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Climate: Past, Present & Future Division program

# Analysis of Regional Climate of Turkey with WRF-ARW Model

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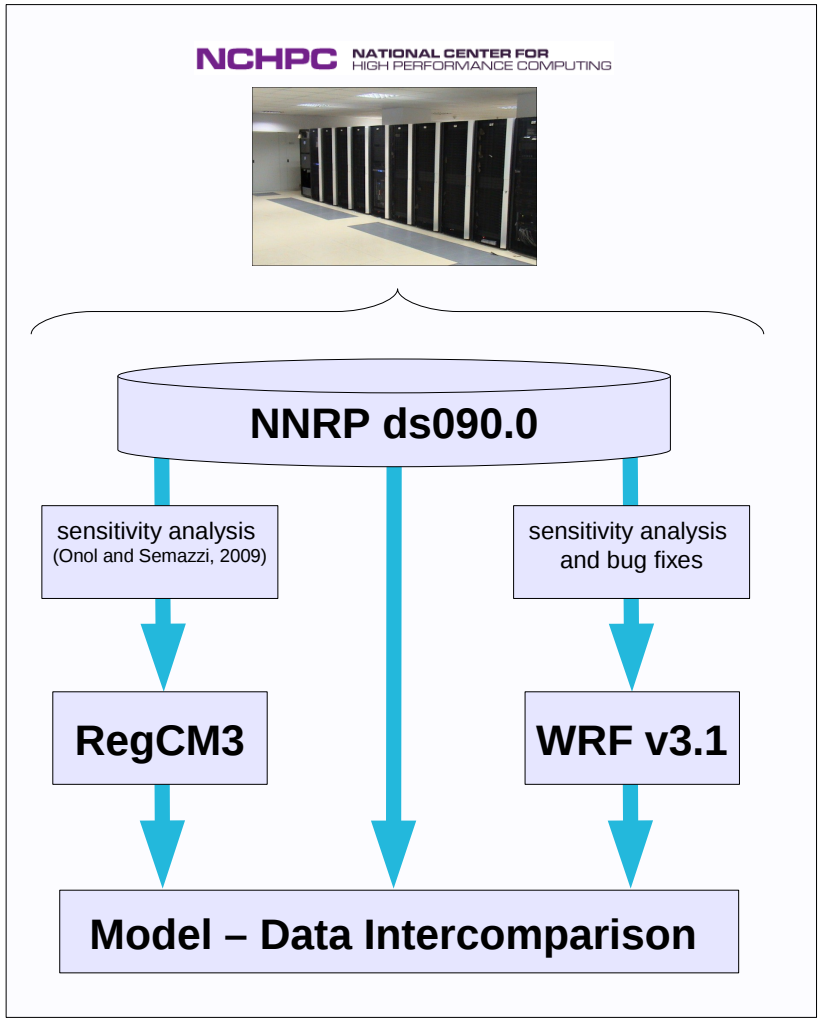
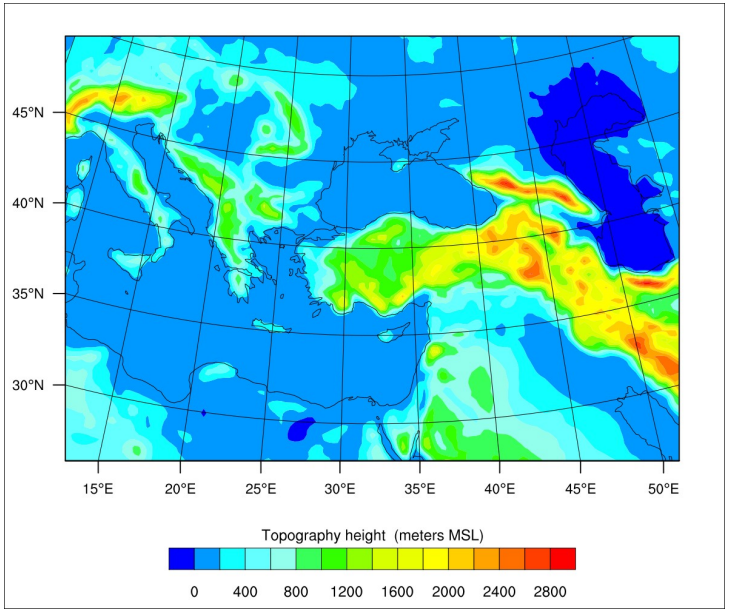
# Introduction & Motivation

- 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



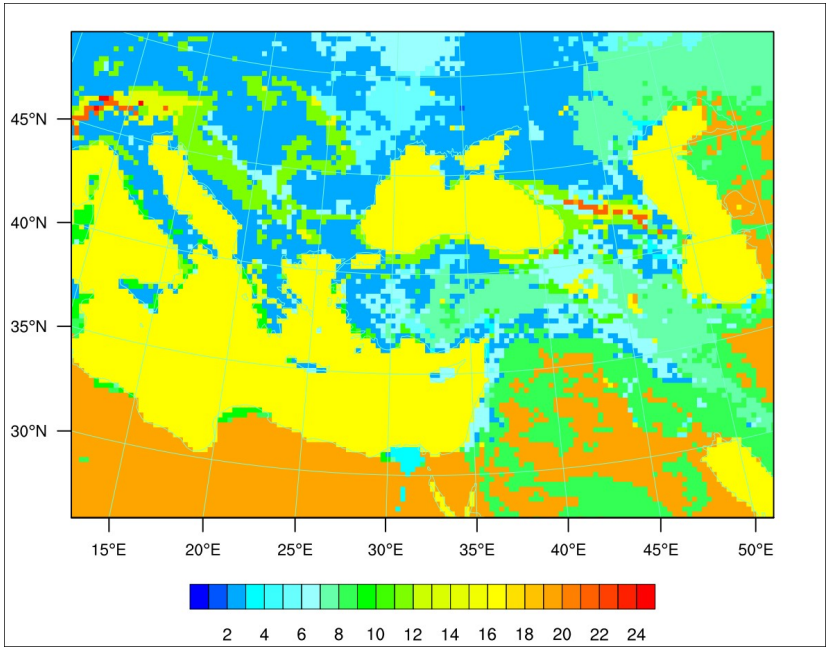

**dx, dy** = 27 km
**nx** = 144; **ny** = 100
**nz** = 18 (RegCM), 35 (WRF)
**dt** = 60 s (RegCM), 60 s with adaptive dt (WRF)

# 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



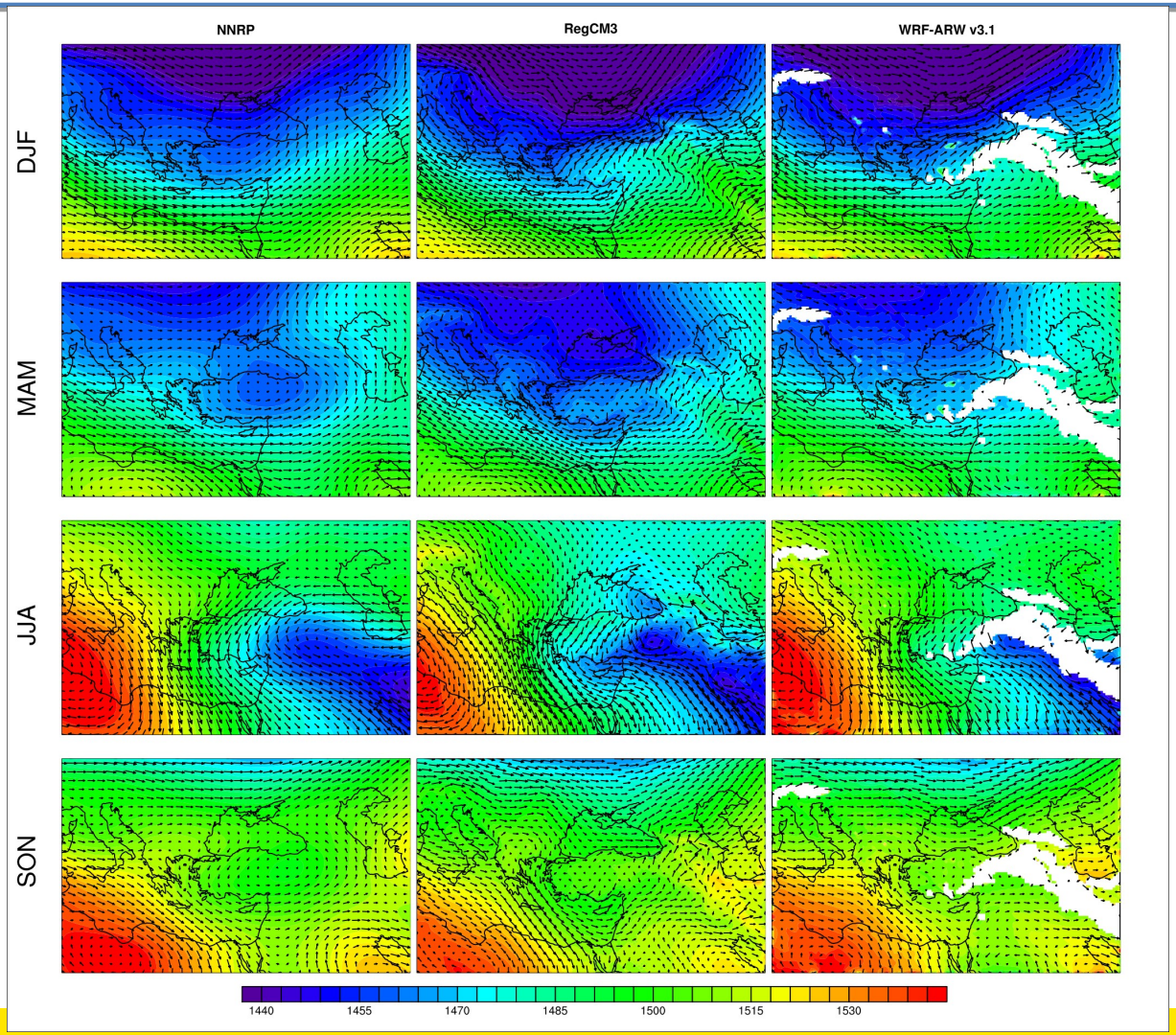
# Methodology – Physics and Dynamics

- **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)

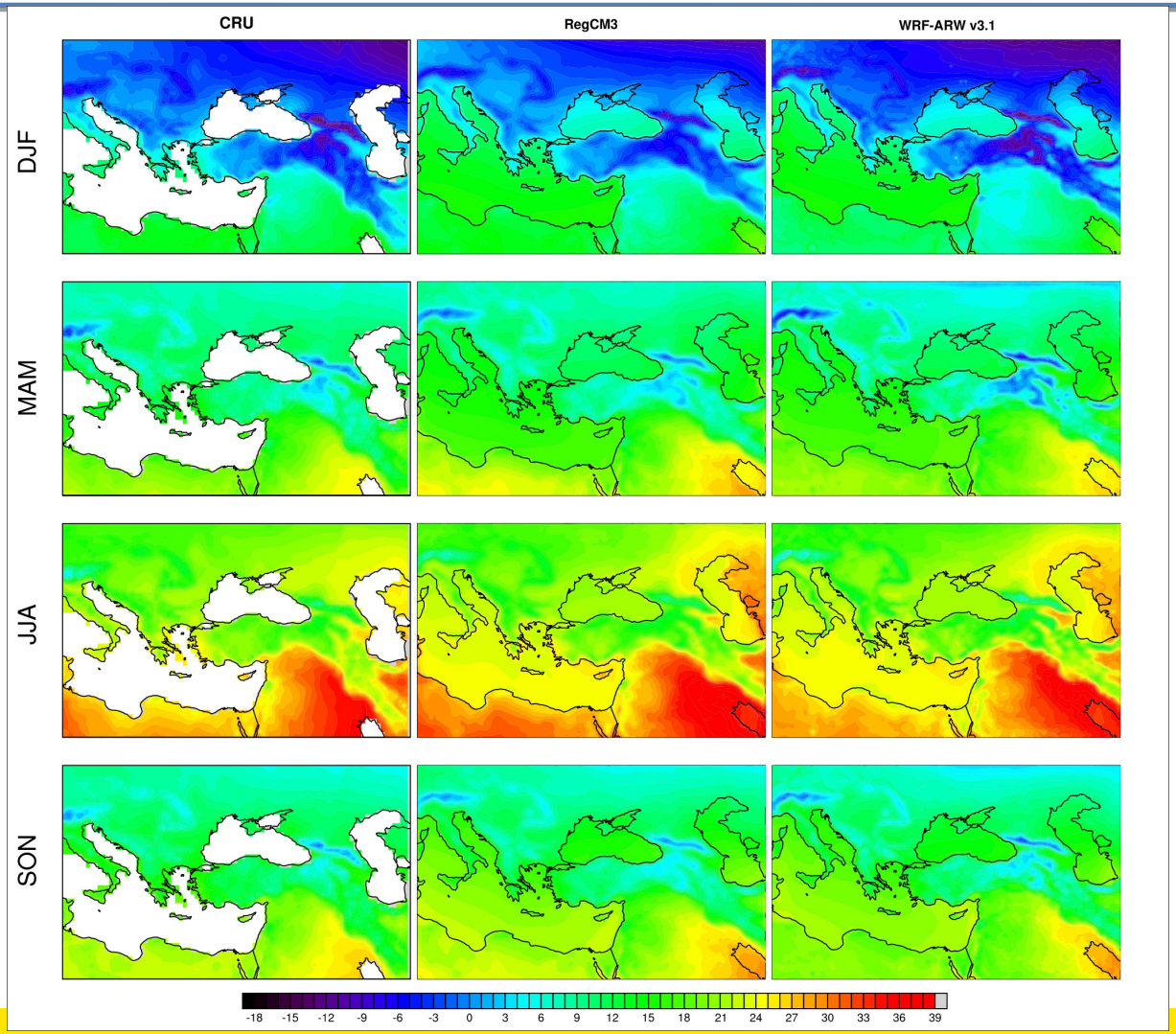
# Methodology – Physics and Dynamics

- **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

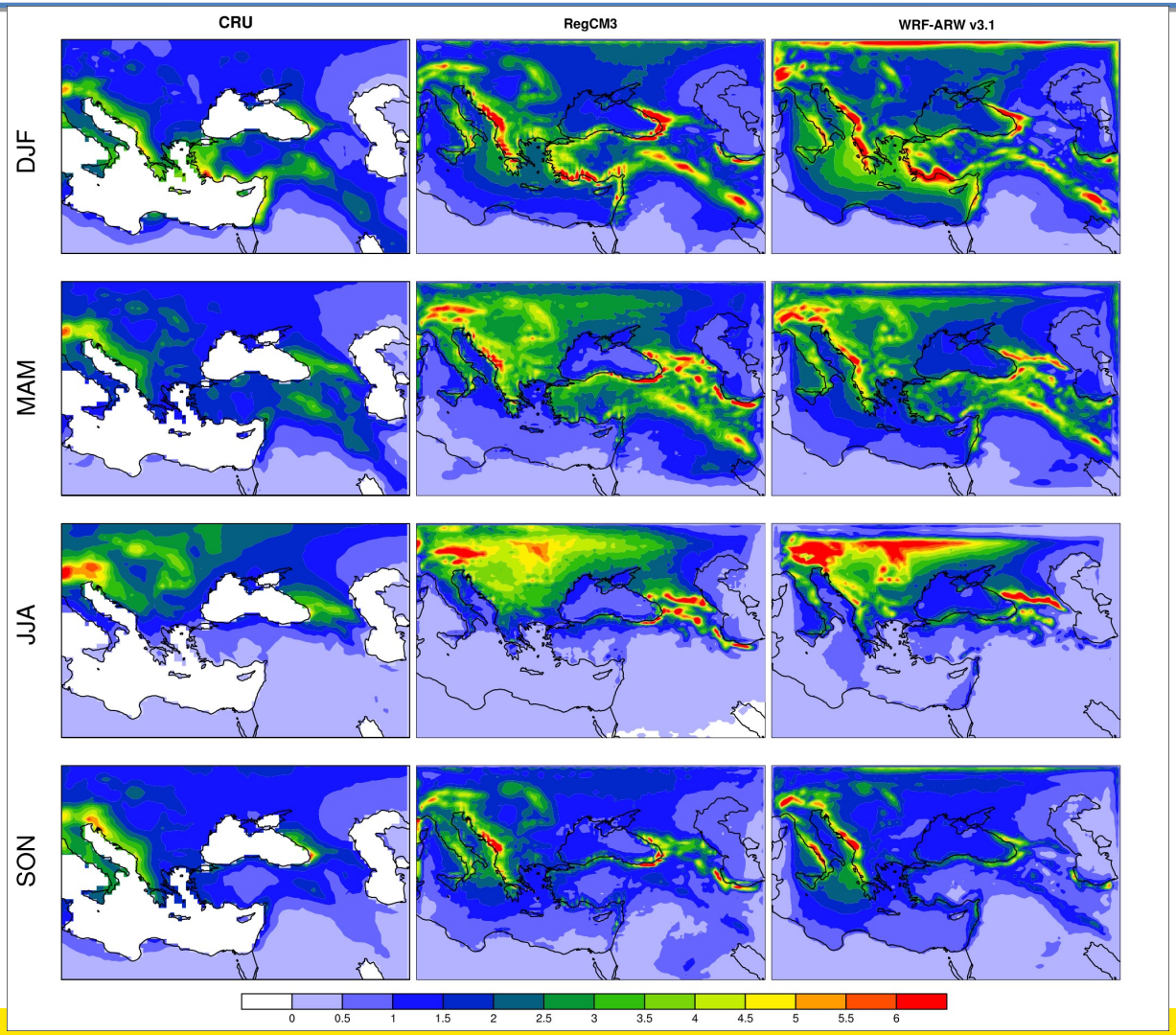
# Results (850 hPa ght and wind field - 30 year seasonal means)



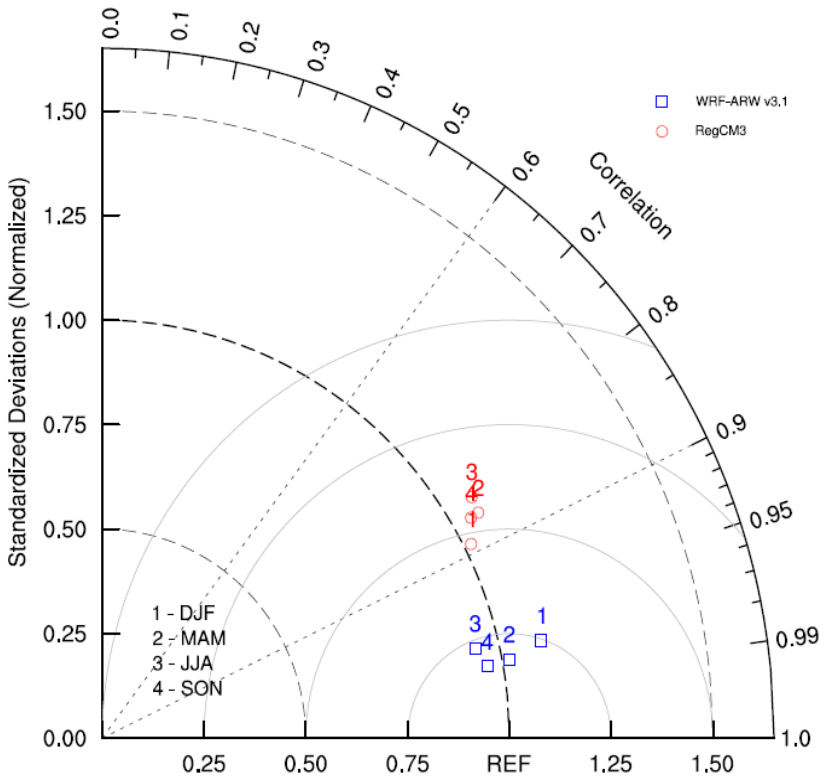
# Results (Surface Temperatures - 30 year seasonal means)



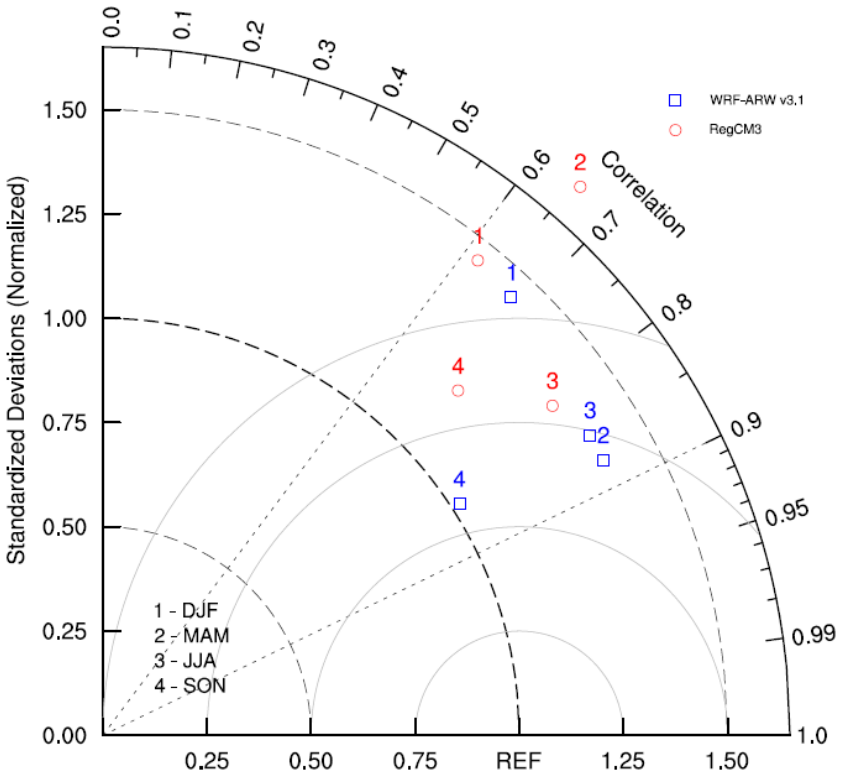
# Results (Precipitation - 30 year seasonal means)



# Results (Taylor Diagrams)




surface temperature

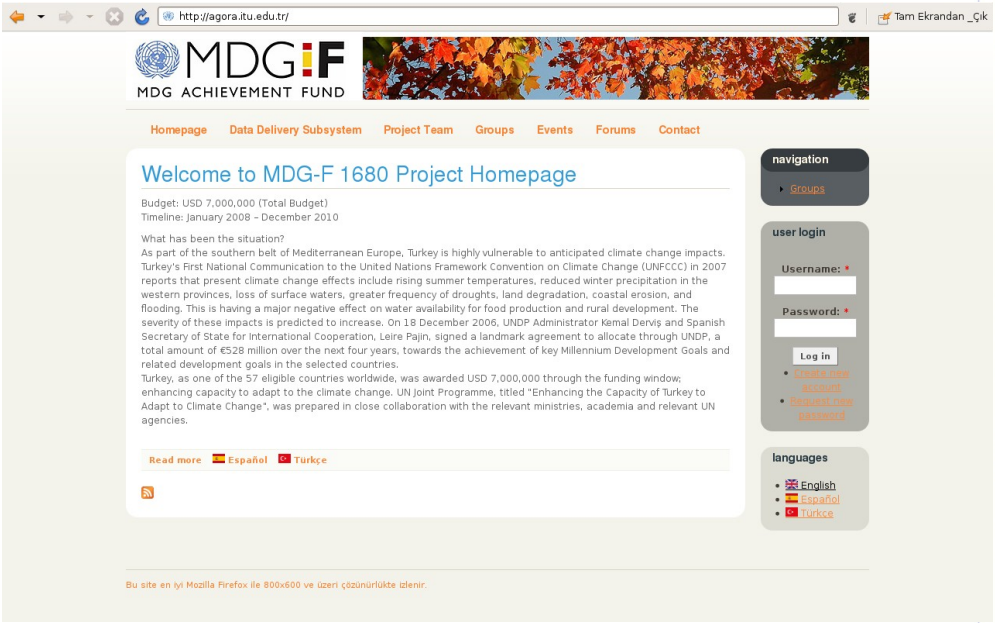


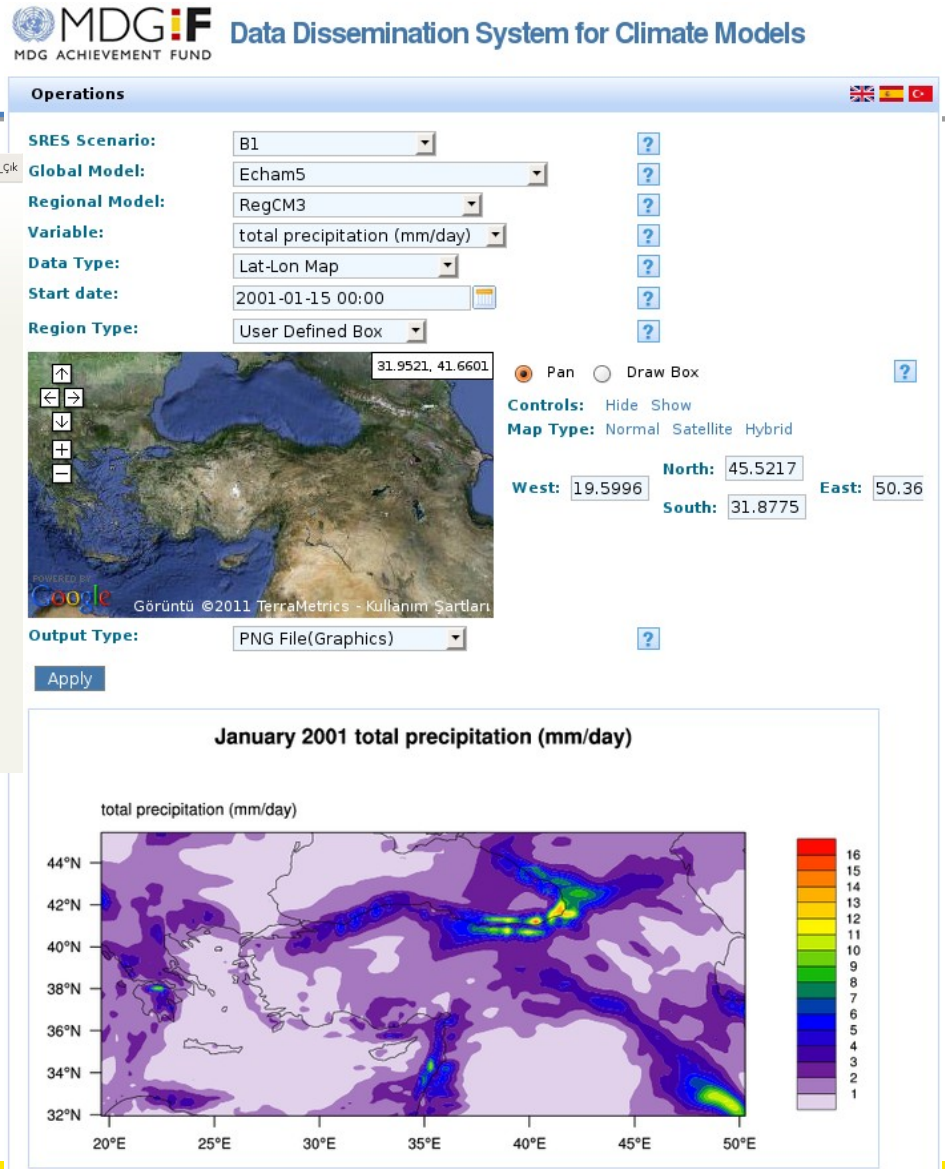

precipitation

# 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


- 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.