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Can no-till farming help mitigate heat waves?

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No-till farming

- Planting system in which tillage is suppressed or reduced and in which a large fraction of the soil remains covered by crop residues
- Reduces erosion, water losses and limits weed growth
- Carbon sequestration potential (Smith et al., IPCC WGIII, 2007)

Source: www.notill.org

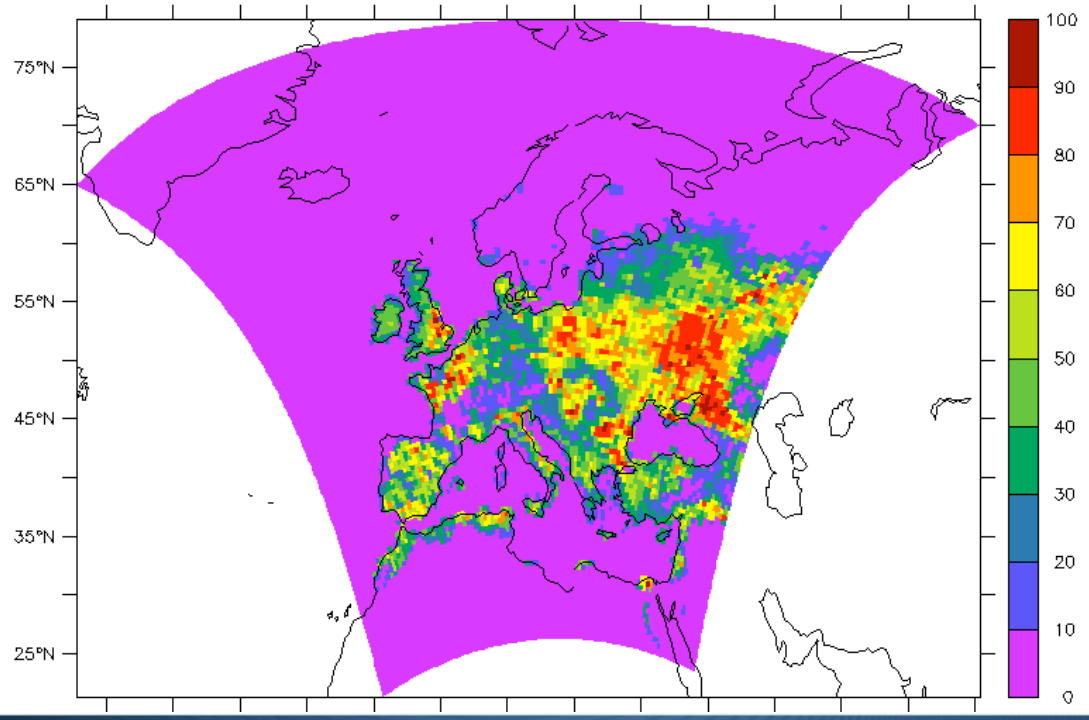
Motivations

- Biogeophysical impacts (e.g., albedo) of no-till agriculture largely overlooked (Lobell et al., 2006)

- Large potential for expansion of no-till agriculture in Europe

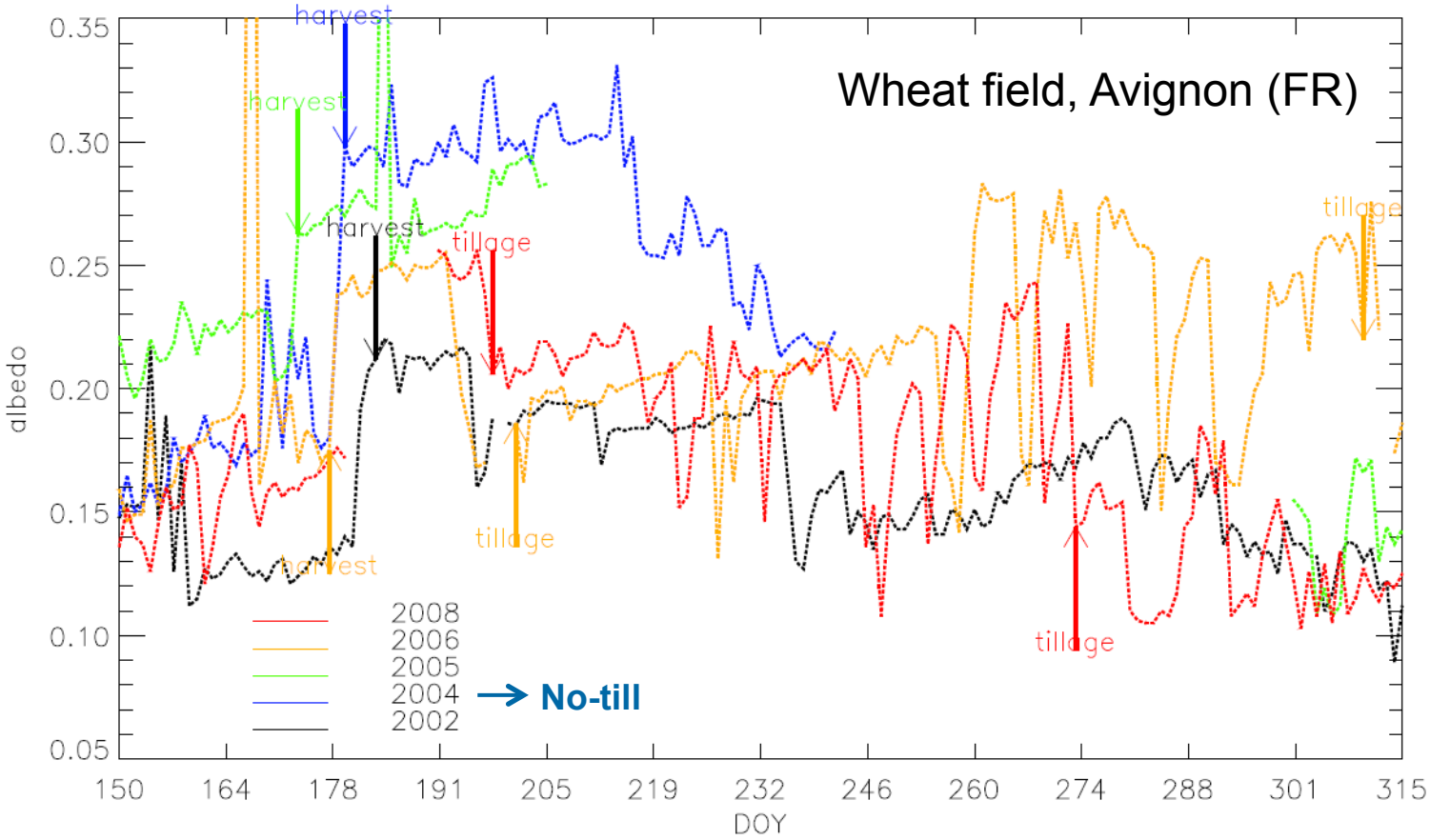
Model experiments

- COSMO-CLM RCM coupled to Community Land Model (CLM3.5)
- ERA40-driven runs over Europe for 1980-2005 (1986-2005 analysed)
- **CTL**: control run; **NOTILL**: 100% no-till scenario, with empirically prescribed albedo increase (~ +0.1) over croplands.



Crop distribution (%)

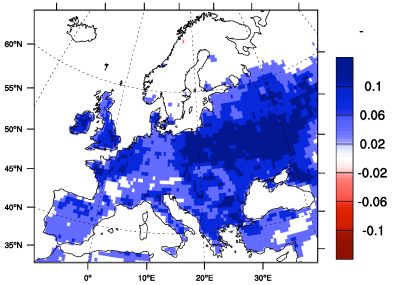
Observational constraints



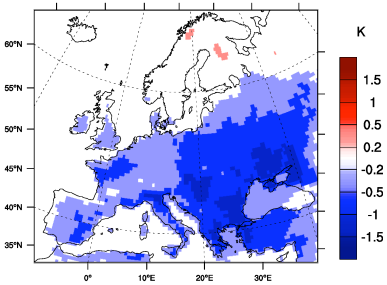
- ~0.1 increase in albedo under no-till conditions
- Comparable to the 50% (relative) increase of soil albedo assumed by *Lobell et al., (2006)*

Summer mean change (NOTILL – CTL)

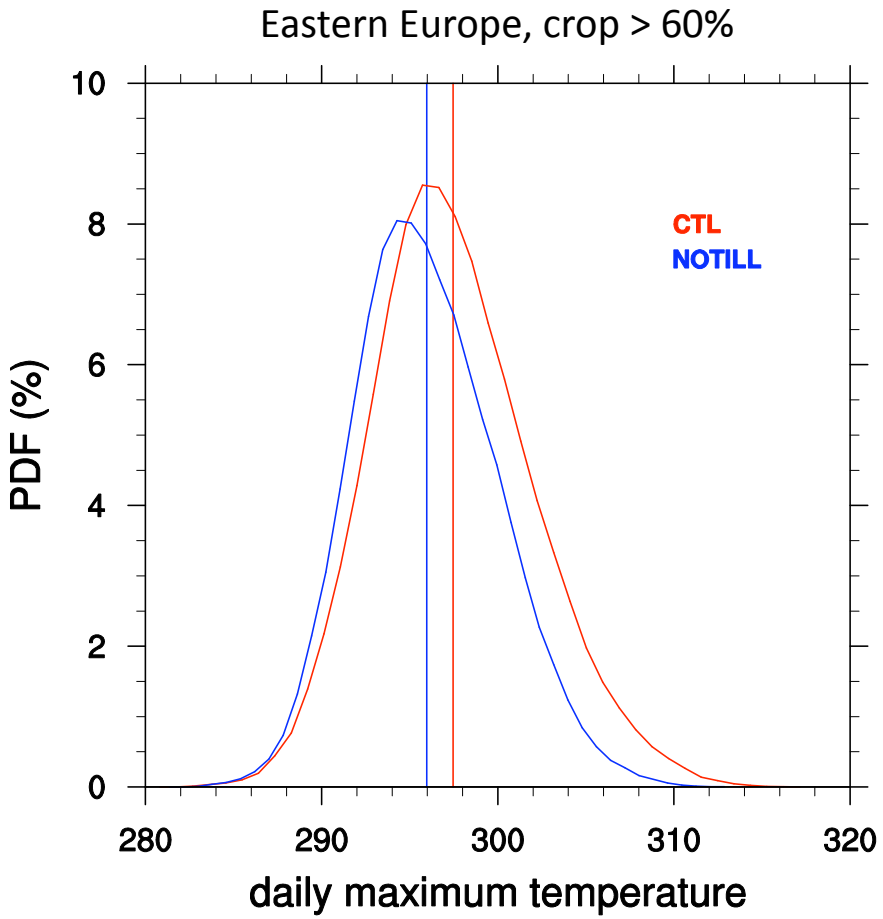
Albedo change



2-meter temperature change



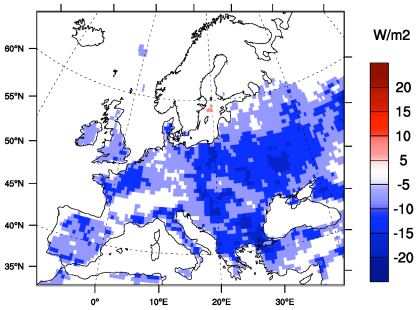
Change in temperature distribution



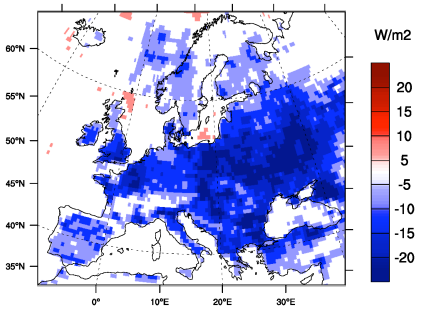
- Asymmetric effect: larger impact on warm extremes

TOA shortwave radiation change (NOTILL – CTL)

Summer mean change

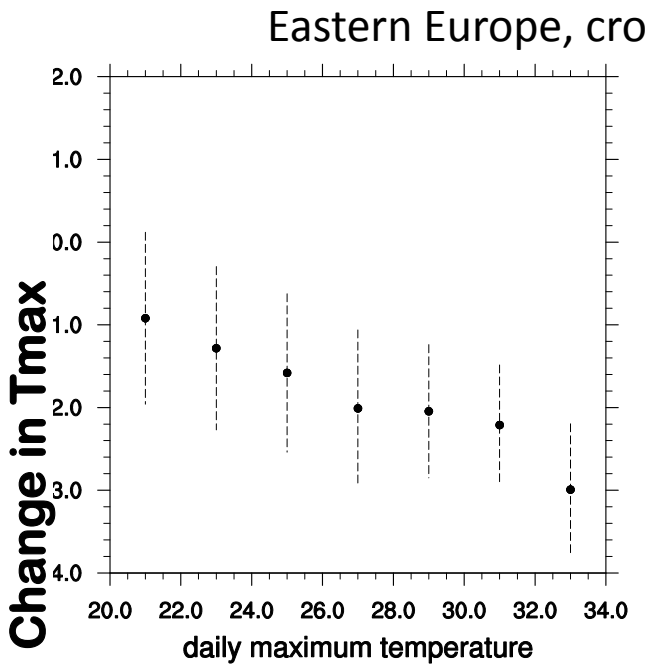


Change for the 10% warmest days



- Radiative perturbation more pronounced for warm days associated with clear sky conditions

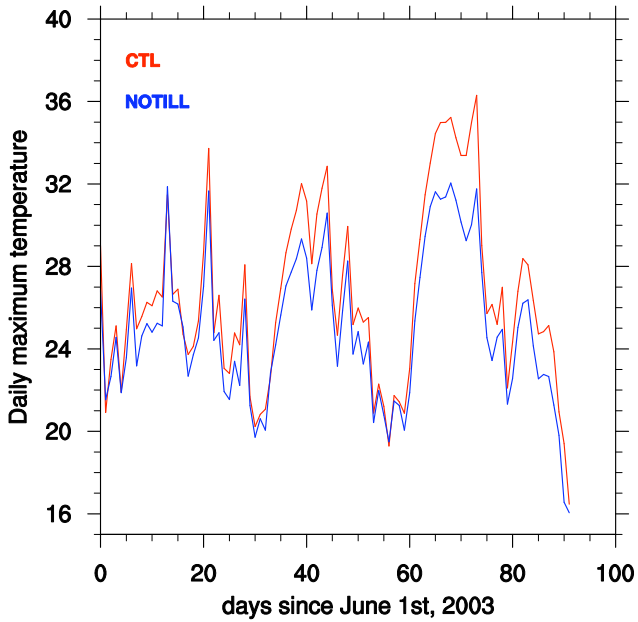
Mitigation potential



- Cooling effect ~3-times larger during a heat wave day compared to a normal summer day

Summer 2003

France, crop > 60%



Conclusions

- No-till farming may have a cooling influence owing to albedo increase
- Mitigation potential is larger for warm events, because clear sky conditions exacerbate the radiative perturbation
- Up to 3-4 K temperature reduction during extremes like 2003 summer in France

Caveats and future directions

- Albedo effect of no-till is poorly constrained → synthesis from multiple sites over Europe is in preparation

- Albedo is not the only biogeophysical impact → incorporate effect on soil evaporation