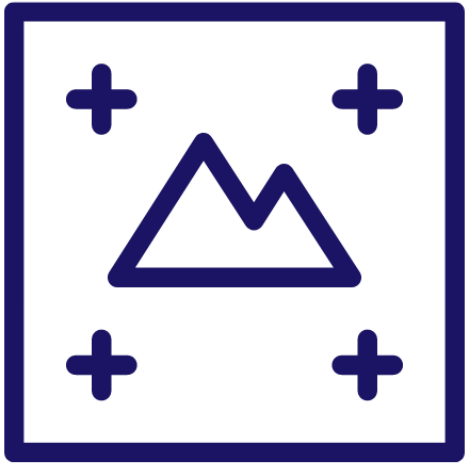


SCREEN CAPTURE

WELCOME



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

Massimo Enrico Ferrario and Sansone Maria



EMS2021-157

18 sep 2021

MPT5 radiometer



- 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

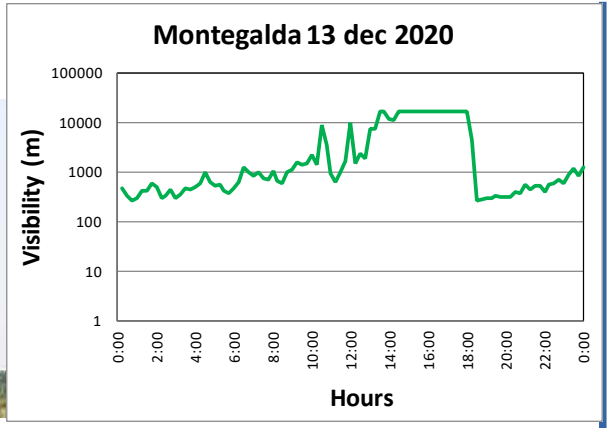
what is it for ?

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

(*) https://www.researchgate.net/project/Meteorological-Temperature-Profiler-MTP-5-and-Meteorological-Thermodynamic-Profiler-MTP-7-for-vertical-temperature-and-humidity-profiles-of-the-Atmosphere
http://www.altostratus.it/Meteo_MTP5.htm http://cetemps.aquila.infn.it/mwrnet/ http://probe-cost.eu/index.php

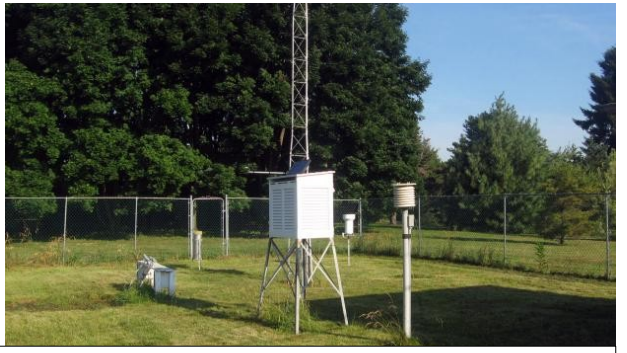
Visibilimeter





- 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

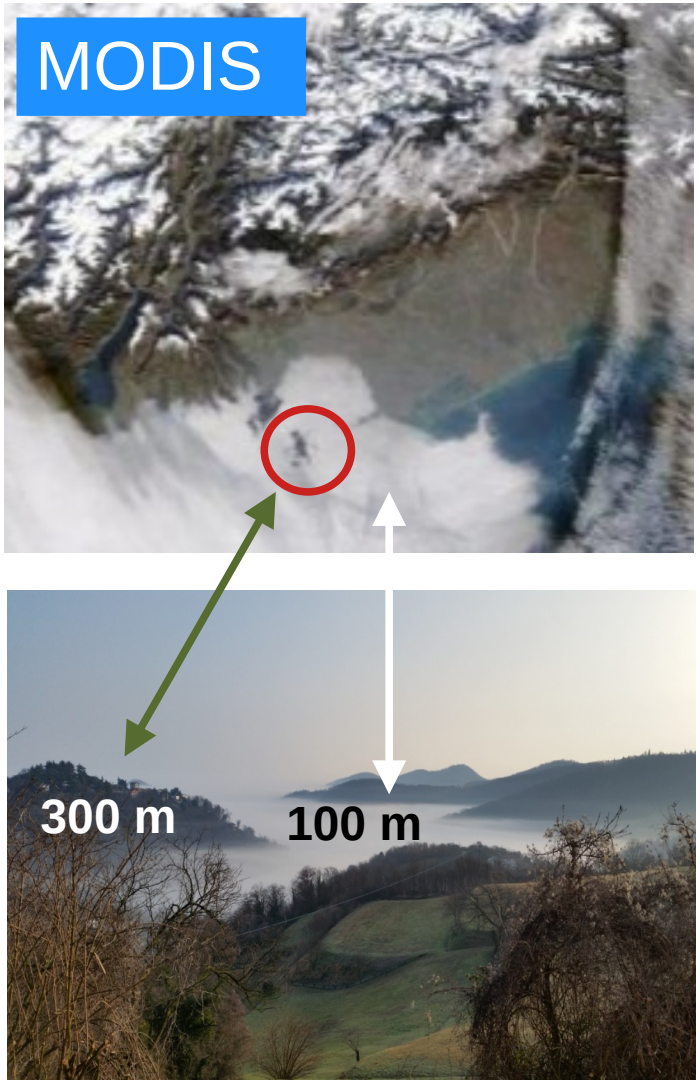
Synop Stations



SYNOPS from 16105, Venezia / Tessera (Italy)

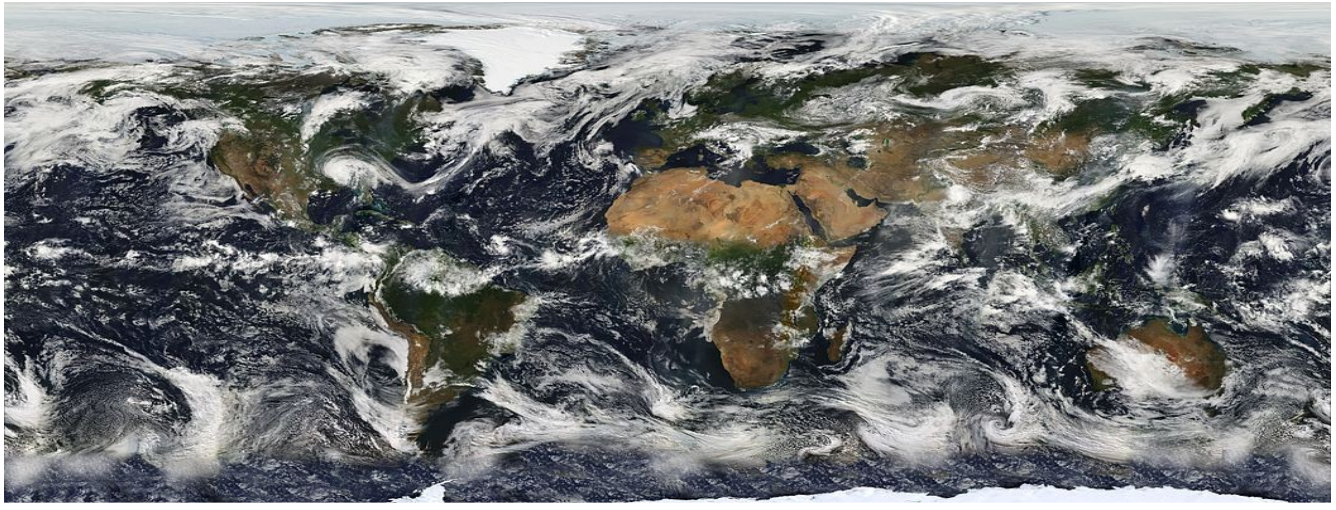
SI	06/02/2019 21:00->	AAXX 06214	16105 26/// /3606 10053 21008 30238 40240 54000 333 60005==

- 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** - 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)."



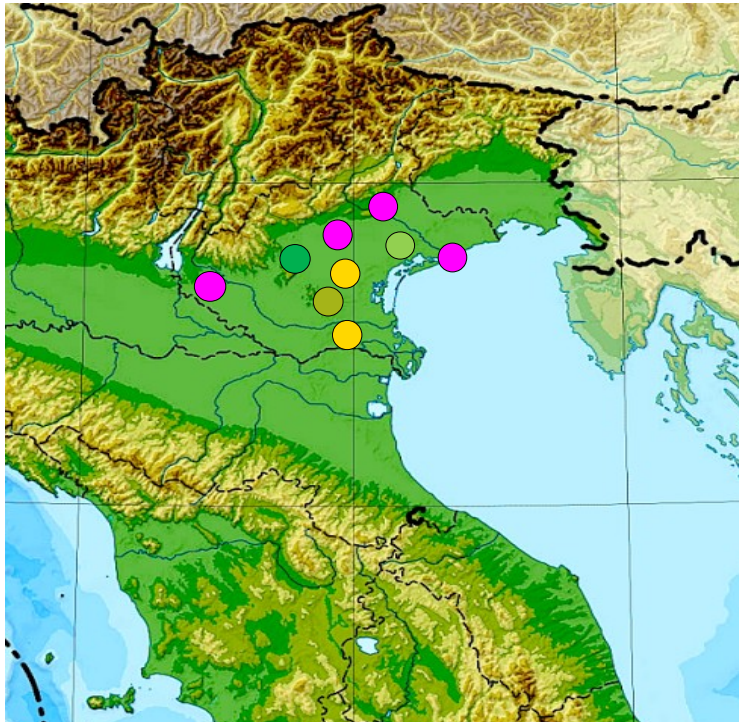
https://wvs.earthdata.nasa.gov/?LAYERS=MODIS_Terra_CorrectedReflectance_TrueColor&CRS=EPSG:4326&TIME=2018-01-30&COORDINATES=42.5615,2.5294,49.0366,14.7389&FORMAT=image/jpeg&AUTOSCALE=TRUE&RESOLUTION=1km



Synop — Venice - Istrana - Treviso - Verona

1960

- Synop
- MTP5
- Visib





Modis — Earth

MTP5 — Padua Rovigo

Visib — Tribano Montegalda Mogliano

1999

2005

2008

2021




arpav

Foggy days definitions

Synop by Ogimet DB elab. ARPAV	every day **1 data every 3 hours** **8** data/day	at least **1 record** visib. <= 1 km
Visibilimeters by ARPAV	every day **1 data every 15 min** hour average **24** data/day	at least **1 hour** visib. <= 1 km **restictive criteria**

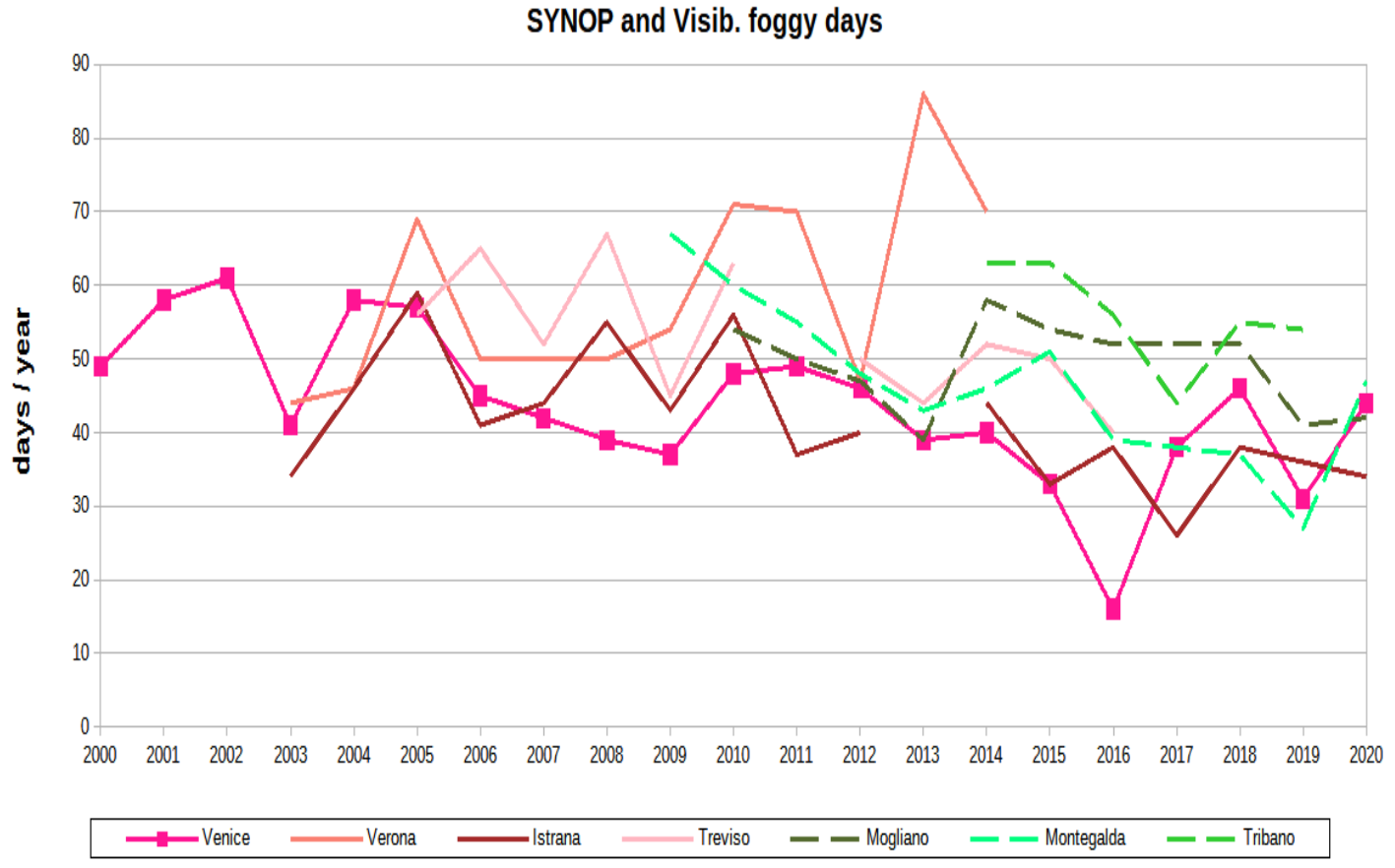
Synop by Tu Tiempo	every day **1 data every 3 hours** **8** data/day	at least 1 record **with MIST or FOG** in **field #7xxyyz** visib. could be > 1 km (!!!) **permissive criteria**
Synop by Tu Tiempo		

Synop

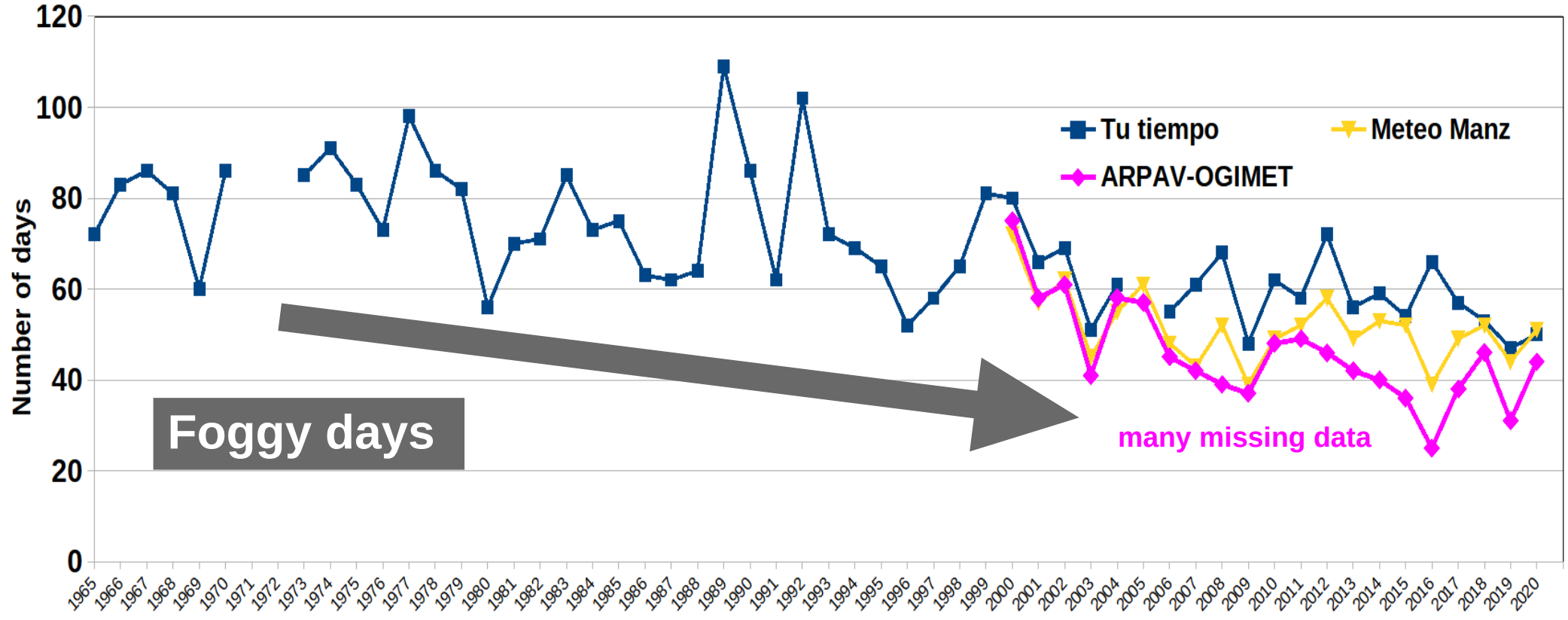
- decreasing total annual days of fog in last 20 years
- about 7 - 10 last days lost compared 20 years ago
- inner station **Verona** more foggy than near coast station (**Treviso/Istrana**) than shoreline site (**Venice**)

Visib.

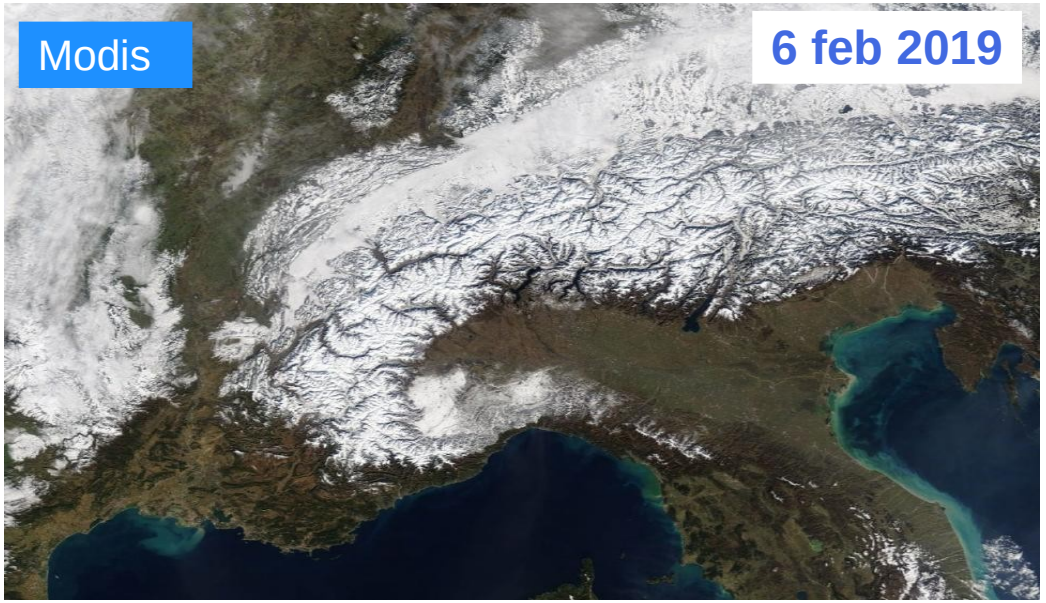
- confirm SYNOP trend
- **Montegalda** near to mountain have less fog days than coastal (**Mogliano**) and (**Tribano**) inner flat land

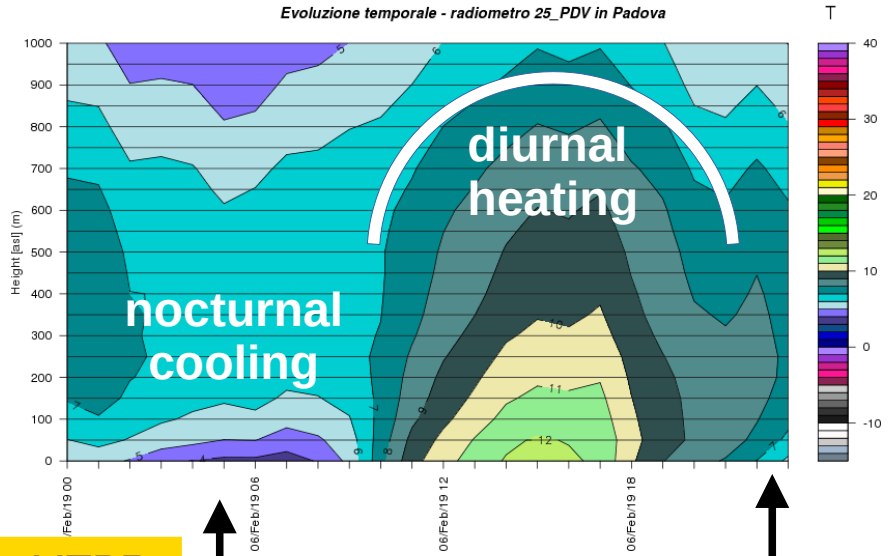


Synop - Climatology



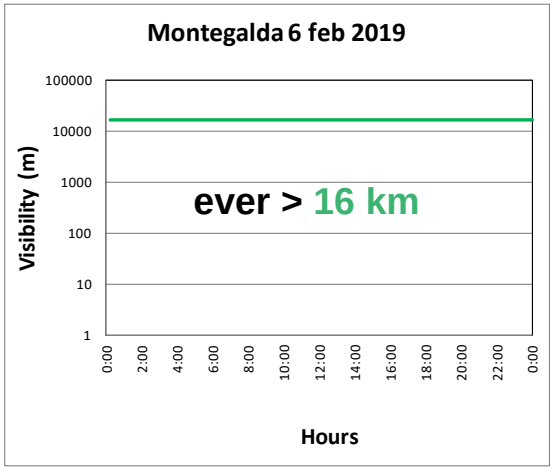
SW Stable Weather - dry air





MTP5

Visib

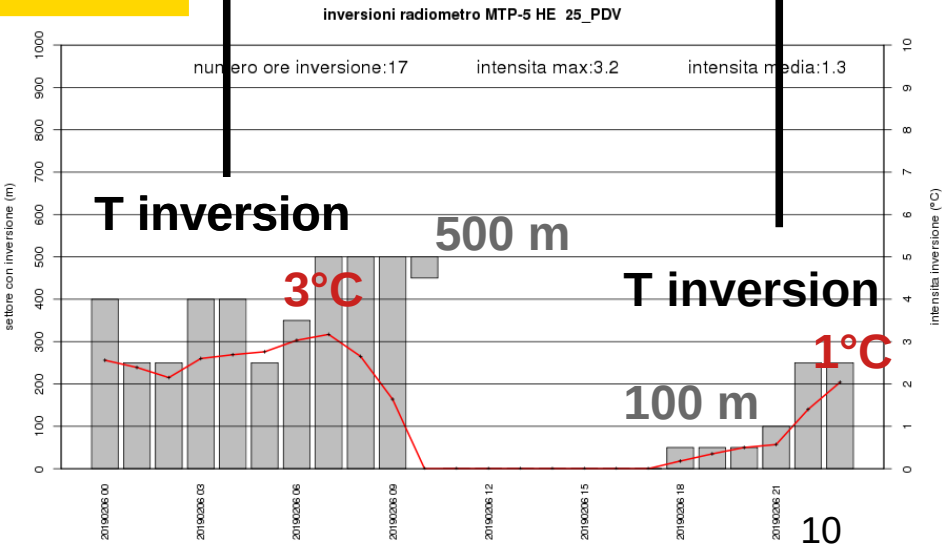


Date	Vis km	ww
02/07/2019 00:00	30.0	
02/06/2019 21:00	----	
02/06/2019 18:00	75.0	
02/06/2019 15:00	75.0	
02/06/2019 12:00	75.0	
02/06/2019 09:00	30.0	
02/06/2019 06:00	20.0	
02/06/2019 03:00	20.0	
02/06/2019 00:00	20.0	

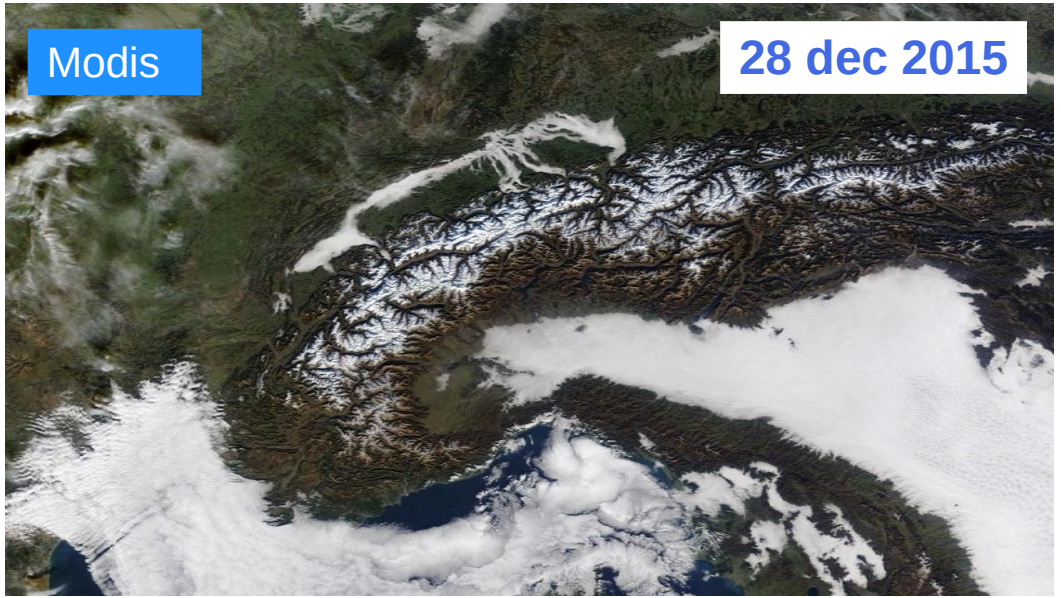
Visib: 20 : 75 km

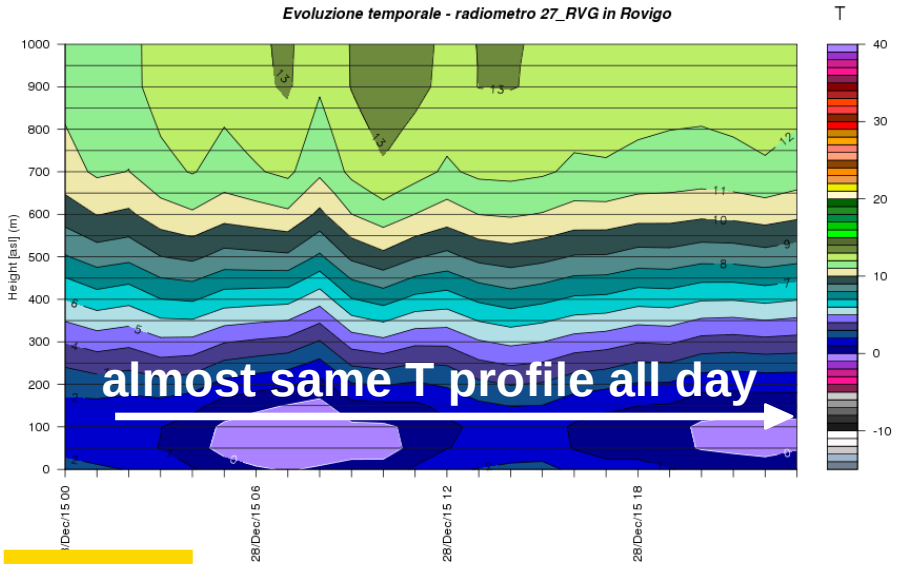
Synop Venice

(c) Ogimet



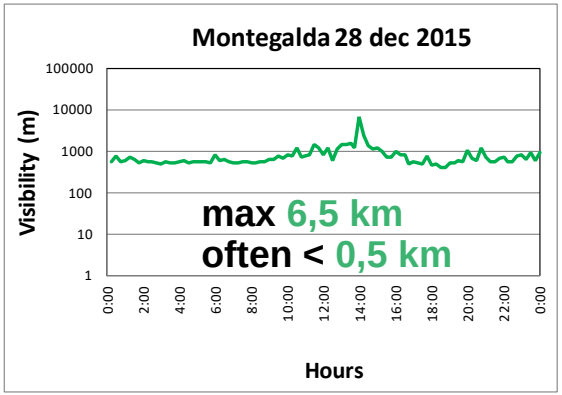
SW - whole Po valley foggy day





MTP5

Visib.

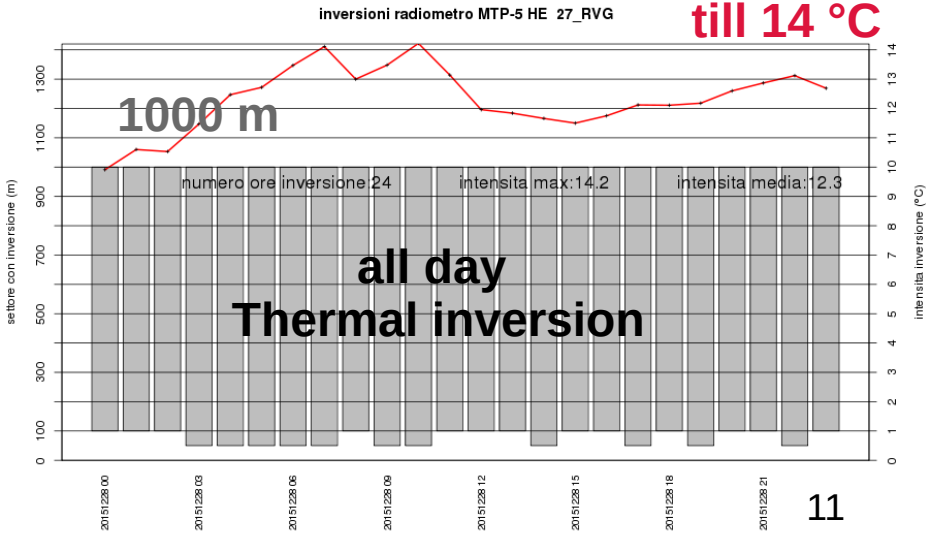


Date	Vis km	WW
12/29/2015 00:00	0.5	
12/28/2015 21:00	0.4	
12/28/2015 18:00	0.5	
12/28/2015 15:00	1.8	
12/28/2015 12:00	0.5	
12/28/2015 09:00	0.3	
12/28/2015 06:00	0.3	
12/28/2015 03:00	0.2	
12/28/2015 00:00	0.2	

Visib: 0,2 : 1,8 km

Synop Venice

(c) Ogimet

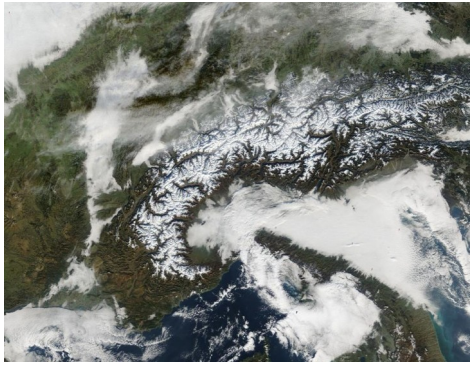


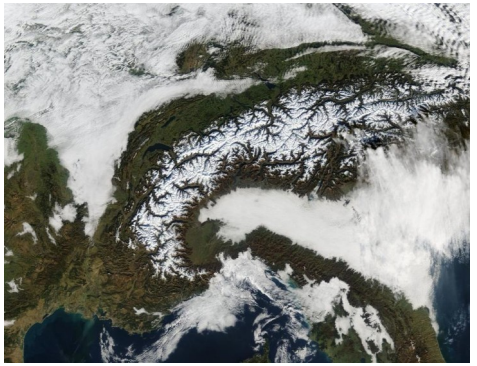
Fog persistent

19 jan 2006	28 dic 2006	13 jan 2007	23 dec 2008

Modis

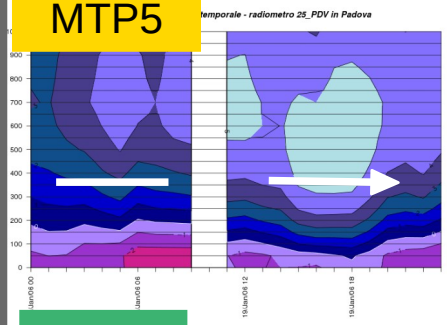


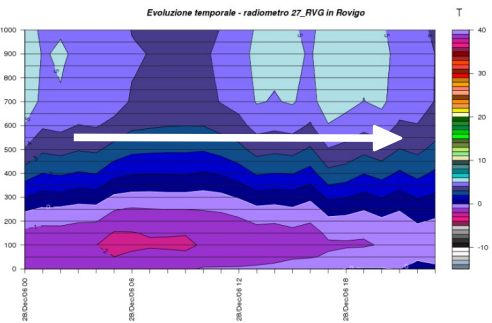


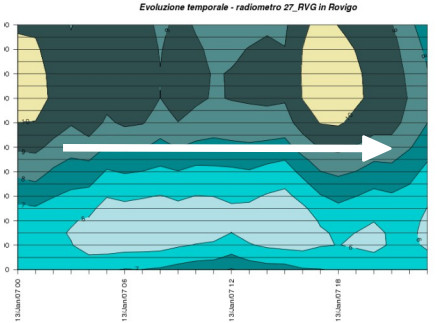


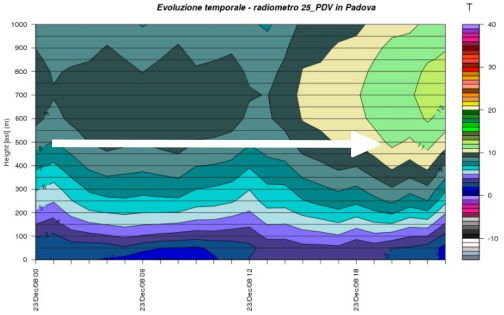


MTP5









Visb



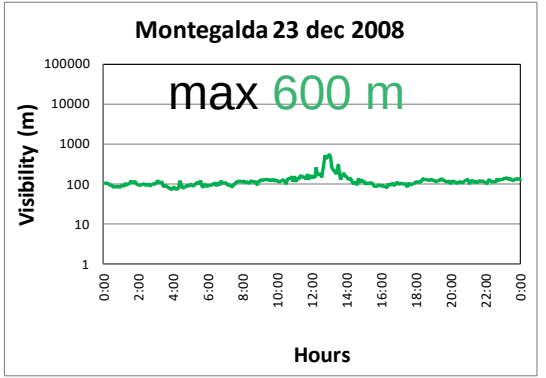
No visib. data



No visib. data



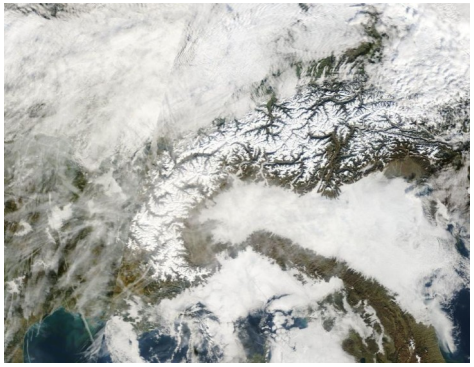
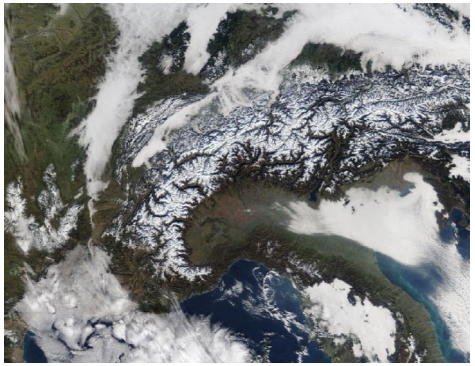
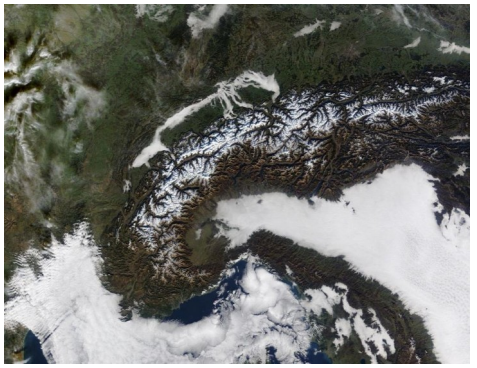
No visib. data



Fog persistent

19 jan 2010	14 jan 2011	13 dec 2013	28 dic 2015

Modis

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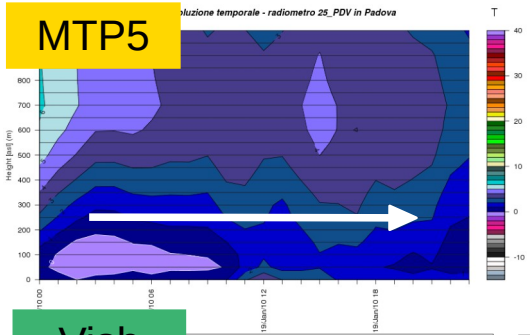
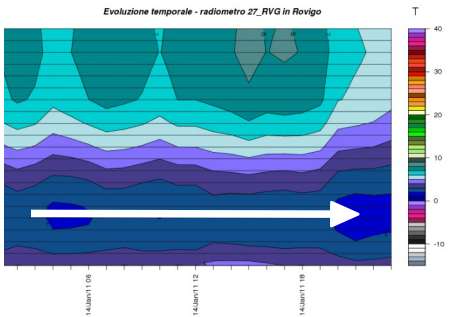
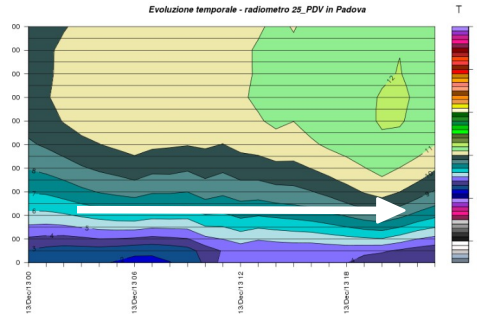
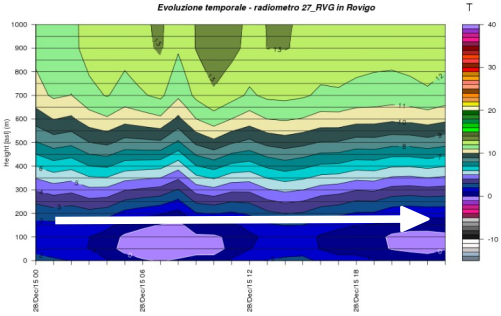
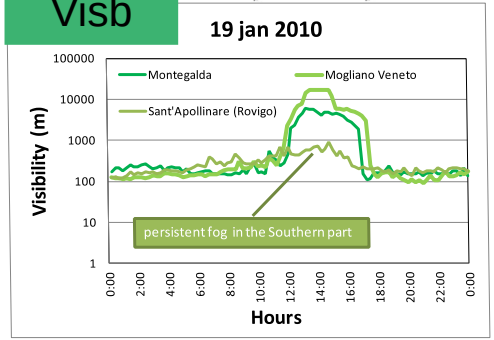


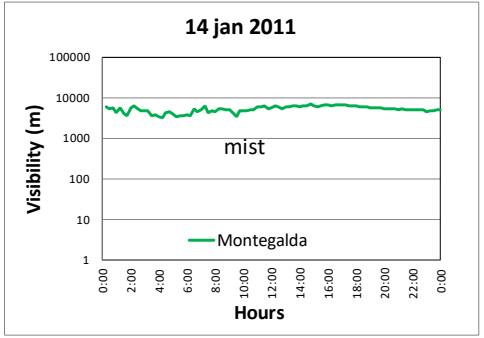


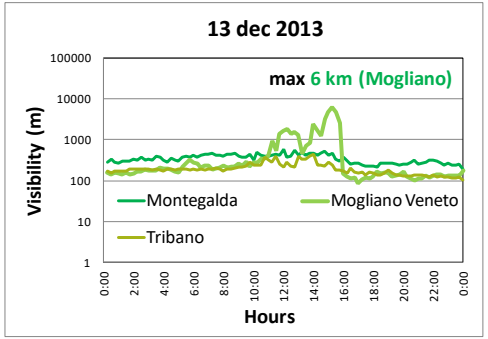


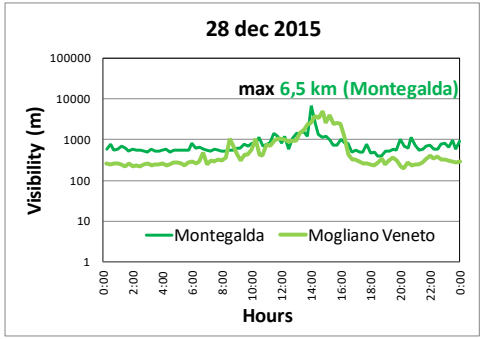


Visb





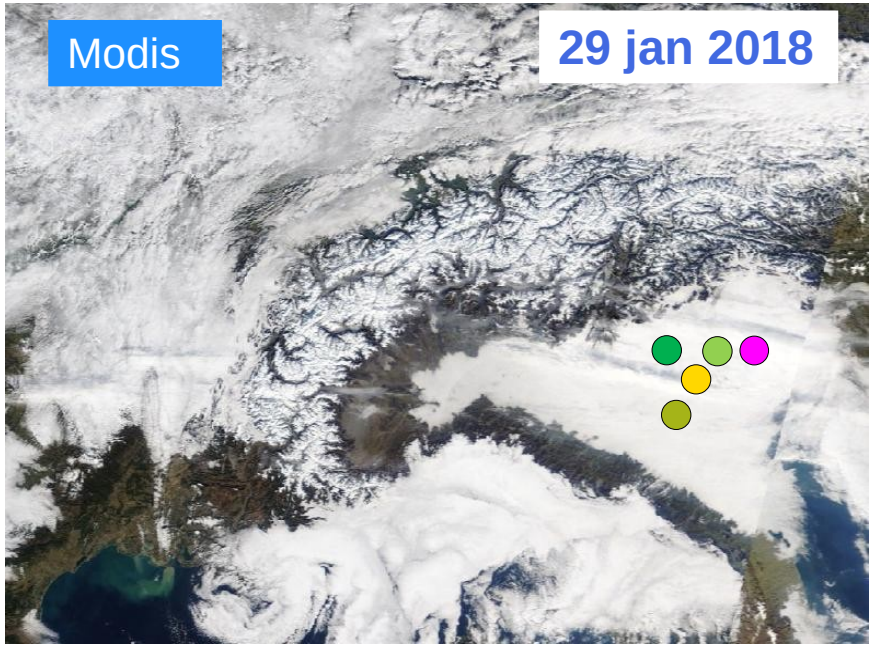




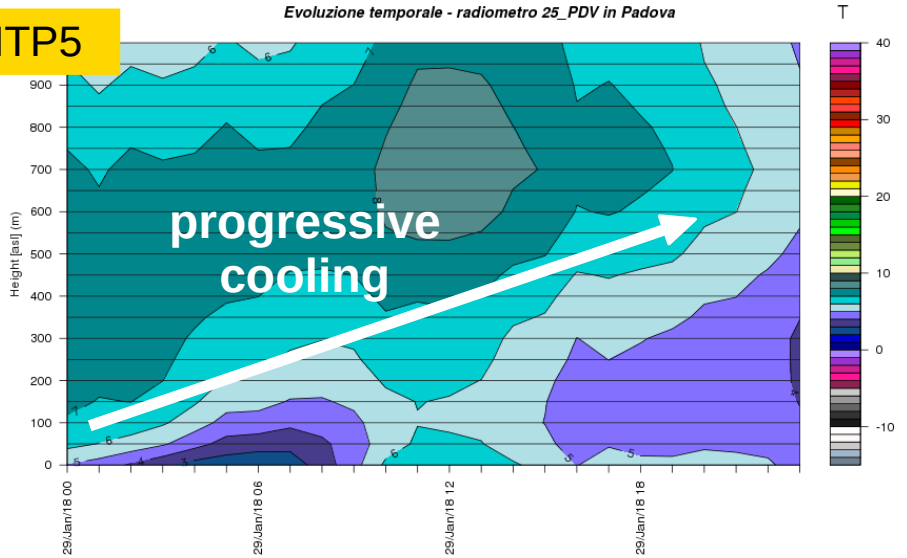
Fog partial rarefaction/reformation

Modis

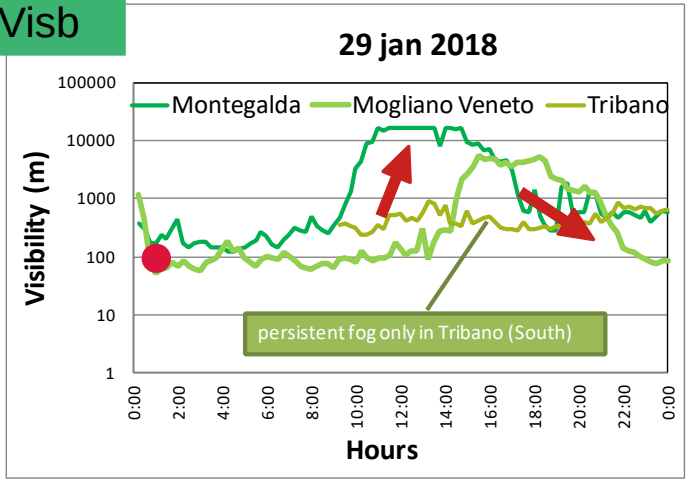
29 jan 2018



MTP5

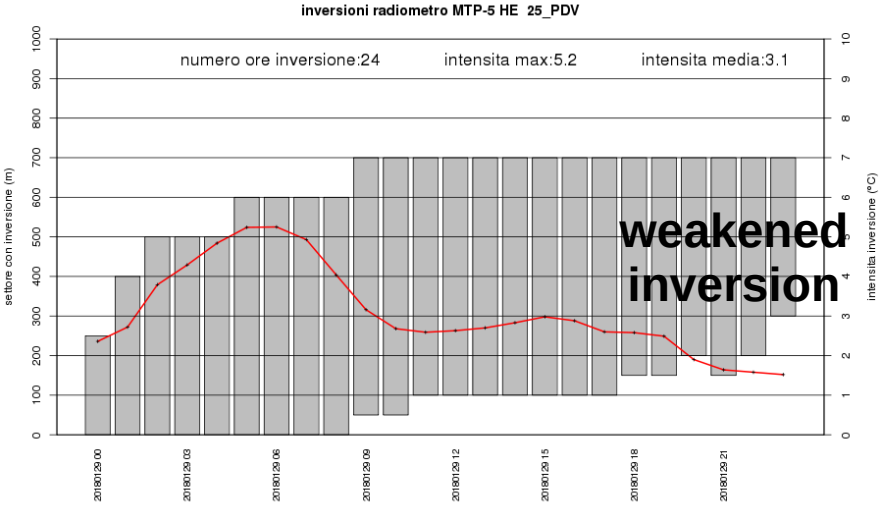


Visb



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	

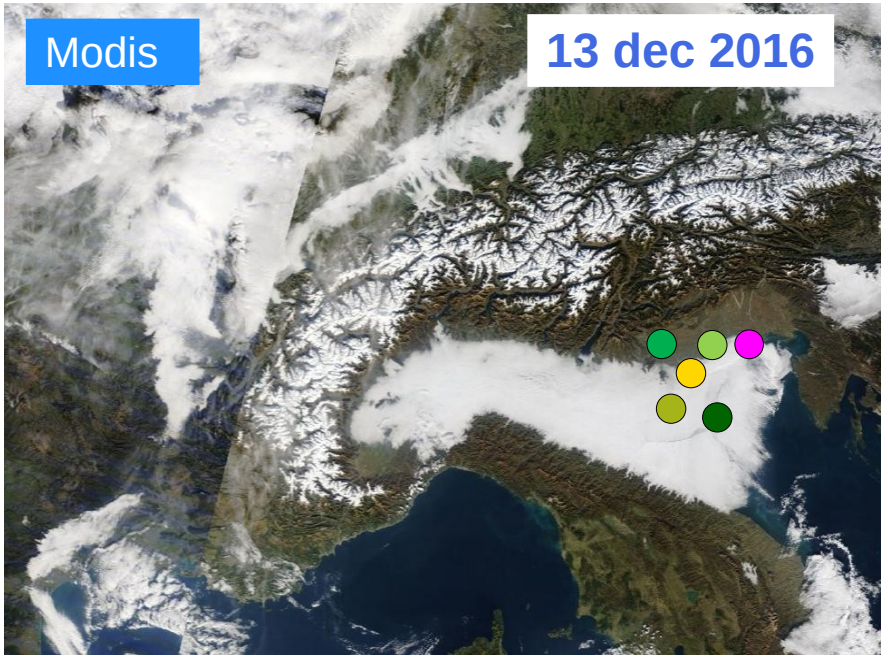
Synop Venice



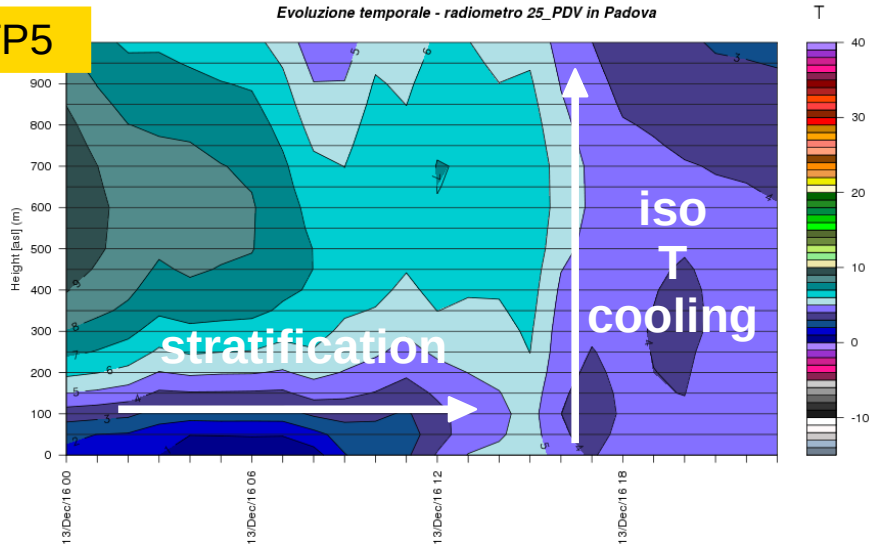
Fog dissipation from north

Modis

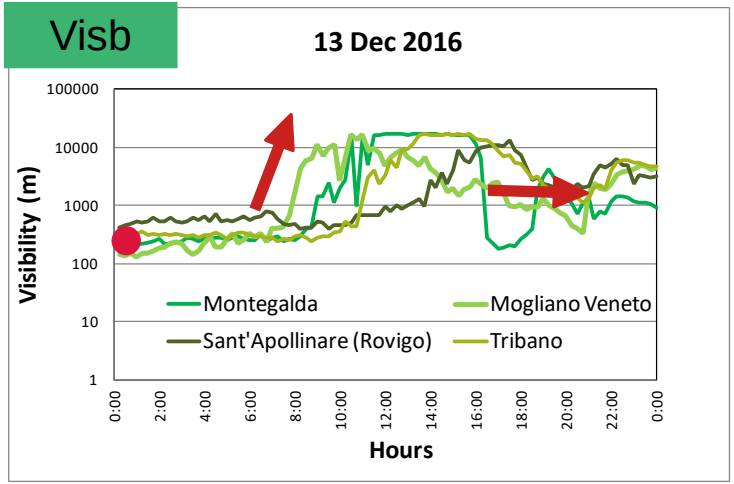
13 dec 2016



MTP5

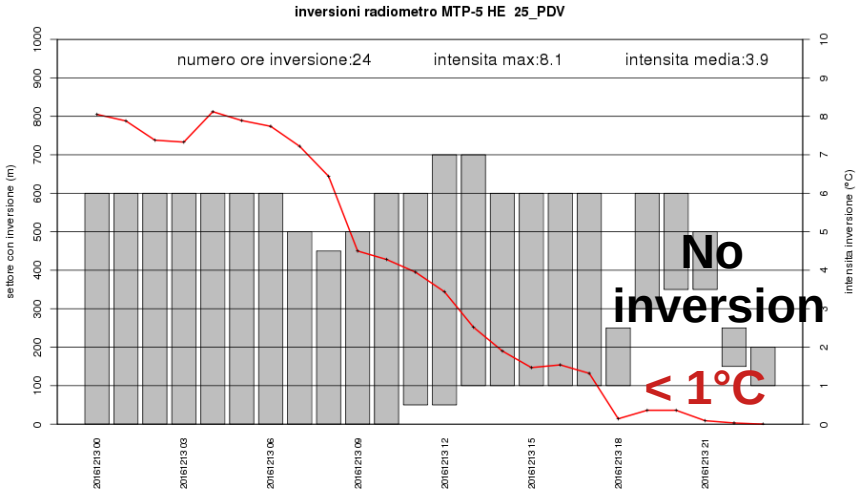


Visb



	Vis km	ww
12/14/2016 00:00		
12/13/2016 21:00	2.5	
12/13/2016 18:00	1.4	
12/13/2016 15:00	1.2	
12/13/2016 12:00	0.4	
12/13/2016 09:00	0.3	
12/13/2016 06:00	0.6	
12/13/2016 03:00	0.2	
12/13/2016 00:00	0.1	
	0.1	

Synop Venice





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**

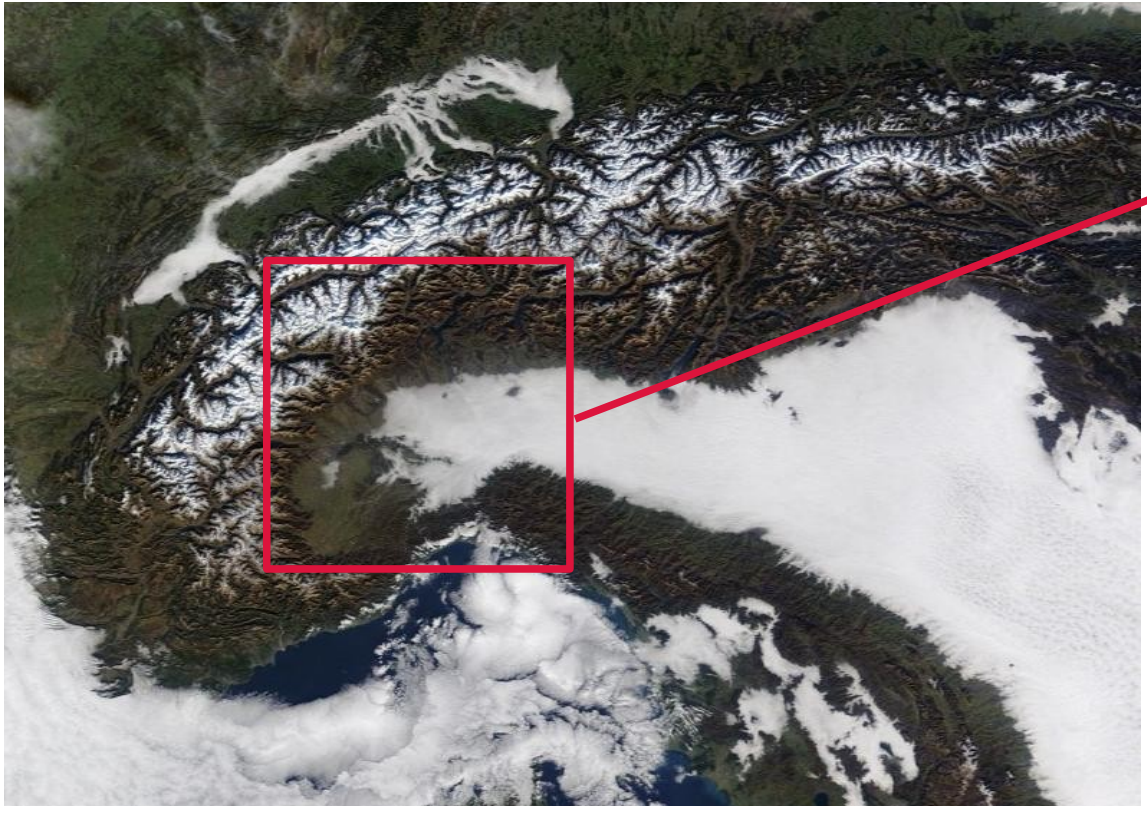




arpav

massimoenrico.ferrario@arpa.veneto.it

FREE TOOL for decode SYNOP data: link





UHI in Milan

