RICCAR

Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region

Impact of Climate Change on Temperature, Precipitation & Extreme Climate Indices in the Arab Region

Phil Graham
Senior Researcher – Climate and Water
Swedish Meteorological and Hydrological Institute (SMHI)
Sweden

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Creating RICCAR Climate Projections

- A first step within RICCAR was to establish a common modelling domain for regional climate downscaling
  (became part of WCRP-CORDEX, a global cooperation)
- An ensemble of RCM projections was created over this domain
- Analyses were performed to assess the projected climate changes

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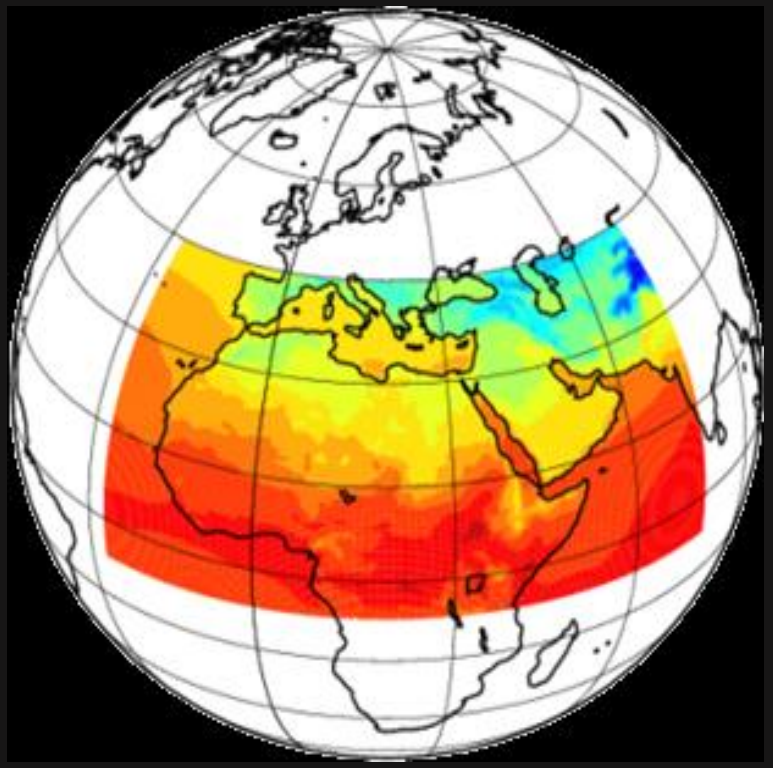
The CORDEX-Mena/Arab Domain

Regional "Domain" (RCM)



Size determined by Arab water resources & climate processes

A specific region of the globe to be investigated in more detail with ***R***egional ***C***limate ***M***odels (RCMs)

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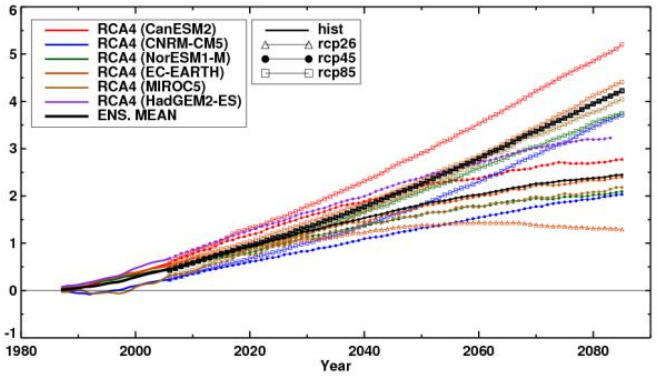
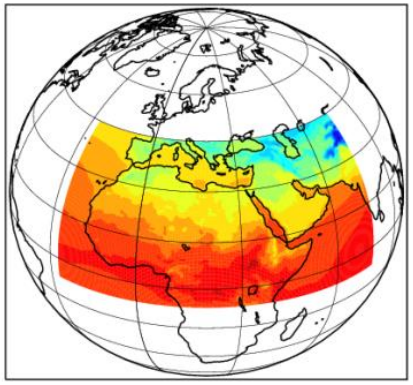
Climate Model Ensembles

- An "*ensemble*" means that we reproduce results many times using variations in how we go about it
- For climate modelling, different GCMs are coupled to RCMs to produce a range of results based on the same emissions





Global ***C***limate ***M***odels (GCMs)

Regional ***C***limate ***M***odels (RCMs)

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RCM Simulations Used

RCM Ensemble Matrix

RCM	Driving GCM/ Reanalysis	Evaluation 1979-2010	Historical 1950-2005	RCP 2.6 2006-2100	RCP 4.5 2006-2100	RCP 8.5 2006-2100	RESOLUTION (km)
RCA4	ERA-INTERIM	X					50
RCA4	EC-Earth		X	X	X	X	50
RCA4	EC-Earth		X			X	25
RCA4	CNRM-CM5		X		X	X	50
RCA4	GFDL-ESM2M		X		X	X	50
RCA4	GFDL-ESM2M		X			X	25
HIRAM	GFDL-ESM2M		X				25
REMO	MPI-ESM-LR		X				50

8 future climate simulations analysed

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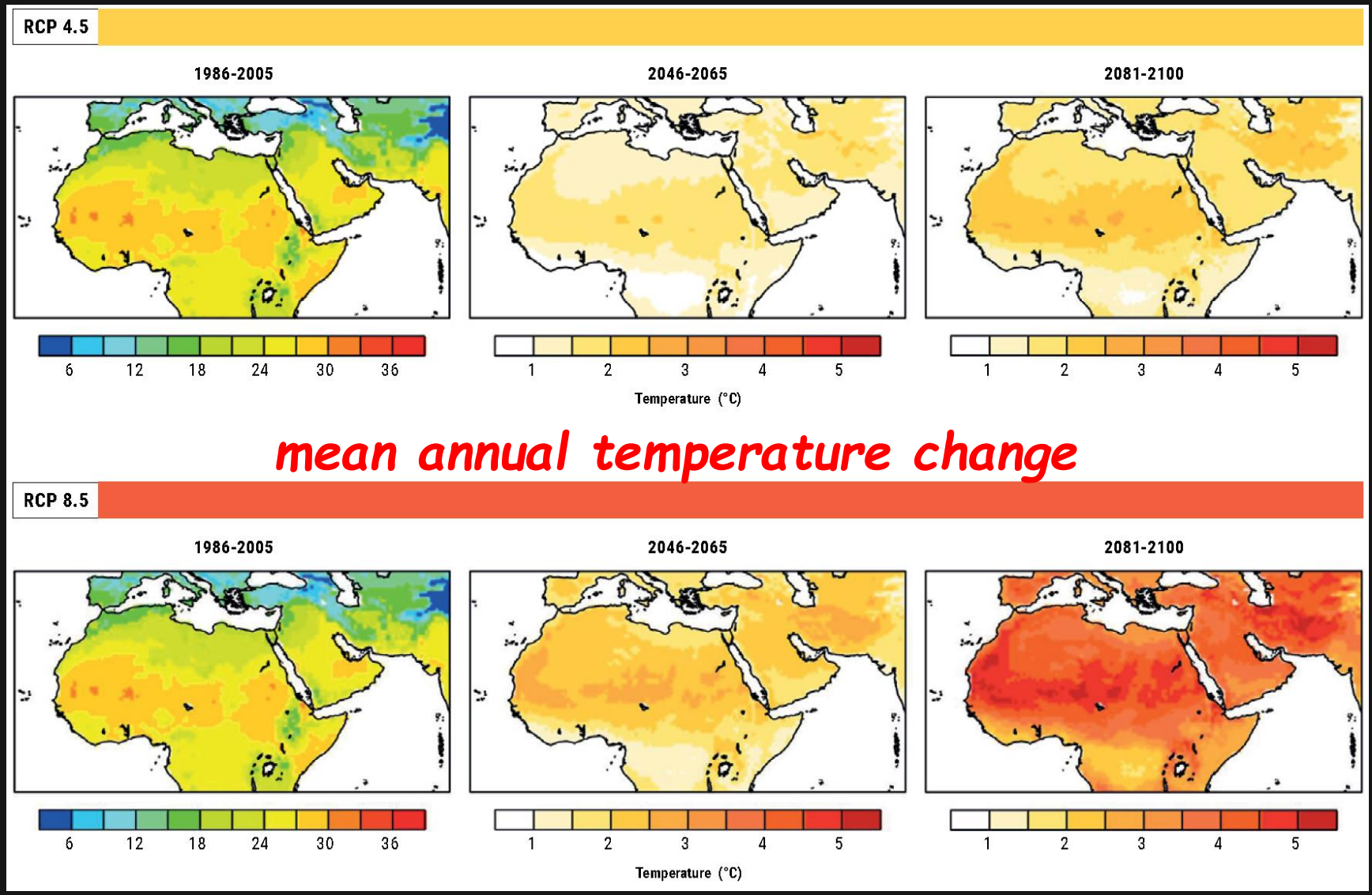
Future Projections - Temperature



RCA4: 3-member ensemble

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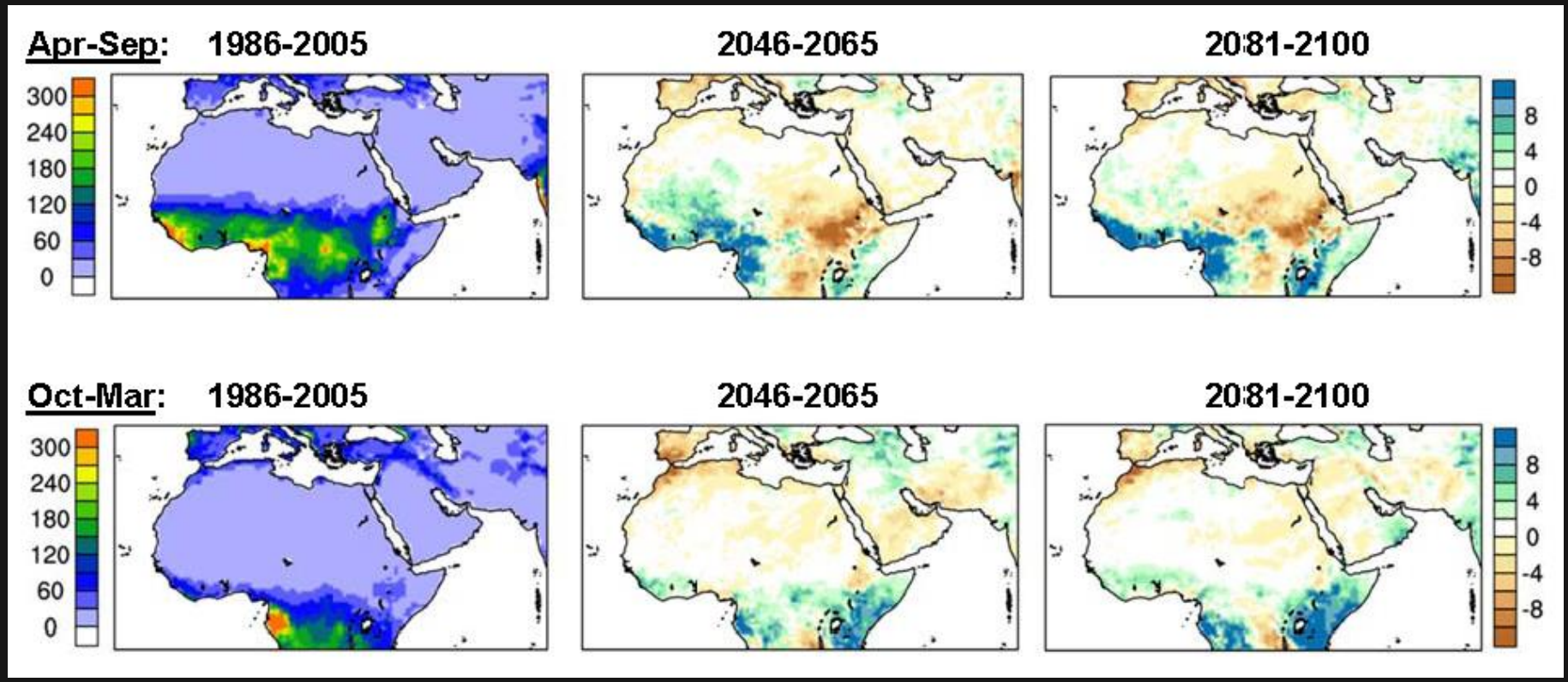
Future Projections - Prec RCP 4.5



Precipitation

RCA4: 3-member ensemble

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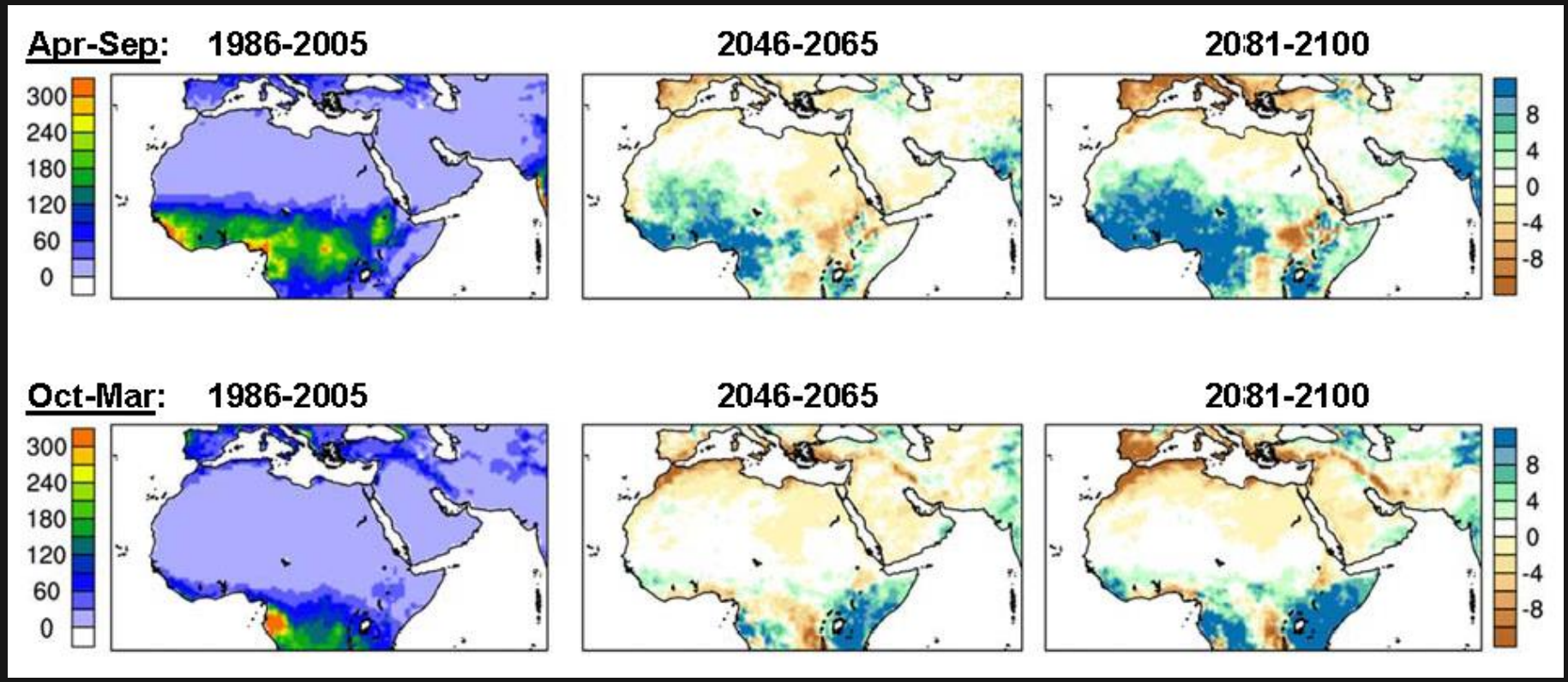
Future Projections - Prec **RCP 8.5**



Precipitation

RCA4: 3-member ensemble

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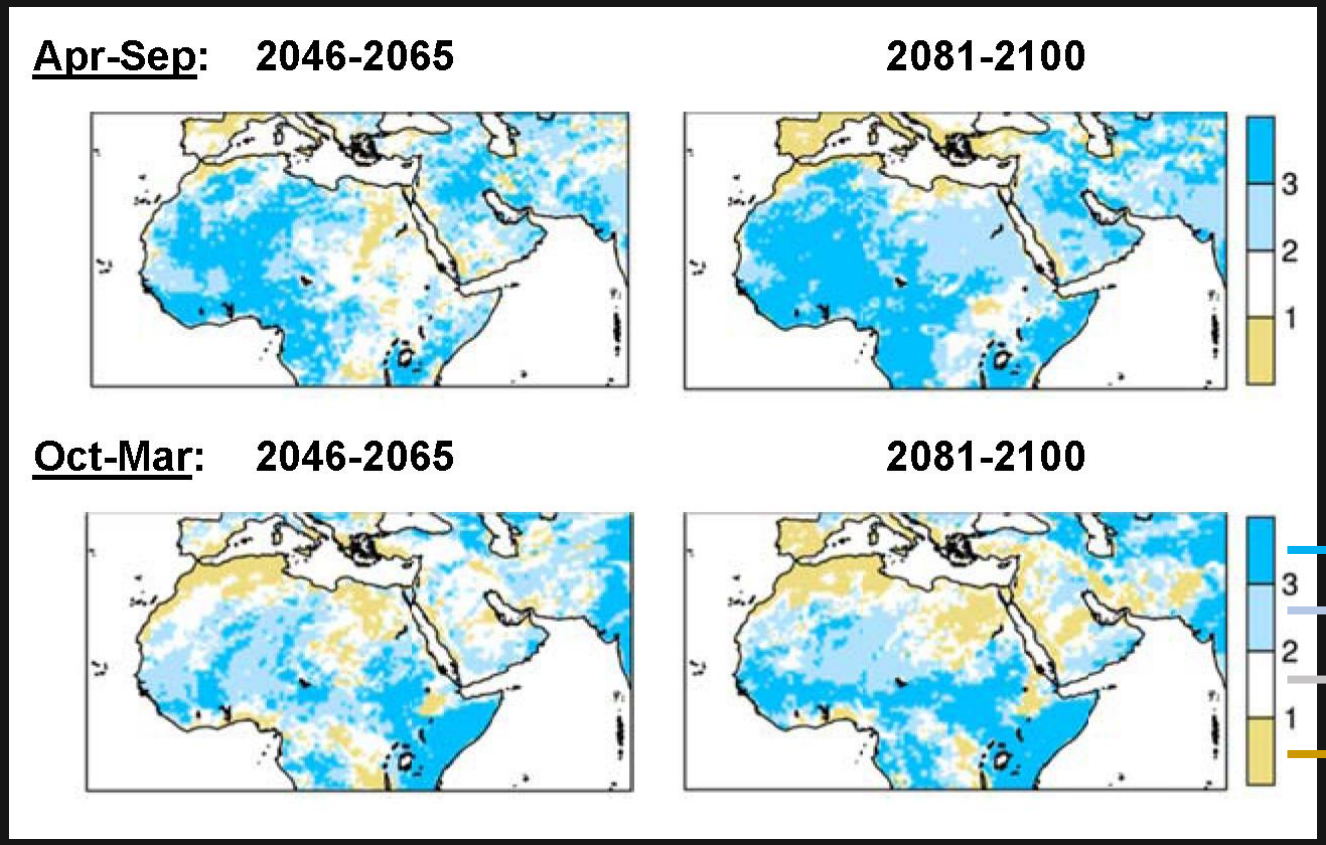
Future Projections - Prec **RCP 8.5**



RCA4: 3-member ensemble

Precipitation – agreement on signal of change

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Climate Extremes Indices

Extreme TEMPERATURE Indices

SU	***Number of summer days***: Annual count of days when, daily maximum temperature > 25ºC
SU35	***Number of hot days***: Annual count of days when, daily maximum temperature > 35ºC *{defined for application in RICCAR}*
SU40	***Number of very hot days***: Annual count of days when, daily maximum temperature > 40ºC *{defined for application in RICCAR}*
TR	***Number of tropical nights***: Annual count of days when, daily minimum temperature > 20ºC.

Extreme PRECIPITATION Indices

CDD	***Maximum length of dry spell***: maximum number of consecutive days with, daily precipitation < 1mm
CWD	***Maximum length of wet spell***: maximum number of consecutive days with, daily precipitation ≥ 1mm
R10	***Annual count of 10mm precipitation days***: when, daily precipitation ≥ 20mm
R20	***Annual count of 20mm precipitation days***: when, daily precipitation ≥ 20mm
SDII	***Simple precipitation intensity index***: defined as, total precipitation amount ÷ number of wet days

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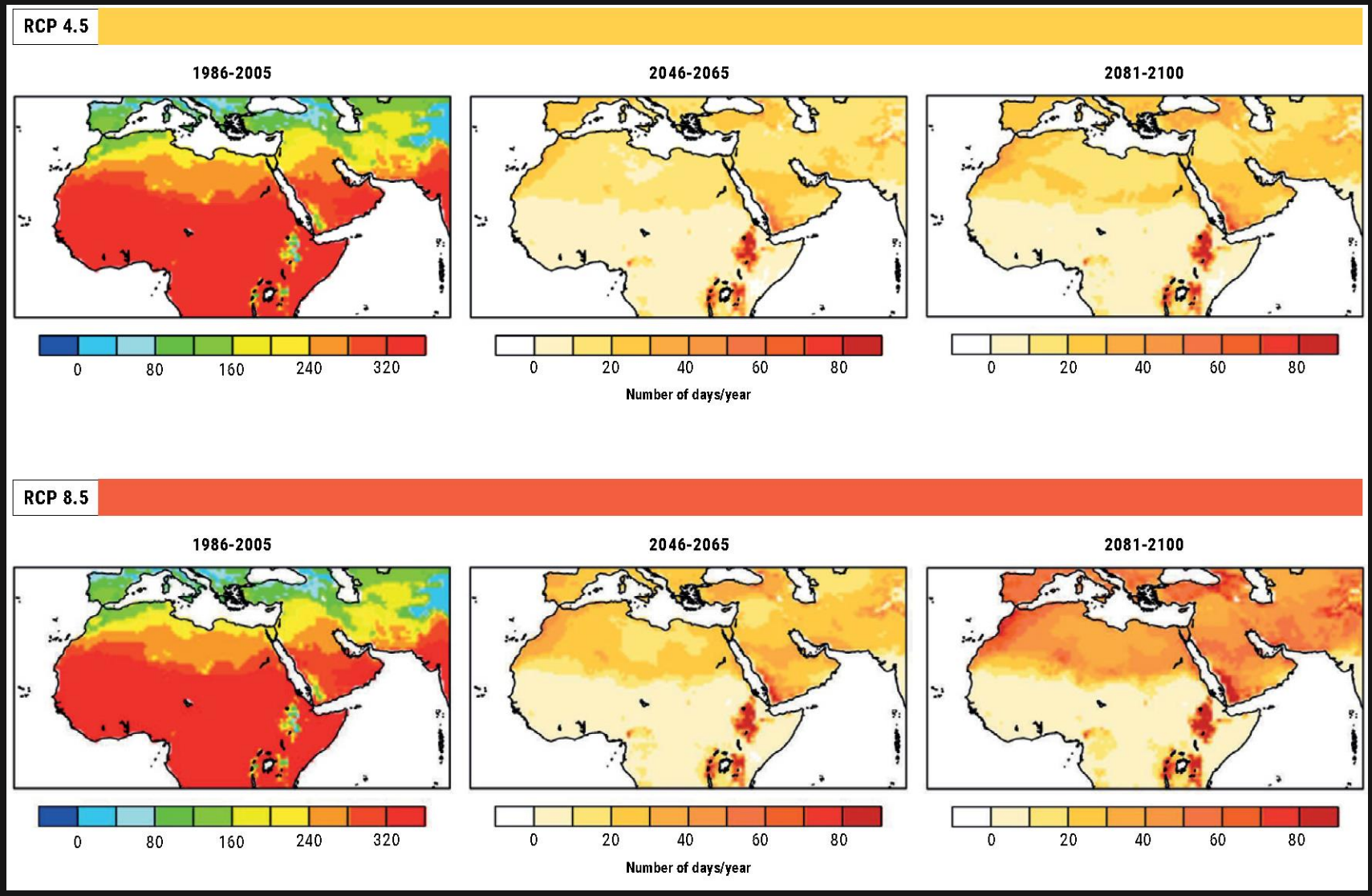
Temperature – "Summer" days (>25ºC)



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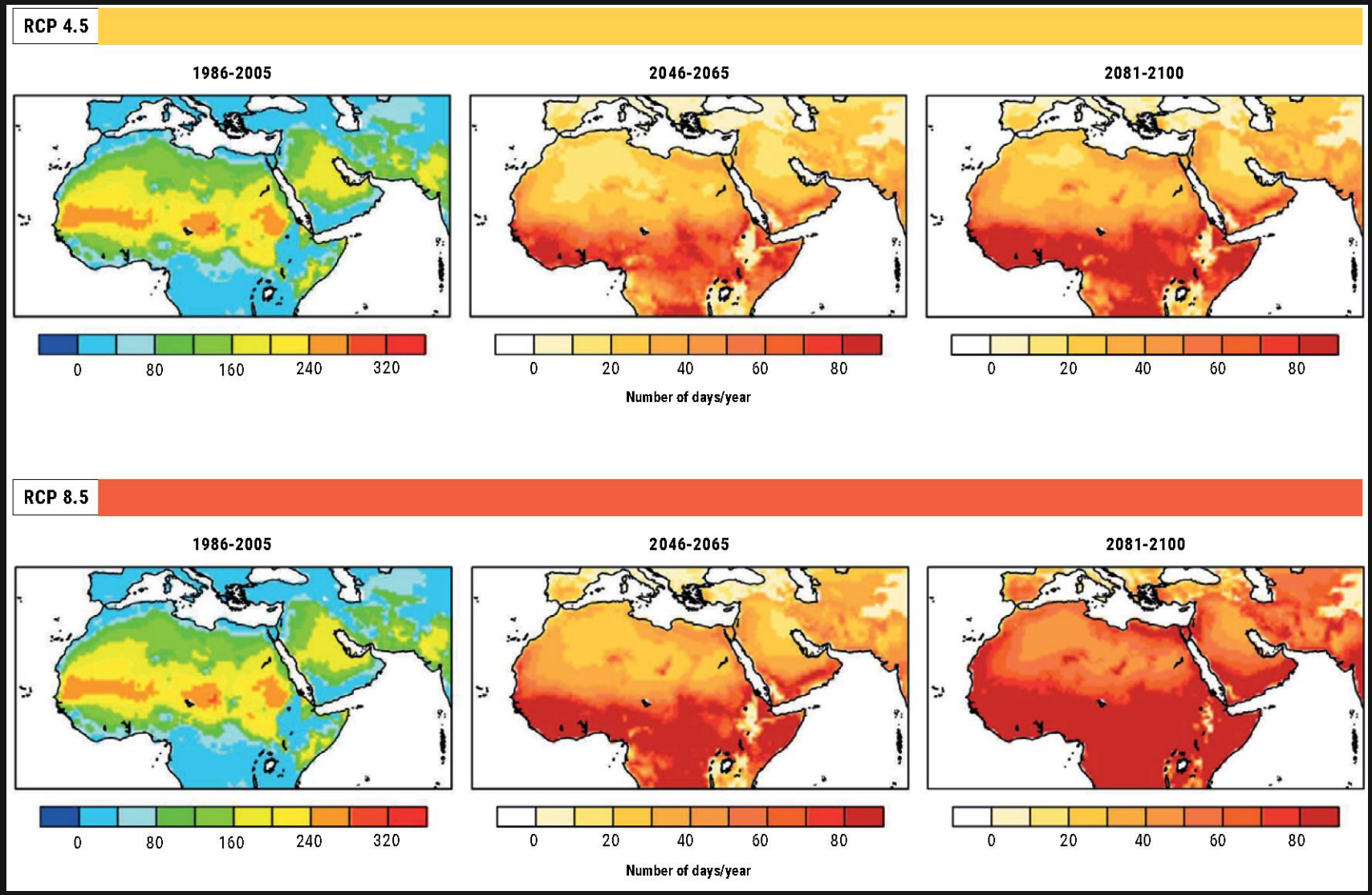
Temperature – "Hot" days (>35ºC)



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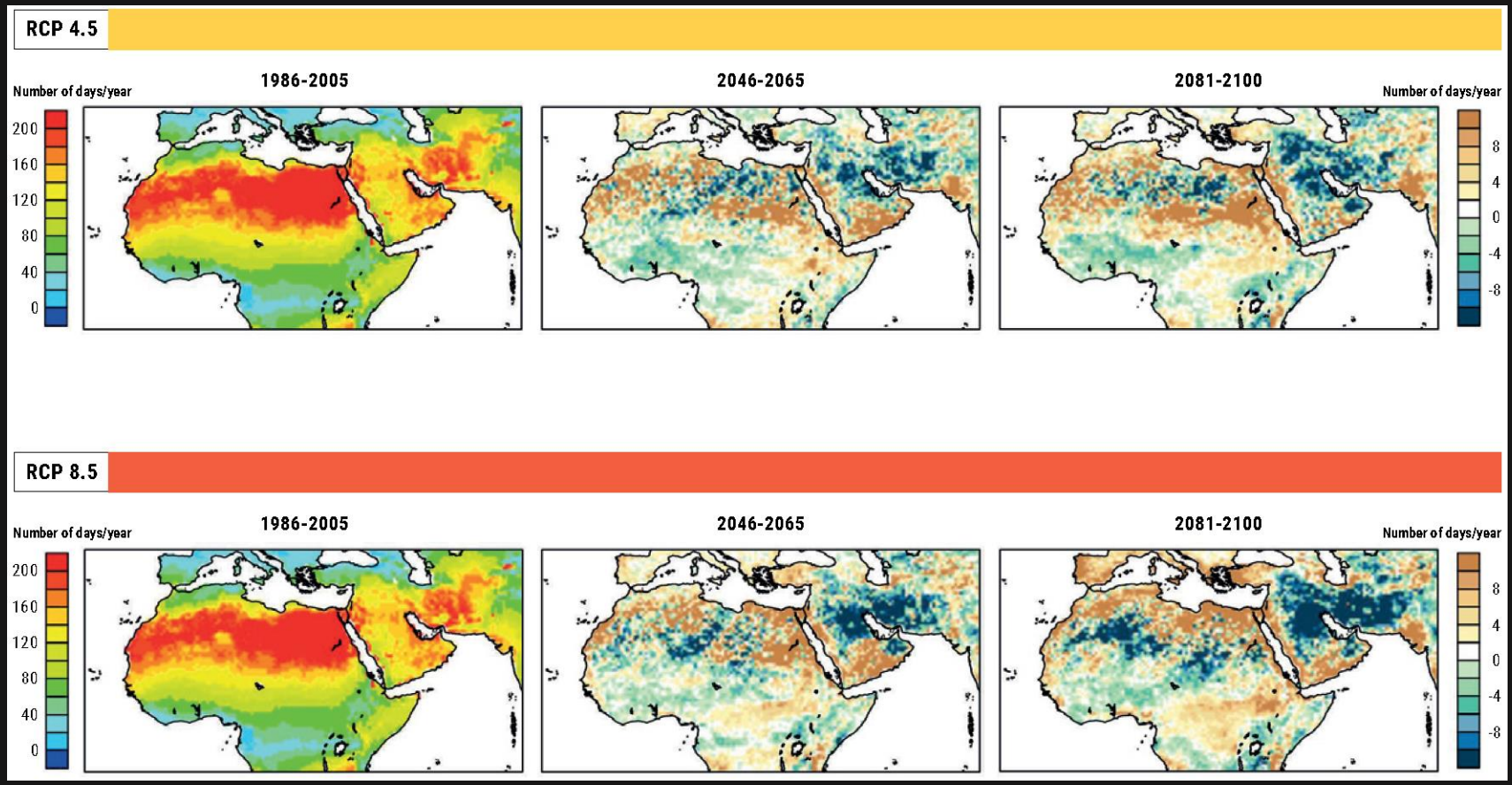
Dry Periods – # Consecutive Dry Days



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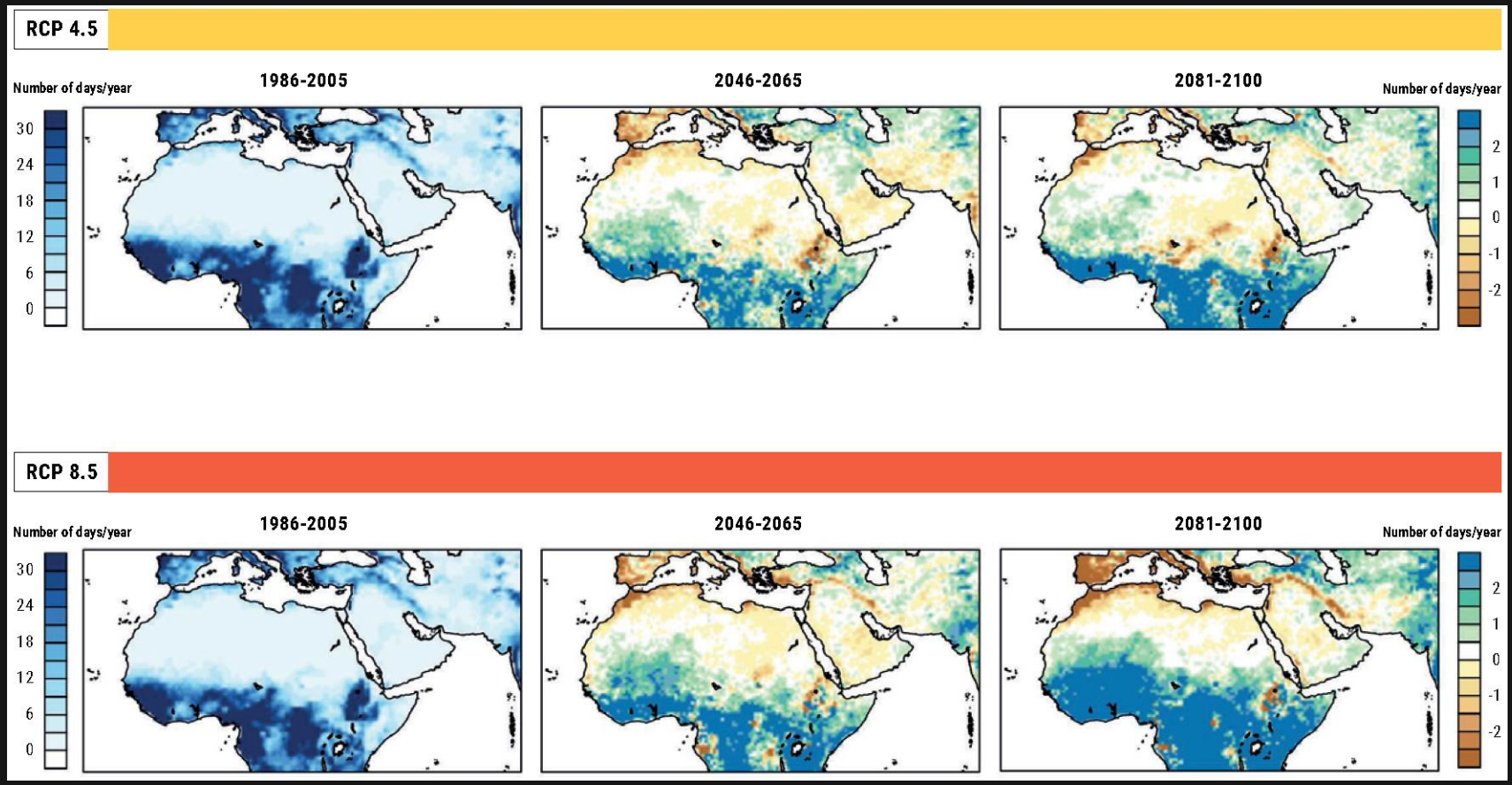
Intense Rainfall – R10 mm



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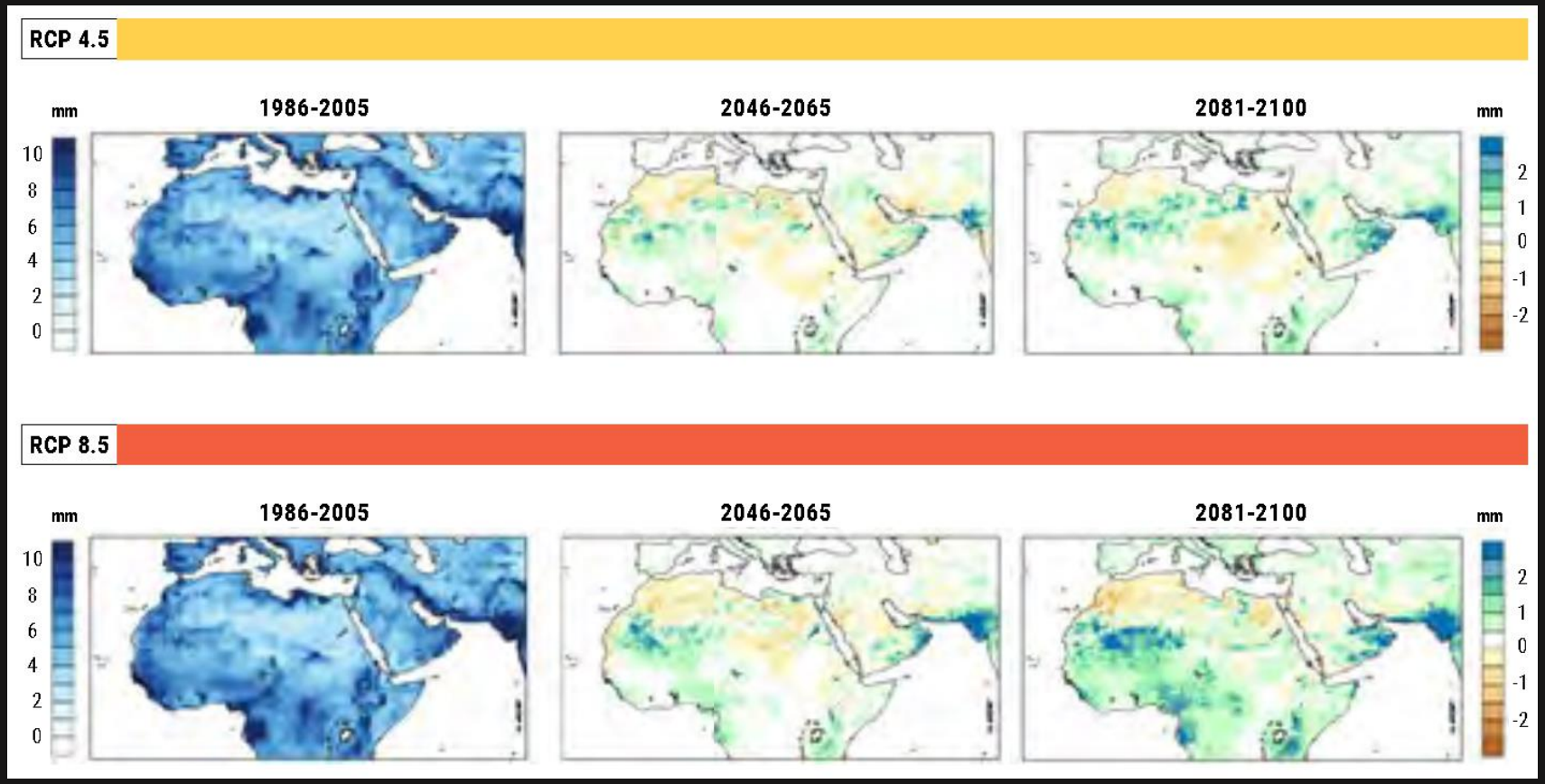
Intense Rainfall – SDII



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Highlights from RCM Projections

- Mean annual temperature change over the entire Arab domain is projected to
  - **1.6 °C** at mid-century, **1.9 °C** by end-of-century for **RCP 4.5**
  - **2.2 °C** at mid-century, **4.0 °C** by end-of-century for **RCP 8.5**

    (with variations over different regions)
- A number of regions show larger temperature increase during summer than during winter
  - large increases for “hot” days (>35°C) and “very hot” days (>40°C)
  - much more severe for **RCP 8.5** than for **RCP 4.5**
- Precipitation changes vary considerably over the region – many areas show decreases
  - more severe for **RCP 8.5** than for **RCP 4.5**
  - length of dry periods mostly increasing in both RCPs

Conclusions

- RICCAR sets a baseline for impact assessment in the Arab Region
- The lifetime of climate projections is usually long
- The RICCAR projection results will continue to be analysed by others over coming years, who will likely
  - apply different (*innovative?*) approaches to look at further aspects of impacts
  - add additional projections to add further insight and perspective