

Bölgesel İklim Modellemesi Uygulamaları

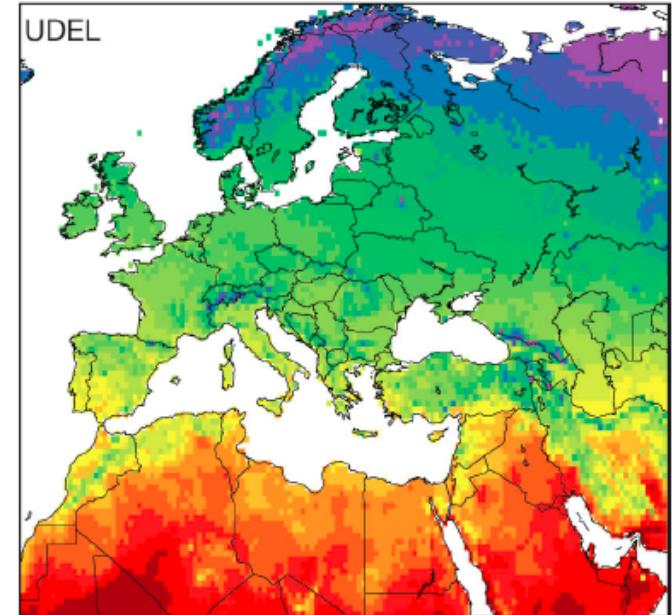
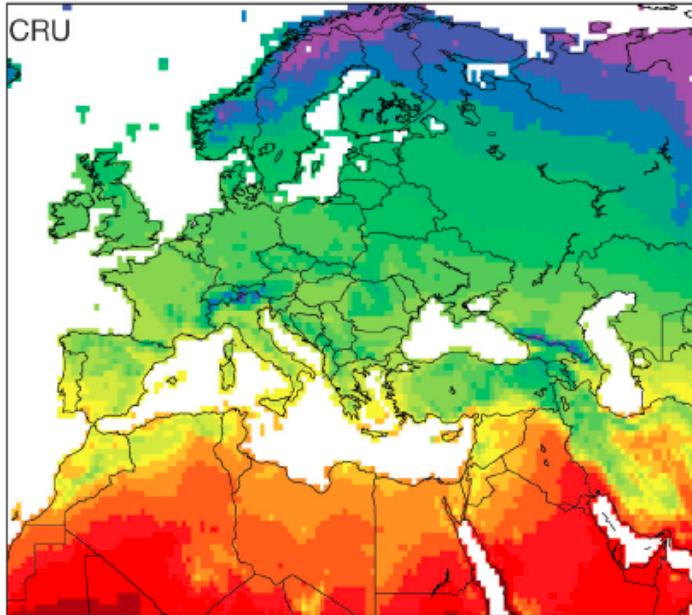
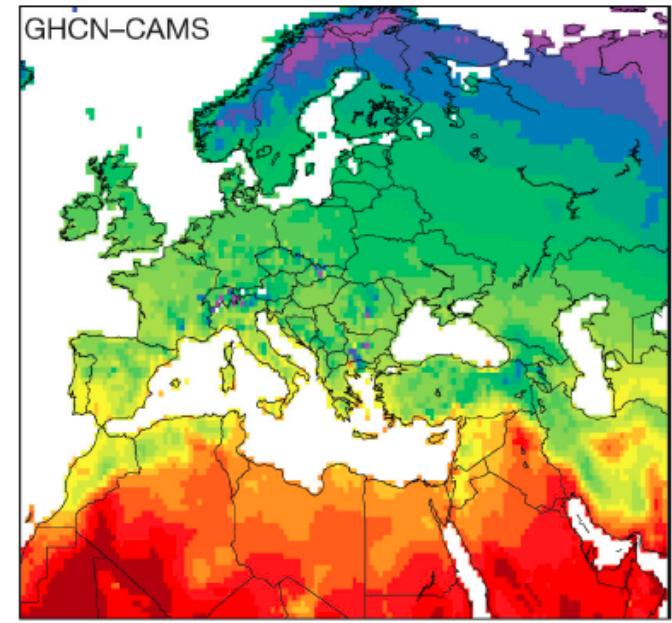
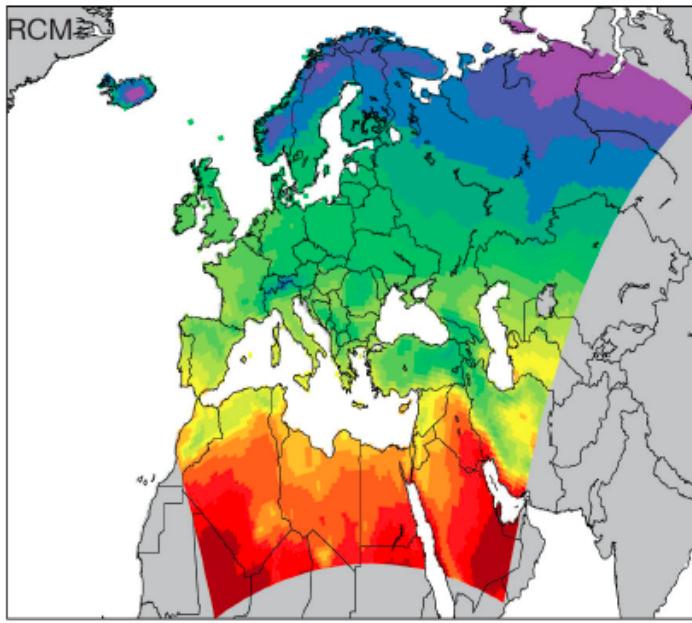
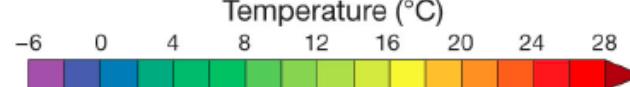


Doç.Dr. Barış Önol

İTÜ METEOROLOJİ MÜHENDISLIĞI

Modelin Performansı

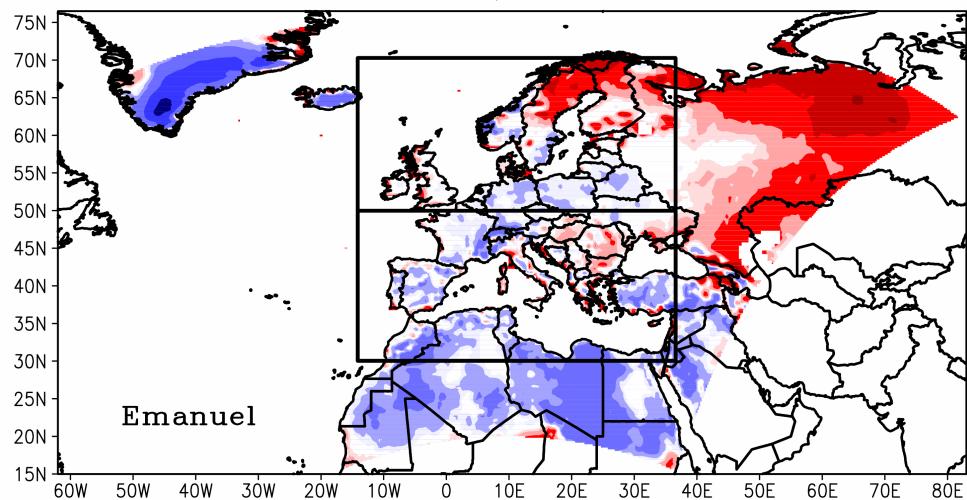
Önol, B.,
Clim. Res., 2012



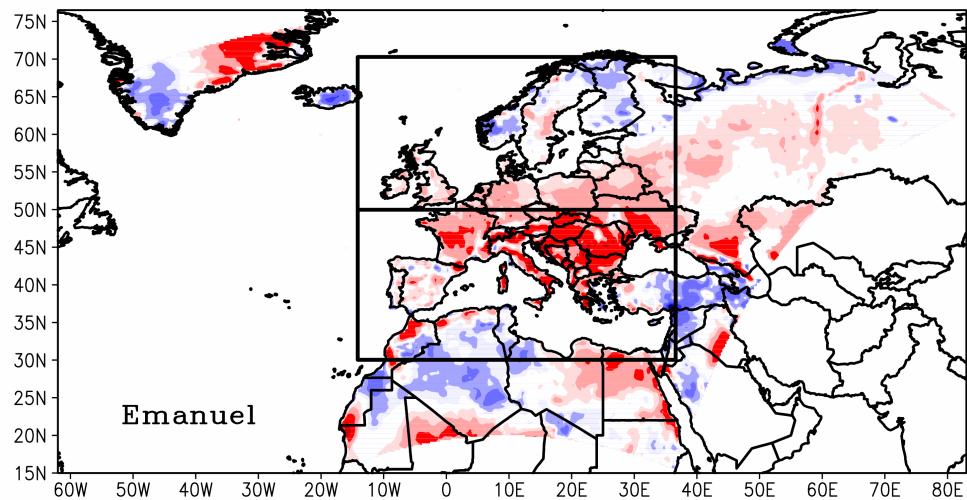
Modelin Performansı:

Torma, ICTP-Workshop, 2012

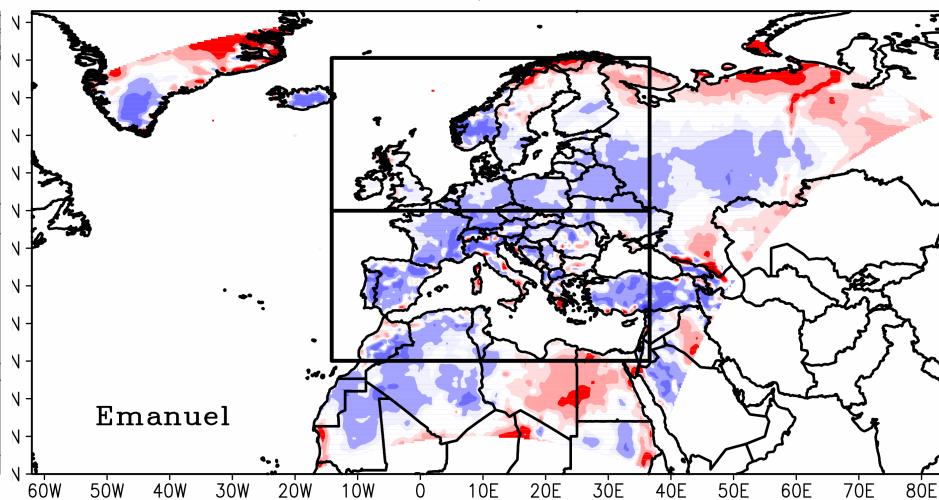
RegCM4.2 – CRU, TEMP DIFF (1998–2002)
DJF: $-0.0434699^{\circ}\text{C}$
north: 0.437339°C , south: $-0.346353^{\circ}\text{C}$



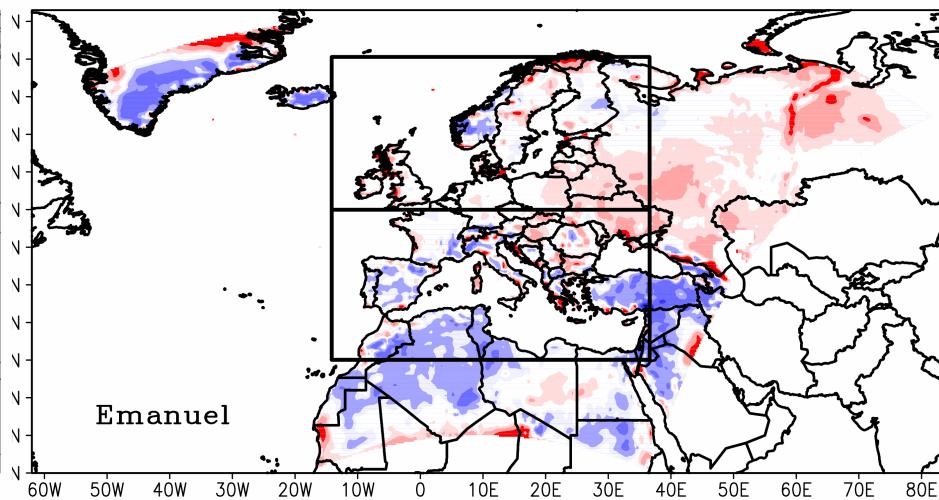
RegCM4.2 – CRU, TEMP DIFF (1998–2002)
JJA: 0.586147°C
north: 0.310531°C , south: 0.759769°C



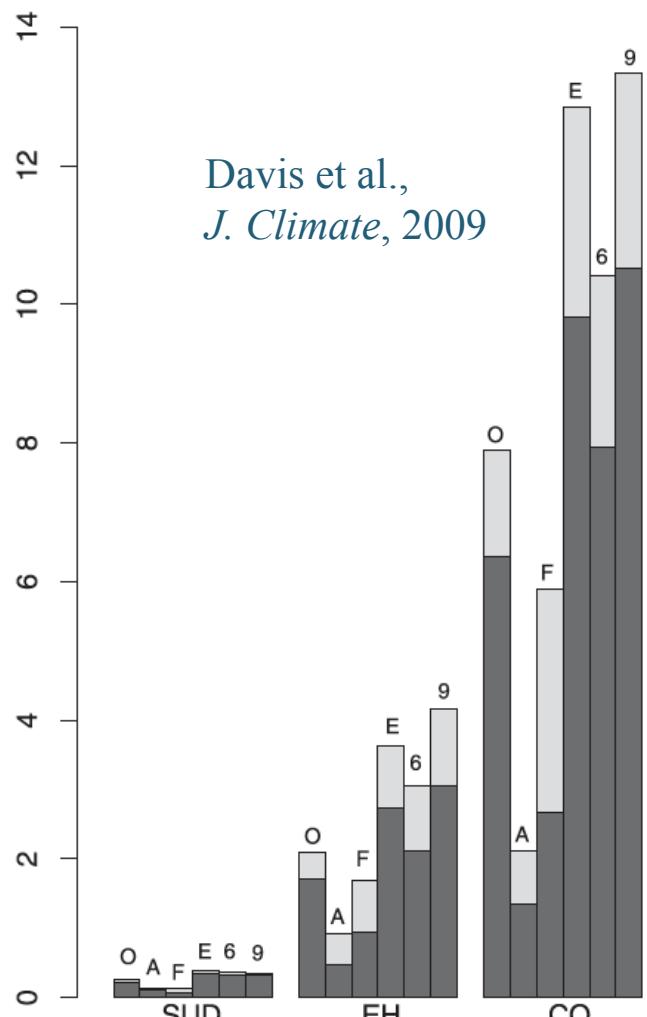
RegCM4.2 – CRU, TEMP DIFF (1998–2002)
MAM: $-0.671254^{\circ}\text{C}$
north: $-0.572225^{\circ}\text{C}$, south: $-0.733638^{\circ}\text{C}$



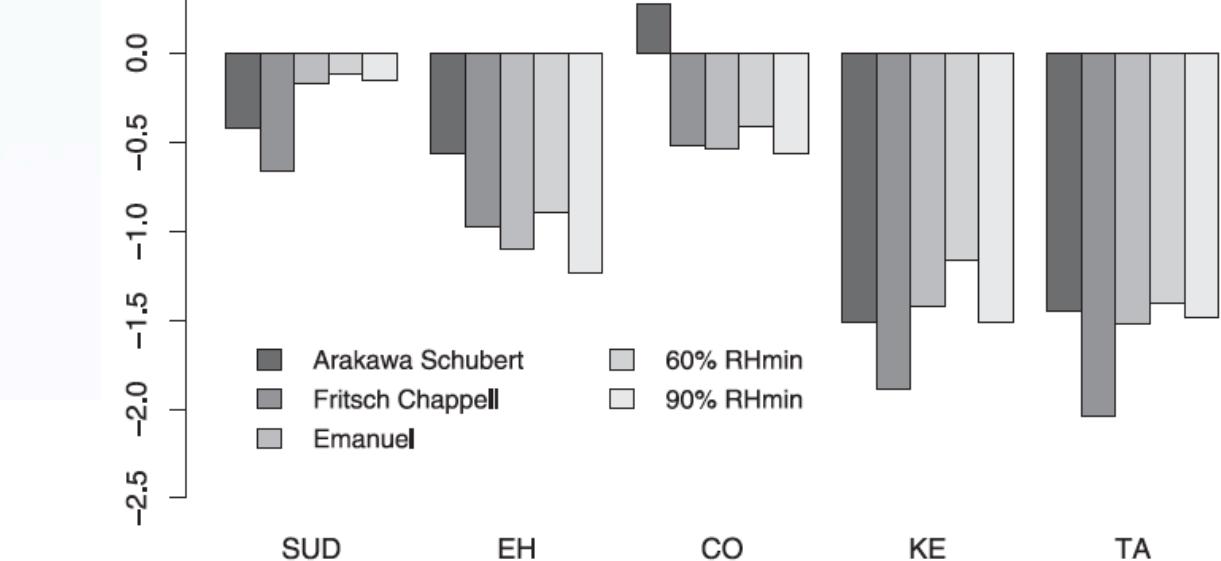
RegCM4.2 – CRU, TEMP DIFF (1998–2002)
SON: $-0.0232425^{\circ}\text{C}$
north: 0.353743°C , south: $-0.260723^{\circ}\text{C}$



'Ince' ayarlar: Tunning

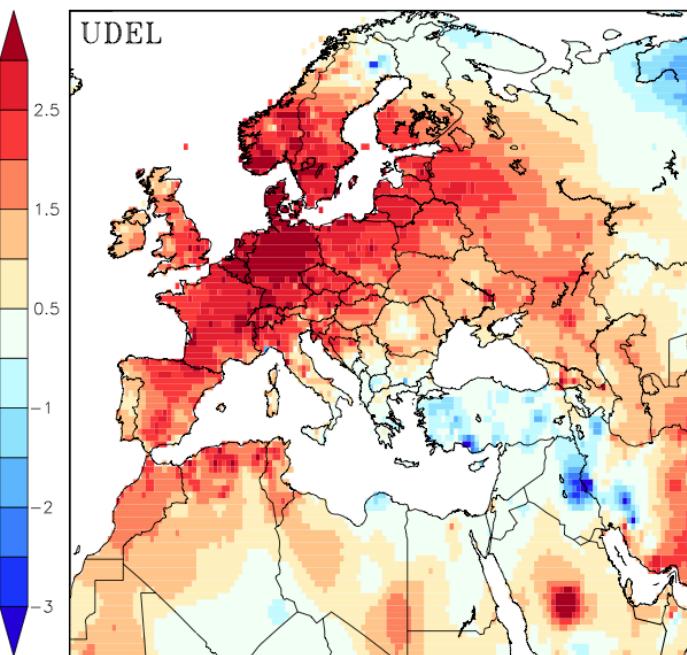
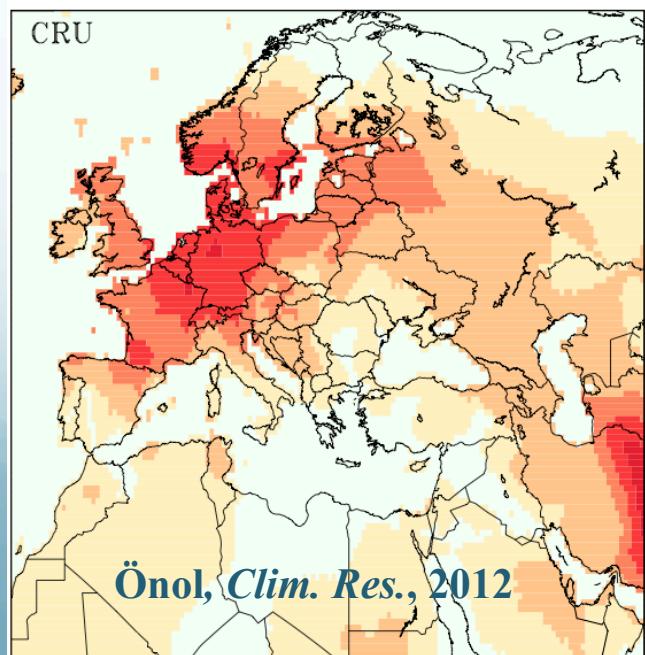
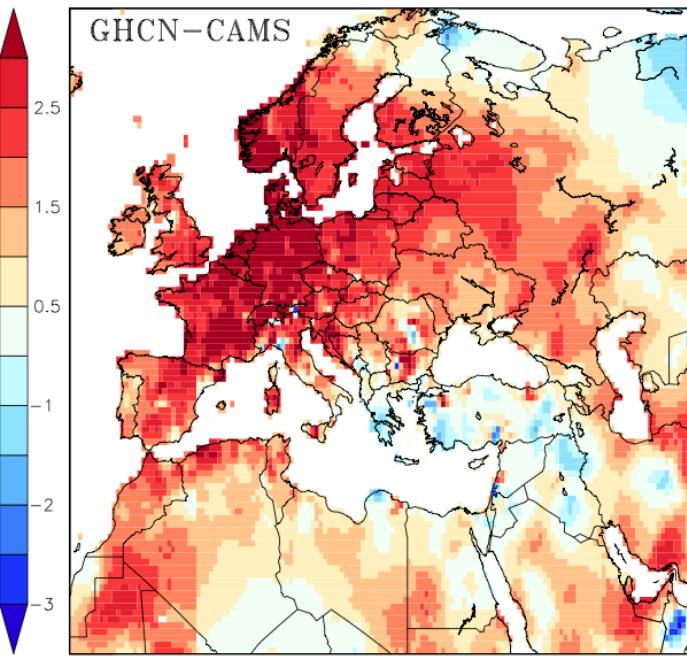
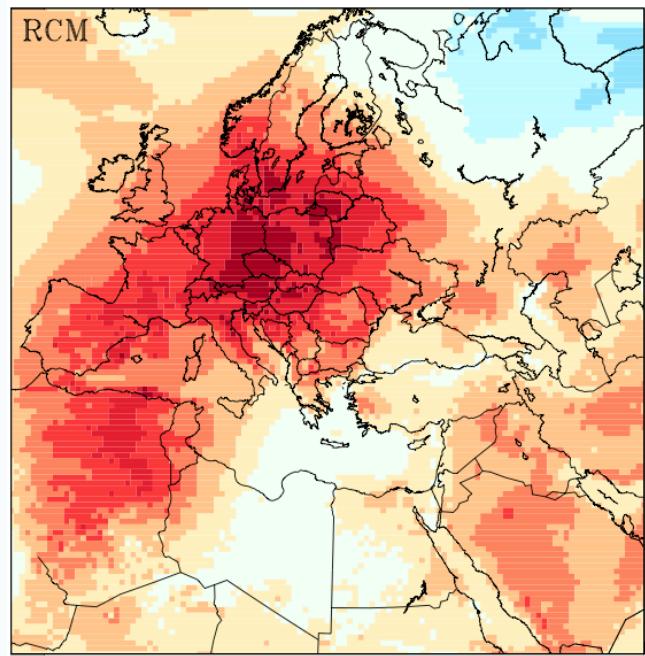


Davis et al.,
J. Climate, 2009



Legend:
 ■ Stratiform
 ■ Convective
 O : Observations
 A : Arakawa Schubert
 F : Fritsch Chappell
 E : Emanuel
 6 : 60% RHmin
 9 : 90% RHmin

```
&subexparam
nclld      = 1,          ! # of bottom model levels with no cloud
qcklland   = 0.0005,     ! Autoconversion Rate for Land
qckloce    = 0.0005,     ! Autoconversion Rate for Ocean
gulland    = 0.65,        ! Fract of Gultepe eqn (qcth) when prcp
gulocce    = 0.30,        ! Fract of Gultepe eqn (qcth) for ocean
rhmax     = 1.01,         ! RH at which FCC = 1.0
rhmin     = 0.01,         ! RH min value
rh0land   = 0.80,         ! Relative humidity threshold for land
rh0oce    = 0.90,         ! Relative humidity threshold for ocean
tc0       = 238.0,        ! Below this temp, rh0 begins to approach
cevaplnd   = 1.0e-5,      ! Raindrop evap rate coef land [[(kg m^-2 s^-1)
cevapoce   = 1.0e-5,      ! Raindrop evap rate coef ocean [[(kg m^-2 s^-1)
caccrlnd   = 6.0,         ! Raindrop accretion rate land [m^3/kg/s]
caccroce   = 6.0,         ! Raindrop accretion rate ocean [m^3/kg/s]
cllwcv     = 0.3e-3,       ! Cloud liquid water content for convect
clfrcvmax  = 0.75,        ! Max cloud fractional cover for convect
cftotmax   = 0.75,        ! Max total cover cloud fraction for rad
conf      = 1.00,          ! Condensation efficiency
rcrit     = 13.5,          ! Mean critical radius
coef_ccn   = 2.0,          ! Geometric mean Diameter and standard d
abulk     = 0.9,           ! Bulk activation ratio
lsrfhack   = .false.,      ! Surface radiation hack
```



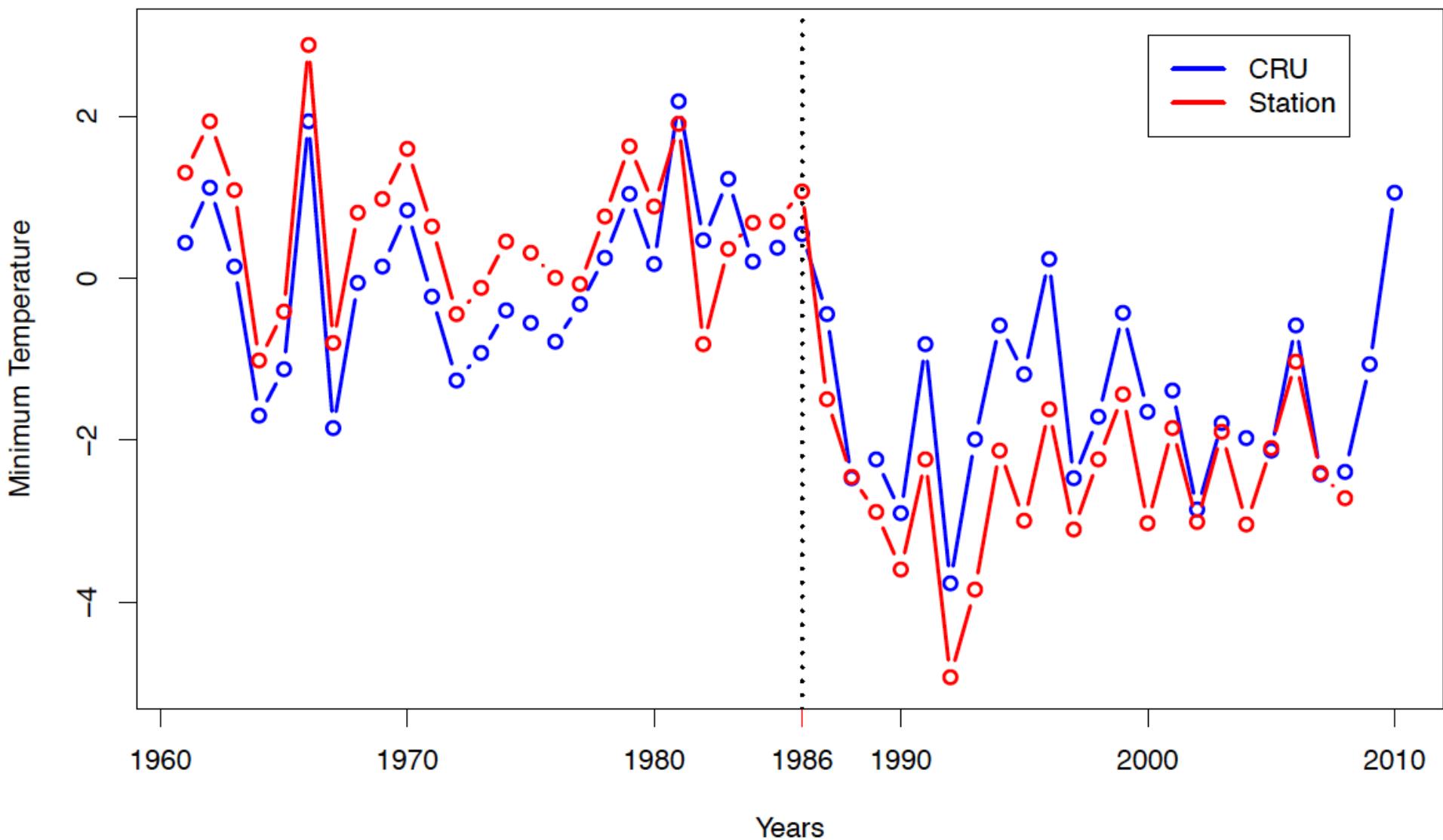
Modelin Performansı

Observational data: OBS vs. OBS

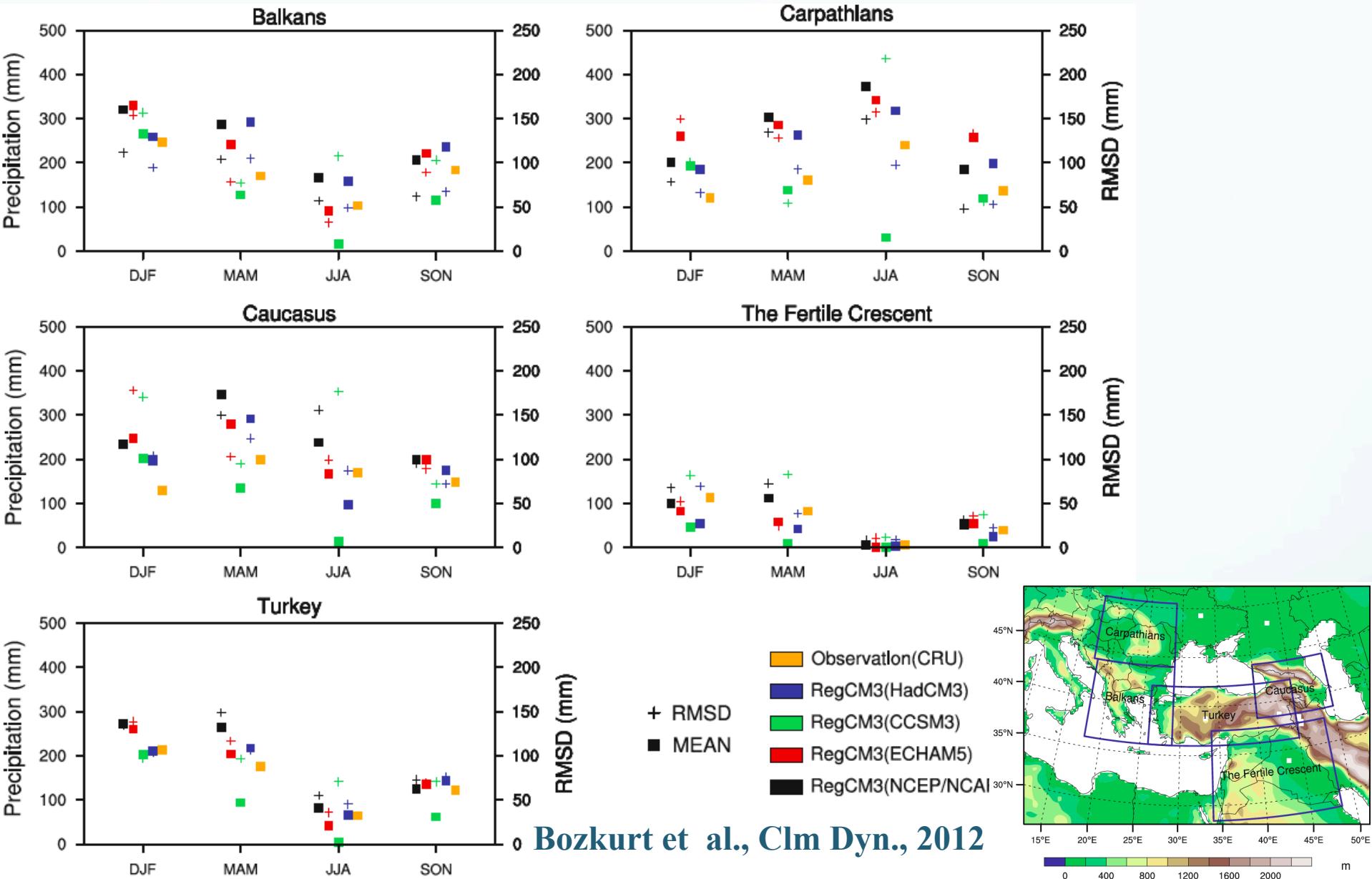
September-November 2006 was very likely the warmest autumn since 1500 in a large part of **Europe** (Luterbacher et al., 2007).

Observational data: Hot/Cold Spots!

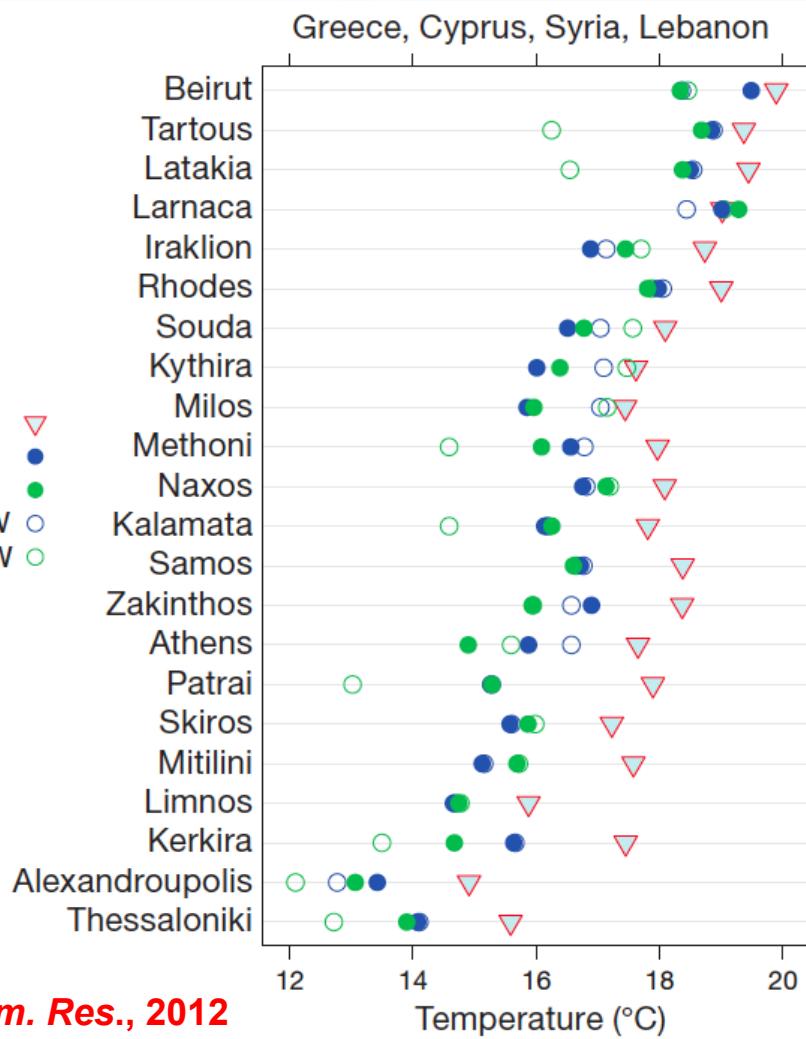
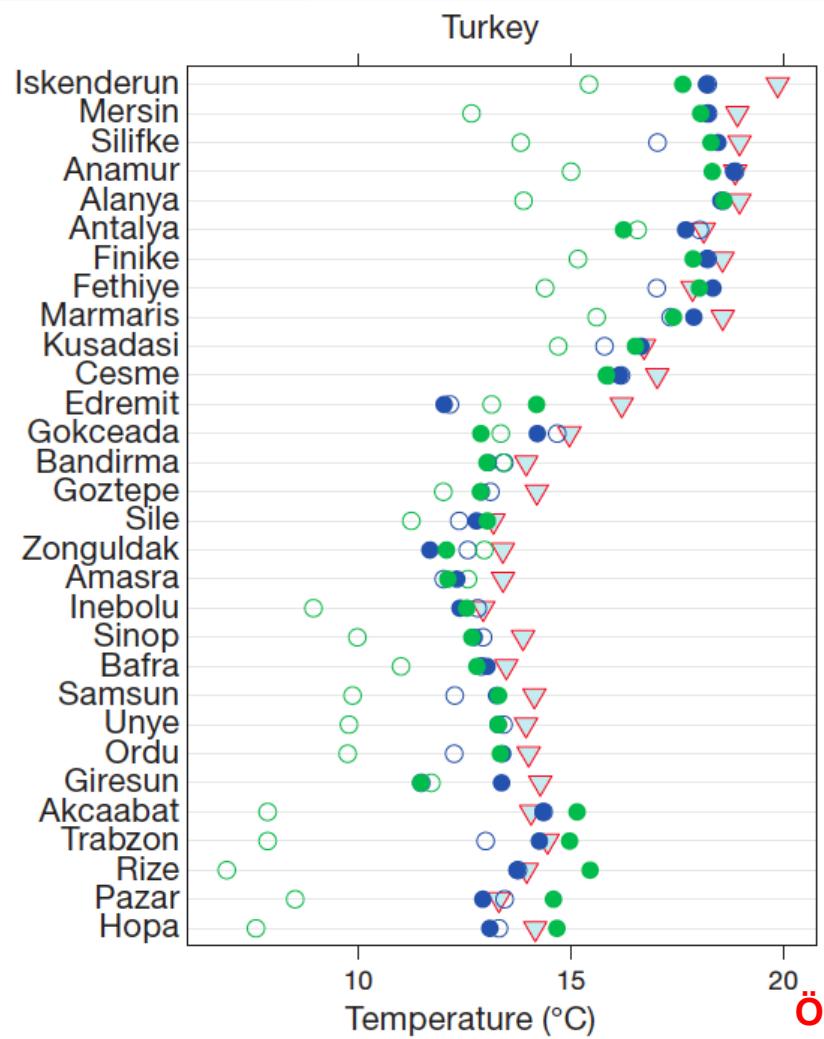
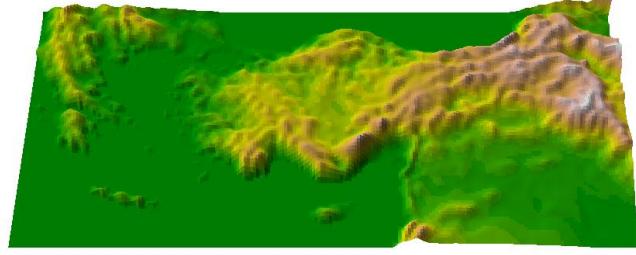
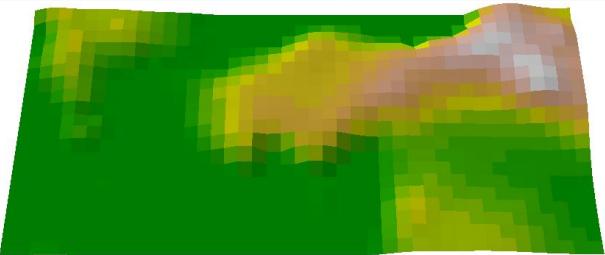
CRU vs. Station (Erzurum)



Modelin Performansı

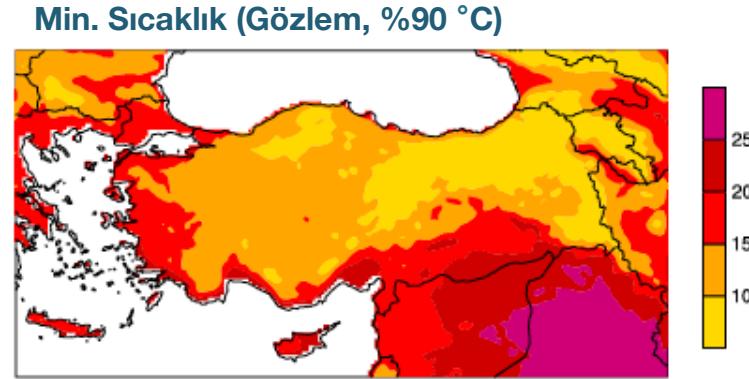
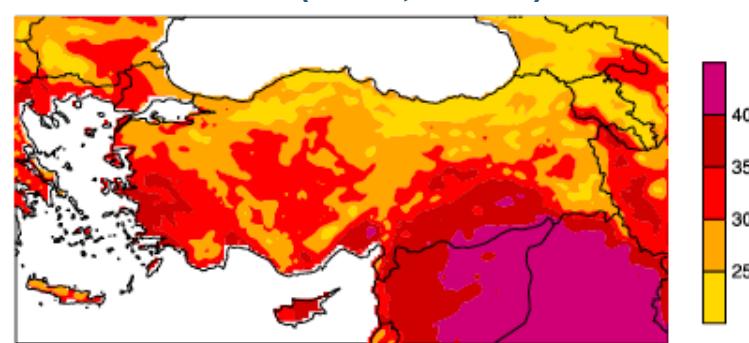
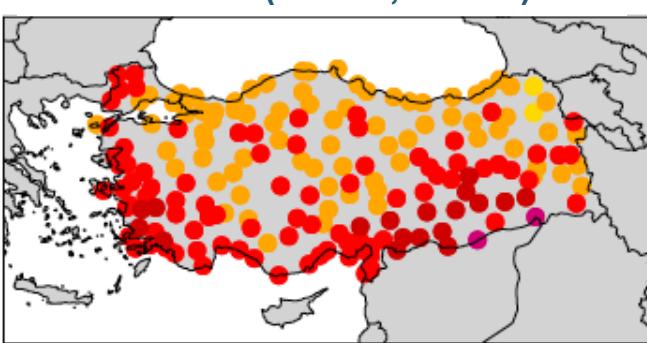
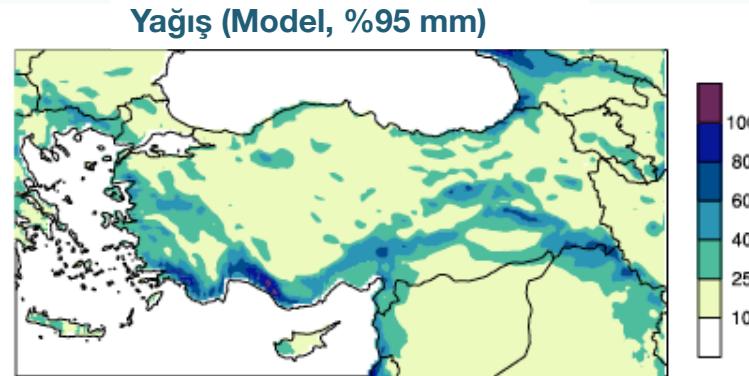
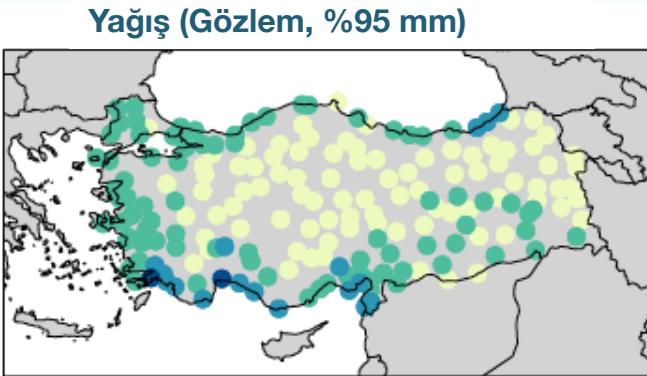


Model Çözünürlüğü ve İstasyonlar



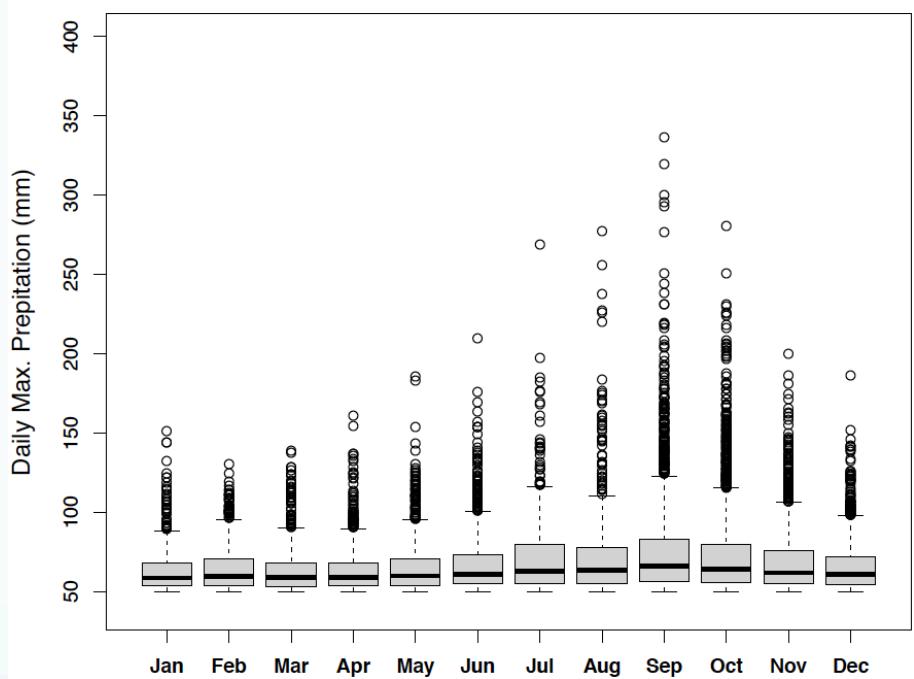
Önol, B., *Clim. Res.*, 2012

Eşik Değerler (%90 ; %95): Gözlem ve Model

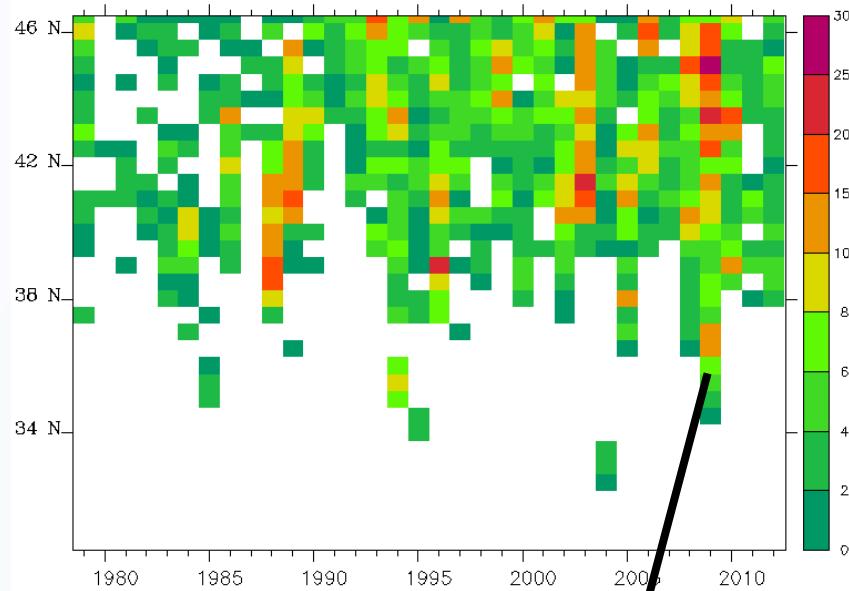


Ekstrem Yağışlar: Gözlem ve Model

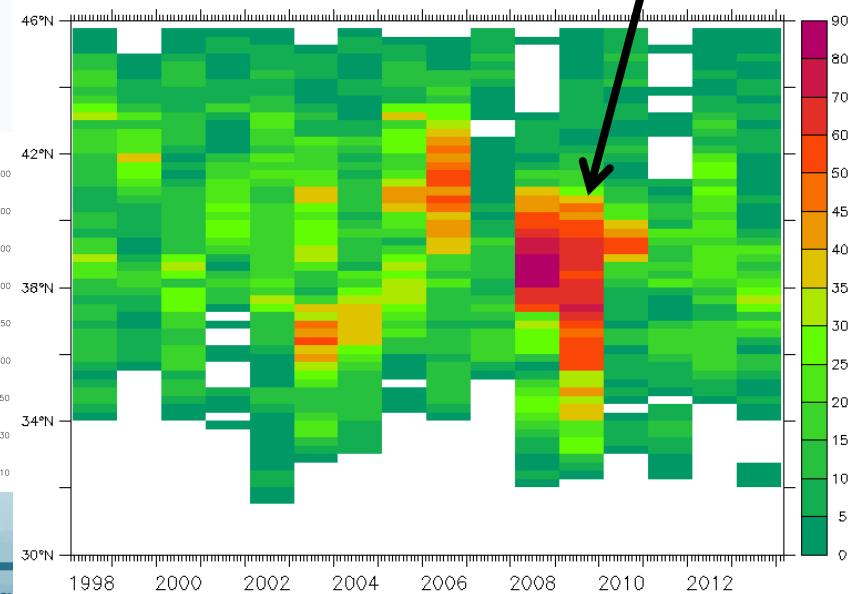
Max.Precip.(>50mm) over Mediterranean (RCM_ERAIInt, 1979–2012)



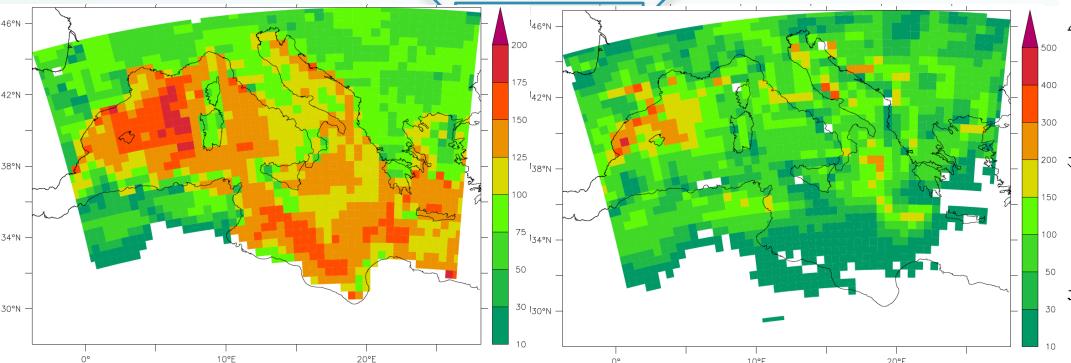
SEP Prec. > 50mm over Mediterranean Sea (RCM_ERAIInt)



SEP Prec. > 50mm over Mediterranean Sea (TRMM)



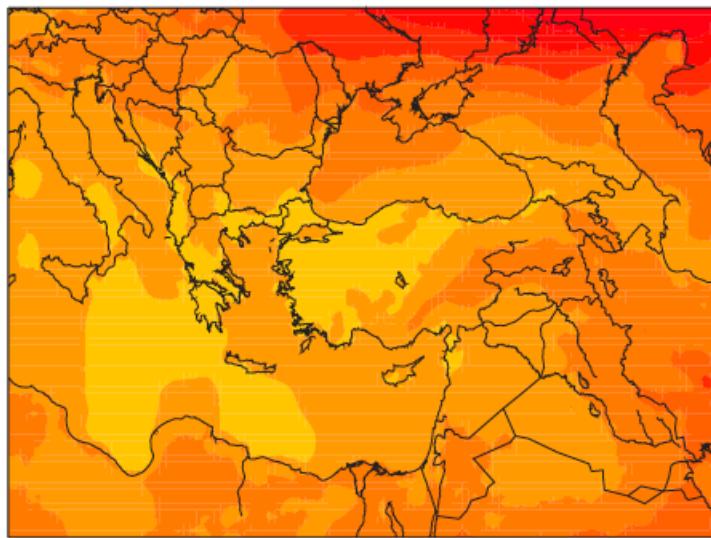
Evapotranspiration ← Sep. 2009 → Precipitation



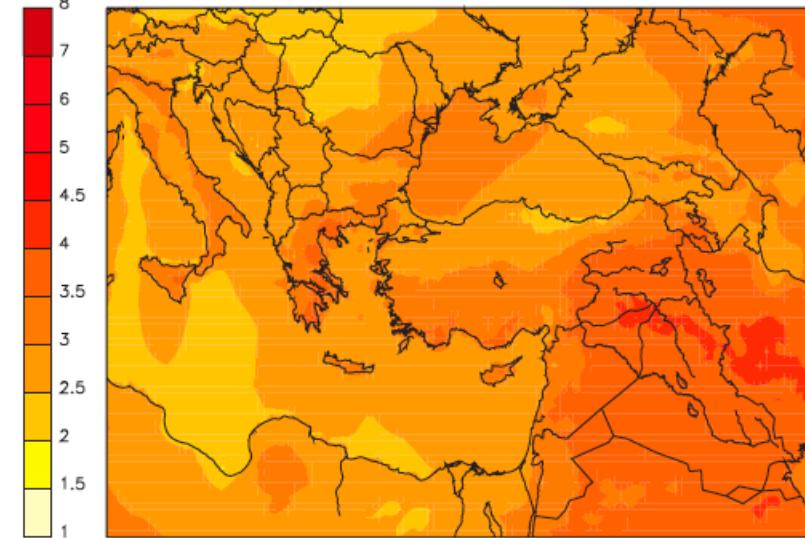
Önol & Turuncoglu, CORDEX 2016

Gelecek Simülasyonları: Sıcaklık değişimleri

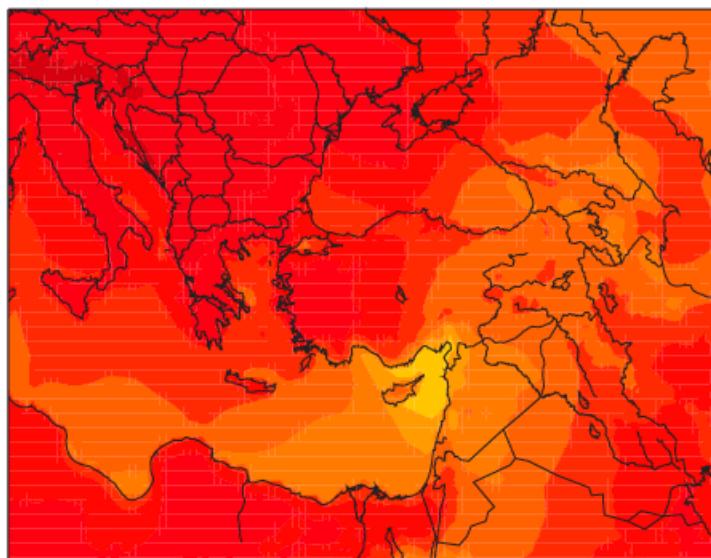
Winter Temperature A2 minus RF



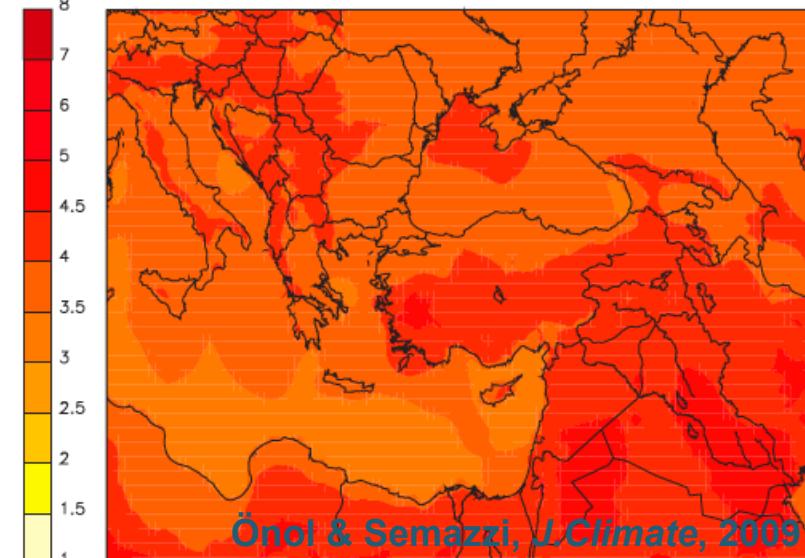
Spring Temperature A2 minus RF



Summer Temperature A2 minus RF

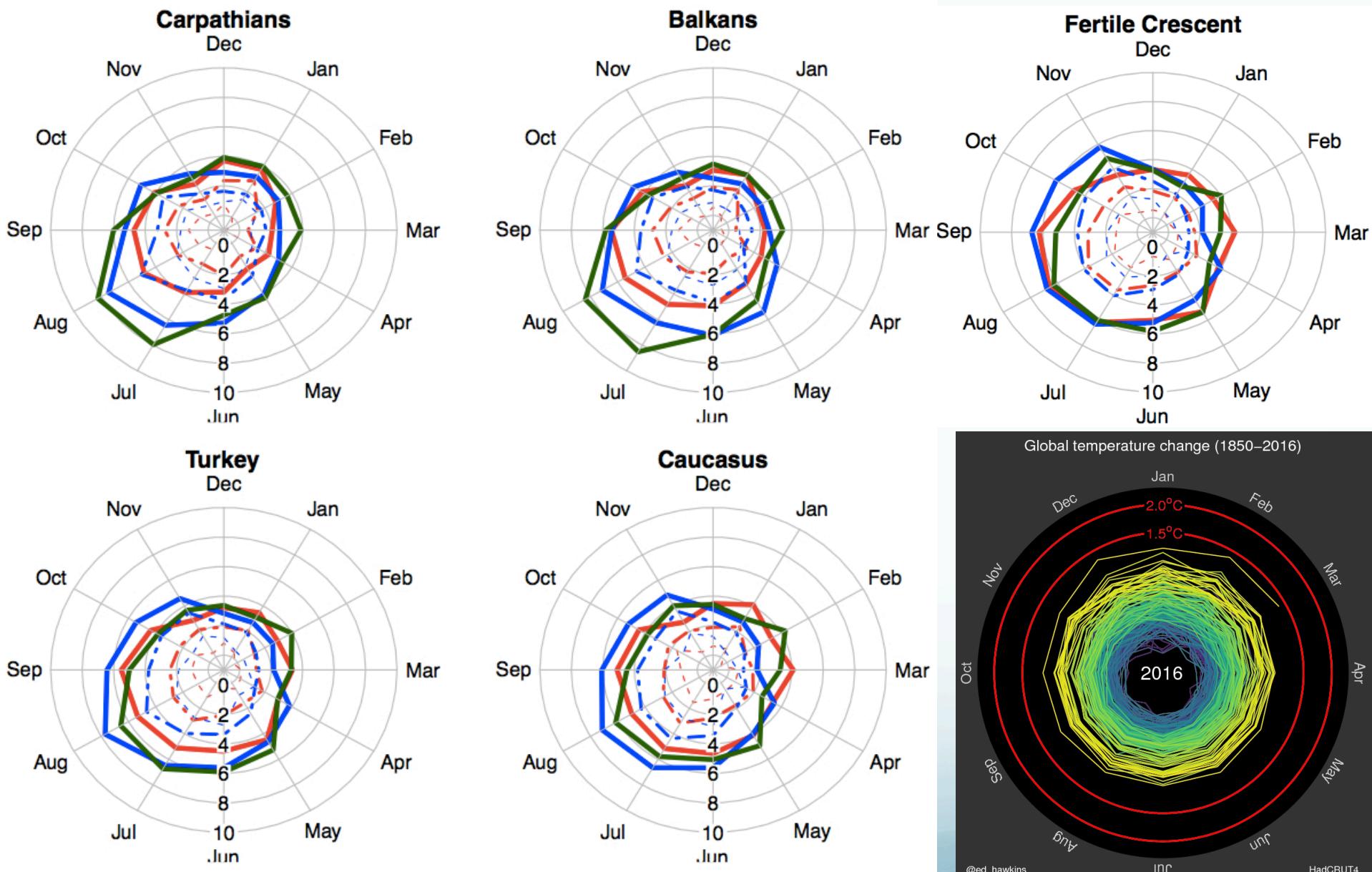


Autumn Temperature A2 minus RF

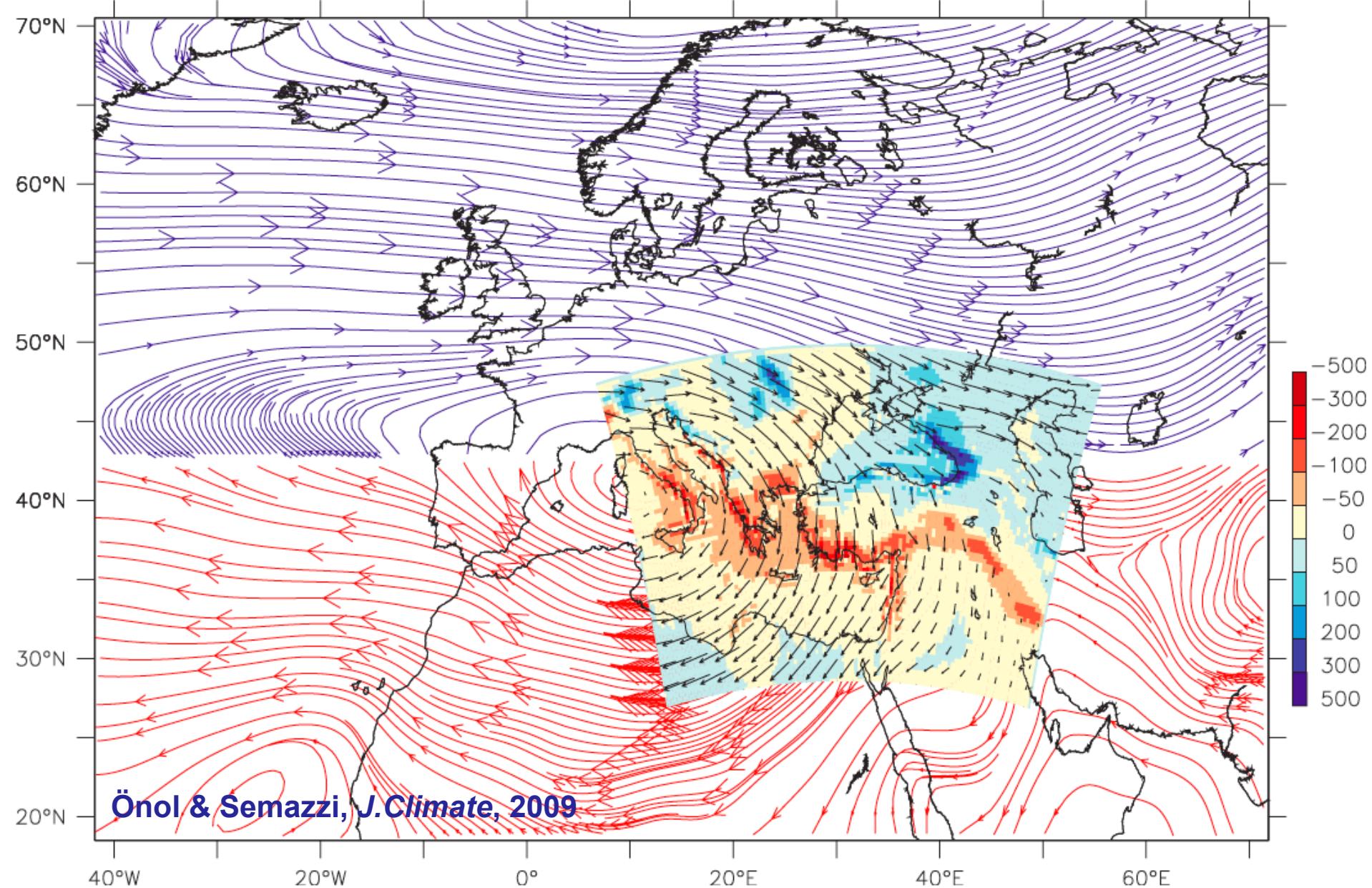


Önol & Semazzi, *J.Climate*, 2009

Gelecek Simülasyonları: alansal ortalamalar

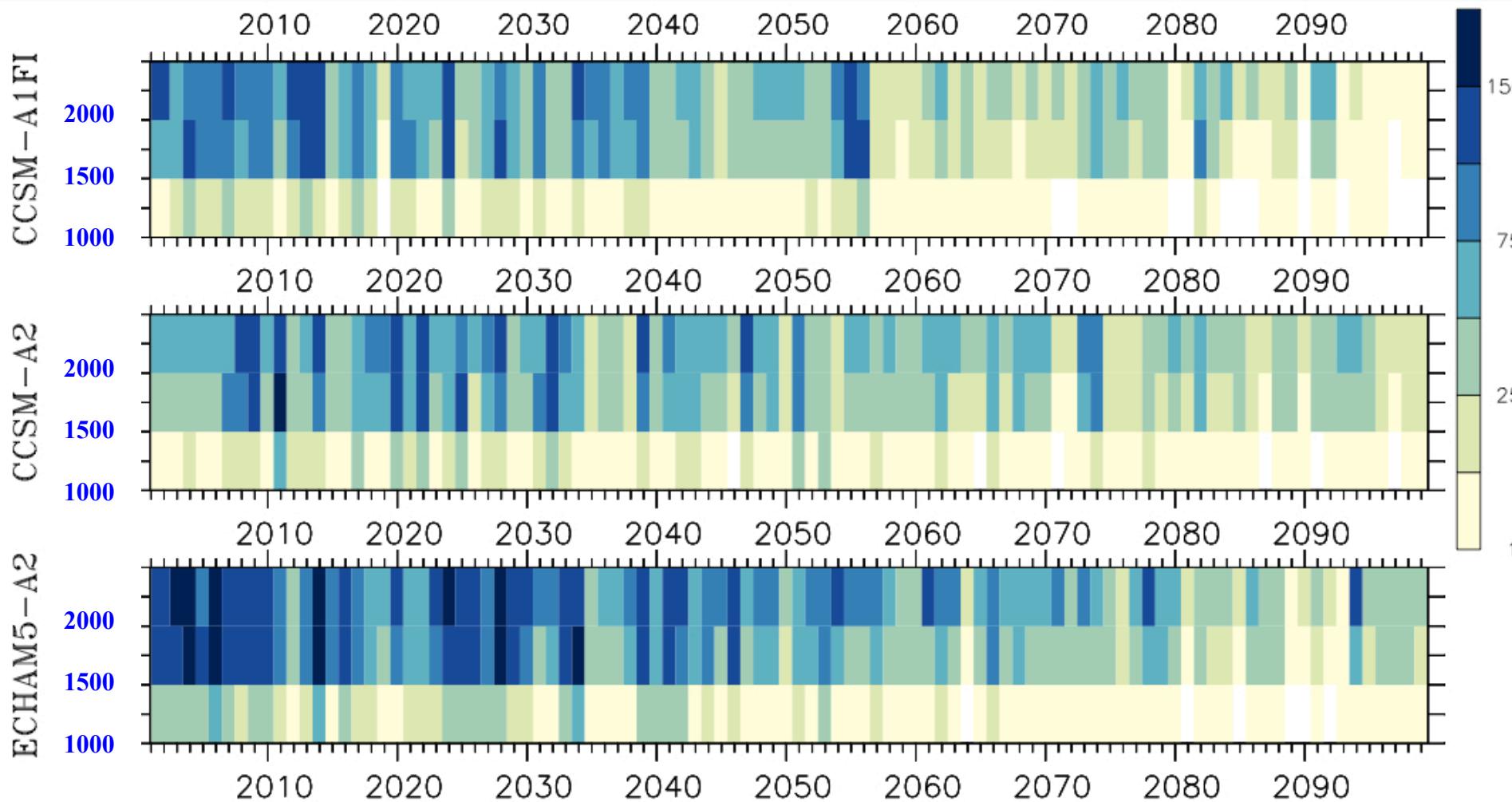


Sikülsiyon Değişiminin Yağışa Etkisi: Kış



CMIP3: Hydrological Impact (DJF)

Snow Water Equivalent Change in Elevations > 1000m



Önol et al. *Clim. Dyn.* 2014

Gelecekte Kış Yağışlarındaki Değişim

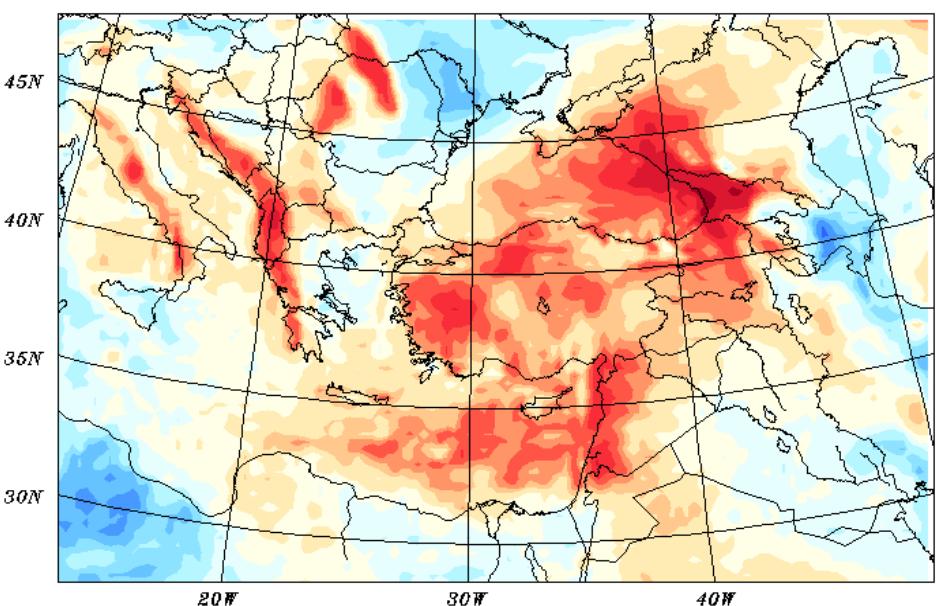
Kış yağışları ve rüzgarın yatay bileşeninin gelecekteki değişimi arasındaki korelasyon.

Rüzgar paternindeki değişimler, gelecek simülasyonlarında orografiyle etkinleşen yağışın kuvvetlenmesine yada zayıflamasına neden olacaktır.

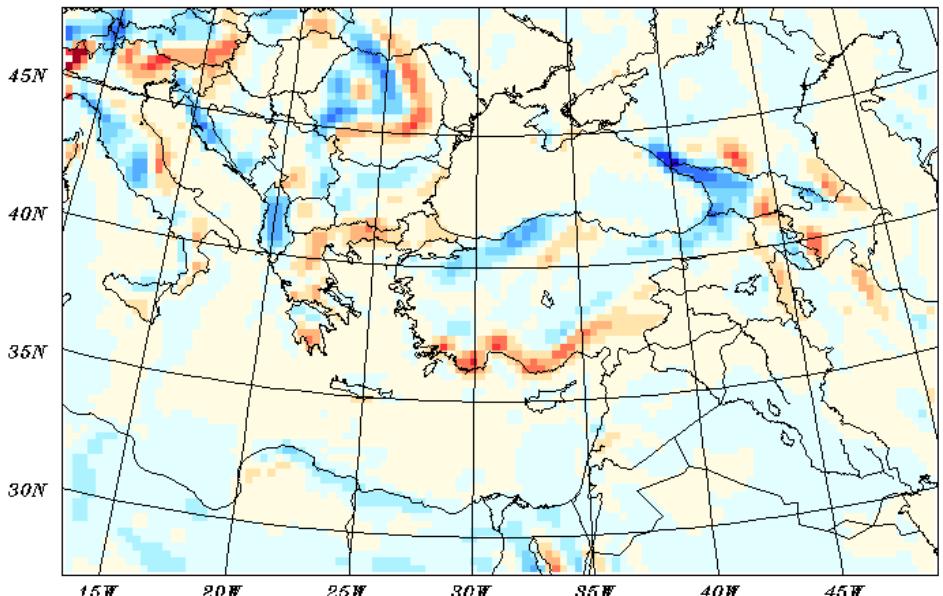
Horizontal Moisture Advection

$$\left[\left(u_{A2} \frac{\partial q_{A2}}{\partial x} + v_{A2} \frac{\partial q_{A2}}{\partial y} \right) - \left(u_{RF} \frac{\partial q_{RF}}{\partial x} + v_{RF} \frac{\partial q_{RF}}{\partial y} \right) \right]$$

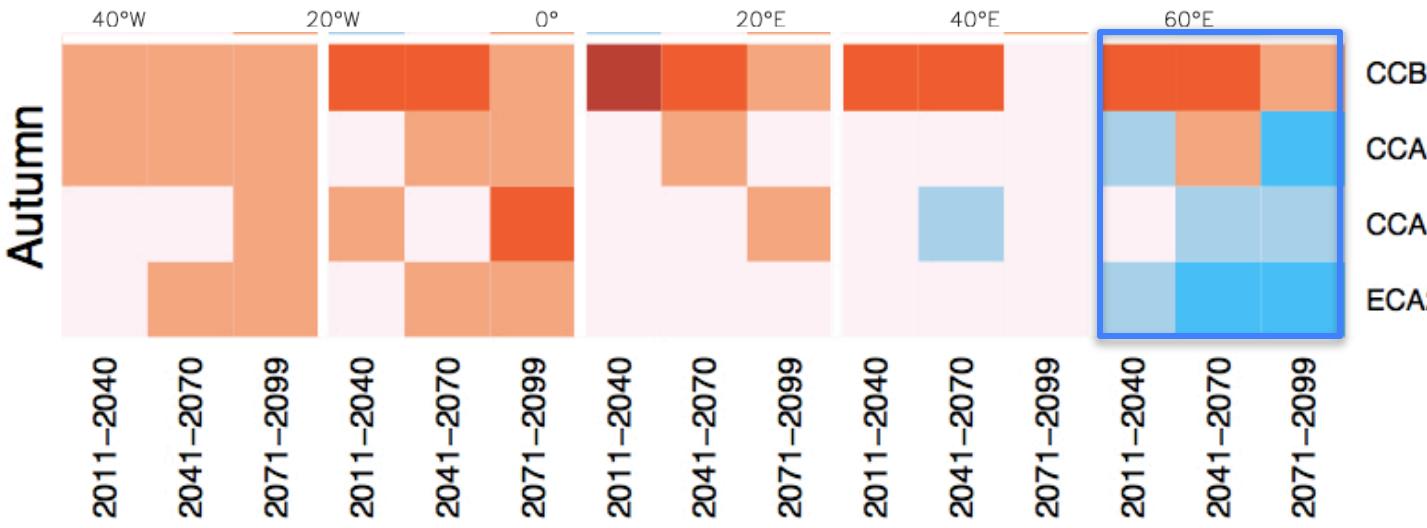
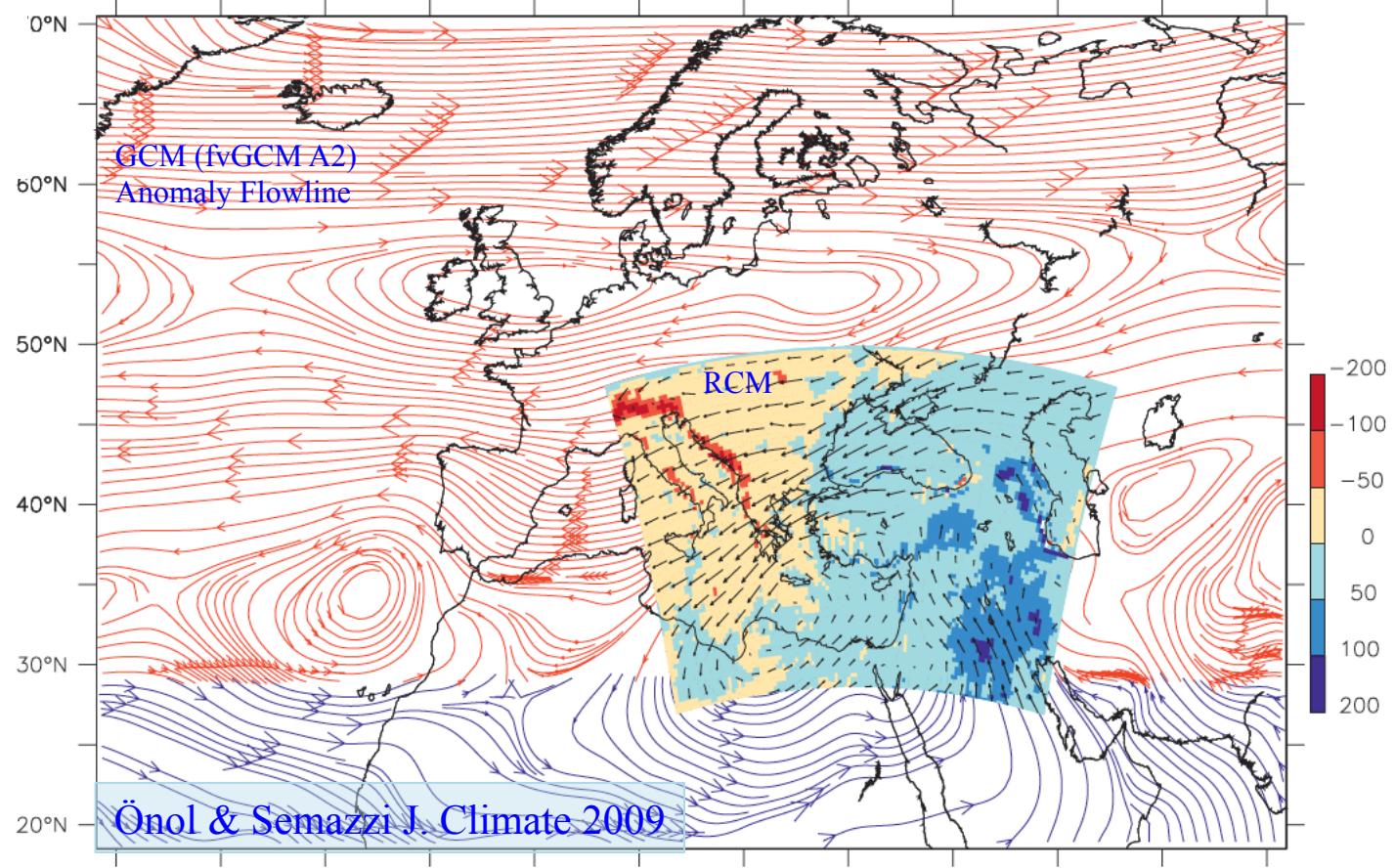
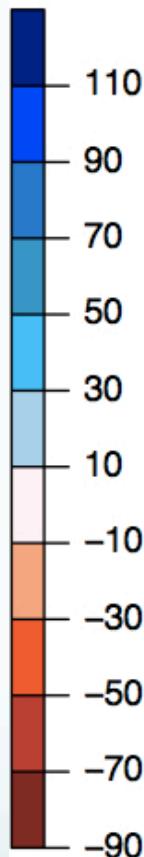
Winter Precip. & Zonal Wind ($\sigma=.86$) Diff. Correlation (A2-RF)



Winter Moist. Advection Diff. (A2-RF; $\sigma=.86$; [gr/kg*sn]*10e-4)



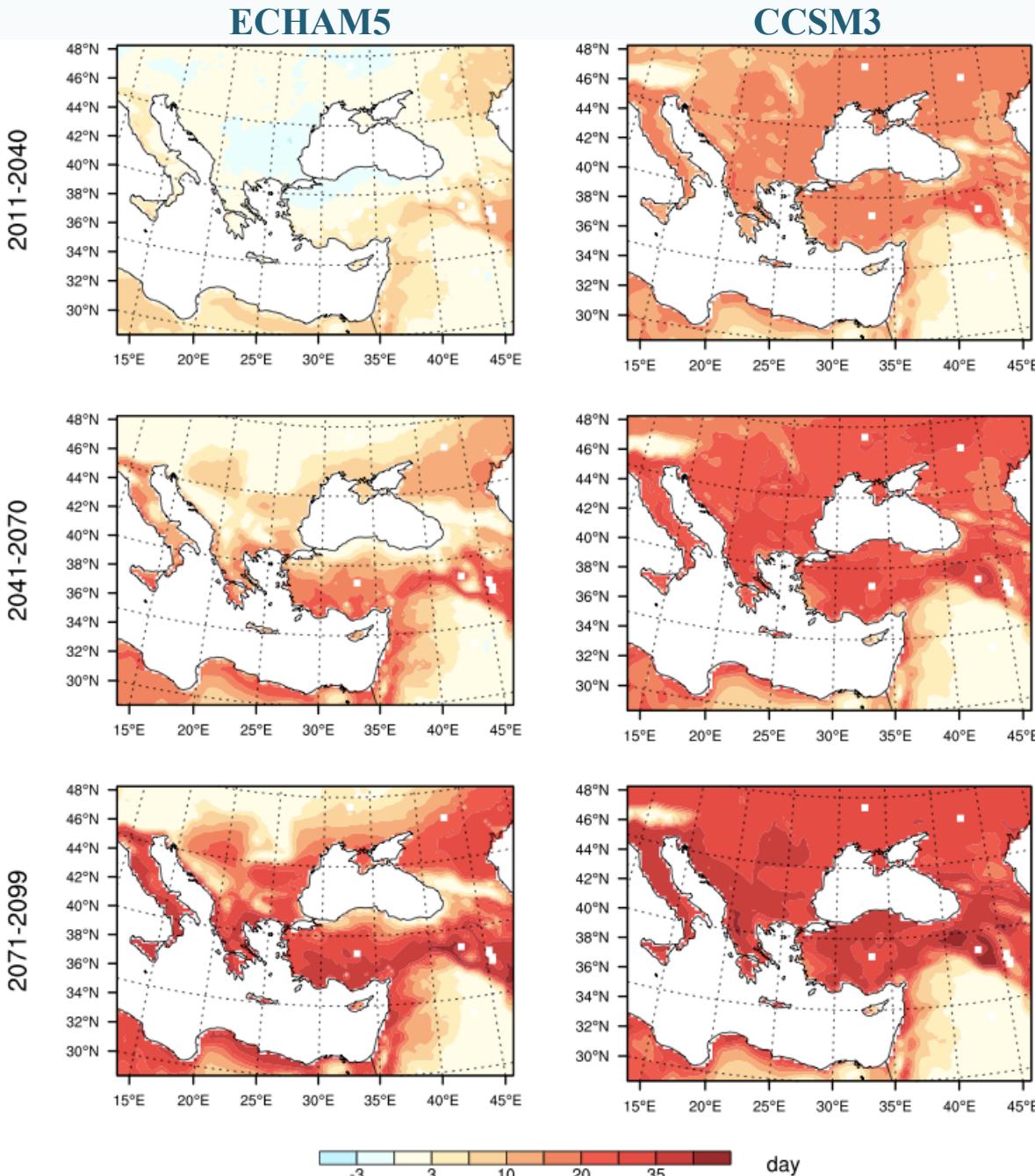
Precipitation Change Table:



Rubik's Cube
of Precipitation
Önol et al. 2014

Ekstrem Sıcaklık İndeksi: SU35

Yaz mevsimi: Günlük çıktılar

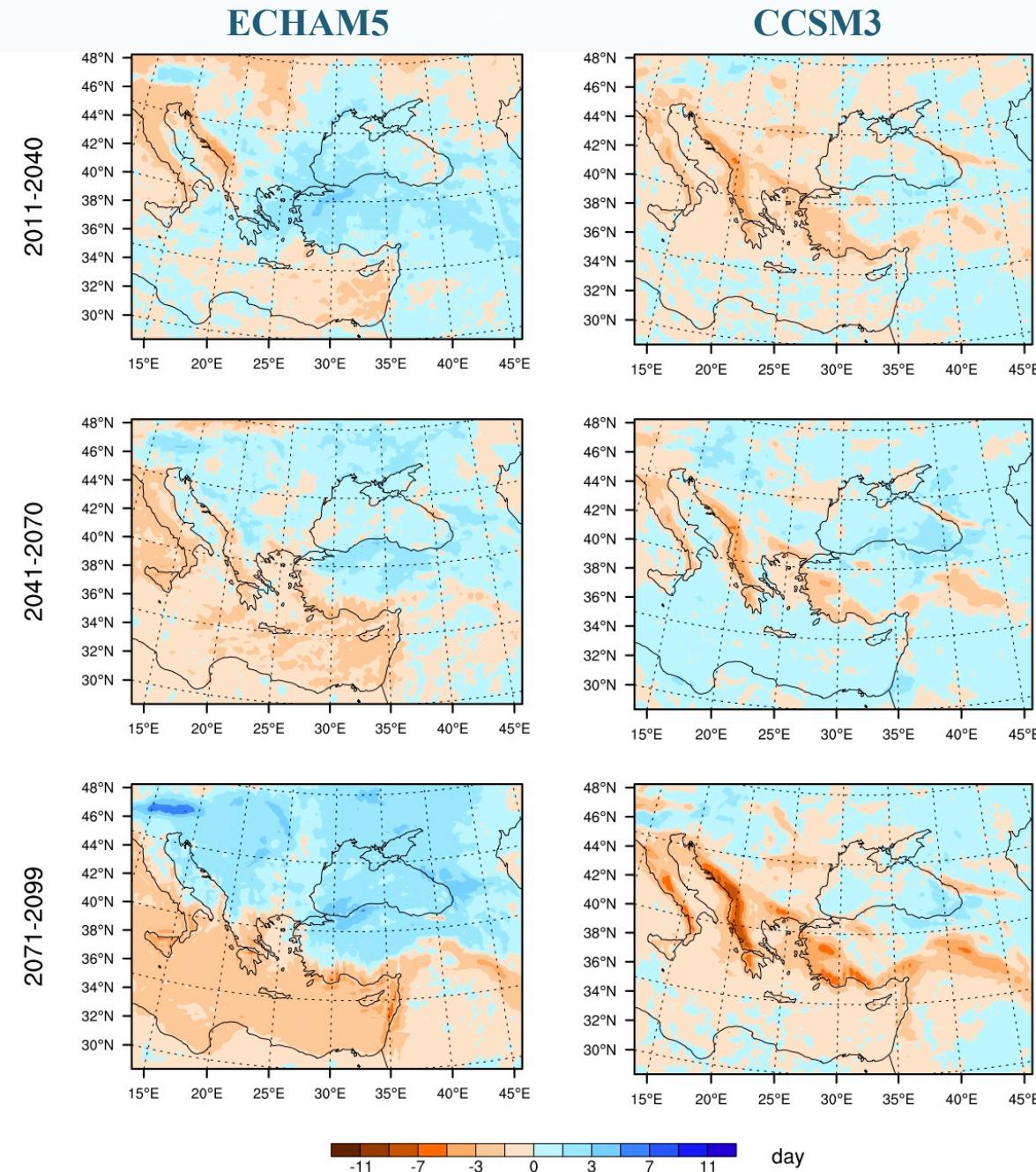


BM ortak programı:
“Türkiye’nin İklim Değişikliğine Uyumu
için Kapasitesinin Arttırılması”

Ekstrem Yağış İndeksi: RR10

Kış mevsimi: Günlük çıktılar

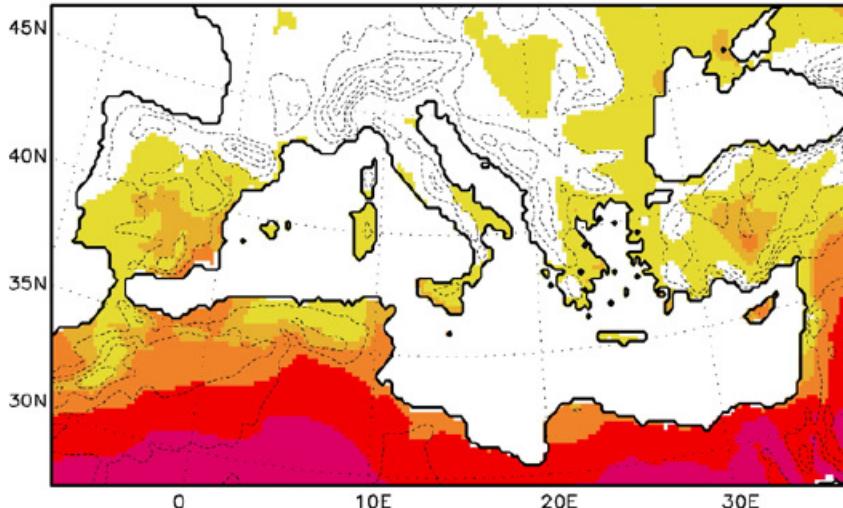
BM ortak programı:
“Türkiye’nin İklim Değişikliğine Uyumu
için Kapasitesinin Arttırılması”



Kuraklık İndeksi:

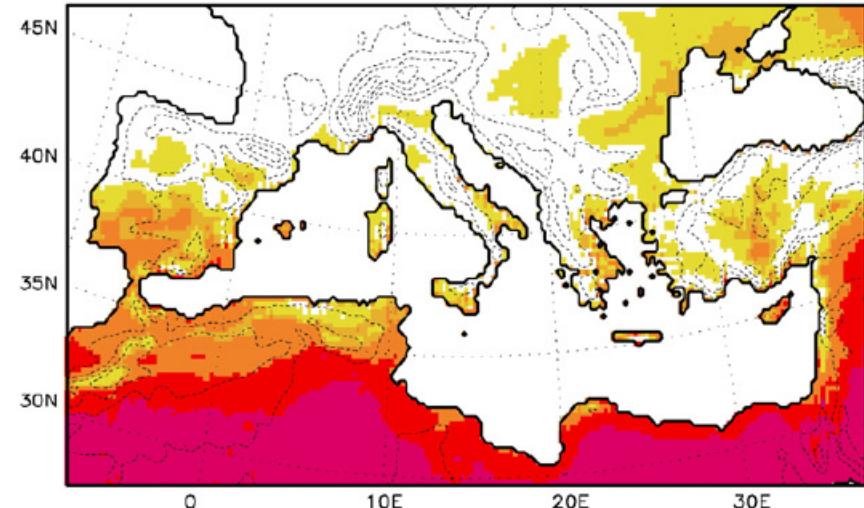
(a)

UNEP drought index, CRU



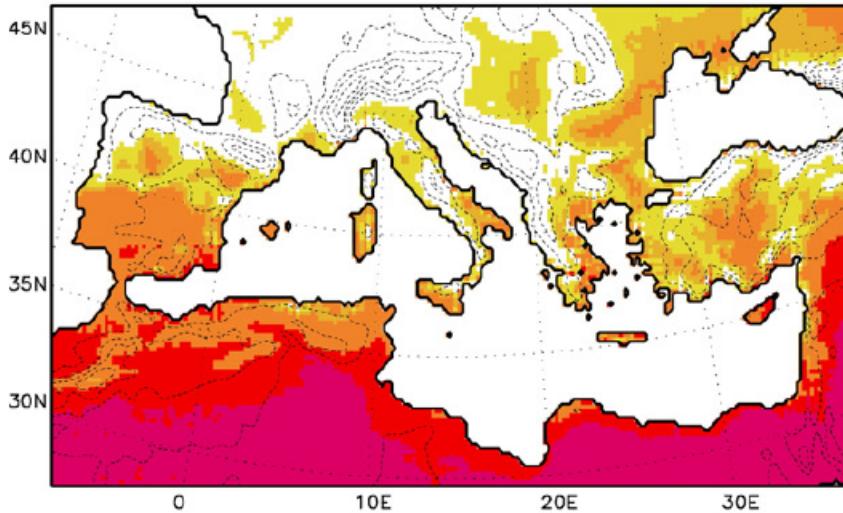
(b)

UNEP drought index, Reference



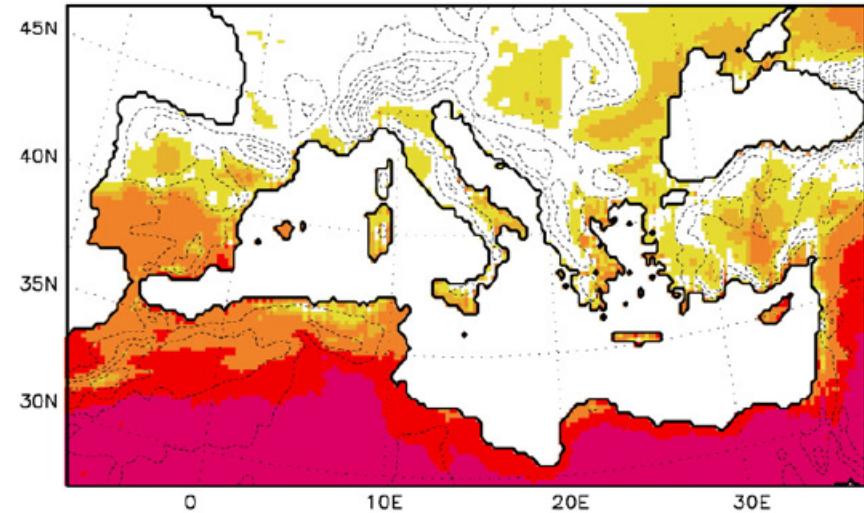
(c)

UNEP drought index, A2

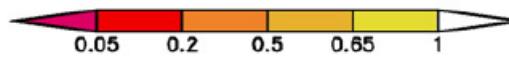


(d)

UNEP drought index, B2



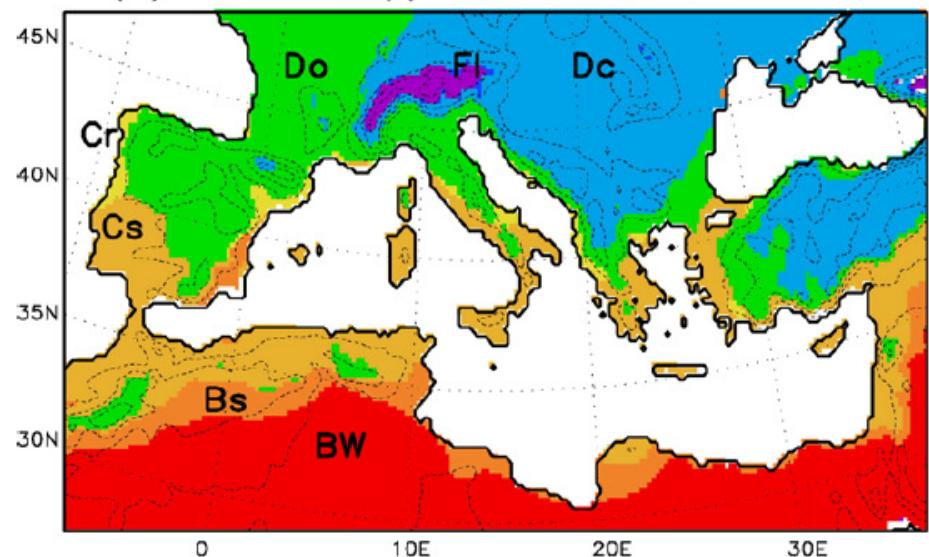
Gao ve Giorgi, Glob.PI.Ch, 2008



İklim Sınıflandırmalarındaki Değişim:

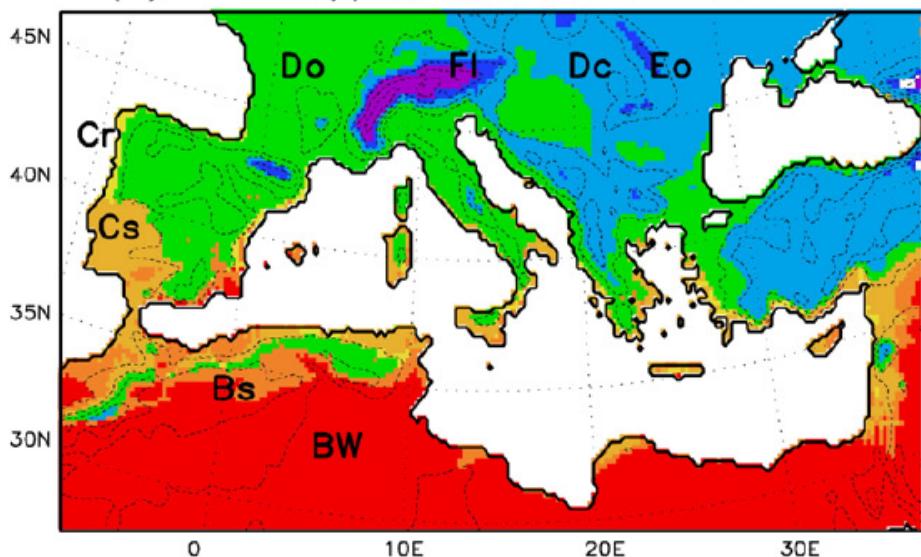
(a)

Koppen climate, CRU



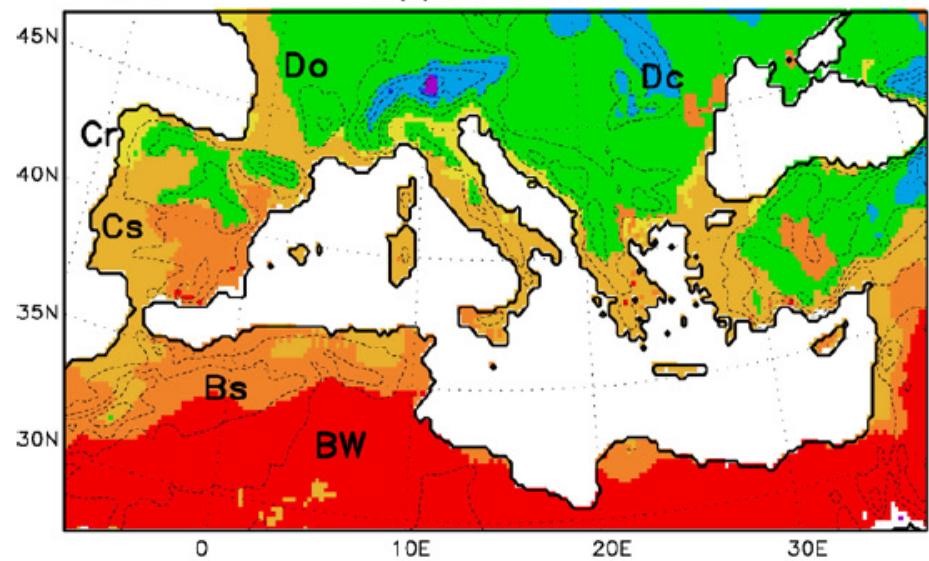
(b)

Koppen climate, Reference



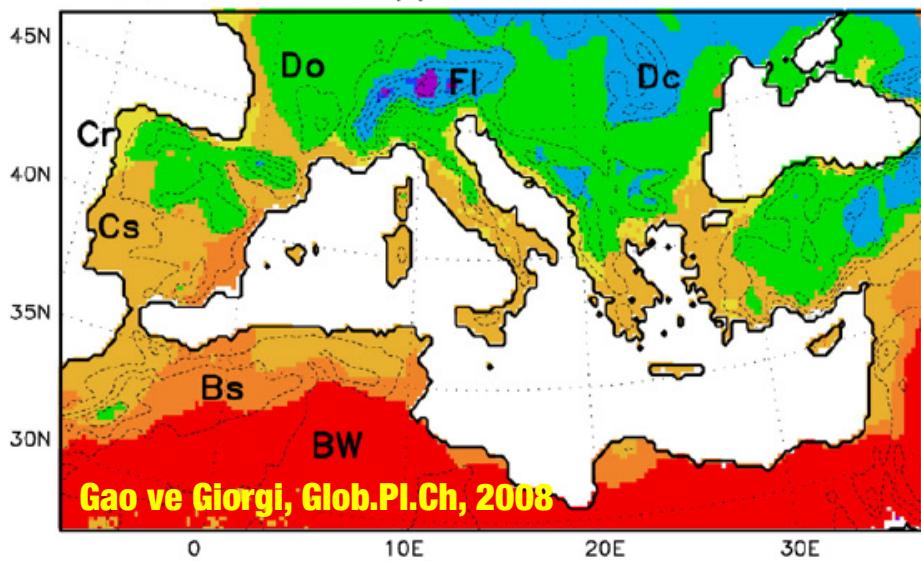
(c)

Koppen climate, A2



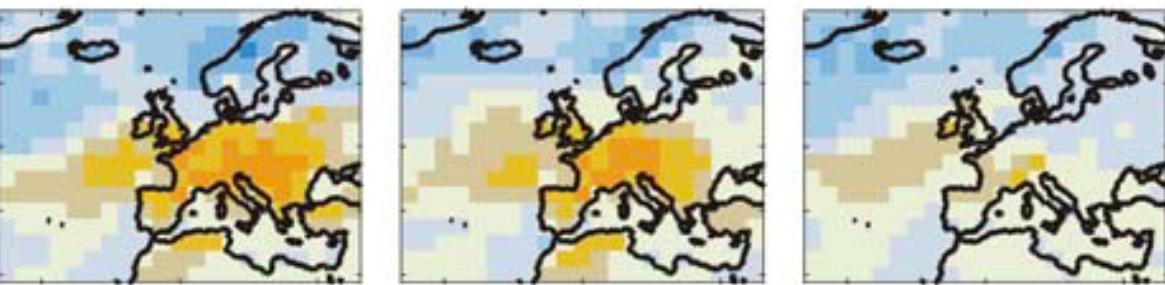
(d)

Koppen climate, B2



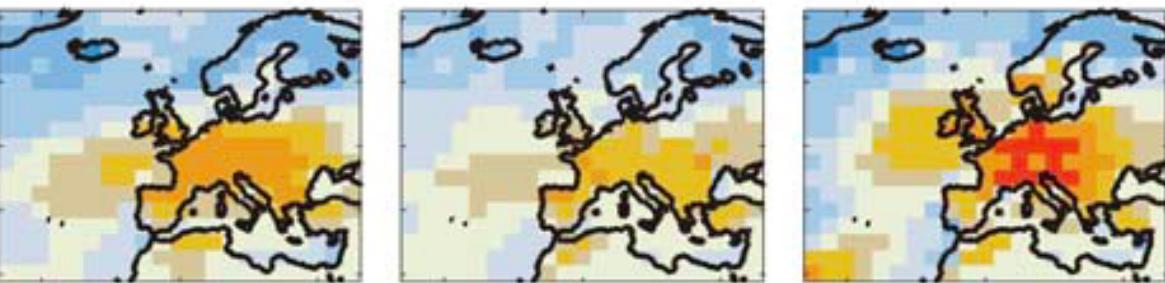
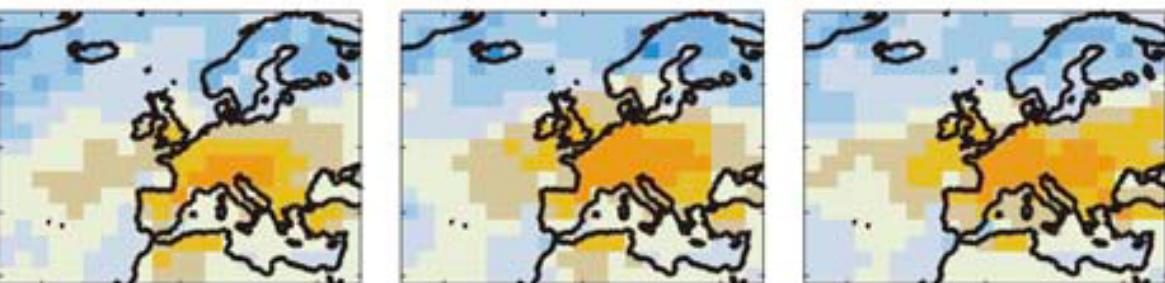
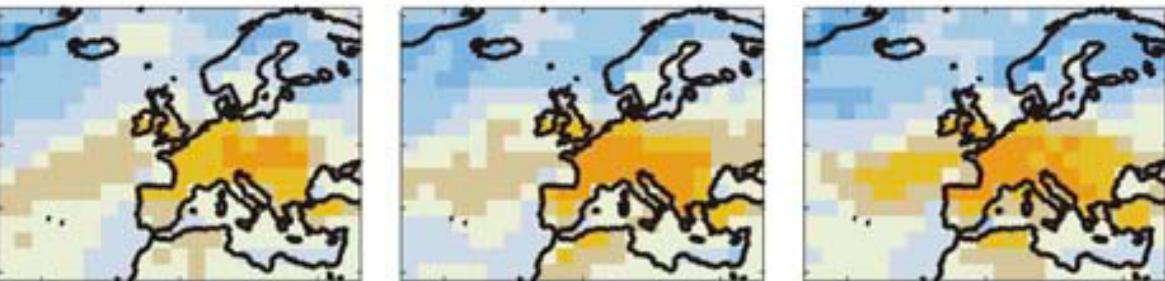
Gao ve Giorgi, Glob.PI.Ch, 2008

Ensemble Simülasyonlar (Simülasyon Kümesi)



<http://www.ensembles-eu.org/>

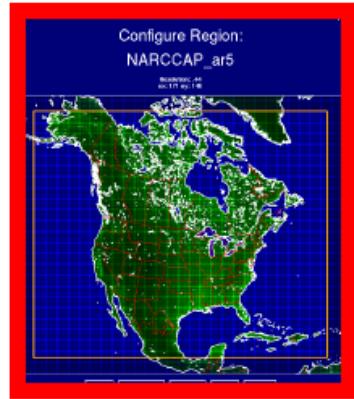
Hewitt, C.D and Griggs, D.J., Eos, 2004



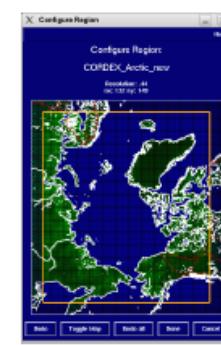
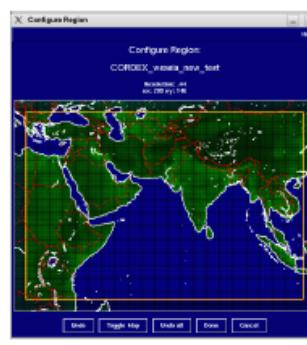
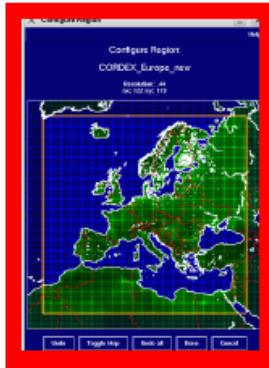
CORDEX (COordinated Regional climate Downscaling Experiment)

Bölgeleri

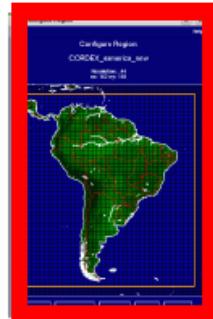
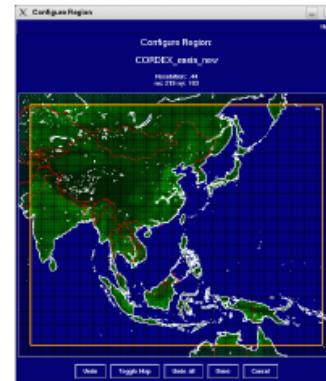
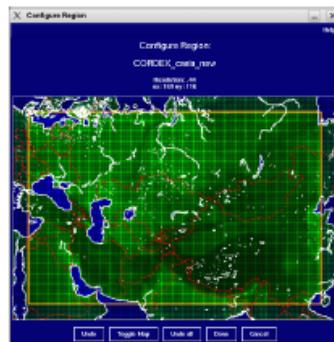
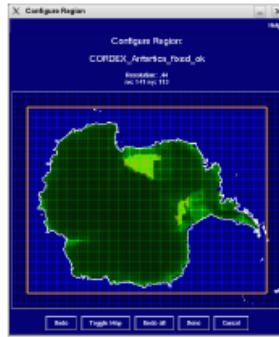
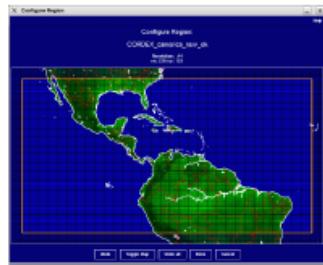
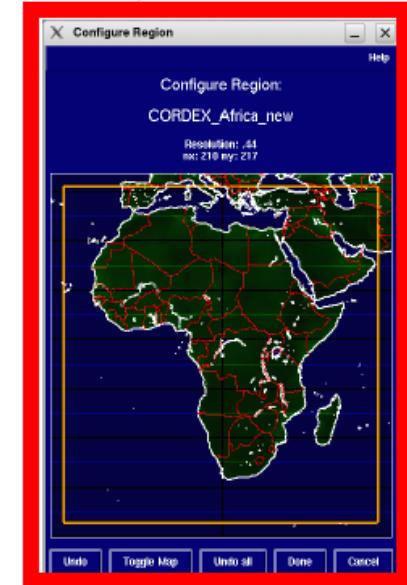
NARCCAP



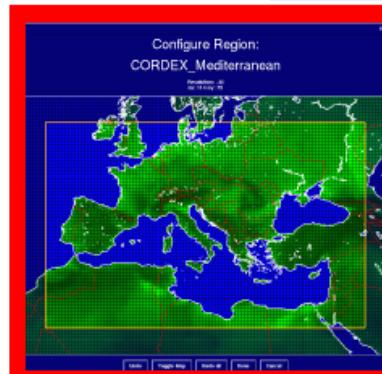
ENSEMBLES
IMPACT2C



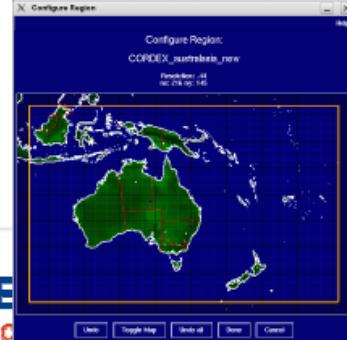
Mandatory domain
AMMA, ENSEMBLES

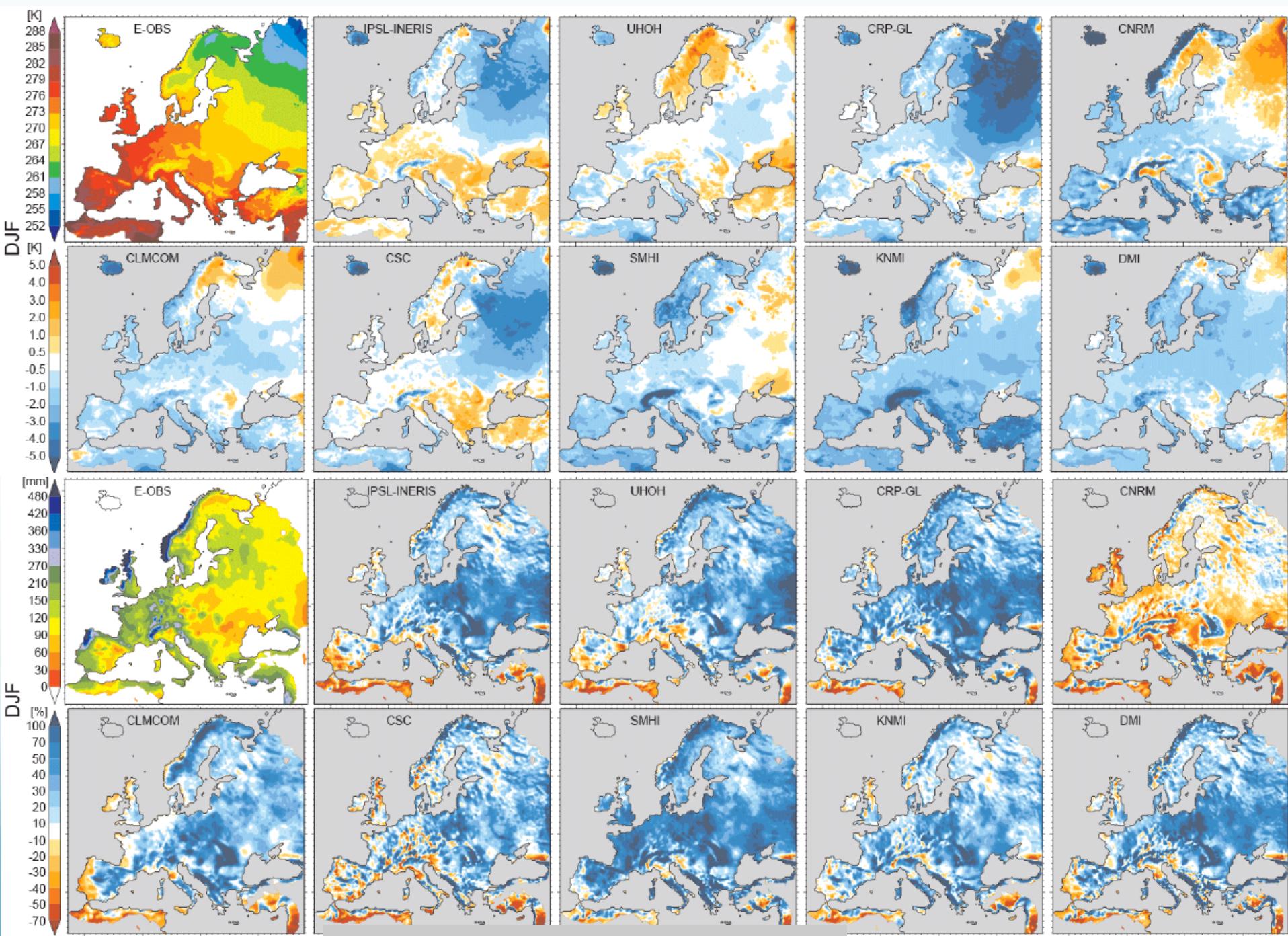


CLARIS-LPB



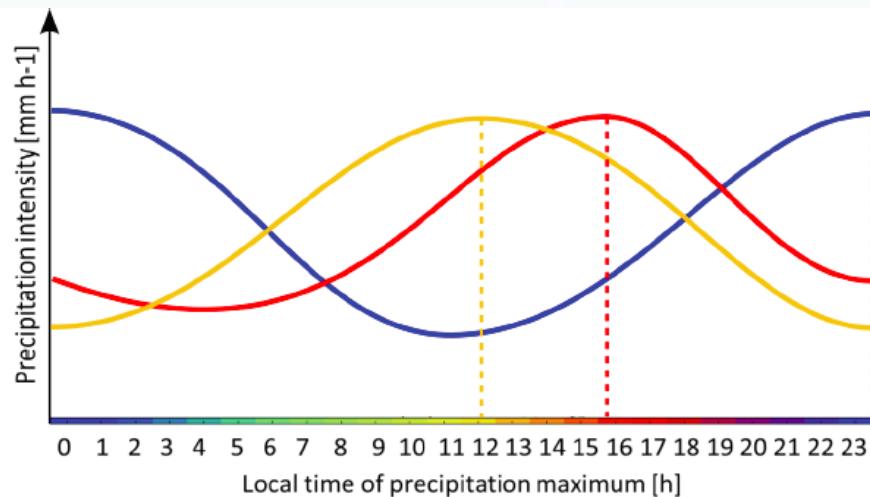
HyMeX
MedCLIVAR
CIRCE
CLIMRUN





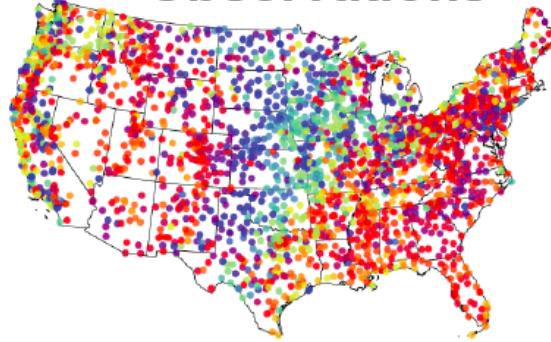
Convective Permitting Climate Modeling

Prein, Stockholm, CORDEX 2016

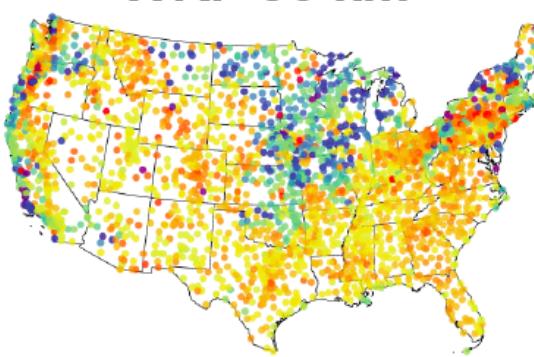


Afternoon Peak
Noon Peak
Nighttime Peak

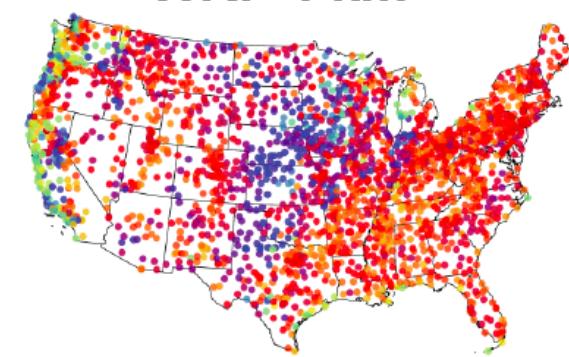
Observations



WRF 36 km



WRF 4 km



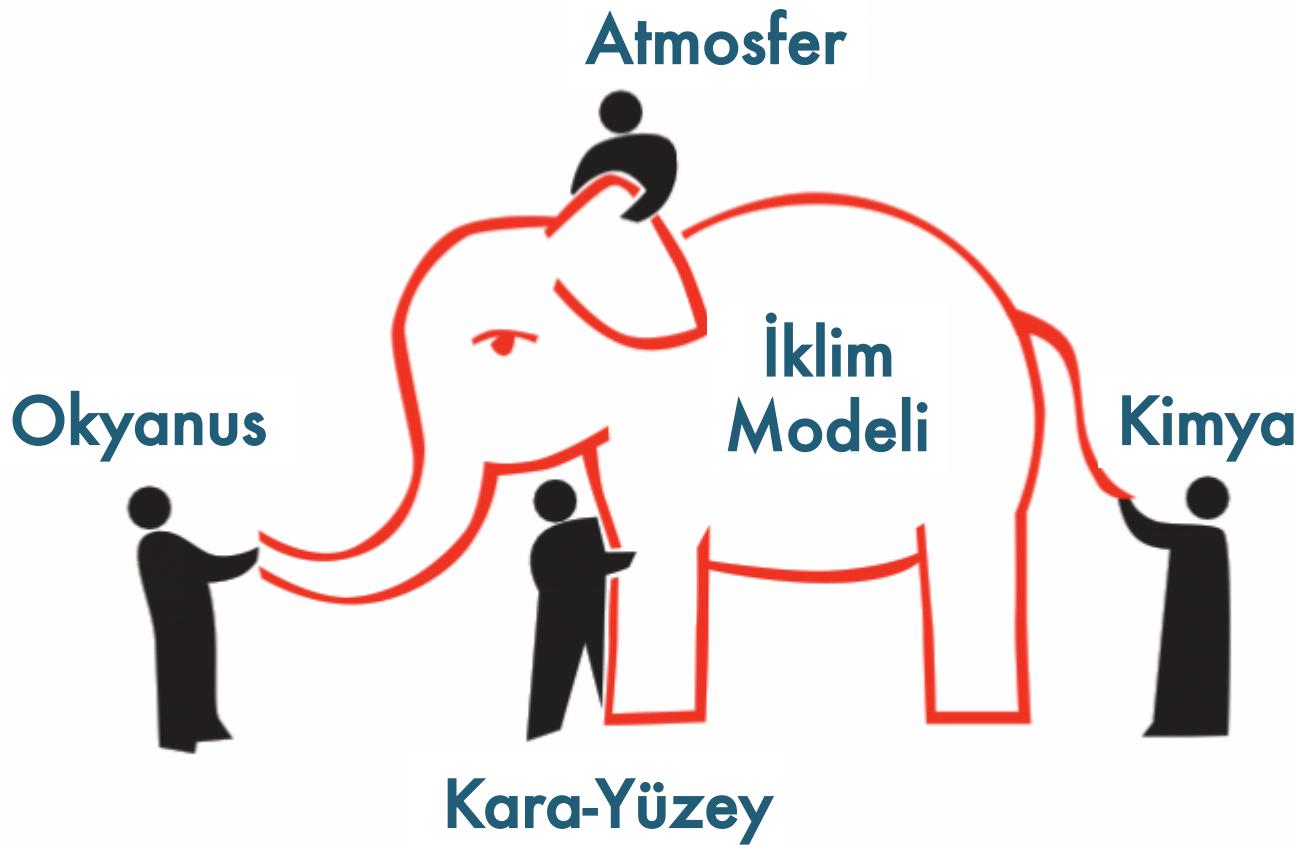
local time of amount maxima [h] during JJA

CPM improve diurnal cycle of the amount, intensity, and frequency of precipitation

[Ban et al. 2014, Kendon et al. 2012, Langhans et al. 2013, Prein et al. 2013; Fosser et al. 2014]

[Mooney et al. 2016]

Fili Gören Oldu mu?!!



BLIND MEN AND THE ELEPHANT