# Evaluation of overshooting tops observed in super RSS experiments in both HRV and IR spectral channels

(with respect to detectability of OT brightness temperatures and penetration heights)

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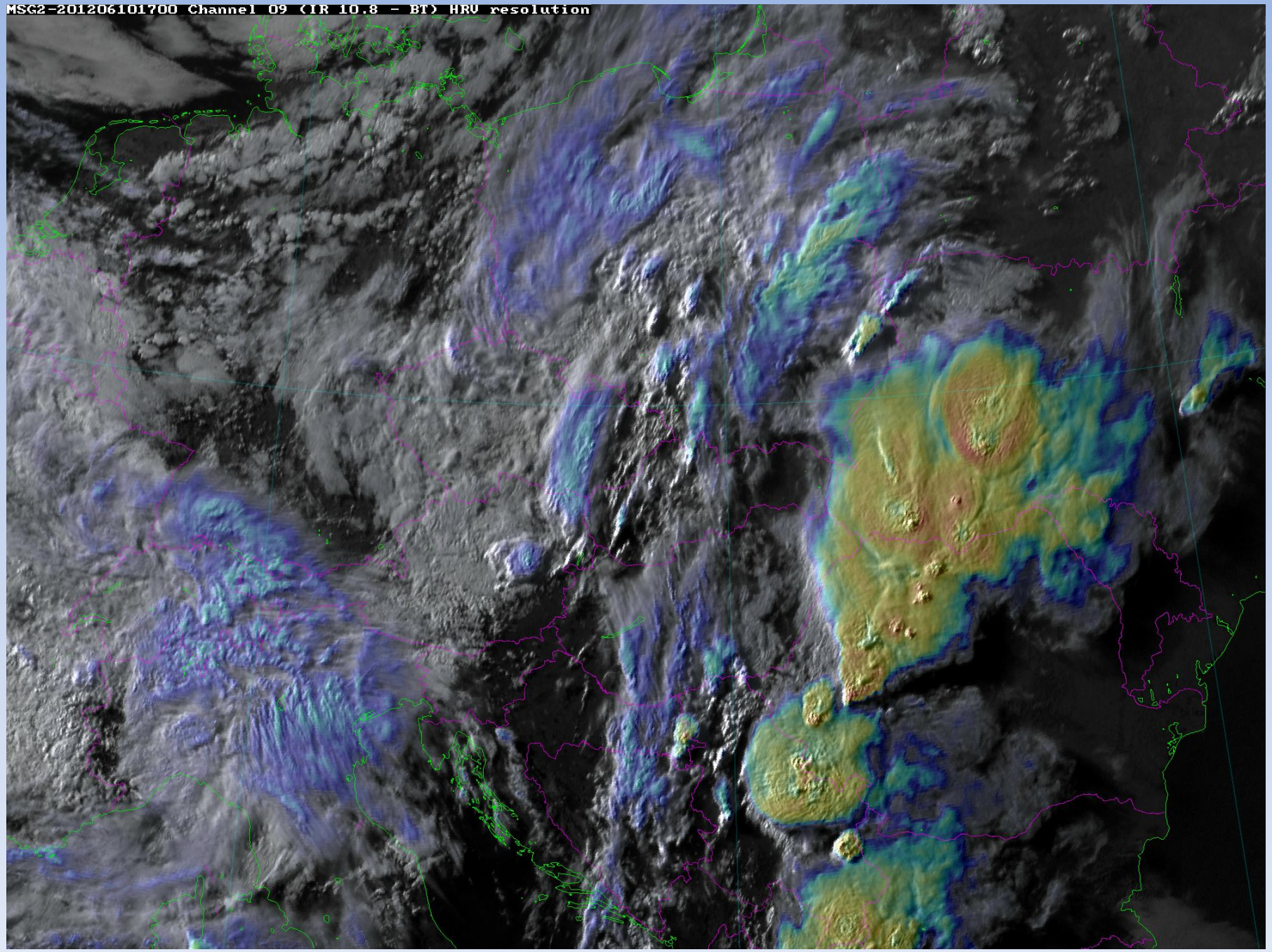
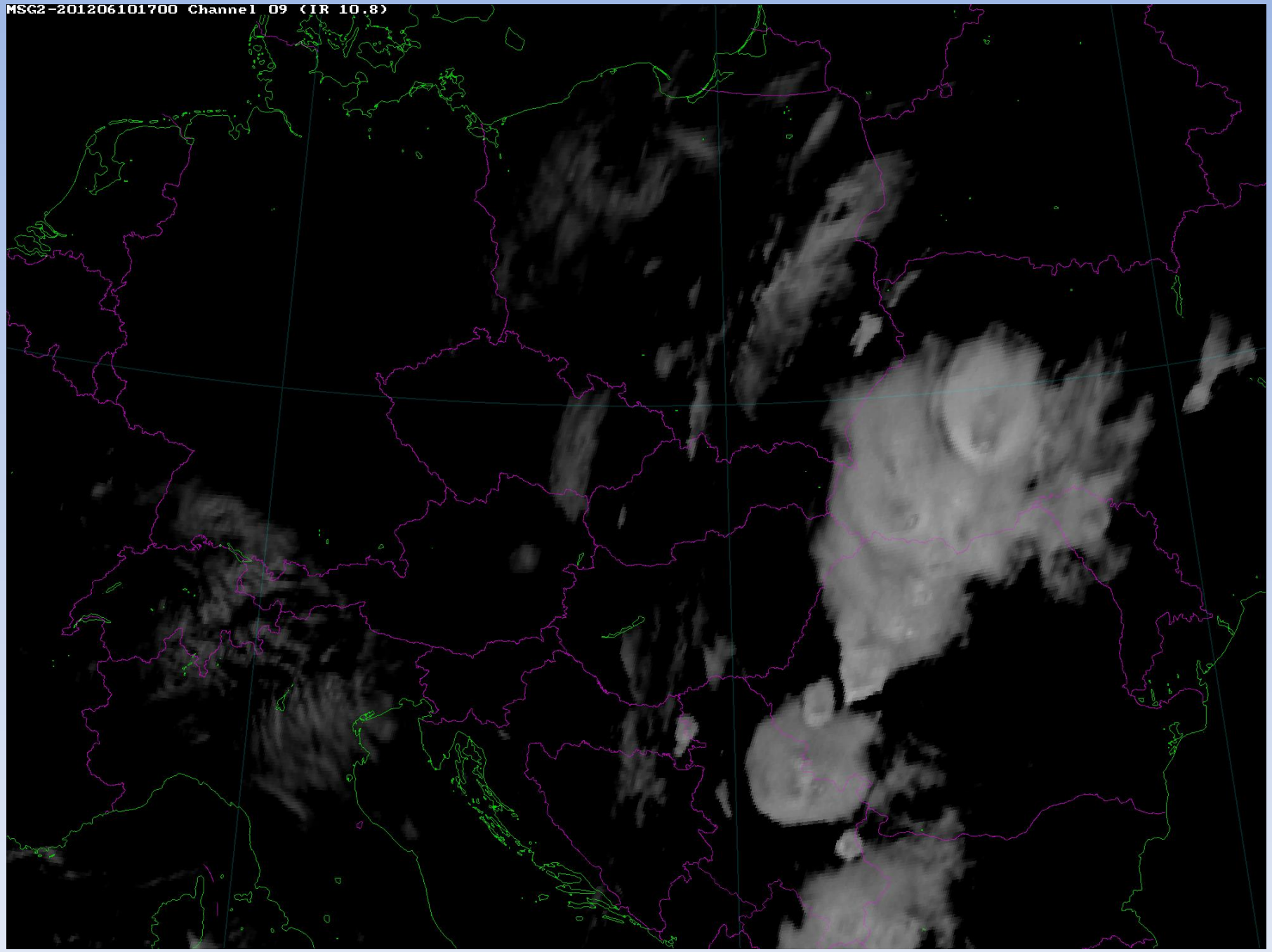
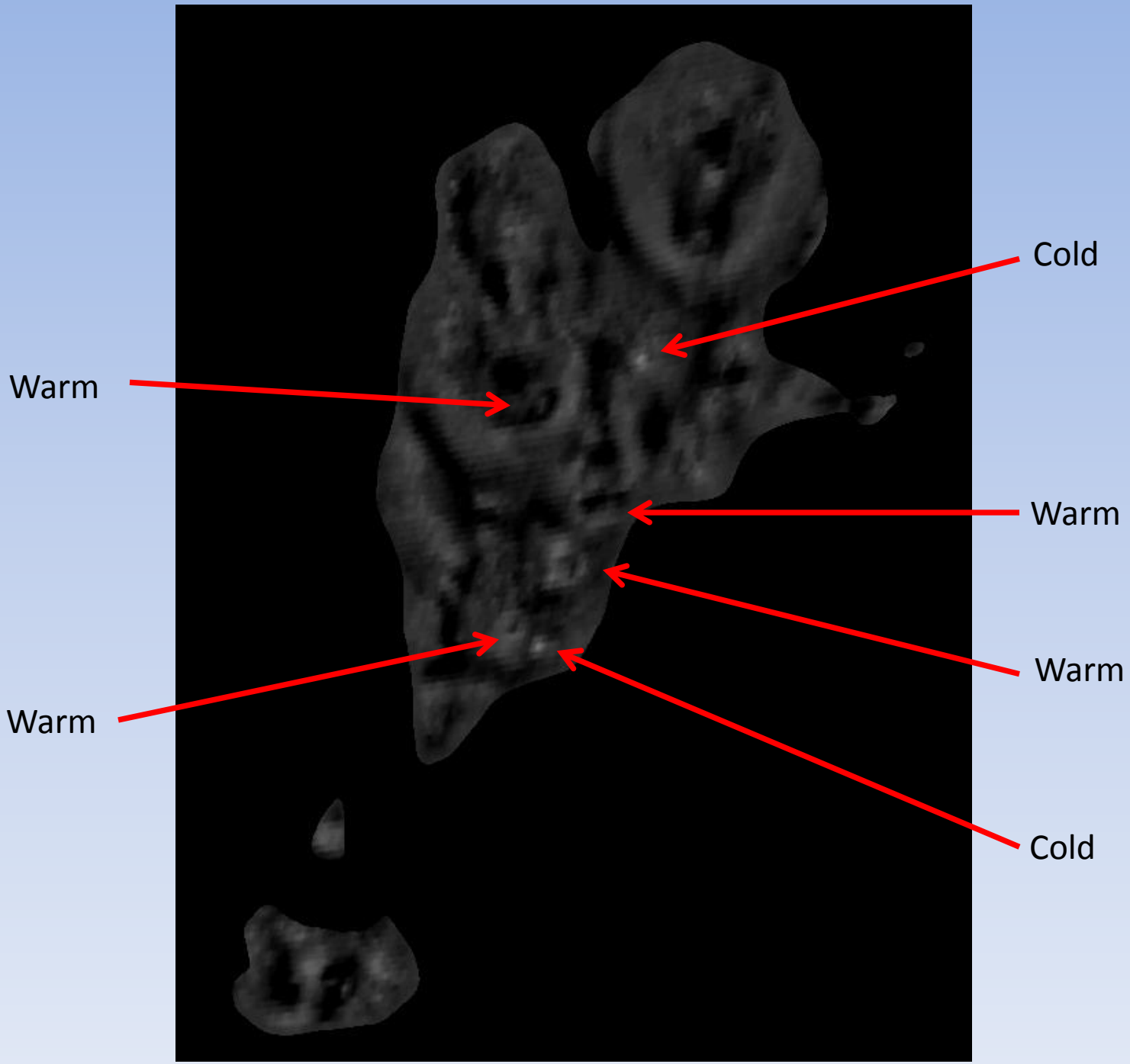
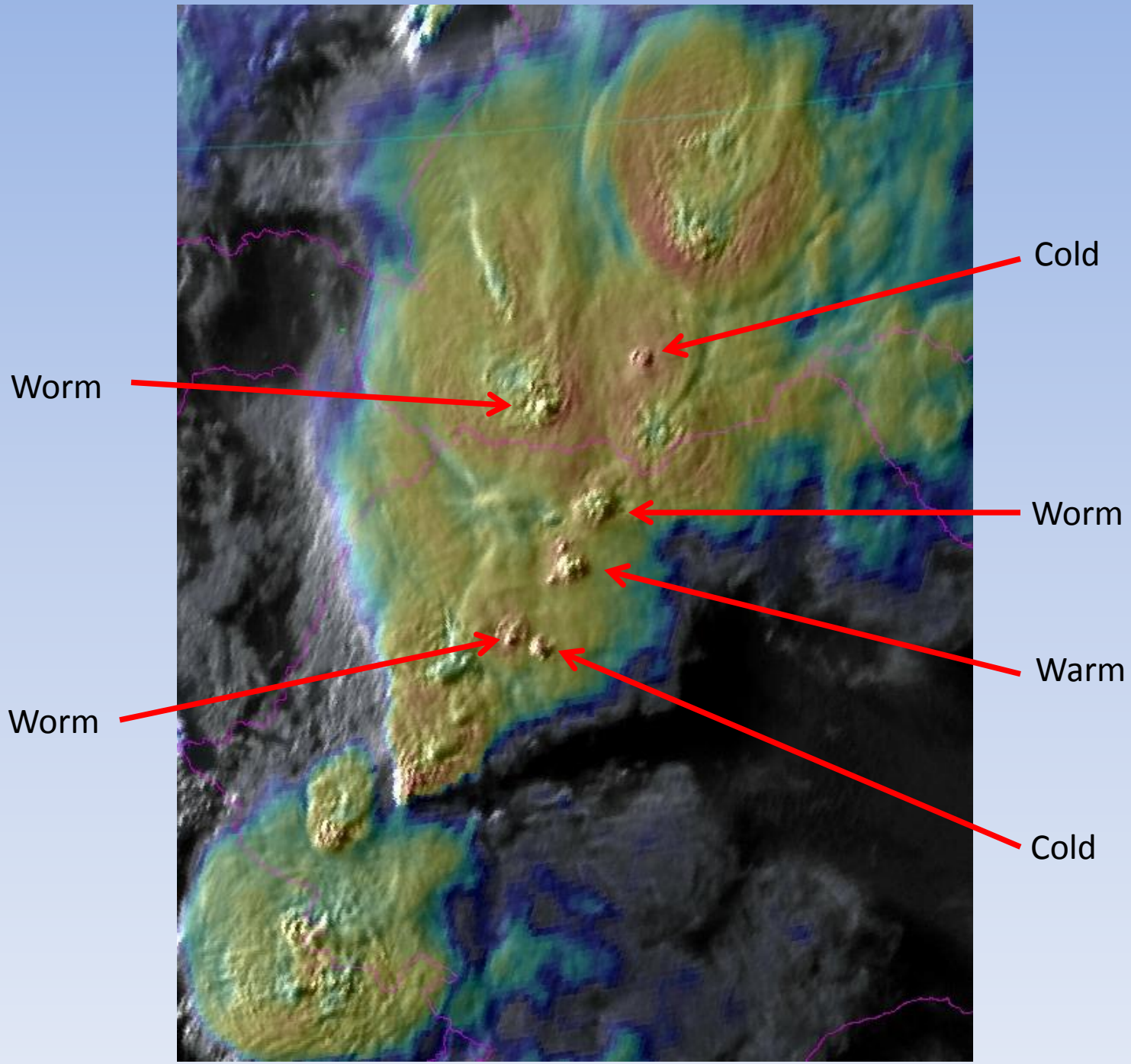
Example of OT as can be observed on HRV-IR sandwich product: 10 June 2012 17:00 UTC



Example of OT as can be observed on simple IR image: 10 June 2012 17:00 UTC




Cold
Warm
Warm
Warm
Warm
Cold

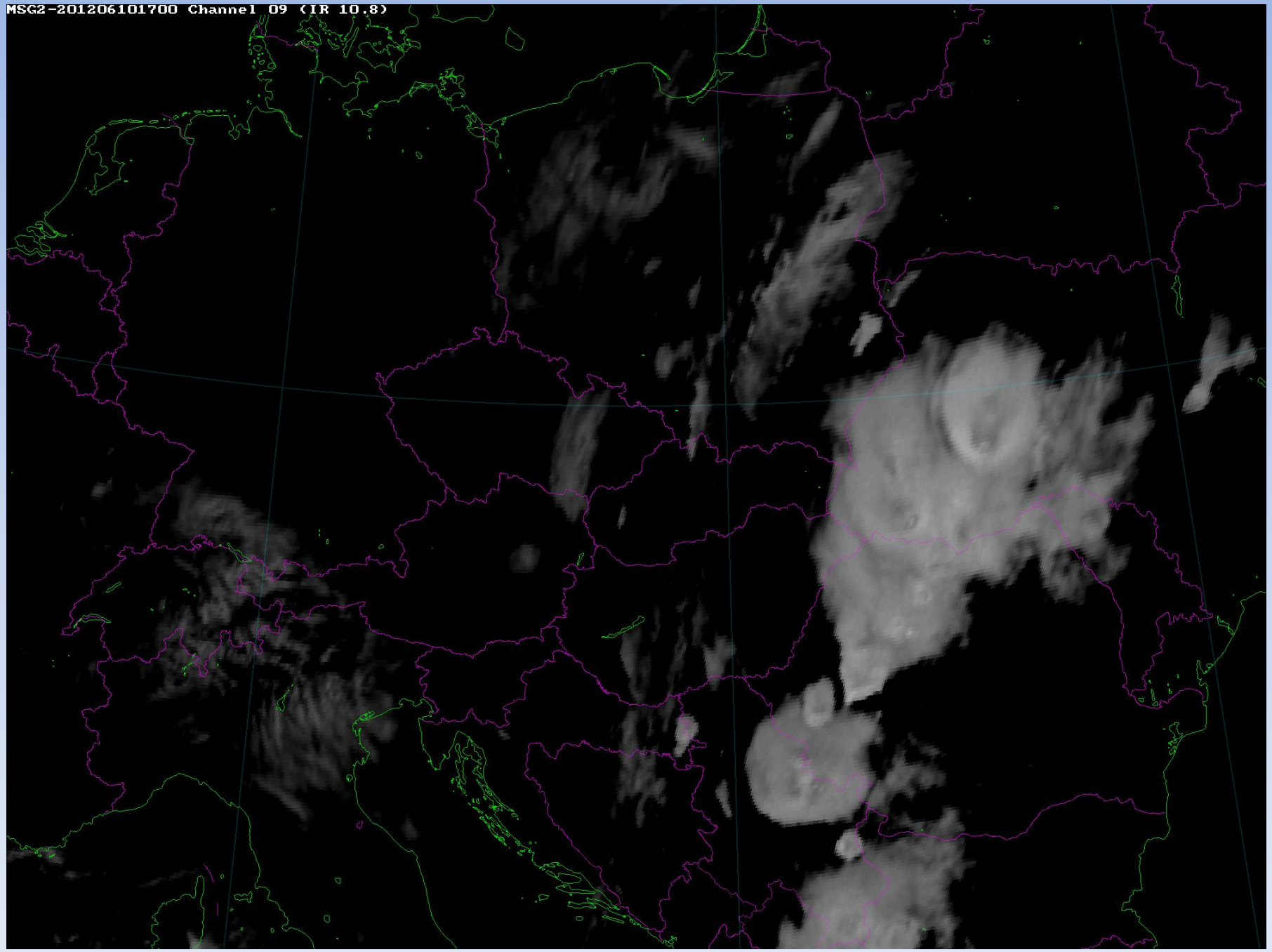

Cold
Worm
Worm
Warm
Worm
Cold

# Proposed additional IR test to existing OT detection methods:

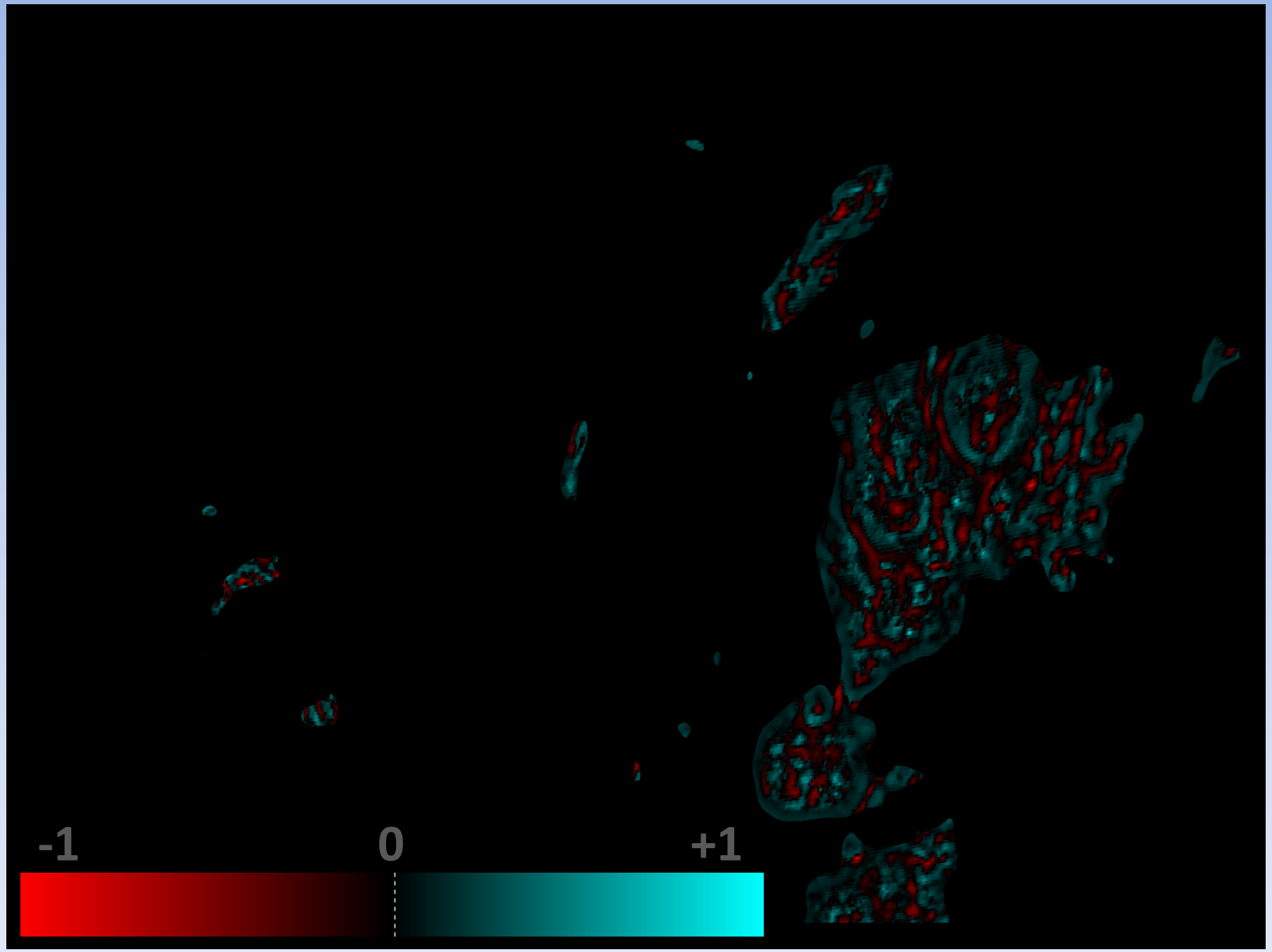
- **Image matrix:** binary IR data; in my case of size 2000x1500 pixels, resolution about 5km$^2$
- **Correlation matrix:** Pre-defined floating window of size n x n pixels (n~20), pixel's values = -50, central pixel value -60 (BT in °C)
- **Correlation/convolution** between image and correlation matrix is reflecting the local extremes of IR BT (not only minimums but also maximums; CC varies from -1 to 1)
- **Extreme pixels values**, which can correspond to OT positions or ATC (Anvil Thermal Couplets) are visible on resulting correlation image as described in: Overshooting Top and Enhanced V-detection by *Kristopher Bedka, Jason Brunner and Wayne Feltz; 2011*

- *Note: correlation is sensitive enough to catch small BT differences (from 1 Kelvin). Then HRV image can be used to consider, if local extreme corresponds to OT or not.*

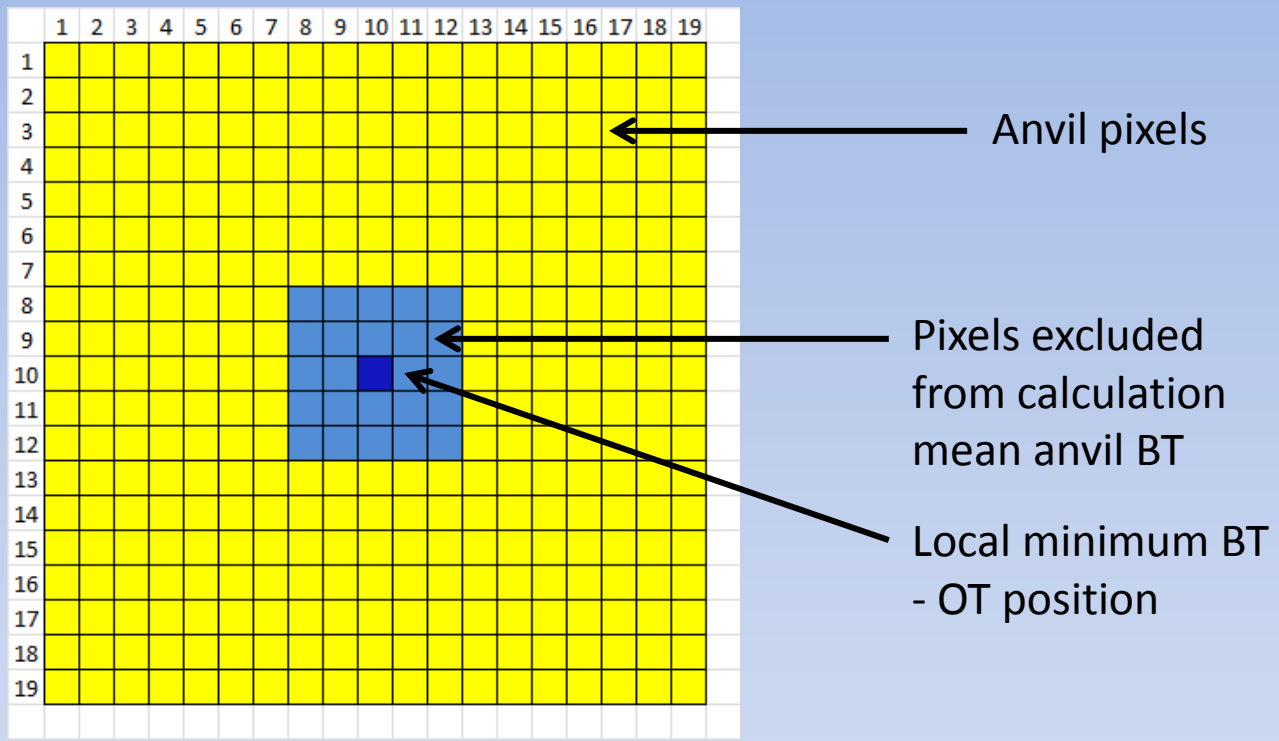
Example of additional IR test based on correlation floating window: 10 June 2012 17:00 UTC



Example of additional IR test based on correlation floating window: 10 June 2012 17:00 UTC

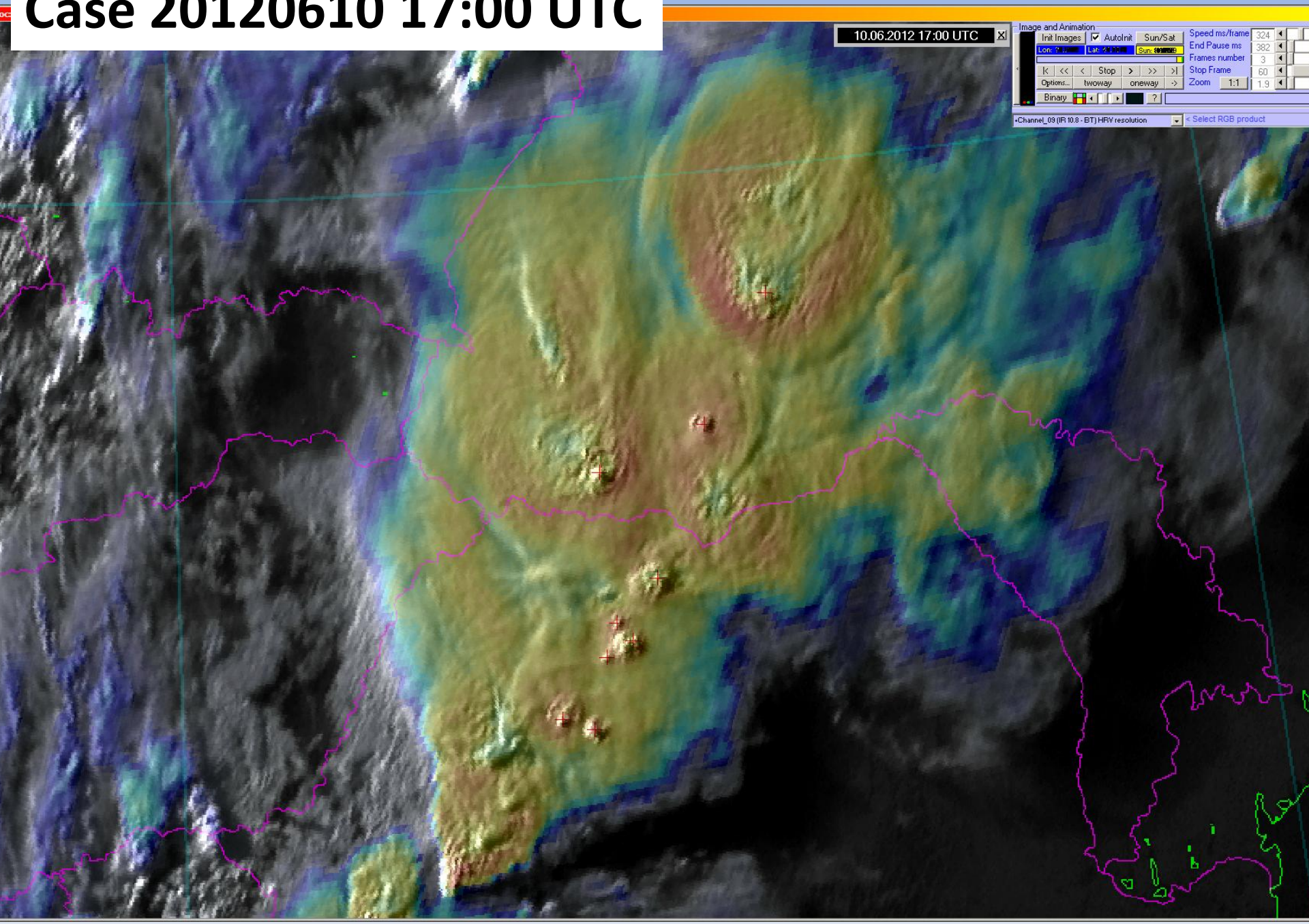


# Evaluation of detected local extreme BT:

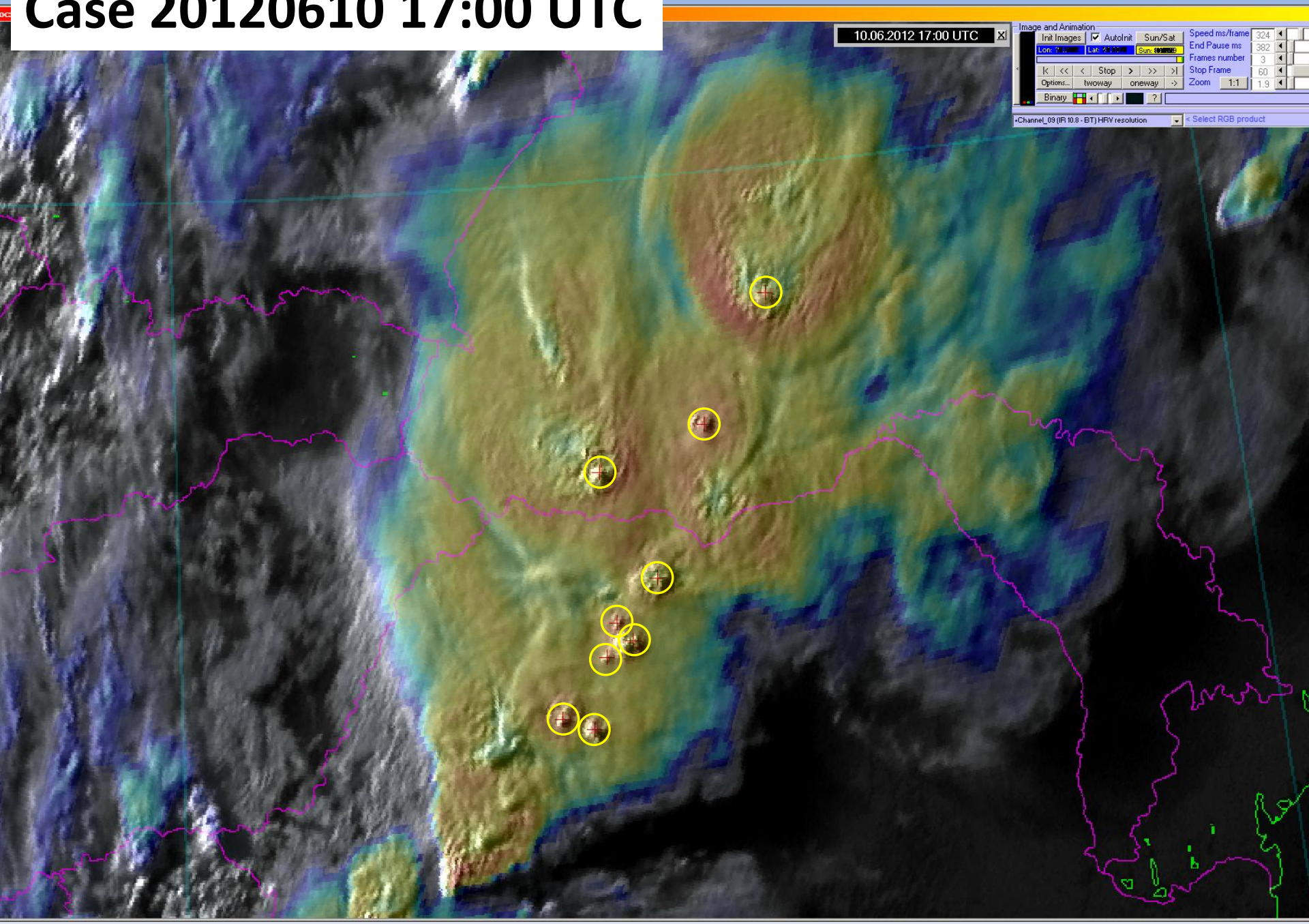



1. Confirmation of OT by local extremes by convolution matrix
2. Visual detection of OT on HRV channel, estimation of exact OT coordinates (dark blue pixel)
3. Calculation of minimum OT BT in area of 5x5 pixels (blue region)
4. Calculation of average Anvil BT in area of 19x19 pixels (yellow pixels) excluding central blue pixels
5. Calculation of Anvil – OT BT difference

# Case 20120610 17:00 UTC



# Case 20120610 17:00 UTC



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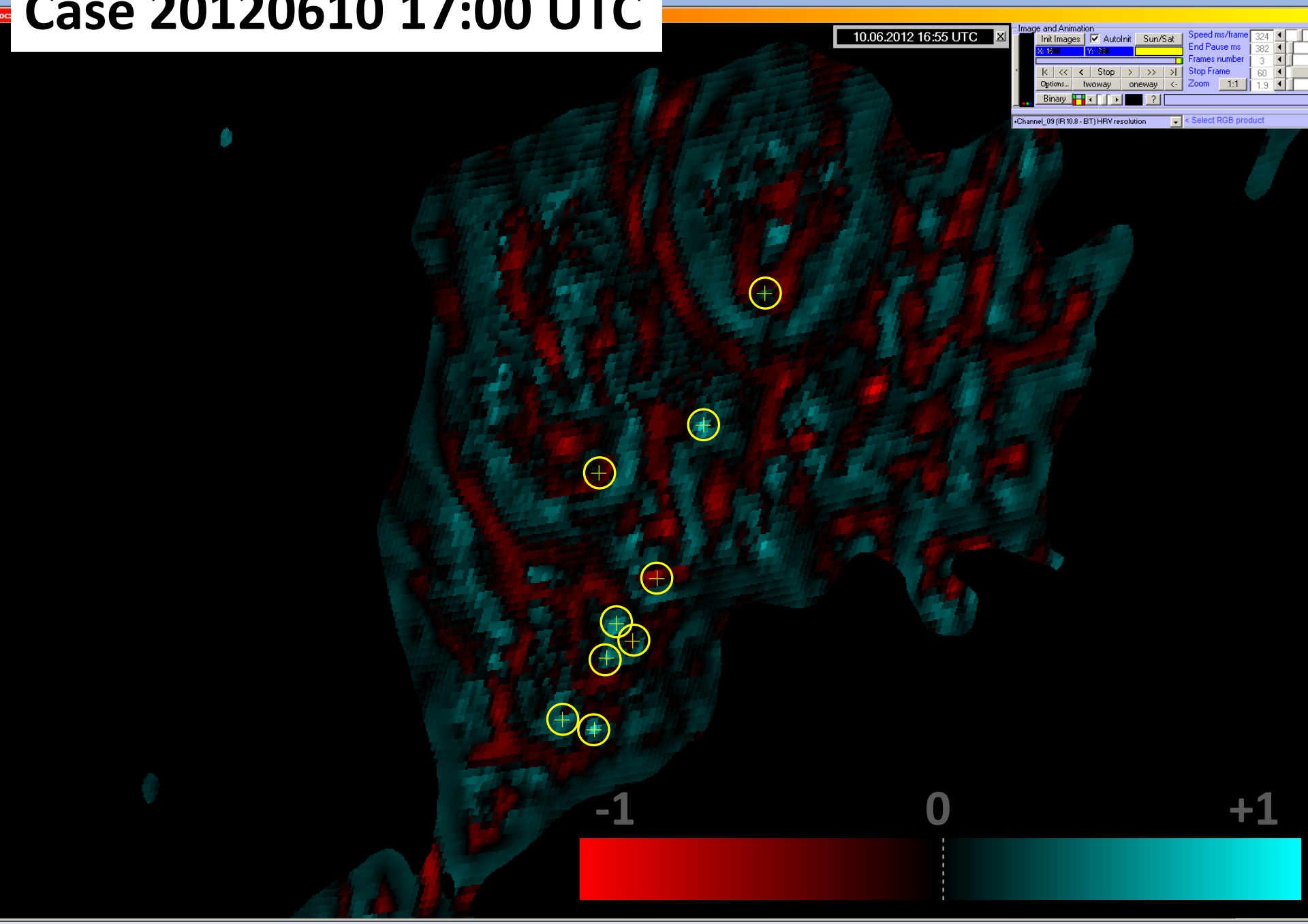

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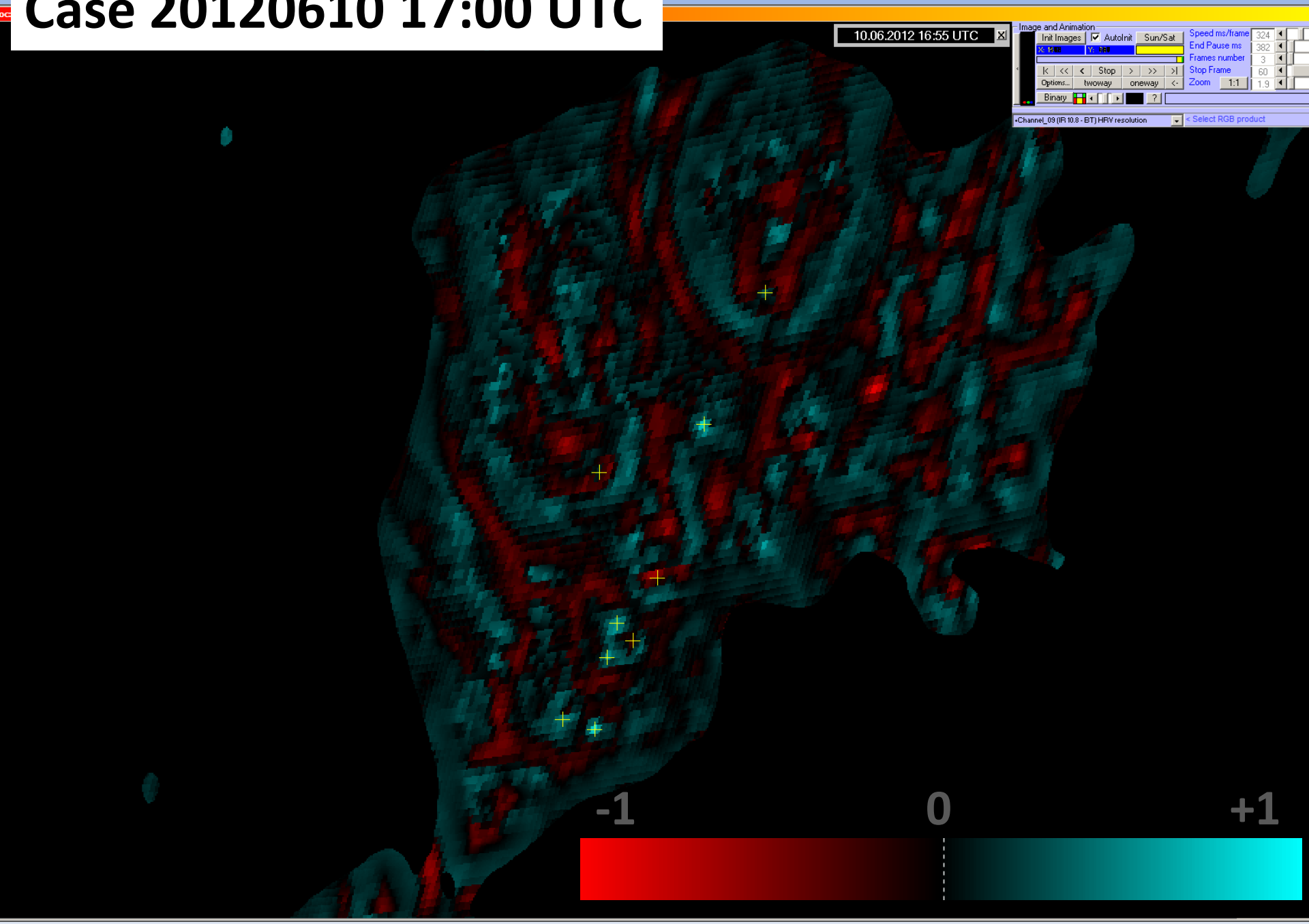
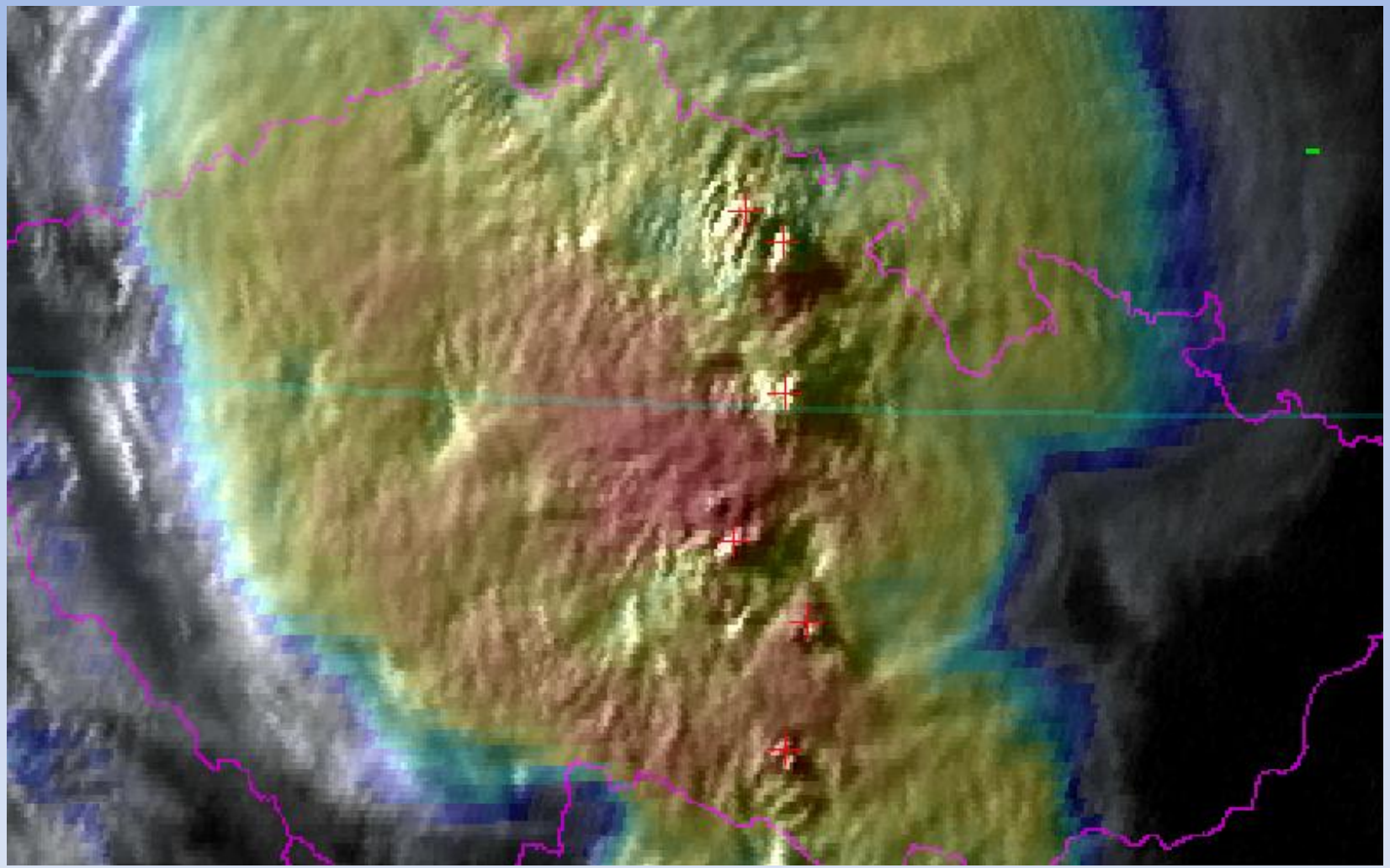


# Case 20130729 18:02 UTC



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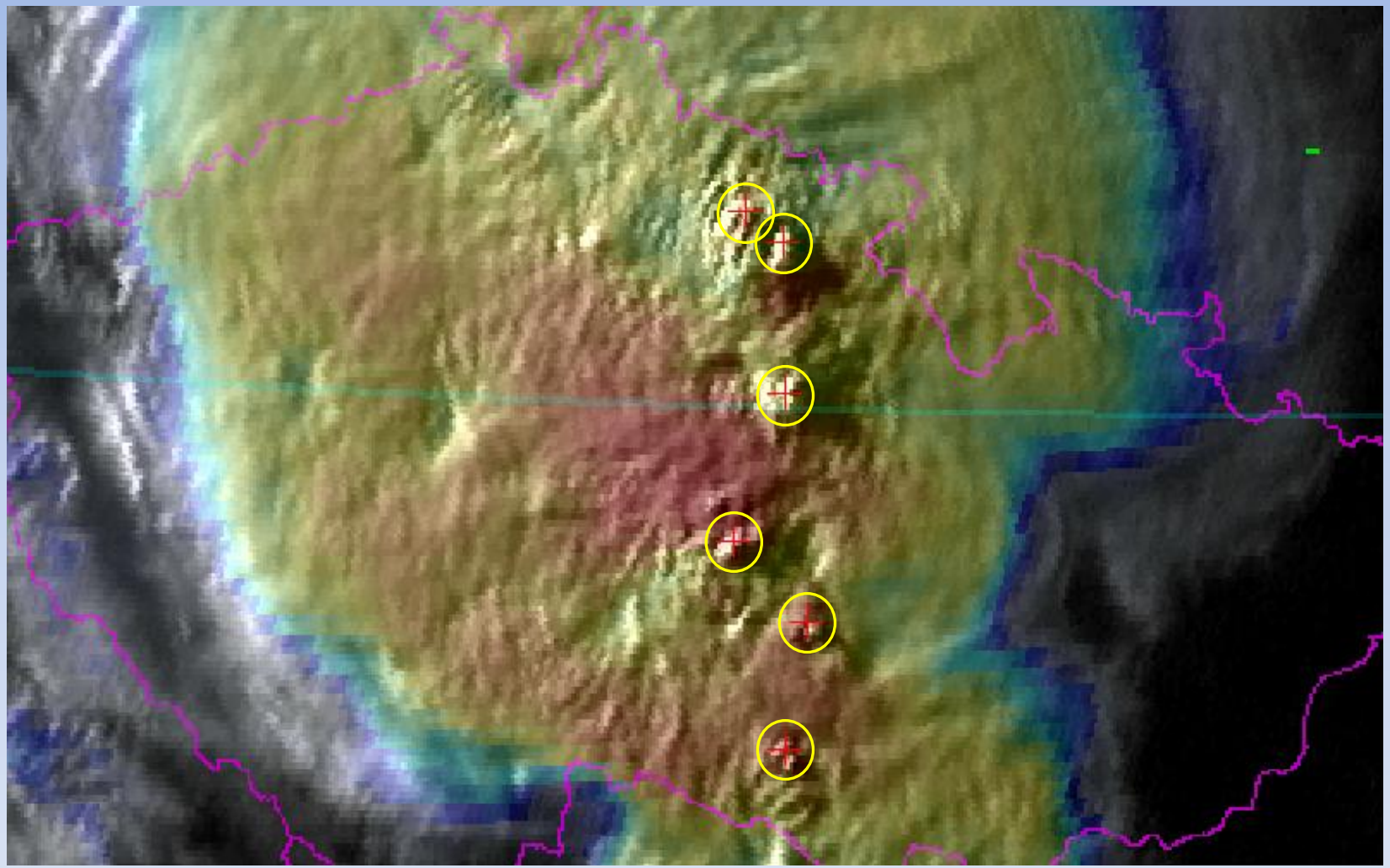

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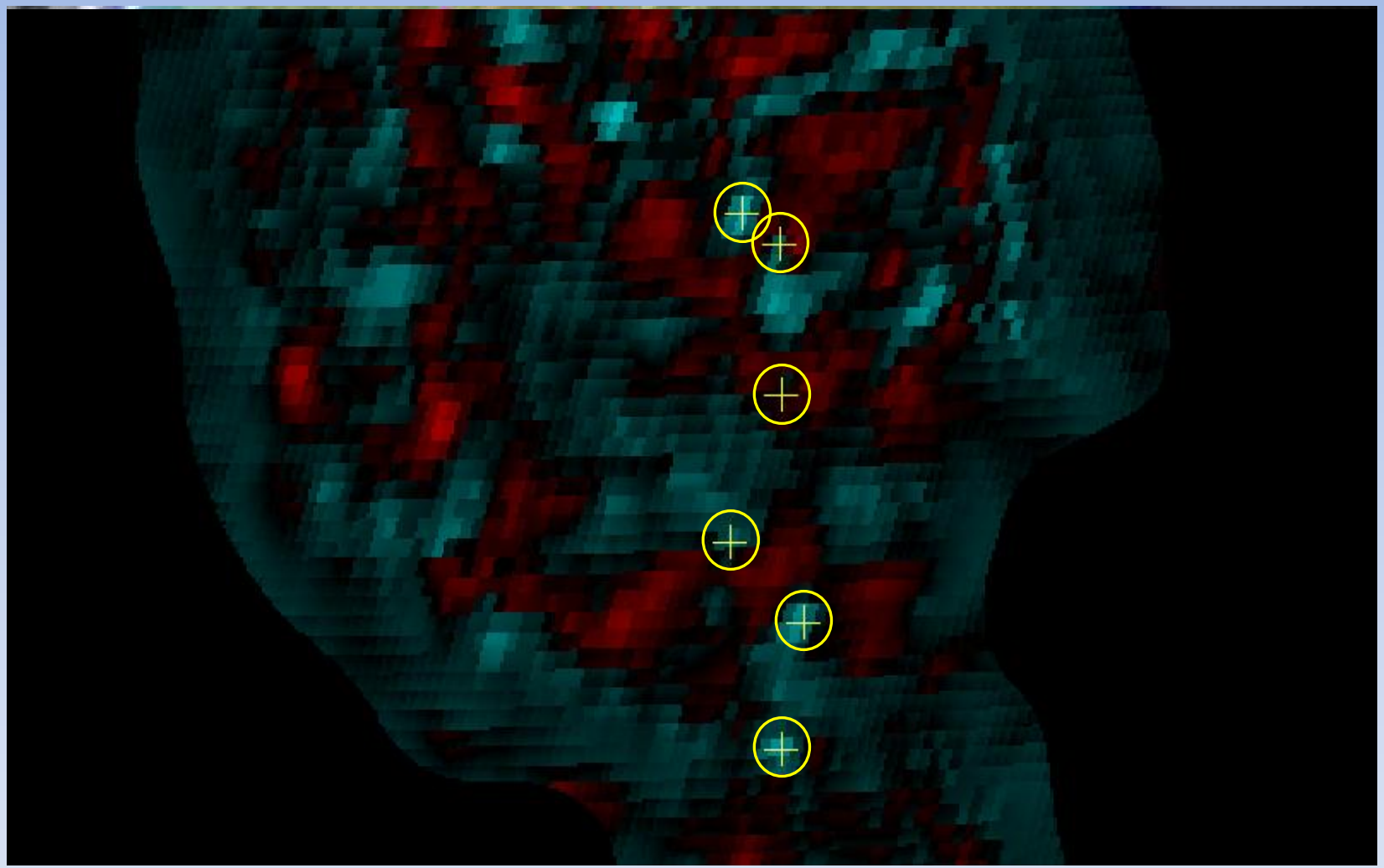

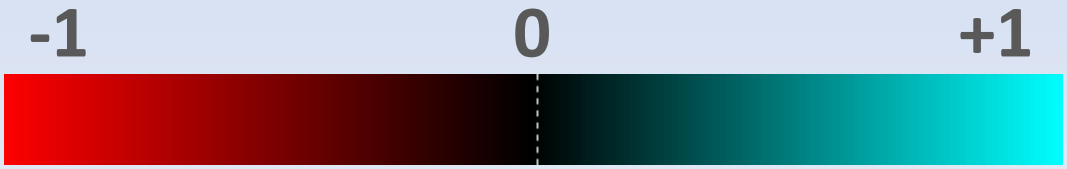

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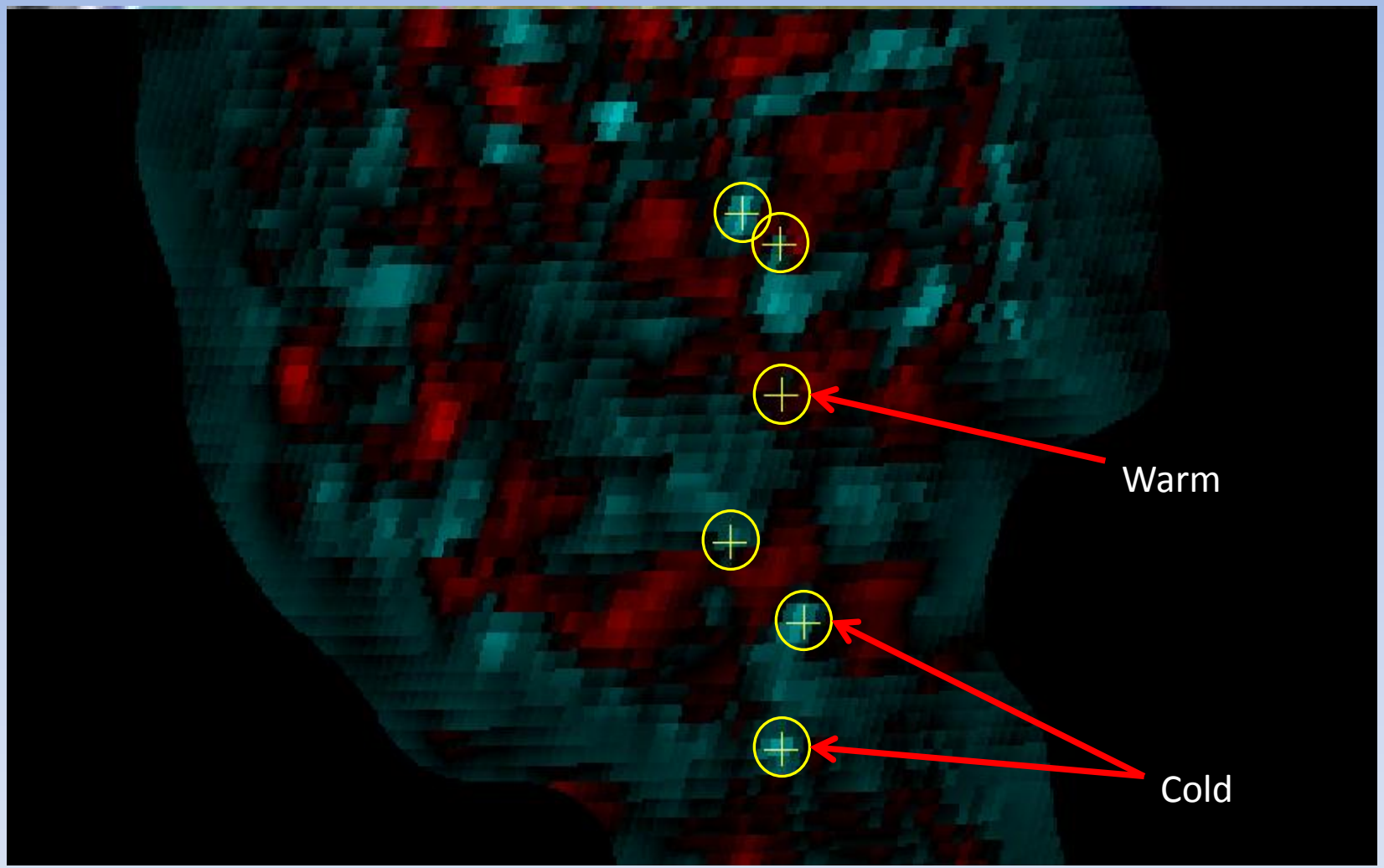
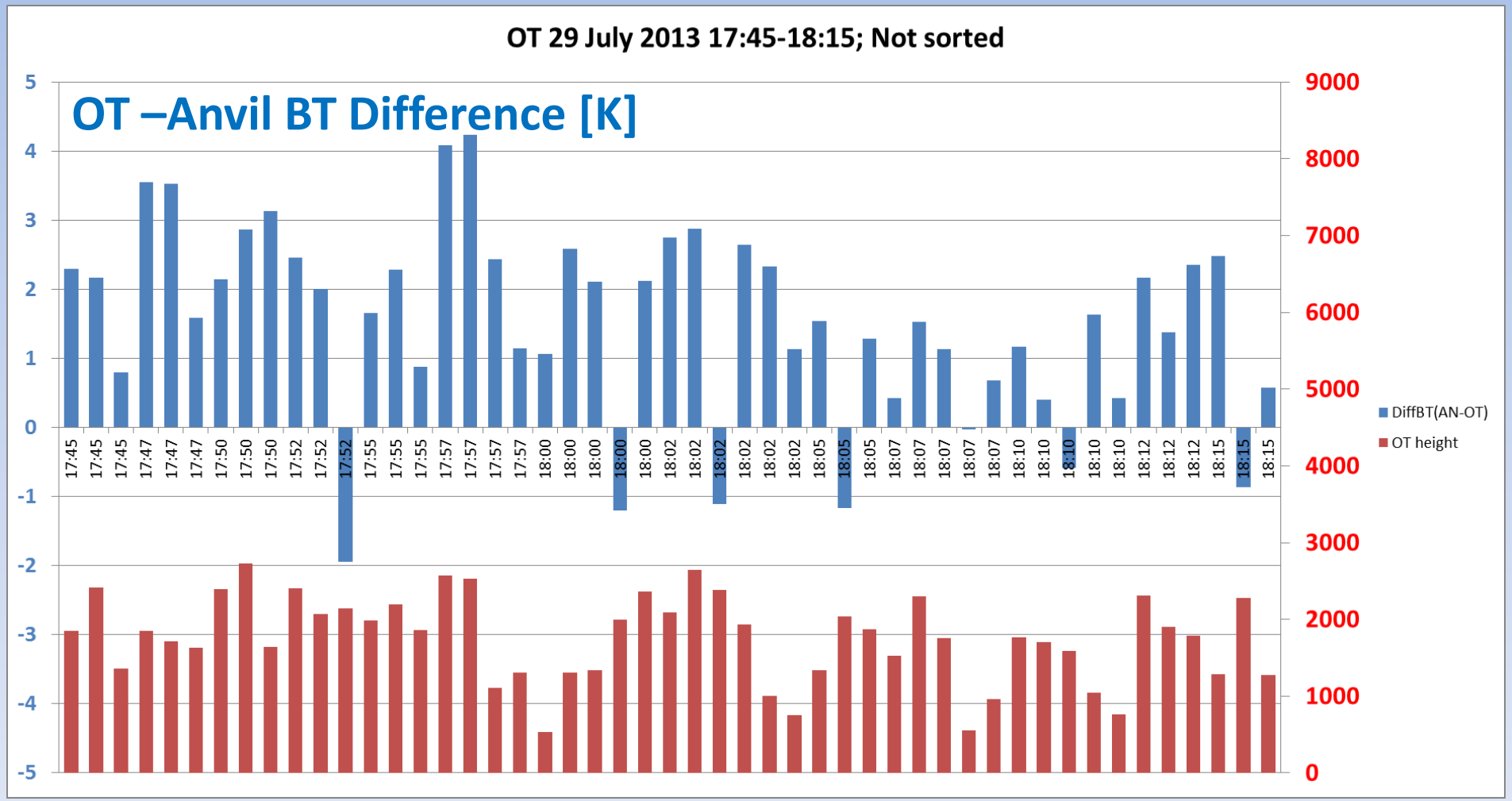



Case 20130729 17:45-18:15 UTC

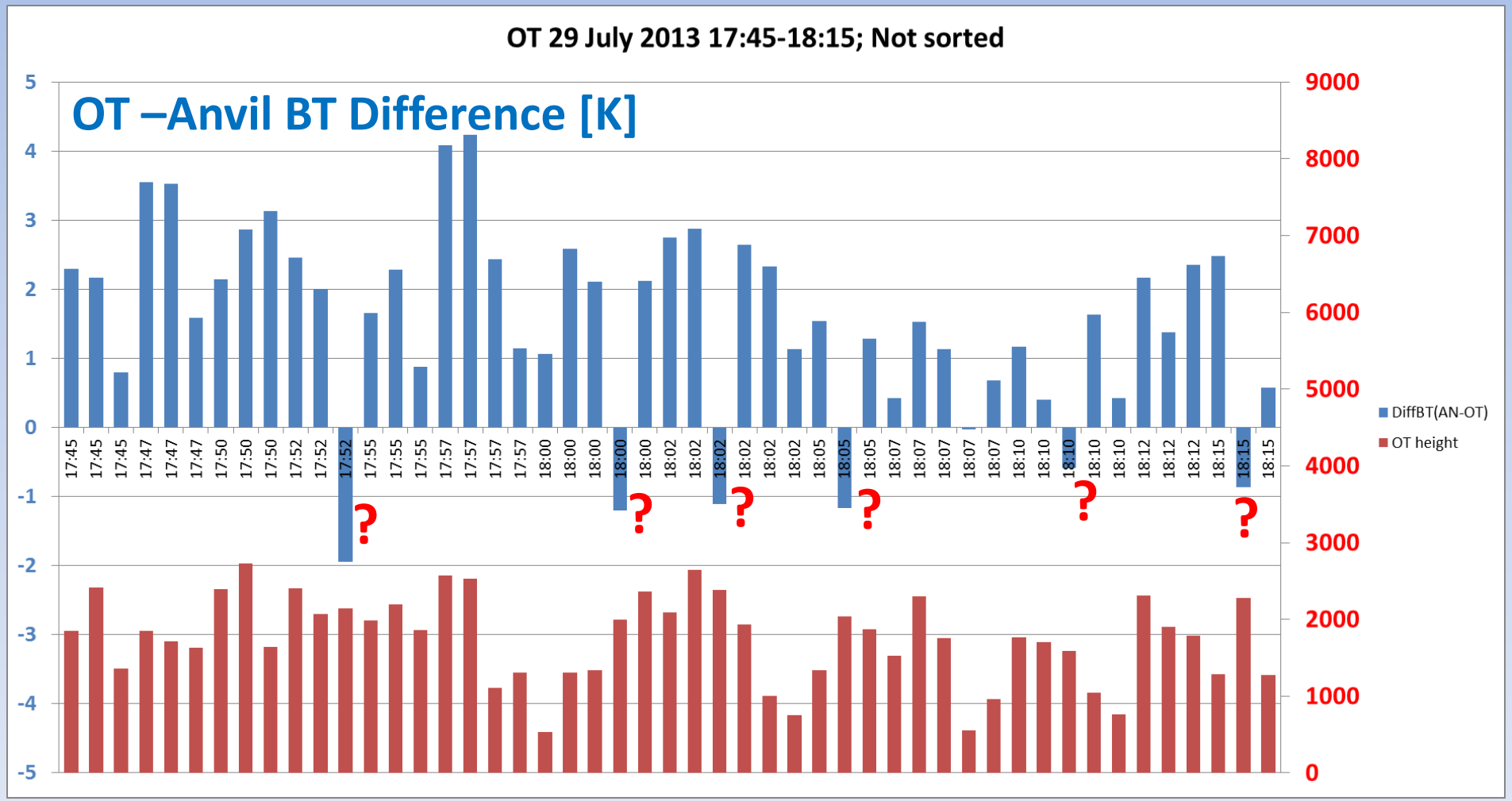
# All OTs visually identified on 2.5min RSS imagery from 17:45-18:15 29 July 2013




OT Height [m]

Case 20130729 17:45-18:15 UTC

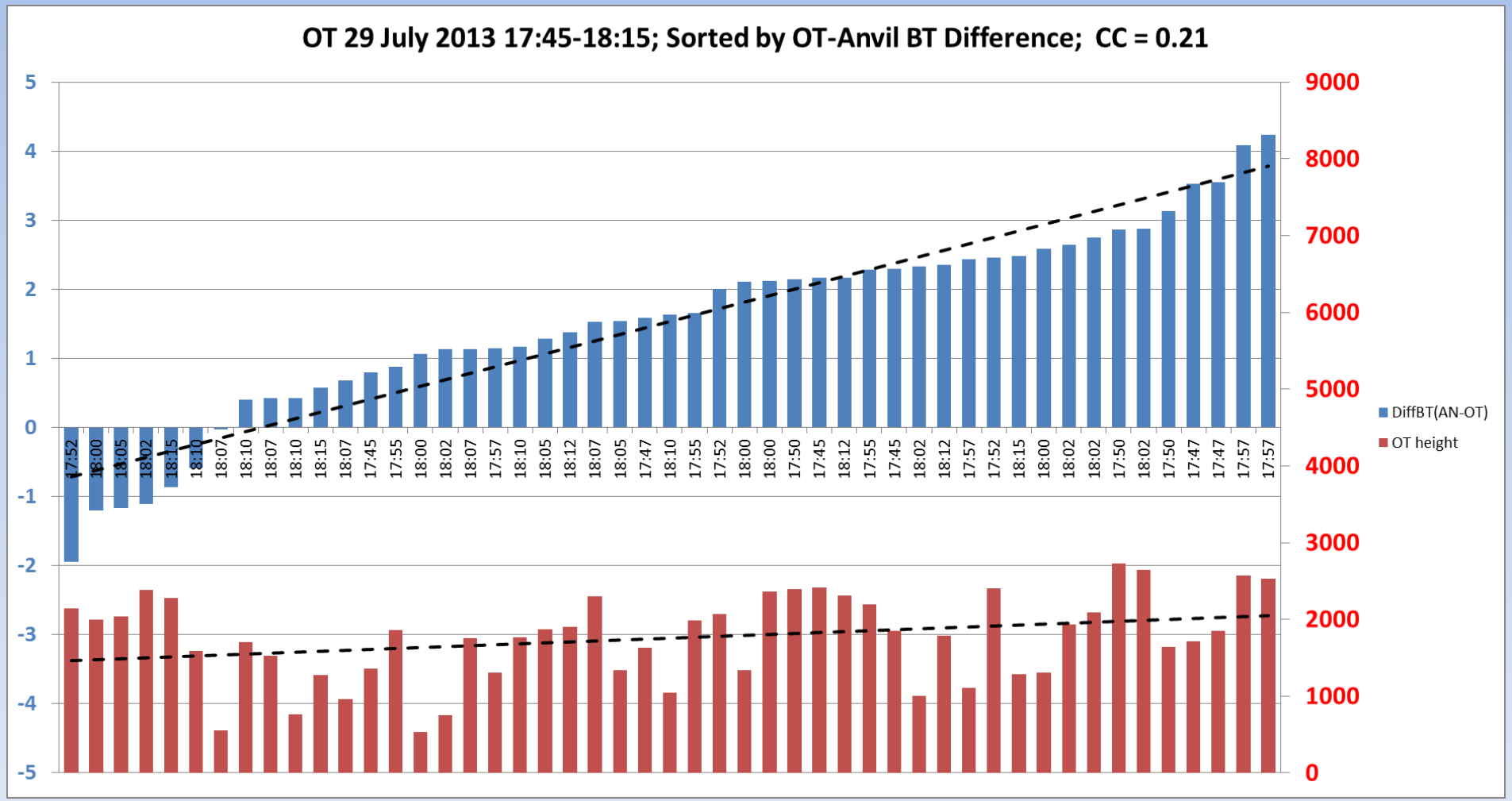
# All OTs visually identified on 2.5min RSS imagery from 17:45-18:15 29 July 2013




OT Height [m]

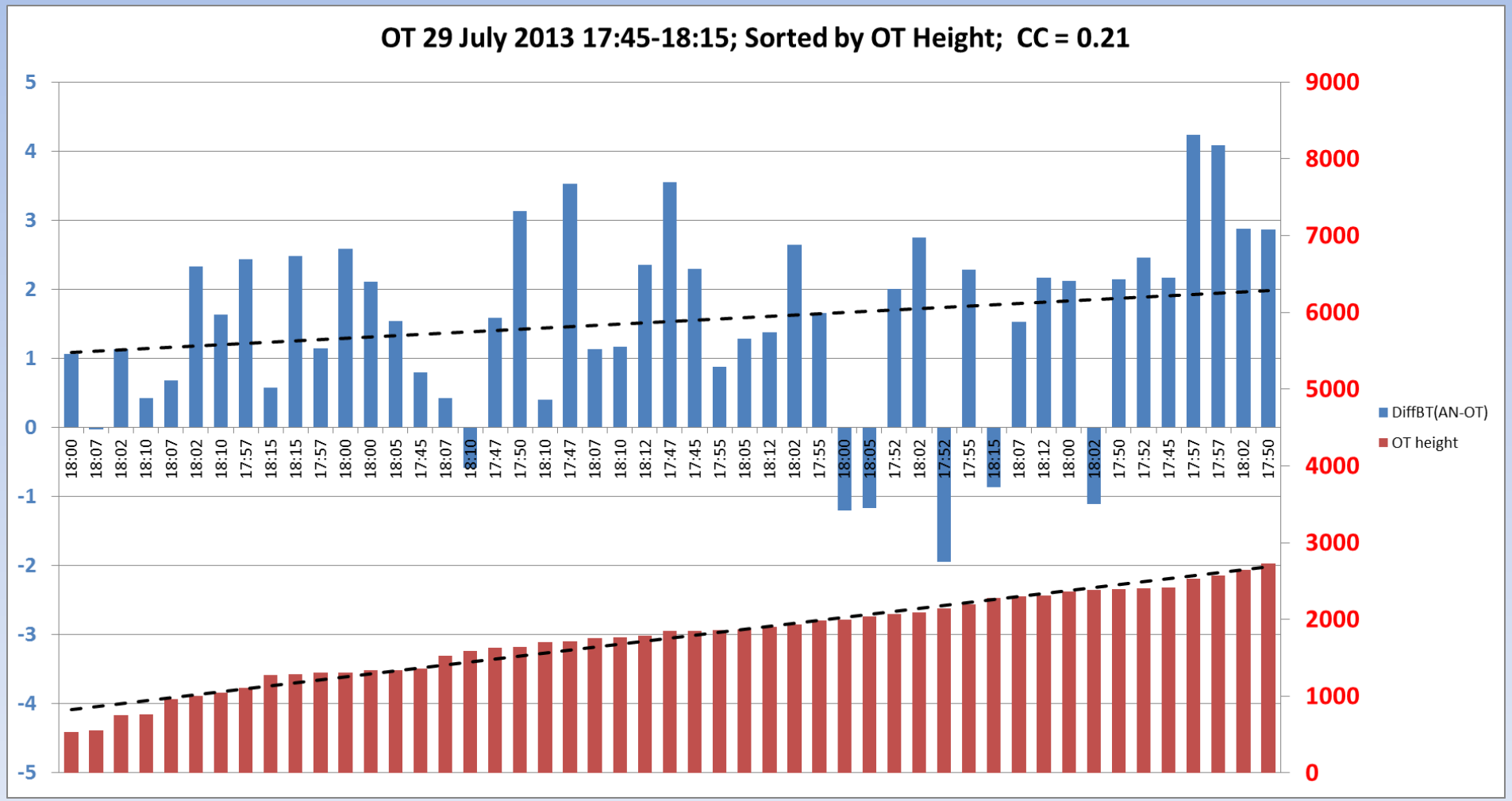
Case 20130729 17:45-18:15 UTC

# All OTs visually identified on 2.5min RSS imagery from 17:45-18:15 29 July 2013 – sorted according OT-Anvil BT difference



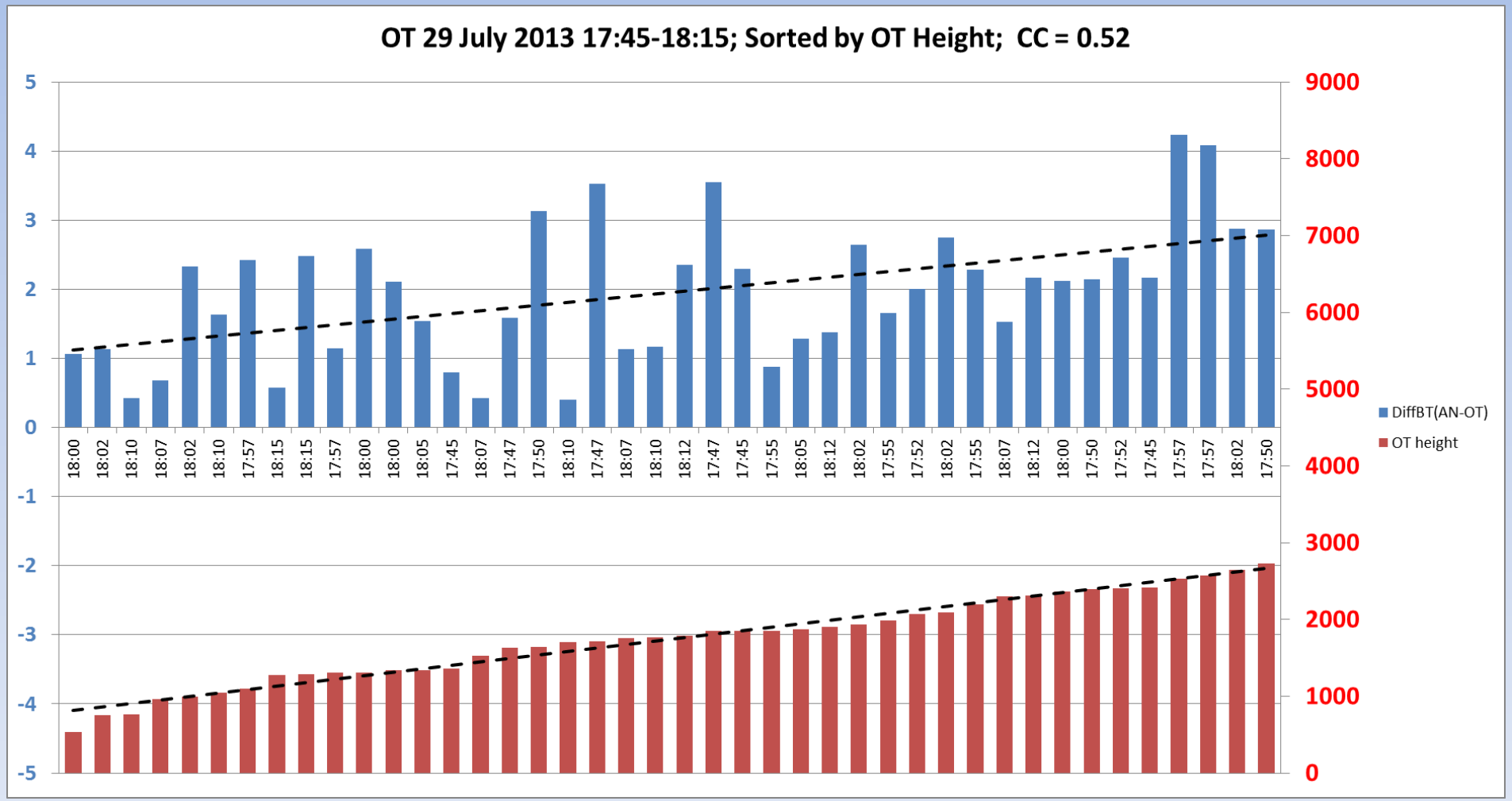
Case 20130729 17:45-18:15 UTC

# All OTs visually identified on 2.5min RSS imagery from 17:45-18:15 29 July 2013 – sorted according OT-height



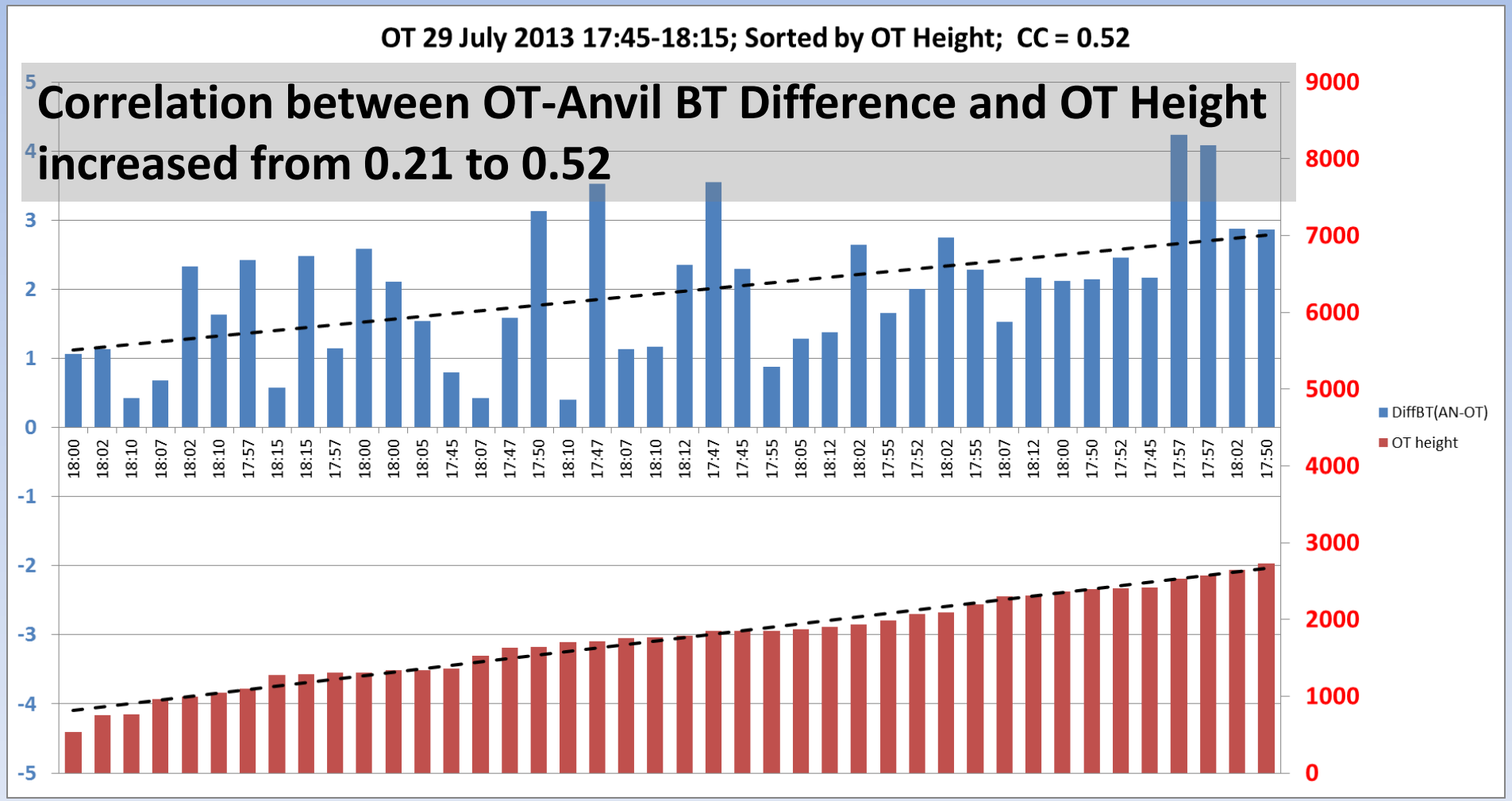
Case 20130729 17:45-18:15 UTC

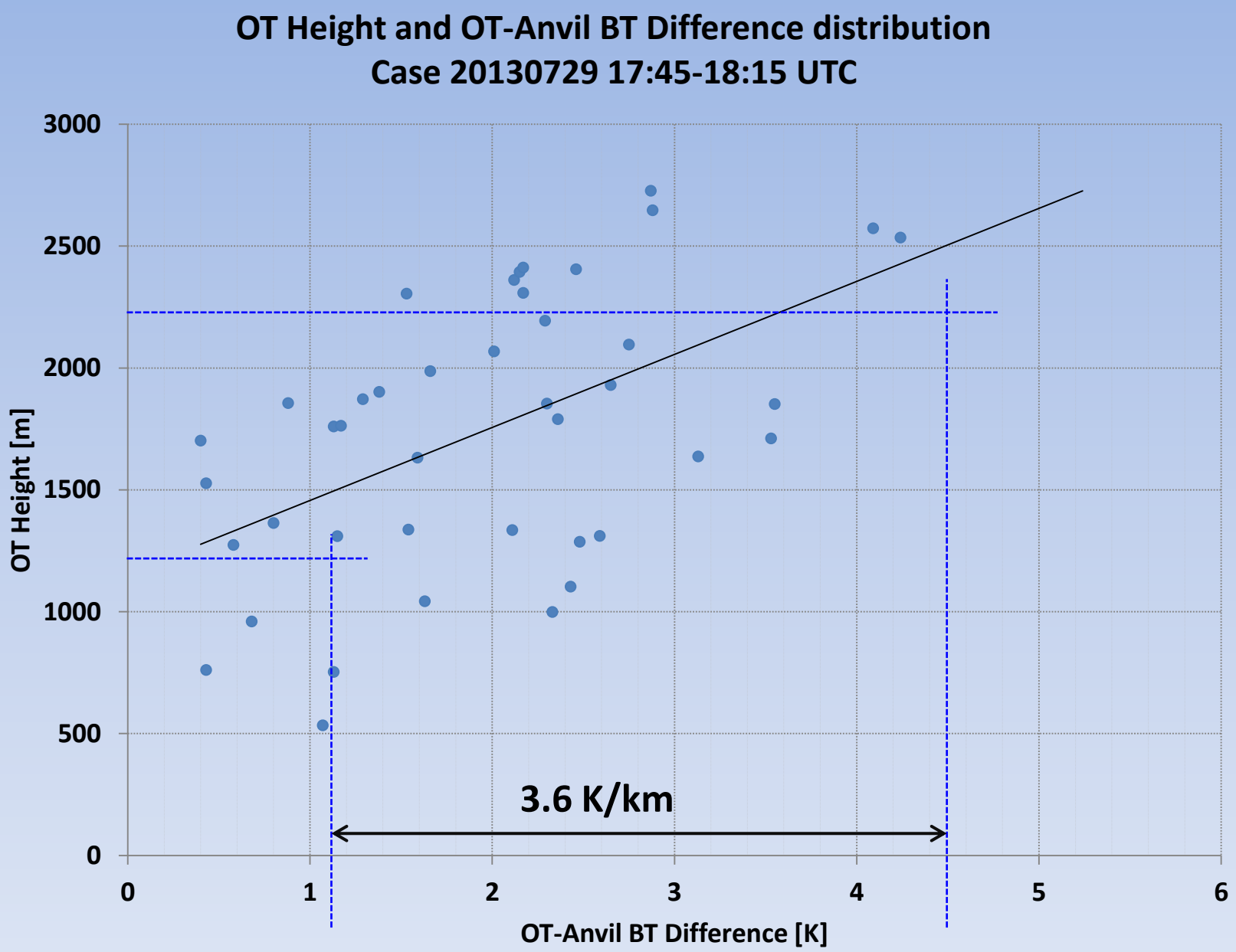
# All OTs visually identified on 2.5min RSS imagery from 17:45-18:15 29 July 2013 – sorted according OT-height and filtered on negative OT-Anvil BT difference



Case 20130729 17:45-18:15 UTC

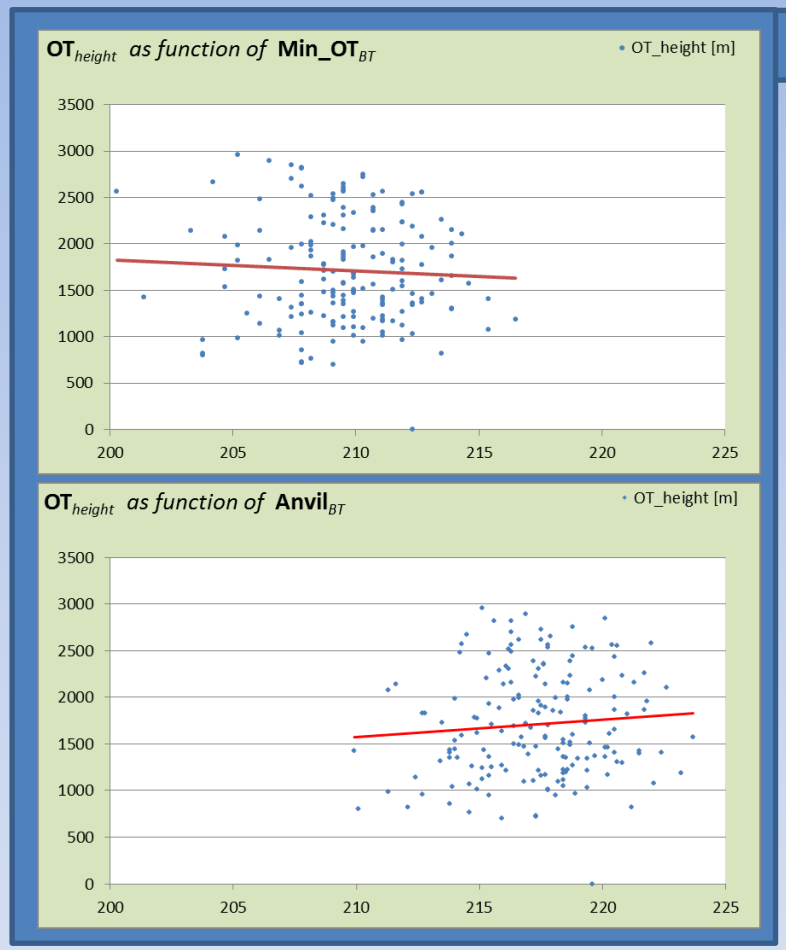
# All OTs visually identified on 2.5min RSS imagery from 17:45-18:15 29 July 2013 – sorted according OT-height and filtered on negative OT-Anvil BT difference



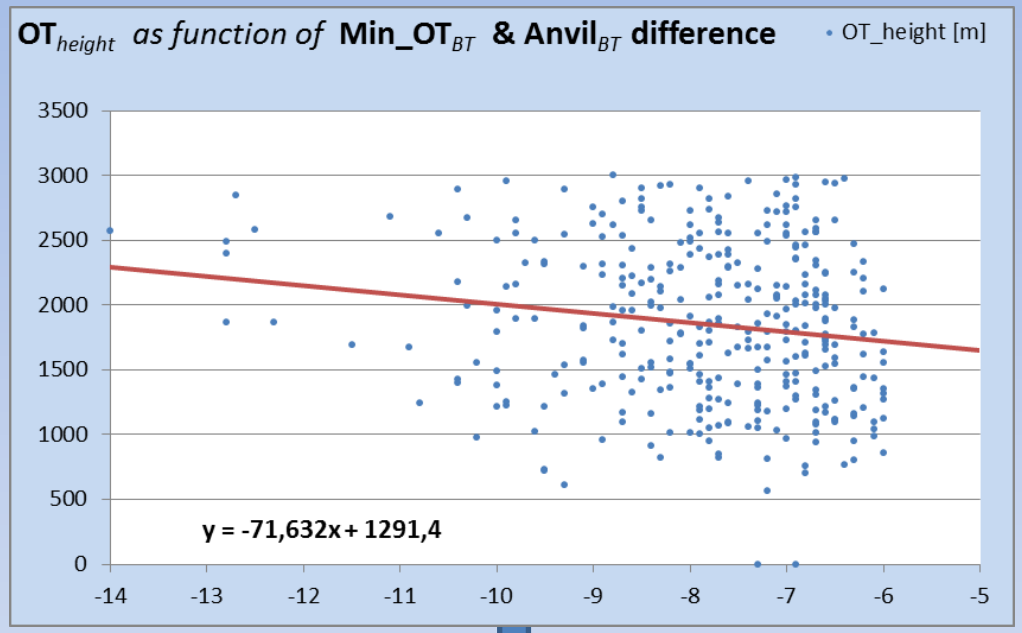


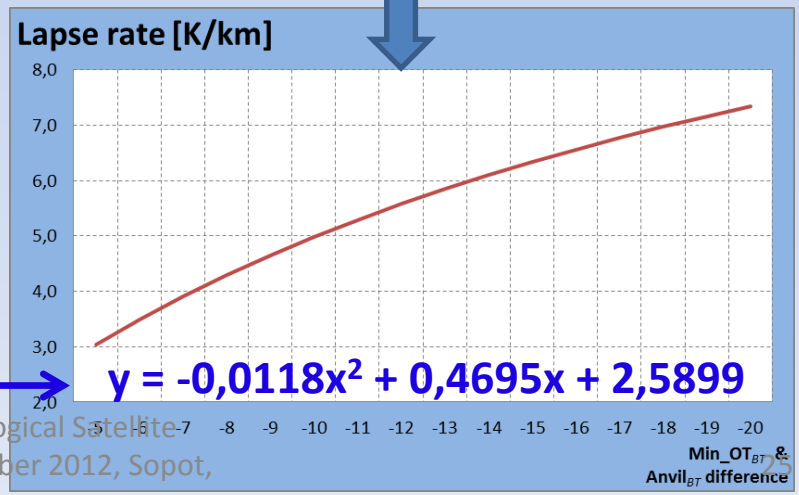

**Theoretical value of dry adiabatic lapse rate: 9.8 K/km**

# Relations between Minimum OT BT, Anvil BT and OT Height obtained in previous study with Kris Bedka (EUM Conf Sopot 2012)



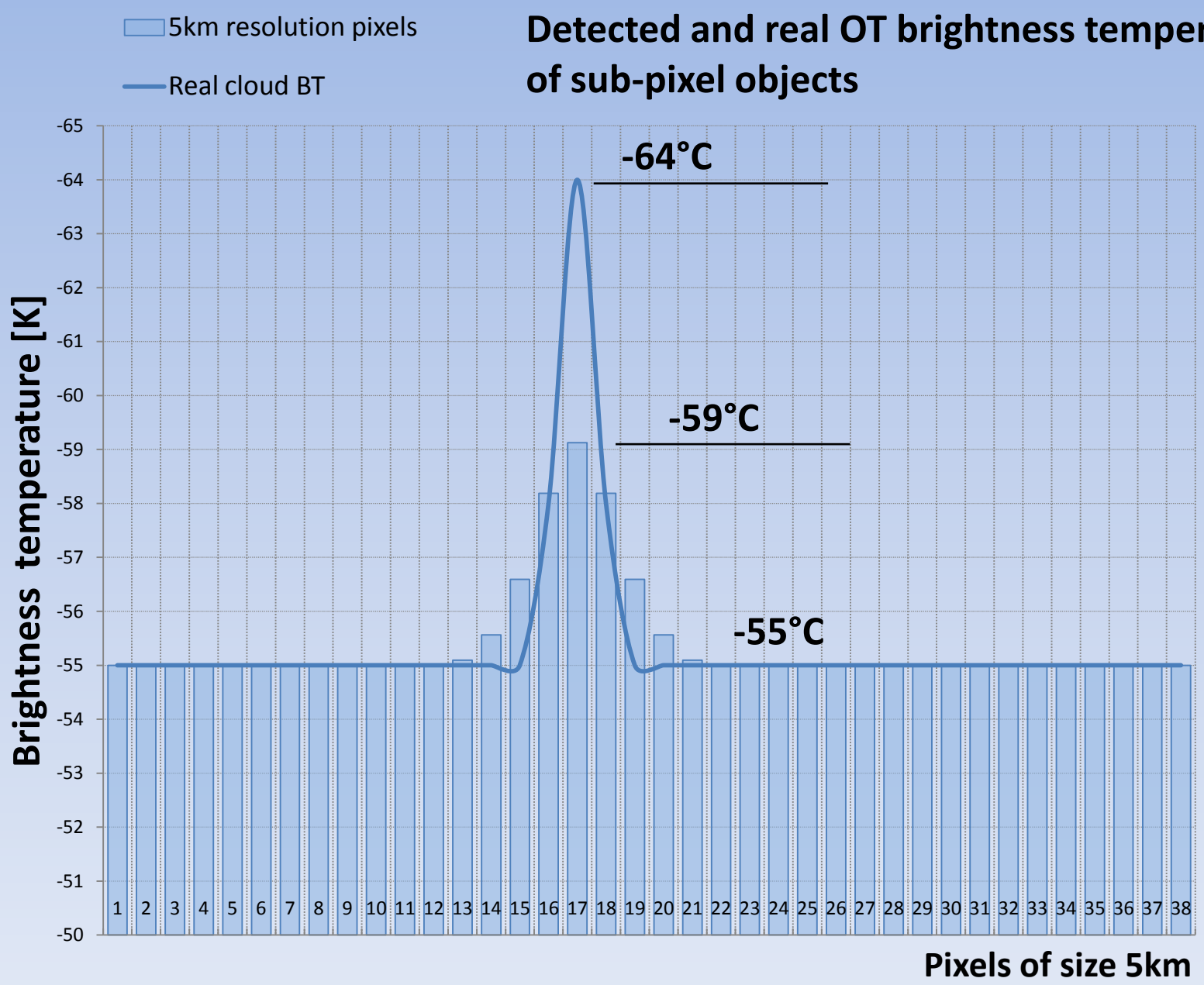

Gain the Height dependence on both Min OT and Anvil BTs:




Colder anvil produce colder and higher OT according lapse rate, which can be expressed by polynomial form but with strong bias from adiabatic theory (9.8K/km)

# Decreasing of temperature peak for sub-pixel objects, like OTs are:



# Conclusions

**Integration of correlation matrix test into detection methods can increase detectability of OTs with relatively warmer brightness temperatures, because we can omit the following test:**

**minimum OT – Anvil BT Difference ≥ 6K**

**but with necessity of visual validation of real OTs.**

**Then visual identification of OTs on HRV imagery can decrease observable/detectable OT-Anvil BT difference to very low values.**