

Five years use of Pulse Doppler RADAR- technology in debris-flow monitoring in comparison with other well established technologies.

Richard Koschuch¹, Michael Brauner², Kaiheng Hu³ and Johannes Hübl⁴

¹ **IBTP Koschuch e.U.**, Langegg 31, 8463, Leutschach, Austria

² **ÖBB-Infrastruktur AG**, Praterstern 3, 1020, Vienna, Austria

³ **Institute of Mountain Hazards and Environment**, Chinese Academy of Sciences Chengdu, 610041, China;

⁴ **Institute of Mountain Risk Engineering**, Department of Civil Engineering and Natural Hazards, University of Natural Resources and Life Sciences (BOKU), Peter Jordanstraße 82, 1190, Vienna, Austria

DI Dr. techn. Koschuch Richard

IBTP Koschuch e.U.
Langegg 31
A-8463 Glanz an der Weinstraße
+ 43 / 699 18448542
office@ibtp-koschuch.com
www.ibtp-koschuch.com

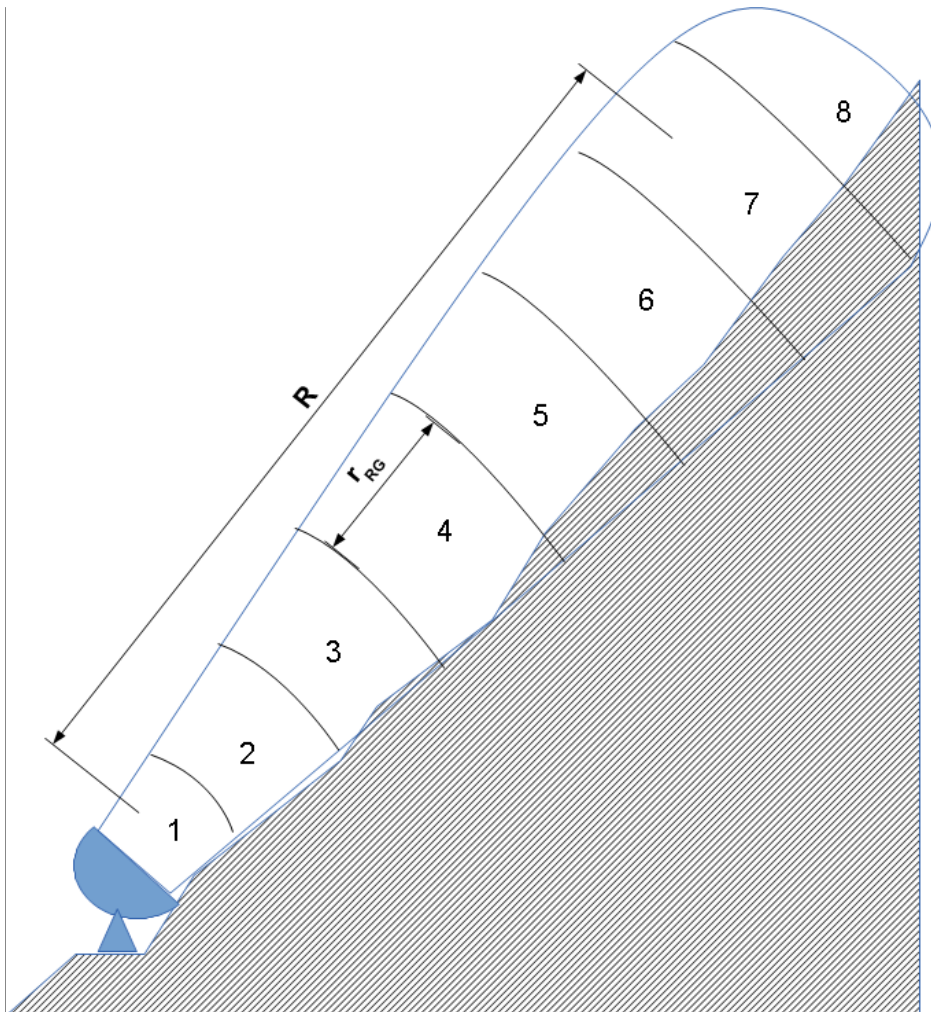


Umhausen

System Umhausen/ Tirol/ Austria



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), an alarming trigger is activated.**

Technology and Benefits of the System

- Reliable recognition of avalanches and mudslides
 - **Minimization of false alerts**
- Recognition of risk in real time
 - **Maximum warning**
- Multifunctional measuring and alert system
 - **Water level**
 - **Debris flow/flood**
 - **Heavy rainfall**
 - **Snow avalanche**
- Low installation requirements
 - **Only a mast and a power supply of 40 W**

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	m ²
	0,25	min > at 1km	m ²
Velocity	0,2-100	min/max	m/s
RG	128	max	
RG-length	15-250	min/max	m

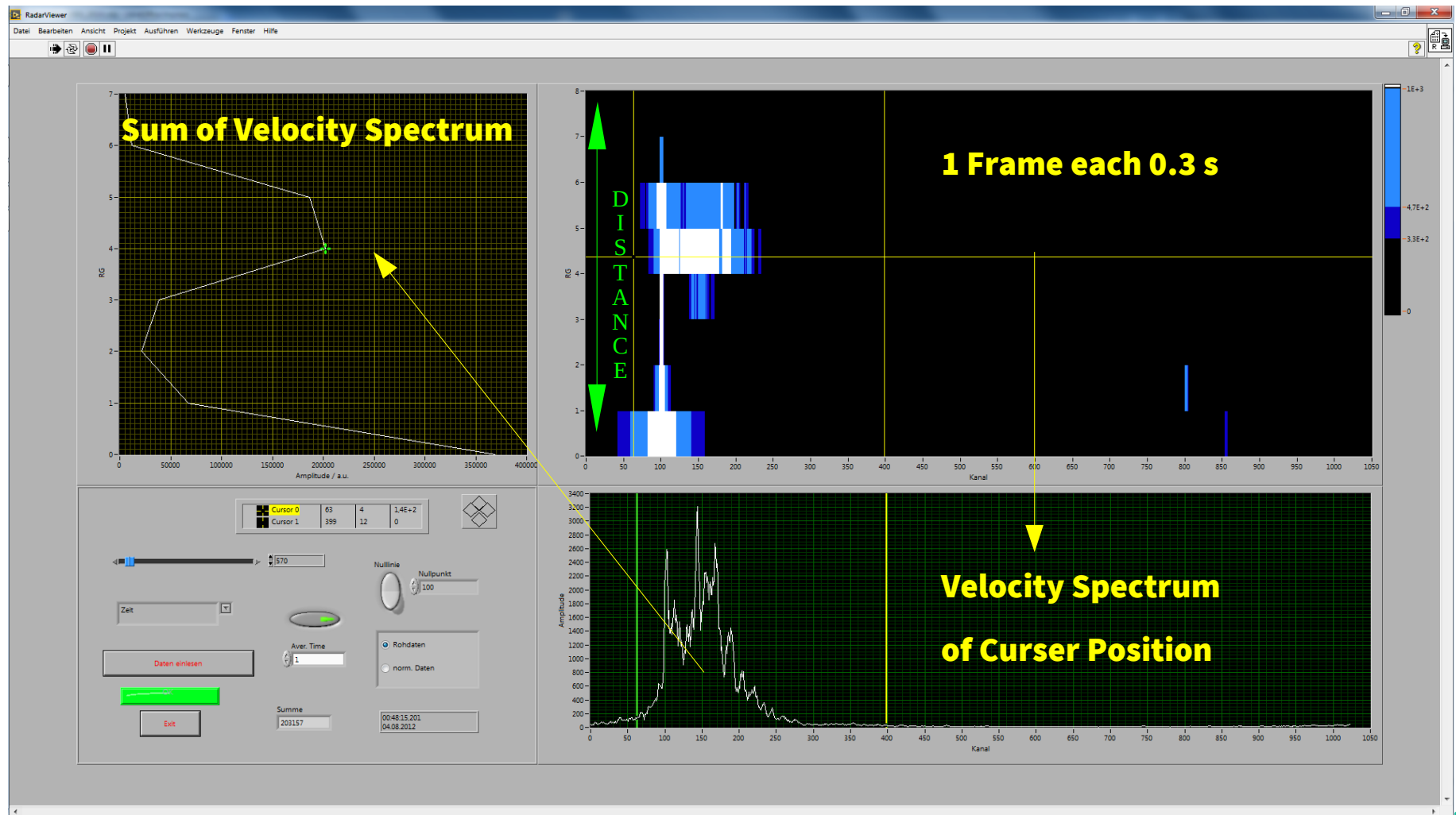
Lattenbach

View



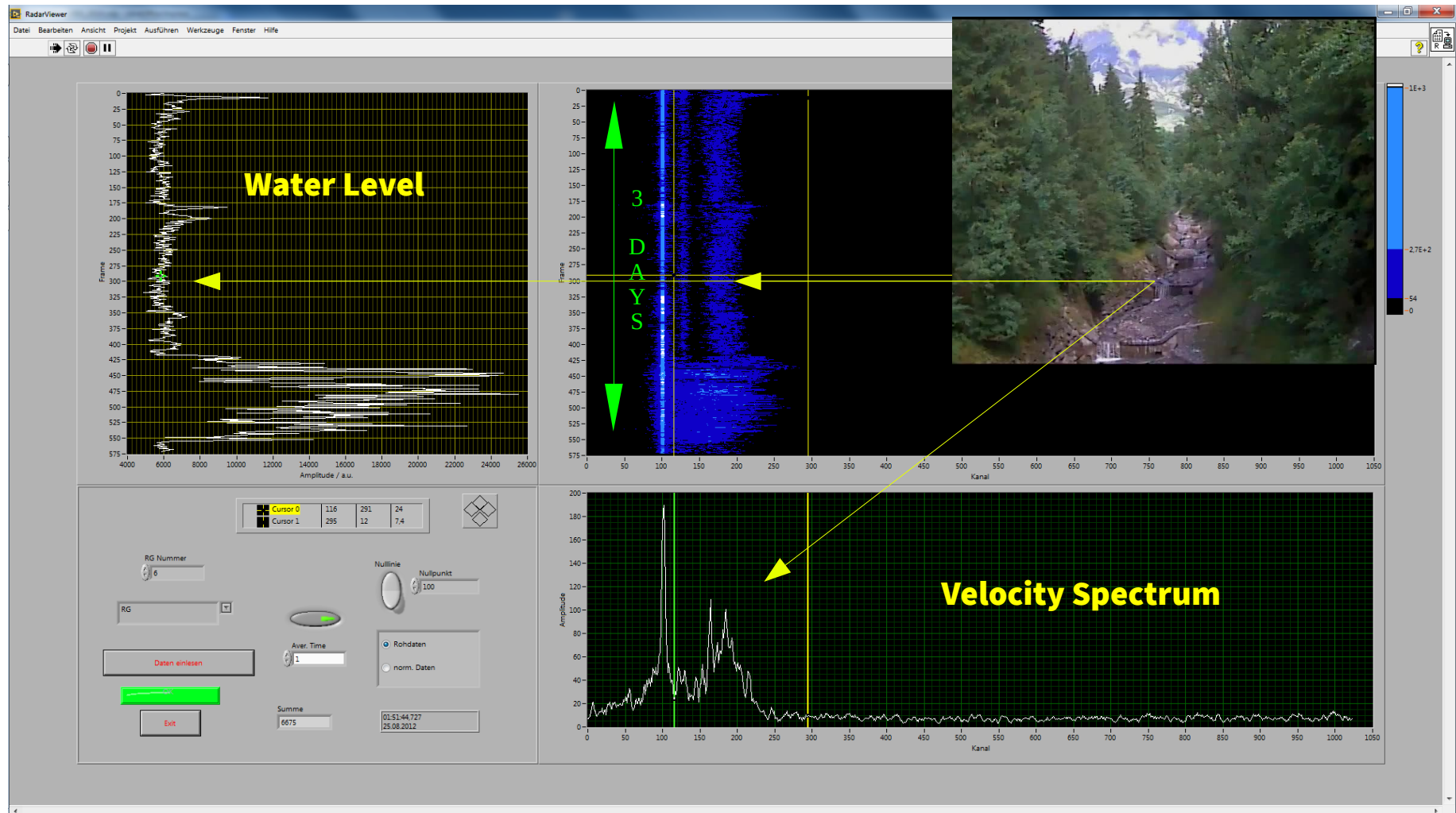
Example Data Lattenbach

Data Analysis 23-26.08.2012: Example Data Frame



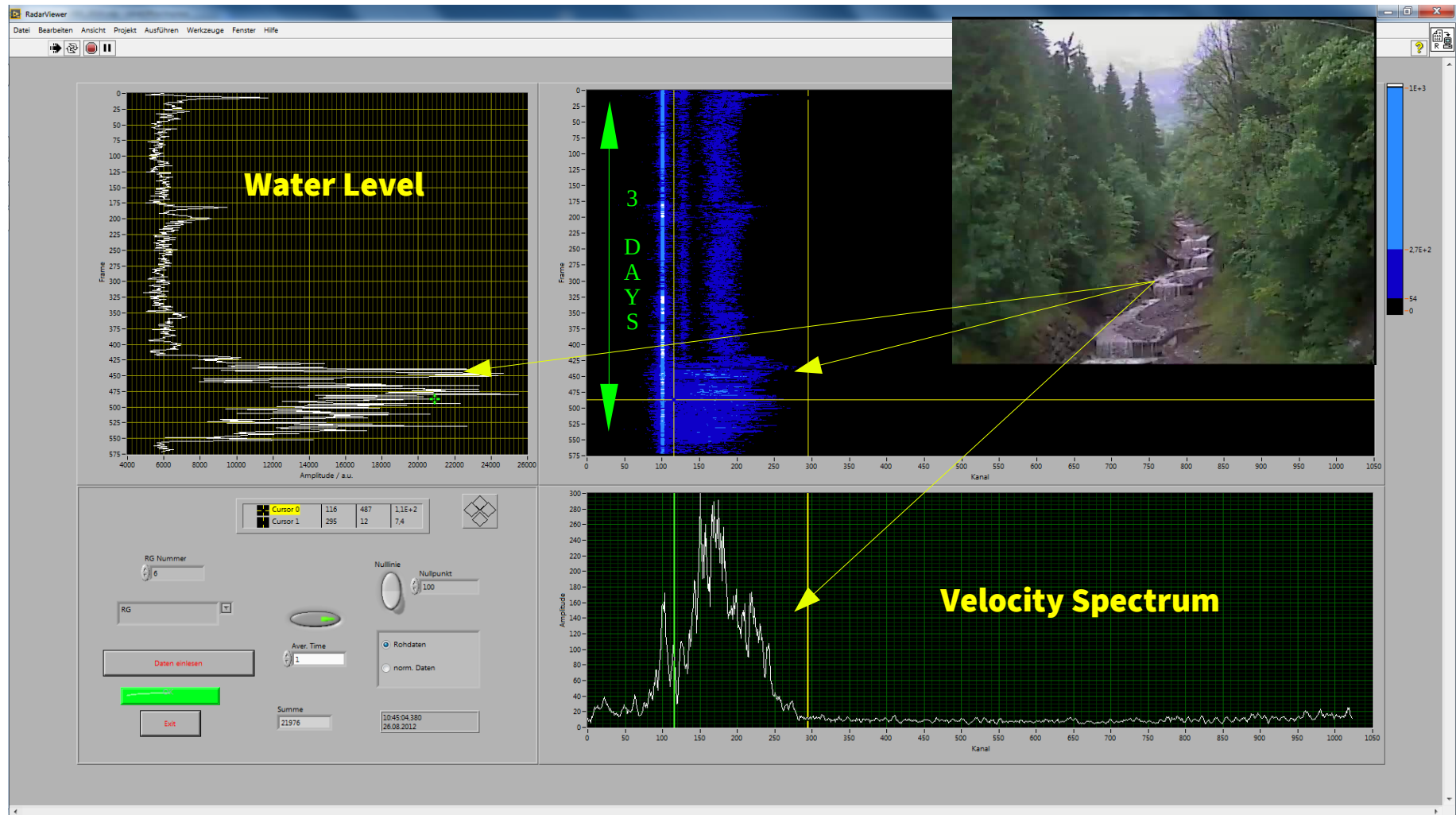
Water Level Lattenbach

Data Analysis 23-26.08.2012: RG 6 Low Water Level



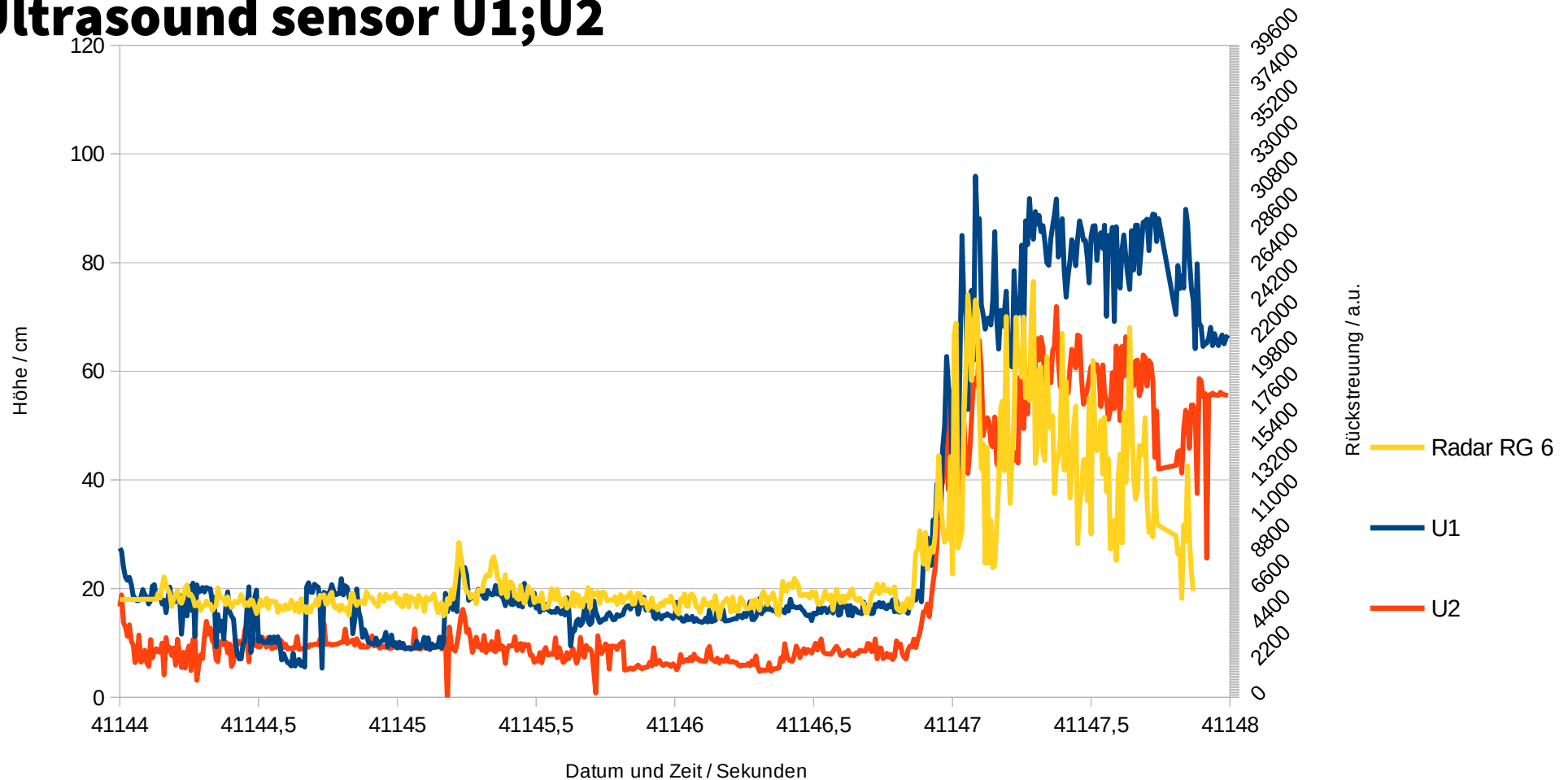
Water Level Lattenbach

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



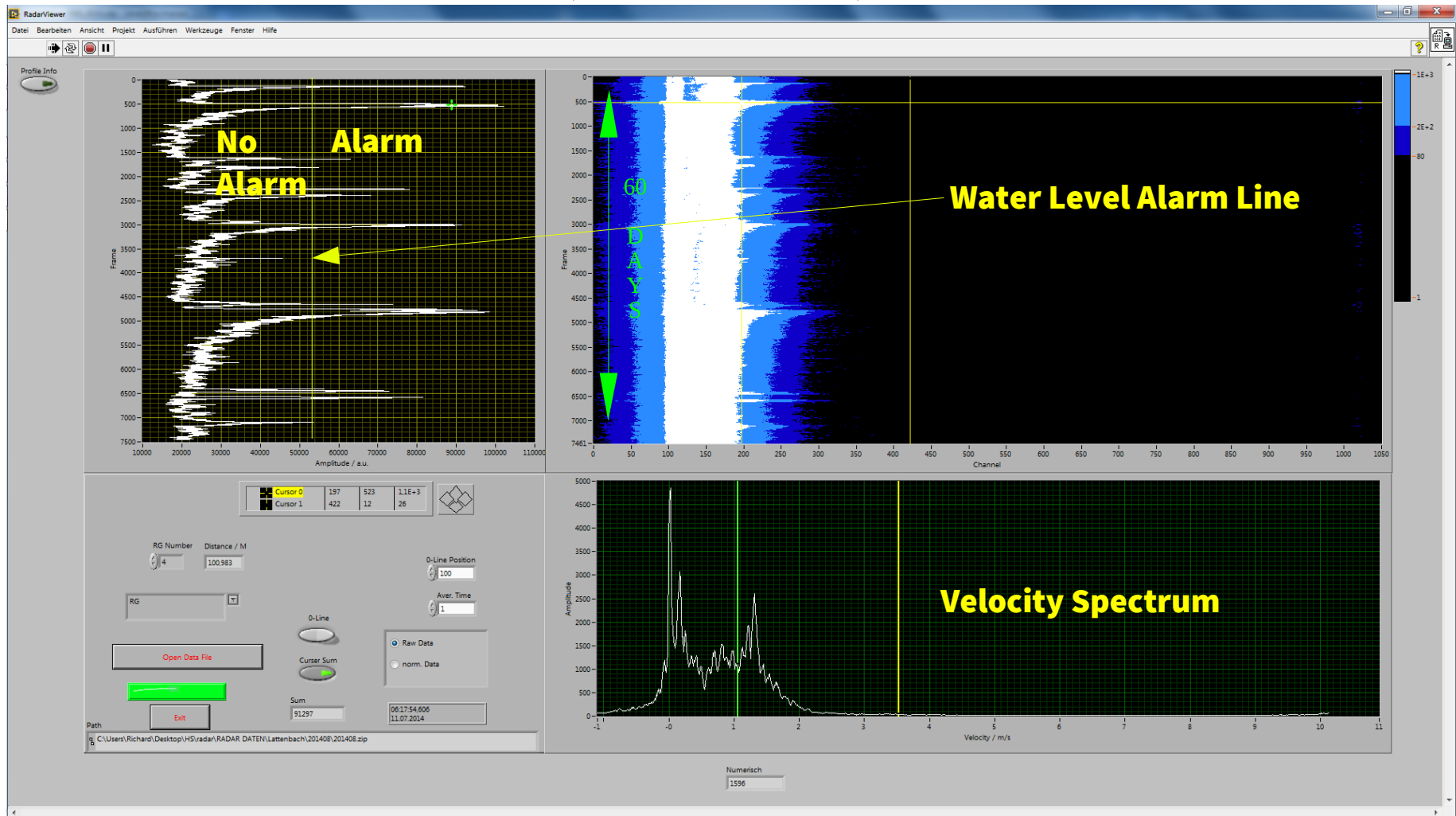
Water Level Lattenbach

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



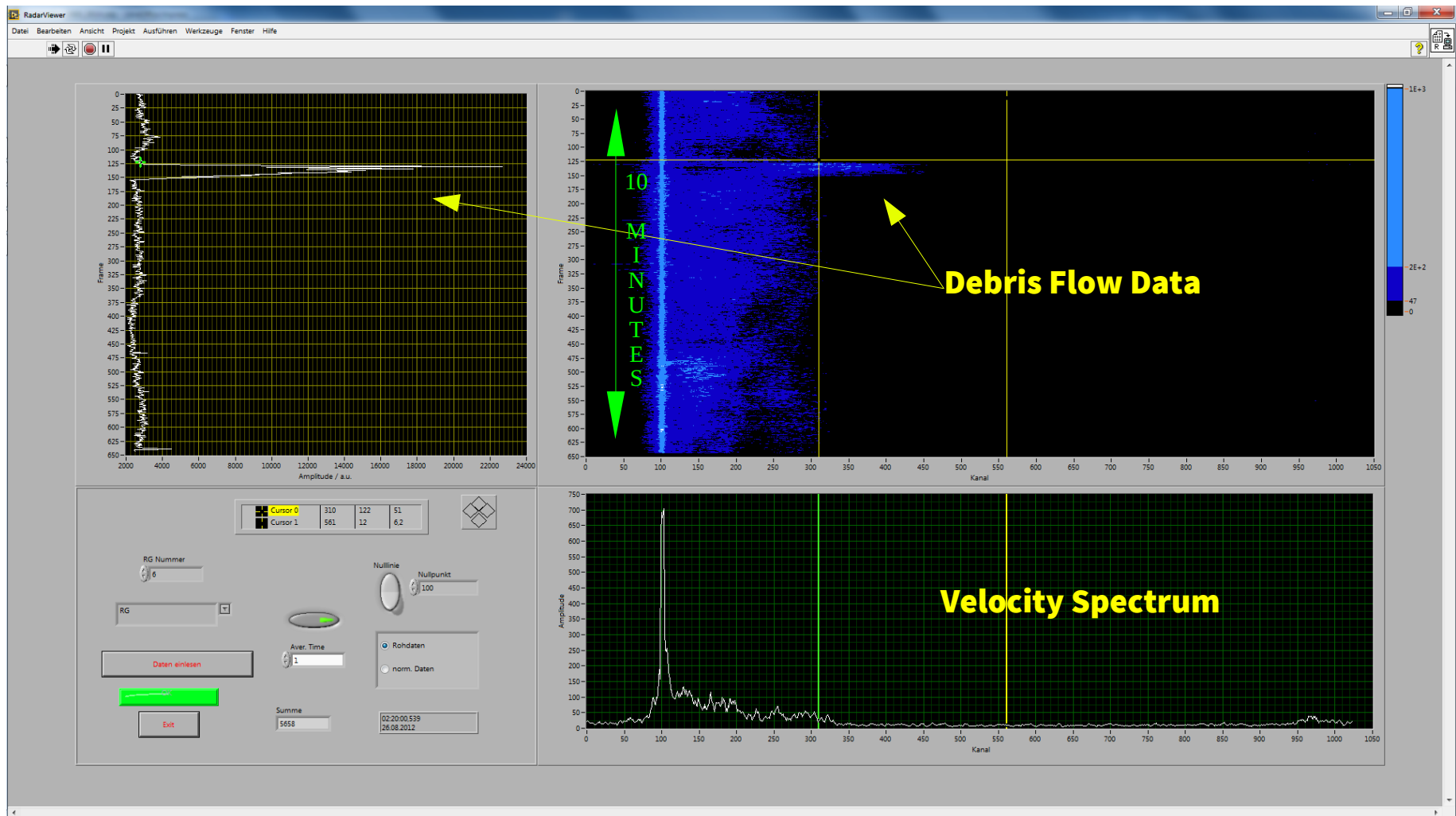
Water Level Lattenbach

Data of RG 4 : 2 months (07/08 2014)



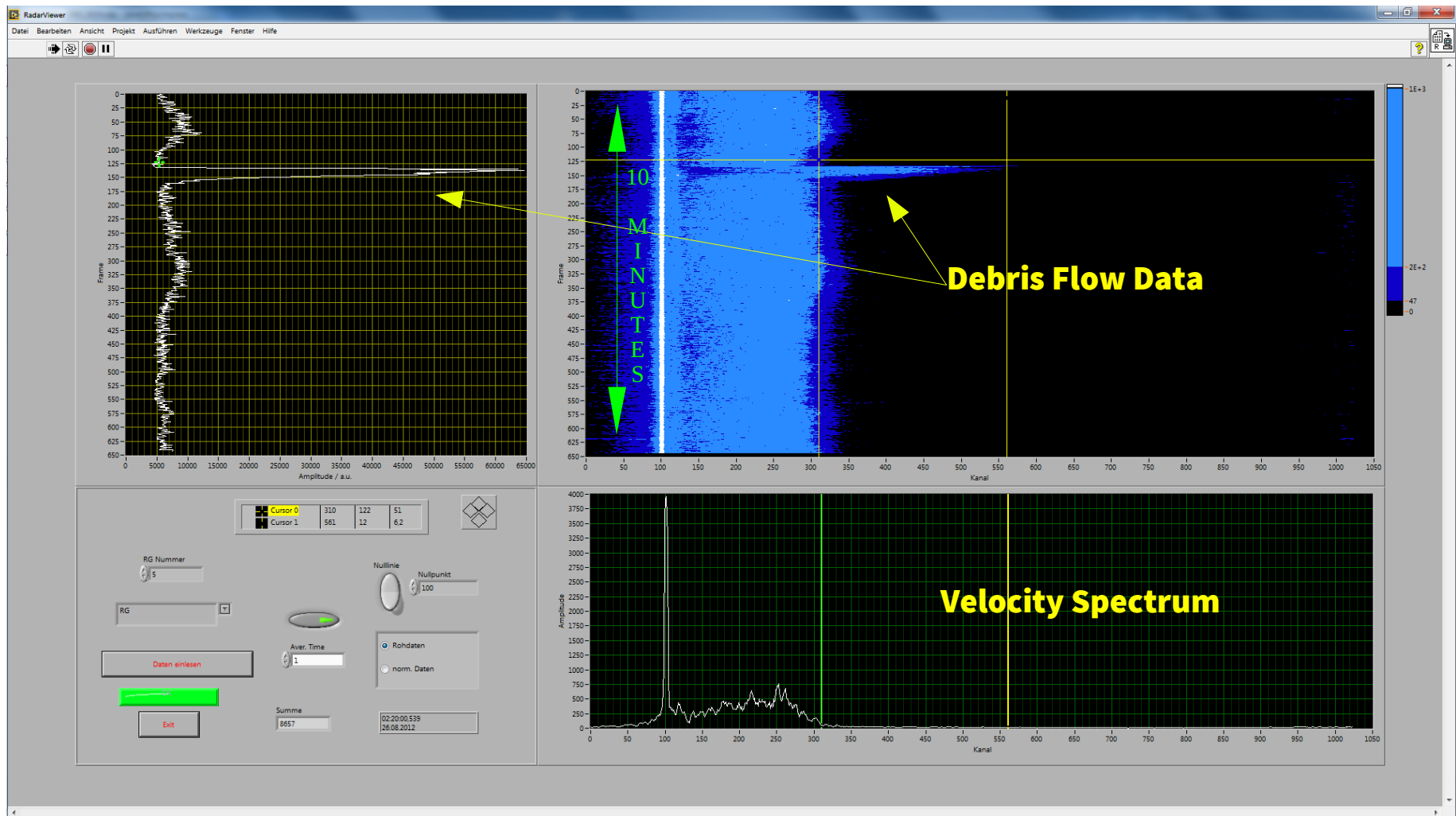
Debris Flow Lattenbach

Small Debris Flow Event from 26.08.2012 RG6



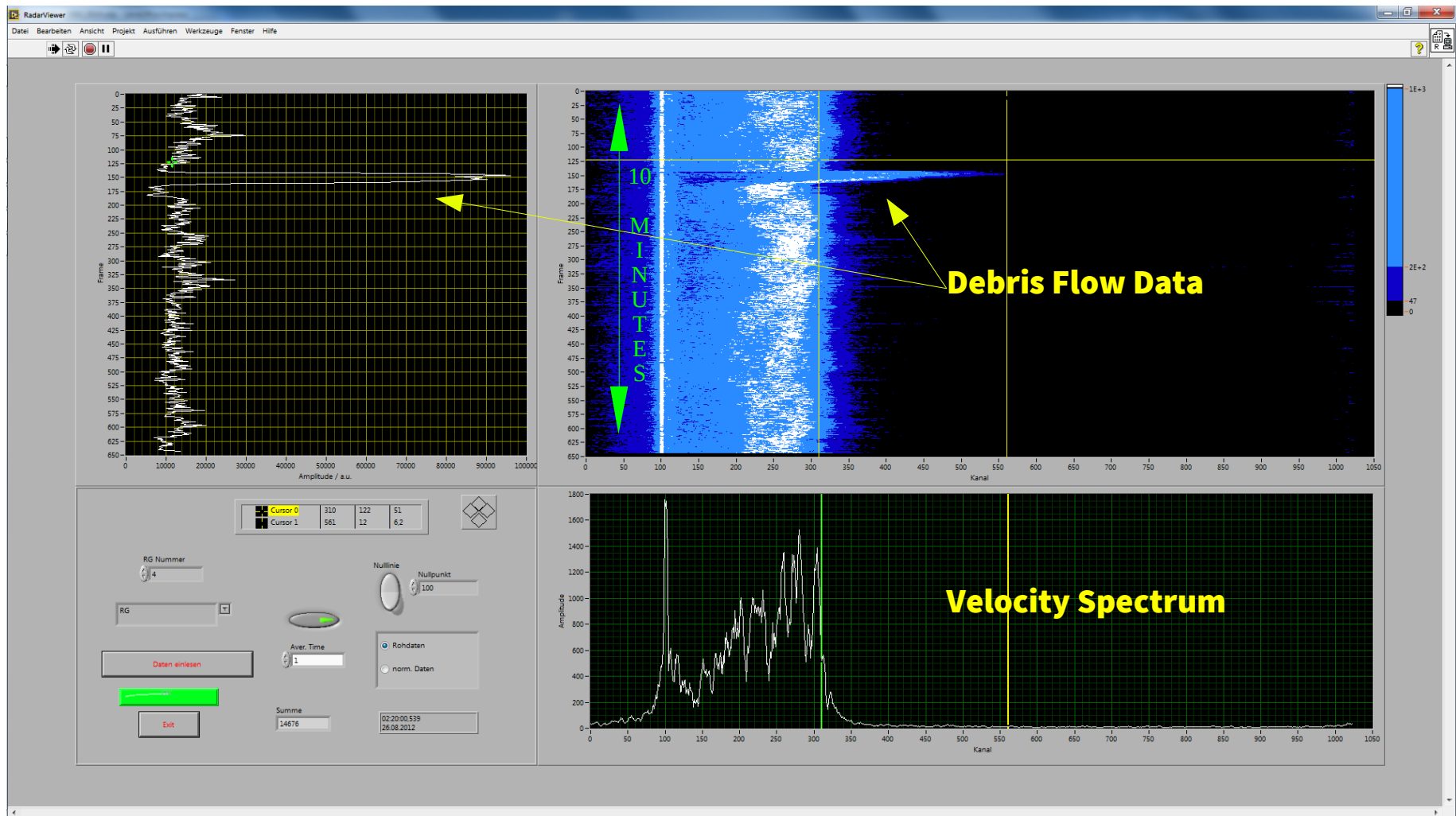
Debris Flow Lattenbach

Small Debris Flow Event from 26.08.2012 RG5



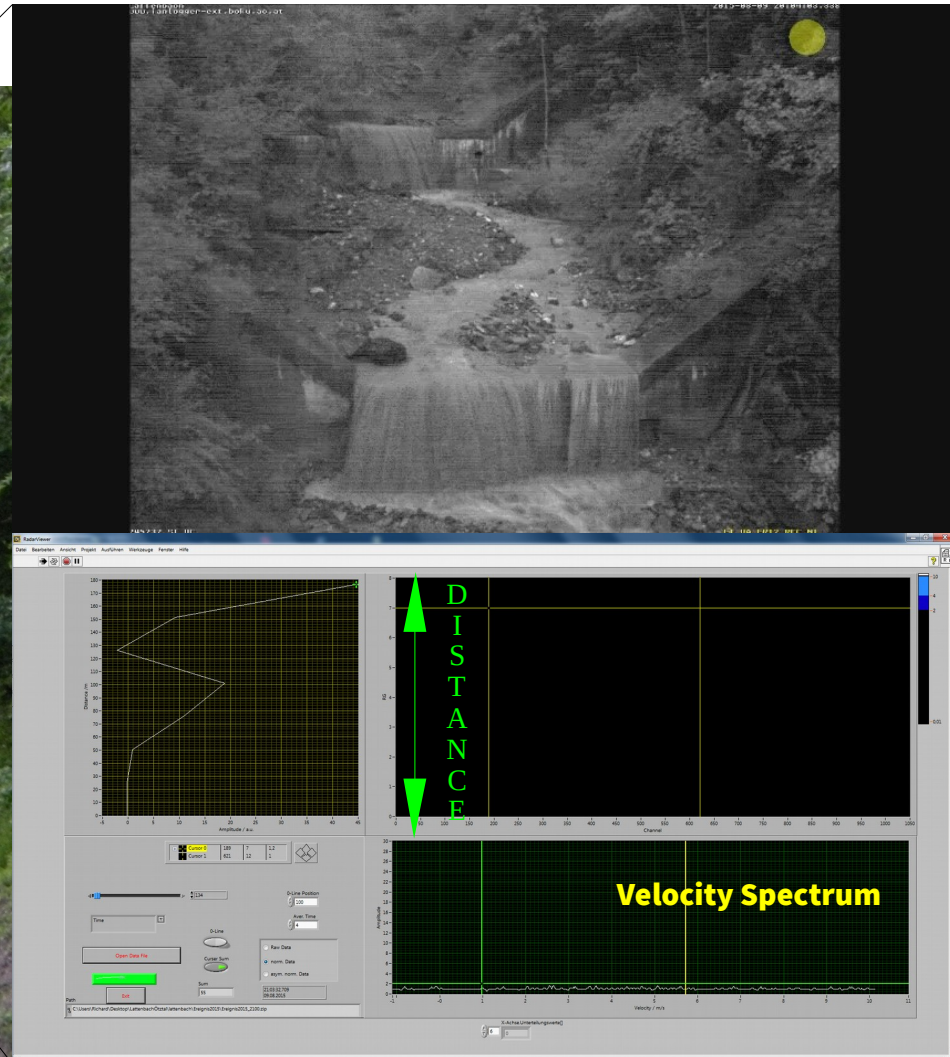
Debris Flow Lattenbach

Small Debris Flow Event from 26.08.2012 RG4



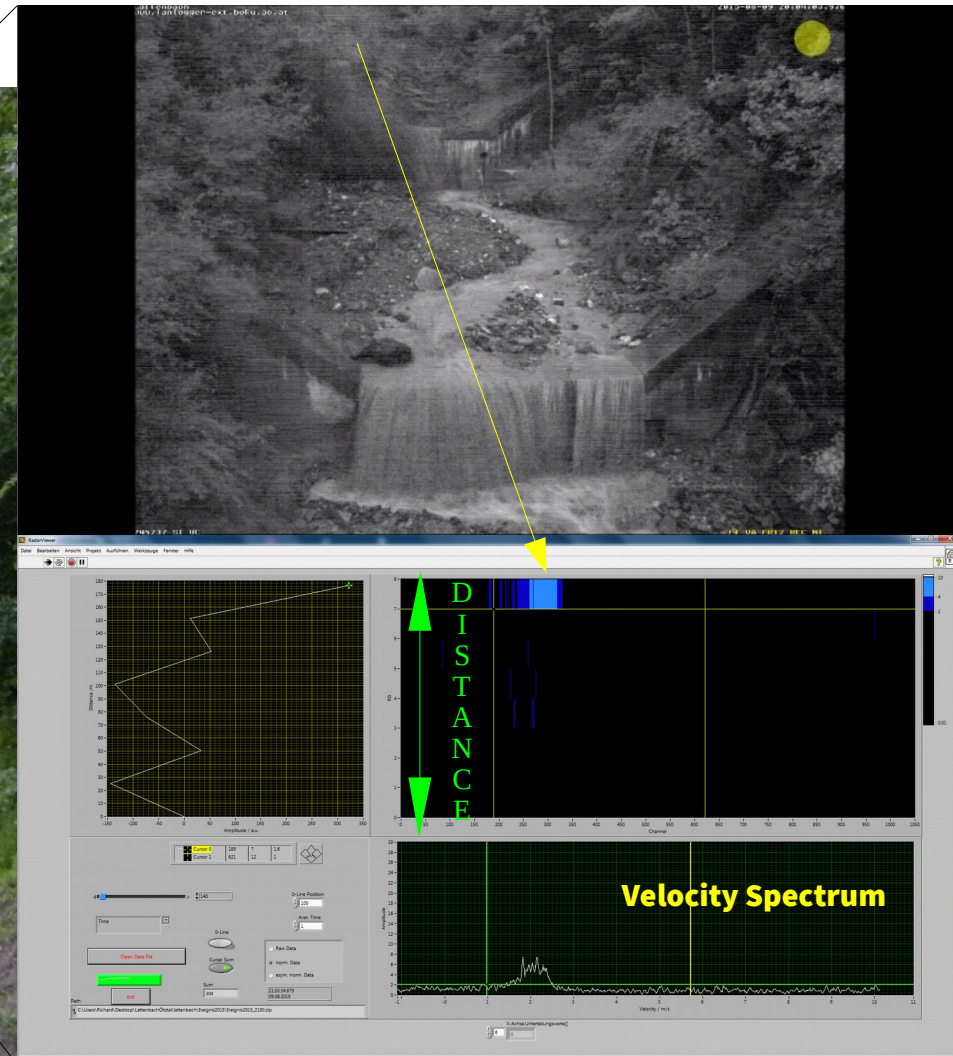
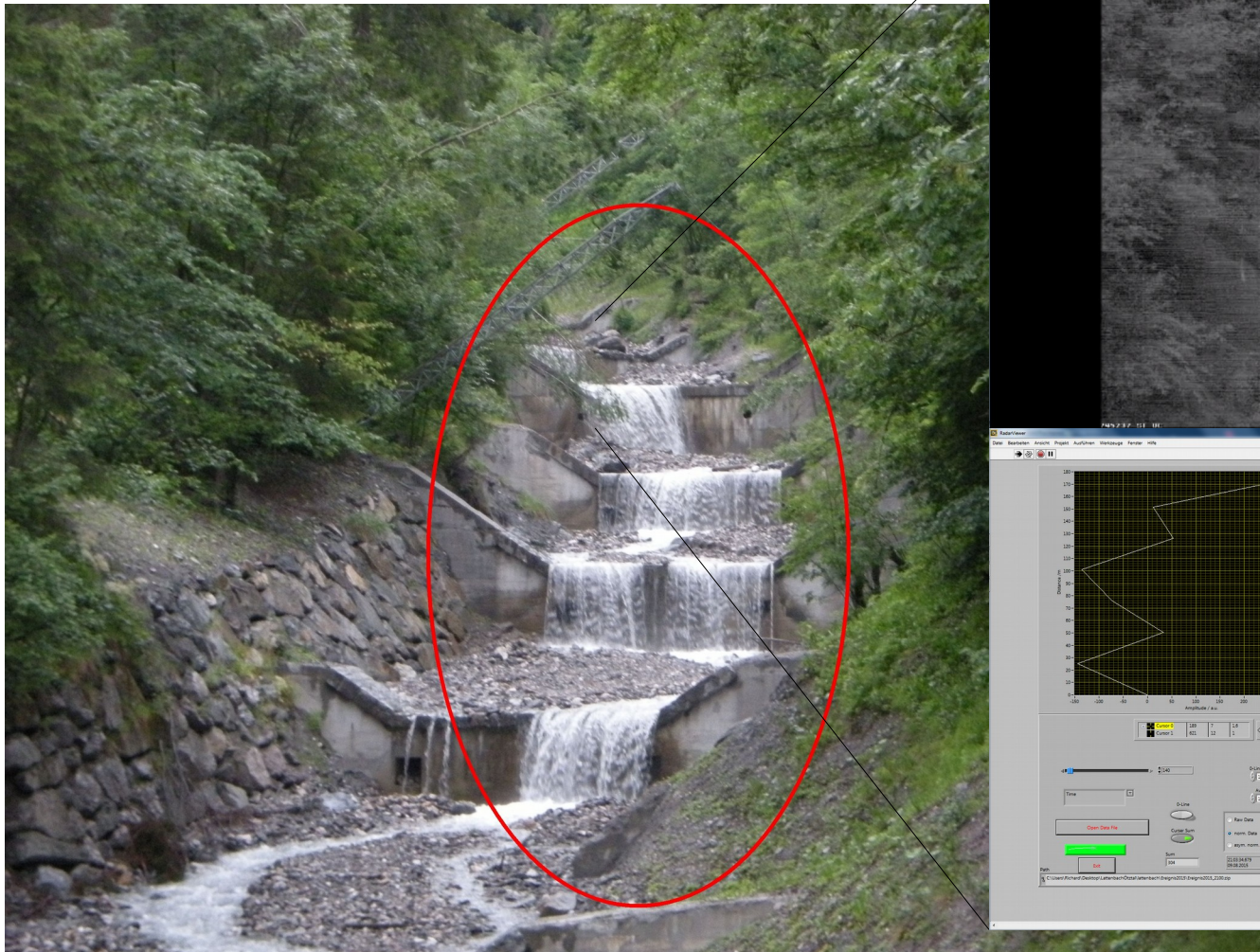
Debris Flow Lattenbach

Debris Flow Event from 09.08.2015 21:03



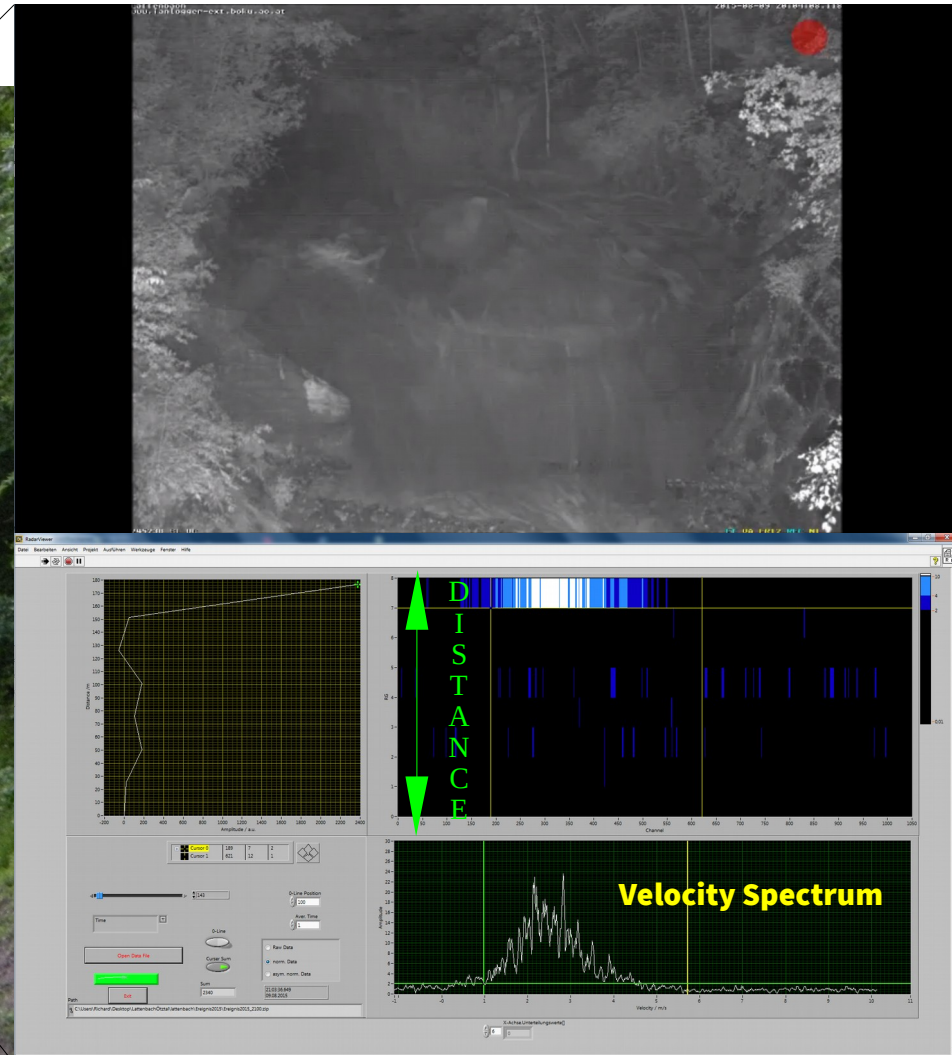
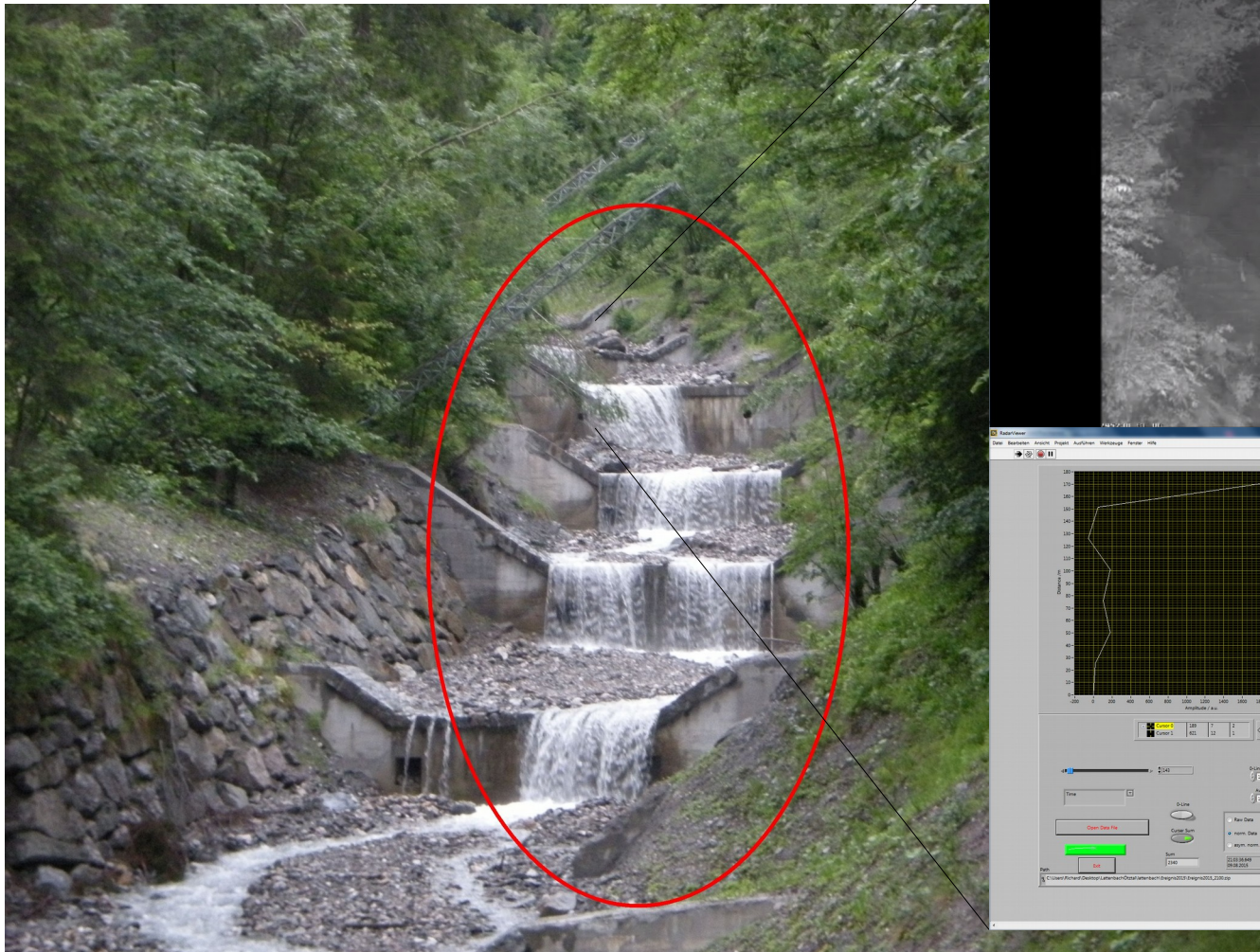
Debris Flow Lattenbach

Debris Flow Event from 09.08.2015 21:03



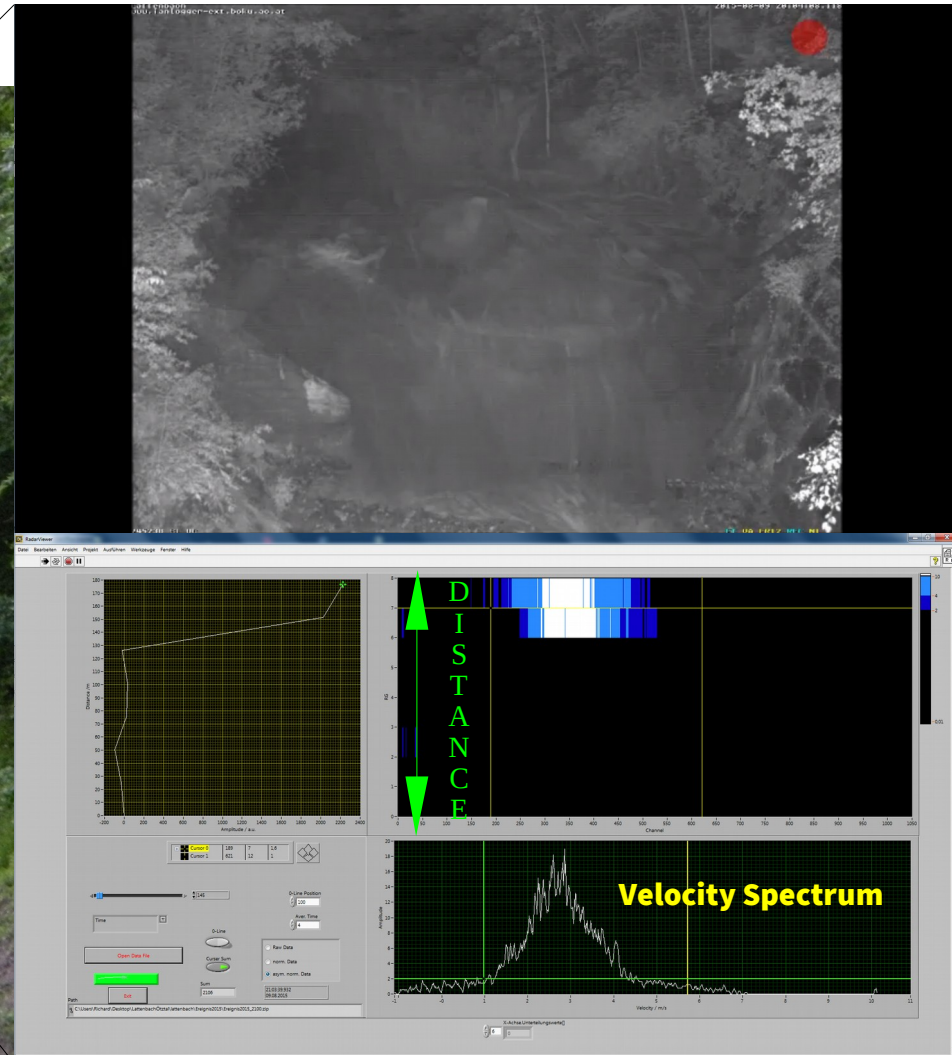
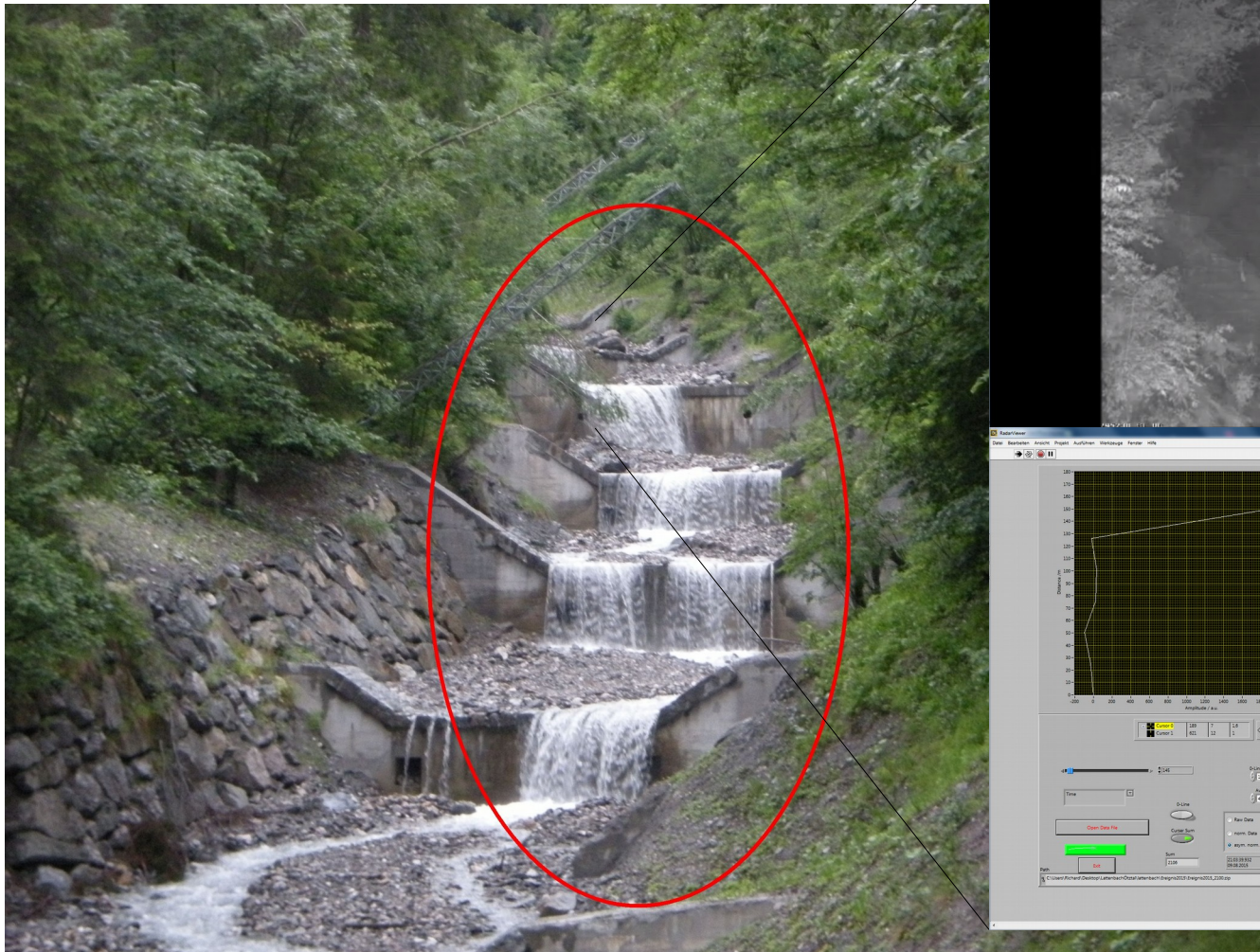
Debris Flow Lattenbach

Debris Flow Event from 09.08.2015 21:03



Debris Flow Lattenbach

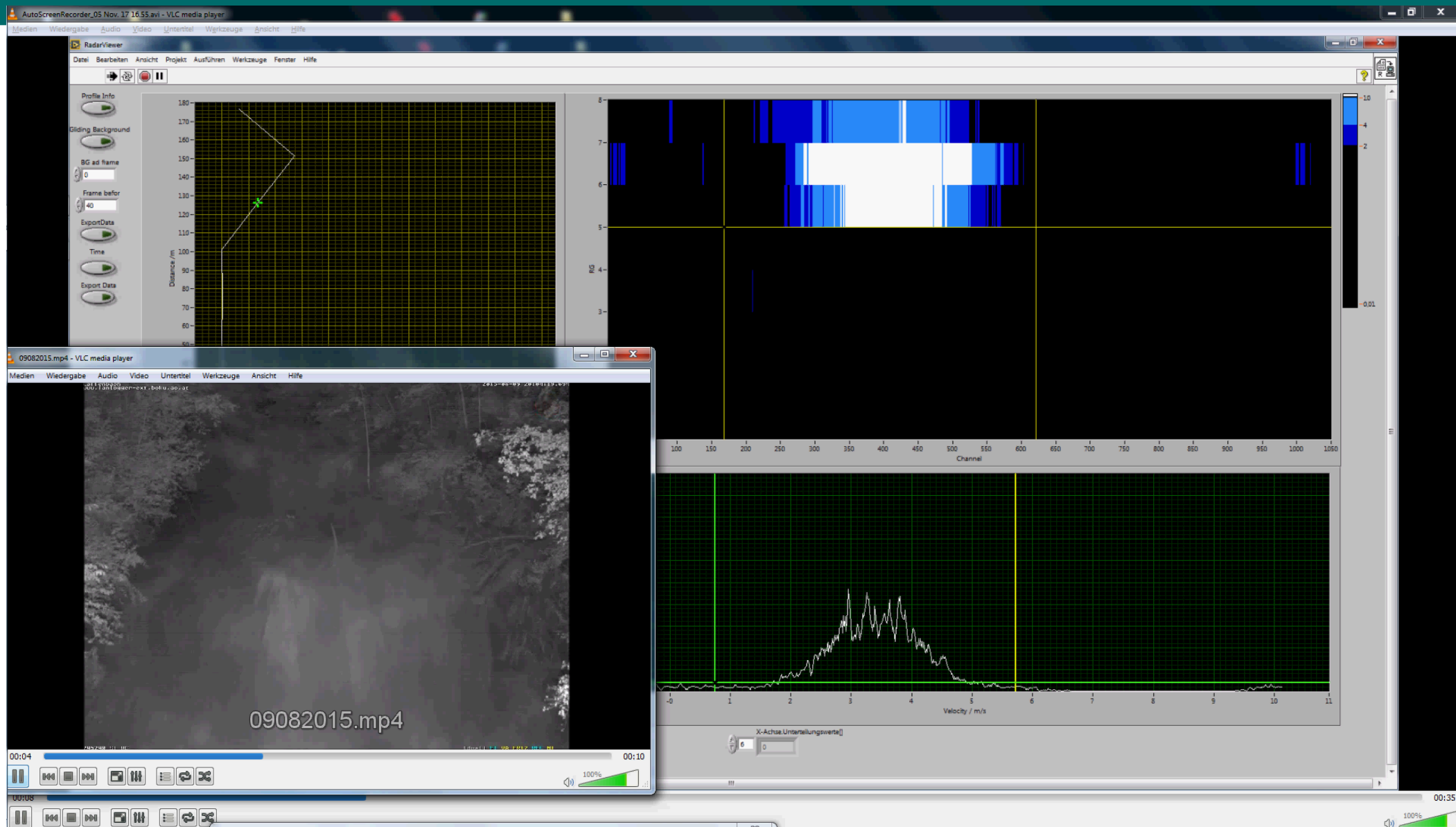
Debris Flow Event from 09.08.2015 21:03



Technology and Benefits of the System

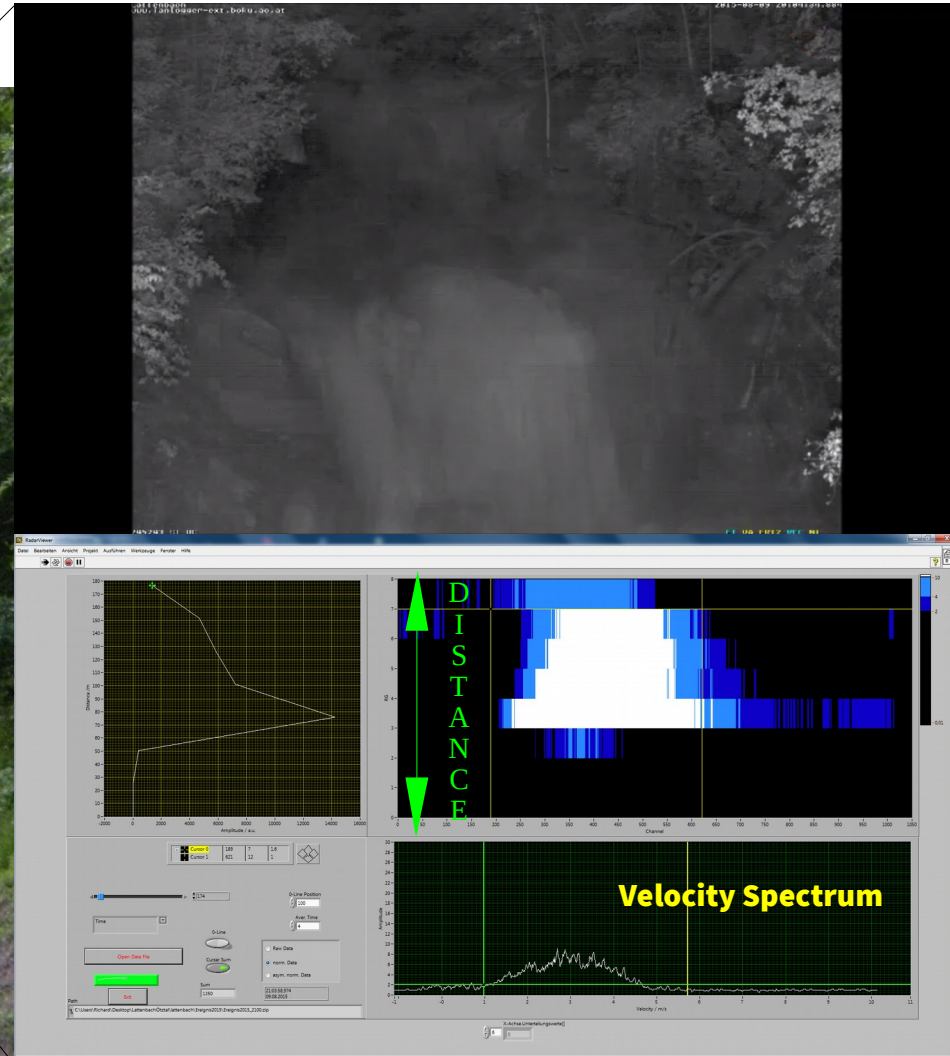
- Reliable recognition of avalanches and mudslides
 - **Minimization of false alerts**
- Recognition of risk in real time
 - **Maximum warning**
- Multifunctional measuring and alert system
 - **Water level**
 - **Debris flow/flood**
 - **Heavy rainfall**
 - **Snow avalanche**
- Low installation requirements
 - **Only a mast and a power supply of 40 W**

Debris Flow Lattenbach



Debris Flow Lattenbach

Debris Flow Event from 09.08.2015 21:03



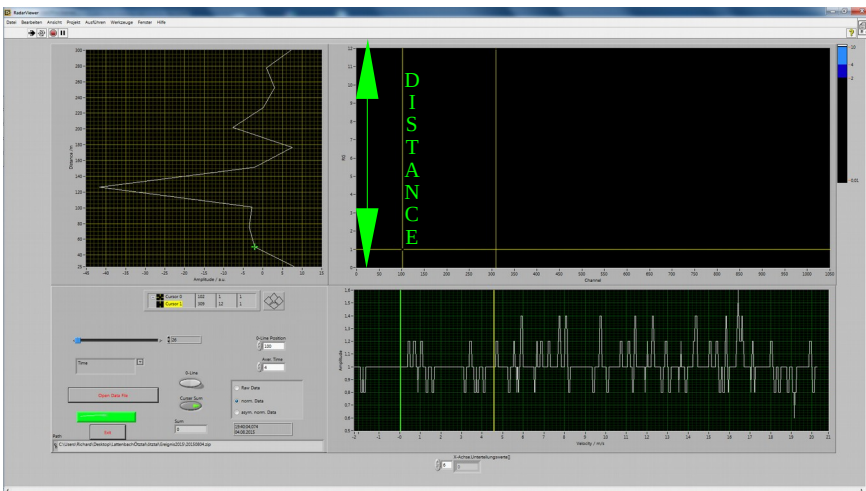
Umhausen

System Umhausen



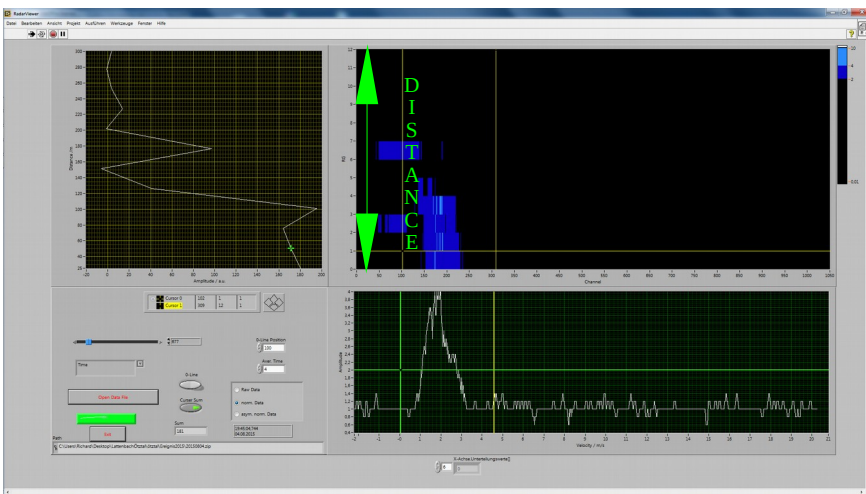
Debris Flow Umhausen

System Umhausen Event from 04.08.2015 19:30



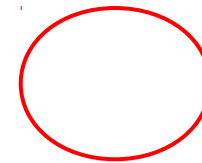
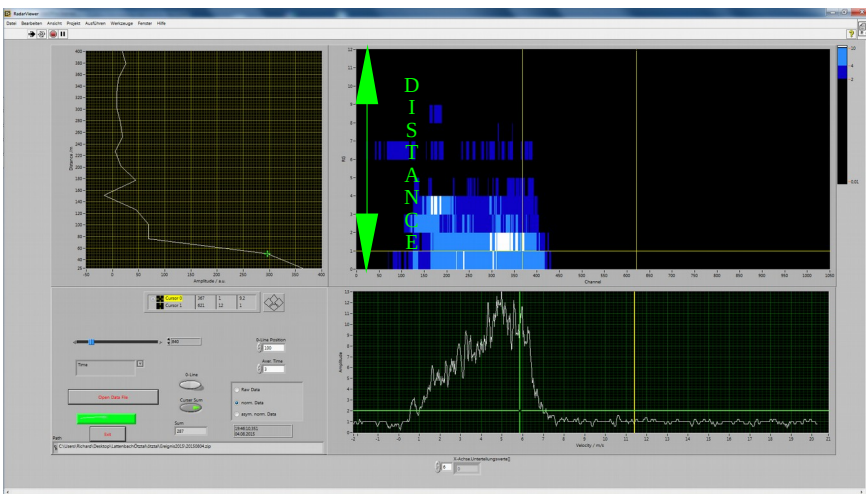
Debris Flow Umhausen

System Umhausen Event from 04.08.2015 19:45



Debris Flow Umhausen

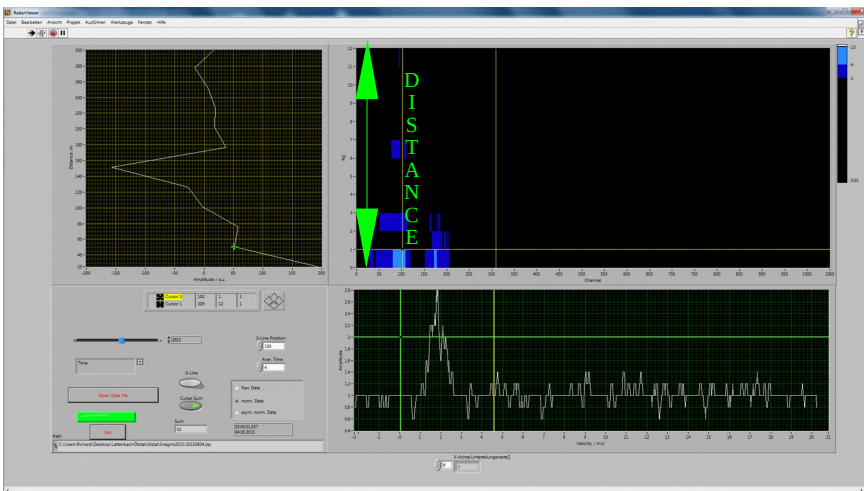
System Umhausen Event from 04.08.2015 19:46



NO PHOTO

Debris Flow Umhausen

System Umhausen Event from 04.08.2015 20:00



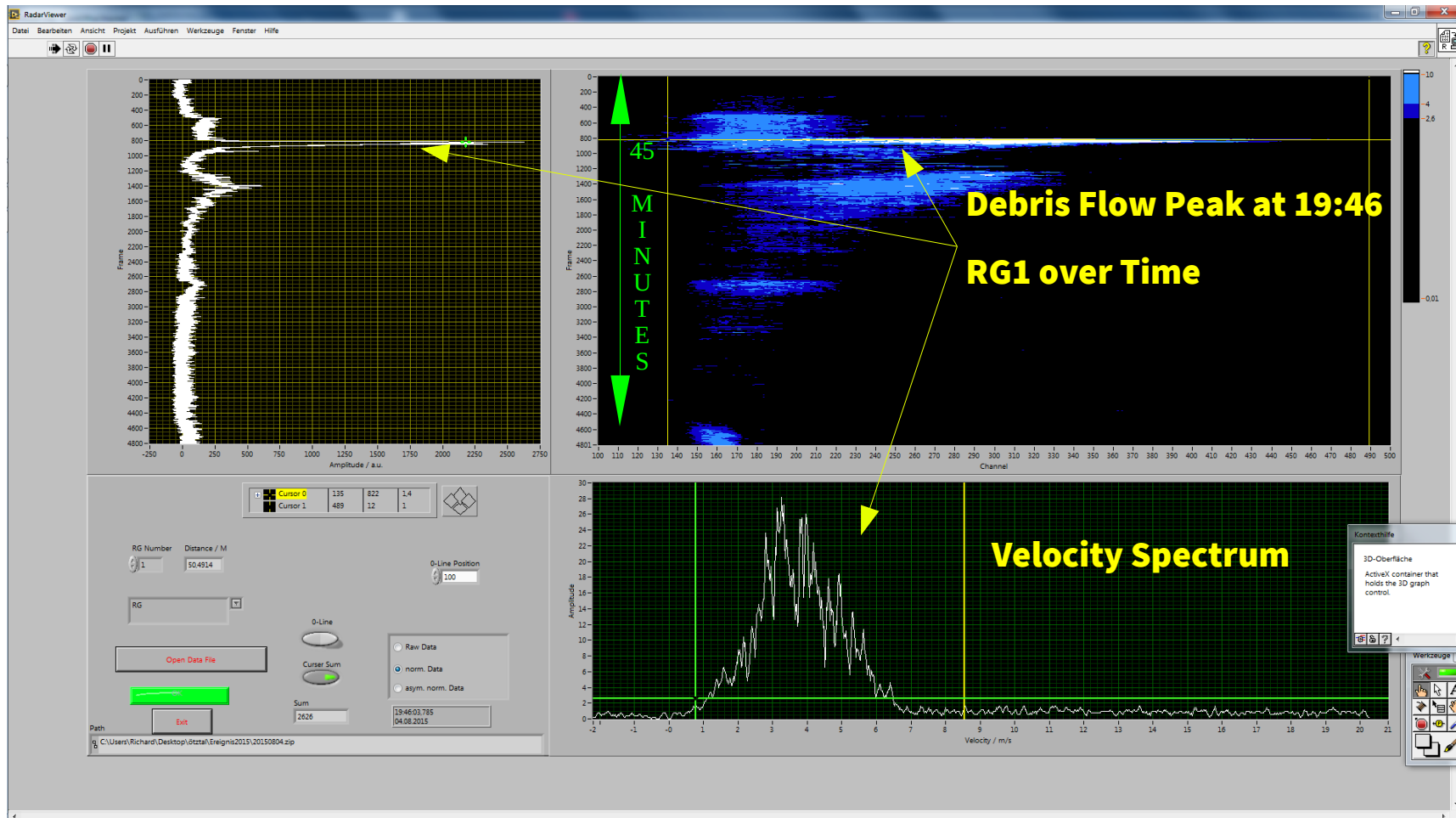
Debris Flow Umhausen

System Umhausen



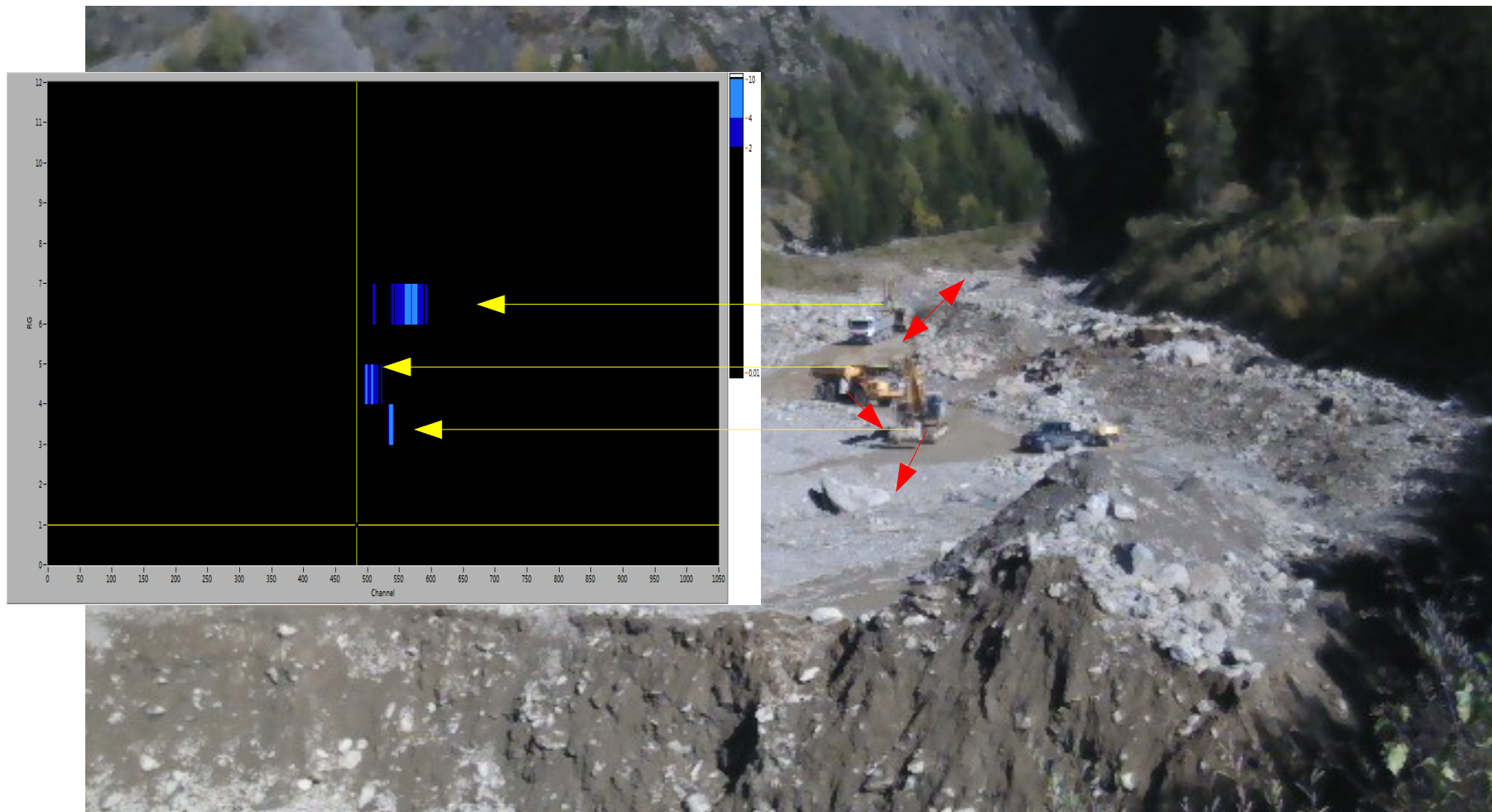
Debris Flow Umhausen

System Umhausen RG 1 over 45 Minutes



Debris Flow Umhausen

System Umhausen: Different 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 Austria	2012-	4	0	0
Umhausen Austria	2014-	2	0	0
Dongchuan China	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

Thank You

Thank You