MTG LI: L2 concepts & algorithms

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Product terminology same as for LIS/GLM

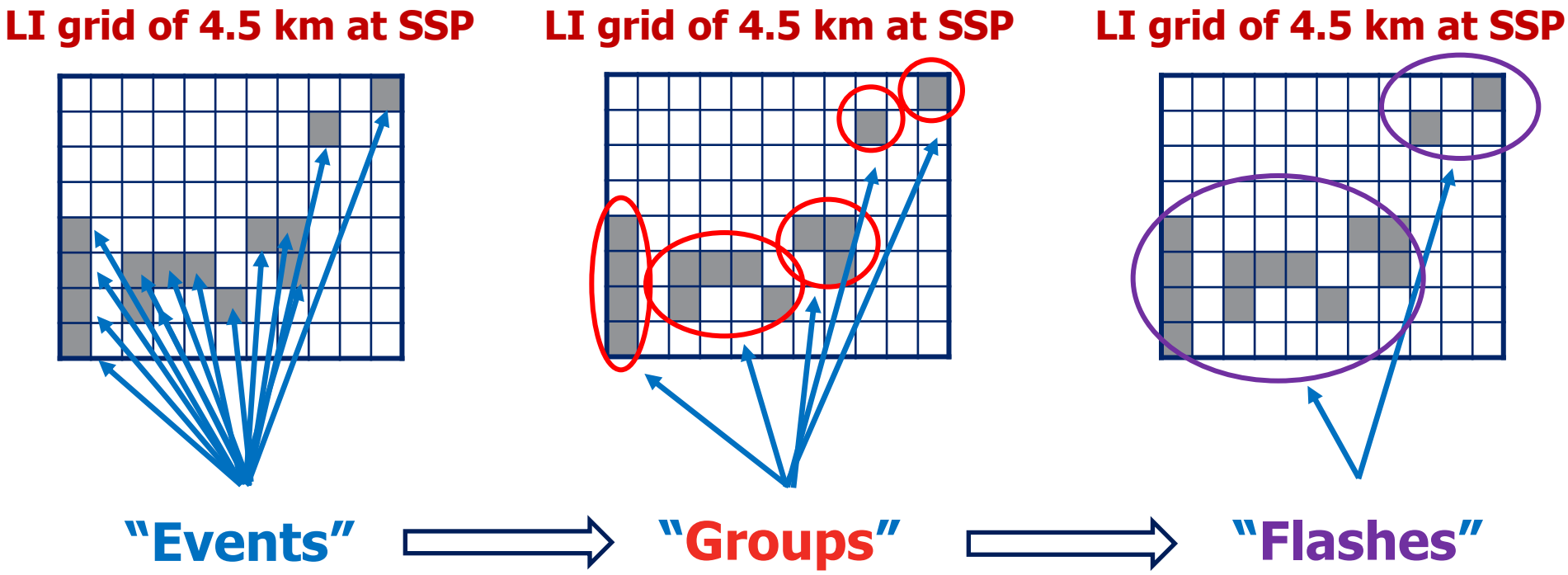
- ***Events:*** **what the instrument measures, a triggered pixel in the detector grid**

- ***Groups:*** **collection of neighbouring triggered events in the same integration period (1 ms), representing a lightning stroke in nature**

- ***Flashes:*** **a collection of groups in temporal and spatial vicinity (XX km, YY milliseconds), representing a "geophysical" flash.**

Groups and Flashes

Example/Conceptual representation of a L2 processing sequence:



SSP = Sub-Satellite Point

Lightning Imager (LI) – User Products

- **"LI Initial Processing"**
  - **Point data in nature in the LI grid**
  - **Groups (strokes) & Flashes with geographical coordinates**

- **"Accumulated products"**
  - **Product density shown in the fixed MTG-FCI (*) imager grid (same grid as for the FCI IR channels in the 2 km FDHSI resolution)**

(*) FCI = Flexible Combined Imager on MTG

L2 Accumulated Products

- **Accumulated products:**
  - **Collecting samples from a 30 second buffer**
  - **Presented in the same 2-km grid as the imager IR channel data for easier combining with imager information**
  - **Events define the extent in the products**
  - **Flashes define the values in the products**

  - **For a longer temporal accumulation, the 30 second products can be stacked according to users' preferences**

Background to accumulated products

- Current understanding has been that EUMETSAT users are mostly interested in:

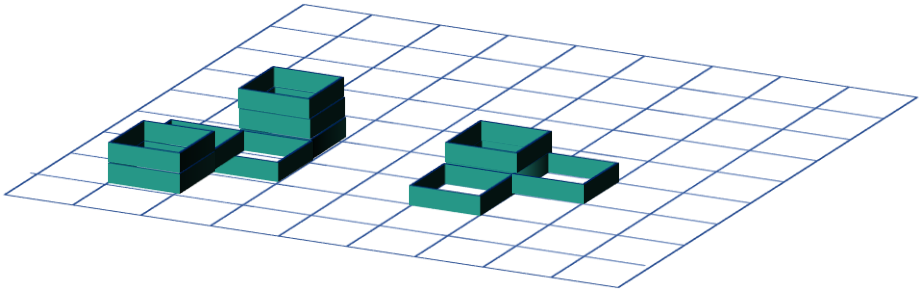
  a) **Flashes**
  b) **Understanding of "what kind of a flash" it is they are getting ("strength", duration, extent)**

  ⇒ After discussion within LI MAG, the assumption has been that real-time users would be well served with the flashes (groups) and a supporting accumulated product coming from events

  ⇒ The periodicity of the product should be short enough that it fits well for any further application allowing stacking of data (30 seconds)

Accumulation status at *t* = 10s

= Events in Flash #1



Event count in density buffer (and density grid)

		3			2	1		
	1	1			1			
	2							

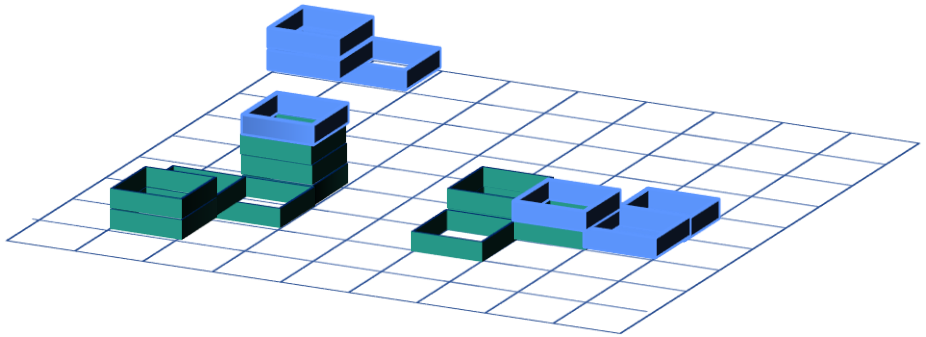
Flash count in density buffer (and density grid)

		1			1	1		
	1	1			1			
	1							

Accumulation status at *t* = 20s

= Events in Flash #1

= Events in Flash #2



Event count in density buffer (and density grid)

2	1							
							1	
		4			2	2	1	
	1	1			1			
	2							

Flash count in density buffer (and density grid)

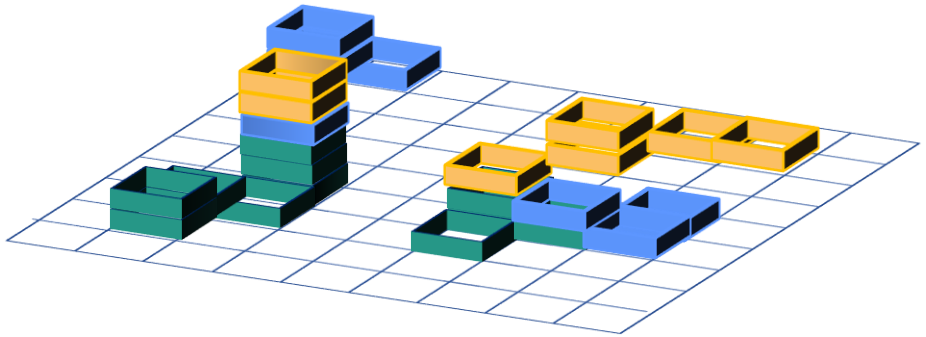
1	1							
							1	
		2			1	2	1	
	1	1			1			
	1							

Accumulation status at *t* = 30s

= Events in Flash #1

= Events in Flash #2

= Events in Flash #3



Event count in density buffer (and density grid)

2	1							
						1	1	
					2			
							1	
		6			3	2	1	
	1	1			1			
	2							

Flash count in density buffer (and density grid)

1	1							
						1	1	
					1			
							1	
		3			2	2	1	
	1	1			1			
	1							

MTG LI Proxy Data – data available before launch

- MTG LI is without heritage in GEO orbit, and the closest comparison is the Lightning Imaging Sensor (LIS) on TRMM – currently still in operation
  - **However, LIS flying on LEO orbit can only monitor storms for less than 2 minutes at a time (and without European coverage)**

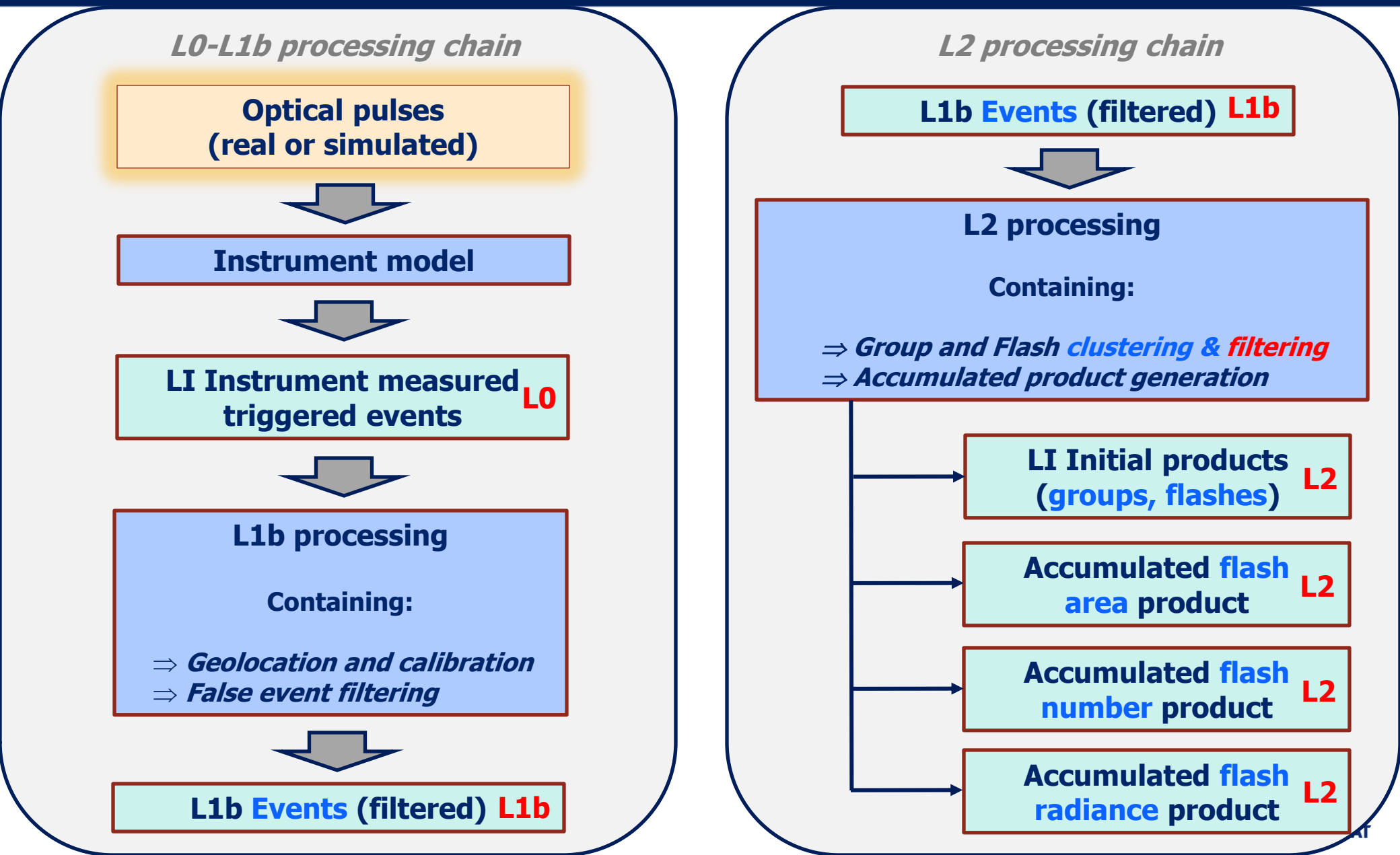
- Use of ground-based Lightning Location System (LLS) networks as a source of proxy data is not straightforward, as they are based on Radio Frequency (RF) observations of lightning and depending on the RF band (VHF, VLF, LF) they are sensitive to different parts of the lightning process

- A combination of **optical + RF** observations has been selected for proxy data generation

MTG LI Proxy Data – current approach

- The best compromise is to use ground-based lightning data, but converted to optical pulses based on case study comparisons with LIS data.
- One of the networks in operation in Europe (LINET) is currently the main source of such proxy data for the LI activities.
- LINET data has been compared in measurement campaigns to other ground-based systems and to LIS
- As an outcome, a model for transforming the LINET stroke data into optical emission (“pulses”) has been created

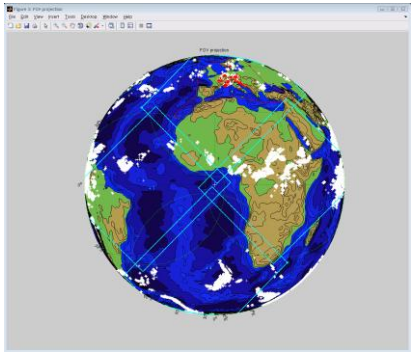
Proxy data generation



Reference processor development status

The Performance Processor – an End-to-End Simulator

Optical Pulses



Different approaches: ground based (LINET, NORDLIS) and space borne (TRMM-LIS)

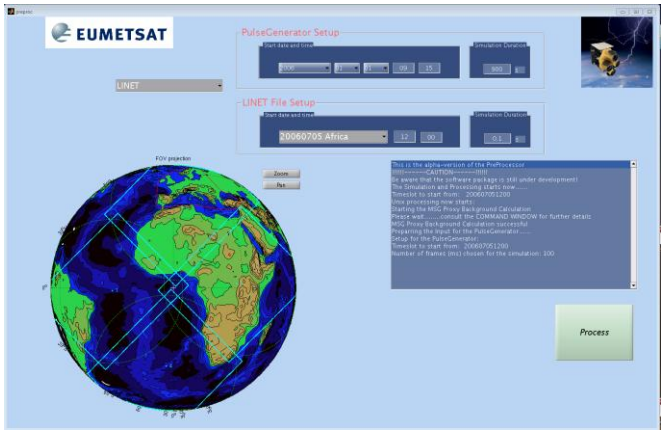
LIDEFAS
Lightning Imager Detection Efficiency & False Alarm Simulator

Core Element

- LI radiometric model (incl. noise models)
- LI on board processing
- L1 filtering
- L2 processing (groups & flashes)

Product & Result Generation, e. g.

- Level 1 and 2 products
- Grouping / Filtering / Testing



Proxy data – Accumulated product stacking

The original 30 sec product stacked into several longer time periods depending on application

Original 30 second product

Accumulated flash area product

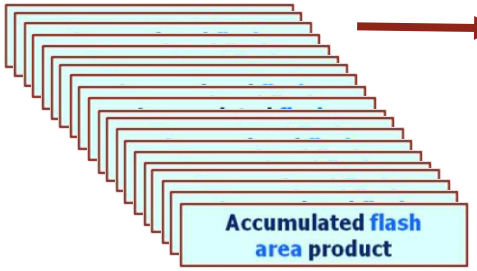
stacking 5 products

2.5 min (= FCI Rapid Scanning Service FDC/4)

stacking 10 products

5 min (= FCI Rapid Scanning Service FDC/2)

stacking 20 products



10 min (= FCI Full Disk Scanning Service FDC)

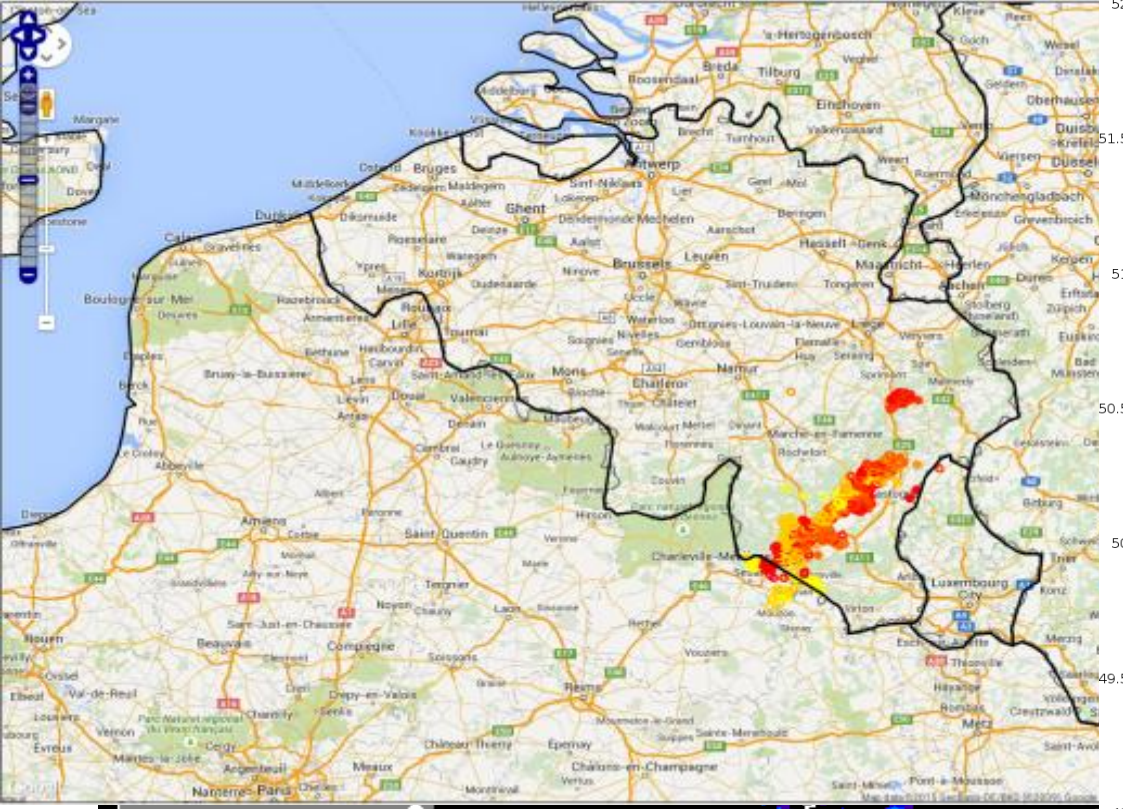
Proxy data examples

- In the following slides a comparison created by RMI (Belgium) is shown. It consists of:

- Top-right panel:
  - **RMI ground-based data: combination of SAFIR and LS700x sensors placed in Belgium and also in France, Netherlands and Germany.**

- Top-left panel:
  - **LI proxy data (L2 accumulated product)**
  - **Based on LIS/LINET transformation statistics, taking into account the varying DE of LINET in the coverage area**

- Bottom panel:
  - **Weather radar composite**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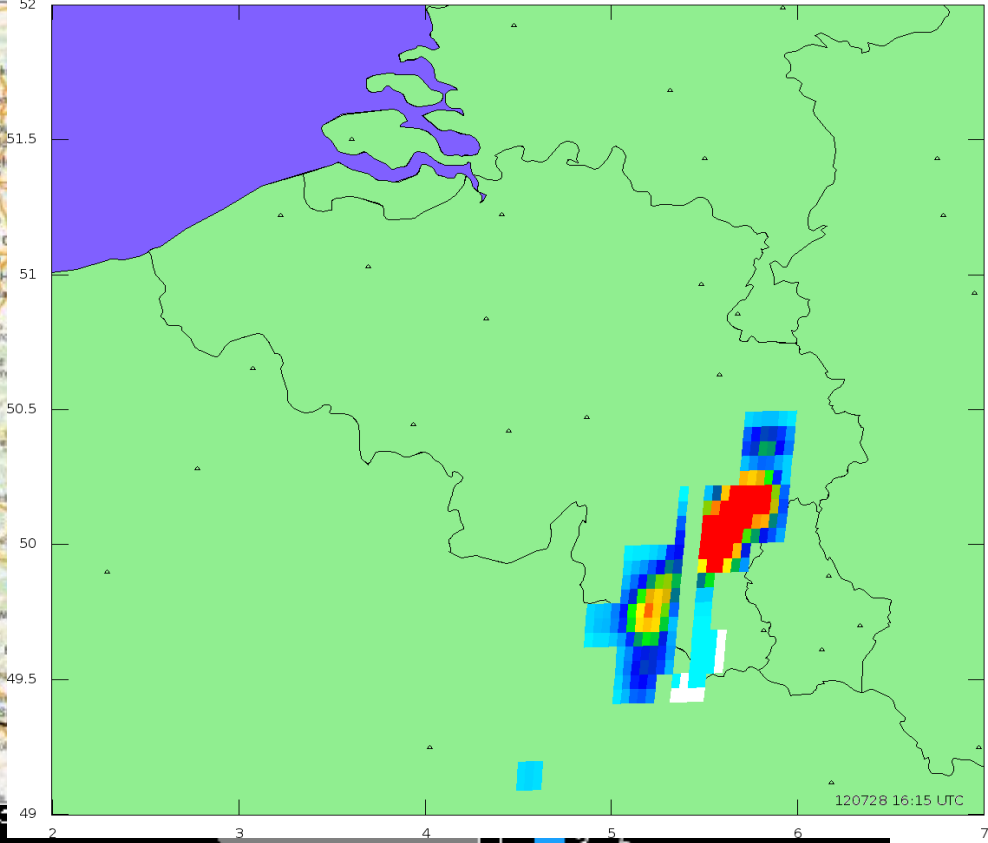
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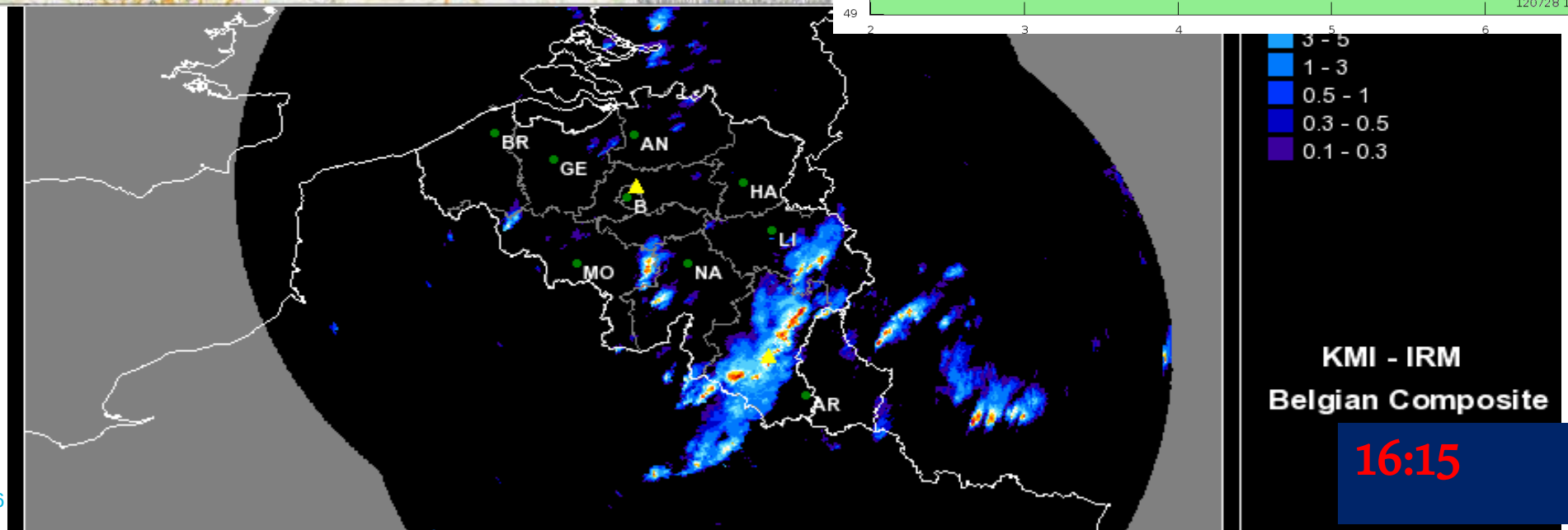
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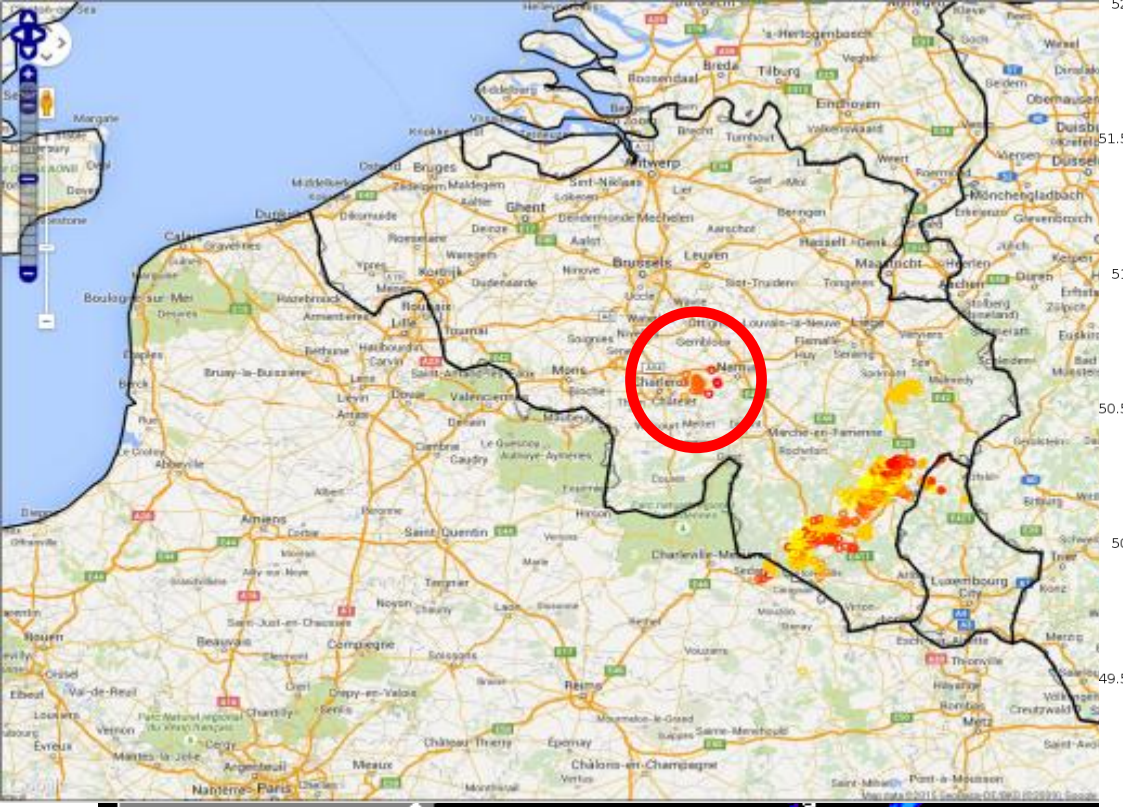

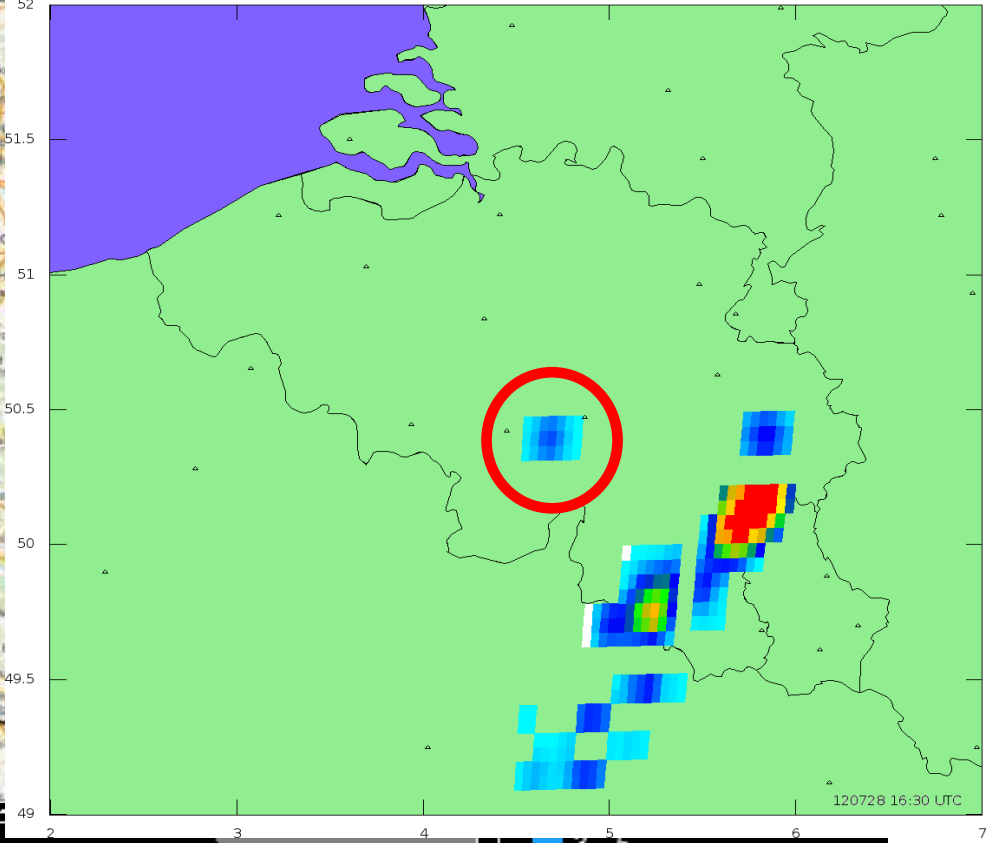
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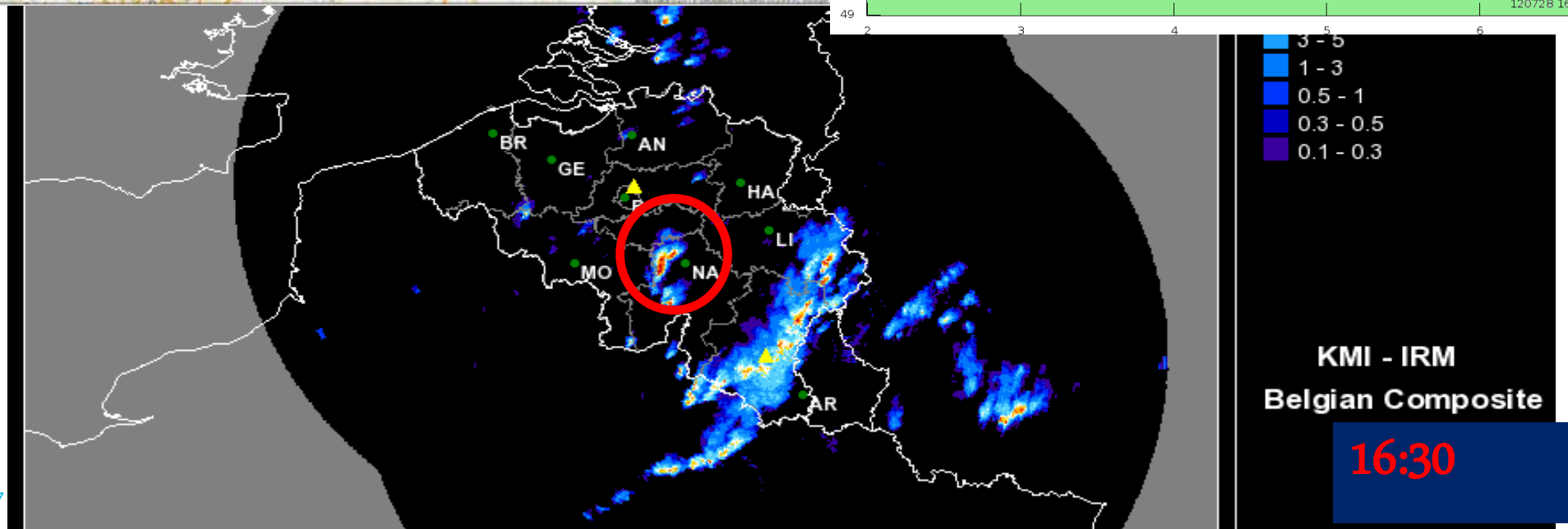
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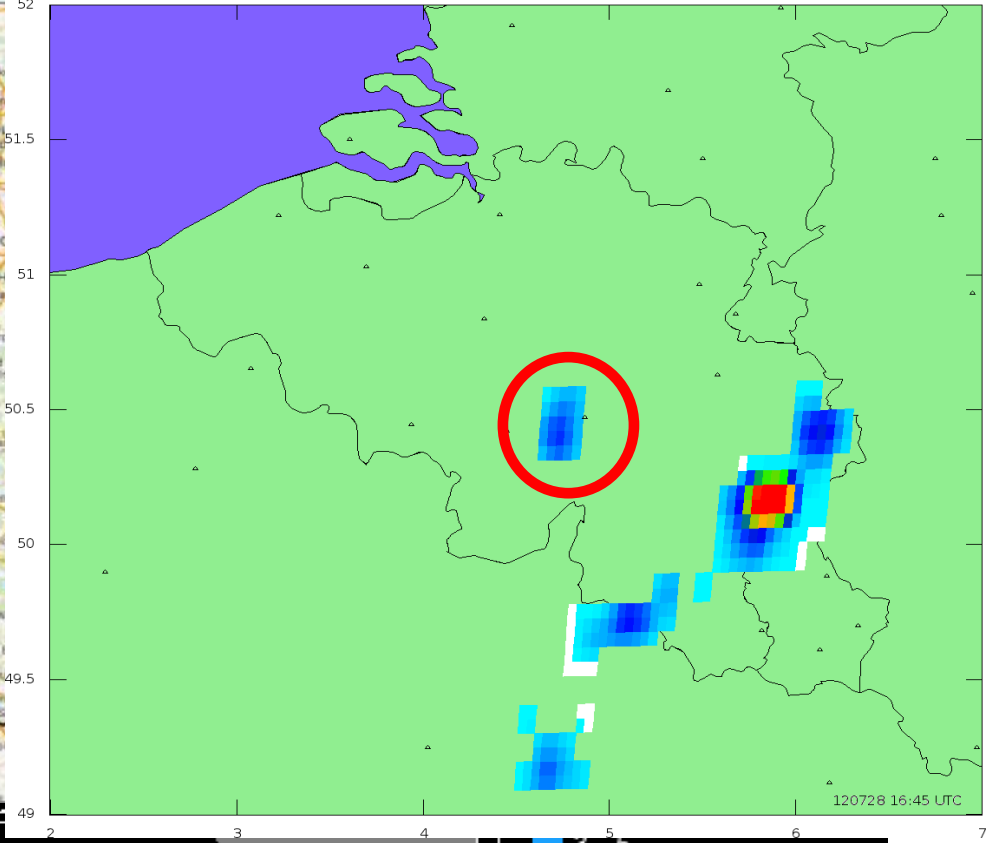
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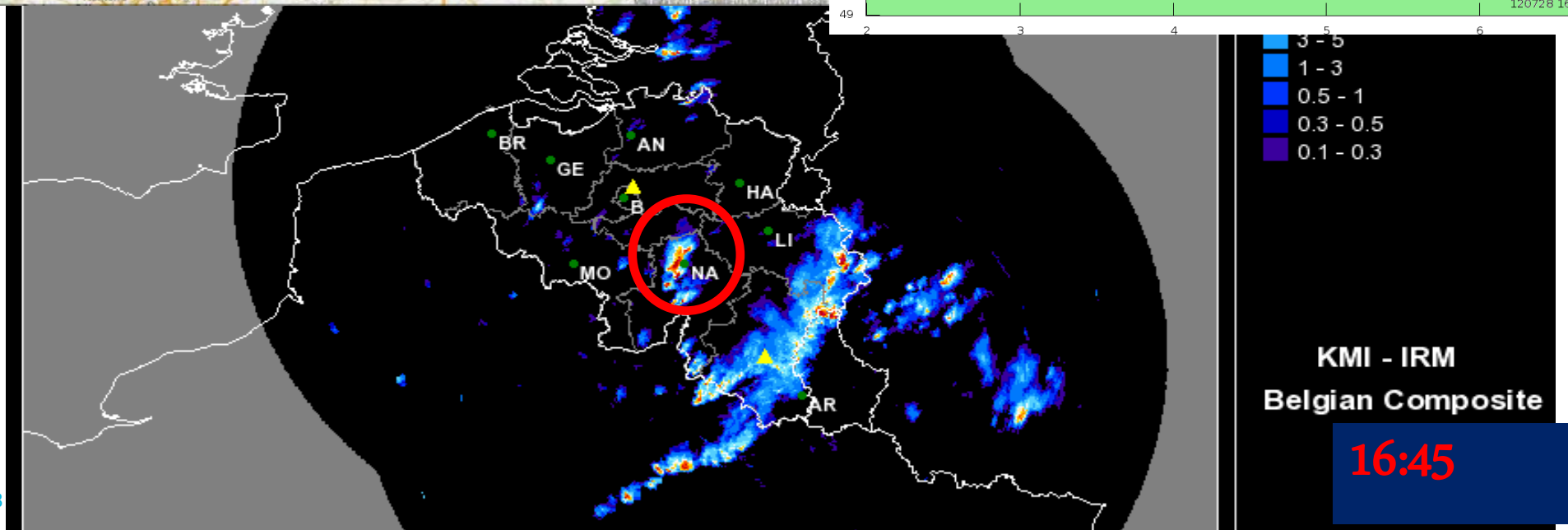
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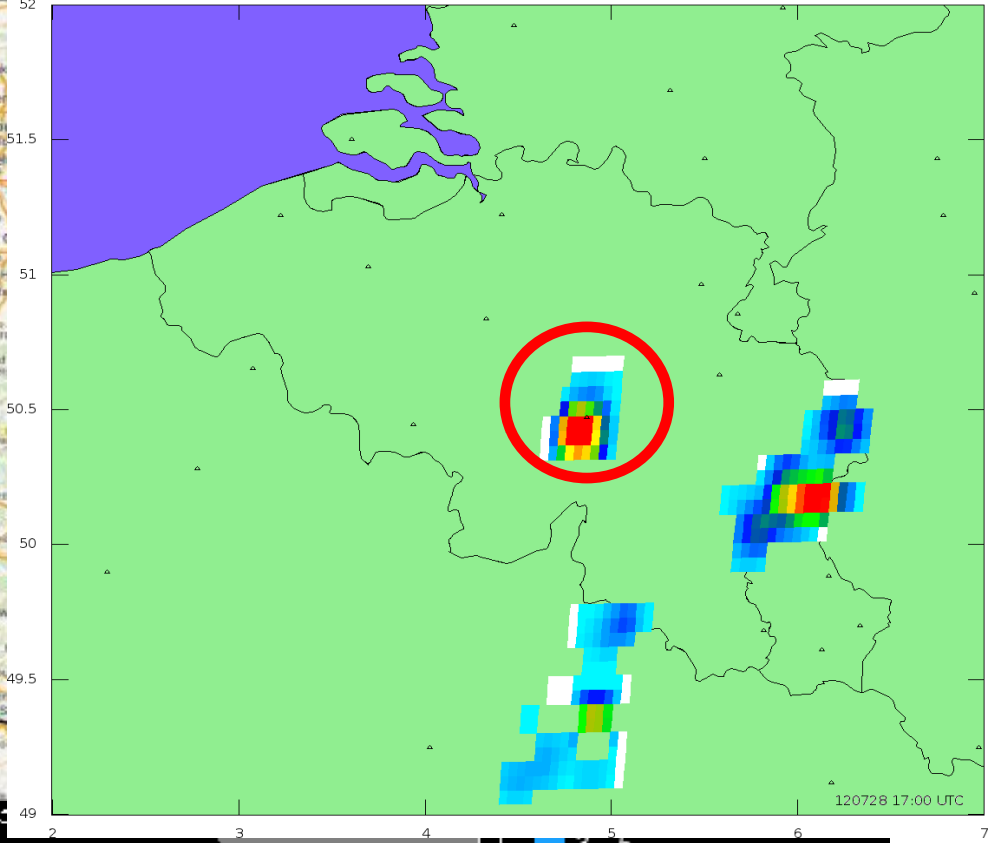
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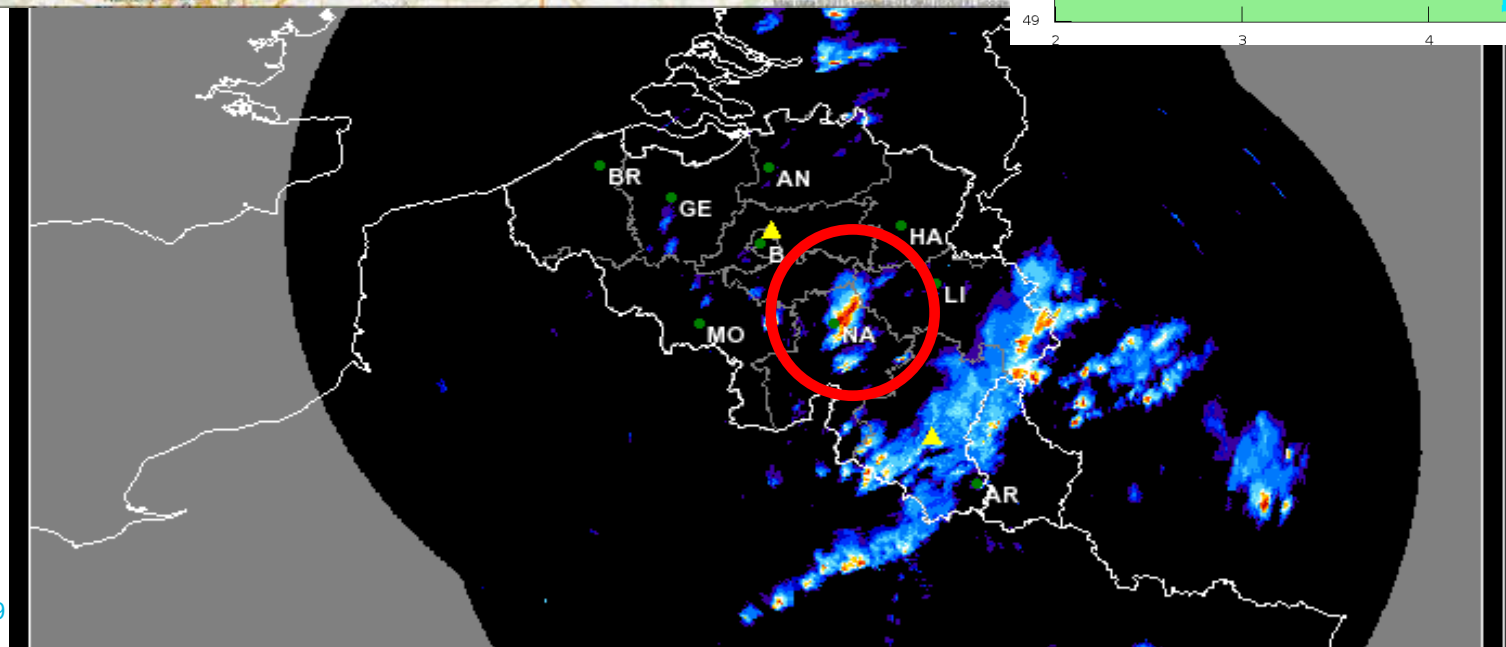
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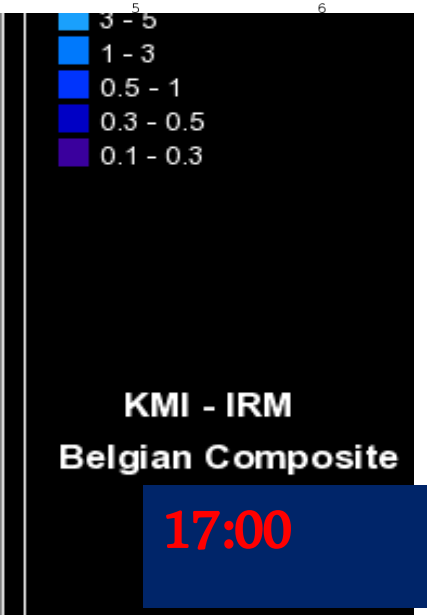
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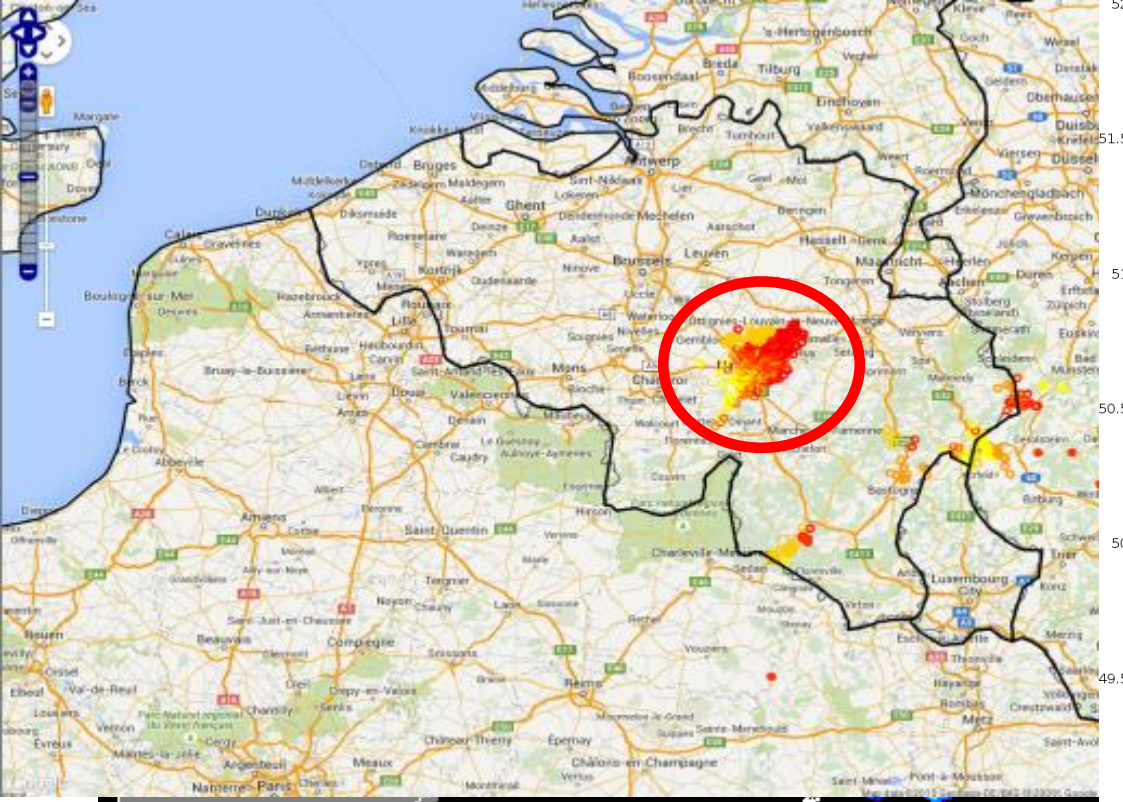

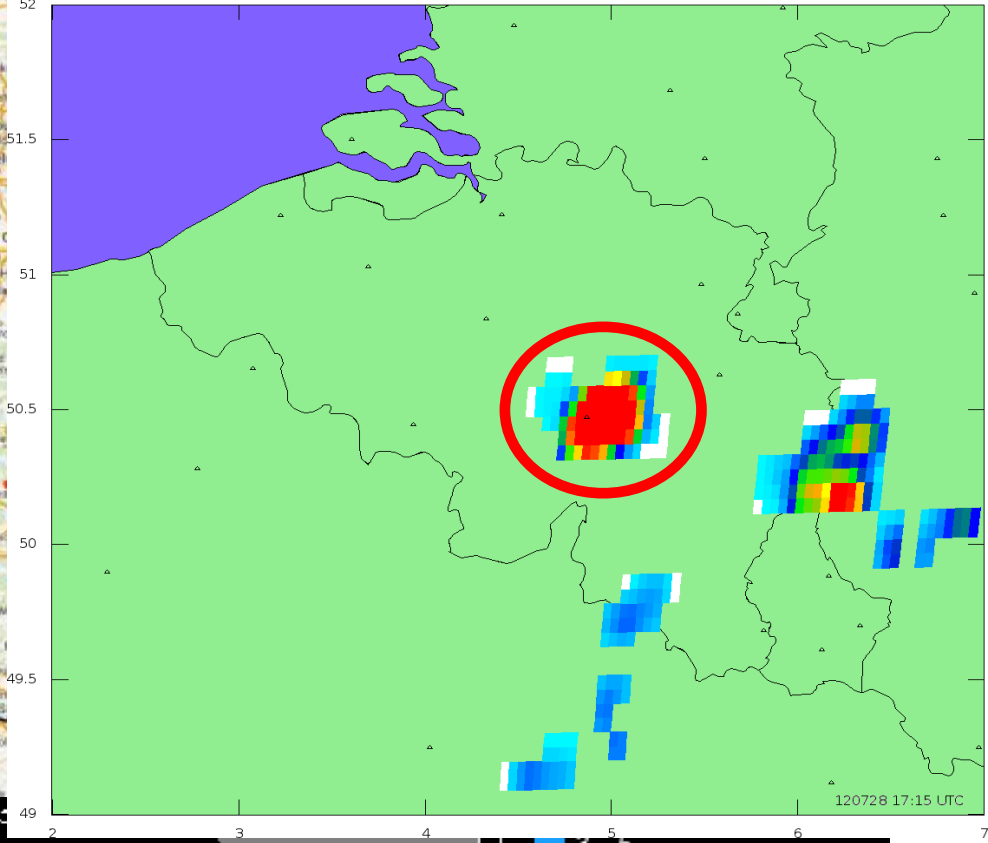
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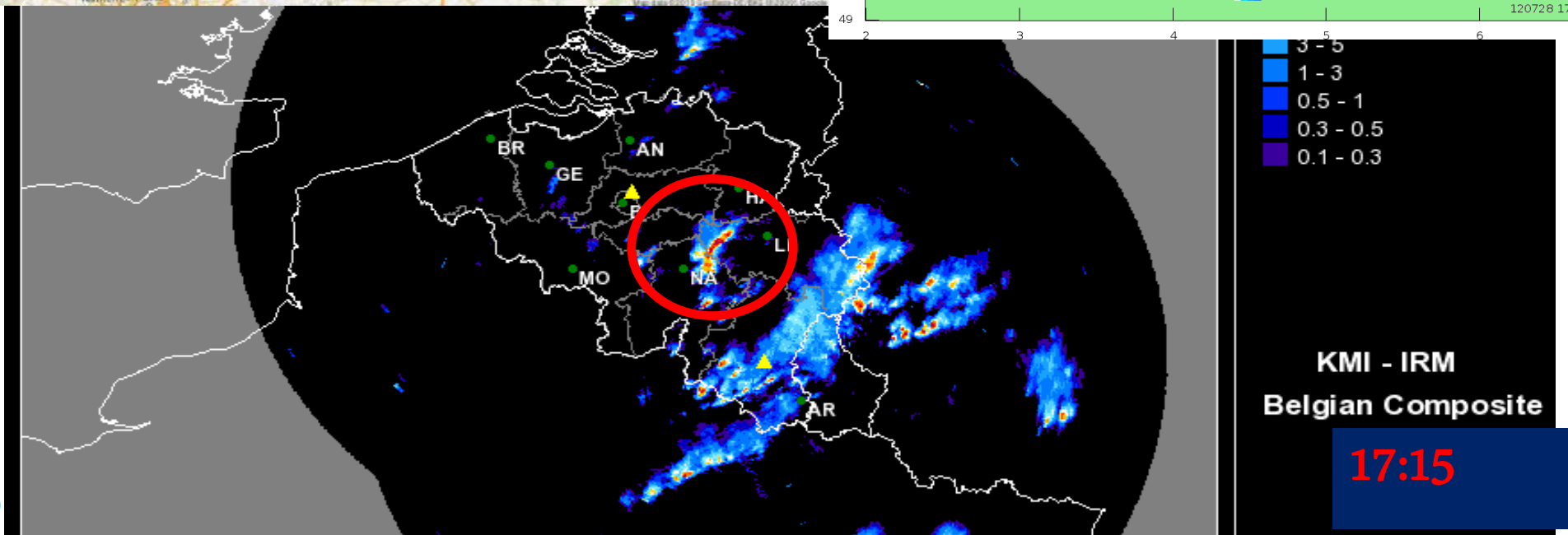
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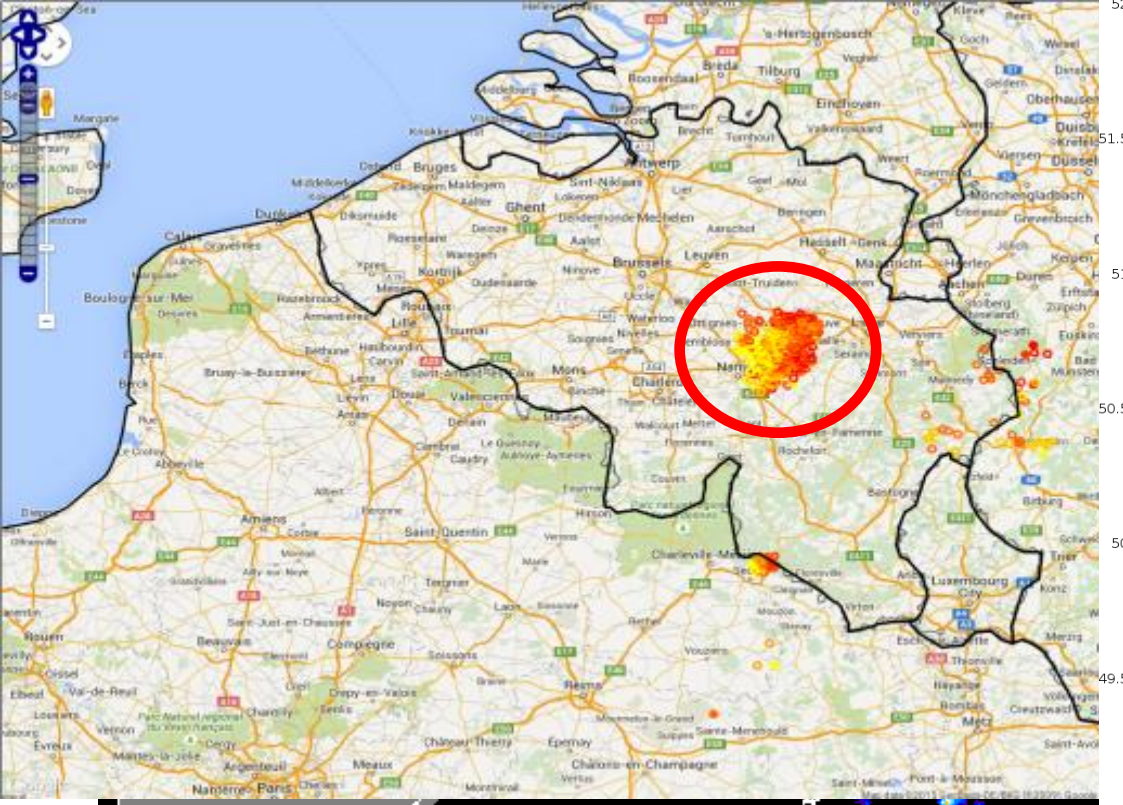

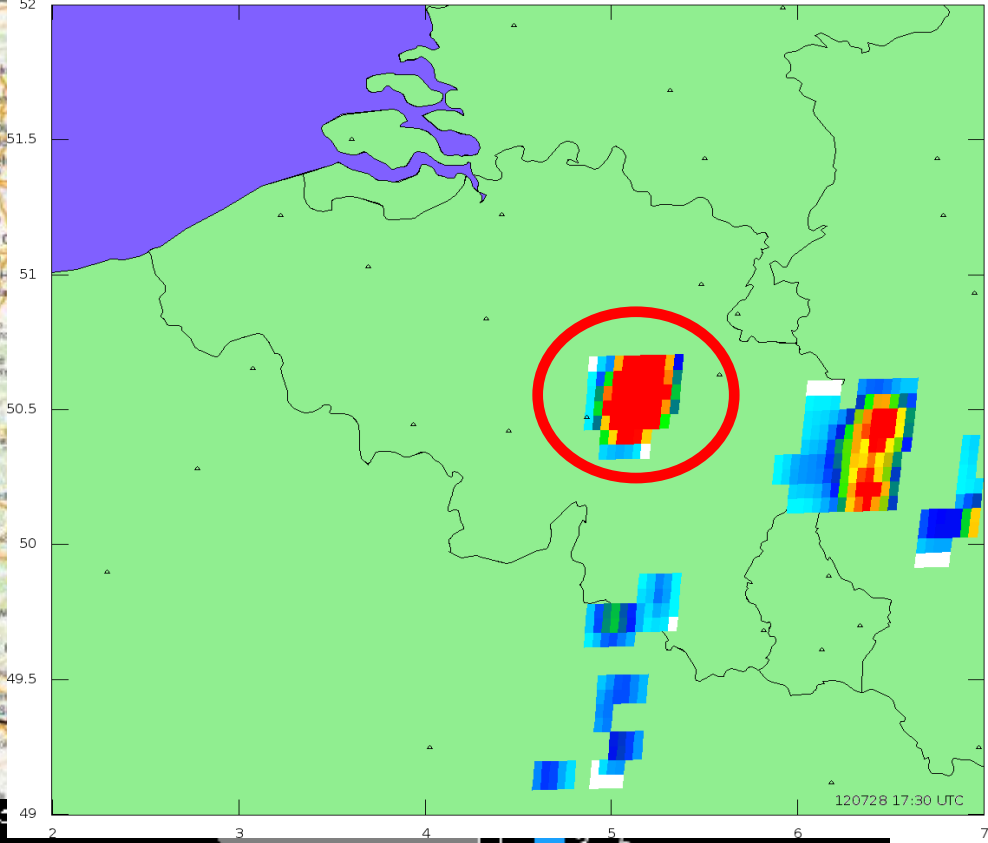
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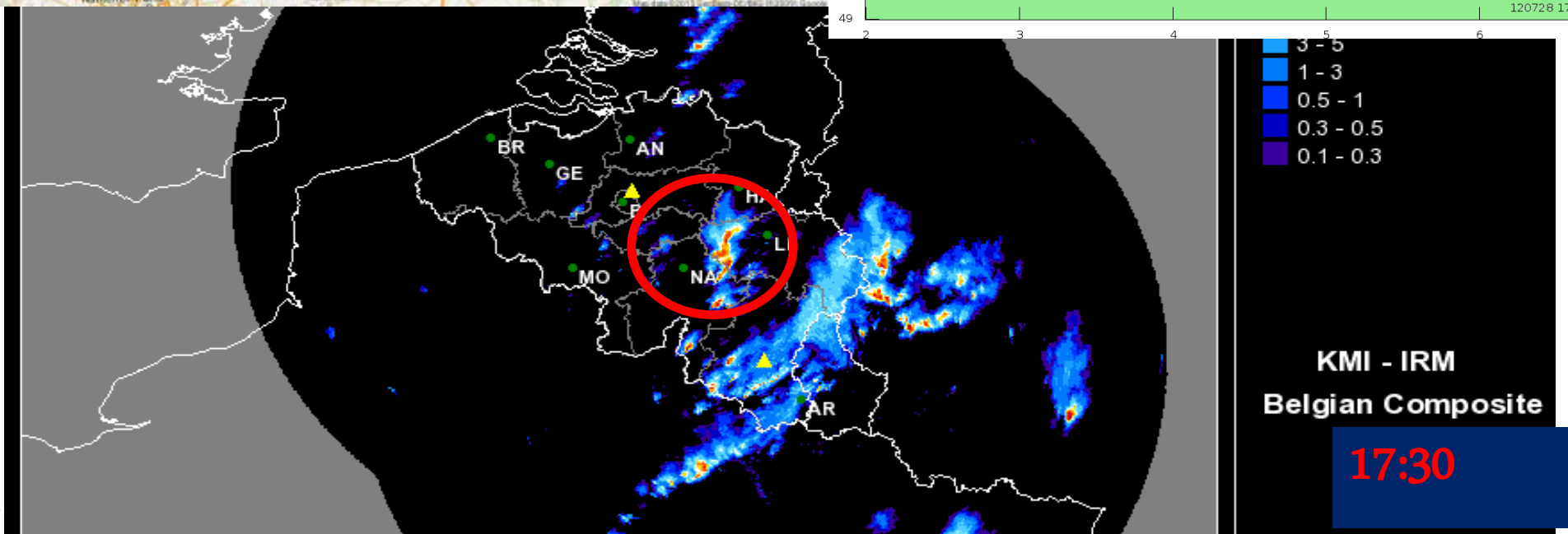
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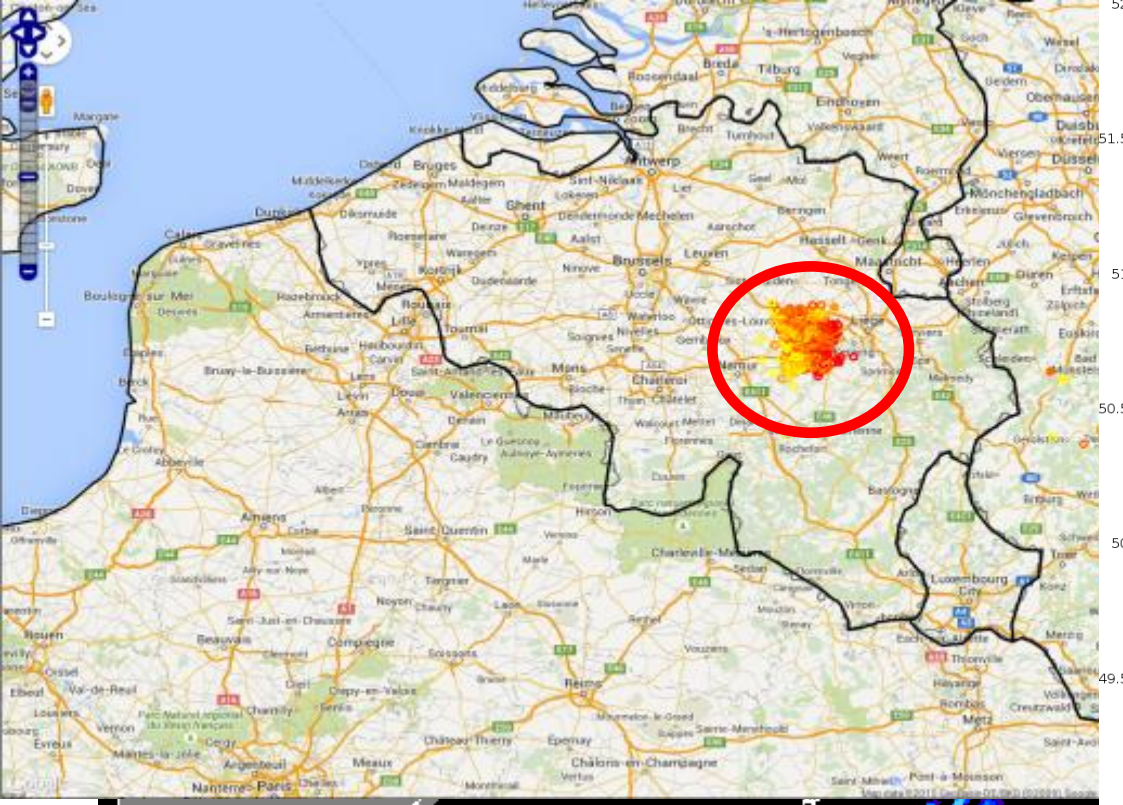

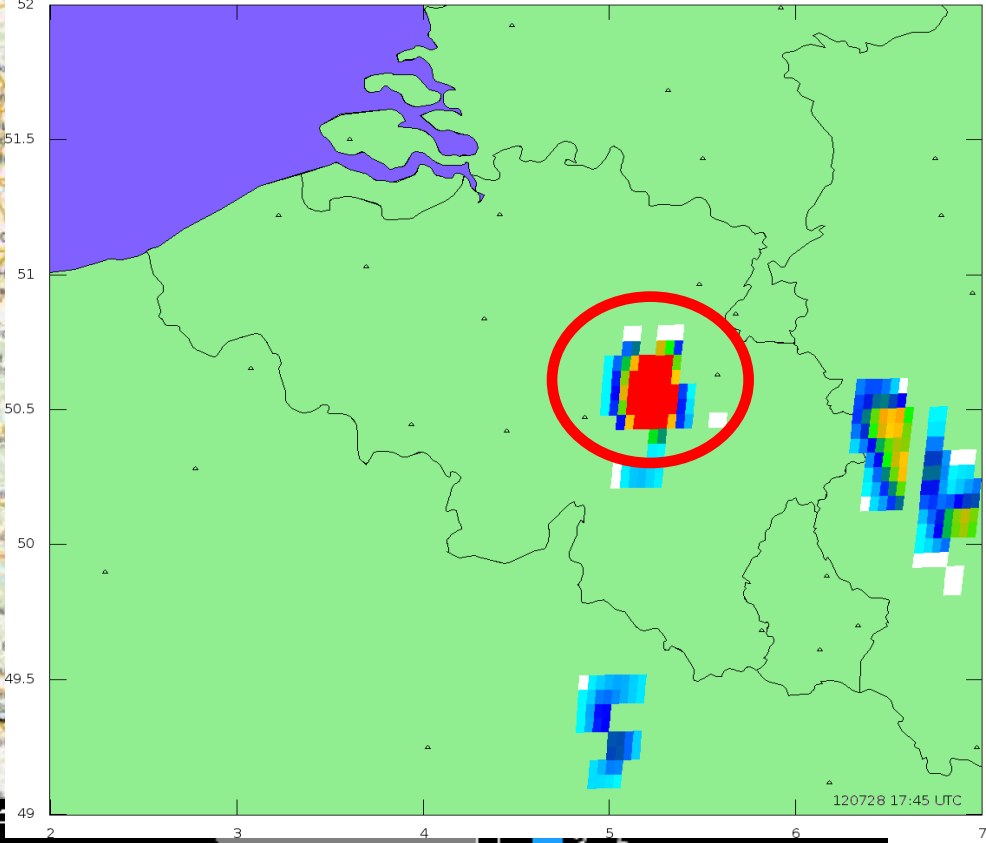
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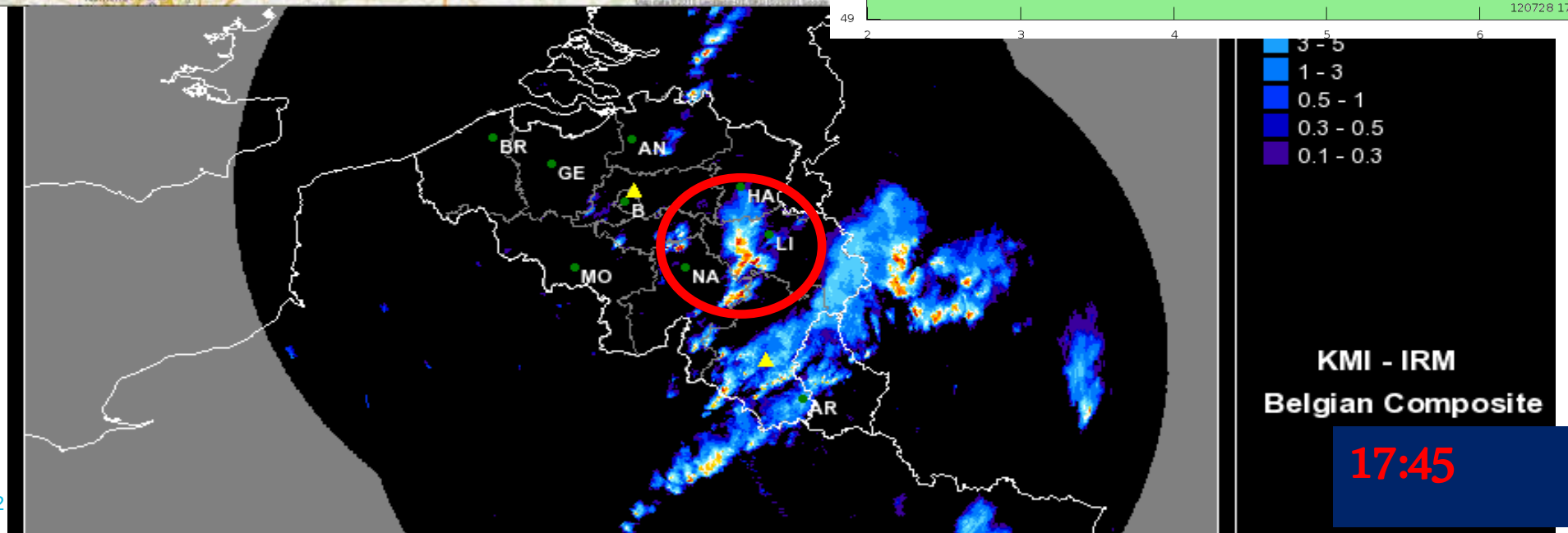
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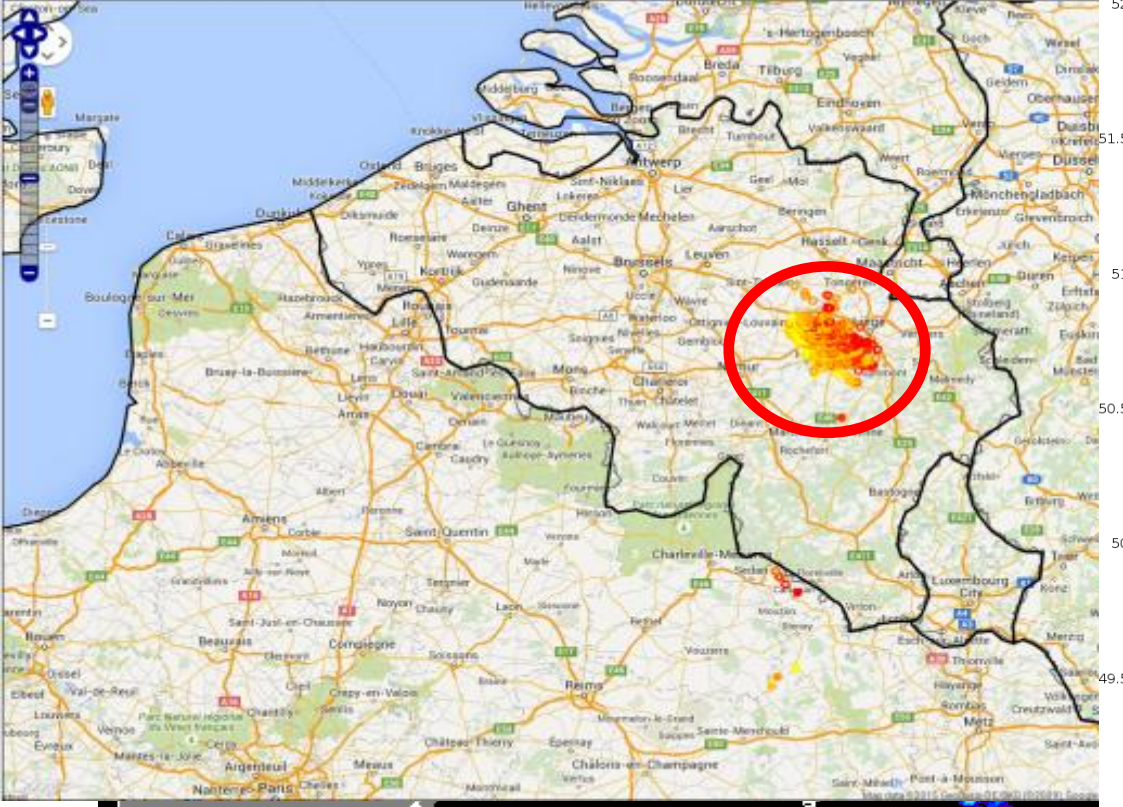
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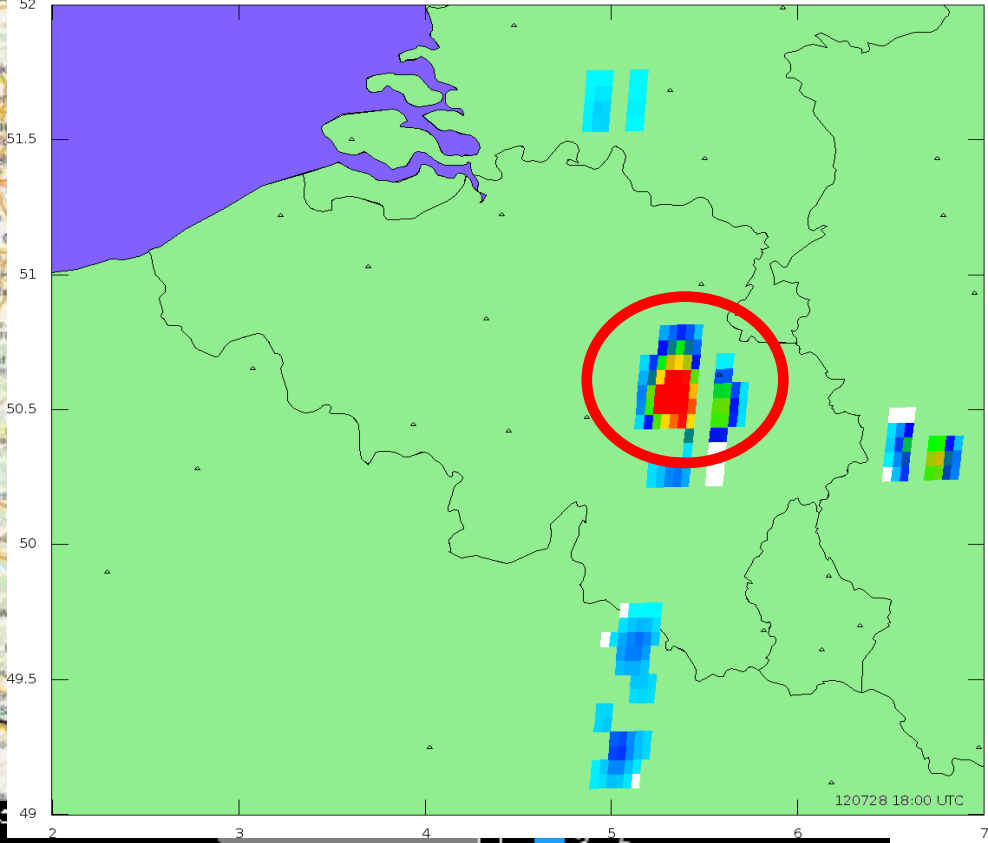
Wells
Glastonbury
Street
Yeovil
Sherborne
Gillingham
Shaftesbury
Blandford Forum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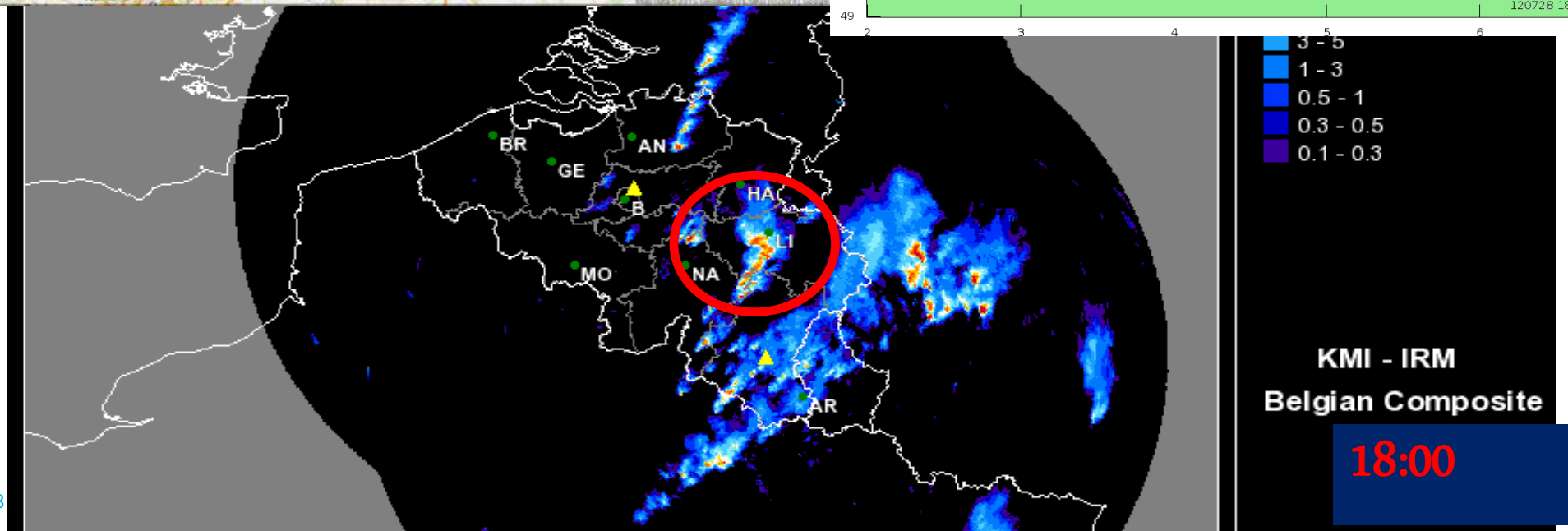
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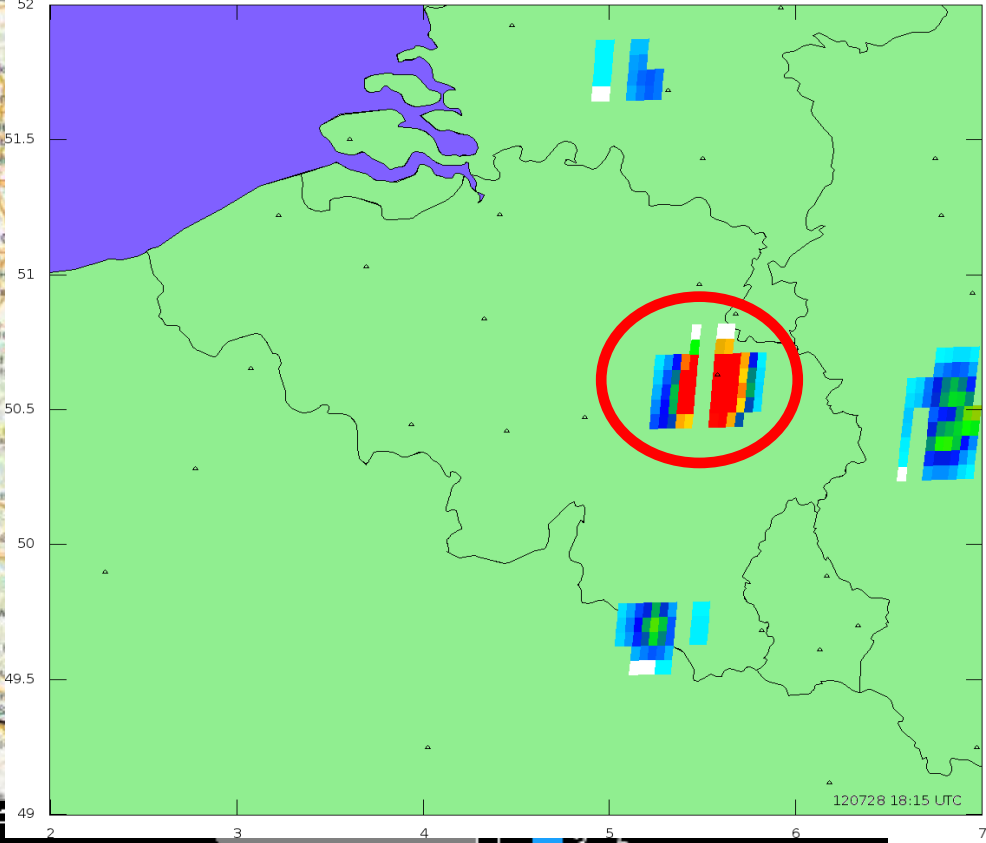

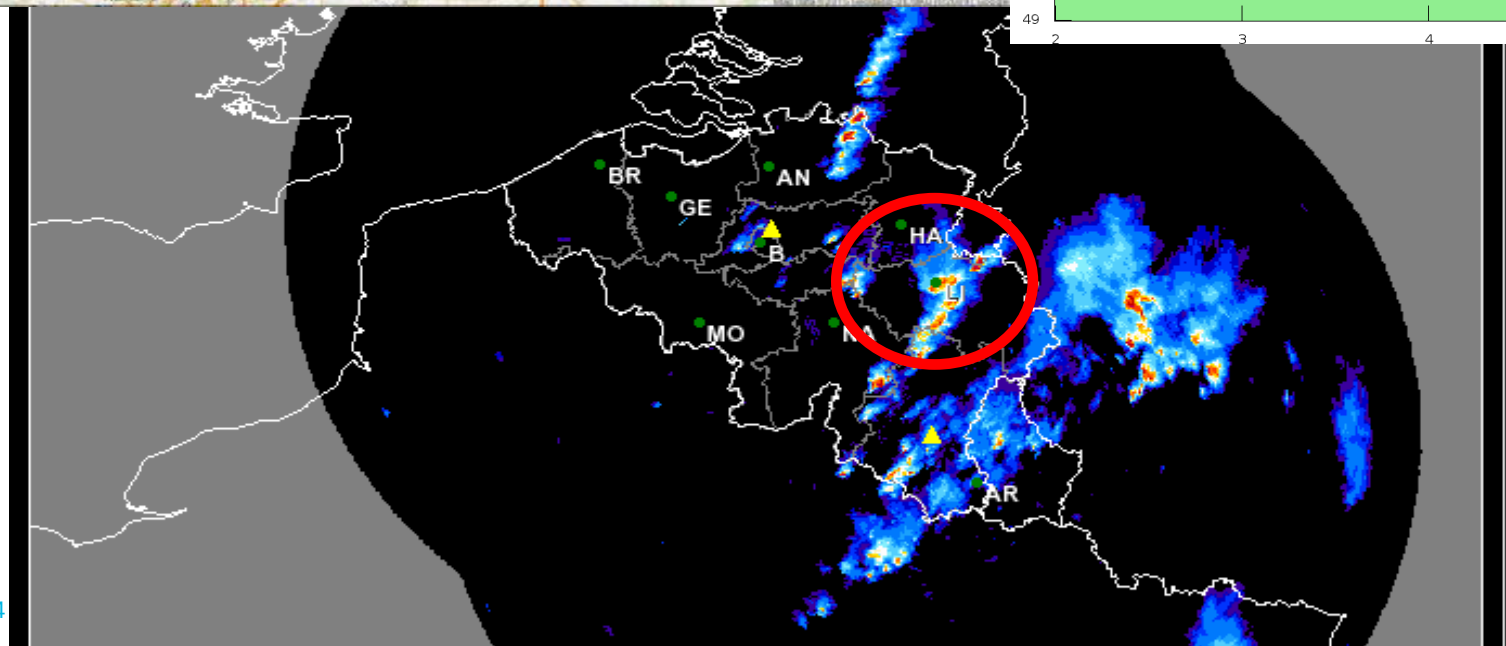

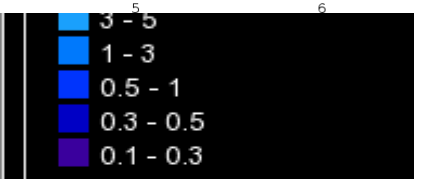

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Belgian Composite

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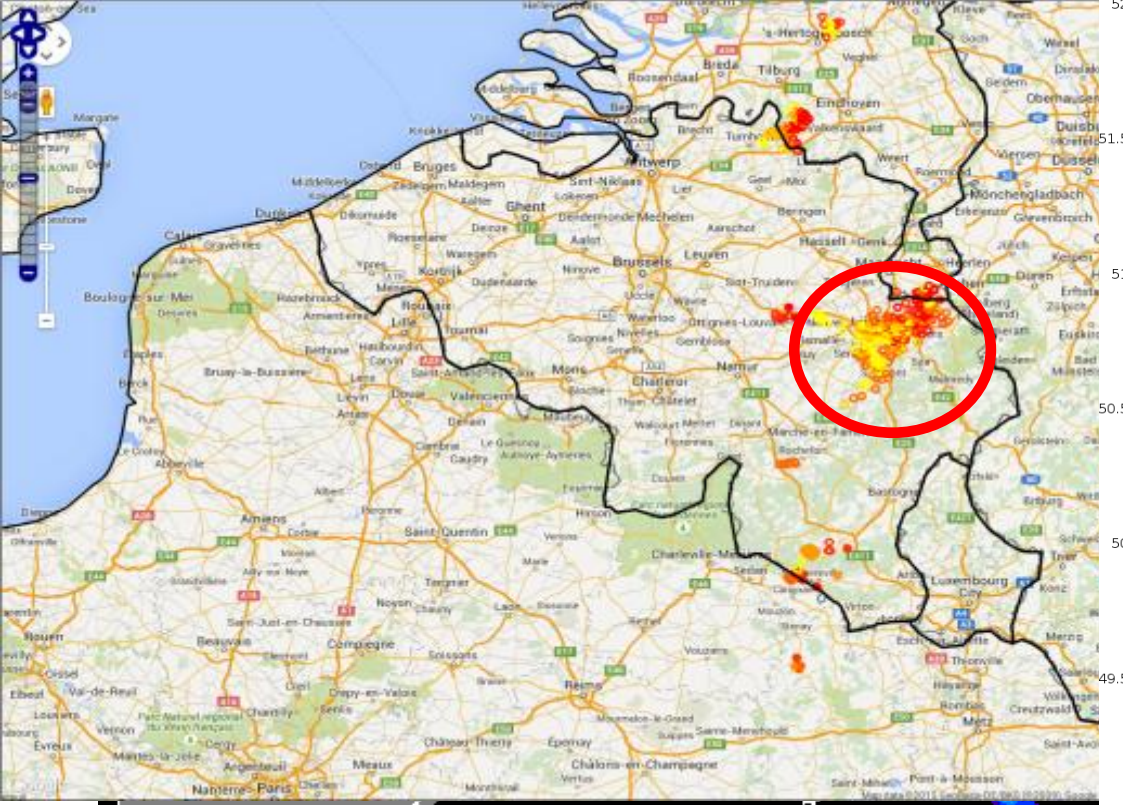

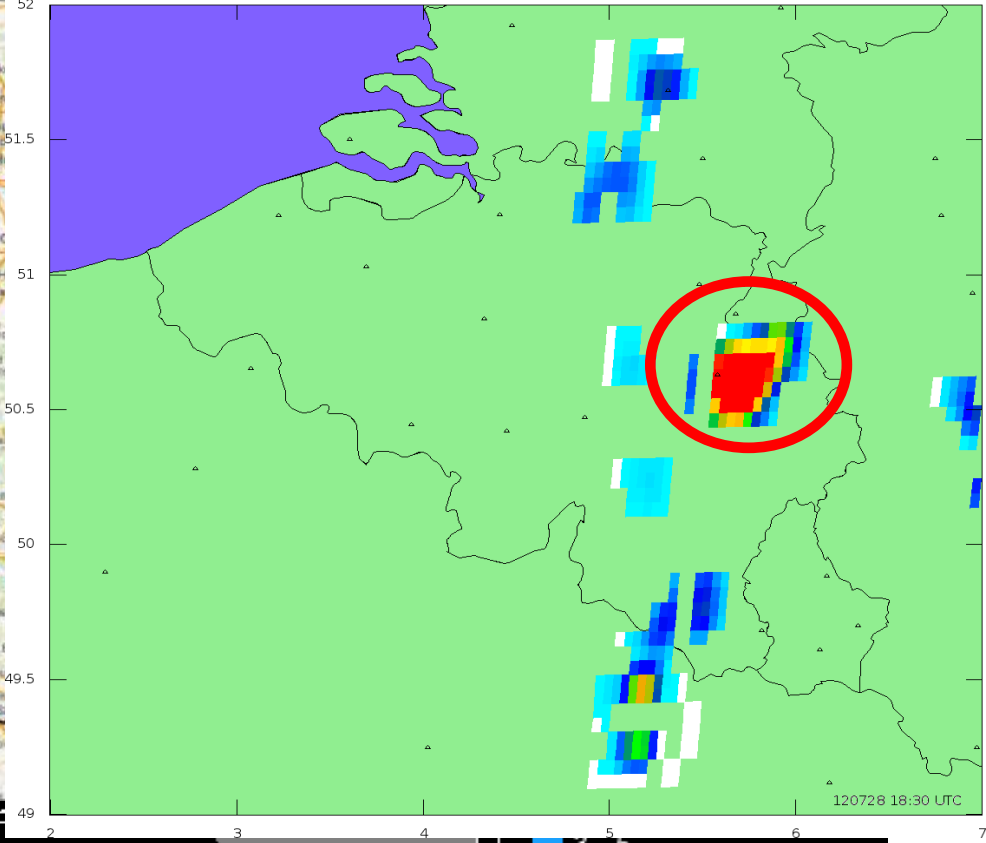
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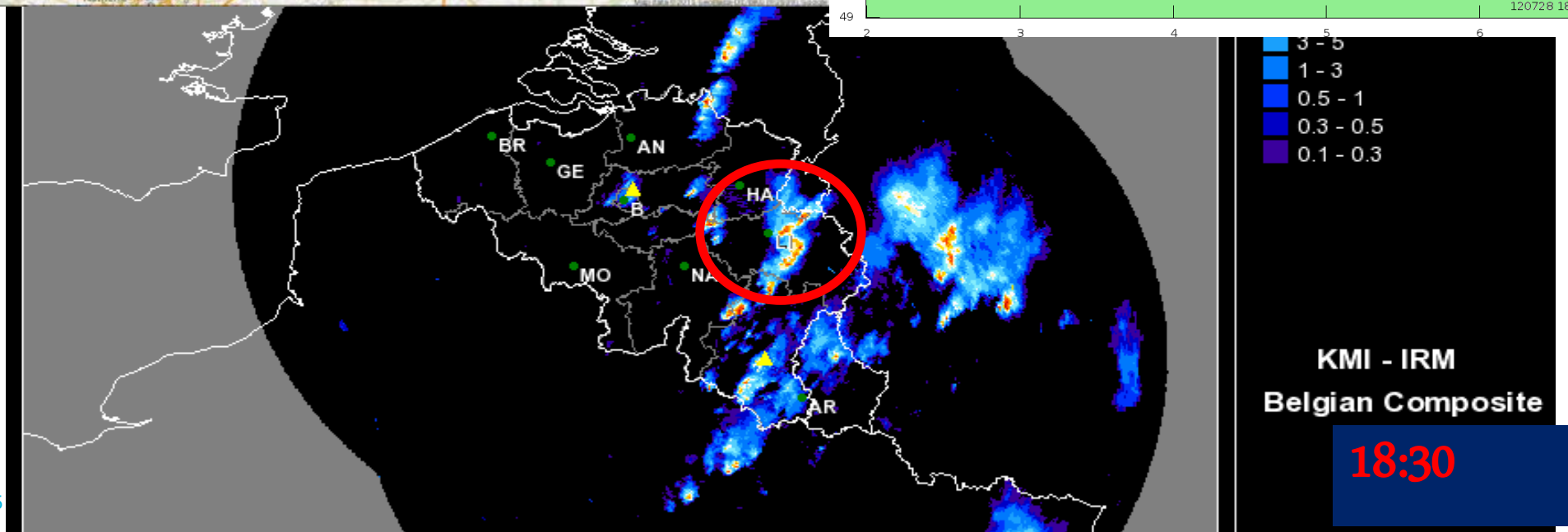
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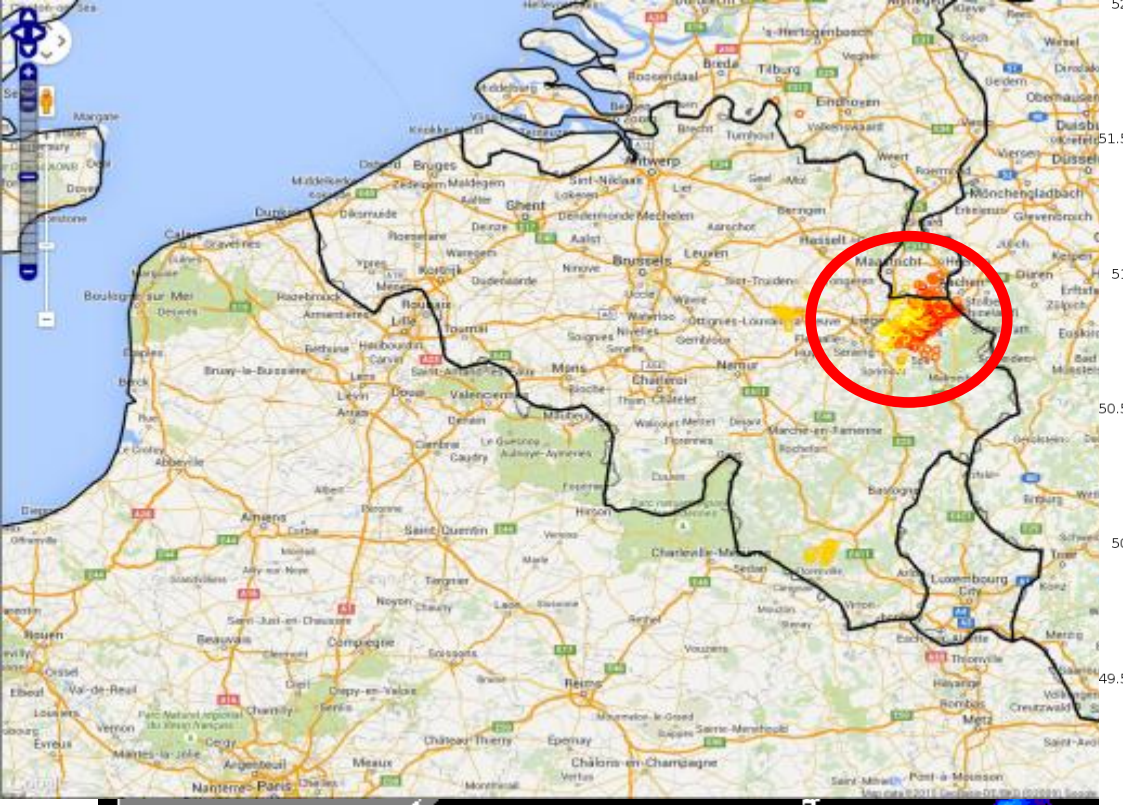
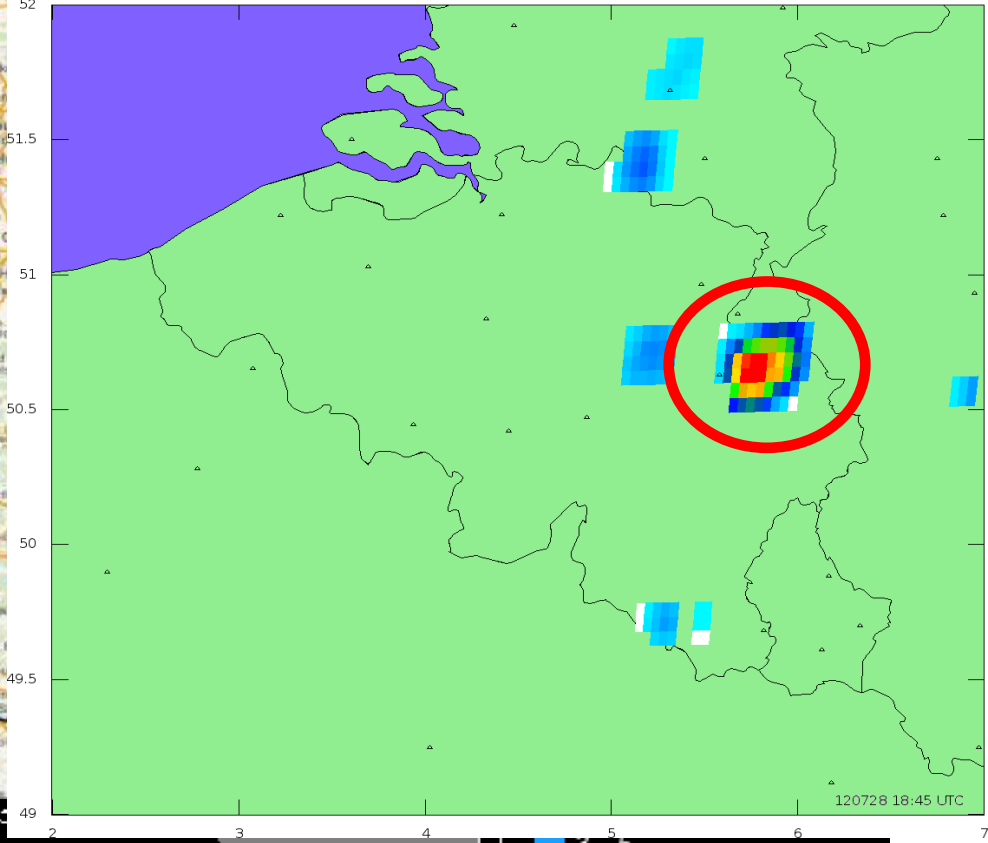
18:30

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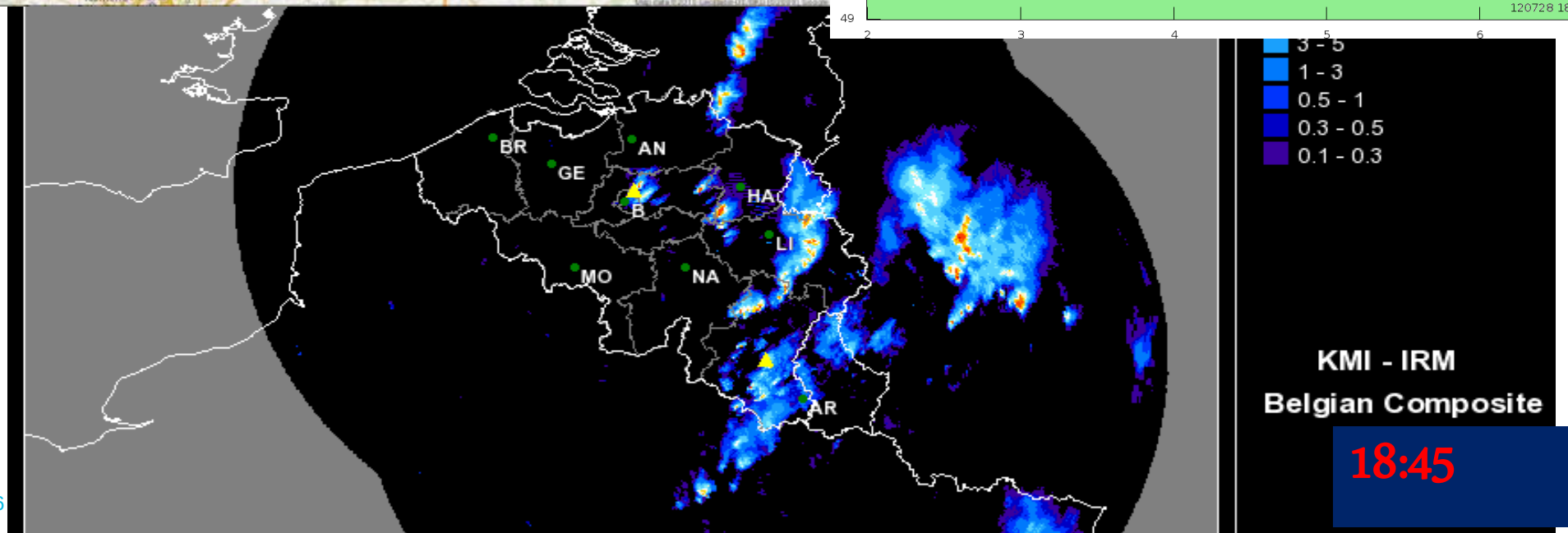
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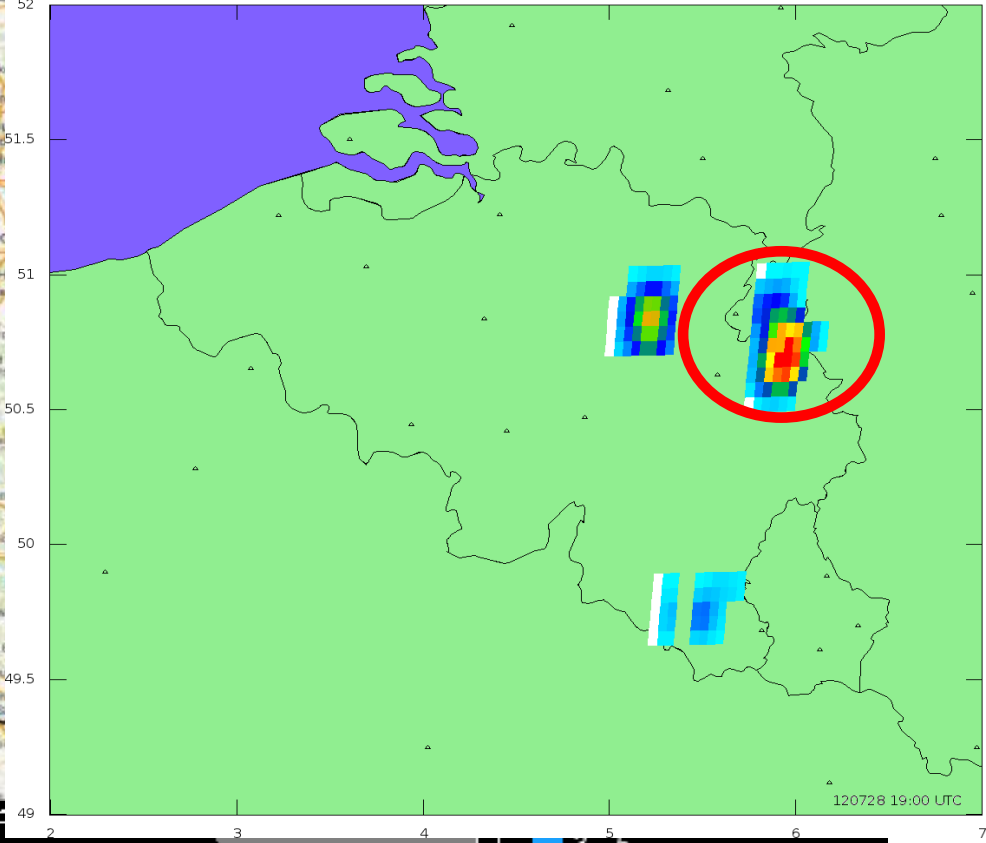
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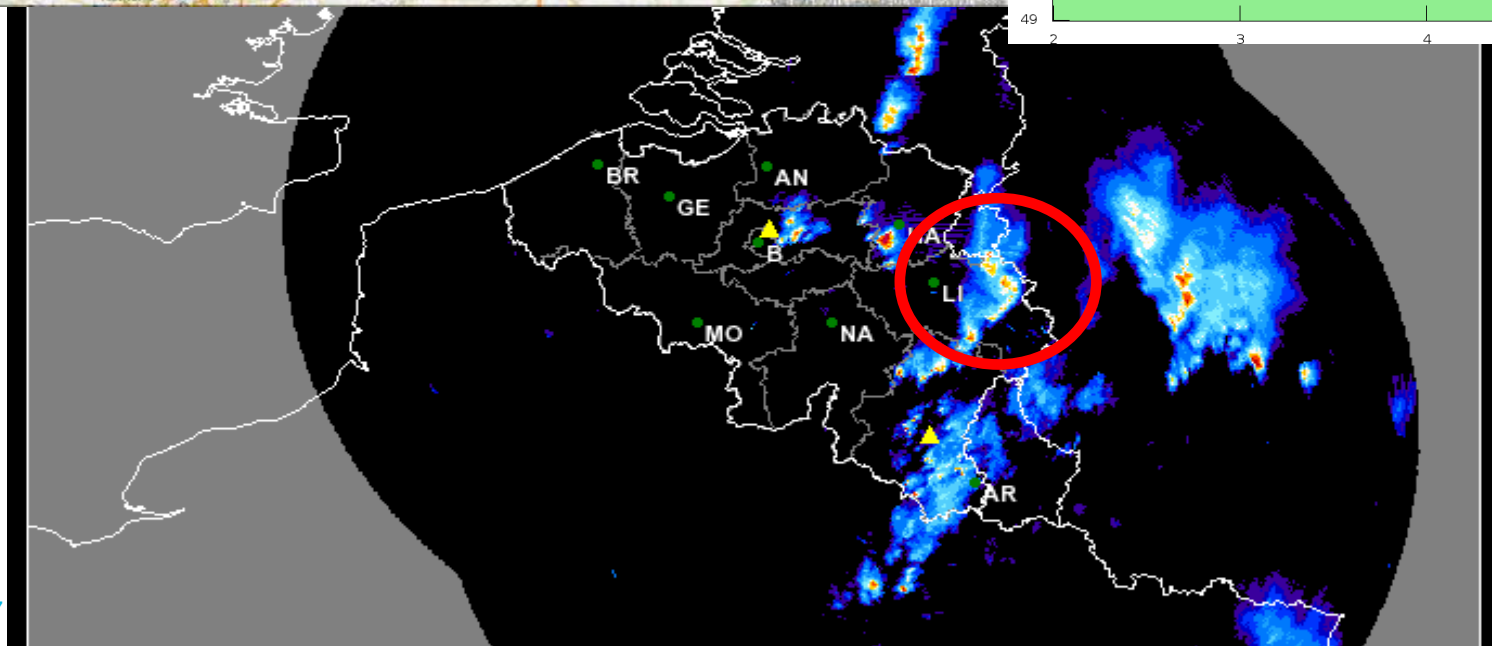
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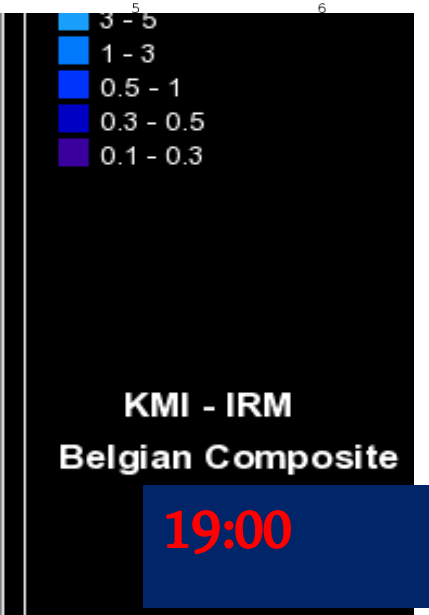
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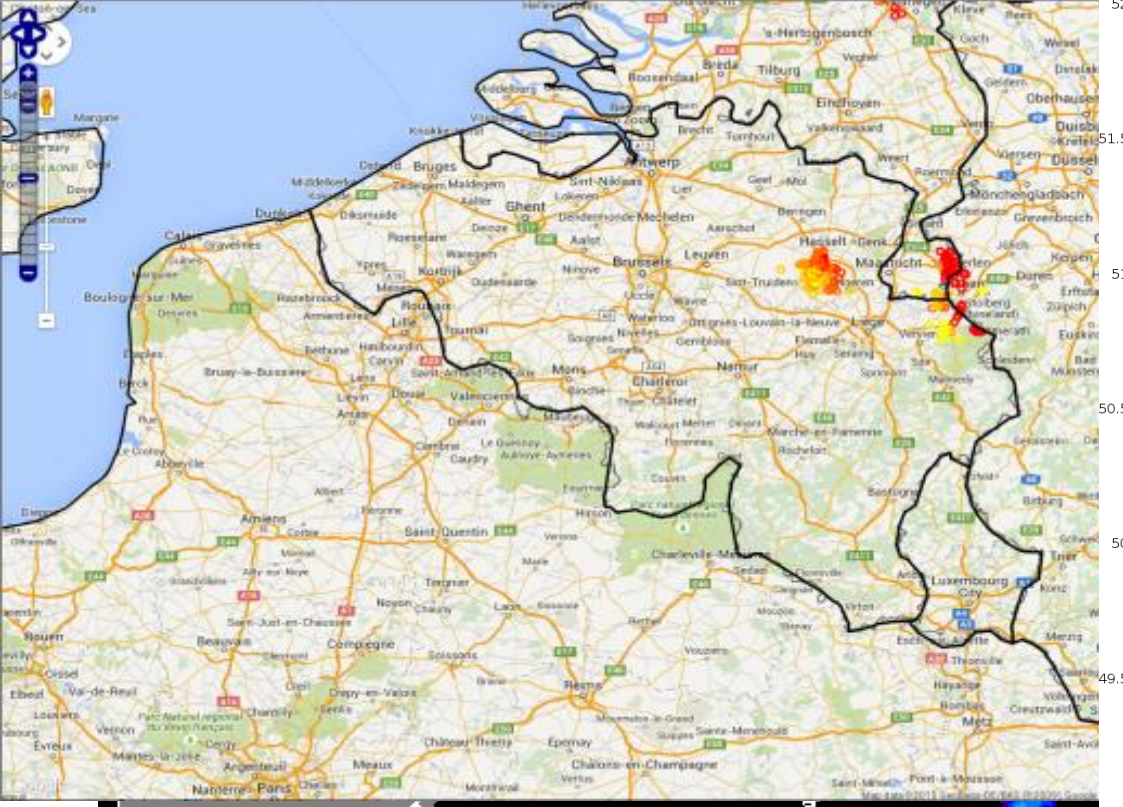

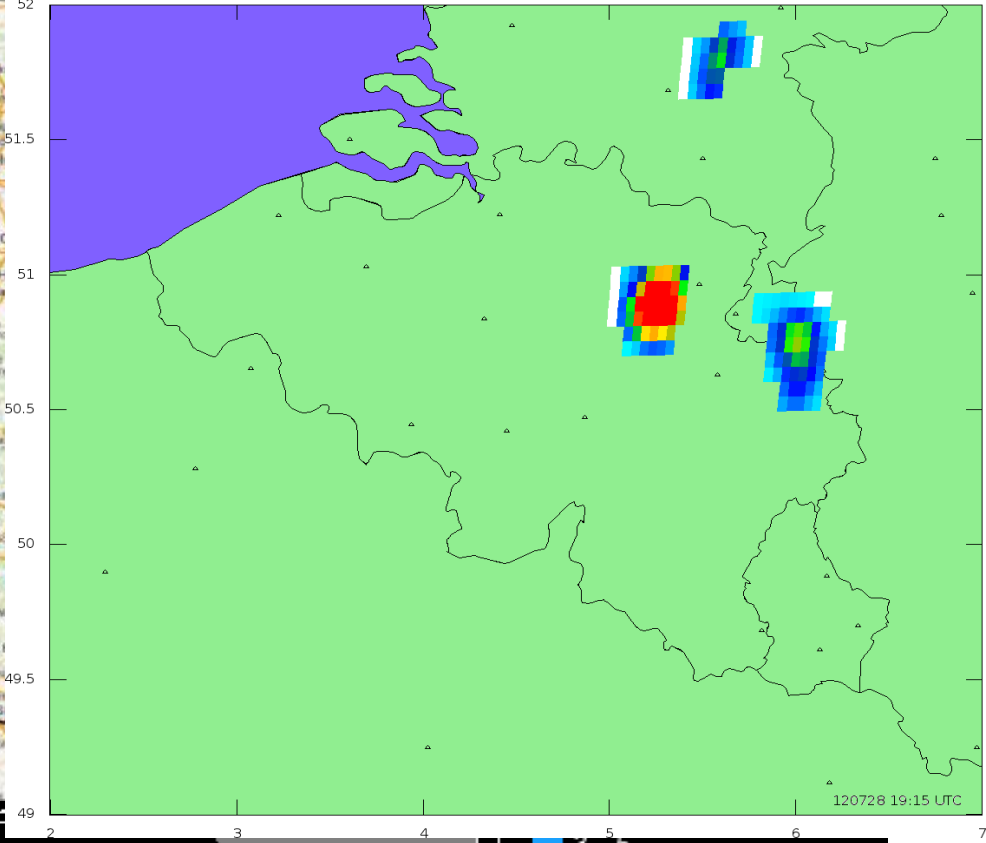
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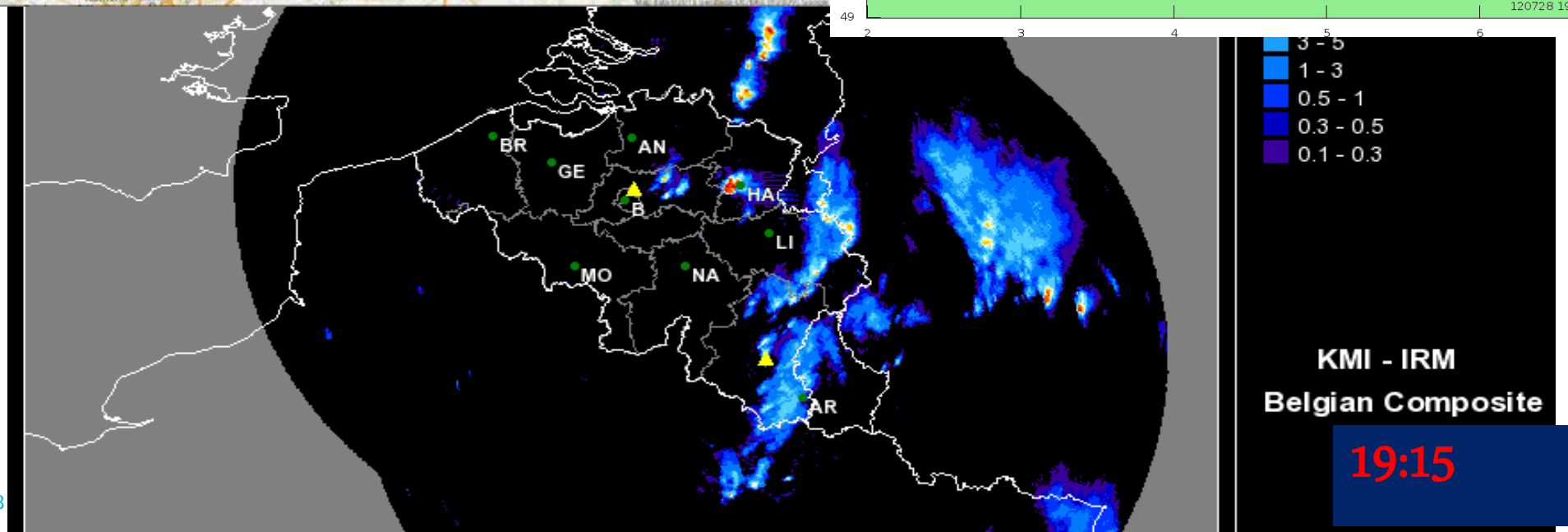
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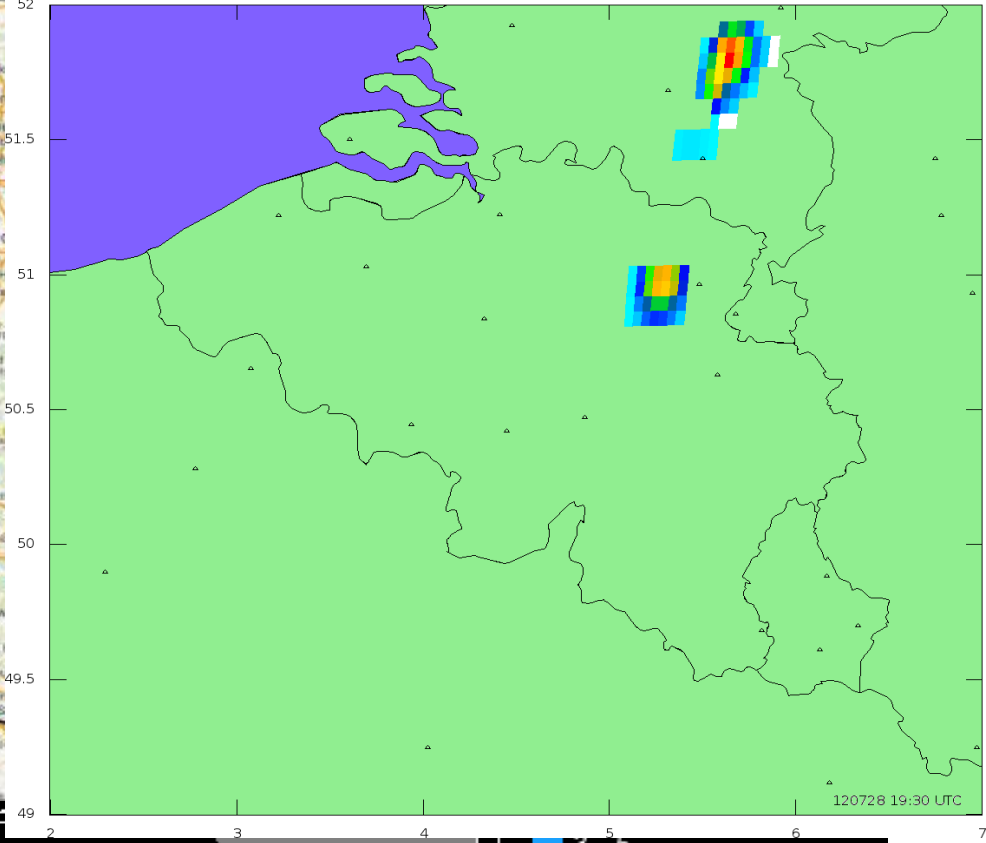
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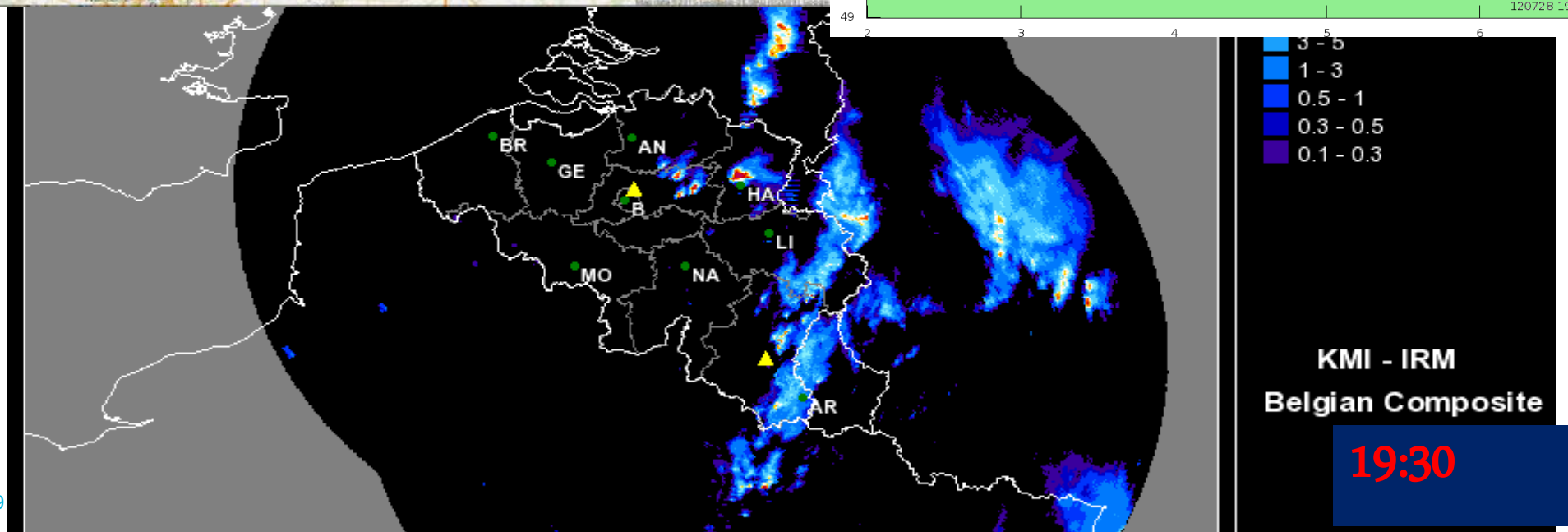
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Belgian Composite
19:30

Summary

- L2 products for LI consist of
  - **Initial processing data (groups and flashes)**
  - **Accumulated product data**
- Proxy data for LI available in 2015
- Prototype data available already now, but not in Level 2 format (still under construction)