ESRL Theme Presentation on the Weather-Climate Connection

Synoptic Impacts on Arctic Pack Ice Surface Energy Budgets
or
Linking Synoptic Events with Variability of Arctic Sea Ice Thickness

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"Our [satellite] data reveal a high-frequency interannual variability in mean Arctic ice thickness that is dominated by changes in the amount of summer melt, rather than by changes in circulation. Our results suggest that a continued increase in melt season length would lead to further thinning of Arctic sea ice." (Laxon et al 2003)

- what determines length of summer melt over Arctic sea ice?
- what causes the start and end of the summer melt?
- how much can the length of the melt season change?

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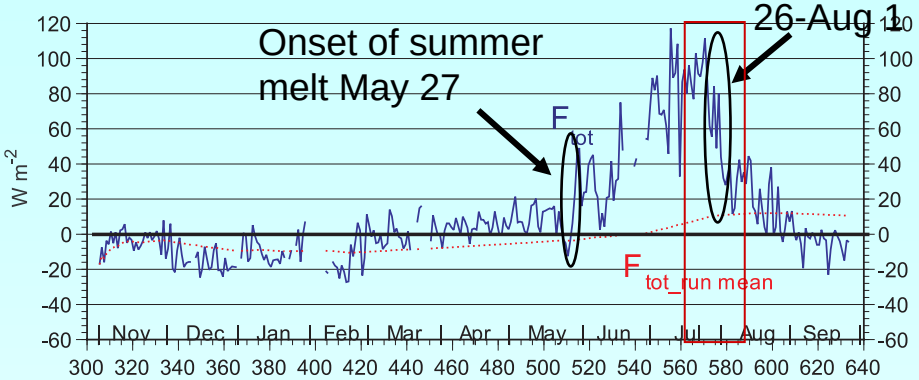
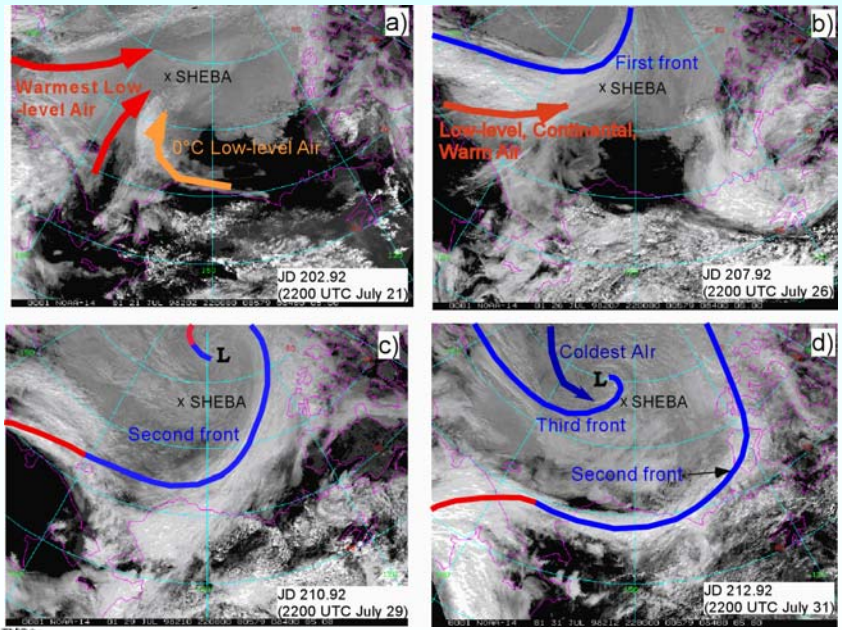
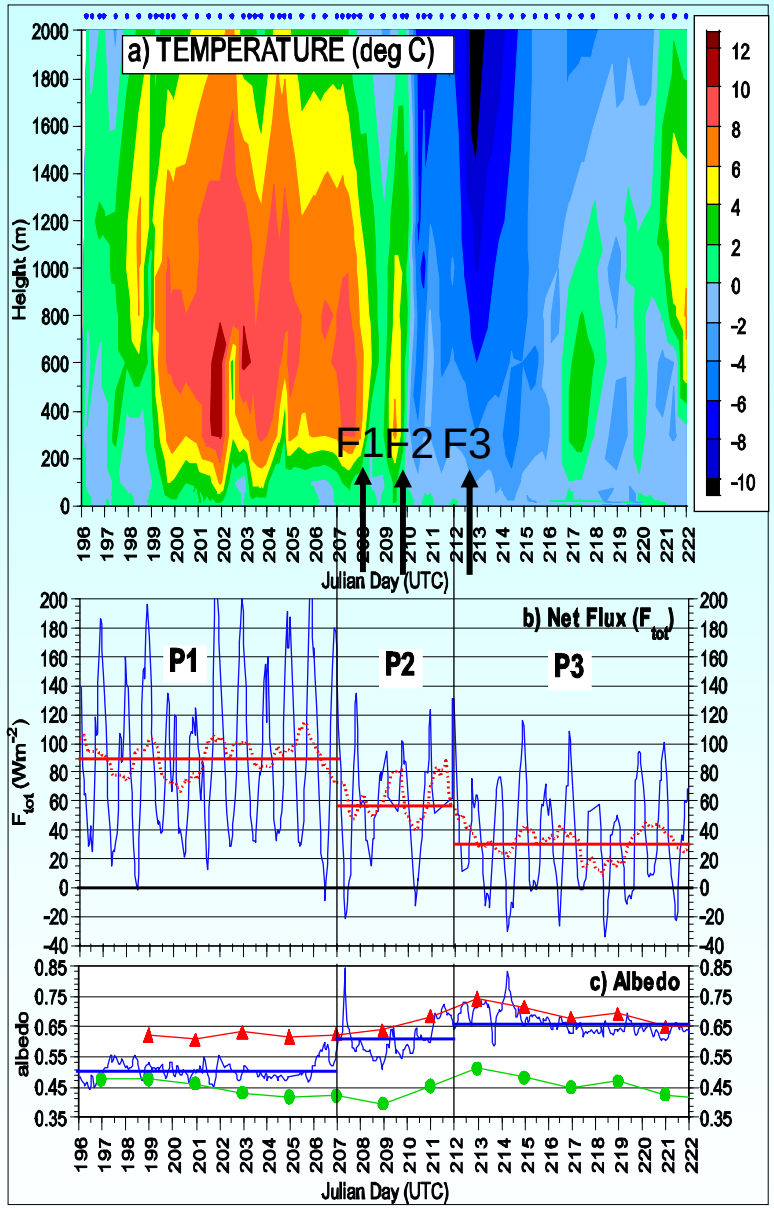
SHEBA Daily Net Surface Energy Flux

$$F_{tot} = Q_{si}(1-\alpha) + Q_{li} - Q_{lo} - H_s - H_l + C$$

Rapid decline in surface melt July 26-Aug 1







- All terms but C contributed 10% or more to the 58 W m^{-2} decrease in F_{tot}
- Over 70% of decrease due to processes related to synoptic disturbance, rather than seasonal cycle of Q_{si}.

End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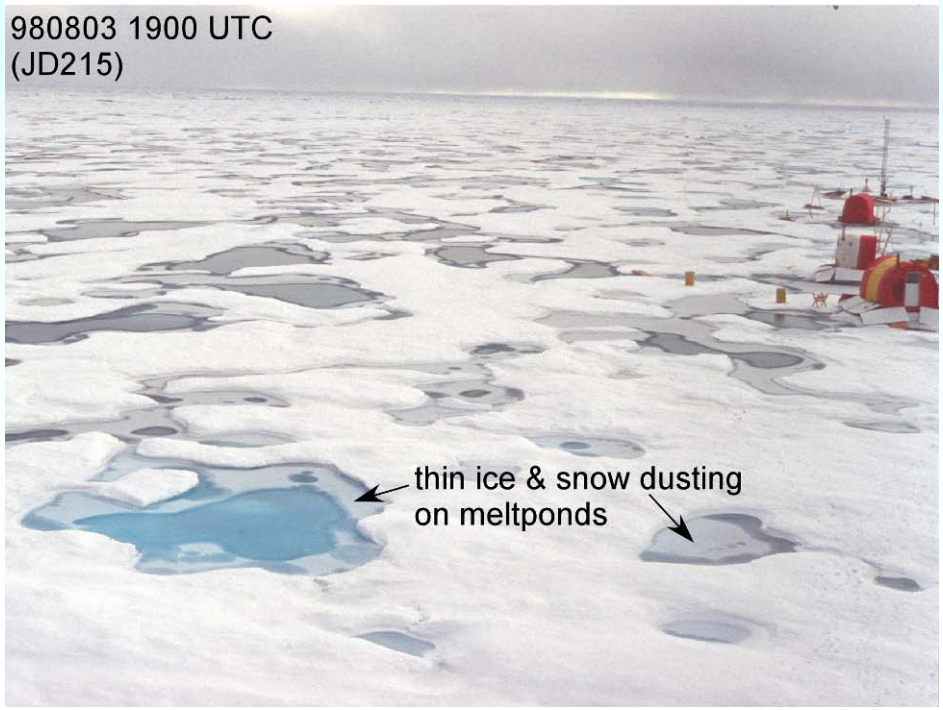
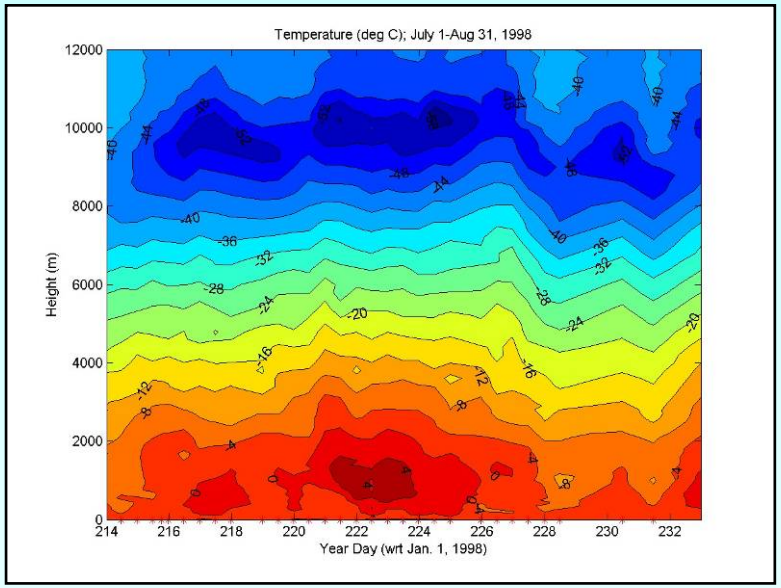
U.S. DEPARTMENT OF COMMERCE

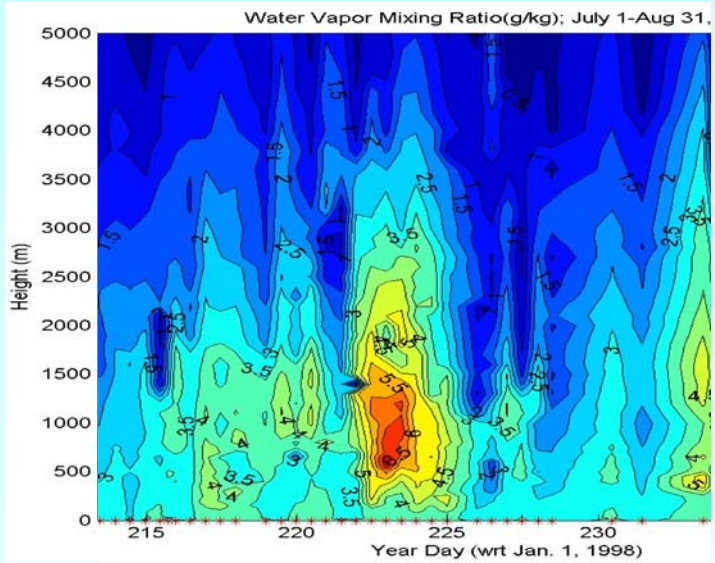

980726 0300 UTC
(JD207)


980803 1900 UTC
(JD215)
thin ice & snow dusting
on meltponds

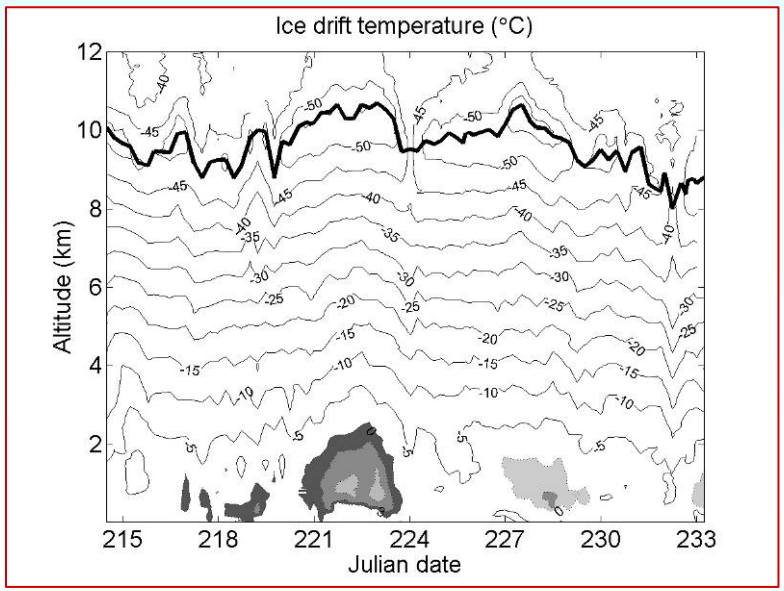
Comparison of SHEBA & AOE-2001 Aug 2-21 Soundings

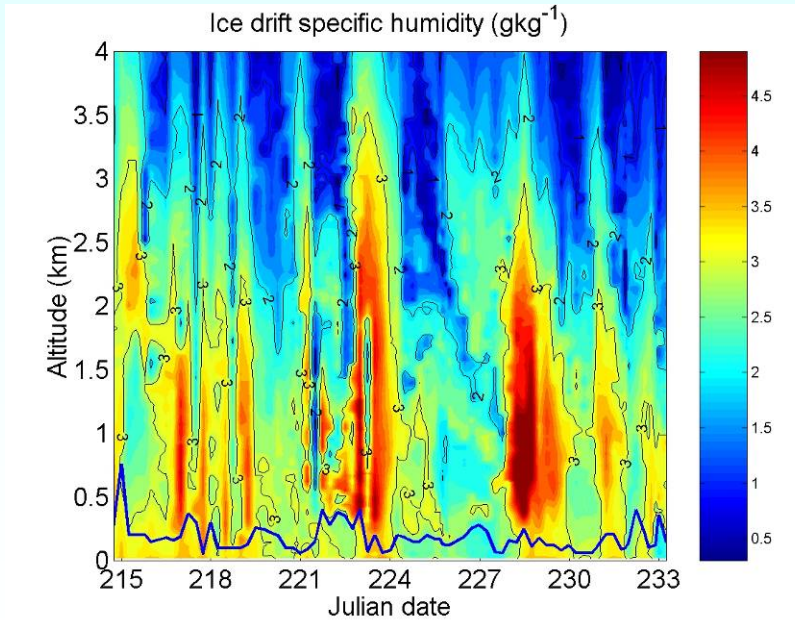
SHEBA





AOE-2001





SUMMARY SEB contributions to change in F_{tot}

$\Delta F_{tot} = F_{tot2} - F_{tot1}$

- $= \Delta Q^* - \Delta H_s - \Delta H_l + \Delta C,$ **(3.1)**

•where

$\Delta Q^* = \Delta Q_s + \Delta Q_l$ **(3.2a)**

- $= \Delta Q_{si} - \Delta Q_{so} + \Delta Q_{li} + \Delta Q_{lo}$ **(3.2b)**
- $= (1-\alpha_1)\Delta Q_{si} + \Delta Q_{li} - \Delta Q_{lo} - Q_{si2}\Delta\alpha$ **(3.2c)**

Decrease of 58 W m^{-2} in F_{tot} from period 1 to period 3 produced by:

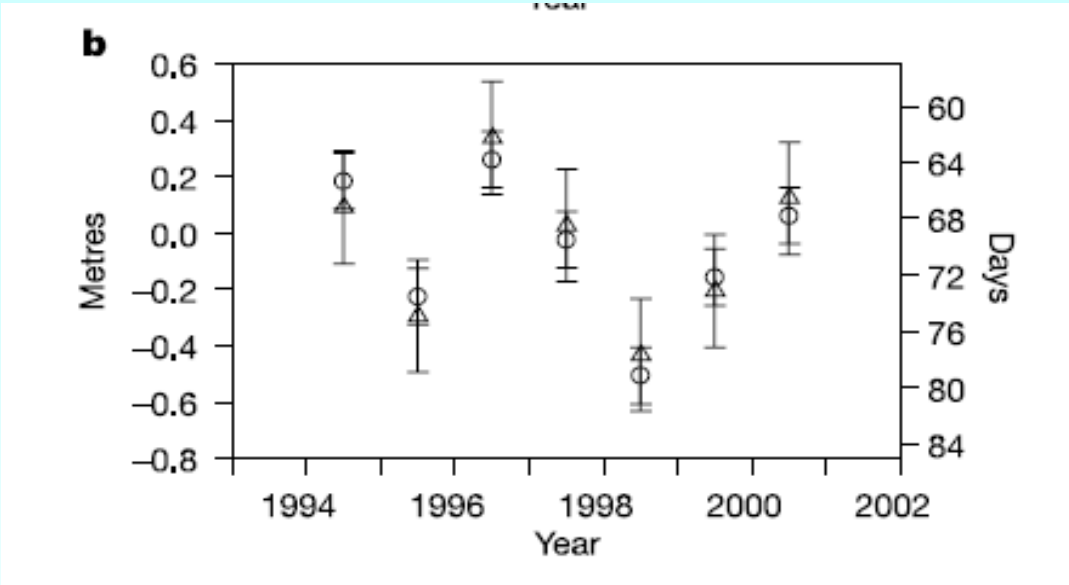
1) albedo effect (25.2 W m^{-2} or 43%),
2) change in Q_{si} (15.3 W m^{-2} or 26%; 14.8 Wm^{-2} due to seasonal change in Q_{si_clear}),
3) change in Q_{li} (9.6 W m^{-2} or 17%),
4) change in $H_s + H_l$ (6.1 W m^{-2} or 11%).

Surface temperature changed very little:

- minimized compensating effect of decreases in Q_{lo}.
- negligible changes in C

All terms but C contributed 10% or more to the decrease in F_{tot}

Over 70% of decrease due to processes related to synoptic disturbance



b, Changes in ice thickness between consecutive winters (circles) and melt season length (triangles) during the intervening summer period, derived from passive microwave observations. The correlation between ice thickness change and melt season length is $R^2 = 0.926$, showing that, during the period of our observations, the variability of mean Arctic sea ice thickness was controlled almost entirely by changes in thermodynamic forcing (Laxon et al 2003)