3. Results

Fig. 2

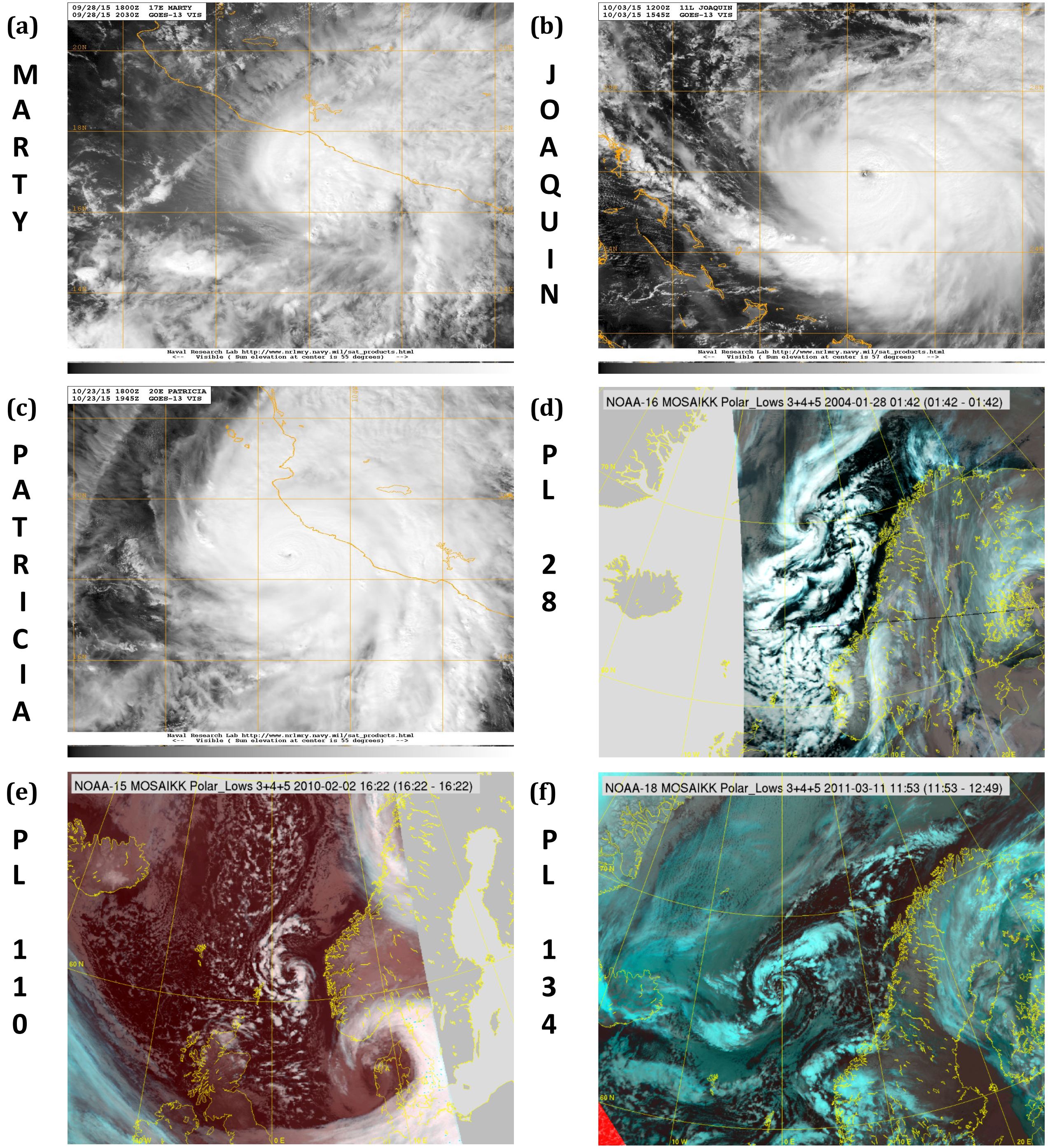

(a)
MARTY
09/28/15 1800Z 17E MARTY
09/28/15 2030Z GOES-13 VIS
(b)
JOAQUIN
10/03/15 1200Z 11L JOAQUIN
10/03/15 1545Z GOES-13 VIS
(c)
PATRICIA
10/23/15 1800Z 20E PATRICIA
10/23/15 1945Z GOES-13 VIS
(d)
PL 28
NOAA-16 MOSAIKK Polar_Lows 3+4+5 2004-01-28 01:42 (01:42 - 01:42)
(e)
PL 110
NOAA-15 MOSAIKK Polar_Lows 3+4+5 2010-02-02 16:22 (16:22 - 16:22)
(f)
PL 134
NOAA-18 MOSAIKK Polar_Lows 3+4+5 2011-03-11 11:53 (11:53 - 12:49)

Fig. 3

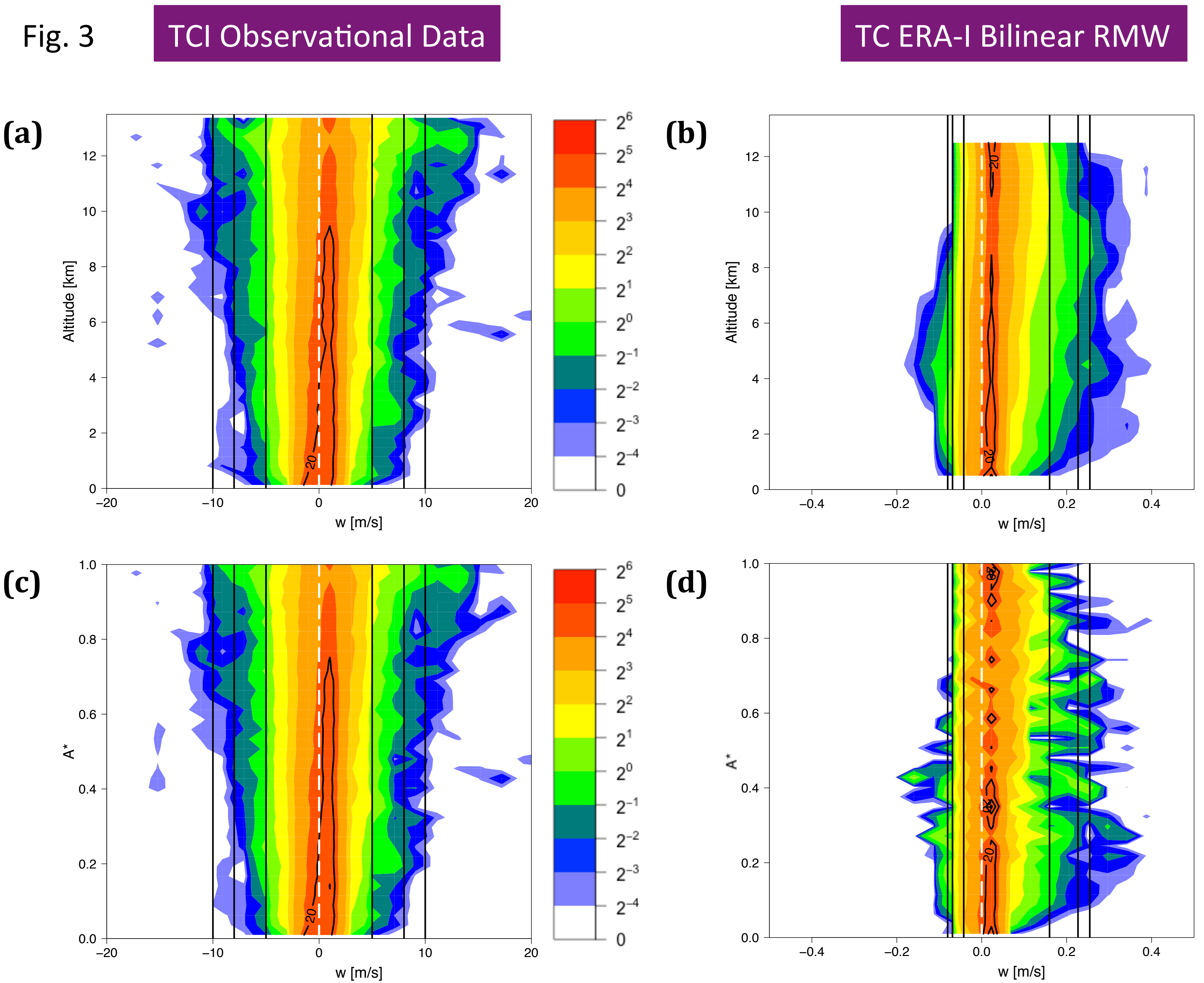

TCI Observational Data
TC ERA-I Bilinear RMW
(a)
(b)
(c)
(d)
Altitude [km]
A*
w [m/s]
20

Fig. 3

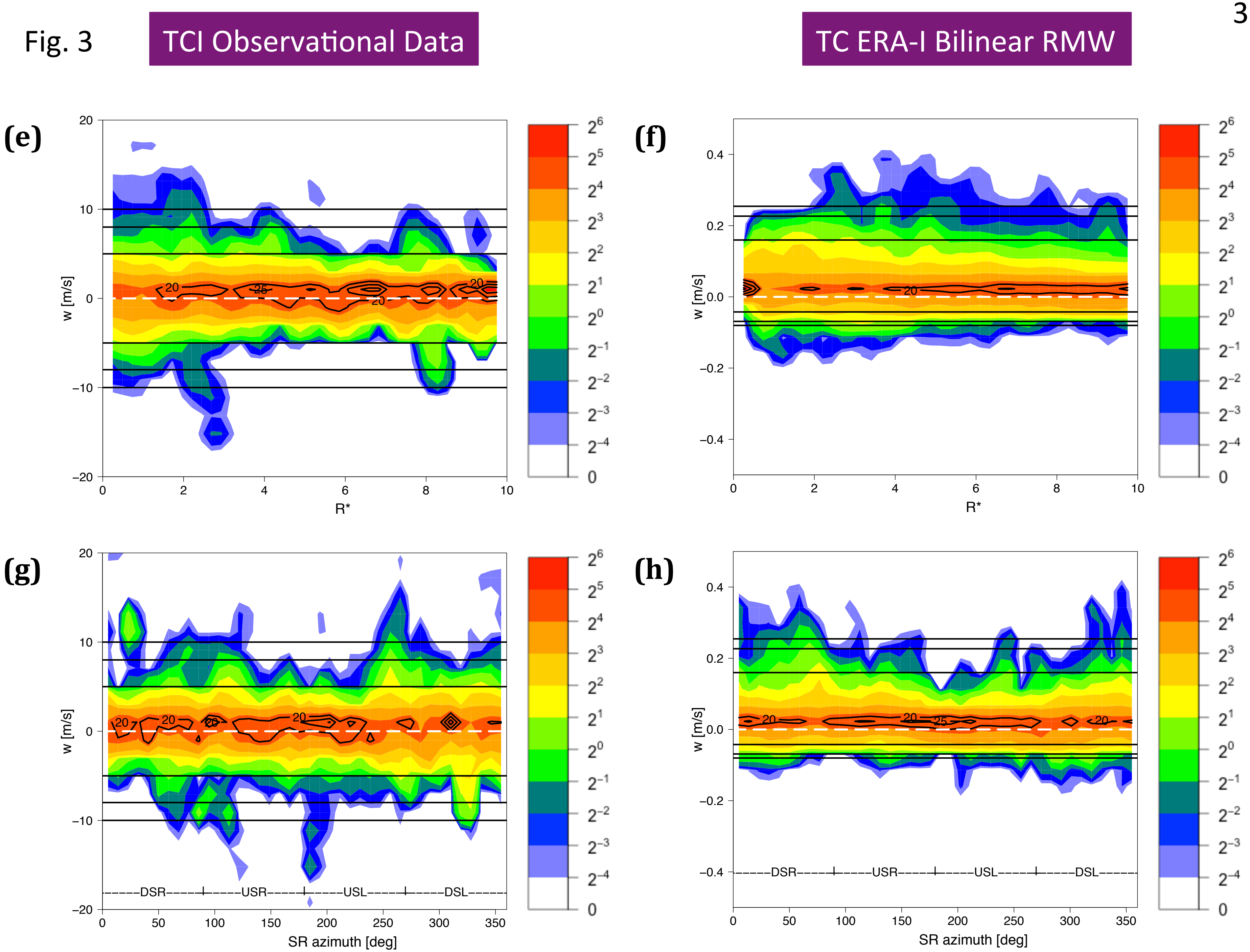
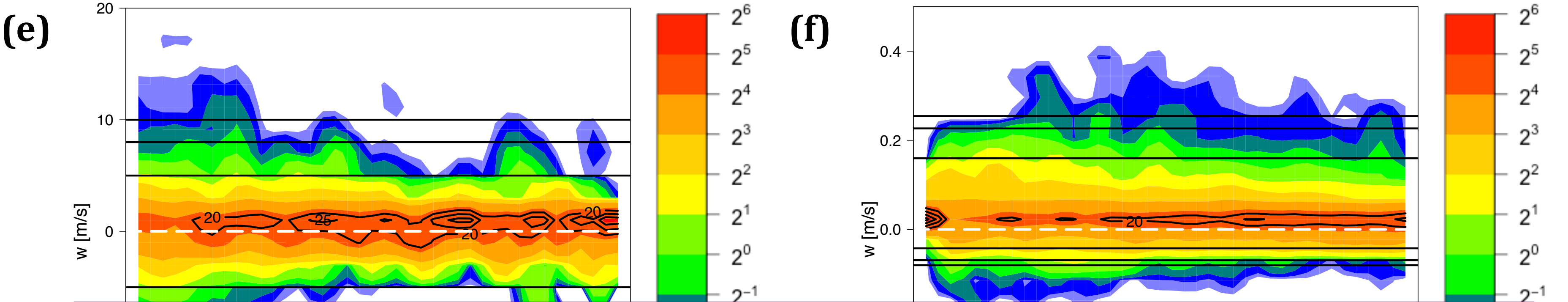

TCI Observational Data
TC ERA-I Bilinear RMW
(e)
(f)
(g)
(h)
w [m/s]
R*
SR azimuth [deg]
20
25
DSR
USR
USL
DSL
2^6
2^5
2^4
2^3
2^2
2^1
2^0
2^{-1}
2^{-2}
2^{-3}
2^{-4}
0

Fig. 3

TCI Observational Data

TC ERA-I Bilinear RMW



Because of the drastic differences in the CFDs, especially in the CFRDs, could the RMW placement be wrong?

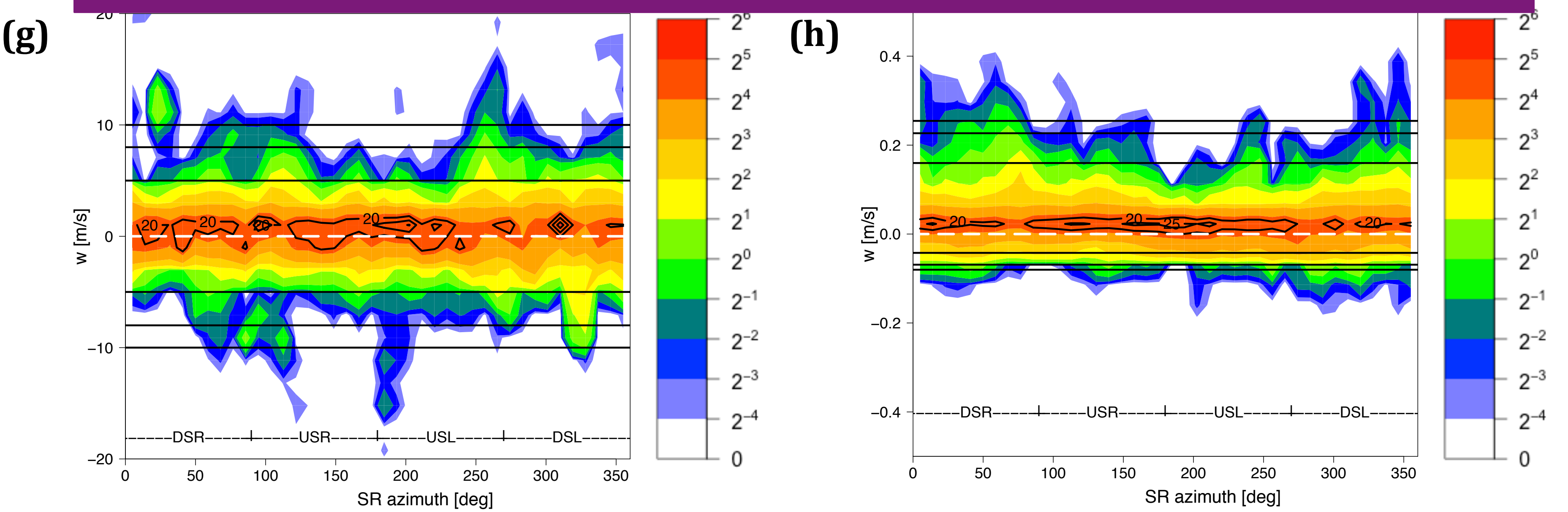


Fig. 4

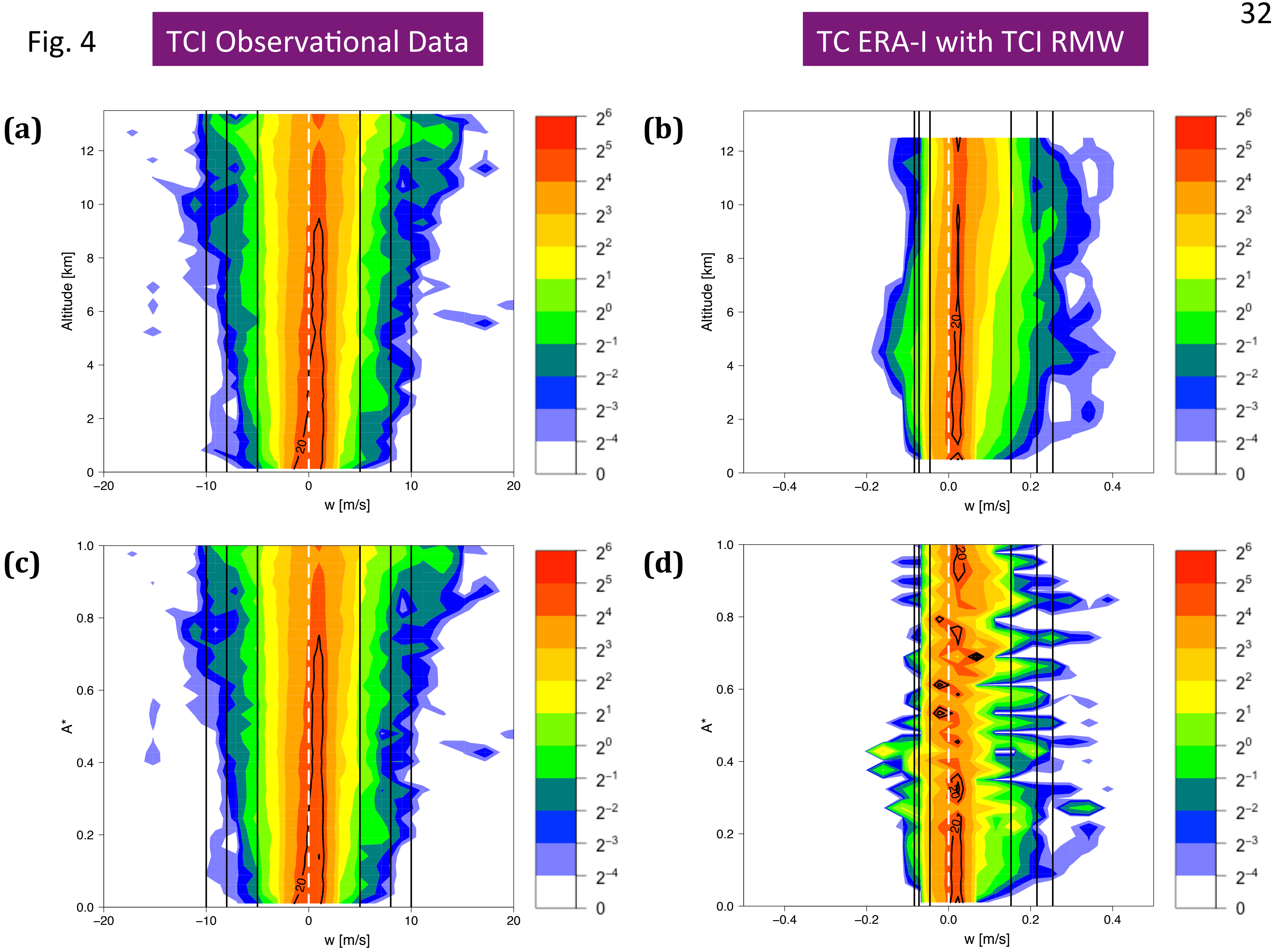

TCI Observational Data
TC ERA-I with TCI RMW
(a)
(b)
(c)
(d)
Altitude [km]
A*
w [m/s]
20

Fig. 4

TCI Observational Data

TC ERA-I with TCI RMW

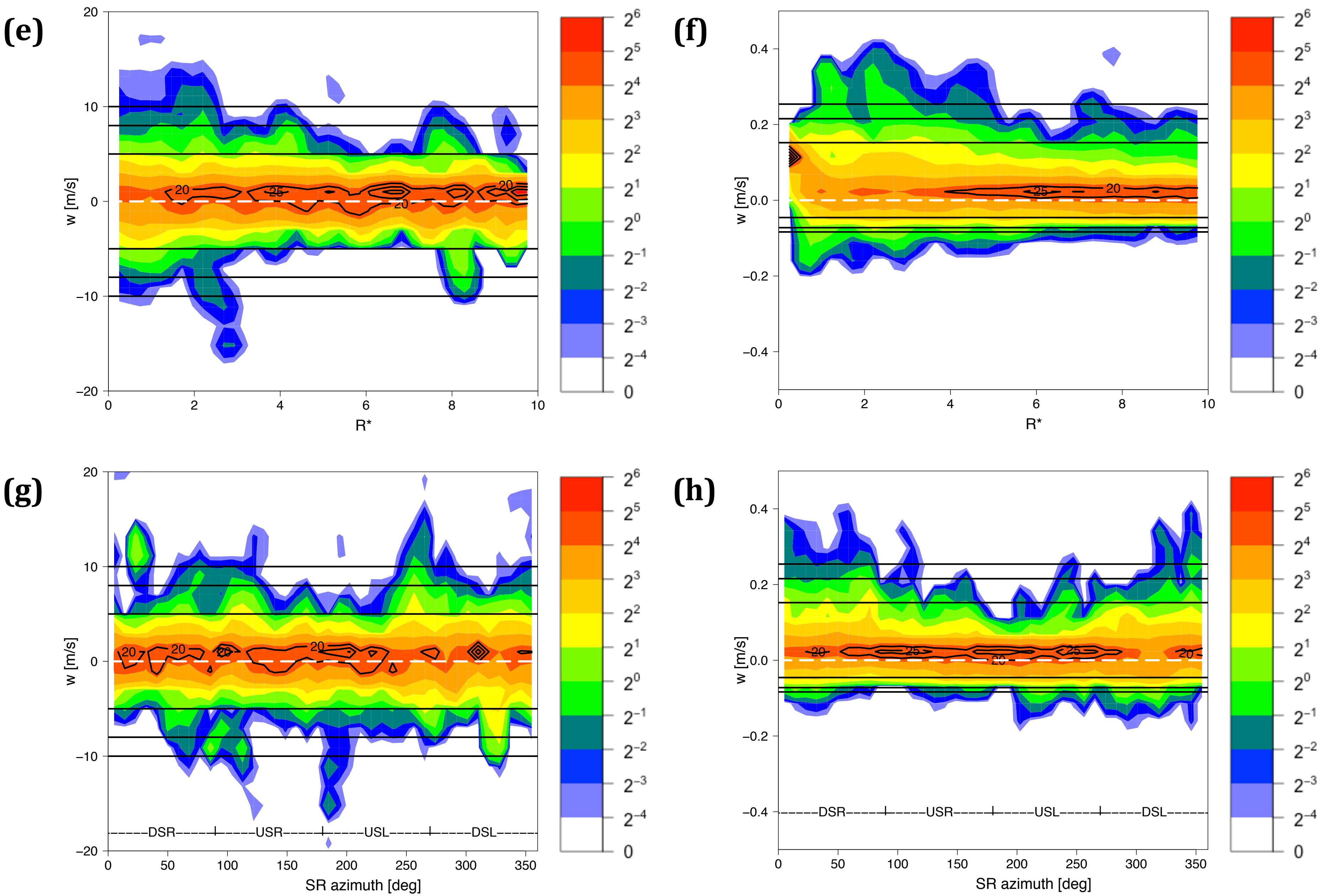
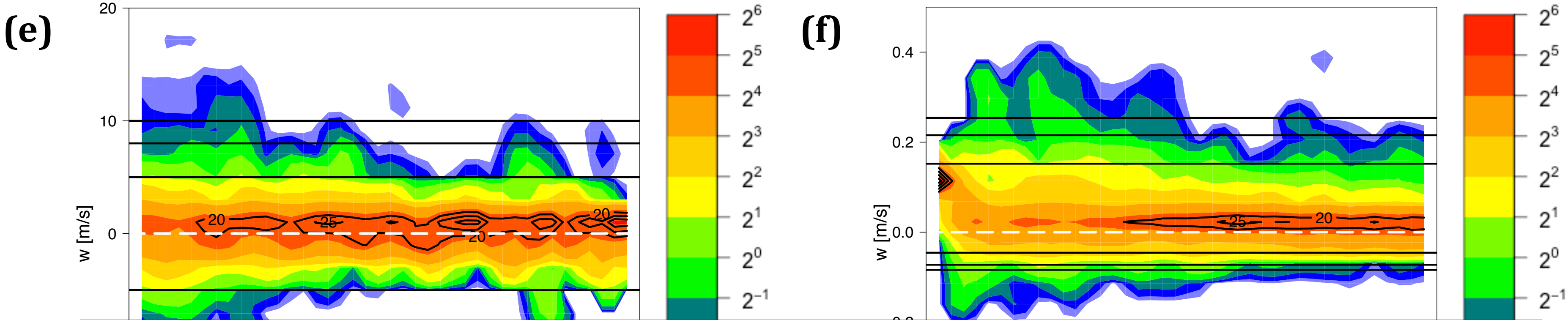


Fig. 4

TCI Observational Data

TC ERA-I with TCI RMW



Despite the lack of agreement between the observational dataset and ERA-I dataset of TCs, some conclusions can still be made about the location of convection in AHs in comparison to TCs

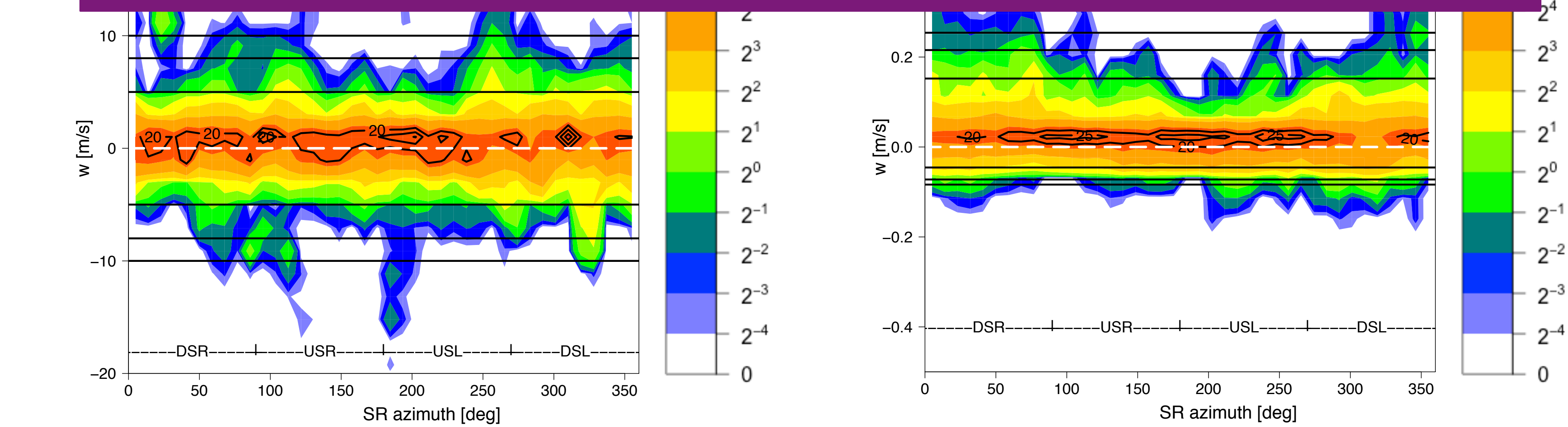


Fig. 5

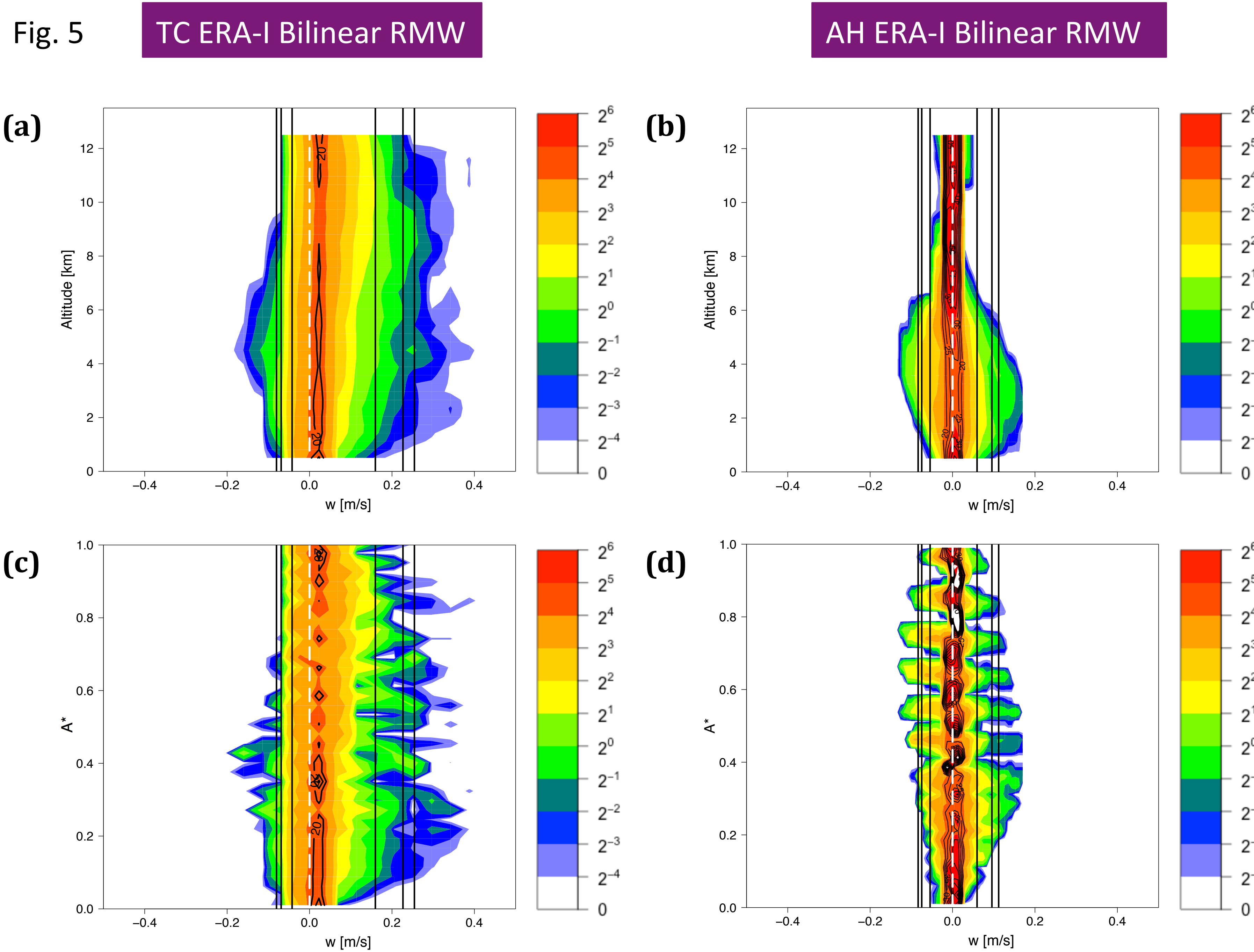

TC ERA-I Bilinear RMW
AH ERA-I Bilinear RMW
(a)
(b)
(c)
(d)
Altitude [km]
A*
w [m/s]
20
30
2^6
2^5
2^4
2^3
2^2
2^1
2^0
2^-1
2^-2
2^-3
2^-4
0

Fig. 5

TC ERA-I Bilinear RMW

AH ERA-I Bilinear RMW

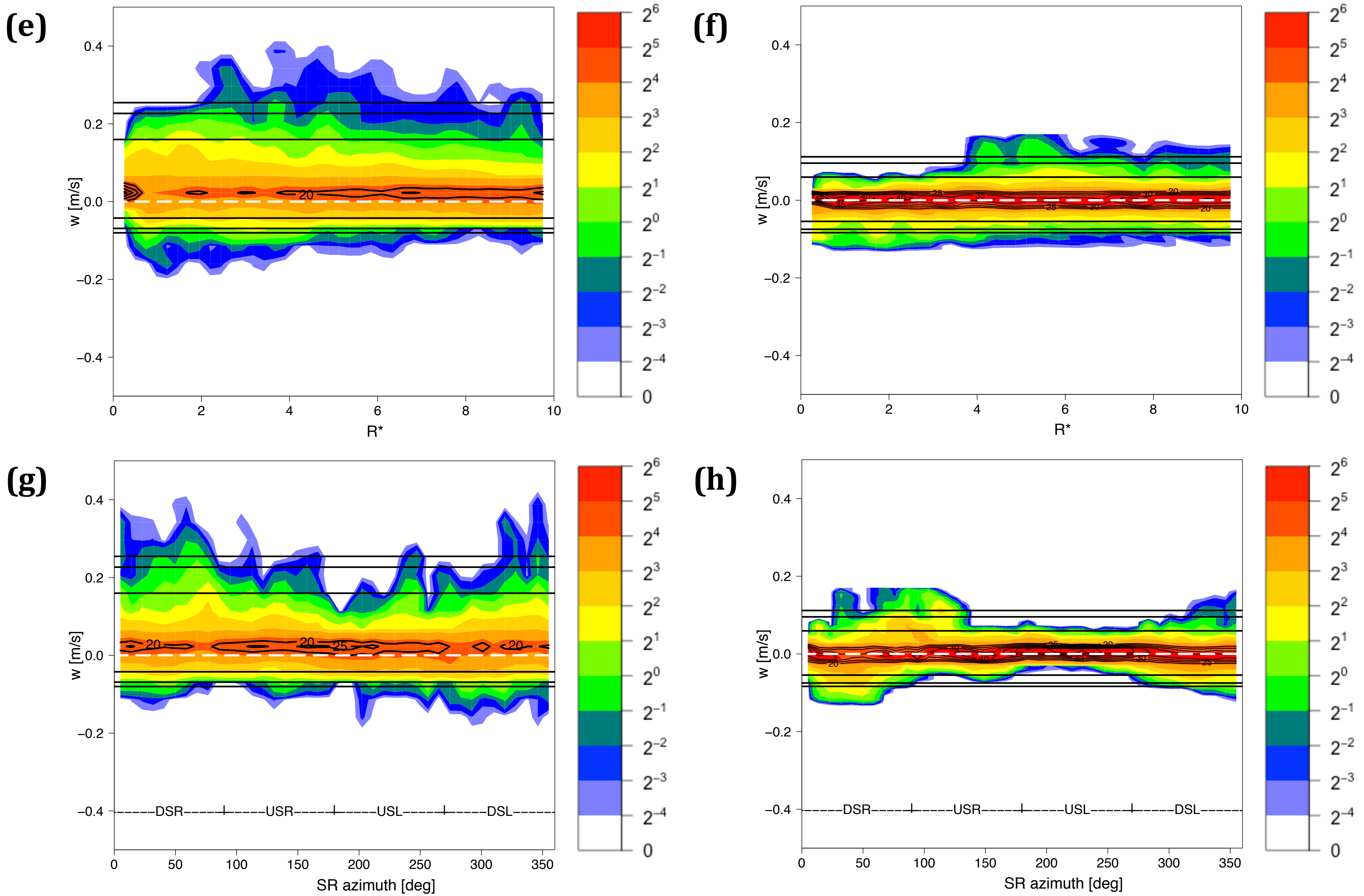
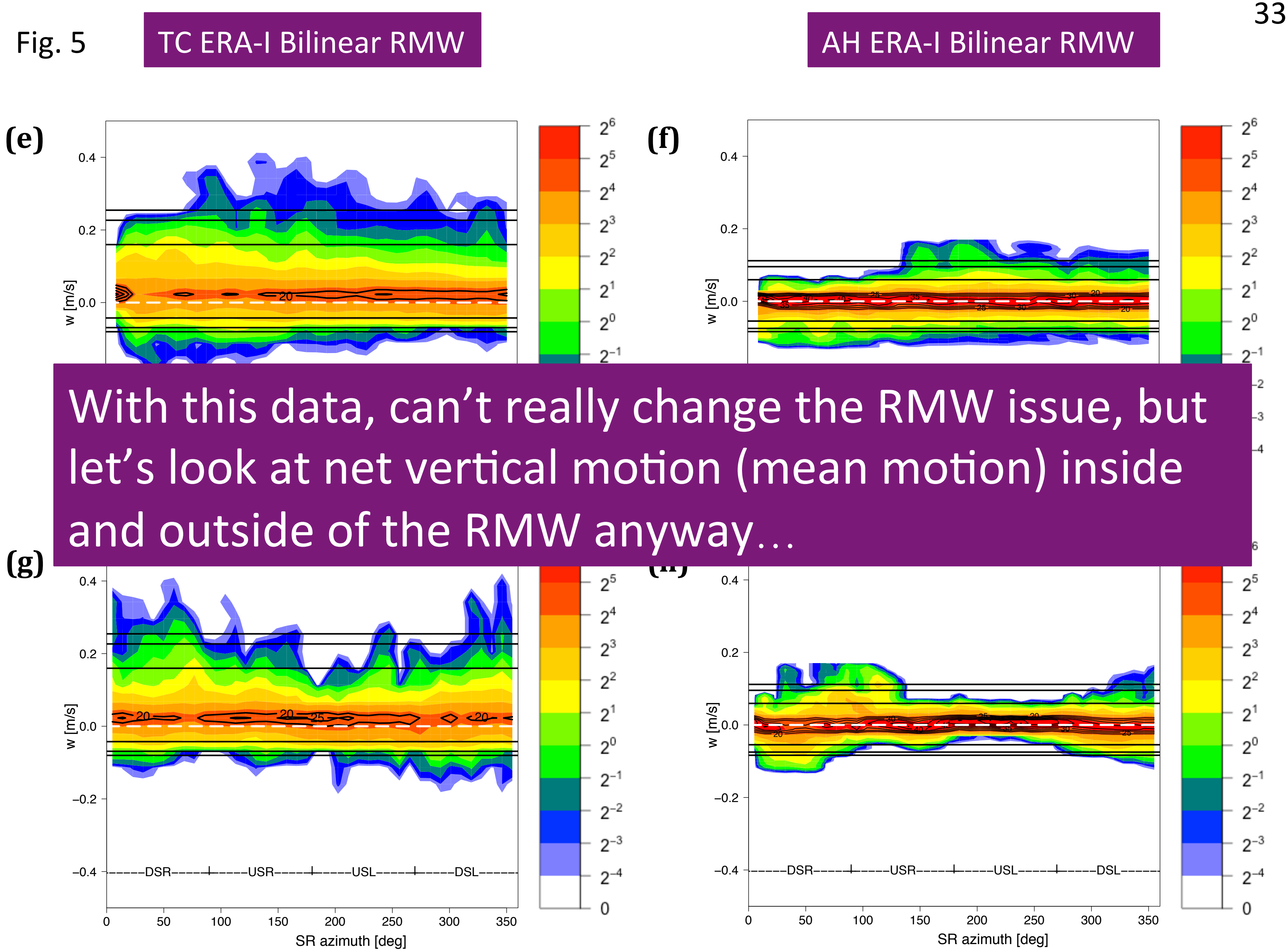


Fig. 5



With this data, can't really change the RMW issue, but let's look at net vertical motion (mean motion) inside and outside of the RMW anyway…

Fig. 6

TC ERA-I Bilinear RMW

AH ERA-I Bilinear RMW

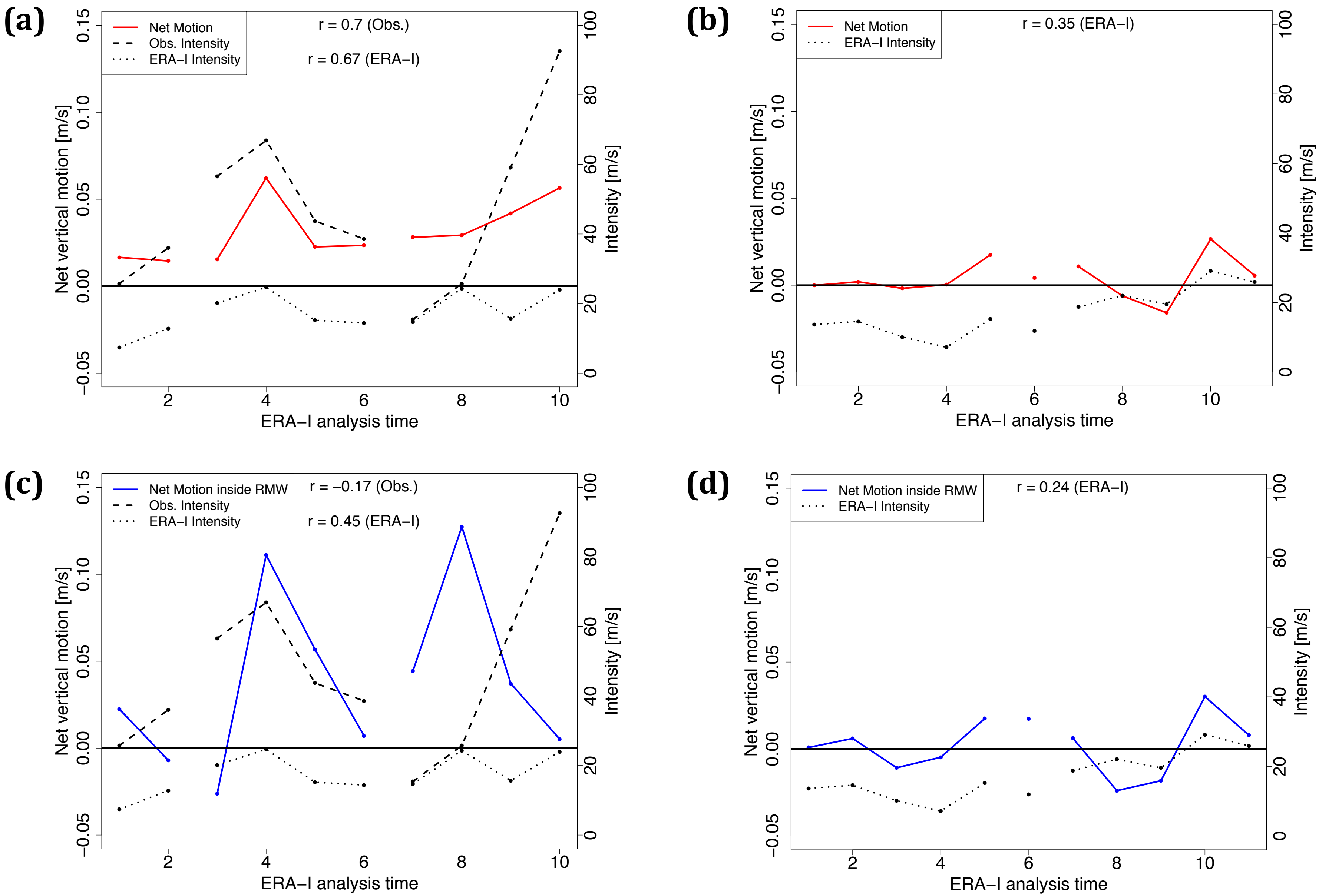


Fig. 7

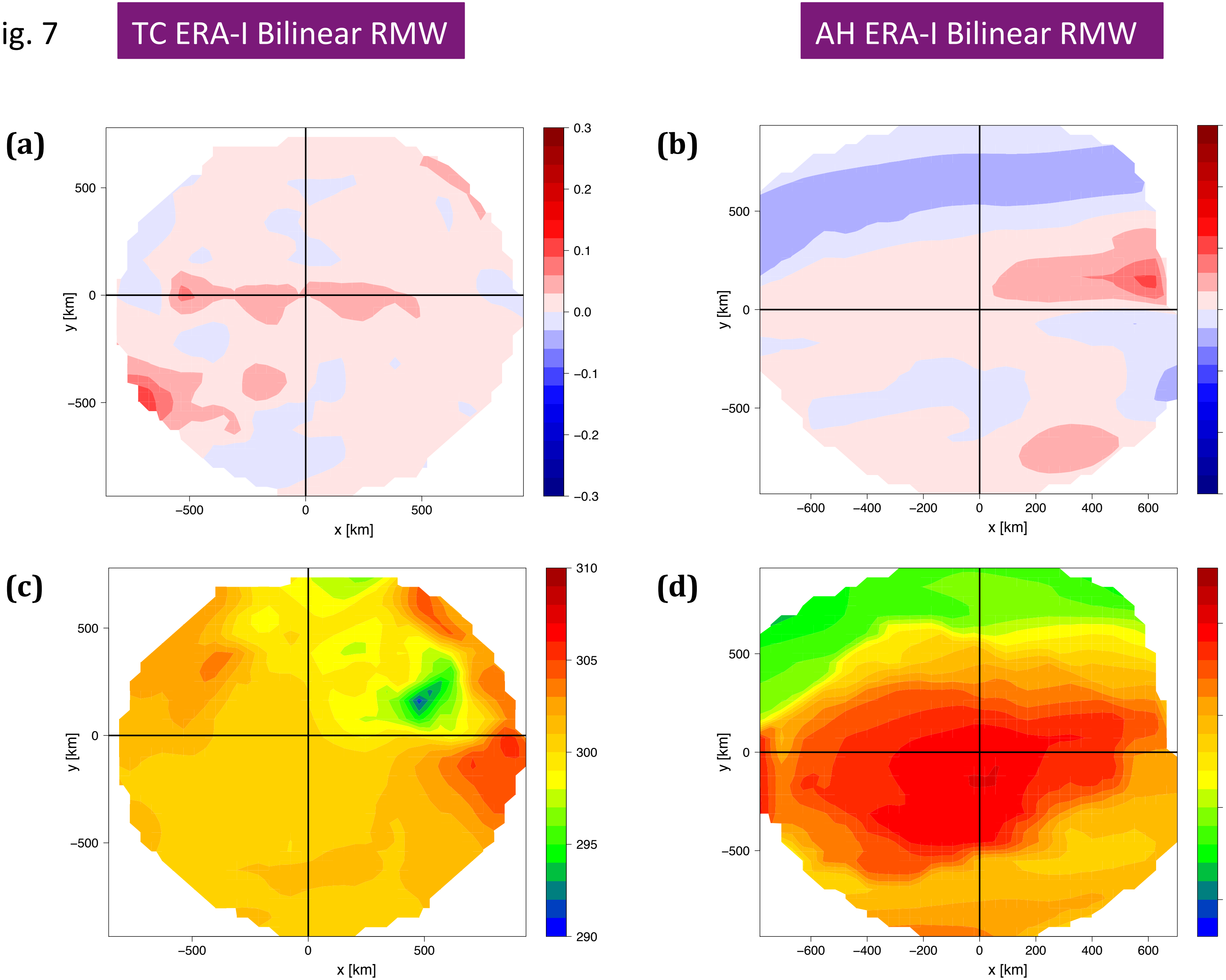


Fig. 8

TC ERA-I Bilinear RMW

AH ERA-I Bilinear RMW

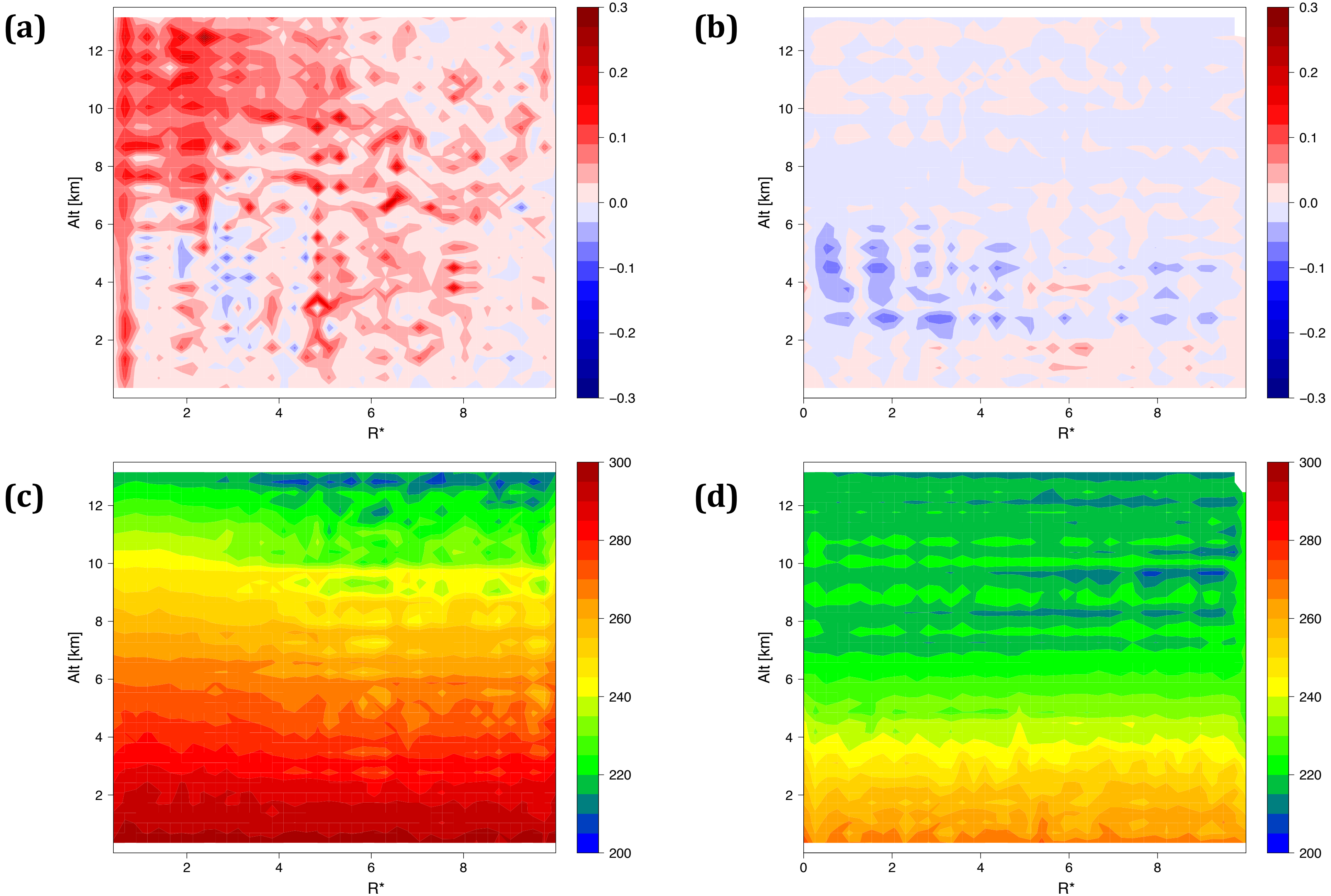


Fig. 8

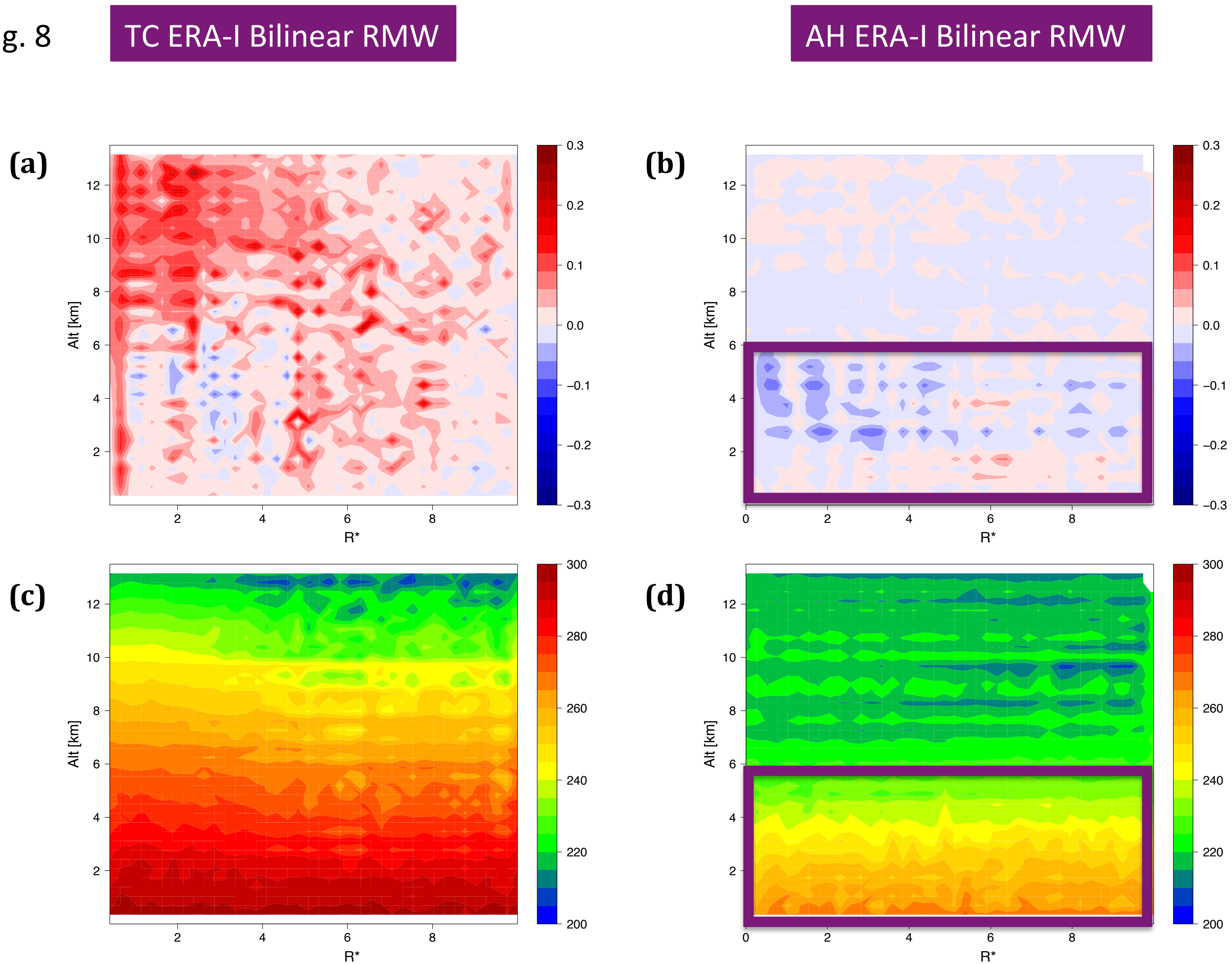
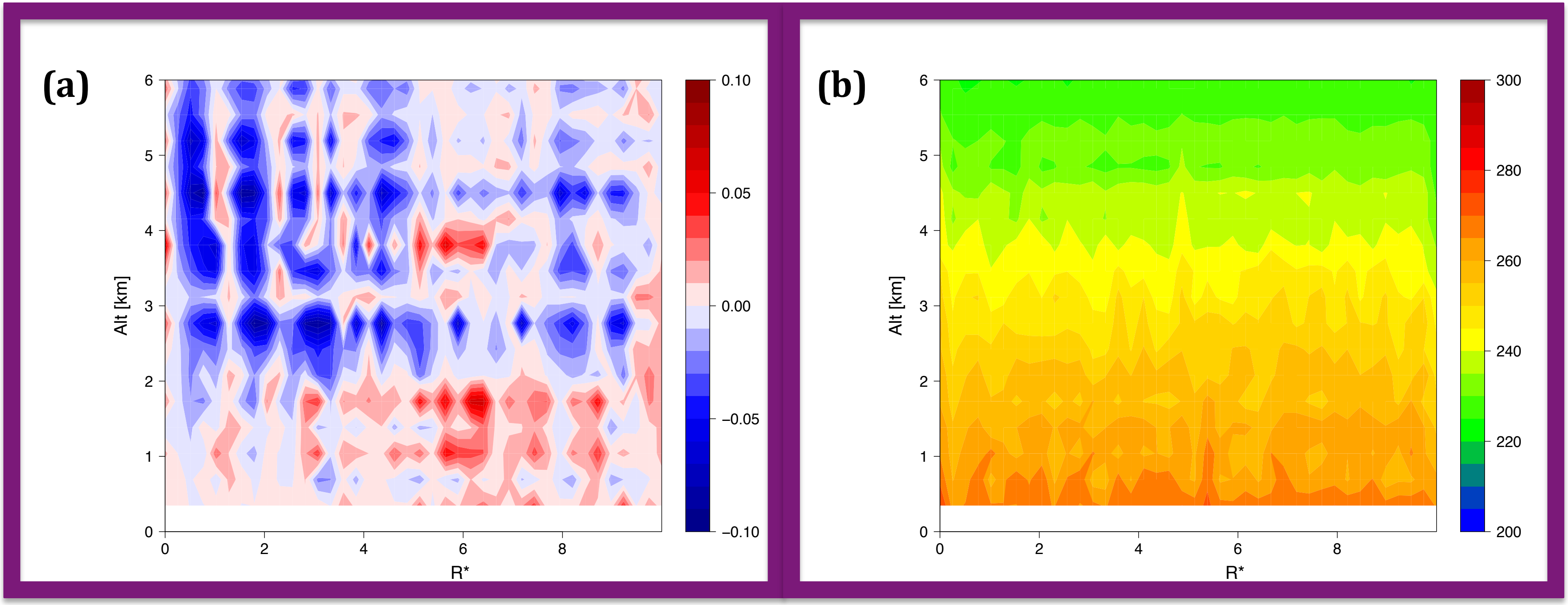

TC ERA-I Bilinear RMW
AH ERA-I Bilinear RMW
(a)
(b)
(c)
(d)
Alt [km]
R*
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3
300
280
260
240
220
200

Fig. 9



4. Conclusions

Summary

- Little study has been conducted to evaluate the similarities and differences in the convective environments of TCs and PLs
  - Specifically, the vertical velocity profiles in the AH archetype of PLs
- In this study, CFDs were constructed for three TCs and three AHs
- The TC ERA-I CFDs were compared to the CFDs from the Nelson et al. (2017) study
- The net vertical motion within 10R* and within the RMW were correlated to intensity change
- Composite planar and cross-sectional plots of vertical velocity and temperature were made for the TCs and AHs

Expectations

- ERA-I tends to underestimate PL intensity (Zappa et al. 2014)
  - 1×10^{-5} s^{-1} for vorticity
  - 2 m s^{-1} for surface wind speed
- The spatial resolution of the ERA-I dataset at 0.7° is not conducive to fully resolve convective scale processes
- ERA-I should not be expected to fully capture the high magnitude (strength), low-frequency vertical velocities that Nelson et al. (2017) and Stern et al. (2016) observed
  - In fact, peak updrafts and downdrafts were, at most, 50 times weaker in the ERA-I TCs than in the TCI XDD dataset!

Comparing TCI observation to ERA-I

- Unfortunately, the CFDs do not compare well between the TCI observations and the TC ERA-I data
  - With respect to altitude, midlevel maximum of vertical velocity in the TC ERA-I dataset = level of non-divergence (?)
- The use of a bilinear interpolated RMW is not accurate enough to produce a correct CFRD
- Both the ERA-I data and the TCI observation data agreed with the presence of convection in the downshear quadrants
  - BUT the peaks of convection in the ERA-I tended to be down-azimuth of the observations
  - ERA-I may not be accurately representing shear driven convective asymmetries

Comparing TCI observation to ERA-I

- Unfortunately, the CFDs do not compare well between the TCI observations and the TC ERA-I data
  - With respect to altitude, midlevel maximum of vertical velocity

Despite the lack of agreement between the observational dataset and ERA-I dataset of TCs, some conclusions can still be made about the location of convection in AHs in comparison to TCs

  - BUT the peaks of convection in the ERA-I tended to be down-azimuth of the observations
  - ERA-I may not be accurately representing shear driven convective asymmetries

AHs vs. TCs

- Peak strength of the vertical velocities in the AHs were half as strong as the TCs
- AHs had convection relatively higher in the troposphere
  - The increase in strength of updrafts above the surface was not as strong as in the TCs
- The strongest vertical velocities in AHs occurred outside of the inner core
  - However, if the RMWs were wrong in the TCs, they are likely to be wrong in the AHs!
- Both the TC ERA-I and AH ERA-I data suggest weaker convection occurred over much of the upshear quadrants
  - However, in the AHs, the strongest updrafts and downdrafts did not *exclusively* occur in the downshear quadrants…
  - The strongest downdrafts appear to have occurred down-azimuth of the strongest updrafts, which contradicts the findings of Nelson et al. (2017) for TCs

Net vertical motion

- The results here do not agree with past studies (e.g., Rogers et al. 2012, Nelson et al. 2017)
  - For TCs and AHs represented by ERA-I net vertical motion inside of the RMW is not a good predictor of cyclone intensity
    - Errors associated with RMW placement (?)
  - The net vertical motion within 10R* had acceptable correlations to intensity
  - Correlations of net vertical motion and intensity for AHs were considerably weaker than for TCs
    - AHs have much weaker RMWs and are relatively short-lived compared to TCs
    - Could have went into building the upper-level vortex instead of the lower-level vortex

Planar composites

- 925-hPa vertical velocity composites of AHs and TCs were not too drastically different
  - One difference is that the vertical velocities near the TC center were stronger than in the AHs
- 925-hPa temperature composites of AHs and TCs were different
  - ‘Bull’s-eye’ of increased temperature in AHs → smaller warm core
  - What does this mean for sensible/latent heat fluxes? (Rasmussen 1981, Terpstra et al. 2016)

Radial composites

- For the TC composite, updrafts maximized in strength aloft and inside the inner core
- For the AH composite, updrafts maximized in strength at outer radii and at low-levels
  - AHs have a band of downdrafts that was not present in the TCs
    - What caused the downdraft band below 3 km to occur?
    - Not caused by a transition of phase as this band occurred at approximately the 250 K level
    - Broad scale subsidence?

Future work

- Create CFDs from runs of the Weather Research and Forecasting (WRF) model for both the three TCs observed in TCI and the three AHs analyzed in this study
- Analyze the role of low-level updrafts inside the RMW and the cause of the band of downdrafts near 3 km in the AHs
- Ultimately, in order to fully understand the convective environments of AHs, high-density dropsonde observations of AHs similar to the TCI experiment should be conducted

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