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Comparison of Local and Transregional Atmospheric Particles Over the Urmia Lake in Northwest Iran, Using a Polarization Lidar Recordings

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[03].[Atmospheric Aerosol and Clouds Properties]

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The 30th International Laser Radar Conference (ILRC) virtual conference, June 26th – July 1st, 2022.

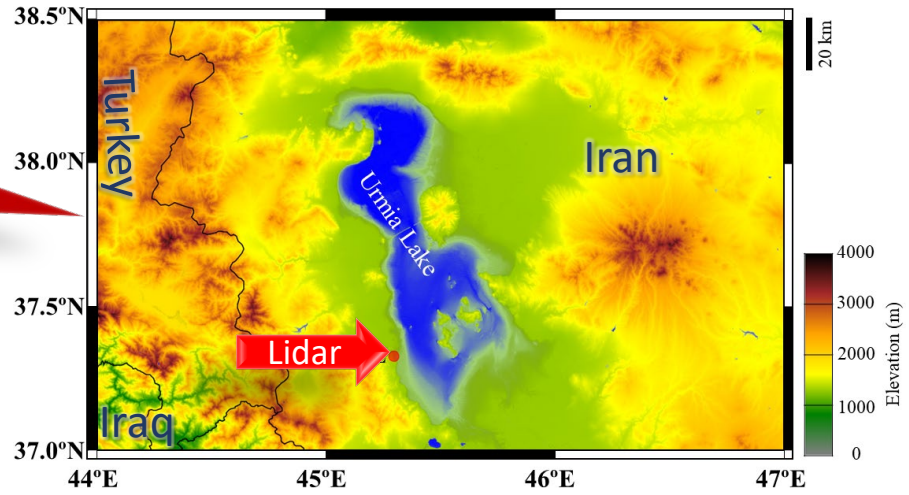
The Urmia Lake

- Urmia Lake, a hyper saline lake in Northwest Iran.
- The lake experiences a severe drying scenario.
- The region is under the influence of dust outbreaks raising from neighboring sources.
- Dust, salt, salt-dust, and anthropogenic aerosols are the main atmospheric particulate matter in the region.

The drying trend of the Urmia Lake

1999	2015	2020	2022

Topography map of the lake catchment area



Khalesifard, H.R., et al. *EPJ Web of Conferences*. 2020. EDP Sciences

The Polarization Lidar

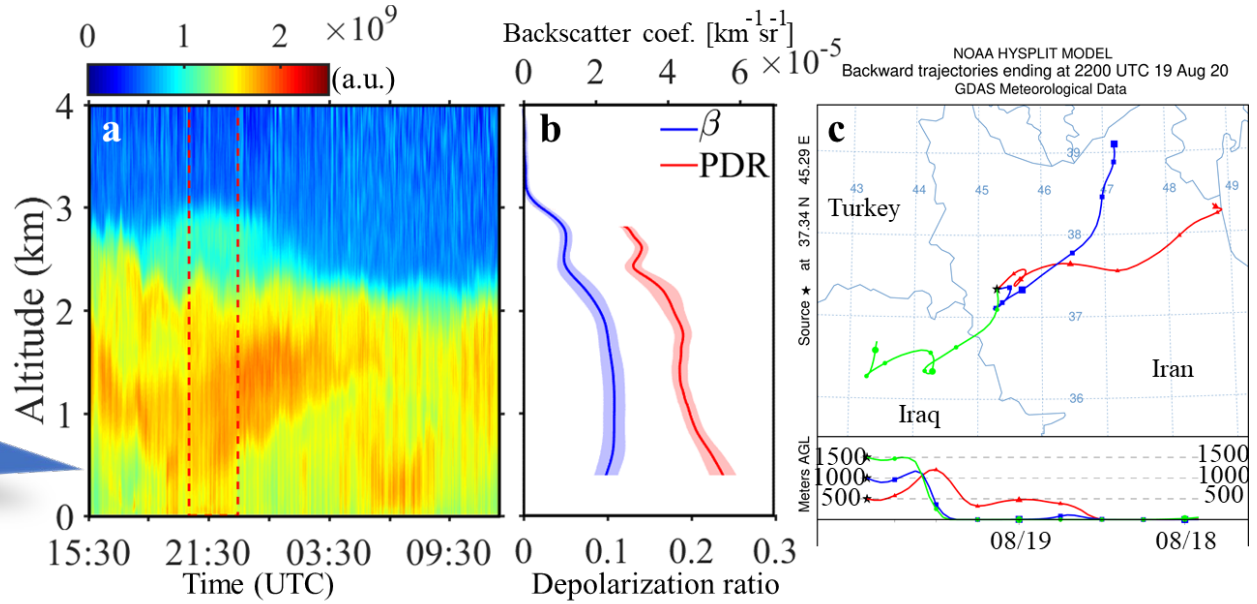
We installed a polarization lidar at the southwest coast of the lake to monitor atmospheric particles.

Transmitter	Q-switched frequency doubled Nd-YAG Laser	Pulse duration : 10 ns
		Energy/Pulse: 100 mJ @ 532 nm, Rep. Rate: 1 – 20 Hz
	Beam Expander	5X, Newtonian
Receiver, cross polarized @ 532 nm	Cassegrain Telescope	8”
	Detectors	PMT, Hamamatsu H9305-03
Digitizer	300 MHz Digital Oscilloscope	Tektronix, TDS 3034B
	Digital interface	NI-GPIB
	Computer	Pentium (R) 4 CPU, 3.2 GHz
Range / Resolution	Zenith	15 km / 10 – 30 m, 10 s
	Horizontal	2 – 5 km / 10 – 30 m, 10 s

Case Studies, Local / Transported Particles

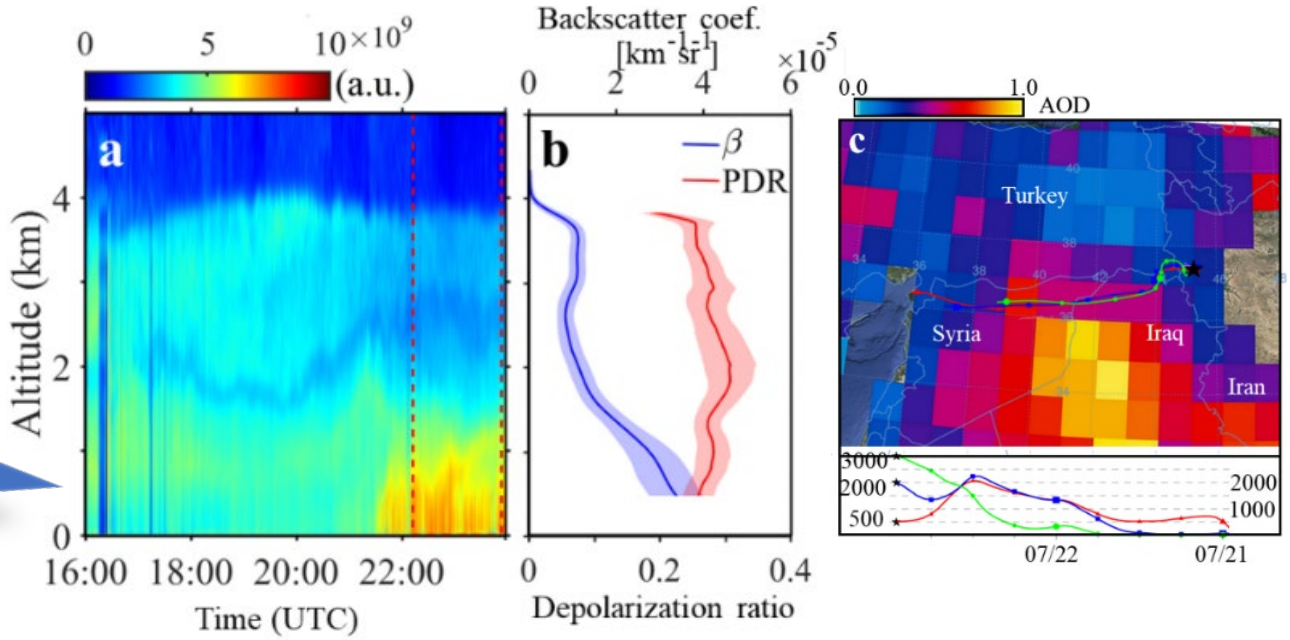
Local particles:
19-20 August 2020, a dense particle plume at the vicinity of the lake (salt and salt-dust particles)

Parallel channel time-height series



Transregional & local particles:
20 – 23 July 2020, a dust layer (~2km AGL), is transported from the Mesopotamia and Northeast Syria to the lake region. A dust plume is also in vicinity of the lake.

Parallel channel time-height series



Overview on all observed cases

An overview of all recorded events by the Lidar from 13 July 2020 to 8 March 2022

Source		Particle type	PDR averaged	Layer height (m)	Events Frequency	
					(days)	(%)
Local (summer)		Salt-dust	0.18 ±0.04	1900 ±600	18	28
Local (winter)		Anthropogenic	0.11 ±0.01	500 ±250	5	7
		Salt-dust	0.17 ±0.02	800 ±350	16	25
Distant	Mesopotamia	dust	0.23 ±0.05	2500 ±850	20	31
	Africa	dust	0.24 ±0.04	4200 ±1800	5	7
	Arabian Peninsula	dust	0.23 ±0.03	900 ±200	1	2
Total					65	100

Conclusions:

- For the first time, we are reporting a comparison of atmospheric particles in the vicinity of the Urmia Lake in Northwest Iran using their particle depolarization ratio (PDR) retrieved from the recordings of a polarization lidar.
- During a 21- month measurement campaign, we recorded 65 days where different types of particles (salt, salt-dust, dust, anthropogenic) were contaminated the atmosphere.
- Salt and salt-dust particles are the most dominant pollutants in this region (52% of all events).
- But distant dust sources also are impacting the region very frequently.
- The Mesopotamian region is the most influential distant source (31% of all events) but we even detected dust layers that had originated from North Africa and the Arabian Peninsula.
- We didn’t find any case where the raised particles from the lake bed got transported to altitudes above 3 km AGL.
- Most probably the Urmia Lake as a source of salt and salt-dust particles can’t influence regions outside its catchment area.