Ilmastomuutoksen riskimallinnuksen tuloksia: millaiset ovat tulevaisuuden ilmasto-olosuhteet viljelylle Suomessa?

Taru Palosuo

Luonnonvarakeskus (Luke)
Biotalous ja ympäristö
Hiilen kierron hallinta

Pellon käytön optimoinnilla ratkaisuja ilmastonmuutokseen –seminaari 5.2.2018

Luke
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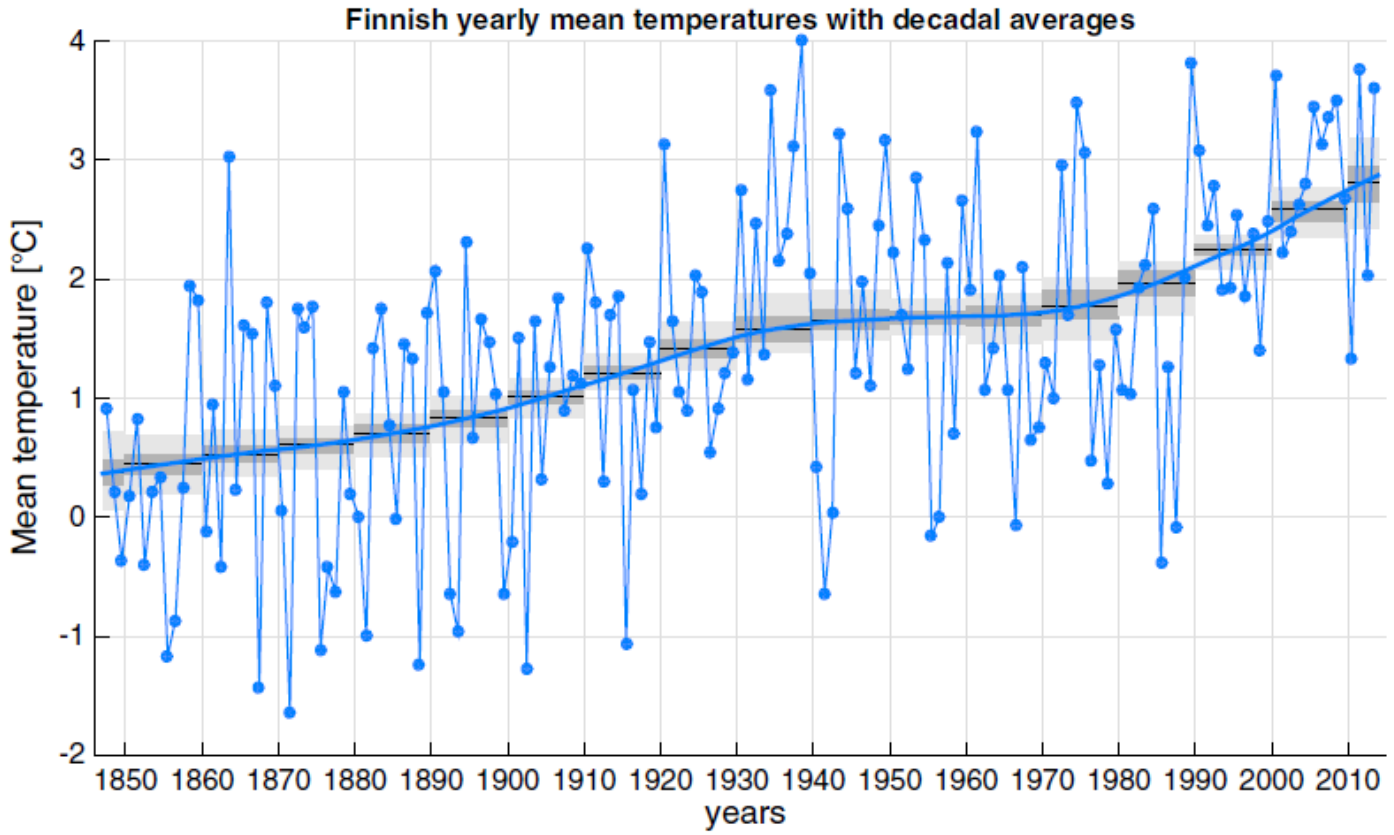
Lämpötila Suomessa on noussut jo yli 2 astetta 1800-luvun puolivälistä.



Mikkonen et al. 2015. Trends in the average temperature in Finland, 1847–2013. Stoc Environ Res Risk Assess (2015) 29:1521–1529.

Luke
LUONNONVARAKESKUS

Ilmastonmuutoksen eteneminen riippuu kasvihuonekaasupäästöjen määrästä.

IPCC on 5. arviointiraportissaan (2013) määritellyt neljä uutta päästöskenaariota:

RCP 8.5 – nykytahdilla kasvavat päästöt
RCP 6.0
RCP 4.5
RCP 2.6 – tiukat päästörajoitukset

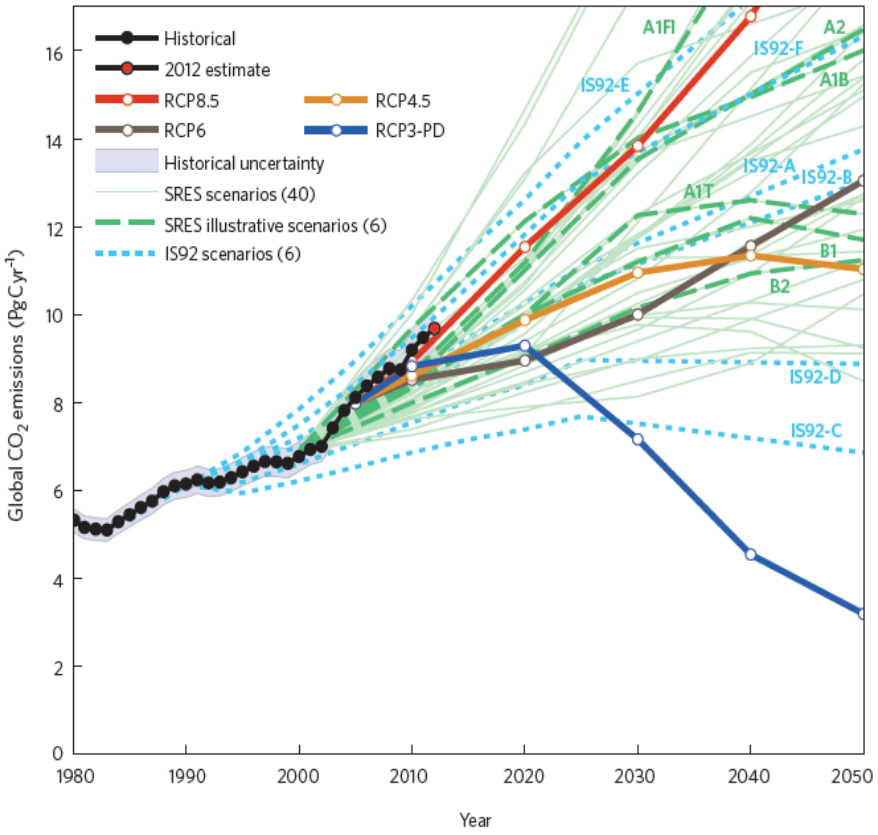


Figure 1 | Estimated CO_2 emissions over the past three decades compared with the IS92, SRES and the RCPs. The SA90 data are not shown, but the most relevant (SA90-A) is similar to IS92-A and IS92-F. The uncertainty in historical emissions is ±5% (one standard deviation). Scenario data is generally reported at decadal intervals and we use linear interpolation for intermediate years.

Peters et al. 2013. Nature Climate Change 3: 4-6.

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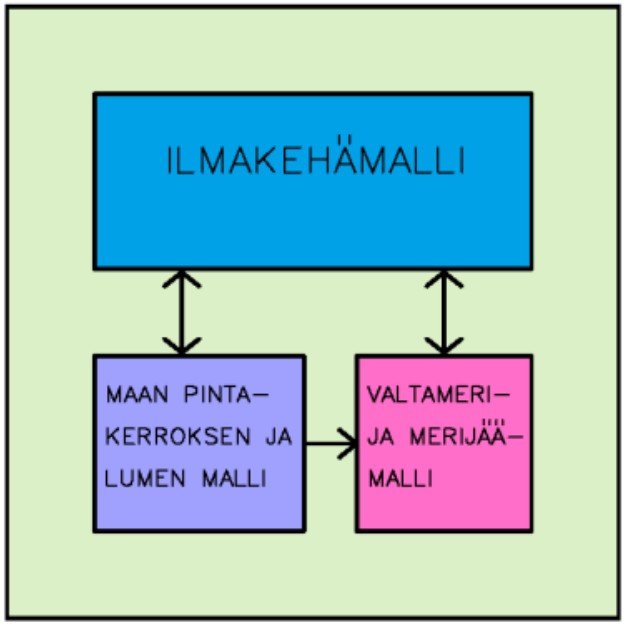
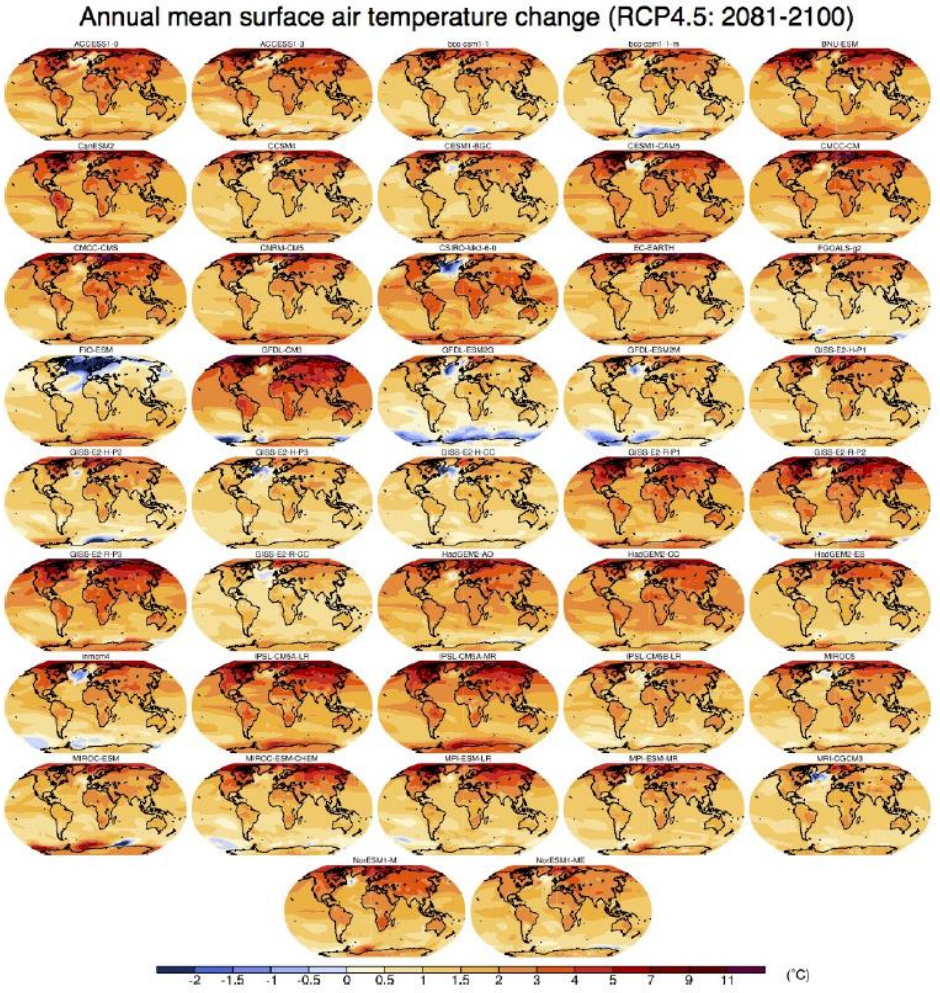
Päästöjen vaikutus ilmastoon arvioidaan ilmastojärjestelmän käyttäytymistä jäljittelevien maailmanlaajuisten ilmastomallien avulla.



Kuva 1. Ilmastomallin osat ja osien väliset vuorovaikutukset: lämpöenergian vaihto alustan ja ilmakehän välillä, veden haihtuminen, alustan aiheuttama ilman virtauksia jarruttava kitka, veden virtaus jokia myöten manneralueilta meriin jne.

www.ilmasto-opas.fi



IPCC:n 5. arviointiraportti, WGI

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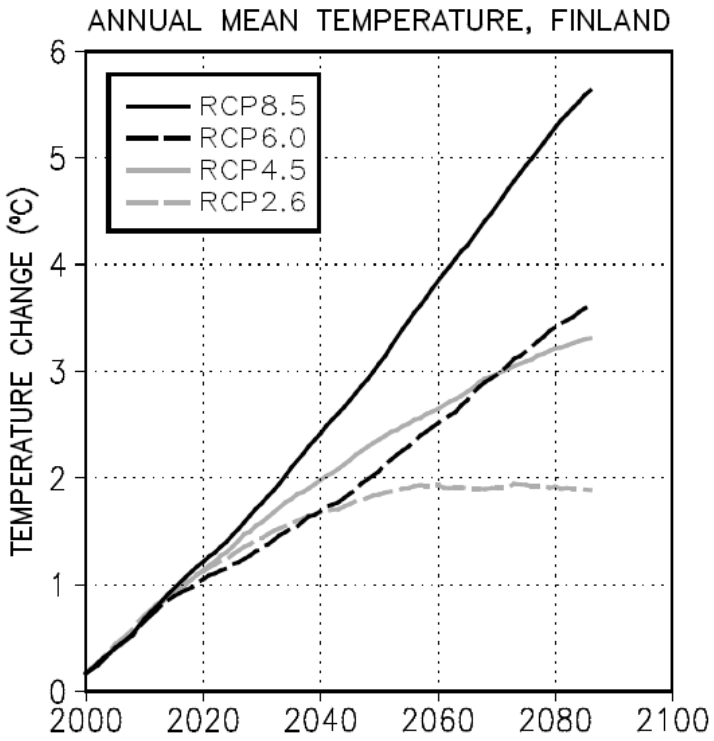
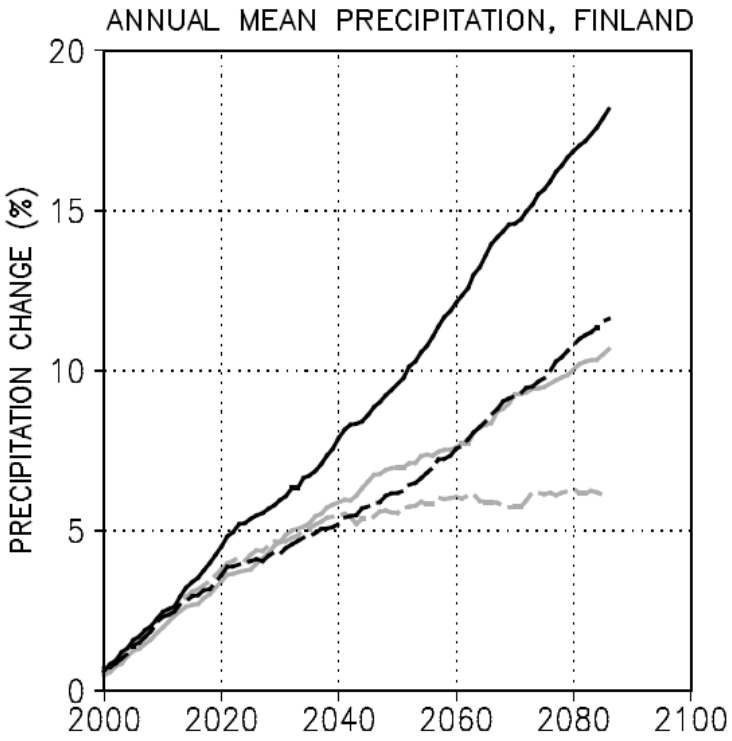
Ilmastomallien ennusteita Suomelle

(28 ilmastomallin keskiarvot verrattuna jaksoon 1981–2010)

Lämpötilan vuosikeskiarvo, Suomi



Sademäärän vuosikeskiarvo, Suomi



Ruosteenoja et al., 2016, Climate Projections for Finland under the RCP Forcing Scenarios. Geophysica 51(1):17-50.

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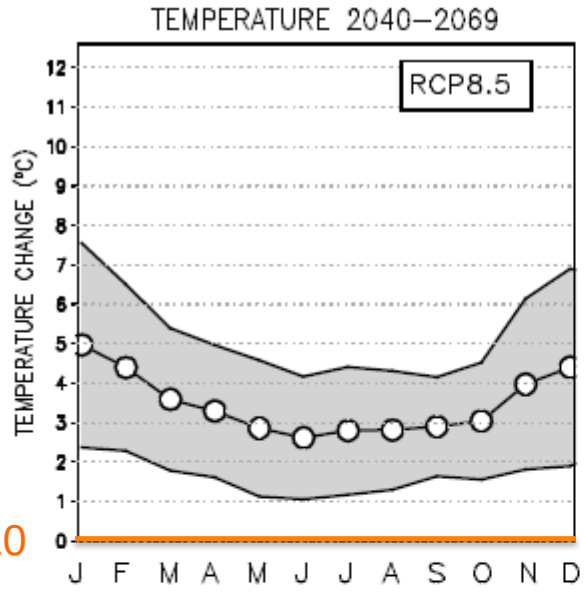
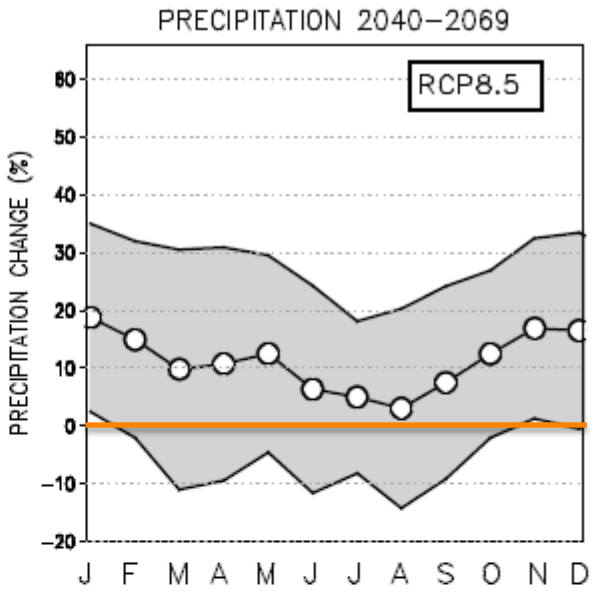
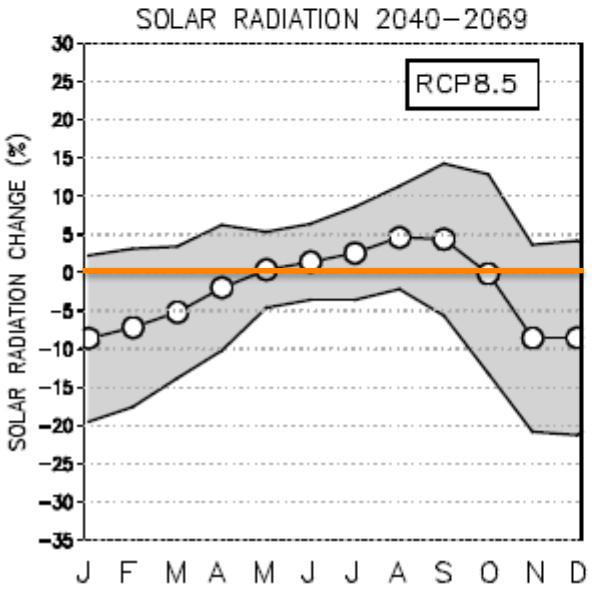
Sekä sademäärä että lämpötila nousevat talvella enemmän kuin kesällä.

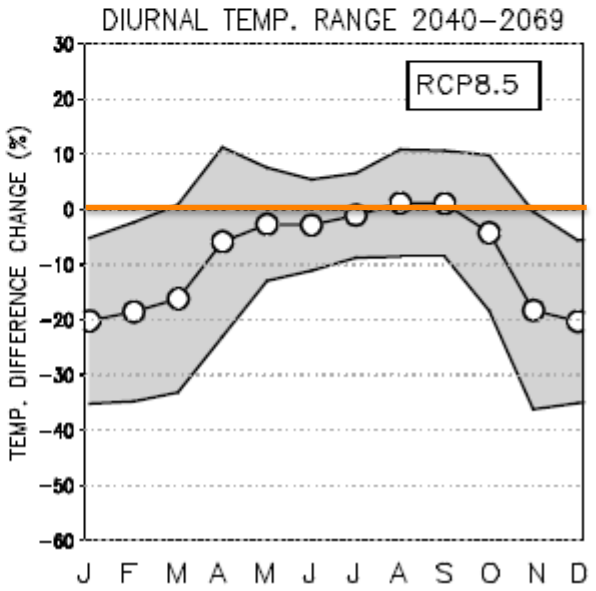
1981-2010

Mallituloksissa merkittäviä eroja.









Ruosteenoja et al., 2016, Climate Projections for Finland under the RCP Forcing Scenarios. Geophysica 51(1):17-50.

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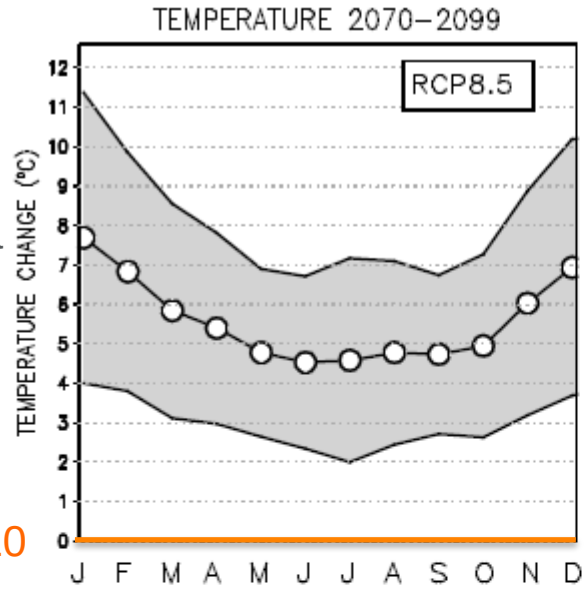
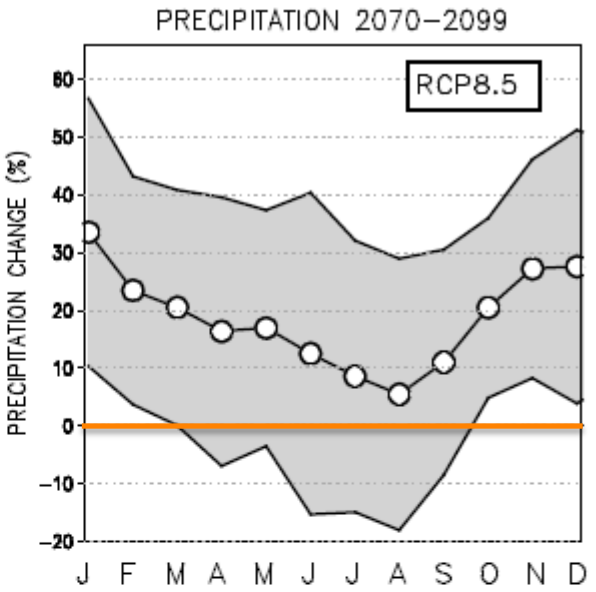
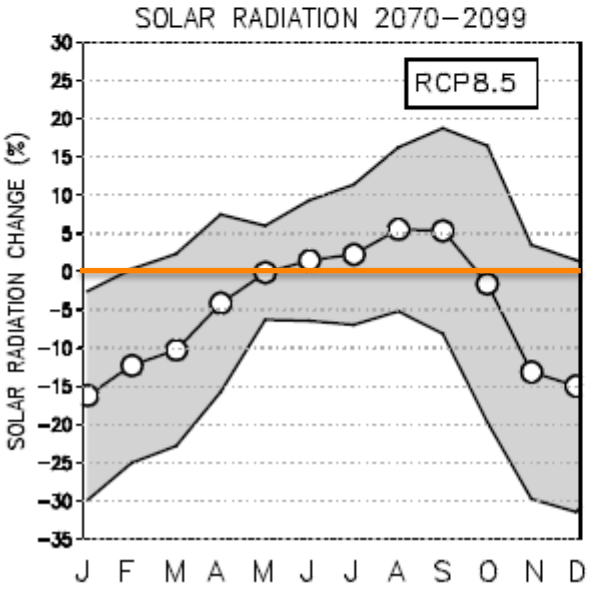
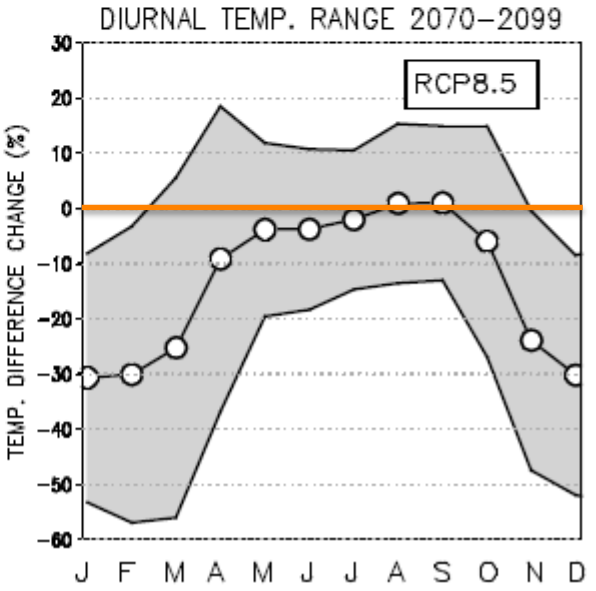
RCP8.5 skenario vuosisadan lopussa näyttää muutosten suuruuden, jos mihinkään hillintätoimiin ei ryhdytä.

1981-2010









Ruosteenoja et al., 2016, Climate Projections for Finland under the RCP Forcing Scenarios. Geophysica 51(1):17-50.

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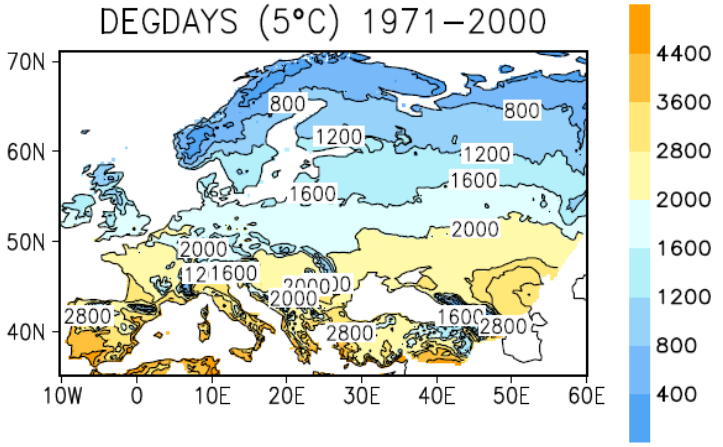
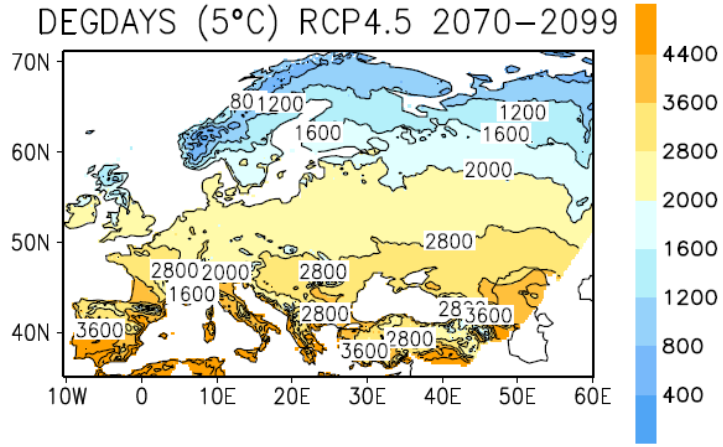
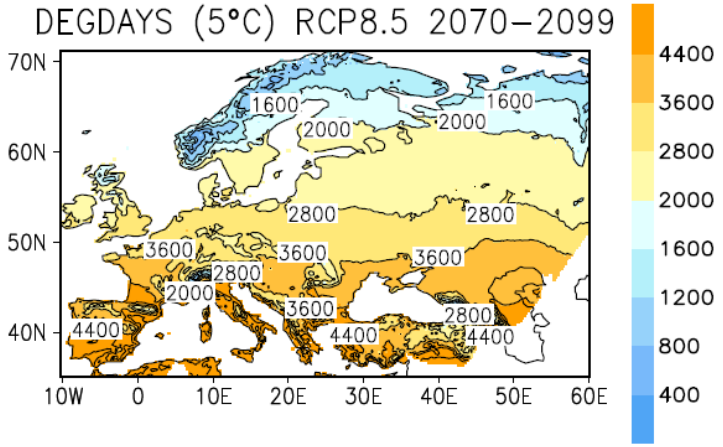
Kasvukauden lämpösumma







Ruosteenoja et al., 2015, Projections for the duration and degree days of the thermal growing season in Europe derived from CMIP5 model output. International Journal of Climatology doi: 10.1002/joc.4535.

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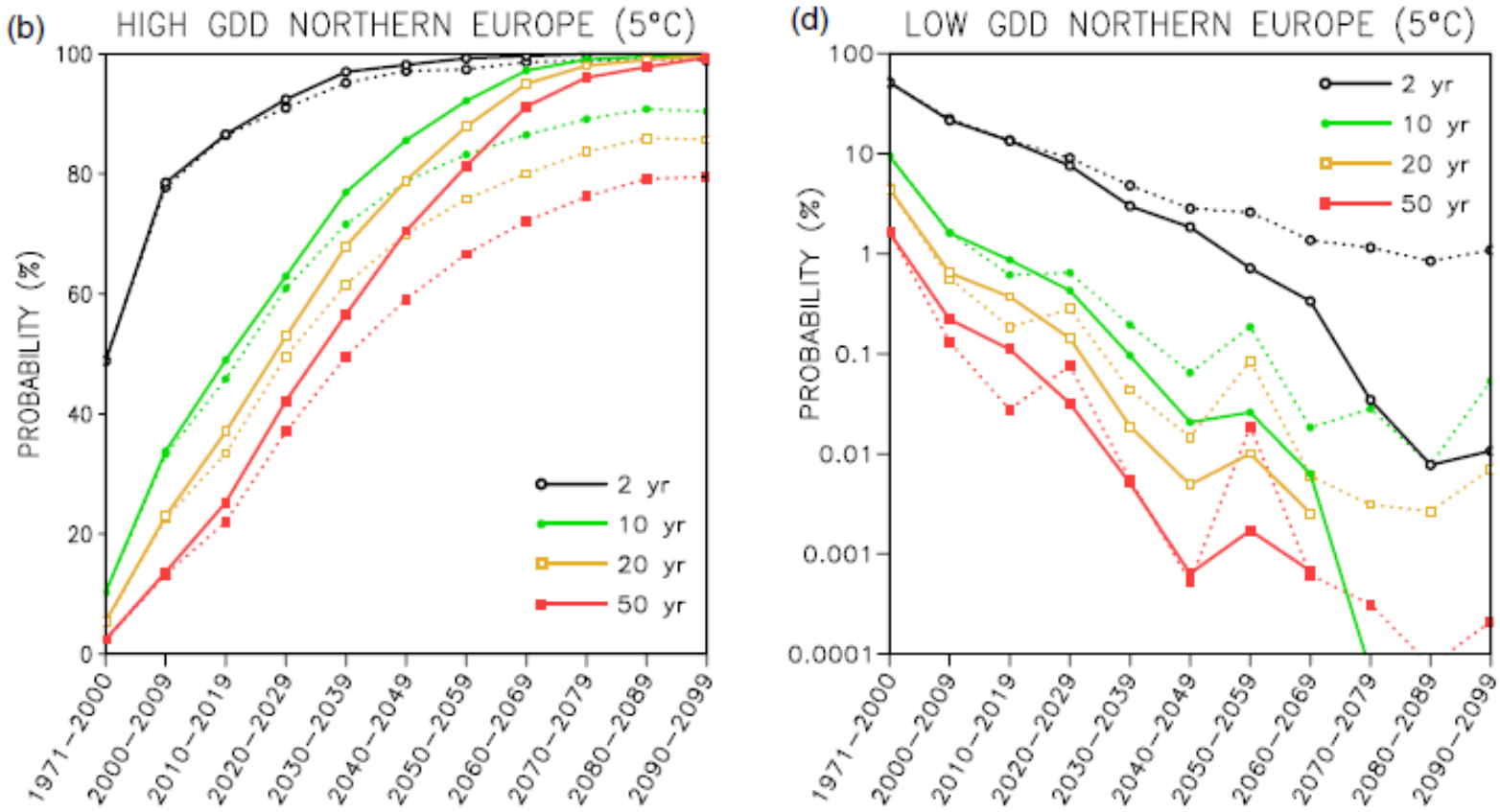
Lämpösummien kasvu



RCP8.5

RCP4.5

Ruosteenoja et al., 2015, Projections for the duration and degree days of the thermal growing season in Europe derived from CMIP5 model output. International Journal of Climatology doi: 10.1002/joc.4535.

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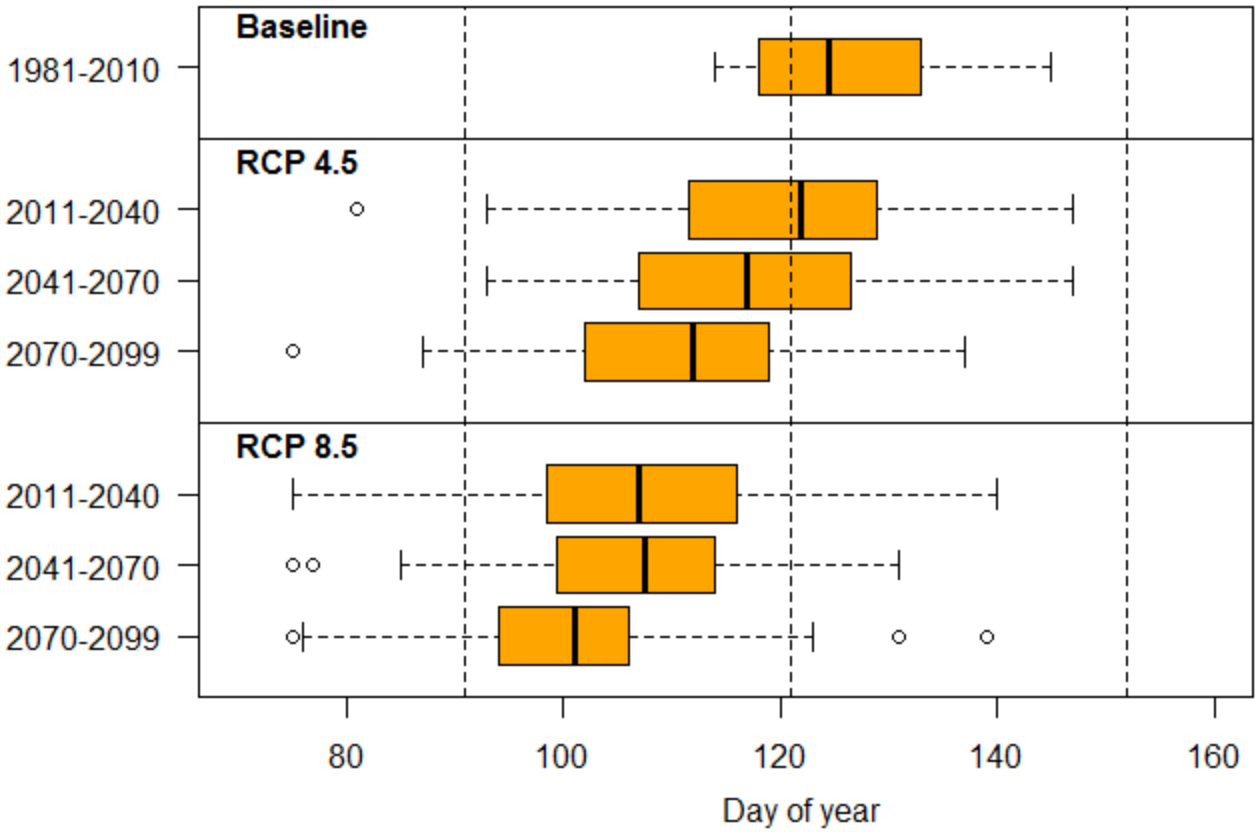
Kylvöaika



Peltonen-Sainio et al. 2018. Warming autumns at high latitudes of Europe: an opportunity to lose or gain in agriculture? Regional Environmental Change. In Press.

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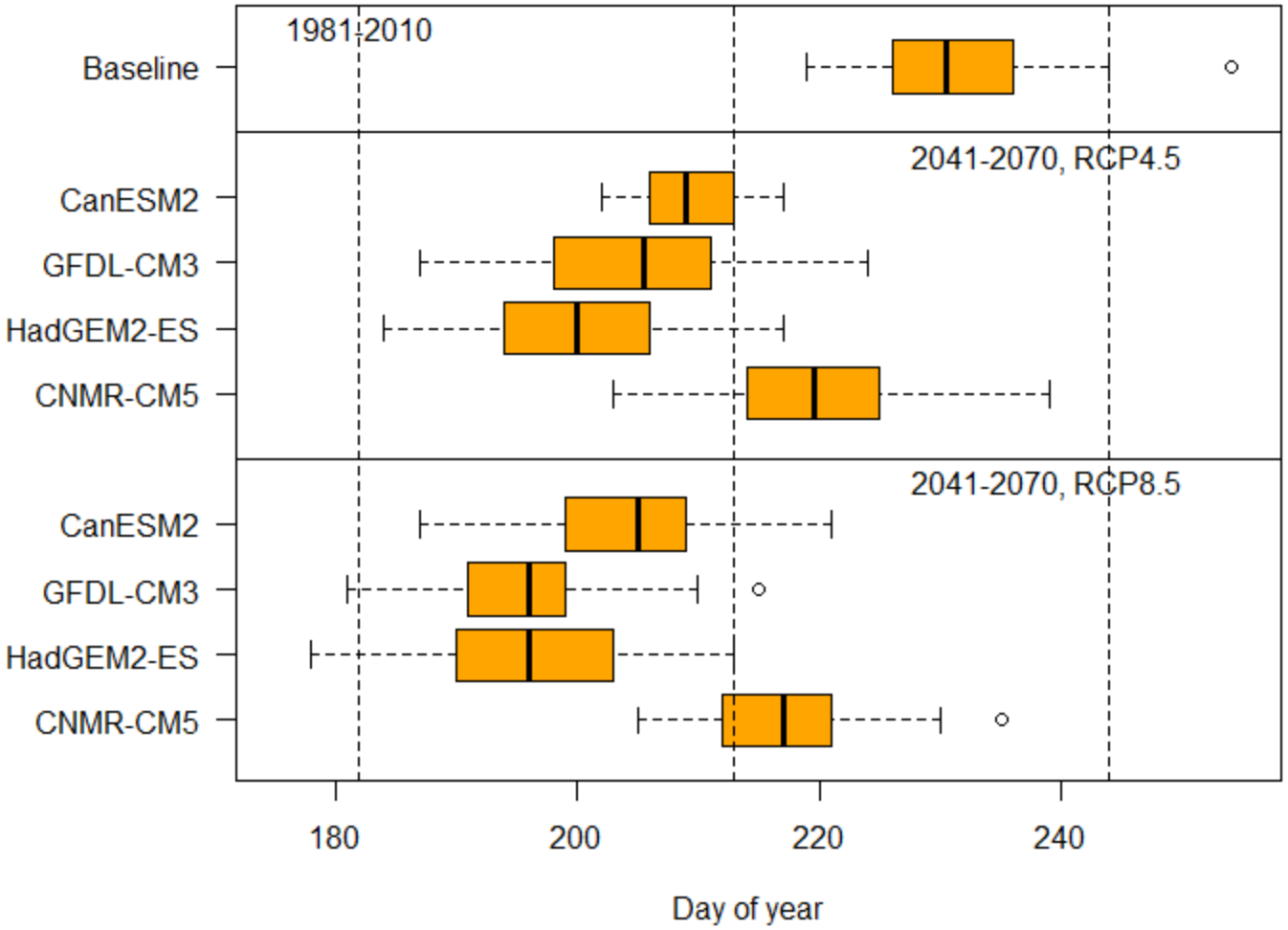
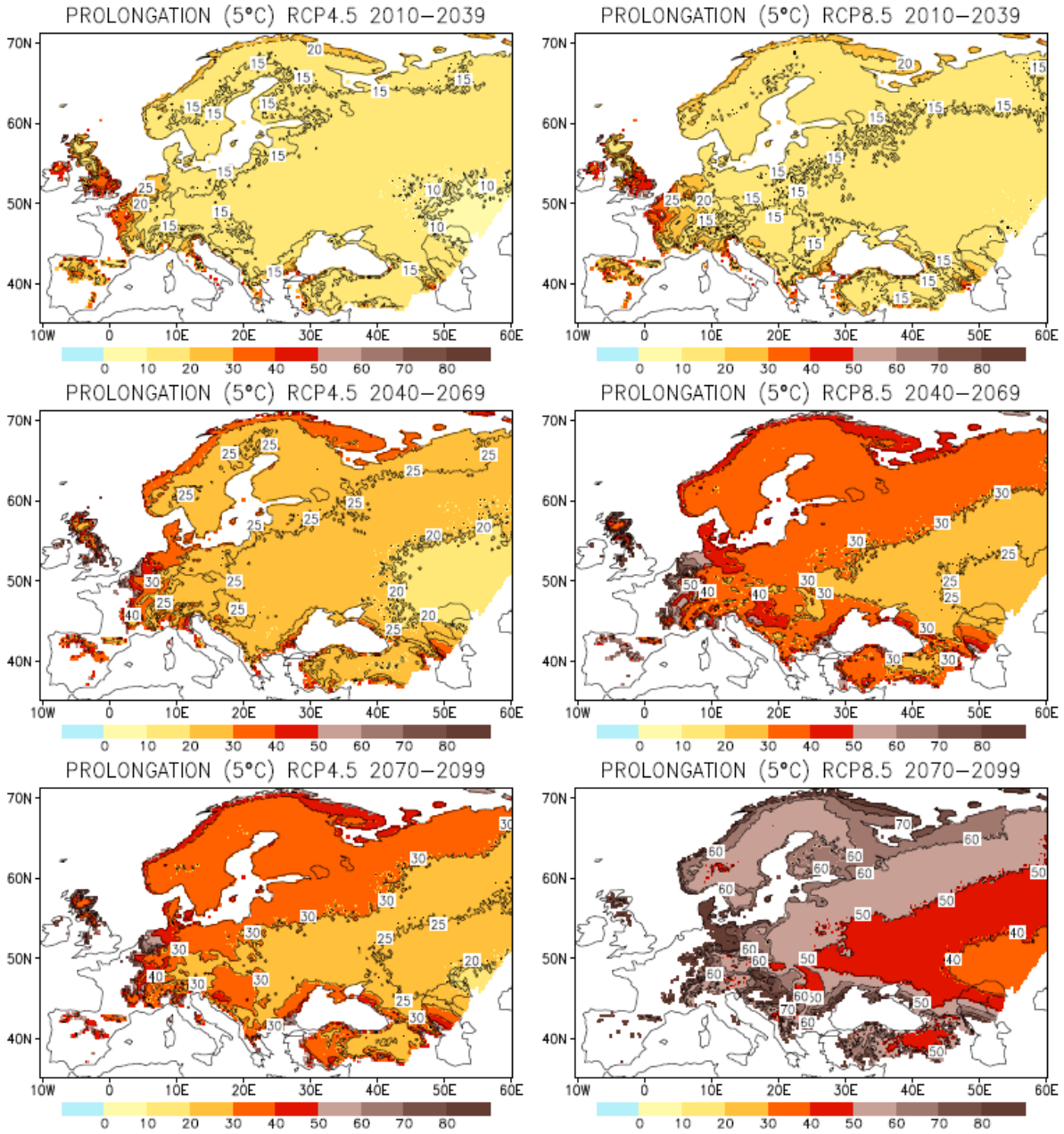
Vehnän kypsyminen, nykyinen lajike



Peltonen-Sainio et al. 2018. Warming autumns at high latitudes of Europe: an opportunity to lose or gain in agriculture? Regional Environmental Change. In Press.

Kasvukauden pituus



Ruosteenoja et al., 2015, Projections for the duration and degree days of the thermal growing season in Europe derived from CMIP5 model output. International Journal of Climatology doi: 10.1002/joc.4535.

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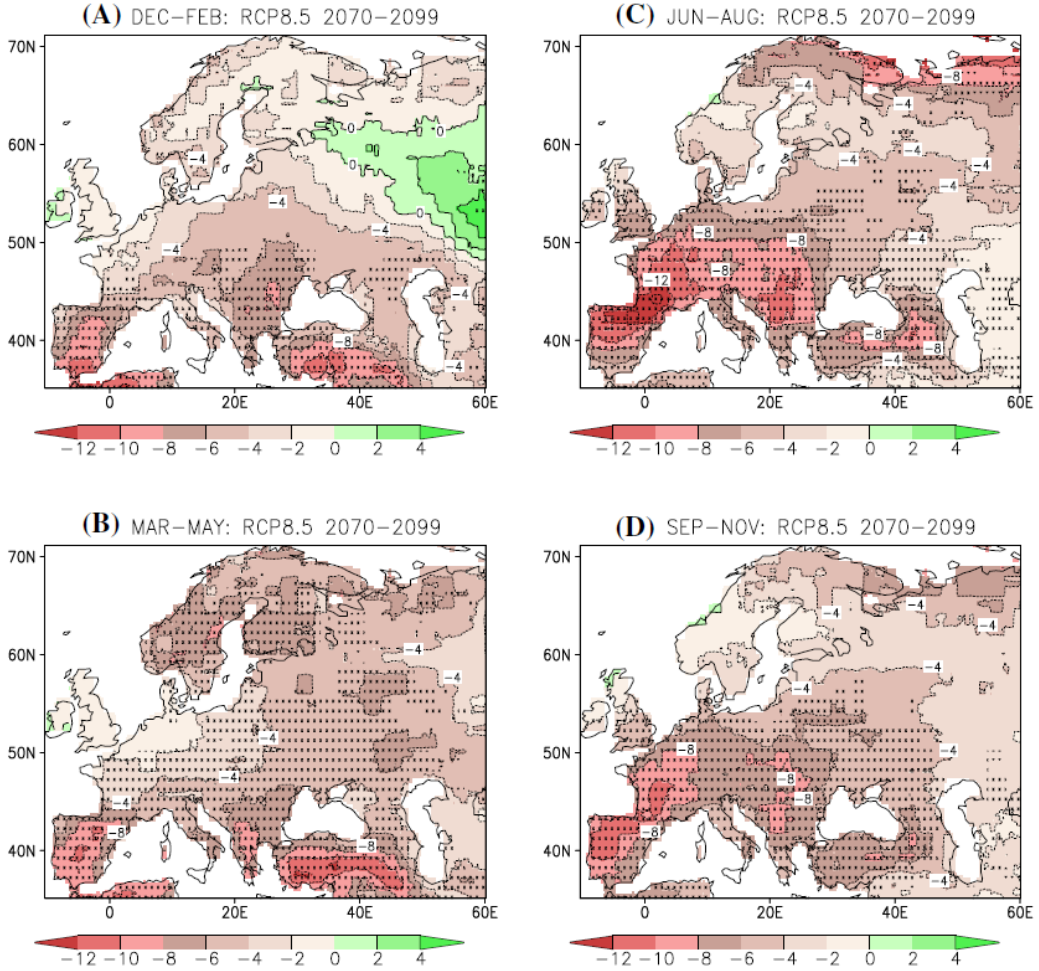
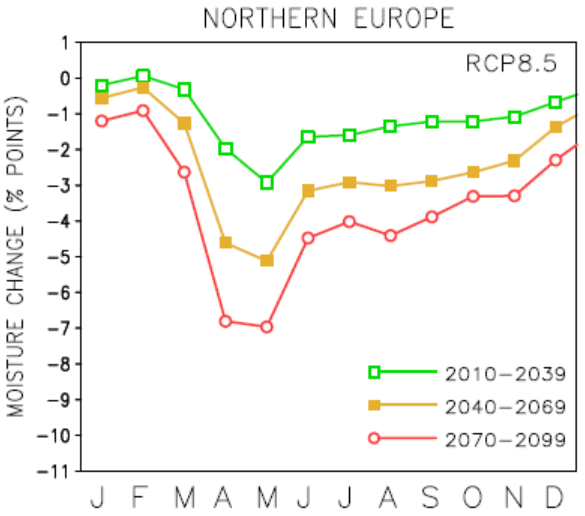
Kuivuusriski ja maaperän kosteus





Ruosteenoja et al., 2017, Seasonal soil moisture and drought occurrence in Europe in CMIP5 projections for the 21st century. Climate Dynamics, doi: 10.1007/s00382-017-3671-4

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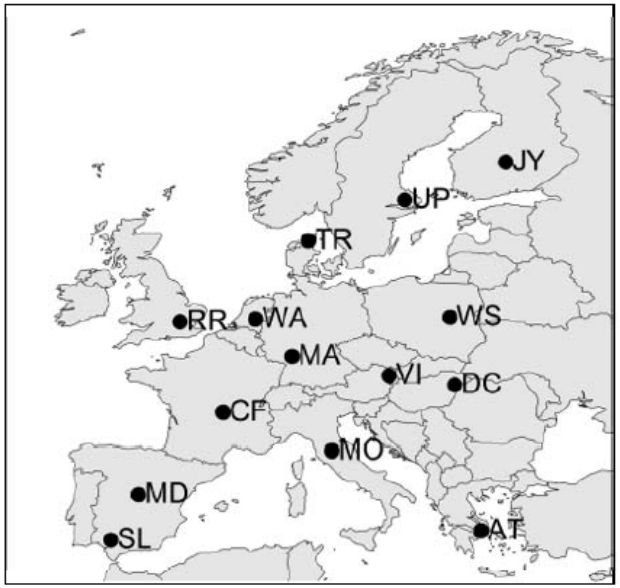
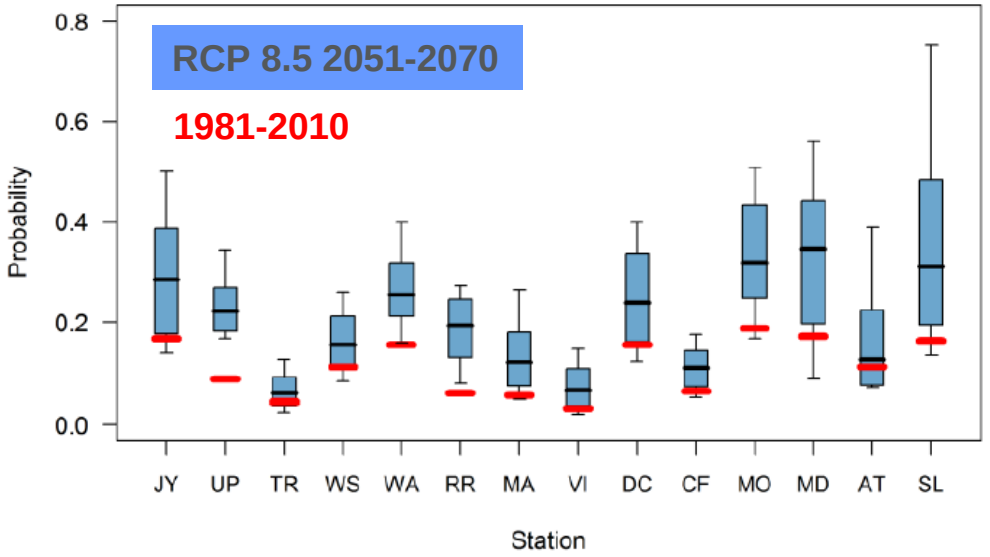
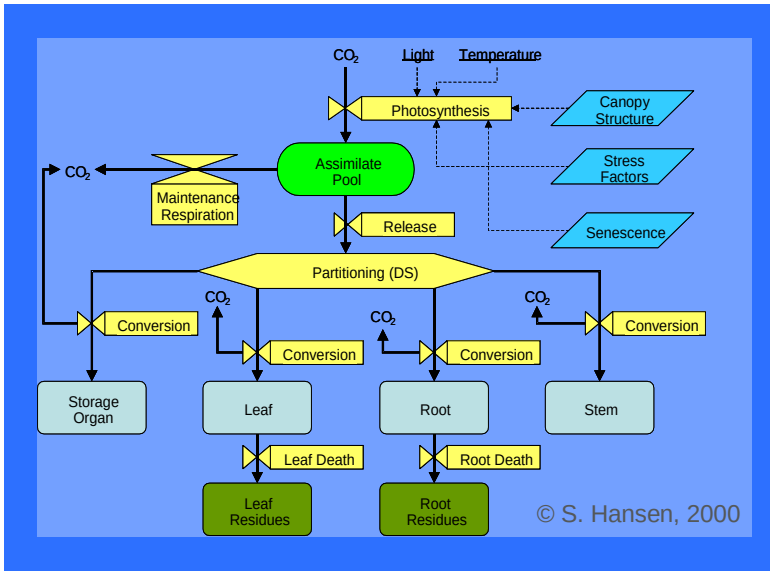
Viljelylle epäsuotuisien sääolosuhteiden riskit ovat kasvussa

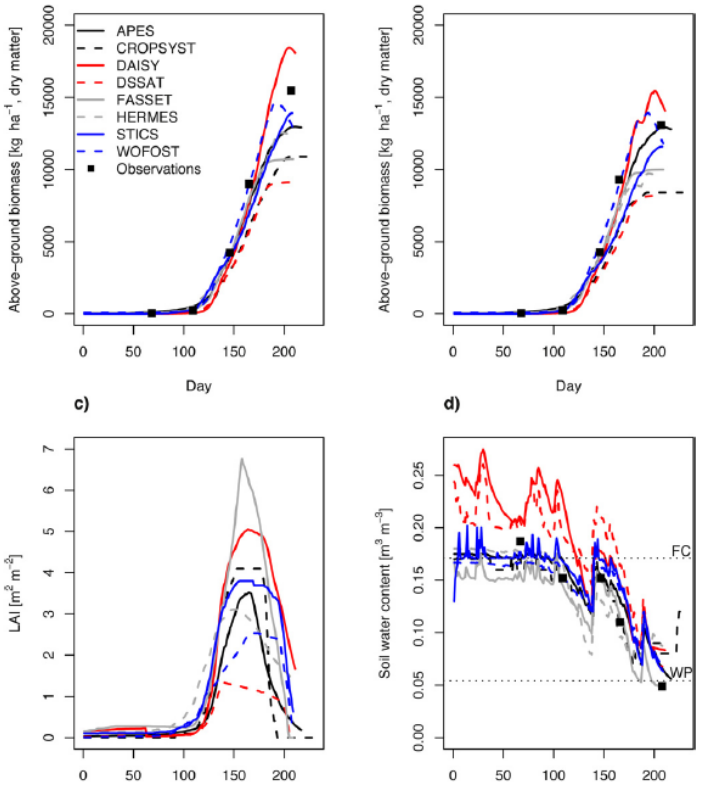




Trnka et al. 2014. Adverse weather conditions for European wheat production will become more frequent with climate change. Nature Climate Change 4:637-643.

Agroekosysteemimallit / Viljelykasvien kasvua simuloivat mallit





Palosuo et. al. 2011. European Journal of Agronomy 35:103-114.

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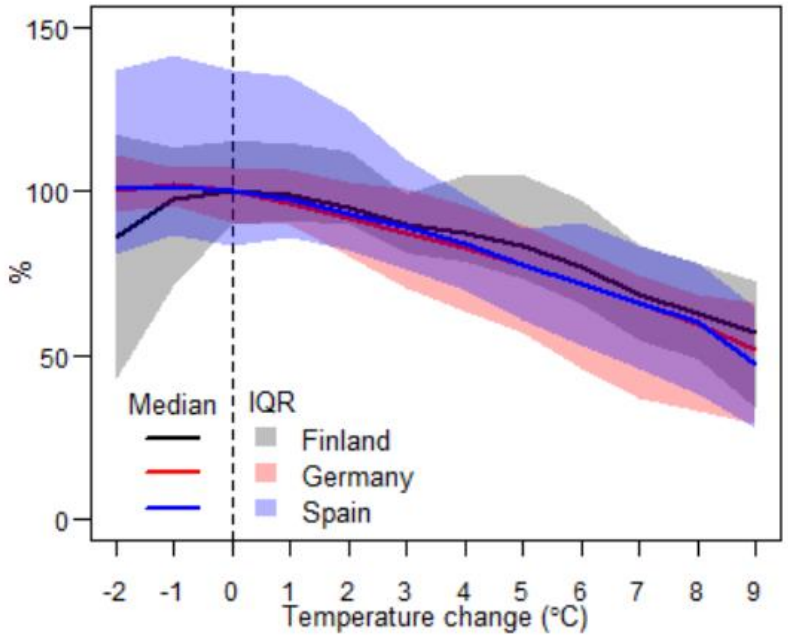
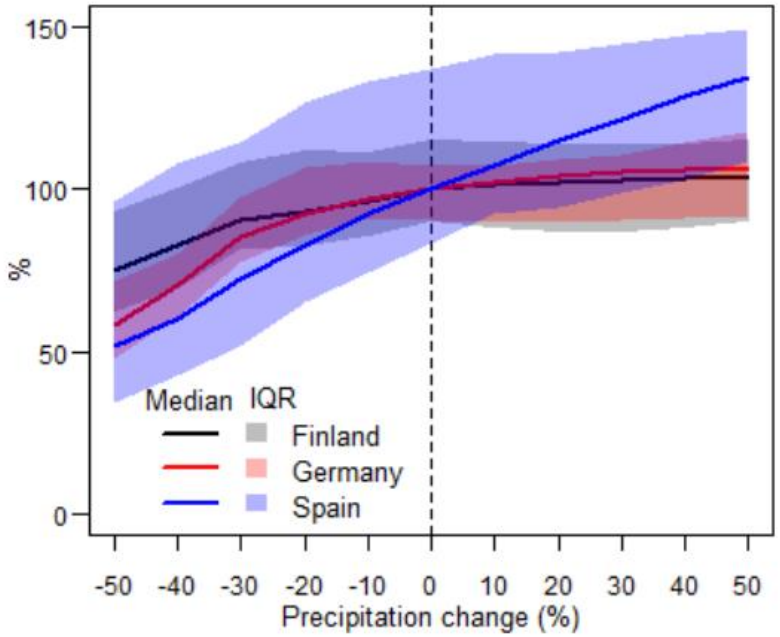
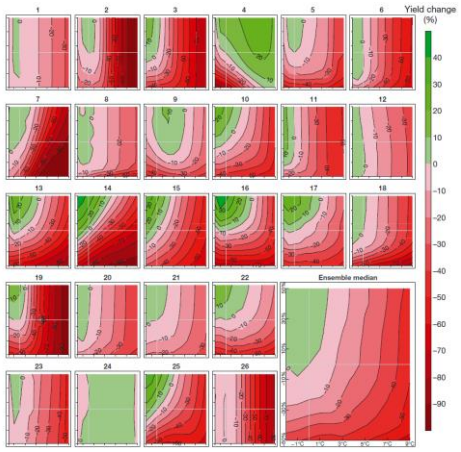
Syysvehnäsatojen simuloidut vasteet lämpötilan ja sadannan muutoksille



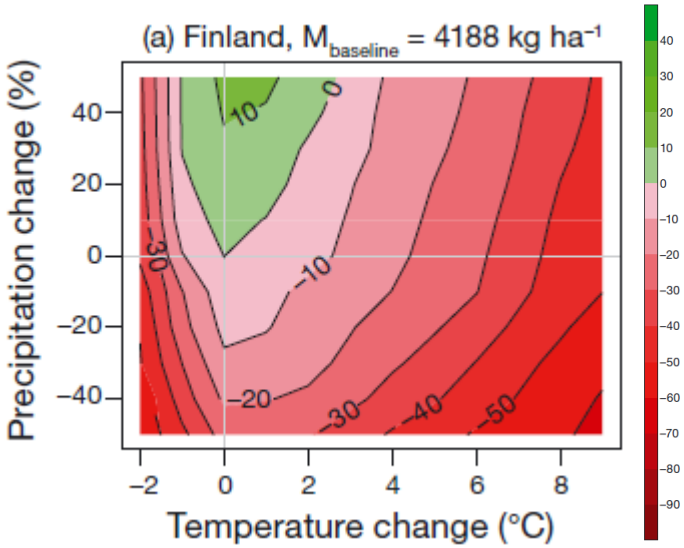


Pirttioja et al. 2015. Temperature and precipitation effects on wheat yield across a European transect: a crop model ensemble analysis using impact response surfaces. Climate Research 65: 87-105.

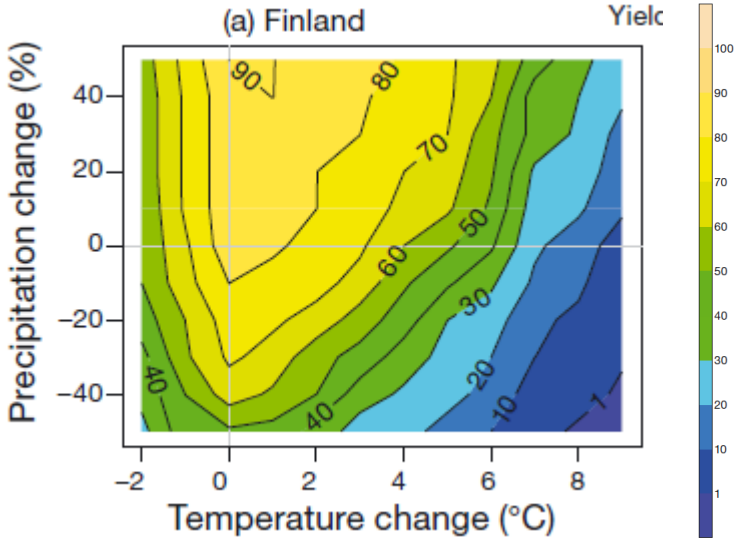


PLUMES
Pathways linking uncertainties in model projections of climate and its effects

Sato, %



Satovarmuus, %



Pirttioja et al. 2015. Temperature and precipitation effects on wheat yield across a European transect: a crop model ensemble analysis using impact response surfaces. Climate Research 65: 87-105.

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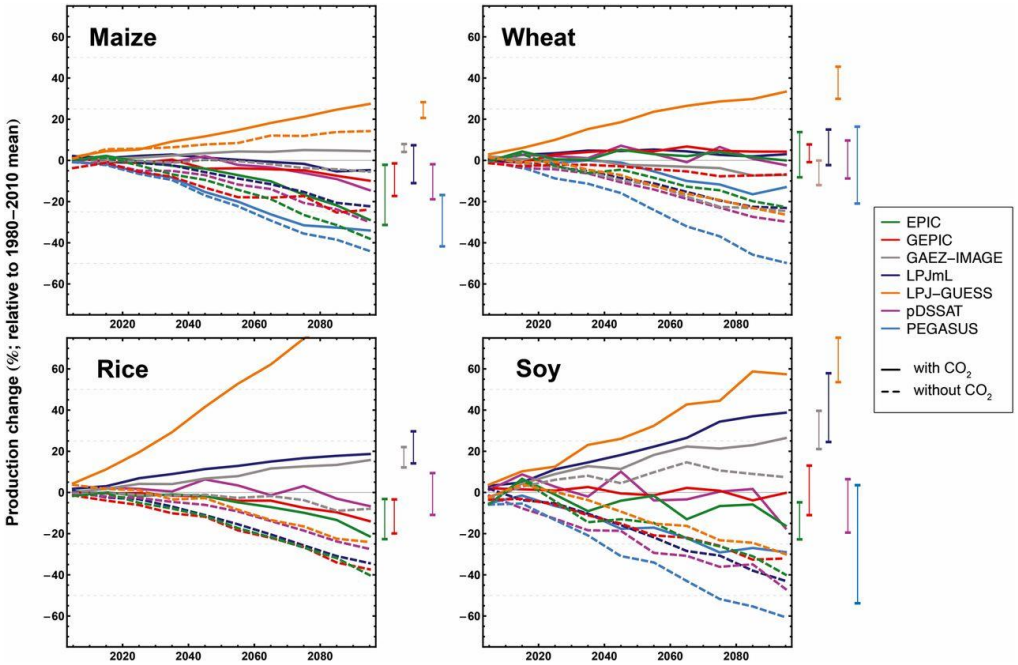
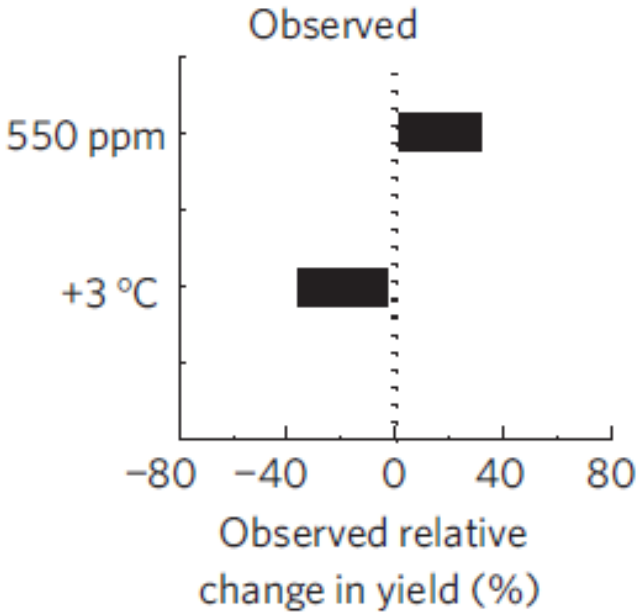
CO2-pitoisuuden nousun vaikutus satoihin

RCP8.5





Rosenzweig et al. 2014. Assessing agricultural risks of climate change in the 21st century in a global gridded crop model intercomparison. PNAS, 111:9:3268-3273

Asseng et al. 2013, Uncertainty in simulating wheat yields under climate change. Nature Climate Change 3(9): 827-832.

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nature climate change

LETTERS

PUBLISHED ONLINE: 22 DECEMBER 2014 | DOI: 10.1038/NCLIMATE2470

AgMIP The Agricultural Model Intercomparison and Improvement Project

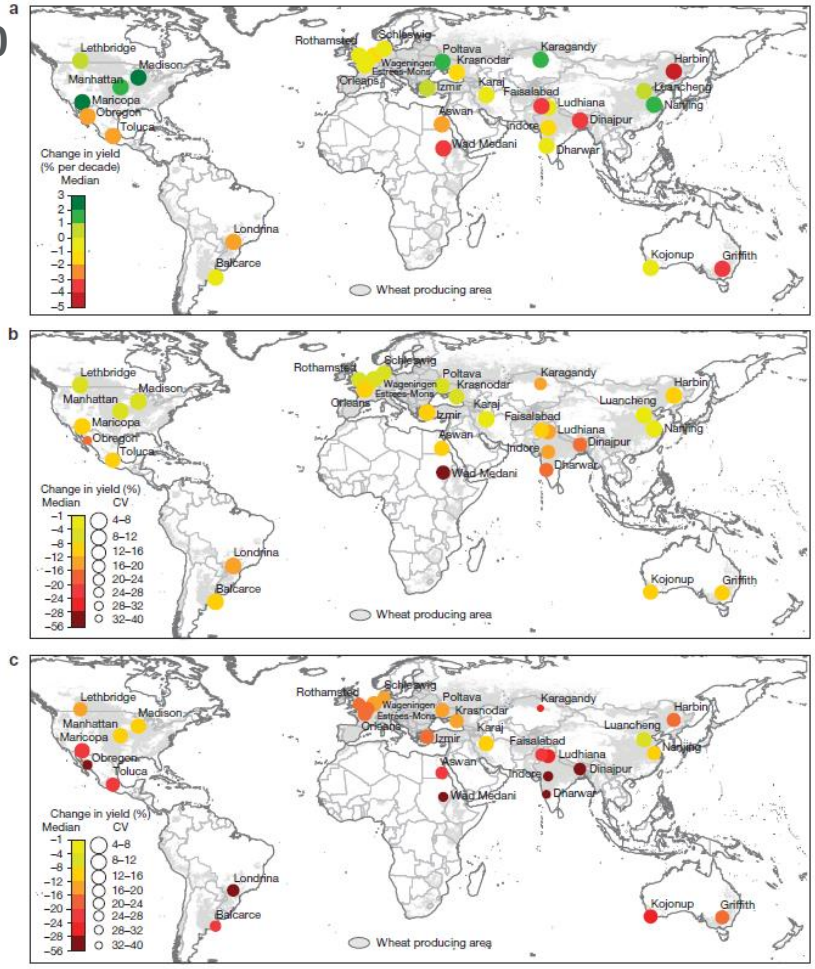
Rising temperatures reduce global wheat production

S. Asseng *et al.*†

1981-2010

+2°

+4°



- 30 vehnämallin systemaattinen testaus yhdistettynä kenttäkokeisiin
- Lämpeneminen on jo pienentänyt satoja valtaosassa vehnänviljelyalueita.
- Globaalin vehnäntuotannon laskettiin pienenevän 6% jokaista nousevaa lämpöastetta kohden. Lisäksi satojen vuosittaisen ja alueittaisen vaihtelun odotetaan kasvavan.

Luke LUONNONVARAKESKUS

nature climate change

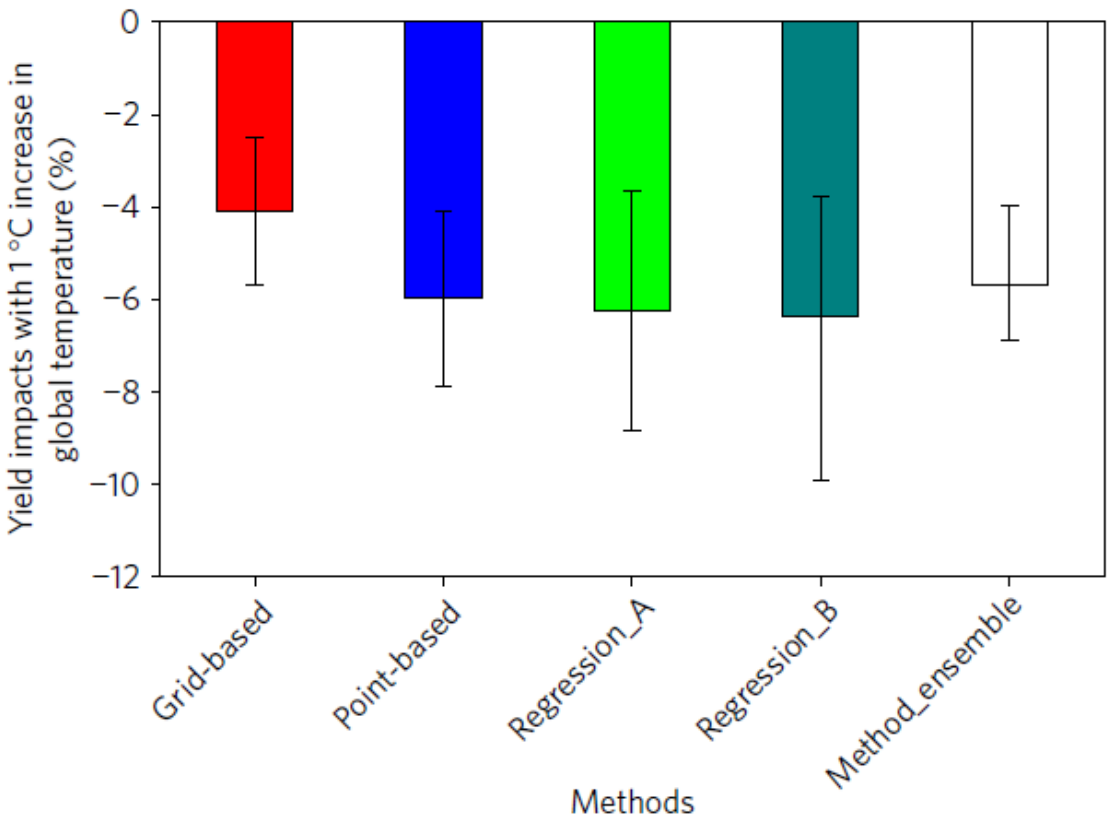
ARTICLES

PUBLISHED ONLINE: 12 SEPTEMBER 2016 | DOI: 10.1038/NCLIMATE3115

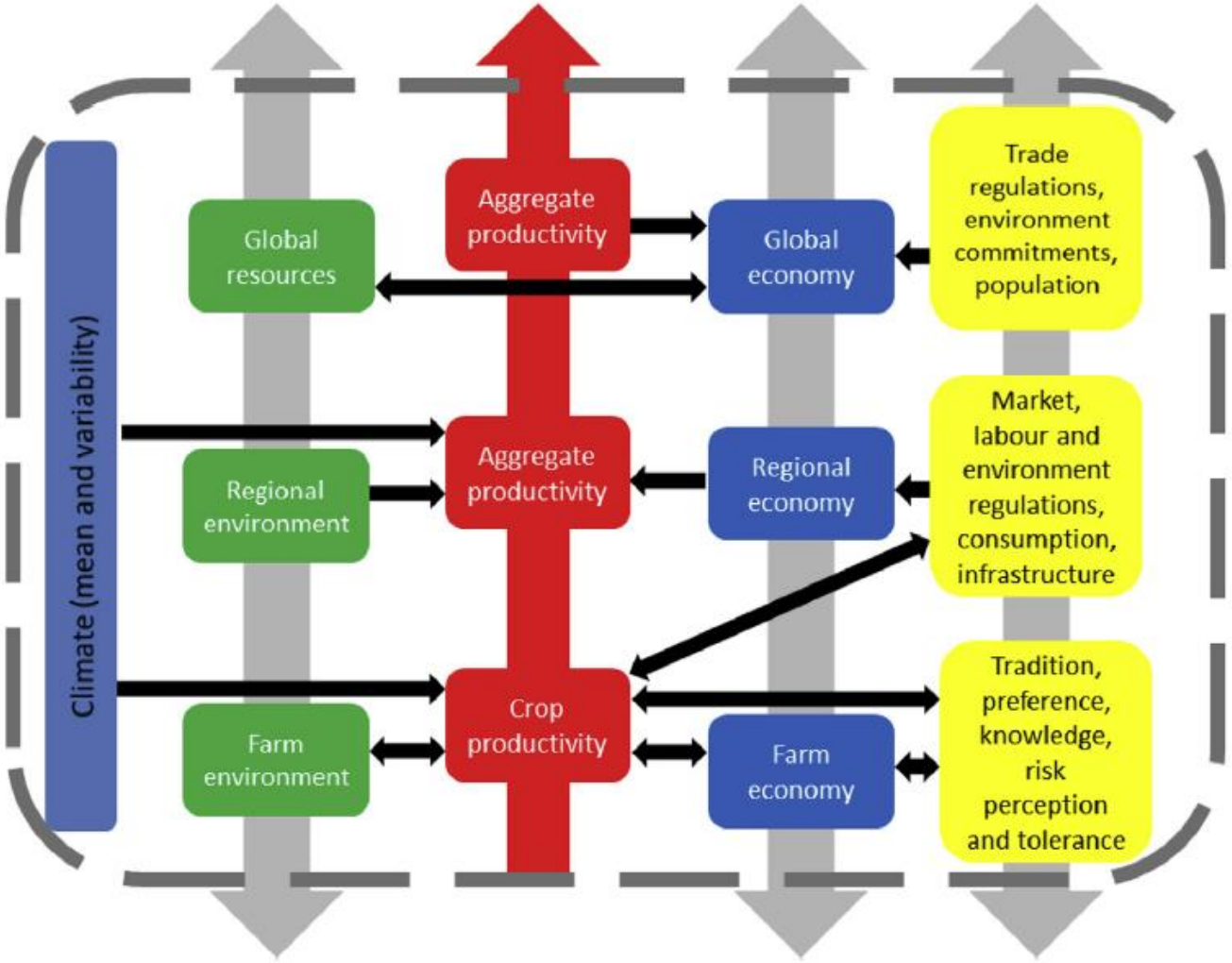
AgMIP The Agricultural Model Intercomparison and Improvement Project

Similar estimates of temperature impacts on global wheat yield by three independent methods

Bing Liu[1,2†], Senthold Asseng[2], Christoph Müller[3], Frank Ewert[4,5], Joshua Elliott[6,7], David B. Lobell[8], Pierre Martre[9,10], A
Pramod K. Aggarwa
Davide Cammaranc
Elias Fereres[24], Chr
Gerrit Hoogenboon
Curtis D. Jones[29], K
Soora Naresh Kuma
Taru Palosuo[37], P. V
Ehsan E. Rezaei[4,5], I
Elke Stehfest[43], Cla
Peter Thorburn[47], K
Zhigan Zhao[48,49] ar



Luke LUONNONVARAKESKUS



Ewert et al. 2015. Crop modelling for integrated assessment of risk to food production from climate change. Env.Mod & Softw. 72: 287-303 .

Miten maataloudessa voitaisiin torjua ilmastonmuutosta ja varautua siihen?

Kiitos!

Verkkosivuja:

ilmasto-opas.fi
ilmase.fi
macsur.eu
agmip.org

taru.palosuo@luke.fi