



**KEMENTERIAN SAINS,
TEKNOLOGI DAN INOVASI**
MINISTRY OF SCIENCE, TECHNOLOGY AND INNOVATION

METMalaysia



Laporan Tahunan **2016**
Annual Report



KANDUNGAN

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PERUTUSAN KETUA PENGARAH MESSAGE FROM DIRECTOR GENERAL



Kebelakangan ini, isu cuaca dan iklim ekstrem sering menjadi tumpuan utama masyarakat. Kejadian cuaca dan iklim ekstrem seperti gelombang haba di Eropah, kemarau di Amerika Tengah dan sebahagian besar Asia Tenggara, dan hujan lebat luar biasa di Malawi dan Zimbabwe adalah amat membimbangkan.

Fenomena cuaca ekstrem seperti ini memerlukan kerjasama antara pemimpin dunia dan para saintis dalam usaha meringankan kesan buruknya. Kejadian cuaca ekstrem yang terkini ialah fenomena El –Nino 2015/2016 yang merupakan antara yang terkuat. Oleh itu, tema sambutan hari Pertubuhan Meteorologi Sedunia (WMO) 2016 bertajuk “**Hotter, Drier, Wetter : Face the Future**” adalah bertepatan dengan situasi dunia semasa.

Jabatan Meteorologi Malaysia (MMD), sebagai agensi kerajaan yang bertanggungjawab bagi memastikan keselamatan Negara dari bencana dan ancaman perubahan iklim, cuaca melampau, gempa bumi dan tsunami, beriltizam menambah baik semua produk dan perkhidmatannya. Ini bertujuan memelihara kepentingan awam serta mencapai visi jabatan sebagai antara pusat meteorologi, klimatologi dan geofizik yang terbaik di Asia menjelang 2020. Sehubungan itu, pelbagai aktiviti dan projek telah dilaksanakan sepanjang tahun 2016 sebagai usaha merealisasikan hasrat dan visi jabatan tersebut.

In recent years, the issue of extreme weather and climate has been the focal interest to the public. The increase in frequent occurrences of weather and climate extremes such as the heat waves in the Europe and the Middle East, dry weather over Central America and parts of the Southeast Asia and unusually heavy rainfall over Malawi and Zimbabwe are alarming.

*These extreme weather phenomena requires the leaders of the world to work together with scientists in order to mitigate the destructive impact of extreme weather. The most recent extreme weather event was the 2015/2016 El- Nino event which was among the strongest. Therefore, the theme of the World Meteorological Organization (WMO) Day 2016 titled “**Hotter, Drier, Wetter : Face the Future**” is appropriate in light of the afore-mentioned events.*

The Malaysian Meteorological Department (MMD), as the administration responsible for ensuring homeland security in Malaysia from disaster and threats imposed by climate change, extreme weather, earthquake and tsunami, is committed to enhance its products, services and efforts to protect public interest and to achieve its vision to be among the best meteorological, climatological and geophysical service centre in Asia by 2020. In this regard, the MMD has implemented various activities and projects in 2016 as an effort to realize this vision and objective.

MMD telah memperoleh kelulusan daripada Unit Perancang Ekonomi, Jabatan Perdana Menteri pada 2015 untuk menaiktaraf sistem ramalan cuaca. Di bawah projek ini, Sistem Perkomputeran Prestasi Tinggi (HPC) telah dibina dan dipasang di Pusat Data Sektor Awam (PDSA) di Bandar Enstek, Nilai, Negeri Sembilan.

Sistem ramalan cuaca ini akan menghasilkan ramalan cuaca setiap jam sehingga 7 hari lebih awal yang merangkumi seluruh kawasan di Malaysia. Selain itu, penggunaan *Geographic Information System (GIS)* dalam memeta topografi, kawasan perbandaran dan guna tanah dalam bentuk 3 dimensi (3D).

MMD juga telah mengambil langkah menaiktaraf dan meningkatkan kawasan liputan radar di Malaysia di bawah Rancangan Malaysia ke-11 (RMK-11). Sistem radar yang bakal dibina di Kuala Krai, Temerloh dan Cameron Highlands berkebolehan memantau cuaca di kawasan pedalaman Semenanjung yang terhalang oleh Banjaran Titiwangsa. Kualiti pemantauan sistem radar juga telah dipertingkatkan dengan penjana *Quantitative Precipitation Estimation (QPE)*, hasil kolaborasi MMD dan Agensi Meteorologi Jepun (JMA).

Kerjasama antara jabatan amat penting dalam mengkoordinasi projek mitigasi bencana ekstrem. Dengan mengguna-pakai konsep *WIGOS (WMO Integration Global Observation System)*, MMD dan Jabatan Pengairan dan Saliran (JPS) bersetuju untuk mengintergrasi perkongsian data hujan antara kedua-dua jabatan. Produk akhir adalah *isohyet* setiap jam dan akses adalah terbuka kepada semua agensi pengurusan bencana. Sebagai tambahan, bacaan tolok hujan daripada pihak Projek Lebuhraya Utara Selatan Berhad (PLUS) akan turut diintegrasikan.

Pada Mac 2016, penerbangan untuk projek penyelidikan bagi operasi pembenihan awan telah dilakukan bagi menilai keberkesanan operasi pembenihan awan dan juga untuk mengoptimalkan kos.

MMD obtained approval to carry out upgrading project on the Weather Forecasting System from the Economic Planning Unit of the Prime Minister's Department in 2015. Under this project, a High Performance Computing (HPC) system was constructed and installed in the Public Data Centre (PDSA), Bandar Enstek, Nilai, Negeri Sembilan.

The HPC will produce high resolution (1km) hourly NWP weather forecast up to 7 days in advance for the whole of Malaysia. The NWP weather forecast output shall be further enhanced with GIS (Geographic Information System) to better portray topographic, urban regions and land use in 3 dimensions (3D).

Meanwhile, MMD has taken measures to upgrade and improve the coverage of weather radars in Malaysia under the Eleventh Malaysian Plan (11th MP). Additional radar systems will be built in Kuala Krai, Temerloh and Cameron Highlands to better observe the interior of Peninsular blocked by the Titiwangsa Mountain Range. Ongoing collaboration with the Japan Meteorological Agency (JMA) to improve Quantitative Precipitation Estimation (QPE) is currently taking place to further enhance the quality of radar observation.

Inter-agency collaboration is crucial to coordinate extreme weather mitigation projects. MMD and the Department of Irrigation and Drainage (DID) have agreed to integrate rainfall data in a two-way data sharing scheme according to the WMO concept of WIGOS (WMO Integration Global Observation System). The final output is that of an hourly rainfall isohyet available to disaster management agencies. Additionally, this shall be extended to include rain gauges from the PLUS.

In March 2016, flights for research project on cloud seeding operation was implemented in order to evaluate the effectiveness of cloud seeding operations and to optimize cost.

Bagi memenuhi tuntutan tanggungjawab sosial korporat, MMD turut berkolaborasi bersama Pusat Sains Negara (PSN) didalam satu program yang dikenali sebagai **Program Bertemu Saintis**. Program ini bertujuan menyemai minat masyarakat tentang kepentingan sains dalam kehidupan seharian.

Dalam usaha memperkasakan pembangunan modal insan, MMD telah melaksanakan projek perintis mentor-mentee yang melibatkan 11 pegawai meteorologi kanan sebagai mentor dan 17 pegawai meteorologi baru sebagai mentor dan mentee.

Kempen kesedaran dan pameran merupakan langkah terbaik bagi meningkatkan kesedaran masyarakat terhadap cuaca ekstrem. Oleh yang demikian, sebanyak 139 kempen kesedaran dan pameran yang merangkumi cuaca umum, iklim, gempa bumi, tsunami dan cuaca ekstrem telah dilaksanakan dengan jayanya sepanjang tahun 2016.

Akhir kata, saya ingin menzahirkan setinggi-tinggi penghargaan kepada kakitangan MMD diatas kesinambungan usaha, dedikasi dan daya usaha yang tinggi bagi meletakkan nama MMD sebaris penerajui agensi-agensi meteorologi dunia.

In fulfillment of corporate social responsibility, the MMD in collaboration with the National Science Center has participated in the “Meet the Scientists Programme” as an effort to spread public interest on the importance of science in our everyday life.

In order to develop human capital, the MMD has implemented a mentor-mentee pioneer project involving 11 senior Meteorological Officers and 17 junior Meteorological Officers as mentor and mentee respectively.

Awareness campaigns and exhibitions are effective tools in increasing public awareness of extreme weather events. Hence, a total of 139 public awareness programme and exhibition on the general weather, climates, earth quake, tsunami and weather extremes had been successfully carried out throughout the year 2016.

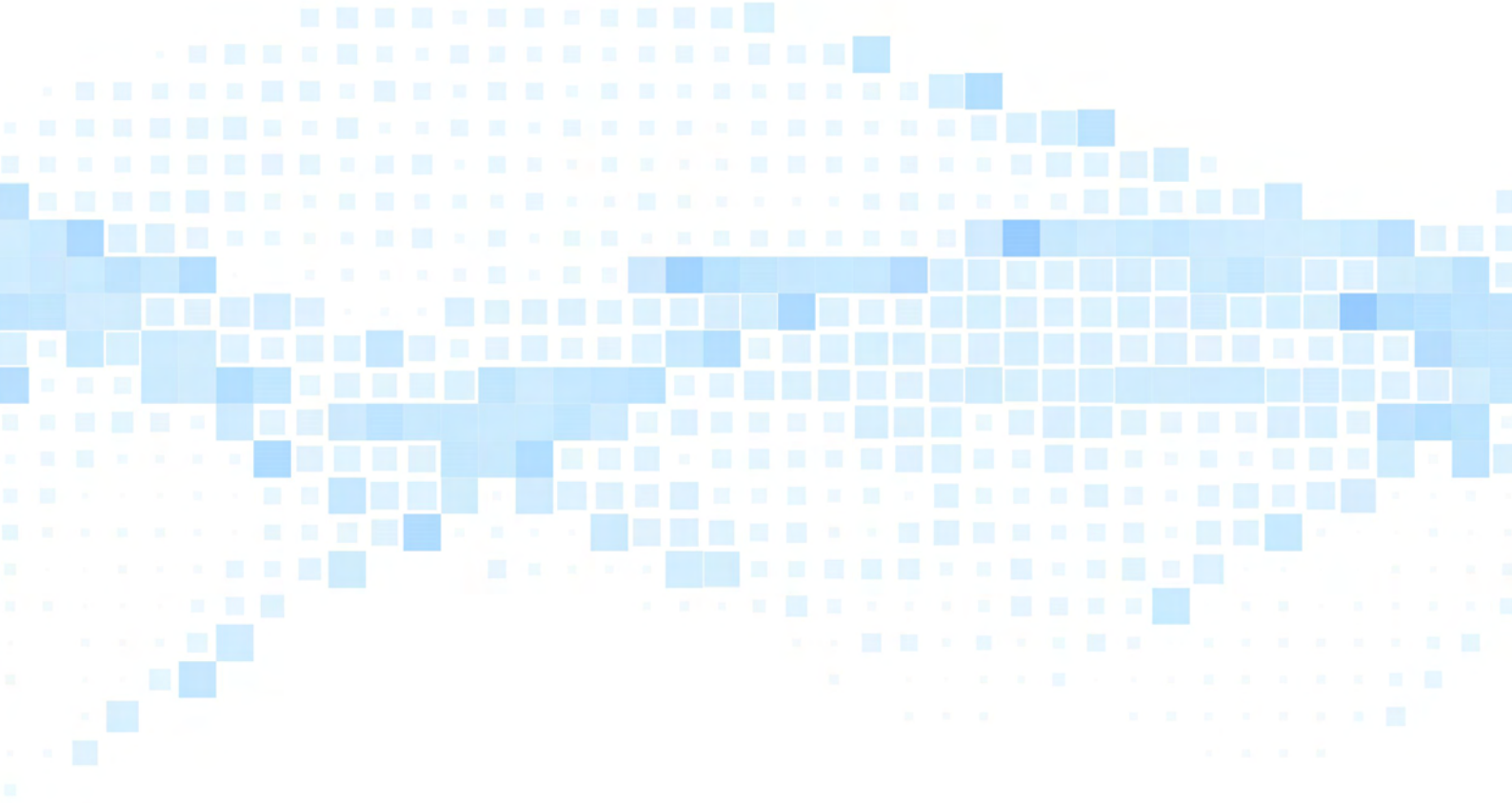
Lastly, I would like to extend my deepest gratitude to MMD staffs for the continuing effort, dedication and being resilient through tough time in order to place MMD at par among the world leading meteorological agencies.



Alui Bin Bahari

Ketua Pengarah Jabatan Meteorologi Malaysia (MMD)

Message from Director General, Malaysian Meteorological Department (MMD)





Profil Korporat Corporate Profile

WAWASAN, MISI DAN OBJEKTIF

VISION, MISSION AND OBJECTIVES

VISION *VISSION*

Menjadi antara pusat meteorologi, klimatologi dan geofizik yang terbaik di Asia menjelang 2020.

To be among the best of meteorological, climatological and geophysical service centre in Asia by 2020.

MISI *MISSION*

Memenuhi keperluan rakyat Malaysia dalam perkhidmatan meteorologi, iklim dan geofizik untuk kesejahteraan hidup, keselamatan negara dan pembangunan sosio ekonomi lestari.

To fulfil the needs of the people of Malaysia for meteorological, climatological and geophysical services for social well-being, national security and sustainable socio-economic development.

OBJEKTIF *OBJECTIVES*

- Mempertingkatkan sistem perkhidmatan meteorologi, iklim dan geofizik untuk :
 - * Keselamatan dan kecekapan operasi di udara, darat, laut dan ketenteraan;
 - * Homeland security (seperti pengurusan bencana alam, ancaman perubahan iklim, cuaca melampau, gempa bumi dan tsunami);
 - * Keselamatan dan kesejahteraan orang awam; dan
 - * Perancangan pembangunan sosio-ekonomi dan pengurusan alam sekitar
- Meningkatkan sistem pencerapan, mewujudkan dan mengawal selia pangkalan data meteorologi, iklim, seismologi dan tsunami negara untuk memenuhi keperluan generasi kini dan akan datang.
- Melindungi kepentingan negara di peringkat antarabangsa serta mempromosikan kefahaman dan kemajuan sains meteorologi, iklim, seismologi dan tsunami dalam negara
- *Enhance the meteorological, climatological and geophysical service system :*
 - * *Safety and operational efficiency on air, land, sea and military;*
 - * *Homeland security (such as disaster management and threats from climate earthquake and tsunami);*
 - * *Public safety and comfort; and*
 - * *Social economic development planning and environmental management.*
- *Enhance the observation system, and establish and regulate the national database of meteorology, climate, seismology and tsunami to meet the needs*
- *Protecting national interests at the international level and to promote the understanding and advancement in meteorological, climatological, seismological and tsunami sciences in the country for the present and future generations*

PIAGAM PELANGGAN

Jabatan Meteorologi Malaysia berusaha memberikan perkhidmatan meteorologi dan geofizik yang berkualiti tinggi bagi memenuhi keperluan ekonomi dan keselamatan negara kita. Kami berjanji akan melaksanakan perkara-perkara berikut:

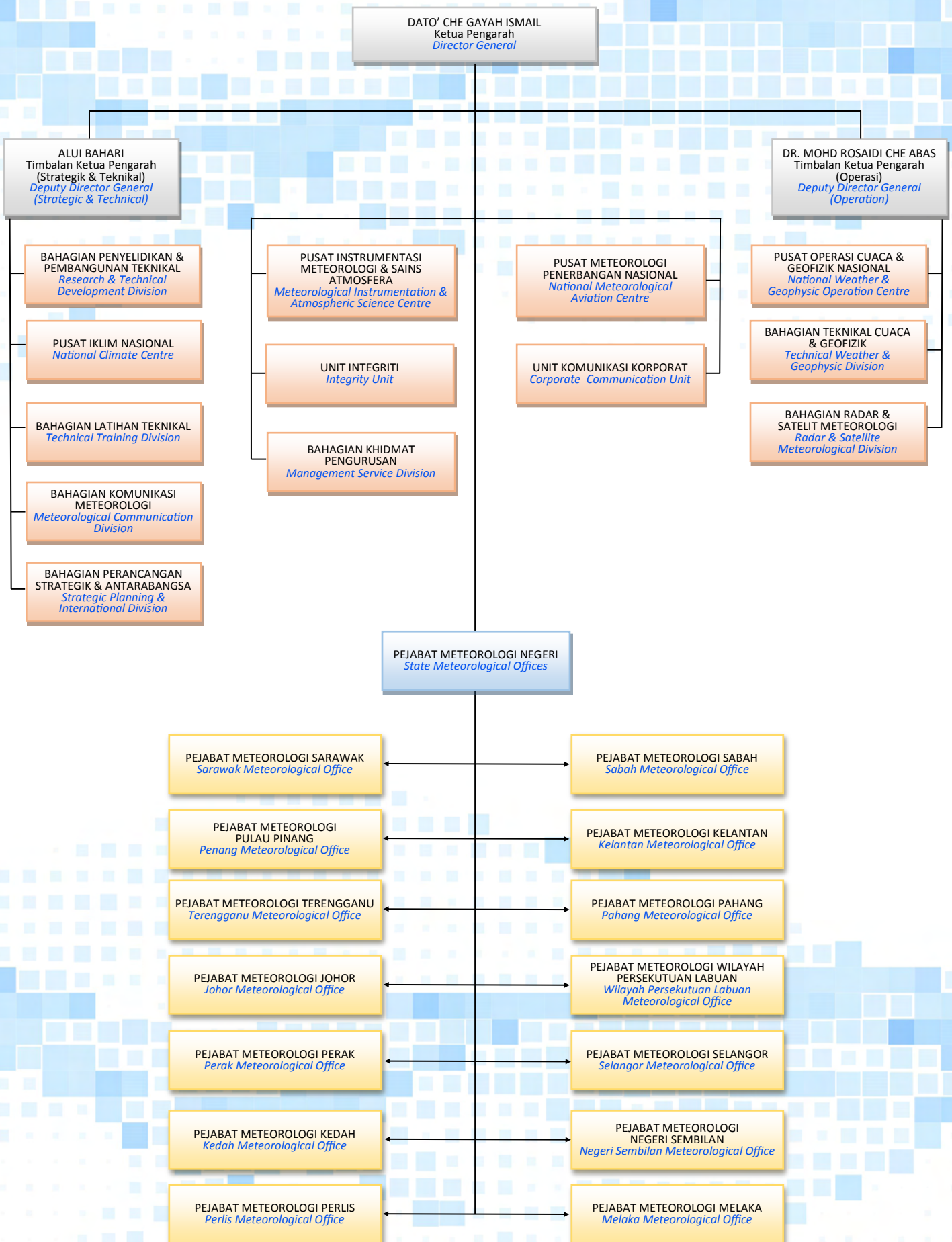
- Permohonan maklumat meteorologi, seismologi dan tsunami akan diberi maklumbalas dalam tempoh 1 hari bekerja dan dibekalkan dalam tempoh 5 hari bekerja.
- Maklumat cuaca untuk penerbangan disediakan dalam tempoh 3 jam sebelum pelepasan.
- Buletin Cuaca Bulanan akan diterbitkan dalam tempoh 10 hari bekerja pada setiap permulaan bulan berikutnya.
- Ringkasan Pencerapan Cuaca Tahunan akan diterbitkan pada Februari tahun berikutnya.
- Buletin Agrometeorologi 10-hari akan diterbitkan dalam tempoh 5 hari bekerja selepas setiap dekad.
- Tinjauan dan Analisis Agroklimatik Bulanan akan diterbitkan pada minggu kedua bulan berikutnya.
- Permohonan untuk operasi pembenihan awan akan dilaksanakan dalam tempoh 10 hari bekerja.
- Imej radar dan satelit di laman web akan dikemaskini setiap 30 minit.
- Maklumat awal gempa bumi dan tsunami akan disebarkan kepada agensi-agensi berkaitan dan media massa dalam tempoh 8 minit daripada kejadian gempa bumi dikesan.

CLIENT CHARTER

The Malaysian Meteorological Department endeavors to provide meteorological and geophysical services of high quality to fulfill the socio-economic and security needs of our nation. We pledge to perform as follows :

- *Request for meteorological, seismological and tsunami information will be responded to within 1 working day and supplied within 5 working days.*
- *Weather information for flights will be ready 3 hours before departure.*
- *Monthly Weather Bulletin will be published within 10 working days at the beginning of the following month.*
- *Annual Weather Observation Summary will be published by February of the following year.*
- *10-day Agrometeorological Bulletin will be published within 5 working days after each decade.*
- *Monthly Agroclimatic Analysis and Outlook will be published within the second week of the following month.*
- *Request for cloud seeding operation will be implemented within 10 working days.*
- *Radar and satellite images on the website will be updated every 30 minutes.*
- *Preliminary earthquake and tsunami information will be disseminated to the relevant agencies and mass media within 8 minutes upon the detection of earthquake.*

CARTA ORGANISASI/ORGANIZATION CHART



PENGURUSAN TERTINGGI

TOP MANAGEMENT MMD



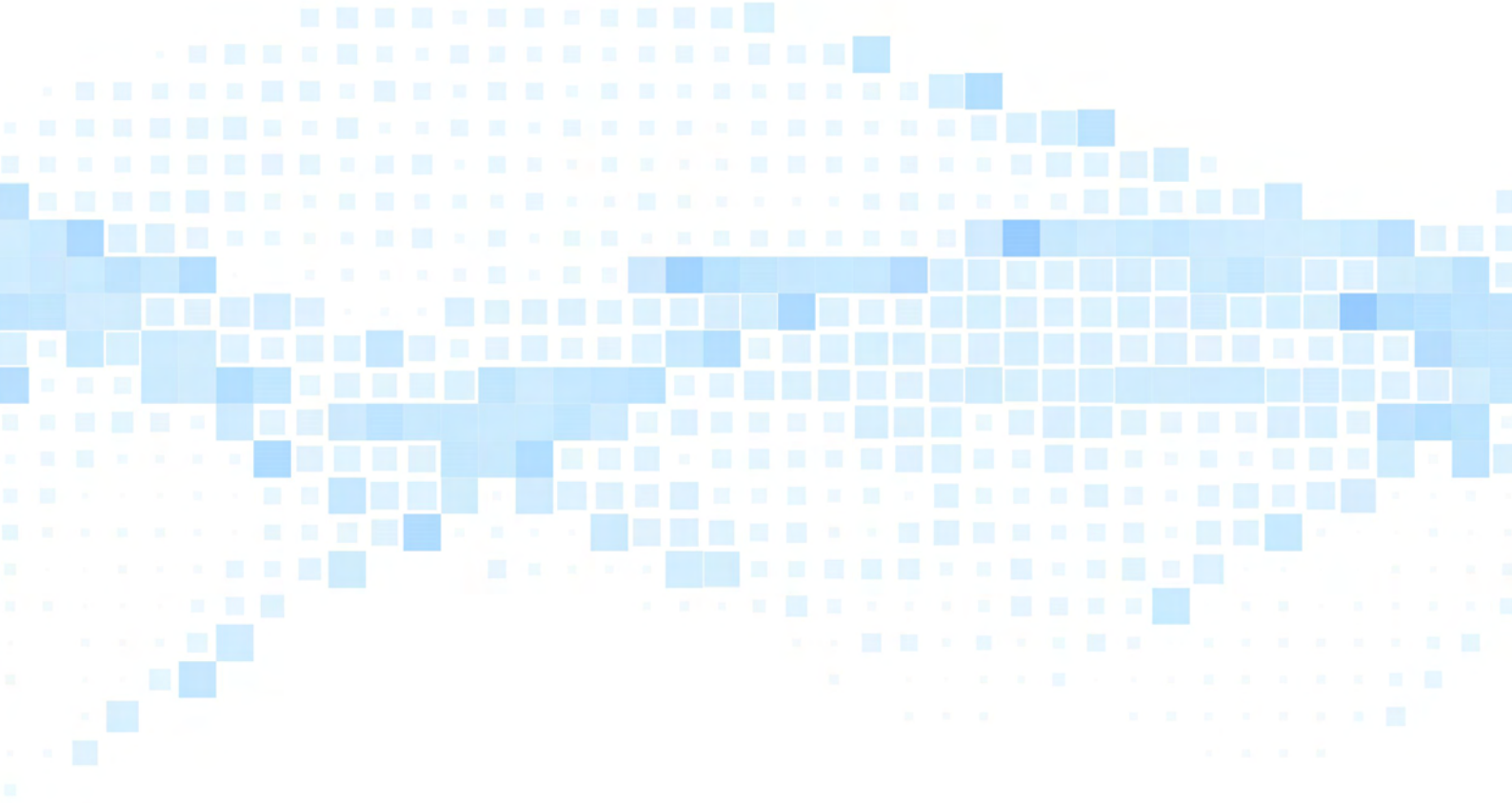
Dato' Che Gayah Ismail
Ketua Pengarah
Director General



Alui Bahari
Timbalan Ketua Pengarah
(Strategik & Teknikal)
*Deputy Director General
(Strategic & Technical)*



Dr. Mohd Rosaidi Che Abas
Timbalan Ketua Pengarah
(Operasi)
*Deputy Director General
(Operation)*





MMD
Bersama MOSTI
MMD
With MOSTI

MMD BERSAMA YB MENTERI MOSTI

MMD WITH YB MINISTER OF MOSTI



YB Menteri ketika menyampaikan ucapan dan menghadiri sidang media
YB Minister in delivering his speech and attending a press conference

Pada 23 Mac 2016, Menteri Sains, Teknologi dan Inovasi, YB Datuk Seri Panglima Wilfred Madius Tangau telah merasmikan sambutan Hari Meteorologi Sedunia 2016 yang bertemakan "*Hotter, Drier, Wetter: Face The Future*" di Sarawak. Dalam majlis yang sama, YB Menteri telah merasmikan Pejabat dan Stesen Radar Meteorologi Miri yang turut disaksikan 350 peserta.

On 23rd March 2016, the Minister of Science, Technology and Innovation, YB Datuk Seri Panglima Wilfred Madius Tangau officiated the World Meteorological Day 2016 celebration, themed "Hotter, Drier, Wetter: Face The Future" in Sarawak. During the event, YB Minister officiated Miri Meteorological Office and Radar Station, which was attended by 350 participants.



YB Menteri menanam pokok dan menandatangani plak perasmian
YB Minister planting a tree and signing inauguration plaque



YB Menteri meninjau Pusat Operasi Cuaca dan Geofizik Nasional
YB Minister during his visit at the National Weather and Geophysics Operations Centre

Pada 4 April 2016, lawatan kerja YB Menteri ke Ibu Pejabat Jabatan Meteorologi Malaysia di Petaling Jaya telah diadakan. Semasa lawatannya, YB Menteri diberi taklimat mengenai fungsi dan peranan MMD serta dibawa meninjau ke Pusat Operasi Cuaca dan Geofizik Nasional.

On 4th April 2016, YB Minister's working visit to Malaysian Meteorological Department (MMD) Headquarters in Petaling Jaya was held. During his visit, he was briefed on the roles and functions of MMD and was taken to the National Weather and Geophysics Operations Centre.



YB Menteri menyampaikan ucapan perasmian dan bergambar bersama orang ramai
YB Minister giving opening speech and a photo with the public

Pada 16 April 2016, YB Menteri merasmikan Kempen Kesedaran Bencana Gempa Bumi dan Tsunami bersama rakyat di Lahad Datu, Sabah. Kempen ini adalah anjuran bersama MMD dan Agensi Pengurusan Bencana Negara (NADMA) yang turut dihadiri 450 peserta.

On 16th April 2016, YB Minister launches the Earthquake and Tsunami Disaster Awareness Campaign with the people in Lahad Datu, Sabah. The campaign was jointly organised by MMD and National Disaster Management Agency (NADMA), with participation of 450 people.

Pada 19 Februari 2016, YBhg. KSU MOSTI telah mengunjungi Pejabat Meteorologi Negeri Sembilan (PMNS) dengan diiringi oleh TKP (ST) MMD. YBhg. KSU MOSTI telah diberi taklimat mengenai operasi PMNS.

On 19th February 2016, the Secretary-General of MOSTI accompanied by MMD's Deputy DG (Strategic) visited the Negeri Sembilan Meteorological Office (PMNS). The Secretary-General of MOSTI was briefed on PMNS operations.



MMD merupakan agensi rasmi tunggal negara yang membekalkan perkhidmatan meteorologi, seismologi dan tsunami...

Teras Pertama :
maklumat cuaca yang tepat dan cepat

Teras Kedua:
perkhidmatan meteorologi untuk navigasi udara dan keselamatan penerbangan

Teras Ketiga:
maklumat gempa bumi dan tsunami yang tepat dan cepat

Teras Keempat:
maklumat tinjauan cuaca jangka sederhana dan iklim

Teras Kelima:
peningkatan kepakaran dan keupayaan

Ringkasan MMD 2016
MMD 2016 In Brief

Sumber Manusia**Human Resources****Kemajuan Kerjaya**

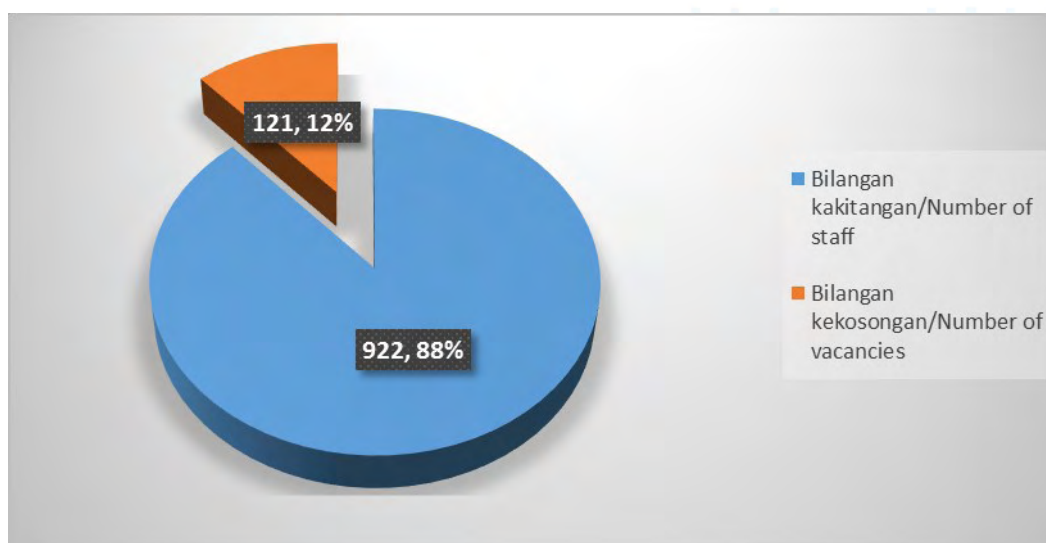
Pada tahun 2016, dalam memastikan kesinambungan fungsi utama jabatan serta kemajuan kerjaya kakitangannya, MMD telah memproses 133 pemangkuan dan 96 kenaikan pangkat bagi kakitangannya.

Pada 31 Disember 2016, pengisian warga kerja MMD adalah seramai 922 orang dari 1043 perjawatan.

Career Development

In 2016, to ensure the continuity of the core business and career development of its staff, MMD has processed the acting posts of 133 and promotion for 96 of its staff.

As at 31st December 2016, MMD has a total number of 922 employees from 1043 posts.



Bilangan anggota MMD pada tahun 2016
Total number of MMD employees in 2016

Program Pementoran

MMD juga telah melaksanakan Program Pementoran dalam menyediakan bimbingan, sokongan dan bantuan kerjaya oleh mentor kepada mentee. Program ini bertujuan meningkatkan pembangunan, kompetensi profesional, budaya, peribadi dan sosial bagi pegawai lantikan baru dan pegawai dinaikkan pangkat. Majlis Pelancaran Program Pementoran Peringkat Jabatan dan penyerahan sijil lantikan kepada mentor dan mentee terpilih telah diadakan pada 25 Ogos 2016 di Auditorium MMD di Petaling Jaya.

Mentoring Programme

MMD has also implemented the Mentoring Programme in providing guidance, support and career assistance by the mentor to mentee. The aims of the programme were to enhance the professional development, competence, culture, personal and social ethics for the newly appointed and promoted officers. The launch of this programme and the presentation of appointment certificates to the selected mentors and mentees was held on 25 August 2016 at the Auditorium MMD in Petaling Jaya.



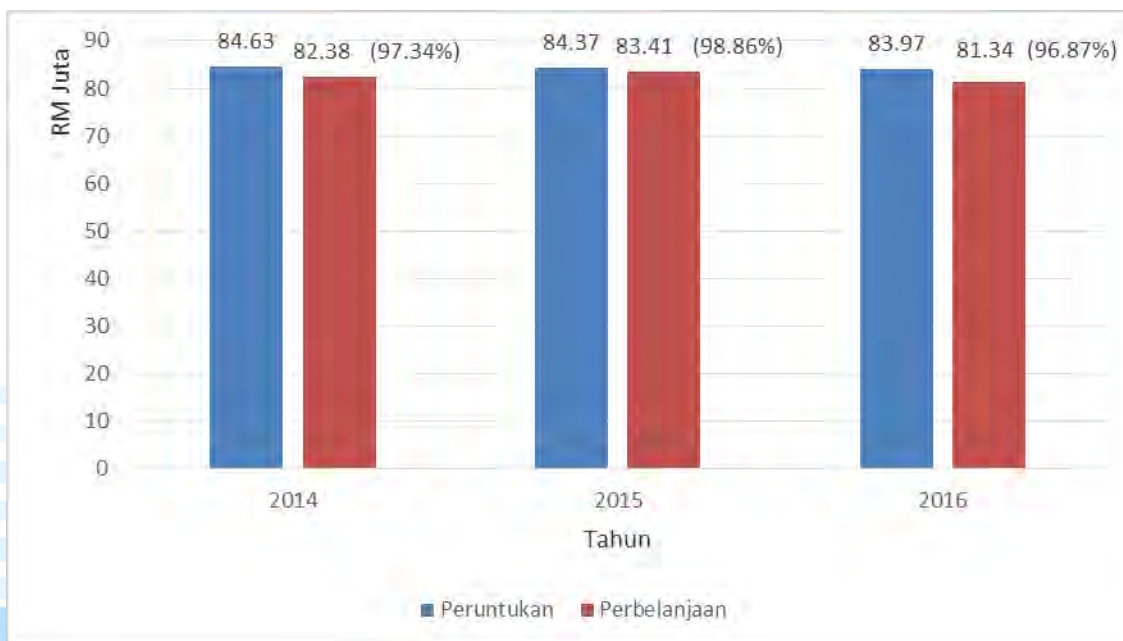
Majlis Pelancaran Program Pementoran Peringkat Jabatan
The Launching Ceremony of MMD's Mentoring Programme

Peruntukan

Perbelanjaan Mengurus MMD bagi tahun 2016 adalah berjumlah RM81.34 juta, iaitu 96.87% berbanding peruntukan yang diluluskan iaitu RM83.97 juta.

Budget

The MMD's Operating Expenditure for the year 2016 was RM81.34 million, which was 96.87% compared to the approved allocation of RM83.97 million.



Prestasi Perbelanjaan Mengurus MMD
MMD's Operating Expenditure

Pembangunan Sumber Manusia

MMD sentiasa memberikan keutamaan terhadap latihan dalam perkhidmatan dalam memastikan kakitangan jabatan sentiasa kompeten dalam menjalankan tanggungjawab.

Sejumlah 17 kursus dalaman telah dilaksanakan dengan jayanya yang merangkumi bidang teknikal, kemahiran dan pembangunan insan. Seramai 890 (96.5%) kakitangan daripada 922 orang telah mengikuti program latihan tersebut sepanjang tahun 2016.



Bilangan kakitangan yang mengikuti program latihan 2016
Total number of employees participated in training programme

Sasaran Tujuh (7) Hari Berkursus

MMD telah mencapai Penunjuk Prestasi Utama (KPI) tahun 2016 sebanyak 85.9% iaitu seramai 792 kakitangan daripada jumlah keseluruhan 922 orang telah berjaya melengkapkan tujuh hari atau lebih hari berkursus.

Aktiviti Kesedaran Awam

Usaha dan pendekatan berorientasikan masyarakat terus dilaksanakan bagi mendidik, memberi kesedaran serta meningkatkan kesiapsiagaan masyarakat terutamanya dari aspek kepentingan memahami maklumat dan data meteorologi.

Human Resources Development

MMD has always given priorities in providing training in the service in ensuring the department employees are competent in carrying out their responsibilities.

A total of 17 internal courses have been successfully held that covered technical, skills and human development areas. A total of 890 (96.5%) out of 922 employees participated in the training programme throughout 2016.



Bilangan kakitangan yang mengikuti 7 atau lebih hari berkursus
Total number of employees completed 7 or more days course

Target of Seven (7) Days Course

MMD has achieved a Key Performance Indicator (KPI) of 85.9% whereby a total of 792 employees out of 922 have successfully completed their seven (7) days or more course.

Public Awareness Activities

Community-orientated efforts and approaches continue to be implemented to educate, create awareness and improve public preparedness, especially the importance of understanding the information and meteorological data.

Dalam mencapai misi ini, MMD telah mengambil langkah menganjurkan pameran dan aktiviti berkaitan di seluruh negara. Sejumlah 139 aktiviti pameran, kempen kesedaran awam, latihan tsunami dan aktiviti-aktiviti lain yang berkaitan telah berjaya dilaksanakan. Pencapaian ini melepasi sasaran KPI MMD yang ditetapkan iaitu sebanyak 100 pameran dan aktiviti setahun.

In achieving this mission, MMD has taken steps to organize exhibitions and related activities throughout the country. A total of 139 exhibition, public awareness campaigns, tsunami drill and other related activities have been successfully organized. This achievement had exceeded MMD's KPI which targeted 100 exhibitions and activities a year.



Penglibatan dalam pameran
Participation in exhibitions



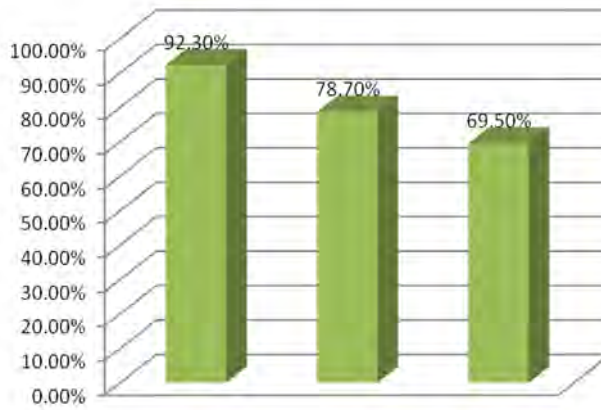
Kempen Kesedaran Awam dan Latihan Amal Tsunami
Public Awareness Campaign and Tsunami Drill

Pencapaian KPI 2016

Petunjuk-petunjuk prestasi utama (KPI) yang diterapkan dalam perkhidmatan awam bertujuan membantu jabatan menjelas dan mengawal tahap kemajuan sesuatu proses perkhidmatan yang disampaikan kepada pelanggan selaras dengan misi dan visi jabatan dan kementerian.

KPI Accomplishments 2016

Key performance indicators (KPI) are applied in the public service in order to help the Department to explain and control the progress of service delivery to clients in accordance with the mission and vision of the department and the ministry.



Purata kejitian ramalan cuaca awam
Public weather forecast accuracy

Sehubungan dengan itu, Petunjuk Prestasi utama (KPI) MMD dipantau dengan teliti agar mematuhi semua kriteria yang telah ditetapkan di dalam Piagam Pelanggan Jabatan. Tindakan pembetulan dan penambahbaikan secara berterusan diambil bagi memastikan perkhidmatan yang disampaikan kepada pelanggan kekal relevan dan berkesan. Pencapaian Piagam Pelanggan MMD dipantau dan dimuatnaik ke dalam laman sesawang MMD secara mingguan.

Accordingly, the key performance indicators (KPI) of MMD is closely monitored in order to comply with criteria in the Client's Charter. Therefore corrective action and continuous improvement is taken to ensure the services delivered to the customer remain relevant and effective. The MMD's Client Charter achievement are monitored and uploaded in the MMD's website on a weekly basis.

Secara keseluruhan, pencapaian Petunjuk Prestasi Utama (KPI) MMD pada tahun 2016 adalah seperti berikut:

The overall achievement of MMD's Key Performance Indicators (KPI) in 2016 are as follows:

- Purata kejitian ramalan cuaca awam bagi tempoh :

- Public weather forecast accuracy for :*

Pencapaian Sasaran			Achieved Target		
1 hari	: 92.3%	85.0%	1 day	: 92.3%	85.0%
3 hari	: 78.7%	75.0%	3 days	: 78.7%	75.0%
7 hari	: 69.5%	65.0%	7 days	: 69.5%	65.0%

- Purata kejitian ramalan cuaca lautan dalam tempoh :

- Average accuracy of ocean weather forecast within :*

Pencapaian Sasaran			Achieved Target		
1 hari	: 92.8%	85.0%	1 day	: 92.8%	85.0%
3 hari	: 78.7%	75.0%	3 days	: 78.7%	75.0%
7 hari	: 68.8%	65.0%	7 days	: 68.8%	65.0%

Purata penghantaran maklumat awal berkaitan gempa bumi dan tsunami tempatan dalam tempoh 8 minit dari masa kejadian gempa tersebut adalah 94.5%.

Average dissemination of early information of local earthquakes and tsunamis within 8 minutes from the beginning of the earthquake is 94.5%.

Projek Pembangunan

Pada tahun 2016 sebanyak tiga projek pembangunan telah berjaya disiapkan. Projek-projek tersebut ialah:

- 1) AWS 1 Daerah yang melibatkan pembinaan 60 buah stesen Pencerapan Cuaca Permukaan Automatik (AWS) dan sebuah Sistem Pemprosesan Data Pusat serta menaiktaraf Sistem Pemprosesan 44 Stesen Meteorologi Utama dengan peruntukkan berjumlah RM9 juta.



*Stesen AWS Banting, Selangor
AWS Station Banting, Selangor*



*Stesen AWS Laban Rata Gunung Kinabalu, Sabah
AWS Station Laban Rata Mount Kinabalu, Sabah*

Development Project

In 2016, three development projects have been successfully completed. The projects are:

- 1) *AWS 1 District involving the construction of 60 Automatic Surface Weather Observation Station (AWS) and a Central Data Processing System as well as upgrading of the 44 Main Meteorological Station Processing System with an allocation of RM9 million.*



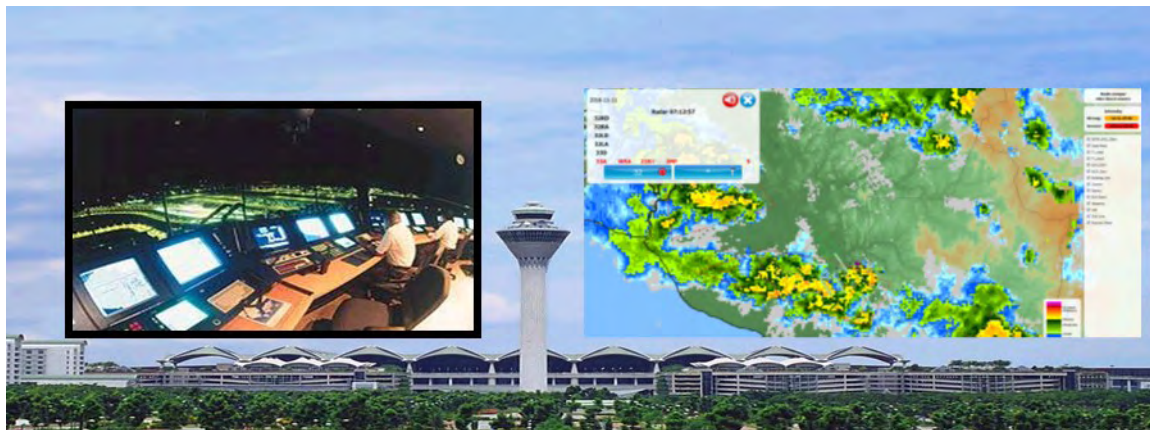
*Stesen AWS Betong, Sarawak
AWS Station Betong, Sarawak*

- 2) Projek Pembelian, Penggantian, Pemasangan, Pengujian dan Pentauliahn Sistem Terminal Doppler Radar (TDR) KLIA, Bukit Tampoi Dengkil, Selangor berjumlah kira-kira RM 12 juta adalah bagi memastikan kesinambungan mutu penyampaian perkhidmatan meteorologi penerbangan melalui penyaluran berterusan maklumat cuaca.

- 2) *The Terminal Doppler Radar (TDR) Procurement, Replacement, Installation, Testing and Commissioning Project with total of RM 12 million is to ensure continuation dissemination of quality aviation meteorological services.*



Peralatan utama TDR dipasang di bangunan sedia ada di Bukit Tampoi, Dengkil di Selangor
TDR's main equipment was installed in the existing building at Bukit Tampoi, Dengkil in Selangor



Maklumat dari TDR yang dipaparkan oleh FDPS di Menara Kawalan Trafik Udara DCA, KLIA dan di ATCC, Subang
Information from TDRs displayed by FDPS at Air Traffic Control Tower DCA, KLIA and at ATCC, Subang

- 3) Memasang alat seismik dan membangunkan peta gegaran yang berjumlah RM 9.6 juta. Ini melibatkan pembinaan 20 stesen, pemasangan peralatan seismograf dan accelerograf, membuat kajian profil geologi dan membangunkan peta gegaran.
- 3) *Installing seismic instruments and developing a ShakeMap costing RM 9.6 million. It involves the construction of 20 stations, installation of the seismograph and accelerographs equipment, conducting geological profile studies and developing shake maps.*



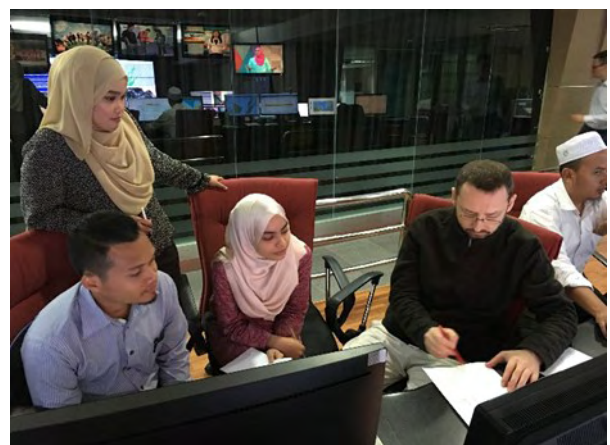
Stesen seismologi dan alat seismograf
Seismological station and seismograph sensor

Di samping itu, MMD juga melaksanakan Projek Peningkatan Sistem Penyampaian Maklumat Cuaca melibatkan *Computer Message Switching System (CMSS)*, *Malaysian Intergrated Forecasting System (MIFS)* dan Laman web dalaman (*eMet*).

Beside that MMD also implemented The Upgrade of Weather Information Dissemination System Project consists of Computer Message Switching System (CMSS), Malaysian Intergrated Forecasting System (MIFS) and internal web (eMet).



Kursus Pengenalan Mi-Cloud diadakan pada
16 – 18 November 2016
*The Mi-Cloud Introduction Course held on
16 - 18 November 2016*



Vendor mendapatkan maklumat daripada kakitangan
MMD
Vendor gathering information from MMD staff's

Cuaca Pada 2016

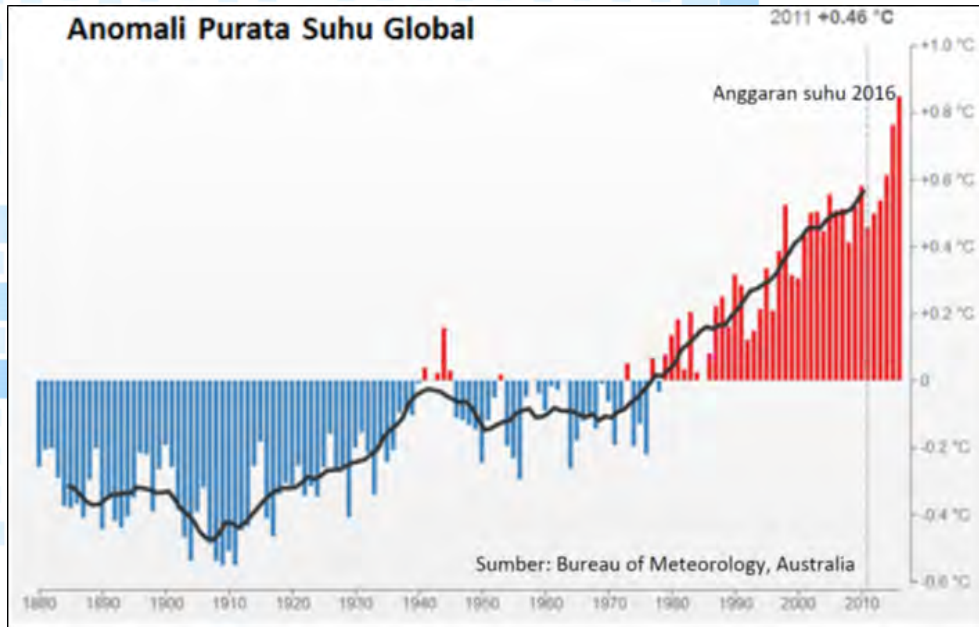
Tahun 2016 merupakan tahun terpanas dalam sejarah Malaysia dengan bacaan purata suhu sebanyak 27.66°C yang mengatasi rekod sebelum ini, iaitu 27.60°C pada tahun 1998. Purata suhu ini adalah 0.78°C melebihi suhu normal, iaitu purata suhu harian dari tahun 1981 sehingga tahun 2010. Sementara itu, purata suhu maksimum harian di Malaysia adalah 0.70°C di atas normal berbanding 1.03°C di atas normal bagi purata suhu minimum harian.

Cuaca di Malaysia amnya amat dipengaruhi oleh keragaman iklim semula jadi fenomena Super El Nino yang berlaku sehingga pertengahan tahun 2016 dan kejadian La Nina yang bermula pada suku ketiga tahun 2016.

Weather In 2016

2016 is the warmest year in Malaysia's history with a mean temperature of 27.66°C exceeded 27.60°C which recorded in year 1998. The average temperature of Malaysia was 0.78°C above normal, which is the average daily temperature from year 1981 till 2010. On the other hand, the average maximum daily temperature in Malaysia was 0.70°C above normal while the average minimum daily temperature was 1.03°C above normal.

In year 2016, Malaysia's weather was strongly influenced by natural climate variability of Super El Nino that took place until the middle of 2016 and the La Nina conditions that began in the third quarter of 2016.



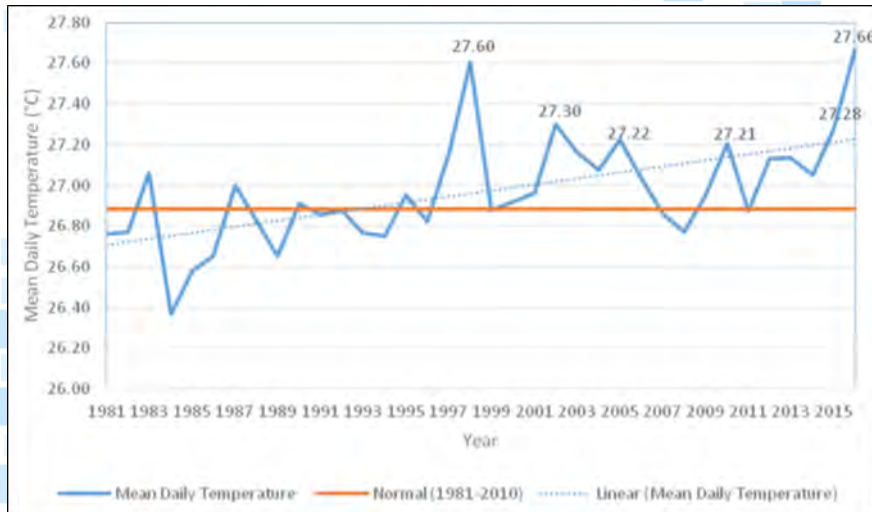
Anomali Purata Suhu Global
Average Global Temperature Anomaly

Kejadian Super El Nino 2015/2016 yang menyamai kekuatan Super El Nino 1997/1998 telah menyebabkan kemarau di hampir seluruh Negara antara bulan Februari hingga Mei. Negeri-negeri di utara dan pantai timur Semenanjung serta Kudat di Sabah merupakan kawasan paling terjejas. Kawasan-kawasan ini menerima jumlah hujan yang kurang dari 60% dari jumlah hujan bulanan di sepanjang tempoh tersebut. Selain itu, beberapa siri kejadian gelombang haba juga direkodkan berlaku di utara Semenanjung, pedalaman Pahang dan Kelantan, dan di Keningau, Sabah di sepanjang tempoh yang sama.

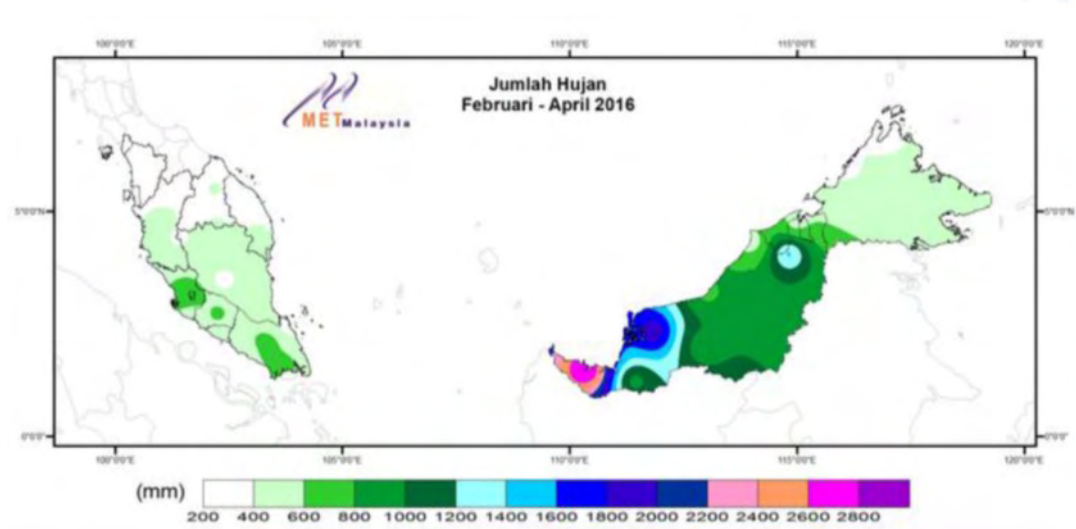
The Super El Nino 2015/2016 that mirrors the strength of Super El Nino 1997/1998 has caused drought nationwide between February and May. The northern and east coast states of Peninsula and Kudat in Sabah were the worst affected states, with a reduction of more than 60% of their monthly rainfall average. Beside that, a series of heat wave events had also recorded over the northern state of Peninsula, interior of Pahang and Kelantan, and Keningau, Sabah throughout the period.

Walaupun mengalami musim kemarau yang agak teruk antara bulan Februari hingga April, secara amnya kebanyakan kawasan di negara ini menerima jumlah hujan tahunan yang purata. Hanya Johor dan Pahang di Semenanjung, kawasan pantai barat Sabah serta Limbang dan Miri di Sarawak menerima jumlah hujan yang kurang iaitu antara 20-40% di bawah purata tahunan.

Despite the relatively severe dry season between February and April, in general, most areas of the country received the average annual rainfall. Only Johor and Pahang in the Peninsular, the west coast of Sabah and Limbang and Miri in Sarawak received less rainfall between 20-40% below the annual average.



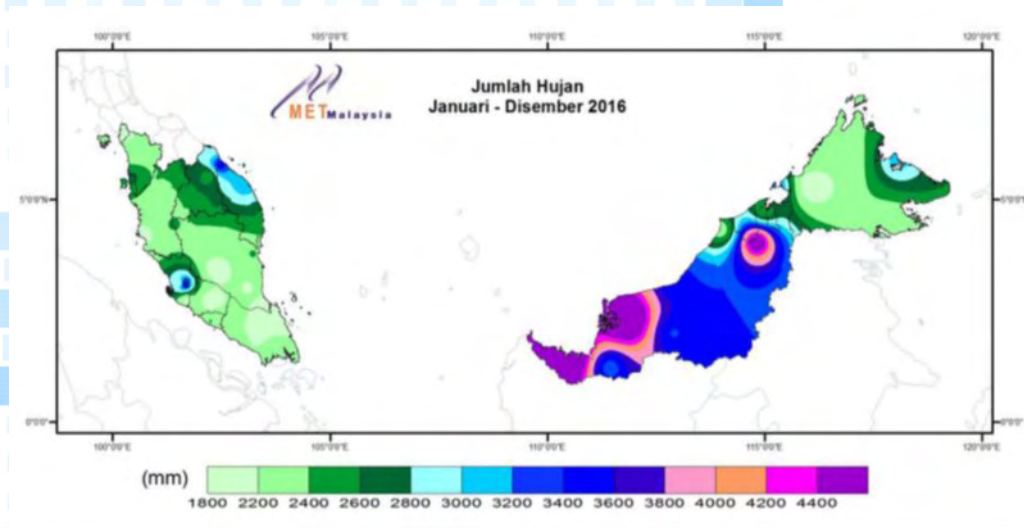
Purata suhu harian di Malaysia (1981-2016)
Daily Temperature Average of Malaysia (1981-2016)



Jumlah Taburan Hujan Februari hingga April 2016
Total Rainfall from February to April 2016

Tahun 2016 juga dicirikan dengan ketidakhadiran luruan sejuk dari Siberia semasa Monsun Timur Laut (bulan November dan Disember) yang biasanya menyebabkan kejadian hujan lebat dan banjir di negeri-negeri pantai timur Semenanjung. Walau bagaimanapun, empat kejadian episod hujan lebat telah menyebabkan kejadian banjir di Kelantan dan Terengganu pada bulan November dan Disember. Kejadian banjir adalah disebabkan oleh tiupan angin timuran yang konsisten dan kuat menyebabkan pembentukan awan hujan bertumpu di kedua-dua negeri tersebut.

The year 2016 is also characterized as a year without presence of cold surge from Siberia during the Northeast Monsoon season (November and December) which usually result in heavy rain and flood events in the east coast states of Peninsula. However, four episodes of heavy rain have caused floods in Kelantan and Terengganu in November and December. These floods are due to the consistent and relatively strong easterly wind resulting in wind convergence and cloud formation in these two states.



Jumlah Taburan Hujan Tahun 2016
Total Rainfall for Year 2016



Hujan lebat menyebabkan beberapa kawasan di Bahagian Kuching dan Samarahan, Sarawak dilanda banjir pada 1 Januari
Heavy monsoon rain occur caused floods at several areas in Kuching and Samarahan Divisions, Sarawak on 1st January



Penurunan paras air di empangan di utara Semenanjung akibat keadaan cuaca panas dan kering pada Mac
Decrease of water level at the dam in Northern Peninsular due to hot and dry weather in March



Hujan lebat berterusan menyebabkan kejadian banjir kilat di Kuala Lumpur pada 12 Mei 2016
Continuous heavy rain caused flash floods in Kuala Lumpur on 12th May 2016



Hujan lebat di Terengganu dan Kelantan menyebabkan banjir di beberapa daerah pada 31 Disember
Heavy rain in Terengganu and Kelantan caused floods in several district on 31st December

Suhu / *Temperature*

Suhu tertinggi direkodkan	39.3°C	Batu Embun, Pahang - 10 April
Suhu terendah direkodkan <i>Lowest temperature recorded</i>	19.0°C	Kuala Krai, Kelantan - 22 Februari Keningau, Sabah - 7 Julai
Perubahan suhu terendah dalam satu hari <i>Lowest temperature changes in a day</i>	1.2°C	Kerteh, Terengganu - 16 November
Perubahan suhu tertinggi dalam satu hari <i>Highest temperature changes in a day</i>	17.3°C	Kuala Krai, Kelantan - 8 April

Hujan / *Rainfall*

Hujan tertinggi dalam sejam <i>Highest rainfall in an hour</i>	119.0 mm	Sibu, Sarawak - 3 Januari
Hujan tertinggi dalam sehari <i>Highest rainfall in a day</i>	249.6 mm	Kuala Krai, Kelantan -31 Disember Gong Kedak, Terengganu 23 Disember
Hujan tahunan tertinggi <i>Highest annual rainfall</i>	5423.3 mm	Kuching, Sarawak
Hujan tahunan terendah <i>Lowest annual rainfall</i>	1212.6 mm	Keningau, Sabah
Bilangan hari hujan tertinggi <i>Highest total daily rainfall</i>	265 hari <i>(days)</i>	Kuching, Sarawak
Bilangan hari tanpa hujan paling lama <i>Longest total of days without rain</i>	42 hari <i>(days)</i>	Kota Bharu -3 April - 14 Mei

Angin / *Wind*

Purata harian tertinggi kelajuan angin <i>Highest daily average of wind speed</i>	8.6 m/s	Kota Bharu, Kelantan – 25 Januari
Kelajuan angin maksimum tertinggi <i>Highest maximum wind speed</i>	28.7m/s	Mersing, Johor - 15 Jun

Kilat dan Ribut Petir / *Lightning and Thunderstorms*

Bilangan hari tertinggi dalam setahun yang ada kilat <i>The highest number of days of lightning in a</i>	339 hari <i>(days)</i>	KLIA, Sepang
Bilangan hari tertinggi dalam setahun yang ada ribut petir <i>The highest number of days of thunderstorm in a year</i>	196 hari <i>(days)</i>	Kuching, Sarawak



Cuaca & Iklim
Weather & Climate

Ramalan Cuaca

MMD berperanan memantau situasi cuaca secara berterusan di seluruh negara melibatkan kawasan darat dan laut. MMD bertanggungjawab menghebahkan maklumat dan ramalan cuaca serta nasihat dan amaran cuaca buruk kepada orang awam, pihak media, agensi kerajaan, sektor swasta dan agensi pengurusan bencana.

Weather Forecast

MMD continuously monitors the weather conditions over land and sea throughout the country. MMD is responsible for disseminating information and forecasts as well as providing advisories and warnings of bad weather to the public, mass media, government agencies, private sector and disaster management agencies.



Pusat Operasi Cuaca dan Geofizik Nasional
National Weather and Geophysics Operational Centre

Fenomena berkaitan cuaca buruk yang melanda negara kita merangkumi kejadian hujan lebat, ribut petir, angin kencang, ribut tropika, ombak besar dan jerebu tebal. Antara medium penyampaian yang digunakan adalah tinjauan, nasihat dan amaran cuaca melalui laman sesawang, media cetak dan elektronik, laman media sosial, faks dan sistem pesanan ringkas (SMS) dan aplikasi mobil myCuaca.

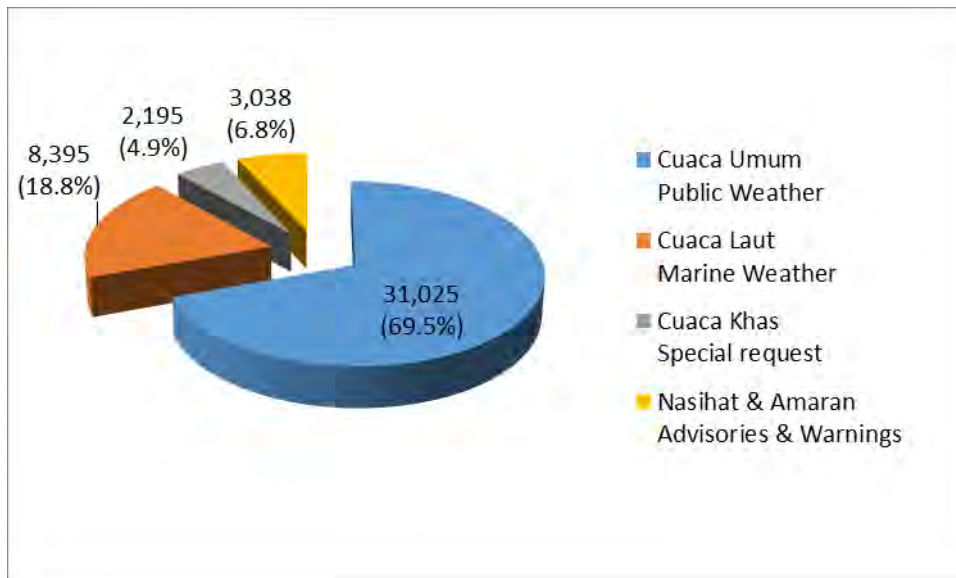
Among the bad weather phenomena in our country are heavy rain, thunderstorm, strong wind, tropical storm, rough seas and thick haze. The medium used to disseminate information on weather, forecast, advisories and warnings are through the official website, printed and electronic media, social media, fax and Short Messaging Service (SMS) and myCuaca mobile application.



Penyampaian Laporan Cuaca
Weather Report Broadcast

Sepanjang 2016, sebanyak **44,653** produk berkaitan cuaca yang meliputi **31,025** ramalan cuaca umum, **8,395** ramalan cuaca laut, **2,195** permintaan cuaca khas serta **3,038** nasihat dan amaran cuaca buruk telah dikeluarkan.

Throughout 2016, a total of 44,653 products related to weather, comprising 31,025 public weather forecasts, 8,395 marine weather forecasts, 2,195 special weather requests and 3,038 advisories and warnings of bad weather were issued.



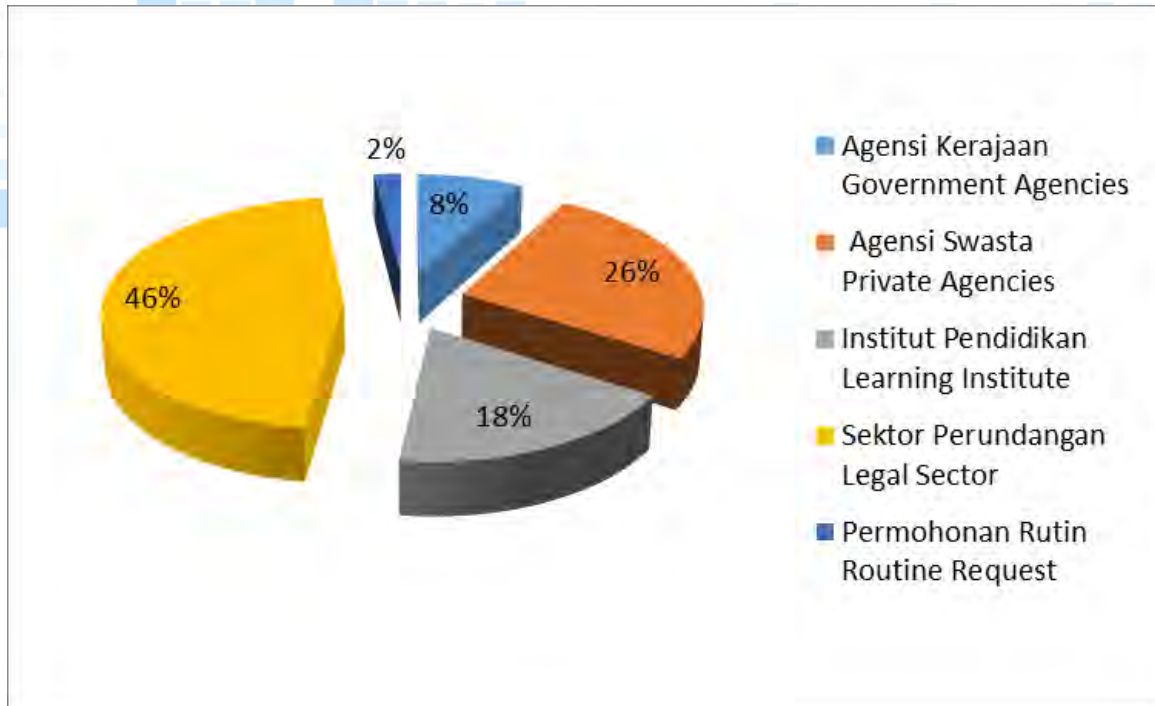
Produk-produk berkaitan cuaca pada tahun 2016
Products related to weather in year 2016

Iklm

Sebanyak 2,542 permohonan maklumat dan data iklim diterima pada tahun 2016 dengan jumlah kutipan sebanyak RM463,144. Permintaan tertinggi adalah daripada sektor perundangan sebanyak 46%, agensi swasta 26%, institut pendidikan 18%, agensi kerajaan 8% dan permohonan rutin 2%.

Climate

A total of 2,542 requests for climate information and data were received in 2016 with a collection of RM463,144. The highest number came from the legal sector with a percentage of 46% followed by private agencies 26%, educational institutions 18%, government agencies 8% and routine requests 2% of the total.



Permohonan maklumat dan data iklim yang diterima pada tahun 2016
Requests for climate information and data in 2016

Tiga jenis penerbitan yang dikeluarkan oleh MMD secara bulanan adalah Buletin Cuaca Bulanan, Ringkasan Bulanan Pemerhati Meteorologi Stesen Utama dan Ringkasan Bulanan Pemerhati Meteorologi Stesen Auksilari.

Three monthly publications issued by MMD are *Monthly Weather Bulletin*, *Monthly Summary of Observations from the Primary Meteorological Station* and *Monthly Summary of Observations of an Auxiliary Meteorological Station*.



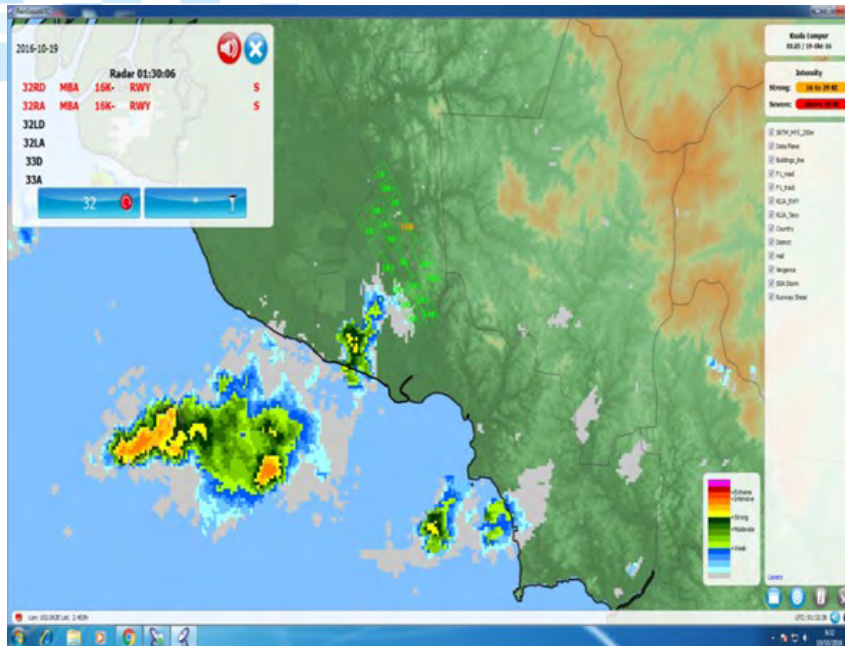
Meteorologi Penerbangan &
Pejabat Meteorologi Negeri
**Aviation Meteorology &
State Meteorological Offices**

METEOROLOGI PENERBANGAN & PEJABAT METEOROLOGI NEGERI

AVIATION METEOROLOGY & STATE METEOROLOGICAL OFFICES

MMD melalui Pusat Meteorologi Penerbangan Nasional (PMPN) membekalkan pelbagai jenis perkhidmatan meteorologi penerbangan selaras dengan ketetapan International Civil Aviation Organization (ICAO), *Annex 3 to the Convention on International Civil Aviation (Meteorological Service for International Air Navigation)*.

MMD through its National Aviation Meteorological Centre (PMPN) provides a range of aviation meteorological services in accordance with the provisions of the International Civil Aviation Organization (ICAO) Annex 3 to the Convention on International Civil Aviation (Meteorological Service for International Air Navigation).



Amaran letusan mikro dan ricih angin yang ditunjukkan dalam bentuk grafik dan teks untuk landasan di KLIA
The microburst and wind shear warning is shown in graphical and textual form for the runways at KLIA

Operasi PMPN disokong oleh Pejabat Meteorologi Sepang (PMS) yang terletak berhampiran dengan Runway 2 KLIA serta beroperasi 24 jam setiap hari untuk melaporkan pencerapan cuaca mengikut masa yang ditetapkan. PMPN dilengkapi dengan pelbagai sistem meteorologi yang automatik dan terkini seperti *Automated Weather Observing System (AWOS)*, Sistem Terminal Doppler Radar, *Meteorological Data Processing System (MDPS)* dan *Automatic Weather Station (AWS)* bagi memastikan pelaksanaan tanggungjawab PMPN yang lebih efisien.

PMPN operations are supported by the Sepang Meteorological Office, which is located near the Runway 2 of KLIA operates 24 hours daily to monitor and report the weather according to standard reporting hours. In carrying out its responsibilities more efficiently, PMPN is equipped with automatic and latest meteorological systems such as the Automated Weather Observing System (AWOS), Terminal Doppler Radar System, Meteorological Data Processing System (MDPS) and Automatic Weather Station (AWS).

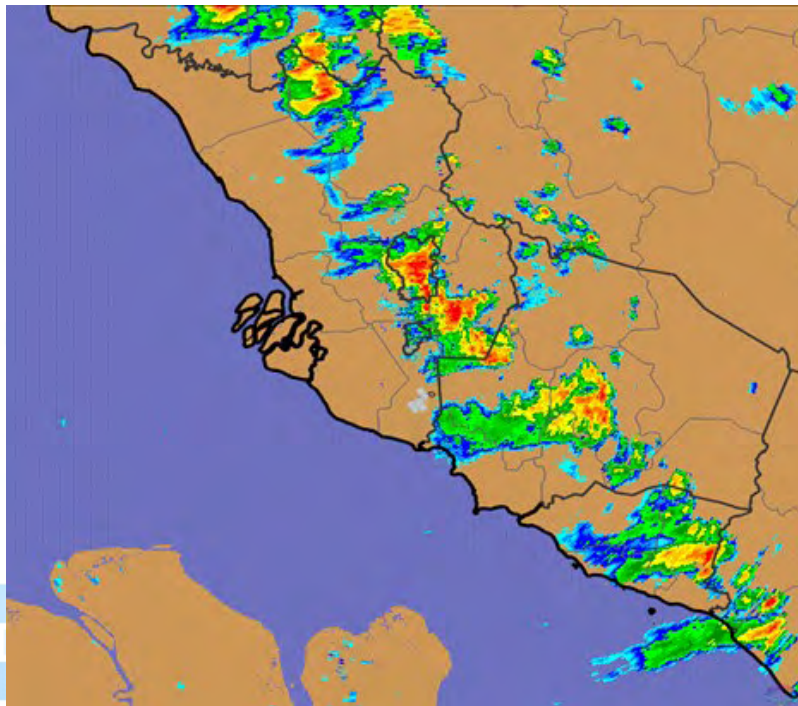
PMPN juga berperanan sebagai Pejabat Pemantau Cuaca (MWO) iaitu pusat pemantauan terhadap cuaca yang boleh mempengaruhi operasi penerbangan di Wilayah Penerbangan Kuala Lumpur (KL FIR). PMPN juga mengeluarkan maklumat SIGMET dan AIRMET berdasarkan pemantauan yang dilakukan kepada pihak-pihak yang berkaitan.

PMPN also plays the role of Meteorological Watch Office (MWO) whereby it continuously monitors the meteorological conditions that will affecting flight operations within Kuala Lumpur Flight Information Region (KL FIR). PMPN also prepares and disseminates SIGMET and AIRMET information based on the weather observation to related flight operators.



Pada 26 April 2016, MMD telah memperbaharui perjanjian bersama Jabatan Penerbangan Awam Malaysia bagi mewujudkan koordinasi di antara *Air Traffic Service Unit* dengan pejabat meteorologi untuk memastikan penyediaan perkhidmatan meteorologi untuk perkhidmatan udara selaras dengan ketetapan ICAO. Perjanjian yang sama turut melibatkan Tentera Udara Di Raja Malaysia.

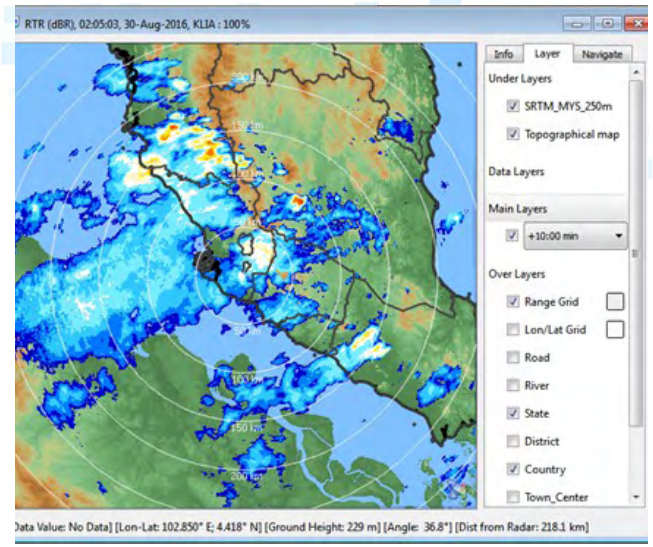
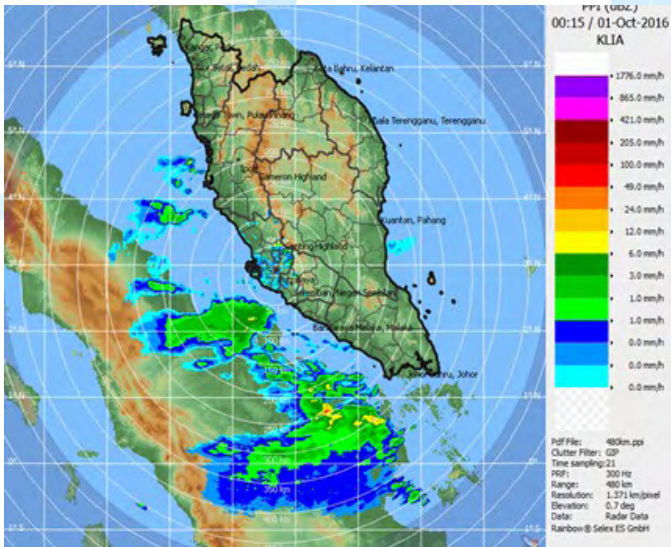
On 26th April 2016, MMD renewed its agreement with the Department of Civil Aviation (DCA) to establish coordination between Air Traffic Service Units (ATSUs) and meteorological offices to ensure the provision of the meteorological service required for air navigation, in accordance with ICAO provision. The same agreement also involved the Royal Malaysian Air Force.



Imej Radar Doppler KLIA
KLIA Doppler Radar Image

PMPN juga telah melaksanakan projek bagi menggantikan Sistem Terminal Doppler Radar (TDR) yang sedia ada dan telah beroperasi sejak 1998 namun sudah tidak menjimatkan untuk diselenggara serta kesukaran memperolehi alat ganti. Peralatan utama TDR dipasang di bangunan Bukit Tampoi, Dengkil, Selangor (terletak lebih kurang 10 kilometer dari Pusat Operasi PMPN. Sistem tersebut telah ditauliahkan pada 31 Oktober 2016.

PMPN has also implemented a project to replace the existing Terminal Doppler Radar (TDR) system that has been operated since 1998, but no longer economical to maintain, as well as the difficulty in obtaining the spare parts. The TDR main component was installed in Bukit Tampoi, Dengkil, Selangor (located approximately 10 kilometres from the PMPN. The system was commissioned on 31st October 2016.



Imej gema TDR yang dipaparkan oleh Met Workstation di Pusat Operasi PMPN dan paparan dalam ABT
TDR echo image displayed by Met Workstation at PMPN Operation Center and display in ABT

Projek ini menambah baik mutu pencerapan dan produk radar mengikut perkembangan teknologi terkini dan mematuhi keperluan Piawaian ICAO bagi perkhidmatan meteorologi penerbangan awam. Ianya berfungsi sebagai sistem pemantauan cuaca buruk di ruang udara, terutamanya untuk mengeluarkan amaran letusan mikro dan ricih angin yang berisiko kepada operasi pendaratan dan pelepasan pesawat di KLIA. Produk yang dijana oleh sistem TDR di PMPN dihantar secara masa sebenar (selaan masa 1 minit) ke *Meteorological Data Processing System* di PMPN.

This project improves the quality of observations and radar products in line with latest technology developments and complies with ICAO standards for civil aviation meteorological services. Its main function is to monitor bad weather in airspace and to issue warnings on microburst and wind shear that could adversely affect the landings and take-offs of an aircraft at KLIA. The products generated by TDR system is transmitted in real time (time interval of 1 minute) to the Meteorological Data Processing System in PMPN.

Pejabat Meteorologi Negeri

MMD melalui Pejabat Meteorologi Negeri bertanggungjawab memantau dan mengeluarkan tinjauan cuaca peringkat negeri masing-masing, menyebarkan nasihat/ amaran cuaca buruk, nasihat/ amaran angin kencang dan laut bergelora, maklumat gempa bumi, tsunami kepada orang awam, Pejabat Setiausaha Kerajaan Negeri, pejabat daerah dan agensi-agensi pengurusan bencana negeri. Pejabat Meteorologi Negeri juga merupakan ahli jawatankuasa pengurusan bencana di peringkat negeri dan daerah.

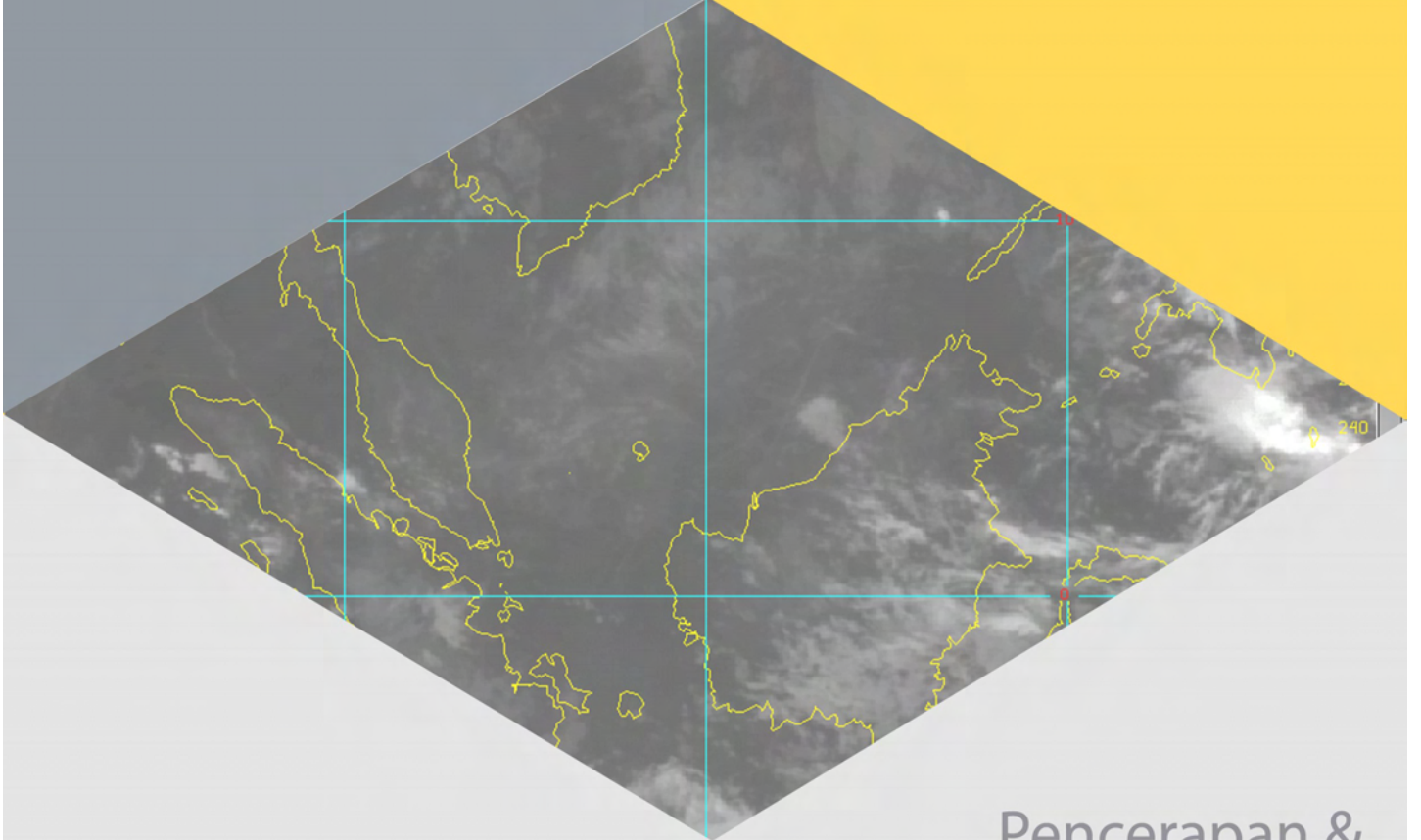
State Meteorological Offices

MMD through its State Meteorological Offices are responsible to monitor and issue weather forecasts for their respective states, broadcasting advisories/warnings of bad weather, strong winds and rough seas, as well as provide information on earthquakes and tsunami to the public, State Secretary Office, district offices and state disaster management agencies. The State Meteorological Offices is also the member of disaster management committee at district and state levels.



Lokasi Pejabat Meteorologi Negeri
Location of State Meteorological Offices





Pencerapan &
Pemantauan Cuaca
**Weather Observation &
Monitoring**

PENCERAPAN DAN PEMANTAUAN CUACA

WEATHER OBSERVATION AND MONITORING

Bagi meningkatkan pencerapan cuaca yang lebih efektif dan menyeluruh di seluruh negara, jabatan sedang melaksanakan Projek Peningkatan Kecekapan Rangkaian Radar Cuaca di dalam Rancangan Malaysia ke-11 yang melibatkan empat komponen iaitu:

- 1) Perolehan dan Pemasangan Sistem Antena Baharu bagi Meningkatkan Sistem Pencerapan Radar Cuaca di Stesen Meteorologi Radar Kuantan (Pahang), Kota Bharu (Kelantan) dan Miri (Sarawak);
- 2) Perolehan dan Pemasangan Sistem Radar Cuaca (X Band) di Pejabat Meteorologi Kuala Krai (Kelantan), Temerloh dan Cameron Highlands (Pahang);

In further improving the effectiveness and coverage of weather observation nationwide, the department is in the process of implementing the Weather Radar Network Enhancement Project in the 11th Malaysia Plan that includes four components:

- 1) *Procurement and Installation of New Antenna Systems in improving the Weather Radar Observation System in Meteorological Stations namely Kuantan (Pahang), Kota Bharu (Kelantan) and Miri (Sarawak);*
- 2) *Procurement and Installation of Weather Radar System (X Band) at the Kuala Krai Meteorological Office (Kelantan), Temerloh and Cameron Highlands (Pahang);*



Bengkel Makmal Kejuruteraan Nilai (VE) di Awana Hotel Genting Highlands, Pahang pada 3 hingga 5 Ogos 2016
Value Engineering Laboratory (VE) Workshop at Awana Hotel Genting Highlands, Pahang from 3rd August to 5th August 2016

- 3) Perolehan bagi Kerja Membina Menara Radar Cuaca, Pejabat dan dua (2) Unit Kuarters (kecuali Tawau tanpa kuarters) di Marang (Terengganu), Kuala Gula (Perak), Kuala Rompin (Pahang), Sibu (Sarawak) dan Tawau (Sabah); dan
- 4) Perolehan dan Pemasangan Sistem Radar Cuaca Baharu (S Band) di Marang (Terengganu), Kuala Gula (Perak), Kuala Rompin (Pahang), Sibu (Sarawak) dan Tawau (Sabah).

- 3) *Procurement for work to Build Weather Radar Towers, offices and two (2) quarters unit (except Tawau without quarters) in Marang (Terengganu), Kuala Gula (Perak), Kuala Rompin (Pahang), Sibu (Sarawak) dan Tawau (Sabah); and*
- 4) *Procurement and Installation of the New Weather Radar System (S Band) in Marang (Terengganu), Kuala Gula (Perak), Kuala Rompin (Pahang), Sibu (Sarawak) and Tawau (Sabah).*

Sebanyak dua Bengkel Makmal Kejuruteraan Nilai (VE) bagi Projek Peningkatan Kecekapan Rangkaian Radar Cuaca MMD telah diadakan di Genting Highlands, Pahang pada 3 Ogos hingga 5 Ogos 2016 dan di Cameron Highlands, Pahang pada 2 hingga 5 November 2016 untuk berbincang dan membuat keputusan bagi perolehan 1 dan 2.

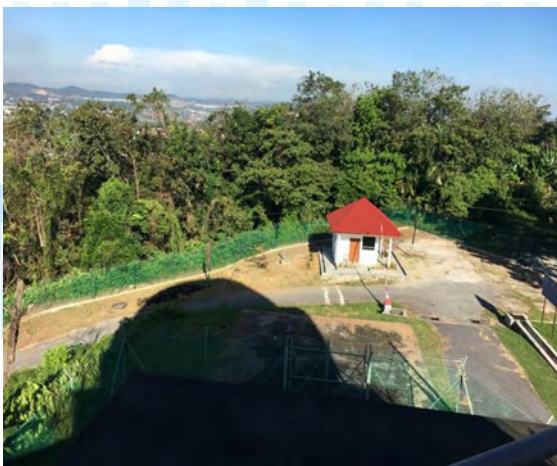
Two workshops on Value Engineering Laboratory (VE) for MMD Weather Radar Network Enhancement Project was held in Genting Highlands, Pahang from 3rd August to 5th August 2016 and in Cameron Highlands, Pahang from 2nd to 5th November 2016 for discussion and decision making with regards to procurement 1 and 2.



Bengkel Makmal Kejuruteraan Nilai (VE) di Cameron Highlands, Pahang pada 2 hingga 5 November 2016
Value Engineering Laboratory (VE) Workshop in Cameron Highlands, Pahang from 2nd to 5th November 2016

Pada tahun 2016, aspek keselamatan Stesen Meteorologi Radar (SMR) Subang telah dipertingkatkan dengan pembinaan pagar keselamatan di sekeliling stesen tersebut dan pembinaan pondok pengawal bagi pengawal keselamatan bertugas.

In 2016, the safety aspect of the Subang Radar Meteorological Station (SMR) was enhanced with the construction of a security fence around the station and the set-up of a guard house for security guards on duty.



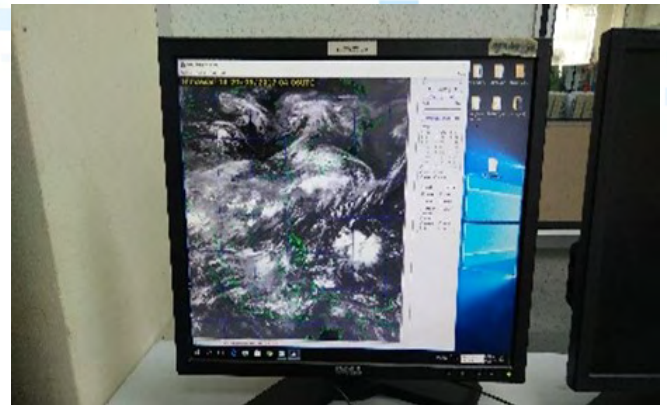
Pembinaan pagar keselamatan dan pondok pengawal di SMR Subang
Construction of a security fence and a guard house at SMR Subang

Jabatan juga telah mempertingkatkan janaan imej-imej satelit meteorologi geopegun Himawari dari 30 minit kepada 10 minit.

Imej Satelit geopegun adalah penting bagi operasi pemantauan litupan dan pergerakan awan, pemantauan ribut petir dan cuaca buruk serta pembentukan dan pergerakan siklon tropika. Ini membolehkan pegawai meteorologi memantau cuaca buruk dengan lebih baik dan amaran awal dapat dikeluarkan dengan lebih berkesan.

The department has also enhanced its geostationary satellites images of Himawari from 30 minutes to 10 minutes.

Geostationary Satellite Images are important in monitoring cloud movements, thunderstorms, bad weather and, formation and movement of tropical cyclones. This allows meteorological officers to monitor bad weather closely and provide effective early warnings.



Produk Satelit Himawari
Himawari Satellite Product



Sains Atmosfera & Pembenihan Awan
Atmospheric Science & Cloud Seeding

MMD turut bertanggungjawab menjalankan pemantauan komposisi atmosfera dan kualiti udara di 26 buah stesen di seluruh negara. Tiga daripadanya ialah Stesen Pemantauan Atmosfera Global (GAW) iaitu di Petaling Jaya, Cameron Highlands dan Lembah Danum.

MMD is also responsible for monitoring the atmospheric composition and air quality at 26 stations throughout the country. Three of the stations are Global Atmospheric Watch (GAW) stations, which are located in Petaling Jaya, Cameron Highlands and Danum Valley.



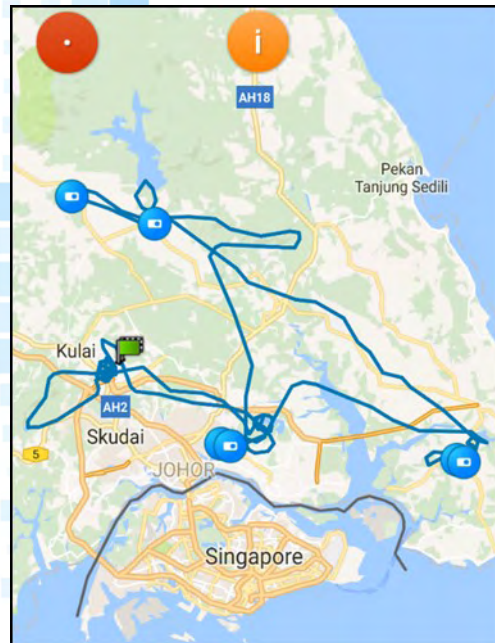
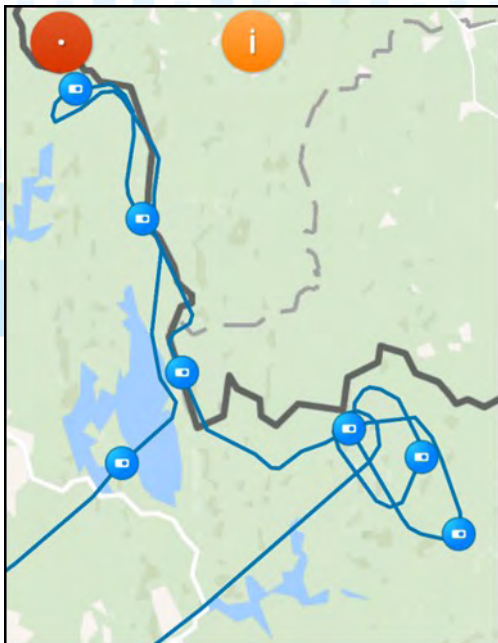
Stesen Pemantauan Atmosfera Global (GAW) di Lembah Danum, Sabah
Global Atmospheric Watch (GAW) Station in Danum Valley, Sabah

Bagi tahun 2016, sebanyak 85 penerbangan telah dijalankan dalam pelaksanaan operasi pembenihan awan (OPA) di seluruh negara. Jumlah tersebut merangkumi kedua-dua kaedah pembenihan iaitu secara semburan larutan garam menggunakan pesawat C130H milik Tentera Udara DiRaja Malaysia (TUDM) (20 penerbangan) dan pembakaran flare menggunakan pesawat CESSNA 340A (65 penerbangan).

In 2016, a total of 85 flights were carried out for cloud seeding operations (OPA) nationwide. This includes both methods of cloud seeding; spraying salt solution using the Royal Malaysian Air Force (RMAF) C130H aircraft (20 flights) and combustion of flares using the CESSNA 340A aircraft (65 flights).

Operasi ini dijalankan kerana cuaca panas dan kering yang melanda Negara terutamanya di negeri-negeri utara Semenanjung dan Sabah.

These operations were carried out due to the hot and dry weather that hit the country especially in the northern states of Peninsular and Sabah.



Trek laluan pesawat semasa OPA dijalankan di MADA, Kedah (kiri) dan empangan di Johor (kanan)
Flight route during the cloud seeding operations at MADA, Kedah (left) and in Johor dam (right)

Fenomena ini telah menyebabkan krisis air yang serius dan berpanjangan. Paras air di beberapa empangan menyusut sehingga melepasi tahap kritikal. Kebakaran hutan berleluasa dan pembakaran tanah gambut di Sabah juga telah menyebabkan masalah jerebu yang teruk di kawasan Kuala Penyu, Membakut, Beaufort dan Penampang.

This phenomenon has caused serious and continuous water crisis. Water level of dams subside to critical level. The widespread forest fires and peat land burnings in Sabah have also caused severe haze problem in Kuala Penyu, Membakut, Beaufort and Penampang.



Operasi Pembenhian Awan dengan pesawat TUDM
Cloud seeding operations using RMAF aircraft

Bagi menangani kemelut ini, MMD dengan kerjasama Agensi Pengurusan Bencana Negara (NADMA), TUDM dan pesawat swasta menjalankan operasi pembenhian awan di kawasan-kawasan yang terjejas.

To mitigate this crisis, MMD in collaboration with the National Disaster Management Agency (NADMA), RMAF and private aircraft have conducted cloud seeding operations in the affected areas.

Operasi telah bermula pada 7 April di negeri Sabah bagi mengurangkan kesan jerebu. Operasi juga turut dilakukan di negeri Johor pada 9 Disember untuk meningkatkan kapasiti air empangan. Secara keseluruhan, hari pelaksanaan OPA mengikut negeri adalah: Perlis (27); Kedah (44); Pulau Pinang (30); Perak (27); Melaka (15); Negeri Sembilan (18); Johor (23); Sabah (4) dan Sarawak (1).

Operations commenced on 7th April in Sabah to alleviate the effect of haze. Operation was also conducted in Johor on 9th December to increase water level at dam. Overall, the implementation of OPA according to the respective states are: Perlis (27); Kedah (44), Penang (30); Perak (27); Melaka (15); Negeri Sembilan (18); Johor (23); Sabah (4) and Sarawak (1).



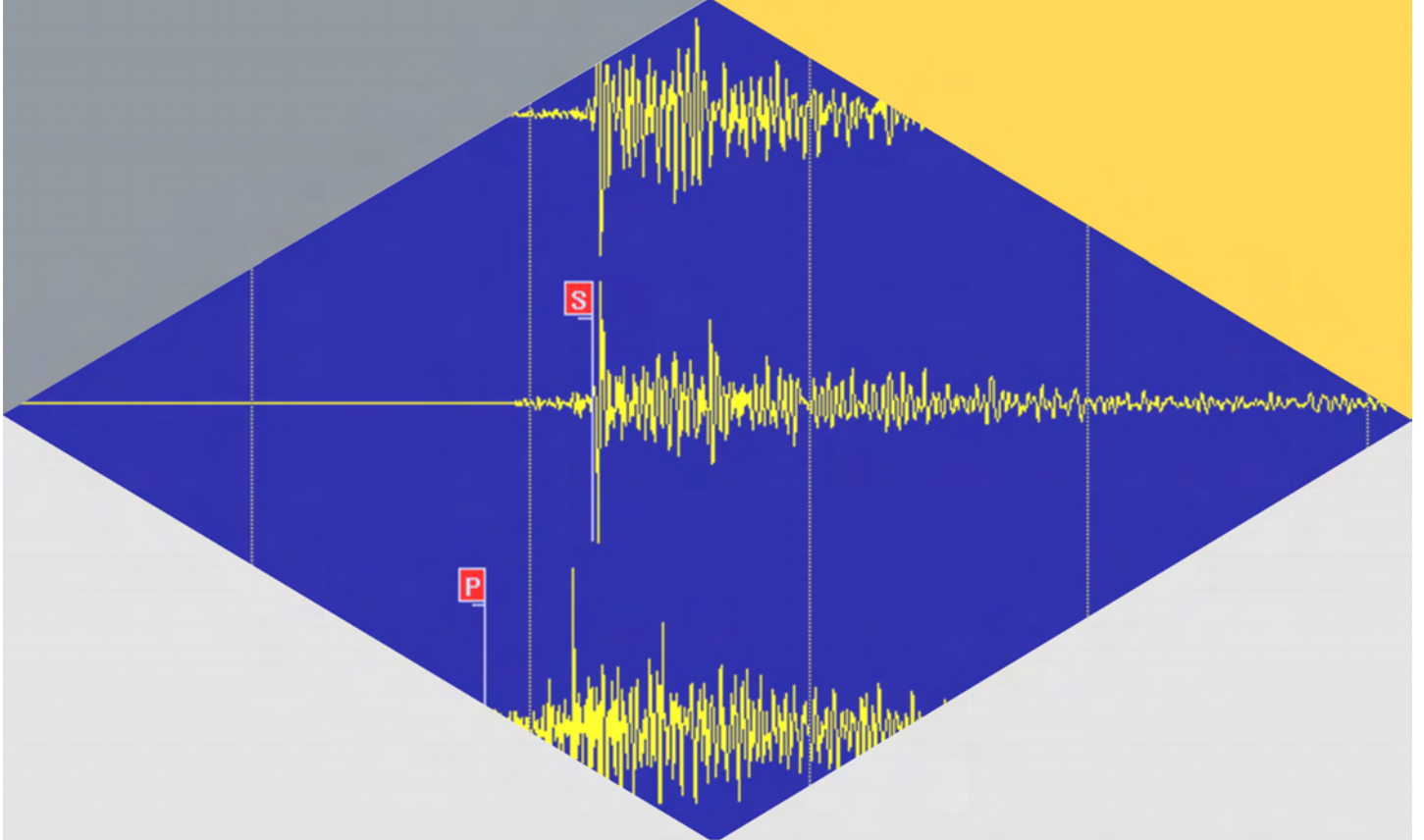
*Operasi Pembenihan Awan dengan kaedah hygroscopic flare
Cloud seeding operations using the hygroscopic flare method*

Pada tahun ini, projek dana e-sains bertajuk *Assessing the Cloud Seeding Effectiveness to Improve the Cloud Seeding Operation* yang bermula pada 2015 telah dilaksanakan dengan kajian memberi tumpuan kepada menilai keberkesanan operasi pembenihan awan dalam tempoh antara monsun.

This year e-science fund project entitled Assessing the Cloud Seeding Effectiveness to Improve the Cloud Seeding Operation, which began in 2015 was conducted and it focused on assessing the effectiveness of the cloud seeding operation during inter-monsoon periods.

Operasi pembenihan awan telah dijalankan dari 14 hingga 31 Mac di kawasan tadahan Empangan Sungai Selangor di Selangor untuk tempoh peralihan monsun pertama dan dari 3 hingga 6 November di kawasan tadahan Empangan Gemencheh di Negeri Sembilan untuk tempoh peralihan monsun kedua. Sebanyak 11 penerbangan telah dijalankan bagi kedua-dua kawasan tadahan tersebut.

Cloud seeding operations were carried out from 14th March to 31st March at the Sungai Selangor Dam catchment area in Selangor for the first inter-monsoon period and from November 3rd until 6th November at the Gemencheh Dam catchment area in Negeri Sembilan for the second inter-monsoon period. A total of 11 flights were carried out for the two catchment areas.



Gempa Bumi
Earthquake

GEMPA BUMI

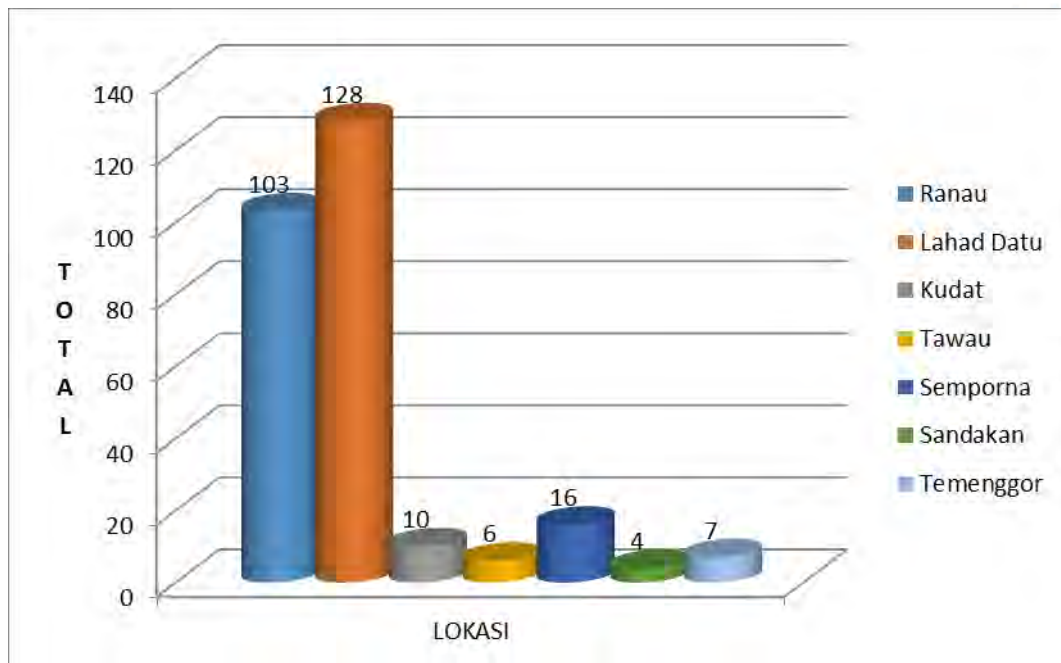
Pada tahun 2016, MMD mengesan sebanyak 1,684 kejadian gempa bumi yang berlaku di seluruh dunia.

274 kejadian gempa bumi tempatan yang lemah (magnitud kurang daripada 5.0 pada skala Richter) telah dikesan di Ranau, Lahad Datu, Kudat, Sandakan, Semporna dan Tawau di Sabah dan di Temenggor, Perak. MMD mendapat laporan bahawa gegaran boleh dirasai daripada orang ramai untuk 13 gempa bumi tempatan bermagnitud 2.3 hingga 4.0 pada skala Richter, kebanyakannya di kawasan Ranau, Sabah. Laporan juga diterima bagi gempa bumi di Tarakan, Indonesia pada 22 Oktober 2016 dengan magnitud 4.1 pada skala Richter yang gegarannya dirasai di kawasan Tawau.

EARTHQUAKE

In 2016, MMD has detected a total of 1,684 earthquakes incident worldwide.

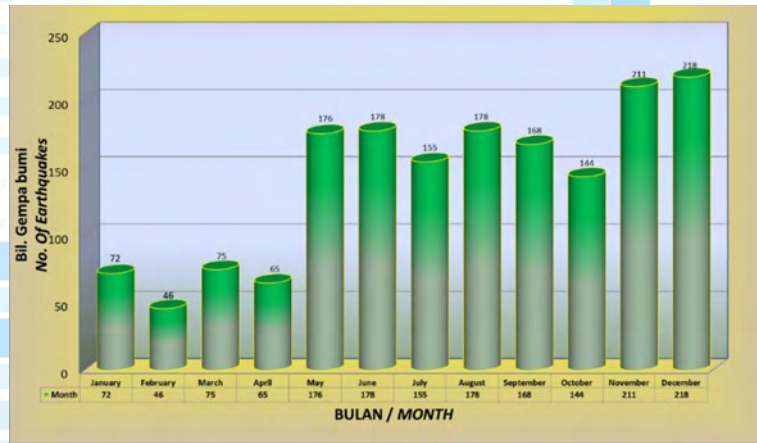
A total of 274 local earthquakes (less than 5.0 on the Richter scale) were detected in Ranau, Lahad Datu, Kudat, Sandakan, Semporna and Tawau in Sabah and in Temenggor in Perak. MMD received reports from the public that tremors can be felt for 13 local earthquakes with magnitude 2.3 to 4.0 on the Richter scale, mostly in the Ranau, Sabah. Reports were also received for the earthquake in Tarakan, Indonesia on 22nd October 2016 with a magnitude 4.1 on the Richter scale where the tremors were felt in Tawau.



Lokasi gempa bumi tempatan pada 2016
Location of local earth quake in 2016

Pencapaian KPI bagi pengeluaran maklumat gempa bumi dalam tempoh 8 minit kepada agensi pengurusan bencana dan orang awam adalah 94.2% (sasaran 90%). Sekiranya gempa bumi besar bermagnitud 6 atau lebih pada skala Richter berlaku di dalam atau luar negara; dan gempa bumi, magnitud 3 atau lebih yang berlaku di dalam negara atau gegarannya boleh dirasai orang awam, maka siaran media dan makluman TV melalui crawler serta laman web, aplikasi myCuaca, Facebook dan Twitter akan dibuat.

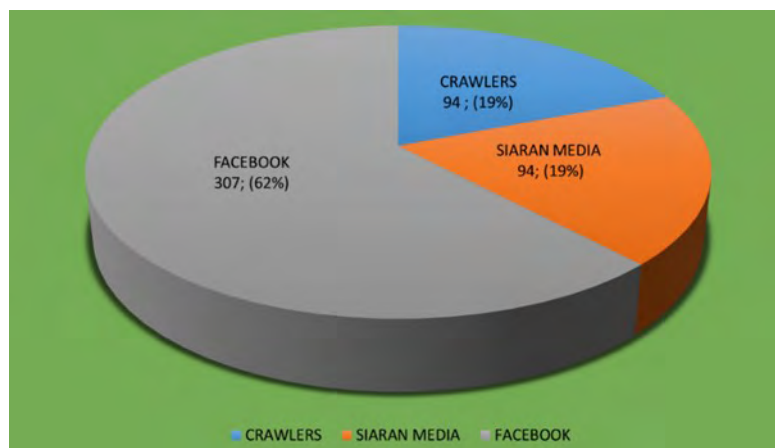
The KPI for the release of earthquake information within 8 minutes to the disaster management agency and the public was achieved with a rate of 94.2% (targeted 90%). If strong earthquake with magnitude 6 or more on Richter scale occur within or outside Malaysia; and earthquake with magnitude 3 or more on Richter scale occurs or tremors could be felt in the country by the public, media broadcasts via TV crawler and website, myCuaca application, Facebook and Twitter will be done.



Bilangan Gempa Bumi Yang Dikesan Tahun 2016
Number Of Earthquake Detected In The Year 2016

Pada tahun 2016, sebanyak 188 siaran media dan TV crawler telah dikeluarkan. Pencapaian KPI untuk penghantaran siaran media dan crawler yang mematuhi masa penghantaran dalam 30 minit adalah 100%.

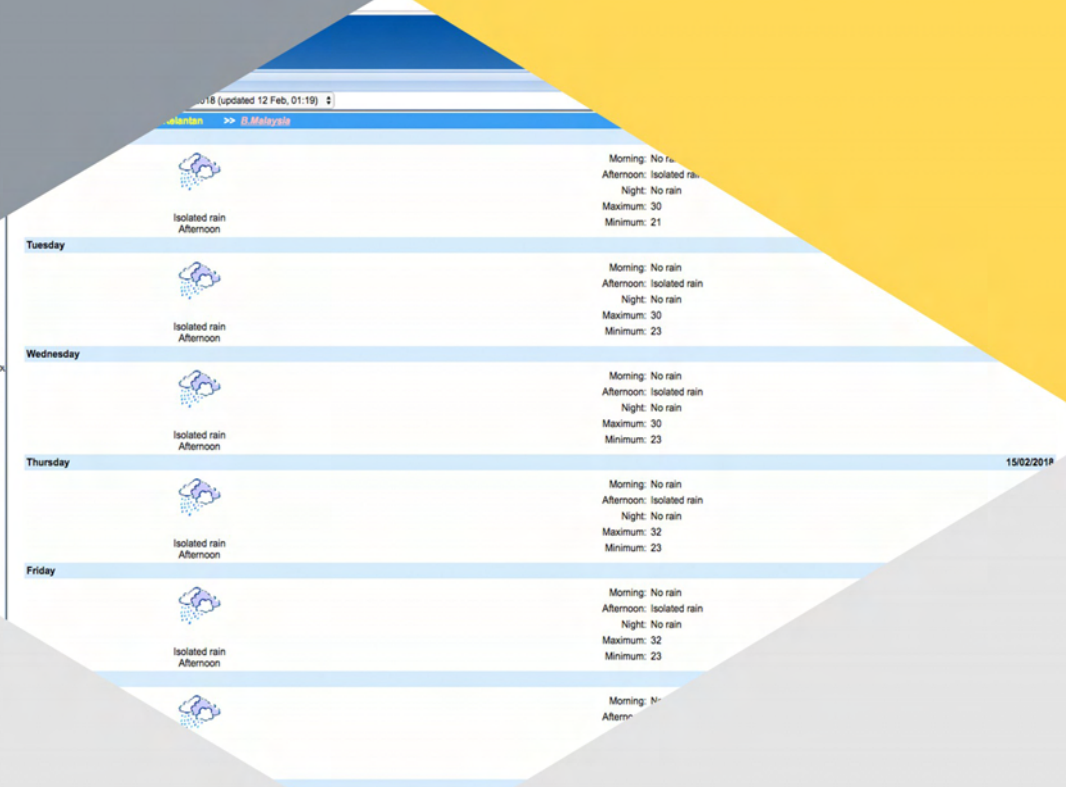
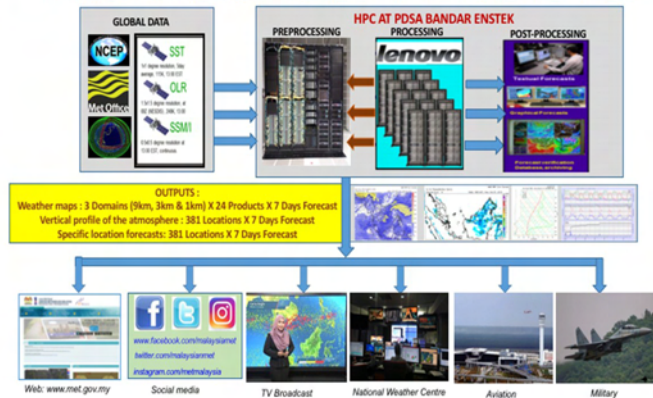
In 2016, a total of 188 press releases and TV crawler were released. The KPI achievement for delivery of media and crawler within 30 minutes is 100%.



Hebahan maklumat gempa bumi dengan pelbagai media
Dissemination of earthquake information through various channels



THE MALYSIAN METEOROLOGICAL DEPARTMENT'S WEATHER MODEL



Penyelidikan & Pembangunan Teknikal
Research & Technical Development

PENYELIDIKAN & PEMBANGUNAN TEKNIKAL

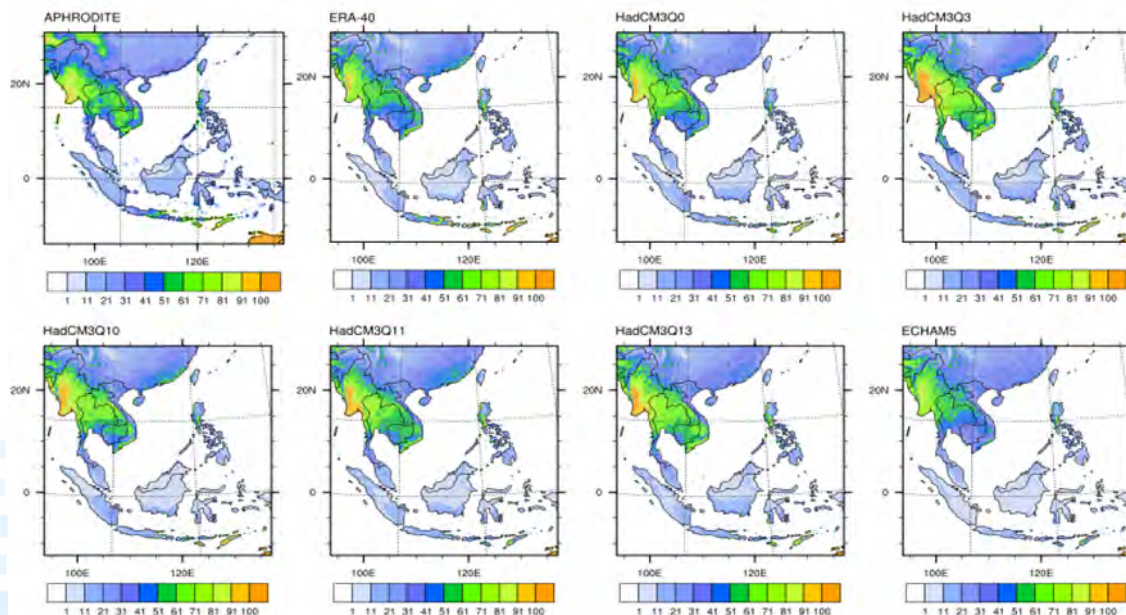
MMD melalui Bahagian Penyelidikan dan Pembangunan Teknikal (BPPT) telah mengendalikan beberapa projek di peringkat antarabangsa iaitu:

- a) *Southeast Asia Climate Downscaling (SEACLID) Project* dibawah *Asia-Pacific Network for Global Change Research (APN)*. Unjuran iklim sehingga tahun 2100 akan dilaksanakan oleh MMD dengan menggunakan Sistem Komputer Prestasi Tinggi;
- b) *Southeast Asia Climate Analysis and Modelling (SEACAM)* yang dianjurkan oleh *Hadley Centre UK Met Office* dan *Centre for Climate Research Singapore (CCRS)*. Projek disiapkan dengan penerbitan bertajuk “*A Regional Climate Modelling Experiment for Southeast Asia*” dan paparan output model boleh dicapai di pautan;

RESEARCH & TECHNICAL DEVELOPMENT

At the international level, MMD through its Research & Technical Development Division (RTDD) have conducted the following projects:

- a) *Southeast Asia Climate Downscaling (SEACLID) Project* under the *Asia-Pacific Network for Global Change Research (APN)*. The downscaling of climate projection until 2100 will be carried out by MMD using its High Performance Computing System;
- b) *Southeast Asia Climate Analysis and Modelling (SEACAM)* hosted by *Hadley Centre of UK Met Office* and *Centre for Climate Research Singapore (CCRS)*. The project was completed with publication of “*A Regional Climate Modelling Experiment for Southeast Asia*” and model output displayed in a portal at www.precisrcm.com/rcct/#;

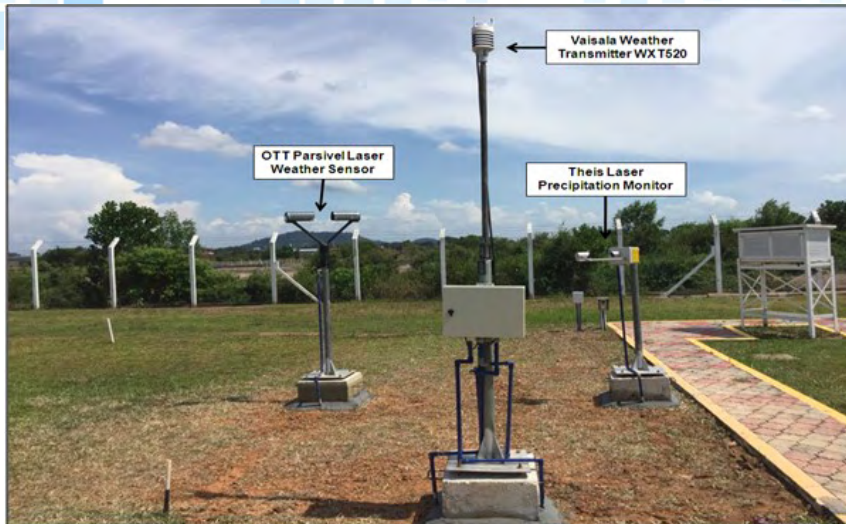


Unjuran suhu maksimum (hari) sehingga tahun 2100 relatif kepada tempoh *baseline* 1971-2000
Maximum temperature projection until 2100 relative to the baseline data period 1971-2000

- c) Kerjasama dengan *UK Met Office* di bawah program *Newton-Ungku Omar Institutional*
- c) *Cooperation with UK Met Office under Newton-Ungku Omar Institutional Linkages*

d) Kerjasama dengan Southeast Asia Disaster Prevention Research Institute - Universiti Kebangsaan Malaysia (SEADPRI-UKM); Fakulti Geologi, Universiti Malaya; Jabatan Mineral dan Geosains dan Jabatan Matematik Gunaan dan Fizik, Universiti Cambridge di bawah Projek Newton-Ungku Omar “Disaster Resilient Cities: Forecasting Local Level Climate Extremes and Physical Hazards for Kuala Lumpur”.

d) *Cooperation with Southeast Asia Disaster Prevention Research Institute - Universiti Kebangsaan Malaysia (SEADPRI-UKM); Faculty of Geology, University of Malaya, Minerals and Geoscience Department and Department of Applied Mathematics and Physics, University of Cambridge under Newton-Ungku Omar project entitled “Disaster Resilient Cities: Forecasting Local Level Climate Extremes and Physical Hazards for Kuala Lumpur”.*



Kajian Keberkesanan Alat Pengukur Hujan
Study of the Effectiveness of Rainfall Measuring Instruments

MMD juga telah melaksanakan beberapa projek di peringkat kebangsaan, antaranya:

Meanwhile, at the national level, the following projects have been implemented by MMD:

a) *Study of the Impacts of Anthropogenic Aerosols on Precipitation Patterns in Malaysia using the WRF-Chem Model dan Modeling of Surface Air Temperature Element in Attainment High Quality Data* di bawah Projek Dana Khas Sains, MOSTI;

a) *Study of the Impacts of Anthropogenic Aerosols on Precipitation Patterns in Malaysia using the WRF-Chem Model and Modeling of Surface Air Temperature Element in Attainment High Quality Data under the ScienceFund Project of MOSTI;*

b) Tiga Projek Dana Khas Sains, MOSTI yang dijalankan:

b) *Three MOSTI's Science Fund Projects:*

- i) *Study of the Effectiveness of Commonly Used Rainfall Measuring Instruments in Measuring Rainfall;*
- ii) *Development of Tsunami Emergency Response Plan for Kudat Intensity in Malaysia; and*
- iii) *Assessing the Cloud Seeding Effectiveness to Improve the Cloud Seeding.*

- c) Projek penyelidikan bertajuk *Modeling of Surface Air Temperature Element in Attainment High Quality Data over East Malaysia* dengan peruntukan RM 550,000 dengan tempoh pelaksanaan selama 30 bulan bermula dari Mac 2014 sehingga Ogos 2016. Model integrasi yang dibangunkan berupaya menganggar suhu permukaan udara di kawasan tiada penceraian terutamanya di tanah tinggi dan pedalaman Sabah dan Sarawak;



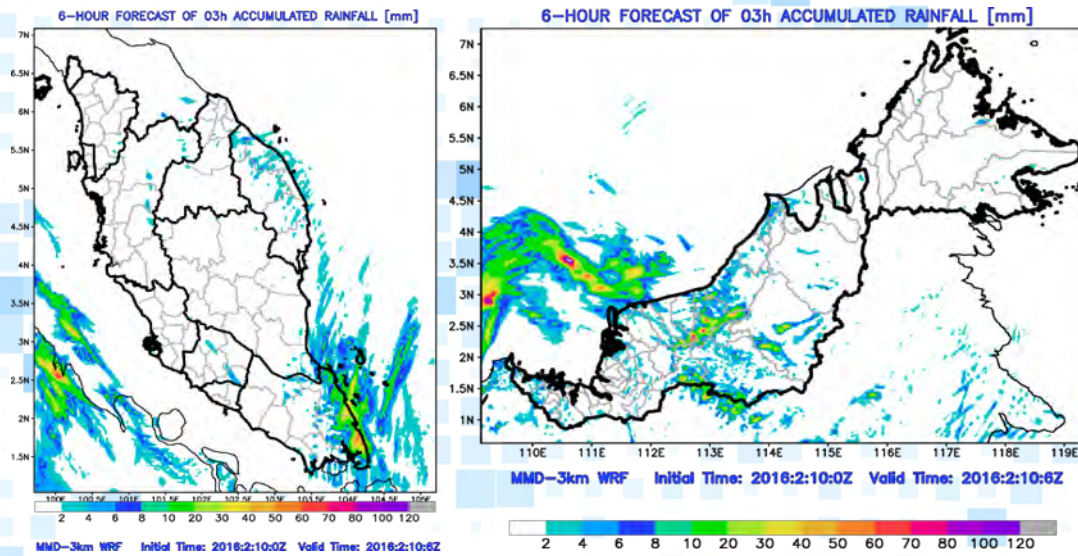
- c) *The research project titled Modeling of Surface Air Temperature Element in Attainment High Quality Data over East Malaysia with an allocation of RM550,000 was completed over a period of 30 months from March 2014 till August 2016. The integrated model was capable in producing accurate surface air temperature over areas without observation stations such as the highlands and interior of Sabah and Sarawak;*



Stesen AWS Kg Lohan Ulu, Ranau, Sabah
AWS Station Kg Lohan Ulu, Ranau, Sabah

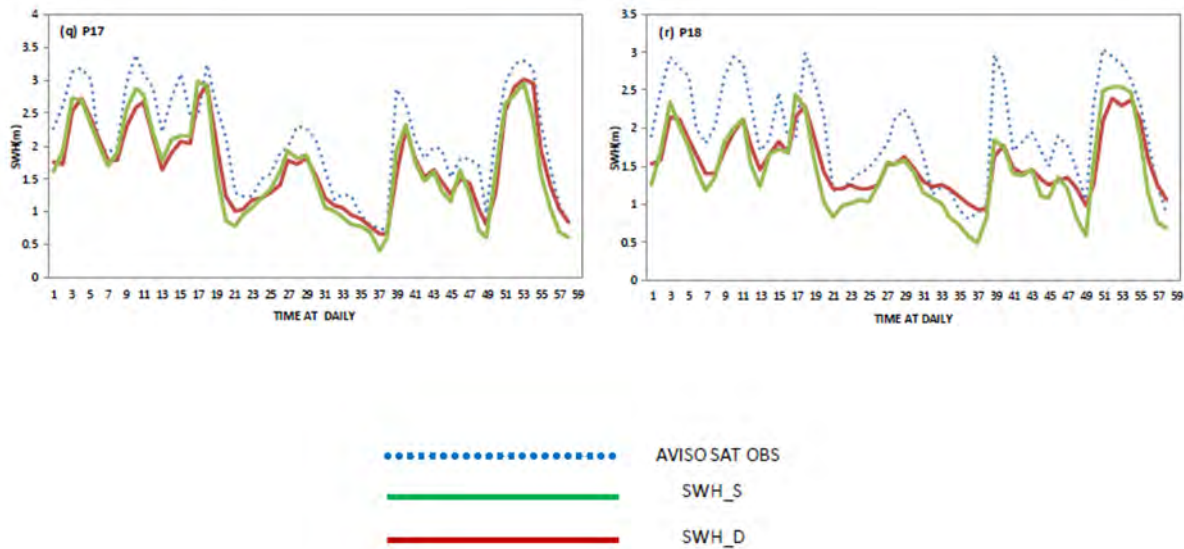
- d) Penggunaan model WRF-CHEM untuk meningkatkan ketepatan model ramalan cuaca numerikal MMD di bawah projek Jawatankuasa Antara Agensi bagi melaksanakan Kajian Komprehensif untuk Ramalan Cuaca Ekstrem dan Banjir;
- e) Mengkaji dan meningkatkan ketepatan model ramalan cuaca berangka (NWP) MMD melalui asimilasi dengan data *Global Positioning System (GPS) Integrated Water Vapour (IWV)* di bawah projek Jawatankuasa antara Agensi bagi melaksanakan Kajian Komprehensif untuk Ramalan Cuaca Ekstrem dan Banjir;

- d) *The use of WRF-CHEM model to increase accuracy of MMD's numerical weather prediction (NWP) model under The Inter-Agency Committee for Implementation of Comprehensive Study for Extreme Weather and Flood Forecasting;*
- e) *To study and enhance the accuracy of MMD's NWP model through data assimilation of Global Positioning System (GPS) Integrated Water Vapour (IWV) under The Inter-Agency Committee for Implementation of Comprehensive Study for Extreme Weather and Flood Forecasting;*



Produk Model NWP MMD-WRF resolusi 3km
Product of MMD-WRF NWP model at 3km resolution

- | | |
|--|--|
| <p>f) <i>Disasters and Climate Extreme - An Integrated Research Framework for Malaysia</i> di bawah program kerjasama MOSTI dan SEADPRI-UKM. MMD berperanan melaksanakan sub-projek bertajuk “<i>Variability and Climate Extremes over Malaysia</i>”;</p> <p>g) Peneraju Kumpulan Kerja Teknikal Penyelidikan dan Pencerapan Sistematis, <i>Third National Communication (NC3)</i> dan <i>Biennial Update Report (BUR)</i>, <i>United Nations Framework Convention on Climate Change (UNFCCC)</i>;</p> <p>h) Kerjasama dengan Lembaga Urus Air Selangor (LUAS) di bawah projek <i>Development of a Decision Support System for Sustainable Water Resources Management System for Sungai Selangor</i>;</p> <p>i) Kerjasama dengan <i>Institute of Ocean and Earth Sciences (IOES)</i>, Universiti Malaya di bawah Projek Simulasi WRF untuk kegunaan Model Hidrologi;</p> <p>j) Kerjasama dengan Jabatan Pengairan dan Saliran untuk Projek Ramalan dan Amaran Banjir Negara Fasa 1 (PRAB); dan</p> <p>k) Kerjasama dengan Institut Penyelidikan Perubatan untuk kajian <i>Assessing Effects of Climatic Factors on Dengue Incidence in Malaysia</i>.</p> | <p>f) <i>Disasters and Climate Extreme - An Integrated Research Framework for Malaysia under the cooperation of MOSTI and SEADPRI-UKM. MMD is involved with the sub-project “Variability and Climate Extremes over Malaysia”;</i></p> <p>g) <i>Lead for Technical Working Group of Research and Systematic Observation, Third National Communication (NC3) and Biennial Update Report (BUR), United Nations Framework Convention on Climate Change (UNFCCC);</i></p> <p>h) <i>Cooperation with Selangor Water Management Board (LUAS) on a project entitled Development of a Decision Support System for Sustainable Water Resources Management System for Sungai Selangor;</i></p> <p>i) <i>Cooperation with Institute of Ocean and Earth Sciences (IOES), University of Malaya on the WRF Simulation Project for Hydrological Model use;</i></p> <p>j) <i>Cooperation with the Department of Irrigation and Drainage on Phase 1 of National Project on Flood Forecast and Warning (PRAB); and</i></p> <p>k) <i>Cooperation with Institute for Medical Research on Assessing Effects of Climatic Factors on Dengue Incidence in Malaysia.</i></p> |
|--|--|



Siri masa bagi simulasi ketinggian ombak signifikan model ramalan numerikal ombak JMA MRI III tanpa skim laut cetek (SWH_D), dengan skim laut cetek dan pencerapan satelit AVISO

Time series of significant wave height for; JMA MRI-III numerical wave model simulation without the shallow water scheme (SWH_D), with the shallow water scheme (SWH), and the AVISO satellite observation

Melalui kertas penyelidikan bertajuk “*The Effect of Shallow Water Calculation in JMA MRI III Wave Model Simulation during Typhoon Sonamu and Typhoon Shanshan*”, MMD telah berjaya menambah baik ketepatan simulasi ramalan ombak di perairan negara dan sekitarnya dengan memasukkan skim pengiraan kesan laut cetek ke dalam fizik model ramalan numerikal ombak.

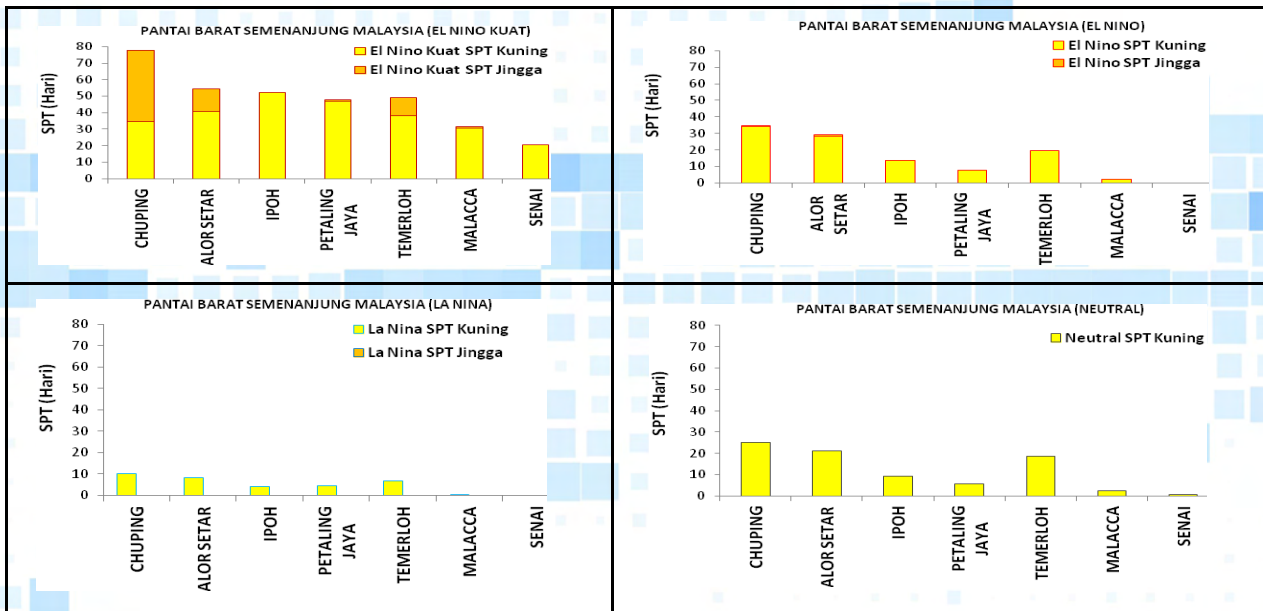
Through the research paper titled “The Effect of Shallow Water Calculation in JMA MRI III Wave Model Simulation during Typhoon Sonamu and Typhoon Shanshan”, MMD has succeeded in improving the accuracy of wave forecast simulation in the waters of country and its surroundings by incorporating a shallow water scheme into numerical wave model’s physics.

Model JMA MRI III yang diadaptasi dari *Japan Meteorological Agency* (JMA) berjaya menghasilkan pekali korelasi setinggi 0.80 dalam proses verifikasi menggunakan data boya tsunami di perairan Pulau Layang-Layang.

The JMA MRI III model adapted for Malaysian waters from the Japan Meteorological Agency (JMA) obtained a high statistical correlation of 0.80 during the verification test using tsunami buoy data in the waters off Pulau Layang-Layang.

Ketepatan sehingga hampir 93% pula dapat dilihat melalui verifikasi simulasi model dengan data pencerapan satelit altimetri AVISO. Kajian kes dilakukan semasa Taufan Sonamu dan Taufan Shanshan berada berhampiran perairan Laut China Selatan pada tahun 2013.

A high accuracy of 93% was also observed through comparison between model simulation and AVISO satellite altimetry observation. The case studies conducted for both Typhoon Sonamu and Shanshan were conducted in the vicinity of the South China Sea in year 2013.



Fasa El Niño & purata SPT tahunan di Pantai Barat Semenanjung
Annual average HOT for each ENSO phase in the West Coast of Peninsular

MMD turut melakukan kajian terhadap kesan ENSO (Ayunan El-Nino Selatan) terhadap suhu permukaan maksimum di stesen-stesen pencerapan seluruh Malaysia ekoran dari kejadian gelombang haba pada suku pertama tahun 2016. Penyelidikan ini telah diterbitkan dalam kertas kerja bertajuk “Analisis Statistik Suhu Permukaan Tinggi (SPT) di Malaysia”. Rumusannya:

- Kejadian Suhu Permukaan Tinggi (SPT) berlaku kerana lebih radiasi sinaran akibat kurangnya litupan awan, terutamanya semasa bulan Mac. Pengurangan litupan awan ini adalah berhubung-kait dengan kedudukan matahari yang tegak di atas rantauan semasa tempoh tersebut;
- Peningkatan dan permulaan kejadian SPT yang lebih awal kebiasaannya berlaku semasa fasa El Nino. Sebaliknya, pengurangan dan permulaan kejadian SPT yang lebih lewat semasa fasa La Nina; dan
- SPT dipantau secara berterusan oleh MMD melalui pencerapan rangkaian stesen meteorologi di seluruh Negara dan juga tinjauan ENSO.

MMD has also studied the effect of ENSO (El Niño Southern Oscillation) against the maximum surface air temperature recorded by stations throughout Malaysia after the heatwave incident in the first quarter of 2016. The research findings have been published in the paper entitled “Statistical Analysis of High Observed Surface Temperature (HOT) in Malaysia”. In summary:

- The Occurrence of High Observed Surface Temperature (HOT) was caused by above normal insolation due to reduced cloud cover, especially during the month of March. This reduced cloud cover was associated to the sun location that directly overhead in the region during the month;*
- Significant rise and early start of HOT days generally occurs in conjunction with El Nino phase. On the other hand, less and start later of HOT days was in conjunction to La Nina conditions; and*
- HOT incidences are continuously monitored throughout Malaysia using nationwide meteorological station network and ENSO outlooks.*





Memorandum Persefahaman
Memorandum of Understanding

MEMORANDUM PERSEFAHAMAN

Satu Memorandum Persefahaman (MoU) telah ditandatangani pada 5 Oktober 2016 antara MMD bersama *Regional Environmental Awareness Cameron Highlands* (REACH) dalam menjalinkan kerjasama untuk membangun dan menyokong aktiviti penyelidikan dalam pemantauan cuaca dan komposisi atmosfera di tapak penyelidikan REACH di Gunung Brinchang, Cameron Highlands, Pahang.

REACH adalah sebuah badan bukan Kerajaan (NGO) berasaskan komuniti setempat yang cakna terhadap kemerosotan kualiti air dan alam sekitar di Cameron Highlands. Ia ditubuhkan untuk menjaga, memulihara dan mengekalkan Cameron Highlands sebagai satu kawasan pertanian dan peranginan yang mesra alam dengan mengekalkan rizab semula jadi. Pada peringkat permulaan, sebuah alat *passive sampler* telah dipasang dan beroperasi di tapak penyelidikan tersebut.

MEMORANDUM OF UNDERSTANDING

A Memorandum of Understanding (MoU) has been signed between MMD and Regional Environmental Awareness Cameron Highlands (REACH) to collaborate in developing and supporting research activities in monitoring weather and atmospheric composition at the REACH research ground in Gunung Brinchang, Cameron Highlands, Pahang.

REACH is a community based non-governmental organisation (NGO) that is concerned with the deterioration of the water and environment quality in Cameron Highlands. It is formed to preserve, restore and maintain Cameron Highlands as an environmentally sustainable agriculture and hill resort within a permanent nature reserve. At the initial stage, a passive sampler instrument has been installed to operate at the research facility.



MoU yang ditandatangani MMD dan *Regional Environmental Awareness Cameron Highlands* (REACH)
MoU signed between MMD and Regional Environmental Awareness Cameron Highlands (REACH)

Pada 18 Oktober 2016, Majlis Menandatangani Memorandum Persefahaman (MOU) di antara MMD dan Universiti Pendidikan Sultan Idris (UPSI) telah diadakan semasa Forum Iklim Kebangsaan – Monsun Timur Laut 2016/ 2017 bertempat Dewan Konvensyen, Bangunan *E-Learning*, UPSI. MoU ini bertujuan mengekalkan hubungan baik dan perkongsian maklumat di antara kedua-dua agensi

On 18th October 2016, a Memorandum of Understanding (MOU) was signing between MMD and Universiti Pendidikan Sultan Idris (UPSI) during the Forum Iklim Kebangsaan – Monsun Timur Laut 2016/ 2017 at the Convention Hall, of E-Learning Building in UPSI. This MoU is aimed at maintaining a good rapport and information sharing between both agencies.



Majlis Menandatangani MoU antara MMD dan UPSI
MoU Signing Ceremony between MMD and UPSI





Latihan Antarabangsa
International Training

EANET Individual Training Course on Air Monitoring di Niigata, Jepun pada 1 hingga 19 Februari 2016.

EANET Individual Training Course on Air Monitoring in Niigata, Japan on 1st to 19th February 2016.

Kursus ini memberi penekanan terhadap kaedah persampelan udara yang betul, pengendalian alat pemantauan serta penilaian dan kawalan kualiti data.

This course focused on the correct method of air sampling, monitoring instrument handling, as well as data quality assessment and quality control.



Pengenalan kepada alat pemantauan PM2.5
Introduction to the PM2.5 monitoring instrument



Demonstrasi kaedah mengambil sampel air sungai
Demonstration on river water sampling method

21st Inter-Governmental Meeting (IGM) / Scientific Planning Group (SPG) Meeting of Asia-Pacific Network for APN di Zhengzhou, China pada 18 hingga 22 April 2016

21st Inter-Governmental Meeting (IGM) / Scientific Planning Group (SPG) Meeting of Asia-Pacific Network for APN di Zhengzhou, China from 18 to 22 April 2016

Mesyuarat ini adalah untuk memupuk kerjasama antara 22 buah negara anggota ke arah mencapai matlamat menyokong penyelidikan, pembangunan kapasiti dan interaksi berkaitan perubahan global di rantau Asia-Pasifik.

This meeting is aimed at fostering cooperation among 22 members' countries in support of research, capacity building and interaction on global change in the Asia-Pacific region.



Sesi Photo (*Photo Session*) 21st Inter-Governmental Meeting (IGM) Scientific Planning Group/(SPG) Meeting of Asia-Pacific Network for APN

1st Task Force Meeting: Future Development of APN di Kobe, Jepun pada 22 hingga 23 Ogos 2016

MMD merupakan ahli *Scientific Planning Group Sub-Committee (SPG-SC)* untuk APN di samping empat orang SPG-SC yang lain dari Amerika Syarikat, Jepun, Bangladesh dan Mongolia untuk sesi 2015/2017. Pegawai MMD telah menghadiri *1st Task Force Meeting: Future Development of APN* pada 22 hingga 23 Ogos 2016 di Kobe, Jepun. Mesyuarat ini diadakan secara ad-hoc untuk membincangkan hala tuju pembangunan masa hadapan APN.

1st Task Force Meeting: Future Development of APN in Kobe, Japan from 22nd to 23rd August 2016

MMD is a member of the *Scientific Planning Group Sub-Committee (SPG-SC)* of the APN in addition to four other SPG-SC members from the United States of America, Japan, Bangladesh and Mongolia for the 2015/2017 session. MMD officer's has attended the *1st Task Force Meeting: Future Development of APN* from 22nd August to 23rd August 2016 in Kobe, Japan. The ad-hoc meeting discussed the direction of future development for APN.



Sesi Photo (*Photo Session*) *1st Task Force Meeting: Future Development of APN*

17th Senior Technical Managers' Meeting (STM17) of the EANET di Listvyanka, Rusia pada 21 hingga 22 September 2016

STM17 bertujuan untuk membincangkan isu-isu teknikal yang dihadapi dan mengkaji laporan data pemantauan bagi setiap negara ahli.

17th Senior Technical Managers' Meeting (STM17) of the EANET in Listvyanka, Russia on 21st to 22nd September 2016

The STM17 meeting was held to discuss technical issues and study the data monitoring report of each member country.



Peserta STM17 di Listvyanka, Rusia
Participants of the STM17 in Listvyanka, Russia

EUBREWNET & WMO-GAW Brewer Spectrophotometer Operator Course di Edinburgh, United Kingdom (UK) pada 4 September hingga 9 September 2016

EUBREWNET (COST Action ES1207) dengan kerjasama WMO-GAW telah menganjurkan *Brewer Spectrophotometer Operator Course* bersempena dengan *Quadrennial Ozone Symposium 2016* di Edinburgh, UK pada 4 September hingga 9 September 2016.

Sebagai satu-satunya agensi di Malaysia yang menjalankan pemantauan kolum ozon total, sinaran ultra ungu, kedalaman optikal aerosol dan sulfur dioksida menggunakan alat Brewer Spectrophotometer, kursus ini telah memberi peluang terbaik bagi mempelajari teori-teori operasi dan saintifik alat ini serta mengkaji isu-isu teknikal yang berkaitan.

EUBREWNET & WMO-GAW Brewer Spectrophotometer Operator Course in Edinburgh, United Kingdom (UK) on 4-9 September 2016

EUBREWNET (COST Action ES1207) together with WMO-GAW had organized the Brewer Spectrophotometer Operator Course in conjunction with the Quadrennial Ozone Symposium 2016 in Edinburgh, UK on 4th September to 9th September 2016.

As the only agency in Malaysia to monitor the total column ozone, UV radiation, aerosol optical depth and sulfur dioxide using the Brewer Spectrophotometer, this course has given the best opportunity to learn about the operational and scientific theories of the instrument and to study the related technical issues.



Taklimat berkenaan alat Brewer Spectrophotometer
Briefing on the Brewer Spectrophotometer

The 8th Asia-Pacific GAW Workshop on Greenhouse Gases (APGG-2016) di Seoul, Republik Korea pada 17 Oktober hingga 21 Oktober 2016

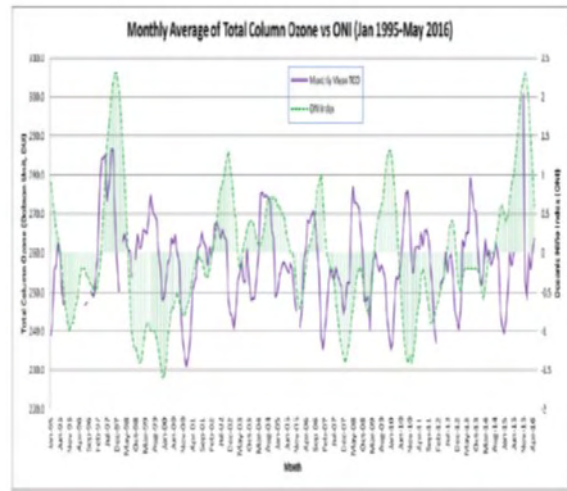
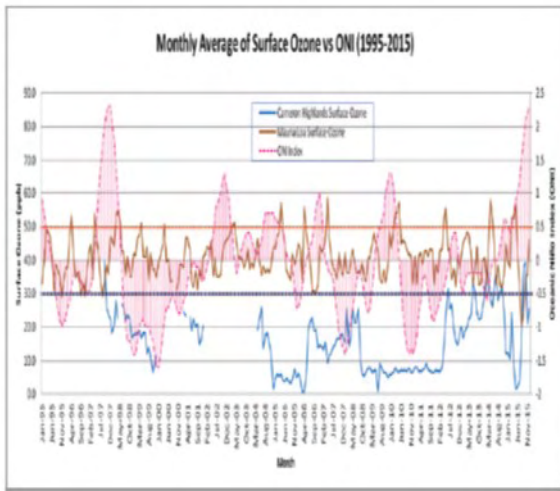
APGG telah menjadi medan kerjasama bagi aktiviti pemantauan gas rumah hijau seperti memperkenalkan teknologi pemantauan dan stesen-stesen pemantauan terbaru, kaedah pengurusan kualiti data serta perkongsian hasil penyelidikan.

Pada APGG-2016, MMD telah membentangkan satu kertas teknikal bertajuk *The Ozone Monitoring Activities and Its Trends Analysis in Malaysia during El Nino and La Nina Phenomena*. Kertas teknikal ini telah diterbitkan dalam *Asia-Pacific GAW on Greenhouse Gases Newsletter Volume 7*, edisi Disember 2016.

The 8th Asia-Pacific GAW Workshop on Greenhouse Gases (APGG-2016) in Seoul, Republic of Korea on 17th October till 21st October 2016

The APGG has become an avenue for cooperation on the greenhouse gases activities such as introducing the latest monitoring technologies and monitoring stations, data quality management methodologies as well as sharing research findings.

At APGG-2016, MMD presented a technical paper titled 'The Ozone Monitoring Activities and Its Trends Analysis in Malaysia during El Nino and La Nina Phenomena'. The technical paper was also published in the Asia-Pacific GAW on Greenhouse Gases Newsletter Volume 7, December 2016 edition.



(Kiri) Purata bulanan ozon permukaan dan Indeks Nino lautan (ONI) di Cameron Highlands dan Mauna Loa (1995-2015)

(Left) *The monthly average of surface ozone and Ocean Niño Index in Cameron Highlands and Mauna Loa (1995-2015)*

(Kanan) Purata bulanan kolum ozon total dan ONI di Petaling Jaya (1995-2016)

(Right) *The monthly average of total column ozone and ONI in Petaling Jaya (1995-2016)*

TCC Training Seminar on Primary Modes of Global Variability and Regional Climate di Japan Meteorological Agency (JMA), Tokyo Jepun dari 14 November hingga 18 November 2016

TCC Training Seminar on Primary Modes of Global Variability and Regional Climate in the Japan Meteorological Agency (JMA) Tokyo, Japan from 14th November to 18th November 2016

MMD menyertai bengkel latihan *TCC Training Seminar on Primary Modes of Global Variability and Regional Climate* yang bertujuan untuk meningkatkan kefahaman dan kemahiran dalam menginterpretasi produk-produk model iklim Tokyo Climate Centre (TCC) serta memahami proses dinamik dalam pengaruh sistem cuaca berskala sinoptik seperti El Nino / La Nina terhadap keragaman cuaca di negara Malaysia dan rantau Asia Tenggara.

MMD has participated the TCC Training Seminar on Primary Modes of Global Variability and Regional Climate. The purpose of the training was to increase the understanding and able to intepret the climate model products of the Tokyo Climate Centre (TCC) and understand the dynamical processes that influences the synoptic scale weather systems in Malaysia and South East Asia in general such as during the event of an El Niño or La Niña episode.



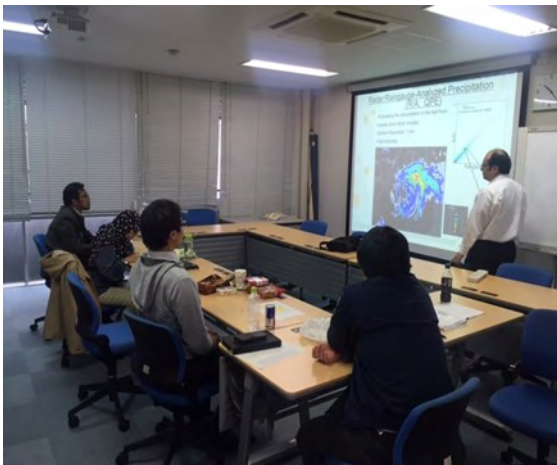
Sesi Foto (Photo Session) TCC Training Seminar on Primary Modes of Global Variability and Regional Climate

18th Session of the Intergovernmental Meeting on the EANET (IG18) di Bangkok, Thailand pada 22 hingga 23 November 2016.

IG18 ini diadakan untuk membincangkan hala tuju EANET dari aspek program pemantauan di negara ahli, program pembangunan, kewangan, belanjawan dan sebagainya.

Bengkel Latihan Dua Hala Kualiti Radar dan QPE di Japan Meteorological Agency (JMA)

Bengkel ini telah diadakan di JMA pada 19 Disember hingga 23 Disember 2016 yang di hadiri oleh wakil MMD. Tujuan bengkel ini adalah sebagai perkongsian kepakaran dan pengalaman oleh pihak JMA untuk meningkatkan kualiti data radar bagi rangkaian radar MMD dan QPE (*Quantitative Precipitation Estimation*).



18th Session of the Intergovernmental Meeting on the EANET (IG18) in Bangkok, Thailand on 22nd to 23th November 2016.

The IG18 meeting was held to discuss the future direction of EANET from the aspects of its monitoring programmes in member countries, development programmes, financial budgetary and others.

Radar Quality and QPE Quality Training Workshops at Japan Meteorological Agency (JMA)

*The workshop was held at JMA from 19th December to 23rd December 2016 and attended by MMD representatives. This workshop is aimed at sharing expertise and experience by JMA to improve the quality of radar data for MMD and QPE radar (*Quantitative Precipitation Estimation*).*



Sesi penerangan dan sesi bergambar dengan pakar dari JMA
Briefing dan photo sessions with JMA experts



2016年9月11-12日 中国·南宁
Nanning, China, 11 to 12 September 2016

主办单位：中国气象局
ORGANIZED BY: China Meteorological Administration

广西壮族自治区人民政府
The People's Government of Guangxi Zhuang Autonomous Region

承办单位：广西壮族自治区气象局
HOST: Guangxi Meteorological Service



Lawatan Antarabangsa International Visit

LAWATAN ANTARABANGSA

INTERNATIONAL VISIT

Pada 1 Jun 2016, MMD telah menerima kunjungan daripada lapan orang pegawai kanan dari Bangladesh. Lawatan ini bertujuan untuk meningkatkan pengetahuan mengenai kaedah yang diguna pakai oleh MMD dalam pemantauan dan pengeluaran amaran cuaca di Malaysia.

On 1st June 2016, eight senior officers from Bangladesh visited MMD. The visit is aimed at improving the knowledge on the methods adopted by the MMD in monitoring and issuing the weather warnings in Malaysia.



Sesi foto bersama pegawai Pegawai Kanan Bangladesh
Photo session with senior officer from Bangladesh

Pada 11 Ogos 2016, MMD telah menerima kunjungan ahli-ahli Pusat Pembangunan Perikanan Asia Tenggara (SEAFDEC) yang melibatkan 14 peserta luar negara dari ASEAN. Lawatan ini bertujuan untuk meningkatkan pengetahuan pegawai-pegawai tersebut mengenai operasi dan kaedah yang digunakan MMD untuk memberikan ramalan cuaca dan laut yang melibatkan sektor perikanan negara.

On 11th August 2016, the MMD received a visit from the Members of Southeast Asian Fisheries Development Center (SEAFDEC) Fisheries Council Meeting involving 14 foreign participants from ASEAN. The visit is aimed at increasing the knowledge of the officers on the operations and methods used by MMD to provide weather and sea forecasts involving the national fisheries sector.



Sesi foto bersama ahli SEAFDEC
Photo session of SEAFDEC Members

Pada 22 September 2016, delegasi Earthquake Administration Guangdong Province (EAGP) China telah melawat MMD. Lawatan ini bertujuan mengukuhkan jalinan kerjasama serta berkongsi pengalaman pemantauan aktiviti gempa bumi antara kedua-dua negara.

On 22nd September 2016, the delegate from Guangdong Earthquake Administration (EAGP) of China visited the MMD. The visit is aimed at strengthening cooperation and sharing experiences on monitoring earthquake activities between the two countries.



Sesi foto lawatan pihak EAGP bersama staf MMD
Photo session of the EADP delegates with MMD's Staff





Senarai Pejabat
Meteorologi Negeri
**List of State
Meteorological Offices**

SENARAI PEJABAT/LIST OF OFFICES

Ketua Pengarah

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Pengarah

Pusat Meteorologi
Penerbangan Nasional
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Pengarah

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Lapangan Terbang Antarabangsa Pulau Pinang,
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Pengarah

Pejabat Meteorologi Pahang
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Faks : 09-5384673



Pengarah

Pejabat Meteorologi Terengganu
Kilometer 8 Jalan
Kuala Besut
22000 JERTIH
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Faks : 09-690 2461



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Faks : 07-599 4521



Pengarah

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Faks : 03-78464982



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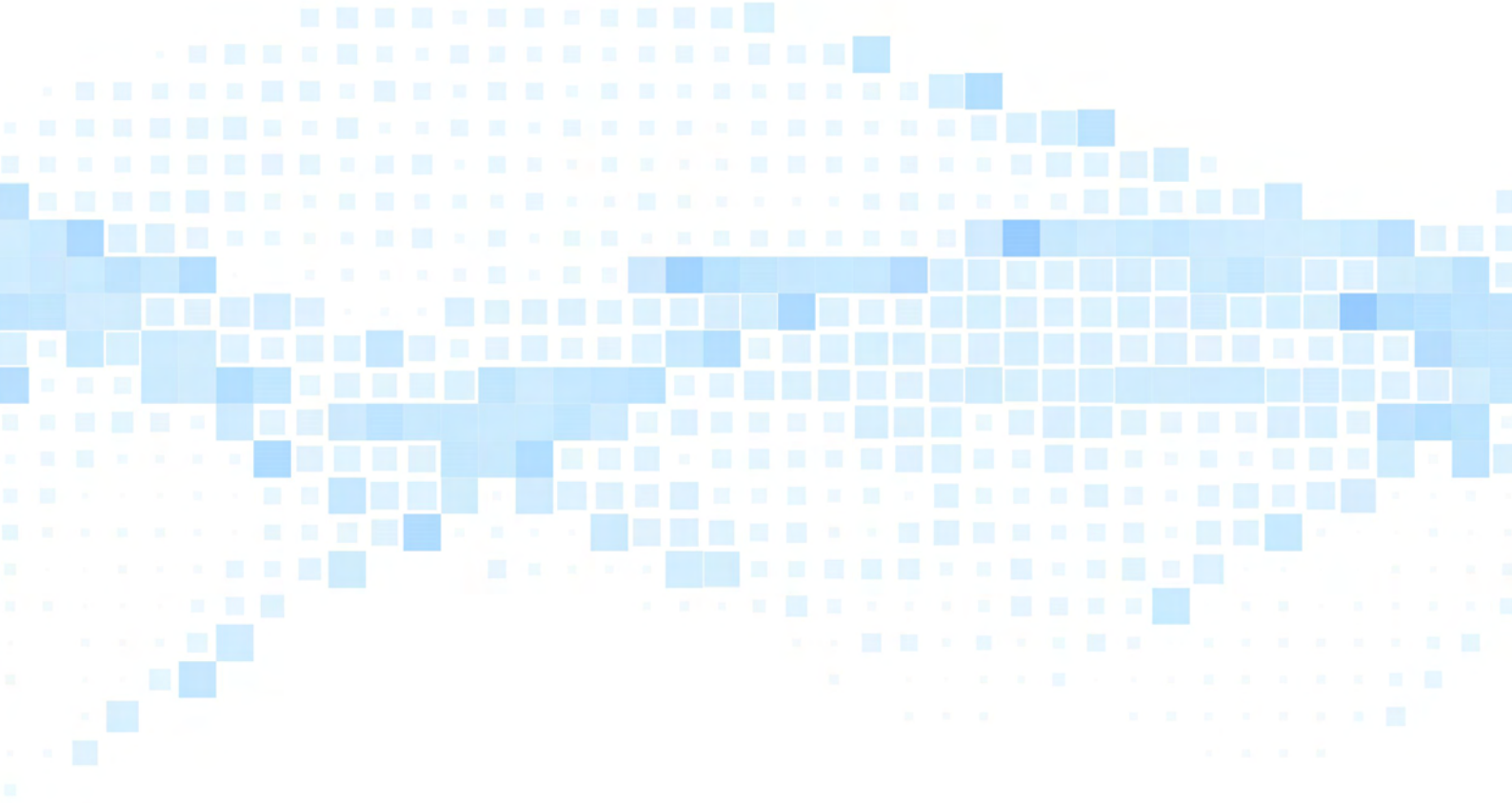
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