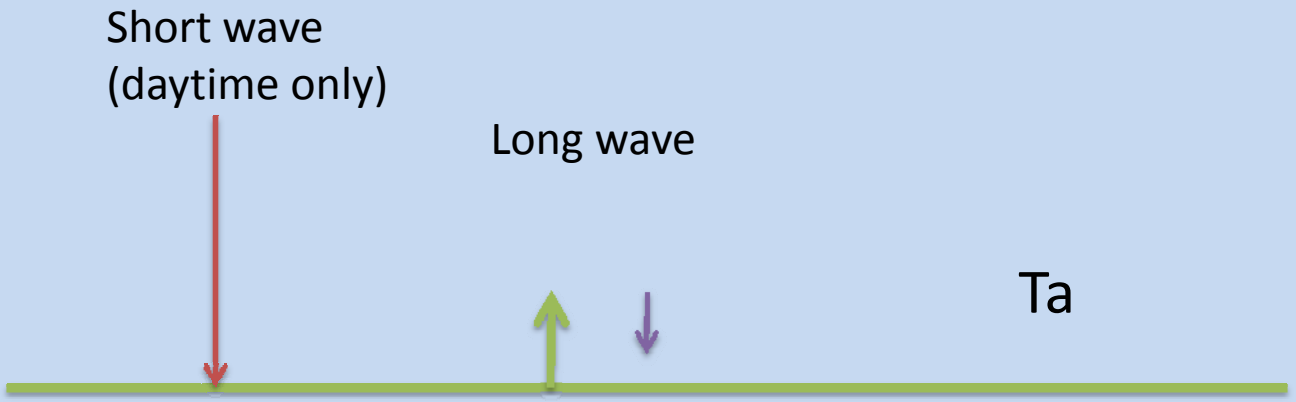
Simple physics of “DT”

- A gas and an adjacent solid surface will tend to equilibrate their temperatures (i.e. DT-> 0) by exchanging heat; according to the Second Law of Thermodynamics
- At the boundary between the atmosphere and the earth’s surface, a temperature difference “DT” can be maintained in the presence of a radiative or other “forcing”.
- The radiative forcing is of two types:
  - Short wave radiation from the sun (S(1-a)cos(phi) = 100 to 1000 W/m2)
  - Differential long wave radiation due to IR “loss to space” (sigma*T^4*(es-ea) = - 100W/m2)
- The magnitude of DT is proportional to the strength of the radiative forcing and inversely proportional to the sensible heat “coupling” between the gas and surface. Rougher surfaces and stronger winds give greater coupling.

Radiative Forcing



DT=Ts-Ta

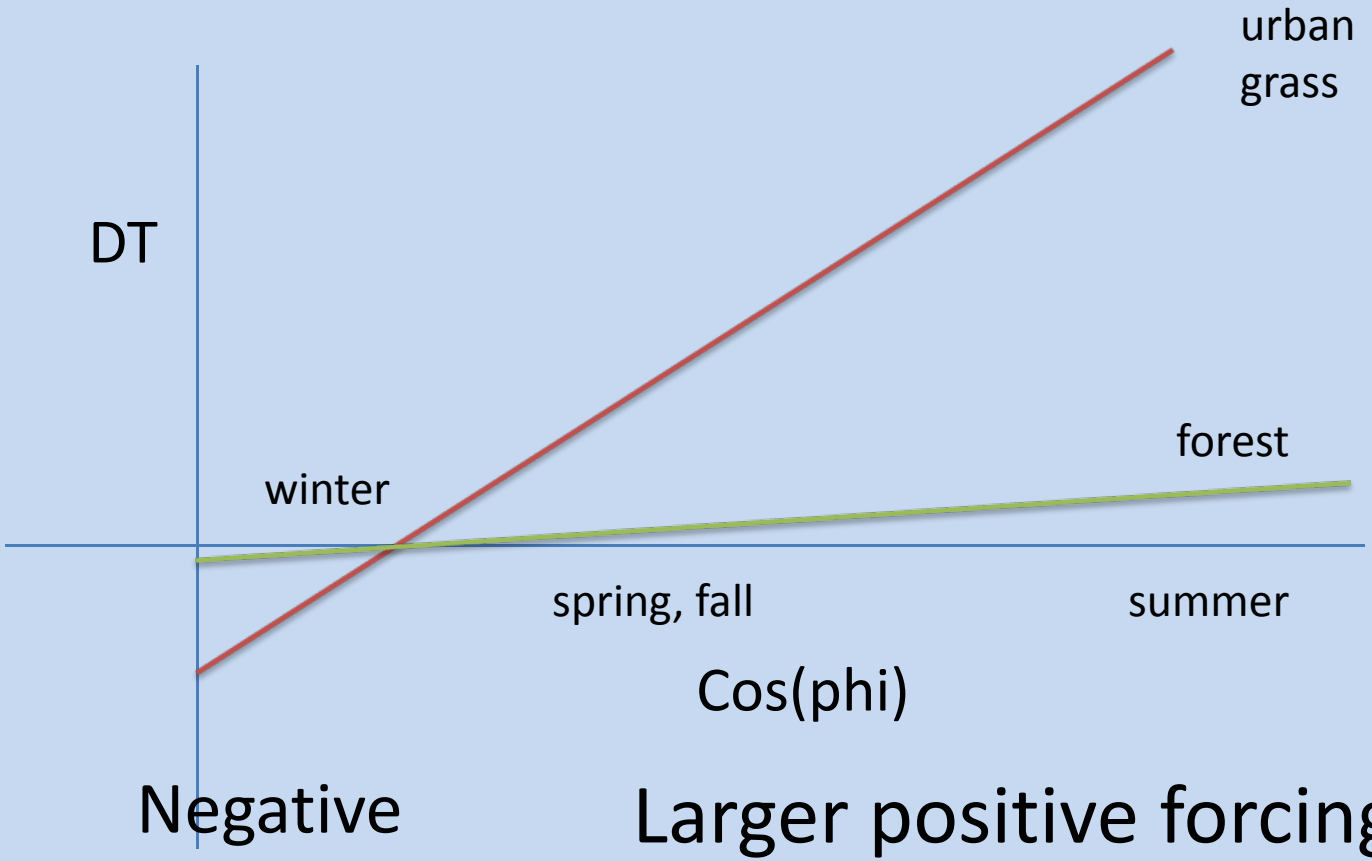
Computation of “DT”

- The surface temperature Ts is computed from the satellite observed TIR radiance by inverting the Planck Function. An emissivity of e=0.95 is used. No atmospheric correction is made.
- The air temperature at the ground is computed from 00Z and 12Z weather balloon data from ALB and OKX, interpolated in time and space. The observed temperature at 925 hPa (at ~700m) is extrapolated down to the elevation of the surface using the adiabatic lapse rate of -9.8 degrees per kilometer.
- The temperature difference is defined as DT=Ts-Ta

Surface types studied

- Conifer forest: low albedo, strong SH coupling, no seasonality
- Deciduous forest: slightly higher albedo, strong SH coupling to leaves, leafout from mid-May to mid-October, weak SH coupling to forest floor
- Grass: higher albedo, weak SH coupling, some seasonality
- Urban: higher albedo, weak SH coupling, some energy storage
- Water: low albedo, weak SH coupling, large energy storage

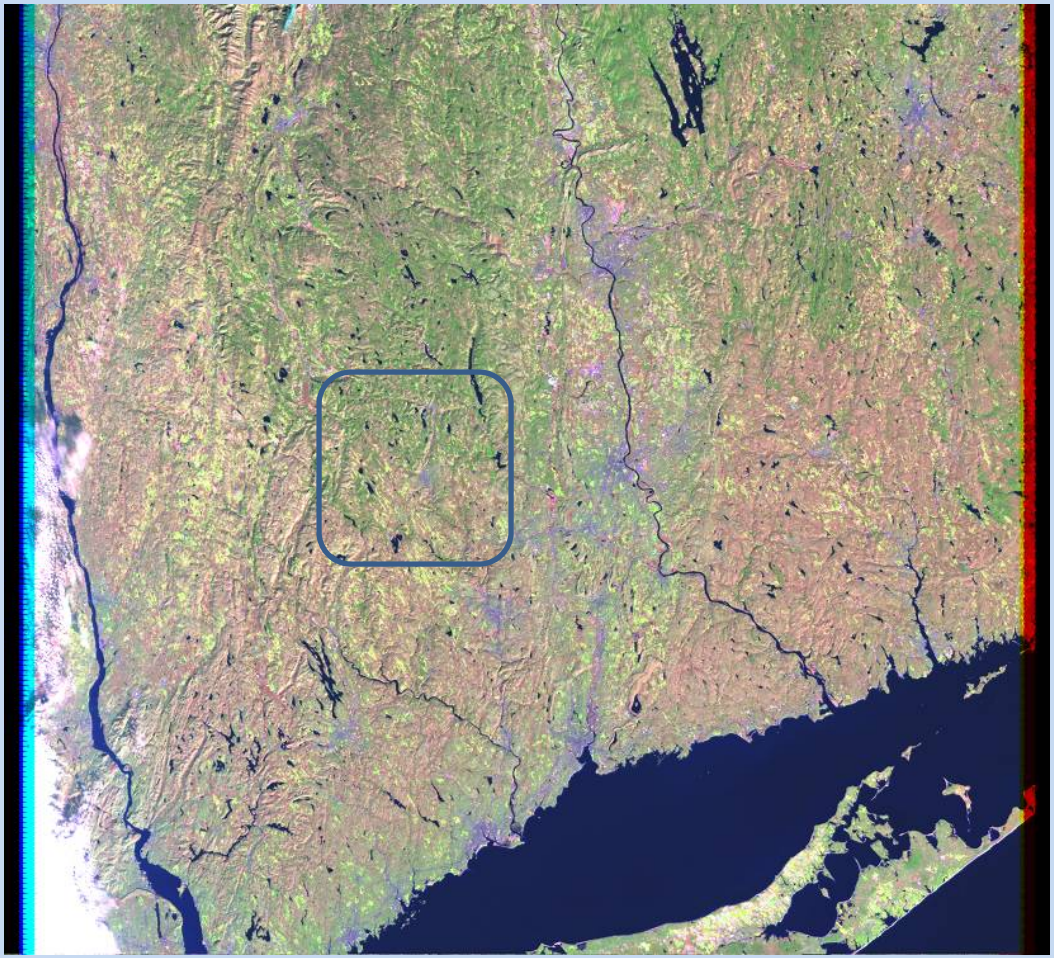
Expected seasonal behavior in Connecticut (10AM EST)



Preliminary land cover survey in NW Connecticut (July 10, 11, 2010)

1. Forest Composition
2. Lake temperatures

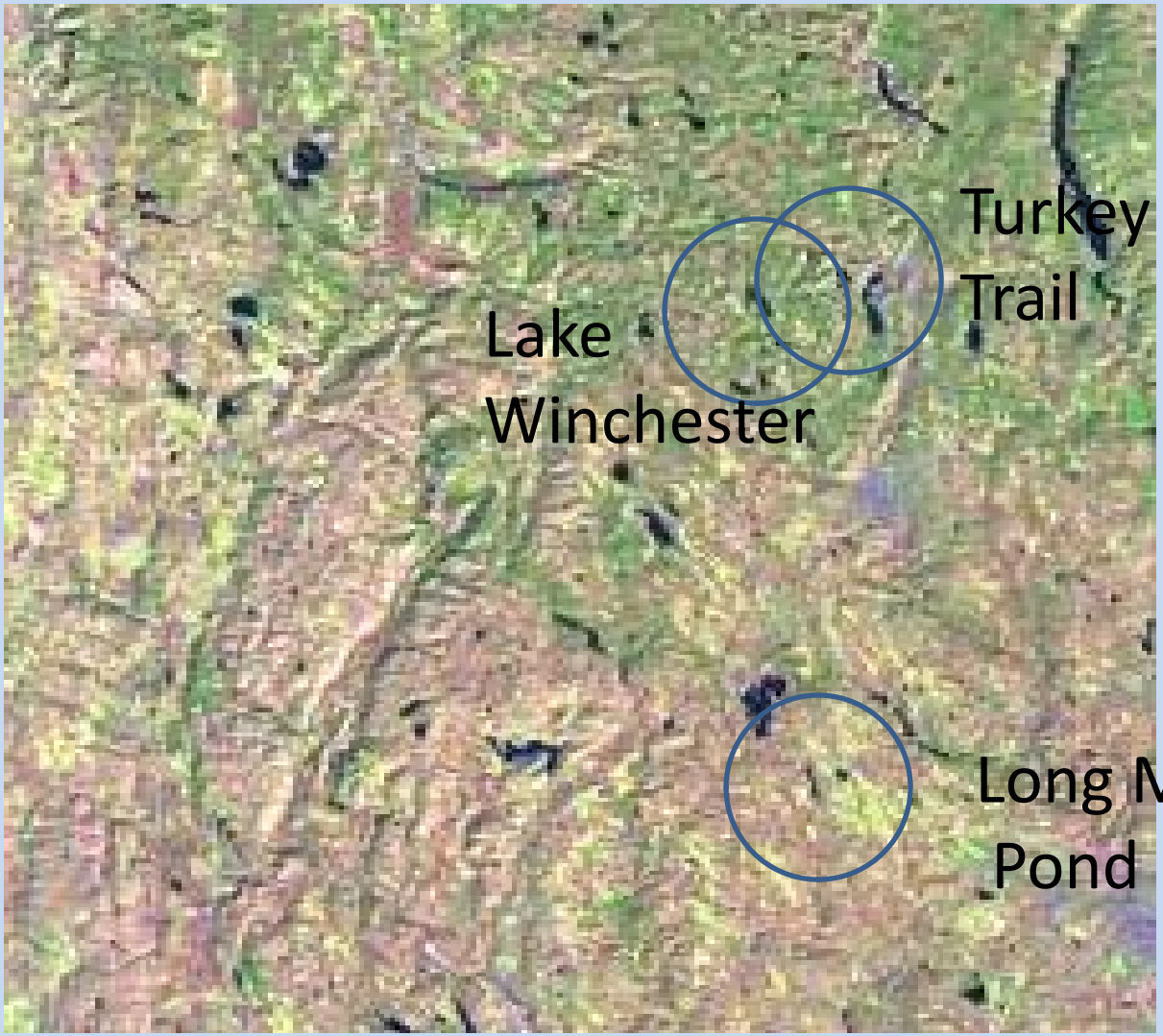
Landsat Browse: April



Locations in Connecticut

1. West central : Long Meadow Pond in Bethlehem (deciduous only)
2. Northern: Lake Winchester (mixed forest)
3. Northern: Turkey Vulture Trail (mixed forest)

NW Connecticut: April Landsat



Long Meadow Pond (Tair=24C; Tlake=27C)

Long Meadow Pond

Lake Winchester
(Tair=26; Tlake= 28)

Lake Winchester shoreline

View SE from Ledges on Turkey Vulture Trail

Turkey Vulture Trail (Mountain Laurel understory)

Conclusions

- In the Bethlehem area, there is nearly pure deciduous forest but the seasonal NDVI signal might be weakened by the winter mountain laurel effect.
- In the northern area there is little or no pure conifer. Forest is mostly mixed conifer and deciduous. The mountain laurel is mostly under the deciduous canopy, possibly weakening its seasonal NDVI signal.
- As shown in the photos, the conifers are less reflective (in the visible) than the deciduous leaves.
- Summer lake temperature can reach 28C and exceed the air temperature (especially after a heat wave).

Wind Turbine in Torrington