



X International Voevodsky Conference "Physics and
Chemistry of Elementary Chemical Processes" (VVV-2022)

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Transfer of soot aerosol of Siberian forest fires in the stratosphere of 2019

Romanchenko I. I., Cheremisin A. A.

Institute of Chemical Kinetics and Combustion SB RAS, Novosibirsk

Marichev V. N., Bochkovsky D. A.,

V.E. Zuev Institute of Atmospheric Optics SB RAS, Tomsk

Novikov P. V.,

Krasnoyarsk Institute of Railway Transport, Krasnoyarsk

Novosibirsk, 2022

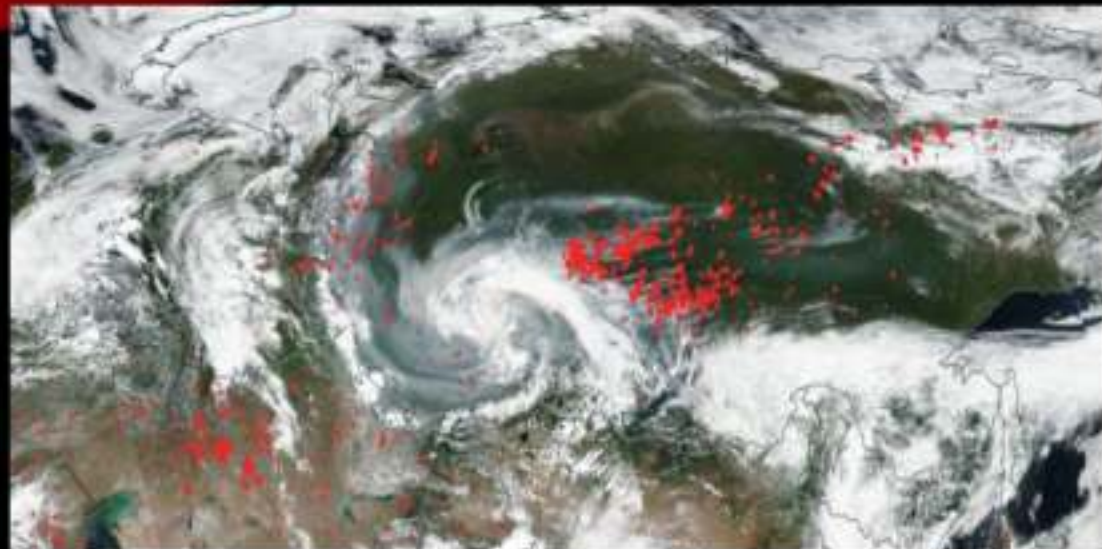
FIRE MAP FOR JULY 2019 (VIIRS)



Active fires for July
2019

ACTIVE SMOKE CLOUD FORMATION

19.07.19



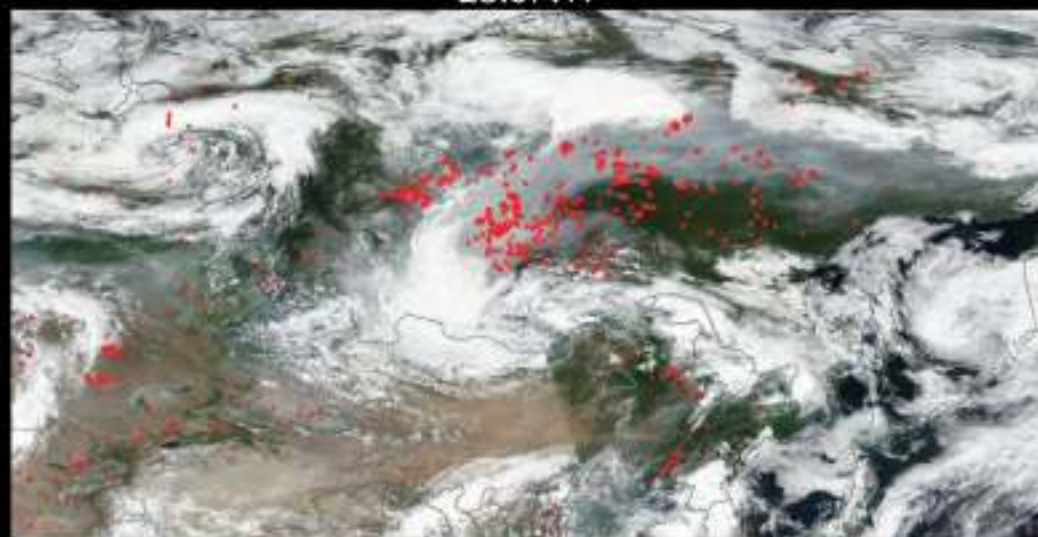
23.07.19



25.07.19



28.07.19



PYROCUMULONIMBUS

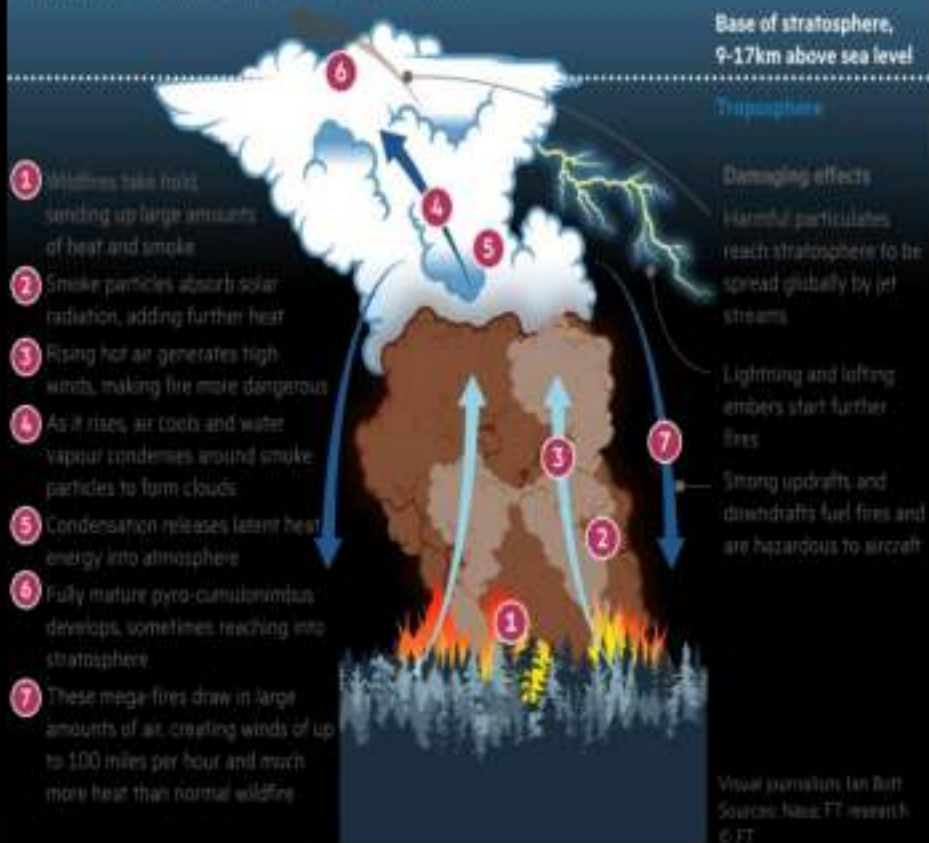


Нимавари-8 в реальном времени

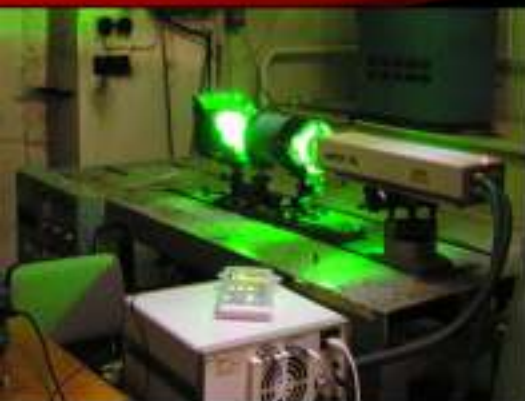
2017/08/15 10:00:00



How pyro-cumulonimbus clouds form

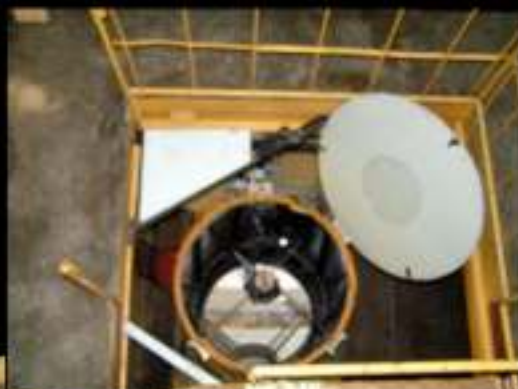


LIDAR STATION FOR HIGH ALTITUDE SOUNDING, ZUEV INSTITUTE OF ATMOSPHERIC OPTICS, TOMSK



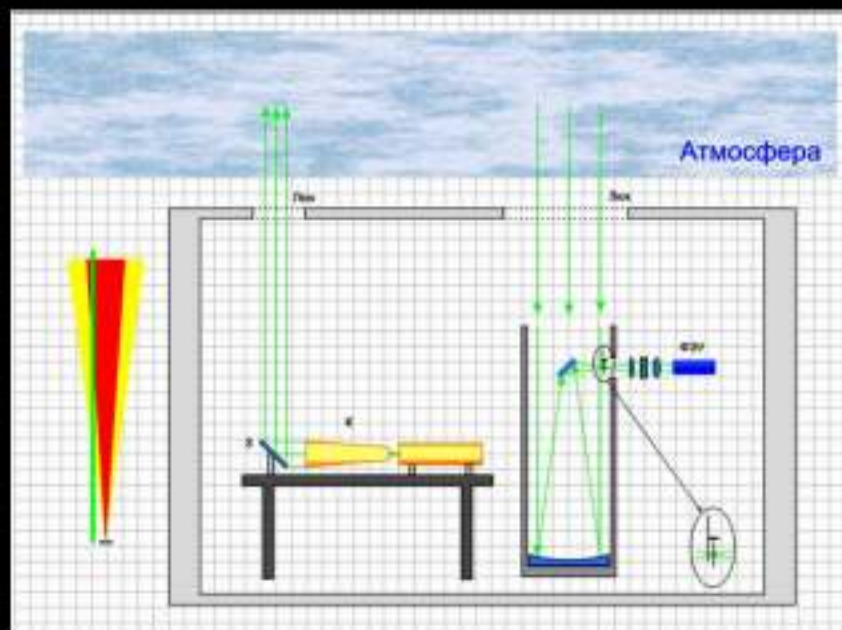
laser LS2137U-UV3

mirror telescope, D=1m



Receiving photoelectron channel

Lidar placement scheme



Back scattering ratio

$$R(H) = \frac{\beta_a(H) + \beta_m(H)}{\beta_m(H)} = 1 + \frac{\beta_a(H)}{\beta_m(H)}$$

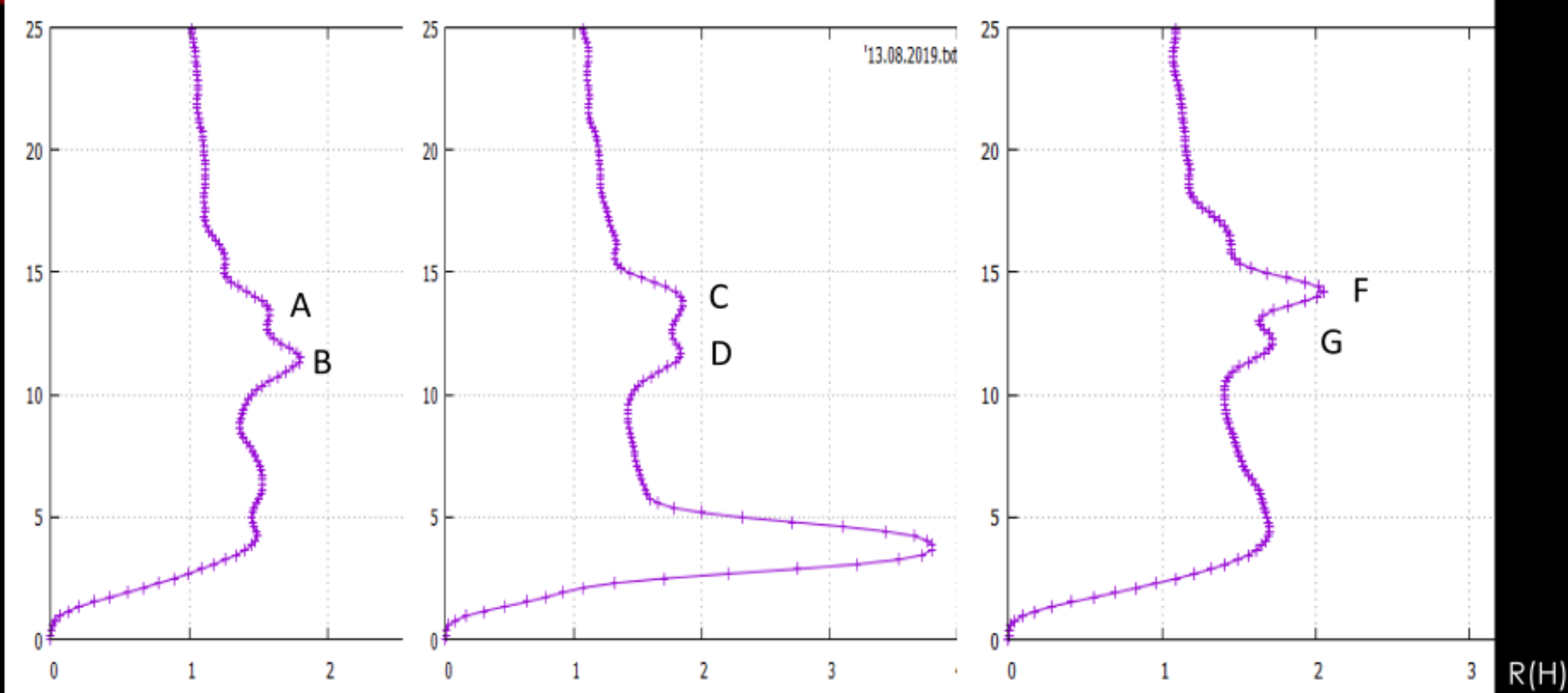
LIDAR OBSERVATIONS IN TOMSK, AUG 2019

H, km

12.08.2019

13.08.2019

26.08.2019

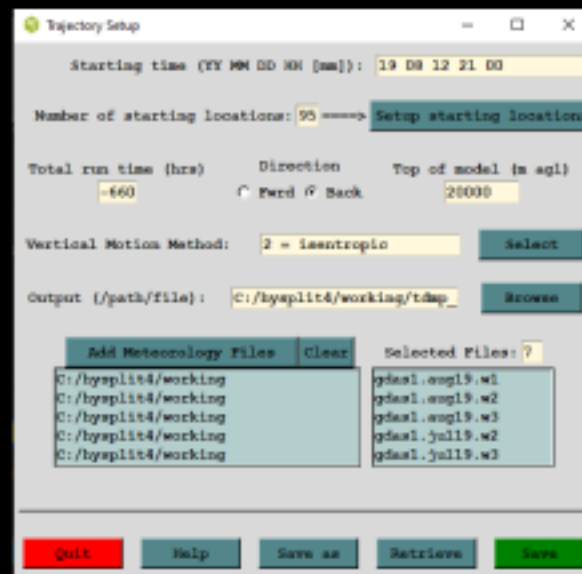


LAGRANGE PARTICLE TRAJECTORIES CALCULATION BASED ON WIND VELOCITY AND TEMPERATURE FROM SATELLITE

HYSPLIT package



HYSPLIT
setup

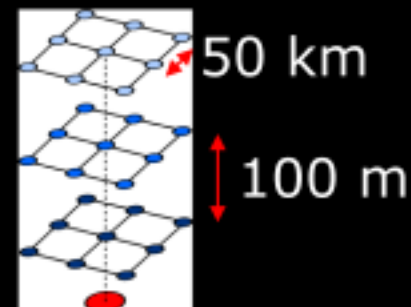


Data source

NOAA (GDAS)

grid $1^{\circ} \times 1^{\circ}$, $\Delta t = 6$ h

Start point positions

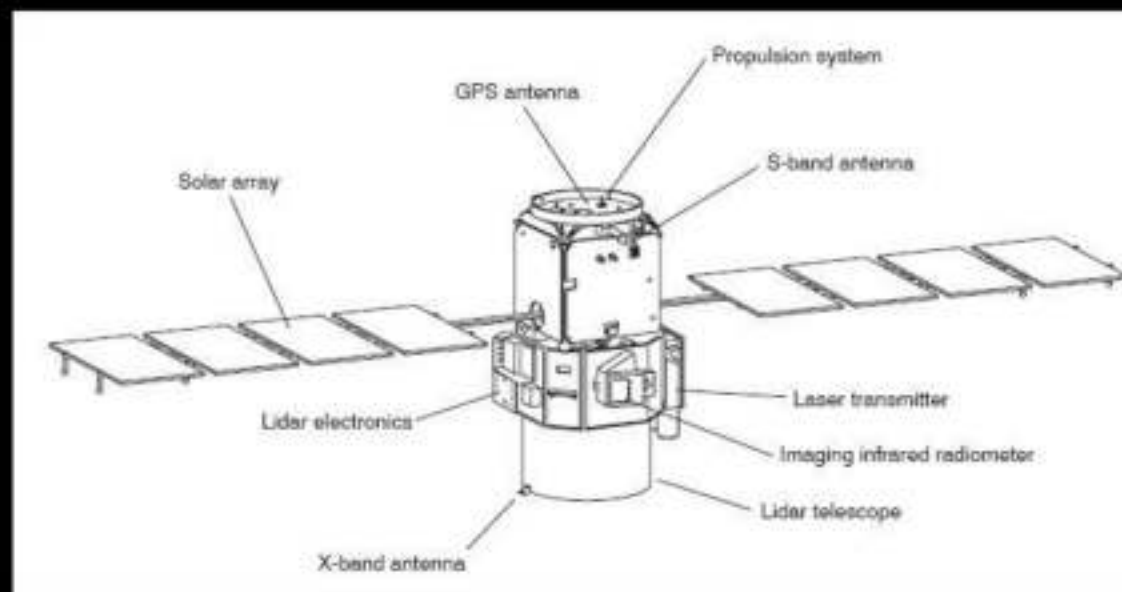
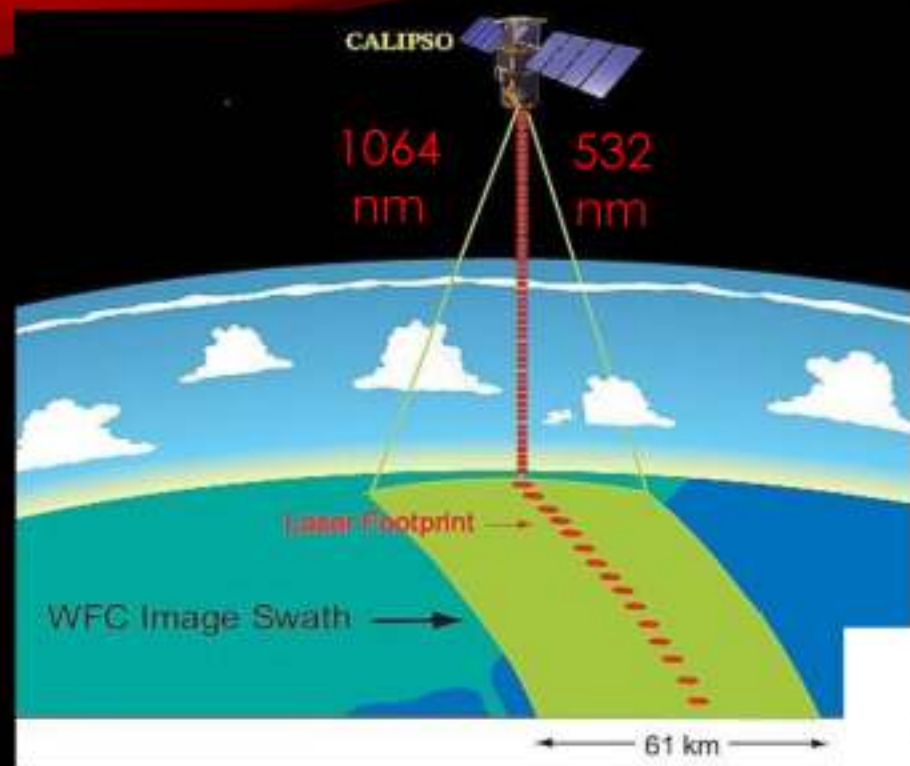


Tomsk

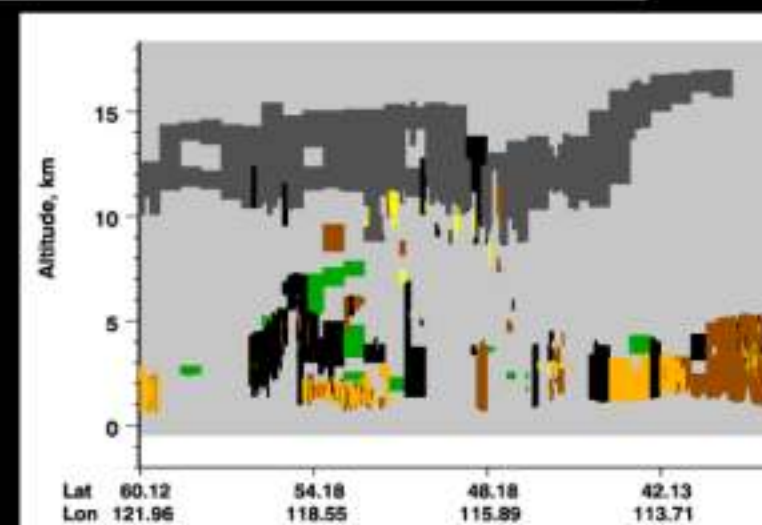
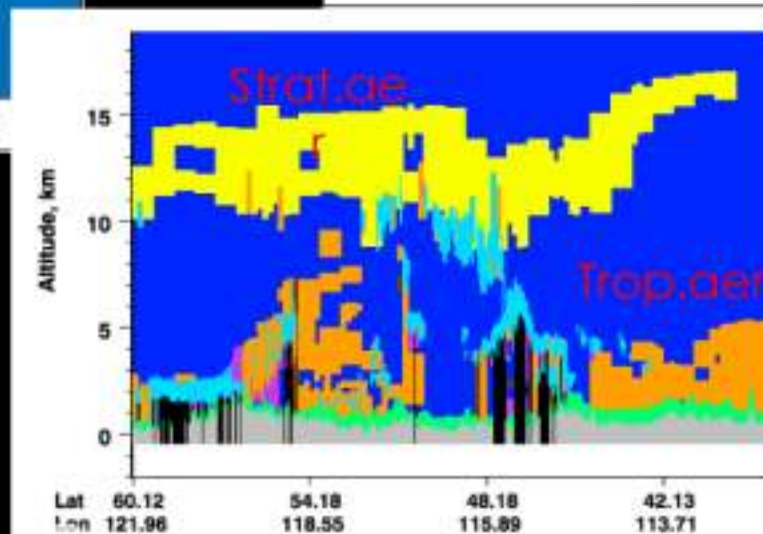
Trajectory type: isentropic

Along $\Theta = \text{const}$ surfaces

CALIOP LIDAR on CALIPSO board



Aerosol traces



HIMAWARI – 8 (BRIGHTNESS TEMPERATURE)

Numbers of
spectral
channels: 16

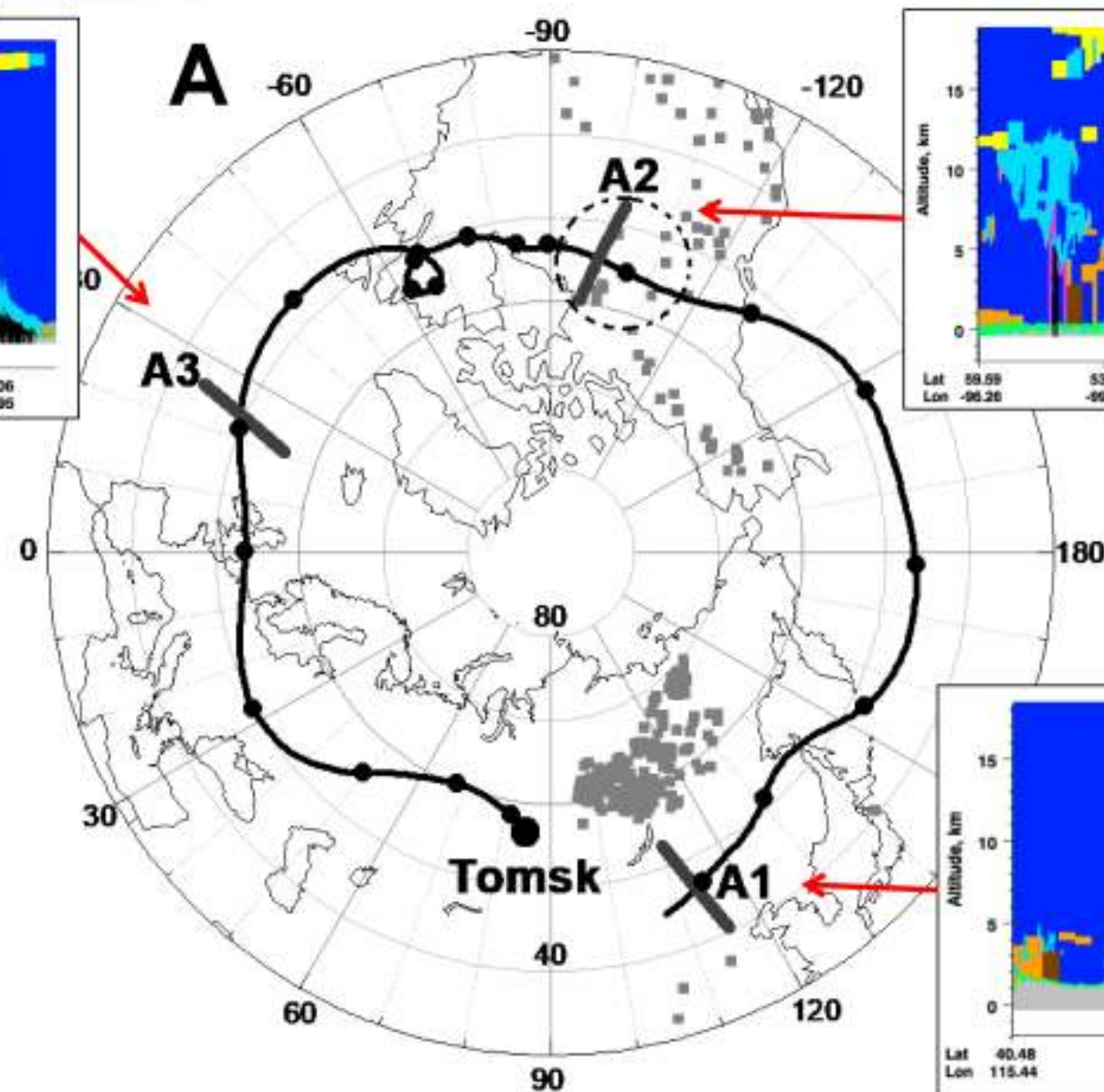
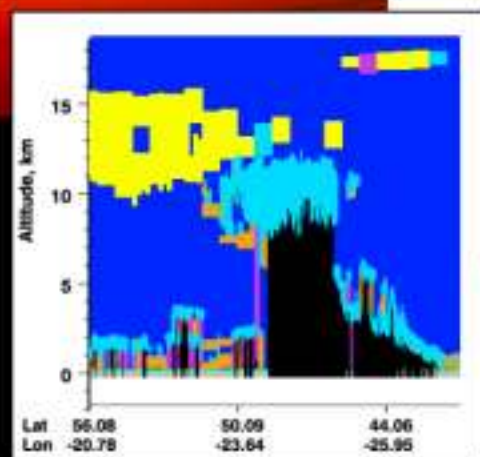
Wavelength of
channels: 410nm
– 13.3 μm

Orbit: Geostationary orbit
Altitude: ~38.800km
Longitude: ~140.7° east

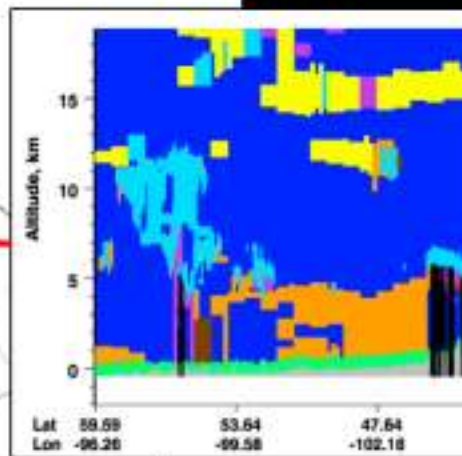


BACKWARD TRAJECTORY FROM TOMSK AT H~14 KM, 12 AUG 2019

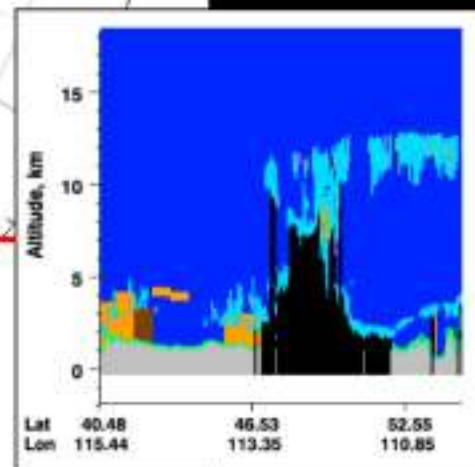
A3
7 Aug



A2
28 July

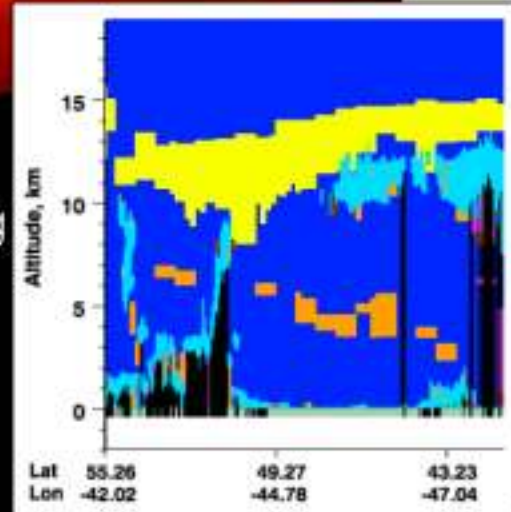


A1
23 July

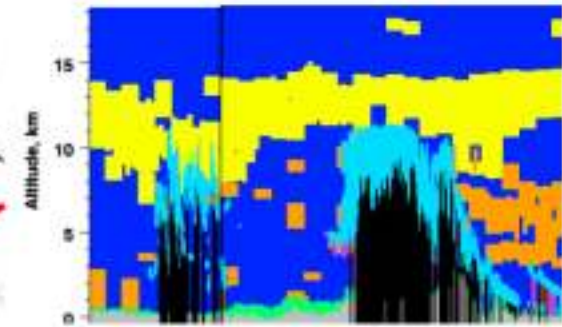


BACKWARD TRAJECTORY FROM TOMSK AT H~12 KM, 12 AUG 2019

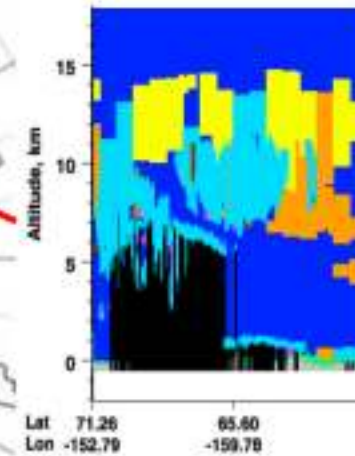
B5
4 Aug



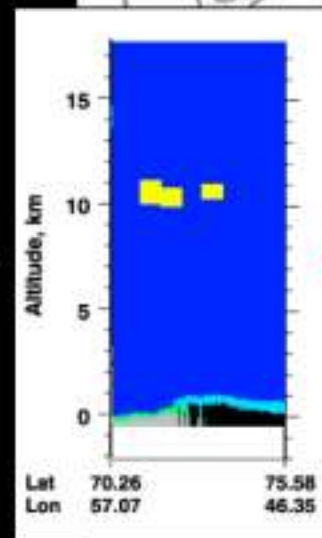
B4
2 Aug



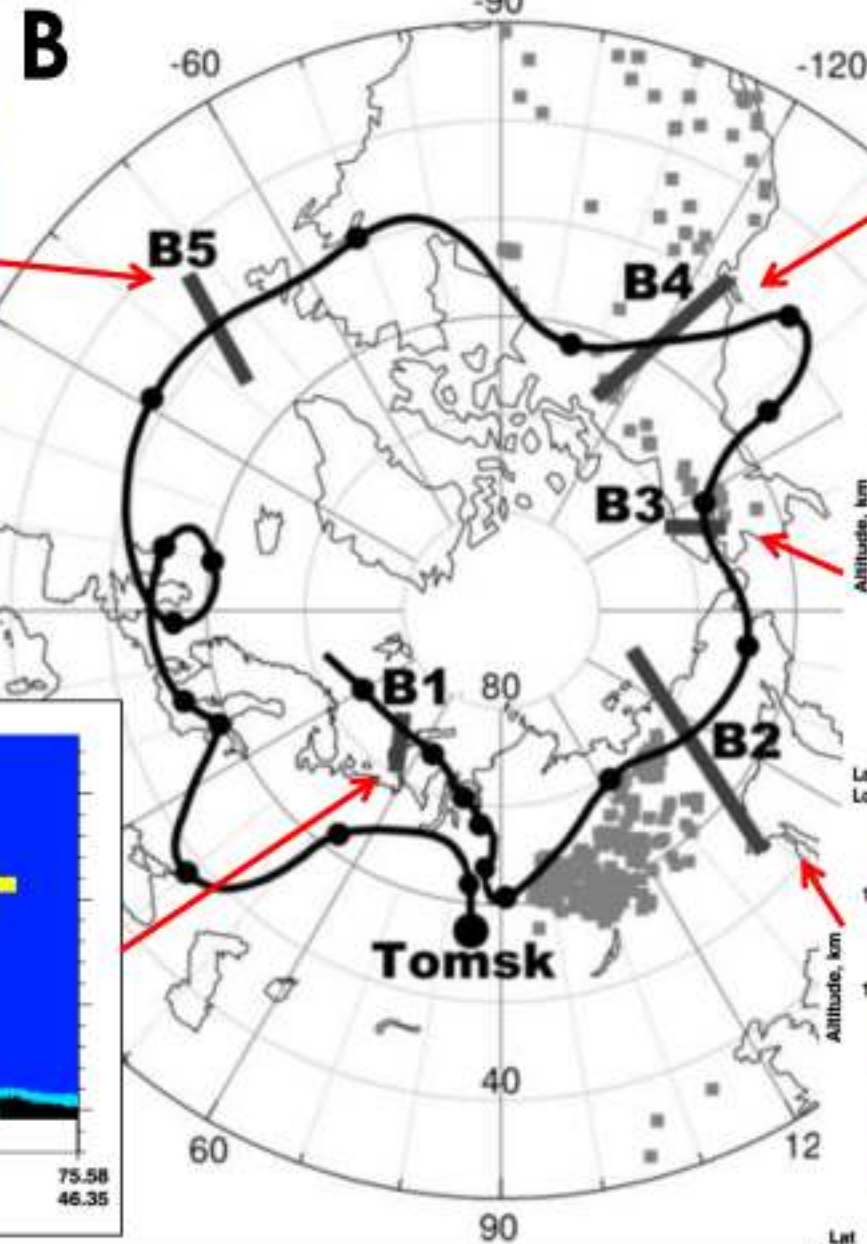
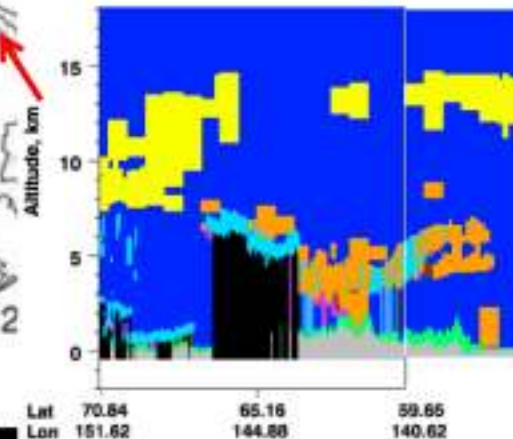
B3
30 July



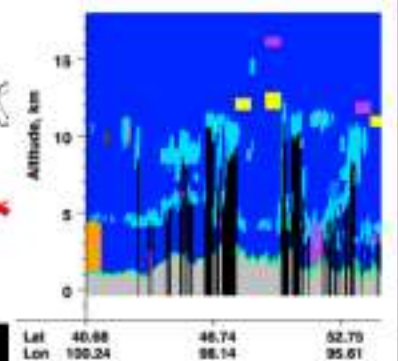
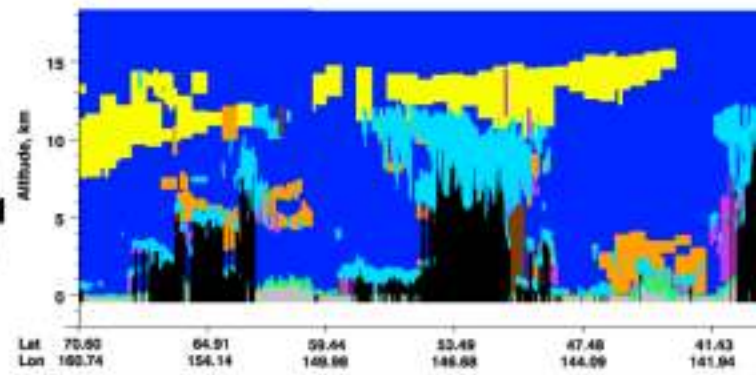
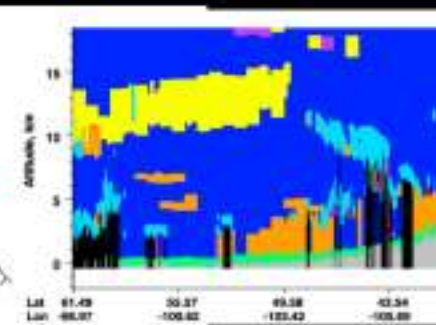
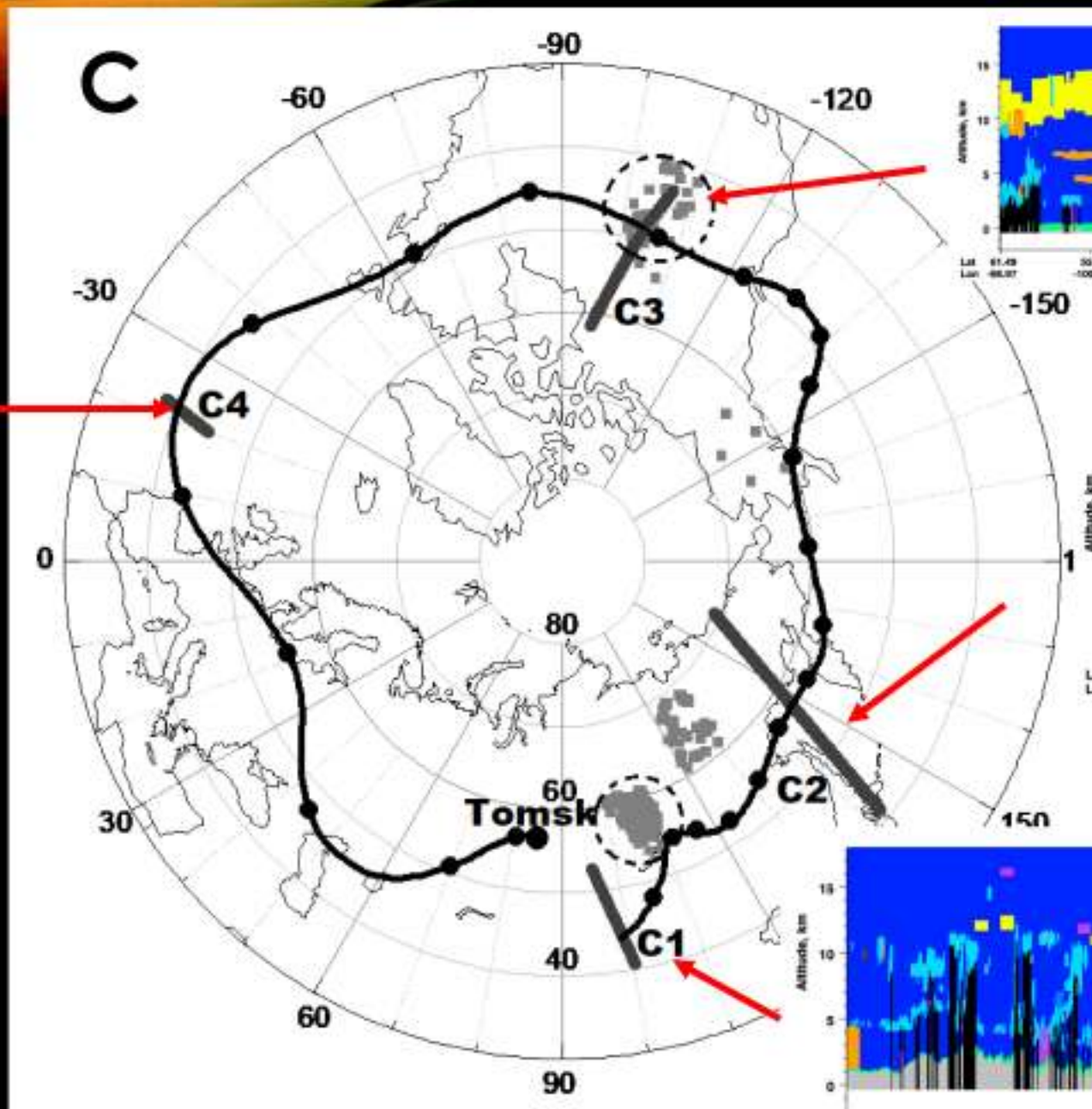
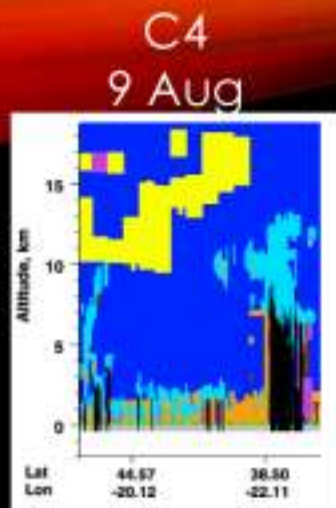
B1
22 July



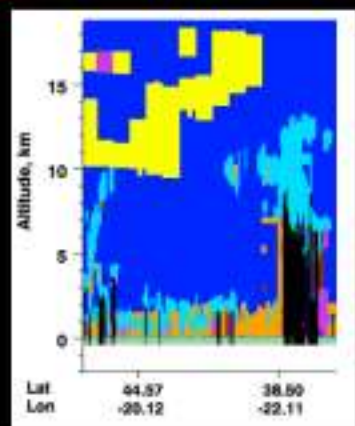
B2
28 July



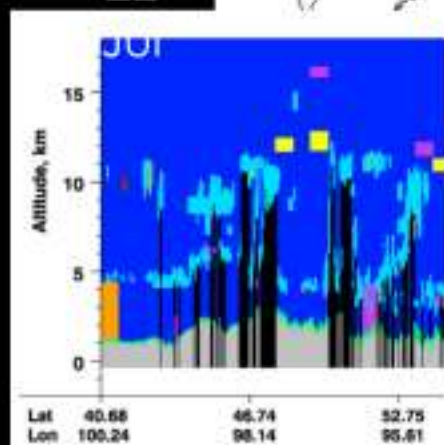
BACKWARD TRAJECTORY FROM TOMSK AT H~13.9 KM, 13 AUG 2019



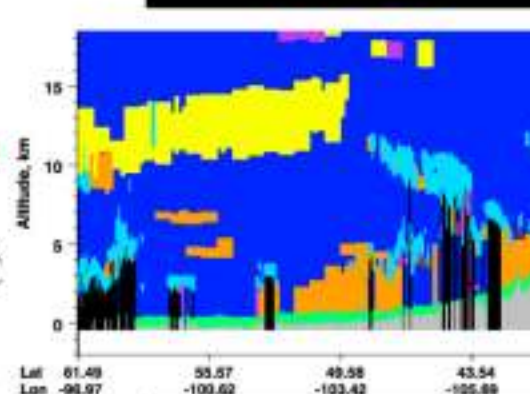
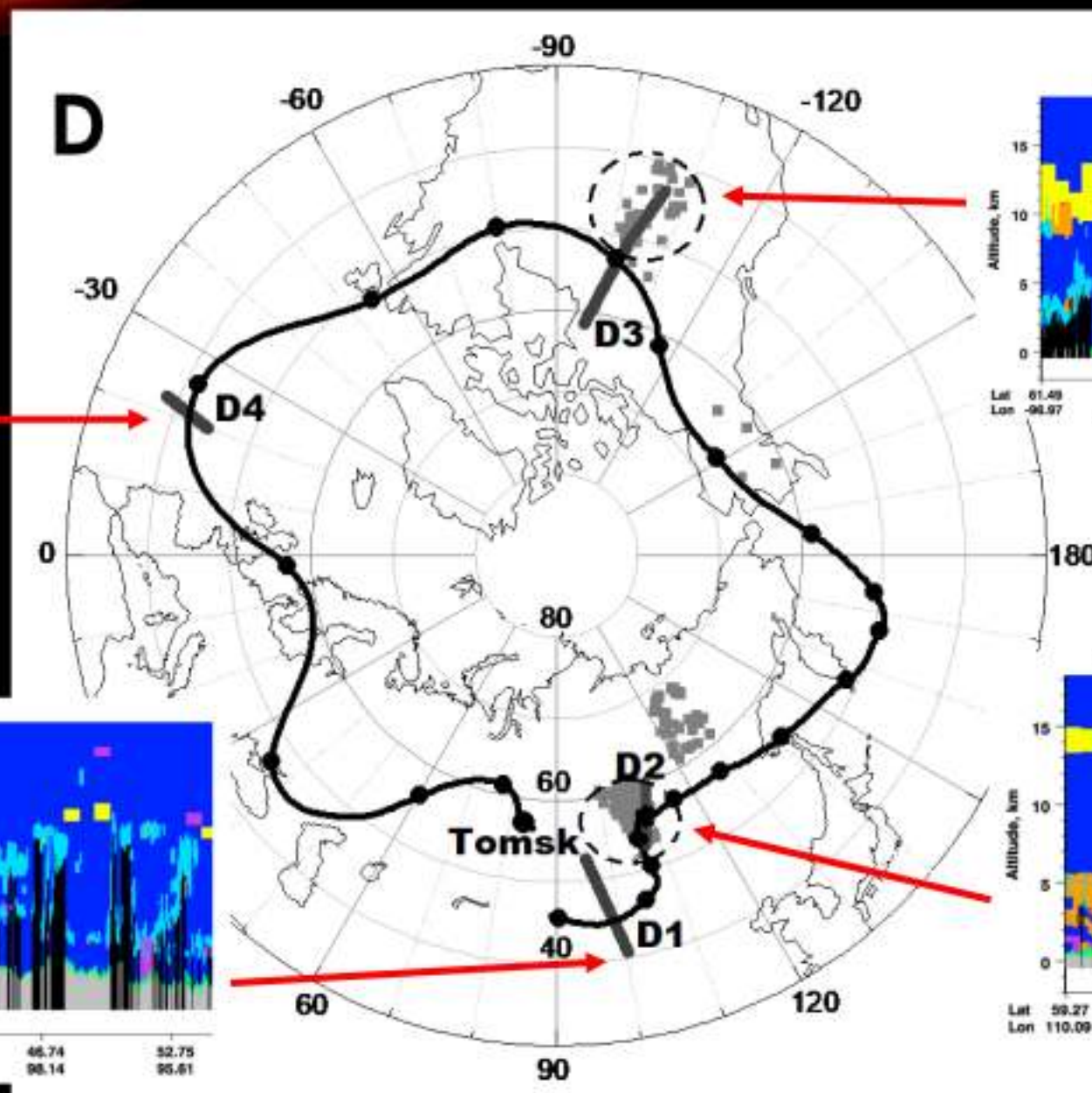
Backward trajectory from Tomsk at H~12 km, 13 Aug 2019



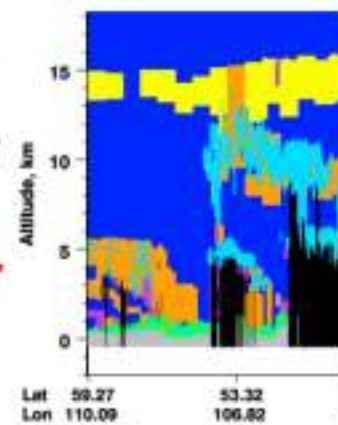
D4
9 Aug



D1
22



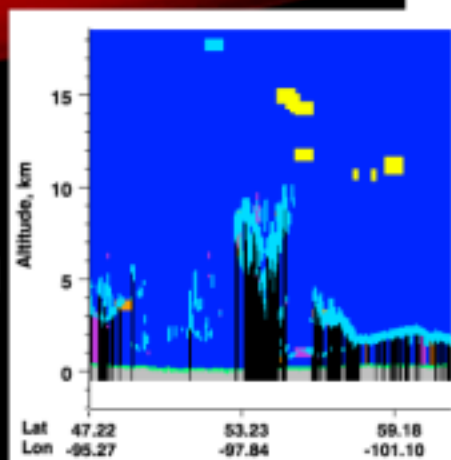
D3
5 Aug



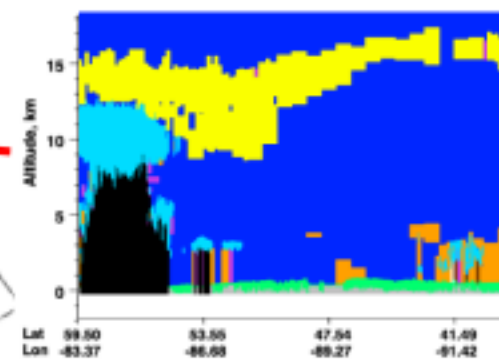
D2
26 Jul

Backward trajectory from Tomsk at H~13.6 km, 26 Aug 2019

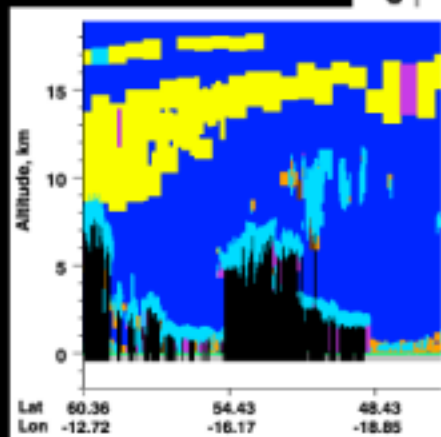
G1
19 Jul



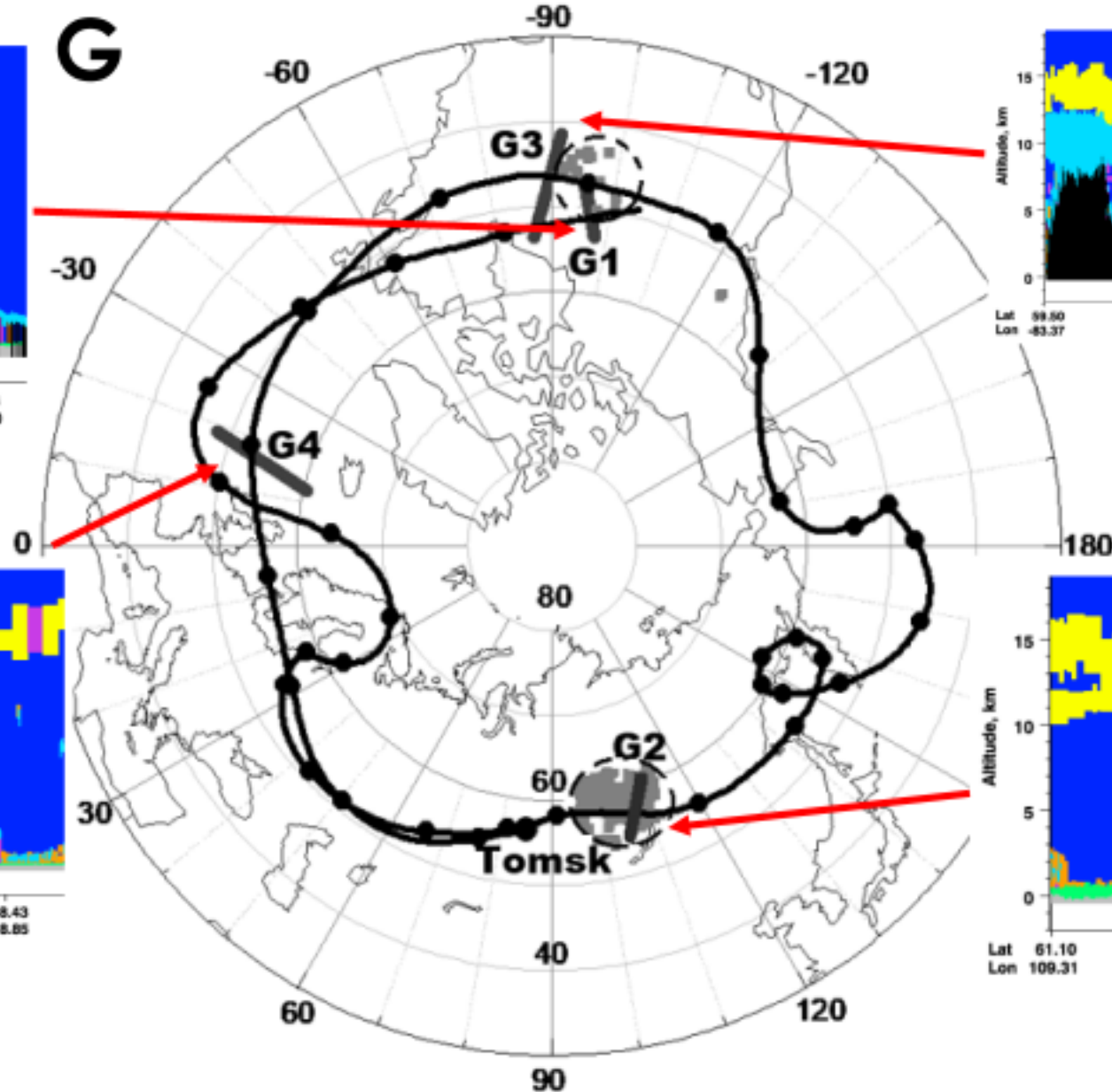
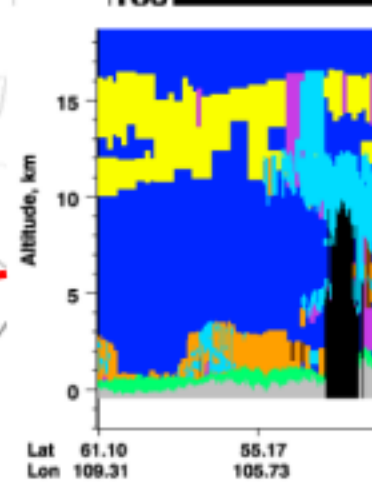
G3
19 Aug



G4
22
Aug

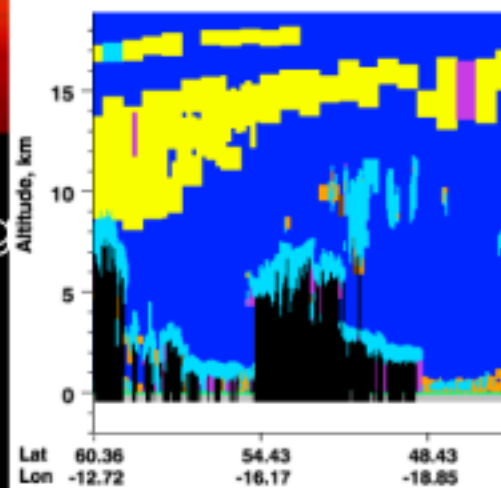


G2
3 Aug

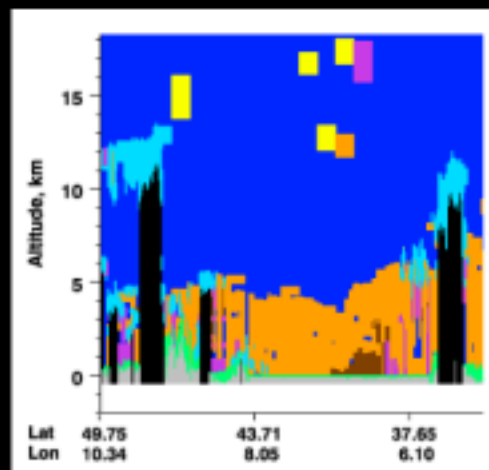
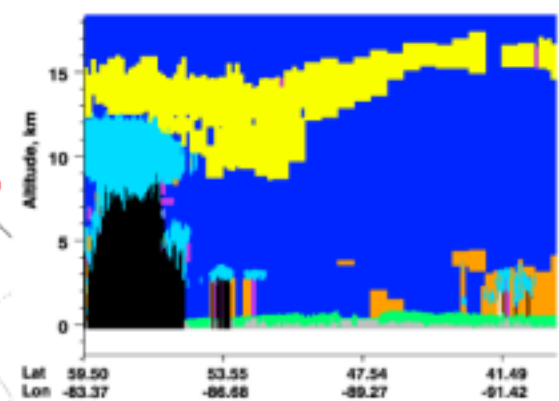


Backward trajectory from Tomsk at H~14.4 km, 26 Aug 2019

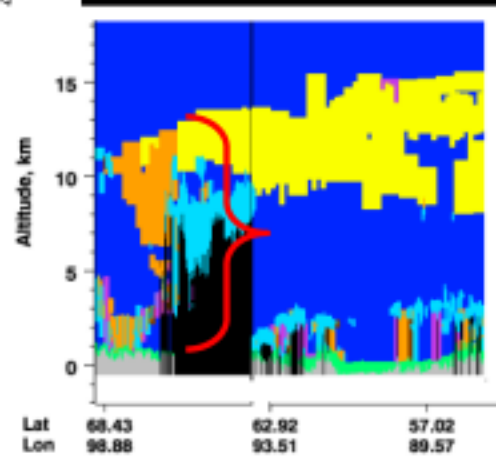
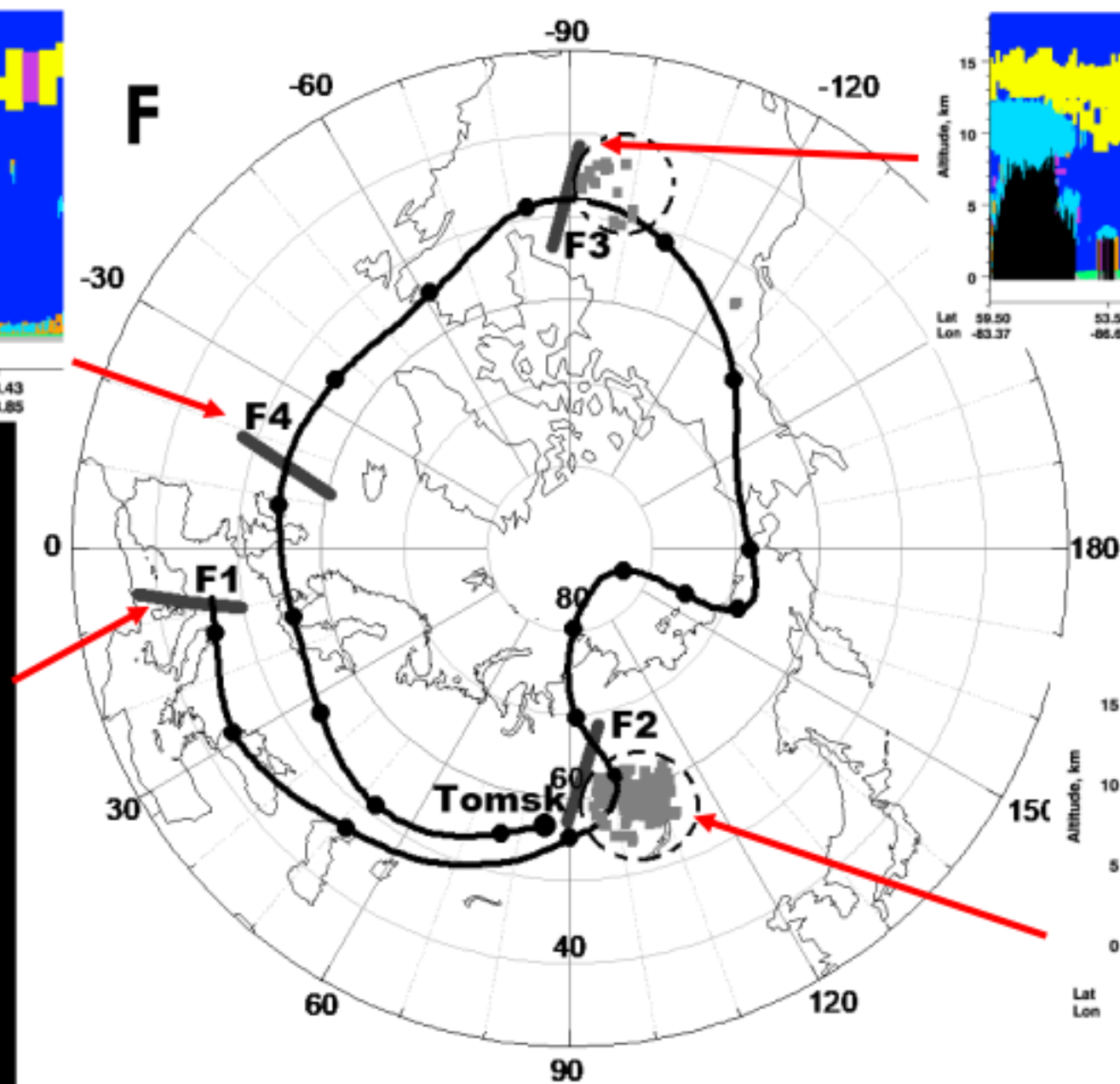
F4
22 Aug



F3
19 Aug

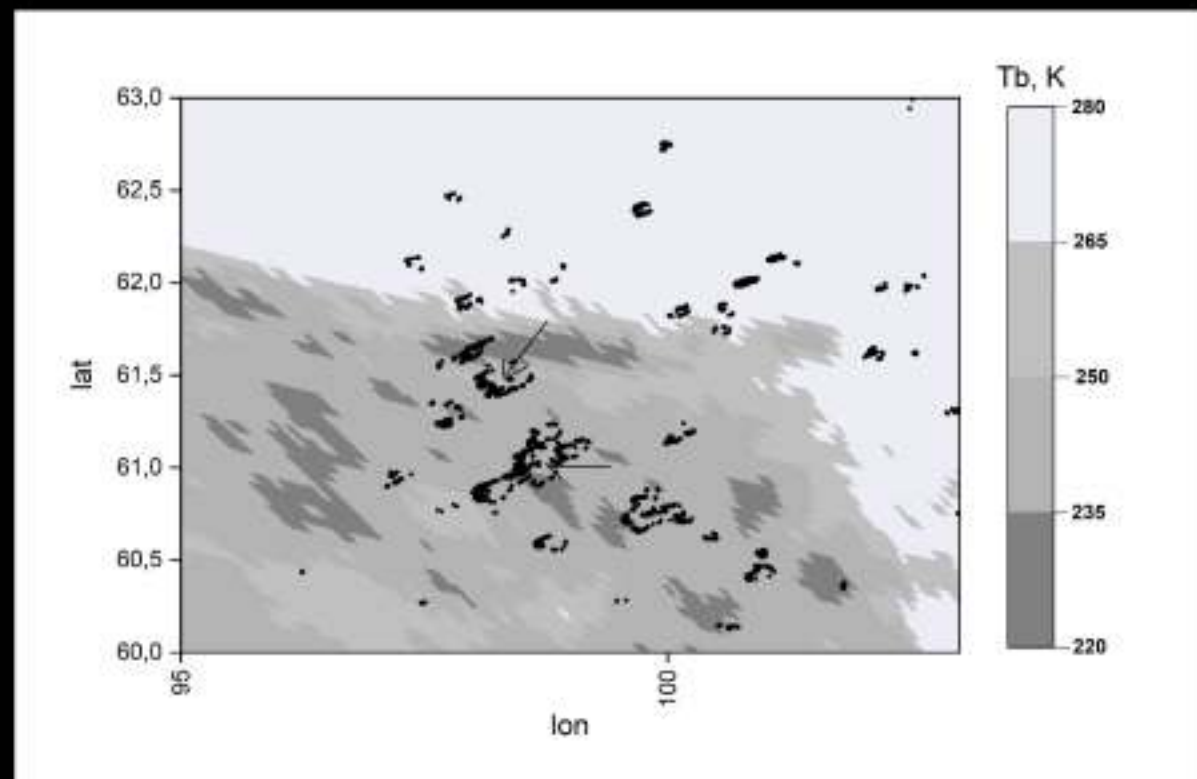
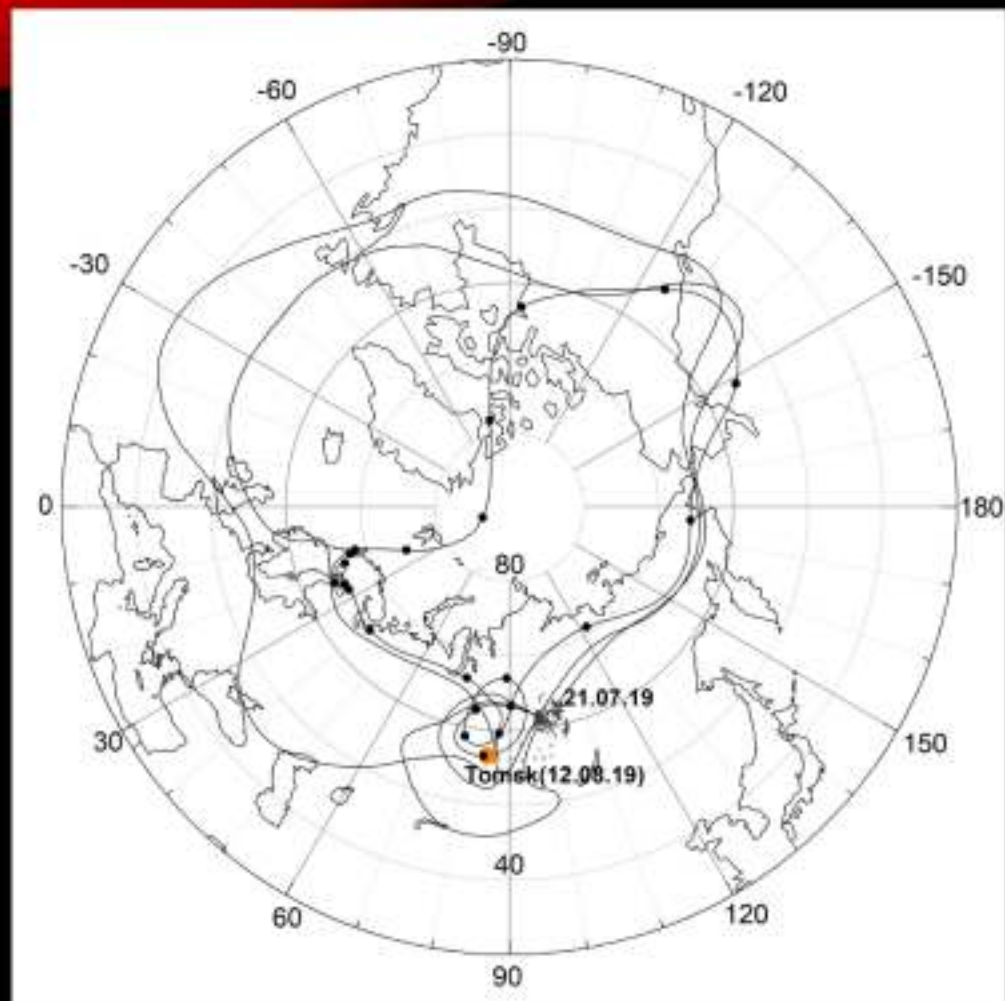


F1
16 Aug

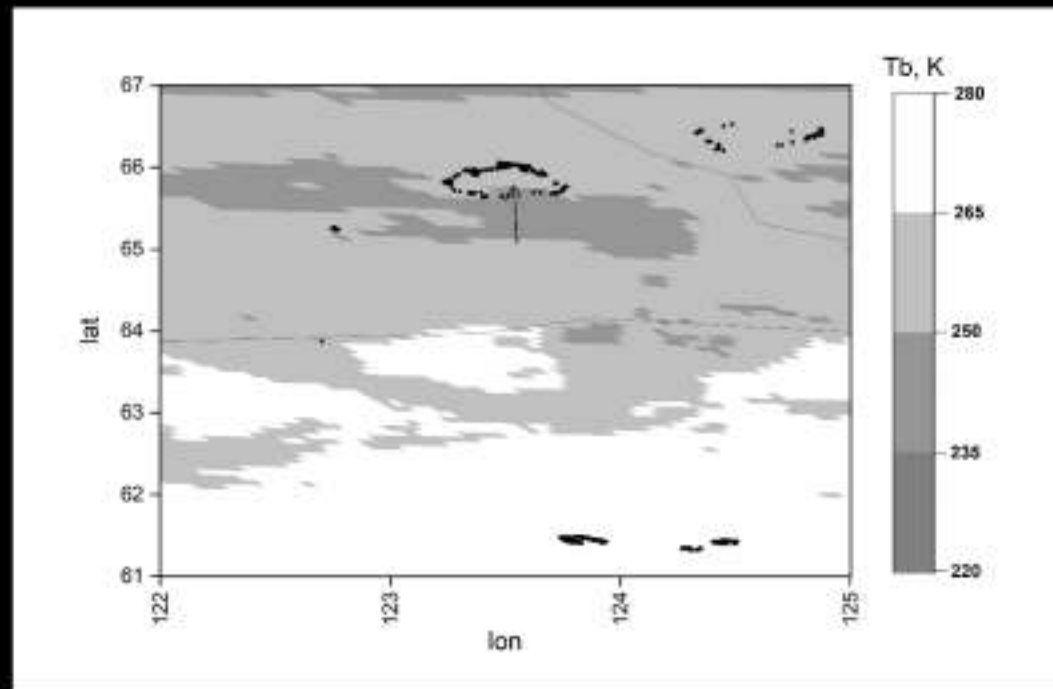
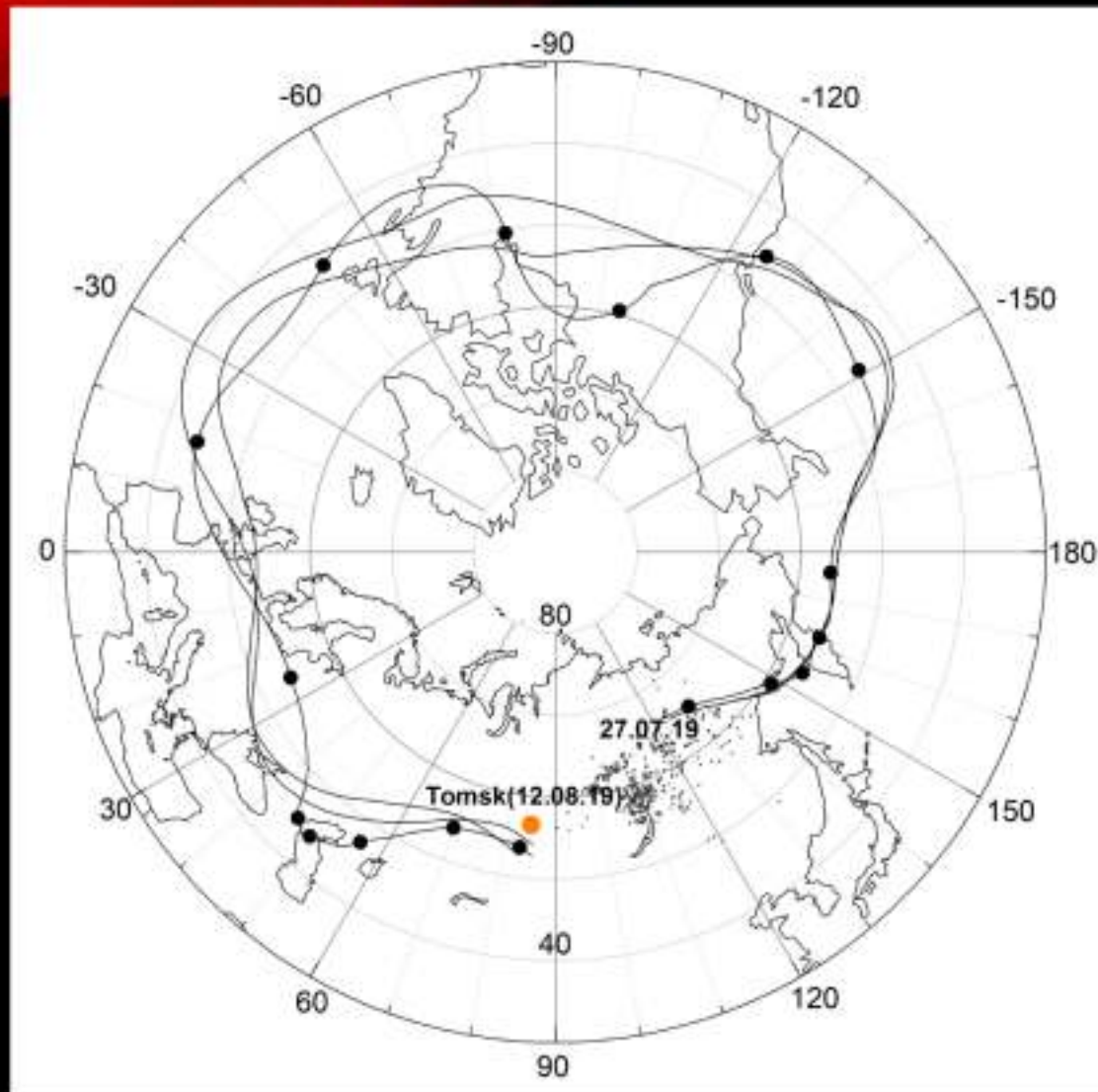


F2
10 Aug

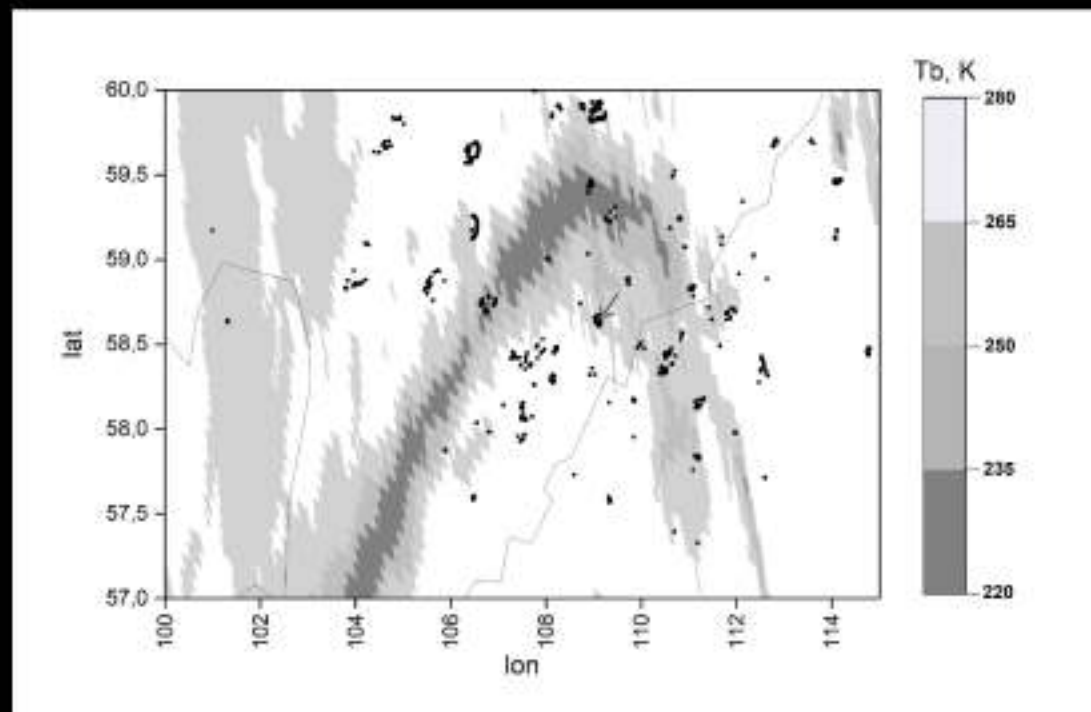
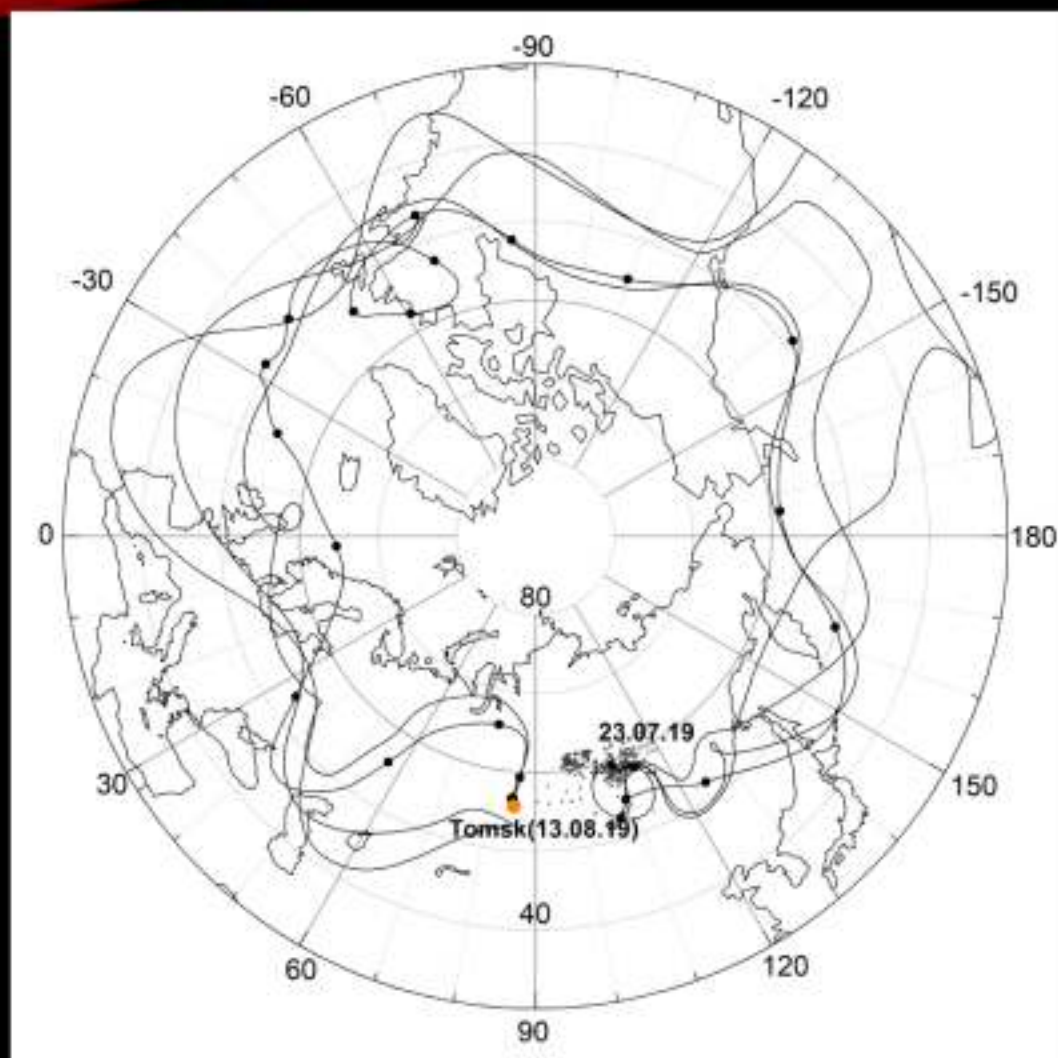
FORWARD TRAJECTORY(21.07.19)



FORWARD TRAJECTORY (27.07.19)



FORWARD TRAJECTORY (23.07.19)



CONCLUSION

- Aerosol traces were analyzed over Tomsk at an altitude of 10-15 km in the summer-autumn period
- The analysis showed that the main sources of aerosol were pyrocumulative emissions into the stratosphere
- Developed method of analysis is already being used in the next study related to aerosol traces over Tomsk in the summer of 2022



Thank you for attention!