WWRP Warning Value Chain Project

Warning Chain Database questionnaire

I. Purpose

Please use this form to record as much information as possible on the end-to-end warning chain for a hazardous weather event. This information will:

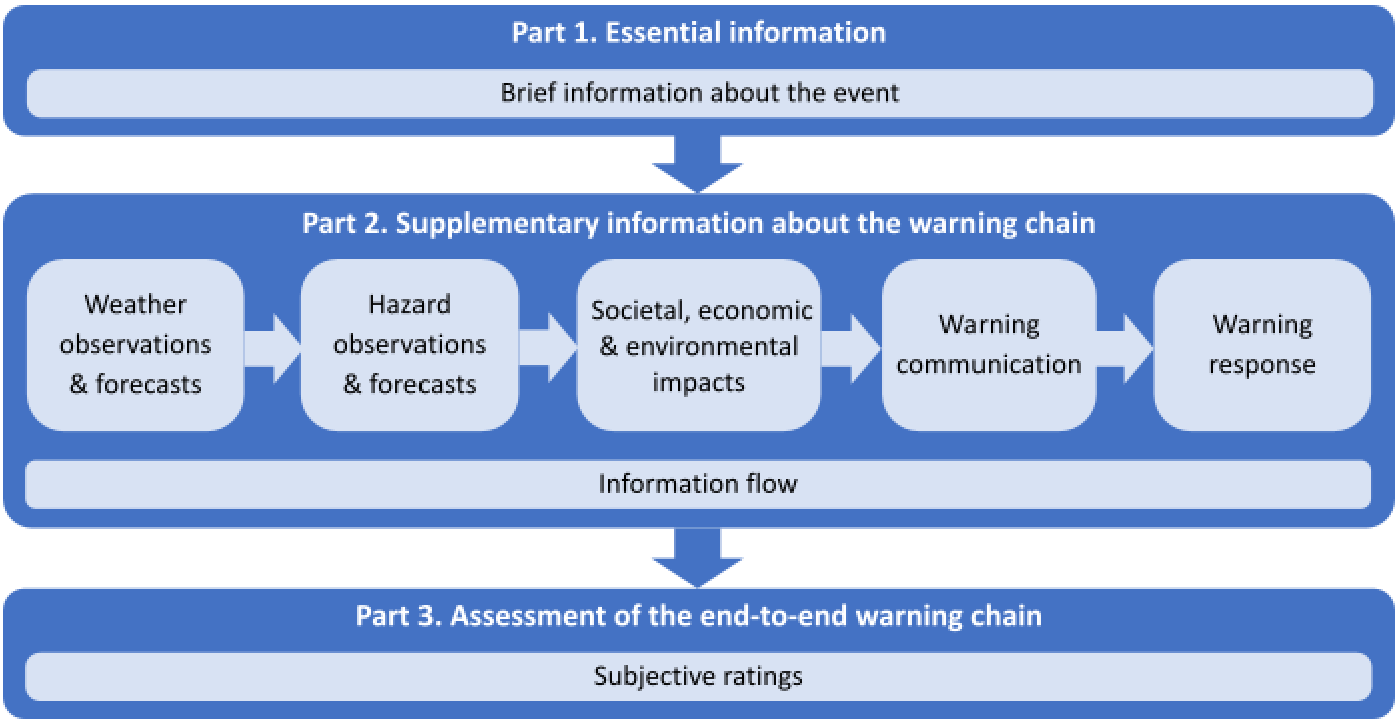
- add to a global database of hazardous weather events with rich information covering the many components of the warning value chain
- enable case studies and cross-cutting analysis of end-to-end warning value chains, from simple to complex, to understand effective practices.

The warning value chain database tries not to duplicate data collected in databases for other purposes. This template provides for a comprehensive picture of the information flow, decision making and response during a high impact weather event.

More information about the WWRP Warning Value Chain Project can be found at http://hiweather.net/Lists/130.html.

II. Structure and format

The form consists of three main parts.



Part 1. The **essential information table** requests brief facts about a particular event, such as what happened, when, where, impacts and responses. This information will help users to filter events. Please provide numerical and short text entries. Links to other databases and catalogues (e.g., ECMWF Severe Event Catalogue, EM-DAT, DesInventar, etc.) about this event should be provided.

Part 2. The second part requests **supplementary information** about different stages in the warning value chain. This more detailed information and analysis about the weather, the hazards, the impacts, the

warning communication and warning response will help users understand what was unique about the warning chain for this event. The guidelines are just suggestions, they are not exhaustive.
Information here might include:

- Graphics (for example, forecast charts, reanalysis maps, warning graphics, photos of impacts, etc.)
- Videos (for example, from social media, weather service outlooks, etc.)
- Free-form text (for example, description of meteorology, selected extracts from reports, data analysis, tables, etc.)
- Links (e.g., to other databases/catalogues, external reports, media, etc.)

Note:

⇒ Part 2 is optional, provide what you feel able to.

⇒ Each section has an "additional analysis" where you can add further information not covered by the items in the template.

⇒ Try to keep your entries brief and include references and links (URLs) to where additional information can be found.

⇒ Many people may contribute information on this event. Where you disagree try to provide evidence to support your position.

⇒ You can acknowledge contributors that provided you with information for the template at the end of the template before Annex 1. This is optional.

Part 3. The subjective assessment asks contributors to rate the effectiveness of the individual elements of the end-to-end warning chain, and its overall effectiveness, on a scale of 1 (poor) to 5 (excellent). This may assist users of the database in choosing cases and performing meta-analysis (recognising the large variability in contributors' judgments).

III. How to add resources

All resources for the supplementary material should be stored in the event data library of the respective case study. Preferably, resources such as forecast maps and warning graphics should be in the corresponding section of the template directly. Others such as reports and extensive graphics are not suitable to be embedded in the template but should be referred to. Best practice for referring to such information is to store the resources in the event data library first and then insert as a hyperlink to the template. To do so, follow these steps:

a) Go to the event data library (SharePoint [access required] or Google Drive [open to anyone]).
b) Locate the folder for the event for which you like to add resources or create a new folder ('New' > 'Folder') if the event does not exist yet in the library.
c) Place your resources in the folder and give an appropriate name so others know what it is about.
d) Right-click the file you want to embed/refer to and select 'Copy link' to retrieve the hyperlink pointing to the file.

IV. Tips

- Detailed instructions, explanations and examples about the data asked for are provided in the dedicated Guidance document (link to document on VC webpage).
- The Value Chain Glossary provides a common terminology. Use the names of hazard types listed in *Annex 1* of the template or this guide.
- A series of prompts (i) in this template provide some quick information to assist with entering the required data. Simply put your cursor over the information symbol i and text should pop up next to

it (ignore the “Ctrl+click to follow link” instruction). *Note, that this feature is only available in the Microsoft Word App, not in the SharePoint or Google Drive browser page.* Consult the Guidance document instead if this feature does not work for you.

- It is not anticipated that a single person can fill in the entire template. Rather, we encourage to share the template with colleagues who can provide information.
- See HERE for a worked example of the template.

Part 1. Essential information

Editors (Name & Institute)	*Fan Zhang, State Key Laboratory of Severe Weather of China, CMA, Beijing, China*

HIGH IMPACT WEATHER EVENT	
Unique identifier i	
Name of event	"5-22" Baiyin 100-km Cross-country Race Tragedy
When did it happen i?	May 22, 2021 Race Event: 0900-1410 LST (Local Standard Time, UTC+8) Tragedy Hours: 1100-1400 LST
Where did it happen i?	Jingtai County, Baiyin City, Gansu Province, China
WHAT HAPPENED – WEATHER, HAZARDS, IMPACTS, WARNINGS, RESPONSES	
Weather event type/system that caused hazards i *Refer to Annex 1*	*A typical cold front*
If possible, provide more detail about weather observations & forecasts (*link to page*)	
Hazards that caused the main impacts i *Refer to Annex* 1	Blizzard-like *Annotation:* There is no operational observation station along the site. The analysis from stations nearby show temperature as 3.0°C and gust wind as 11.2 m/s, and precipitation (Graupel and Sleet), however simulation research shows the lowest temperature is around -3.0°C and gust wind may reach 23 m/s.
Classify hazard in regard to the location's climatology i	Rain/Wind/Temperature
If possible, provide more detail about hazard observations and forecasts (*link to page*)	
What were the main direct impacts i?	*21 Death of hypothermia and 8 injured*
Economic damage in USD i	
Fatalities	*21*
If possible, provide more detail about impact observations and forecast (*link to page)*	
Main warnings issued i	**1649 LST, May 21:** The meteorological station of Jingtai issued a special weather forecast of the scenic area to the organizing committee. **2150 LST, May 21:** The meteorological station of Baiyin City issued a blue warning signal for high winds. **2216 LST, May 21:** The meteorological station of Jingtai issued a blue warning signal for high winds through 12379 platform, cell phone SMS, and WeChat working group.

Who issued the warnings? i	The meteorological station of Baiyin City The meteorological station of Jingtai County
If possible, provide more detail about the warnings and communication (*link to page*)	
Main responses to warnings i	None
If possible, provide more detail about responses to warnings (*link to page*)	
Links to other databases *(ECMWF catalogue of severe events, WMO CHE, DesInventar, EM-DAT, GLIDE, etc.)*	

Part 2a. Supplementary information about weather i

Wherever possible, please include references to information you provide!

Editors (Name & Institute): Fan Zhang, State Key Laboratory of Severe Weather, Beijing, China

Reference:

The government report:Responsibility Report on the "5-22" Jingtai, Baiyin 100-km Cross-country Race Accident.

Zhang, Q. H., C.-P. Ng, K. Dai, J. Xu, J. Tang, J. Z. Sun, and M. Mu, 2021: Lessons learned from the tragedy during the 100 km Ultramarathon race in Baiyin, Gansu Province on 22 May 2021. Adv. Atmos. Sci., 38(11), 1803–1810, https://doi.org/10.1007/s00376-021-1246-0.

Meteorological overview i

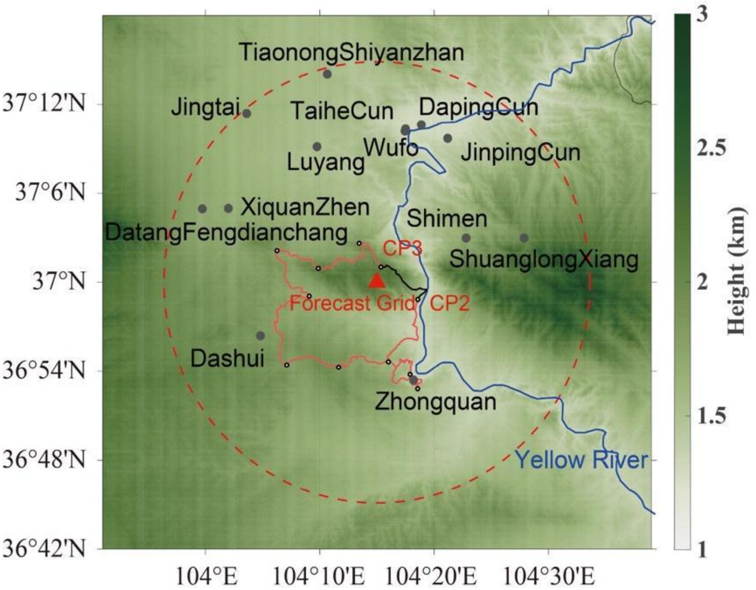


Fig. 1. Topography and spatial distribution of weather stations around the 100 km Ultramarathon race site. Shading indicates the altitude of the terrain. Dark circles represent weather stations. The radius of 27.6 km centered at the CP2–CP3 segment is marked as a red dash line. The red triangle is the forecast grid in the ECMWF and GRAPES models. The red and blue lines represent the route of the marathon and the Yellow River, respectively.

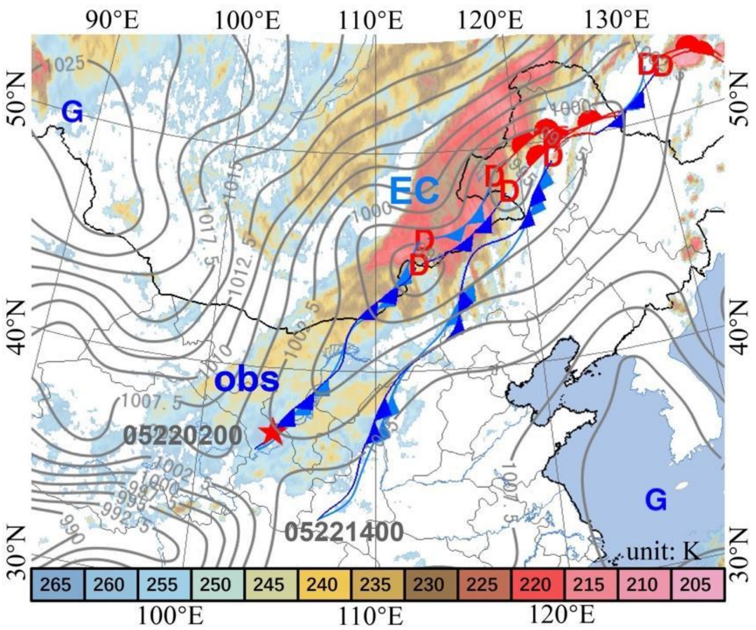


Fig. 2. Sea level pressure (solid dark lines) at 0200 MICAPS. The cold fronts, marked by light blue lines, were forecasted by the ECMWF model at 0200 LST 22 May and 1400 LST 22 May, initialized at 2000 LST (1200 UTC) 20 May 2021. The dark blue lines are the surface cold front observed by surface meteorological stations. Shading represents the 10.8 μm infrared brightness temperature at 1400 LST from FY-4A. The red star indicates the Jingtai Station. D and G represent the low-pressure and high-pressure centers, respectively.

On 22 May, 2021, Check Point (CP) was under the influence of a typical large-scale cold front, extending from northeastern China to Gansu Province. The length of the cold front was more than 3000 km (Fig. 2). The cold front passed CP3 from northwest to southeast at 0200 LST, seven hours before the start of the Ultramarathon race on the Tragedy Day. The infrared satellite imagery at 10.8 μm from Fengyun-4A (FY-4A) indicated that the main frontal precipitation was located at the northeast part of the cold front. It also shows that the brightness temperature near CP3 was 255–260 K, implying a low and thin cloud layer and no possibility for hail precipitation. CP3 had a surface temperature of 12.6°C before the frontal passage around 0200 LST with warm air coming from the south; cold air was coming from the north afterward. The temperature dropped continuously after the cold front passed CP3, reaching a minimum of 3.0°C at 1200 LST within the Tragedy Hours. Meanwhile, gust wind speed intensified and reached a maximum of 11.2 m s^{-1} around 1100 LST. Precipitation occurred during 1100–1900 LST. By considering the wind chill effect and the influence of precipitation, the apparent temperature at CP3 reached a minimum of –5.1°C at 1200 LST. Based on the observed satellite infrared brightness temperature and analyzed surface temperature near CP3, the precipitation type was most likely graupel or sleet.

Weather observations and analyses i

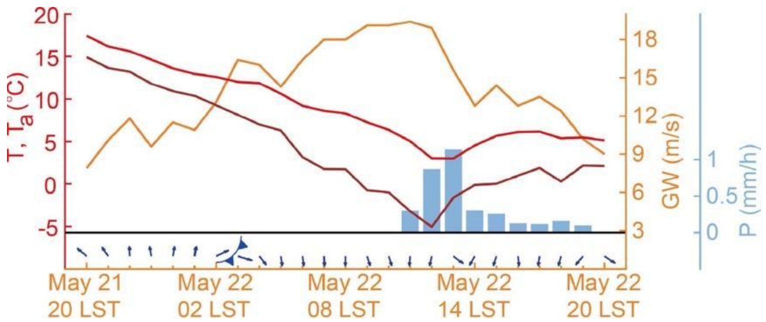


Fig. 3. Time series of the analyzed hourly temperature (red solid line), apparent temperature (dark red solid line), gust wind speed (yellow solid line), wind direction (blue arrows), and precipitation (light blue bars) at CP3 from 2000 LST 21 May to 2000 LST 22 May 2021. The cold front arrived at 0200–0300 LST 22 May 2021 and is marked in the figure.

Hourly surface temperature, precipitation, and gust wind speed observations are obtained from the national operational meteorological station of Jingtai and 12 nearby Automatic Weather Stations (AWS). The elevation difference between the 13 stations and CP3 varies from 380.0 m to 945.2 m. To obtain reasonable analysis at CP3 (Fig.3), the temperature (dewpoint temperature) values were adjusted to the height of CP3 assuming a lapse rate of 6.5°C km^{-1} (2.0°C km^{-1}). As shown in Fig.2, sea level pressure and surface observations at 0200 LST and 1400 LST 22 May 2021 are obtained from Meteorological Information Comprehensive Analysis and Process System (MICAPS).

Temperature: at 0800 LST on May 22, the temperature observed by meteorological stations around the race area declined and then rebounded. The lowest temperature during the day appeared at 1100–1300 LST. From the start to the No. 4 CP, the temperature ranged from 4 to 14℃ at 0900 to 1700 LST. The temperature from the No. 2 to No. 4 CP started to drop from 0800 LST, with a 5-hour cooling of 5 to 7℃, and the lowest temperature appeared around 1300 LST, with the temperature near the No. 3 CP dropping to about 4℃.

Precipitation: it started to appear around 1030 LST in the race area. The maximum precipitation period was 1100-1200 LST with the maximum of 7.2 mm registered at Shimen Automatic Weather Station.

The end time of precipitation was different in each race section with the latest end time being 1800 LST. From CP 2 to CP 4 the accumulated precipitation in 24 hours was 3-5 mm, while the accumulated precipitation in the rest of the race course was below 1.5 mm. As the altitude rises from CP 2 to CP 3, some sections of the race could have experienced graupel (ice particles), which did not constitute weather conditions for freezing rain or hail.

Wind: from 0900 to 1700 LST, the average wind at low altitude was force 4-6, with maximum gust of force 7-8. The average wind from 0800 to 1300 LST at the high-altitude section from CP 2 to CP 3 was of force 6-7, with maximum gust of force 8-9. Maximum gust over force 9 was possible, which might be accompanied by and dust.

How did the observed weather relate to climatology and/or previous extreme events? i

The weather that occurred during the Tragedy Hours (1100-1400 LST) is considered an extreme cold event and an extreme high wind event for the month of May based on the records of the past six years (if the lower proposed threshold of top or bottom 5% is used to define an extreme event). In terms of precipitation, the Tragedy Day event was nowhere near an extreme weather event. However, when any given adjacent three hours were checked for surface temperature lower than 3.0°C, gust wind speed greater than 11.2 m s^{-1}, and precipitation greater than 0.1 mm, besides the Tragedy Day, 1 and 13 May 2016, 3 May 2017, and 21 May 2018 were the only four samples found to meet the criteria, ranking the Tragedy Hours in the top 0.1%. Based on this analysis of combining low temperature, high wind speed, and precipitation, it can be concluded that the weather event during the Tragedy Hours was extreme.

Special/non-traditional observational data used in the weather forecast or assimilated into NWP i

Weather models

(Info on operational NWP systems: http://wgne.meteoinfo.ru/nwp-systems-wgne-table/wgne-table/)

Name	**Horizontal resolution**	**Ensemble size**	**Forecast length**
ECMWF deterministic model	9 km/137 levels		10 days
ECMWF 50 ensemble forecast system	18 km/137 levels	50	15 days
GRAPES-GFS deterministic model	25 km/87 levels		15 days
GRAPES-GFS 30 ensemble forecast system	50 km/87 levels	30	15 days

Post-processing/calibration applied to weather model output i

Deterministic weather forecast outputs and examples i

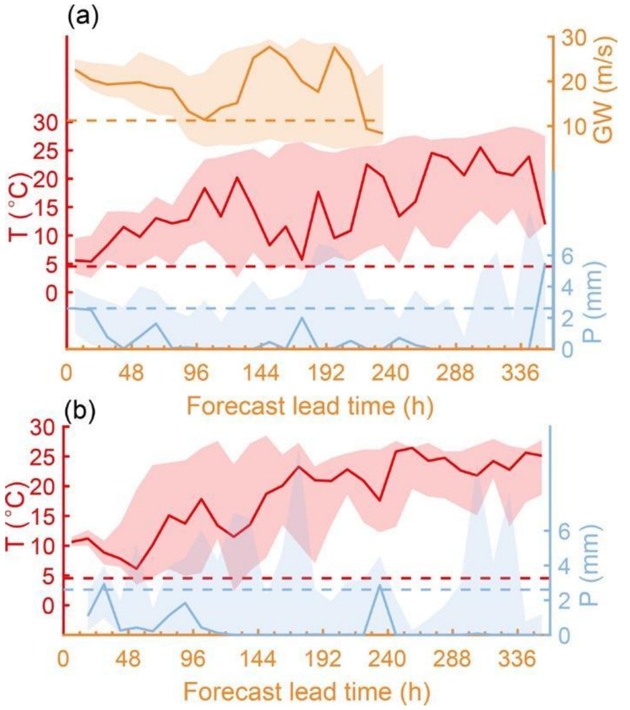


Fig. 4. ECMWF (a) and GRAPES (b) forecasts valid at 1400 LST 22 May 2021 with 6–354 h lead times. The colors of light blue, red, and yellow represent the 6-h accumulated precipitation, temperature, and maximum gust wind speed between 0800–1400 LST, respectively, from the deterministic run (solid line) and ensemble runs (shading). The dashed lines represent the analyzed values for the three variables at the valid time at CP3.

Ensemble/probabilistic weather forecast outputs and examples i

As shown in Fig.4, the shading indicates the range of outputs from ensemble runs.

Interpretation/guidance for forecast users i

What was the level of agreement between the different forecasts? i

How reliable and accurate were weather forecasts? i

Cold Front: the ECMWF deterministic run initialized at 1200 UTC (2000 LST) on 20 May made an almost perfect 30-h forecast of the location of the cold front at 0200 LST, 22 May, when the cold front passed Jingtai County. The location of the 30-h forecast cold front agreed well with observations, although the forecast front moved a little bit faster at 1400 LST, 22 May than the observed front. GRAPES also made a similar forecast to the ECMWF in terms of the movement of the cold front.

Surface Temperature: the ECMWF deterministic run initiated 24 hours prior forecasted a low temperature of 5.5°C, which was within 1.0°C of the estimated actual low temperature. The GRAPES ensemble run initiated two days prior predicted a low temperature close to 4.5°C (Fig.1), but that forecast may not have been useful because the accurately forecasted low temperature did not persist as lead time was reduced. Moreover, the top and bottom temperature range from ensemble forecasts valid at 1400 LST, 22 May with different lead times (represented by the shading in Fig. 1) covered the low temperature in all seven (five) days prior to the event for the ECMWF (GRAPES) model.

Gust Wind: the deterministic forecasts-maintained gust wind speeds stronger than 11.2 m s−1 for all nine days leading up to the event (Fig.1a). Additionally, more than half of the 50 ensemble members with 10 days lead time forecasted gust wind speed to exceed the analysed value. These persistent high gust wind speed forecasts provided evidence to support high wind warnings.

Precipitation: both the ECMWF and GRAPES models produced light precipitation forecasts 1–3 days before the Tragedy Hours for the deterministic runs, while the ensemble runs provided a certain likelihood of precipitation with 15 days lead time.

When was the potential event first detected in the models? i

Low-temperature forecasts were produced in deterministic runs with one day lead time by ECMWF, while a few ensemble members forecasted temperatures lower than the estimated value at CP3 as early as seven days prior by ECMWF and five days prior by GRAPES. The gust wind speed was also predicted by ECMWF starting from nine days before the Tragedy Hours.

Additional analysis i

Successes/issues/challenges experienced? i

Part 2b. Supplementary information about hazards i

Wherever possible, please include references to information you provide!

Editors (Name & Institute): Fan Zhang, State Key Laboratory of Severe Weather, Beijing, China

Reference:

The government report:Responsibility Report on the "5-22" Jingtai, Baiyin 100-km Cross-country Race Accident.

Zhang, Q. H., C.-P. Ng, K. Dai, J. Xu, J. Tang, J. Z. Sun, and M. Mu, 2021: Lessons learned from the tragedy during the 100 km Ultramarathon race in Baiyin, Gansu Province on 22 May 2021. Adv. Atmos. Sci., 38(11), 1803−1810, https://doi.org/10.1007/s00376-021-1246-0.

Brief overview of the hazard event(s) i

Both temperature and wind are considered. In terms of precipitation, the Tragedy Day event was nowhere near an extreme weather event. However, when any given adjacent three hours were checked for surface temperature lower than 3.0°C, gust wind speed greater than 11.2 m s^{-1}, and precipitation greater than 0.1 mm, besides the Tragedy Day, 1 and 13 May 2016, 3 May 2017, and 21 May 2018 were the only four samples found to meet the criteria, ranking the Tragedy Hours in the top 0.1%. The simultaneous occurrence of extreme low temperature and high wind speed, and precipitation can be concluded the main hazard during the Tragedy Hours.

Hazard observations and analyses i

Replies to this and the following questions are similar to those corresponding answers replied in Weather observations and analyses.

How did the hazard(s) relate to climatology? i

How was the hazard(s) made worse by pre-existing conditions? i

Observational data used in the hazard forecast or assimilated into the hazard model i

Hazard prediction models/tools i

Name	Resolution	Ensemble size	Forecast length

Deterministic hazard forecast outputs and examples i

Ensemble/probabilistic hazard forecast outputs and examples i

How reliable and accurate were the hazard forecasts? i

What was the trigger used to classify the event as hazardous and start the warning process? i

Additional analysis i

Successes/issues/challenges experienced? i

Part 2c. Supplementary information about impacts i

Wherever possible, please include references to information you provide!

Editors (Name & Institute): Fan Zhang, State Key Laboratory of Severe Weather, CMA, Beijing, China

Reference:

The government report:Responsibility Report on the "5-22" Jingtai, Baiyin 100-km Cross-country Race Accident.

Brief overview of the impact(s) i

On May 22, 2021, the 2021 (Fourth) 100 km Yellow River Stone Forest Mountain Marathon and Rural Revitalization Health Run was held in Jingtai County, Baiyin City. A high impact weather of sudden cooling, precipitation and strong wind occurring during the race resulted in the death of 21 runners and the injury of 8.

After the accident, CPC General Secretary Xi Jinping and other Chinese leaders made important instructions, with a requirement to perform emergency rescue, treat the injured, take aftermath measures and fully investigate the accident. They also required a bitter lesson to be learnt from the tragedy by strengthening risk prevention, improving the organisation and management of sports events and calling those responsible to account according to laws and regulations. The CPC Gansu Provincial Party Committee and the provincial government attach great importance to the accident. Yin Hong, Secretary of the provincial party committee, and Ren Zhenhe, Governor of the province immediately presided over a special meeting to make arrangements for the tragedy, at which the emergency preplan was launched. Governor Ren Zhenhe rushed to the scene to direct the rescue efforts. An on-the-spot rescue command was set up to focus on victim search and rescue, treatment of the injured and of the aftercare and aftermath. At the same time, a joint investigation group was set up to look into the accident according to laws and regulations. The group conducted site survey and technical forensics for more than 10 times. More than 360 people (times) were visited or questioned, including relevant personnel from the sponsors, organizers, co-organizers and operators as well as players, staff, volunteers, rescue workers and local residents, among which 90 talks were highlighted and recorded. More than 800 documents were referred to, including the event-related programs, plans, emergency response plans, the plans to determine the size, posts and functions of the staff, rules and regulations, minutes of meetings of related city and county departments.

Observed health impacts i

21 runners died and 8 runners injured.

Observed property and business impacts i

Observed critical infrastructure damage and service disruption i

Environmental damage observed i

Impact prediction models/tools (if used) i

Name	Method

Impact forecast outputs and examples i

Comparison of predicted/expected and actual impacts i

Informal rules/tools used to identify impacts i

Who and what were exposed to the hazards, when, for how long and why? i

172 runners who participated the 100 km cross-country ultramarathon Race in Baiyin CIty.

Exposure time: 0900-1410 LST

Out of those exposed, who and what were vulnerable to the hazards and why? i

Runners in shorts and vests are vulnerable to low temperatures, which in this case were exasperated by high wind speeds and precipitation. In this case, the organizers and most of the runners were not aware of the high wind speed warning and the precipitation forecast. It should be pointed out that there were 4–5 runners who had passed the CP2–CP3 segment successfully that day because they had brought outdoor jackets to keep them warm.

Additional analysis i

Successes/issues/challenges experienced? i

Part 2d. Supplementary information about warning communication

Wherever possible, please include references to information you provide!

Editors (Name & Institute): Huiyi Fan, State Key Laboratory of Severe Weather, CMA, Beijing, China

Reference:

The government report:Responsibility Report on the "5-22" Jingtai, Baiyin 100-km Cross-country Race Accident.

Brief overview of the communication "story" i

1649 LST, May 21: The meteorological station of Jingtai issued a special weather forecast of the scenic area to the organizing committee.

2150 LST, May 21: The meteorological station of Baiyin City issued a blue warning signal for high winds.

2216 LST, May 21: The meteorological station of Jingtai issued a blue warning signal for high winds through 12379 platform, cell phone SMS, and WeChat working group.

What information was provided to emergency responders, government and other stakeholders about the hazard and its possible impact, and by whom? i

The warning information was provided by the meteorological station of Baiyin City and Jingtai county.

Public warnings in detail i

Warning name	Warning lead time	Issued by	Warning area i	Type of warning i	Did it include safety advice?	Scaled i	Channel i	Warning frequency
Special weather forecast	~16 hrs	The meteorological station of Jingtai	Local					
Blue warning signal for high winds	~11 hrs	The meteorological station of Baiyin City	Regional	Meteorological threshold	Yes	Blue (the lowest severity level for warning in China)		
Blue warning signal for high winds	~11 hrs	The meteorological station of Jingtai	Regional	Meteorological threshold	Yes	Blue	12379 platform, cell phone SMS, and WeChat working group	

Warning outputs and examples

Was uncertainty included in the warning? If so, how? i

No.

Were communication systems in place and operating effectively?

No.

Were warning messages received and understood by the public? How did you know?

Were the needs of specific communities and populations addressed? If so, how?

Additional analysis i

Communication success/issues/challenges experienced i

Part 2e. Supplementary information about responses to warnings

Wherever possible, please include references to information you provide!

Editors (Name & Institute): Huiyi Fan, State Key Laboratory of Severe Weather, CMA, Beijing, China

Reference:

The government report: Responsibility Report on the "5-22" Jingtai, Baiyin 100-km Cross-country Race Accident.

Brief overview of the response to the hazard by emergency services and other partners i

Before the Marathon race:

According to the government report, there was no specific preparation for the warning (the blue warning signal for high winds).

During the race day: May 22nd

11:50, almost 3 hours after the Marathon began, one of the runne Cihua Luo (number M162) sent out the SOS message through GPS, but got no response.

12:03, captain of the Baiyin Blue Sky Rescue Team, Zhang Long, received a report from Zhang Wei, the No. 1 team member stationed at the race site, saying because of strong wind and heavy rain at the site he has lost his strength, requesting withdrawal. Zhang agreed and asked another team member to replace him.

Then from 12:03 to 14:10, the Baiyin Blue Sky Rescue Team, Shengjing Company and Jingtai County 110 Command Center received the calls stated that several runners had symptoms of hypothermia caused by the weather, and had been unable to move. A large number of runners withdrew from the competition, and the competition organization began to implement rescues. However, no suspension was announced.

15:00, the investigation group determined that this moment was the time when the management committee officially reported the accident to the county party committee and county government.

The rescue working had been ongoing until 17:00, rescue team found 3 runners dead near the check-in point No.3.

17:10, Jingtai County reported to city Baiyin, Baiyin immediately organised professional rescue teams and joint the rescue work.

19:00, the organisers confirmed that 139 people were safe or had returned, and 33 people were lost.

On 9:10 23rd May, the status of all the 172 runners were confirmed, of which 151 were picked up (8 were in the hospital), the other 21 runners died.

What were the main response actions by the public to the warnings? i

Institutional responses i

Response actions	Taken by whom	When taken	On the basis of what information?	Benefit (if any)	Cost

How did the overall response to this event compare to similar previous events? i

How knowledgeable was the community about the hazard?

Were disaster preparedness and response plans in place and used?

What capacity did the community have to respond to warnings?

Additional analysis i

Success/issues/challenges experienced i

Part 2f. Analysis of the warning chain

Editors (Name & Institute): Huiyi Fan, State Key Laboratory of Severe Weather, CMA, Beijing, China

Reference:

The government report: Responsibility Report on the "5-22" Jingtai, Baiyin 100-km Cross-country Race Accident.

Information flow through the warning chain

Warning chain	**Was all necessary input information available? (yes/no)**	**If no, what input information was missing?**	**Who should have provided the missing information?**
Weather forecast			
Hazard forecast			
Impacts forecast			
Warning communication			
Warning response			

Tools and operational workflows for sharing information between partners

How were social media data used in the warning chain? i

Evidence that warning chain was effective in reducing fatalities, injuries, damage, and/or disruption?

No

What were the strongest links in the warning chain? i

What were the weakest links in the warning chain? i

What procedures were used to identify lessons learned from the event? i

If known, how did lessons learnt from previous events contribute to greater warning success for this event?

Additional analysis

At 21:50 on May 21, the meteorological station of Baiyin City issued a blue warning signal for high winds. At 16:49 on May 21, the meteorological station of Jingtai issued a special weather forecast of the scenic area to the organizing committee. At 22:16 on the same day, the meteorological station of Jingtai issued a blue warning signal for high winds through 12379 platform, cell phone SMS, and WeChat working group.

According to the governmental report, the organization-related causes of this accident is that the event organizers didn’t have high awareness of the risks. They did not take effective measures after receiving the special weather information and strong wind warning from the meteorological service before the race. They did not include windproof and warmth equipment in the mandatory equipment list according to the standard of high-altitude races. The supply points were not set reasonably, with no medical and supply points in the most difficult and dangerous high-altitude section (2230m). The organizers did not take measures to strengthen or improve the communication, resulting in poor contact at the most dangerous moments. The arrangement, management and operation of the organizers and operation companies were poor, with no emergency response plan and security measures being made as required, and the rescue personnel being seriously under-prepared. After receiving information for rescue and of withdrawal of a large number of runners from the race, the early-stage rescue was not coordinated well.

Part 3. Assessment of the end-to-end warning chain

Assessor (Name & Institute) (optional):
Profession:
Please rate your level of expertise on a scale of 1 (no expertise) to 5 (established expert) for:

Weather:

Hazard:

Impact:

Warning/communication:

Response:

High-impact weather event evaluation:

HOW SUCCESSFUL WERE THE FORECASTS, WARNINGS AND RESPONSES?

How well was the event observed? *Scale of 1 (poor) to 5 (excellent)*
Reason for this rating i

How well was the weather forecast? *Scale of 1 (poor) to 5 (excellent)*
Reason for this rating i

How well were the hazards forecast? *Scale of 1 (poor) to 5 (excellent)*
Reason for this rating i

How well were the impacts predicted? *Scale of 1 (poor) to 5 (excellent)*
Reason for this rating i

How well were warnings communicated? *Scale of 1 (poor) to 5 (excellent)*
Reason for this rating i

How well were the warnings used? *Scale of 1 (poor) to 5 (excellent)*
Reason for this rating i

How well did the entire warning chain perform overall? *Scale of 1 (poor) to 5 (excellent)*

Thank you very much for contributing to the WWRP Warning Value Chain Project database!

Acknowledgements (e.g., information providers) i

Annex 1: *Weather system and hazard types based on pre-defined hazards in the Sendai Framework Monitor*

a) Weather system types

Blizzard	Derecho	Tornado
High pressure system	Extra-tropical storm	Tropical cyclone
Convective storm	Extreme temperature	
Cyclone surge	Fog	
Cyclonic rain	Rain	
Cyclonic wind	Snow	

b) Hazard types

Coastal erosion	Fog	Lightning
Coastal flood	Freak waves	Riverine flood
Cold wave	Freeze	Snow
Dust	Frost	wind
Fire	Hail	Wave action
Flash flood	Heat wave	Wildfire
Flood	Ice	

<table>
<tr><th colspan="2">Weather (system) types</th><th colspan="4">Hazard types</th></tr>
<tr><td>Type</td><td>Sub-type</td><td>Type</td><td>Sub-type I</td><td colspan="2">Sub-type II</td></tr>
<tr><td colspan="2" rowspan="3">`Tropical storm/cyclone</td><td>Rain</td><td>Flood</td><td colspan="2">Riverine flood, coastal flood, flash flood</td></tr>
<tr><td rowspan="2">Wind</td><td>Wave action/ storm surge/ freak waves</td><td colspan="2">Coastal erosion</td></tr>
<tr><td colspan="2">Dust</td><td rowspan="2">Dust</td></tr>
<tr><td rowspan="2">Convective storm</td><td>Tornado</td><td>Lightning</td><td>Fire</td><td>Urban fire, wildfire</td></tr>
<tr><td>Derecho</td><td colspan="4" rowspan="2">Hail</td></tr>
<tr><td rowspan="3">Extratropical storm</td><td>Cyclonic storm</td></tr>
<tr><td rowspan="2">Blizzard</td><td rowspan="2">Snow</td><td colspan="3">Avalanche</td></tr>
<tr><td colspan="3">Snow drift</td></tr>
</table>

High pressure system	Extreme temperatures	Cold wave	Freeze, frost, ice
		Heat wave	
Fog	Fog		