Ministry of Earth Sciences (MoES)
Summary of Important Developments –May, 2018

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
37	51

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:

1. The monsoon arrived in Kerala on 29th May, 2018 exactly as per the forecast of IMD made on 17th May, 2018.

2. As per the Second Stage Long range forecast of southwest monsoon rainfall-2018, rainfall over the country as a whole for the 2018 southwest monsoon season (June to September) is most likely to be NORMAL (96% to 104% of long period average (LPA)).Region wise, the season rainfall is likely to be 100% of LPA over North-West India, 99% of LPA over Central India, 95% of LPA over South Peninsula and 93% of LPA over North-East India all with a model error of ± 8 %..The monthly rainfall over the country as whole is likely to be 101% of its LPA during July and 94% of LPA during August both with a model error of ± 9 %.

3. The global high resolution (12 km) NCMRWF Ensemble Prediction System (NEPS) with 22 members is made operational in the new High Performance Computer (HPC) 'Mihir' for generating probabilistic forecasts. Further, the upgraded global 12-km NCMRWF Unified Model (NCUM) along with its upgraded Data Assimilation System is also made operational in 'Mihir'.

4. A MoU was signed between SavitribaiPhule Pune University (SPPU), Pune, and IndianInstitute of Tropical Meteorology (IITM), Pune with a view to exploit the scientific expertise of the IITM in the human resource development for training manpower in the area of Atmospheric Sciences and Environmental Sciences on 4th May 2018.

5. IITM provided scientific assistance to Bihar State Disaster Management Authority (BSDMA), Govt of Bihar for Assessment of Air Quality of Patna in various Micro-environments.

6. Memorandum of Understanding (MoU) with Lakshadweep Administration was signed on 21 May 2018 at MoES, New Delhi for the establishment of Low Temperature Thermal Desalination plant powered by Ocean Thermal Energy Conversion (OTEC) at Kavaratti.

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Minimum Government, Maximum Governance:

Dissemination of Agromet. Advisories to users community through SMS and IVR technology is being continued in the country through Kisan Portal and under PPP mode. Presently 22.7 Million farmers in the country are getting advisories through SMS directly.

Adverse weather SMS warning are being sent through mobiles to State Govt. officials / Disaster related officials /Central Govt. Organization/Common men.

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	Data Reporting
Automatic Weather Station (AWS)	682	350
Automatic Rain Gauge (ARG)	1350	609
GPS Sonde based RS/RW Stations	43	43
Doppler Weather Radar (DWR)	25	23
Ozone (Ozone Sonde + Total Ozone)	05	05
Surface Ozone over Delhi (Electrochemical Concentration Cell)	07	07
Nephelometer	12	12
Sky Radiometer	20	16
Black Carbon Monitoring Systems (Aethalometer)	16	15
Air Quality Monitoring System (SAFAR-Delhi)	10	10
Hydromet. (IMD & Extra-departmental excluding AWS & ARG)	---	2341@
Aviation	76	76

@ Data received from various agencies viz. Air Force, Railways, Central Water Commission, State Agriculture, State Irrigation and India Meteorological Department (IMD)

Atmospheric Processes, Modeling and Services

Significant weather events:

Cyclonic Storm (CS) Sagar originated from a low pressure area which formed over South-West Arabian Sea (AS) in the morning (0300 UTC) of 14th May. Under favourable environmental conditions, the low pressure area concentrated into aDepression (D) over Gulf of Aden in the evening (1200 UTC) of 16th May. Moving west-northwestwards, it intensified into a deep depression (DD) in the early morning (0000 UTC) and further into a cyclonic storm (CS) **"Sagar**" in the morning (0300 UTC) of 17th May 2018 over Gulf of Aden. Thereafter, it moved west-southwestwards and crossed Somalia coast near latitude 10.65^{0}N and longitude 44.0 ^{0}E as a cyclonic storm with wind speed of 70-80 kmph gusting to 90 kmph between 1330 and 1430 IST of 19th May. Moving further west-southwestwards, it weakened into a DD in the mid night (1800 UTC) of 19th, D in the early morning (0000 UTC) of 20th and well-marked low pressure area (WML) over Ethiopia and adjoining Somalia in the morning (0300 UTC) of 20th.

Themovement of a low pressure area towards Yemen coast was predicted 72& 108 hours in advance of formation of low pressure area & D respectively. The landfall point forecast errors for 12, 24, and 36 hrs lead period were 6.6, 40.4, and 100.5 km respectively and the landfall time forecast errors for 12, 24, and 36 hrs lead period were 1.0, 1.0, and 5.5 hrs respectively. The track forecast error for 12, 24, and 48 hrs lead period were 42.7, 49.6, and 117.2 km respectively, which is significantly less than the average track forecast errors of 57, 93, and 144 km during last five years (2013-17). The track forecast skill was about 18%, 53%, and 64% against the long period average (LPA) of 45%, 55%, and 68% during 2013-17 for 12, 24 and 48 hrs lead period respectively. The root mean square error (RMSE) of intensity (wind) forecast for 12, 24 and 48 hrs lead period were 2.7, 8.1 and 12.7 knots against the LPA of 8.7, 14.0, and 20.6 knots respectively. The skill based on RMSE of intensity (wind) forecast for 12, 24 and 48 hrs lead period was 53.8, 22.1 and 47.5% against the LPA of 28.0, 40.1 and 60.0% respectively.

Extremely Severe Cyclonic Storm (ESCS) Mekunu originated from a low pressure area which formed over southeast Arabian Sea (AS) in the morning (0300 UTC) of 20th May. Under favourable environmental conditions, the low pressure area concentrated into aDepression (D) over southwest AS in the evening (1200 UTC) of 21st May. Moving west-northwestwards it intensified into a deep depression (DD) in the morning (0300 UTC) of 22nd May. It then moved north-northwestwards and intensified into a cyclonic storm (CS) **"Mekunu**" in the evening (1200 UTC) of same day over southwest AS. It continued to move north-northwestwards, intensified into a Severe Cyclonic Storm (SCS) in the morning (0300 UTC) and into a Very Severe Cyclonic Storm (VSCS) in the afternoon (0900 UTC) of 23rd May. Moving further north-northwestwards, it intensified into an Extremely Severe Cyclonic Storm (ESCS) in the morning (0300 UTC) of 25th and crossed south Oman coast near 16.85^0N/53.75^0E around midnight (between 1830-1930 UTC) of 25th May as an ESCS with an estimated wind speed of 170-180 kmph gusting to 200 kmph. It further moved northwestwards and weakened into a VSCS over Oman in the early hours (2100 UTC of 25th May) of 26th May. Continuing to move north-northwestwards, it weakened into an SCS in the early morning (0000 UTC), into a CS in the afternoon (0900 UTC) and into a DD around midnight (1800 UTC) of 26th May. It further weakened into a D in the early morning (0000 UTC) and into a well marked low pressure area over Saudi Arabia and adjoining Oman & Yemen in the morning (0300 UTC) of 27th May.

The advisories prediction was provided with moderate probability (51-75%) of the intensification of a low pressure area over southeast AS into a D, 36 hours in advance of formation of D.First information regarding landfall of was issued 88 hours in advance of actual landfall. The landfall point forecast errors for 24, 48 and 72 hrs lead period were 17.2, 12.5 and 29.0 km respectively and the landfall time forecast errors for 24, 48 and 72 hrs lead period were 7.0, 8.0, and 7.0 hrs respectively. The track forecast error for 24, 48, and 72 hrs lead period were 48.8, 63.3, and 79.4 km respectively, which is significantly less than the average track forecast errors of 93, 144 and 201 km during last five years (2013-17). The track forecast skill was about 54.9%, 68.3%, and 71.6% against the long period average (LPA) of 45%, 55%, and 68% during 2013-17 for 24, 48 and 72 hrs lead period respectively. The root mean square error (RMSE) of intensity (wind) forecast error for 24, 48 and 72 hrs lead period were 6.9, 6.1 and 16.2 knots against the LPA of 14.0, 20.6 and 20.6 knots respectively. The skill based on RMSE of intensity (wind) forecast for 24, 48 and 72 lead period was 78.4, 63.1 and 78.3% against the LPA of 40.1, 60.0 and 73% respectively.

IMD received appreciation from WMO for round the clock monitoring and providing advisories to WMO and affected countries including Oman, Yemen and Somalia

Deep Depression (DD) over eastcentral and adjoining northeast Bay of Bengal (29-30 May)A depression formed over eastcentral and adjoining northeast Bay of Bengal around noon (0600 UTC) of 29th May. It moved northeastwards, intensified into DD in the same evening and crossed Myanmar coast to the north of Kyakpyu between 1700 & 1800 UTC of same night. It continued to move northeastwards and weakened gradually into a depression in the early morning of 30th May over Myanmar and into a well marled low pressure area over Myanmar around noon (0600 UTC) of same day.

Western Disturbances (WDs) and Associated Weather**:** Eight (08) active western disturbances passed across western Himalayan region and adjoining plains of northwest India during 1-7, 4-10, 12-14, 13-17, 15-18, 16-19, 18-25, 25-28 May 2018. Out of 08 western disturbances 2 caused fairly widespread to widespread precipitation and rest 6 caused scattered to fairly widespread precipitation over western Himalayan region and isolated to scattered over adjoining plains of northwest India.

Heavy rainfall Activity: Extremely heavy rain occurred at isolated places over Sub-Himalayan West Bengal & Sikkim, Nagaland, Manipur, Mizoram & Tripura, Lakshadweep, Andaman & Nicobar islands and Coastal Karnataka on one day each; heavy to very heavy rain at isolated places occurred over Assam & Meghalaya, Bihar Odisha, Coastal Andhra Pradesh, South Interior Karnataka, Rayalaseema, Tamilnadu& Puducherry and Kerala on one or two days and heavy

rainfall at isolated places occurred over Arunachal Pradesh. Jharkhand, Uttar Pradesh, Telangana and Coastal & North Interior Karnataka on one or two days during the month of May 2018.

No. of Heavy rainfall events and Skill (% correct) during the month is as follows:

Lead Time	No. of heavy Rainfall (Events):136 (Heavy rainfall events: 129, very heavy rainfall: 25)
	Overall (>64.4mm)
24 Hour	87%
48 Hour	88%
72 Hour	88%

Heat wave: Heat wave to severe heat wave conditions were observed at many places over West Rajasthan on many days and over East Rajasthan, West Madhya Pradesh and Vidarbha on a few days. Heat wave observed at a few places over East Madhya Pradesh and Madhya Maharashtra on a few days and over Himachal Pradesh, Haryana, Chandigarh & Delhi, Uttar Pradesh and Saurashtra& Kutch on one or two days during the month. The highest maximum temperature of 48.7^{0}C was recorded at Ganganagar (West Rajasthan) on 29th May over the country during the month of May 2018. The above Heat wave scenario had been predicted & warnings were issued about three days in advance of its occurrence.

Rainfall in May, 2018

Rainfall during the month of May, 2018 was large excess in 4, excess in 6, normal in 10, deficient in 9, large deficient in 6 and no rain in 1 of 36 meteorological sub- divisions. The rainfall for the country as a whole for the month has been recorded as 63 mm against the Long Period Average of 62.3 mm.

Modeling

The GFS analysis system along with its forecast model & ensemble modules were successfully installed and tested on new HPC 'Mihir'. The reception stations for EUMETCAST Terrestrial broadcast and NOAA PDA system were also set up and new data sets are being received.

An image and data generation and product display system was developed.

NCMRWF/IMD installed latest HWRF system in Mihir HPC. A successful run for Cyclone Okhi is carried out with Ocean initial conditions from NCEP.

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

Climate Diagnostics Bulletin of India for April 2018 and Annual Climate Summary for 2017 were brought out

Monthly El Nino–Southern Oscillation (ENSO) and Indian Ocean Dipole (IOD) Bulletin for May 2018 and Seasonal Climate Outlook for South Asia for the months of August 2018 were issued.

Geoscience Research

Seismological Observational Network

Observation Type	Target	Commissioned so far	Data reporting during the month
Seismic stations	116	114	108
GPS stations	40	28	21

Earthquake and Tsunami monitoring

Earthquake: 19 earthquakes were monitored in the Indian region out of which 7 eventswere greater than magnitude (M) of 5.0.

Tsunami**:** 1 major seabed earthquake (M> 6) with a potential to generate tsunami was monitored. This information in respect of one event was provided within 12 minutes of occurrence.

Ocean Observation System

Type of Platform	Target	Commissioned till May, 2018	Data received during May, 2018
Argo Floats *	200	323	149
Drifters*	150	108	4
Moored Buoys	16	20	21
Tide Gauges	36	35	27
High Frequency(HF) Radars	10	10	10
Current Meter Array	10	11	2
Acoustic Doppler Current Profiler(ADCP)	20	20	15
Tsunami Buoys	7	9	5
Wave Rider Buoy	16	17	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)	20
2	Tuna Fishing Advisories	20
2	Ocean State Forecast(OSF)-Wave, Wind, Currents, SST, MLD and D20 forecasts	30
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

INCOIS provided daily forecasts on surface and sub-surface currents at a number of sites for ONGC, for their drilling operations off Kakkinada,Andhra Coast.

Capacity Building and Outreach:

IMD in collaboration with Department of Fisheries, Govt. of Kerala , organised a workshop on “Usefulness of disastrous weather warnings to the fishermen community” on 30th May, 18 at Thycaud, Thiruvananthapuram. Approximately hundred participants from various operational fields of fisheries, ports, State Disaster Management Authorities and representatives of fishermen community attended the workshop.

One day brain storming meeting organized at IITM Pune in collaboration with National Institute of Wind Energy, Chennai on “Roadmap for operational set up of Solar Power Forecasting System”, 11th May 2018, IITM, Pune

The India UK Water Centre organised a three day workshop on 'Integrating precipitation forecasts and climate predictions with basin-scale hydrological modelling in the Himalayas' at Wildlife Institute of India, Dehradun, India from 2nd – 4th May 2018 under the guidance of Coordinators, Dr. A.K. Sahai (IITM Pune) and Dr. Harry Dixon (Centre for Ecology and Hydrology, UK). The workshop aimed to foster the development of short-, medium-, and long-term hydrological predictions for Himalayan basins.

Scientific Documentary Films (8 in total), highlighting the INCOIS Services and Products, were released on 26 April 2018 during MoES Mid-year Review Meeting held at Hyderabad. The films are in 5-minute and 1-minute formats; and are available in all 8 Indian Coastal State languages besides in English and Hindi (80 in grand total).

INCOIS organized a one-day workshop and user interaction/awareness meeting in collaboration with Centre for Fisheries Studies (CFS), Thiruvananthapuram Social Service Society (TSSS) on 8thMay 2018 at Thiruvananthapuram. Ninety representatives of fisher folks from various parts of south Tamil Nadu, Thiruvananthapuram and Kollam districts of Kerala attended the meeting.

Utilization of Ocean Research Vessels during the month

Vessel	Days at Sea / Utilization	Maintenance/ Inspection /Scientific Logistics / Cruise Preparation	No. of Cruise
Sagar Nidhi	16	15(dry dock/statutory survey)	1
SagarManjusha	19	12(4 days bad weather)	2
SagarPurvi	15	16(9 days bad weather)	2
SagarKanya	25	6	2
SagarSampada	28	3	1

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

Subject	Publications			Ph.Ds		
	April, 2018	May, 2018	Total	April, 2018	May, 2018	Total
Atmospheric Sciences	14	12	26	-	-	-
Ocean Science and Technology	5	4	9	-	1	1
Polar Sciences	0	5	5	-	-	-
Geosciences and resources	-	-	-	-	-	-
Total	19	21	40	-	1	1

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

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Dated, the 1st June, 2018

CERTIFICATE

(FOR THE MONTH OF MAY, 2018)

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 May, 2018. A summary of the status is given below:-

(a)	The total number of posts required to be entered on AVMS	- 06
(b)	Number of posts filled as on date	- 06
(c)	Number of posts totally vacant as on date	- 00
(d)	Number of posts under additional charge arrangement	- 00
(e)	Number of posts that would fall vacant during the next 6 months	- 00

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