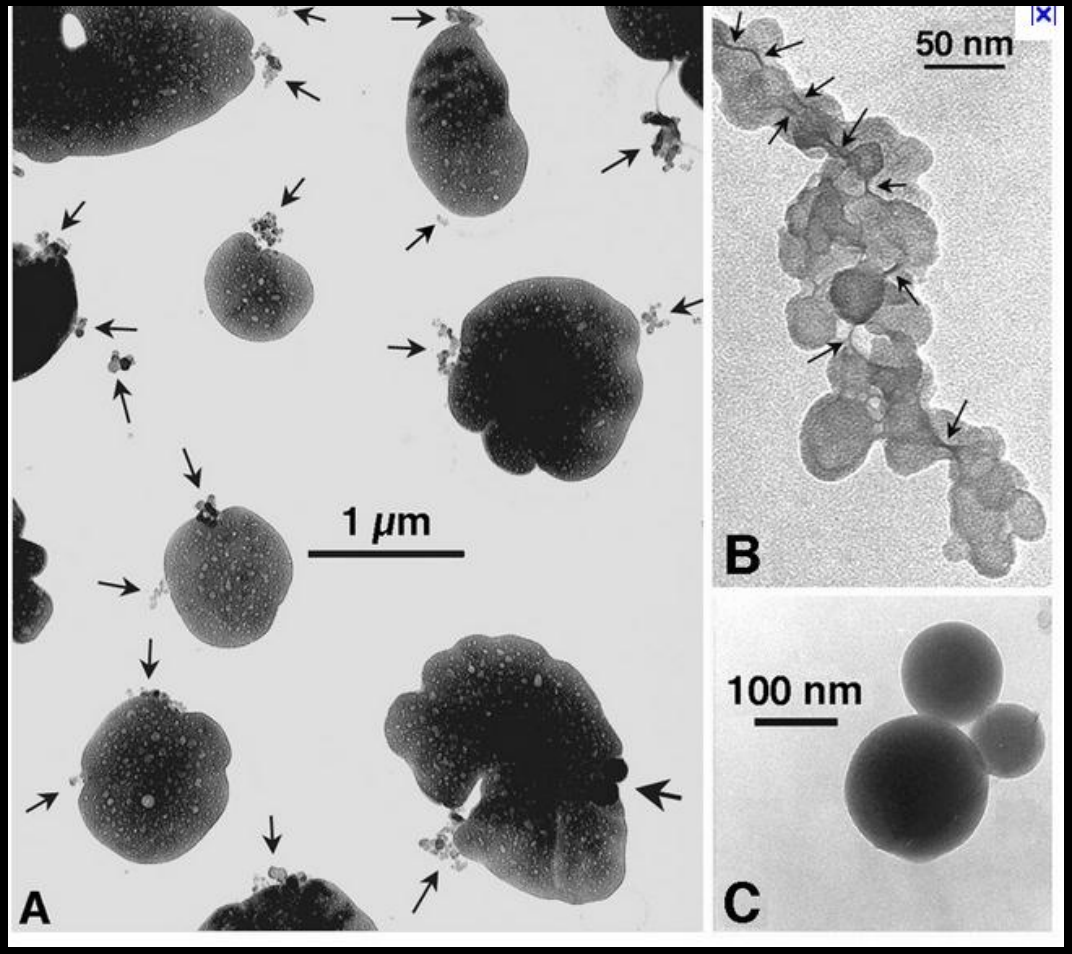
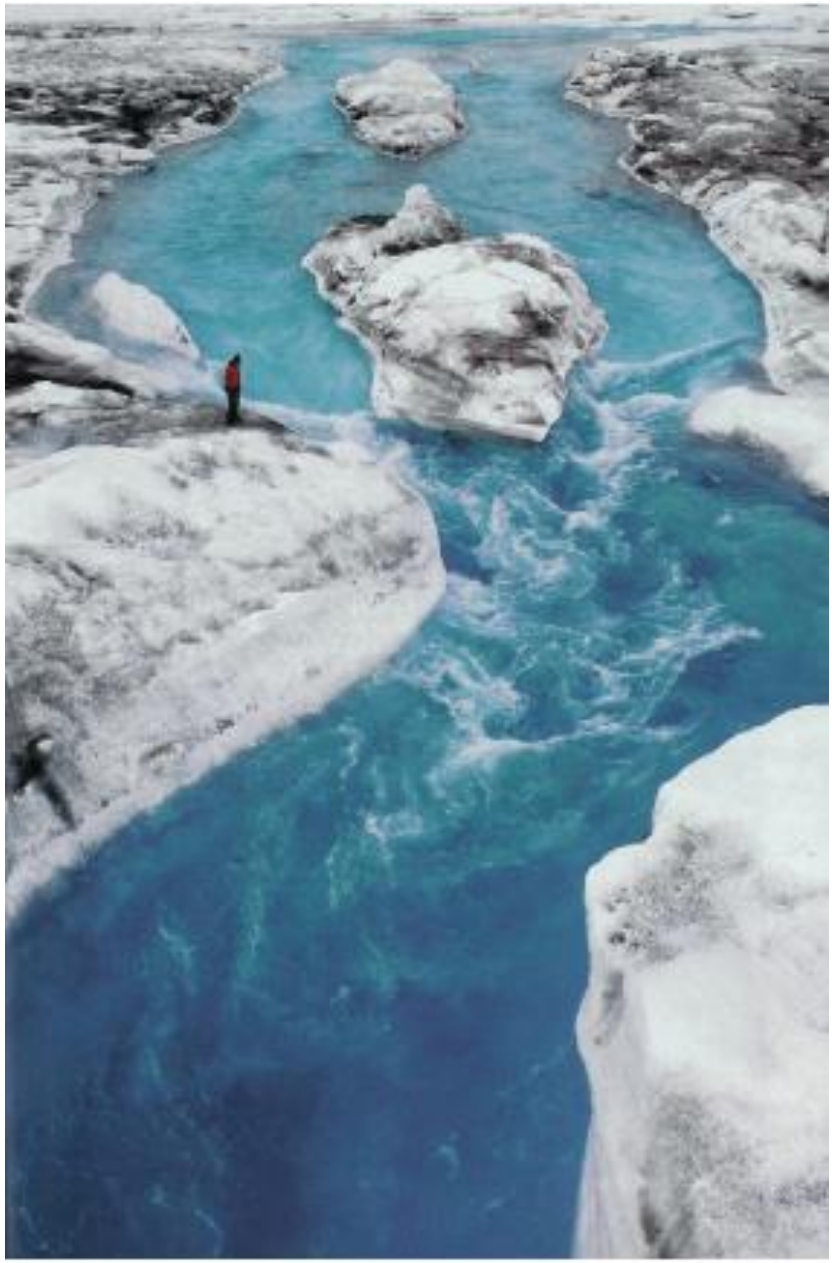
Measurements of Atmospheric Black Carbon in Arctic Regions
T. Uttal





A straight forward theory:

There are anthropogenic sources of soot that go up to the Arctic

It settles on the ice and snow and decreases the surface albedo

Everything melts faster

We can do something about this right away by decreasing sources……(like burning coal and wood)

But are observations supporting this?

A second atmospheric is direct effect: For instance smoke from forest fires……some recent studies indicate that the smoke layers stay up in the atmosphere and do not deposit on the surface…..a possible summer-time cooling effect?

Black carbon radiative heating effects on cloud microphysics and implications for aerosol indirect forcing: 1. Extended Köhler theory

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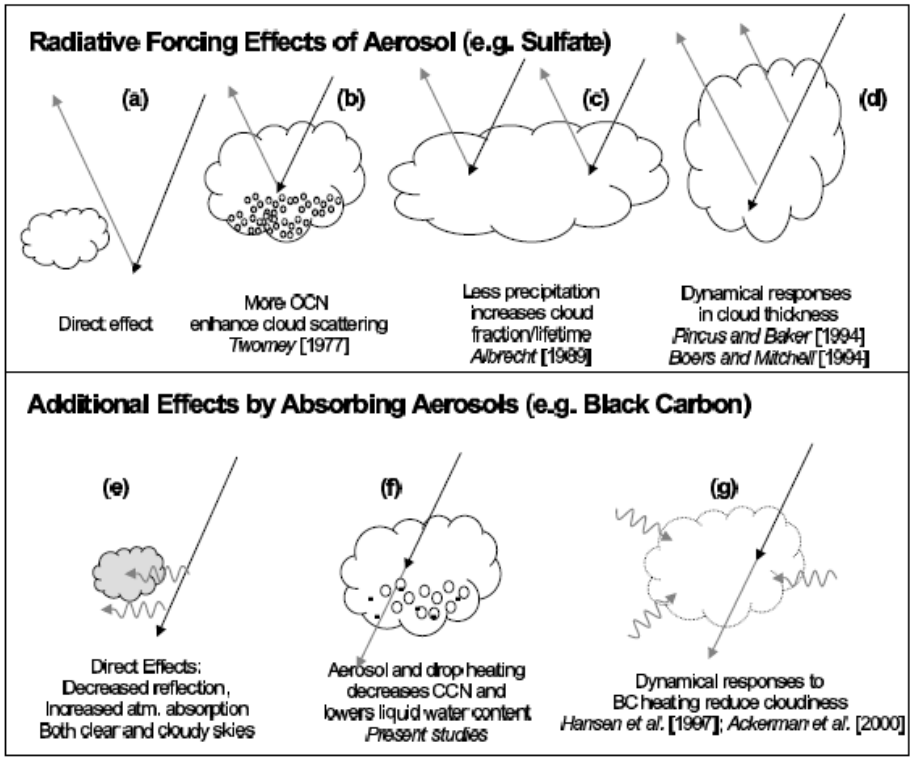
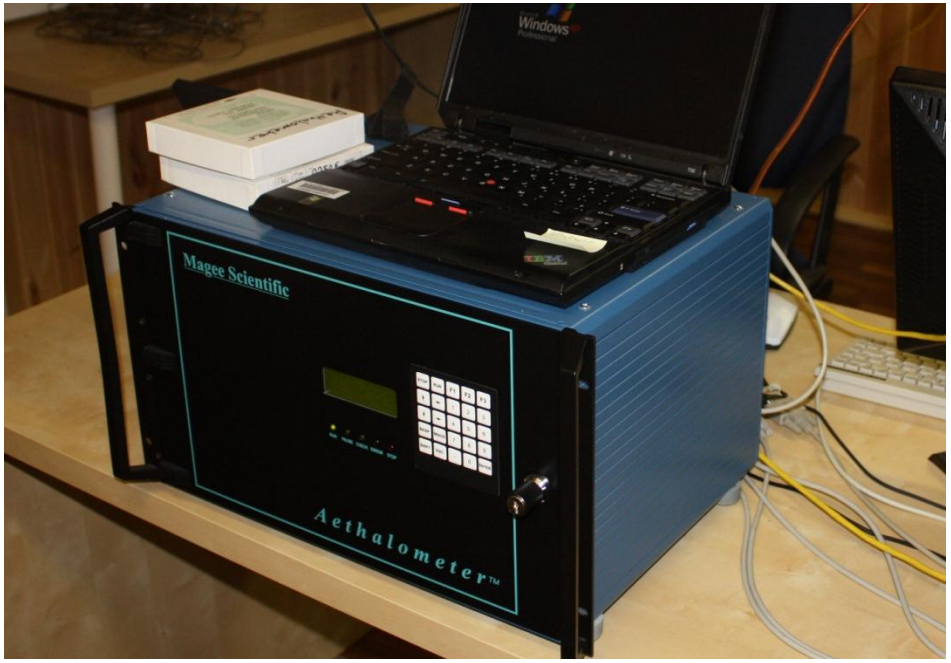
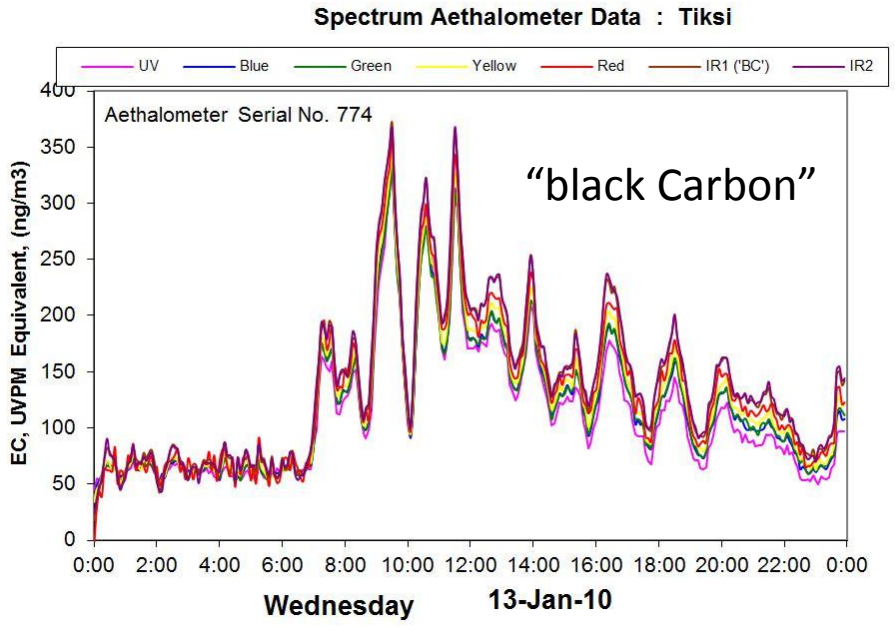


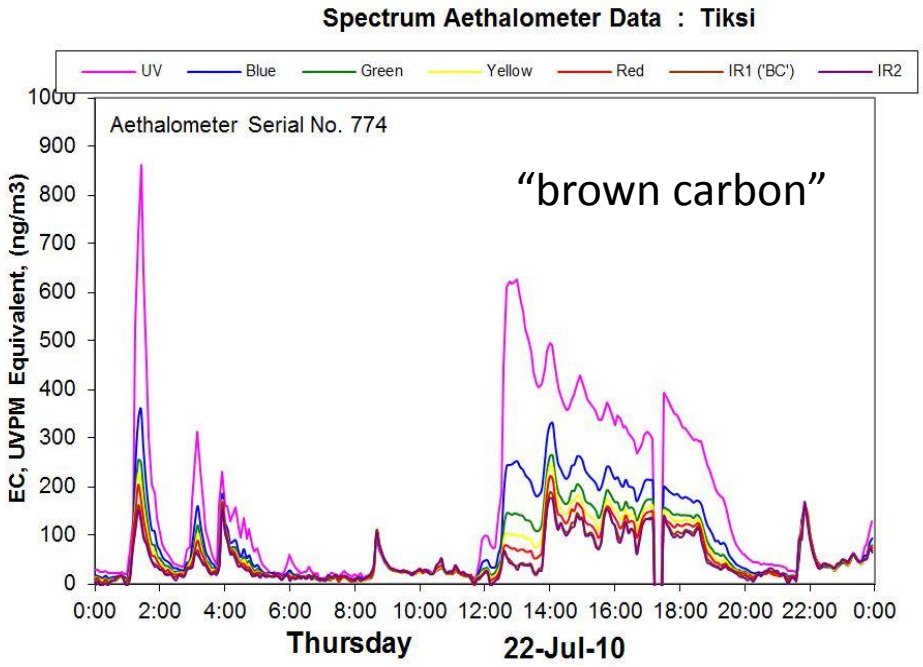
Figure 1. Direct and indirect radiative effects of aerosol, divided into those effects unrelated to aerosol absorption (a)-(d), and those related to aerosol absorption (e)-(g).

A third effect is the possible influence of black carbon on modifying cloud properties…….black carbon heating effects lowers cloud liquid and CCN leading to reduced cloudiness



A filter sampling instrument: The Model AE31 "Spectrum" Aethalometer acquires data in seven channels at wavelengths ranging from the ultraviolet to near-infrared, namely 370, 450, 571, 615, 660, 880 and 950 nm.



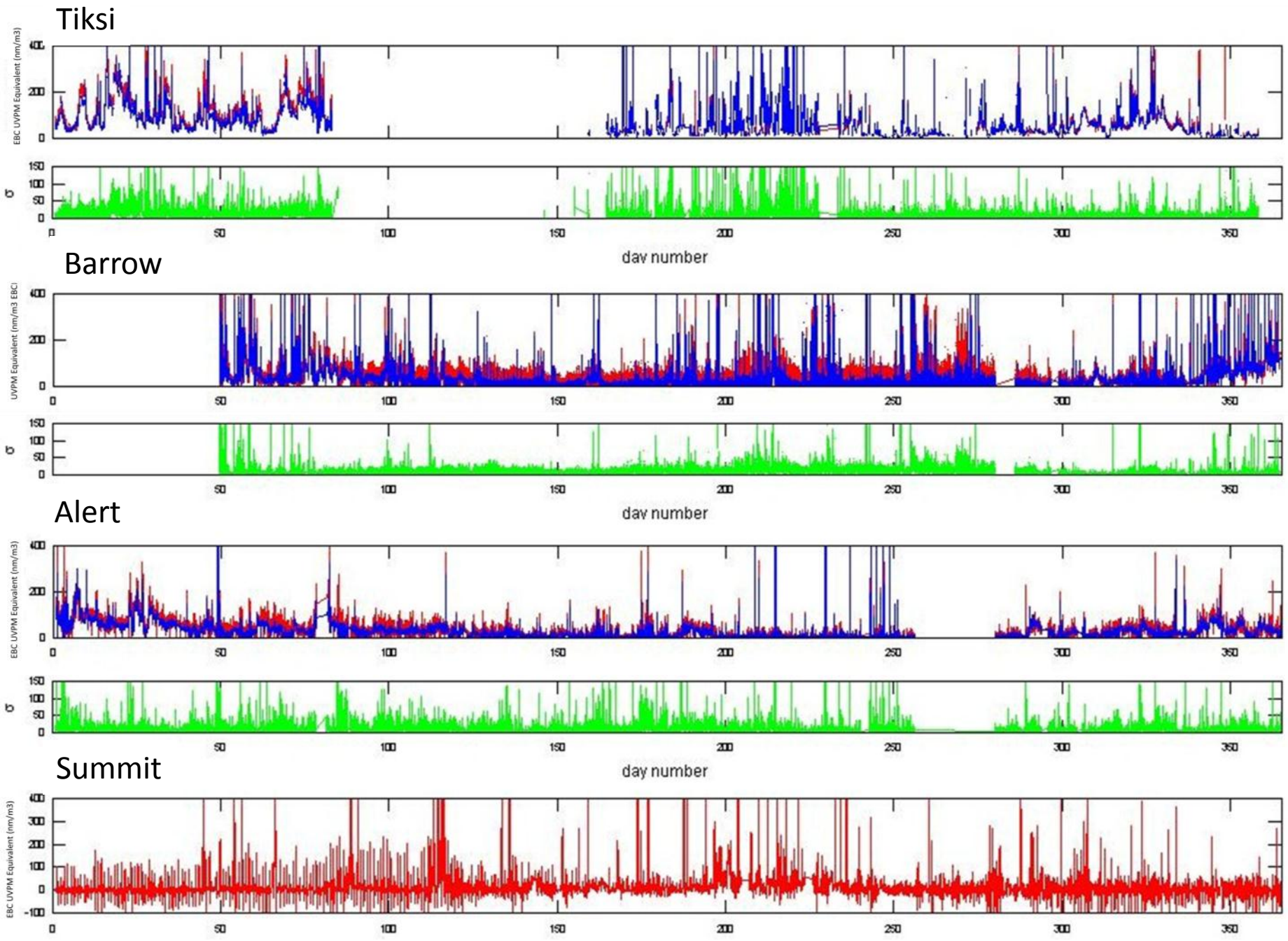


For aerosol consisting only of extremely small pure black spheres, the signals in all channels are interpreted identically as the same mass , and the seven wavelength traces are perfectly superimposed.

Different conditions can result in spectral dispersion. Examples include: large particle size (more absorption per unit mass in red, less in blue); presence of aromatic organic compounds (onset of enhanced absorbance in yellow and blue channels); colored mineral dust (extra absorption in particular channel); and other effects due to specific details of the aerosol composition*.

*T. Hansen - McGee Scientific

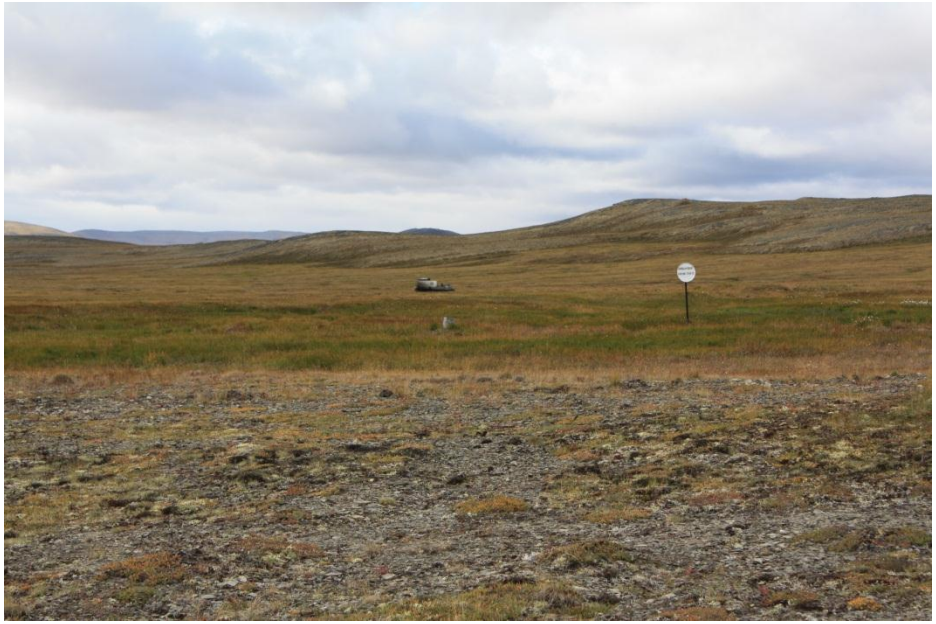

Cherskii, Russia
Tiksi, Russia
Barrow, Alaska
Sodankylä, Finland
CHERSKII
TIKSI
Alert, Canada
BARROW
NY-AALESUND
SODANKYLA
PALLAS
ALERT
ABISKO
EUREKA
Abisko, Sweden
SUMMIT
Eureka, Canada
Summit, Greenland
Ny-Ålesund, Svalbard


Tiksi
EBC UVPM Equivalent (nm/m3)
σ
day number
Barrow
UVPM Equivalent (nm/m3 EBC)
σ
day number
Alert
EBC UVPM Equivalent (nm/m3)
σ
day number
Summit
EBC UVPM Equivalent (nm/m3)

Careful interpretation of data is necessary…..

Contamination from:

- Town of Tiksi
- Regular Summer commute
- Local traffic through site
- Polyarka weather station



There are current snow sampling studies showing that:

(1) Arctic black carbon is decreasing

(2) Black carbon on the snow/ice is very hard to distinguish from naturally occurring background organic brown carbon

	2005-2007	1983-4 (Clarke & Noone)
Greenland		
Summit	2	2
Steffen's AWSs	1-10	
SGW Northeast	2	
Thule	4 (dust)	
Dye-2 melting surface	9	
Dye-2 melting subsurface	3	
Canada		
Hudson Bay	7	21
Eureka	3	
Resolute traverse	5	
Cambridge Bay	3	
Sturm traverse	8	
Alaska		
Barrow	8	15
McCall Glacier	7	

http://www.atmos.washington.edu/sootinsnow/