Numerical Study of Influence of Mountain Ranges in Taiwan on a cold Front

Wen-Yih Sun*
National Center for High Performance Computing
Hsin-Chu, Taiwan
and
Jiun-Dar Chern
Laboratory for Atmospheres, NASA Goddard Space Flight Center,
Greenbelt, MD 20771, USA

Abstract:

The numerical simulations were performed to study the intrusion of a shallow cold front along the China coastal mountain range and the deformation of the front by the Central Mountain Range (CMR) in Taiwan during the IOP-9 (1600 UTC June 14 - 1700 UTC June 15, 1987) of the Taiwan Area Mesoscale Experiment (TAMEX). The essential features of the observed front, such as the faster movement of the eastern part of the front than the western part, were well reproduced. The control and sensitivity simulations suggested that the frontal deformation in Taiwan was caused by the dynamical interaction between the front and the underlying topography. As the cold air approached northern Taiwan from the north, a relative high pressure with anticyclonic circulation built up on the windward side. More oncoming flow was diverted to the northeast of Taiwan than to the northwest and caused the difference of the frontal speed between the eastern and western parts of the front. The dynamics of the frontal movement along southeast China was similar to the dynamics of coastally trapped mesoscale ridges or orographical jet. The momentum budget equation showed that the contribution of the nonlinear advection, ageostrophic forcing, and friction were equally important to the local change of the wind just behind the front. This might indicate that the dynamics of the front was more complicated than that described by the density current theory derived from an irrotational fluid. The invicid sensitivity simulation revealed a faster propagating front and a stronger wind behind its leading edge in comparison with the control simulation. The front bears no dynamical resemblance to either an orographically trapped density current or a Kelvin wave, because the major forces in the momentum budget are the pressure gradient force, Coriolis force and advection terms.