微物理、輻射及地面過程於天氣和氣候模擬上之作用

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摘 要

本研究利用中尺度大氣模式嘗試選擇模擬某段時間內加州及其鄰近地區之區域性尺度氣候。本模式在下述物理過程方面已有主要的改進和成就：

1.雲、雨、冰、雪和霰之微物理過程以直接顯示法代表之。
2.採用Delta-Eddington 短波輻射程式和改良式寬頻式紅外線長波輻射程式。
3.置入奧瑞岡州立大學土壤及邊界層模式。

本模式曾以北加州1986年2月11-12日之豪雨個案評估其成效。本個案採用雙層網格方式，外層網格含蓋整個美國西部，網格間距爲60公里；內層巢狀網格則含蓋加州，網格間距爲20公里。本模式以 NMC之2.5° x 2.5° 分析場爲初始值和側邊界條件。

本個案所模擬之降雨量及其分佈十分接近觀測值，並在Sierra山脈背風面產生十分適切的降雪。此種積雪源起於Sierra山脈迎風面之液態降水，當其東飄過山時逐漸轉化爲雪；部份山前之融雪變成雨並造成清晰的山頂雪線。於海岸山脈之高度存在有雲層，冰狀雲則出現於較高之層次。

本模擬十分有趣，且展示了微物理在中尺度模式上之重要性。此外，(1)以區域性尺度模式模擬氣候的可行性，(2)覆雲量和輻射間之交互作用 ，以及(3)邊界層內土壤含水量對於本模式之影響作用等，均將包含在本研究之討論範疇內。

The effects of microphysics, radiation, and surface processes on the simulation of Weather and climate.

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A mesoscale atmospheric model was used to simulate the regional scale climate for selected periods over California and the surrounding areas. Major improvements of the model physical processes have been made and those include:

1. The explicit representation of the microphysical processes including the cloud, rain, ice, snow, and graupel.
2. The adoption of the Delta-Eddington solar radiation module and modified broadband infrared radiation module.
3. The implementation of the Oregon State University soil and boundary layer model.

The model was evaluated for a heavy precipitation event in northern California for the period of February 11-22, 1986. For this case, the model was programmed to run on two domain sizes: the outer domain covers the entire western United States with a resolution of 60 km; the inner domain, which is nested in the outer domain, covers the area of California area with a resolution of 20 km. The model used the 2.5 degree analysis data produced by NMC as the initial and lateral boundary conditions.

The simulated distribution and amount of precipitation were very close to the observations. There was considerable snow in the lee side of the Sierra. The snow was first produced in liquid form in the upwind side of the Sierra and that gradually turned into snow while drifting eastwards. Some of the snow melted to form rain in the upwind side of the mountain making a clearly defined snow line near the top of the mountain. A layer of cloud also existed over the Coastal Range and some ice cloud were observed in the higher levels. This simulation is quite interesting and it has demonstrated the importance of microphysics in mesoscale models. Other topics to be presented include: (1)the feasibility of climate simulation using a regional scale model; (2)the interaction between cloud cover and radiation; and (3) the effect of the soil moisture on the boundary layer development in the model.