TIMED Doppler Interferometer Neutral Wind Measurements using the O_2 P-Branch Broadband Filter

T. L. Killeen[1], Q. Wu[1], R. D. Gablehouse[1], R. M. Johnson[1], S. C. Solomon[1], D. A. Ortland[3], W. R. Skinner[2], R. J. Niciejewski[2], and D. A. Gell[2]

[1]National Center for Atmospheric Research
[2]The University of Michigan
[3]Northwest Research Associates

NCAR

The TIDI Instrument

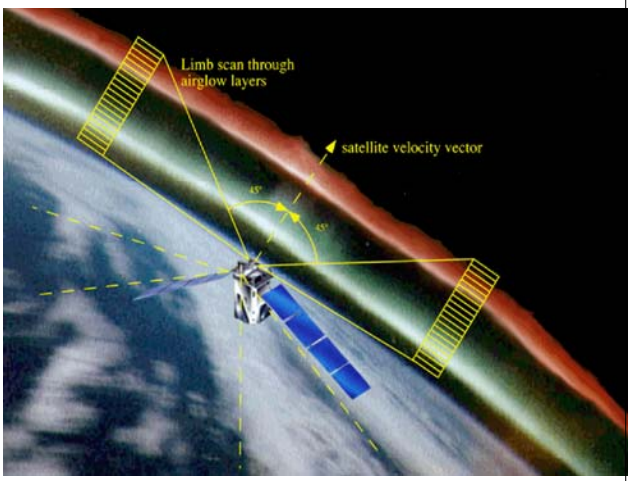
The TIMED Doppler Interferometer (TIDI) is a 4-telescope Fabry-Perot interferometer for measuring global winds and temperatures in the Earth's upper atmosphere

Primary measurement goal:
Global wind field, 60–180 km

Additional measurements:
Temperature, O_3 (day), O (night)

Primary emissions observed:
O_2 $^1\Sigma$ (0-0) P9 line pair

Other emissions observed:
O_2 $^1\Sigma$ (0-0) P15 line pair,
O(^1S) "green line"



TIDI Viewing Geometry

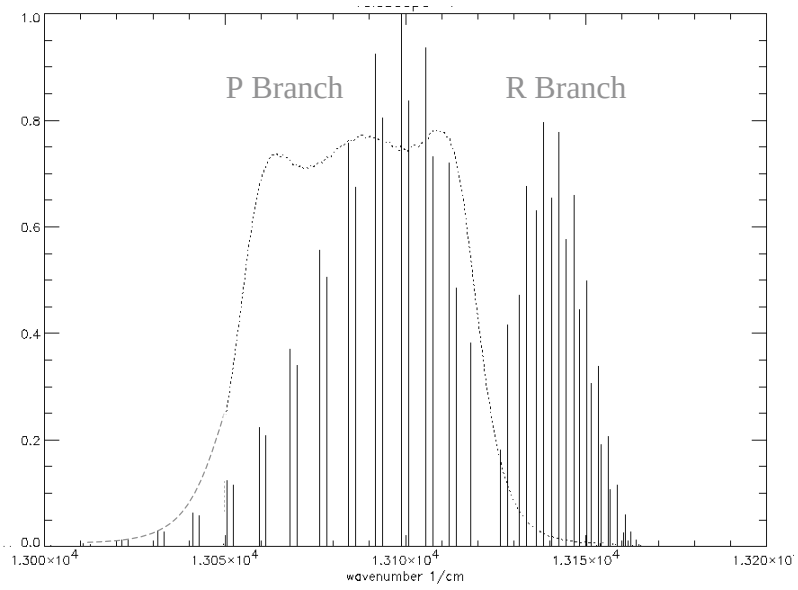
2

Motivation for “Broadband” Measurements

- The TIDI instrument is a single-etalon FPI that normally uses narrow-band filters to select a few lines of a rotational band.
- Due to elevated background levels, we have been looking for ways to increase instrument throughput and hence the signal-to-noise ratio.
- The instrument includes a 4-nm “broadband” filter that passes the entire O_2 Atmospheric (0,0) band P-branch, originally for calibration and photometric measurements.
- This study investigates the utility of this filter for measuring neutral winds in the mesosphere and lower thermosphere.

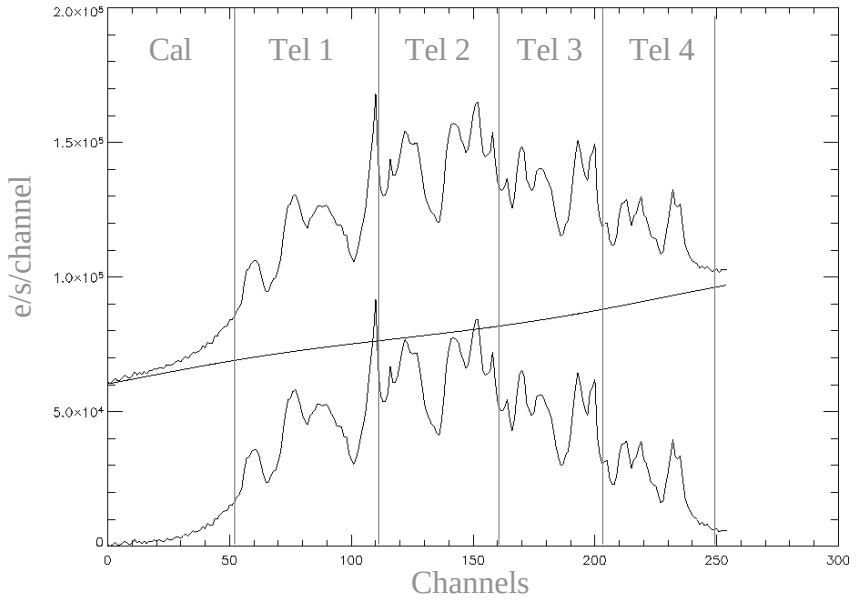
3

Filter Transmission Curve and O_2 (0-0) Band Emission lines



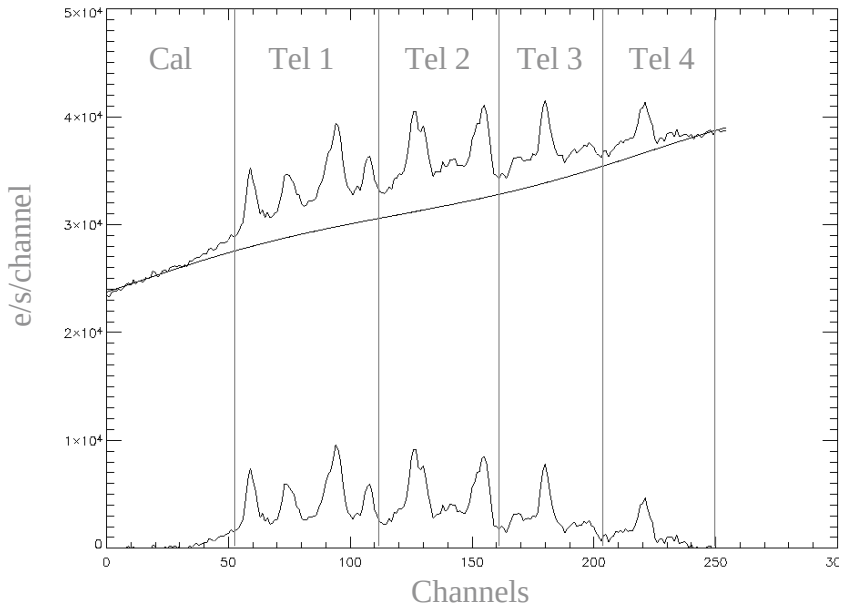
4

Daytime O_2 Broadband Data



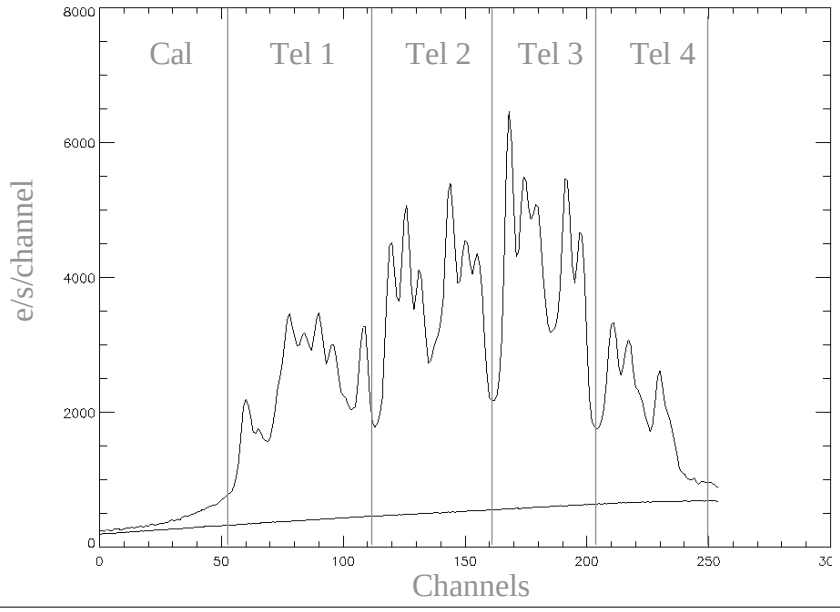
5

P9 Daytime Data



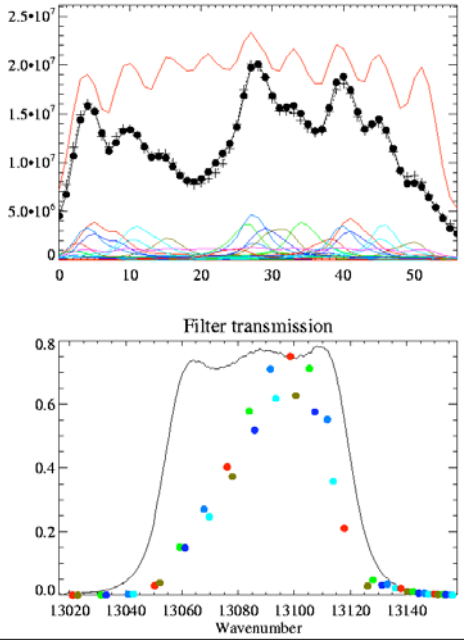
6

Nighttime O_2 Broadband Data



7

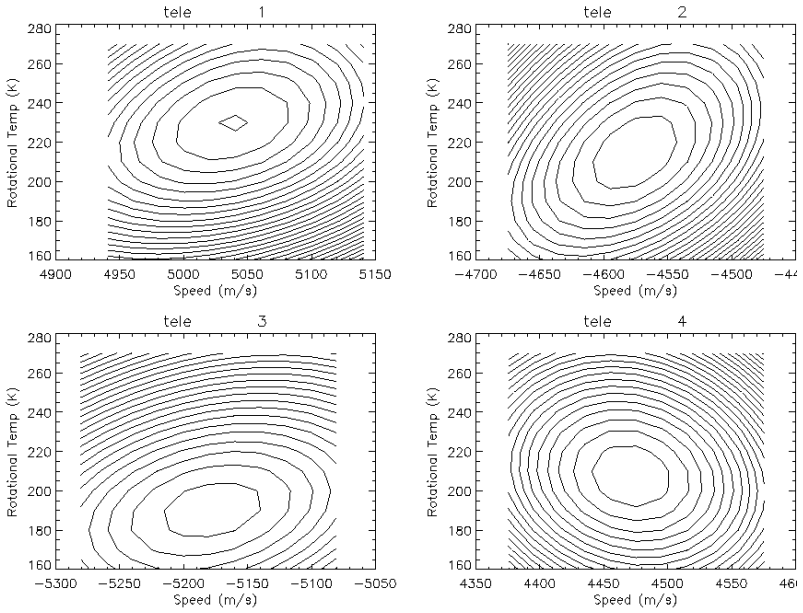
Forward Model and TIDI Spectrum



A total of 27 emission lines are used

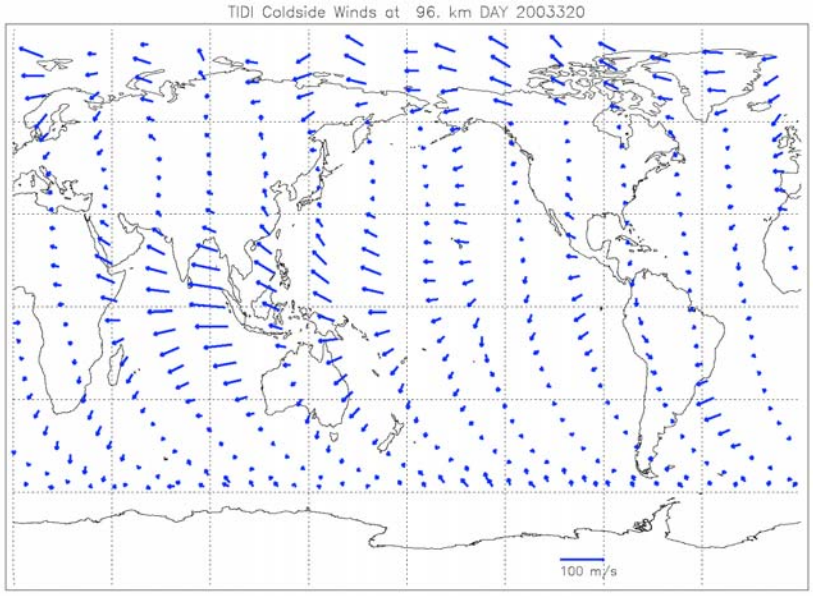
8

Wind Speed and Rotational Temperature



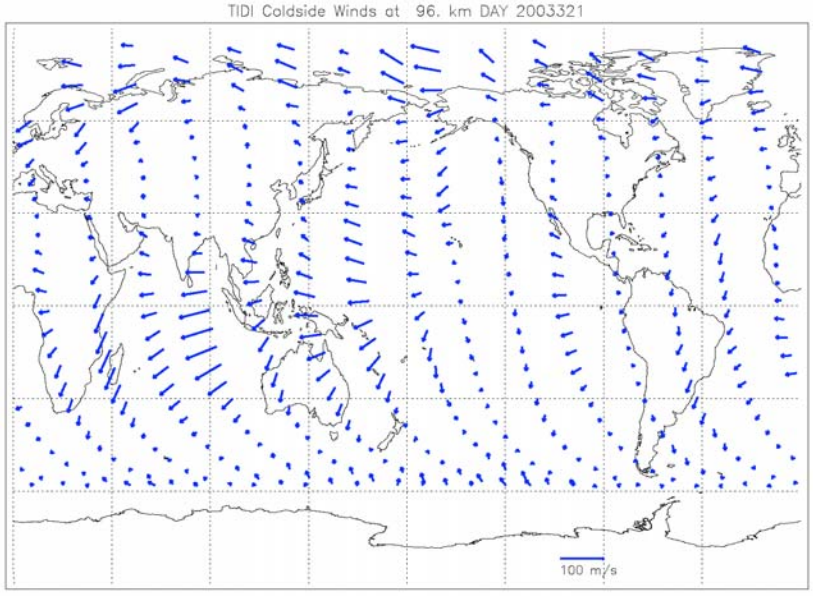
9

Wind Vector Maps



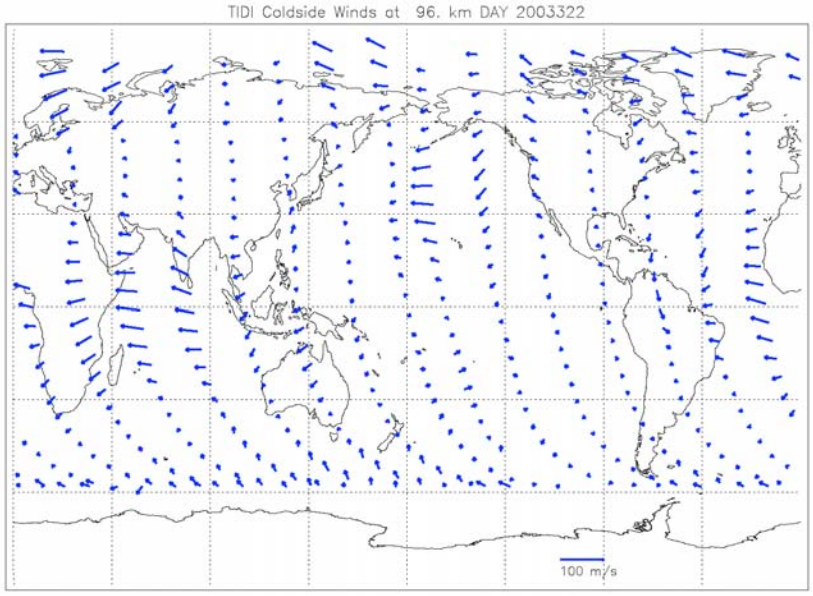
10

Wind Vector Maps



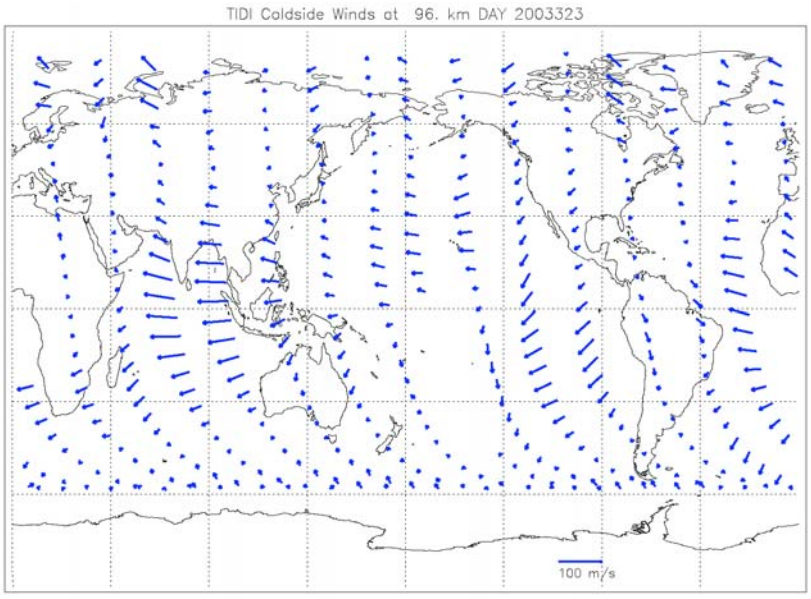
11

Wind Vector Maps



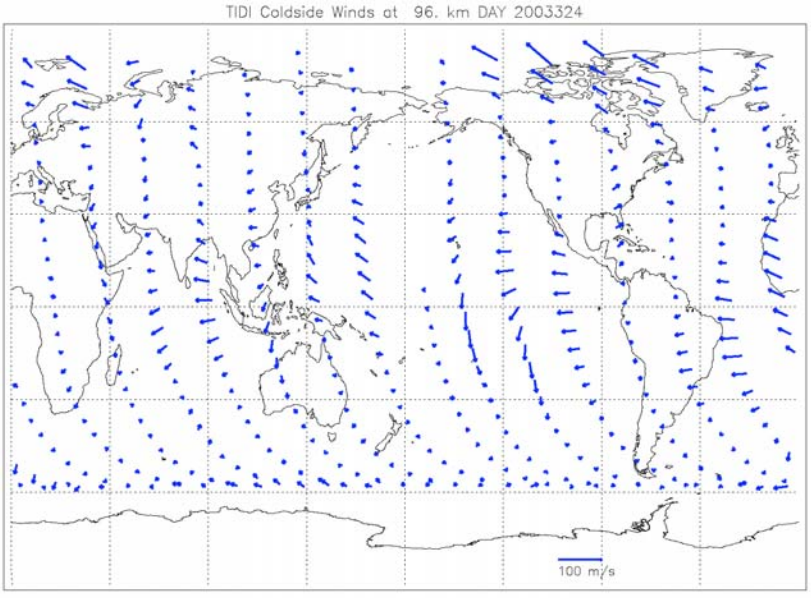
12

Wind Vector Maps



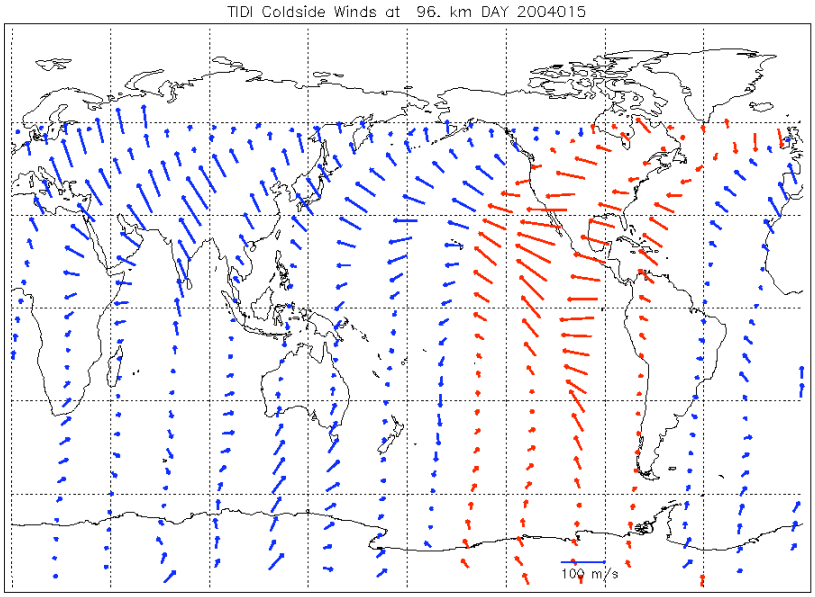
13

Wind Vector Maps



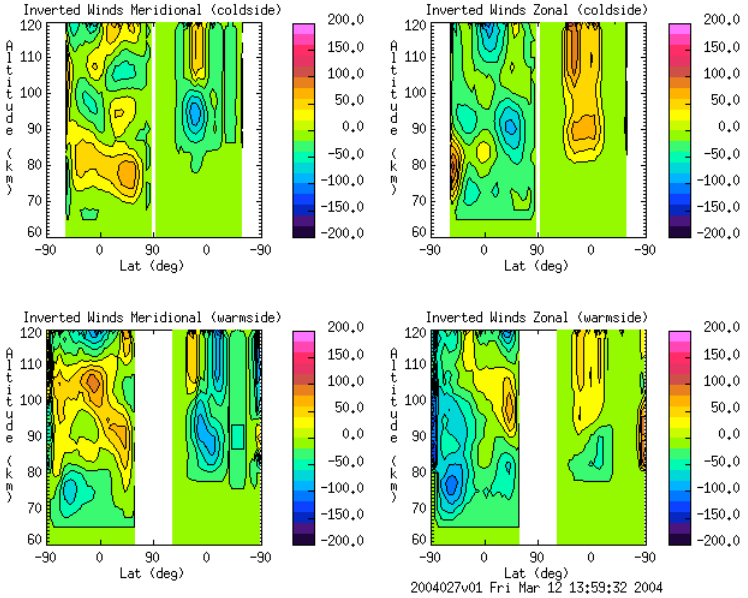
14

Wind Vectors During Yaw Maneuver



15

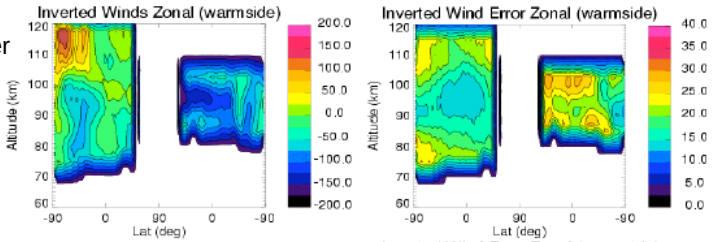
Broadband Filter Winds



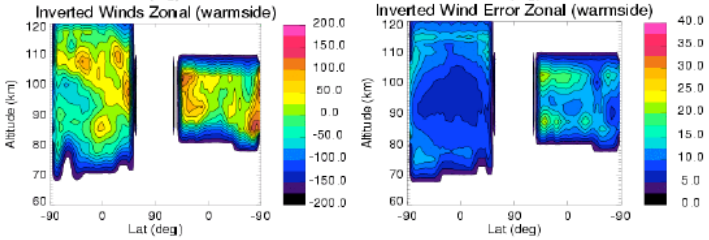
16

Comparison of Winds and Error Estimates

Narrow Band Filter
(P9 line pair)

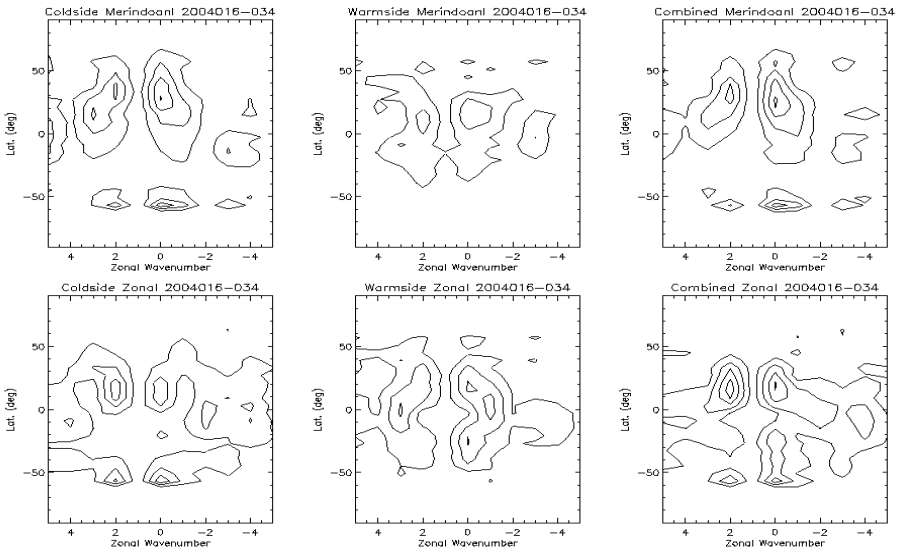


Broad Band Filter



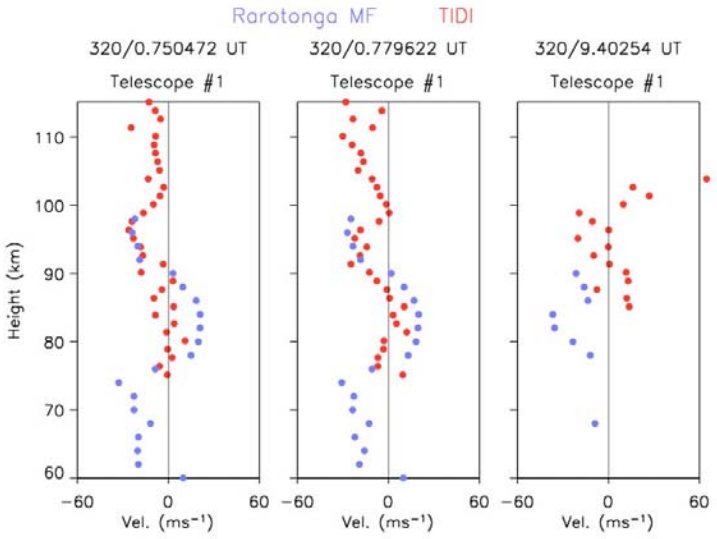
17

Non-migrating Diurnal Tides



18

Rarotonga MF Radar Comparison



19

Summary

•The broadband filter data have better signal-to-noise ratio and apparently better wind accuracy than the narrow-band filters.

•The broadband filter data processing is more complex and rotational temperature effects need to be investigated.

•Comparison with P9 filter data show similar results.

•Non-migrating diurnal tide results are reasonable.

•Early comparisons with ground-based measurements show promising agreement.

20