

# Stratospheric ozone profiles from Mauna Kea, Hawai'i using infrared heterodyne spectroscopy, 1988-2003

K.E. Fast, T. Kostiuik, F. Espenak (Goddard),  
T.A. Livengood (Challenger Center),  
T. Hewagama, M.F. A'Hearn (Univ. of Maryland)

Fast, K.E., T. Kostiuik, F. Espenak, T. A. Livengood, T. Hewagama, & M. F. A'Hearn 2004. Stratospheric ozone profiles from Mauna Kea, Hawai'i (19.8°N, 155.5°W) using infrared heterodyne spectroscopy, 1988-2003, *Geophys. Res. Lett.* **31**, L08109, doi:10.1029/2004GL019443.

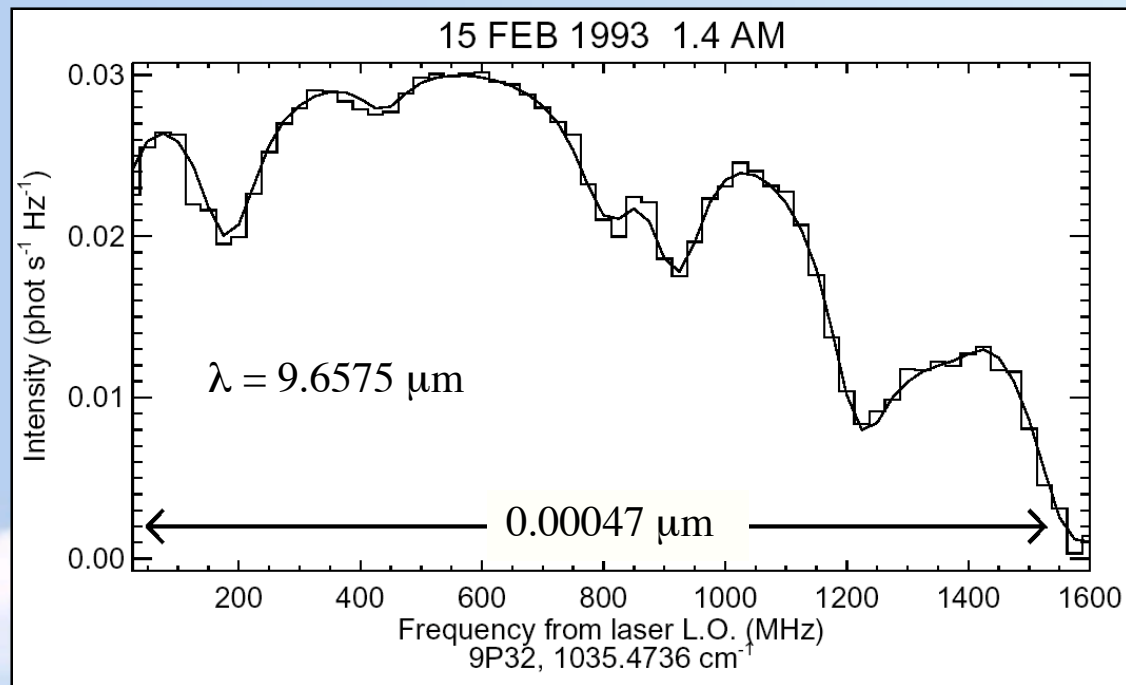
# Stratospheric Ozone

- Shields biosphere from solar ultraviolet radiation.  
Helps maintain atmospheric radiative balance.  
Abundance and distribution variable (solar activity, season, chemistry, circulation, etc.)

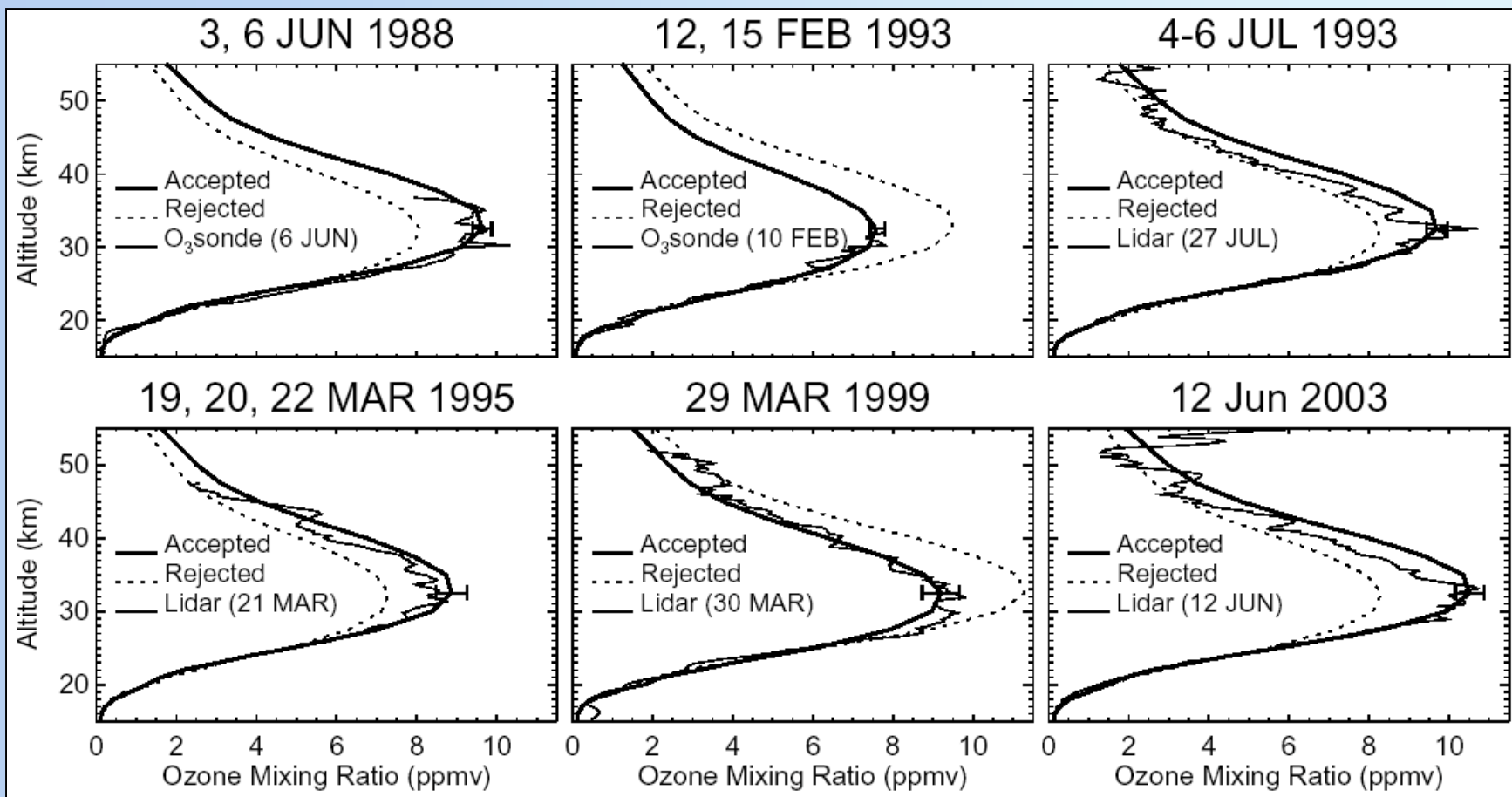
## IR Heterodyne Spectroscopy

- Very high spectral resolution ( $\lambda/\Delta\lambda > 10^6$ ).
- Fully-resolved ozone lineshapes probe ozone vertical distribution, as well as temperature.
- Passive remote alternative to active (e.g. lidar) and in situ (e.g. ozonesonde) techniques.

- Spectra acquired between 1988 and 2003 at the NASA Infrared Telescope Facility on Mauna Kea, Hawai'i.
- Calibration spectra for Mars ozone campaigns stand on their own as passive probes of telluric ozone abundance and distribution ( $\leq 8$  km altitude resolution).



Example heterodyne spectrum of telluric ozone against the Moon (histogram). Fully-resolved ozone absorption features are matched by a radiative transfer model (solid curve).



Ozone profiles retrieved from heterodyne spectra (solid bold) compare well to nearby lidar and ozonesonde profiles (solid). Analysis techniques were developed that correctly ruled out other potential profiles (dotted).

# Summary

- Ozone profiles retrieved from IR heterodyne spectra taken at IRTF are consistent with nearby active and in situ measurements.
- Other species, such as water and ClO, are accessible to direct measurement contemporaneous with ozone measurements, enabling regular monitoring of ozone chemistry using repeatable passive observations
- IR heterodyne spectroscopy has the potential to provide important new information regarding the structure and chemistry of the Earth's stratosphere.

