Empirical and semiempirical models of middle atmosphere wind and wind variability

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Summary of results, March 2004 - August 2006

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Participating teams are Institute of Meteorology, University of Leipzig, Germany; Hovemere Ltd., United Kingdom; Institute for Experimental Meteorology, Russia; Kazan State University, Russia.

The research programme included the construction of global, monthly tables of wind and its variability in the atmosphere up to 100 km. This work included the use of global analyses from Met Office reanalyses in the stratosphere, the update of mesosphere/lower thermosphere (MLT) wind models from radar and satellite data, and the combination of these models using a circulation model to include the mesosphere that is not well covered with measurements.

Results

In summary, during the project the following results were achieved:

1. Update of the mesosphere/lower thermosphere empirical wind model
   The Global Empirical Wind Model (GEWM) consists in 3 parts, presenting monthly tables of I) monthly mean winds, II) semidiurnal tidal amplitudes and phases, and III) migrating diurnal amplitudes and phases. The model is based on the majority of radars available worldwide, and UARS satellite data. The model covers the region 80-100 km, and extended version includes the 70-80 km region also.

2. Construction of a stratospheric wind model
   This model bases on Met Office stratospheric reanalysis data and covers the height region from the ground to about 55 km. The model consists in I) a mean wind model II) a long-term mean stationary wave model, III) a monthly mean quasi-stationary wave model, and IV) a total variance model. All the models use daily winds, and thus provide an overview of stratospheric mean state and long-period variability. All models are available both for the zonal and the meridional wind component.

3. Construction of a semiempirical model of the entire middle atmosphere through assimilation of the zonal mean winds into a circulation model
   The combined global model uses the stratospheric mean wind model, the GEWM I MLT prevailing wind model, and numerical model output using the COMMA-LIM mechanistic circulation model in the regions not covered by the other models. The model thus includes the height range from the ground to 100 km.

All the models, as well as additional information, are available on the internet on http://www.uni-leipzig.de/~jacobi/intas03/index.htm. The website includes a description of the project, access to tables of model data, and detailed descriptions of the single models.

The models have been extensively validated during the project. Additional results, also available on the internet, include regional wind models and COMMA-LIM circulation model output. Additional research included tendencies of mesosphere/lower thermosphere winds that were investigated using updated multi-year ground-based data obtained at three mid-latitude stations. Our results suppose a change in rates and directions of wind tendencies during the 1964-2004 time interval.

Potential impact of the results

Presently, there is an urgent need in updated middle atmosphere wind models for scientific and technical use. Existing wind models like CIRA86 should be updated using new data. The wind models constructed during this project may contribute to these new models, e.g., to the construction of a new CIRA.
Consequently, the results have been presented at COSPAR Scientific Assemblies, in particular in session C4.1 (Development and Adoption of a New Series of COSPAR International Reference Atmospheric Models). They will be presented in Special Volumes of Advances in Space Research devoted to the New CIRA.

References


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