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Wild-land fires

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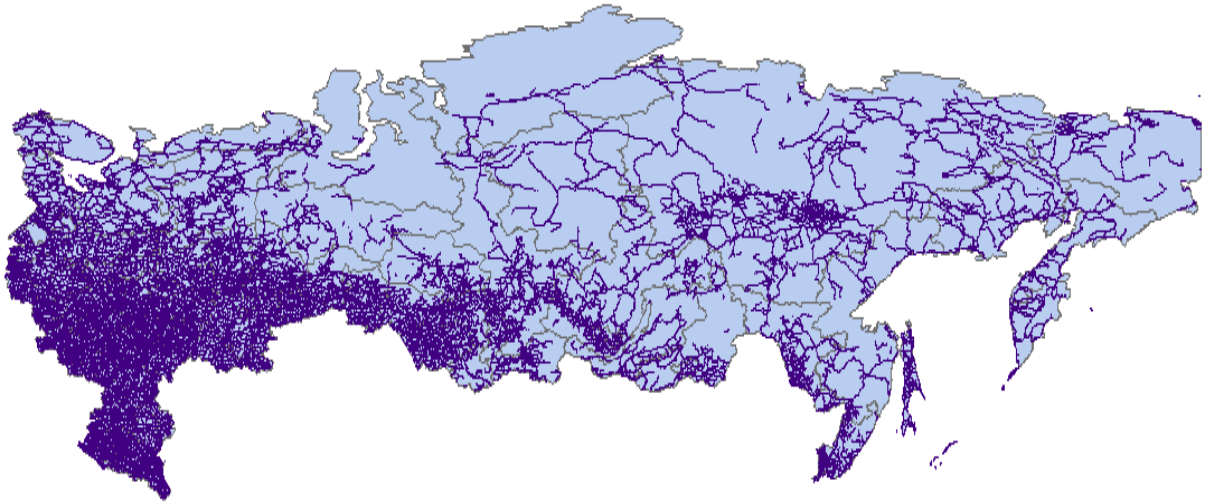
Outline

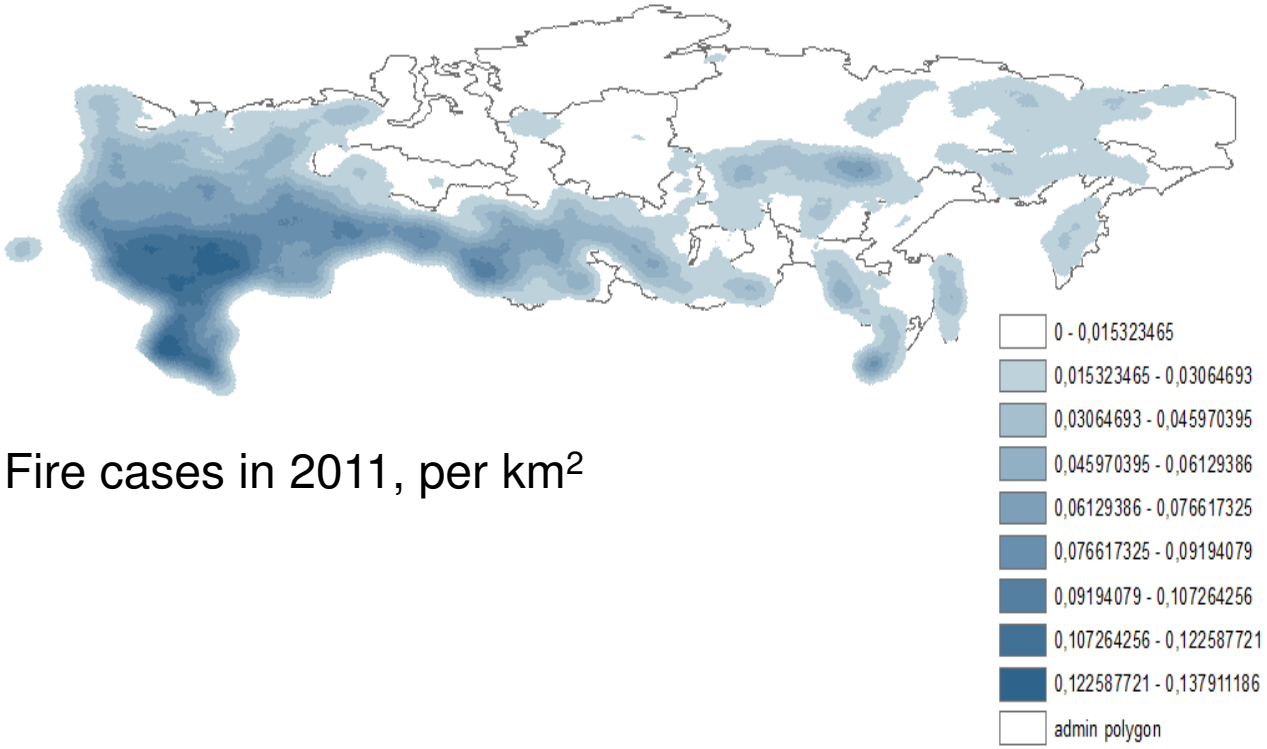
- Introduction
- Components and features of IS4FIRES
- From emission to AQ forecasting
- Specifics of IS4FIRES
  - diurnal variation of fire emission intensity
  - injection height of fire plumes
- Examples: fires 2010 and 2012
- Summary

Wild-land fires: an outlook

- The second most-powerful source of atmospheric tracers after fossil fuel burning
  - direct atmospheric emission: 1.4-2.8 Gt C / year: CO_2 ~90%, CO ~9%, BC+OC aerosols ~1%, also NOx, NH_3, SO_2, VOC
  - burnt area: 3-4 10^6 km^2 / year
- Well-identified fire seasons
- Strong anthropogenic impact
  - deforestation
  - agriculture burning
  - field cleaning, insect control
  - accidental fires
  - control and fire-fighting measures
- Outside human presence, started by lightning

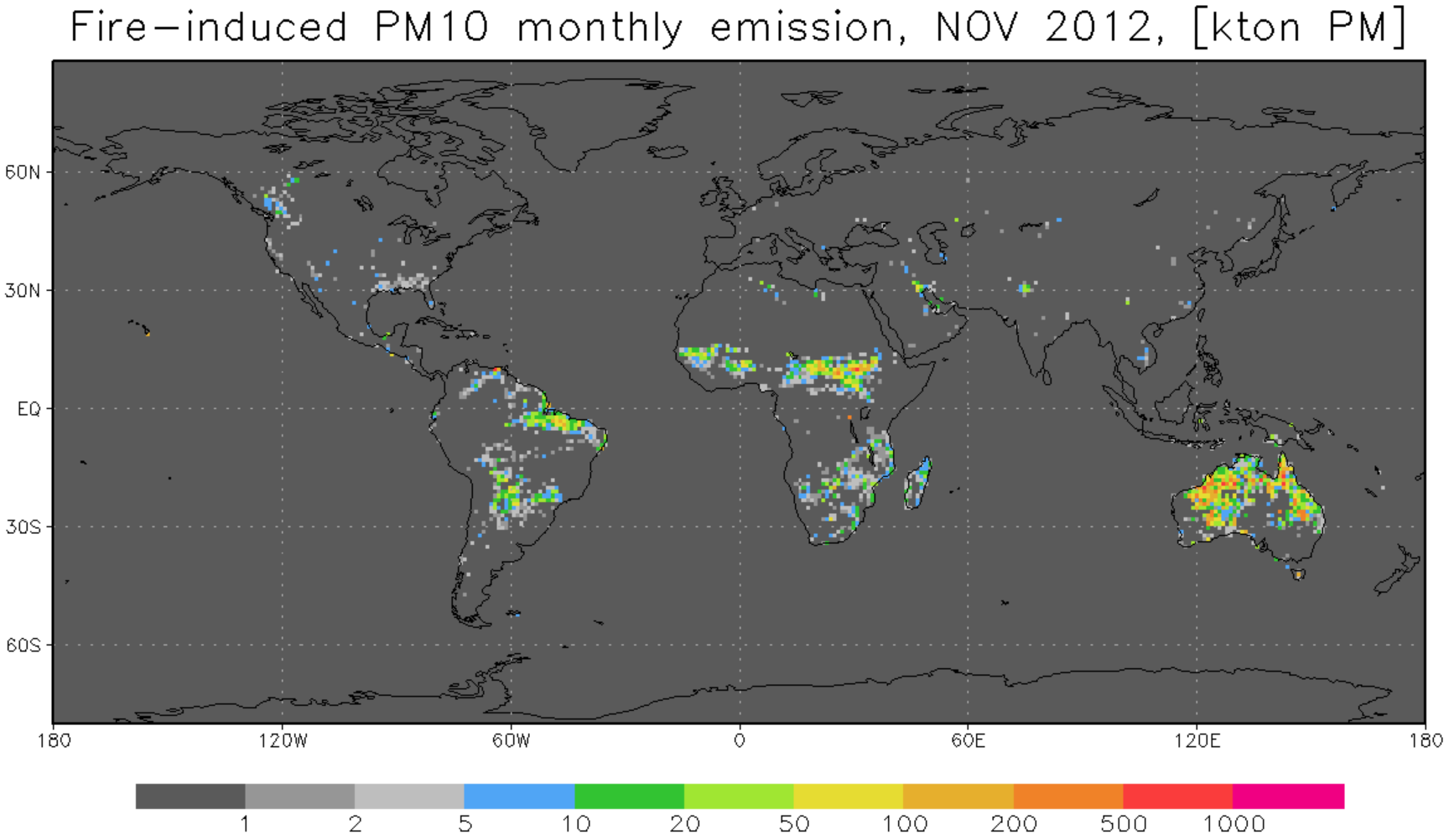


Road network of Russia

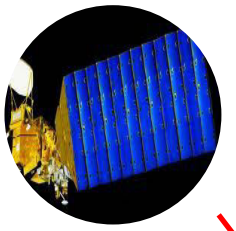


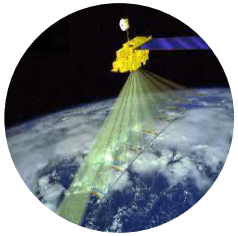
Fire cases in 2011, per km^2

Recent fires (2012, July-November)



Fire information to emission: IS4FIRES v1.3

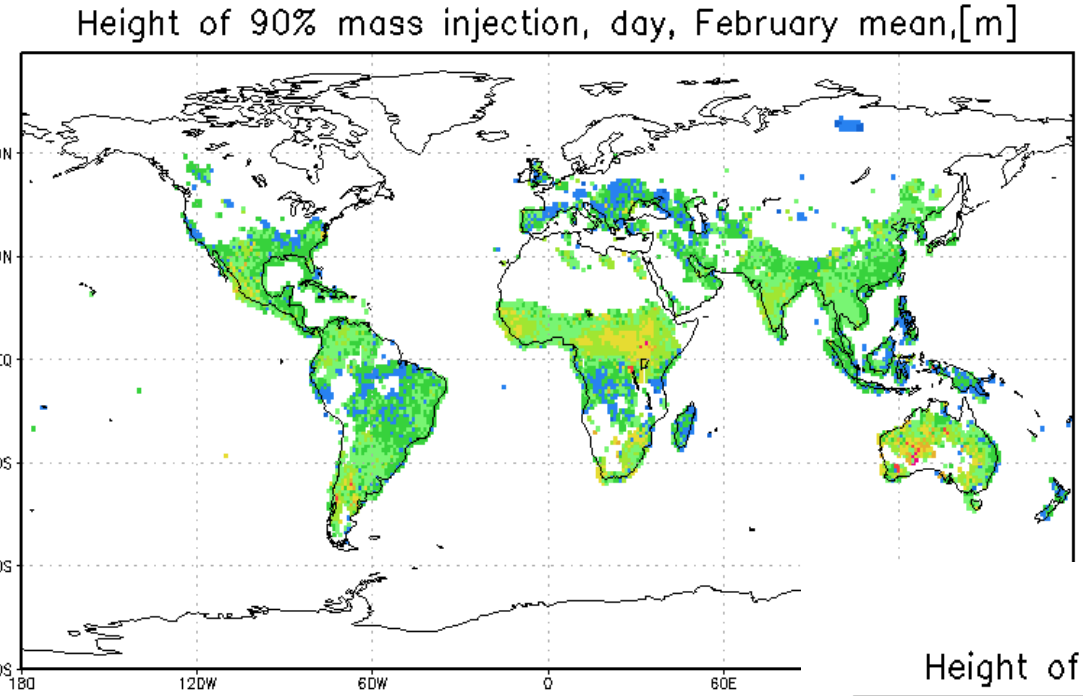


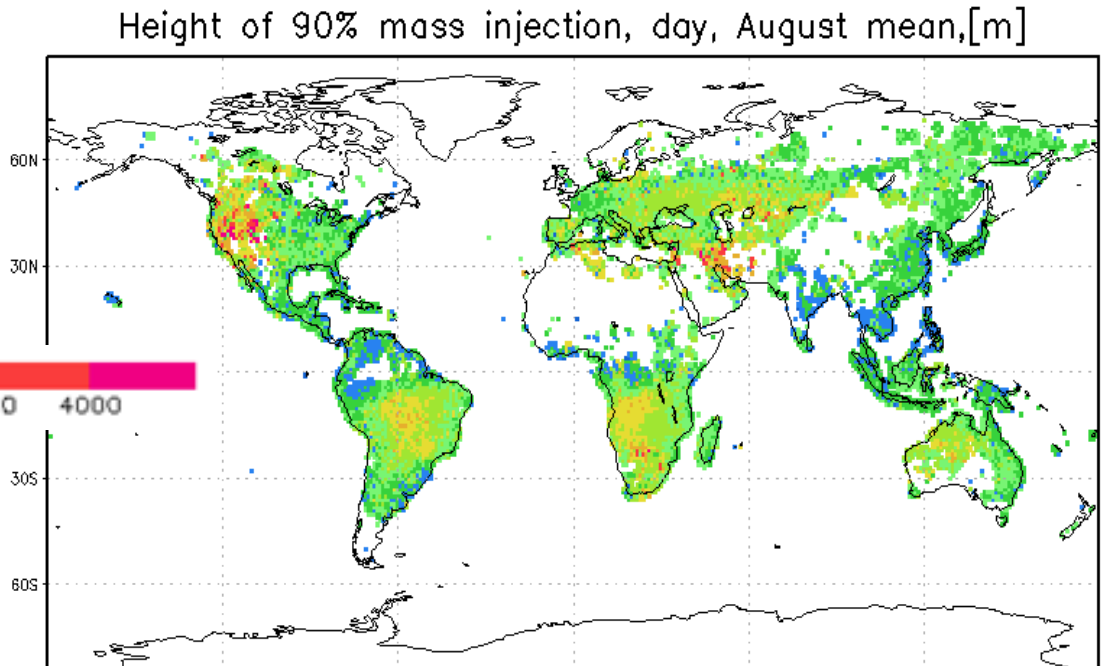


Features of IS4FIRES v.1.3

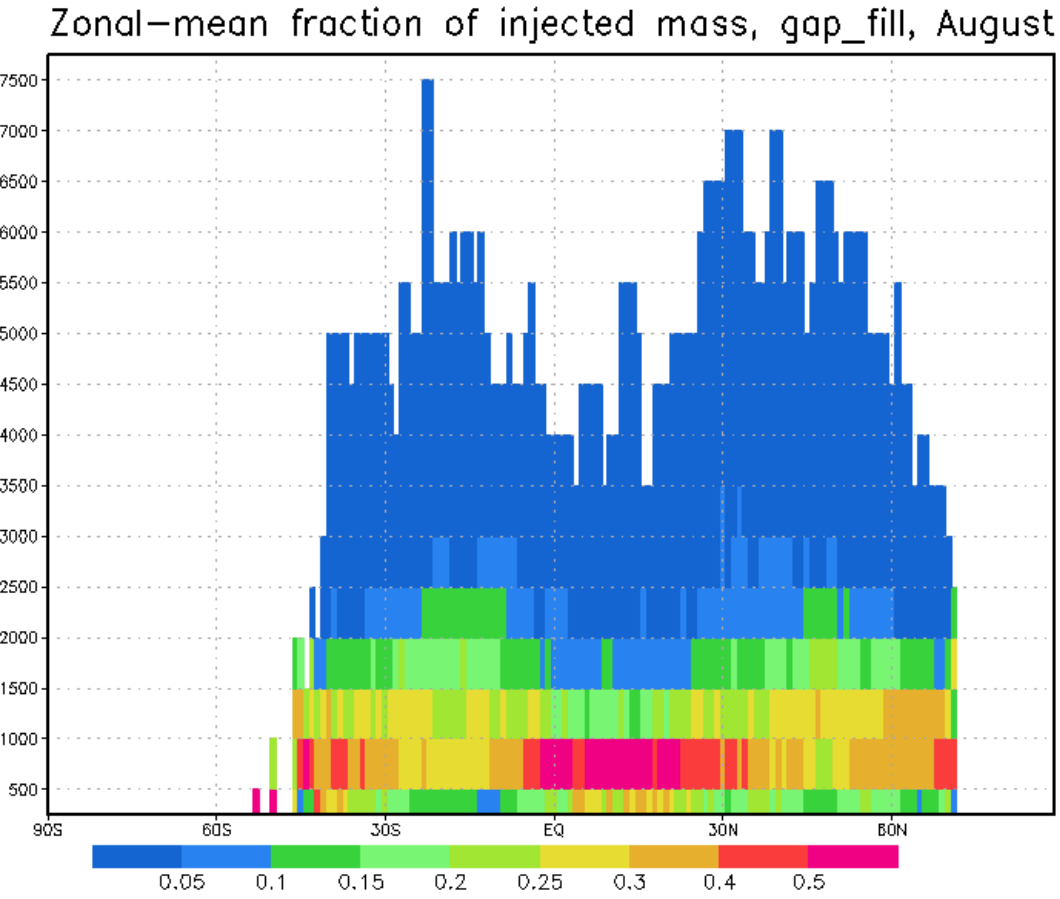
- Domains: global, European; resolution: 10km, daily + diurnal variation SEVIRI & VIIRS
- Timeliness: MODIS Rapid Response, persistence-based forecast
  - NRT fire alert for Finland (receiving antenna in Sodankyla)
- Primary scaling: FRP / TA to PM_{10} (Sofiev et al., 2009)
  - Cross-scaling (Andreae & Merlet, 2001): $PM_{2.5}$, SO_2, NO_2 CO, NH_3, HCHO
- Injection height:
  - crude ~(1÷1.5) H_{ABL}
  - average injection profiles (global 3D map, 1^0 resolution)
  - dynamic (Sofiev et al, 2012)
- AQ impact: chemistry transport model SILAM
  - Fire plume forecasting: Europe, resolution of 20km and 1hr, horizon 72 hours
  - persistence assumption on fire behavior is the main limitation
- Data are available at
  - Emission 10km: http://is4fires.fmi.fi
  - Emission 0.5 deg: http://www.geiacenter.org
  - Forecasted PM fields: http://silam.fmi.fi

Height of 90% of emission injection, Feb, Aug

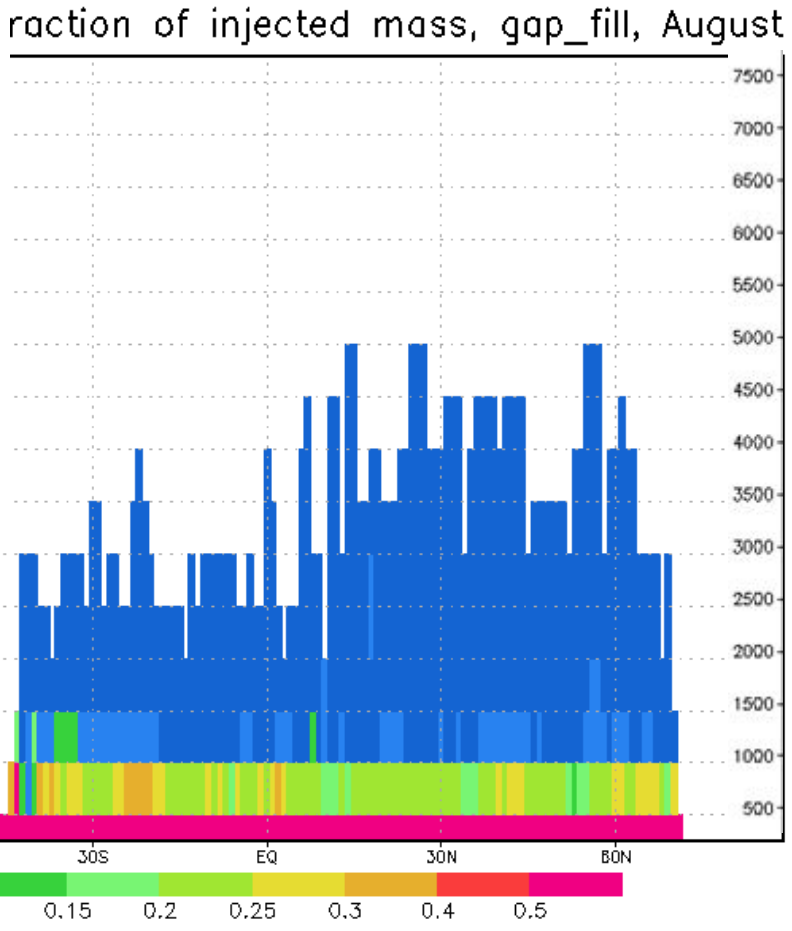




Injection profile, diurnal variation, Aug

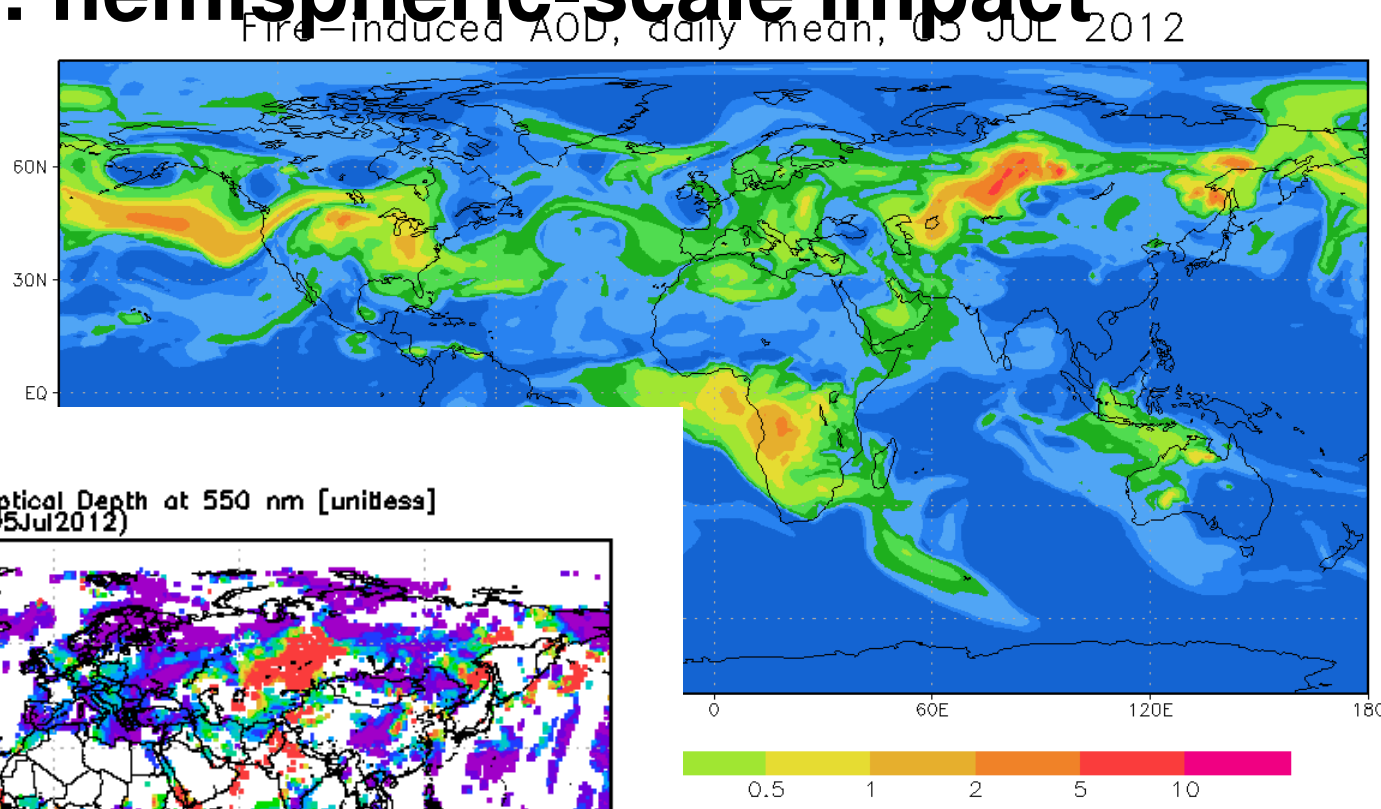


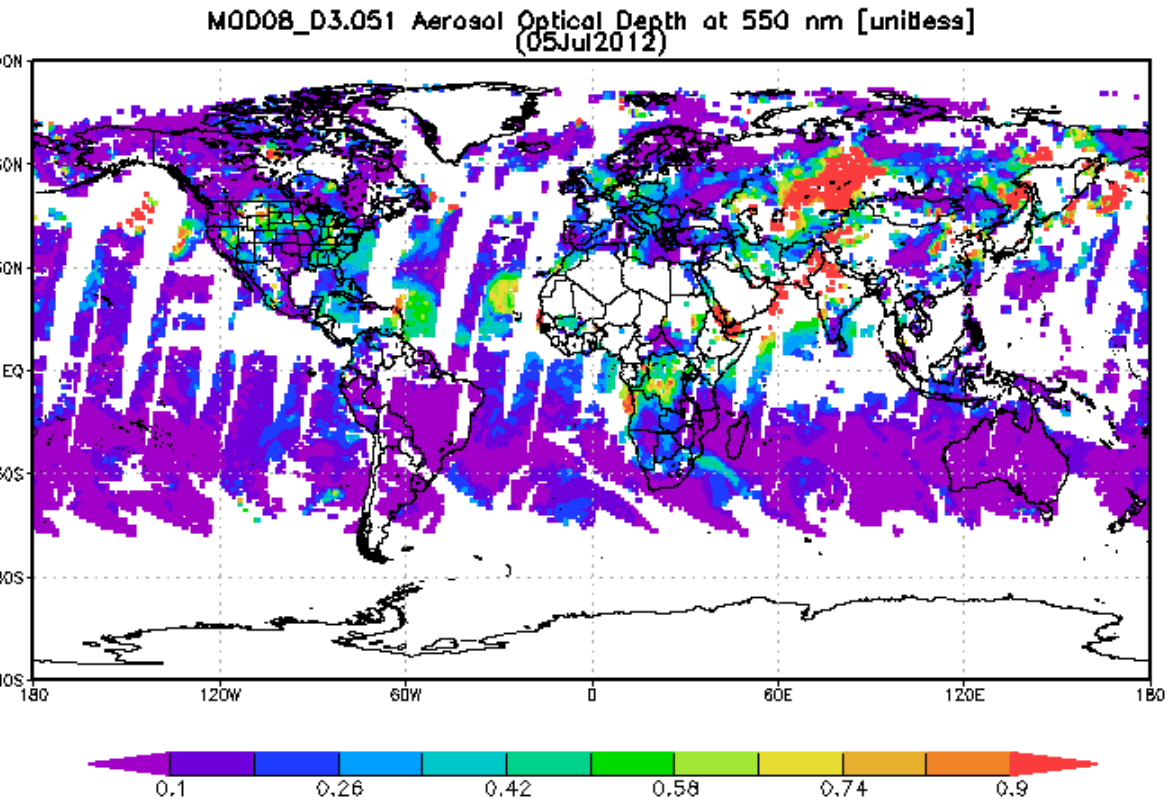
Daytime



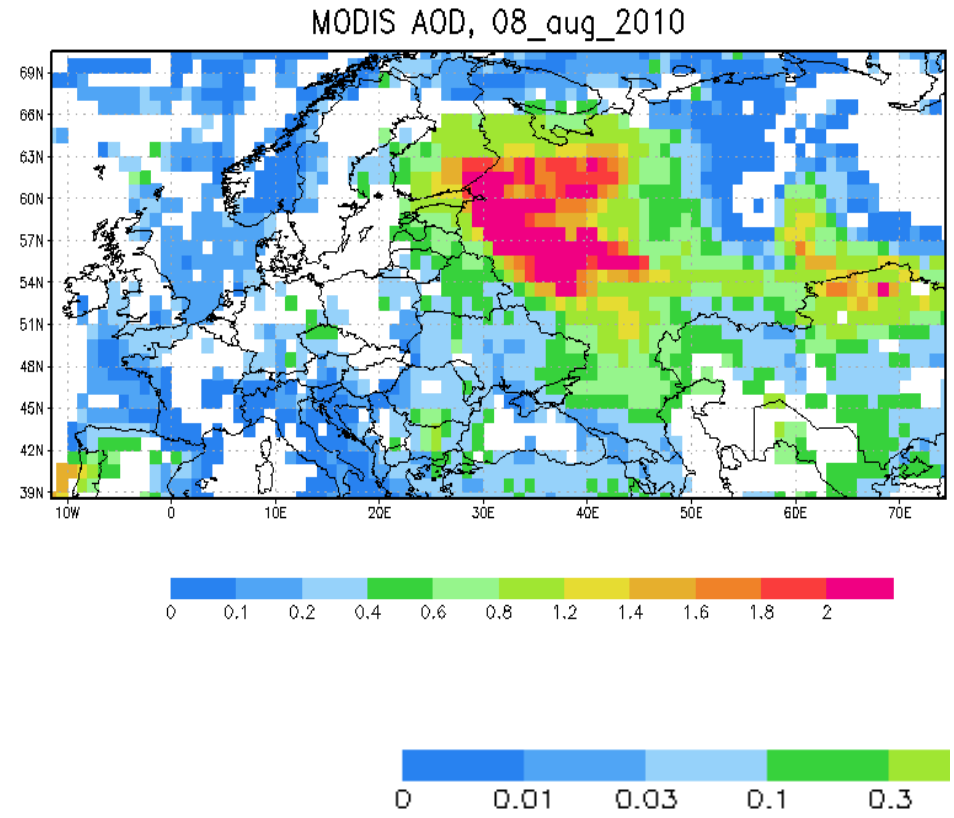
Night time

5 July 2012: hemispheric-scale impact

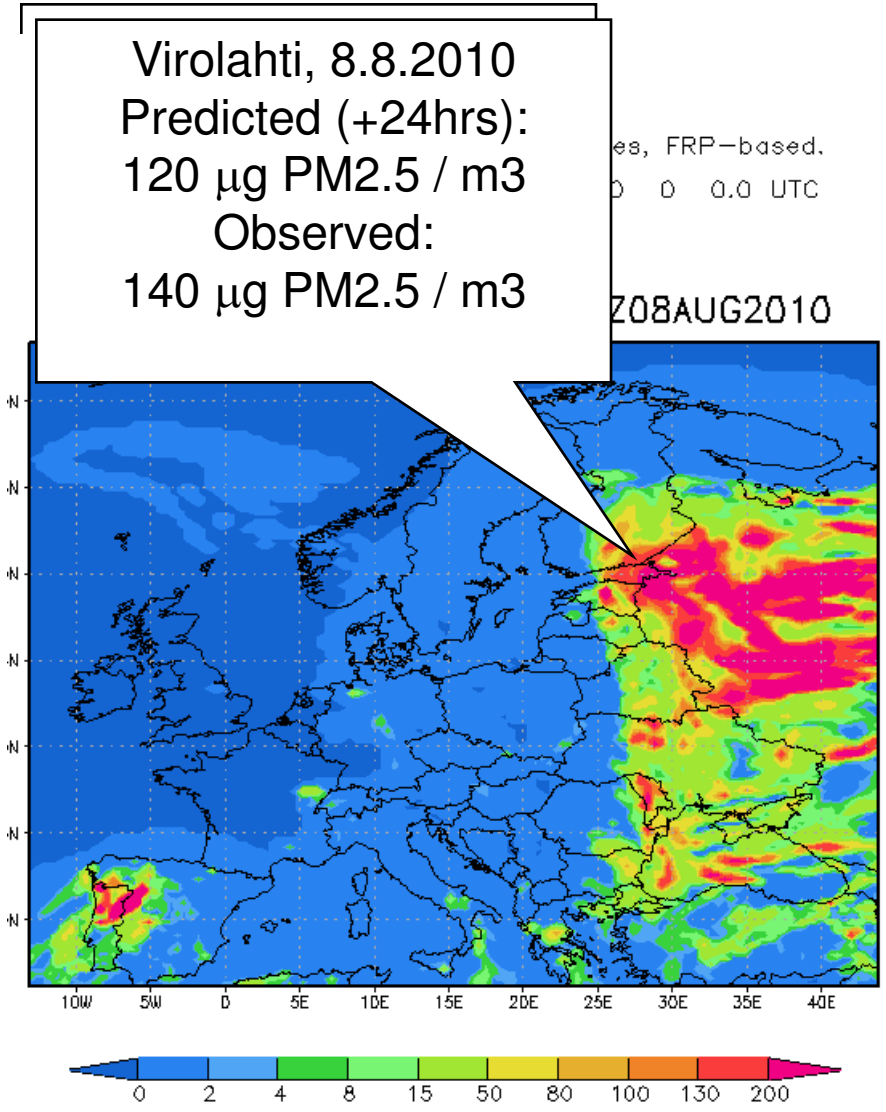




Compare with: August, 2010, Russia



Virolahti, 8.8.2010
Predicted (+24hrs):
120 µg PM2.5 / m3
Observed:
140 µg PM2.5 / m3



Summary

- Fires is the second most-powerful source of atmospheric tracers after fossil fuel combustion
  - Strong impact of anthropogenic activity
  - Highly episodic character
  - Strongly buoyant sources

- Observations: satellites
  - IS4FIRES data- and knowledge-base: http://is4fires.fmi.fi
    - Emission database, 2000-c.m. (daily, 10km, global, NRT)
  - GEIA database: 2000-2011 (daily, 0.5º, global)
  - Complementing the existing emission databases, the global map of "climatologic" injection profile from wild-land fires