COMMISSION G: IONOSPHERIC RADIO AND PROPAGATION

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G1. Ionospheric Techniques

Igi et al. [1999] studied thermospheric meridional winds for one solar cycle (1981-1991) that were derived from hmF2 data at Kokubunji, Japan and pointed out the solar cycle variations of the winds over Japan to be qualitatively similar to those in other sectors.
Shiokawa et al. [1999] reported development of comprehensive optical instruments (OMTIs: optical mesosphere thermosphere imagers) which consists of an imaging Fabry-Perot interferometer, three all-sky cooled-CCD cameras, three tilting photometers and a Spectral Airglow Temperature Imager (SATI). The OMTIs measure nighttime airglow at altitudes of 80-400 km.
An integrated optical/radio observations of Arctic middle and upper atmosphere at Poker Flat, Alaska, has been conducted by a Japan-US collaboration. Middle atmosphere and thermospheric studies and scientific results arose from MF radar, Rayleigh lidar, Fabry Perot interferometers, all-sky imagers, etc. at Poker Flat, Alaska, and Super DARN HF radar at King Salmon, and related-funded works.

G2. Ionospheric Structure and Modeling

G2.1. Ionospheric Structure

Ionosphere structure was mainly studied from electron density observation. Electron tenperture data obtained in 1981-1982 by Japan's sun observer Hinotori are still being analysed to study seasonal latitude , and longitude dependence with respect to local time .[Denton et al,1999]
[Dabas er al,1999],[Bailey et al 2000]. Electron Tenperature of the topside ionosphere which is useful to calculate topside electron density was studied up to the height of 8000km using Akebono data[Pavlov,2000a,2000b],[Pavlov,2001].

Mu radar is actively being operated and many findings have been reported[Su et al,1999],[Zhang et al,1999],[Balan et al,1999],[Kawamura et al,2000],[Zhang et al,2000],[Zhang et al,2001a,2001b],[Kawamura et al,2002],[Zhang et al,2002].

G2.2. Ionospheric Disturbances

Since the middle of 1996,University of Electro-Communication has made a routine observation of TEC using GPS in Chofu, Tokyo. We examine in this paper the relationship between the perturbation components of TEC and geomagnetic field variations during 11 storm events for 1997-1998 to clarify the mid-latitude characteristics of TEC variations at the time of magnetic storms(Yamamoto et al.,2000). The perturbation components of TEC were derived every 20 seconds by subtracting quiet-time TEC values which are estimated as the average of both 3 days just before and after the storm period. The magnetic field data from Memanbetsu Magnetic Observatory, Hokkaido, are used for the identification of the storm-time variations. Our results show that

(1) the amplitude level of the TEC variation tends to increase during the first 24 hr of storm and then decrease below its usual-day level with recovery in one or two da ys later for the typical magnetic storm, and (2) during a negative-value phase of the TEC variation, which

follows the initial positive hump structure, the perturbation amplitude of TEC shows a remarkable reduction in summer compared to in winter.

Shiokawa et al. [2000] studied storm-time airglow enhancements observed at midlatitudes using an airglow imager, a GPS receiver network, ionosondes and the DMSP satellite. The airglow enhancement observed equatorward of Japan was explained by equatorial plasma fountain caused by electric field penetration associated with storm-time substorms, which was identified as an upward plasma drift by the DMSP satellite.

Kubota et al. [2000] and Saito et al. [2001] showed large-scale view of medium-scale traveling ionospheric disturbances (MSTIDs) over Japan using multi-point airglow imaging observations and a GPS receiver network. They found that MSTIDs propagated southwestward over more than 1500 km. The correlation between MSTIDs seen in the airglow and GPS-TEC (total electron content) was very good. Occurrence of field-aligned irregularities observed by the MU radar was also correlated with the observed MSTIDs.

Sahai et al. [2001] studied small-scale (30-50km) airglow depletion structures in 630-nm images during a storm of February 12, 2000, possibly caused by non-linear interactions of mesoscale TIDs and enhanced equatorial anomaly. They also showed that enhanced storm-time ionospheric disturbances represented by spread-F and GPS phase fluctuations were confined in the midlatitudes.

Minami et al. [1999] performed an experiment of artificial stimulation of the ionosphere using high power radio waves at the HIPAS facility in Alaska. Diagnostics, using a multi-channel 30 MHz scanning cosmic radio noise absorption, at a site 35 km from the transmission site revealed the excited height of 90 km. Atmospheric pressure waves with a period of 10 min, probably generated in the ionosphere by the high-power HF, were simultaneously observed on the ground.

G2.3. Ionospheric Irregularities

Kagan et al. [2000] tried to explain the generation mechanism of midlatitude E region irregularities in sporadic E layer in terms of neutral wind-driven instability instead of traditional plasma instabilities pertinent to the E region.

Ionospheric E and F region irregularities at southern high latitudes has been explored using the SuperADRN coherent HF radars at Syowa Station. Fukumoto et al. [1999, 2000] analyzed a large data-set of F region echoes to find relationship among echo power, Doppler velocity and spectral width, and discussed plasma instability processes capable of explaining the relationship. Ogawa et al. [2001] examined statistical characteristics of E region Doppler velocity to show in particular that part of the velocities at near ranges represents motions of the lower thermosphere and the upper mesosphere. Makarevitch et al. [2001] compared simultaneous HF and VHF radar echoes returned from common volume in the E region to show dissimilarity between echo characteristics at HF and VHF bands, and pointed out the importance of HF wave refraction due to disturbed ionosphere.[Tsunoda Many results are being ohfained by MO radar and other radar [Tsunoda et al,1999],[Tsunoda et al,2000],[Rao et al,2000],[Maruyama et al,2000],[Otsuka et al,2002],[Saitoh et al,2002],[Maruyamaet al,2002].

G2.4. Ionospheric Dynamics

Shiokawa et al. [2001] reported unusual appearance of an SAR arc at 34.7 MLAT (northern part of Japan) during a weak storm of Dst = -49nT, about 2 days after the very weak solar wind interval of May 10-11, 1999.

G2.5. Particles and Auroras

From observations with a 500-MHz incoherent scatter radar on Svalbard, Buchert et al. [1999] found unusual coherent echoes probably due to ion-acoustic plasma waves excited by field-aligned currents.

Nishino et al. [1999a] case-studied slowly varying daytime radio wave absorption at 30 MHz observed with an imaging riometer at Ny Alesund, Svalbard. From simultaneous F region HF backscatter echo and electron flux observations, they concluded that the absorption was likely caused by precipitation of eastward drifting auroral electrons generated by substorms in the midnight region.

30 MHz imaging riometers at Ny Alesund (NYA) and Danmarkshavn (DMH) in the Arctic and Zhongshan (ZHS) in Antarctica were used to examine conjugate features of daytime ionospheric radio wave absorption. Nishino et al. [1999b] studied post-noon absorption simultaneously observed at these stations. The absorption was a spike-type with weak intensity during high solar wind dynamic pressure and was due to high-energy electrons precipitation from the closed dayside magnetosphere. Nishino et al. [2000] identified simultaneous afternoon and noon absorption spikes at NYA and ZHS and at DMH and ZHS, respectively, in association with a steep increase in solar wind dynamic pressure and its synchronized spike-type IMF excursion. Magnetic field compression associated with the sudden pressure increase might stimulate a population of magnetospheric electrons located at the equatorward boundary of the cusp/cleft. Nishino et al. [2001] reported quasi-periodic, conjugate absorption spikes associated with a sequence of solar wind dynamic pressure pulses during northward interplanetary magnetic field. Comparison between absorption images and simultaneous all-sky aurora images at ZHS showed that the spikes had a feature of small-scale, eastward-moving enhancement embedded within a large-scale absorption region

G2.6. Polar Electrodynamics

The SuperDARN HF radars have been utilized to investigate electrodynamics in the cusp ionosphere. Nishitani et al. [1999] found very large-scale (5 hours in magnetic local time) flow burst that occurred in association with large-scale reconnection at the dayside magnetopause under high solar wind density and strong southward interplanetary magnetic field. In conjunction with the EISCAT Svalbard radar, Ogawa et al. [2001] case-studied in detail plasma density suppression process in the cusp ionosphere to find enhanced plasma convection or flow burst to be important process to generate polar patches.

G2.7. Modeling of Planetary Ionospheres

Shinagawa and Bougher [1999] studied the dynamics and structure of the Martian ionosphere using a two-dimensional MHD model. It was found that the scale height of the modeled ionosphere is significnatly smaller than that of the observed ionosphere under typical solar wind conditions, suggesting that the ionosphere of Mars is controlled by possible intsinsic magnetic field or some other effects.

Shinagawa [2000] reviewed observations and modeling studies of the ionosphere of Mars. Recently the Mars Global Surveyor has detected strong but local magnetic field of crustal origin in various regions at Mars, while the global intirinsic magnetic field of core origin was

insignificant.
Although the ionosphere of Mars is basically similar to Venus, the crustal magnetic field at Mars is likely to play an important role in the ionospheric processes.

G3. Ionospheric Radio Propagation

G3.1. ELF/VLF

An analytical time domain solution of ELF electromagnetic waves in the subionospheri c waveguide is studied [Nickolaenko et al., 1999d]. Multiple electromagnetic pulses [N ickolaenko and Hayakawa, 1999 a] are found to turn into a single pulse when propagat ing in the subionospheric waveguide[Nickolaenko and Hayakawa, 1999 b]. A new ELF observing station is established in Moshiri, Hokkaido, using fully-calibrated wide-band(1Hz < f < 1kHz) 3-component ELF measurement to study ELF transients and Schuman n resonances [Hobara et al., 2000].
The continuons analog records of the horizontal magnetic field during the period of August 1967 to November 1970 have been analyzed and a comparison of these Schumann resonance data with those made recently in Europe allows us to demonstrate the similarity and stability of the global thunderstorm variations on a seasonal scale [Nickolaenko et al., 1999 e]. We suggest an algorithm for choosing the position for the observation of Schumann resonances [Nickolaenko and Hayakawa, 1999 c]
Detailed analysis of early/fast Trimpi phenomena revealed two different regimes in their temporal behavior. These regimes are used to deduce the plasma structure of the ionospheric perturbation associated with sprites [Molchanov et al., 1998]. The effect of those Trimpi-induced ionospheric perturbations on subionospheric VLF propagation has been studied by means of FDTD method [Otsuyama et al., 2001].

G3.2. VHF

Nishino et al. [1999c] conducted experiments, using radio links between a 30 MHz transmitter located at Murmansk, Russia and two receivers used as an imaging riometer at Ny Alesund, Svalbard, and Tjornes, Iceland, to characterize radio wave scatter in the high-latitude ionosphere, and found that the scatter was caused by large-scale, irregular electron density enhancements at the lower edge of the ionosphere.

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