

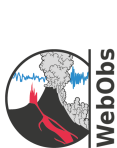
WebObs: An integrated web-based system for volcanological observatories

At the frontier between research and monitoring

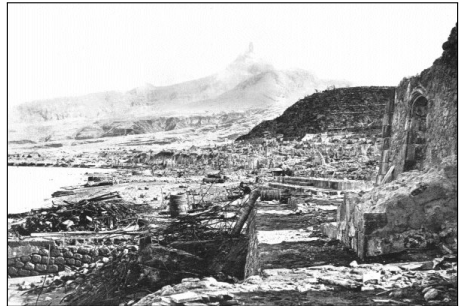
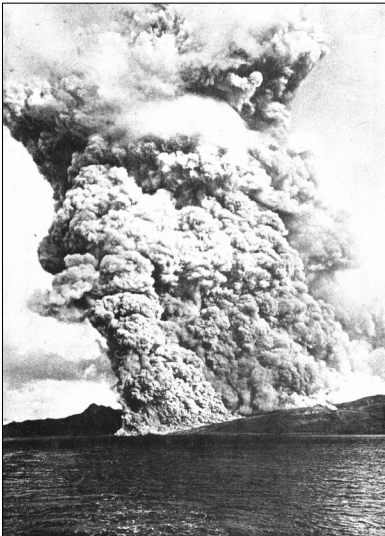
Pr. Dr. Ir. François BEAUDUCEL

with support and collaboration of

D. Lafon, X. Béguin, P. Boissier, A. Bosson, A. Lemarchand, D. Mallarino, A. Nercessian,
J.-M. Saurel, A.A. Fahmi, I.G.M. Agung Nandaka, D.K. Syahbana, M. Hardipto

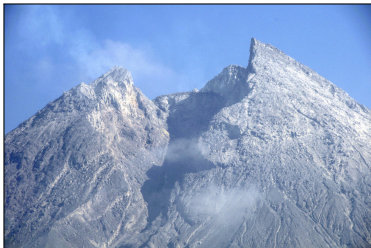


May 8, 1902: Mount Pelée eruption, 29,000 deaths



- ▶ Many “precursory observations” (earthquakes, explosions, lava dome and spine, incandescence, pyroclastic flows, ...) BUT misinterpreted
- ▶ No evacuation

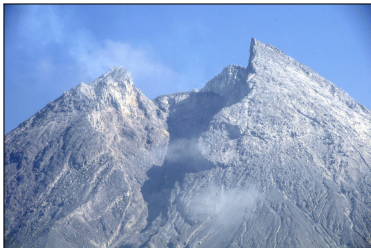
How to predict eruptions?



Questions raised

- ▶ Volcanic hazards characterisation:
 - source type: magmatic / phreatic / gravitational
 - amplitude and volumes
 - locations and directions
 - time delays
- ▶ Description of the phenomenon complexity

How to predict eruptions?



Questions raised

- ▶ Volcanic hazards characterisation:
 - source type: magmatic / phreatic / gravitational
 - amplitude and volumes
 - locations and directions
 - time delays
- ▶ Description of the phenomenon complexity

Needs (deterministic approach)

- ▶ Physical and geometrical **quantitative observations**
- ▶ **Data and interpretative model**

How to monitor natural systems ?



Objectives

- ▶ **collecting** observation data
- ▶ **understanding** the phenomena
- ▶ **improving** forecasting/prediction
- ▶ **protecting** population from hazards

How to monitor natural systems ?



Objectives

- ▶ **collecting** observation data
- ▶ **understanding** the phenomena
- ▶ **improving** forecasting/prediction
- ▶ **protecting** population from hazards

Needed characteristics of observations

- ▶ **continuity** and steady measurements (in space and time)
- ▶ **long-term** (consistent with phenomenon)
- ▶ **real-time** or near real-time (operational monitoring)
- ▶ notion of **uncertainty** (precision, redundancy, artifacts)
- ▶ **meta-data** (sensors characteristics and acquisition context)
- ▶ **perpetuate** (archiving + documentation)

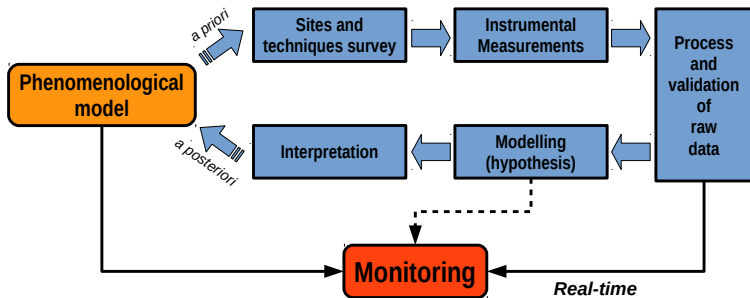
Permanent observatories: an obvious solution



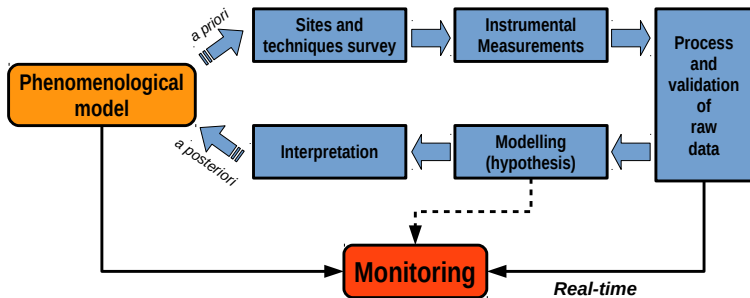
Missions of volcanic observatory

- ▶ Understanding phenomena through:
 - periodic instrumental observations
 - multidisciplinary techniques
- ▶ **Monitoring:** Detecting any change in the volcano behavior
- ▶ **Modelling:** Evaluate the potential hazard
- ▶ Communicate with authorities in charge of the civil protection
- ▶ Inform the public
- ▶ Education and preventive information **upstream**

Ambivalence research/monitoring



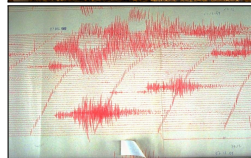
Ambivalence research/monitoring



Axiom

Monitoring = real-time data + interpretative model


Operational monitoring



Objectives

- ▶ **Real-time** : instant access to all raw & interpreted data (model result), all techniques, as support to crisis management
- ▶ **Archiving** : centralizing data and meta-data
- ▶ **Sharing** : access to a single information level, support for distant monitoring


[203.189.89.115] WebObs-beta-1.7.0e*
login: François Beauducel







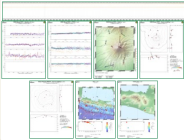
WebObs DOMERAPI Project

Balai Penyelidikan dan Pengembangan Teknologi Kebencanaan Geologi
Jalan Cendana No. 16 Yogyakarta 55166
Contact: beauducel@ppg.ji or see the [team coordinates](#)

News





Info

Selamat Datang / Sugeng Rawuh / Bienvenue / Welcome !

This site provides access to all the DOMERAPI's project [instrumental networks](#) and associated data and metadata:

- Access to data in real time (in both graphic and numerical form)
- Station status, information, maintenance logs
- And much more...

NB Real time data and graphs are generated automatically without human input. Please contact the [project coordinator](#) of the DOMERAPI data before making any other use of this data.

Gazette Today

~ Jemuwah Kliwon ~

Friday, May 20 2016 (day 141, week 20)

Meeting / Officials

- 2016-05-20 - 2016-05-23 - UGM - Workshop "Risk and perception of natural hazards" - (François Beauducel, Jean-Christophe Komorowski, Jean-Philippe Mikosian, Karim Kalfoun)

Calendar

4	4	May 2016	►	◄		
Mo	Tu	We	Th	Fr	Sa	Su
17	20	28	27	28	29	30
18	02	23	04	26	06	07
19	03	10	11	12	13	14
20	16	17	18	19	20	21
21	23	24	25	26	27	28
22	20	31	01	02	03	04

Indonesia WIB, Friday 20 May 2016 - 13:21

USA Washington, Thursday 19 May 2016 - 23:21

France/Germany, Friday 20 May 2016 - 08:21

UTC, Friday 20 May 2016 - 08:21

The WebObs system: specifications

Data and information sharing

- ▶ Single web portal
- ▶ User authentication
- ▶ Support for discussion and data exchange


Networks management


- ▶ Automatic control of acquisitions
- ▶ Data quality control
- ▶ Technical specifications and events log
- ▶ Shared agenda

Instant access to monitoring data

- ▶ “Near real-time” processes, including for manual data
- ▶ Data access levels:
 - raw data
 - validated data
 - first order modeling
- ▶ Pre-set moving time windows + manual requests
- ▶ Cross link with stations metadata
- ▶ All types of permanent pluridisciplinary networks:
 - permanent
 - temporary
 - instrumental or not (ex. journal)



















































WebObs: List of GRIDS


[domerapi] WebObs-beta-1.7.0e+


login: François Beauducel

[NEWS](#)
[MONITORING](#)
[NETWORKS](#)
[DATA](#)
[DOCUMENTS](#)
[WEBObs](#)

Grids

Domain	Grid	 Name	Nodes	Type	Owner	Graphs	Raw Data
Seismology (S)	PROC	 Indonesian seismicity USGS	1 node				
	PROC	 MUSIC3C Merapi	5 nodes				
	PROC	 Test Arclink	1 node				
	VIEW	 Generic View	1 node				
	VIEW	 Seismic Antenna Merapi	6 stations	Permanent stations	PVMBG		
	VIEW	 Seismic Gamalama	2 nodes				
	VIEW	 Seismic Tomography	53 stations	Temporary stations	PVMBG		
Deformations (D)	PROC	 GNSS Merapi APPS/JPL	5 nodes	not active			
	PROC	 GNSS Merapi GIPSY	9 stations	automatic processing			
	PROC	 Merapi Tiltmetry BPPTKG	7 nodes				
	VIEW	 Tilt Merapi	12 stations	Permanent stations	PVMBG		
Geochemistry (C)	PROC	 Merapi DOAS	3 scanners				
	PROC	 Merapi Multigas	1 node				
	VIEW	 Radon	4 stations	Temporary deployed sensors	PVMBG		
Geophysics (G)	VIEW	 Temperature	8 stations	Temporary deployed sensors	PVMBG		
	VIEW	 Multiparameter Dukono	6 nodes				
	VIEW	 Multiparameter Ibu	1 node				
	VIEW	 Multiparameters Merapi	4 stations	Permanent stations			
Phenomenology (P)	PROC	 Stereography cameras	3 cameras	permanent stations			
	VIEW	 Merapi eruptions	2 nodes	Reports	PVMBG		
	VIEW	 Merapi reports	2 nodes	Reports	PVMBG		
	VIEW	 Visual Merapi	1 camera	Temporary experiment	PVMBG		
Acquisitions (A)	VIEW	 Computing	1 node				
	VIEW	 Transmissions	11 stations				

WebObs: Example of GPS stations

[domerapi] WebObs-beta-1.7.0e+ login: François Beauducel

DOMERAPI NEWS MONITORING NETWORKS DATA DOCUMENTS WEBOBS

DEFORMATIONS » GNSS GRAPHS
 GEOPHYSICS » GNSS STATIONS
 GEOCHEMIA » TILT GRAPHS
 SEISMOLOGY » TILT STATIONS
 PHENOMENOLOGY »
 ACQUISITIONS »
 ALL VIEWS
 ALL PROCS
 ALL NODES

Deformations / {PROC.GIPSY}

» [Procs | Q | 📍 | 📍 | 📍 | 📍] Specifica ct | Events | References]

Purpose

Specifications

- "station": 9 [Associate existing node(s) | Create a new node]
- Type: **automatic processing**
- Access to data (RAWDATA): /rawdata/GNSS
- Graphical routine: GIPSY (10d,80d,01y,05y.all)

List of station(s)

Nodes [Active | Valid | All] - Coordinates [Lat/Lon | UTM | XYZ] - Export [TXT | CSV | KML] - Project [On | Off]

Alias	Name	Lat. (WGS84)	Lon. (WGS84)	Elev. (m)	Start / Installation	End / Stop	Type	Nb Evtnt	Project	Last Data (TZ +0)	Sampl.	Status
BABA	"Pos Babadan"	-7.52621	110.41067	1274	2013-06-13		DOMERAPI GR25 @1s	18	replace repaired GR10 (François Beauducel)	2016-05-19 00:00:00+00:00	84 %	100 %
BPTK	"BPPTKG Yogyakarta"	-7.79868	110.38384	111	2010-12-25		BPPTKG GX1220 @1s	0		2015-09-13 00:00:00+00:00	0 %	0 %
DELS	"Deles"	-7.56783	110.46469	1399	2011-11-01		BPPTKG GR10 @1s	0		2016-05-19 00:00:00+00:00	100 %	100 %
GRWH	"Jurang Grawah"	-7.52160	110.45150	2045	2011-09-26		BPPTKG GR10 @1s	0		2016-05-12 00:00:00+00:00	63 %	100 %
JRAK	"Pos Jarakah"	-7.49723	110.42158	1261	2013-06-09		DOMERAPI GR10 @1s	6		2016-05-19 00:00:00+00:00	96 %	100 %
KLAT	"Klatakan"	-7.53470	110.42800	1640	2011-12-01		BPPTKG GR10 @1s	0		2016-05-19 00:00:00+00:00	96 %	100 %
PASB	"Pasar Bubar"	-7.53666	110.44865	2676	2013-06-22		DOMERAPI GR10 @1s	10		2016-05-19 00:00:00+00:00	84 %	100 %
PLAW	"Plawangan"	-7.58794	110.43148	1235	2013-06-27		DOMERAPI GR10 @1s	3		2016-05-19 00:00:00+00:00	96 %	100 %
SELO	"Pos Selo"	-7.49894	110.45717	1646	2013-06-10		DOMERAPI GR10 @1s	7	Download data manually from SD card + find the serial number of AR10 (François Beauducel)	2016-03-18 00:00:00+00:00	0 %	0 %

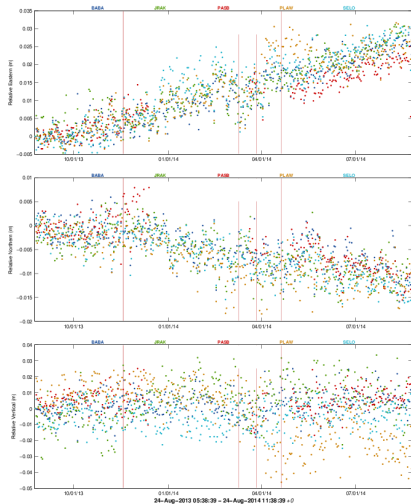
Location

Maps [MAP] - Export [EPS | KML]



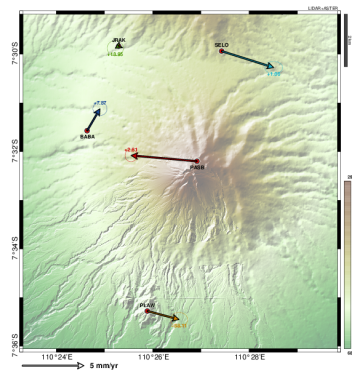
GNSS Merapi GIPSY – ITRF08 (1 year)

24-Aug-2014 11:38:39 +0
© DOMERAPI, 2014 + © BPPTIG, 2014



GNSS Merapi GIPSY – Relative (1 year)

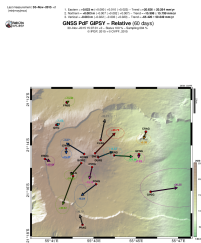
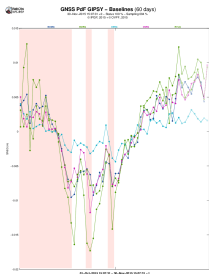
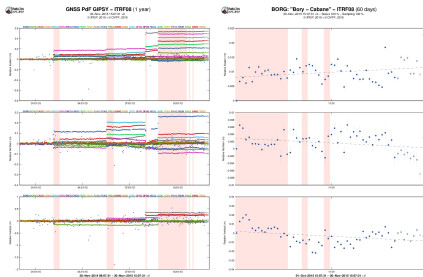
24-Aug-2014 11:38:39 +0
© DOMERAPI, 2014 + © BPPTIG, 2014



Network mean velocity (ITRF08):

Eastward = +27.15 mm/yr
Northward = -11.56 mm/yr
Vertical = -1.56 mm/yr

Piton de la Fournaise: Real-time source modelling



GNSS data

- ▶ Daily solutions (GIPSY)
- ▶ Plots time series, baselines, trends and vectors
- ▶ Automatic time scales (week, month, year, ...)

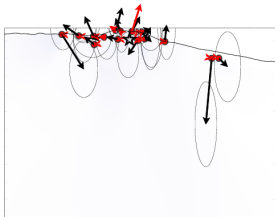
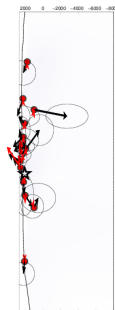
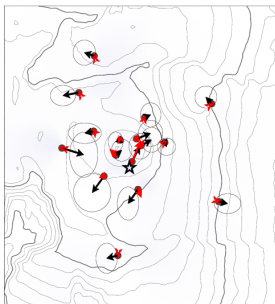
Source modelling

- ▶ Mogi + topography (*Williams & Wadge, 2000*)
- ▶ Exhaustive grid search (location XYZ + ΔV)
- ▶ Plots PDF with shading colors + best solution



GNSS Pdf GIPSY – Source modelling

12-Jun-2014 +0
© IGF, 2014 • © CVPF, 2014

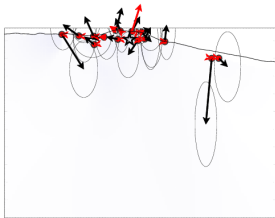
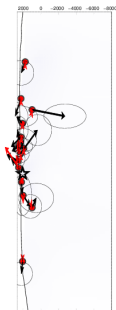
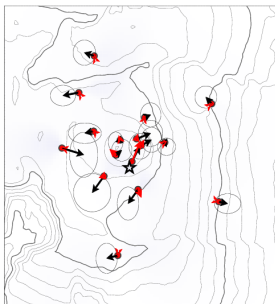


Best source:
depth = -2.1 km
 $\Delta V = +0.01 \text{ Mm}^3$
width (1%) = 9700 m
misfit = 3.71 mm



GNSS Pdf GIPSY – Source modelling

12-Jun-2014 +0
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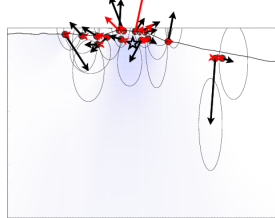
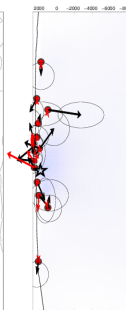
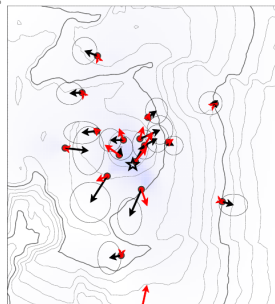


Best source:
depth = -2.1 km
 $\Delta V = +0.01 \text{ Mm}^3$
width (1%) = 9700 m
misfit = 3.71 mm



GNSS Pdf GIPSY – Source modelling

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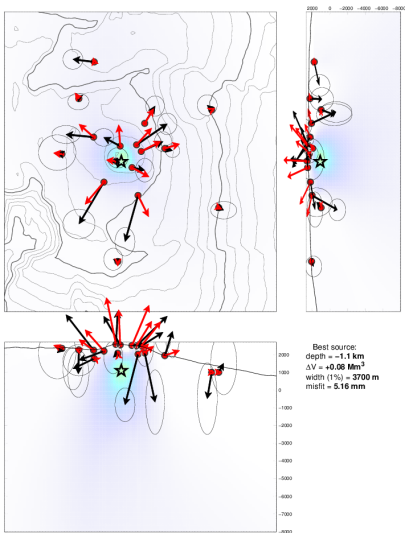


Best source:
depth = -1.8 km
 $\Delta V = +0.02 \text{ Mm}^3$
width (1%) = 5200 m
misfit = 3.98 mm



GNSS Pdf GIPSY – Source modelling

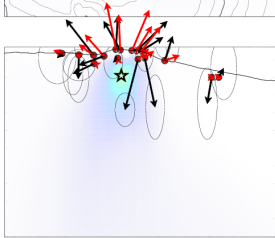
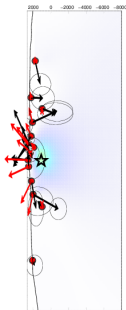
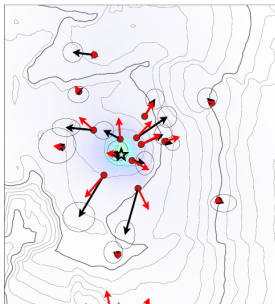
16-Jun-2014 +0
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GNSS Pdf GIPSY – Source modelling

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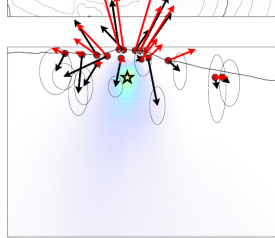
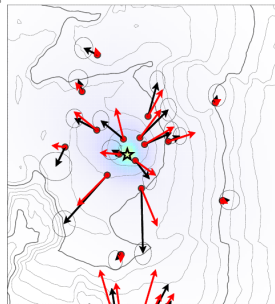


Best source:
depth = -1.1 km
 $\Delta V = +0.06 \text{ Mm}^3$
width (1%) = 3700 m
misfit = 5.16 mm



GNSS Pdf GIPSY – Source modelling

19-Jun-2014 +0
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Best source:
depth = -1.0 km
 $\Delta V = +0.16 \text{ Mm}^3$
width (1%) = 4100 m
misfit = 5.14 mm

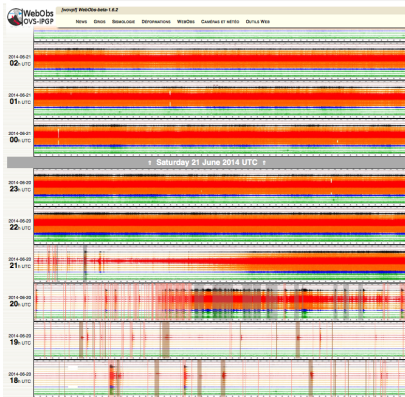
WebObs seismic chart (Sefran)

- ▶ visual seismic activity
- ▶ automatic & manual events detection



WebObs seismic chart (Sefran)

- ▶ visual seismic activity
- ▶ automatic & manual events detection



June 20, 2014 eruption

- ▶ 8 days of consistent precursors
- ▶ increasing probability and ΔV
- ▶ real erupted volume = 0.3 Mm^3 (non DRE)



Matur sembah nuwun !