Ministry of Earth Sciences (MoES)
Summary of Important Developments –December,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 MoES will 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 mooted through NITI Aayog for collaboration with Norway for krill fishing.

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
27	19

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:

Transfer of Technology of the design and development of Remotely Operated Vehicle was completed on Non-Exclusive basis to Engineers of Bharat Electronics Limited (BEL), with class room lectures and operational training with Shallow water Remotely Operated Vehicle (ROV) at Acoustic Test Facility (ATF), National Institute of Ocean Technology(NIOT) from 16.12.19 to 23.12.19.

A three-day International Symposium on "Advances in Coastal Research with special reference to Indo-Pacific (AdCoRe IP-2019)" was organised by National Centre for Coastal Research, Chennai at NIOT Campus in Chennai from 17-19 December 2019 with participation of 350 researchers from India and abroad in 8 research themes viz. Coastal Erosion and Sediment Transport, Marine Pollution and Marine Litter, Forecasting Coastal Hazards and Sea Level Change, Coastal Vulnerability, Floods and Modeling, Coastal Ecosystems and Modeling - SDG 14, Climate Change and its Impacts on the Coasts, Blue Economy (Resources, Energy) and Coastal Governance and Ocean Technologies and Small Island Developing States.

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, 40.1 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)	300	--	213
Automatic Rain Gauge (ARG)	1356	--	352
GPS Sonde based RS/RW Stations	56	--	56
Doppler Weather Radar (DWR)	* 25	--	25
Ozone (Ozone Sonde + Total Ozone)	04	--	04
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)	---	--	2935
Aviation	79	--	79
Radiation Stations	45	--	45

***** Includes 2 Doppler Weather Radar of ISRO.

Atmospheric Processes, Modelling and Services

Major Weather Systems during the Month

i) Cyclonic Storm 'Pawan' over southwest Arabian Sea and adjoining equatorial Indian Ocean during 02-07 December: A low pressure area developed over southwest Arabian Sea (AS) and adjoining equatorial Indian Ocean in the early morning (0530 hrs IST) of 30th November, 2019. It lay as a well marked low pressure area over the same region in the early morning (0530 hrs IST) of 2nd December. Under favourable environmental conditions, it concentrated into a depression over southwest Arabian Sea & adjoining equatorial Indian Ocean in the same is evening (1730 hrs IST). Moving north-northwestwards, it further intensified into a deep depression over southwest Arabian Sea & adjoining equatorial Indian Ocean in the early morning (0530 hrs IST) of 3rd December. It intensified into the cyclonic storm "PAWAN" (pronounced as PAVAN) in the early morning (0530 hrs IST) of 5th December, 2019 over southwest Arabian Sea. Moving west-southwestwards, it crossed Somalia coast near latitude 7.4°N and longitude 49.6°E during 0730 to 0830 hrs IST of 07th December 2019 as a cyclonic storm with a wind speed of 60-70 kmph gusting to 80 kmph. It weakened into a deep depression in the morning (0830 hrs IST) of 07th December, 2019 over coastal Somalia and neighborhood. Moving westwards, it weakened into a depression in the same afternoon (1430 hrs IST) and into a well marked low pressure area over north Somalia & adjoining Ethiopia in the same night (2030 hrs IST of 7th December). Moving further westwards, it lay as a low pressure area over Ethiopia in the early morning of 8th December and became insignificant thereafter.

ii) Deep Depression over southeast Arabian Sea and adjoining Lakshadweep area during 03-05 December: A low pressure area formed over southeast Arabian Sea (AS) and adjoining Lakshadweep area in the morning (0830 hrs IST) of 1st December, 2019. It lay as a well marked low pressure area over southeast AS and adjoining areas of eastcentral AS & Lakshadweep in the morning (0830 hrs IST) of 3rd. Under favourable environmental conditions, it concentrated into a depression in the same midnight (2330 hrs IST of 3rd December) over eastcentral AS and adjoining areas of southeast AS & Lakshadweep. Moving northwestwards it intensified into a deep depression in the early morning (0530 hrs IST) of 04th December over the same region. Thereafter, it entered unfavourable environment and weakened into a depression in the early morning (0530 hrs IST) of the 5th December, 2019 over eastcentral Arabian Sea. It further weakened into a well marked low pressure area over the same region in the evening (1730 hrs IST) of 05th December 2019, into a low pressure area in the early morning (0530 hrs IST) of 6th December over the same region and became less marked in the same morning (0830 hrs IST). It occurred simultaneously with CS Pawan over southwest AS.

iii) Deep depression over southwest Arabian Sea during 08-10 December : A low pressure area formed over southeast Arabian Sea and adjoining equatorial Indian Ocean in the early morning (0530 hrs IST) of 7th December, 2019. It lay as a well marked low pressure area over southeast & adjoining southwest Arabian Sea in the early morning (0530 hrs IST) of 8th December. It concentrated into a depression in the same afternoon (1430 hrs IST) over southwest Arabian Sea. It moved west-northwestwards and intensified into a deep depression in the early morning (0530 hrs IST) of 9th December over the same region. Thereafter, it entered into unfavourable environment and weakened into a depression over southwest AS in the same evening (1730 hrs IST of 9th December) and into a well marked low pressure area around noon (1130 hrs IST) of 10th December over southwest AS.

India Meteorological Department (IMD) maintained round the clock watch over the north Indian Ocean and all the systems were monitored and predicted well in advance with the help of available satellite observations from INSAT 3D

and 3DR, polar orbiting satellites and available ships & buoy observations in the region. Various numerical weather prediction models developed by Ministry of Earth Sciences (MoES) institutions and dynamical-statistical models were utilized to predict the genesis, track, landfall and intensity of the cyclone. A digitized forecasting system of IMD was utilized for analysis and comparison of various models guidance, decision making process and warning product generation.

iv) Fog-Delhi: A prolonged spell of dense to very dense fog had been observed over Delhi on 30th December 2019 with poor visibility conditions prevailing for more than 12 hours, from early morning hours till noon. This has caused the record breaking lowest maximum temperature of Delhi on 30th December 2019.

v) Temperature Scenario: The Mean Temp for the month for the country as a whole was 20.55°C; this was slightly above normal (+0.06°C).

a) Severe cold wave conditions have been observed at many places over Haryana, Chandigarh & Delhi on two days. it has been observed at isolated places over Rajasthan on 4 days and over Jammu & Kashmir, Vidarbha, Odisha, Bihar, East Uttar Pradesh, Haryana, Chandigarh & Delhi, Punjab, Madhya Pradesh and Chhattisgarh on one or two days during the month.

b) Severe cold day conditions prevailed at most places over Haryana, Chandigarh & Delhi, Uttar Pradesh, Punjab and Bihar on 4 to 5 days; at many places over Madhya Pradesh on two days; at a few places over Madhya Pradesh and Jharkhand on one day each and at isolated places over Rajasthan on 5 days and over Jammu & Kashmir, Himachal Pradesh Gangetic West Bengal and Uttarakhand on one or two days during the month.

c) Delhi (Safdurjang) recorded the coldest day for the month of December on 30th December 2019 with a maximum temperature of 9.4°C (about 11.4 degrees below normal) since 1901.

d) The lowest minimum temperature of -1.0°C had been recorded at Sikar (East Rajasthan) on 28th December 2019 over the plains of the country during the month.

vi) Heavy Rainfall Activity: No. of Heavy/Very Heavy Rainfall Events (>64.4 mm) and Warning Skill (correctness in %) of spatial distribution in issued warnings during the month is given below:

Lead Time of warning issued	No. of Heavy Rainfall Events (>64.4 mm): 31 correctness in % (Rainfall >64.4mm)
24 Hour	97%
48 Hour	98%
72 Hour	98%

vii) Rainfall Scenerio: The rainfall for the country as a whole for the month of December 2019 has been recorded as 19.2 mm which is 10% above to its Long Period Average (LPA) i.e., 17.4 mm and for the NE Monsoon season i.e., October to December 2019 the rainfall has been recorded as 60.0 mm which is 29% above to its Long Period Average (LPA) i.e., 123.8 mm.

viii) Western Disturbance and Easterly wave along with associated weather:

Five numbers of Western Disturbances (WDs) affected the NW India during the month. These WDs have caused fairly widespread to widespread rainfall/snowfall with isolated intense rainfall activity over Western Himalayan Region. One or two among these WDs have caused scattered to fairly widespread rainfall/thunderstorm activity along with isolated hailstorm over the adjoining plains of NW India.

Movement of an active easterly wave has caused extremely heavy rainfall over Lakshadweep, heavy to very heavy over Tamil Nadu, Puducherry & Karaikal and heavy rainfall over Coastal Andhra Pradesh and Rayalaseema in the first week of the month.

Interaction between the Western Disturbance and easterly wave has caused isolated to scattered rainfall/thunderstorms activity with isolated intense activity over parts of Central India during the second week of the month.

ix) Thundersquall & Hailstorm activity: Thundersquall & Hailstorm activity during the month is given in the table below**:**

S.No.	Region	TS Days	Date of Maximum TS Activity	Hail Events	Squall Events

1.	South Peninsular India	14	02-12-19	Nil	Nil
2.	Northwest India	04	26-12-19	01 (Aligarh on 12-12-19)	01(Safdarjung on 12-12-19)
3.	Northeast India	01	13-12-19	Nil	Nil
4.	East India	03	13-12-19, 14-12-19 & 15-12-19	Nil	Nil
5.	Central India	04	12-12-19	Nil	Nil
6.	West India (Goa only)	0	Nil	Nil	Nil

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. In addition to that, nowcasts were also given by corresponding RMCs/MCs with respect to these events.

Bulletins / Operational Reports/ Services

Bulletins/Warnings/Press Releases Issued**:** Bulletins for National level Disaster Managers, special tropical weather outlook/tropical cyclone advisories for WMO/ESCAP Panel Member Countries(44), All India Weather Bulletins(124), All India inference and severe weather warnings(124), Press Releases related to related to (a) intense rainfall activity(5),(b) Related to Fog, Cold Wave & Cold Day(6), (c)current weather status and outlook for next two weeks (3),(d)Cyclones/Depressions/Low Pressures(12), Nowcast Guidance Bulletins for severe weather (31), All India Weekly Weather Reports (4), Mountain weather bulletins including severe weather warnings for western and central Himalayan region(62),

Publications & Operational Reports issued: Daily All India Weather Summary and Weekly Weather Reports, Report on extremely severe cyclonic storm Maha was circulated to all stake holders and uploaded on RSMC website.http://www.rsmcnewdelhi.imd.gov.in/images/pdf/publications/preliminary-report/maha.pdf, El Nino Southern Oscillation (ENSO) bulletin for the month of December 2019 ,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 computed and maps of same timescales are being uploaded at weekly basis on IMD Pune website,

Geoscience Research

Seismological Observational Network

Observation Type	Target	Commissioned so far	Data reporting during the month
Seismic stations	115	115	105
GPS stations	40	20#	19

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

Earthquake and Tsunami monitoring

Earthquake: 27 earthquakes were monitored in the Indian region out of which 5 events were greater than magnitude (M) of 5.0.
Tsunami**:** 2 seabed earthquakes (M> 6) with a potential to generate tsunami occurred. This information was provided within 12 minutes of occurrence for both the events.

Ocean Observation System

Type of Platform	Target	Commissioned till November, 2019	Data received during November, 2019
Argo Floats *	200	368	146
Drifters*	150	108	5
Moored Buoys	16	22	17
Tide Gauges	36	36	31
High Frequency(HF) Radars	10	12	9

Current Meter Array	10	11	0
Acoustic Doppler Current Profiler(ADCP)	20	20	17
Tsunami Buoys	7	9	5
Wave Rider Buoy	16	24	12

*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	30
2	Ocean State Forecast(OSF)-Wave, Wind, Currents, SST, MLD and D20 forecasts	31
4.	Real time global ocean analysis (daily)	31
5.	Coral Bleaching Alert System	10

Polar Research

As a part of the MoU signed between National Centre for Polar and Ocean Research (India) and National Institute of Polar Research (Japan) during March 2019, a sediment coring project was initiated with participation of 2 Indian and 3 Japanese scientists and a suite of sediment cores were collected from different lakes of Schirmacher Oasis, Antarctica with their length varying from 50 cm to 800 cm. The longest sediment core of 800 cm was collected from an epishelf lake which is the longest retrieved for Schirmacher Oasis and for Antarctica. Also, erratic boulders and bedrock samples from this region were collected for cosmogenic dating to reconstruct the deglaciation and glaciation events in the region. This is being carried for the first time in Schirmacher Oasis. To generate a base line data for the biological community for the lakes of Schirmacher Oasis, over 40 lakes from Schirmacher Oasis were sampled for DNA and pigments from lake water.

Ocean Technology

A tripartite agreement for transfer of technology "Lutein production from marine microalgae" was signed between NIOT, M/s. Vectrogen Biologicals Pvt. Ltd, Hyderabad and NRDC on 19th November 2019.

A Memorandum of Understanding was signed between NIOT and BARC, Mumbai for "Lipid Hyperaccumulation in microalgae employing radiation and induced mutation selection for Biodiesel production" on 19.11.2019.

Topographic Survey of Exclusive Economic Zone

Area covered during the month:= 19,250 sq km

Marine Living Resources Programme (MLRP)

A pilot expedition to Angria Bank (West cost of India)onboard FORV Sagar Sampada to assess the biodiversity using SCUBA diving and acoustic technology was undertaken in collaboration with Wild life Conservative Society, India. During the expedition, 13 diving trips which included 69 dives were conducted at the bank for the qualitative and quantitative biodiversity survey. Apart from the SCUBA diving, structured acoustic survey were conducted all along the bank to map the extension of the bank and current pattern using EK-60 echo sounder and ADCP.

Another expedition to the Andaman Sea during FORV Sagar Sampada cruise no. 388 yielded first zoogeographical record of the reef-associated rock crab *Cyrtocarcinus truncatus* for the Indian waters. This species is previously known only from Hawaii and is only the second overall record so far. It was collected with a chain dredge at 69 meters depth in the Andaman Sea off Nicobar.

Study tour of Parliamentary Standing Committee

Department-related Parliamentary Standing Committee on Science and Technology, Environment, Forest & Climate Change undertook study visits to NCESS, Trivandrum and NIOT, Chennai on December16 and December, 28, 2019 respectively . The committee reviewed the activities and appreciated the achievements made by NCESS and NIOT .

Capacity Building and Outreach

UNESCO-IOC Tsunami Ready Workshop was organised in collaboration with Indian Ocean Tsunami Warning and Mitigation System (IOTWMS) and Indian Ocean Tsunami Information Centre (IOTIC) for Coastal Disaster Management Officers of India during 10-12 December 2019 at Indian National Centre for Ocean Information Services (INCOIS), Hyderabad.

A Workshop on 'Plastics in the polar areas' was organized by Norwegian Polar Institute(NPI) and National Centre for Polar and Ocean Research (NCPOR) on 3rd December 2019 at NCPOR.Goa. The Ambassador, Hans Jacob Frydenlund of Norwegian Embassy along with other Norwegians and Indians also participated in the workshop. This Workshop aimed to initiate dialogue on collaboration in the said research domain.

International Training workshop on "Operational Climate Service" was jointly organized by India Meteorological Department and Regional Integrated Multi-Hazard Early Warning System, Bangkok, Thailand at Meteorological Training Institute (MTI), Pashan, Pune during 9th to 20th December 2019.

International Training Centre on Operational Oceanography (ITCOOcean) conducted a training course on "Ocean Data Utilization and Ocean Observation System" during 02–05, December 2019. Thirty seven (37) students from IIT-Bhubaneswar & IIT Kharagpur participated in this programme.

ITCOOcean conducted a training course on "Remote Sensing and GIS Applications using QGIS" during 16-20, December, 2019. Thirty one (31) Young Faculty/Research Scholar and Post-Graduate Students from School Of Earth Sciences, SRTM University, Nanded, Maharashtra attended the training course.

5 days training program was arranged at Indian Institute of Tropical Meteorology(IITM) for 10 Flight Lieutenant from Indian Air Force, Directorate of Meteorology, during 9-13 December 2019.

National Symposium on "Meteorological Advancement and its Utilization" was held on 24th December 2019 at New Delhi to commemorate 70 years of Accomplishment of research journal Mausam. On this occasion a Souvenir containing the overview of journey of the journal "MAUSAM" in last seven decades and the summary of the main research findings/papers published in the journal "MAUSAM" in the fields of Meteorology, Geophysics, Hydrology, Seismology and other allied subjects were released.

"On-Site Training Workshop on Preparation for approaching Fog Season 2019-2020" was organised at MWO Palam (New Delhi) on 10th Dec 2019.

Hands-on training in open sea fish cage fabrication, deployment and culture management was conducted during 11-12, 2019 at Kollam, Kerala by NIOT. Forty nine participants inclusive of fish farmers, promoters and Kerala Fisheries Department officials participated in the programme.

National Centre for Medium Range Weather Forecasting(NCMRWF) organized a workshop on "Official Languages Act, 1963 and Official Languages Rules, 1976 problems and solutions" at NCMRWF, Noida on 18.12.2019. The workshop was attended by 60 officers and staff of NCMRWF.

Utilization of Ocean Research Vessels during the month

Vessel	Days at Sea / Utilization	Maintenance/ Inspection /Scientific Logistics / Cruise Preparation	No. of Cruise
Sagar Nidhi	26	5	2
Sagar Manjusha	25	6	2
Sagar Purvi	8	22(maintenance)	1
Sagar Tara	20	11	2
Sagar Kanya	25	6	2
Sagar Sampada	21	10	2

Subject	Publications			Ph.Ds		
	April-November, 2019	December, 2019	Total	April-November, 2019	December, 2019	Total
Atmospheric Sciences	121	15	136	-	2	2
Ocean Science and Technology	70	8	76	1	-	1
Polar Sciences	18	1	19	-	-	-
Geosciences and resources	14	2	16	2	-	2
Total	223	26	249	2	2	5

Annex – II

No.MoES/20/01/2017-Estt.
Government of India
Ministry of Earth Sciences

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Dated, the January, 2020

CERTIFICATE

(FOR THE MONTH OF DECEMBER, 2019)

It is certified that the detailed status regarding all the posts pertaining to Ministry of Earth Sciences have been updated on AVMS as on last day of the month of December, 2019. A summary of the status is given below:-

(a)	The total number of posts required to be entered on AVMS	- 13
(b)	Number of posts filled as on date	- 12
(c)	Number of posts totally vacant as on date	- 01
(d)	Number of posts under additional charge arrangement	- 00
(e)	Number of posts that would fall vacant during the next 6 months	- 02

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