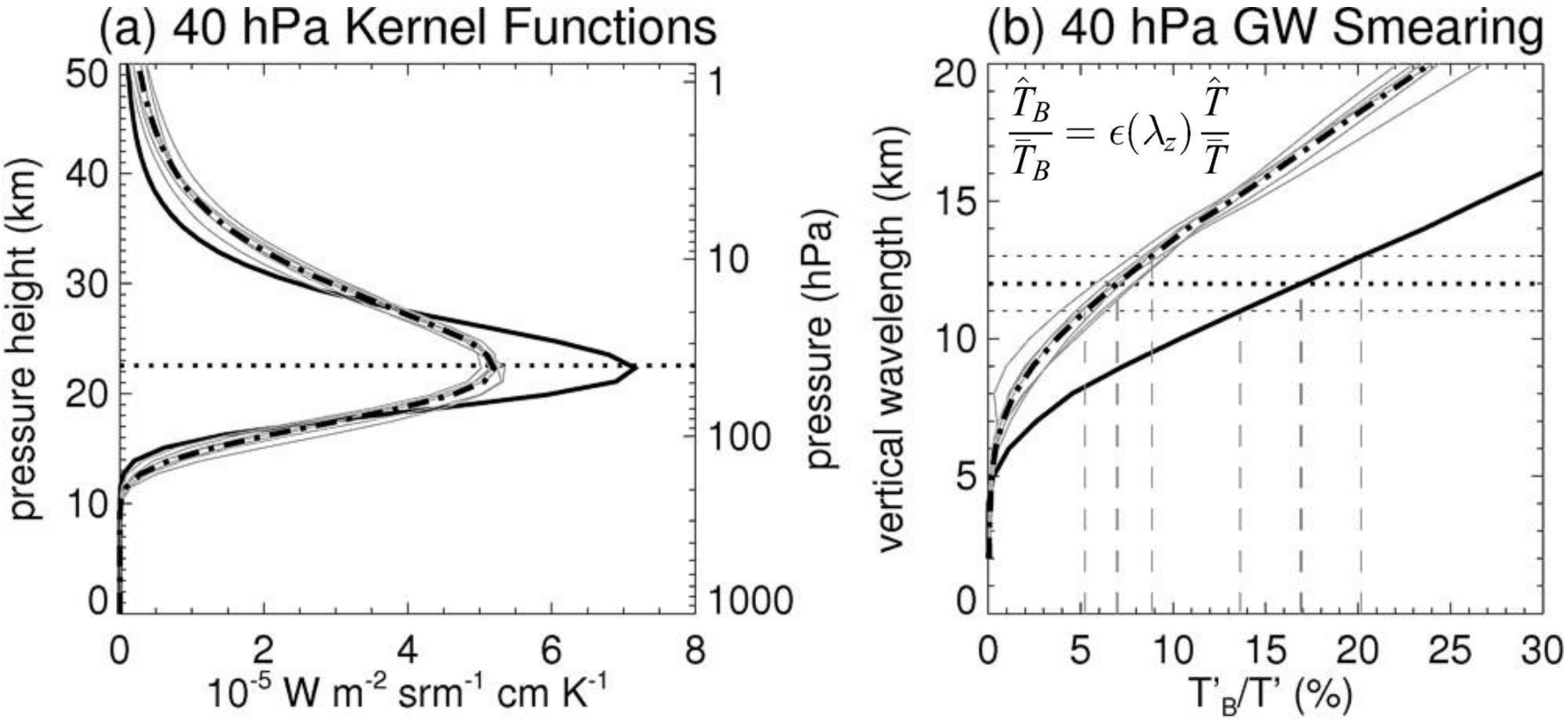
# AIRS 40 hPa Radiance Channels




AIRS channels 64, 88, 90, 94, 100, 106 & 118 (665.015–678.839 $cm^{-1}$)

Individual Channel Radiances 64,…,118

Mean Channel Radiance 64,..,118

AIRS channel 71 (666.773 $cm^{-1}$).

see Hoffmann and Alexander (JGR, 2009)
Eckermann et al. (GRL 2009)

# Variation of Gravity-Wave Vertical Wavelength with Winds

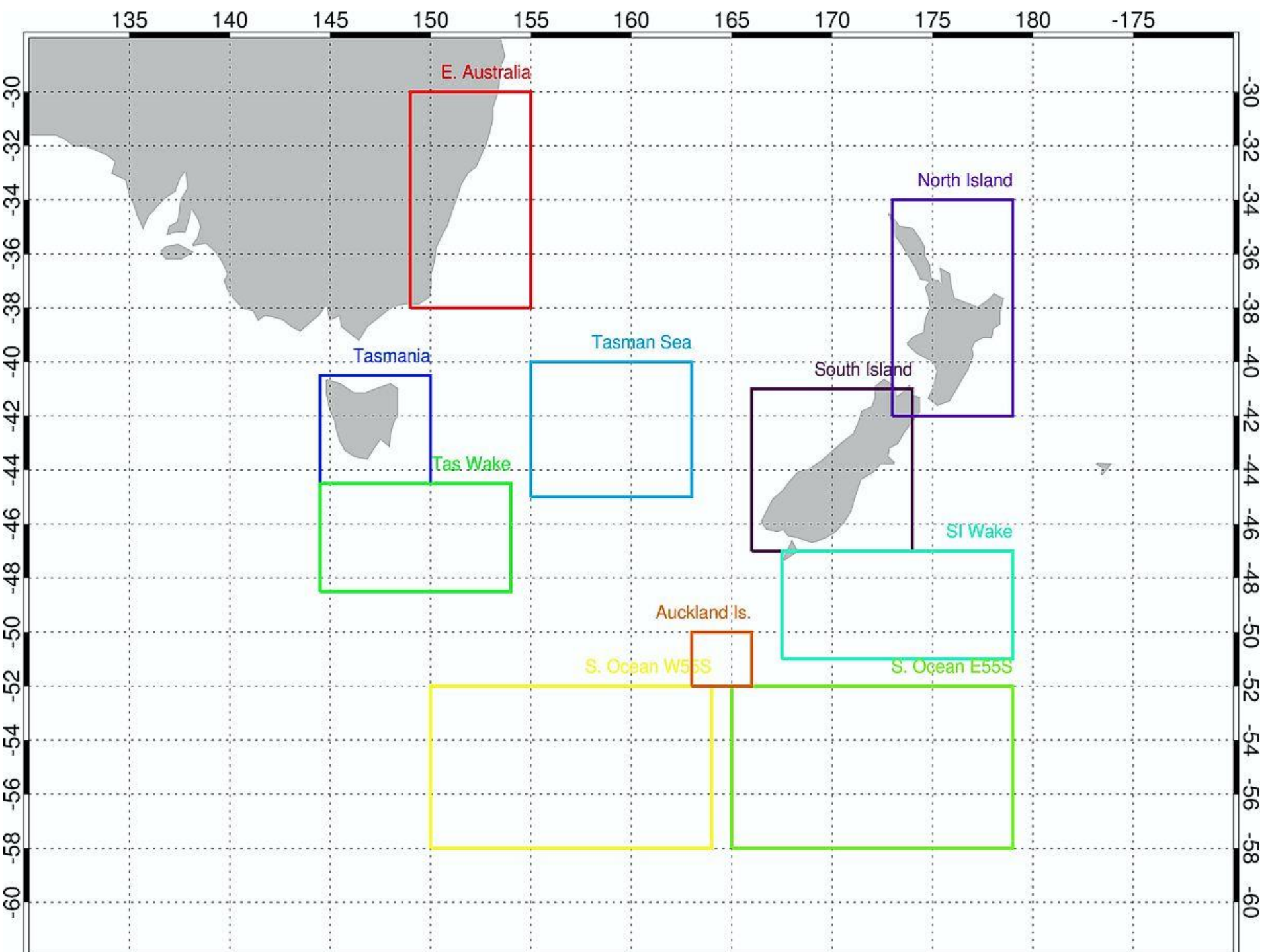
$$\lambda_Z = \frac{2\pi \left| c - \overline{U}\cos\left(\phi - \varphi\right) \right|}{N} \propto \overline{U}$$

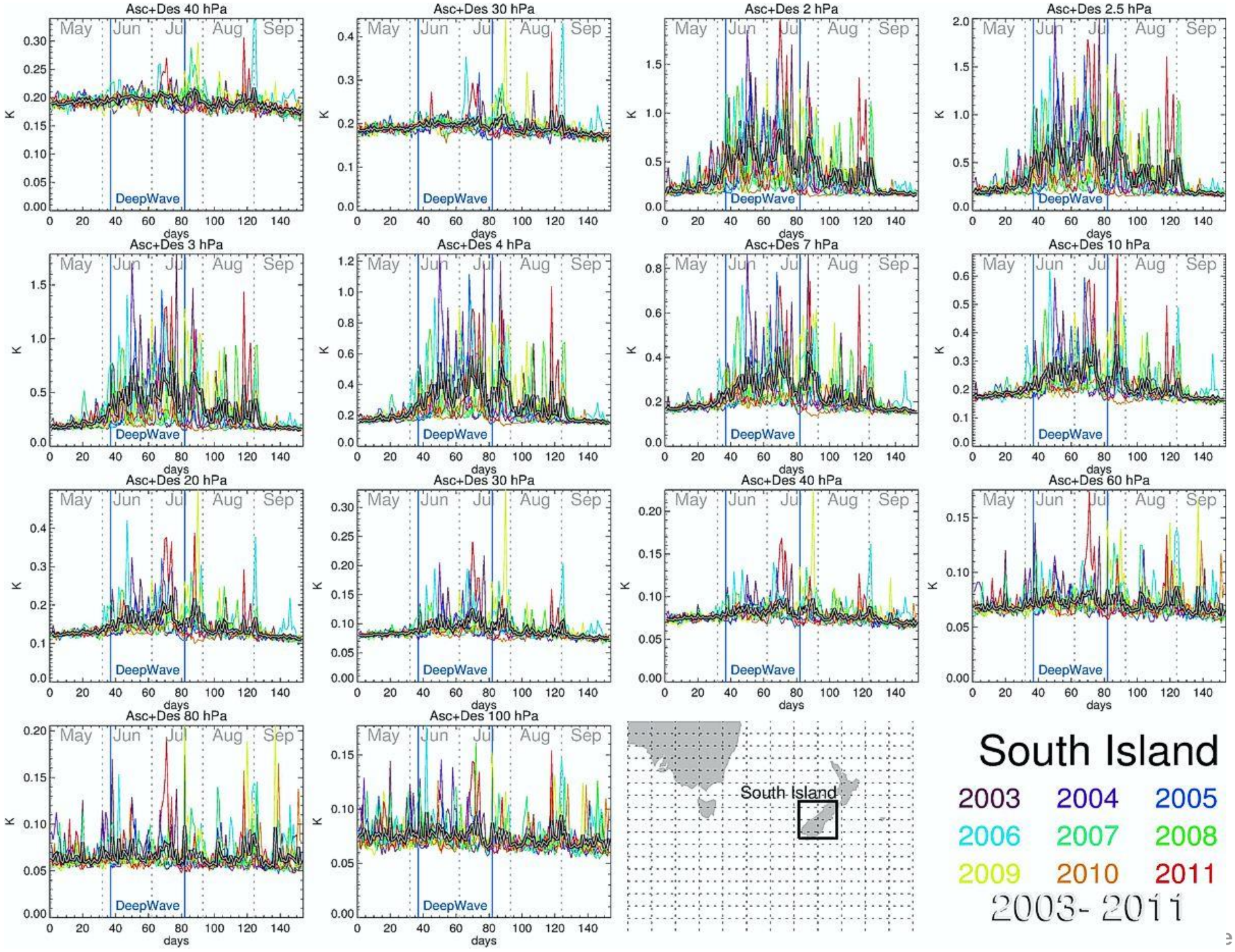
| | |
|---|---|
| $\varphi$ | wind vector azimuth |
| $\phi$ | wave vector azimuth |
| $\lambda_Z$ | gravity-wave vertical wavelength |
| $c$ | gravity-wave phase velocity ($c \approx 0$) |
| $N$ | background buoyancy frequency |
| $\overline{U}$ | background wind speed |

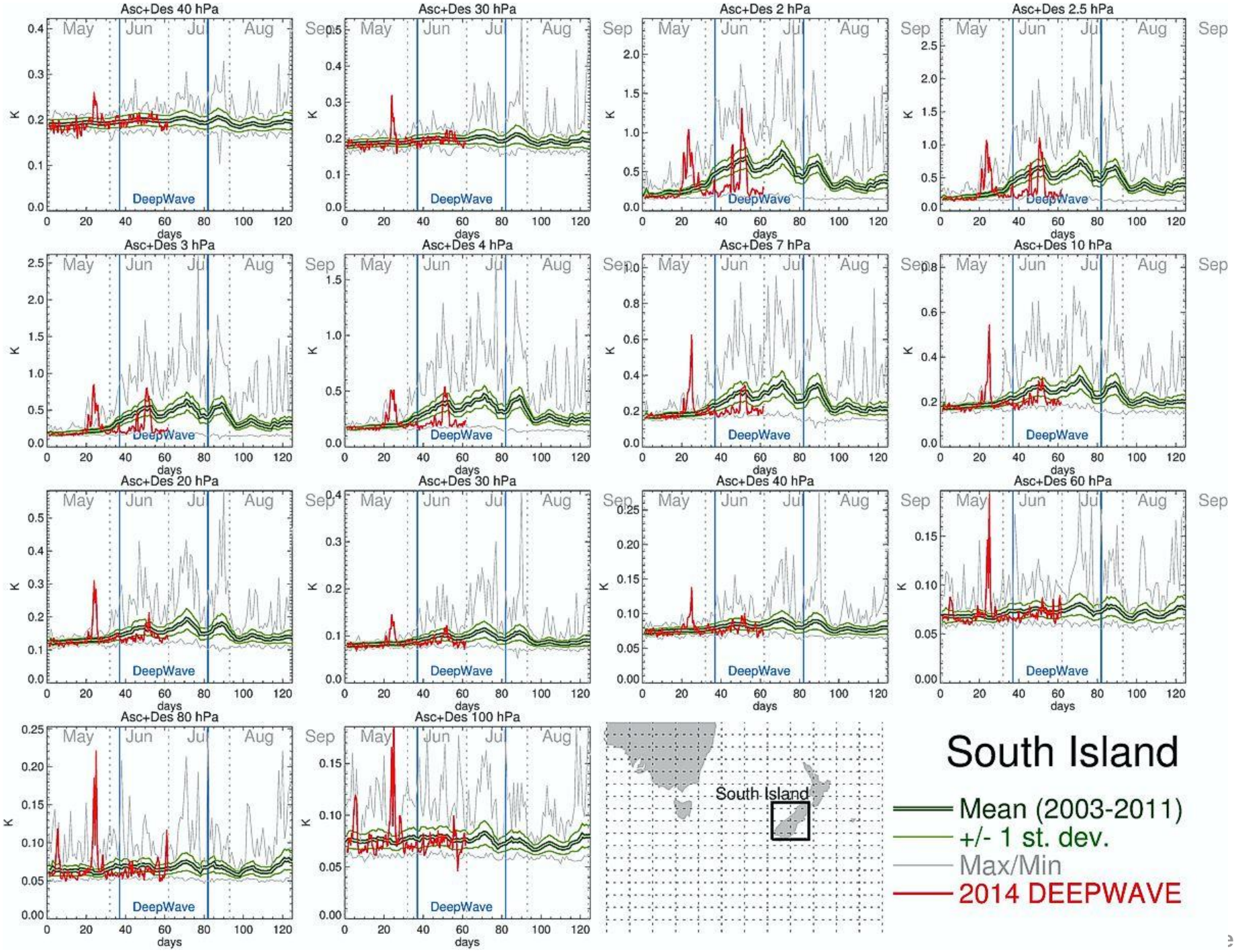
# Channel Averaging: 100-2 hPa

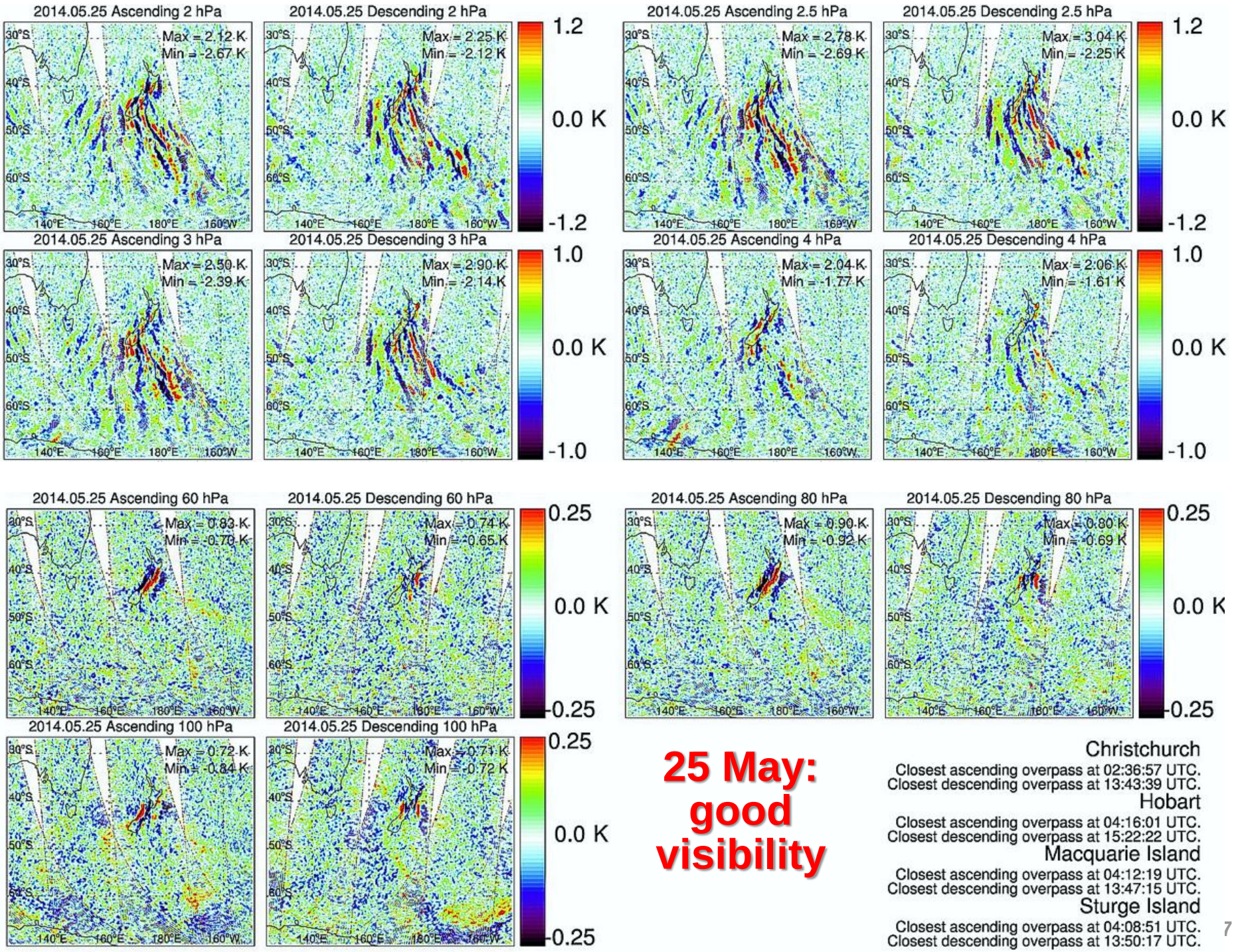
## 50 raw channel radiances → 12 net channel radiances

| Pressure (hPa) | Channel numbers | Noise ($K^2$) | NEdT ($K^2$) | Min. detectable GW var. ($\times 10^{-3}$ $K^2$) | |
|---|---|---|---|---|---|
| | | | | Zonal mean | Map |
| 2 | 74 | 0.149 | 0.165 | 3.78 | 26.64 |
| 2.5 | 75 | 0.147 | 0.166 | 3.72 | 26.22 |
| 3 | 76 | 0.143 | 0.161 | 3.63 | 25.55 |
| 4 | 77 | 0.145 | 0.160 | 3.66 | 25.80 |
| 7 | **78** | 0.153 | 0.162 | 3.88 | 27.34 |
| 10 | **79** | 0.182 | 0.172 | 4.62 | 32.53 |
| 20 | 81, 82 | 0.084 | 0.078 | 2.14 | 15.05 |
| 30 | **102**, **108**, **114**, **120**, 125, 126 | 0.039 | 0.029 | 0.98 | 6.88 |
| 40 | 64, 88, 90, **94**, **100**, 106, 118 | 0.033 | 0.028 | 0.83 | 5.86 |
| 60 | 66, 68, 70, 86, 87, 91, 93, **97**, 130 | 0.026 | 0.018 | 0.66 | 4.68 |
| 80 | 92, 98, 104, 105, 110, 111, **116**, 117, 122, 123, 128, 129, 134, 140 | 0.020 | 0.011 | 0.50 | 3.54 |
| 100 | 132, 133, 138, 139, 149, 152 | 0.026 | 0.014 | 0.67 | 4.73 |


135
140
145
150
155
160
165
170
175
180
-175
-30
-32
-34
-36
-38
-40
-42
-44
-46
-48
-50
-52
-54
-56
-58
-60
E. Australia
North Island
Tasman Sea
Tasmania
South Island
Tas Wake
SI Wake
Auckland Is.
S. Ocean W55S
S. Ocean E55S


Asc+Des 40 hPa
Asc+Des 30 hPa
Asc+Des 2 hPa
Asc+Des 2.5 hPa
Asc+Des 3 hPa
Asc+Des 4 hPa
Asc+Des 7 hPa
Asc+Des 10 hPa
Asc+Des 20 hPa
Asc+Des 30 hPa
Asc+Des 40 hPa
Asc+Des 60 hPa
Asc+Des 80 hPa
Asc+Des 100 hPa
May
Jun
Jul
Aug
Sep
DeepWave
K
days
South Island
2003
2004
2005
2006
2007
2008
2009
2010
2011
2003- 2011


Asc+Des 40 hPa
Asc+Des 30 hPa
Asc+Des 2 hPa
Asc+Des 2.5 hPa
Asc+Des 3 hPa
Asc+Des 4 hPa
Asc+Des 7 hPa
Asc+Des 10 hPa
Asc+Des 20 hPa
Asc+Des 30 hPa
Asc+Des 40 hPa
Asc+Des 60 hPa
Asc+Des 80 hPa
Asc+Des 100 hPa
May
Jun
Jul
Aug
Sep
K
days
DeepWave
South Island
Mean (2003-2011)
+/- 1 st. dev.
Max/Min
2014 DEEPWAVE



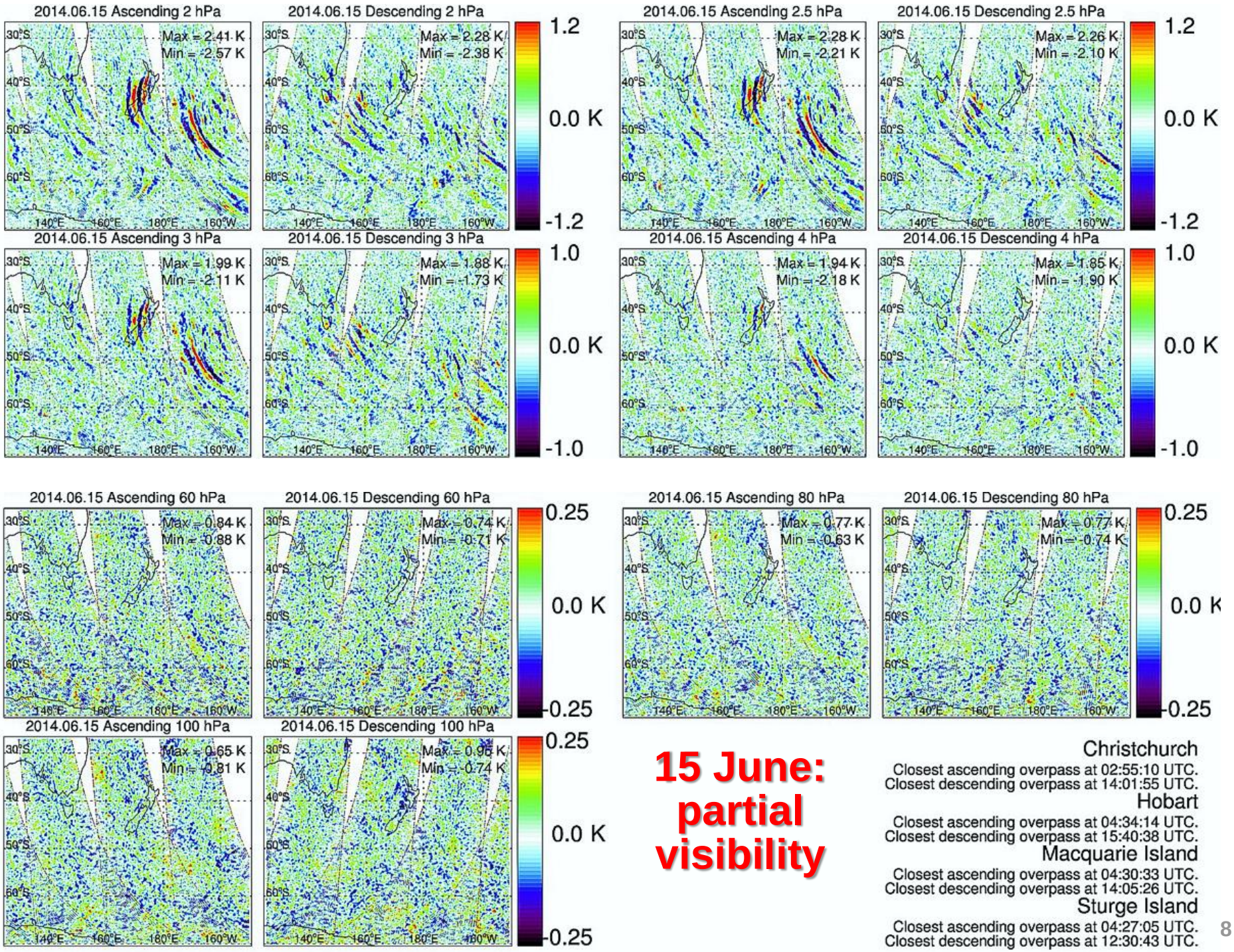

**25 May: good visibility**

**Christchurch**
Closest ascending overpass at 02:36:57 UTC.
Closest descending overpass at 13:43:39 UTC.

**Hobart**
Closest ascending overpass at 04:16:01 UTC.
Closest descending overpass at 15:22:22 UTC.

**Macquarie Island**
Closest ascending overpass at 04:12:19 UTC.
Closest descending overpass at 13:47:15 UTC.

**Sturge Island**
Closest ascending overpass at 04:08:51 UTC.
Closest descending overpass at 13:50:17 UTC.



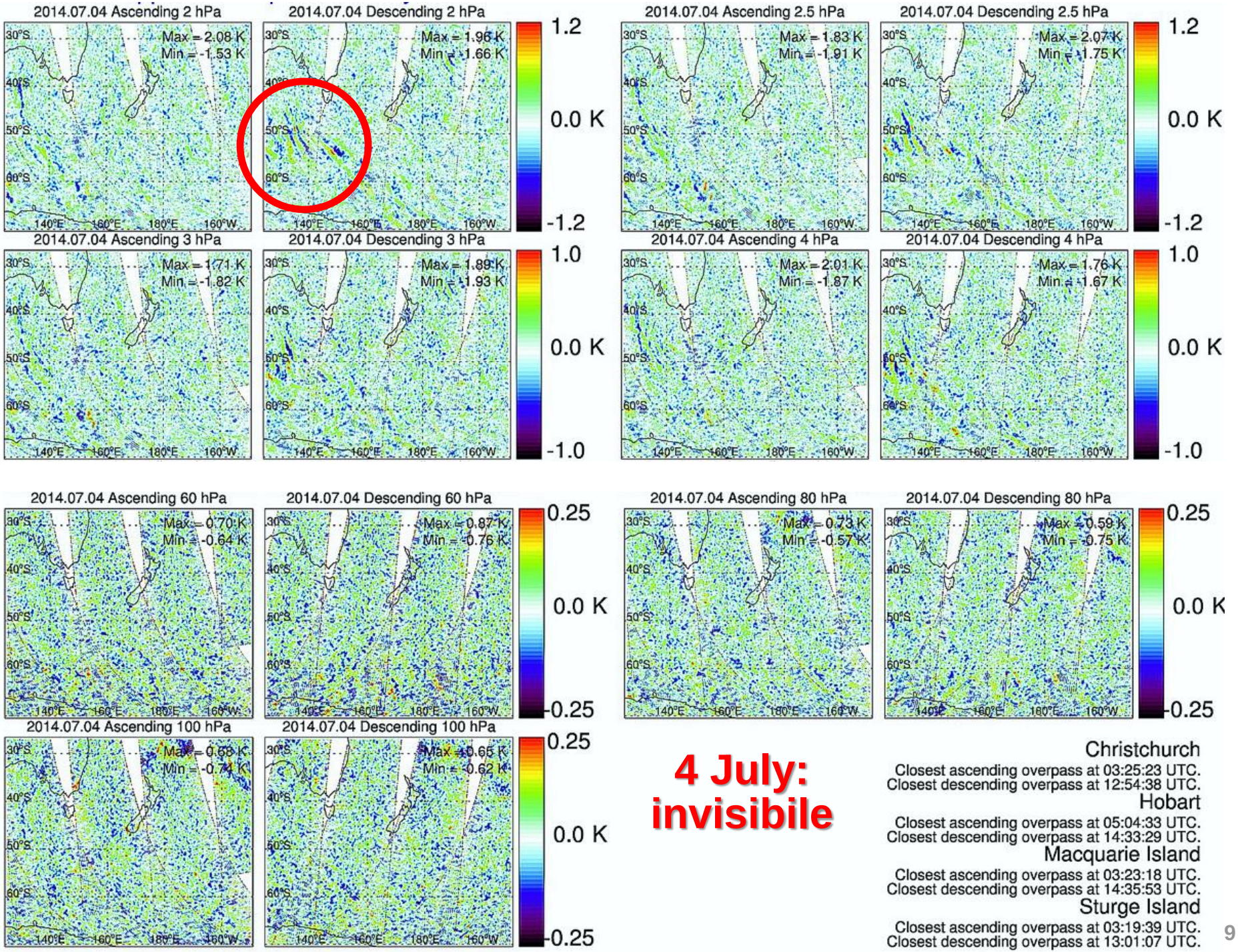

**15 June: partial visibility**

**Christchurch**
Closest ascending overpass at 02:55:10 UTC.
Closest descending overpass at 14:01:55 UTC.

**Hobart**
Closest ascending overpass at 04:34:14 UTC.
Closest descending overpass at 15:40:38 UTC.

**Macquarie Island**
Closest ascending overpass at 04:30:33 UTC.
Closest descending overpass at 14:05:26 UTC.

**Sturge Island**
Closest ascending overpass at 04:27:05 UTC.
Closest descending overpass at 12:30:43 UTC.




**4 July: invisibile**

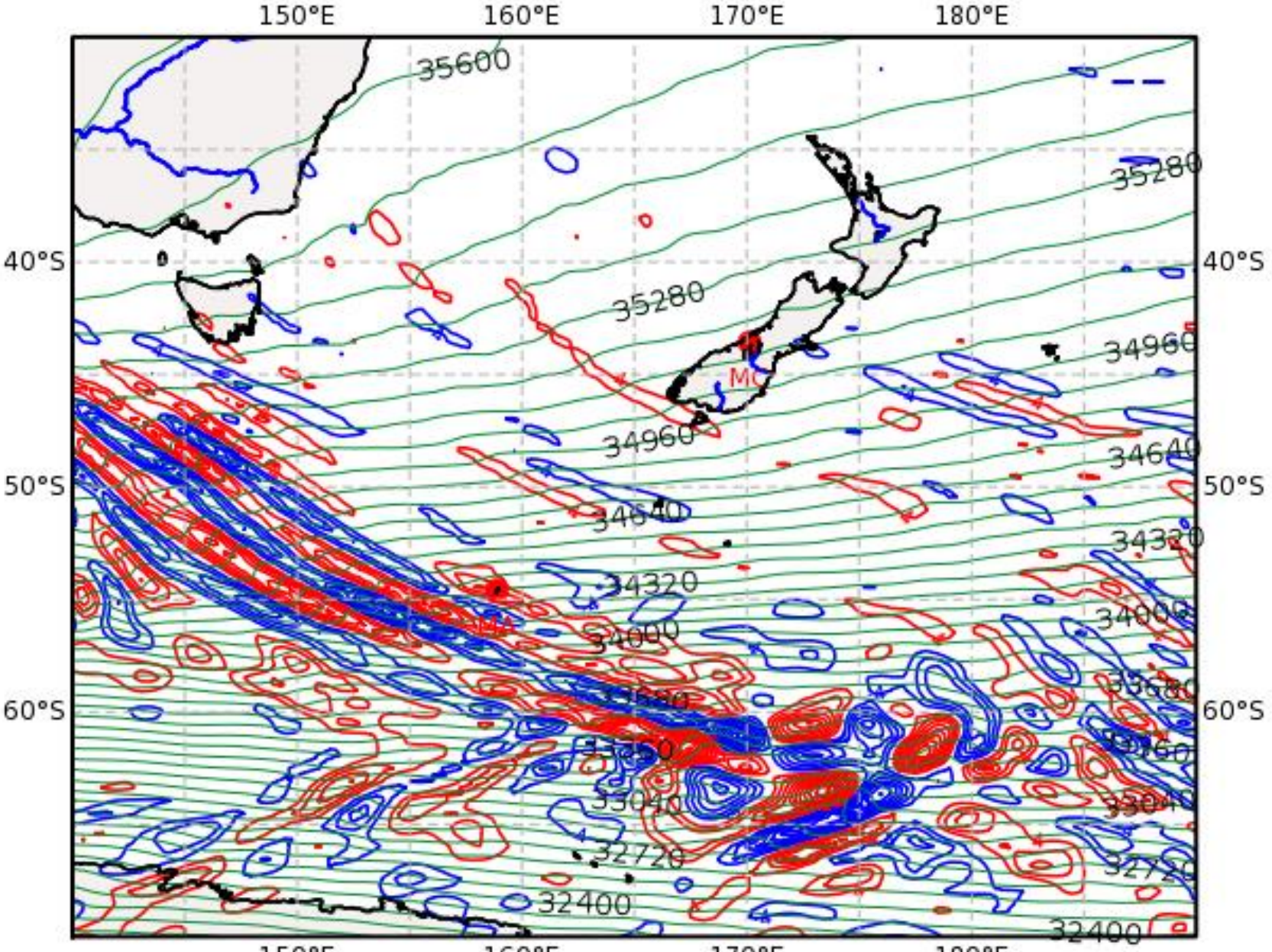
**Christchurch**
Closest ascending overpass at 03:25:23 UTC.
Closest descending overpass at 12:54:38 UTC.

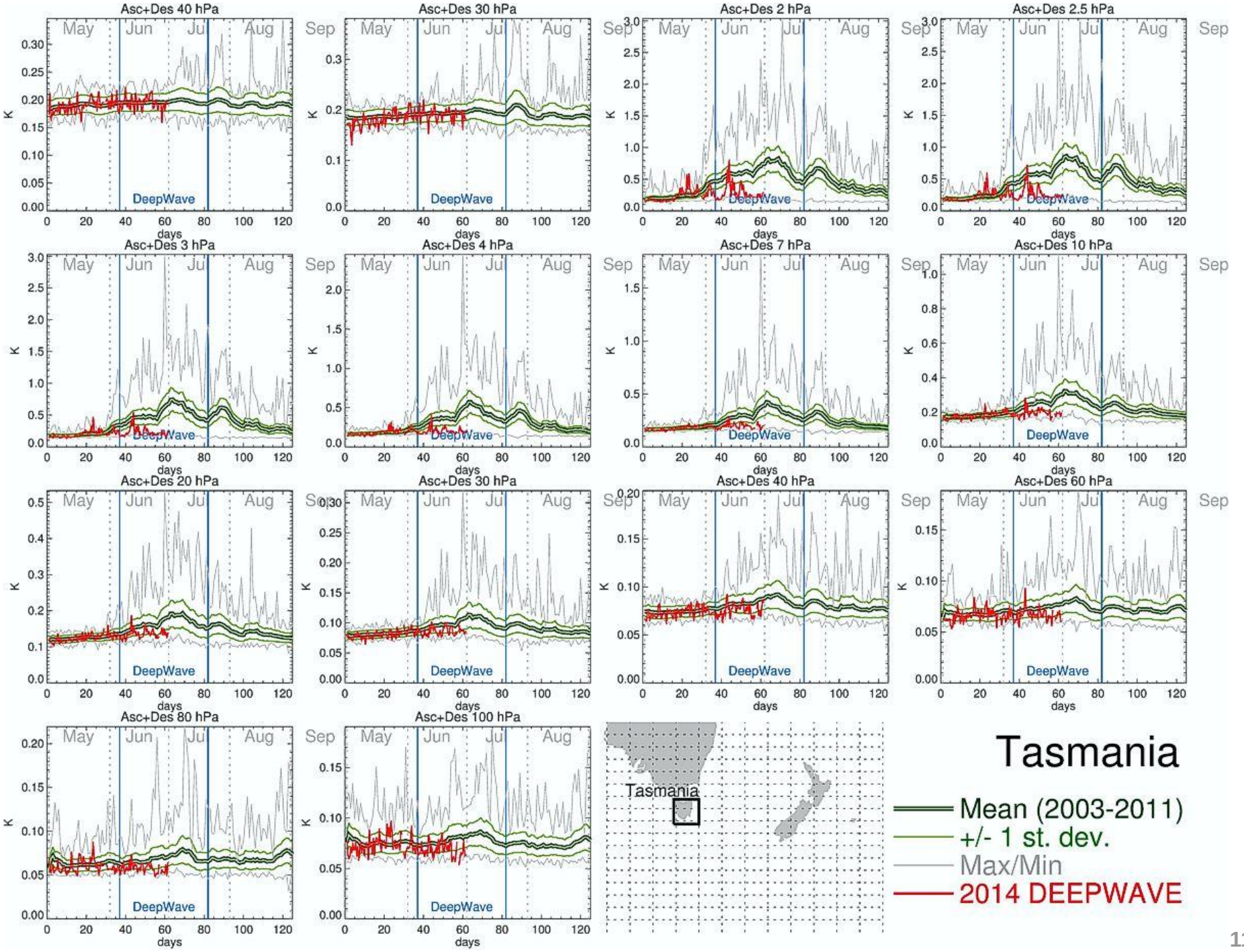
**Hobart**
Closest ascending overpass at 05:04:33 UTC.
Closest descending overpass at 14:33:29 UTC.

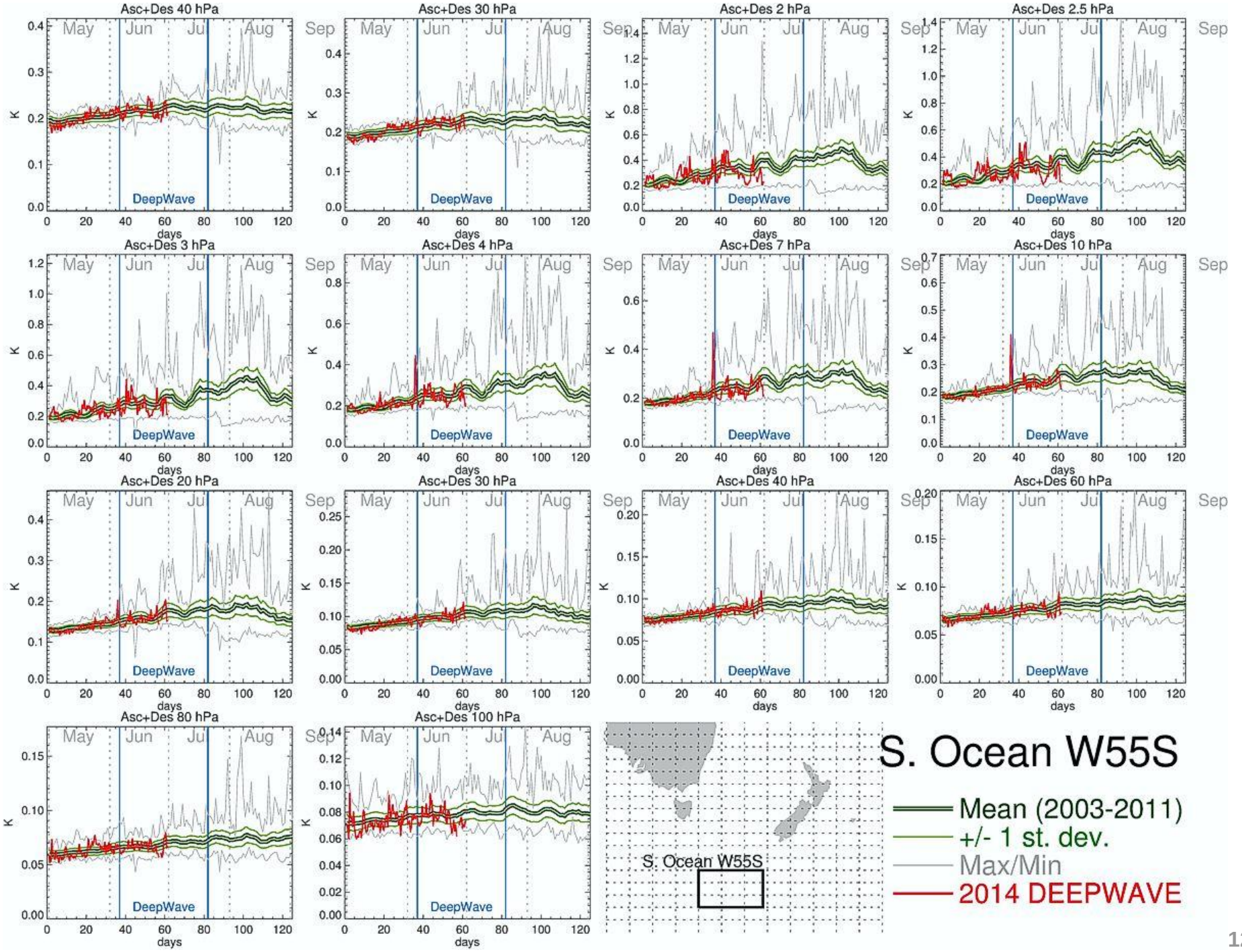
**Macquarie Island**
Closest ascending overpass at 03:23:18 UTC.
Closest descending overpass at 14:35:53 UTC.

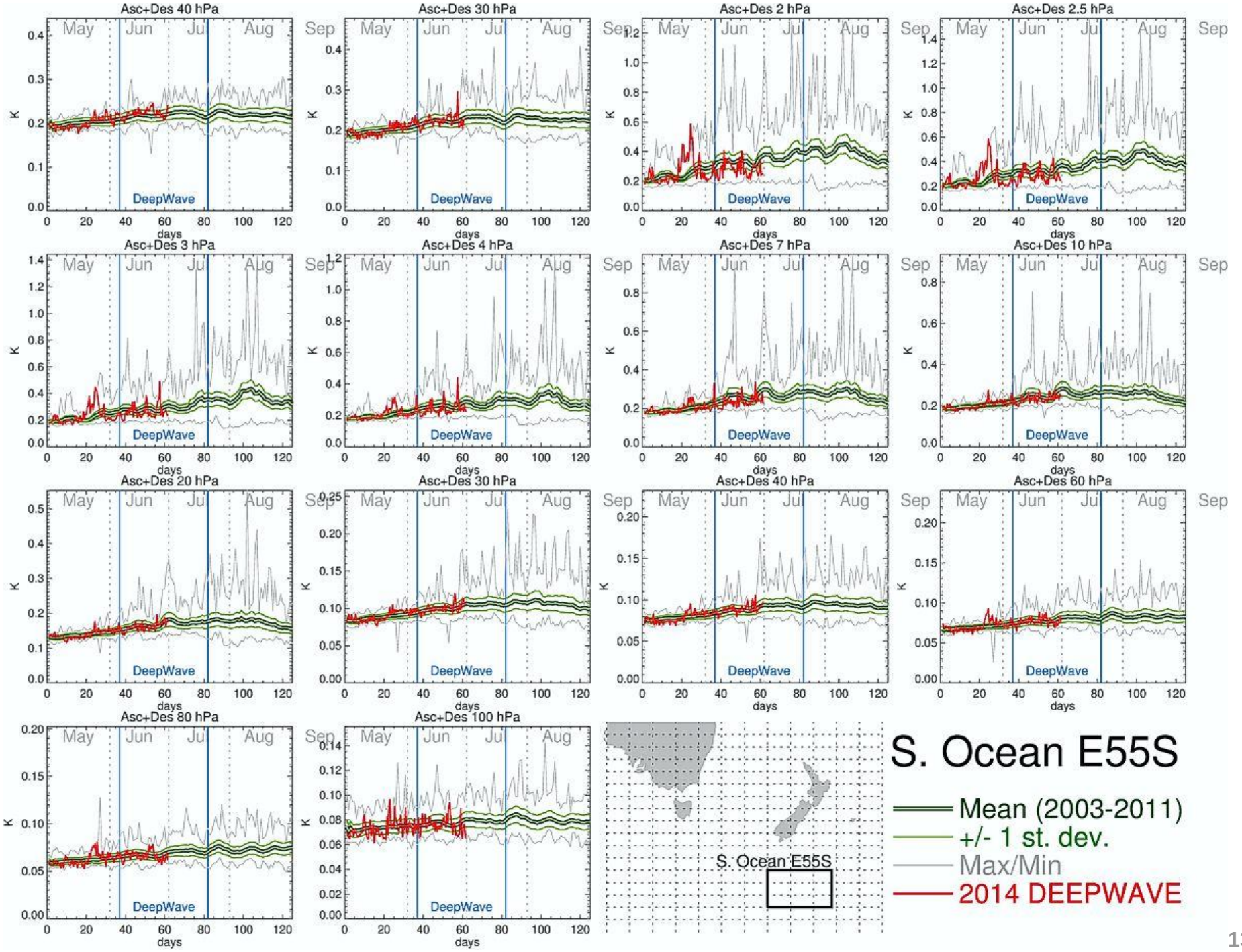
**Sturge Island**
Closest ascending overpass at 03:19:39 UTC.
Closest descending overpass at 13:01:07 UTC.

DIV (10^-5 s^-1, pos.: red, neg.: blue, Delta=4.) and Z (m) at 5 hPa
Valid: Sun, 06 Jul 2014, 12 UTC (step 048 h from Fri, 04 Jul 2014, 12 UTC)

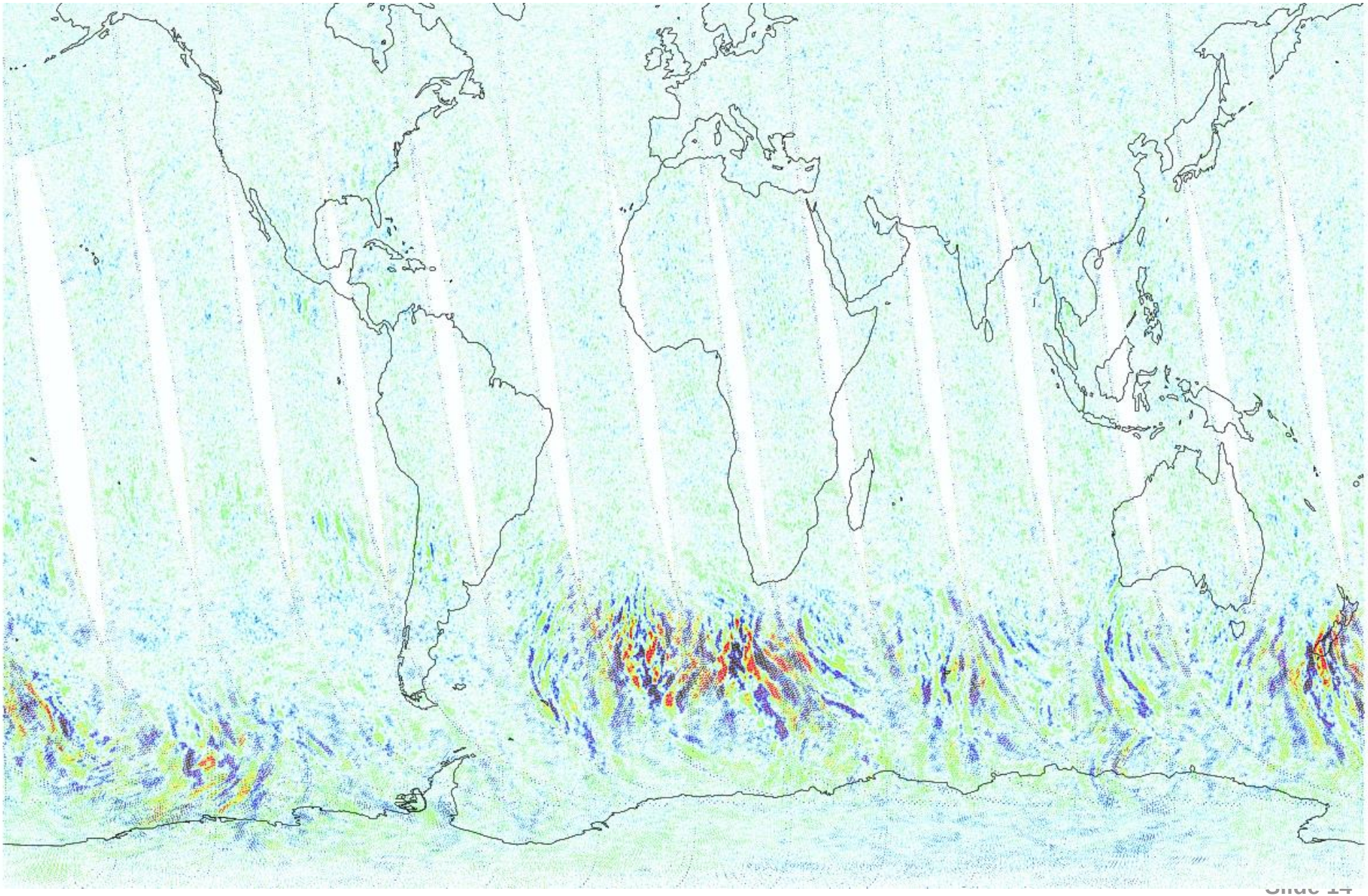


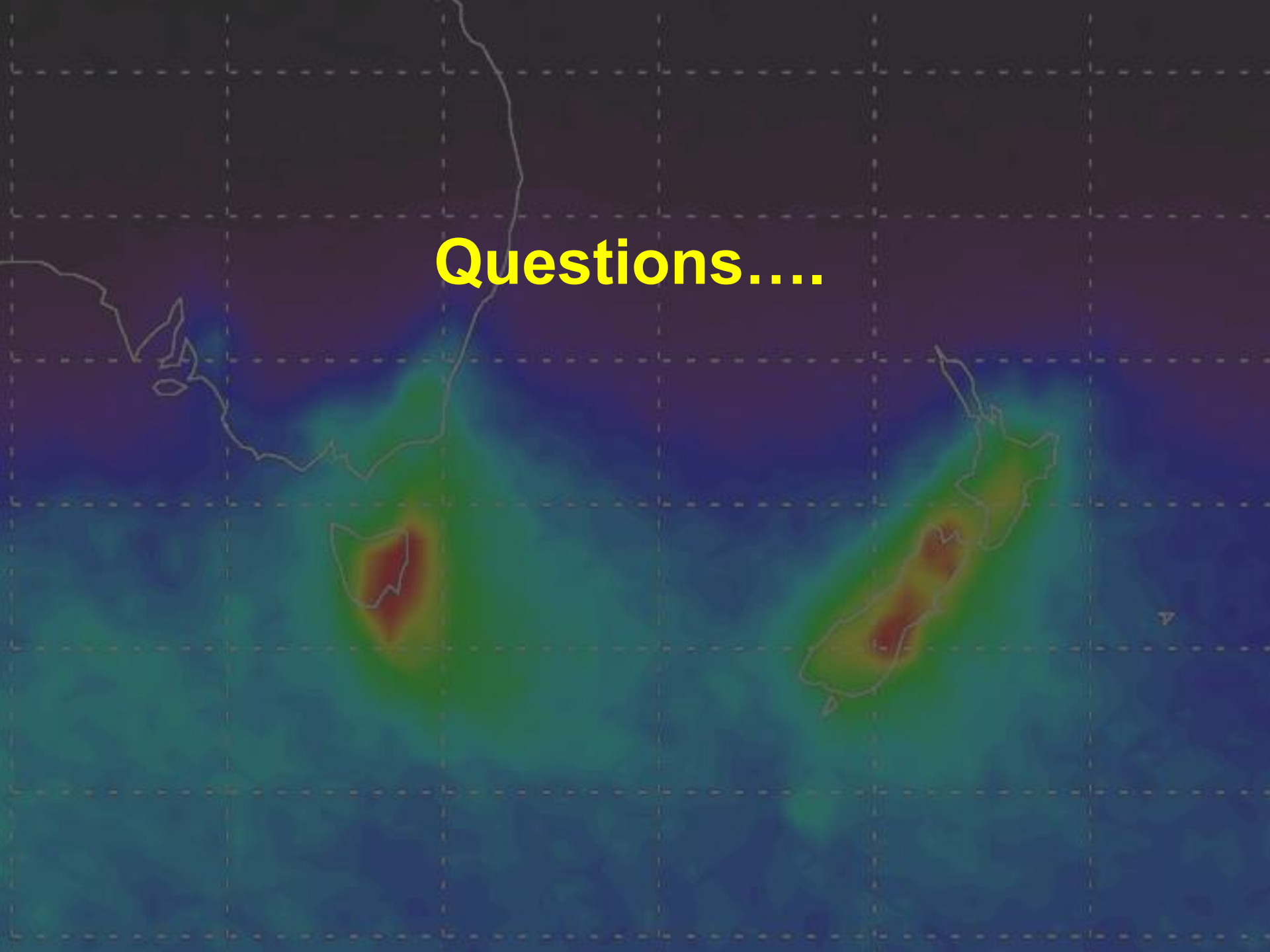

Asc+Des 40 hPa
Asc+Des 30 hPa
Asc+Des 2 hPa
Asc+Des 2.5 hPa
Asc+Des 3 hPa
Asc+Des 4 hPa
Asc+Des 7 hPa
Asc+Des 10 hPa
Asc+Des 20 hPa
Asc+Des 30 hPa
Asc+Des 40 hPa
Asc+Des 60 hPa
Asc+Des 80 hPa
Asc+Des 100 hPa
May
Jun
Jul
Aug
Sep
K
days
DeepWave
Tasmania
Tasmania
Mean (2003-2011)
+/- 1 st. dev.
Max/Min
2014 DEEPWAVE

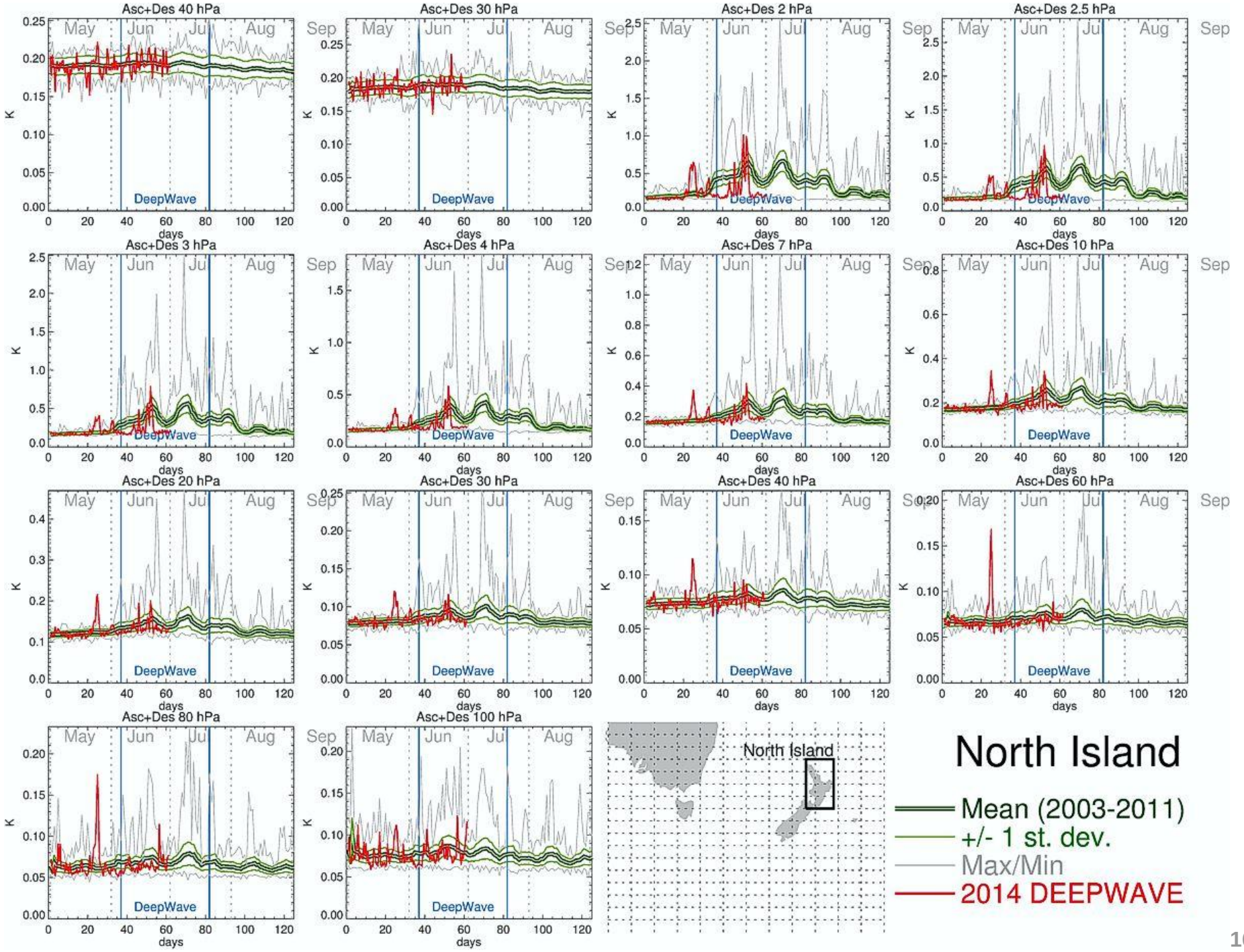

Asc+Des 40 hPa
Asc+Des 30 hPa
Asc+Des 2 hPa
Asc+Des 2.5 hPa
Asc+Des 3 hPa
Asc+Des 4 hPa
Asc+Des 7 hPa
Asc+Des 10 hPa
Asc+Des 20 hPa
Asc+Des 30 hPa
Asc+Des 40 hPa
Asc+Des 60 hPa
Asc+Des 80 hPa
Asc+Des 100 hPa
May
Jun
Jul
Aug
Sep
DeepWave
K
days
S. Ocean W55S
Mean (2003-2011)
+/- 1 st. dev.
Max/Min
2014 DEEPWAVE

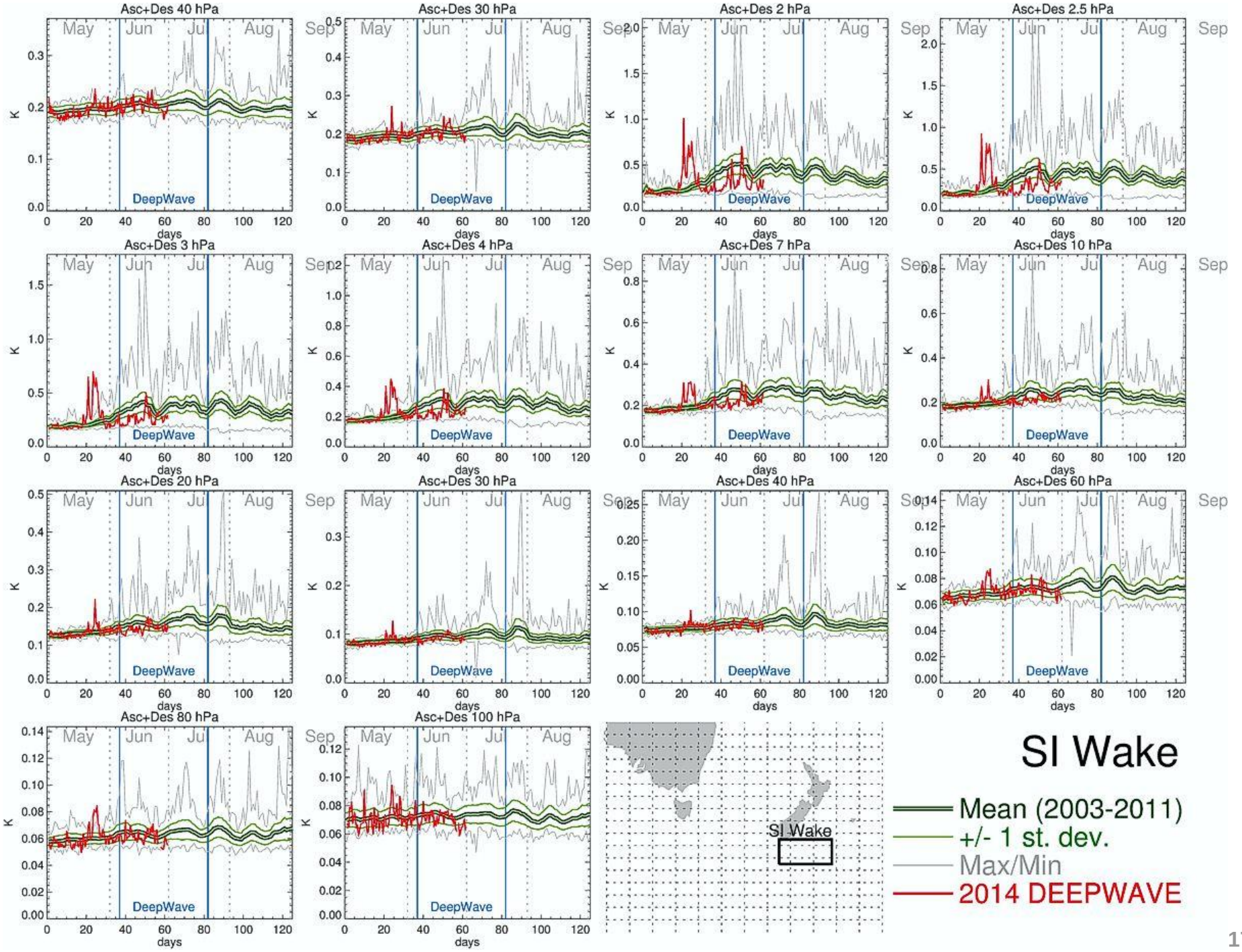

Asc+Des 40 hPa
Asc+Des 30 hPa
Asc+Des 2 hPa
Asc+Des 2.5 hPa
Asc+Des 3 hPa
Asc+Des 4 hPa
Asc+Des 7 hPa
Asc+Des 10 hPa
Asc+Des 20 hPa
Asc+Des 30 hPa
Asc+Des 40 hPa
Asc+Des 60 hPa
Asc+Des 80 hPa
Asc+Des 100 hPa
May
Jun
Jul
Aug
Sep
K
days
DeepWave
S. Ocean E55S
S. Ocean E55S
Mean (2003-2011)
+/- 1 st. dev.
Max/Min
2014 DEEPWAVE

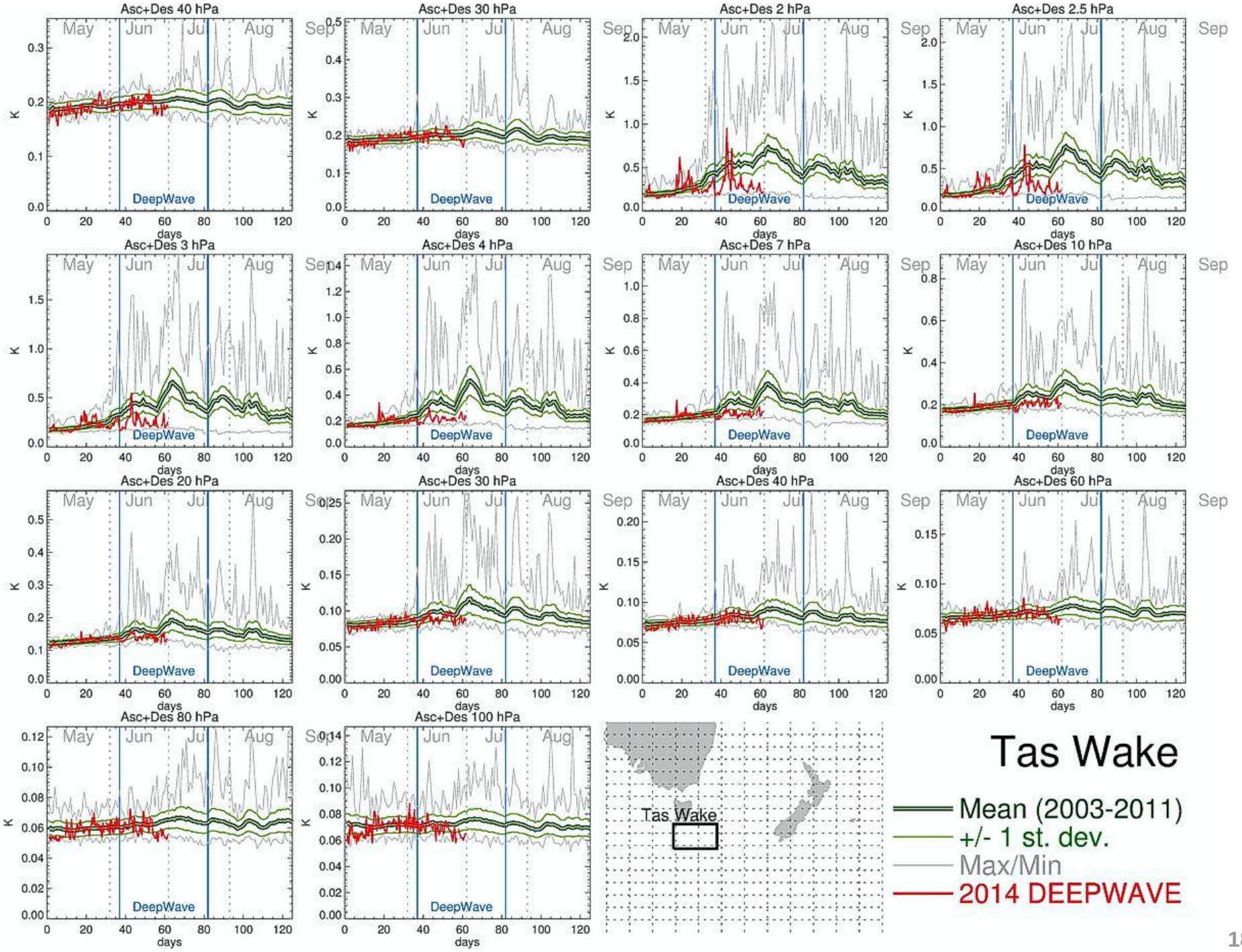
# Cross-Track Infrared Sounder: 25 May 2014

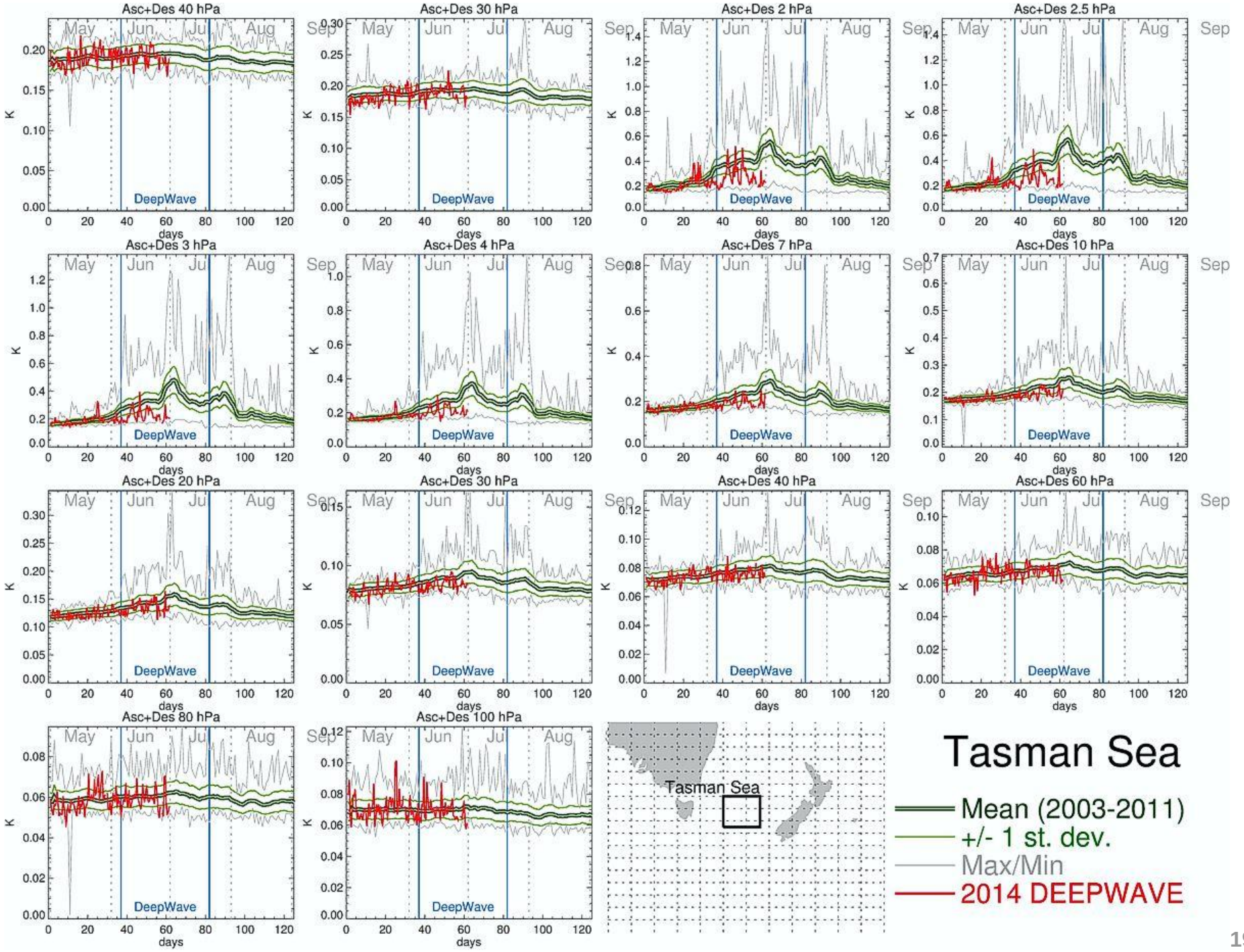



Questions….


Asc+Des 40 hPa
Asc+Des 30 hPa
Asc+Des 2 hPa
Asc+Des 2.5 hPa
Asc+Des 3 hPa
Asc+Des 4 hPa
Asc+Des 7 hPa
Asc+Des 10 hPa
Asc+Des 20 hPa
Asc+Des 30 hPa
Asc+Des 40 hPa
Asc+Des 60 hPa
Asc+Des 80 hPa
Asc+Des 100 hPa
May
Jun
Jul
Aug
Sep
DeepWave
K
days
North Island
North Island
Mean (2003-2011)
+/- 1 st. dev.
Max/Min
2014 DEEPWAVE


Asc+Des 40 hPa
Asc+Des 30 hPa
Asc+Des 2 hPa
Asc+Des 2.5 hPa
Asc+Des 3 hPa
Asc+Des 4 hPa
Asc+Des 7 hPa
Asc+Des 10 hPa
Asc+Des 20 hPa
Asc+Des 30 hPa
Asc+Des 40 hPa
Asc+Des 60 hPa
Asc+Des 80 hPa
Asc+Des 100 hPa
May
Jun
Jul
Aug
Sep
DeepWave
K
days
SI Wake
SI Wake
Mean (2003-2011)
+/- 1 st. dev.
Max/Min
2014 DEEPWAVE


Asc+Des 40 hPa
Asc+Des 30 hPa
Asc+Des 2 hPa
Asc+Des 2.5 hPa
Asc+Des 3 hPa
Asc+Des 4 hPa
Asc+Des 7 hPa
Asc+Des 10 hPa
Asc+Des 20 hPa
Asc+Des 30 hPa
Asc+Des 40 hPa
Asc+Des 60 hPa
Asc+Des 80 hPa
Asc+Des 100 hPa
May
Jun
Jul
Aug
Sep
DeepWave
K
days
Tas Wake
Tas Wake
Mean (2003-2011)
+/- 1 st. dev.
Max/Min
2014 DEEPWAVE


Asc+Des 40 hPa
Asc+Des 30 hPa
Asc+Des 2 hPa
Asc+Des 2.5 hPa
Asc+Des 3 hPa
Asc+Des 4 hPa
Asc+Des 7 hPa
Asc+Des 10 hPa
Asc+Des 20 hPa
Asc+Des 30 hPa
Asc+Des 40 hPa
Asc+Des 60 hPa
Asc+Des 80 hPa
Asc+Des 100 hPa
May
Jun
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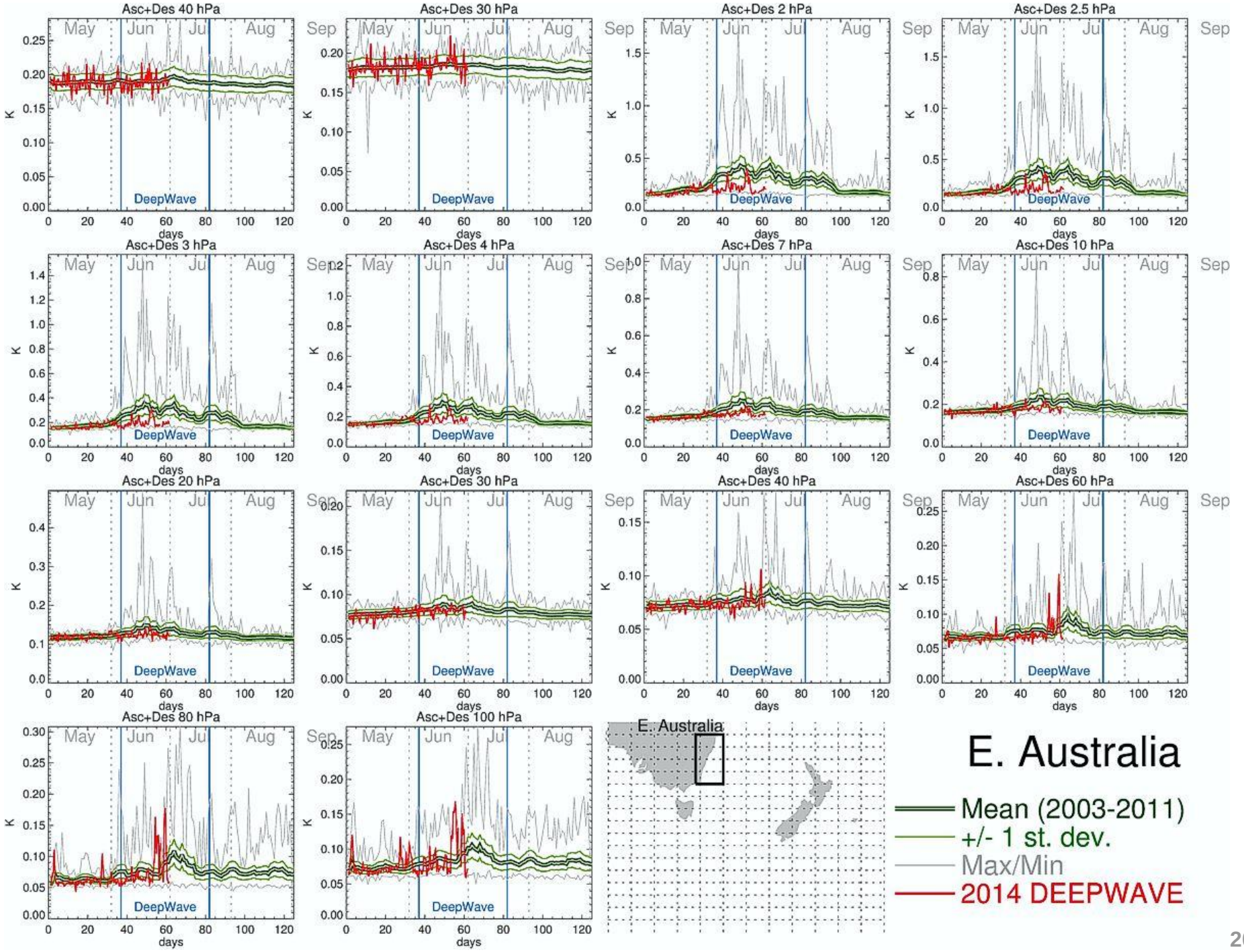
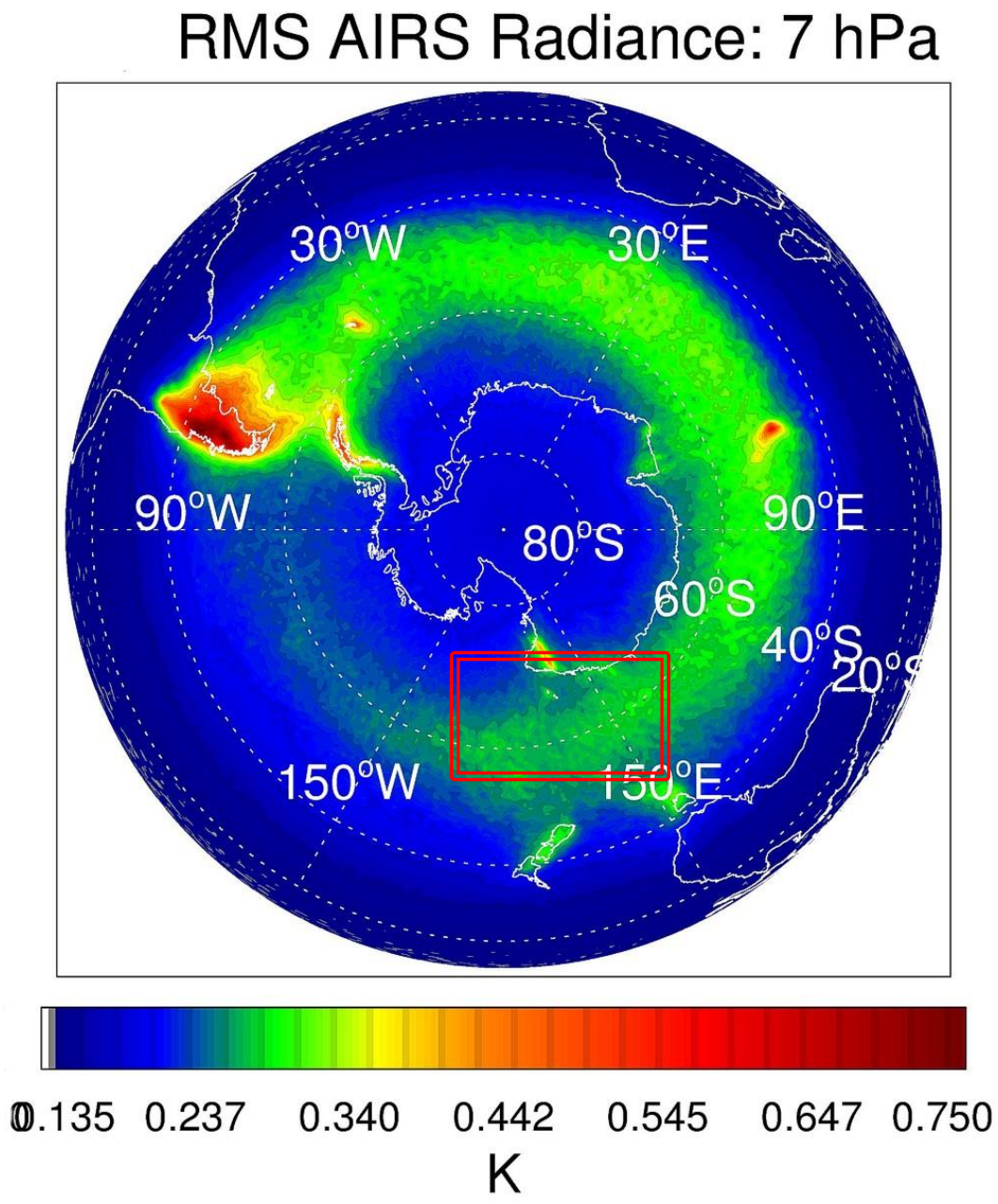
Sep
DeepWave
K
days
Tasman Sea
Tasman Sea
Mean (2003-2011)
+/- 1 st. dev.
Max/Min
2014 DEEPWAVE


Asc+Des 40 hPa
Asc+Des 30 hPa
Asc+Des 2 hPa
Asc+Des 2.5 hPa
Asc+Des 3 hPa
Asc+Des 4 hPa
Asc+Des 7 hPa
Asc+Des 10 hPa
Asc+Des 20 hPa
Asc+Des 30 hPa
Asc+Des 40 hPa
Asc+Des 60 hPa
Asc+Des 80 hPa
Asc+Des 100 hPa
May
Jun
Jul
Aug
Sep
DeepWave
K
days
E. Australia
E. Australia
Mean (2003-2011)
+/- 1 st. dev.
Max/Min
2014 DEEPWAVE

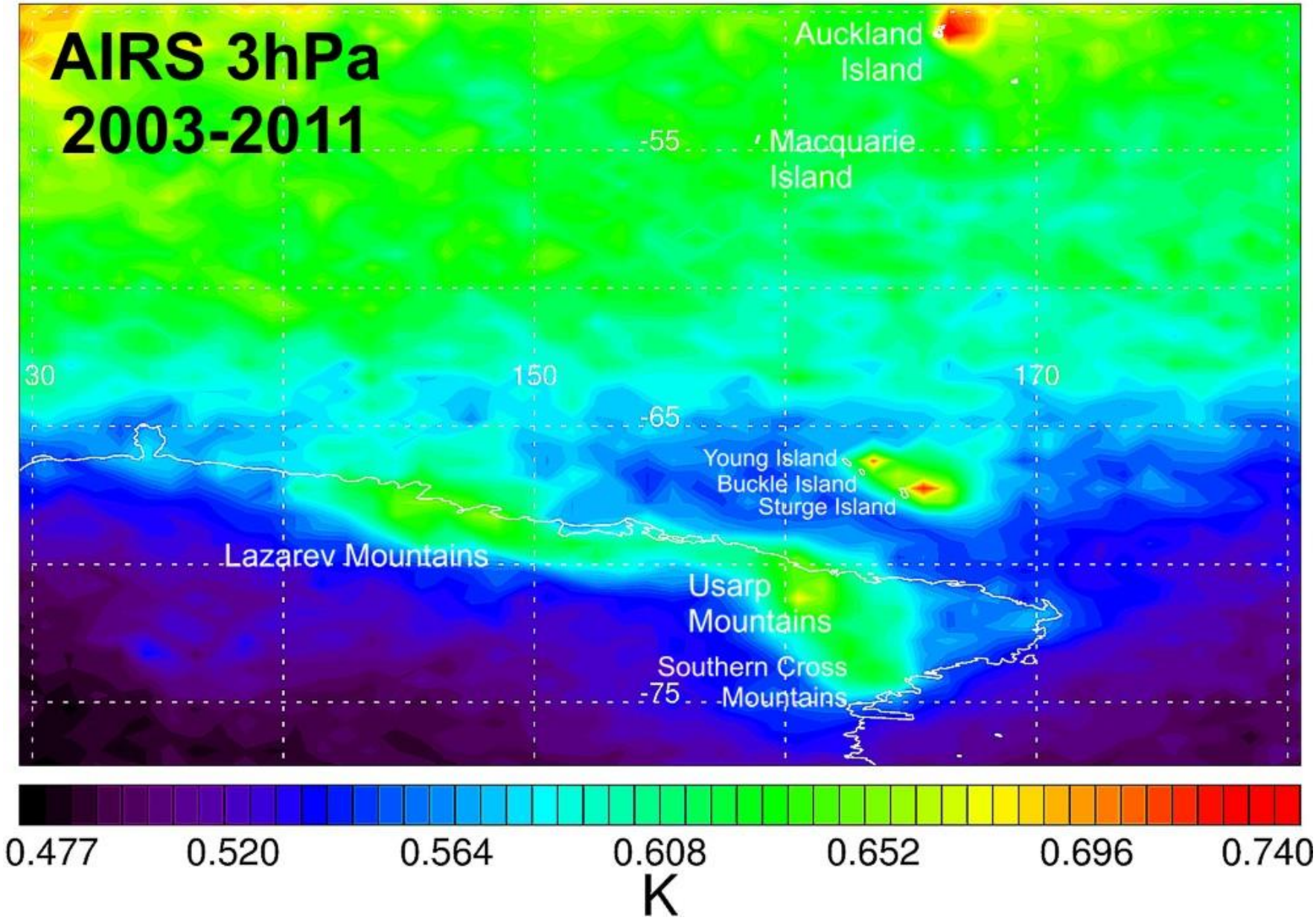


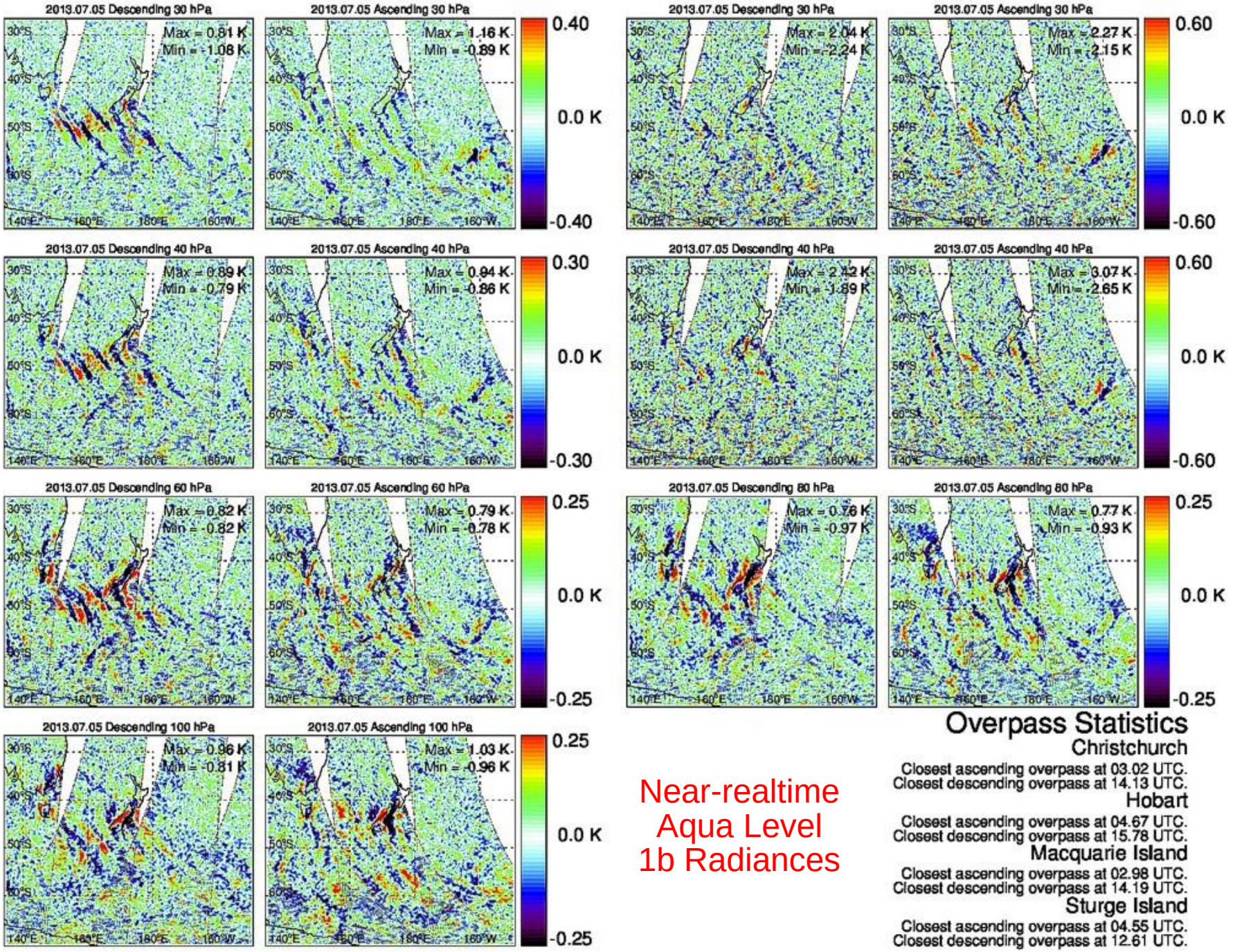

# Hemispheric Perspective

- Broad band of enhanced variance over Southern Ocean
- Clearly nonorographic sources
- Well correlated with midlatitude spiral jet

***Hendricks et al. J. Atmos. Sci., in press, 2014.***

# Southern Ocean to Antarctica






Near-realtime
Aqua Level
1b Radiances

## Overpass Statistics

### Christchurch

Closest ascending overpass at 03.02 UTC.
Closest descending overpass at 14.13 UTC.

### Hobart

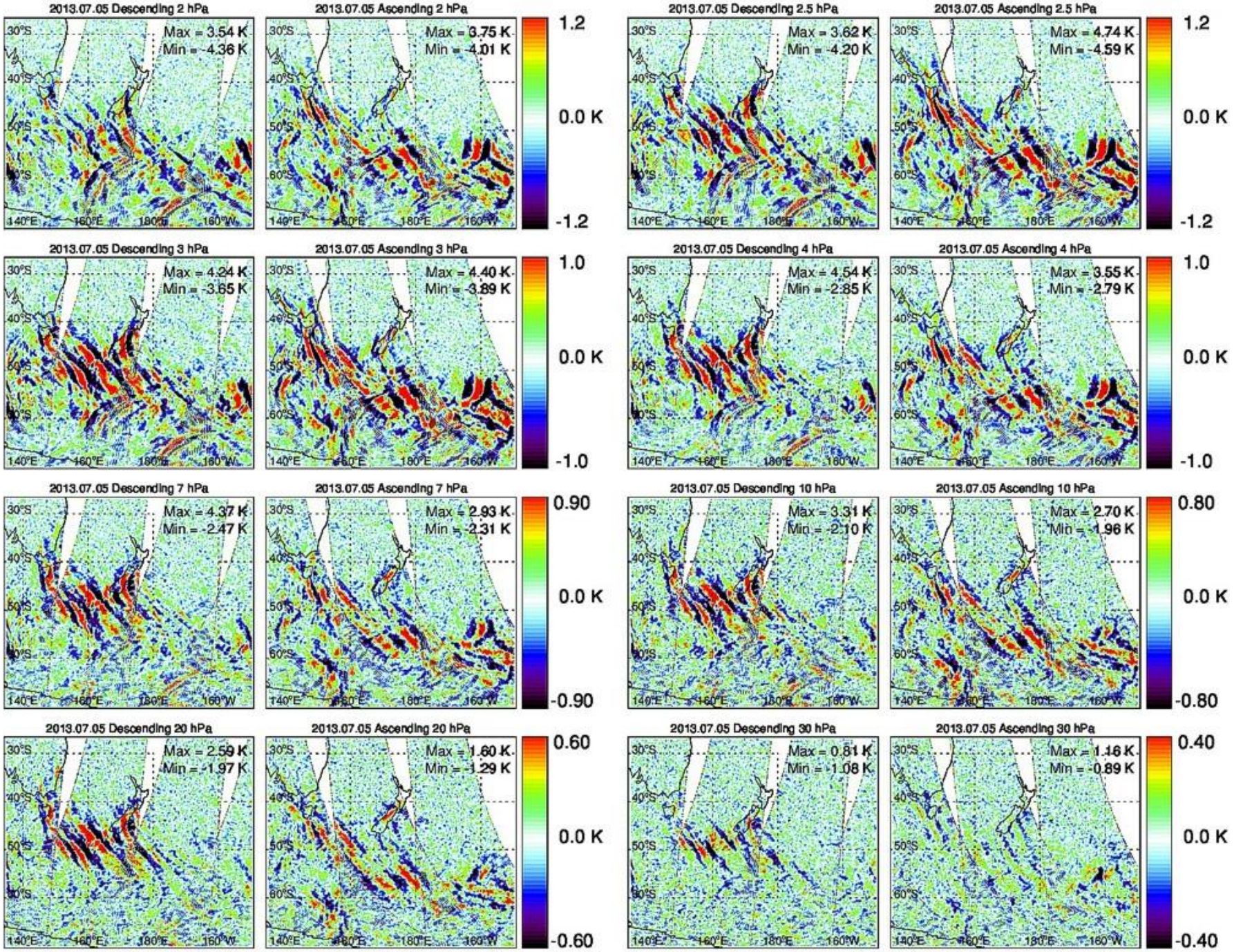
Closest ascending overpass at 04.67 UTC.
Closest descending overpass at 15.78 UTC.

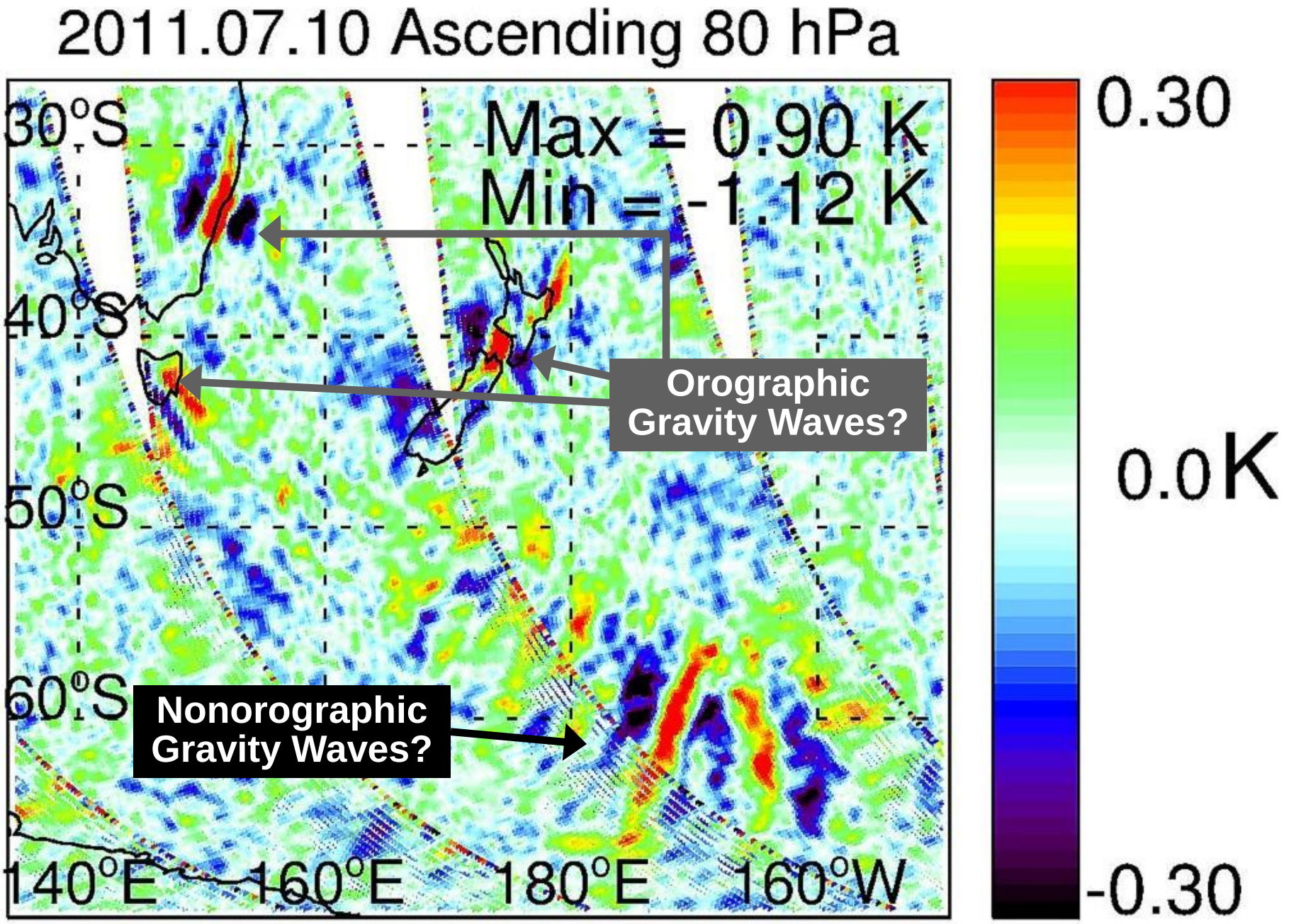
### Macquarie Island

Closest ascending overpass at 02.98 UTC.
Closest descending overpass at 14.19 UTC.

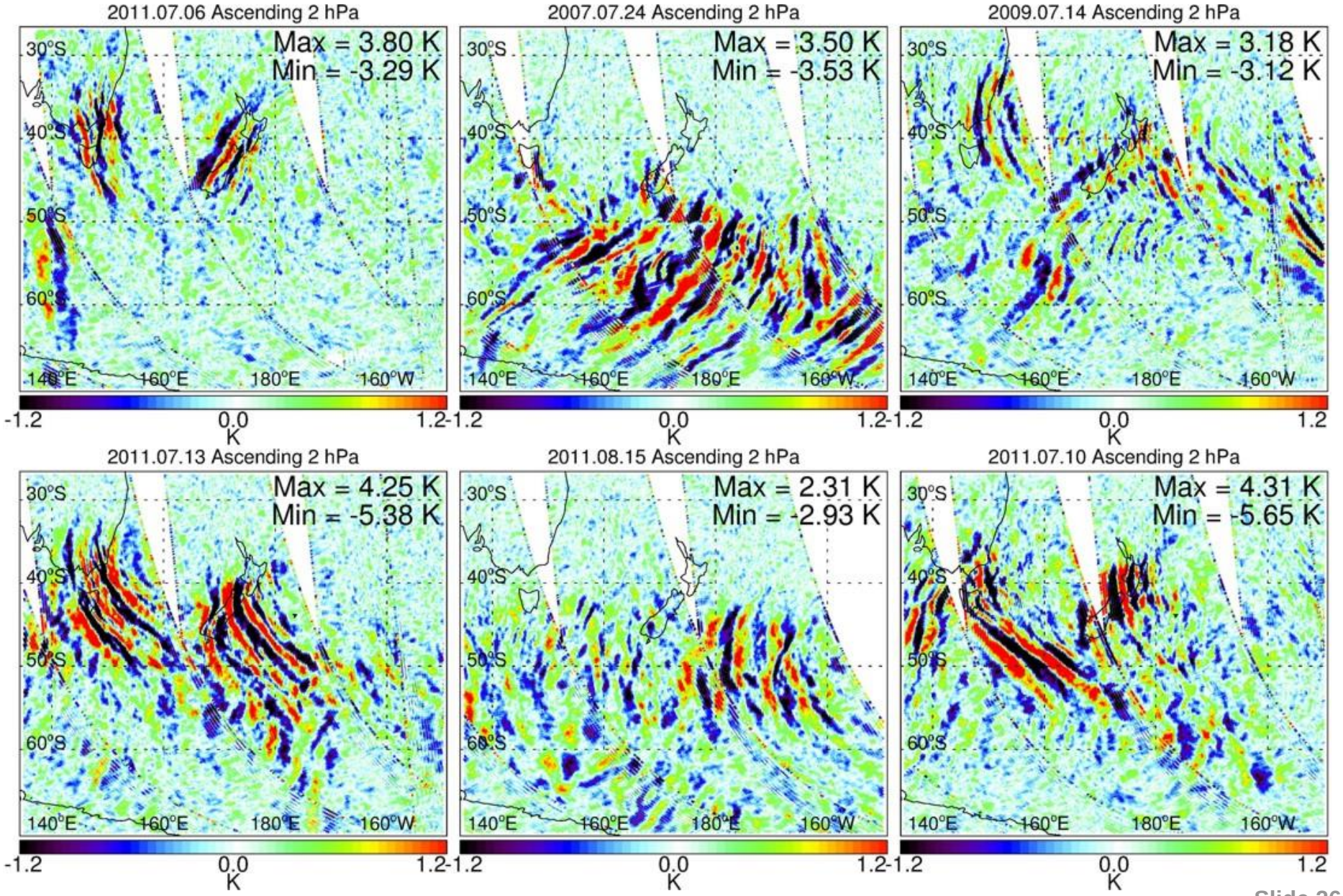
### Sturge Island

Closest ascending overpass at 04.55 UTC.
Closest descending overpass at 12.61 UTC.


2013.07.05 Descending 2 hPa
Max = 3.54 K
Min = -4.36 K
2013.07.05 Ascending 2 hPa
Max = 3.75 K
Min = -4.01 K
1.2
0.0 K
-1.2
2013.07.05 Descending 2.5 hPa
Max = 3.62 K
Min = -4.20 K
2013.07.05 Ascending 2.5 hPa
Max = 4.74 K
Min = -4.59 K
1.2
0.0 K
-1.2
2013.07.05 Descending 3 hPa
Max = 4.24 K
Min = -3.65 K
2013.07.05 Ascending 3 hPa
Max = 4.40 K
Min = -3.89 K
1.0
0.0 K
-1.0
2013.07.05 Descending 4 hPa
Max = 4.54 K
Min = -2.85 K
2013.07.05 Ascending 4 hPa
Max = 3.55 K
Min = -2.79 K
1.0
0.0 K
-1.0
2013.07.05 Descending 7 hPa
Max = 4.37 K
Min = -2.47 K
2013.07.05 Ascending 7 hPa
Max = 2.93 K
Min = -2.31 K
0.90
0.0 K
-0.90
2013.07.05 Descending 10 hPa
Max = 3.31 K
Min = -2.10 K
2013.07.05 Ascending 10 hPa
Max = 2.70 K
Min = -1.96 K
0.80
0.0 K
-0.80
2013.07.05 Descending 20 hPa
Max = 2.59 K
Min = -1.97 K
2013.07.05 Ascending 20 hPa
Max = 1.60 K
Min = -1.29 K
0.60
0.0 K
-0.60
2013.07.05 Descending 30 hPa
Max = 0.81 K
Min = -1.08 K
2013.07.05 Ascending 30 hPa
Max = 1.16 K
Min = -0.89 K
0.40
0.0 K
-0.40
30°S
40°S
50°S
60°S
140°E
160°E
180°E
160°W


2011.07.10 Ascending 80 hPa
Max = 0.90 K
Min = -1.12 K
30°S
40°S
50°S
60°S
140°E
160°E
180°E
160°W
Orographic Gravity Waves?
Nonorographic Gravity Waves?
0.30
0.0K
-0.30

# Rich Variable Wave Structure: Not Understood



# Isolating Small-Scale Gravity-Wave Perturbations from AIRS Level 1b Swath Radiance Imagery

**Fit large-scale radiance structure in swath imagery:**

- Smooth raw radiances along track using a 33-point running average (660 km)
- Fit every cross-track scan (90 points) of these smoothed radiances using a sixth-order polynomial (to capture both geophysical cross-track gradients as well as limb effects)
- Smooth fitted fields further using 15-point along-track running average

**Subtract these fits of large-scale structure from raw radiances to isolate small-scale perturbation structure in the swath imagery.**

# AIRS RMS Brightness Temperatures
# June-August 2003-2011