An Overview, SIMLAR: GIS Based 2D Lahar Simulation

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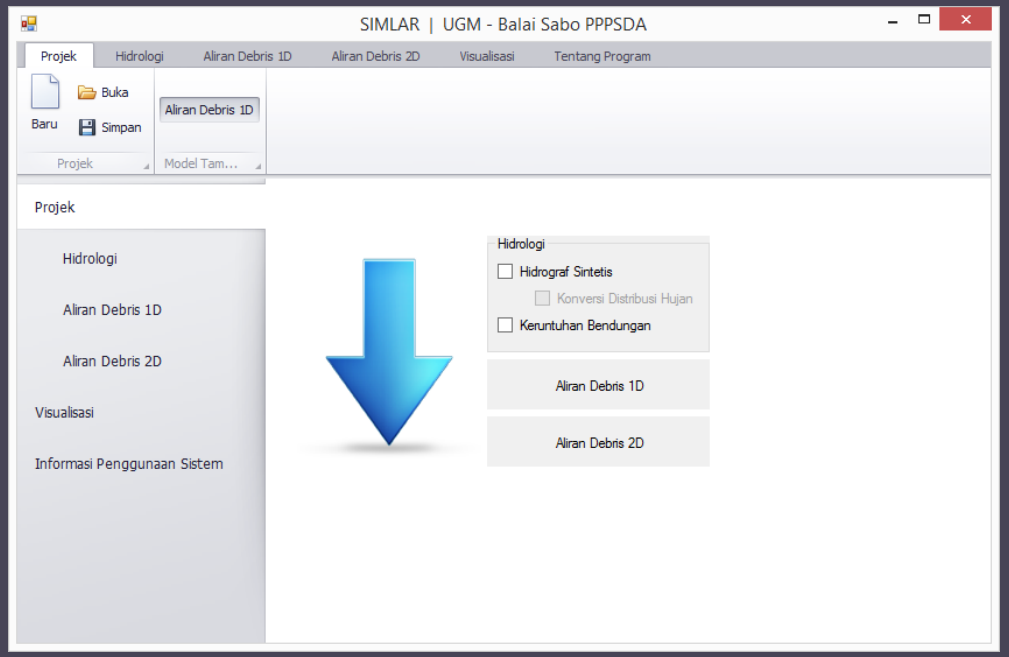
Background

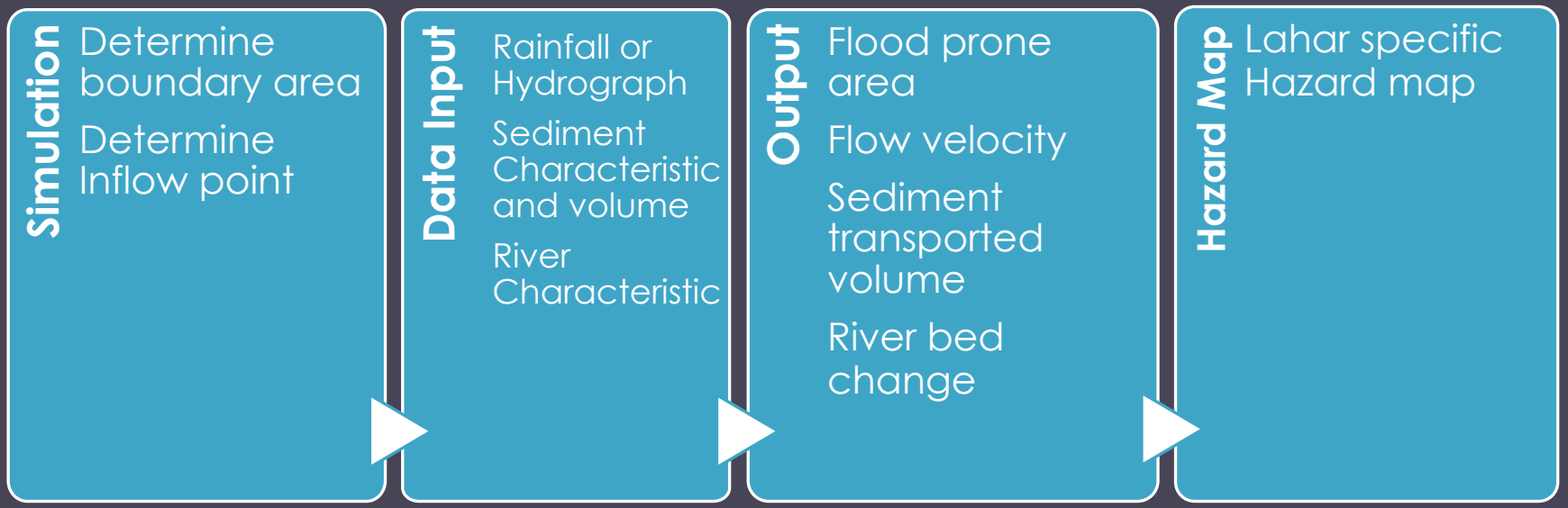
- Frequent lahar occurrence in Merapi Volcano Area
- Many importance infrastructures settle near or cross the river which is originated in Merapi Volcano.
- Many people live along the riverside.
- Hazard map can support the Mitigation plan.

Introduction to SIMLAR

- Stand for Simulasi Lahar (In Bahasa) or Lahar Simulation.
- GIS based 2D numerical simulation.
- Windows OS Platform with GUI for easy to use.
- Input topography by Digital Elevation Model (DEM).
- The output consist of flood area, flow velocity, sediment volume, river bed change.

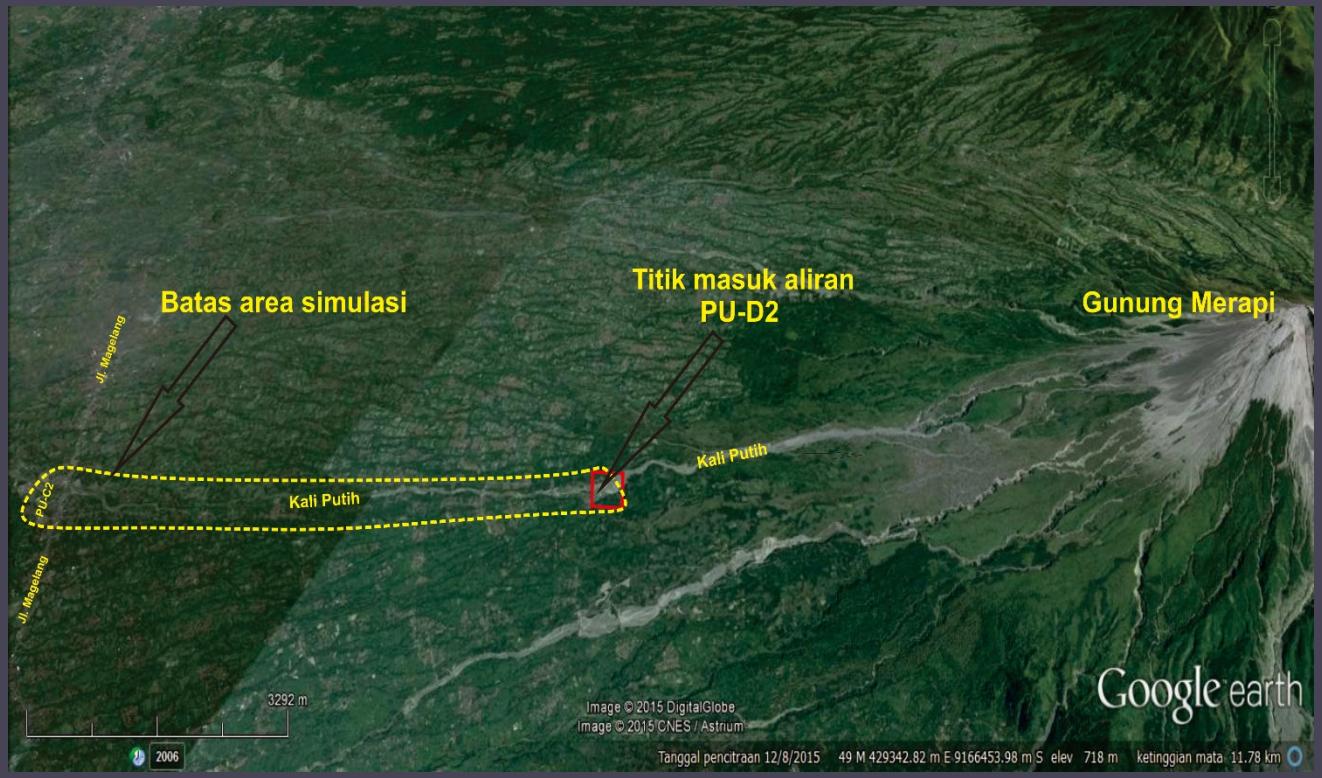


The Simulation



Case Study: Kali Putih

Boundary area for simulation sets at 1784 × 154 grids for x and y direction respectively. Inflow point determined at PU-D2 Sabodam, Kali Putih .



Hydrograph

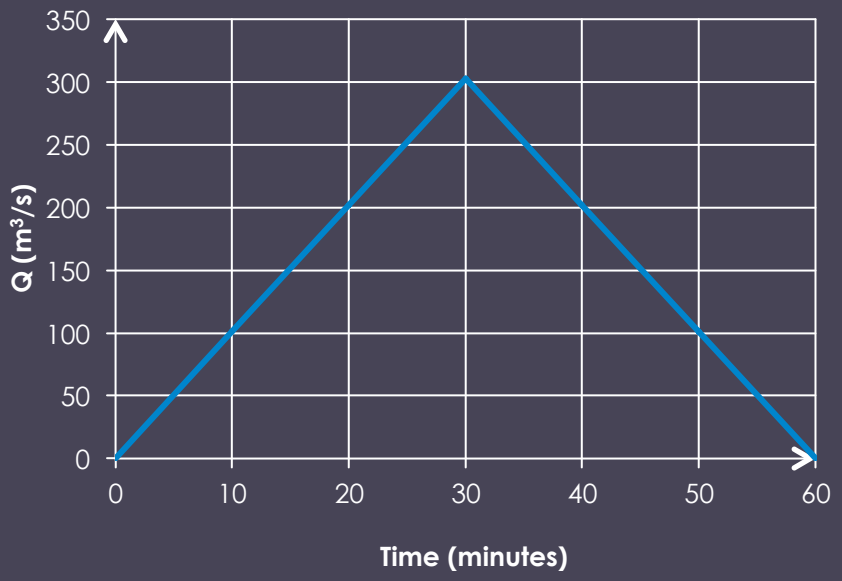
Due to limited observed rainfall-runoff data, we currently use Triangle Shape Hydrograph Proposed by Sutikno and Sasahara (1996). This type of hydrograph generate from field observation.

$$\ln Vq = \frac{\ln Q_p - \ln 0{,}0227}{0{,}7265}$$

$$Tb = \frac{2.V_q}{\left(\frac{Q_p}{3600}\right)}$$

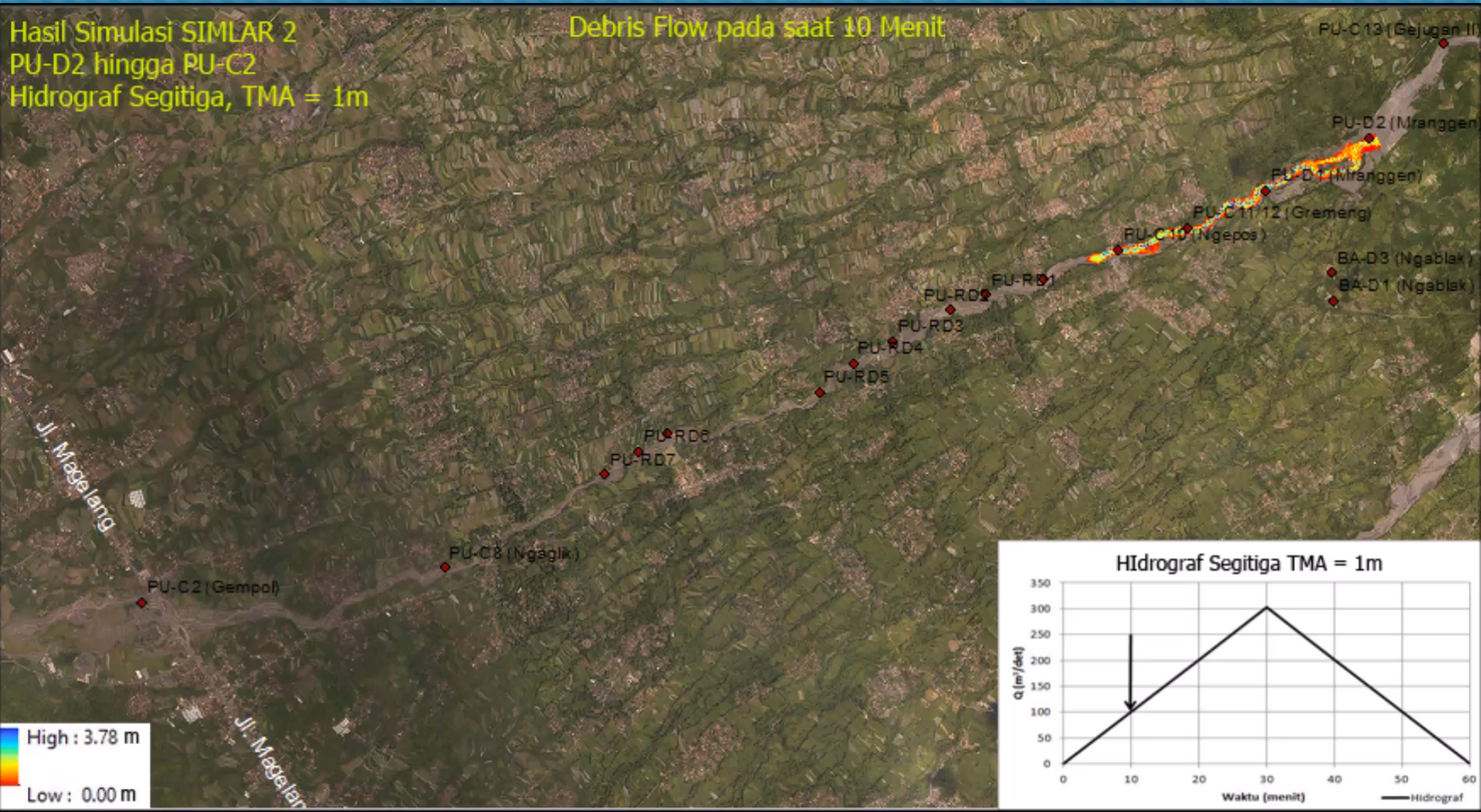
$$Tp = \frac{L}{(V.3600)}$$

Where V_q is volume of hydrograph (m^3), Qp is peak discharge (m^3/s), V is flow velocity (m/s), L is lenght of the watershed (m), and Tp is time to peak (s)



10 minutes of 1.00 meter water level at PU-D2, Kali Putih

Results


Hasil Simulasi SIMLAR 2
PU-D2 hingga PU-C2
Hidrograf Segitiga, TMA = 1m
Debris Flow pada saat 10 Menit
PU-C13 (Gejugan II)
PU-D2 (Mranggen)
PU-D1 (Mranggen)
PU-C11/12 (Gremeng)
PU-C10 (Ngepos)
BA-D3 (Ngablak)
BA-D1 (Ngablak)
PU-RD1
PU-RD2
PU-RD3
PU-RD4
PU-RD5
PU-RD6
PU-RD7
Jl. Magelang
PU-C8 (Ngaglik)
PU-C2 (Gempol)
Jl. Magelang
High : 3.78 m
Low : 0.00 m
HIdrograf Segitiga TMA = 1m
Q (m³/det)
Waktu (menit)
Hidrograf

Discussion

Flow Velocity

Simulation results

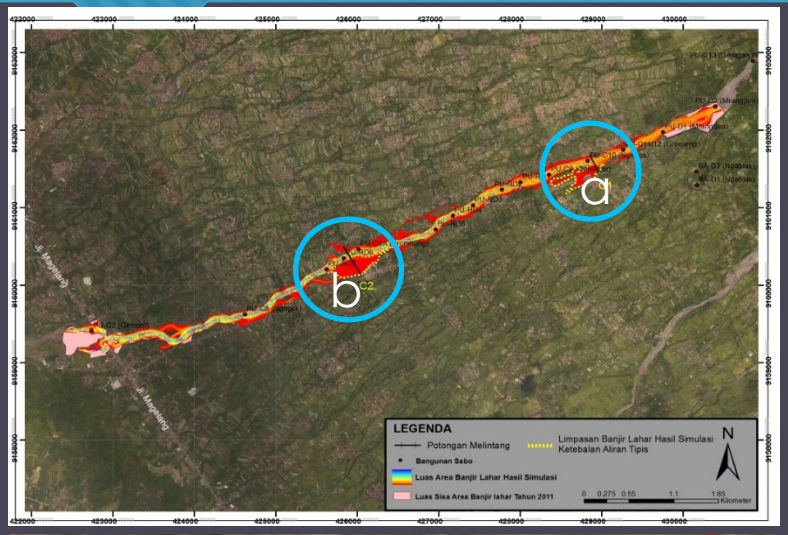
Interval cumulative (minutes)	Flow reach (m)	Velocity (m/s)
10	2037,35	3,40
20	3842,12	3,20
30	5979,85	3,32
40	7870,96	3,27
50	9039,23	3,01

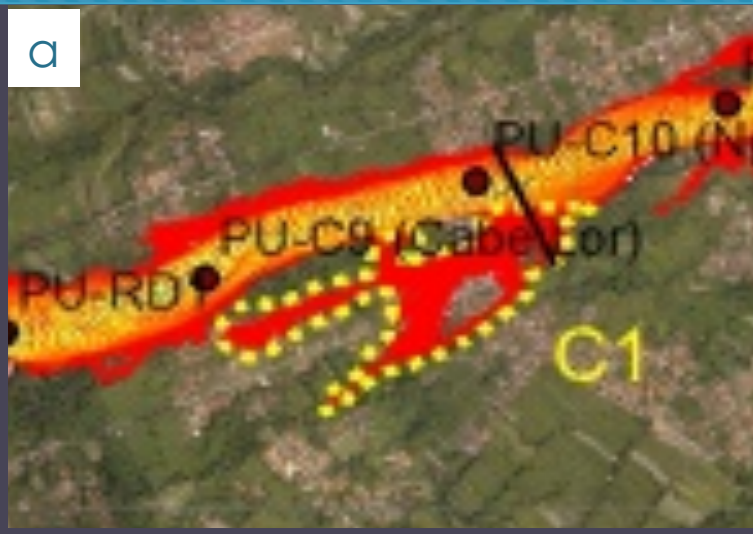
Observed by geophone (Sulistyani et. al, 2015)

No.	Date of occurrence	Name of Geophone Station	Correlation Coeff.	Correlation velocity (m/s)	Cross Correlation Velocity (m/s)
1	2/03/2011	PTH1 - PTH2	0,81	3,50	2,18
2	4/03/2011	PTH1 - PTH2	0,99	7,53	5,00
3	8/03/2011	PTH1 - PTH2	0,96	7,00	8,14
4	11/03/2011	PTH1 - PTH2	0,98	7,00	5,92
5	3/11/2011	PTH1 - PTH2	0,82	5,00	7,00

Discussion (2)

Flood Prone Area

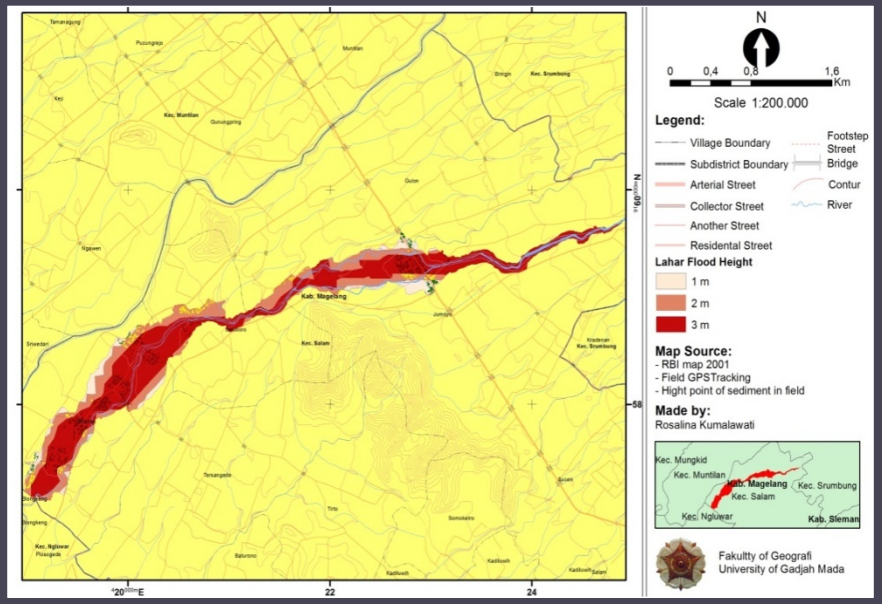




Compare to 2011 lahar flood, the area deviation is about 0,46 km^2 or 27.38 %

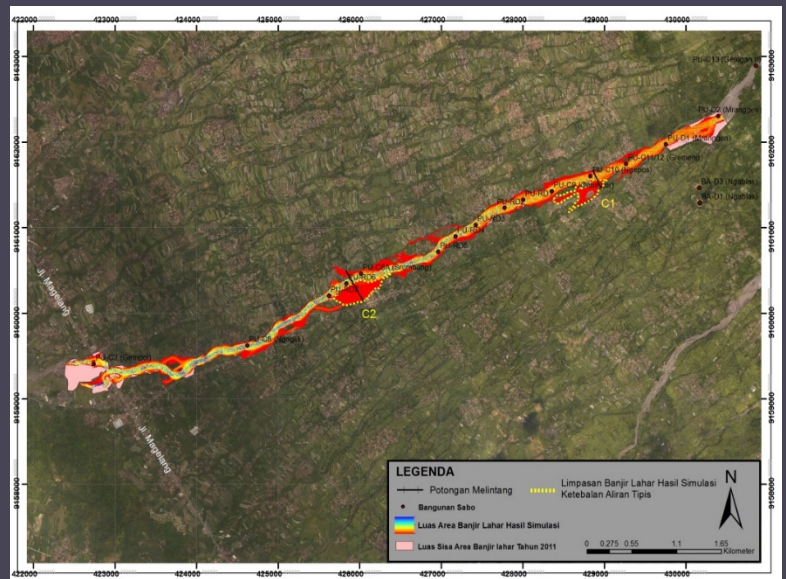
Discussion (3)

Flow Depth



Flow depth measurement in Kali Putih (Rosalina, et. al, 2012)

Maximum flow depth on simulation was 3.78 meters



Conclusion

- The flow velocity of the simulation lies within the range of velocity observed by geophone measurement.
- The flow depth of the simulation reaches 3.78 m, 0.78 m higher than flow depth measurement in 2011.
- The flood area deviation is 0.46 Km^2 or 27. 38% compare to field measurement in 2011.

Terima Kasih
Arigato Gozaimasu
Thank You