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Climatologies of the global atmosphere based on radio occultation data from CHAMP

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The radio occultation (RO) technique is based on a satellite-to-satellite limb sounding concept using microwave signals to probe the Earth's atmosphere. The propagation of Global Navigation Satellite System (GNSS) signals is influenced by the atmospheric refractivity field resulting in slowing and bending of the signal. The atmospheric phase delay as the principle observable is measured with millimetric accuracy. It is the basis for high-quality retrievals of atmospheric key variables, particularly of temperature profiles. Highest temperature accuracies of < 1 K are obtained in the upper troposphere and lower stratosphere. The high accuracy, long-term stability, essentially all-weather capability, high vertical resolution, and global coverage of RO data suggests them as a promising tool for global short- and long-term monitoring of atmospheric temperature change with benchmark quality.

The German/US research satellite CHAMP (CHAllenging Minisatellite Payload for geoscientific research) continuously records RO profiles since March 2002. The mission is expected to last at least until 2007, thus CHAMP RO data provide the first opportunity to create RO based climatologies on a longer term. We have developed a retrieval scheme which is tailored to minimizing biases, yielding a new atmospheric data set especially tuned for monitoring climate variability and change. The retrieved atmospheric profiles (˜150-160 profiles/day) are used to create climatologies on a monthly, seasonal, and annual basis by binning-and-averaging techniques. We will show temperature climatologies over 4 years from the spring season (MAM) 2002 to the winter season (DJF) 2005/2006, as well as examples for climatologies of refractivity, pressure, and geopotential height. We will discuss potential sampling errors due to spatial

and temporal undersampling of the true evolution of atmospheric fields and effects like drift in local time of the satellite orbit. Our results show that valuable climatologies resolving horizontal scales $>$ 1000 km can be obtained even with data from the single CHAMP satellite. RO based climatologies have the potential to improve modern operational climatologies, especially in regions where the data coverage and/or the vertical resolution and accuracy of RO data is superior to traditional data sources.