Preface

Water vapor plays a multifaceted role in the global climate system. It is central to the atmospheric branch of the global hydrologic cycle where it links evaporation and precipitation. Its horizontal and vertical transport results in important redistribution of energy and moisture, and as the most abundant greenhouse gas, it is a factor in the radiative balance of the climate system. Yet despite its importance, essential aspects of the distribution and variability of water vapor are poorly documented. These deficiencies in our understanding of the behavior of water vapor contribute to uncertainties in our understanding of the climate system and its potential changes.

This special section of the *Journal of Geophysical Research* is dedicated to papers from the Second AGU Chapman Conference on Water Vapor in the Climate System held in Potomac, Maryland, October 12-15, 1999. The conference brought together a diverse group of scientists with a common interest in water vapor. Presentations included observational, theoretical, and modeling studies of water vapor from the troposphere to the stratosphere. Four areas of particular focus were (1) improvements in measuring water vapor, (2) climate feedback processes involving water vapor, (3) the hydrologic cycle and its possible intensification, and (4) water vapor in the upper troposphere and lower stratosphere.

The atmospheric concentration of water vapor ranges over 4 orders of magnitude, from a few percent near the surface to a few parts per million in the lower stratosphere. This poses severe challenges in designing a single instrument for atmospheric water vapor measurements. Therefore a plethora of technologies exist, from low-cost, expendable radiosonde sensors designed for daily weather observations, to research-quality aircraft- and satellite-borne instruments. Papers in the special section by *Tjemkes et al.* [this issue] and *Whiteman et al.* [this issue] discuss improved or emerging water vapor measurement techniques.

It has long been thought that water vapor responds to long-term temperature changes as a positive feedback mechanism for climate change because increased temperatures lead to enhanced evaporation and thus increased atmospheric water vapor which results in further warming. Uncertainties regarding the net feedback depend on the behavior of water vapor in the upper troposphere where, until recently, water vapor measurements were quite limited. Exchange processes between the upper troposphere and the lower stratosphere are also of interest because of the role of water vapor in stratospheric chemistry and as a tracer of stratospheric circulation. The paper by *Escoffier et al.* [this issue] addresses these issues.

Water vapor feedback influences not only the radiation budget but also the hydrologic cycle, since an increase in evaporation associated with increases in surface and tropospheric temperature could lead to an accelerated hydrologic cycle. More fundamentally, there are uncertainties regarding the response of water vapor to climate variations such as El Niño-Southern Oscillation (ENSO) and regarding the relationship between water vapor and precipitation. The paper by *Blankenship and Wilheit* [this issue] is relevant to these topics.

The main objective of the conference was to bring together researchers with related interests in water vapor but who may come from different corners of the atmospheric science community. The diverse range of presentations combined with the many enthusiastic comments of the participants indicates that this objective was achieved. We hope this special section of the *Journal of Geophysical Research* helps clarify the role of water vapor in the climate system and perhaps stimulates further interest in the scientific community.

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