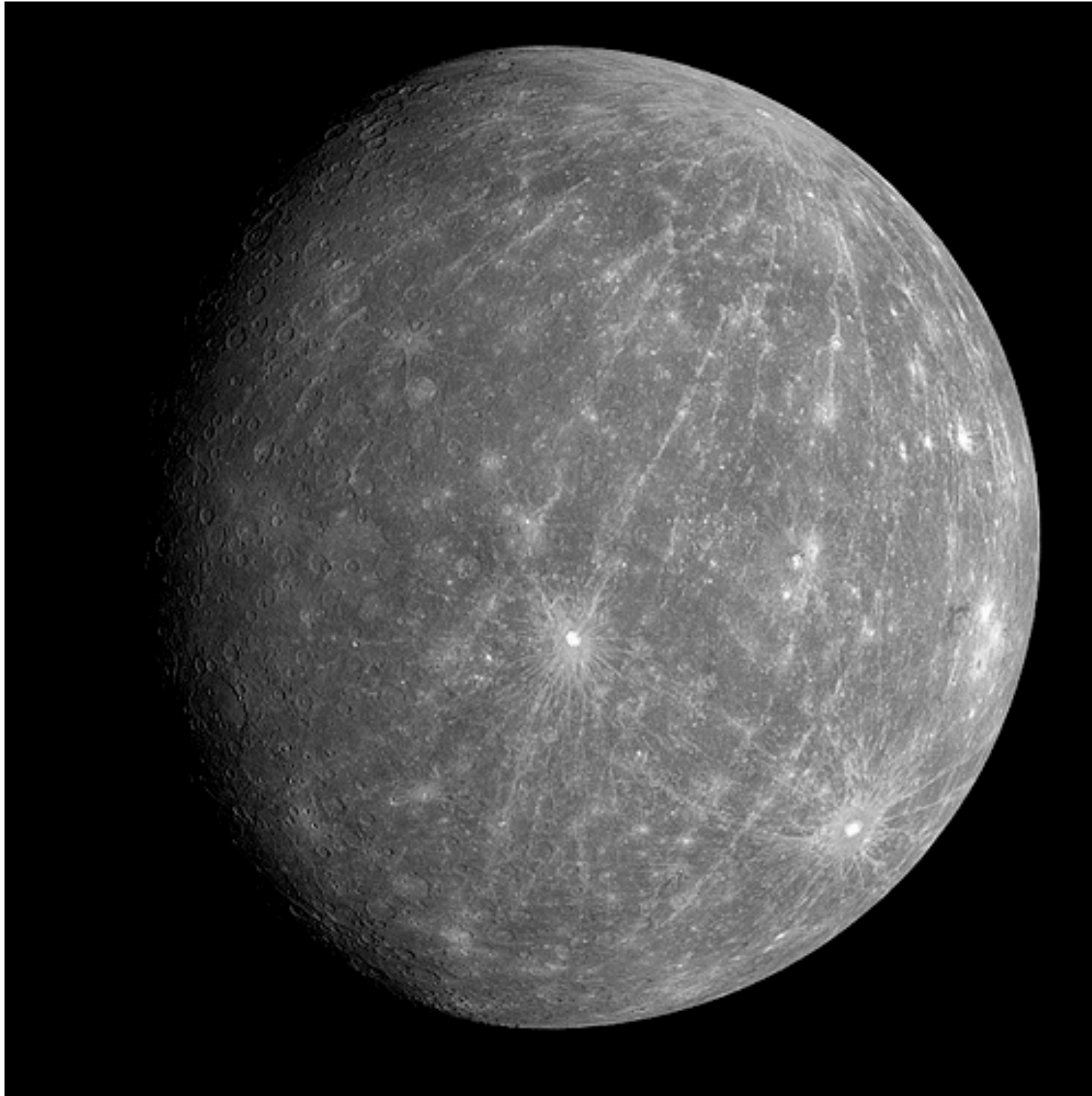


# BepiColombo Laser Altimeter Simulator

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Geodaetisches Observatorium Wettzell

# Mercury Exploration by Laser Altimeters

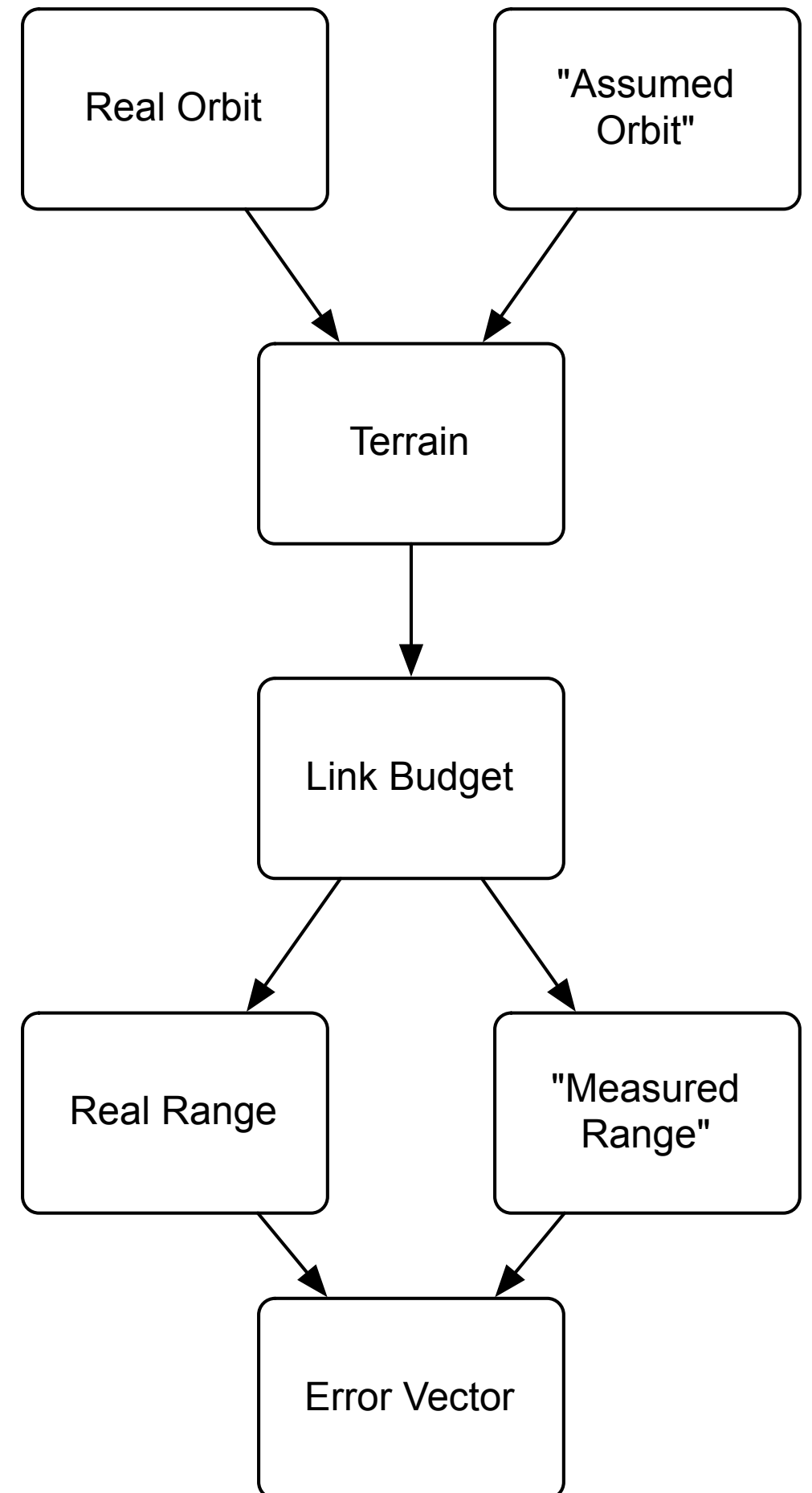


## Simulation Wishlist

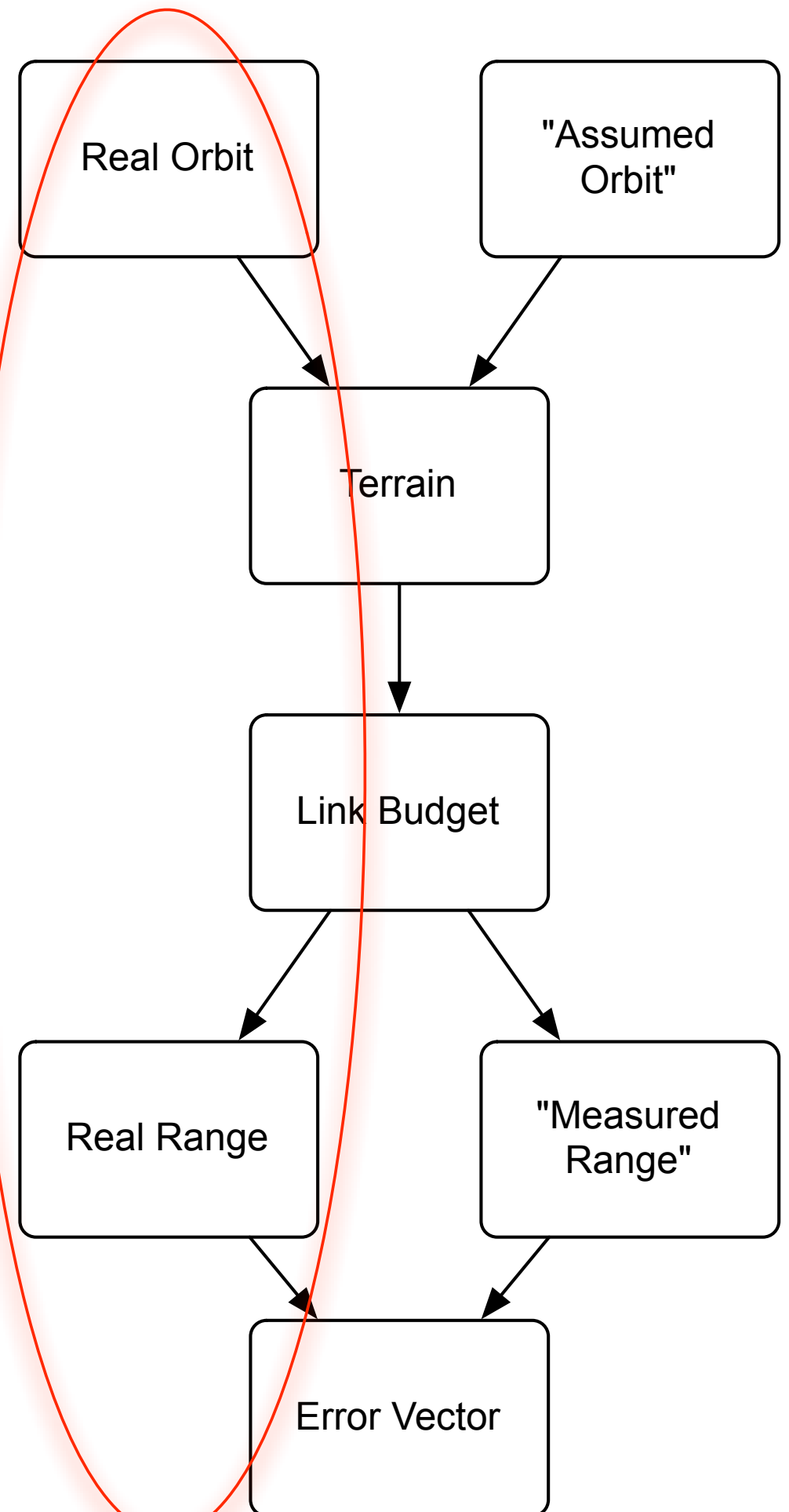
- a) Check out Orbits
- b) Recover Terrain  
(User defined)
- c) Slopes in Terrain
- d) Link Budget
- e) Shot by Shot Range  
window
- f) Test of various Signal  
Recovery Methods

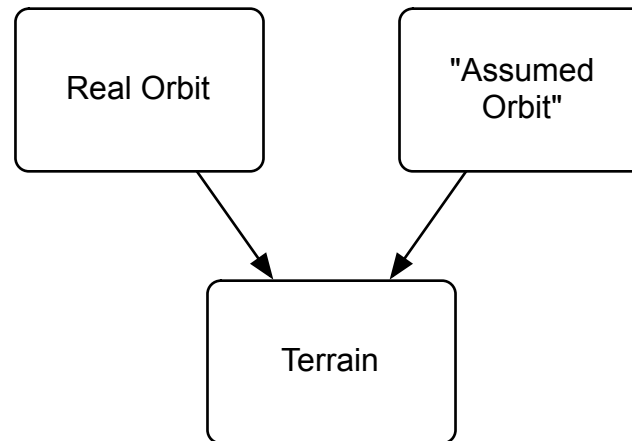
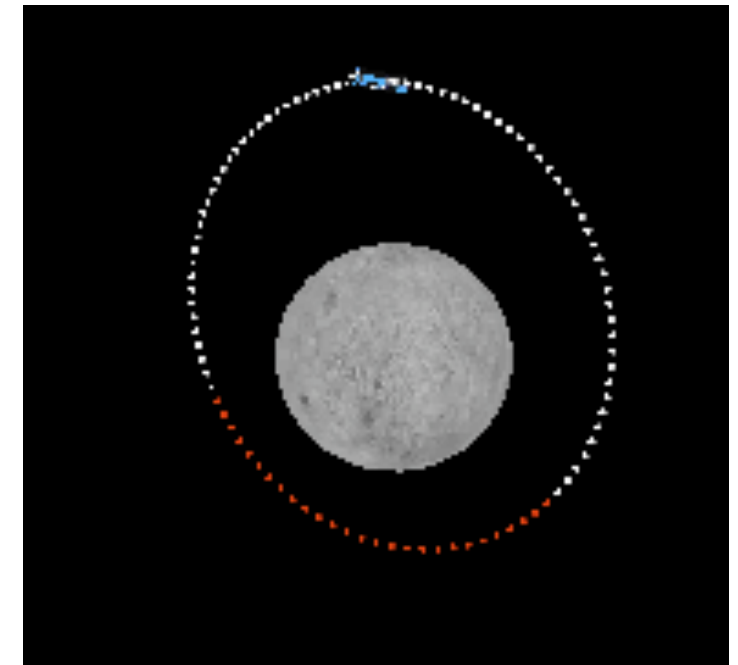
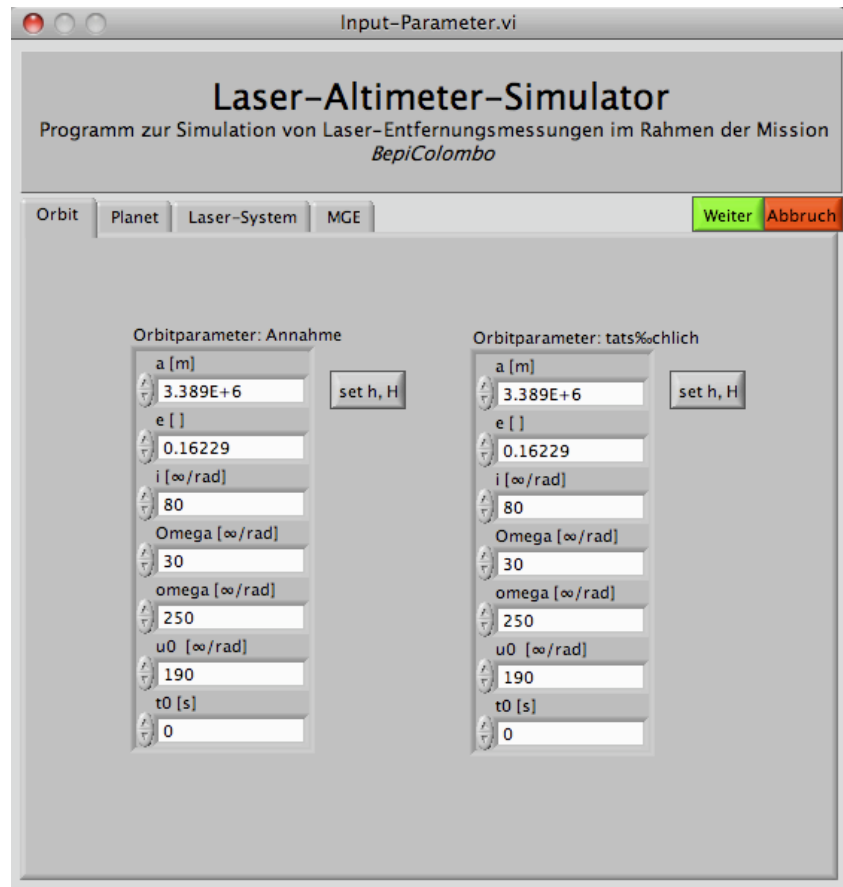
# Simulator Flow Chart

1. Generate a "real" Scenario
2. Set up an "expected" Scenario
3. Use Software Modules and Hardware Specifications to examine Efficiency
4. Error Vector shows how well it worked



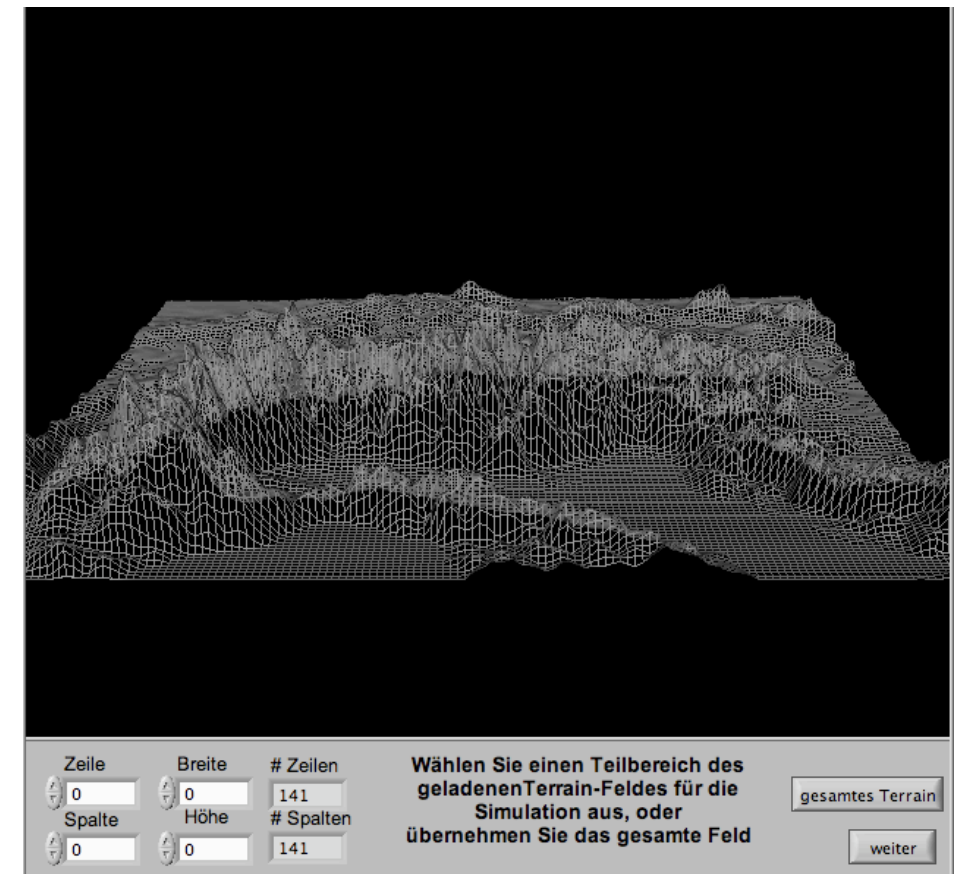
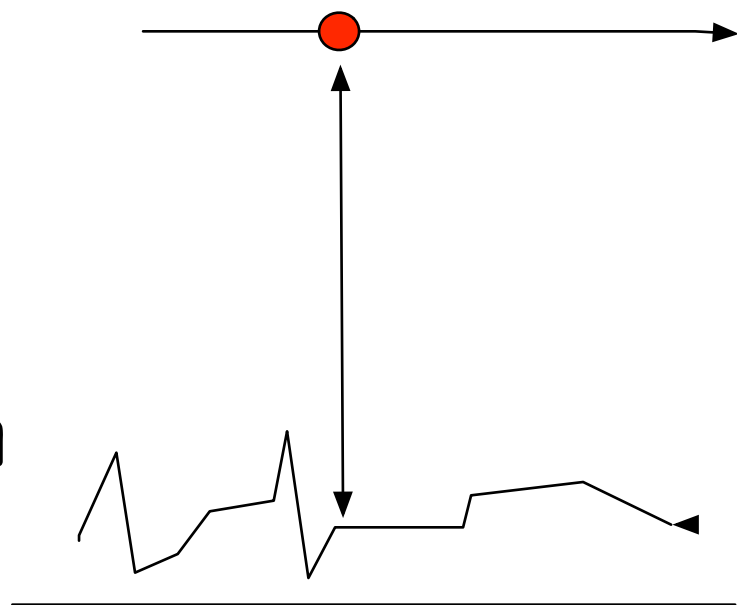
1. Elements encircled in red are invisible and set up at Startup
2. Variable System Parameters at Runtime
3. Graphical display of many Parameters on a Shot by Shot basis
4. Range Window for Illustration



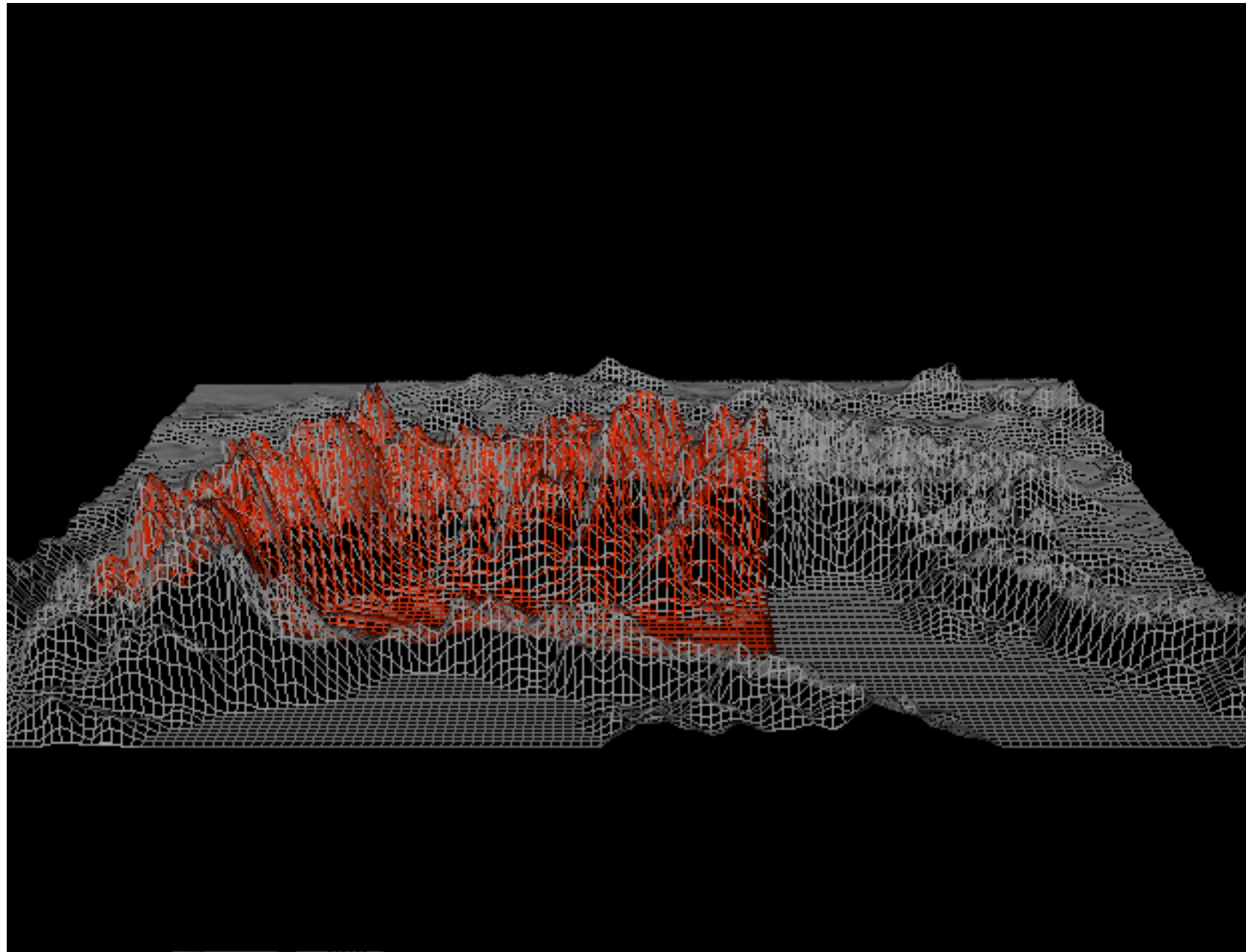


Orbit

Terrain  
Planet



# The Contour is a Part of Central Europe



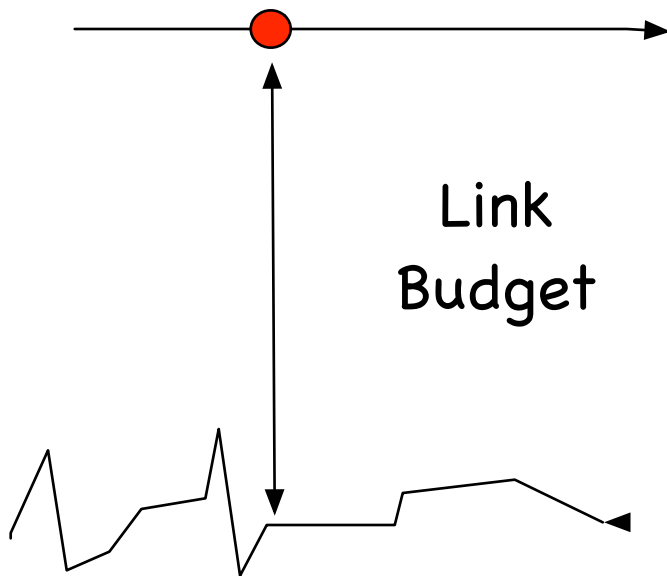
Full Terrain or Sections may be chosen



# Altimeter Parameters

Link Budget

Orbit



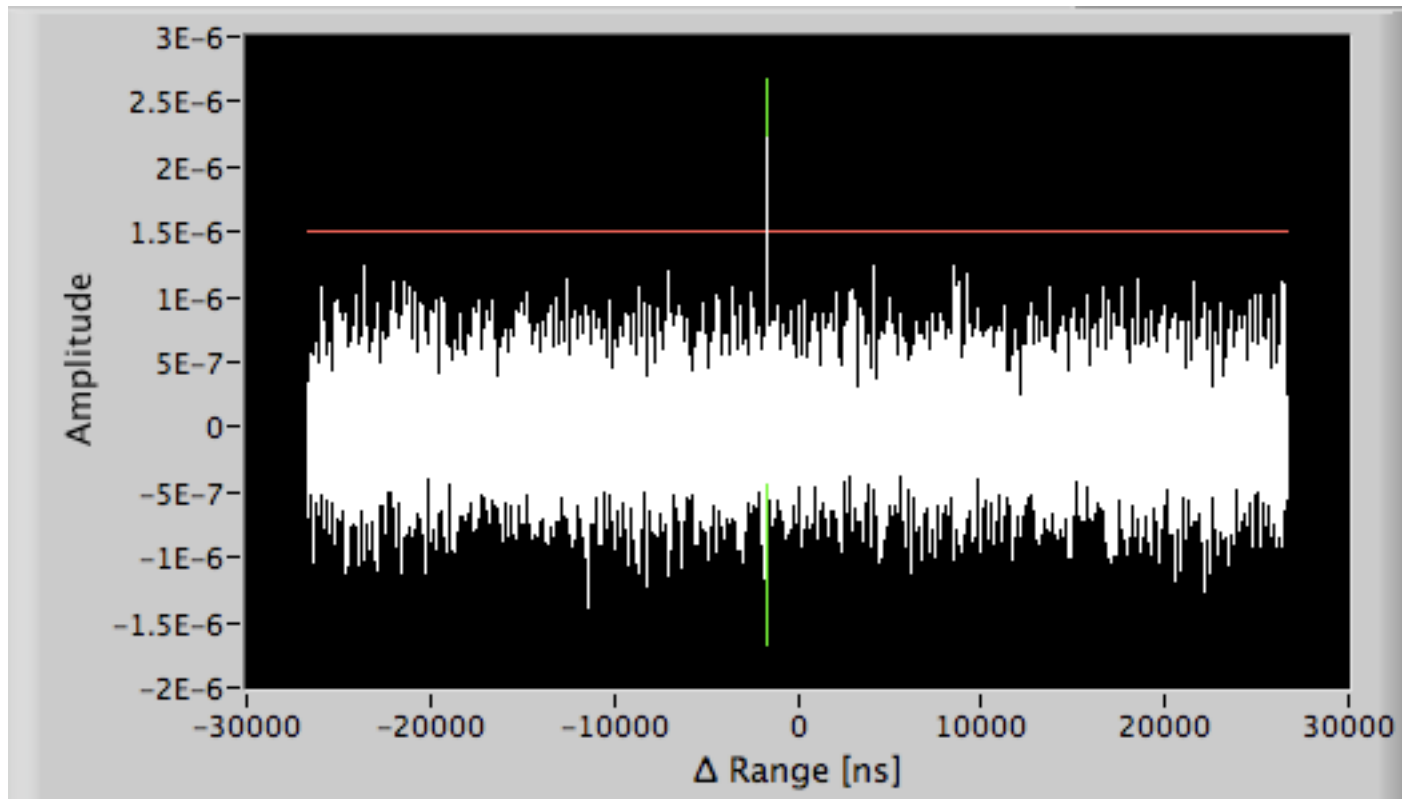
Link Budget

Terrain

Planet

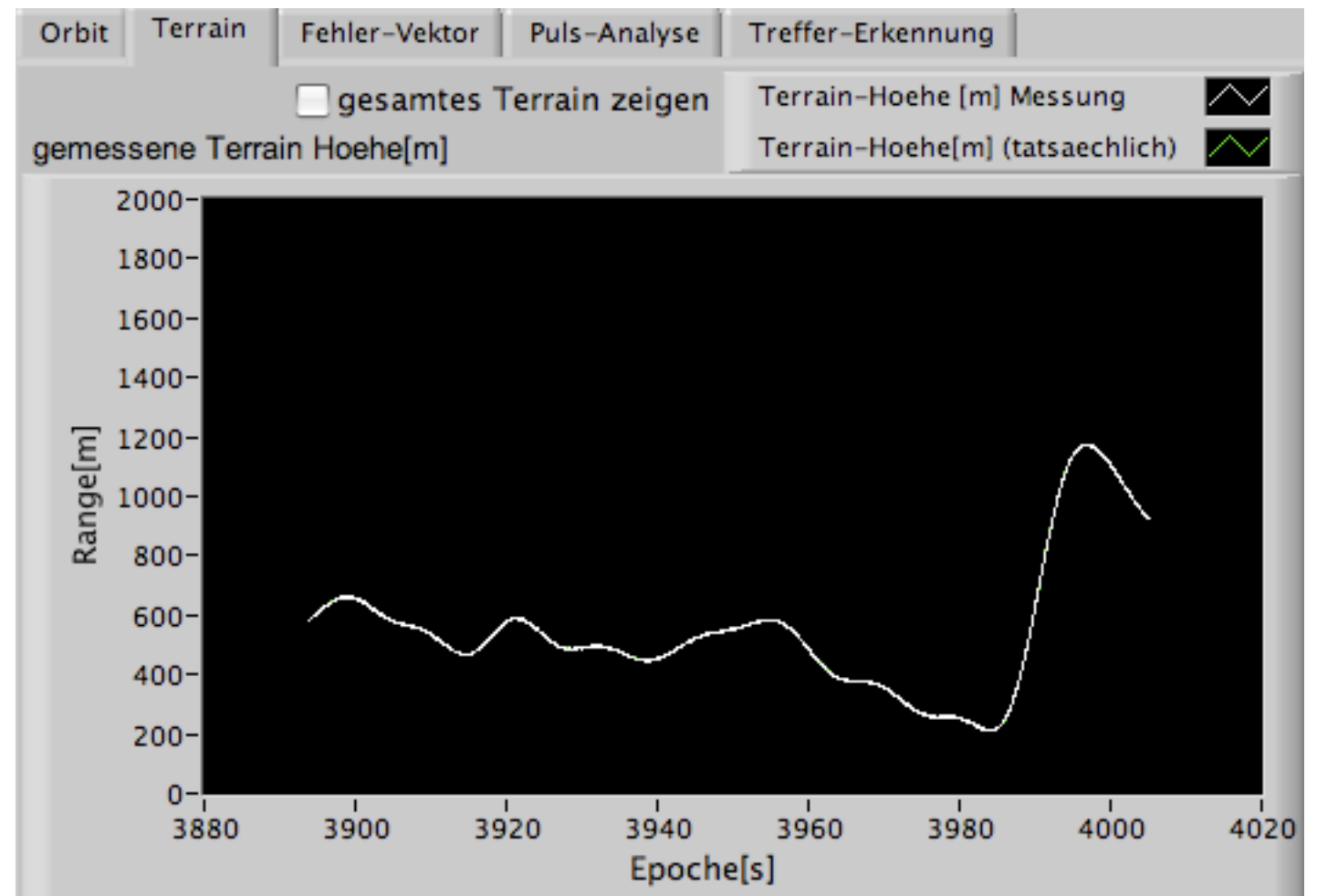
Transmitter		Receiver	
Wavelength / $\mu\text{m}$	1.064	Noise equivalent power [W/sqrt(Hz)]	3E-14
Pulse Energy / $\mu\text{J}$	8000	Detector quantum efficiency	0.7
Pulse length FWHM/ns	10	Sampling frequency /MHz	200
Laser beam divergence (full angle) / $\mu\text{rad}$	100	Receiver field of view (full angle) / $\mu\text{rad}$	850
Telescope diameter /m	0.24	Time Gate / $\mu\text{s}$	10
Receive optics transmission	0.7	Filter Bandwidth /nm	0.2
Pulse repetition frequency /kHz	0.02		
Sol		Surface	
Sonnen Hintergrundrauschen an/aus	<input checked="" type="checkbox"/>	Albedo	0.26
Background radiance (W/m <sup>2</sup> sr $\mu\text{m}$ )	432.3	Sigma for surface variations /m	2
		Range [km]	490.92
		Incident angle [ $^\circ$ ]	-0.358897

weiter

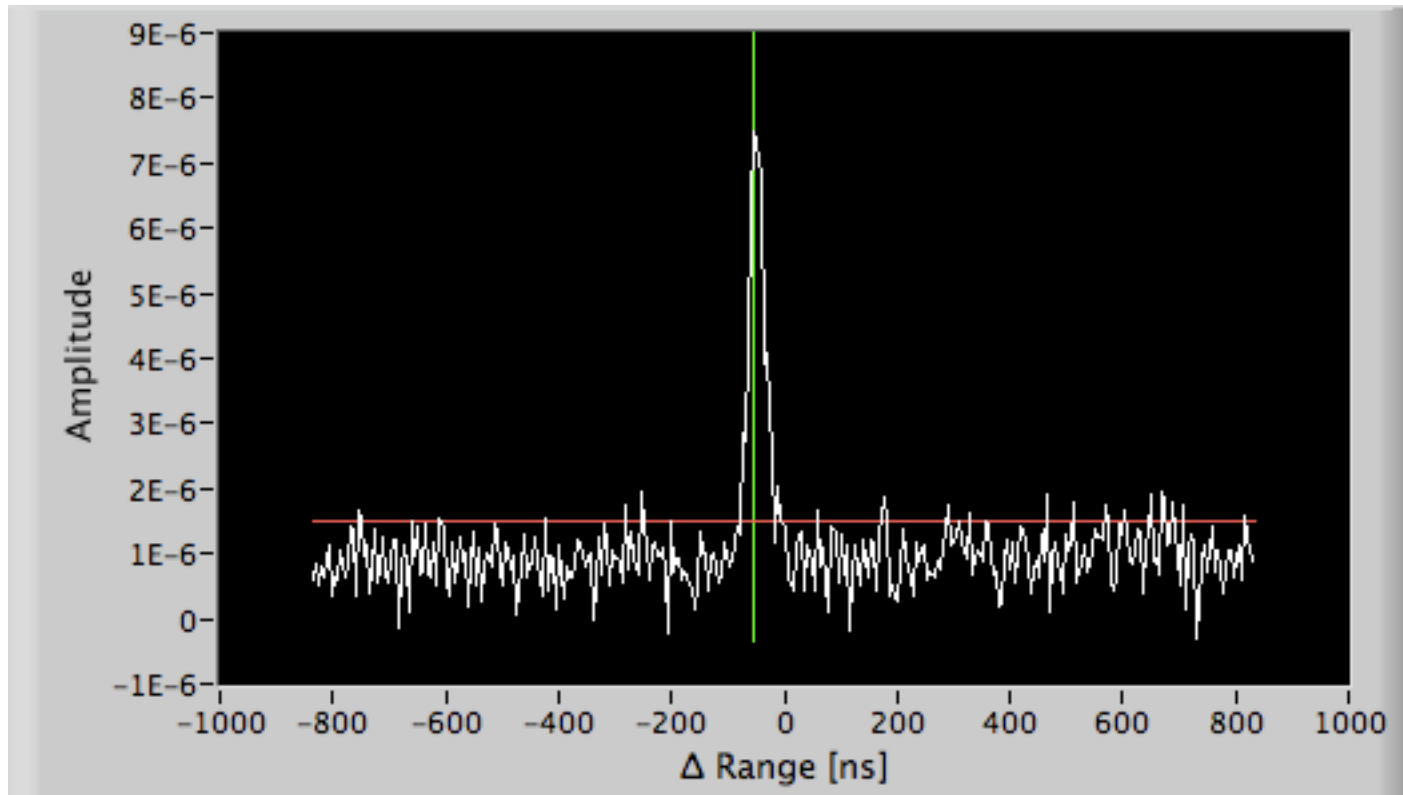


View of the full Rangepate with Threshold Detection on

Recovered Terrain taken at a good SNR



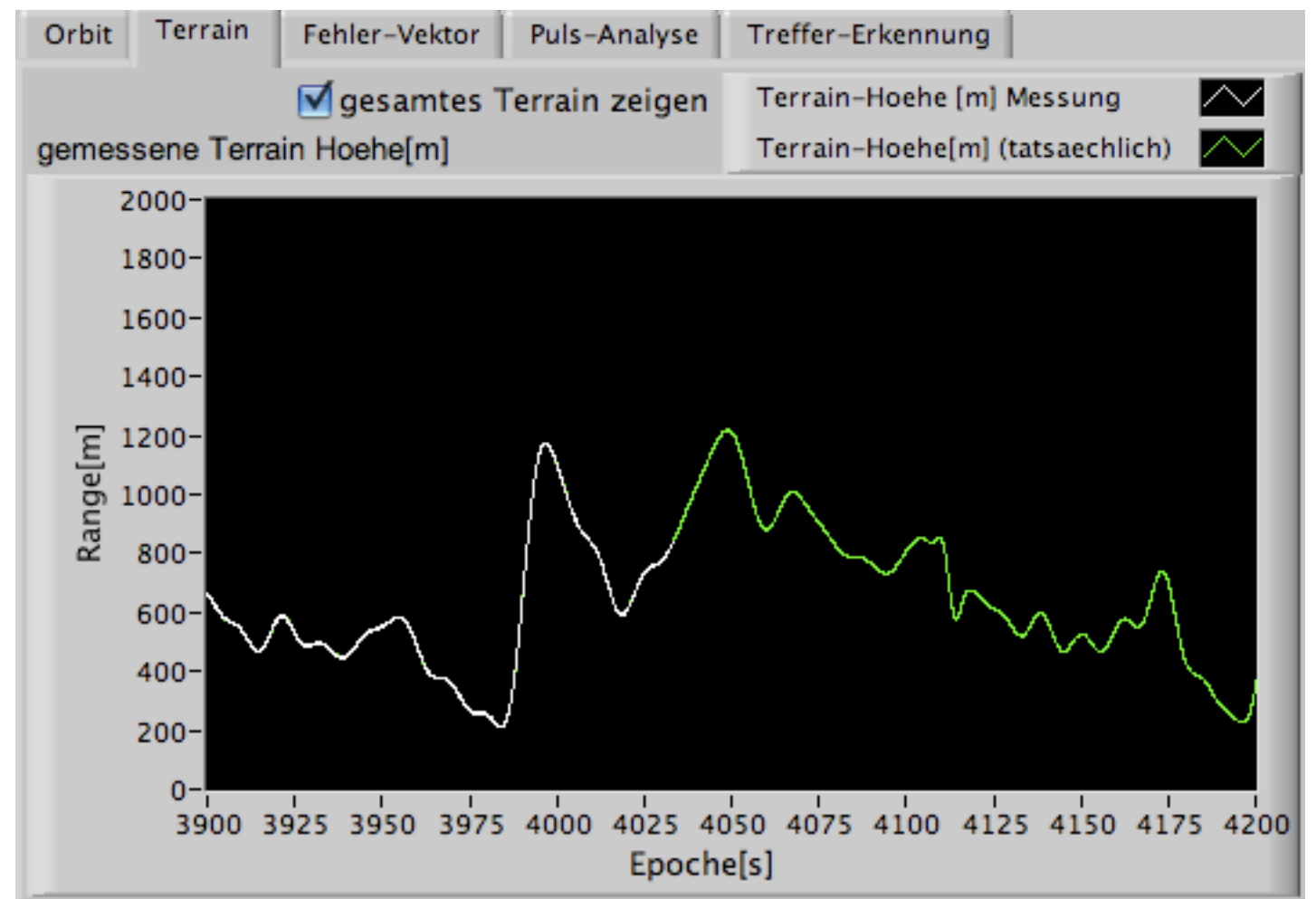


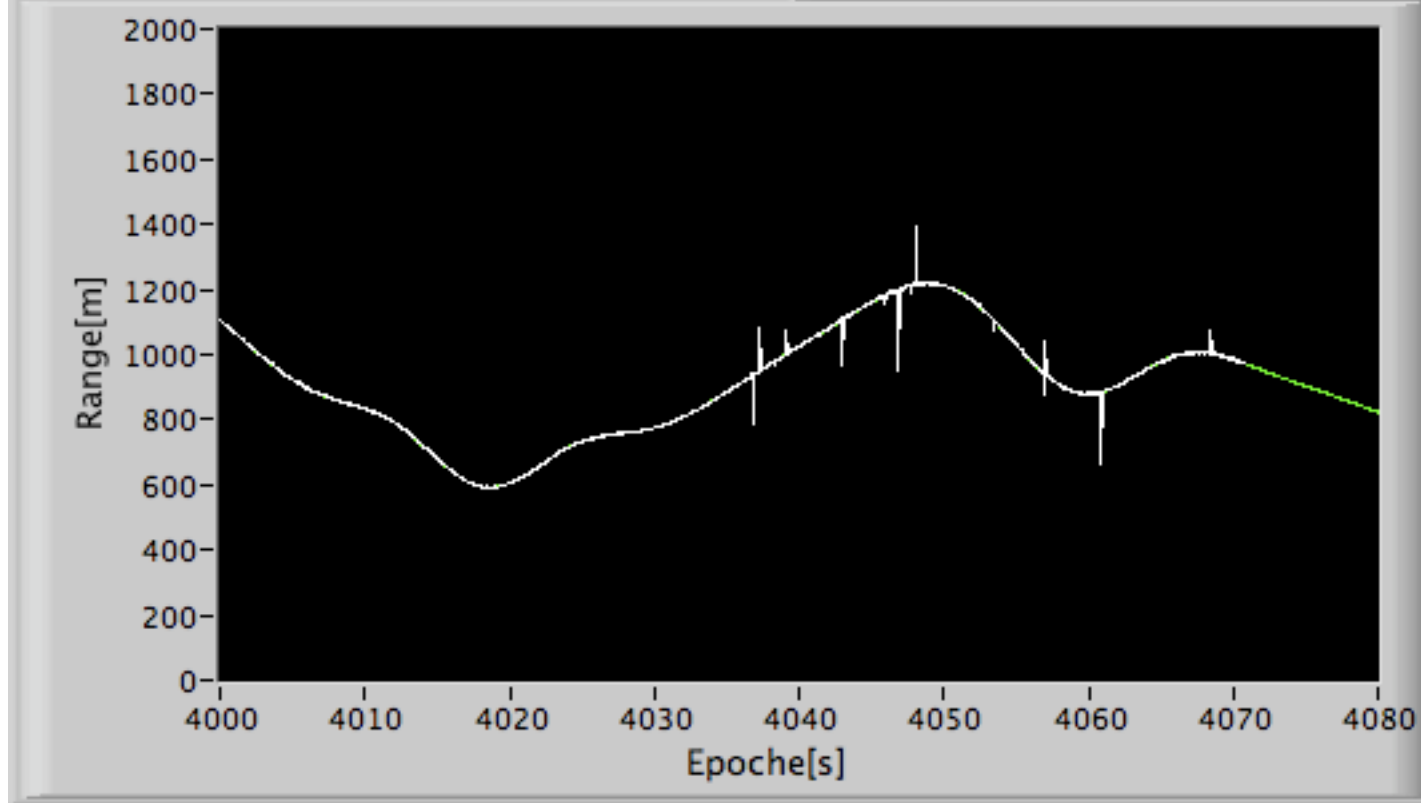
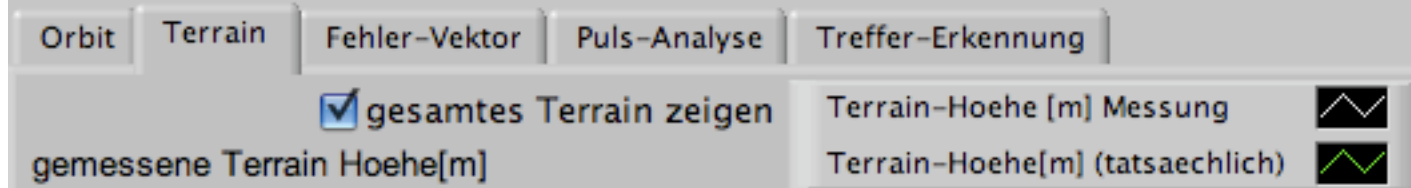
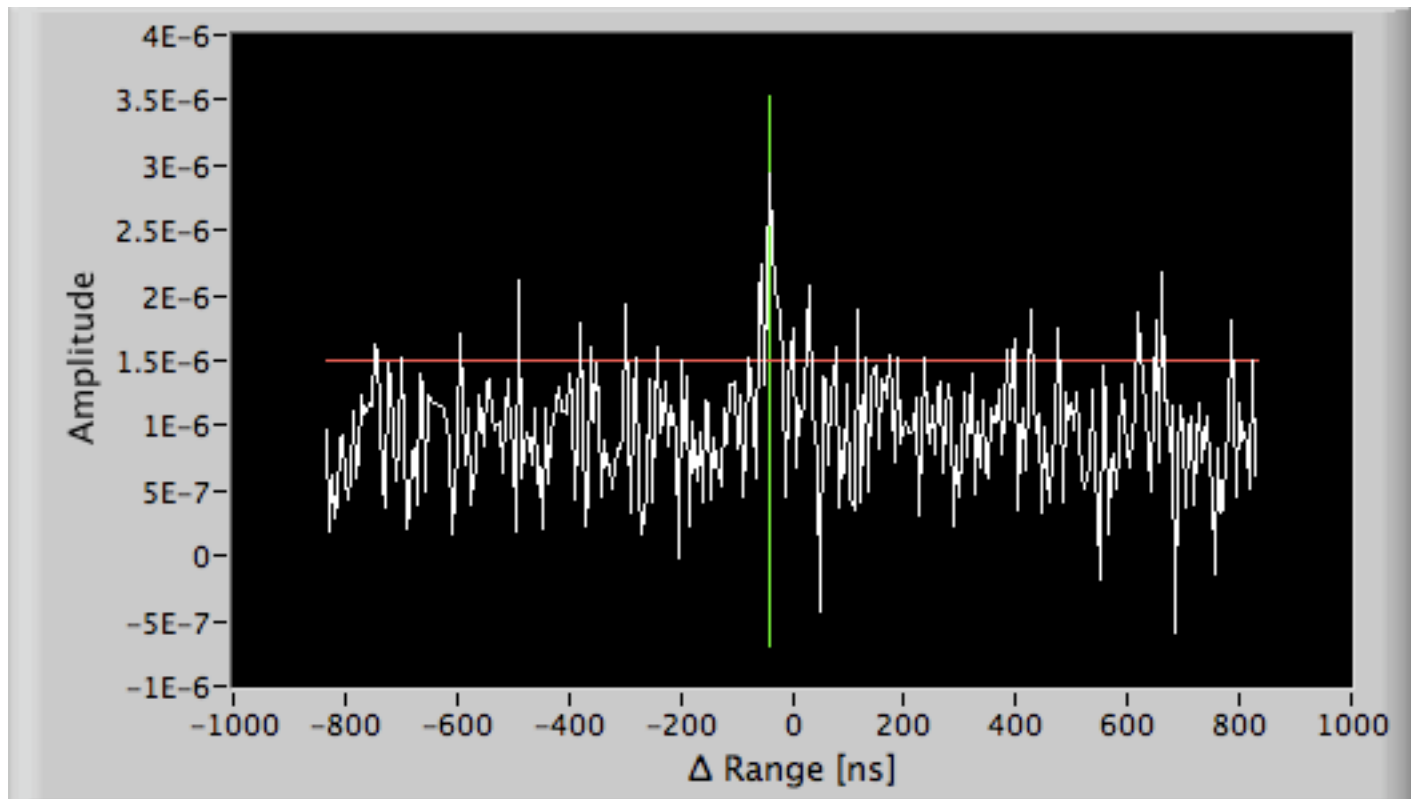


Once Data is detected in the full Gate, the Gate is reduced

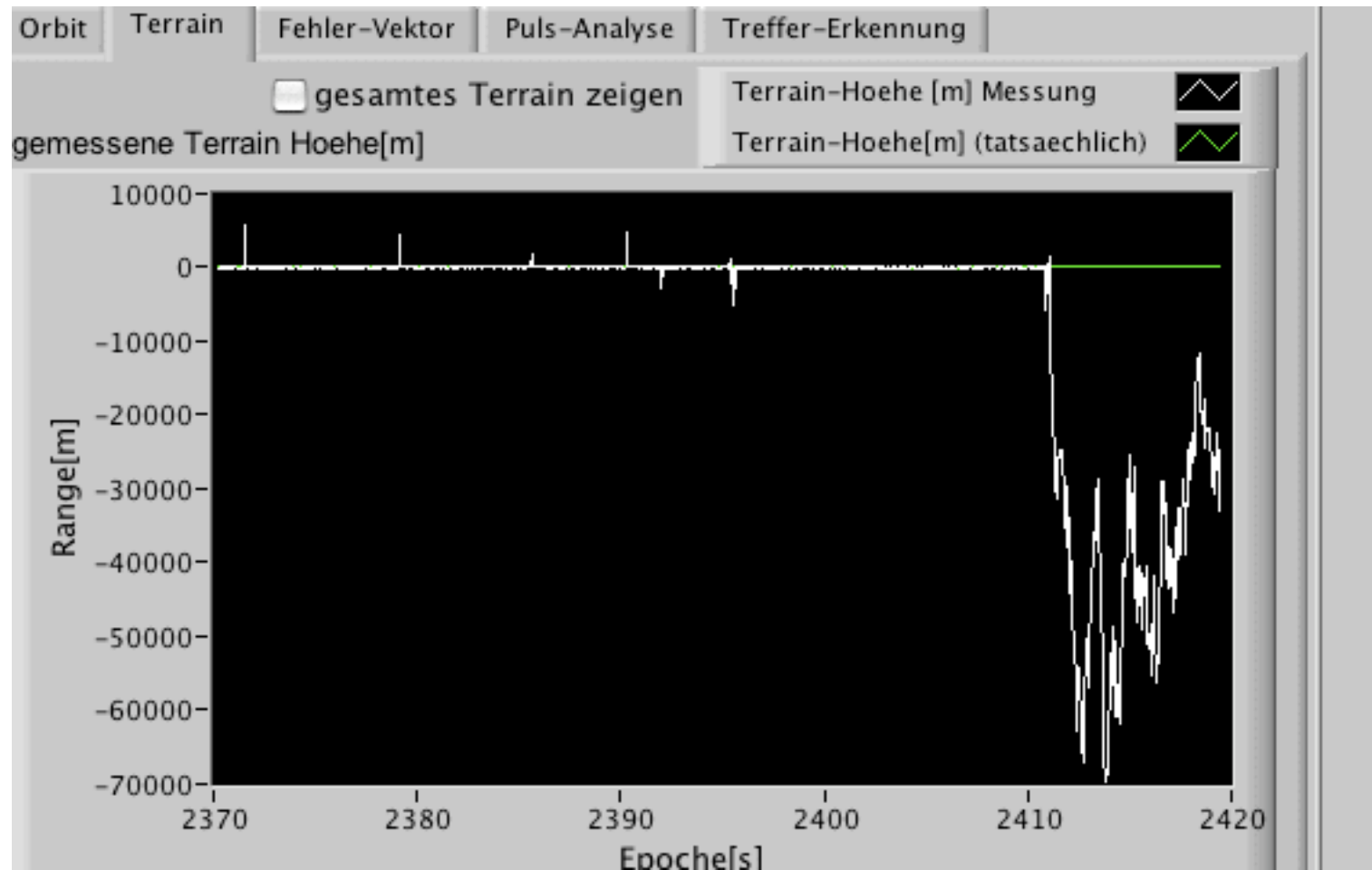
2 Methods "Threshold" and "Pulsewidth" available right now

Recovered Terrain (white) and "real" Terrain (green) at a good SNR



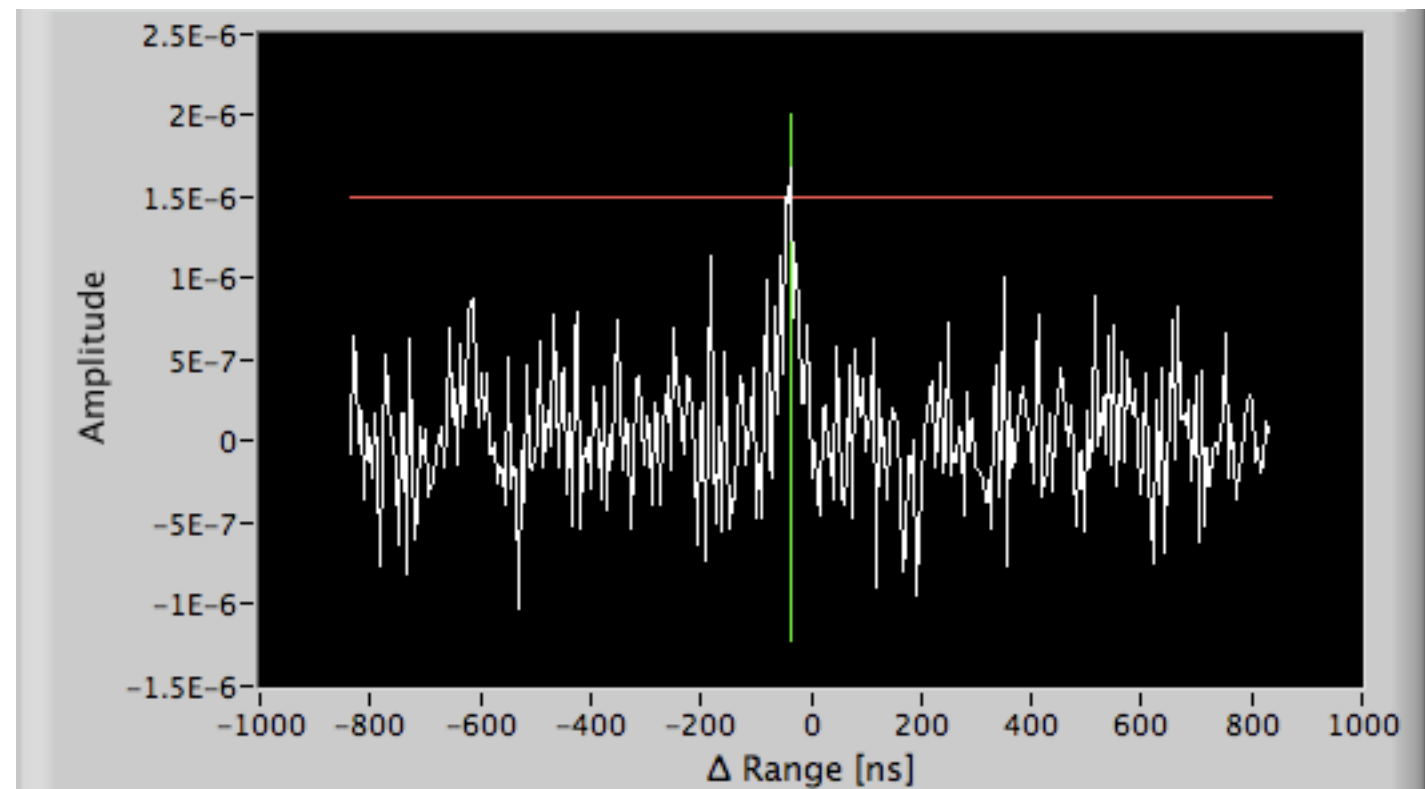


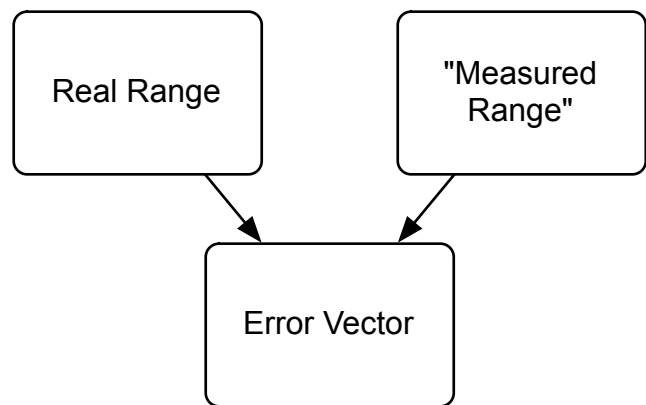
Same Situation at bad SNR



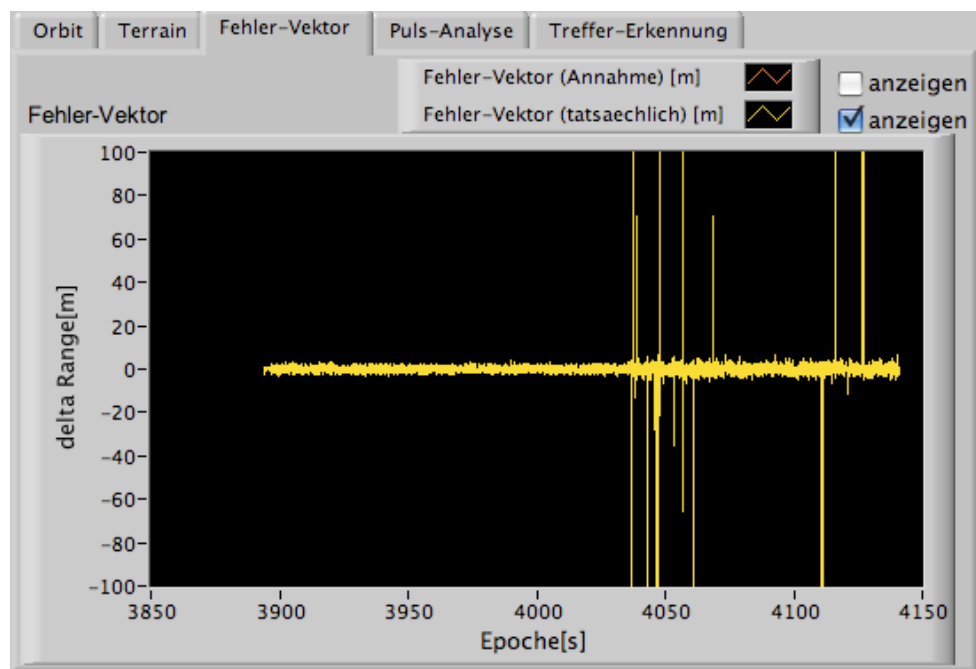
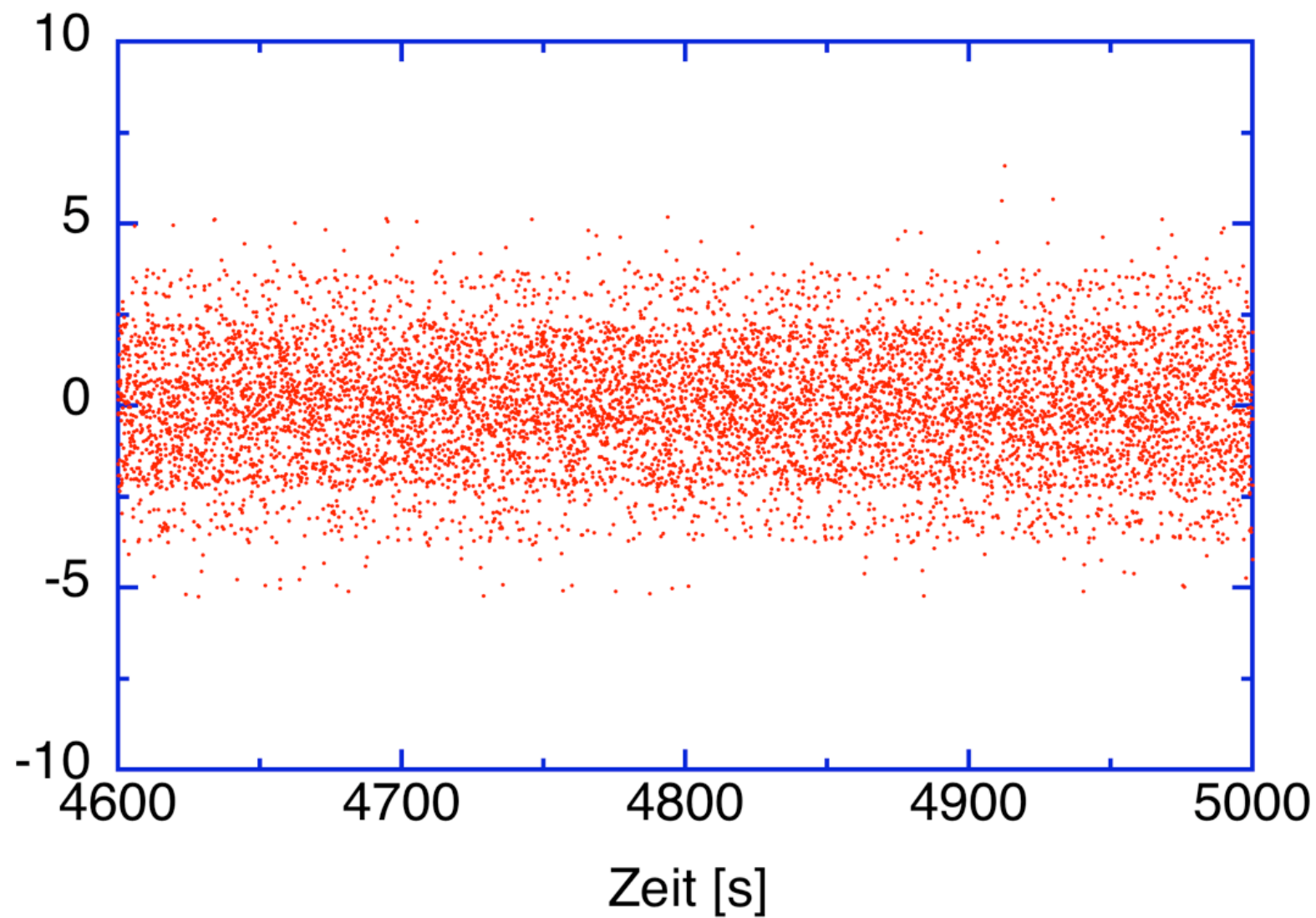
Example where the Track has been lost

Weak Signal in the Presence of Solar Background light

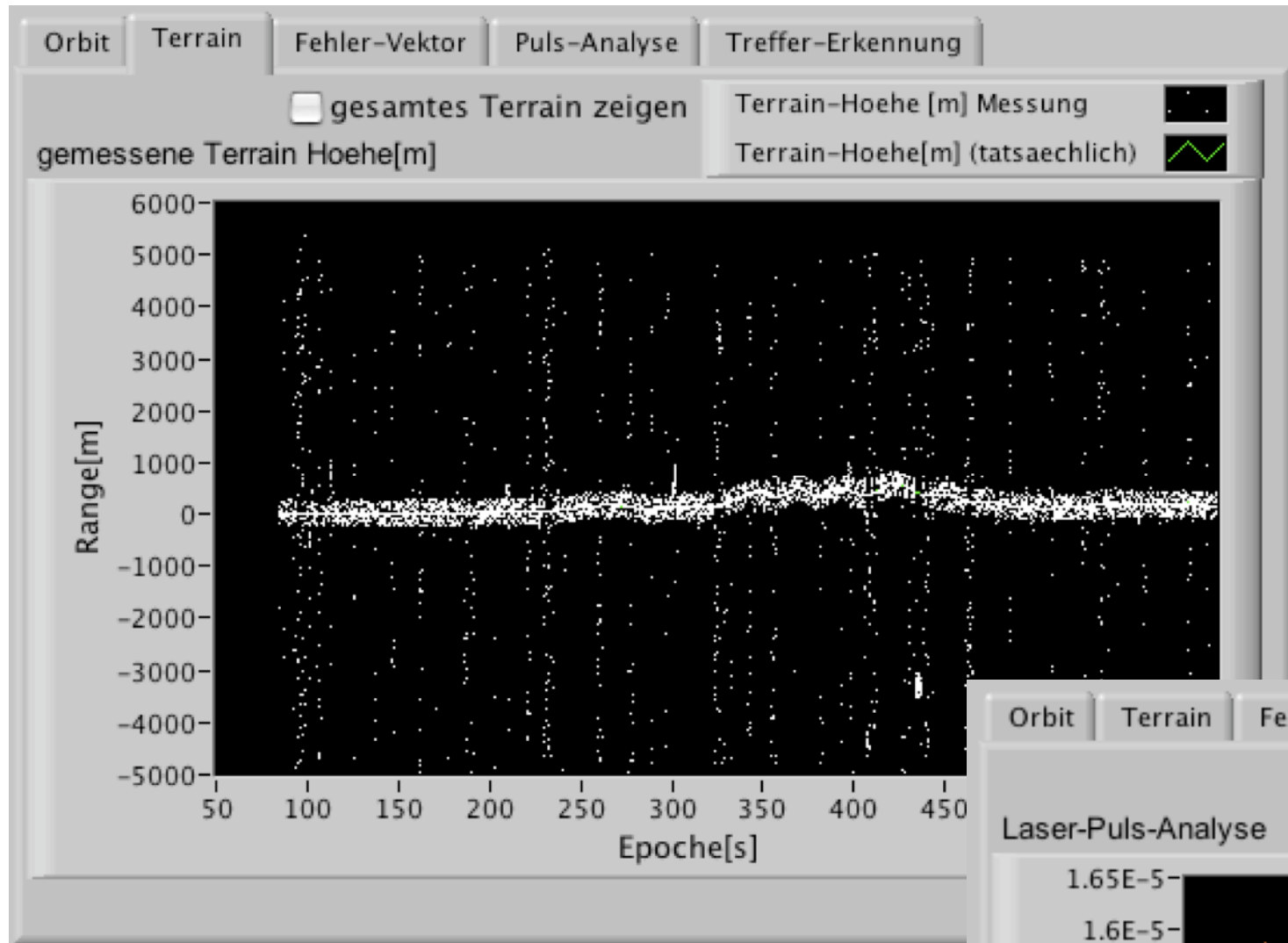




$\Delta r$  [ns]

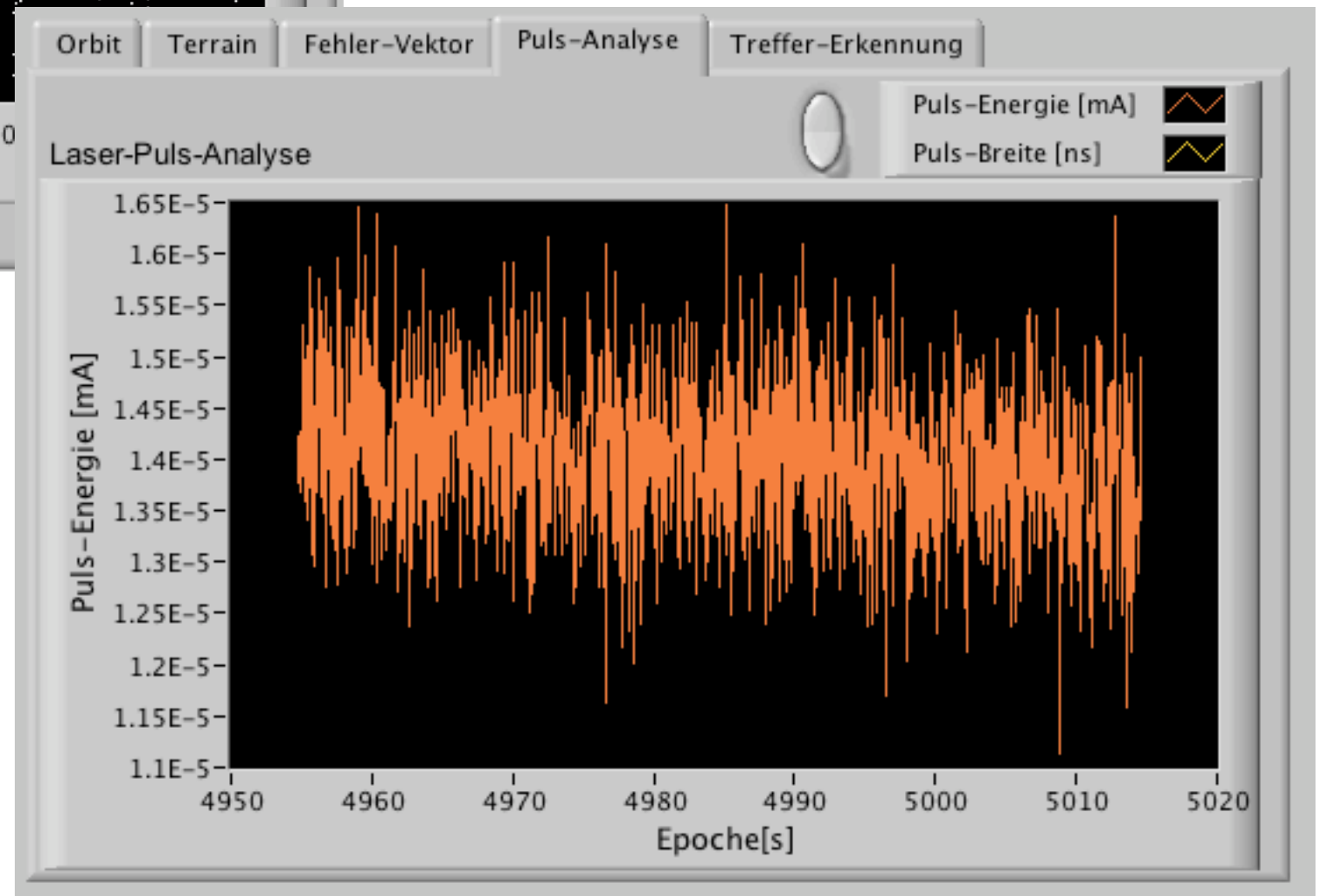


Display of the Error Vector at a reasonable SNR



Example of a noisy track

Display of Receive Signal Power as a function of time



**FESG** **BepiColombo Laser-Altimeter-** **TUM**  
Version 1.0

**Programm Status**

- Orbitbahn: Annahme ▶
- Orbitbahn ▶
- Terrain-Modell ▶
- Laser-Altimeter-Simulation ▶
- ▶

**Programm Parameter ändern**

LA-Parameter

MGE-Parameter

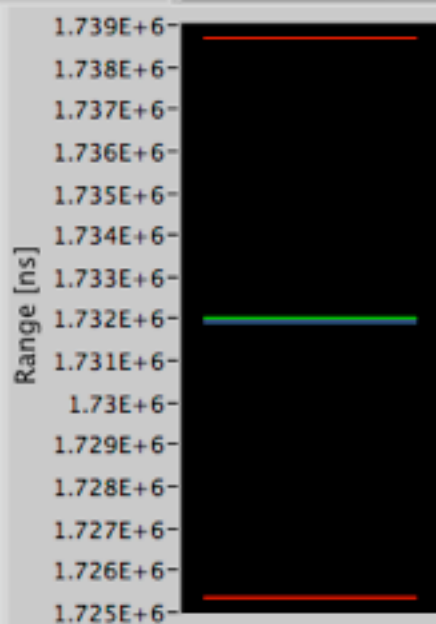
Timer [s]

**Darstellung**

- 
- 

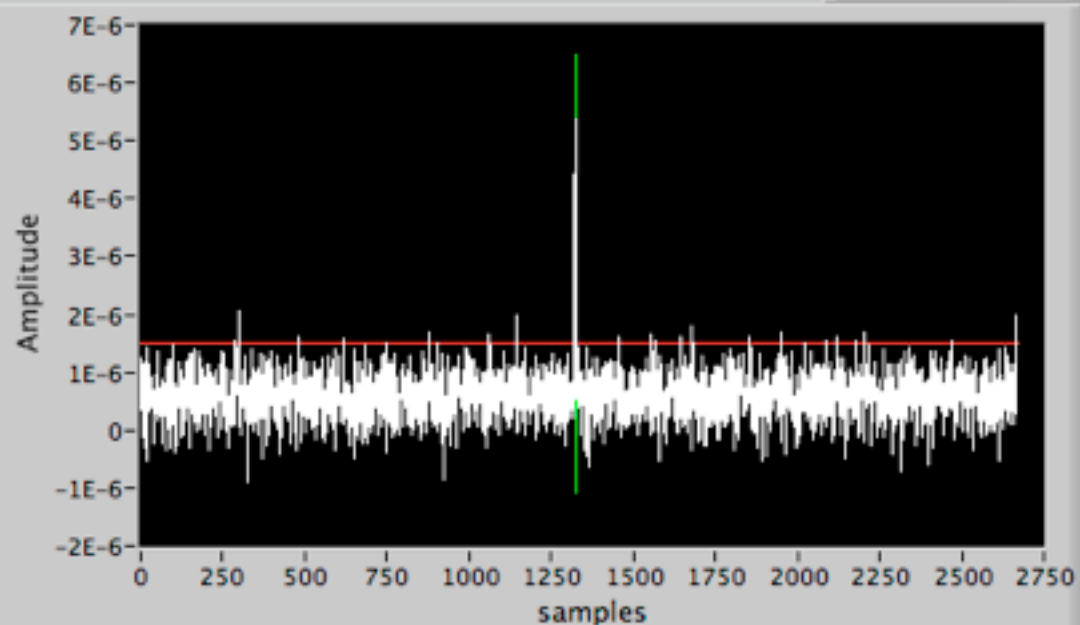
- GATE OG [ns]
- GATE UG [ns]
- Gate OG [ns]
- Gate OG [ns]
- Messung [ns]
- Annahme [ns]

**Gate**



**Laser-Altimeter-Analyse**  anzeigen

- LA-Signal
- Schwellwert
- Messwert



- 
- 
- 
- 
- 

- gesamtes Terrain zeigen
- Terrain-Hoehe [m] Messung
- Terrain-Hoehe[m] (tatsaechlich)

gemessene Terrain Hoehe[m]

