**Using ECMWF-forecasts (UEF2019)**
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Deutscher Wetterdienst
Wetter und Klima aus einer Hand

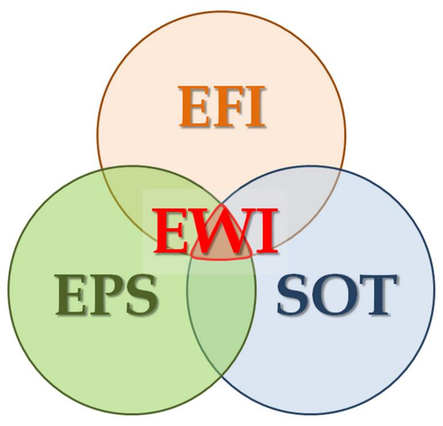
# *The new Extreme Weather Index as a possible tool to predict high impact weather*

**Thomas Schumann, Michael Denhard, Lars Kirchhuebel**

*An accurate prediction of severe and high-impact weather events is the core task of the DWD. Public authorities (Home ministry, Flood response agencies, Civil protection) as well as internal DWD units are vital interested to get tailored related alerts already for the medium range time scale. For relief organizations (Emergency management, the Red Cross etc.) forecasts on a global scale are desired.*
*A key role for these predictions plays the ENS of the ECMWF. To condense the outcome of the ENS the Extreme Forecast Index (EFI) has been established. Because of the systematic weakness of the EFI that suppresses the part of the ENS distribution beyond the model climate maximum the "Shift of Tails" (SOT) has been introduced. EFI and SOT are designed to alert forecasters and other well-skilled users. But a large value of the EFI does not necessarily mean that an extreme event will happen. On the other hand, the SOT analyses leads to very uncertain predictions. Therefore, users outside of the meteorological community may have difficulties to interpret these products.*
*To create a single quantity which gives an indication of severe weather, the development of the Extreme Weather Index (EWI) has been started at DWD. The idea is to blend EFI and SOT with the 90th Percentiles of the ECMWF- as well as the ICON-EPS by applying well-proven severe weather thresholds. Comparing the EWI to observed historical extreme weather events allows its calibration. The result is a product in a traffic-light style which provides absolute values for the severity of the expected events.*

## Idea and introduction

The ENS of the ECMWF provides a vast amount of information for the prediction of more or less extreme and/or high impact weather events. To create a tool that alerts forecasters and other trained users the EFI and SOT has been developed. Both parameters providing signals which are not easily to be translated into relevant weather pattern. The strength of the signal depends from the deviation between the pattern and the related model climate which is a function of the region and altitude, the time of the year and the type of the event. The model climate is an expression of the limits of general range of the meteorological field. Finally it gives an indication about the return period of the predicted extrema.
Therefore the intensity of an event might be derived related to the model climate but not to the possible impact. Absolute values (severe weather related thresholds) will not be taken into consideration. Consequently it was essential for each EFI/SOT pattern to go there much more into details and seeking the reasons for it at least by generating ENSgrams for this region or checking the HIRES model output.
Less severe events may have a strong impact and vice versa. The impact mainly depends from the population density, from the existence of sensitive infrastructure and several other not weather-related parameters. Further factors like the weather background before the event or the time of the season playing a less important role. The assessment of the impact of an upcoming severe weather event is a challenge in the process of the preparation of warnings and forecasts.
To obtain an impression about the possible impact the indications derived from the EFI and SOT has to put into relation to EPS-derived probabilities combined with the will-tried warning criteria of the DWD. Based on the Q90-percentiles the fields of EFI, SOT and warning-criteria related probabilities will be blended to derive the "Extreme weather Index" (EWI). The intention is to present the EWI as a world-wide traffic-light style product (yellow, orange, red) that users allows at a glance to see what is going on related to high-impact weather for short- and early medium-range time scales. The objective is to get a very user-oriented product that allows a verification by contingency tables (hit, miss, false alarm, correct rejection). Therefore the EWI will be calculated by empirical methods.



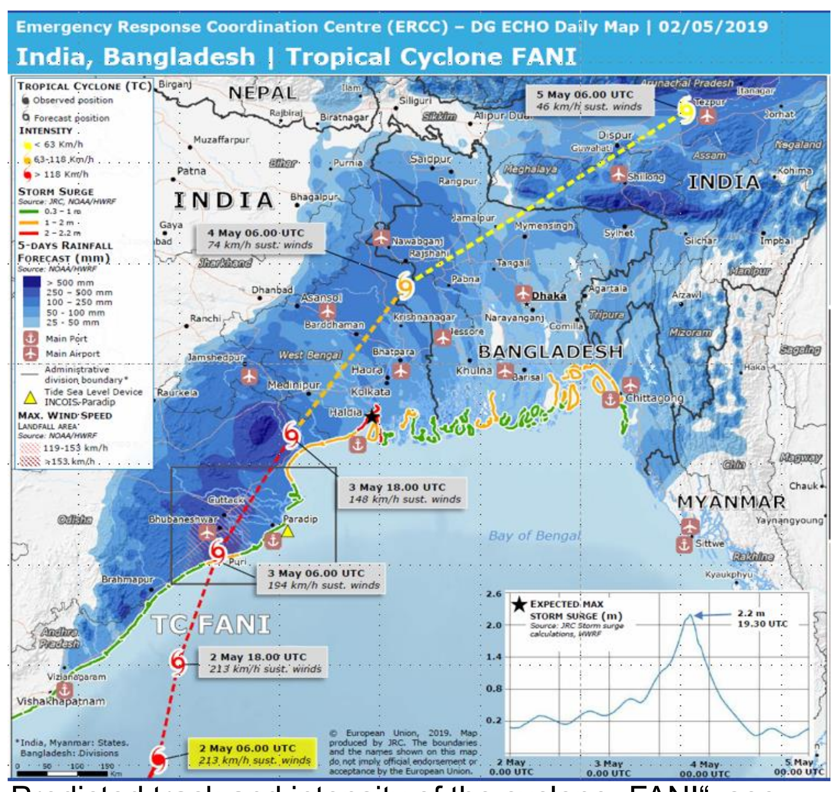

## The calculation of the EWI

**The „Blending" to derive the EWI – How does it works?**
For the EFI, SOT and 90%-Quantile initial thresholds has been empirically defined and calculated by linear interpolation for certain forecast ranges (see table below). If these threshold will be exceeded by EFI, SOT and by the 90%-Quantile of the weather parameter the 90%-Quantile from the current forecast will be extracted.

| | SOT | | | EFI | | | | 90%-Quantile |
|---|---|---|---|---|---|---|---|---|
| Forecast Range | ≤ 96 h | 120 – 144 H | 168 H | ≤ 48 H | 72 – 96 H | 120 - 144 H | 168 H | |
| Weather parameter | | | | | | | | |
| 24-hr total precipitation | 0,2 | linear interpl | 0,0 | 0,8 | linear interpolation | | 0,5 | 50,0 mm |
| 24-hr total snowfall | 0,2 | linear interpl | 0,0 | 0,7 | 0,7 | linear interpl | 0,5 | 20,0 cm |
| Windgust, 10 m, 24-hr | 0,2 | linear interpl | 0,0 | 0,8 | 0,8 | linear interpl | 0,6 | 24,0 m/s |

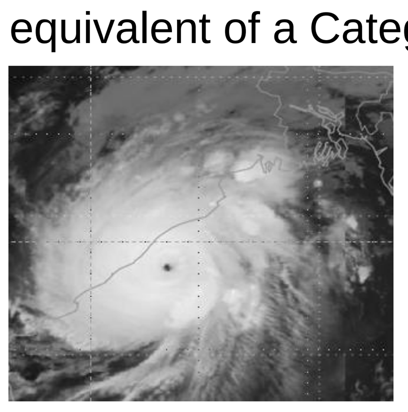
It is obvious that this method to calculate the EWI as a parameter for the prediction of high-impact weather events is not a completely scientific exact way. The initially objective is to obtain a dataset to allow a comprehensive verification of the EWI by as much as possible high impact but mostly rare weather situations. The collection and evaluation of these data is one of the tasks of the daily morning shifts in the Central Forecasting Office of the DWD. A large sufficient dataset is essential to apply statistical verification methods like the contingency table to get values for false alarm and hit rates as well as for missed events and correct rejections. Dependent from the results of the verification the initial thresholds of the table above might be modified.

## Case study – Cyclone "FANI", 29 April – 05 May 2019



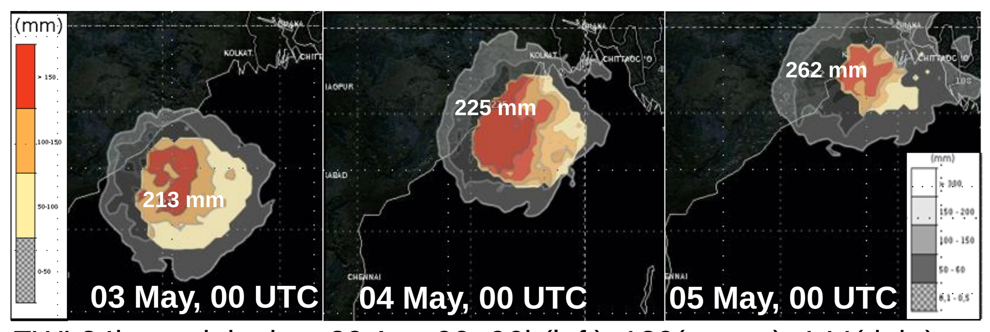

Predicted track and intensity of the cyclone „FANI", see https://erccportal.jrc.ec.europa.eu/Maps/Daily-maps

"FANI" was the first cyclone that affected eastern India and Bangladesh of the 2019 North Indian cyclone season. This cyclone reached its maximum intensity on 2 May, equivalent of a Category 4 hurricane.

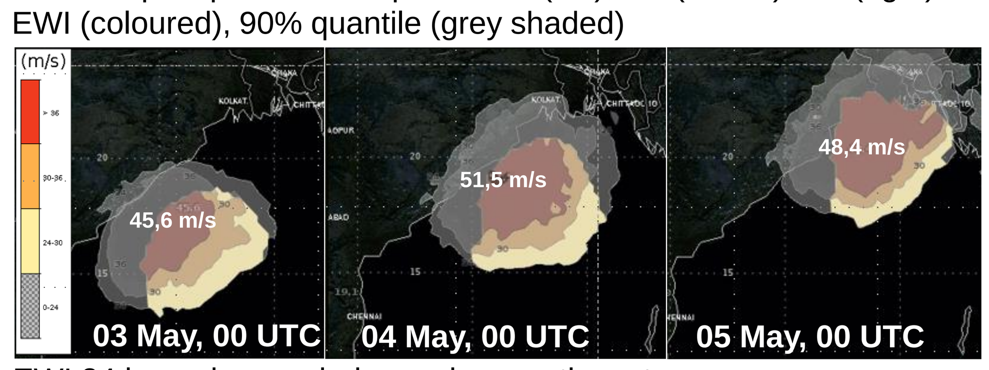


Cyclone „FANI", Sat IR (section), 02 May 2019, 18 UTC

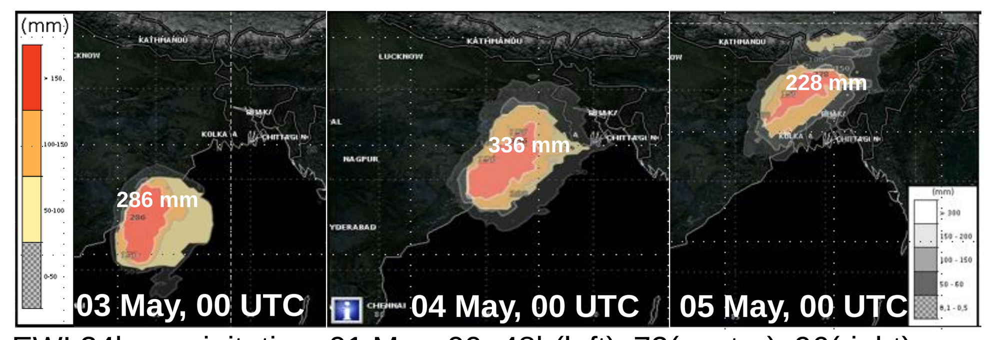
More than a million people have been evacuated before landfall. However, 89 people have been killed, damages caused a loss of at least 170 million $ in India / Bangladesh.



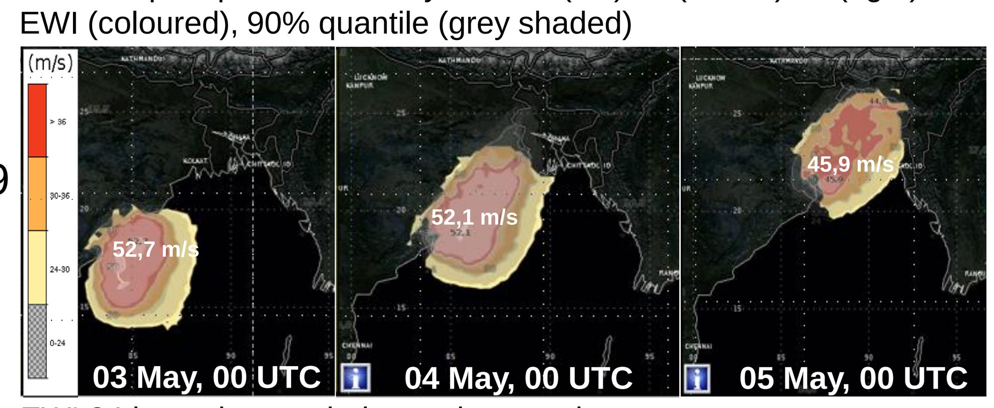

EWI 24h precipitation, 29 Apr, 00+96h(left), 120(center), 144(right)
EWI (coloured), 90% quantile (grey shaded)




EWI 24 h maximum wind speed, same time steps




EWI 24h precipitation, 01 May, 00+48h(left), 72(center), 96(right)
EWI (coloured), 90% quantile (grey shaded)




EWI 24 h maximum wind speed, same time steps

## References

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**National Forecast and Advisory Centre of DWD**
**Frankfurter Straße 135, D – 63067 Offenbach**