Reply TO 'Comment on egusphere-2025-2012', Anonymous Referee #2, 16 Jul 2025

Response to Referee #2's comments

Referee #2: egusphere-2025-2012

Synopsis: *The Round-trip Drifting Sounding System (RDSS) proposed in this study demonstrates significant innovation and holds promising application potential. It is recommended for publication after minor revision. The RDSS's key advantage lies in completing a continuous atmospheric observation cycle of "ascent (1 hour) - drifting (4 hours) - descent (1 hour)" with a single balloon launch. Notably, the drifting phase provides continuous observation of the lower stratosphere, while the descent phase provides atmospheric vertical profiles over remote areas far from the launch site. This effectively addresses the gap in traditional sounding observations at 06 and 18 UTC. Furthermore, by utilizing long-distance drifting, RDSS expands the capability for vertical atmospheric sounding in remote regions through the descent observations.*

Field experiments conducted in the Yangtze River Basin successfully tackled several key technical challenges. Compared to China's previous-generation L-band sounding system, RDSS exhibits reduced observation errors, particularly in tropospheric wind fields and humidity. Additionally, RDSS possesses a degree of mobility, suggesting potential for targeted observation campaigns. The study also presents preliminary results from RDSS data assimilation and forecast impact experiments, indicating a significant improvement in the skill of 12-24 hour accumulated precipitation forecasts initialized at 06UTC and 18UTC.

Response: We thank Referee #2 (RC2) for her/his positive evaluation of our research. We have addressed each of reviewer's comments and inquires point by point and revised the manuscript carefully. And We sincerely thank the Referee #2 (RC2) for her/his valuable feedback that we used to improve the quality of the manuscript. Based on the comments and suggestions from the RC2, we have carefully and substantially revised the manuscript. We have included a detailed response addressing each of comments. The comments are laid out below in italicized font and specific concerns have been numbered. Our response is given in normal font and changes/additions to the manuscript are given in the blue text. The line numbers correspond to the revised manuscript without the track changes displayed. For precise details on the modifications made in the latest version, please consult the supplementary material, where track changes are enabled.

Specific Recommendations for Revision:

1. *Table 1: The horizontal lines in the three-line table vary in thickness. It is recommended to standardize the line weight.*

Response: We thank the RC2 for the valuable and creative comments. Your statement is correct, we standardize the line weight of Table 1 in revised manuscript.

No		Instruments	Key Function
1	"ADD" subsystem	zero-pressure dual-mode meteorological balloon	"outer balloon"as ascent carrier， "inner balloon" as drift carrier
2		parachute	parachute as the carrier of the descent phase
3		drifting controller	Adaptive control of drift and descent
4		radiosonde	The temperature, pressure, humidity, wind measurement meet the demand for long-term stratospheric observation
5	Ground operation control subsystem	ground station	ground inspection ground check, balloon inflation, launch, and other tasks before the equipment is launched
6		ground data-receiving device	8 channels receive radiosonde data simultaneously
7		control command transmitter	In the weather-sensitive area without a station, the active fusing drifting controller is carried out and the descent measurement is started
8		operational management system	Real-time acquisition, transmission, quality control, and timely delivery of control instructions for RDSS data, providing real-time high-quality data to weather analysis and numerical prediction models

2. *Table 4: Words are hyphenated across lines. It is recommended to adjust the table format to prevent word breaks.*

Response: We thank the RC2 for the valuable and creative comments. Your statement is correct, we prevent word breaks,the new Table 4 in revised manuscript.

Time	Height	Atmospheric temperature [K]	Relative humidity [%RH]	Geopotential height [m]	Pressure [hPa]	Wind (horizontal)direction [°]	Wind (horizontal)speed [ms-¹]	Wind (horizontal)vector [ms-¹]
Day	PBL	$0.18_{0.17}^{-0.05}\pm0.03$	$7.00_{4.41}^{-5.43}\pm0.74$	X	X	X	X	X
	FT	$0.12_{0.11}^{+0.05}\pm0.04$	$8.75_{8.02}^{-3.50}\pm0.60$	$5.9_{5.5}^{+2.0}\pm1.8$	$0.4_{0.4}^{-0.0}\pm0.1$	$3.6_{3.6}^{-0.4}\pm0.2$	$0.2_{0.2}^{-0.0}\pm0.0$	$0.3_{0.1}^{+0.2}\pm0.0$
	UTLS	$0.09_{0.08}^{+0.01}\pm0.03$	$7.73_{7.58}^{-1.55}\pm0.40$	$13.2_{8.6}^{+10.0}\pm3.8$	$0.4_{0.2}^{-0.3}\pm0.1$	$2.5_{2.5}^{-0.2}\pm0.3$	$0.2_{0.2}^{-0.0}\pm0.0$	$0.3_{0.2}^{+0.2}\pm0.0$
	MUS	$0.27_{0.16}^{-0.22}\pm0.10$	$1.69_{0.82}^{+1.48}\pm0.46$	$29.5_{17.9}^{+23.4}\pm4.2$	$0.3_{0.1}^{-0.2}\pm0.0$	$6.1_{6.1}^{-0.4}\pm0.2$	$1.3_{1.3}^{-0.0}\pm0.0$	$1.5_{1.5}^{+0.3}\pm0.0$
Night	PBL	$0.38_{0.34}^{-0.18}\pm0.05$	$4.72_{4.66}^{+0.74}\pm0.15$	X	X	X	X	X
	FT	$0.15_{0.15}^{+0.02}\pm0.02$	$6.41_{6.03}^{+2.16}\pm0.11$	$5.8_{5.8}^{+0.4}\pm0.4$	$0.5_{0.5}^{+0.1}\pm0.2$	$2.6_{2.6}^{-0.2}\pm0.2$	$0.2_{0.2}^{-0.0}\pm0.0$	$0.2_{0.1}^{+0.2}\pm0.0$
	UTLS	$0.12_{0.10}^{+0.06}\pm0.05$	$6.82_{5.74}^{+3.70}\pm0.26$	$11.5_{8.6}^{+7.7}\pm3.4$	$0.3_{0.2}^{-0.1}\pm0.1$	$2.4_{2.4}^{-0.1}\pm0.1$	$0.2_{0.2}^{+0.0}\pm0.0$	$0.2_{0.1}^{+0.2}\pm0.0$
	MUS	$0.10_{0.10}^{-0.03}\pm0.02$	$1.71_{0.74}^{+1.54}\pm0.28$	$26.7_{16.8}^{+20.7}\pm4.2$	$0.1_{0.1}^{-0.1}\pm0.0$	$4.5_{4.4}^{-0.6}\pm0.2$	$0.2_{0.2}^{-0.0}\pm0.0$	$0.4_{0.3}^{+0.3}\pm0.0$

3. *Figure 6(a): The 3D plot lacks clarity. It is recommended to replace it with a 2D plot, using different colors to represent trajectory altitudes.*

Response: Thank you for your constructive comments. We have plotted the trajectories on a two-dimensional map (Fig. 6) in the revised manuscript. The simulated and observed trajectories are represented by red and black, respectively. A color gradient based on pressure altitude is used to indicate the variation of trajectory height along the path. The Fig.6(b)(c) only shows Temperature and Wind field at 200 hPa in the middle and lower reaches of the Yangtze River. Deleting this picture will not affect our discussion. So, we omit this picture in the revised manuscript.

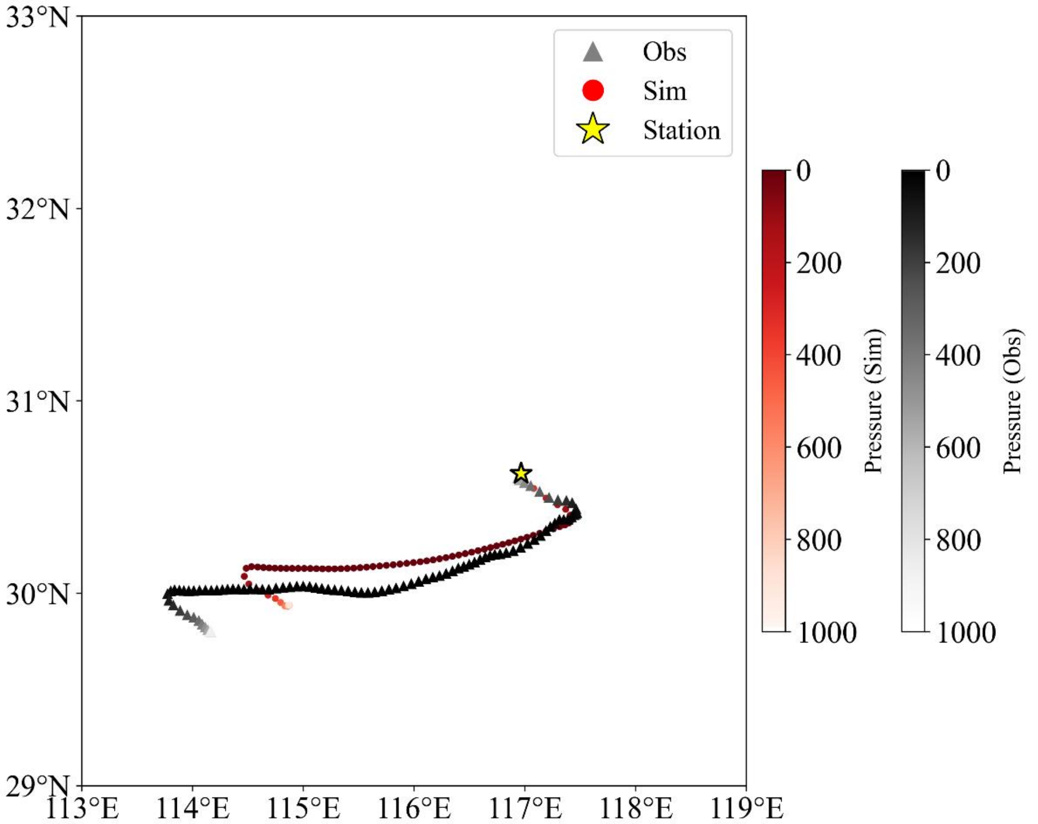


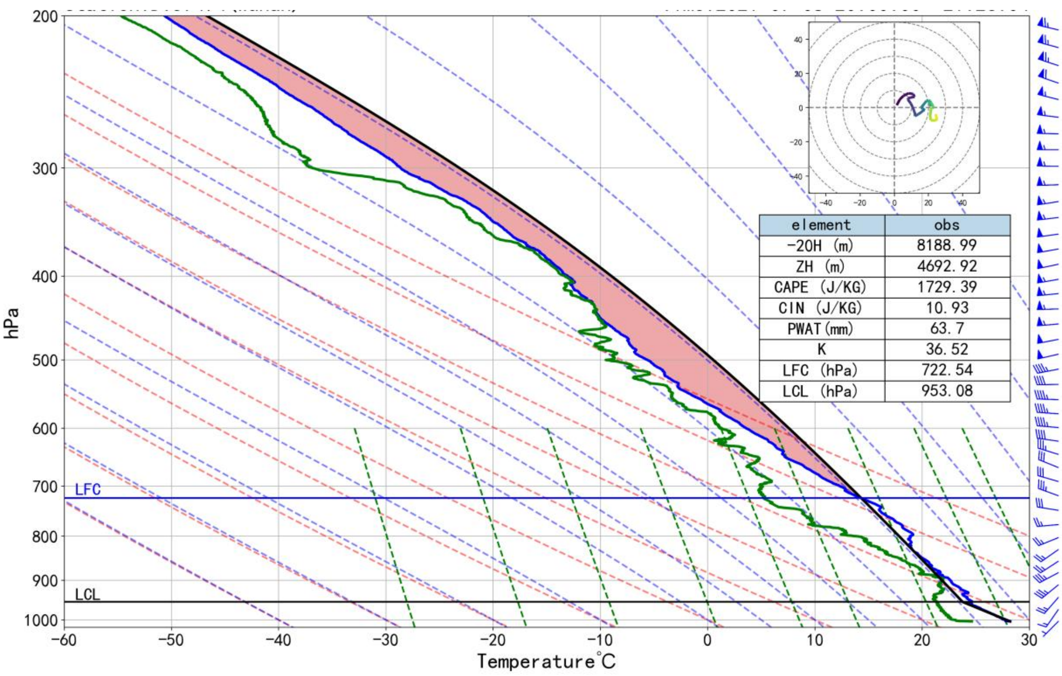
Fig.6 Observation (black triangles) and simulation (red dots) trajectory diagram. The yellow pentagrams represent sounding stations, and the colors of the dots represent the corresponding pressure heights. The colors range from light to dark, indicating the process of the trajectory rising from low altitude (high pressure) to high altitude (low pressure).

4. *Figure 7: This figure solely displays radar reflectivity for a specific weather event and has weak relevance to the main focus of the paper. It is recommended for deletion.*

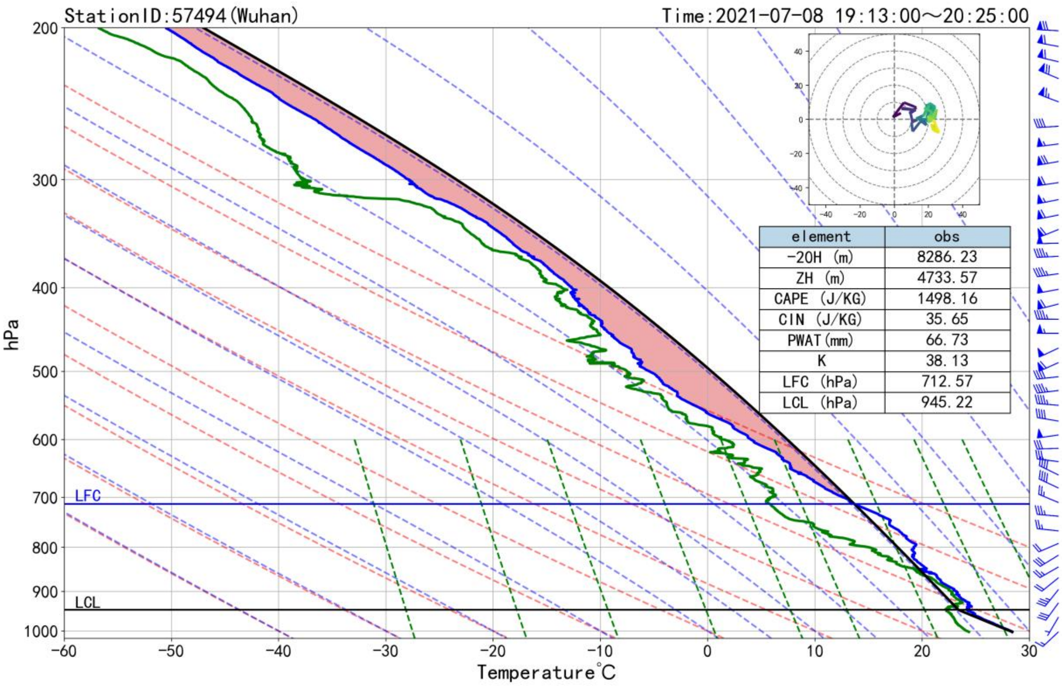
Response: Thank you for your suggestion. We apologize for the inconvenience caused to you. The Fig.7 only shows one precipitation weather process. Deleting this picture will not affect our discussion. So, we omit this picture and “L374-375Convection developed and moved to northern Jiangxi, northern Zhejiang, southern Anhui, and southern Jiangsu overnight on July 8 (Fig. 7)” “L400 Figure 7. Combined Reflectivity Factor of Radar Mosaic in the Yangtze River Basin, China, at 20:00 on July 8, 2021.”in the revised manuscript.

5. *Figures 8(a)-(c): The three T-logP diagrams are unclear. Furthermore, they have differing vertical axis ranges and inconsistent sizes, which is unsuitable for formal journal publication. It is strongly recommended to redraw these figures uniformly.*

Response: Thank you for your suggestion. Because these pictures are screenshots from our weather forecast operation system software, they are indeed not clear. Therefore, we redrew the T-logP plot (see Figure 8(a)(b)(c)) and unified the scale in the revised manuscript. And we modify “L402-403 Figure 8. Comparison of RDSS GTH3 and GTS1 radiosonde T-logP at the Wuhan station: (a) Wuhan Balloon Sounding at 19:15; (b) Wuhan RDSS ascent phase at 20:00; (c) Wuhan RDSS descent phase at 21:30.” to “Figure 8. Comparison of RDSS and GTS1 radiosonde T-logP at the Wuhan station: (a) GTS1 operational sounding; (b) ascent phase of RDSS sounding; (c) descent phase of RDSS sounding.”



element | obs
-20H (m) | 8188.99
ZH (m) | 4692.92
CAPE (J/KG) | 1729.39
CIN (J/KG) | 10.93
PWAT(mm) | 63.7
K | 36.52
LFC (hPa) | 722.54
LCL (hPa) | 953.08
LFC
LCL
hPa
Temperature℃



StationID:57494(Wuhan)
Time:2021-07-08 19:13:00～20:25:00
element | obs
-20H (m) | 8286.23
ZH (m) | 4733.57
CAPE (J/KG) | 1498.16
CIN (J/KG) | 35.65
PWAT(mm) | 66.73
K | 38.13
LFC (hPa) | 712.57
LCL (hPa) | 945.22
LFC
LCL
hPa
Temperature℃

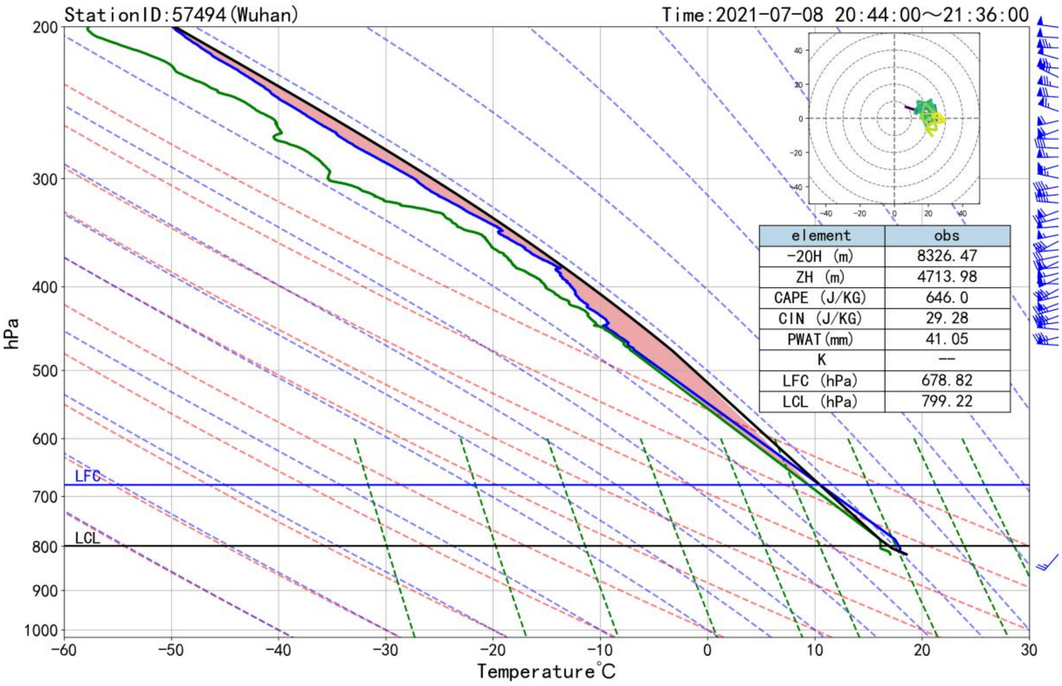


Figure 8. Comparison of RDSS and GTS1 operational soundingT-logP at the Wuhan station: (a) GTS1 operational sounding; (b) ascent phase of RDSS sounding; (c) descent phase of RDSS sounding.

6. *Figure 9:*

- *(a): This panel merely illustrates the experimental domain and provides limited information. It is recommended for deletion; the location can be described textually in the main body.*
- *(b): The symbols are confusing and undefined. It is recommended to recreate this figure with clear labeling of all symbols in the legend. The caption should provide a detailed explanation of the figure's content.*

Response: Thank you for your suggestion. Indeed, Figure 9 is not very clear and definite, and “L391-393 The drifting trajectories of RDSS radiosondes in the middle and lower reaches of the Yangtze River in China from July to August 2021 (Fig. 9) uniformly followed a west-to-east path, aligning with the region's strong convective direction.”causing confusion for you and the readers. We deleted Figure 9(a) (b) and L391-393.Thank you again for your suggestion, which makes this picture more readable.

7. *Figure 12: The image is unclear and primarily demonstrates the trajectory visualization software's output. It has minimal connection to the paper's core innovations and technical content. It is recommended for deletion.*

Response: Fig. 12 is a screenshot of an online prediction trajectory display system we established, with a relatively low resolution. Here, we will delete it.

8. ***Data Assimilation Experiments:*** *The assimilation application experiments using RDSS data in this paper are relatively limited. It is recommended that subsequent research focuses on: (a) Further refining assimilation techniques for RDSS second-level data (e.g., data thinning methods); (b) Conducting more extensive numerical forecast assimilation impact experiments utilizing additional observational data; (c) Conducting a thorough evaluation of the forecast skill improvement offered by RDSS compared to China's conventional L-band sounding system.*

Response: Thank you for the suggestions of the RC2. In the subsequent research, we will evaluate and improve the data on numerical forecasting for the RDSS about your suggestion.

9. *"Zhuang Z R, Wang R C (2019), Wang J C, et al." - Literature duplication.*

Response: Thank you for the suggestions of the RC2. We apologize for the inconvenience caused to you. We will delate L715-716 in revised manuscript.

10. *The two attached papers also studied and confirmed the impact and value of the RDSS data on numerical forecasting. It is recommended to include them.*

ZHANG Xin, WANG Qiuping, MA Xulin, et al. 2025. The Influence of New Round-Trip Drifting Sounding Observation on the Quality of Numerical Prediction in the Middle and Lower Reaches of the Yangtze River [J]. Chinese Journal of Atmospheric Sciences, 49(1): 245−256. doi:10.3878/j.issn.1006-9895.2304.22224

Zhang, X., Sun, L., Ma, X., Guo, H., Gong, Z., Yan, X. Can the Assimilation of the Ascending and Descending Sections' Data from Round-Trip Drifting Soundings Improve the Forecasting of Rainstorms in Eastern China? Atmosphere 2023, 14, 1127. https://doi.org/10.3390/ atmos14071127

Response: We read the two papers. It was of great help to us. In the subsequent research, And we will evaluate and improve the data on numerical forecasting for the application of RDSS.

We will add the two paper attached in REFERENCES:

ZHANG Xin, WANG Qiuping, MA Xulin, et al. 2025. The Influence of New Round-Trip Drifting Sounding Observation on the Quality of Numerical Prediction in the Middle and Lower Reaches of the Yangtze River [J]. Chinese Journal of Atmospheric Sciences, 49(1): 245−256. doi:10.3878/j.issn.1006-9895.2304.22224

Zhang, X., Sun, L., Ma, X., Guo, H., Gong, Z., Yan, X. Can the Assimilation of the Ascending and Descending Sections' Data from Round-Trip Drifting Soundings

Improve the Forecasting of Rainstorms in Eastern China? Atmosphere 2023, 14, 1127. https://doi.org/10.3390/ atmos14071127