UNIVERZITET U NOVOM SADU

POLJOPRIVREDNI FAKULTET

METEOROLOGIJA

Bowen ratio and daily temperature range thresholds: Are they signals of transient seasons?

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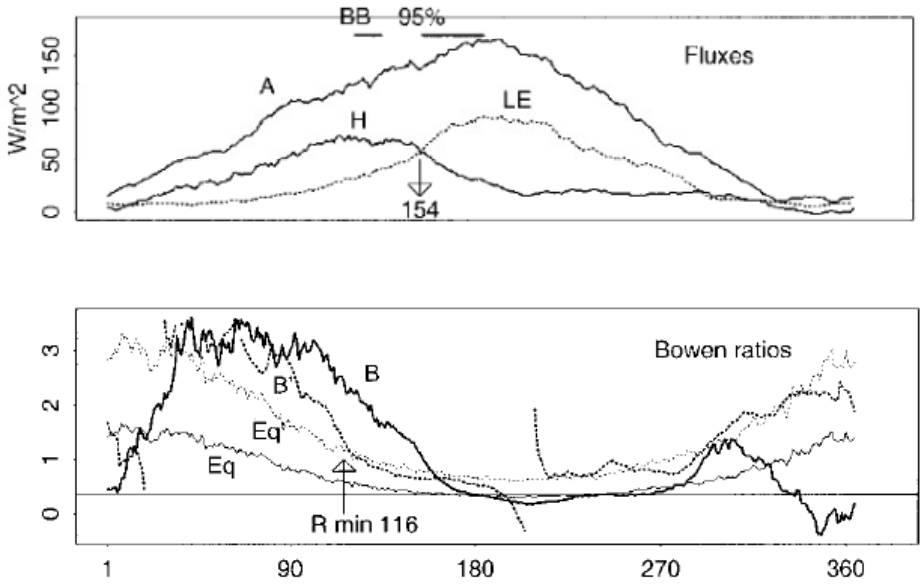
Transition seasons can last several weeks

- Leaf emergence in midlatitude climates decreases the ratio of sensible (*H*) and latent heat (*LE*) flux - the Bowen ratio (*B*)



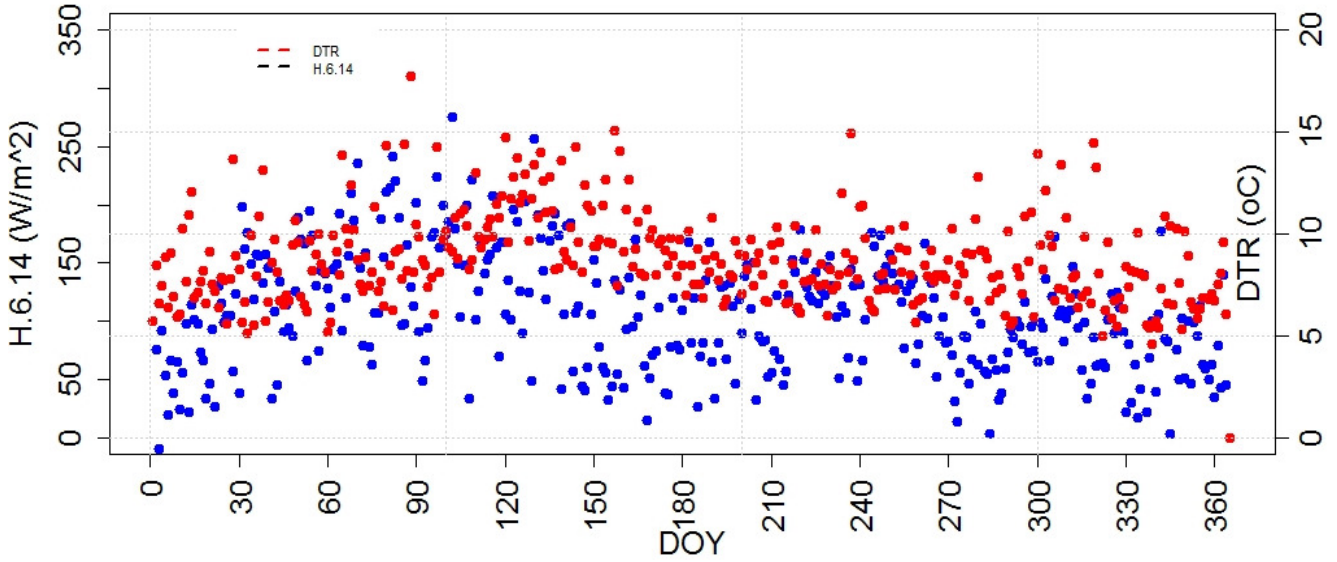
Fitzjarrald et al., 2001, 10.1175/1520-0442(2001)014<0598:CCOLPI>2.0.CO;2.

- Onset of sping = time when LE equals H and continue to increase while H decreases.
- B' ≈ 1 (a *tendency* Bowen ratio)

- Fitzjarrald et al. used long-term averaged day-to-day differences in surface *T* and *q* to reveal the consequences of leaf emergence.
- *Advantage*: There are many more surface climate stations than flux-measuring sites
- Here, we refine methods to relate plant characteristics to surface climate state, emphasizing the spring transition at Harvard Forest (HF, MA, USA), a site featuring detailed data of significant phenological events & flux observations (Klosterman et al., 2018), and many nearby conventional climate stations.

The transition to the ‘growing season’ in Harvard forest begins with bud break (mid-April), ending with nearly fully leafed crowns ("95%") in most species by mid-May

From the start of spring transition until the end of autumn, DTR changes along with H, particularly during the period from sunrise until the daily maximum air temperature occurs (H.6.14)



Harvard forest 2002-2010 average

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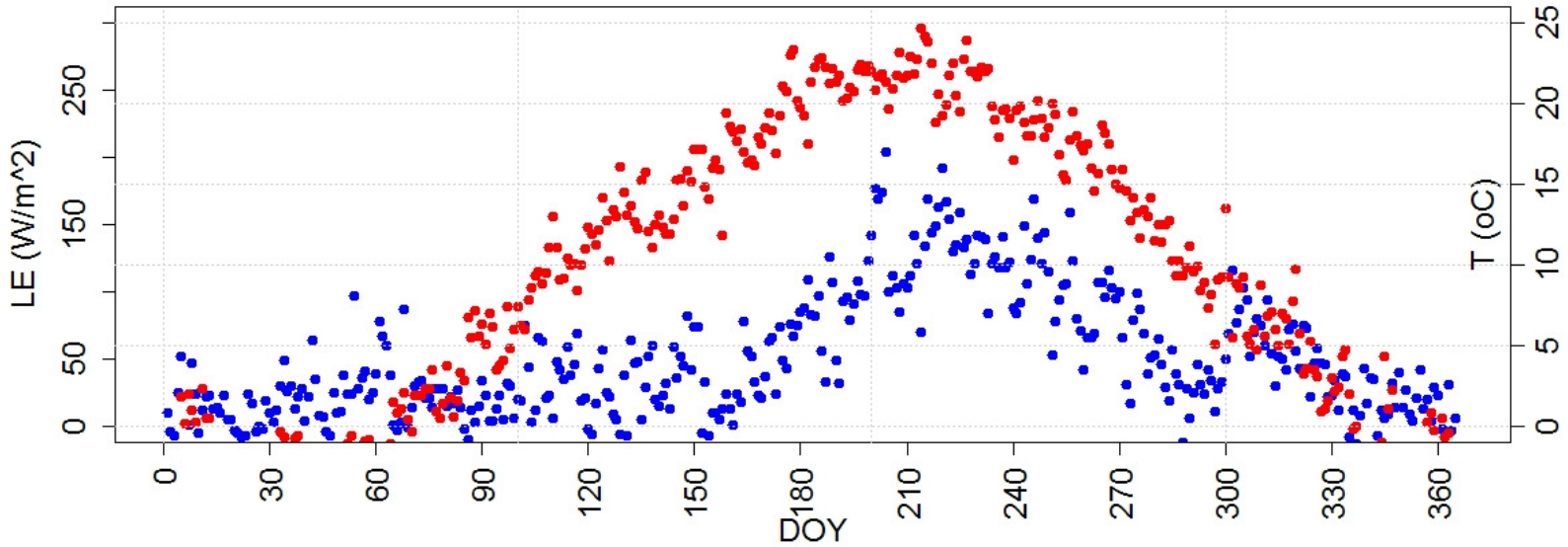
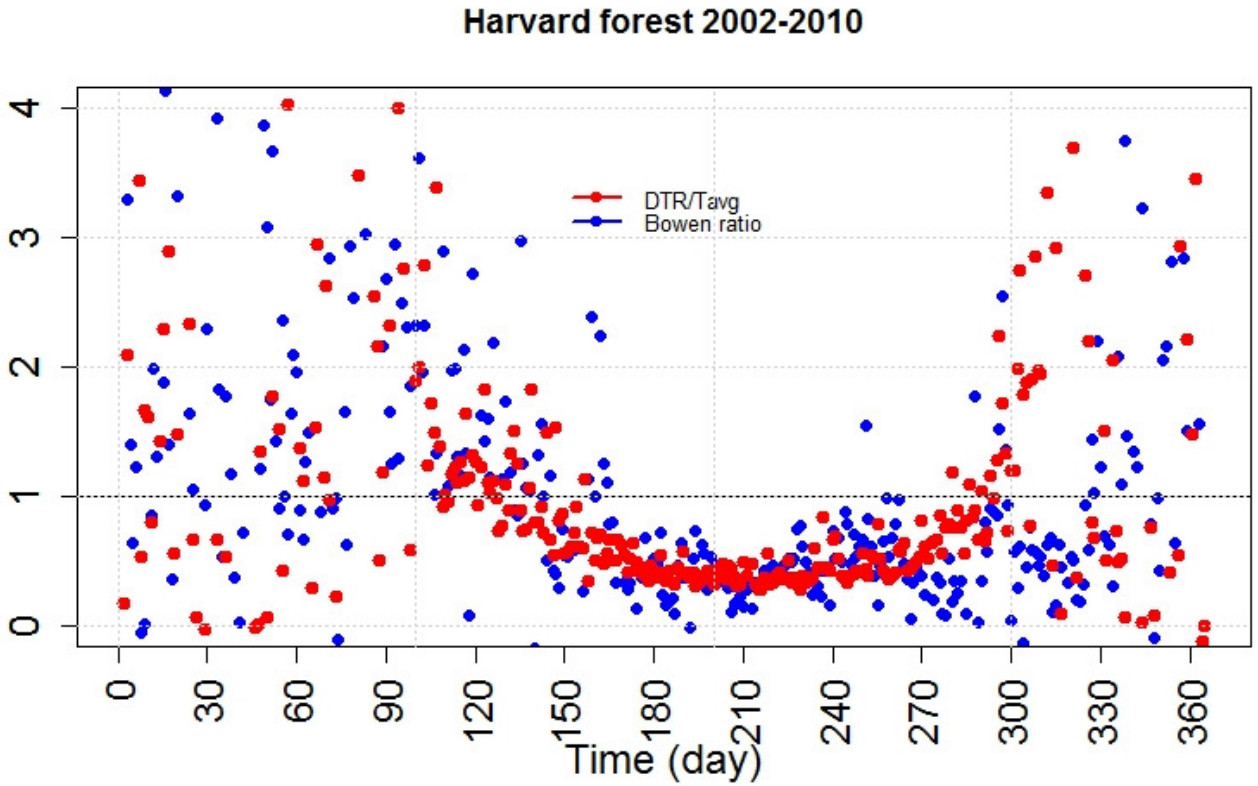
Seasonal course of daily temperature T_d (°C) follows the latent heat flux trend



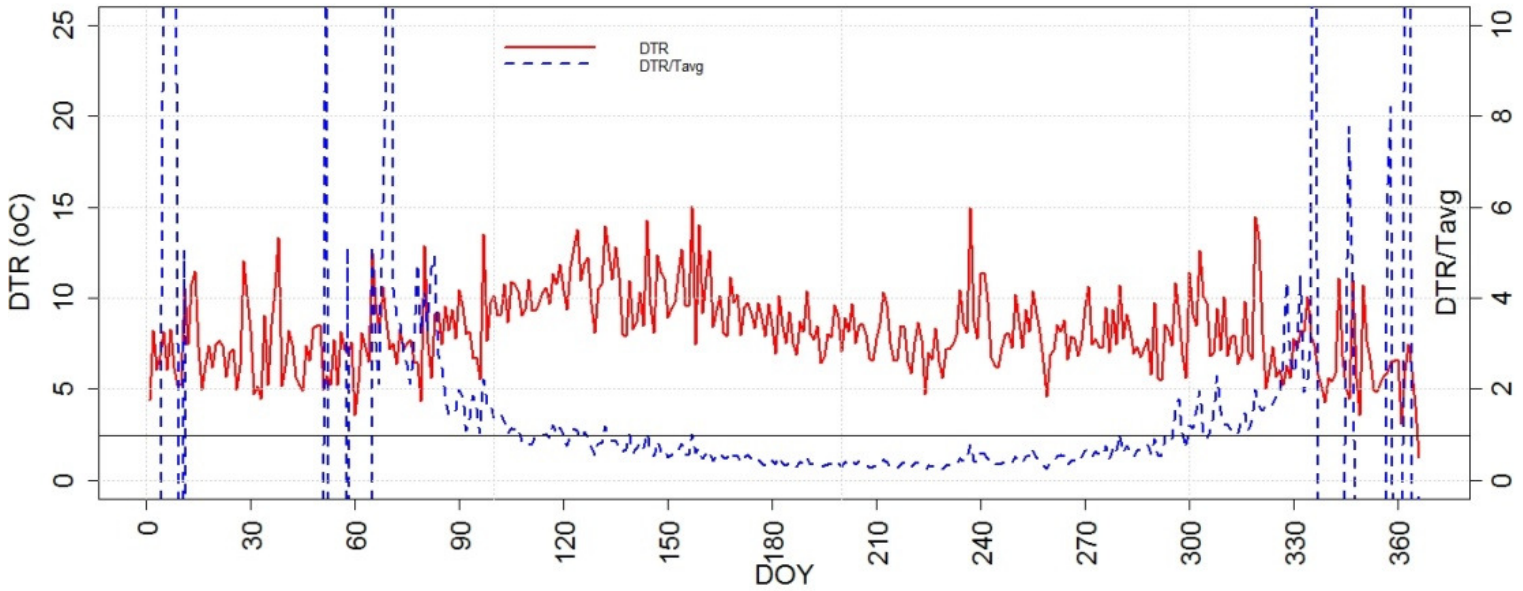
Harvard forest 2002-2010 average

Bowen ratio and normalised DTR

Since DTR changes along with H.6.14, and the seasonal course of daily averaged temperature T_d (°C) follows LE trend, we *normalized* the DTR (DTR/T_d)

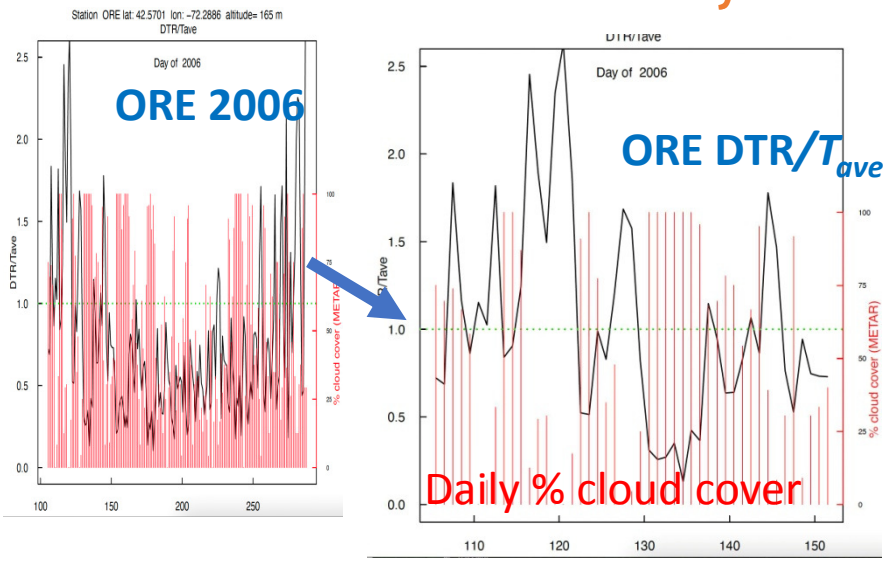


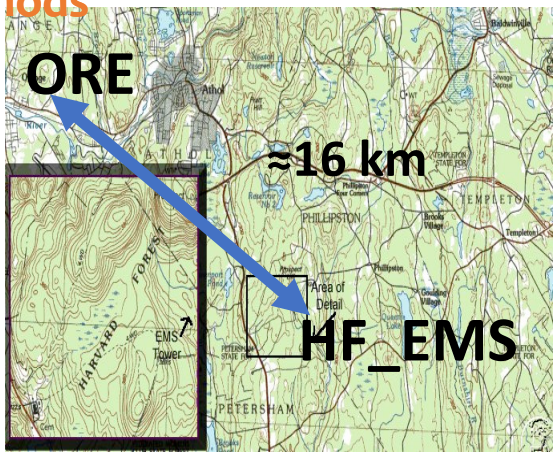
DTR and normalised DTR



- DTR/T_d > 1 before budbreak and after the end of growing season
- DTR/T_d ≈ 1 approximately between budbreak and "95%" and at the end of growing season. **In the Harvard forest** *spring transition takes app. 40 days while in the autumn it is just a 3-5 days.*
- DTR/T_d < 1 during growing season

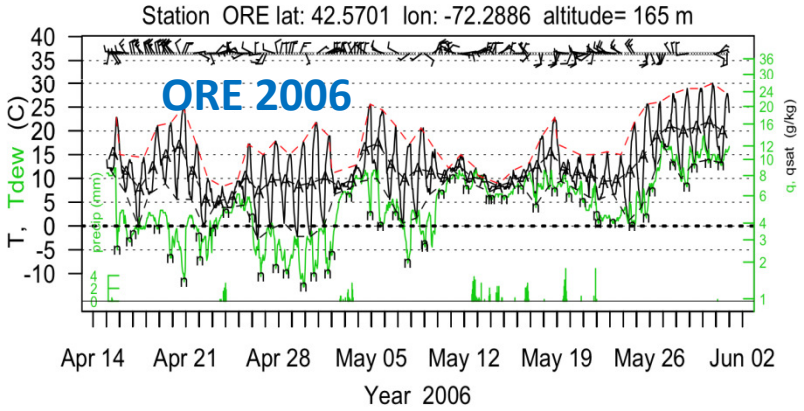
Sensitivity of DTR/T to cloudy/clear periods

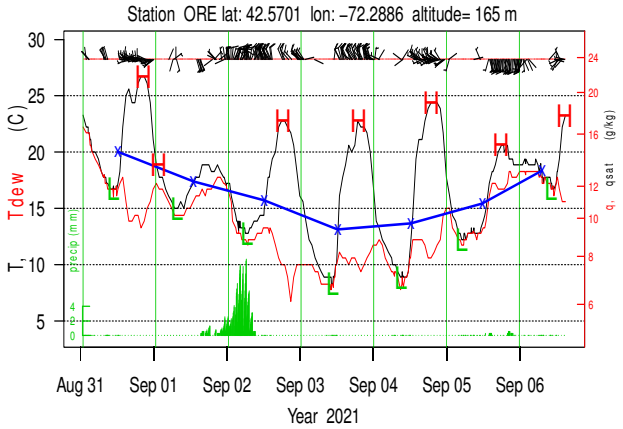


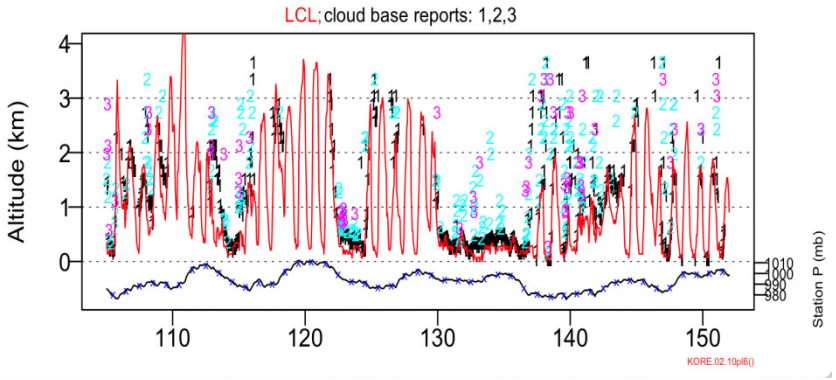


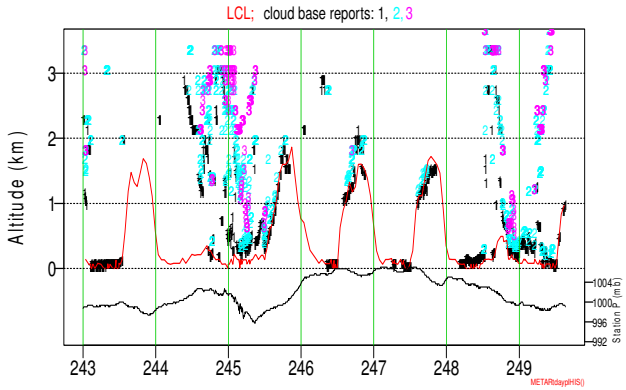
Operational METAR (ASOS in USA) reports to identify the role of clouds on the normalized DTR

ORE analysis up to last Sunday 6 Sept 2021



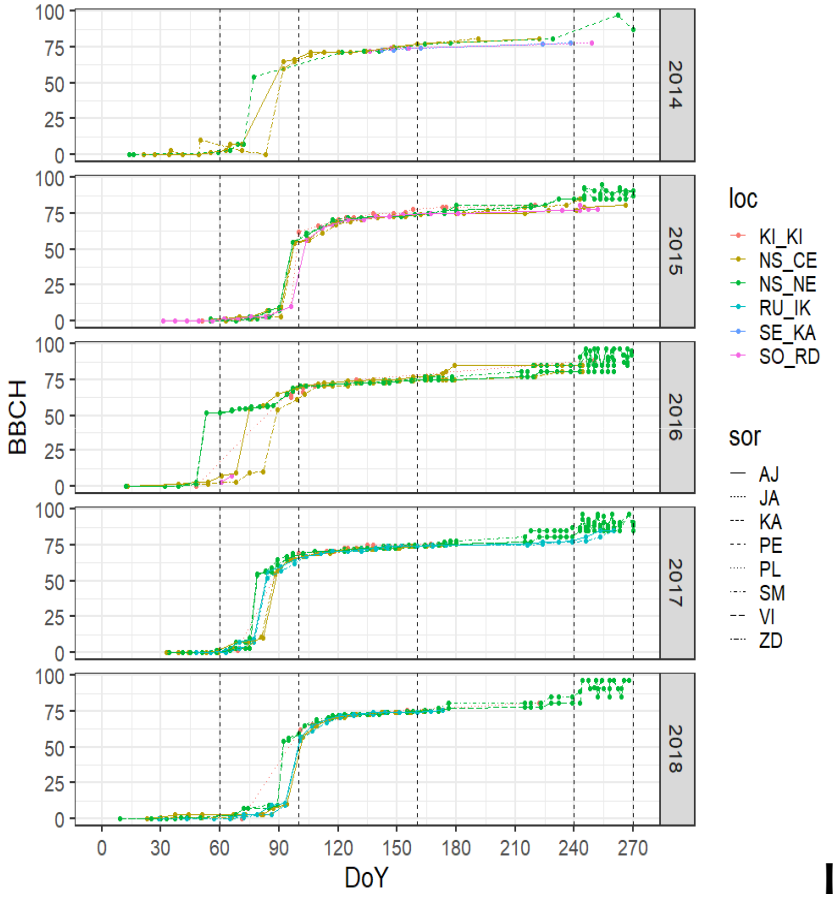


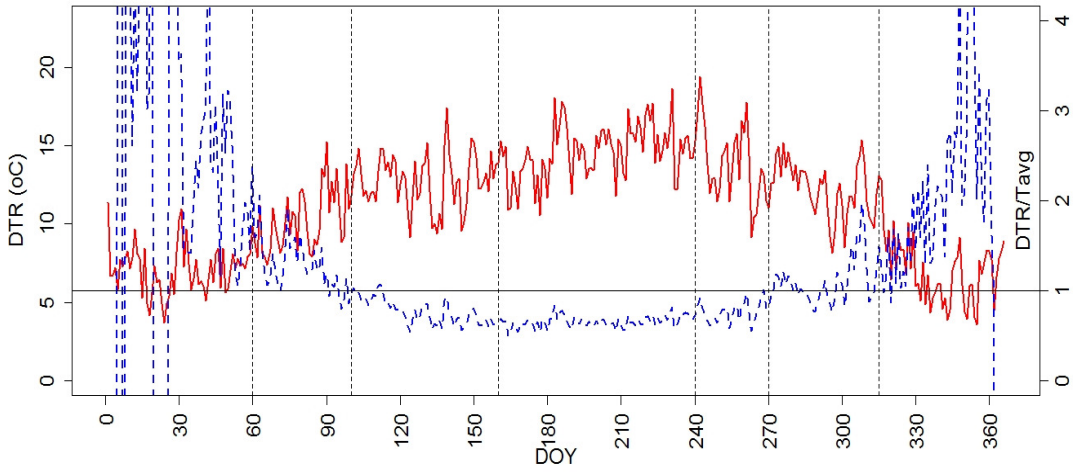




- Seasonal pattern at ORE (Orange MA airport) follows that at nearby HF-EMS flux site.
- Low daily-averaged cloud cover leads to higher values of DTR/T_{ave} .
- Coming soon: distinguishing

DTR/T_d ratio as an indicator of spring and autumn transitions at apple orchard on Čenej (Serbia)





NS_CE (Čenej, Srbia) orchard location

Legend: DTR/T – blue line; DTR – red line;

phenological phases start – dashed line

In the apple orchard, *spring transition takes app. 10-20 days. The autumn transition takes almost 30 days.*

Conclusions

Preliminary results indicate that this approach can identify significant effects of leaf state on local surface climate without the need for averaging over a decade or longer.