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A. Stratospheric General Circulation with Chemistry Model (SGCCM)
(RTOP # 673-64-01-20)

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C. The goal of this project is to enhance our understanding of the fully interactive general circulation of the stratosphere. The strategy of investigation is to construct and analyze models of the system and compare with observations. Parallel studies of observations and model simulations provide the most effective mechanism for understanding stratospheric processes.

D. In the past two years constituent transport and chemistry experiments have been performed using both simple single constituent models and more complex reservoir species models. Winds for these experiments have been taken from our data assimilation effort (Stratospheric Date Analysis System (STRATAN), RTOP # 673-41-43-20). The application of winds from data assimilation to chemistry and transport studies is unique of this research effort.

Winds from STRATAN allow the quantitative computation of stratospheric transport. This has been verified by comparison of modeled ozone behavior to ozone behavior observed by the Limb Infrared Monitor of the Stratosphere (LIMS). By using winds from STRATAN meaningful transport experiments can be carried out at much lower resolution than if a free running general circulation model (GCM) was used. Because of the great cost of chemical models, the ability to run at coarse resolutions is particularly important.

In an application of the three-dimensional (3D) model to stratospheric chemistry problems, the behavior of nitric acid in the lower stratosphere has been studied. By studying the manner in which the modeled nitric acid diverges from the LIMS observations, it has been possible to offer additional information on the longstanding problem of wintertime nitric acid chemistry. These results indicate the need for a low light source. The results strongly depend on the use of a 3D model, and comparison to 3D data.

Collaboration with the 2D modeling effort at Goddard (C. Jackman, PI) has been increased. This collaboration is exemplified by the use of the 2D model to generate production and losses for the single constituent models, the development of algorithms to generate 3D initial conditions from the 2D model, and the use of the 3D model to guide improvement of the 2D model parameterizations.

Modeling changes: The grid point GCM has been dropped. A version of the Community Climate Model is operational (spectral GCM). The radiation model has been improved, and its computational speed has been reduced 70%. Numerous simple single constituent models have been developed. A twelve reservoir species model has been developed.

E. The publication list showing the most recent publications for the Stratospheric General Circulation with Chemistry Project is attached. Numerous papers are in preparation.

SGCCP PUBLICATIONS (as of 9/13/89)

Published Papers

32. Rood, R. B., D. J. Allen, W. E. Baker, D. J. Lamich, and J. A. Kaye, "The use of assimilated stratospheric data in constituent transport calculations," J. Atmos. Sci., 46, 687-701, 1989.

38. Wu, M. F., M. A. Geller, E. R. Nash, and M. E. Gelman, "Global atmospheric circulation statistics--four year averages," NASA Technical Memorandum 100690, June 1987.

41. Geller, M. A., and M.-F. Wu, "Troposphere-stratosphere general circulation statistics," Transport Processes in the Middle Atmosphere, (G. Visconti and R. Garcia, eds.), D. Reidel Publishing Co., 3-17, 1987.

42. Chao, W. C., "On the origin of the tropical intraseasonal oscillation," J. Atmos. Sci., 44, 1940-1949, 1987.

43. Kaye, J. A., and R. B. Rood, "Chemistry and transport in a three-dimensional stratospheric model chlorine species during a simulated stratospheric warming," J. Geophys. Res., 94, 1057-1083, 1989.

44. Rosenfield, J. E., M. R. Schoeberl, and P. A. Newman, "Antarctic springtime ozone depletion computed from temperature observations," J. Geophys. Res., 93, 3833-3849, 1988.

45. Kaye, J. A., "Mechanisms and observations for isotope fractionation of molecular species in planetary atmospheres," Rev. Geophys., 25, 1609-1658 1987.

46. Geller, M. A., M.-F. Wu, and E. R. Nash, "Satellite data analysis of ozone differences in the Northern and Southern Hemispheres," Pure & Appl. Geophys., 130, 263-275, 1989.

47. Geller, M. A., "Solar cycles and the atmosphere," Nature, 332, 584-585, 1988.

48. Kaye, J. A., R. B. Rood, and D. J. Allen, "Variability of chlorine containing species as revealed by three-dimensional stratospheric transport and chemistry models," Proceedings of Quadrennial Ozone Symposium, August 8-13, 1988, Gottingen, FRG.

49. Rood, R. B., and J. A. Kaye, "Stratospheric ozone models and super-computers," Proceedings of the Fourth International Conference on Supercomputing, April 30-May 5, 1989, Santa Clara, California.

50. Rosenfield, J. E., "A simple parameterization of ozone infrared absorption for atmospheric heating rate calculations," J. Geophys. Res., (submitted), 1989.

51. Rood, R. B. J. A. Kaye, D. J. Allen, W. E. Baker, and D. J. Lamich, "The use of winds and temperatures from a stratospheric assimilation model in three-dimensional constituent transport studies," Proceedings of Quadrennial Ozone Symposium, August 8-13, 1988, Gottingen, FRG.

52. Rood, R. B, J. A. Kaye, A. R. Douglass, D. J. Allen, S. Steenrod, and E. M. Larson, "Wintertime nitric acid chemistry: Implications from three-dimensional model calculations," J. Atmos. Sci., (submitted), 1989

53. Kaye, J. A. and R. B. Rood, "Simulations of Short-Term Variability of Stratospheric Trace Constituents," Proceedings of the 28th International Astrophysical Colloquium, "Our Changing Atmosphere," Leige, Belgium, June 1989.

54. Kaye, J. A., R. B. Rood, D. J. Allen, E. M. Larson, and C. H. Jackman, "Three Dimensional Simulation of Spatial and Temporal Variability of Stratospheric Hydrogen Chloride," Geophys. Res. Lett., (accepted), 1989.