Recent results on atmospheric and ionospheric disturbances obtained using the Optical Mesosphere Thermosphere Imagers (OMTIs)

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Wave breaking and momentum flux release

Gravity waves

Tropospheric convection

Airglow imaging

Oxygen 630nm 200-300km

80-100km

O/Na/OH

Tropospheric convection
20 stations are in operation
Ground-based stations of the PWING Project. (since May 2016)

- Existing sites
- New sites

Shiokawa et al. (EPS, 2017)
1. Takeo et al. (JGR, 2017) and Tsuchiya et al. (JGR, submitted, 2018) studied 16-year variation of horizontal phase velocity and propagation direction of mesospheric and thermospheric waves in airglow images observed by an airglow imager at Shigaraki (34.8N), Japan. We show yearly, and seasonal variation of gravity wave propagation characteristics.

2. Okoh et al. (JGR, 2017) showed statistical characteristics of plasma bubbles at Abuja, Nigeria with their relation to the GNSS scintillation statistics.

3. Nakamura et al. (EPS, 2017) obtained average thermospheric temperatures observed by four FPIs at Norway, Thailand, Indonesia, and Australia for 2–3 years are compared with those estimated by the GAIA model to investigate the validity of the model.

4. Dao et al. (JGR, 2017) studied coordinated observations of post-midnight irregularities and thermospheric neutral winds and temperatures at low latitudes to show the relation of the post-midnight irregularities with the midnight temperature maximum and associated thermospheric winds.

5. Fukushima et al. (EPS, 2017) show geomagnetic conjugacy and non-conjugacy of ionospheric and thermospheric variations accompanied by a midnight brightness wave at low latitudes reported by using airglow imagers, ionosondes and an Fabry–Perot interferometer at Thailand and Indonesia.
557.7 nm airglow image

Rikubetsu, 16 March 2010

14:58:30 UT

3D FFT analysis developed by Matsuda et al. (JGR, 2014)

\[ v_x = \frac{\omega k}{k^2 + l^2} \]
\[ v_y = \frac{\omega l}{k^2 + l^2} \]

<table>
<thead>
<tr>
<th>Rikubetsu</th>
<th>Shigaraki</th>
</tr>
</thead>
<tbody>
<tr>
<td>Period</td>
<td>16 years from Feb 21, 1999 to Feb 20, 2015</td>
</tr>
<tr>
<td>airglow wavelength</td>
<td>557.7 nm (assumed height: 95 km, for AGWs) 630.0 nm (assumed height: 250 km, for MSTIDs)</td>
</tr>
</tbody>
</table>

Tsuchiya et al. (submitted to JGR, 2018)
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16-year averages

Rikubetsu

Shigaraki

557.7 nm

1999-2014

East

West

zonal: wind filtering

meridional: duct

Summer

Phase speed [m/s]

Winter

-10.0
-8.5
-7.0

log10(P) [s^2 m^-2]

Takeo et al. (JGR, 2017)

Atmospheric temperature

Mesosphere

Troposphere
Local time variation of the wind direction occurs by diurnal tides. The wind filtering causes the observed local time variation of AGW propagation directions.

Tsuchiya et al. (submitted to JGR, 2018)
The seasonal variation of the propagation direction of AGWs is changed not by the SSW itself but by the associated mesospheric wind reversal only at Rikubetsu.
1. Anti-phase between MSTIDs and solar activity
2. SEward + minor NEward

\[ \gamma = \frac{g \sin^2 I}{v_{in} H_n} \]

Tsuchiya et al. (submitted to JGR, 2018)

Takeo et al. (JGR, 2017)
Airglow imaging and GNSS ROTI measurement of plasma bubbles at Nigeria

From June 9, 2015 to January 31, 2017 (total: 147 nights of clear sky)

Okoh et al. (JGR, 2017)
Comparison of average thermospheric temperatures observed by four FPIs at Norway, Thailand, Indonesia, and Australia over 2-3 years with the GAIA model.
Detailed event study of the growth of a post-midnight plasma bubble.

- growth of a plasma bubble
- ascend of F2-peak at off-equator
- invariant of F2-peak at equator
- equatorward wind at Kototabang
- equatorward gradient of thermospheric temperature

Dao et al. (JGR, 2017)
Geomagnetic conjugate observation of brightness wave.

Fukushima et al. (JGR, 2017)
Summary

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