WORLD METEOROLOGICAL ORGANIZATION
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COMMISSION FOR BASIC SYSTEMS
OPEN PROGRAMME AREA GROUP ON INTEGRATED OBSERVING SYSTEMS

INTER-PROGRAMME EXPERT TEAM ON SATELLITE UTILIZATION AND PRODUCTS

SECOND SESSION

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VLab Status and Plans

(Submitted by VLab co-chairs)

Summary and Purpose of Document

This document reports on activities within the WMO-CGMS Virtual Laboratory for Education and Training in Satellite Meteorology (VLab) along with future plans. Since IPET-SUP-1, VLab members have offered a variety of training opportunities; with highlight to the Train the Trainer Workshop on GEONETCast Americas and Science Week.

Furthermore, two major events addressing the next generation of satellites: **The Himawari-8 Training Campaign** and **Preparing for the Next Generation of Satellites** provided very good opportunities for stakeholders from all WMO Regional Associations to be informed and make effective use of new technology and data that is or will soon be available.

ACTION PROPOSED

The second session is invited to note the important achievements of the VLab, to provide comments, to consider the actions and recommendations below.

In particular, the session is invited to discuss the proposed Satellite Skills and Knowledge for Operational Meteorologists, and suggest a way forward for their recognition by WMO.

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Appendices:

A. Satellite Skills and Knowledge for Operational Meteorologists

B. Expectations from the Centres of Excellence

C. Expectations from the Satellite Operators

D. Training Activities organized by VLab from January to December 2015

VLab STATUS AND PLANS

1 INTRODUCTION

This document reports on the activities and plans of the WMO-CGMS Virtual Laboratory (VLab). Since IPET-SUP-1 the VLab management group (VLMG) has met three times in virtual meetings (March, July and December 2015). A document describing the skills supporting the WMO Competencies related to the use of satellite data by operational meteorologists was written A revision of expectations from VLab Centres of Excellence (CoE) and supporting Satellite Operators was also conducted in 2015. These documents are available in Appendices A, B and C. Regarding the most recent activities of VLab (since March 2015), a short review of major achievements and plans is given below.

2 MAJOR ACTIVITIES OF THE VIRTUAL LABORATORY SINCE IPET-SUP-1

Besides the various regional activities that were planned by the VLab Centres of Excellence (see Appendix C) and the regular offering of monthly Regional Focus Group sessions (American and Caribbean, South African, and Australian Focus Groups), the major activities conducted by the VLab within the last 11 months can be summarised as follows:

2.1 Train the Trainer Workshop on GEONETCast Americas

VLab has again conducted a WMO/NOAA sponsored Train the Trainer Workshop on GEONETCast Americas, on 25-26 April 2015, prior to the NOAA Satellite Conference (27 April to 01 May). The TtT workshop was a follow up to the successful 2013 workshop at the same conference. The workshop highlighted resources for GEONETCast: the system, installation guidelines, what data the system has, and software to visualize the data. There was an update on the progress of the Satellite Data Requirements group and how these efforts link in to preparations for GOES-R. Hands on software activities highlighted case examples that demonstrated RGB capabilities for GOES-R using VIIRS and MODIS imagery. The VLab participants also took part in the WMO Coordination Group on Satellite Data Requirements for Region III and IV meeting at the beginning of the conference. As part of the Conference session was devoted to International training, a presentation about VLab was made by the VLab co-chair to highlight its role in International Training in satellite meteorology.

2.2 Science Week 2015

The VLab CoE in Australia hosted the “Science Week” from the 27th to the 30th July 2015. Fifteen online sessions were presented in collaboration with presenters from the Australian Bureau of Meteorology Training Centre (BMTC), the Centre for Australian Weather and Climate Research (CAWCR), Japan Meteorological Agency (JMA), Met Service New Zealand, Korea Meteorological Administration (KMA), China Meteorological Administration (CMA) and South African Weather Service (SAWS). The event featured sessions pertaining to the latest developments in meteorological science with respect to operational forecasting, including sessions about the new generation of geostationary satellites.

All sessions were recorded and are available in the website of the VLab CoE Australia at http://www.virtuallab.bom.gov.au/events/science-week-2015/science-week-2015-recordings/

2.3 Himawari-8 Training Campaign

A training campaign was organised by the CoE in Australia to help WMO Region V and stakeholders elsewhere to prepare for the effective use of Himawari-8 data. The first phase of the Campaign started in January, prior to Himawari-8 data availability, and included thirteen tutorial sessions. A second phase of the Campaign took place from June to December, with another eighteen tutorial sessions conducted. All tutorials were offered online.

A considerable amount of training resources was produced for this event and is available at http://www.virtuallab.bom.gov.au/training/hw-8-training/

2.4 Event Week – Preparing for the next generation of satellites

Another event that also addressed the importance of preparing stakeholders for the next generation of satellites was organised by the VLab in the format of an Event Week.

The Event was composed of a selection of webinars presented from 16 to 20 November by Japan Meteorological Agency – JMA, China Meteorological Administration – CMA, India Meteorological Department – IMD, National Oceanic and Atmospheric Administration – NOAA, Cooperative Institute for Research in the Atmosphere – CIRA, European Organisation for the Exploitation of Meteorological Satellites – EUMETSAT, National Institute for Space Research – INPE, Korea Meteorological Administration – KMA and the COMET Program.

Ninety-five attendees from all WMO Regional Associations participated in this event. A good number of attendees participated in more than one session, showing the interest in learning about everything that is new in the next generation of satellites.

All resources presented and recorded sessions are available at http://www.wmo-sat.info/vlab/next-generation-of-satelliles/

2.5 Conceptual Models for the Southern Hemisphere Project

Conceptual Models for Southern Hemisphere (CM4SH) is a joint project between four southern hemispheric Centres of Excellence: Argentina, Australia, Brazil and South Africa. The project is co-funded by WMO and EUMETSAT. The first CM4SH project was completed in March 2014 (full report available at http://www.wmo-sat.info/vlab/conceptual-models-southern-hemisphere/). The second phase of the project started in January 2015. A thorough report of the project is available as IPET-SUP-2/Doc 13.2.

3 COORDINATION WITH PARTNER PROGRAMMES:

3.1 WMO Train the Trainer Online Seminar for WMO RA VI

WMO Education and Training offered a Train the Trainer Online Seminar for trainers from WMO RA VI in 2015. The seminar was 10 weeks long and had participants from VLab CoE in RA VI (Russian Federation). Also participating in the seminar were trainers and training managers from CoEs Argentina and Barbados. The concession for participants from VLab CoEs in RA III and IV was based on the idea that these might help to facilitate the course in 2016, when the TtT online Seminar will be offered in their regions.

In 2015, VLab collaborated in the event with one course facilitator (VLab Technical Support Officer), who was also responsible for the development of some training material and activities.

3.2 CALMet Moodle Course

In order to fulfil a common need for training trainers to use the Learning Management System Moodle, VLab is working in collaboration with other training programmes to create a self-paced course, which will be offered via CALMet.

During 2015, three units of the course were created and are now being offered via a pilot scheme. Additional units will be produced during 2016.

Collaborators in the production of this course include trainers and technical support officers from VLab, EUMeTrain, EUMETSAT, Eumetcal, MeteoFrance, Institute of Meteorology and Water Management Research (IMGW-PIB, Poland) and WMO Education and Training.

4 FUTURE ACTIVITIES PLANNED

4.1 VLMG-8 Meeting in 2016

The next face-to-face meeting of the VLab management group (VLMG-8) will take place in Barbados, from 9 to 13 May 2016. The Caribbean Institute for Meteorology and Hydrology will be hosting the meeting in its main campus, in Bridgetown.

The VLMG-8 meeting will offer a critical opportunity for all VLab partners to assess achievements, exchange experiences, address challenges, and take decisions that will shape the VLab 's future. The meeting will define the steps to put the new 2015-2019 VLab strategy into practice. It will also consider first results from the WMO 2016 Satellite User Survey. VLab CoEs and supporting Satellite Operators and Agencies are working on reports that will be discussed in the meeting, as VLab partners are aiming to identify the strengths and weaknesses of VLab training in order to further enhance achievements.

4.2 Plans for regional training events

VLab members will be presenting their training plans for this year in the report of activities that is due at the end of February.

5 Satellite Skills and Knowledge for Operational Meteorologists

This document describes the underpinning skills that support the WMO Competencies that relate to the use of satellite data by operational meteorologists. The writing of this document was initiated by VLMG and then further developed by Ian Bell, Roger Deslandes and Bodo Zeschke from the Australian Bureau of Meteorology, and Ian Mills and Mark Higgins form EUMETSAT. Consultation with VLab Centres of Excellence was done in 2014, when the document was presented for discussion during the VLMG-7 Meeting in Saint Petersburg. Members of the CALMet community were also consulted and had the opportunity to comment. The final version of this document is available as Appendix A.

The second session of IPET-SUP is invited to discuss the proposed Satellite Skills and Knowledge for Operational Meteorologists, and suggest a way forward for their recognition by WMO.

6 VLab Expectations

The two documents describing the VLab expectations from its Centres of Excellence and the supporting Satellite Operators were revised in 2015. Updates include links to important documents released by the WMO Education and Training Programme, the WMO Product Access Guide and also the new VLab Strategy for 2015-2019. The document also makes clear statements of the functions of nominated VLMG representatives and focal points of contact.

These documents were approved by VLMG and circulated within VLab members of CGMS. The revised documents are included in this report as Appendices B and C for reference, but are also available at http://www.wmo-sat.info/vlab/governance-documents/

7 CONCLUSION

VLab continues to make great strides in the forging of training in satellite meteorology. With the onset of the Next generation of satellites, VLab's new strategy is designed to face and address the challenges that this presents. This will be accomplished with a strong, cohesive core, which is the VLab office members and Management Group, as well as supporting Satellite Operators and Centres of Excellence.

One issue that continues to challenge the VLab is the difficulty to aid CoEs in meeting the agreed expectations, whilst the number of personnel available in their Centres is often not adequate to meet the scope of training activities required in their respective area of responsibility.

IPET-SUP and its membership have been a strong supporter and advisory body to VLab. It is important that this support continues so that initiatives such as the Virtual Round Table events, the Preparation for the Next Generation of Satellites and many others can be built upon as we bridge the gap between satellite data providers and users.

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APPENDIX A

Satellite Skills and Knowledge for Operational Meteorologists

Summary

This document describes the underpinning skills that support the WMO Competencies that relate to the use of satellite data by operational meteorologists. The skills are:

1. Identify surface features
2. Identify cloud types and their characteristics
3. Identify and interpret broadscale, synoptic and mesoscale systems
4. Identify and interpret atmospheric phenomena
5. Interpret derived fields and derived products
6. Identify and interpret oceanic features and systems

The skills definition was developed by the WMO-CGMS VLab to make it quicker and easier for training centres to develop learning objectives that relate to the WMO competencies.

Acknowledgements

These enabling skills were initiated by the WMO-CGMS VLab Management Group and developed by Ian Bell, Roger Deslandes, Bodo Zeschke from the Australian Bureau of Meteorology and Ian Mills and Mark Higgins form EUMETSAT with consultation with the WMO-CGMS Centres of Excellence and members of the CALMet community. The authors warmly thank everyone who took the time to provide feedback on the drafts.

Background

The interpretation of satellite imagery is not an end in itself but is an element of the competent forecasters' toolbox.

The WMO-CGMS VLab is a global network of specialized training centres and meteorological satellite operators working together to improve the utilisation of data and products from meteorological and environmental satellite. The WMO Competencies for operational meteorologists and hydrologists and the qualifications for meteorologists and meteorological technicians is framework for the VLab training that targets operational meteorologists. The question for VLab trainers is:

What general satellite skills should we teach operational meteorologists that underpin the WMO Competencies?

The enabling skills described in this document are an answer to that question.

The application of satellite data is most relevant to the first two of WMO Competencies for each area of Operational Meteorology and Hydrology. These require the competent meteorologists to "Analyse and monitor continually the evolving meteorological and/or hydrological situation" and "Forecast meteorological and hydrological phenomena and parameters".

As these skills are supporting the high level competencies, we have designated the satellite interpretation requirements as contributing or enabling skills rather than as competencies in their own right.

Trainers who wish their courses to be more aligned to the qualifications and competencies can use this document to more quickly develop appropriate learning objectives for the satellite related elements of their courses. Of course this document should be used in conjunction with the qualification (WMO-1083) and WMO competency definitions1.

Operational meteorologists can use the document to calibrate that the breadth and depth of the underlying knowledge and competence with respect to the application of satellite data.

Six skills are detailed in this document:

7. Identify surface features
8. Identify cloud types and their characteristics
9. Identify and interpret broadscale, synoptic and mesoscale systems
10. Identify and interpret atmospheric phenomena
11. Interpret derived fields and derived products
12. Identify and interpret oceanic features and systems

The performance and knowledge requirements that support these skills should be customised based on the particular context of the organisation, its service requirements and available satellite data. This document covers the full range of possible skills and knowledge requirements. Any individual will require only a subset of these, according to their needs.

Meteorologists in different locations or performing different job tasks will have access to different satellites with their particular characteristics and to various display and manipulation systems and tools. They will also be dealing with a variety of local meteorological systems and phenomena.

The focus of this document is on meteorological forecasting. Other uses of satellite data, for example, research, oceanography, hydrology, climatology and other specialist areas, will be considered separately in other documents.

1 http://www.wmo.int/pages/prog/dra/etrp/competencies.php

In addition to the general competencies of a meteorological forecaster, the following conditions and background skills and knowledge will apply.

General conditions

- Imagery includes single and multiple channels and combinations of channels, including RGB displays, derived quantitative products (processed satellite data blended with NWP data) and synthetic satellite imagery from numerical model predictions.
- Satellites include geosynchronous and polar orbiting satellites with passive and active sensing.
- Satellite interpretation does not happen in isolation but occurs within the context of all other observations, guidance and situational awareness
- Systems, features and phenomena of interest will be dependent on the required forecasting tasks and location.

Access, select, display and manipulation of satellite data

The forecaster will be able to:

- Access data from geostationary and polar orbiting satellites
- Select the most appropriate channels or combinations of channels for the task at hand
- Display and manipulate the imagery as individual or combined channels, singly or with animation
- Apply enhancements to imagery
- Access and display derived data

Characteristics, limitations and possible errors in the satellite data

The forecaster will take into account factors affecting data quality and characteristics, including:

- Satellite resolution (time, horizontal, vertical), channel
- Position of the satellite sub-point – resolution, parallax errors
- Time of scan for different parts of the image
- Satellite sensitivities, precision, accuracy and wavelength characteristics
- Variations due to sun angle

How to use this document

This document specifies the satellite interpretation skills required of a meteorological forecaster. It does not specify how satellite meteorology should be taught. This will vary according to many circumstances, including the particular job tasks required; whether it is taught as part of a short course, a full initial course or independent learning; and, whether it is a separate subject, integrated with other data sources and theory as part of a meteorological systems approach, or a combination by initially teaching background satellite theory followed by an integrated systems approach.

In any case it is recommended that the training be activities based with the following sequence used for development:

1. Set your training goals. These are the required job skills from this document (and/or higher level competencies). This is what the forecaster needs to do.
2. Identify any sub-tasks required to achieve this. If all of these sub-tasks are learned the job task will be achieved.
3. Identify learning activities for each sub-task. If the activities are well chosen, we can be confident that, when successfully completed, the learner will be able to perform the job tasks.
4. Unlike in the conventional approach, only now do we identify the knowledge and skills that are required to enable someone to perform the learning activities. Note that these are *essential* knowledge and skills only. Any extra content that is in the “nice to know” category, or that we think they might need one day, has been shown to decrease overall learning and should not be included.

Learning guide

It is envisaged that a learning guide will accompany these guidelines. It will include details of techniques, channel combinations, possible learning activities, etc. These will be updated as new understanding, techniques and tools become available, whereas the skills in this document will remain more constant.

Skill 1: Identify surface features

Description

Identify geographical features, surface characteristics and conditions

Performance components

1. Identify terrain and geographical features
    - Discriminate between land and sea.
    - Distinguish mountainous from low lying regions.
    - Locate rivers and river valleys.
    - Identify lakes.
    - Differentiate natural vs human modified areas.
2. Identify surface characteristics and conditions, including dry/wet, different vegetation types and clear areas, sand and desert
    - Discriminate between areas of vegetation and areas of drought
    - Identify different types of desert surface e.g. sand, desert pavement
    - Identify areas of recent burning
    - Identify hotspots (fires, volcanic activity etc.)
    - Identify areas of recent volcanic ash cover
    - Identify areas of flooding
3. Identify snow/ice cover and analyse its extent
    - Discriminate between cloud and snow.
    - Indentify frozen rivers and lakes

Skills, techniques and knowledge requirements

- Infrared and visible channels (including high resolution visible channel)
- Appropriate RGB products (Natural Colour RGB, Day Microphysics RGB, Microphysics RGB, Snow RGB, Dust RGB)
- Appropriate Derived Products (Land SAF, Normalised Vegetation Index etc.)

Skill 2: Identify cloud types and their characteristics

Description

Identify cloud types and features including height and temperature of tops, thickness and microphysics.

Performance components

1. Identify stratiform, cumuliform and cirriform cloud regions and individual cloud types and their characteristics (thick, thin, multi-layered, developing, decaying) based on texture, brightness, brightness temperature and synoptic and mesoscale context.
2. Identify Cumulonimbus clouds, their intensity and their stage of development.
3. Identify fogs and discriminate between fog and low cloud
4. Identify contrails and ship trails
5. Deduce cloud top heights based on brightness temperatures, surface observations and sounding data (observed, satellite derived and numerical models)
6. Identify clouds made of water droplets, ice particles or a mixture
7. Discriminate between clouds with small or large cloud particles

Skills, techniques and knowledge requirements

- Cloud types and characteristics
- Brightness temperatures, contamination from higher levels
- Use Fog and Night Microphysics RGB products, shadows on visible imagery and animation to identify valley fogs as well as meteorological situational awareness and surface and aircraft observations.
- Use appropriate RGB products and/or microphysical parameters to identify clouds composed of different phases and clouds with small or large cloud particles

Skill 3: Identify and interpret broadscale, synoptic and mesoscale systems

Description

Identify and interpret broadscale, synoptic and mesoscale atmospheric systems, their characteristics, strength and stage of evolution and deduce atmospheric dynamical and thermodynamical properties

Performance components

For each system, select and apply conceptual models to locate and identify the system, its orientation, strength and stage of evolution, including precursor signatures, taking into account departures from climatological or idealised models. (Categories are not exclusive and some features relate to more than one category.)

Note that a full analysis or prediction involves all available data and guidance and is a higher order competency. Thus, the satellite interpretation task is not an end in itself but, in conjunction with other data, contributes to this higher level task.

1. **Broadscale systems and features:**
   - Intertropical convergence zones, monsoon and trade wind regimes
   - Westerly regimes with embedded cyclones and anticyclones
   - Polar easterlies and systems
   - Broadscale waves
   - Zonal, meridional flows, mobile and blocking systems
   - Upper and low level circulations
2. **Synoptic scale systems and features:**
   - Anticyclones
   - Cyclones (including rapid cyclogenesis), tropical cyclones,depressions, extratropical and polar lows, at upper and lower levels
   - Jet streams, convergence and frontal zones, conveyor belts
   - Troughs, ridges and cols, deformation axes, waves
   - Cloud regions – stratiform, stratocumulus, cumulus (cold outbreaks, trade cumulus), cloud bands and cloud shields
   - Cold pools and thermal shear
3. **Mesoscale scale systems and features:**
   - Local thermal and topographic circulations including land and sea breezes, katabatic and anabatic winds, foehn winds, mountain waves, island and peninsula effects (including Karman Vortices and v-shaped wave clouds), heat lows and troughs
   - Convective cells and cloud systems (including pulse convection, multicells, supercells, squall lines, mesoscale convective complexes and systems) and associated mesoscale features including outflow boundaries and stormtop features.
   - Mesoscale boundaries and interactions, dry lines
   - Low level jets
   - Gravity waves

Skills, techniques and knowledge requirements

- Detailed conceptual models of each atmospheric system.
- Dvorak tropical cyclone enhancement and techniques for tropical cyclone intensity.
- RGB products (Airmass RGB, Microphysics RGB etc.)
- Infrared, water vapour and visible (including high resolution visible channel)

Skill 4: Identify and interpret atmospheric phenomena

Description

Identify and interpret atmospheric phenomena

Performance components

For each phenomenon, locate and identify it and determine its strength, characteristics and, when appropriate, stage of evolution.

Note that a full analysis or prediction involves all available data and guidance and is a higher order competency. Thus, the satellite interpretation task is not an end in itself but, in conjunction with other data, contributes to this higher level task.

Phenomena include:

- Dust and sand storms and plumes and areas of raised dust
- Fires and smoke
- Precipitation types and amounts
- Volcanic ash particulates and chemical emissions
- Aerosol and particulate pollution
- Features indicating regions of clear air turbulence

Skills, techniques and knowledge requirements

Dust, and sand storms

- Conditions - detect dust over land and water, night and day
- Discriminate between dust, cloud, smoke and desert surfaces.
- Use Dust RGB products

Fires and smoke

- Discriminate between natural and industrial hotspots

Pollution

- Pollutants include SO_2, NO_2, etc.
- Discriminate between natural and anthropogenic pollution

Volcanic ash

Identify and analyse In particular:

- Volcanic emissions including ash, SO_2
- Determine the areal extent of the ash cloud, its height and its temporal evolution.
- Use Volcanic Ash RGB

Precipitation

- Precipitation type (convective, stratiform, deep versus shallow precipitation) using appropriate satellite channels including microwave channel data

Other aerosols

- Use the (EUMETSAT) Airmass RGB to identify ozone rich regions in the middle and upper atmosphere

CAT

- Identify CAT signatures using water vapour channels, synthetic satellite imagery

Skill 5: Interpret derived fields and derived products

Description

Interpret fields and parameters

Performance components

Interpret fields and parameters in order to integrate them with other data, observations and guidance as input to analysis and diagnosis.

1. Derived fields include*:*

- Surface temperatures
- Vertical temperature and moisture profiles
- Atmospheric winds
- Cloud type, cloud top temperature
- Total and liquid precipitable water.
- Vegetation and fire danger indices

Skills, techniques and knowledge requirements

- Strengths and weaknesses of satellite derived products/fields
- Image interpretation - both single channel, RGB products and derived products
- Be able to effectively use satellite data in combination with derived products

Skill 6: Identify and interpret oceanic features and systems

Description

Identify and interpret oceanic features and systems relevant to meteorological forecasting. (Note that oceanographers would require more skills, not covered here.)

Performance components

1. Interpret sea surface temperature fields and their characteristic broadscale, synoptic and mesoscale patterns.
2. Interpret near surface wind data.
3. Identify and interpret sea state data and relate this to wave height and swell.
4. Identify and interpret oil slicks and their evolution
5. Identify areas of sun glint
6. Identify and interpret sea-ice, its extent, movement and characteristics (young and old sea ice, sea ice undergoing ablation and containing melt ponds).
7. Identify and interpret ocean currents and eddies and regions of ocean upwelling

Skills, techniques and knowledge requirements

- Understand how infrared imagery is used to determine sea surface temperatures, including limitations such as cloud cover, skin temperature vs deeper temperatures.
- Understand how microwave data is used to measure sea surface wind, and be able to identify limitations in the data including wind direction ambiguities, wind speed inaccuracies, rain effects
- Understand how active microwave sensors and synthetic aperture radar are used to measure sea state, including limitations in the method. Know how to identify regions of error.
- Understand how microwave sensors, synthetic aperture radar and multispectral radiometers are used to measure sea ice. Know how to effectively use imagery produced using the MODIS Sea Ice algorithm to detect and monitor sea ice.
- Discriminate between areas of sun glint and discriminate from high cloud
- Discriminate between sea ice and cloud.

APPENDIX B

EXPECTATIONS FROM THE CENTRES OF EXCELLENCE[2]

1. Nominate a person to be part of the VLab Management Group (VLMG). This person should have some authority to make decisions regarding the use of the VLab within the Centre of Excellence (CoE). VLMG members should participate in the VLMG online meetings and the biannual face-to-face VLMG;
2. Nominate a focal **point of contact** for Virtual Laboratory (VLab) business. The **point of contact** will be included in all VLab communications and will be responsible for delivering the messages to their regional community. The **point of contact** may be the same person nominated as VLMG member (if appropriate);
3. Organise national and international training events that conform with the Guidelines For Trainers In Meteorological, Hydrological And Climate Services document published by WMO (WMO, 2013[3]);
4. Organise regular weather briefings and satellite related discussions (and also possibly discussions covering other GEO and GFCS topics) in the form of “Regional Focus Groups”;
5. Perform a regional training needs assessment every year (couple of years) in order to identify and prioritise the organisation of VLab training events;
6. Develop and maintain proficiency in providing online training using the learning technologies available;
7. Support the personnel involved in the organising and delivering of VLab training events to develop and acquire competencies mentioned in the Competency Requirements for Education and Training Providers for Meteorological, Hydrological, and Climate Services (WMO, 2013[4]);
8. Ensure that all training events organised within the VLab Network are advertised and reported in the VLab Online Calendar of events[5];
9. Maintain regular contact with the regional community, sponsoring satellite operator and VLMG;
10. Provide the Co-chairs (or designated people) an annual report of activities following the template and guidelines provided;
11. Ensure that activities adhere to the VLab Strategy 2015-2019 (VLab, 2015[6]).

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2 This document was primarily based on the Annex VII of the CGMS VL FG 2nd Session Report (Barbados/2003). Updates were made and approved by VLMG members in 2015, as part of Action VLMG7.12.
3 WMO (2013) Guidelines For Trainers In Meteorological, Hydrological And Climate Services [Online] Available in English at http://www.wmo.int/pages/prog/dra/documents/wmo_1114_en.pdf
4 WMO (2013) Competency Requirements for Education and Training Providers for Meteorological, Hydrological, and Climate Services [Online] Available in English at http://www.wmo.int/pages/prog/dra/etrp/documents/CompetencyRequirements_en.pdf
5 VLab Online Calendar of events. Available at http://www.wmo-sat.info/vlab/calendar-of-events/
6 VLab (2015) Five-Year Strategy For The WMO-CGMS Virtual Laboratory for Education And Training in Satellite Meteorology 2015-2019 [Online] Available at http://www.wmo-sat.info/vlab/wp-content/uploads/2015/07/VLabStrategy_2015-2019.pdf

APPENDIX C

EXPECTATIONS FROM THE SATELLITE OPERATORS[7]

1. Nominate a person to be part of the VLab Management Group (VLMG). This person should have some authority to make decisions regarding the collaboration with the VLab and the sponsored Centre of Excellence (CoE). VLMG members should participate in the VLMG online meetings and the biannual face-to-face VLMG;

2. Nominate a focal **point of contact** for Virtual Laboratory (VLab) business. The **point of contact** will be included in all VLab communications and will be responsible for delivering the messages to their regional community. The **point of contact** may be the same person nominated as VLMG member (if appropriate);
3. Create and maintain a page in their main websites, dedicated to explain their involvement and support to the VLab, and include the VLab logo. The inclusion of links to the VLab Online Calendar of Events[8] and the WMO Product Access Guide[9] are also recommended;
4. Make near real-time data, products and/or selected case study data available for education and training purposes to CoEs. Data formats should follow WMO recommendations and be suitable for use in software environments such as VisitView, McIdas-V, SATREP and Ramsdis;
5. Assist CoE(s) with regular weather discussions (and also possibly discussions covering other GEO and GFCS topics) in the Regional Focus Groups;
6. Maintain regular contact with the CoE(s) that the satellite operator is sponsoring, focusing in particular, but not solely, on communications and data access issues. As appropriate, provide an alerting role for the CoE(s) on new training resources and material generated within or for the satellite operator;
7. Maintain regular contact with the other VLab satellite operators on data access and format issues and other matters as appropriate;
8. Maintain regular contact with members of the VLab Management Group (VLMG), participating in the VLMG online meetings and the biannual face-to-face VLMG meetings;
9. Provide the Co-chairs (or designated people) an annual report of activities following the template and guidelines provided;
10. Assist the CoE(s) to overcome resource constraints on VLab related matters through advice, championing with other funding bodies and direct assistance as appropriate;
11. Contribute to the funding of the Technical Support Officer (TSO) of the VLab, to assure the smooth and coordinated continuous running of the VLab activities;
12. Ensure that activities adhere to the VLab Strategy 2015-2019 (VLab, 2015[10]).

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7 This document was primarily based on the Annex VII of the CGMS VL FG 2nd Session Report (Barbados/2003). Updates were made and approved by VLMG members in 2015, as part of Action VLMG7.12.
8 VLab Online Calendar of events. Available at http://www.wmo-sat.info/vlab/calendar-of-events/
9 WMO Product Access Guide. Available at https://www.wmo-sat.info/product-access-guide/
10 VLab (2015) Five-Year Strategy For The WMO-CGMS Virtual Laboratory for Education And Training in Satellite Meteorology 2015-2019 [Online] Available at http://www.wmo-sat.info/vlab/wp-content/uploads/2015/07/VLabStrategy_2015-2019.pdf

APPENDIX D

TRAINING ACTIVITIES PLANED BY VLAB FROM JANUARY TO DECEMBER 2015

Name of training event	Type	Language	CoE involved
Clave Metar/Speci	Online	Spanish	Argentina
Cenizas Volcánicas	Online	Spanish	Argentina
Oms Regional	Blended	Spanish	Argentina
Geomagnetismo Y Relaciones Terrestres Solares	Classroom	Spanish	Argentina
Taller De Evaluación De Radiación Solar	Classroom	Spanish	Argentina
Procesamiento E Interpretacion De Imágenes Satelitales Para Meteorologia Y Medio Ambiente	Classroom	Spanish	Argentina
Calibracion De Instrumentos Meteorológicos	Classroom	Spanish	Argentina
National Himawari-8 Training Campaign tutorial sessions	Online	English	Australia
Basic Satellite Meteorology	Classroom	English	Australia
Advanced Satellite Meteorology	Blended	English	Australia
Science Week	Event Week	English	Australia
NOAA/ WMO Train the Trainers event on GEONetCast.	Blended	English	Barbados
Virtual Roundtable on Climate	Online	English	Barbados
Training Course For The Application Of The Satellite Image In Weather Forecaster	Classroom	Chinese	Beijing
Training Course For Pre-Post Forecaster	Classroom	Chinese	Beijing
Training Course For Senior Forecaster	Classroom	Chinese	Beijing
Seminar On Nwp	Classroom	Chinese	Beijing
The Training Course For The Application Of Ep In Forecasting	Classroom	Chinese	Beijing
12th International Seminar On Climate System And Climate Change (Iscs)	Classroom	English	Beijing
Training Course For Pre-Post Forecaster	Classroom	Chinese	Beijing
Training Course For Pre-Post Forecaster For Wmo Fellowship Students	Classroom	English	Beijing
International Training Course On Meteorological Satellite	Classroom	English	Beijing
Seminar On Meteorological Disasters Risk Management For Officials From Developing Countries	Classroom	English	Beijing
Workshop For Chief Forecaster	Classroom	Chinese	Beijing
Meteorologia Por Satélite: Imagens, Produtos e Aplicações Meteosat Segunda Geração	Classroom	Portuguese	Brazil
Aplicações de Satélite para Análise Meteorológica	Online	Portuguese	Brazil
Satellite Meteorology Course - Fourth Edition	Online	Portuguese	Brazil
Aeronautical Continuous Professional Development	Online	Spanish	Costa Rica
Training Course for Aeronautical Meteorological Observers from Macao, China	Classroom	English	Nanjing
Training Course on Radar Meteorology for Developing Countries	Classroom	English	Nanjing
International Training Course on Numerical Weather Prediction	Classroom	English	Nanjing
Training Seminar on Climate Change and Climate Information Service for Developing Countries	Classroom	English	Nanjing
Training Seminar on Management for Meteorological Officials from the Asia-Pacific Countries	Classroom	English	Nanjing
International Training Course on Use of Meteorological Instruments	Classroom	English	Nanjing
Seminar on Meteorological Disaster Management and Weather Information Service for Developing Countries	Classroom	English	Nanjing
International Training Course on Agro meteorology	Classroom	English	Nanjing
Training Seminar on Meteorological and Earthquake Forecast, Mitigation and Relief for Developing Countries	Classroom	English	Nanjing
Applied Meteorology Course for Forecasters from Macao, China	Classroom	English	Nanjing

Name of training event	Type	Language	CoE involved
ESAC –XIIIF	Online	French	Niger
ESAC –XIIIF	Classroom	French	Niger
Methods of hydrological forecasts. Provision of consumers with forecasting data. Generation of information resources of Roshydromet using the hydrologist-forecaster workstation	Classroom	Russian	Russian Federation
Meteorological forecasting for aviation service	Classroom	Russian	Russian Federation
Processing and use of the satellite data for the hydrometeorological forecasts	Classroom	Russian	Russian Federation
Organization of the state observation network and its functioning in modern conditions	Classroom	Russian	Russian Federation
Modern methods and means of calibration. Regulatory base and documentation on metrology	Classroom	Russian	Russian Federation
Digital receiving stations and data processing of new generation satellites: polar-orbital series "METEOR -M", MetOp, geostationary "ELEKTRO-L"	Classroom	Russian	Russian Federation
Methods and means of data processing from the Russian hydrometeorological satellites	Classroom	Russian	Russian Federation
Space system of data collecting and transmission of Roshydromet via hydrometeorological satellites	Classroom	Russian	Russian Federation
Application of satellite information in tasks of the analysis and a weather forecast (virtual satellite laboratory http://meteovlab.meteorf.ru)	Online	Russian	Russian Federation
The normal training courses will be given as scheduled by University and CE@UP	Classroom	English	South Africa
MSG workshop	Classroom	English	South Africa
Climate workshop	Blended	English	South Africa
VLab Climate Trend Regional Focus Group (on demand)	RFG	Spanish	Argentina
Australian Regional Focus Group (monthly)	RFG	English	Australia
Caribbean Weather Discussion (on demand)	RFG	English	Barbados
South African Regional Focus Group (monthly)	RFG	English	South Africa
Americas and Caribbean Regional Focus Group (monthly)	RFG	English and Spanish	* Costa Rica and Barbados

* Organised by CIRA/NOAA in collaboration with VLab CoEs.