ISSUE 1 | VOLUME 8 | 2019

Hydrologic Research Center
www.hrcwater.org

Flash Flood Guidance Gazette

Flash Flood Guidance (FFG) Gazette, a bi-annual newsletter bringing users of FFG products all the latest news – operational information, technical advances, case studies and education for the flash flood community.

Impact-based Forecast and Warning Services

International impact-based forecasting and warning services (IBFWS) aim to bridge the gap between National Meteorological Hydrological Services (NMHSs), National Disaster Management Agencies (NDMAs) and the public by providing users with the hydrometeorological hazard information they need to take appropriate action to protect their families, livelihoods and property.

As the increase in urbanization and population continue, the impacts of hydrometeorological events around the world increase the likelihood of casualties and significant damage to property and infrastructure, with adverse economic consequence for communities. These consequences may persist for many years. Recognizing the transformative role of impact-based forecasting in disaster risk reduction, the National Meteorological Hydrological Services (NMHSs) and National Disaster Management Agencies (NDMAs) of several countries are currently implementing IBFWS projects to build capacity and facilitate cooperation among agencies. These countries include the Republic of South Africa, El Salvador, Costa Rica, Guatemala and Indonesia.

Unlike objective meteorological, climate and hydrological forecasts, which can be developed with one or two disciplines, impact-based forecasts require access to a wide range of expertise and new data that may vary according to the situation in space and time and also represent changing vulnerabilities to provide effective warning to at-risk communities. An example of an IBFWS tool is the Global Flash Flood Guidance System (FFGS). The aim of the FFGS is to provide a diagnostic value (known as flash flood guidance) that estimates the amount of rainfall of a given duration within a watershed that is required to produce flooding at the outlet of the catchment. The FFGS is designed to update its values in time and space and to "remember" rainfall that has already occurred in the catchment. In this way, the FFGS takes account of antecedent catchment conditions and can calculate the amount of additional rainfall that is needed in order to produce flooding. When these values are used in real time with nowcasts or in a forecasting capacity, they provide an objective basis to generate flash flood warnings.

Several FFGS's have been implemented globally and used by NMHSs for many years, providing non-fixed, spatially and temporally varying rainfall thresholds for flash flood risk assessment. The use of this tool in IBFWS has the ability to improve the synergy between NMHSs, NDMAs and citizens that play a role in hazard mitigation (e.g. flash floods), by bridging the gaps between the four components for effective early warning systems: 'risk knowledge', 'monitoring and warning service', 'dissemination and communication' and 'response capability'. The adoption of such a robust approach is identified as a high priority in the WMO Guidelines on Multi-hazard Impact-based Forecast and Warning Services (2015, WMO-No 1150) as well as in the Multi-hazard Early Warning Systems: A Checklist (2018). These support the Sendai Framework for Disaster Risk Reduction 2015-2030 (United Nations, 2015).

For more information click here.

Rochelle Campbell and Robert Jubach, Hydrologic Research Center

Flood Guidance System Statistics

Flash floods are defined as a flood of short duration with a relatively high peak discharge in which the time interval between the observable causative event and the flood is less than six hours[1]. As flash floods are complex hydrometeorological events occurring over a small timescale, they are extremely hard to predict. Findings from a recent survey by the United Nations International Strategy for Disaster Reduction (UNISDR) indicated that in terms of occurrences, floods (including flash floods) and storms accounted for the two most frequently occurring disasters, at 43.4% and 28.2%, respectively[2]. The same study also observed that floods affected the maximum number of people at more than 2 billion or 45% of the total number of people affected by disasters over the last 20 years. Nevertheless, many countries do not have the capacity to accurately forecast flash flood events due to their complex nature and short durations. As a result, these events cause significant loss of life, property, and livelihood.

Recognizing the importance of predicting flash flood events, the Flash Flood Guidance System (FFGS) project with global coverage was approved during the 15th session of the World Meteorological Congress in May 2007[3]. Since its inception and following the implementation of the Central America Flash Flood Guidance System (CAFFGS) (see map), the project has expanded to over **64 countries** (as of December, 2018), with more to be included in the future.

Figure. 1 An infographic of the global flash flood guidance system

Global Coverage

The FFGS provides coverage to 3 billion people or 40% of the world's population. The countries using the FFGS have a combined land surface area of around 25 million square kilometers which is equivalent to 18% of the total land surface area of the world[4]. Specifically, the South Asia FFGS (SAsiaFFGS) provides coverage for nearly 51% of the world's population. Combined with the Southeastern Asia-Oceania FFGS (SAOFFGS) and Pakistan Afghanistan Regional FFGS (PARFFGS) the coverage extends to 71% of the population where FFGS has been implemented (see map). The Southern Africa Region FFGS (SARFFGS) covers the largest region and accounts for 19% of the total area under FFGS coverage. The Black Sea Middle East FFGS (BSMEFFGS) includes the largest number of countries at 10, but, covers only 7.5% of the total global FFGS area,

Training

Training is an additional critical component of the FFGS, to this end the World Meteorological Organization (WMO) in conjunction with HRC has developed a rigorous training program to support sustainability. Participants who successfully complete: Step-2 (Online Training Programme), Step-3 (Specialized training at HRC, San Diego) and Step-4 (Regional Operations Follow-up Workshop) and demonstrate their knowledge and understanding of the FFGS are eligible to be a (WMO) certified trainer. To date more than 400 hydrological and meteorological forecasters from around the world have participated in various aspects of the training program.

Continued on Next Page

Flash Flood Guidance System

Statistics continued...

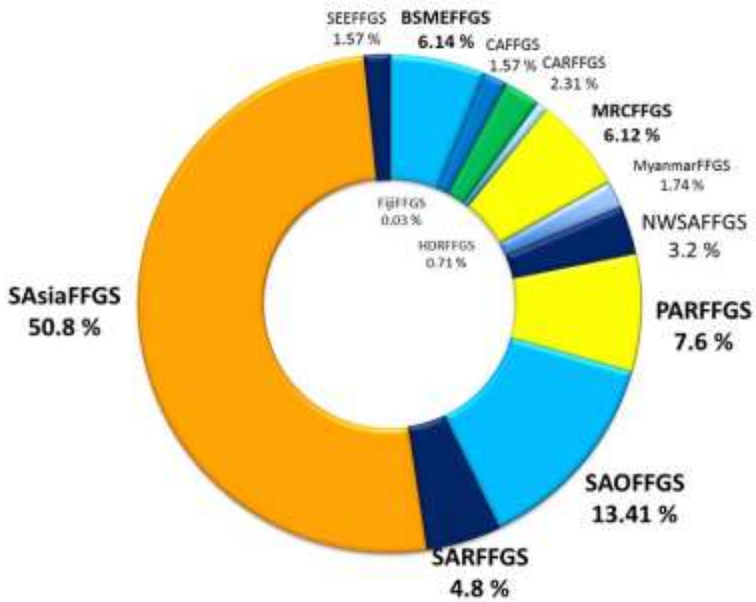

Figure. 2 Percentage distribution of the population across the various FFGS projects under the global Flash Flood Guidance System

Currently, there are 61 WMO-certified FFGS trainers speaking 56 different official languages which also includes 5 of the 6 official languages of the United Nations (UN). Keeping in line with the Sustainable Development Goal-5 (SDG-5) of the U.N., which is 'Achieve Gender Equality and Empower all Women and Girls'. Among the 61 certified trainers, 64% of them are males and the remaining 36% are females. A similar trend can be observed for participants in Step-3 and Step-4 training, where two-thirds of the participants are males and the remaining one-third are females. Region wise, the BSMEFFGS has the highest contribution of male certified trainers at 13% and the SARFFGS has the highest contribution of female trainers at 10% of the total certified trainers. However, there are regions, where the female participation has been higher than the male participation. For instance, in Myanmar, 100% of the participants for Step-3 training were female. The project partners are working on introducing measures that will encourage and further improve the participation of women in the Global Flash Flood Guidance System, in particular, for regions where they are underrepresented.

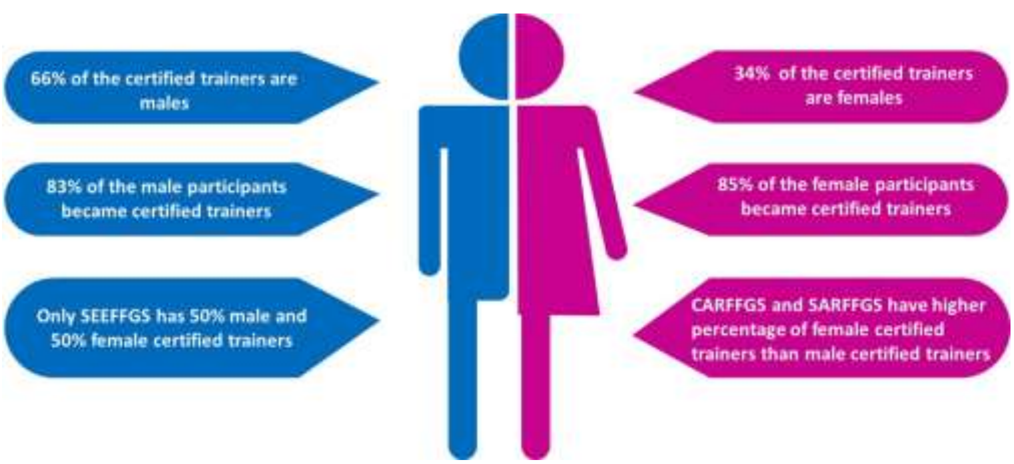

Figure. 3 An illustration of the gender dynamics within the Global Flash Flood Guidance System

References:

[1] WMO Technical Regulations, Volume III : Hydrology; *ISBN 978-92-63-15049-3*

[2] Economic Losses, Poverty & Disasters 1998-2017 (https://www.unisdr.org/2016/iddr/CRED_Economic%20Losses_10oct_final.pdf)

[3] Abridged final report with resolutions of the Fifteenth World Meteorological Congress; *ISBN 92-63-11026-3*

[4] UN Data *(www.data.un.org)*

Contribution by Nakul Prasad, Petra Mutic and Milica Dordevic - World Meteorological Organization

Case Study of Flash Floods in the Lima and Ancash Region in March 2017

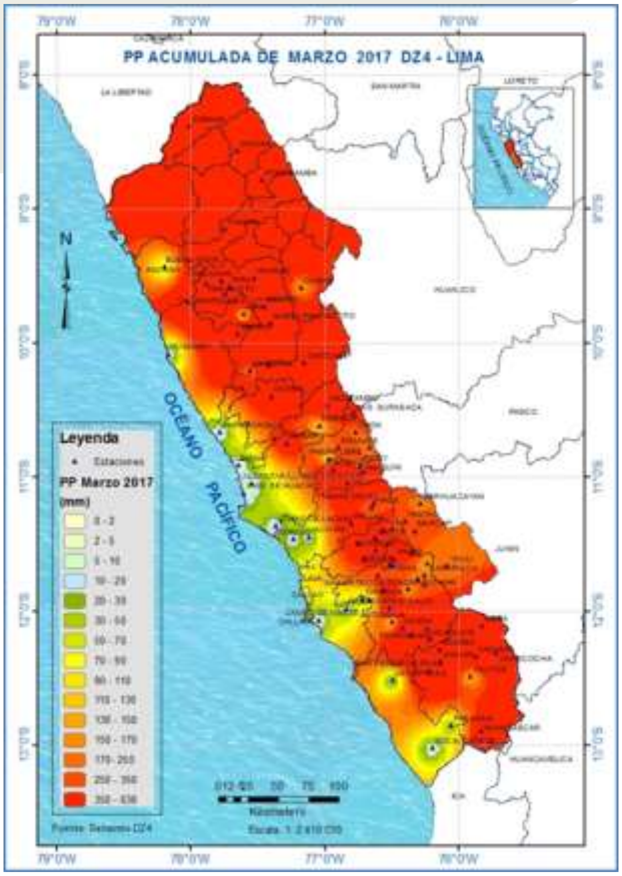

Figure 1. Accumulated precpitation in the Lima and Ancash región, March 2017.

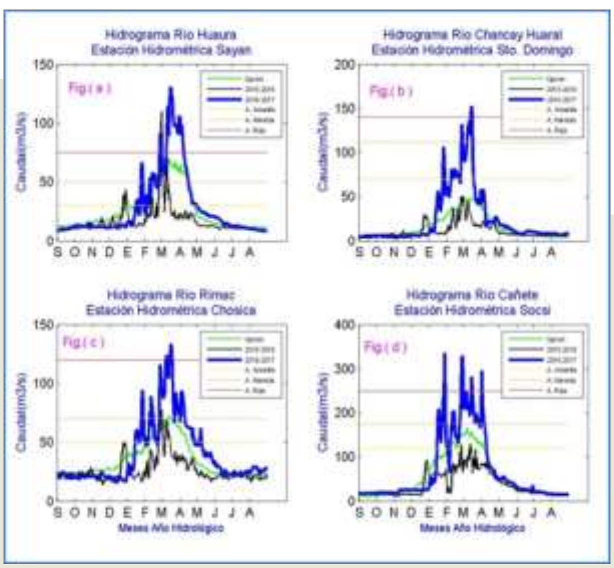

Figure 2. Hydrograph of flow and thresholds of alerts for hydrometric stations in the Lima region

The warming of the central Pacific Ocean (Niño 3.4 region) and ocean-atmosphere dynamics along the north and central coast of Peru favored the development of the "Niño Costero 2017" event. Along the central coast of Peru, the regions of Lima and Ancash received 10 times more rainfall than normal in March 2017.

As a result of the above normal rainfall and saturated soil moisture conditions, flash floods occurred in many of the coastal rivers of this region. The flash flood events occurred between March 13-18, 2017, in the rivers of Cañete, Mala, Lurin, Rimac, Chillon, Chancay Huaral, Huaura, Pativilca, Supe, Fortaleza and Huarmey.

During this period, Servicio Nacional de Meteorologia e Hidrologia del Peru (SENAMHI Peru) carried out the corresponding hydrometeorological analysis and issued warnings for the flash flood events. SENAMHI Peru also conducted surveys of the hydrometric stations located in the rivers of the Lima and Ancash regions. The magnitude of the flash floods in rivers and streams was confirmed.

The most important negative impacts of the events was the flooding in the coastal cities of Cañete, Mala, Lurin, Chosica, Santa Rosa de Quives, Huaral, Huaura, Barranca, Huarmey, among others. These flash flood events caused material damage to homes, civil and hydraulic infrastructures, and farmland.

The World Meteorological Organization, U.S. Agency for International Development/Office of U.S. Foreign Disaster Assistance, Hydrologic Research Center, and the U.S. National Weather Service have partnered to develop and implement a Flash Flood Guidance System (FFGS) for the Northwest South America region, including Peru as well as Colombia and Ecuador. The system is currently under development. Once implemented, agencies such as SENAHMI will be able to access data and information from the FFGS to further support the development and dissemination of forecasts and warnings for flash flood events such as described here.

Figure 3. Flooding in the city of Huarmey (15 March 2017).

Contribution by Mario Servan Vargas (SENAMHI, Peru)

Social Media and its Impact on Flash Flood Guidance System

Flash floods result in the loss of more than 5000 lives around the world annually, and cause significant social, economic and environmental losses [1]. The implementation of the Flash Flood Guidance System (FFGS) is a major step towards mitigating some of the adverse impacts associated with these events. Along with the development and implementation of the FFGS, it is equally important to ensure the continuous operation and maintenance of the system and setting up of dedicated communication channels between the various stakeholders, especially the National Meteorological and Hydrological Services and the Disaster Management Agencies. The latter is very crucial considering flash flood events occur on very short time scales and with little or no warnings[1]. Additionally, the inability to quickly and effectively communicate relevant information across agencies has been observed on many occasions and this can often lead to disastrous consequences [1] .

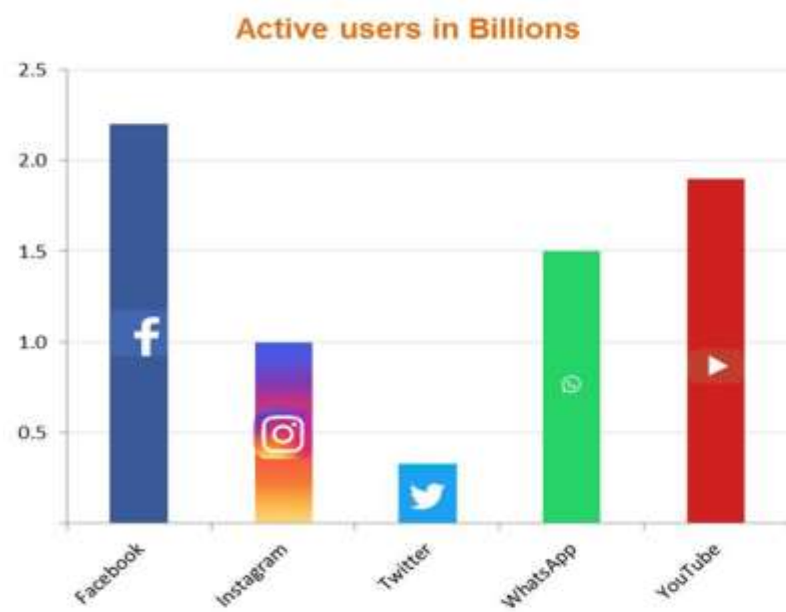

Fig.1 Number of active users on various social media platforms as on January, 2019[2].

However, over the last decade, there have been significant improvements in the field of telecommunications. Notably, the advent of low-cost and high-speed wireless internet connection across the globe has turned social media platforms such as Facebook, WhatsApp, Twitter, Instagram etc. into powerful and popular means of communication. Over 4 billion people around the world have access to the internet which is roughly 50% of the total world population[2]. As of January 2019, there are 3.5 billion active social media users which is a 9% increase over the previous year. Similarly, there are around 3.2 billion active mobile social media users, which is a 9% year over last year[2]. Among current social media platforms, Facebook has the highest number of active users around the world with 2.2 billion people; WhatsApp comes in at third position with an active user base of 1.5 billion people[2]. (what was 2nd?) This highlights the potential of social media and mobile internet penetration in acting as a medium of spreading awareness and information among the masses. Recent statistics show that India, Indonesia, Philippines, Viet Nam, Thailand and Turkey are among the top 10 countries in the world with highest Facebook usage. They are also among the top countries with the fastest annual growth of mobile social media users[2]. The aforementioned countries are also covered by the Global Flash Flood Guidance Systems.

The inherent nature of social media platforms allow for rapid dissemination and amplification of information among the key players both within the country and outside [3]. WhatsApp in particular has emerged as a widely used tool for such communications between weather forecasters, emergency managers and communities. Tapping in on the potential of the social networking platforms, WMO, HRC and partner countries have commenced the process of establishing WhatsApp groups for several FFGS countries/regions.

Continued on Next Page

Malawi Weather Chasers was the first WhatsApp group formed to support the meteorological service in the transmission and collection of severe weather information. The group was formed in January of 2016 and currently has 256 members. Since the group was established, many other groups have been created, such as, Southern Africa Region FFGS (SARFFGS), Central America FFGS (CAFFGS), South Asia FFGS (SAsiaFFGS), Pakistan Afghanistan Regional FFGS (PARFFGS) and more recently, Southeastern Asia-Oceania FFGS (SAOFFGS).

Figure.2 Screenshots of WhatsApp groups (a) Malawi Weather Chasers group conversation depicting a weather satellite image and warning members of potential flash flood threats in certain regions (b) SARFFGS WhatsApp group with a member sharing video of a flash flood event in Mozambique (c) Members of SAsiaFFGS WhatsApp group discussing a flash flood event that occurred in Bhutan (d) SAsiaFFGS group members discussing FFGS products (e) SARFFGS members discussing FFGS products and comparing it with satellite images for a thunderstorm event.

Continued on Next Page

To date, the experience has been positive and informative. Forecasters, WMO, HRC and disaster managers use this tool to exchange information on severe weather events including flash floods, updates on forecasts, and interpretation of FFGS products. NMHS forecasters are taking advantage of this platform to discuss the meteorological and hydrological conditions and also to compare and learn more about the FFGS products. In addition, members are sharing photographs and videos of flash flood events. This is a powerful tool for gathering information for verification studies of FFGS products and flash flood warnings as it allows for the information to be transmitted instantly and in real-time from the field.

Following the success of WhatsApp groups, the extension of this structure to other social networking platforms such as Facebook, Twitter etc. has been planned.

This can facilitate public participation for providing and receiving updates on flash flood events across the globe. The launch of a public Facebook page or Twitter handle however, has its own challenges. One of the key challenges includes the flow of information from unverified/unreliable sources, which can potentially divert attention from actual events or important issues. As the FFGS countries/regions are spread across several time zones, it also poses an additional challenge of employing multiple human resources for around the clock monitoring of these pages. However, with the rapid advances being made in various emerging technologies , there exists the possibility, in near future, of automating the filtering and transmission of this information on social media networks[3].

Despite the challenges that may exist, social media has become a cheap, efficient and reliable means of communication and transmission of data and relevant information on flash flood events, beyond geographical barriers. This paves the way for enhanced co-operation not only within a country but also among the countries and other stakeholders involved in the Flash Flood Guidance System, as has been demonstrated by the active WhatsApp groups.

References

[1] WMO Webpage on Flash Flood Guidance System (FFGS) (Source: http://www.wmo.int/pages/prog/hwrp/flood/ffgs/index_en.php)

[2] Global social media research summary 2018 by Dave Chaffey (Source: https://www.smartinsights.com/social-media-marketing/social-media-strategy/new-global-social-media-research/)

[3] Fohringer, J., D. Dransch, H. Kreibich, and K. Schröter, Social media as an information source for rapid flood inundation mapping, Natural Hazard Earth Systems and Sciences, Discussions, 3, 4231-4264, 2015

**Contribution by Nakul Prasad, Petra Mutic and
Milica Dordevic - World Meteorological Organization**

We would like to ask you to share your suggestions, stories, pictures and experiences relating to flash floods or flash flood guidance systems to publish in the gazette. Please send your information to Dr R. Campbell (editor) at rcampbell@hrcwater.org.