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Title: Studies of Baroclinic Instability in the Presence of Surface Topography and Stratospheric Ozone

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Research Objectives:

Major goals of this study are to gain a better understanding of the planetary-scale tropospheric / stratospheric circulation and to better utilize global-scale routine measurements from satellites. The focus on the latter goal for this study is determining the relationship between total column ozone measurements and the tropopause altitude. (A proposal to NASA Headquarters for the ozone/tropopause work was submitted in early June, 1988.)

Significant Accomplishments:

Work has been accomplished on the problem of the interaction of a wave with an idealized topography of the same wavenumber in a two-layer quasi-geostrophic channel flow. The topography is a major portion of the linear dynamics, in which the eigenmodes exhibit a coupling between various spectral components, i.e., wavenumbers. Although various investigators have emphasized wave/mean flow interactions in the sense of a decomposition of the flow into zonal averages and departures, there seems to be merit in using the linear eigenmodes to study the nonlinear evolution. A scheme has been devised to project the nonlinear solution onto the linear eigenmodes, and has been briefly described in a paper submitted for the preprint volume of the Palmen Memorial Symposium.

An approach to the study of the relationship between the tropopause height and total column ozone has been defined and presented in the proposal mentioned in the "Research Objectives." Some of the data has been gathered, and some development of multilayered models has been carried out.

Current Activity:

A small portion of the investigator's Ph.D. dissertation has been prepared. It was submitted once and rejected due to the absence of a couple of pertinent references. It is now undergoing significant modification and it is planned to resubmit this paper this summer.

A manuscript based on a more significant portion of the investigator's Ph.D. dissertation, concerning the influence of an idealized topography on waves of wavelengths different from that of the topography is also under preparation. The investigator is convinced that dynamical systems theory has much potential for yielding insight into nonlinear dynamics and has spent a significant amount of time attending and preparing lectures on the subject.

Future Plans:

Plans for FY89 are to commence the data analysis and preliminary modeling studies for the proposed ozone / tropopause study. Initially, it is planned to consider a model similar to that of an earlier model of Hartmann and Garcia, with the addition of a total ozone calculation. Data analysis will focus on the question of whether the tropopause height variations can be studied by means of quasigeostrophic theory. The possibility of using a general circulation model to help answer this question will also be addressed.

Publications (Peer-Reviewed Scientific Journals):

Fichtl, G. H., N. D. Reynolds, A. E. Johnston, S. I. Adelfang, W. Batts, L. Lott, P. J. Meyer, O. E. Smith, M. S. Swint, and O. H. Vaughan (1988), "Analysis of the Ascent Meridional Winds for Mission 51-L", J. Clim. Appl. Met., in press.

Reynolds, N. D. (1988), "A Note on Linear Baroclinic and Orographic Instability, to be submitted to J. Atmos. Sci..

Reynolds, N. D. (1988), "Topographic Modulation of Free Unstable Baroclinic Waves", in preparation.

(Non-refereed Publications)

Reynolds, N. D. and T. L. Miller (1987): "Linear Baroclinic Instability in the Presence of Large-Scale Topography." Poster presented at the Sixth Conference on Atmospheric and Oceanic Waves and Stability, Seattle WA, August 25, 1987.

Reynolds, N. D. (1988) "Baroclinic Wave-Mean Flow Interaction due to the Presence of Large-Scale Topography." In preparation for the Palmen Memorial Symposium on Extratropical Cyclones, Aug., 1988.