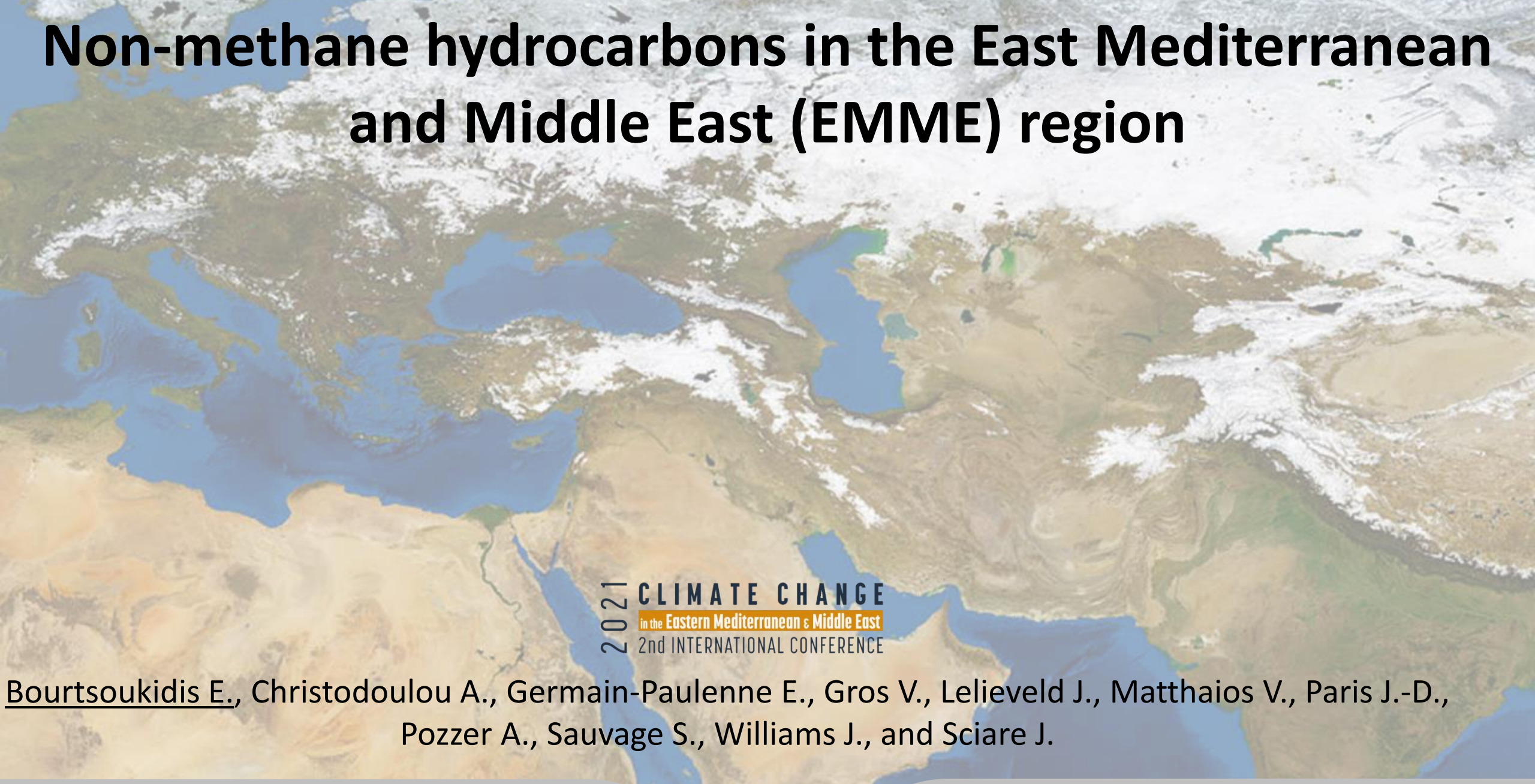
Non-methane hydrocarbons in the East Mediterranean and Middle East (EMME) region

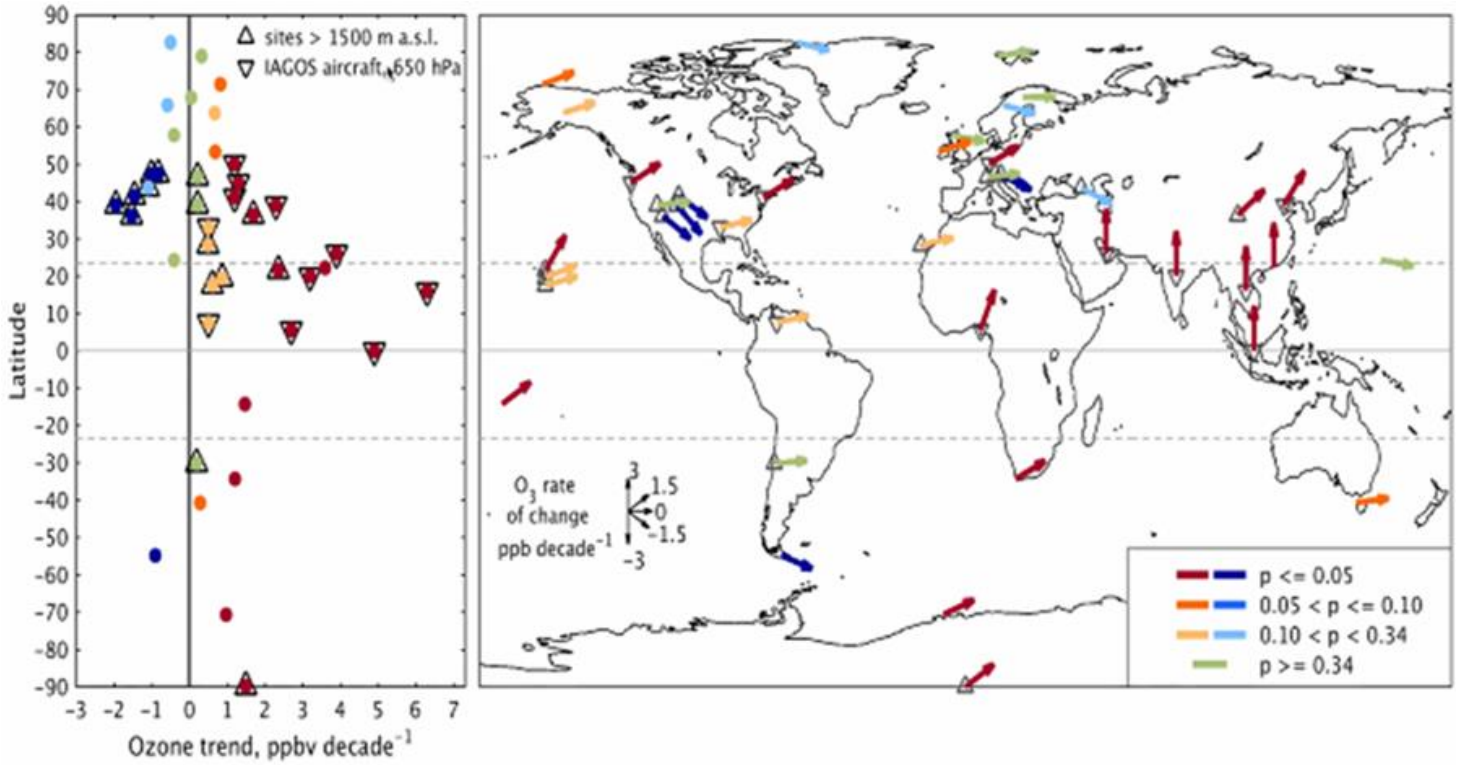


2021 CLIMATE CHANGE in the Eastern Mediterranean & Middle East 2nd INTERNATIONAL CONFERENCE

Bourtsoukidis E., Christodoulou A., Germain-Paulenne E., Gros V., Lelieveld J., Matthaios V., Paris J.-D., Pozzer A., Sauvage S., Williams J., and Sciare J.

The focus on non-methane hydrocarbons

- **Importance:** Ozone production + Source & Sink identification tracers
- **Sources:** Multiple (15 in global emission models). E.g.: Oil and Gas operations, Transport, Solvent use
- **Sinks:** Reactions with atmospheric radicals (OH, Cl, NO_3) = > Oxidative history markers
- **CARE-C objectives**: Source & sink quantification = > model evaluation focusing in the EMME region



Gaudel et al. (2020), Wang et al. (2019), Cooper et al. (2020)

The AQABA ship campaign

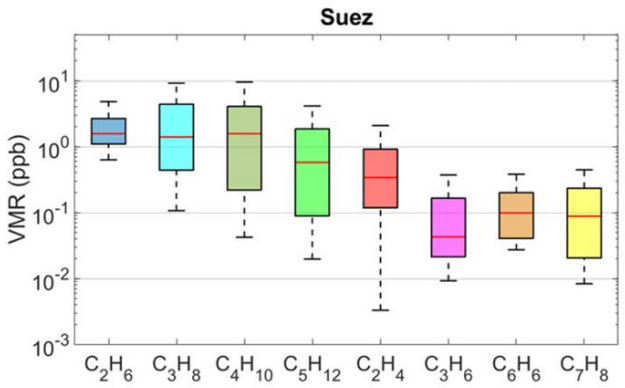
MAX PLANCK INSTITUTE FOR CHEMISTRY

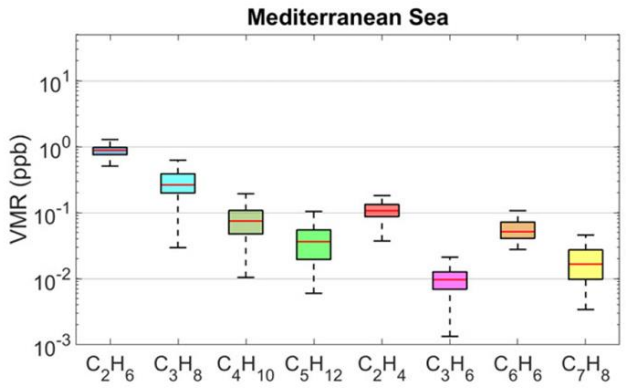
EMME-CARE
EASTERN MEDITERRANEAN MIDDLE EAST – CLIMATE & ATMOSPHERE RESEARCH CENTRE

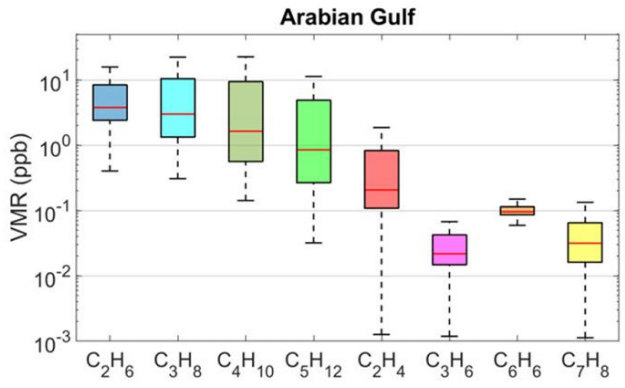
	Alkanes		Alkenes		Aromatics
1	Ethane	1	Ethene	1	Benzene
2	Ethene	2	Propene	2	Toluene
3	Propane	3	trans-2-butene	3	m,p-xylenes
4	Propene	4	1-Butene		
5	i-Butane	5	1-Pentene		
6	n-Butane	6	Isoprene		
7	i-Pentane				
8	2-Methylpentane				
9	2,2,4-Trimethylpentane				
10	n-Hexane				
11	n-Heptane				
12	Octane				

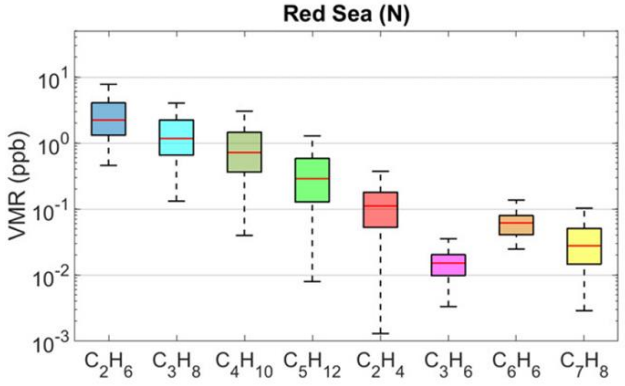
Compounds measured during the AQABA ship campaign

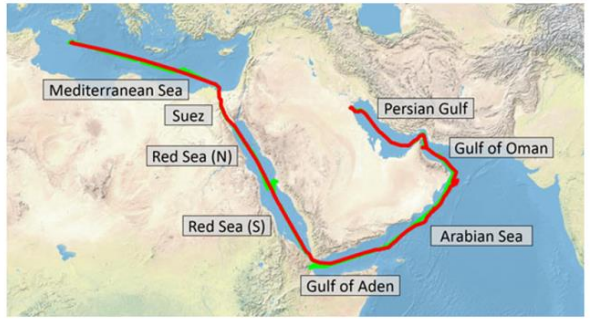
Photo by S. Dörner

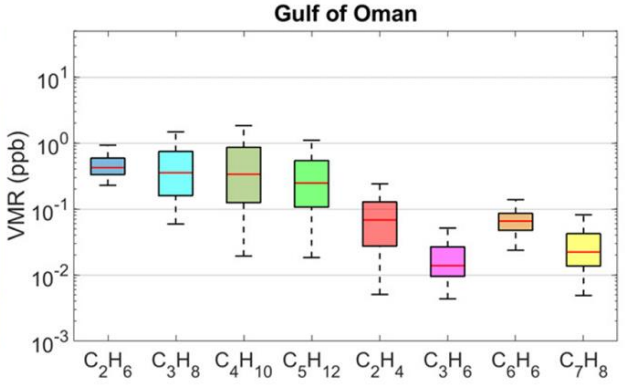

Suez
VMR (ppb)
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
C_2H_6 C_3H_8 C_4H_{10} C_5H_{12} C_2H_4 C_3H_6 C_6H_6 C_7H_8

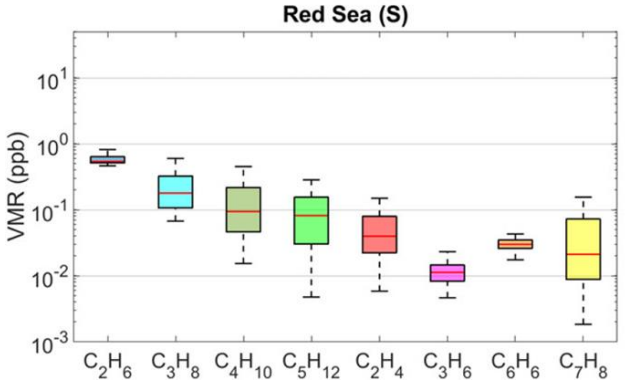

Mediterranean Sea
VMR (ppb)
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
C_2H_6 C_3H_8 C_4H_{10} C_5H_{12} C_2H_4 C_3H_6 C_6H_6 C_7H_8

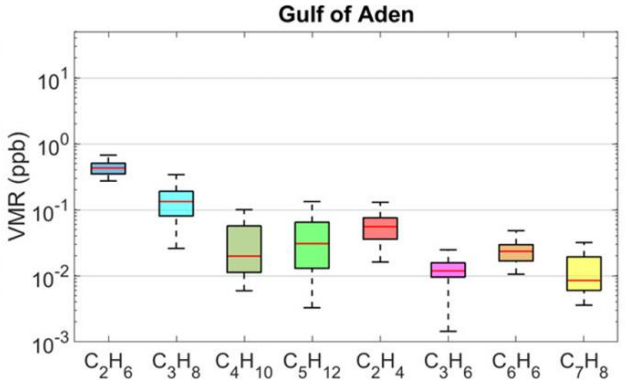

Arabian Gulf
VMR (ppb)
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
C_2H_6 C_3H_8 C_4H_{10} C_5H_{12} C_2H_4 C_3H_6 C_6H_6 C_7H_8

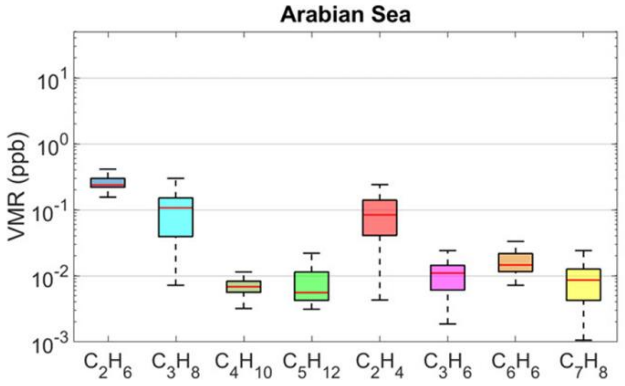

Red Sea (N)
VMR (ppb)
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
C_2H_6 C_3H_8 C_4H_{10} C_5H_{12} C_2H_4 C_3H_6 C_6H_6 C_7H_8


Mediterranean Sea
Suez
Red Sea (N)
Red Sea (S)
Gulf of Aden
Persian Gulf
Gulf of Oman
Arabian Sea

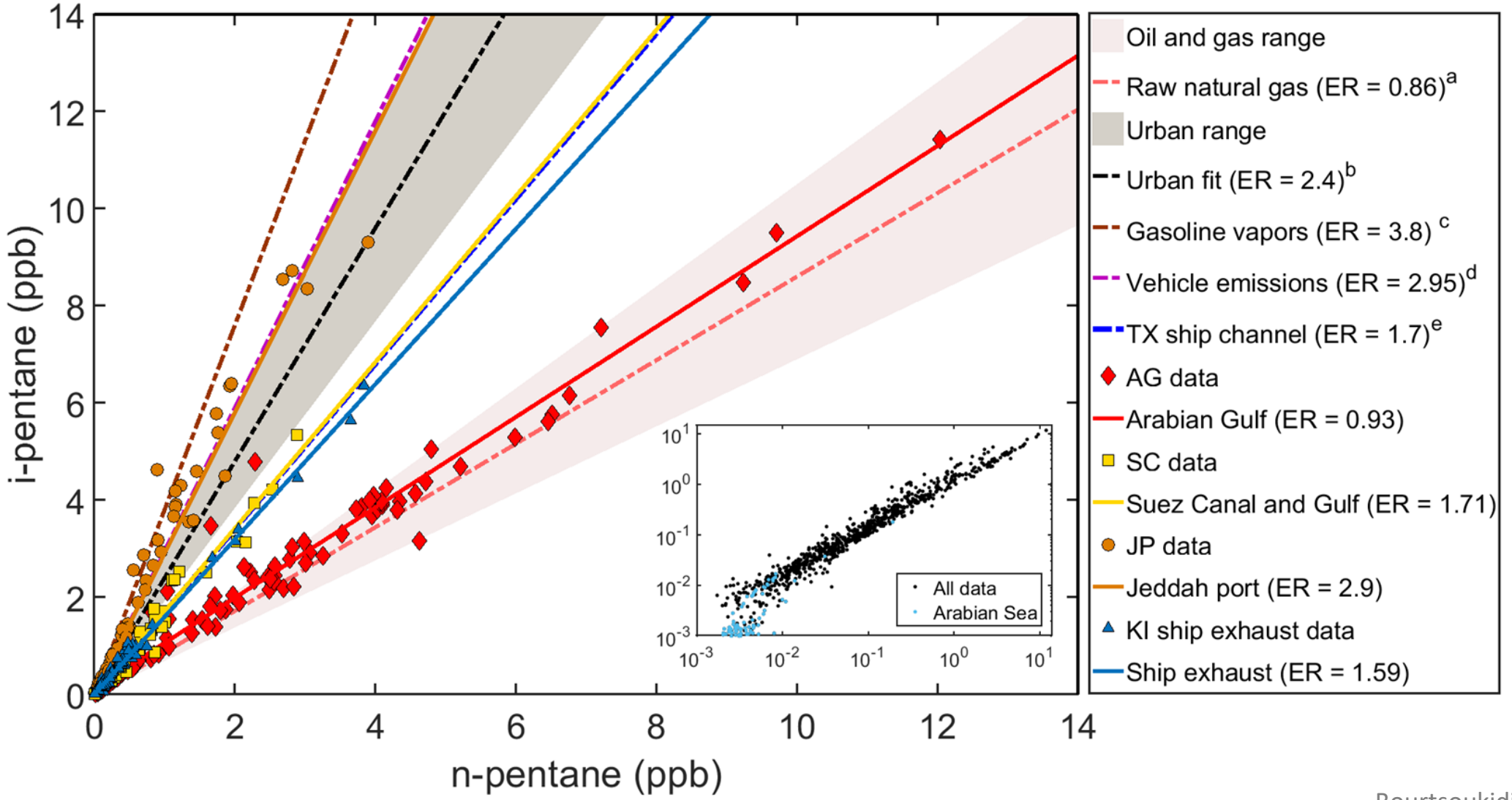

Gulf of Oman
VMR (ppb)
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
C_2H_6 C_3H_8 C_4H_{10} C_5H_{12} C_2H_4 C_3H_6 C_6H_6 C_7H_8


Red Sea (S)
VMR (ppb)
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
C_2H_6 C_3H_8 C_4H_{10} C_5H_{12} C_2H_4 C_3H_6 C_6H_6 C_7H_8


Gulf of Aden
VMR (ppb)
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
C_2H_6 C_3H_8 C_4H_{10} C_5H_{12} C_2H_4 C_3H_6 C_6H_6 C_7H_8

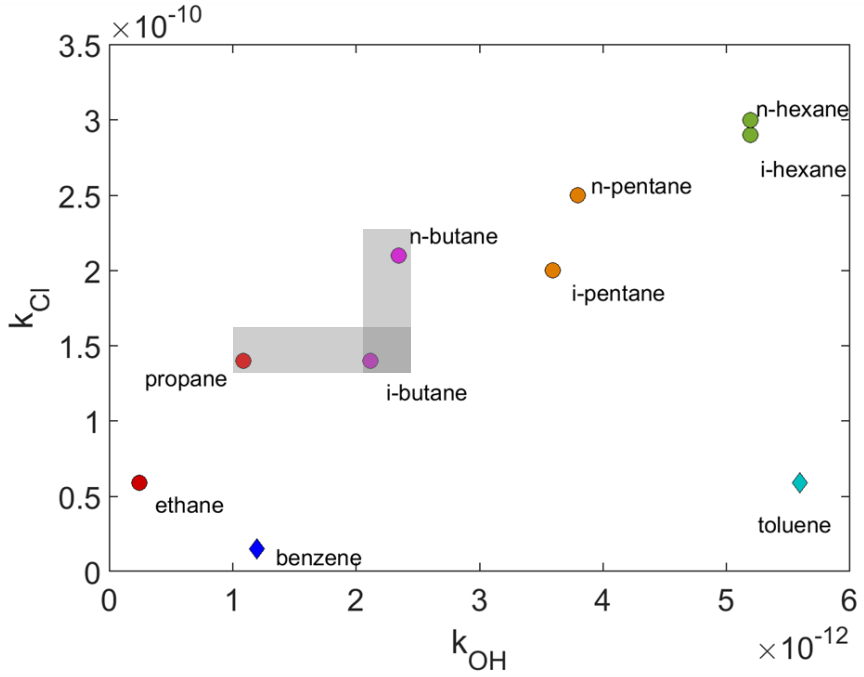

Arabian Sea
VMR (ppb)
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
C_2H_6 C_3H_8 C_4H_{10} C_5H_{12} C_2H_4 C_3H_6 C_6H_6 C_7H_8

NMHCs as source tracers : pentane isomers



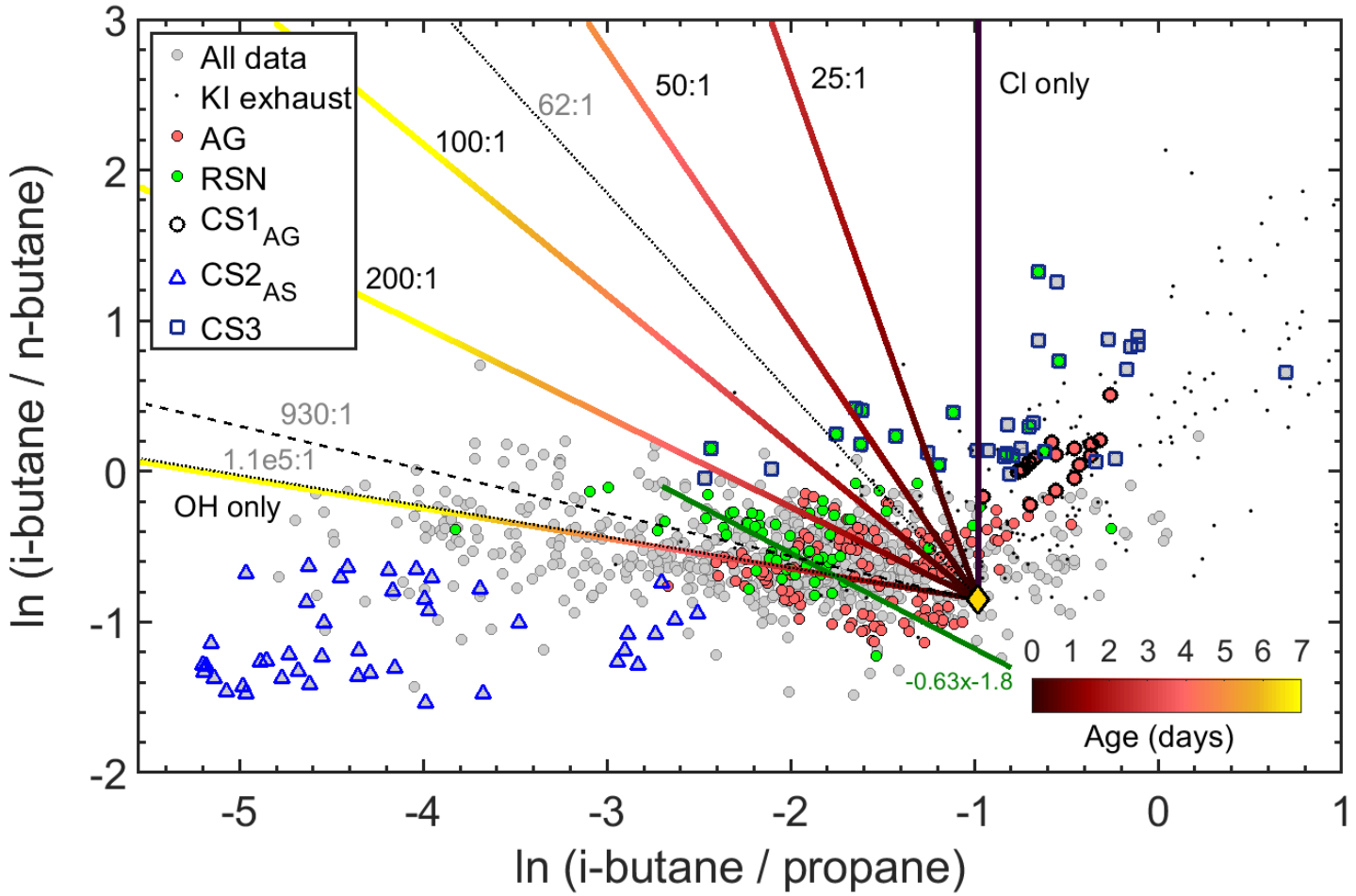
Bourtsoukidis et al., 2019

NMHCs as sink tracers : defining the radical chemistry



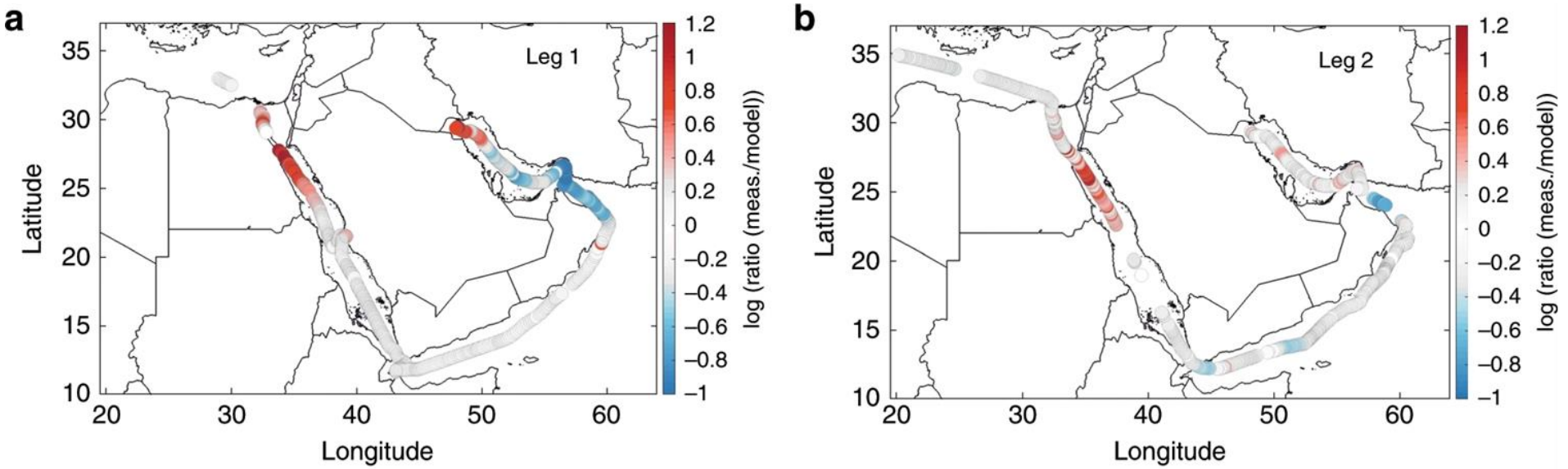
$$\frac{OH}{Cl} = \frac{-80}{\sigma + 0.2}$$

e.g. σ = -0.63 → OH/Cl = 186:1



Bourtsoukidis et al., 2019

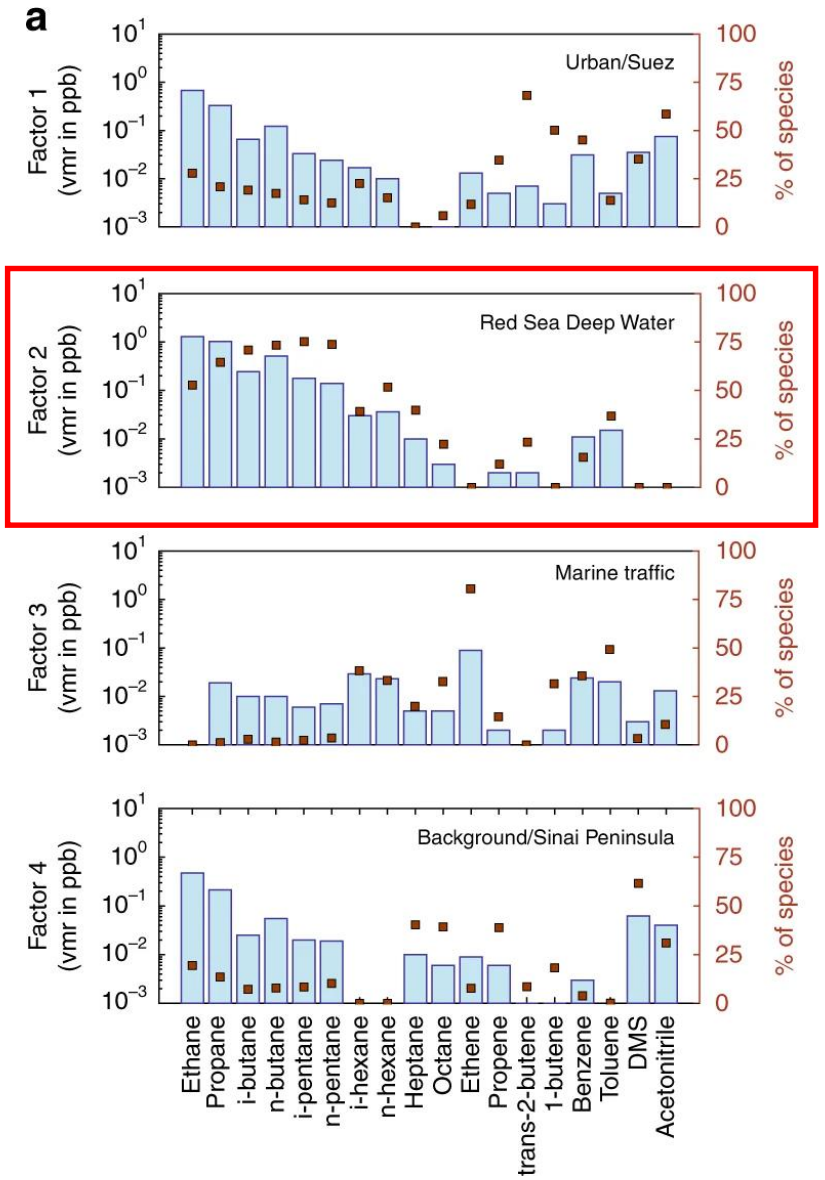
Measurements vs model simulations



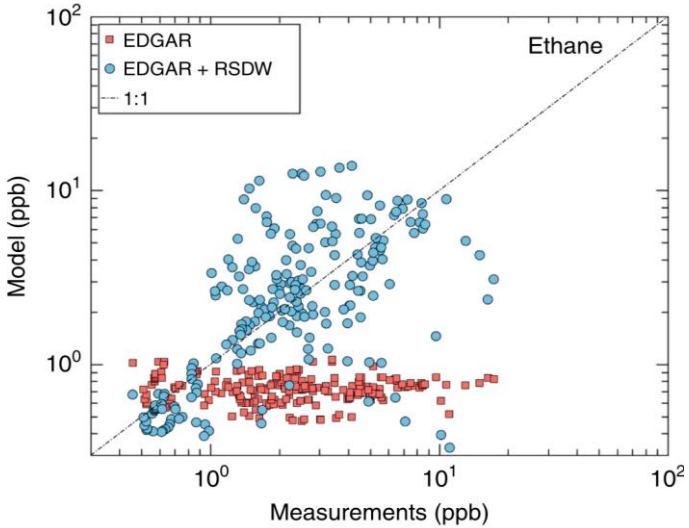
- Underprediction of observed ethane over the northern part of Red Sea up to a factor of 20!
- None of the known sources can explain the high hydrocarbon measurements

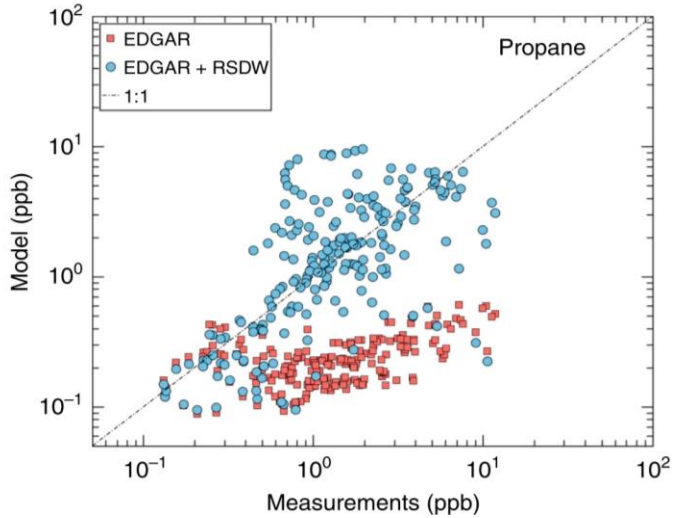
Bourtsoukidis et al., 2020

PMF analysis



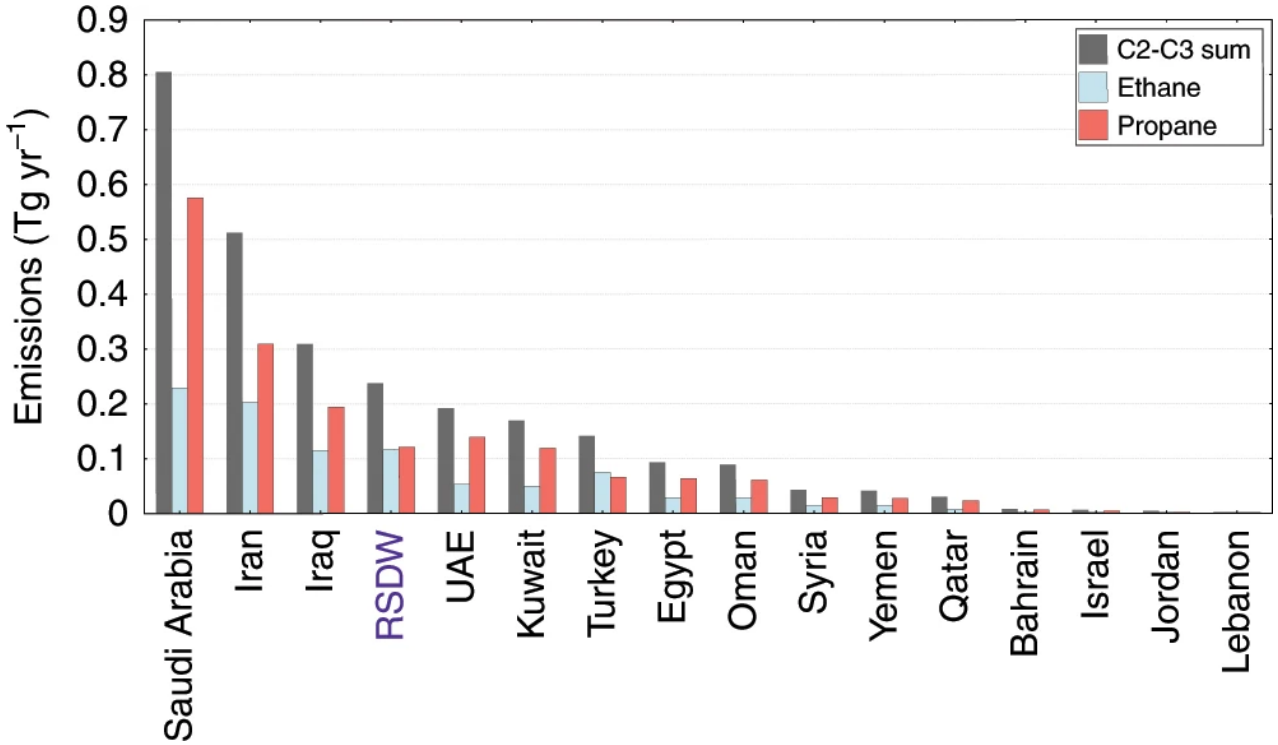
- PMF identified 4 distinct chemical signatures. Factor 2 :
  - High in light hydrocarbons (C2-C6)
  - Absence of anthropogenic influence (i.e. no alkenes)
  - Independent from wind direction / air trajectories
  - Correlation with sea-air exchange mechanisms



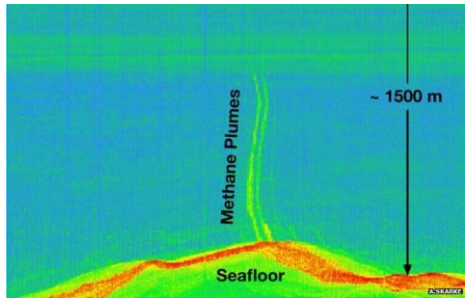


Bourtsoukidis et al., 2020

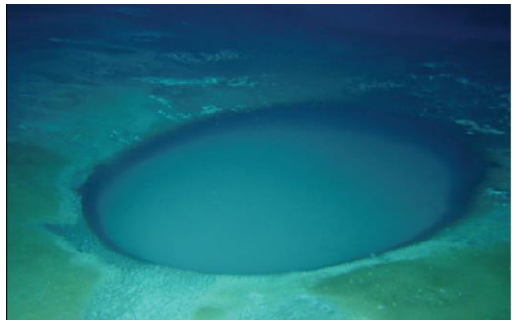
A new potent source of atmospheric hydrocarbons



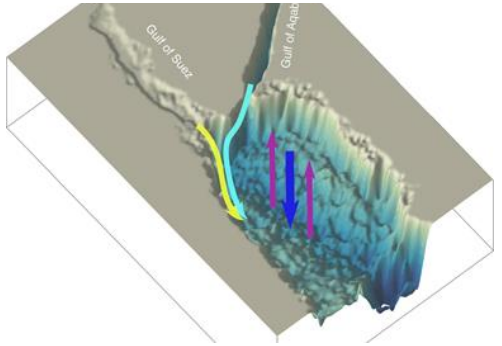
Seepage



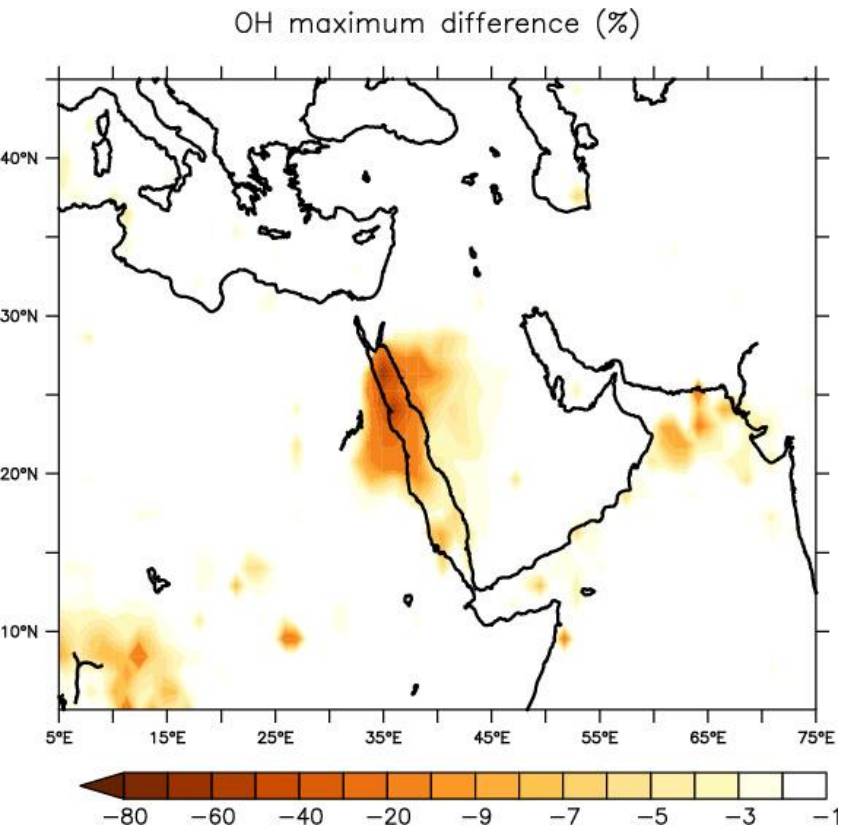
Brine pools

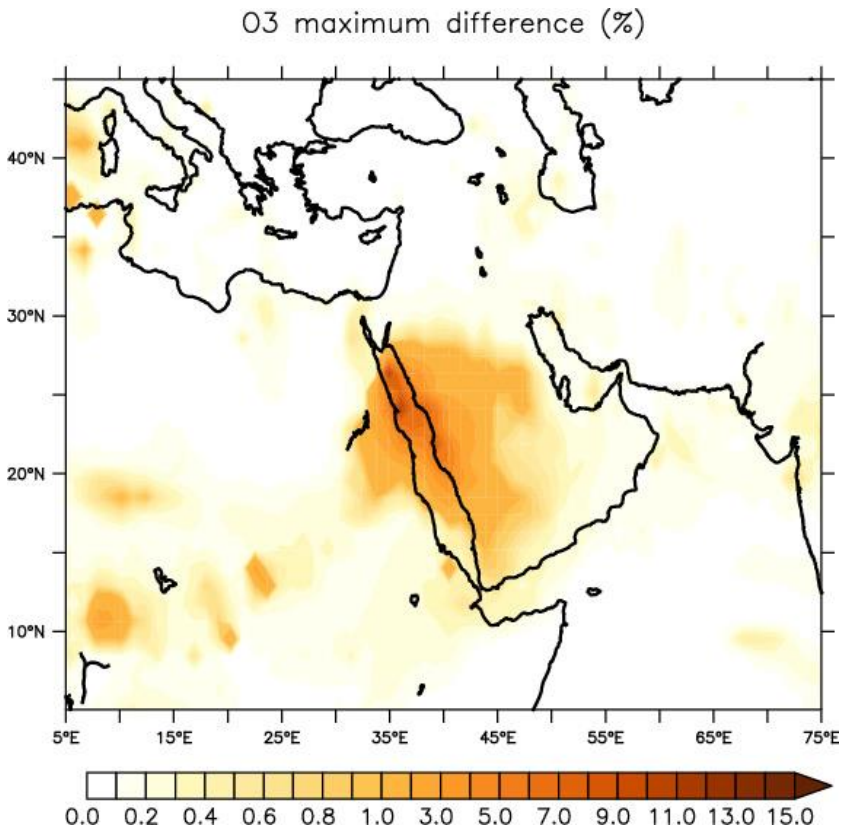


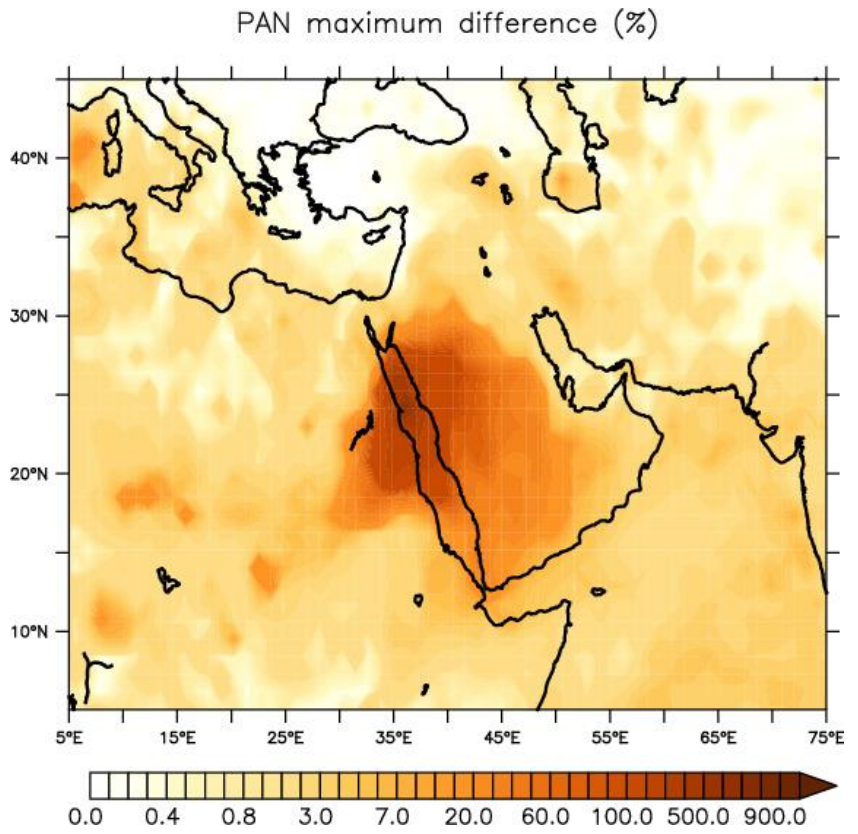
Leaks from oil rigs



Bourtsoukidis et al., 2020



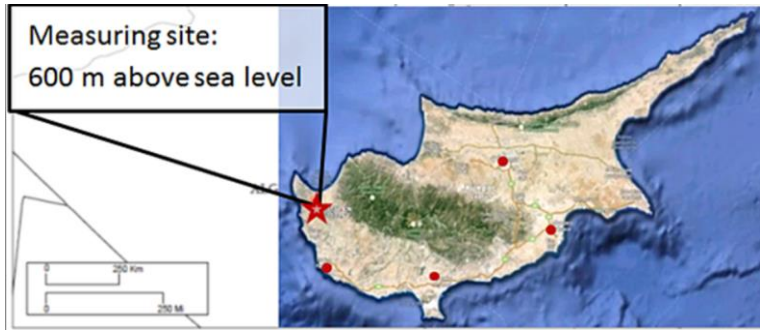


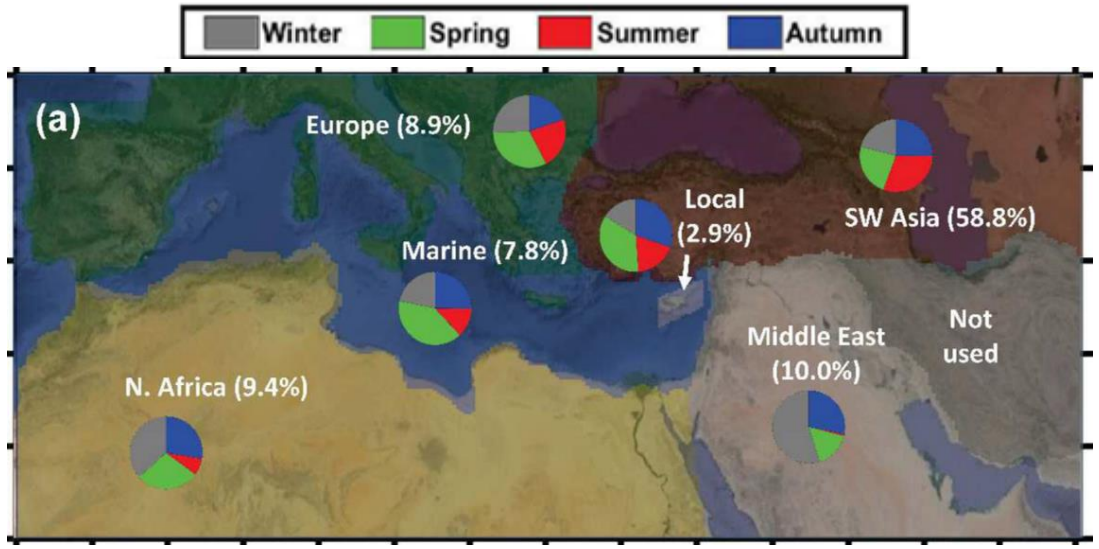


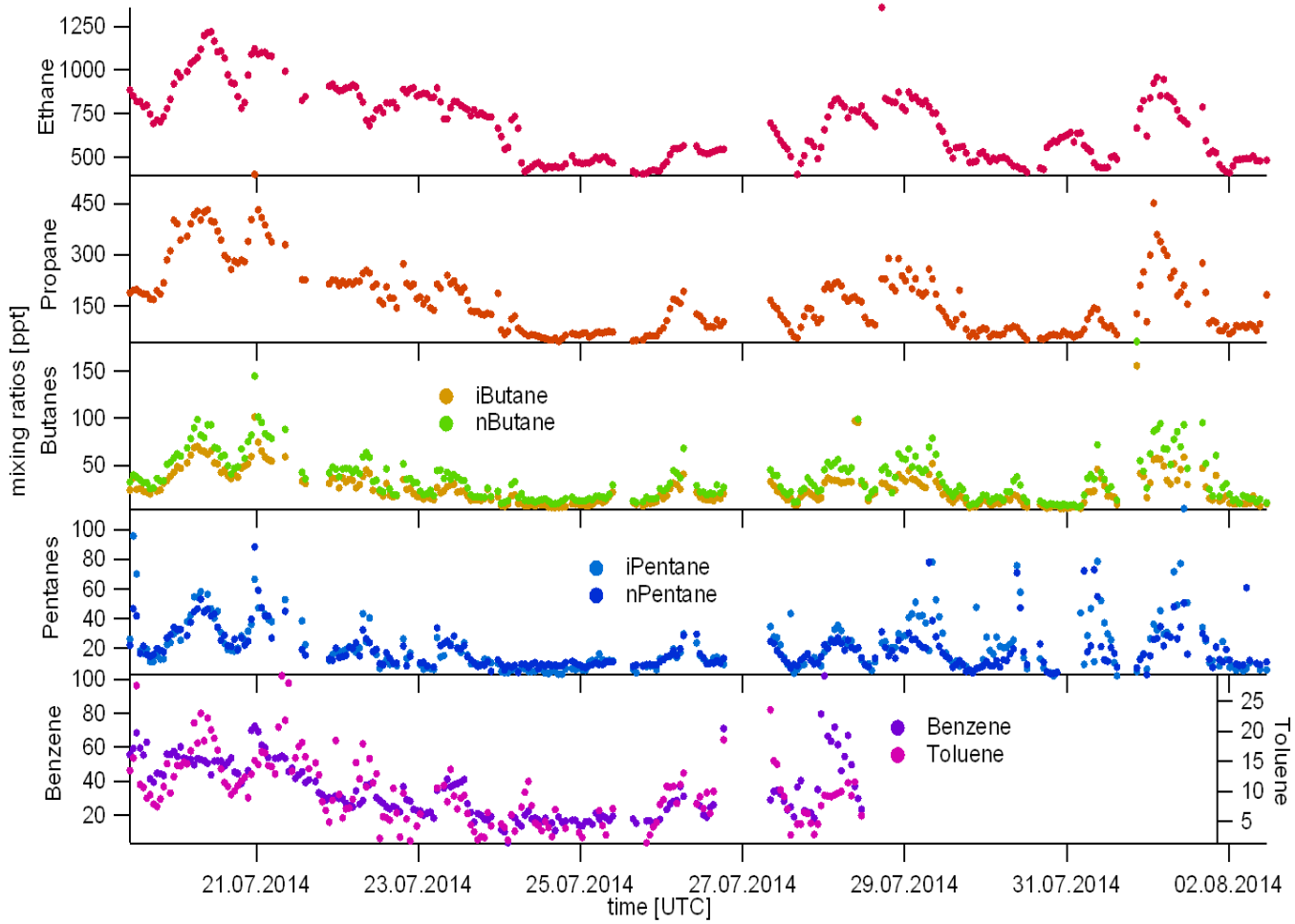
- Reducing the most important atmospheric radical (OH) locally
- Increasing tropospheric ozone production downwind the emission
- Increasing peroxyacetyl nitrates (PAN) production over large areas

Bourtsoukidis et al., 2020

NMHCs in Cyprus – Ineia (CYPHEX Aug. 2014)



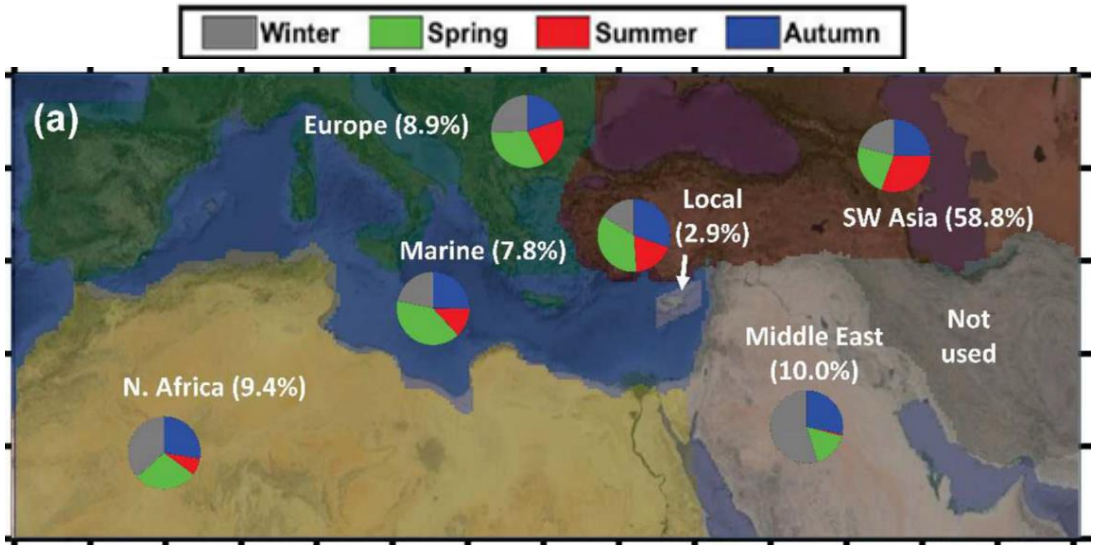




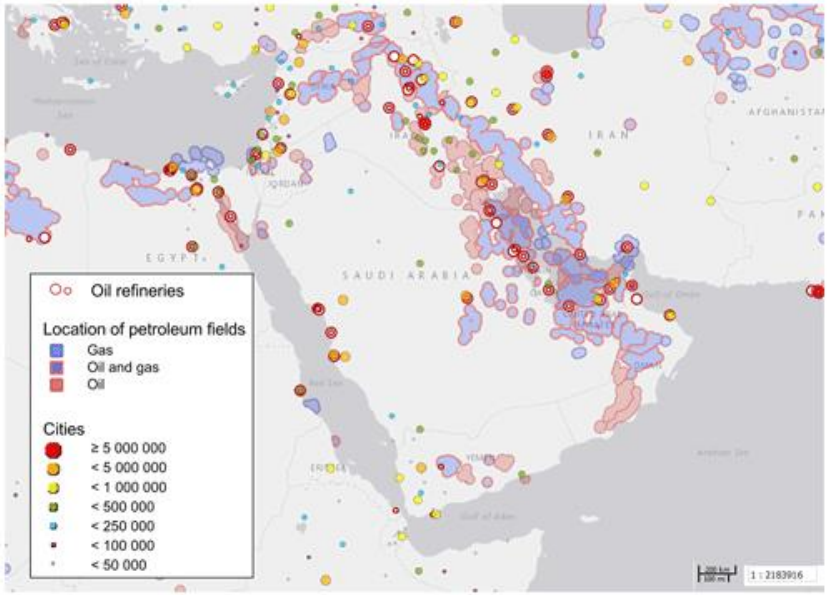
Pikridas et al., 2018

Carina Sauvage, MPIC

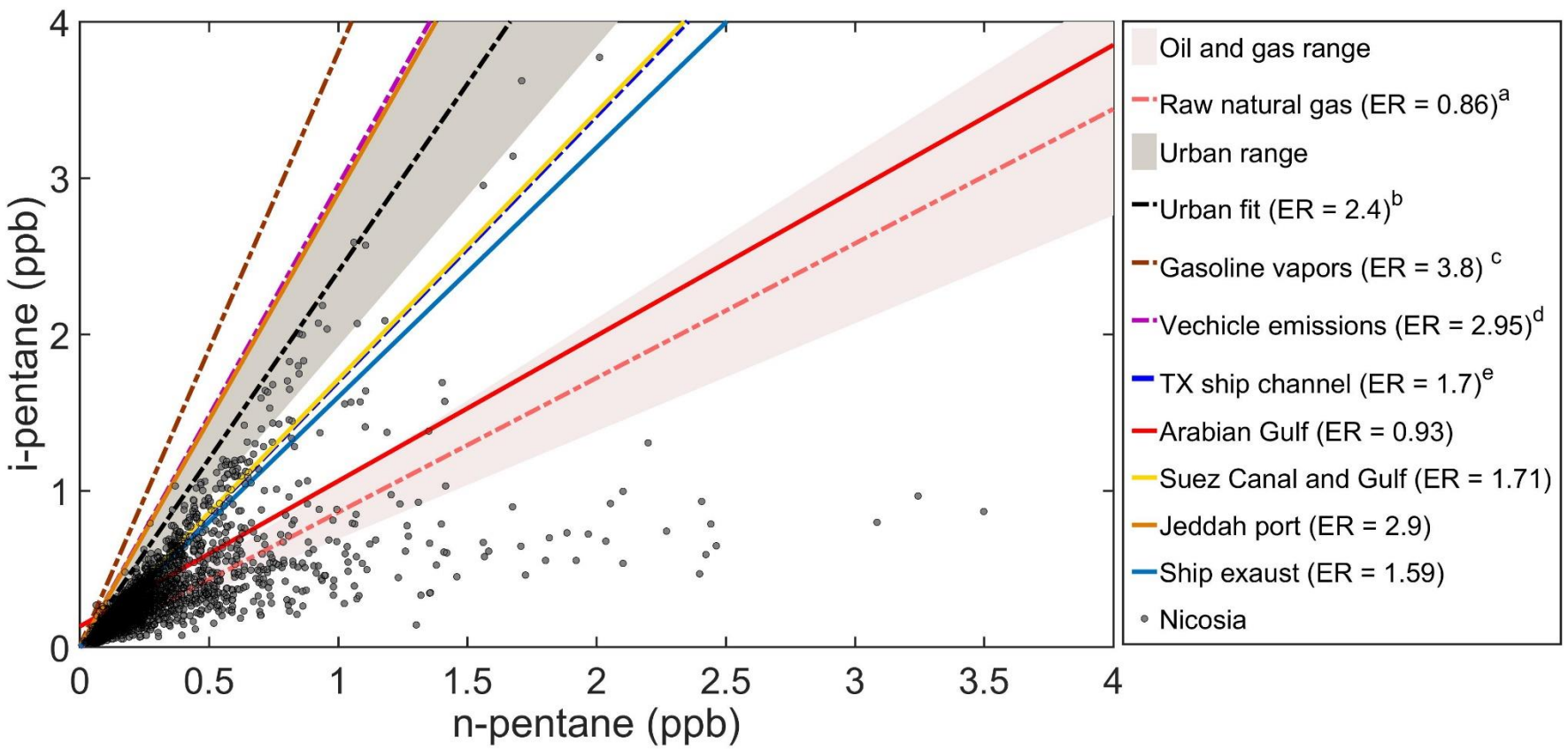
NMHCs in Cyprus – Transported O&G emissions



Pikridas et al., 2018



NMHCs in Cyprus – Nicosia (Feb.- May 2021)



- More @ vPICO presentation from Emeric Germain Paulenne

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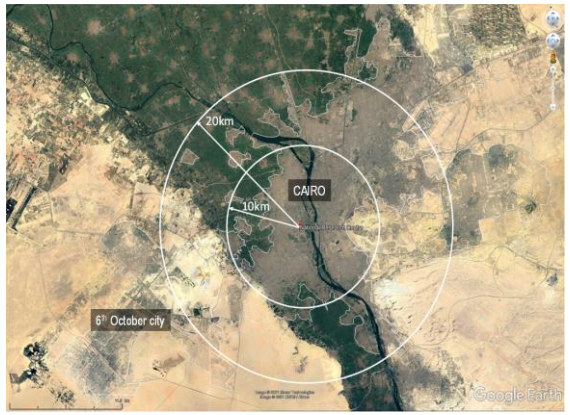
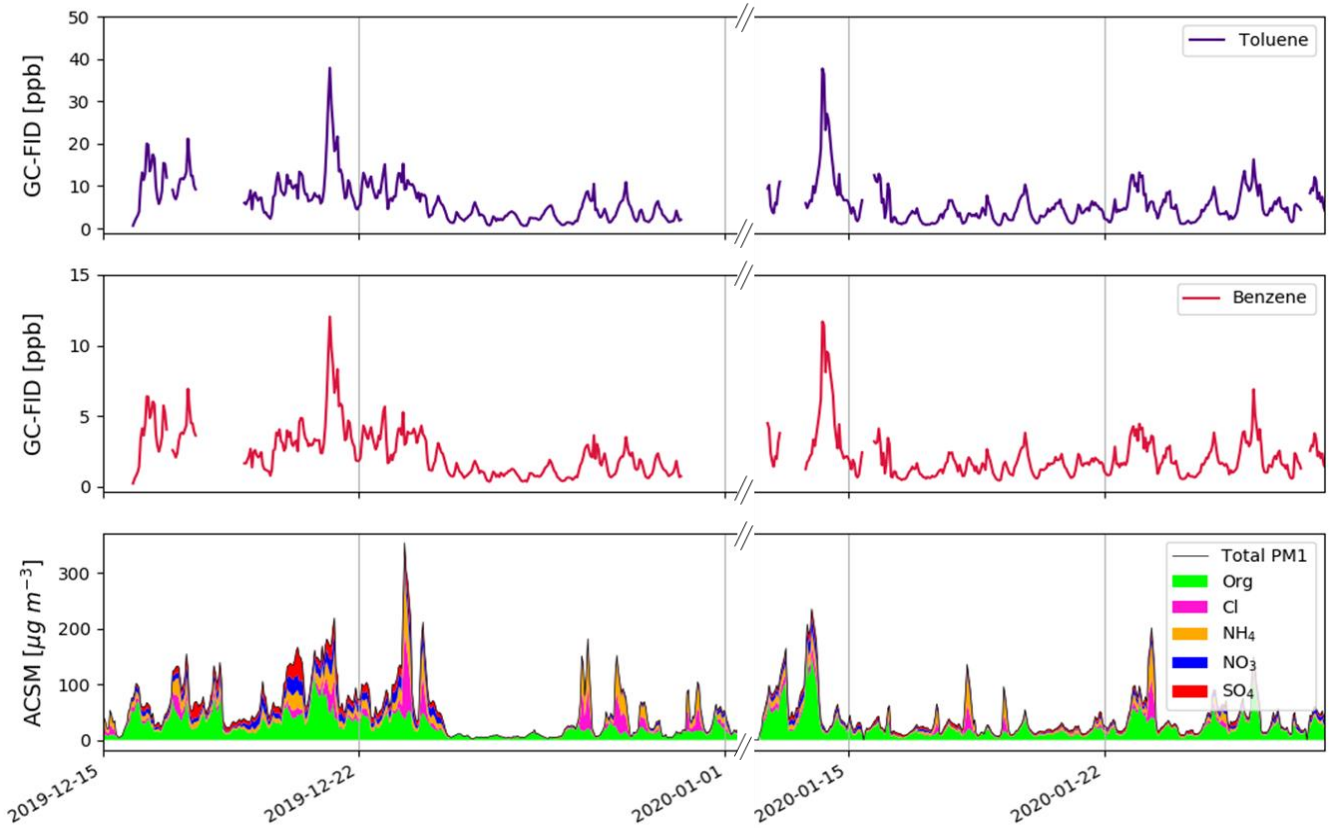
LABORATOIRE DES SCIENCES DU CLIMAT & DE L'ENVIRONNEMENT

NMHCs in Egypt - Cairo





- More @ vPICO presentation from Aliki Christodoulou

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IMT Nord Europe
École Mines-Télécom
IMT-Université de Lille

Upcoming campaigns (Dec. 2021) - Ioannina (Greece)

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NATIONAL OBSERVATORY ATHENS

IERSD - NOA

ΠΑΝΕΠΙΣΤΗΜΙΟ ΚΡΗΤΗΣ

ENVIRONMENTAL CHEMICAL PROCESSES LABORATORY
E C P L

PANACEA

Upcoming campaigns (Spring 2022) - Doha (Qatar)

“ Quantification of traffic emissions in the greater Doha area and characterization of the regional NMHC background”

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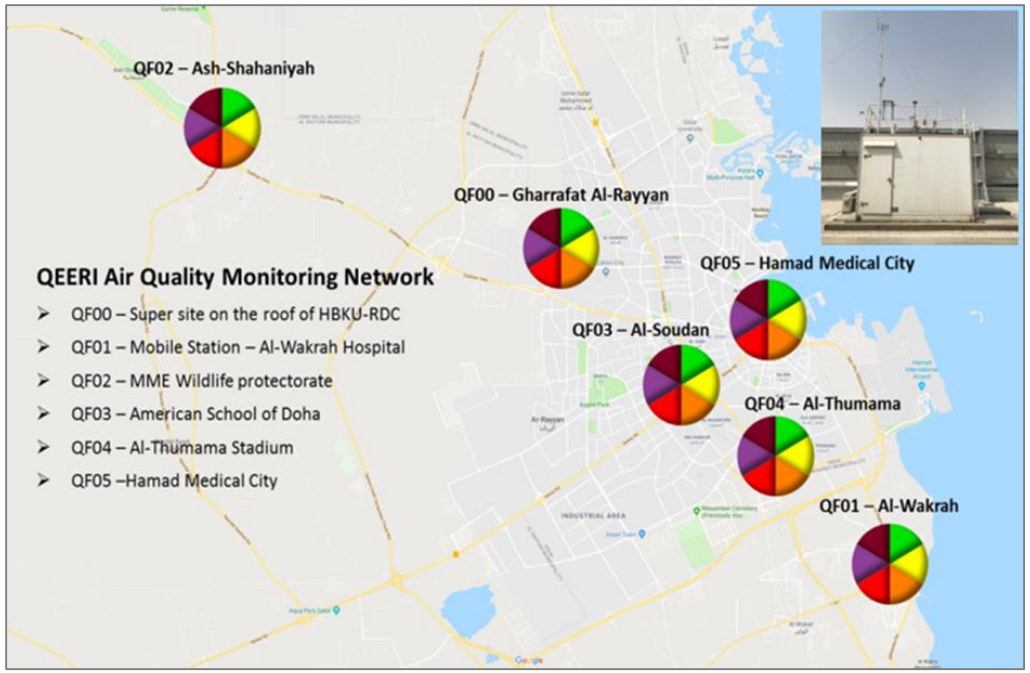
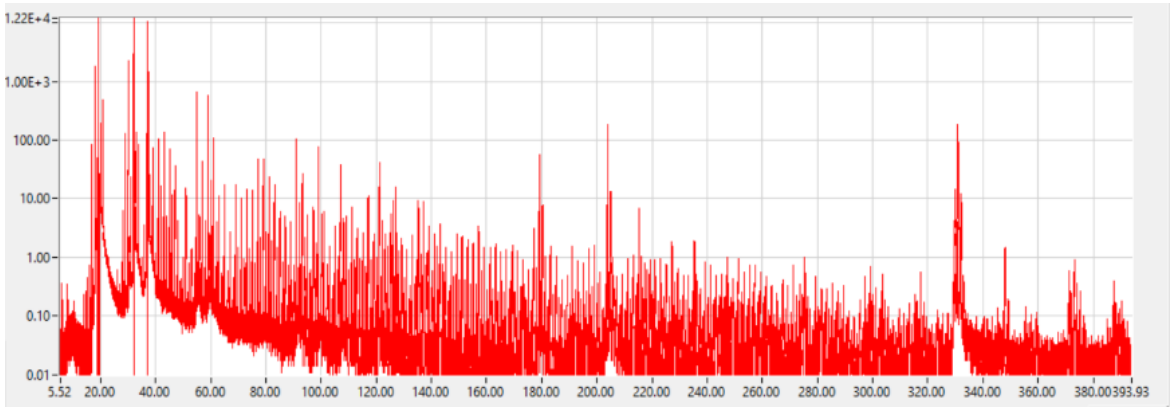
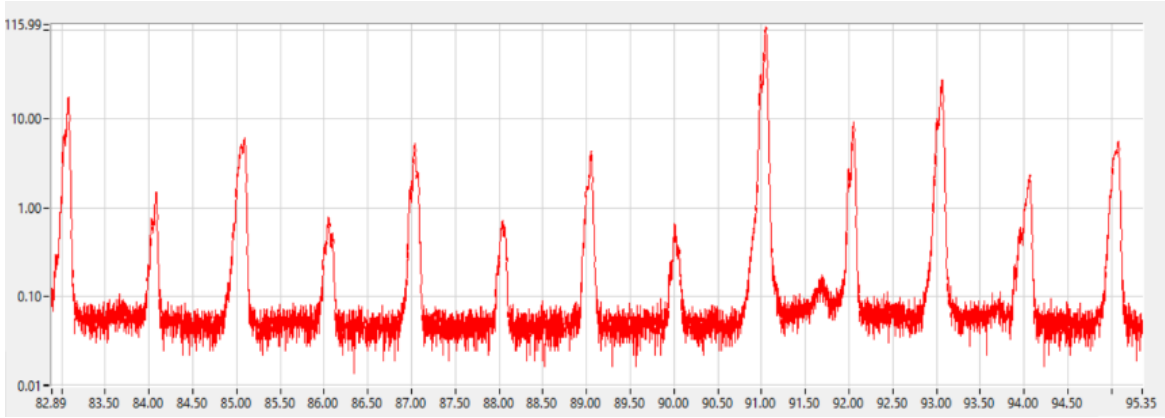
Co-funded by the Horizon 2020 programme of the European Union

QEERI
معهد قطر لبحوث البيئة والطاقة
Qatar Environment & Energy Research Institute
جامعة حمد بن خليفة
HAMAD BIN KHALIFA UNIVERSITY



A new requirement: PTR-ToF-MS





Back to list **Call for post-doc applications**

Description	Reference
☑ Postdoc(s) in Atmospheric Sciences	CARE-C_PDF_21_08

Postdoc(s) in Atmospheric Sciences

Closing Date: 04/11/21

Thank you!!!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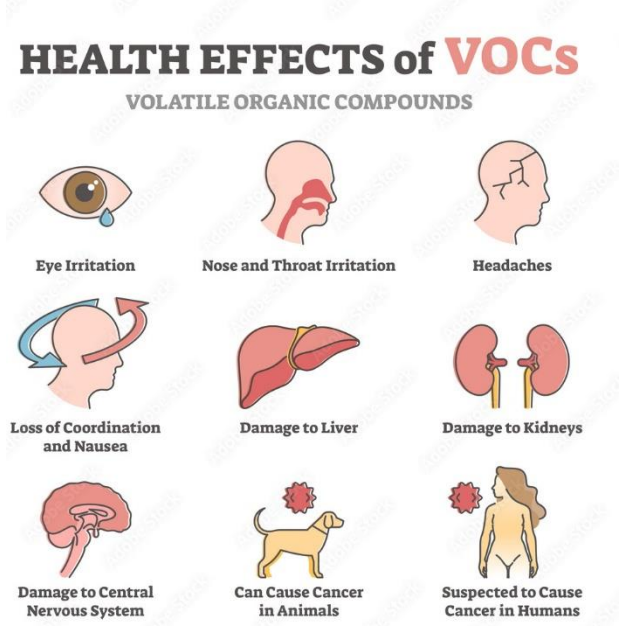
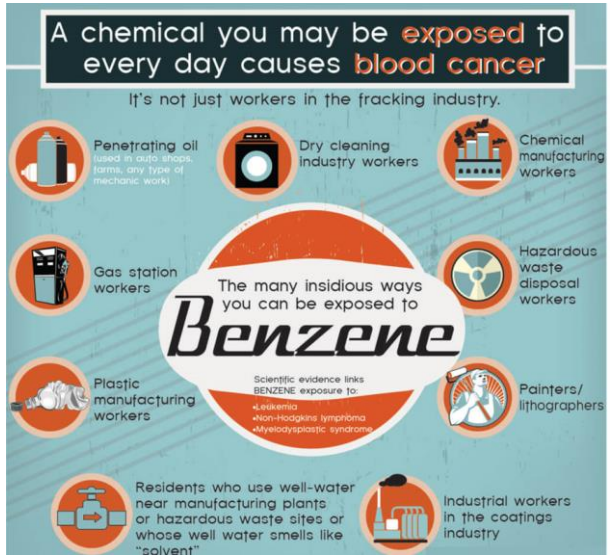
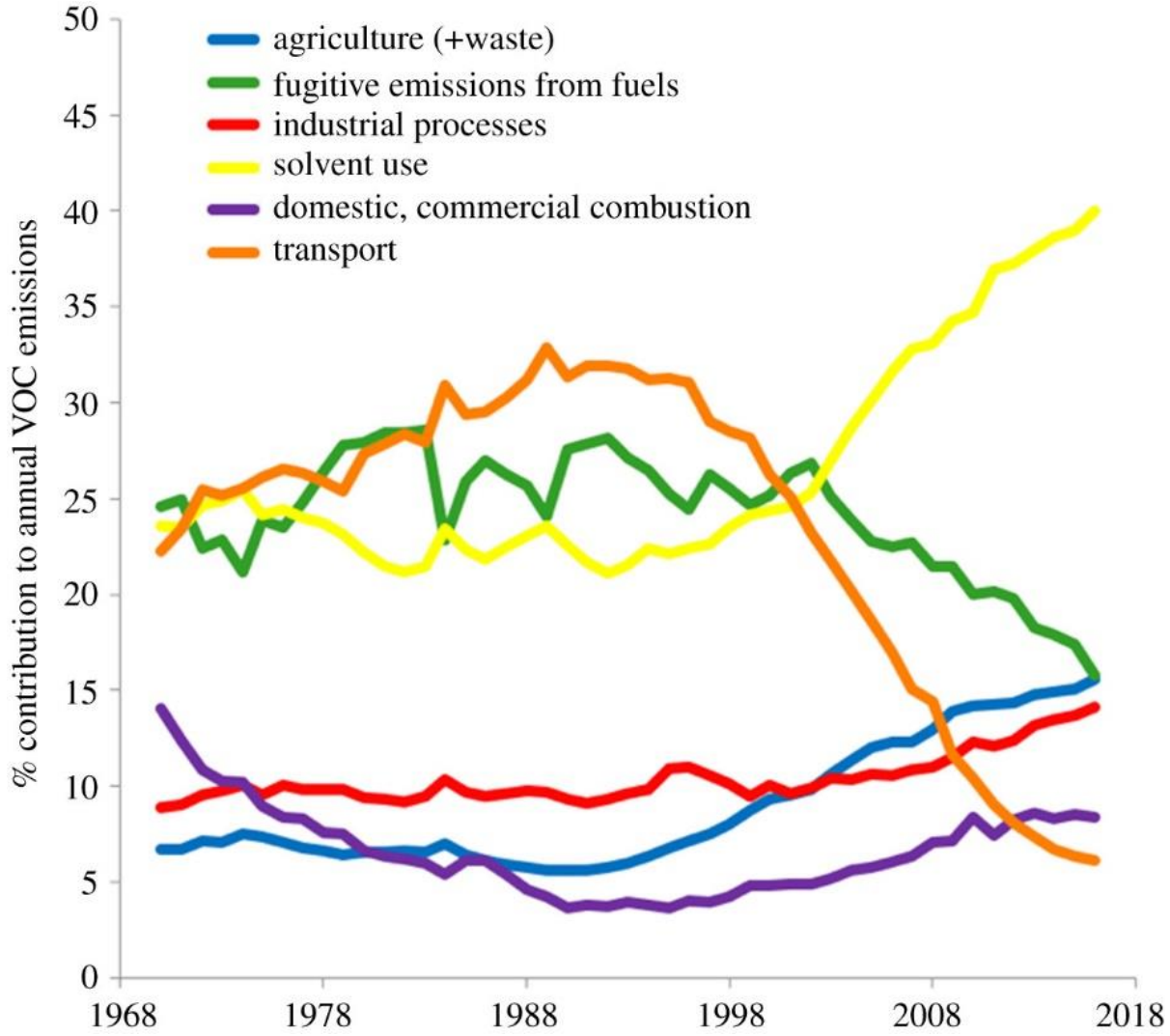
AIR QUALITY


HEALTH EFFECTS of VOCs
VOLATILE ORGANIC COMPOUNDS
Eye Irritation
Nose and Throat Irritation
Headaches
Loss of Coordination and Nausea
Damage to Liver
Damage to Kidneys
Damage to Central Nervous System
Can Cause Cancer in Animals
Suspected to Cause Cancer in Humans


A chemical you may be exposed to every day causes blood cancer
It's not just workers in the fracking industry.
Penetrating oil (used in auto shops, farms, any type of mechanic work)
Dry cleaning industry workers
Chemical manufacturing workers
Gas station workers
The many insidious ways you can be exposed to
Benzene
Hazardous waste disposal workers
Plastic manufacturing workers
Scientific evidence links BENZENE exposure to:
•Leukemia
•Non-Hodgkins lymphoma
•Myelodysplastic syndrome
Painters/ lithographers
Residents who use well-water near manufacturing plants or hazardous waste sites or whose well water smells like "solvent"
Industrial workers in the coatings industry


agriculture (+waste)
fugitive emissions from fuels
industrial processes
solvent use
domestic, commercial combustion
transport
% contribution to annual VOC emissions
0
5
10
15
20
25
30
35
40
45
50
1968
1978
1988
1998
2008
2018