A Summary of MTP Results for DEEPWAVE

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Introduction

We summarize in this document, the results of the analysis of the Microwave Temperature Profiler (MTP) data obtained on the NSF/NCAR GV (NGV) during the DEEPWAVE field campaign. Its purpose is two-fold: to present the final MTP data with comments on data quality for each flight in the table below, and to describe the statistically-based MTP retrieval scheme which uses local radiosonde data as a priori information. This document can be found under *Documentation* in the data archive for the DEEPWAVE MTP dataset so that users can obtain a summary of data quality and interesting features associated with each flight. For each flight we also provide plots to show comparisons between dropsonde temperature profiles and the closest MTP profile.

1 Results

Comments on the DEEPWAVE MTP Final Data

Color-coded temperature curtain (CTC) plots are available for each of the DEEPWAVE research flights with comments which include summaries of each flight. These comments may indicate areas of reduced data quality and/or significant features noted in the temperature profiles. Comparisons of dropsonde temperature profiles and the closest MTP profile are also available for most flights.

On each of the following CTC plots the x-axis is the Universal Time (UT) in kilo-seconds (ks), the left y-axis is the pressure altitude in kilometers (km), and the right y-axis is the pressure altitude in thousands of feet (kft). On the right is the color-coded temperature scale, which ranges from 170- 320 K. Also shown on each plot is the GV's altitude (black trace), the tropopause altitude (white trace), and a quality metric (gray trace at the bottom). The quality metric, which we call the MRI, ranges from 0 to 2 on the left pressure altitude scale. If the MRI is <1, we consider the retrieval to be reliable; if it is >1 the retrieval is less reliable, and users should contact us as to whether it can be used or not. The MTP production data have been edited to include retrievals with the MRI <0.8. If this excludes a specific time period of interest, users may contact us to see whether we can salvage data that is not shown here. The CTC plots are generally restricted to $\pm$ 8 km from flight level.

1.1 RF01

Flight track followed Mt Cook - 1b flight track with trailing leg south in Tasman Sea. Mountain waves were weak as were non-orographic waves in Tasman Sea.

MTP retrievals are good with a relatively low MRI throughout the flight. The MRI is slightly elevated from 39-44 ksec. The tropopause height is fairly steady at 11 km with some small variation that may be associated with weak wave activity (Figure 1).

See Figure 2 for RF01 MTP-Dropsonde comparisons.

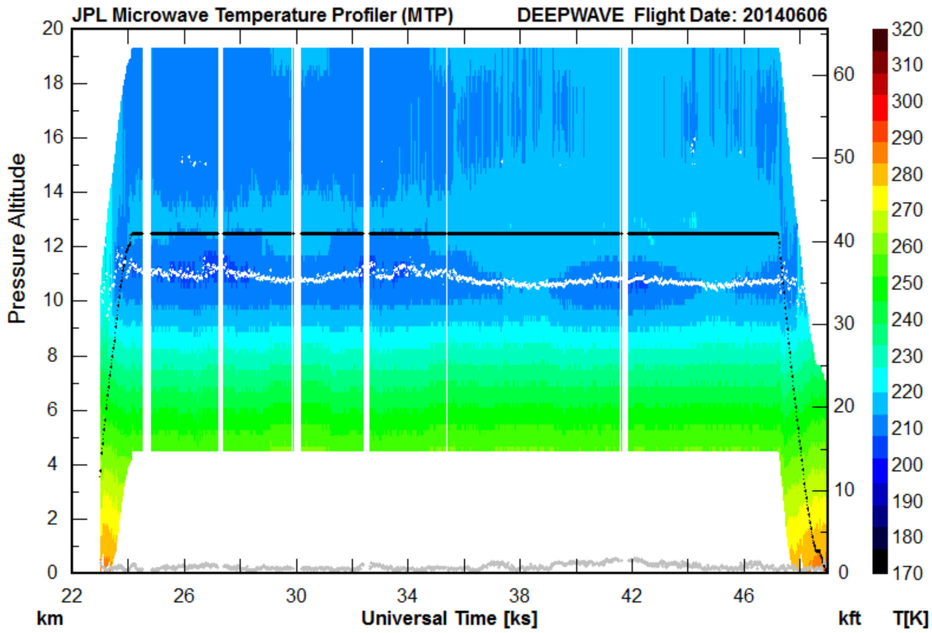


Figure 1: CTC Plot from Research Flight 1 on June 6, 2014

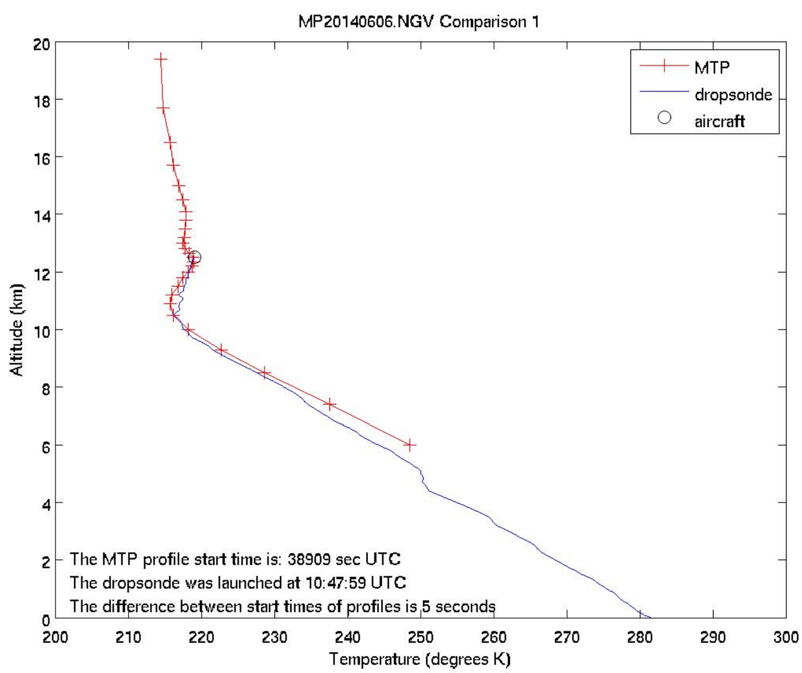


Figure 2: RF01 MTP-Dropsonde Comparison

1.2 RF02

Flight track designed to investigate wave activity in the lee of Tasmania. Performed "V" pattern making multiple passes over Tasmania. Weak waves with different orientation and amplitude were forecast.

MTP retrieval quality is reasonable with reduced tropopause heights near the beginning/end of the flight (Figure 3).

See Figure 4 for RF02 MTP-Dropsonde comparisons.

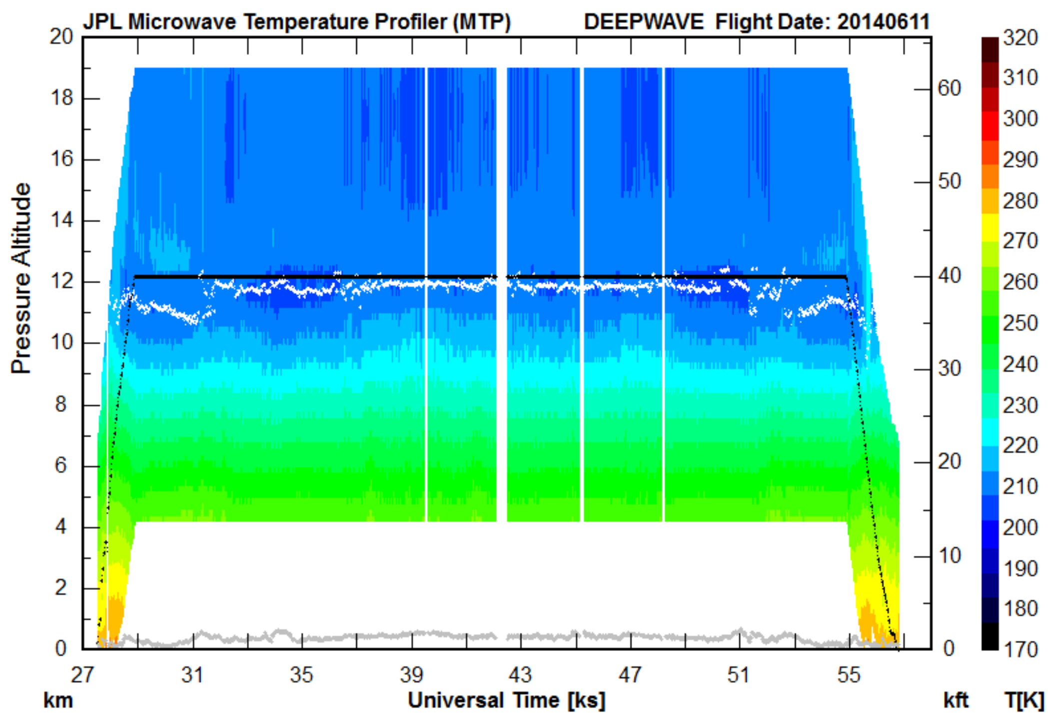
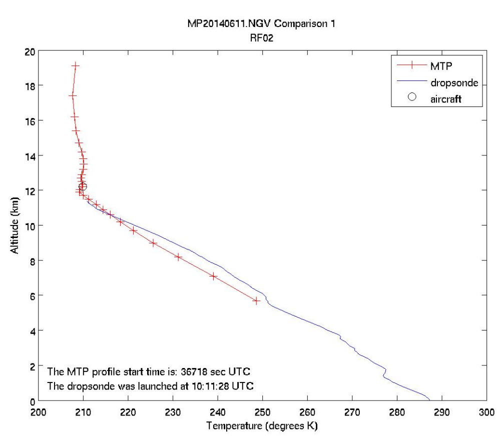
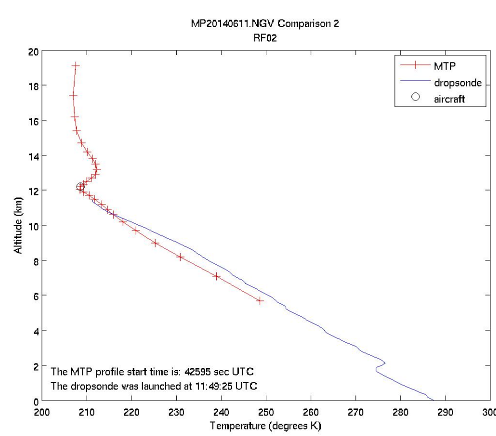


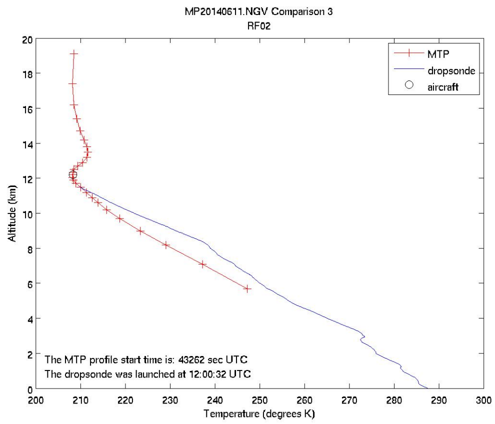
Figure 3: CTC Plot from Research Flight 2 on June 11, 2014



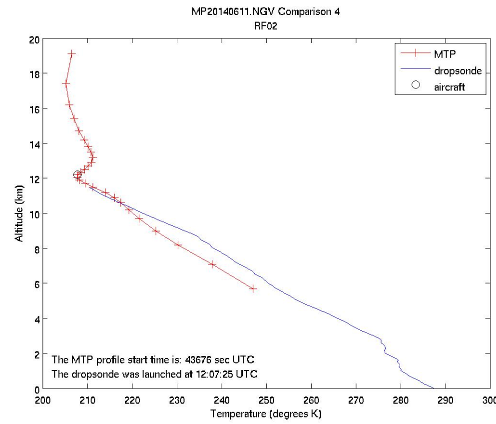
(a) RF02 MTP-Dropsonde Comparison 1



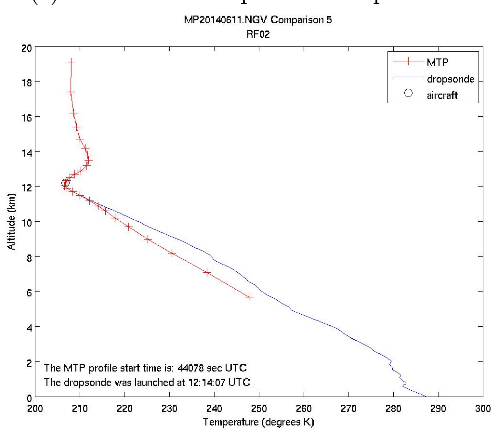
(b) RF02 MTP-Dropsonde Comparison 2



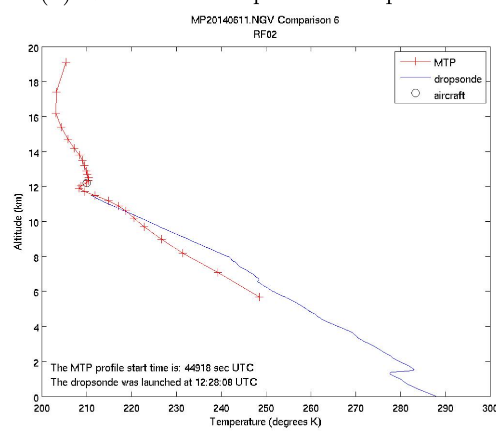
(c) RF02 MTP-Dropsonde Comparison 3



(d) RF02 MTP-Dropsonde Comparison 4



(e) RF02 MTP-Dropsonde Comparison 5



(f) RF02 MTP-Dropsonde Comparison 6

Figure 4: RF02 MTP-Dropsonde Comparisons

1.3 RF03

Predictability flight investigating upstream sensitivities of predicted Southern Alps wave event. Triangle track over Tasman Sea.

Good quality retrievals throughout the flight with tropopause height varying from 10-11 km. Some evidence of secondary tropopause at around 15 km (Figure 5).

See Figure 6 for RF03 MTP-Dropsonde comparisons.

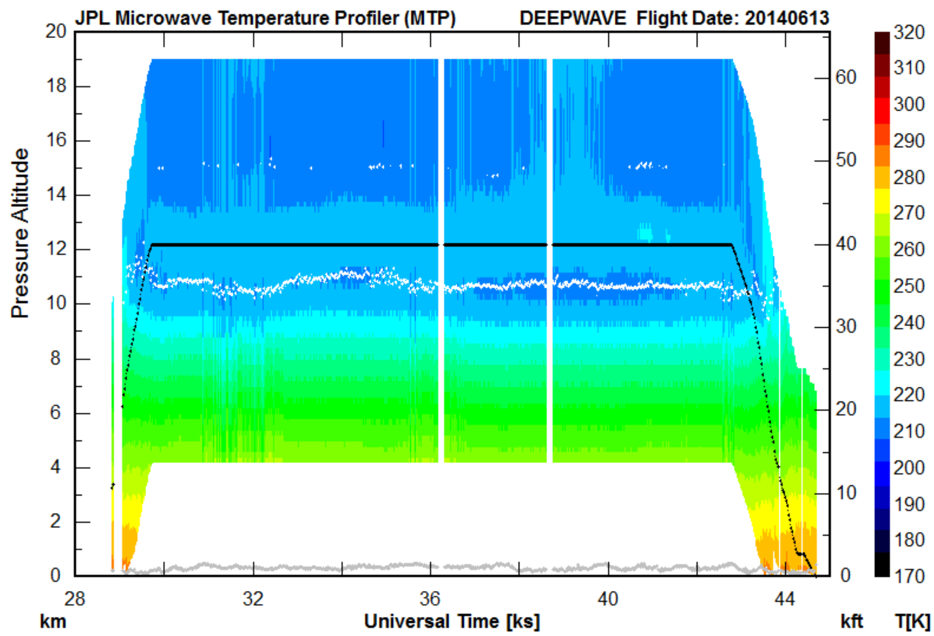
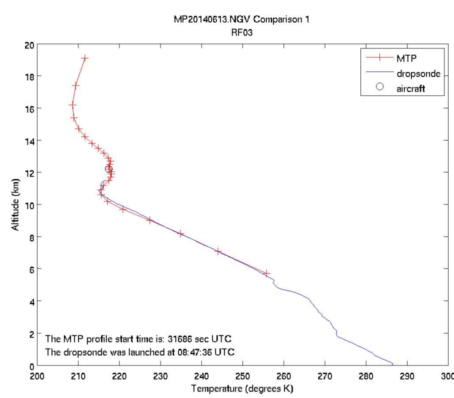


Figure 5: CTC Plot from Research Flight 3 on June 13, 2014



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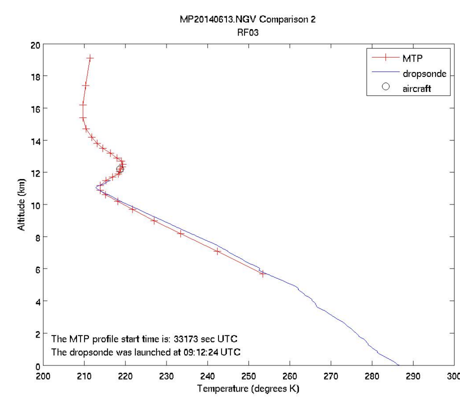
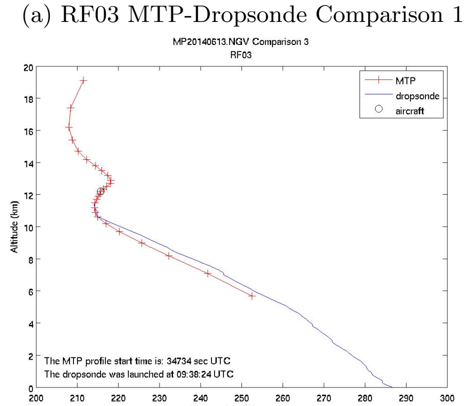
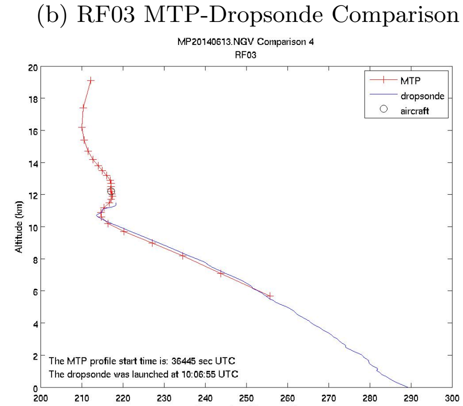


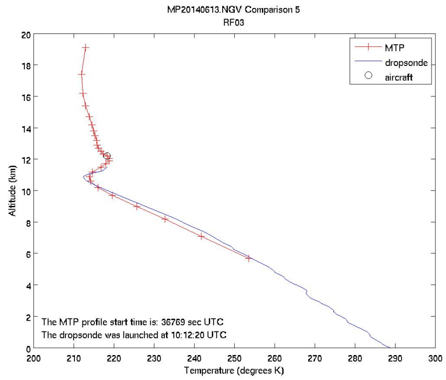
(b) RF03 MTP-Dropsonde Comparison 2



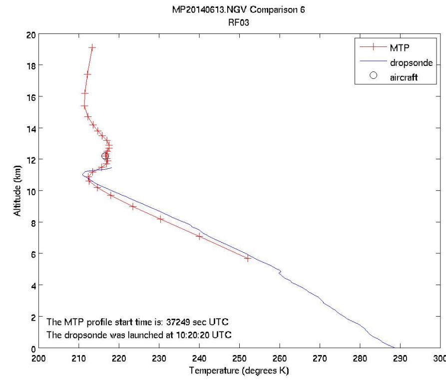
(c) RF03 MTP-Dropsonde Comparison 3



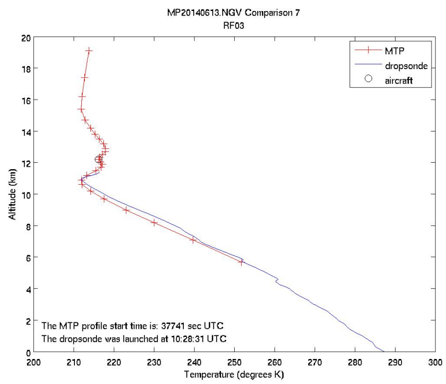
(d) RF03 MTP-Dropsonde Comparison 4



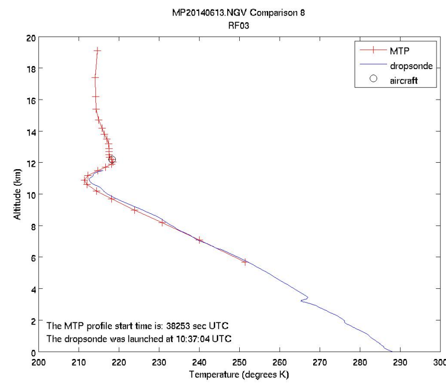
(e) RF03 MTP-Dropsonde Comparison 5



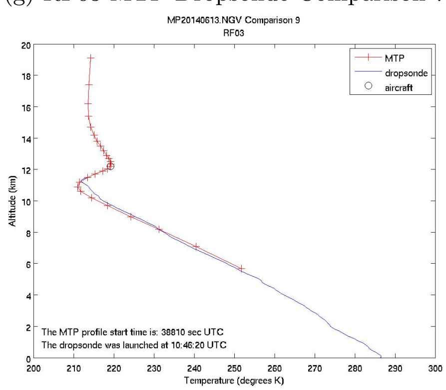
(f) RF03 MTP-Dropsonde Comparison 6



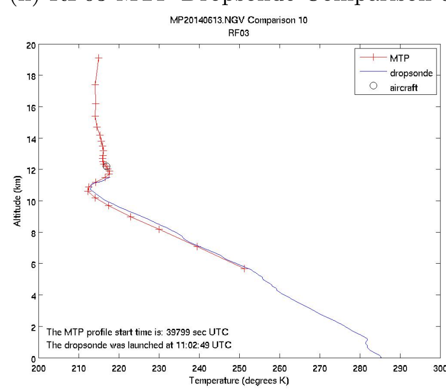
(g) RF03 MTP-Dropsonde Comparison 7



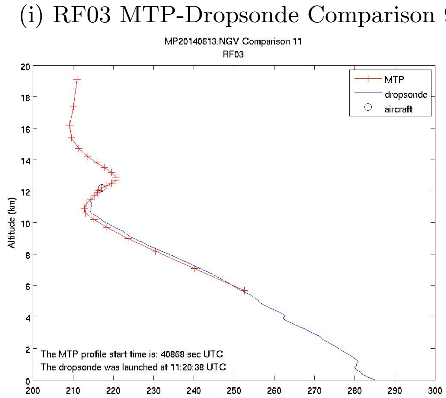
(h) RF03 MTP-Dropsonde Comparison 8



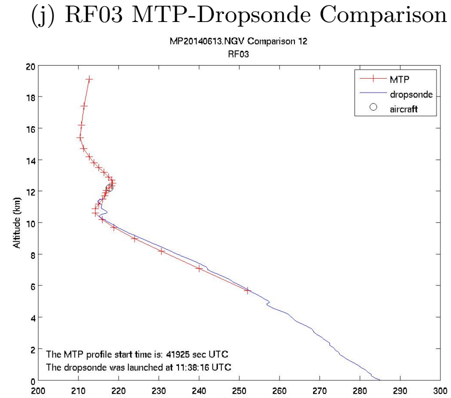
(i) RF03 MTP-Dropsonde Comparison 9



(j) RF03 MTP-Dropsonde Comparison 10



(k) RF03 MTP-Dropsonde Comparison 11



(l) RF03 MTP-Dropsonde Comparison 12

Figure 6: RF03 MTP-Dropsonde Comparisons

1.4 RF04

Mt Aspiring cross island track with legs parallel to the coast both upstream and downstream. Cross island legs showed smooth periodic waves.

MTP retrievals are of good quality and reflect the periodic variation in temperature structure. (Figure 7).

See Figure 8 for RF04 MTP-Dropsonde comparisons.

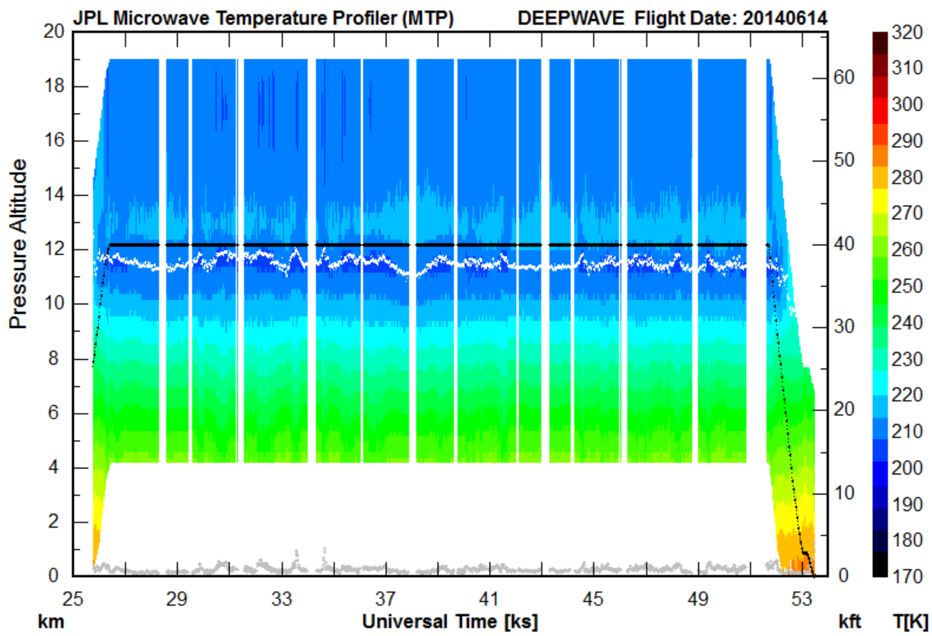
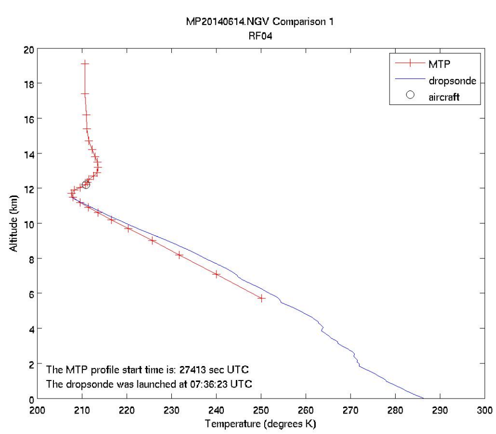


Figure 7: CTC Plot from Research Flight 4 on June 14, 2014



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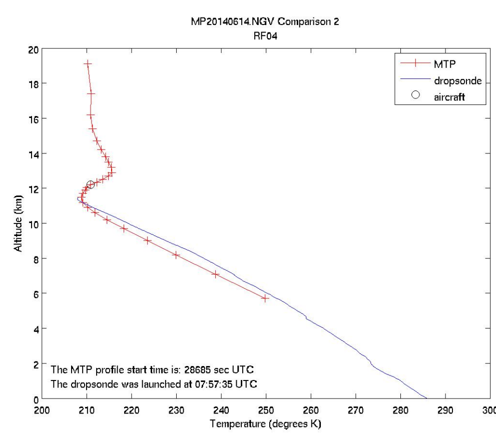

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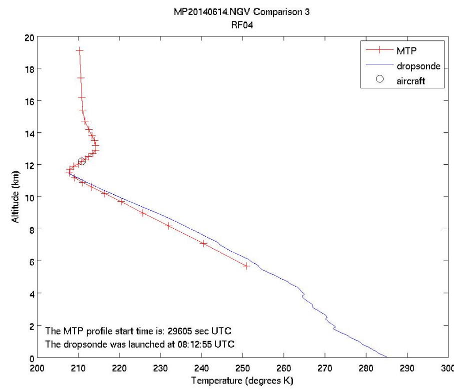
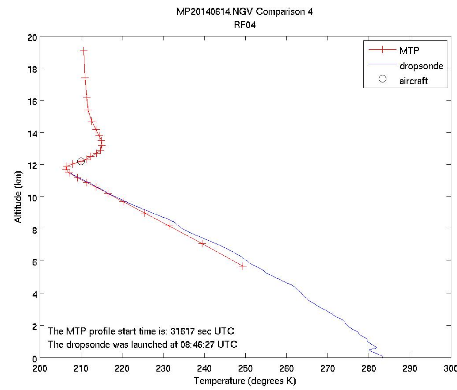
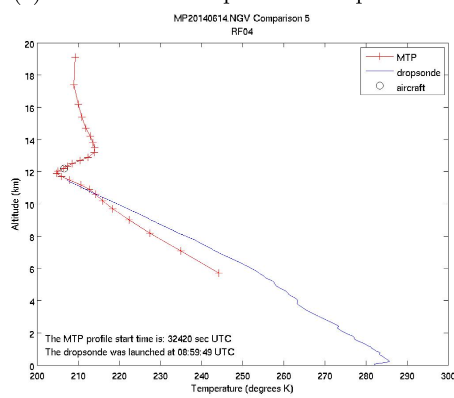


(c) RF04 MTP-Dropsonde Comparison 3



(d) RF04 MTP-Dropsonde Comparison 4



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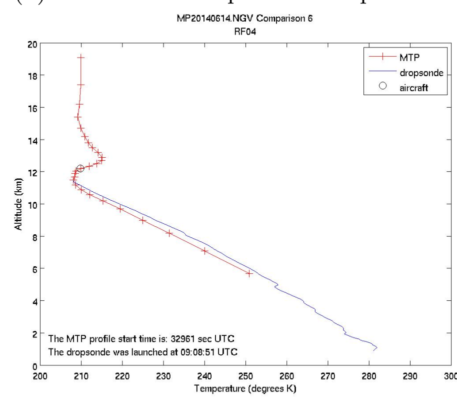

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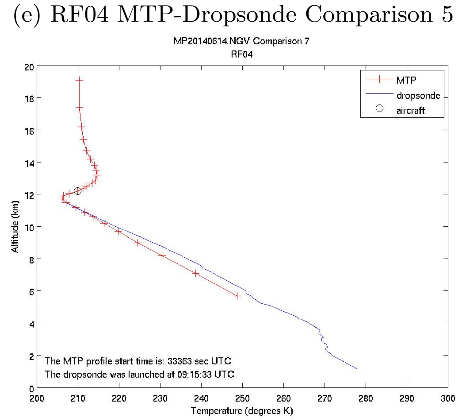
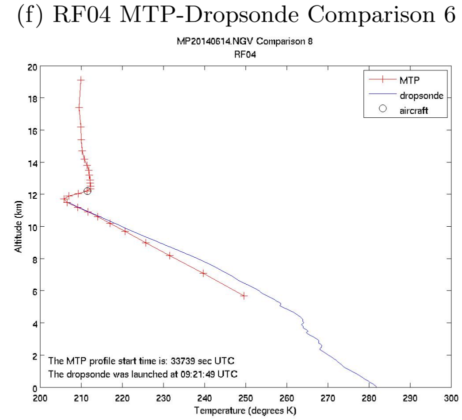
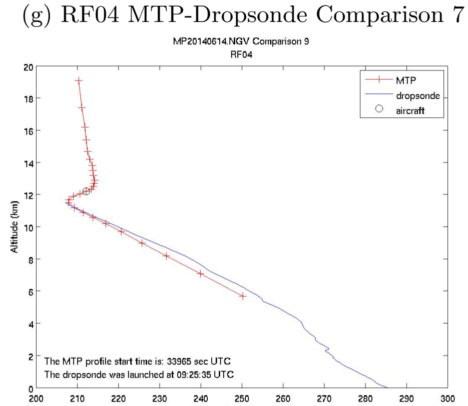


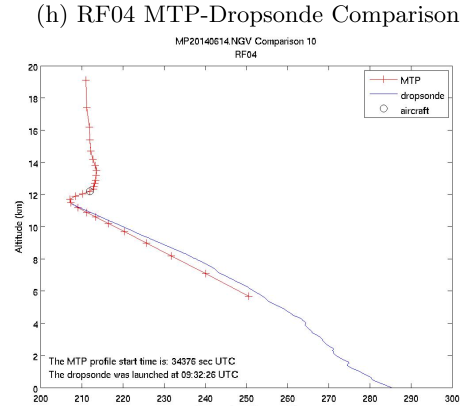
(g) RF04 MTP-Dropsonde Comparison 7



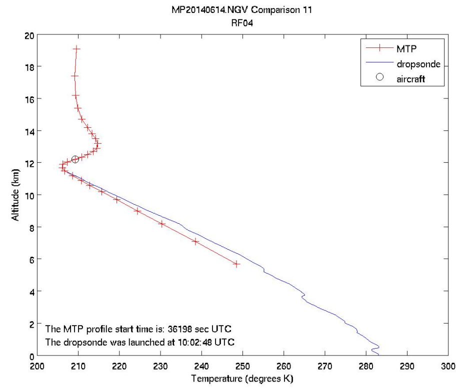
(h) RF04 MTP-Dropsonde Comparison 8



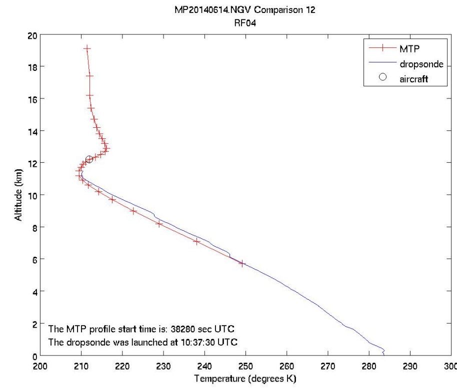
(i) RF04 MTP-Dropsonde Comparison 9



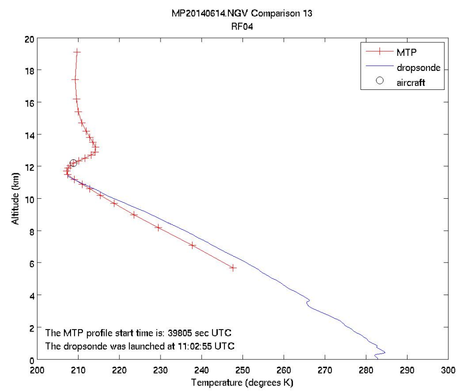
(j) RF04 MTP-Dropsonde Comparison 10



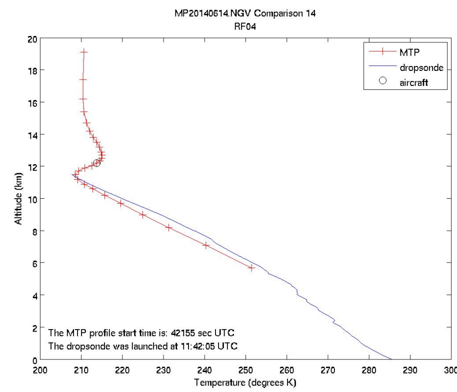
(k) RF04 MTP-Dropsonde Comparison 11



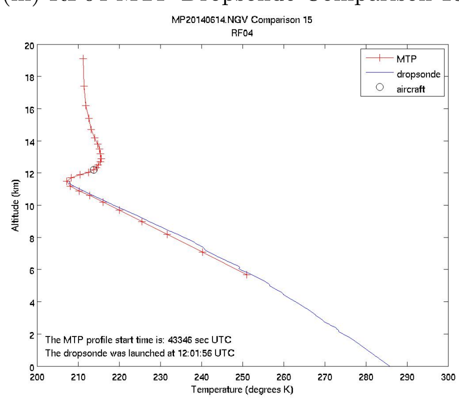
(l) RF04 MTP-Dropsonde Comparison 12



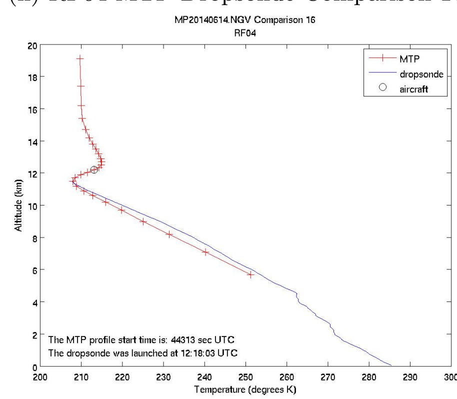
(m) RF04 MTP-Dropsonde Comparison 13



(n) RF04 MTP-Dropsonde Comparison 14



(o) RF04 MTP-Dropsonde Comparison 15



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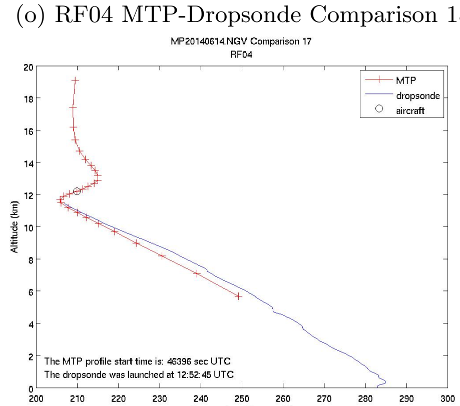
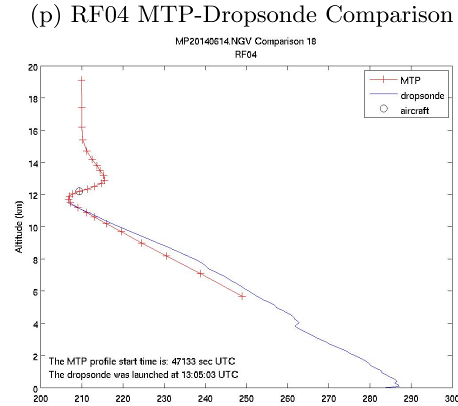


(q) RF04 MTP-Dropsonde Comparison 17



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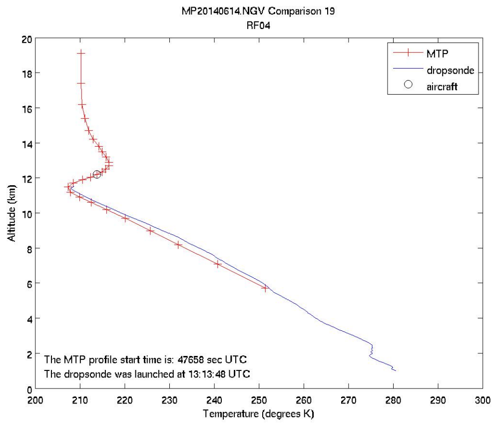

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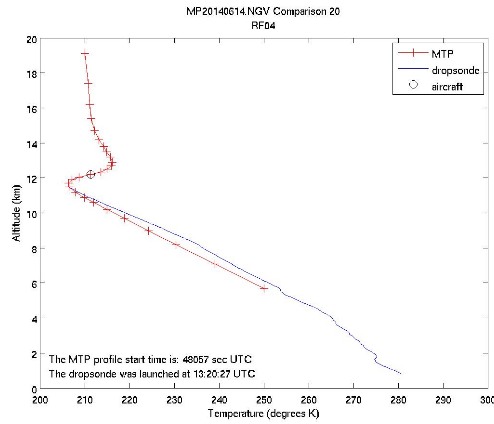

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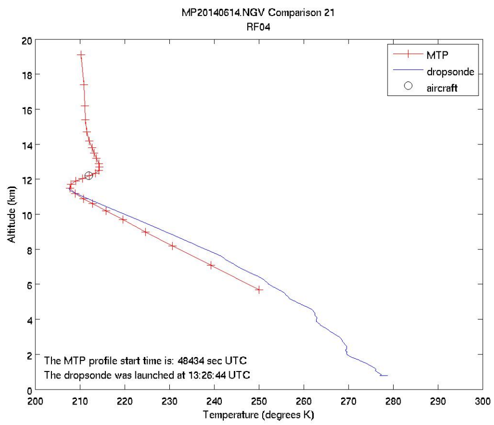

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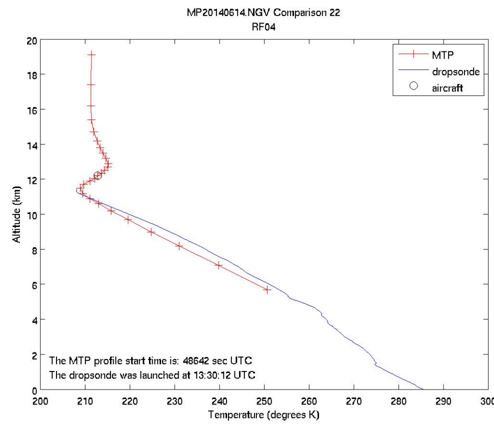

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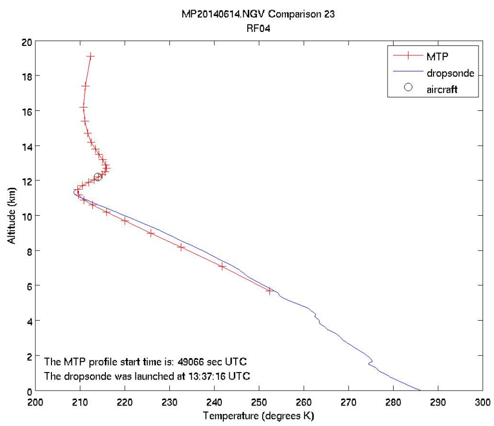


(w) RF04 MTP-Dropsonde Comparison 23

Figure 8: RF04 MTP-Dropsonde Comparisons

1.5 RF05

Mt Aspiring cross island track with legs parallel to the coast both upstream and downstream. Cross island legs showed smooth periodic waves.

MTP retrievals are of good quality and reflect the periodic variation in temperature structure. (Figure 9).

See Figure 10 for RF05 MTP-Dropsonde comparisons.

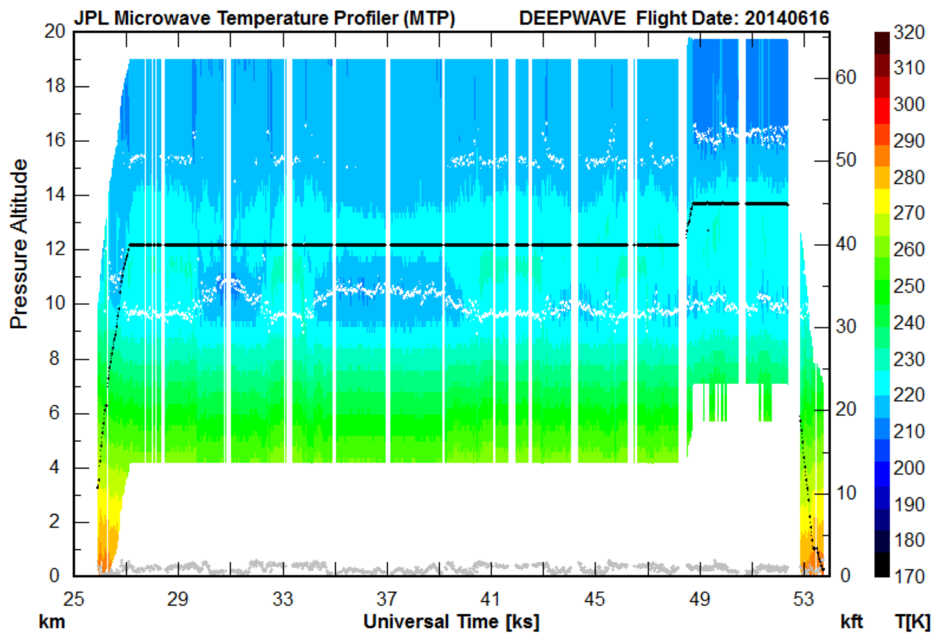
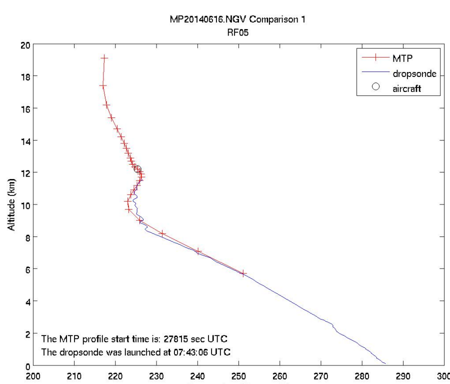
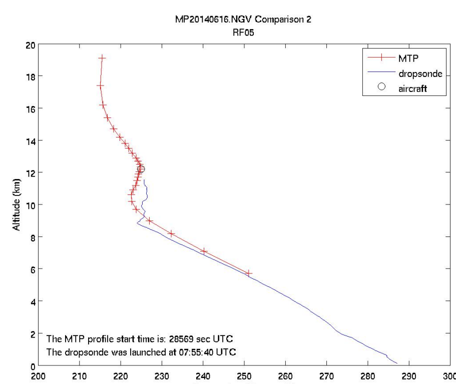


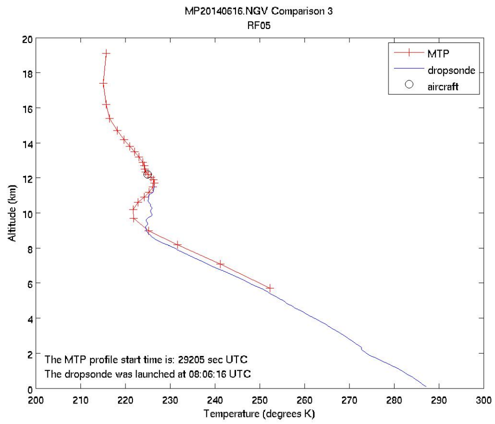
Figure 9: CTC Plot from Research Flight 5 on June 16, 2014



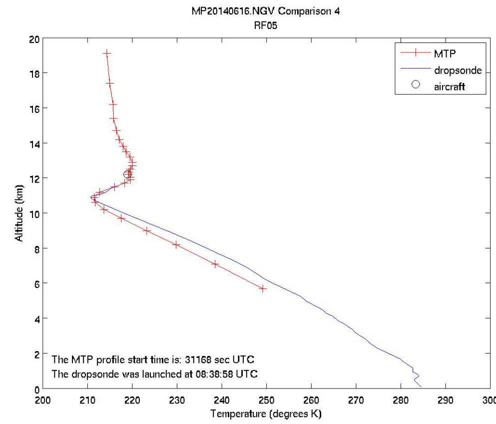
(a) RF05 MTP-Dropsonde Comparison 1



(b) RF05 MTP-Dropsonde Comparison 2



(c) RF05 MTP-Dropsonde Comparison 3



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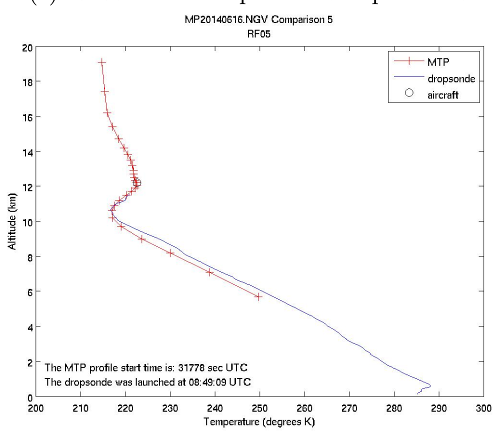

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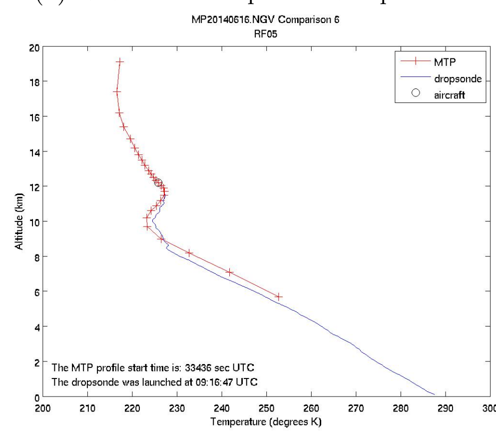
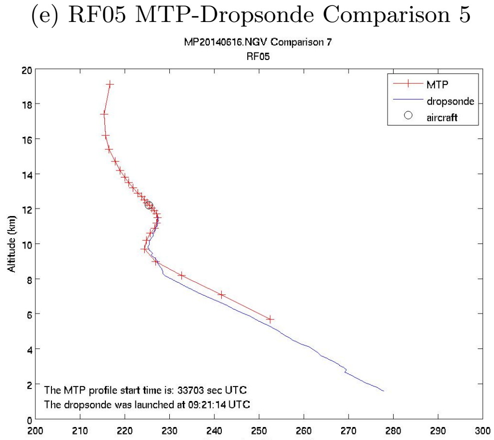
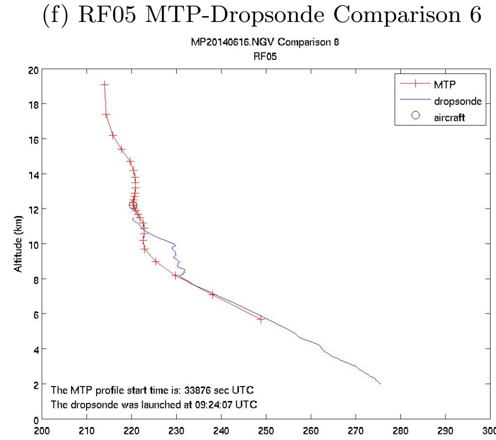


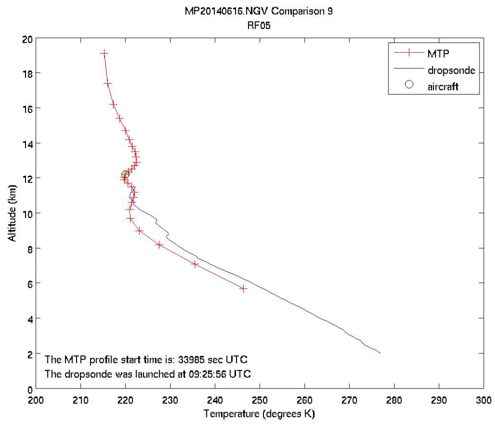
(f) RF05 MTP-Dropsonde Comparison 6



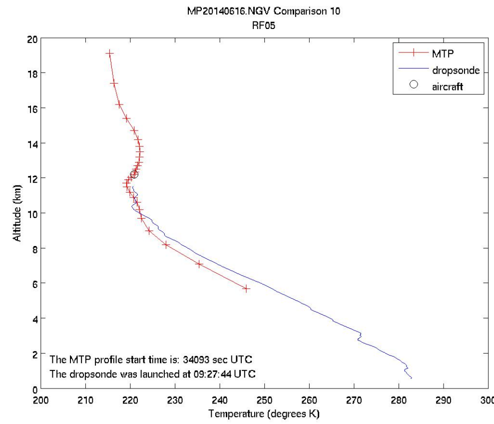
(g) RF05 MTP-Dropsonde Comparison 7



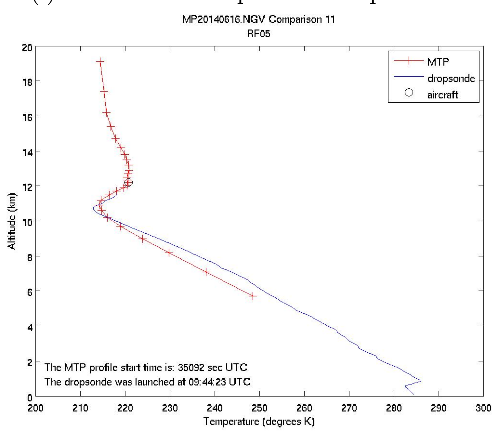
(h) RF05 MTP-Dropsonde Comparison 8



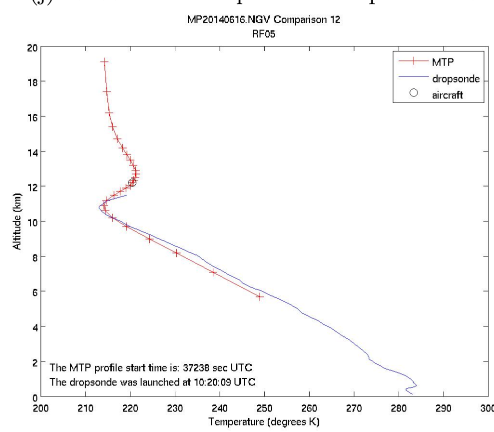
(i) RF05 MTP-Dropsonde Comparison 9



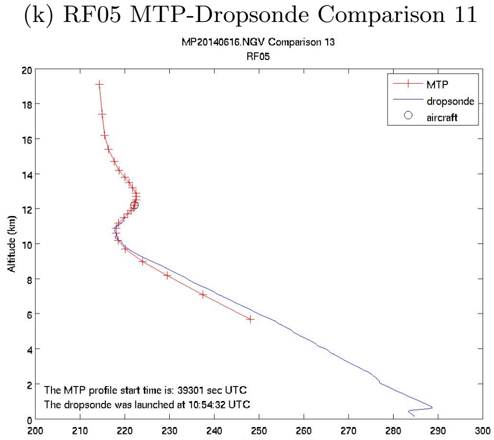
(j) RF05 MTP-Dropsonde Comparison 10



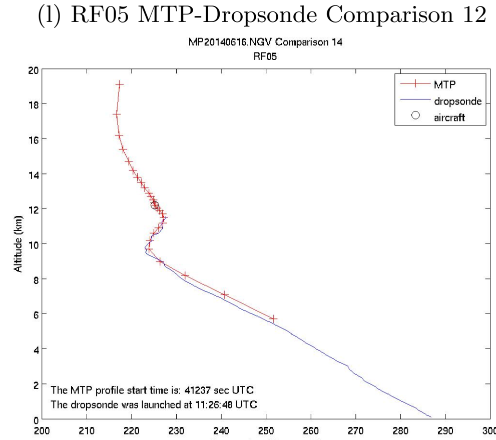
(k) RF05 MTP-Dropsonde Comparison 11



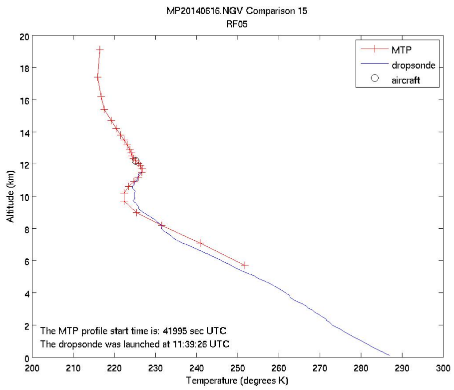
(l) RF05 MTP-Dropsonde Comparison 12



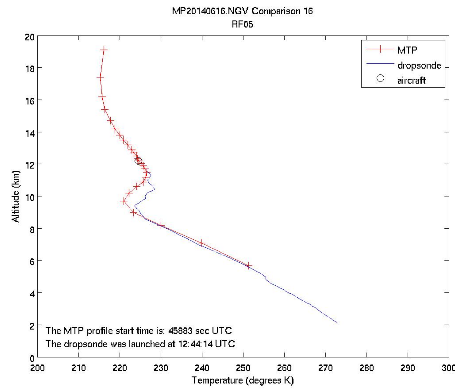
(m) RF05 MTP-Dropsonde Comparison 13



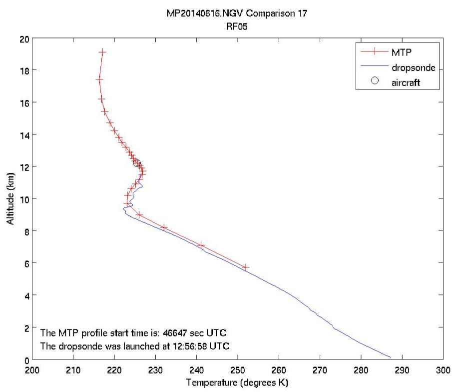
(n) RF05 MTP-Dropsonde Comparison 14



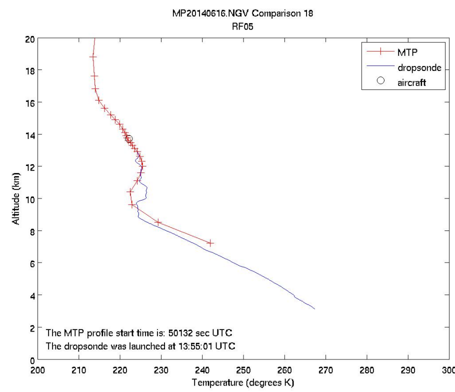
(o) RF05 MTP-Dropsonde Comparison 15



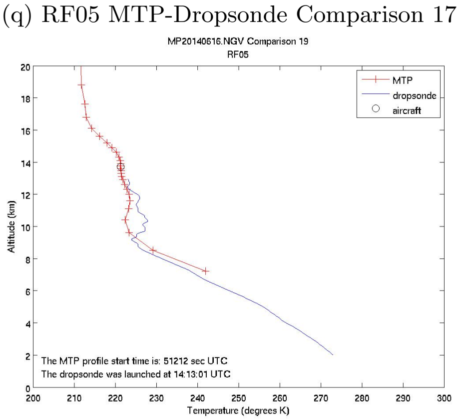
(p) RF05 MTP-Dropsonde Comparison 16



(q) RF05 MTP-Dropsonde Comparison 17



(r) RF05 MTP-Dropsonde Comparison 18



(s) RF05 MTP-Dropsonde Comparison 19

Figure 10: RF05 MTP-Dropsonde Comparisons

1.6 RF06

Tasman Sea flight with "V" formation flown over Tasmania.

Retrieval quality is more variable on this flight. The tropopause height appears to shift abruptly between 11 and 12 km in the period between 33-35 ksec UTC. Dropsondes confirm the rapidly changing temperature structure during this time period (Figure 11).

See Figure 12 for RF06 MTP-Dropsonde comparisons.

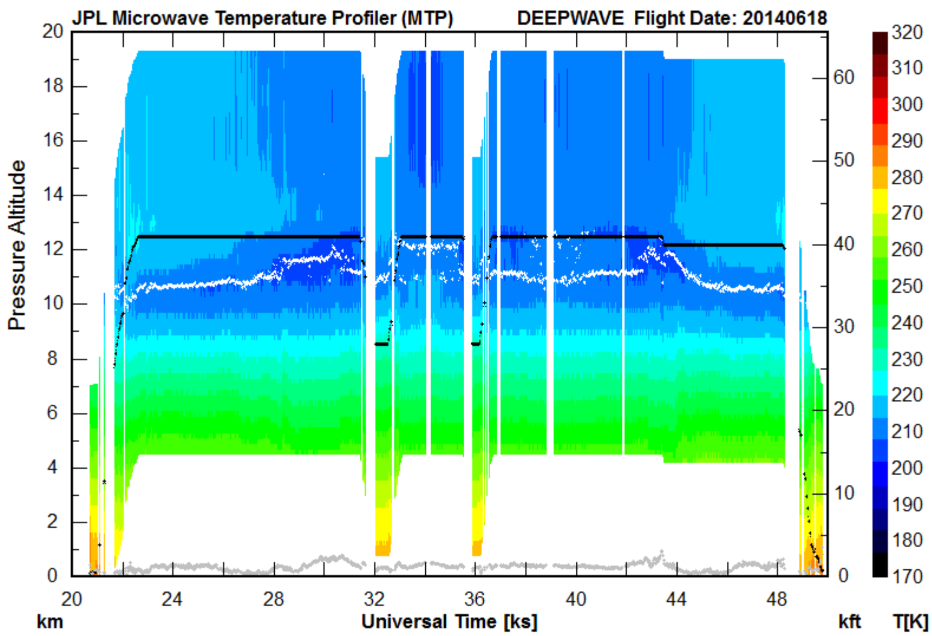
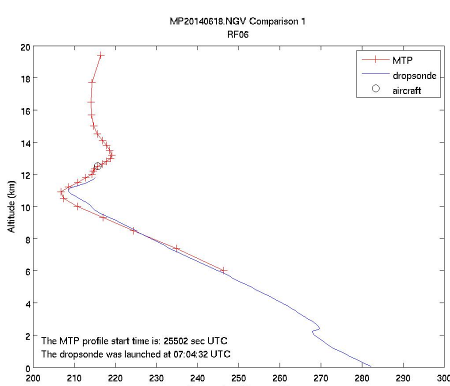
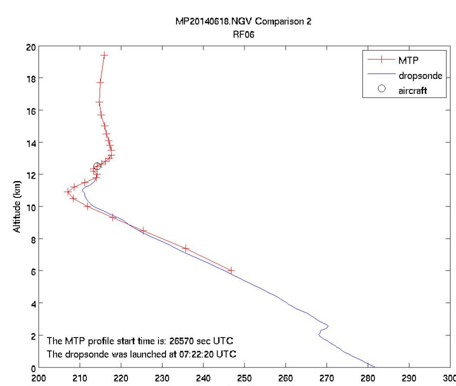


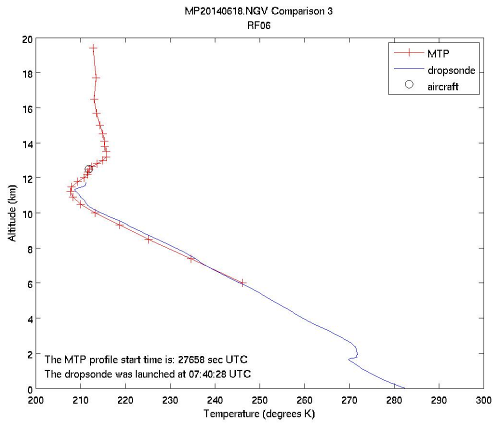
Figure 11: CTC Plot from Research flight 6 on June 18, 2014



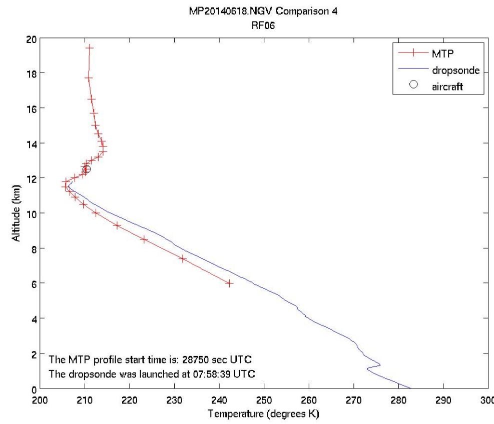
(a) RF06 MTP-Dropsonde Comparison 1



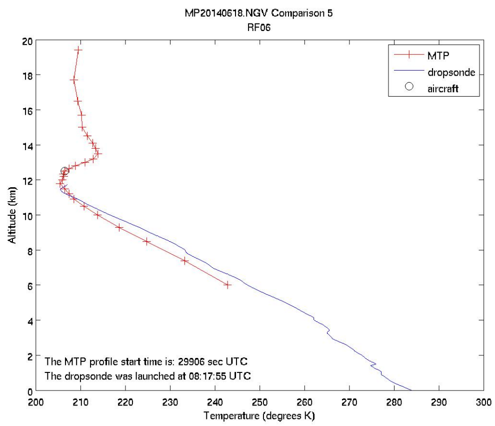
(b) RF06 MTP-Dropsonde Comparison 2



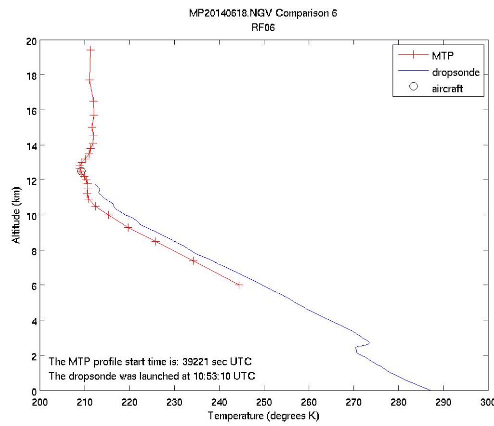
(c) RF06 MTP-Dropsonde Comparison 3



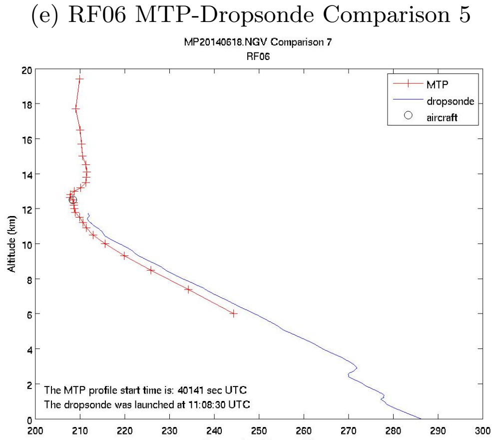
(d) RF06 MTP-Dropsonde Comparison 4



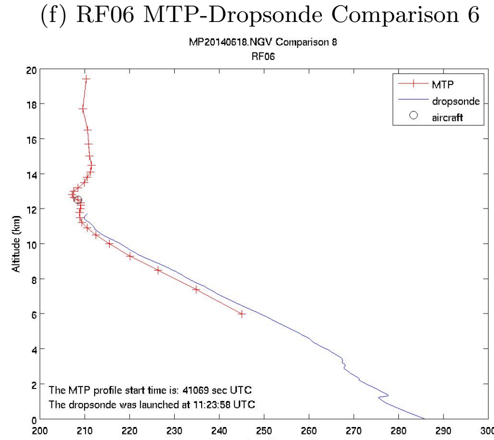
(e) RF06 MTP-Dropsonde Comparison 5



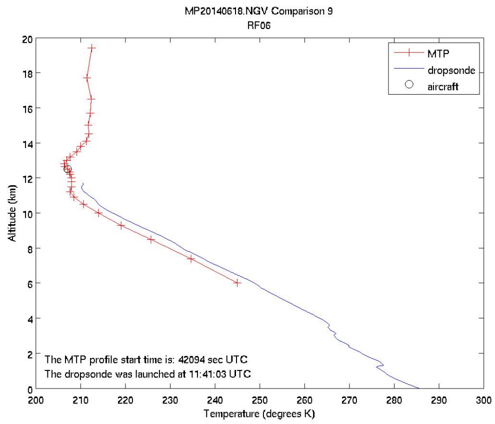
(f) RF06 MTP-Dropsonde Comparison 6



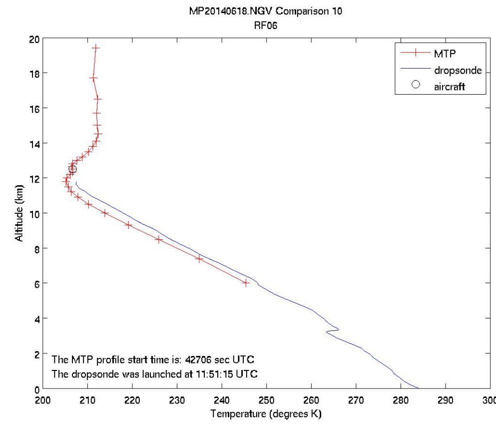
(g) RF06 MTP-Dropsonde Comparison 7



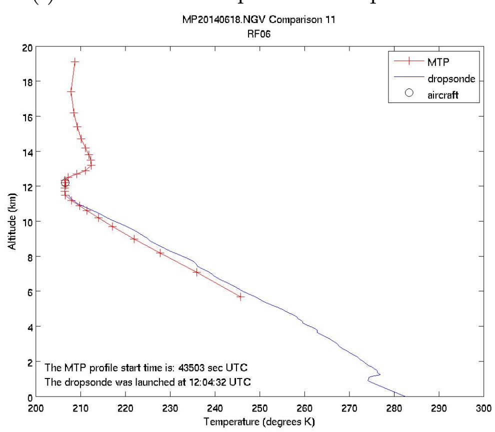
(h) RF06 MTP-Dropsonde Comparison 8



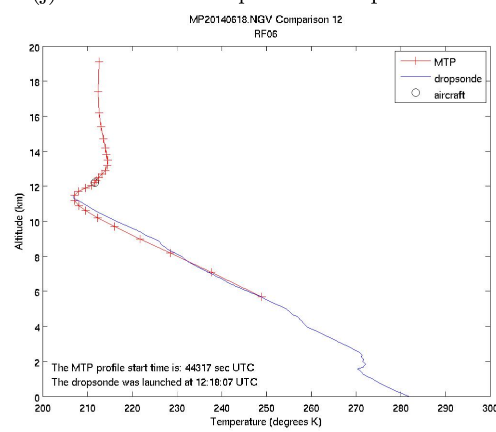
(i) RF06 MTP-Dropsonde Comparison 9



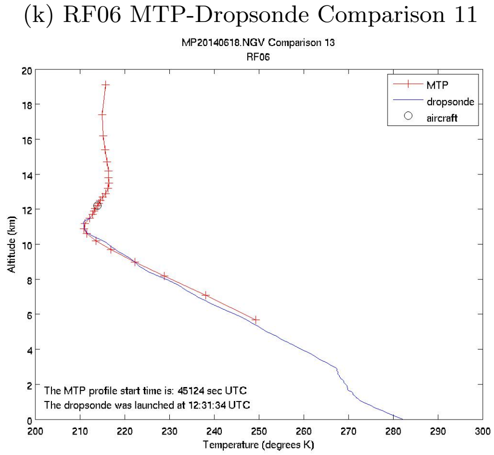
(j) RF06 MTP-Dropsonde Comparison 10



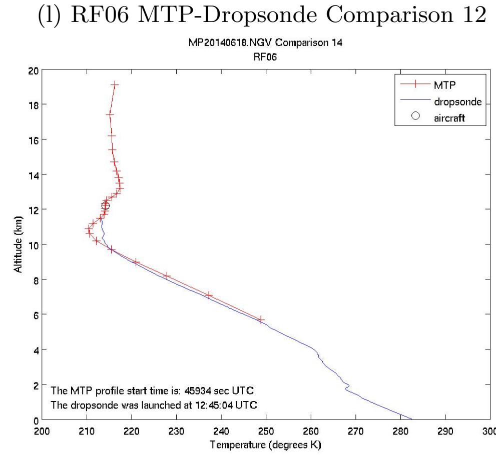
(k) RF06 MTP-Dropsonde Comparison 11



(l) RF06 MTP-Dropsonde Comparison 12



(m) RF06 MTP-Dropsonde Comparison 13



(n) RF06 MTP-Dropsonde Comparison 14

Figure 12: RF06 MTP-Dropsonde Comparisons

1.7 RF07

Rectangular pattern aligned with mountains downstream of island.

Good retrievals showing longer period waves in the temperature field (Figure 13).

See Figure 14 for RF07 MTP-Dropsonde comparisons.

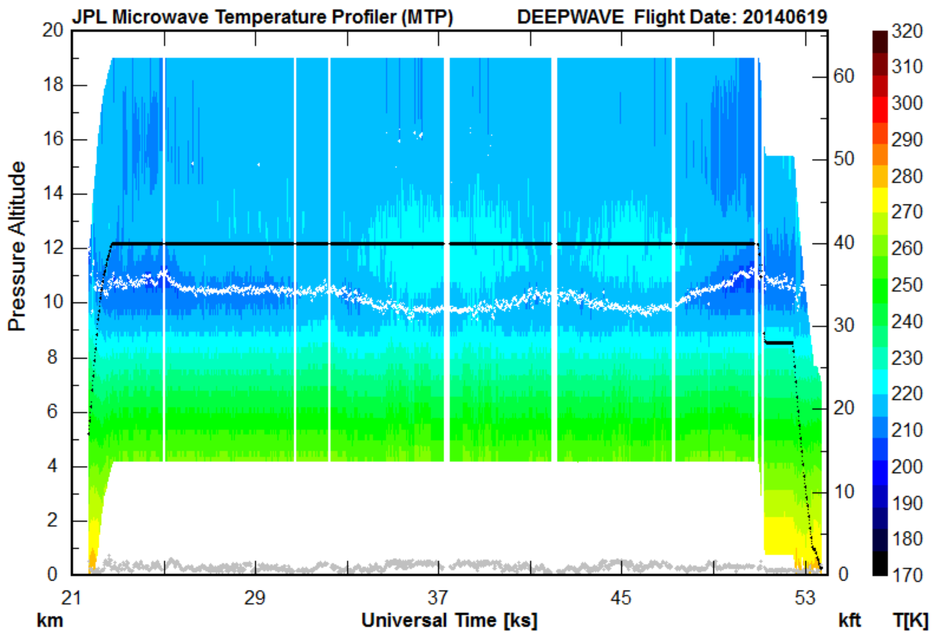
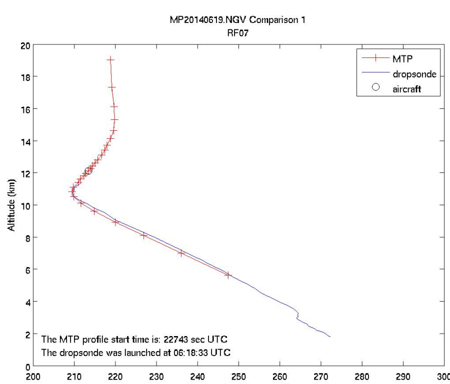
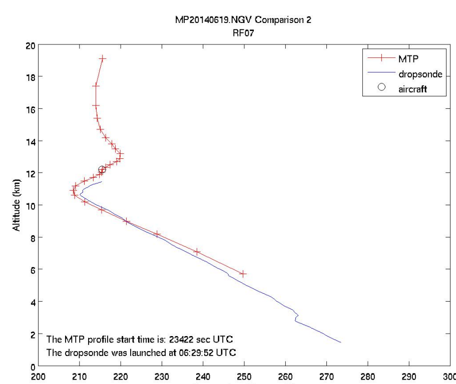


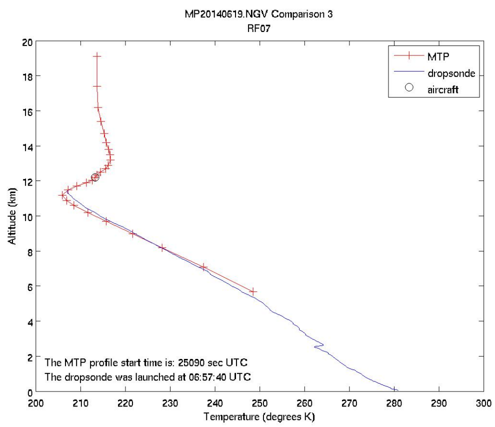
Figure 13: CTC Plot from Research flight 7 on June 19, 2014



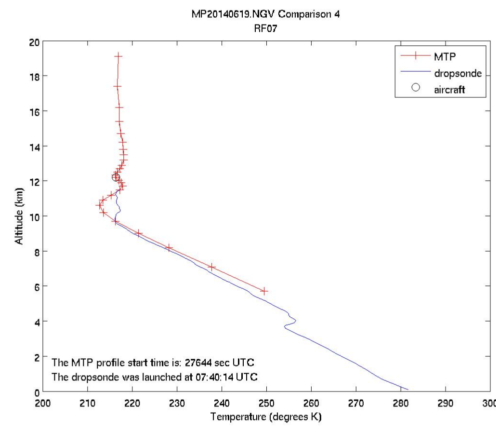
(a) RF07 MTP-Dropsonde Comparison 1



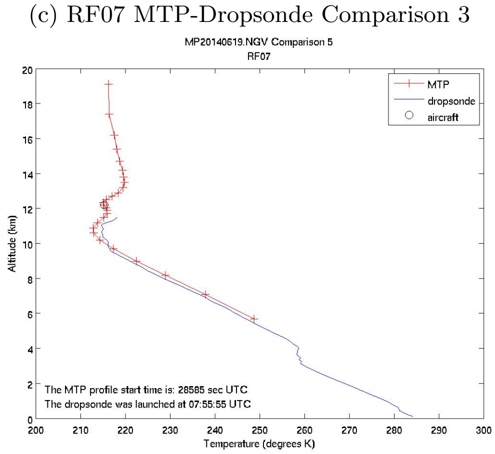
(b) RF07 MTP-Dropsonde Comparison 2



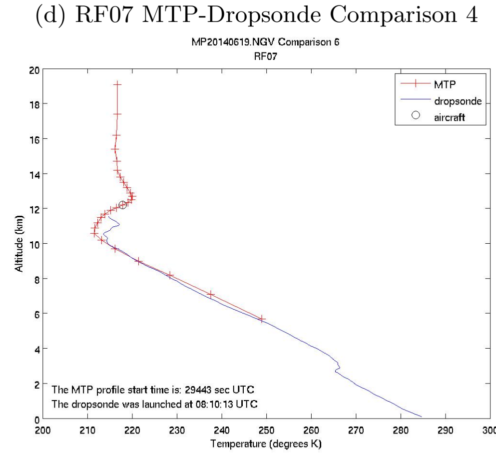
(c) RF07 MTP-Dropsonde Comparison 3



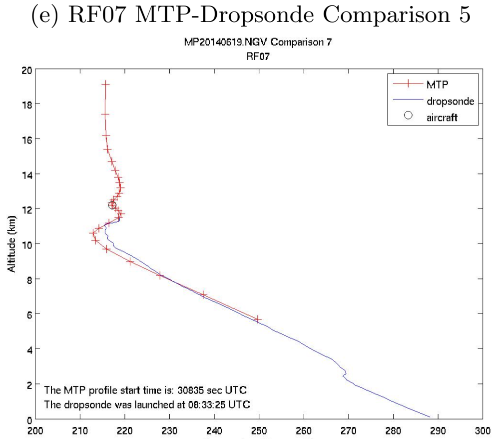
(d) RF07 MTP-Dropsonde Comparison 4



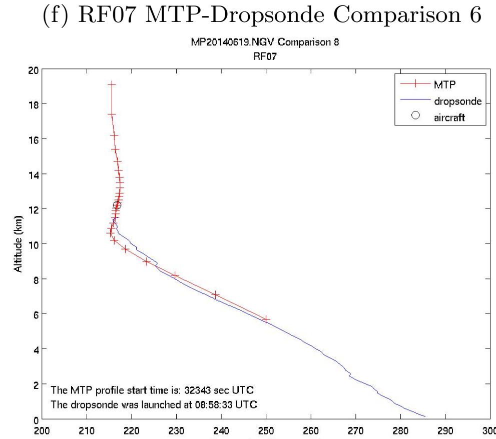
(e) RF07 MTP-Dropsonde Comparison 5



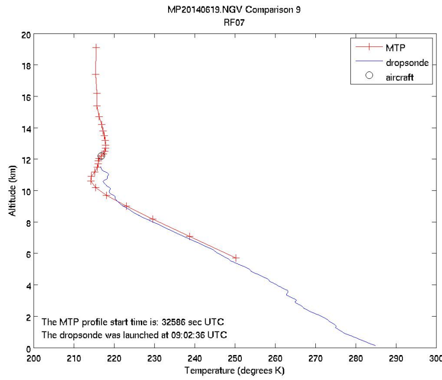
(f) RF07 MTP-Dropsonde Comparison 6



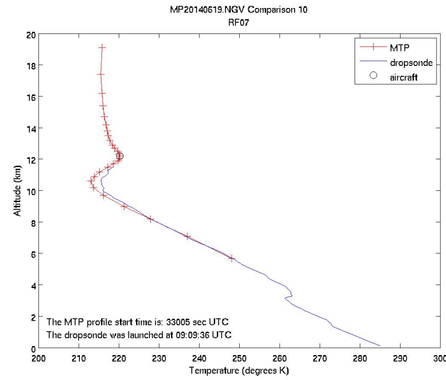
(g) RF07 MTP-Dropsonde Comparison 7



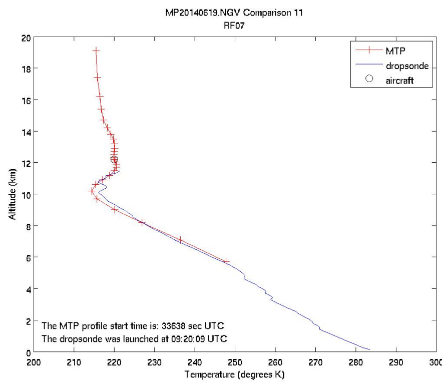
(h) RF07 MTP-Dropsonde Comparison 8



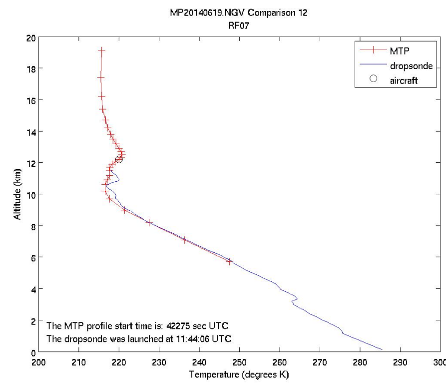
(i) RF07 MTP-Dropsonde Comparison 9



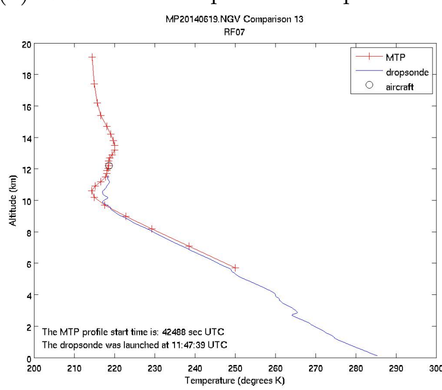
(j) RF07 MTP-Dropsonde Comparison 10



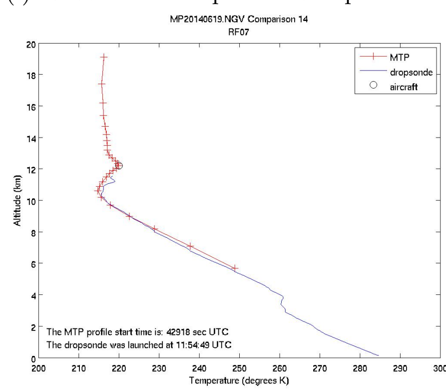
(k) RF07 MTP-Dropsonde Comparison 11



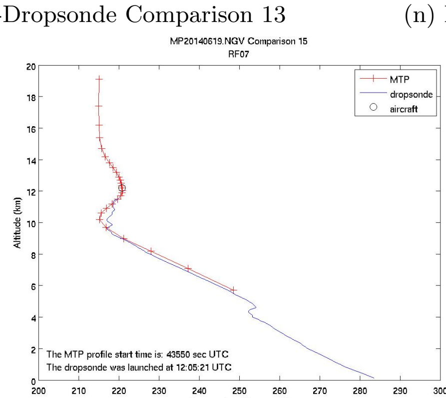
(l) RF07 MTP-Dropsonde Comparison 12



(m) RF07 MTP-Dropsonde Comparison 13



(n) RF07 MTP-Dropsonde Comparison 14



(o) RF07 MTP-Dropsonde Comparison 15

Figure 14: RF07 MTP-Dropsonde Comparisons

1.8 RF08

Mt Aspiring track with multiple cross mountain passes and one downstream trailing leg.

MTP retrievals for this flight are very good, and profiles agree well with dropsonde temperature profiles (Figure 15).

See Figure 16 for RF08 MTP-Dropsonde comparisons.

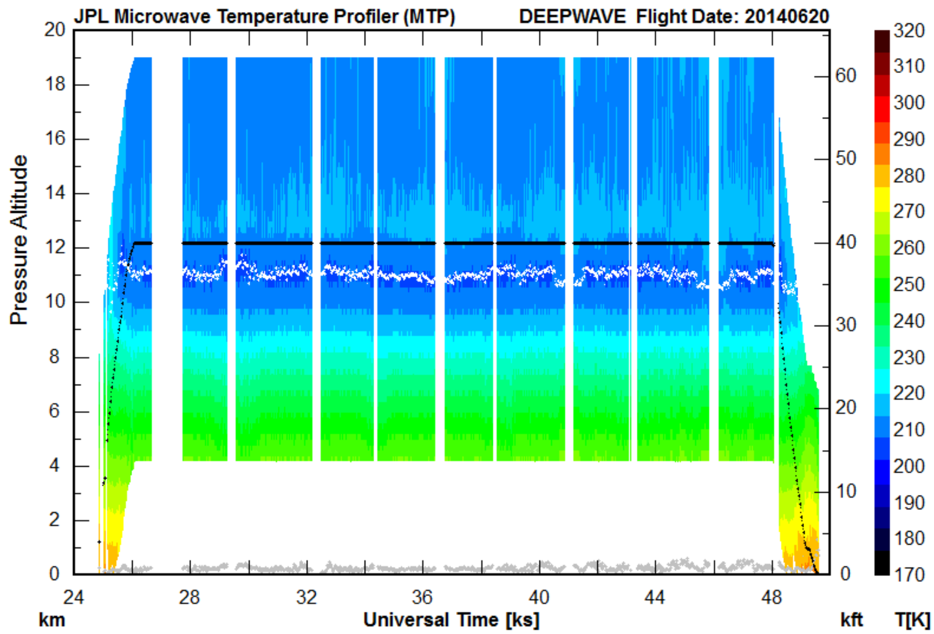
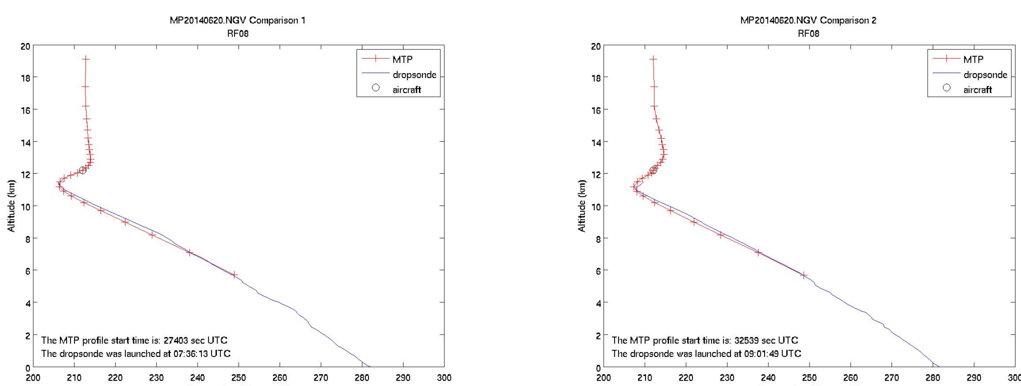
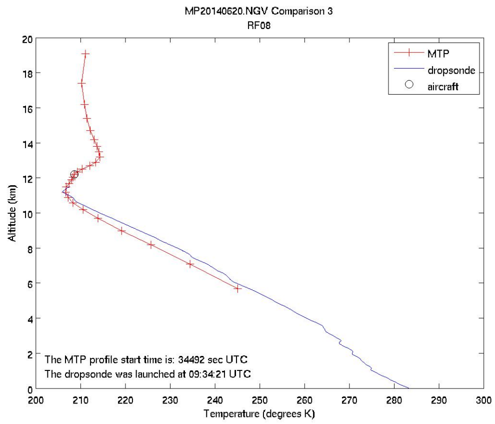


Figure 15: CTC Plot from Research flight 8 on June 20, 2014

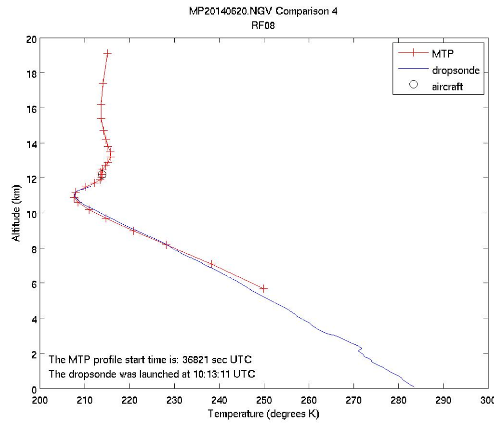


(a) RF08 MTP-Dropsonde Comparison 1

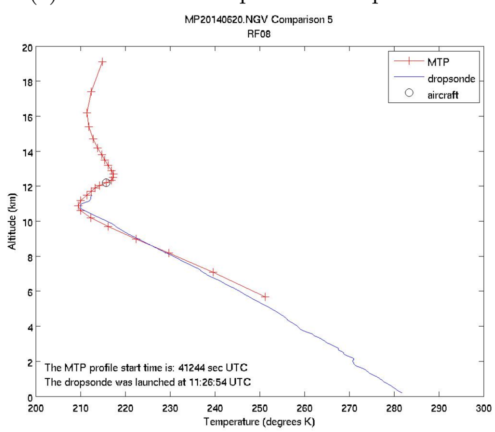
(b) RF08 MTP-Dropsonde Comparison 2



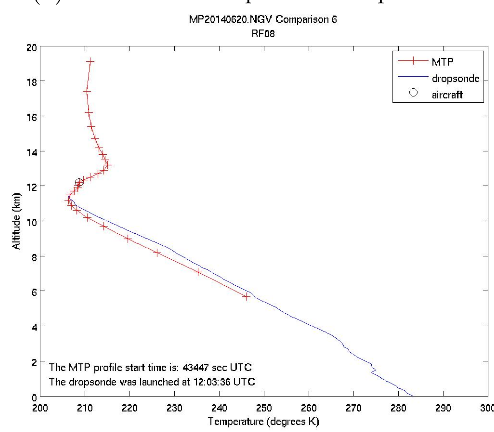
(c) RF08 MTP-Dropsonde Comparison 3



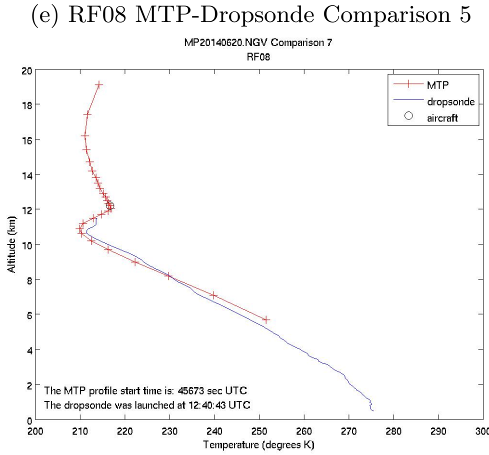
(d) RF08 MTP-Dropsonde Comparison 4



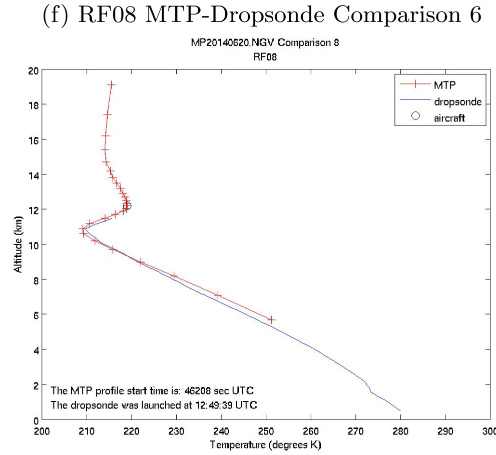
(e) RF08 MTP-Dropsonde Comparison 5



(f) RF08 MTP-Dropsonde Comparison 6



(g) RF08 MTP-Dropsonde Comparison 7



(h) RF08 MTP-Dropsonde Comparison 8

Figure 16: RF08 MTP-Dropsonde Comparisons

1.9 RF09

Mt Aspiring cross island track with legs parallel to the coast both upstream and downstream. Cross island legs showed smooth periodic waves.

MTP retrievals are of good quality and reflect the periodic variation in temperature structure. (Figure 17).

See Figure 18 for RF09 MTP-Dropsonde comparisons.

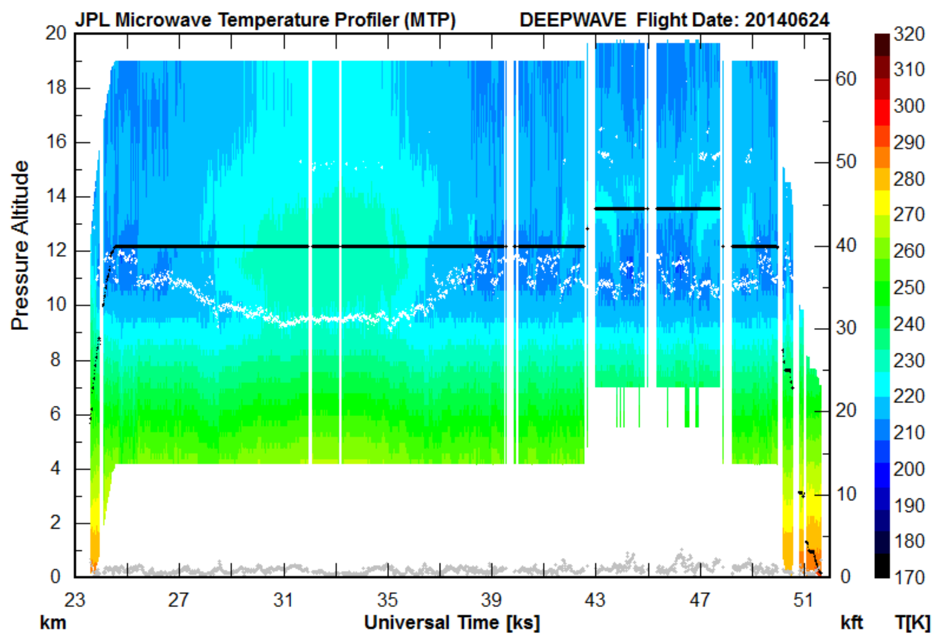
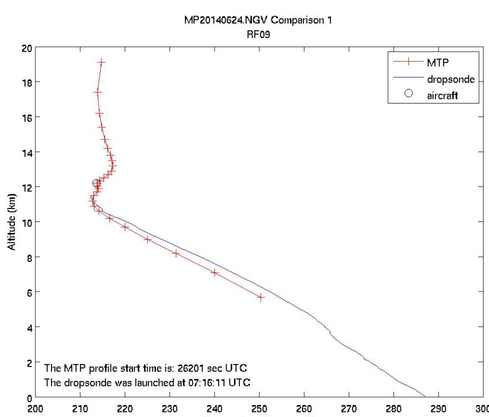
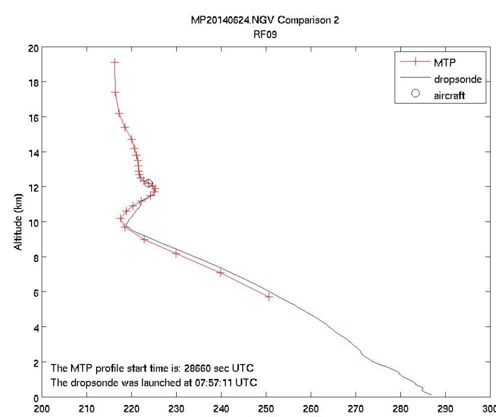


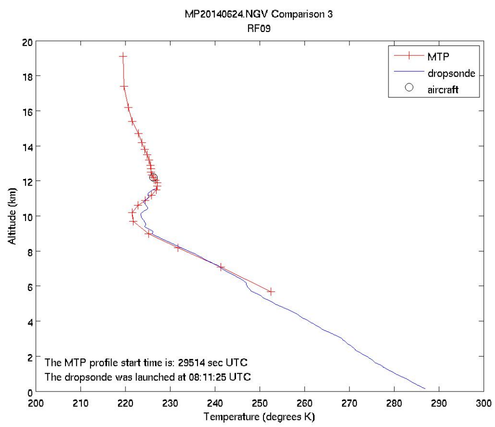
Figure 17: CTC Plot from Research Flight 9 on June 24, 2014



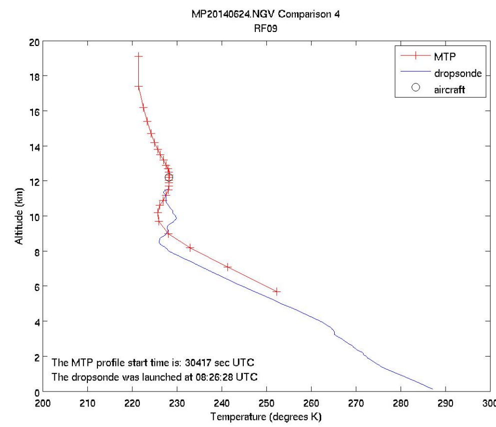
(a) RF09 MTP-Dropsonde Comparison 1



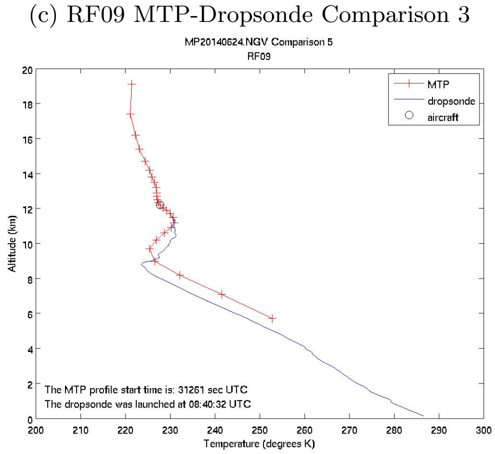
(b) RF09 MTP-Dropsonde Comparison 2



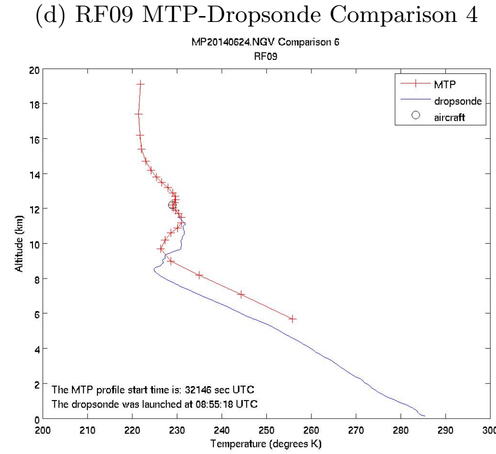
(c) RF09 MTP-Dropsonde Comparison 3



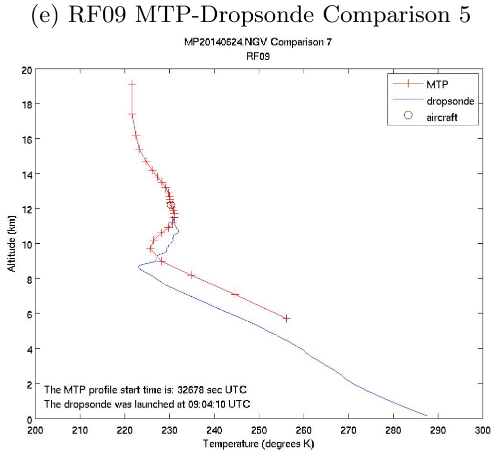
(d) RF09 MTP-Dropsonde Comparison 4



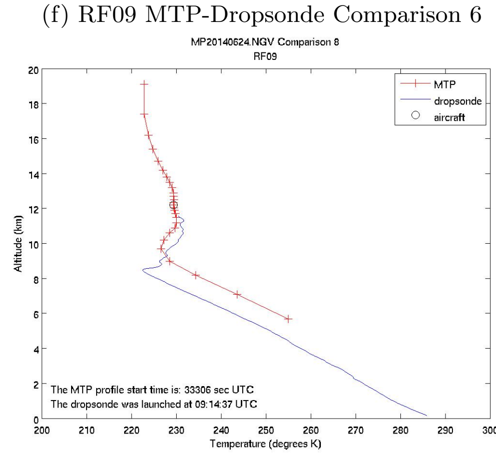
(e) RF09 MTP-Dropsonde Comparison 5



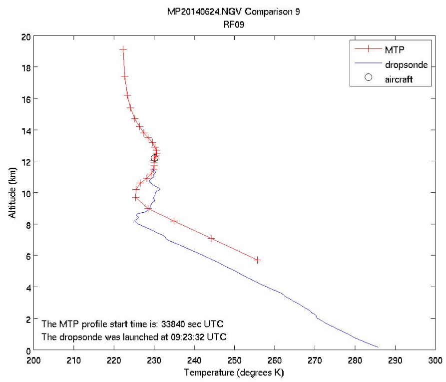
(f) RF09 MTP-Dropsonde Comparison 6



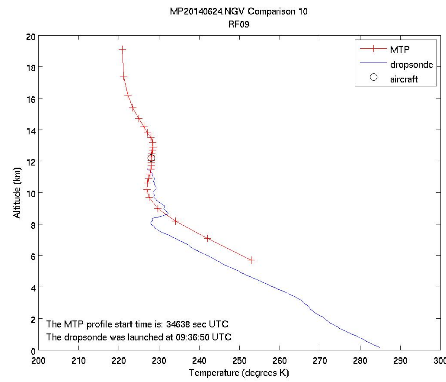
(g) RF09 MTP-Dropsonde Comparison 7



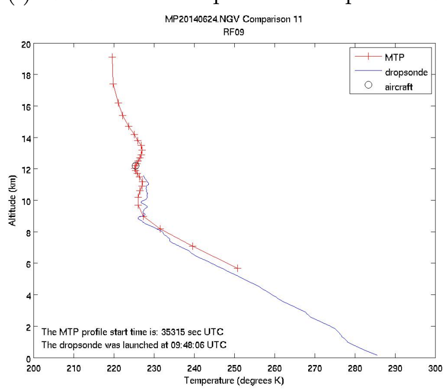
(h) RF09 MTP-Dropsonde Comparison 8



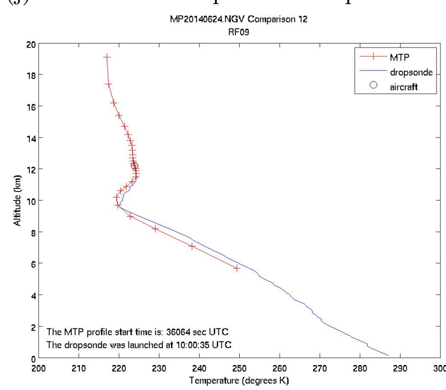
(i) RF09 MTP-Dropsonde Comparison 9



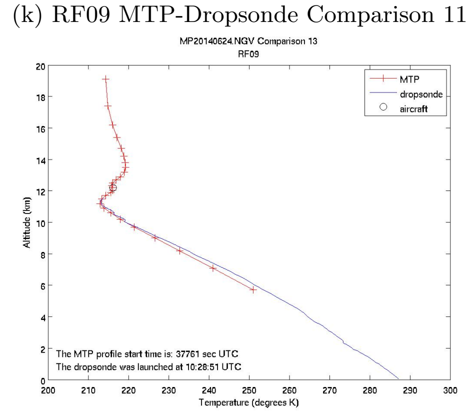
(j) RF09 MTP-Dropsonde Comparison 10



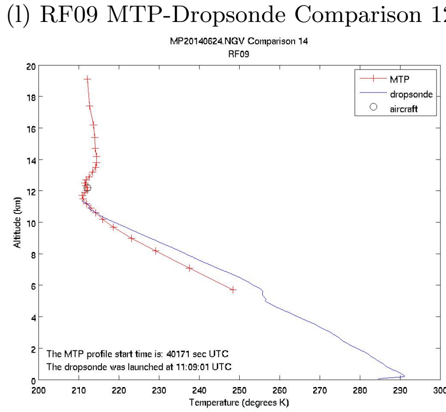
(k) RF09 MTP-Dropsonde Comparison 11



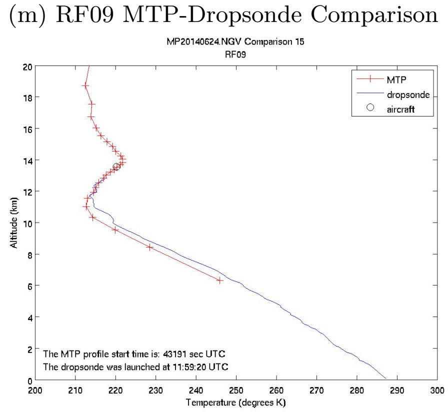
(l) RF09 MTP-Dropsonde Comparison 12



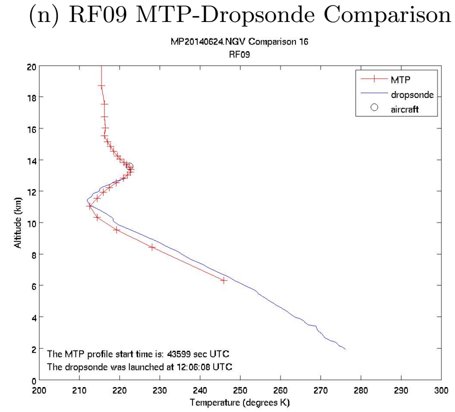
(m) RF09 MTP-Dropsonde Comparison 13



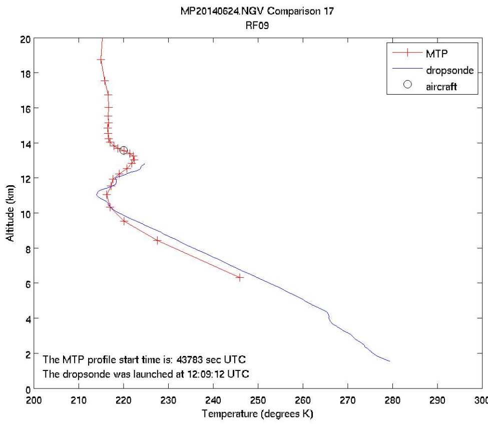
(n) RF09 MTP-Dropsonde Comparison 14



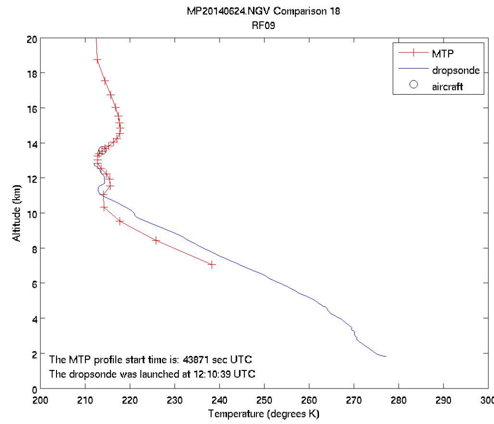
(o) RF09 MTP-Dropsonde Comparison 15



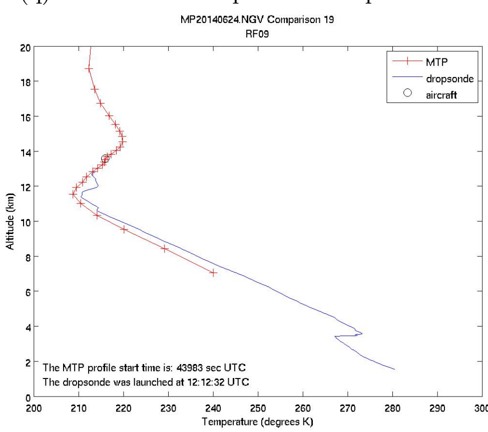
(p) RF09 MTP-Dropsonde Comparison 16



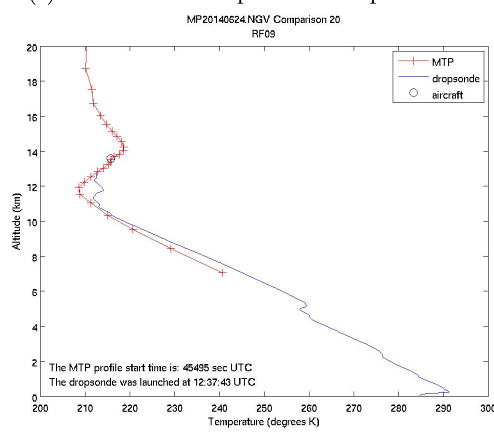
(q) RF09 MTP-Dropsonde Comparison 17



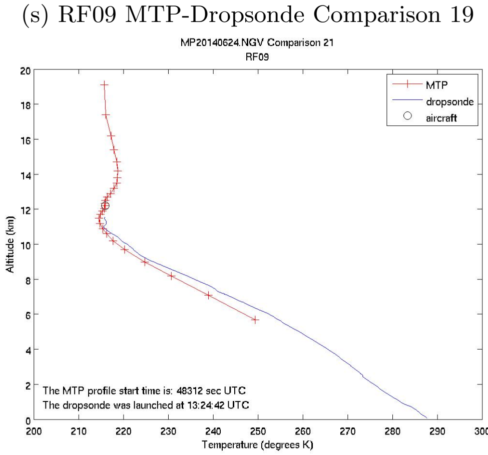
(r) RF09 MTP-Dropsonde Comparison 18



(s) RF09 MTP-Dropsonde Comparison 19



(t) RF09 MTP-Dropsonde Comparison 20



(u) RF09 MTP-Dropsonde Comparison 21

Figure 18: RF09 MTP-Dropsonde Comparisons

1.10 RF10

Research Flight 10 on June 25, 2014 pending re-calibration.

1.11 RF11

Predictability triangle over Tasman Sea with Mt Cook for outbound and inbound cross mountain legs. Calibration maneuvers (yaw, pitch, roll) performed.

Curtain plot shows transition from mid-latitude tropopause heights to tropical tropopause heights during the northern-most portion of the flight. Agreement with dropsonde profiles is good, although height of the tropopause cannot be verified when it is above flight level (Figure 19).

See Figure 20 for RF11 MTP-Dropsonde comparisons.

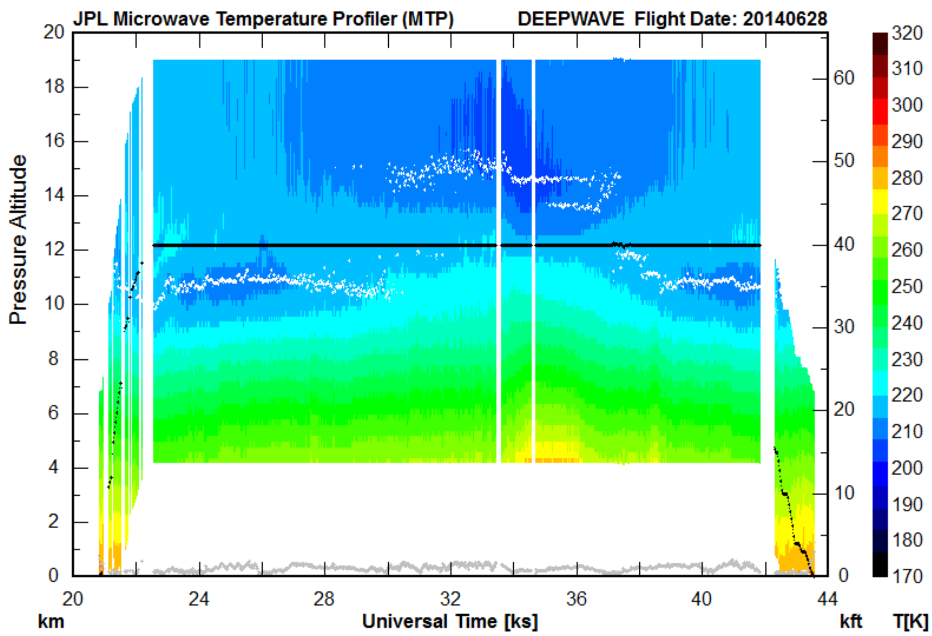
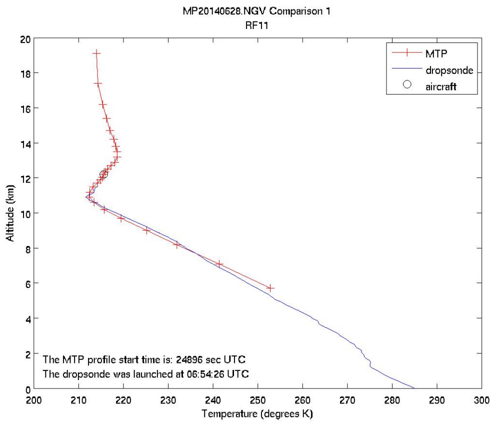
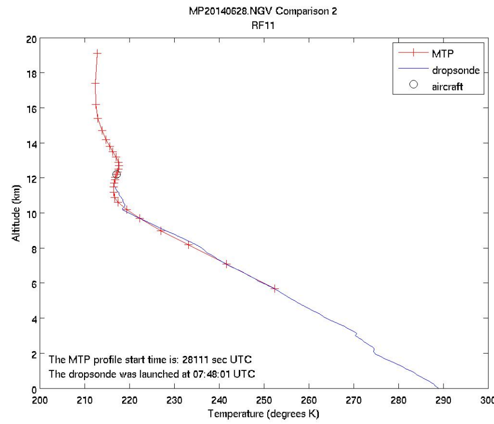


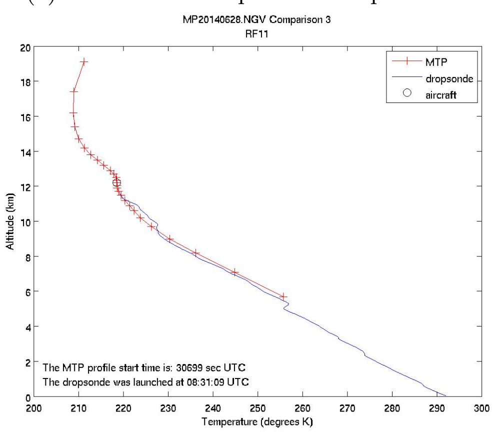
Figure 19: CTC Plot from Research Flight 11 on June 28, 2014



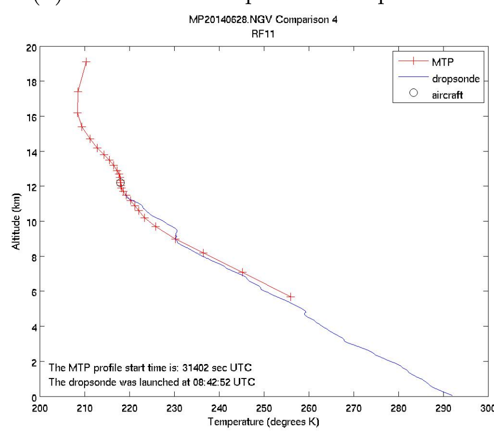
(a) RF11 MTP-Dropsonde Comparison 1



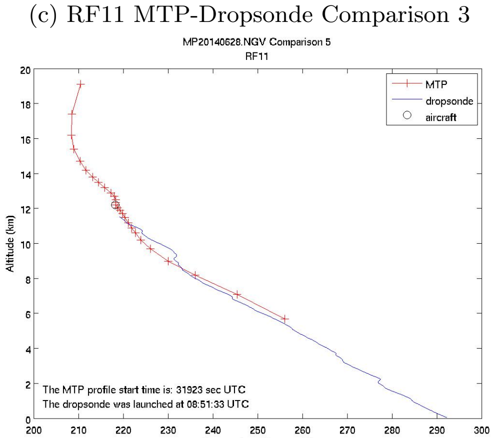
(b) RF11 MTP-Dropsonde Comparison 2



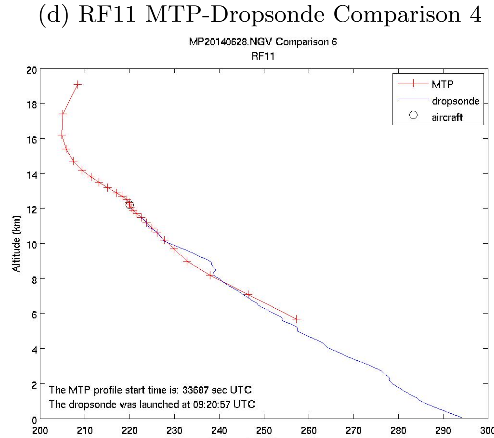
(c) RF11 MTP-Dropsonde Comparison 3



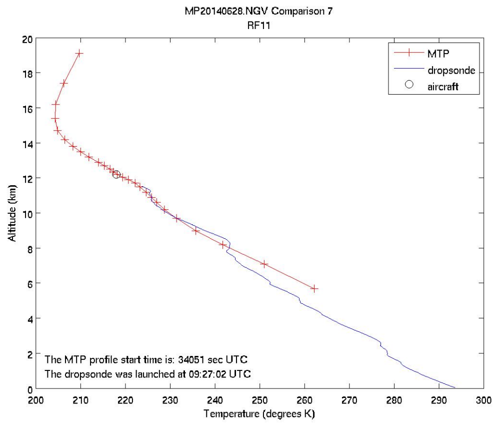
(d) RF11 MTP-Dropsonde Comparison 4



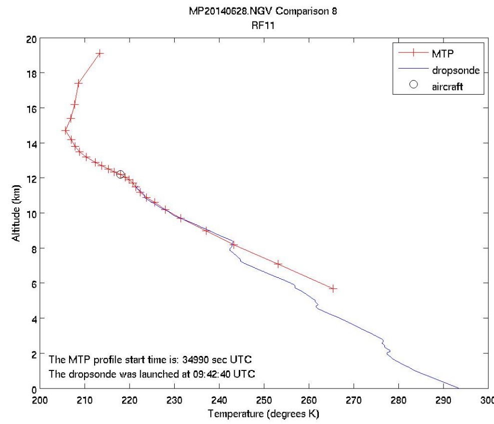
(e) RF11 MTP-Dropsonde Comparison 5



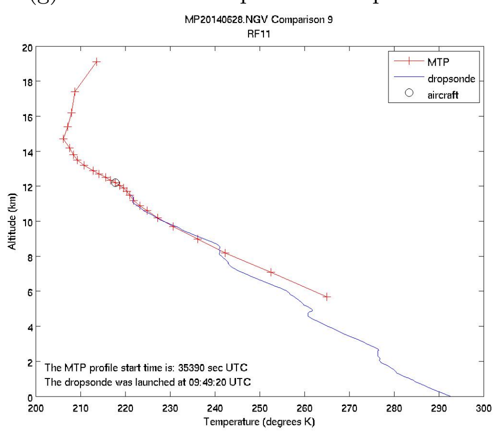
(f) RF11 MTP-Dropsonde Comparison 6



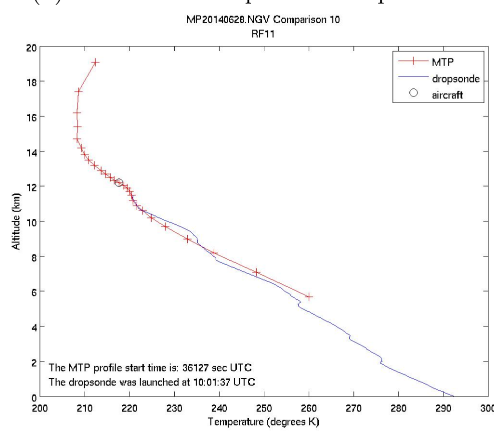
(g) RF11 MTP-Dropsonde Comparison 7



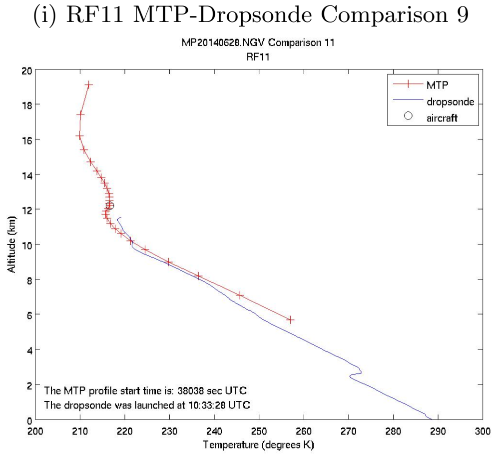
(h) RF11 MTP-Dropsonde Comparison 8



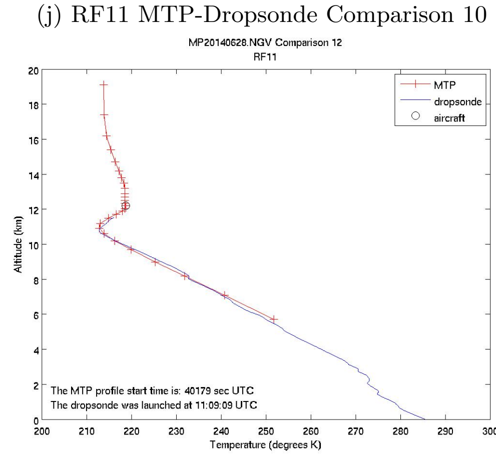
(i) RF11 MTP-Dropsonde Comparison 9



(j) RF11 MTP-Dropsonde Comparison 10



(k) RF11 MTP-Dropsonde Comparison 11



(l) RF11 MTP-Dropsonde Comparison 12

Figure 20: RF11 MTP-Dropsonde Comparisons

1.12 RF12

Mt Aspiring cross island track with legs parallel to the coast both upstream and downstream. Cross island legs showed smooth periodic waves.

MTP retrievals are of good quality and reflect the periodic variation in temperature structure. (Figure 21).

See Figure 22 for RF12 MTP-Dropsonde comparisons.

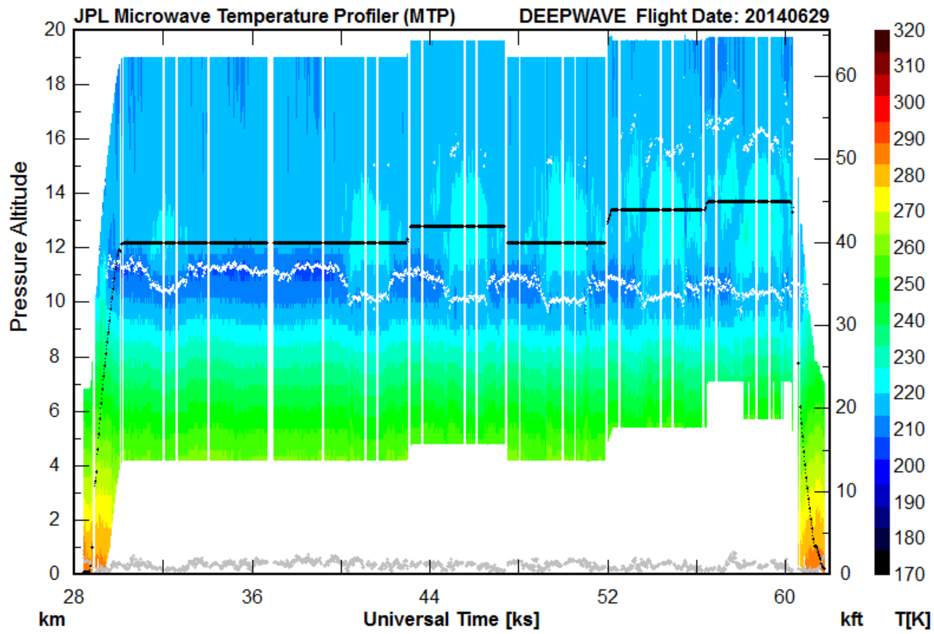
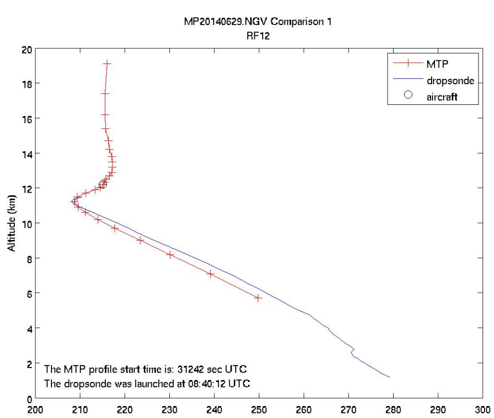
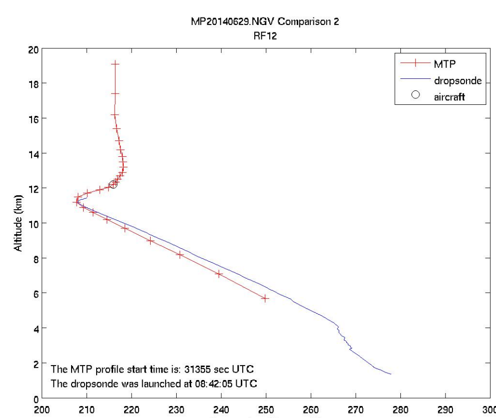


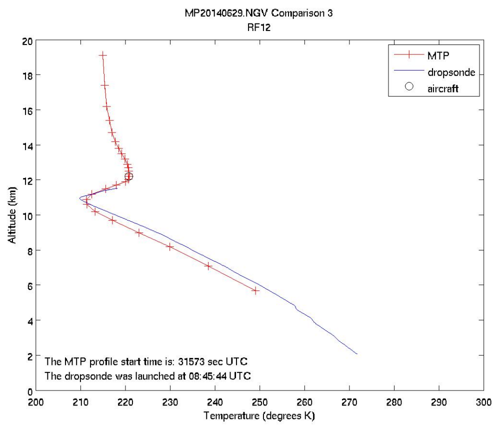
Figure 21: CTC Plot from Research Flight 12 on June 24, 2014



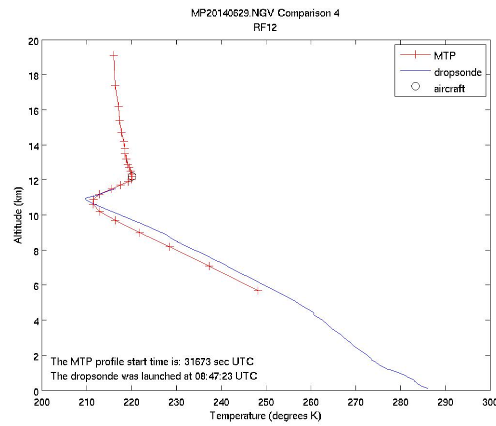
(a) RF12 MTP-Dropsonde Comparison 1



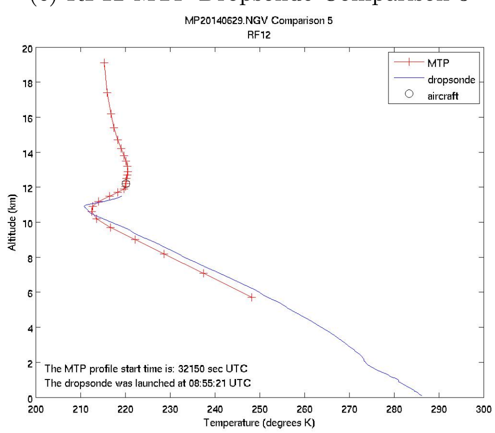
(b) RF12 MTP-Dropsonde Comparison 2



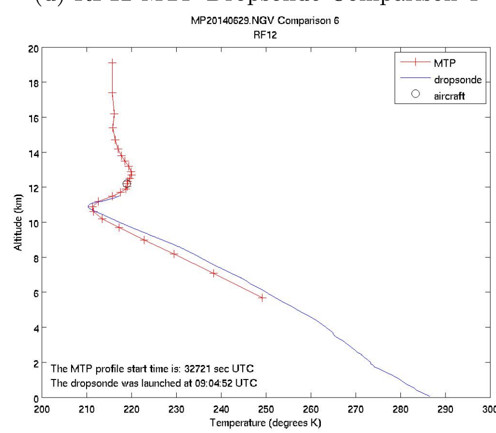
(c) RF12 MTP-Dropsonde Comparison 3



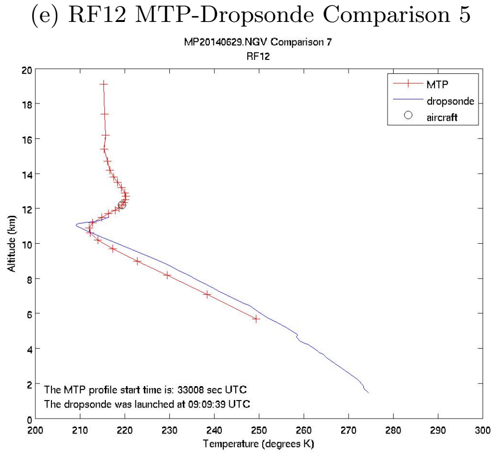
(d) RF12 MTP-Dropsonde Comparison 4



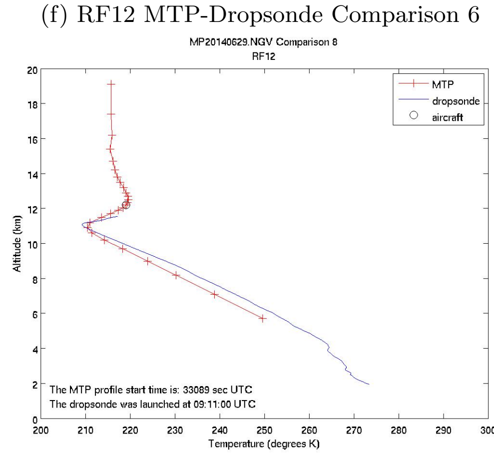
(e) RF12 MTP-Dropsonde Comparison 5



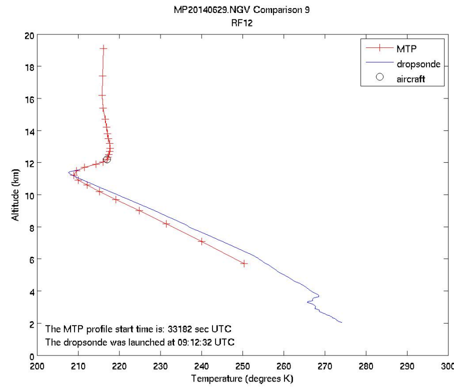
(f) RF12 MTP-Dropsonde Comparison 6



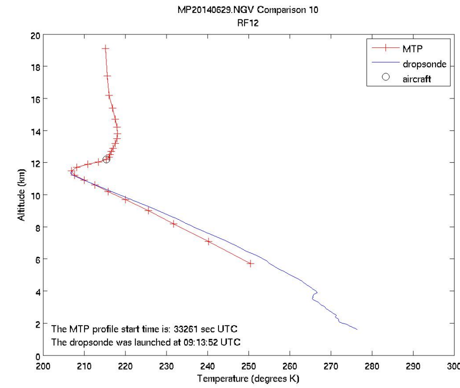
(g) RF12 MTP-Dropsonde Comparison 7



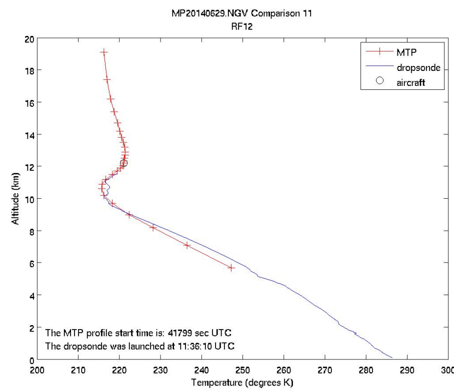
(h) RF12 MTP-Dropsonde Comparison 8



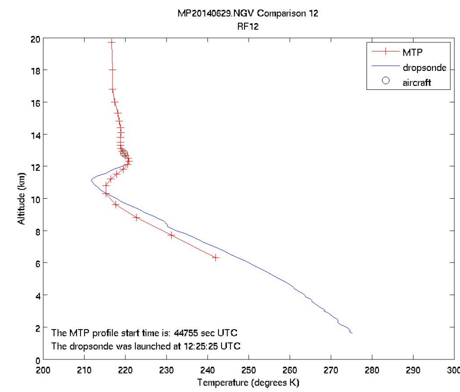
(i) RF12 MTP-Dropsonde Comparison 9



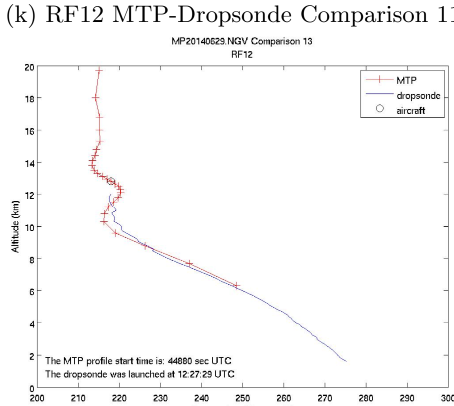
(j) RF12 MTP-Dropsonde Comparison 10



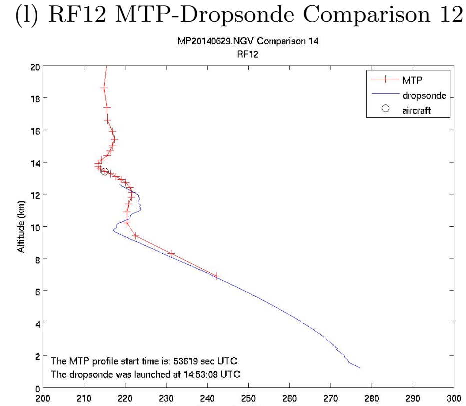
(k) RF12 MTP-Dropsonde Comparison 11



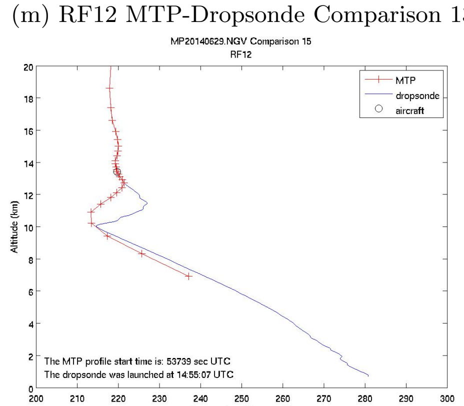
(l) RF12 MTP-Dropsonde Comparison 12



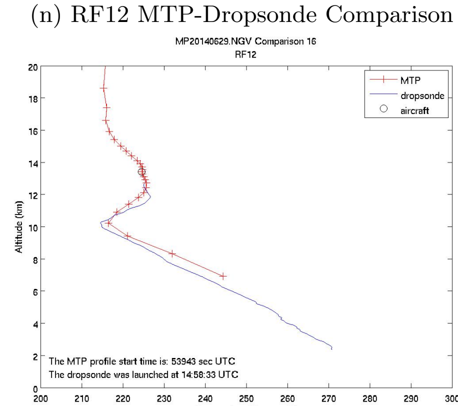
(m) RF12 MTP-Dropsonde Comparison 13



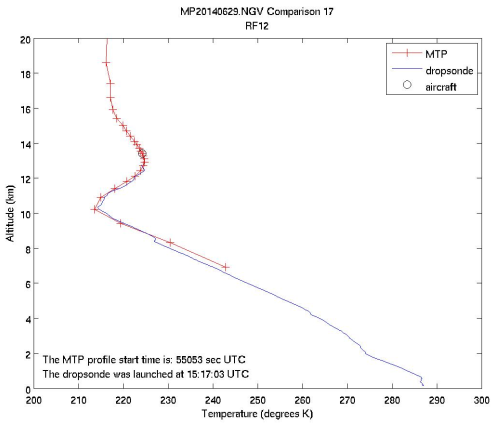
(n) RF12 MTP-Dropsonde Comparison 14



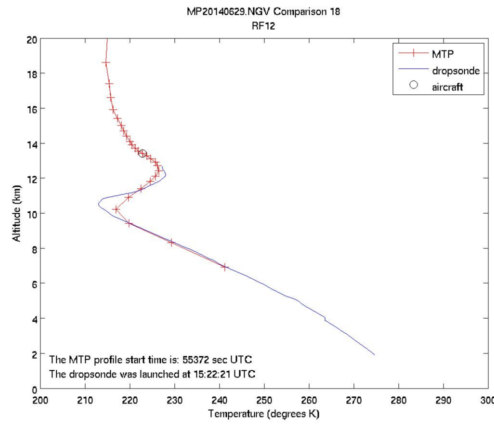
(o) RF12 MTP-Dropsonde Comparison 15



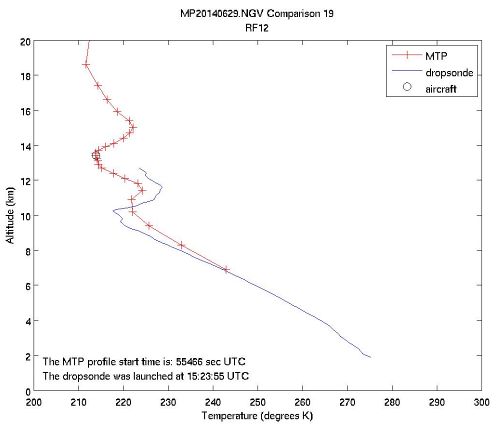
(p) RF12 MTP-Dropsonde Comparison 16



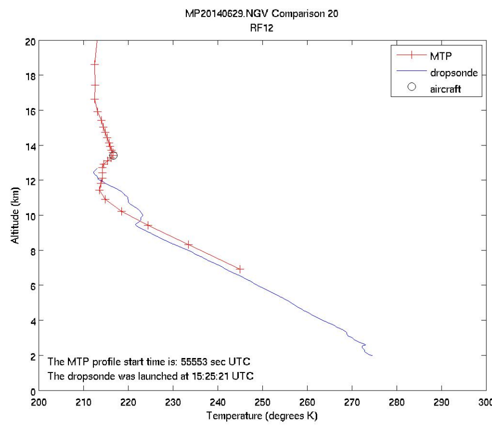
(q) RF12 MTP-Dropsonde Comparison 17



(r) RF12 MTP-Dropsonde Comparison 18



(s) RF12 MTP-Dropsonde Comparison 19



(t) RF12 MTP-Dropsonde Comparison 20

Figure 22: RF12 MTP-Dropsonde Comparisons

1.13 RF13

Rectangular track crossing island at Mt Cook and Mt Aspiring; one trailing leg downstream of island.

Retrieval quality varies a bit on this flight. The rise in mean tropopause height during the higher flight level leg may be an artifact of the retrieval method (Figure 23).

See Figure 24 for RF13 MTP-Dropsonde comparisons.

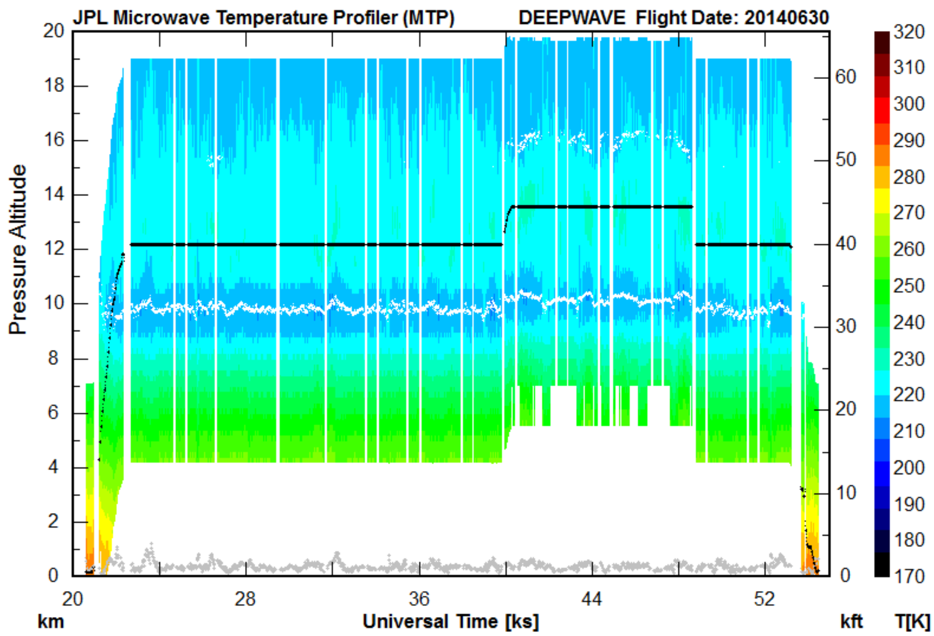
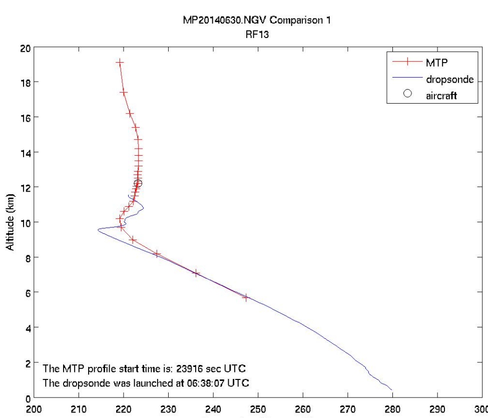
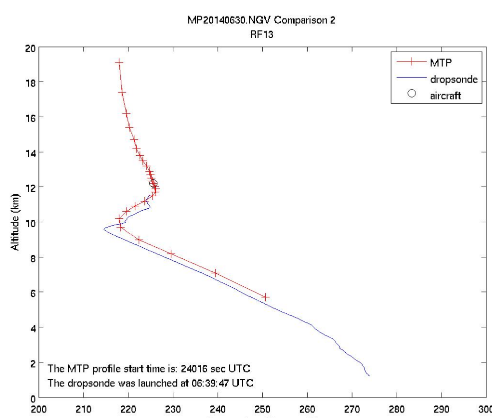


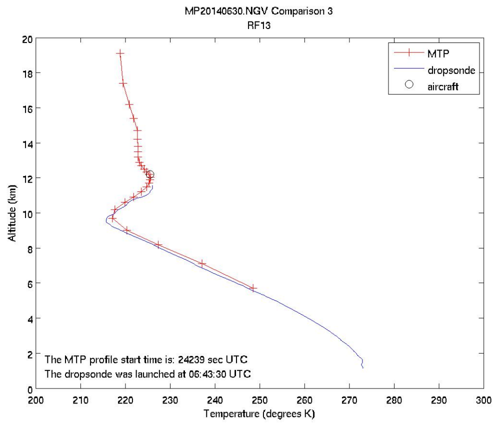
Figure 23: CTC Plot from Research Flight 13 on June 30, 2014



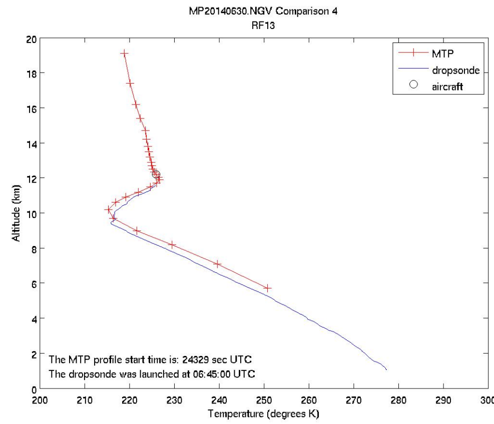
(a) RF13 MTP-Dropsonde Comparison 1



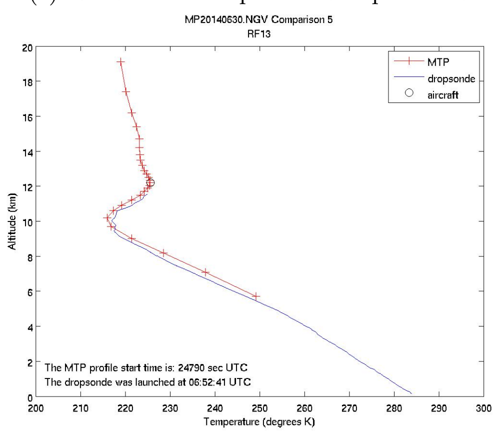
(b) RF13 MTP-Dropsonde Comparison 2



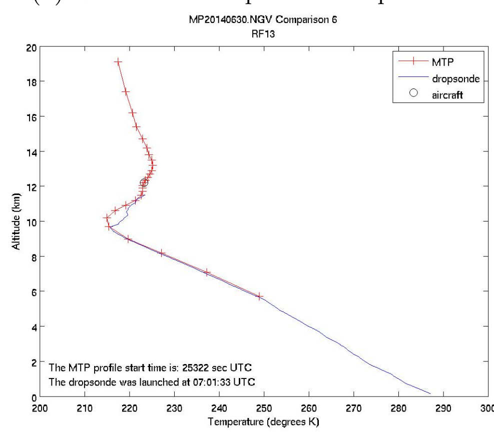
(c) RF13 MTP-Dropsonde Comparison 3



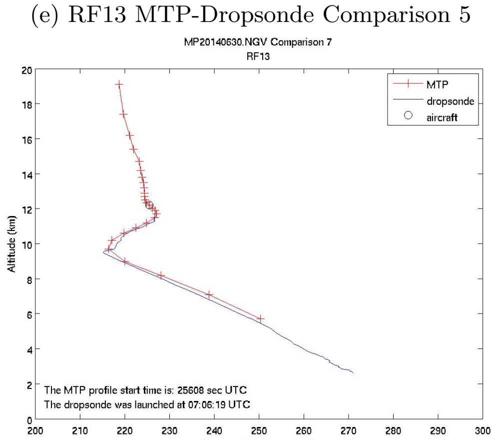
(d) RF13 MTP-Dropsonde Comparison 4



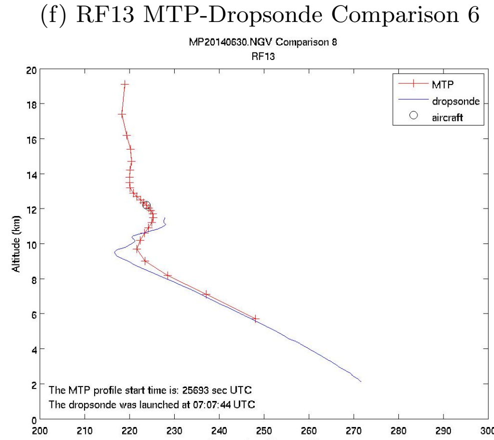
(e) RF13 MTP-Dropsonde Comparison 5



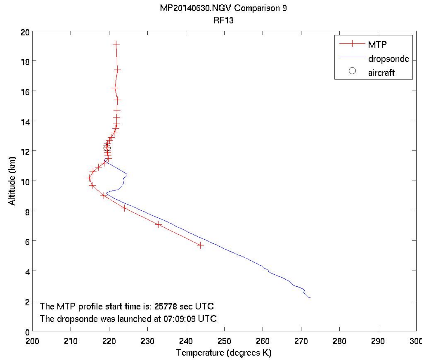
(f) RF13 MTP-Dropsonde Comparison 6



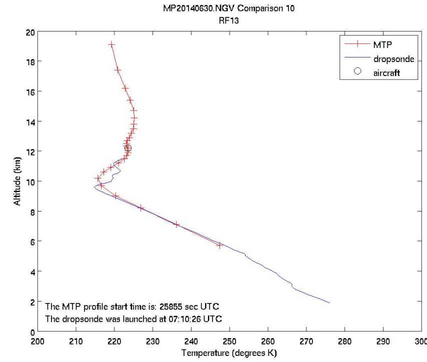
(g) RF13 MTP-Dropsonde Comparison 7



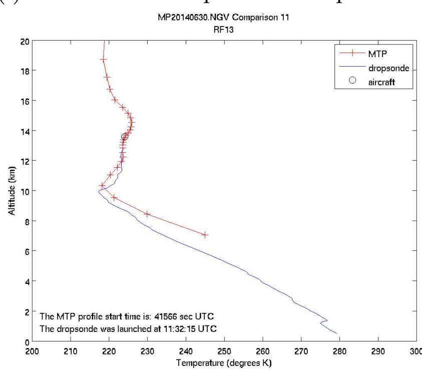
(h) RF13 MTP-Dropsonde Comparison 8



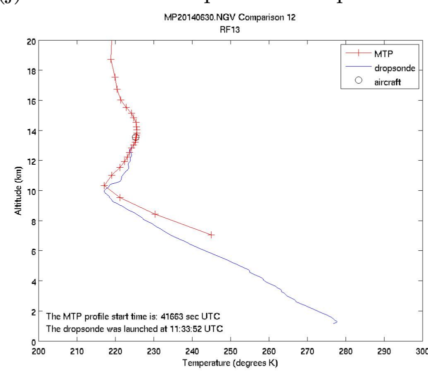
(i) RF13 MTP-Dropsonde Comparison 9



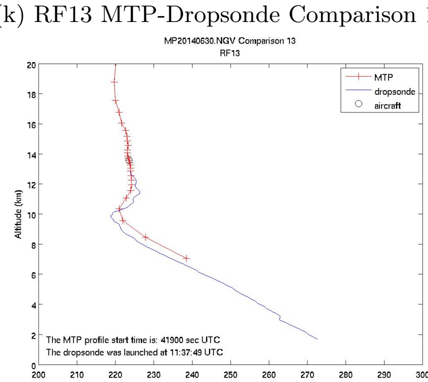
(j) RF13 MTP-Dropsonde Comparison 10



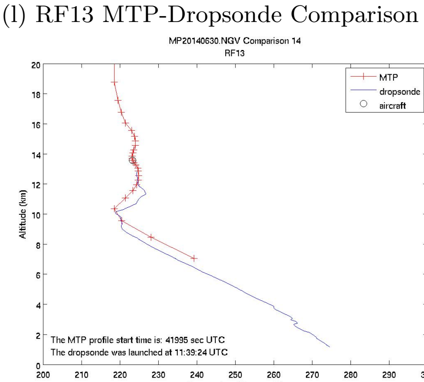
(k) RF13 MTP-Dropsonde Comparison 11



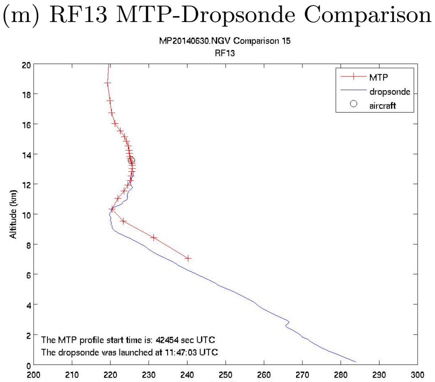
(l) RF13 MTP-Dropsonde Comparison 12



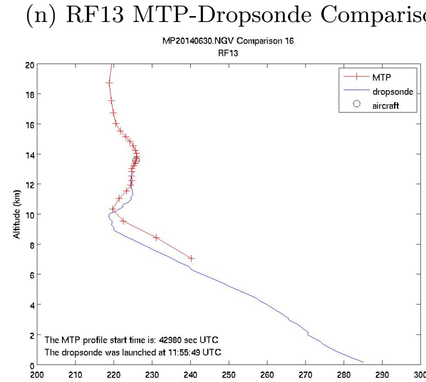
(m) RF13 MTP-Dropsonde Comparison 13



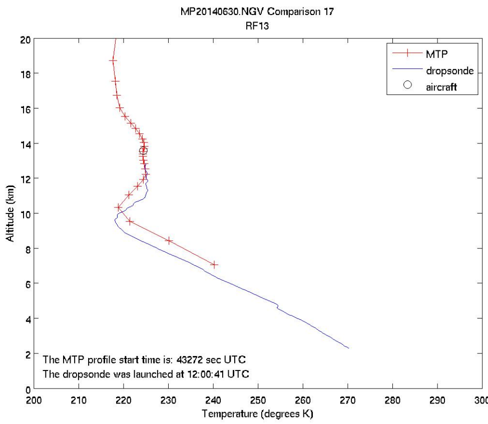
(n) RF13 MTP-Dropsonde Comparison 14



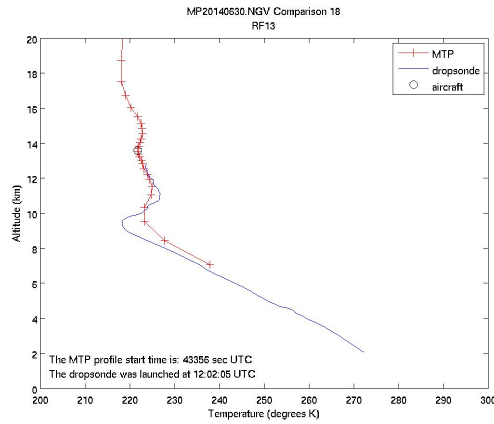
(o) RF13 MTP-Dropsonde Comparison 15



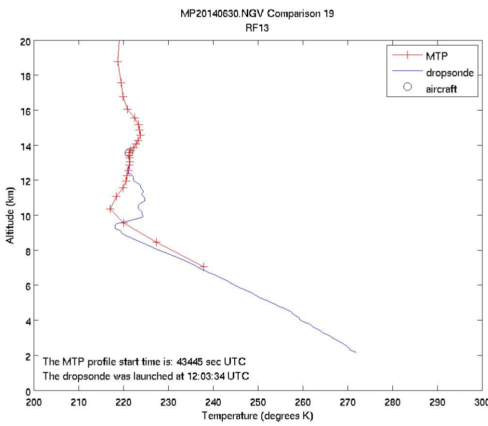
(p) RF13 MTP-Dropsonde Comparison 16



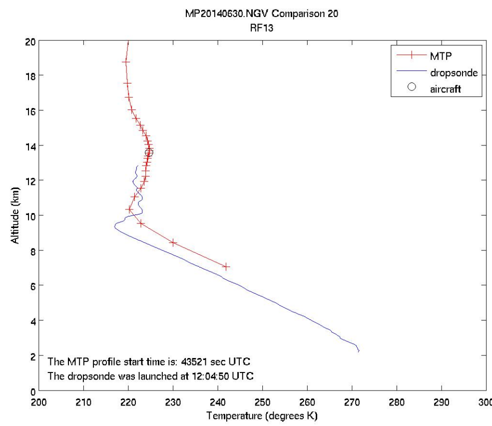
(q) RF13 MTP-Dropsonde Comparison 17



(r) RF13 MTP-Dropsonde Comparison 18



(s) RF13 MTP-Dropsonde Comparison 19



(t) RF13 MTP-Dropsonde Comparison 20

Figure 24: RF13 MTP-Dropsonde Comparisons

1.14 RF14

Cross island flight track over Mt Cook with one trailing leg downstream of island.

Reduced retrieval quality in lowest altitude leg (37-39 ksec UTC). Comparison with dropsondes is generally poorer on this flight (Figure 25).

See Figure 26 for RF14 MTP-Dropsonde comparisons.

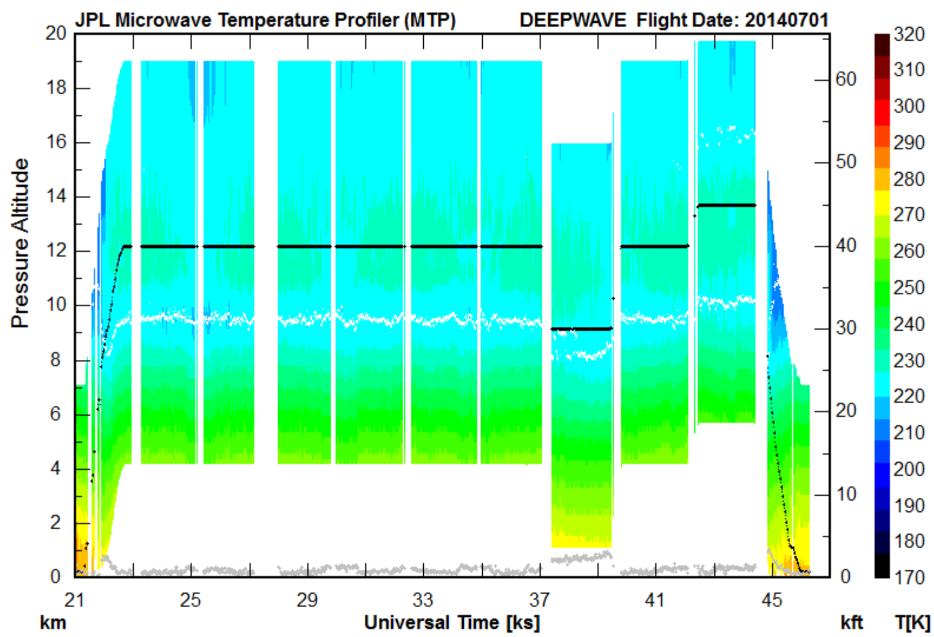
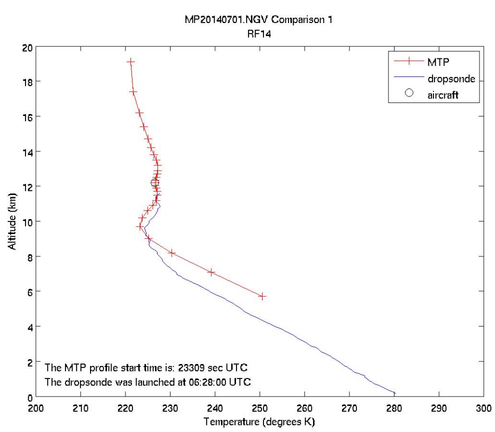
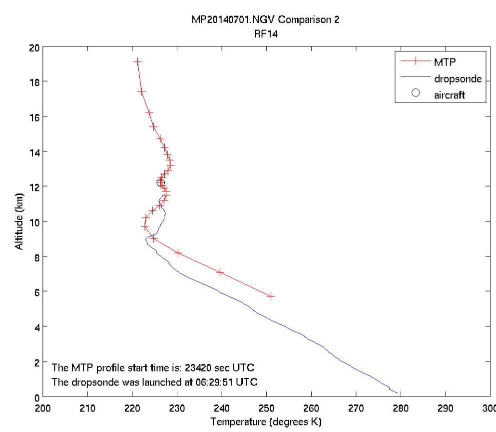


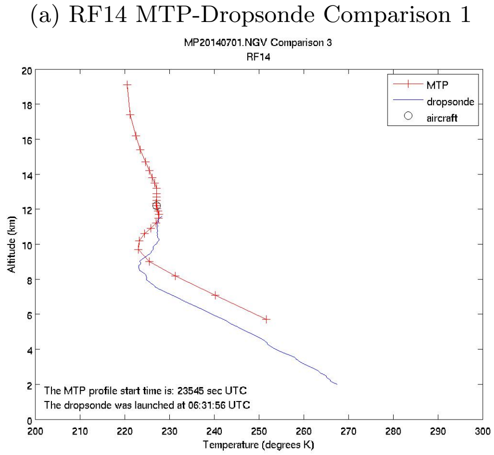
Figure 25: CTC Plot from Research Flight 14 on July 1, 2014



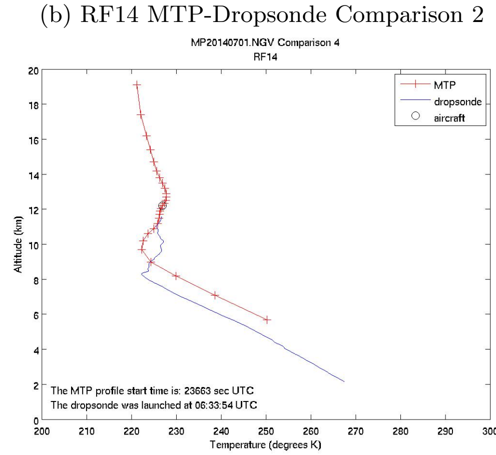
(a) RF14 MTP-Dropsonde Comparison 1



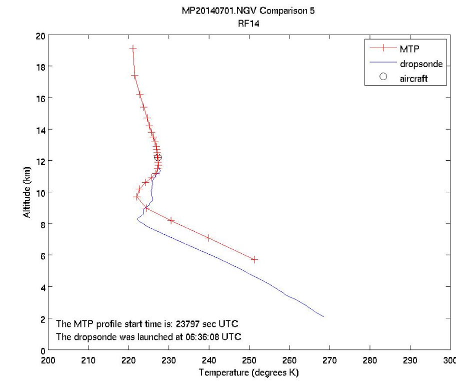
(b) RF14 MTP-Dropsonde Comparison 2



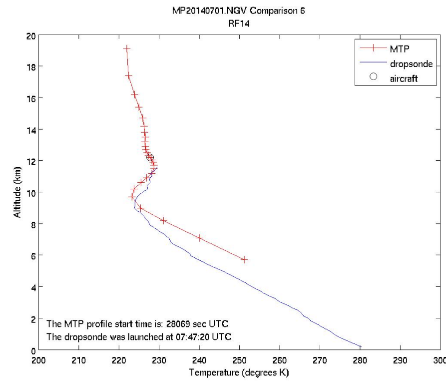
(c) RF14 MTP-Dropsonde Comparison 3



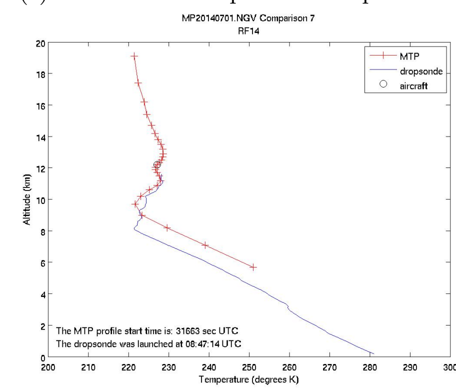
(d) RF14 MTP-Dropsonde Comparison 4



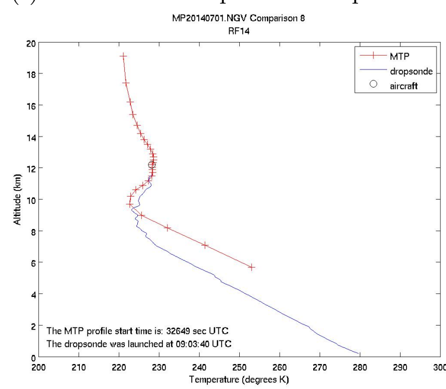
(e) RF14 MTP-Dropsonde Comparison 5



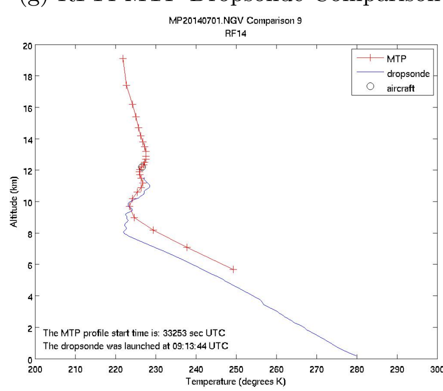
(f) RF14 MTP-Dropsonde Comparison 6



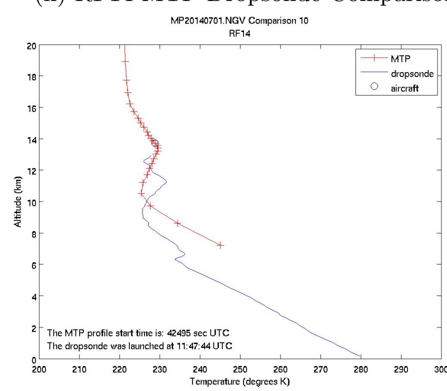
(g) RF14 MTP-Dropsonde Comparison 7



(h) RF14 MTP-Dropsonde Comparison 8



(i) RF14 MTP-Dropsonde Comparison 9



(j) RF14 MTP-Dropsonde Comparison 10

Figure 26: RF14 MTP-Dropsonde Comparisons

1.15 RF15

Calibration Flight. No dropsonde were released on this flight so there are no MTP-Dropsonde comparisons (Figure 27).

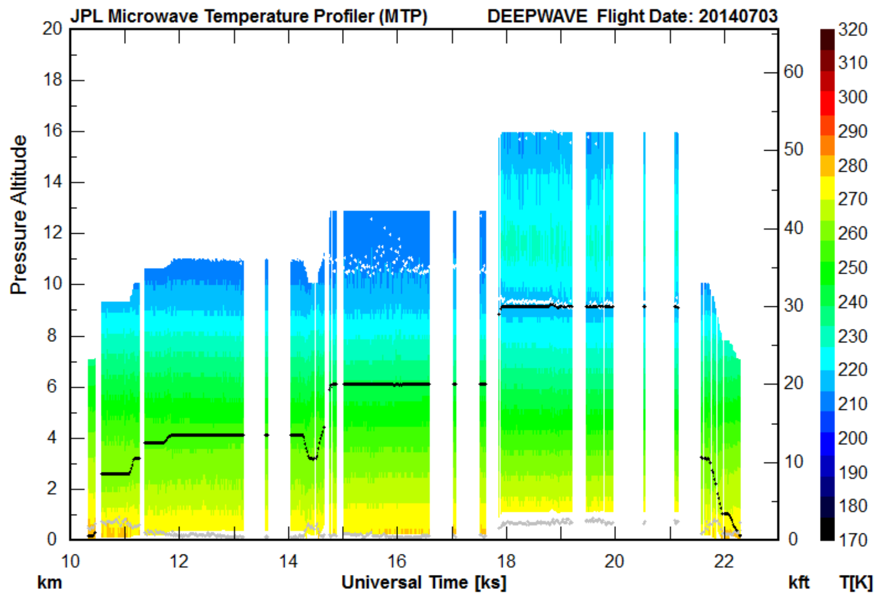


Figure 27: CTC Plot from Research Flight 15 on July 3, 2014

1.16 RF16

Cross mountain track over Mt Cook with one short downstream trailing leg.

Retrievals of moderate quality. Evidence of secondary tropopause around 15 km. Comparisons with dropsondes are of mixed quality (Figure 28).

See Figure 29 for RF16 MTP-Dropsonde comparisons.

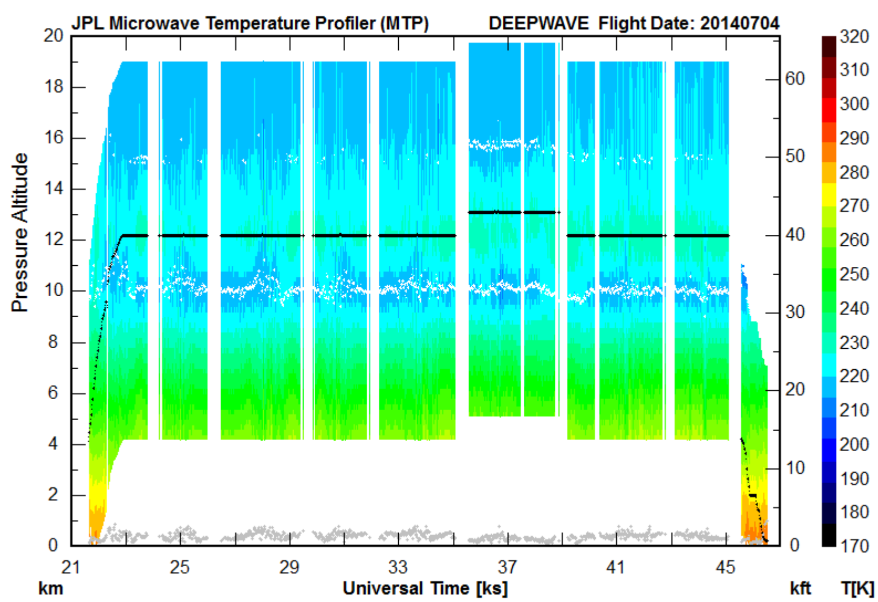
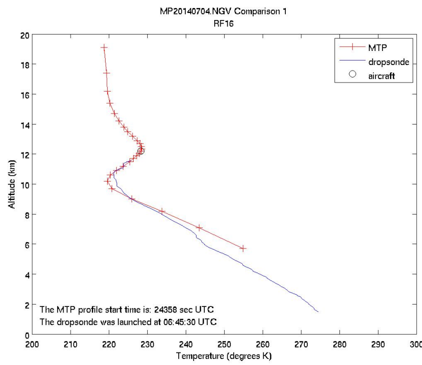
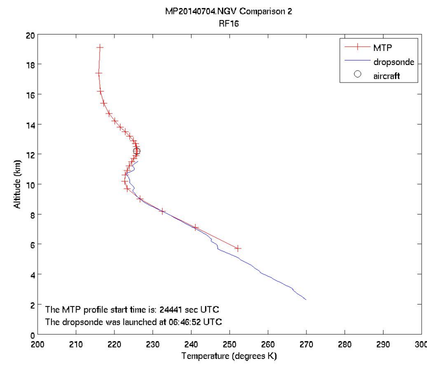


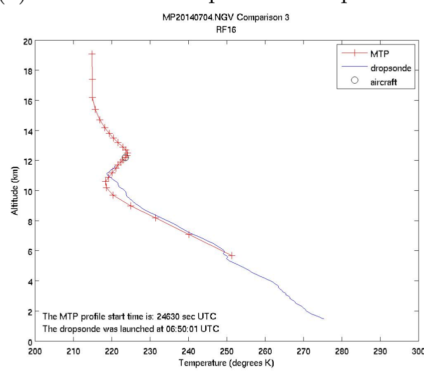
Figure 28: CTC Plot from Research Flight 16 on July 4, 2014



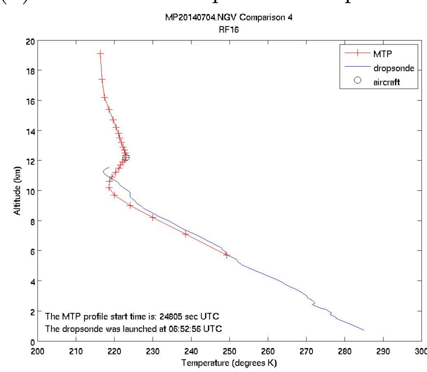
(a) RF16 MTP-Dropsonde Comparison 1



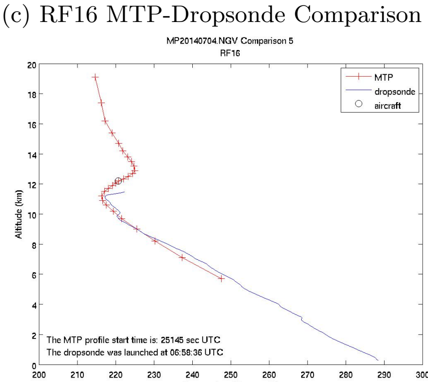
(b) RF16 MTP-Dropsonde Comparison 2



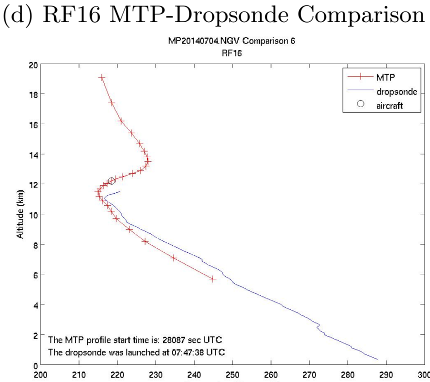
(c) RF16 MTP-Dropsonde Comparison 3



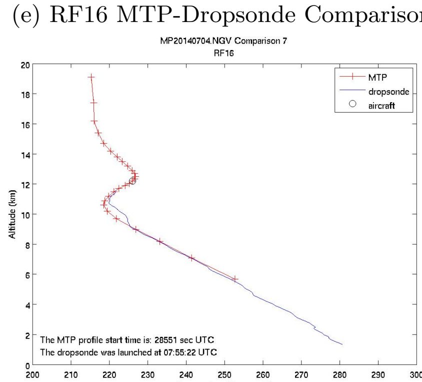
(d) RF16 MTP-Dropsonde Comparison 4



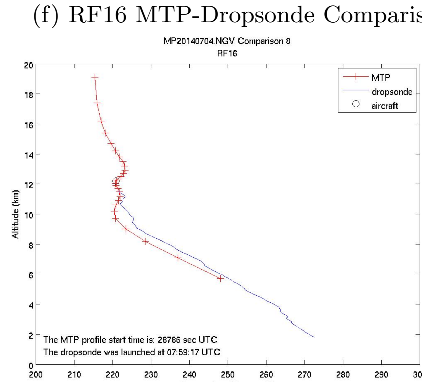
(e) RF16 MTP-Dropsonde Comparison 5



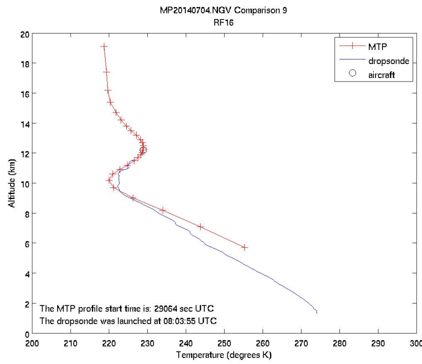
(f) RF16 MTP-Dropsonde Comparison 6



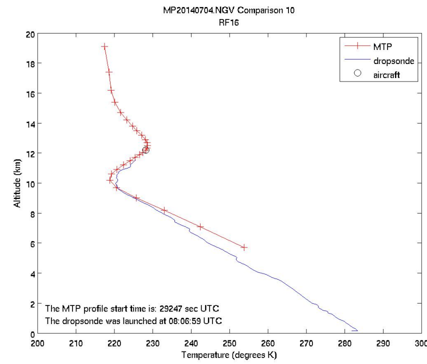
(g) RF16 MTP-Dropsonde Comparison 7



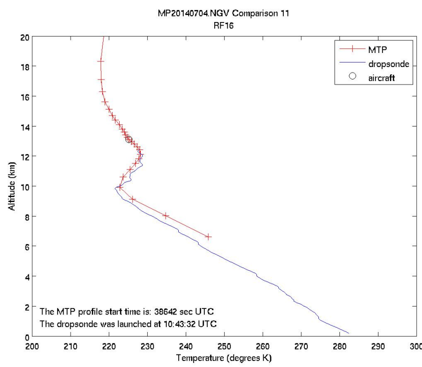
(h) RF16 MTP-Dropsonde Comparison 8



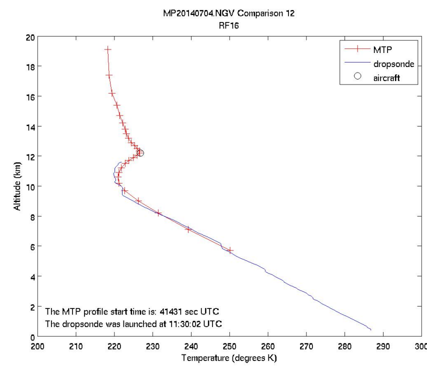
(i) RF16 MTP-Dropsonde Comparison 9



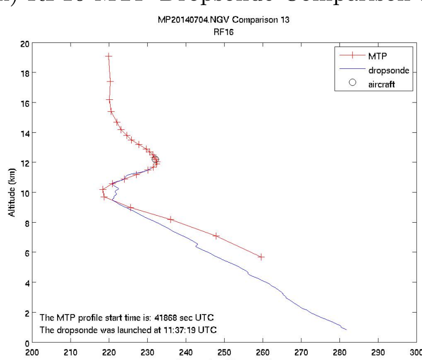
(j) RF16 MTP-Dropsonde Comparison 10



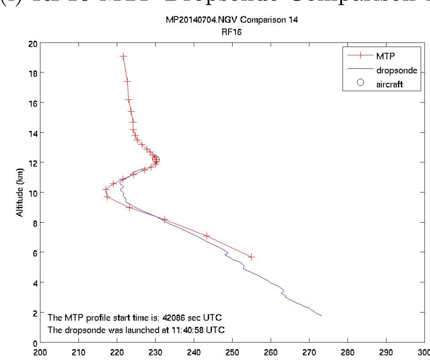
(k) RF16 MTP-Dropsonde Comparison 11



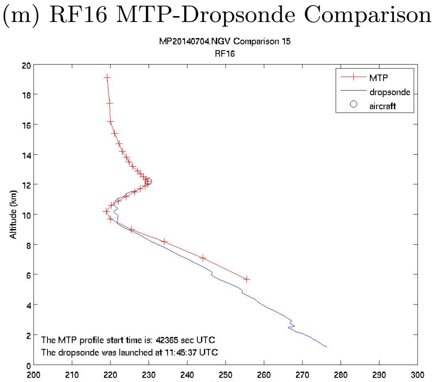
(l) RF16 MTP-Dropsonde Comparison 12



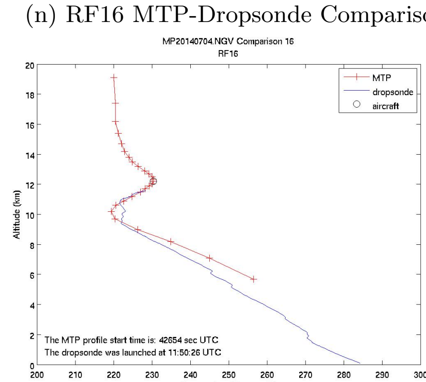
(m) RF16 MTP-Dropsonde Comparison 13



(n) RF16 MTP-Dropsonde Comparison 14



(o) RF16 MTP-Dropsonde Comparison 15



(p) RF16 MTP-Dropsonde Comparison 16

Figure 29: RF16 MTP-Dropsonde Comparisons

1.17 RF17

Southern ocean flight with southeast leg to measure trailing waves followed by due south leg to examine southern jet.

MTP places the tropopause higher than dropsonde in the early and later parts of this flight, but they compare well during the middle part of the flight. (Figure 30).

See Figure 31 for RF17 MTP-Dropsonde comparisons.

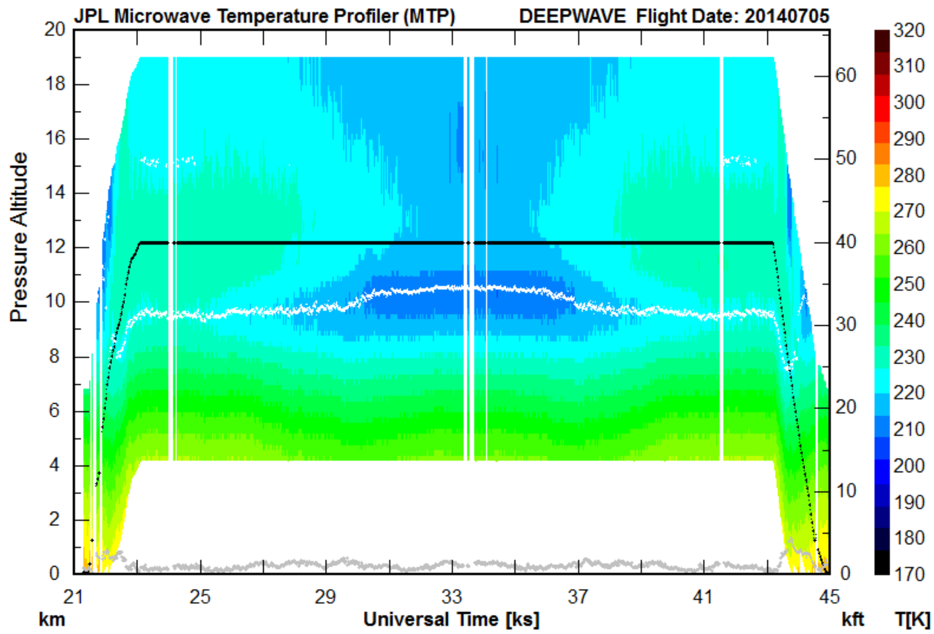
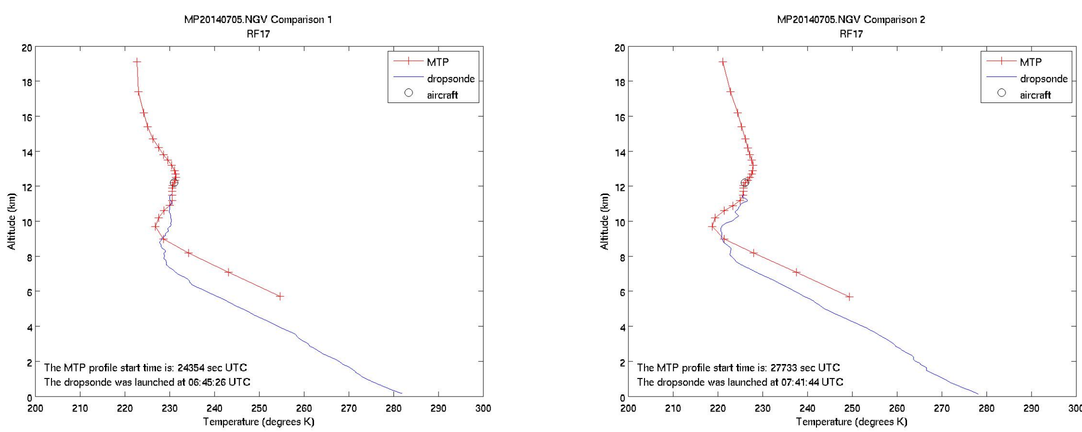
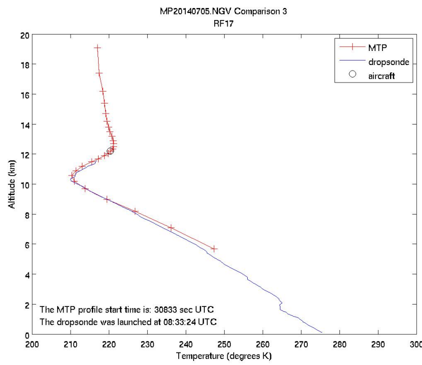


Figure 30: CTC Plot from Research Flight 17 on July 5, 2014

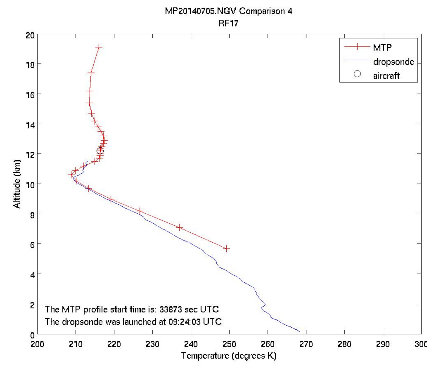


(a) RF17 MTP-Dropsonde Comparison 1

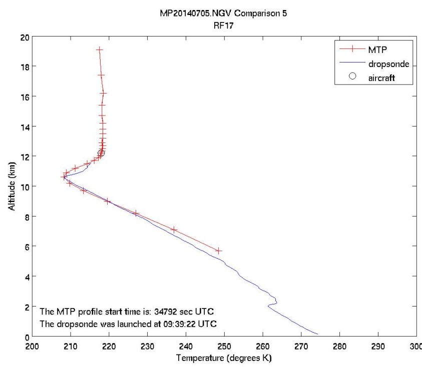
(b) RF17 MTP-Dropsonde Comparison 2



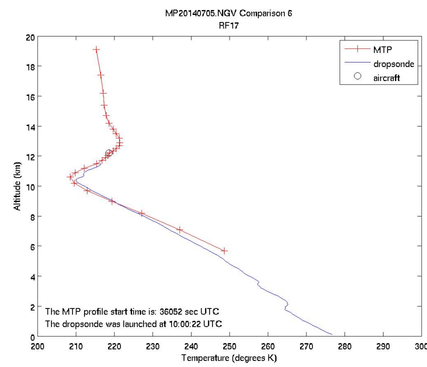
(c) RF17 MTP-Dropsonde Comparison 3



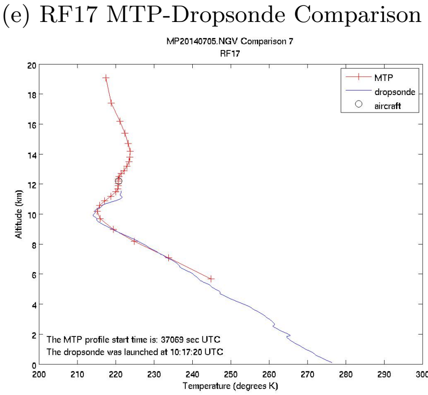
(d) RF17 MTP-Dropsonde Comparison 4



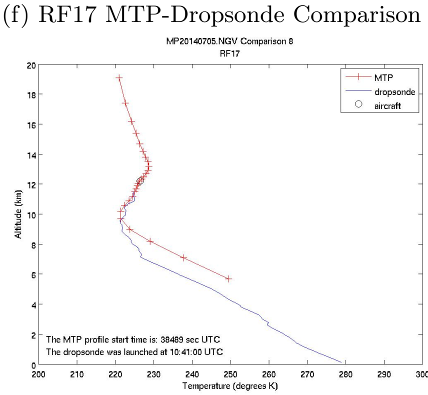
(e) RF17 MTP-Dropsonde Comparison 5



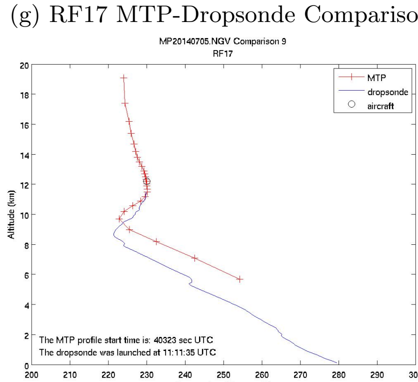
(f) RF17 MTP-Dropsonde Comparison 6



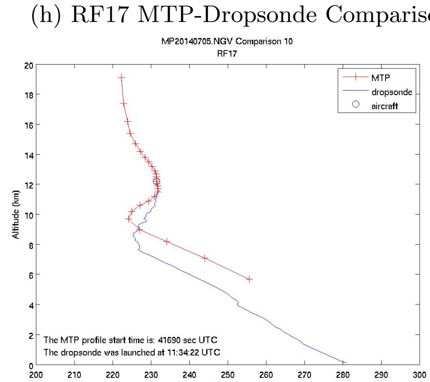
(g) RF17 MTP-Dropsonde Comparison 7



(h) RF17 MTP-Dropsonde Comparison 8



(i) RF17 MTP-Dropsonde Comparison 9



(j) RF17 MTP-Dropsonde Comparison 10

Figure 31: RF17 MTP-Dropsonde Comparisons

1.18 RF18

Flight track went south and west of island performing "Z" pattern to sample across phase fronts.

Retrieval quality declines in cold features, but comparisons with dropsondes are generally very good (except for some bias in the mid-troposphere) (Figure 32).

See Figure 33 for RF18 MTP-Dropsonde comparisons.

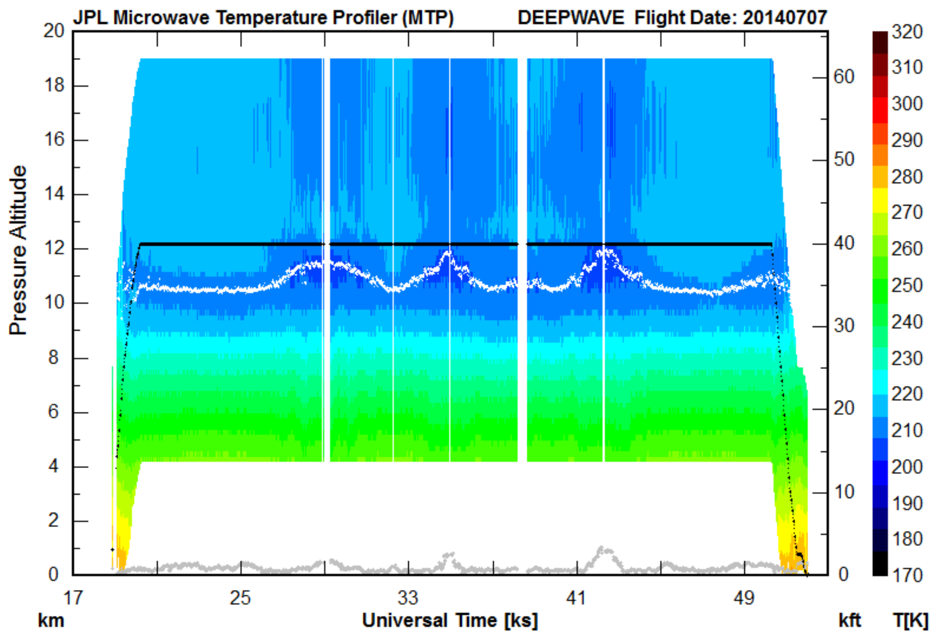
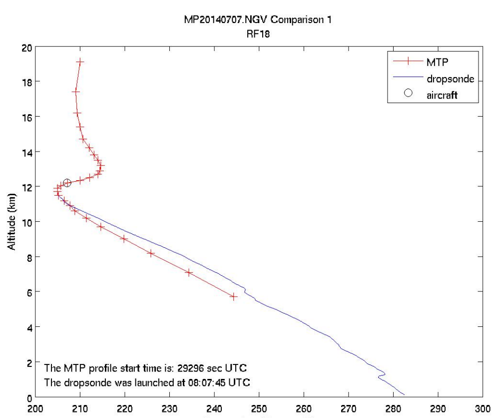
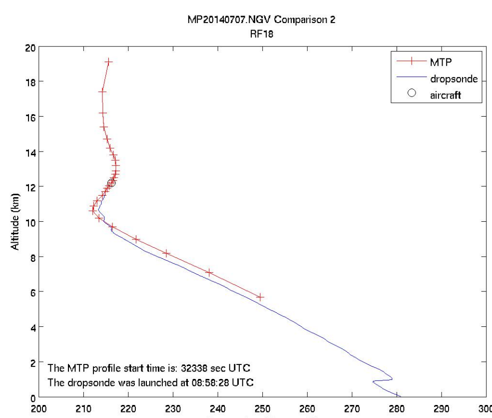


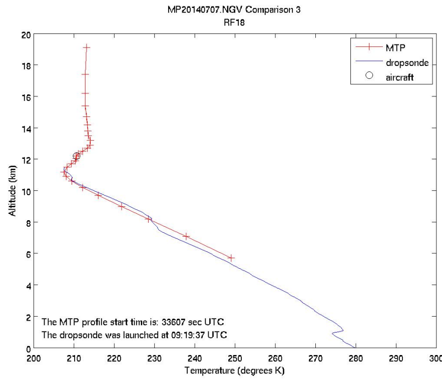
Figure 32: CTC Plot from Research Flight 18 on July 7, 2014



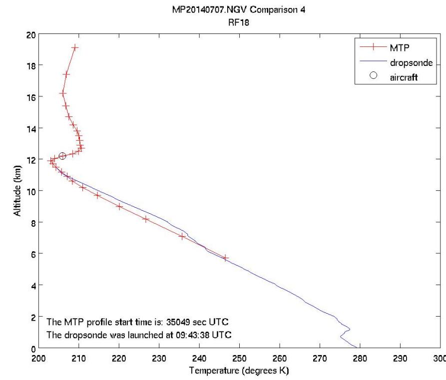
(a) RF18 MTP-Dropsonde Comparison 1



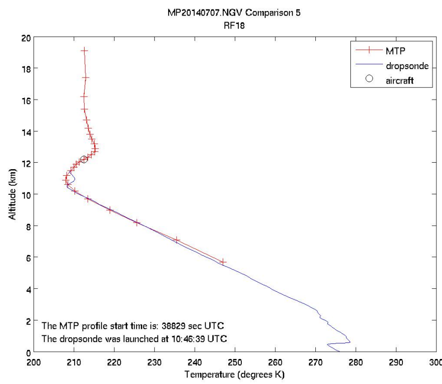
(b) RF18 MTP-Dropsonde Comparison 2



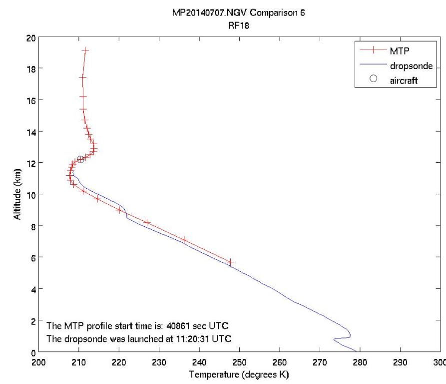
(c) RF18 MTP-Dropsonde Comparison 3



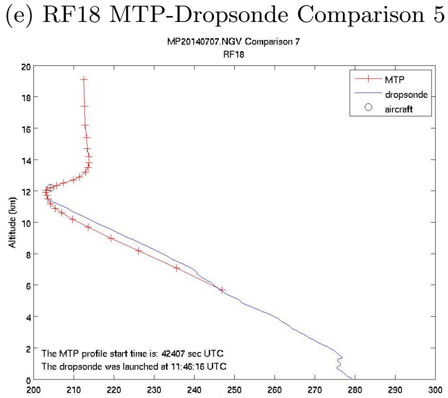
(d) RF18 MTP-Dropsonde Comparison 4



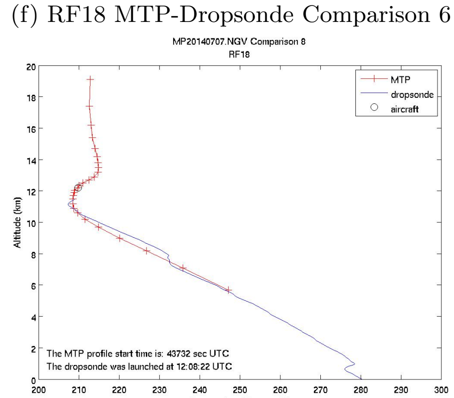
(e) RF18 MTP-Dropsonde Comparison 5



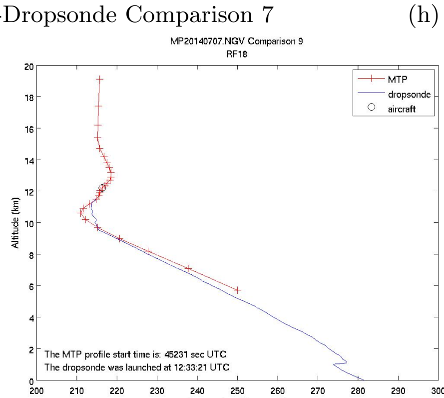
(f) RF18 MTP-Dropsonde Comparison 6



(g) RF18 MTP-Dropsonde Comparison 7



(h) RF18 MTP-Dropsonde Comparison 8



(i) RF18 MTP-Dropsonde Comparison 9

Figure 33: RF18 MTP-Dropsonde Comparisons

1.19 RF19

Out and back southward track, with multiple passes over section between Auckland Islands and the southernmost way point.

Similar to RF18 with more stable retrieval quality. Comparisons with dropsondes are good (Figure 34).

See Figure 35 for RF19 MTP-Dropsonde comparisons.

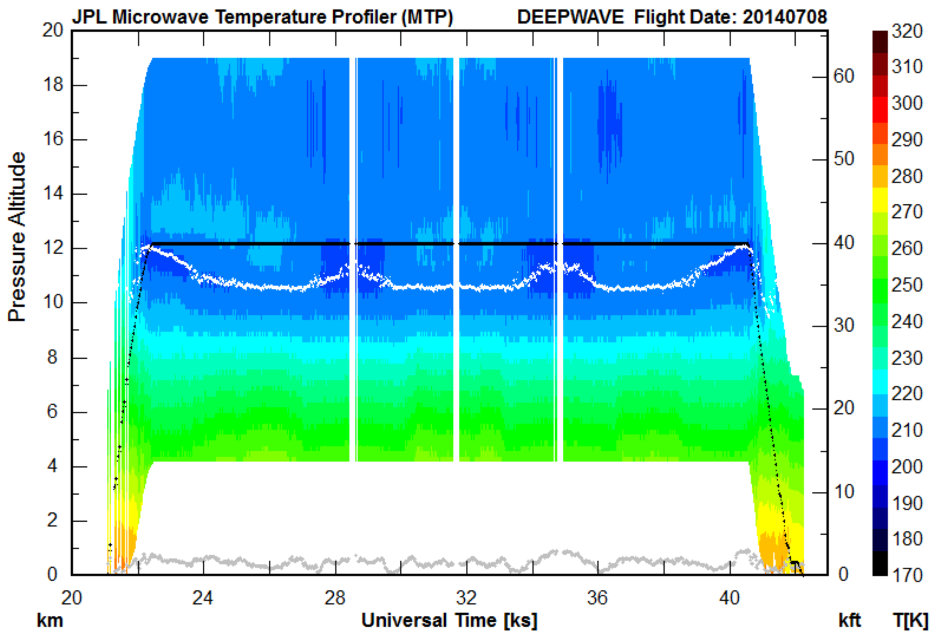
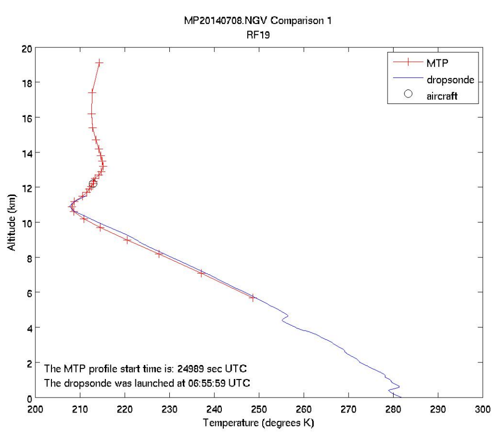
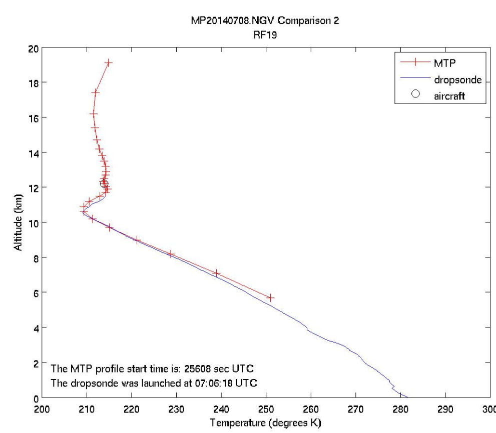


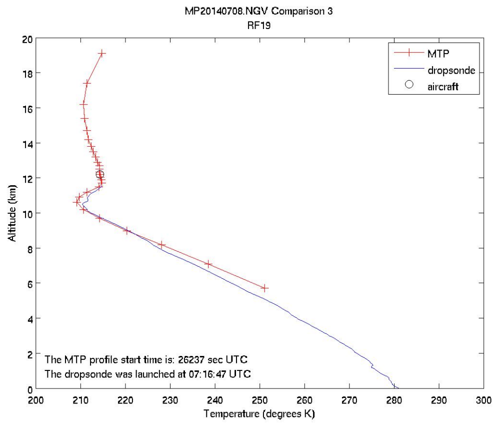
Figure 34: CTC Plot from Research Flight 19 on July 8, 2014



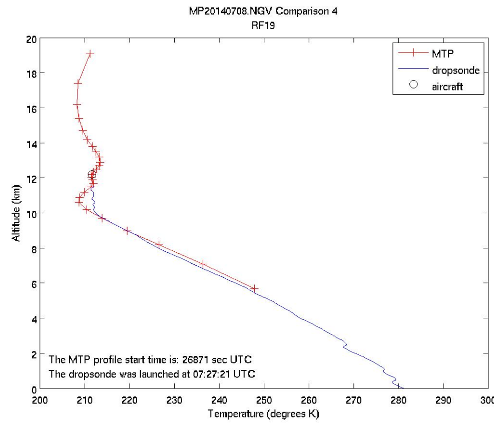
(a) RF19 MTP-Dropsonde Comparison 1



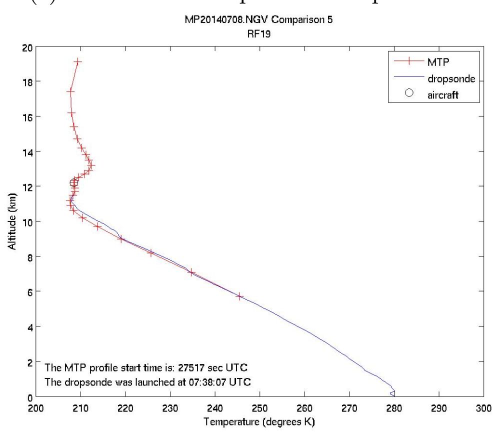
(b) RF19 MTP-Dropsonde Comparison 2



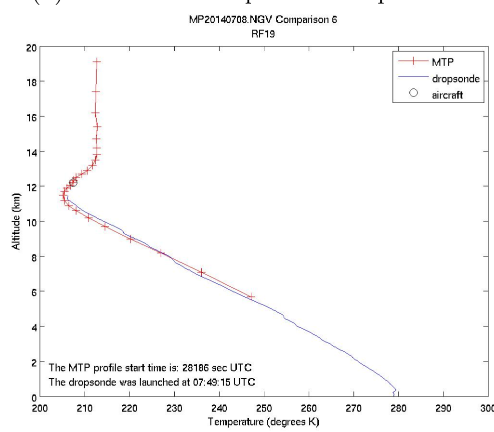
(c) RF19 MTP-Dropsonde Comparison 3



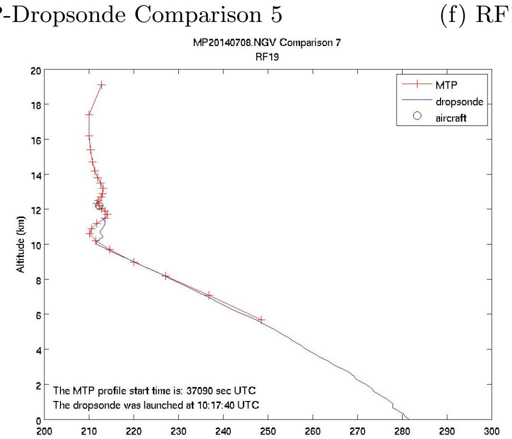
(d) RF19 MTP-Dropsonde Comparison 4



(e) RF19 MTP-Dropsonde Comparison 5



(f) RF19 MTP-Dropsonde Comparison 6



(g) RF19 MTP-Dropsonde Comparison 7

Figure 35: RF19 MTP-Dropsonde Comparisons

1.20 RF20

Intercomparison flight with DLR Falcon followed by predictability triangle is Tasman Sea(Figure 36).
See Figure 37 for RF20 MTP-Dropsonde comparisons.

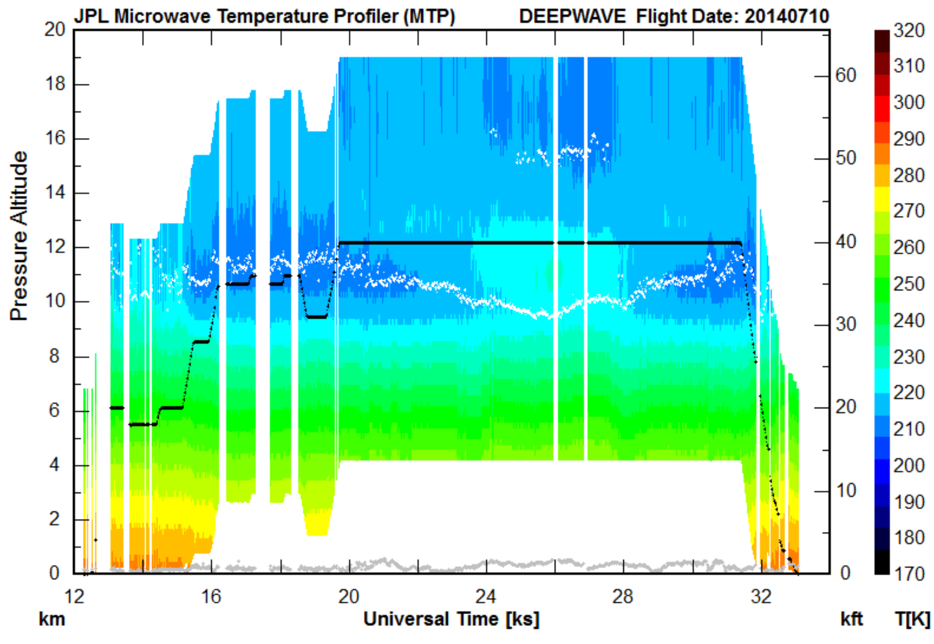
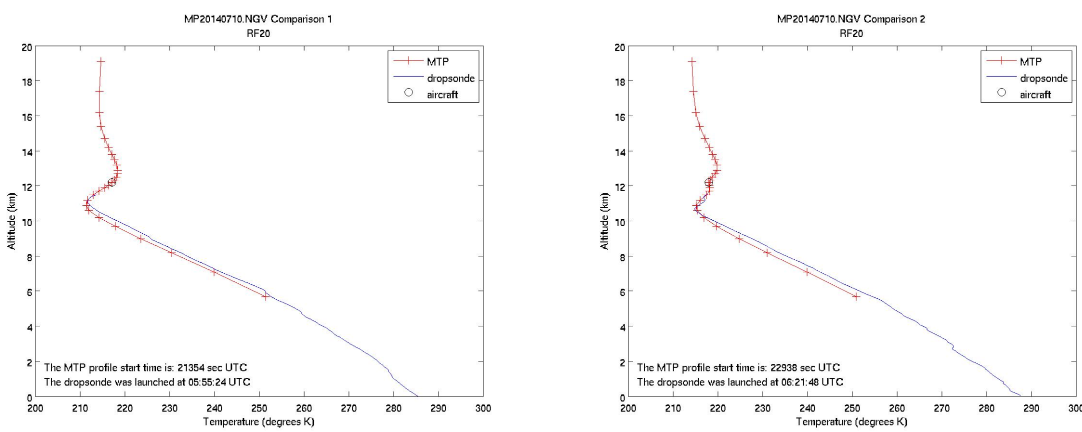
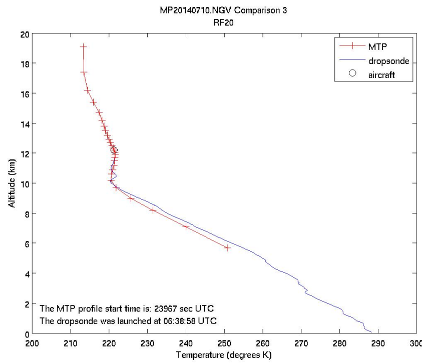


Figure 36: CTC Plot from Research Flight 20 on July 10, 2014

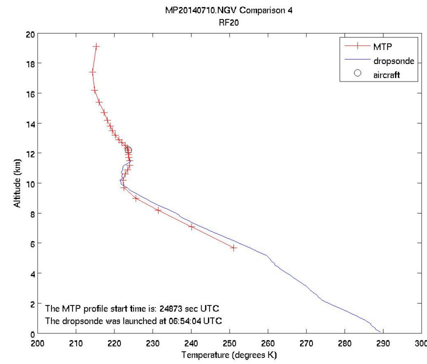


(a) RF20 MTP-Dropsonde Comparison 1

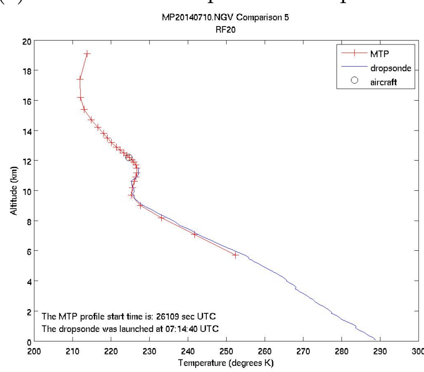
(b) RF20 MTP-Dropsonde Comparison 2



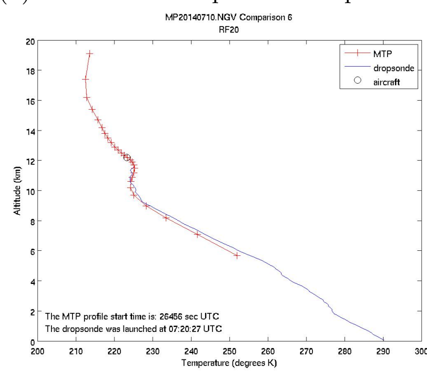
(c) RF20 MTP-Dropsonde Comparison 3



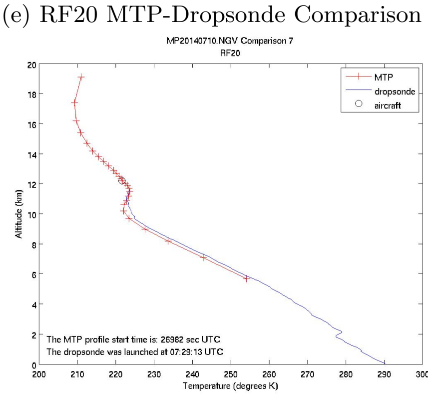
(d) RF20 MTP-Dropsonde Comparison 4



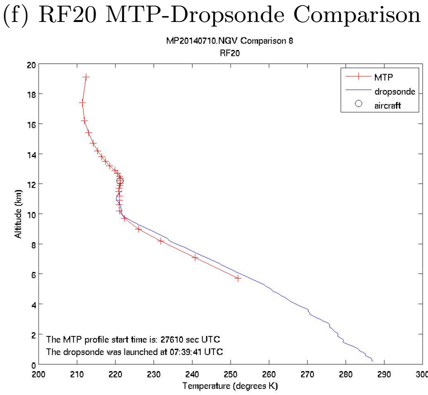
(e) RF20 MTP-Dropsonde Comparison 5



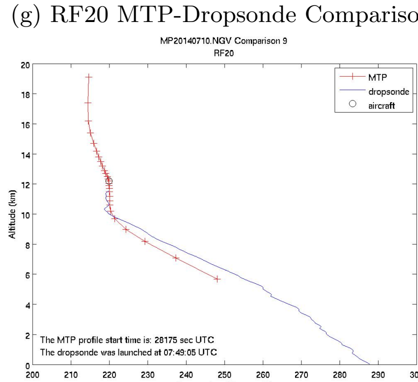
(f) RF20 MTP-Dropsonde Comparison 6



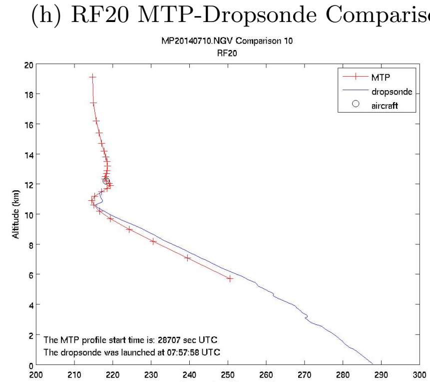
(g) RF20 MTP-Dropsonde Comparison 7



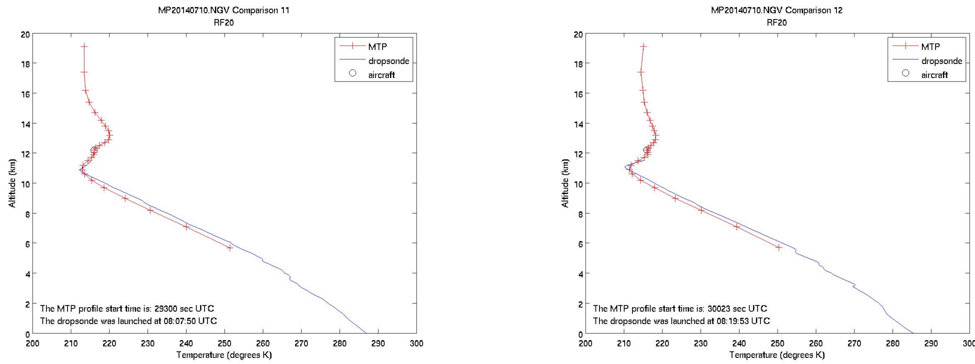
(h) RF20 MTP-Dropsonde Comparison 8



(i) RF20 MTP-Dropsonde Comparison 9



(j) RF20 MTP-Dropsonde Comparison 10



(k) RF20 MTP-Dropsonde Comparison 11

(l) RF20 MTP-Dropsonde Comparison 12

Figure 37: RF20 MTP-Dropsonde Comparisons

1.21 RF21

Cross mountain flight track over Mt Cook with single downstream trailing leg.

Generally good retrieval quality and good comparisons with dropsondes except for some bias in mid-troposphere (Figure 38).

See Figure 39 for RF21 MTP-Dropsonde comparisons.

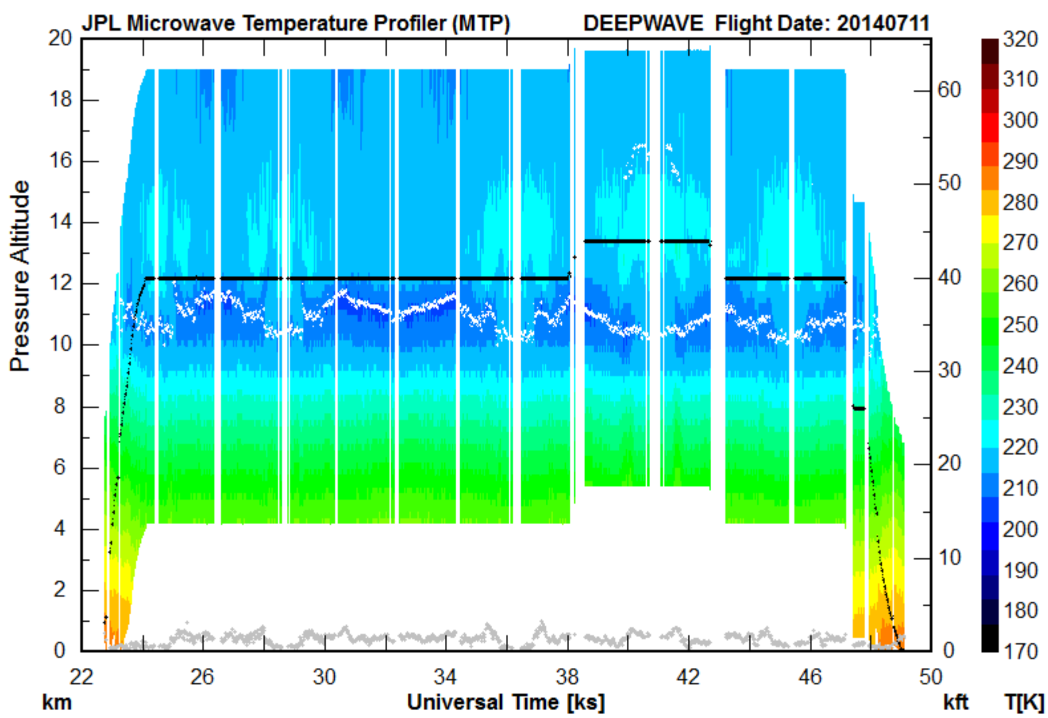
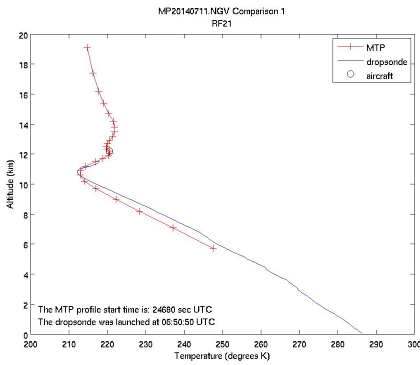
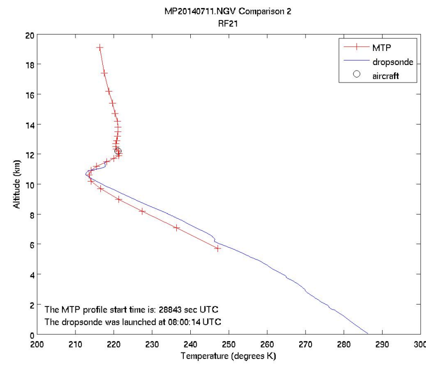


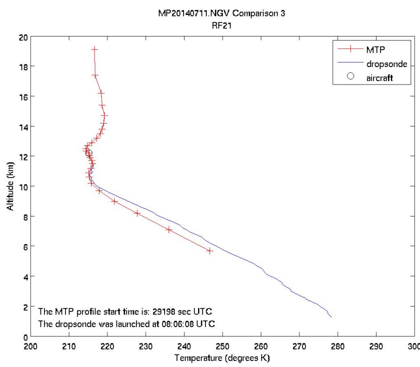
Figure 38: CTC Plot from Research Flight 21 on July 11, 2014



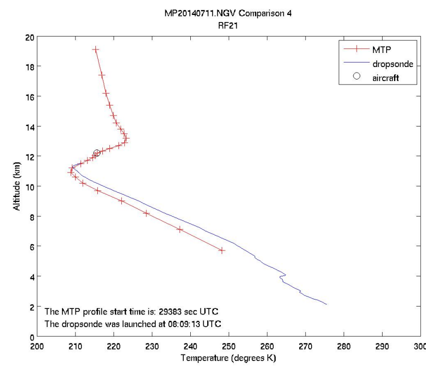
(a) RF21 MTP-Dropsonde Comparison 1



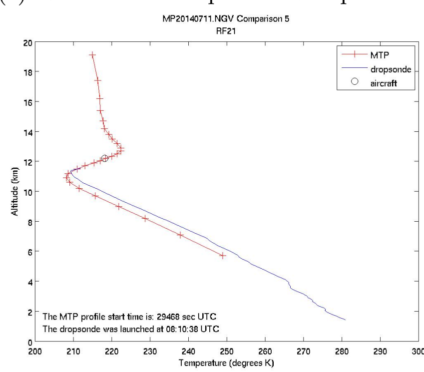
(b) RF21 MTP-Dropsonde Comparison 2



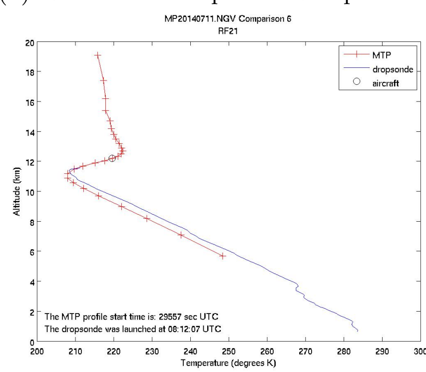
(c) RF21 MTP-Dropsonde Comparison 3



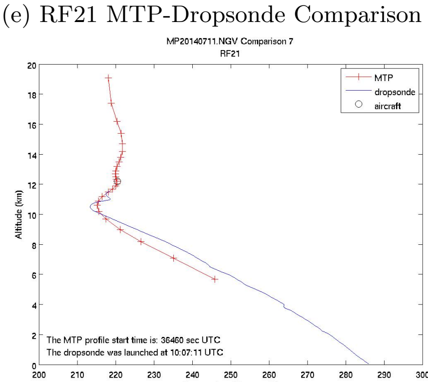
(d) RF21 MTP-Dropsonde Comparison 4



(e) RF21 MTP-Dropsonde Comparison 5



(f) RF21 MTP-Dropsonde Comparison 6



(g) RF21 MTP-Dropsonde Comparison 7

Figure 39: RF21 MTP-Dropsonde Comparisons

1.22 RF22

Cross mountain flight track over Mt Cook. Reasonable retrieval quality. Decent agreement with dropsondes around flight level (Figure 40).

See Figure 41 for RF22 MTP-Dropsonde comparisons.

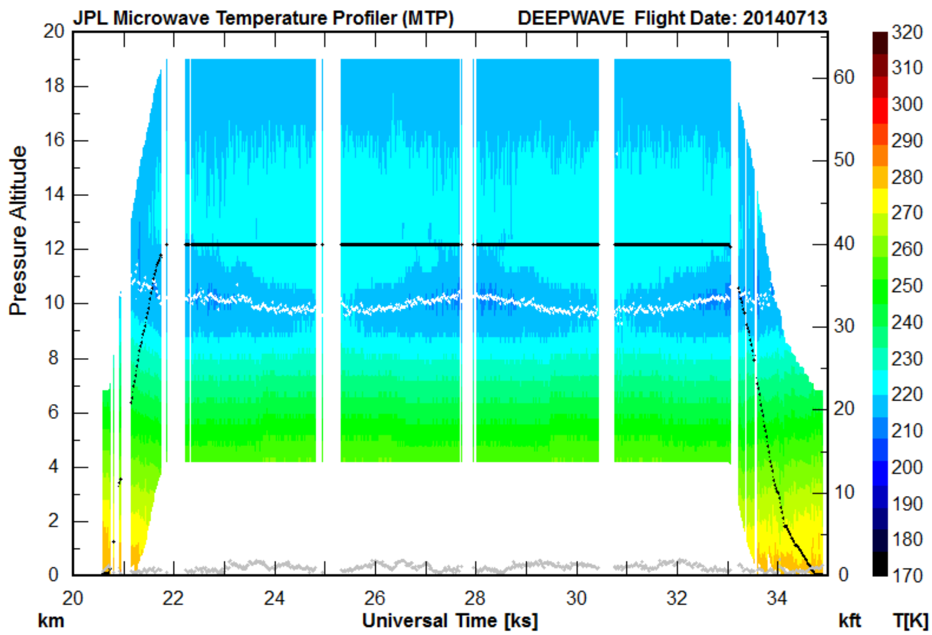
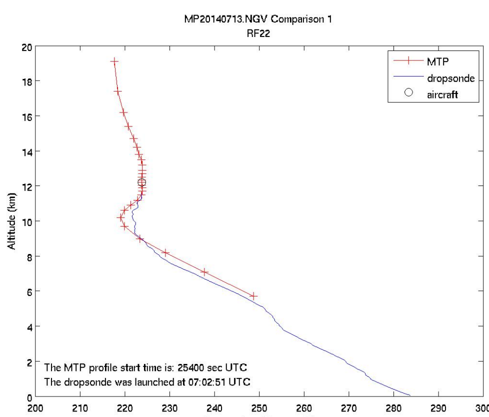
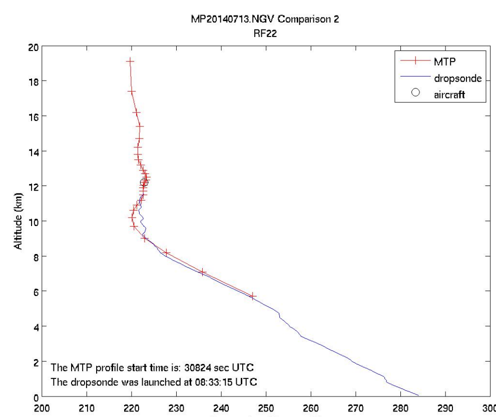


Figure 40: CTC Plot from Research Flight 22 on July 13, 2014



(a) RF22 MTP-Dropsonde Comparison 1



(b) RF22 MTP-Dropsonde Comparison 2

Figure 41: RF22 MTP-Dropsonde Comparisons

1.23 RF23

Flight track focused on multiple passes between Auckland Islands and Macquarie Island.

Retrieval quality is reduced on portions of this flight (altitude changes are often challenging for MTP). We're unsure whether the significant cold feature centered at 38 ksec UTC is real, but we asked JPL experts to examine data from this flight and they concluded that the sensor was functioning normally. There were no dropsondes launched at this time to confirm or refute our result. We are interested in hearing from anyone who uses our data from this flight (Figure 42).

See Figure 43 for RF23 MTP-Dropsonde comparisons.

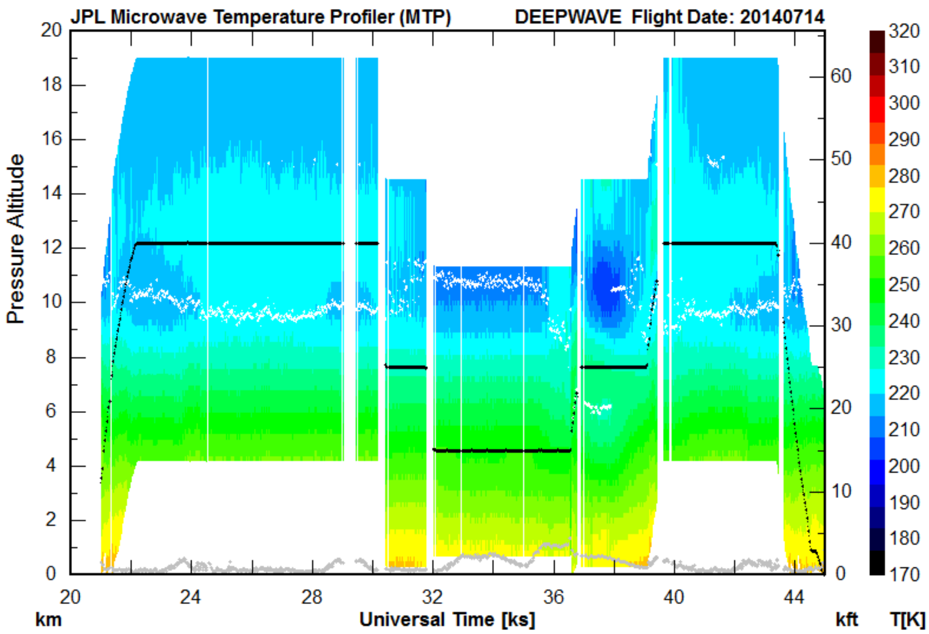
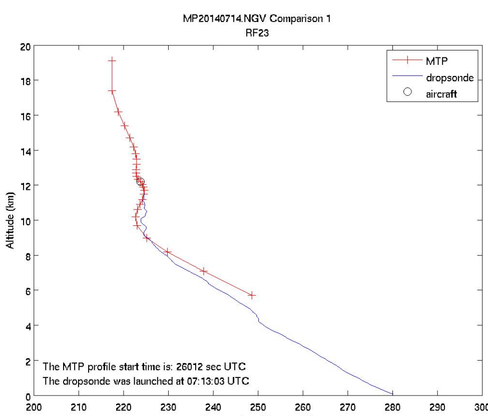
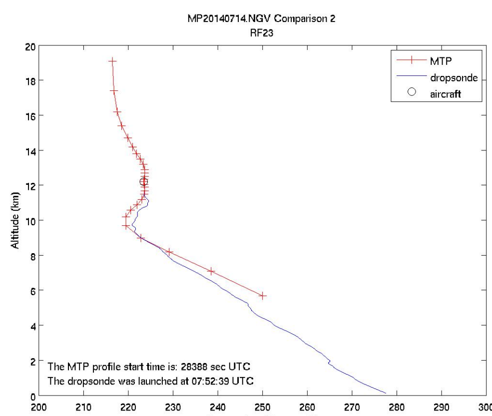


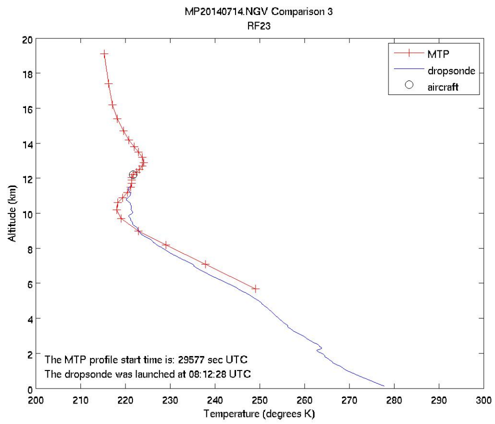
Figure 42: CTC Plot from Research Flight 23 on July 14, 2014



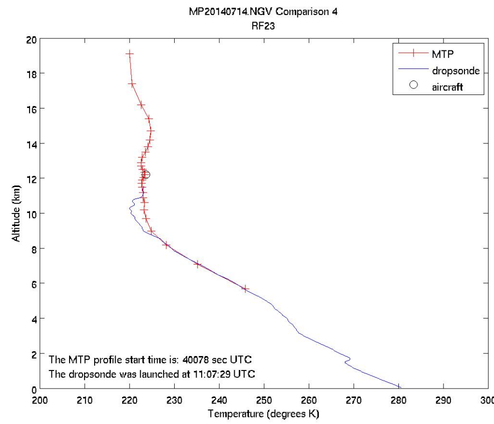
(a) RF23 MTP-Dropsonde Comparison 1



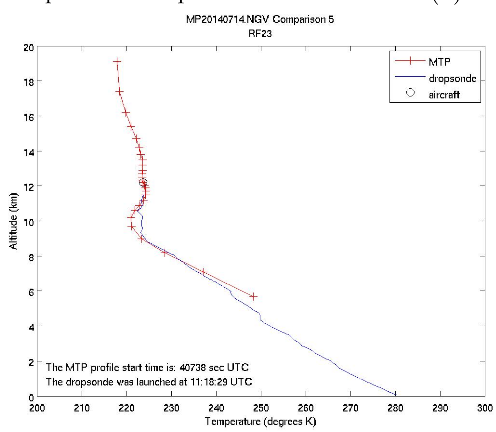
(b) RF23 MTP-Dropsonde Comparison 2



(c) RF23 MTP-Dropsonde Comparison 3



(d) RF23 MTP-Dropsonde Comparison 4



(e) RF23 MTP-Dropsonde Comparison 5

Figure 43: RF23 MTP-Dropsonde Comparisons

1.24 RF24

Primarily southern flight track with two westward segments to investigate deep non-orographic wave packets. Good quality retrievals (Figure 44).

See Figure 45 for RF24 MTP-Dropsonde comparisons.

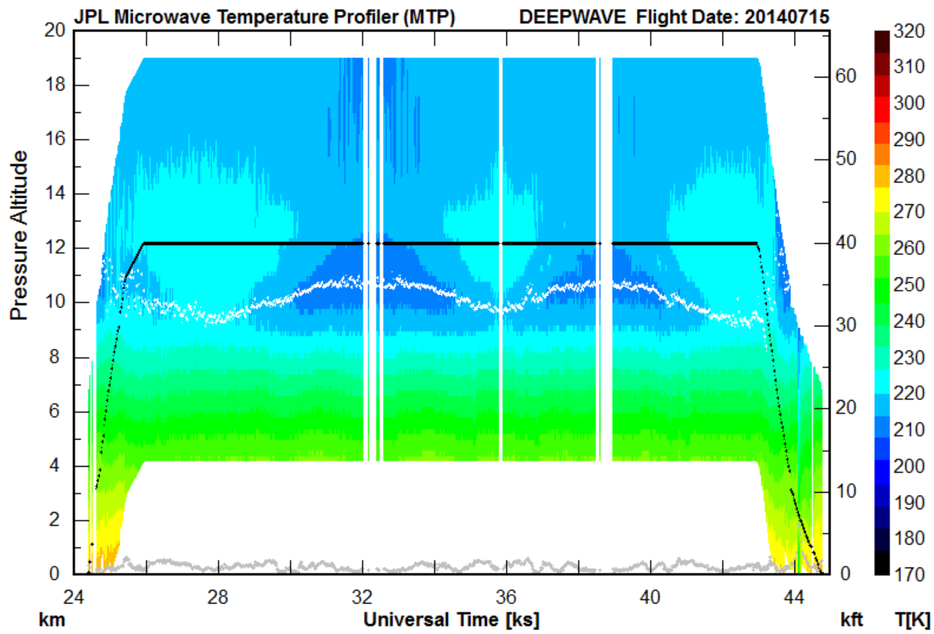
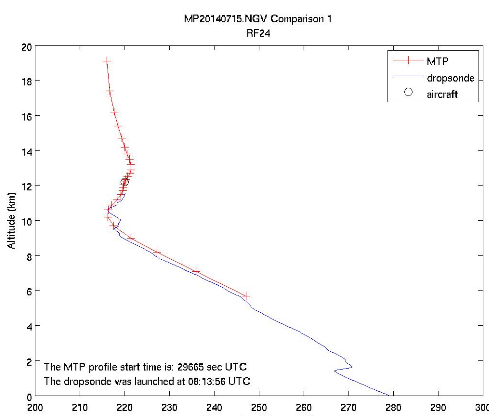
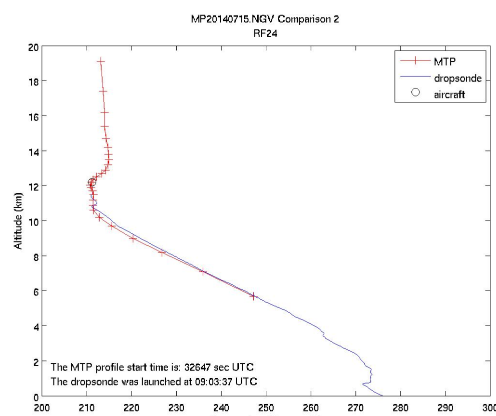


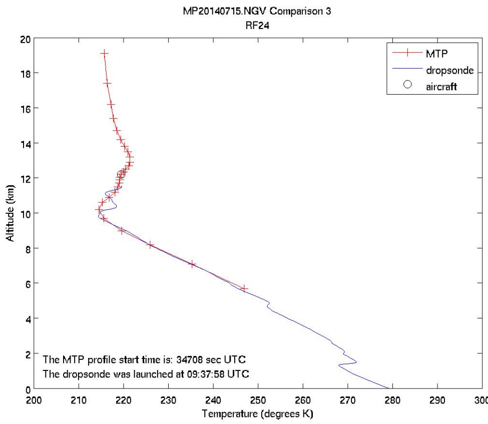
Figure 44: CTC Plot from Research Flight 24 on July 15, 2014



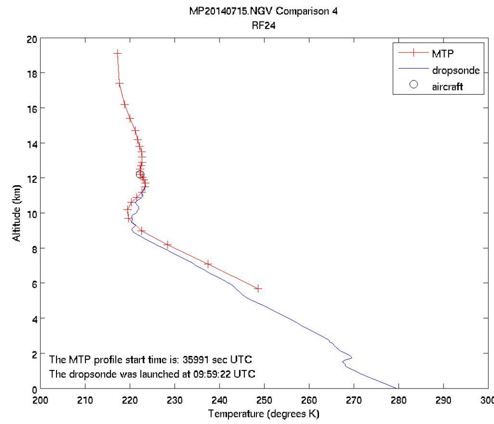
(a) RF24 MTP-Dropsonde Comparison 1



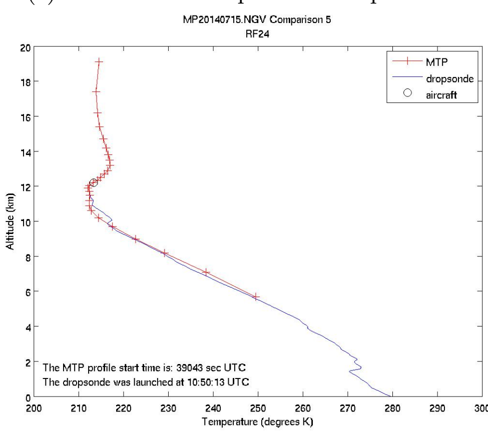
(b) RF24 MTP-Dropsonde Comparison 2



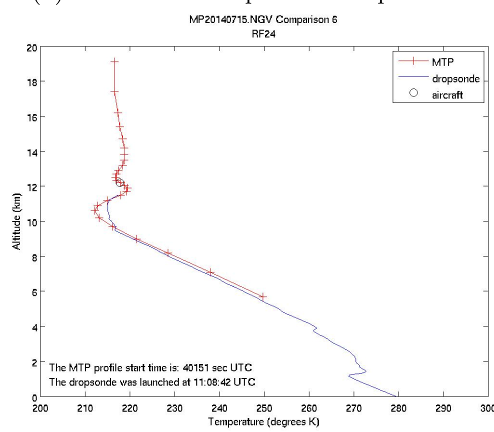
(c) RF24 MTP-Dropsonde Comparison 3



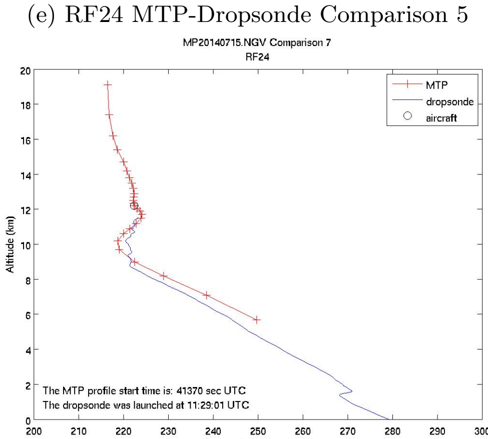
(d) RF24 MTP-Dropsonde Comparison 4



(e) RF24 MTP-Dropsonde Comparison 5



(f) RF24 MTP-Dropsonde Comparison 6



(g) RF24 MTP-Dropsonde Comparison 7

Figure 45: RF24 MTP-Dropsonde Comparisons

1.25 RF25

Primarily southward flight track to 63S, out and back pattern. Retrieval quality is reasonable. Some of the MTP-dropsonde comparisons show significant bias at lower altitudes (Figure 46).

See Figure 47 for RF25 MTP-Dropsonde comparisons.

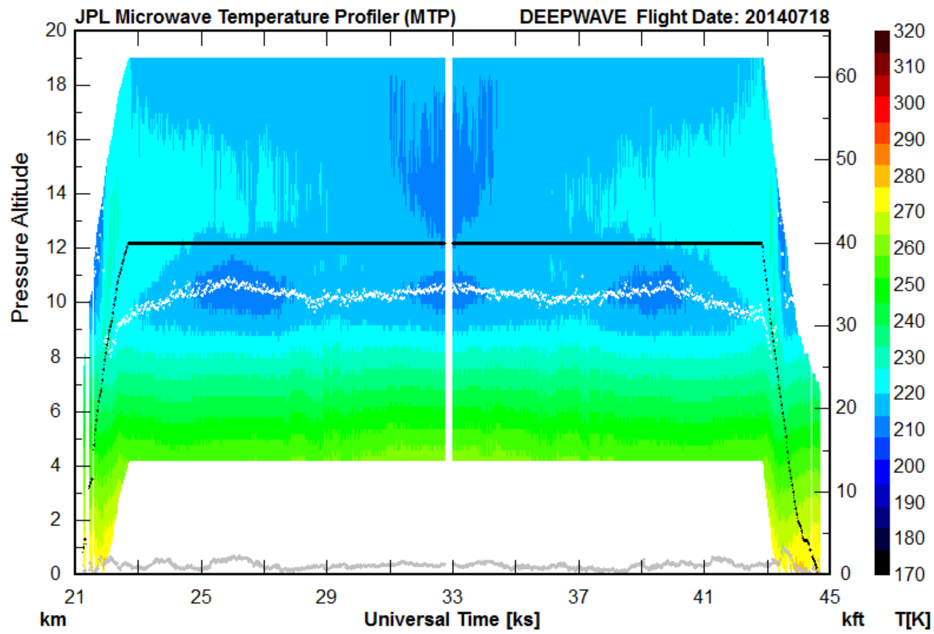
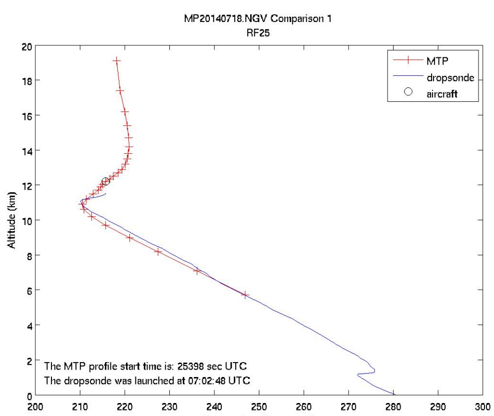
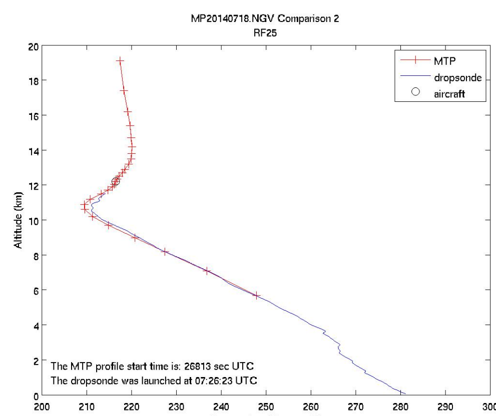


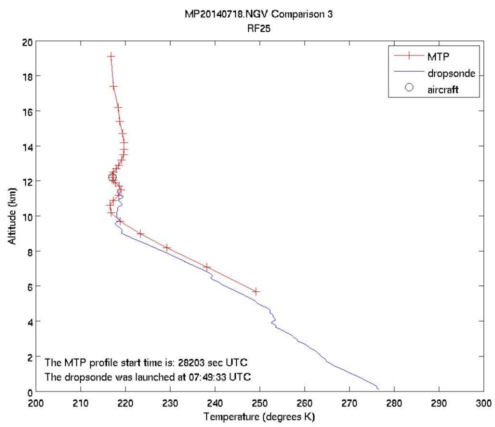
Figure 46: CTC Plot from Research Flight 25 on July 18, 2014



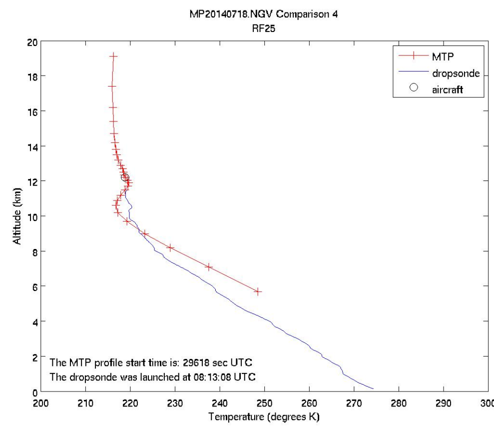
(a) RF25 MTP-Dropsonde Comparison 1



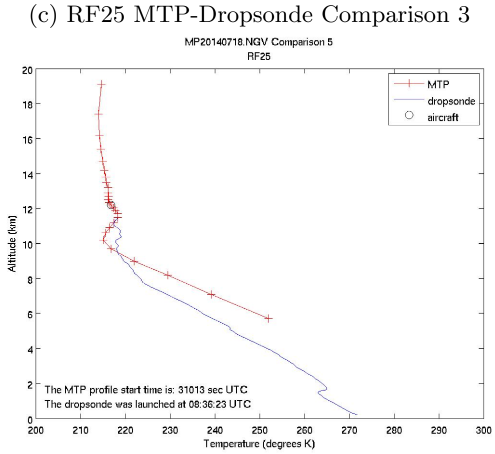
(b) RF25 MTP-Dropsonde Comparison 2



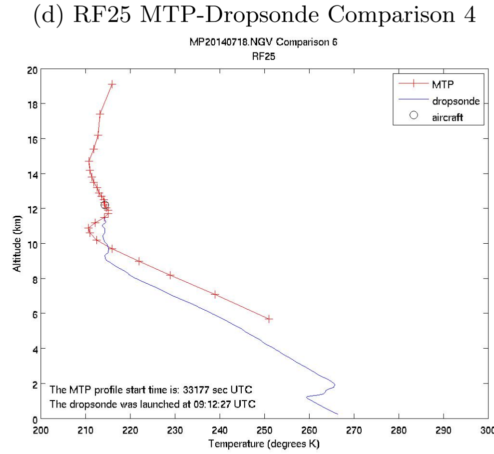
(c) RF25 MTP-Dropsonde Comparison 3



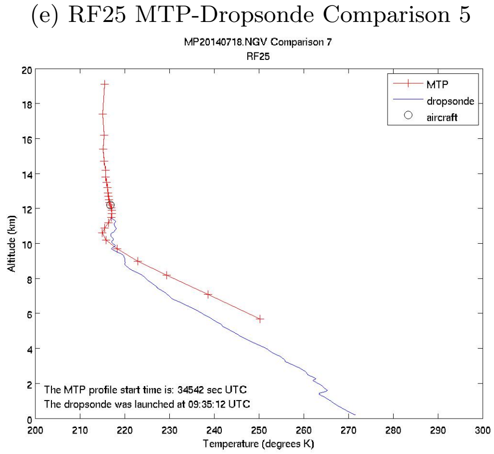
(d) RF25 MTP-Dropsonde Comparison 4



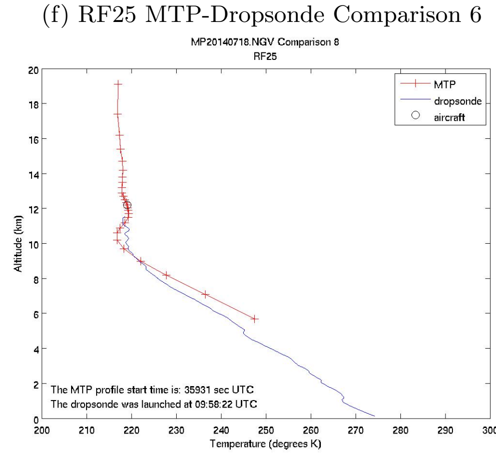
(e) RF25 MTP-Dropsonde Comparison 5



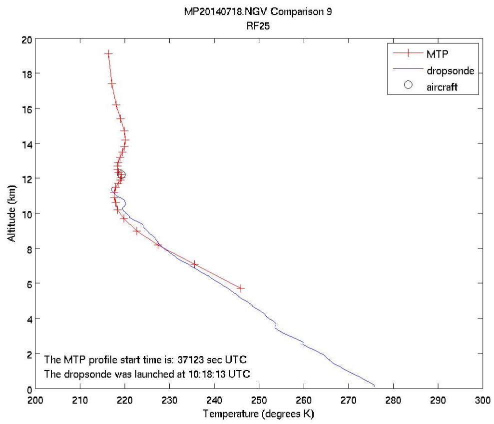
(f) RF25 MTP-Dropsonde Comparison 6



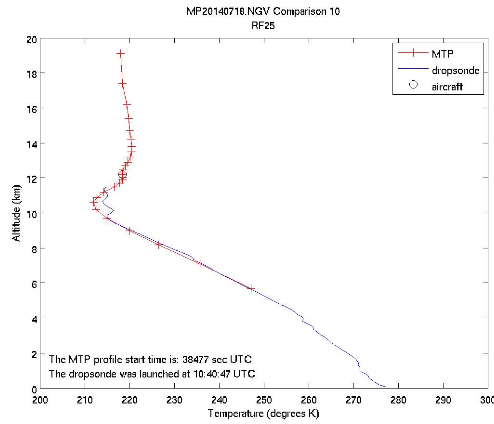
(g) RF25 MTP-Dropsonde Comparison 7



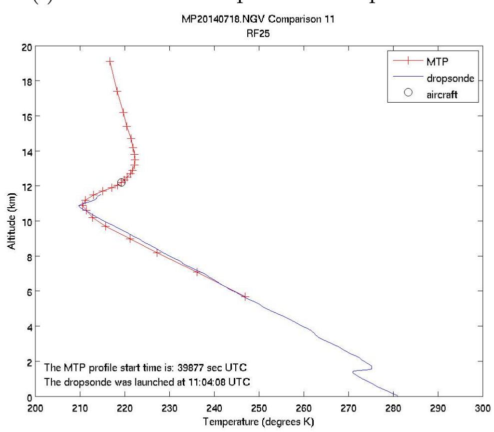
(h) RF25 MTP-Dropsonde Comparison 8



(i) RF25 MTP-Dropsonde Comparison 9



(j) RF25 MTP-Dropsonde Comparison 10



(k) RF25 MTP-Dropsonde Comparison 11

Figure 47: RF25 MTP-Dropsonde Comparisons

1.26 RF26

Tight racetrack pattern aligned with mountains, including passes over both Mt Cook and Mt Aspiring.nRetrieval quality is good (Figure 48).

See Figure 49 for RF26 MTP-Dropsonde comparisons.

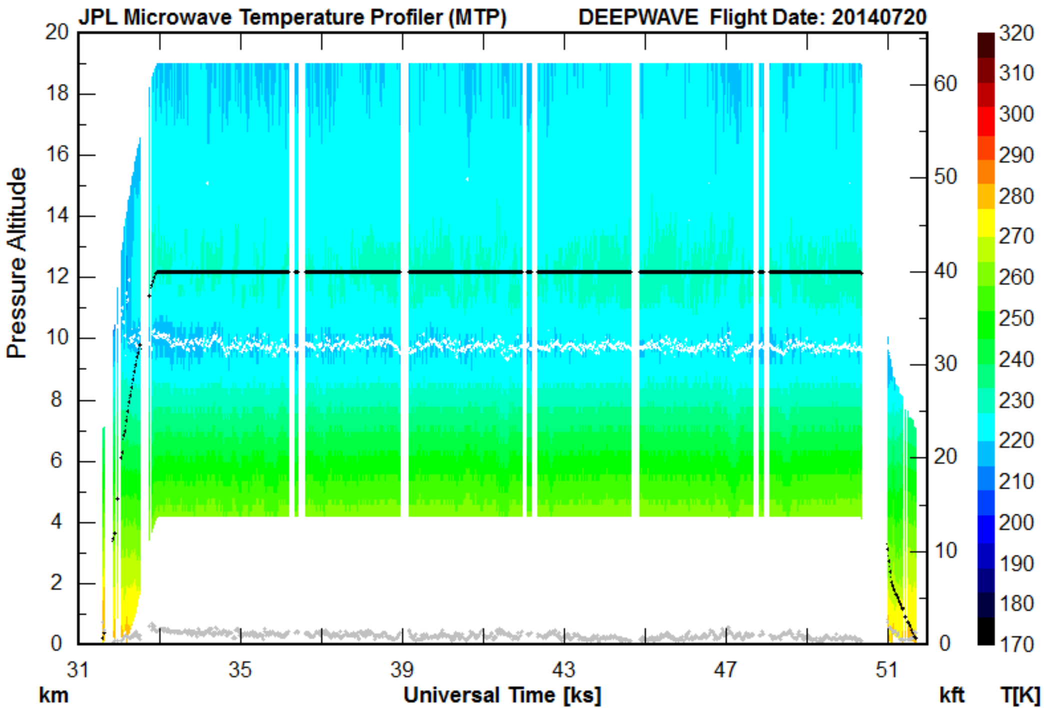
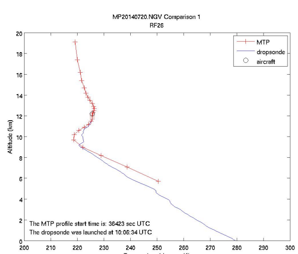
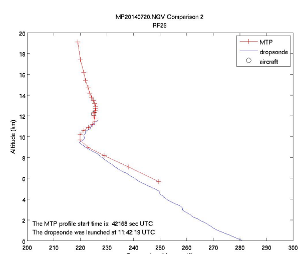


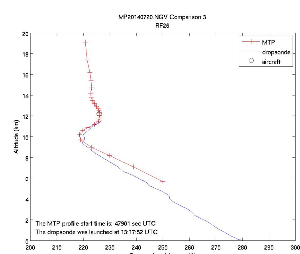
Figure 48: CTC Plot from Research Flight 26 on July 20, 2014



(a) RF26 MTP-Dropsonde Comparison 1



(b) RF26 MTP-Dropsonde Comparison 2



(c) RF26 MTP-Dropsonde Comparison 3

Figure 49: RF26 MTP-Dropsonde Comparisons

2 The Retrieval Process for DEEPWAVE

The scheme used to retrieve vertical temperature profiles from measurements is a statistical inversion method originally implemented by M.J. Mahoney (JPL). Radiosonde temperature profiles obtained from the region of the project are used to generate a priori information to constrain the retrieval. A forward radiative transfer calculation is performed on the selected set of radiosondes to obtain a set of corresponding brightness temperature profiles at each of the MTP frequencies. A regression is then performed to relate the set of brightness temperatures (TB) to the physical temperature at a specific altitude. The regression coefficients at each altitude in the profile, referred to as "retrieval coefficients", are then stored in a file associated with a specific radiosonde.

For each scan of the MTP, a measured brightness temperature profile is obtained by applying appropriate calibrations. During the retrieval process, each measured TB profile is compared to each of model-generated TB profiles derived from radiosondes. An optimal estimation technique is employed to select the model-generated TB profile that most closely approximates the measured TB profile. Having identified the closest match, the algorithm obtains the retrieval coefficients associated with the select radiosonde. Those coefficients are then applied to the measured TB at each frequency and angle to calculate the physical temperature. The uncertainty associated with the retrieval process is a function of how well the radiosonde TB profiles approximate the measured TB profiles, and is characterized by the MRI parameter.

Due to the significant spatial and temporal variability in the temperature field during DEEPWAVE, obtaining a set of radiosonde profiles that would approximate our observations was quite challenging. Despite frequent launches of special raobs during the project, we encountered numerous situations where the observed temperature structure did not resemble any of the available raob profiles on a given flight date. Using dropsonde profiles to generate retrieval coefficients was a possibility and would obviously more closely approximate MTP observations, but dropsondes only provide information below the aircraft while MTP retrievals require a priori information above and below. In addition, we prefer to reserve dropsonde data for independent validation of our retrievals. Hence, we searched radiosonde databases for the region in years prior to DEEPWAVE, and also employed COSMIC profiles. Ultimately, we collected a reasonably representative set of temperature profiles that captured the features observed in DEEPWAVE, although this task required an a priori data set about twice the size of our usual sets. And even with this larger set, there are still instances where the differences between measured TBs and modeled TBs are larger than we would prefer. For this reason, retrieval uncertainties as characterized by the MRI parameter are somewhat larger than we normally see, but are still within acceptable ranges.