

ROYAL METEOROLOGICAL SOCIETY: AUSTRALIAN BRANCH MEETING

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Recent Results from Satellite Sounding Experiments

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Dr Smith, Chief, Radiation Branch, National Environmental Satellite Service, NOAA, began with a review of the technique of remote temperature sounding using radiation measurements in several channels in the vicinity of an absorption band. He outlined the steady progress made from 1969 (Nimbus 3) to the present (Nimbus 6), noting that the next generation of operational satellites (TIROS N series) will carry the two instrument system being tested aboard Nimbus 6. This system provides 22 channels of spectral information from the visible into the microwave regions of the spectrum: 4 channels for sensing the properties of the earth's surface and clouds; 3 channels to sense the water vapour concentration of the lower and upper troposphere; and 15 channels to sense the vertical temperature profile between the surface and the mesosphere (45 km). Both the infrared (IR) and microwave (MW) instruments scan the earth to provide global coverage every 12 hours. The spatial resolution of the IR is 30 km; the MW 150 km.

Some extremely interesting results were then shown for the 4.3μ (MW) channel, which senses temperature in the vicinity of the stratopause (40 km). The data showed intense warm eddies in the winter hemisphere with length scales of ~ 200 km and temperature gradients of $\sim 10^\circ\text{C}/100$ km. These disturbances were confined to the stratosphere and were characterised by rapid onset and decay. Their origin appeared to be in the subtropics with generally poleward motion during a lifetime of the order of one week.

While IR data are affected by clouds the MW data are not and now enable unambiguous interpretation of radiometric data in the low troposphere regardless of cloud conditions. Two examples of the enhanced temperature analysis capability in the low troposphere using microwave data were illustrated. Cross-section analyses of temperature and winds calculated from the thermal wind equation illustrated that in some situations the increased horizontal resolution available from the satellite data can adequately compensate for the high vertical resolution available in radiosonde data.

Dr Smith then addressed the question of the impact of satellite data on numerical analysis and prognosis. He indicated that in the northern hemisphere the impact on NMC products had been small. He explained that this was due to (a) the availability of conventional data and (b) the additional information provided by the satellites was often at scales smaller than those retained in the operational global analysis and forecast system. In contrast recent experiments at GFDL have shown a more positive impact, e.g., r.m.s. error analyses suggest that a two day forecast with satellite data shows the same skill as a one day forecast without the data. A surprising fact is that the r.m.s. difference between the GFDL and NMC analyses based on the same information is as large as the difference between the GFDL analyses with and without satellite data.

Impact studies are presently being undertaken at the ANMRC using its limited area primitive equation model and a variational blending analysis scheme. In none of the cases examined so far has the impact of the satellite data been negative. One case of positive impact was illustrated.

Dr Smith closed his address by noting the potential of satellite-borne lasers to overcome the two remaining limitations of passive sounding systems, namely (i) the need for a surface pressure or other suitable pressure-height reference measurement and (ii) the lack of vertical resolution - so important in moving towards higher resolution prediction models.

Dr Tucker asked whether the existing communication facilities available to the Bureau of Meteorology were capable of handling the presently available hemispheric data from Nimbus 6. It would seem that only one-quarter of the data available can be operationally utilised at present (a tragic irony since southern hemisphere meteorologists have always been plagued by the lack of available data).

W.K.D.