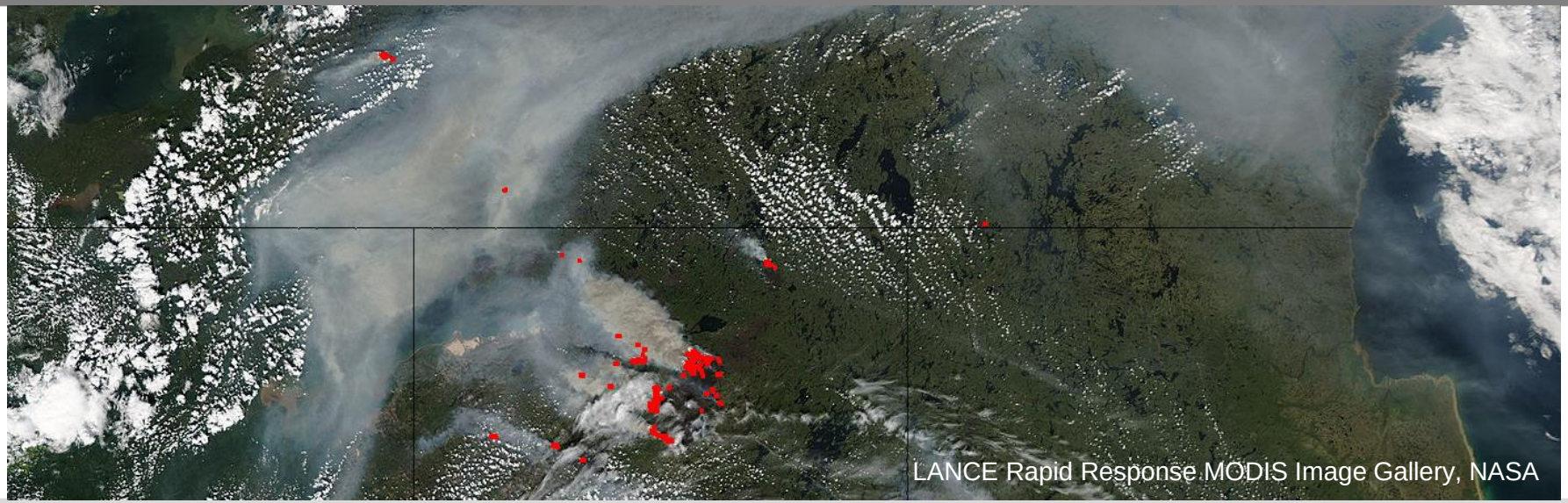
Karlsruhe Institute of Technology

Influence of biomass burning emissions on radiation, temperature and precipitation patterns

Carolin Walter, Saulo R. Freitas, Isabel Kraut, Daniel Rieger, Heike Vogel, Bernhard Vogel

Institute for Meteorology and Climate Research



Biomass burning aerosol

Significant part of the global aerosol load (Stocker et al., 2013)

- Difference of 7.5 K between forecast and measurement (Ding et al., 2013)
- Unlikely hail events (Andreae et al., 2004)
- Decrease of cloud cover (Koren et al., 2004)

→ Quantification of their influence on radiation, temperature and cloud formation

Biomass Burning

Athanasopoulou et al. (2014)

D. Rieger

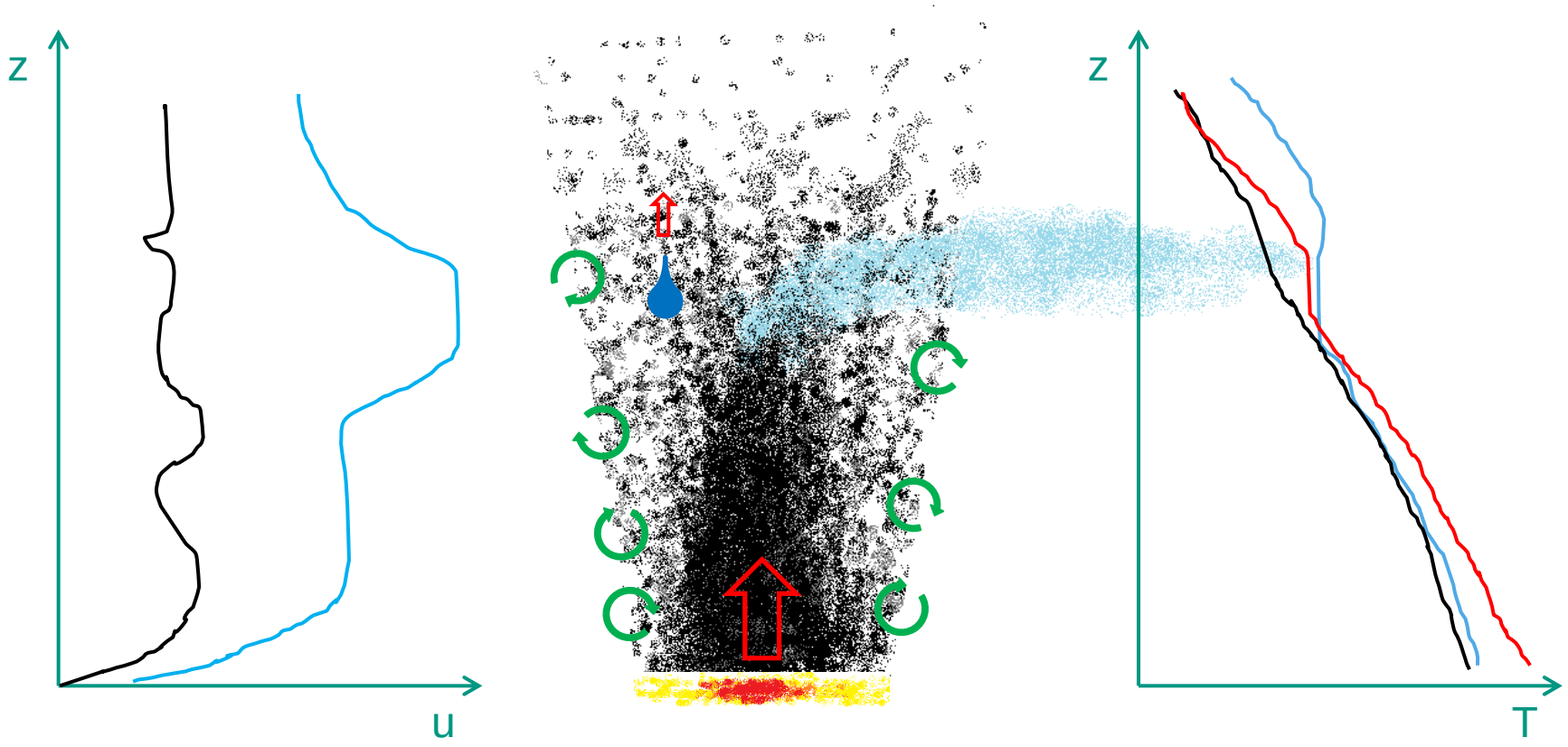
Trentmann et al.(2002),
Freitas et al. (2006)

M.O. Andreae

Plume Height

- Homogeneous distribution of emissions between the surface and 800 m height (Wang et al., 2004)
- Homogeneous distribution of emissions between the surface and 400 hPa (Pfister et al., 2004)
- Direct simulation of the rising plume, the grid resolution of 50x50x20 m considers the buoyancy (Trentmann et al., 2002)
- One-dimensional plume rise model, provides the lower and upper limit of the emission layer for gridpoints of a already existing atmospheric model (Freitas et al., 2006)

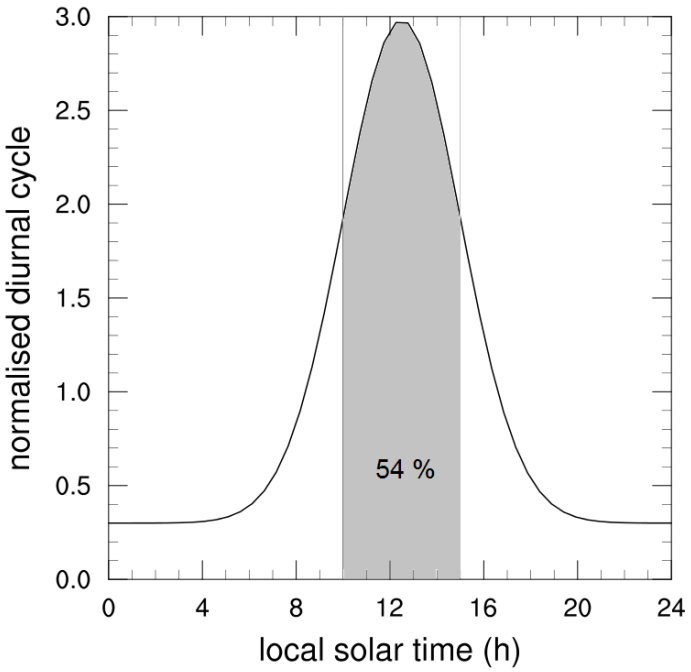
Plume Rise Model



Fire Emissions

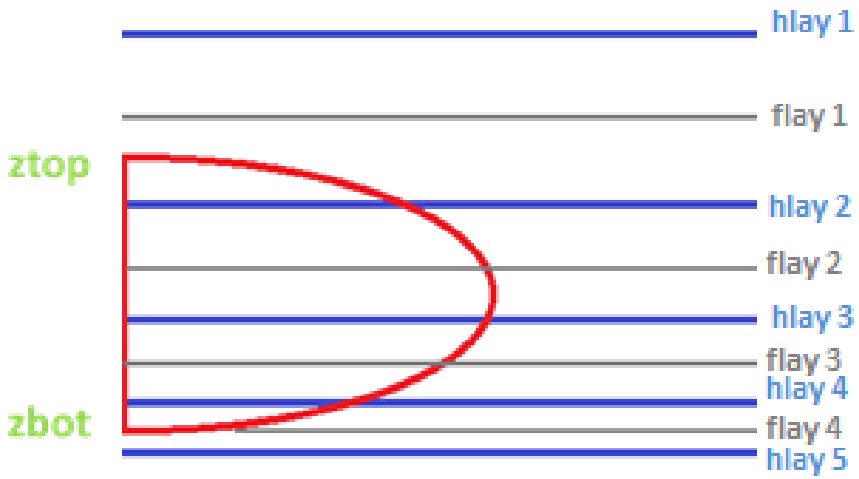
- Global Fire Assimilation System version 1.1 (ECMWF)
  - Spatial resolution 0.1°
  - Temporal resolution 24 h

- Diurnal cycle of fires



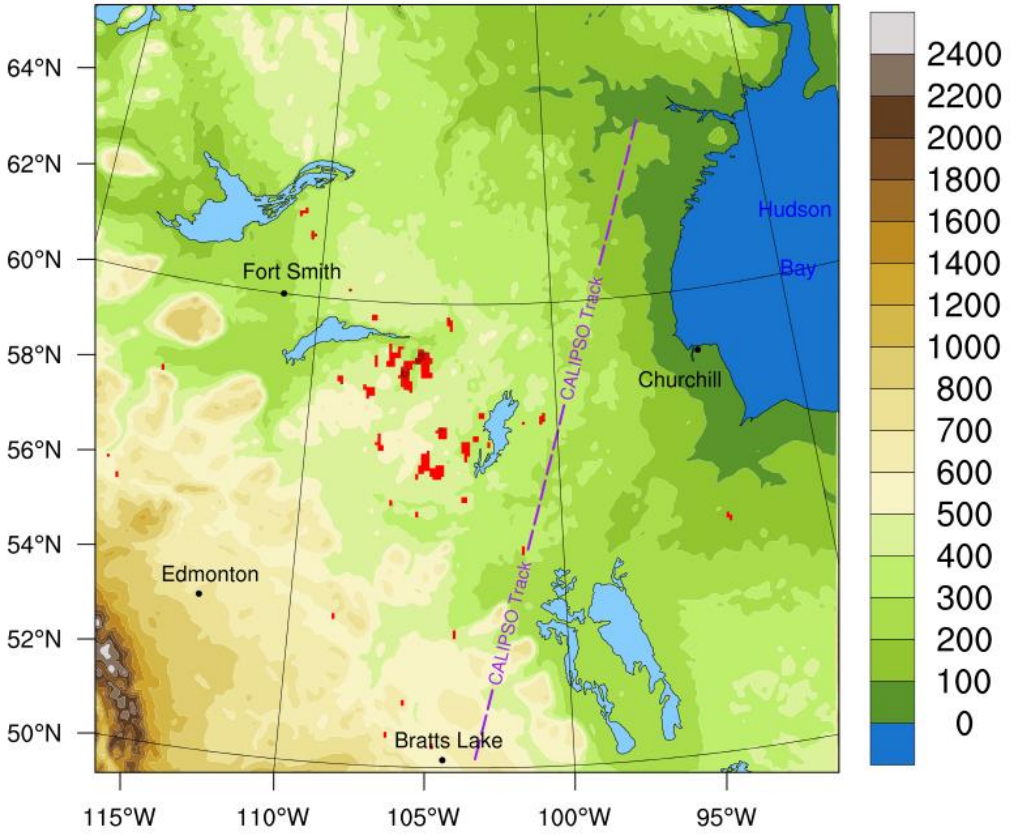
Implementation in COSMO-ART

- Grid points with active fires are determined hourly
- Call of the plume rise model and transfer of the current meteorological values
- Calculation of the upper and lower limit of the emission layer in dependence of the parameters fire size and fire intensity
- Vertical mass distribution between these limits with a parabolic function, accounting for the not equal spaced levels of COSMO-ART



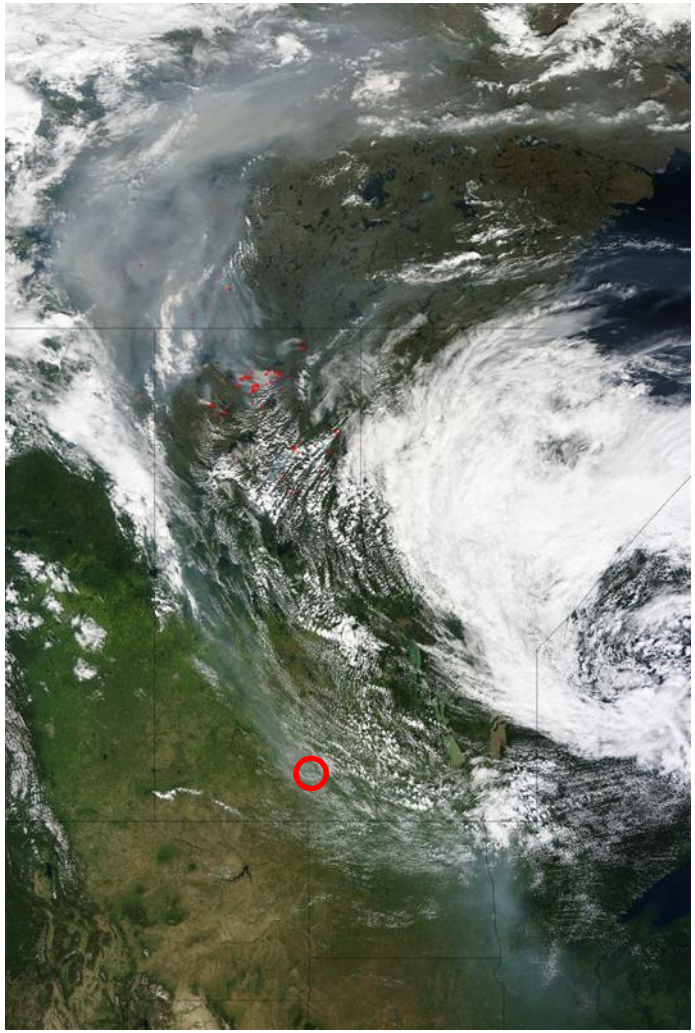
Model Setup

- Simulation period
  10.-19.07.2010
- 7 km horizontal grid spacing
- Biogenic emissions, sea salt, fire emissions
- Extended two-moment cloud scheme

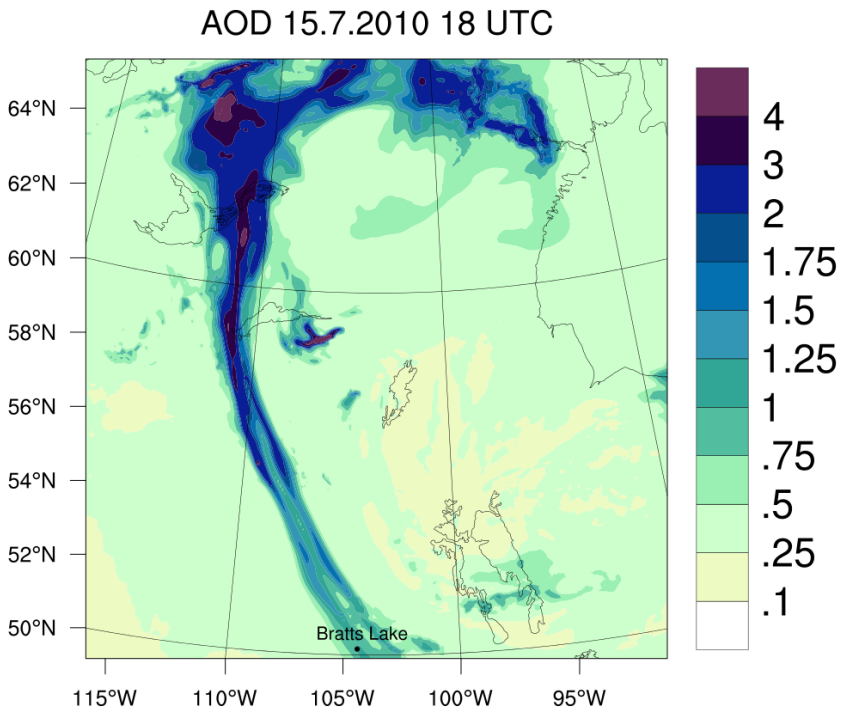


Horizontal Distribution of Fire Emissions

15.7.2010 17:55 UTC

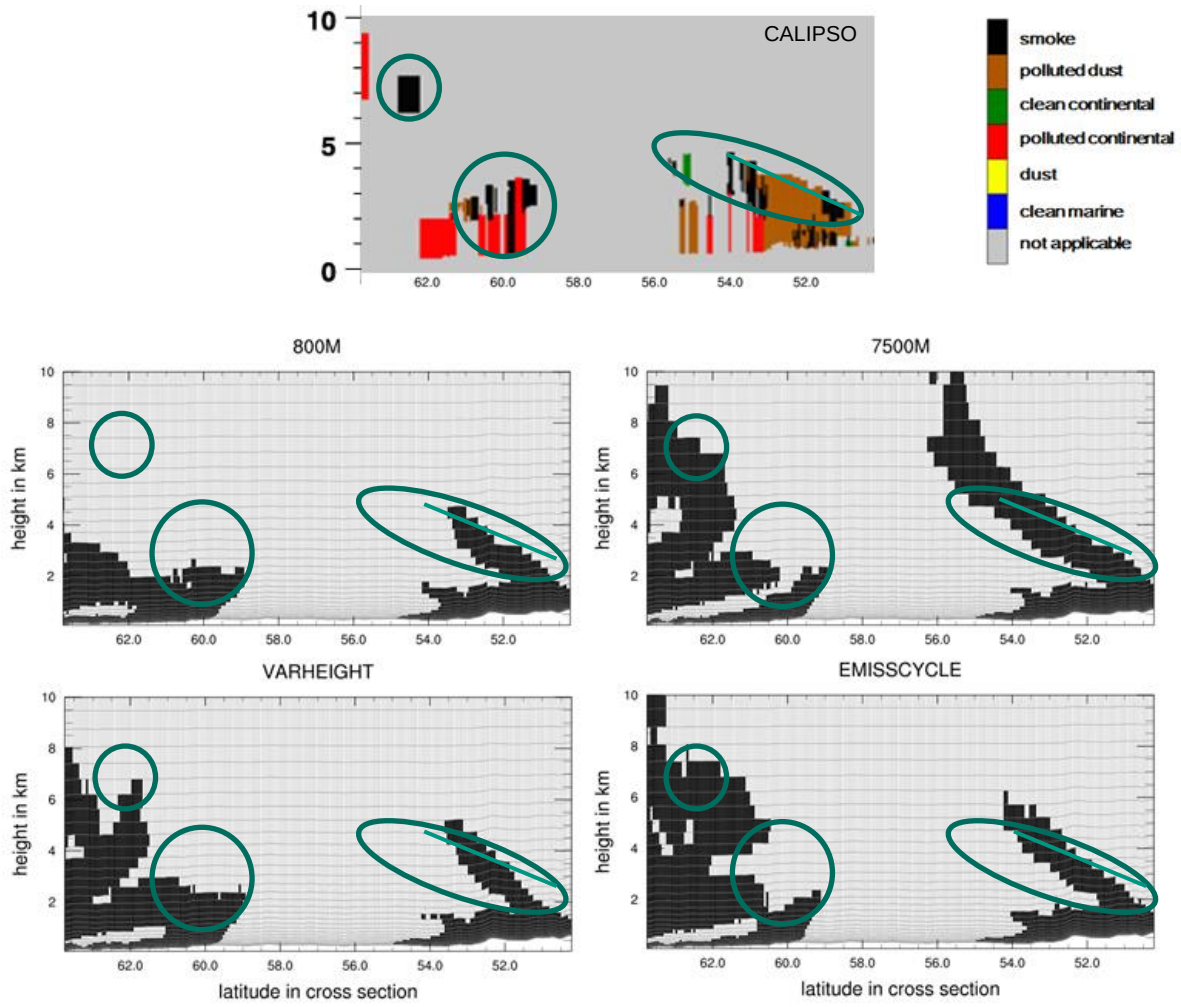


LANCE Rapid Response MODIS Image Gallery, NASA

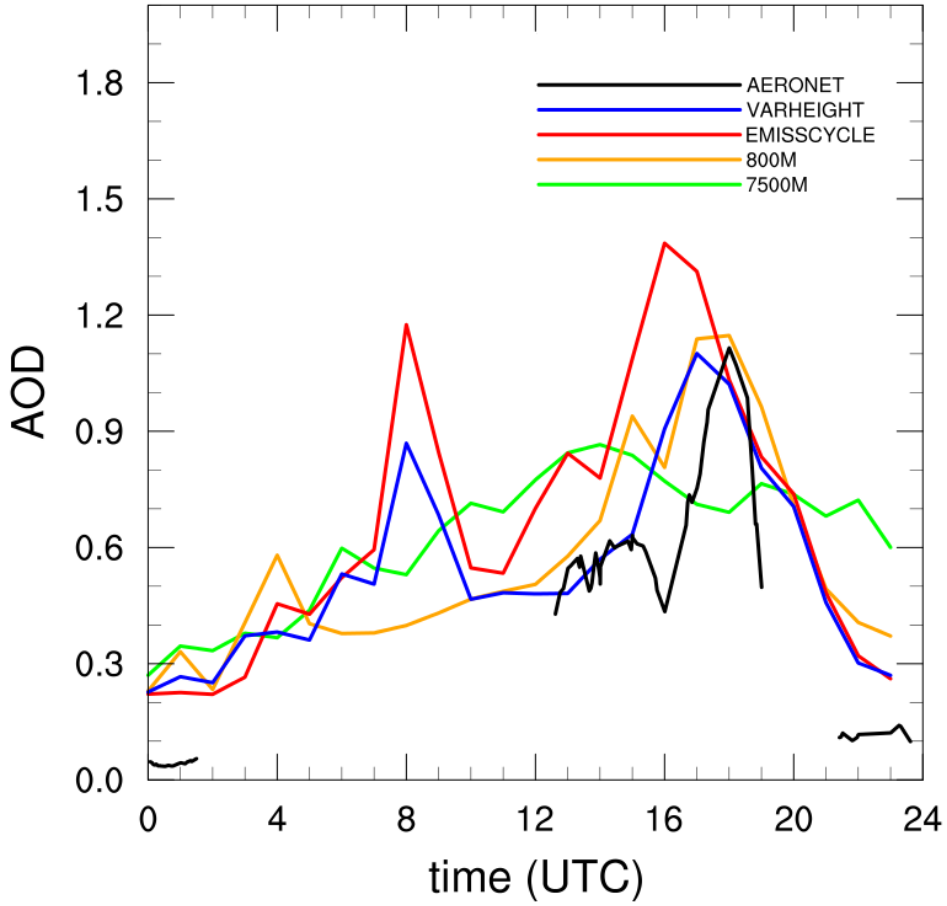


Dispersal of Fire Emissions

Comparison of Different Approaches for the Effective Emission Height

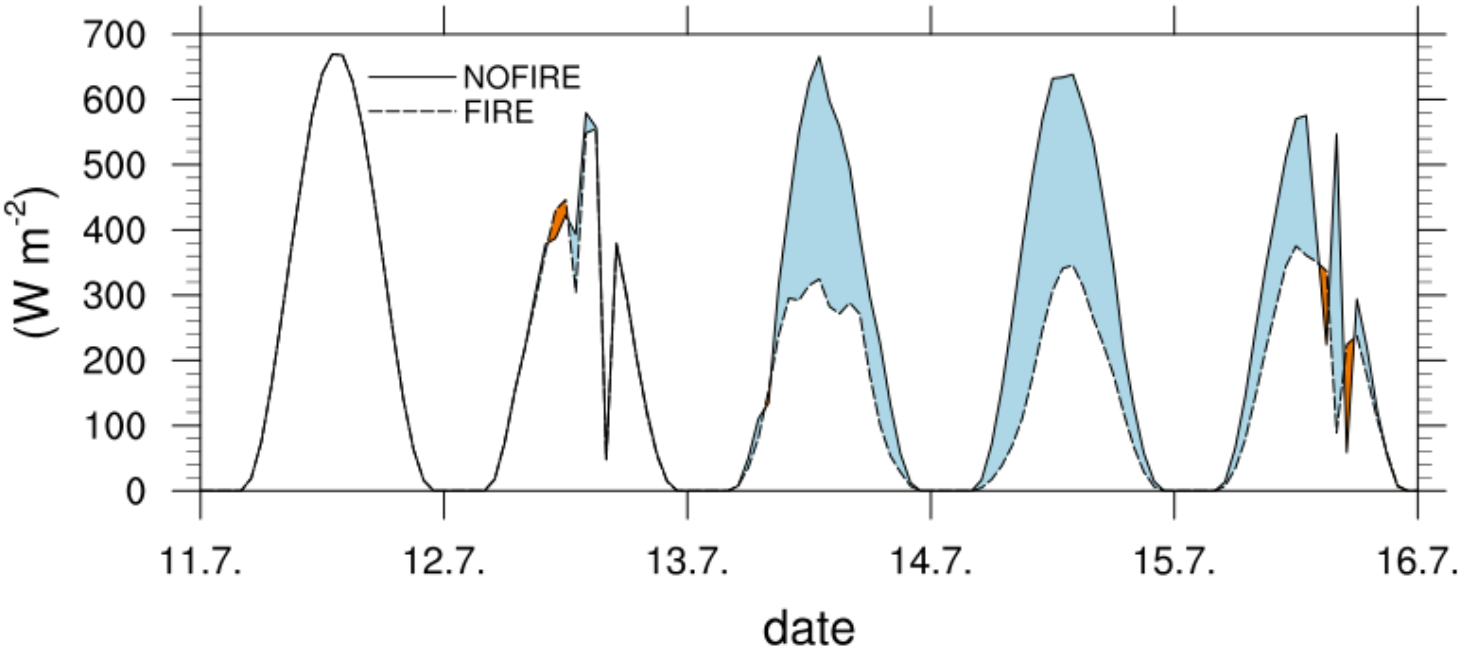


Aerosol Optical Depth



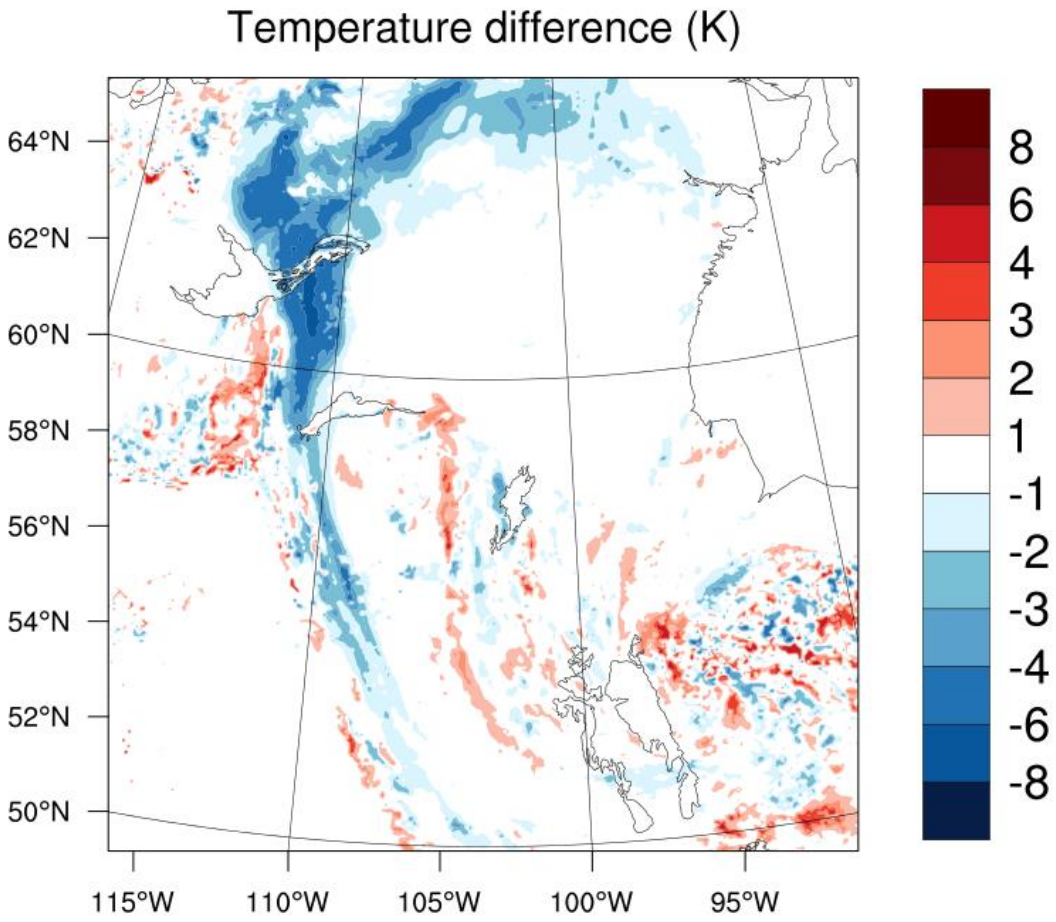
AOD at 550 nm at Bratts Lake for 15 July 2010 for different emission scenarios.

Radiative Impact



Simulated surface shortwave radiation at Fort Smith

Temperature Influence at 2 m Height



PDF for Cloud Droplets