

September 2024 floods in Japan exacerbated by human-driven climate change & natural variability

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Press Summary (First Published 2024/09/30)

- Meteorological conditions similar to that causing floods in Japan are up to 5 mm/day (up to 30%) wetter over the prefecture of Ishikawa (Japan) in the present than they have been in the past. Temperatures are up to 1.5 °C warmer in the present compared to the past .
- This event was associated with very rare meteorological conditions
- We mostly ascribe the increase in precipitation of Japan floods to human driven climate change and natural climate variability likely played a modest role.

Event Description

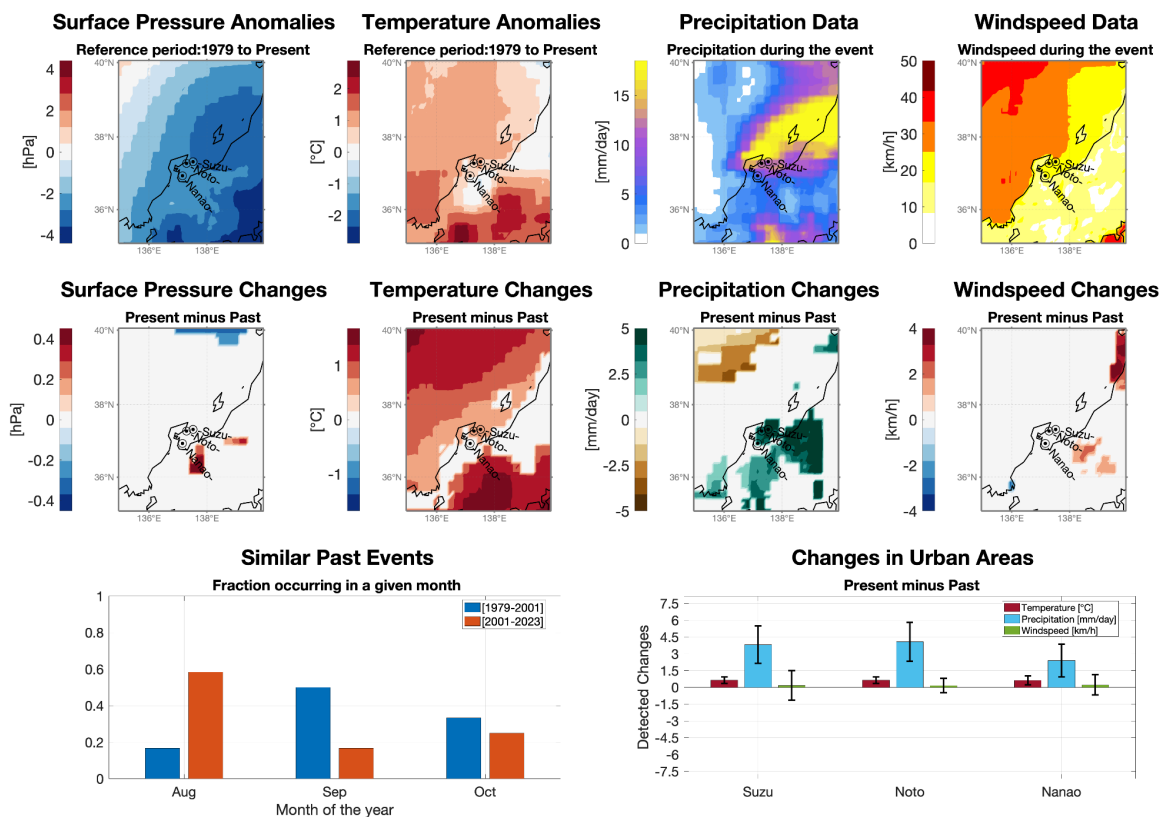
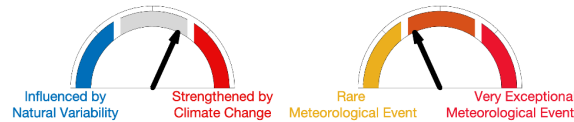
On September 22nd and 23rd, 2024, record-breaking rainfall in Japan's Ishikawa prefecture triggered [severe floods and landslides, with six people dead and leaving 10 others missing](#). The hardest-hit cities, Wajima and Suzu, already reeling from a devastating New Year's Day earthquake, experienced the double of their average September rainfall in a single day (on Sunday 22nd), causing rivers to overflow and isolating over 100 communities. Among the victims were two individuals near a landslide-hit tunnel, including a road repair worker, and three elderly residents. Thousands of homes were flooded, including temporary housing for earthquake survivors, while 4,000 households lost power. Over 40,000 residents in Ishikawa and neighboring prefectures were evacuated as authorities maintained warnings amid ongoing heavy rain.

The *Surface Pressure Anomalies* show a large area of negative pressure anomalies (-4 hPa) over Japan with *Temperature Anomalies* up to +2.5°C. *Precipitation data* show high daily amounts of precipitation over the Ishikawa prefecture exceeding 15 mm/day. *Wind speed Data* indicates moderate winds over the Japan sea. We remind that our analysis is based on MSWX data. This product does integrate some station observations, especially

for rain data. The values reported here can be different from those observed at single weather stations.

25-Nov-2024CNRS-IPSL (MSWX Data)

ClimaMeter for Japan Floods 22-Sep-2024 to 23-Sep-2024



Climate and Data Background for the Analysis

The Intergovernmental Panel on Climate Change's Sixth Assessment Report ([IPCC AR6](#)) highlights that human-induced climate change has increased the likelihood and severity of extreme weather events, including heavy rainfall and flooding, in various regions worldwide. While the report does not provide detailed, country-specific analyses for Japan, it notes that several recent heavy rainfall events in countries such as China, Japan, and the USA, which led to substantial flooding, were made more likely by anthropogenic climate change. Japan's geographical characteristics, including its extensive coastline and mountainous terrain, make it particularly susceptible to

flooding and landslides. The [IPCC AR6](#) emphasizes that the intensification of the hydrological cycle due to human-induced climate change is affecting physical aspects of water security, thereby exacerbating existing water-related vulnerabilities caused by other socioeconomic factors. In response to these findings, Japanese authorities have acknowledged the increased risks associated with global warming, such as rising sea levels, increased flooding. The [Japanese government](#) has expressed its commitment to strengthening both mitigation and adaptation measures to address these challenges.

Our analysis approach rests on looking for weather situations similar to those of the event of interest having been observed in the past. For this event, we have medium-high confidence in the robustness of our approach given the available climate data, as the event is similar to other past events in the data record.

ClimaMeter Analysis

We analyze here (see [Methodology](#) for more details) how events similar to the meteorological conditions leading to the Japan Floods have changed in the present (2001–2023) compared to what they would have looked like if they had occurred in the past (1979–2001) in the region [135°E 140°E 35°N 40°N].

The *Surface Pressure Changes* show no significant differences in the present climate than what they would have been in the past. *Temperature Changes* show that similar events produce temperatures in the present climate that are more than 1 °C warmer than what they would have been in the past. The *Precipitation Changes* show up to 5 mm/day (up to 30%) wetter conditions over Japan inland and up to 2 mm/day drier conditions over the ocean. *Windspeed Changes* indicate no significant changes. We also note that *Similar Past Events* tend to occur more in August in the present climate while they were occurring in September in the previous climate. *Changes in Urban Areas* reveal that there is a significant increase in the precipitation (up to 5 mm/day) for the cities of Suzu, Noto and Nanao analyzed.

Finally, we find that sources of natural climate variability, notably the Atlantic Multidecadal Oscillation, may have only partly influenced the event. This means that the changes we see in the event compared to the past may be mostly due to human driven climate change.

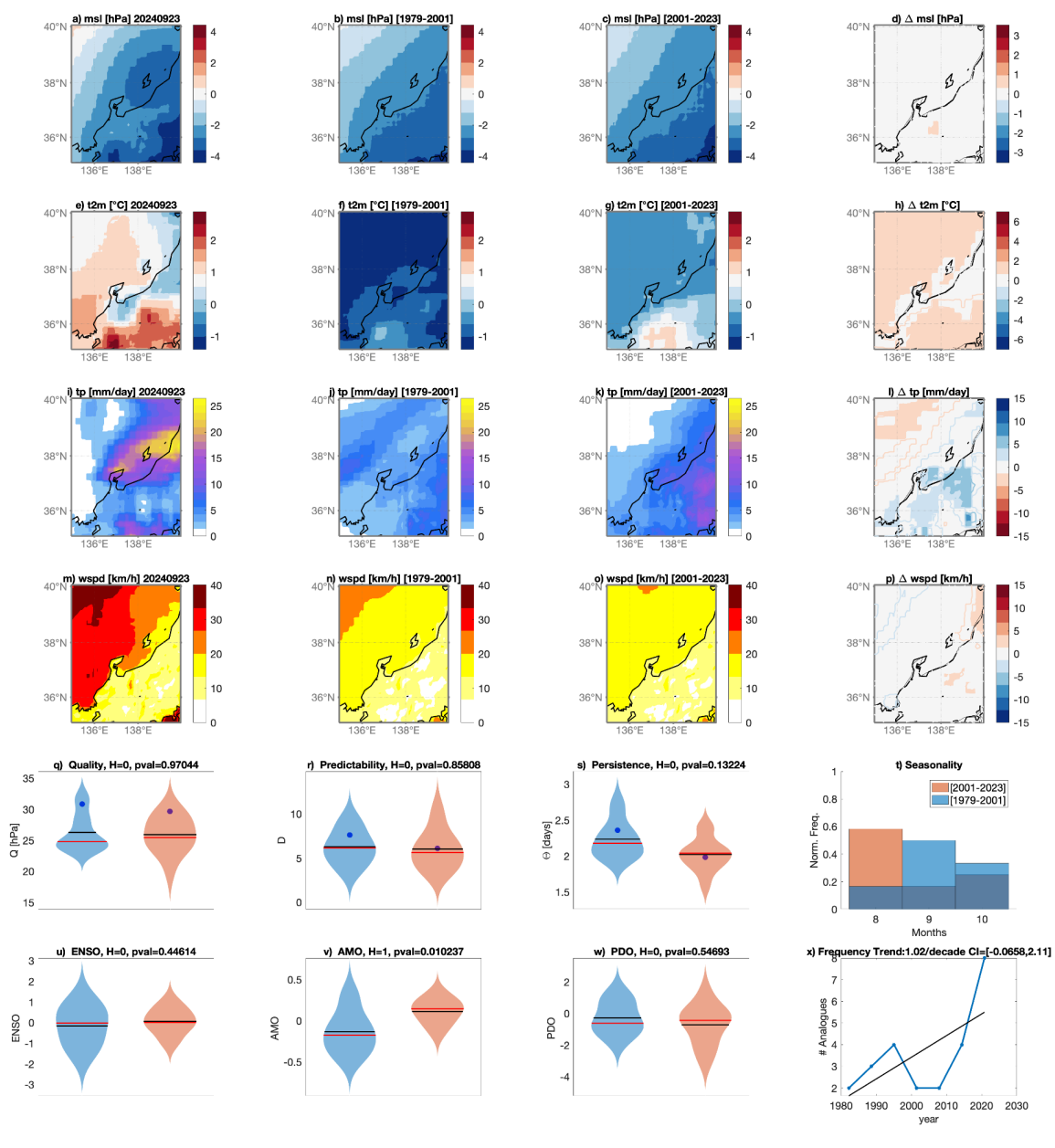
Conclusion

Based on the above, we conclude that Meteorological conditions similar to that causing floods in Japan are up to 5 mm/day (up to 30%) wetter over the prefecture of Ishikawa (Japan) in the present than they have been in the past. Temperatures are up to 1.5 °C warmer in the present compared to the past. We interpret the Japan floods as an event driven by very rare meteorological conditions, whose characteristics can mostly be ascribed to human driven climate change.

Additional Information : Complete Output of the Analysis

NB1: The following output is specifically intended for scientists and contain details that are fully understandable only by reading the methodology described in Faranda, D., Bourdin, S., Ginesta, M., Krouma, M., Noyelle, R., Pons, F., Yiou, P., and Messori, G.: A climate-change attribution retrospective of some impactful weather extremes of 2021, *Weather Clim. Dynam.*, 3, 1311–1340, <https://doi.org/10.5194/wcd-3-1311-2022>, 2022.

NB2: Colorscales may vary from the ClimaMeter figure presented above.



The figure shows the average of surface pressure anomaly (msl) (a), average 2-meter temperatures anomalies (t2m) (e), cumulated total precipitation (tp) (i), and average wind-speed (wspd) in the period of the event. Average of the surface pressure analogs found in the counterfactual [1979-2000] (b) and factual periods [2001-2022] (c), along with corresponding 2-meter temperatures (f, g), cumulated precipitation (j, k), and wind speed (n, o). Changes between present and past analogues are presented for surface pressure Δslp (d), 2 meter temperatures $\Delta t2m$ (h), total precipitation Δtp (i), and windspeed $\Delta wspd$ (p): color-filled areas indicate significant anomalies with respect to the bootstrap procedure. Violin plots for past (blue) and present (orange) periods for Quality Q analogs (q), Predictability Index D (r), Persistence Index Θ (s), and distribution of analogs in each month (t). Violin plots for past (blue) and present (orange) periods for ENSO (u), AMO (v) and PDO (w). Number of the Analogues occurring in each subperiod (blue) and linear trend (black). Values for the peak day of the extreme event are marked by a blue dot. Horizontal bars in panels (q,r,s,u,v,w) correspond to the mean (black) and median (red) of the distributions.