



Analysis of Regional Climate of Turkey with WRF-ARW Model

Poster Presentation XL78 on 6.4.2011 from CL2.3 - Mediterranean Climate: from past to future

Deniz URAL

M.S. Candidate, Computational Science and Engineering

B.S., Meteorological Engineering

Istanbul Technical University, TURKEY

urald@itu.edu.tr



Introduction & Motivation

- Testing the performances of regional models in climate analysis.
- RegCM3 and WRF-ARW 3.1 has been used for 61 – 90 period (reference) over Eastern Mediterranean (EM) domain.
- RegCM is a regional *climate* model and it has been already tested on EM domain (Onol and Semazzi, 2009; Bozkurt et al., 2011; Bozkurt and Sen, 2011).
- WRF, on the other hand is more complex and relatively new *NWP* model.
- WRF supports regional climate modelling but it needs to be validated for climate studies.
- EM domain is a perfect testbed for the models for testing their performances.

Methodology - An Overview

NCHPC NATIONAL CENTER FOR
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NNRP ds090.0

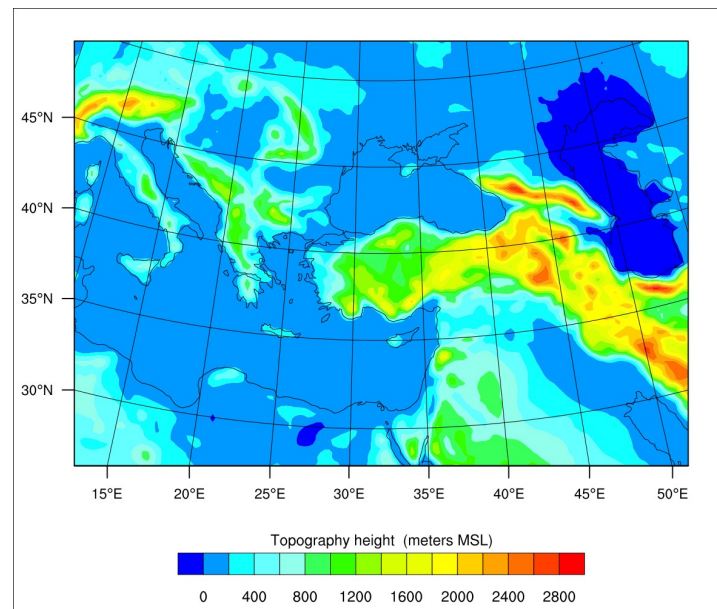
sensitivity analysis
(Onol and Semazzi, 2009)

sensitivity analysis
and bug fixes

RegCM3

WRF v3.1

Model – Data Intercomparison



dx, dy = 27 km

nx = 144; ny = 100

nz = 18 (RegCM), 35 (WRF)

dt = 60 s (RegCM), 60 s with adaptive dt (WRF)



Methodology - Data Set (Atmosphere and Sea)

- **NNRP ds090.0**

- ▶ 17 pressure levels (1000- 10 hPa)
- ▶ Spatial resolution: $2.5^{\circ} \times 2.5^{\circ}$
- ▶ Frequency: 6 hours
- ▶ +80 variables

- **GISST**

- ▶ Global SST and Ice coverage
- ▶ $1^{\circ} \times 1^{\circ}$ grids
- ▶ Monthly mean values, interpolated to 6 hours



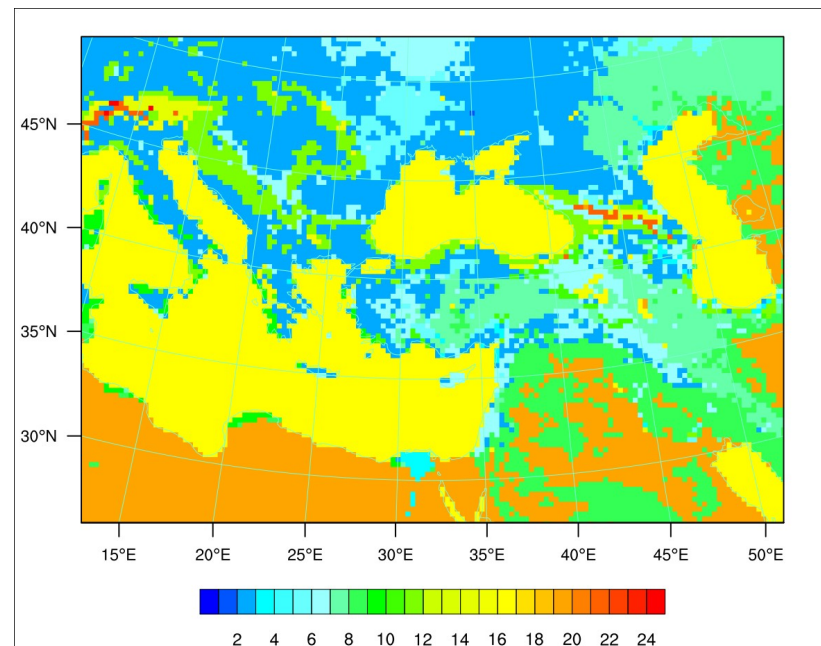
Methodology - Data Set (Land)

- **RegCM**

- ▶ 10' resolution GTOPO and GLCC data sets

- **WRF**

- ▶ 30" MODIS geographical and landuse data
- ▶ Gravity Wave Drag (GWD) fields





Methodology - Physics and Dynamics

● RegCM

- ▶ Compressible Hydrostatic dynamics
- ▶ Derived from MM4, very similar to MM5
- ▶ SUBEX microphysics, Grell Cumulus
- ▶ CCM3 radiation with time step = 30 s
- ▶ Holtslag PBL
- ▶ Exponential lateral boundary (LB) relaxation
- ▶ BATS land-surface model (LSM)



Methodology - Physics and Dynamics

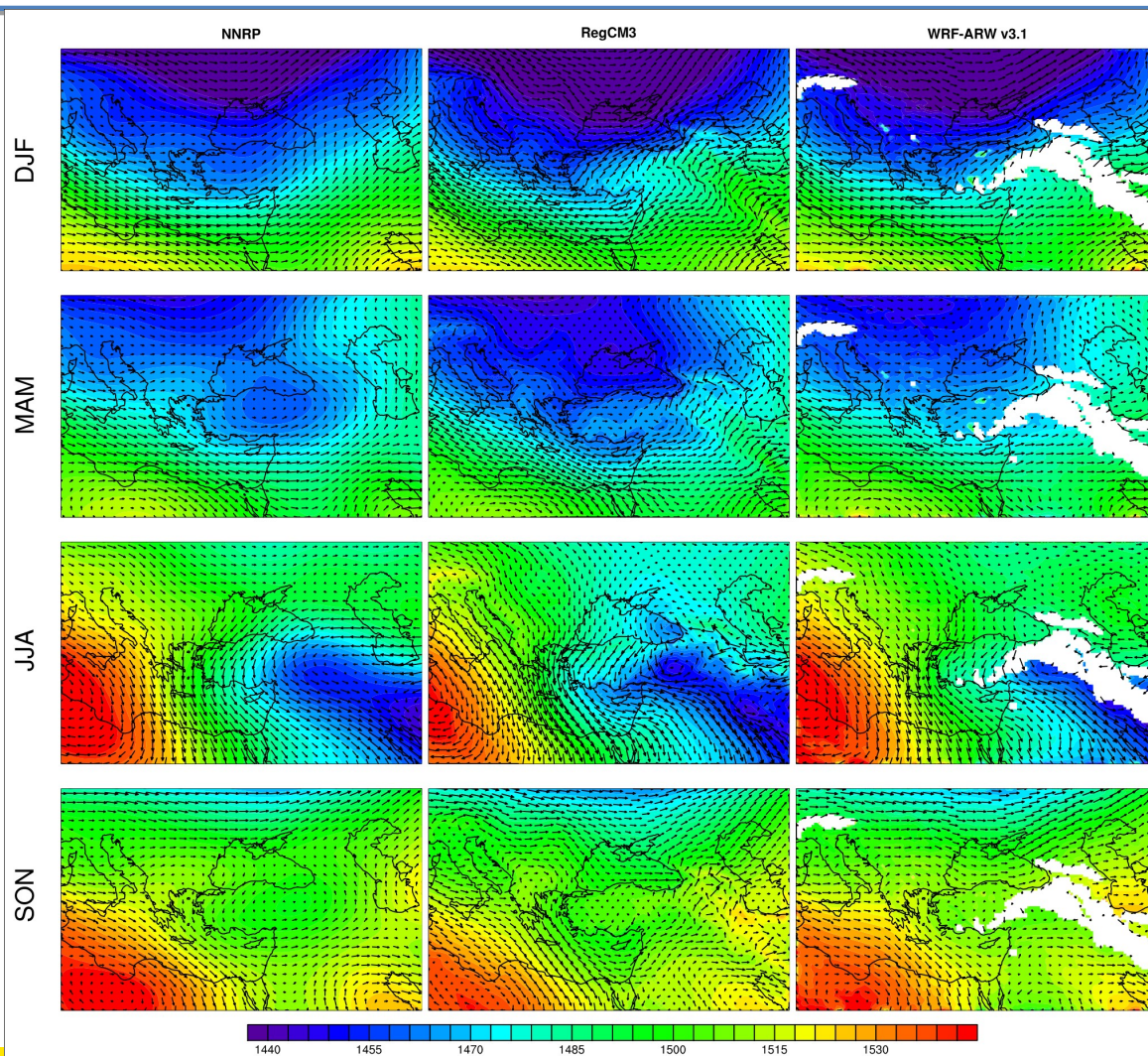
● WRF

- ▶ Fully compressible, Eulerian Non-hydrostatic dynamics
- ▶ Successor of MM5
- ▶ WSM 6-class graupel microphysics
- ▶ CAM radiation with time step = 30 s
- ▶ YSU PBL scheme
- ▶ New Grell Cumulus scheme
- ▶ Exponential relaxation over 10 grid points on LB
- ▶ GWD parameterization is used
- ▶ Noah LSM

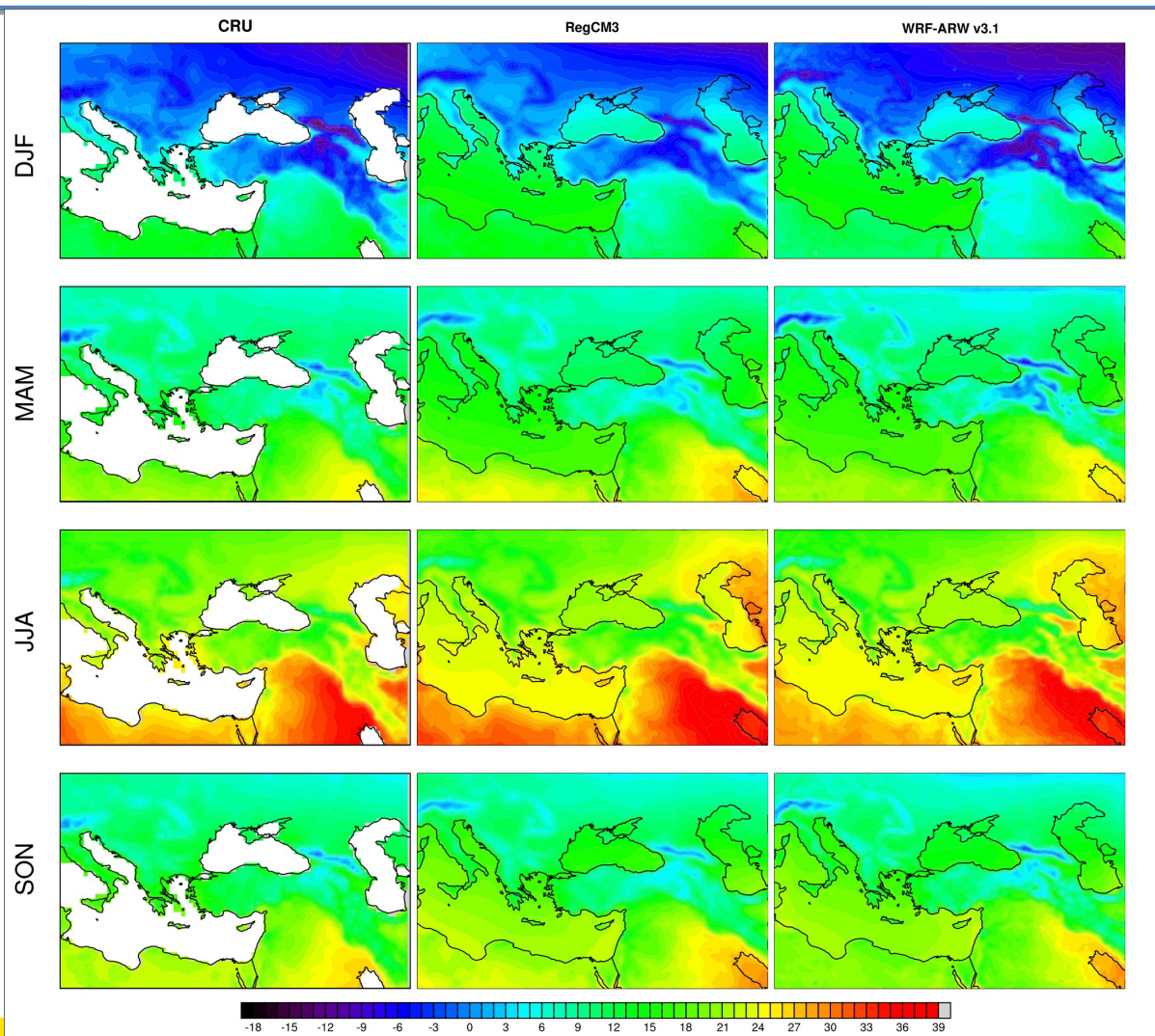


Climate: Past, Present & Future Division program

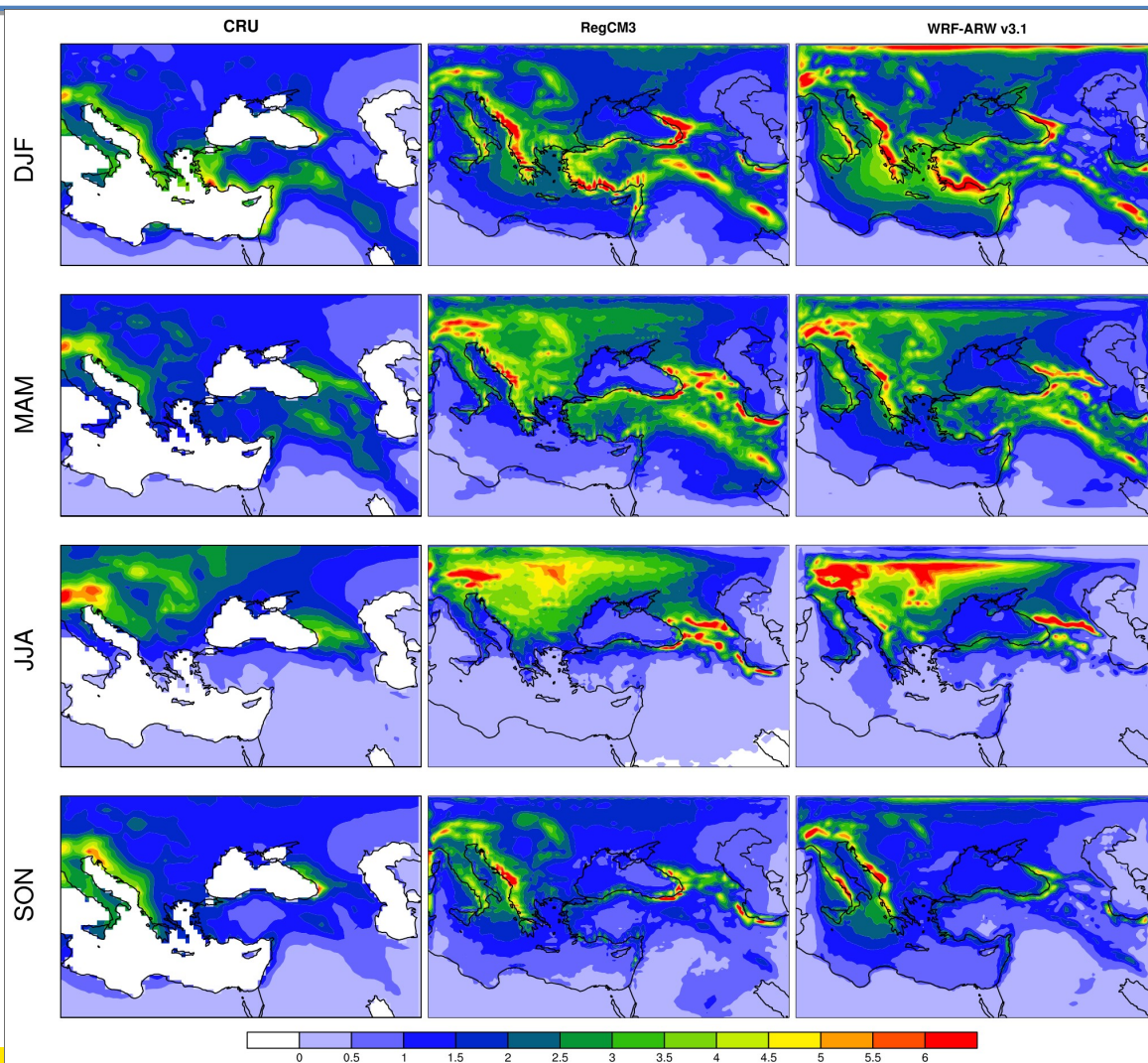
Results (850 hPa ght and wind field - 30 year seasonal means)



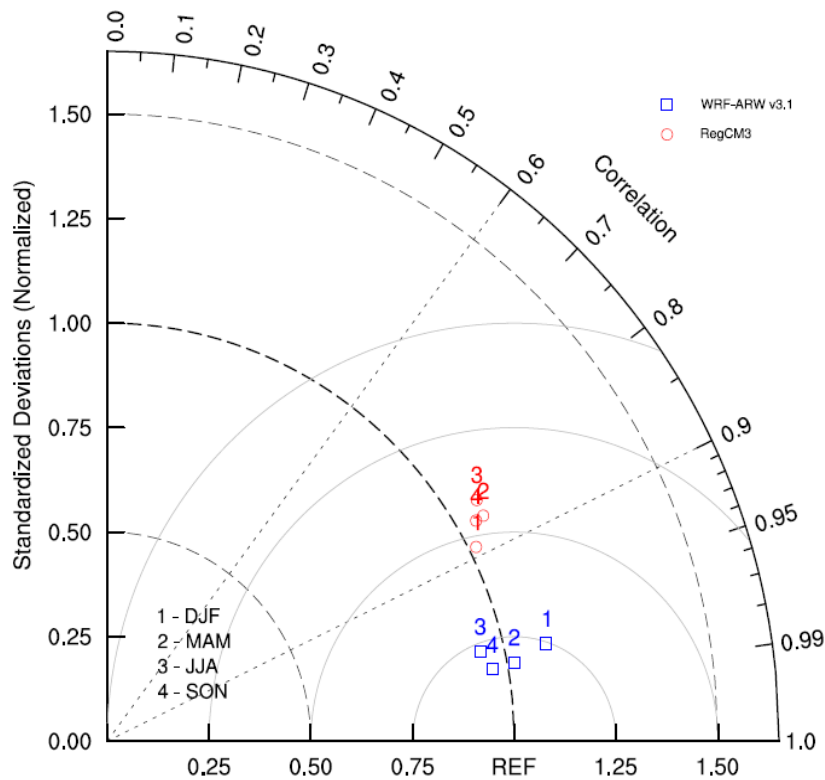
Results (Surface Temperatures - 30 year seasonal means)



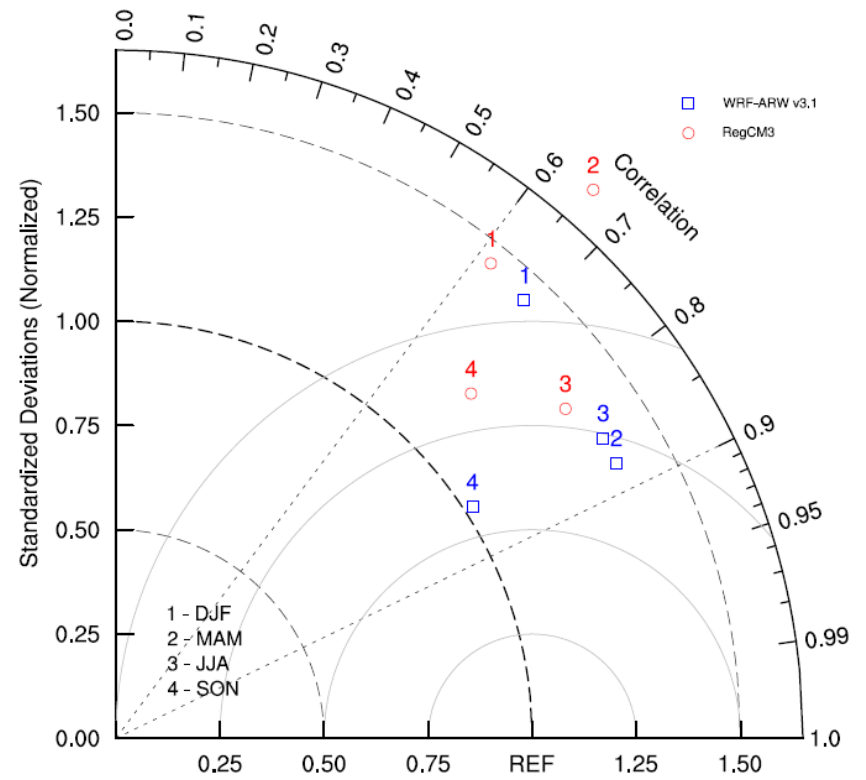
Results (Precipitation - 30 year seasonal means)



Results (Taylor Diagrams)



surface temperature



precipitation



Future Work

- More sensitivity analyses → Fine tuning for EM region
- Coupling → better simulation of atmosphere - ocean interactions
- Statistical analyses can be applied on sub domains instead of the whole domain.
- Nesting → One-way, Two-way
- Climate projections



Climate: Past, Present & Future Division program

Future Work



MDG **ACHIEVEMENT FUND**

Data Dissemination System for Climate Models

Operations

SRES Scenario:

B1



Global Model:

Echam5



Regional Model:

RegCM3



Variable:

total precipitation (mm/day)



Data Type:

Lat-Lon Map



Start date:

2001-01-15 00:00



Region Type:

User Defined Box



☒ Pan ☐ Draw Box



Controls: ☐ Hide ☒ Show

Map Type: Normal Satellite Hybrid

West: 19.5996

North: 45.5217

East: 50.36

South: 31.8775

Output Type:

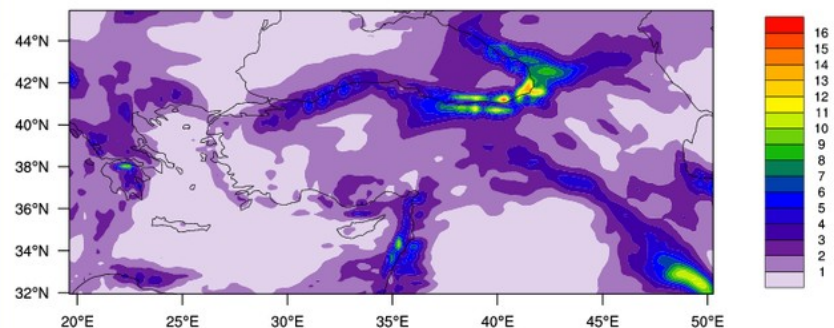
PNG File(Graphics)



Apply

January 2001 total precipitation (mm/day)

total precipitation (mm/day)



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Budget: USD 7,000,000 (Total Budget)
Timeline: January 2008 - December 2010

What has been the situation?

As part of the southern belt of Mediterranean Europe, Turkey is highly vulnerable to anticipated climate change impacts. Turkey's First National Communication to the United Nations Framework Convention on Climate Change (UNFCCC) in 2007 reports that present climate change effects include rising summer temperatures, reduced winter precipitation in the western provinces, loss of surface waters, greater frequency of droughts, land degradation, coastal erosion, and flooding. This is having a major negative effect on water availability for food production and rural development. The severity of these impacts is predicted to increase. On 18 December 2006, UNDP Administrator Kemal Derviş and Spanish Secretary of State for International Cooperation, Leire Pajín, signed a landmark agreement to allocate through UNDP, a total amount of €528 million over the next four years, towards the achievement of key Millennium Development Goals and related development goals in the selected countries.

Turkey, as one of the 57 eligible countries worldwide, was awarded USD 7,000,000 through the funding window, enhancing capacity to adapt to the climate change. UN Joint Programme, titled "Enhancing the Capacity of Turkey to Adapt to Climate Change", was prepared in close collaboration with the relevant ministries, academia and relevant UN agencies.

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Climate projections upto 2100 with various emission scenarios (A1, B1) and GCMs including CCSM, ECHAM, HadCM



References

- Onol, B., 2009, Semazzi, F.H.M., Regionalization of Climate Change Simulations over Eastern Mediterranean, Journal of Climate.
- Bozkurt et al, 2011. Downscaled simulations of the ECHAM5, CCSM3 and HadCM3 global models for the eastern Mediterranean-Black Sea region: Evaluation of the reference period, Climate Dynamics, (in review).
- Bozkurt, D., Sen, O.L., 2011, Precipitation in the Anatolian Peninsula: sensitivity to increased SSTs in the surrounding seas, Climate Dynamics.