Tropical Storm Risk's Spatial Data Suite

Tropical Storm Risk (TSR) is the leading provider of accurate forecasts for tropical storms, hurricanes, typhoons, and cyclones. Since 2004, TSR has provided advanced warnings and footprints of the locations likely to be affected, to protect people, businesses, and infrastructure. TSR works with aid agencies, governments, energy, finance, insurance, and marine and tourism organisations around the world to help them manage the real-time risks associated with active tropical storms. Over 20,000 individuals and organisations subscribe to our free alerts.

Alongside its free email alerting service and public forecasts, TSR has a product suite for organisations who can utilise high-resolution spatial data for additional support with disaster planning, post-event analysis, loss estimation, aircraft/vessel rerouting, and event response. Based on its proprietary models, TSR's storm footprints offer unrivalled accuracy in identifying the likely wind strengths across affected areas, together with the timing of landfall and probabilities of damaging winds. Footprints are available in Geographic Information Systems (GIS) formats, HTML browser, and as numerical data, allowing them to be automatically integrated into a client's risk management tools via API.

The Tropical Storm Risk Management Suite is made up of:

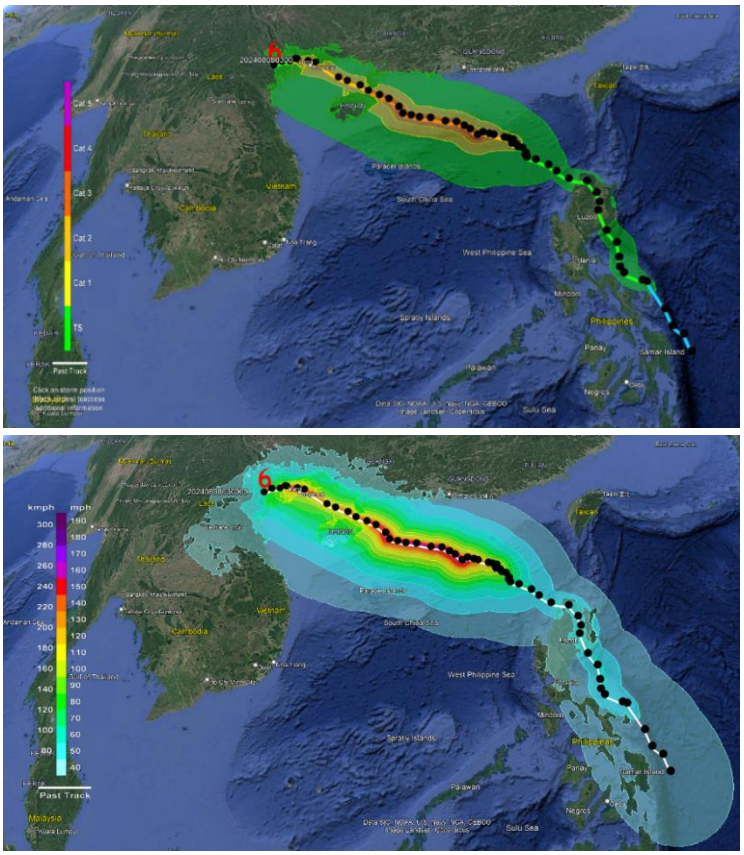
- Post-Event Footprints
- Deterministic Forecast Wind and Gust Footprints
- Forecast Rainfall Accumulations
- Probabilistic Windfields for TS+ and Cat 1+ Strength Winds

The Tropical Storm Risk Management Suite helps businesses and organisations improve planning and response to tropical storm events throughout the year. TSR footprints offer the following features:

- Available for tropical storms, cyclones, hurricanes, and typhoons, worldwide.
- Spatial resolution of 0.05 degrees (~5km).
- Footprints are based on data from the National Hurricane Centre (NHC), Joint Typhoon Warning Centre (JTWC), and Global Forecast System (GFS). Regional advisories are produced from the Japan Meteorological Agency (JMA), Indian Meteorology Department (IMD), La Reunion, and the Bureau of Meteorology (BoM). More information about which datasets are included in regional data sources and their specifications can be found here.
- Updates occur every 3-6 hours for the Northern Hemisphere, and 6-12 hrs for the Southern Hemisphere, and are issued within 5 minutes of a public forecast release.
- Available in a choice of four map formats (KML, SHP, NetCDF, ASCII) for display on different Earth-mapping platforms and risk mapping software, HTML for browser-based analysis, with additional formats available upon request.
- Able to overlay shapefiles with other data e.g. population for greater depth of understanding.
- Shapefiles can be automatically downloaded via API integration
- Spatial storm data for Wind products dating back to 2008 are available to readily download, and wind data for storms dating back to 1990 can be issued upon request.
- Standard Annual subscription to TSR is priced based on the number of basins, and number of products purchased.

Post-Event Wind and Gust Footprints

TSR offers immediate post-event windfield and gustfield footprints for tropical storms, hurricanes, typhoons, and cyclones. This data provides insight into which regions are most-likely impacted by damaging winds from tropical cyclones, by showcasing real-time wind and gust swaths created through the storm's lifetime up to and including the latest advisory. Wind footprints accurately represent storm impacts, categorising winds into Tropical Storm (TS) and wind categories based off of regional wind scales, while gusts are depicted with speeds in kilometres or miles per hour. By visually depicting the extent of storm-related hazards, from strong winds to powerful gusts, this tool aids in post-event assessment, facilitating efficient response and recovery efforts.

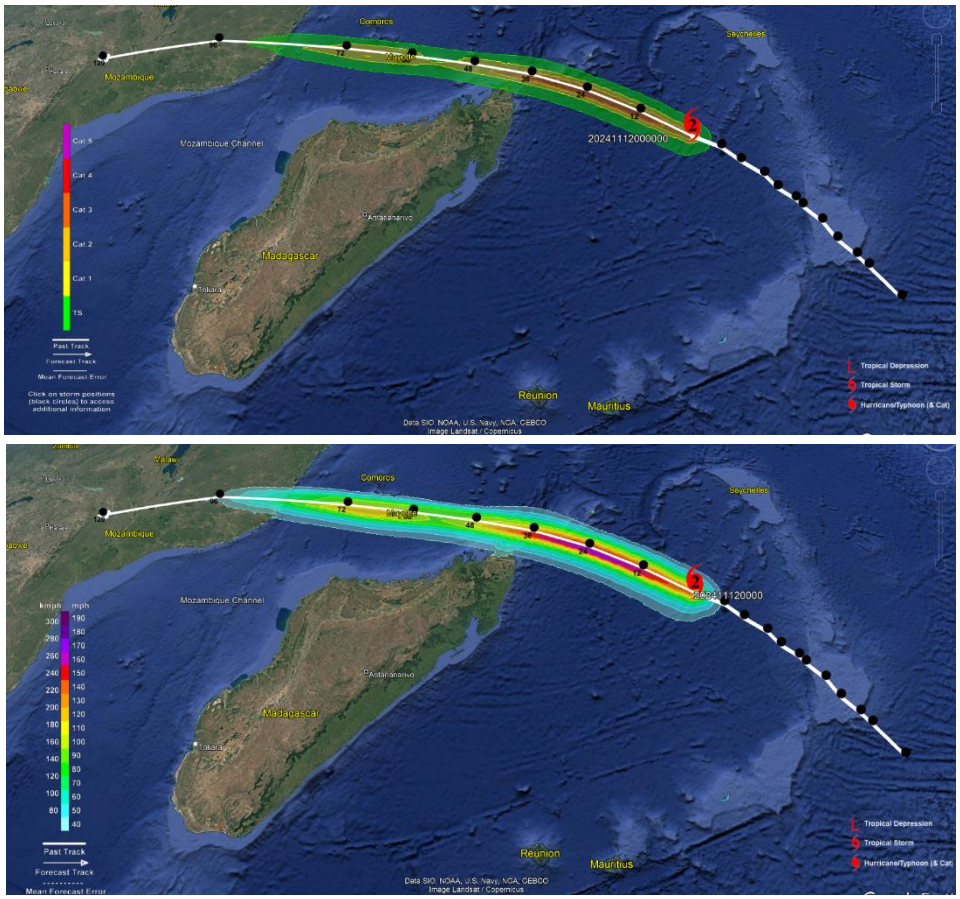


*Post-event footprints for Typhoon Yagi, 8th September, 2024 03:00). The post-event Windfield (**above**) shows the historical wind speed categories as per JMA's wind scale. Binary scales are useful for aligning damage with insurance policies. The post-event Gustfield (**below**) is scale-agnostic and shows the most damaging winds on a wider extent.*

- Early and more-accurate loss estimation.
- Effective event response and post-event planning.
- Maps the regions affected by sustained winds of tropical storm strength and Cat 1-5 strengths, and by three-second maximum gusts of 40-190 mph at 10 mph intervals.
- Excellent real-time accuracy (assessed against station wind observations from 2017-2021.
- Includes data from NHC, JTWC, and advisories from regional agencies for high-frequency updates.
- Outperforms US National Hurricane Centre's forecast wind probability product due to TSR's inclusion of surface roughness and topographic correction at landfall, more-detailed wind information, and the inclusion of gust, which is usually the more damaging factor.
- Data available for historical events back to January 2008.

Forecast Wind and Gust Footprints

These datasets display high-resolution maps of the track and intensity of tropical storms, offering the most likely (deterministic) forecasts of wind and gust extents up to 120 hours in advance. Utilising TSR's proprietary models, it combines maximum sustained wind data, quadrant wind radii, and storm positioning to map the most likely scenario, updated on receipt of each advisory. Based on an analysis of historic events, TSR's model has been consistently shown to provide the most accurate windfield forecasts. Whether assessing potential impacts on infrastructure, communities, or industries, this data provides users with crucial information for planning and risk mitigation.

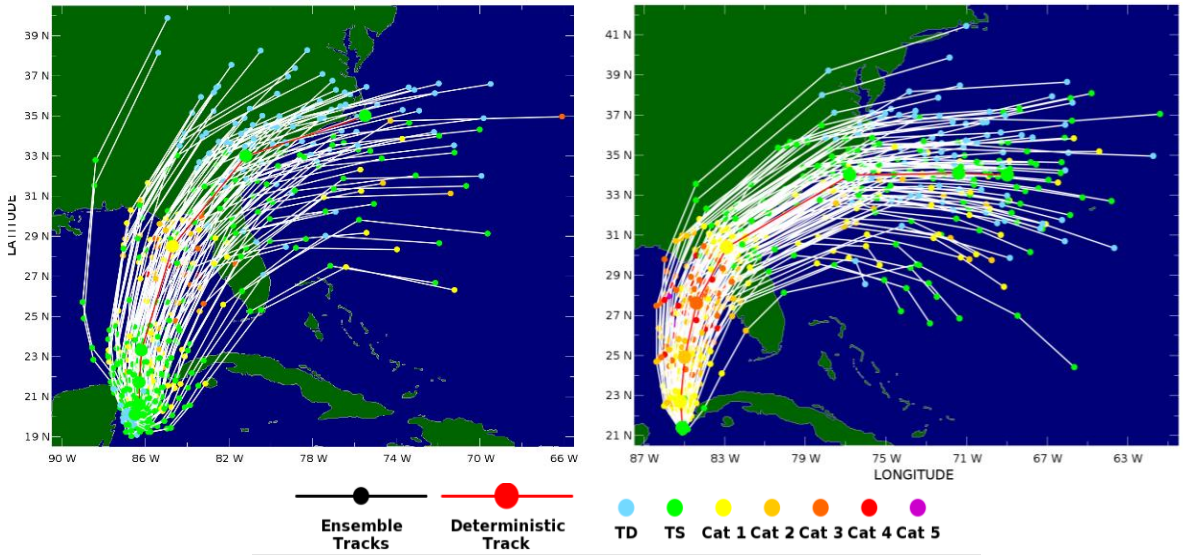


Forecast Swaths of Cyclone Chido (12th December 2024, 00::00). ***Above*** *- storm position and intensity on La Réunion's Wind Scale is labelled. Past storm track and forecast track out to 120 hrs is displayed, indicating when damaging winds are likely to impact, and with what intensity.* ***Below*** *- Gustfields represent the extent of the most damaging 3-second peak gusts.*

- User-friendly display, with wind contours colour-coded at a range of thresholds in different category strengths as per the regional area of responsibility, and up to 190mph at 10mph intervals (three-second maximum gust).
- Includes current storm position and intensity, past and forecast tracks, and lead times
- Includes surface roughness correction and topography model for accurate estimation of wind/gust speeds over land.
- Includes data from NHC, JTWC and advisories from regional agencies 3-6 hour updates.
- Data available for historical events back to January 2008.

Wind and Gust Ensemble (100-Member) Forecast

By generating 100 unique scenarios with the same chance of occurrence, and accounting for forecast uncertainties, this ensemble provides a robust characterisation of potential alternative storm tracks and intensities. From assessing the likelihood of different storm tracks to evaluating the range of possible impacts on coastal regions, infrastructure, and beyond, this ensemble forecast enables users to accurately model risk, providing valuable insights for informed decision-making and risk management strategies.

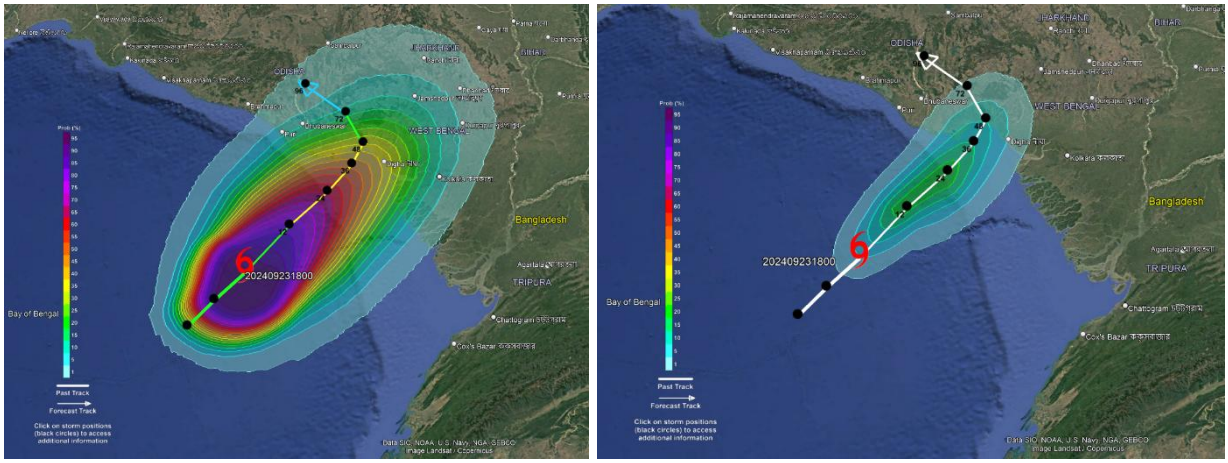


Hurricane Idalia (2023). ***Left*** *– Several days before landfall, a small number of the ensemble tracks suggested the possibility of a Cat 3 landfall.* ***Right*** *– 24 hrs later, deterministic track shows Cat 3 Landfall was made.*

- High-accuracy wind modelling (assessed against post-event station wind observations 2018-2022).
- Models the forecast uncertainty and provides an alternative perspective to the simulated event output of catastrophe models.
- An ensemble set of 100 different forecast wind/gust swathes, each with the same chance of occurrence. Each track opens as an individual 5km resolution footprint for GIS and risk platforms.
- Insurers with access to a wind loss model may calculate the impact on their portfolios of each of the 100 outcomes. The likelihood that portfolio wind loss will exceed different thresholds can be calculated.
- Models the uncertainty in storm track, storm intensity, and storm size.
- Models storm size and its effect on the rate of inland windfield decay.
- Models the impact of the change in surface roughness and topography at landfall on wind/gust speed.
- Advisories and error margins are from NHC and JTWC advisories only.
- Data available for historical events back to May 2010.

Forecast Probabilities for TS+ and Cat 1+ Strength Winds

High-accuracy, high-frequency and high-resolution forecasts of the probability of being struck by Tropical Storm-strength (39+ mph) or Category 1-strength (74+ mph) winds are critical to assess the timing, location and risk to potential business impact, provide reliable information for the decision-makers, and steer effective pre-event planning. A static, low-resolution version of this interactive dataset can be found on TSR's public site.



Forecast Footprints of Cyclone Dana (23rd October 2024, 18:00), modelled by advisories from the Joint Typhoon Warning Center. ***Left*** *– Up to 50% chance of Tropical Storm force winds (39+ mph) making landfall.* ***Right*** *- 5-10% chance of Cat 1+ winds (74+ mph).*

- Maps the current likelihood of a given location being struck by tropical storm strength (39+mph) or hurricane (74+mph) one-minute sustained winds at 0, 12, 24, 36, 48, 72, 96, and 120-hour lead times.
- User-friendly display with probability contours colour-coded in 5% increments from 1% to 100%. Allows users to see another view of the same storm, in terms of their proximity to risk, rather than exact wind speeds.
- Includes storm current position and intensity, storm past and forecast tracks, and lead times along the storm forecast track.
- Advisories and error margins are from NHC and JTWC advisories only.
- Data available for historical events back to February 2008.

Forecast Rainfall Footprints

Forecast rainfall maps are available, alongside wind and gust footprints, for hurricanes, typhoons, and tropical cyclones, worldwide.

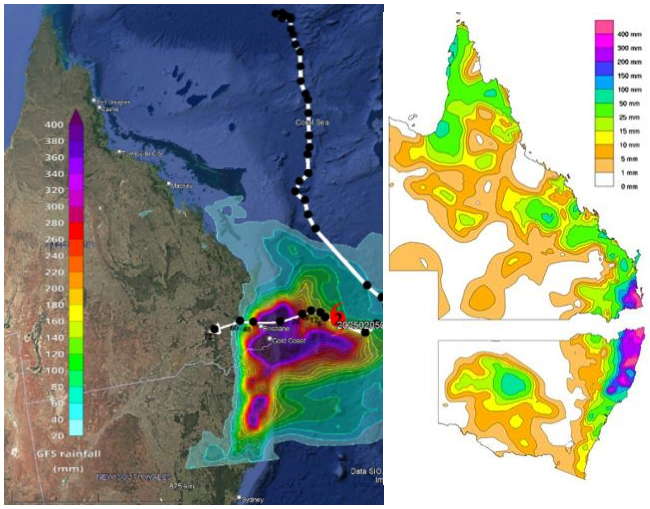
A tropical disturbance can generate torrential rains, which often have more devastating consequences (floods, landslides, and mudslides) compared to the damage from high winds. Unlike the wind, the intensity of rainfall is not linked to the intensity of the disturbance. Relatively weak tropical low-pressure systems (e.g., tropical depressions) can result in heavier rains than mature cyclones. Even for systems of similar intensity, rainfall can vary a lot from one cyclone to another.

Flooding from Hurricane Harvey, 2017

In August 2017, Hurricane Harvey, one of the most damaging hurricanes on record, made landfall near Rockport in Texas. After a second landfall event, the storm lingered over eastern Texas, depositing in places over a metre of rain, peaking at 1,539mm at Hederland. The storm caused $125 billion in damage, primarily from catastrophic rainfall-triggered flooding in the Houston metropolitan area and Southeast Texas, making it equivalent to Katrina in impact, and the costliest natural disaster recorded in Texas at the time.

Rainfall forecasts are available at 12, 24, 36, 48, 72, 96, and 120-hour forecast intervals, displayed as 5 km resolution maps. These accumulations, based on the GFS forecast model, are overlaid with storm tracks from national agencies (such as the National Hurricane Center and Joint Typhoon Warning Center) or regional agencies (the Indian Meteorology Department, Japan Meteorology Agency, Bureau of Meteorology, and La Réunion).

Produced with every new advisory, every 3 to 6 hours, the data is available in multiple formats for use in GIS and risk modelling platforms. Access is offered via subscription, either as a standalone product or alongside wind footprints. Downloads can be automated via API, and historical data is available from October 2023 onwards.



*Cyclone Alfred (20th Feb – 8th March 2025). The 5-day rainfall forecast from 5th March, 00:00 (**left**), aligned with observed 7-day rainfall reported after the event (**right**, source BoM). The rainfall is overlaid with a storm path derived from BoM. Cyclone Alfred was the first storm to cross the coastline in southeastern Queensland since 1974. Parts of Brisbane received over 490mm of rainfall during the event, which reached a Category 4 on the Australian Tropical Cyclone Intensity Scale at its peak.*

TSR works with aid agencies, governments, re/insurers, energy, finance, and marine organisations, helping them manage the risks associated with live tropical storms. Contact neha.shah@eurotempest.com to find out more.