

***SCREEN CAPTURE***  
***WELCOME***



arpav

# Possible contribution of passive radiometers to the analysis of the evolution of fog episodes

*Massimo Enrico Ferrario and Sansone Maria*



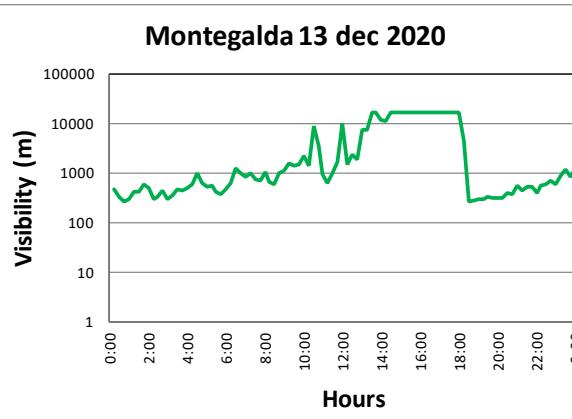


- passive radiometer for **thermal profile**
- technology available from **1986** (35 years)
- has undergone many improvements over the years by increasing the measurement top level from **600 m** to the current **2000 m**
- ARPAV model is MTP5 HE thermal profile **till 1000 m**
- easy to use, not binding, stand alone
- more than **120** pieces sold in **27 country** (from 1992)
- groups: *MWRnet*, *Research Gate*, *MTP5 Community*
- last news: take part **E-probe** project

## what is it for ?

- study **stability of ABL**
- study **dispersive capacities of atmosphere** - air quality
- study and evolution of **thermal inversions**, thanks to availability **data every 5 min**

# Visibilimeter



- Measures atmospheric visibility (meteo optical range) by determining the amount of **light scattered by particles** (smoke, dust, haze, fog, rain, & snow)
- In ARPAV 10 site with Visibility Sensors model 56-VISI-1 are used
- light source is an 880 nm LED
- visibility range is 30 m - 16 km
- scatter angle is 42°
- **pro: stand alone**, easy to install and use
- **cons:** ageing produce a drift (calibration required), sometime problems with sunset and dawn light

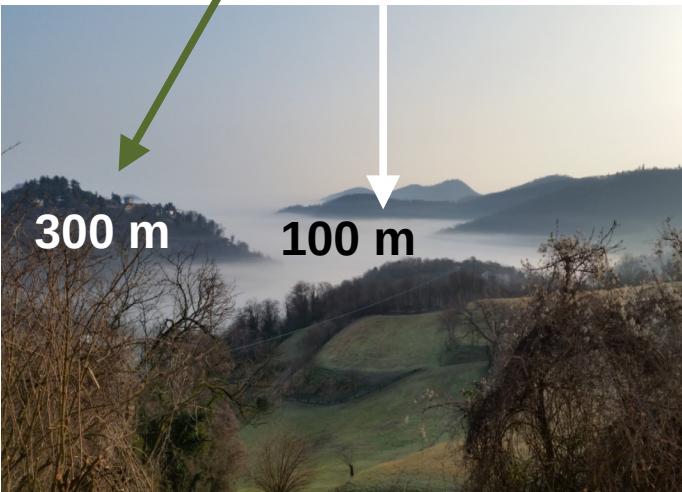
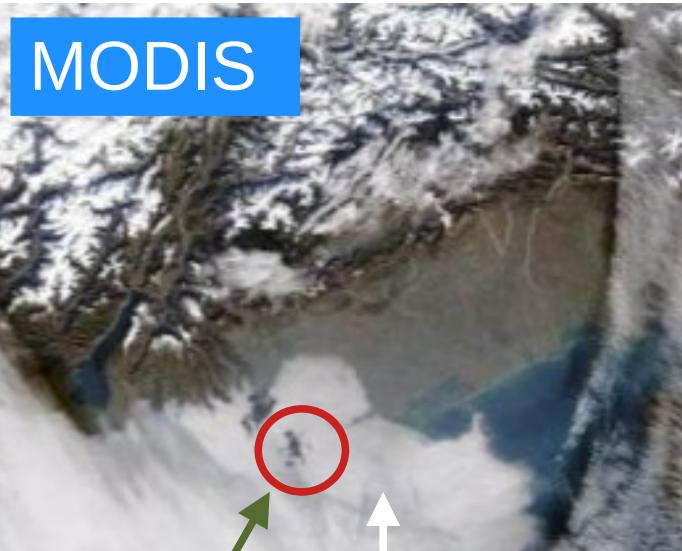
# Synop Stations



SYNOPS from 16105, Venezia / Tessera (Italy)			
SI	06/02/2019 21:00-> AAXX 06214	16105 26///3606 10053 21008 30238 40240 54000 333 60005==	

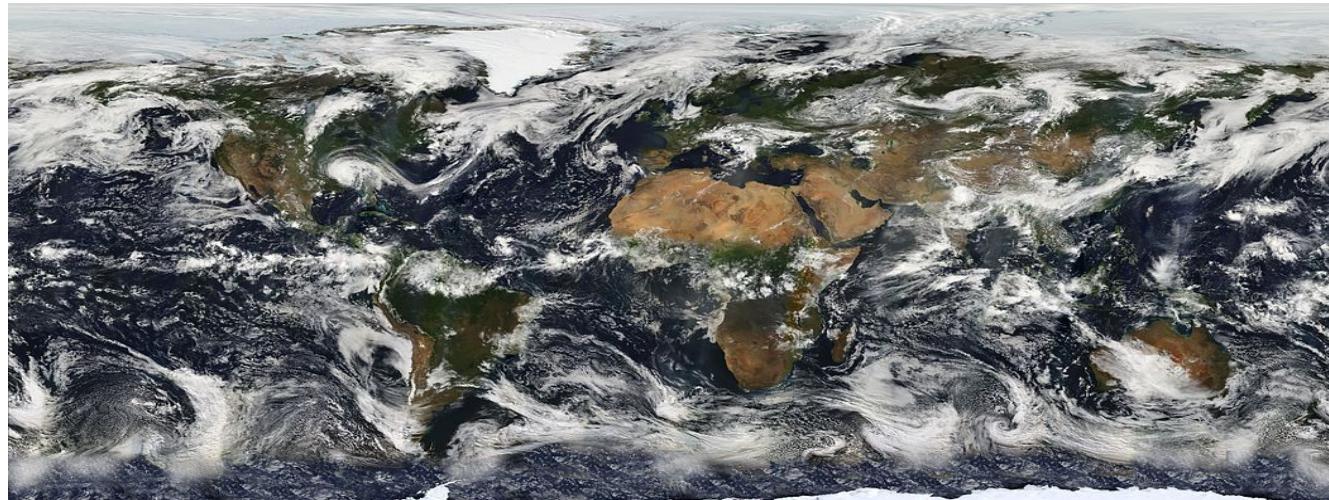
- often located **in airports**
- for many years, before celiometer, LIDAR, disdrometers and satellites...the only **meteo info point** about cloud high, hail, **fog/mist** condition at surface
- string of field: **1xxyyz 2zzxxx 3kkjjy...etc**
- a **FREE TOOL to decode synop data** was created to extract from OGIMETwebsite meteo variables of interest (visibility for us)
- **pro:** long data series, often from 1960 (Italy)
- **cons:** old technology in evolution, data not ever available, site relocations

# MODIS



- **MODIS** - Moderate Resolution Imaging **Spectroradiometer** is a key instrument aboard the Terra (1999) and Aqua (2002) satellites
- Terra's orbit around the Earth is timed so that it passes from **N to S across the equator in the morning**, while Aqua passes S to N over the equator in the afternoon
- Terra MODIS and Aqua MODIS are viewing the entire **Earth's surface every 1 to 2 days** acquiring data in 36 spectral bands

*We acknowledge the use of imagery from the Worldview Snapshots application (<https://wvs.earthdata.nasa.gov>), part of the Earth Observing System Data and Information System (EOSDIS)."*

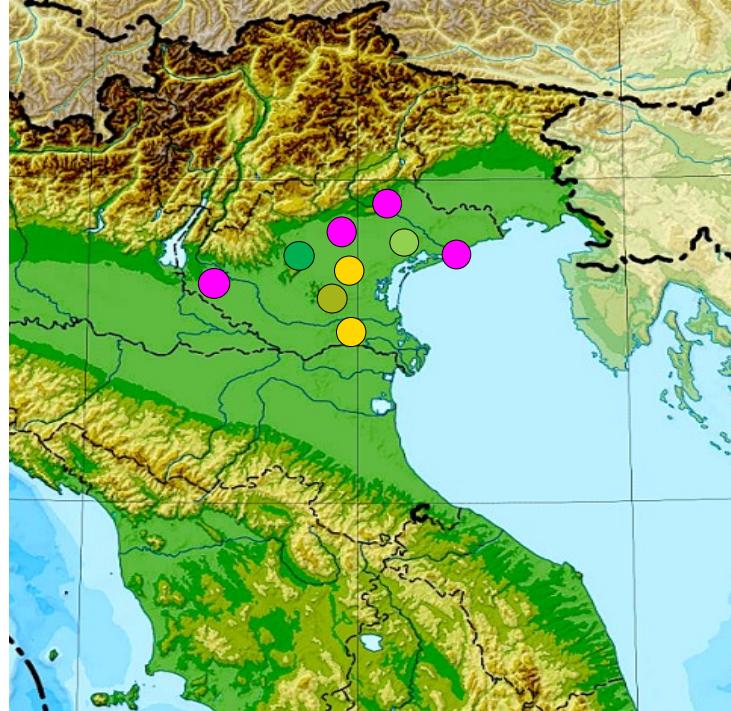
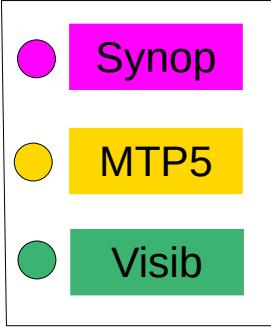


# Synop



Venice - Istrana - Treviso - Verona

**1960**



# Modis

# Earth

MTP5

Padua Rovigo

Visib

Tribano Montegaldà Mogliano

1999

2005

-  
2008



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## Foggy days definitions

Synop  
by Ogimet DB  
elab. ARPAV

every day **1 data every 3 hours**  
**8 data/day**

at least **1 record** visib.  $\leq 1$  km

Visibilimeters  
by ARPAV

every day **1 data every 15 min**  
hour average  
**24 data/day**

at least **1 hour** visib.  $\leq 1$  km

restrictive criteria

Synop  
by Tu Tiempo

every day **1 data every 3 hours**  
**8 data/day**

at least 1 record **with MIST or FOG**  
in **field #7xxxyz**  
visib. could be  $> 1$  km (!!?)

Synop  
by Tu Tiempo

permissive criteria

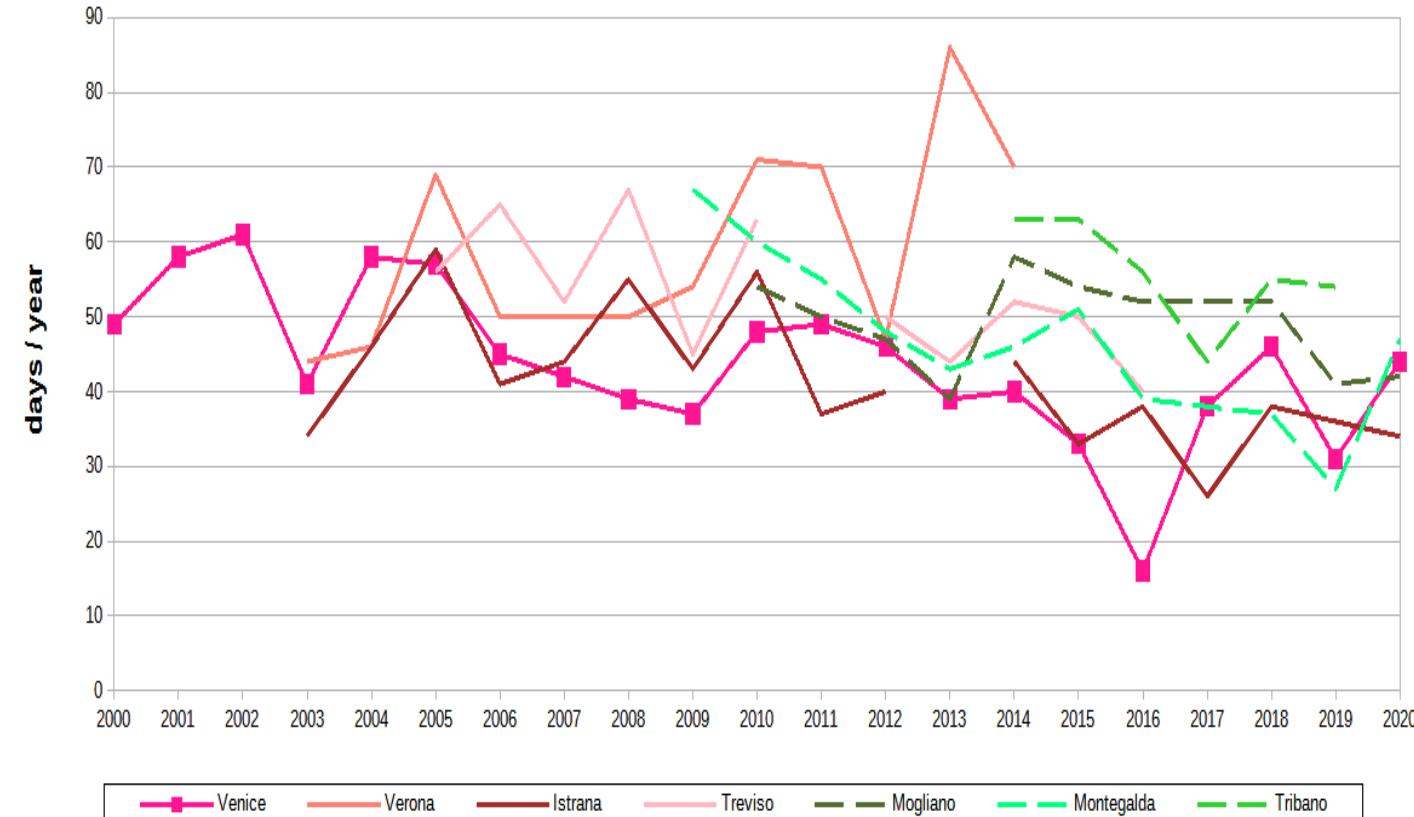
## Synop

- decreasing total annual days of fog in last 20 years
- about 7 - 10 last days lost compared 20 years ago
- inner station **Verona** more foggy than near coast station (**Treviso/Istrana**) than shoreline site (**Venice**)

## Visib.

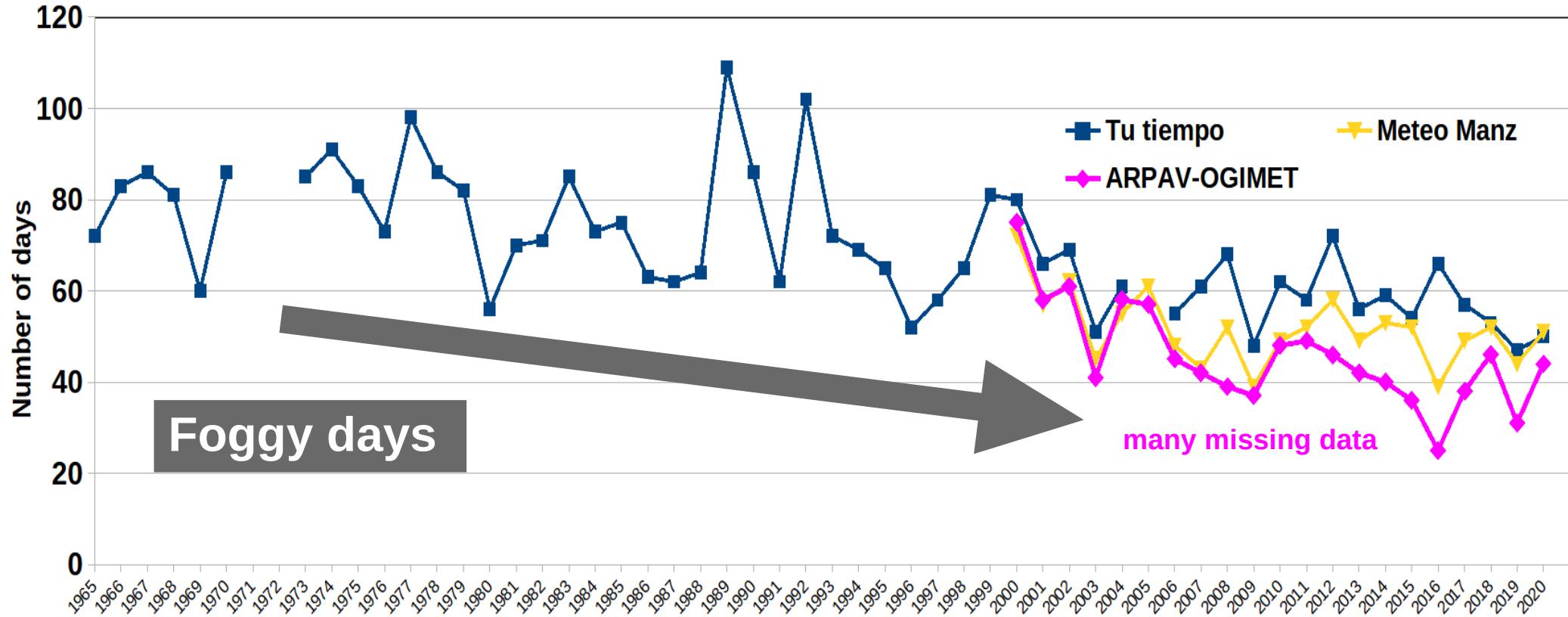
- confirm SYNOP trend
- Montegaldola** near to mountain have less fog days than coastal (**Mogliano**) and (**Tribano**) inner flat land

SYNOP and Visib. foggy days

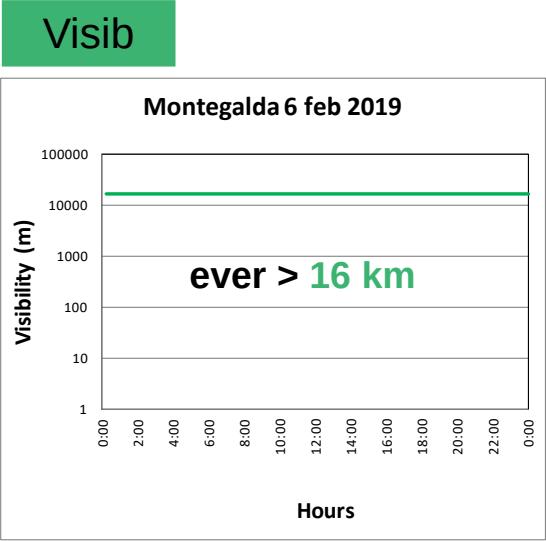
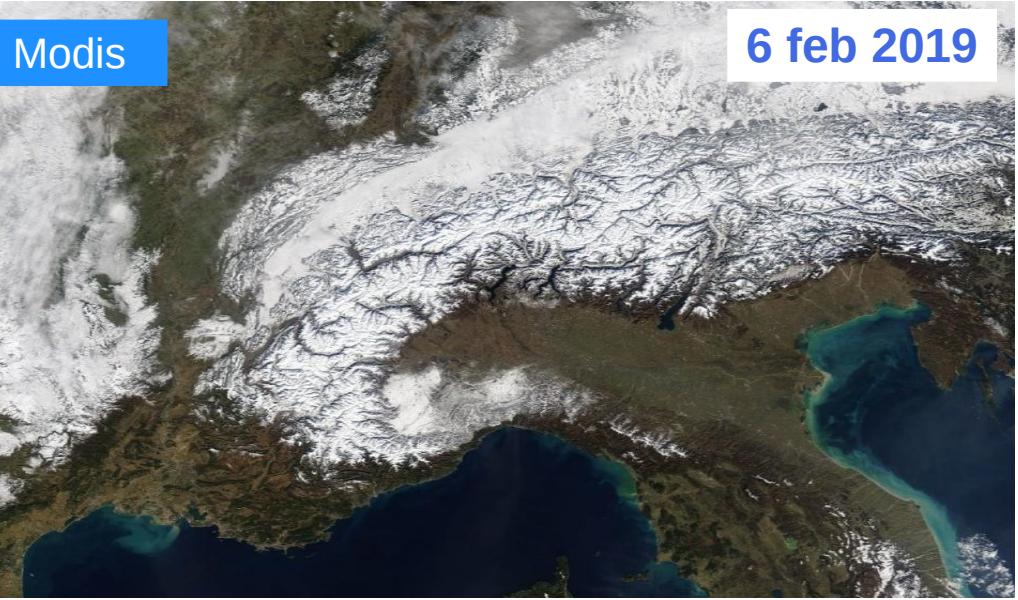


## Synop - Climatology

## Foggy days in Venice - 3 methods



# SW Stable Weather - dry air

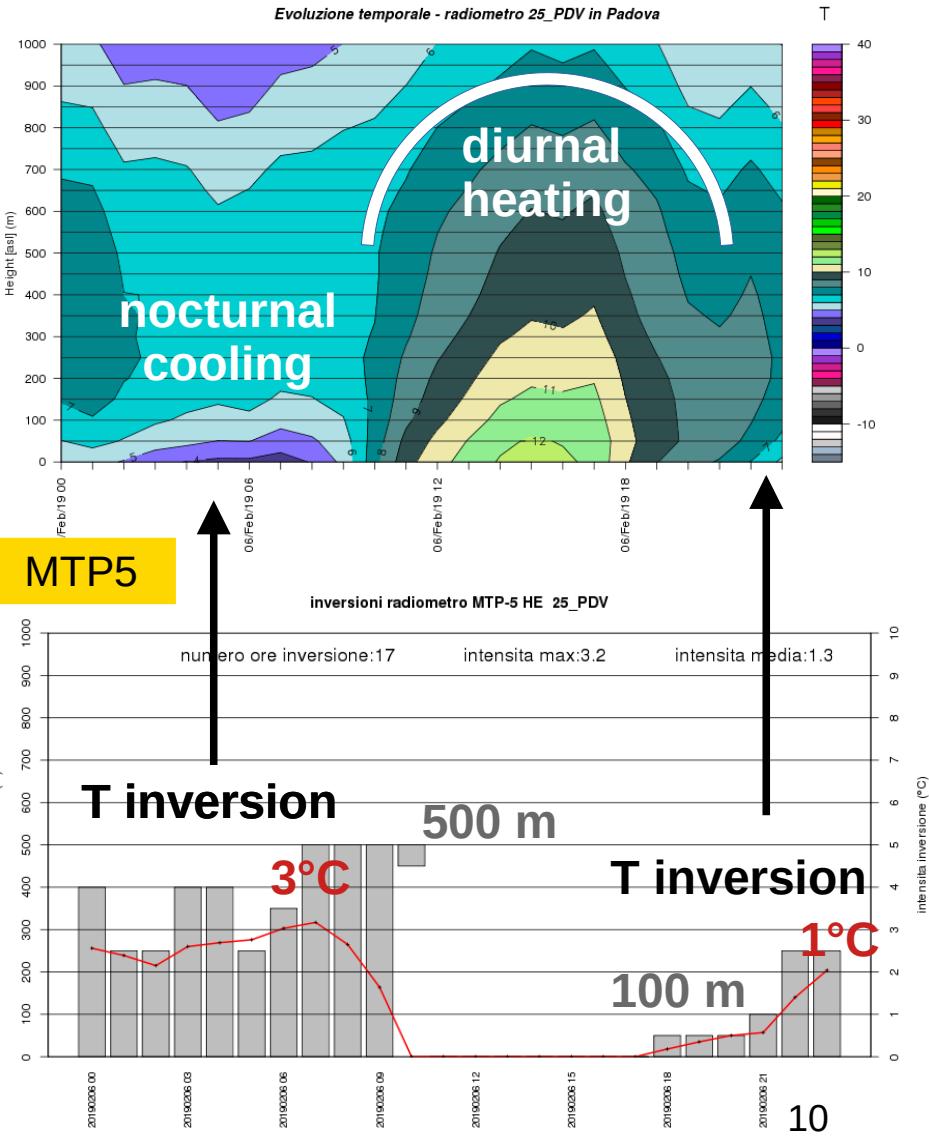


Date	Vis km	WW
02/07/2019 00:00	30.0	🌙
02/06/2019 21:00	-----	---
02/06/2019 18:00	75.0	🌙
02/06/2019 15:00	75.0	🌙☀
02/06/2019 12:00	75.0	☀
02/06/2019 09:00	30.0	☀
02/06/2019 06:00	20.0	🌙
02/06/2019 03:00	20.0	🌙
02/06/2019 00:00	20.0	🌙

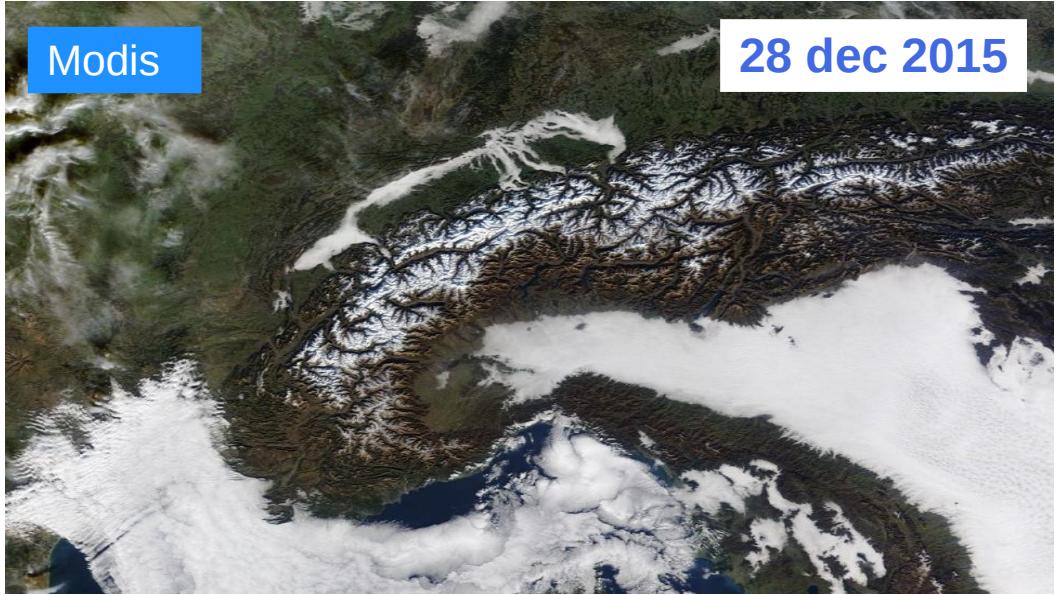
Visib: 20 : 75 km

Synop Venice

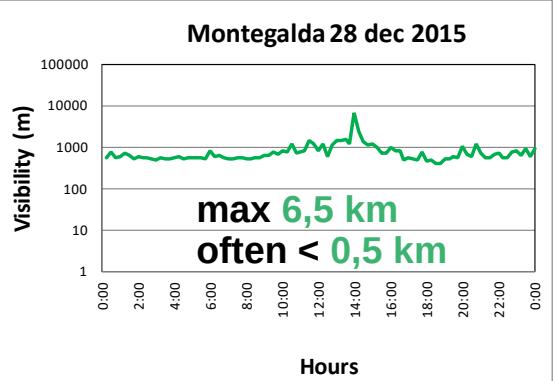
(c) Ogimet



# SW - whole Po valley foggy day



Visib.

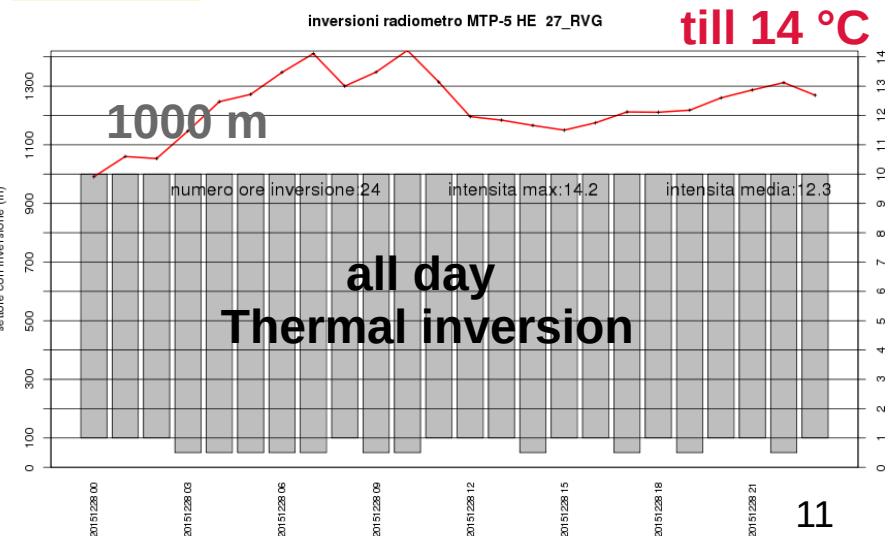
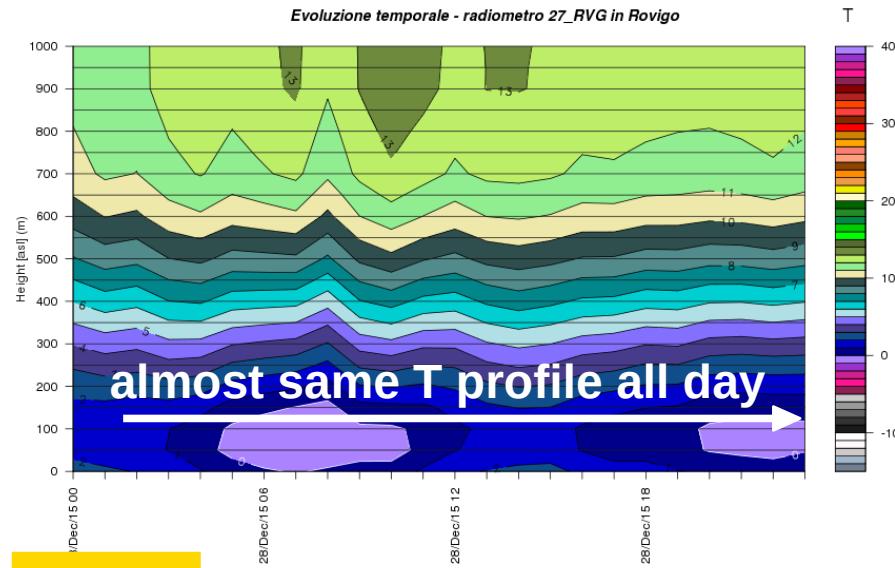


Date	Vis km	WW
12/29/2015 00:00	0.5	■■■
12/28/2015 21:00	0.4	■■■
12/28/2015 18:00	0.5	■■■
12/28/2015 15:00	1.8	■■■
12/28/2015 12:00	0.5	■■■
12/28/2015 09:00	0.3	■■■■
12/28/2015 06:00	0.3	■■■■
12/28/2015 03:00	0.2	■■■■■
12/28/2015 00:00	0.2	■■■■■

Visib: 0,2 : 1,8 km

Synop Venice

(c) Ogimet



# Fog persistent

19 jan 2006



28 dic 2006



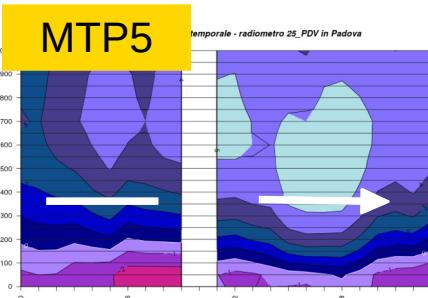
13 jan 2007



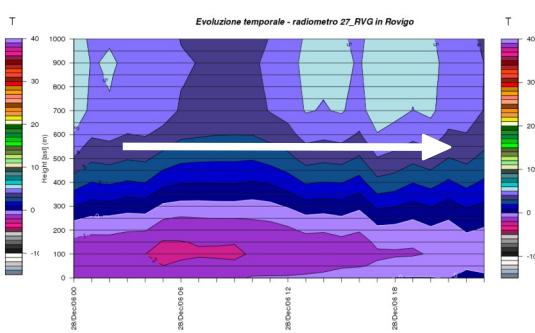
23 dec 2008



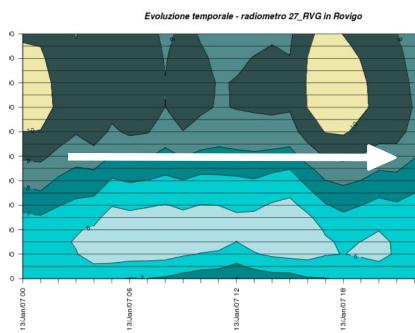
MTP5



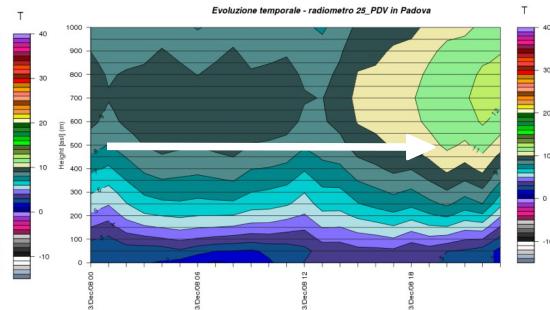
Visb



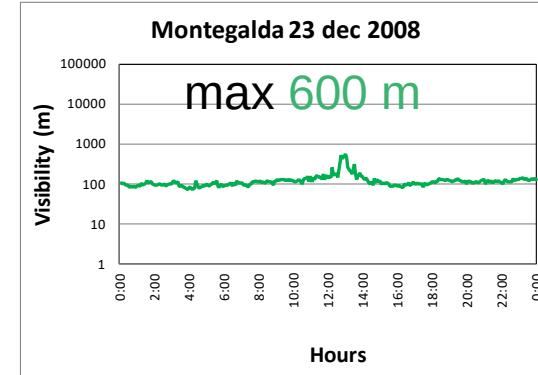
No visib. data



No visib. data

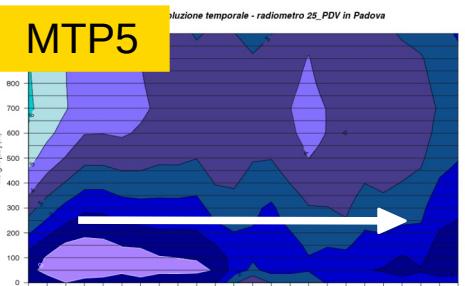


Montegaldà 23 dec 2008

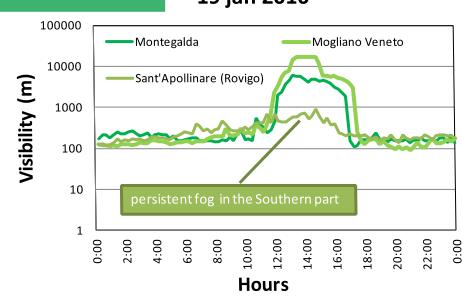


# Fog persistent

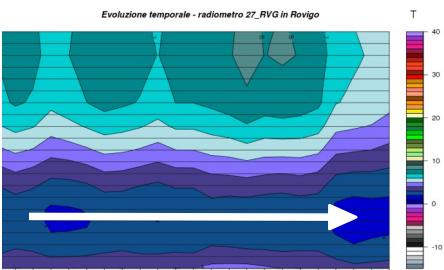
19 jan 2010



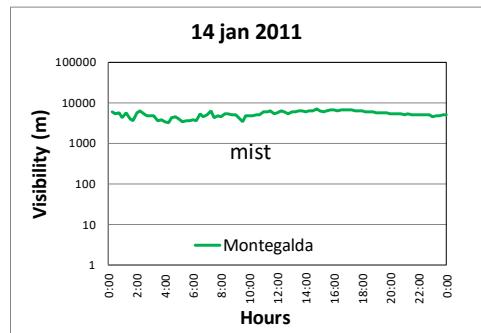
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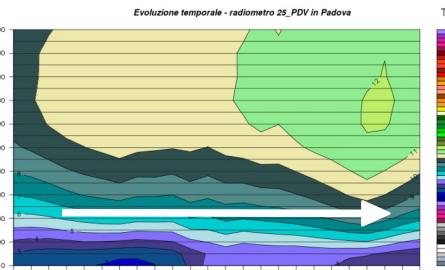
14 jan 2011



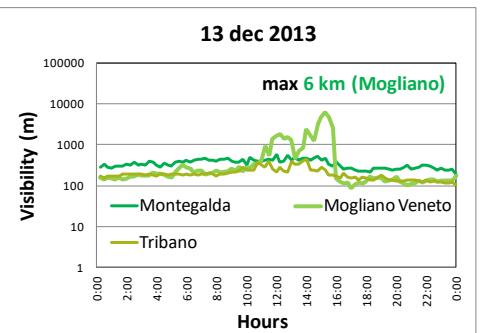
14 jan 2011



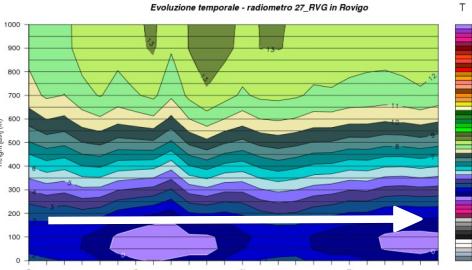
13 dec 2013



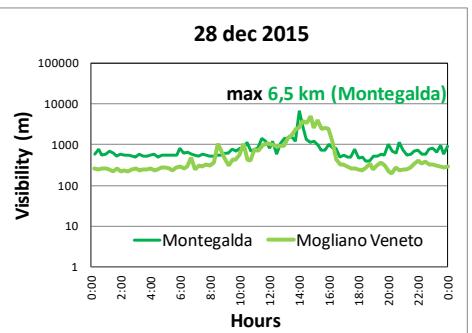
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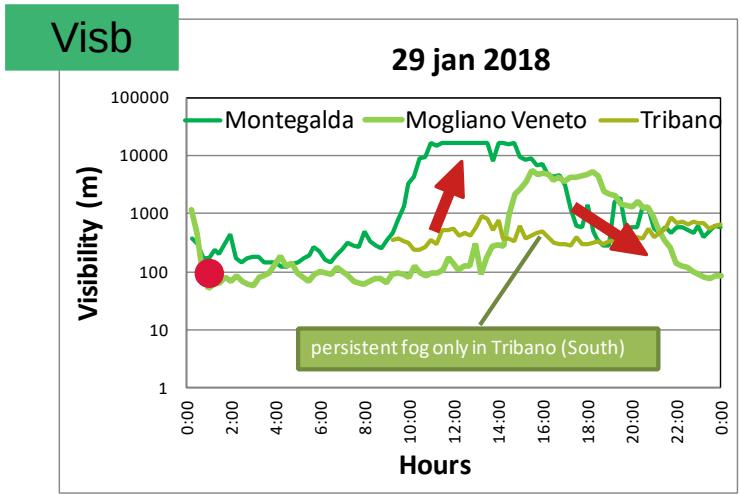
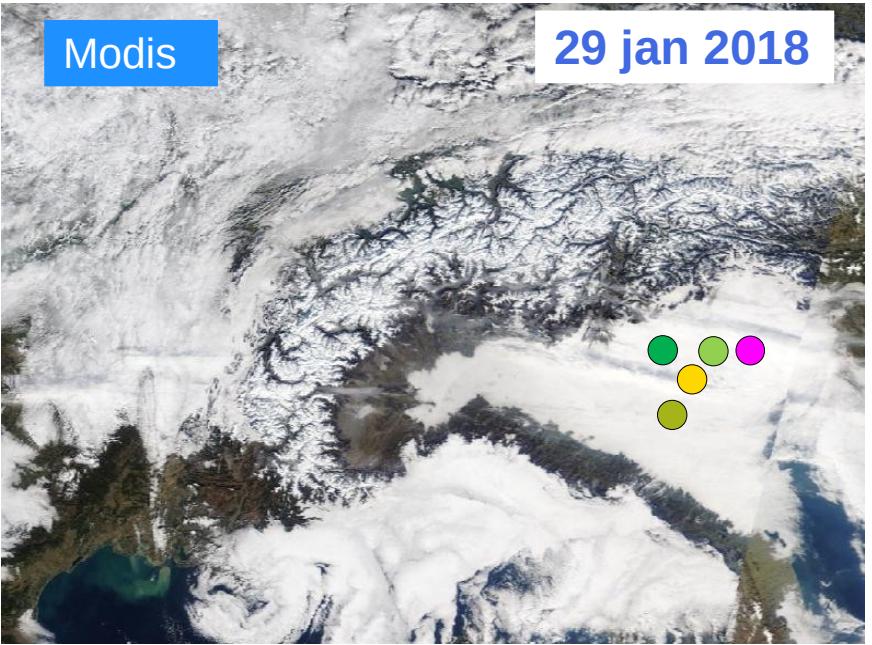
28 dic 2015



28 dic 2015

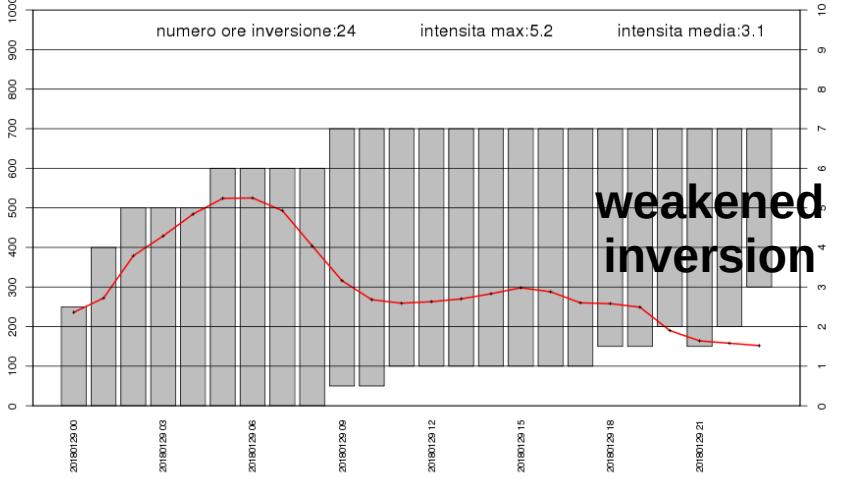
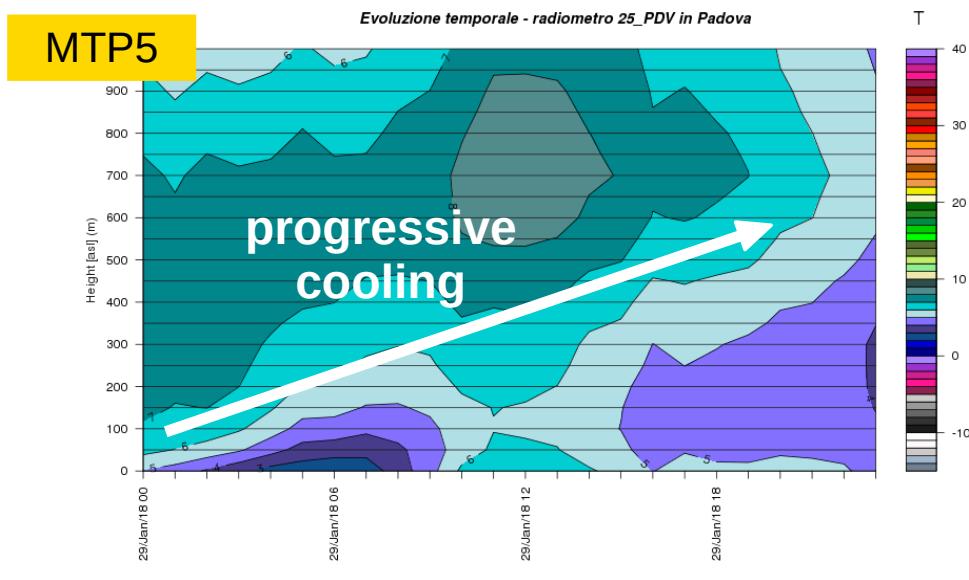


# Fog partial rarefaction/reformation

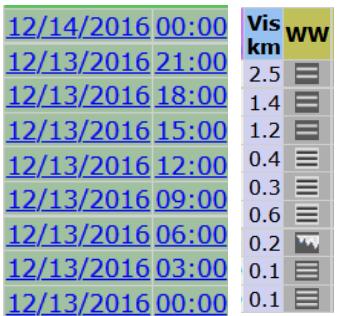
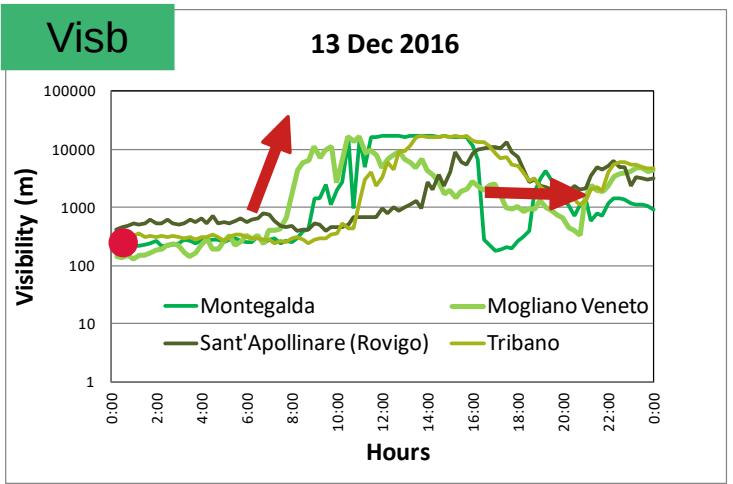
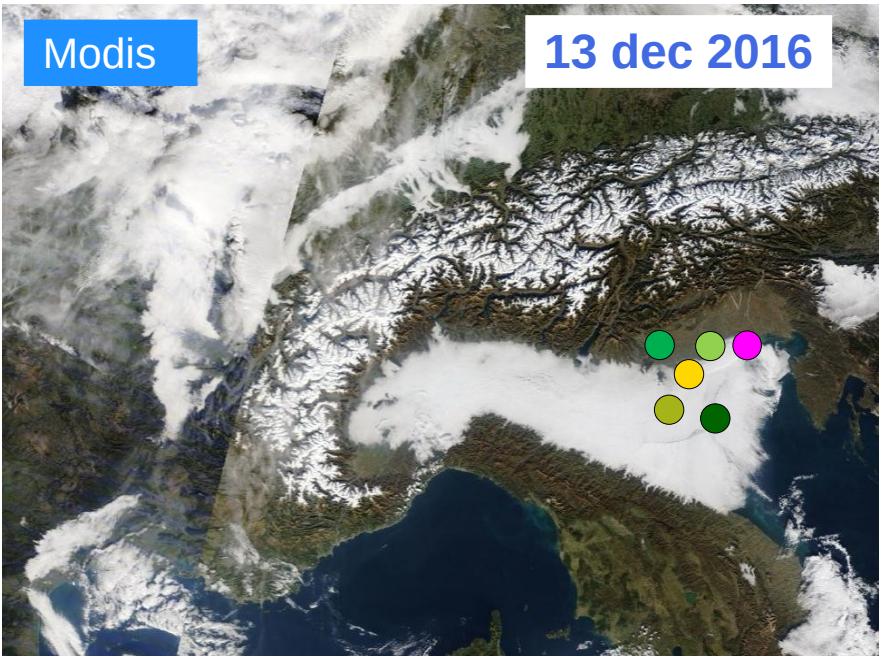


Date	Vis km	WW
01/30/2018 00:00	1.8	
01/29/2018 21:00	0.4	
01/29/2018 18:00	0.7	
01/29/2018 15:00	0.9	
01/29/2018 12:00	0.3	
01/29/2018 09:00	0.2	
01/29/2018 06:00	0.1	
01/29/2018 03:00	0.1	
01/29/2018 00:00	0.6	

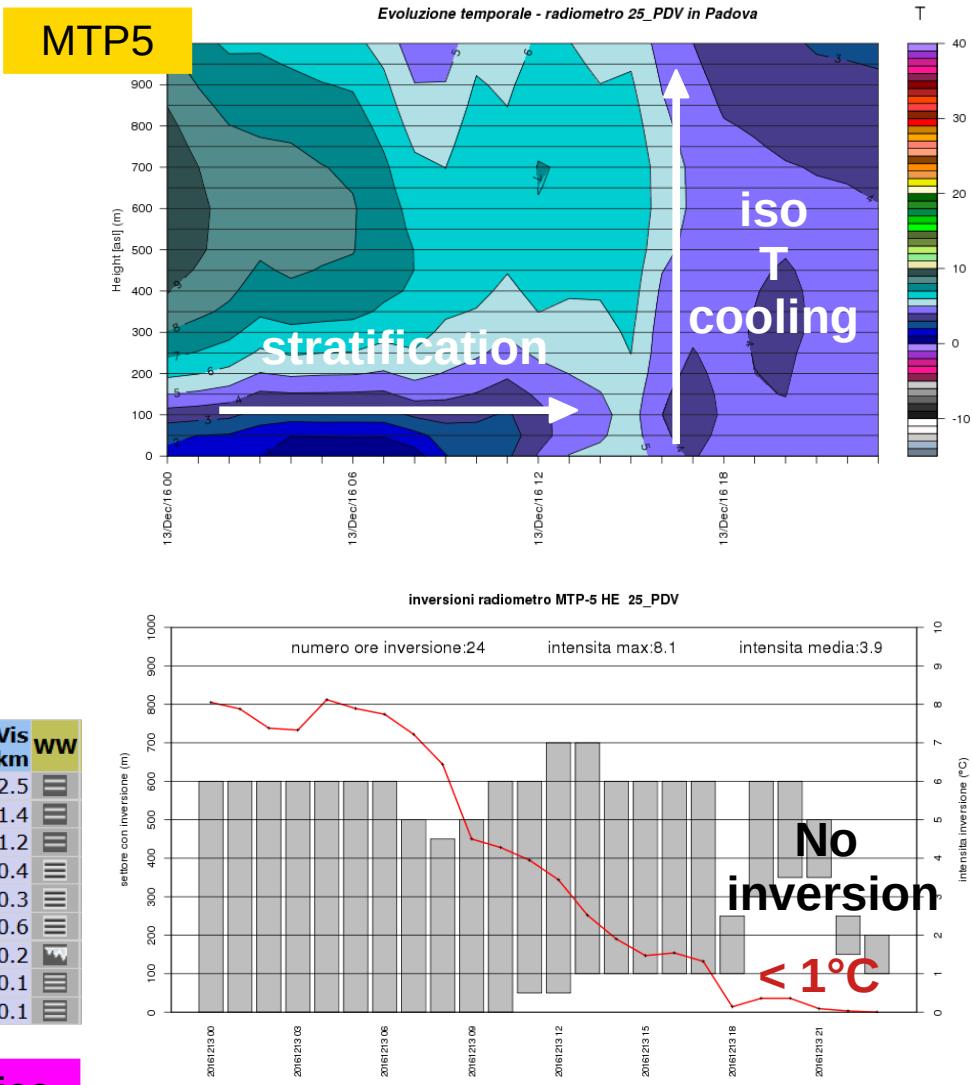
Synop Venice



## Fog dissipation from north



# Synop Venice





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# CONCLUSIONS

MTP5

Visib

Synop

we analysed the **thermal profile** and **visibility condition** in some particular days: **foggy days**

we have discover:

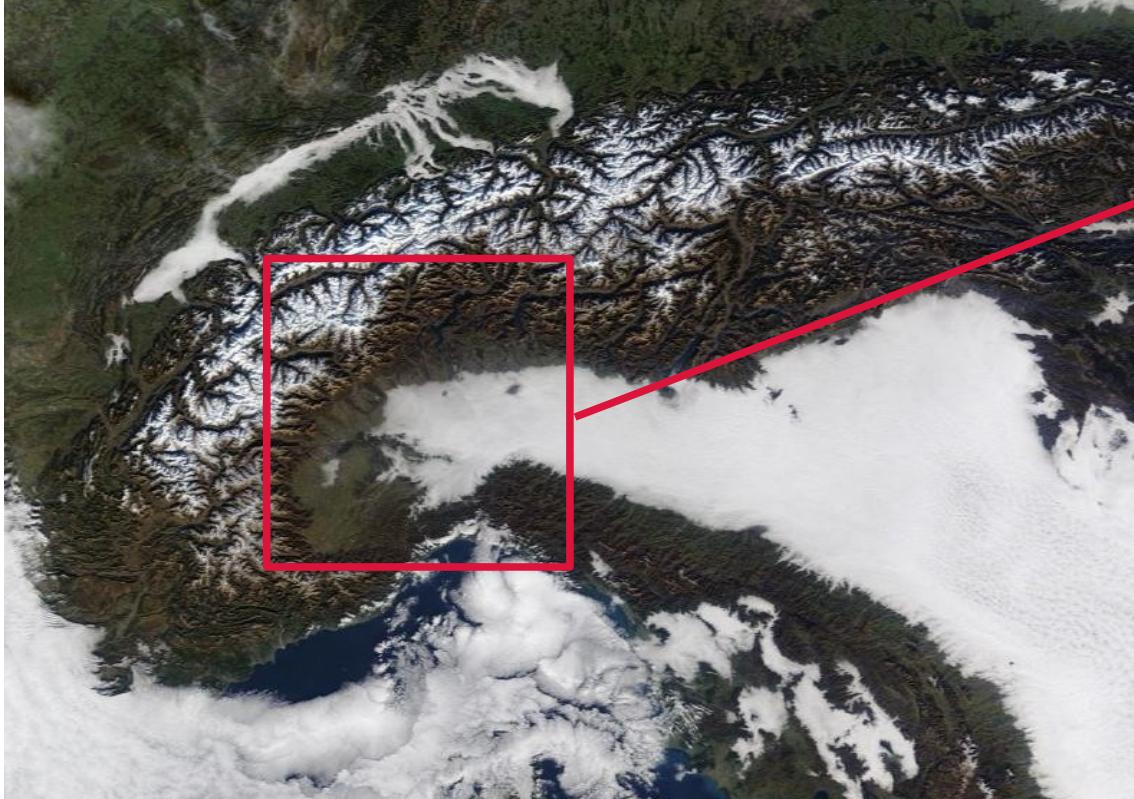
- during whole Po valley foggy days the thermal profile doesn't show diurnal/nocturnal cycle  
but is replaced from **unchanged thermal profile** - usually with thermal inversion
- iso-temperature at every level is a characteristic especially in the layers **inside the fog** and "seems" remain **also** the upper layers **without fog**
- presence of (often) strong thermal inversion ► also 14°C in 1000 m (cause "hot" upper levels)
- ever **top inversion layer >> top fog layer** (► in general max 100-400 m in Po valley)
- confirm that # **foggy days** (although based on often incomplete data) **is decreasing in Po valley**



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**FREE TOOL** for decode SYNOP data: [link](#)



**UHI in Milan**

