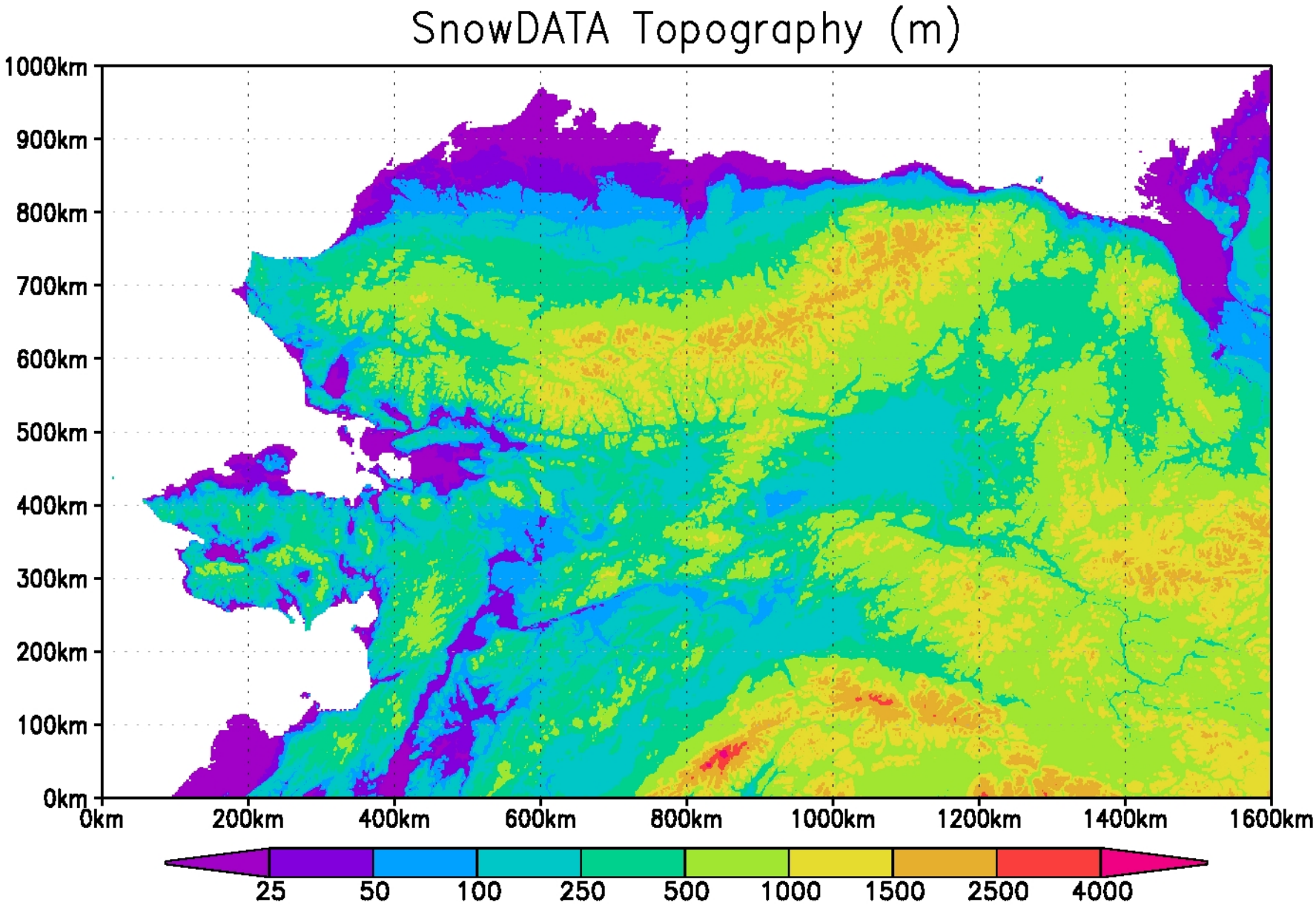
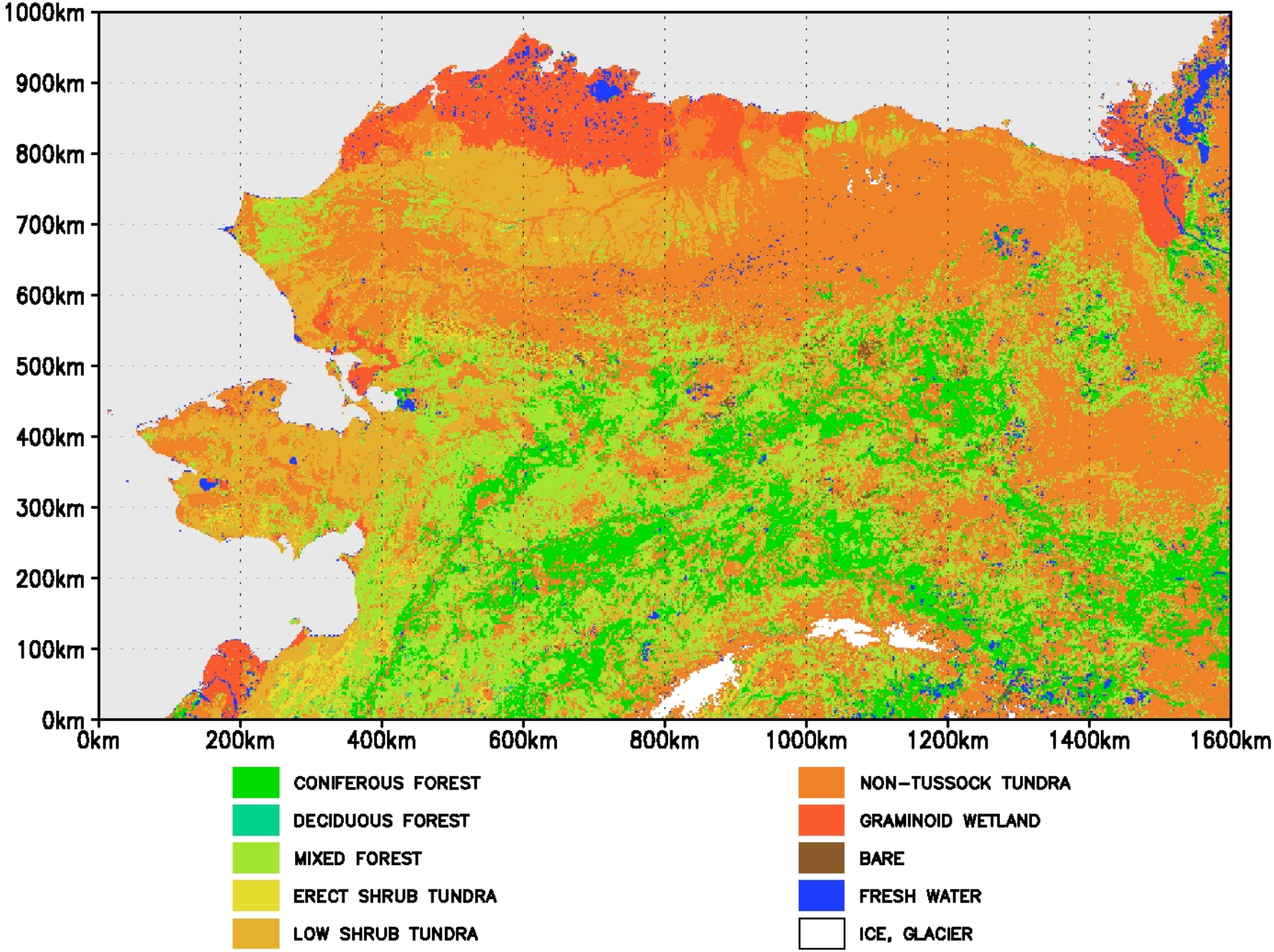
# SnowDATA Simulation Summary
## (Final Simulation)

(Photo by Kenneth G. Libbrecht and Patricia Rasmussen)

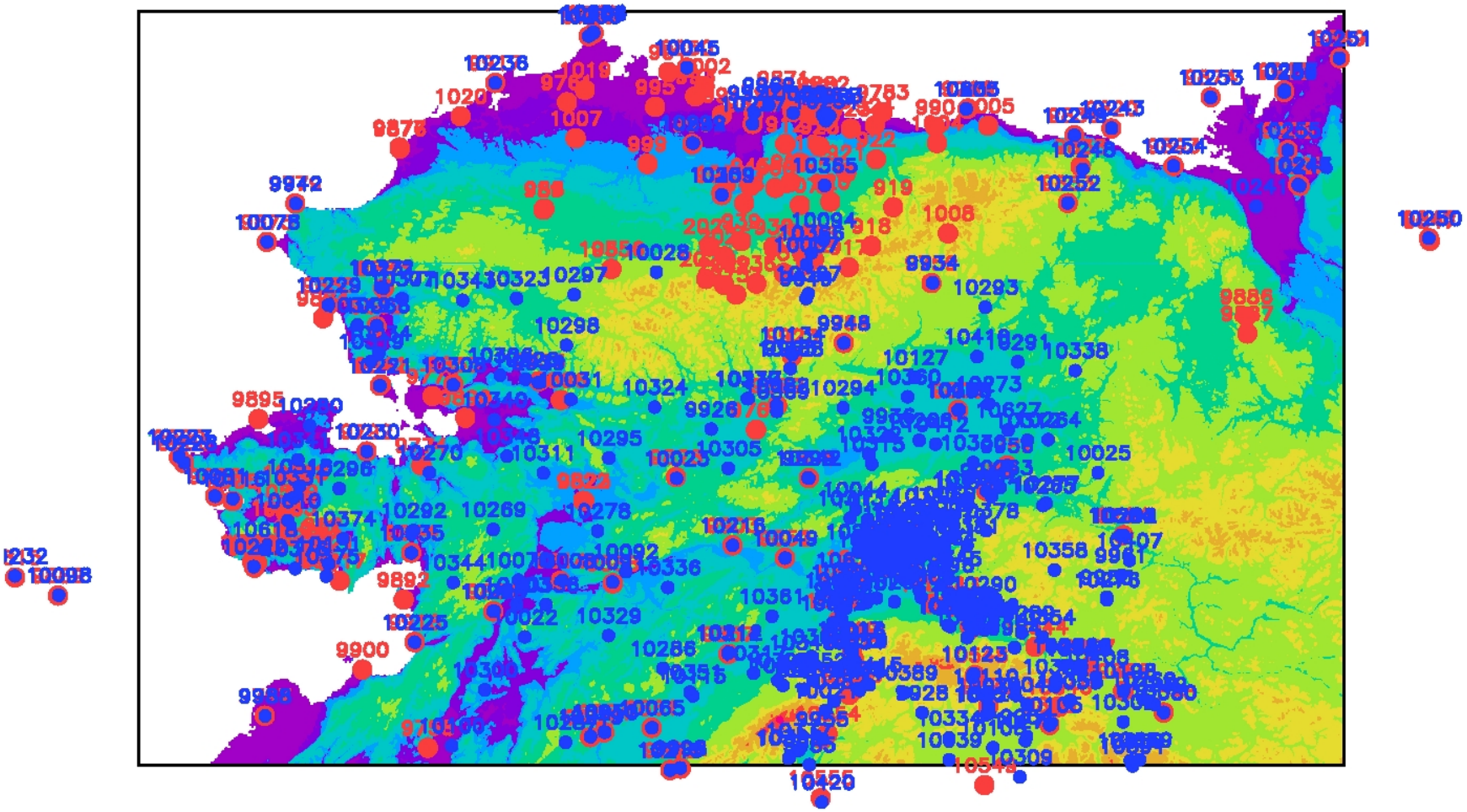
# SnowDATA Simulation Domain



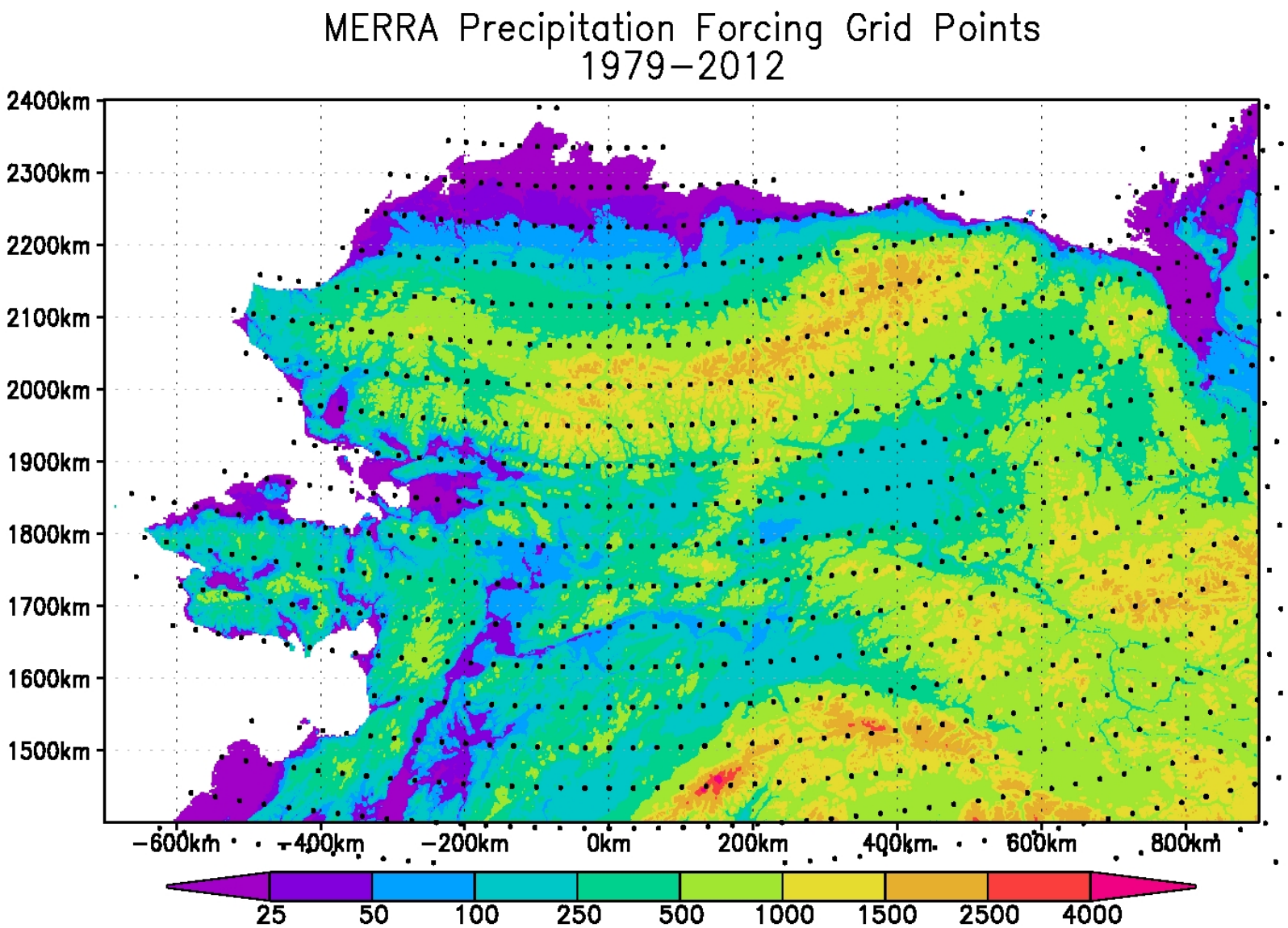
# SnowDATA Land Cover



SnowDATA Met Stations
(red = hourly, blue = daily)



Daily met station data were converted to hourly using various sub-models, then all hourly data were aggregated to 3-hourly for the model simulations. The met stations provided air temperature, relative humidity, and wind speed and direction inputs.




NASA 3-hourly MERRA atmospheric reanalysis data were used for the precipitation inputs (available on a 2/3° longitude by 1/2 ° latitude grid; 851 points).

# SnowDATA Simulation Overview:

dx = dy = 2 km

dt = 3 hours

nx = 801

ny = 501

Total number of grid cells = 401,301

Time period = 3Z 1 Sep 1979 – 0Z 1 Sep 2012

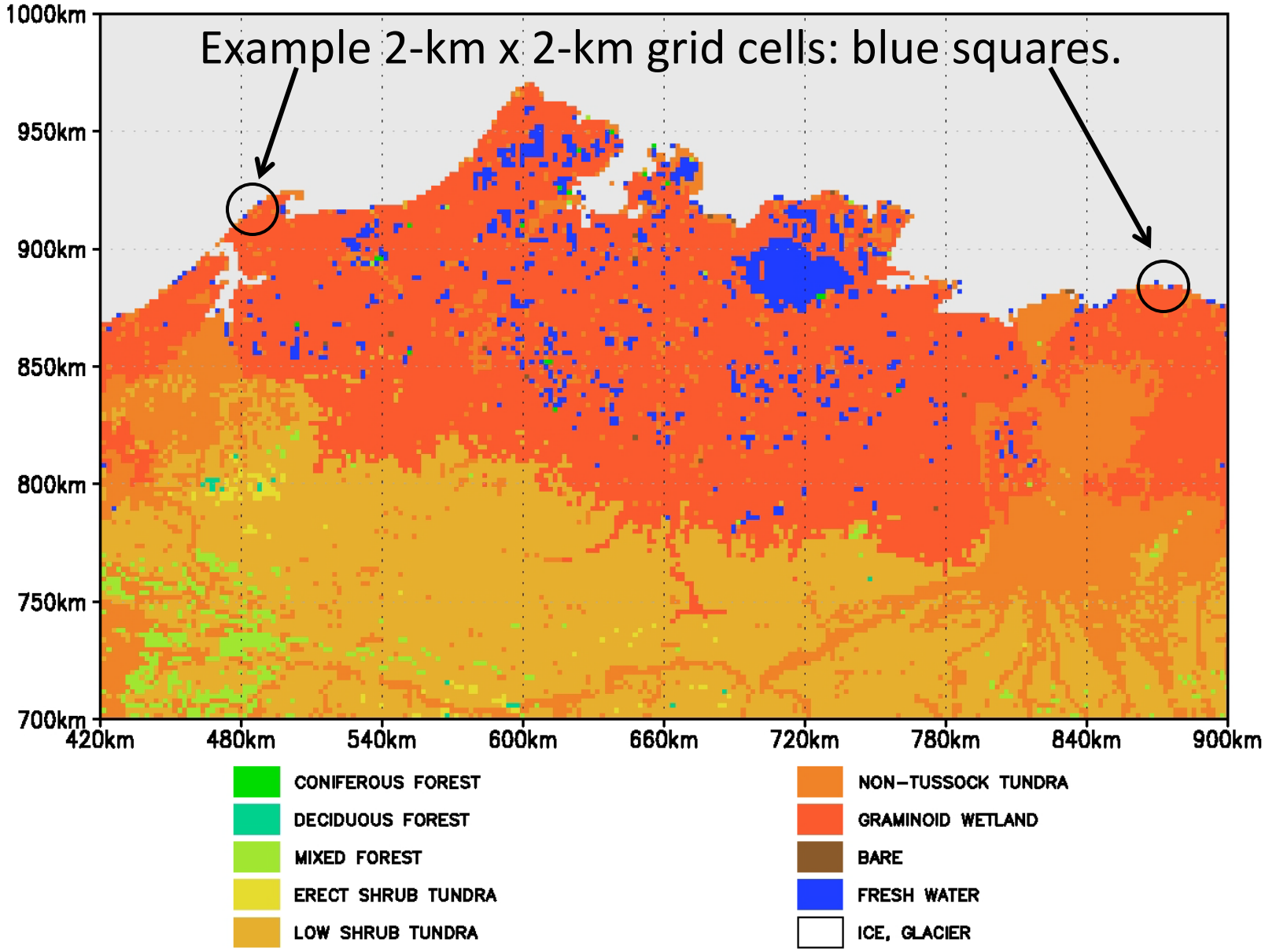
Total number of time steps = 96432

Total required CPU time = 11.1 days

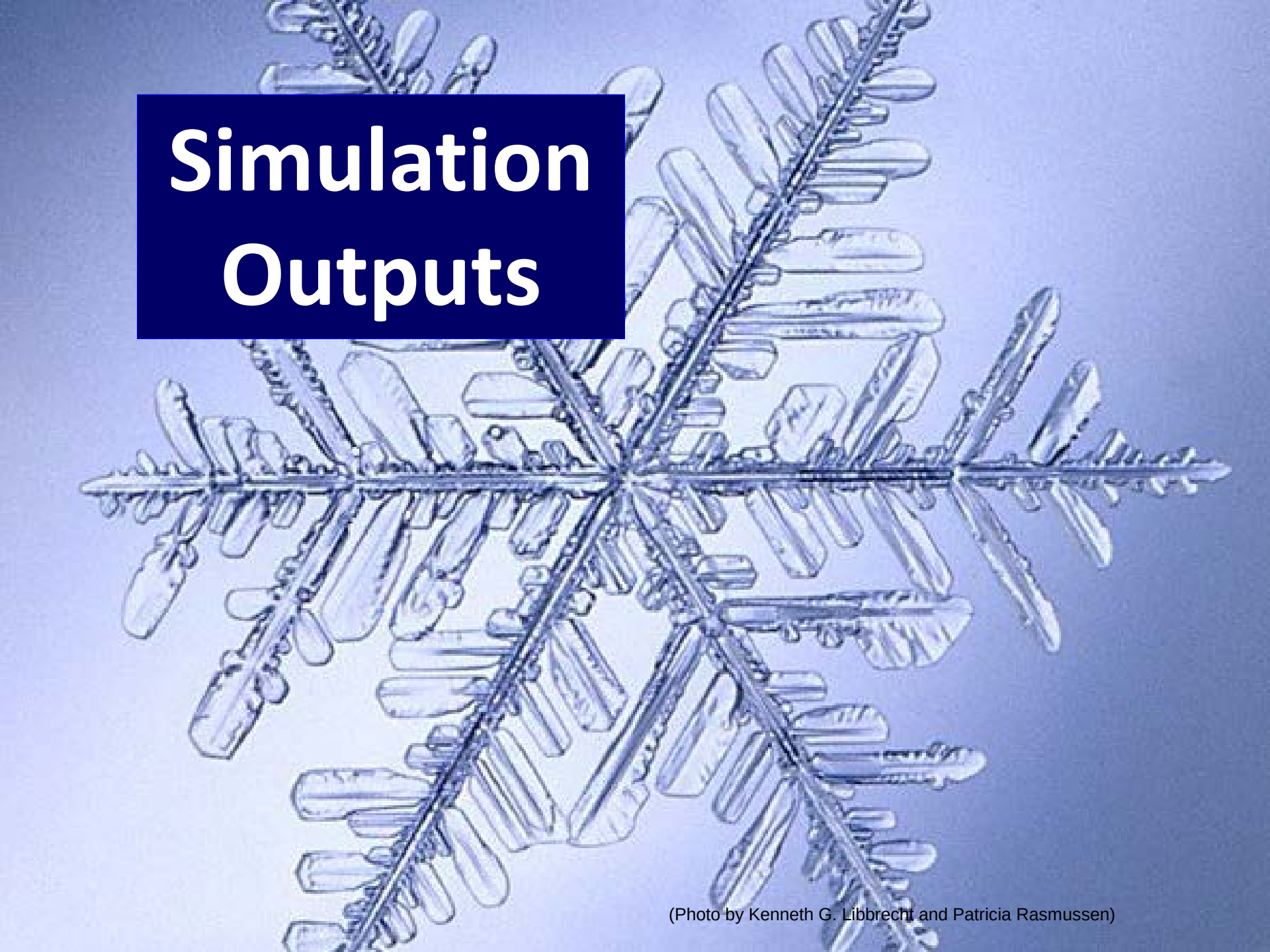
Total number of met stations = 528

Total data output (at daily interval) = 378 GB

# Illustration of SnowModel Grid Resolution



# Simulation Outputs



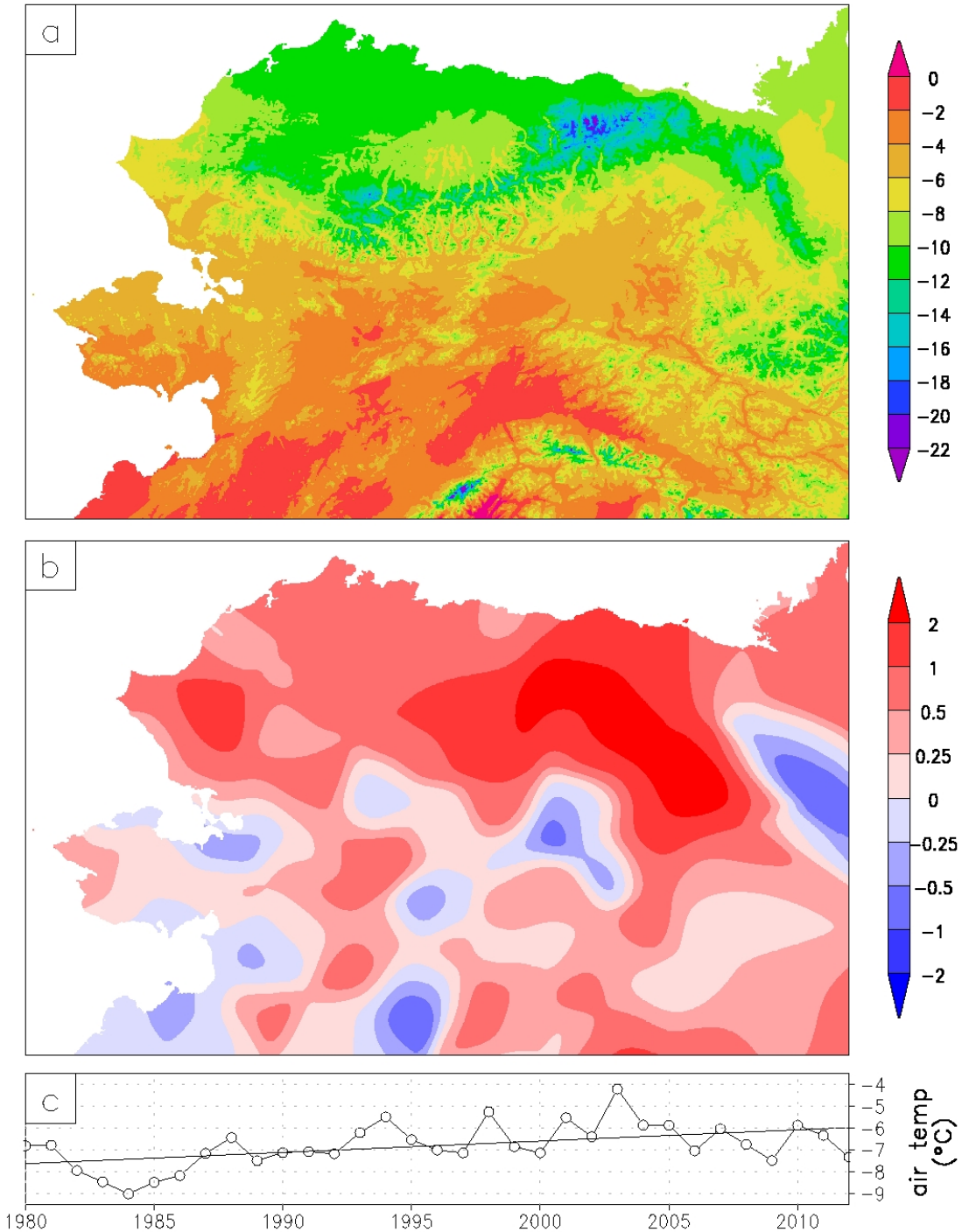
(Photo by Kenneth G. Libbrecht and Patricia Rasmussen)

# Air Temperature

(a) 33-year average, 10-m air temperature (°C).

(b) Trend in 10-m air temperature (°C decade$^{-1}$).

(c) Area- and yearly-averaged 10-m air temperature, for the simulation domain in (a) and (b).

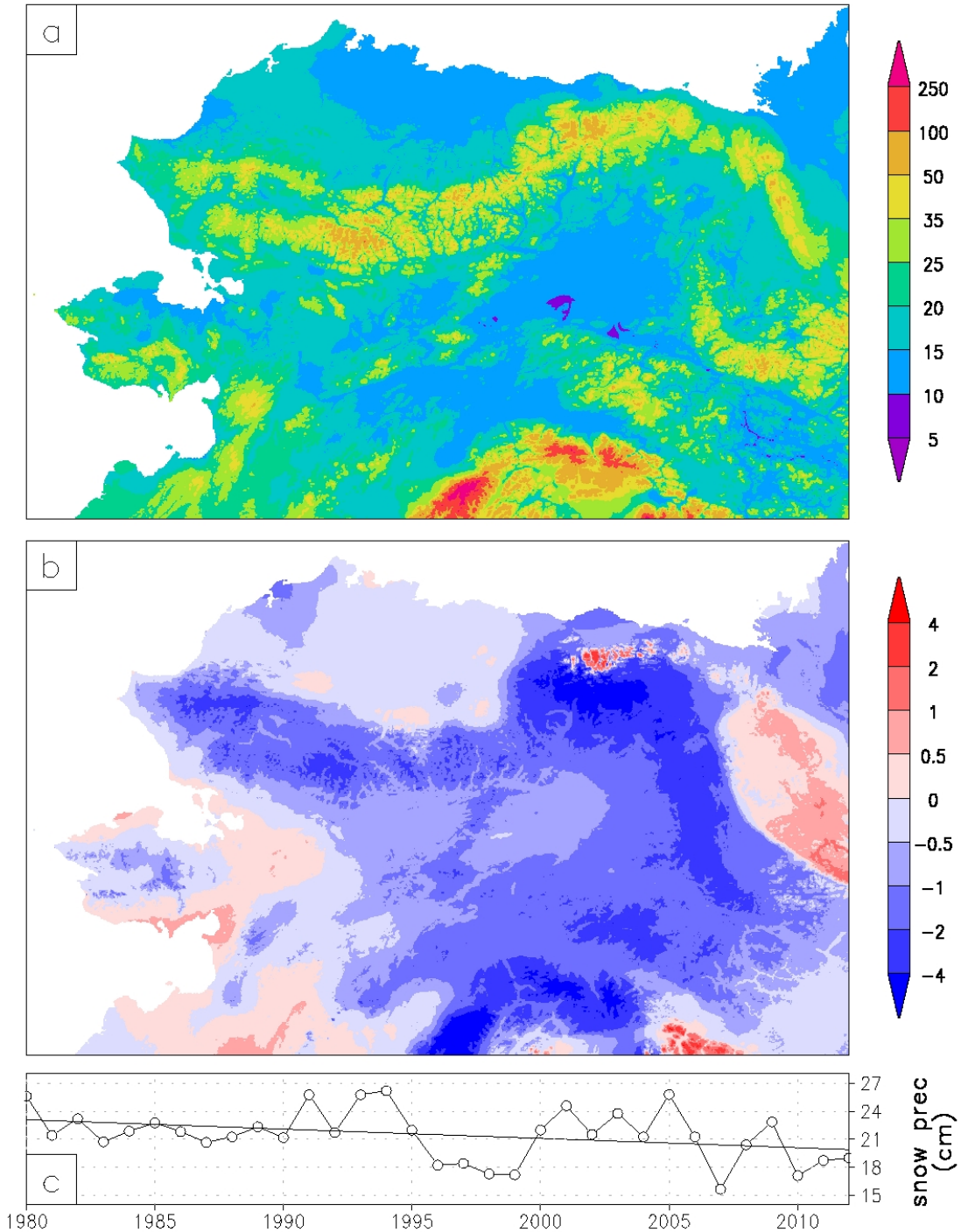


# Snow Precipitation

(a) 33-year average, total annual water-equivalent snow precipitation (cm).

(b) Trend in snow precipitation (cm decade$^{-1}$).

(c) Area- and yearly-averaged total annual snow precipitation, for the simulation domain in (a) and (b).

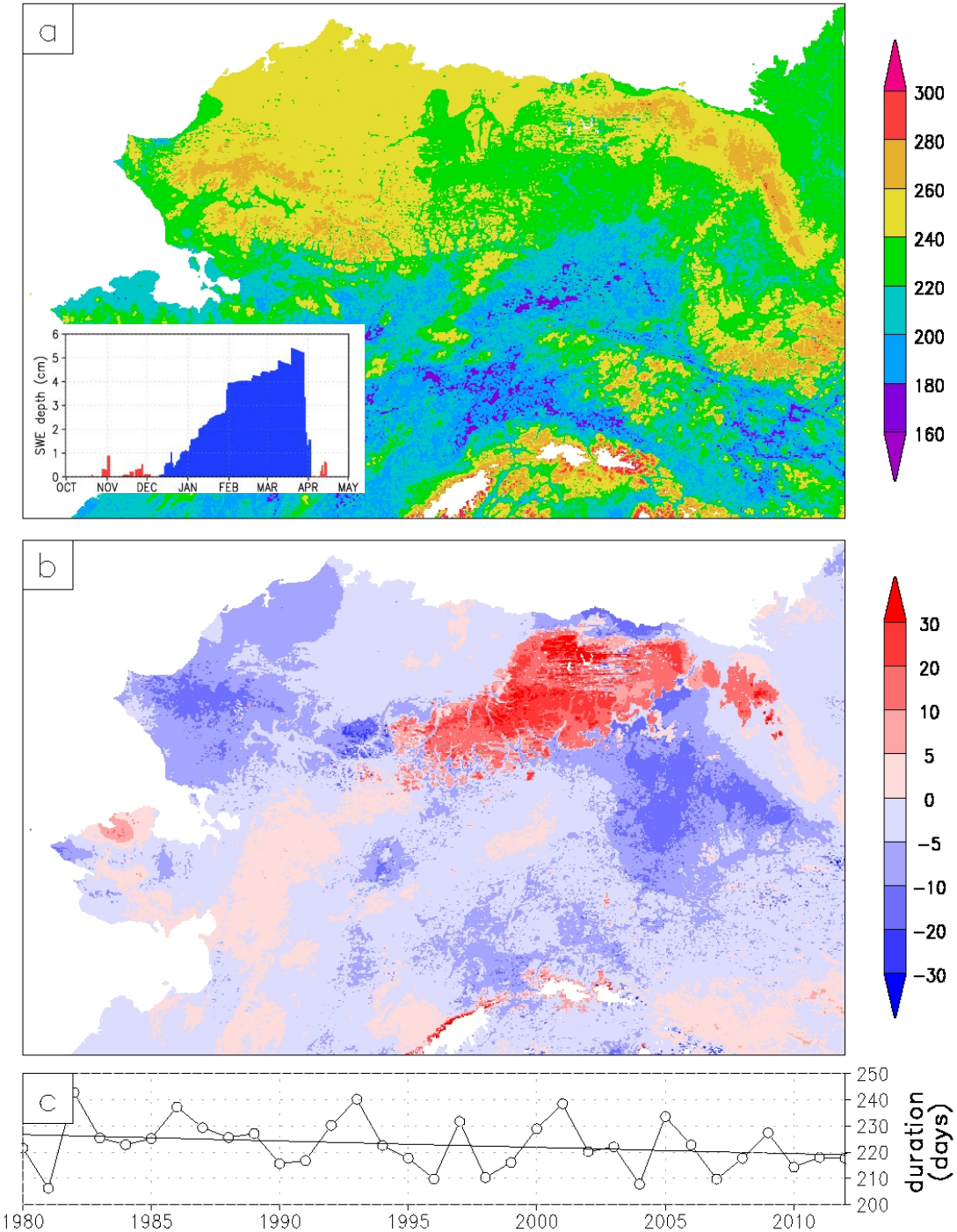


# Snow Duration

(a) 33-year average, snow duration during the core snow season (days).

(b) Trend in snow cover duration (days decade$^{-1}$).

(c) Area- and yearly-averaged snow duration, for the simulation domain in (a) and (b).



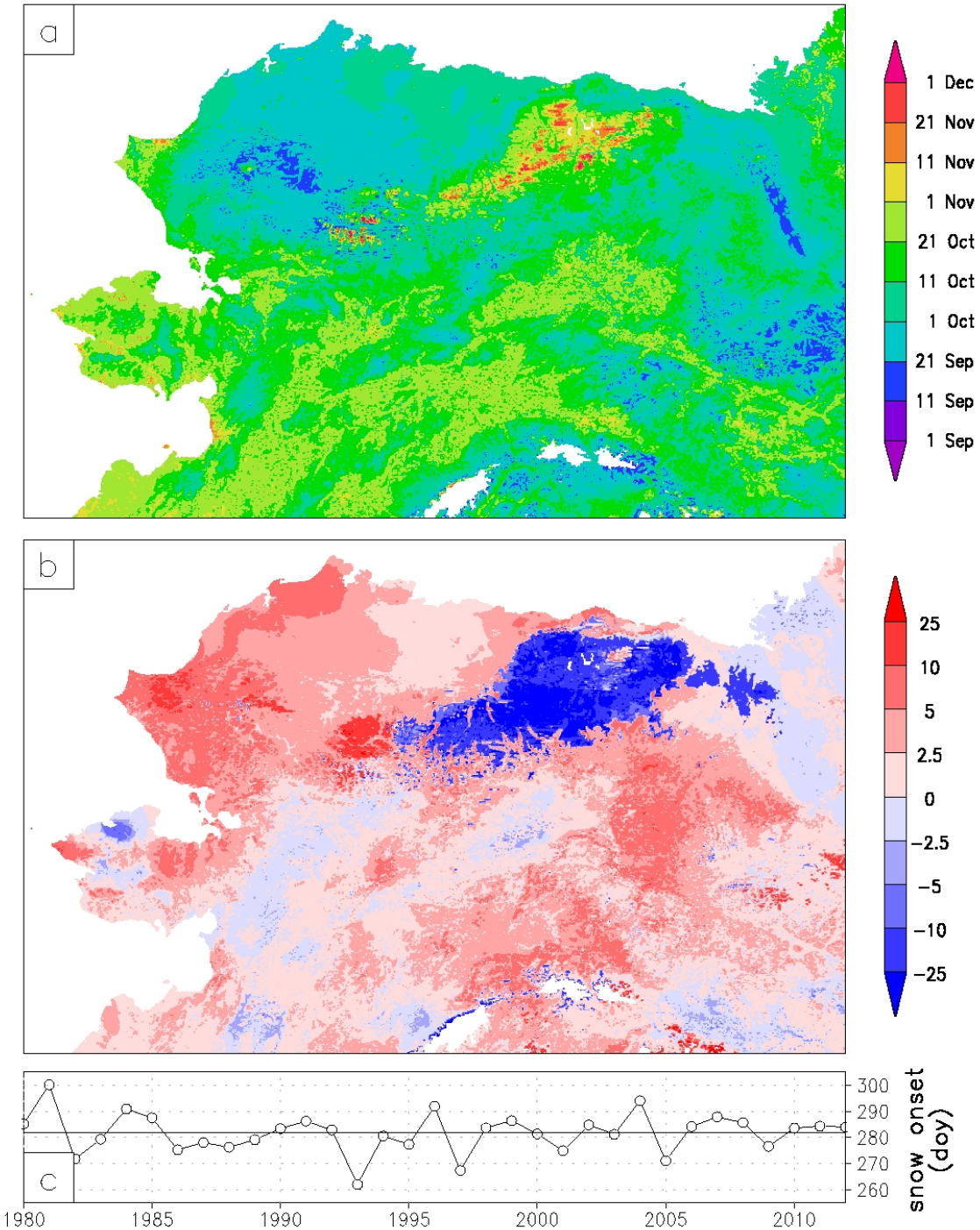

The core snow season is defined to be the longest period of continuous snow cover in each year [e.g., the blue shading in the (a) inset].

# Snow Onset Date

(a) 33-year average, snow onset date (date).

(b) Trend in snow onset date (days decade$^{-1}$).

(c) Area- and yearly-averaged snow onset date (day-of-year), for the simulation domain in (a) and (b).

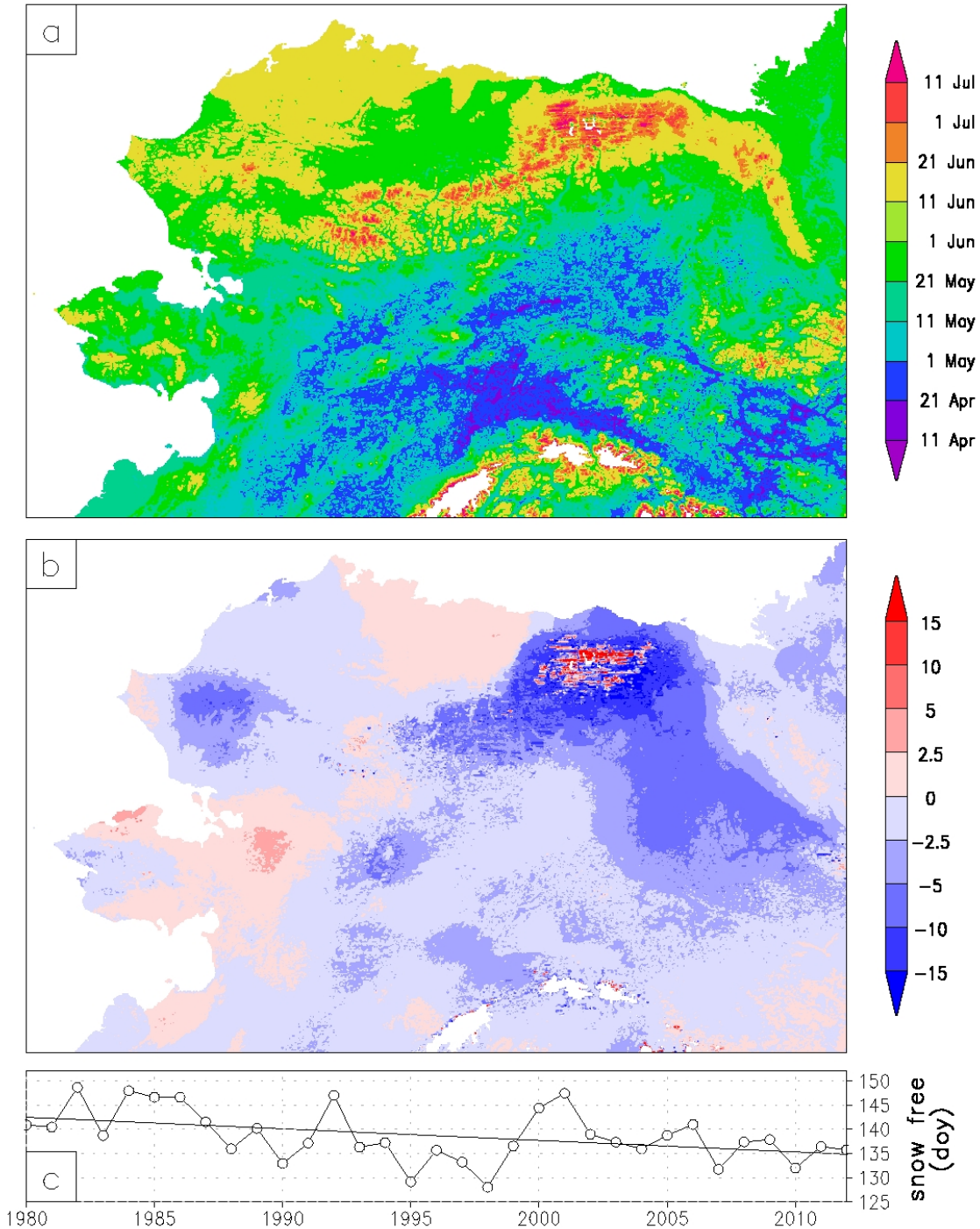


# Snow Free Date

(a) 33-year average, snow free date (date).

(b) Trend in snow free date (days decade$^{-1}$).

(c) Area- and yearly-averaged snow free date (day-of-year), for the simulation domain in (a) and (b).

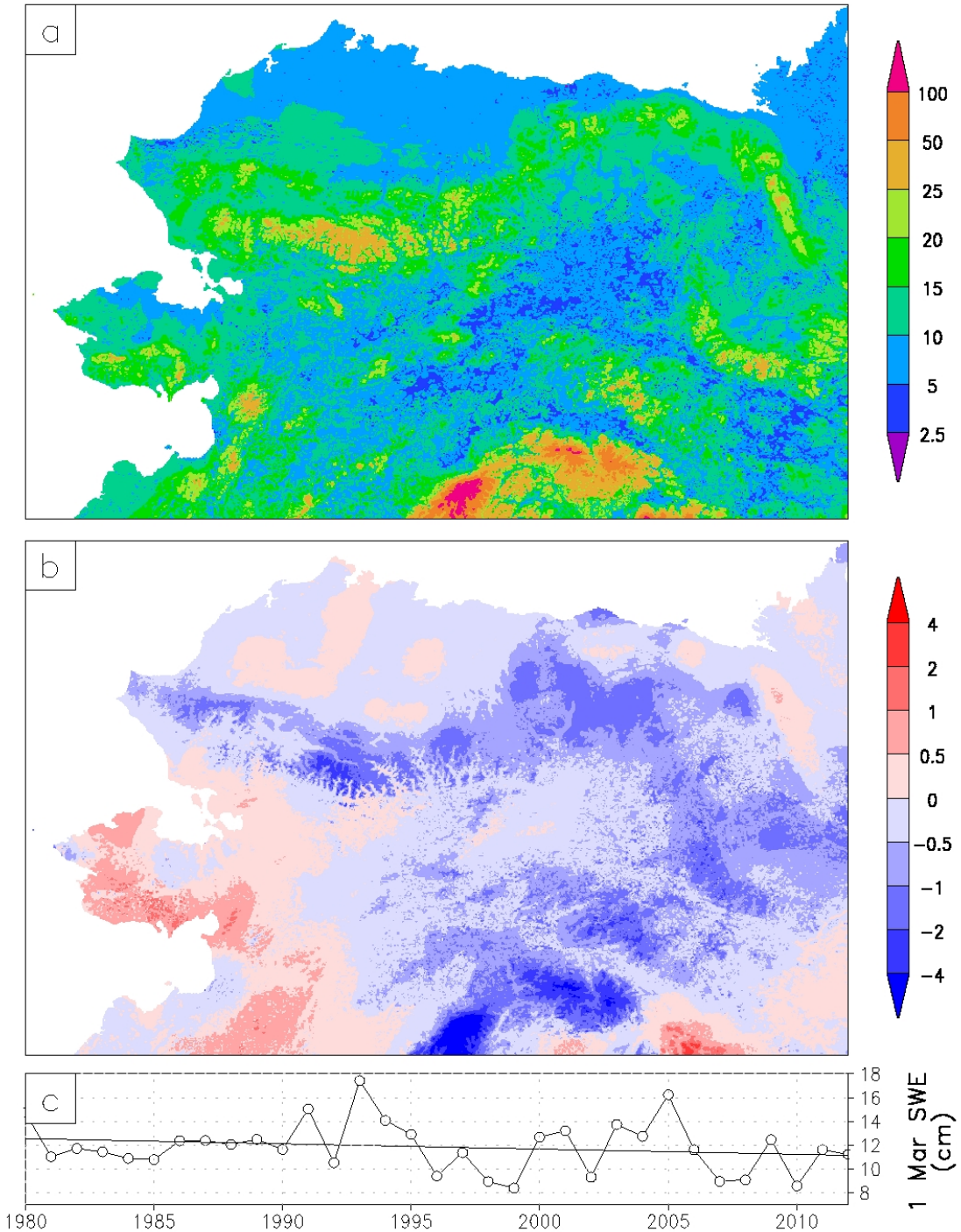


# Snow Water Equivalent Depth

(a) 33-year average, snow water equivalent (SWE) depth on 1 March (cm).

(b) Trend in 1 March SWE (m decade$^{-1}$).

(c) Area- and yearly-averaged 1 March SWE, for the simulation domain in (a) and (b).

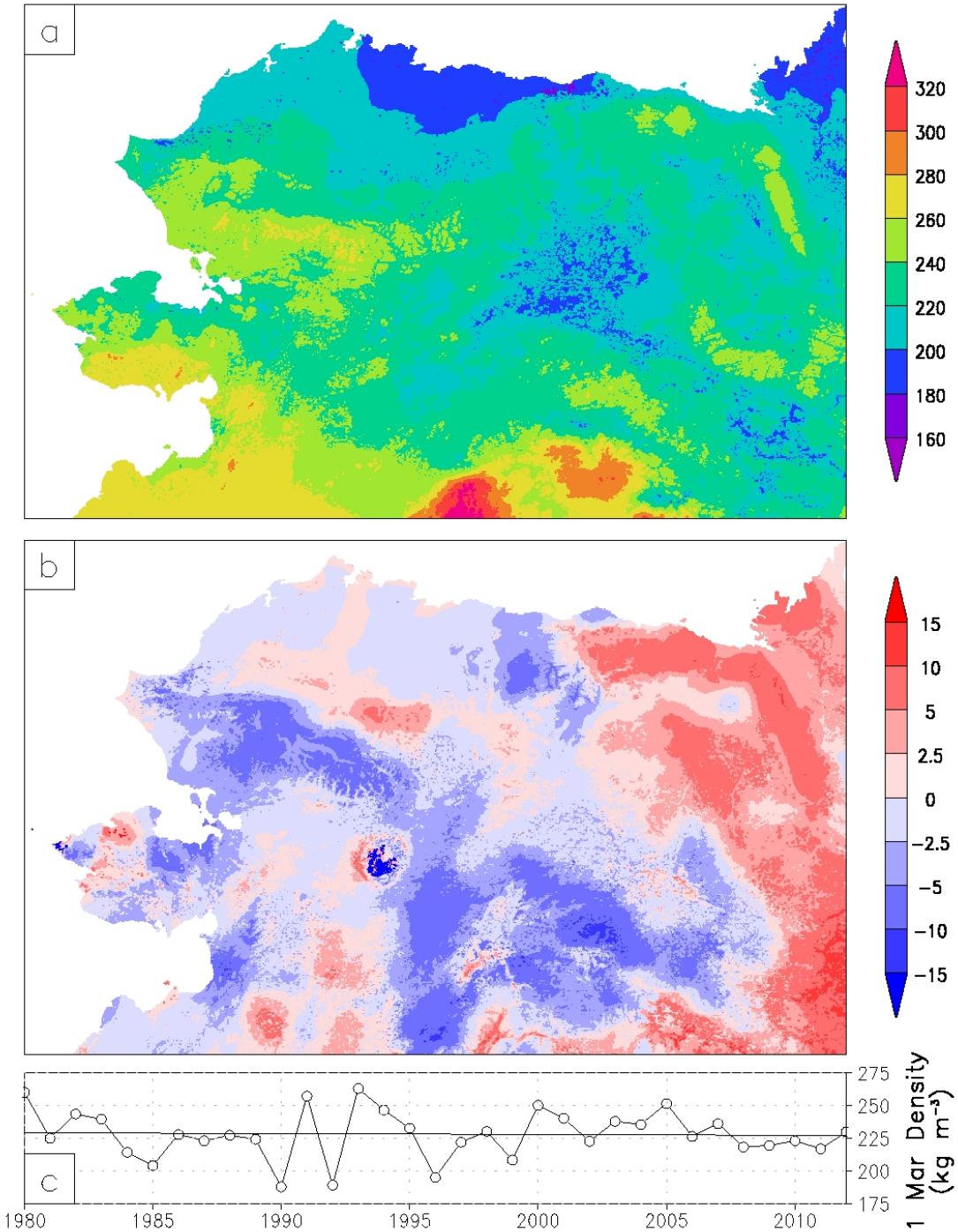


# Snow Density

(a) 33-year average, snow density on 1 March (kg/m$^3$).

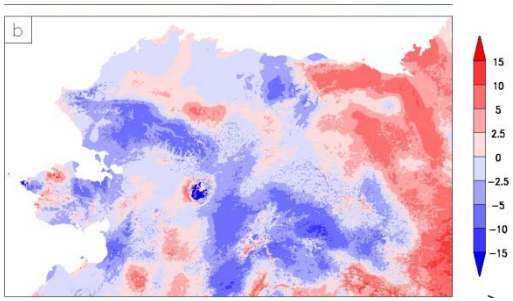
(b) Trend in 1 March snow density (kg/m$^3$ decade$^{-1}$).

(c) Area- and yearly-averaged 1 March snow density (kg/m$^3$), for the simulation domain in (a) and (b).

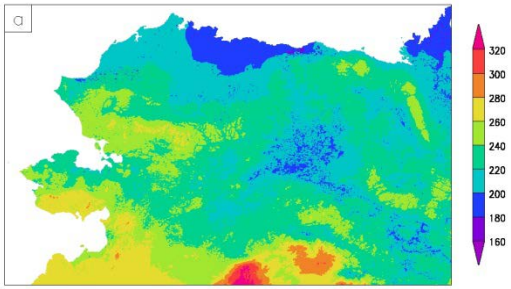


# Snow Density Comments

Some snow density trends in the simulation domain are masked out (the white areas on land) because if there is no snow, there is no density, and some of these grid cells don't have snow in them on 1 March.



The snow densities in non-forested areas are lower than in the natural system because the blowing snow model is not running (because of coarse grid increment; snow doesn't really blow from one grid cell to the next at this scale).

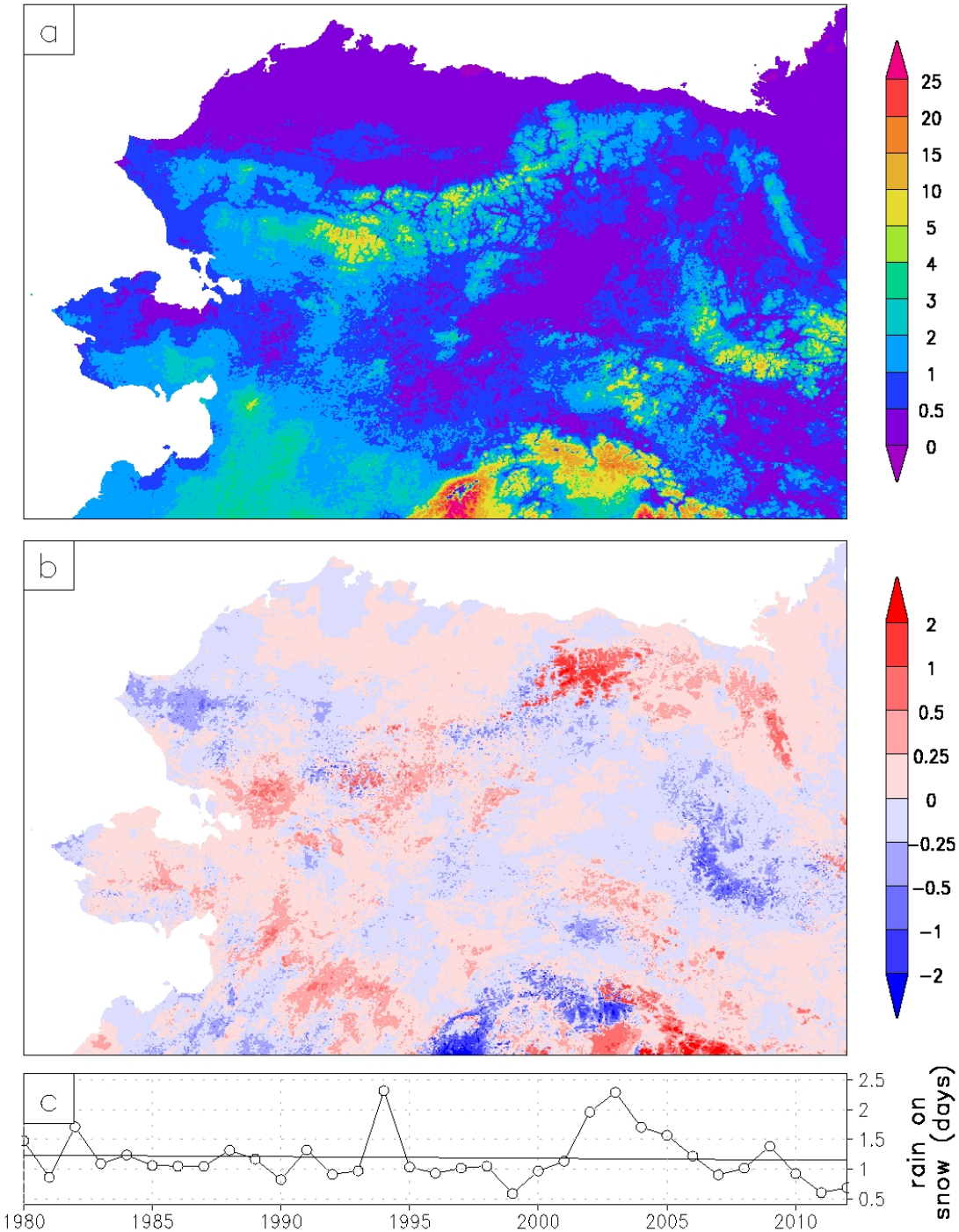


# Rain On Snow

(a) 33-year average, rain on snow (ROS) events (days).

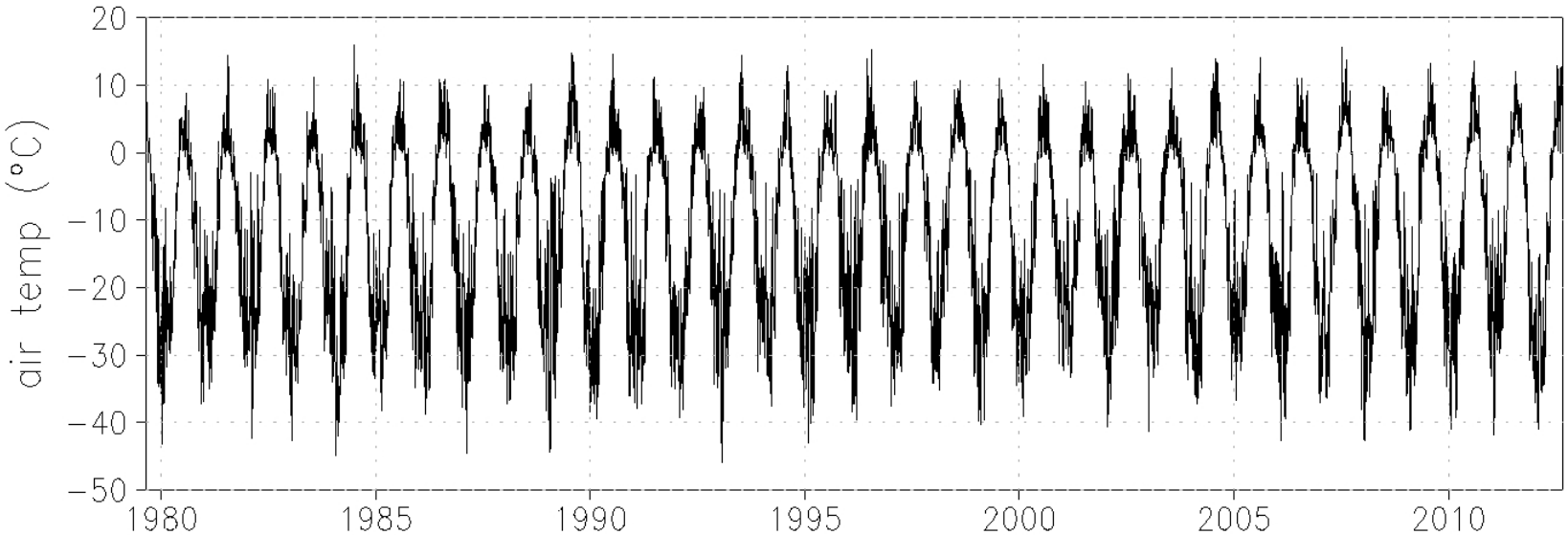
(b) Trend in ROS events (days decade$^{-1}$).

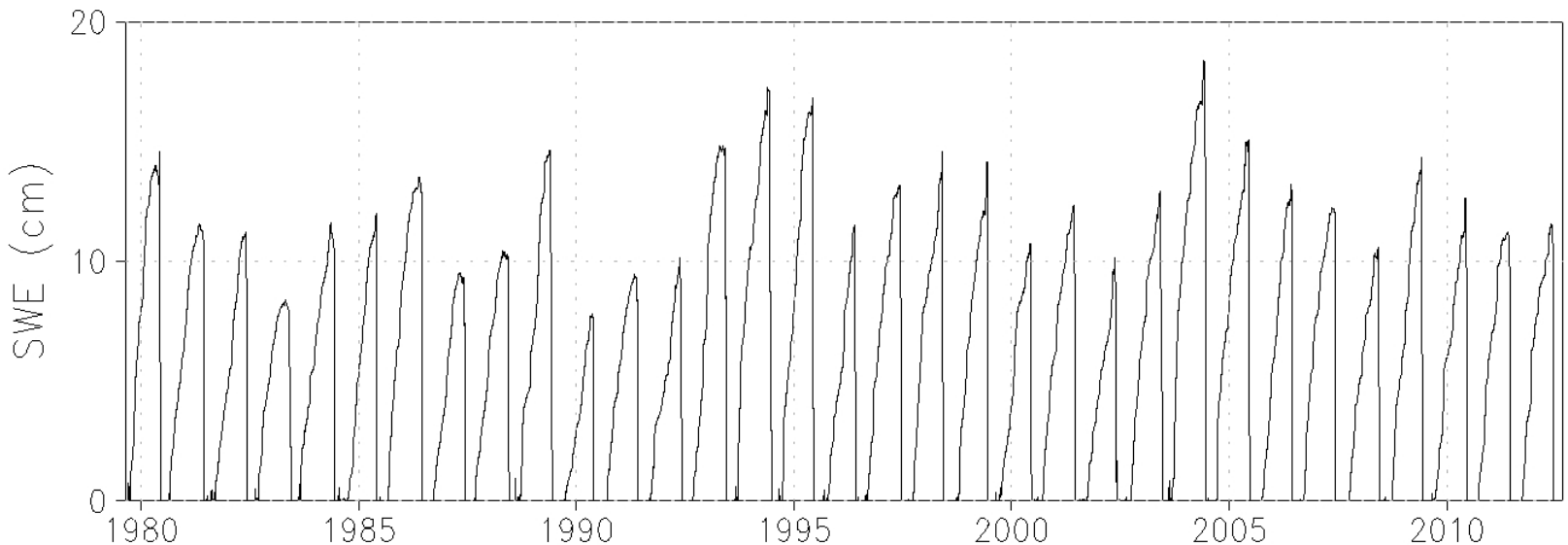
(c) Area- and yearly-averaged ROS events (days), for the simulation domain in (a) and (b).



# Example SnowModel Time Series Output

[this from (i,j) grid cell coordinate (300,484), near Barrow; daily outputs]



# Issues to Think About for Future Simulations

(Photo by Kenneth G. Libbrecht and Patricia Rasmussen)

# Issues to Consider:

Snow density values are too low in windy areas because the blowing snow model is not running (because of coarse grid increment). This could be corrected with a subgrid parameterization.

Consider adding hardness and other value-added and ecologically relevant variables to the next simulation.

Other ideas?

(Photo by Kenneth G. Libbrecht and Patricia Rasmussen)