IBIS - Image by Interferometric Survey

IBIS-L – RWE Mine Monitoring

Niederzier (Germany) - 2008 September 2nd – 6th

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TARGET

- RWE Power has to monitor the long term slope (outside border of the open pit) by regulations from Mining Authority (safety of the neighbourhood)
- GEOROBOT system with LEICAtotal stations and > 200 targets on the slope is established for years
- Parts of the slope are not reachable for fitting targets
- Other slopes inside the mine are not monitored yet, but there is a demand due to accidents and disturbances of operation
- RWE is searching for an operational system for this application

Open mine Hambach
3.681 ha mine ara

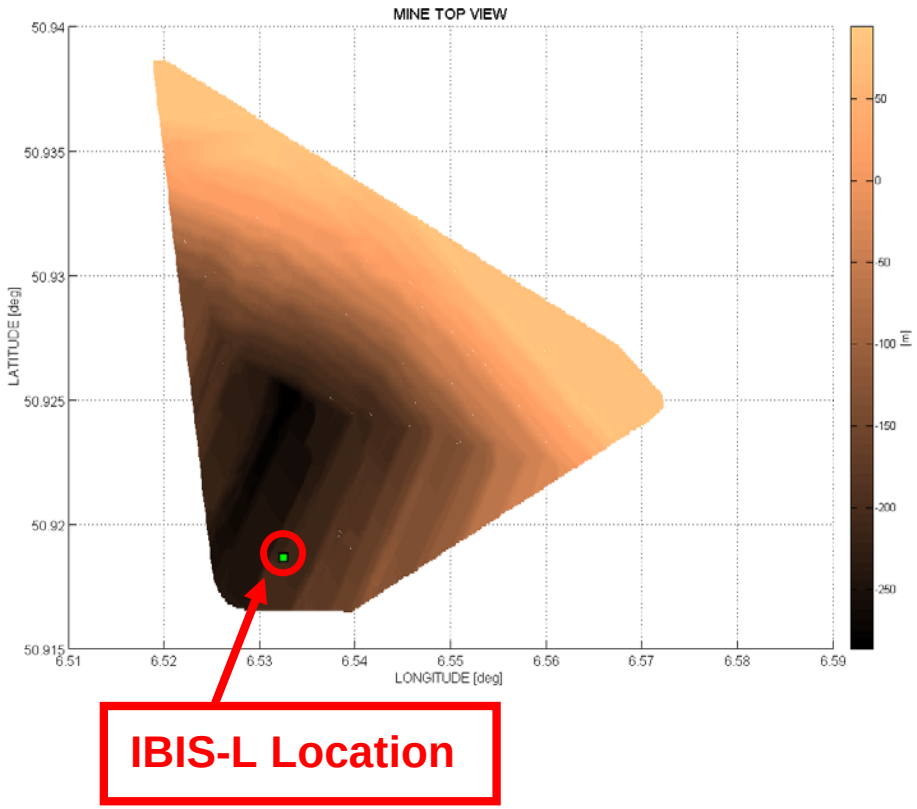
Slope to be monitored
-Regular by GEOROBOT totalstations
-Test by IBIS-L radarinterferometric system

System Configuration and Positioning

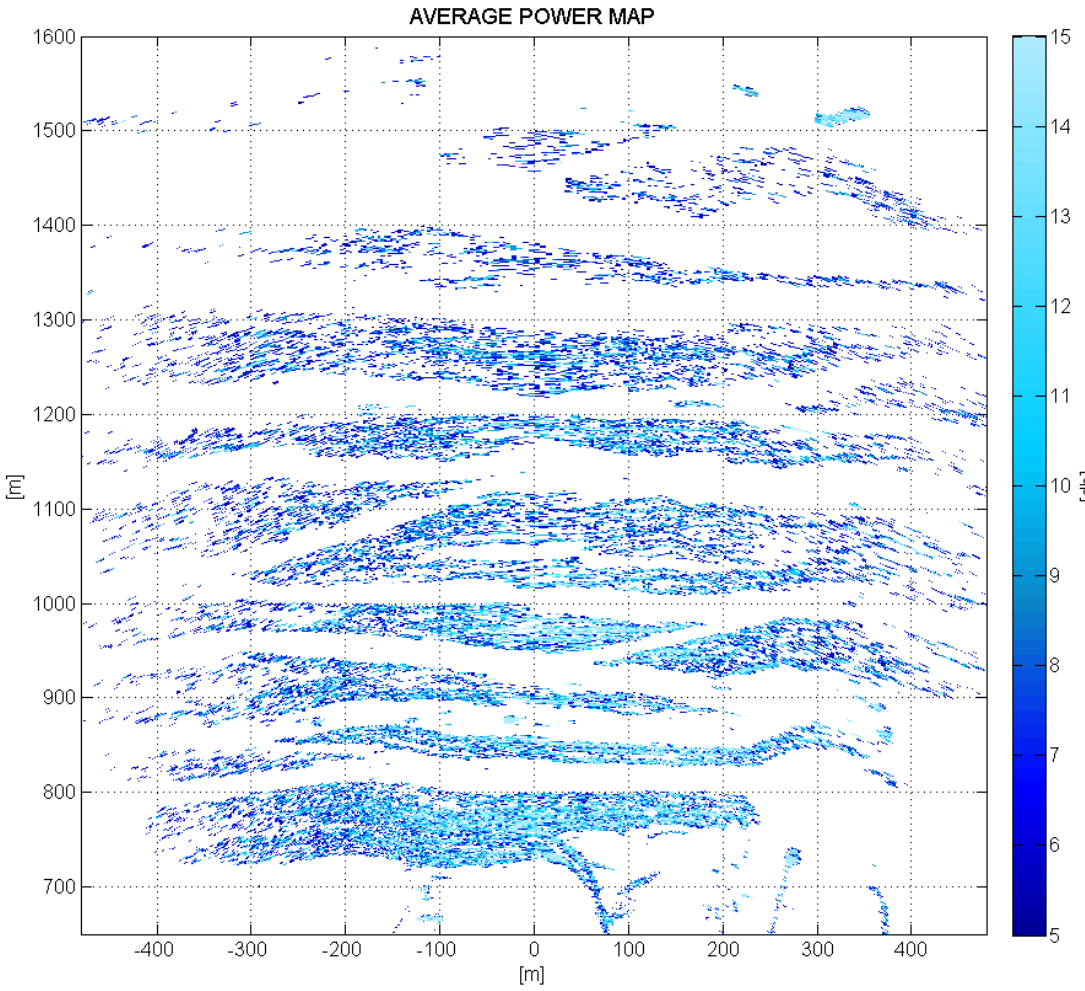
IBIS-L Configuration

DISTANCE FROM THE SLOPE CENTRAL SECTION [m]	**730-1600**
RADAR HEIGHT FROM GROUND [m]	**1,2**
ANTENNA TILT [deg]	**5**
HALF POWER BEAM WIDTH (-3dB) [deg]	**39**
SAMPLING FREQUENCY [number of acquisitions per hour]	**8**
TOTAL MONITORING TIME EXTENT [hours]	**88**
RANGE RESOLUTION [m]	**0.5**
CROSS-RANGE RESOLUTION [mrad]	**4.5**
MAXIMUM DISTANCE [m]	**1900**

System Positioning



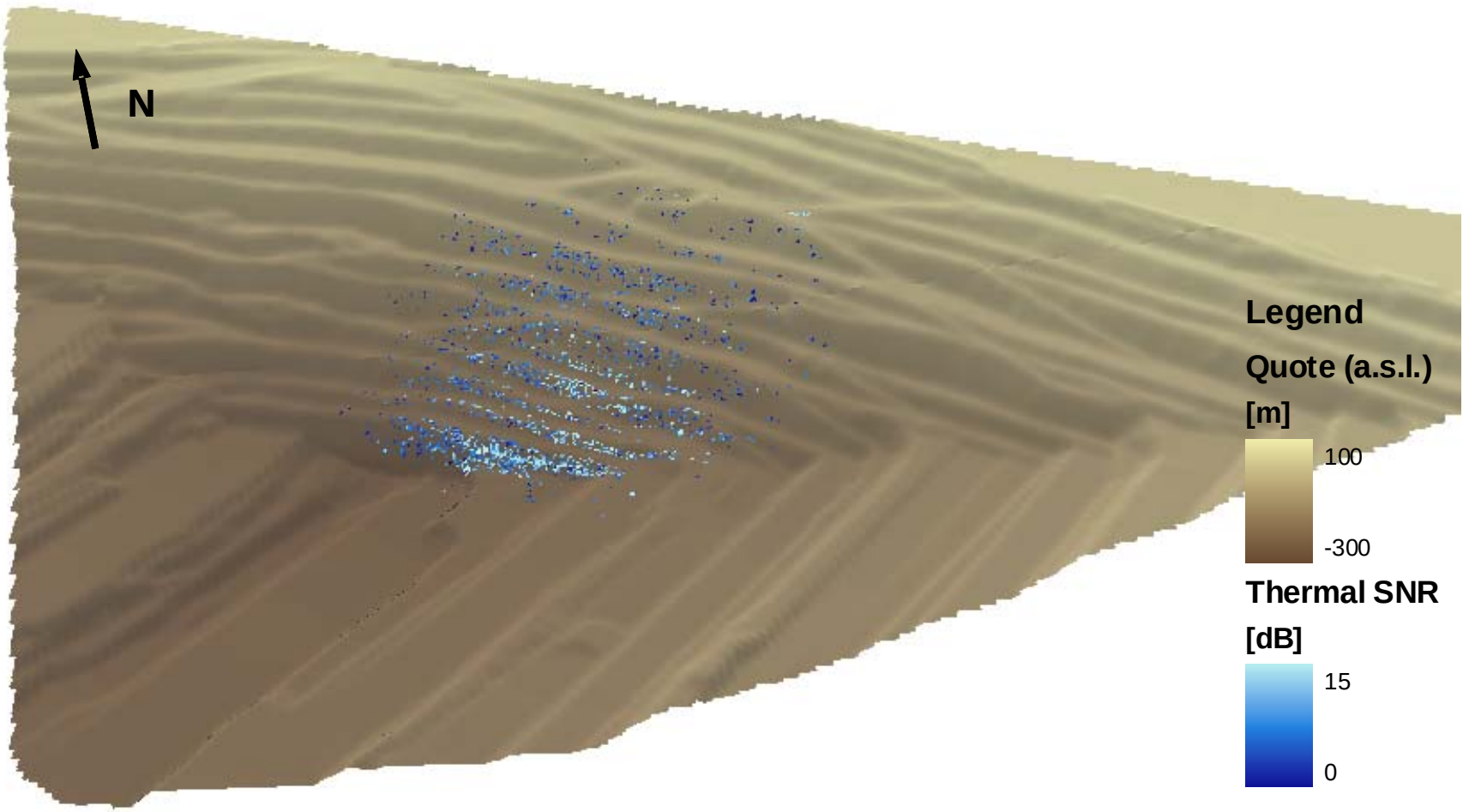
Thermal SNR Map – (average over 88h)



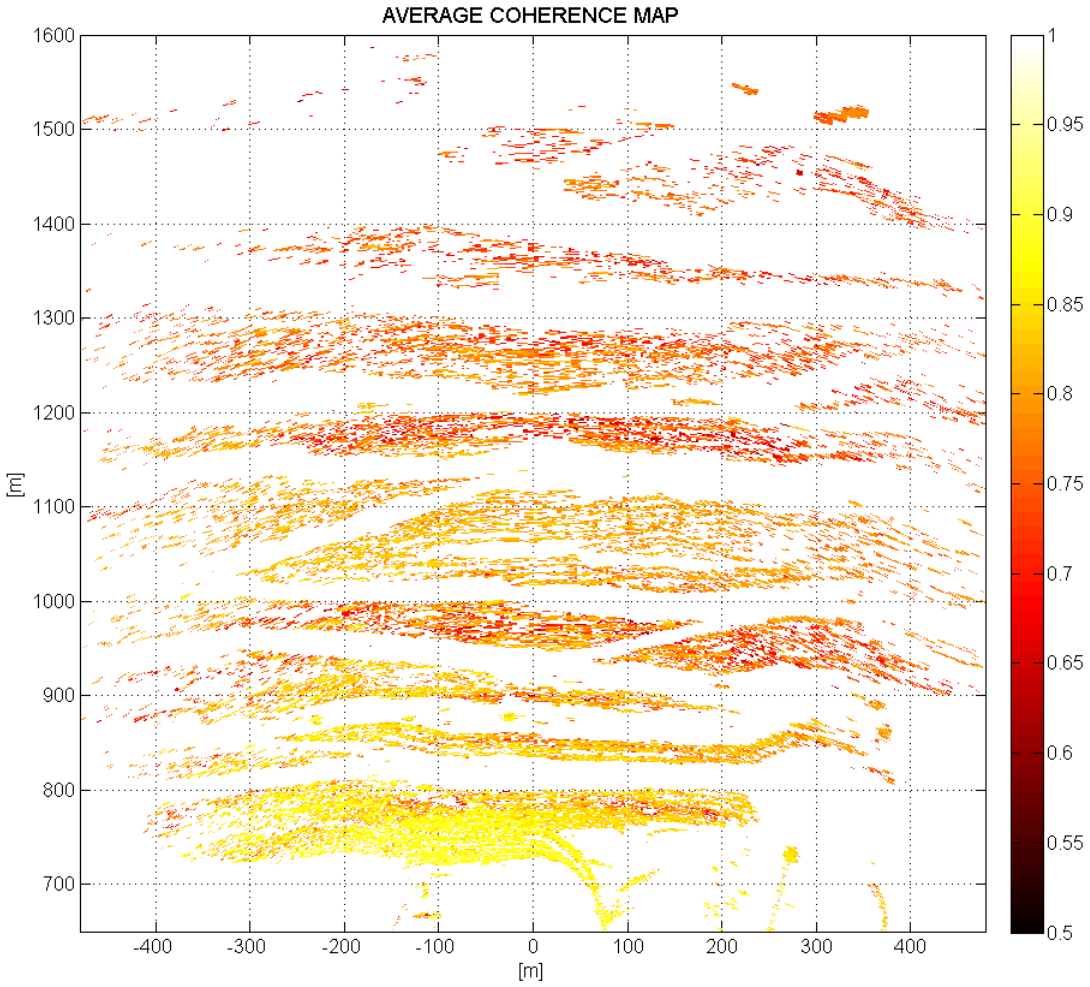
IBIS-L view on the slope

Thousands of pixel belonging to the slope have a quite good power response showing a Thermal SNR above 10 dB

Geolocated Power Map



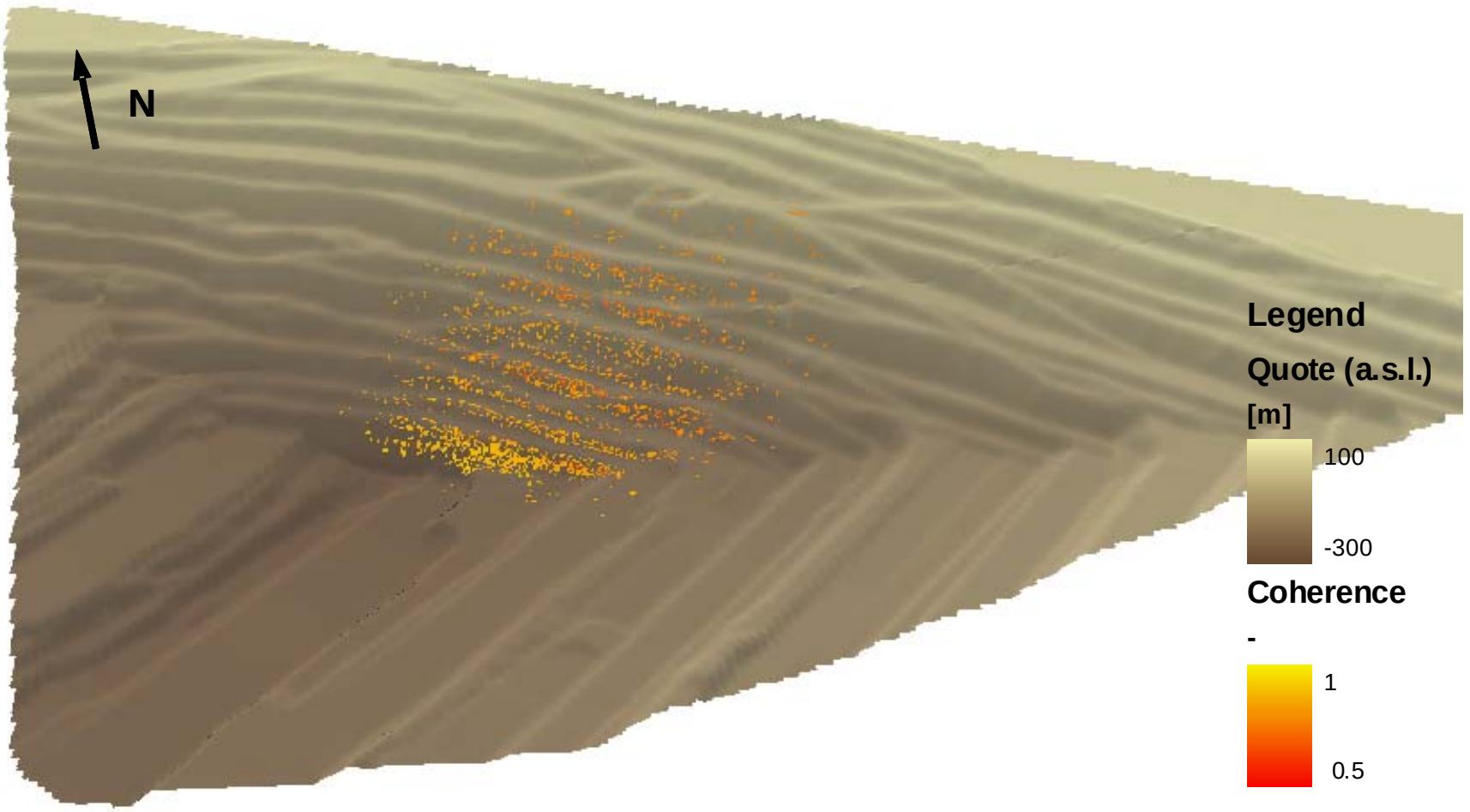
Coherence Map – (average over 88h)



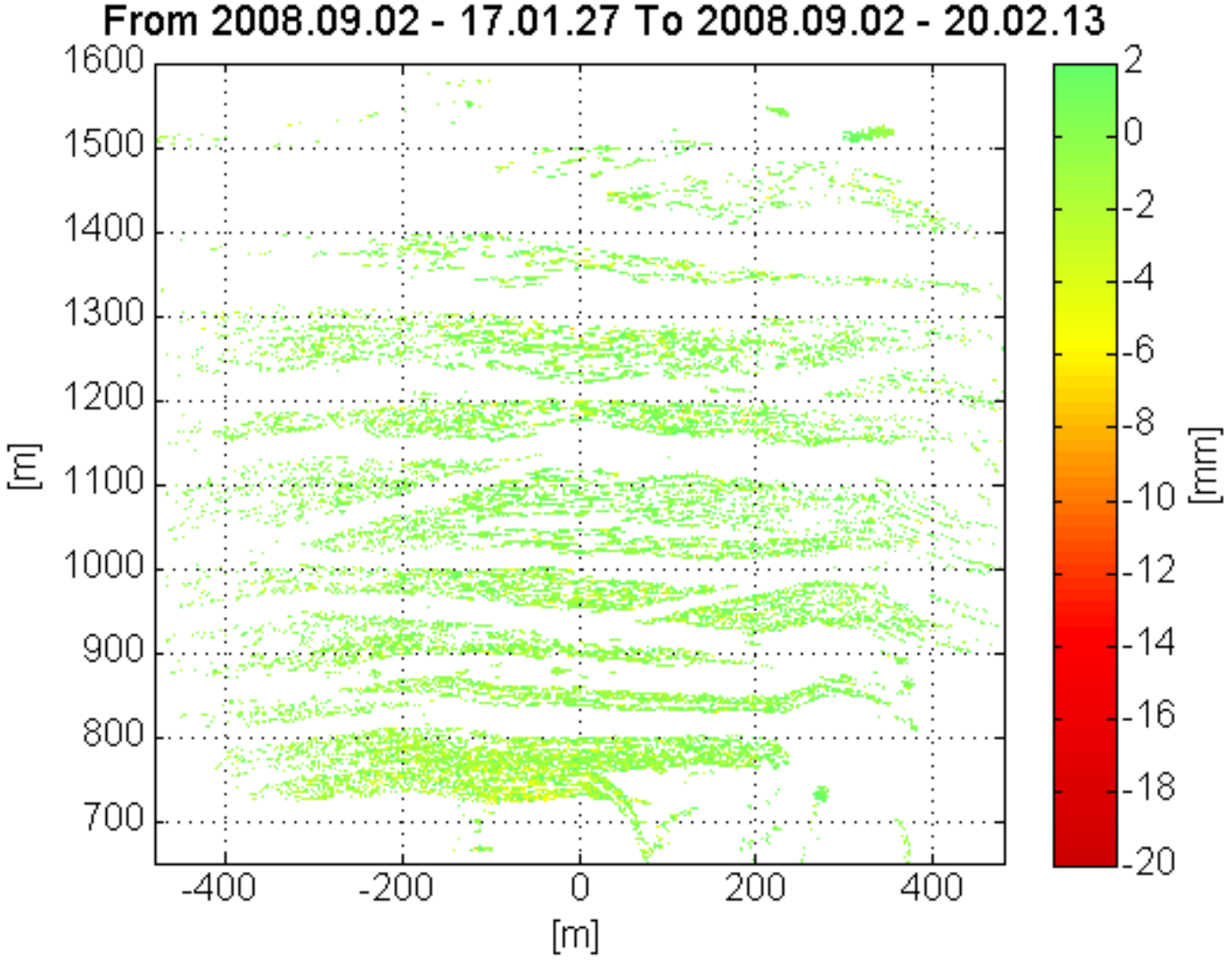
IBIS-L view on the slope

Thousands of pixel belonging to the slope have a quite stable phase response showing a Coherence above 0.7

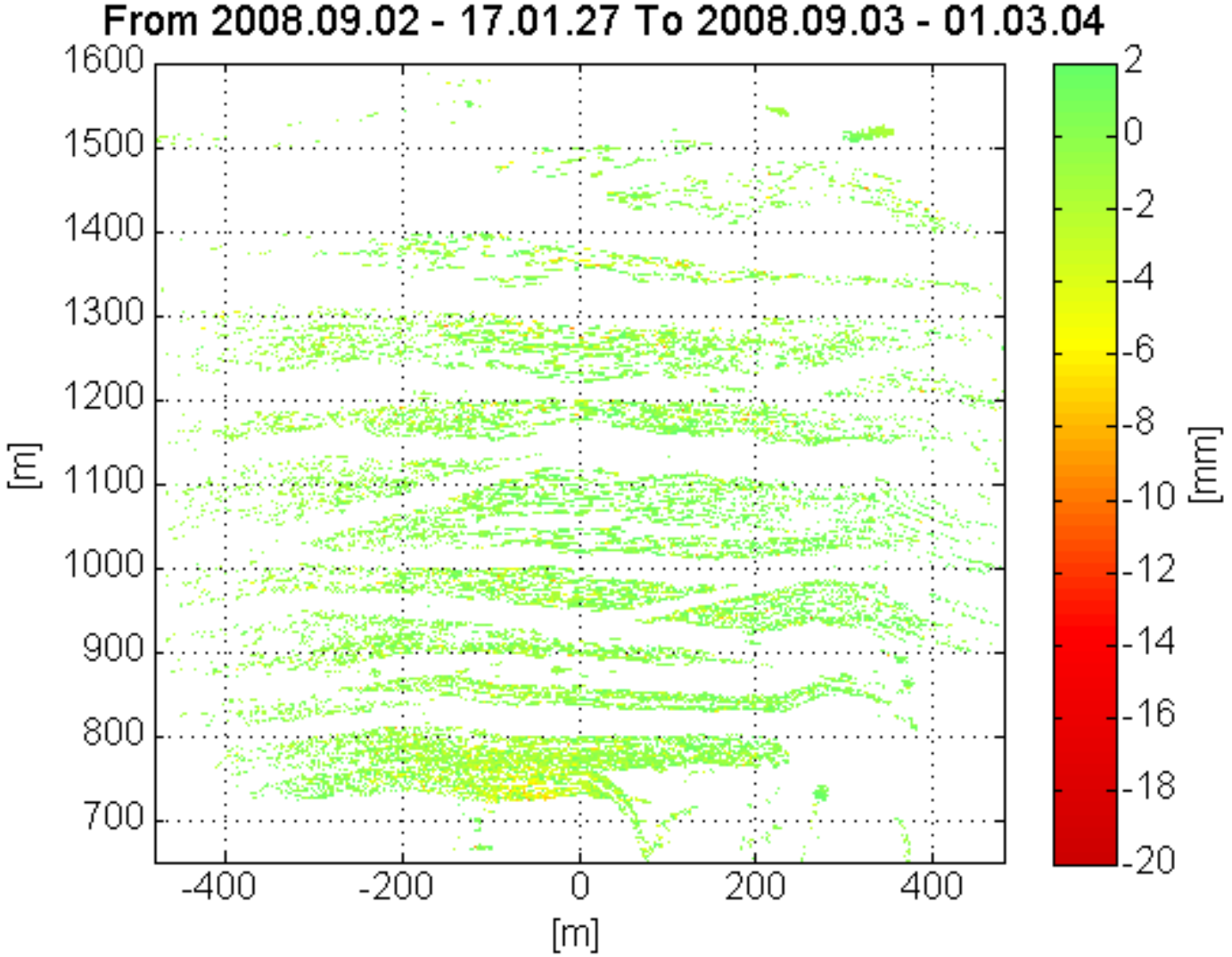
Geolocated Coherence Map



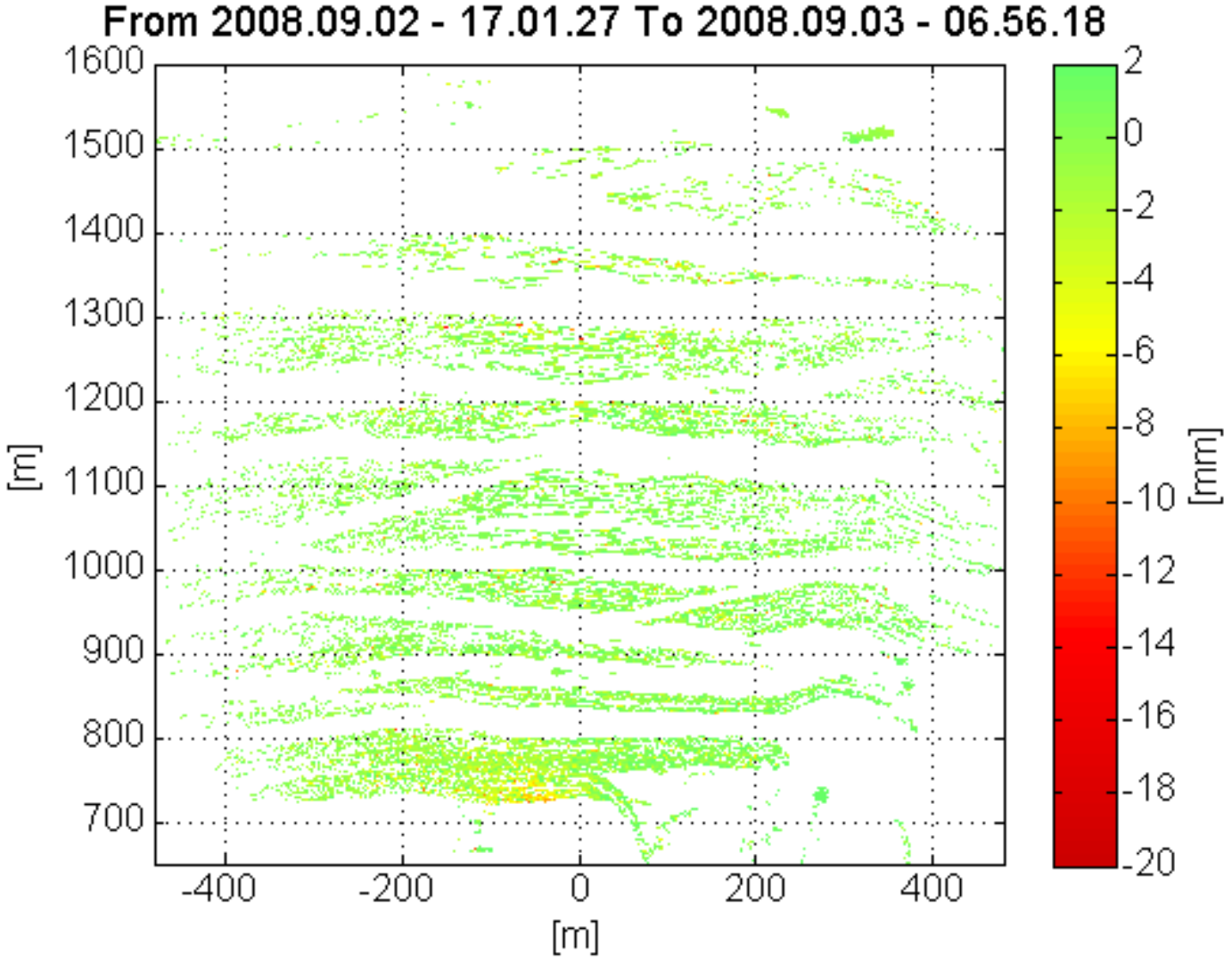
CUMULATE LOS DISPLACEMENT MAP (3 h)



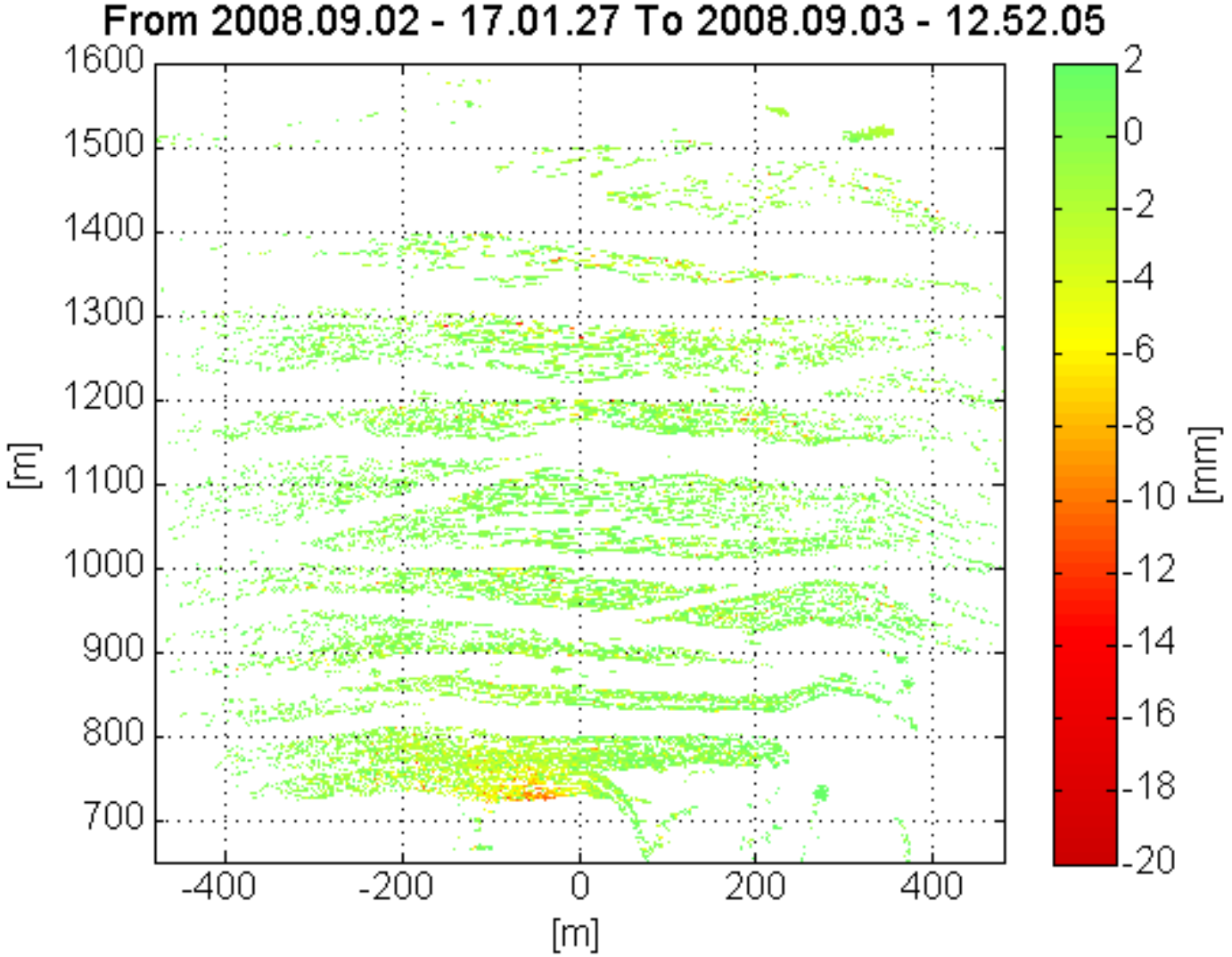
CUMULATE LOS DISPLACEMENT MAP (8 h)



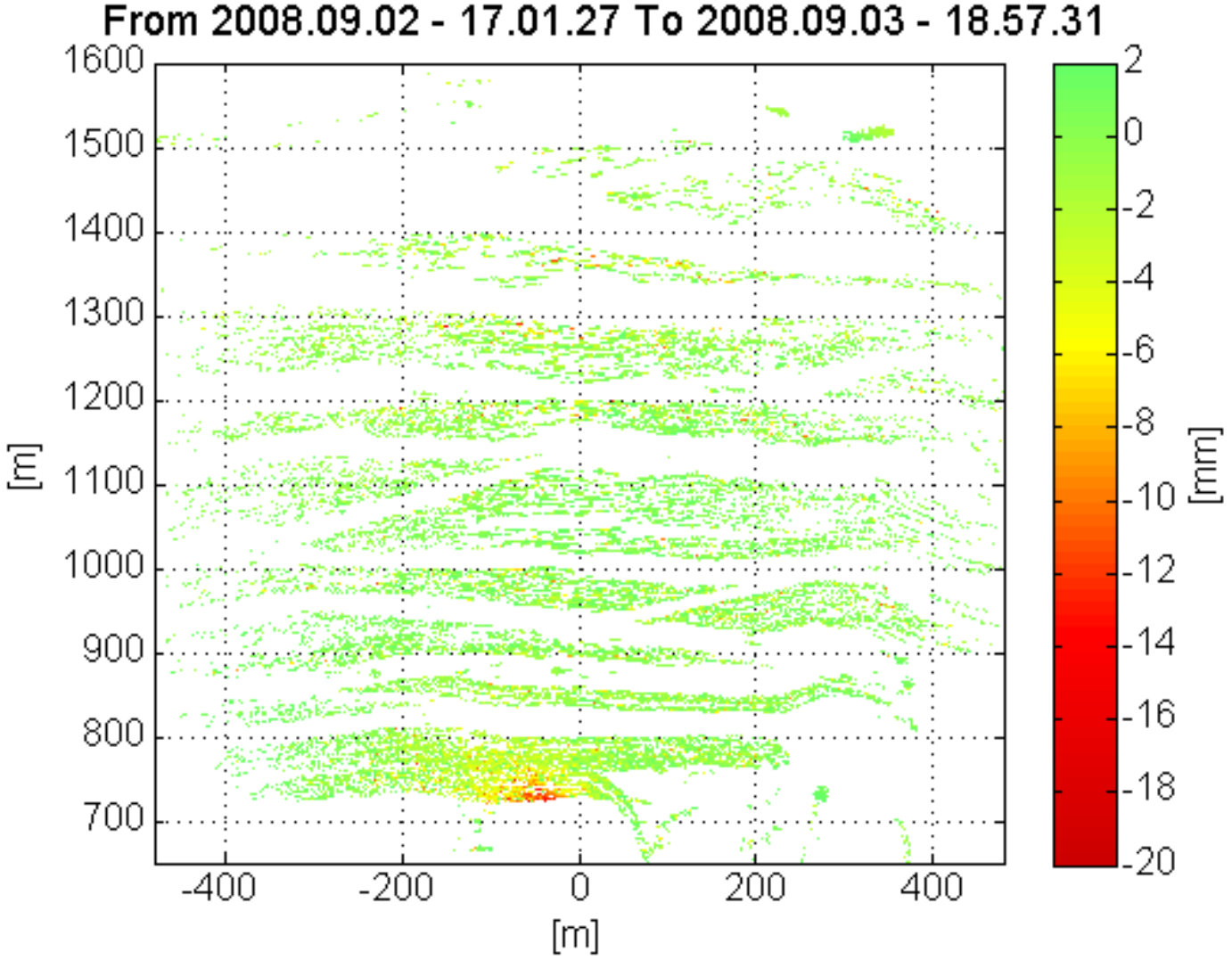
CUMULATE LOS DISPLACEMENT MAP (14 h)



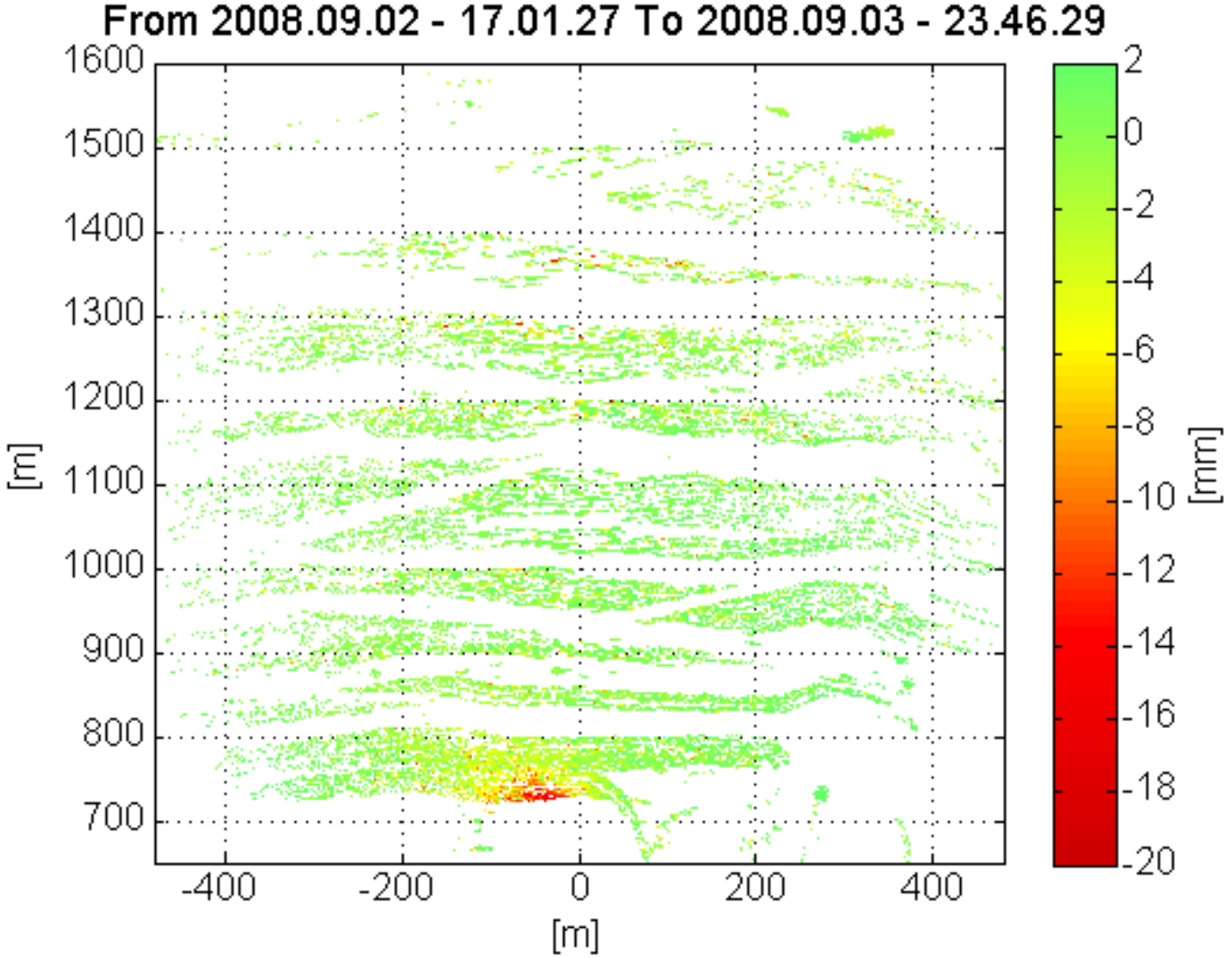
CUMULATE LOS DISPLACEMENT MAP (20 h)



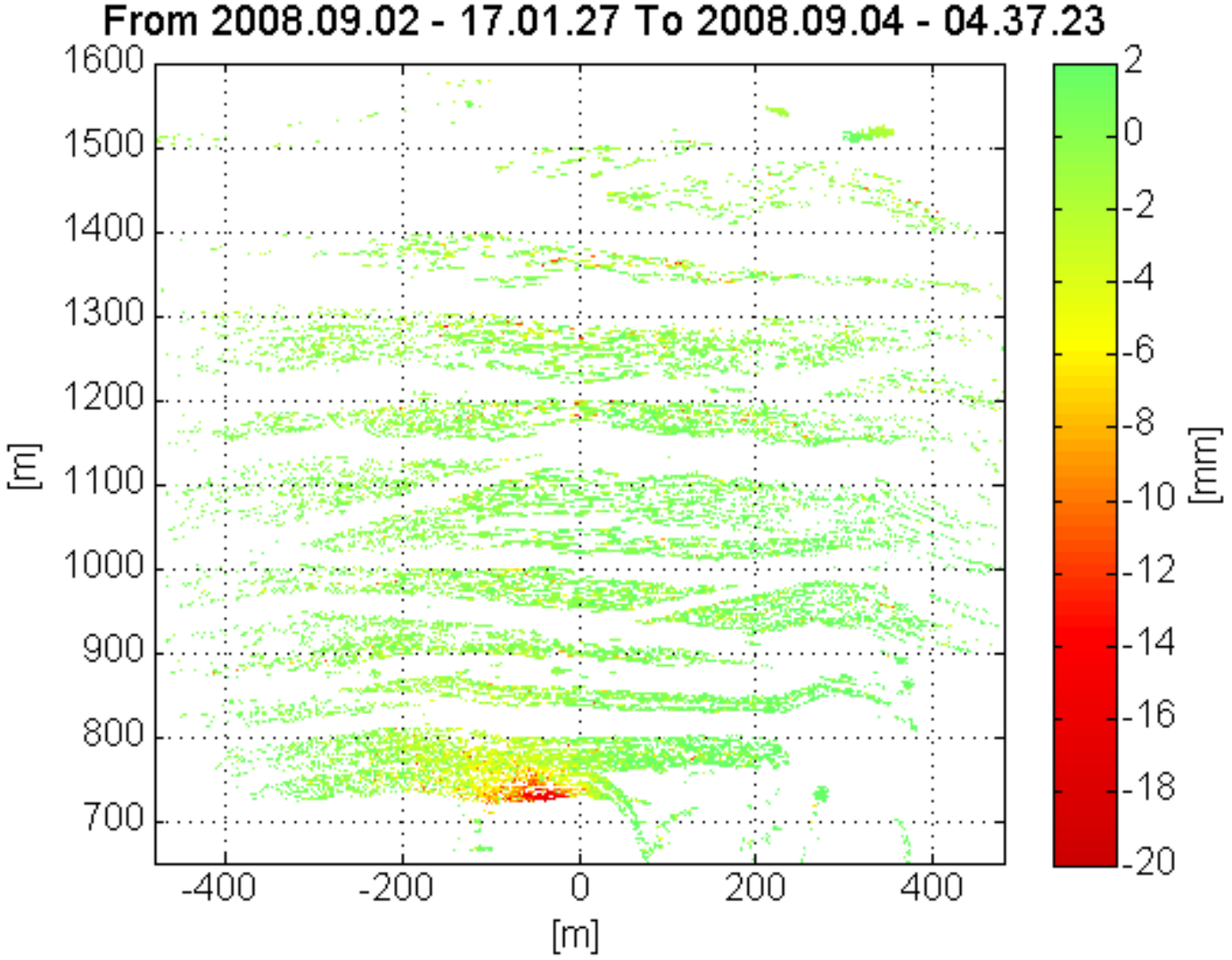
CUMULATE LOS DISPLACEMENT MAP (26 h)



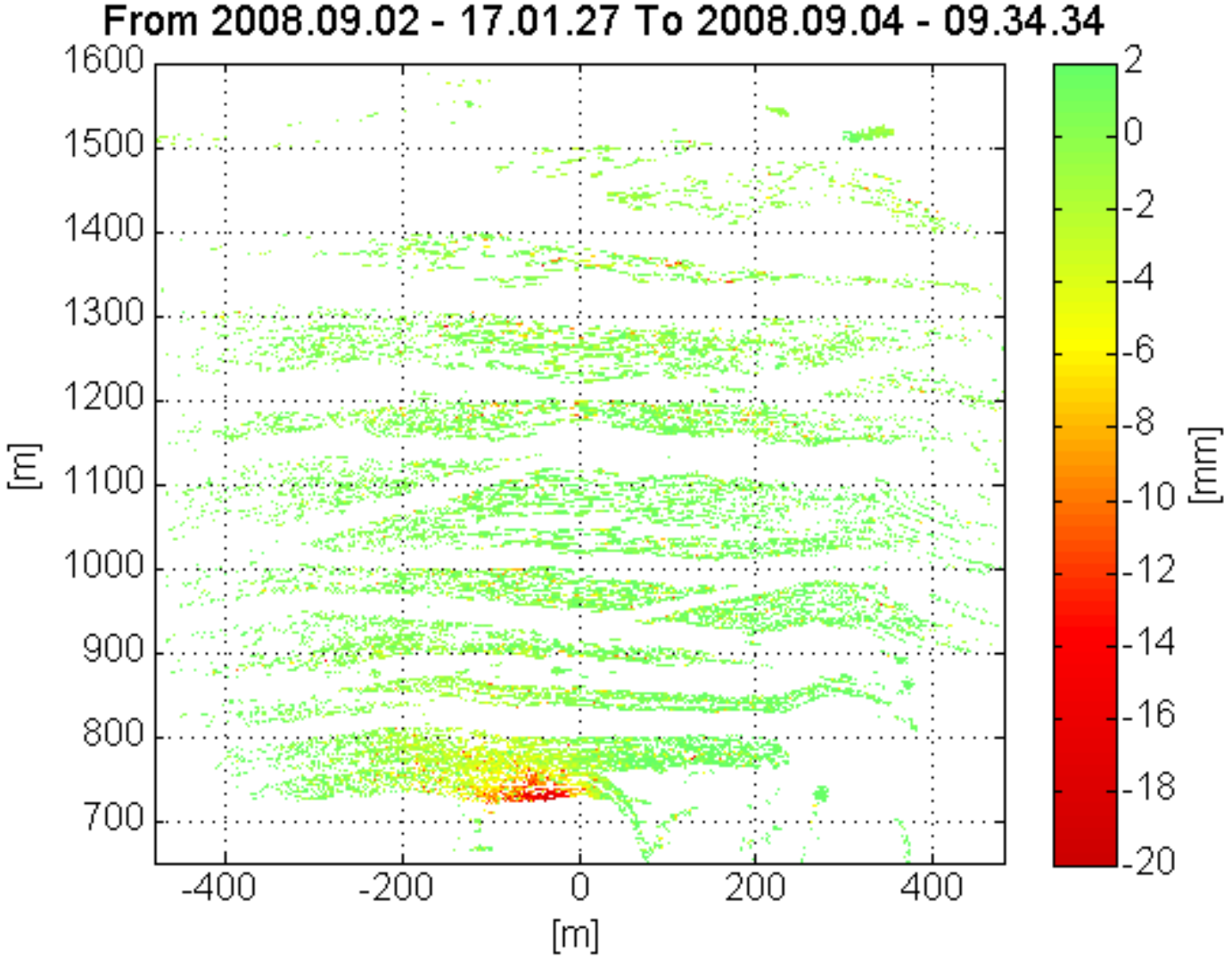
CUMULATE LOS DISPLACEMENT MAP (31 h)



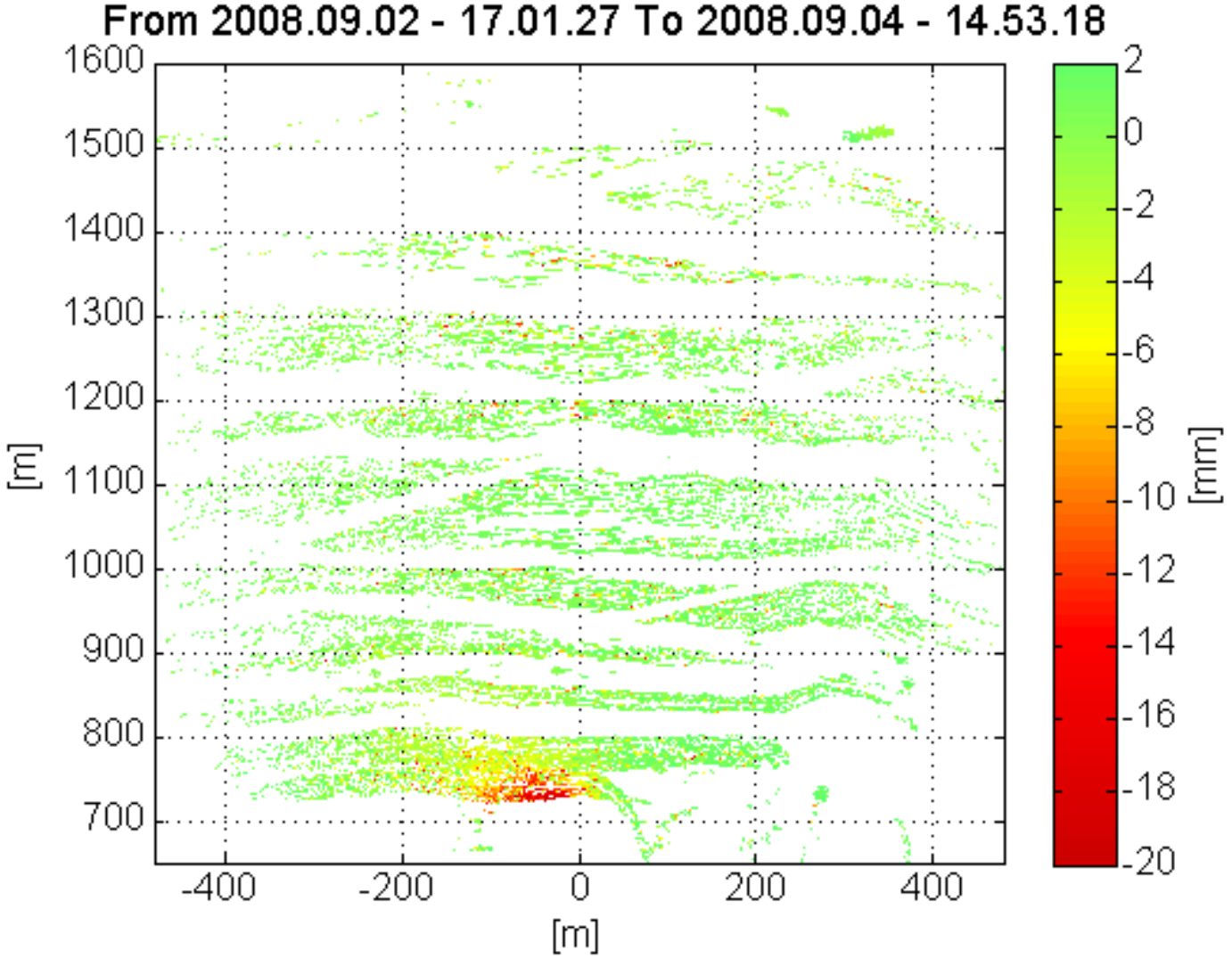
CUMULATE LOS DISPLACEMENT MAP (36 h)



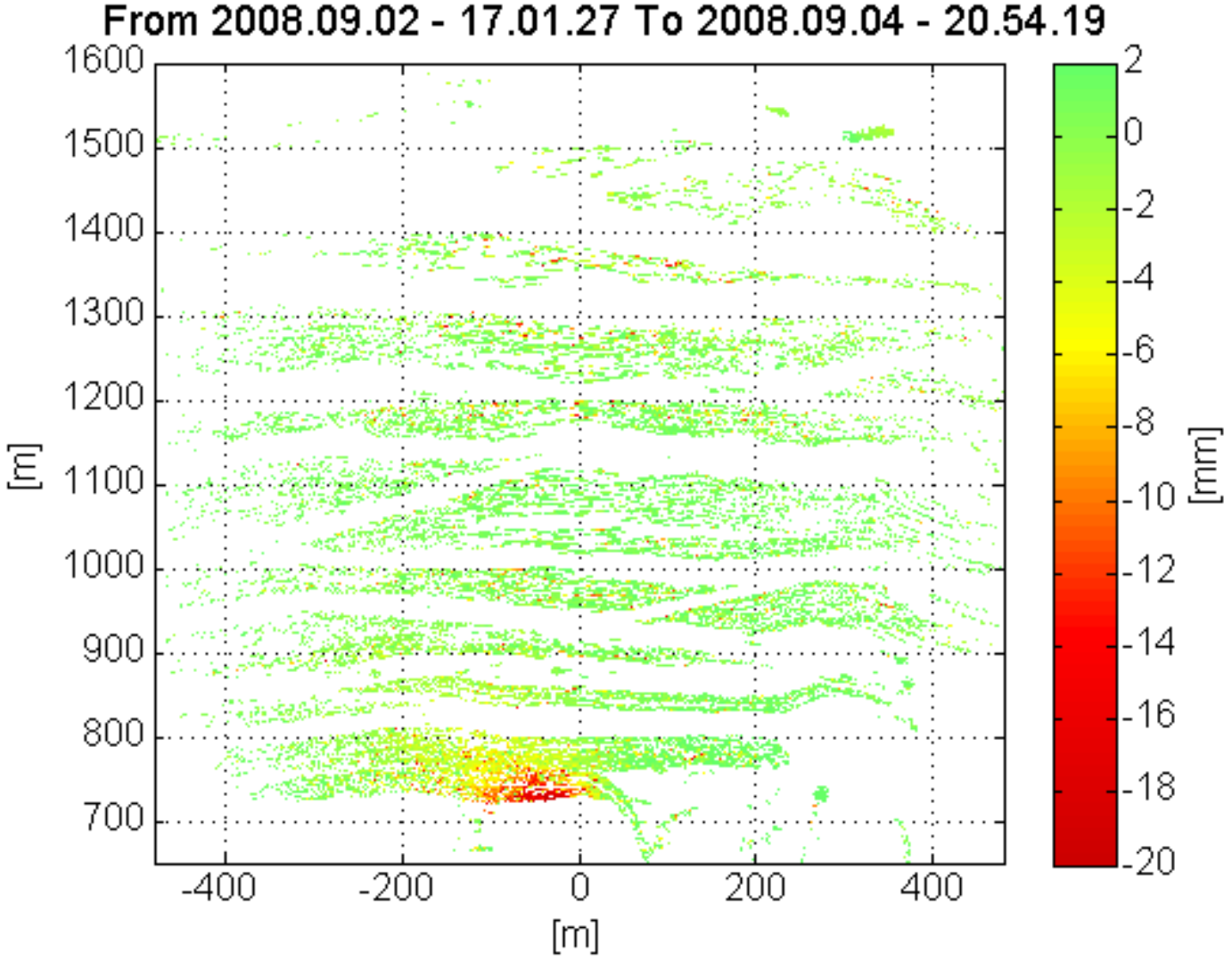
CUMULATE LOS DISPLACEMENT MAP (41 h)



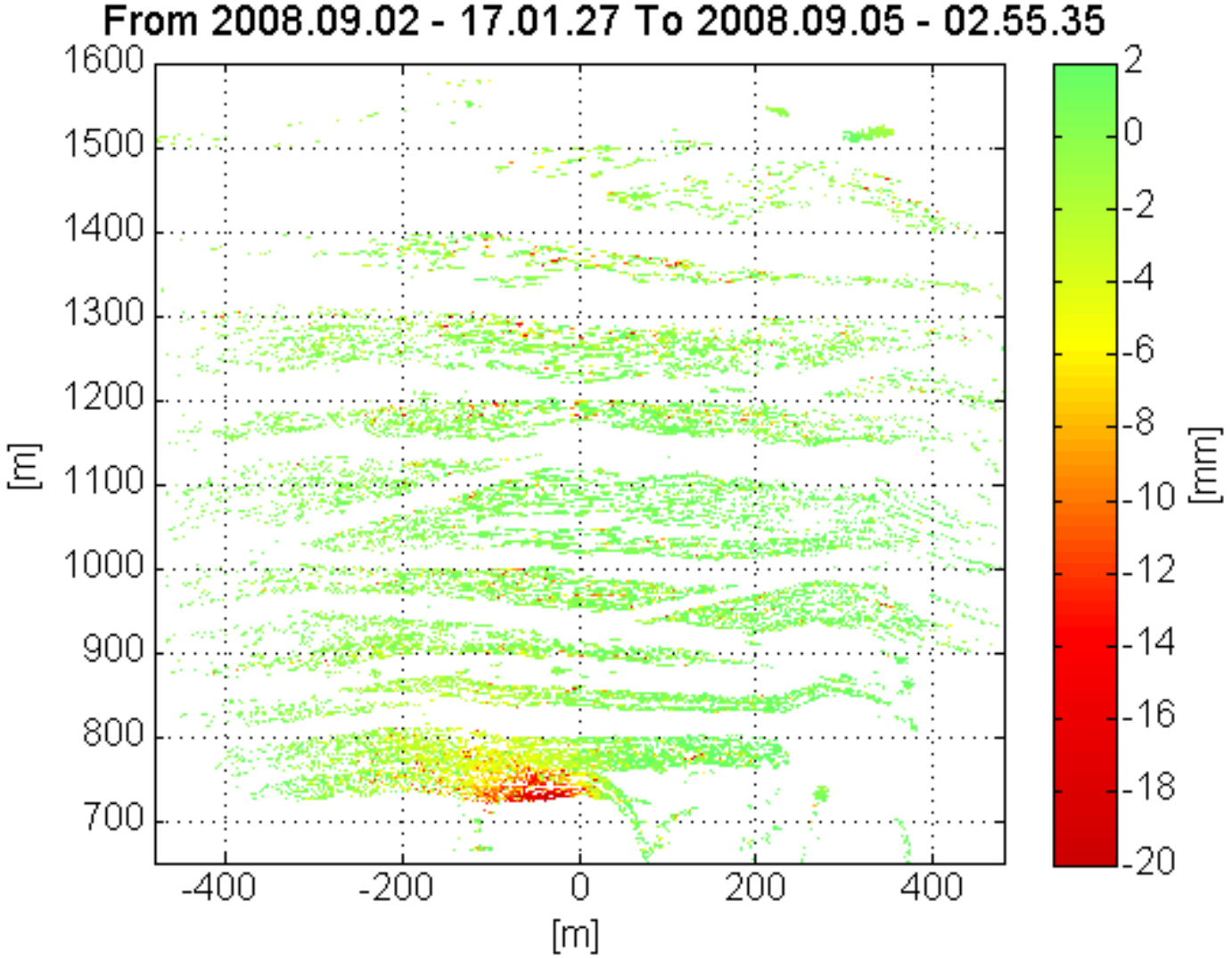
CUMULATE LOS DISPLACEMENT MAP (46 h)



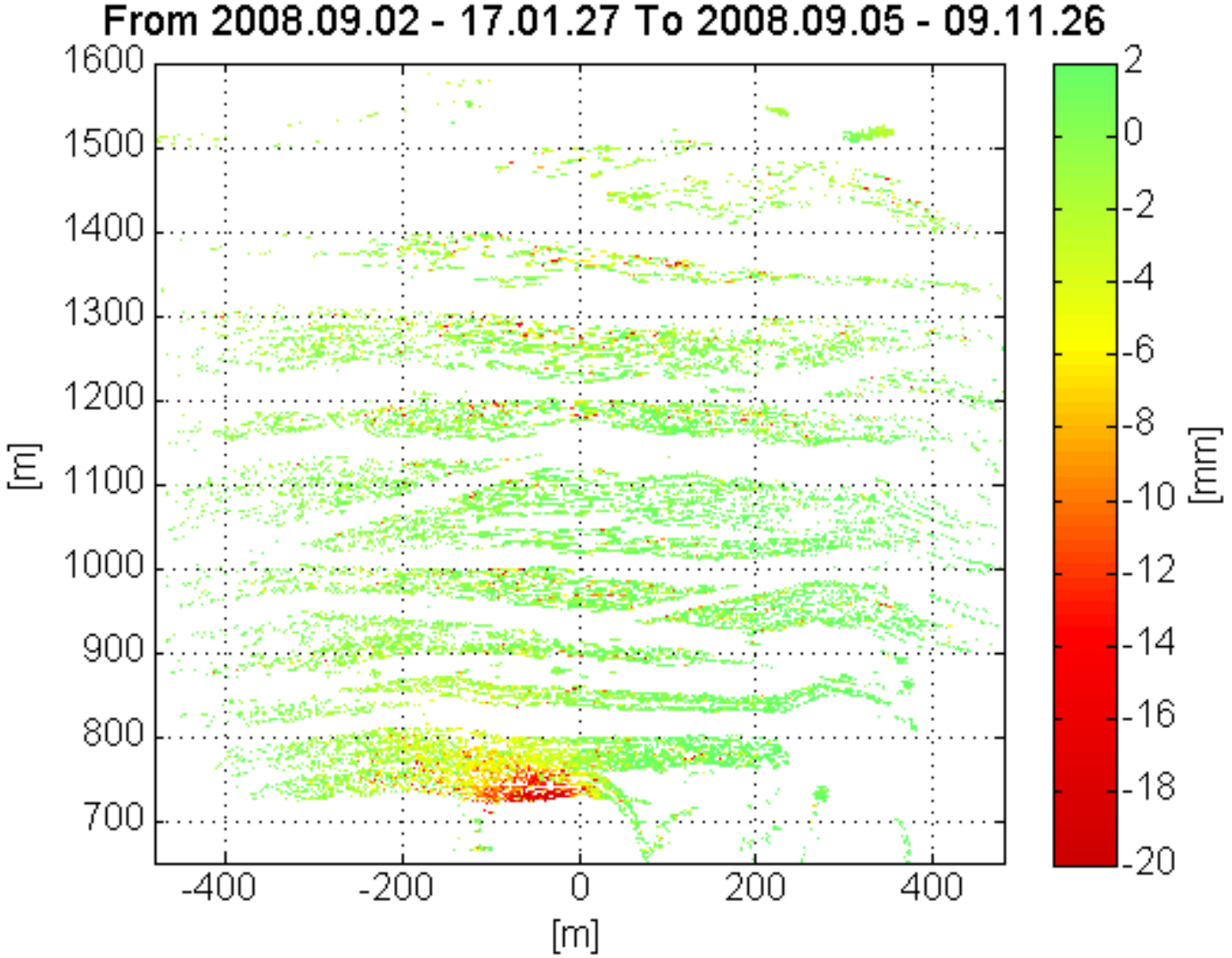
CUMULATE LOS DISPLACEMENT MAP (52 h)



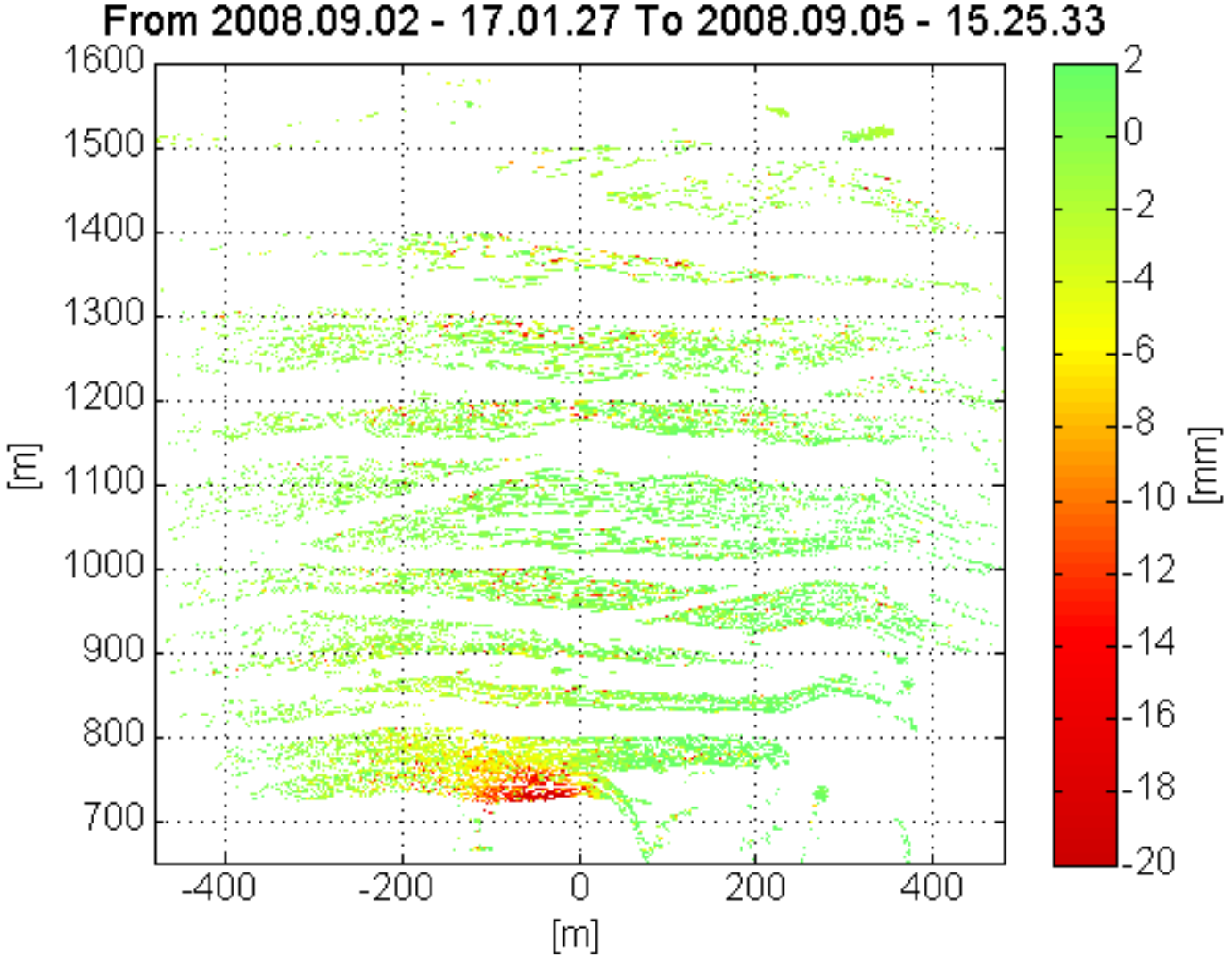
CUMULATE LOS DISPLACEMENT MAP (58 h)



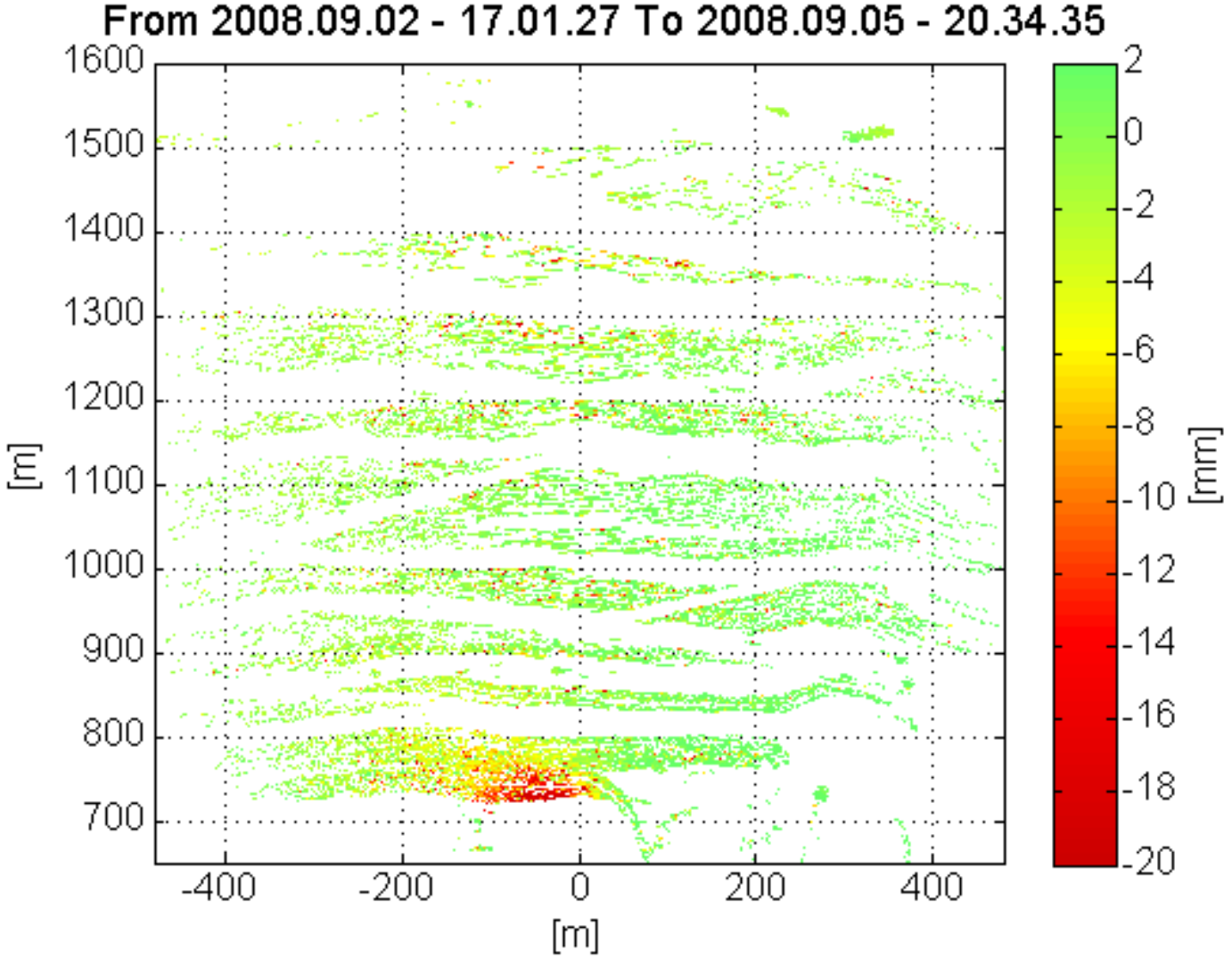
CUMULATE LOS DISPLACEMENT MAP (64 h)



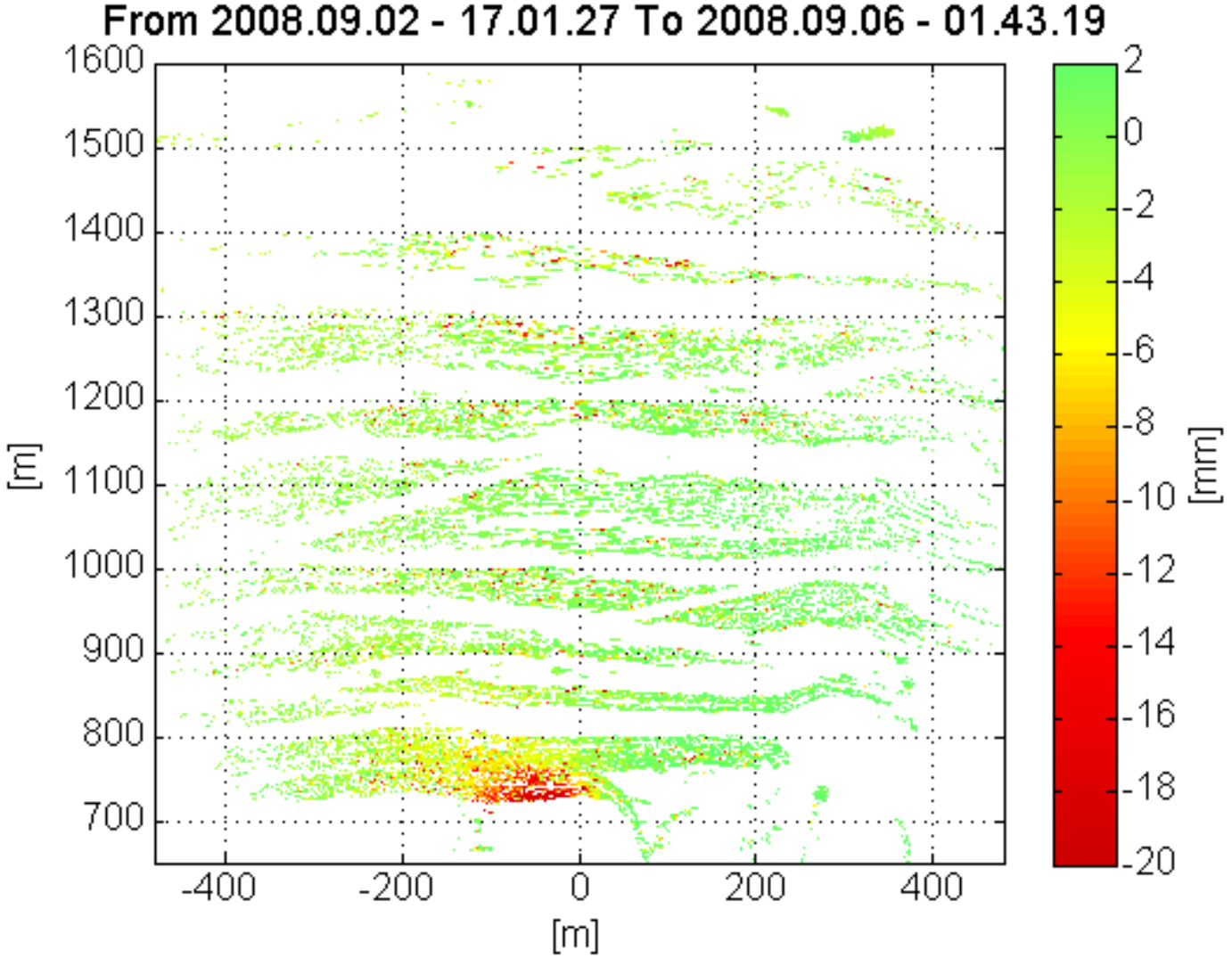
CUMULATE LOS DISPLACEMENT MAP (70 h)



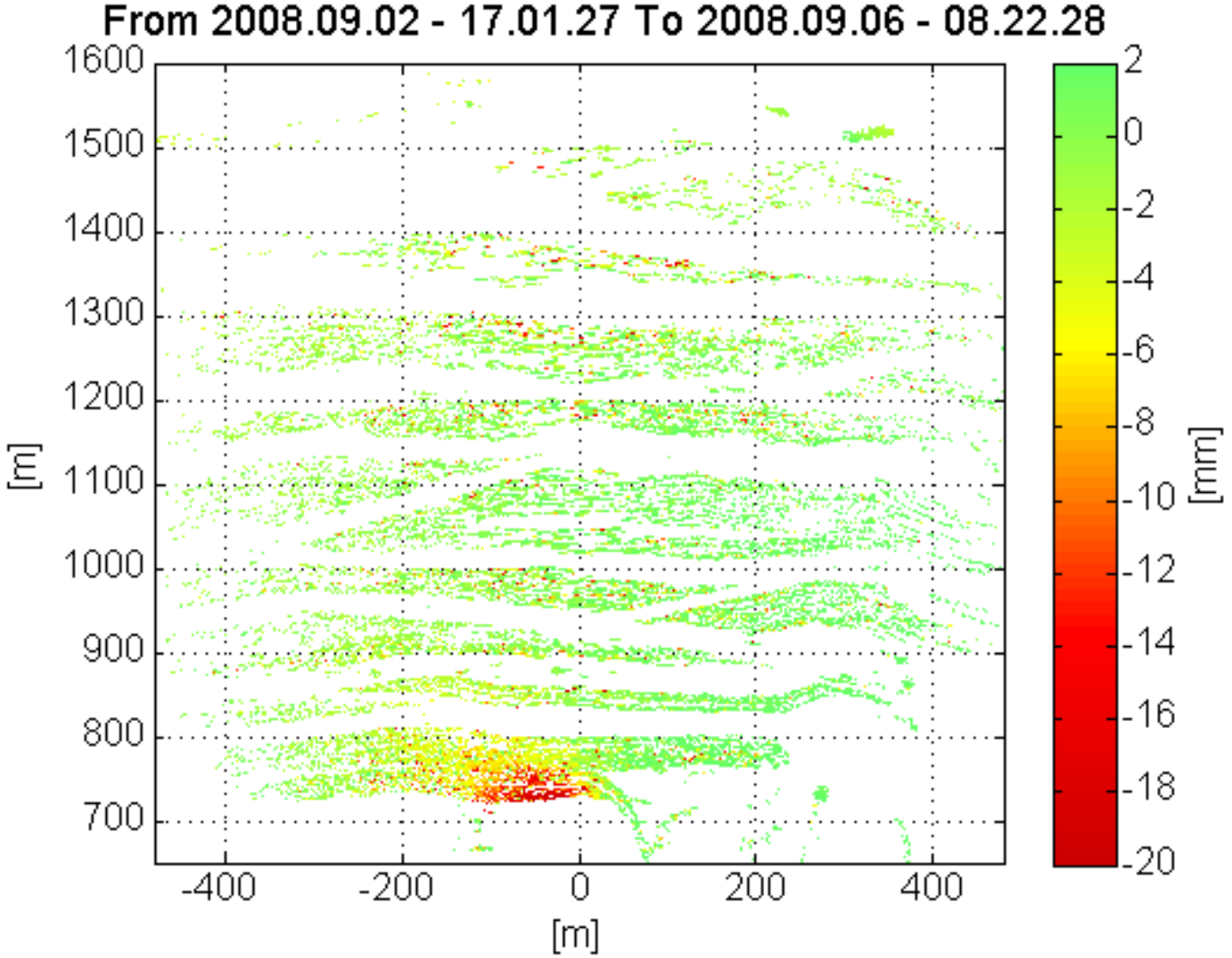
CUMULATE LOS DISPLACEMENT MAP (76 h)



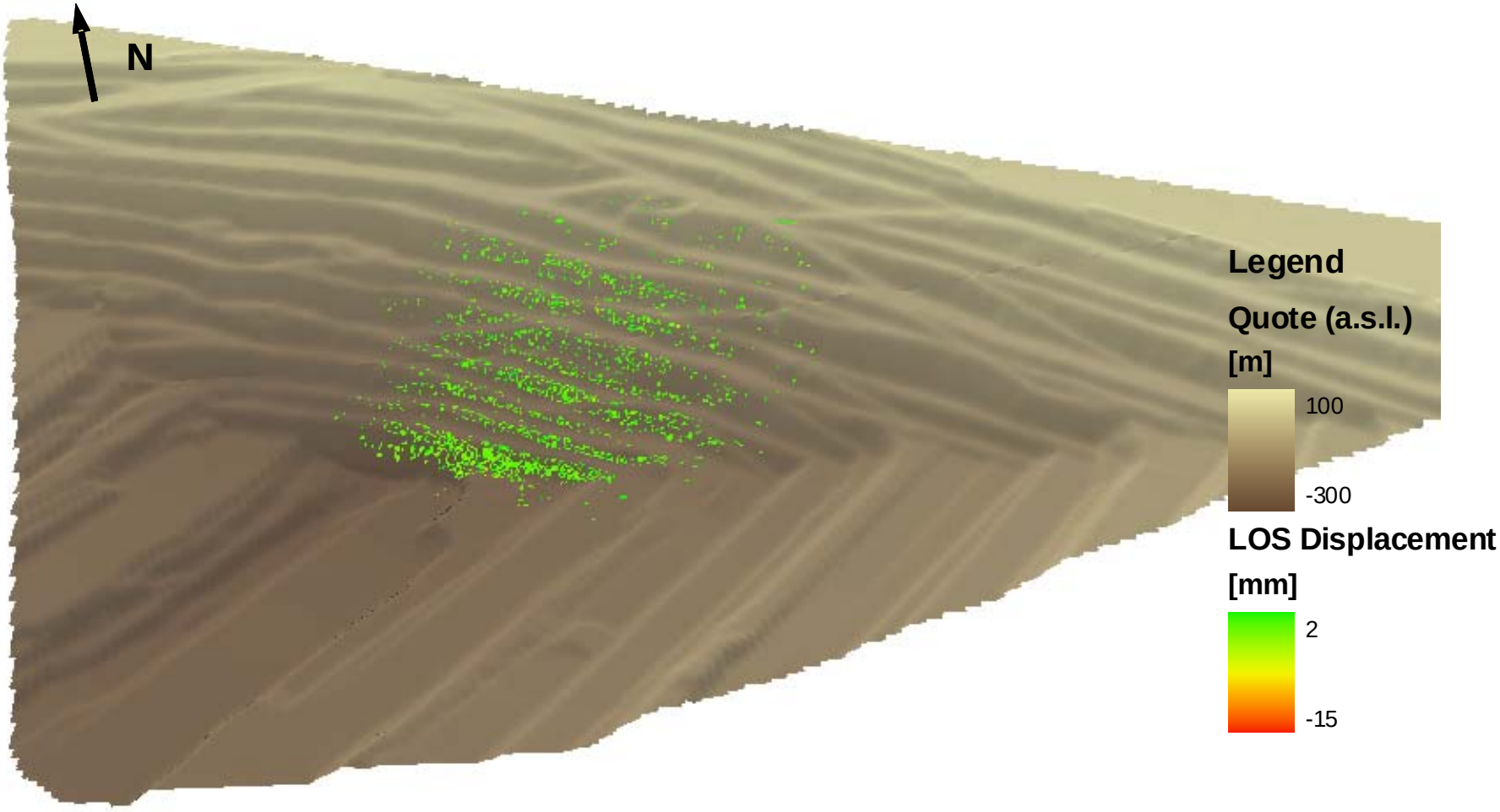
CUMULATE LOS DISPLACEMENT MAP (81 h)



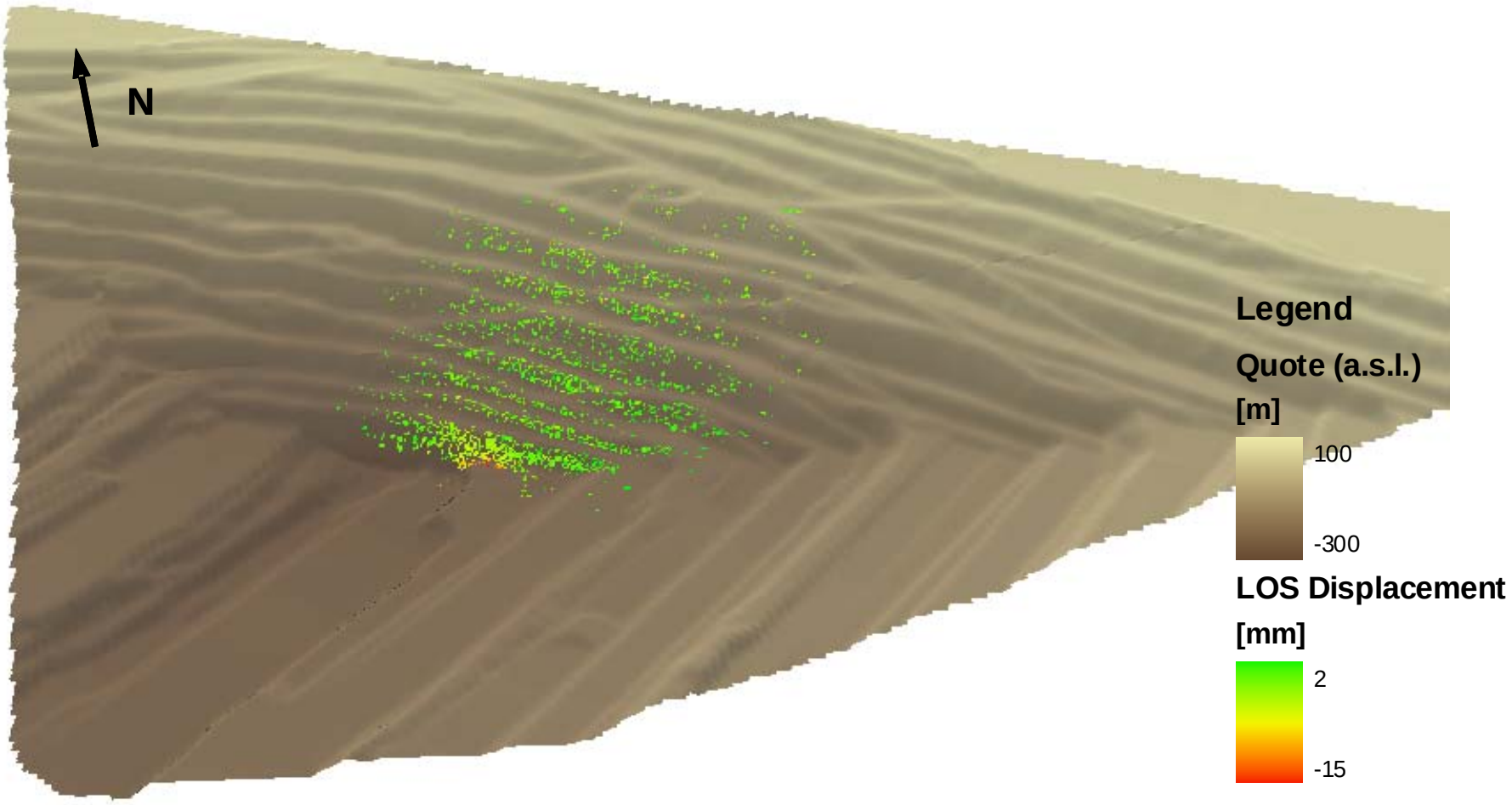
CUMULATE LOS DISPLACEMENT MAP (88 h)



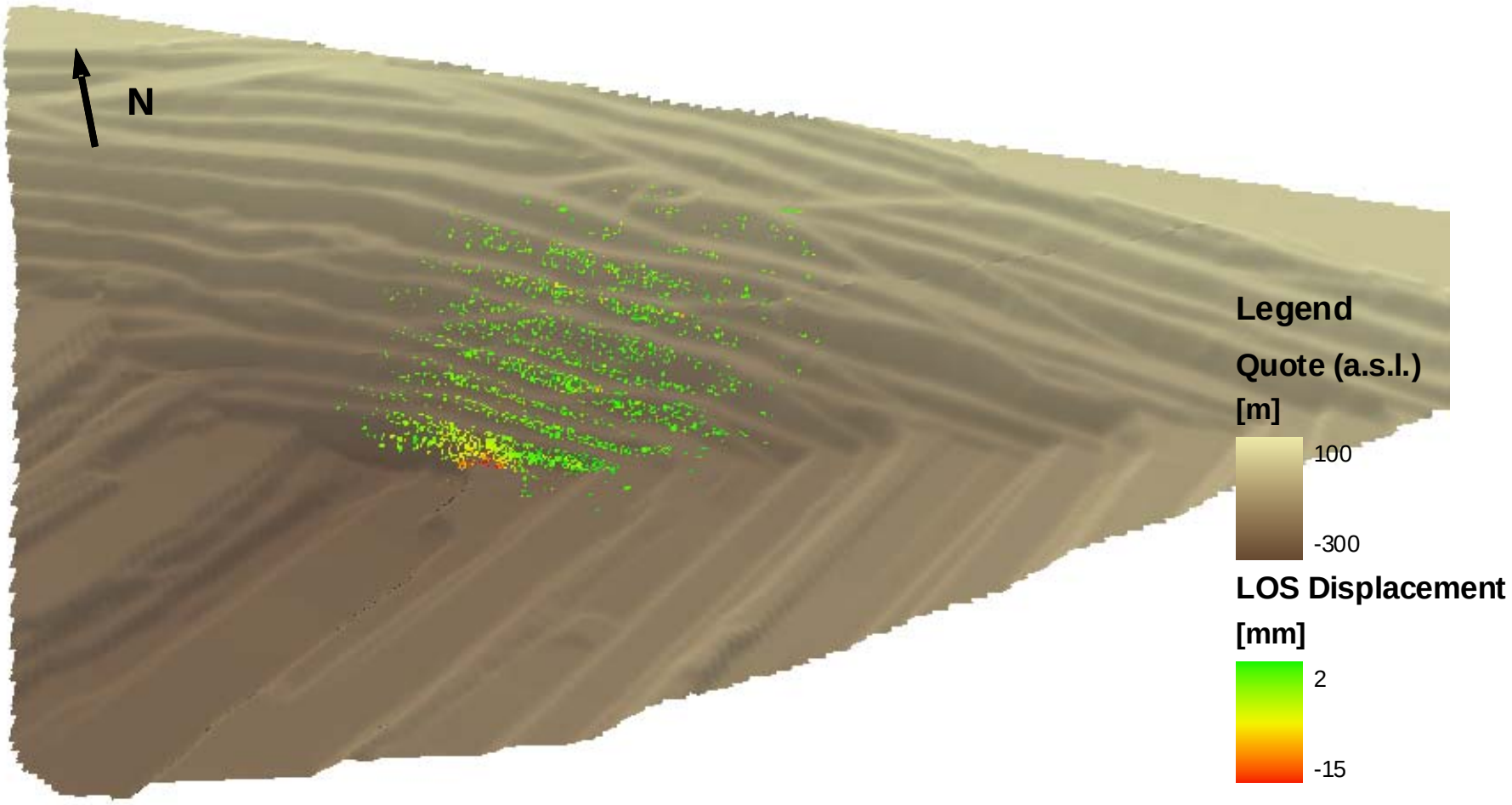
GEOLOCATED CUMULATE LOS DISPLACEMENT MAP (03 h)



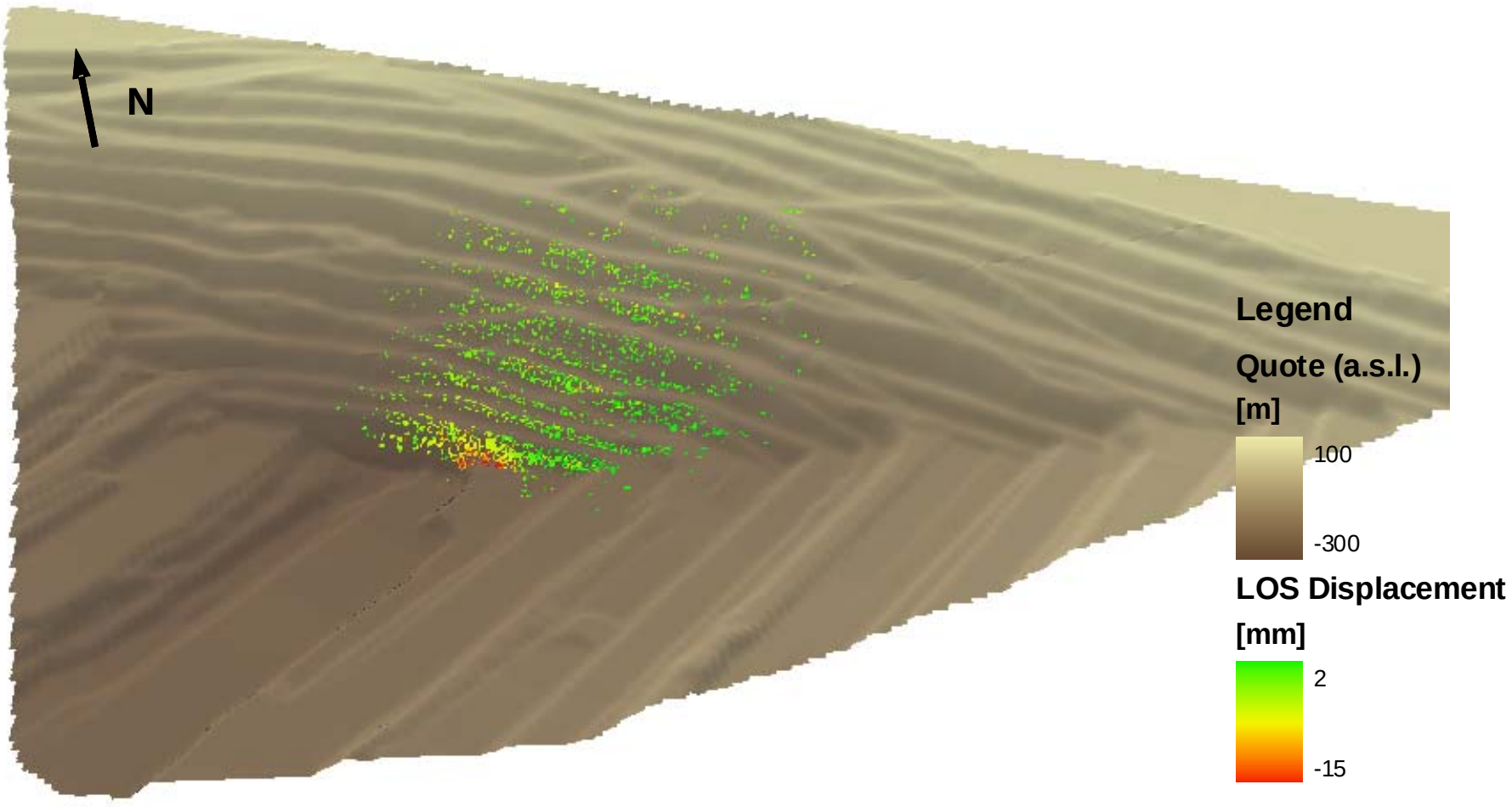
GEOLOCATED CUMULATE LOS DISPLACEMENT MAP (31 h)



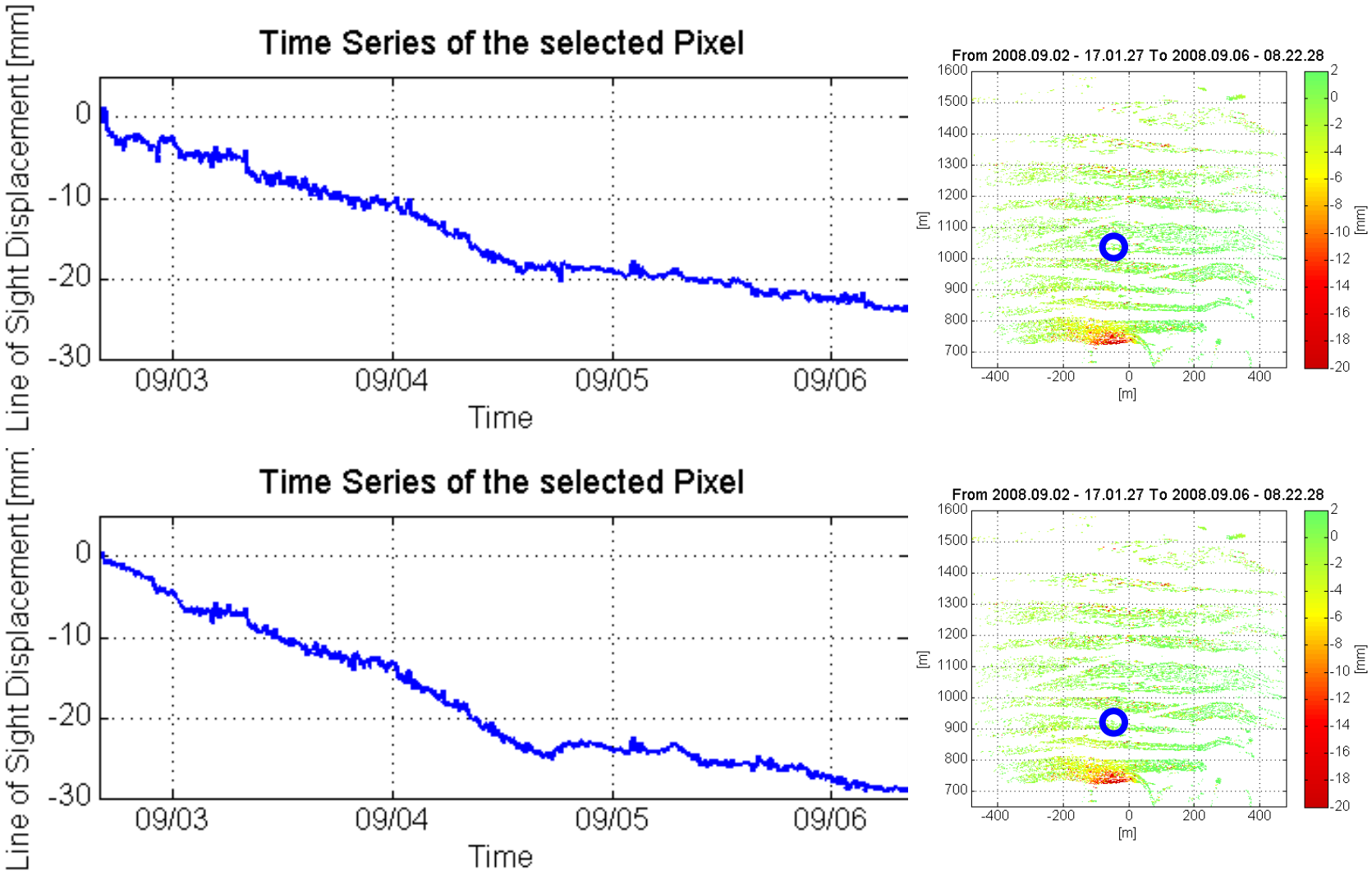
GEOLOCATED CUMULATE LOS DISPLACEMENT MAP (64 h)



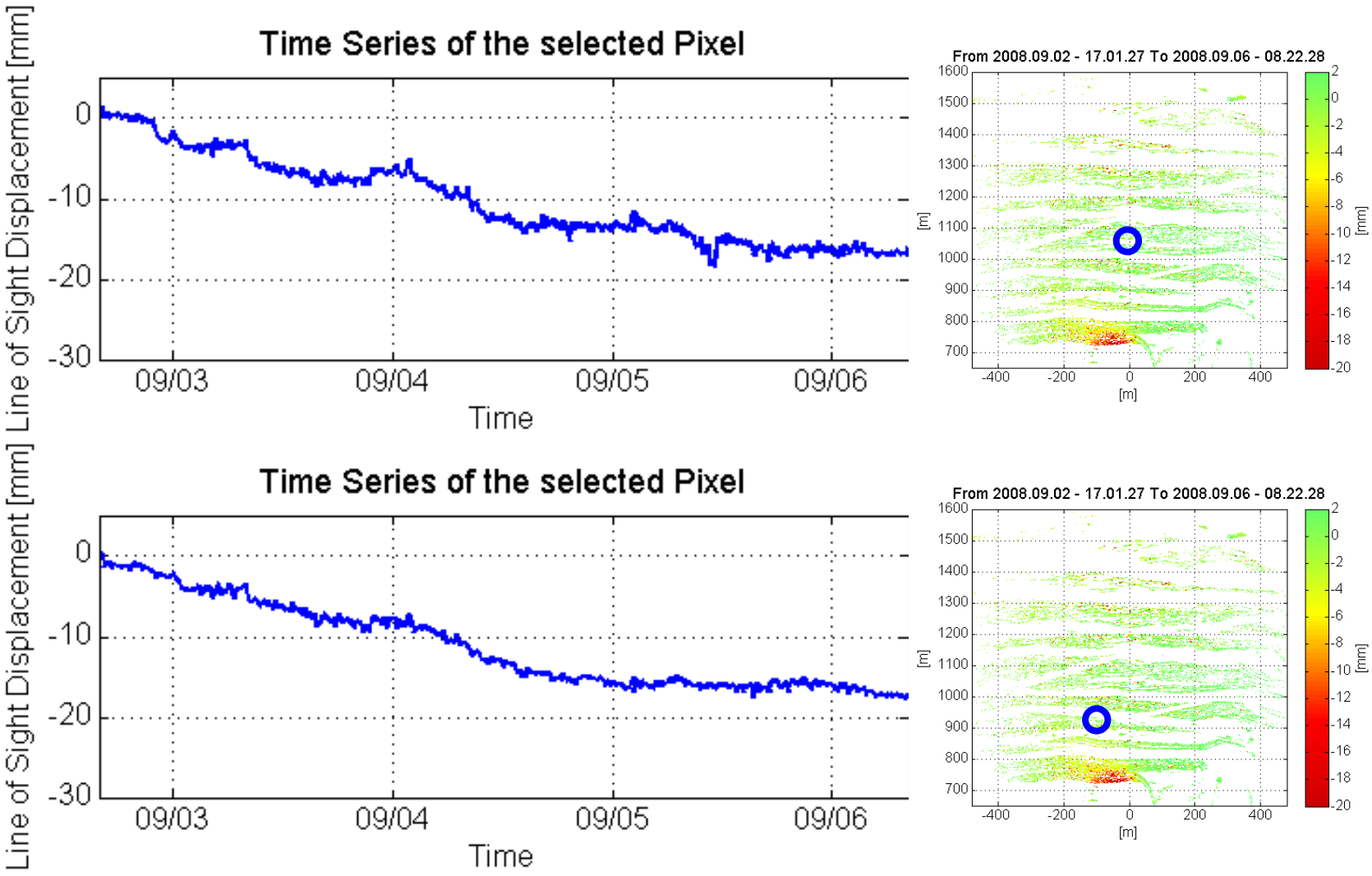
GEOLOCATED CUMULATE LOS DISPLACEMENT MAP (88 h)



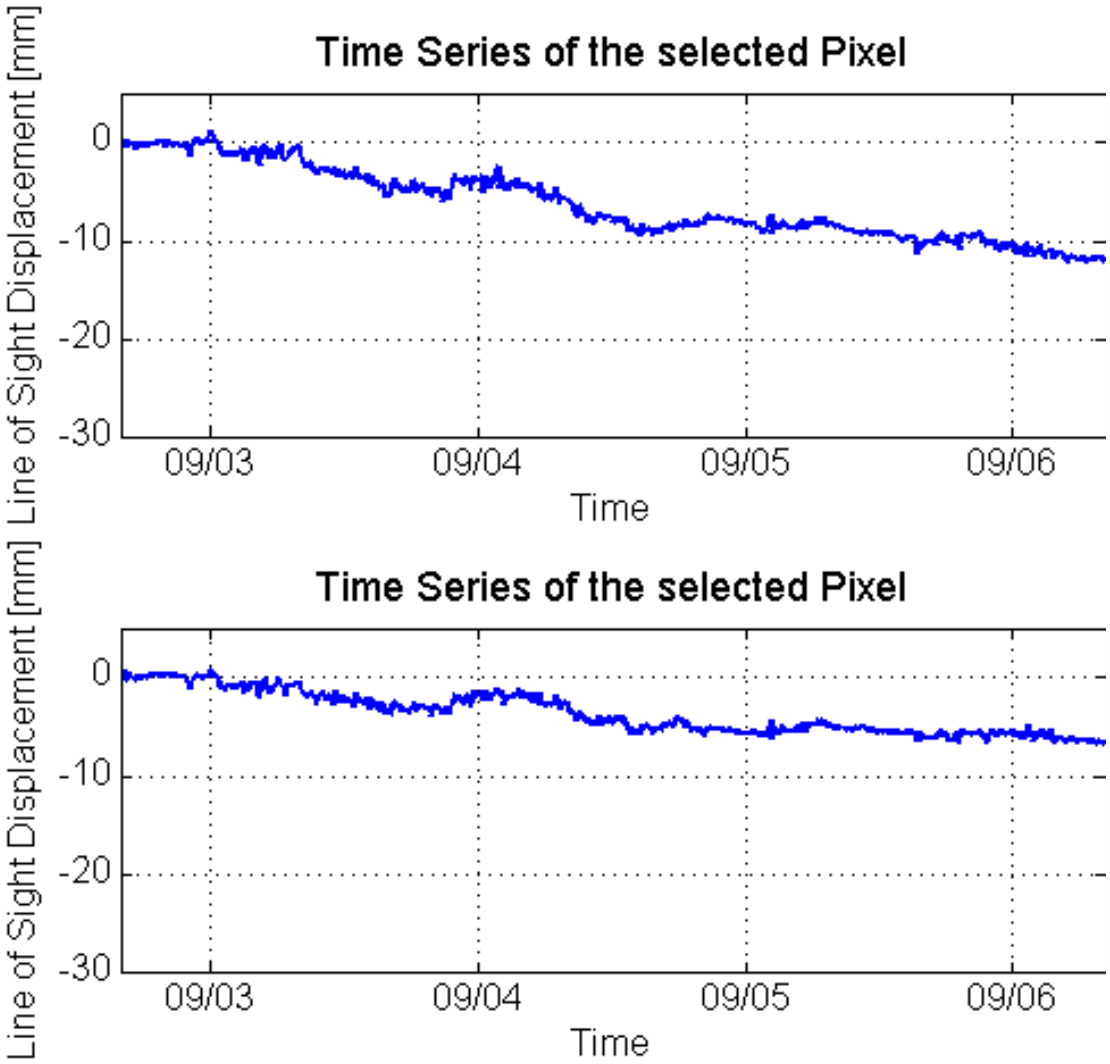
Time Series of some Selected Points

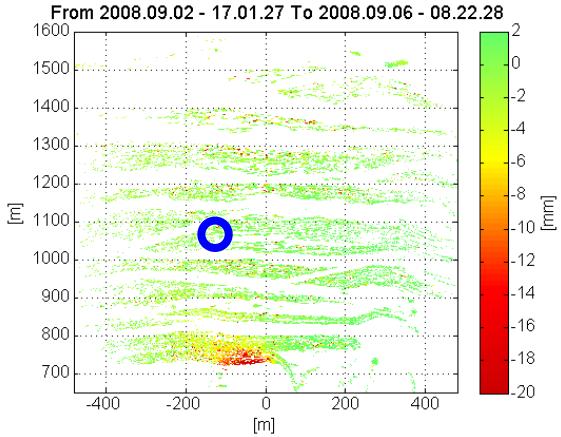


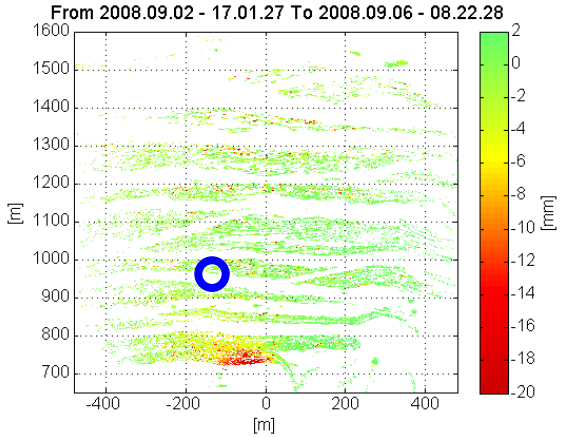
Time Series of some Selected Points



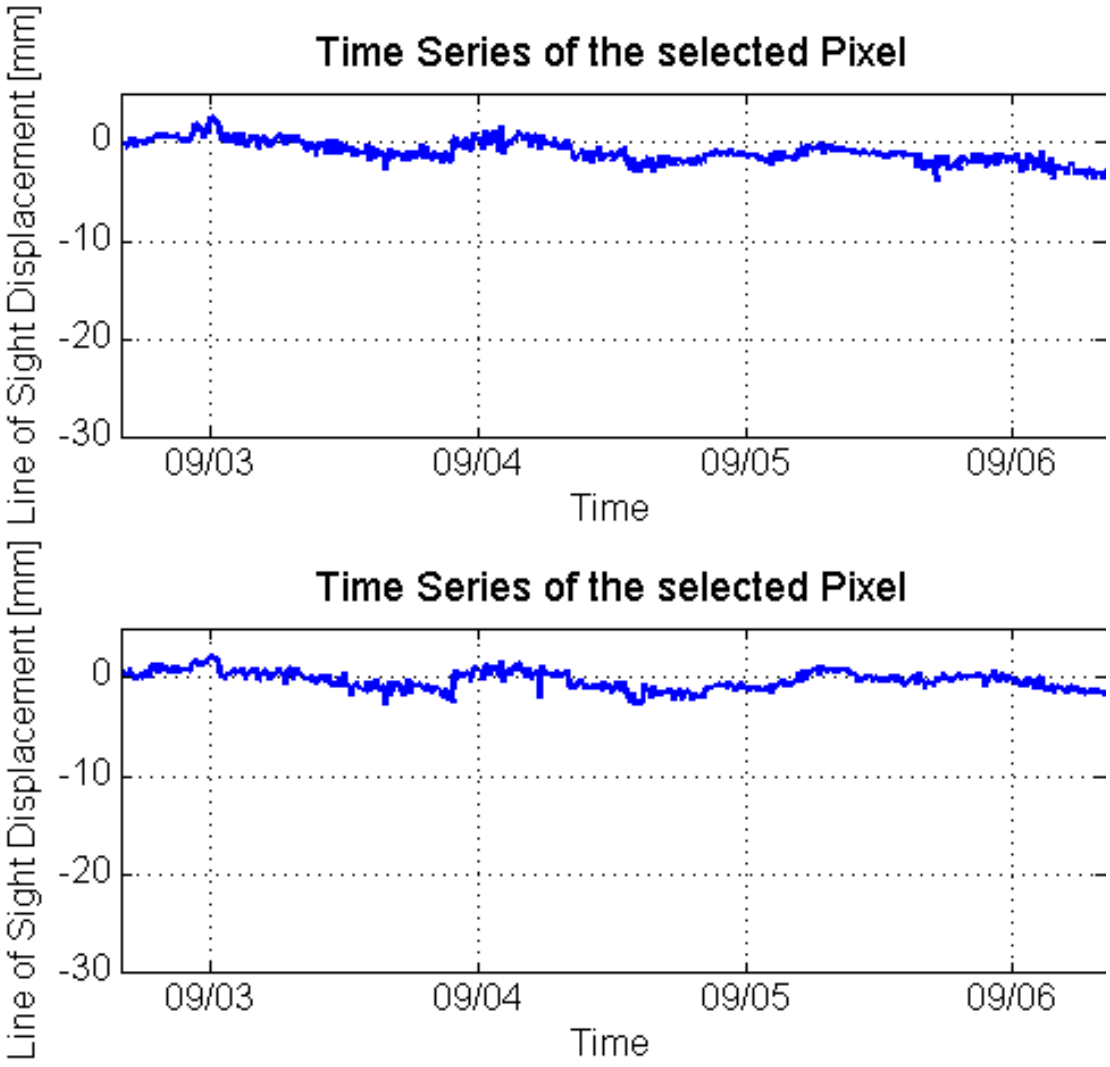
Time Series of some Selected Points

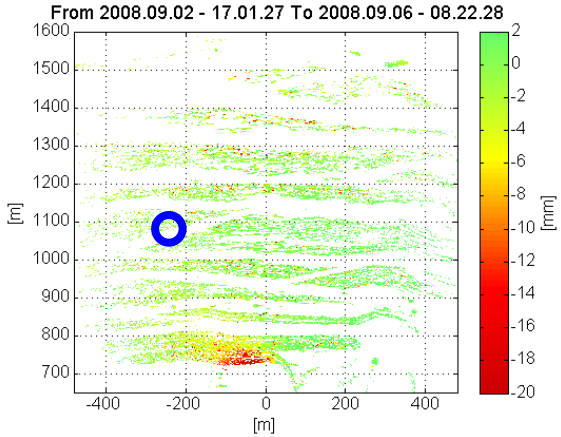


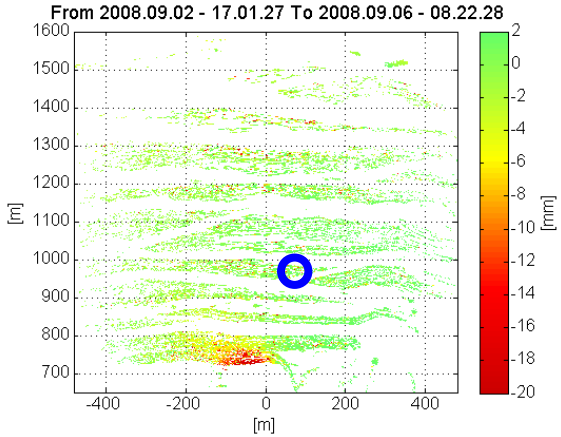




Time Series of some Selected Points







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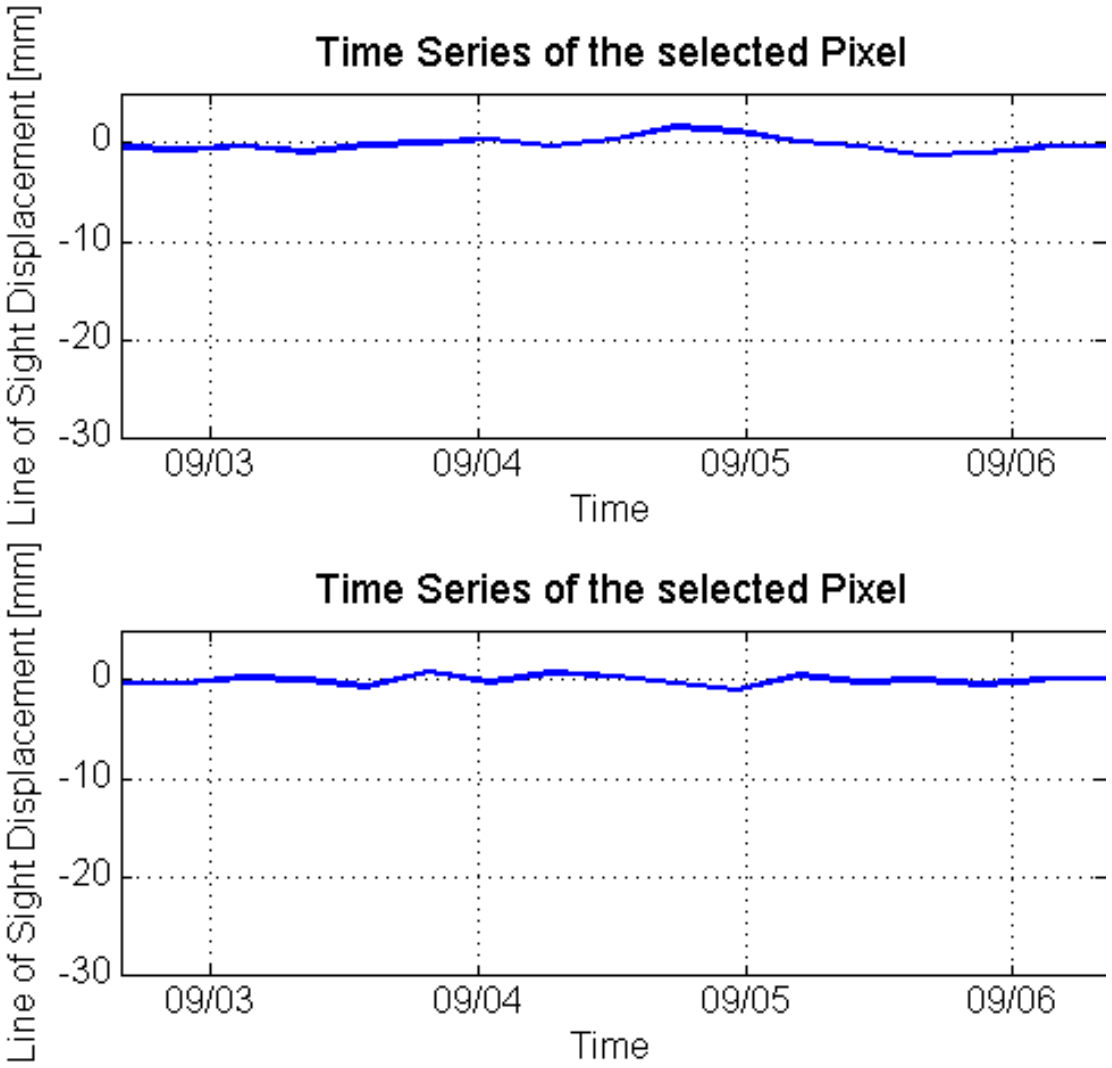
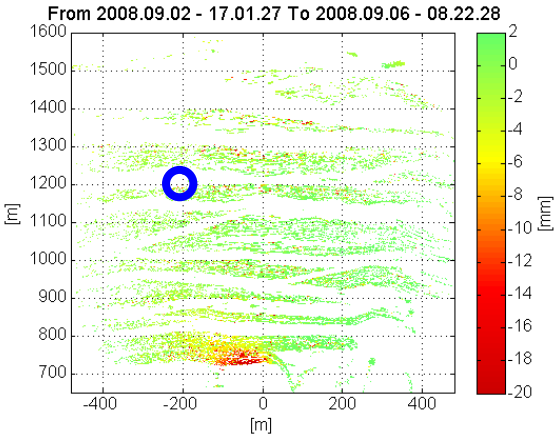
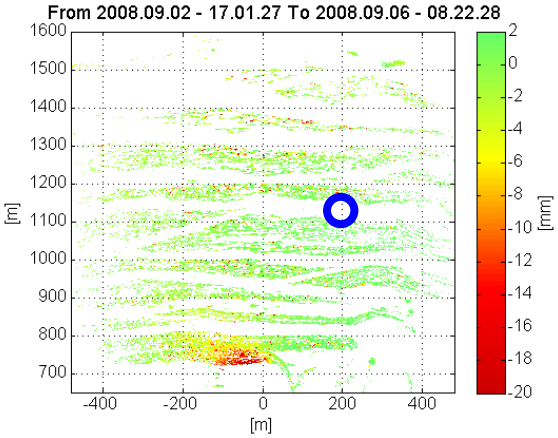
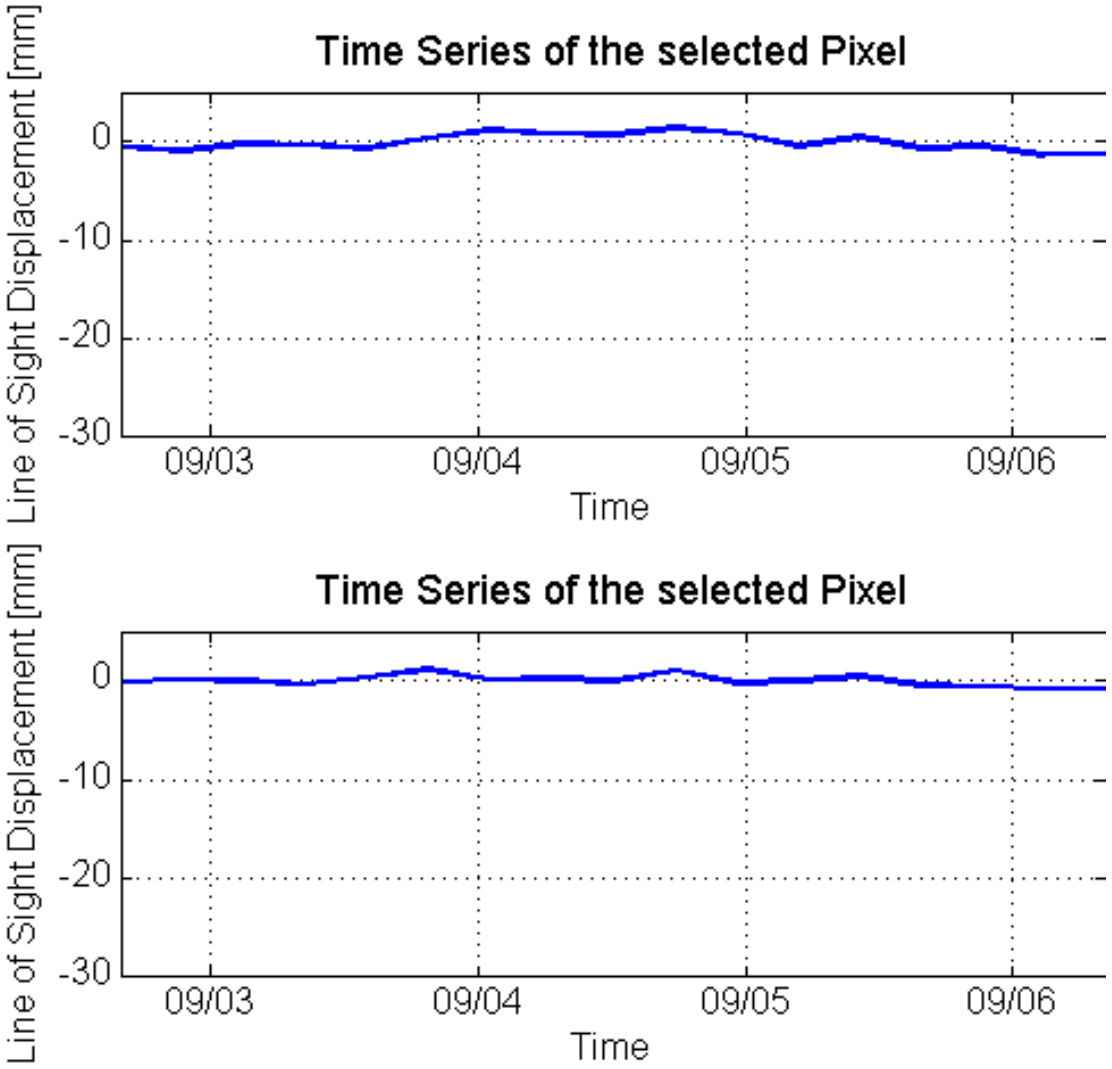
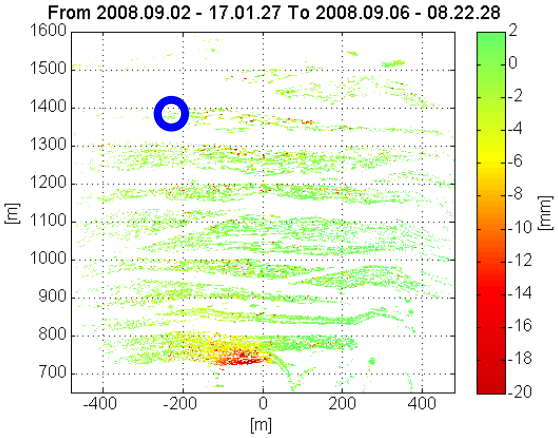


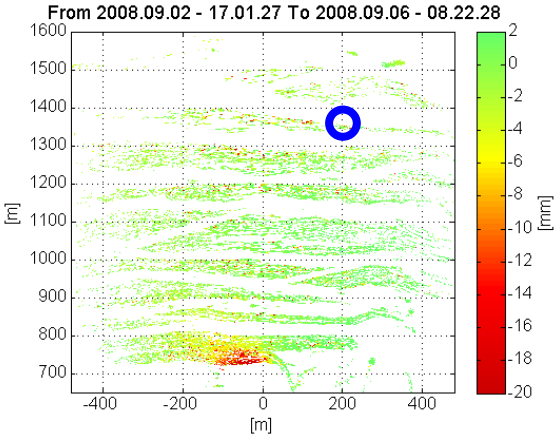




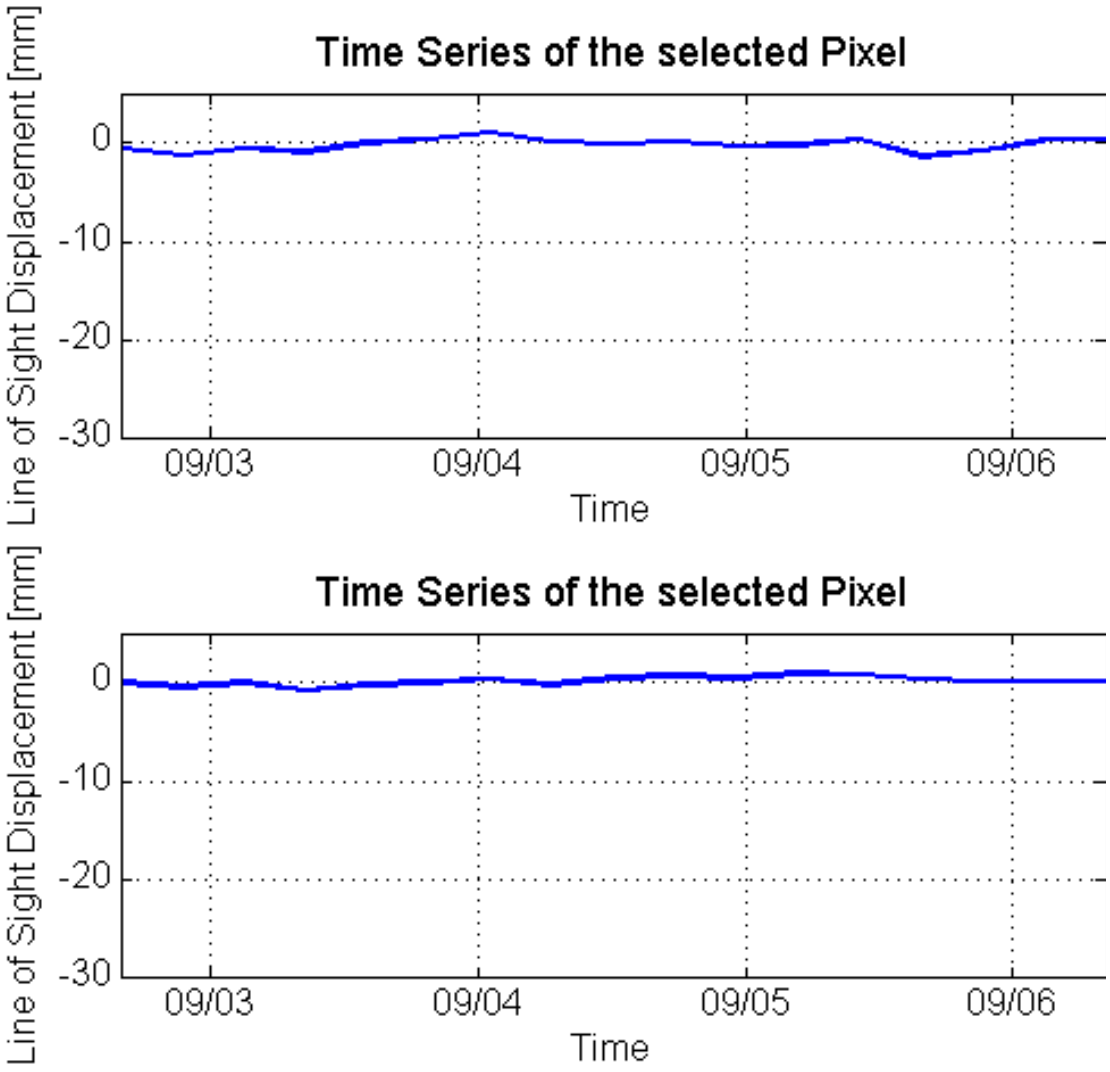
Time Series of some Selected Points

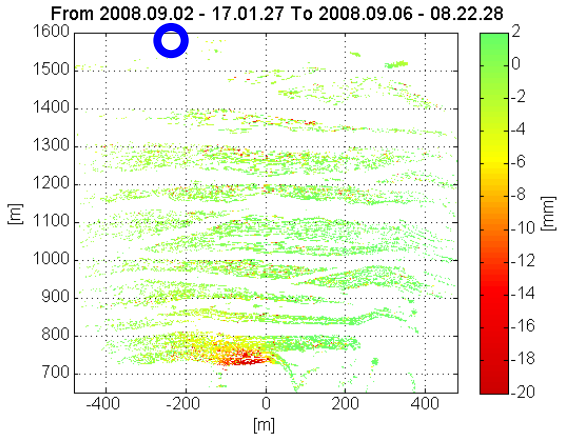


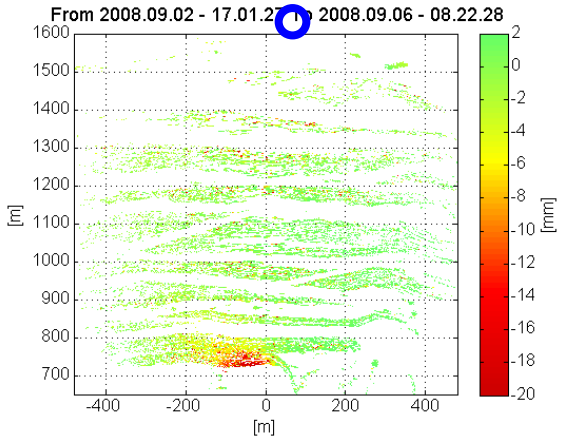




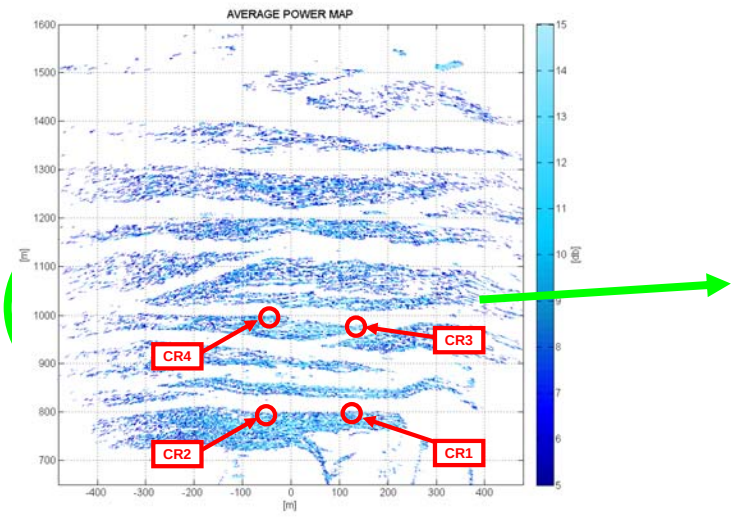
Time Series of some Selected Points

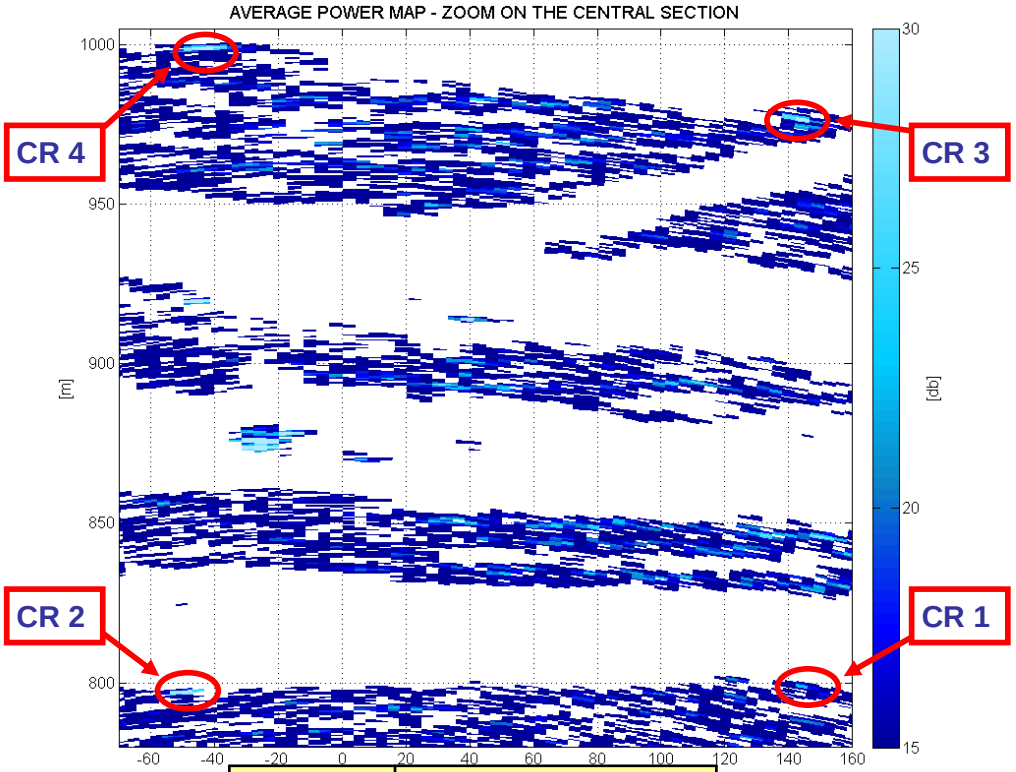






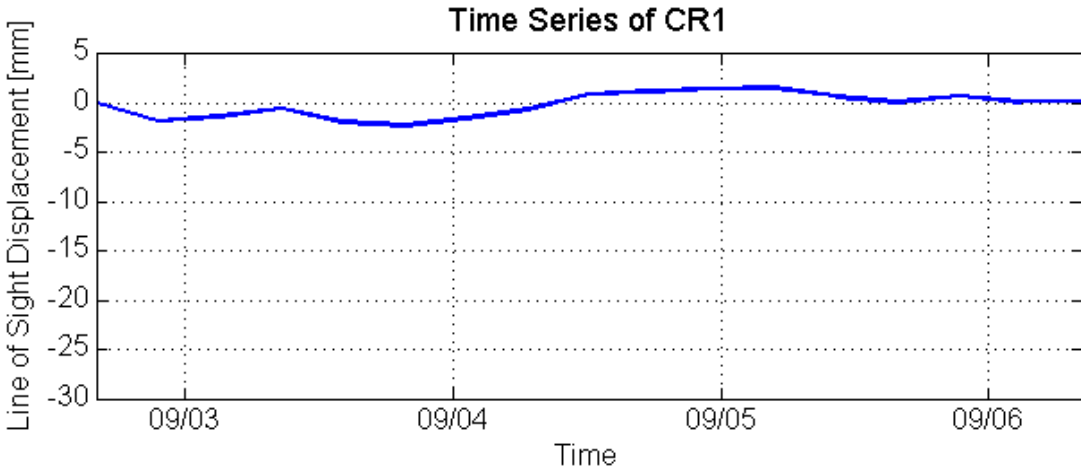
Corner Reflectors Installation Points

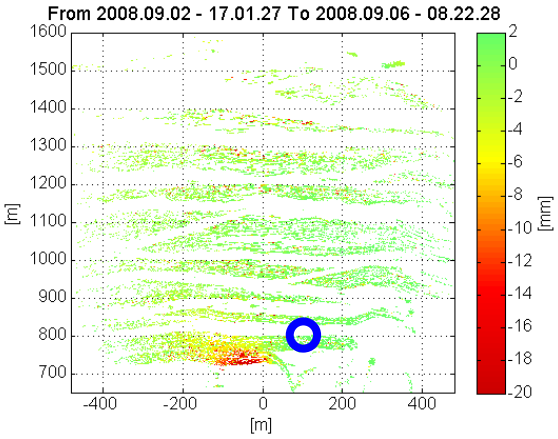


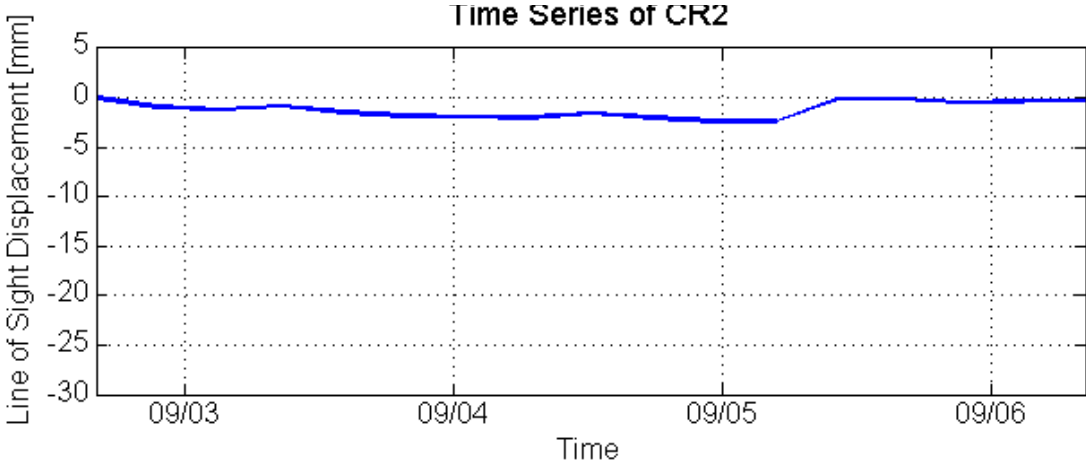


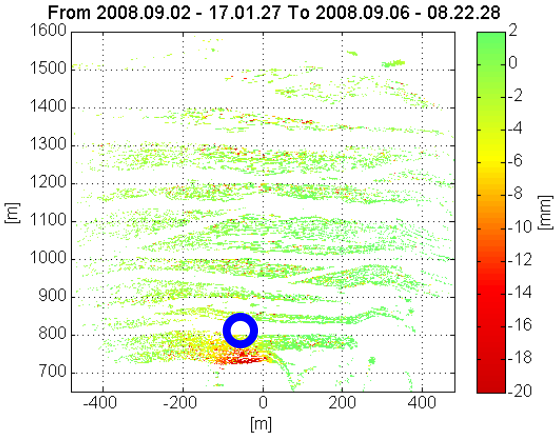
CR	TOTAL STATION BENCHMARK
1	51909
2	51809
3	51907
4	51807

Time Series of the Corner Reflectors

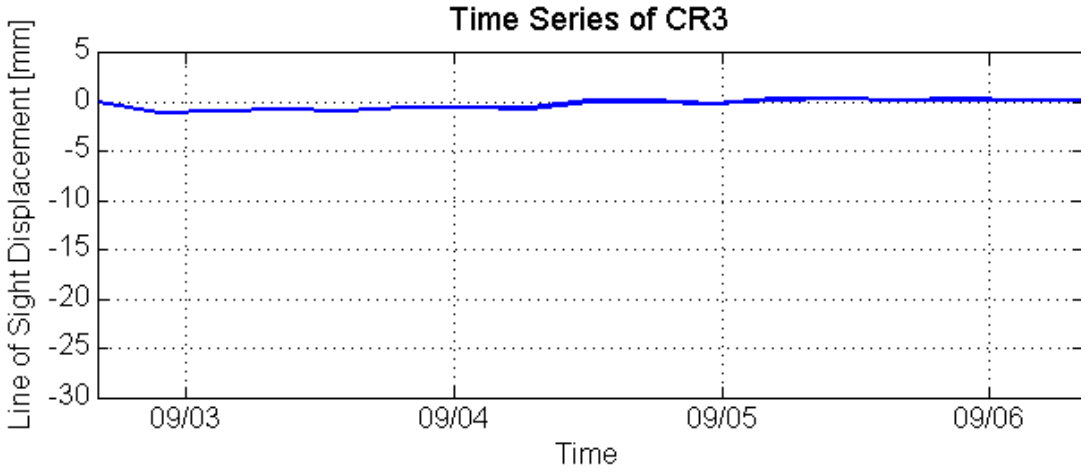


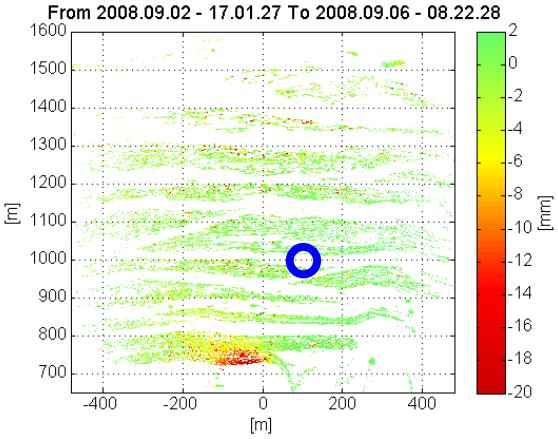


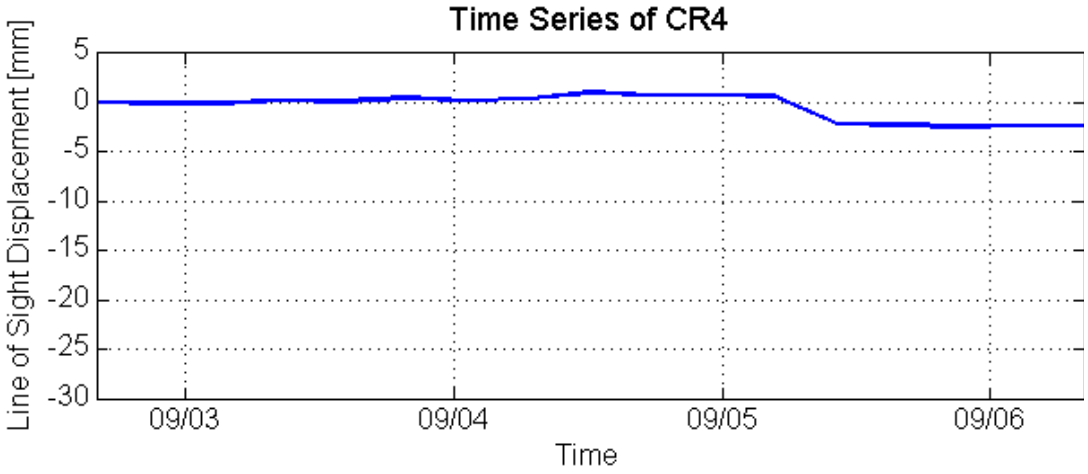


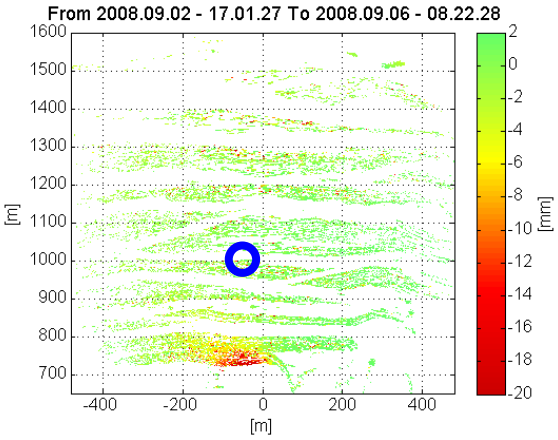


Time Series of the Corner Reflectors

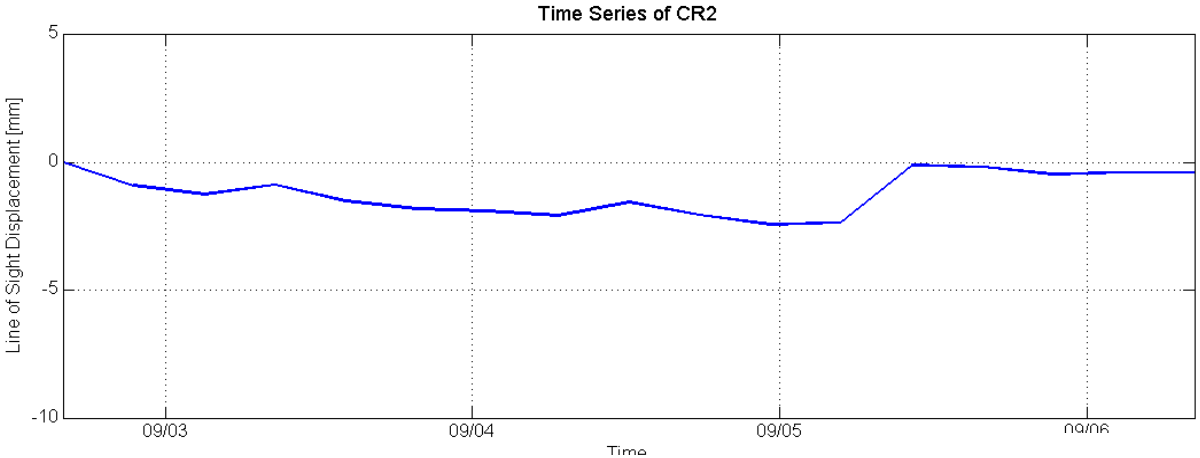






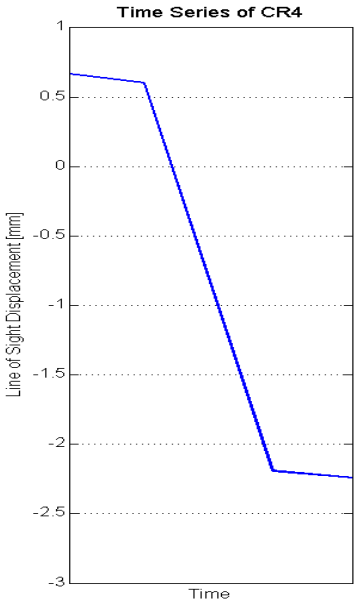


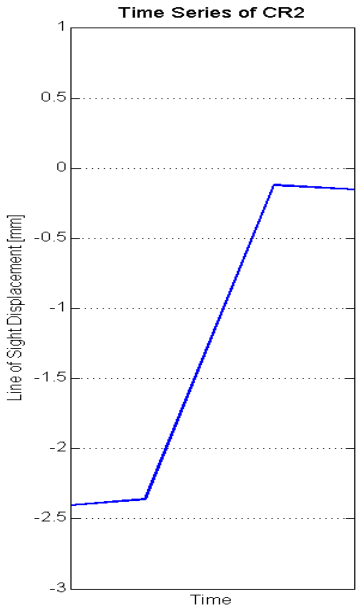
Test on CR2 and CR4



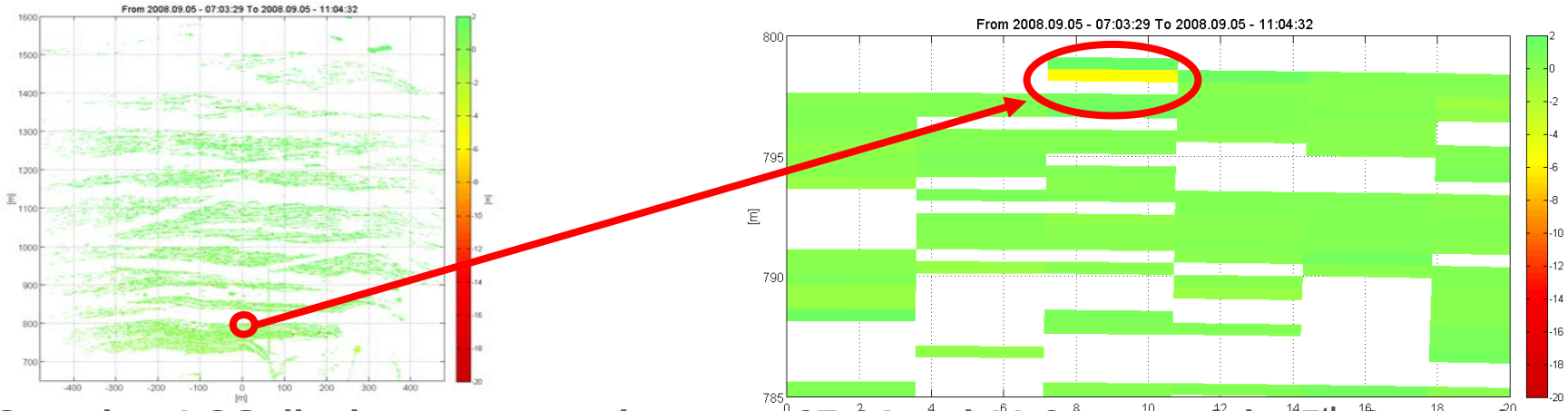
CR2 shows a slow approaching trend (about 1 mm/day).

Two steps on the CR2 and CR4 time series corresponding to the artificially driven movements



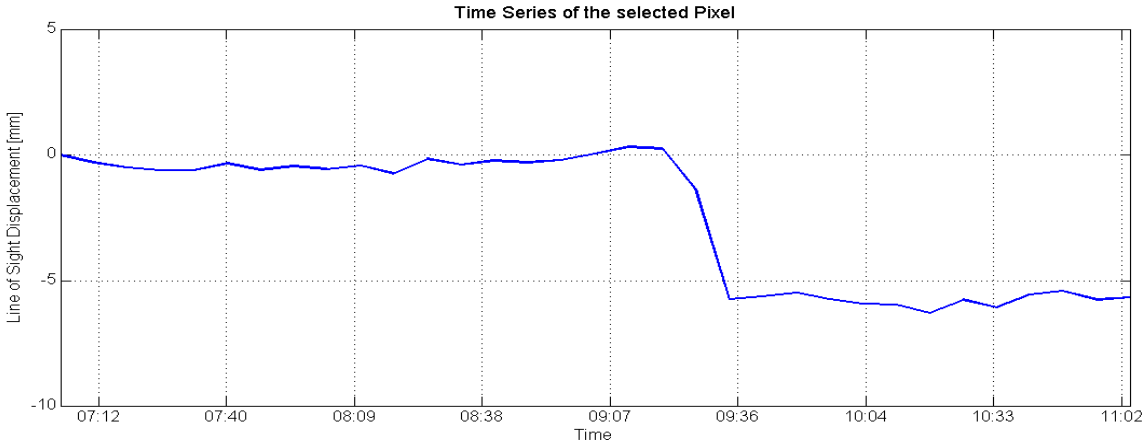


Test on a limited portion of the slope



Cumulate LOS displacement map between 07:04 and 11:04 a.m. of the 5th September

Time series of the pixel corresponding to the artificially moved sector



The step correspond to the artificially driven movement of the considered portion of the slope

Final Remarks

- **The IBIS-L 88 hours monitoring has shown maximum Line of Sight displacement of the lower part of the slope of about 25 mm**
- **The upper part of the slope has instead shown a good stability**
- **The performed tests have shown the IBIS-L capability to detect the artificially driven movements both on the corner reflectors and on the moved portion of the slope**