Mission Scientist Report (by J.D. Doyle)

IOP12, RF20

Mission Date: 11 July 2014

Takeoff Time: 0325 UTC (1525 NZST)

Landing Time: 0915 UTC (2115 NZST July 10)

Duration: approximately 6 hours

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Objective: The first objective was to perform an intercomparison with the DLR Falcon for several altitudes. A second objective was to sample gravity waves Southern Alps and Mt. Cook region, and then to sample a region of high initial condition sensitivity over the Tasman Sea. The intercomparison portion of this flight will be reported on in a separate report.

Track design: The flight track is summarized in Fig. 1. The first 2-2.5 hour consisted of an intercomparison mission coordinated with the DLR Falcon, followed by a transect across the Southern Alps along the 1b Mt. Cook transect, a predictability module, and on return a second transect along 1b.

Dropsondes: Dropsondes were deployed at the upstream point of the Mt. Cook 1b leg on the outbound and return. A total of 10 dropsondes were deployed for the predictability module.

Instrument problems: There were some issues with the sodium lidar. The WIC indicator seemed to give an incorrect mean value during a portion of the flight (at altitudes other than FL400).

Results: The forecast models were predicting moderate amplitude waves under northerly flow. The ECMWF forecasts are summarized in Figs. 2-3. The forecast gravity waves can be seen in the horizontal divergence forecasts from the IFS valid at 0600 UTC 10 July at 1 hPa (Figs. 4). Some weak high level wave activity can be seen nearly perpendicular to the ridge, possibly associated with some non-orographic sources.

The MTM and sodium lidars reported seeing many wave structures over the Tasman Sea in particular. Examples are shown in Figs. 5 and 6. The AIRS instrument indicated some temperature perturbations in this region at 2 hPa, shown in Fig. 7.
The gravity waves were moderate in amplitude crossing the Mt. Cook region. A long train of trapped waves were present in the lee on both passes across the mountain (Fig. 8).

The predictability survey pattern was devised to sample a region of large initial condition sensitivity, shown in Figs. 9 and 10. The evolved perturbations grew rapidly, shown in Fig. 11. A total of 10 dropsondes were deployed along the predictability survey (Fig. 12). The dropsondes were ingested into the ECMWF and Navy FNMOC operational centers (Fig. 13).

Two example dropsondes are shown in Fig. 14. The top figure in Fig. 14 is the upstream dropsonde of transection along Mt. Cook 1b, which shows a NE barrier jet. The bottom figure is an example from the predictability survey, which highlights the strong jet stream winds and unstable sounding.
Figure 1: RF20 flight track for the GV and dropsonde locations. Winds along the flight track are shown.
Figure 2. ECMWF forecasts valid at 06Z 10 July for 750 hPa, showing the vertical velocity at 150 hPa (upper left), 5 hPa (upper right), and horizontal velocity at 300 hPa (lower left) and 700 hPa (lower right).
Figure 3. Forecasts from ECMWF of the horizontal divergence (left two columns) and vertical velocity (right column) along the Mt. Cook 1b cross section valid at 03, 06, and 09 UTC 10 July comparing early and recent forecast times.
Figure 4. Forecasts from ECMWF of the horizontal divergence at 1 hPa valid at 0600 UTC 10 July.
Figure 5. ATMT camera quick look image from right camera at 0722 UTC 10 July.
Figure 6. Sodium lidar quick look image at 0837 UTC 10 July.
Figure 7. AIRS image valid at 1355 UTC 10 July.

Figure 8. The vertical velocity from the G-V at 40,000 ft for the two Mt. Cook 1B transects.
Figure 9. The 850-hPa water vapor sensitivity valid at 0600 UTC 10 July.
Figure 10. The total perturbation energy valid at 1200 UTC 10 July.
Figure 11. The total evolved (24 h) perturbation energy valid at 1200 UTC 11 July.

Figure 12. The 700-hPa water vapor sensitivity valid at 0600 UTC 10 July, and the dropsonde plan.
Figure 13. The dropsonde coverage from ECMWF (left) and FNMOC (right) valid at 0600 UTC 10 July.
Figure 14. Example dropsondes of interest include the first sonde at the upstream portion of the 1b transect (top) and one of the dropsondes in the predictability transect.