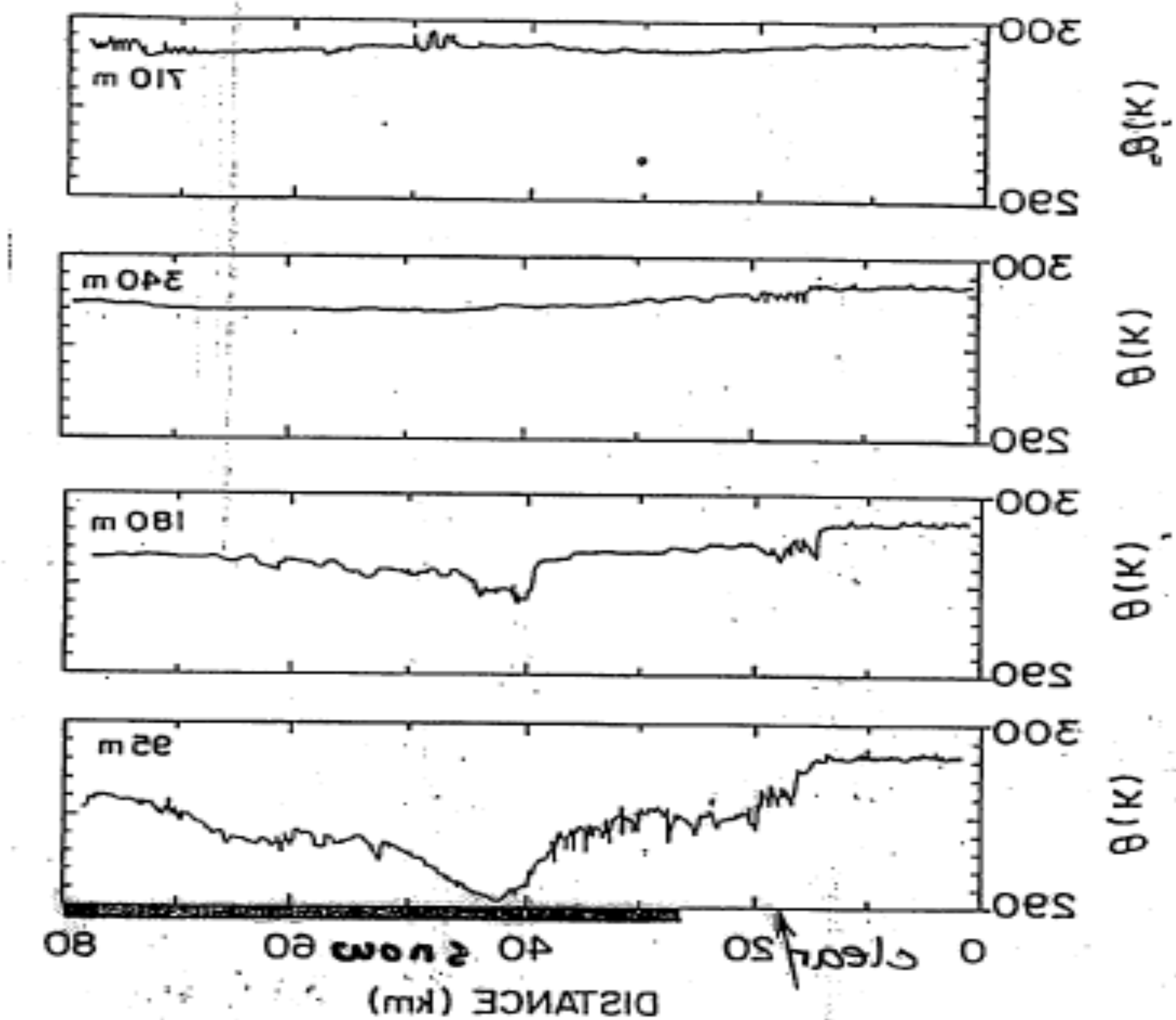
Snow breezes

- Often there is a fairly well-defined boundary between snow-covered and snow-free regions. Over the snow-covered region, heating of the air is restricted for two main reasons:

(1) the albedo of the snow usually will be greater than that of the land and vegetation, so that less sunlight is absorbed at the surface. Notice however that snow albedo decreases with snow age, so that "old" or dirty snow may have an albedo not too much greater than that of the snow-free surface

(2) the frozen snow surface must have a temperature < 273 K. As long as the air temperature is > 273 K, the surface sensible heat flux is downward.

- Then we will tend to have a shallower or nonexistent mixed layer over the snow, whereas the mixed layer may grow relatively deeper and warmer over the snow-free ground. The result is a pressure gradient force directed from the snow-covered ground to snow-free region


710 m
340 m
180 m
95 m
θ(K)
300
290
80
60
snow
40
20
clear
0
DISTANCE (km)

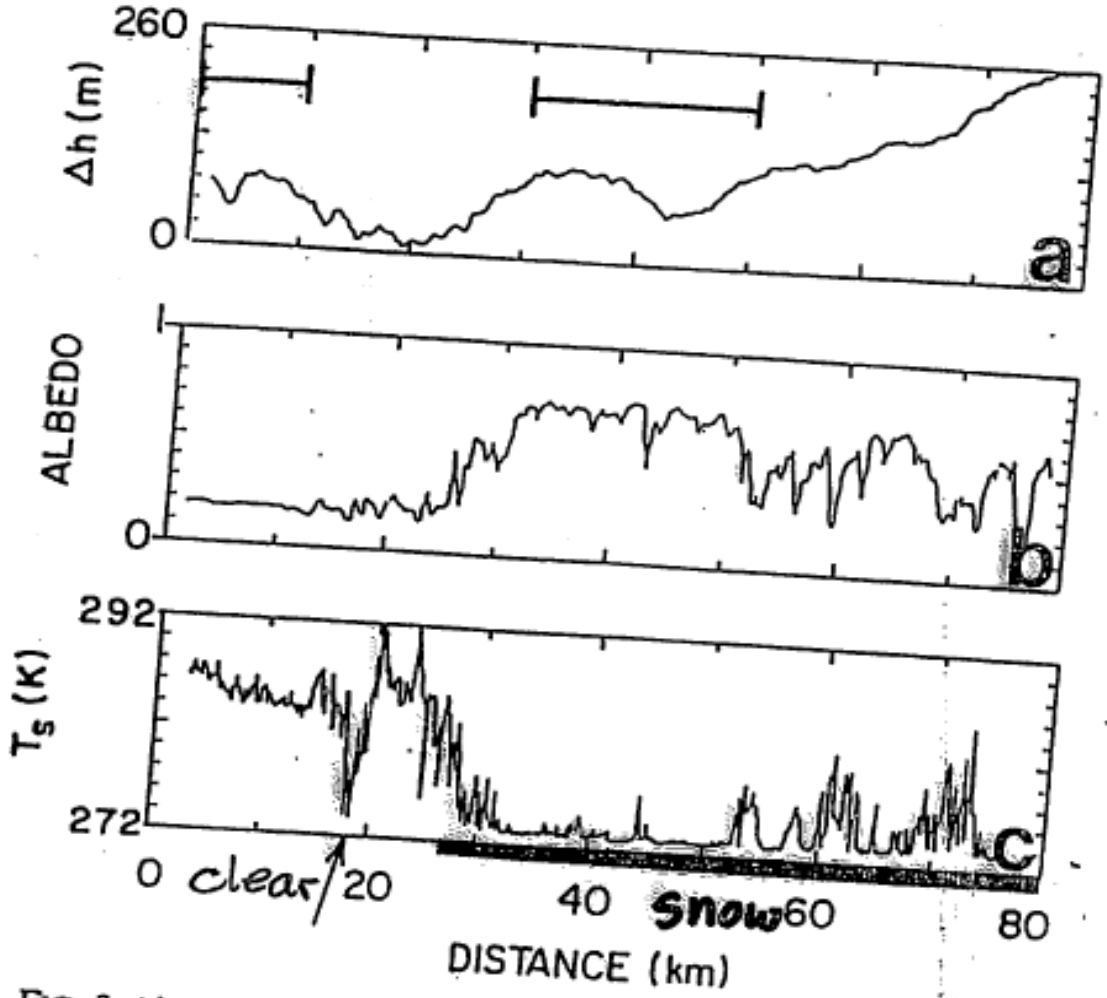


FIG. 3. Aircraft observations of: (a) terrain elevation relative change, Δh; the horizontal bars indicate the locations of the vertical profile measurements presented later; (b) surface albedo; and (c) surface temperature, T_s, for Flight No. 1 based on flight altitude data measured at 95 m from 1248:48–1313:24 MST. The dark line indicates the snow-covered portion of the transect. The arrow indicates the location of the frozen Arkansas River. See Figs. 2a,b for flight transect.

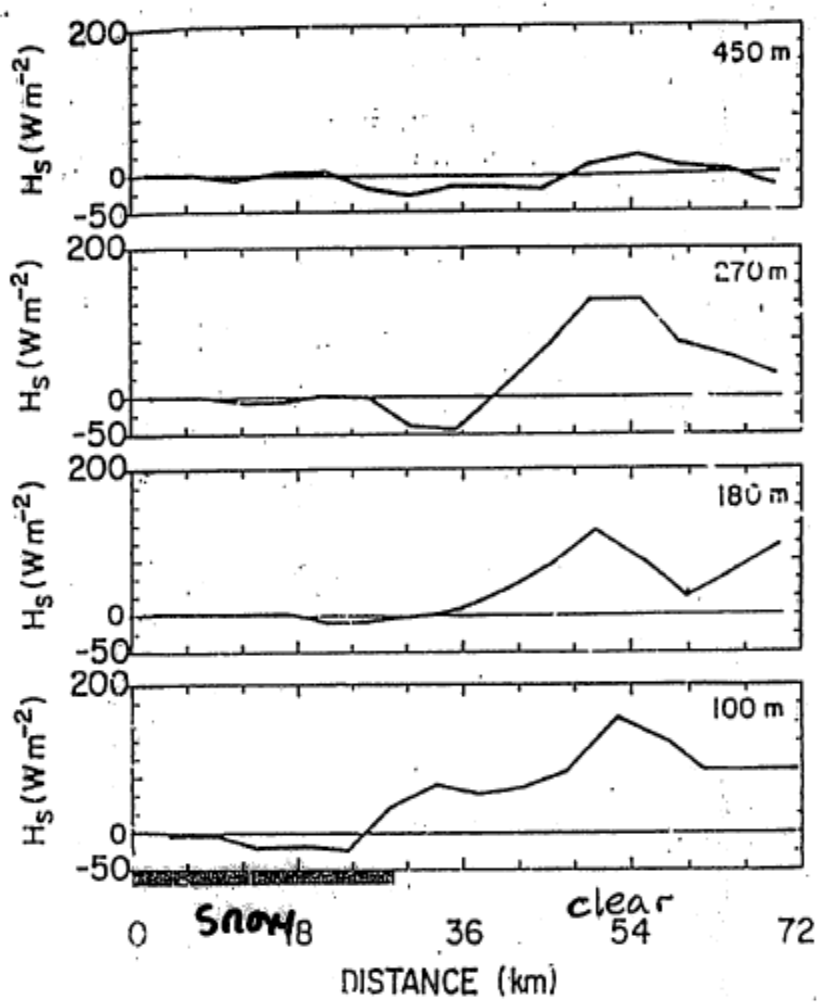


FIG. 18. Sensible heat fluxes measured at various altitudes, Flight No. 3: 100-m data measured from 1314:00–1327:05 CST; 180-m data measured from 1329:04–1342:10; 270-m data measured from 1345:08–1359:15; 450-m data measured from 1401:25–1414:35 CST. The dark line indicates the snow-covered portion of transect.

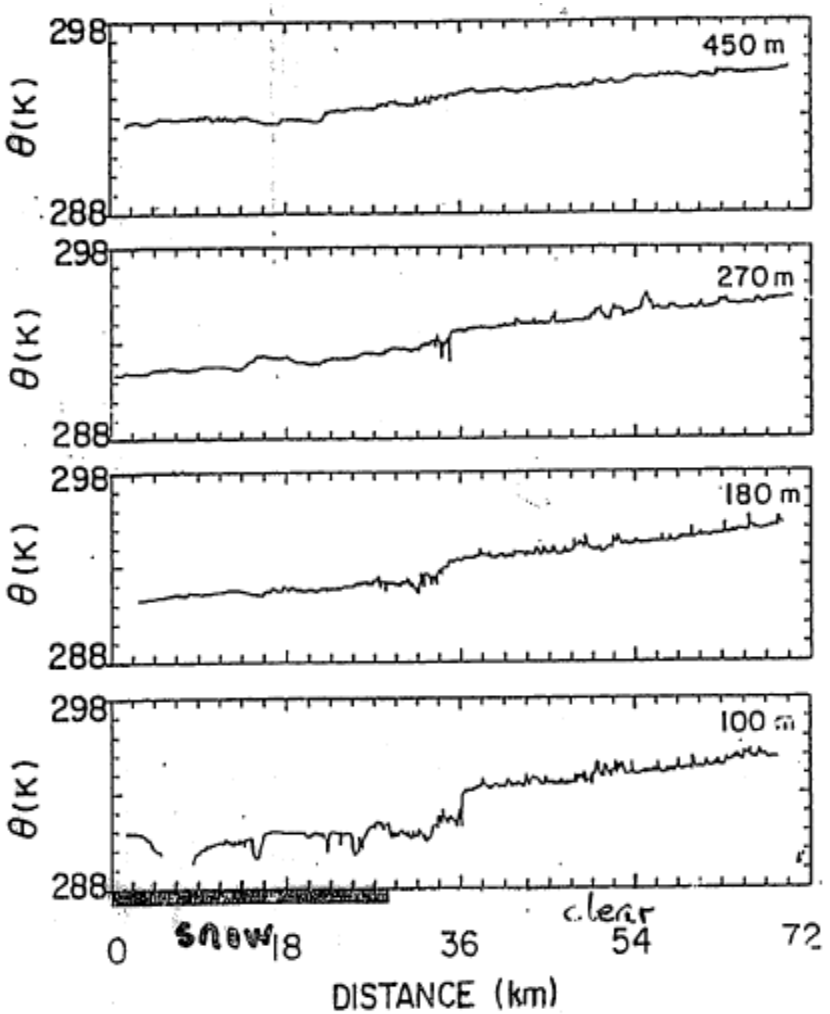


FIG. 19. Potential temperature, θ, for the transect altitudes indicated in Fig. 18.

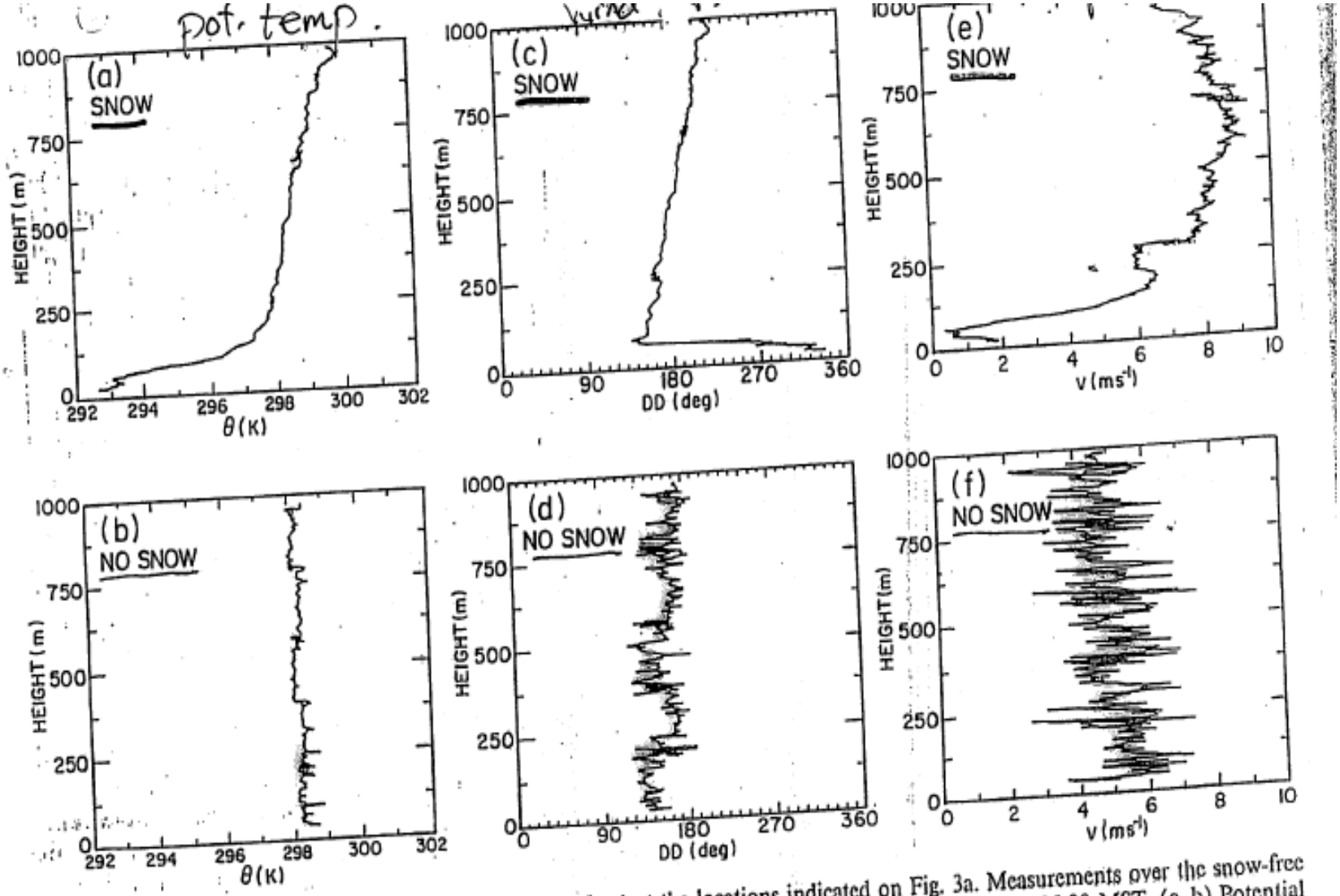


FIG. 4. Vertical profiles of several variables from Flight No. 1 at the locations indicated on Fig. 3a. Measurements over the snow-free ground were made from 1230:00–1257:10 MST; measurements over the snow were made from 1416:55–1435:00 MST. (a–b) Potential temperature, θ; (c–d) wind direction, DD; and (e–f) wind speed, V.

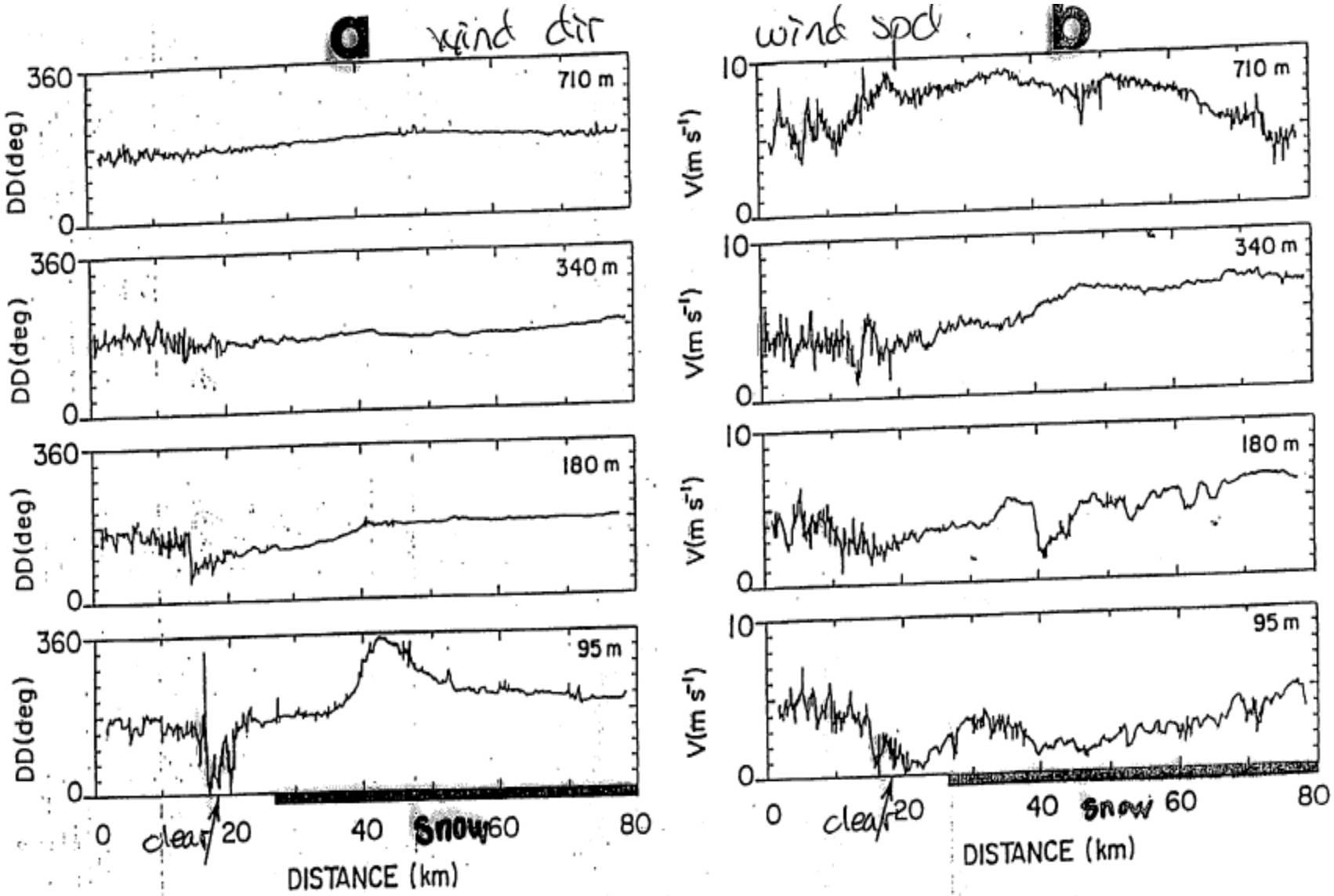
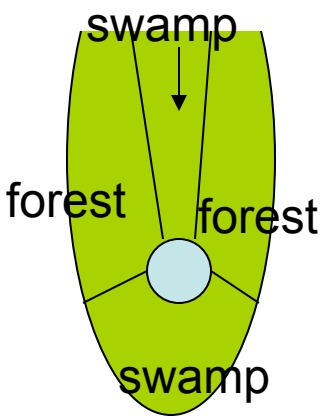


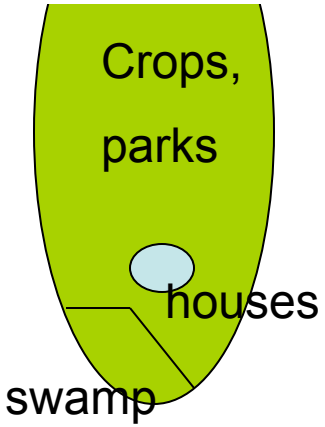
FIG. 6. The same as Fig. 5, except for (a) wind direction, *DD*; and (b) wind speed, *V*.

Consider Pielke et al. paper on Florida landscape changes in recent years

Old Florida



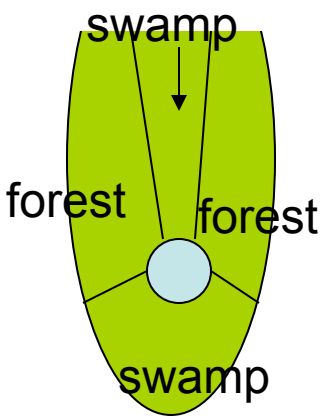
New Florida



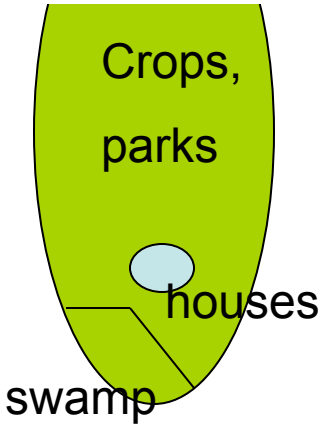
What would be the impact of the land changes on Tmax, Tmin, Td, precip?

Higher Bowen ratio now means lower Td, bigger Temp swing, Tmax is higher, Tmin is lower. What about Precip?

Old Florida



New Florida



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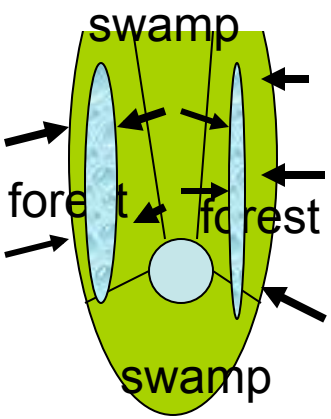

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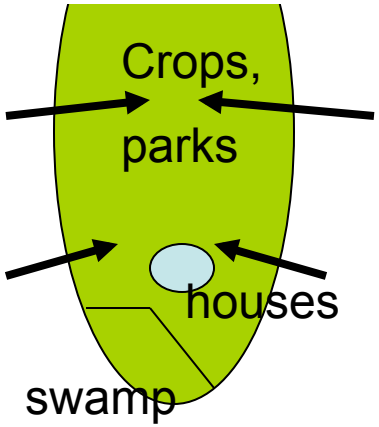

For next class…

- Look over the next lecture notes
- We will begin class with another group activity