

Hydro-climatic Effects of Present and Future Land Cover / Land Use Changes in the Upper Mesopotamia



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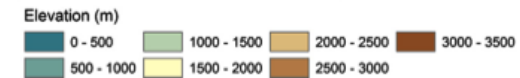
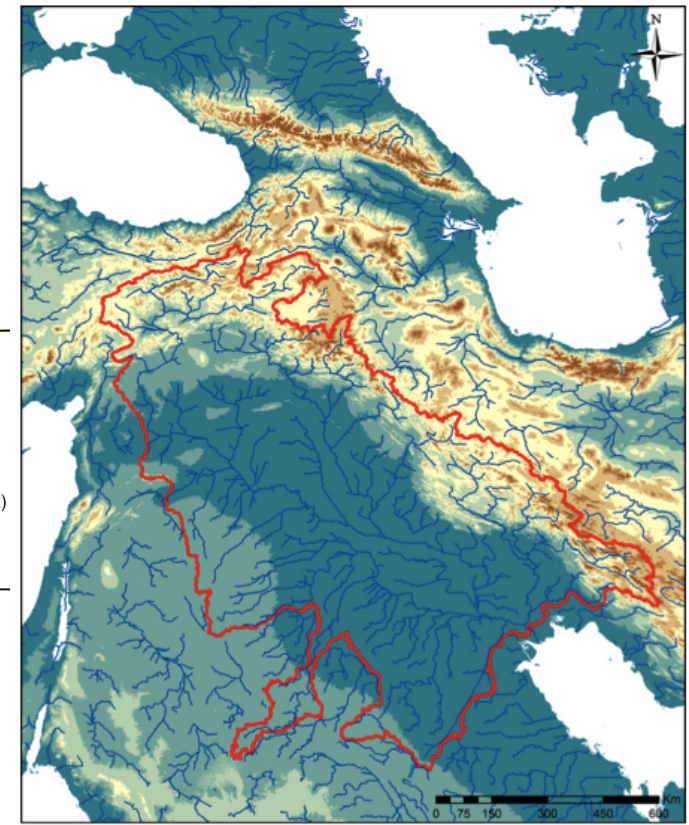
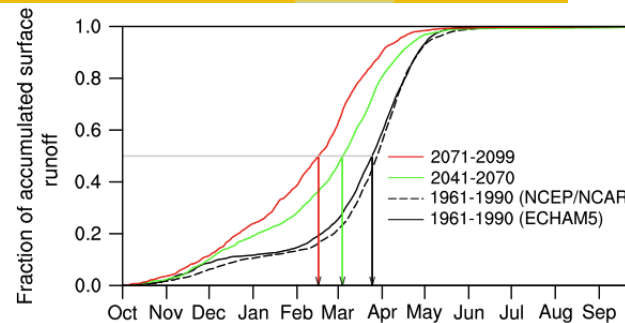
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Motivation

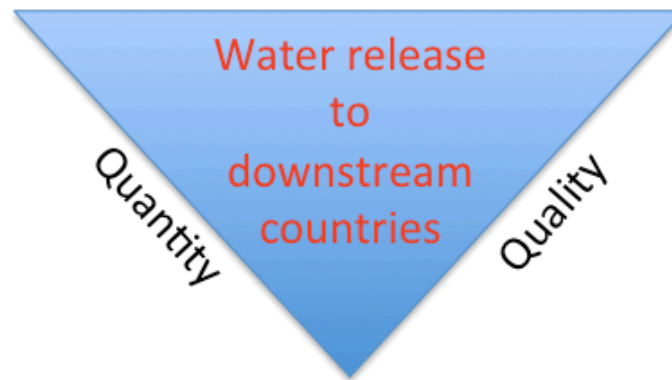
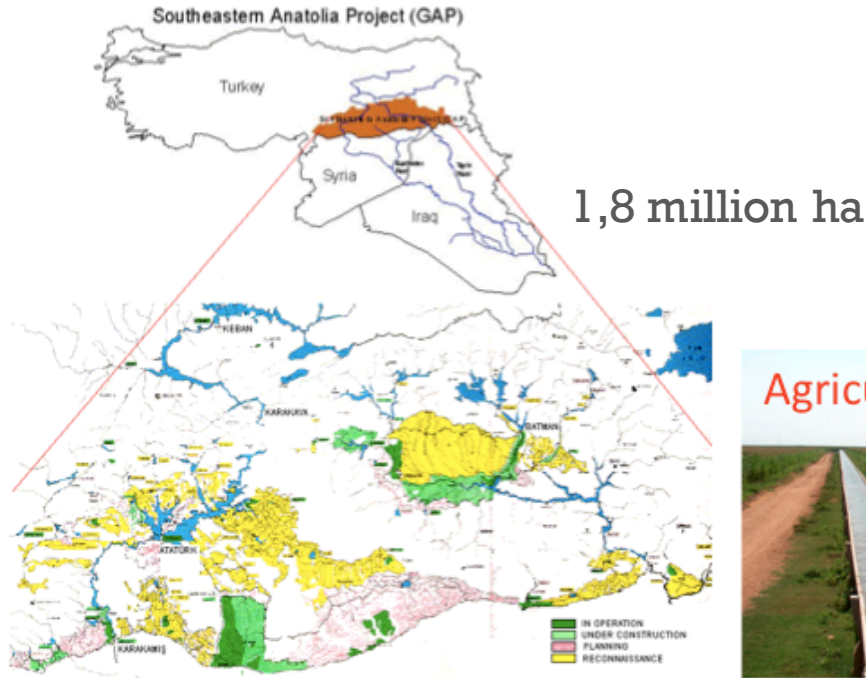
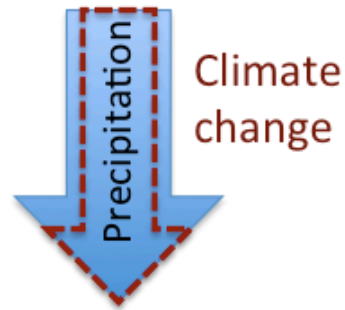
Euphrates & Tigris Basin

Bozkurt and Sen, J. of Hydro., 2013



- Snow-fed river basin
- Irrigated cultivation
- Southeastern Anatolia Project
- Streamflow timings are shifting to earlier days in the year

Southeastern Anatolia Project (SAP)



???



Potential for conflict



Objectives

- To reveal the **effect of LCLU changes** as a result of irrigation projects within the scope of GAP in the ETB on the climate and water resources of the region.
- To calculate the **water loss** via evapotranspiration from the region due to extension of irrigated cultivation.

Method

- RegCM4 (revision 4283)
 - BATS – land surface model (with subgrid option)

Simulation name	OD48 (48 km)	TR12 (12 km)
Grid number (y,x), Vertical Resolution	75x95, 18 level	100x160, 23 level
Center (latitude, longitude)	40, 32	38.7, 37
Initial and Boundary Conditions (atmosphere, sst)	NNRP, OI_WK	NNRP, OI_WK
Boundary Condition Parameters (nspgx, nspgd)	12,12	18,18
Boundary Layer Model	Holtslag PBL	Holtslag PBL
Cumulus Convection Scheme	Grell	Grell
Cumulus Closure Scheme	Fritsch & Chappell	Fritsch & Chappell
Moisture Scheme	SUBEX	SUBEX
Ocean Flux Scheme	Zeng	Zeng
Radiation Model	CCSM	CCSM

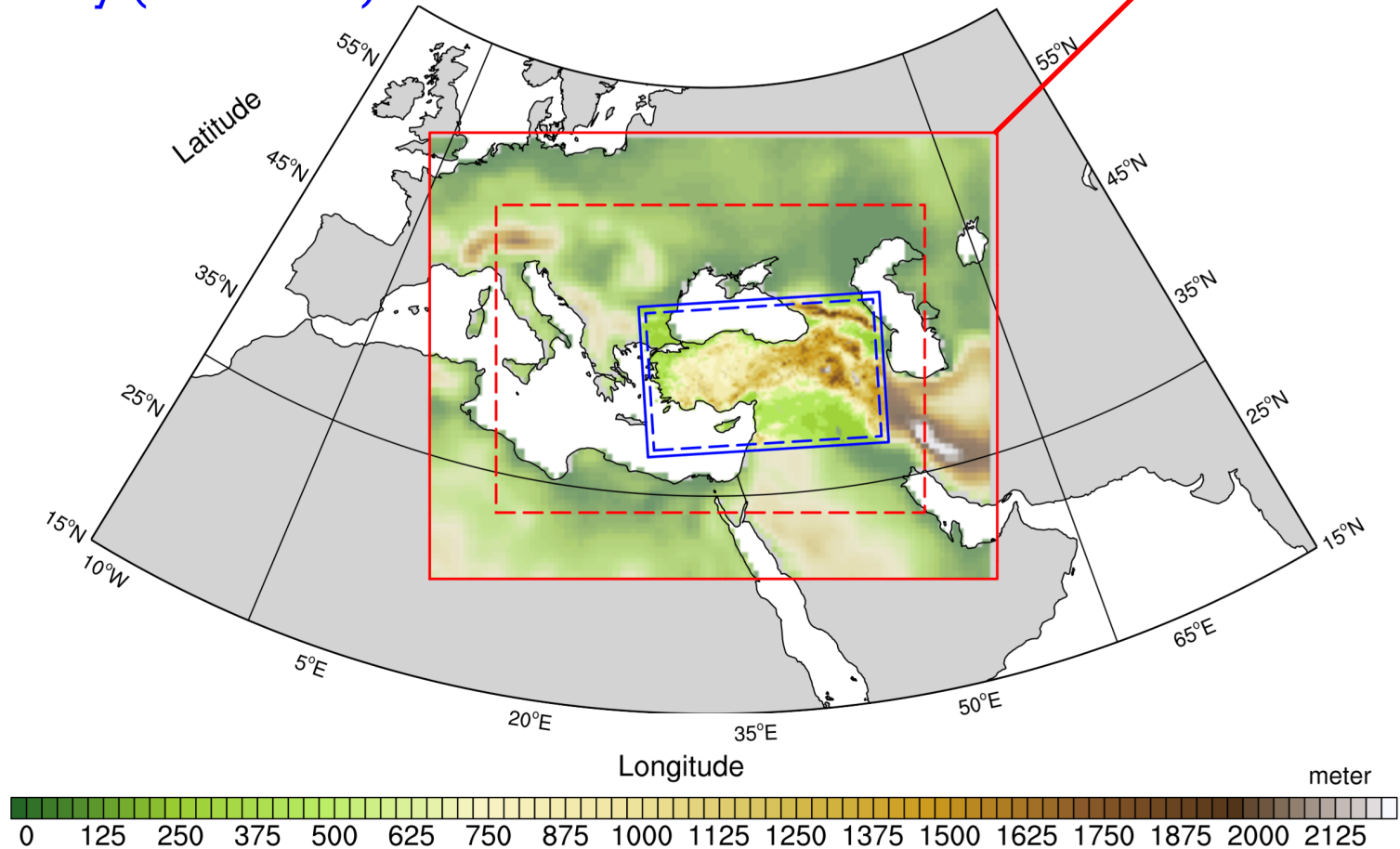
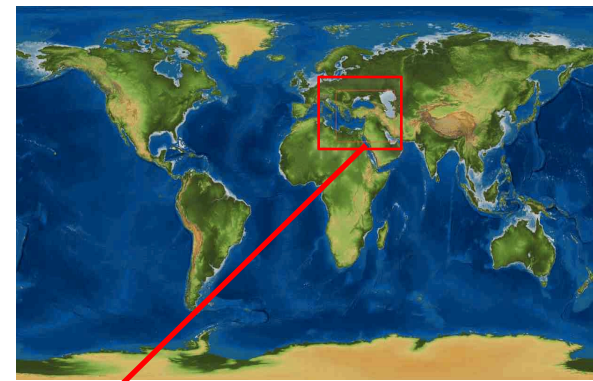
- Simulations (with default + current and future landuse maps)





Study Domain

- Eastern Mediterranean and Black Sea (OD - 48 km)
- Turkey (TR - 12 km)



Model Setup

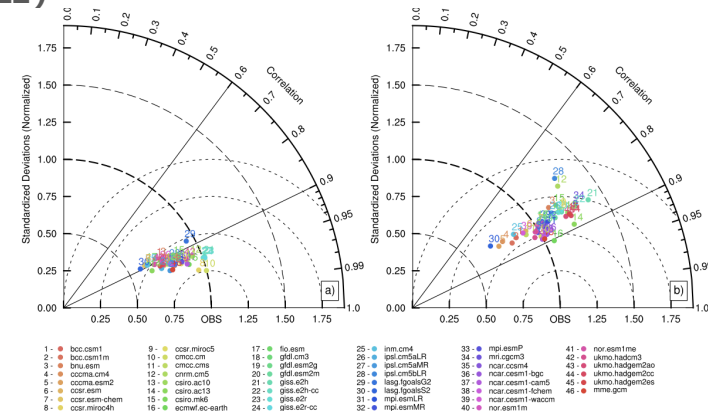
- Forcing data sets
 - Reanalysis (**NNRP** – NCEP/NCAR Reanalysis)
 - GCM (Global Circulation Model) (**EC-EARTH**)

- ## ■ Model Validation (Observation)

- **CRU** (Climate Research Unit)
- High Resolution Gridded Data
- $0.5^\circ \times 0.5^\circ$

- ## ■ Temperature, precipitation, evapotranspiration

- 1991 – 2010 (**20** years) -> NNRP
- 1986 – 2009 (**24** years) -> EC-EARTH





Landuse Maps

1993 period

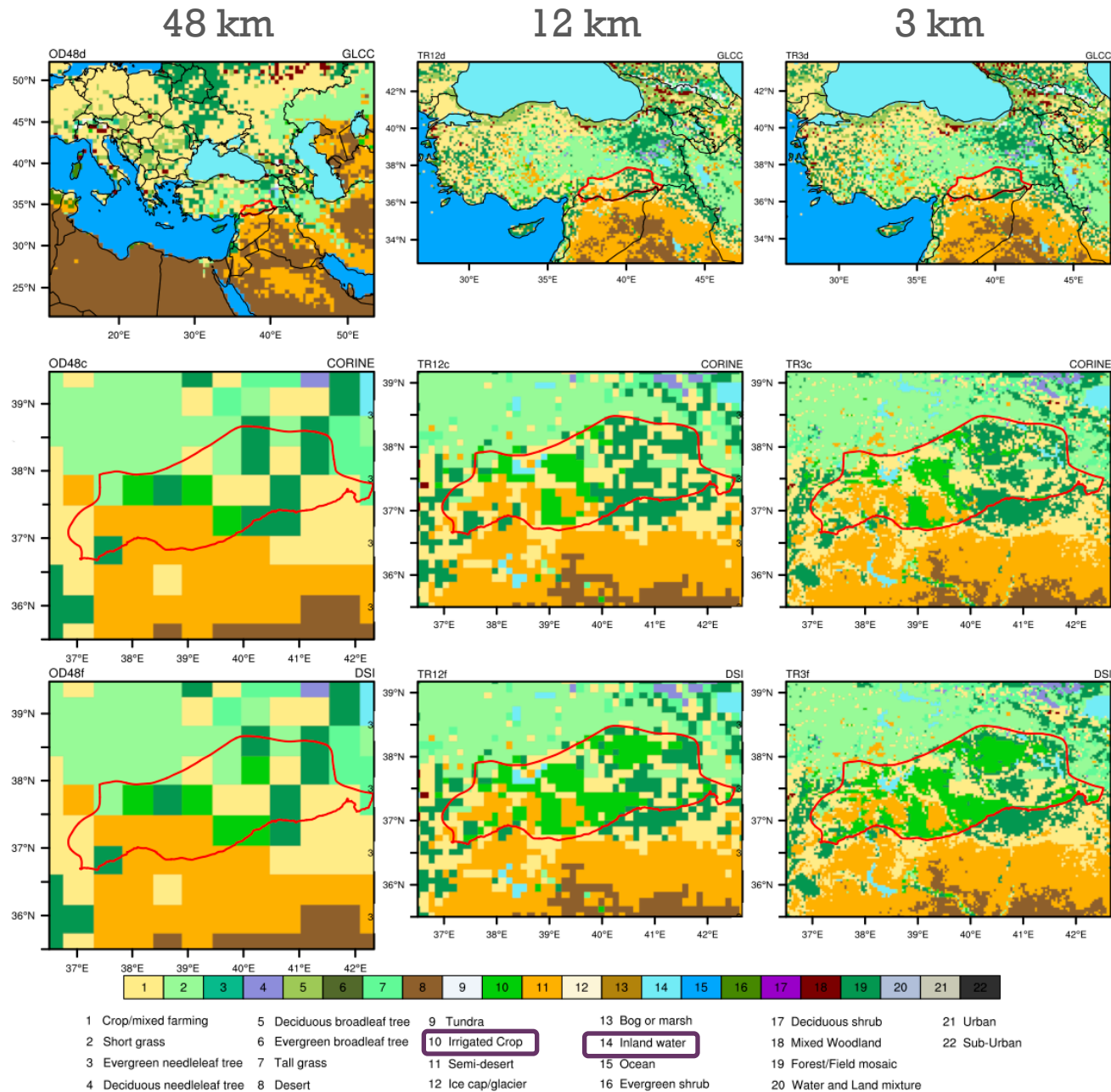
- Pre-SAP
- GLCC (USGS)

2000 period

- SAP (25%)
- CORINE (EEA)

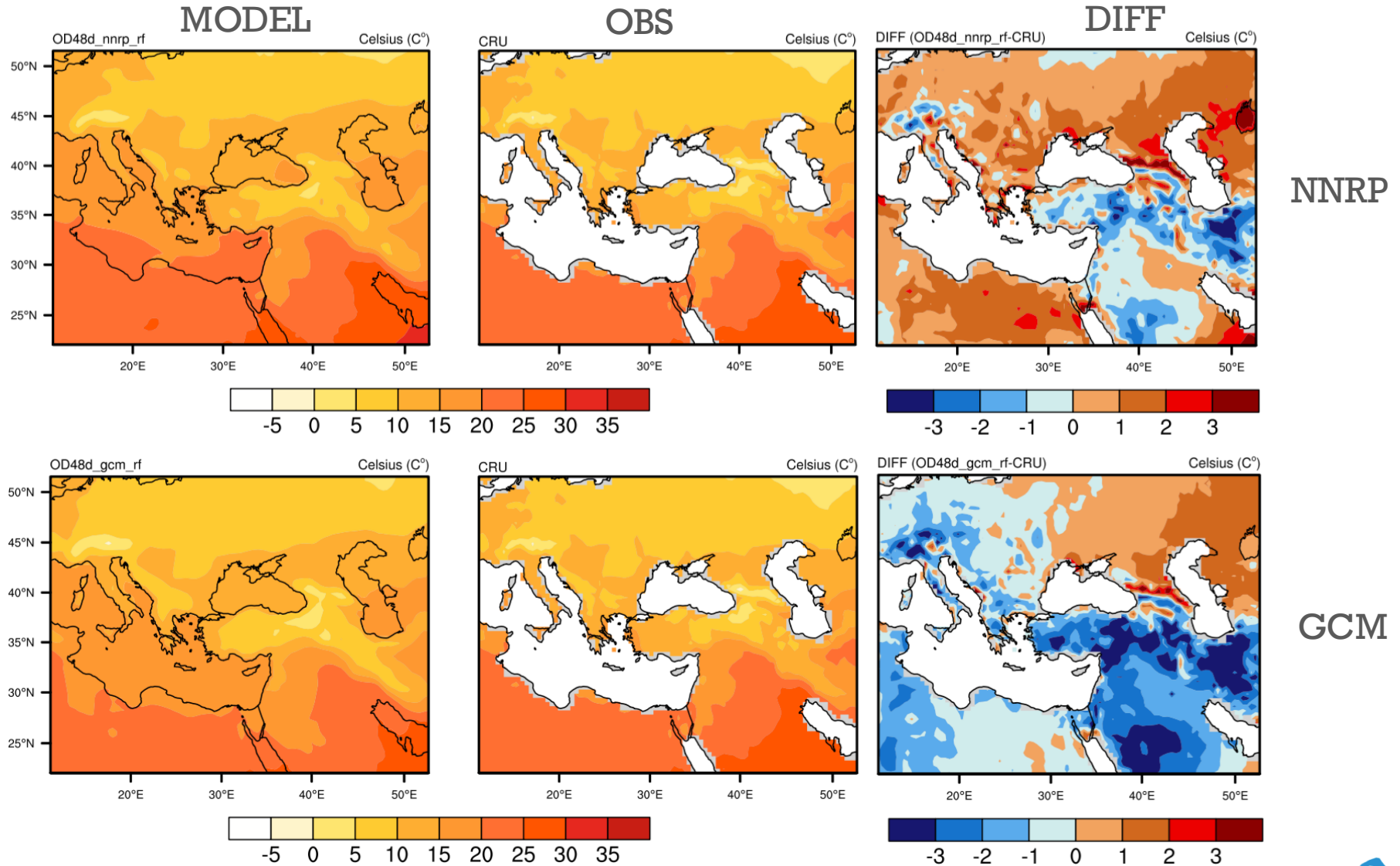
Future

- SAP (%100)
- DSI (Turkish State Hydraulic Work)



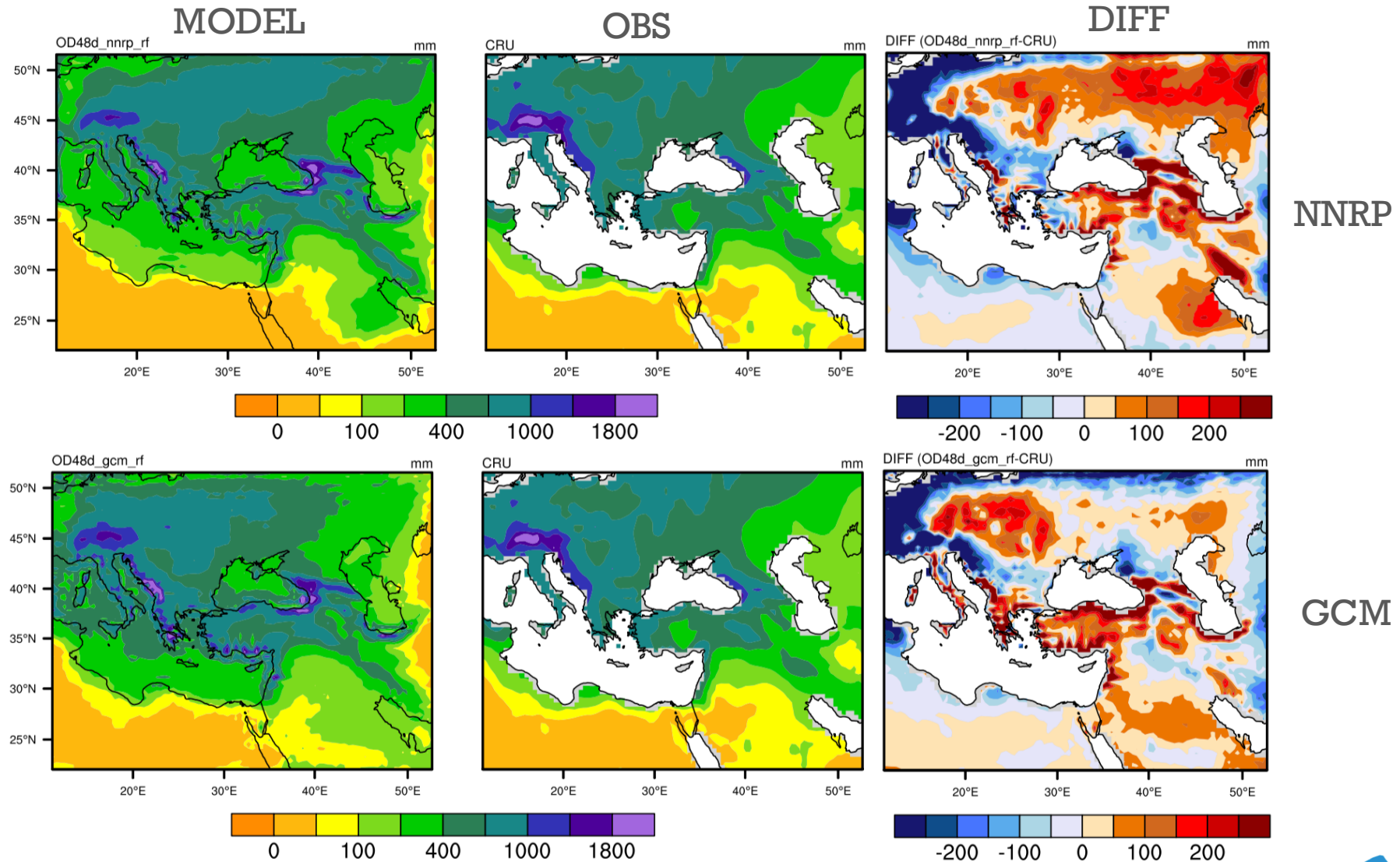
Model Performance

1991-2008 / Mean Annual Temperature



Model Performance

1991-2008 / Mean Annual Total Precipitation

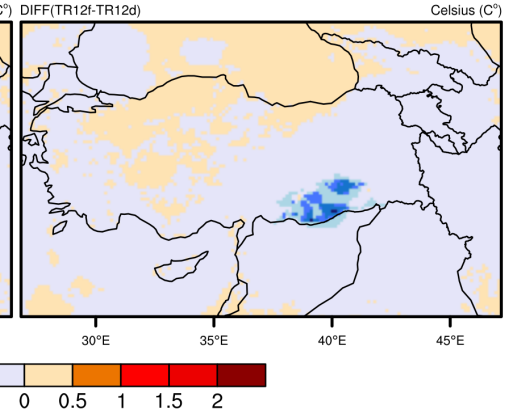
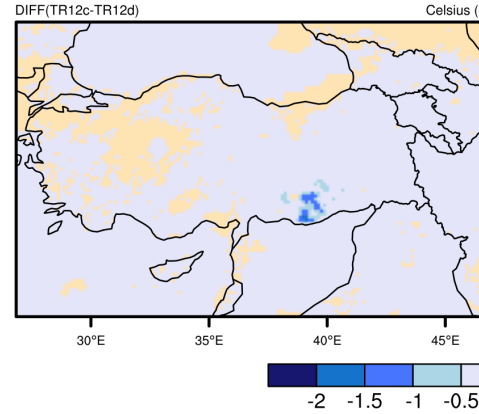
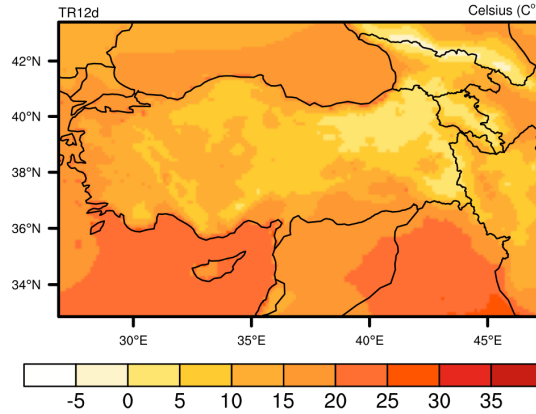


Pre-SAP

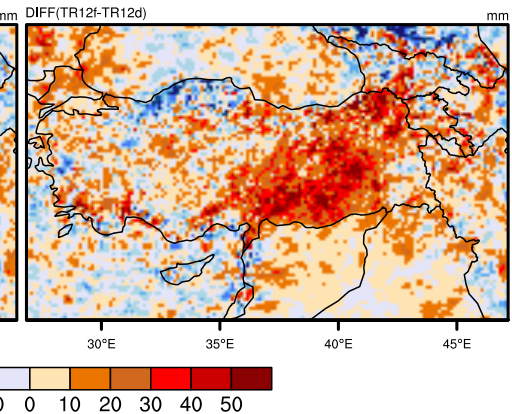
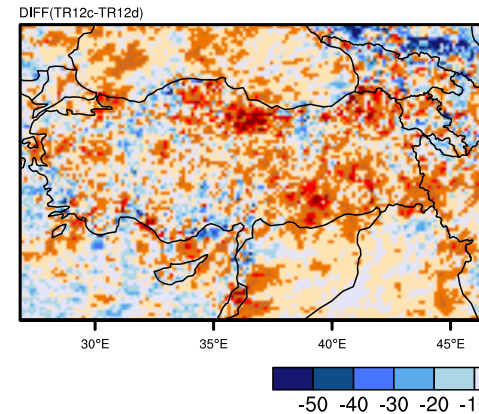
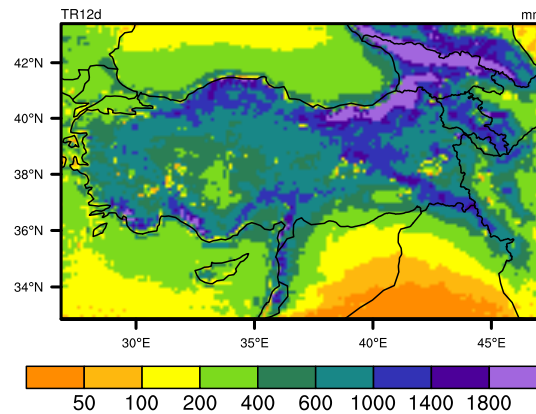
SAP (25%)

SAP (100%)

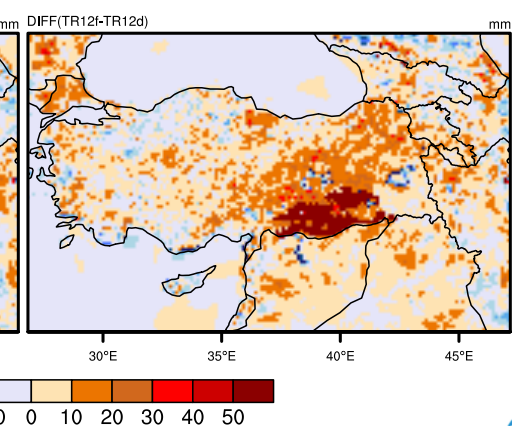
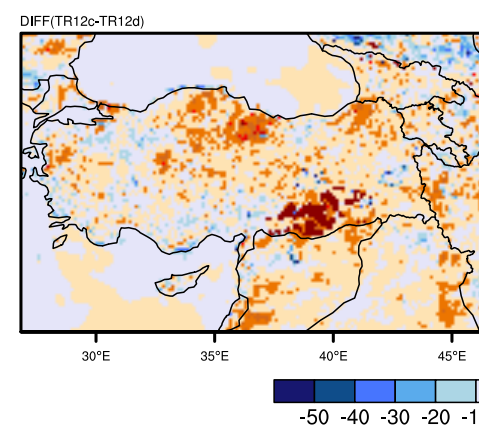
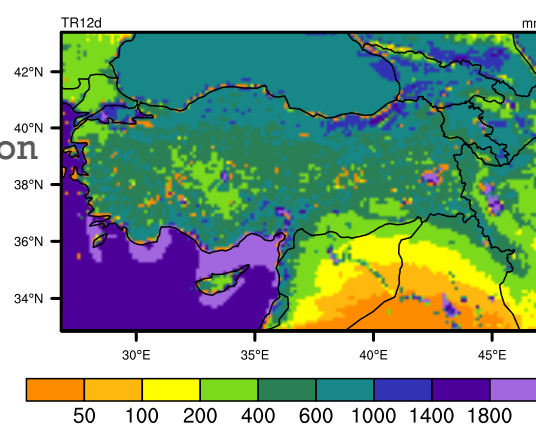
Temperature



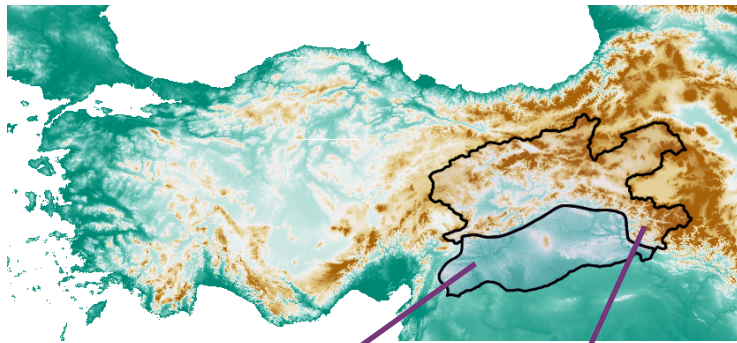
Precipitation



Evapotranspiration



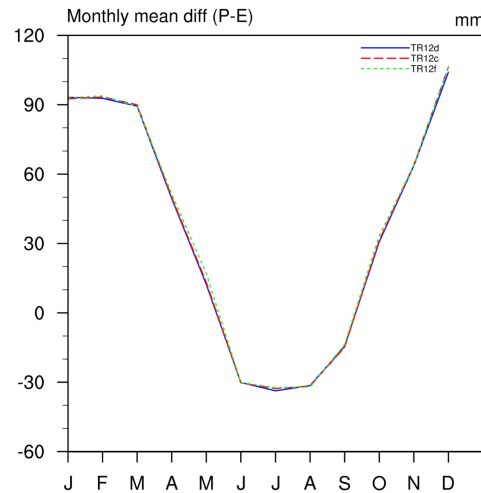
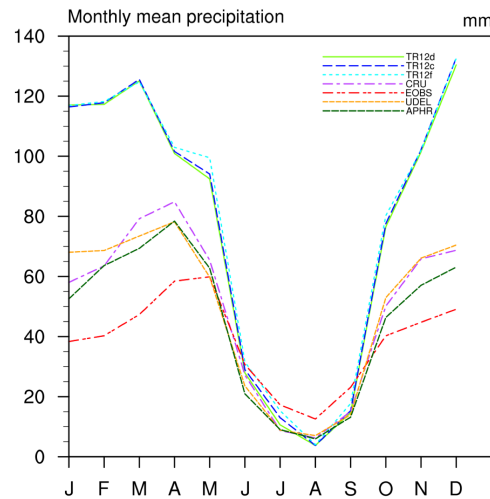
Annual Cycle



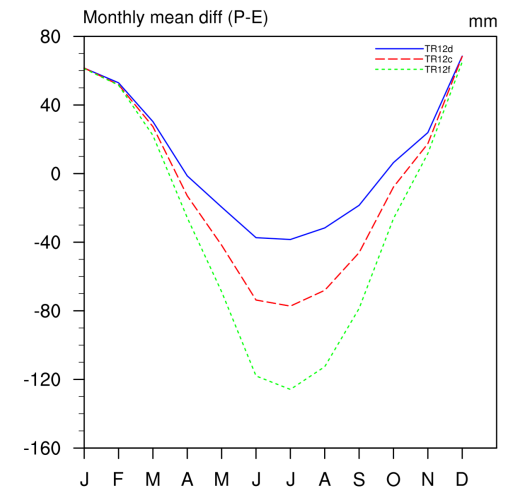
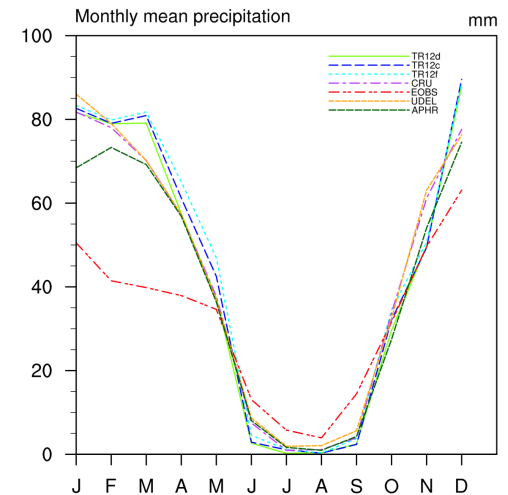
SAP region

Upper
Euphrates&Tigris

Upper Euphrates&Tigris

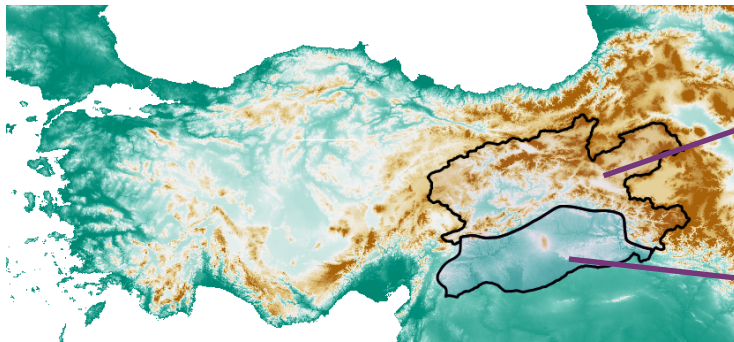


SAP region



Water Budget

		Pre-SAP	SAP (25%)	SAP (100%)
		Past	Current	Future
Upper E&T	P	935.553	946.665 (1% ↑)	963.516 (3% ↑)
	ET	534.584	540.868 (1% ↑)	550.177 (3% ↑)
	P-ET	400.969	405.797	413.339
SAP region	P	510.336	527.121 (3% ↑)	544.748 (7% ↑)
	ET	420.746	637.374 (51% ↑)	901.293 (114% ↑)
	P-ET	89.590	-110.253	-356.545



Upper
Euphrates&Tigris

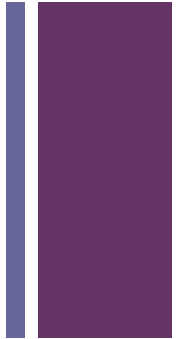
SAP region

P : Precipitation
ET : Evapotranspiration

*unit (mm/year)

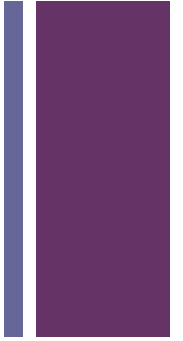


Summary



- In the SAP region **annually**, due to the LCLU changes
 - **0.4-0.8 °C** decrease in temperature
 - **3-7%** increase in precipitation
 - **51-114%** increase in evapotranspiration
- Increases in precipitation and evapotranspiration amounts in the upper Mesopotamia have been calculated mostly over the SAP region.
- The study is currently being extended to simulate **integrated effects of future climate changes** (RCP 4.5 and RCP 8.5 scenarios by using EC-EARTH) **with anthropogenic climate changes** (land cover land use changes) for the assessment of possible changes in the regional water budget.





Thank you*

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