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A global network for operational flood risk reduction

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ABSTRACT

Every year riverine flooding affects millions of people in developing countries, due to the large population exposure in the floodplains and the lack of adequate flood protection measures. Preparedness and monitoring are effective ways to reduce flood risk. State-of-the-art technologies relying on satellite remote sensing as well as numerical hydrological and weather predictions can detect and monitor severe flood events at a global scale. This paper describes the emerging role of the Global Flood Partnership (GFP), a global network of scientists, users, private and public organizations active in global flood risk management. Currently, a number of GFP member institutes regularly share results from their experimental products, developed to predict and monitor where and when flooding is taking place in near real-time. GFP flood products have already been used on several occasions by national environmental agencies and humanitarian organizations to support emergency operations and to reduce the overall socio-economic impacts of disasters. This paper describes a range of global flood products developed by GFP partners, and how these provide complementary information to support and improve current global flood risk management for large scale catastrophes. We also discuss existing challenges and ways forward to turn current experimental products into an integrated flood risk management platform to improve rapid access to flood information and increase resilience to flood events at global scale.

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1. Introduction

Riverine flooding affects the vast majority of the world's regions. Flood risk has considerable spatial variability, due to heterogeneous natural processes, varied exposure and vulnerability to flooding, and to each country's or region's investments in flood preparedness and mitigation. Alfieri et al. (2017) estimated that combined flood losses in Asia and Africa account for 95% of people annually affected by floods globally and 73% of the total direct economic damage. While flash floods often result in the highest average mortality rates, flooding from large rivers is responsible for the majority of people affected by floods every year, due to the vast extent of flood prone areas in populated regions (Jonkman, 2005; Pesaresi et al., 2017).

Satellite technologies have progressively changed the way we cope with large scale floods throughout the entire disaster management cycle, from the preparedness to the recovery phase. For example, Numerical Weather Predictions (NWP) have dramatically benefited from satellite data to improve forecast skill over the oceans, in areas poorly covered by conventional measurement networks, and in general to extend their predictability in time and for extreme events (Bouttier and Kelly, 2001). In addition, different sensors mounted on satellites have shown key capabilities in detecting and monitoring surface water extent (Pekel et al., 2016), rivers and lakes height (Alsdorf et al., 2007; Calmant et al., 2008), and large-scale flooding (Smith, 1997).

Such a wealth of data available in near real-time has prompted research groups from many institutions worldwide to develop methods for flood prediction and monitoring at large scales. This also affords economies of scale: regions that might not have otherwise been able to set up local models and observation programs can benefit from the global extent of these products. The potential benefits of these new products include a large variety of new applications for improved disaster preparedness and response. However, an immediate consequence is the need to 1) adapt experimental scientific tools for operational emergency activities, and 2) identify the limits of applicability of each tool and its outputs. To this end, the Global Flood Partnership (GFP, https://gfp.jrc.ec.europa.eu) was established as an open international group of academics, research institutes, practitioners, public and private organizations active in the field of flood risk and emergency management. The core group consists of organizations interested in bridging the gap between science and operations. The goal is to foster the dialogue between scientists and users, whereby 1) scientists adapt their systems to the needs of emergency managers, and 2) emergency managers adapt and adjust existing workflows to include new systems and data. Currently, the GFP includes more than 300 members from 6 continents, registered through a dedicated mailing list. More than 90 organizations were represented during the past annual meetings, which have been held since 2011, while special sessions and side events are regularly held at other relevant conferences throughout the year.

De Groeve et al. (2015) described the launch of the Global Flood Partnership with the aim to improve future flood management worldwide. They introduced five main pillars for the GFP to focus on: Flood Service and Toolbox, Flood Observatory, Flood Record, User Guidance and Capacity Building, and User Forum. Since then the GFP has received increasing attention by engaging more partners, sharing flood products, and through its designation in 2016 as participating organization in the Group on Earth Observations (GEO, http://earthobservations.org).

This paper illustrates the value of the GFP in supporting flood risk management for large scale disasters by providing access to flood information and working towards closing the gap between availability and use of the information. We describe how a suite of various products and expert knowledge can work in synergy to provide key information at different stages, before, during and after severe floods. So called "GFP activations" consist of the sharing of data and model results related to a specific upcoming or ongoing flood event through the GFP mailing list, which reaches all GFP members. Activations are commonly requested by partner institutes involved in the development of early warning systems, by organizations active in emergency operations, and by end-users responding to the severe events. In the following section, GFP models and products are grouped and described based on their time of availability and the type of information they provide (Fig. 1). In addition, a non-exhaustive list of GFP flood products available for operational flood risk reduction is reported in Table S1 of the Supplementary material.

2. Models and products

2.1. Early warning systems (EWS)

Early warning systems are developed to predict natural disasters before these occur. They are normally operated at large scales, with updating cycles on the order of hours to days, and variable levels of complexity including purely statistical processing, geophysical modelling, and forecast-based impact and cost-benefit assessments (see e.g., Emerton et al., 2016). EWS have a crucial role in the disaster risk management cycle as they can trigger flood preparedness actions among humanitarian organizations, emergency responders, and end users in potentially affected areas. Likewise, EWS can activate the flood management cycle within the GFP, and prompt further analysis and products from other member institutes.

Consequently, the skill of those systems must be evaluated continuously, to optimize the tradeoff between correct predictions, false alarms and missed events. An important element of the evaluation of EWS is defining how these will be deemed to be effective, keeping in

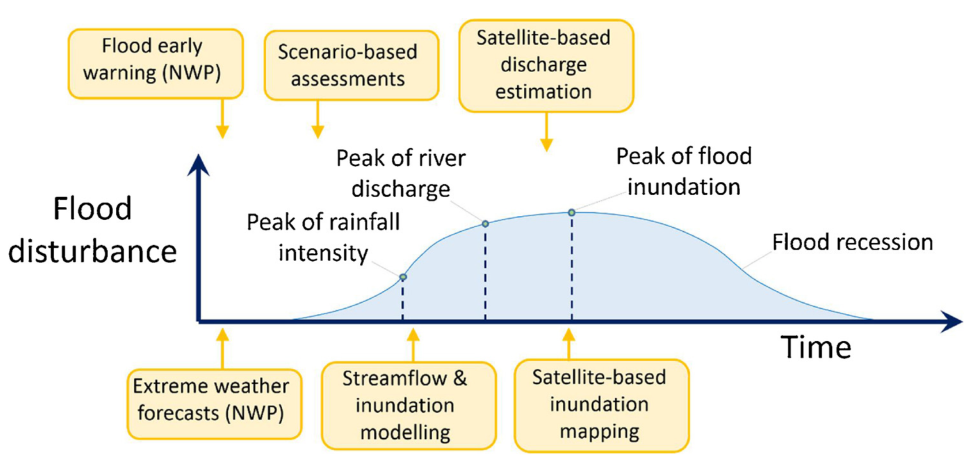

Fig. 1. Timeline of a river flood and GFP product types to support disaster risk reduction before and during the event.