

Handbook Flood Warning Indonesia



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Introduction

Thank you for downloading this handbook. This handbook is designed as a supplementary document for flood warning Indonesia website and cannot be used out of context. For further enquiries, please contact the author at the section below.

Acknowledgement

Probabilistic flood warning system: icons, symbols, colors, codes are adapted from the UK Environment Agency. Infographic and image used in handbook cover from Freepik.

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Disclaimer

The flood forecast model is developed carefully using scientific approaches; however, the document and related graphics could include technical inaccuracies or typographical errors and the information may not be appropriate to all situations. In no event shall we be liable for any damages whatsoever, whether in an action of contract, negligence, or other tortious action, arising out of or in connection with the use of or reliance on any of the information in this handbook.

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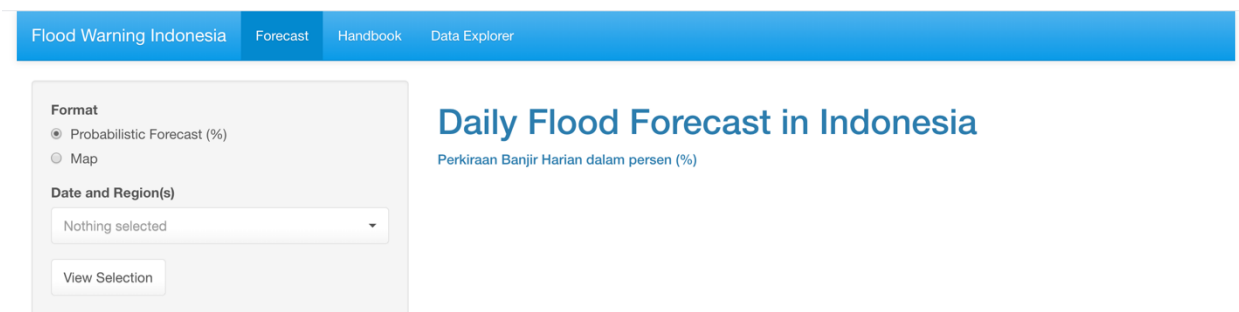
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How to Use

The flood warning Indonesia website is very simple and easy to use. Please read the quick tutorial below as step by step for using the website.

1. Go to website address

Go to https://banjir.shinyapps.io/Flood_Warning_Indonesia. The web view of this webpage as described below.



The screenshot shows the web interface of the Flood Warning Indonesia website. At the top is a blue navigation bar with the text "Flood Warning Indonesia" and three tabs: "Forecast", "Handbook", and "Data Explorer". Below the navigation bar is a light gray sidebar on the left containing the following elements: a "Format" section with two radio buttons, "Probabilistic Forecast (%)" (which is selected) and "Map"; a "Date and Region(s)" section with a dropdown menu currently showing "Nothing selected"; and a "View Selection" button. To the right of the sidebar, the main content area has the title "Daily Flood Forecast in Indonesia" in blue, followed by the subtitle "Perkiraan Banjir Harian dalam persen (%)" in a smaller font.

Figure 1. Web view

2. Format, date, and region selection

Please select desired format, date, and regions. It is possible to select multiple regions at the same time. It is also possible to “Select All” regions and “Deselect All”. After the selection, click “View Selection” button provided in the bottom of the sidebar panel.

The screenshot shows the 'Flood Warning Indonesia' application interface. At the top is a blue navigation bar with the following tabs: 'Flood Warning Indonesia', 'Forecast', 'Handbook', and 'Data Explorer'. The 'Forecast' tab is currently active.

On the left side, there is a sidebar panel with the following sections:

- Format**
 - ☒ Probabilistic Forecast (%)
 - ☐ Map
- Date and Region(s)**
 - A dropdown menu showing 'Date, Bali, Jakarta, Jawa.Barat, Jawa.Timur, Kalir'.
 - Below the dropdown are two buttons: 'Select All' and 'Deselect All'.
 - A list of regions with checkboxes to their right:
 - Date
 - Aceh
 - Bali
 - Bangka.Belitung
 - Banten
 - Bengkulu
 - Gorontalo
 - Jakarta
 - Jambi
 - Jawa.Barat
 - Jawa.Tengah
 - Jawa.Timur
 - Kalimantan.Barat
 - Kalimantan.Selatan
 - Kalimantan.Tengah
 - Kalimantan.Timur
 - Kalimantan.Utara
 - Lampung

On the right side, the main content area displays the title 'Daily Flood Forecast in Indonesia' in blue, followed by the subtitle 'Perkiraan Banjir Harian dalam persen (%)'.

Figure 2. Select format, date, and regions.

3. Daily flood forecast

The selections will result in probabilistic flood warning. The number stated the change of flood events occurrence where 0% indicating No flood, and 100% indicating Flood.

The result of selection also can be copied, printed, or downloaded in .csv or .xlsx.

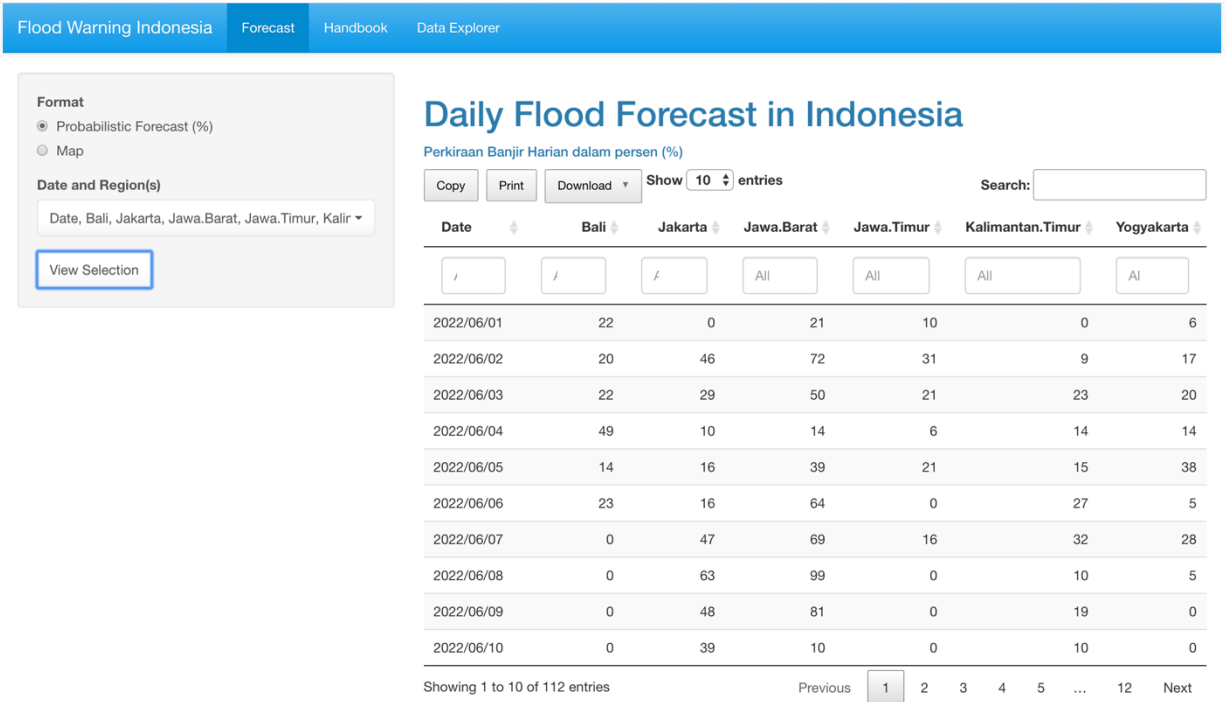


Figure 3. Probabilistic flood forecast

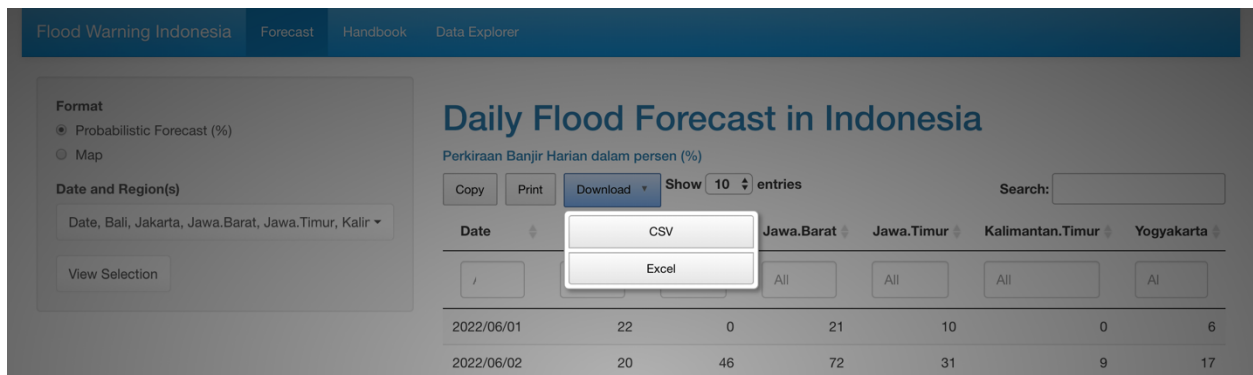


Figure 4. Downloadable format

4. Handbook

Besides the “Forecast” tab, you may notice other tabs on the website such as “Handbook” tab. The handbook tab is giving information about the model, its method and accuracy. This information is available in two languages, English and Indonesian. The handbook can be downloaded using “Download” button in the end of each paragraph of information.

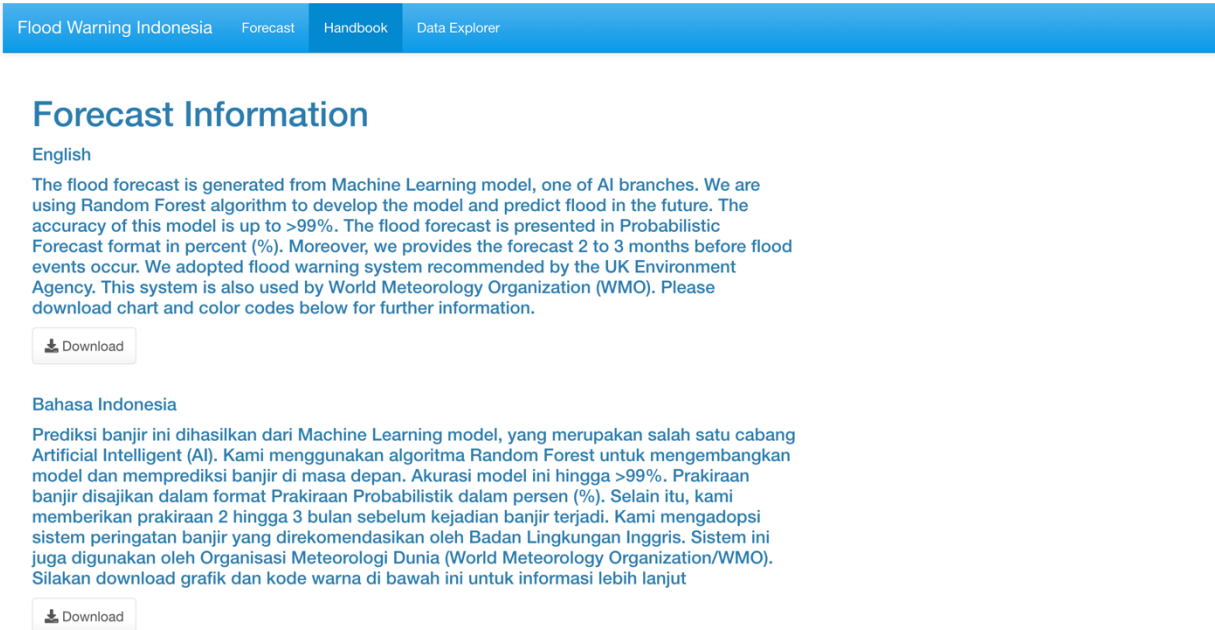


Figure 5. Information of model and handbook download

5. Data Explorer

The last tab of this flood warning is “Data Explorer” which located next to “Handbook” tab. Data explorer is used for those who want to collect the data that are used to develop the model and website. These data include a set of daily rainfall, streamflow, forest ratio and flood events data for 14 years from 2008 to 2021; the summary of local prediction; codes for both model and website UI and server written in R programming language.

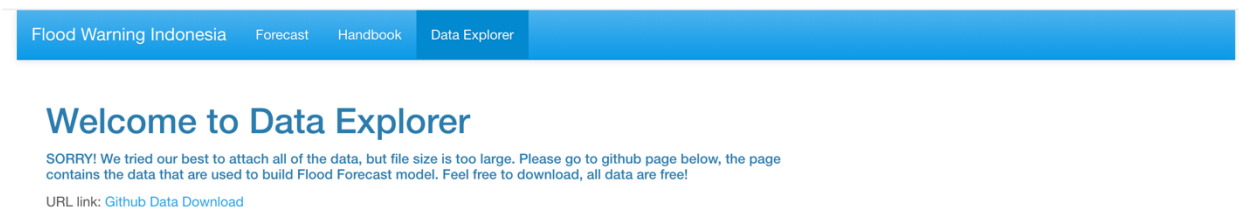






Figure 6. Data Explorer

How to Read the Numbers

The warning system integrates three (3) elements:

- a) The flood forecast generated from the model which was developed by Random Forest algorithm. It is provided in percentage number (%) from 0% to 100%. To understand the meaning of these numbers, the “Interpretation” column will interpret the “Percentage” column, please refer to Table 1 below. Further details of “Interpretation” column is explained by Figure 7.
- b) Flood warning symbols in Figure 7 are adapted from UK Environment Agency.
- c) Probabilistic flood warning codes in Table 1 are also adapted from UK Environment Agency.

Table 1. Probabilistic flood warning codes and interpretation

Color	Percentage	Intrepretation
	> 10%	All clear
	40% - 60%	Flood watch
	60% - 80%	Flood warning
	> 80%	Severe flood warning



Flood watch

"This is the first stage of the warning. If your area is issued with a flood watch it means there is the possibility of some flooding. You're advised to keep a close eye on local radio or television reports, alert your neighbours, watch water levels, check on your pets, reconsider any travel plans, make sure you can put your flood plan into action, and ring the flood information telephone line for further information and advice."



Flood warning

"If a flood warning is issued in your area, it means flooding is expected and will cause disruption. You are advised at this stage to move pets, vehicles, food, valuables, and other items to safety, be prepared to turn off the gas and electricity, be ready to evacuate your home, and put sandbags or flood boards in place to protect your home."



Severe flood warning

"This is the warning issued when serious flooding is expected and there is imminent danger to life and property. If your warning is upgraded to this you should be prepared for your gas, electricity, water and telephone supplies being lost. You're advised to keep calm and reassure others, and cooperate with the emergency services."



All clear

"This is issued when the flood water levels are going down and no flood watches or warnings are in force any longer. At this stage you can check if it is safe to return home."

Figure 7. Flood warning symbols

Background Study

Title: Machine Learning For Flood Prediction In Indonesia: Providing Online Access For Disaster Management Control

Purpose: conducted in partial fulfillment of the requirements for the degree of Master of Science in the Gwangju Institute of Science and Technology

Attribution: where material from this handbook and study is used for any purpose, please contact the author or supervisor

Abstract

Climate change has altered the hydrological cycle which leads to unpredictable and extreme precipitation events, triggering a high risk of flooding across the globe. As one of the most vulnerable countries to floods, there should be a high necessity for accurate and reliable flood forecasting in Indonesia. In a megacity such as Jakarta, several proper flood forecasting methods are already available; however, the rest of the Indonesian regions are left behind. The current flood forecasting provided by the Indonesian government is on a monthly basis and made of monthly forecasts of precipitation and flood-prone area maps without mathematical or statistical analysis. The sample of current forecast from the last 3 years was evaluated and resulted in hundreds of wrong predictions. Therefore, a new prediction model using a machine learning algorithm is proposed to provide daily flood prediction in Indonesia, which consists of 33 regions. Data crawling was conducted to obtain daily precipitation, streamflow, land cover, and flood data for the last 13 years, from 2008 to 2021. The model was built using Random Forest (RF) algorithm for classification. The accuracy, specificity, precision, recall, and f_1 -score of the prediction model using the RF algorithm are approximately 99.91%, 99.90%, 99.47%, 99.99%, and 99.72%, respectively. Moreover, the AUC (Area Under the Curve) of the ROC (Receiver Operating Characteristics) curve results in 99.97% and an OOB (Out of Bag) error of < 0.001 . The Partial Dependence Plots (PDP) indicate that flood in Indonesia is highly dependent on precipitation rate value. Furthermore, the variable importance plot shows the most to the least important variables, which are precipitation rate, forest ratio, and streamflow. Both the PDP and variable importance suggest that the vast majority of

occurred flood events are flash flooding and only a few coastal, riverine, or other types of flooding in Indonesia. The precipitation forecast for June 2022 was gathered and input into the model, resulting in the flood prediction. Flood prediction for June 2022 was then deployed as an open-access website using shinyR. This flood prediction model is a fast and accurate alternative to complement the current flood forecast with extensive information.