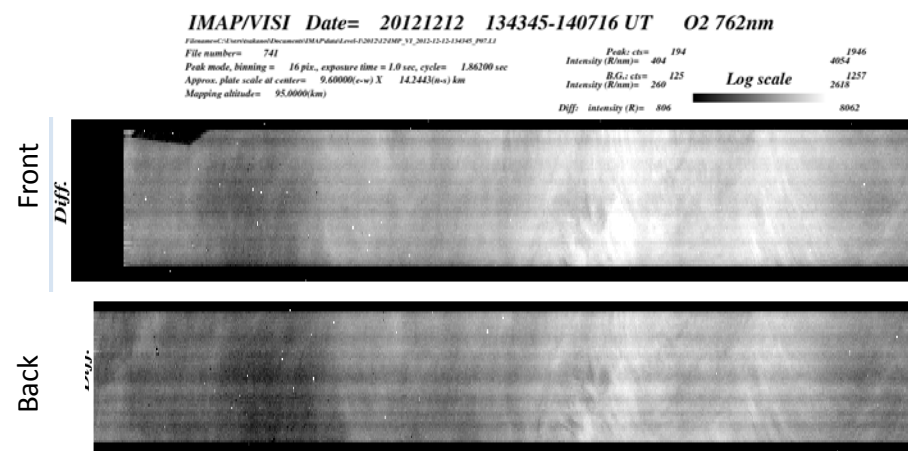


Relationship between [Peak-B.G.] and [intensity (integration of Gaussian curve)]



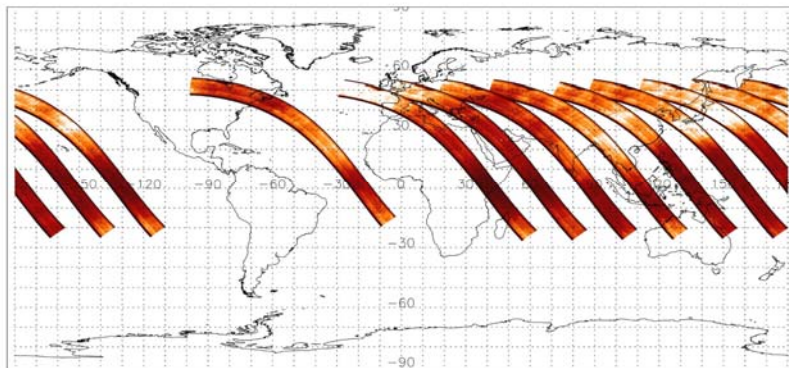
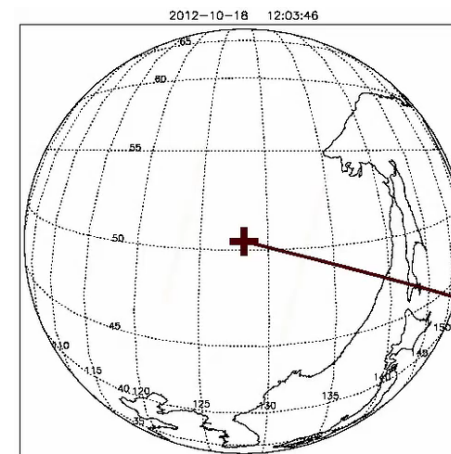
Plot with calibrated data

Not bad, but horizontal line structures still remains, which
should be corrected by flat-fielding.



Global 2-day map: O₂ airglow

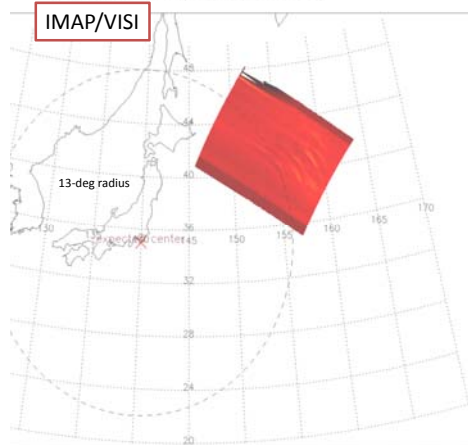
2012.OCT.15 – 30

O₂ airglow movie

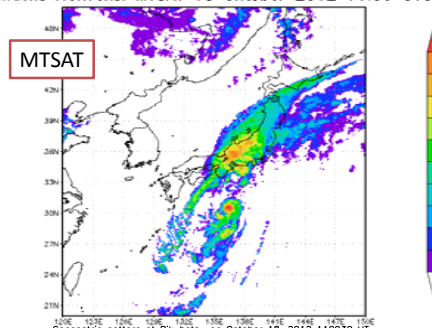
Concentric GW pattern

(Poster by Septi et al.)

2012-OCT-18, 762 nm

O₂ atmospheric band nightglow on 18-10-2012

Indeks Konveksi MTSAT 18 Oktober 2012 11:00 UTC



Rikubetsu

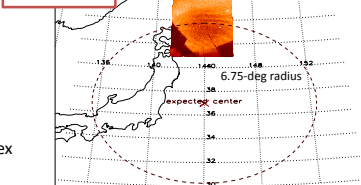
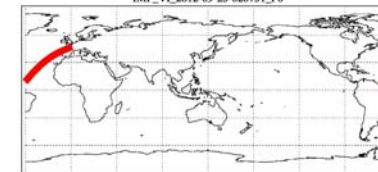


Fig. The expected center of the concentric GW in 762 nm observed by VISI, OI observed at Rikubetsu, and convective index from MTSAT on October 18, 2012

O 630 nm airglow plasma bubble

IMP_VI_2012-09-25-020751_P0



20120925 0207UT

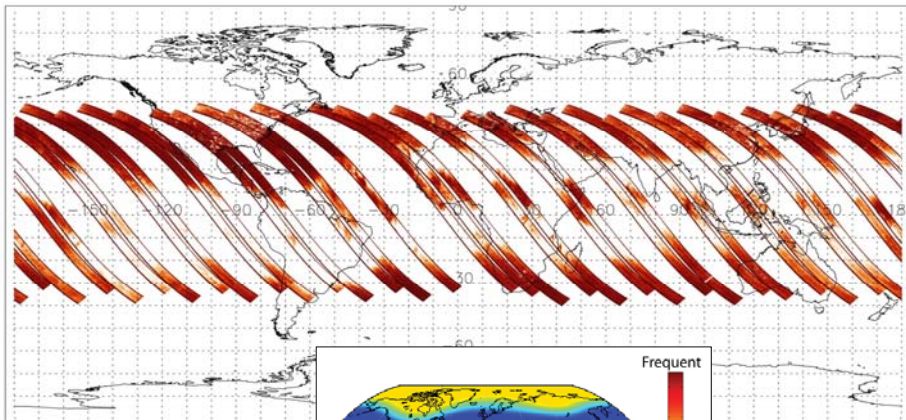
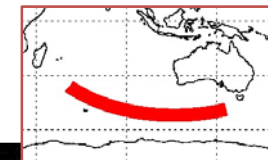
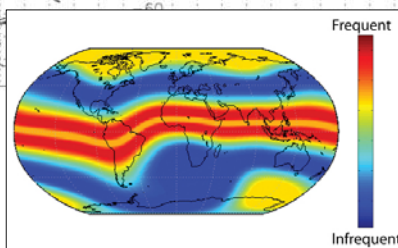
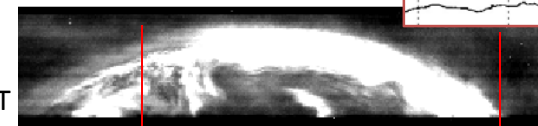
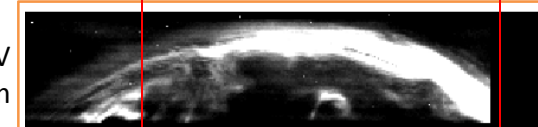
Mapping altitutde=250km

Front FOV

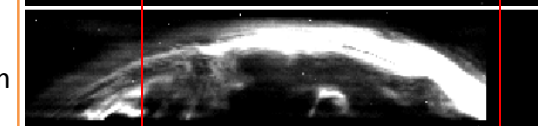


Back FOV

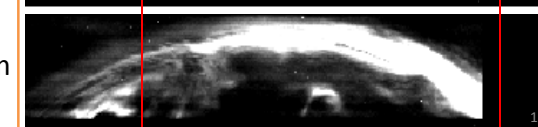


Ionospheric
Scintillations**E-region
(O2 762)**20120907 1549UT
FRONT FOVBack FOV
Map. Alt=135km

Map. Alt=115km



Map. Alt=95km



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(SDR文章より) ミッション要求：成功基準 (1/2)

ミニマムサクセス

- 地理緯度51.6度以下において電離圏、中間圏、熱圏、プラズマ圏の撮像観測を行い、以下のいずれかを達成する：
- 中間圏・下部熱圏と電離圏における水平スケール50km-500kmの構造を測定する。
- プラズマ圏・電離圏におけるイオン共鳴散乱光の高度分布を測定する。

フルサクセス

- **1年間にわたり** 地理緯度51.6度以下の全経度域の電離圏、中間圏、熱圏、プラズマ圏の撮像観測を行い、以下のいずれかを達成する：
- 中間圏・下部熱圏と電離圏における水平スケール50km-500km構造の出現特性および波面方向の経度、緯度、地方時、季節依存性を解明する。
- プラズマ圏・電離圏におけるHe+密度、O+密度の高度分布を測定し、その経度、緯度、地方時、季節依存性を解明する。
- 超高層大気の急激な変動の衛星航法システムなどの宇宙利用システムへ与える影響を観測的に解明する。

(SDR文章より) ミッション要求：成功基準 (2/2)

エクストラサクセス**3年間にわたり** 地理緯度51.6度以下の全経度域の電離圏、中間圏、熱圏、プラズマ圏の撮像観測を行い、以下のいずれかを達成する

- 「フルサクセス」にあげられた項目の太陽活動度依存性を解明する。超高層領域は下層大気に対して11年の太陽サイクルの変動が大きく、そのような大きな環境の変化がエネルギー及び物質の輸送過程に与える影響を明らかにする。
- 中間圏・下部熱圏と電離圏における水平スケール50km-500km構造の伝播速度の測定をする。
- 地磁気擾乱時のオーロラ帯及びサブ・オーロラ帯を含むプラズマ及び中性大気の変動を観測的に解明する。
- 台風などの活発な下層大気現象と中間圏における大気重力波の出現との直接的な因果関係を示す例を観測する。
- VISIによる分光観測により、中間圏OH温度を測定し、ライダーなど地上観測との比較を行う。

Summary

	O2 762	OH 730	O 630
Current status and achievement	- Many events of airglow: Large to medium scale - Mostly useful even in bright moon phases - E-region aurora	- E-region aurora (N2 1P) - OH Spectra with spectral modes	- Equatorial anomaly - Plasma bubble - F-region aurora
Future subject	- Precise analysis (contrast bet. Front and Rear, comparison with clouds, ground structure etc.) - Statistics / global distribution - Seasonal dependence - Comparison with model - Auroral height	- Operate with the average mode - Rotational temperature - Global distribution	- Mid-lat. TID - High-lat. TID associated with aurora - Auroral height - SAR arc - Storm