RIMS

RESEARCH INFORMATION MANAGEMENT SYSTEM

Projects	Award Information - ER61673-1004716-0000171
Project Detail	<p>ID: ER61673-1004716-0000171</p> <p>Principal Investigator: Richard S. Lindzen 617-253-2432</p> <p>Co-PIs:</p> <p>Institution: Massachusetts Institute of Technology</p> <p>Title: Dynamic Heat and Moisture Transport and Baroclinic Adjustment</p> <p>SC Division: SC-74</p> <p>Program Manager: David C. Bader 301-903-5329</p> <p>Research Areas: Climate Pred, CHAMMP</p> <p style="text-align: right;">FINAL REPORT</p>
Other Items	<p>In connection with our work on the apparent Iris Effect, we have acquired 2 years of additional data, and are redoing our analysis with the larger amount of data. So far, the results duplicate earlier results with greater statistical significance. We have also responded (successfully) to a number of criticisms of our initial publication. In particular, while differing estimates of cloudy and clear ir emissivity may be correct, we have shown that they reduce feedback factors by no more than 20%. The resulting feedback factors remain negative and large. Moreover, current data analyses suggest that our earlier estimates may be low for other reasons. We have also shown that all cloudy regions in the region covered by the GMS satellite are convective in origin. We are, however, continuing our work on an improved measure of cumulus activity. In particular, we are using TRMM data to determine thresholds in the T11 channel of GMS that are functions of time, position and SST. We have confirmed that our previous results had a very high statistical significance. However, we expect that the use of the improved measure of cumulus will improve this still further.</p> <p>We have completed our study of the possible reconciliation of temperature records for the troposphere and the surface. We have shown that the two time series can be reconciled by assuming that the surface temperature is responding to a jump in atmospheric temperature which occurred rapidly in 1976 associated with an observed regime change. The suddenness of the change observed in 1976 seems inconsistent with a greenhouse origin. Moreover, the relative rapidity with which the surface responded (a delay time of about ten years) is most consistent with low climate sensitivity.</p> <p>We have completed a simple study in which we show that rough agreement of observed and model predicted warming of the deep ocean does not test the climate sensitivity of models. Rather, it is simply an indication that models have been tuned to roughly replicate observed surface temperature time series.</p> <p>We are also continuing to study the implications of nonlinear equilibration of baroclinic instability for climate. Our results, thus far, suggest that such equilibration does not uniquely determine the equator-pole temperature distribution. The question then is what does determine this. Because the associated advective time scales are faster than the diabatic processes, the tropospheric dynamics is usually regarded as quasi-adiabatic. However, it should be noted that the mass of a given isentropic layer is invariant in adiabatic dynamics. In other words, though the baroclinic eddies can deform the isentropic layers and redistribute the mass within, they can never change its total mass. The mass of an isentropic layer must be ultimately controlled by the diabatic processes, no matter how slow.</p> <p>The explanation to this apparent inconsistency is that, as an Eulerian quantity, the fast advective time scale is relevant to the instantaneous transport between fixed Eulerian locations, but not to the transport between two adjacent isentropic layers, which are themselves moving back and forth through that location. In fact, the net heat transport across an Eulerian location arises from the strong cancellation between instances of advective heat transport with opposite sign. Hence, the relevant time scale for the heat transport is not the fast advective time scale, but, rather, the slower diabatic time scale. We can show this by constructing a time series for the mass of the isentropic layers, which varies on much slower time scales than more traditional Eulerian measures of the thermal mean state, such as the temperature gradient.</p> <p>The main consequence of the fast advective time scale is the strong drifting of the isentropic layers. This implies that the cooling and heating of the isentropic layer need not occur at the Eulerian mean location. In particular, we expect an isentropic layer to warm (cool) most efficiently when it is deformed poleward (equatorward) of some equilibrium location. As a result, the net heating/cooling of a layer is controlled by the integrated diabatic interaction of the perturbed isentropic distributions, rather than that of its Eulerian mean. For this, however, the magnitude of the eddies becomes important as well.</p> <p>Our approach to the problem involves two steps. First, we need to characterize the eddy-induced isentropic motion, which may not require a full description of the eddy statistics, and thus be more easy to parameterize. We have made some progress in this direction. We have defined two idealized modes of quasi-adiabatic transport, with very different implications for the motion of the isentropes, and are currently involved in</p>

DOE Patent Clearance Granted

Date June 7, 2002

Mark P. Dvorscak

(630) 252-2393
E-mail: mark.dvorscak@ch.doe.gov
Office of Intellectual Property Law
DOE Chicago Operations Office

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

diagnosing which of these modes is more relevant for the atmosphere. A second step of our work will require the modeling of the diabatic exchange of the perturbed isentropic states. This is trivial in a Newtonian cooling formulation, but potentially very complicated when non-local formulations of the diabatic processes are used.

Most recent products delivered:

Zurita, P. and R.S. Lindzen (2001) The equilibration of short Charney waves: Implications for potential vorticity homogenization in the extratropical troposphere. accepted J. Atmos. Sci.

Harnik, N. and R.S. Lindzen (2001) The effect of reflecting surfaces on the vertical structure and variability of stratospheric planetary waves, accepted J. Atmos. Sci.

Lindzen, R.S. and C. Giannitsis (2001) Reconciling observations of global temperature change. submitted Geophys. Res. Ltrs.

Lindzen, R.S. (2001) Do Deep Ocean Temperature Records Verify Models? Submitted Geophys. Res. Ltrs.

Lindzen, R.S. (2001) Richard J. Reed and Atmospheric Tides to appear in Reed Symposium Proceedings to be published by AMS

Chou, M.-D., R.S. Lindzen, and A.Y. Hou (2001a) Impact of Albedo Contrast between Cirrus and Boundary-Layer Clouds on Climate Sensitivity. Submitted to Atmospheric, Chemistry and Physics Discussion.

Chou, M.-D., R.S. Lindzen, and A.Y. Hou (2001b) Response to "No evidence for iris." submitted to Bull. Amer. Met. Soc.

Chou, M.-D., R.S. Lindzen, and A.Y. Hou (2001c) Response to "The Iris hypothesis: A negative or positive cloud feedback?" submitted J. Climate

Bell, T. L., M.-D. Chou, R.S. Lindzen, and A.Y. Hou (2001) Response to Comment on "Does the Earth Have an Adaptive Infrared Iris?" submitted to Bull. Amer. Met. Soc.

Most recent notes concerning the project:

None

Other Project Information Sources:**Project URL:**

None

Related URL at institution:

None

Contact: RIMSAdmin@science.doe.gov

Search OBER Abstracts Database Note: There is a delay in posting abstracts to allow for Program Manager review.