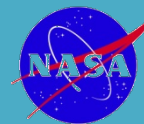




CSPP/IMAPP
Users' Group Meeting
Madison, Wisconsin (USA)
21-24 May 2013



IMPLEMENTATION OF IMAPP/IDEA-I OVER THE PO VALLEY REGION, NORTHERN ITALY, FOR AIR QUALITY MONITORING AND FORECASTING

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Outline

- Po Valley Domain: area of interest
- IMAPP IDEA-International Application
- PM₁₀ – AOD Correlation: ground stations over Po Valley
- Aerosol vertical distribution: analysis of PBL information
- PM₁₀ – AOD Correlation improvement: use of PBL information over the Po Valley
- Conclusion
- Outgoing and Future work

Po Valley



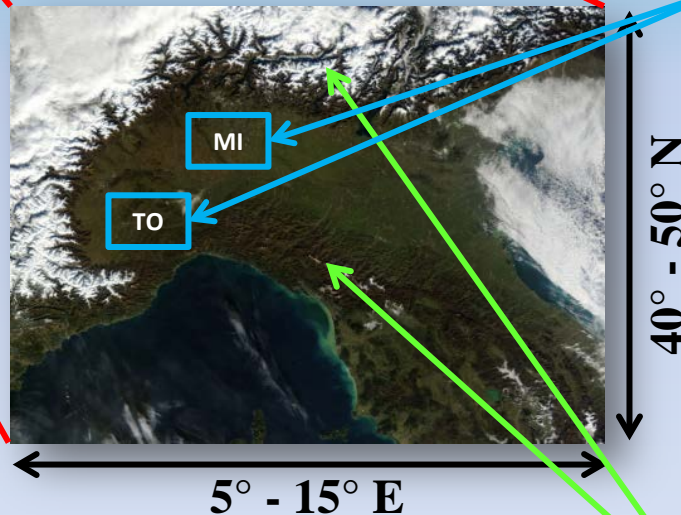
Specific **geographic domain** of interest

The largest **industrial, trading** and **agricultural** area with a high population density

Area with the most severe **air pollution** problems in the country



Alpine chain acts as a barrier to winds blowing from Northern Europe and the Mediterranean, favoring the **stagnation of pollutants**





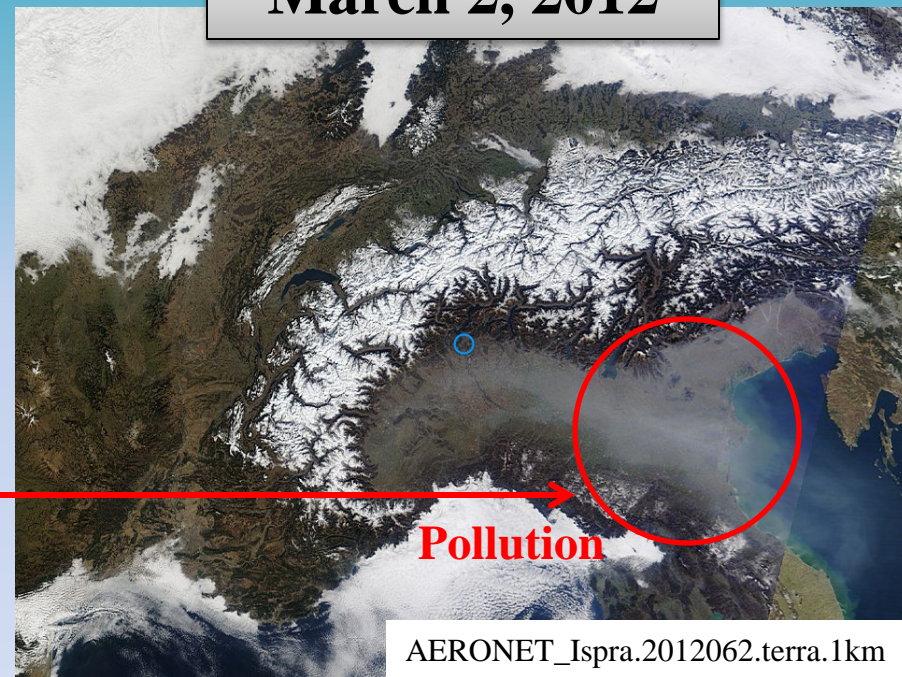
Po Valley IDEA-International Application (I)

March 1, 2012



MODENA

March 2, 2012



	March 2, 2012
Temperature (K)	285,8
Rel.Humidity (%)	70.5
Wind direction (°)	ENE
PM ₁₀ mean value (µgm ⁻³)	76.9
AOD mean value	0.28

Po Valley IDEA-International Application (II)

MODIS AOD & AOD Trajectories on 2012-03-02 10Z

The use of Terra or Aqua MODIS AOD (Aerosol Optical Depth) products – available daily – by IDEA-I permits

VENTING OF AEROSOL TO SOUTH-EAST

real-time

HOW DOES MODIS AOD COMPARE TO SURFACE PM_{10} IN THE PO VALLEY?

↑ PM_{10}
↑ AOD

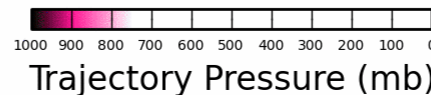
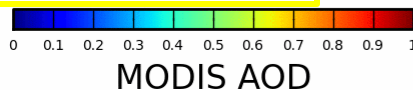
OR

↑ PM_{10}
↓ AOD

BACKG

BASEMAP:
daily Terra MODIS AOD product (MOD04)

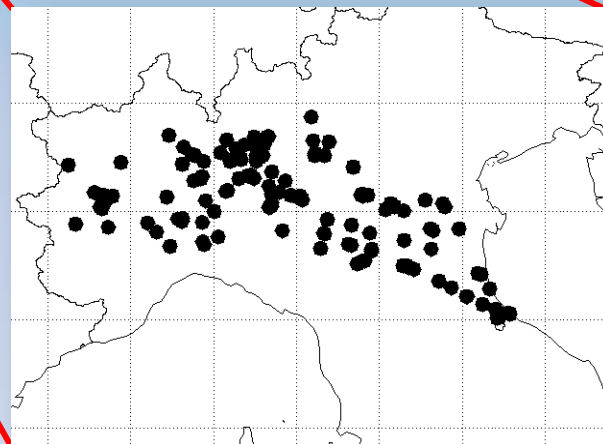
USED TO INITIALIZE TRAJECTORIES WHICH SHOW WHERE THE AEROSOL WILL MOVE IN THE NEXT 48 HRS.



Po Valley Surface PM₁₀ Network



Specific **geographic domain** of interest

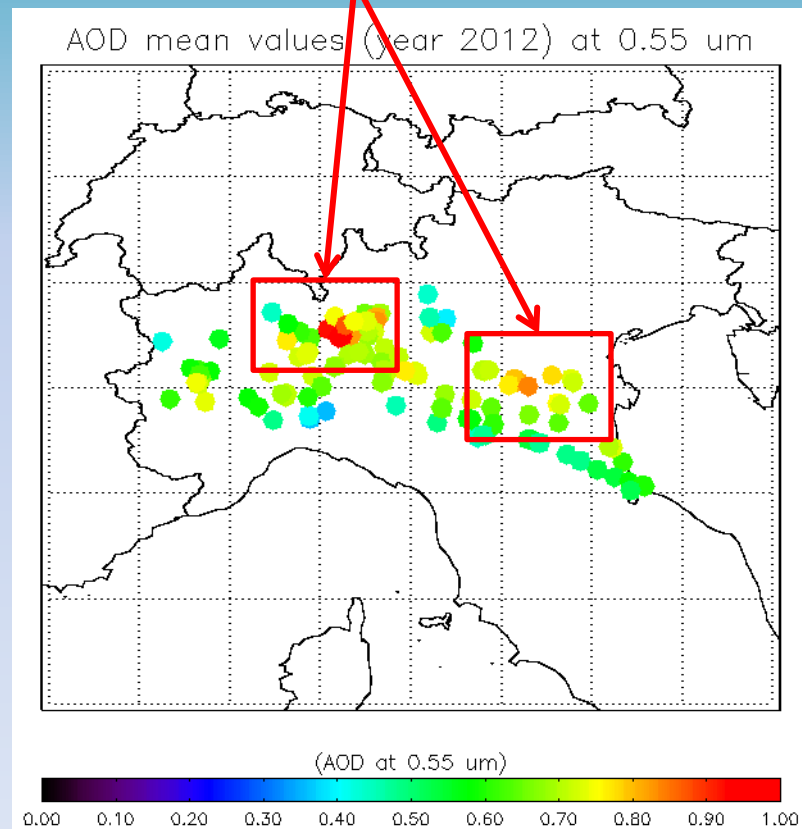
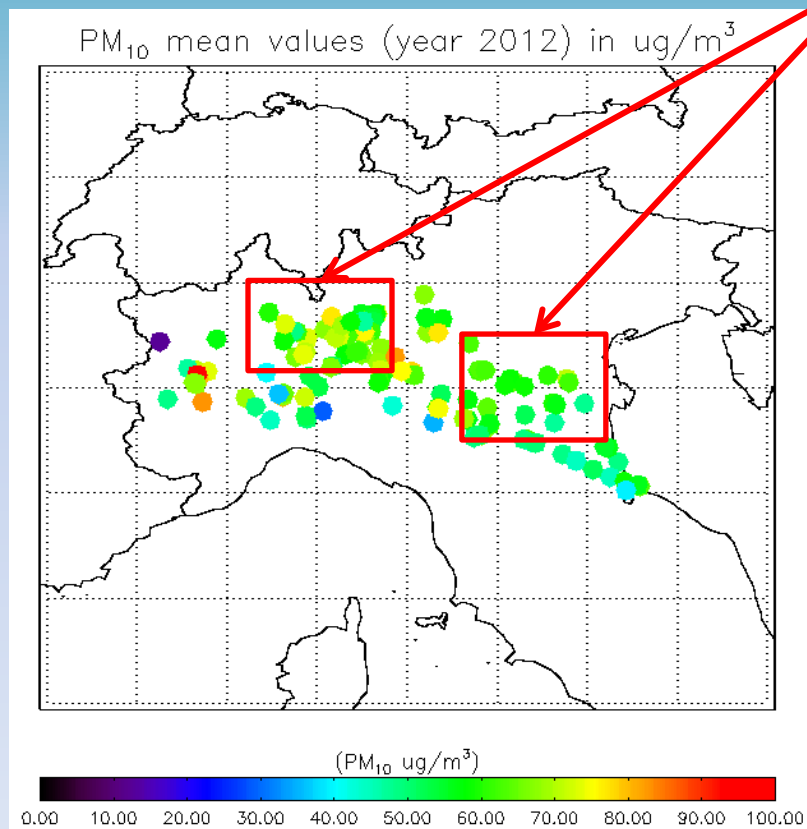


DISTRIBUTION OF 126 AIR QUALITY GROUND MONITORING STATIONS OF ARPA NETWORK FOR PM₁₀ MEASUREMENTS

MODIS (Terra) AOD DATA AT 0.55 μm WITH 10x10 km² OF SPATIAL RESOLUTION

Po Valley Surface PM_{10} vs AOD

HIGHER VALUES OF MEAN AOD DO NOT APPEAR TO CORRESPOND TO HIGHER SURFACE PM_{10}



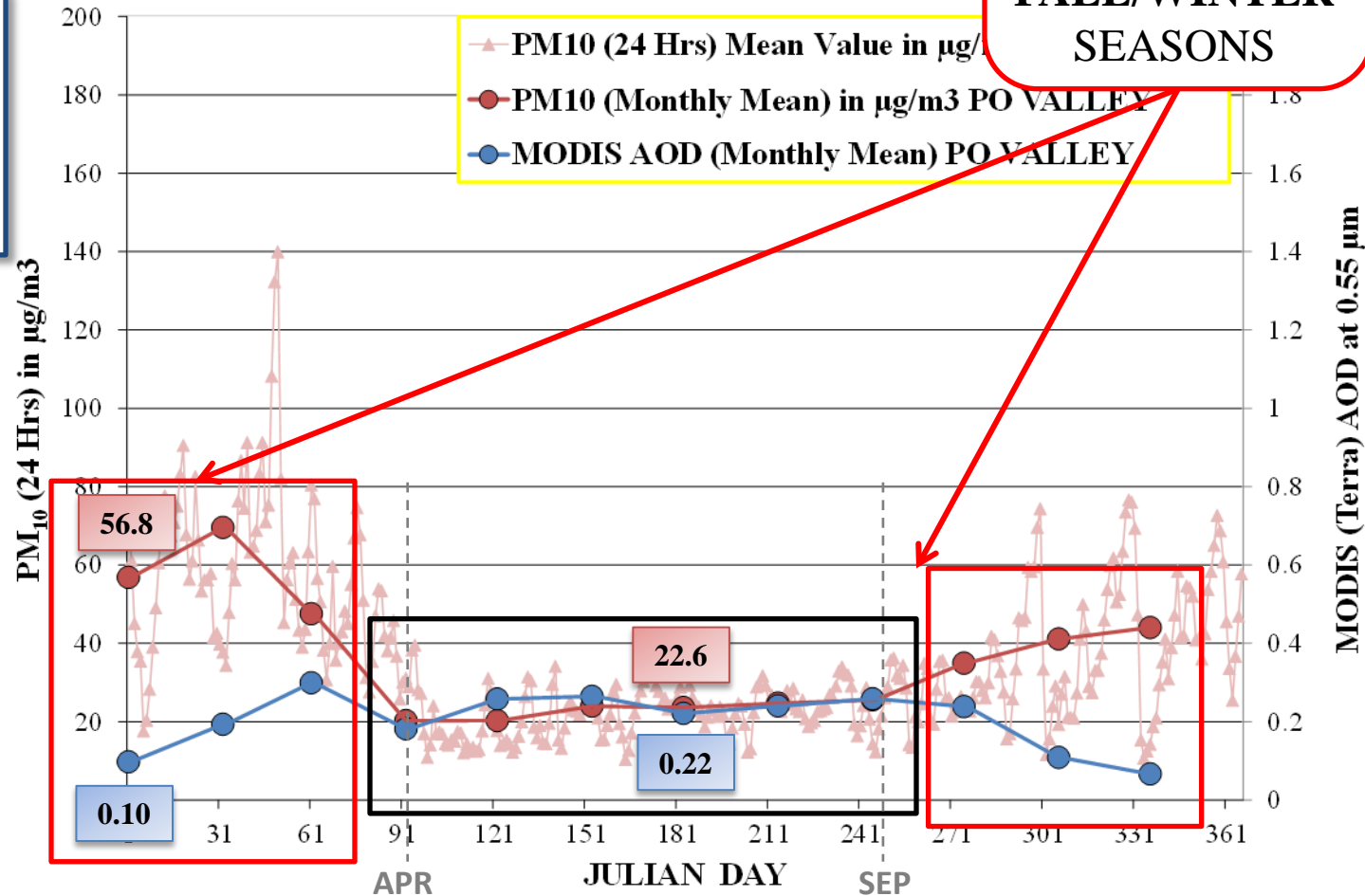
PM₁₀ – AOD Correlation (II)

No. of stations: 126

PO VALLEY (ITALY)

Variation in PM₁₀ mass concentration ($\mu\text{g}\cdot\text{m}^{-3}$) and MODIS AOD at 0.55 μm over Po valley during 2012

TRENDS NOT COMPARABLE FOR THE FALL/WINTER SEASONS



PM₁₀ – AOD Correlation (II)



CORRELATION

MAY BE IMPROVED BY CONSIDERING:

- **METEOROLOGICAL DATA**
- **VERTICAL DISTRIBUTION OF AEROSOL**

Aerosol vertical distribution:

PBL Inf

Planetary Boundary Layer
the lowest part of the atmosphere,
directly influenced by its contact
with the Earth's surface.

Aerosol C
(AOD) f
Sensing measurements

**AEROSOL CONFINED AND
MIXED HOMOGENEOUSLY
WITHIN BOUNDARY LAYER**

$$AOD = \int_0^{TOA} \sigma_{0.5}^{ext} dz$$

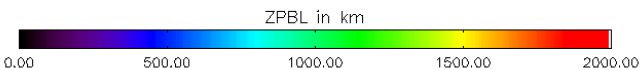
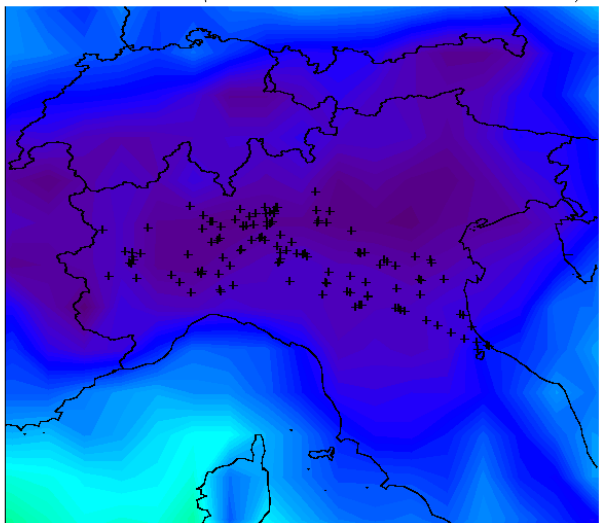
**A
O
D**

**A
O
D**

**THE VALUES OF AOD
NORMALIZED BY PBL HEIGHT
(ZPBL) MAY BE REGARDED AS
MEAN PBL EXTINCTION (km^{-1})**

Extinction coefficient

ZPBL AT 12Z (2012_01_02 - 2012_02_01)

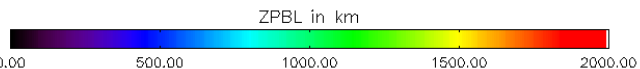
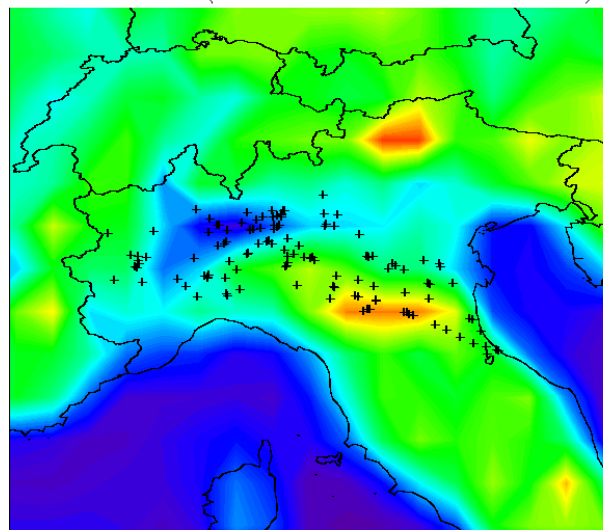


AOD Improv PBL Informa

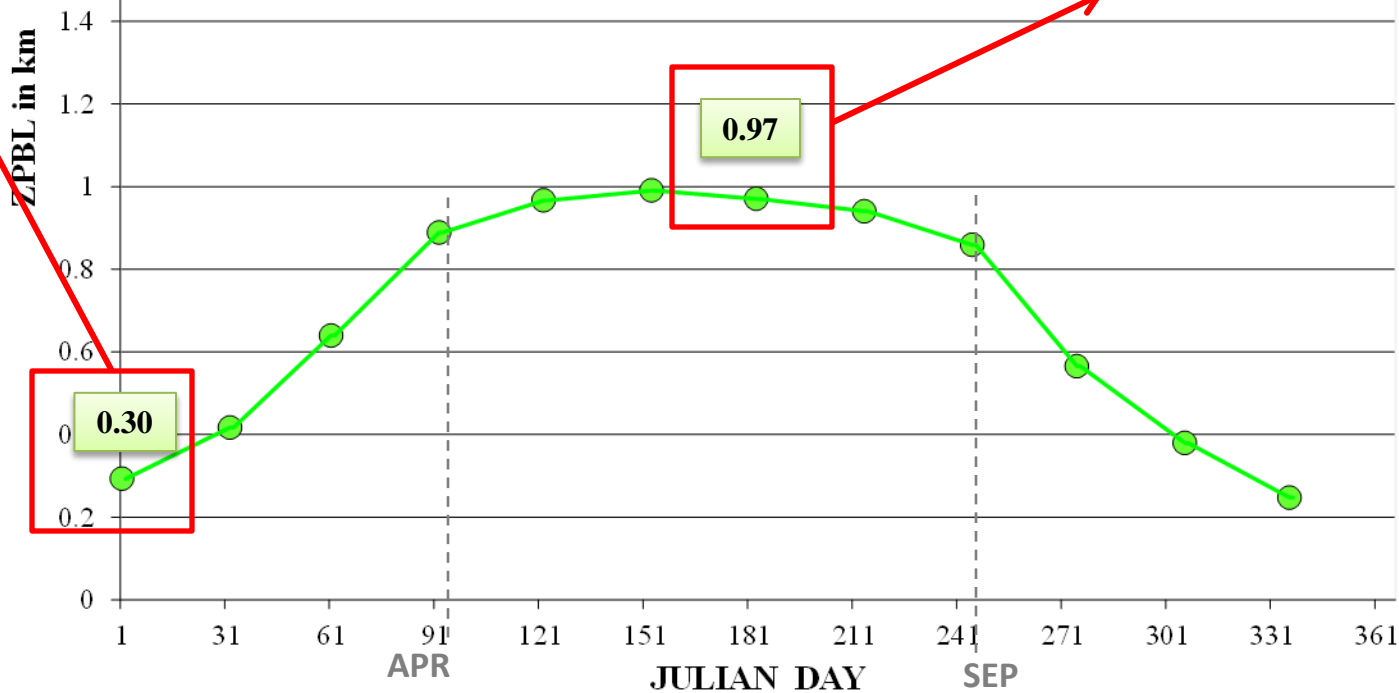
26 PO VALLEY

ZPBL

ZPBL AT 12Z (2012_07_01 - 2012_08_01)



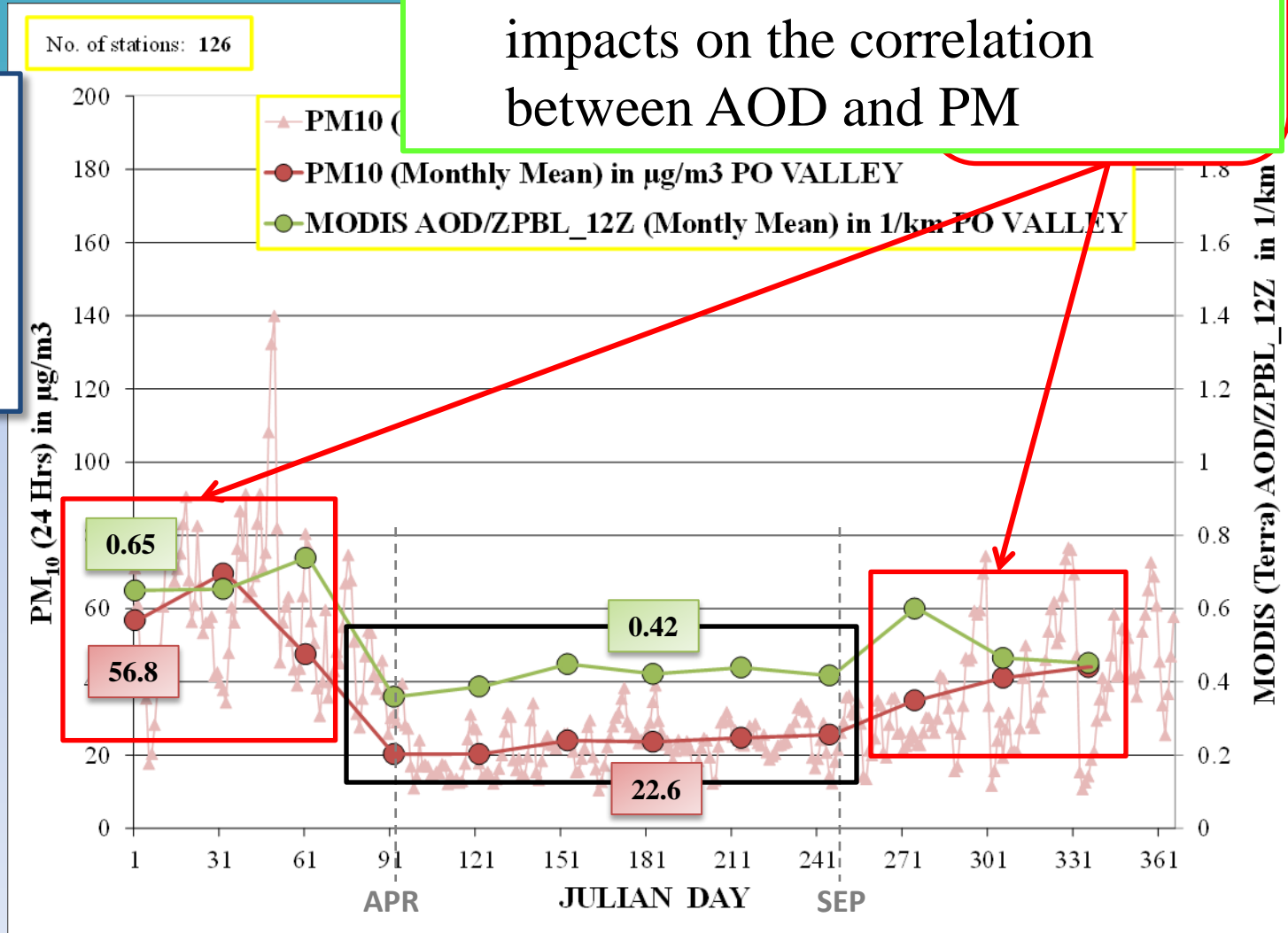
PBL values from GFS
grib2 files are used,
over Po valley during
2012



PM₁₀ – AOD I

- The majority of aerosol abundance resides in the PBL
- The thickness of PBL has direct impacts on the correlation between AOD and PM

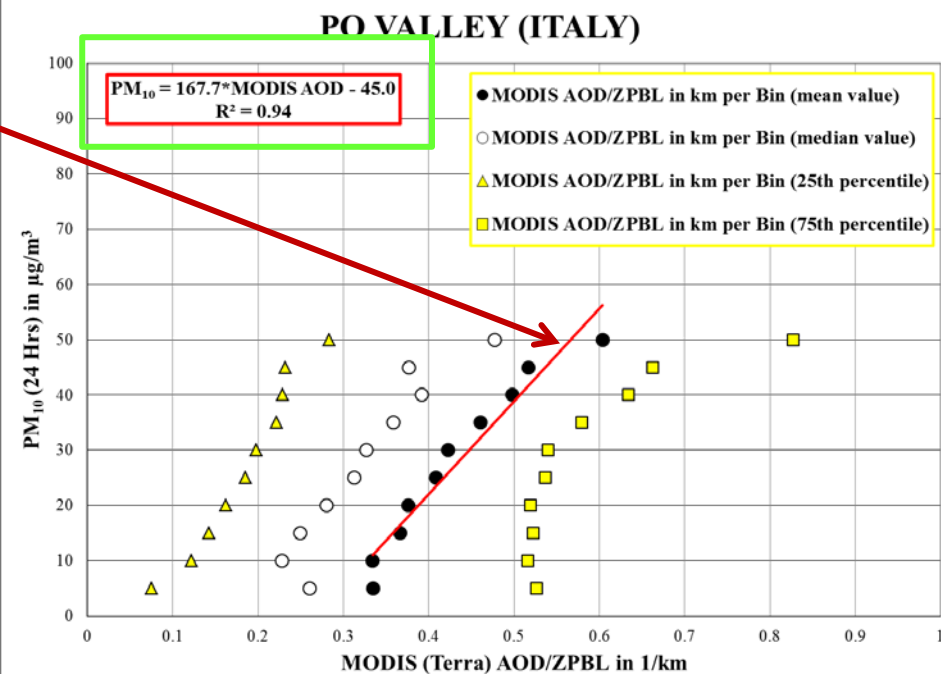
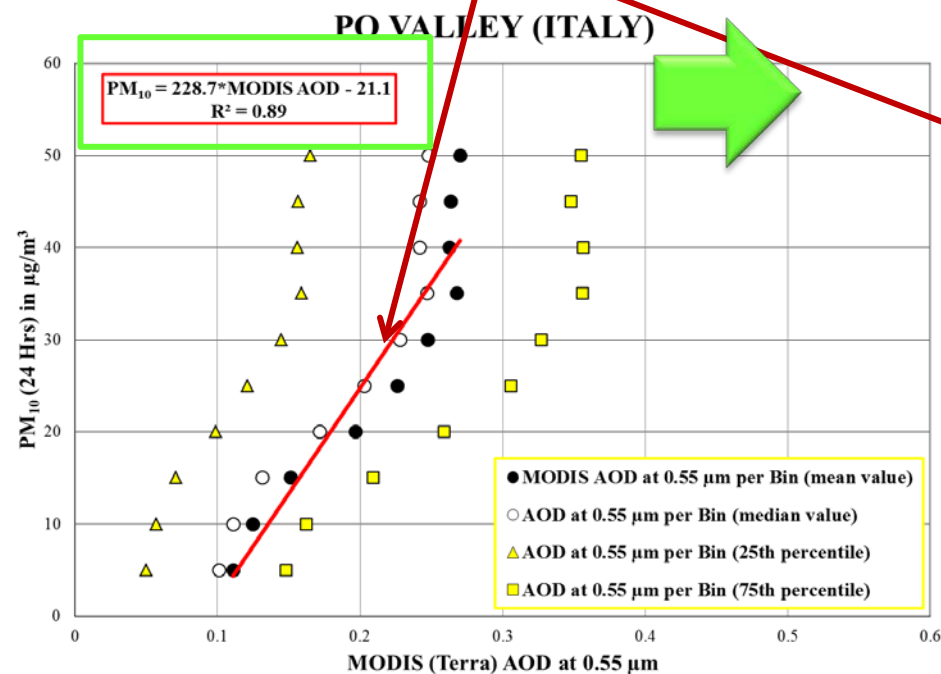
Variation in PM₁₀ mass concentration ($\mu\text{g}/\text{m}^3$) and normalized MODIS AOD at 0.55 μm by ZPBL over Po valley during 2012



PM₁₀ – AOD Correlation (II)

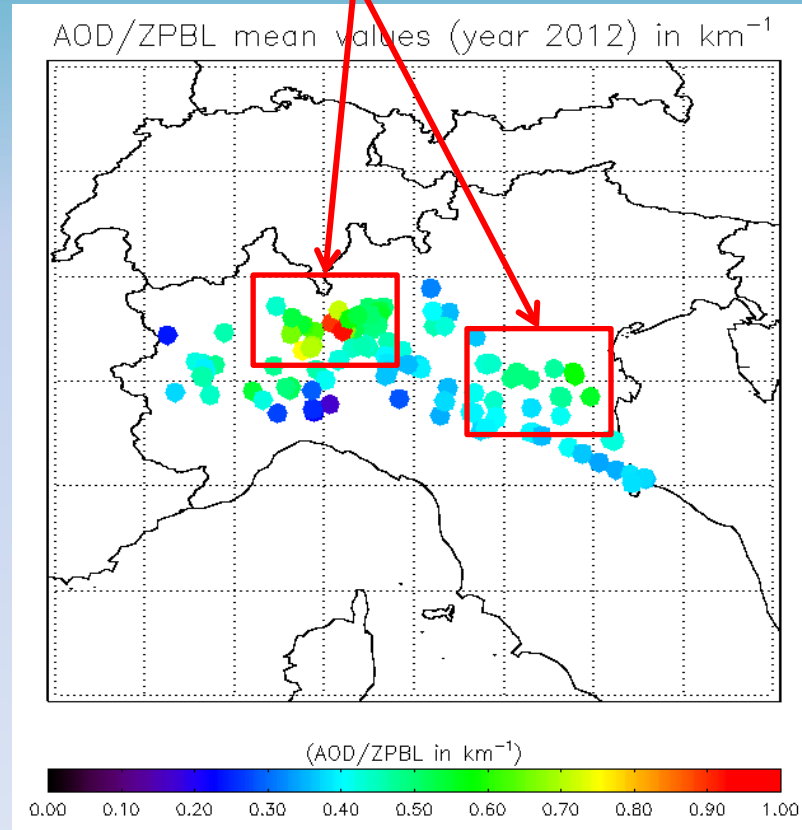
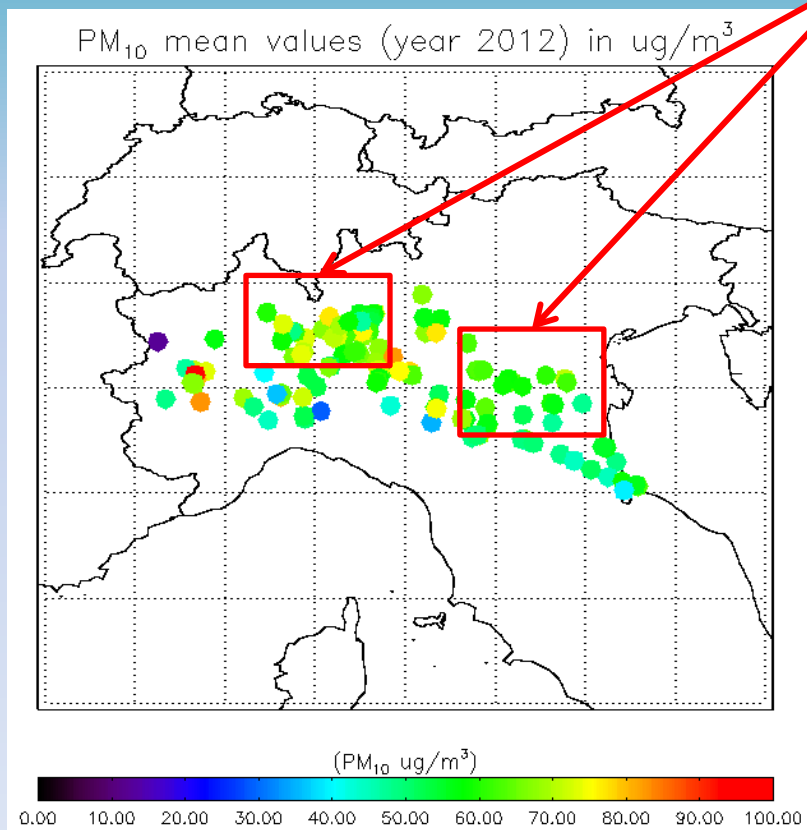
LINEAR REGRESSION EQUATION DERIVED BY DIVIDING PM₁₀ (24 Hrs) INTO 10 BINS OF 5 μg/m³ INTERVALS (Gupta et al., 2006)

THE CORRELATION PM - AOD/ZPBL IS HIGHER THAN THE PM – AOD CORRELATION



Po Valley Surface PM_{10} vs AOD/ZPBL

VALUES OF MEAN AOD/ZPBL MATCH MEAN PM BETTER ON THE EASTERN SIDE OF THE PO VALLEY



Conclusion

- IMAPP IDEA-I aerosol forecasts heightens the comprehension of air quality within the Po Valley
- MODIS AOD and AOD/ZPBL has been co-located ground-based PM_{10} concentration measurements at 126 stations over the Po Valley
- The correlation between PM_{10} and AOD/ZPBL ($R^2=0.94$) is found to be superior to the correlation between AOD and PM_{10} ($R^2=0.89$) within the Po Valley



Outgoing and Future Work

- Validation of GFS PBL analyses with CALIPSO measurements
- Improvement of spatial resolution of MODIS AOD by using 1km MAIAC retrieval (Lyapustin, A. et al., 2011)