Nefodina 2.0: the evolution of the Nefodina model for HSAF

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Outline

- The starting point
- The requirements
- Nefodina 2.0
- Validation with MET
- A case study over Italy
- A case study over South Africa
- The H15 product integration
- Summary
- Future developments

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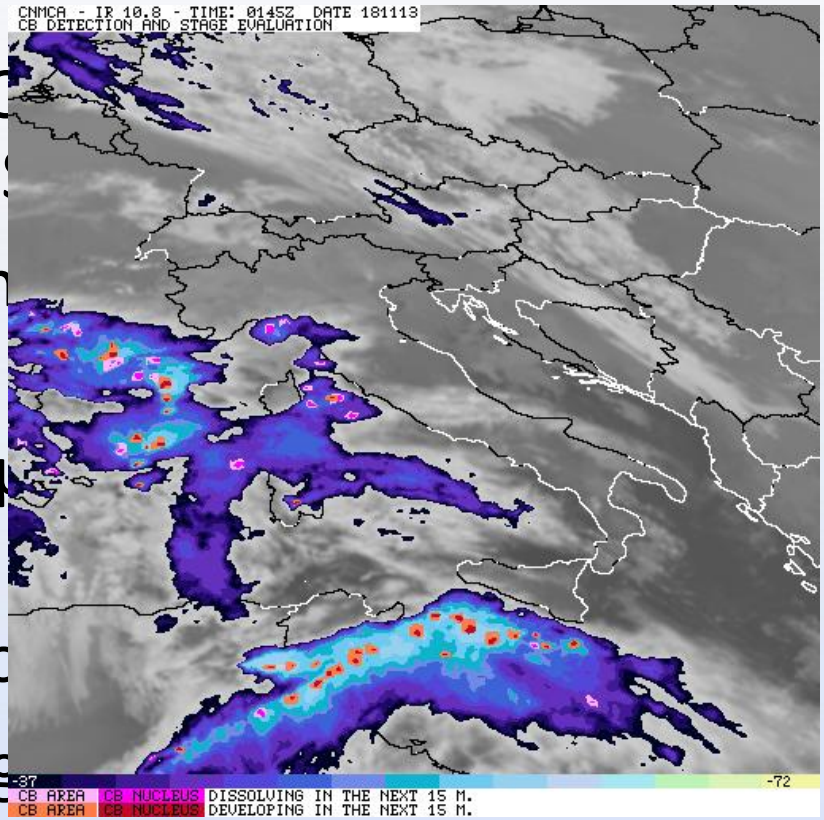
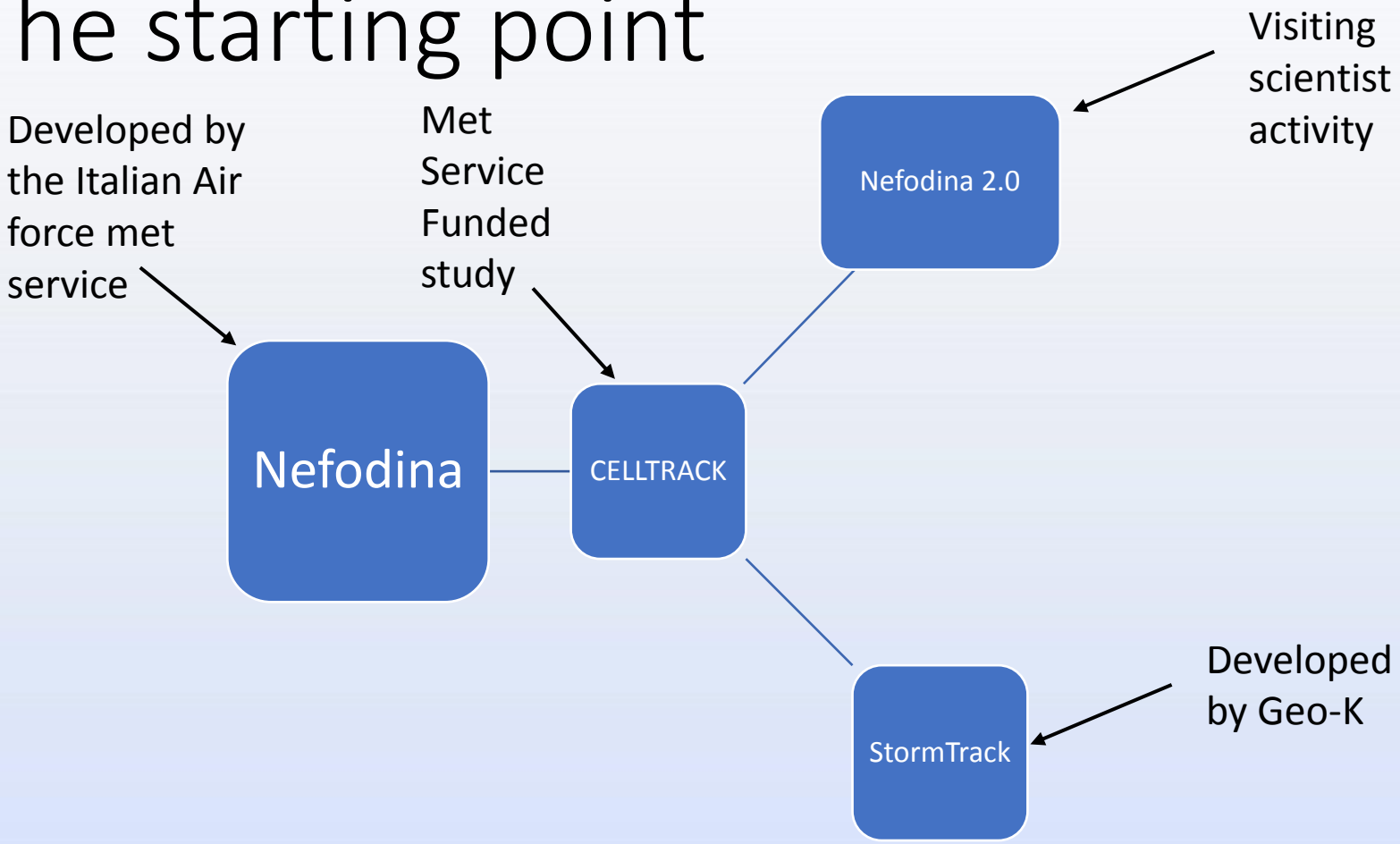
The starting point: Nefodina

- Nefodina (DYNAmic NEFC
  the Italian Air Force Met S
- Thunderstorms detection
  satellite
- Cell detection using 10.8μ
  threshold.
- 6.3μm WV channel to mo
- Output formats: text, png



The starting point



The requirements

- MSG as primary data source
- (Early) Detection of the convective objects
- Tracking of the detected objects
- Cells lifecycle monitoring
- Temporal and spatial extrapolation of the detected objects
- Severity assignment
- High computation efficiency and reliability (FD computation time below 15 mins)
- Easy to use

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Nefodina 2.0

- Multichannel detector ($BTD_{5,9}$ + K-means)
- Objects Oriented approach
- Real time processing over the MSG full disk
- Novel and flexible architecture
- Standard output formats (HDF5, KML, PNG)

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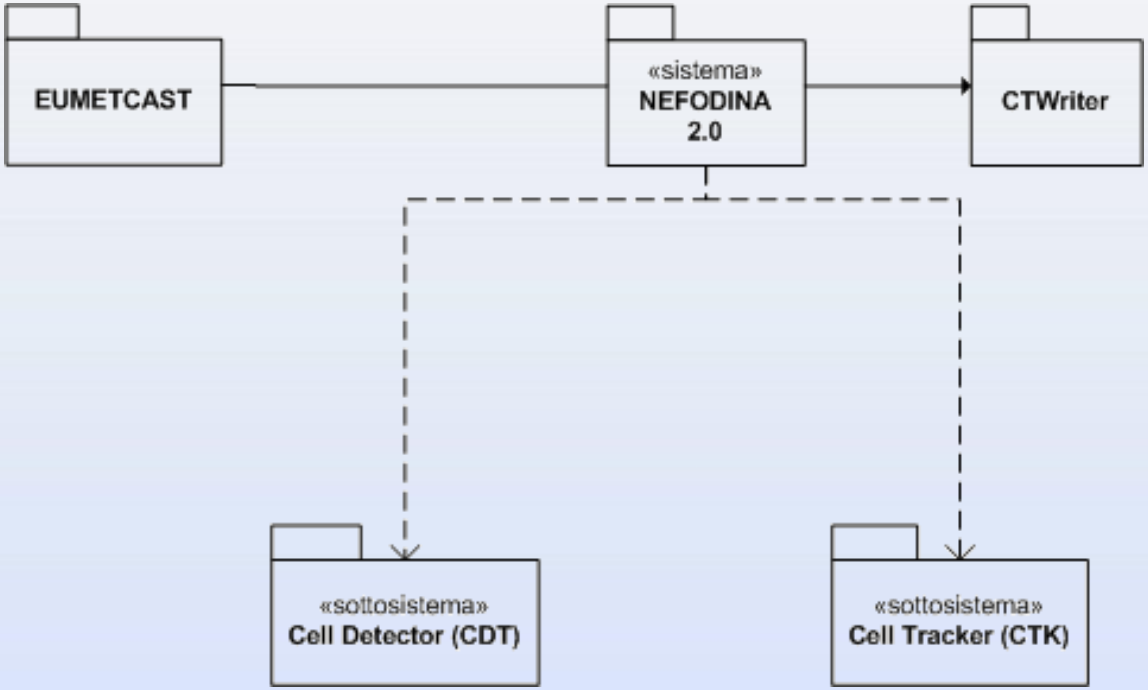
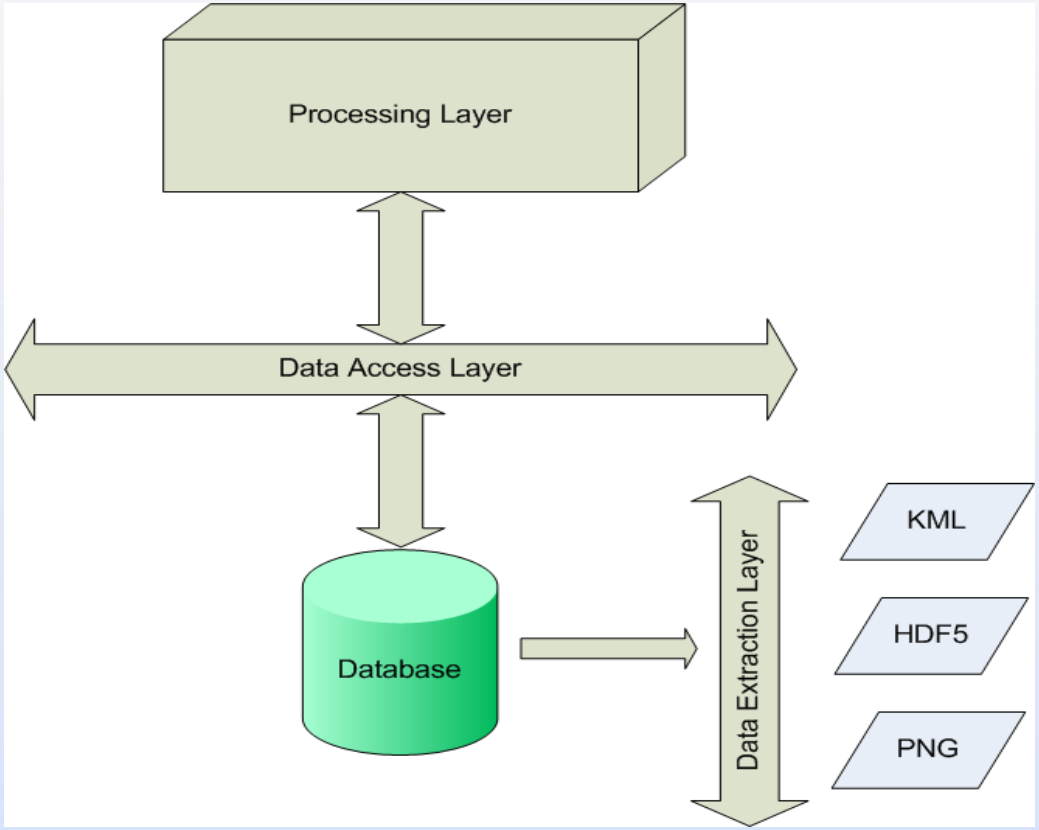
Nefodina 2.0

- Cell Detector (CDT)
- Cell Tracker (CTK)
- Cell Writer (CWT)



Nefodina 2.0


Processing Layer
Data Access Layer
Database
Data Extraction Layer
KML
HDF5
PNG

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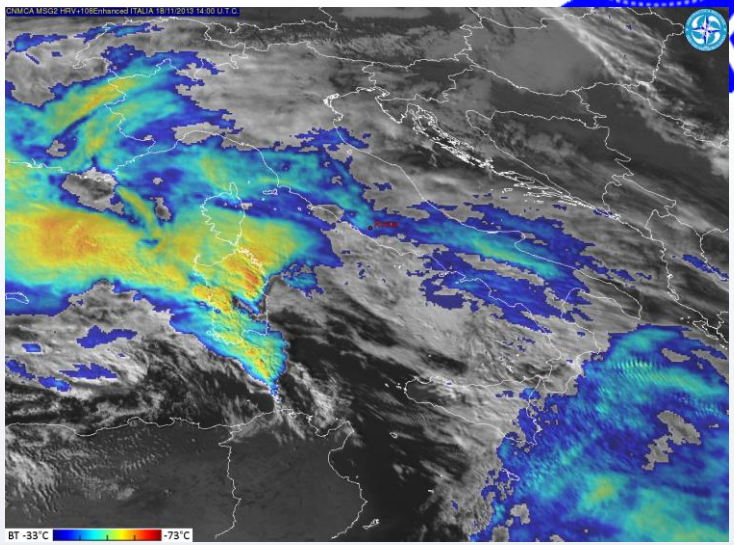
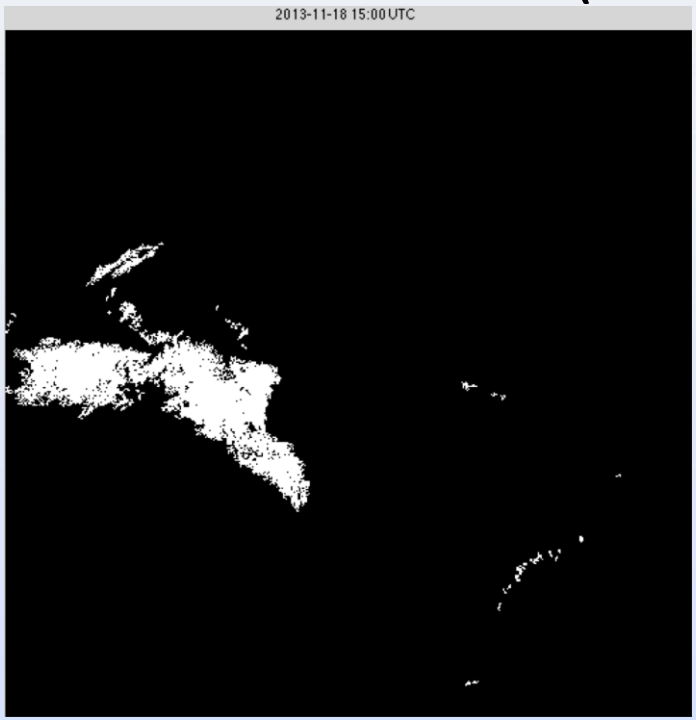
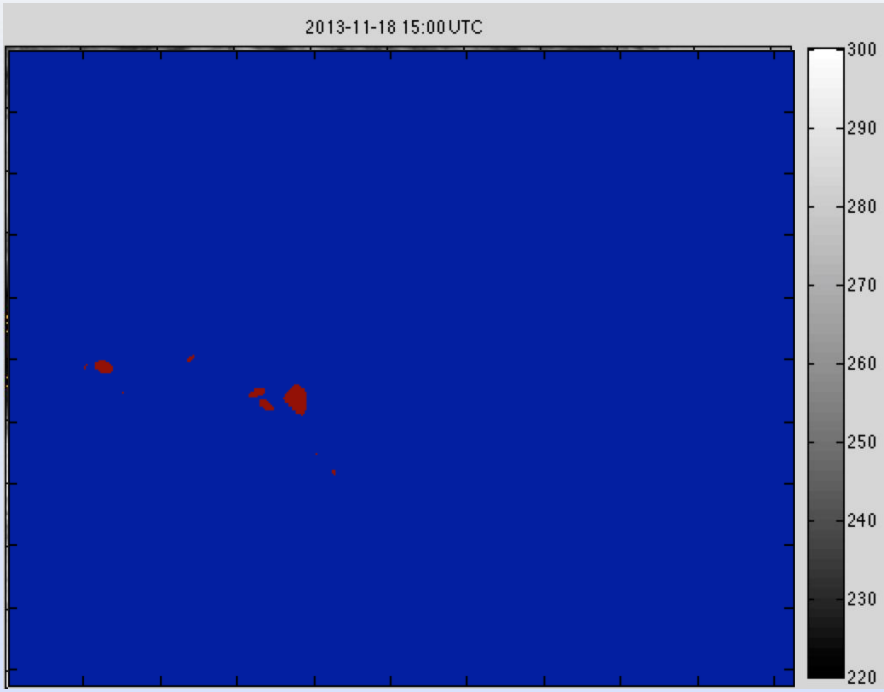
Nefodina 2.0

- Cell detection: $BTD_{5,9}$
- Nuclei identification (K-means)

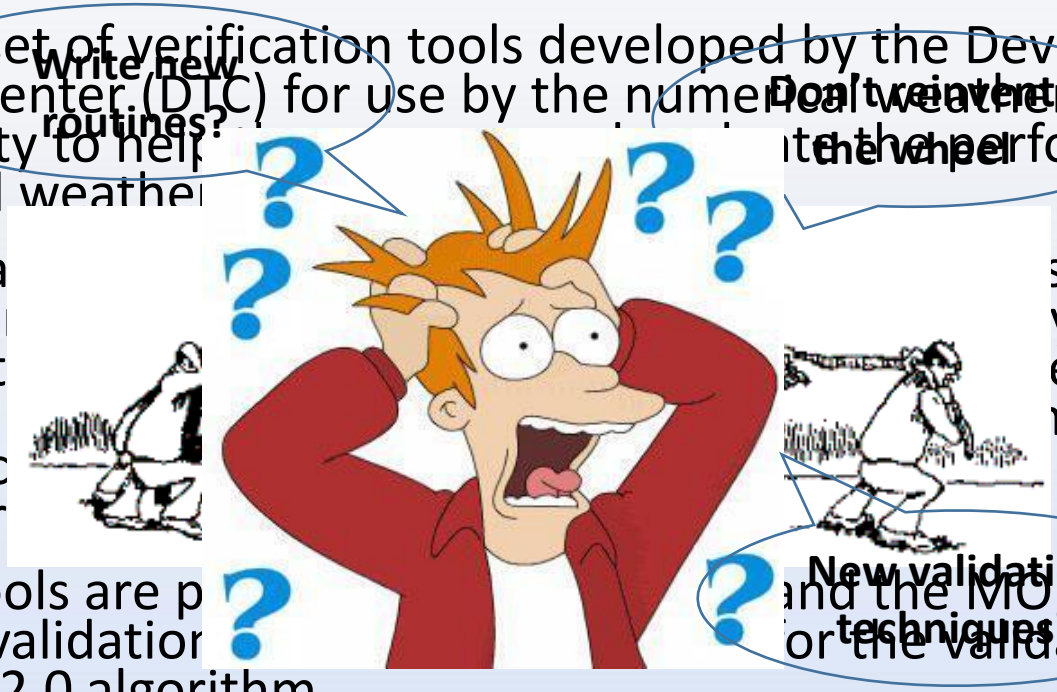






Validation with MET

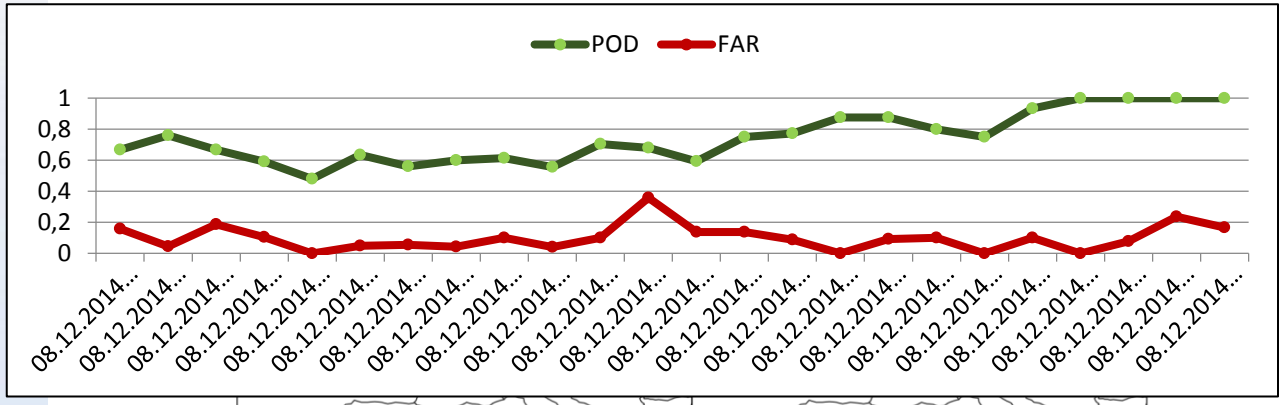
- MET is a set of verification tools developed by the Developmental Testbed Center (DTC) for use by the numerical weather prediction community to help [illegible] the performance of numerical weathe[illegible]
- The prima[illegible] state-of-the-art ve[illegible]y "state-of-the-art" it[illegible]eloped and advanced [illegible]ethods for diagnostic[illegible] provided by the ver[illegible]
- Several tools are p[illegible]and the MODE (object oriented validatior[illegible]or the validation of the Nefodina 2.0 algorithm.

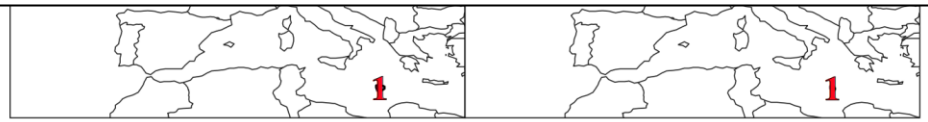


Validation with MET

Forecast Observation

Cluster Object Information





CLUS PAIR	CEN DIST	ANG DIFF	FCST AREA	OBS AREA	INTER AREA	UNION AREA	SYMM DIFF	FCST INT 50	OBS INT 50	FCST INT 90	OBS INT 90	TOT INTR
1	6.18	51.89	241	129	93	277	184	1.00	0.00	1.00	1.00	0.9647
2	3.77	2.06	497	774	339	932	593	1.00	0.00	1.00	0.00	0.9858

Validation with MET

Forecast	Observation		Total
	O=1 (e.g. "Yes")	O=0 (e.g. "No")	
f = 1 (e.g., "Yes")	n_{11}	n_{10}	$n1. = n_{11} + n_{10}$
f = 0 (e.g., "No")	n_{01}	n_{10}	$n0.= n_{01} + n_{00}$
Total	$n_{.1} = n_{11} + n_{01}$	$n_{.0} = n_{10} + n_{00}$	$T = n_{11} + n_{10} + n_{01} + n_{00}$

- Probability of detection (POD)

$$POD = \frac{n_{11}}{n_{11}+n_{01}} = \frac{n_{11}}{n_{.1}}$$

- False alarm ratio (FAR)

$$FAR = \frac{n_{10}}{n_{11}+n_{10}} = \frac{n_{10}}{n_{1.}}$$

A case study over Italy

- ATDNet lightning data (sampled every 5 mins)
- Strikes 5 mins before, 10 mins after MSG slot time
- RDT as benchmark
- Nefodina 2.0 setup: *MSG HRIT*
- RDT setup: *MSG HRIT, NWP data*

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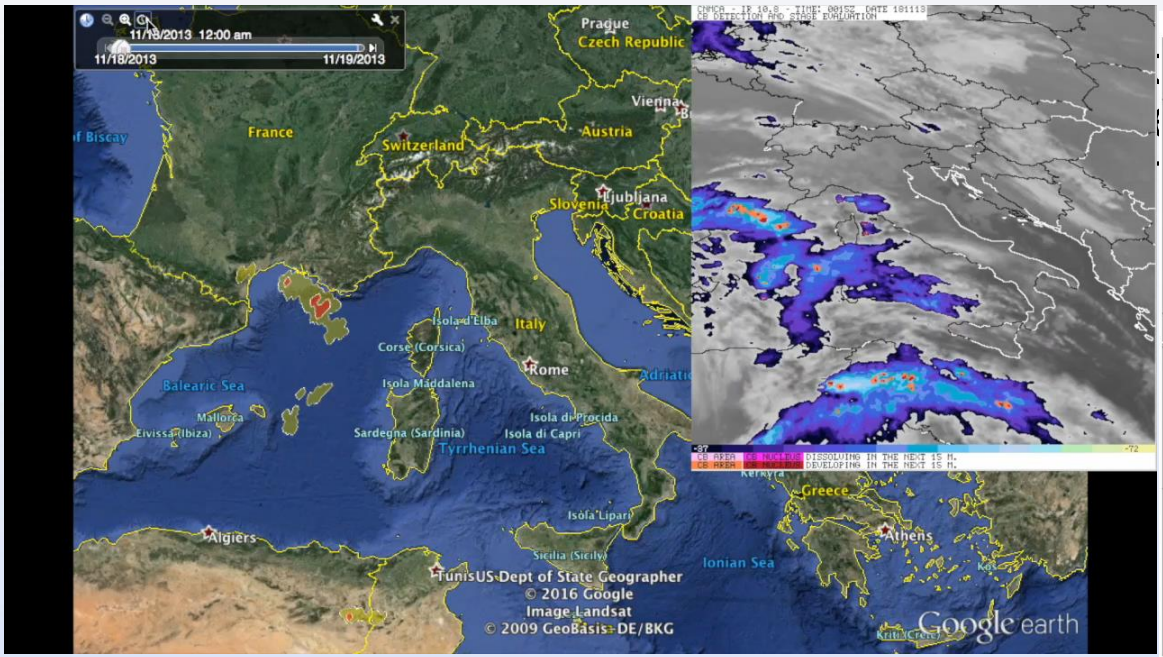
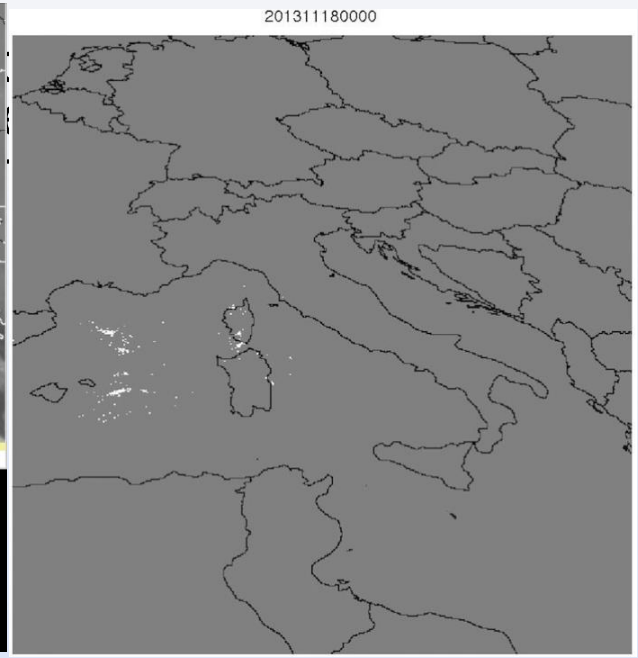
A case study over Italy: 2013-11-18 storm over Sardinia





Lightning

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A case study over Italy: 2013-11-18 storm over Sardinia

Validation area

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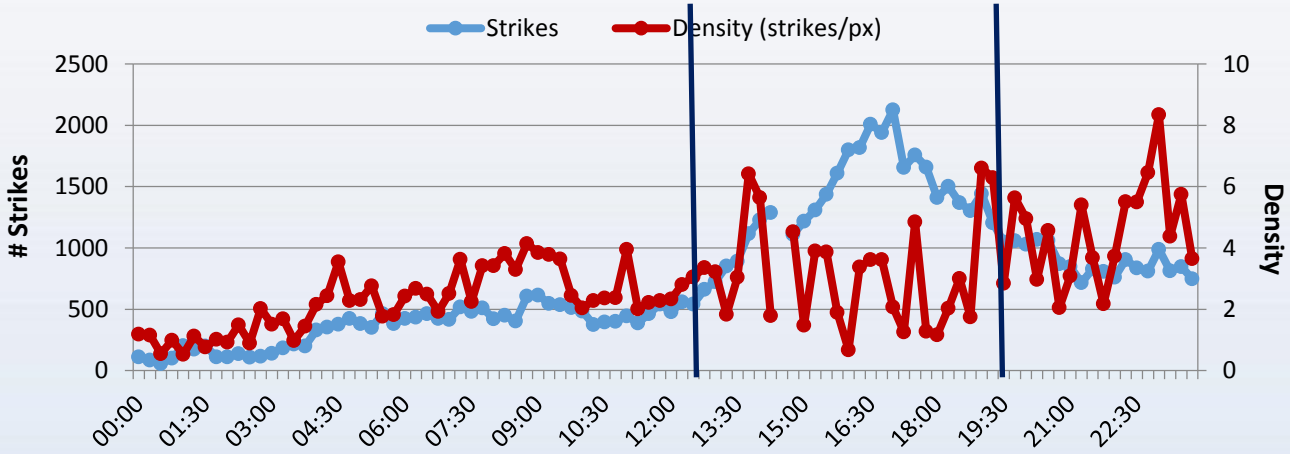
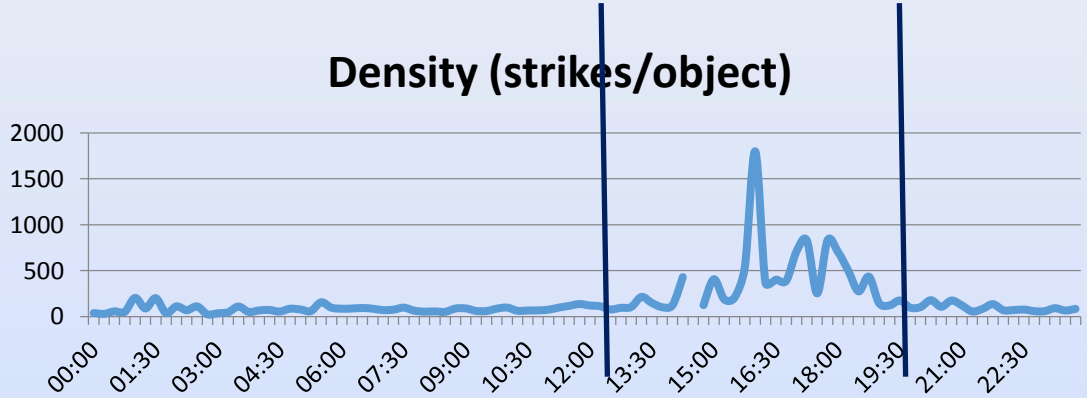
A case study over Italy: 2013-11-18 storm over Sardinia





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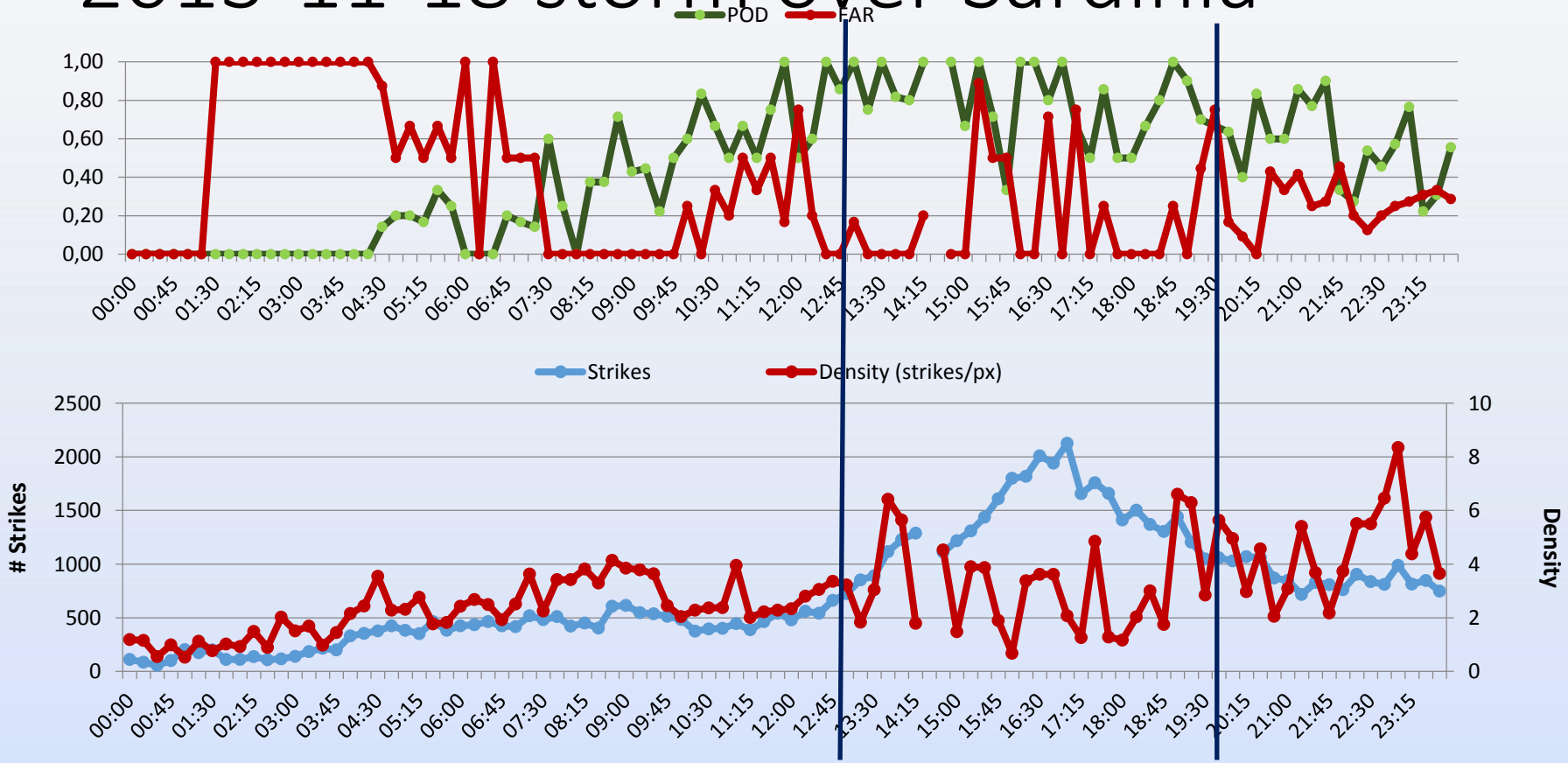
A case study over Italy: 2013-11-18 storm over Sardinia



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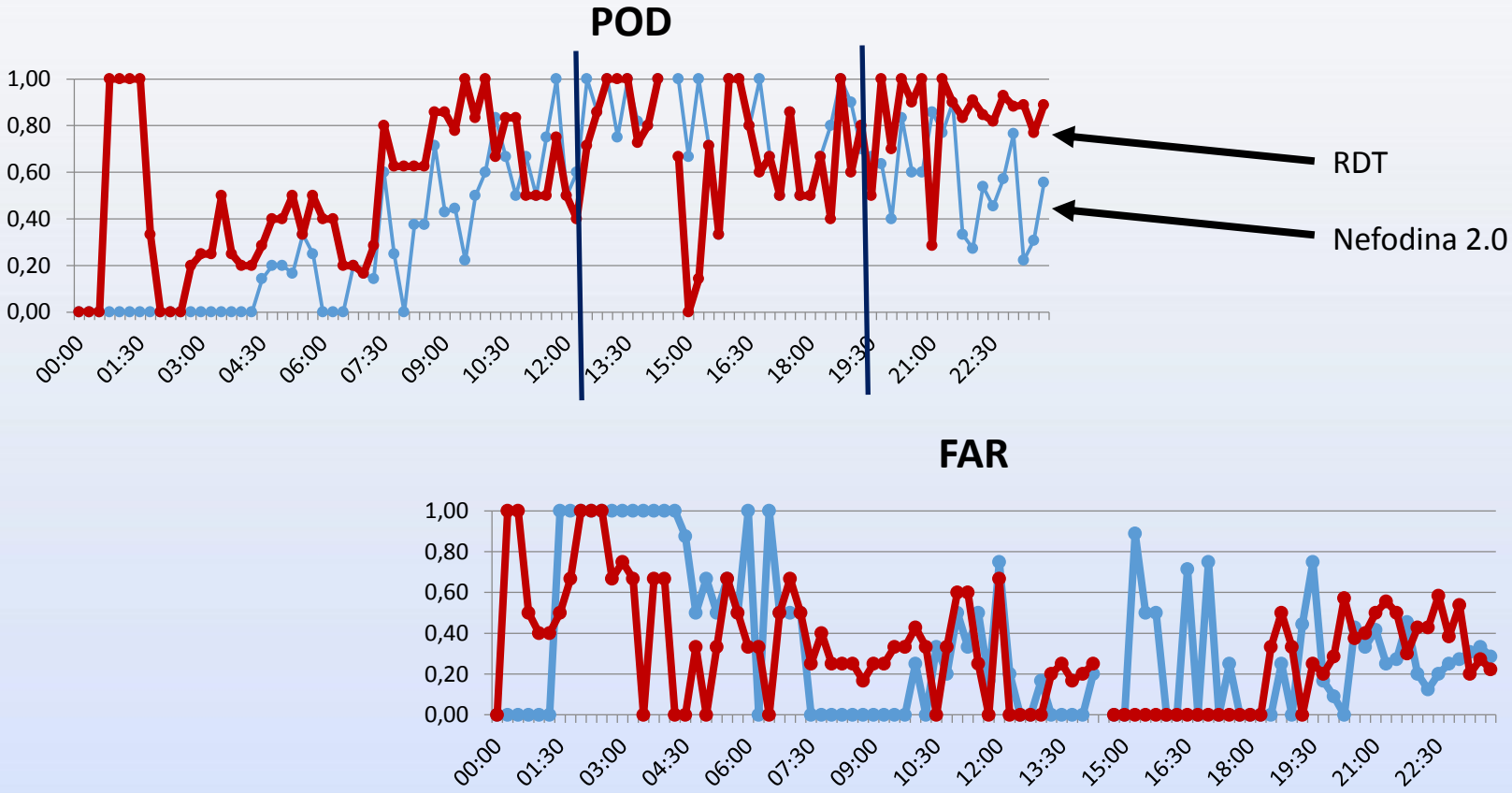

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A case study over South Africa

- SAWS lightning data
- Strikes 5 mins before, 5 mins after MSG slot time
- RDT as benchmark
- Nefodina 2.0 setup: *MSG HRIT*
- RDT setup: *MSG HRIT, NWP data, Lightning data*

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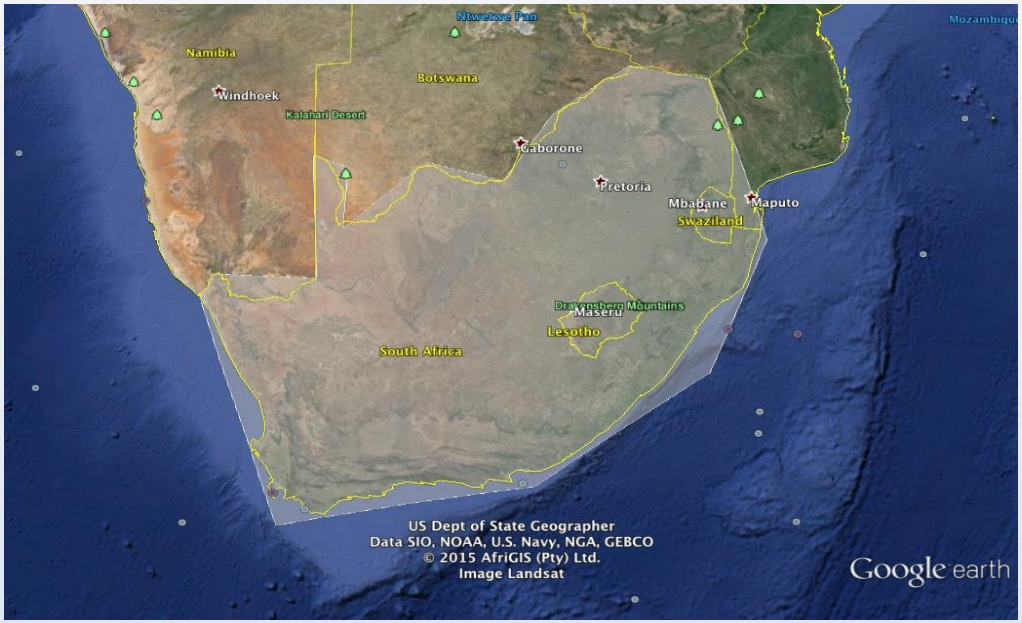
A case study over South Africa: 2014-12-08 12:00-18:00 UTC



Validation area

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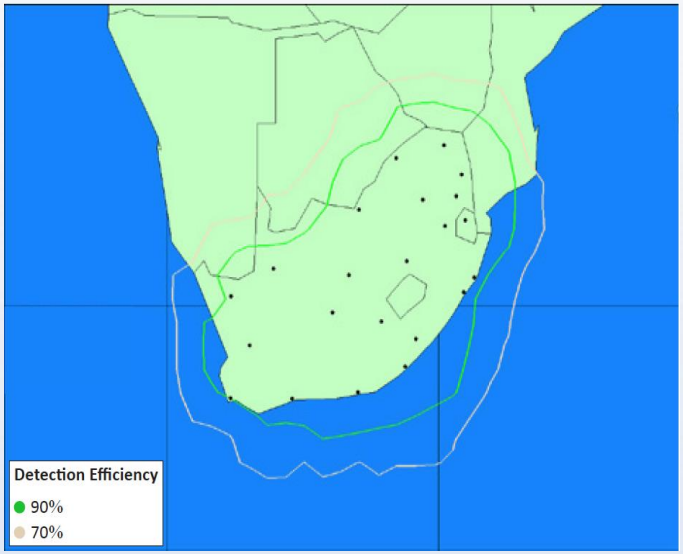
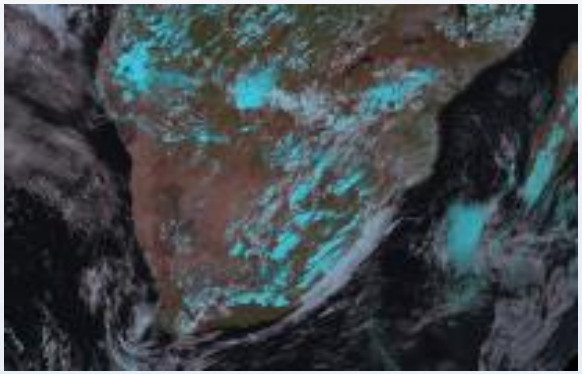
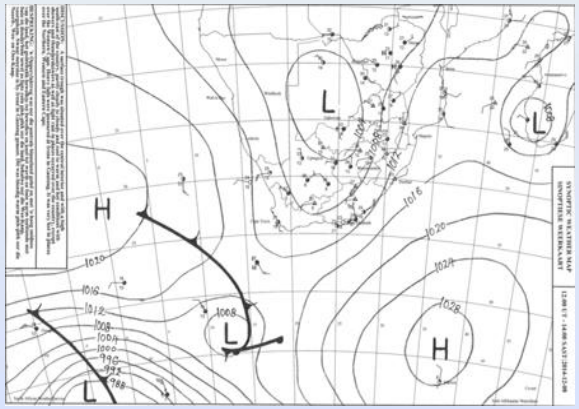
A case study over South Africa: 2014-12-08 12:00-18:00 UTC



SA Lightning network





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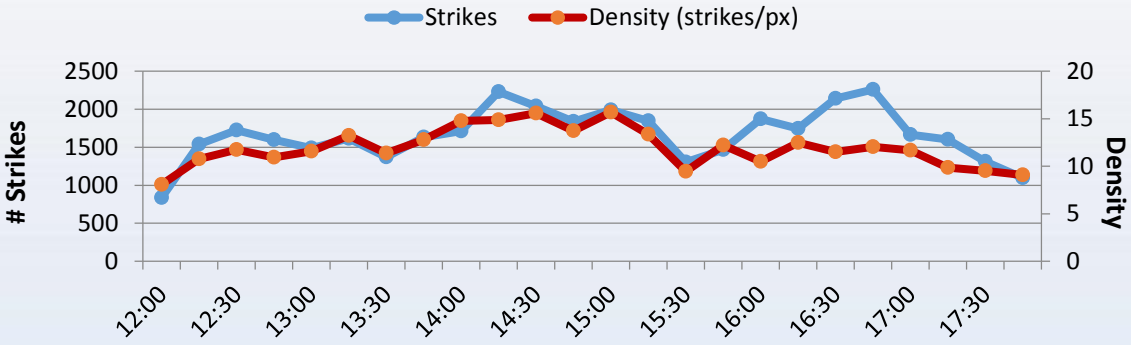

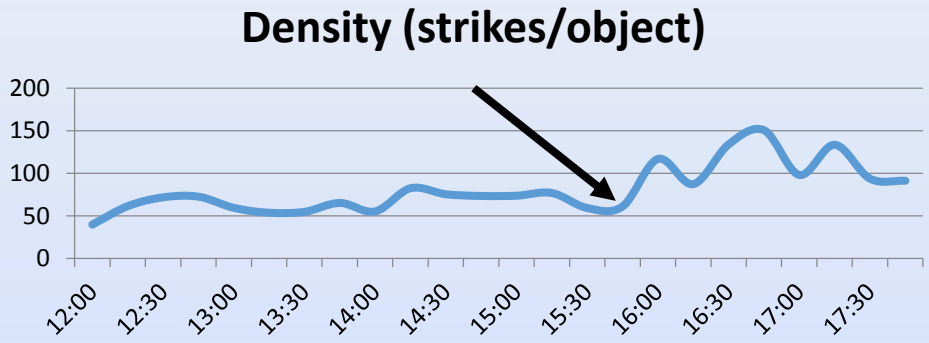

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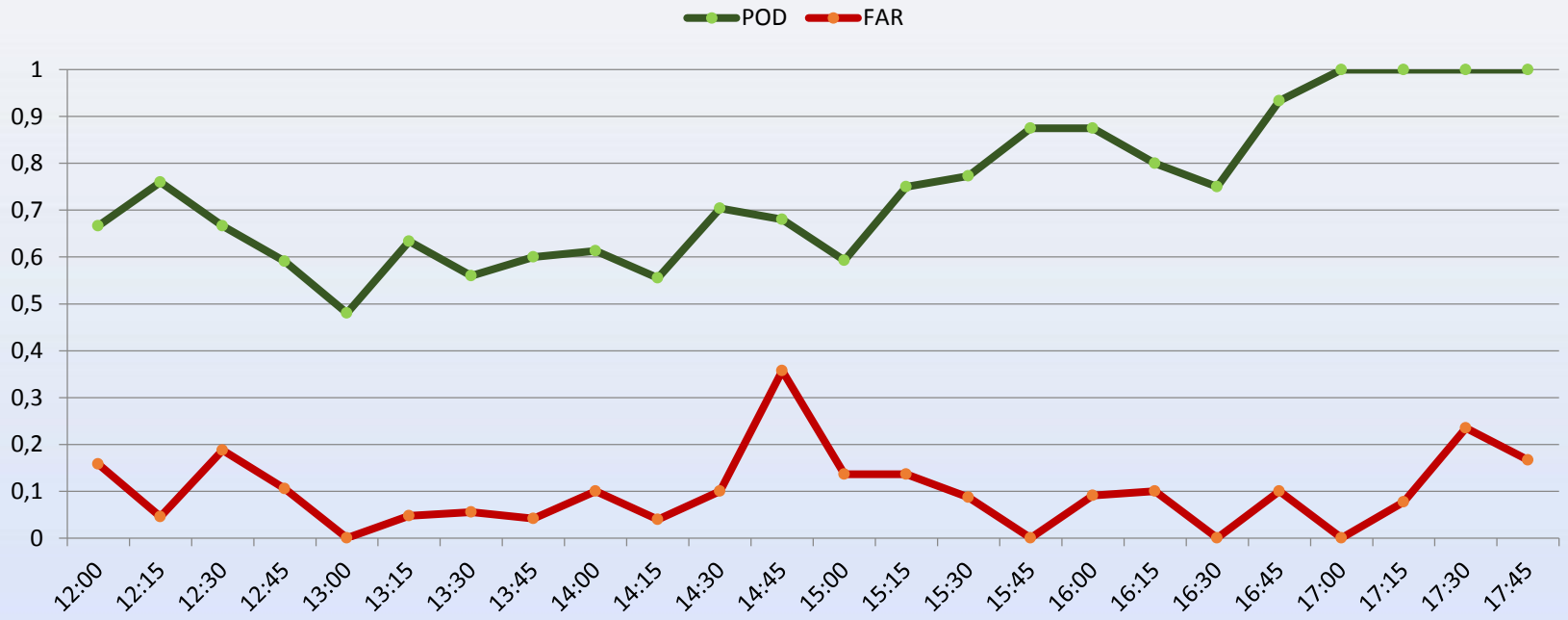
A case study over South Africa: 2014-12-08 12:00-18:00 UTC



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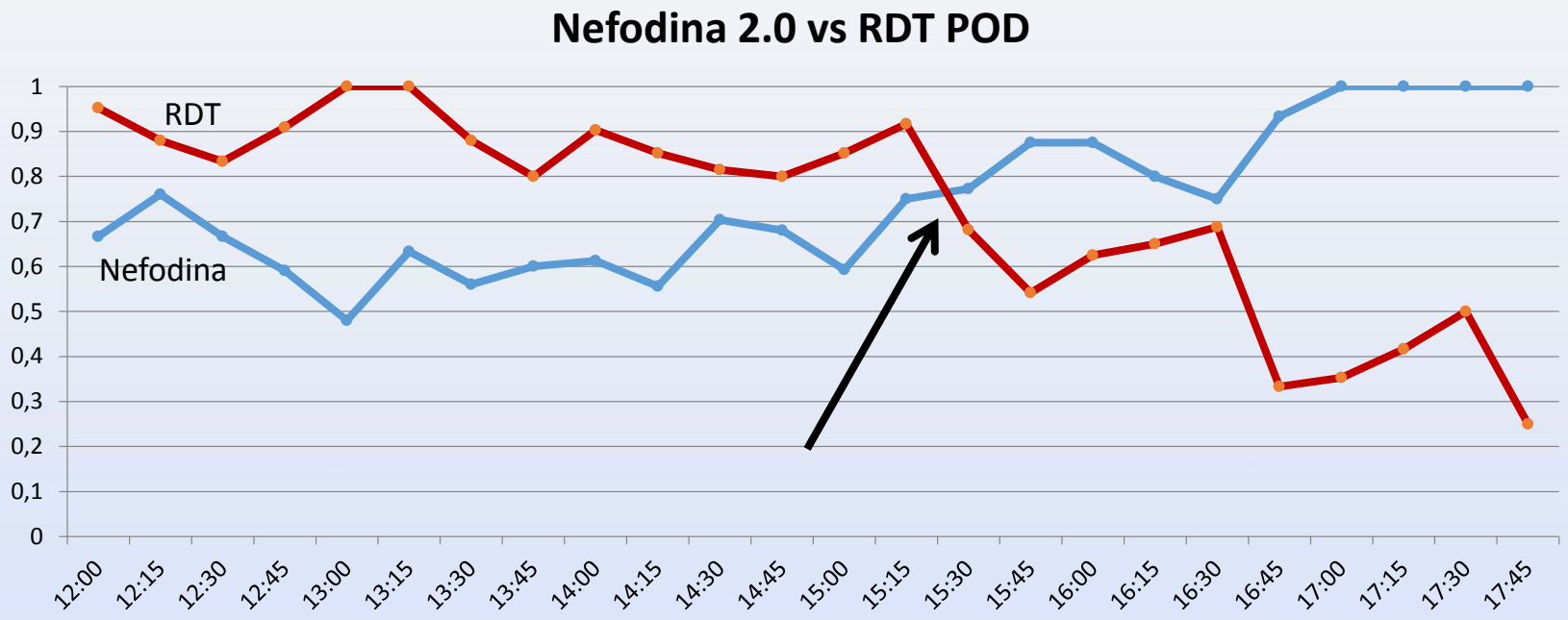
A case study over South Africa: 2014-12-08 12:00-18:00 UTC



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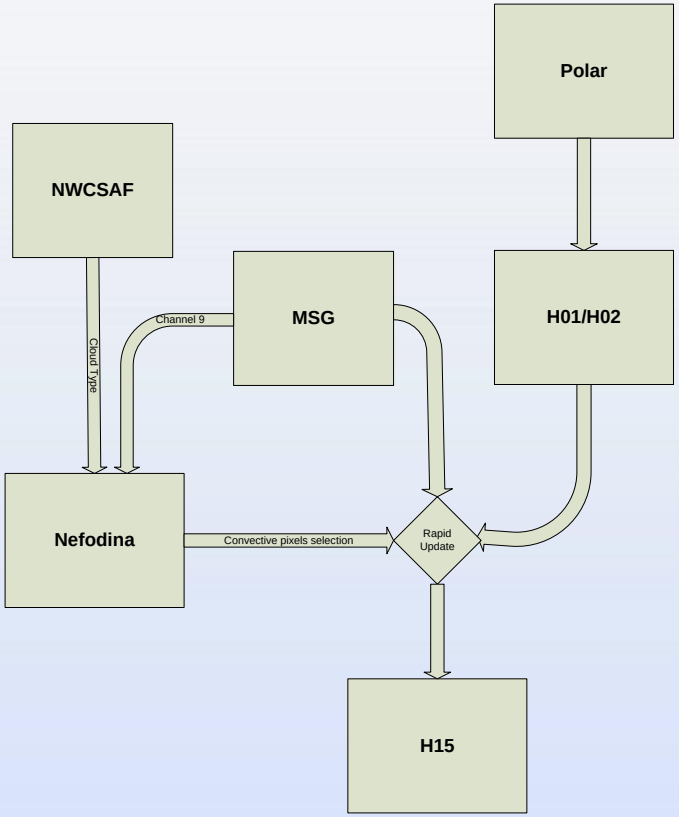
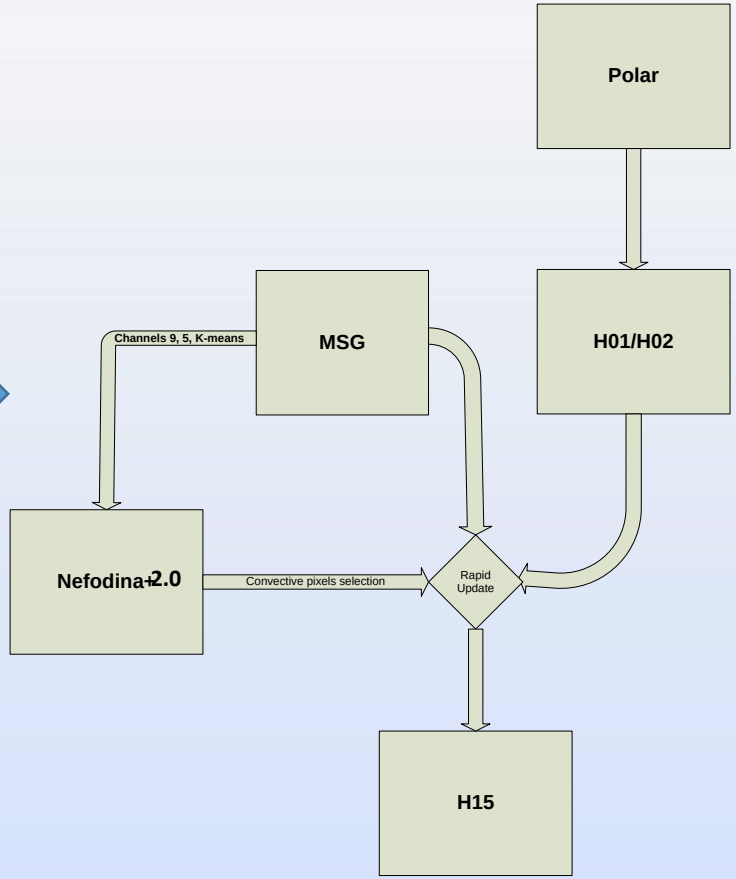
The H15 product integration

Old version



New version



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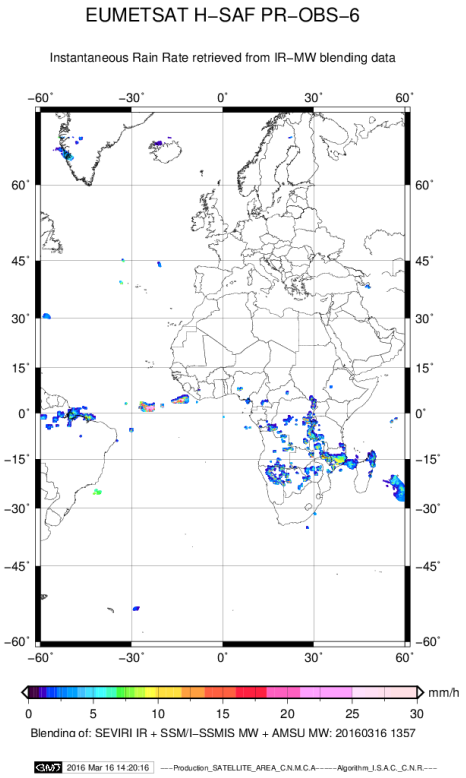
The H15 product integration



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Summary

- Nefodina 2.0: a novel algorithm for the monitoring of the thunderstorms
- Use MSG as unique data source
- Multispectral approach
- Multi formats output (easier for the integration with other products)
- Fast runs over full disk (about 5 minutes on Quad-core VM)
- Validation with MET (MODE tool) using lightning as ground truth and RDT as benchmark
- Good scores under high lightning activity (heavy convection)
- Highly configurable

Future developments

- RSS integration to make a better estimation of the “acceleration” of the thunderstorm development
- 15-30 minutes nowcasting from the StormTrack model as new module
- Assimilation of NWP data and lightning to have a better detection and reduce false alarms
- Parallax correction

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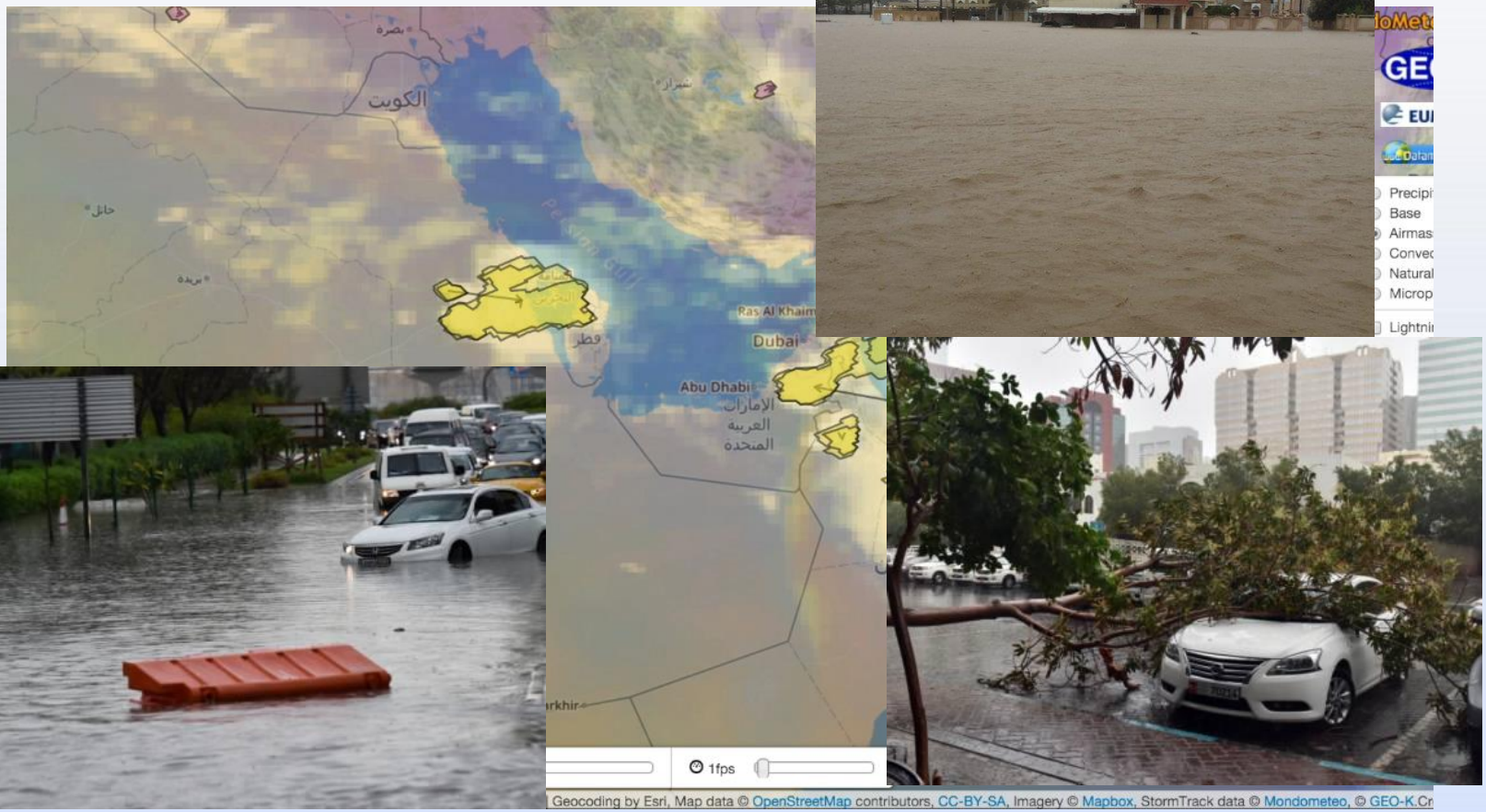
9th of March 2016: S[illegible] Dubai



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Acknowledgements

- **Italian Air force Meteorological Service** for the support
- **Estelle de Coning** (SAWS) and SAWS for the RDT and the lightning data over South Africa
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Thanks for your attention

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Questions?