

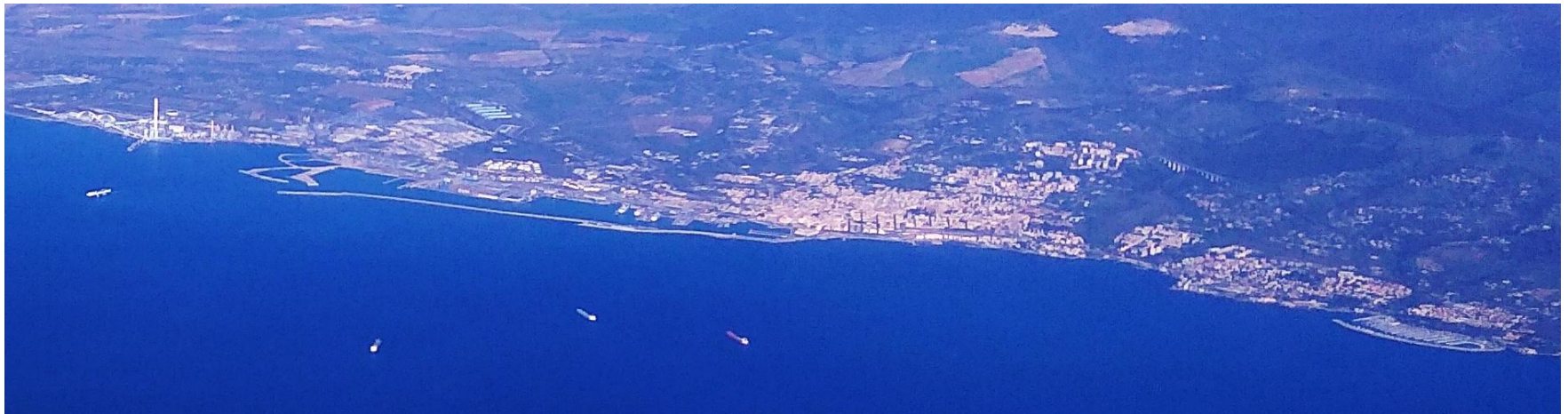
Air Quality, Black Carbon and Ultrafine particles in the Port Area of Civitavecchia

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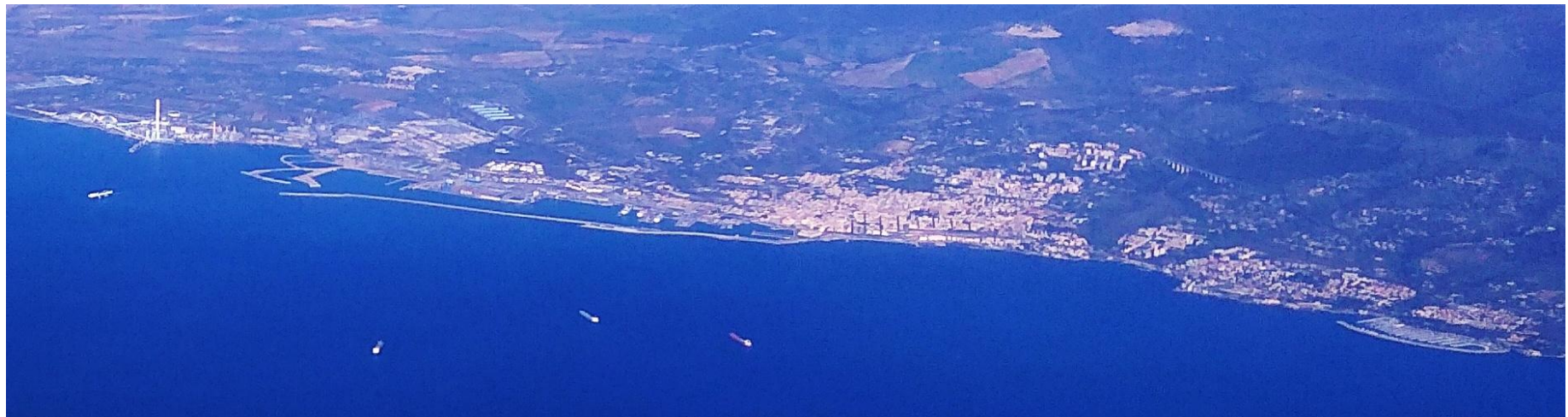
GOALS

- In spite of epidemiological studies showing higher mortality of residents with respect to the surrounding region (respiratory pathologies and cancer), air quality thresholds for PM10 and NO2 are rarely exceeded in Civitavecchia.
- This study addresses the port loads and origins of black carbon (BC) and ultrafine particles (UFP) (two pollutants with stronger associations with health effects than PM10), as measured in the month of April 2016 by the CNR-ISAC van “AEROLAB”.
- Concurrently, short and long-term air quality measurements performed by the regional environmental agency (ARPA Lazio) and by the Port Authority are analyzed to investigate the port’s impact on regulated air constituents.



BOUNDARY CONDITIONS

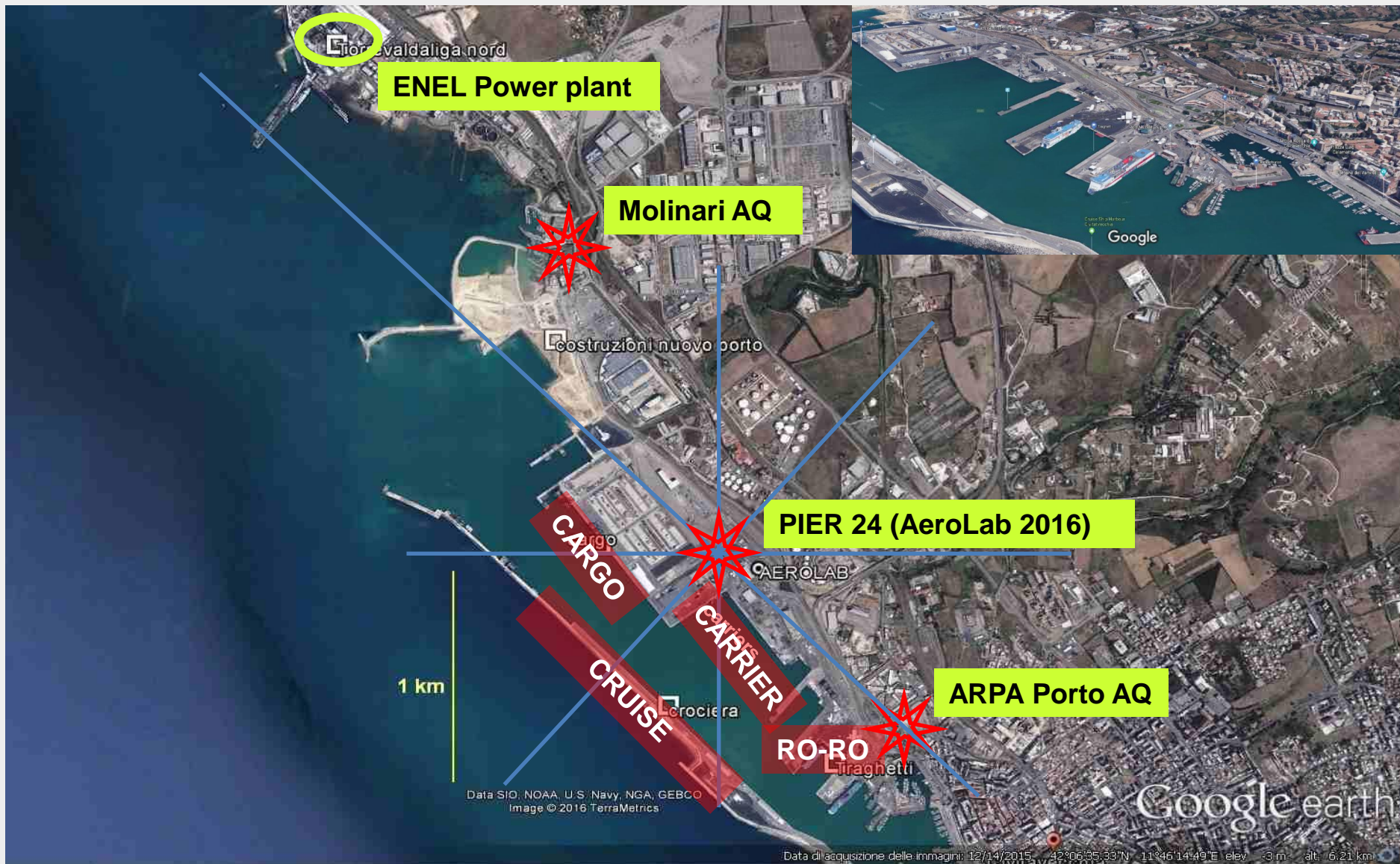
- Civitavecchia is the major port serving the Rome area in central Italy.
- In addition to regular ferry links with Sardinia, north Africa, and Spain the port hosts an important traffic of cruise ships, cargo ferries, and carrier ships summing-up to some 3000 ship movements per year, involving 4 million passengers, 1 million vehicles, and 17 Mt of goods.



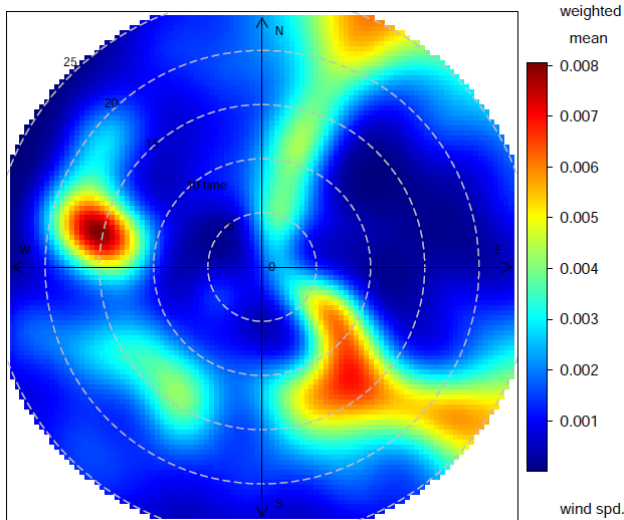
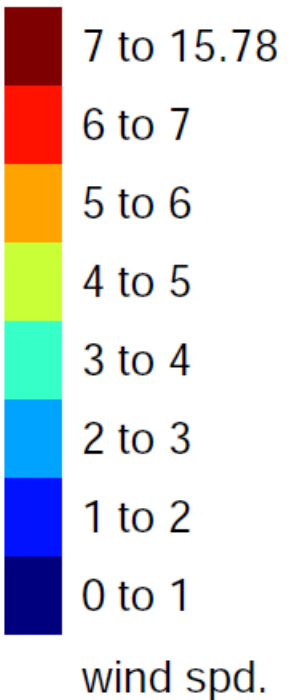
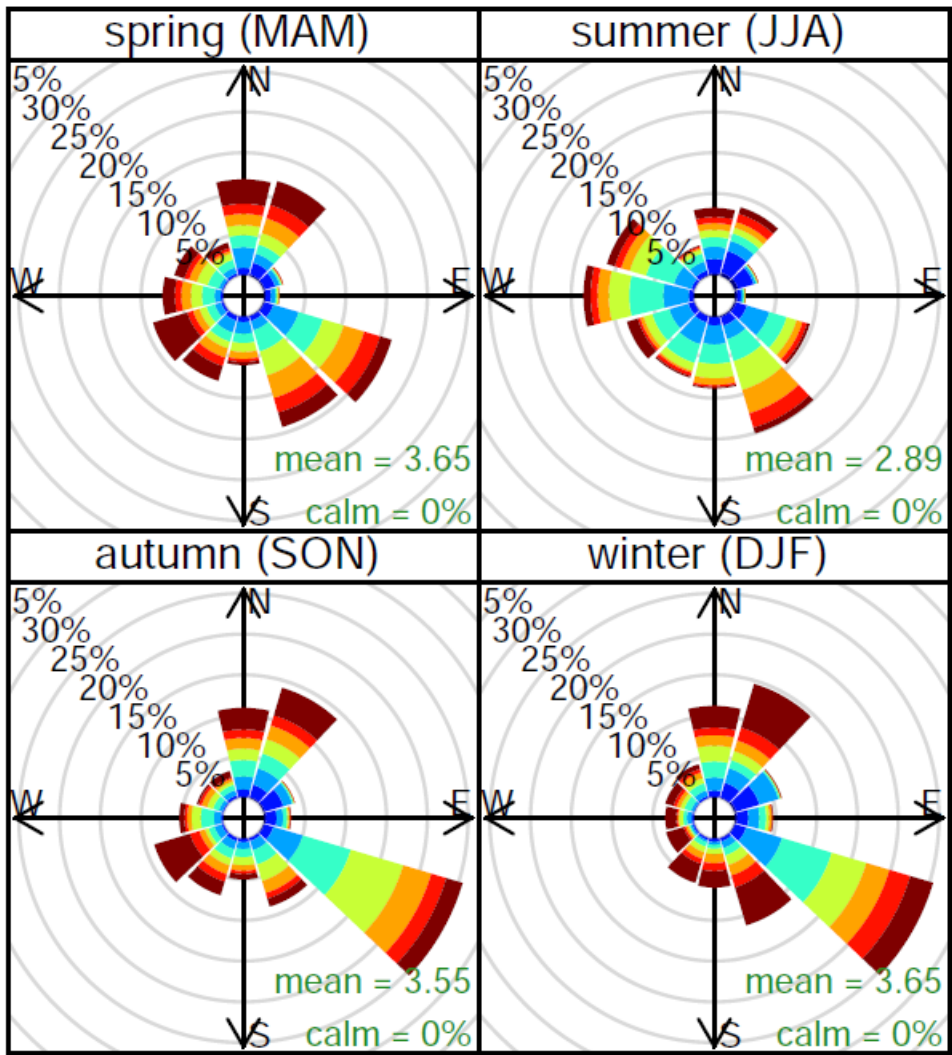
- The port touches the NW portion of the city of Civitavecchia (50,000 inhabitants), and extends NW for about 3 km, up the coal cargo pier serving the 2000 MW, coal-fired power station of Torrevaldaliga Nord .



CIVITAVECCHIA PORT'S SITES



CIVITAVECCHIA 'PORTO' STATION - WIND CLIMATOLOGY 2013-2016








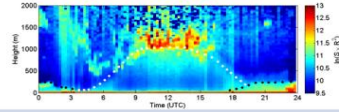


Proportion contribution to the mean (%)





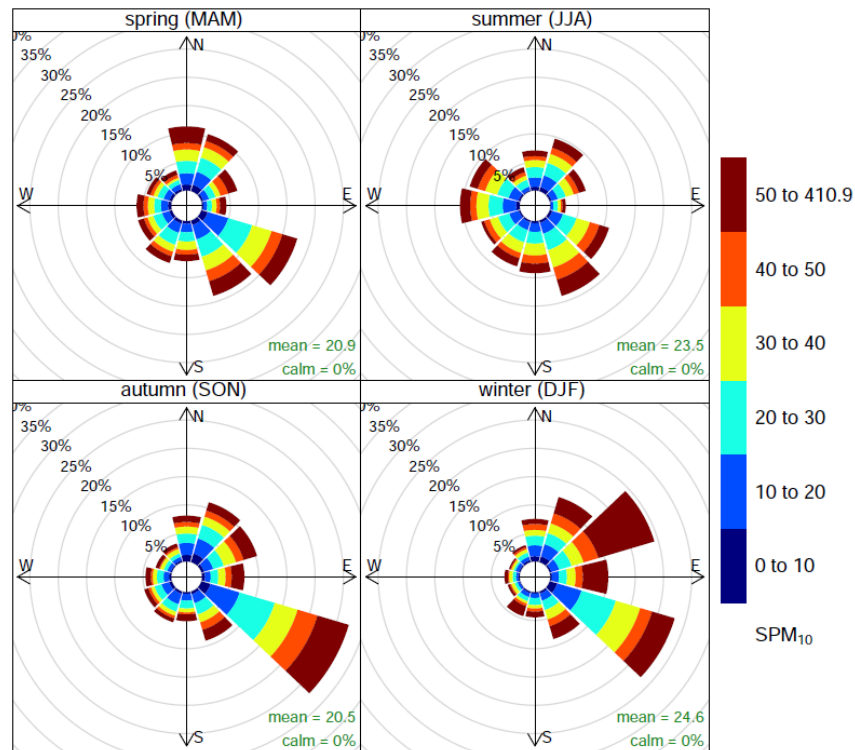
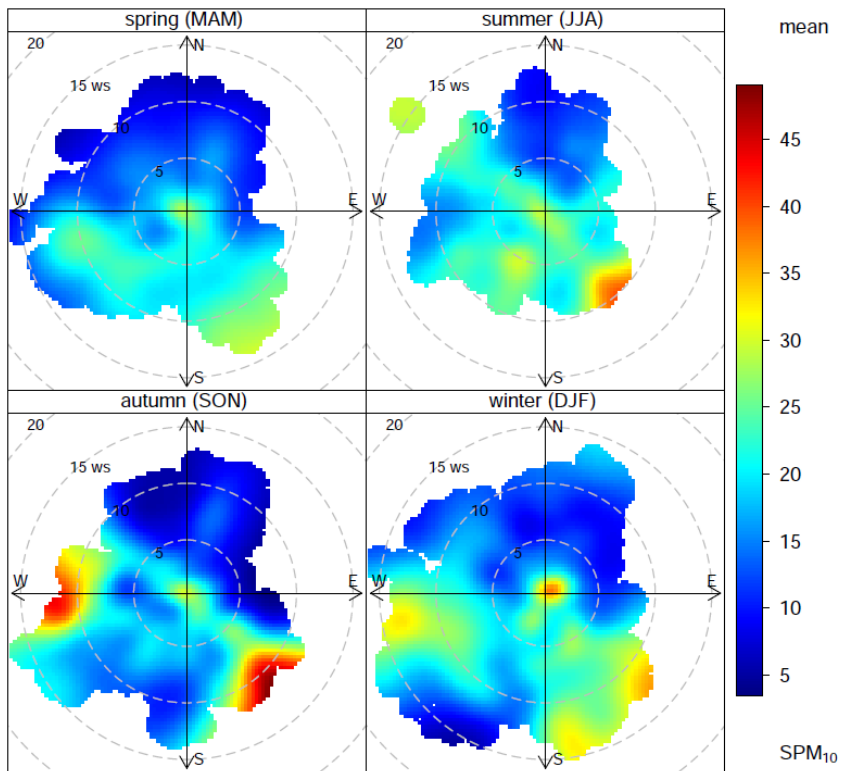
AEROLAB instrumentation



Instrument	Measured Variable	Time Res	Operation	
APS	Aerosol number size Distribution (da 500-20000 nm)	5 min	5-27APR16	
SMPS	Aerosol number size Distribution (dm 10-800 nm)	5 min	5-27APR16	
Nephelometer	Aerosol Scattering Coeff. @ 3 wavelengths	1 min	5-27APR16	
Aethalometer	Aerosol Absorption Coeff. @ 7 wavelengths	1 min	5-27APR16	
OPC	Aerosol (optical) size Distribution 0.25-20 um + PM10-PM2.5-PM1	1 min	5-27APR16	
CHM15K Lidar-Ceilometer	Range-resolved Aerosol Backscatter, MLH, Clouds, Fog	5 min	5-27APR16	
Meteo & Radiation	Meteo Station + Pyranometer	1 min	5-27APR16	
Aerosol Chemical Speciation Monitor-Isac-BO	PM1 organics + sulfates + nitrates (@ISAC Bologna)	20 min	12-27APR16	
PM2.5 + PM10 streaker (INFN-FI)	PIXE Elemental analysis @ INFN accelerator Florence	60 min	6-27APR16	

ARPA-Porto a Three-Year Climatology 2013-2016

PM10 (avg. 23 ug/m3)



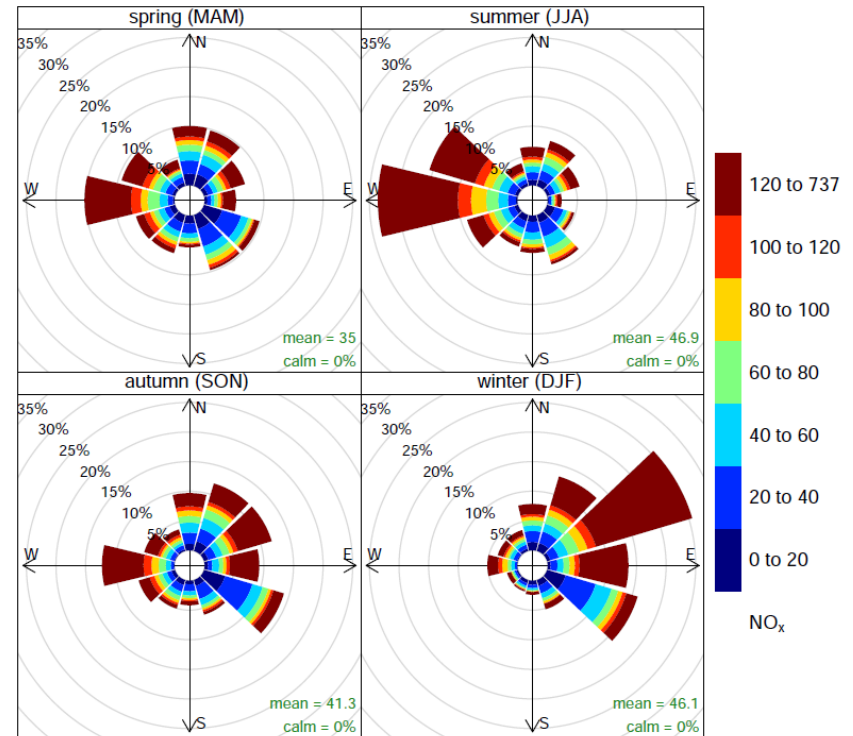
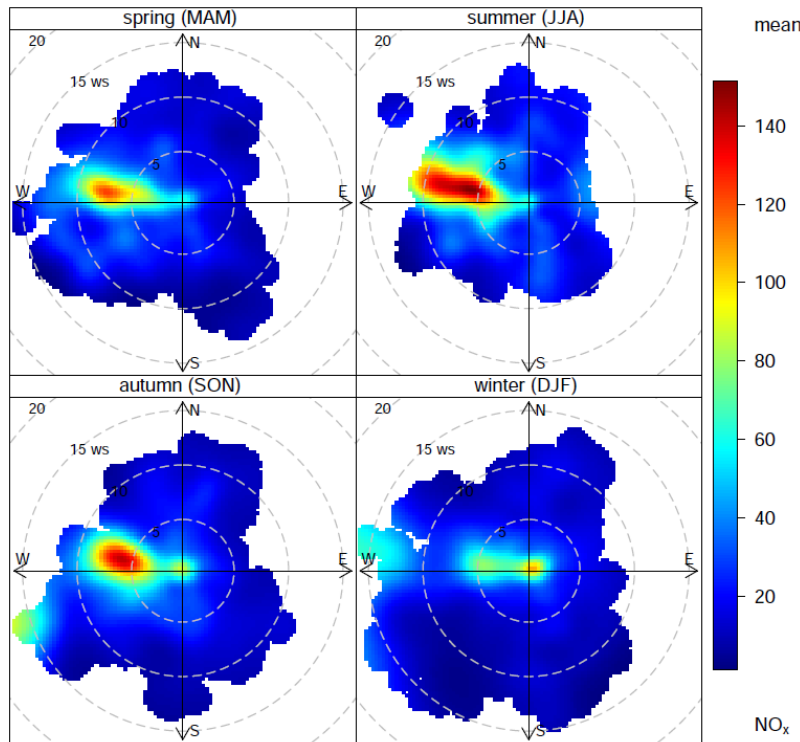
Proportion contribution to the mean (%)



ARPA-Porto Three-Year Climatology 2013-2016



NO_x (42 ug/m³)

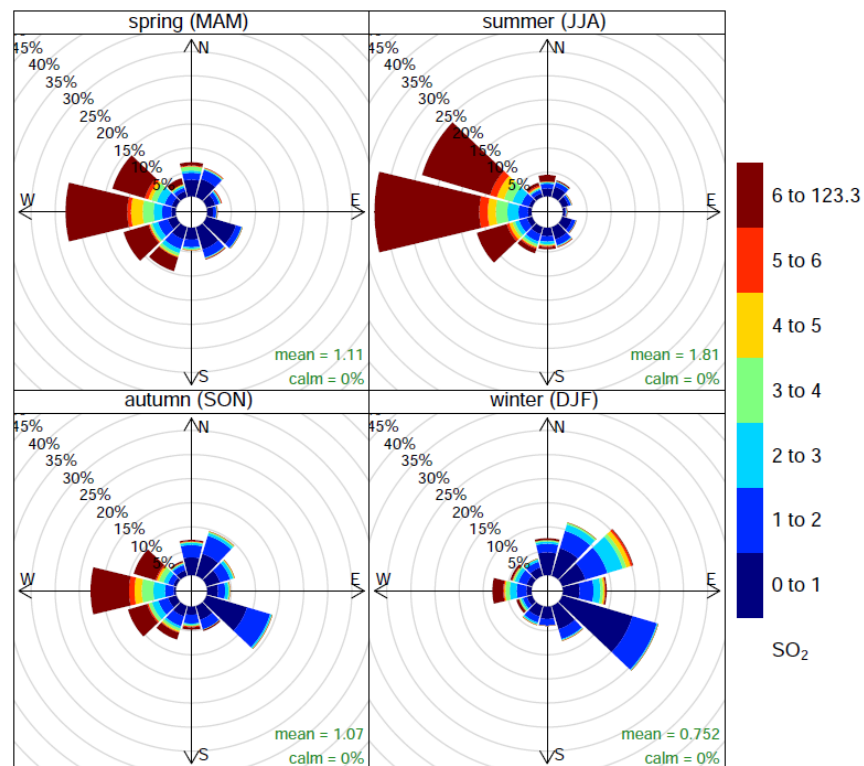
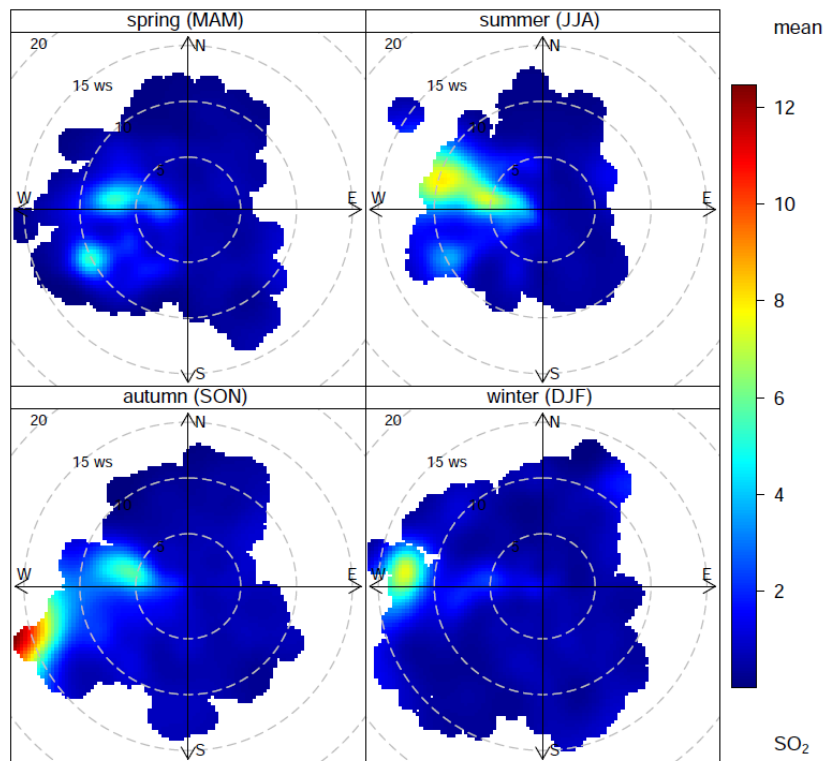


Proportion contribution to the mean (%)



ARPA-Porto Three-Year Climatology 2013-2016

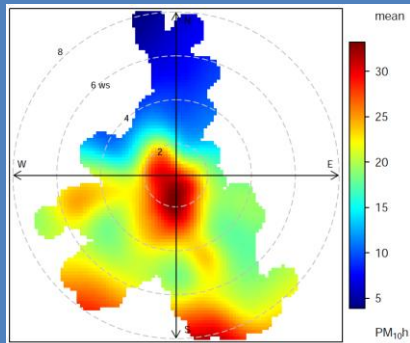
SO₂ (1.21ug/m³)



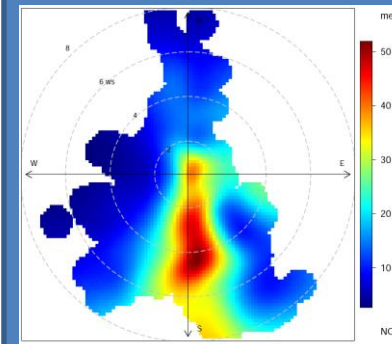
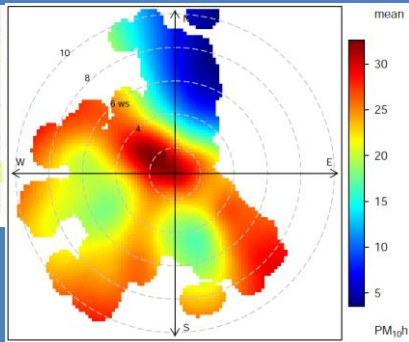
Proportion contribution to the mean (%)



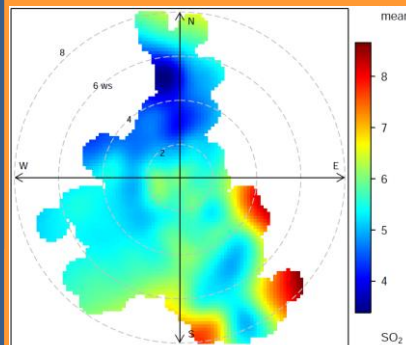
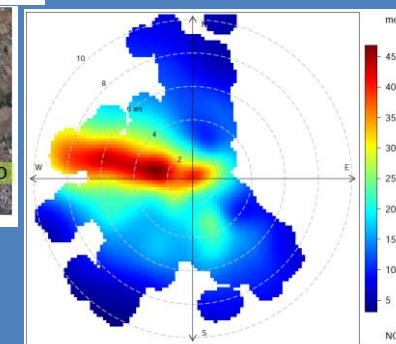
Civitavecchia – April 2016 – ARPA Porto / Molinari AQ stations



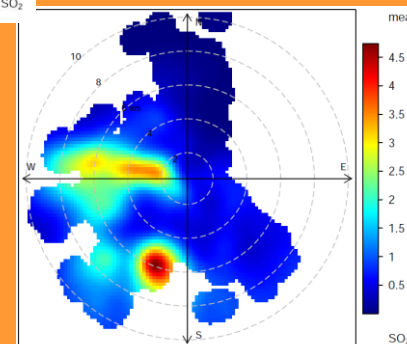
PM10
Avg. [$\mu\text{g}/\text{m}^3$]:
Molinari 23.5
Porto 26.7



NO2
Avg. [$\mu\text{g}/\text{m}^3$]:
Molinari 26
Porto 24.5



SO2
Avg. [$\mu\text{g}/\text{m}^3$]:
Molinari 5.6
Porto 1.1



Average levels and percent contribution from the port area

Regulated pollutants

PERIOD	SITE	PM10 µg/m3	% PM10 from Port	NOx µg/m3	% NOx from Port	SO2 µg/m3	% SO2 from Port
2013-2016	Arpa Porto	22.4	40%	42.6	49	1.21	65
APR 2016	Arpa Porto	26.7	30	36.2	50	1.11	65

Black Carbon and Ultra Fine Particles

DATE	SITE	eBC µg/m3	% eBC from Piers	UFP cm-3	% UFP from Piers
APR-2016	PIER 24	1.3	60	20400	75



Some Conclusions

- **The Civitavecchia port area includes important sources of pollutants affecting the city (about 50% of regulated ones); Minimum port emissions occur in winter;**
- **Principal port emissions:**
 - **BC: Ferries+Cargo+Ground Traffic+Carriers;**
 - **UFP: Ferries+Carriers+Cruise+Ground Traffic**
 - **SO₂ & NO₂: Ferries+Cruise+Ground Traffic**
 - **PM₁₀: All**
- **Local meteorology plays an important role at conveying pollutants away from the city; it should be better exploited.**
- **In April 2016, Ro-Ro ferries conveyed the highest BC+PM₁₀ emissions; Cruise ships and Ro-Ro ferries the maximum UFP and NO₂; Ferries, Cruise and Tug-boats Cruise the highest SO₂ emissions;**
- **Average levels of UFP and BC similar to the ones observed in major cities;**
- **No meaningful impact was observed from the ENEL power station;**



**THANK YOU
VERY MUCH
FOR YOUR
ATTENTION**

