



DEVELOPMENT OF WINTER WHEAT MODEL IN CLM4.5

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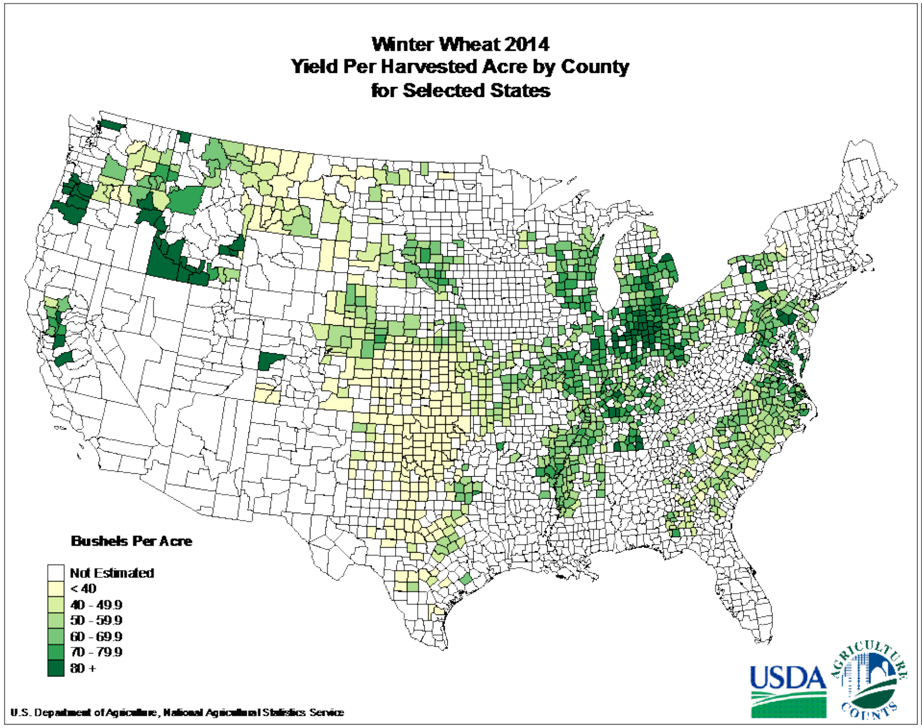
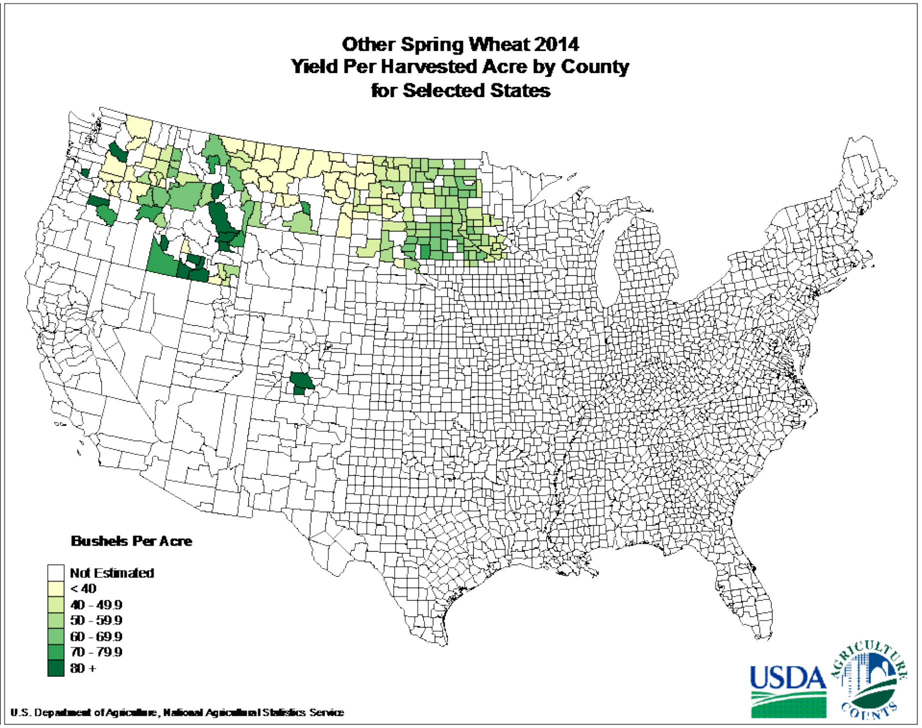
2/9/2016



http://www.nass.usda.gov/Charts_and_Maps/A_to_Z/in-wheat_winter.php



http://www.nass.usda.gov/Charts_and_Maps/A_to_Z/in-wheat_spring.php

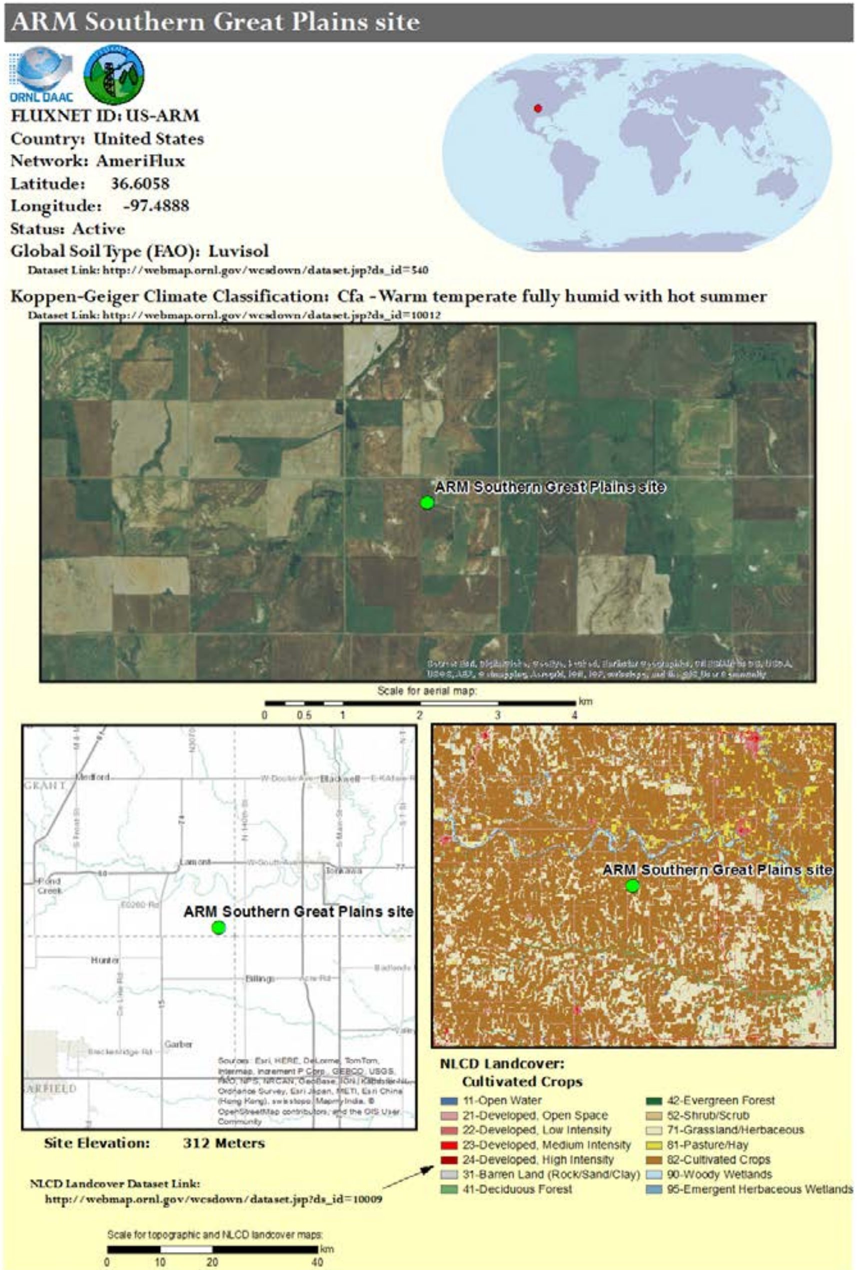
WINTER WHEAT SITES

ARM SGP Main site (US-ARM)

- Site measured NDVI and LAI
- Planting date
- Well documented Land management

Single point CLM45 simulations

- CLM45BGCCROP (crop on)
- CLM45SP (crop off)

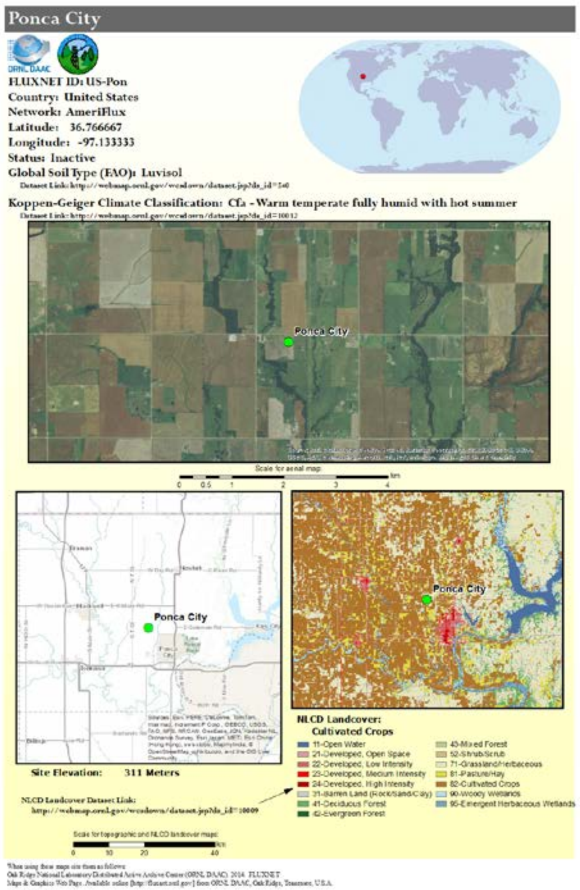


When using these maps cite them as follows:
Oak Ridge National Laboratory Distributed Active Archive Center (ORNL DAAC). 2014. FLUXNET Maps & Graphics Web Page. Available online [http://fluxnet.ornl.gov] from ORNL DAAC, Oak Ridge, Tennessee, U.S.A.
Created: 7/24/2015

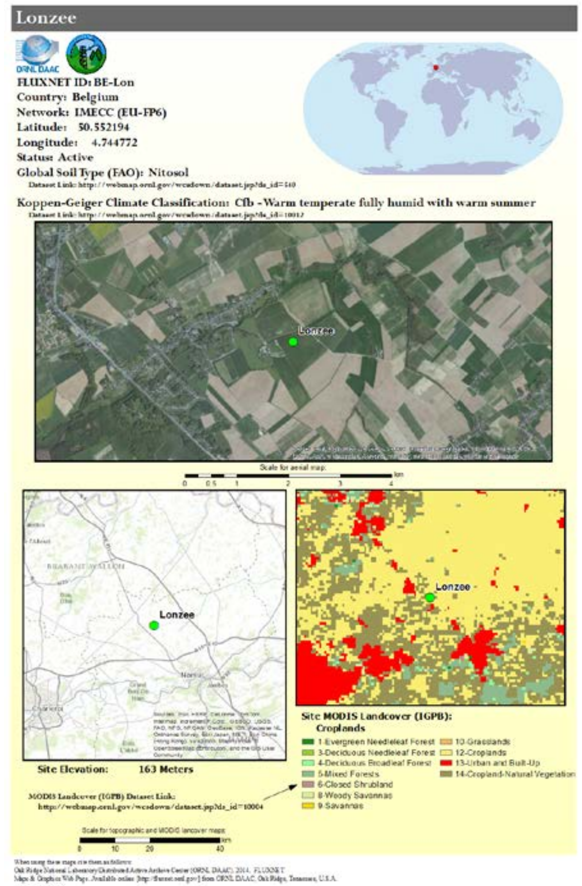
Three cross validation sites:
Flux, LAI, yield

1. Ponca city site, OK, US (US-Pon)
2. Lonzee site, Belgium (BE-Lon)
3. Merzenhausen, Germany

US-Pon



BE-Lon



Phenology phases

Phase 1: Planting:

- $T_{min5}<5^{\circ}C$
- days>Sep 1
- $GDD_{020}>50$

Pase 2: Leaf emergence:

- $GDD_{tsoi}>3\%GDD_{mat}=51$
- Base temperature is $0^{\circ}C$
- Leaf, stem, root carbon increasing

Phase 3: Grain fill:

- $GDD_{plant}>40\%GDD_{mat}=680$
- base temperature is $0^{\circ}C$
- Leaf and stem carbon decreasing
- Grain carbon increasing

Phase 4: Harvest:

$GDD_{plant}>GDD_{mat}=1700$

VERNALIZATION

winter crops must expose to low, nonfreezing temperatures to enter the reproductive stage.

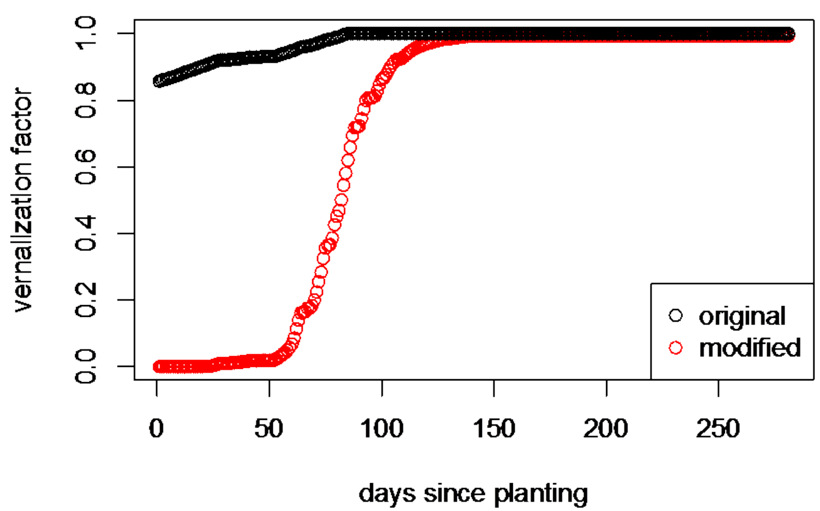
A generalized vernalization function for winter wheat (Streck et al., 2003)

Vernalization begin after germination end before flowering

Minimum temperature : -1.3 °C

Optimum temperature : 4.9 °C

Maximum temperature : 15.7 °C



vf →

$GDD_{plant} = vf \times GDD_{plant}$

$agrain = vf \times agrain$

FROST TOLERANCE AND DAMAGE

LT50

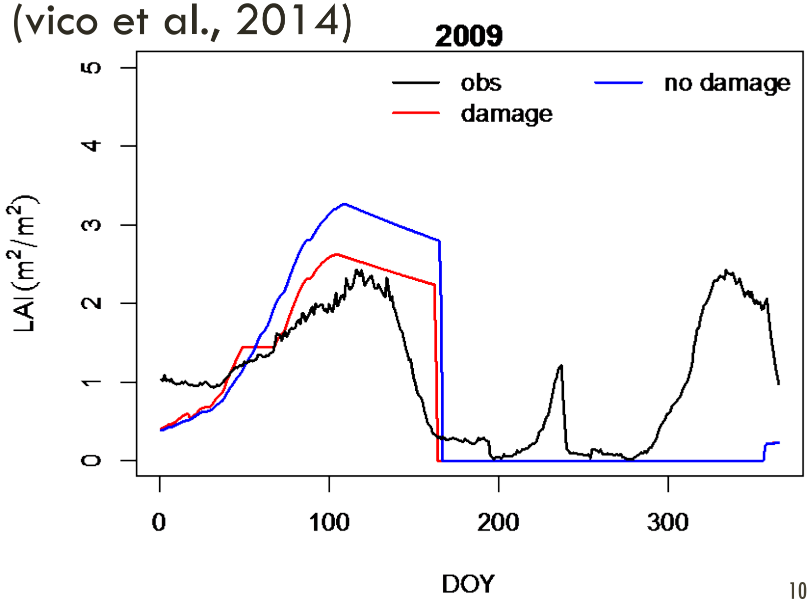
The Lethal temperature at 50% of the individuals are damaged (Bergjord et al., 2008)

Survival rate

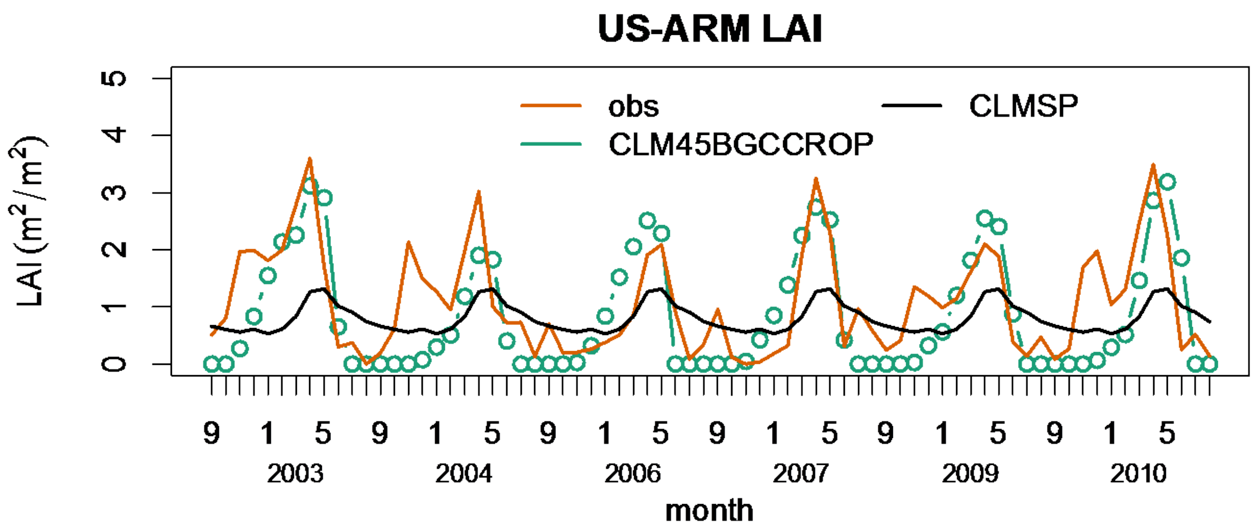
representing the likelihood that an individual is damaged by exposure to a certain temperature (Vico et al., 2014)

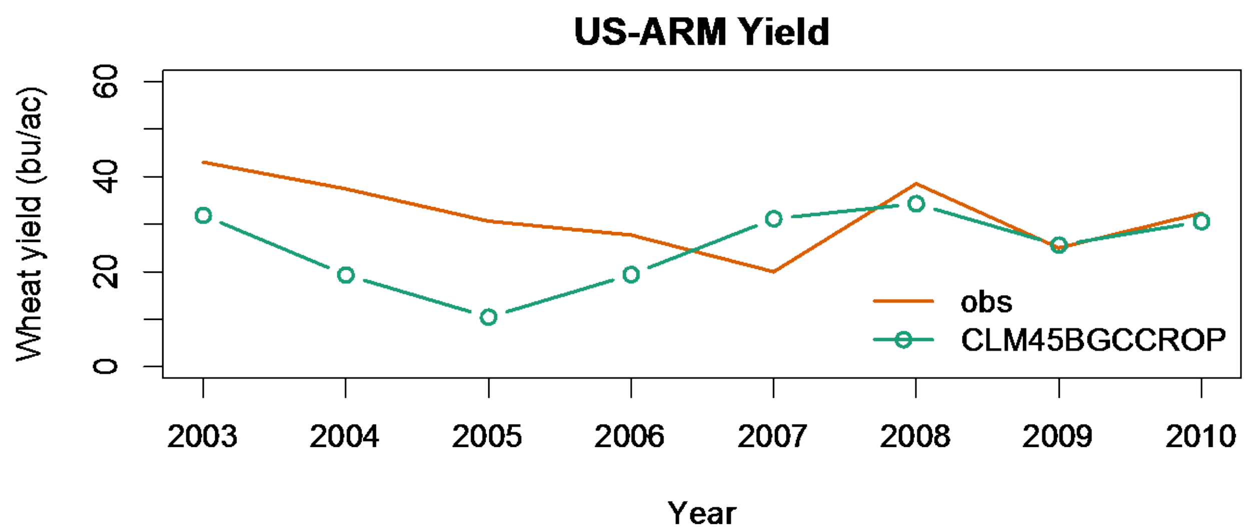
WDD > 1
Reduce leaf and stem carbon by a factor of mean survival rate

Weighted killing degree days (vico et al., 2014)

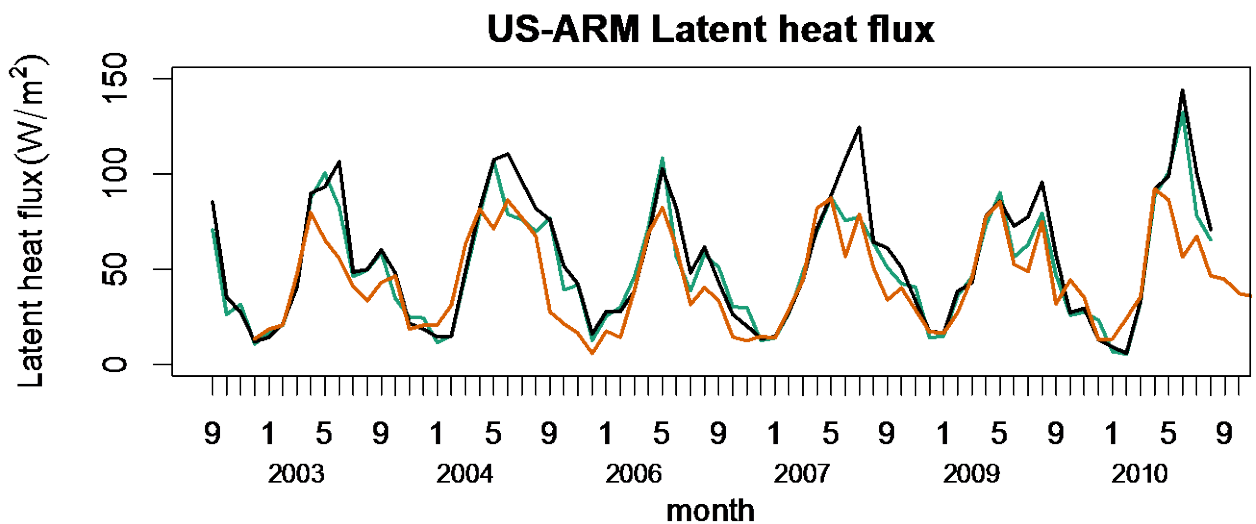


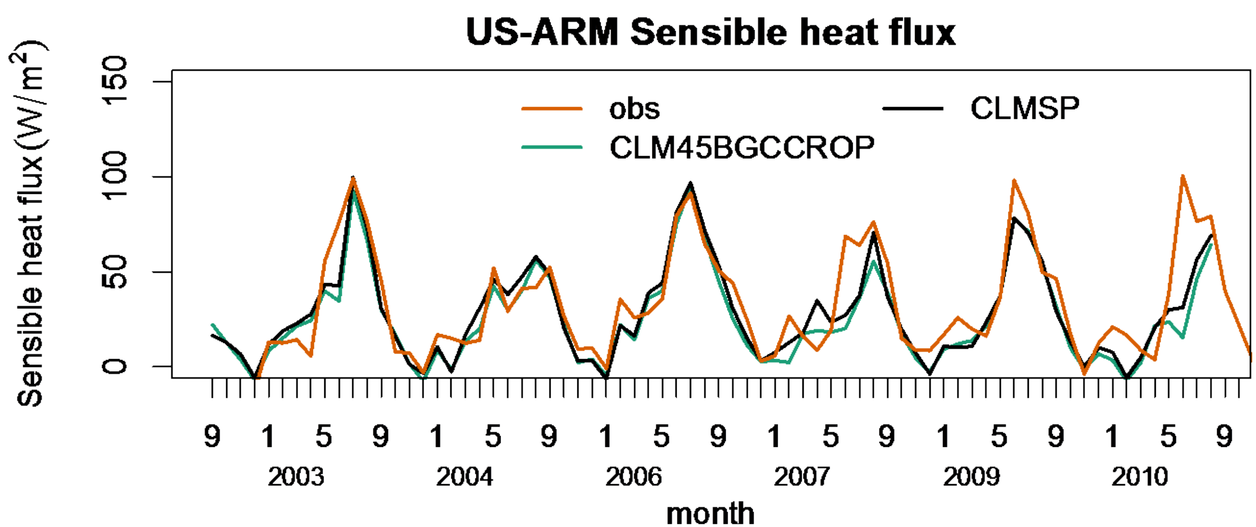
Winter wheat growth at ARM site



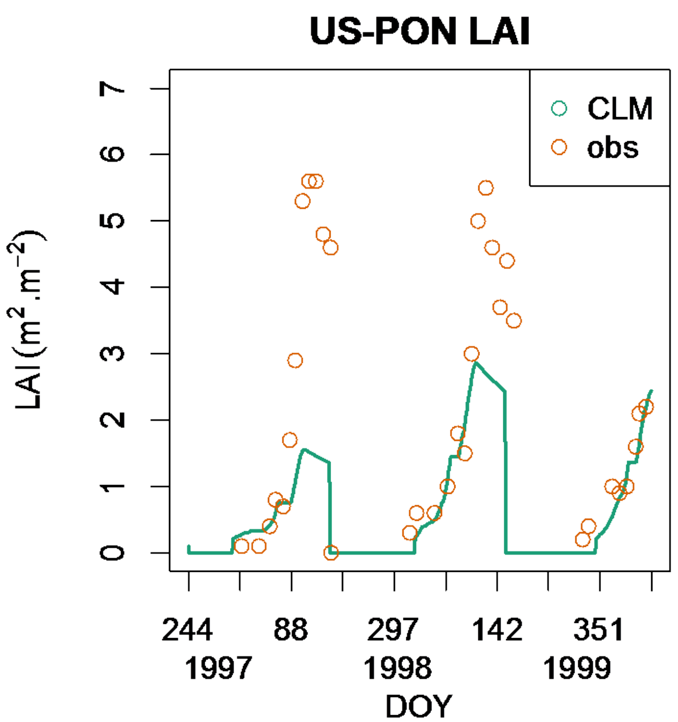


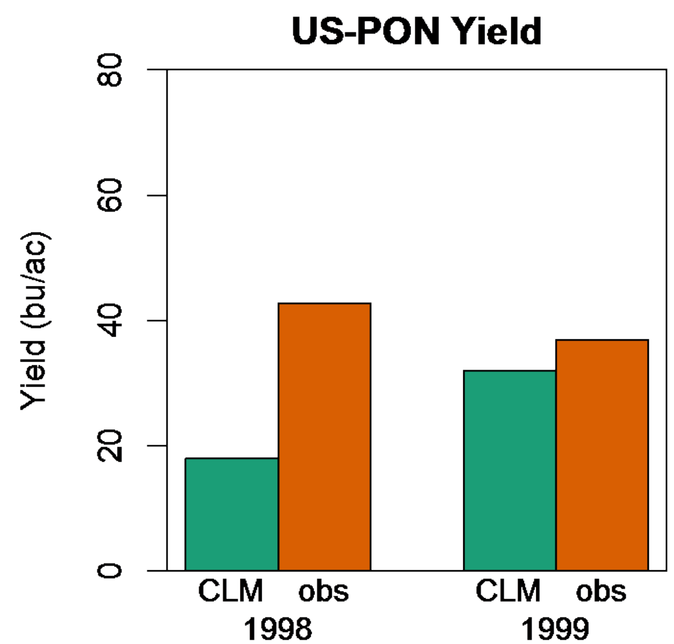
Improved latent heat fluxes compared to prescribed crop



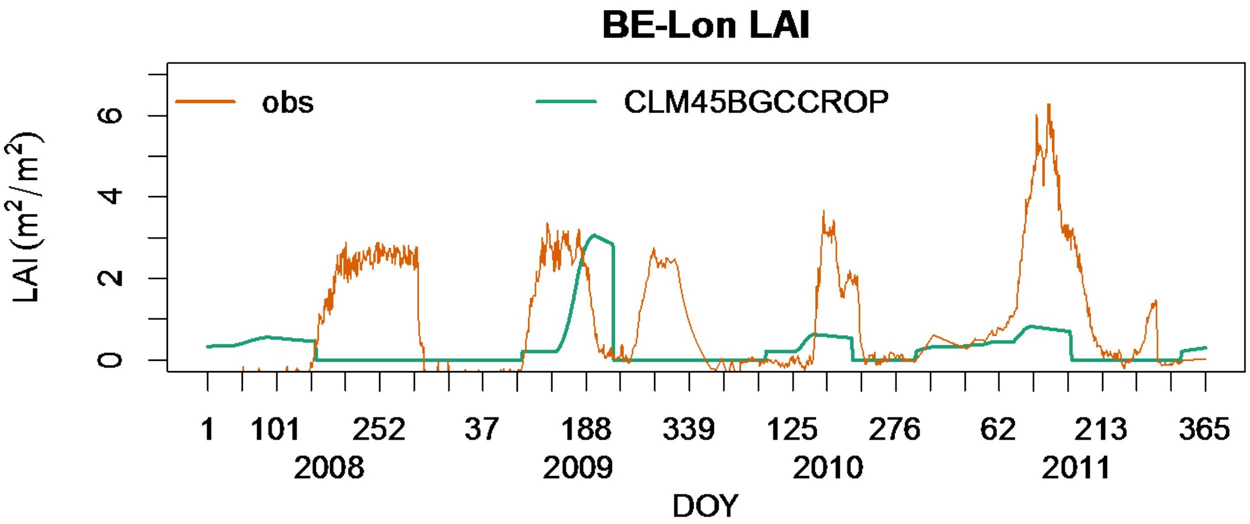


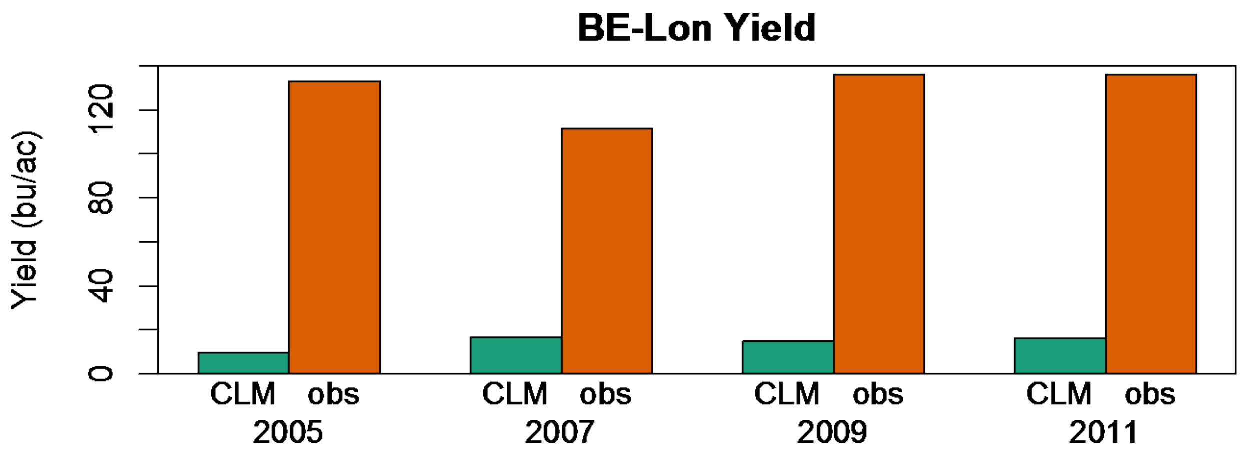
Not well represent the winter wheat growth in the three cross validation sites, especially at the two European sites



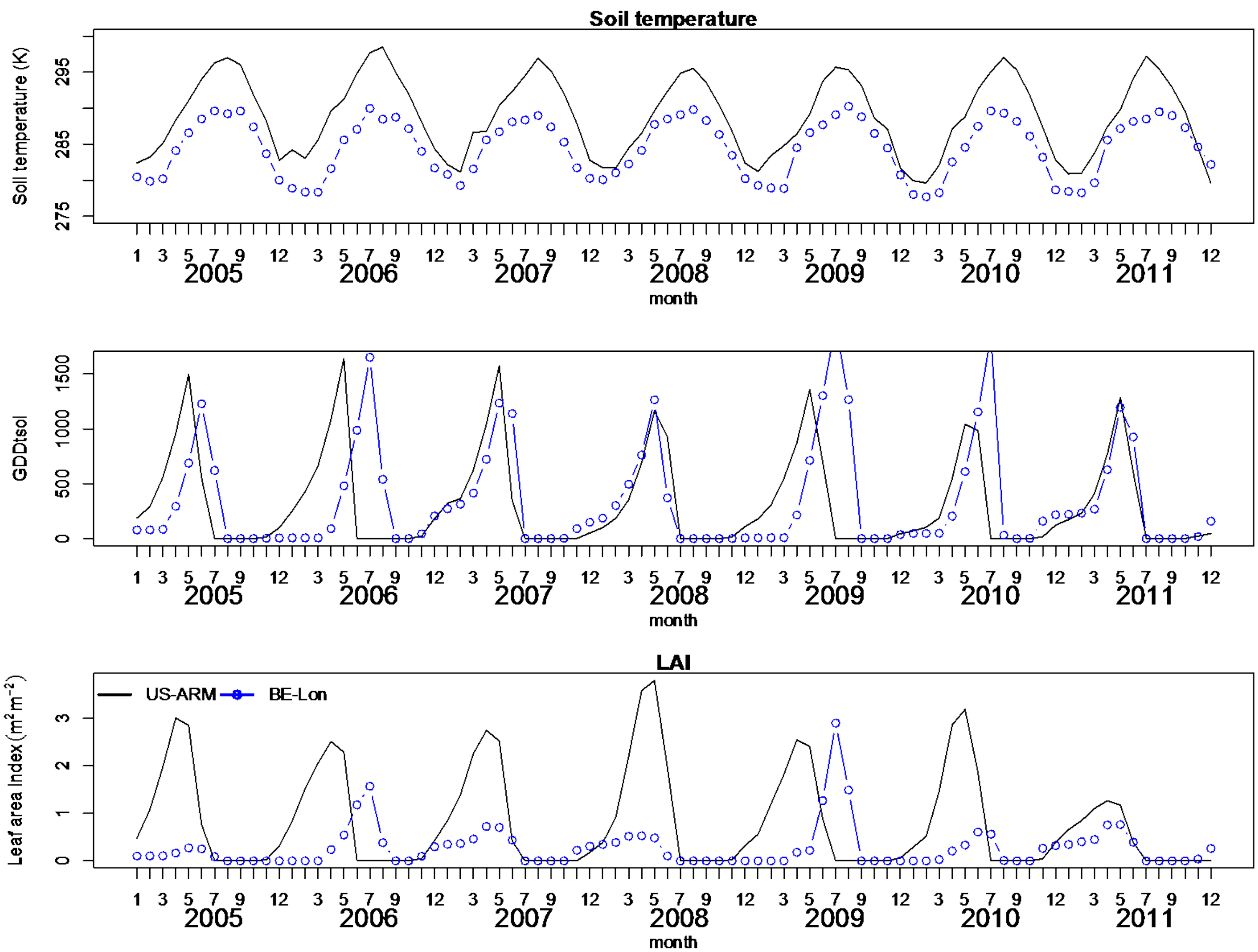


Very small LAI and yield simulations at BE-Lon site



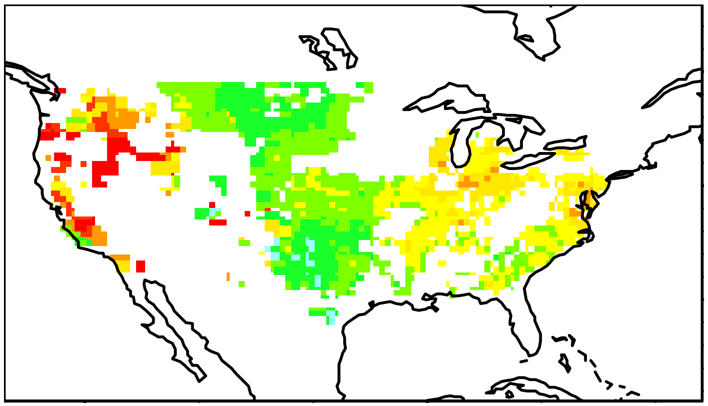


Why such poor simulation at the two European sites?



Regional CLM offline simulation in US

age



ACKNOWLEDGEMENT

Hanna Post, University of Cologne, Germany

Pauline Buysse and Tanguy Manise, Université catholique de Louvain, Belgium

Fadong Li, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences

Jiquan Chen, Ranjeet John, and Housen Chu, Michigan State University