Operational prediction within Climate Services Information System of WMO

Valentina Khan

Hydrometcentre of Russia/ North Eurasia Climate Centre

Chair of CCl/CBS IPET-RCA WMO
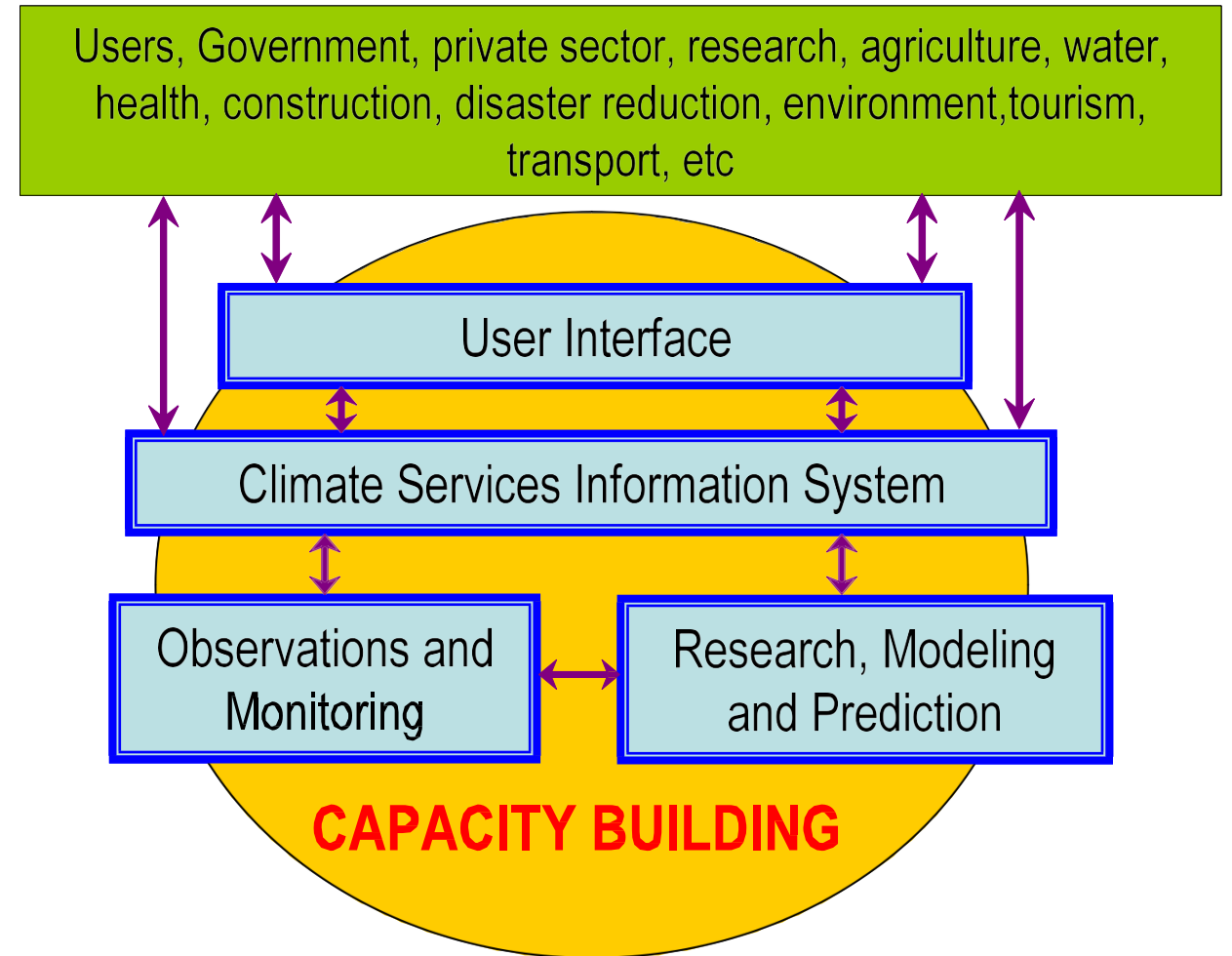
Kumar Kolli

World Meteorological Organization

International Young Scientist School

27-31 May 2019, Moscow

Global Framework for Climate Services (GFCS)

- **Society is vulnerable to the impacts of climate variability**
- **There is a growing need for understanding and obtaining reliable information about ongoing climate change and climate variability.**
- **GFCS is an inter-governmental initiative spearheaded by WMO to guide the development and application of science-based climate information and services in support of decision-making in climate sensitive sectors.**
- **GFCS contributes to reducing the vulnerability of society to climate-related hazards.**
- **The GFCS aims to maximize the benefits of using the existing climate service infrastructure.**

Users, Government, private sector, research, agriculture, water, health, construction, disaster reduction, environment,tourism, transport, etc

User Interface

Climate Services Information System

Observations and Monitoring

Research, Modeling and Prediction

CAPACITY BUILDING

GFCS Sectoral Priorities

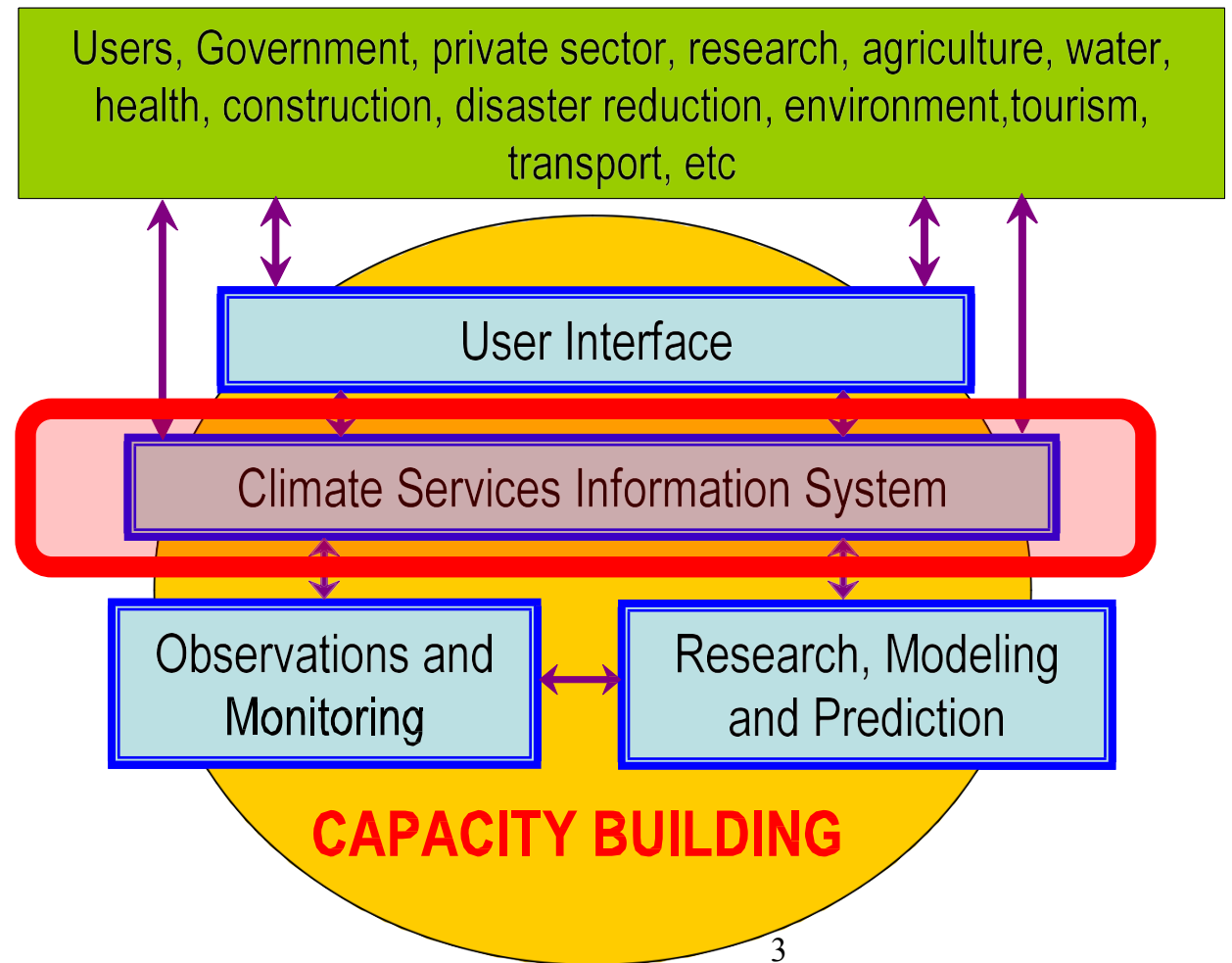All sectors to be covered but initial priority is given to the sectors:

- Agriculture and Food Security
- Disaster risk reduction
- Water
- Human Health
- Energy*
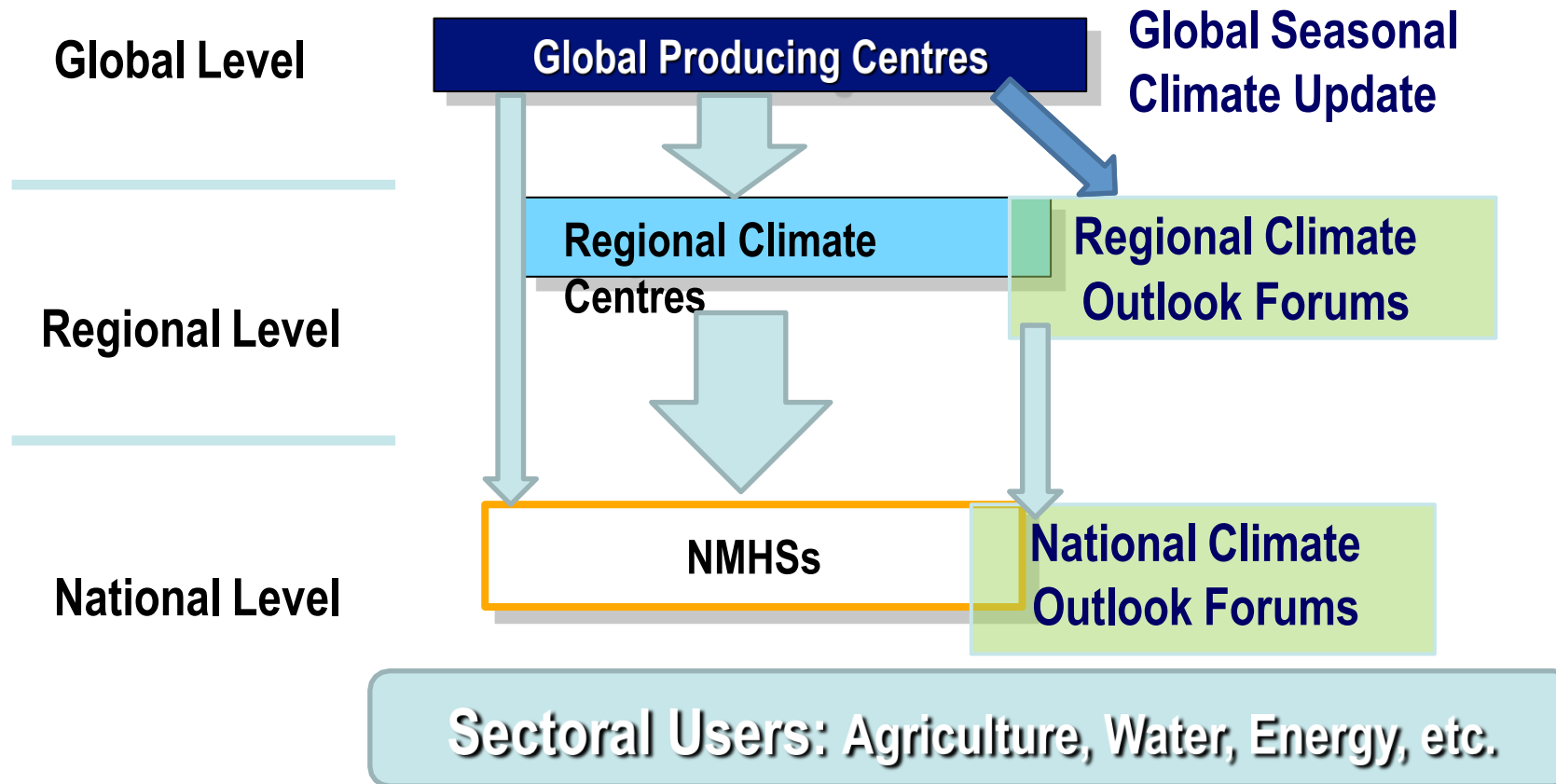
*Endorsed by Congress-17 (2015)

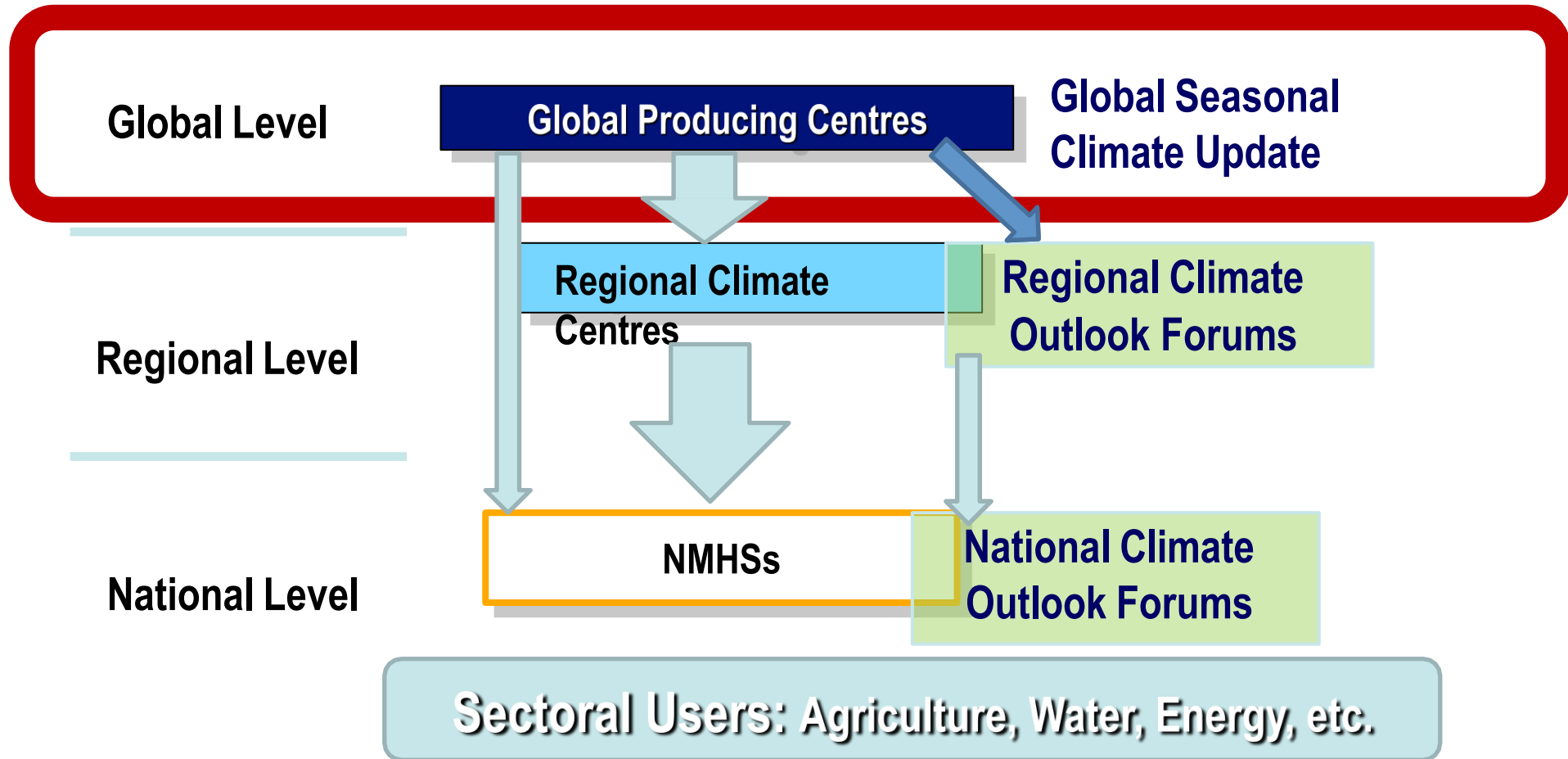# Global Framework for Climate Services (GFCS)

- **The CSIS is the component of the GFCS most concerned with the generation and dissemination of climate information.**

- **It is the 'operational centre' of the GFCS.**

- **HLT report: 'The Climate Services Information System is the system needed to collect, process and distribute climate data and information according to the needs of users and according to the procedures agreed by governments and other data providers.'**

Users, Government, private sector, research, agriculture, water, health, construction, disaster reduction, environment,tourism, transport, etc

User Interface

Climate Services Information System

Observations and Monitoring

Research, Modeling and Prediction

CAPACITY BUILDING

3

Structure of Climate Services Information System

Structure of Climate Services Information System

Global Level

Global Producing Centres

Global Seasonal Climate Update

Regional Level

Regional Climate Centres

Regional Climate Outlook Forums

National Level

NMHSs

National Climate Outlook Forums

Sectoral Users: Agriculture, Water, Energy, etc.

WMO Global Producing Centres of Long Range Forecasts (GPCLRFs)

- In 2006, WMO set up a process to designate centres making global seasonal forecasts as WMO Global Producing Centres of Long Range Forecasts
- GPCLRFs are required to adhere commonly defined standards:
  - a fixed forecast production cycle
  - a standard set of forecast products
  - verification standards
- A comprehensive set of standard verification measures has been defined (the WMO Standard Verification System for Long-Range Forecasts – SVSLRF)

WMO has officially designated 13 GPCLRFs:

In addition to the institutions referenced above, WMO has also designated the following Lead Centres:
•WMO Lead Center for Long-Range Forecast Multi-Model Ensemble (LC-LRFMME) jointly coordinated by KMA and CPC/NOAA
•WMO Lead Center for Standard Verification System of Long-Range Forecasts (LC-SVSLRF) jointly coordinated by BOM and MSC

lat=-90 90
lon=0 360

2m Temperature : JJA2019

(issued on May2019)   [Unit: K]

Links to GPCs sites
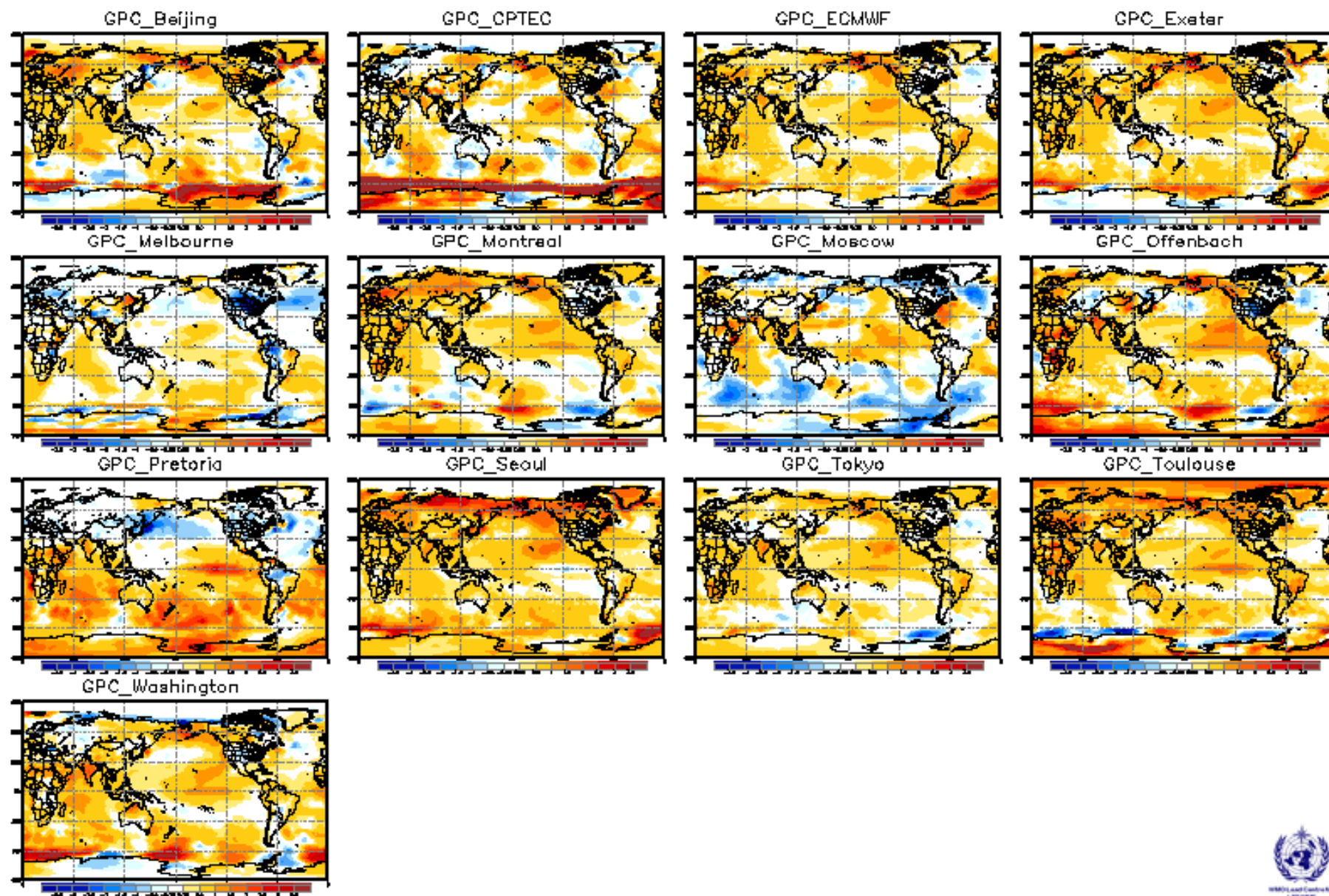
- Predictive Ocean Atmosphere Model for Australia(POAMA), Melbourne
  http://poama.bom.gov.au/

- Canada
  http://www.weatheroffice.gc.ca/saisons/index_e.html

- National Climate Center of CMA (NCC/CMA), Beijing
  http://bcc.cma.gov.cn/Website/index.php?ChannelID=63&show-product=1

- METEO-FRANCE
  http://france.meteofrance.com/france/accueil

- Japan Meteorological Agency, Tokyo
  http://ds.data.jma.go.jp/tcc/tcc/products/model/index.html

- Korea Meteorological Administration (KMA), Seoul
  http://wmolc.org/~GPC_Seoul/

- Met Office, Exeter
  http://www.metoffice.gov.uk/research

- National Centers for Environmental Prediction (NCEP), Washington
  http://cfs.ncep.noaa.gov/

- ECMWF
  http://www.ecmwf.int/products/additional/gts_headers_seasonal.html

- Hydrometeorological Research Centre of Russia
  http://wmc.meteoinfo.ru

- South African Weather Service, Pretoria
  http://dev2.weathersa.co.za/web/

- Center for Weather Forecasting and Climate Research(CPTEC), CPTEC/INPE
  http://www.cptec.inpe.br/

- The Deutscher Wetterdienst institute, Germany

- https://www.dwd.de/EN/ourservices/seasonals_forecasts/charts.html

Links to WMO GPCs page:
http://www.wmo.int/pages/prog/wcp/wcasp/clips/producers_forecasts.html

WMO Lead Center for Long-Range Forecast Multi-Model Ensemble (LC-LRFMME)
https://www.wmolc.org/

WMO Lead Center for Standard Verification System of Long-Range Forecasts (LC-SVSLRF)
http://www.bom.gov.au/wmo/lrfvs/

WMO El Niño/La Niña Update

- El Niño/La Niña Update are altering global weather and climate patterns.

- Outcomes of each event of El Niño/La Niña are never exactly the same.

- The forecasting of El Niño and La Niña episodes developments is undertaken in a number of ways.

- The exchange and processing of the data monitoring and forecasting of El Niño and La Niña are carried out under coordination of the WMO.

- WMO El Niño/La Niña Update is prepared on a quasi-regular basis through a collaborative effort between WMO and the leading centres around the world dealing with this phenomenon.

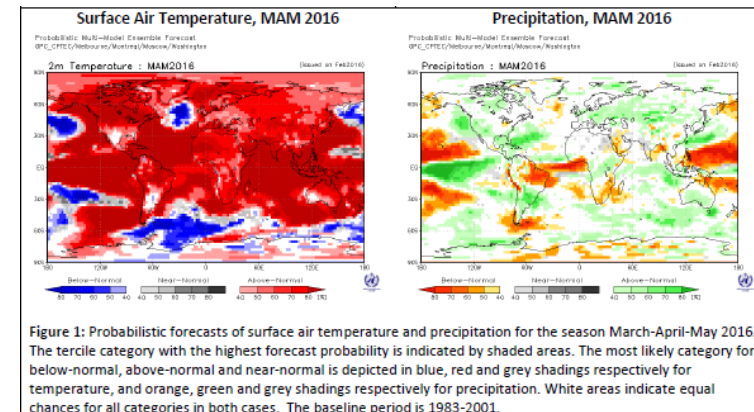Model Predictions of ENSO from May 2019

Global Seasonal Climate Update

- Purpose: International consensus on current state of climate plus outlook for the next season;

- Addresses: major climate modes and indices; temperature and precipitation;

- Issued: ahead of each conventional season (at the minimum);

- Target users: Regional and national centres and entities (globally acting users also interested);

- Dedicated Task Team under CCl;

- Trial versions of GSCU being developed in near real-time and subjected to peer-review process/operational testing..
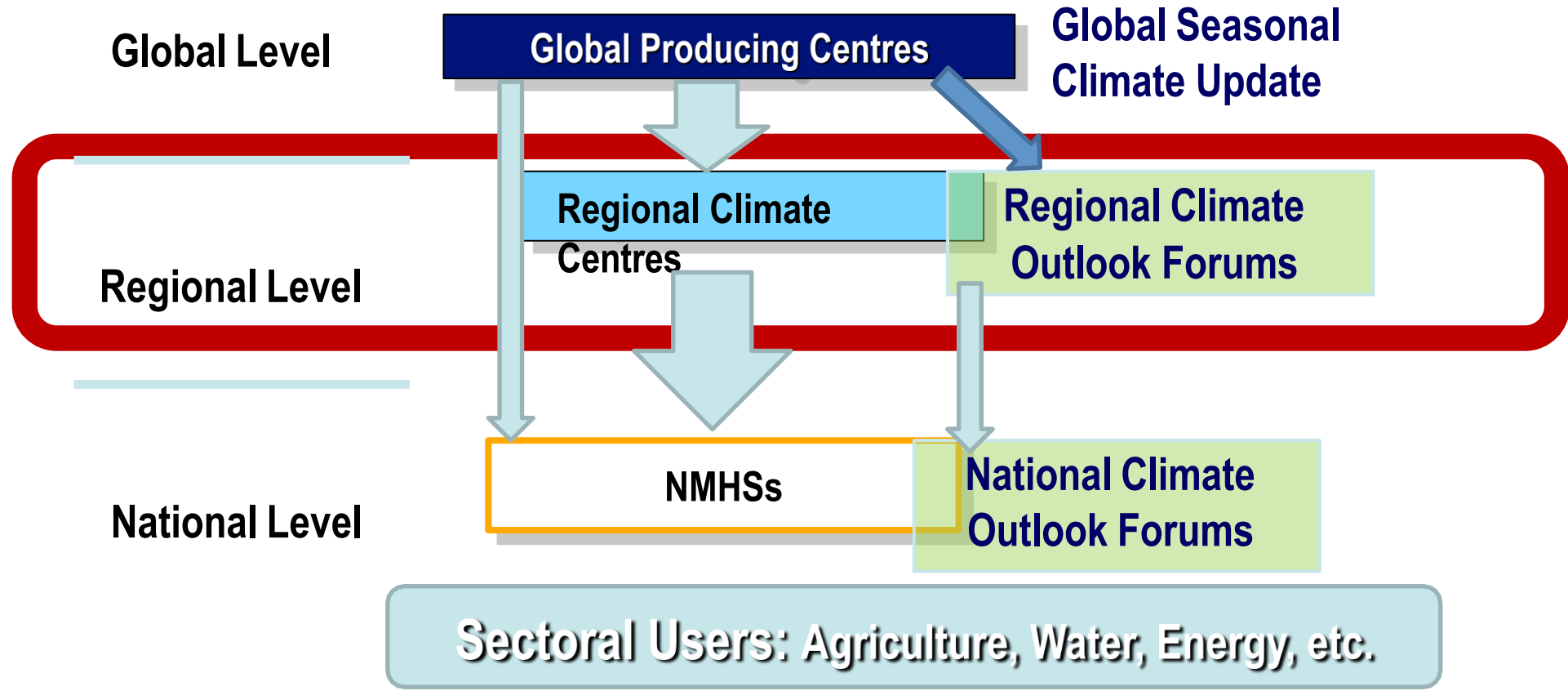

WORLD METEOROLOGICAL ORGANIZATION
Commission for Climatology

Global Seasonal Climate Update

(TRIAL PHASE)

Issued: February 2016   **Target Season: March-April-May 2016**
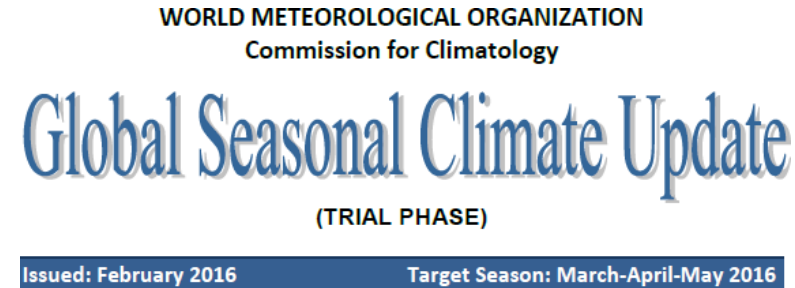
Summary

A strong El Niño episode has prevailed from the second half of 2015 through to the present, and it is predicted to continue, while slowly weakening, during March-May 2016 (see the WMO El Niño/La Niña Update, 18 February 2016). All models predict maintenance of the strong El Niño levels through March 2016, moderating during April and weakening further during May, not to return to neutral until after the March-May season. The model consensus for continuing El Niño conditions is reflected in some predicted large-scale seasonal anomalies for March-May, such as the strong tendency towards above-normal temperature over much of the globe and also precipitation effects in some regions (e.g. northeast Brazil, and the northwest and southwest tropical Pacific islands), which are consistent with canonical responses to a mature and weakening El Niño.
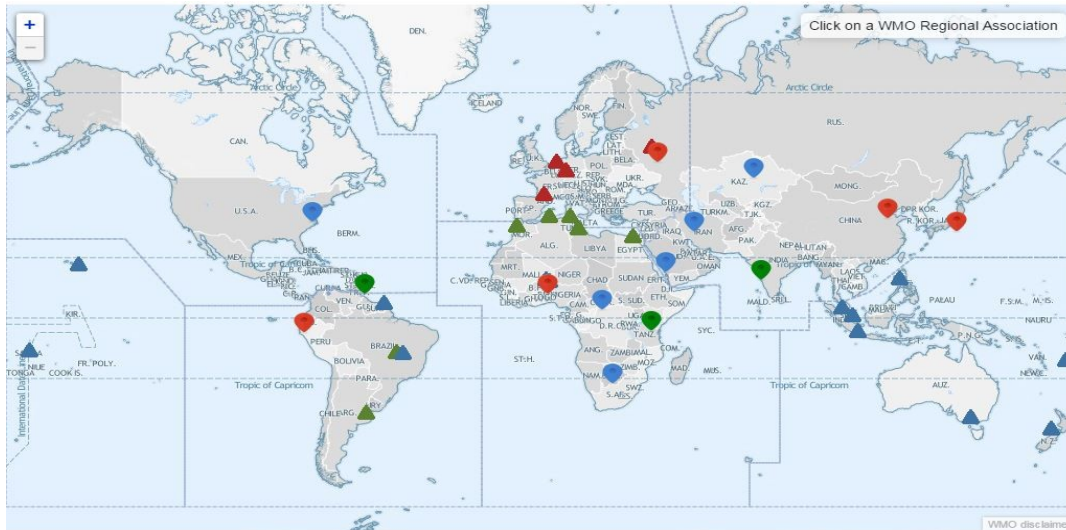
Figure 1: Probabilistic forecasts of surface air temperature and precipitation for the season March-April-May 2016. The tercile category with the highest forecast probability is indicated by shaded areas. The most likely category for below-normal, above-normal and near-normal is depicted in blue, red and grey shadings respectively for temperature, and orange, green and grey shadings respectively for precipitation. White areas indicate equal chances for all categories in both cases. The baseline period is 1983-2001.

Climate Services Information System

WMO RCC Status Worldwide

- WMO Regional Climate Centres are centres of excellence that create regional climate products including long-range forecasts in support of regional and national climate activities.

- The mandate of RCCs is cascading forecast process from global scale and tailoring for use at regional and local scale.

- RCC users: NMHSs, other RCCs, etc.

North Eurasia Climate Center (NEACC) as a part of RCCs network worldwide

The structure of NEACC:

NHMSs of CIS
    +
Consortium of the 7 Roshydromet organizations:
Hydrometeorological Research Centre of the Russian Federation is coordinator and host institution

For RA-VI Region NEACC functions as one of Long-Range Forecast nodes of the RA-VI Regional Climate Network.

For RA-II Region NEACC functions as a Multifunctional Regional Climate Center.

NEACC contributes to ArcRCCs operations

The North Eurasia Climate Centre (NEACC) coordinated by the Russian Federation under the auspices of the Commonwealth of Independent States (CIS). NEACC was formally designated as a WMO RCC NEACC by WMO Executive Council in May 2013.

Mission of NEACC

The priority of the NEACC as a regional climate center of WMO is to support the CIS NMHSs in climate services provision at the regional and national levels .

According to WMO requirements, the NEACC performs a number of mandatory and recommended RCC functions. (Criteria for the mandatory functions of the RCC OF THE RCC are formulated in the Manual of the WMO GDPFS)
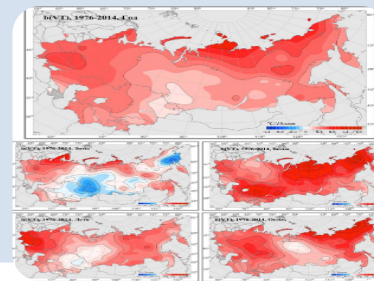
Mandatory functions of NEACC
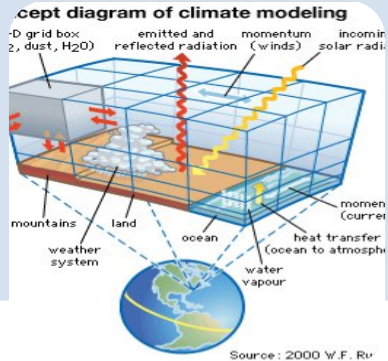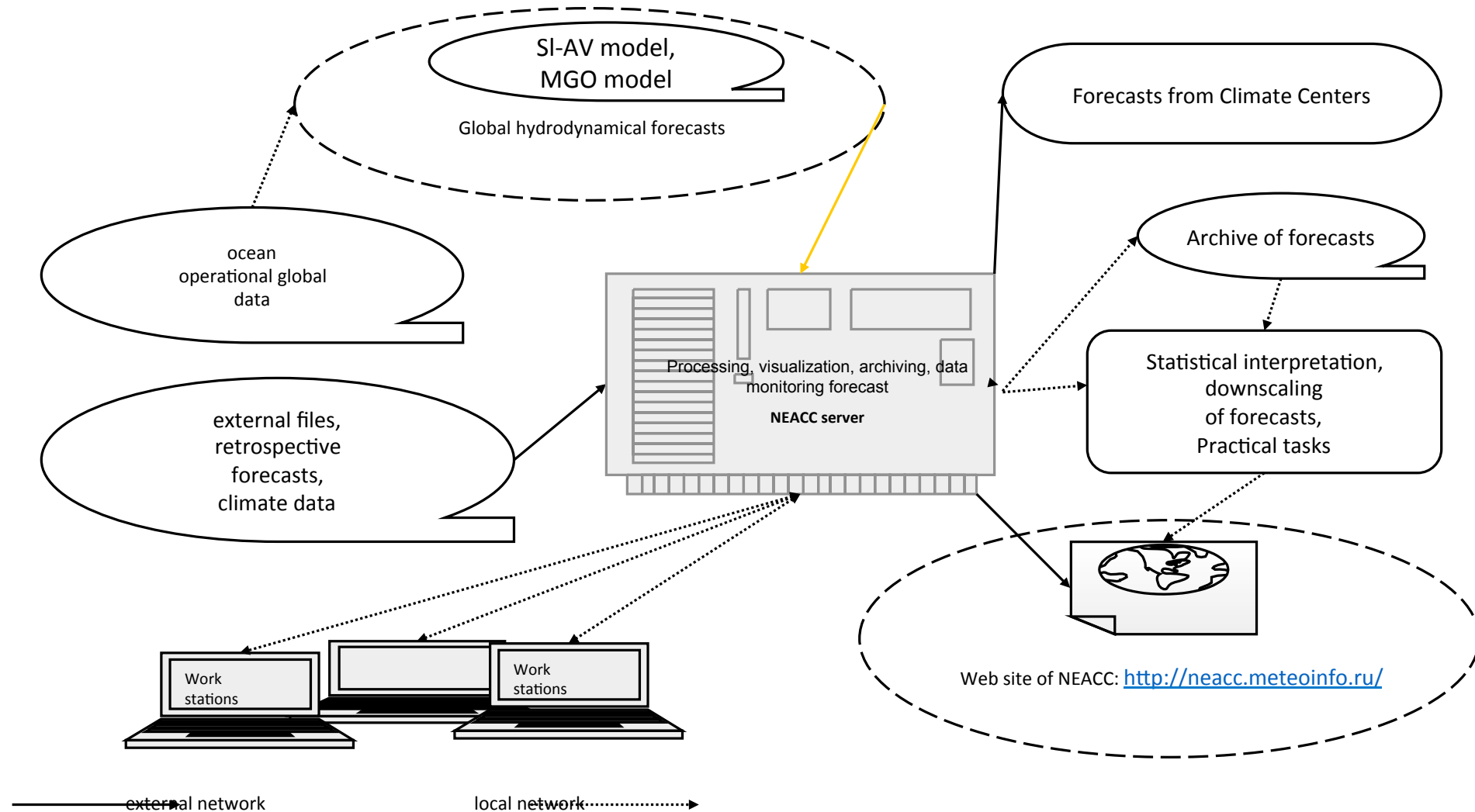

Operational LRF activity

Operational climate data provision

Operational climate monitoring
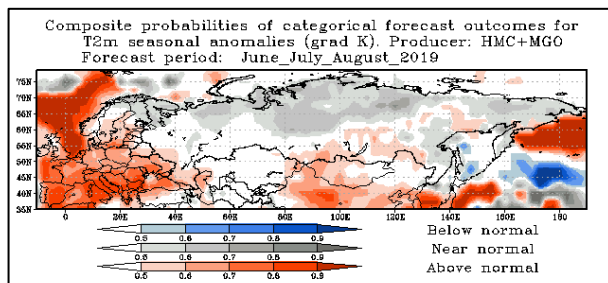
Capacity building activities

Operational long-range forecasting technology at NEACC

Monthly to seasonal multimodel forecasts (SL-AV + MGO models) of basic meteorological parameters with monthly update
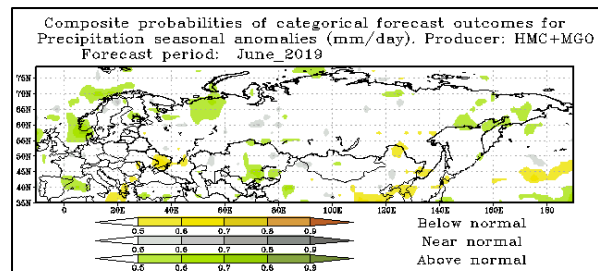
Forecasts of climate indices (including Arctic Oscillation Index, Polar Oscillation Index) with monthly update

Subseasonal forecasts of basic meteorological parameters with weekly update

Probabilistic forecast of air temperature for JJA2019

Composite probabilities of categorical forecast outcomes for T2m seasonal anomalies (grad K). Producer: HMC+MGO Forecast period: June_July_August_2019

Probabilistic forecast of precipitation for June 2019

Composite probabilities of categorical forecast outcomes for Precipitation seasonal anomalies (mm/day). Producer: HMC+MGO Forecast period: June_2019

index	MAY, JUNE, JULY, AUGUST 2019					
	1 month	2 month	3 month	4 month	1 season	2 season
EA	-1,61	-1,45	-0,83	-0,44	-1,99	-1,03
WA	-1,29	-1,2	-2,32	-1,84	-1,63	-1,9
EU	-0,1	-0,06	0,08	-0,6	-0,07	-0,28
WP	0,49	-1,65	-0,66	0,36	-0,49	-0,79
PNA	0,38	0,84	-0,56	-0,06	0,63	0,11
NAO	-0,14	1,48	0,69	1,03	0,5	1,44
POL	0,14	-0,69	0,09	-0,52	-0,26	-0,33
AOS	0,36	0,1	0,1	-0,01	0,18	0,06

EA - East Atlantic Oscillation
WA - West Atlantic Oscillation
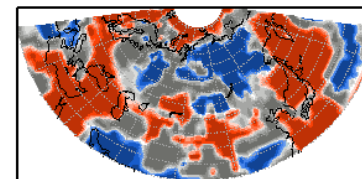**EU -** Eurasia Pattern
WP - West Pacific Oscillation
PNA - Pacific – North American Pattern
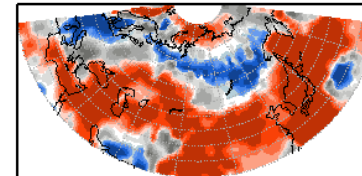**NAO -** North Atlantic Oscillation
POL - Polar Oscillation
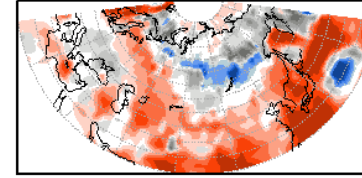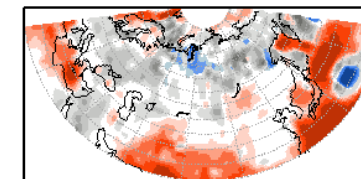**AOS -** Arctic Oscillation
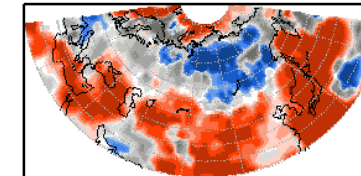
HMC (TRSF) Week 1 (17.05–23.05.2019)

HMC (TRSF) Week 4 (07.06–13.06.2019)

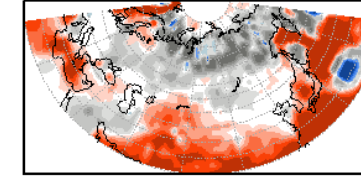HMC (TRSF) Week 2 (24.05–30.05.2019)

HMC (TRSF) Month 1 (17.05–15.06.2019)

HMC (TRSF) Week 3 (31.05–06.06.2019)

HMC (TRSF) Month 2 (31.05–29.06.2019)

Climate Watch Advisories have been issued based on monitoring and subseasonal forecast information
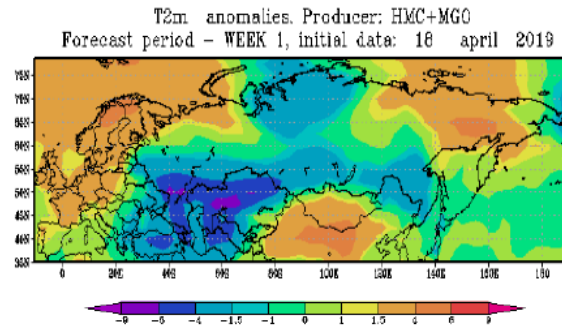

CLIMATE WATCH ADVISORY

WMO RA VI
WMO RA II
RCC-Network

TEMPERATURE WILL BE SIGNIFICANTLY BELOW NORMAL

The forecasts (from 18.04.2019) for the next week (till 26.04.19) show anomalously cold weather for the territory of Central Asia, except south-eastern regions, and for Caucasus region. The most significant temperature anomalies (down to 6-8°C) are expected in Armenia and the southern regions of Kazakhstan.

WEEKLY DETERMINISTIC FORECASTS OF TEMPERATURE ANOMALIES (HYDROMETEOROLOGICAL CENTRE OF RUSSIA (SL-AV) and MGO MODEL)
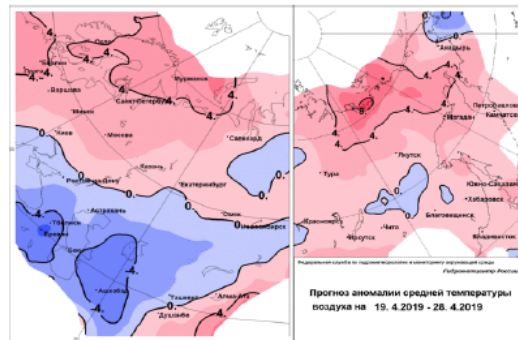
T2m anomalies. Producer: HMC+MGO
Forecast period – WEEK 1, initial data: 18 april 2019

WEEKLY DETERMINISTIC FORECASTS OF TEMPERATURE ANOMALIES
https://meteoinfo.ru/prognoz-na-dekadu

Прогноз аномалии средней температуры воздуха на 19.4.2019 - 28.4.2019

Abnormal cold weather
At a period (from October to March) when the mean daily temperature anomalies are less than 7 °C during the 5 or more days.

Abnormal hot weather
At a period (from April to September) when the mean daily temperature anomalies are more than 7 °C during the 5 or more days.

The dangerous phenomena are the phenomena of weather which intensity, duration and time of occurrence represent threat of a security of people, as well as they can cause significant damage to branches of economy. The list of the typical dangerous phenomena which are used and specified by the local territorial hydrometeorological services of Russia Federation is located on the web site of the Hydrometeorological centre of Russia: http://meteoinfo.ru/hazards-definitions

http://neacc.meteoinfo.ru

NORTH EURASIA CLIMATE CENTRE

Climate Watch Advisory

WMO RA VI
RCC Network
DWD

Guidance on heavy precipitation   ID: 201808-t

Area concerned:

Heavy precipitation: Eastern Mediterranean and Middle East (Greece, western and southern Turkey, Cyprus, Syria, Lebanon, Israel, western Jordan)

Initial statement issued on 6 July 2018
First update issued on 20 July 2018
Second update issued on 3 August 2018
Third update issued on 17 August 2018
Fourth update issued on 24 August 2018
Fifth update issued on 07 September 2018
Sixth update issued on 19 September 2018
Seventh update issued on 2 October 2018
Eighth update issued on 16 October 2018
Ninth update issued on 24 October 2018
Tenth update issued on 2 November 2018
Eleventh update issued on 14 November 2018
Twelfth update issued on 26 November 2018
Thirteenth update issued on 11 December 2018
Fourteenth update issued on 19 December 2018
Fifteenth update issued on 8 January 2019
Sixteenth update issued on 15 January 2019
Seventeenth update issued on 29 January 2019
Eighteenth update issued on 12 February 2019
Termination issued on 19 February 2019

End: 19 February 2019

To: Climate Watch focal points of NMHSs: Iceland, Norway, Denmark, Sweden, Ireland, United Kingdom, Netherlands, Belgium, Luxemburg, France, Germany, Switzerland, Slovenia, Croatia, Bosnia-Herzegovina, Montenegro, Serbia, Albania, FYR of Macedonia, Greece, Bulgaria, Turkey, Portugal, Spain, Monaco, Italy, Malta, Cyprus, Syria, Lebanon, Israel, Jordan

The RA VI RCC Network Offenbach Node on Climate Monitoring (RCC Node-CM) is responsible for providing Climate Watch guidance information for NMHSs' own consideration for issuing climate advisories for their territory.
After having consulted the consortium partners of the RCC Node-CM and RCC Node-LRF (RA VI RCC Network Toulouse and Moscow Node on Long-Range Forecasting), RCC Node-CM issues the following guidance information:

Due to the results from monthly forecasts we announce:
The end of above-normal precipitation in the eastern Mediterranean subregion."

Skill scores of monthly-seasonal forecasts

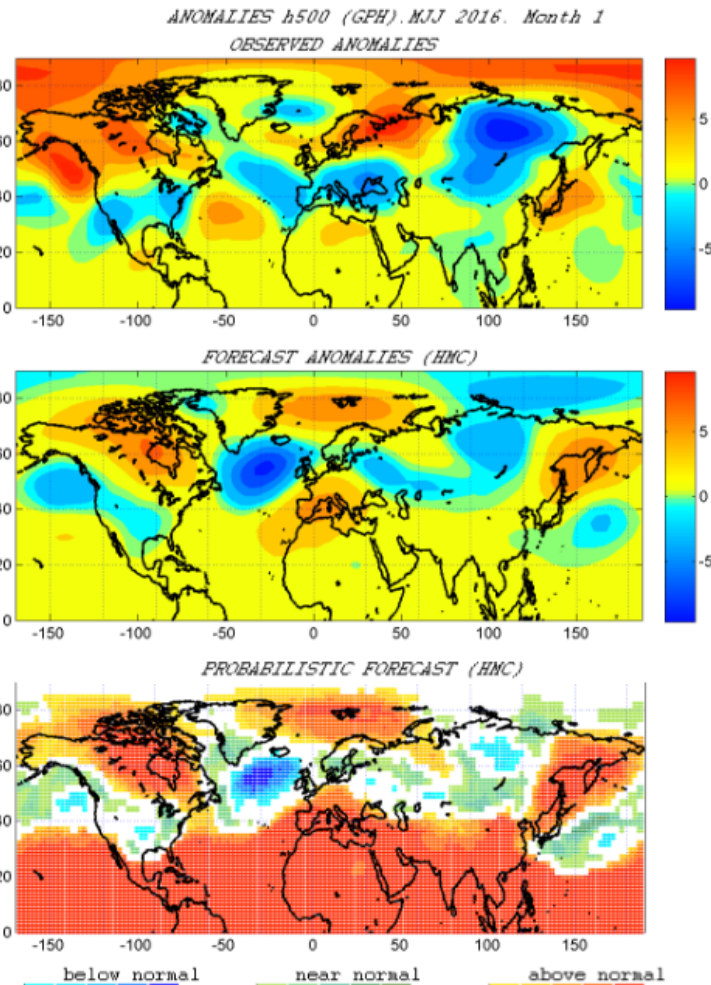## Operational forecasts

Forecast verifications

Skill scores of seasonal forecast

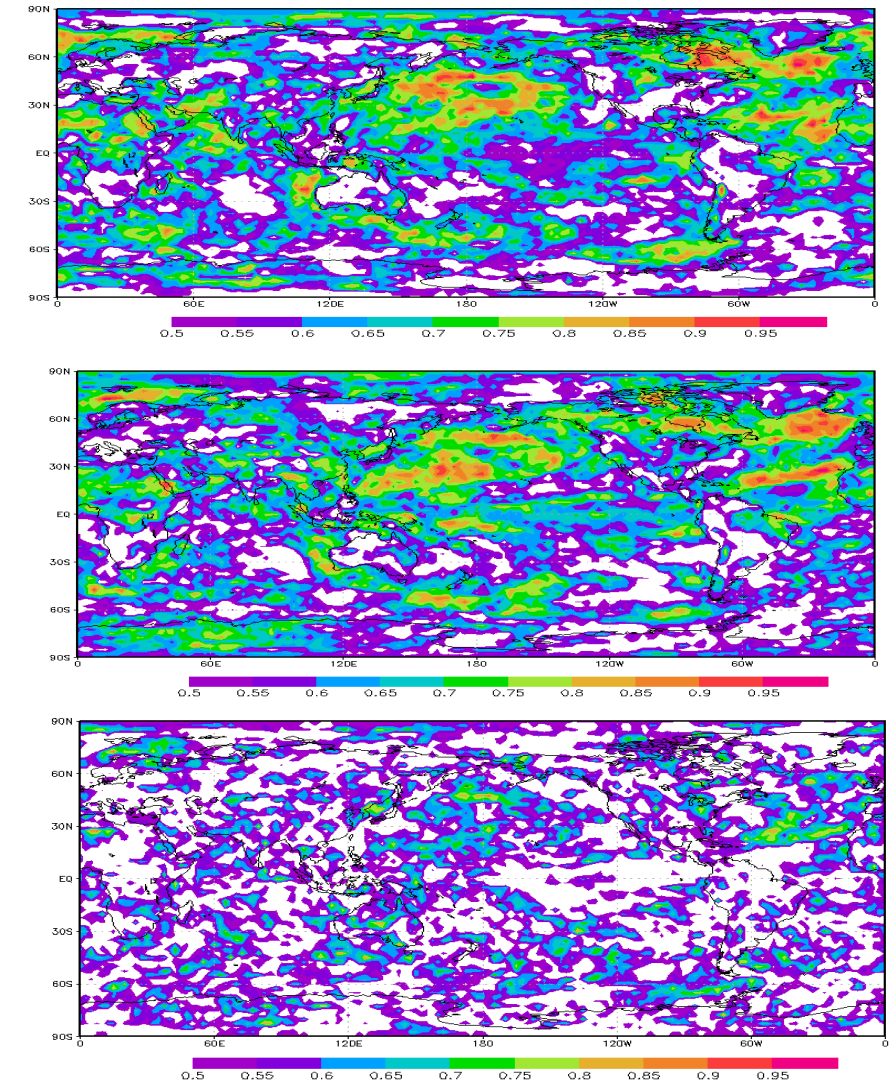| Date	Region	Parameter	
2016-05-01 ▼	GLOBUS ▼	H500 ▼	**Upload**

Parameter: H500
Region: GLOBUS (90S - 90N; 0 - 360)
Date: 2016-05-01

Model	Verifications						Maps
	ROC_A	ROC_N	ROC_B	RO	ACC	RMSE	
May 2016							
PLAV	0.8	0.7	0.79	0.63	0.63	32.5	Open
MGO	0.88	0.72	0.84	0.65	0.73	29.25	Open
PLAV+MGO	0.88	0.74	0.85	0.66	0.72	29.19	Open
June 2016							
PLAV	0.77	0.64	0.86	0.74	0.53	38.33	Open
MGO	0.78	0.65	0.83	0.65	0.68	35.47	Open
PLAV+MGO	0.79	0.67	0.88	0.74	0.66	35.81	Open
July 2016							
PLAV	0.69	0.63	0.76	0.63	0.46	28.61	Open
MGO	0.67	0.61	0.71	0.55	0.28	31.94	Open
PLAV+MGO	0.69	0.64	0.77	0.64	0.41	29.22	Open
Season							
PLAV	0.83	0.75	0.89	0.84	0.8	17.52	Open
MGO	0.84	0.74	0.83	0.71	0.71	20.6	Open
PLAV+MGO	0.87	0.77	0.88	0.8	0.8	18.04	Open

Skill scores:

Hindcasts

Updating of computational facilities at Roshydromet

New supercomputer complex (2018) has been facilitating operational LRF work at GPC-Moscow and NEACC
- increased storage of forecast and monitoring information
- increase of resolution of dynamical model forecasts
- optimization of LRF technology

Center	Peak Performance TFlops (10^{12} Flops)	System	Cores	RAM TB/ GB per core	Manufacturer	Storage
GPC-Moscow	1200	Cray XC40-LC	33696/ 36	120/3,55	Cray (USA)	2,8 PB Cray Sonexion 3000 + 360 TB EMC
	13	Bull S6 130	384/384	4/10	Bull SAS (France)	

Uniqueness of Arctic Regional Climate Centre Network (ArcRCC-N)

- The domain of the ArcRCC-N falls across three of the WMO Regional Associations.
- The Arctic Council countries are members of ArcRCCs-N.
- Contributing countries in domain also have well supported NHMSs.
- Two levels structure for the ArcRCC-Network: 1. Multifunctional operation in three sub-regional geographic domains 2. Each node udertakes a cross-node mandatory function for the entire pan-Arctic domain

The goal of ArcRCC-N is to provide effective, user-relevant, decision-support climate information needed by indigenous people, governments, businesses and other users at high northern latitudes.

NATIONAL		REGIONAL		CIRCUMPOLAR
Countries	Meteorological Organizations	Regional Climate Centres (RCCs)		
United States	NOAA	North American Node	Forecasting	Arctic Regional Climate Centre
Canada	ECCC			
Denmark	DMI	Northern European / Greenland Node	Data Services	
Iceland	IMO			
Norway	NMI			
Sweden	SMHI			
Finland	FMI			
Russia	AARI	Northern Eurasia Node	Monitoring	

Status for the ArcRCC-N

- The structure for ArcRCC-N endorsed by EC-69

- Demonstration Phase launched on 17th endorsed by EC-70

- Plan to be designated as an RCCs-N WMO by mid-2020

- Climate Outlook Forums (PARCOFs) are important to achieve the designation

More information about ArcRCC-N,
products and services in the
demonstration phase
are accessible through the
https://www.arctic-rcc.org
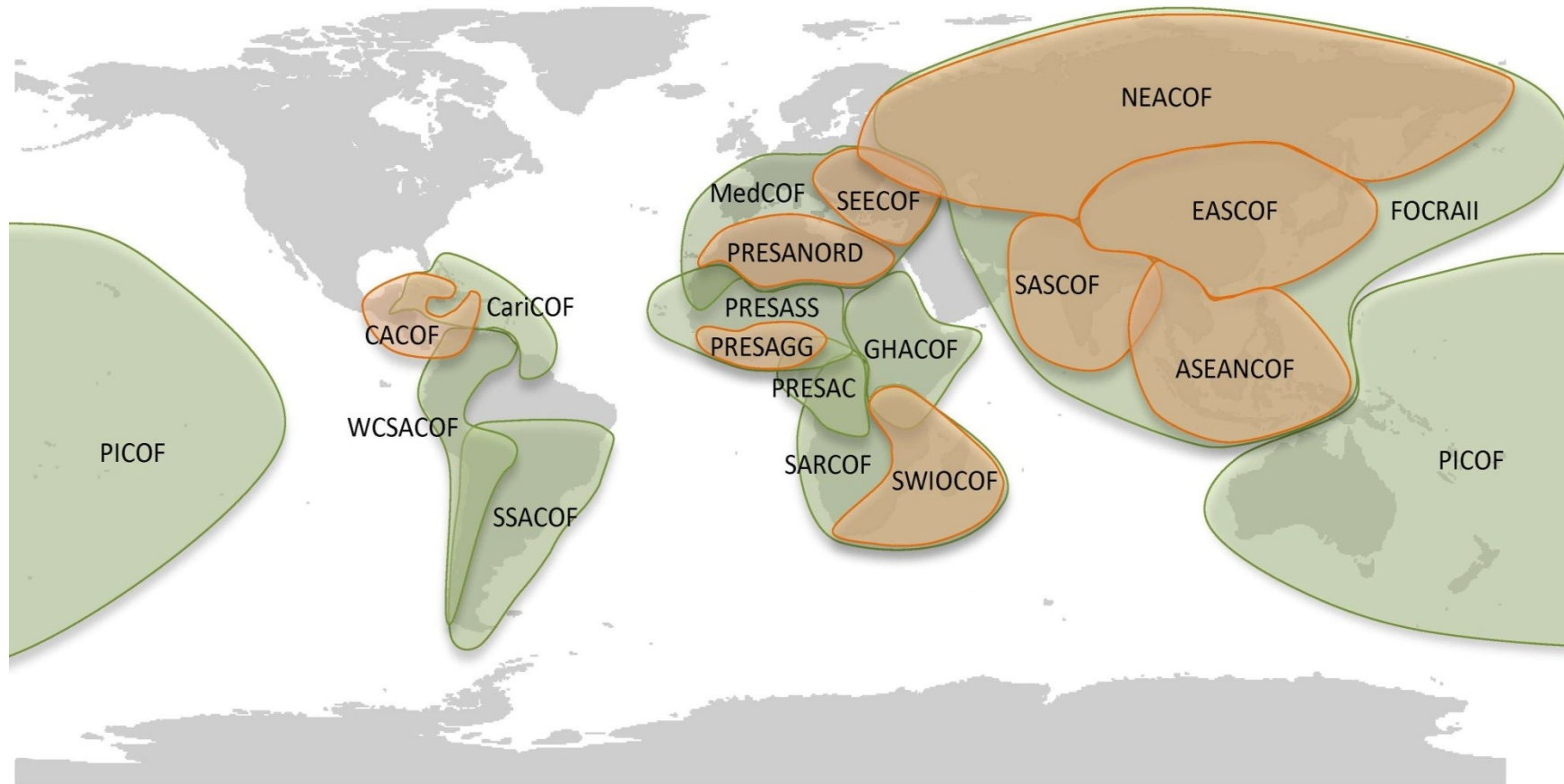
Climate Services Information System

Global Level

Global Producing Centres

Global Seasonal Climate Update

Regional Level

Regional Climate Centres

Regional Climate Outlook Forums

National Level

NMHSs

National Climate Outlook Forums

Sectoral Users: Agriculture, Water, Energy, etc.
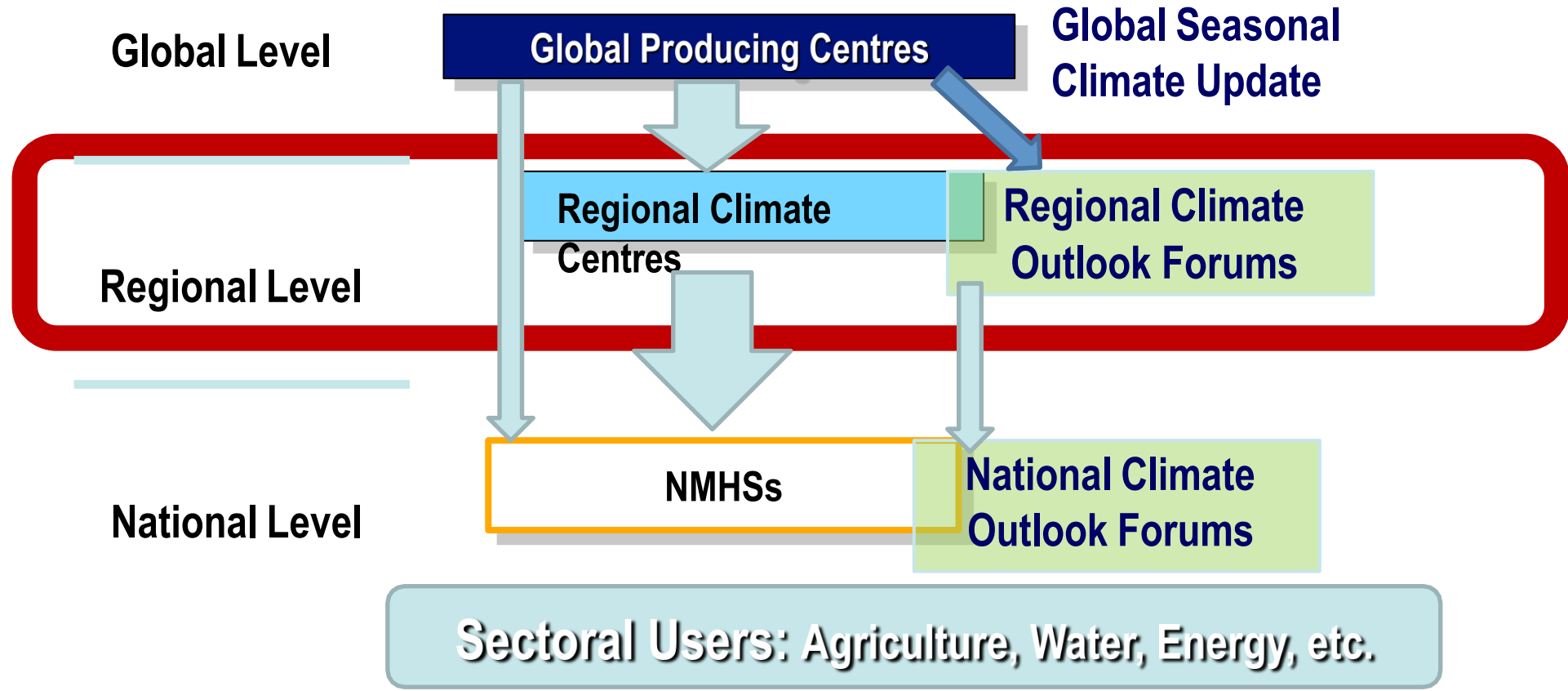
Regional Climate Outlook Forums (RCOFs)

- RCOF Concept was pioneered in Africa and spread worldwide.
- WMO and a number of national, regional and international organizations and development agencies (e.g., NOAA, IRI, Meteo France, Met Office, IGAD, SADC, USAID, AusAID, etc.) have supported their growth, stability and expansion.
- RCOFs provide platforms for Climate experts and climate information users to:
  - Discuss current climate status
  - Exchange views on scientific developments in climate prediction
  - Develop consensus-based regional climate outlooks that can feed into national climate outlooks produced by NMHSs
  - Engage in user-provider dialogue
- An important aspect of RCOFs is the facility to bring together experts in various fields, at regular intervals, operational climate providers and end users of forecasts in an environment that encourages interaction and learning.

RCOFs Worldwide

North Eurasia Climate Outlook Forum (NEACOF) in RCOF process

The NEACOF has been conducted twice a year at the end of the springtime, in May, (on the base of Internet resources) and at the end of the autumn, in November (physical sessions), with focus on the seasonal prediction for summer and winter respectively.

http://seakc.meteoinfo.ru/about-centre/-neacof (Russian version)

http://neacc.meteoinfo.ru/neacc/north-eurasian-climate-outlook-forum (English version)
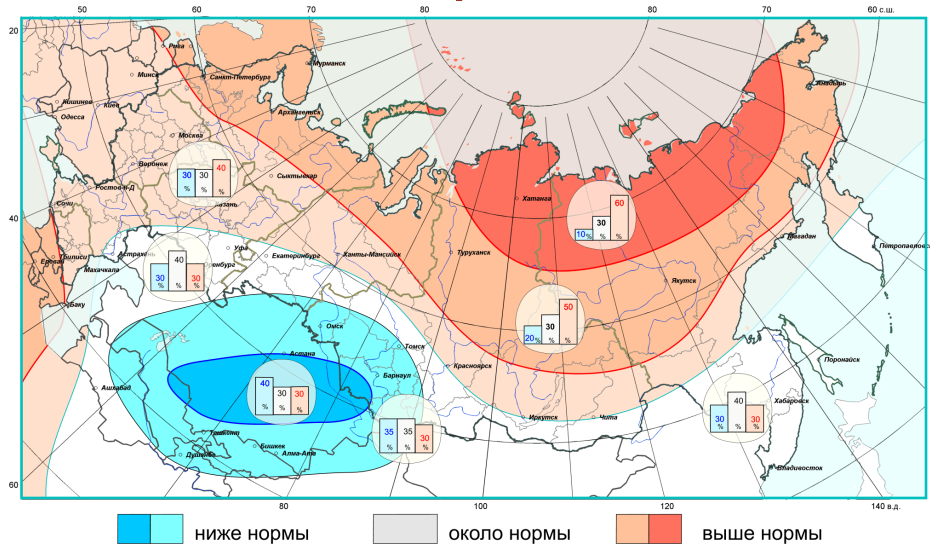
Procedure to develop consensus forecast during NEACOF sessions

- Combining of the seasonal forecasts both empirical and dynamical from the leading forecasting centers (GPCs, RCCs etc) and NHMSs

- Review the previous season's consensus forecast in comparison with the actual conditions realized;

- Review current large-scale (global and regional) climate anomalies known to influence the regional climate, and the most recent predictions for their evolution;

- Review current climate conditions in form of climate indices and their potential impacts at local and regional levels

- Considering all monitoring and forecast information to produce a climate outlook with related output (e.g. maps of temperature and/or precipitation anomaly patterns in terms of tercile probabilities)

- Discuss the consensus statement document

- Discuss applications of the outlook and related climate information to climate-sensitive sectors in the region; consider practical products for development by NMHSs;

- Collect feedback the session and its results:
  - Achieved improvements to the process and any challenges encountered,
  - Establish steps required to further improve the process for subsequent sessions.
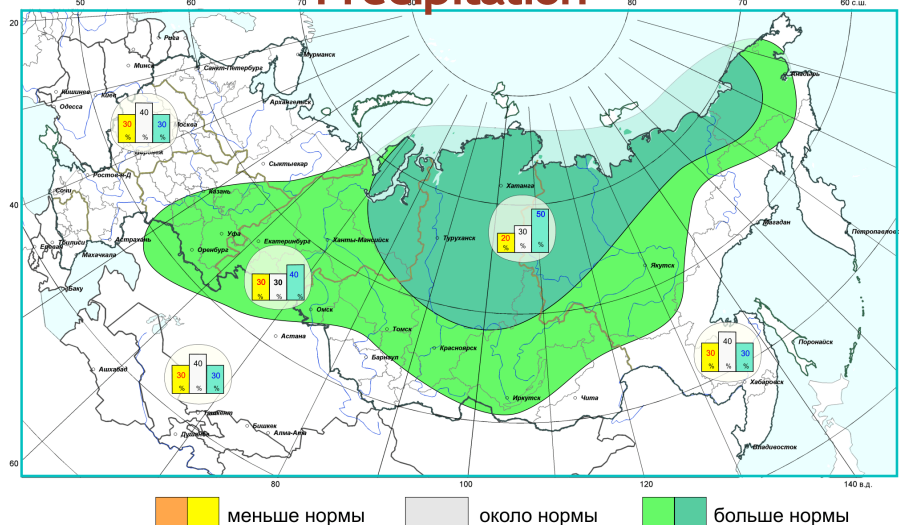
Example of consensus outlooks from NEACOF

DJF 2018/2019

Air temperature

ниже нормы   около нормы   выше нормы

Precipitation

меньше нормы   около нормы   больше нормы

Consensus process was mostly subjective but objective approach is in development

16th session of NEACOF is holding as an parallel section of CITES2019

Pan-Arctic Regional Climate Outlook Forum

The third session of the Pan-Arctic Climate Outlook Forum (PARCOF) was held on 8-9 May 2019 Rovaniemi, Finland

It was attended by permanent participants of the Arctic Council, representatives of Arctic Indigenous Peoples, scientists from all the Arctic Council Member States, and stakeholders.

Representatives of Arctic indigenous organizations shared their knowledge about changing conditions, the challenges they face, and the type of forecasts and climate services they need.

Commercial shipping stakeholders from the dry-bulk and tourism sectors informed about their activities and their needs for climate and weather information to ensure not only their safety, but the protection of the environment.

The Northern Sea Route Administration

The Main Results of the navigation in the Northern Sea Route waters in 2018

Third Session of the Pan-Arctic Regional Climate Outlook Forum (PARCOF-3), Rovaniemi, Finland, May 2019

Consensus Statement for the Arctic Summer 2019 Season Outlook

To meet climate adaptation and decision-making needs in the Arctic, substantial progress has been made towards the establishment of an Arctic Regional Climate Centre Network (ArcRCC-Network). The ArcRCC-Network is based on the World Meteorological Organization (WMO) RCC concept with active contributions from all the Arctic Council member countries. The Pan-Arctic Regional Climate Outlook Forum (PARCOF) is a flagship activity of the ArcRCC-Network to create a forum to meet directly with Arctic users of climate information, and follows the well-known Regional Climate Outlook Forum (RCOF) concept supported by WMO and its partners around the world. The ArcRCC is now in the second year of its demonstration phase.

Outlook for Summer 2019:

Surface air temperatures are expected to be above normal across the majority of the Arctic regions

Precipitation forecast during JJA 2019 over the majority of the Arctic is non-decisive

Below to near normal sea ice conditions are expected for the majority of the Arctic, with the exception of Greenland and the Canadian Arctic.

Verification of the previous seasonal forecast February, March, April 2019:
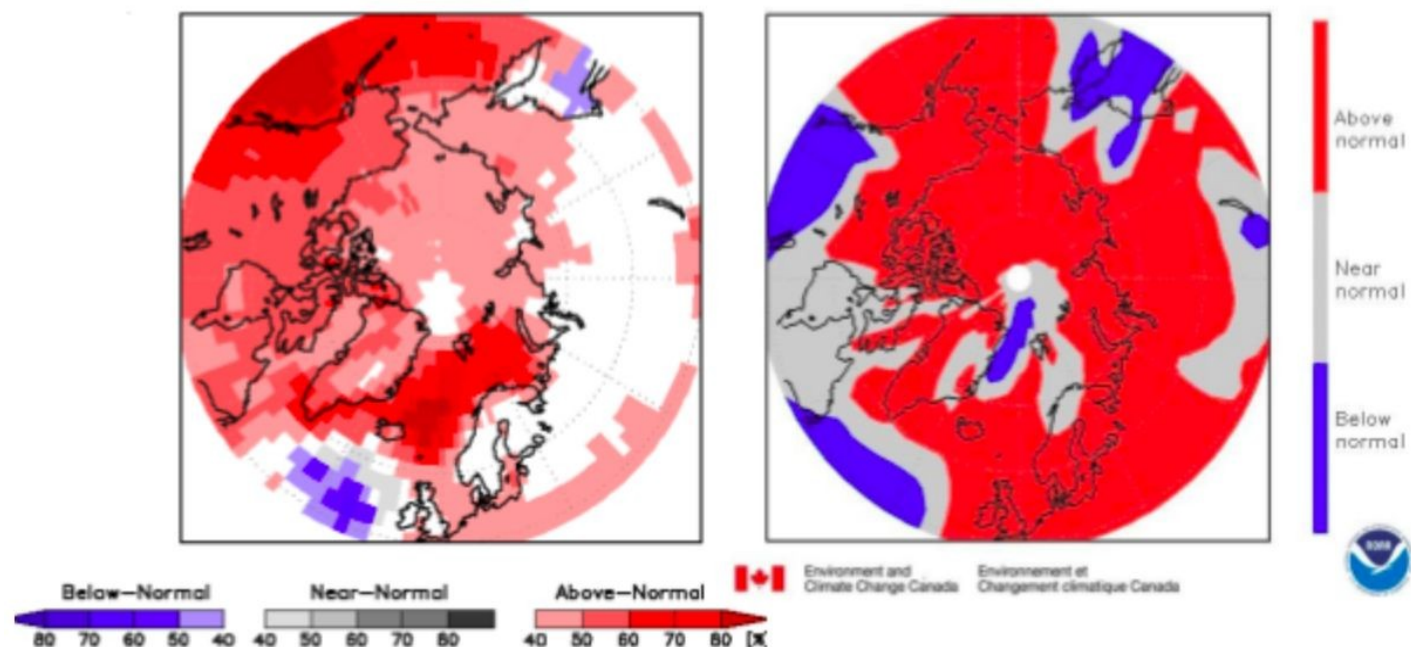
Figure 2: Left: Surface Air Temperature Outlook for February, March and April 2019. Multimodel ensemble (MME) probability forecast of three categories (below normal, near normal and above normal) (www.wmolc.org). Right: NCAR (National Center for Atmospheric Research) Climate forecast System Reanalysis (CFSR) for air Temperature, February, March and April 2019.

Surface air temperature over North America and the Atlantic regions was for the most part accurately forecasted. The accuracy over the European and western Siberian regions varied spatially between an accurate, indecisive (below 33% accuracy) and incorrect forecast. Surface air temperature forecast over the ocean for both regions was accurately forecast. The above normal surface air temperature forecast for western Siberia
was also accurate. Forecast over remainder of the European and western Siberian continental regions were mostly indecisive.

Discussing historical skill over the Arctic, Temperature
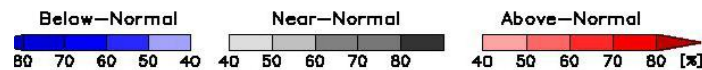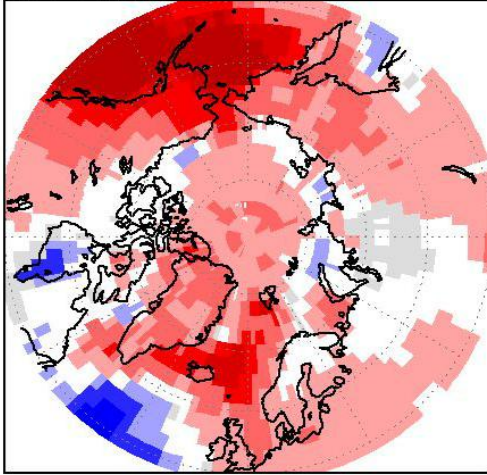## (confidence with respect to the historical skill)

Above-normal 0.712
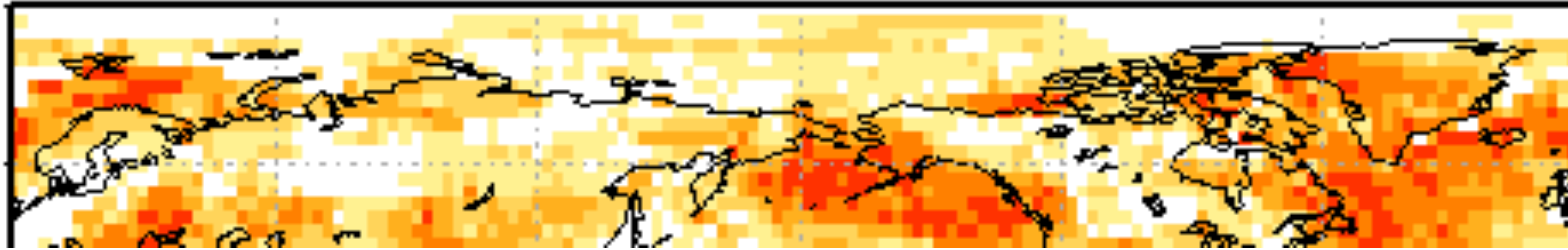
silistic Multi-Model Ensemble Forecast
washington/GPC_tokyo/GPC_exeter/GPC_moscow/GPC_beijing/GPC_melbourne
cptec/GPC_pretoria/GPC_montreal/GPC_offenbach

n Temperature : JJA2019 (issued on May20)

Below-Normal   Near-Normal   Above-Normal
80 70 60 50 40 40 50 60 70 80 40 50 60 70 80 [%]
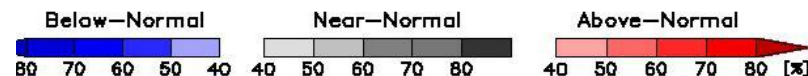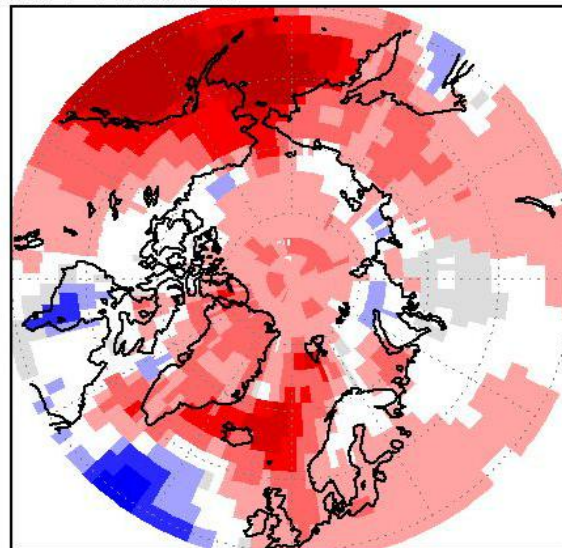
- If a historical skill was good over a certain region (e.g. colored region on the upper figure) we are more confident about the forecast results over the same region

- Overall confidence is modest in JJA over the Arctic with the exception of the Atlantic, Siberian and Chukchi regions.

From PPT M.Marcovic, 2019

Tailoring of seasonal consensus forecasts to navigation tasks

Key shipping regions

Beaufort Sea: Although there is less multi-year ice in the Beaufort Sea than normal this winter, it is expected that some multi-year ice will persist near the Alaska coast into late summer which could impact shipping. In the Eastern Beaufort there is a possibility (low risk) that multi-year ice could drift south of Banks Island as in September 2018, restricting ship traffic through Amundsen Gulf.

Northwest Passage (NWP): A return to normal concentrations of multi-year ice along the southern route of the NWP could delay melt and the start of the shipping season compared to the last 10 years. The presence of multi-year ice is expected to be a hazard throughout the shipping season. Along the northern route of the NWP, concentrations of multi-year ice are the 7th highest since 1980 and are expected to keep the route closed this season.

Svalbard: The ice extent around Svalbard is expected to be below normal throughout the summer season.

Northern Sea Route (NSR):
Sea ice in the northern Barents Sea is expected to clear later than normal (compared to last 10-years) and may restrict fishing and tourist vessel activities in this region until July 2019. Easy ice conditions for navigation are expected for the western part of the NSR (Kara and western Laptev Seas) through the summer 2019 season. Near normal ice extent expected in the eastern Laptev and western Eastern Siberian Seas (ESS) may lead to increased icebreaker support or higher ice class ships required for safe navigation in this region, particularly along the northern navigation routes. There is also a risk of multi-year ice along the northern routes; similar to 2018 a strip of sea ice in the central ESS could persist through late summer 2019. Very easy ice conditions for navigation will dominate the Chukchi Sea area.

RCOF and PUBLIC HEALTH

Caribbean Health Climatic Bulletin
Vol 3 | Issue 1
March 2019

This Bulletin is a joint effort between the Caribbean Public Health Agency (CARPHA), the Pan American/World Health Organization (PAHO/WHO) and the Caribbean Institute for Meteorology and Hydrology (CIMH). It aims to help health professionals identify and prepare health interventions for favorable or inclement climate conditions in the Caribbean. The period covered is March to May 2019. It is recommended that health stakeholders should use the combination of monitoring (November 2018 - January 2019) and forecast (March - May 2019) climate information presented in this Bulletin in tandem with weather forecasts (1-7 days). This suite of information is intended to guide strategic and operational decisions related to health interventions and the management of health care systems.

What are the Key Climate Messages for March to May 2019?

- Climatically, March to May forms the **second half of the Caribbean Dry Season** in Belize and the Caribbean Islands, characterised by relatively few wet days and a small number of wet spells, but many dry days and quite a few dry spells. That said, the intensity of heavy showers increases towards May, especially in the Greater Antilles. Consequently, despite being very low in March, the potential for flooding increases in April and May *(high confidence)*. In the coastal Guianas, a steady increase in flooding potential should manifest by May which is the start of their primary wet season *(high confidence)*.
- Whereas in March **extreme wet spells** are virtually non-existent across the region, the chance for such spells increases steadily from April onwards. Extreme wet spells may coincide with thunderstorms and high winds, and may result in **flash floods**, land slippage, power outages and possible contamination of food and water supplies.
- Moderate to severe **drought** has started impacting many areas in the Caribbean. Notably, Barbados, parts of Belize, much of Hispaniola, much of the Leeward Islands, Saint Lucia, St. Vincent and Tobago have seen long term drought developing. Short term drought is seen in the ABC Islands, northern Barbados, south-eastern Cuba, much of Hispaniola, St. Vincent, Trinidad and Tobago. This is, in part, due to a developing weak El Niño. That said, extreme to exceptional drought such as that experienced by many territories between 2014 and 2016, when El Niño was particularly strong, is unlikely.
- Regionally, **rainfall totals** from March to May are forecast to likely be at least as dry as usual in the ABC Islands, Belize and the Lesser Antilles, but likely the usual or wetter in Cayman, Cuba and eastern portions of the Guianas *(medium confidence)*.
- **Short term drought** (on a 3-6 months timescale) is currently evolving in Barbados, parts of Belize, Dominica, Grenada, Guyana, St. Vincent, Trinidad & Tobago *(high confidence)*. Such conditions increase the potential for bush fires and may temporarily increase smoke and soot concentrations in the air.
- **Long term drought** (on a 12 months timescale), which affects the largest water reservoirs, is evolving in Antigua, west-central Belize, Cayman, N & S Dominican Rep., NE Guyana, St. Kitts, Trinidad & Tobago, Windward Islands *(high confidence)*, and may develop in most other areas of the Caribbean by the month of May *(medium confidence)*.
- Night-time and day-time **temperatures** in the Caribbean are set to increase as the Caribbean approaches its annual heat season which starts in May, with the exception of the Guianas. Night-time and day-time temperatures are forecast to be at least as warm as usual *(medium to high confidence)* and, from April onwards, may locally feel uncomfortable at times due to dry heat.
- The first **heat waves** of the year are usually noted in April or May in Belize and Trinidad. In view of the ongoing drought, which increases the chance of occurrence of heat waves, other areas may also experience one or two heat waves locally between April and May *(medium confidence)*.
- The **2019 Hurricane Season officially starts on June 1st**. However, it is important to note that storms and hurricanes can and, in many recent years, did occur before the official start date. Severe weather systems, which can come with a range of hazards, including high winds, landslides, flash floods, among others, could possibly affect Caribbean territories.
- Episodes of **Saharan dust** incursions into the Caribbean tend to increase towards May (access more detailed forecast information on dust and air quality in the Caribbean here: http://dafc.cimh.edu.bb/). In addition, with ongoing or potentially pending drought during the dry season, local

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The Health-Climatic Bulletin is developed and disseminated by the Caribbean Public Health Agency (CARPHA), the Pan American Health Organization (PAHO) and the Caribbean Institute for Meteorology and Hydrology (CIMH) to help the health sector to manage climate risk.

The HCB:
• Offers insights on the typical climate conditions of the upcoming season or forecast period;
• Advises on the health implications arising from this seasonal climate information.

The HCB guides health professionals to identify several implications of forecasted climate in a number of key areas including respiratory illness, non-communicable diseases, vector borne illness, gastrointestinal illness, physical injury or death, and well-being and mental health.

Use of this information can help to inform strategic and operational decisions.

What are the Health Implications for March to May 2019?

Non-communicable Diseases

- **Morbidity from excessive heat** due to high temperatures during heat waves across the region may become an issue from May onwards.

- If unprotected, prolonged and/or repeated exposure to dangerous UV radiation may lead to **skin damage** across the population, especially in view of the many expected sunny days in this period (for more information, see: https://www.epa.gov/sunsafety/uv-index-scale-1).

Vector-Borne Illness

- With drought evolving and with recurrent dry spells in this period, there may be increased use of containers for storage, as well as water accumulating in any unattended, open containers. This may potentially create a proliferation of artificial breeding sites for the *Aedes aegypti* mosquito which is the major vector for diseases such as **Dengue**, **Chikungunya** and **Zika**. Access to additional information on these mosquito-borne diseases can be found here: http://carpha.org/What-We-Do/Public-Health-Activities/Dengue. Guidelines on mosquito-borne diseases for travelers, tourist accommodations and tourism and health officials can be found here: http://carpha.org/What-We-Do/Tourism-and-Health-Programme

- At the household level, careful attention should be given to management of water storage containers. This includes properly covering barrels, drums and buckets. Access to useful materials on mosquito control measures can be found here: https://www.paho.org/hq/index.php?option=com_content&view=article&id=12355:cde-mosquito-awareness-week&Itemid=42087&lang=en

- The presence of stagnant water in the aftermath of a flood may promote the breeding of mosquitoes. However, note that in the case of flash floods, flood waters may sweep away mosquito eggs, larvae and pupae, potentially reducing mosquito populations.

- At the Ministry level, focus should be on education, source reduction and space spraying or fogging operations. The fogging operations would be weather- (temperature, wind speed, humidity etc.) dependent as advised by local meteorological services.

- Where episodes of flooding may occur, particularly in the Bahamas, the Greater Antilles and the Guianas towards May, there is increased risk of **Leptospirosis** due to displacement of vectors such as rodents into houses, increasing the risk of contamination of household surfaces and food-stores.

Gastrointestinal Illness

- Drought conditions may increase concentrations of water pollutants. Additionally, a drop in water pressure in the pipes of water supply systems may result in cross-contamination and reduced access to water by consumers. Alternative use of unsafe sources of water, in turn may potentially contribute to higher incidences of gastrointestinal illness.

- Where episodes of flooding may occur, cases of **gastroenteritis** may increase, due to persons wading in flood waters (which could also inflict skin-disease), or consuming foods contaminated by flood waters. This is particularly the case in the Bahamas, the Greater Antilles, and the coastal Guianas towards May.
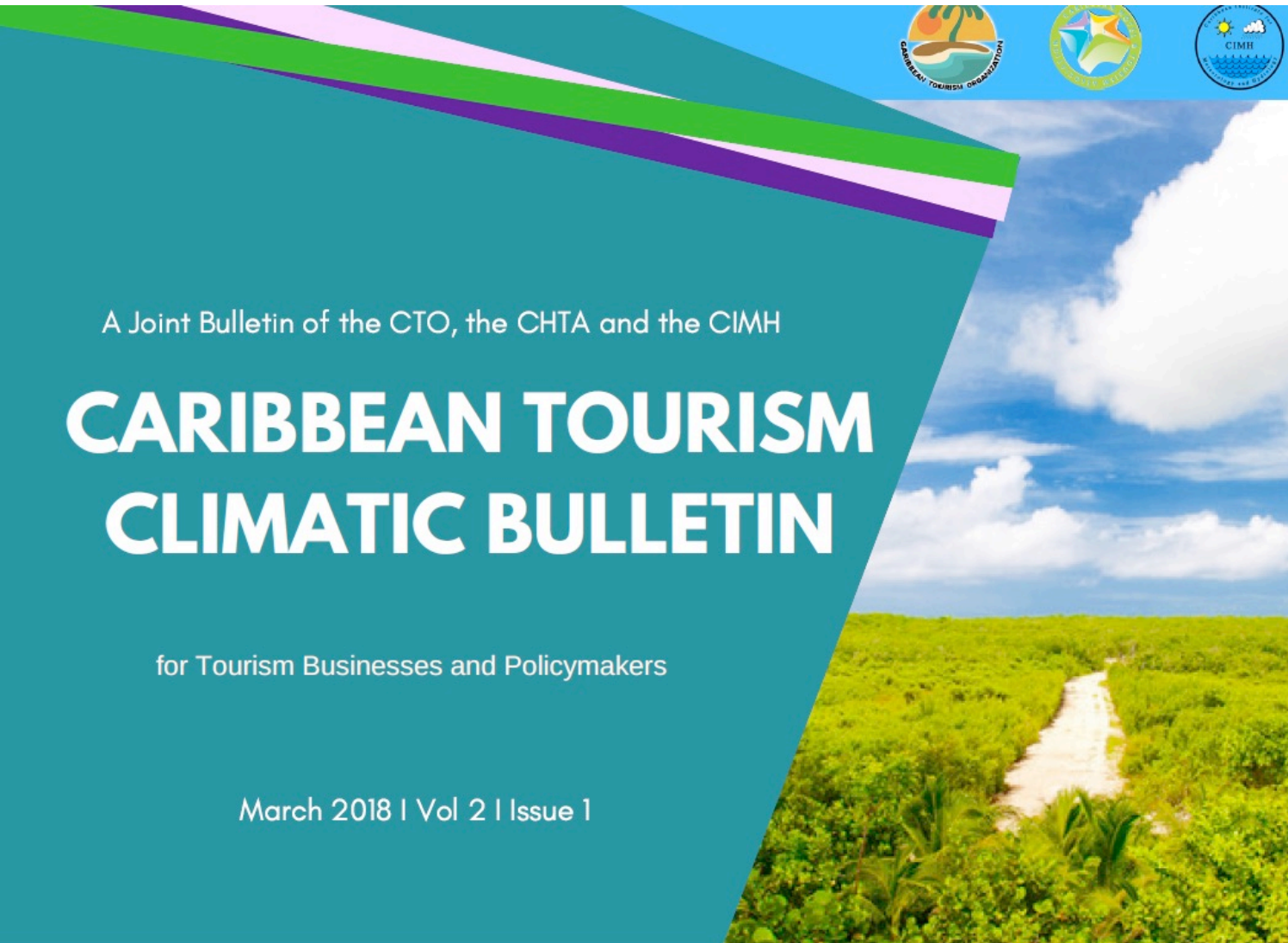
Respiratory Illness

- More frequent episodes of Saharan dust incursions into the Caribbean in the coming season may increase the risk of exacerbation of **allergic rhinitis** and **asthma** in susceptible persons. The short term drought and associated increase in dust, as well as, potential soot and smoke from bush fires may contribute to higher concentrations of airborne particulate matter. This could result in an increase in acute respiratory illnesses. Towards the month of May, this effect on acute respiratory illness may be offset by the increased humidity in the Bahamas, the Greater Antilles and the coastal Guianas, which may promote mold growth in damp and poorly ventilated buildings, leading to increased respiratory symptoms.

Well-Being and Mental Health

- Severe weather systems, which can come with a range of hazards, including high winds, landslides, flash floods, among others, may possibly affect Caribbean territories. With the possibility of tropical cyclones before the official start of the 2019 Atlantic Hurricane Season, health practitioners and administrators should maintain a state of **readiness**.

- **Food insecurity** may be a concern due to the potential for crop damage and loss or inability to have productive cropping resulting from ongoing drought.

- **Psychosocial impacts:** When disasters have seasonal patterns, like hurricanes, floods and drought, anxiety among survivors will increase as alerts on isolated events arise. Health Care Professionals are therefore advised to be sensitive to these issues, as they interact with patients.

RCOFs and Tourizm

A Joint Bulletin of the CTO, the CHTA and the CIMH

CARIBBEAN TOURISM CLIMATIC BULLETIN

for Tourism Businesses and Policymakers

March 2018 I Vol 2 I Issue 1

The Tourism-Climatic Bulletin (TCB) is jointly developed and disseminated by the Caribbean Tourism Organization (CTO), the Caribbean Hotel and Tourism Association (CHTA) and the Caribbean Institute for Meteorology and Hydrology (CIMH) to help the tourism sector manage climate risk.

The TCB based on climate outlook provides a overview of climate conditions in the concerned regions and communicates implications for the tourism sector 3 months in advance.

Tailored advice using climate information help tourism businesses and policymakers identify and prepare for favourable or inclement climate conditions in the Caribbean and source markets, before they occur.

https://rcc.cimh.edu.bb/caribbean-tourism-climatic-bulletin/

RCOFs and Tourism

Climate Advisories: Caribbean

March through May marks: 1) the first part of the long dry season in the ABC Islands, 2) the late dry season in Belize and the Lesser Antilles, and 3) the transition from the dry to wet season in the Greater Antilles and the Guianas. What should you do?

Tourism operators in south-eastern Haïti should monitor water resources in view of long-term evolving **drought**. Hotels in these territories should take precautionary measures such as rainwater harvesting and advise guests of these measures.

Climatically, March usually is the best month of the year for tourism operators to organise outdoor activities throughout the region, thanks to comfortable temperatures, many sunny days and fewer wet days. From May, due to the possibility of **wet spells** in the Greater Antilles and Belize, the chance of having **flash floods and long-term flooding** in at least one or two countries is high. In the event of flash floods, contamination of food and water supplies might occur, and proper planning / contingencies are highly encouraged.

Night-time and day-time **temperatures** in the Caribbean are forecast to increase to uncomfortably hot for some by May. There is also the possibility of **heatwaves** in Belize and Trinidad. Tourism practitioners may experience an increase in demand for cooling/hydration services (e.g. AC use and drinking water) in the upcoming period.

The **UV index** will be very high on sunny days., and there is a high risk of skin damage on sunny days due to intense UV radiation. Tourists should be encouraged to apply high SPF sunscreen lotion (preferably reef safe), and seek shaded areas between the hours of 10 AM and 3 PM.

No **coral bleaching** is expected until later in the year.

Though the 2018 Hurricane Season officially starts June 1st, tropical cyclones can and do occur in May. Such storms have regularly affected land in the region, mostly through excessive rainfall, leading to flooding and the possibility of landslides. Tourism operators should monitor advisories issued by their local National Met Services and Disaster Management agencies. The Caribbean Disaster Emergency Management Agency (http://cdema.org/) also provides Information Notes during the Hurricane Season for the region.

Thank you for your attention!