Title: SOCRATES Fabry-Perot Interferometer (FPI) Data at Mt. John

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Data Collection Location: Mount John Observatory is at latitude -43.98, longitude 170.42.

Description:

The dispersing element of the spectrometer is an air-spaced, 13 cm diameter effective clear-aperture Fabry-Perot interferometer, which is both self-aligning and self-stabilizing. It is operated at the optimum operational point for kinetic temperature determinations (Hernandez, 1988).

The spectrometer operates simultaneously at two wavelengths, which are arbitrarily selected by the use of dichroic mirrors and narrow (0.2 nm wide) interference filters. The inherent stability of the spectrometer is about 0.5m/s (632.8 nm) for periods of months, because of its self-stabilizing properties. The instrumental internal stability calibration is updated every 9s.

The spectrometer wavelengths used at Mount John during the DEEPWAVE interval are:

(1) The green line (557.7345 nm) of atomic oxygen (OI) has an emission height peak range near 94-98 km. However, if an aurora is above the 'normal', chemically generated, emission near 96 km, then the temperatures will be larger since the auroral emission altitudes are higher, and the relative emissions will also be much larger.

(2) The [OH] line (840.0 nm) of the nightglow excited hydroxyl [OH*] with an emission peak between about 87 and 91 km.

The spectrometer observes at the 4 cardinal directions at 20-degree elevation above the horizon, as well as zenith during nighttime. Since the instrument is light-limited, the time spent in observing this 5 direction cycle can be as short as 12 minutes and the instrument is internally time-limited to spend no more than 15 minutes in any given direction. Other observing protocols, such as two orthogonal directions and zenith, have also been used. The observations are made every evening and only those with clear weather -as reported by the astronomical personnel performing their observations on site- are reported. Because of the narrow filters used, operation of the instrument is not affected by moonlight. Typically, about 35% of the nights observed are clear.

Reduction:

Doppler shifts (winds) are determined from the displacement of the line profile relative to the long-term zenith observations, which are considered to have no long-term vertical Doppler shift. (Long-term is defined as months for continuing observations.) Further, the determined line-of-sight winds are converted to horizontal winds using a spherical Earth and presuming that vertical winds are negligible. The reported winds are horizontal and vertical. The original azimuth and elevation angles are also provided, from which the geographic separation between the observing location and the ground projection of intersection at the airglow observation height can be obtained.

The temperatures are determined based on the instrumental measurements of single-wavelength laser profiles and measured instrumental parameters, such as the reflectivity. The reduction is a least-squares deconvolution in the Fourier plane (Hernandez, 1988) for single-line spectra, and steepest-descent techniques for multiple-line spectra (Conner et al,

1993). Although single-line spectra can also be reduced by the steepest-descent techniques, the Fourier deconvolution is much faster and robust. Finally, the measurements reported here have been made with a 2.154 cm air-spaced etalon.

Summarizing, the reported measurements are horizontal and vertical winds and kinetic temperatures. The time between successive measurements is light-limited and has been arbitrarily set such that OI 557.7 nm emission measurement uncertainties (for example) do not exceed about 10 K and 5 m/s respectively for temperature and winds. Emission rates are reported as counts normalized for unit time. They are not calibrated, and are given as base-10 logarithm (relative emission rate) * 1000.

The errors given in the data are uncertainties of measurement, that is the statistically estimated effect that noise in the measurement will cause in the final result. This noise is inherent to the signal, since photons obey Bose-Einstein statistics. These uncertainties are 1 sigma uncertainty of the deduced horizontal wind, temperature and emission rate.

Reference: http://cedar.openmadrigal.org/index.html/

Data Format Description:

A file contains nnn+1 lines of information. The first line is a header and indicates the station, the date, #observations and wavelength. The format of the first line is:

sta yymmdd ddd 0 nnn D L

where:

sta is a 3-letter station designation (MJO=Mount John Observatory)

yymmdd is a 6 digit year, month, day designation (910621=21Jun1991)

ddd is a 3 digit day of year (001=01Jan)

0 is unused (deprecated field)

nnn is #observations for this day = #following lines in file

D is a direction convention (0 means 4 azimuth measurements, where a positive value for north/south measurements means wind motion towards north, and positive value for east/west measurements means wind motion toward east.

L is wavelength (2=557.7nm, 4=840.0nm)

Remaining lines in the file contain 12 fields:

time1 time2 temp dtemp wind dir dwind bright dbright int dcode qual

time1 is observation start time as UT hhmm (1220=12h20m)

time2 is time1 formatted in centihours (1234=12.34h=12h20m)

temp is kinetic temperature in Kelvin

dtemp is 1-sigma uncertainty of temperature in Kelvin

wind is a geometrically-corrected horizontal wind speed in m/s

dir is instrument look direction (N=north, Z=zenith, etc)

dwind is 1-sigma uncertainty for wind in m/s

bright is relative emission rate in arbitrary units

dbright is 1-sigma uncertainty for bright

int is a deprecated field

dcode is a coded look direction (25=zenith, 1=N, 2=NE, etc)

qual is a quality flag (0=passed basic diagnostic tests)