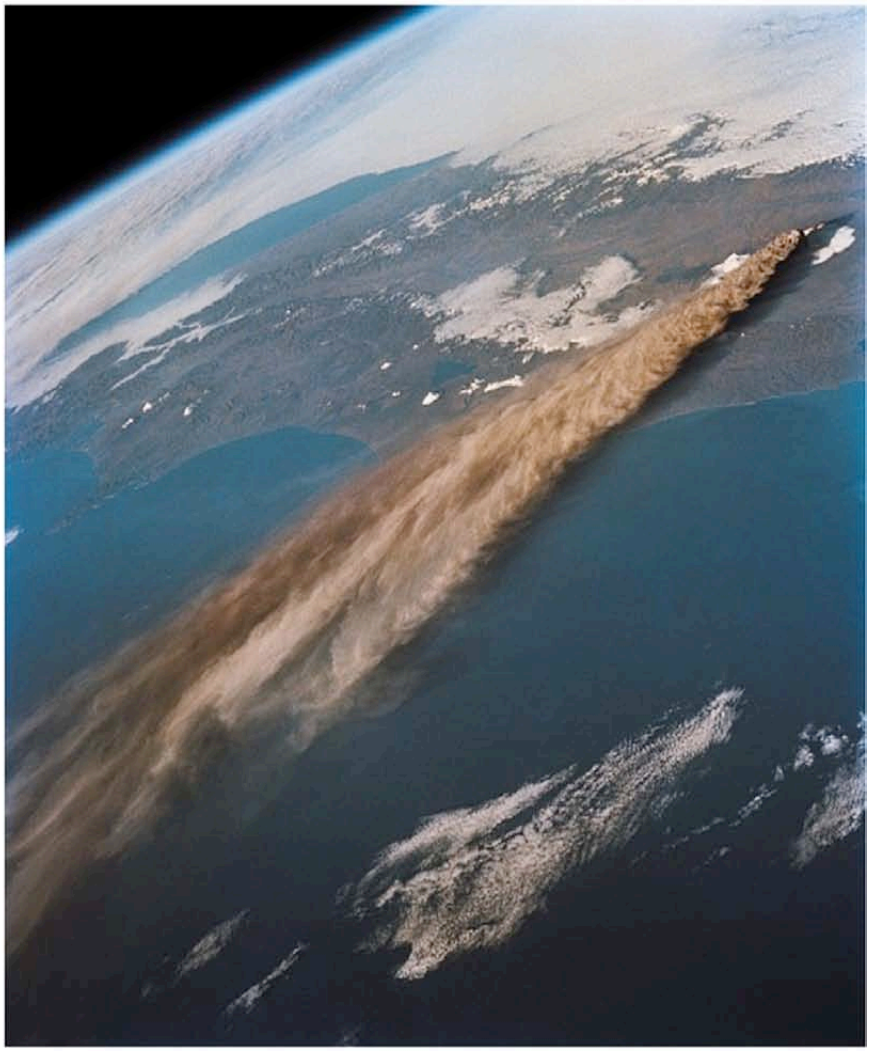
# Wildfires, Volcanoes and Aerosols and Their Impact on Visibility and Weather

Georg Grell

Georg.a.Grell@noaa.gov

***This work uses a fully coupled weather/chemistry modeling system, WRF-Chem, which is now also used (at ESRL) for the Rapid Refresh (RR-Chem) and the High Resolution Rapid Refresh (HRRR-Chem).***

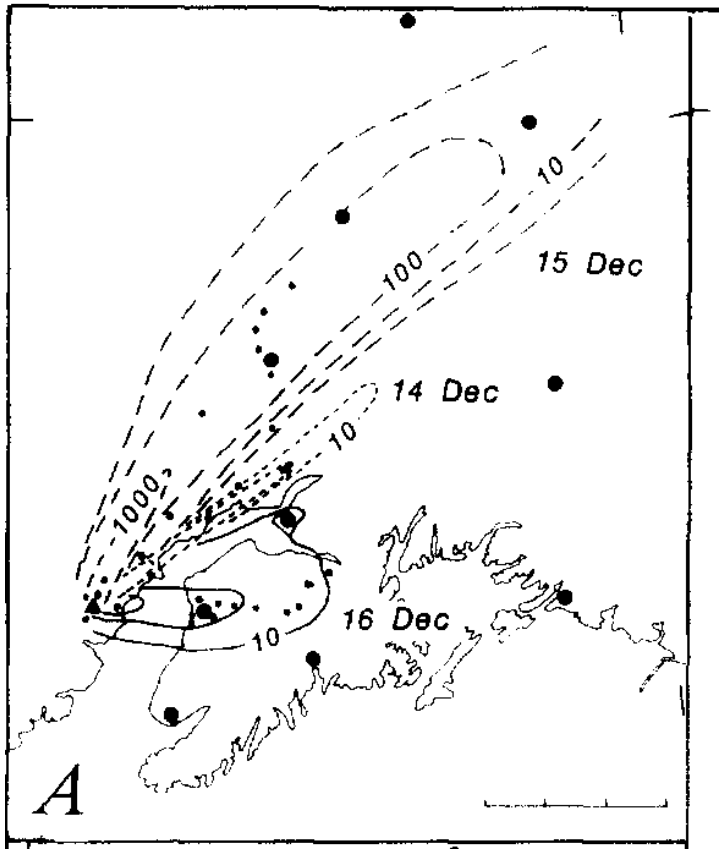
# Both wildfires and volcanoes are a threat for health and aviation

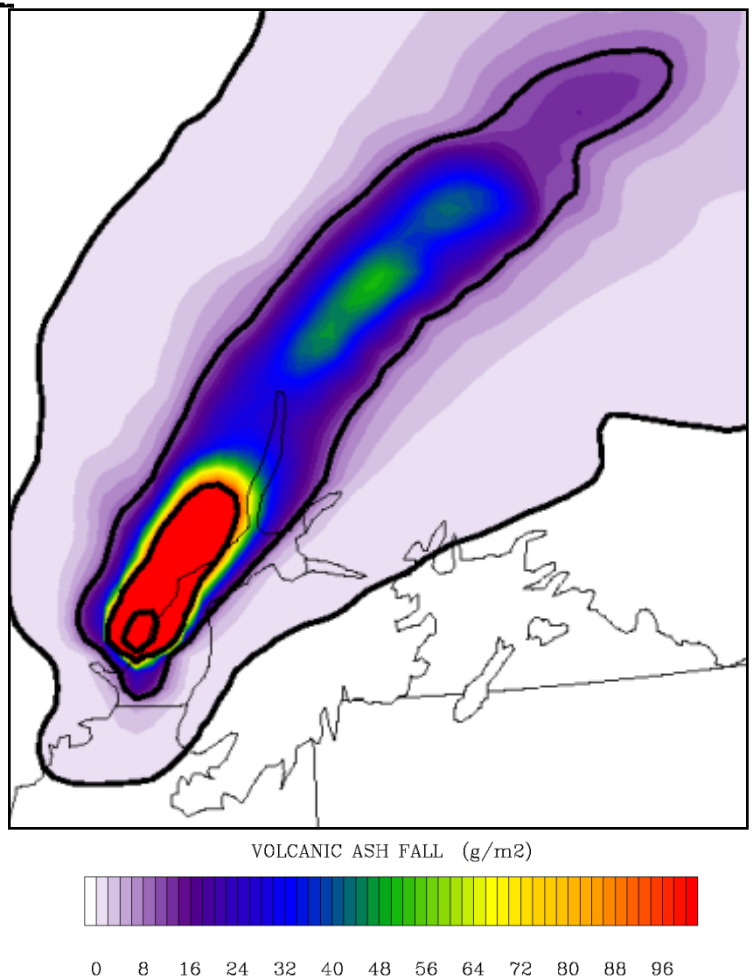


# Wildfires, volcanoes and their impact on weather, air quality and visibility

- Collaborative project of ESRL (GSD+CSD), University of Fairbanks, CPTEC in Brazil
- using Rapid Refresh (RR-Chem) regional and FIM-Chem global model to forecast:
  - Ash concentrations, ash-fall, and sulfuric acid production from volcanoes
  - Impact of wildfires on air quality and weather
  - Direct and indirect impact on visibility (aerosol optical properties)

# Tephra-fall deposits (g/m$^2$), Redoubt Volcano south-central Alaska, explosive 43 minute eruption December 15, 1989



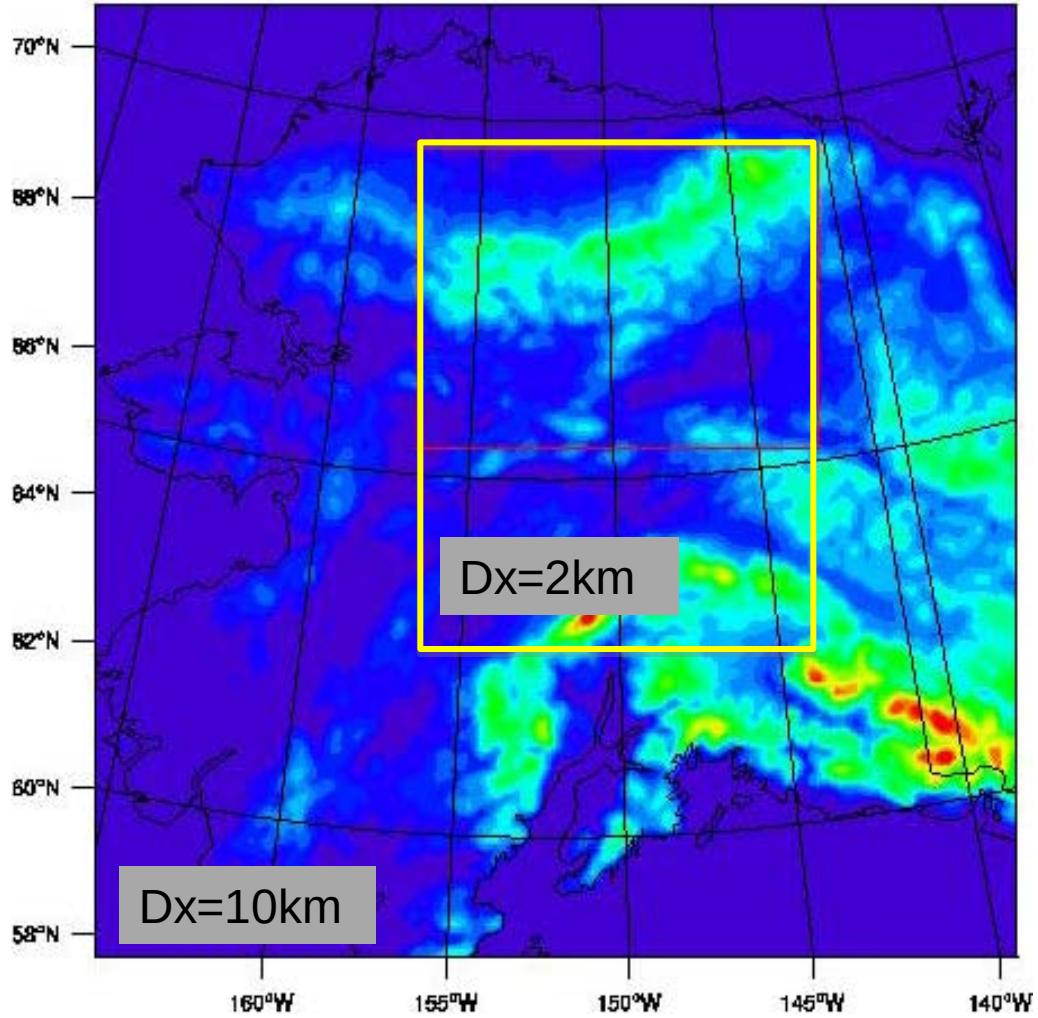




Observed

Predicted by WRF-Chem, using *RR-Chem setup*

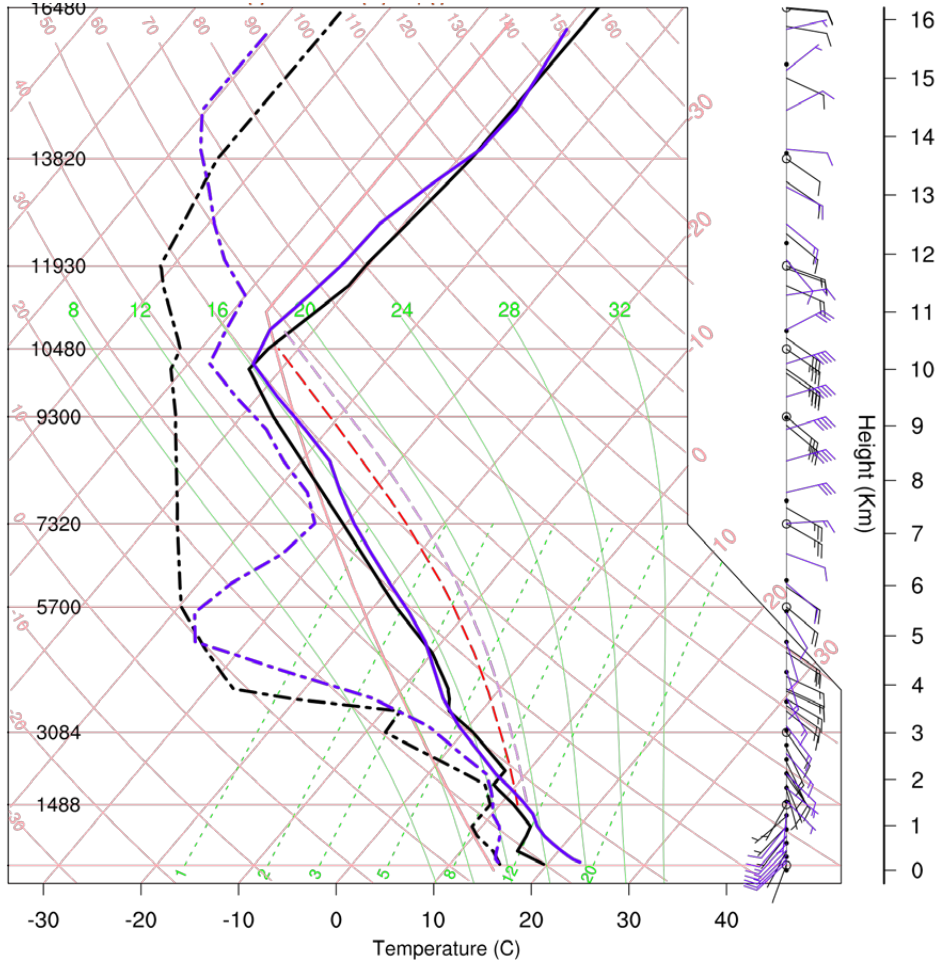
# WRF-Chem simulation on effects of fires on weather

- ✓ 10-day spin up
- ✓ 2-day simulation July 3, 00UTC to July 5, 00UTC with and without fires
- ✓ Fires initialized using WF-ABBA, MODIS, as well as aerial and ground observations

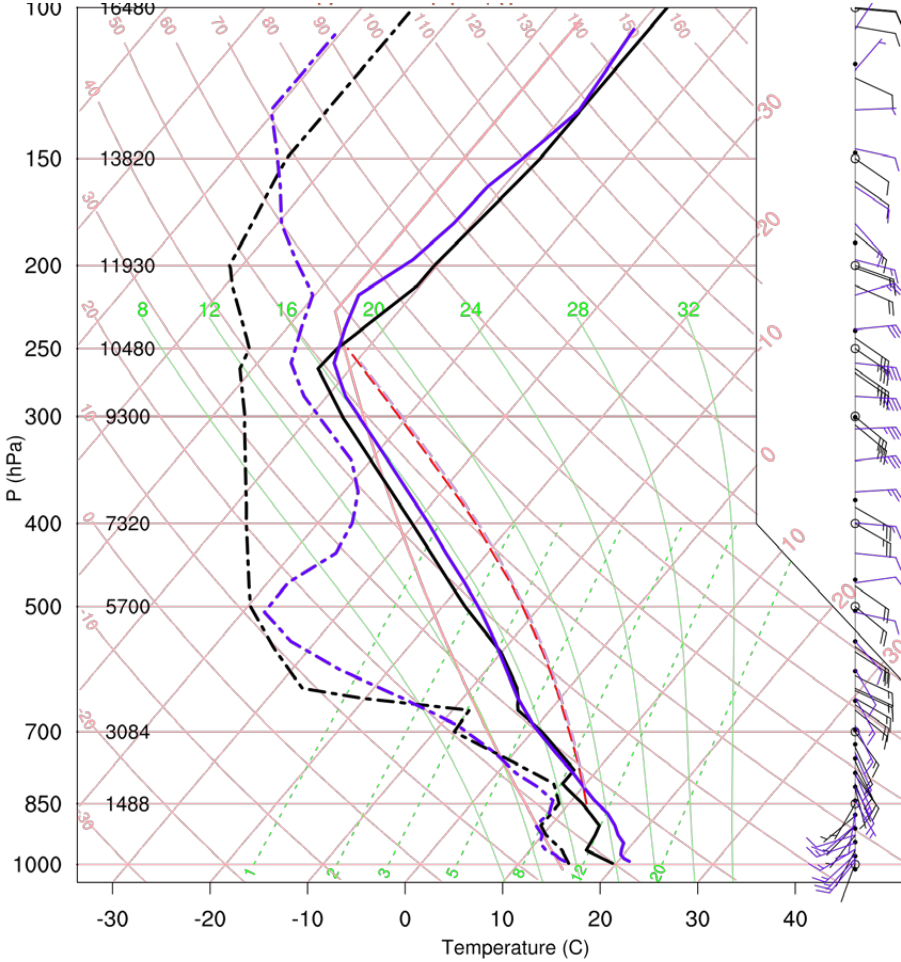


# 24 hr cloud-resolving (HRRR type setup) forecast (blue) and observed (black) sounding for Fairbanks, Alaska
# 4 July 2004 00UTC

## Without Fires

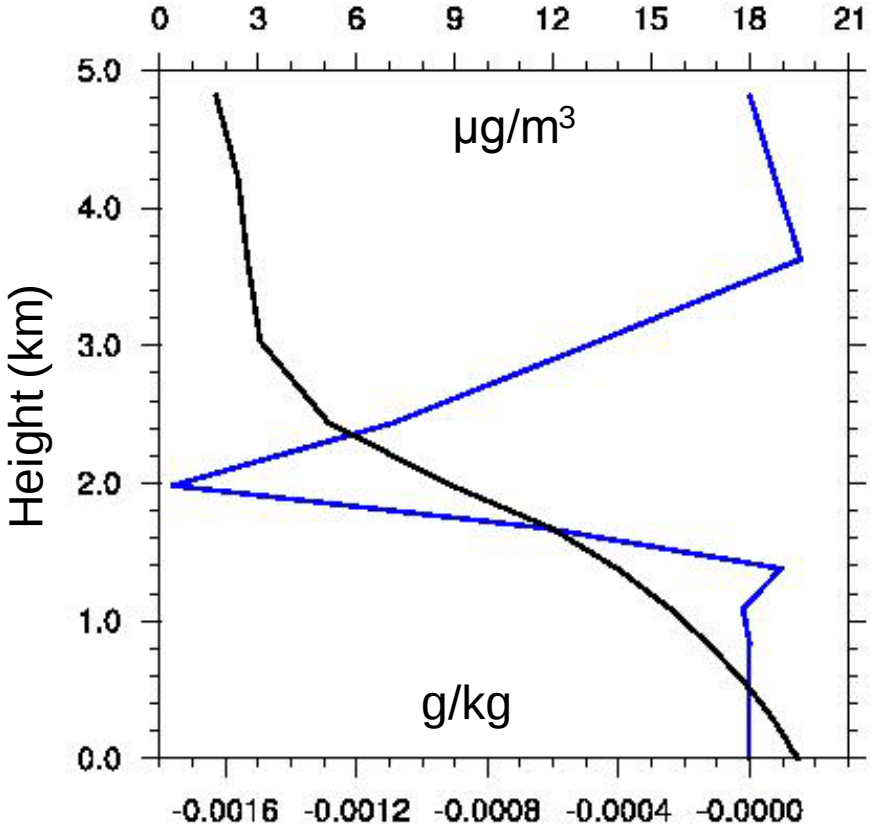



## With Fires




**For this case: Significantly less thunderstorms and clouds and better agreement with observations when run with fires!**

**Indirect impact: box averaged cloud water difference (blue) and PM2.5 (black)**

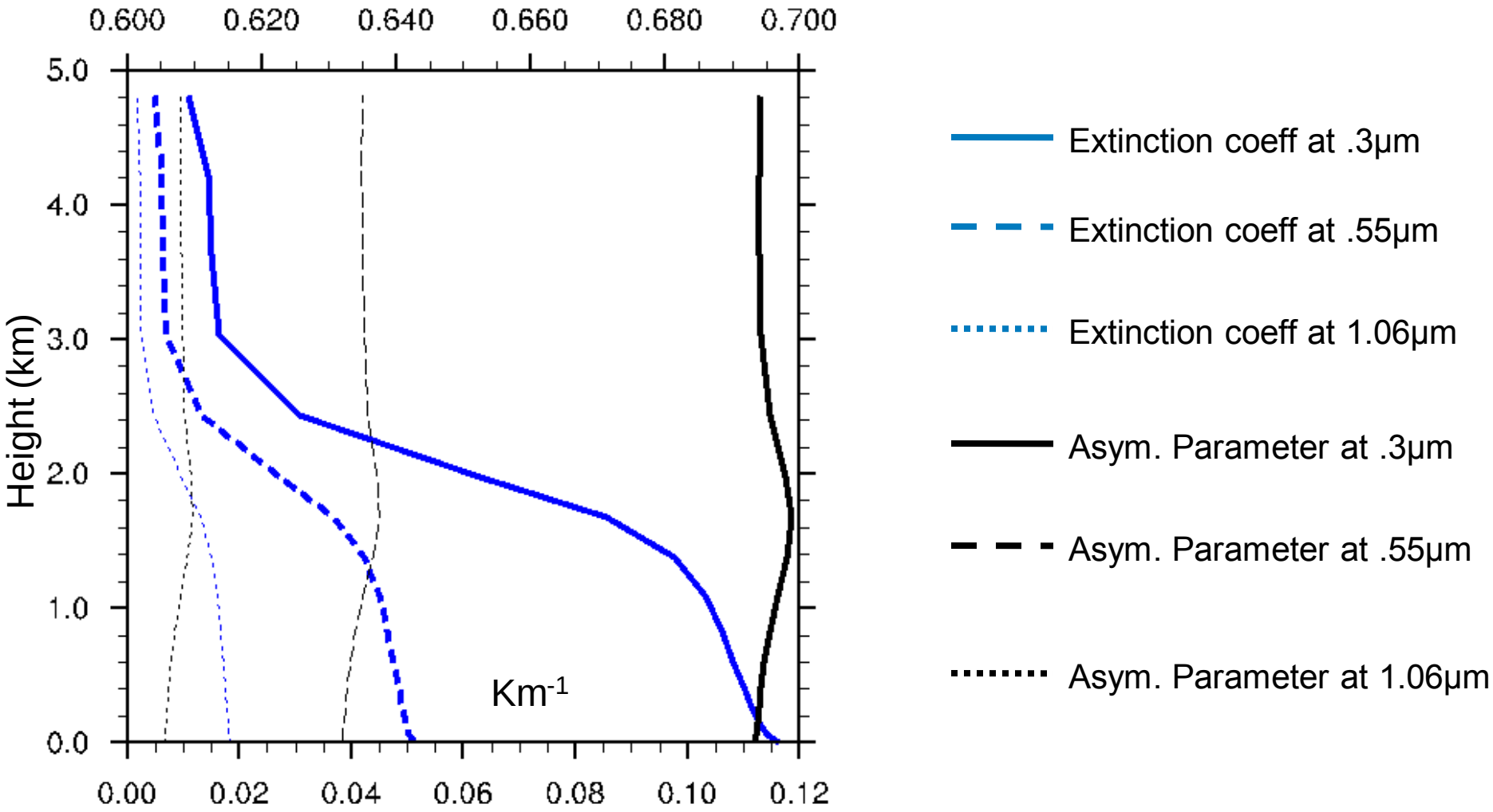



Less clouds!

# Development of an operational prediction and assimilation system for weather and air quality (aerosol) for AFWA

- ESRL(GSD +CSD) and NCAR, using RR-Chem setup, WRF-Chem, GSI for data assimilation
- Visibility (aerosol optical properties) and line of sight related predictions (phase functions)
- Dust, sea salt, fires, sulfate, anthropogenic aerosols
- Boundary conditions from operationally available global model (Navy? UKMet? GFS? FIM?)
- Chemical and meteorological data assimilation
  - Chemistry should improve meteorological data assimilation too!!

## Box averaged over 100x100 grid points




**Significant visibility restrictions in lowest 3km due to aerosols from wildfires even on larger scales**

**Directly in the plume, extinction coeff's can have values larger than 1**