

Annex 1: Present day and projected occurrence of key hazards in focus countries

Hazard	Present-day	Future
Extreme heat	<ul style="list-style-type: none"> • Iraq - Observed increases in maximum temperature (Naqi et al., 2021). Basrah reached 54C in 2016 (WMO, 2017) • Syria - Heat event in Aleppo in Aug 2010 (Tuholske et al., 2021) • Yemen - Currently 14 extremely uncomfortable days per year (Red Cross Red Crescent Climate Centre, 2021a). Observed increase in number of heatwave days (Chambers, 2020). Observed warming in Red Sea. Observed increases in marine heatwave frequency and duration (Mohamed et al., 2021) • Egypt - Frequency, intensity and duration of warm extremes have increased (Nashwan and Shahid, 2022) - e.g., 2015 heatwave led to deaths (Mitchell, 2016) • Morocco - Observed increasing trend in warm temperature events (Driouech et al., 2021) 	<ul style="list-style-type: none"> • Intensification of summer heat extremes in MENA – longer and more severe (Zittis et al., 2021) • Growing area experiencing heat stress globally (Brimicombe et al., 2021) • Projected increase in frequency of marine heatwaves (Richardson et al., 2021). • Morocco – projected significant warming (Balhane et al., 2022).
Flooding	<ul style="list-style-type: none"> • Syria - Flooding in the NE in 2019 (ReliefWeb, 2019) • Yemen - Flash flooding has led to landslides e.g., 2008 (Soliman et al., 2015) • Egypt - Intense precip leading to flash 	<ul style="list-style-type: none"> • Egypt – projected increase in flood frequency along Nile (He et al., 2022). • Iraq - individual downpours are projected to become more intense (Richardson et al., 2021), which could result in increased flash

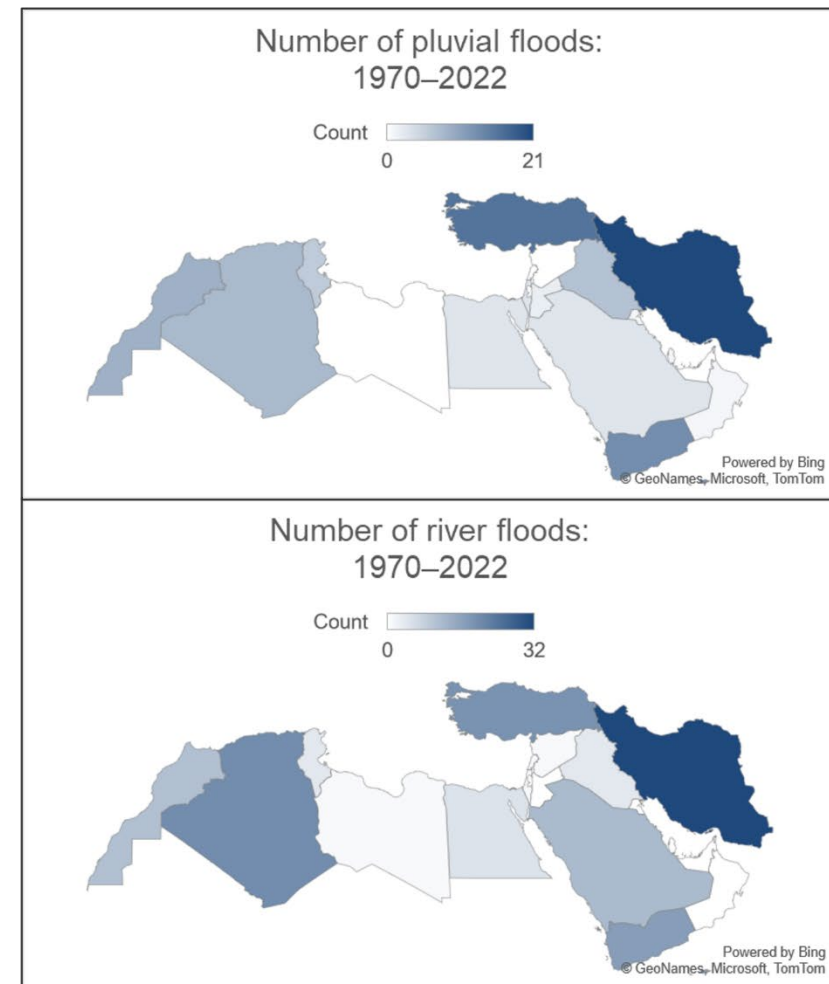
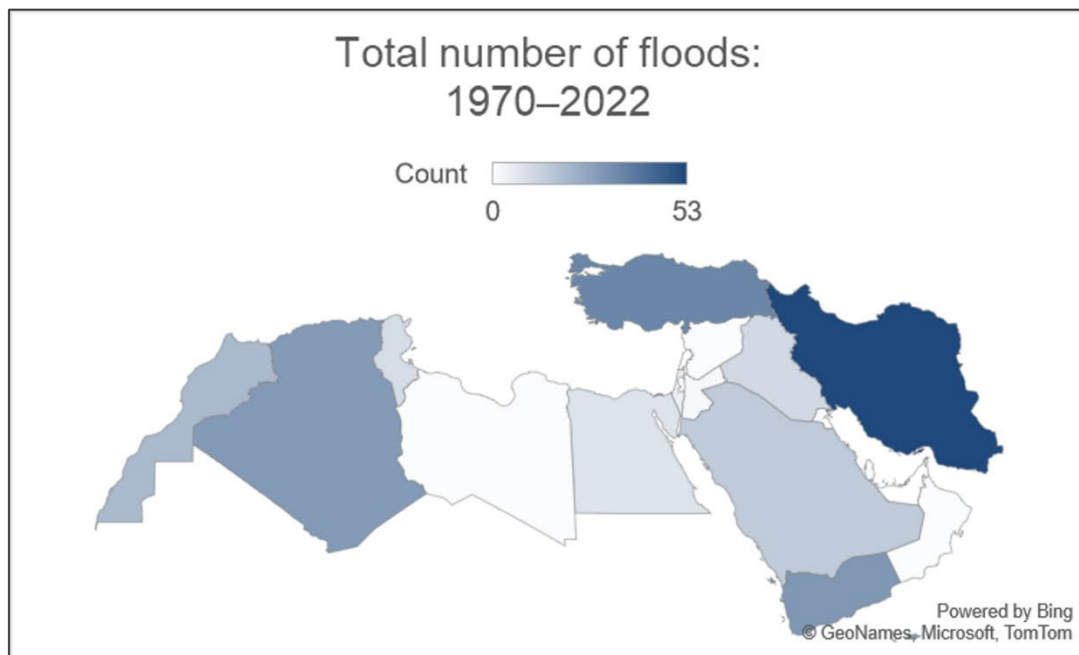
Hazard	Present-day	Future
	<p>flooding has become more frequent (Nashwan and Shahid, 2022)</p> <ul style="list-style-type: none"> • Morocco - Flooding particularly observed in mountainous part of semi-arid basins of western High Atlas (El Alaoui El Fels et al., 2022). Flash floods have led to landslides, e.g., in northeastern Morocco (World Bank, 2022b) 	<p>flooding.</p> <ul style="list-style-type: none"> • Morocco – projected increase in intensity of rainfall events (IPCC, 2013), which can lead to flash flooding (Richardson et al., 2021).
Drought	<ul style="list-style-type: none"> • Syria - Observed worsening of agricultural drought (Mohammed et al., 2021). • Iraq – e.g., drought in 2021 (Relief Web, 2021b) • Yemen - Observed increase in drought intensity in Tihama, an important agricultural area (Allah, 2022). Severe water crisis – rainwater and groundwater (Al-Mashreki, 2022) • Egypt - Observed increases in aridity (Sahour et al., 2020) • Morocco - Close to threshold for severe water stress (IPCC, 2022). Observed trends to drier conditions in parts of northern Morocco (Driouech, 2020). Decline in groundwater levels in Marrakesh (Analy and Laftouhi, 2020) • Palestine - Severe water shortages and 	<ul style="list-style-type: none"> • Projected increases in frequency and severity of seasonal drought in MENA (Tomaszkiewicz, 2021) • Egypt - projected increases in drought intensity (El-Tantawi et al., 2021) and long dry spells (Nashwan and Shahid, 2022) • Morocco – projected increase in seasonal drought in winter and spring in highlands (Tomaszkiewicz, 2021). Projected longer and more severe dry periods (Balhane et al., 2022). • Yemen – increasing water scarcity (Odhiambo, 2017)

Hazard	Present-day	Future
	desertification (ref)	
Fire weather	<ul style="list-style-type: none"> • Iraq - Observed increases in burned area, mainly in NE and N Iraq (Rasul et al., 2021) • Syria - Forest fires e.g., Oct 2020 (Relief Web, 2020) 	
Sea level rise	<ul style="list-style-type: none"> • Morocco - Saltwater intrusion already experienced (Ouhamdouch, 2021) 	<ul style="list-style-type: none"> • Egypt – coastal flooding projected to increase, and seawater intrusion (Omar et al., 2021) • Morocco – saltwater intrusion projected to increase with sea level rise (ref), affecting groundwater quality. Also coastal retreat projected (Kasmi et al., 2020) • Syria – coastal flooding and saltwater intrusion (ref) • Yemen – projected increase in sea level in the Gulf of Aden and Red Sea (Richardson et al., 2021). • Syria and Palestine - Mediterranean sea level projected to rise (Richardson et al., 2021).
Storms/cyclones	<ul style="list-style-type: none"> • Iraq - Cyclones associated with extreme precipitation (Naqi et al., 2021). Heavy rain events often associated with cut-off lows (Mutar et al., 2021) • Yemen - Cyclone Chapala in 2015 (Relief Web, 2015) • Egypt - Rare cyclone in 2020 (Madkour, 2022) 	<ul style="list-style-type: none"> • Egypt – projected increase in extreme precip (Nashwan and Shahid, 2022) • Yemen – increasing number of people projected to be exposed to category 1 and category 3 cyclones (Bloemendaal, 2022) • Morocco – uncertain trend in frequency of extra-tropical cyclones in the North Atlantic and Mediterranean, however severity is

Hazard	Present-day	Future
	<ul style="list-style-type: none"> Morocco - Northern Morocco has high hail hazard (Raupach et al., 2021). Extreme rainfall at Atlantic coast associated with atmospheric rivers during autumn-winter (Khouakhi et al., 2022). Increased frequency of extra-tropical cyclones in the North Atlantic and Mediterranean have been observed (Richardson et al., 2021). 	<p>projected to increase (Richardson et al., 2021).</p> <ul style="list-style-type: none"> Syria and Palestine – severity of storms projected to increase (Richardson et al., 2021).
Sandstorms/dust storms	<ul style="list-style-type: none"> Iraq - Sandstorms associated with NWly Shamal wind, mostly in summer (Al-Zuhairi and Kadhum, 2021) Yemen - Dust storms common all year, mostly in summer, e.g., Aden in 2019 and Aljafnah camp in 2018 (Ghalib et al., 2021) 	<ul style="list-style-type: none"> Drought increases sandstorm risk (Richardson et al., 2021) Syria – drought increasing severity and persistence of dust storms (Hamzeh et al., 2021)
Cold spells	<ul style="list-style-type: none"> Iraq – cold waves generally caused by air mass advection from Siberia and Eastern Europe (Naqi et al., 2021). Heavy snow has caused flooding (ref). Syria - 2022 Jan and March cold waves (Ouda, 2022) Morocco - Observed tendency towards decreasing cold extremes (Driouech, 2020) 	<ul style="list-style-type: none"> Projected reduction in number of cold days and cold nights in MENA (Babaousmail et al., 2022)

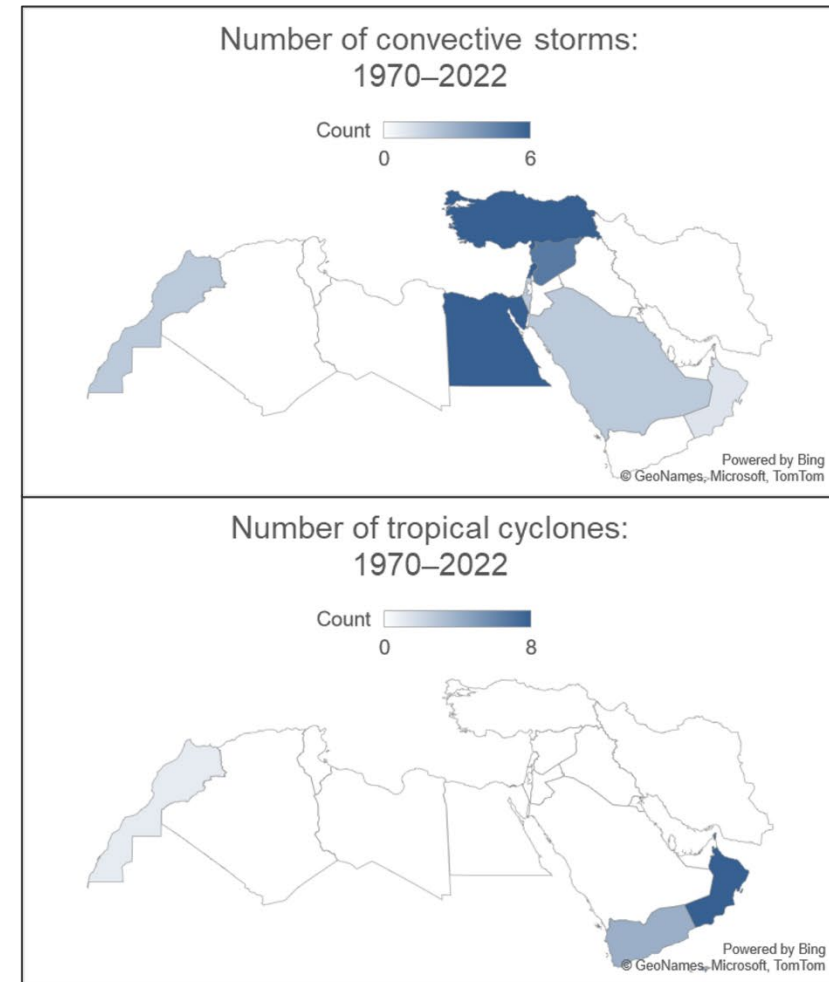
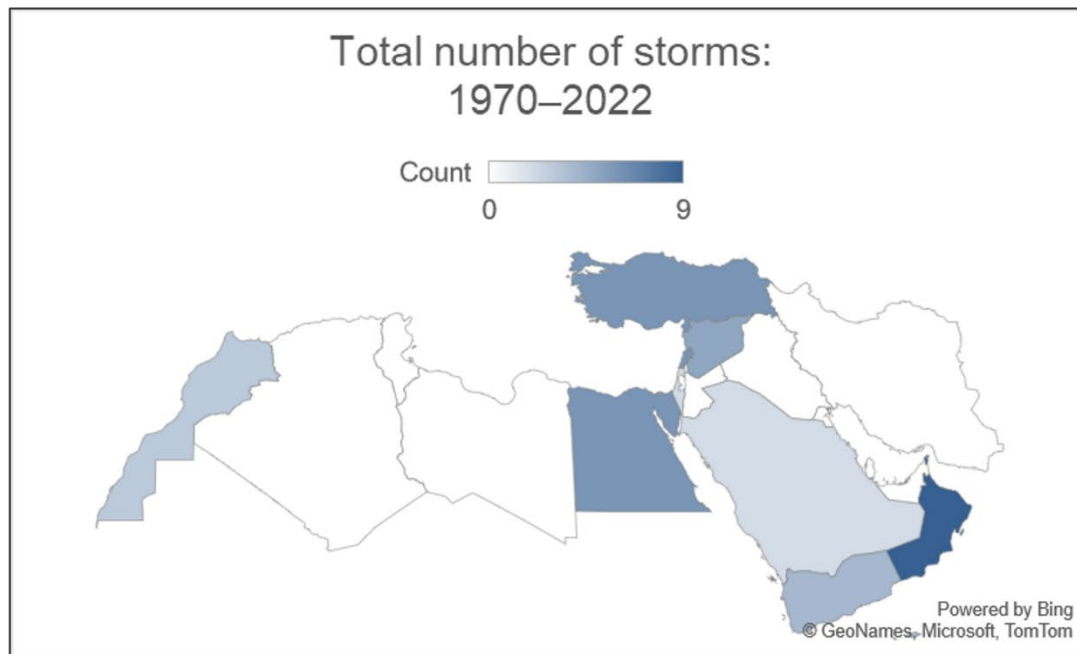
Annex Table 1.1

Disaster analysis – floods



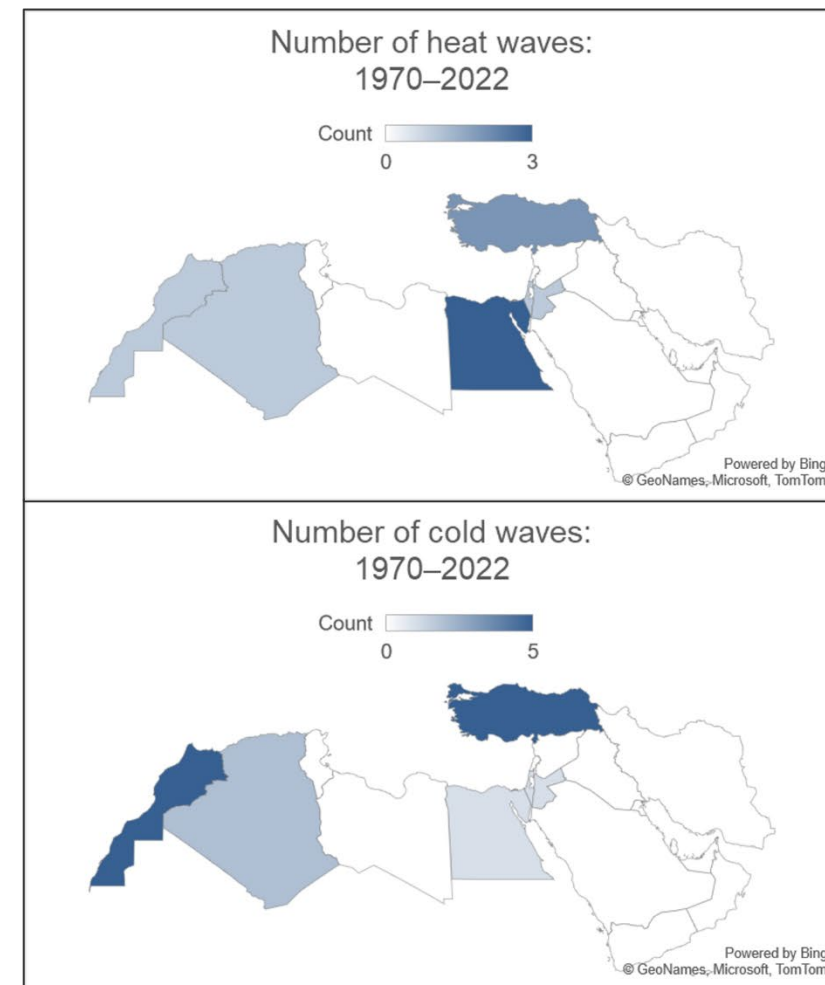
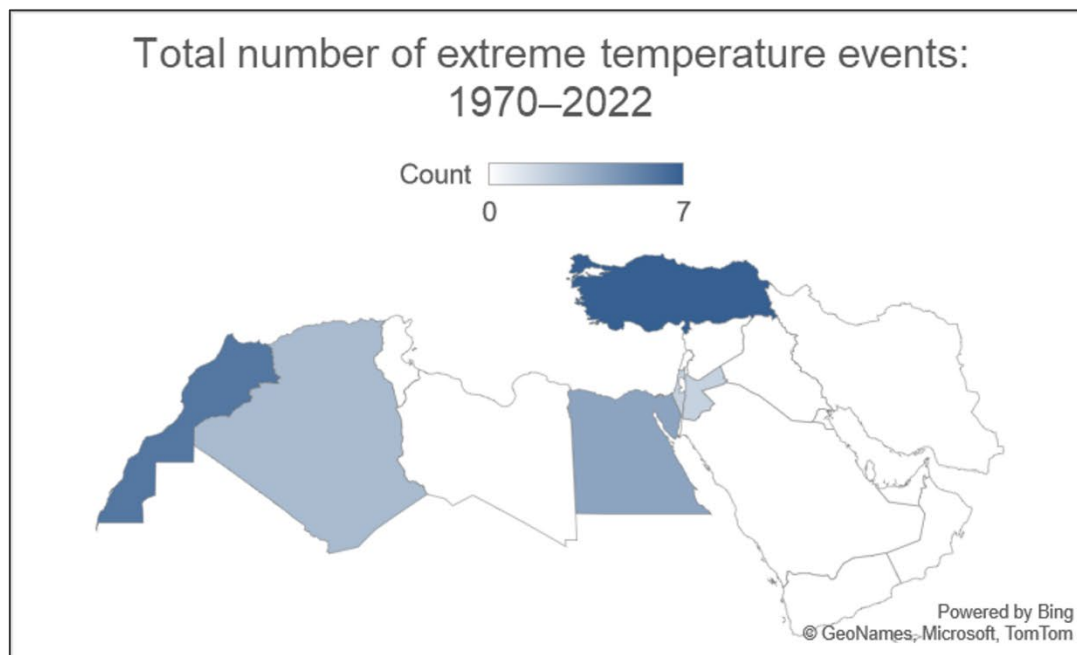
Annex Figure 1.1: Reported frequency of occurrence of flood events in the MENA region. Source: EM-DAT (Guha-Sapir et al., 2022).

Disaster analysis – storms



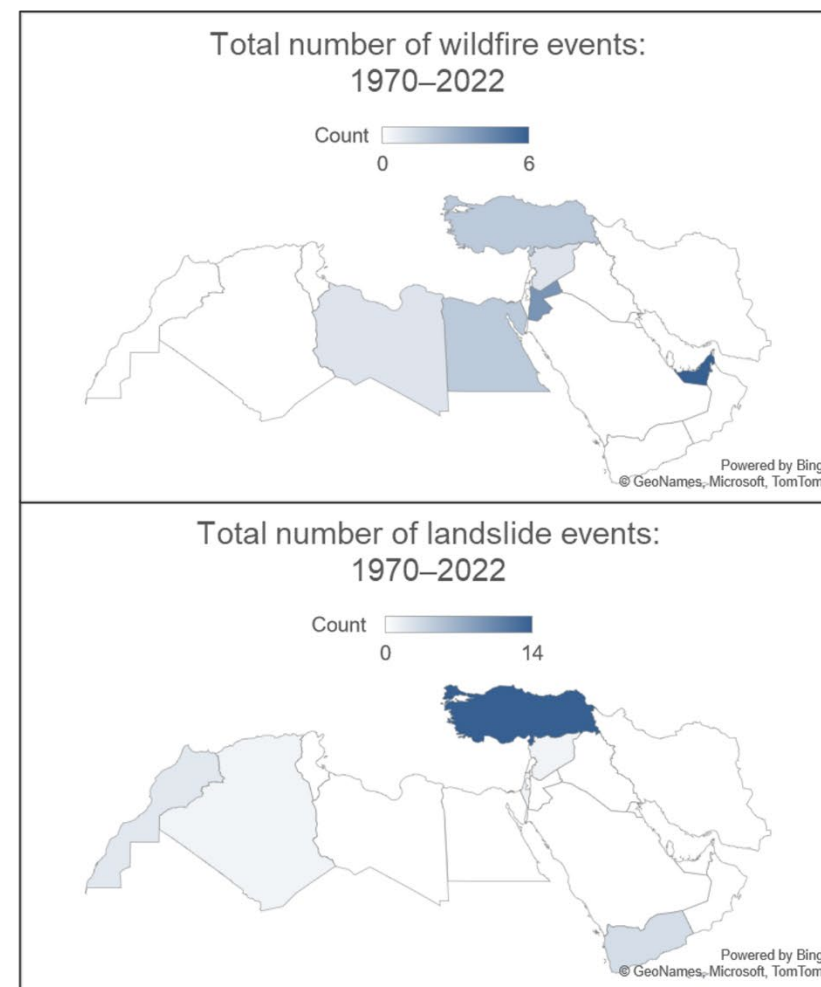
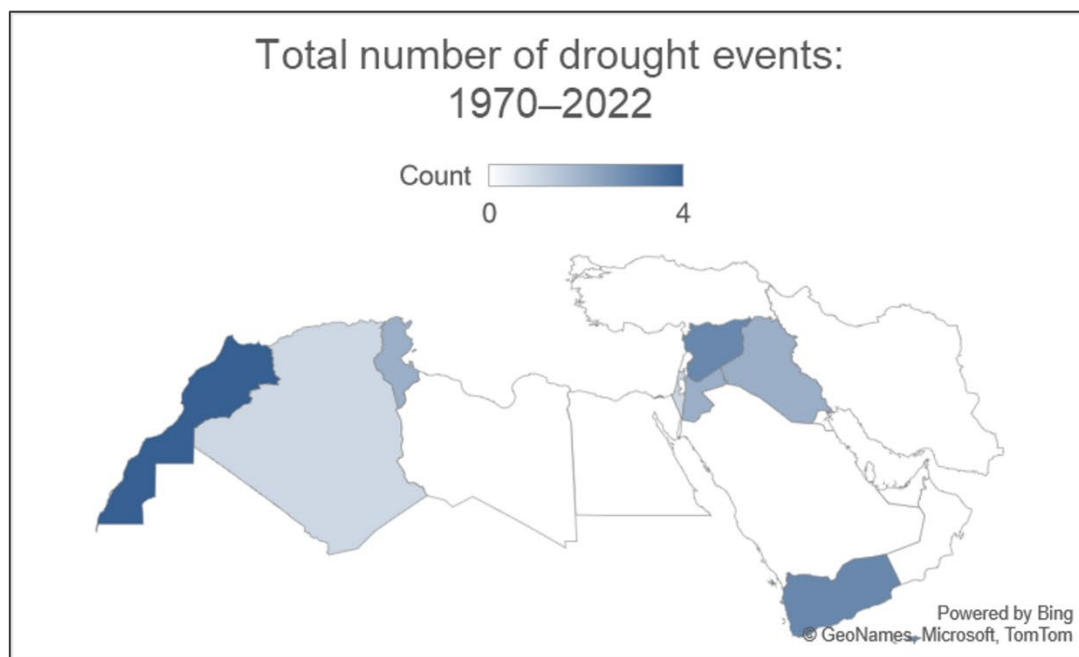
Annex Figure 1.2: Reported frequency of occurrence of storm events in the MENA region. Source: EM-DAT (Guha-Sapir et al., 2022).

Disaster analysis – extreme temperature events



Annex Figure 1.3: Reported frequency of occurrence of extreme temperature events in the MENA region. Source: EM-DAT (Guha-Sapir et al., 2022).

Disaster analysis – droughts, wildfires, and landslides



Annex Figure 1.4: Reported frequency of occurrence of drought, wildfire and landslide events in the MENA region. Source: EM-DAT (Guha-Sapir et al., 2022).

Annex 2: Users of Weather and Climate information

List of stakeholders

Community Jameel
Foreign, Commonwealth and Development Office (FCDO)
Gulf Cooperation Council (GCC)
International Water Management Institute (IWMI)
KS Relief
Morocco Met Service
RAED (Arab Network for Environment and Development)
Red Cross Climate Centre (RCCC)
Risk-informed Early Action Partnership (REAP)
Saudi Arabia National Center of Meteorology
Tunisia National Institute for Meteorology
UNDRR (United Nations Office for Disaster Risk Reduction)
United Nations Economic and Social Commission for Western Asia (UNESCWA)
United Nations High Commissioner for Refugees (UNHCR)
United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA)
World Food Programme (WFP)
World Met Organisation (WMO)

Annex Table 2.1

Annex 2: Users of Weather and Climate information

Identified WCS users and direct partners in Palestine

WCS User Category	WCS user subsidiaries
Government Ministries	<ul style="list-style-type: none"> Ministry of Agriculture Ministry of Health Ministry of Local Government
Other Government bodies	<ul style="list-style-type: none"> Environment Quality Authority (EQA) Palestinian Civil Defence (PCD) Palestinian Civil Defence Centre – District Level Higher Council of Civil Defence Palestinian Water Authority Water scarcity task force Palestine Centre for Disaster Risk Management
International and National Non-Government actors acting locally	<ul style="list-style-type: none"> World Food Program Food and Agriculture Organization Palestinian Red Crescent Society (PRCS) International Federation for the Red Cross International Committee of the Red Cross Save the Children Oxfam Mercy Corps The United Nations Office for the Coordination of Humanitarian Affairs United Nations Development Program World Health Organization UNRWA ACTED Action against hunger ACF CARE International Others (there is a wealth of other potential NGO users)
National Centres or Organisations	<ul style="list-style-type: none"> MA'AN Development Centre The Palestinian Energy and Environment Research Centre (PEC) Water Sector Regulatory Council Union of Agricultural Work Committees in the Occupied Palestinian Territories Palestinian Agricultural Relief Committees House of Water and Environment (HWE) Palestinian Hydrology Group (PHG) Palestine Hydrology Group in the Occupied Palestinian Territories Palestinian Environmental NGOs Network – Friends of Earth Palestine
Academia or Research Institutes	<ul style="list-style-type: none"> Biodiversity and Environmental Research Centre (BERC) National Agriculture Research Centre Applied Research Institute of Jerusalem/the Water and Environment Research Unit (WERU) An-Najah National University Palestine Academy for Science and Technology National Institute for Environment and Development (NIED) Birzeit University Al Quds University Water and Environmental Studies Institute (WESI) University of Bethlehem

Annex Table 2.2

Identified WCS users and direct partners in in Yemen

WCS User Category	WCS user subsidiaries
Government Ministries	<ul style="list-style-type: none"> Ministry of Water and Environment <ul style="list-style-type: none"> Environmental Emergency Unit Ministry of Agriculture and Irrigation Ministry of Interior <ul style="list-style-type: none"> Disaster Management Unit Ministry of Transport
Other Government bodies	<ul style="list-style-type: none"> Civil Aviation and Meteorology Authority Environmental Protection Authority Ministry of Health Ministry of Information Ministry of Planning and International Cooperation
International and National Non-Government actors	<ul style="list-style-type: none"> FAO World Bank UNDP WFP UNICEF IFRC Save the Children UN-OCHA Yemen Red Crescent Society (YRCS) ICRC Yemen Organization for Humanitarian Relief and Development Humanitarian Action Localization Initiative in Yemen Others (more NGOs, Civil Society Organization have the potential to be users)
Academia or Research Institutes	<ul style="list-style-type: none"> Yemeni Organization for Science and Technology Research The Yemeni Center for Strategic Studies & Research Sana'a Center For Strategic Studies Sana'a University University of Science and Technology Yemen

Annex Table 2. 3

Identified WCS users and direct partners in Iraq

WCS User Category	WCS user subsidiaries
Government Ministries	<ul style="list-style-type: none"> • Ministry of Water Resources • Ministry of Agriculture • Ministry of Health and Environment • Ministry of Science and Technology
National Centres or Organisations	<ul style="list-style-type: none"> • National Center for Water Resources Management • Agricultural Meteorological Center • Al-Aghsan Foundation for Agricultural and Environmental Development
International and National organisations	<ul style="list-style-type: none"> • IRCS • Oxfam • Save the Children • IFAD • WFP • UNEP • UNDP • UNESCO • UNICEF • FCDO • World Bank • International Organization for Migration • Others (more NGOs, Civil Society Organization have the potential to be users)
Academia or Research Institutes	<ul style="list-style-type: none"> • Al Nahrain Center for Strategic Studies

Annex Table 2. 4

Identified WCS users and direct partners in Syria	
WCS User Category	WCS user subsidiaries
Government Ministries	<ul style="list-style-type: none"> • Ministry of Local Administration and Environment • Ministry of Agriculture and Agrarian Reform • Ministry of Health • Ministry of Water Resources • Ministry of Electricity • Ministry of the Interior
Other Government Bodies	<ul style="list-style-type: none"> • Hasakah Directorate of the Autonomous Administration of North and East Syria • Civil Defence Department • Highest Council for Civil Defence • The Highest Committee of Emergency Management
National Centres or Organisations	<ul style="list-style-type: none"> • National Agriculture Policy Center (NAPC) • Emergency Operations Centre • National Disaster Risk Management Centre • General Organization of Remote Sensing (GORS) • The Syrian Environment Protection Society (SEPS)
International and National Non-Government actors	<ul style="list-style-type: none"> • Save the Children • Mercy Corps • United Nations Office for the Coordination of Humanitarian Affairs • International Committee of the Red Cross • Oxfam • Food and Agriculture Organization • World Food Program • Syrian Arab Red Crescent • IFRC • UN-Habitat • UNDP • Others (more NGOs, Civil Society Organization have the potential to be users)
Academia	<ul style="list-style-type: none"> • Higher Institute for Applied Sciences and Technology • Higher Institute of Water Management (HIWM) Al-Baath University • International Centre for Agricultural Research in the Dry Areas (ICARDA) • Higher Institute for Environmental Research – Tishreen University • Arab Center for the Studies of Arid Zones and Dry Lands (ACSAD)

Annex Table 2. 5

Identified WCS users and direct partners in Egypt

WCS User Category	WCS user subsidiaries
Government Ministries	<ul style="list-style-type: none"> • Ministry of Water and Irrigation • Ministry of Agriculture • Ministry of Civil Aviation
National Centres or Organisations	<ul style="list-style-type: none"> • Nile Basin Initiative • Egyptian General Authority for the Protection of Beaches
Academia or Research Institutes	<ul style="list-style-type: none"> • National Water Research Center • Alexandria Research Center for Climate Change Adaptation • Alexandria University • Central Laboratory for Agricultural Climate

Annex Table 2. 6

Identified WCS users and direct partners in Morocco

WCS User Category	WCS user subsidiaries
Government Ministries	<ul style="list-style-type: none"> • Ministry of Interior • Ministry of Agriculture, Fisheries, Rural Development, Water and Forests • Ministry of Equipment and Water • Ministry of Transport and Logistics
International and National Non-Government actors	<ul style="list-style-type: none"> • Food and Agriculture Organization • World Food Programme • Moroccan Red Crescent (supported by German Red Cross) • International Federation for the Red Cross • The United Nations Office for the Coordination of Humanitarian Affairs • United Nations Development Program • Office of the United Nations High Commissioner for Human Rights (OHCHR) • United Nations Information Centre (UNIC) • United Nations Development Fund for Women in North Africa (UNIFEM) • CARE International • OXFAM
Other Government Bodies	<ul style="list-style-type: none"> • General Directorate of Water (DGE) • Hydraulic Basin Agency • Directorate General of Civil Aviation • The Royal Center for Spatial Remote Sensing
National Centres or Organisations	<ul style="list-style-type: none"> • The Higher Council for Water and Climate (CSEC) • Center for Environment, Human Security and Governance (CERES) • Morocco Foundation
Academia or Research Institutes	<ul style="list-style-type: none"> • The Center for Environment, Human Security & Governance, Inb Zohr University, • University Mohamed VI Polytechnique, Benguerir, Morocco • National Research Institute for Agriculture, Food and Environment (INRAE), France • Agronomic and Veterinary Institute Hassan II (Institut Agronomique et Vétérinaire Hassan-II)

Annex Table 2. 7

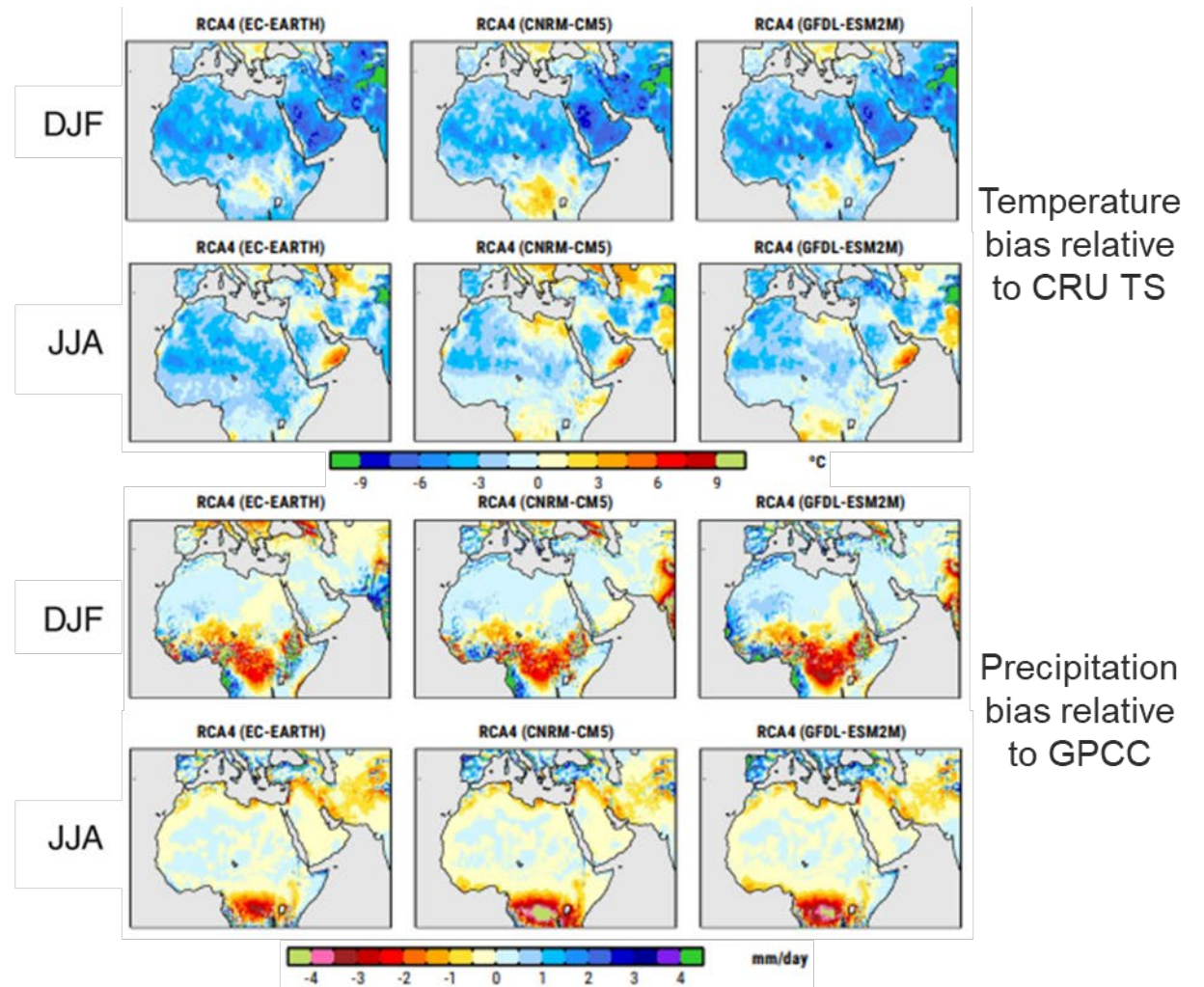
Annex 3: RCM model evaluation

Institute ID1	Model ID	Resolution	Driving Model ID	Driving Experiment
BOUN	RegCM4-4	0.44 deg	MPI-ESM-MR	rcp45
BOUN	RegCM4-4	0.44 deg	MPI-ESM-MR	rcp85
BOUN	RegCM4-4	0.44 deg	HadGEM2-ES	rcp45
BOUN	RegCM4-4	0.44 deg	HadGEM2-ES	rcp85
CLMcom	CCLM4-21	0.44 deg	CMCC-CM	rcp45
CLMcom	CCLM4-21	0.22 deg	CMCC-CM	rcp45
GERICS	REMO2009	0.44 deg	MPI-ESM-LR	rcp26
GERICS	REMO2009	0.44 deg	MPI-ESM-LR	rcp45
GERICS	REMO2009	0.44 deg	MPI-ESM-LR	rcp85
CYI	WRF351	0.44 deg	CESM1	rcp85
CYI	WRF351	0.44 deg	CESM1	rcp45
DMN-MOR	ALADIN	0.44 deg	CNRM-CM5	rcp45
DMN-MOR	ALADIN	0.44 deg	CNRM-CM5	rcp85
ICBA	WRF36	0.44 deg	CESM1	rcp45
ICBA	WRF36	0.44 deg	CESM1	rcp85
SMHI	RCA4	0.44 deg	CNRM-CM5	rcp45
SMHI	RCA4	0.44 deg	CNRM-CM5	rcp85
SMHI	RCA4	0.44 deg	EC-EARTH	rcp26
SMHI	RCA4	0.44 deg	EC-EARTH	rcp45
SMHI	RCA4	0.44 deg	EC-EARTH	rcp85
SMHI	RCA4	0.44 deg	GFDL-ESM2M	rcp45
SMHI	RCA4	0.44 deg	GFDL-ESM2M	rcp85
SMHI	RCA4	0.22 deg	CNRM-CM5	rcp85
SMHI	RCA4	0.22 deg	EC-EARTH	rcp85

Annex Table 3. 1: The twenty-four available RCM simulations for the MENA region under CORDEX-MENA. Each simulation comprises of an RCM and a driving GCM. The resolution and greenhouse gas emissions scenarios are also listed for each simulation. Source: <http://mena-cordex.cyi.ac.cy/index.php/simulations-status>.

RCA4

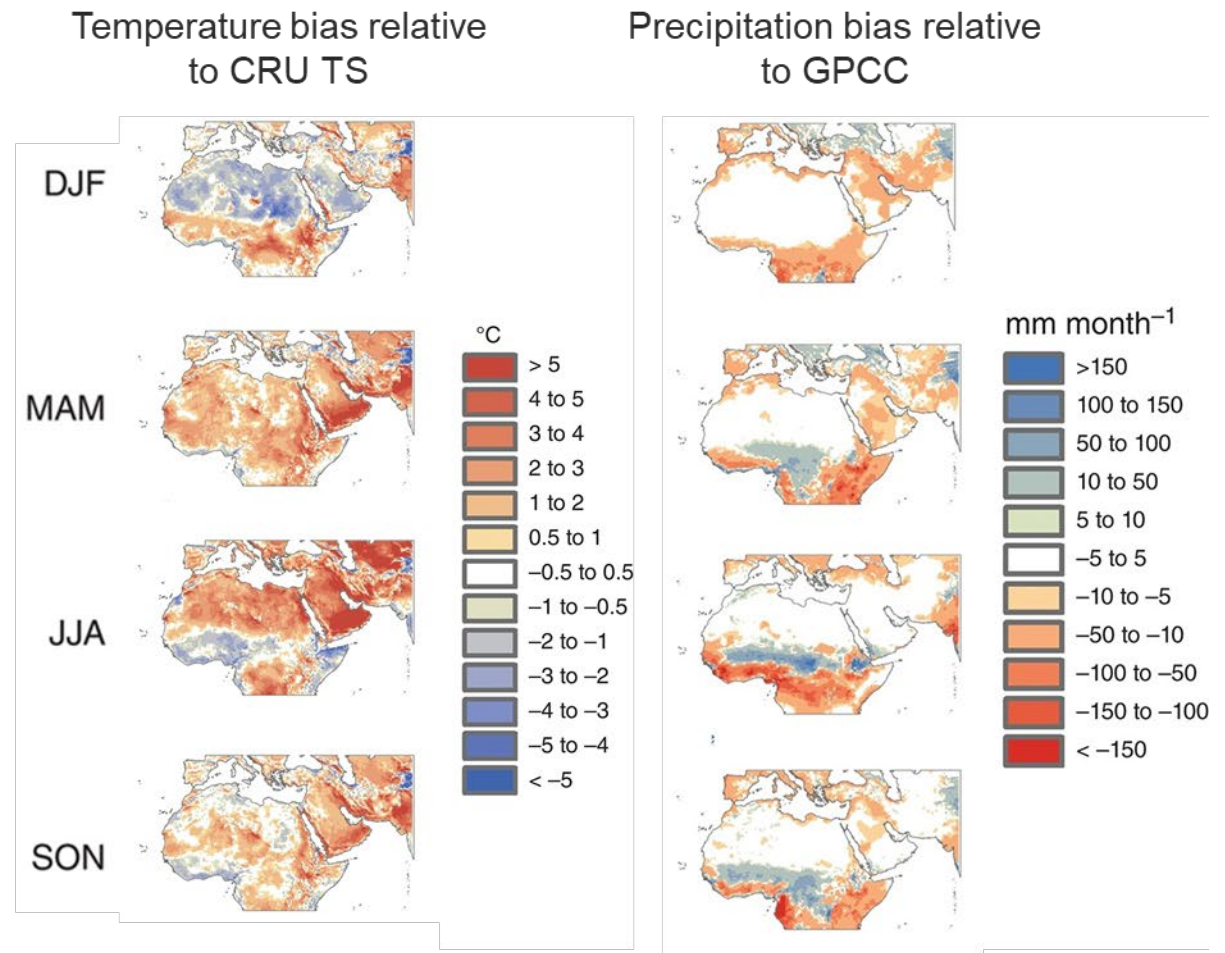
Seasonal temperature and rainfall bias evaluated over 1980–2004.
Driving GCM indicated in parentheses.



Annex Figure 3. 1: Bias in the RCA4 RCM as compared to observations. Temperature bias is calculated relative to the CRU TS dataset (Harris et al., 2020) and precipitation relative to GPCC (Schneider et al., 2014), both of which are widely used observational datasets. Biases are calculated for summer and winter (rows), and for each of the three driving GCMs (columns). Figure adapted from Graham & Sjökvist (2017).

CCLM4

Seasonal temperature and rainfall bias evaluated over 1980–2011.



Annex Figure 3. 2: Bias in the CCLM4 RCM as compared to observations. Temperature bias is calculated relative to the CRU TS dataset (Harris et al., 2020) and precipitation relative to GPCC (Schneider et al., 2014), both of which are widely used observational datasets. Biases are calculated on a seasonal basis. Figure adapted from Bucchignani et al. (2016).

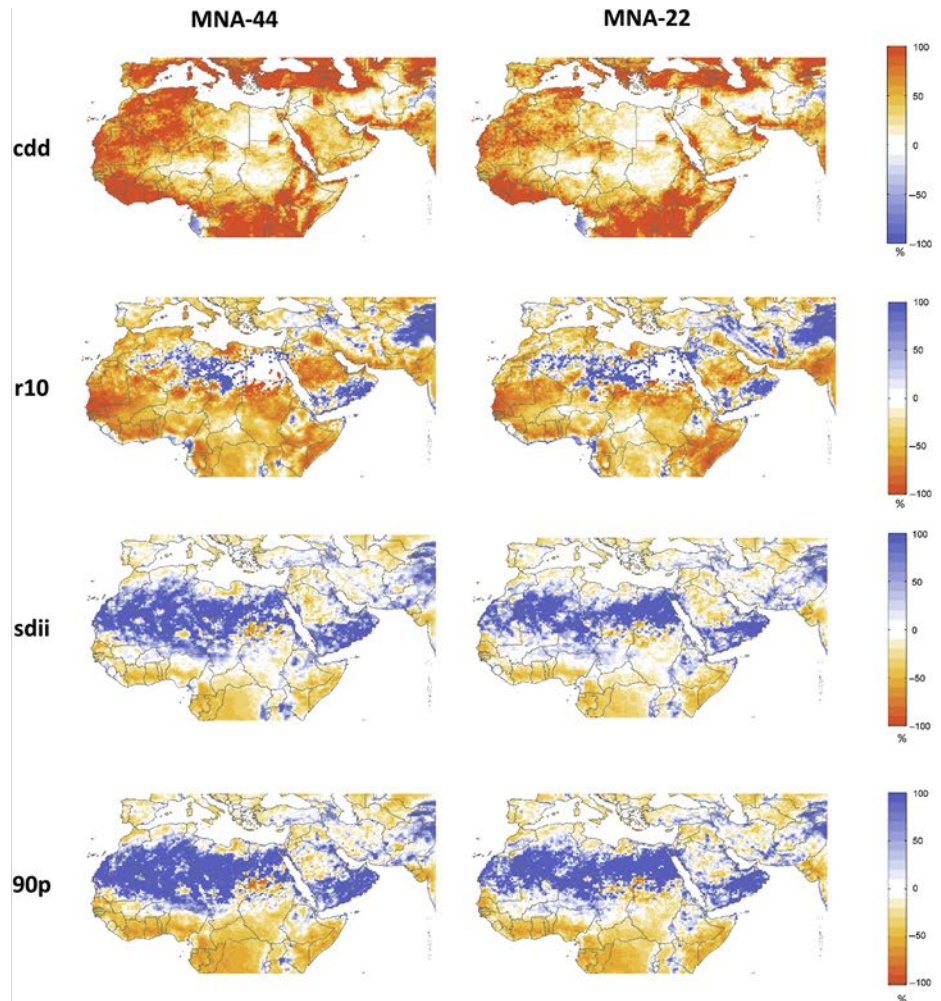
CCLM4

Bias in extreme precipitation indices evaluated at higher (MNA-44) and lower (MNA-22) resolution configurations against TRMM over 1998–2011.

- cdd = maximum number of consecutive dry days (< 1 mm) (days per year)
- r10 = number of days with precipitation ≥ 10 mm (days per year)
- sdii = mean precipitation on wet days (> 1 mm) (mm per day)
- 90p = 90th percentile of daily precipitation (mm per day)

There is small evidence to suggest that higher resolution modelling benefits the representation of precipitation extremes.

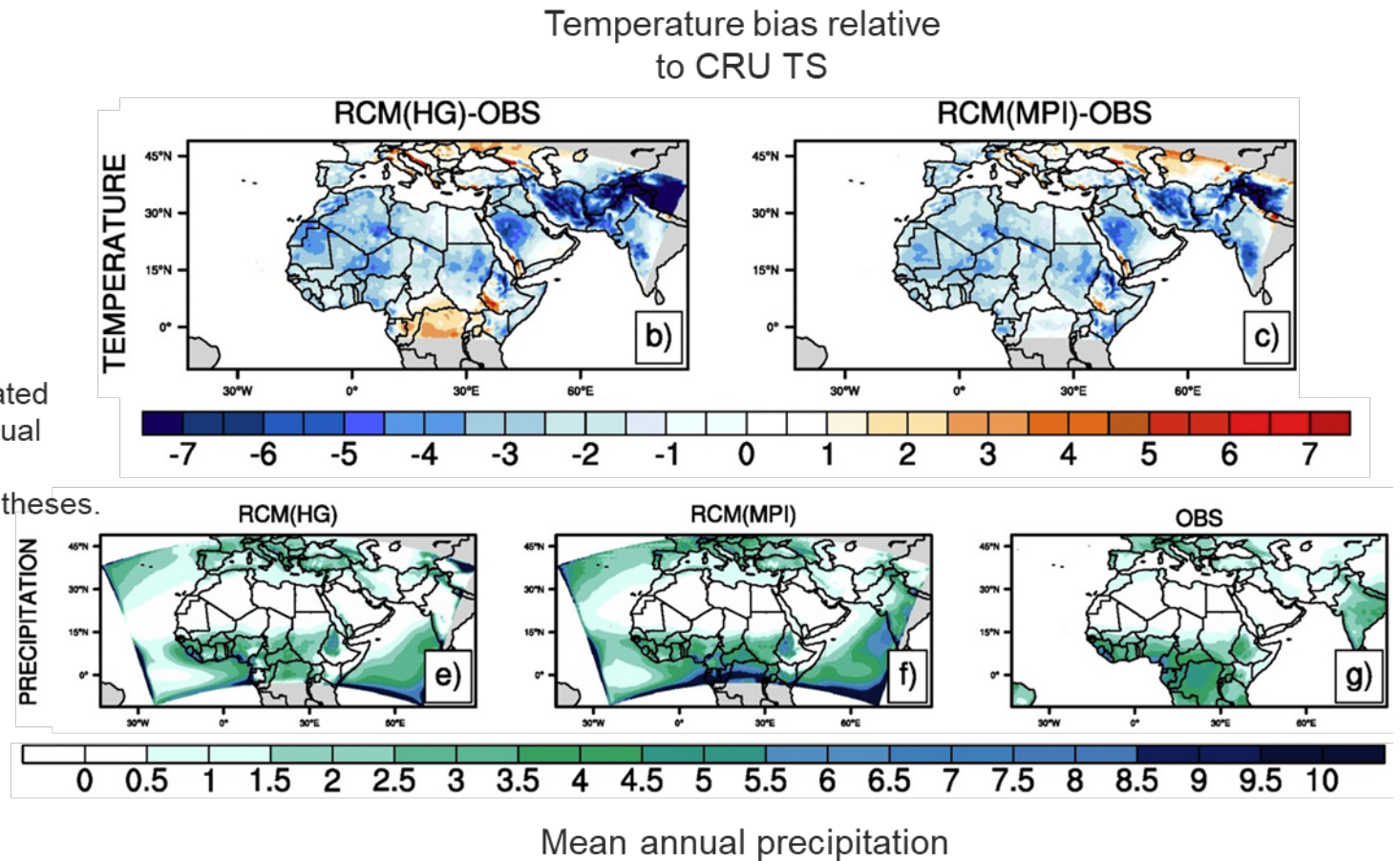
“The reproduction of extreme temperature indices is more complicated and has not been considered in the present analysis, due to the lack of a reliable daily observational dataset over MENA domain” (Bucchignani, 2018).



Annex Figure 3. 3: Bias in the representation of precipitation extremes in CCLM4 RCM as compared to observations. Bias is calculated relative to the TRMM satellite observational dataset (Huffman et al., 2007), which is used here because extreme rainfall data is not well captured in the MENA region by datasets reliant on weather station data, such as CRU TS and GPCC; this is because weather station data is relatively sparse in MENA. Figure adapted from Bucchignani et al. (2018).

Reg-CM4

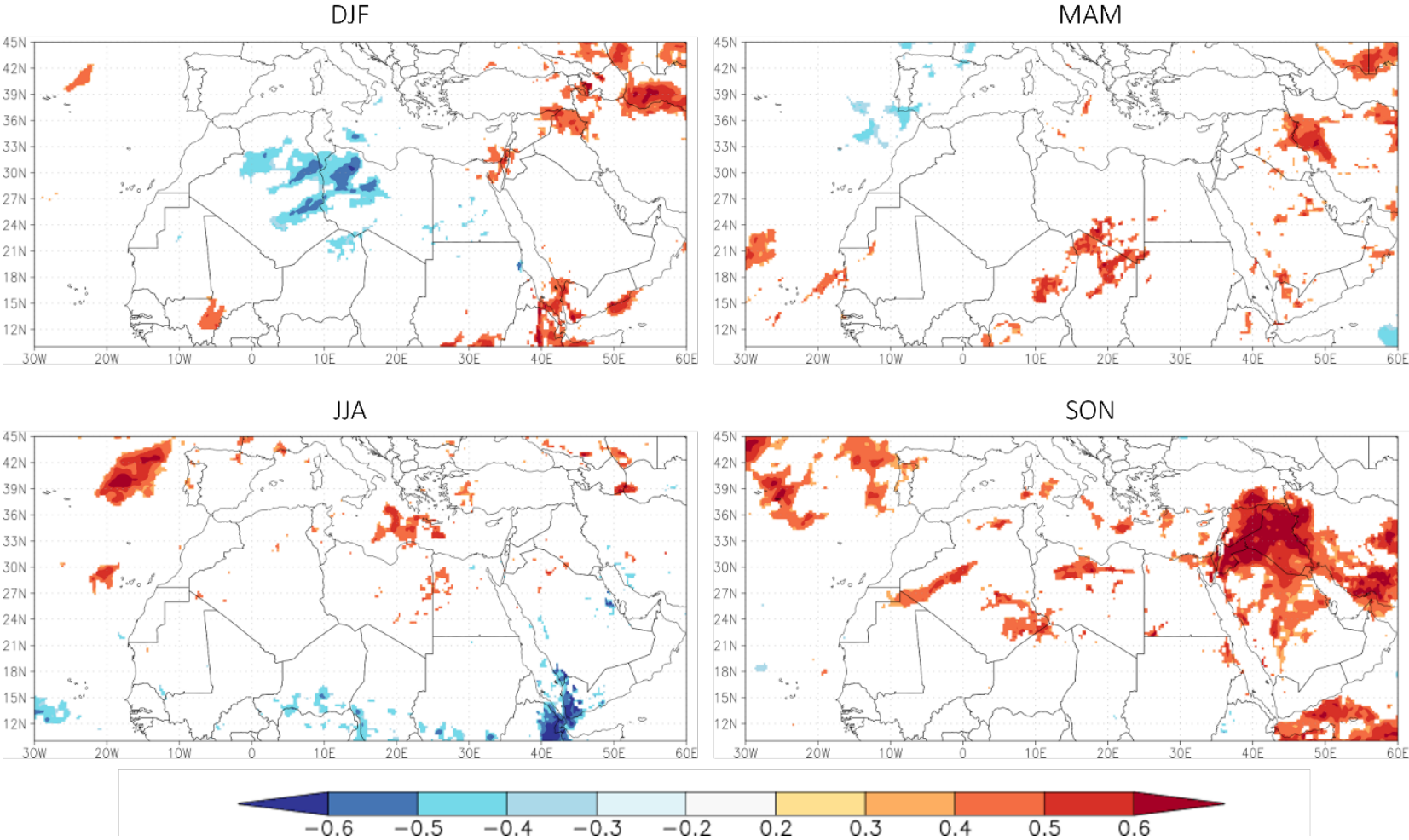
Annual temperature bias evaluated over 1980–2000 and mean annual precipitation for 1970–2000. Driving GCM indicated in parentheses.



Annex Figure 3. 4: Annual bias in the Reg-CM4 RCM as compared to observations. Temperature bias is calculated relative to the CRU TS dataset (Harris et al., 2020), which is a widely used observational dataset. Precipitation is simply plotted against the CRU TS dataset for qualitative evaluation. Figure adapted from Ozturk et al. (2018).

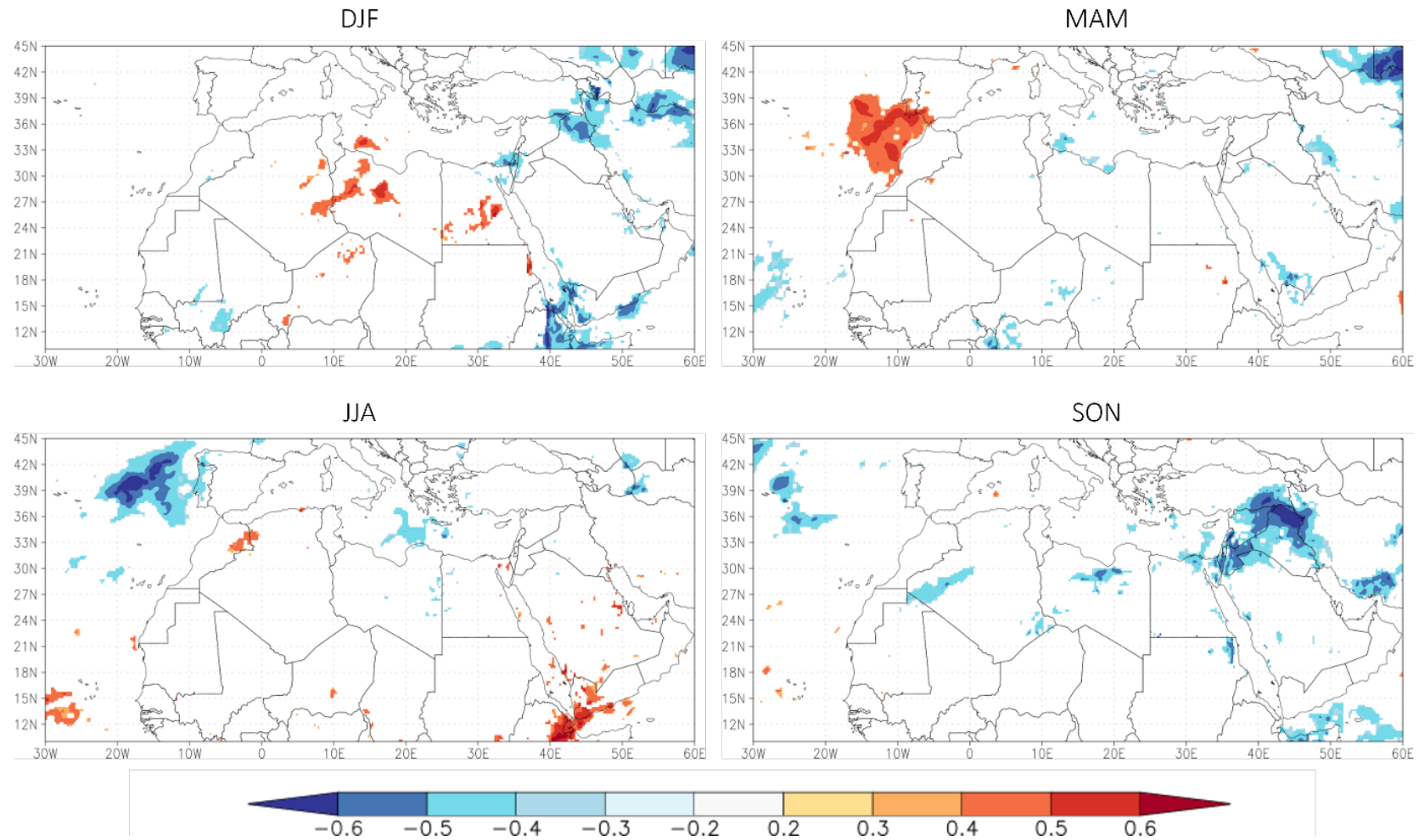
Annex 4

Detrended ENSO–precipitation correlations (p -value < 0.05) for 1991–2020



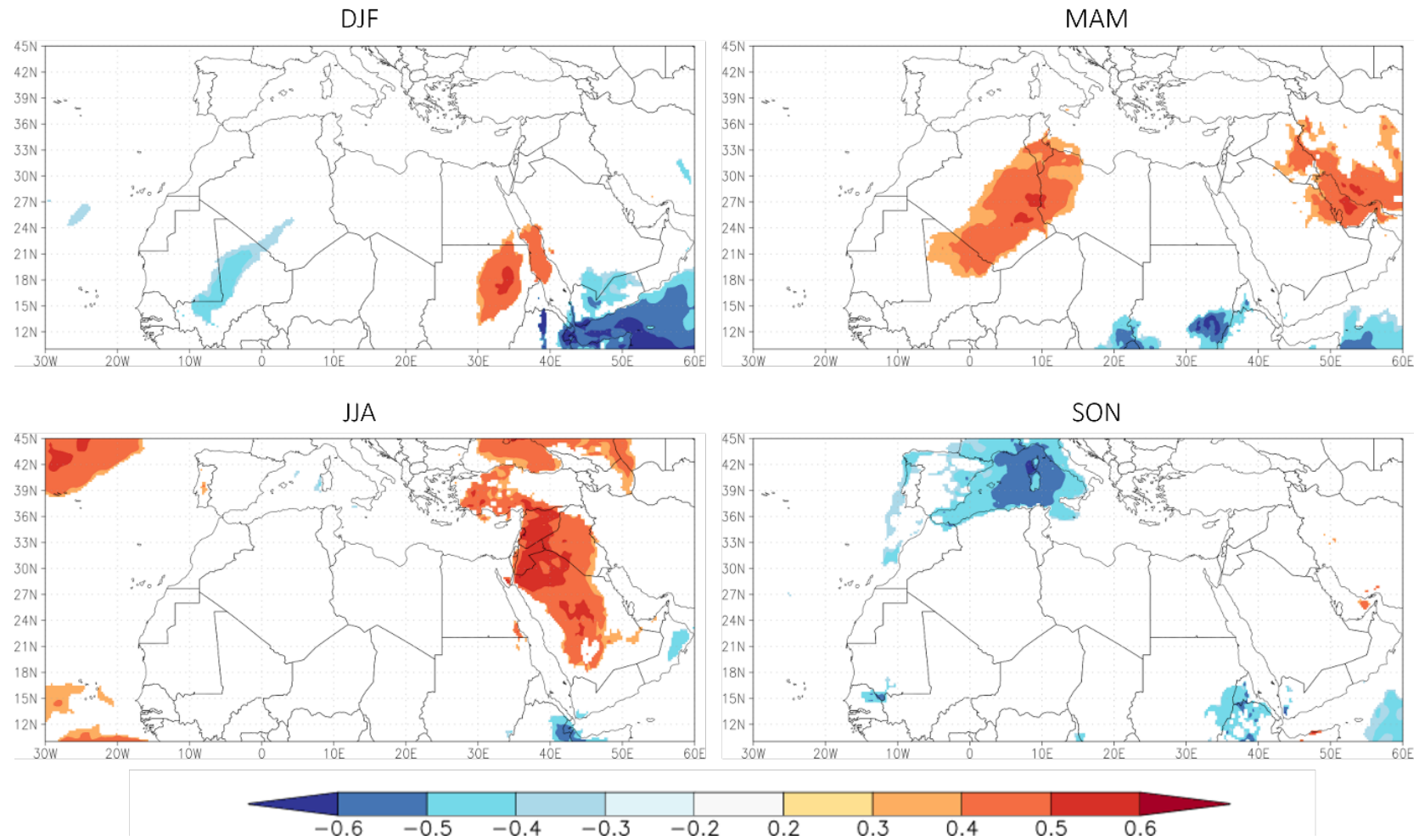
Annex Figure 4. 1

Detrended IOD–precipitation correlations (p -value < 0.05) for 1991–2020



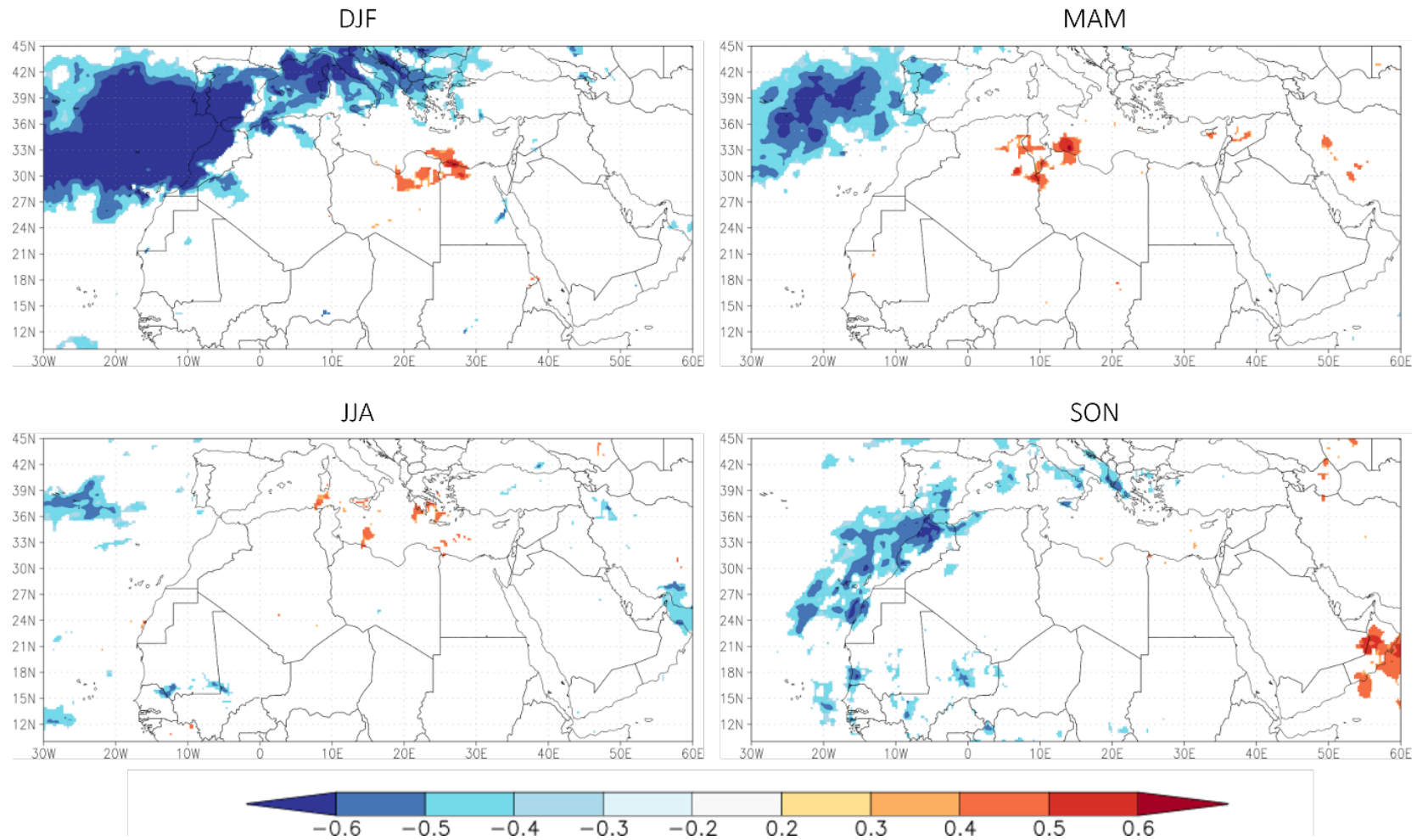
Annex Figure 4. 2

Detrended IOD–temperature correlations (p -value < 0.05) for 1991–2020



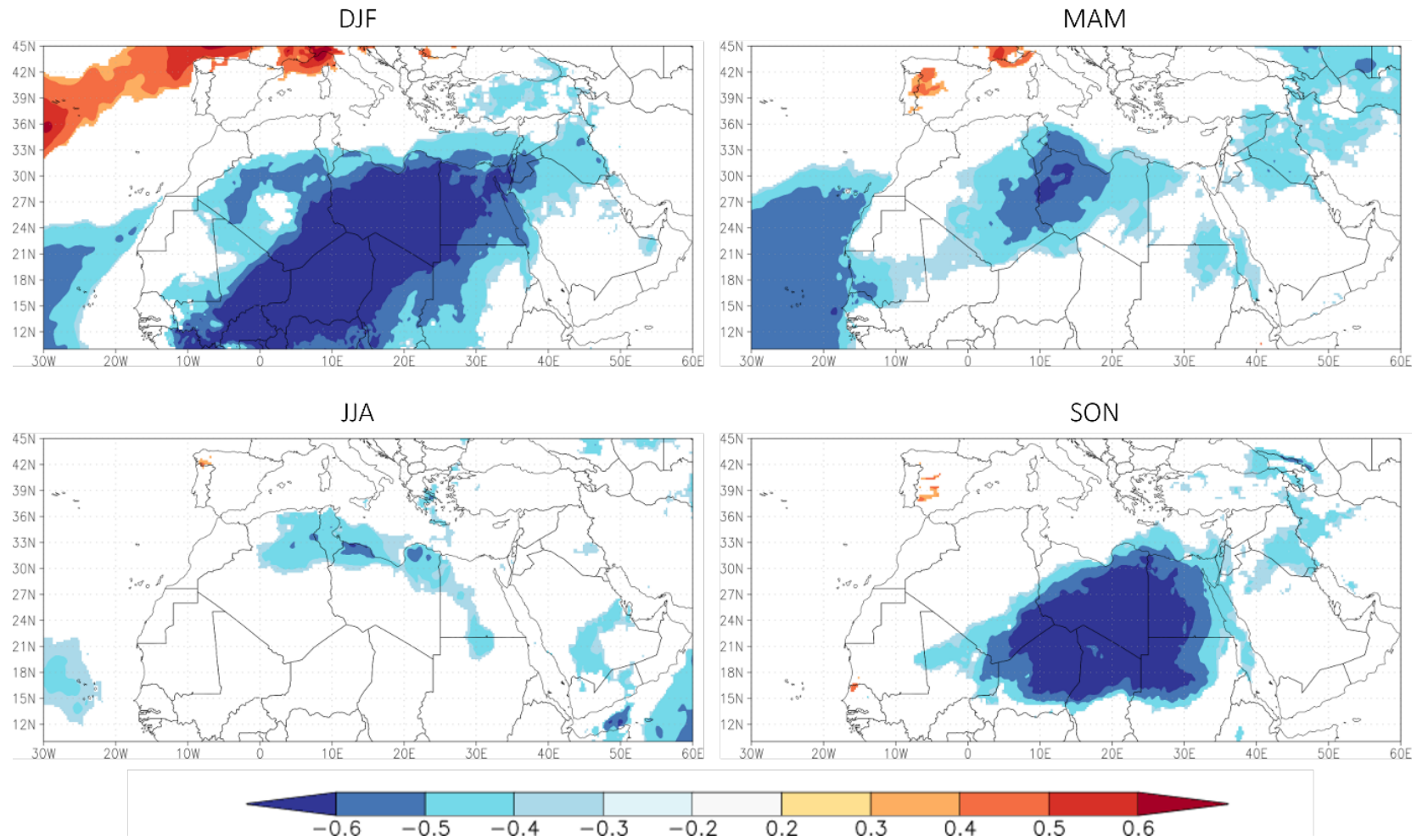
Annex Figure 4. 3

Detrended NAO–precipitation correlations (p -value < 0.05) for 1991–2020



Annex Figure 4. 4

Detrended NAO–temperature correlations (p -value < 0.05) for 1991–2020



Annex Figure 4. 5

Annex 5: Current MENA Weather and Climate Initiatives/Programmes

Sector	Key projects, programmes, policy in Palestine that use (or express intent to use) WCS
Agriculture/ Food Security	<p>The National Strategy, Action Programme and Integrated Financing Strategy to Combat Desertification. Mentions the establishment of desertification and drought data base and monitoring system as one of the proposed projects with one of the activities to harmonize and integrate with other national and sectoral databases, providers and users' needs and requirements.</p> <ul style="list-style-type: none"> • The National Agricultural Sector Strategy (2017-2022) titled 'Resilience and Sustainable Development' mentions that a monitoring report on weather information and rain as well as periodic reports on early warning in relation to weather and climate change are outputs of the first programme policy statement. Under the second strategic objective of the strategy taking measures and arrangements to adapt with or avoid negative impact of climate change and natural hazards, particularly high temperatures and fluctuating precipitation or declining rainwater is one of the priorities. • The Palestinian Disaster Risk Reduction and Insurance Fund (PADRIF) project 'Building the Palestinian Agricultural Insurance Systems and Services' prioritises using organised information and functional databases on agricultural risk environment including data on climate as one of the outputs/indicators of achievement. For the development of drought early warning systems, several studies were conducted, and many components are in place at the MoA. • Rainwater Harvesting Analysis using water Harvesting Evaluation Tool - WHEAT- (by National Academy of Sciences – NAS) This project started in 2017, further research need to understanding potential collaboration opportunities.
DRR	<ul style="list-style-type: none"> • With the support from the Danish Red Cross and the Climate Centre a FbF feasibility study was conducted in April 2022, the priority hazard to develop an Early Action Protocol is Winter Storms and associated hazards (floods, snow, cold), however it is highly recommended to further research the possibility of an EAP for heatwaves, given the high likelihood of humanitarian impacts. A potential FbF project is likely to be supported by the ECHO Pilot Programmatic Partnership (PPP) initiative or any other partners national society in country with support from the IFRC. The feasibility study also concluded that there is potential for a wider anticipatory action system in collaboration with other UN agencies, NGOs and Government Authorities, there is a lot of interest in co-production of Impact based Forecasting services. • Palestinian RC (PRCS) receives forecasts from the National Meteorological and Hydrological Service(s) (NMHS), mainly hazardous forecasts and disseminates the information through their social media accounts. In addition, PRCS plans and implements DREF operations which rely on weather information (usually immediate), the most recent of which is DREF OPERATION/MDRPS013 - Palestine - Extreme Weather 2022. • Palestine Centre for Disaster Risk Management (PaIDRM) is a relatively new government institution tasked with coordination of DRM efforts in the OPT. Currently there is limited operational capacity due to funding and technical capacity limitations, but plans are

	<p>underway for PalDRM to expand their role in risk information coordination. PalDRM together with Al Najah are developing a multi-hazard risk assessment (mainly focusing on exposure).</p> <ul style="list-style-type: none"> • Flood hazard mapping using a multi-criteria decision analysis and GIS (case study Gaza Governorate, Palestine) UN-OCHA and WASH Cluster. • Modelling of rainfall–runoff events using HEC-HMS model in southern catchments of Jerusalem Desert-Palestine which used rainfall data.
Water	<ul style="list-style-type: none"> • The Water Scarcity Taskforce was formed to improve coordination among actors and was active after the 2010-2011 drought. Even though it is water scarcity taskforce its response was intersectoral to address impacts of agriculture and livelihoods as well. • Development of high-resolution hydro climate model through the projects fostering cooperation on water management between Palestinian, Jordanian and Israeli water authorities funded by EU and implemented by UNDP. • GLOWA Jordan River Project has the aim of providing simulation tools and instruments in order to develop and realise strategies for sustainable water management.
Energy	<ul style="list-style-type: none"> • National master plan for developing renewable energy resources and increasing energy efficiency. Developed by The Palestinian Energy and Environment Research Centre, PEC, uses solar irradiance available from Palestinian Authority central metrological department in Ramallah and Jericho metrological station as well as other meteorological data such as temperature, humidity, wind.

Multi-sectoral	<ul style="list-style-type: none"> • National Climate Change Adaptation Strategy and National Adaptation Plan (NAP) to Climate Change. The NAP was developed with a participatory approach in consultation with stakeholders and as such reflects the views of those throughout. With regards to climate information needs for planning there was wide agreement among consulted stakeholders that: <ul style="list-style-type: none"> ○ Long-term (10-50 years) climate change information is needed for strategic policy and planning purposes ○ Medium-term (6-9 months) information on climate variability is needed for planning and operational purposes ○ Short-term (0-10 days) weather data is needed for operational ends (e.g., flood warnings). <p>There was also general agreement that the information needs for climate risk management include: the availability of climate information, assessments of climate vulnerability, open adaptation decision-making, and information on integrating adaptation into economic or social development.</p>
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Annex Table 5. 1

Sector	Key projects, programmes, policy in Yemen that use (or express intent to use) WCS
Agriculture	<ul style="list-style-type: none"> • FSSRP - Food Security Response and Resilience Project in Yemen. <p>This project aims to provide emergency financial support to improve the availability of food across Yemen, develop the country's agricultural and environmental infrastructure, and have a lasting impact on food security resilience across Yemen. The project will broadly work within the ten governorates of Abyan, Al Bayda, Al Dhale'e, Al Hudaydah, Al Jawf, Amran, Dhamar, Hajjah, Lahj, and Taiz. One of the components of the project is <i>Capacity building for food security management and climate resilience</i>. It includes establishing a satellite-based Earth Observation (EO) crop and pasture monitoring and EWS for detecting climate-induced hazards (WFP, 2022). This entails designing and deploying a satellite remote sensing and GIS tool to monitor agricultural production activities and enable informed decision-making for food import planning. This EO tool would support monitoring agricultural production, providing information to the Government of Yemen for decision-making regarding food imports planning. The data generated by the EO tool will also feed into the FSPP implementation. FAO, through Strengthening Food Security Information and Early Warning Systems Project, has launched an initiative to establish an Early Warning System in collaboration with government authorities. The programme has invested heavily to boost its monitoring network through rehabilitation of 41 weather stations and installation of 8 new Automatic weather stations (AWS) and one marine station in selected locations throughout the country to ensure availability of near real time data in support of early warning for early</p>

	<p>action. The project aimed at Improving Food Security and Nutrition Governance for decision making at national and Governorate levels, and future plans include systematization and expansion of the scope of the current Early Warning System to include food and nutrition security to ensure generation of holistic information utilizing socio—economic factors. The targeted end users are farmers and fisherman (World Bank, 2021) .</p> <p>Others:</p> <ul style="list-style-type: none"> Yemen Desert Locust Monitoring and Control Centre (DLMCC) of the Ministry of Agriculture and Irrigation
DRM/AA	<ul style="list-style-type: none"> Cholera Anticipatory Action In 2016, the UKMO in partnership with UNICEF and other actors, started a Cholera Anticipatory Action initiative, the UK provides rainfall information to users in Yemen on a weekly basis. This includes a 7-day hindcast, a 7-day forecast, a 4-week forward outlook, and a summary highlighting high impact weather. It also includes maps showing the spatial distribution of rainfall and tables giving forecast rainfall, by category, for specific locations around the country. Cholera monitoring and response is coordinated in Yemen by an Emergency Operation Centre which prepares a table of the administrative districts most affected by cholera. Yemen Red crescent Forecast-based Financing Feasibility Study and Climate Smart Programing. In the framework of the ECHO funded Pilot Programmatic Partnership PPP, the IFRC and Climate Centre supported the Yemen Red Cross Society YRCS to conduct a FbF feasibility study in March –April 2022. A cholera related Early Action protocol has been recommended as part of the efforts from the UKMO and UNICEF to advance Cholera Anticipatory Action. A cyclone EAP is also highly recommend given the high humanitarian impacts, in addition to the ECHO PPP potential, the 510 (NL Red Cross) also aim to support a future EAP. There is high appetite for co-production of Impact based Forecasting services. Under the ECHO PPP new programme, Climate Smart Programming is also likely to be supported, this would require long term climate projections and impacts support. Crisis Modifiers for Early Action In 2014, Save the Children UK ran a pilot early warning system in Yemen to distribute cash assistance ahead of conflict escalation. The program was built using social triggers through a Household Economy Approach (HEA) instead of meteorological data. The Yemen pilot project used the Situation and Response Analysis Framework (SRAF), which outlines a process through which forecasts, local knowledge, coordination and communication can help actors predict, prepare and deliver responses in an appropriate and efficient manner.

Annex Table 5. 2

Sector	Key projects, programmes, policy in Iraq that use (or express intent to use) WCS
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<p>Agriculture</p>	<ul style="list-style-type: none"> • BRAC - Building Resilience of the Agriculture Sector to Climate Change in Iraq (Adaptation Fund project). This project aims to strengthen the agro-ecological and social resilience to climate change in the four target governorates (Muthanna, Qadisiya, Missan and Thi Qar), by enhancing water availability and use efficiency, and promoting adaptive agriculture production systems and technologies for improved livelihoods and food security of rural households. The project is designed to deal with one of the major constraints in the country that centres around the growing scarcity of irrigation water and to assist the country with strengthening its capacity at the national level for monitoring climate change patterns and providing relevant information to key stakeholders and farmers to enable them to undertake adaptation and risk mitigation measures through an early warning system. Implemented by the International Fund for Agricultural Development (IFAD), the project consists of two components: 1) Capacity development to integrate CC adaptation and risk reduction into agriculture planning and production systems Component, 2) Climate-resilient agriculture investments (Adaptation Fund, n.d.). • Promoting Climate Resilient Livelihoods for Food Insecure People in Southern Iraq (Green Climate Fund project). One of the expected outcomes of this project is “Strengthened technical and institutional capacity in the targeted governorates to support climate-resilient agricultural development and integration of climate risks in regional and local plans” where smallholder farmers receive weather information and obtain training and advice on response to climate change and variability. A key output is enhanced climate risk management through improved decision support tools and services
<p>DRR/M</p>	<ul style="list-style-type: none"> • National Adaptation Plan. The process for climate change resilience (three-year project in collaboration with the Government of Iraq and UN Environment Programme, funded by the Green Climate Fund): A key aspect of Iraq's NAP process is to identify, assess and bridge existing gaps in climate knowledge, as these gaps constitute barriers to long-term climate planning across local, regional and national planning processes (Reliefweb, 2020). • Iraq Red Crescent Society receives forecasts from the NMHS (medium-range and hazardous weather forecasting) – they conduct EW using social media networks. • Oxfam undertakes emergency response to drought especially with farmers in Diyala region. • Integrated drought risk management – DRM: national framework for Iraq. This report prepared by the UNESCO Iraq Office is an attempt to facilitate the development of a National Framework for Drought Risk Management in Iraq by assessing the status of sector knowledge, the availability of data and scientific evidence, and the given and predicted vulnerabilities of Iraq towards the occurrence of drought, in the context of its physiographic and socio-economic dimensions (UNESCO, 2014). • Workshop on Disaster Risk Reduction Standard Operating Procedures Crucial to Address Vulnerability in Iraq (January 29-30, 2022). Funded by the EU and implemented by International Organization for Migration (IOM), this workshop was aimed at senior government stakeholders from Baghdad and Erbil, to support their work developing standard operating procedures for crisis preparedness and response

	(UNESCO, 2014).
Water	Strengthened Delivery of Climate Resilient Services and Water Security including in humanitarian situations. This project contributes to Environmental Sustainability, Sanitation, Sanitation (Covid), Water, Water (Covid). UNICEF aims to achieve this through advocacy and public engagement, systems strengthening and institution building. This contributes to the following Country Programme result: By 2024, children, adolescents and their families, especially the most vulnerable, have improved access to sustainable, equitable and safely managed water, sanitation and hygiene services including in most vulnerable communities (FCDO, n.d.1). (Start: 2020-01-01, End: 2024-12-31, Partners: UNICEF)
Multi-sectoral	<ul style="list-style-type: none"> • Promoting Catalytic Climate Action in Iraq - National Determined Contribution, Energy, Water and Drought Management. This programme seeks to catalyse climate action in Iraq by supporting activities to increase climate ambition. Iraq ratified the Paris Agreement on January 14, 2021. In October 2021, the Government of Iraq (GoI) signed their first National Determined Contribution (NDC), which will be presented at COP26. The GoI has asked for support to deliver climate mitigation and adaptation objectives. This programme will support the GOI transition to a low-carbon and climate-resilient economy. Iraq is highly dependent on oil, accounting for 90% of revenue and 37% of GDP. Iraq is exposed to declining oil demand and climate impacts, including water shortages, desertification and emissions, compounded by rapid population growth (FCDO, n.d.2). (Start: 2022-01-16, End: 2025-03-31, Partners: FCDO). • Iraq Crisis Response and Resilience. Iraq Crisis Response and Resilience is a programme that supports crisis response and helps to strengthen resilience in Iraq (FCDO, n.d.3). (Start: 2014-10-14, End: 2021-12-31, Partners: UNDP, Green Climate Fund) • Integrated Drought Risk Management- DRM National Framework for Iraq. Developed by UNESCO, recommends the Development of the current meteorological system to include an early warning system as well as a more efficient and accurate collection and classification of meteorological information based on an Automated Telemetric Meteorological Observation System (ATMOS).

Annex Table 5. 3

Sector	Key projects, programmes, policy in Syria that use (or express intent to use) WCS
Agriculture	<ul style="list-style-type: none"> • FAO-GCF capacity building programme on climate resilience. This two-year (2019-2021) capacity building programme funded by FAO and the Green Climate Fund (GCF) aimed at making Syria ready to implement projects to adapt to and mitigate climate change in several sectors, mainly agriculture, natural resources, environmental and energy sectors. The programme has involved all relevant stakeholders, under the umbrella of the Ministry of Local Administration and Environment (MoLAE). The programme achieved three specific milestones, including engagement with GCF; the implementation of a well-structured and well-equipped NDA; and the development of the first two project concept notes that would meet GCF investment criteria (FAO, 2021). The first focuses on strengthening resilience to climate change through an early warning system linked to the agriculture-water-energy nexus. One of the outputs of the project was the national climate document where EWS was identified as a top priority. • Agriculture and Food Security Monitoring System (AFSMS). AFSMS, a FAO-Syria system, regularly collects agricultural and food security information, including on crop, livestock, pasture condition, water supply and food security from randomly selected sub-districts and communities. This information is published in the form of bi-monthly bulletins through the Food Security Cluster (FSC). However, there is no dissemination of the information and warnings provided in these bulletins. There are ongoing plans that consider the need for improving and modernizing communication/dissemination using social media to reach the farmers living in remote areas with additional training on how to get support and use the EW messages. (Note that FSC is a global initiative co-led by FAO and WFP to coordinate the food security response during a humanitarian crisis, addressing issues of food availability, access and utilization.) • Impact Analysis of a Food Security and Resilience Program in Syria. This FAO project (2018-2019) was aimed at studying the micro-level mechanisms linking food insecurity and resilience with violent conflict and climate shocks in the context of Syria, assess the causal, short-term impacts of the Syrian FAO program, and derive policy implications for targeting and modalities for interventions in emergency settings affected by extreme violence (ISDC, n.d.). <p>Others:</p> <ul style="list-style-type: none"> • Capacity building in drought early warning system for the Syrian rangelands (TCP/SYR/003/ITA) • Monitoring and combating desertification in Jabal Al-Bishri - Syrian Badia • SNARZ project/program for estimating crop yields from satellite images • National Programme for Food Security in the Syrian Arab Republic • Producing bioclimatic maps to estimate areas suitable for crops
Disaster Risk	<ul style="list-style-type: none"> • Syria-Forests and Fire Monitoring Platform (FIRMO). <p>The General Organization for Remote Sensing (GORS), of the Ministry of Communications and Technology, has established a special platform for</p>

Reduction / Management	<p>forests and fire monitoring in Syria "FIRMO". FIRMO uses WCS information as a primary input to determine the "Fire Severity Index". The latter depends on the climatic factors affecting the speed of the spread of fires such as temperature, wind speed and relative humidity. Combining climatic data with other factors, through mathematical methodologies and models, FIRMO stores, processes and provides information about forest fires. The platform produces fire risk maps and reports in a periodic manner to raise awareness and help with anticipatory action and early response. These reports are provided to the forestry departments, the ministries of agriculture and agrarian reform, the local administration, the environment and the Presidency of the cabinet Ministers, as well to the public via a Facebook page. FIRMO is only active in the governorates of Latakia, Tartous, Hama and Homs as a first stage. The platform's coverage is due to be expanded to include all Syrian forests.</p> <ul style="list-style-type: none"> • REACH-IDP Camps and Informal Sites Flood Susceptibility and Flood Hazard Assessment in Northern DANA district-Idlib-Syria. <p>In Syria, REACH teams have been leading flood hazard mapping efforts destined to help IDP in Northwest Syria build their resilience to future shocks. This project has the potential to inform a more targeted and informed response to the current shocks created by the floods in Northwest Syria. To leverage such a tool is key for supporting IDPs who are among the most vulnerable to the impacts of natural hazards. With the current COVID-19 outbreak, and the recent floods in Northwest Syria, degrading conditions in IDP camps and settlements are of particular concern, especially during winter. Simulating flood-like conditions in the northern Syrian context by feeding data into a hydraulic modelling software, REACH teams were able to evaluate locations within the area that were most exposed to severe flood hazards, and also identify which infrastructure and settlements were most vulnerable. Results from the hydraulic modelling exercise revealed that during modelled extreme rainfall events, nearly 2,500 IDP shelters within the study area are exposed to a significant flood hazard. However, due to the lack of weather and climatic data in the study area, the simplified modelling approach gives a "big picture" perspective of the flooding and not a precise flood depths and extents. The presented results should be considered as estimates.</p> <p>Others:</p> <ul style="list-style-type: none"> • Syrian Arab Red Crescent (SARC) preparedness plans • Activation of the Civil Defence Department centralized National Plan • REACH Flooding Susceptibility and Preparedness Survey (FSPS) • The national drought strategy in collaboration with UNCCD
Water	<ul style="list-style-type: none"> • Development of a drought Early Warning System in Syria. The Syria Drought Response Plan 2009 aimed to address emergency needs and to prevent further impact on the 300 000 people most affected by protracted drought. One of the Plan's objectives was to develop, using WCS, a national Early Warning System (EWS) for drought with emphasis on the rangelands and marginal areas. Activities included improving and implementing procedures for data collection, processing, analysis and dissemination, training at institutional and community levels, and

	<p>establishing procedures, manuals and networks of dedicated government officers and community representatives. The main end-users/beneficiaries of this EWS are: Rainfed farmers, herders and Government staff. However, due to the outbreak of conflict in Syria the status of the outputs of this plan are not clear. In 2017, there was a study conducted to understand how to build capacity (strengths/weaknesses) with the ultimate aim of restoring and developing the drought EWS so as to include other hazards (floods, frost, forest fires, etc.). The technical coordination work around this ambition is ongoing, and the targeted project will officially start in September 2022 with an expected duration of 1.5-2 years</p> <ul style="list-style-type: none"> • Increasing the Climate Change Resilience of Communities in Eastern Ghouta in Rural Damascus to Water Scarcity Challenges through Integrated Natural Resource Management and Immediate Adaptation Interventions. This project funded by the Adaptation Fund and will be implemented by UN-HABITAT, UNDP, and FAO, in cooperation with the Ministry of Local Administration and Environment. The project will address climate change in the Syrian Arab Republic manifesting itself through various weather-related phenomena across different regions, particularly increasing temperatures and droughts in the short term and projected reduction of precipitation in the long term. The 3.5-years project targets Eastern Ghouta as one of the most populated agricultural areas in Syria and vulnerable to climate change and water scarcity. Targeting the municipalities of Al Mleiha, Zebdine, Deir El Assafir and Marj El Sultan in Rural Damascus, the project aims to strengthen the capacities of national and sub-national government institutions and communities to assess, plan and manage climate change-induced and post-crises water and land challenges in an efficient, sustainable and climate resilient way (Reliefweb, 2021).
Health	<ul style="list-style-type: none"> • Early Warning, Alert and Response System (EWARS)
Academia	<p>Others include:</p> <ul style="list-style-type: none"> • Hydrological climate change impact analysis for the Figei spring near Damascus, Syria • Assessment of future Syrian water resources supply and demand by the WEAP model • Using remote sensing and GIS technologies to map forest fire danger in Latakia governorate (Syria) • Evaluation of flood simulation for Zeyzoun dam-break in Syria using HEC-RAS model
Multi-Sectoral	<ul style="list-style-type: none"> • National drought management policy • Dust storm monitoring • Project to estimate the wind erosion of the soil

Annex Table 5. 4

Sector	Key projects, programmes, policy in Egypt that use (or express intent to use) WCS
Agriculture/Food Security	<ul style="list-style-type: none"> HudHud mobile application. Hudhud is an application offered by the Ministry of Agriculture (joint project with Ministries of Water and IT) has many components, some have to do with climate predictions for farmers. The information is fed by the climate change centre belonging to Central Laboratory for Agricultural Climate under the Ministry of Agriculture. Launched in December 2021, Hudhud is a smart assistant project for farmers, an Arabic mobile application that relies on artificial intelligence techniques to provide guidance to farmers on several topics in the agriculture process. When the farmer discovers any type of infection in crops, s/he can take a photo of the infected plant using his smartphone and send it to Hudhud to identify through artificial intelligence the disease and it will provide the farmer with the necessary instructions to stop infection. Hudhud is an Arabic mobile application that capitalises on Artificial Intelligence (AI) to create more effective communication with farmers through providing digital guidance on topics of interest to farmers and smallholders, facilitating their access to advice and proper guidance (Farmers Review Africa, 2021).
DRM	<ul style="list-style-type: none"> Nile Basin Initiative Flood and Drought Monitoring System. There are three components of the system: 1) Nile Flood Forecast and Early Warning System, 2) Nile Drought Forecast and Early Warning System, and 3) Nile River Flow Forecasting System. In the Eastern Nile basin, during the rainy season flood levels and rainfall conditions are monitored daily in the flood prone areas. Rainfall is monitored at meteorological stations and validated against satellite-based earth observations. In addition, flows and water levels are monitored at hydrological stations. These regular monitoring activities support validation and quality control of flood forecasts produced with the Eastern Nile Flood Forecast and Early Warning System (EN-FFEWS). Flood forecasts are carried out for Lake Tana Blue Nile Baro-Akobo-Sobat (BAS) Tekeze-Setit-Atbara (TSA) sub-basins. The forecasts use rainfall forecasts from the Weather Research and Forecasting (WRF) model as the input. WRF is a regional customization with input from NCEP's (National Centers for Environmental Prediction) Global Forecast System (GFS). On this basis, peak runoff and peak floodwater levels are simulated with hydrological and hydrodynamic models. The forecast results are managed with MIKE Operations, a flood forecasting system with customized solutions for data integration, analysis of forecasts, results visualizations and dissemination of flood warnings. The three days lead-time forecast results are disseminated using The Eastern Nile web page, as well as SMS and e-mail to different users and concerned stakeholders, such as communities, local and national flood communities and humanitarian organizations among others (Nile Basin Initiative, n.d.). There is also a Facebook page (https://www.facebook.com/nfc.mwri) where news items with predictions and maps about rainfall forecasts and flooding are posted. FlaFloM – An Early Warning System for Flash Floods in Egypt. The Flash Flood Manager project (FlaFloM) is aimed at developing an EWS

	<p>for forecasting flash floods in the Wadi Watier catchment, located in the Sinai Peninsula. Forecasts have a lead time of up to 48 hours. The system is currently in an operational testing phase. The project FlaFloM was co-funded by the European Commission under the LIFE Third Countries Fund (project number LIFE/TCY/ET/000232) in 2007- 2009 (Vanderkimpen et al., 2010).</p> <ul style="list-style-type: none"> • National Strategy for Disaster Risk Reduction 2030. The Egyptian National Platform for DRR has developed a roadmap that aims to provide guidance and highlight a number of areas of focus to implement the Sendai Framework emerging from the review of HFA implementation. In this context, the Egyptian National Platform for DRR has completed reviewing and updating the National Strategy for DRR, taking into account the Sendai Framework's innovative elements and considerations, through incorporation of the DRM concept (Cabinet of Egypt, 2017). • Emergency response to strengthen Egypt's national capacity for early warning, monitoring and management of Fall Armyworm. The objective of this two years (2019-2021) project by the Ministry of Agriculture and Land Reclamation is to reduce the impact of Fall Armyworm spread by strengthening Fall Armyworm monitoring and building integrated management capabilities for all stakeholders (MOA, 2021).
Multi-sectoral	<ul style="list-style-type: none"> • Enhancing Climate Change Adaptation in the North Coast of Egypt. This \$31 million UNDP project contributes to efforts to cope with climate change to reduce floods in low lying coastal areas due to rising sea levels and severe weather phenomena through establishment of an early warning and monitoring system to monitor changes in climate and sea levels. It supports the development of an Integrated Coastal Zone Management Plan (ICZM) for the North Coast of Egypt that links the plan for shore protection from sea-level rise with the national development plan of the coastal zones. The ICZM plan will be associated with the establishment of a systematic observation system to monitor Oceanographic parameters changes under a changing climate as well as the impact of the different shore protection scenarios on the coastal erosion and shore stability (UNDP, n.d.).

Annex Table 5. 5

Sector	Key projects, programmes, policy in Morocco that use (or express intent to use) WCS
Agriculture	<ul style="list-style-type: none"> • Online countrywide satellite-based drought maps. The Ministry of Agriculture, Fisheries, Rural Development, Water, and Forests (MAFRWF) in Morocco has published countrywide satellite-based drought maps online for the first time. The maps visually present satellite data on rainfall, land surface temperature, soil moisture, and vegetation health, which have been compiled into an easy-to-interpret enhanced Composite Drought Index (eCDI). By analysing the colour-coded maps and seeing how the underlying value of the eCDI changes from the start of the growing season onwards, users can detect early on if a drought is emerging – even before its effects are visible on the ground (IWMI, 2021). Furthermore, users can also download the satellite map data files and undertake their own analyses to understand the present condition and progression of drought.
DRR	<ul style="list-style-type: none"> • Forecast-based Financing /Anticipatory Action. The Moroccan Red Crescent Society is developing a FbF system to support the communities more likely to be impacted by climate risks. This process is supported by the German Red Cross and funded by the German Ministry of Foreign Affairs. The project's aim is to access the IFRC funding Mechanism FbA by Disaster Response Emergency Fund (DREF). The development of impact-based forecasting in collaboration with the General Directorate of Meteorology focuses on cold waves rather than other hazards that occur in Morocco (storms, flooding, heatwave, forest fires). This is because the country is not used to the impacts of cold waves (thus low resilience) and it is the opposite for heatwaves (i.e., the country is well adapted to the impacts of heatwaves). Also, DRM on floods is fully absorbed by the government, and there wasn't scope for engagement. A stakeholder's workshop was organized, but the participation of national stakeholders (i.e., representatives from governmental ministries) was low and limited. A MoU was established with the government in early 2022. Due to the nature of the project, there was a need for national experts with sound weather and climate data analysis/management skills, but the government was not satisfactorily responsive. This project proved that persistency is a must to establish healthy contacts with the governmental level stakeholders. It should be noted that there are not many NGOs in Morocco since there isn't ongoing humanitarian crisis/conflict. Those active NGOs are either political organizations doing civil society promotion, but none looking into disaster preparedness or anticipatory work. • Weather Watch Map. This system was developed in partnership with the Directorate of Water Research and Planning, the Monitoring and Coordination Centre (MCC) of the Ministry of the Interior and the Directorate General of Civil Protection (GDGP). It provides information on the dangerous meteorological phenomena of concern, i.e., heavy precipitation, strong winds, cold and heat waves, heavy snowfalls and high

waves. It aims to improve weather information and facilitate its dissemination and accessibility.

- **Vigilance-Maroc-Météo.** The Moroccan General Directorate of Meteorology has set up a new vigilance system at municipal level. This new system will allow the development of forecasts and alerts on even finer spatio-temporal scales, meeting the needs of decision-makers at the local level of the municipality. This system contributes effectively to the development of the early warning of phenomena at the local level, which ensures effective mobilization of resources and crisis preparedness and management, in addition to proactive decision-making to reduce the impact of extreme weather events. Produced in partnership with the Department of Natural Risk Management of the Ministry of the Interior, the General Directorate of Civil Protection (DGPC) and the General Directorate of Hydraulics, this system will be distributed and communicated through a smartphone application and on the web platforms of the General Directorate of Meteorology. It is also accompanied by a system for making forecasts available at the municipal level, sent regularly to local decision-makers by SMS. This new municipal meteorological vigilance thus makes it possible to closely monitor and follow extreme meteorological phenomena while determining the possibility of occurrence of one or more dangerous phenomena during the next 48 hours and indicating by zone (municipalities and provinces) and in four colors (green, yellow, orange, and red) the levels of weather-related risks (Vigilance Maroc Météo, n.d.).
- **Ourika valley and flood warning system in the High Atlas Mountains.** Ourika watershed is a small sub-basin (503 km²) in the high Atlas Mountains, part of Tensift catchment, South of Morocco. After the 1995 disaster, structural measures against flooding have been implemented in the Ourika basin given its importance in terms of touristic activities and flood exposure. With the assistance of the Japanese International Cooperation Agency (JICA), the Ourika Valley was provided with a Flood Prevention and Warning System (FPWS) in 2001, consisting of 5 observation stations, 2 data transmission stations, 4 monitoring posts and a warning post located at Ighref. Since 2007, the Hydraulic Basin Agency (ABH) in Tensift has also taken part in this project by financing the extension of the telemetry network to 16 sites, including 3 pluviometric and 13 pluviometric and limnometric sites. The Ourika Valley FPWS played a successful part in the detection and warning for ten floods between 2003 and 2012. During the 2014 floods, which affected Al Haouz Province, no loss of life occurred despite some property damage. In addition to providing an efficient early warning system, this project has connected local populations with emergency procedures. Now, when flooding occurs, many local volunteers are tasked with warning tourists, keeping them informed and helping them evacuate (OECD, 2017).

<p>Water</p>	<ul style="list-style-type: none"> Flood Risk Management Center. Recently, the Moroccan Ministry of Interior announced the creation of Flood Risk Management Center incorporating operational monitoring, warning, and assistance for flood management. The project is financed by the Fund to combat Effects of Natural Disasters (FLCN) that was created earlier in 2009. Initially, four pilot zones were targeted by this project for their flood history, namely Ourika valley, El Ghrab plain, Guelmim desertic area, and the coastal city of Mohammedia. A Provincial/Regional Coordination Center (PCC/RCC) will be installed in the administration representing the MI locally (Prefecture, Province or Region). The PCC/RCC will ensure coordination between the MI, the DGE, the General Directorate of Meteorology (DGM), the DRPE, the regional ABHs, and international organization partners. INDAR: An intelligent Moroccan flood prediction and early warning system. INDAR is a smart flood early warning system based on mobile technology, created by Mohamed Tabyaoui. INDAR uses algorithms to automatically assess the hydro-pluviometric status of at-risk areas. If there is an imminent risk of flooding, INDAR issues an automatic early warning 48 hours before the crisis occurs (EU Neighbours, 2019). INDAR visualizes the infrastructures at risk through 2D and 3D images. It can also generate warning bulletins and send them to authorized people.
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Annex Table 5. 6