

Doina Nicolae

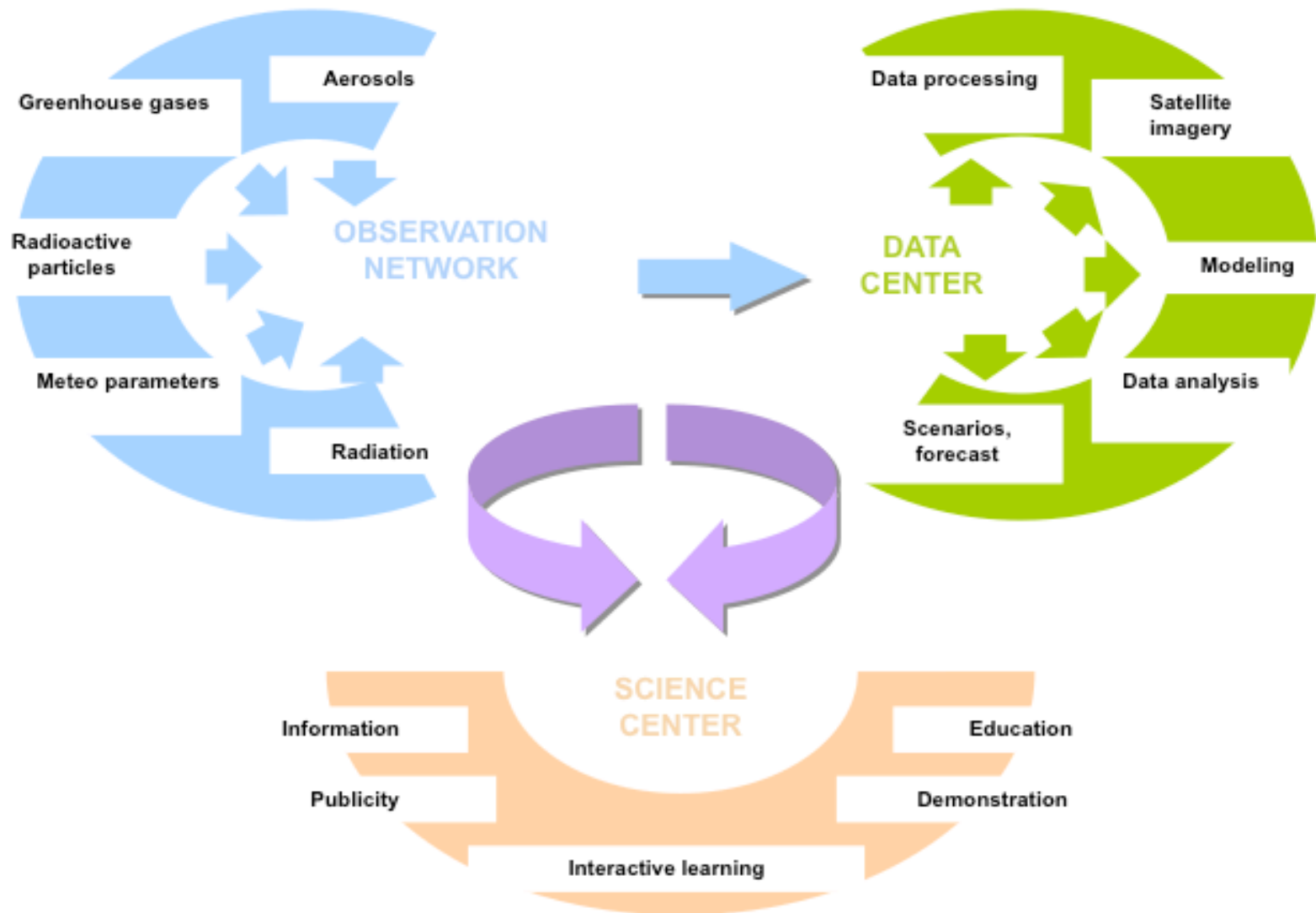
Romanian Atmospheric research 3D Observatory RADO



- Goal:
 - to improve air research capabilities in Romania
- Main objective:
 - creation of the observatory and implementation of specific procedures
- Main functions of RADO:
 - Experimental and theoretical research for atmospheric composition and air quality assessment
 - Operational activities (monitoring)
 - Scientific activities (studies, analysis)
 - Education
 - Dialog with civil society
 - Publicity
 - Information
 - Awareness

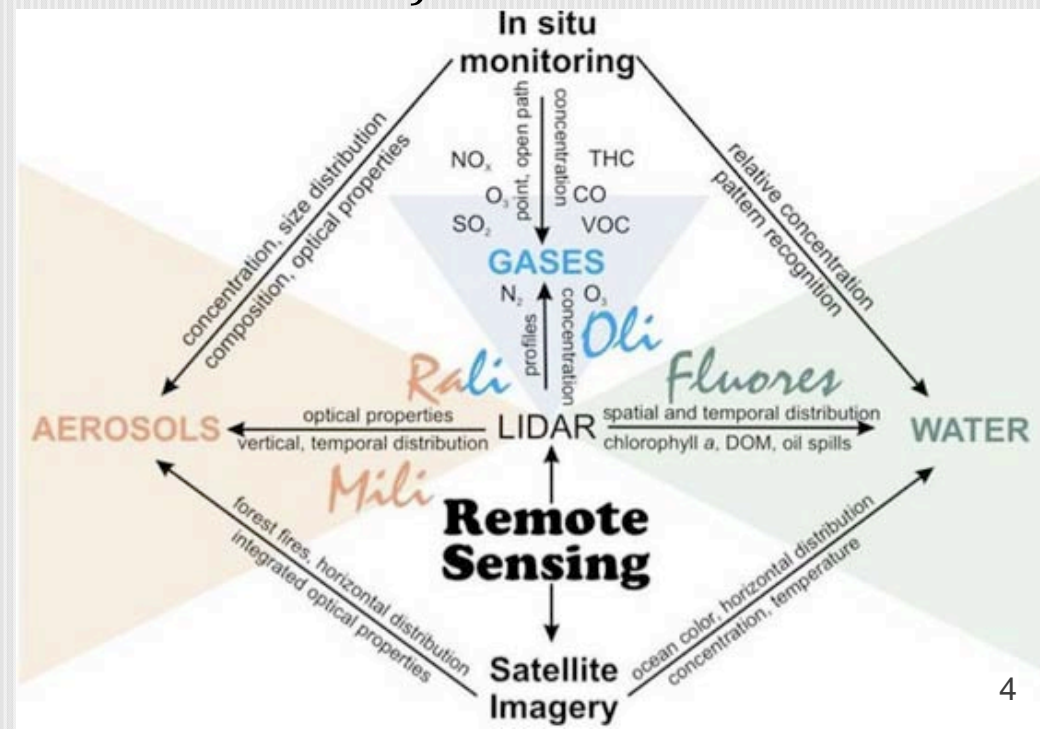
<http://inoe.inoe.ro/RADO>

Components

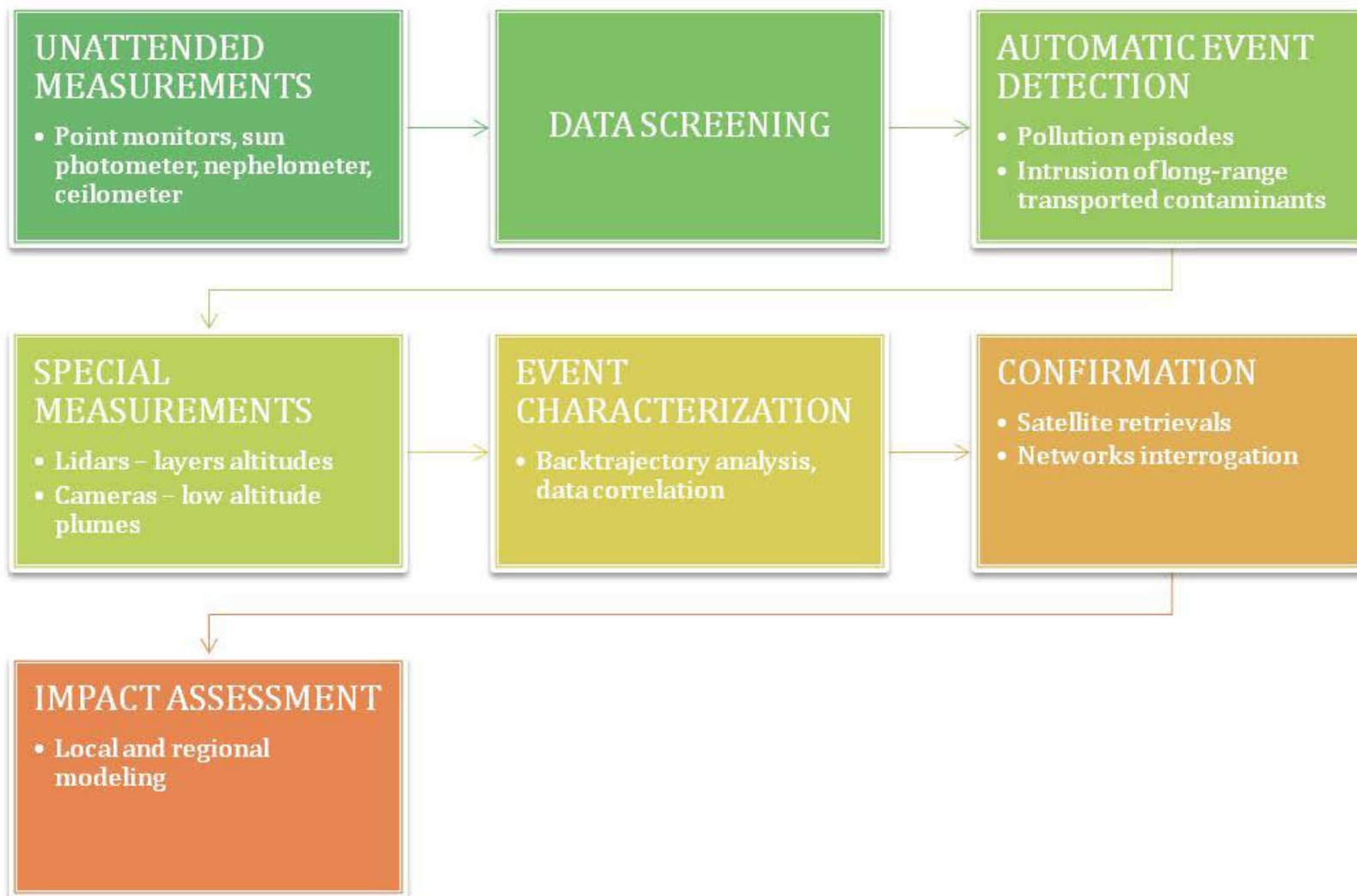


Synergy of techniques

- **Automatic, continuous monitoring** ↔ **Regular and special measurements**
 - Ground-level in situ monitoring (point monitors, nephelometer, particle sizer, weather station)
 - Chemical composition-aerosol mass spectrometer
 - Integrated column (sun photometer)
 - Remote sensing (ceilometer, microwave radiometer)
- Remote sensing (PBL and FT lidars, UV and IR cameras, EUMETCAST)
- Trajectory analysis (FLEXPART, HYSPLIT)



Data flow



Steps

- Development / purchase of instruments
- Installation, training
- Calibration
 - lidars: intercomparison with reference system from EARLINET
 - sunphotometers: standard procedure AERONET
- Development of local data centers:
 - data collection
 - data screening
 - pre-processing
- Development of General data center:
 - data collection from local data centers
 - processing
 - web data display
 - advanced analysis and correlation



<http://rado.inoe.ro/Quicklooks>

Observation Network

7 stations, located in 5 places

■ Each dot on the map has:

- Backscatter/Raman lidar
 - clouds and PBL height
 - temporal evolution of aerosol layers
 - optical coefficients profiles
- Sunphotometer
 - 6 wavelengths
 - integrated optical parameters of the atmosphere
- Particle sizer (APS)
 - characterization of microphysical properties of ground-level aerosols
- UV and IR cameras
 - SO₂, particles, volcanic plume, visual range
- Point monitors
 - O₃ and CO₂
- Weather station
 - ground-level meteorological parameters

■ Magurele super site :

- Multiwavelength lidar
 - Aerosol level 2 parameters
- DIAL Ozone
 - Ozone concentration profile up to 12km
- Microwave radiometer + wind profiler
 - Meteorological parameters at various height levels
- Aerosol Mass Spectrometer
 - Aerosols chemical composition
- Nephelometer
 - Integrated backscatter coefficient
- Ceilometer
 - Cloud base and top



Current status



Magurele

- Point monitors working
- Sun photometer working, in AERONET
- Aerosol lidar working, in EARLINET
- PBL lidar working
- Ceilometer working
- Ozone lidar working
- Microwave radiometer working
- AMS working
- General data center under development



Baneasa

- Point monitors working
- Aerosol lidar working, intercomparison performed, needs upgrade
- Local data center under development



Timisoara

- Point monitors working
- Sun photometer working
- Aerosol lidar working, intercomparison end of Oct
- Local data center under development



Cluj

- Point monitors working
- Sun photometer working, in AERONET
- Aerosol lidar working, intercomparison end of Oct
- Local data center under development



Iasi

- Point monitors working
- Waiting for sun photometer
- Aerosol lidar under construction
- Local data center under development

Examples from the database

RADO instruments & outputs

Remote sensing: aerosol LIDARS

PBL LIDARS

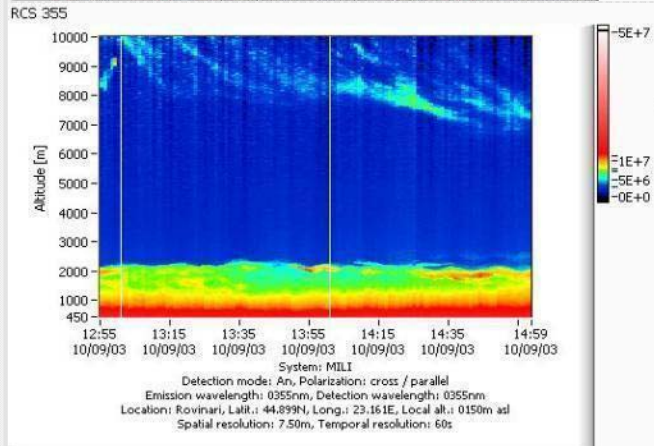
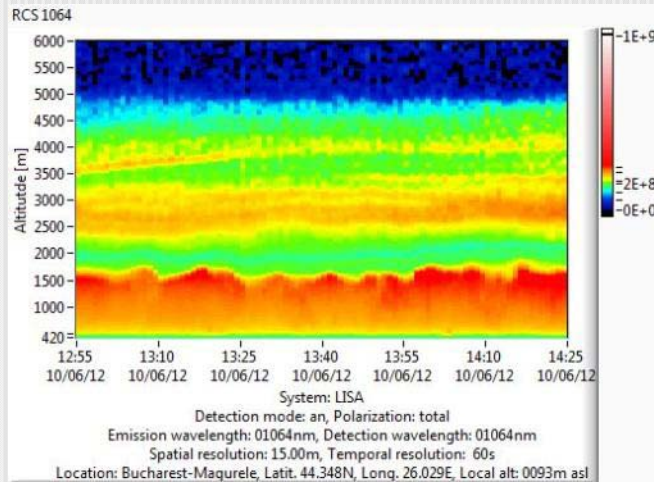
- channels: 1064, 532, 355p, 355s
- dynamic range: 0.25-6Km
- direct measurement: layers and sub-layers altitude and dynamics
- retrieved parameters:
 - backscatter coefficient
 - color ratios
 - depolarization ratio 355

FT LIDARS

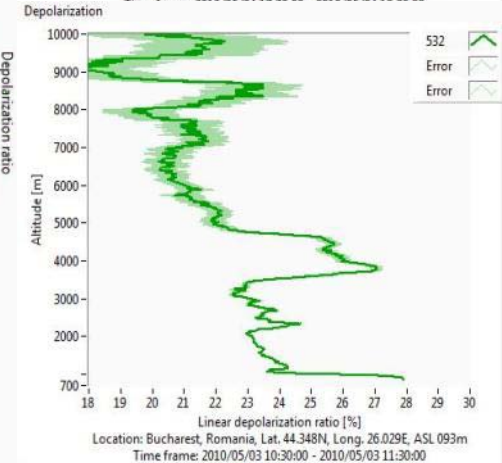
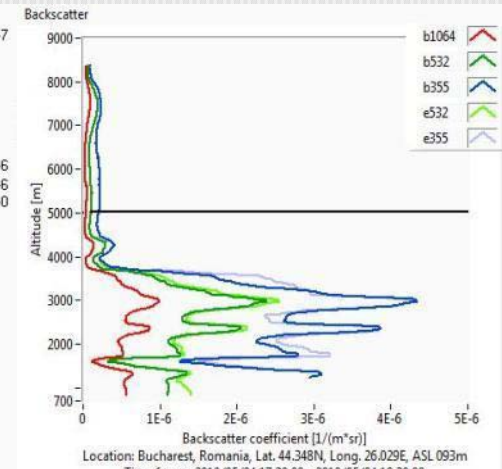
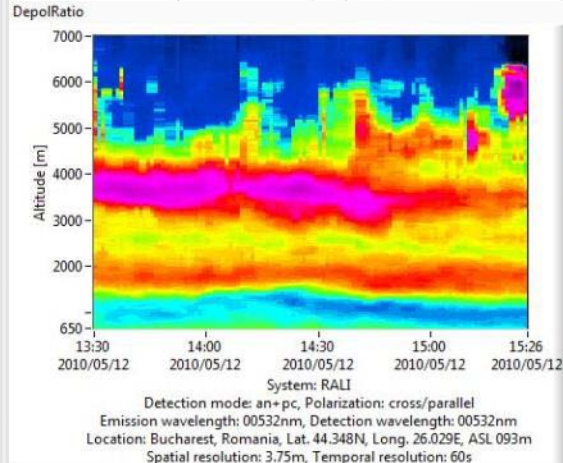
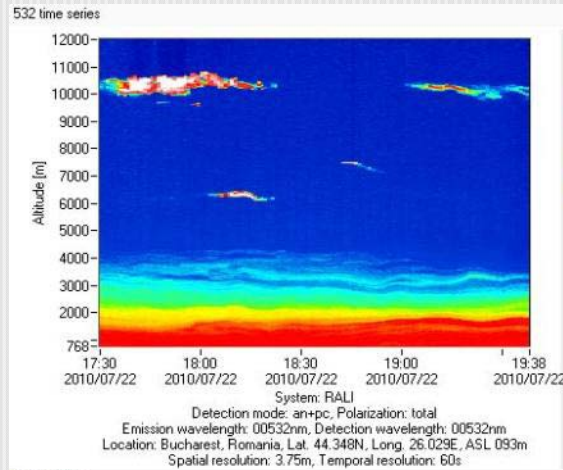
- channels: 1064, 532p, 532s, 355, 607, 387, 408
- dynamic range: 0.8-15Km
- direct measurement: layers altitude and dynamics
- retrieved parameters:
 - backscatter coefficient
 - extinction coefficient
 - lidar ratios
 - color ratios
 - Angstrom exponents
 - depolarization ratio 532
 - water vapor mixing ratio

Remote sensing: aerosol LIDARS

PBL LIDARS

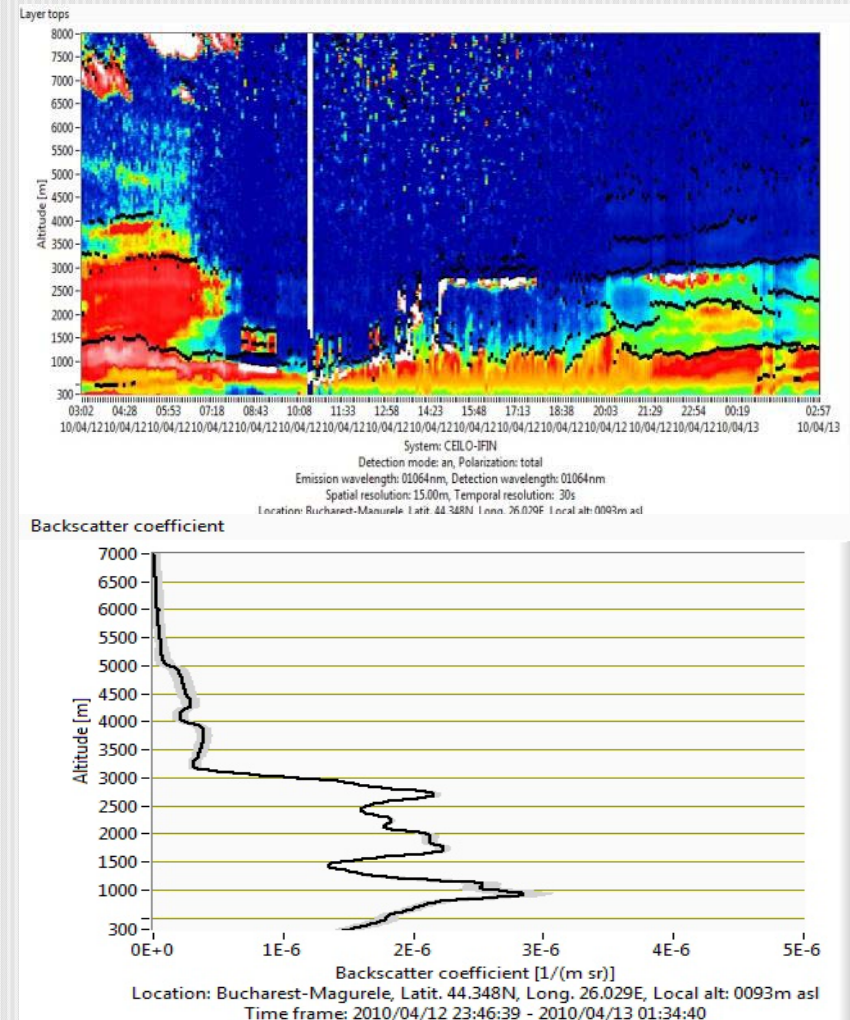


FT LIDARS



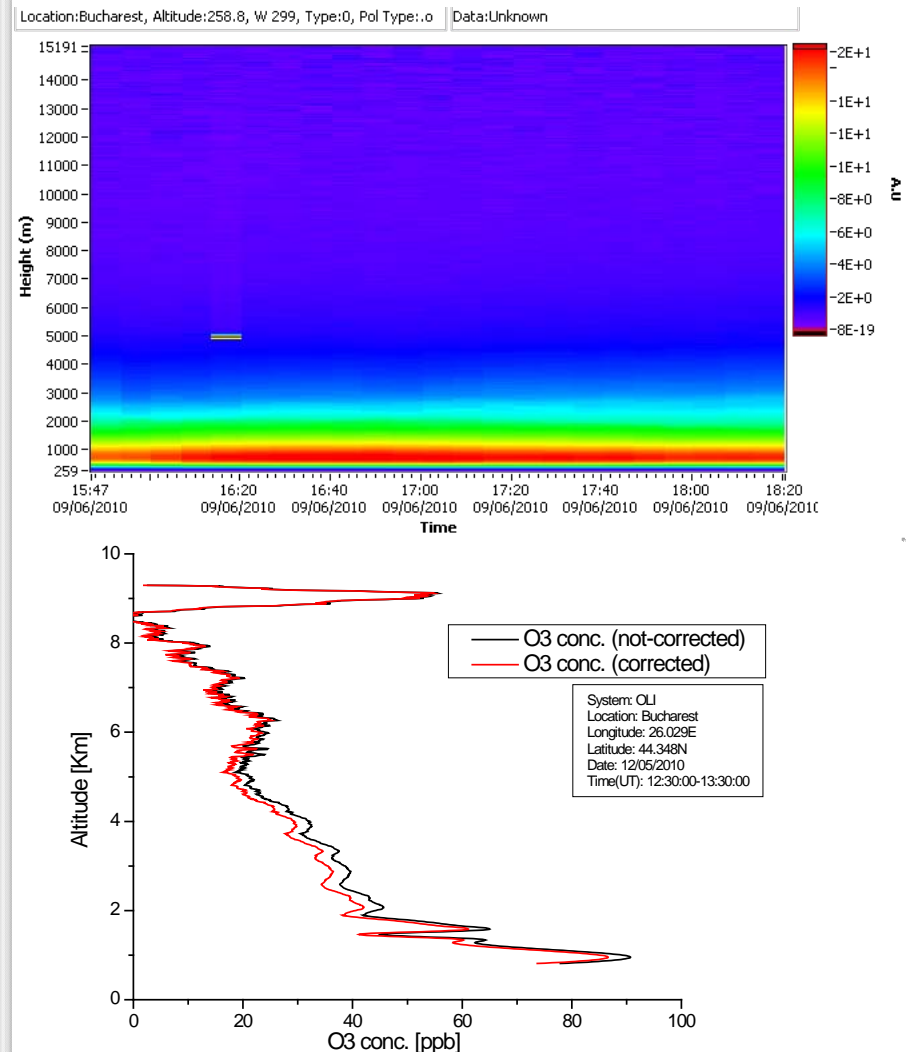
Remote sensing: ceilometer

- operation: continuous, unattended
- channels: 1064nm
- dynamic range: 0.30 - 15 km
- raw resolution: 15 m
- direct measurement: layers and sub-layers altitude and dynamics
- retrieved parameters:
 - cloud heights (standard: three layers)
 - penetration depth
 - vertical visibility,
 - PBL height



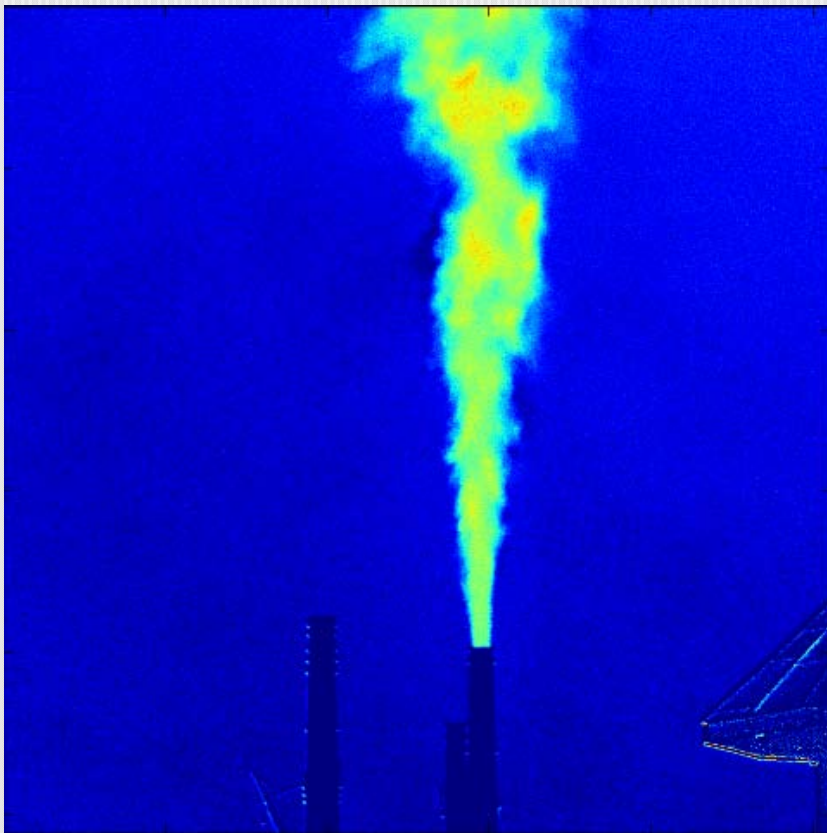
Remote sensing: ozone LIDAR

- channels: 266, 289, 299, 316nm
- dynamic range: 0.8-15Km
- direct measurement: layers altitude and dynamics
- retrieved parameters:
 - backscatter coefficient
 - color ratios
 - Angstrom exponents
 - Ozone concentration

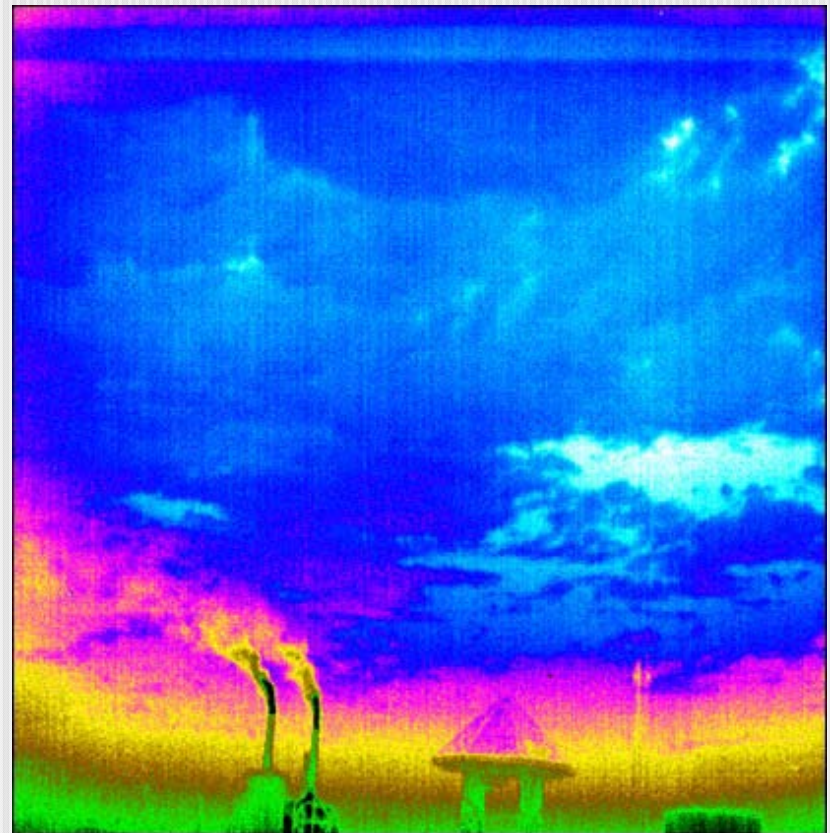


Remote sensing: UV-IR cameras

UVGASCAM: SO₂ (UV)



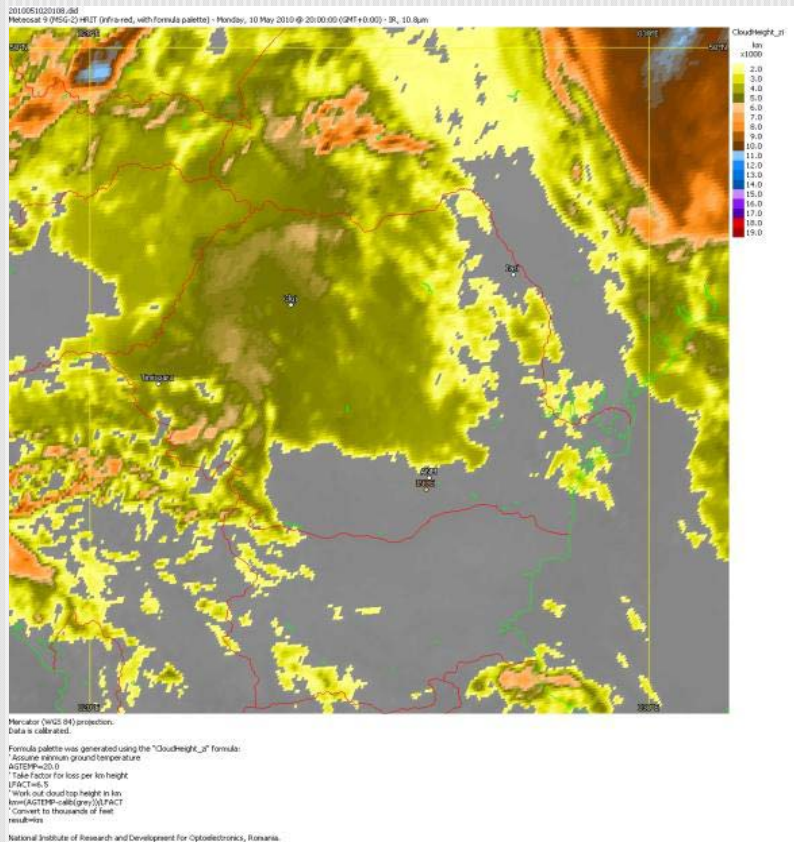
CYCLOPS: THERMAL (IR)



Stack plumes at Rovinari fossil-fuel plant

Remote sensing: EUMETCAST

CLOUDS HEIGHT



Cloud height over Romania

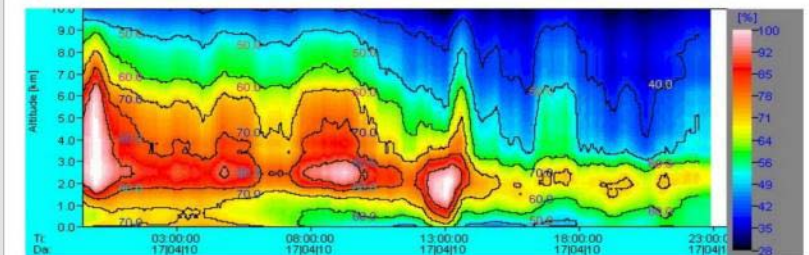
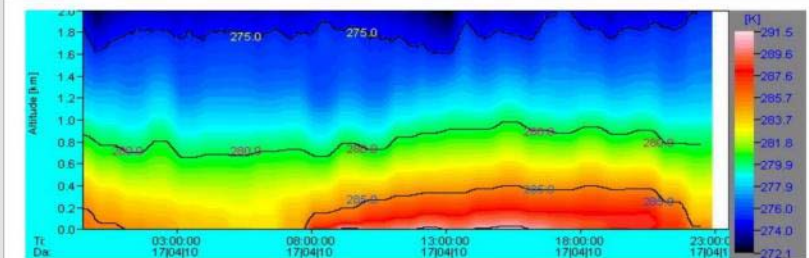
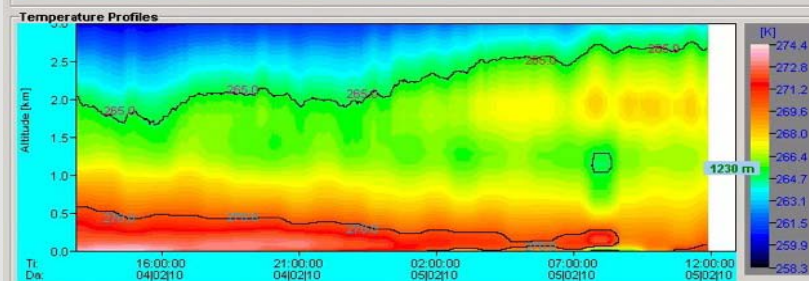
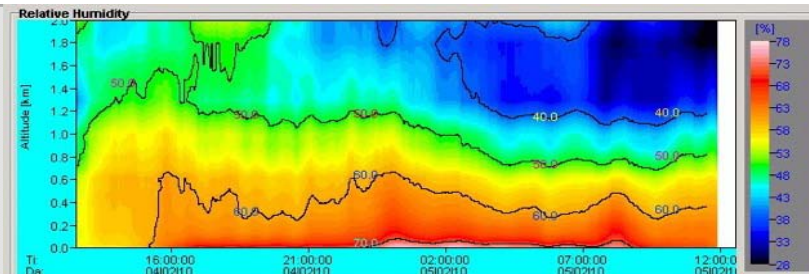
VOLCANIC PLUMES



Volcanic plume over Iceland

Remote sensing: microwave radiometer

- Humidity profile performance (zenith and along track)
 - Vertical resolution:
 - 200 m (range 0-2000 m)
 - 400 m (range 2000-5000 m)
 - 800 m (range 5000-10000 m)
 - Accuracy:
 - 0.4 g/m³ RMS (absolute hum.)
 - 5% RMS (rel. humidity)
- Temperature profile performance (zenith and along track)
 - Vertical resolution:
 - BL-Mode: 50 m (range 0-1200 m)
 - Z-Mode: 200 m (range 1200-5000 m), 400m (range 5000-10000 m)
 - Accuracy:
 - 0.25 K RMS (range 0-500 m)
 - 0.50 K RMS (range 500-1200 m)
 - 0.75 K RMS (range 1200-4000 m)
 - 1.00 K RMS (range 4000-10000 m)
- Channel center frequencies
 - K-Band: 22.24 GHz, 23.04 GHz, 23.84 GHz, 25.44 GHz, 26.24 GHz, 27.84 GHz, 31.4 GHz
 - V-Band: 51.26 GHz, 52.28 GHz, 53.86 GHz, 54.94 GHz, 56.66 GHz, 57.3 GHz, 58.0 GHz
- Channel bandwidth
 - 2000 MHz @ 58.0 GHz
 - 1000 MHz @ 57.3 GHz
 - 600 MHz @ 56.66 GHz
 - 230 MHz @ all other frequencies



Regional air quality forecast

POLLUTION AT GROUND

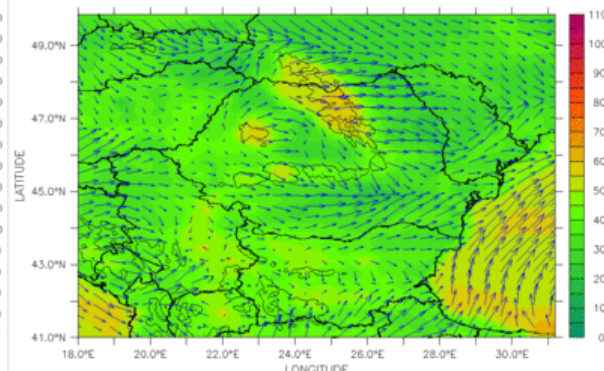
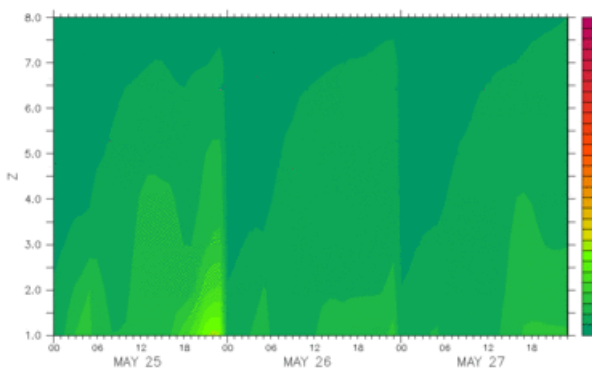
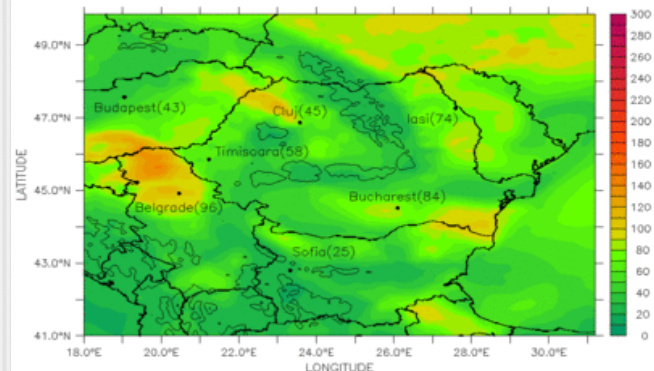
VERTICAL DYNAMICS

METEO AT GROUND

25.05.2010

Magurele

25.05.2010 18:00 (GMT)



PM10 ($\mu\text{g}/\text{m}^3$)

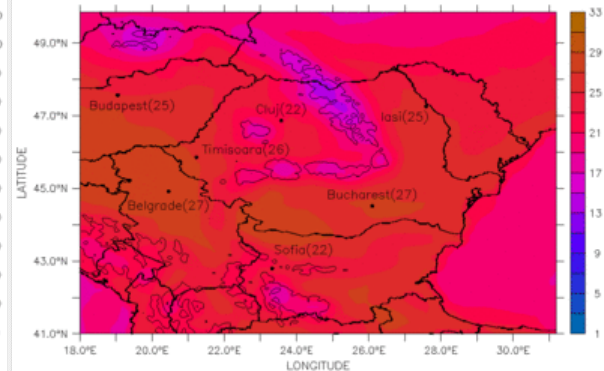
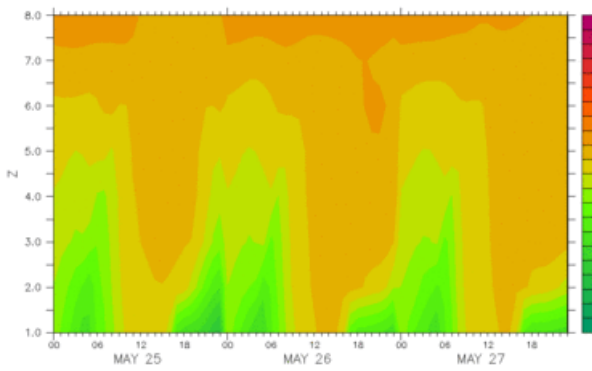
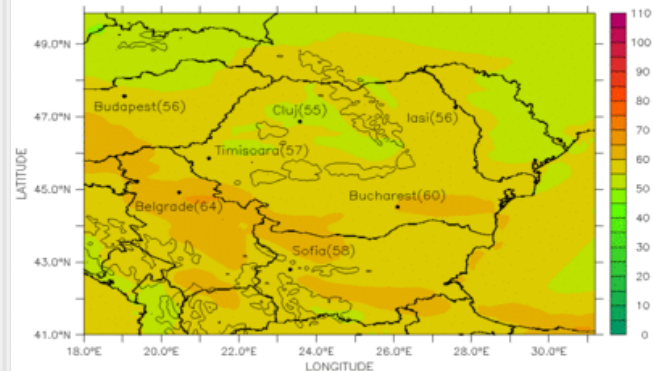
PM10 ($\mu\text{g}/\text{m}^3$)

Ozone (ppb)

25.05.2010

Magurele

25.05.2010



Ozone (ppb)

Ozone (ppb)

Temperature ($^{\circ}\text{C}$)

- RADO = state-of-the art facility for atmospheric research in SE Europe
- Added value to already existent air monitoring in Romania: vertical sounding
- Overall strategy: complementary use of instruments and techniques
 - in situ and remote
 - passive and active
 - ground-based and satellite
 - measurements and modeling
- Challenges:
 - Validation of instruments, operational checks
 - Data handling, data homogeneity, data correlation
 - Automatic procedures as possible
 - Financing

We wish to
acknowledge
Norway Grants
for RADO
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115266.



MAN-MADE CLIMATE CHANGE

It really is(n't) happening