Review for
Dynamics of Gap Winds in the Great Rift Valley, Ethiopia: Emphasis on Strong Winds at Lake Abaya
by Weiß et al

Summary:

The authors examined the structure of gap wind in the Great Rift Valley. In general, the introduction, methods, data, and almost of results are very clearly explained in this paper. However, there is a lack of explanation in some parts of the results and discussions, and the manuscript seems to require improvement. Therefore, I can recommend its publication in Weather and Climate Dynamics only after some major revisions.

Major comments

(1) Relation between Δz_{800hPa} and Gap wind

The authors contend that Δz_{800hPa} may be a predictor of gap wind in the target area. Indeed, Δz and Δp are the largest in the first half of the period when the Gap wind is strongest (Gray shade in Fig. 3b). However, in the second half of the period, Δz (and Δp) are smaller. Furthermore, even during the period when the gap wind was not blowing, Δz is comparable to those during the period when the gap wind was strong. Since the wind is driven by Δz (Δp), they need to be linked. If gap wind did not blow despite the large Δz (Δp), some local pressure gradient can be inhibiting gap wind. Therefore, the authors need to further elaborate on the structure of the atmosphere during the periods when the gap winds did not blow.

(2) Flow pattern of gap winds

The authors contend that thermally driven currents and pressure gradients (basin and plateau winds) play important roles in the flow pattern of the gap wind and its time evolution. However, a detailed analysis of the thermally driven flow is lacking. It is recommended to check not only Δp and Δz between the ends of the gap, but also Δz and Δp between the ends of the gap and inside the gap. Alternatively, numerical experiments without the ground surface heat flux might be helpful.

In addition, it seems very difficult for the readers to understand the flow pattern and time evolution of each of them only from the description in Section 6. Therefore, I recommend that the manuscript include conceptual flow diagrams for the northeast and southwest wind cases to assist the authors in their understanding.

(3) Hydraulic theory

The authors contend that the localized strong winds at Lake Abaya in the southwesterly wind case were caused by a transition from subcritical to supercritical flow. What is the basis for this? It could simply be that the flow path has become narrower, and the wind velocity has increased. The authors should clearly show that the characteristics of the southwesterly wind cases are consistent with the qualitative characteristics of the transition flows.

Specific comments

(1) L92

evens -->events

(2) L111

domian --> domain

(3) L134

What is your basis for this assumption?

(4) L140

Why is it warm advection here?

(5) L143

What is responsible for this pressure gradient? Synoptic scale phenomena, temperature differences, or other things?

(6) L147

Why is the ITCZ not clearly visible from this figure?

(7) L150

Figure 2b shows that there is cold air advection from the southwest, but cold air advection from the Indian Ocean (southeast) does not appear to be present. Could you please explain exactly what you mean?

(8) L155

What do you mean by "the large-scale flow" here? On the flip side, did the large-scale flow not affect the gap winds in the first case? How did you determine the impact of the large-scale field from Figure 2?

(9) L170

Could you please indicate the time zone of the target area, e.g. in the introduction?

(10)L179

The authors need to explain why $\Delta p(\Delta z)$ does not match the gap wind strength.

(11) L188

tow --> two

(12) L229

I think we should break the line because the topic has changed.

(13) L231

Are you referring to the local acceleration between GA and CN in Figure 6c? If so, it would be better to add something like "between GA and CN" to make it easier for the readers to identify the location.

(14) L289

In what ways do you think this local acceleration resembles the transition from subcritical to supercritical flow? It could simply be that the flow path has become narrower, and the wind velocity has increased (Venturi effect).

In addition, in the transition from supercritical flow to subcritical flow (the front of the Gap wind), a flow discontinuity such as a hydraulic jump is thought to occur. What is the cause of the lack of hydraulic jump at the head of this local acceleration region?

(15) L299

Are these local accelerations caused by the same reason as the local accelerations over Lake Abaya?

(16) L321

"distance of 800 km"

Where is the distance between? I don't think there were any observation points as far apart as 800 km in your manuscript.

(17) L323

Indeed, Δz and Δp are the largest in the first half of the period when the Gap wind is strongest (Gray shade in Fig. 3b). However, in the second half of the period, (and Δp) are smaller. Furthermore, even during the period when the gap wind was not blowing, Δz is comparable to those during the period when the gap wind was strong. This hardly suggests that Δz can be a useful predictor of gap winds in the target area.

Since the wind is driven by Δz (Δp), they need to be linked. If gap wind did not blow despite the large Δz (Δp), some local pressure gradient can be inhibiting gap wind. However, Therefore, the authors need to further elaborate on the structure of the atmosphere during the periods when the gap winds did not blow. Alternatively, I recommend deleting this sentence from the manuscript.

(18) Paragraph started from L345

It would be very difficult for readers to understand the pattern and time evolution of each gap wind event with only the description in section 6. Therefore, I propose that conceptual flow diagrams for the northeasterly and southwesterly wind cases be included in the manuscript to aid the reader's understanding.

(19)L360

If the basin winds are preventing the gap winds from penetrating the basin, there should be a flow into the basin. However, Figure 9a shows no such flow. Is there any reason why the Basin wind did not develop?

To answer this question, it is recommended to check not only Δp and Δz between the ends of the gap, but also Δz and Δp between the ends of the gap and inside the gap. Alternatively, numerical experiments without the ground surface heat flux might be helpful.

(20)L360

Do you mean that the gap wind near x=600 km in Figure 9a is localized because the gap wind in Figure 9c is blocked by the thermally driven flow? Could you describe it more clearly?