Reply letter to the anonymous referee #1

The authors have satisfactorily addressed my scientific concerns from the first round of review, especially with regard to the development of the temperature inversion. That said, the word selection is not always appropriate and some phrases are vague or open to misinterpretation. The captions also tend to be longer than necessary and should be condensed where possible. I have attached a marked-up copy of the pdf with some suggestions that might help to improve the readability of the paper and clarify some minor points.

<u>Reply:</u>

Sincerely thanks for your detailed comments and valuable suggestion. We have checked the manuscript carefully, and some revisions have been made in the current version.

Specific comments:

Fig. 2: With units of $m^2 \cdot s^{-2}$, should captions be ϕ (geopotential) as opposed to Z (geopotential height).

Reply:

The error has been corrected and some revisions have been made.

<u>Revisions:</u>







Figure 2. Composite distribution of atmospheric circulation anomalies on severe haze/non-haze episodes. Anomalies were calculated with respect to the 1979-2010 climatology. The green (white) box indicates the BTH region (the area covered by AANAI_{Z500}). (a) **Z**₅₀₀ (**shading, units: gpm**) and U₂₀₀ (contour, units: $m \cdot s^{-1}$) on severe haze episodes; white dots indicate that Z₅₀₀ anomalies exceeded the 95% confidence level (*t* test). (b) SLP (shading, units: hPa) and surface air temperature (SAT; contour, units: K) on severe haze episodes; white dots indicate that SLP anomalies exceeded the 95% confidence level (*t* test). (c) **As in (a), but for non-haze episodes.** (d) **As in (b), but for non-haze episodes.**

Fig. 3: The caption tends to be longer than necessary and should be condensed where possible.

<u>Reply:</u>

Thanks for this suggestion. Some revisions were made.

Revisions:

Figure 3. Composite distribution of local atmospheric circulation anomalies on severe haze/non-haze episodes. Anomalies were calculated with respect to the 1979-2010 climatology. The green (black) box indicates the BTH region (the area covered by AANAI_{V850}). (a) V_{850} (arrow, units: $m \cdot s^{-1}$), PBLH (contour, units: m) and temperature inversion potential (TIP, T_{850} - T_{1000} , shading, units: K) on severe haze episodes; the bold black contours indicate that PBLH was more than 200m below normal; white dots indicate that temperature inversion potential anomalies exceeded the 95% confidence level (*t* test). (b) Surface wind (arrow, units: $m \cdot s^{-1}$) and surface RH (shading, units: %) on severe haze episodes; white dots indicate that surface RH anomalies exceeded the 95% confidence level

(*t* test). (c) As in (a), but for non-haze episodes; the bold black contours indicate that PBLH was more than 200m above normal. (d) As in (b), but for non-haze episodes.

Fig. 9: Here significance testing is against the null hypothesis that the composite values are indistinguishable from the mean? From the opposite phase? Also, ditto comment for Fig. 3.

<u>Reply:</u>

According to the PM_{2.5} concentration, the meteorological variables were divided into three groups: severe haze, non-haze and non-severe haze (i.e., PM_{2.5} concentration \in [50,150] µg · m⁻³). Non-severe haze episodes represent the normal state. Here we used two-sample *t*-test to determine the difference between severe haze episodes (non-haze episodes) and non-severe haze episodes. In other words, significance testing here is to check whether the composite values of severe haze episodes (non-haze episodes) are distinguishable from those of the normal state.

<u>Revisions:</u>

Figure 9. The vertical circulation during severe haze/non-haze episodes (composite synoptic processes): (a) Meridional component of the vertical circulation averaged over the BTH region (114 °-120 °E) on severe haze episodes (vertical velocity, shading, units: $Pa \cdot s^{-1}$; vectors represent the vertical and meridional components); white dots indicate that vertical velocity exceeded the 95% confidence level (*t* test). (b) Zonal component of the vertical circulation (36 °-42 °N mean) on severe haze episodes (vectors represent the vertical and zonal components) and the vertical transport of westerly momentum (shading, units: $10^{-5}m \cdot s^{-2}$); white dots indicate that vertical transport of westerly momentum exceeded the 95% confidence level (*t* test). (c) **As in (a), but for non-haze episodes. (d) As in (b), but for non-haze episodes.** To make the horizontal velocity and the vertical velocity the same order of magnitude, the vertical velocity (omega) has been magnified 100 times.

Reply letter to the anonymous referee #2

The authors made a very good effort in addressing the various issues raised by this reviewer in my first review. I much appreciated the detailed response of the authors; it was helpful in tracking the manuscript changes that were made. (One point for possible future use: When providing the modified text, next time include the line number where the modified text appears in the new version of the manuscript).

The authors have responded to most of the issues raised in my first review. While there are still a few clarity problems, these appear to reflect difficulties of translation rather than theoretical misunderstandings. Thus, the manuscript appears to be nearly ready for publication. There are, however, two parts of the text that require further clarification prior to publication. One part (lines 108-113) involves use of the word "process;" the other" (lines 205 ff) involves consistency in the use of the words "flow" and "motion." These two areas are highlighted in **bold text** in the "Specific Comments" section (below). The remaining suggested edits in "Specific Comments" are most minor and expository. The numbers appearing in that section refer to lines in the revised manuscript.

<u>Reply:</u>

Sincerely thanks for your valuable comments. We have checked the manuscript carefully, and some revisions have been made in the current version.

Minor Comments

14. Add comma at end of line (after "relative humidity")

<u>Reply:</u>

Some revisions were made.

<u>Revisions:</u>

a shallower boundary layer, and higher relative humidity),

31. Change "could" to "can"

<u>Reply:</u>

Some revisions were made.

<u>Revisions:</u>

Haze is a weather phenomenon, which could that can restrict the visibility visual range

40. Need to define "PM_{2.5}" as it is given as "PM" in line 33.

<u>Reply:</u>

Some revisions were made to describe this point more explicitly.

Revisions:

Lines 30-32: Haze events in China are mainly caused by **fine particulate matter (with a diameter less than 2.5 micrometers; PM_{2.5})**, which contains primary pollutants and sulfate or nitrate aerosols (Wang et al., 2016; Cai et al., 2017; Shen et al., 2018).

46. Change "These" to "The occurrence of" near the end of the line

47. Eliminate "were detected" and "which," and change "processes" to "episodes"

48. Add comma after "attribution"

Reply:

Some revisions were made.

Revisions:

Lines 45-46: The occurrence of two long-term severe haze episodes within 20 days of each other triggered a broader discussion over their formation, scientific attribution, and reasonable methods of management (Wang, 2018).

69. Add "a" after "that"

<u>Reply:</u>

Some revisions were made.

<u>Revisions:</u>

have indicated that a weak East Asian winter monsoon

74. Eliminate "the" before "composite," and add "in the" before "500 hPa"

Reply:

Some revisions were made.

Revisions:

Lines 71-74: To better represent the intensity of the AANA and its physical impacts on haze pollution, we defined $AANAI_{Z500}$ (AANAI_{ω 500}) and AANAI_{V850} according to

anomalies in the 500 hPa geopotential height (vertical velocity) field and 850 hPa wind field composited on severe haze episodes, referring to previous EAWM indices (Wang and Jiang, 2004; He and Wang, 2012).

82. Add "the" before "China"

Reply:

Some revisions were made.

<u>Revisions:</u>

from the China Meteorological Administration,

88. I do not know what "distribution data" means in the context of the sentence; do you mean, "The surface relative humidity field"? If so, I advise making the suggested wording change.

<u>Reply:</u>

Thanks for this suggestion. Some revisions were made.

Revisions:

Lines 87-88: **The surface RH field** was calculated based on the surface temperature and dew point temperature from the ERA-Interim reanalysis data.

94. Add comma after "20:00," and eliminate "in" before "Beijing"

Reply:

Some revisions were made.

<u>Revisions:</u>

for 02:00, 08:00, 14:00 and 20:00, in Beijing local time.

98. Add comma before "and used composite"

Reply:

Some revisions were made.

Revisions:

 $(PM_{2.5}\ concentration\ {\leq}50\ \mu g\cdot m^{-3})_{_{a}}$ and used composite analysis

99. Add "have" before "investigated," and add comma after "days"

Reply:

Some revisions were made.

<u>Revisions:</u>

Most previous studies have investigated haze events in units of hours or days, :

100. Replace "processes" with "different episodes"

<u>Reply:</u>

Some revisions were made.

Revisions:

variations among different haze pollutionepisodes processes v

105. Change "pollution processes" to "episodes" or "events"

Reply:

Some revisions were made.

Revisions:

different haze pollution processes episodes,

105-106. I'm not sure that "rebuilt" is the correct term here given that you are creating a totally new form of data. I suggest changing sentence to read "...among different haze episodes (or events), a new data field called the synoptic process mean (SPM) was calculated."

Reply:

Thanks for this suggestion. Some revisions were made.

Revisions:

Lines 103-105: To better describe the relationships and mechanisms manifesting among different **haze episodes**, **a new data field** called synoptic process mean (SPM) data was calculated.

107. I am not certain what the symbol after "concentration" is supposed to mean; please check on this

<u>Reply:</u>

The error has been corrected.

Revisions:

(i.e., $PM_{2.5}$ concentration $\subseteq \subseteq [50, 150] \, \mu g \cdot m^{-3}$).

108-113. Add "that" after "ensure." More importantly, I am not certain what is meant by use of the word "process" or "processes" in this range of lines. Would the word "episode" suffice, or do you indeed mean "process"? If you do mean "process," then that term will need to be defined --- preferably when the words "process" or "processes" first appear (i.e., in lines 105 or 108). This uncertainty needs to be clarified prior to publication.

111. Eliminate "method" after "averaging"

<u>Reply:</u>

The misleading word choice has been corrected. Some revisions were made.

<u>Revisions:</u>

Lines 106-111: Two criteria were used to ensure that each type of **haze episode** was typical and mutually independent: (1) a **haze episode** should have a minimum duration of at least 12 hours (i.e., two timesteps; a timestep represents 6 hours); (2) if any two **haze episodes** of the same type were detected within 24 hours (i.e., four timesteps), these two episodes would be merged into one. The SPM data applied time averaging to calculate mean PM_{2.5} concentrations and meteorological variables during each **haze episode**. Based on the SPM data, synoptic process correlation coefficients (SPCCs) were calculated in units of **haze episodes**, rather than in units of hours or days.

114. Add comma after "factor"

Reply:

Some revisions were made.

<u>Revisions:</u>

meteorological factors, while removing 138. Add comma after "weakened"

Reply:

Some revisions were made.

<u>Revisions:</u>

Lines 133-135: These results indicated that the meridional circulation over the middle-high latitude area in East Asia was weakened during severe haze events, so that the circulation over the BTH region was mainly occupied by zonal.

142. Change "change in" to "pressure"

Reply:

Some revisions were made.

Revisions:

Lines 138-139: The change in land-sea contrast implies southeasterly winds.

145. Add "the" before "southeasterly"

<u>Reply:</u>

Some revisions were made.

Revisions:

Moreover, the warm air brought by the southeasterly winds -

165. Change "taking" to "taken"

<u>Reply:</u>

Some revisions were made.

Revisions:

the critical areas takening into account a

172. Eliminate "was" and "to" (on either side of "encouraged")

<u>Reply:</u>

Some revisions were made.

Revisions:

Lines 166-167: The AANA was associated with southeasterly winds near the surface (Figure 3a), which favored the accumulation of pollutants and water vapor.

183. Add "a" before "temperature," eliminate "layer," replace "the" with "an" before "increase"

<u>Reply:</u>

Some revisions were made.

<u>Revisions:</u>

Lines 177-178: These effects were propitious to the formation and development of a stronger temperature inversion and an increase in atmospheric stability (Figure 3a).

190. Add "a" before "temperature

<u>Reply:</u>

Some revisions were made.

Revisions:

The emergence of a temperature inversion layer

195. I'd suggest adding the parenthetical words "west" after "rear" and "east" after "front" --- assuming that I have interpreted the relative directions correctly --- to clarify this section.

Reply:

Thanks for this suggestion. Some revisions were made.

<u>Revisions:</u>

Lines 189-191: Thus, the mid-level reflection of AANA was accompanied by anomalous synoptic-scale ascending motion to the **rear** (west) of the AANA, and anomalous descending motion to the **front** (east) of the AANA.

196. Add comma after "appeared." Also, ditto comment for line 195; clarify what is meant by "front" and "rear" with the directions "east" and "west" would be helpful.

<u>Reply:</u>

Some revisions were made.

Revisions:

Lines 191-193: The distribution of anomalies was opposite during non-haze events: cyclonic anomalies appeared, with anomalous synoptic-scale ascending motion to the **front (east)** of the cyclonic anomalies, and anomalous descending motion to the **rear (west)** of the cyclonic anomalies (Figure 6b).

199. You might consider adding the phrase "i.e., on the back or west side of the anomalous upper-level ridge" after "to the rear of the AANA" to clarify the exposition here --- assuming that my interpretation is correct.

<u>Reply:</u>

Some revisions were made.

Revisions:

Lines 194-196: This result suggested that anomalous synoptic-scale ascending motions to the rear of the AANA (i.e., on the back or west side of the anomalous upper-level ridge) had a significant effect on haze pollution in the BTH region.

200. Eliminate "insufficient"

Reply:

Some revisions were made.

Revisions:

. Our results appeared to contradict with the insufficient speculation 1

204. Eliminate "of" after "Considering"

<u>Reply:</u>

Some revisions were made.

Revisions:

Considering-of the climatological climate mean state over the BTH region

205. Change "vertical" to "usual descending"

<u>Reply:</u>

Some revisions were made.

<u>Revisions:</u>

weakened the usual descendingvertical motion in the local area v

207. Change "the sink of cold air" to "descent;" add "the" before "upper levels;" and replace "flow" with "motion" (In general, use "motion" consistently to refer to synoptic-scale vertical motions, and "flow" to refer to actual winds that can be instantaneously observed)

<u>Reply:</u>

Thanks for this suggestion. We have fully checked the manuscript and the error has been corrected.

<u>Revisions:</u>

Lines 202-203: Even though **sinking motion** still prevailed over the BTH region, descent from the upper levels was greatly weakened due to the anomalous **ascent** (Figure 9a).

208. Add "yet" before "did not"

209. Add hyphen between "lower" and "level"

<u>Reply:</u>

Some revisions were made.

<u>Revisions:</u>

and yet_did not predominate in-the changes inof lower-level

210. Change "the" to "a" after "represented;" eliminate "the" before "dry air intrusion"

<u>Reply:</u>

Some revisions were made.

<u>Revisions:</u>

represented a-the decline in the dry air

212. Change "flow" to "motion" after "sinking"

<u>Reply:</u>

Some revisions were made.

Revisions:

normal sinking flowmotion,

213. Change "westerly" to "mid-or upper level"

Reply:

Some revisions were made.

<u>Revisions:</u>

Lines 207-210: The anomalous ascending motion in the middle troposphere not only weakened the normal sinking motion, but also inhibited **the downward transport of** westerly momentum at mid- and upper-levels (i.e., $\frac{\partial u\omega}{\partial P}$ >0, Figure 9b), leading to weaker northerly winds near the surface (Lu et al., 2010; Liu and Guo, 2012).

223. Add "an" before "inversion"

224. Eliminate "layer"

<u>Reply:</u>

Some revisions were made.

<u>Revisions:</u>

t the emergence of an inversion layer in the BTH region

227. Add "the" before "anomalous;" replace "sink" with "descent"

<u>Reply:</u>

Some revisions were made.

<u>Revisions:</u>

. Once<u>the</u> anomalous ascentding flows

228. Add "mid- and" before "upper;" add hyphen after "upper"

<u>Reply:</u>

Some revisions were made.

<u>Revisions:</u>

sinksupply of clean air from <u>mid- and upper</u>_-levels <u>helped</u>tended to break the inversion layer 230. Change "represented" to "marked," add "the" before "haze," and eliminate "pollution"

<u>Reply:</u>

Some revisions were made.

Revisions:

These factors representedmarked the dissipation process for the haze-pollution.

232. Change "westerly" to "mid- and upper-level"

<u>Reply:</u>

Some revisions were made.

<u>Revisions:</u>

Lines 225-227: For non-haze episodes, the cyclonic circulation induced anomalous descending motion over the BTH region, which strengthened the local meridional

circulation (Figure 8c–d) and **the downward transport of westerly momentum at midand upper-levels** (Figure 9c–d).

234. Change "conducive conditions" to "conditions conducive"

<u>Reply:</u>

Some revisions were made.

<u>Revisions:</u>

leading to-conducive conditions conducive tofor pollutant dispersion.

235. Change "ascending flows" to "ascent"

Reply:

Some revisions were made.

<u>Revisions:</u>

anomalous synoptic-scale ascentascending flows to its rear,

236. Change "transportation" to "transport"

237. Eliminate "the conditions"

Reply:

Some revisions were made.

<u>Revisions:</u>

Lines 231-233: The resulting weak local vertical circulation also inhibited downward momentum transport and led to lower surface wind speeds, weaker turbulence and a shallower boundary layer in the local area.

247. Eliminate "direction"

<u>Reply:</u>

Some revisions were made.

Revisions:

reduced the dispersion of pollutants disperse in the vertical direction

256. Change "the" to "a"

257. Change "of weakening" to "to weaken"

<u>Reply:</u>

Some revisions were made.

<u>Revisions:</u>

which had thea tendency toof weakening over time

259. Change "at the mid-level" to "at mid-levels"

<u>Reply:</u>

Some revisions were made.

<u>Revisions:</u>

strong at-the mid-levels,

262. Add comma after "circulation"

263. Eliminate "pollution"

<u>Reply:</u>

Some revisions were made.

Revisions:

7 a cyclonic circulation, --and haze pollution-tended to dissipate

270. Change "by" to "to near" (assuming my interpretation of things is correct here)

<u>Reply:</u>

Some revisions were made.

<u>Revisions:</u>

Lines 265-266: The cyclonic circulation then moved eastward, pushed by the positive anomaly over Lake Baikal (Figure 10n).

275. Change "Basing" to "Based"

<u>Reply:</u>

Some revisions were made.

<u>Revisions:</u>

Baseding on the PM2.5 concentration

- 280. Add "and the" before "gathering"
- 281. Change "to" to "over," and add "a" before "temperature"

Reply:

Some revisions were made.

<u>Revisions:</u>

in the lower troposphere, and the gathering pollutants and moisture overto the BTH region.

also generated a temperature inversion t

282. Change "As a synoptic-scale system," to "Being synoptic in scale,"

<u>Reply:</u>

Some revisions were made.

<u>Revisions:</u>

. Being synoptic in scale, As a synoptic scale

283-284. Eliminate "from higher levels"

<u>Reply:</u>

Some revisions were made.

<u>Revisions:</u>

reduced the frequency of invasions of cold and dry air invasions from higher levels.

284. Add "also" after "motion"

<u>Reply:</u>

Some revisions were made.

<u>Revisions:</u>

the anomalous vertical motion also restrained inhibited

292. Eliminate "the" before "fine"

<u>Reply:</u>

Some revisions were made.

<u>Revisions:</u>

It is well-widely acknowledged that the fine PM i

296. Change "researches" to "research"

Reply:

Some revisions were made.

Revisions:

to draw_-a-comparisons with previous researches.

298. Add "the" after "between"

<u>Reply:</u>

Some revisions were made.

<u>Revisions:</u>

between the AANA indexes indices :

301. Add comma after "surface"

<u>Reply:</u>

Some revisions were made.

<u>Revisions:</u>

near the surface, but also

302. Eliminate "conducive" before "local," and change "for" to "conducive to" after "conditions"

<u>Reply:</u>

Some revisions were made.

Revisions:

Lines 298-300: These synoptic-scale environments led to local meteorological conditions that were conducive to severe haze, including weaker surface winds, a stronger temperature inversion, a shallower boundary layer and higher RH.

304. Eliminate "the" after "detected at" and add "s" to "mid-level"

<u>Reply:</u>

Some revisions were made.

Revisions:

the AANA could be detected at the mid levelin the middle troposphere

305. Add "The" before "BTH region"

Reply:

Some revisions were made.

<u>Revisions:</u>

The BTH region was occupied by

308. Add comma after "features"

<u>Reply:</u>

Some revisions were made.

Revisions:

Lines 304-305: The relationship between the AANA and severe haze in the BTH region expressed different features in different years, but remained strong themselves.

312. Change "It might be associated with" to "This result might reflect"

Reply:

Some revisions were made.

<u>Revisions:</u>

Lines 309-310: **The weaker correlation might reflect** the influence of ENSO on the midtropospheric circulation.

313. Change "in the" to "at" after "evident;" add "s" to "mid-level;" add comma after "troposphere"

Reply:

Some revisions were made.

Revisions:

evident <u>atim the mid-levels</u>, it still emerged in the lower troposphere, : 315. Change "on" to "in" after "differences"

<u>Reply:</u>

Some revisions were made.

<u>Revisions:</u>

some differences inon how the AANA

316. You might want to refresh the reader's mind as to what "TIP" stands for here (likewise for SPCC in line 308).

<u>Reply:</u>

Thanks for this suggestion. Some revisions were made.

<u>Revisions:</u>

by enhancing TIP (temperature inversion potential) :

In 2014, 2016 and 2017, the SPCCs (synoptic process correlation coefficients)

317. Eliminate "could" and add comma after "RH"

Reply:

Some revisions were made.

<u>Revisions:</u>

The AANA-could promoted weaker surface winds, higher surface RH2 :

319. Add "s" to "situations"

Reply:

Some revisions were made.

<u>Revisions:</u>

Similar situations werecould be (

320. "Indices" is usually used instead of "indexes" but "indexes" is okay (same could be said for use of "indexes" in line 298)

329. Ditto comment for line 320.

Reply:

Thanks for this suggestion. We have fully checked the manuscript and some revisions have been made.

<u>Revisions:</u>

These results proved that the AANA indexes indices

the three AANA indexes indices

Fig. 2 caption: Need to define acronym "SAT"

Reply:

Some revisions were made.

<u>Revisions:</u>

Figure 2. Composite distribution of atmospheric circulation anomalies on severe haze/nonhaze episodes. Anomalies were calculated with respect to the 1979-2010 climatology. The green (white) box indicates the BTH region (the area covered by AANAI_{Z500}). (a) Z_{500} (shading, units: gpm) and U₂₀₀ (contour, units: $m \cdot s^{-1}$) on severe haze episodes; white dots indicate that Z_{500} anomalies exceeded the 95% confidence level (*t* test). (b) SLP (shading, units: hPa) and **surface air temperature** (**SAT**; contour, units: K) on severe haze episodes; white dots indicate that SLP anomalies exceeded the 95% confidence level (*t* test). (c) As in (a), but for non-haze episodes. (d) As in (b), but for non-haze episodes.

Fig. 3 caption: Should include acronym "TIP" after "temperature inversion potential." Also, in parts (a) and (c), should "contour" really be "shading"?

<u>Reply:</u>

Some revisions were made to describe this part more explicitly.

Revisions:





Figure 3. Composite distribution of local atmospheric circulation anomalies on severe haze/non-haze episodes. Anomalies were calculated with respect to the 1979-2010 climatology. The green (black) box indicates the BTH region (the area covered by AANAI_{V850}). (a) V_{850} (arrow, units: $m \cdot s^{-1}$), PBLH (contour, units: m) and **temperature inversion potential** (**TIP**, T_{850} - T_{1000} , shading, units: K) on severe haze episodes; **the bold blue contours indicate that PBLH was more than 200m below normal**; white dots indicate that temperature inversion potential anomalies exceeded the 95% confidence level (*t* test). (c) As in (a), but for non-haze episodes; **the bold red contours indicate that PBLH was more than 200m above normal**.

Fig. 7: Change "process" to "processes" after "diabatic heating"

<u>Reply:</u>

Some revisions were made.

<u>Revisions:</u>

diabatic heating processes process

Fig. 8: Change "in" to "of" in last sentence

<u>Reply:</u>

Some revisions were made.

<u>Revisions:</u>

. To make the horizontal velocity and the vertical velocity-in the same order of magnitude,

Fig. 9: In (a), add "component of the vertical" after "meridional; in (b), add "component of the" after "zonal;" in (c), add "component of the vertical" after 'meridional;" and in (d), add "component of the" after "zonal"

<u>Reply:</u>

Some revisions were made.

<u>Revisions:</u>

Figure 9. The vertical circulation during severe haze/non-haze episodes (composite synoptic processes): (a) **Meridional component of the vertical circulation** averaged over the BTH region (114 °-120 °E) on severe haze episodes (vertical velocity, shading, units: $Pa \cdot s^{-1}$; vectors represent the vertical and meridional components); white dots indicate that vertical velocity exceeded the 95% confidence level (*t* test). (b) **Zonal component of the vertical circulation** (36 °-42 °N mean) on severe haze episodes (vectors represent the vertical and zonal components) and the vertical transport of westerly momentum (shading, units: $10^{-5}m \cdot s^{-2}$); white dots indicate that vertical transport of westerly momentum exceeded the 95% confidence level (*t* test). (c) As in (a), but for non-haze episodes. (d) As in (b), but for non-haze episodes. To make the horizontal velocity and the vertical velocity the same order of magnitude, the vertical velocity (omega) has been magnified 100 times.