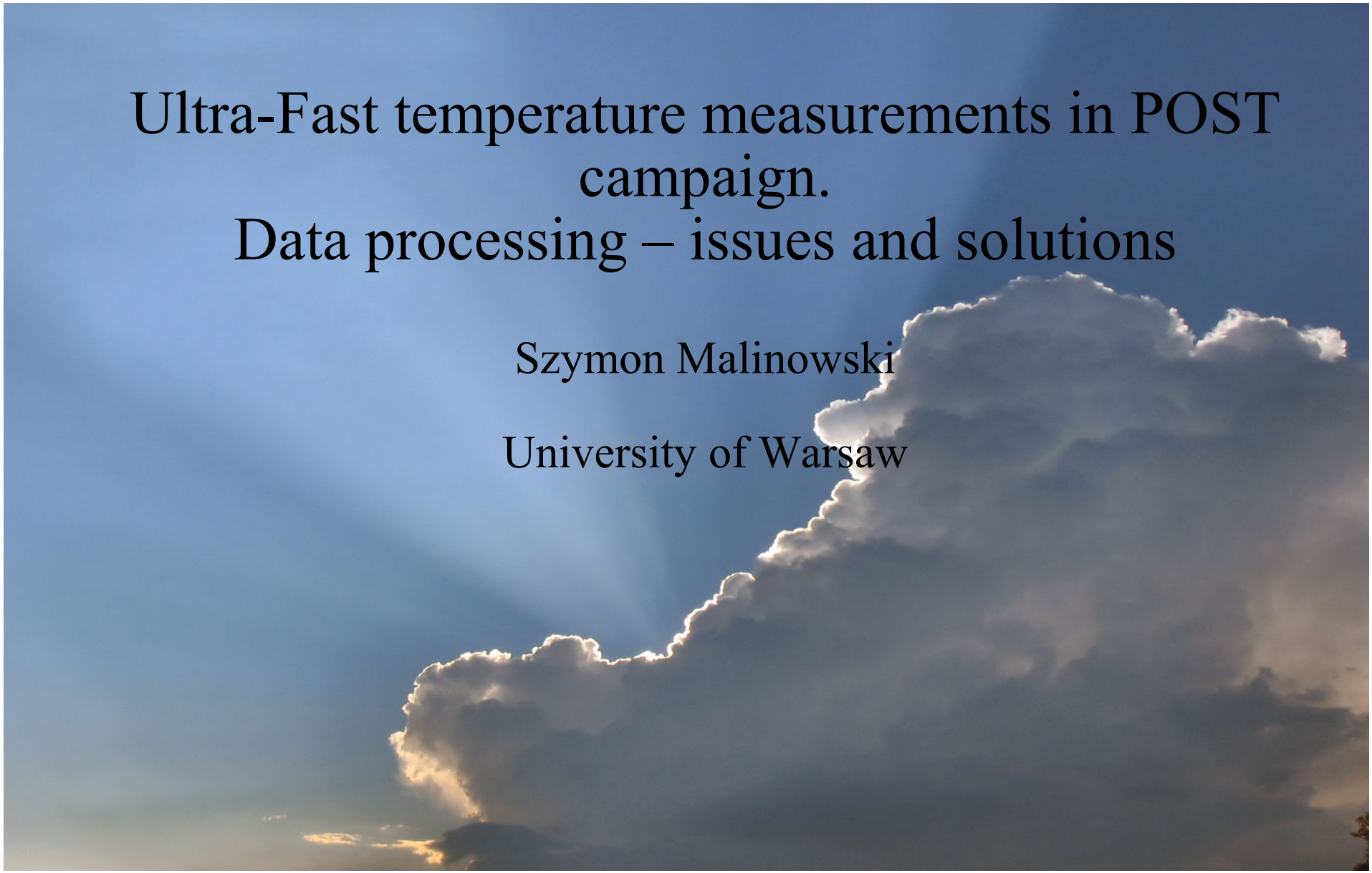
Ultra-Fast temperature measurements in POST campaign. Data processing – issues and solutions



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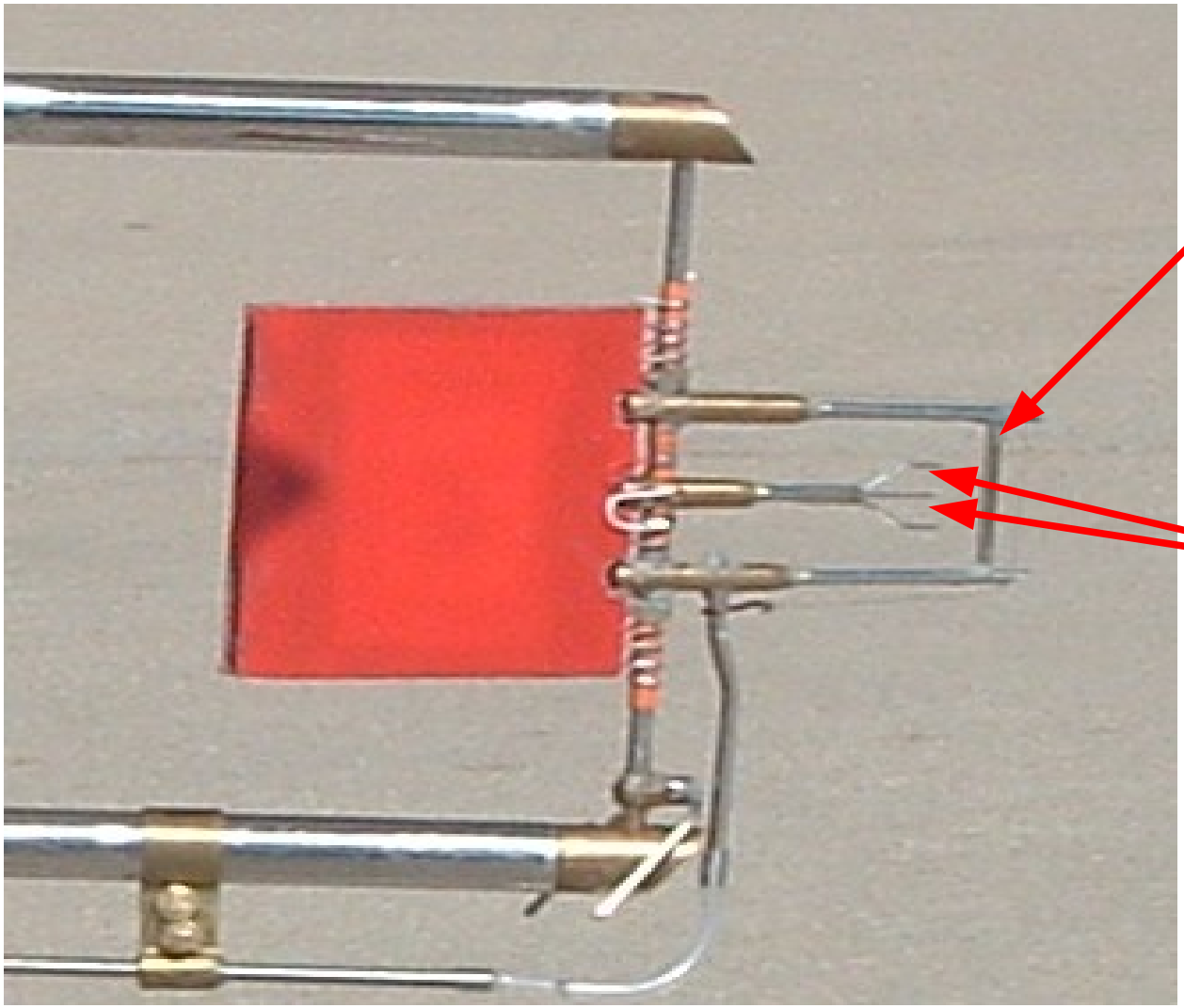
POST – Physics of Stratocumulus Top, California, 2008

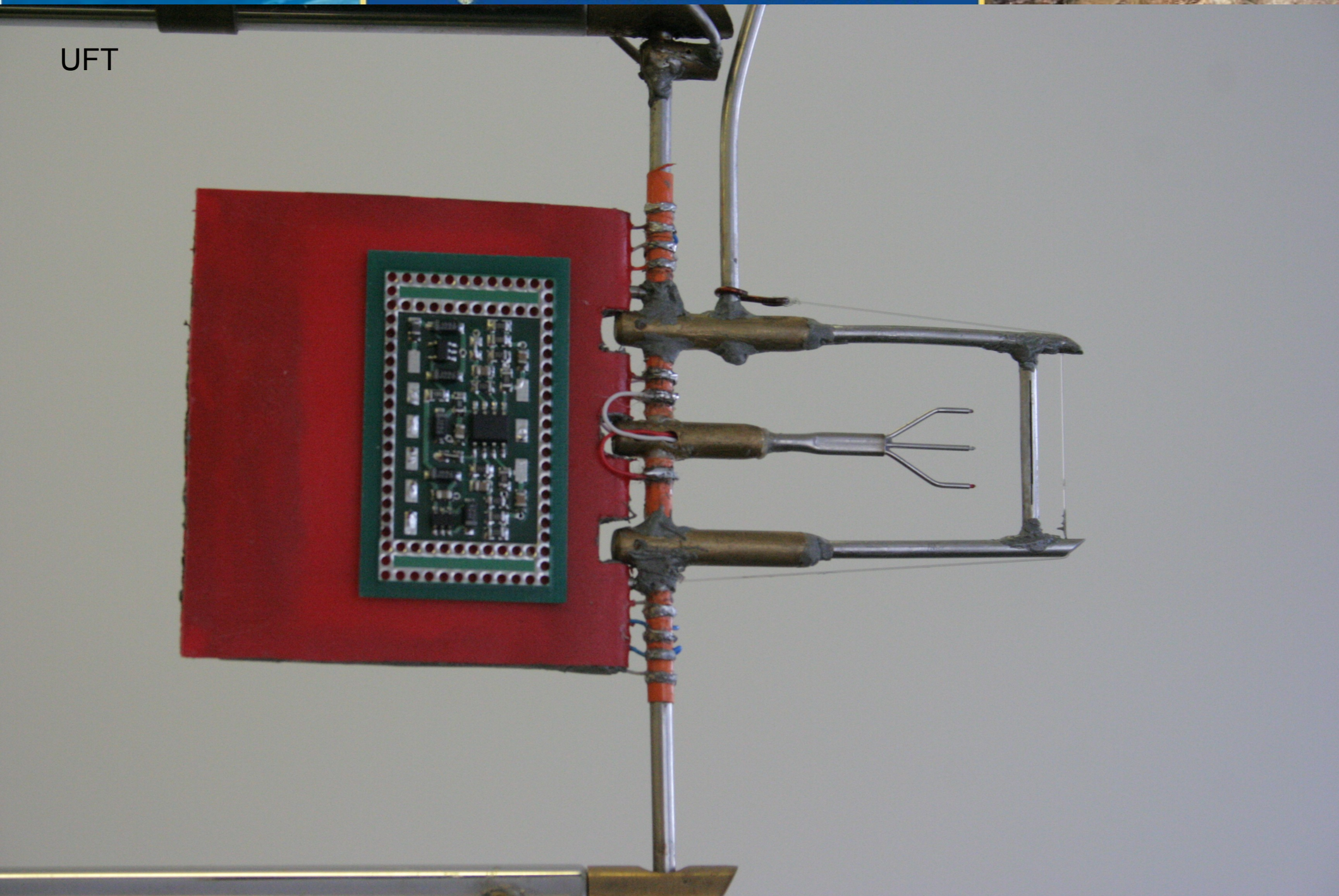
microphysics

temperature,
humidity,
liquid water,
turbulence,

droplet counting


protective rod
sensing wires

UFT



Recorded at 20 kHz each, i.e. ~ 360 000 000 data points in each channel from one flight

Time signal

UFT-1

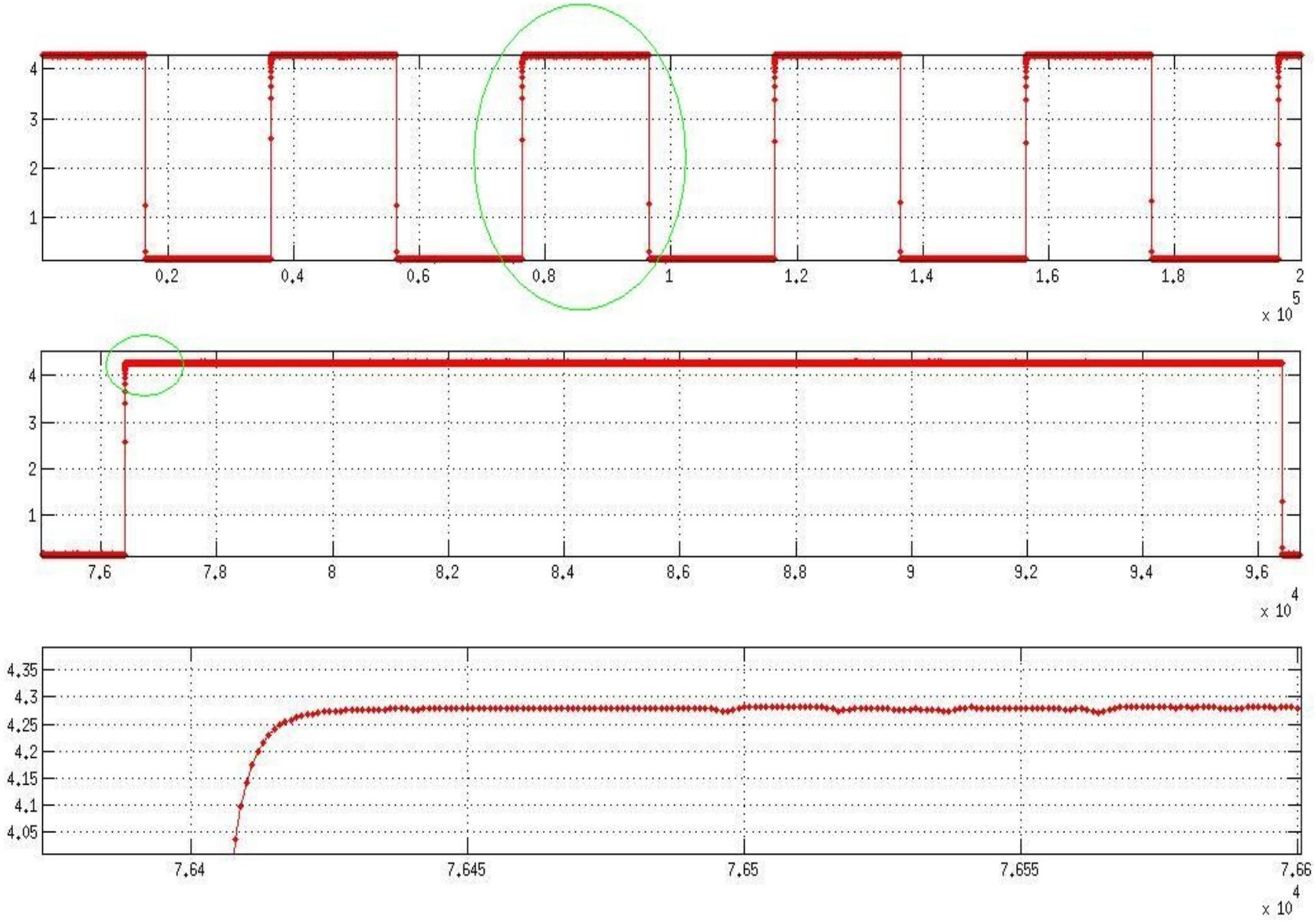
UFT-2

15 successful flights, 4 with very good data, 5 with good data, 6 acceptable data

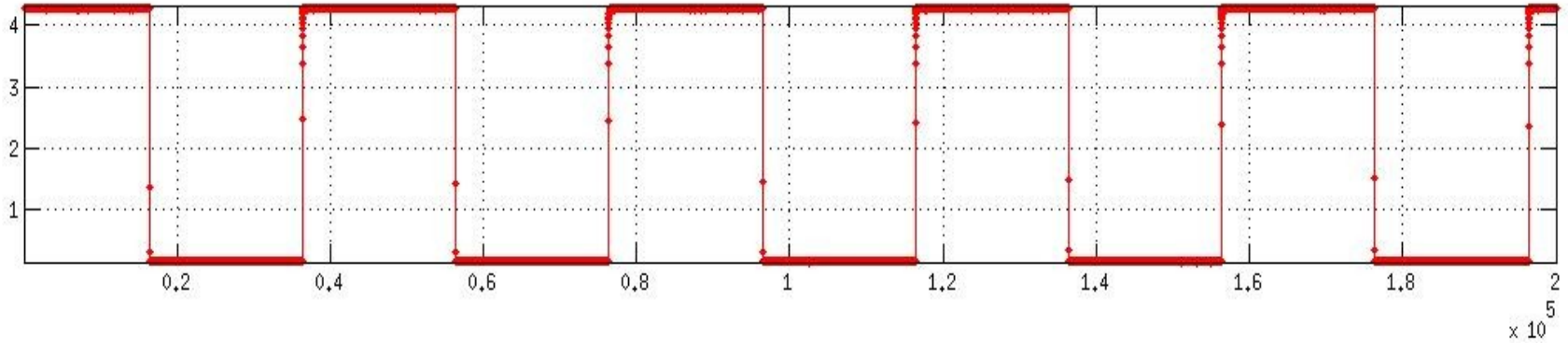
130GB of binary data to process

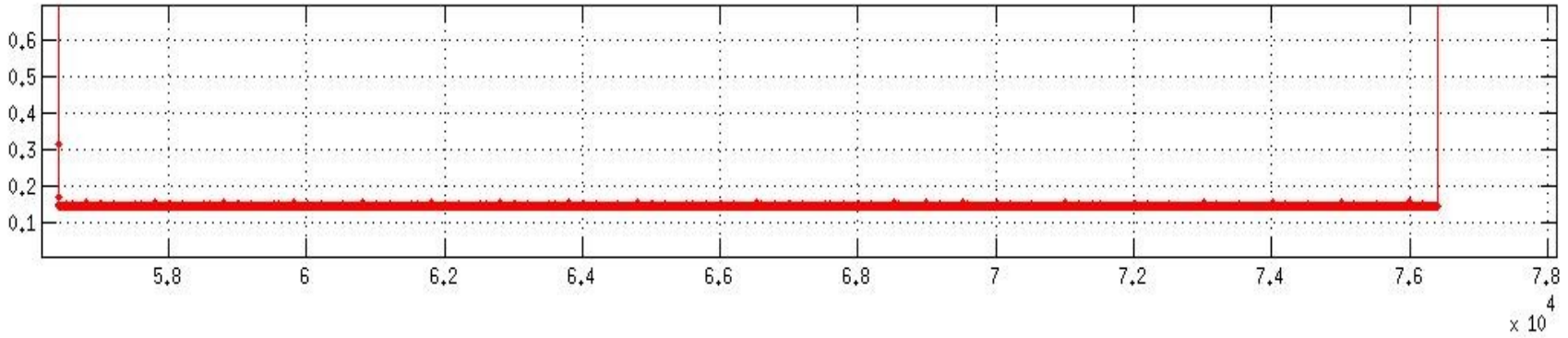
Still some issues

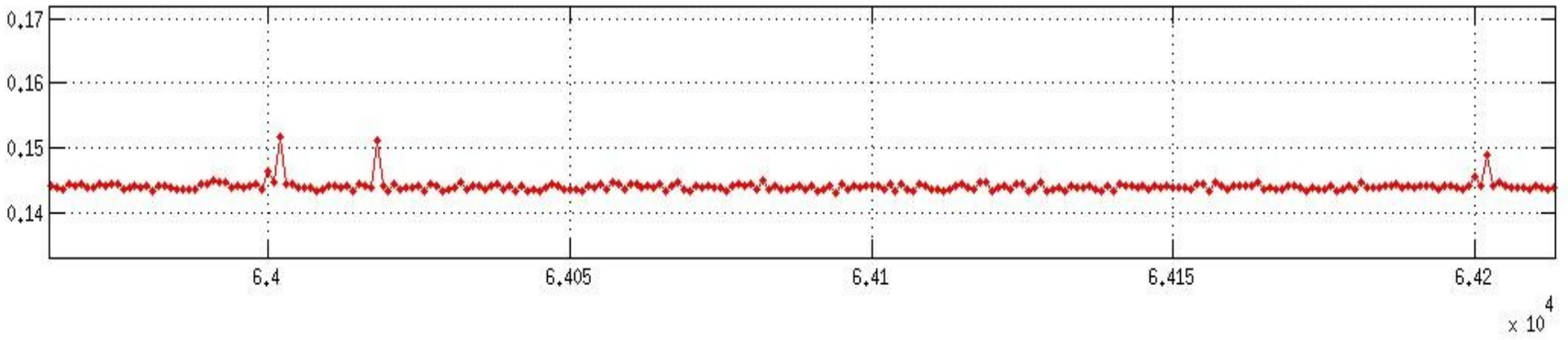
Time signal


4
3
2
1
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
x 10^5
4
3
2
1
7.6
7.8
8
8.2
8.4
8.6
8.8
9
9.2
9.4
9.6
x 10^4
4.35
4.3
4.25
4.2
4.15
4.1
4.05
7.64
7.645
7.65
7.655
7.66
x 10^4

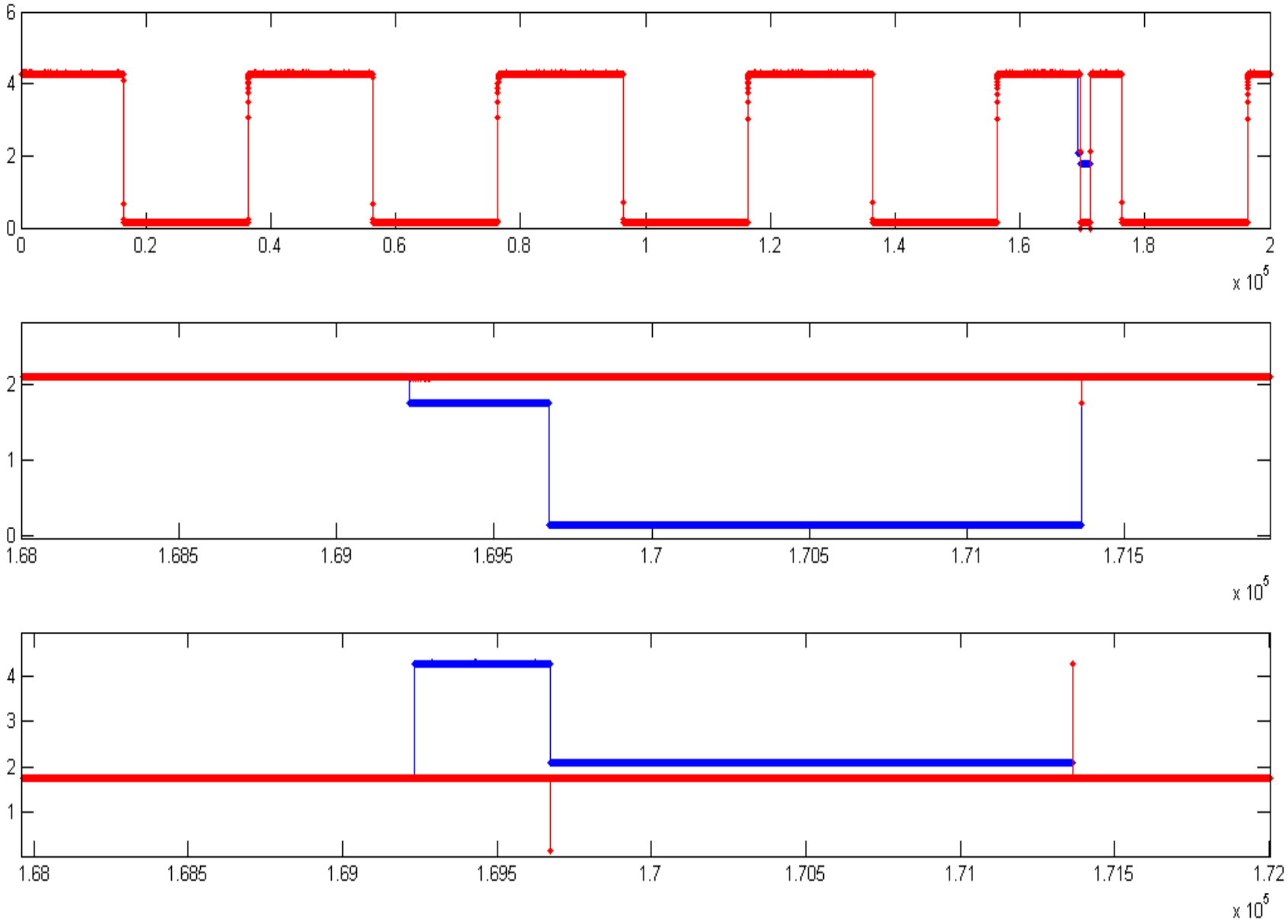
Time signal - noise



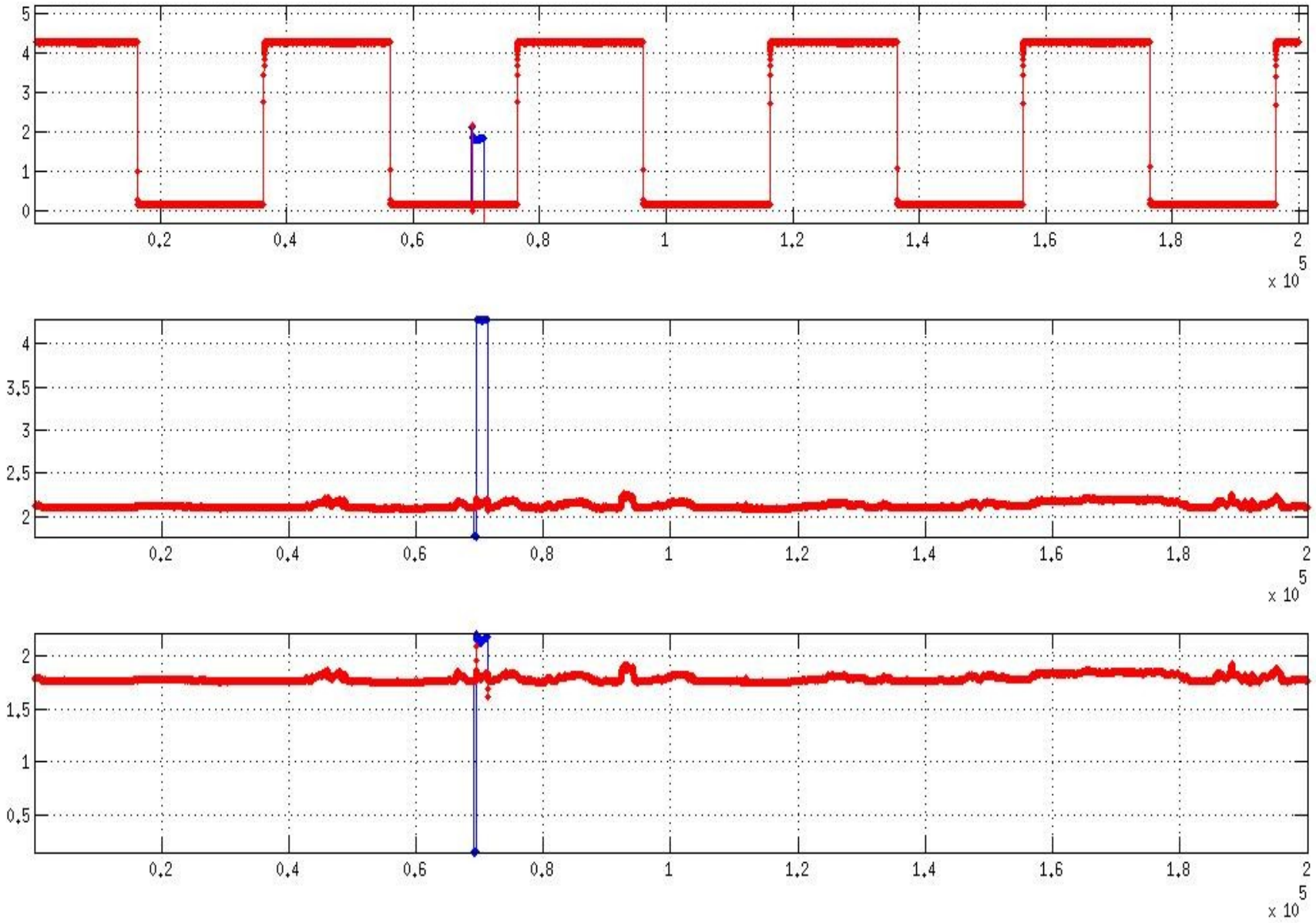




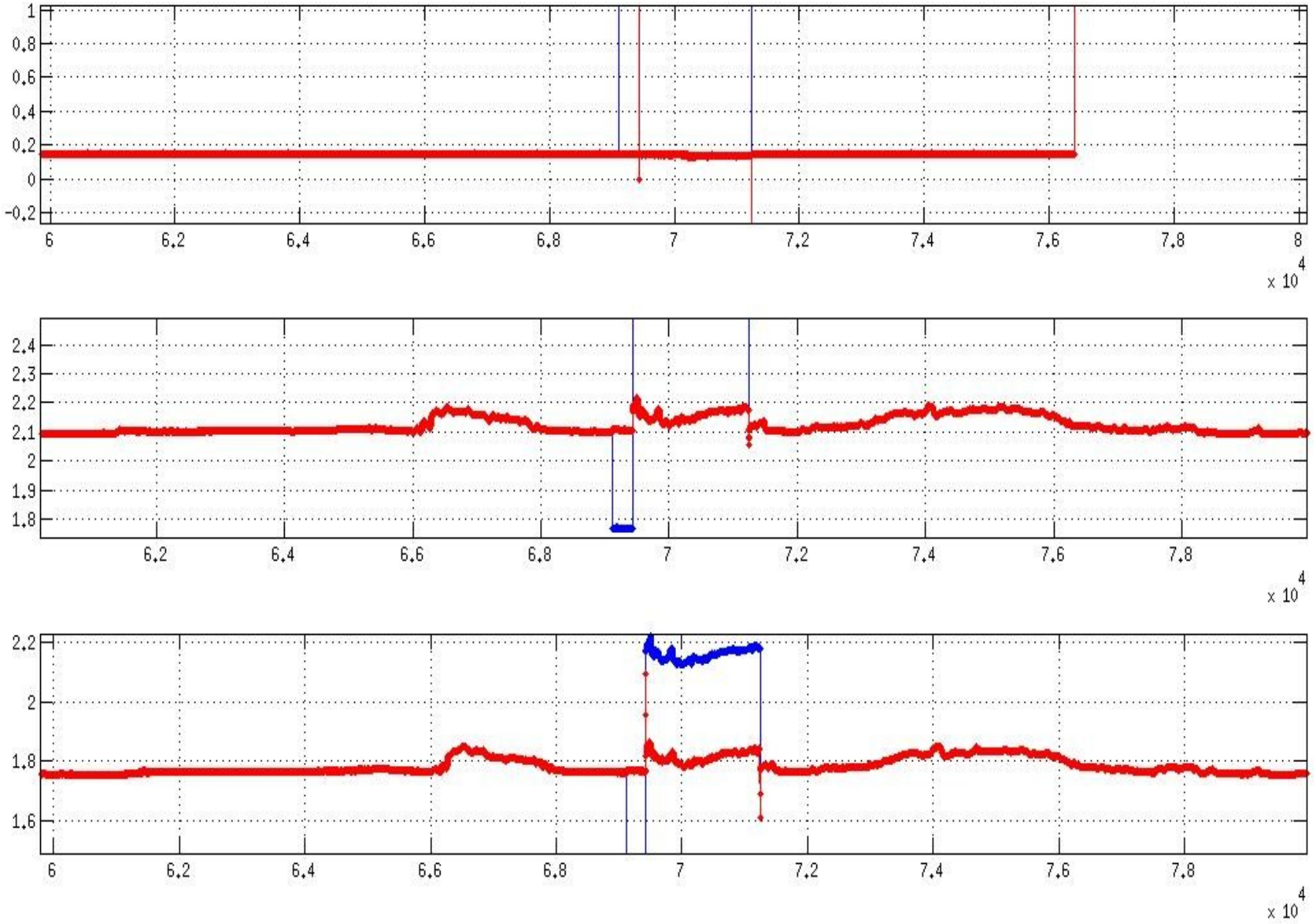
Channel switch problem



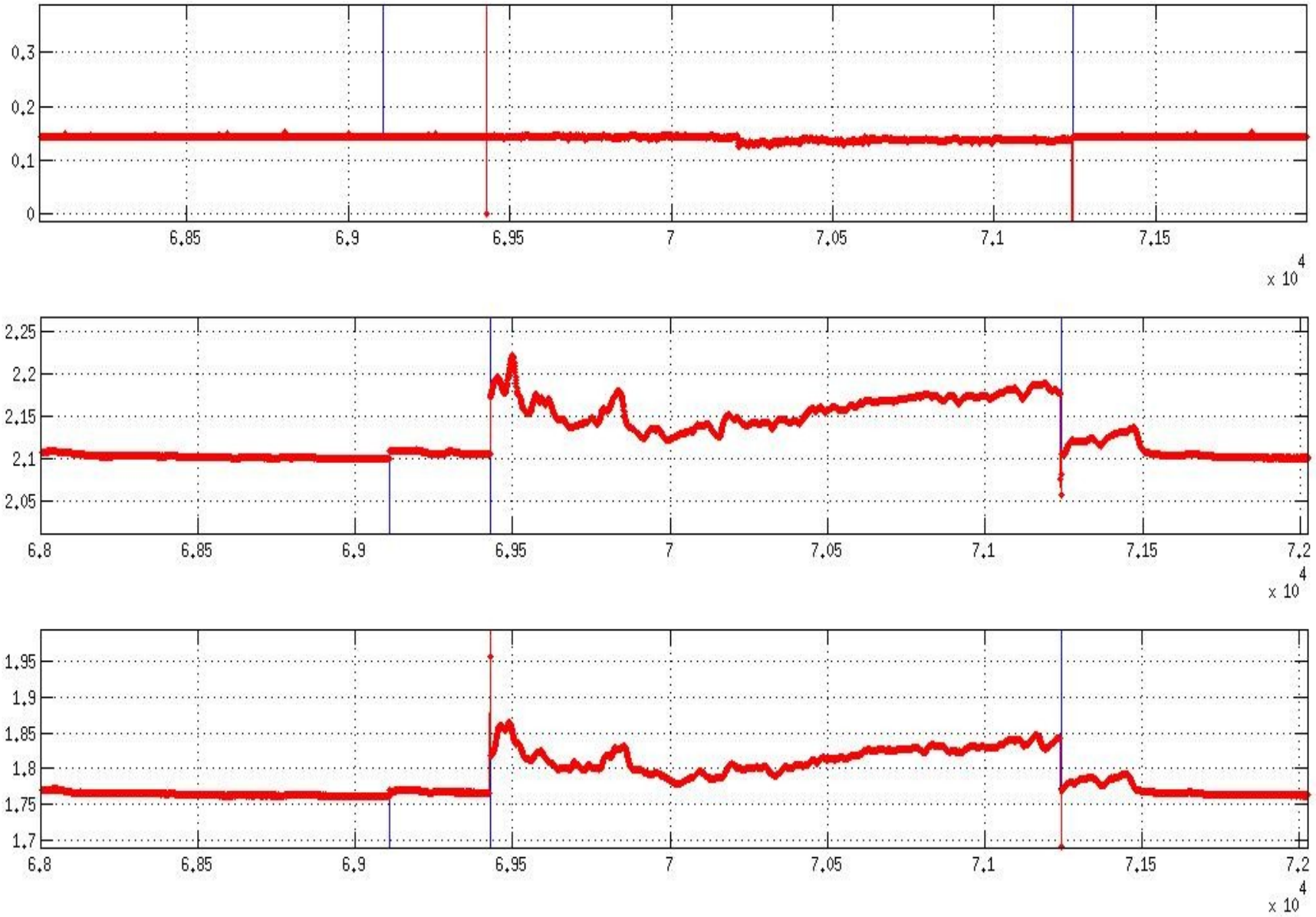
Channel switch problem



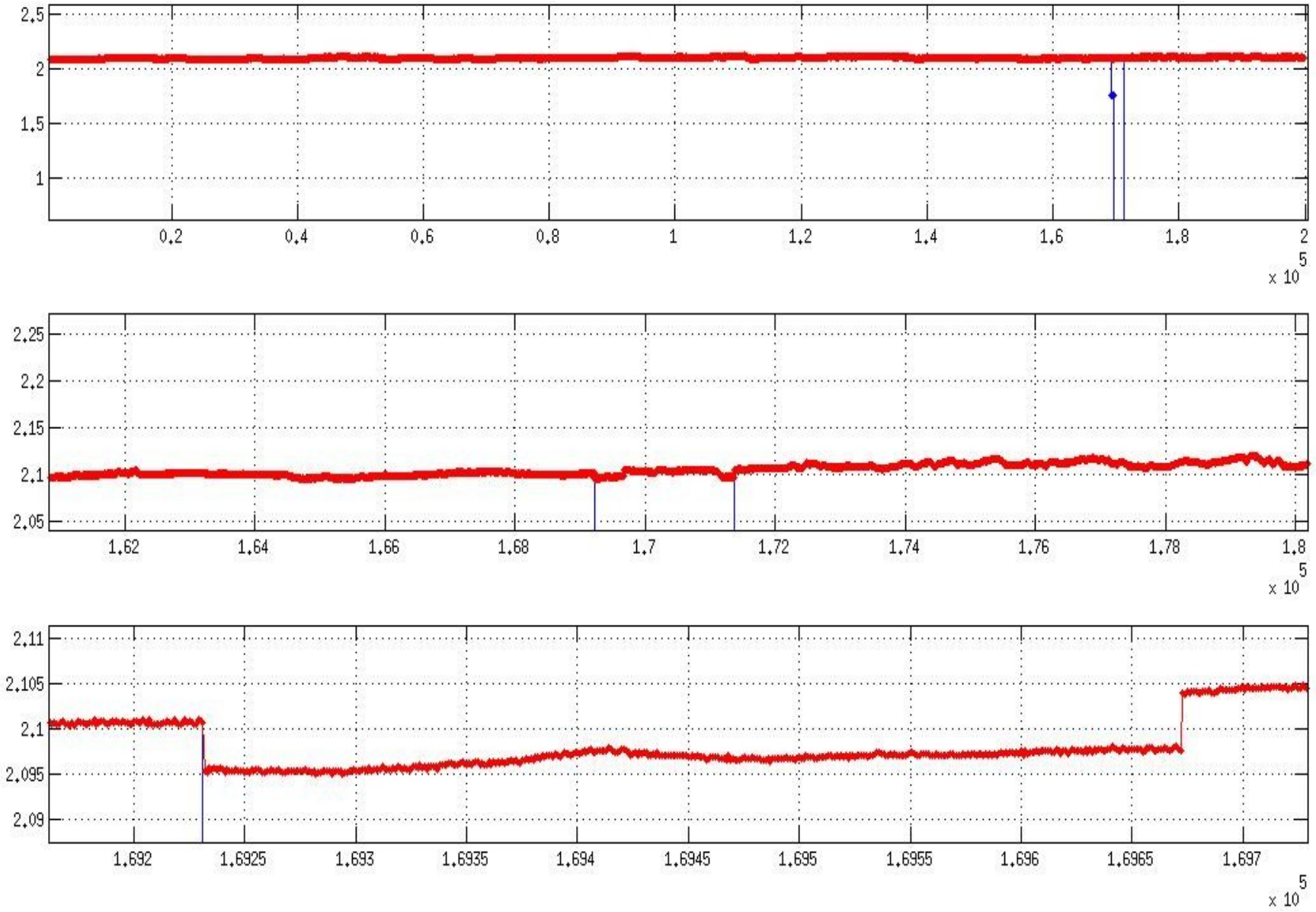
Channel switch problem



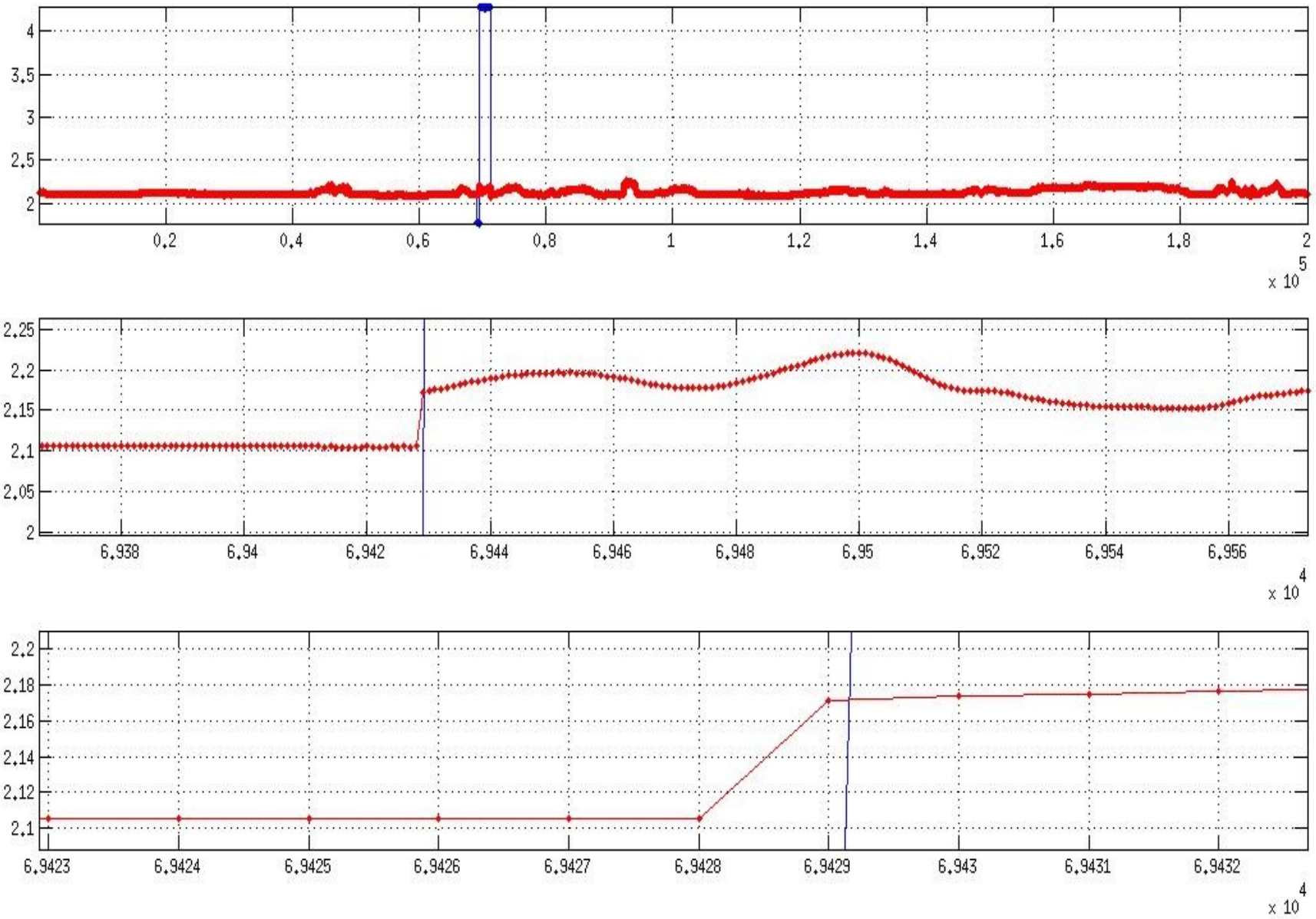
Channel switch problem



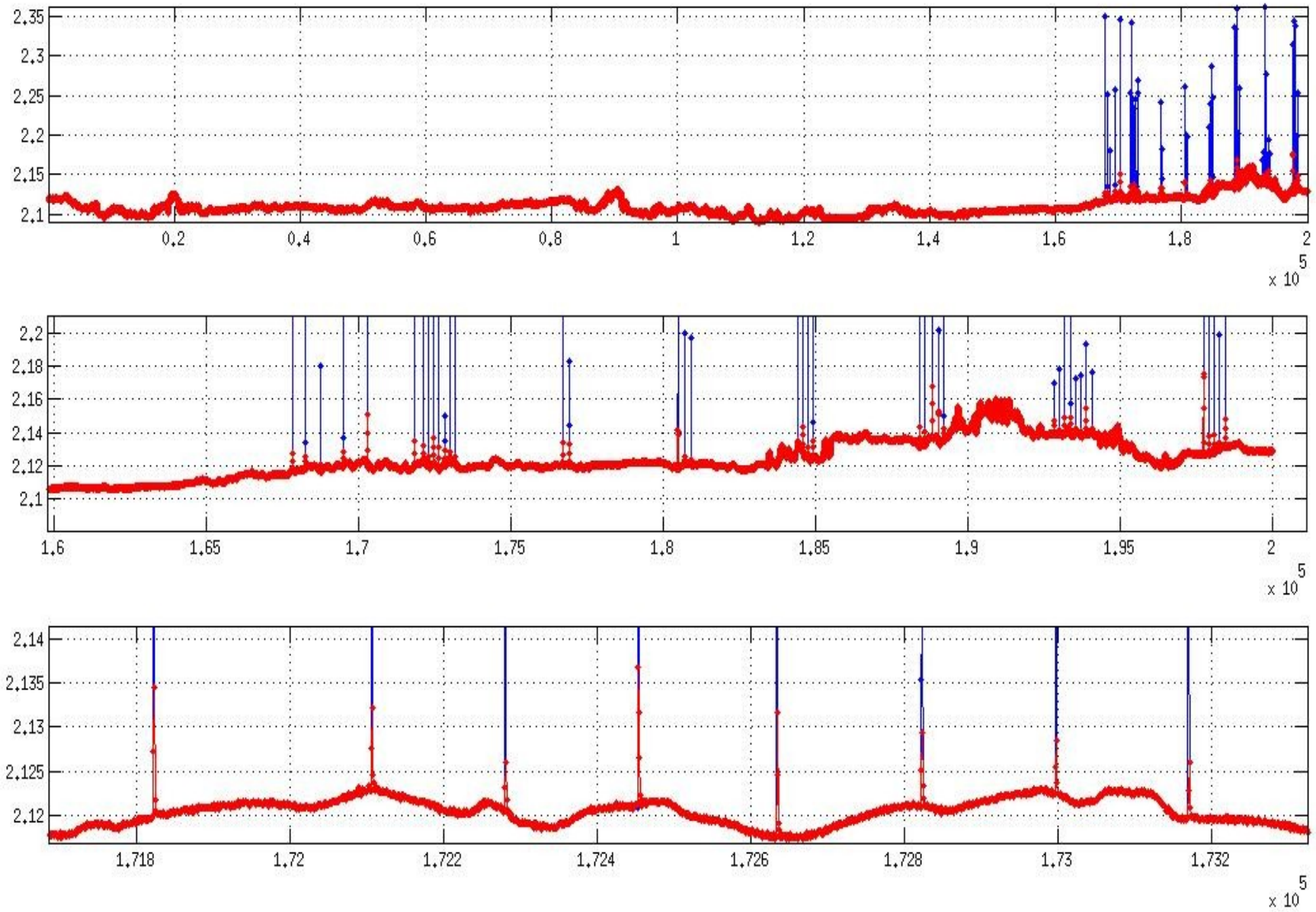
Channel switch – data uncertain – lost?? - explanation



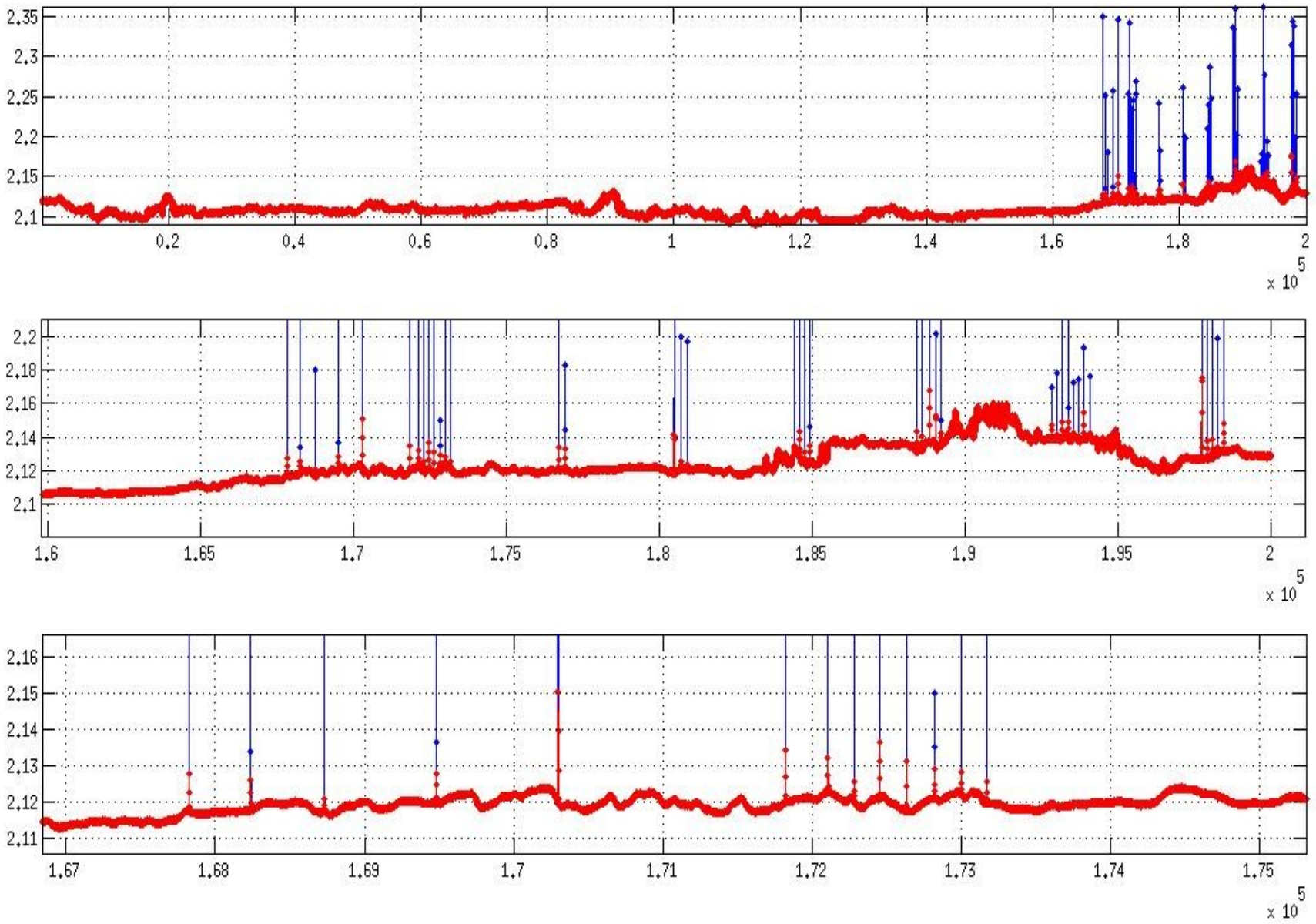
Channel switch – data uncertain – lost?? - explanation



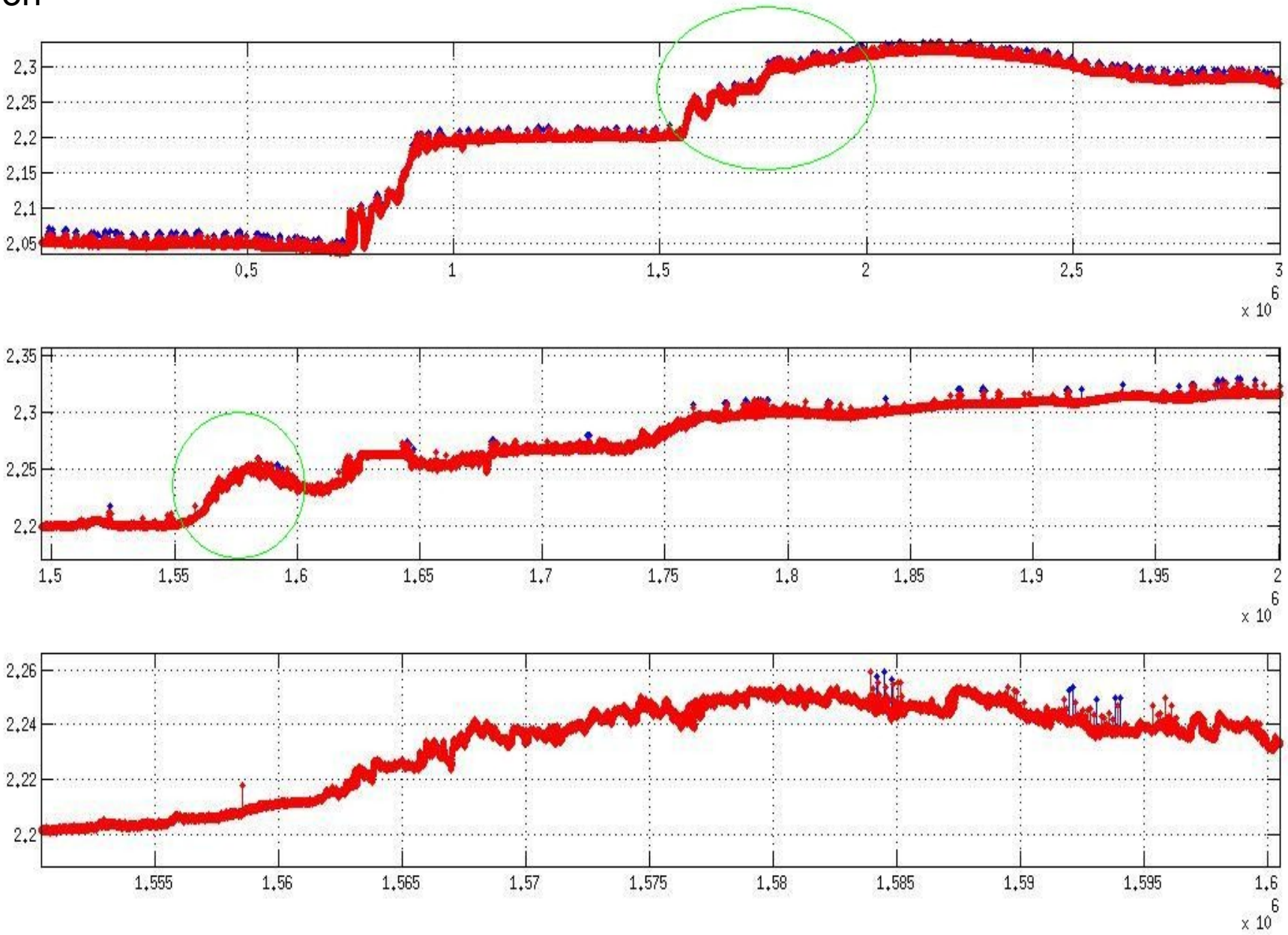
Spikes - typical



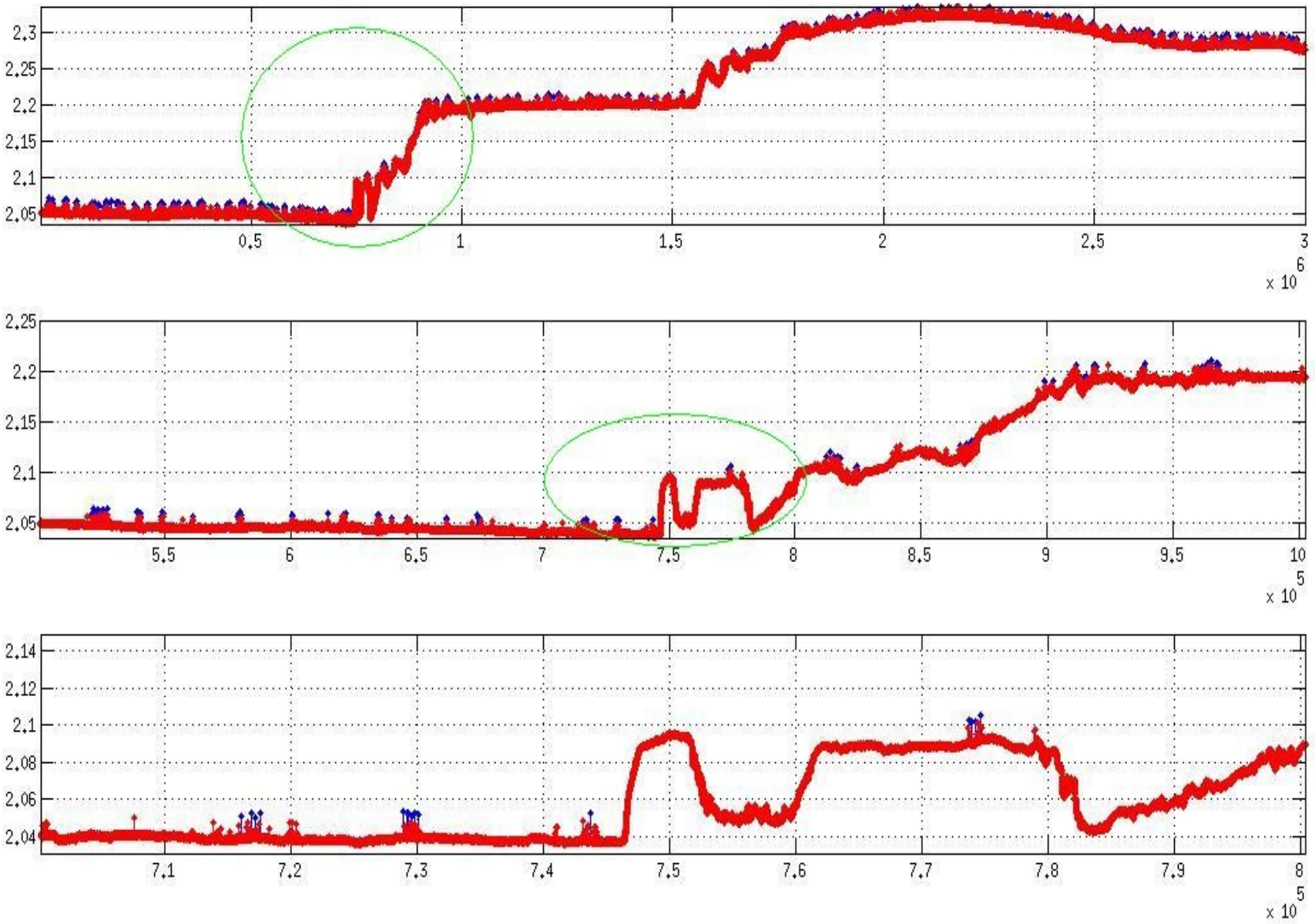
Spikes -in groups



Correction

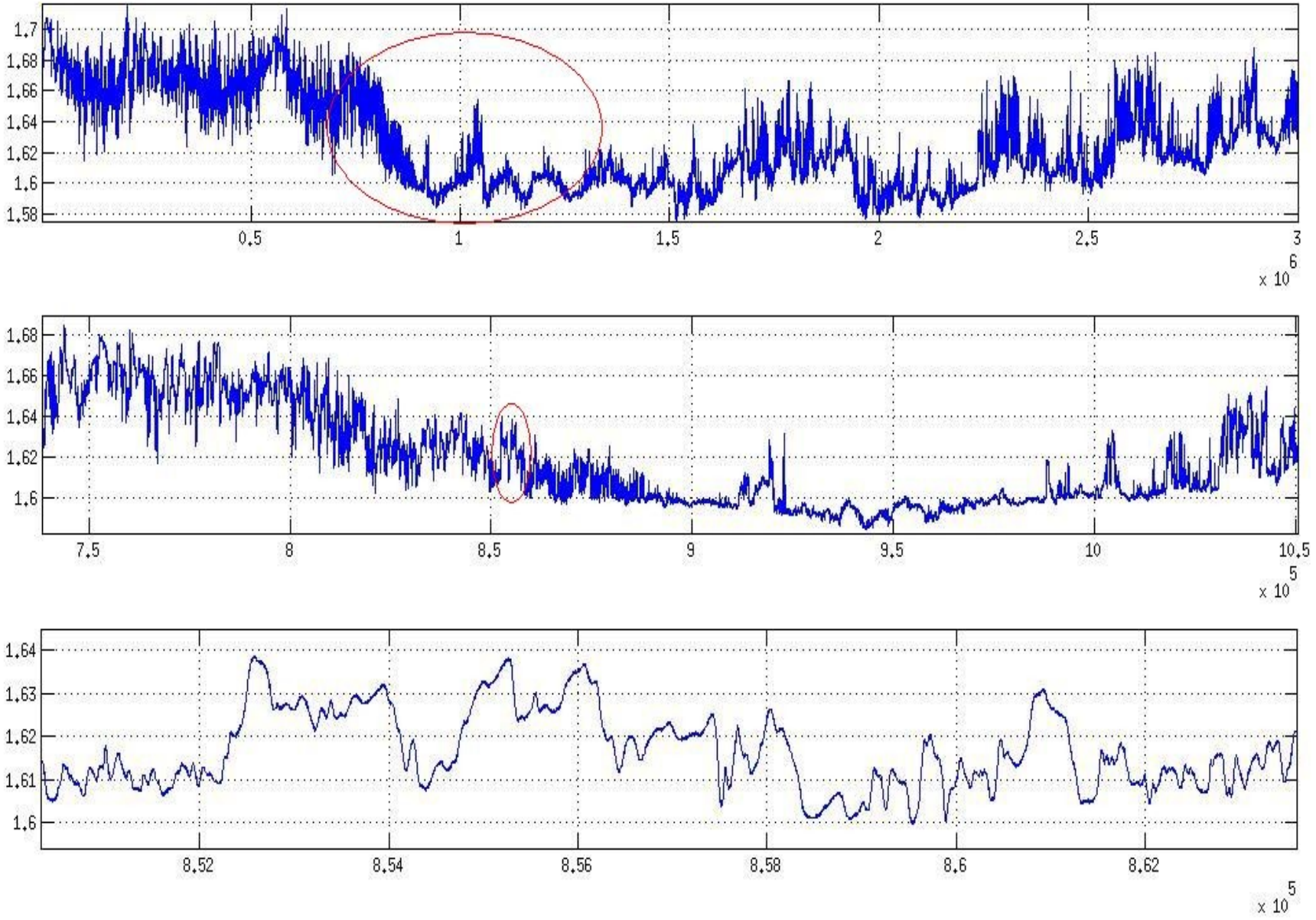

2.3
2.25
2.2
2.15
2.1
2.05
0.5
1
1.5
2
2.5
3
x 10^6
2.35
2.3
2.25
2.2
1.5
1.55
1.6
1.65
1.7
1.75
1.8
1.85
1.9
1.95
2
x 10^6
2.26
2.24
2.22
2.2
1.555
1.56
1.565
1.57
1.575
1.58
1.585
1.59
1.595
1.6
x 10^6

Correction- typical variability.



Flight date	Binary size	Conversion to Matlab	Channels quality	Priority	Channel jump problem	Spikes (DMU)	Data lost	Overall quality	Time mark localization	Averaging	Temperature correction
2008-07-16	8,69GB	done	T1-poor T2-poor	low	moderate	many, filtered	Some, localized	2	yes		
2008-07-17	8,96GB	done	T1-poor T2-poor	low	moderate	many, filtered	Some, localized/f	2	yes		
2008-07-18	7,75GB	done	T1-poor T2-broken	low	moderate	many, filtered	Few, localized	1	yes		
2008-07-28	7,89GB	done	T1-good T2-drift	high	high	sporadic, filtered	Few, localized	3	yes		
2008-07-29	9,16GB	done	T1-good T2-good	high	moderate	In groups, filtered	Some, localized,f	4	yes		
2008-07-30	9,05GB	done	T1-good T2-drift	high	moderate	Sporadic, filtered	Some, localized	3	yes		
2008-08-01	9,47GB	done	T2-good T2-drift	top	moderate	Rare, filtered	Some, localized	3	yes		
2008-08-02	9,19GB	done	T1-good T2-good	High	Moderate	Sporadic, filtered	Few, localized	4	yes		
2008-08-04	9,35GB	done	T1-good T2-poor	High	Moderate	Sporadic, filtered	Some, localized	3	yes		
2008-08-06	8,68GB	done	T1-good T2-goos	High	Low	Sporadic, filtered	Some, localized	4	yes		
2008-08-08	8,90GB	done	T1-good T2-good	High	Moderate	Sporadic, filtered	Some, localized	4	yes		
2008-08-09	8,86GB	done	T1-problem T2-good	low	moderate	Sporadic, filtered	Few, problem	2	yes		
2008-08-12	8,26GB	done	T1-good T2-good	Top	low	In gropus, filtered	Few, localized	4	yes		
2008-08-13	8,54GB	done	T1-poor T2-poor	low	moderate	Sporadic, filtered	Some, localized	2			
2008-08-15	8,16GB	done	T1-moderate	high	moderate	In gropups, filtered	Some, localized	3	yes		

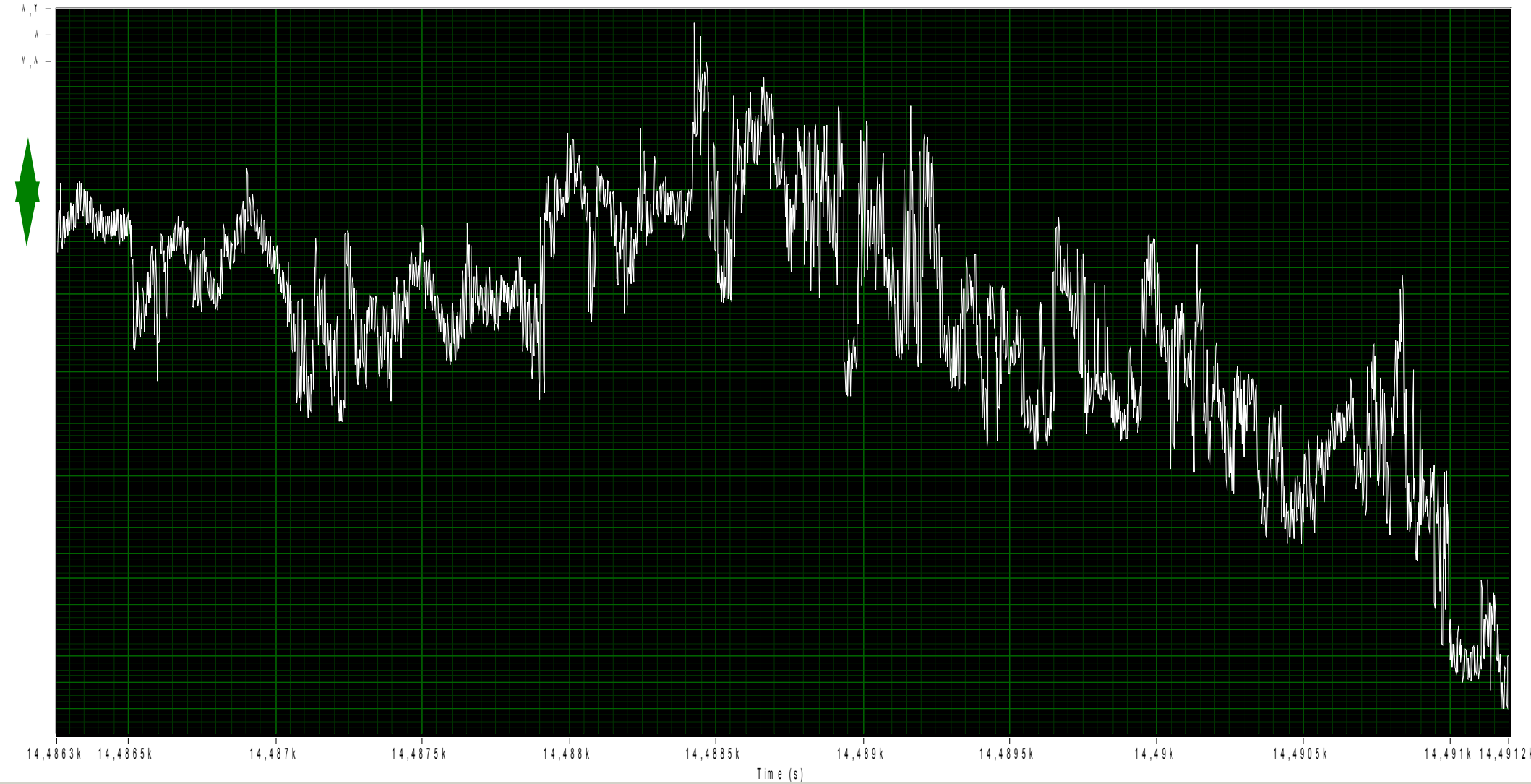
Extreme variability – to be verified.



POST, 2008-08-02, TOF09, example of the UFT record.
Vertical axis – temperature fluctuations [K];
Horizontal axis – time in seconds from the beginning of the record (k-kilo), TAS~50m/s
Descend 2 into the cloud

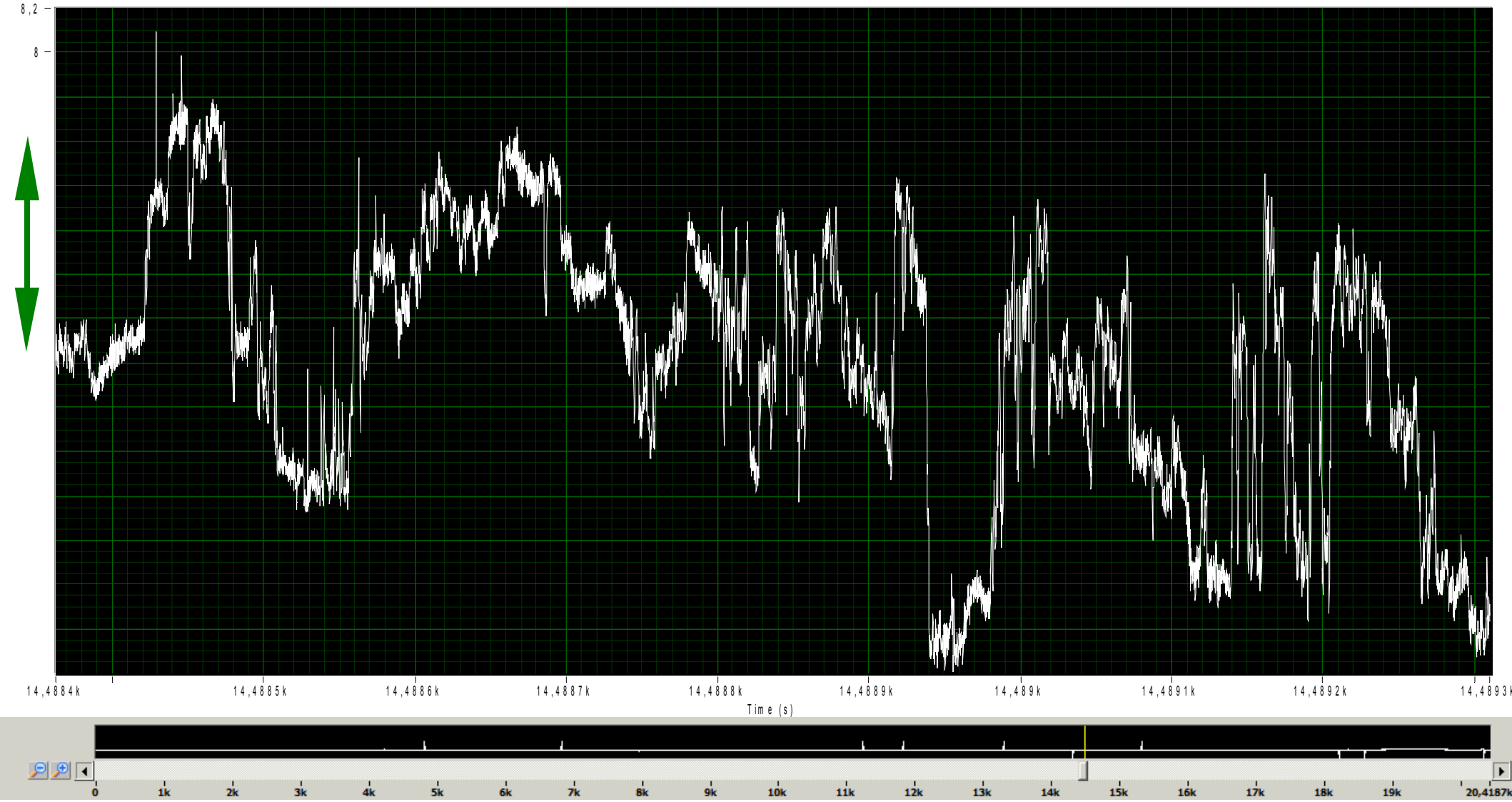
Descend 2, blowup A1

0.5s - 25m

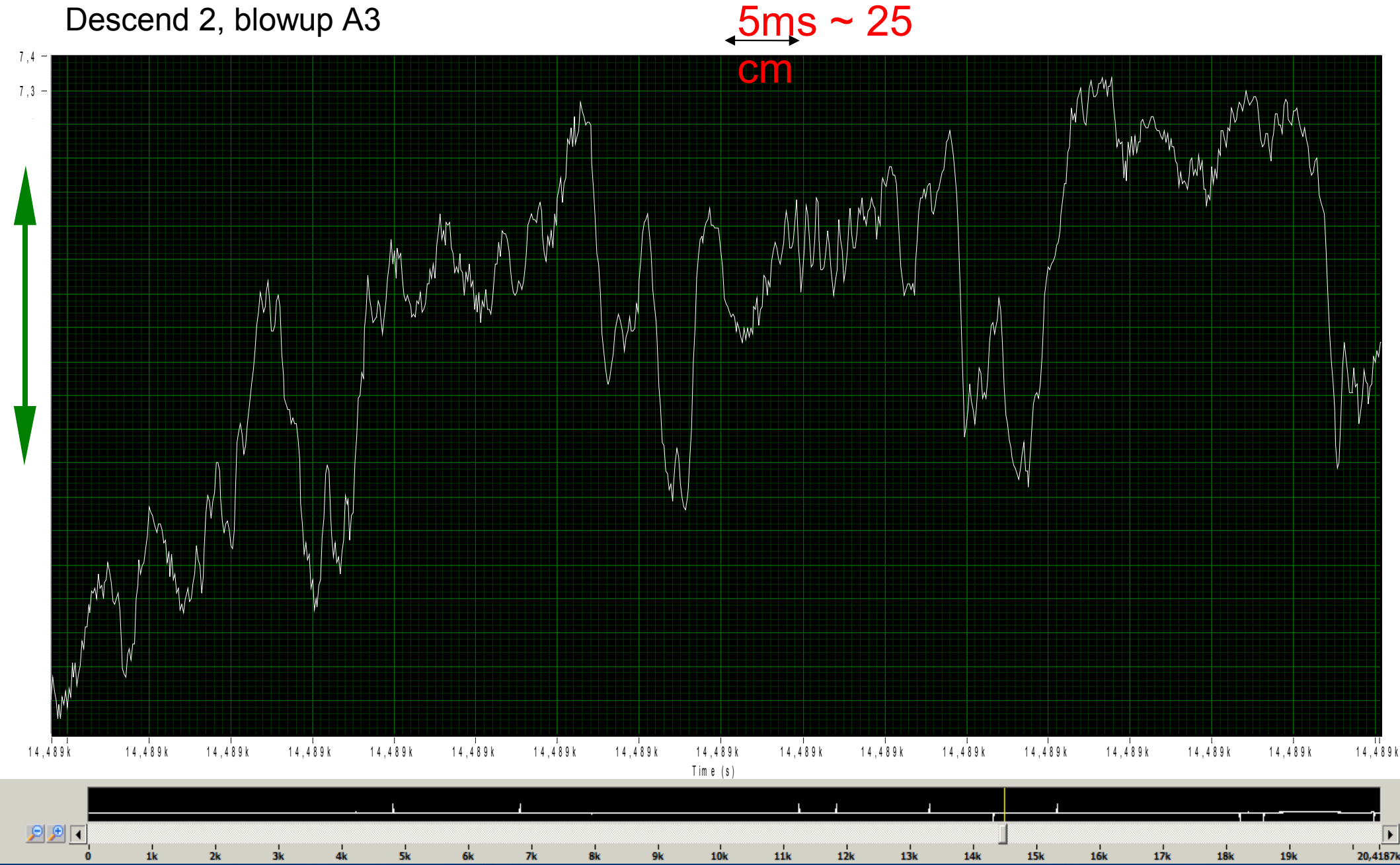


Descend 2, blowup A2

0.1s - 5m



Descend 2, blowup A3



Further investigation

Temperature and LWC

- structures of dry filaments in EIL – active turbulence or still remnants?
- identification of regions of active mixing – maximum gradients of T?
- characterization of fluctuations of temperature and LWC in regions of sizes of 100m, 20m, 5m for the purpose of verification with LES

Turbulence/mixing

Estimates of enstrophy – rotational and irrotational regions;
TKE at the cloud top;
Filaments, characteristic size – related to TKE on scales of ~100m or not??? for the purpose of homogeneous/inhomogeneous mixing parameterization

Entrainment/cloud holes

Calculations of buoyancy (density, temperature density) – small and large-scale buoyancy fluctuations.
Relative role of evaporative cooling /radiative effects.