The powerful Tropical Cyclone Idai made landfall near the city of Beira during the night of 14 – 15 March 2019, causing severe flooding in Mozambique and Malawi, and making its way further inland to areas as far as Harare, Zimbabwe. The cyclone has been reported to have affected over 2.6 million people in its path, leaving upwards of 400 lives lost, key infrastructure damaged or destroyed, and communication, electricity and water supplies compromised. Already in early March, prior to the tropical cyclone making landfall, severe flooding was reported in Malawi and Mozambique as a result of Idai’s larger weather system during which several people were reported to have lost their lives, approximately 82 700 people were displaced and thousands of hectares of croplands were destroyed. Although the weather system is expected to weaken over the coming days, latent effects of the damages and losses already incurred are anticipated and further intense rainfall and widespread flooding is expected to continue in parts of the affected countries.

The purposes of this bulletin are to: 1) Provide an update based on the most recently available information regarding the ongoing flooding in Malawi, Mozambique and Zimbabwe, 2) Provide information regarding the current situation based on the most recently available data from the ARC Flood Extent Depiction dataset (AFED) and other relevant sources of spatial data with the intention to serve ARC Members States, humanitarian actors and partners in their efforts to support affected people, and 3) Provide brief background information regarding the capabilities of the AFED dataset, which forms the basis of the ARC River Flood Model (AFM-R) to detect and depict large-scale river flooding such as the flooding described above.

AFM-R is currently in its pilot phase and will be available to ARC Members States as of the next season.

For more information visit our website: www.africanriskcapacity.org

Detection and Mapping:

AFED Depictions of Recent Flooding in Malawi, Mozambique and Zimbabwe:

- The ARC Flood Extent Depiction (AFED) makes use of Satellite-based Microwave Data in combination with Digital Elevation and Persistent Water Distribution data to produce depictions of Non-persistent Surface Water which represents the distribution of large-scale river flooding.
- The map below shows the extent of non-persistent surface water detected by the ARC Flood Extent Depiction (AFED) v05r00 during the periods of flooding described above. Flooding detected during the period prior to Idai making landfall (5—14 March, 2019) is shown in orange whilst flooding detected post– Idai making landfall (15—20 March 2019) in deep red.
- The depictions indicate flooding along the river Zambezi between Tete and the Shire-Zambezi confluence as well as the river Shire flowing southwards towards the confluence prior to Idai making landfall. Widespread flooding was detected during the post-landfall period along the Shire, the post-confluence stretch of the Zambezi and the coastal areas north of the Zambezi.
- Flooding in and around Beira was initially not detected. This is possibly due to the inability of the microwave sensors to ‘see’ through rain and/or possible interference with the microwave signal from the ocean. Widespread flooding was, however, detected in AFED depictions from 18 March onward in the south of Beira where the river Buzi flows into the Indian Ocean.
- Some flooding was detected in the east of Zimbabwe from 18 March onward. Based on the available reports it is expected that the AFED layers made available in the coming days will depict more flooding in Zimbabwe.
- More information regarding the ARC River Flood Model (AFM-R) and AFED is provided in the section that follows.
MORE ABOUT AFM-R:

AFM-R MODEL CONCEPT:

- Following a nearly two-year consultative process with more than 15 countries across the continent, flooding has consistently, in addition to droughts, been identified as another major risk to food security. Upon request from Member States, the Research & Development (R&D) Department initiated the development of an index-based flood model in 2014. ARC Ltd will use the resulting flood index for underwriting river flood insurance, which will be the first sovereign index-based flood insurance in its kind. To this end, the ARC Secretariat contracted in 2015 and has since been collaborating with Atmospheric and Environmental Research, Inc. (AER) to develop the daily input dataset to the ARC River Flood Model (AFM-R). Through a series of iterations that involved the regular evaluation of modelled outputs and the implementation of adjustments to the algorithm based on feedback from in-country experts and ARC’s R&D Department, the resulting ARC Flood Extent Depiction (AFED) (v05r00) was released in August 2018.

- In parallel to the abovementioned efforts, ARC’s R&D Department has developed the AFM-R Index, which has undergone a number of revisions informed by input from pilot countries. It should be noted that, due to the type of satellite data used, AFED and the resulting AFM-R index have been designed to detect large-scale river floods and do not target coastal floods, flash floods or urban flooding due to drainage imperfections.

- AFED is the daily flood data underlying the insurance product. To meet ARC’s requirements, AFED is: pan-African, objective, historical (1998-present), and updated in near real-time with methods consistent with historical processing.

THE ARC FLOOD EXTENT DEPICTION (AFED):

- AFED Flood Depiction Features are as follows:
  - Uses daily passive microwave remote sensing with topographic downscaling using Digital Elevation Model (DEM) data.
  - Detects long-lasting (>2-3 days) floods in wide (>2 km) flood plains.
  - ~90 m postings, over all of Africa, daily, 1998-present.
  - Continuing near real-time coverage from AMSR-2 and GMI sensors.

- AFED data are managed and analysed using the Africa RiskView Flood Data Explorer (FDE) software tool, an ARC in-house developed tool that allows for the extraction of flood depictions and derived data and automatically updates when new AFED data become available.

- Daily flood depiction data are combined with exposure data (e.g. population distribution/density data, land use/cover-derived cropland distribution data) and further aggregated to an agreed-upon polygon level (e.g. Sub-River Basin Level) within the FDE environment. The accuracy of the estimates provided in the output time series is highly dependent on that of the input data. The current default exposure layer in FDE is the 1km resolution Landscan™ dataset and ARC R&D is continuously sourcing and testing alternative datasets such as WorldPop, the University of Columbia’s High Resolution Settlement Layer (HRSL) and the European Space Agency’s Africa-wide Landcover Map to achieve more accurate estimates of flood exposure and derive time series used as input metrics for the calculation of AFM-R Index Values that characterise the relative severity of flood events in a given area of interest.

AFED Depiction compared to Optical Imagery

The AFM-R Prototype River Flood Index

- The AFM-R Index is designed to use the polygon-level time series variables as the basis for triggering payouts to countries. ARC collaborates with in-country experts to identify the ideal input data to derive exposure layers and to define the ideal and most flexible aggregation polygon definitions using historical flood-extent maps.

- The polygon-level time series data are used directly as input metrics and to derive additional metrics to calculate a daily index value that characterises the polygon-specific magnitude of flooding throughout the time series.

Index Calculation and Thresholding (Nigeria, 2012)