Carbon fluxes and soil moisture data assimilation

Tested at Siberian measuring sites

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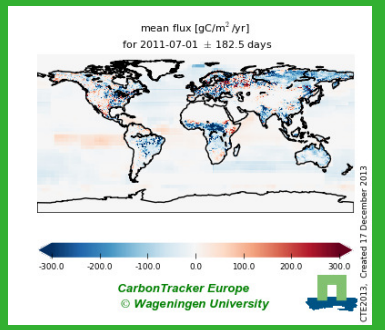
Introduction and objective

- droughts are becoming more frequent
- affecting regional carbon balance
- remote sensing data of soil moisture are available
  - passive microwave
  - active scatterometer

➔What is the potential of assimilating soil moisture data in vegetation models?

Methods

- Passive microwave observations
  - 1982-now, 0.25°×0.25° lat, lon (1)
- Metop ASCAT 25 km
  - 2007-now, 0.25°×0.25° lat, lon (2)
- SiBCASA vegetation model (3)
  - vegetation model in CarbonTracker
- Tower-based NEE



(1) Owe et al., JGR, 2008, Liu et al., HESS, 2011, Miralles et al., HESS, 2011
(2) Wagner et al., RSE, 1999, Naeimi et al., IEEE Trans. Geosci. R.S., 2009, 2012
(3) Schaefer et al., JGR, 2008

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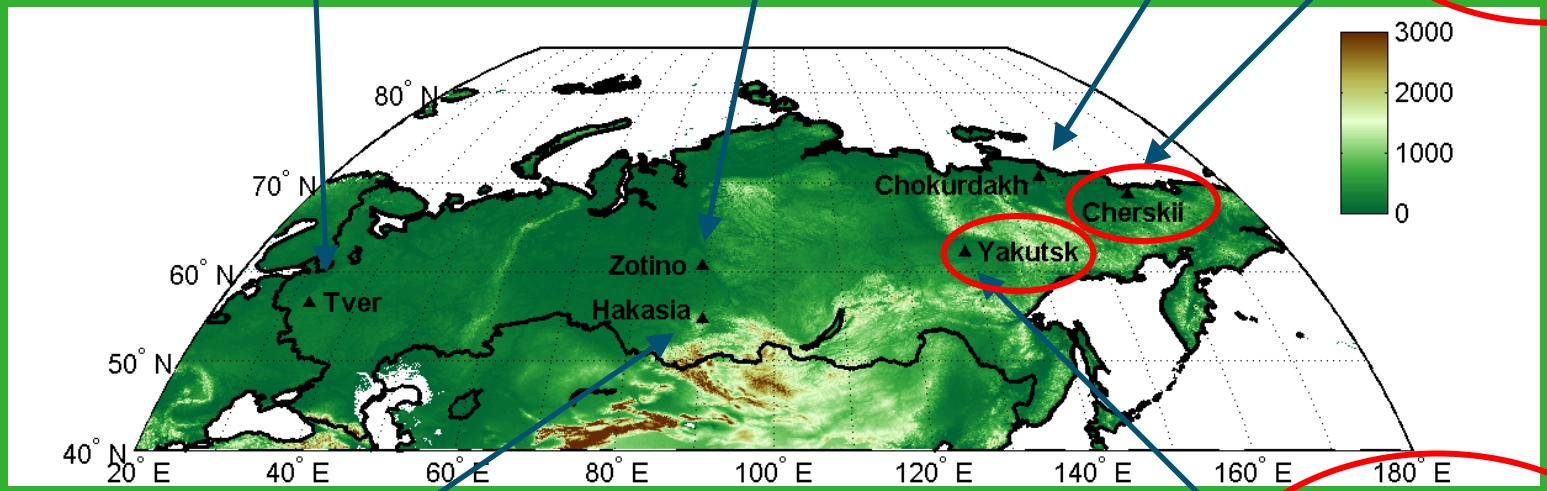
Tower sites in Siberia (between 1997 and now)

Tver
2x Spruce forest + bog

Zotino
bog + Pine + mixed + Spruce

Chokurdakh
tundra

Cherskii
floodplain tundra



Hakasia
natural and regenerating steppe

Yakutsk
Larix + Pine forest

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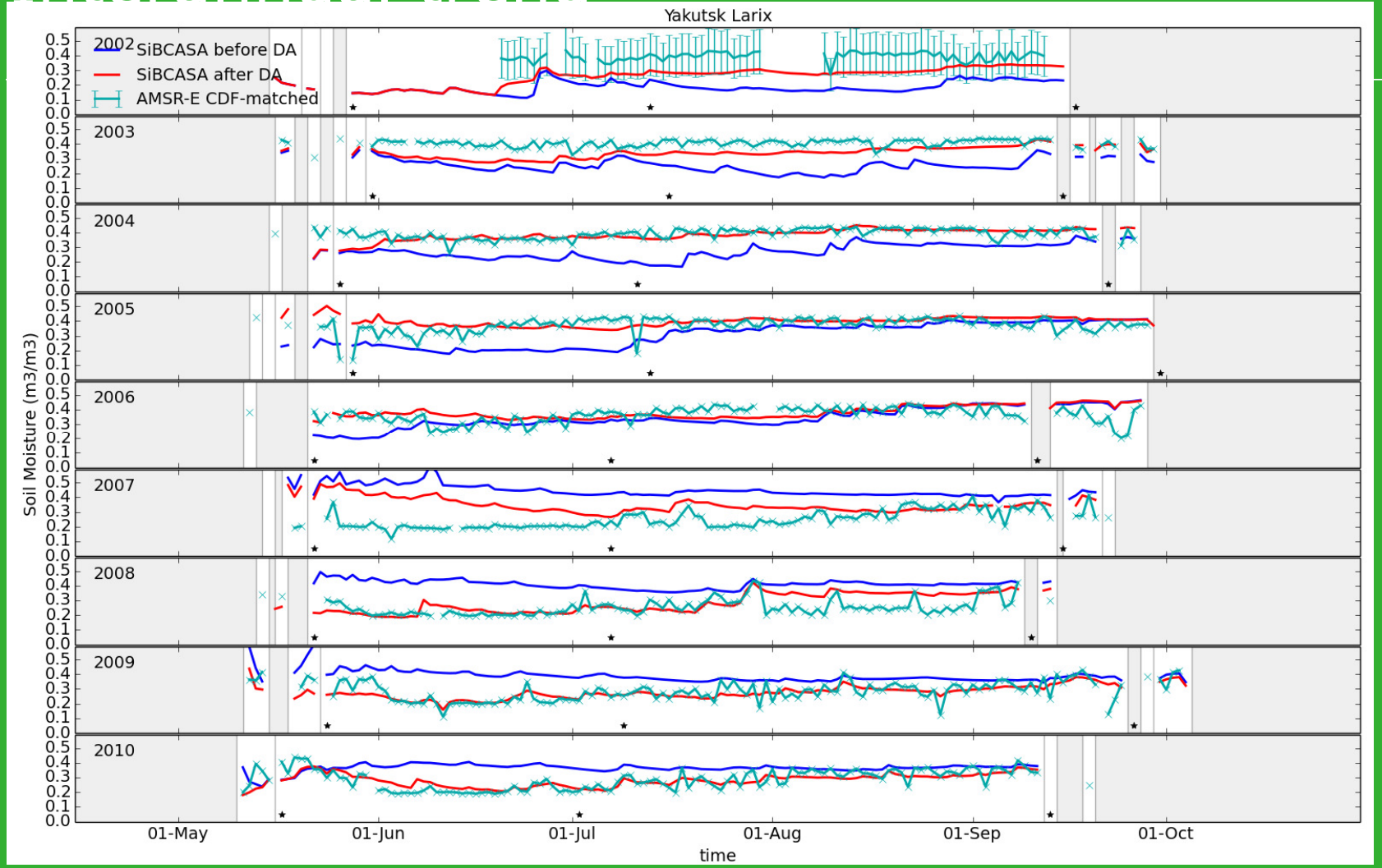
Results

- Passive Microwave vs. ASCAT
  - @Yakutsk Larix
- Effect of assimilation on:
  - soil moisture
  - NEE and components
- formulation of drought stress

Passive microwave at Yakutsk: Interannual trend



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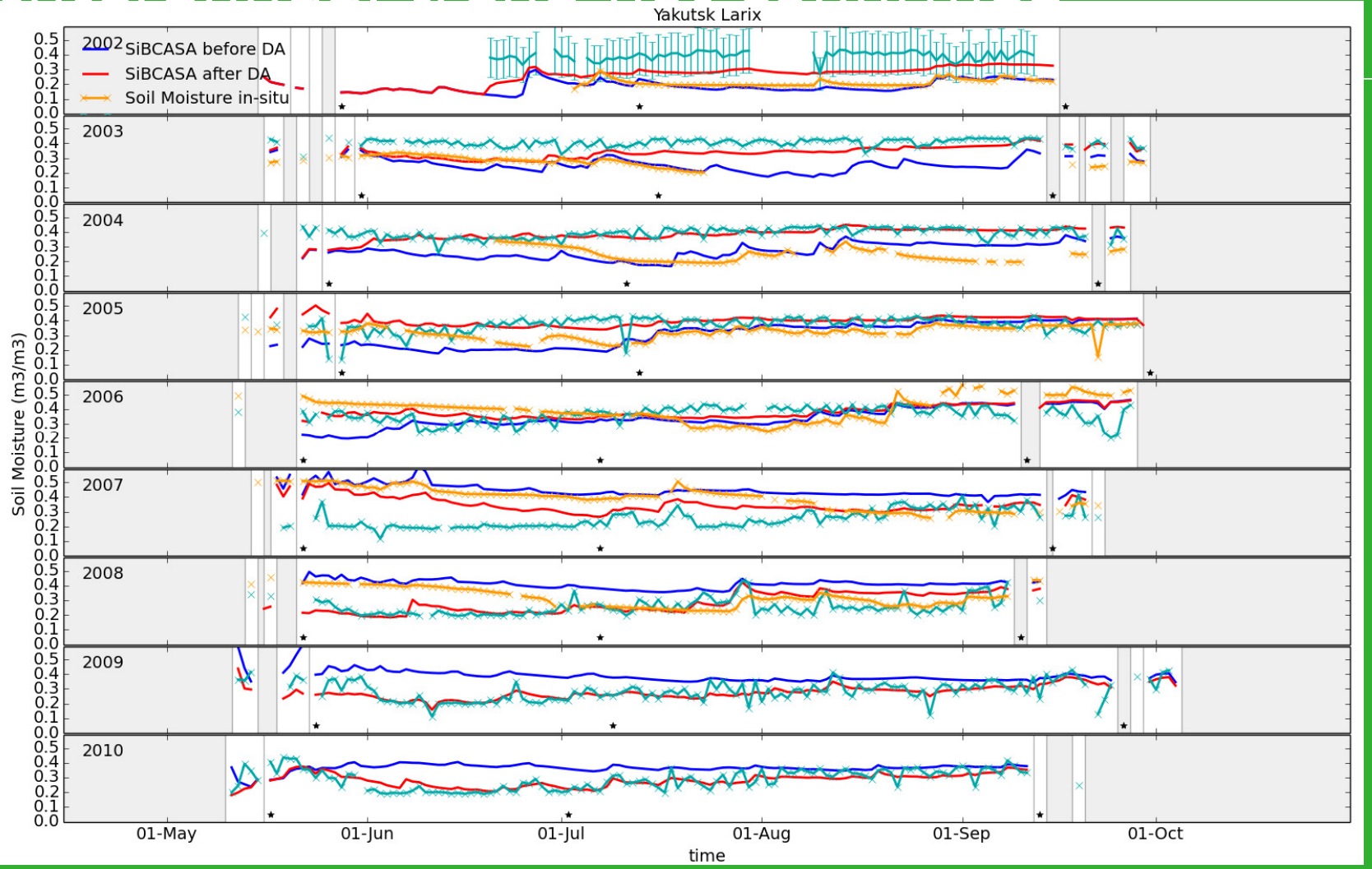
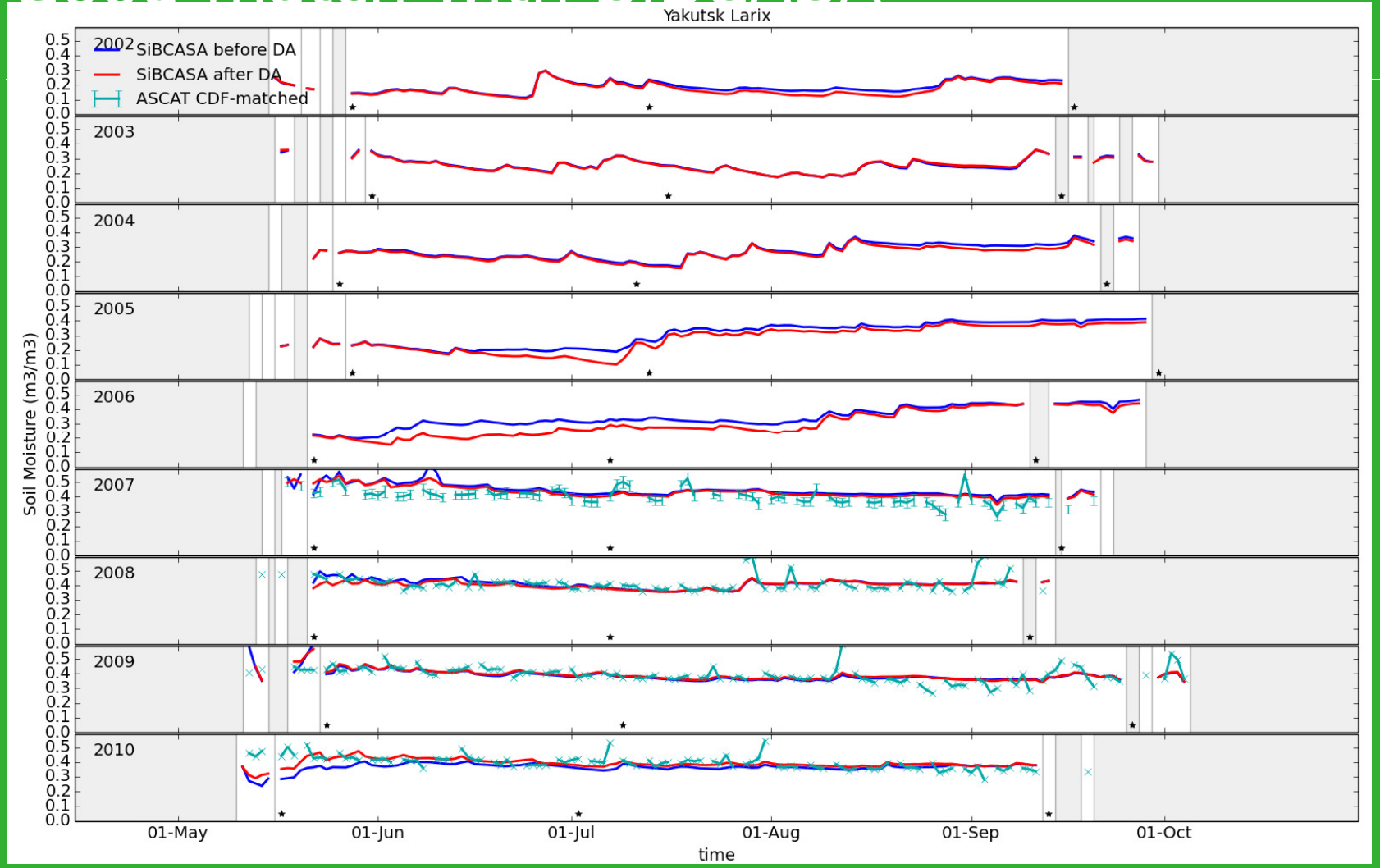
Passive microwave & In Situ: Interannual trend not confirmed



ASCAT25:
Good match with SiBCASA



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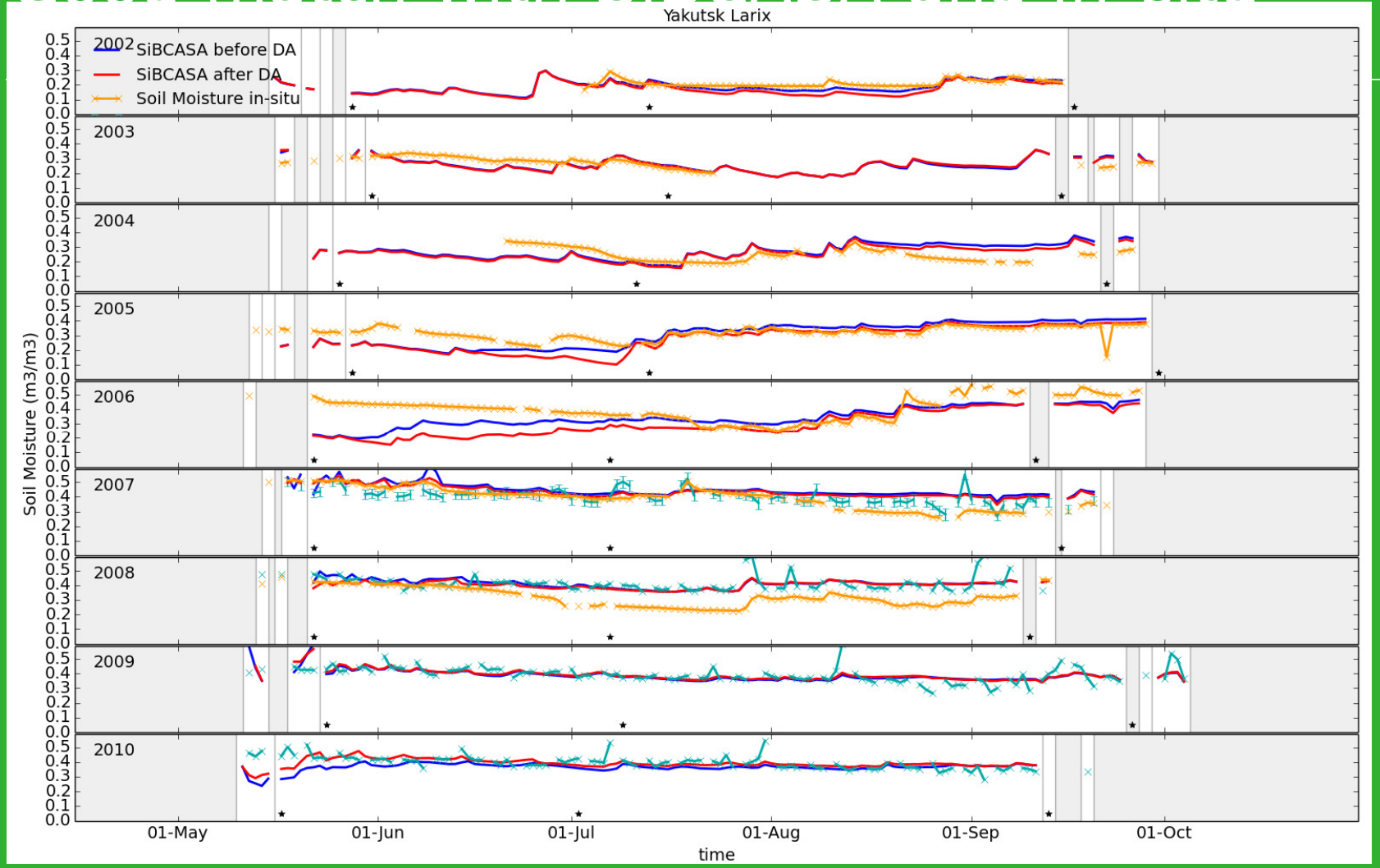
ASCAT25 & In Situ:
Good match with SiBCASA and in-situ



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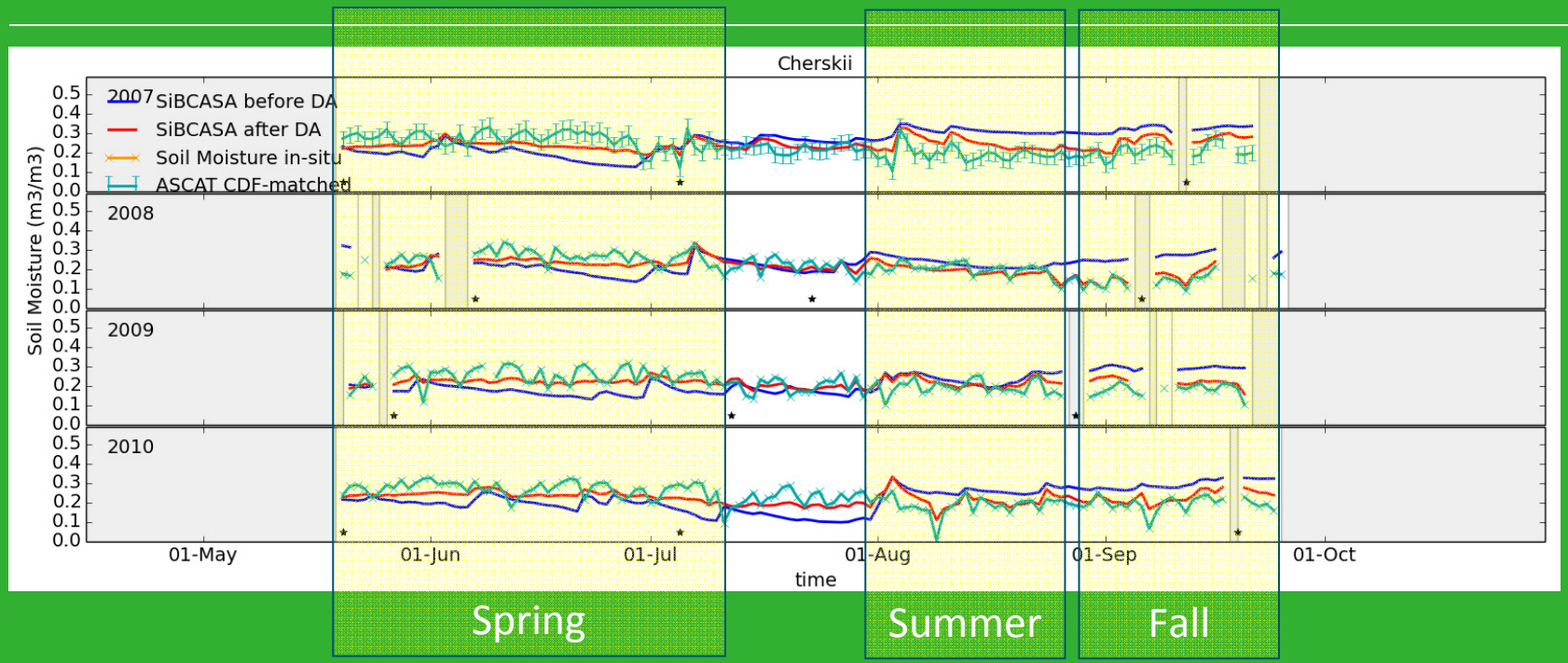
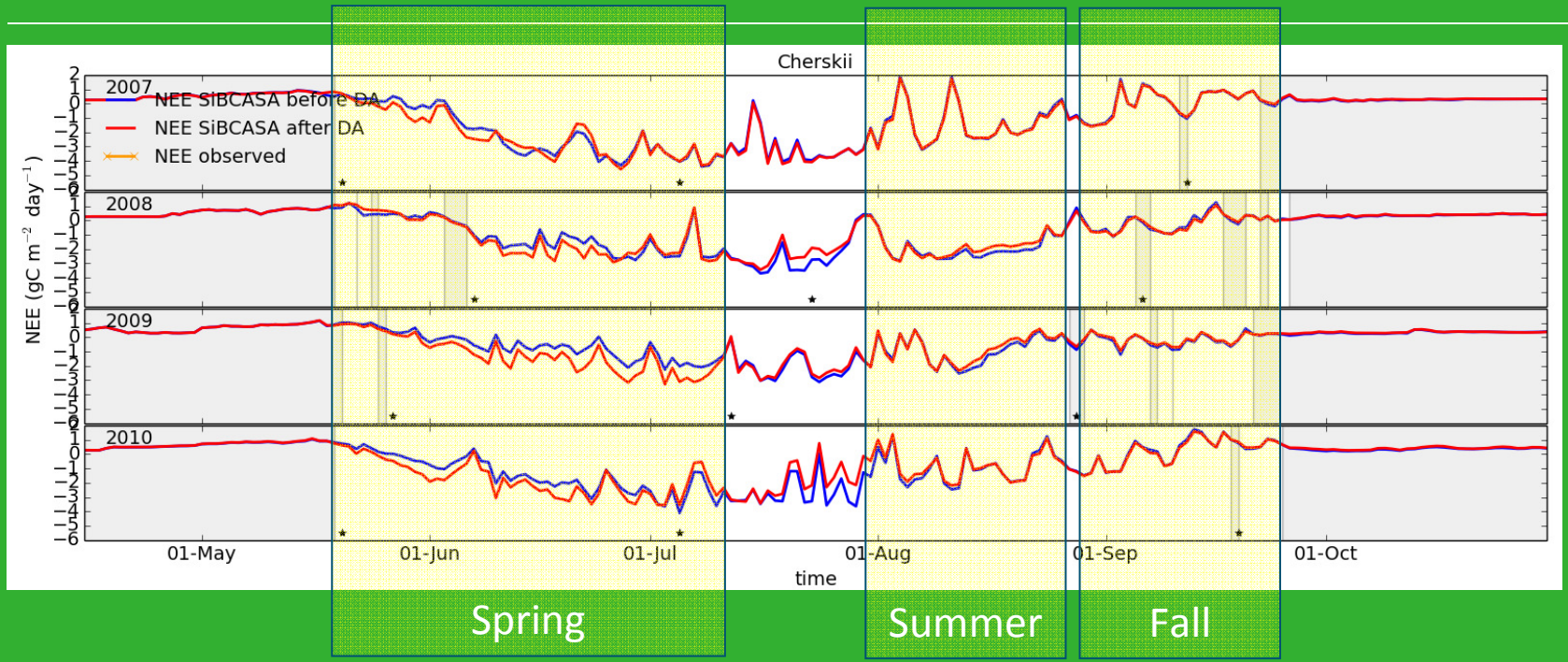
Soil moisture data assimilation



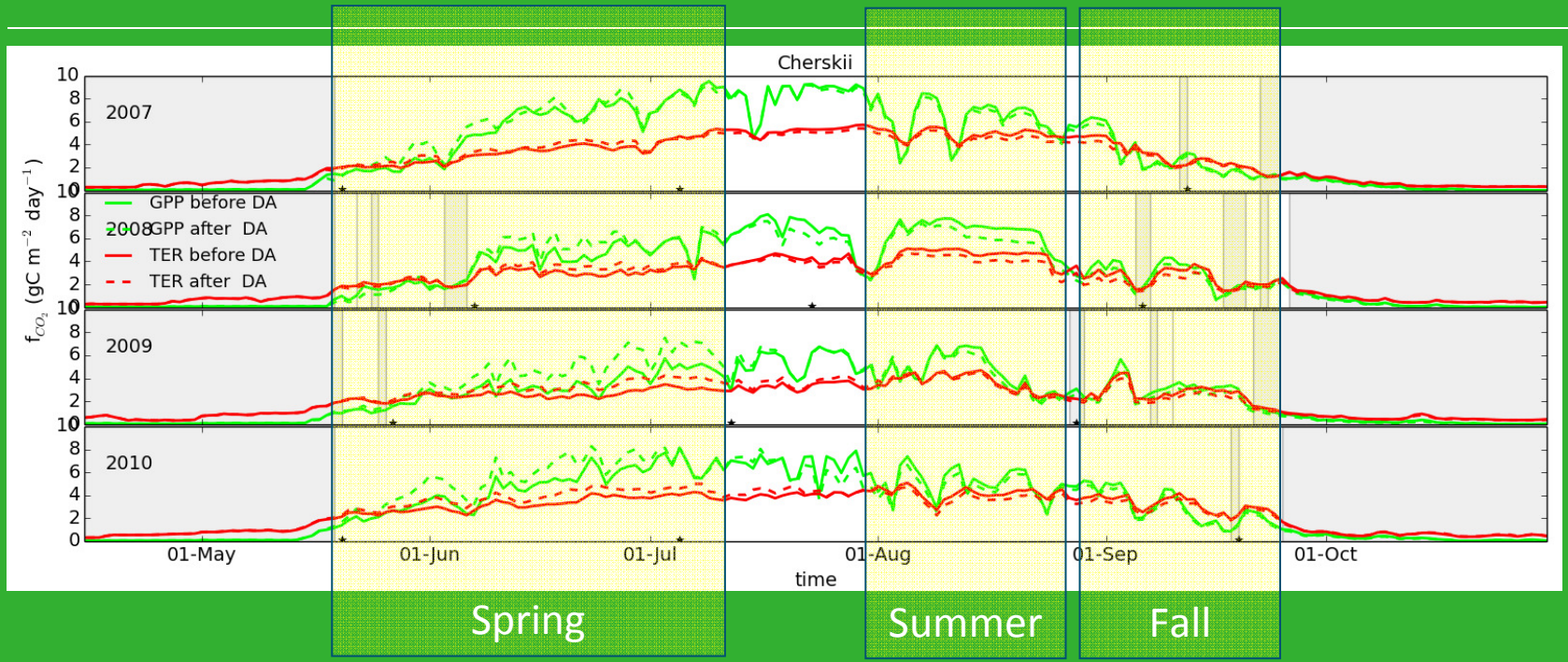
- Wetting tendency in spring (May&June)
- Drying tendency in summer/fall (Aug/Sept)

Effect on NEE



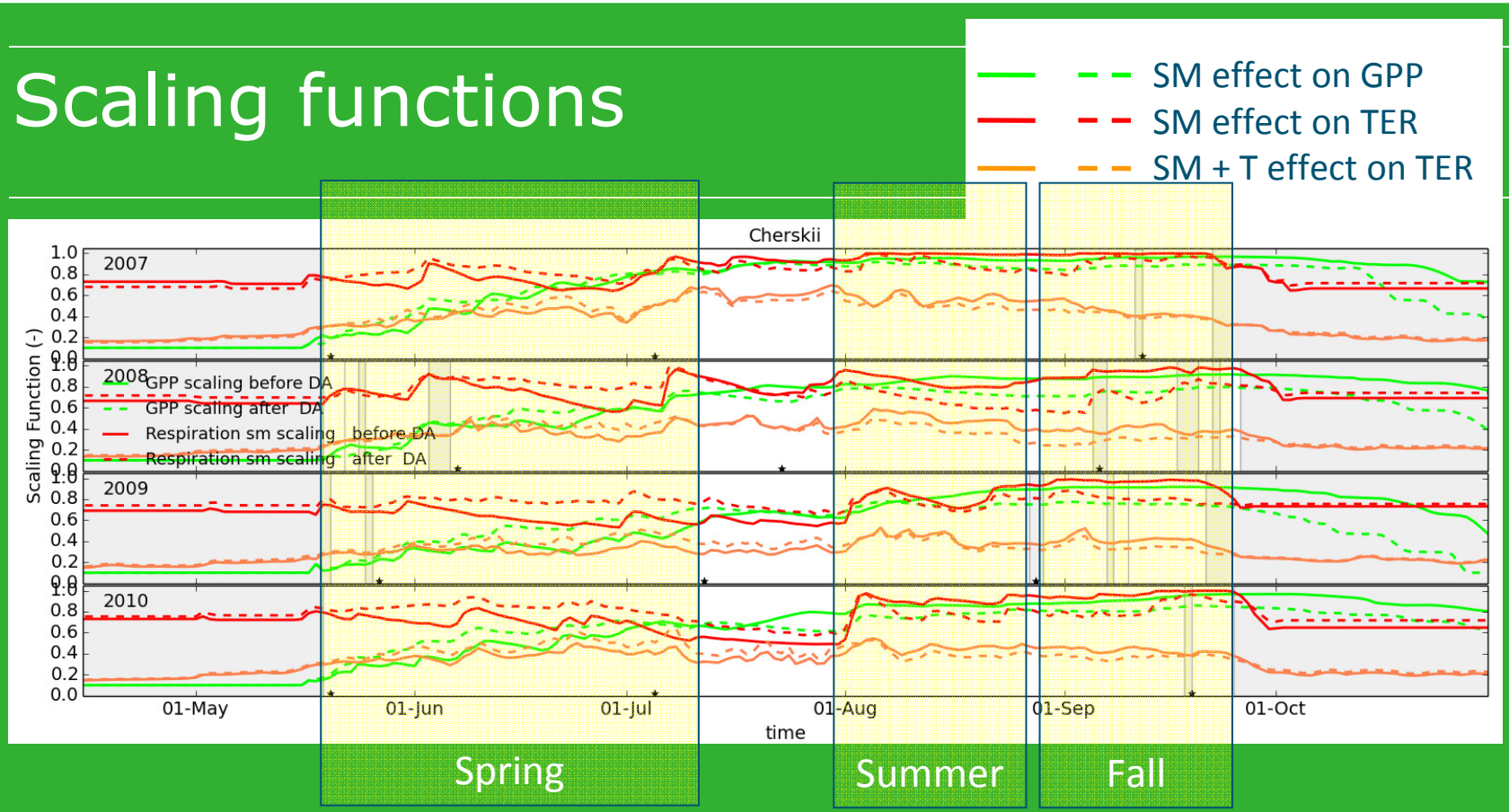
- More uptake in spring
- Less uptake in summer
- No change in fall

NEE = TER – GPP



- Wetter spring stimulates GPP
- Dryer summer reduces GPP and TER
- Dryer fall does little

Scaling functions



- Wetter spring stimulates GPP *at solar maximum*
- Dryer summer reduces TER *when it is warm*
- Dryer fall does little *when it is cold*

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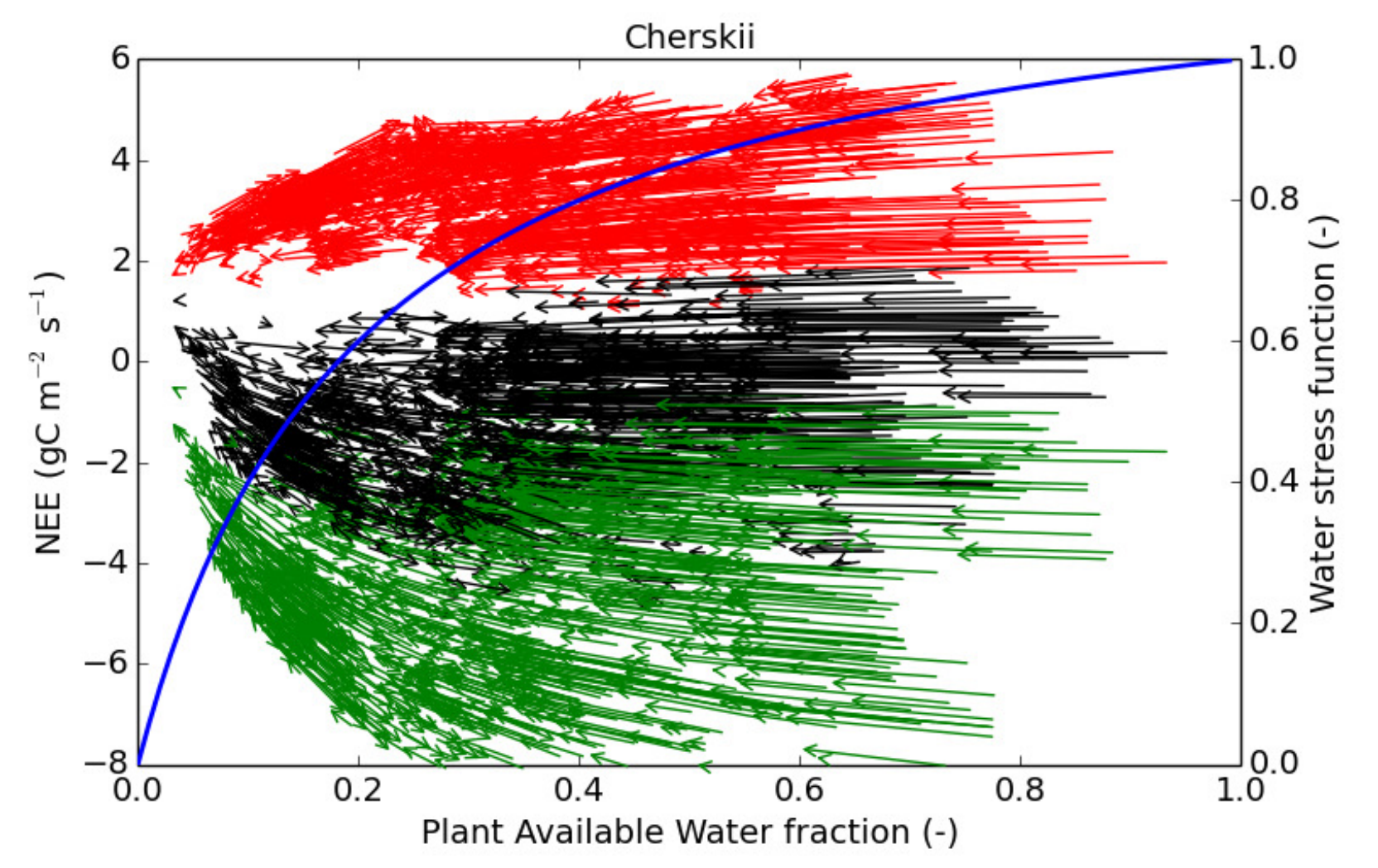
Parameterisation of drought stress



Conclusions

- SiBCASA, ASCAT and in-situ match
- Assimilation improves soil moisture
- Effect on C-fluxes depends on season

- reliability in permafrost
- formulation of drought stress

The end

Questions,
comments?

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