Analysis of ozone vertical profile day-to-day variability in the lower troposphere during the Paris-2022 ACROSS campaign

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Objectives:

- Analysis of 21 days of ozone vertical profiles by QUALAIR station, AIRPARIF network, and IAGOS flights

- Dependency of ozone daytime increase in the urban layer on vertical stucture of the PBL and on regional scale plume advection

- Comparison with satellite observations (IASI) and CAMS ozone simulations

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Analysis of the day-to-day variability of ozone vertical profiles in the lower troposphere during the 2022 Paris ACROSS campaign

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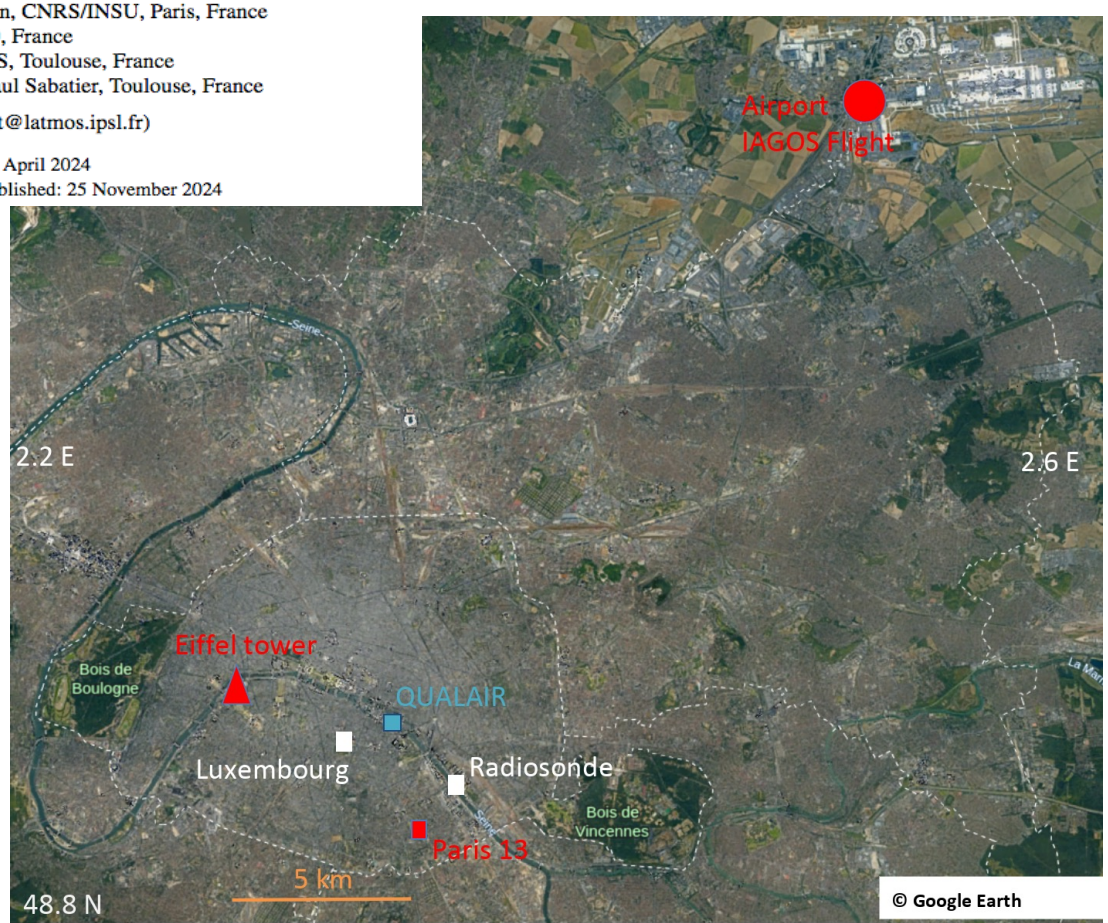
Mesures surface du réseau mesures sol AIRPARIF + capteur O_3 tour Zamanski

Profil O3 (200 m -3000 m) Lidar ALTO

Mesures quotidiennes des vols IAGOS sur Paris

Suivi hauteur PBL (radiosondage, microlidar SLIM)

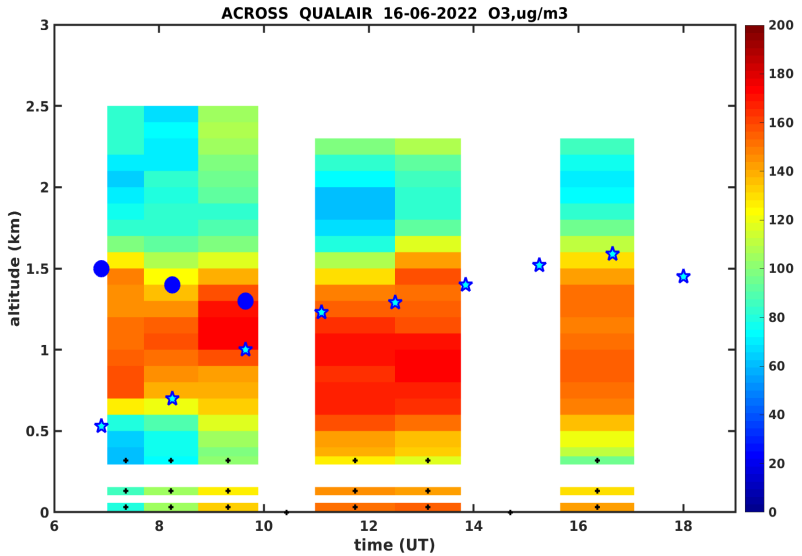


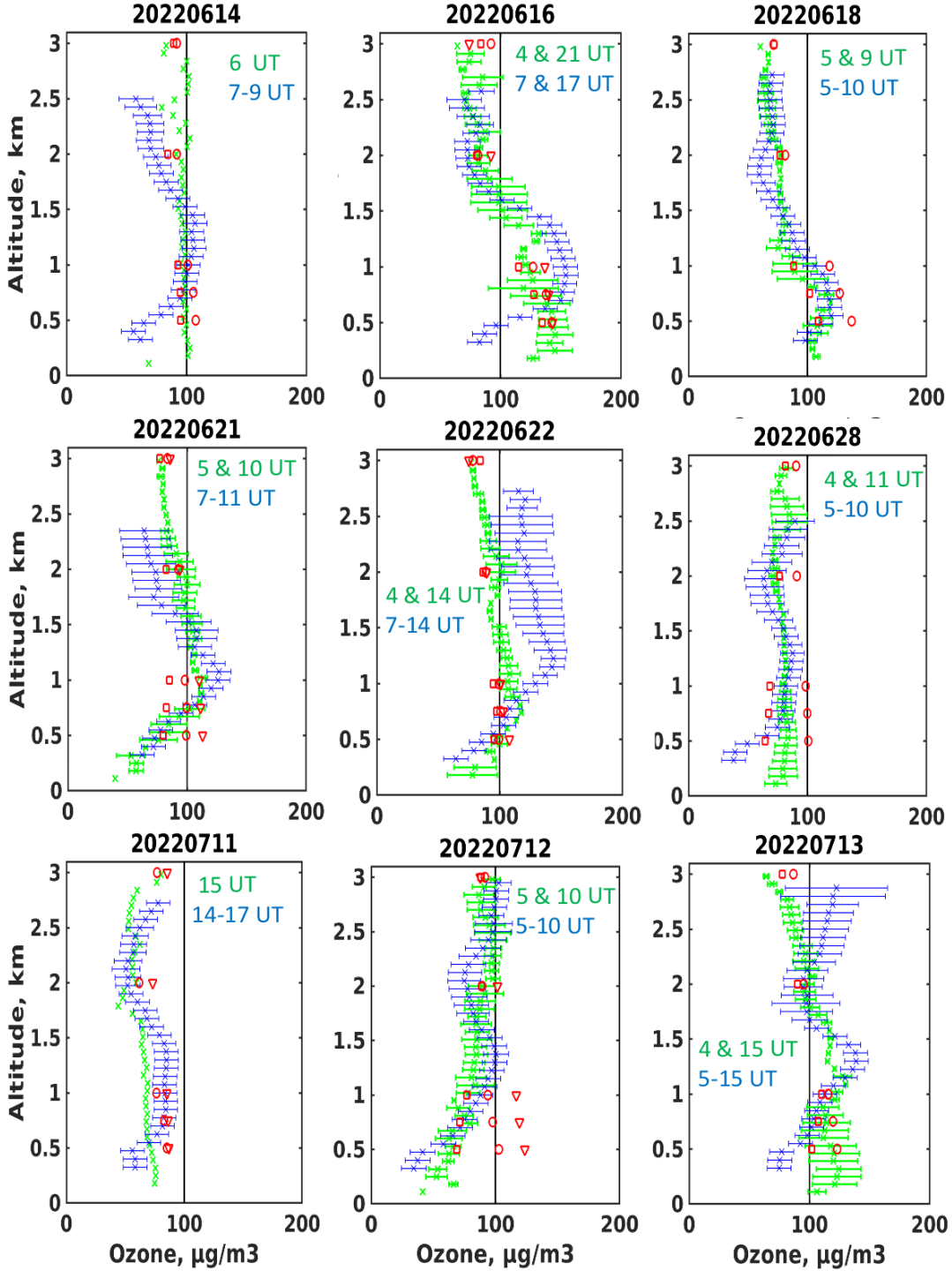
ACROSS

21 jours de mesures de évolution diurne des profils d'ozone

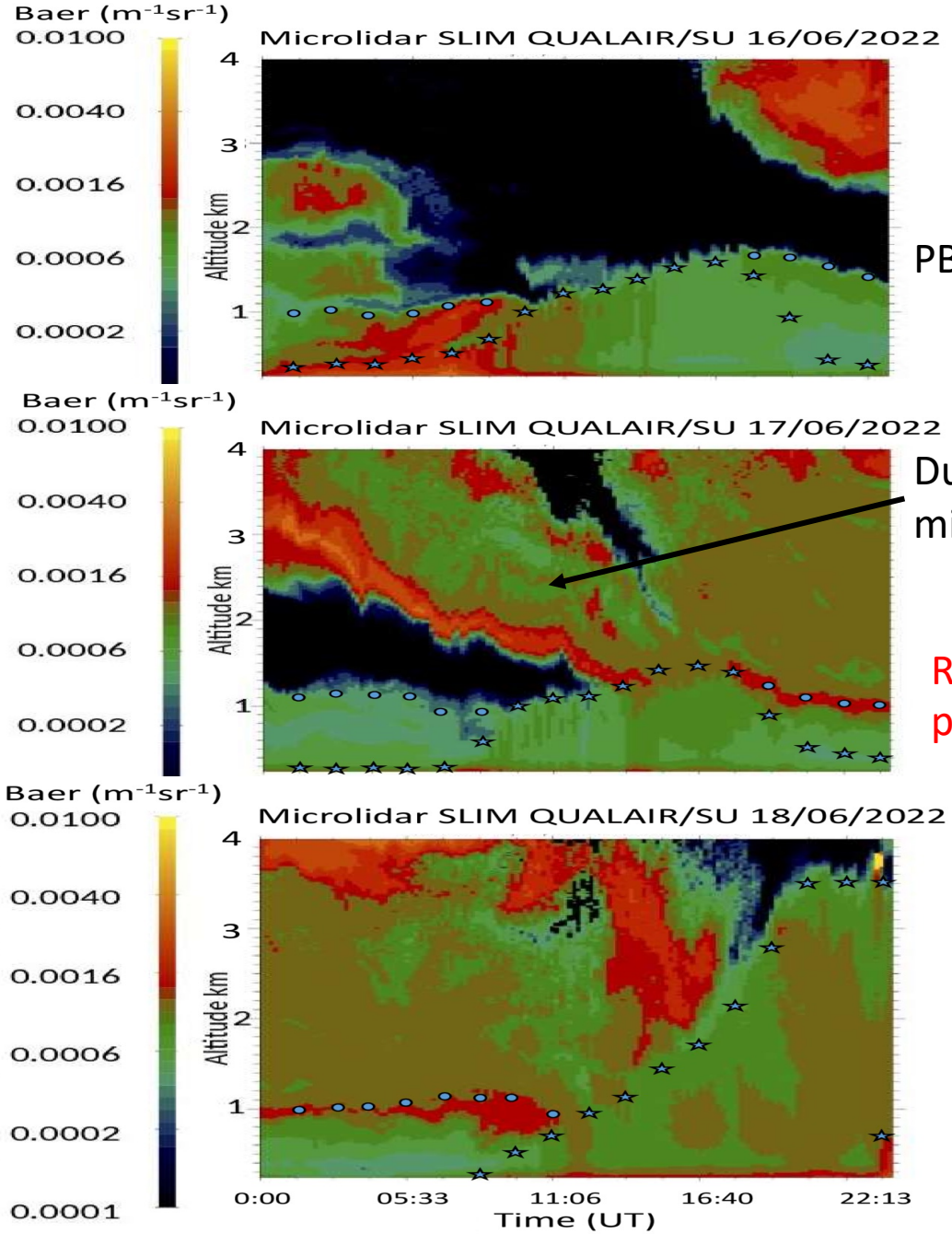
Bonne coherence des profils verticaux lidar au centre de Paris et des profils deduit des vols IAGOS → exploitation vols IAGOS pour suivi des épisodes de pollution

Exploitation des simulations CAMS et retropanaches des couches O3 observées par le lidar avec le modèle FLEXPART pour analyse du transport régional





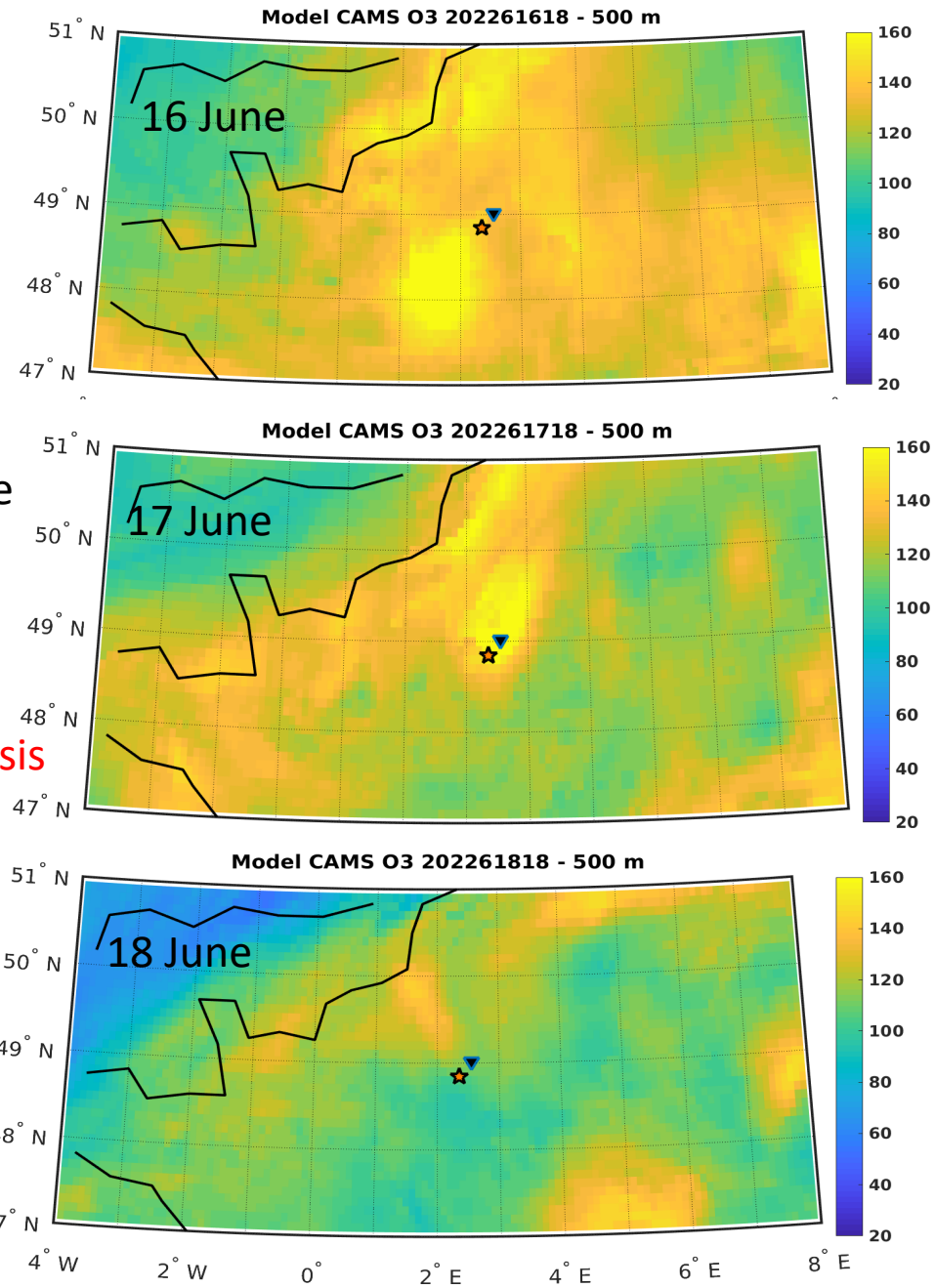
Case # 1 16-18 June: heat wave with long range transport of dust plume



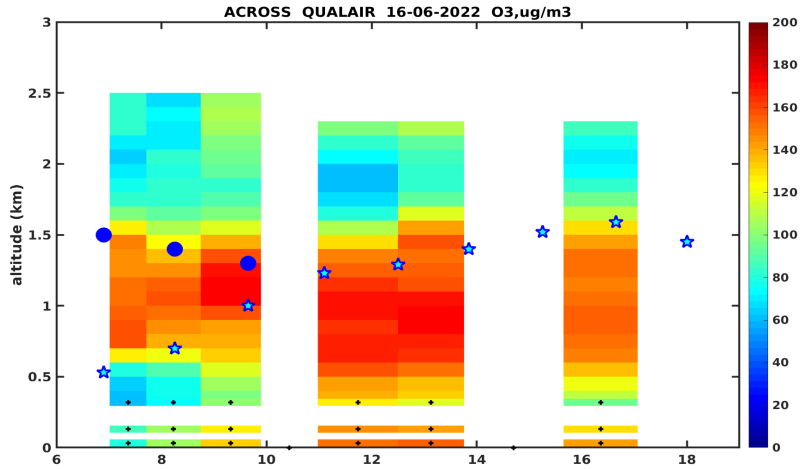
PBL height < 1.5 km

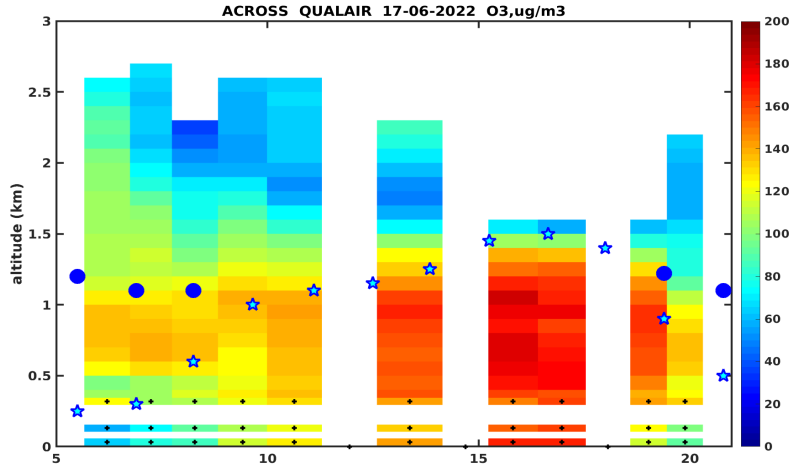
Dust plume 17-18 June mixing with PBL

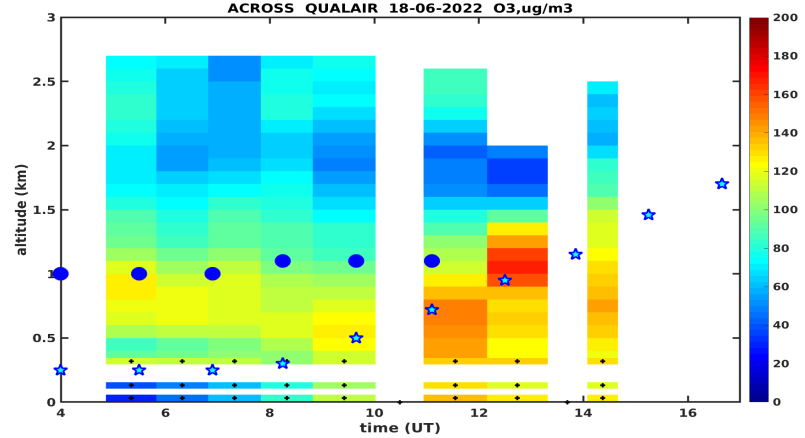
Regional scale ozone plume in CAMS analysis



CAMS Ozone µg/m³



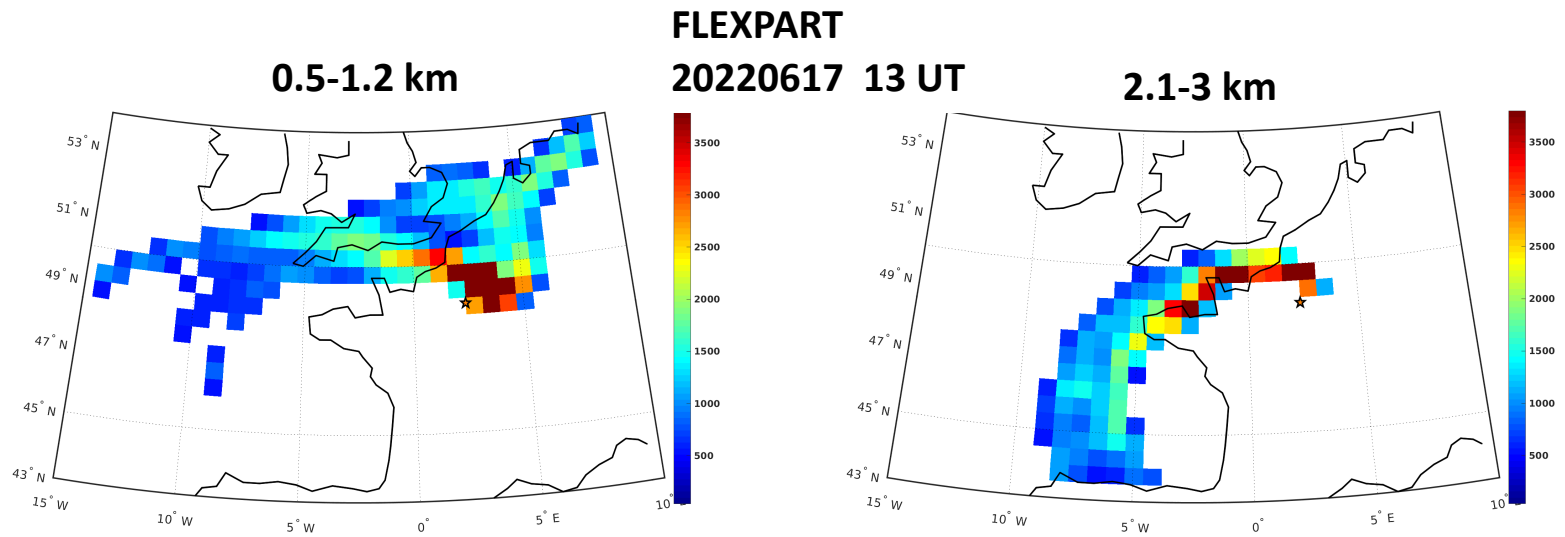




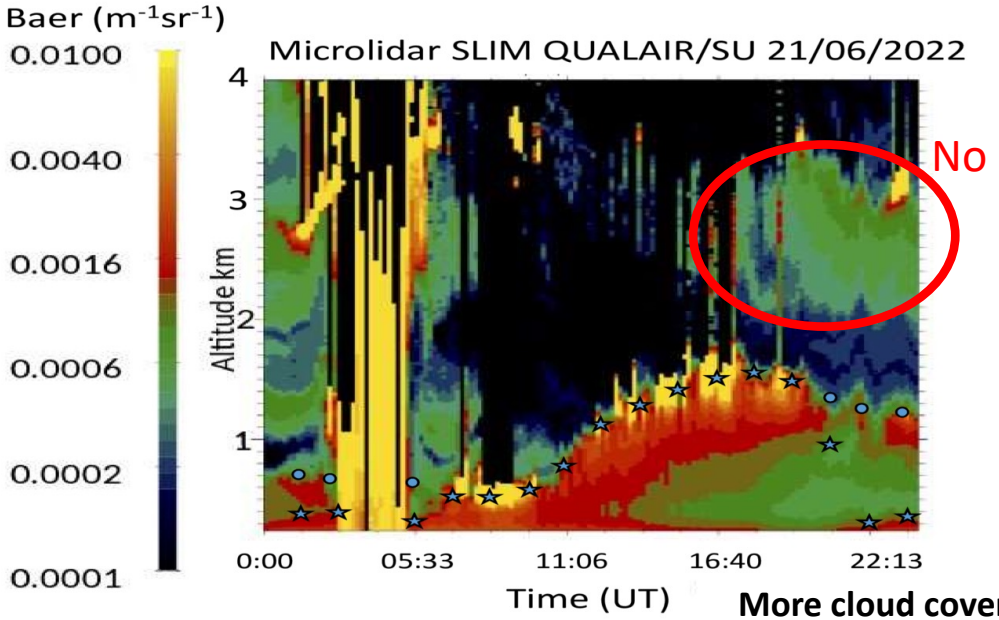
Ozone observations case # 1: 16-18 June

- Mixing of the Residual layer (RL) does not fully explain PBL O3 increase during the day (> 150 µg/m^3)

- Aloft advection of the dust plume corresponds to an O3 decrease above 1.5 km on June 17 and in the PBL on June 18



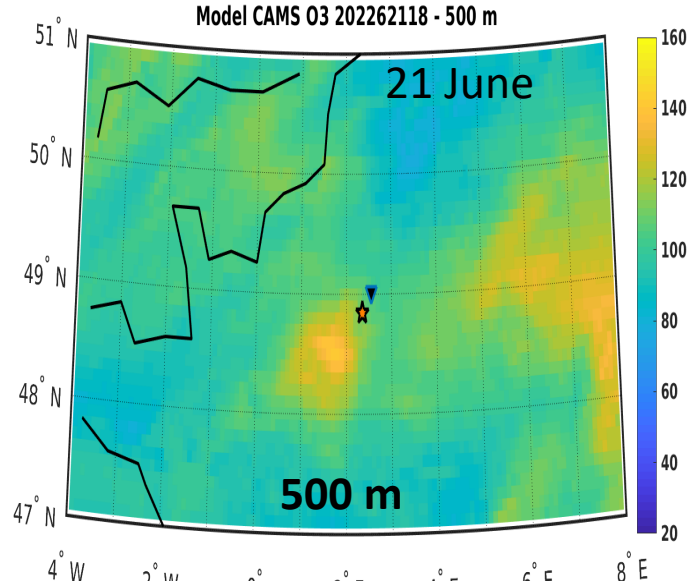
Case # 2 21-22 June: no long range transport but aloft advection of continental aerosol

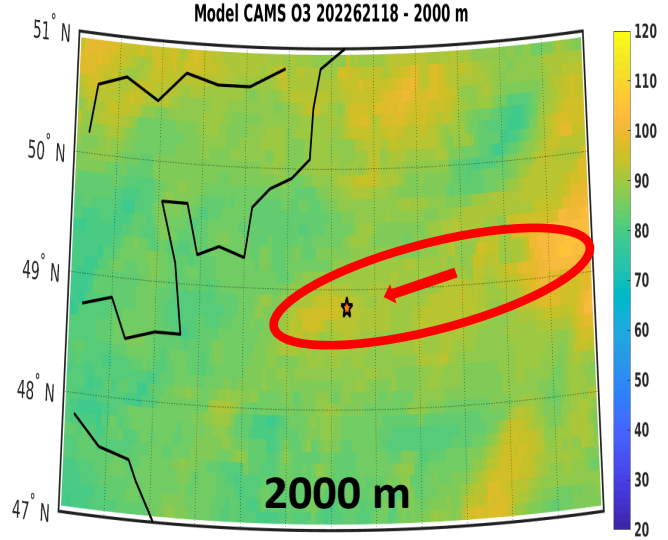


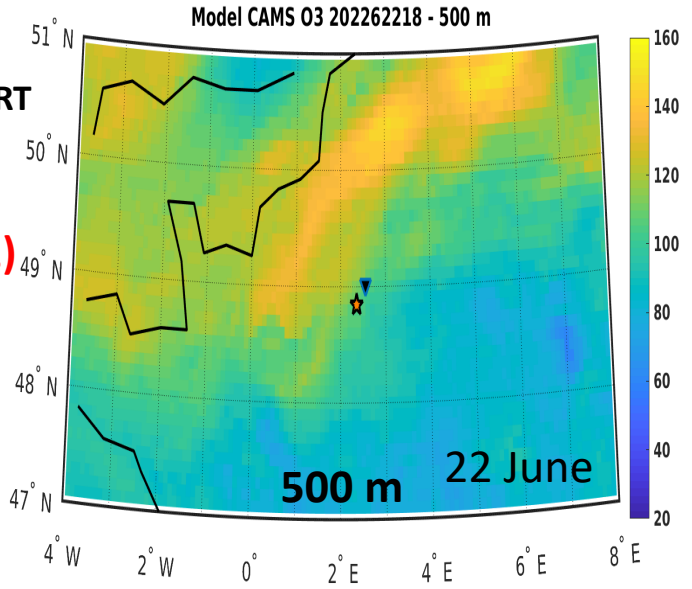
No depol.

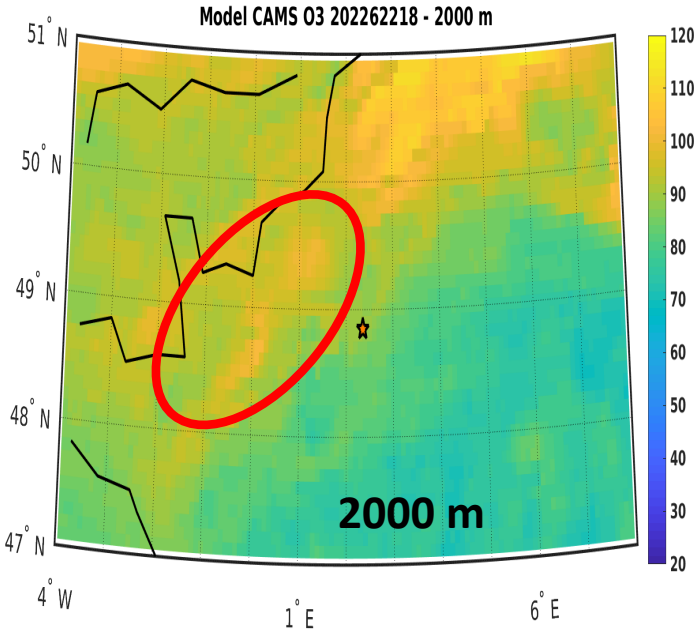
More cloud cover

CAMS Ozone µg/m³



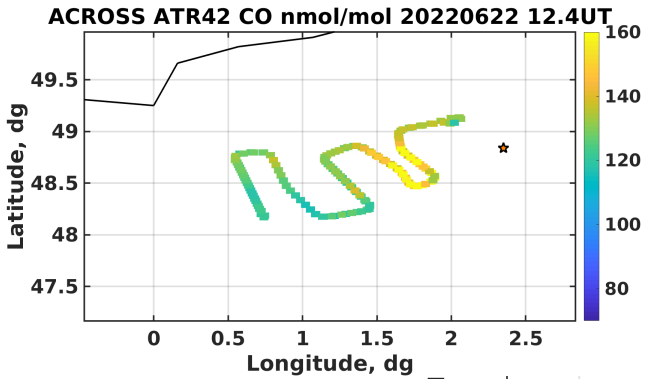


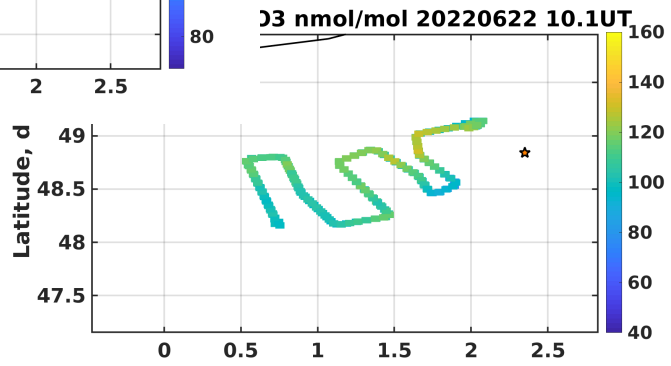


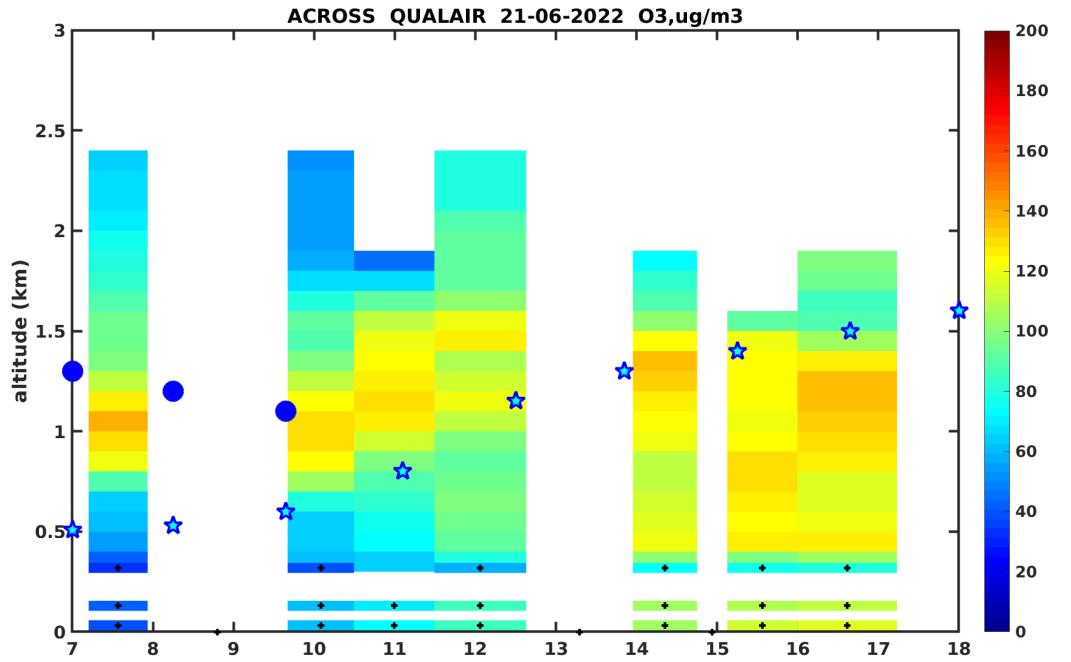


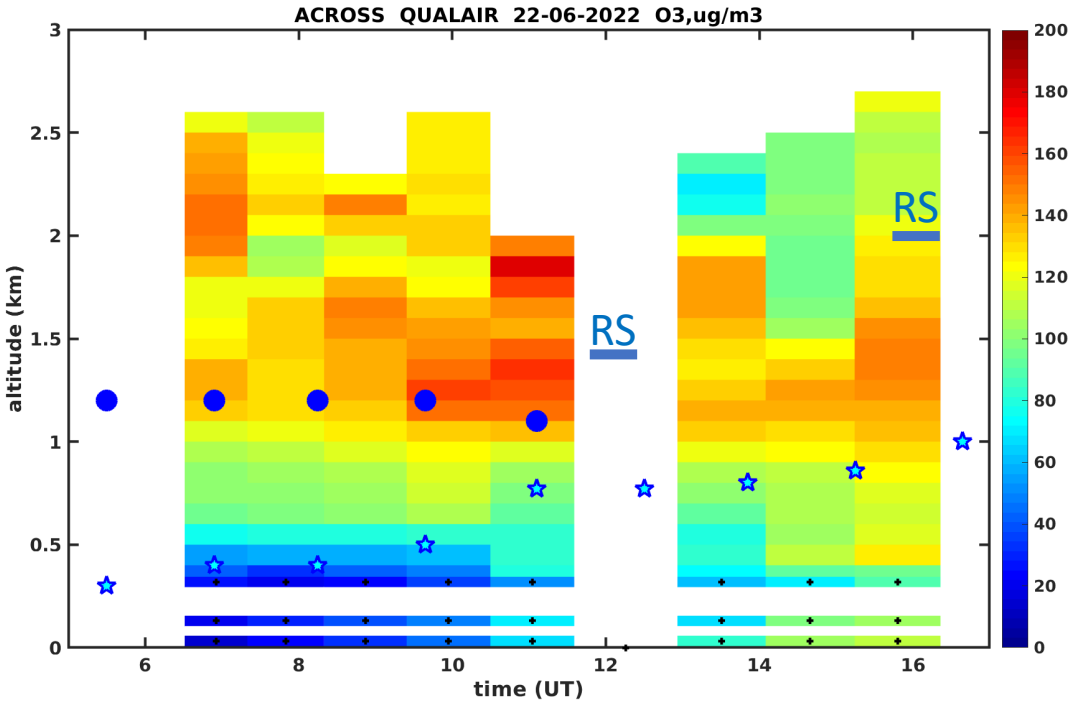
No dust but european aerosol plume (FLEXPART model

Westward advection of O_3 plume (CAMS, ATR42)







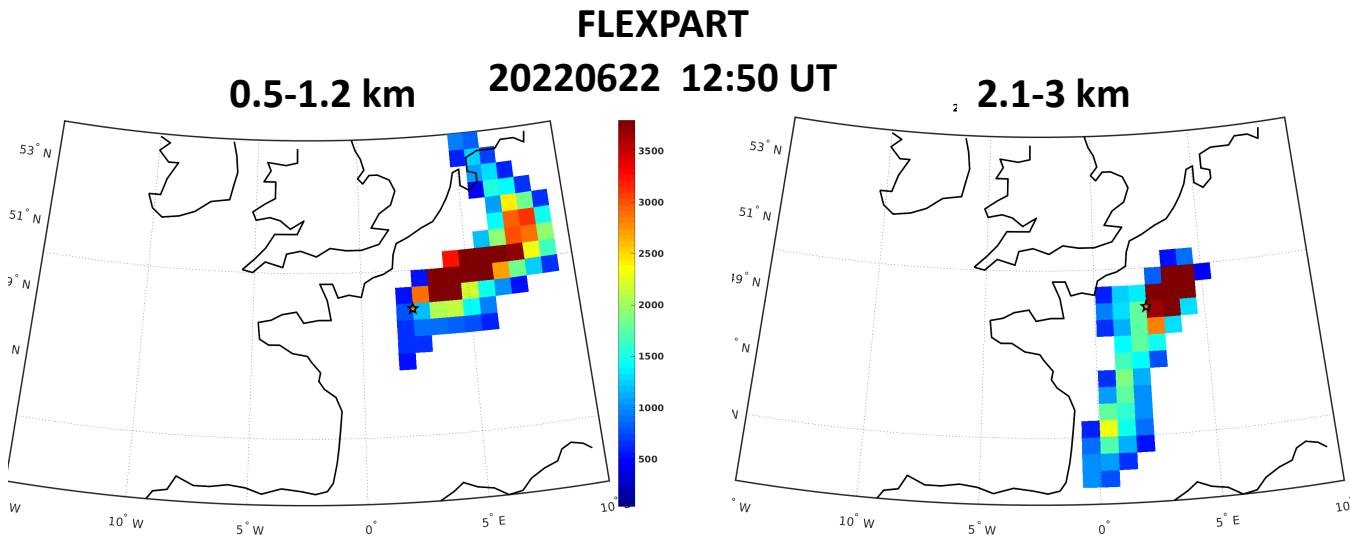


Ozone observations case # 2: 21-22 June 2022

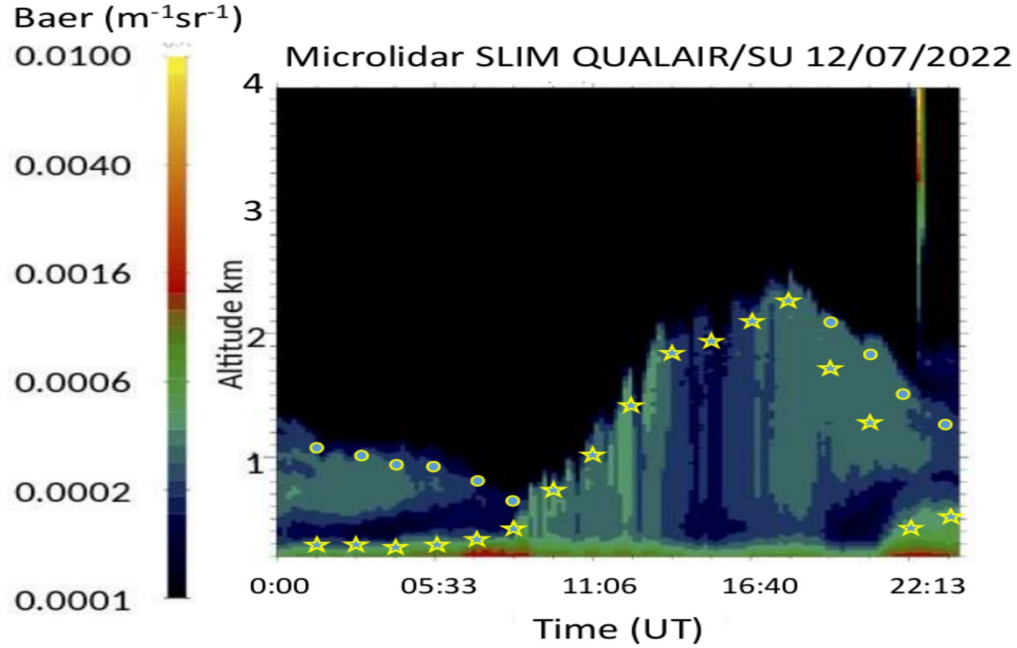
- Cloud cover and lower temperature explain lower PBL ozone increase (O3 < 130 µg/m^3)

- High ozone (> 140 µg/m^3) and aerosol plume in the free troposphere on 22 June

- Afternoon O3 layer depth thicker than lidar PBL height at 16UT on 22 June (Radiosounding temperature inversion ~ 2 km)

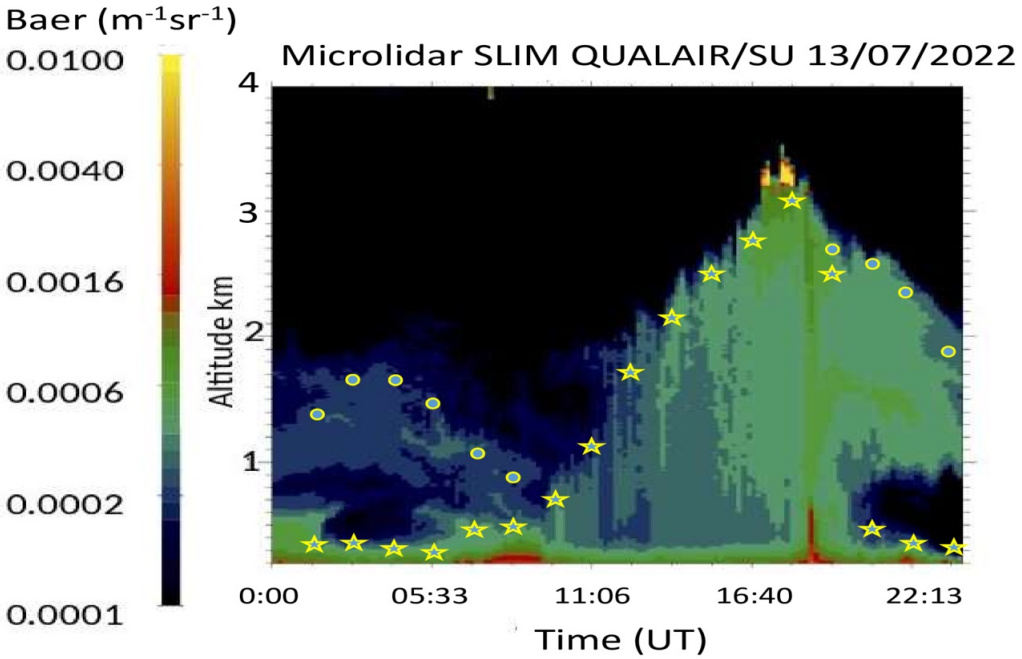


Case # 3 12-13 July: heat wave, no aloft advection of aerosol plumes, thick PBL

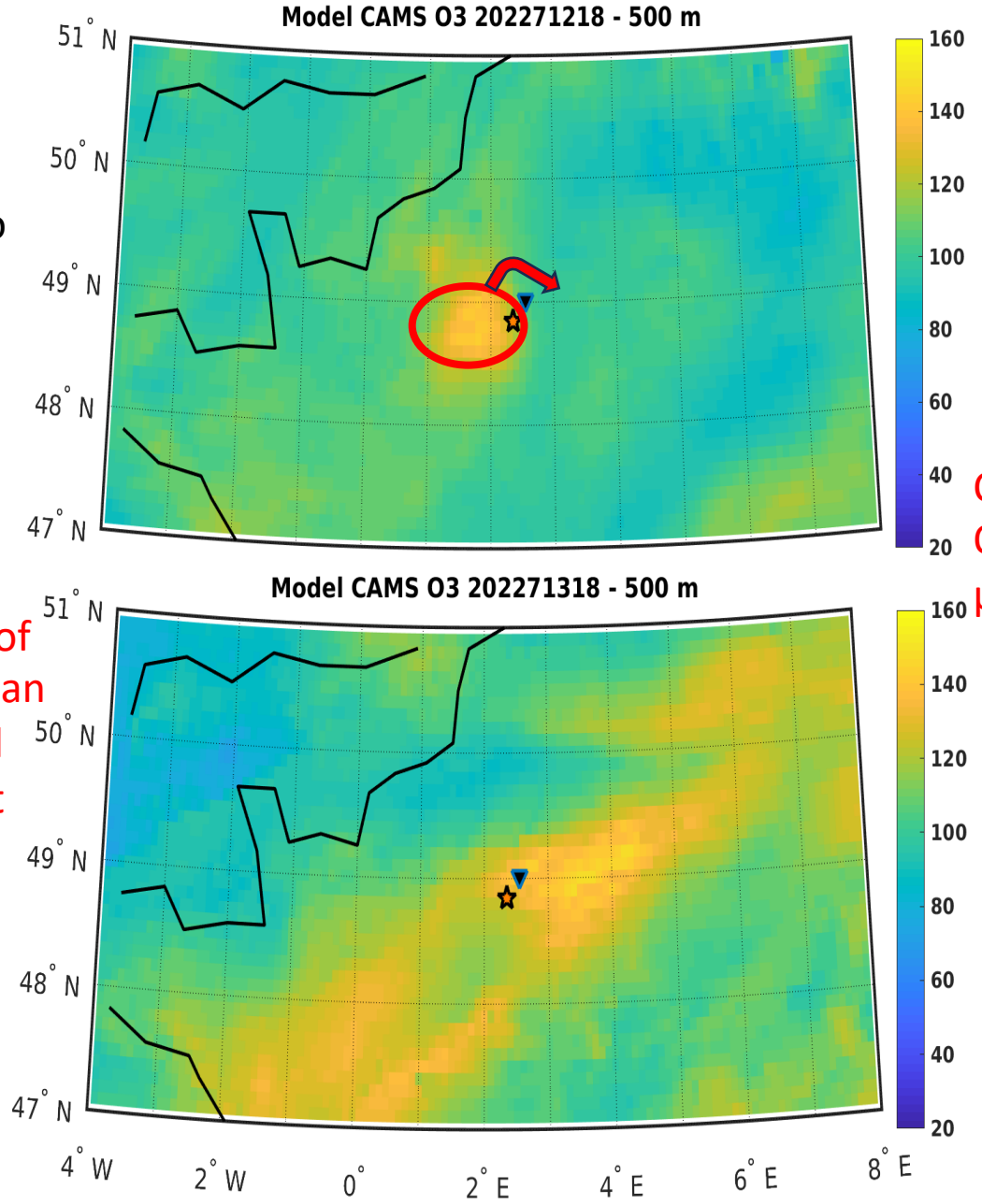


PBL height up to 3km

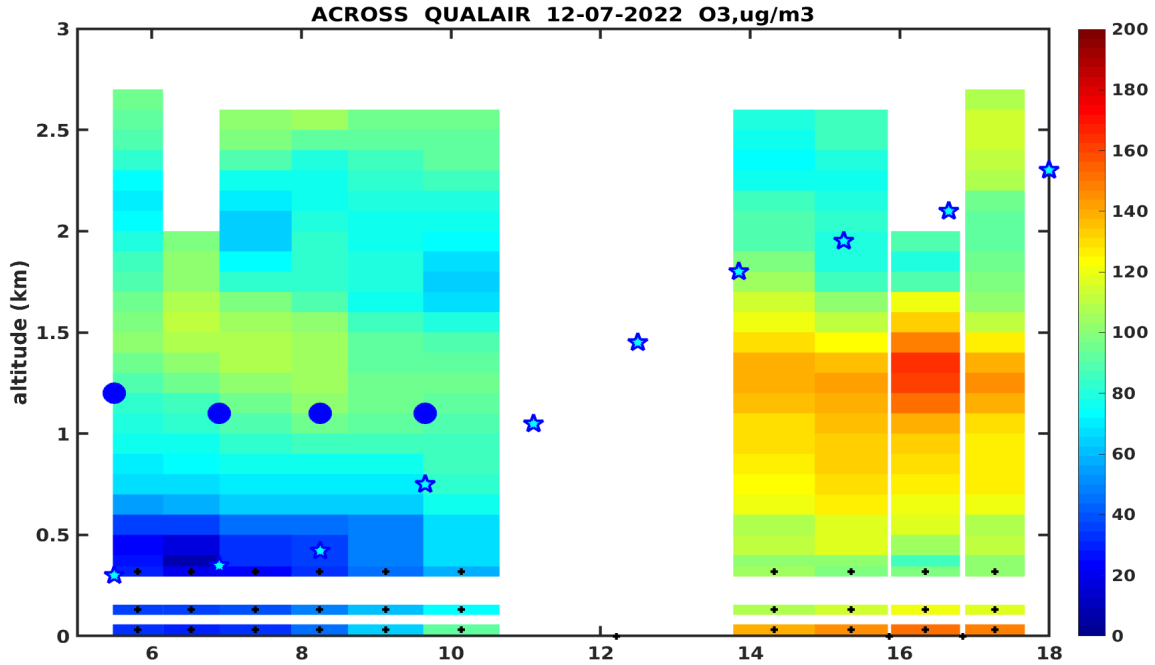
No aerosol plume in free troposphere

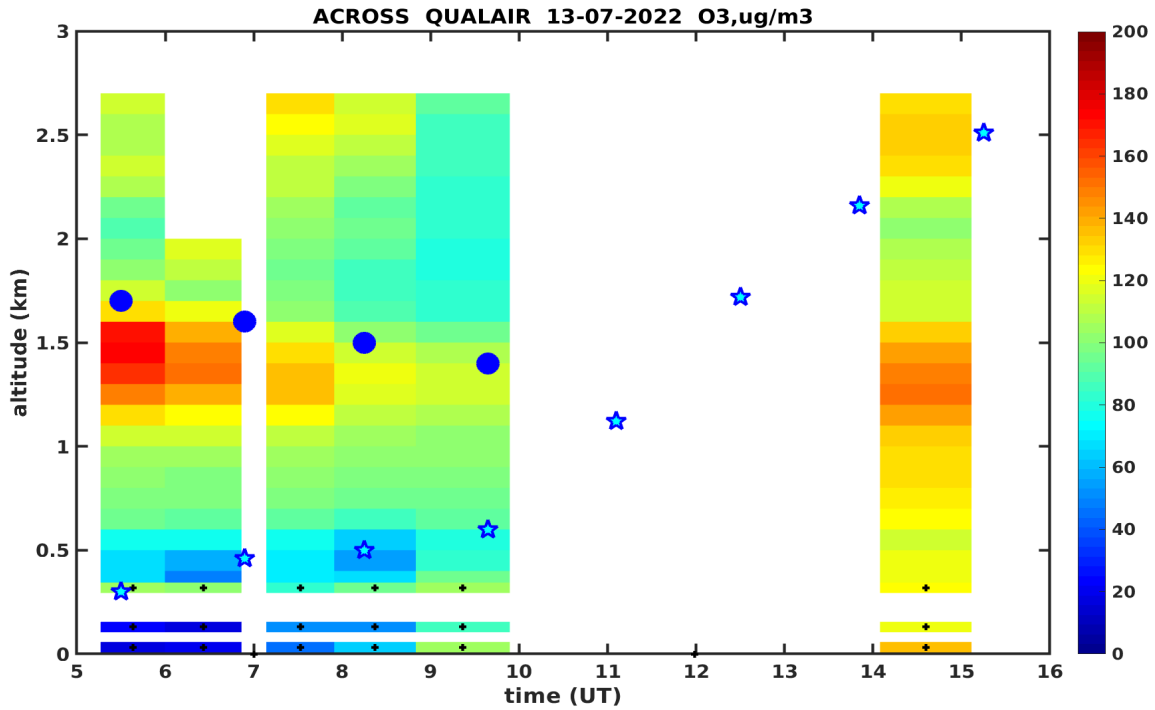


Recirculation of the ozone urban plume around Paris (Flexpart model)



CAMS Ozone µg/m³





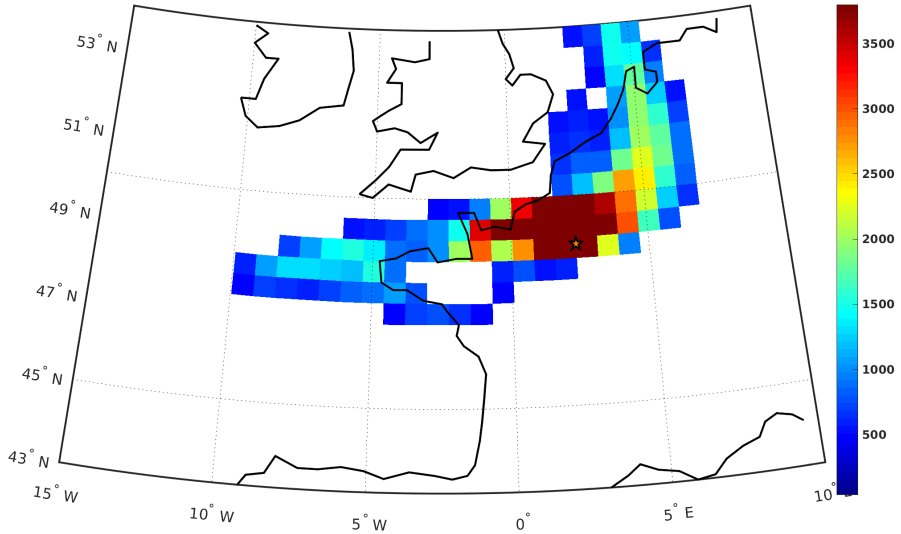
Ozone observations case #3 12-13 July 2022:

- O3 daily max < 150 µg/m^3 but 0-3 km ozone column as high as case # 1

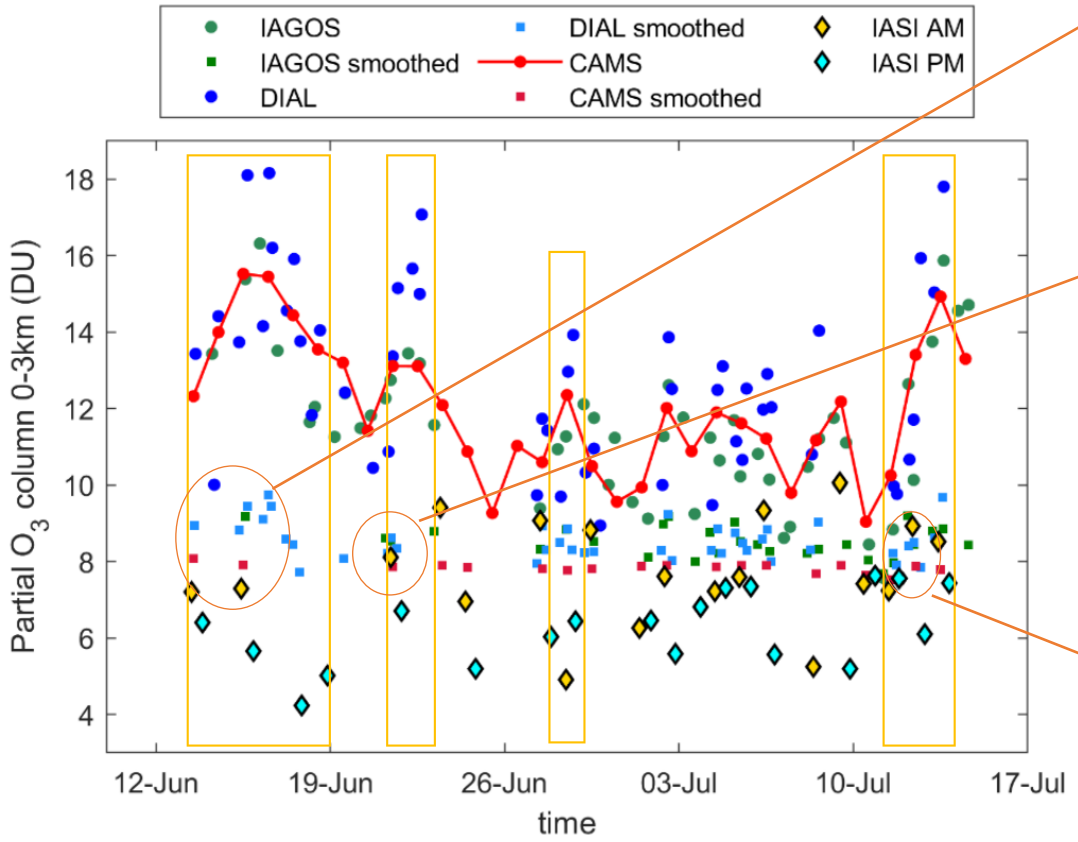
- PBL ozone layer height > 2.5 km and dilution of the ozone concentrations

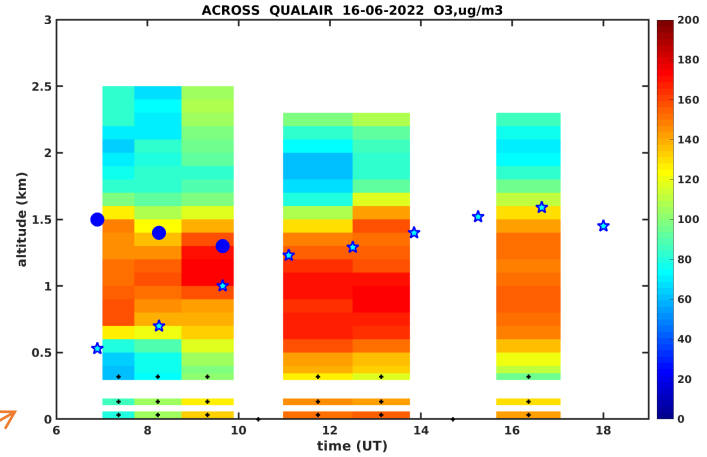
- main contribution from the Paris plume (low regional ozone plume in CAMS simulation and IASI)

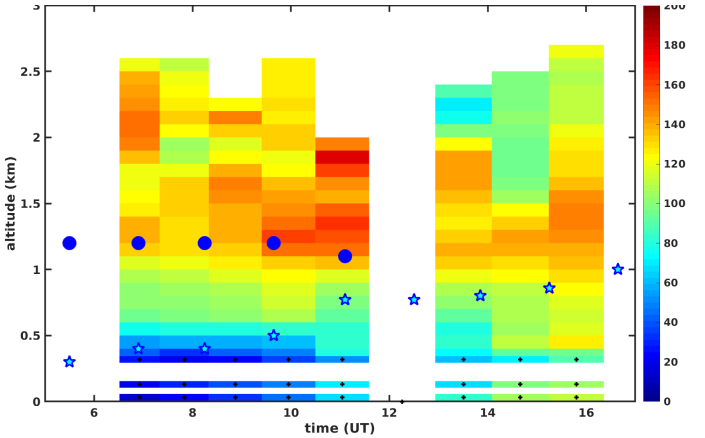
FLEXPART
20220713 14 UT
0.5-1.2 km

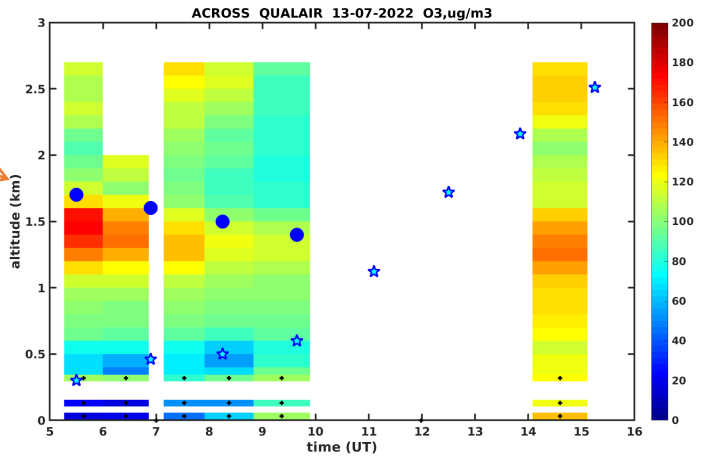


Principaux résultats de campagne ACROSS
Validation des observations IASI









Synthése des principaux résultats de campagne ACROSS

Sensibilité des épisodes de pollution au transport régional et à la structure de la PBL

Characteristics of the Paris ozone episodes in summer 2022.

Date	**14-18 June**	**21-22 June**	**28 June (or 2 July)**	**11-13 Jul**
O_3 plume altitude, km	<1.5	<2.5	<2.5	<3
O_3 plume maximum, µ$\mathrm{g.m^{-3}}$	170	150	110	150
O_3 0-3 km column, DU	14-16	12-13	12	13-15
High temperature, No clouds	Yes	No	No	Yes
PBL height maximum, km	1.5	1.5	2.5	3.0
PBL O_3 and NO_2 regional increase	Yes	Yes	No	13 June on
Regional plume above PBL	Dust plume	European pollution	No	No
Bias IASI vs O_3profiles, DU	-1.5 to -5	0 to -1.5	-2 to -3.5	0 to -2