FIREWORK POLLUTION MEASUREMENTS ON NEW YEAR'S EVE 2018

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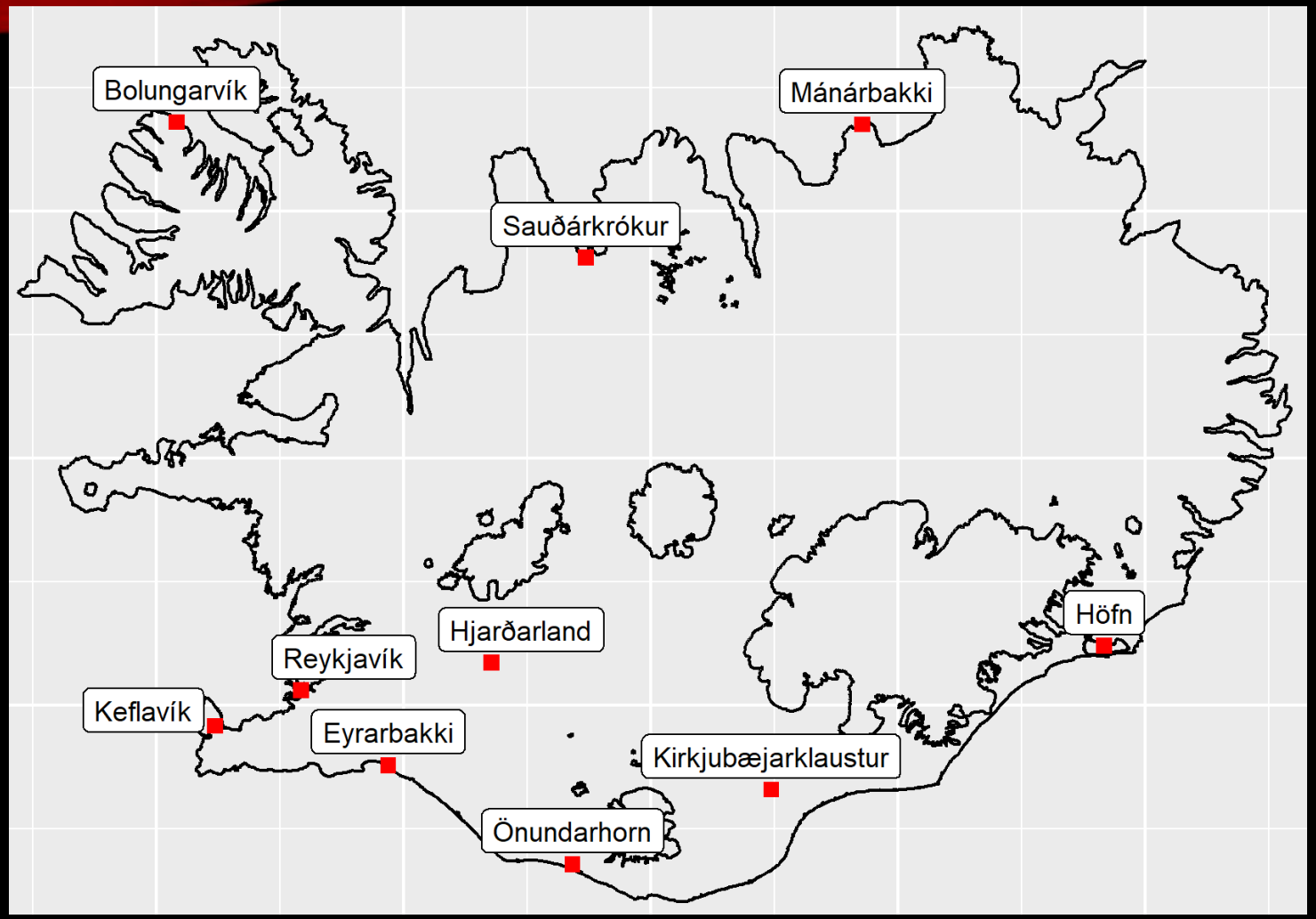
ATMOSPHERIC LIDAR AND CEILOMETER NETWORK



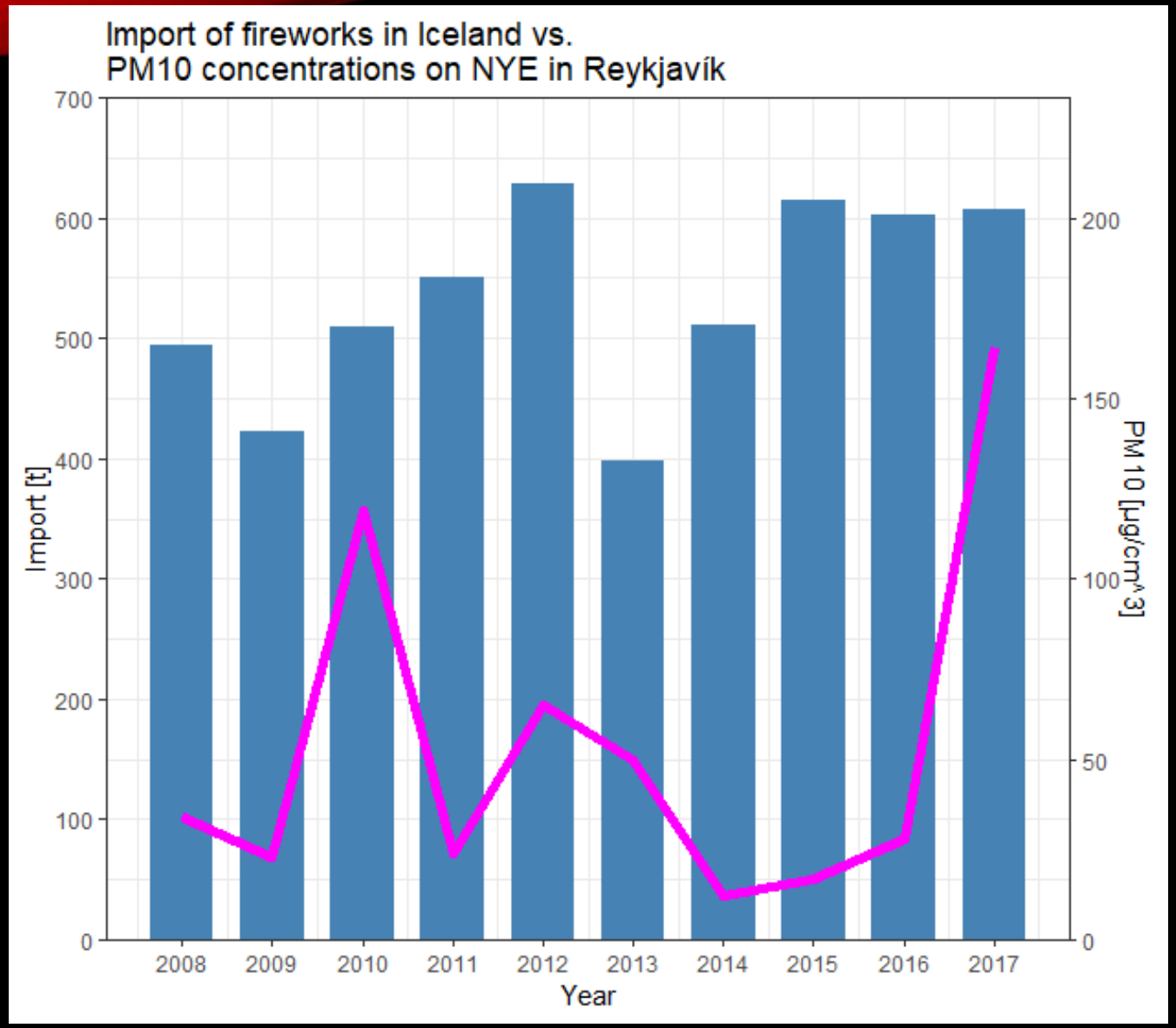
Vaisala CL31 / CL51

- pulsed laser (Indium Gallium Arsenide); 910 ± 10nm
- Meas. range: 7500 / 15000 m
- Meas. resolution: 5 or 10 / 10 m

Leosphere WINDCUBE 200S-AT

- pulsed lidar; 1543 nm
- Meas. range: 50 to 12000 m
- Range resolution: 25, 50, 75 or 100 m
- Scanning Doppler lidar (0 ...360°; -10 ... 190°)
- Depolarization channel

FIREWORKS IN ICELAND



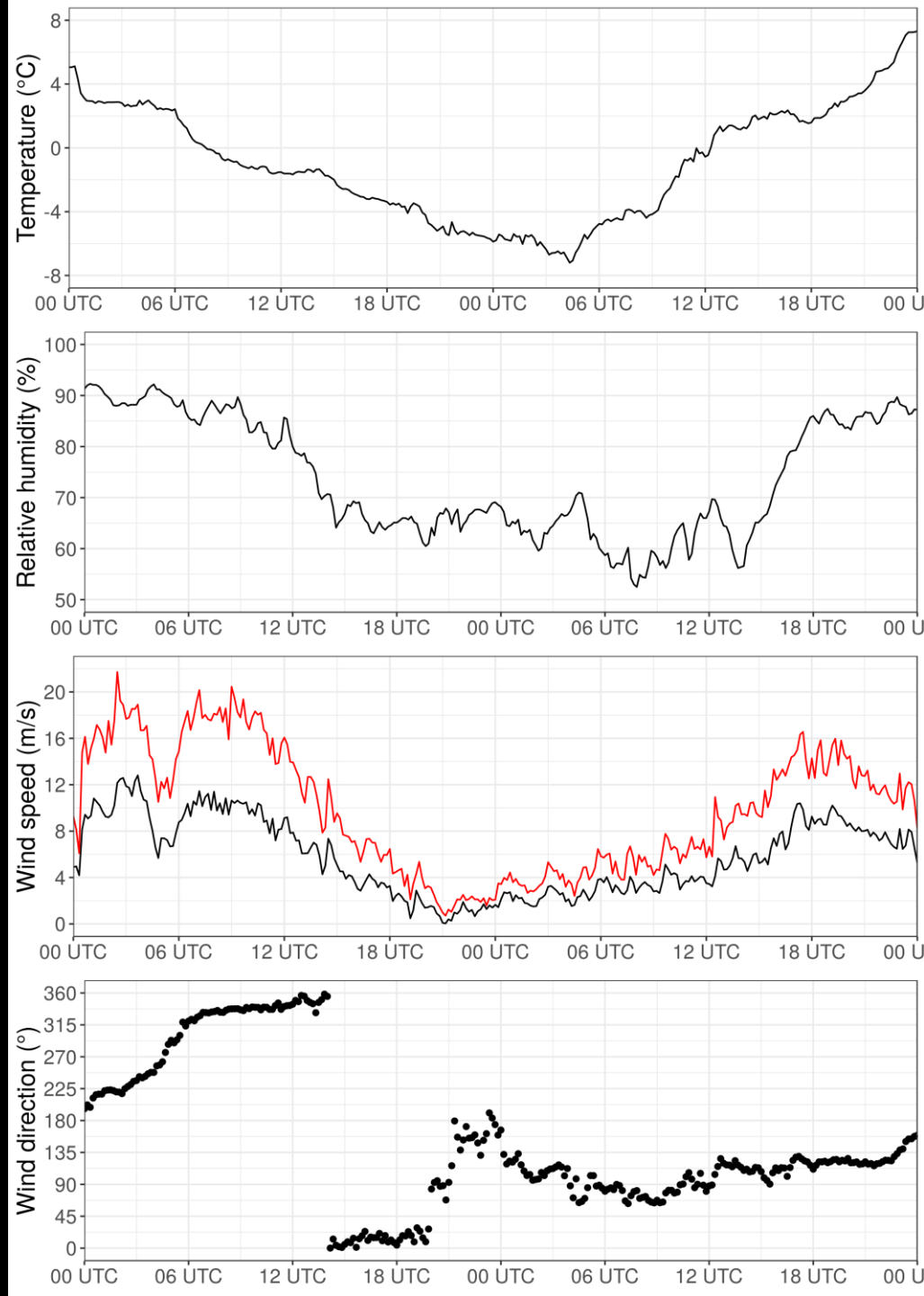
- High amount of fireworks imported every year
- PM10 observation at night NYE not correlated to dimension of import
- Weather conditions determine level of air pollution
- Calm conditions and low level inversion favours bad air quality

EQUIPMENT INSTALLED DURING THE EXPERIMENT

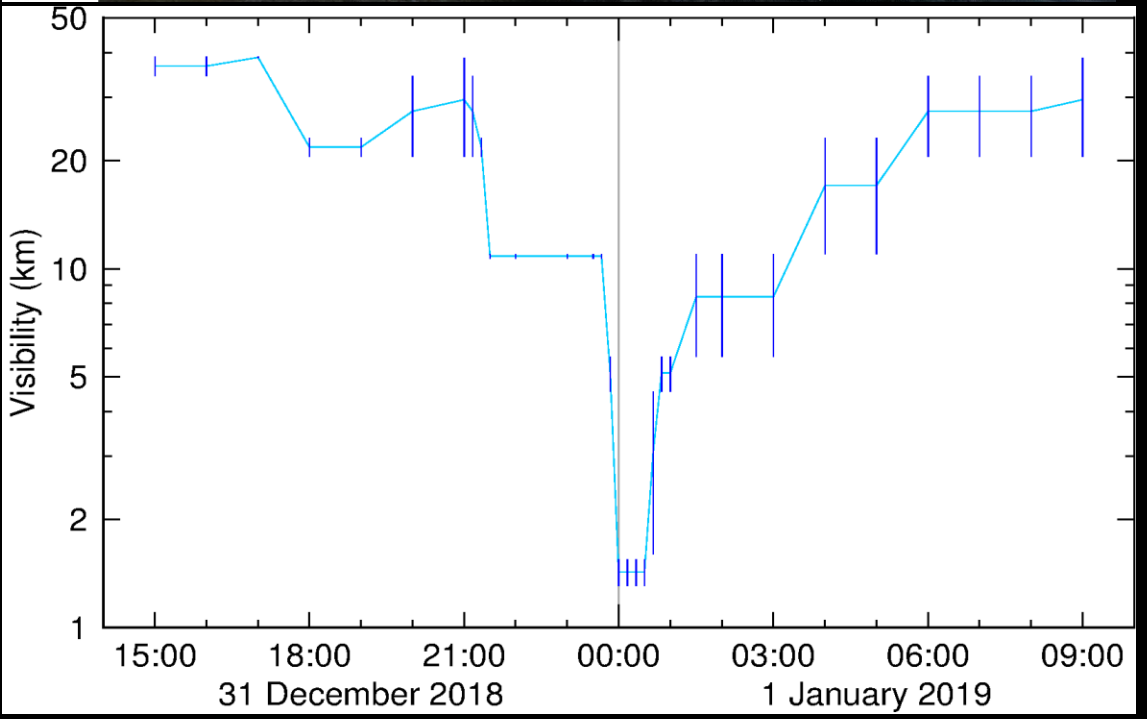
- Three webcams at the roof of IMO building
- Lidar and ceilometer installed in the trailer situated and the meteorological measurments field
- Optical Particle counter (OPS 3330, TSI inc.) within an enclosure collocated to the trailer
- Multigas instrument was not sensitiv enough
- Environmental Agency station i n ~4 km distance to IMO

WEATHER CONDITIONS ON NYE 2018/19

- Sleet and snow was observed during the morning hours but it cleared off in the afternoon
- Temperature and relative humidity decreasing towards midnight
- Inversion developed during NYE night
- Wind turned to east but almost calm conditions
- In the afternoon on New Year´s Day wind speed was increasing as well as the relative humidity and temperature



VISIBILITY ESTIMATIONS



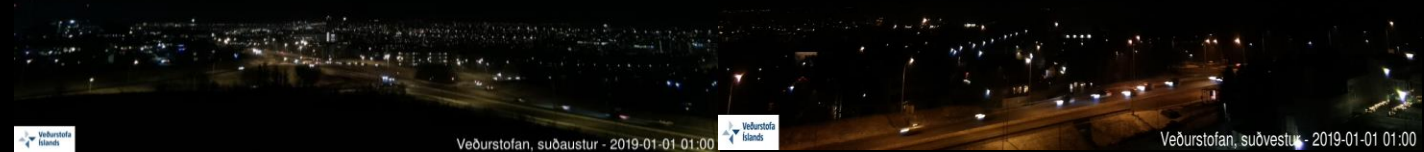
South east

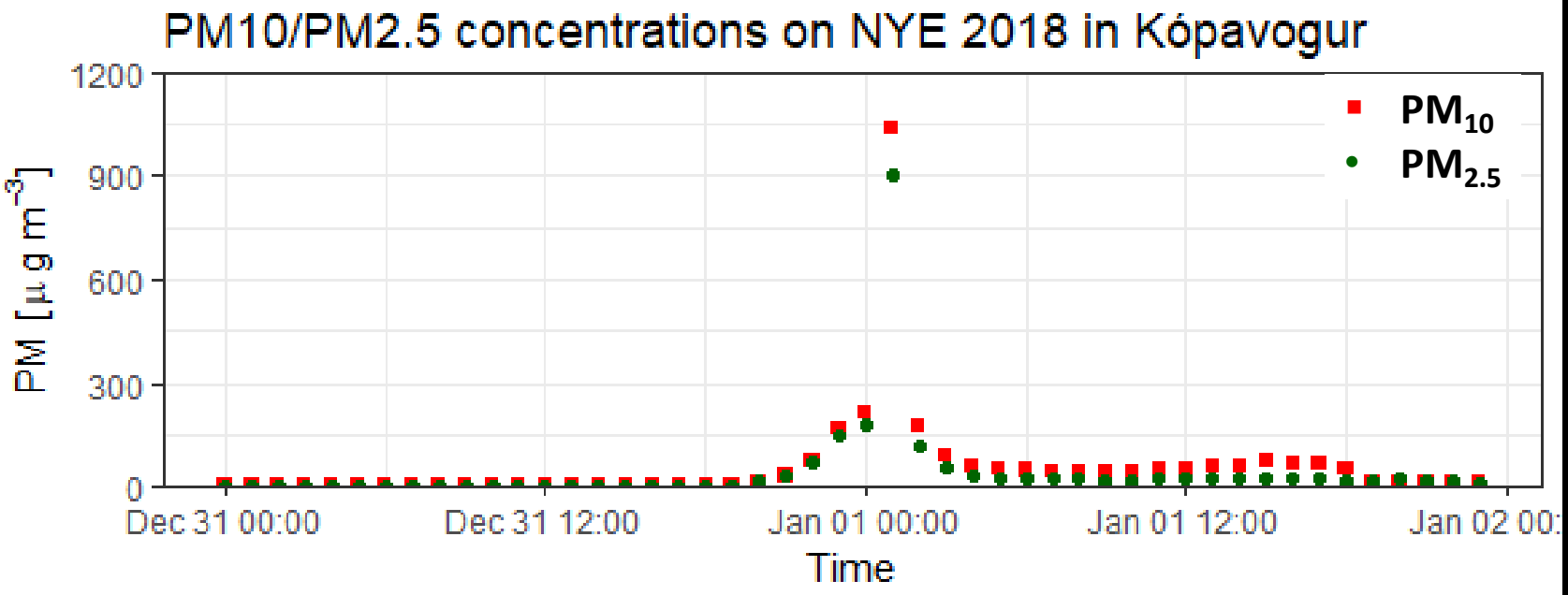
South west

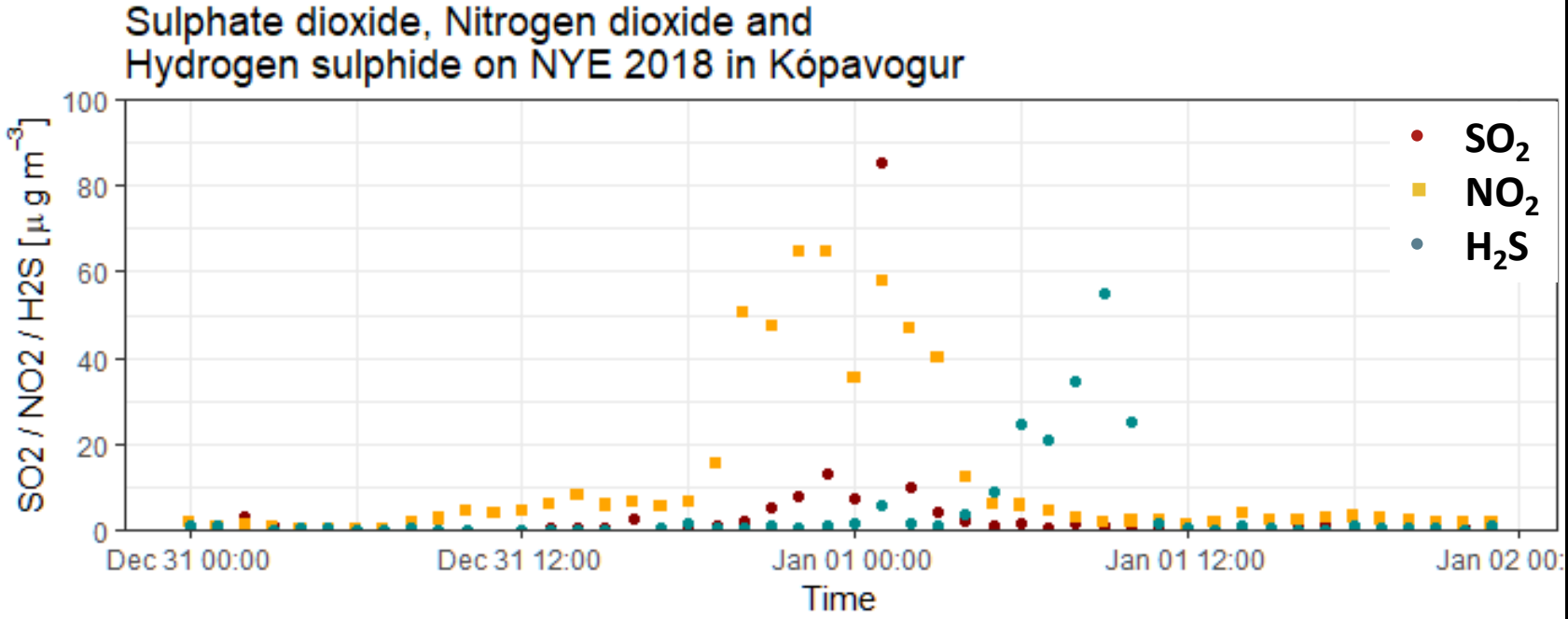
18 UTC

00 UTC

01 UTC

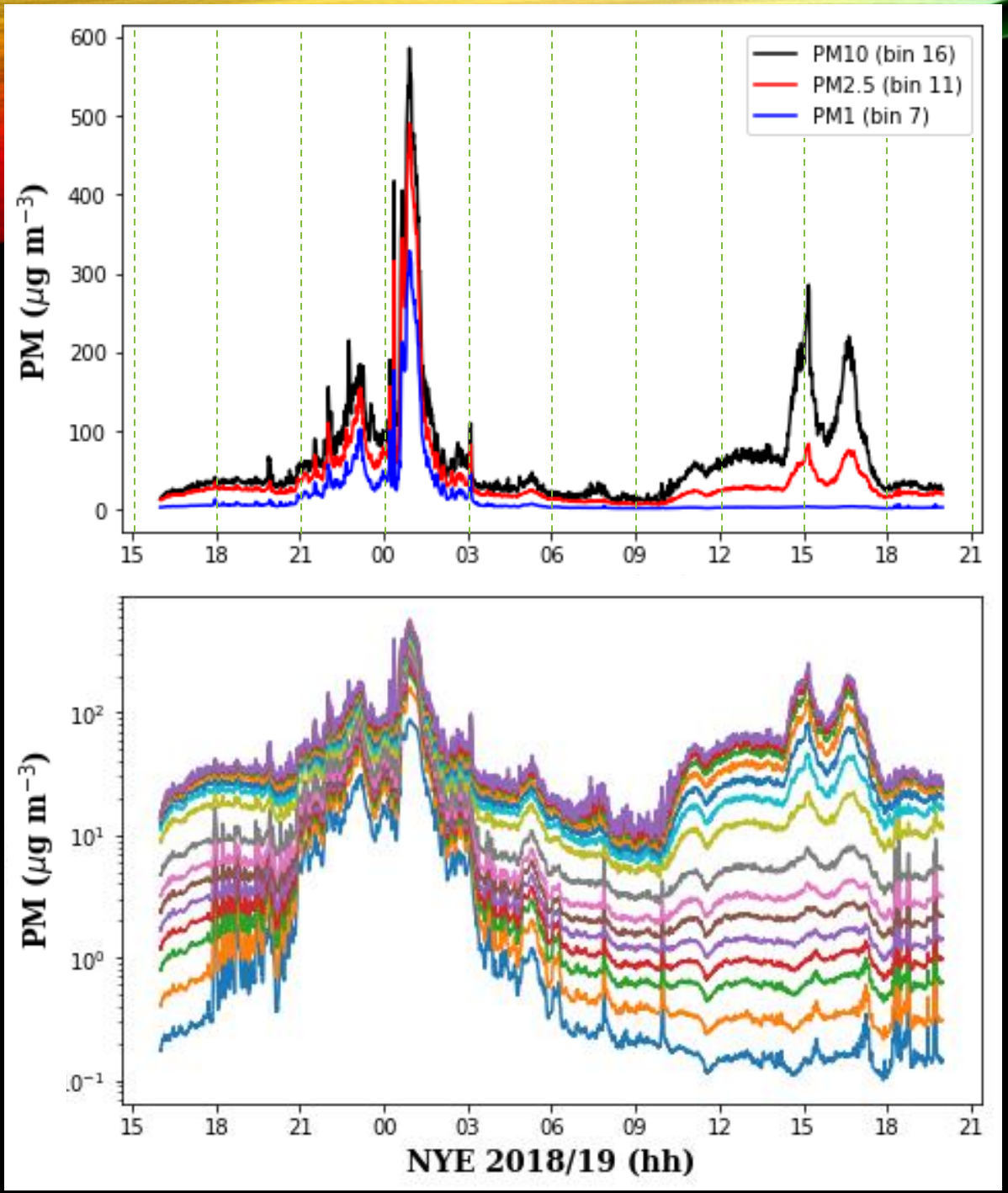






EA ICECLAND MEASUREMENTS

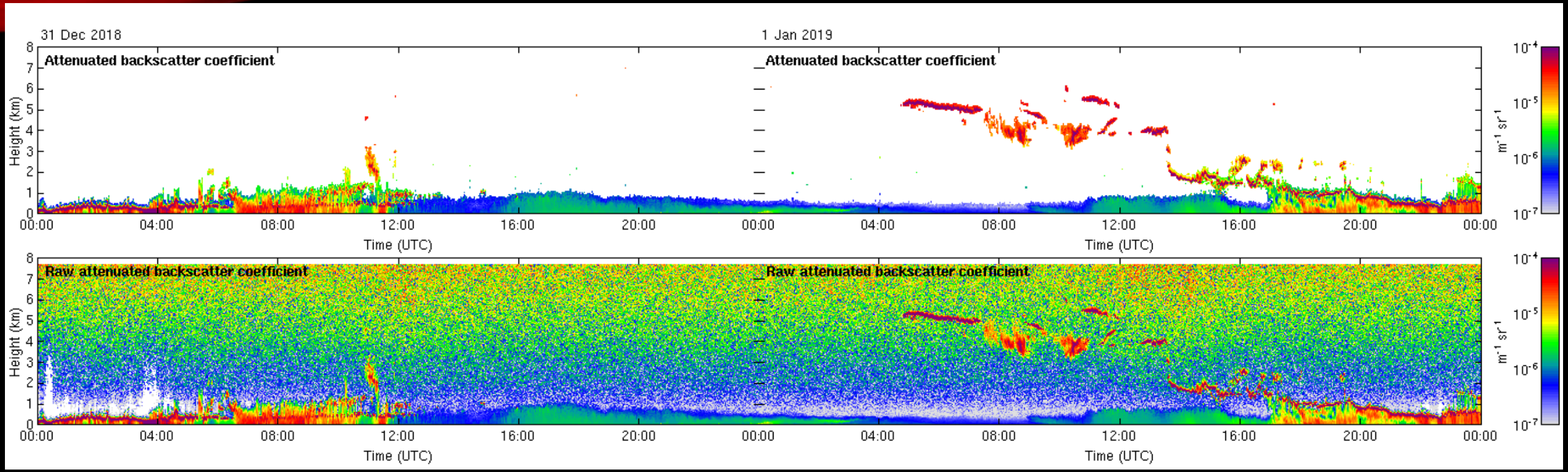
- hourly PM10 and PM2.5 measurement in Kópavogur valley
- continuous increasing towards midnight
- PM10 second maximum in afternoon
- very high level of SO_2 at midnight, but the whole evening of NO_2
- H_2S concentrations unrelated to fireworks



OPC MEASUREMENTS

- OPC size range: 0.3 to 10 μm
- Particle number concentration measured in 16 size bins
- Particle number converted in PM1, 2.5, and 10
- PM concentration decrease 22:30 - 23:30 UTC due to very popular TV show
- Max. PM concentration one o'clock
- High number and mass concentrations of particles smaller than 1 μm around midnight
- Secondary peak probably due to resuspension in the afternoon
  - doesn't show for fine particles

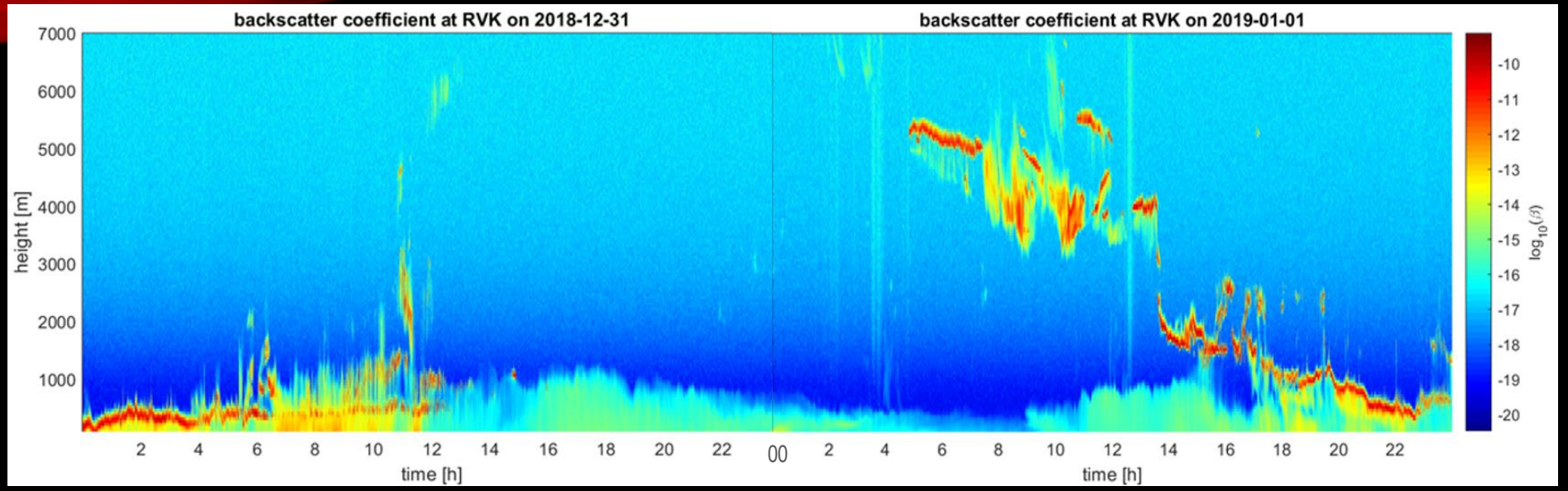
CEILOMETER MEASUREMENTS

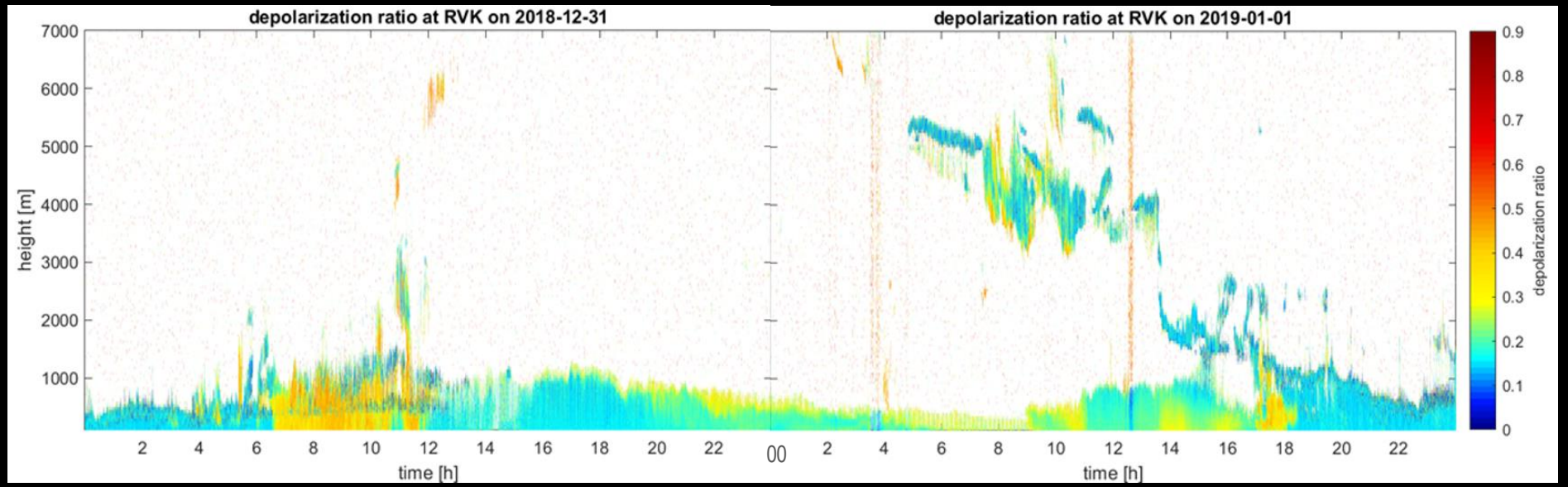


- precipitation until noon (sleet or snow)
- clear off in early afternoon
- increase of beackscatter in afternoon due to firework release
- high density around midnight
- resuspension in afternoon
- starts snowing around 17 UTC

LIDAR MEASUREMENTS

courtesy: Yang Shu





- Backsatter coefficient shown above but depolarization ratio in bottom
- Sleet or snow before noon on NYE
- Clear off but inversion develops and level of air pollution increasing
- Firework particle seems to be non-spherical
- Re-suspended particles observed in afternoon

SUMMARY AND OUTLOOK

- New Year's Eve fireworks produce a high level of particulate matter
- Air pollution in the boundary layer was observed with different instruments
- Ceilometer seems more sensitive to fireworks pollution then the lidar
- A higher resolution preferable but purpose is to monitor volcanic ash cloud
- Depolarization channel helps to distinguish different types and shapes of particles
- Data can be useful for interpretation of volcanic ash cloud
- Instruments moved to a dusty environment to study physical properties of particles released in a dust storm as test case for volcanic eruption

THANK YOU FOR YOUR ATTENTION