Avalanche-, Debris Flow- and Mudslide RADAR

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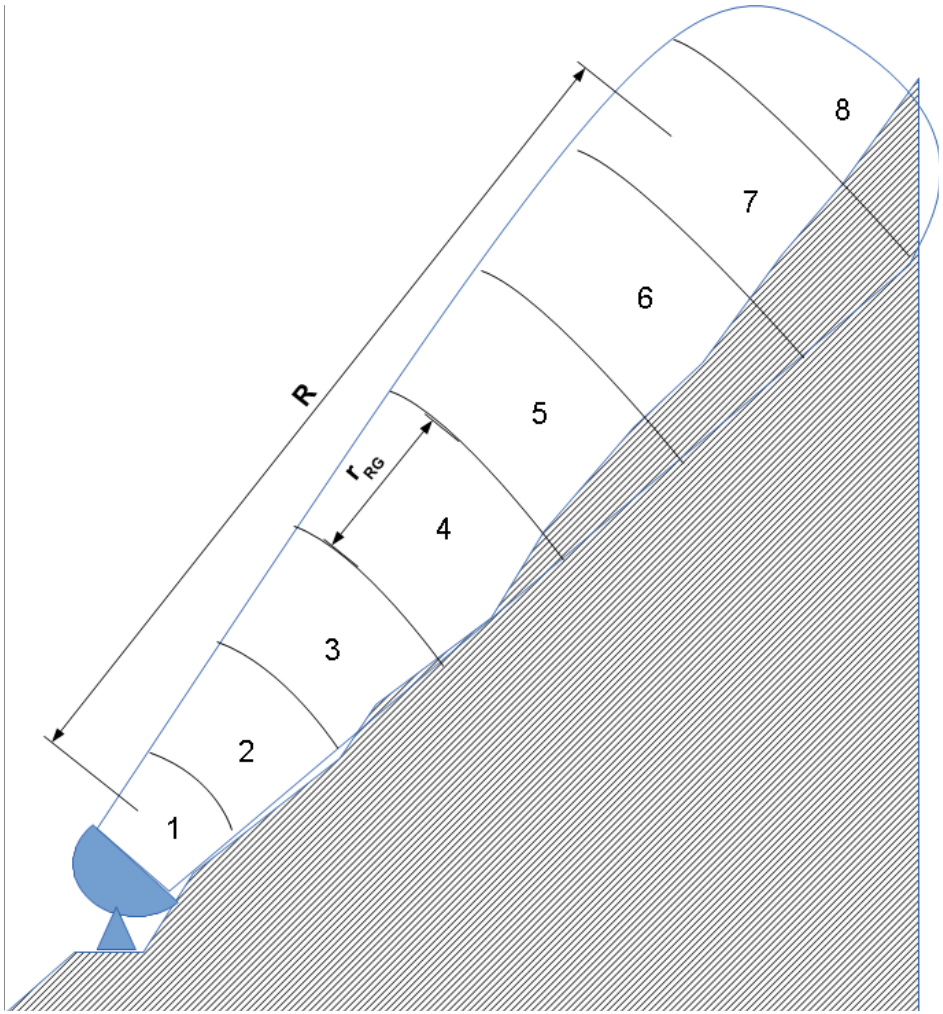
About IBTP Koschuch e.U.

IBTP Koschuch was founded in 2010 to make application-oriented physical methods available for the public, for companies and for private individuals.

About DI Dr. Koschuch Richard:

- **1990-1998 Technical physics studies at the TU-Graz. Diploma thesis at the institute for nuclear physics.**
- **1998-2002 Technical sciences studies at the TU-Graz and the institute of biophysics and X-ray structure physics of the Austrian Academy of Sciences. Dissertation at the Institute of Biophysics and X-Ray Structure Physics of the Austrian Academy of Sciences.**
- **1998-2003 Employed at the Institute of Biophysics and X-Ray Structure Physics of the Austrian Academy of Sciences.**
- **2002-2006 Chief of development and production at Hecus XRS.**
- **2006-2008 Inspector for the investigation of radioactivity in food and environment at the Austrian Agency for Health and Food Safety (AGES).**
- **2009 Preliminary work for the company foundation**
- **2010-2015 Chief of development and production at H&S Hochfrequenztechnik**
- **2010 Establishment of IBTP Koschuch**

Principle of the Radar



- **The RADAR emits modulated pulses**
- **Max. measurement distance R=2,5 km**
- **RG-length r_{RG}=15-250 m**
- **Velocities up to 300 km/h are detected simultaneously in each RG**
- **If there is a hazardous event (fast moving objects), a alarming trigger is activated.**

Specification

Parameter	Quantity	Tolerance	Unit
Mode	Pulse/PCM		
Frequency	10,0-10,5		GHz
Power C.	40	<	W
Range	30-2500		m
Targetsize	1	min > at 2km	m²
	0,25	min > at 1km	m²
Velocity	0,2-100	min/max	m/s
RG	128	max	
RG-length	15-250	min/max	m

Technology and Benefits of the System I

- Reliable recognition of avalanches and mudslides
  - **Minimization of false alerts**

- Low transmitted power
  - **Energy- and environment- friendly**

- Possibility of mobile operations

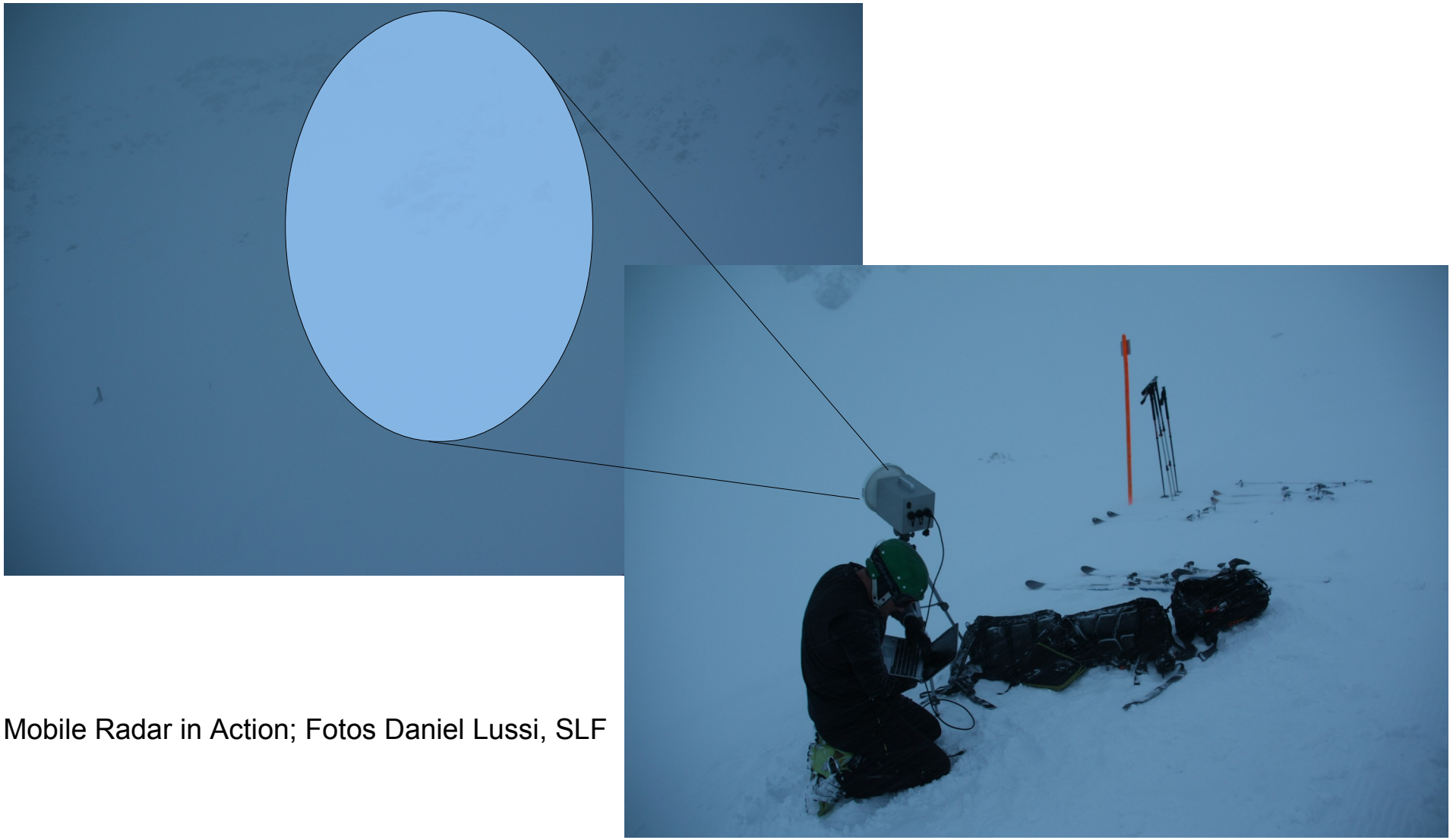
- Low installation requirements
  - **Only a mast and a power supply of 40 W**

Technology and Benefits of the System II

- Recognition of risk in real time
  - **maximum warning**

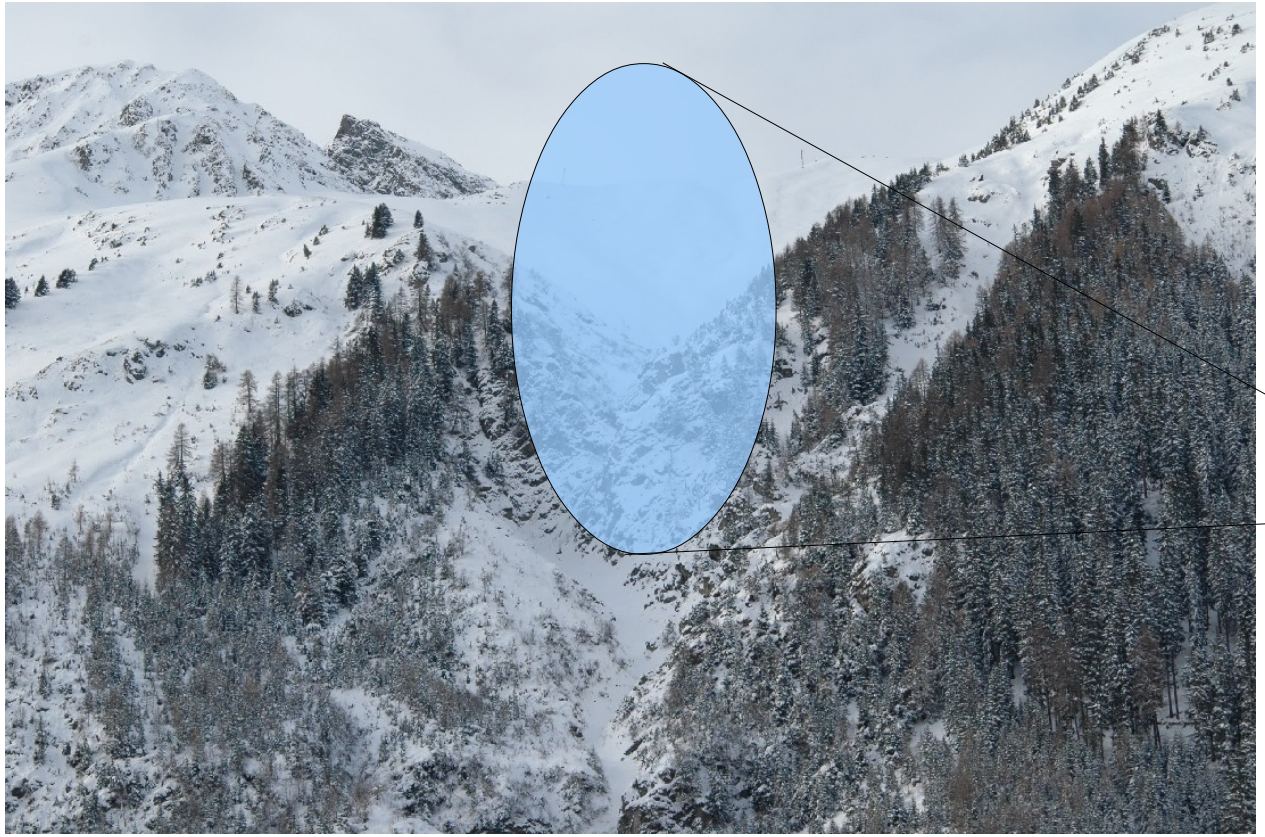
- Multifunctional alert system
  - **trigger to local signal systems**
  - **real time information to central warning institutions**
  - **fast, save and regardless from weather conditions**

Function I: Mobile RADAR

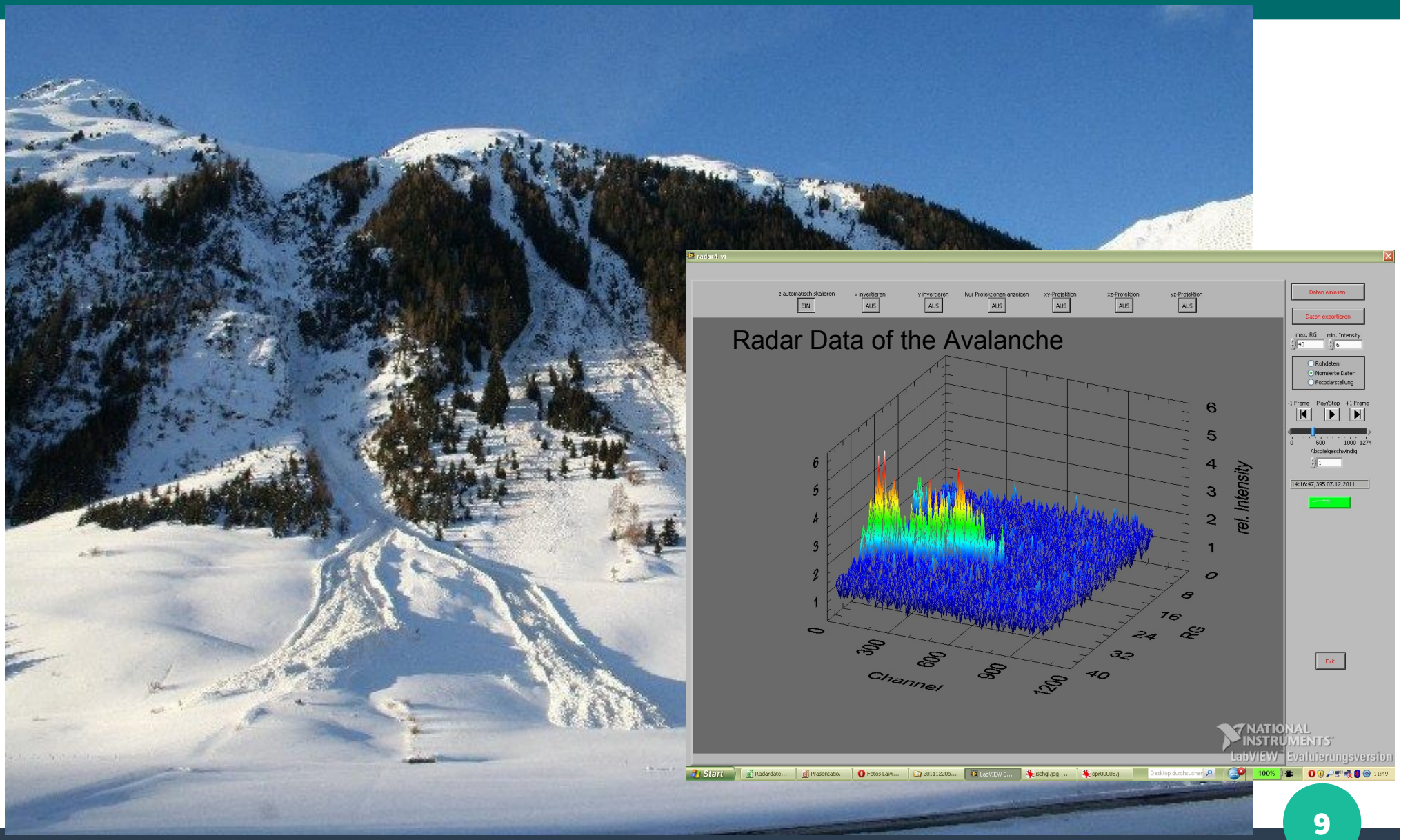


Mobile Radar in Action; Fotos Daniel Lussi, SLF

Function II: Fix Installation Ischgl



Function II: Fix Installation Ischgl



Project Avalanche Detection Systems SLF

Summery Comparison Tests SLF:

Tabelle 10: Ermittelte Leistungsparameter im Winter 2011/2012

Standort	System	*a*	*b*	*c*	POD	FAR
Täsch	ARFANG	*3*	*10*	*138*	0.77	0.93
Belalp/Blatten	ARFANG	-	-	-	-	-
Lavin	ARFANG	*10*	*40*	*205*	0.8	0.84
Lavin	Geophone AlpuG	*28*	*9*	*0*	0.24	0
Sedrun	Radar H&S	*0*	*11*	*7*	1	0.39
Ischgl	Radar H&S	*0*	*17*	*0*	1	0

Tabelle 8: Kategorien für Quantifizierung der Leistung

Verpasste Lawine *(a)*	Ein Lawinenabgang fand statt (bestätigt durch lokalen Beobachter), doch das Detektionssystem hat diesen nicht gemeldet.
Detektierte Lawine *(b)*	Ein Lawinenabgang fand statt (bestätigt durch lokalen Beobachter), das Detektionssystem hat diesen erfasst und gemeldet.
Fehlalarm *(c)*	Es fand kein Lawinenabgang statt, doch das Detektionssystem hat einen Abgang gemeldet.

Master Thesis Boku Vienna

Summery Thesis Christian Kienberger 2013:
„Evaluation of Avalanche Detection Systems and Development of a Plan for a Simple Detection System“

Tabelle 13: Zusammenfassung des Vergleiches der Lawinenwinter 2011/2012 und 2012/2013 zur Erkennung etwaiger Verbesserungen. Die Bewertung erfolgte anhand der in Kapitel 3 ersichtlichen Ergebnisse, jedoch stellen die einzelnen Parameter der Tabelle subjektive Werte dar und basieren nicht auf festgelegten Zahlenkriterien.

Standort	System	Technologie	Verbesserungen	Zuverlässigkeit	Verfügbarkeit	Zukunftschancen
Gonda	ARFANG	Infrasound	keine	unbefriedigend	unbefriedigend	keine weiteren Investitionen, mit Ablaufdatum
Gonda	UHU	Infrasound	-	unbefriedigend	unbefriedigend	möglich, Sensorenstandorte als großes Problem
Gonda	AlpuG Geophon West	Seismik	keine	unbefriedigend	hervorragend	groß, vor allem in Kombination mit Infrasound
Gonda	AlpuG Geophon Ost	Seismik	ja	unbefriedigend	hervorragend	groß, vor allem in Kombination mit Infrasound
Ischgl	Lawinen – Radar	Radar – technologie	keine	hervorragend	hervorragend	groß
Ischgl	IDA	Infrasound	-	unbefriedigend	-	groß, sofern Weiterentwicklung erfolgt

Avalancheradar

Avalanche Detection Radar

Avalanche Detection Rate for installed Radar Systems:

Place of Radar	Years of operation	Alarm and Avalanche	False Alarm	No Alarm but Avalanche
Sedrun	2010-2012	12	7*	0
Ischgl	2011-	40	3**	0
Kaunertal	2012-	2	1***	0
Kappl	2012-	23	7**	2****

*...all alarms within one hour caused by a truck covering time by time the detection-cone
**…all alarms on one evening caused by a heavy rain shower in January; new algorithms can handle this.
***…Module defect
****…Radar detected the avalanche, but the phone connection did not work

Debris Flow Lattenbach

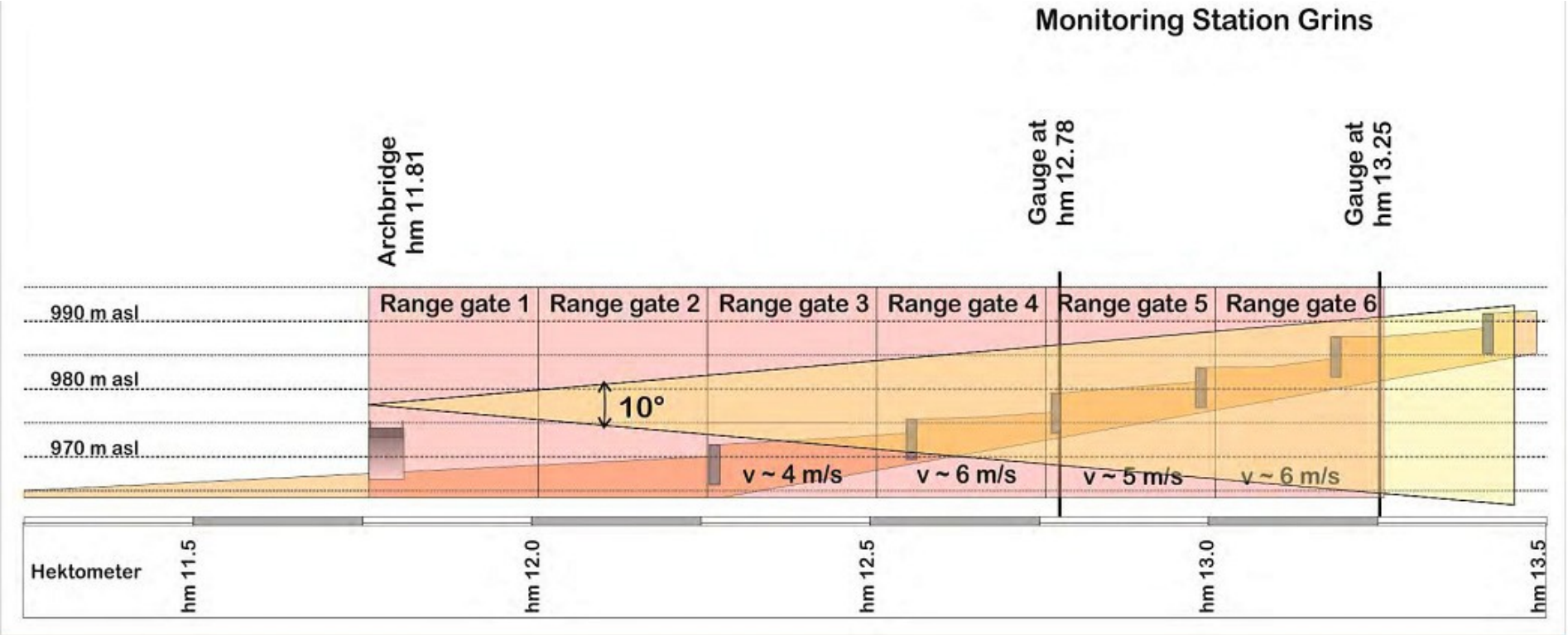
Location: Grins Lattenbach 10°30'38" O and 47°08'32" N

Debris Flow Lattenbach

View

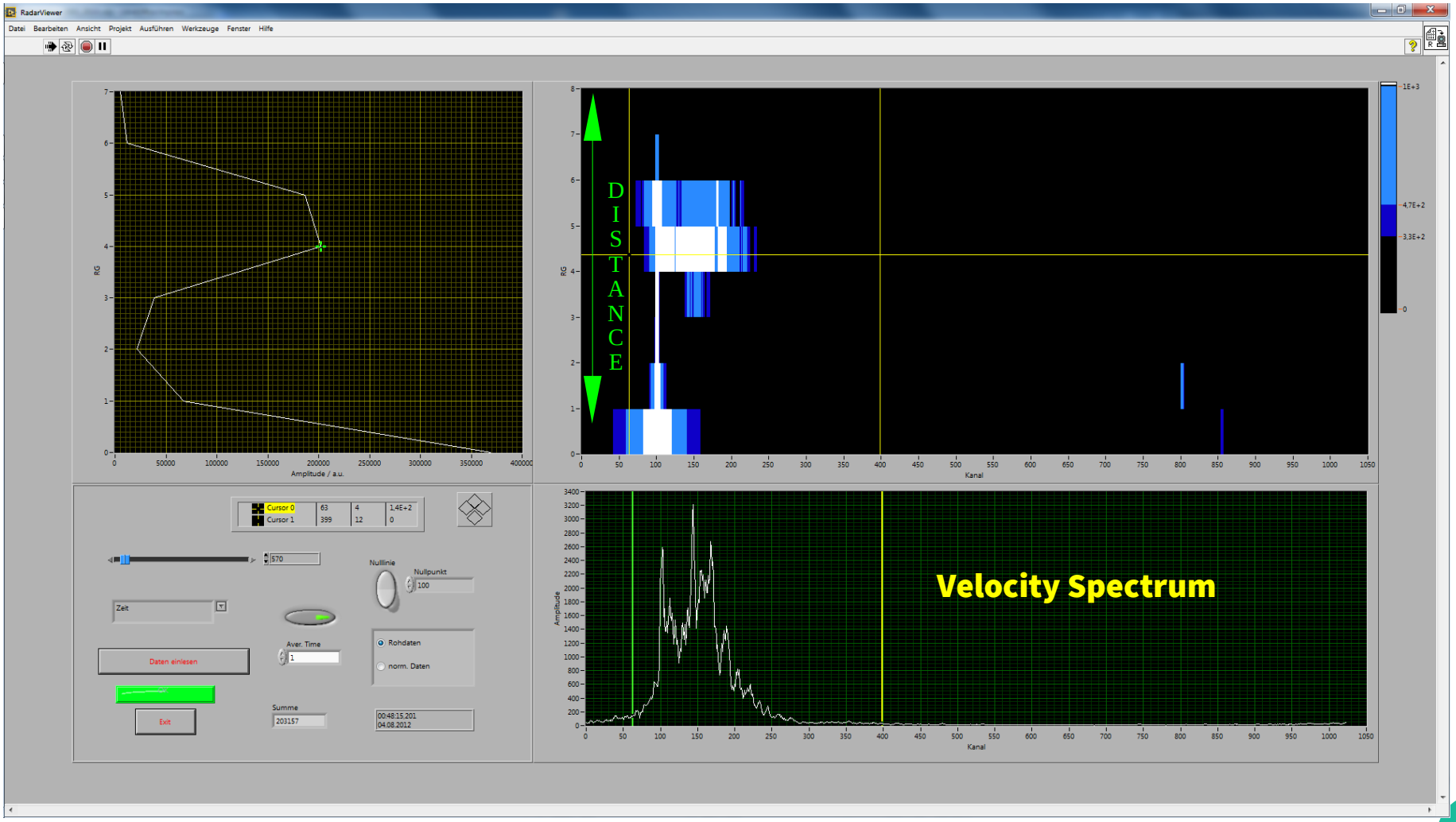
Debris Flow Lattenbach

Situation Lattenbach



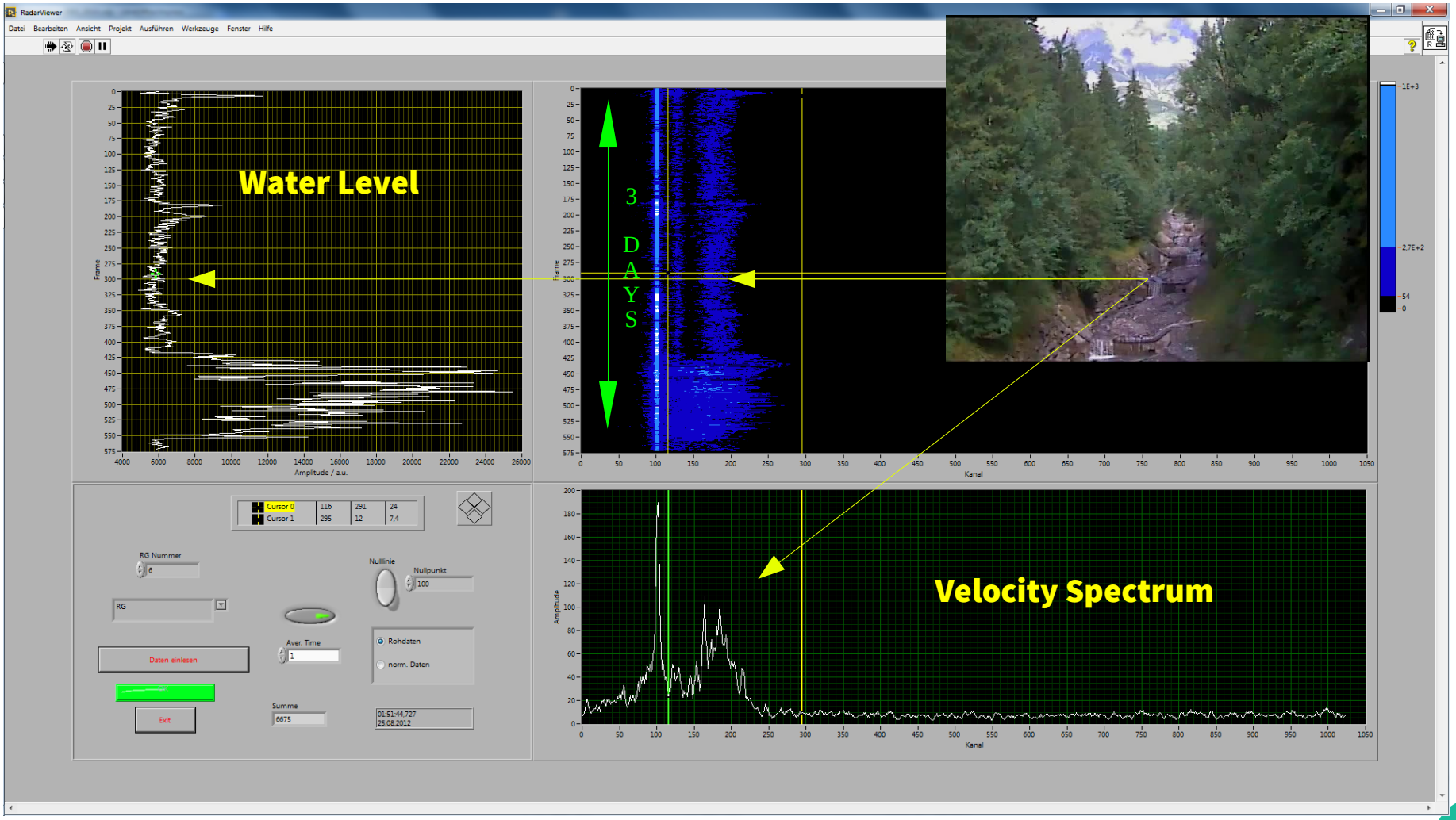
Debris Flow Lattenbach

Data Analysis 23-26.08.2012: Example Data Frame



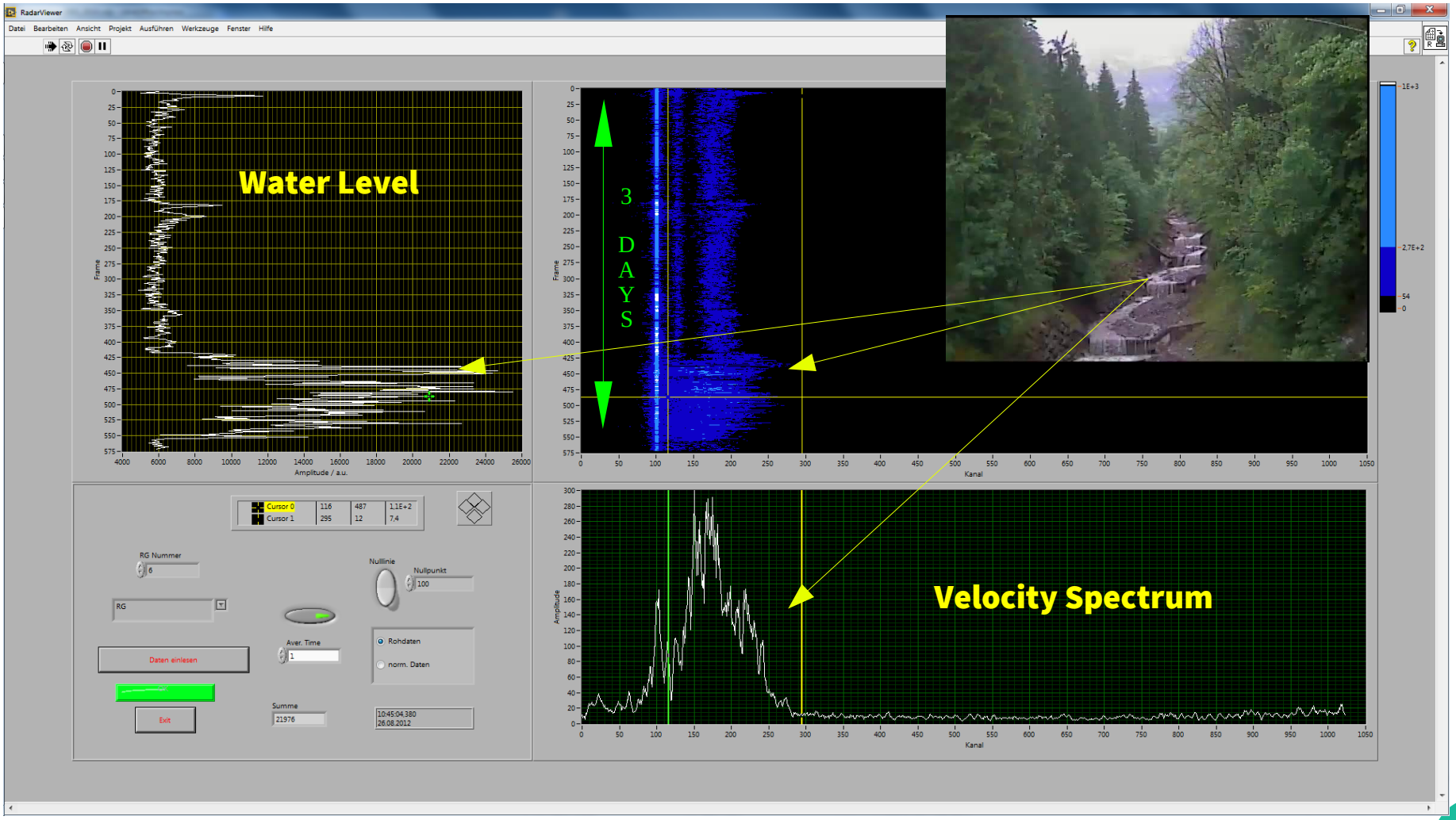
Debris Flow Lattenbach

Data Analysis 23-26.08.2012: RG 6 Low Water Level



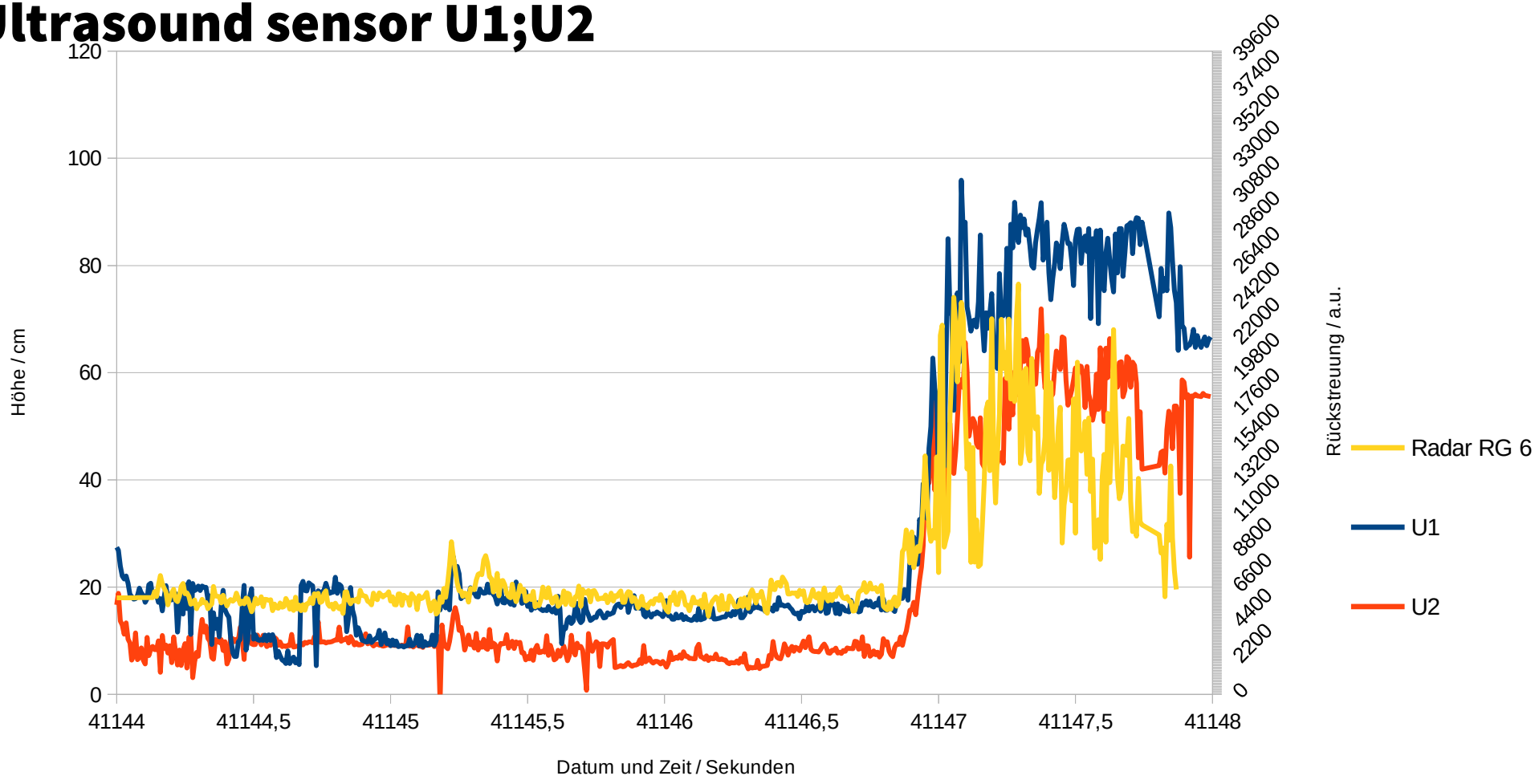
Debris Flow Lattenbach

Data Analysis 23-26.08.2012: RG 6 High Water Level → Alarm



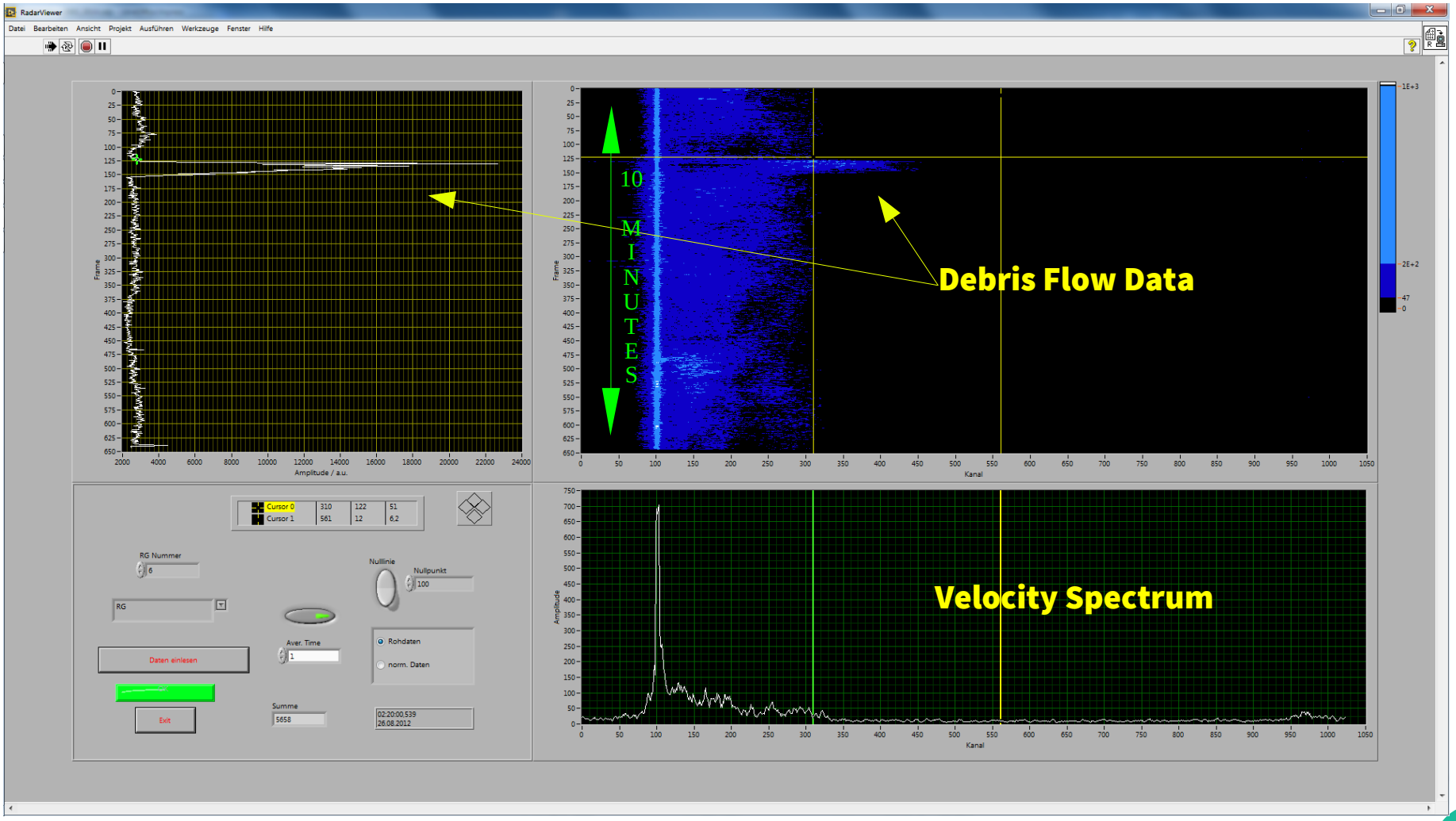
Debris Flow Lattenbach

Data Analysis 23-26.08.2012: Water Level Radar versus Ultrasound sensor U1;U2



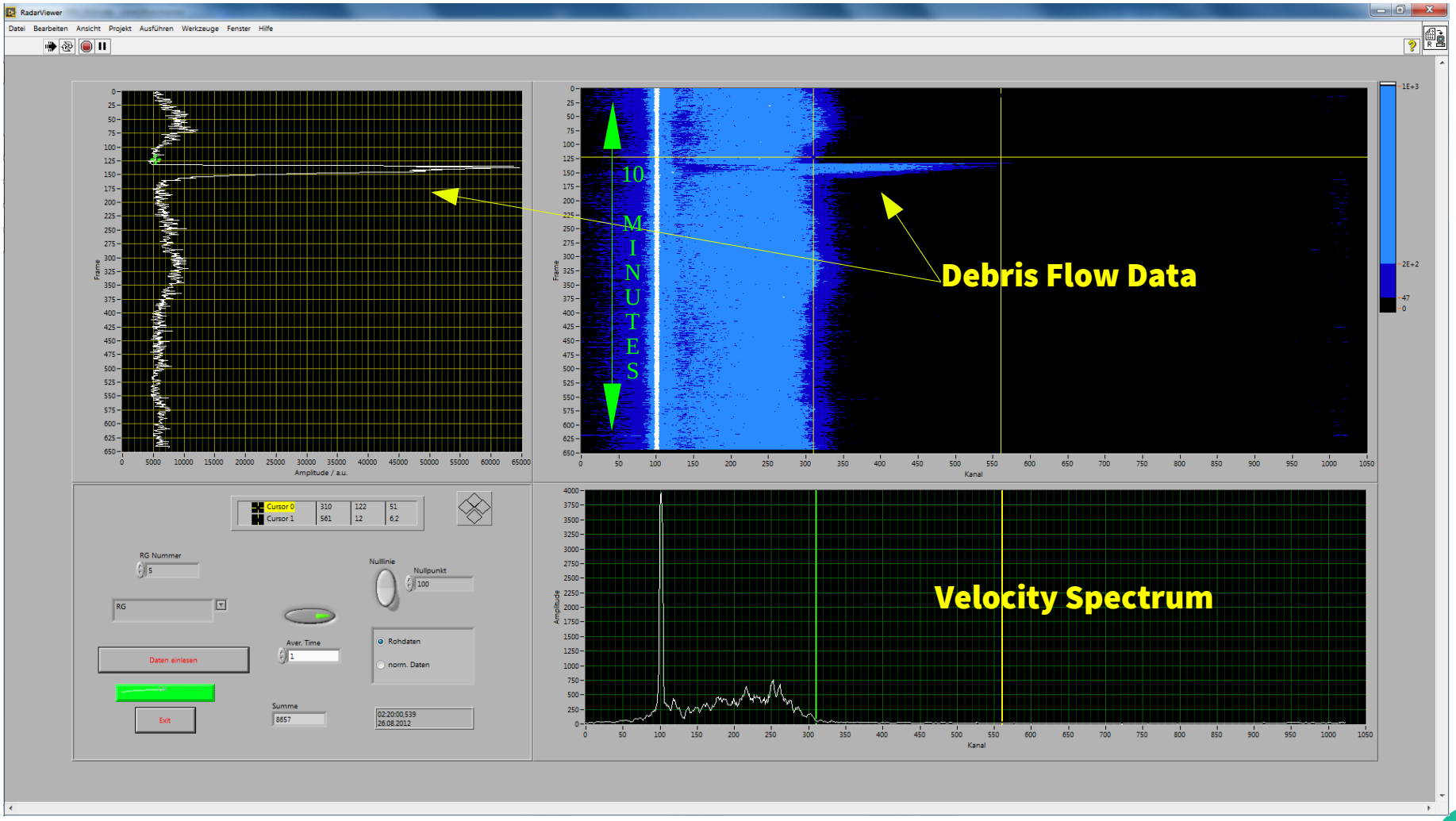
Debris Flow Lattenbach

Small Debris Flow Event from 26.08.2012 RG6



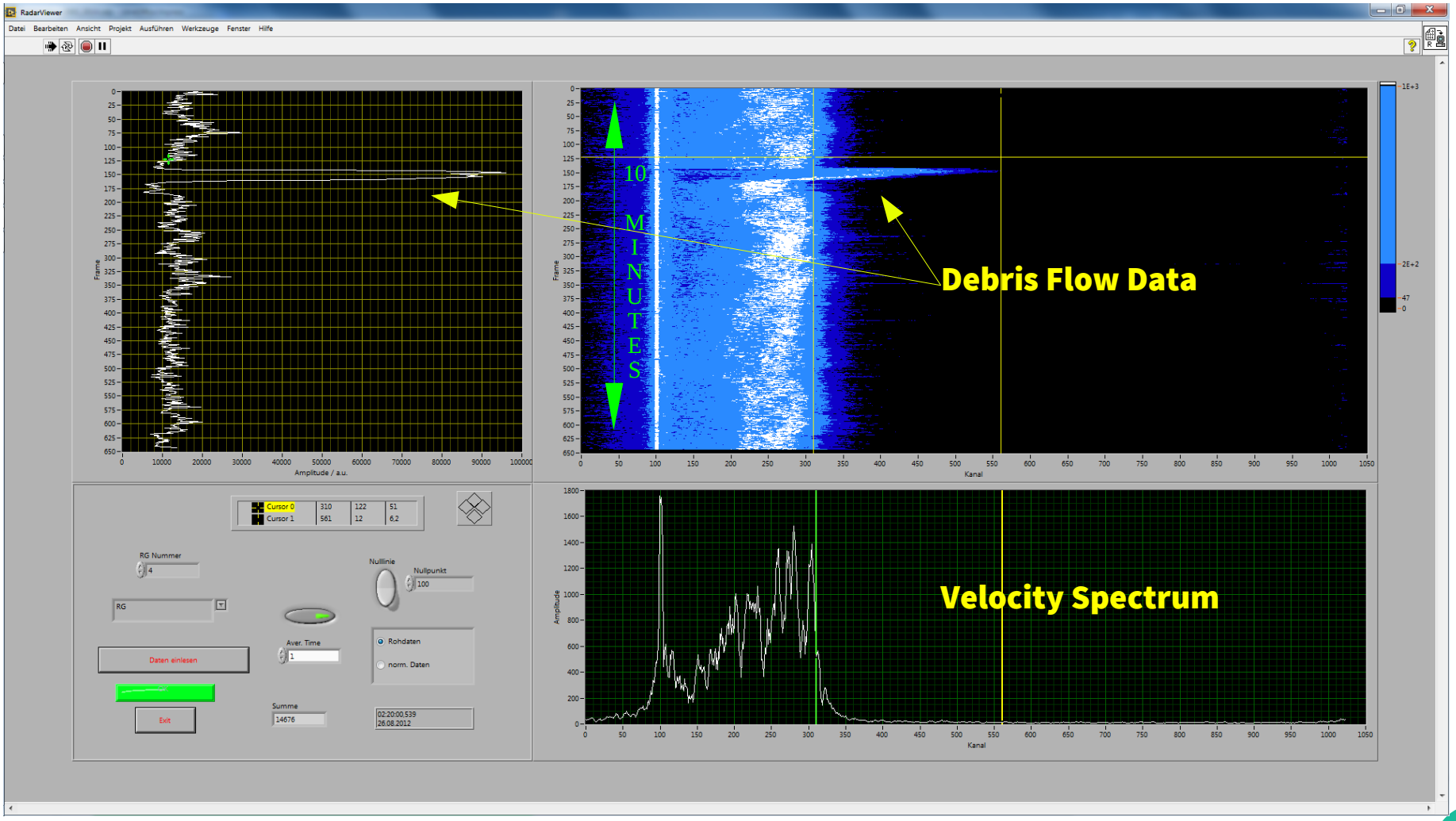
Debris Flow Lattenbach

Small Debris Flow Event from 26.08.2012 RG5



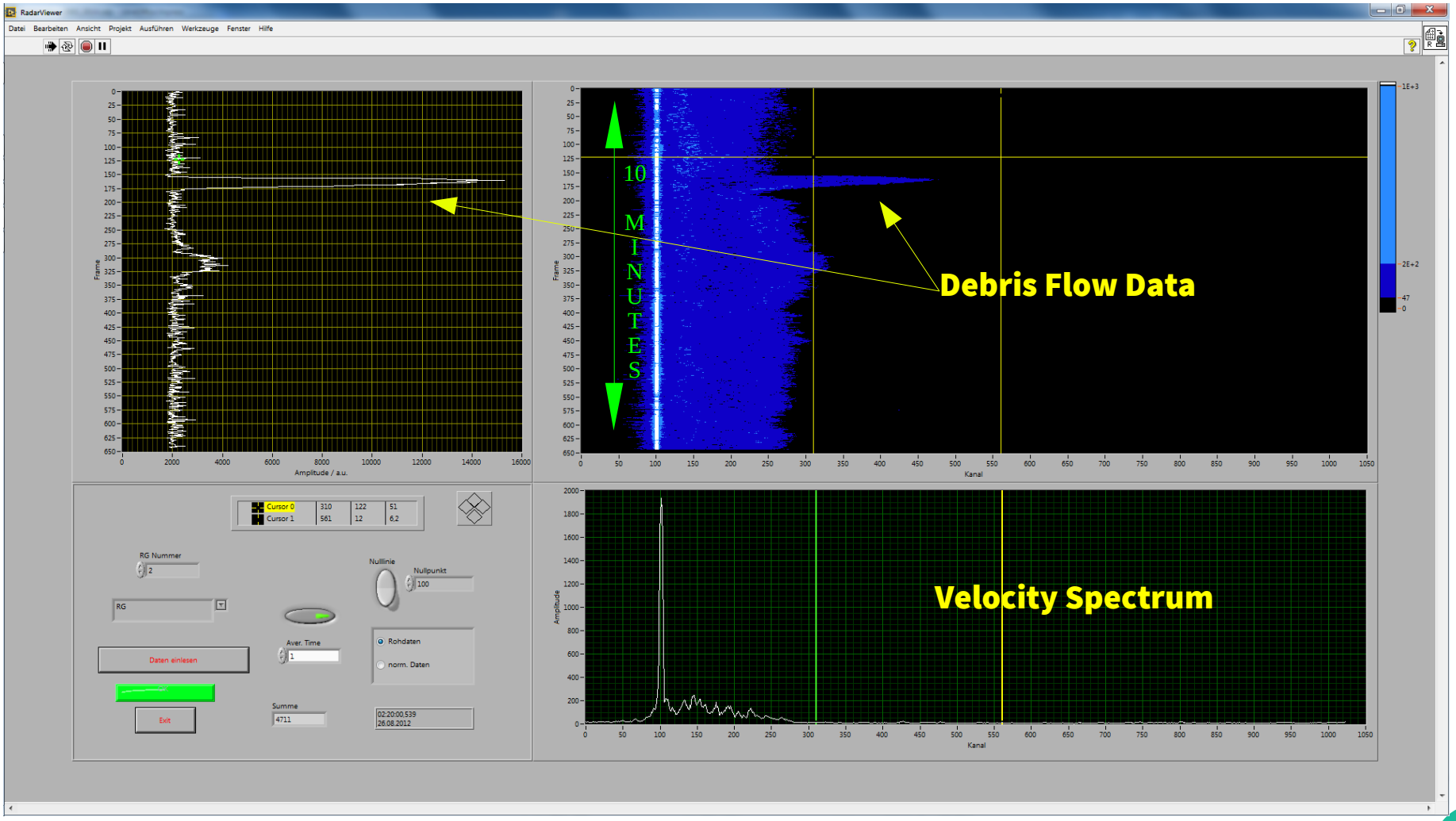
Debris Flow Lattenbach

Small Debris Flow Event from 26.08.2012 RG4



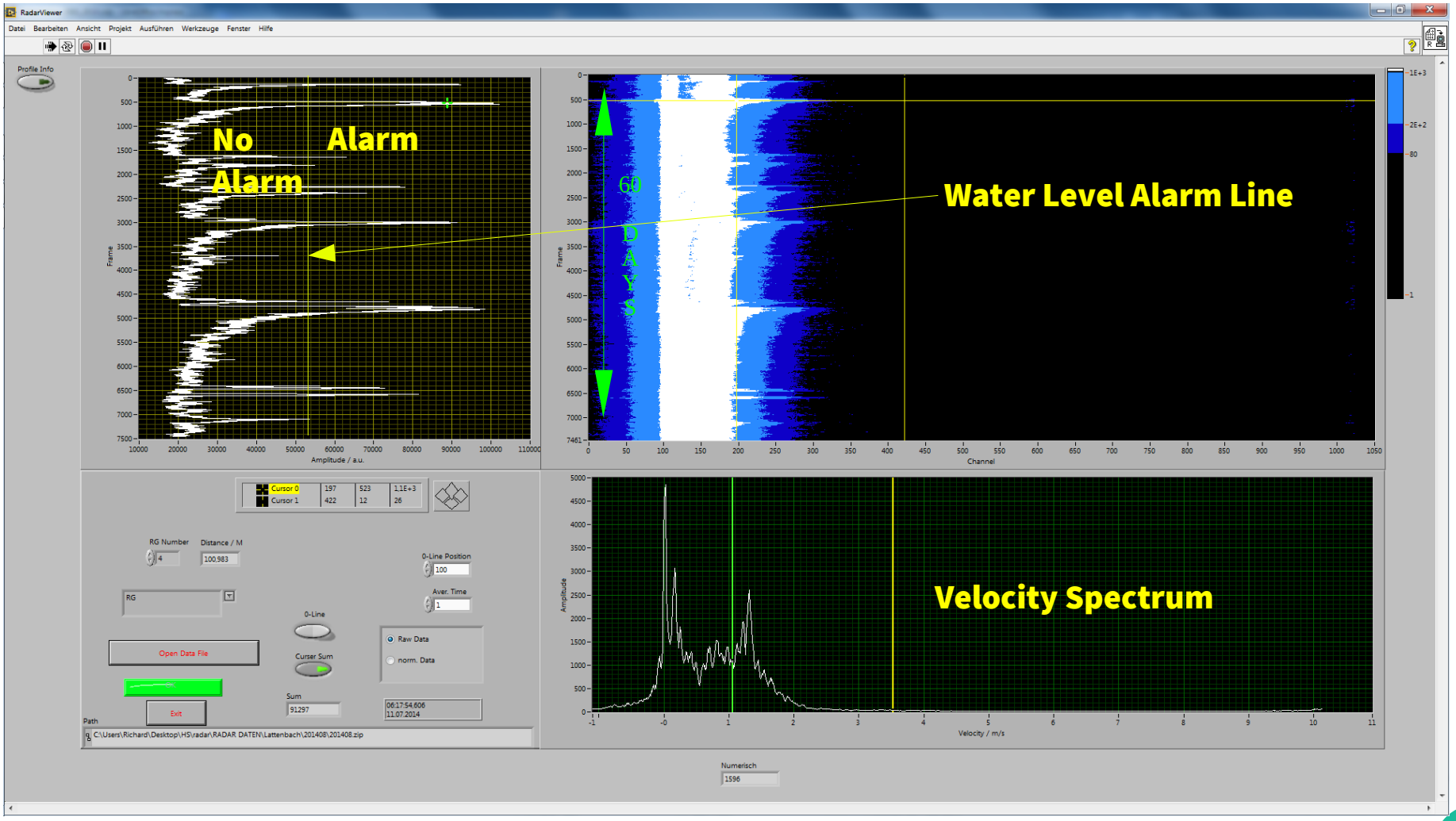
Debris Flow Lattenbach

Small Debris Flow Event from 26.08.2012 RG2



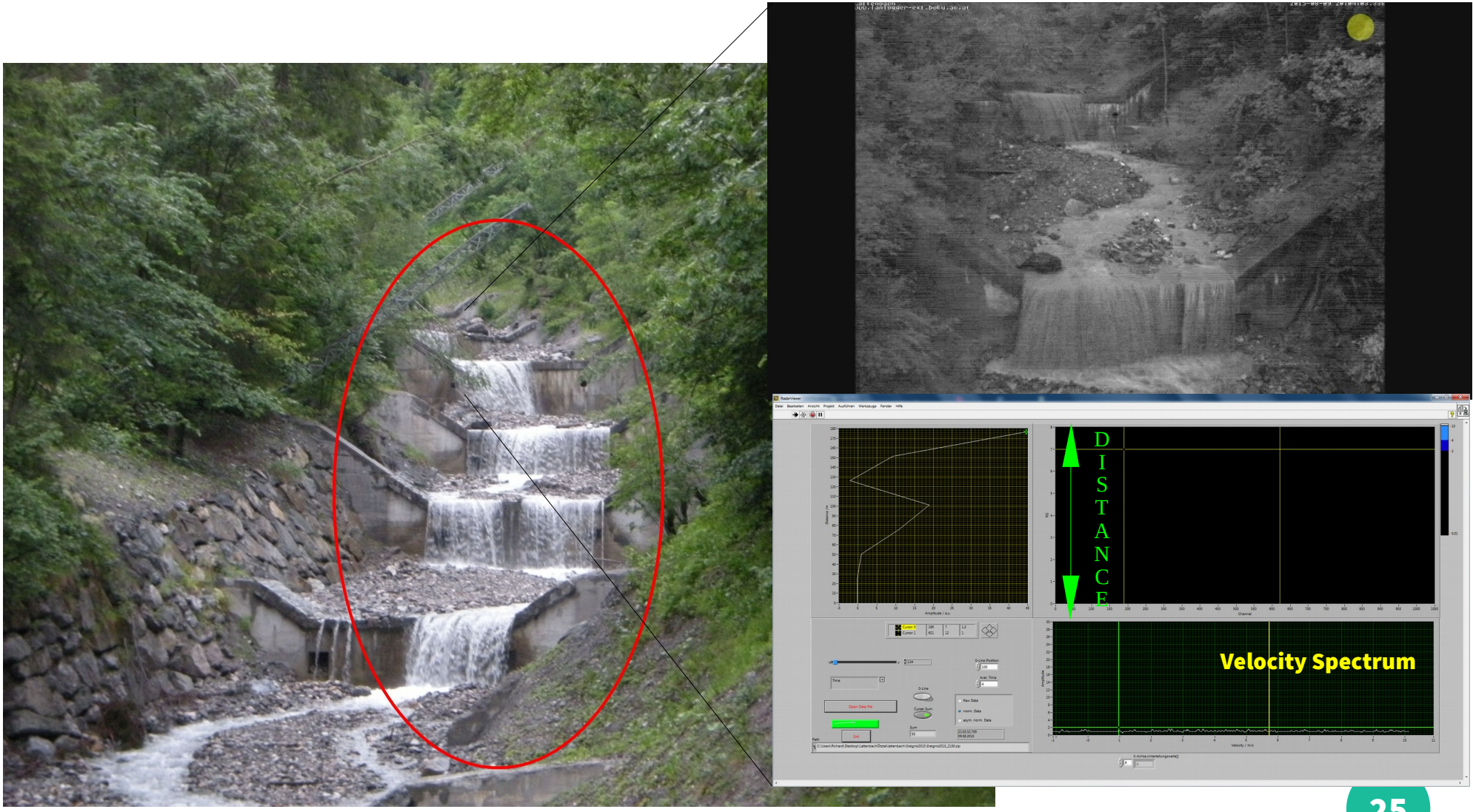
Debris Flow Lattenbach

Data: 2 months 07/08 2014



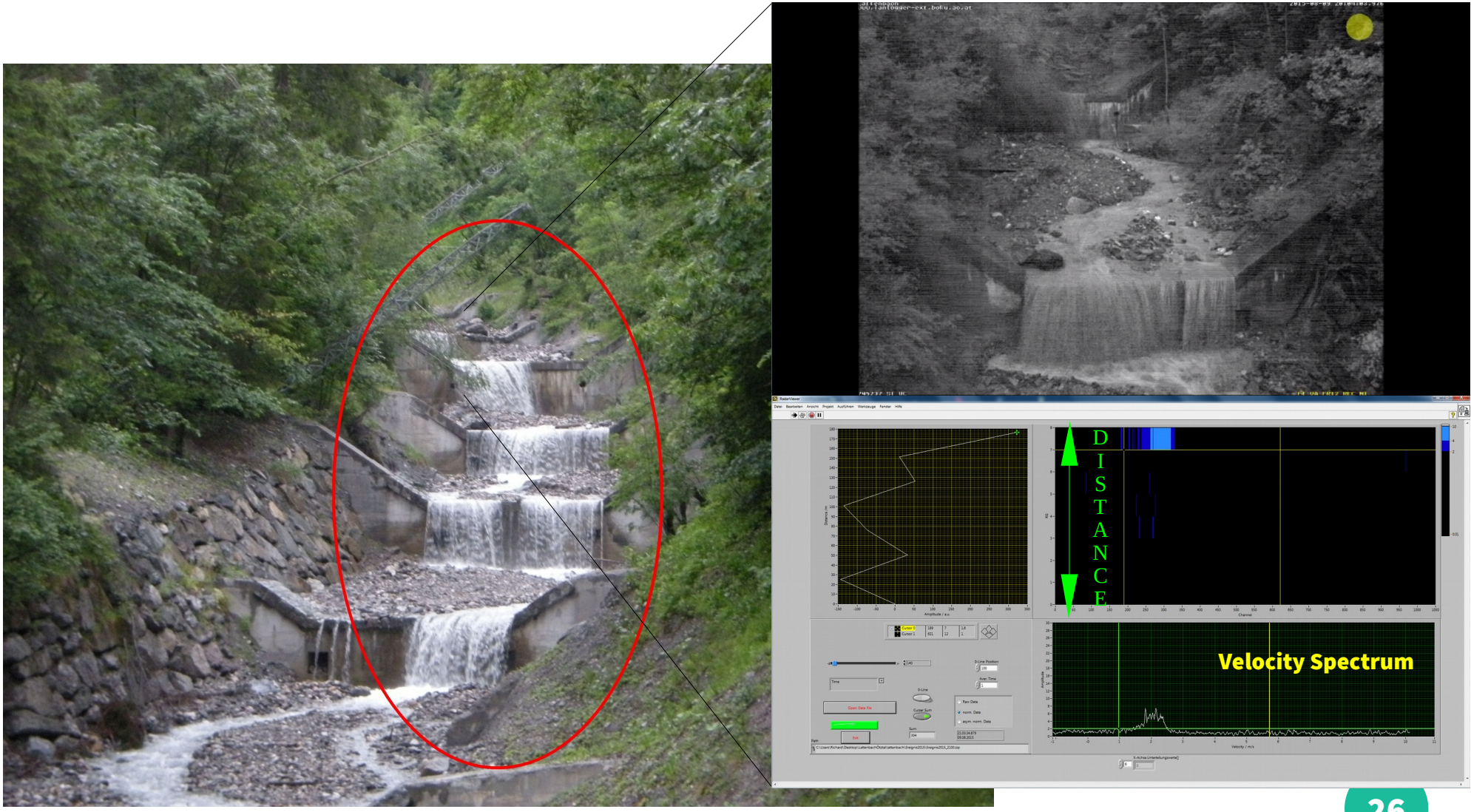
Debris Flow Lattenbach

Debris Flow Event from 09.08.2015 21:03



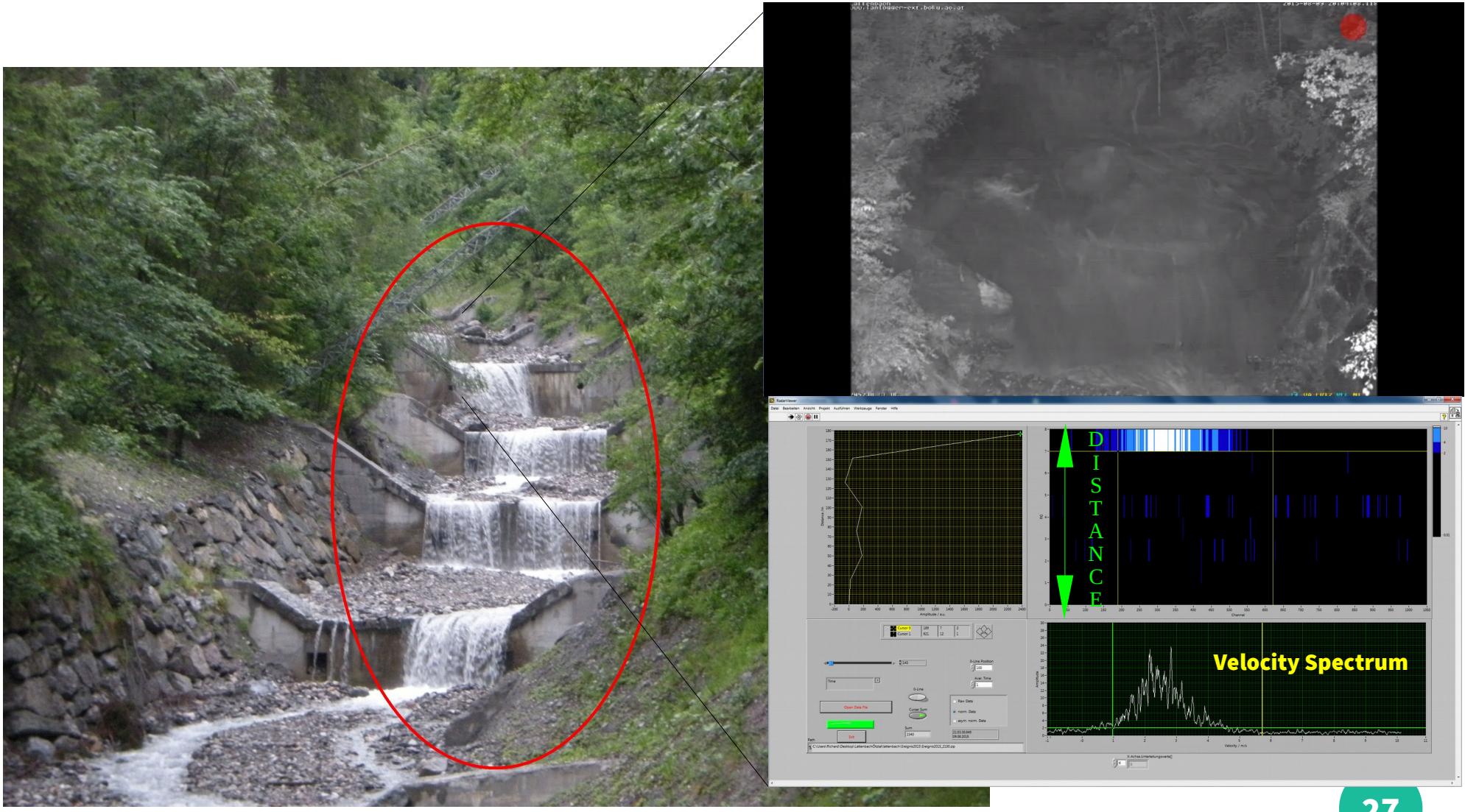
Debris Flow Lattenbach

Debris Flow Event from 09.08.2015 21:03



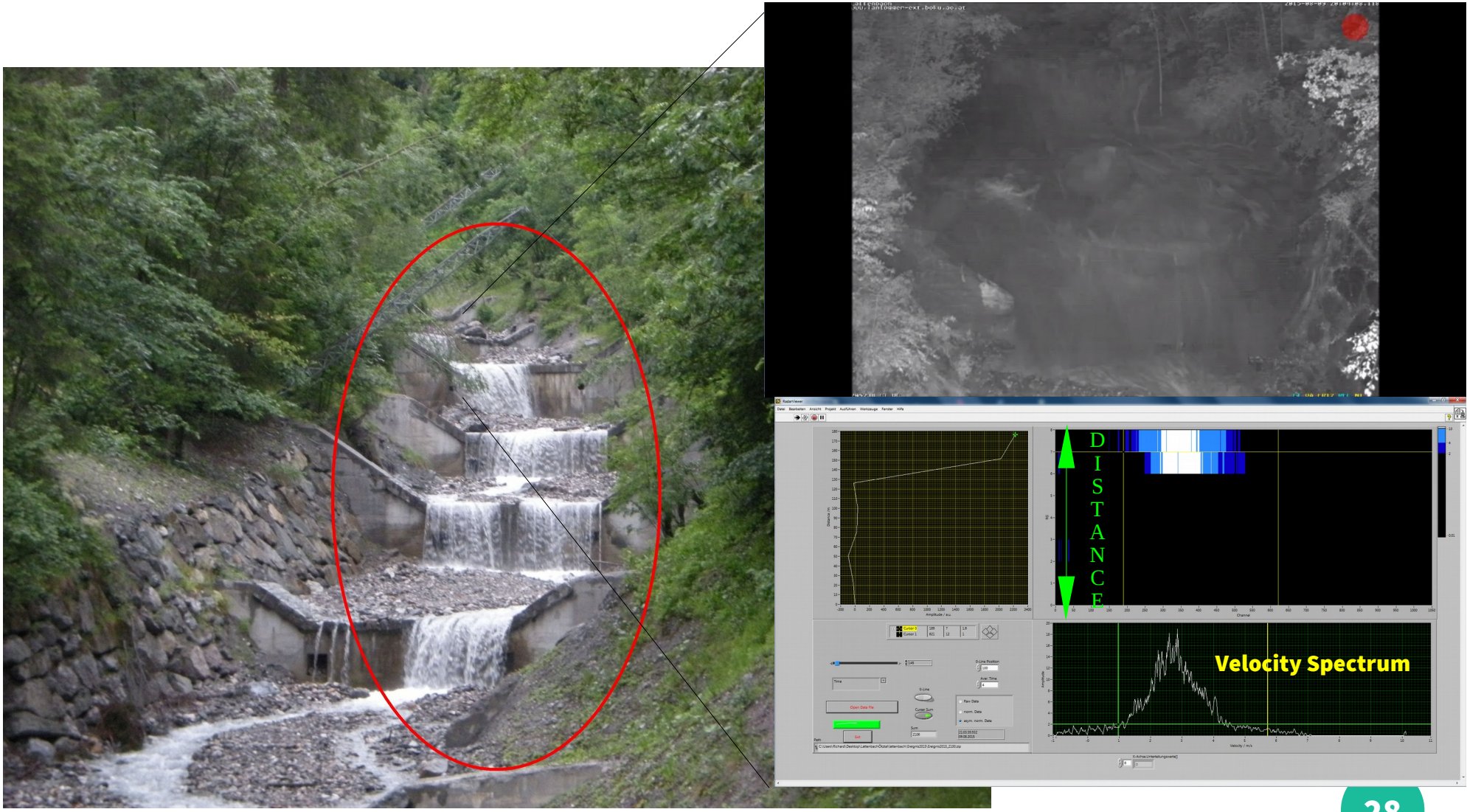
Debris Flow Lattenbach

Debris Flow Event from 09.08.2015 21:03



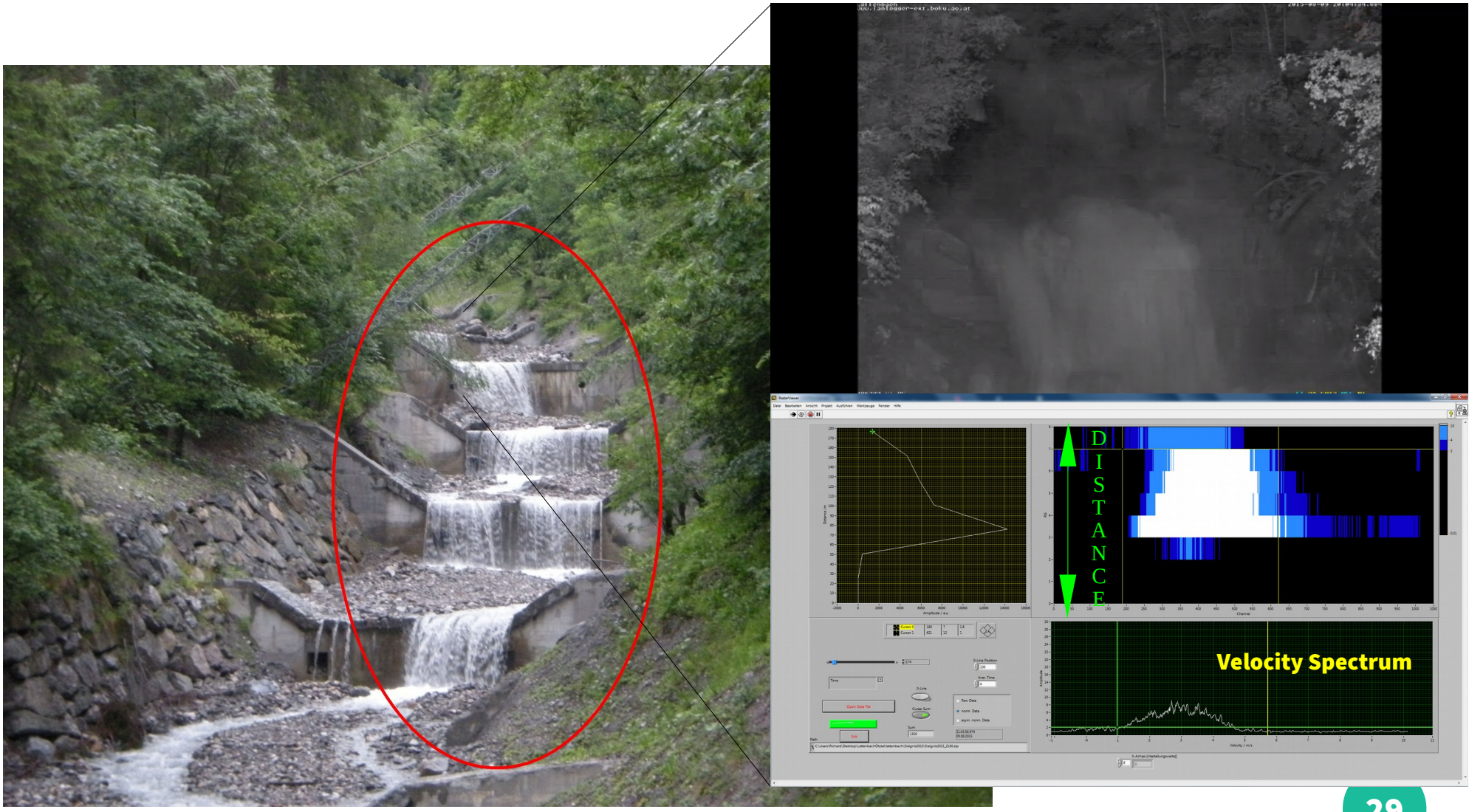
Debris Flow Lattenbach

Debris Flow Event from 09.08.2015 21:03



Debris Flow Lattenbach

Debris Flow Event from 09.08.2015 21:03

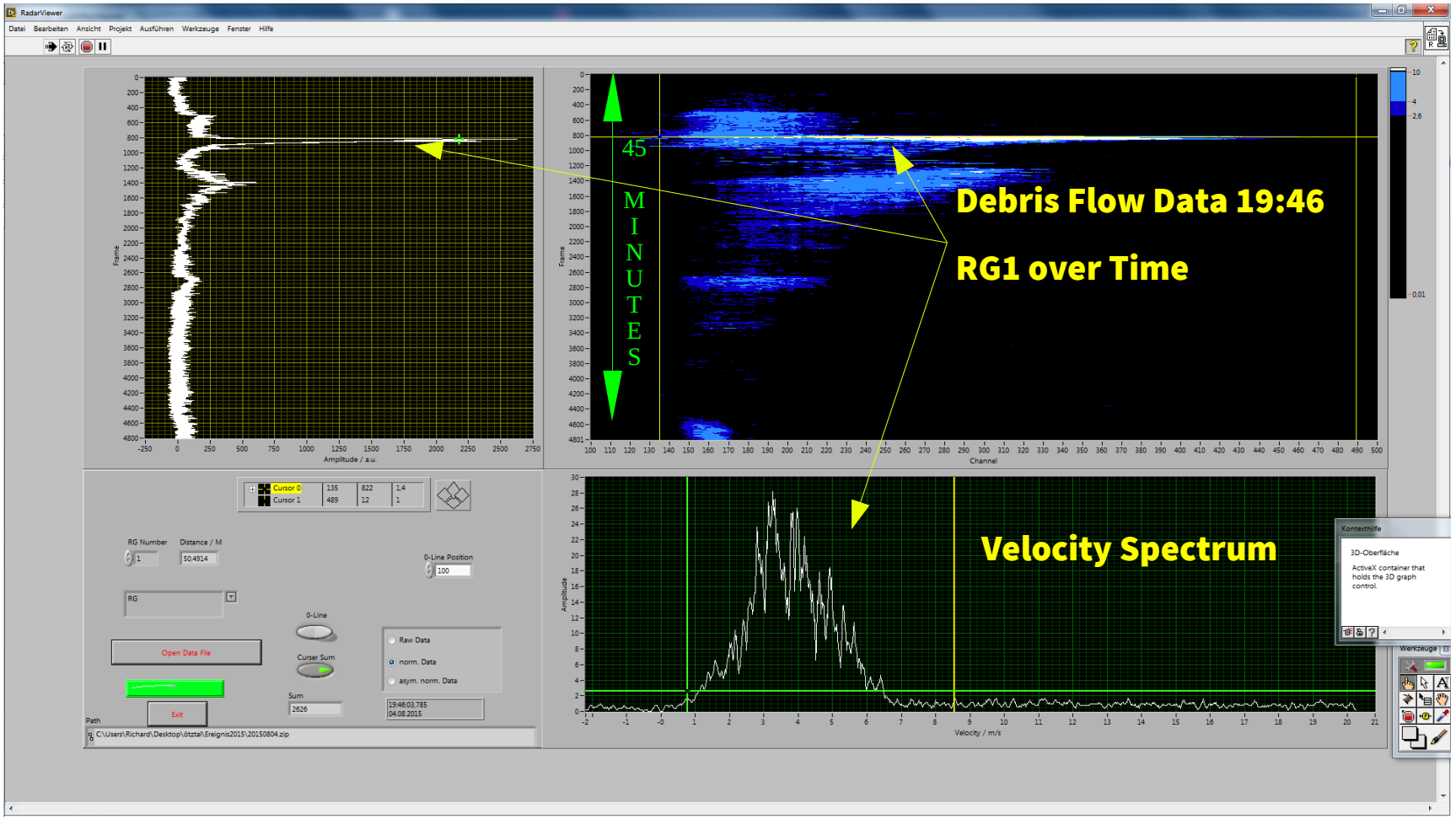


Debris Flow Umhausen

System Umhausen

Debris Flow Umhausen

System Umhausen RG1 04.08.2015



Debris Flow Umhausen

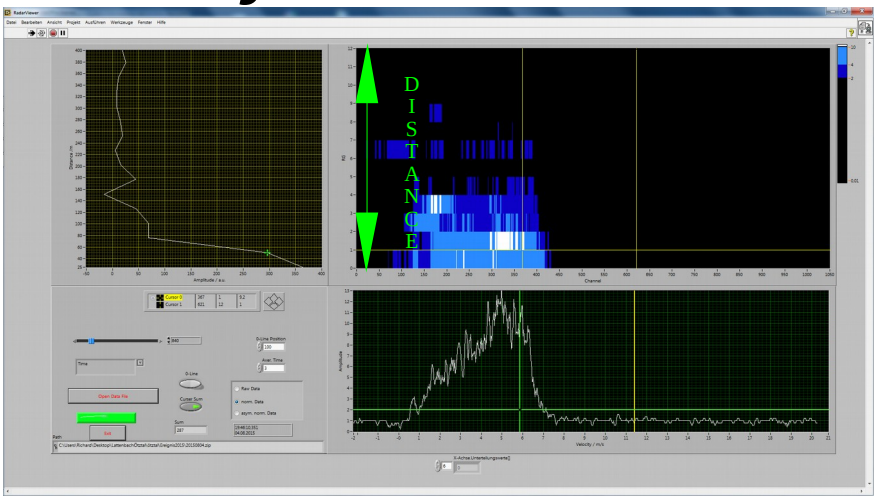
System Umhausen 04.08.2015 19:30

Debris Flow Umhausen

System Umhausen 04.08.2015 19:45

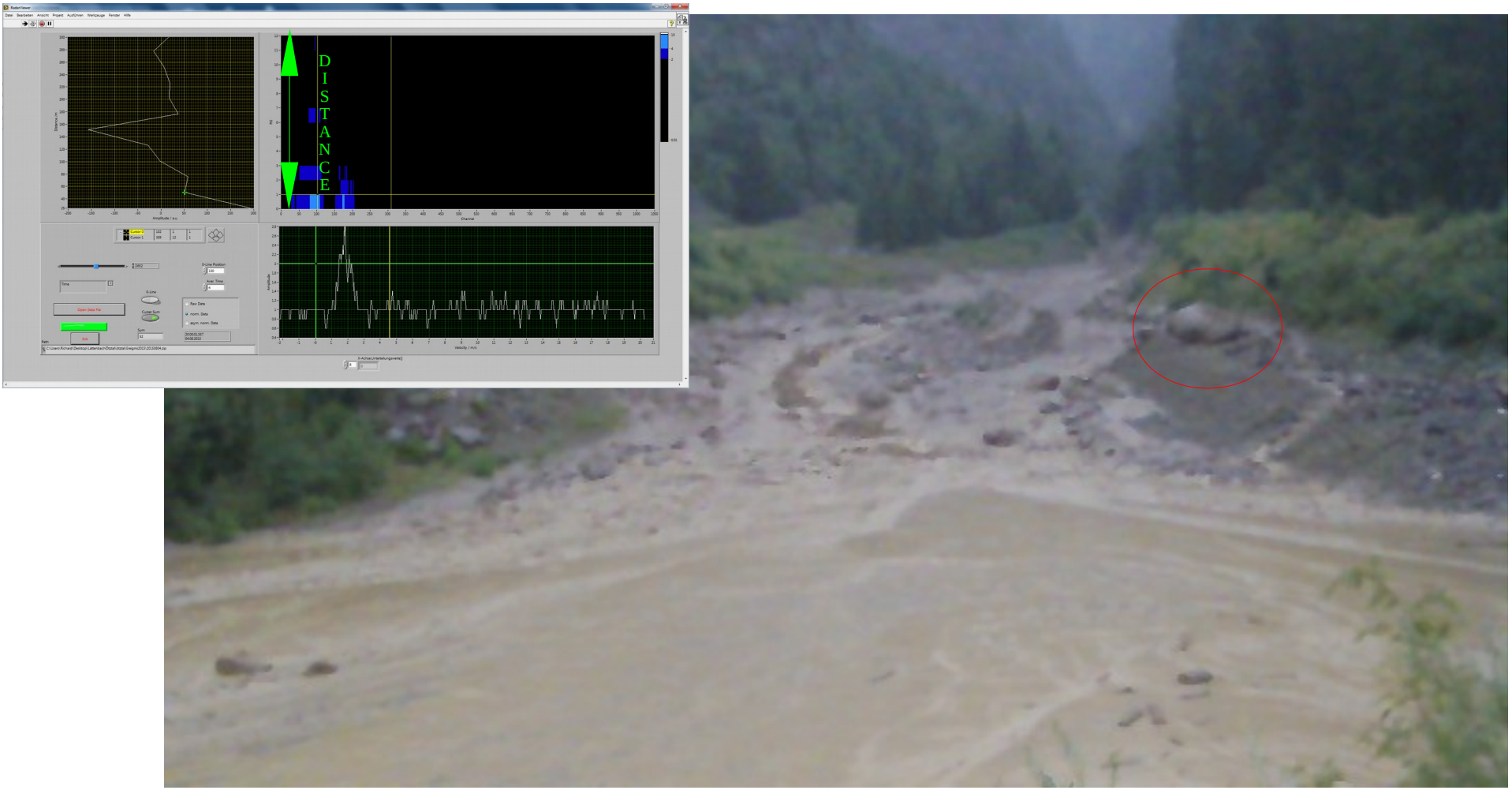
Debris Flow Umhausen

System Umhausen 04.08.2015 19:46



Debris Flow Umhausen

System Umhausen 04.08.2015 20:00

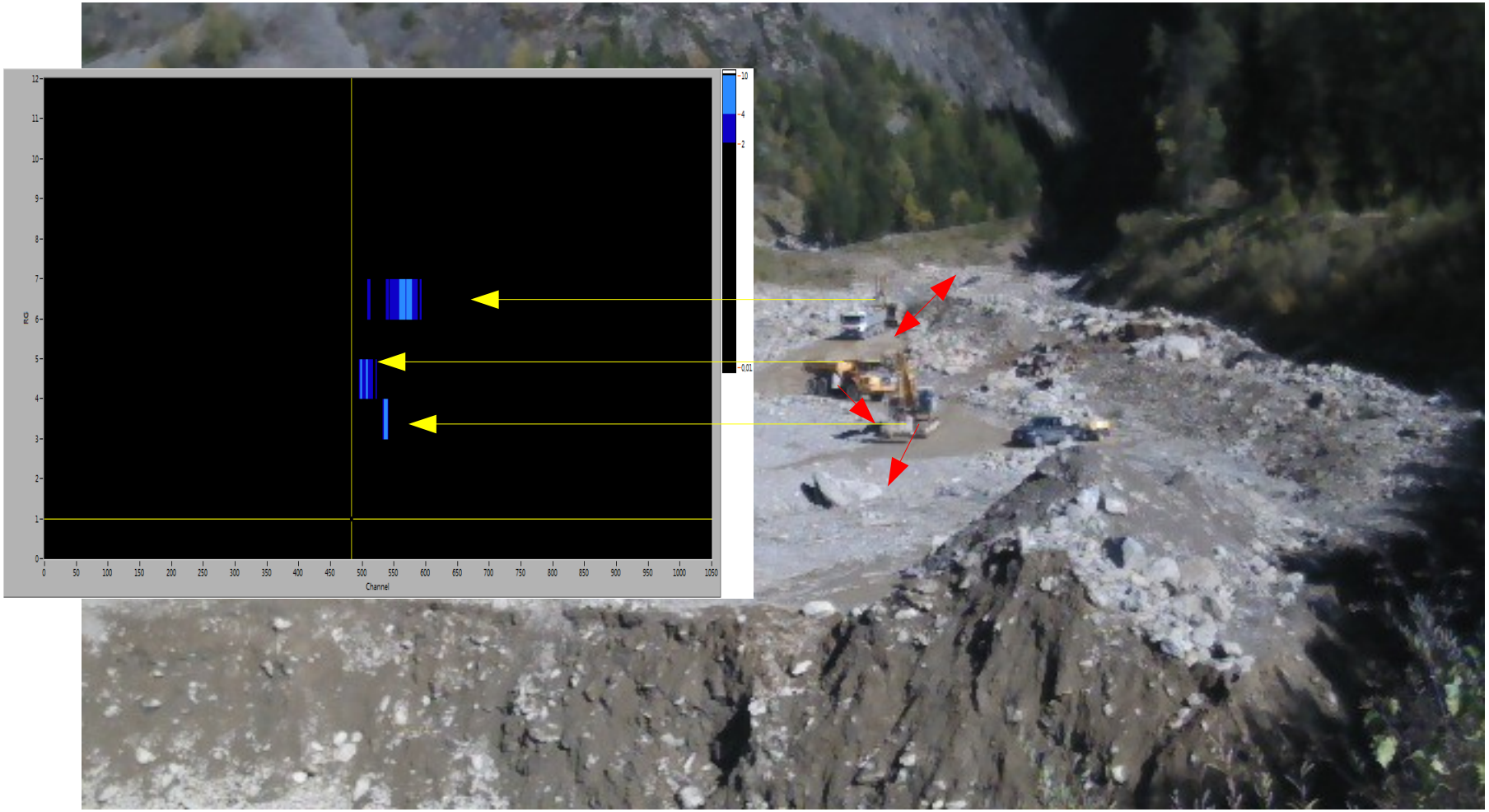


Debris Flow Umhausen

System Umhausen 04.08.2015 20:30

Debris Flow Umhausen

System Umhausen Moving Objects



Avalanche Detection Radar

Debris Flow Detection Rate for installed Radar Systems:

Place of Radar	Years of operation	Alarm and Debris Flow	False Alarm	No Alarm Debris Flow
Lattenbach	2012-	4	0	0
Umhausen	2014-	2	0	0
Dongchuan	2015-	0	0	1*

*...system defect after lightning

Conclusion

- We are able to detect reliable even smallest debris flows and avalanches
- We are able to detect very accurate water levels
- We are able to trigger an alarming system within a second
- We are also able to detect heavy rainfalls up in the sky

Development this year

- **Rain Radar**
- **Remote Motor Antenna**

Thank You

Thank You