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Origin of Arctic Haze Aerosols

Based on

Stock et al., Springtime arctic aerosol:
smoke versus haze, a case study for March
2008, *Atmos. Environ.*, 52, 48-55, 2011

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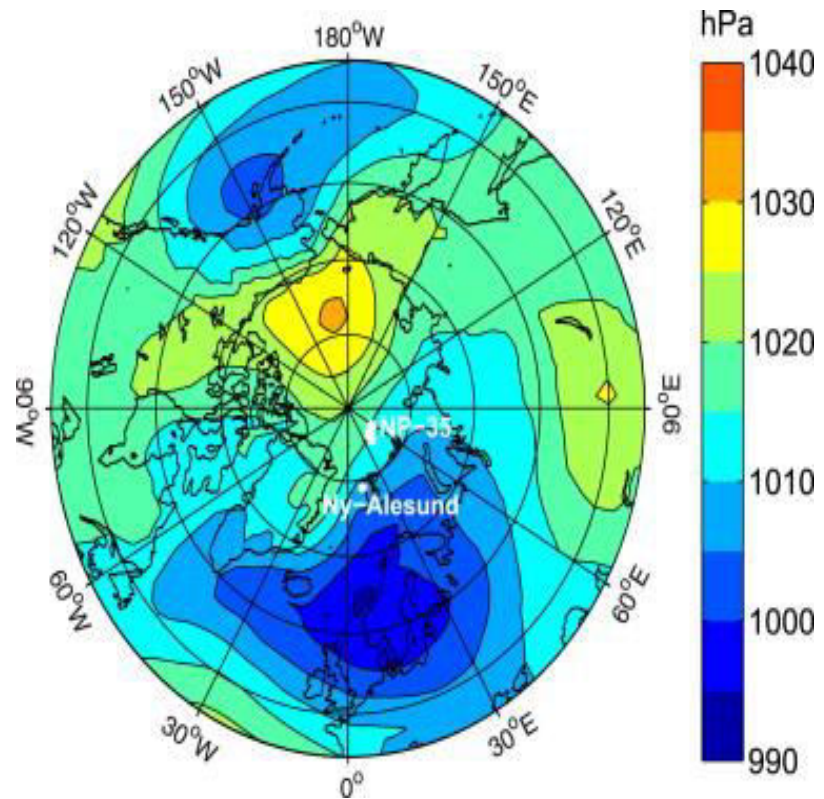
Arctic Springtime Haze

- **Usually of anthropogenic origin**
- **Dust haze**
- **Smoke haze (not common)**
- **Long staying staying time during arctic spring: 1. Lack of wet deposition. 2. Elevated layer**



Aerosol measurements

- **Sun photometer + Lidar measurements at two locations**
- **Ny-Ålesund in Spitzbergen (78.9° N, 11.9° E)**
- **NP-35, A Russian ice-floe drifting station (85.5-84.2° N, 56.7-42.0° E)**
- **Sun photometer results far north in March!!!!**



From Stock et al.

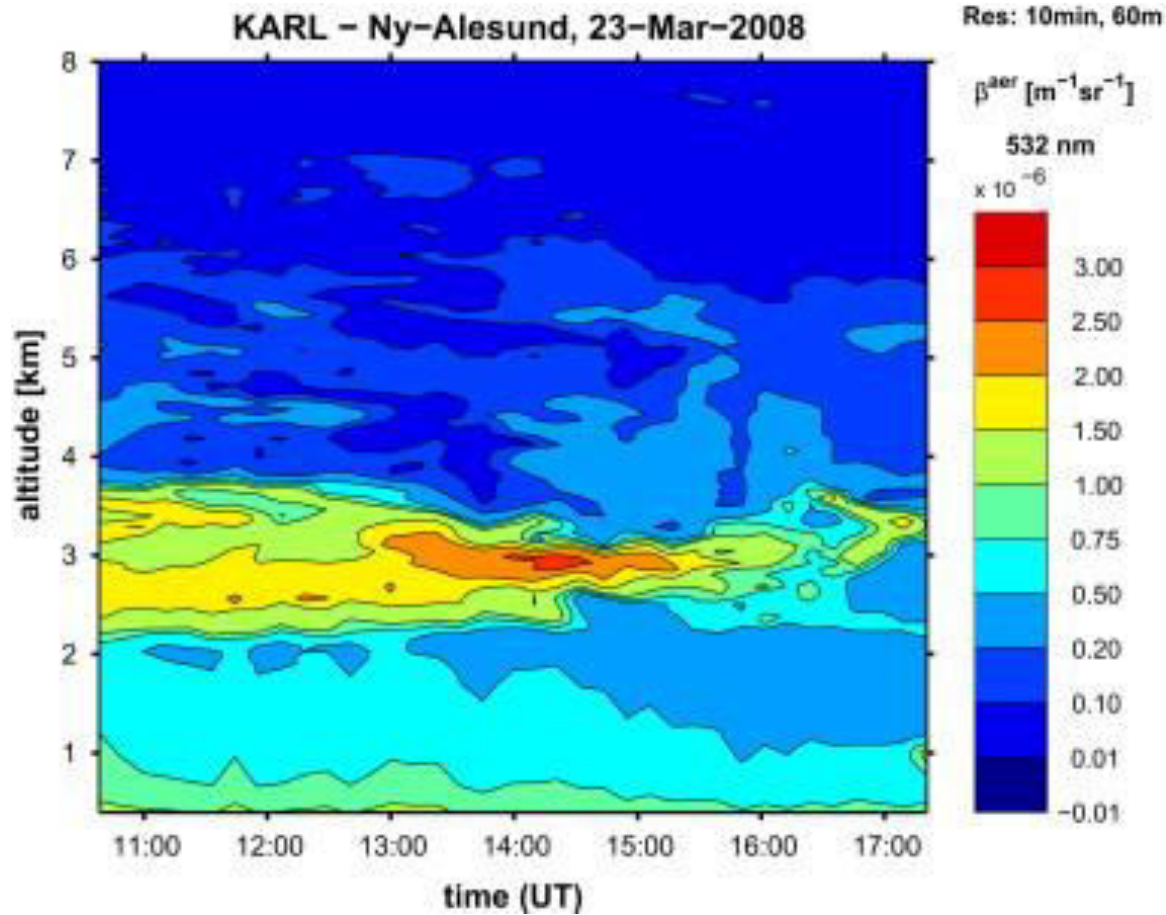


Sun photometer results

		Ny_Ålesund	NP-35
03.08	N	961	251
$\tau_{500\text{nm}}$		0.17 ± 0.05	0.19 ± 0.05
τ_{fine}		0.13 ± 0.05	0.15 ± 0.05
τ_{coarse}		0.03 ± 0.05	0.04 ± 0.02
α		1.4 ± 0.09	1.4 ± 0.19
17.03	N		10
$\tau_{500\text{nm}}$			0.35 ± 0.005
τ_{fine}			0.28 ± 0.004
τ_{coarse}			0.07 ± 0.004
α			1.2 ± 0.01
21.03	N		12
$\tau_{500\text{nm}}$			0.32 ± 0.006
τ_{fine}			0.25 ± 0.007
τ_{coarse}			0.07 ± 0.012
α			1.3 ± 0.04
23.03.	N	358	
$\tau_{500\text{nm}}$		0.22 ± 0.026	
τ_{fine}		0.19 ± 0.026	
τ_{coarse}		0.03 ± 0.004	
α		1.5 ± 0.02	



LIDAR example



From Stock et al.



Motivation for transport modeling

- **Locate the origin of the haze (high AOD) aerosols**
- **Possibly draw conclusion about the cause of the aerosols**
- **Hypothesis: high, spatially concentrated, PM in SILAM footprint may indicate point or small area source**



SILAM setup

- **Backward runs, 5 days**
- **Point of interest: footprints**
- **Source: elevated (2500-3000 m) 2-mode standard aerosol cocktail, 24 hour "measurement"**



How we broke SILAM

- **Backward runs close to pole with extensive lateral area may be unstable. Example: backward run started to run forward**
- **Solution: adjust the region of interest**
- **ECMWF meteo is sparse far north (Stock et al.). Meteo with polar coordinates would be more desirable**



Reference data

- **SMOKE: satellite (MODIS, AATSR) fire mapping or AOD. Not applicable: too early time of the year => sun zenith angle too big**
- **SMOKE: OMI aerosol index shows locations of absorbing aerosols. Qualitative only, determined at UV**
- **GENERAL AOD: AERONET sun photometer data inside a footprint. No go: same as satellite fire products**

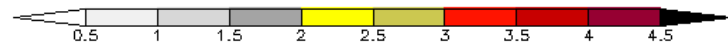
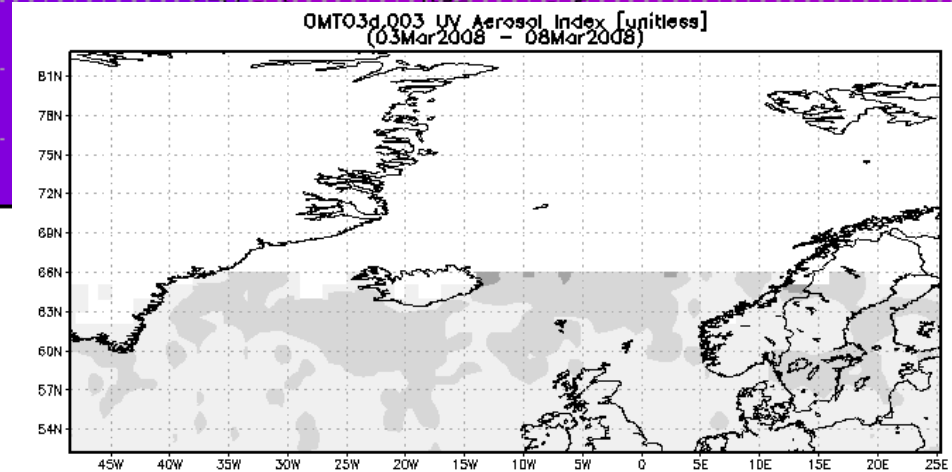
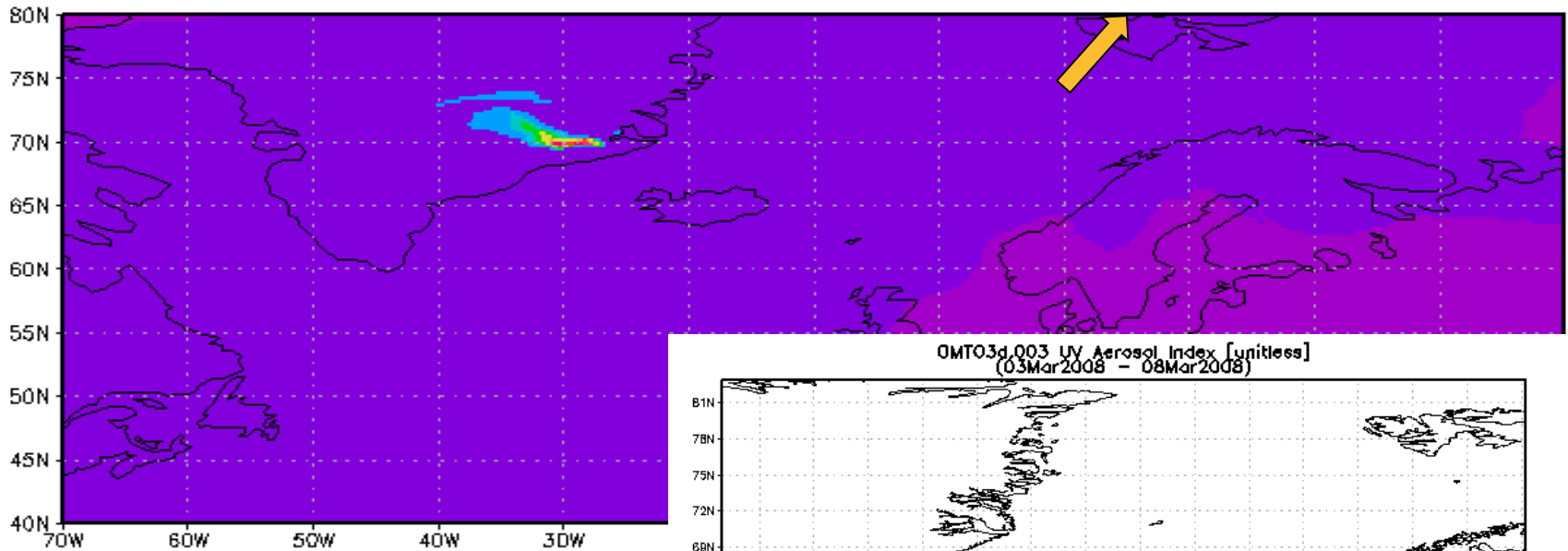


Results

- **Averaged footprints of PM**
- **Ground layer as ground sources were sought**
- **OMI aerosol index (AI) as a reference**

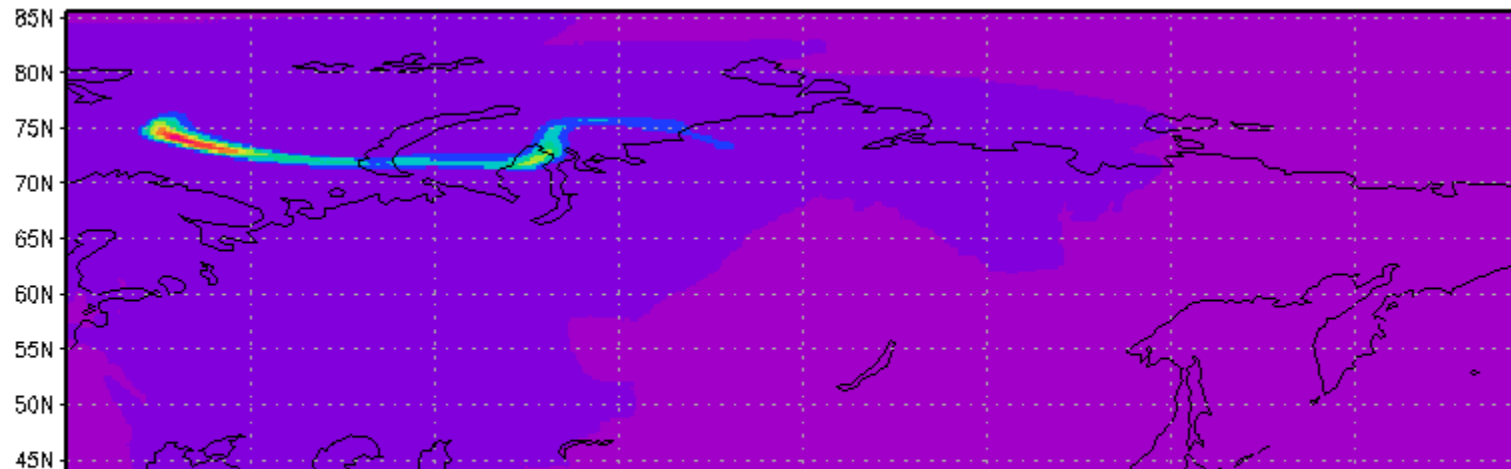


Ny-Ålesund, 2008.03.08, AOD = 0.17

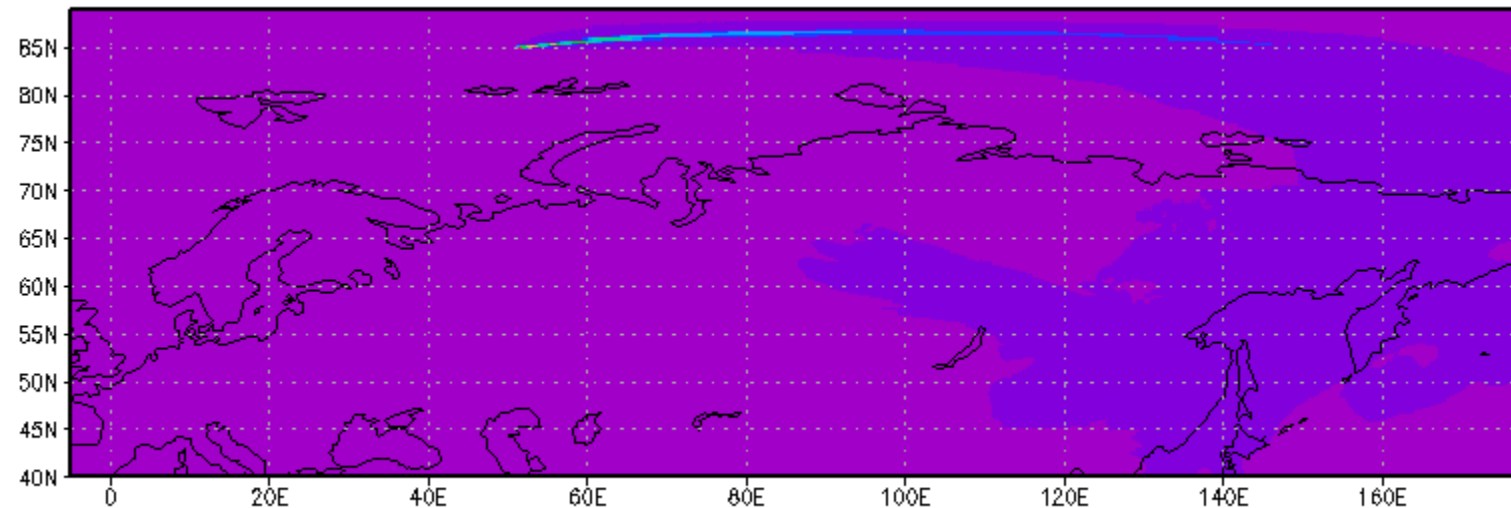




NP-35, 2008.03.08, AOD = 0.19



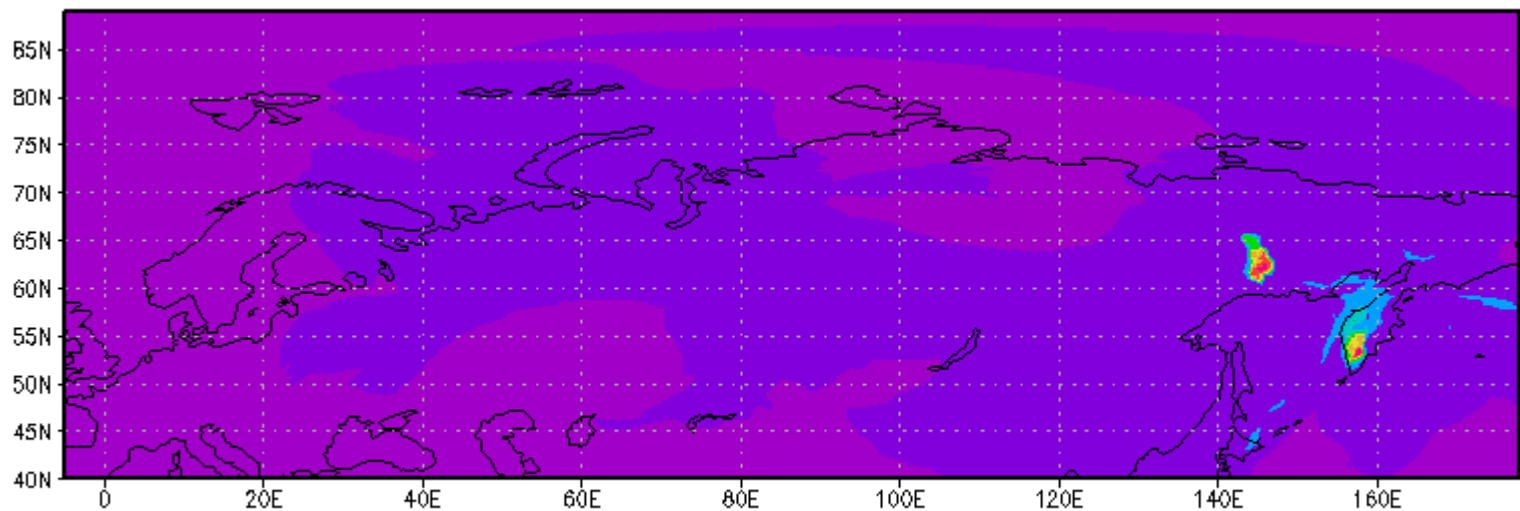
Elevated souce



Ground source

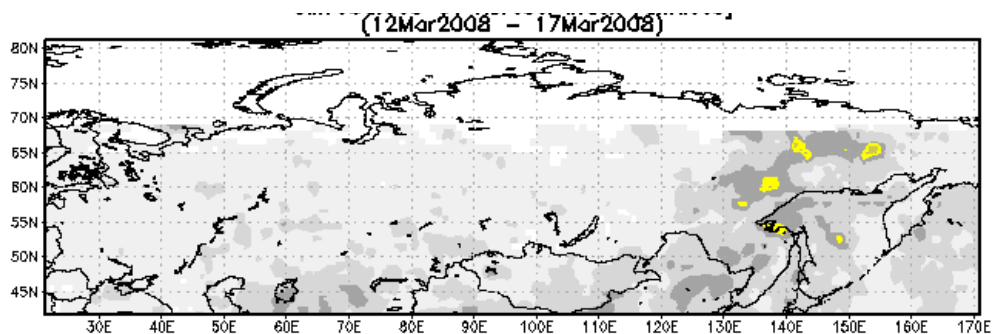


NP-35, 2008.03.17, AOD = 0.35



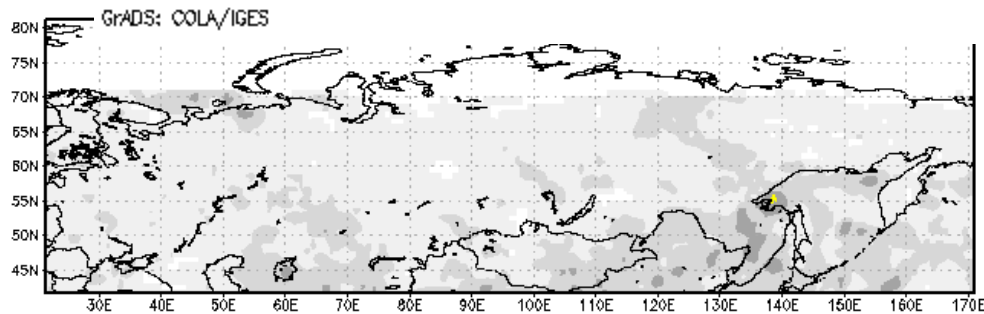
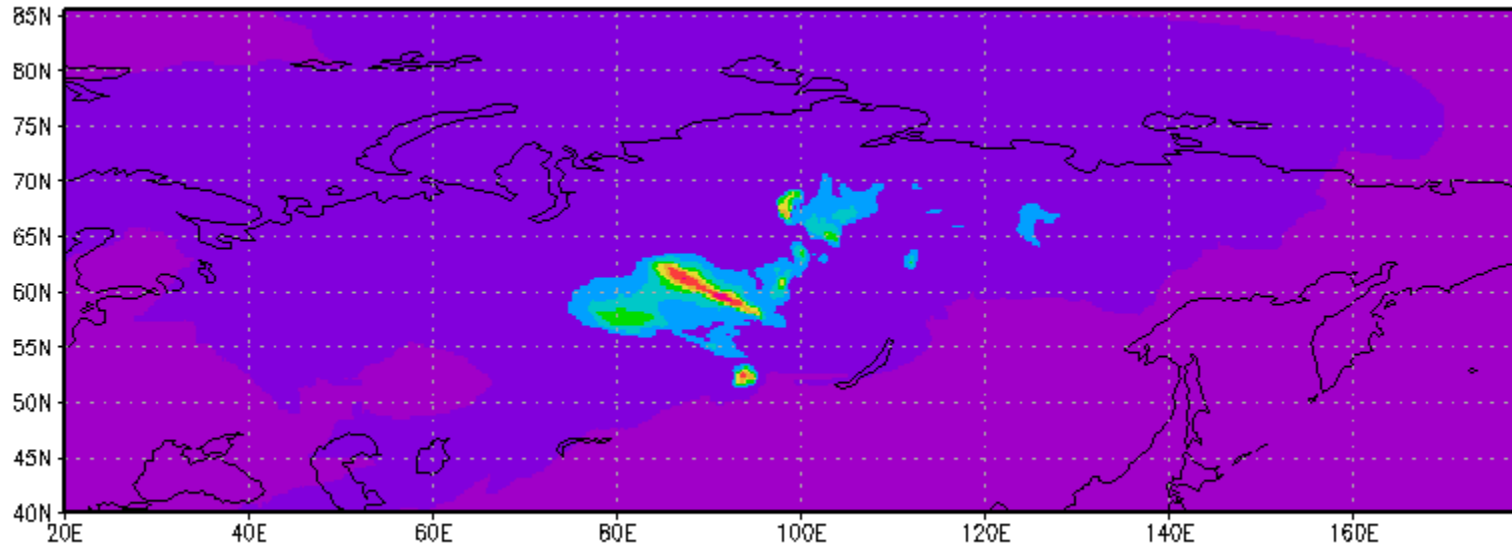
GrADS: COLA/IGES

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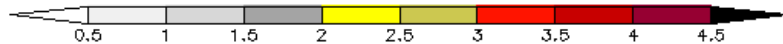




NP-35, 2008.03.21, AOD = 0.32



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Discussion

- **SILAM worked**
- **Input data must be checked thoroughly**