Operational nowcasting products for storm detection over Ukraine

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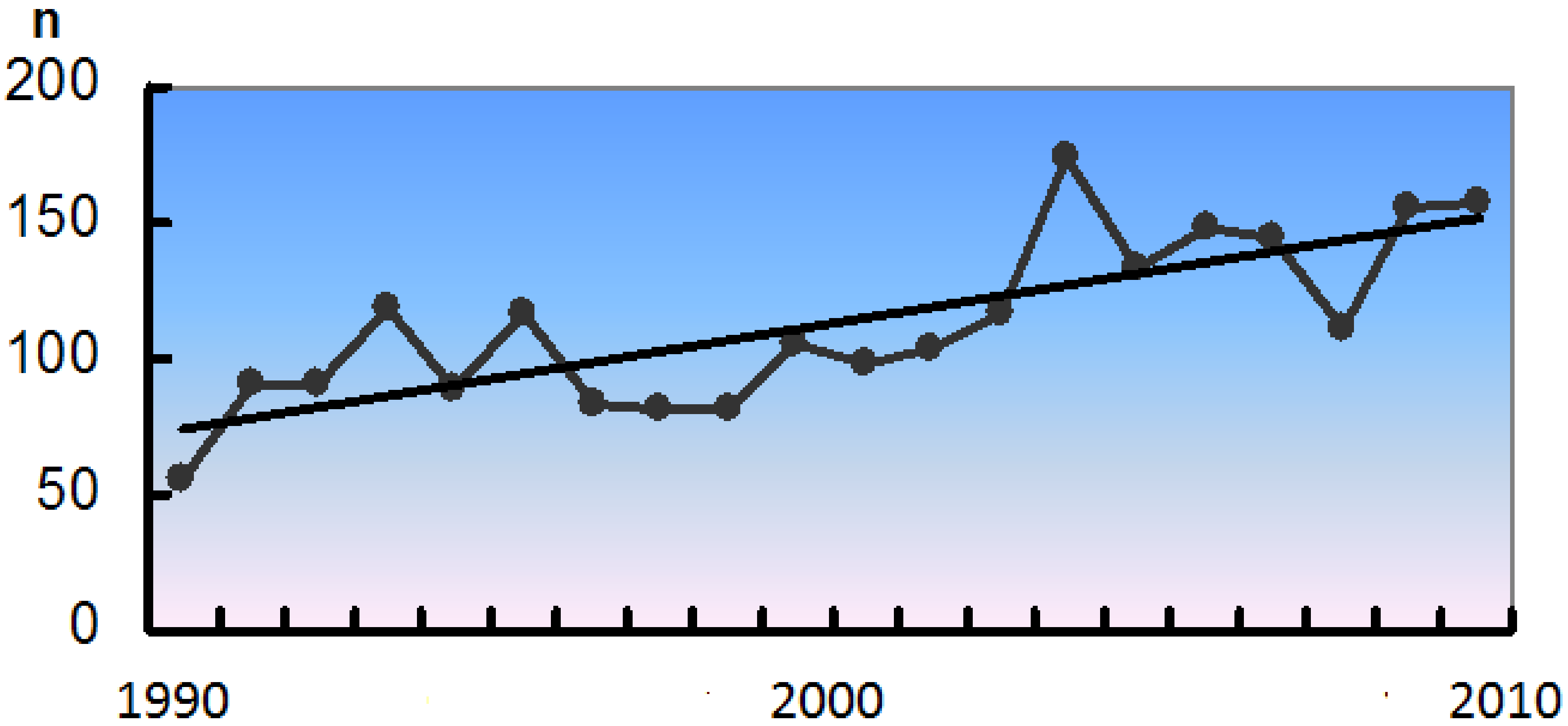
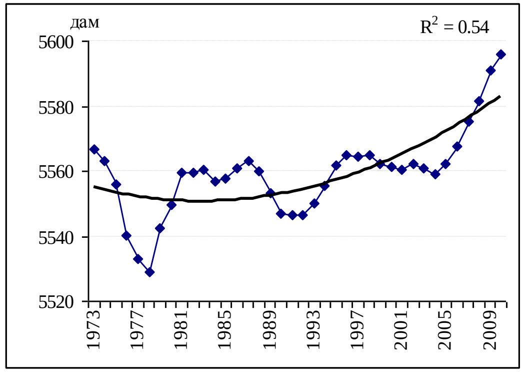


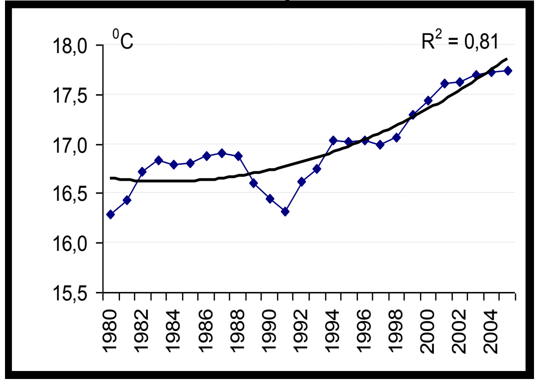
The number of severe weather cases over Ukraine

Changing of intensity of convection in summer time

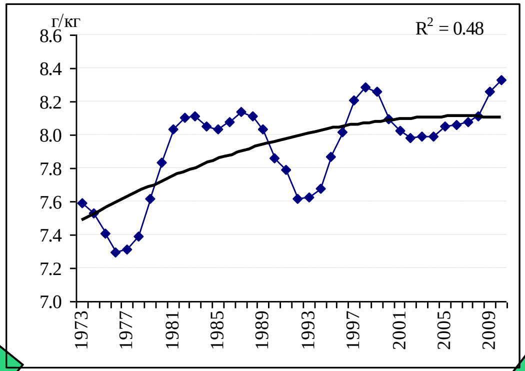
The thickness of 1000-500 hPa



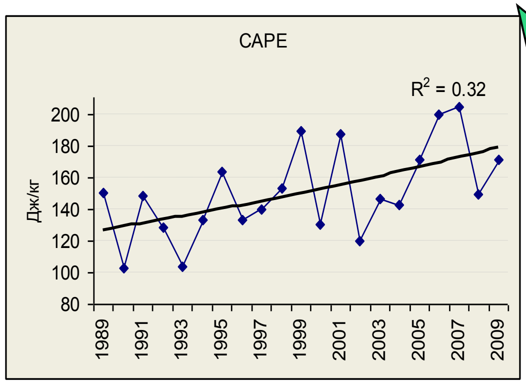
Surface temperature



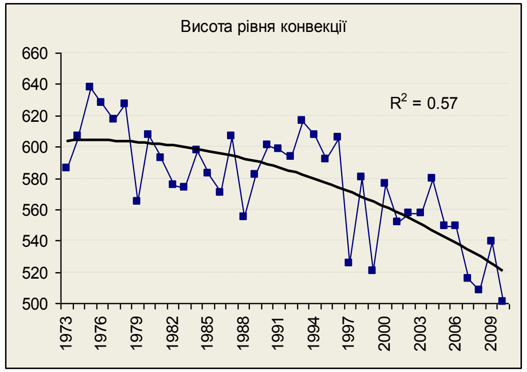
Water vapour mixing ratio



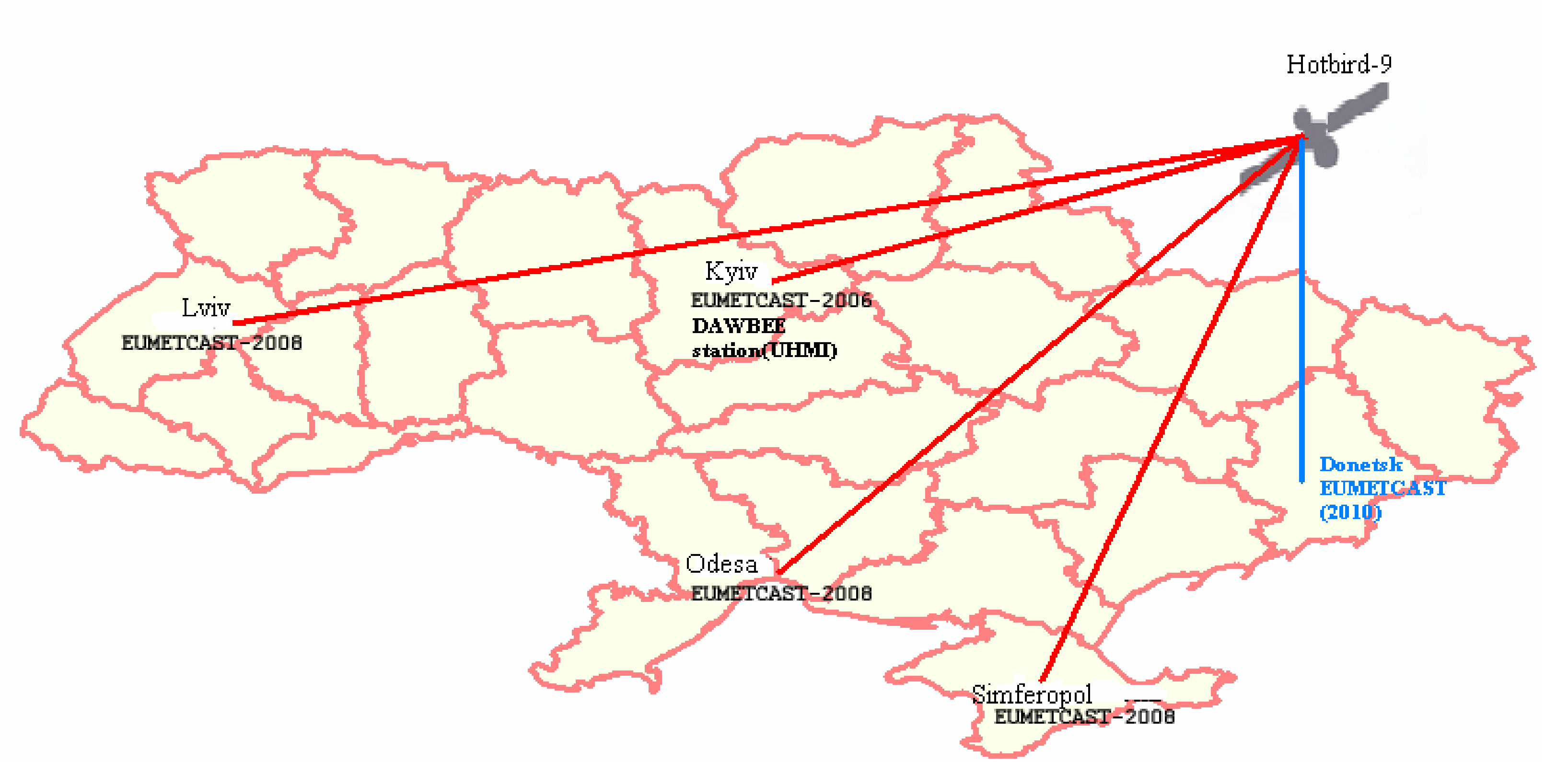
CAPE



The level of covection



Satellite data reception in the Hydrometeorological Service of Ukraine



EUMETCast reception -Ukrainian Hydrometeorological Institute (Kyiv), Ukrainian Hydrometeorological Centre (Kyiv) , Centre of Hydrometeorology of Azov and Black seas (Odesa), Crimea Centre of Hydrometeorology (Simferopol), L'viv Centre of Hydrometeorology (L'viv) and Donetck Centre of Hydrometeorology.

FTP access to operational RGB images and products (GeoTiff and JPG). Data update every 15 (basic) and 5 (only on demand) minutes

SEVERE CLOUD DETECTION ON MSG

Some standard RGB composites were used for detection of severe cloud (convection) (Final Report RGB Composite Sattelite Imagery Workshop. BOULDER, CO, U.S.A. 5-6 June 2007) and Best Practice Document (Version 2.0 of 01 July 2012), Advanced Satellite Image Products for Monitoring and Nowcasting of Severe Convective Storms . The physical features for detection of convection on the RGB composites are the following: low cloud top temperature; appearance of small ice crystals on the top of clouds; high content of water vapour in the mid level of the atmosphere; significant values of cloud optical thickness. RGB composites with HRV channel gives an additional spatial characteristic – image texture (for example, detection of storm anvils). Enhanced MSG IR10.8 image shows so called *cold-ring* and *cold U/V* shape storm.

1. Any product can not guarantee 100% ability to detect severe storm.

2. The forecasters must understand, at least from statistical point of view how useful for detection of severe storm the product can be.

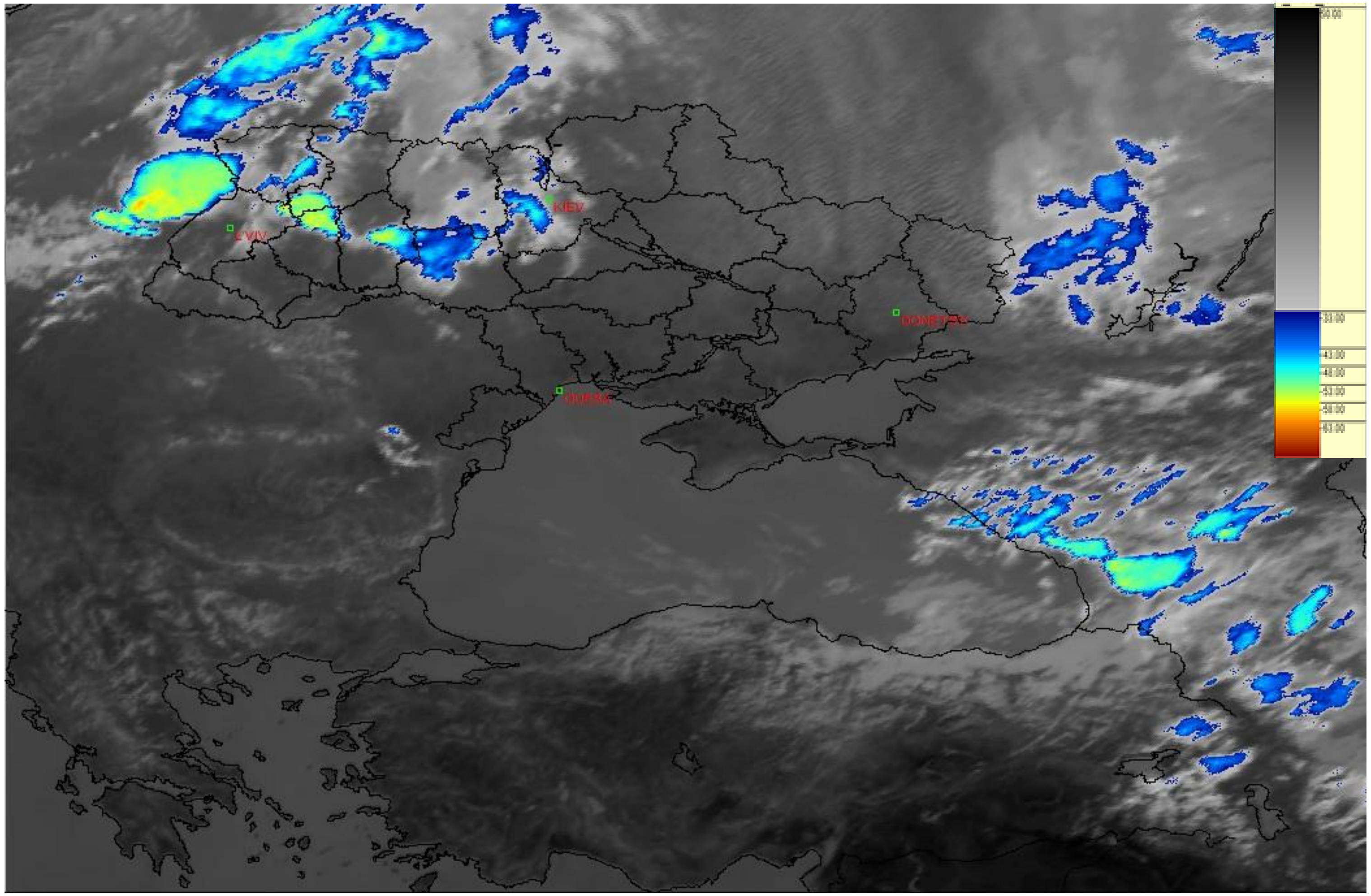
$$POD = \frac{a}{a + c}$$

$$FAR = \frac{b}{a + b}$$

Satellite \Observations	Yes	No
Yes	a	b
No	c	d

The convective environment on days with severe thunderstorms in Ukraine was investigated. Satellite derived Parameters (RGB and Products) were verified against subsequent thunderstorm observations derived from SYNOP station data, radar data, and damage reports of a building insurance company. The skill of satellite derived parameters to nowcast thunderstorms was evaluated by POD and FAR.

Enhanced MSG IR10.8



POD=0.67 and FAR=0.36.

"Cold ring" and U, V shape on IR10.8 image

1. We have investigated more than 100 cases (June, July 2008-2010) of severe weather, when "Cold ring" and U, V shape were detected. These cases include different synoptic situation, localization (all regions in Ukraine) and severe weather (thunderstorm, heavy rain, strong wind and hail).
2. To define some specific parameters, which could be useful for forecaster to predict intensity of severe weather we analyzed the following of them (based on M.Setvak color scale palette):

   a) $T_{min(s)}$ - min temperature when the "Cold ring" or U, V shape clearly visible on the image;

   b) $T_{min(m)}$ min temperature when the "Cold ring" or U, V shape in the mature stage;

   c) $T_{min(d)}$ min temperature when the "Cold ring" or U, V shape begin to disappear;

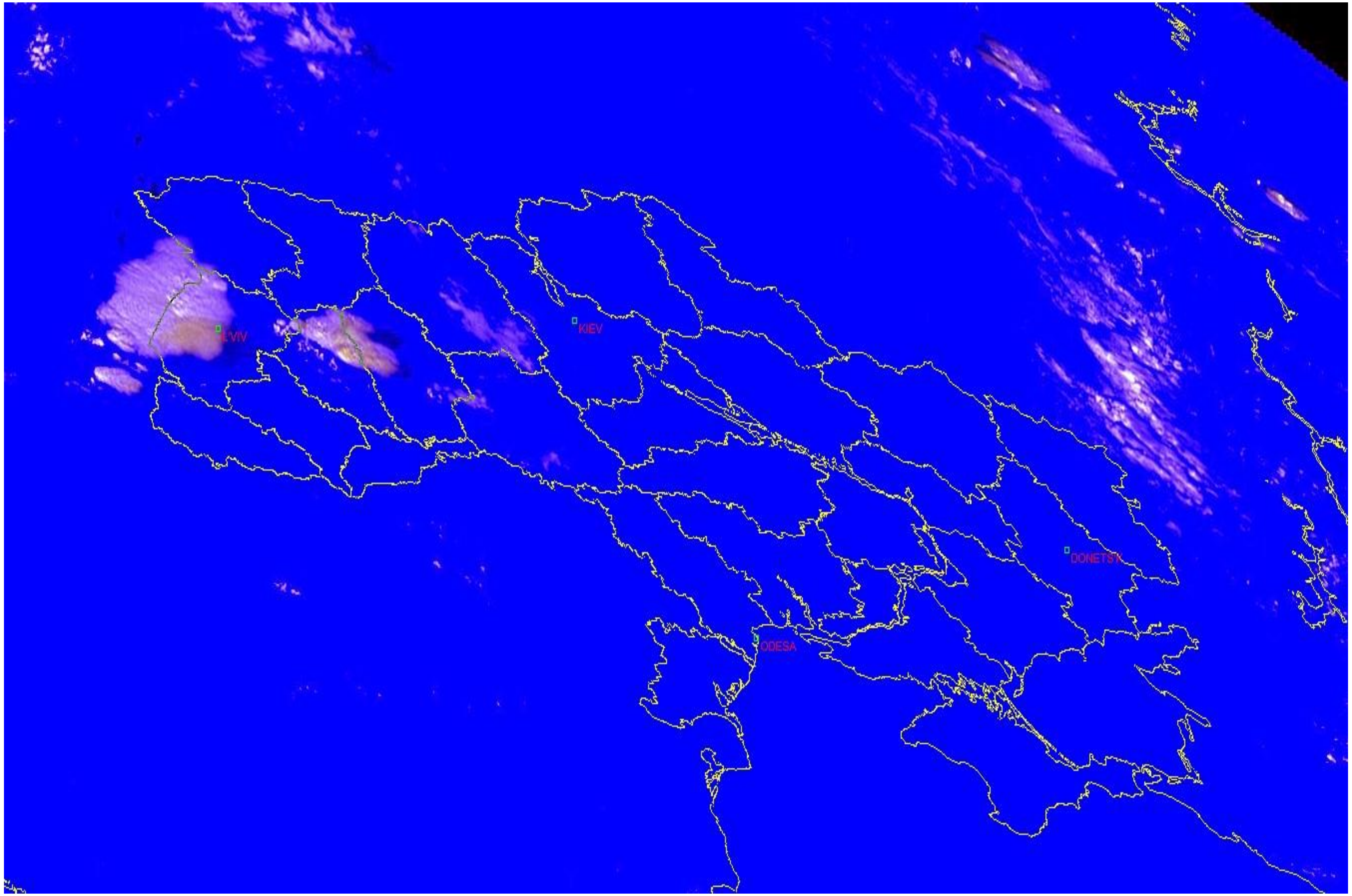
   d) $T_{min(m)} - T_{ed}$ temperature difference in mature stage, where T_{ed} temperature on the edge of the "Cold ring" and U, V shape.

"Cold ring" and U, V shape on IR10.8 image

1. The analysis shows that:
   a) $T_{min(s)}$ varies from 218K to 211K, the average value of $T_{min(s)}$ =213.5K;
   b) $T_{min(m)}$ varies from 213K to 201K, the average value of $T_{min(s)}$ =208.2K;
   c) $T_{min(d)}$ varies from 215K to 203K, the average value of $T_{min(s)}$ =210.7K;
   d) T_{ed} varies from 226K to 215K, the average value of $T_{min(s)}$ =219.4.7K;
   e) $T_{min(m)} – T_{ed}$ varies from 6K to 18K, the average values of $T_{min(m)} – T_{ed}$ =13K

2. We have not found any robust relation between analyzed parameters and duration and severity of severe storm, additional information and research are need.

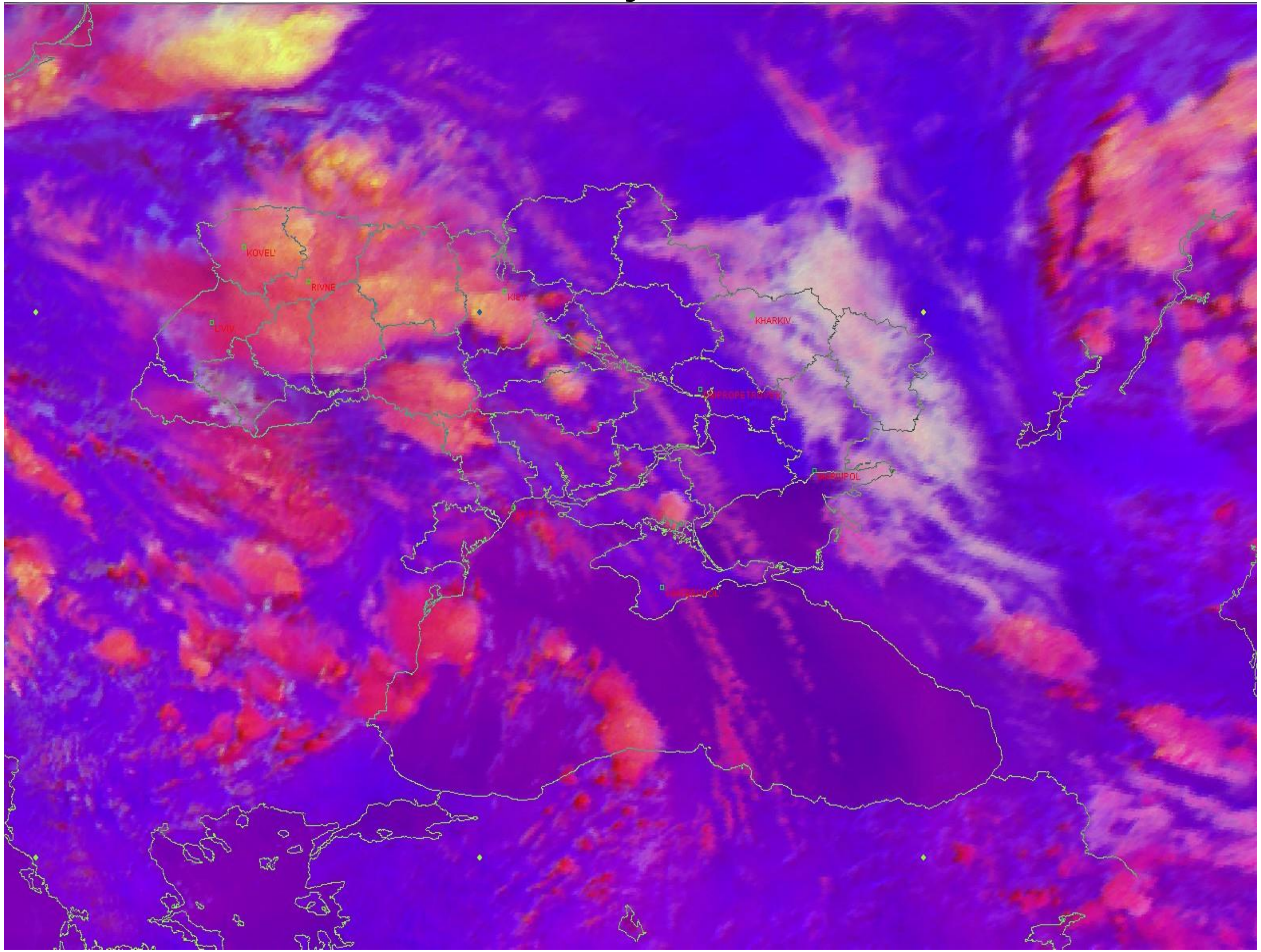
HRV SEVERE STORM



RGB 12,12,9-4

Some cases were studied POD=0.44 and FAR=0.30, disadvantage more false alarms when the sun is low (<15). We provided additional information of Sun Angle to forecaster.

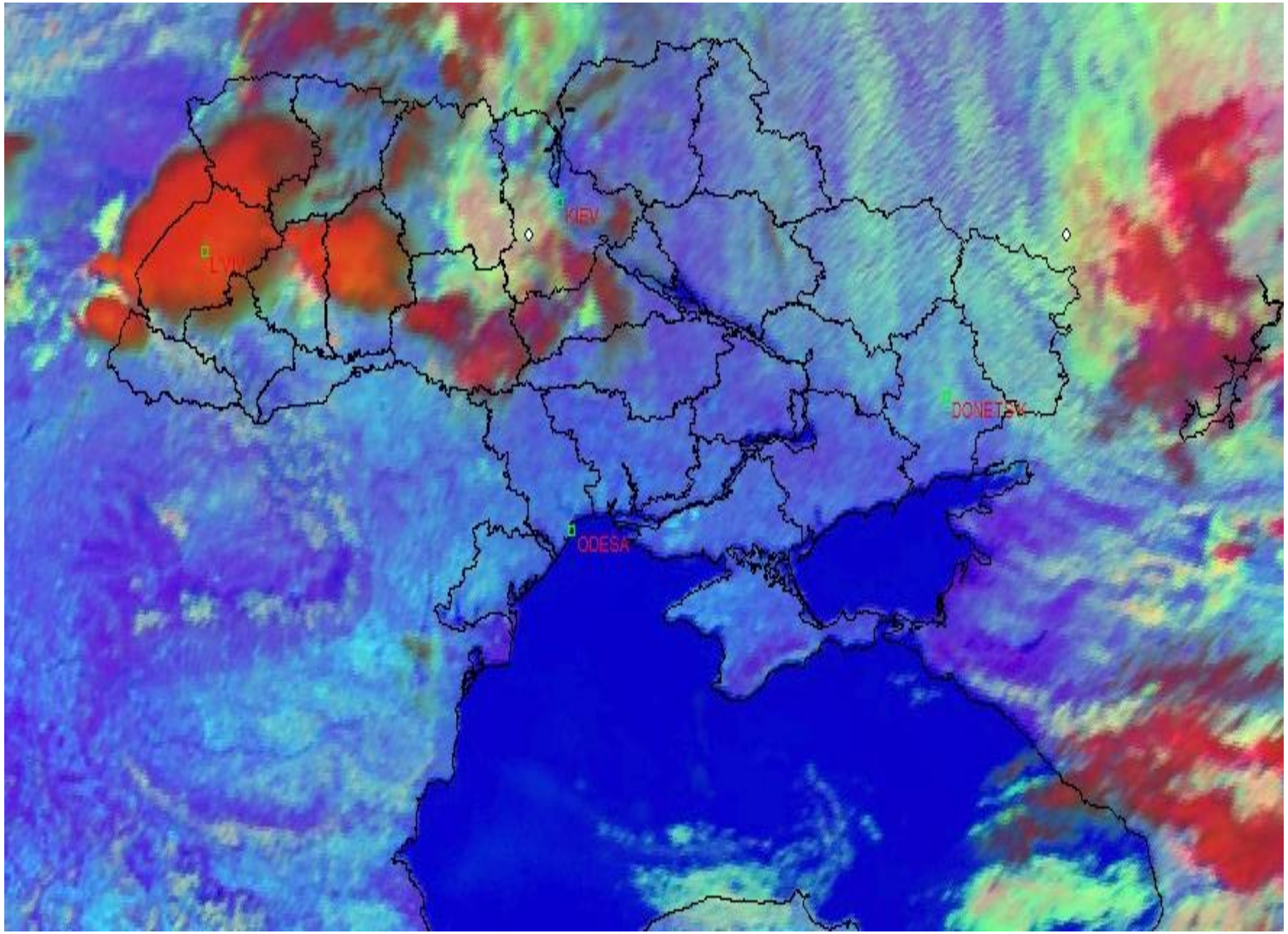
Day Severe Convection **RGB 5-6,4-9,3-1**



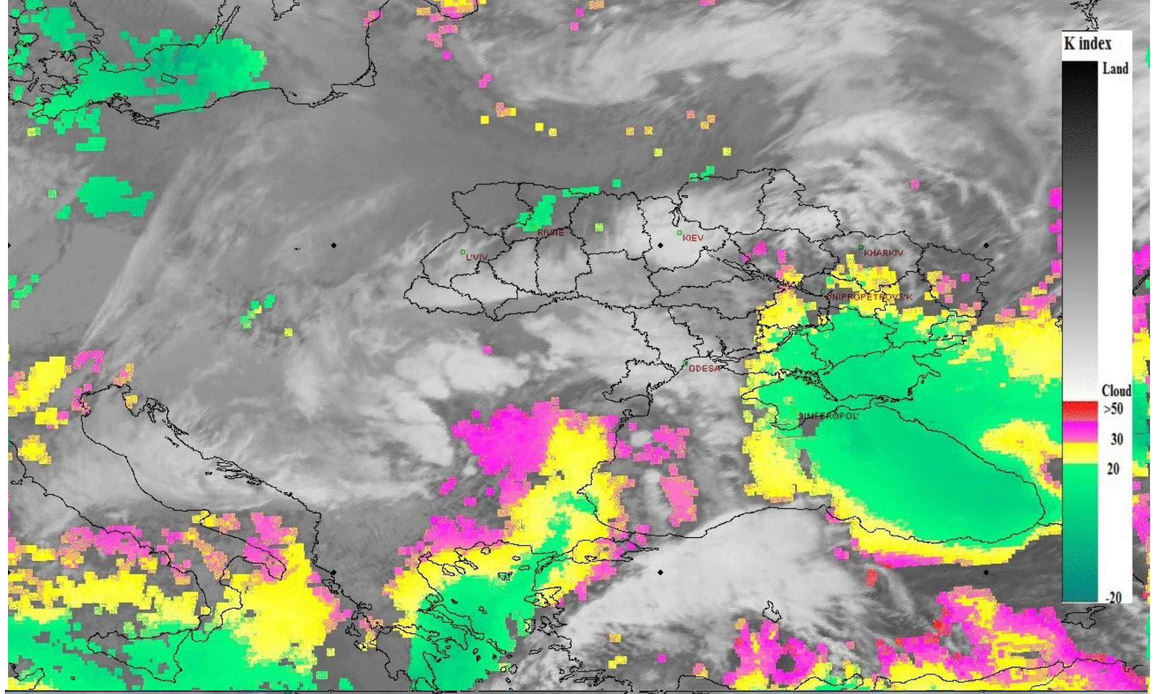
POD=0.53 and FAR=0.51.

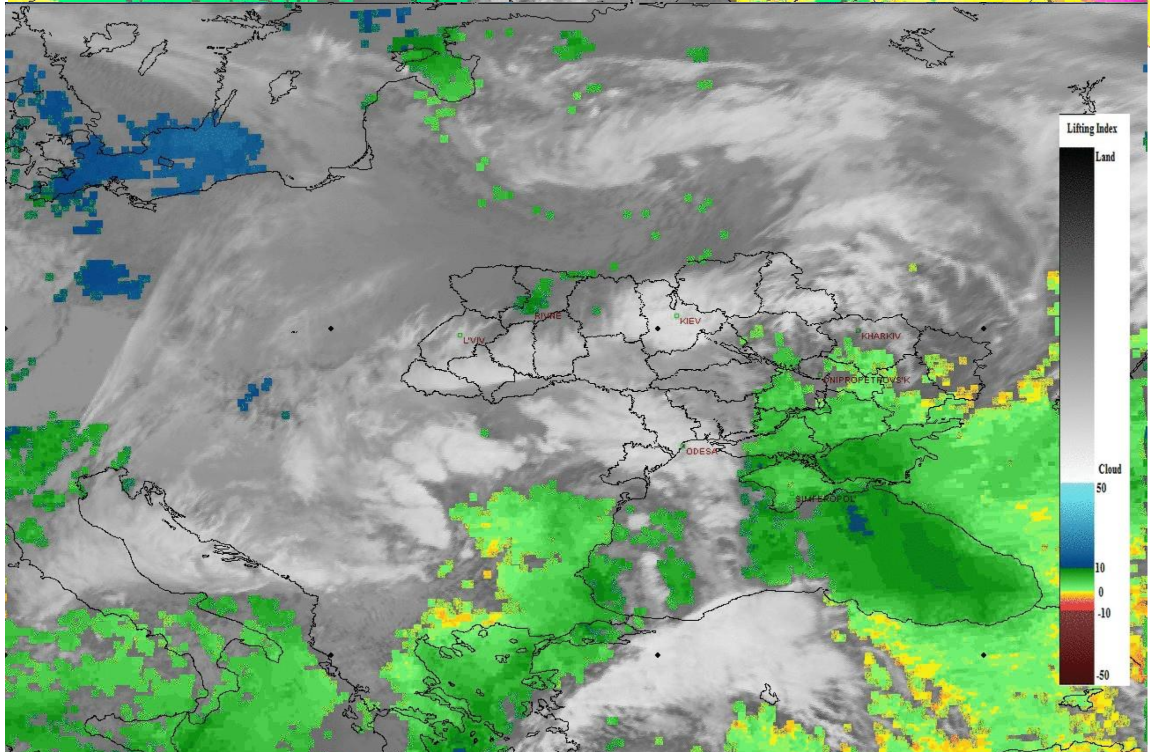
Overestimated the area of real thunderstorm activity (dependence of sun angle).

Day microphysics **VIS06 IR3.9 IR10.8**



POD=0.37 and FAR=0.66, overestimates the real thunderstorm activity



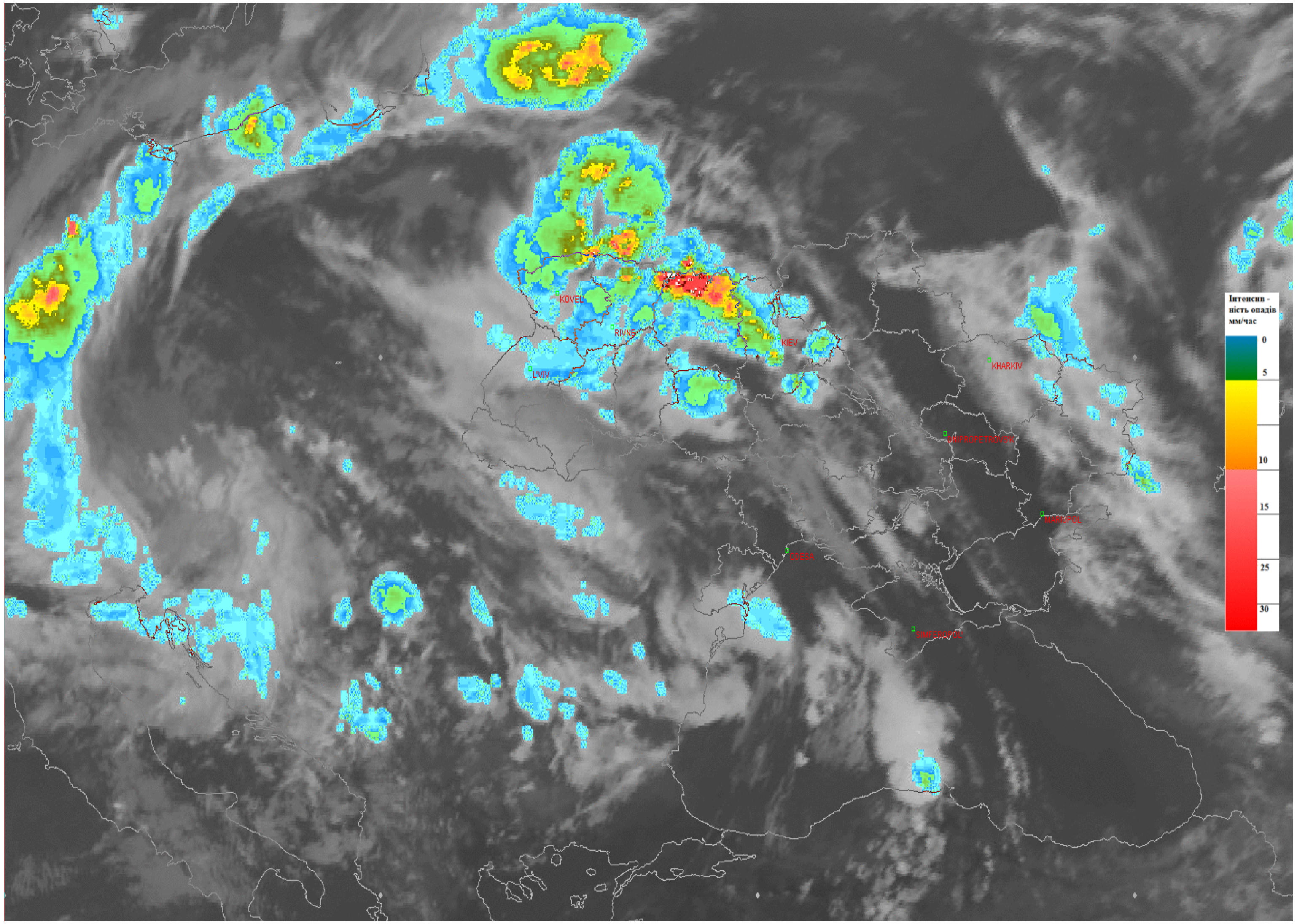


MPEF GII

KI is sensitive to early instability but shows much larger unstable areas then really exist and gives many false alarms.

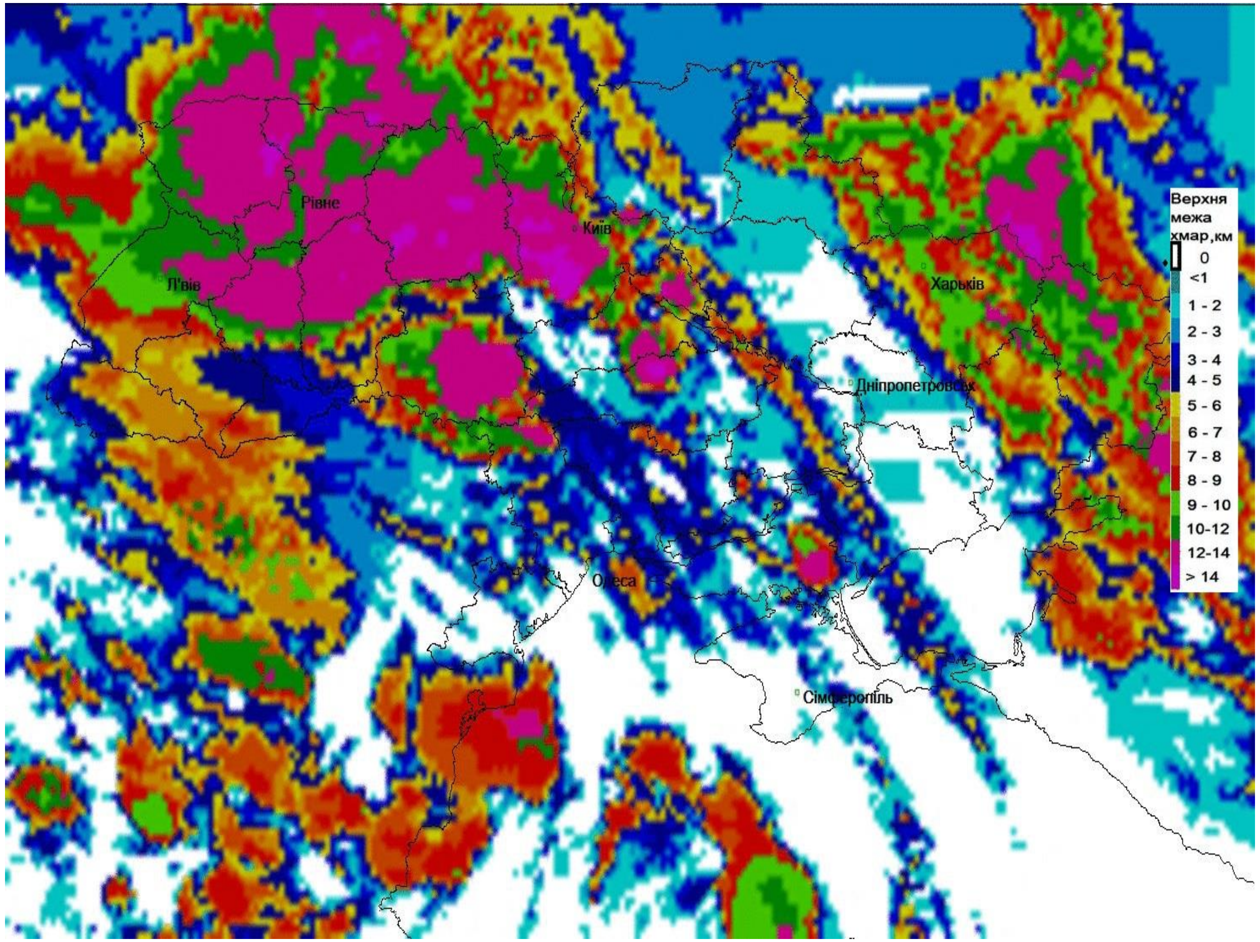
LI gives reasonable information just before convection, but more missed prediction then real.

MPEF MPE

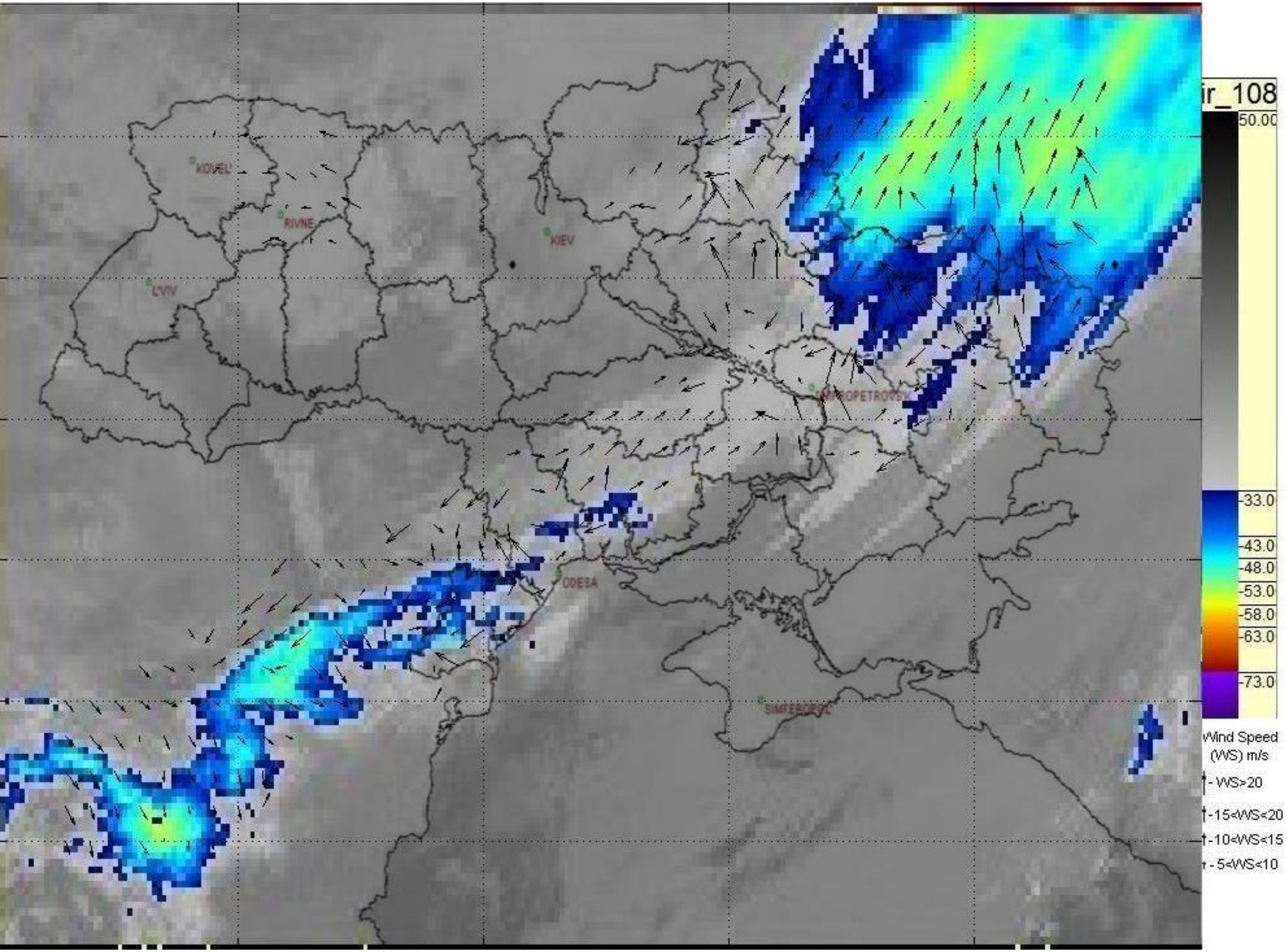


Useful as additional product for estimation of precipitation, but the accuracy is low. Bias correction provides quite reliable results for area of precipitation during summer time, but rain rate accuracy is still low.

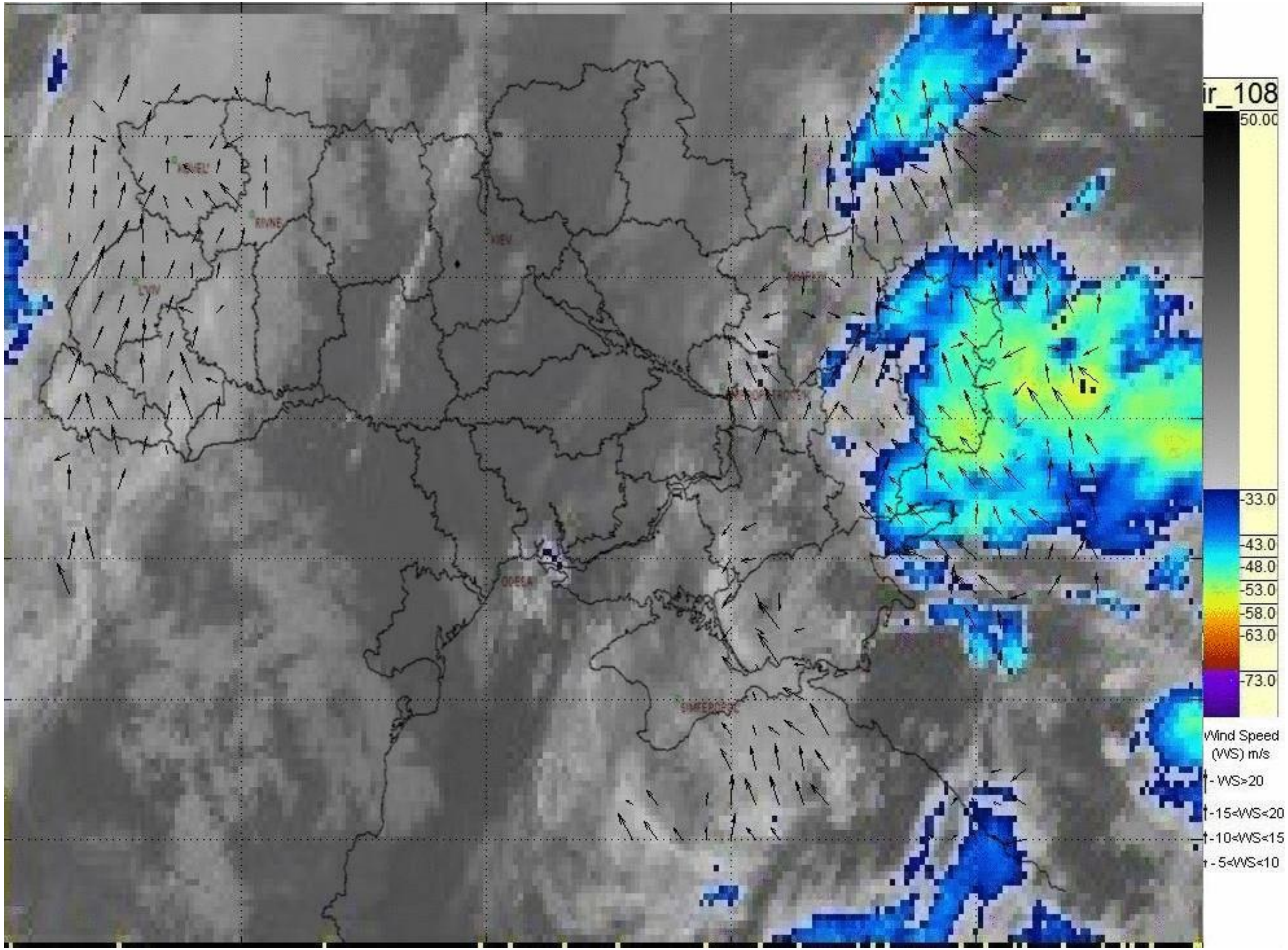
Cloud Top Height

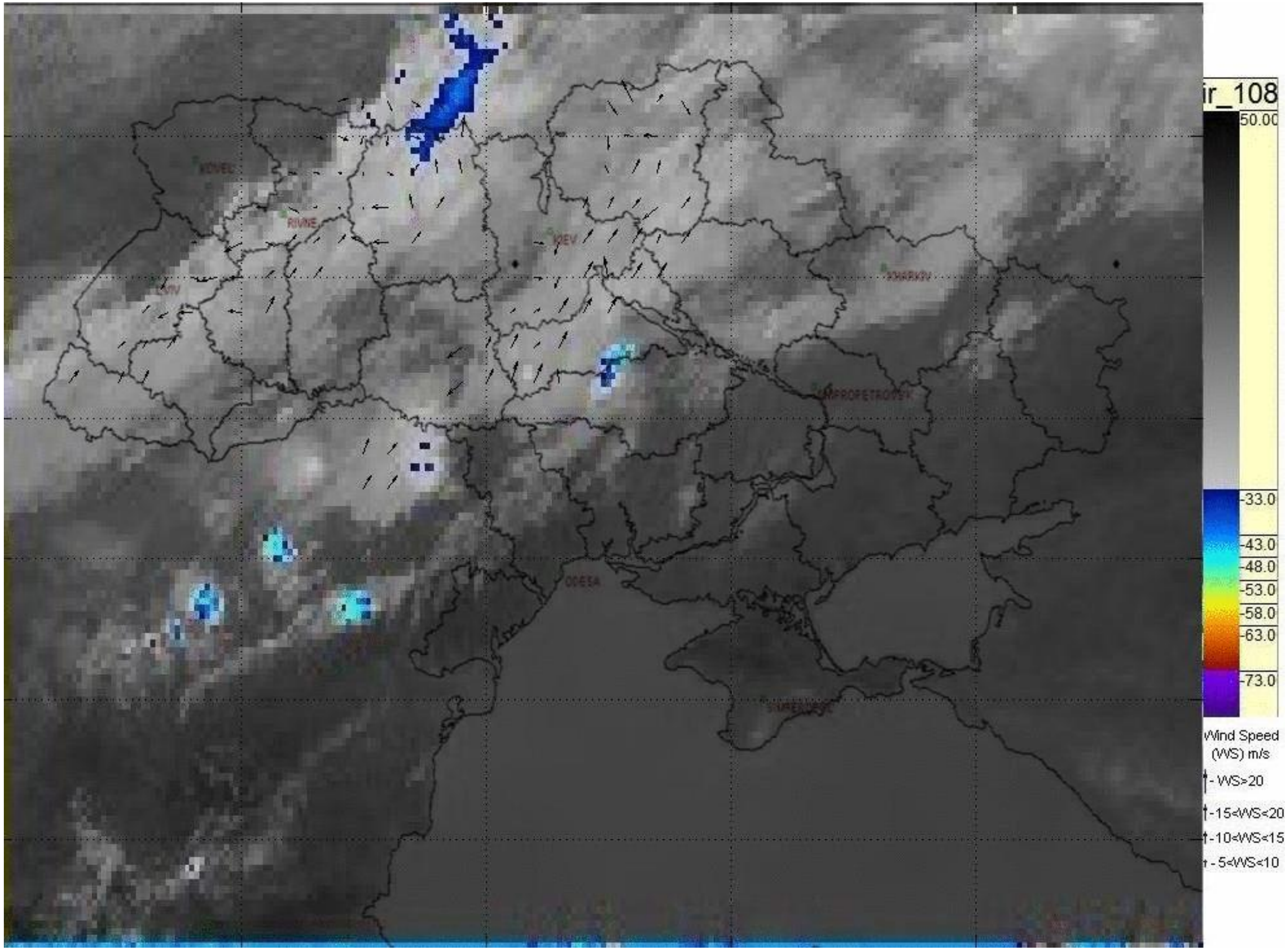


Useful as additional product for estimation of cloud penetration of the tropopause and estimation of parallax correction for validation between satellite and ground measurements.

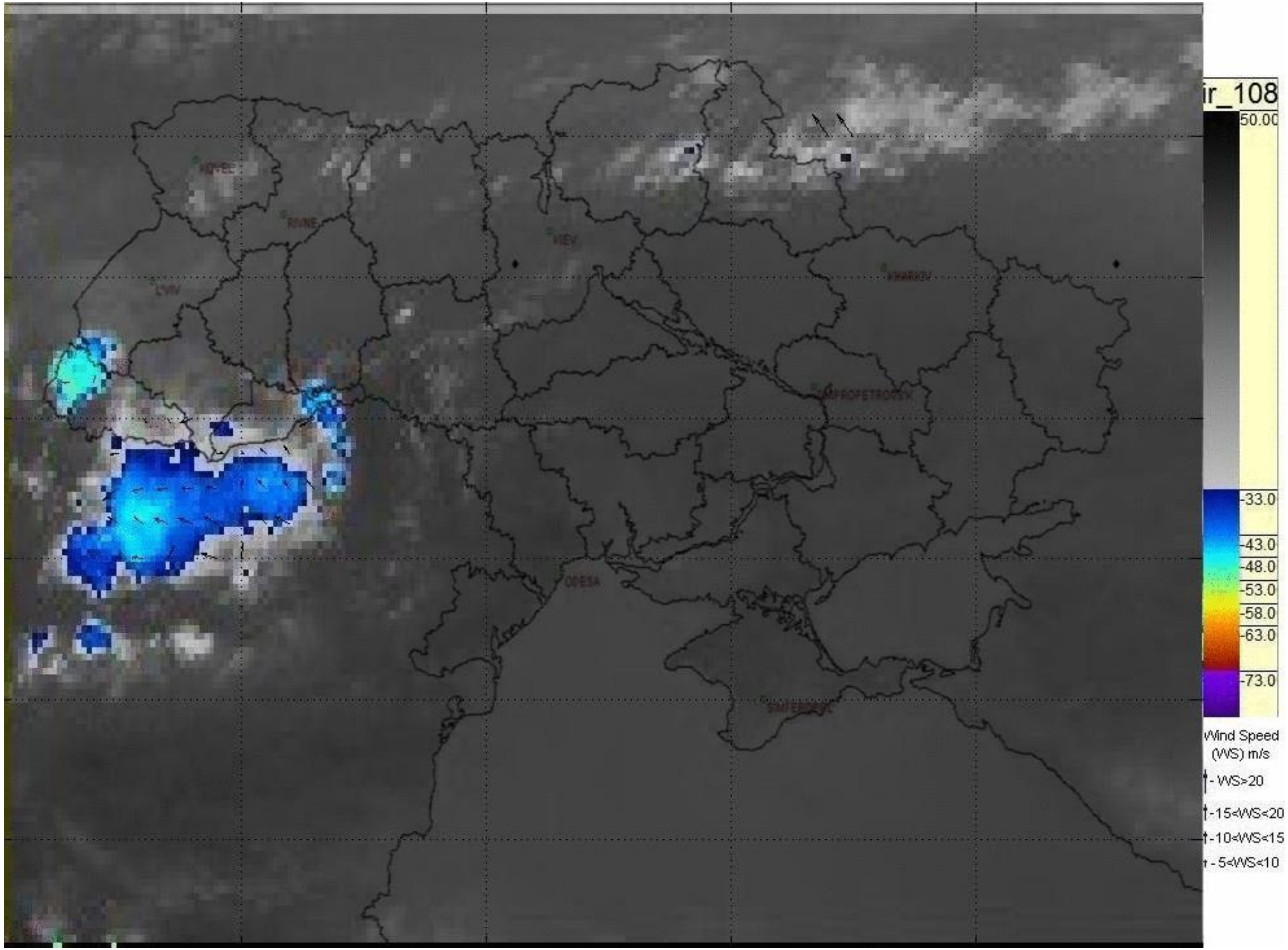


Wind vector based on satellite images can be useful for estimation of the cooling rate


ir_108
50.00
-33.0
-43.0
-48.0
-53.0
-58.0
-63.0
-73.0
Wind Speed
(WS) m/s
- WS>20
-15<WS<20
-10<WS<15
- 5<WS<10



RIVNE
KIEV
ODESA
ir_108
50.00
-33.0
-43.0
-48.0
-53.0
-58.0
-63.0
-73.0
Wind Speed (WS) m/s
- WS>20
-15<WS<20
-10<WS<15
- 5<WS<10



ir_108
50.00
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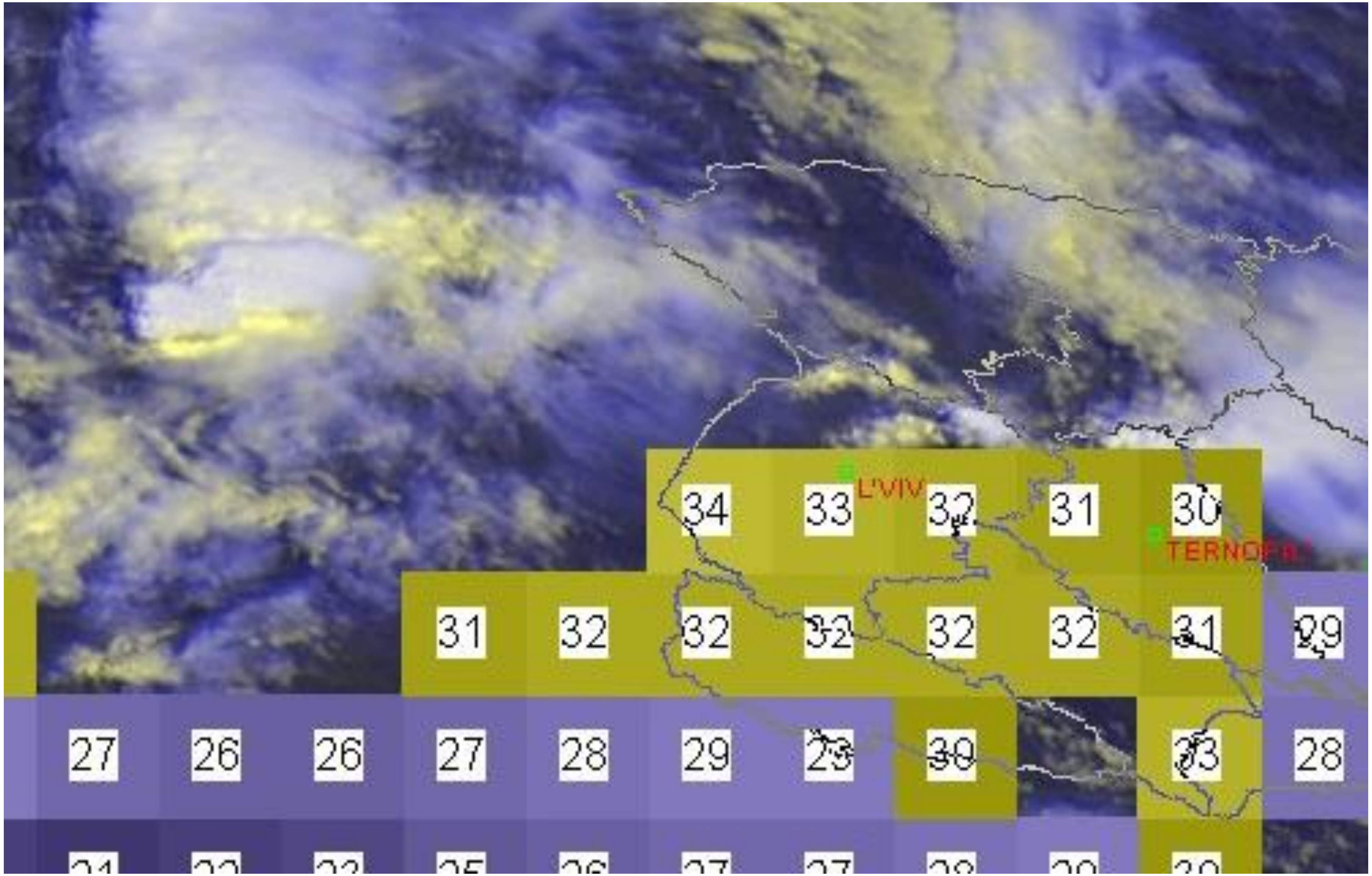
-58.0
-63.0
-73.0
Wind Speed (WS) m/s
- WS>20
-15<WS<20
-10<WS<15
- 5<WS<10
RIVNE
KIEV
ODESA

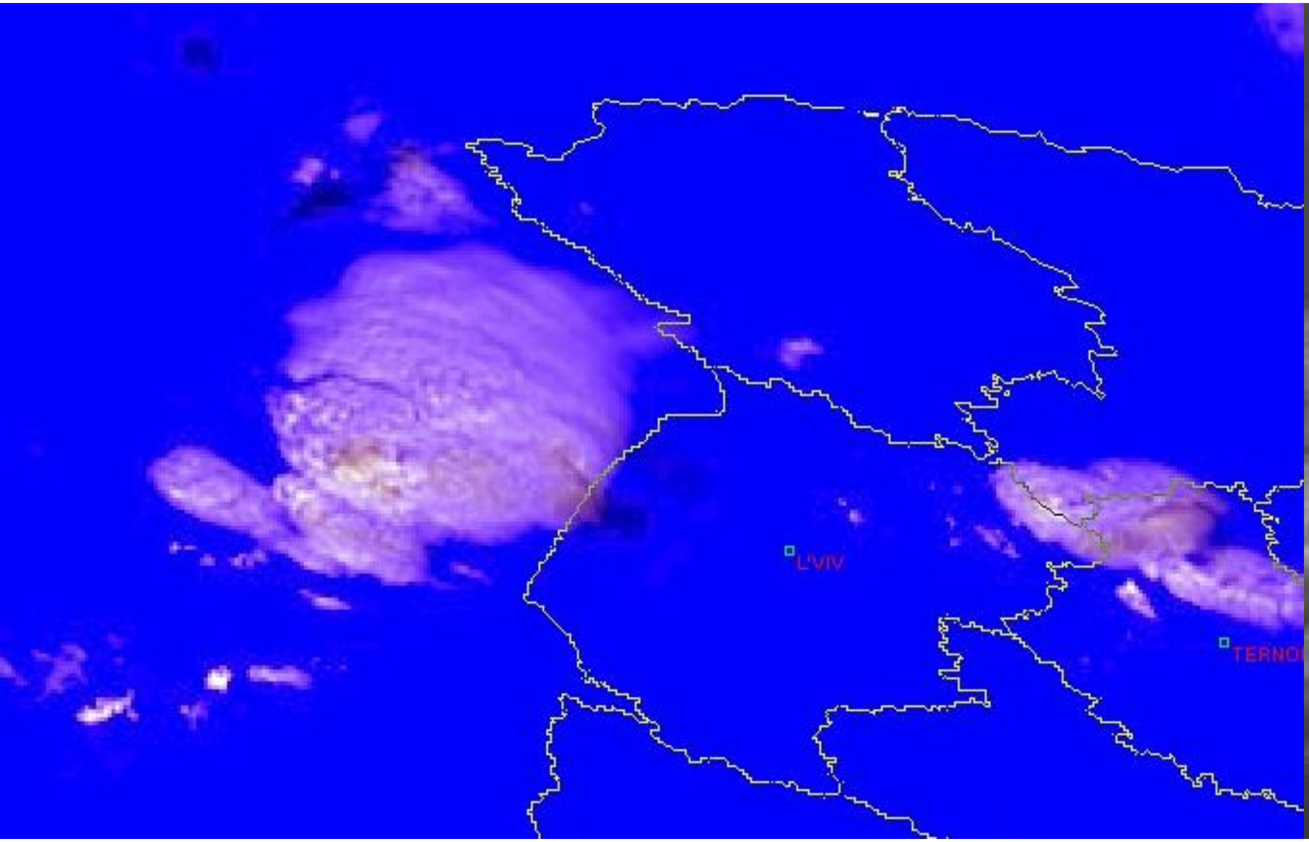
Analysis of severe storm over L'viv on 23.06.08



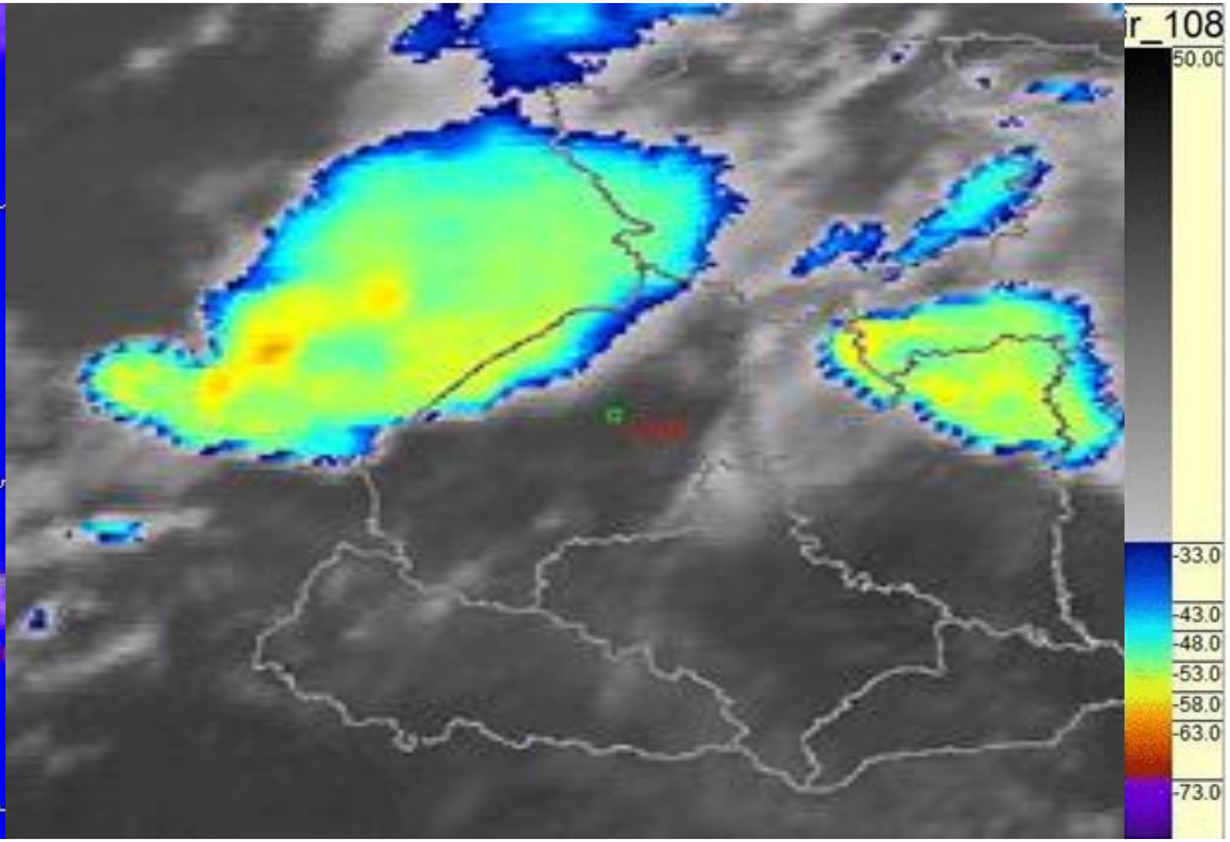
First detection of severe convective
cloud and distribution of instability K Index at 8:30 UTC

Analysis of severe storm in L’viv on 23.06.08 at 10:30 UTC

MSG RGB 12,12,4-9

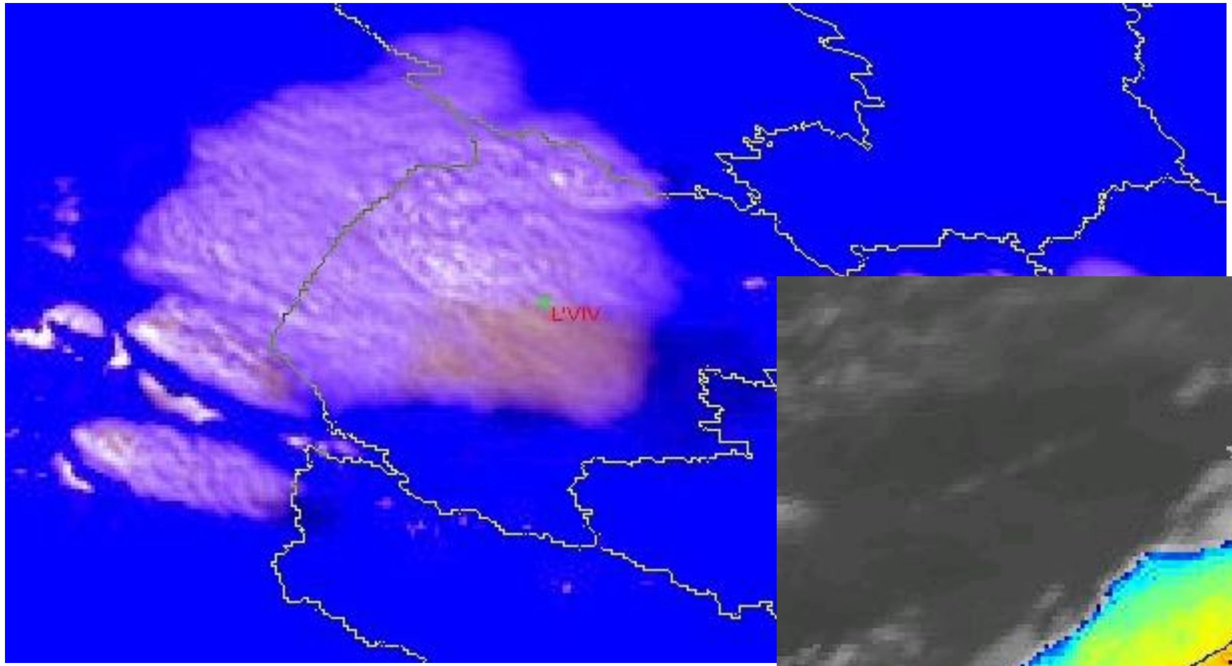


MSG IR10.8

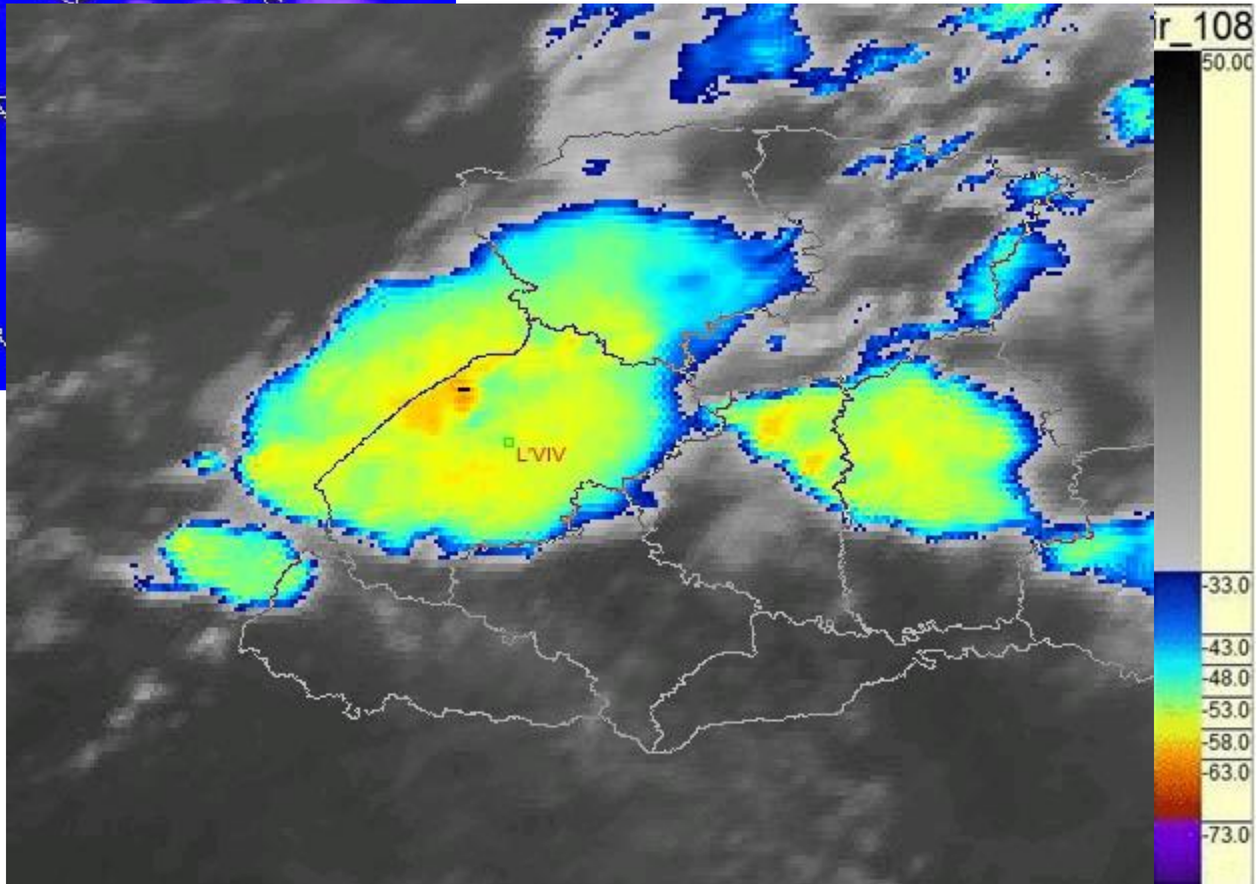


Analysis of severe storm in L'viv on 23.06.08 at 11:30 UTC

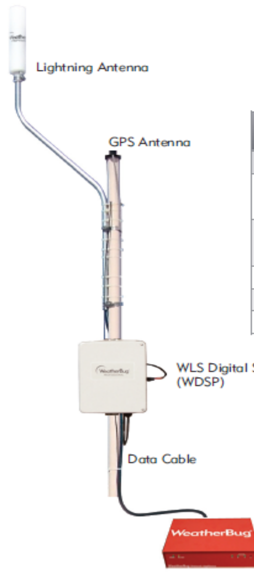
MSG RGB 12,12,4-9



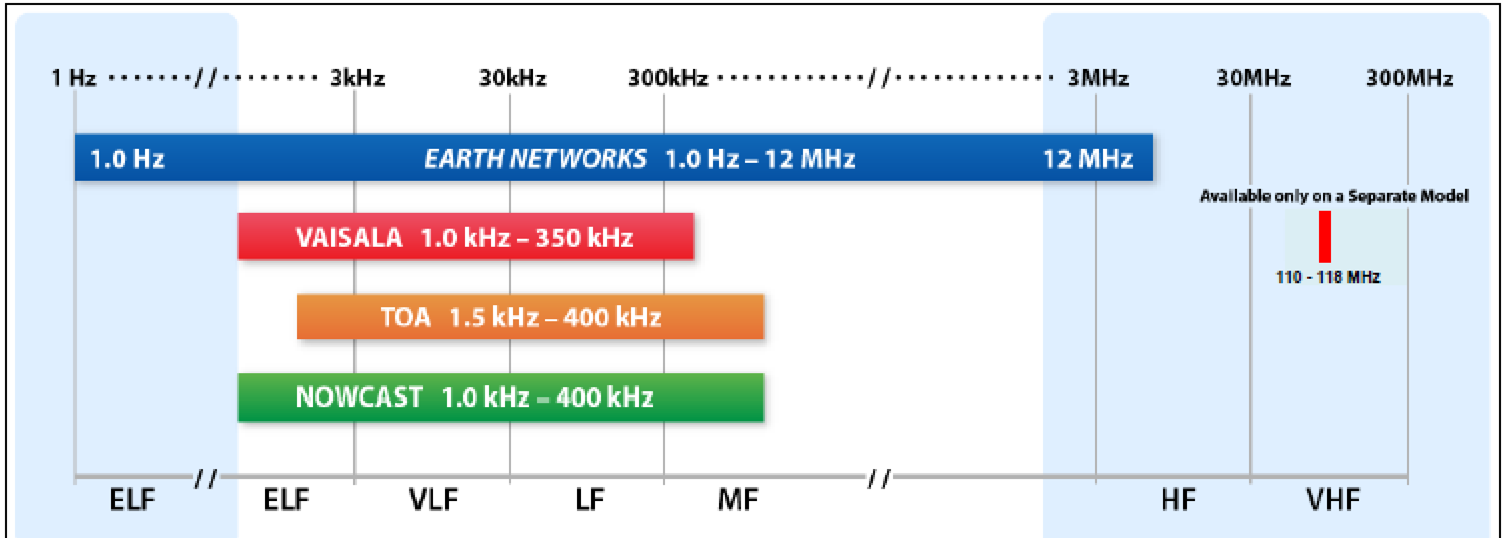
MSG IR10.8

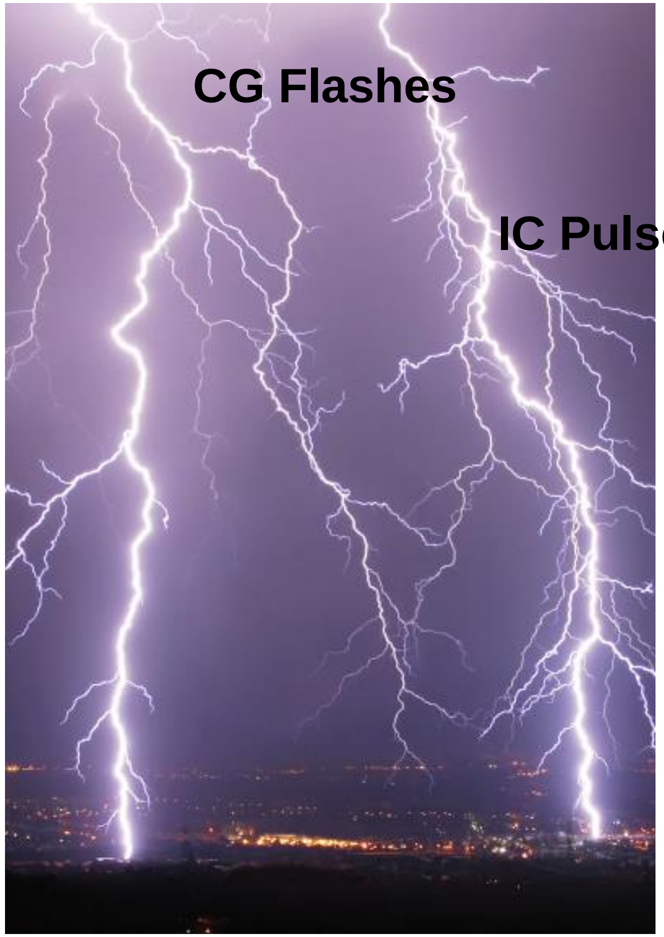


Lightning network in Ukraine (UTLN)

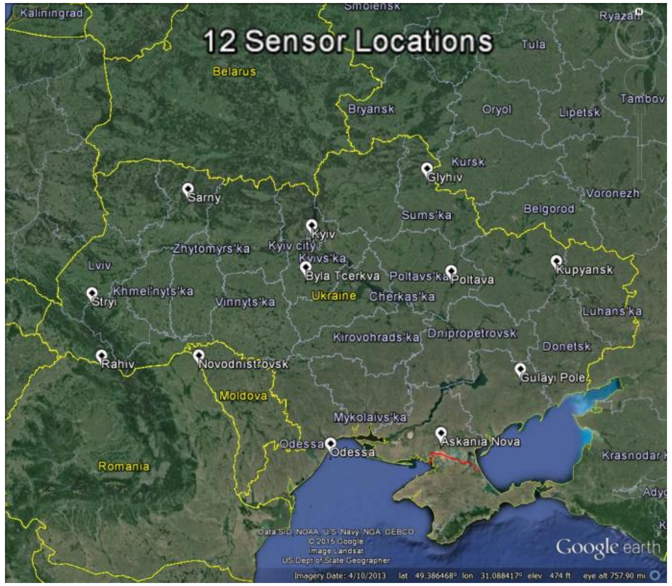


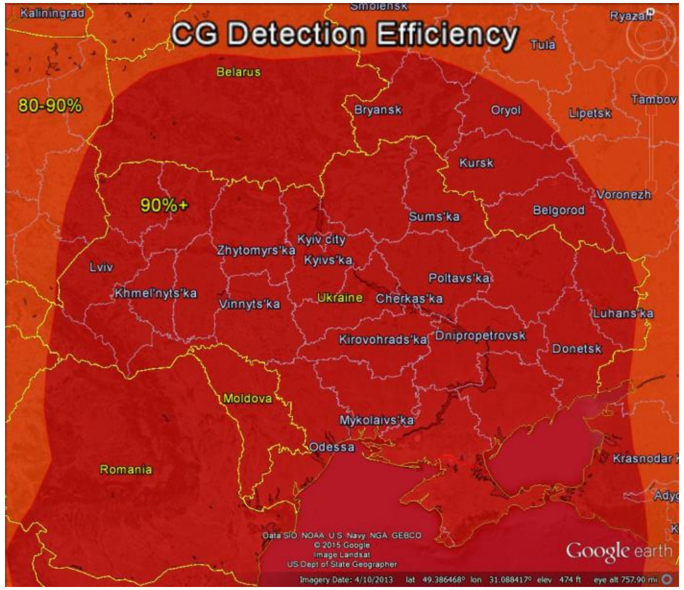
WLS Hardware and Specifications		
Device	**Weight**	**Dimensions (L x W x H)**
WeatherBug Network Appliance (WNA)	6.5 lbs	9 ¼″ x 6 ½″ x 3 ¼″
WLS Digital Signal Processor (WDSP)	4.5 lbs	11 ½″ x 9 ¼″ x 4 ¼″
Lightning Antenna	0.5 lbs	2″ x 2″ x 10 ¼″
GPS Antenna	.5 lbs	1.75″ x 1.65″ x .5″
Data Cable	3 lbs	200′ Length

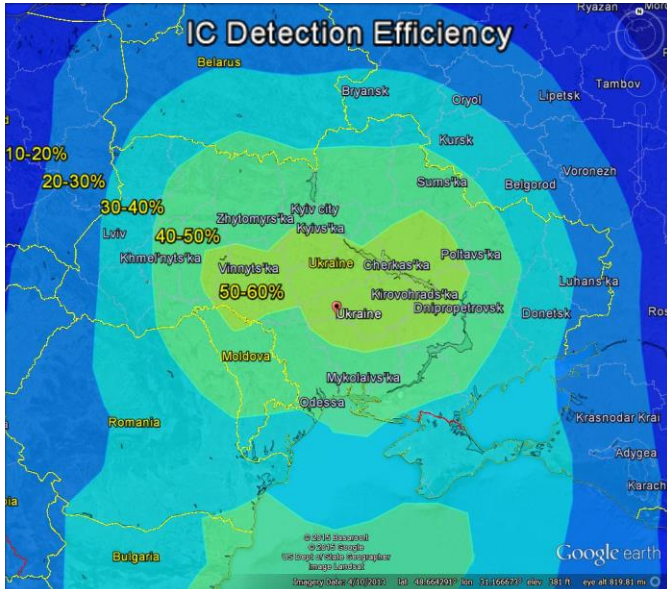


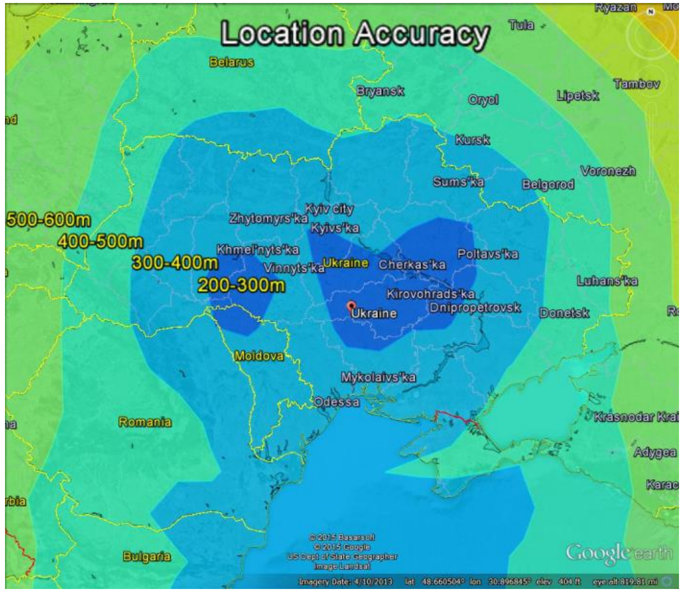


Projected 12-Sensor UTLN Meteorological Network Performance (DE/LA for CG & IC)



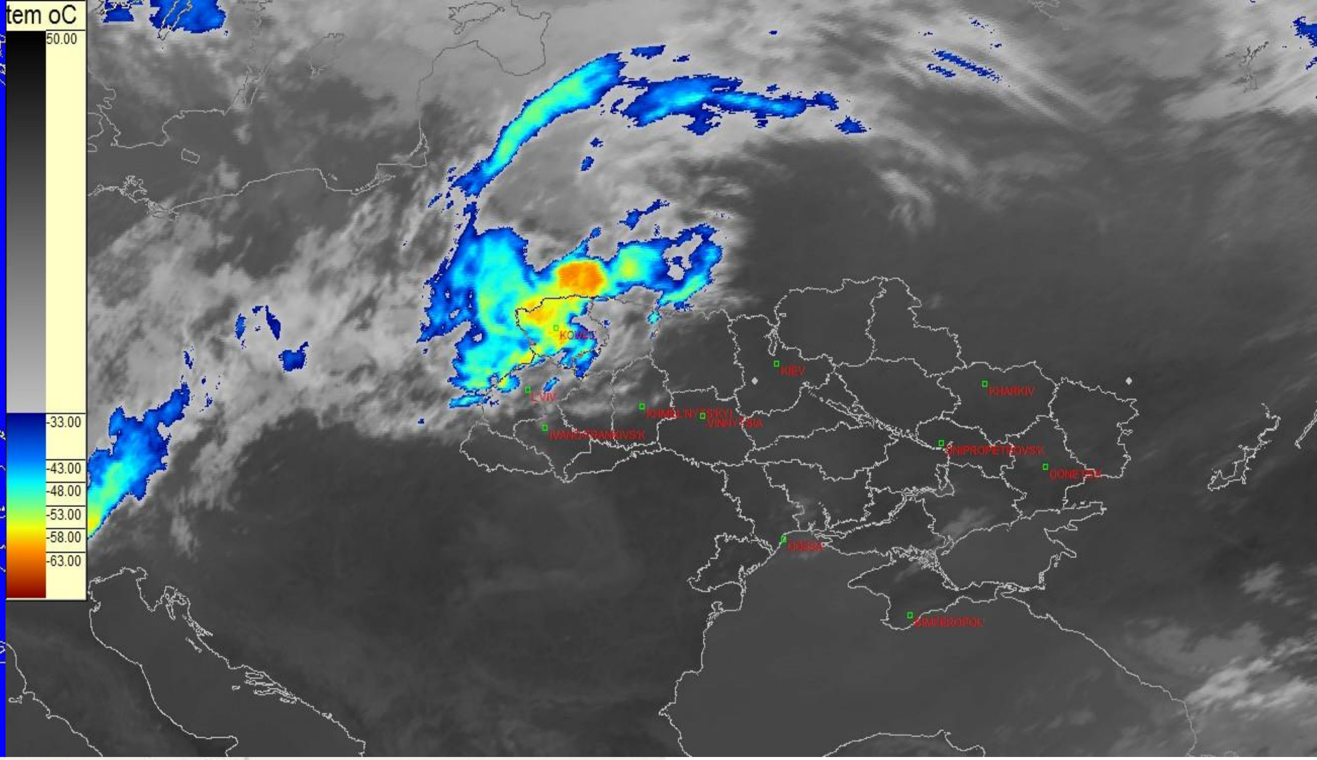






1. The 12 sensor ENLS deployment has sufficient density to enable a high degree of total lightning detection efficiency and location accuracy.
2. The highly useful CG lightning detection efficiency for most of Ukraine within the 12 sensor network would be over 95 percent.
3. The Earth Networks design of a 12 sensor network for the region is expected to provide an IC detection efficiency of over 50 percent.
4. Location accuracy would be under 200 meters for most regions of the country.


KOVEL'
L'VIV
KIEV
KHARKIV
IVANO-FRANKIVS'K
KHMEL'NYTS'KYI
VINNYTSIA
DNIPROPETROVS'K
DONETS'K
ODESA
SIMFEROPOL'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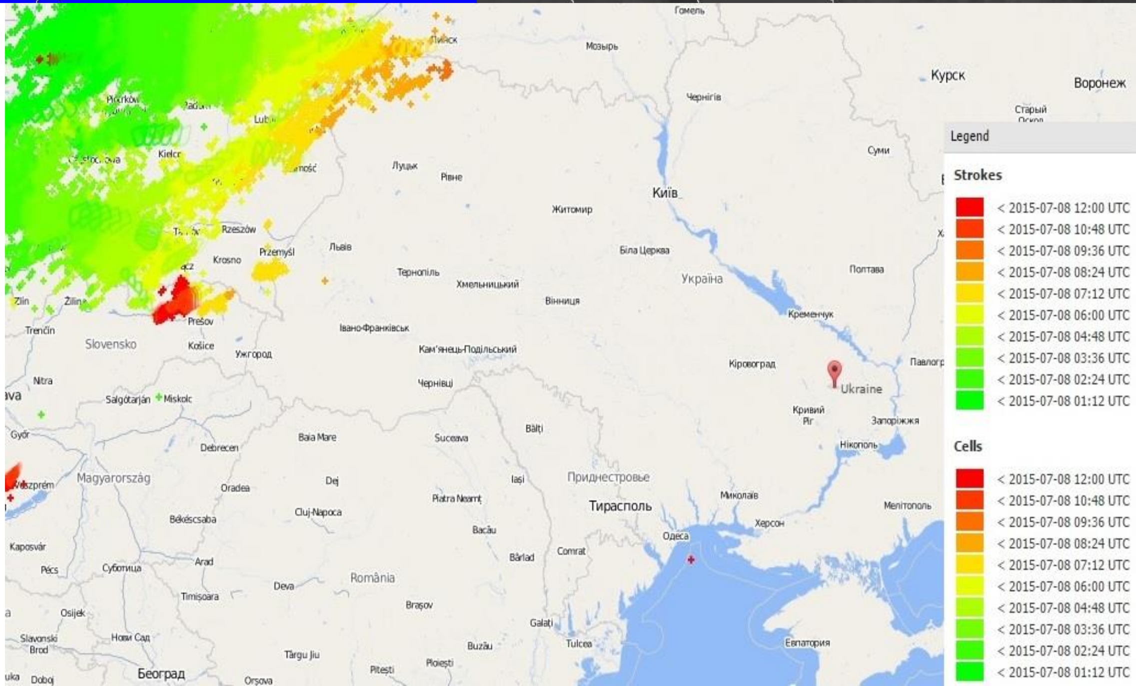
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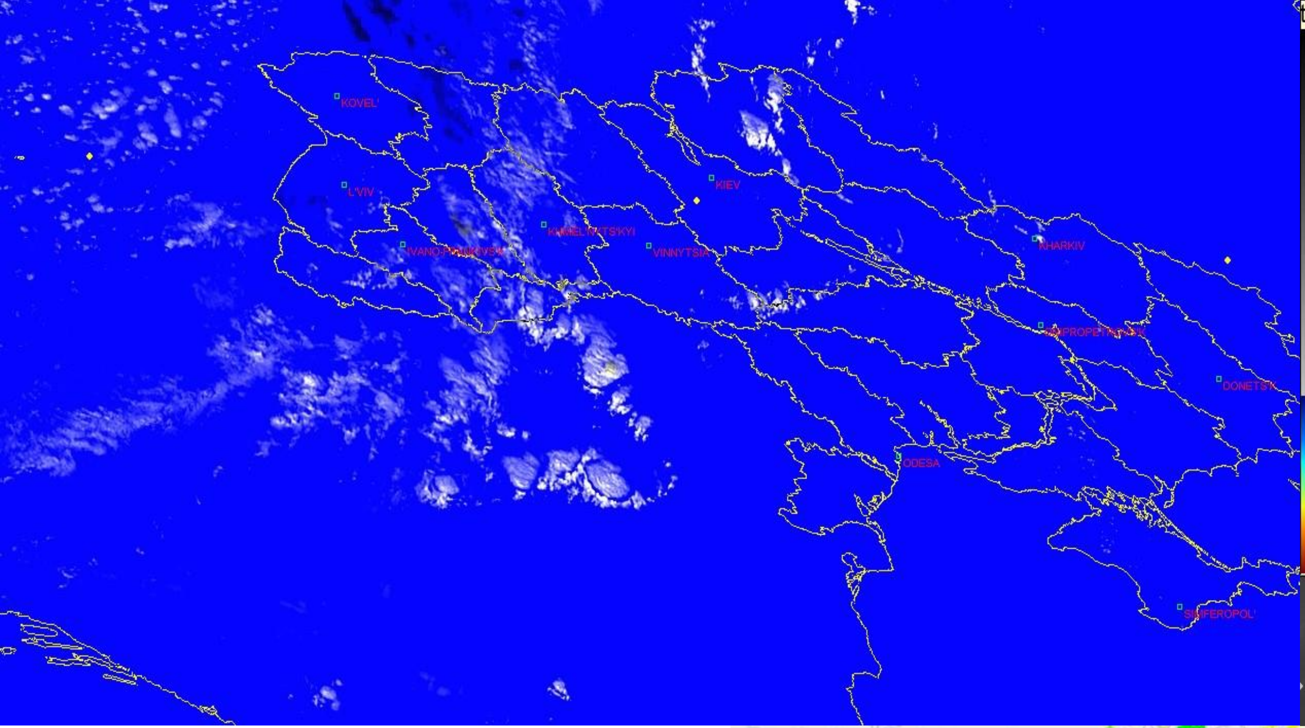
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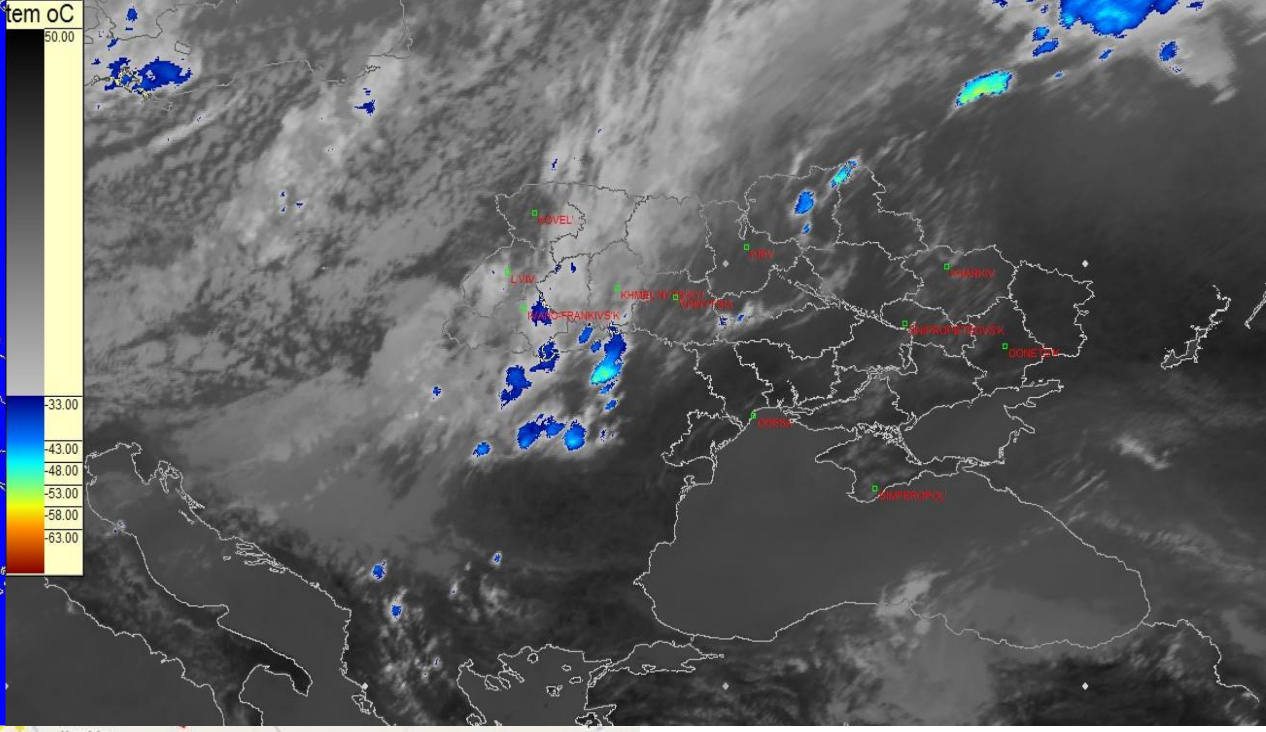
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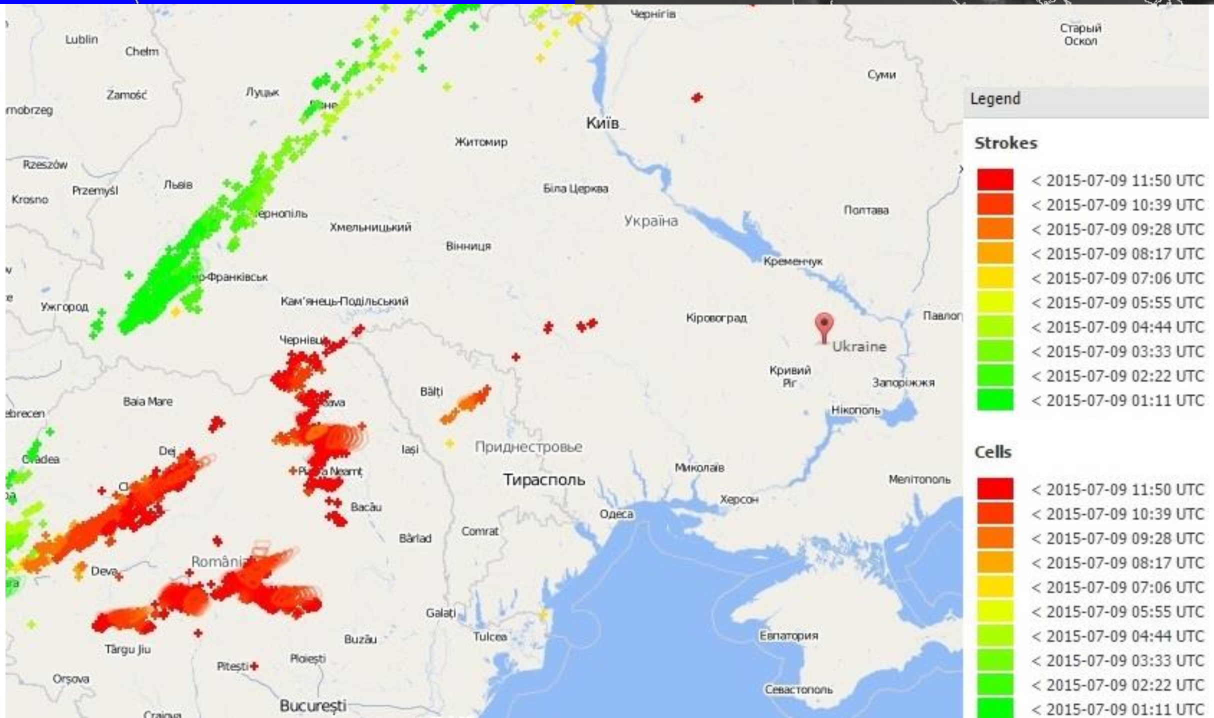
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Ужгород
Кам'янець-Подільський
Житомир
Київ
Біла Церква
Вінниця
Чернігів
Суми
Старый Оскол
Україна
Полтава
Кременчук
Кіровоград
Ukraine
Кривий Ріг
Запоріжжя
Нікополь
Чернівці
Baia Mare
Bălți
Iași
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Bârlad
Comrat
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Târgu Jiu
Pitești
Ploiești
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Thank you for attention