Analysis of Regional Climate of Turkey with WRF-ARW Model

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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

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° x 2.5°
  - Frequency: 6 hours
  - +80 variables

- **GISST**
  - Global SST and Ice coverage
  - 1° x 1° 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
Results (850 hPa ght and wind field - 30 year seasonal means)
Results (Surface Temperatures - 30 year seasonal means)

- **DJF**
  - CRU
  - RegCM3
  - WRF-ARW v3.1

- **MAM**
  - CRU
  - RegCM3
  - WRF-ARW v3.1

- **JJA**
  - CRU
  - RegCM3
  - WRF-ARW v3.1

- **SON**
  - CRU
  - RegCM3
  - WRF-ARW v3.1
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
Future Work

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


- Bozkurt, D., Sen, O.L., 2011, Precipitation in the Anatolian Peninsula: sensitivity to increased SSTs in the surrounding seas, Climate Dynamics.