# Introduction

The purpose of this paper is to…[finish the sentence] [What are we doing, why, and how. Argument/Findings]

Flash floods are rapid-onset events, typically occurring in small areas within minutes or few hours after a torrential triggering-rainfall event. Flash floods in Ecuador cause severe, long-term impacts such as damages to infrastructure and agriculture, interruptions to business and education, disruption of healthcare services, and outbursts of waterborne diseases (Galarza-Villamar et al. 2018). While there are no official statistics describing the occurrence of flash floods in Ecuador, a recent study analysing historical disaster reports has shown that about 60% of flood reports could represent flash flood events (Kruczkiewicz et al. 2021b). Furthermore, humanitarian and news reports from specialized websites such as FloodList[[1]](#footnote-1) and Reliefweb[[2]](#footnote-2) suggest that flash floods are one of the most recurrent and damaging type of floods in the country.

Although flash flood forecasting systems are developed at regional (Speight et al. 2018; Corral et al. 2019; Ibarreche et al. 2020; Ramos Filho et al. 2021; Shuvo et al. 2021; Georgakakos et al. 2021), national (Javelle et al. 2016; Liu et al. 2018), and continental scale (Raynaud et al. 2015; Park et al. 2019). flash floods remain one of the most difficult types of flood to predict, with high levels of uncertainty in the overall forecasting process (Zanchetta and Coulibaly 2020). across up to

Such impacts are exacerbated in low-income countries that have fewer resources to recover from the impacts of extreme natural hazards (Winsemius et al. 2018). In Latin America, floods cause severe impacts due to exponential, unregulated urbanization of floodplains, human-triggered catchment degradation, lack of preparedness and resilience for emergency response, the persistence of poverty, inefficient public policies, and infrastructural problems (Pinos and Quesada-Román 2022). Ecuador’s vulnerability to flash flooding is also worrying in the context of climate change as the frequency of floods is expected to increase in South America in the coming decades (Hirabayashi et al. 2021). With more than 5000 fatalities every year (Dordevic et al. 2020), flash floods have the highest mortality rate amongst other types of flood (Jonkman and Vrijling 2008) and have severe social, economic, and environmental impacts due to the increased vulnerability of people living and having economic activities in flood-prone areas and cities (Dordevic et al. 2020). Forecast-triggered strategies for flood risk reduction such as “early warning systems, EWSs” (Golnaraghi 2012) and “forecast-based financing, FbF” protocols (Coughlan De Perez et al. 2015) can increase resilience, reduce mortality, and reduce recovery costs (UNICEF and WFP 2015), especially in low-income countries with poor or no alternative solutions for flood protection (Golnaraghi 2012).

Their limited predictability is linked to the challenge of predicting extreme localized rainfall accurately (Golding et al. 2016), and representing in detail hydrological factors such as topography, soil conditions, and terrain coverage that can modulate the occurrence and severity of flash floods (Xing et al. 2019; Kastridis and Stathis 2020). In a recent review, Zanchetta and Coulibaly (2020) have shown that, while km-scale numerical weather prediction (NWP) models have improved the skill of short-range forecasts for localized rainfall (up to 2 days ahead), issues related to extending the lead time of reliable predictions beyond day 3 are still not fully resolved. Furthermore, the need for high quantities of observational data and high computational costs can often be a limiting factor for the development of operational in-house flash flood forecasting systems for low-income and data-poor countries.

Ecuador’s high susceptibility to flash flooding and its hydro-climatological diversity make the country a good test bed for the evaluation of ecPoint’s performance in the identification of areas at risk of flash flooding in diverse hydro-climatological scenarios. In addition, a well-documented flash flood database has been recently developed in Ecuador (Kruczkiewicz et al. 2021b) which allows for the analysis to be conducted. This paper assesses the ability of ecPoint-Rainfall forecasts to identify areas at flash flood risk in Ecuador but proposing a methodology that uses historical flash flood reports to define the extreme rainfall events that can potentially generate flash floods. The first research questions asked in this study is: can ecPoint rainfall forecasts provide added value in capturing flash floods compared to ENS, in particular in terms of forecast accuracy and lead-time extension to medium-ranges? Since Ecuador has also strong rainfall diurnal cycles (Kikuchi and Wang 2008), which tend to not be well represented in models with parametrized convection schemes, adversely affecting the timing of extreme rainfall forecasts (Stephens et al. 2010), the second research question asked in this study is: are ecPoint-Rainfall forecasts able to maintain a constant performance during different parts of the day compared to ECMWF ENS which tend to not represent correctly rainfall’s diurnal cycles in the tropics (Haiden et al. 2021)?

1. <https://floodlist.com/> [↑](#footnote-ref-1)
2. <https://reliefweb.int/disasters> [↑](#footnote-ref-2)