Ministry of Earth Sciences (MoES)
Summary of Important Developments –March, 2019

1. Important policy decisions taken and major achievements during the month: Provided in Annex I.

2. **Important policy aspects / matters held up on account of prolonged Inter- Ministerial consultations/ delays, etc.:** Nil

3. Compliance of COS decisions:

S.No.	**Number of COS decisions pending for compliance**	**Proposed action plan/timelines**	**Remarks**
1.	Dt 14/08/2014 PROPOSAL FOR KRILL FISHING MoES, in collaboration with MEA, will study the experience of different countries showing varied interest in krill fishing so that India could learn from their experiences.MEA, in collaboration with MoES, will examine and identify the countries with which India can collaborate for krill fishing. MoES will ascertain the interest of Indian industry in krill fishing and also explore the feasibility of Indian companies collaborating directly with foreign companies MoESwill study legislations enacted by other member countries before finalising the draft legislation as part of international convention obligations. MoES will bring out a paper on krill fishing giving a detailed account of demand analysis, financial viability, interest of industry, experiences of other countries, criteria for fishing license, existing knowledge gap, etc. Thereafter, the CoS will meet again to decide whether India should engage in commercial krill fishing.	The Ministry has examined the aspect of Krill fishing. Japan &Norway have developed expertise and these countries have been tentatively identified for collaboration on Krill fishing. Their experiences have been obtained. Indian Industries have been approached for Krill fishing to ascertain their interests. However, so far we have not received any response. The draft paper is prepared and suggestions of Cabinet Secretariat have been obtained.	A proposal has been received for krill fishing which is under examination.

- **Cases of sanction for prosecution pending in the Ministry for more than three months:** Nil

- **Particulars of cases in which there has been a departure from the Transaction of Business rules of established policy of the Government:** Nil

- **Status of implementation of e-Governance :** Being implemented

- **Status of Public grievances:**

No. of Public Grievances redressed during the month	No. of Public Grievances pending at the end of the month
17	39

8. Information on the specific steps taken by the Ministry/Department for utilization of the Space Technology based tools and applications in Governance and Development:

Potential Fishing Zone advisories are generated using the satellite derived parameters viz. Sea Surface Temperature, and Chlorophyll. Further, data from Global satellite data are used on continuous basis for generating short range and medium range weather forecasts.

9. (i) **Confirmation that the incumbency details of all posts in the Ministry/Department and its organizations falling under the purview of the ACC have been updated on AVMS**: It is confirmed that the incumbency details of all the posts in the Ministry/Department and its organizations falling under the purview of the ACC have been updated on AVMS and are placed at Annex-II.

(ii)**Status regarding compliance of the directions of ACC**: It is also confirmed that the directions of ACC are complied with.

(iii)**Status of cases where recommendations from PESB have been received but the proposals are yet to be submitted to the ACC Secretariat**: NIL

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Annex-I

Important policy decision taken and major achievements:

Consortium Agreement by the Ministry of Earth Sciences (MoES) with the Unified Model (UM) Consortium of U. K. Met Office (UKMO), Korea Meteorological Administration (KMA) and the Commonwealth of Australia through its Bureau of Meteorology and the Commonwealth Scientific Industrial and Research Organisation (CSIRO) was extended for a period of 5 years up to March, 2024, The UM Consortium/Partnership enables scientific and technical collaboration on a shared modelling system, across a range of modelling and science issues relevant for weather and climate prediction.

There was no matter pending before the Cabinet requiring decision/approval.

Minimum Government, Maximum Governance:

- Dissemination of Agromet Advisories to user communities through SMS and IVR technology is continued in the country through Kisan Portal and under PPP mode. Presently, 40 million farmers in the country are getting advisories through SMS directly.
- Adverse-weather SMS warnings are being sent through mobile to the State Government officials / Disaster-related officials / Central Government organizations/common man.
- Daily forecast along with warning and city forecast for many cities are disseminated through email to all users including state authorities, electronic and print media.

Atmospheric Observation Systems Network

Observation Type	Commissioned so far	Installations during the month	Data Reporting
Automatic Weather Station (AWS)	682	--	228
Automatic Rain Gauge (ARG)	1350	--	502
GPS Sonde based RS/RW Stations	43	--	38
Doppler Weather Radar (DWR)	25	--	23
Ozone (Ozone Sonde + Total Ozone)	05	--	05

Surface Ozone (Electrochemical Concentration Cell method)	07	--	07
Nephelometer	12	--	12
Sky Radiometer	20	--	19
Black Carbon Monitoring Systems (Aethalometer)	25	---	24
Air Quality Monitoring System (SAFAR)	10(Delhi) 10(Mumbai) 10(Ahmedabad)	--	10(Delhi) 10(Mumbai) 10(Ahmedabad)
Hydromet. (IMD & Extra-departmental excluding AWS & ARG)	---	--	2570
Aviation	79		79

Atmospheric Processes, Modelling and Services

Rainfall in March,2019: Rainfall during the month of March, 2019 was large excess in 0, excess in 1, normal in 7, deficient in 14, large deficient in 12 and no rain in 2 of 36 meteorological sub- divisions. The rainfall for the country as a whole for the month of March, 2019 has been recorded as 18.3 mm which is 48% above its Long Period Average (LPA) of 30.9 mm.

Temperature Scenerio: The Mean Temp for the month for the country as a whole was 24.9 °C; this was slightly below normal (-0.14°C).

Significant Weather Conditions:

(a) Heavy Rainfall Activity: Very heavy rainfall had been observed at isolated places over Tamil Nadu and Arunachal Pradesh and heavy rainfall at isolated places over Gangetic West Bengal and North Interior Karnataka on one day each during the month of March.

No. of Heavy rainfall events and (% correct) of spatial distribution of warnings during March 2019 is given below:

Lead Time	No. of Heavy Rainfall (Events): 4 (>64.4mm)
24 Hour	99%
48 Hour	99%
72 Hour	99%

(b) Western Disturbances and associated weather: Ten (10) Western Disturbances (WDs) affected the weather over the Western Himalayan region, during 28th Feb. – 1st March, 1st – 5th March, 5th -6th March, 5th – 10th March, 8th – 14th March, 12th – 16th March, 16th – 19th March, 18th – 22nd March, 22nd – 27th March and 27th – 31st March. Out of these, three active WDs with their induced cyclonic circulations caused fairly widespread to widespread rain / snow over the western Himalayan region and adjoining plains of northwest India. The remnants of these WDs' eastward movement often caused fairly widespread to widespread rainfall over Arunachal Pradesh and adjoining areas of Assam & Meghalaya and Nagaland as well. Low level wind confluence and moisture incursion, supported by favourable upper level wind flow caused fairly widespread rain / thundershowers with isolated thunder squalls and hailstorms over parts of central India on a few days during 14th – 20th March. Passage of WDs and associated weather caused the prevalence of below normal temperatures over major parts of north & central India during the first half of March. However, the day temperatures in general remained above normal by 2-4ºC over southern parts of Peninsular India all through the month. Frequency of active WDs reduced significantly from 15th March. North- south troughs and short lived cyclonic circulations

aided by heating of the land surface caused isolated thundershowers over Tamil Nadu, Kerala, Karnataka, Andhra Pradesh, Telangana and Maharashtra on 4-6 days each during the month.

(c) Thundersquall & Hailstorm activity: Thundersquall & Hailstorm activity during the month (till 0830 IST of 31-03-2019) is given in the table below**:**

S.No.	Region	TS Days	Maximum TS Activity	Hail	Squall
1.	South Peninsular India	25	31-03.19	Nil	Nil
2.	Northwest India	14	11-03.19	Dehradun (04 March), Batote (13, 19, 20 & 21 March), Mukteshwar (14 & 20 March)	Nil
3.	Northeast India	20	22-03-19	Nil	Nil
4.	East India	19	22-03-19	Gangtok (20 March), Tadong (20 March), Alipore (22 March), Coochbehar (31 March), Jalpaiguri (31 March)	Alipore (17 March), Haldia (17 March), Digha (17 March), Alipore (22 March), Dumdum (22 March), Gaya (26 March)
5.	Central India	07	20-03-19	Chinddwara (20 March)	--

Note: The convective activities mentioned above had been predicted and corresponding warnings were issued about 4-5 days in advance of the occurrence of the event.

(d) Cold wave Cold wave conditions were observed at isolated pockets over Madhya Pradesh only on one day (1st March). The lowest minimum temperature of 5.0ºC had been recorded at Rewa (East Madhya Pradesh) and at Narnaul & Karnal (Haryana) on 1st March 2019, over the plains of the country during the month. Cold day conditions were observed in some parts over West Madhya Pradesh, East Rajasthan and East Uttar Pradesh on one day each; at isolated pockets over East Madhya Pradesh on 2 days and over Haryana, Chandigarh & Delhi, West Madhya Pradesh and West Uttar Pradesh on one day each during the month.

(e) Heat wave: Heat wave conditions were observed in many parts of Madhya Pradesh on 2 days, in some parts of Rajasthan and Gujarat on 2 days and at isolated pockets over interior Maharashtra, Tamil Nadu and Rayalaseema on 2 days each. The highest maximum temperature of 44.7ºC had been recorded at Khargaon (West Madhya Pradesh) on 31st March 2019, over the plains of the plains of the country during the month.

Modelling and Research

Atmospheric Reanalysis for years 2017-18 at T574 resolution is completed by National Centre for Medium Range Weather Forecasting(NCMRWF). This work is carried out to support Extended Range Forecast of IMD.

Bulletins / Operational Reports/ Services during the month

All India Weather Bulletins, All India Inference and Severe Weather Warnings 124 each and 34 Heat Wave Bulletins were issued during the month; 02 number of Press Releases related to enhanced rainfall/ thunderstorm activity over northern India and one on seasonal outlook for temperatures during March to May 2019 were issued; Current Weather Outlook and Forecast for next two weeks (4) and All India Weekly Weather Reports (4) were also issued during the month.

Sixty Two (62) mountain weather bulletins including severe weather warnings for western and central Himalayan region were issued during the month.

A total of 31 Nowcast Guidance Bulletins for severe weather were issued (daily once) during the month.

Daily All India Weather Summary and Weekly Weather Reports and are being brought out on routine basis.

Climate Diagnostics Bulletin of India for February 2019 and Winter Season (January-February 2019) was brought out and has been uploaded in IMD Pune website.

Gridded Standardized Precipitation Index (SPI) & Standardized Precipitation Evapotranspiration Index (SPEI) at 0.5 *0.5 degree resolution at 4 weekly 1, 2, 3 & 4 monthly time scales were computed and maps of same timescales are being uploaded at weekly basis on IMD Pune website.

Monthly El Niño–Southern Oscillation (ENSO) and Indian Ocean dipole (IOD) Bulletin for March 2019, Seasonal Climate Outlook for South Asia for February to May 2019 and Seasonal Outlook for the Temperatures for March to May 2019 were issued. (www.imdpune.gov.in/Clim_Pred_LRF_New/Products.html)

Geoscience Research

Seismological Observational Network

Observation Type	Target	Commissioned so far	Data reporting during the month
Seismic stations	115	115	110
GPS stations	40	20#	17

#10 VSATS (6) have been dismantled to shift them to new locations.

Earthquake and Tsunami monitoring

Earthquake: 20 earthquakes were monitored in the Indian region out of which 3 events were greater than magnitude (M) of 5.0.

Tsunami**:** 1 seabed earthquakes (M> 6) with a potential to generate tsunami occurred. This information was provided within 12 minutes of occurrence.

Ocean Observation System

Type of Platform	Target	Commissioned till March, 2019	Data received during March, 2019
Argo Floats *	200	328	138
Drifters*	150	108	2
Moored Buoys	16	22	18
Tide Gauges	36	36	26
High Frequency(HF) Radars	10	10	10
Current Meter Array	10	11	2
Acoustic Doppler Current Profiler(ADCP)	20	20	17
Tsunami Buoys	7	9	4
Wave Rider Buoy	16	22	15

*The remaining floats/drifters have completed their life time and as such no data can be received from them.

Ocean Science Services

No	Types of forecasts	No. of advisories issued during the month
1	Integrated Potential Fishing Zone (PFZ) advisories (Sea Surface Temperature(SST), Chlorophyll., wind)	31
2	Tuna Fishing Advisories	31
2	Ocean State Forecast(OSF)-Wave, Wind, Currents, SST, MLD and D20 forecasts	31
3.	Near Real time global ocean analysis (5-day averaged)	6
4.	Real time global ocean analysis (daily)	31
5.	Coral Bleaching Alert System	10

Perigean Spring Tide Alert issued for the coastline of India for the period during February 19-24, 2019.

Topographic survey of Exclusive Economic Zone(EEZ)

Area surveyed during the month: 8250 sq. km.

India UK Water Centre (IUKWC)

Third IUKWC Grassroots Field Exposure Initiative (GFES):The GFES was conducted by IUKWC at IISER, Bhopal, Madhya Pradesh from 25th Feb – 2nd March 2019. The event brought together a team of 24 scientists, both from India and UK, who were given the opportunity to gain a closer perspective of the management of water at ground level, its associated issues, as well as the current use, and need for scientific outputs by end users. A series of field visits were organized that were aimed to help participants understand the impacts of energy, agriculture and abstraction on ground and surface water quantity and quality in the region. The team of scientists were exposed to grassroots-level interventions that centred around improving land and water management..

Second User Engagement Initiative (UEI) on `Water Resource Management and Supply in Central India' UEI was conducted by IUKWC at IISER, Bhopal (M.P) during 28th February - 2nd March 2019. The event aimed to address the key scientific needs of the water resource management and supply sector in Central India. The 3-days User Engagement Initiative brought together over 20 scientists and about 30 stakeholders from the government (State, Regional and National) and NGO sectors, as well as academic organisations based in Central India. The event enabled discussions on the challenges and needs of water resource managers and provided researchers an opportunity to share outputs from recent joint Indo-UK science that could be used to support water resource management and security in the region.

Capacity Building and Outreach

A Brainstorming Meeting/Workshop on Artificial Intelligence (AI) and Machine Learning (ML) Techniques in Earth Science Problem was organized at IITM during 25-27 March 2019. The event gathered the researchers working on AI/ML and scientists from Earth sciences (such as Atmosphere, ocean and other weather and climate related areas) to exchange expertise and develop innovative ideas and strategies to demonstrate a wide range of open problems utilizing the potential of AI/ML Around 45 Delegates from MOES, IMD, IITs, IISc participated in the meeting

A discussion workshop was conducted with UK scientists on Weather and Climate Science for Service Partnership (**WCSSP**) projects and work packages on 14-3-19 at National Centre for Medium Range Weather Forecasting(NCMRWF), Noida. Plans related to coupled data assimilation, regional coupled modeling, model verification and diagnostics were discussed along with planned science activities between India and UK.

In association with Vidyasagar University, INCOIS organized two day (29th -30th, March,2019) National Workshop on "Operational oceanography to serve coastal community of West Bengal" at Digha, Purba Medinipur, West Bengal to make ware stake holders on INCOIS services and to sensitize scientific and academic community on the necessity of Operational Oceanography for a sustainable future.

NIOT team won the 'National Meritorious Invention Award 2018' of National Research & Development Corporation (NRDC) for the development of Polar and Shallow water ROV for the year 2018.

An International conference on Renewable Energy & Water (INDACON-19) was organized at NIOT during March 7-8, 2019 with joint collaboration from Indian Desalination Association (InDA) and IEEE-OES.

Training course on "Marine Phytoplankton - optics, pigment and taxonomy" was conducted at ITCO-ocean during 25 - 29 March, 2019. Eighteen (18) participants from various national institutes and universities across India participated in this course. Faculty members were from INCOIS.

Grid Connected Rooftop Solar PV (Photovoltaics) System of 121.5 kWp Capacity was commissioned at NIOT Chennai on 8th March 2019 as a Green Energy initiative.

Ministry of Earth Sciences (MoES) organised a one day DERCON Workshop at IITM on 12 March 2019. DERCON stands for MoES Digital Earth Consortium.

International Workshop on Chemistry Climate Interaction (IWCCI) was held at IITM during 12-15 March 2019. This Workshop brought together talented young scientists, international and national experts in regional and global coupled chemistry-climate observations and modeling. Around 7 international experts, 15-20 national experts and approximately 40 Indian participants from various MoES organizations and research institutions participated in this workshop.

A Media Workshop for on "Dissemination and Outreach of Weather Forecast & Warning for Media Persons" was conducted at Nagpur on 28th March 2019.

Telangana State Disaster Management, TSDPS, UNICEF Hyderabad, IMD & IMS Hyderabad Chapter jointly organised a workshop on "Extreme Weather Events with reference to Heat Wave over Telangana State" at Hyderabad on 6th March 2019.
A Media Workshop on "IMD's Role and Technological Advances made by the Department" was organized at Kolkata on 8th March 2019.
A Media Workshop on "Nowcast and Weather Services" was organized at M.C. Bhubaneswar on 14th March 2019.
A Media Workshop on "Weather Forecasting and Weather Services" was conducted at Met.Centre Ahmadabad on 22nd March 2019.

World Meteorological Day-2019 was celebrated on the theme "The Sun, the Earth and the Weather" on 22.03.2019 at various offices of IMD across India.

Utilization of Ocean Research Vessels during the month

Vessel	Days at Sea / Utilization	Maintenance/ Inspection /Scientific Logistics / Cruise Preparation	No. of Cruise
Sagar Nidhi	28	3	2
Sagar Manjusha	23	8	2
Sagar Purvi	12	19(maintenance, bad weather)	1
Sagar Kanya	23	8	2
Sagar Sampada	17	14(assessment of fire incident)	1

Publications in Science Citation Index(SCI) journals and PhDs awarded

Subject	Publications			Ph.Ds		
	April, 2018 - February, 2019	March, 2019	Total	April, 2018 - February, 2019	March, 2019	Total
Atmospheric Sciences	183	33	216	6	--	6
Ocean Science and Technology	69	5	74	2	-	2
Polar Sciences	23	2	25	-	-	-
Geosciences and resources	7	-	7	1	--	1
Total	282	40	322	9	--	9