SABER Temperature Data and Derived Geostrophic Winds

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Purpose of Study

- Evaluate SABER LTE Temperature by Comparisons with HALOE and Falling Spheres data and with UKMO analyses

- Map SABER Temperature Data to Synoptic Distributions on Constant Pressure Surfaces and Compare with UKMO analyses

- Create Geopotential Height Fields from Mapped SABER Temperature Data and Derive Geostrophic Winds for Comparison with UKMO analyses
SABER Temperature Data (LTE)

- Version 1.02  Level 2A
- Altitudes below 70 km (about 0.05 hPa)
- Vertical resolution about 2km
- 1-28 February and 17 June-14 July 2002
Temperature Mapping

- **Sequential Estimation Technique**
- **Kalman Filter Algorithm used for LIMS archived data** (Haggard et al. 1986, NASA TP 2553 and Remsberg et al. 1990, J. Atmos. Ocean Tech.)
- **Input precision from retrieved temperature profiles within 5° of 50° S for 1 February 2002**
- **Fourier coefficients output daily at noon UT (6 wave numbers per latitude)**
Mapped Temperature Results

- Synoptic temperature fields on constant pressure surfaces calculated from Fourier coefficients

- Comparisons with UKMO analyses
  - NH active period 12 Feb. 2002 (100, 10, 1 hPa)
  - NH quiet period 4 July 2002 (100, 10, 1 hPa)

Very Good Agreement Throughout

The Stratosphere/Lower Mesosphere
Data Quality

LTE temperature profiles in good agreement with HALOE and falling sphere data

- HALOE V19: 10 K maximum difference (generally within 5 K in NH stratosphere)

- Falling spheres: 10 K maximum difference

Hemispheric average of daily zonal mean differences with UKMO data within 2.5K (Remsberg et al. 2003. J. Geophy. Res.)
1) NH Temperature 100.0hPa 12 Feb 2002
2) NH Temperature 10.0hPa 12 Feb 2002
3) NH Temperature  1.0hPa  12 Feb 2002
4) NH Temperature 100.0hPa  4 Jul 2002
5) NH Temperature 10.0 hPa  4 Jul 2002
6) NH Temperature  1.0hPa  4 Jul 2002
SABER-UKMO Temperature
Northern Hemisphere  12 Feb 2002
Zonal Mean Temperature on 12 February 2002
TEMPERATURE DIFFERENCES

- SABER–UKMO SURFACE PLOTS
  - Middle and lower stratosphere differences less than 3 K
  - Large differences in tropics
    100 hPa -> SABER vertical resolution
  - Stratosopause differences
    UKMO deep-layer radiances unable to resolve features

- ZONAL MEAN PLOTS
  - SABER–UKMO and SABER–NCEP show maximum differences of
    ~ 2 K in stratosphere

- SMALL DIFFERENCES IN HORIZONTAL GRADIENTS
  => Accurate wind calculations
WINDS

- SABER
  - CALCULATED GEOPOTENTIAL HEIGHT USING MAPPED TEMPERATURE AND UKMO 100hPa REFERENCE LEVEL HEIGHTS
  - SMOOTHED HEIGHTS 1–2–1 IN LATITUDE AND LONGITUDE
  - CALCULATED GEOSTROPHIC WINDS USING GEOPOTENTIAL HEIGHTS

- UKMO
  - COMPUTED FROM FORECAST STREAMFUNCTION FIELDS
  - INTERPOLATED TO SABER GRID
WINDS (con’t)

- **SABER/UKMO COMPARISONS**

  - **WIND VECTORS ON GEOPOTENTIAL HEIGHT MAPS**
    - SIMILAR LARGE-SCALE FLOW PATTERNS
    - NOTABLY BOTH ANALYSES SHOW COMPARABLE FLOW FOR NH ACTIVE PERIOD AT MIDDLE AND HIGH LATITUDES WHERE HEIGHT GRADIENTS ARE LARGE

  - **WIND SPEED DIFFERENCES**
    - MOSTLY SMALL DIFFERENCES (< 10 m/s) FOR NH QUIET PERIOD AND MIDDLE STRATOSPHERE NH ACTIVE PERIOD
    - LARGE DIFFERENCES AT STRATOPAUSE NH ACTIVE PERIOD MOST LIKELY DUE TO UKMO RESOLUTION
SABER WINDS
IN MESOSPHERE

- SABER => MULTI-YEAR MEASUREMENTS IN MESOSPHERE

- GOOD AGREEMENT FOR STRATOSPHERE COMPARISONS GIVE CONFIDENCE IN EXTENDING ANALYSES AT LEAST TO LOWER MESOSPHERE

- WIND VECTORS ON GEOPOTENTIAL HEIGHT MAPS AND CORRESPONDING WIND SPEED MAPS SHOW:
  - THE POLAR JET FOR NH ACTIVE PERIOD AS SEEN IN LIMS DATA (Dunkerton, T. J., and D. P. Delisi, The subtropical mesospheric jet observed by the Nimbus 7 Limb Infrared Monitor of the Stratosphere, J. Geophys. Res., 90, 10681–10692, 1985)
  - ZONAL FLOW FOR NH QUIET PERIOD
NH Geopotential Height 10.0hPa 12 Feb 2002
NH Geopotential Height  1.0hPa  4 Jul 2002
SABER-UKMO Wind Speed
Northern Hemisphere 12 Feb 2002
SABER V1.02 Calculated Geopotential Height
Northern Hemisphere  0.100hPa  12 Feb 2002
SABER V1.02 Calculated Geopotential Height
Northern Hemisphere  0.100hPa  4 Jul 2002
SABER V1.02 Geostrophic Wind Speed
Northern Hemisphere  0.100hPa  4 Jul 2002
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  - ZONAL FLOW FOR NH QUIET PERIOD
V1.04 SABER/HALOE TEMPERATURE COINCIDENCE  4 JUL 2002

- Average SABER (S) Lat=-34.0 Lon=132.5
- SABER Orbit 3093 Lat=-34.7 Lon=132.1 Time=1510 UT, 2359 LT
- HALOE V19 SS Lat=-33.7 Lon=131.7 Time=0813 UT

- SABER-HALOE
- Average SABER-HALOE

Pressure (mb)

Temperature (K)

Difference (K)
SUMMARY

COMPARISONS WITH UKMO ANALYSES ARE VERY GOOD, INDICATING THAT SABER DATA ARE SUITABLE FOR SPECIFIC STUDIES OF LARGE-SCALE TEMPERATURE AND GEOPOTENTIAL HEIGHT VARIABILITY THROUGHOUT MUCH OF THE MIDDLE ATMOSPHERE

PUBLIC RELEASE SABER VERSION 1.04 WILL BE AVAILABLE SOON

* GEOPOTENTIAL HEIGHT PROFILES WILL BE INCLUDED AS A DATA PRODUCT ELIMINATING THE NEED TO CALCULATE IT USING TEMPERATURE AND SOME REFERENCE LEVEL HEIGHT