Turkish State Meteorological Service

Directorate of Climatology

Climate Assessment of Turkey in 2012 and Expected Climate Change for Eastern Mediterranean According to HadGEM2 RCP4.5 Scenario

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Presentation's Content

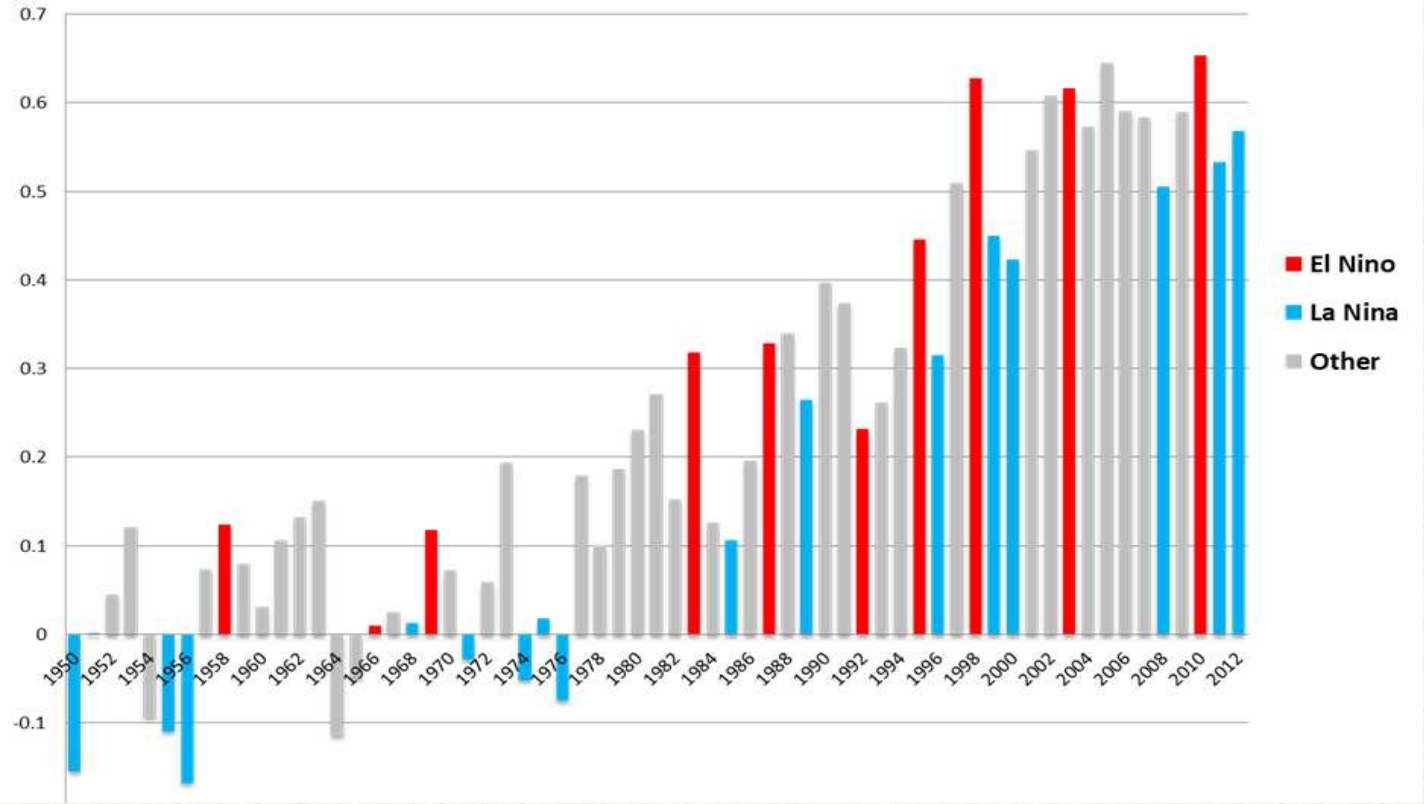
Assesment of Climate

- Temperature Anomalies in Turkey
- Heat and Cold Wave in Turkey
- Precipitation Anomalies in Turkey
- Assessment of Extreme Events

Climate Prediction

- New Scenarios (RCP's)
- Models and Data Sets
- Precision and Control Tests
- Temperature and Precipitation Projections
- Results and Discussion

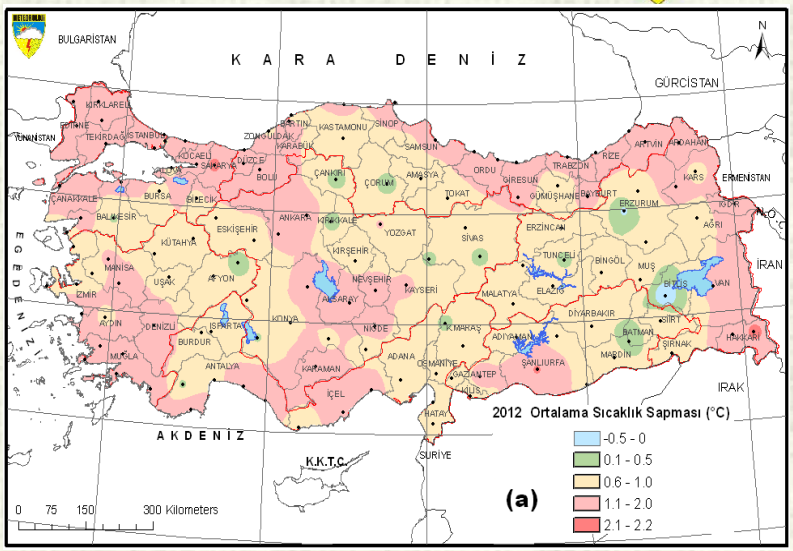
Temperature Anomalies in Turkey

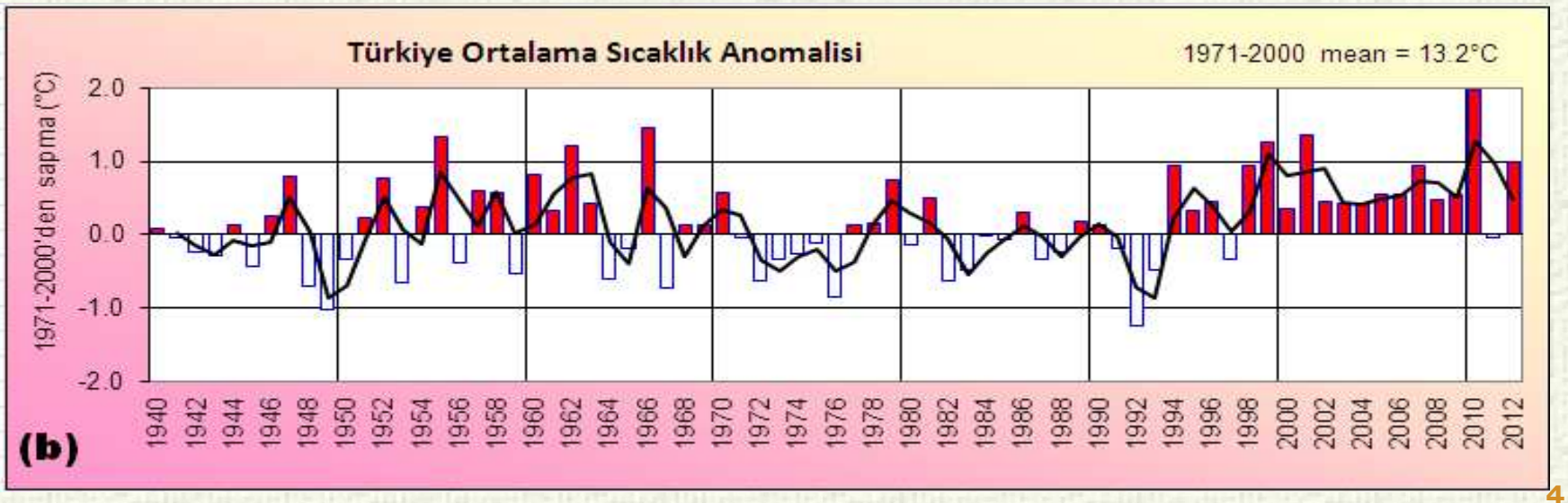


Global land mean temperature anomalies was measured 0.57 °C above normals and 2012 have been seventh warmest year since 1880. Although 2012 is La Nina year, Temperature records are reported at some countries.

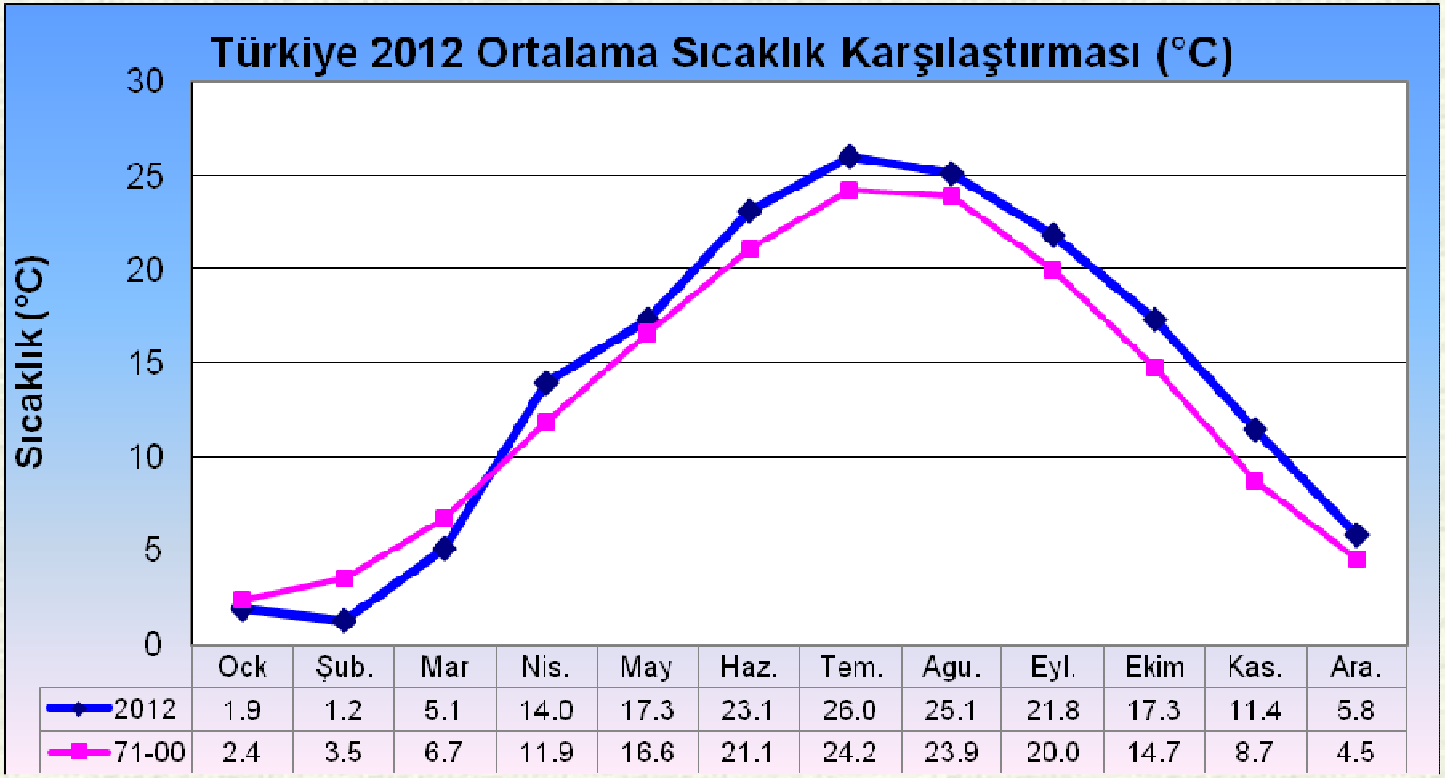
Temperature Anomalies in Turkey

2012 mean temperature was measured 14.2 °C and avarage of 1971-2000(reference period) is 13.2 °C. Anomaly is 1 °C. Mean temperatures have positive anomaly since 1994 in Turkey. The warmest year was 2010 with 2 °C anomaly.





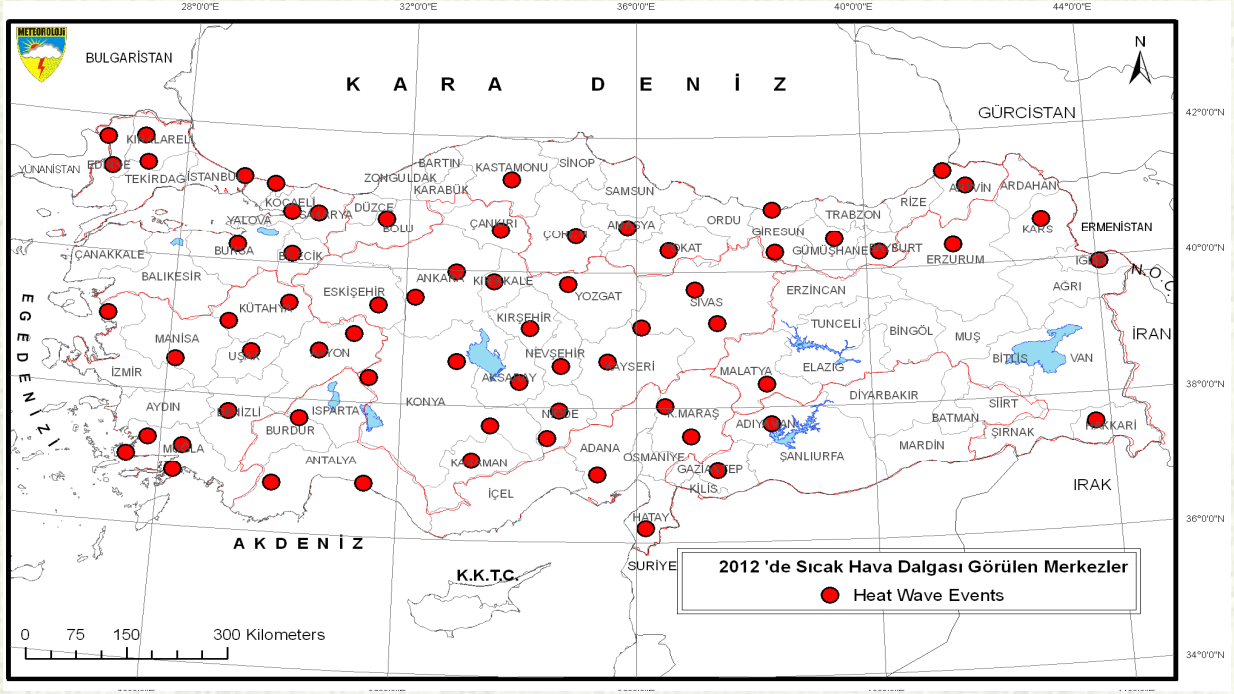
Temperature Anomalies in Turkey



	Ock	Şub.	Mar	Nis.	May	Haz.	Tem.	Agu.	Eyl.	Ekim	Kas.	Ara.
2012	1.9	1.2	5.1	14.0	17.3	23.1	26.0	25.1	21.8	17.3	11.4	5.8
71-00	2.4	3.5	6.7	11.9	16.6	21.1	24.2	23.9	20.0	14.7	8.7	4.5

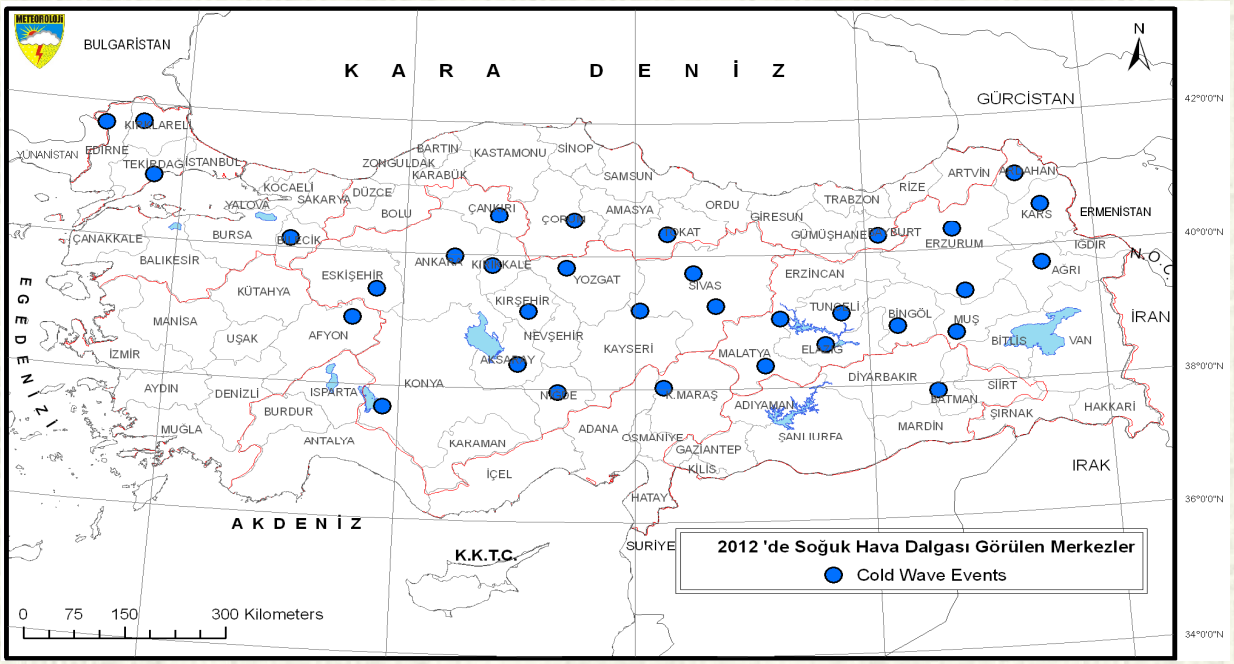
January, february, march mean temperatures were below normals, the other months were above normal in 2012

Heat and Cold Wave in Turkey



166 heat waves were observed at 66 stations in 2012. Also 29 stations exceeded their max temperatures. Tropical days (max tepm > 30 °C) were observed at 122 stations. Beside, daily max temperatures was measured above 40 °C at 46 stations.

Heat and Cold Wave in Turkey

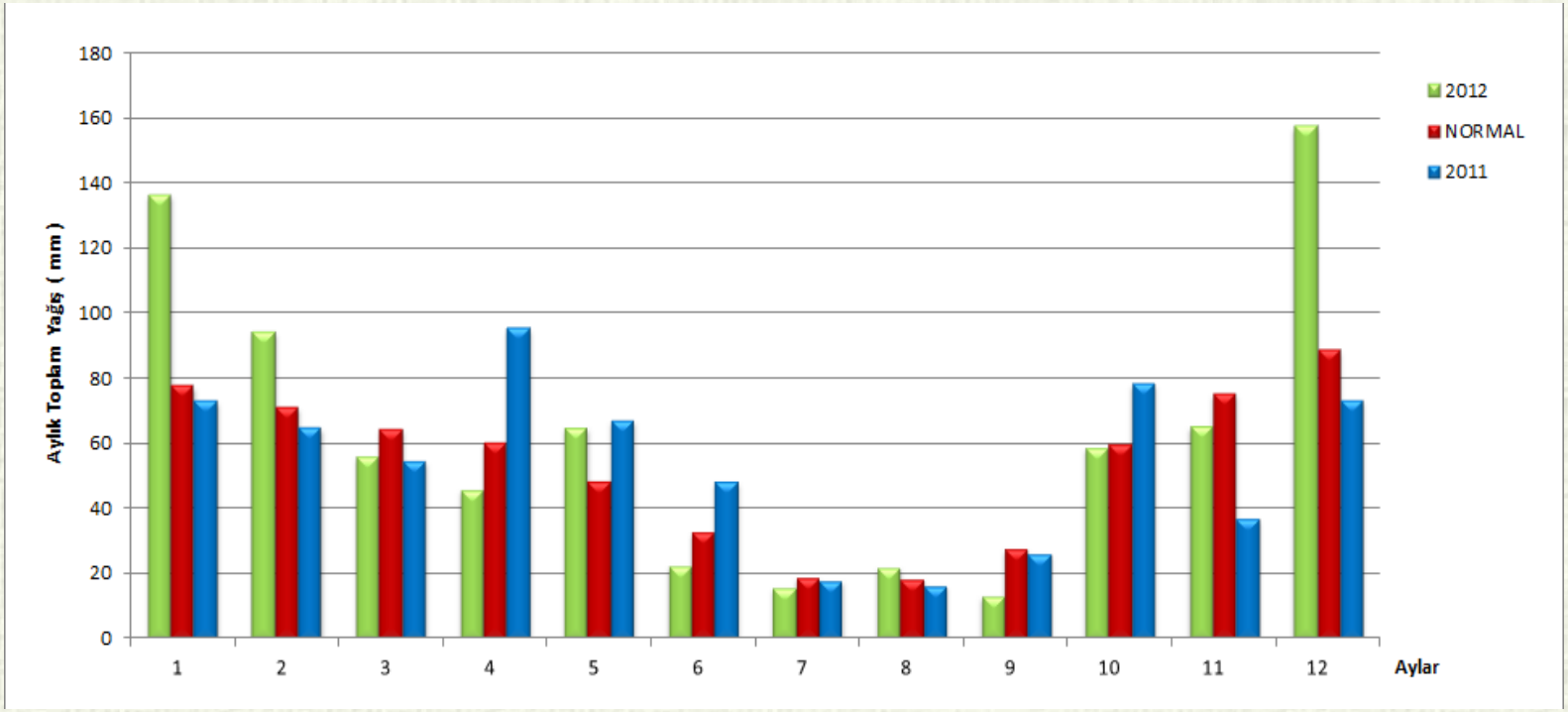


46 cold waves were observed at 33 stations in 2012. Especially 34 cold waves were reported at february.

Precipitation Anomalies in Turkey

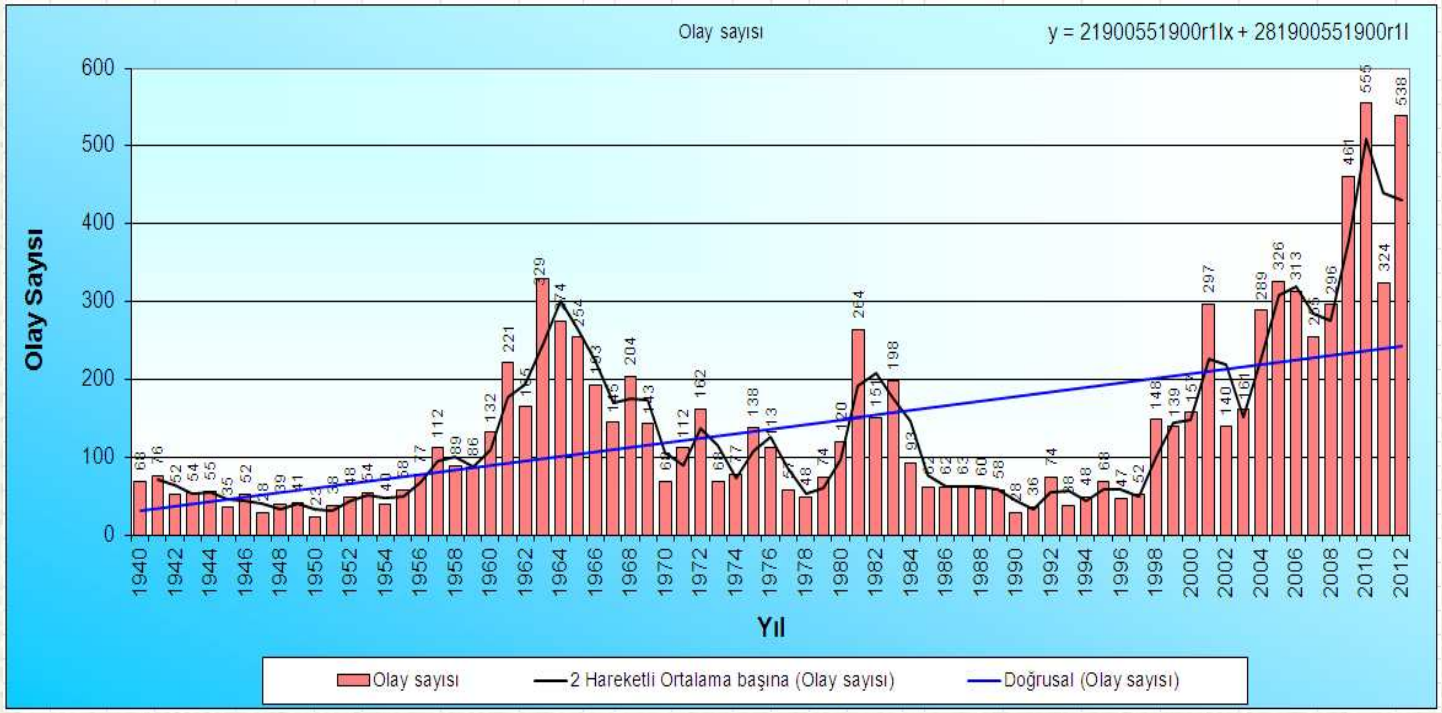
The average of total precipitation was 746 mm and it was more than %16 from 1971-2000 reference period. Especially southern regions precipitation amount was more than %50 from reference period.

Precipitation Anomalies in Turkey



Total precipitation amount at January and December were pretty high.

Assessment of Extreme Events



The number of extreme events trend has increased since 1940. 219 Extreme event / 100 years. 538 extreme events were report in 2012. Storms, heavy rain and flooding, drought and hail were most reported.

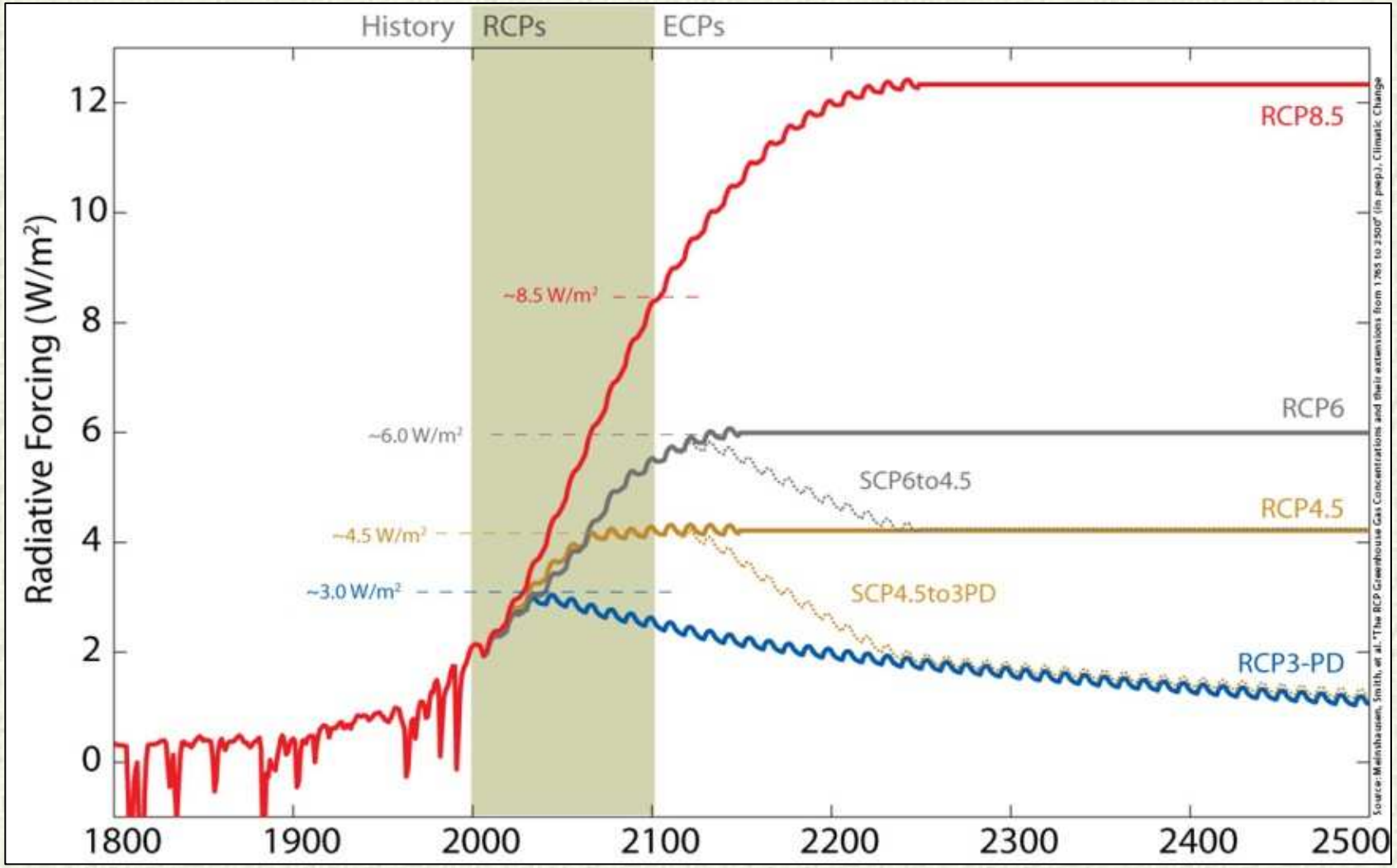
New Climate Change Scenarios (RCP)

The expert meeting of IPCC was held on 19–21 September 2007 in the Netherlands. The meeting brought together over 130 participants, including users of scenarios and representatives of the principal research communities involved in scenario development and application. It was decided to built new concentration scenarios (hereafter will be called as RCPs-representative concentration pathways), that would use in climate change researches for a possible IPCC 5. Assessment Report.

Types of RCPs and Features

RCPs	Radiative Forcing	Time	Radiative Forcing Changing	Total Cocentration (CO2 EQ)	Emissions (KYOTO greenhouse gasses)
RCP 8.5	> 8.5 W/m2	In 2100	Rising	~1370 ppm in 2100'	Rising up to 2100
RCP 6.0	~6.0 W/m2	After 2100	Stabilization without overshoot	~ 850 ppm in 2100	Decreasing in last quarter of century
RCP 4.5	~4.5 W/m2	Before 2100	Stabilization without overshoot	~ 650 ppm in 2100	Decreasing after middle of century
RCP3-PD*	~3.0 W/m2	Peak at ~3.0 W/m2 Before 2100	3.0 W/m2 Peak and decline	Peak at ~ 490 ppm and decreasing in 2100	Decreasing in first quarter of century

Global Total Radiative Forcing



(RCP Concentration & Data Group, 2010)

Model and Data Sets

Global Model	Regional Model	Sensitivity Analysis	Periyod
HadGEM2	RegCM4.3.4	• HadGEM2-ES RF(1971-2000) • CRU (1971-2000) • UDEL (1971-2000) • UDEL-C (1971-2000)	2013-2099

Method

After determining appropriate parametrization, model was run 4 times with resolution of 20 km in matrix of 130x180 for reference period (1971-2000) and future period (2013-2040, 2041-2070, 2071-2099). Regional Climate Model (RCM), takes initial and boundary conditions from general circulation model (GCM) data for selected domain. First 12 grids in all directions were ignored because they fed boundary conditions and data pass topography of RCM. Moreover, each run was started 1 year earlier than target period for spin-up time.

1971-2000 Reference Period Seasonal Mean Temperature Outputs were Compared with Different Observation Data Sets

Sıcaklık (°C)	RCM	CRU	UDEL	RAW
KIŞ	0.436	0.561	0.258	1.762
İLKBAHAR	8.294	9.712	9.503	9.867
YAZ	20.792	20.859	20.834	20.763
SONBAHAR	10.412	12.480	12.177	12.349
ORTALAMA	**9.987**	**10.906**	**10.694**	**11.190**

It is seen that model output values of especially winter and summer season conform to other observation data.

In spring and autumn, model output values are 1.5 **°C** below according to observation data.

When we consider Turkey' general mean temperature value, we see that it is **0.71 - 0.92 °C** below than CRU and UDEL data.

1971-2000 Reference Period Seasonal Precipitation Outputs were Compared with Different Observation Data Sets

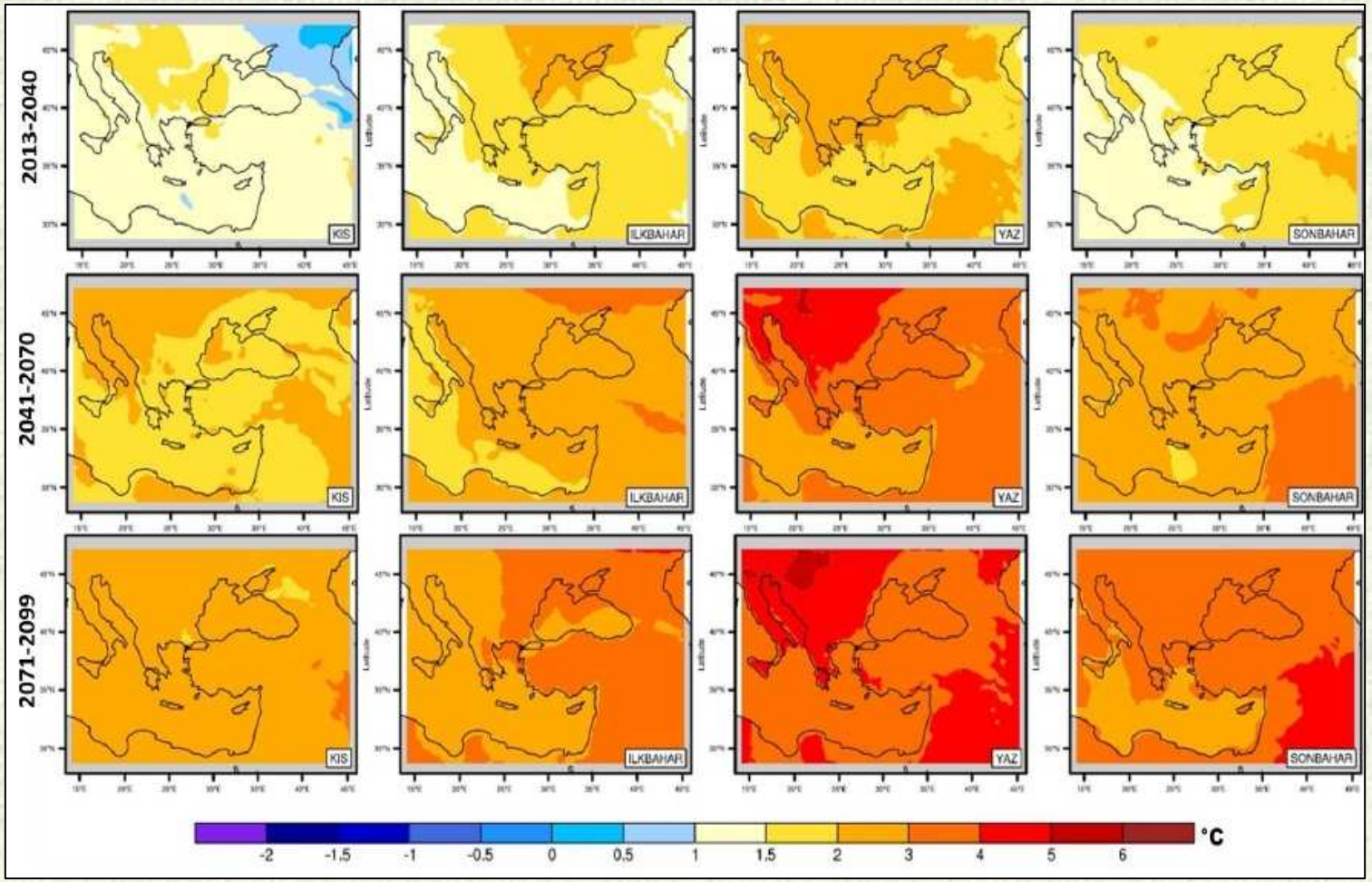
Yağış (mm/gün)	RCM	CRU	UDEL	UDEL-C	RAW
KIŞ	2.159	2.126	2.064	2.452	2.764
İLKBAHAR	2.622	1.974	1.881	2.101	2.874
YAZ	0.947	0.686	0.653	0.733	0.952
SONBAHAR	1.830	1.333	1.347	1.497	1.858
ORTALAMA	**1.886**	**1.531**	**1.487**	**1.697**	**2.107**

It is seen that model output (RCM) precipitation values of especially winter season conform to other observation data.

In spring and autumn, RCM precipitation values are higher than observation values.

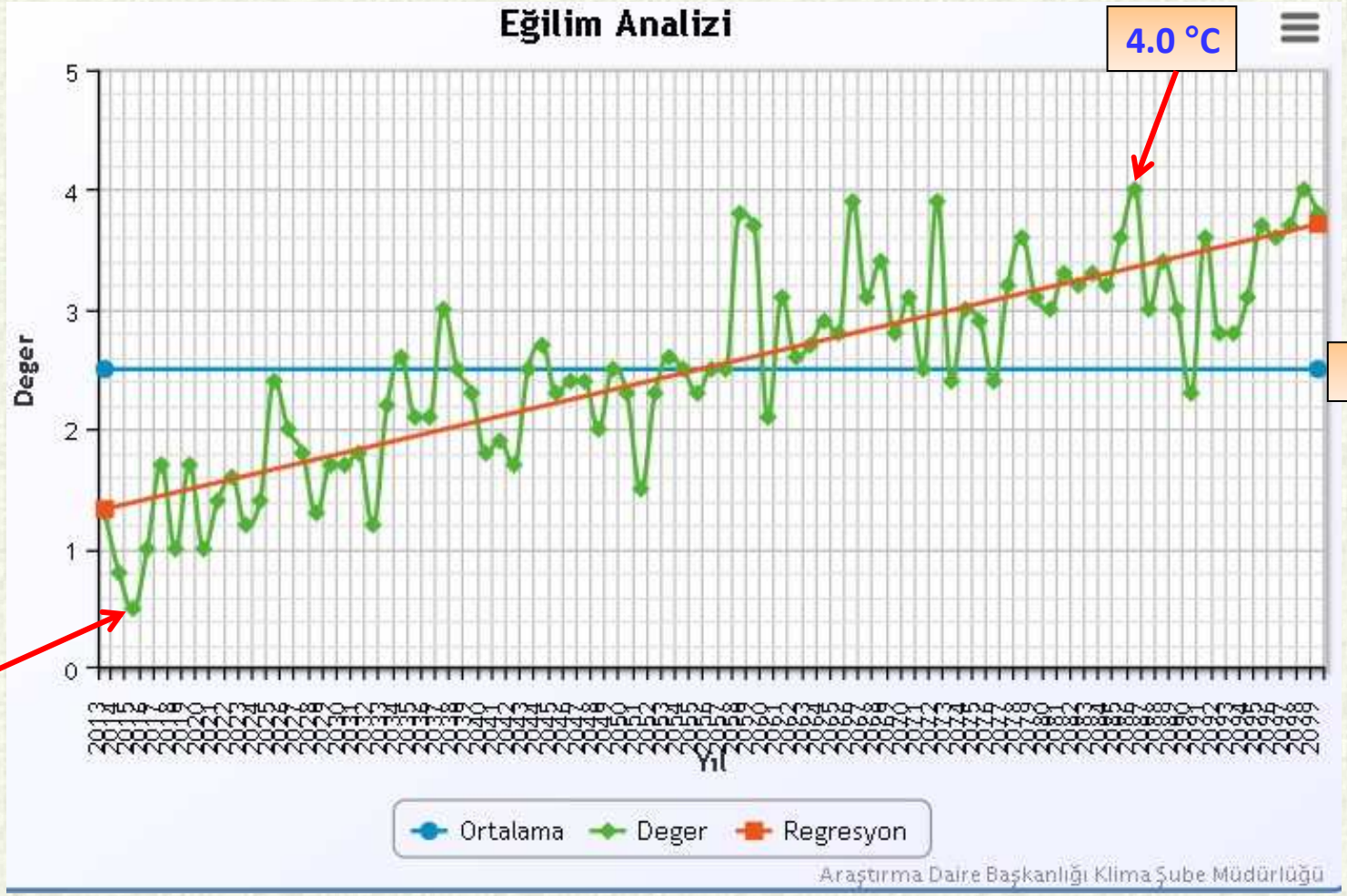
When we regard countrywide values, genarally, RCM shows %23 more precipitation than global observation data sets.

For all seasons: 2013-2040, 2041-2070 ve 2071-2099 Temperaure Difference Maps According to 1971-2000 Reference Period

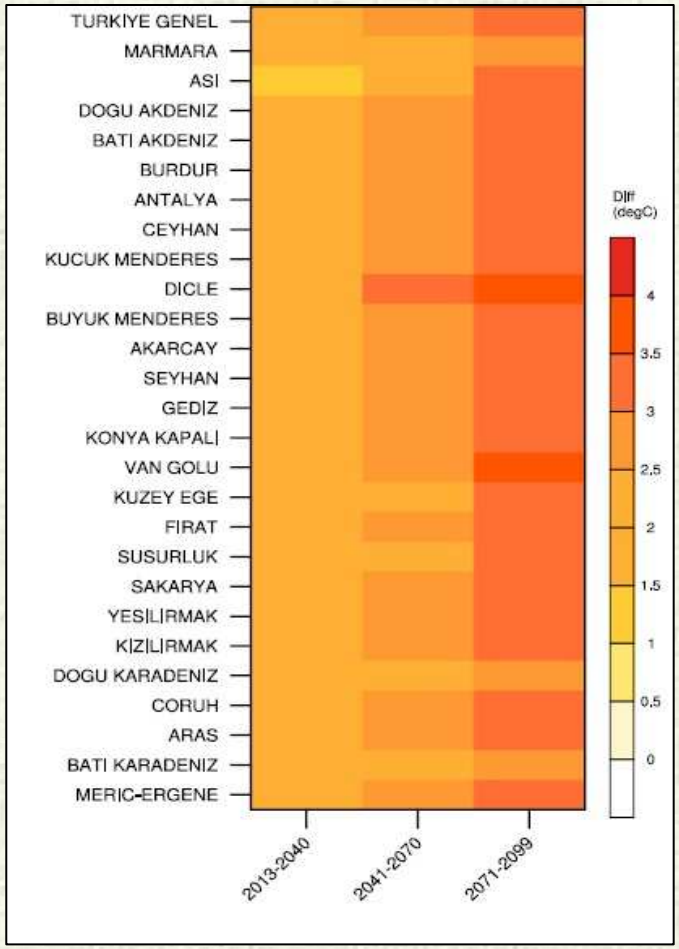


Temperature difference maps produced 1971-2000 reference period shows a rising trend up to end of century. According to this, it is seen rising trend up to end of century. Generally 1-1.5 °C rising is estimated to whole Eastern Mediterranean region in the period of 2013-2040. 2-3 °C rising is estimated for regions of East part of Turkey, Iraq, Italy, North of Egypt and Libya, 1.5-2 °C for the ohter regions in period of 2041-2070. Towards end of century, temperatures will rise 2-3 °C in Eastern Mediterranean region. In spring, temperature rising is 1 °C for all of period(1.5-2, 2-3, 3-4). In summer, there are remarkable temperature rising, especially in Italy, Syria, Israel and south Eastren part of Turkey with 4-5 °C at towards end of century. In autumn, the most vulnerable areas are south Eastren part of Turkey, Syria, Iraq with 3-4 and 4-5 °C.

Trend Analysis

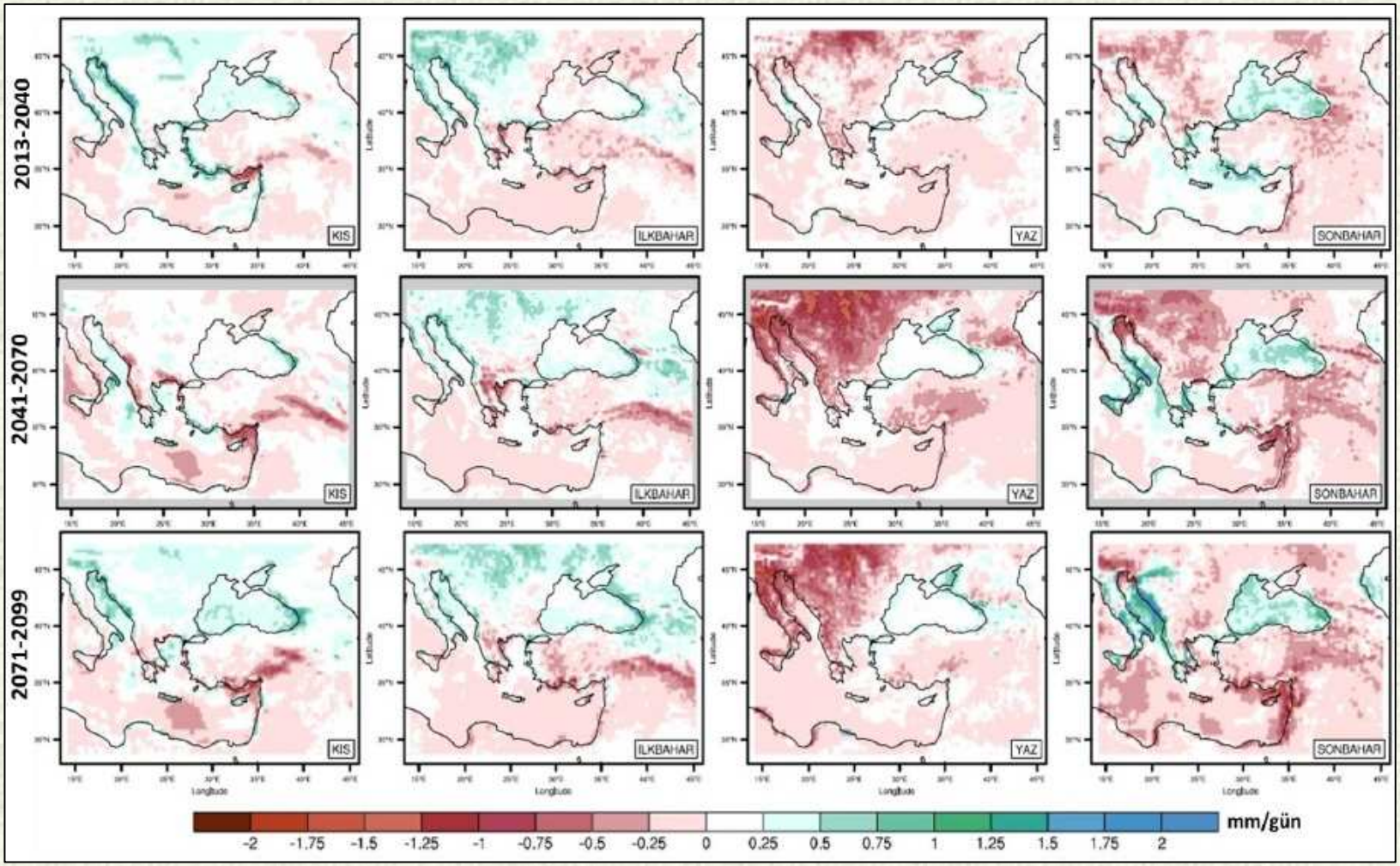


Temperature Prediction for Each River Catchment



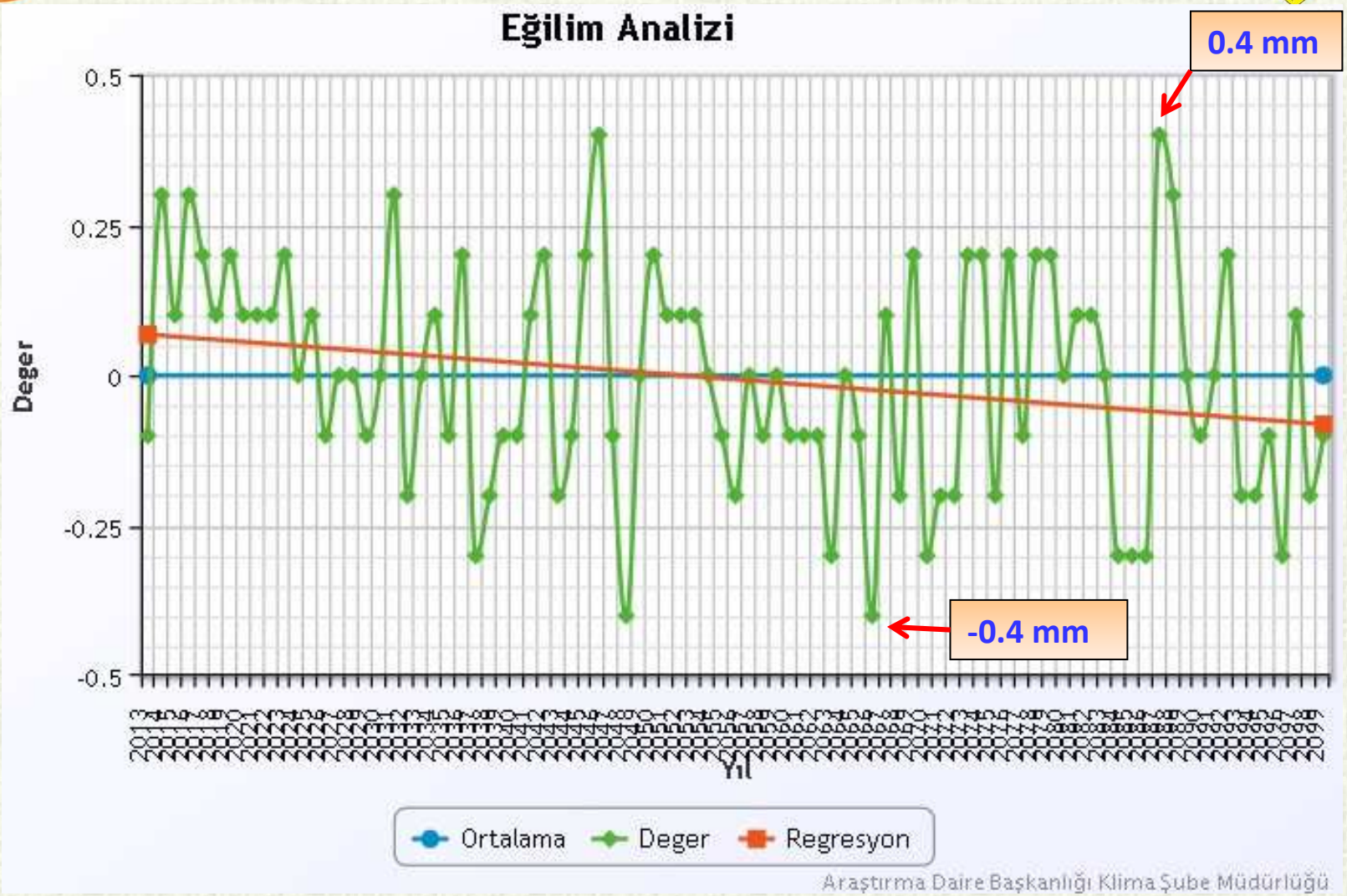
This table provides details to us that how will be affect each river basins.

For All Seasons: 2013-2040, 2041-2070 ve 2071-2099 Precipitation Difference Maps According to 1971-2000 Reference Period

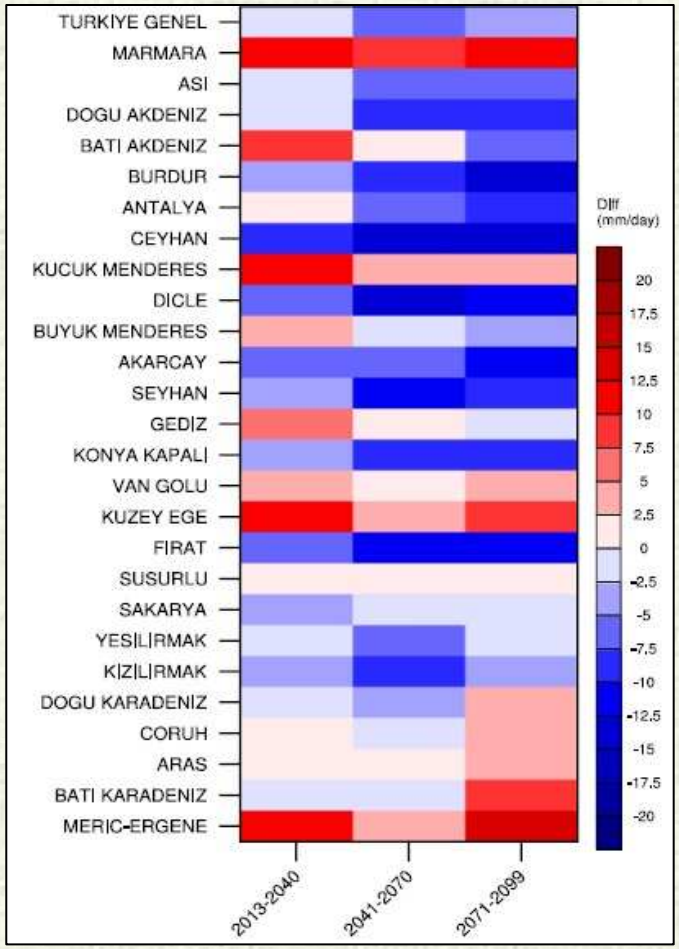


Generally northern regions will be affected pozitive at winter and spring season, especially in Italy. In summer; whole Eastern Mediterranean regions precipitation amounts will be decreased, nearly 0.25-1.25 mm/day. In autumn; Italy, coast of Greece and North part of Turkey will be affected pozitive but Israel, Lebanon and South part of Turkey's precipitation amounts will be seriously decreased.

Trend Analysis



Precipitation Prediction for Each River Catchment



Results and Discussion

According to outputs, altough rising of temperature is limited of 1-1.5 °C in first period (2013-2040), especially in last period (2071-2099) considerable rising (4-5 °C) of temperature attracts attention in Europe, Israel, Syria, Iraq.

Regarding precipitation, while rising in Italy almost all of period, in south part of Turkey, Israel, Syria, Iraq's precipitation amount will be decreased in winter and autumn seasons .

This study is the first step of a comprehensive research for Turkey and its region. That's why, here is one (using RegCM4, it was produced from HadGEM2-ES general circulation model outputs based on RCP4.5) of the 6 data sets to produce near future. It is targeted to produce 5 more RCM (in total 3 GCM and 2 RCPs -4.5 and 8.5) data sets for analysis of future climate change projections on Turkey and its region.

Results and Discussion

Meanwhile, when one evaluates model studies and findings on climate, it must be considered that:

1- Climate is too complex system

2- There are still too many sources of uncertainty about climate system

3-Models have limitations to represent these uncertainties and interactions between climate components.

4- There are pretty strong difficulties about model parametrizations.

Thanks...

İletişim:

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