# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>TABLE OF CONTENTS</td>
<td>0</td>
</tr>
<tr>
<td>EXECUTIVE SUMMARY</td>
<td>2</td>
</tr>
<tr>
<td>GENERAL SUMMARY OF THE WORK OF THE SESSION</td>
<td>4</td>
</tr>
<tr>
<td>1. ORGANISATION OF THE SESSION</td>
<td>4</td>
</tr>
<tr>
<td>1.1 Opening of the Session</td>
<td>4</td>
</tr>
<tr>
<td>1.2 Adoption of the Agenda</td>
<td>4</td>
</tr>
<tr>
<td>1.3 Program of Work</td>
<td>4</td>
</tr>
<tr>
<td>2. BACKGROUND AND STATUS TO DISTANCE AND ONLINE LEARNING IN METEOROLOGY</td>
<td>4</td>
</tr>
<tr>
<td>2.1 BACKGROUND</td>
<td>4</td>
</tr>
<tr>
<td>2.2 CURRENT STATUS OF MEMBERS IN RELATION TO DISTANCE AND ONLINE LEARNING</td>
<td>5</td>
</tr>
<tr>
<td>3. POSSIBLE APPROACHES TO PROVIDING DISTANCE AND ONLINE LEARNING OPPORTUNITIES FOR NMHS PERSONNEL</td>
<td>7</td>
</tr>
<tr>
<td>4. RECOMMENDATIONS FOR EC PANEL</td>
<td>11</td>
</tr>
<tr>
<td>5. FUTURE WORK PLAN</td>
<td>12</td>
</tr>
<tr>
<td>6. APPROVAL OF THE DRAFT REPORT</td>
<td>12</td>
</tr>
<tr>
<td>7. CLOSURE OF THE SESSION</td>
<td>13</td>
</tr>
<tr>
<td>Annex 1 Agenda</td>
<td>14</td>
</tr>
<tr>
<td>Annex 2 TT-DOL Members</td>
<td>15</td>
</tr>
<tr>
<td>Annex 3 Extracts from the 23rd Session of the WMO EC Panel of Experts on Education and Training, and the 61st Session of WMO Executive Council</td>
<td>16</td>
</tr>
<tr>
<td>Annex 4 WMO-ETR Task Team on Distance and Online Learning</td>
<td>18</td>
</tr>
<tr>
<td>Annex 5 Summary of Survey on Members responses to DOL questionnaire</td>
<td>19</td>
</tr>
<tr>
<td>General Distance and online undergraduate Courses</td>
<td>19</td>
</tr>
<tr>
<td>Distance and Online Continuing Professional Development opportunities</td>
<td>20</td>
</tr>
<tr>
<td>Annex 6 Future work programme</td>
<td>29</td>
</tr>
</tbody>
</table>
Figure 1. Members and invited experts attending the first meeting of the EC Panel of Experts on Education and Training Task Team on Distance and Online Learning.

Back Row (L – R) Dr Vilma Castro (Costa Rica – Co Chair), Mr Ian Mills (Met Office UK invited expert), Dr David Farrell (Principal CIMH, Barbados)
Front Row (L – R) Mr Jeff Wilson (WMO), Ms Kathy-Ann Caesar (CIMH), Dr Tim Spangler (USA, Co-Chair), Mr Eduard Podgaisky (Russian Federation)

Unable to attend the meeting: Mr. Ibrahim Hamza (Niger) and Prof. Zheng Youfei, RTC Nanjing, China
Executive Summary

The Task Team on Distance and Online Learning (TT-DOL) was created by the EC Panel of Experts on Education and Training (EC Panel) at its 23rd meeting (Costa Rica, March 2008). The WMO Executive Council endorsed the formation of the TT-DOL at its 60th session in June 2008 with the terms of reference approved by the Chair of the EC Panel in May 2009. The Terms of Reference (ToR) set three basic tasks for the team:

- Identify suitable accredited online undergraduate courses available to all Members;
- Identify suitable accredited online courses to support the recommendations from the Task Team on Aviation Forecaster Qualifications (TT-AFQ) taking into account subsequent views of the EC Panel and EC-LXI.
- Identify strategies to enhance the availability of online undergraduate courses and degree programs in meteorology.

The TT-DOL held its first meeting at the Caribbean Institute for Meteorology and Hydrology (CIMH) from 23 to 27 November 2009.

Using data from a survey conducted in the second half of 2009, and the experience and knowledge of the TT-DOL members, it was not possible to identify any suitable completely online courses that would satisfy both the degree and the Basic Instruction Package – Meteorology (BIP-M) requirements. A correspondence course is offered in Russian in the Russian Federation that would meet the requirements. There are also options for personnel to undertake online education in mathematics and physics at the undergraduate level in many countries. Only one online course of study in meteorology was identified but at the present time it does not fully satisfy the BIP-M requirements. Whilst someone could take the meteorology components online, currently it is still necessary for the student to spend at least one year on campus if they wished to take a full degree, although that requirement may be removed in the near future.

Similarly, no suitable accredited online courses that support the recommendations of the TT-AFQ were identified. However, a great deal of material was identified that could be used to create online courses to support the recommendations of the TT-AFQ. The TT-DOL strongly supported the ideas being proposed by CIMH to expand their Professional Development courses to address some of the TT-AFQ outcomes. The TT-DOL warmly welcomed the proposal from CIMH to develop, in collaboration with the TT-DOL, an on-line aeronautical meteorological forecaster training demonstration project. The project would look to build on existing capabilities e.g. http://www.caem.wmo.int/moodle/ whilst also seeking to identify and address the issue of missing on-line resources.

Taking into account the recommendations from TT-AFQ and the subsequent directions of the Executive Council relating to:

- (i) the implementation of aeronautical meteorological personnel ‘competence’ and qualification Standards and;
- (ii) necessary revisions to WMO-No.258 and its Supplement No.1, particularly in relation to the term, ‘or equivalent’; and
- EC’s recommendation to Congress regarding a change in the definition of WMO Meteorologist.

The TT-DOL concluded that the best way to meet the Members need for a cost effective online program that met BIP-M requirements would be for interested Members to create a consortium to develop, test, implement and maintain such a program. This would not be a full graduate program but would meet the requirements of the BIP-M and specialize in the knowledge requirements for operational meteorology. Such a program would be very difficult for most individual members or an individual institution to develop. However by sharing
existing resources and expertise it would be possible. The EUMETCAL consortium in Europe and the WMO Virtual Laboratory are examples of such approaches.

As a strategy to enhance the availability of online undergraduate courses and degree programs in meteorology the TT-DOL suggested that WMO could assist Members in the use and development of Online learning through:

- Promoting more virtual communities using as a model the WMO Virtual Laboratory for Satellite Education;
- Enhancing the current online training calendar to become a global calendar of training events that would allow Members ready access to information about future training events around the globe;
- Increasing assistance to Members, in particular RTCs, in developing their staff to create and deliver online learning; and
- Creation of an Expert Team for the Enhancement of Distance and Online Learning.

In developing the recommendations, the TT-DOL noted the positive benefits of the proposed approaches:

- First and foremost, implementation of these recommendations should improve the opportunities and quality of education and training available to WMO Members;
- They provide Members with a range of pathways to develop personnel to the level of WMO Meteorologist and beyond;
- They build upon existing material;
- They are consistent with the original intention of the fourth edition of WMO-NO. 258; and,
- They encourage the participation of new partners and approaches being used with the WMO Education and Training Programme;
GENERAL SUMMARY OF THE WORK OF THE SESSION

1. ORGANISATION OF THE SESSION

1.1 Opening of the Session
The first meeting of the EC Panel of Experts on Education and Training Task Team on Distance and Online Learning (TT-DOL) was opened by the Co-Chair, Dr Vilma Castro, at 1000 on Monday 23 November 2009 in the Caribbean Institute of Meteorology and Hydrology (CIMH).

Dr David Farrell, Director of CIMH welcomed the Task Team to CIMH. He described how the CIMH has been adapting their programs to the 4th edition of WMO 258 and aviation regulations, and he hoped that CIMH could become a model for other WMO training centers. Dr Farrell is working with the Caribbean Meteorological Organization (CMO) Board to expand the role of CIMH from purely a training institute towards a regional research and development center offering specialized education and training programs. Dr Farrell very much welcomed the TT-DOL holding their first meeting in Barbados as CIMH is actively investigating opportunities for using distance learning in their Continuous Professional Development Program and is interested in being able to offer at least components of an online BSc as part of the CIMH spread of courses to meet members needs.

1.2 Adoption of the Agenda
The provisional agenda was adopted by the session with slight amendments, and is reproduced in Annex 1.

1.3 Program of Work
The Co-Chairs proposed that the working hours would be from 07:30 to 12:30 and from 13:00 to 15:30, with coffee breaks taken as required.

2. BACKGROUND AND STATUS TO DISTANCE AND ONLINE LEARNING IN METEOROLOGY

2.1 BACKGROUND
Terms of Reference
The Task Team reviewed the background to the creation of the Task Team in the context of the outcomes of the 23rd Session of the EC Panel Of Experts on Education and Training and, directions from the 60th Session of the WMO Executive Council. The pertinent sections from these two sessions are summarized in Annex 3 to this Report. In particular the Team noted the EC Panel tasks:

- The second team (TT-DOL) is to investigate options for delivery of an accredited online undergraduate degree that could be taken by Members whilst continuing to work as aviation forecasters. The team will initially pilot the project for RA III and RA IV Members and then extend it to other regions as suitable providers are identified.

These tasks were further refined by the Chair of the EC Panel following the 60th meeting of the Executive Council. Annex 4 contains “The Terms of Reference” for the Task Team. The three key tasks are:

- Identify suitable accredited online undergraduate courses available to all Members;
- Identify suitable accredited online courses to support the recommendations from the TT-AFQ taking into account the subsequent views of the EC Panel and EC-LXI;

- Identify strategies to enhance the availability of online undergraduate courses and degree programs in meteorology.

**Identification of target groups**

Following a review of the background, the Task Team noted that there appeared to be two priority target groups for WMO Members where distance and online courses may be able to assist Members meet qualification and competency requirements for aviation forecasters and observers:

- Existing aeronautical meteorological forecasters (AMF) and observers (AMO) who need to upgrade their skills and knowledge to satisfy the anticipated requirements to be contained in the November 2010 edition of WMO Tech Regulations 49 Volume II. These will become mandatory by November 2013. An accurate estimate of the total number of personnel affected by this change is currently unavailable but it could be of the order of 7,000 to 8,000 for aeronautical meteorological forecasters based on figures from Members collected by the Task Team on Aviation Forecaster Qualifications.

- Existing and future AMFs who need to qualify as a WMO Meteorologist (expected to be formally required by November 2016)

**2.2 CURRENT STATUS OF MEMBERS IN RELATION TO DISTANCE AND ONLINE LEARNING**

A short survey on Distance and Online Learning opportunities was sent to the WMO Regional Training Centres, WMO Education and Training National Focal Points, the Coordinating Committee of the Standing Conference of Heads of Training Institutions and several hundred educational institutions in the US. The three questions from the survey are shown in Appendix 5. The summary of the twenty five (25) responses from the survey are summarized below:

**Distance and Online Undergraduate Courses in basic Science**

The Co-Chairs identified at least 10 academic institutions in North America, Europe and Australia that offer the requisite basic sciences to the condensed BIP-M online. All of the courses were only available in English. The typical science degree program was in Environmental Science or Environmental Engineering. Costs for a full degree ranged from ~8000 USD for a correspondence undergraduate science degree at the UK Open University to more than 40,000 USD for some of the online US institutions (some of these require at least one year of the degree to be spent at the university. The living expenses are not included in the USD 40,000 price).

**Distance and Online Undergraduate "or equivalent" Courses in Meteorology**

The Task Team was not able to identify any online courses that fully met the requirements of the Basic Instruction Package – Meteorology (BIP-M). The closest offering was part of a BSc in Geosciences with emphasis on Operational Meteorology from the Mississippi State University (MSU) in the US. However, it lacks dynamic meteorology. The Task Team were advised that MSU would be testing a dynamic meteorology module in the first half of 2010.

---

1 The BIP-M is essentially a full undergraduate program that would qualify a person for a degree. The condensed BIP-M only covers the core meteorology components of the BIP-M and is thus less than an undergraduate degree. Institutions offering a condensed BIP-M as a vocational course may or may not offer the prerequisite mathematics and physics as part of their course.
which may meet the current condensed BIP-M requirements. The approximate cost of completing a BIP-M equivalent from MSU would be around USD 10,000 whilst the full undergraduate degree would be of the order of USD 30,000 for the remaining units, ie a total cost of around USD 40,000 for the entire degree. Correspondence courses of study that are BIP-M compliant are currently offered by the Russian State Hydrometeorological University in St Petersburg (and a number of Russian universities) to Russian nationals as a specialist diploma (six years of study which is more than a typical undergraduate degree). The US Dept of Agriculture offers an “or equivalent professional qualification” for US Federal Government employees who already possess a degree or its equivalent.

Distance and online courses for professional development
There are many opportunities for NMHS staff to undertake online learning as part of their ongoing professional development using online resources. The largest and most diverse of these offerings are from COMET in the US (http://meted.comet.ucar.edu). There are some 500 hours of instruction available in English with approximately 250 hours of instruction supported by text in Spanish and 60 hours in French. Other offerings come from groups such as EUMETCAL (Europe, in English), ASMET (Africa, in English and French), the WMO Virtual Laboratory (global in English, Russian, Portuguese and Chinese), China Meteorological Administration and Nanjing University of Science and Technology (in Chinese) and many other sources such as universities and meteorological data suppliers.

The majority of these resources have been designed to be used as standalone asynchronous modules. The Task Team is not aware of any academic institution using these available online modules as the sole basis of any accredited course but many institutions use online modules, such as those from COMET, as integral parts of degree programs.

In Central, South America and the Caribbean, monthly online weather briefings are conducted in Spanish and English. These WMO Virtual Laboratory Focus Group sessions introduce participants to the use of satellite data and products in the context of the current weather situation. A similar routine weather briefing occurs in Europe under the SATREP Online umbrella from EUMETRAIN. This briefing features the use of NWP data as well as satellite data and products. SATREP online is being started in Southern Africa in 2010.

The Co-Chairs advised the Task Team that at least in South America, and they suspect the same applies in many other parts of the world, the NMHSs administration are not aware of the level of use made by their staff of distance learning. The survey responses received by Dr Necco from the Directors of the NMHSs in South America indicated that online learning was not used in RA III. The Co-Chairs were able to provide Dr Necco with participation data from the WMO VL sessions as well as the use of the COMET MetEd site that indicated significant use of online learning in these NMHSs. Noting their own experience, the Task Team concluded that in many NMHSs there was little institutional encouragement or reporting of the use of Distance and Online learning for professional Development. NMHSs must address this issue as a priority as they implement their Quality Management Systems.

The Task Team was unable to identify any existing cost effective solution for using distance learning to provide a large number of staff located around the world with either a degree in Meteorology or a Science degree and a condensed basic instruction package in meteorology within a five year time frame. The minimum estimated cost of USD 15,000 in Table 1 for a degree in Meteorology would apply to someone eligible to pursue a general science degree from the Open University in the UK and then taking the online units of the BSc in Geosciences with emphasis on Operational Meteorology from the Mississippi State University. The Permanent Representative of their NMHS would then have to agree that this course of study met the minimum requirements of a WMO Meteorologist through the “or equivalent” clause currently in WMO 258, or as proposed by EC-LXI.

Table 1 summarises the findings from the survey with further details available in Annex 5.

<table>
<thead>
<tr>
<th>Mode of Training</th>
<th>Basic Science or</th>
<th>Degree in</th>
<th>Condensed Basic</th>
</tr>
</thead>
</table>

Table 1
Table 1. Summary of course availability

<table>
<thead>
<tr>
<th></th>
<th>Mathematics Degree</th>
<th>Meteorology</th>
<th>Instruction Package – Meteorology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face to face</td>
<td>Widely available in all languages and WMO Regions</td>
<td>Available in most WMO Regions and languages but not all countries. Courses often academically focused with limited operational application</td>
<td>Available in most WMO Regions. In some institutions the course is accredited as a post graduate course but in many there are no academic qualifications. The quality of the courses vary.</td>
</tr>
<tr>
<td>Distance / blended</td>
<td>Available in some languages and WMO Regions</td>
<td>Available by correspondence in the Russian Federation. One course available in the US but in its current form does not meet the requirements of the BIP-M</td>
<td>One course available to US Federal Government employees with an existing degree. The University of Costa Rica has an approved MSc in Applied Meteorology which they have not yet run and an 18-month diploma (estimated cost of USD 7,000 / 5,000 respectively) student for students with an existing undergraduate degree</td>
</tr>
<tr>
<td>Costs</td>
<td>From USD 15,000 to more than USD 50,000 per student</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. POSSIBLE APPROACHES TO PROVIDING DISTANCE AND ONLINE LEARNING OPPORTUNITIES FOR NMHS PERSONNEL

To help guide the discussions, the Task Team debated what an ideal outcome of the Task Team work would be for Members in late 2013 and 2016.

Ideally, WMO Members are seeking a range of cost effective options for the training of new staff and the upgrading of the knowledge and skills of current staff that at least meet, if not exceed, the minimum requirements for the aeronautical competencies to be proposed for November 2013 and the meteorologist qualifications for November 2016. Some Members will wish to, and have the resources to, take staff through national or regional training institutes whilst others will be seeking options for their staff to undertake either short term courses in the work place or embark upon distance or online courses either from the work place or during their personal time. For many NMHSs, in the latter category, funding will have to be found to meet the cost of this training.

The Task Team noted that the TT-AFQ and the CAeM Expert Team on Education and Training (CAeM ET/ET) were also working on associated issues. To minimize overlap with the other groups, the TT-DOL focused on the knowledge component of the two issues. In relation to the competencies issue, the Task Team noted the work of the CAeM ET/ET in
identifying global resources of available training material and the work of the TT-AFQ and CAeM ET/ET on leading the discussions on assessment of competencies

In simple terms, the TT-DOL identified the areas of concern as:

- By November 2013, AMFs and AMOs worldwide will have to demonstrate competency in critical areas proposed for WMO 49 volume II
- By November 2016, AMFs would need the qualifications required for a WMO Meteorologist, either an appropriate degree OR an equivalent level of professional qualification.

After a lengthy and animated discussion, the TT-DOL agreed that online learning had the possibility, with time, of supporting each of the three qualification streams originally proposed by the TT-AFQ (two degree paths and one non-degree path). In addition to supporting these pathways, the TT-DOL proposed the coordination and development of online resources that could be used by Members in assessing and upgrading the knowledge of existing aeronautical forecasters.

With regard to the third pathway for non-degreed meteorologists, the difference between the approach taken by the TT-AFQ and that suggested by the TT-DOL, is the use of a consortium of institutions to develop and deliver the material and which should provide more quality assurance on the level of the course. This would address some of the concerns WMO Members expressed in Executive Council regarding the proposals by the TT-AFQ. This course would address the minimum qualifications and knowledge for the competencies, individual Members could still set their own minimum qualifications at a higher level in line with national priorities and requirements.

**Approach 1. Professional development upgrade course**

The TT-DOL proposed the development of a model online aeronautical forecaster course based around existing online modules and traditional resources. This could be viewed as part of continuous professional development if used with existing forecasters or as a specialist course for existing meteorologists without the aeronautical meteorology background. The course would address the background knowledge component of the competencies that are being developed by the CAeM ET/ET and the TT-AFQ. Once the model course has been tested in one region, it could be made available to other countries. Each country would need to adapt the model course to their own requirements. This approach is designed to assist Members demonstrate that their staff meet the knowledge requirements of the competencies proposed to be mandated in November 2013.

This course would

- Utilize existing online materials
- Require new material from “experts” providing invited lectures. Use software such as articulate presenter to fill in the online resource holes, for example SIGMETs.
- Require instructors from different regions to provide regional cases and regional perspective

For such a proposal to work it would be necessary to identify key regional institutions, such as Regional Training Centres or national training centres, to “own the course”. At a first
guess 100 hours of aviation specific instruction would be required. Members may have to add further modules if they found that their staff needed additional modules on use of numerical weather prediction model output, radar or satellite data and products, basic precipitation processes, elements of dynamic or synoptic meteorology etc. These institutions would be required to localize and run the course and provide certificates of completion for successful students.

The TT-DOL noted the work CIMH were already undertaking in this area and warmly welcomed their interest in further developing and testing the approach. CIMH noted that the ready availability and relevance of COMET resources to the region would assist their efforts greatly. Dr Spangler offered to seek resources to provide assistance to CIMH to demonstrate the concept. The TT-DOL noted the desirability of also engaging one or two key people from the Spanish speaking Members in the geographic region to observe the development and then lead it for the Spanish speaking countries.

Approach 2. Online ‘science-based’ Degree

The TT-DOL were pleased to note the number of ‘science based’ courses available to students by distance or online. In order for Members to be able to take advantage of these, the TT-DOL agreed to continue consulting members and people in the academic community so that the ETR Office could provide WMO Members with information on the opportunities either in their Region or language groupings.

The TT-DOL noted that it could take students twice as long to complete a degree in this manner and the costs for such courses varied considerably, ranging from less than USD 10,000 for some countries at the UK Open University to more than USD 50,000 at other institutions. If it were possible to better identify the need for such courses, and the commitment of NMHSs to put their staff through such courses it may be possible to negotiate cost reductions and exemptions with specific universities.

Approach 3. An online condensed BIP-M Programme

Noting the high impact of cost for some Members and potentially extended times required for existing staff to obtain a degree based qualification, the TT-DOL supported the recommendations of the TT-AFQ regarding a third pathway to become a WMO Meteorologist. The TT-DOL proposed a solution that would meet the “or equivalent professional qualification” that EC-LXI recommended Congress include in a revised definition of WMO Meteorologist.

This suggestion is much more ambitious than the Professional Development course. It would build on the lessons learned in implementing such a course and require the development of a consortium of partners to fund, develop, test and deliver an online condensed BIP-M program. The TT-DOL acknowledged the enormity of the challenge and the wide range of obstacles (funding, time, intellectual property, rights for commercial use ….) that would need to be overcome to deliver such a programme. However following exhaustive debate and discussion during the session, the TT-DOL concluded that this may be the only practical approach.

The development of an online course could take several approaches:

WMO to work with one or more academic institutions who are already offering either a similar course, or one that has the potential of delivering an online condensed BIP-M. Ideally personnel would be able to complete such a course of instruction and graduate with a
recognized qualification such as an associate degree or similar. The Geosciences course with an emphasis on Operational Meteorology run by the Mississippi State University is an example of such a course. Dr Spangler offered to continue discussions with MSU on this topic. Ideally it would be possible for a number of universities, particularly the RTCs, to offer such a program.

If it were not possible to identify a suitable partner(s) who were already offering such a program of study, WMO could facilitate the forming of a consortium to develop a program of study for operational meteorologists.

The consortium approach would help address the concerns of some Members regarding quality control if a non-degree route was chosen. It would probably rely on the more advanced countries to lead the development of the resources and provide opportunities for the less developed countries to contribute regional case studies and procedures. For many of the developed countries, the consortium approach would assist them to tackle a problem that individually they could not do on their own. Many of them are under pressure from their governments to include distance and online learning in their education and training schemes to reduce costs to the NMHSs of training their staff. The consortium would strongly encourage members to obtain accreditation of the courses within national or regional frameworks. It could be marketed under a web umbrella such as http://openmet.edu or openmet.org.

Producing resources to deliver a condensed BIP-M course online would provide Members the opportunity to run it all online or mix and match the modules to meet their local organizational and funding requirements.

**General comments**

The TT-DOL remarked that it could take at least 12 to 18 months for some of these proposals to start delivering. In the mean time, Members would need to be proactive and act on this issue by identifying the components of the BIP-M or aeronautical meteorology area that easily lend themselves to adaptation to the online environment.

The TT-DOL took the opportunity of meeting at CIMH to engage in discussions with Dr Mosely (Professor Emeritus Pure and Applied Science, UWI Cave Hill Campus) to seek feedback from someone outside the group and from a university sector to the proposals. The TT-DOL were pleased to hear that the UWI rules and regulations would be able to address these ideas and there were already some examples of these approaches in other UWI campuses or courses. The TT-DOL encouraged CIMH to explore possible links with the UWI Open Campus to see if the Open Campus could play a role in the proposed demonstration project with CIMH.

On the last afternoon of the session CIMH organized for a number of students, current staff and recently retired staff and the PR of Barbados with WMO (Mr Chester Layne) to join the discussion and provide the TT-DOL with feedback on the proposed actions. The overall reaction was positive although all thought the proposals were ambitious. The group raised good questions on implementation details. Key questions related to assessment of practical aspects of the job, the requirement for some level of academic recognition of the condensed training program and, of course, from where would come the resources to develop and implement such a program.

The TT-DOL noted that several of the respondents to the survey had suggested that WMO could assist Members in the use and development of Online learning through:
• Promoting more virtual communities using the WMO Virtual Laboratory for Satellite Education as a model;
• Hosting a global calendar of training events on the WMO website to allow Members ready access to information about future training events around the globe; and
• Assisting Members, in particular RTCs in developing their staff to create and deliver online learning.

The Director of the Education and Training Office advised the TT-DOL that a global calendar already exists but could be improved. Within the limit of available resources, the ETR Office is supporting RTC staff in developing online skills. The model course and proposed program and consortium may provide a suitable focus for a new Virtual Laboratory focused on aviation meteorology.

<table>
<thead>
<tr>
<th>Meteorological Degree</th>
<th>Non meteorological Degree</th>
<th>No degree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qualifies for WMO Meteorologist here</td>
<td>Condensed BIP-M from consortium</td>
<td>Prerequisite Maths, Physics as set out in WMO-NO. 258</td>
</tr>
<tr>
<td>Role specific education and training via online specialised course</td>
<td>Qualifies for WMO Meteorologist here</td>
<td>Online Condensed BIP-M from Consortium</td>
</tr>
<tr>
<td>Closely supervised OJT in operational area, does not issue any products (minimum 300 hours)</td>
<td>Role specific education and training via online specialised course</td>
<td>Qualifies for WMO Meteorologist here</td>
</tr>
<tr>
<td>Close monitoring and feedback prior to be assessed as competent for independent operations.</td>
<td>Closely supervised OJT in operational area, does not issue any products (minimum 300 hours)</td>
<td>Role Specific education and training via online specialised course</td>
</tr>
<tr>
<td>Minimum of 6 months</td>
<td>Close monitoring and feedback prior to be assessed as competent for independent operations.</td>
<td>Closely supervised OJT in operational area, does not issue any products (minimum 300 hours)</td>
</tr>
<tr>
<td>Minimum of 12 months</td>
<td>Minimum of 24 months</td>
<td>Close monitoring and feedback prior to be assessed as competent for independent operations.</td>
</tr>
</tbody>
</table>

Table 2. TT-DOL options for becoming a WMO meteorologist with a specialisation via online learning

4. RECOMMENDATIONS FOR EC PANEL

It has been estimated that 7,000 or more AMFs will need to acquire additional skills and knowledge to satisfy the proposed aeronautical competencies in WMO 49, Volume II by November 2013. The TT-DOL has met with CIMH, The COMET Program, and the WMO Secretariat to propose a joint effort to create an Aviation Curriculum which combines distance learning and residence components. This effort, if successful, would demonstrate how other regions and training organizations could address the issue of aviation competencies.

In relation to supporting aeronautical meteorological personnel develop their competency knowledge and skills the TT-DOL recommends that the EC Panel:

• Ask the WMO Secretariat to support, as appropriate, and within the available resources, the proposed demonstration project between CIMH and the COMET Program
• Express its gratitude to CIMH for taking on this project and, recognize the importance of its success to WMO Members

The TT-DOL examined WMO 258 and Supplement No 1 carefully during its deliberations, and is aware of several issues requiring attention during the next revision. The TT-DOL recommends that the EC Panel:

• Consider the WMO Meteorologist\(^2\) definition proposed by EC-LXI and provide EC-LXII with comments on the definition and any implementation issues that it may raise.
• Look for ways in which WMO 258 can specifically encourage the use of distance learning programs to meet Members education and training needs
• Encourage training centers and training programs to seek accreditation of resident and distance learning courses, either at a national level or via bilateral arrangements between Members or training institutions.

The TT-DOL proposes that the EC Panel endorse and expand upon their suggestions for the: development and testing of an online condensed Basic Instruction Package – Meteorology Program. Only by combining the expertise of a range of institutions (key online developers, universities and NMHSs and their training institutions) and, utilizing existing material does such a program become economically feasible.

A consortium of interested partners would be required to fund, direct, create and sustain the program. The consortium members could include WMO Regional Training Centres, national training centers, COMET, universities and other interested parties such as Meteorological Societies, who are able to contribute. For this approach to be viable it would be necessary for the successful graduates from such a course to be recognized as meeting either the current “or equivalent” or, the proposed “or equivalent professional qualification”, within the definition of a WMO meteorologist. There are already two successful consortium models in meteorological education and training that could be examined, the EUMETCAL model which is subscription based and the WMO Virtual Laboratory model which is volunteer based.

The TT-DOL thus recommends the EC Panel:

• Endorse the concept of a consortium offering different BIP-M levels courses which together will satisfy the requirement of an appropriate level of knowledge;
• Endorse the idea that an appropriate level of knowledge can be acquired solely through online and distance courses, despite the fact that some of courses may not be specifically accredited in a single degree program.
• Encourage the WMO Secretariat to work closely with Members who wish to establish such a consortium, and work toward an organization modeled after the WMO Virtual Laboratory where appropriate

5. FUTURE WORK PLAN

The TT-DOL developed a work plan to guide the activities of the team over the four months to the twenty-fourth session of the EC Panel (Boulder, USA, March 2010). The work program is outlined in Annex 6.

6. APPROVAL OF THE DRAFT REPORT

6.1 The TT-DOL reviewed the draft report of the session and approved it, subject to the inclusion of agreed corrections and editorial amendments.

\(^2\) EC-LXI has recommended that Congress XVI define a WMO Meteorologist as “Meteorologist – a person who holds a university-level degree or equivalent level of professional qualifications; who has acquired an appropriate level of knowledge of mathematics, physics, chemistry and computer science, and has completed the Basic Instruction Package for Meteorologists (BIP-M). The level of requisite academic qualifications shall be defined at the national level by Permanent Representatives with the WMO in consultation with the appropriate governing bodies” – WMO EC-LXI Paper 4(2).
7. CLOSURE OF THE SESSION

7.1 The Co-Chairs of the session expressed their satisfaction with respect to the constructive spirit in which the TT-DOL worked throughout the present session and they looked further to even more productive work prior to the March 2010 meeting of the EC Panel.

7.2 The session was closed on 27 November 2009 at 1902.
Annex 1 Agenda

AGENDA

1. ORGANIZATION OF THE SESSION
   1.1 OPENING OF THE SESSION
   1.2 APPROVAL OF THE AGENDA

2. BACKGROUND AND STATUS TO THE ISSUE OF DISTANCE AND ONLINE LEARNING
   2.1 BACKGROUND
   2.2 CURRENT STATUS OF MEMBERS IN RELATION TO DISTANCE AND ONLINE LEARNING
   2.3 ACCREDITATION AND CERTIFICATION ISSUES

3. POSSIBLE APPROACHES TO PROVIDING DISTANCE AND ONLINE LEARNING OPPORTUNITIES FOR NMHS PERSONNEL

4. RECOMMENDATIONS FOR EC PANEL

5. FUTURE WORK PLAN

9. APPROVAL OF THE DRAFT REPORT

10. CLOSURE OF THE SESSION
### Annex 2 TT-DOL Members

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Institution</th>
<th>Address</th>
<th>Tel.</th>
<th>Fax</th>
<th>E-mail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. V. CASTRO</td>
<td>Professor (Retired)</td>
<td>School of Physics, University of Costa Rica</td>
<td>2060 San Pedro, SAN JOSE, Costa Rica</td>
<td>(506) 8811-35-83</td>
<td>(506) 2252-82-40</td>
<td><a href="mailto:vilmac2001@yahoo.com">vilmac2001@yahoo.com</a></td>
</tr>
<tr>
<td>Dr T. SPANGLER</td>
<td>Director</td>
<td>COMET</td>
<td>P.O. Box 3000, BOULDER, CO 80307, USA</td>
<td>(1-303) 49-78-473</td>
<td>(1-303) 49-78-491</td>
<td><a href="mailto:tspang@ucar.edu">tspang@ucar.edu</a></td>
</tr>
<tr>
<td>Mr Eduard Podgaisky</td>
<td>Instructional Design and Distance Learning Unit</td>
<td>Russian State Hydrometeorological University, Malookhtinsky Ave., 98, 195196, St Petersburg, Russia</td>
<td></td>
<td>+7 905 274 28 56</td>
<td>+ 7 812 444 60 90</td>
<td><a href="mailto:Podgaisky@rshu.ru">Podgaisky@rshu.ru</a></td>
</tr>
<tr>
<td>Mr. Ibrahim Hamza</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prof. Zheng Youfei</td>
<td></td>
<td>RTC Nanjing, China</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**INVITED EXPERTS**

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Institution</th>
<th>Address</th>
<th>Tel.</th>
<th>Fax</th>
<th>E-mail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ms Kathy-Ann Caesar, Meteorologist</td>
<td></td>
<td>Caribbean Institute of Meteorology and Hydrology</td>
<td>P.O. Box 130, Bridgetown, Barbados, West Indies</td>
<td>+1 246 425 1362</td>
<td>+1 246424 4733</td>
<td><a href="mailto:kacaesar@cimh.edu.bb">kacaesar@cimh.edu.bb</a></td>
</tr>
<tr>
<td>Mr Ian Mills</td>
<td></td>
<td>MetOffice College Met Office FitzRoy Road EXETER EX1 3PB, UK</td>
<td></td>
<td>(44-1392) 885-442</td>
<td></td>
<td><a href="mailto:ian.mills@metoffice.gov.uk">ian.mills@metoffice.gov.uk</a></td>
</tr>
<tr>
<td>Mr Ian. Lisk (Friday only)</td>
<td>WMO Manager</td>
<td>Met Office FitzRoy Road EXETER EX1 3PB, UK</td>
<td></td>
<td>(44-1392) 885-135</td>
<td>(44-1392) 885681</td>
<td><a href="mailto:ian.lisk@metoffice.gov.uk">ian.lisk@metoffice.gov.uk</a></td>
</tr>
</tbody>
</table>

**WMO SECRETARIAT**

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Institution</th>
<th>Address</th>
<th>Tel.</th>
<th>Fax</th>
<th>E-mail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mr J. WILSON</td>
<td>Director</td>
<td>Education and Training Office</td>
<td>7bis, Avenue de la Paix, Case postale No. 2300, 1211 GENEVA 2, Switzerland</td>
<td>(41-22) 730-82-94</td>
<td>(41-22) 730-80-41</td>
<td><a href="mailto:Jwilson@wmo.int">Jwilson@wmo.int</a></td>
</tr>
</tbody>
</table>

Background from the WMO Executive Council Panel of Experts on Education and Training
(extract from Section 4.4 of the final report for the 23rd meeting)

Regarding the certification of Aeronautical Forecasters and Observers the Panel considered processes and timelines to assist Members have their personnel certified to provide meteorological services for air navigation. The Panel noted that it was not practical or desirable to change the underlying thrust of the fourth edition of WMO publication 258 and retrospectively remove the requirement that WMO Meteorologists hold an appropriate degree in meteorology or an appropriate science and mathematics degree and have successfully completed a condensed basic instruction package (meteorology) course. With this starting point the Panel noted the following time lines:

- Aviation Forecasters trained prior to 1 January 2005 don't need to have a degree to be independent forecasters but they do need to be able to demonstrate that they meet the requirements outlined in Supplement 1 to WMO No. 258.
- Aviation forecasters trained after 31 December 2004 must have an appropriate degree as well as meet the requirements laid down in Supplement 1 to WMO No. 258.
- In late 2010, ICAO will mandate that Air Navigation Service Providers (ANSP) must have implemented an ISO approved Quality Management Framework.

Given these timelines the Panel recommended the following actions:

- Revision and strengthening of Supplement 1 to WMO No. 258 into a standalone "Guide" or minimum set of standards that must be met. This would include developing an instruction and assessment "kit", to complement the Guide that could be used by Members.
- Advising ICAO that non-degreed forecasters trained after 31 December 2004 and prior to 1 January 2011 be allowed to continue operating as independent aviation forecasters provided they are pursuing appropriate undergraduate studies that will allow them to graduate with the appropriate qualification prior to 31 December 2014 AND they can demonstrate that they meet the requirements outlined in Supplement 1 to WMO No. 258.

To assist in the implementation of these two actions the Panel formed two Expert Teams, the first one to revise and strengthen Supplement 1 to 258 and develop the instruction and assessment "kit". The Convenor for this team is Mr Ian Lisk from the UK Meteorological Office. The second team to be convened by Dr Vilma Castro from the University of Costa Rica is to investigate options for delivery of an accredited online undergraduate degree that could be taken by Members whilst continuing to work as aviation forecasters. The team will initially pilot the project for RA III and RA IV Members and then extend it to other regions as suitable providers are identified. In addition the Panel noted the discussions in some Regions for Members to form regionally based Aviation Forecasting Centres to provide meteorological services for air navigation to a range of Members. Noting that in this situation, staff from one Member would be providing services to one or more other Members consideration of training and fellowship requests to support these initiatives should take into account the potential for these activities to benefit the Members in that region.
Background from the WMO Executive Council
(Extract from doc 4.2 of the 60th session, paragraphs 4.2.46)

The Council strongly supported the work of the EC Panel of Experts on Education and Training to assist Members in ensuring that their personnel providing meteorological services for air navigation meet the requirements of Supplement No.1 to WMO-No.258. The time lines suggested by the Panel are consistent with ICAO plans, but are likely to cause significant difficulties for some Members. The Council therefore requested the Secretary-General to support the EC Panel to work through two task teams to:

(i) Review the implementation time lines suggested by the EC Panel;

(ii) Provide clarification of the meaning of relevant items of text contained in WMO No.258, and Supplement 1, including the term “or equivalent” and its application in Supplement 1, and recommend revisions as necessary; and

(iii) Investigate means of enhancing the availability of university-level education opportunities for meteorological personnel;

The Council requested that the status of Supplement 1 to WMO-No.258 should be reviewed by appropriate WMO bodies, and the implementation plan and any revision recommendations should be presented to EC-LXI for consideration of adoption. The Council therefore proposed that when a final decision on the recommendations would be reached by ICAO and WMO, the Members be informed through a joint letter from the Secretary-General of both Organizations, addressed to the relevant Ministers in order to ensure national action and compliance. The Council welcomed the offer by JMA to contribute to the work of the EC Panel of Expert on Education and Training Task Team.
Annex 4 WMO-ETR Task Team on Distance and Online Learning
(TT-DOL)

Terms of Reference:
(i) Identify suitable accredited online undergraduate courses available to all Members;
(ii) Identify suitable accredited online courses to support the recommendations from the TT-AFQ taking into account the subsequent views of the EC Panel and EC-LXI;
(iii) Identify strategies to enhance the availability of online undergraduate courses and degree programs in meteorology.

The implementation plan and recommendations are to be presented to the EC Panel in March 2010 for consideration of adoption.

WORKPLAN AND TIMELINES
The majority of the work will be done on an intersessional basis with significant investigatory work already been undertaken by Dr Vilma Castro and Dr Tim Spangler. It is proposed to hold a meeting of the TT-DOL in Barbados in November 2009 in-conjunction with the CAeM Expert. The majority of the participants at that session will be self funded. Some of the Advisors may also be present at the meeting.

April to November 2009:
• Establish TT membership and TT discussion forum;
• Agree deliverables and scope of TT-DOL particularly in light of the reaction of the EC Panel and EC-LXI to the recommendations from the Task Team on Aviation Forecaster Qualifications (TT-AFQ);
• TT-DOL Chair to coordinate further investigatory work with the team and with the TT-AFQ.

November 2009:
• Meet with CAeM ET-ETR to discuss options for distance learning in general and a pilot project for RA III and RA IV Members in particular.

December 2009 to March 2010:
• Consolidate the report of the TT-DOL for further presentation at the EC Panel Meeting notionally scheduled for March 2010 and input into EC-LXII, including any possible financial implications for the next financial period.

TT-DOL CORE MEMBERSHIP
Dr. Vilma Castro, Costa Rica (Chair) RA IV
Dr. Tim Spangler, USA RA IV
Mr. Eduard Podgaisky, Russian Federation RA VI
Prof. Zheng Youfei, RTC Nanjing, China RA II
Mr. Ibrahim Hamza, Niger RA I

WMO SECRETARIAT Point of Contact
Jeff Wilson, D/ETR
Annex 5 Summary of Survey on Members responses to DOL questionnaire
Information about distance training in Meteorology

General Distance and online undergraduate Courses

AUSTRALIA

Monash University has at least two international campuses
http://www.monash.edu.au/study/coursefinder/course/0050/

COSTA RICA

The RTC-UCR University of Costa Rica offers a Post graduate Diploma and an MSc in Applied Meteorology on-line

FIJI

The University of the South Pacific (USP) is based in Fiji. They do some distance (print) correspondence in first year for maths, physics and computing. The later years must be done face to face.


New Zealand

Massey University (main campus in Palmerston North, 2 hrs north of Wellington ), offers extramural study in mathematics and physics. Their website is http://extramural.massey.ac.nz/.

NETHERLANDS

ITC -University for developing countries in the Netherlands. It is expected that they will make much progress in the near future in distance learning.

http://www.itc.nl/Home
http://www.eumetcal.org/
http://www.zamg.ac.at/eumetrain/
http://www.eumetsat.int/Home/Main/What_We_Do/Training/Distance_Learning/index.htm?l=en

RUSSIAN FEDERATION

Correspondence courses of study that are BIPM compliant are currently offered by the Russian State Hydrometeorological University in St Petersburg (Russian Federation) and a number of other Russian universities to Russian nationals as a specialist diploma (6 years of study, which is more than an undergraduate degree). There are several e-books, books and study texts available on-line as well as 21 lectures captured as webcasts.

UNITED KINGDOM
The Open University offers a career in Sciences which can be complemented with the BiP-M.

United States of America
Mississippi State University (MSU) Doug Gillham

http://www.distance.msstate.edu/geosciences/BMP/descriptions.html
In this website is the description of 18 courses that completely fulfill WMO 258 requirements. These courses are applicable to an undergraduate degree from MSU. Other courses can be taken elsewhere or at MSU. Tuition fees apply: $214.75 + $50 distance learning fee per course.

To be opened in fall of 2010: a graduate level track in Applied Meteorology, with courses in tropical meteorology, numerical weather prediction, hydrology, natural hazards, environmental geosciences, climate change, etc. We will also include a course or two in GIS (Principles of GIS and Remote Sensing); MSU already delivers five GIS courses online

URL for MSU BSc Geoscience program with emphasis on Operational Meteorology
http://www.distance.msstate.edu/geosciences/OMP/index.html

US Department of Agriculture
The USDA Graduate School has a correspondence course all paper and text based that largely satisfies WMO 258 and provides an "accredited certificate in meteorology". Tuition fees apply.
The URL for accessing the AMS recommended BS in meteorology is
http://www.ametsoc.org/policy/statement_2005_BS_degree_atmospheric_science.html

Distance and Online Continuing Professional Development opportunities

I- EUROPE

Eumetcal

Eumetcal (http://www.eumetcal.org) offers online/blended courses on various meteorological disciplines, such as Radar, Satellite, NWP applications and Aviation meteorology.

Eumetcal also offers the platform for member states and other collaborators to run online events and courses: SATREP Online or EUMeTrain Event weeks are activities that Eumetcal helps with providing the online environment.

SATREP Online/ EUMeTrain - Jarno Schipper  jarno.schipper@zamg.ac.at, www.zamg.ac.at
http://www.satreponline.org/today.php

SATREP Online focuses on the recognition of conceptual models from satellites and comparisons of satellite products with NWP data. The method behind this is called Satrep, and it helps a forecaster to make a better understanding of the processes in the atmosphere. It can also help to do a good model diagnosis.

International on-line weather briefings take place every month. These briefings are for free and are intended to teach meteorologists in Europe basic skills for the interpretation of satellite images and the recognition of different conceptual models.

http://saws.satreponline.org/ is the South African "Satrep Online". The intension is to extend it to Northern Africa and Arabia.

A distant learning activity takes place twice a year, the so-called event weeks.

http://www.satreponline.org/event.php
Event weeks extend over a whole week, with 12 presentations dealing on a topic, convection and fog were the first ones. The presentations always have a researcher talking on the latest developments and then are followed by a forecaster by some NMS in Europe talking about how she or he treats convection or fog and which tools they have available. The event weeks are getting popular with the one in June 2009 having listeners from South Africa to Norway and from Brazil to India. Such events will be definitely be also organized in 2010, it would be nice to have forecasters from Central America participating. Working language is English.

SPAIN

Spain offers several on-line courses through the Agencia Española de Meteorología and the Universidad Complutense de Madrid. Some topics are aeronautical meteorology forecasting, climate change risks and environmental impact, training of teachers in meteorology and convection.

UNITED KINGDOM

Interesting education section on the Met Office website aimed at schools: http://www.metoffice.gov.uk/education/

The Met Office offers several meteorological training courses, though few remote learning ones. http://www.metoffice.gov.uk/training/

II LATIN AMERICA AND THE CARIBBEAN

RTC in the regions III and IV

- There are 5 RTC in the region: Argentina, Brazil, Venezuela, Costa Rica and Barbados.
- All of them are interested in delivering on-line training.
- None of them have an on-line undergraduate degree.
- There are no universities in the region that deliver on-line undergraduate degrees in Meteorology at the professional level.
- Chile has an on-line course for aeronautical meteorology observer (technician level)
- Costa Rica offers an on-line course in aeronautical forecasting at a technician or postgraduate level.
- Argentina is planning to open an on-line course in aeronautical forecasting.
- Countries with institutions (excluding RTCs) that can support on-line training in Meteorology:
  - Chile
  - Peru
  - Uruguay
  - Colombia
  - El Salvador
  - Mexico
COSTA RICA

The RTC-UCR University of Costa Rica offers a Post graduate Diploma and an MSc in Applied Meteorology on-line, and a BSc in residence. Considerations for offering the BSc on line are:

- To obtain a BSc in Meteorology, a student has to take courses in humanities, sports, chemistry, mathematics, physics and meteorology.
- Humanities courses are also routinely offered by a state managed distance learning university: UNED Universidad Estatal a Distancia.
- Physics and meteorology courses are delivered by the School of Physics. The School of Physics hosts the RTC, as an interested partner it can accept to make the effort to go on-line.
- Chemistry and Mathematics courses are delivered by independent schools within UCR and it is their decision if they want to go on-line or not.
- UCR enforces that students have to take sports in situ throughout at least one year.
- The issue of sports, chemistry, mathematics and the laboratories in an on-line context needs to be solved; if an agreement cannot be reached then we must find an alternative for those topics (e.g. opening our own courses or seek availability in other institutions). Students will complete the curriculum required, but UCR will not grant a degree.

III ASIA AND OCEANIA

CHINA

Considerable training takes place on-line for the personnel of the Chinese Meteorological Agency, but there are no degrees offered on-line. Activities include conferences, lessons, weather discussions.

JAPAN

JMA does not have online sources for online education that would allow individuals to comply with the requirements in the publication WMO 258 Guidelines, either the meteorology component or the mathematics and physics pre-requisites.

JMA provides the following distance-learning websites primarily to individuals working in operational meteorological services:

Virtual Laboratory (in the framework of WMO-CGMS Virtual Laboratory)
http://mscweb.kishou.go.jp/VRL/index.htm

The Tokyo Climate Center was recently designated as the first WMO RCC together with the Beijing Climate Center, in recognition of its contribution to improving the capabilities of NMHSs’ climate services in the Asian region. Several training modules for long-range forecast and climate monitoring are available on the website http://ds.data.jma.go.jp/tcc/tcc/library/index.html.

New Zealand - Chris Webster

The first thing to point out is that training and operational meteorology at the Meteorological Service of New Zealand Limited (MetService) is completely centralized in one building in Wellington. Therefore the MetService has no requirement for distance learning, although it is used to enhance the variety of teaching experiences for our students, particularly relevant COMET modules.

There are six main universities in NZ. One of these, Massey University (main campus in Palmerston...
First Session of the EC Panel of Experts on Education and Training Task Team on Distance and Online Learning

North, 2 hrs north of Wellington), offers extramural study in mathematics and physics. Their website is http://extramural.massey.ac.nz/.

There were several extramural mathematic papers offered in 2009 but only one extramural physics paper:

1st year math example:

2nd year math example:

1st year physics:

Examinations may be sat at a number of overseas centers.

None of the NZ universities offers undergraduate courses in meteorology (the closest we have are face-to-face post-grad papers taught at Victoria University of Wellington that form part of the ab-initio meteorologists' course).

In NZ trainees come to the Met Service with a prior degree in (usually) mathematics and/or physics. We then employ the trainees as they embark on a training program for a full academic year. This program includes six 4th-year taught papers at Victoria University of Wellington plus a comprehensive meteorologists' course that we run in-house at Met Service with a more practical emphasis. The university work and the Met Service work are built around each other - we have a close relationship with the university.

Trainees without any research component in their degree also do a Diploma project for 3-months (at the university) immediately after the taught part of the course.

The combination of the university education and Met Service training complies with WMO No 258 fairly closely.

IV MIDDLE EAST

IRAN - Mohammad Rahimi, Director of Higher Education of Meteorology and Atmospheric Science Center, mrahimi@irimet.net

I.R. of Iran Meteorological organization training center (www.irimo.ir) has established an e-learning website for many types of courses since 2008 in http://elearning.irimo.ir

This website is in the national language (Farsi) for Iranian students, as the first step. We will provide an English version as soon as possible for courses in English language.

We started e-learning for IRIMO personnel job training at first step for all over the country specially observers in far Meteorological stations to keep their knowledge and information up to date. This helped us a lot for saving time of travel and also money.

Since RTC-Tehran is one of our training center offices also, we would like to use this system for foreign students as well.

It is possible someone to take a (short) course completely online. However we prefer to have both methods (off-line and online training) in a given (short) course.
First Session of the EC Panel of Experts on Education and Training Task Team on Distance and Online Learning

We have not organized online education for undergraduate degree in Meteorologist till now; moreover this is our future plan.

V UNITED STATES OF AMERICA

Massachusetts Institute of Technology -

The MIT Open source has some good course work in mathematics, physics, earth science and Tropical Meteorology (No Credit though)

Free Online MIT Undergraduate Courses


<table>
<thead>
<tr>
<th>Updated within the past 180 days</th>
<th>Course #</th>
<th>Course Title</th>
<th>Term it was taught</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.000</td>
<td></td>
<td>Solving Complex Problems</td>
<td>Fall 2003</td>
</tr>
<tr>
<td>12.001</td>
<td></td>
<td>Introduction to Geology</td>
<td>Spring 2008</td>
</tr>
<tr>
<td>12.003</td>
<td></td>
<td>Atmosphere, Ocean and Climate Dynamics</td>
<td>Fall 2008</td>
</tr>
<tr>
<td>12.005</td>
<td></td>
<td>Applications of Continuum Mechanics to Earth, Atmospheric, and Planetary Sciences</td>
<td>Spring 2006</td>
</tr>
<tr>
<td>12.006</td>
<td></td>
<td>Nonlinear Dynamics I: Chaos</td>
<td>Fall 2006</td>
</tr>
<tr>
<td>12.007</td>
<td></td>
<td>Geobiology</td>
<td>Spring 2007</td>
</tr>
<tr>
<td>12.010</td>
<td></td>
<td>Computational Methods of Scientific Programming</td>
<td>Fall 2008</td>
</tr>
<tr>
<td>12.085</td>
<td></td>
<td>Seminar in Environmental Science</td>
<td>Spring 2008</td>
</tr>
<tr>
<td>12.086</td>
<td></td>
<td>Modeling Environmental Complexity</td>
<td>Fall 2008</td>
</tr>
<tr>
<td>12.090</td>
<td></td>
<td>Special Topics: An Introduction to Fluid Motions, Sediment Transport, and Current-generated Sedimentary Structures</td>
<td>Fall 2006</td>
</tr>
<tr>
<td>12.091</td>
<td></td>
<td>Trace Element Analysis of Geological, Biological &amp; Environmental Materials by Neutron Activation Analysis: An Exposure</td>
<td>January (IAP) 2005</td>
</tr>
<tr>
<td>12.091</td>
<td></td>
<td>Medical Geology/Geochemistry: An Exposure</td>
<td>January (IAP) 2006</td>
</tr>
<tr>
<td>12.091</td>
<td></td>
<td>Radon Research in Multidisciplines: A Review</td>
<td>January (IAP) 2007</td>
</tr>
<tr>
<td>12.091</td>
<td></td>
<td>Basics of Impact Cratering &amp; Geological, Geophysical, Geochemical, Environmental Studies of Some Impact Craters of the Earth</td>
<td>January (IAP) 2008</td>
</tr>
<tr>
<td>12.097</td>
<td></td>
<td>Chemical Investigations of Boston Harbor</td>
<td>January (IAP) 2006</td>
</tr>
<tr>
<td>12.102</td>
<td></td>
<td>Environmental Earth Science</td>
<td>Fall 2005</td>
</tr>
<tr>
<td>12.103</td>
<td></td>
<td>Strange Bedfellows: Science and Environmental Policy</td>
<td>Fall 2005</td>
</tr>
<tr>
<td>12.108</td>
<td></td>
<td>Structure of Earth Materials</td>
<td>Fall 2004</td>
</tr>
<tr>
<td>12.109</td>
<td></td>
<td>Petrology</td>
<td>Fall 2005</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Term</td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>--------------------------------------------------------</td>
<td>-------------</td>
<td></td>
</tr>
<tr>
<td>12.110</td>
<td>Sedimentary Geology</td>
<td>Fall 2004</td>
<td></td>
</tr>
<tr>
<td>12.110</td>
<td>Sedimentary Geology</td>
<td>Spring 2007</td>
<td></td>
</tr>
<tr>
<td>12.113</td>
<td>Structural Geology</td>
<td>Fall 2005</td>
<td></td>
</tr>
<tr>
<td>12.114</td>
<td>Field Geology I</td>
<td>Fall 2005</td>
<td></td>
</tr>
<tr>
<td>12.119</td>
<td>Analytical Techniques for Studying Environmental and Geologic Samples</td>
<td>Spring 2006</td>
<td></td>
</tr>
<tr>
<td>12.141</td>
<td>Electron Microprobe Analysis by Wavelength Dispersive X-ray Spectrometry</td>
<td>January (IAP) 2006</td>
<td></td>
</tr>
<tr>
<td>12.163</td>
<td>Surface Processes and Landscape Evolution</td>
<td>Fall 2004</td>
<td></td>
</tr>
<tr>
<td>12.201</td>
<td>Essentials of Geophysics</td>
<td>Fall 2004</td>
<td></td>
</tr>
<tr>
<td>12.215</td>
<td>Modern Navigation</td>
<td>Fall 2006</td>
<td></td>
</tr>
<tr>
<td>12.301</td>
<td>Past and Present Climate</td>
<td>Fall 2008</td>
<td></td>
</tr>
<tr>
<td>12.307</td>
<td>Weather and Climate Laboratory</td>
<td>Spring 2009</td>
<td></td>
</tr>
<tr>
<td>12.333</td>
<td>Atmospheric and Ocean Circulations</td>
<td>Spring 2004</td>
<td></td>
</tr>
<tr>
<td>12.400</td>
<td>The Solar System</td>
<td>Spring 2006</td>
<td></td>
</tr>
<tr>
<td>12.586</td>
<td>Modeling Environmental Complexity</td>
<td>Fall 2008</td>
<td></td>
</tr>
<tr>
<td>12.842</td>
<td>Past and Present Climate</td>
<td>Fall 2008</td>
<td></td>
</tr>
<tr>
<td>12.556</td>
<td>GPS: Where Are You?</td>
<td>Fall 2008</td>
<td></td>
</tr>
</tbody>
</table>

Post-graduate courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.800</td>
<td>Fluid Dynamics of the Atmosphere and Ocean</td>
<td>Fall 2004</td>
</tr>
<tr>
<td>12.802</td>
<td>Wave Motions in the Ocean and Atmosphere</td>
<td>Spring 2004</td>
</tr>
<tr>
<td>12.802</td>
<td>Wave Motion in the Ocean and the Atmosphere</td>
<td>Spring 2008</td>
</tr>
<tr>
<td>12.804</td>
<td>Large-scale Flow Dynamics Lab</td>
<td>Fall 2005</td>
</tr>
<tr>
<td>12.806J</td>
<td>Atmospheric Physics and Chemistry</td>
<td>Spring 2005</td>
</tr>
<tr>
<td>12.808</td>
<td>Introduction to Observational Physical Oceanography</td>
<td>Fall 2004</td>
</tr>
<tr>
<td>12.810</td>
<td>Dynamics of the Atmosphere</td>
<td>Spring 2008</td>
</tr>
<tr>
<td>12.811</td>
<td>Tropical Meteorology</td>
<td>Spring 2005</td>
</tr>
<tr>
<td>12.812</td>
<td>General Circulation of the Earth's Atmosphere</td>
<td>Fall 2005</td>
</tr>
<tr>
<td>12.815</td>
<td>Atmospheric Radiation</td>
<td>Fall 2006</td>
</tr>
<tr>
<td>12.815</td>
<td>Atmospheric Radiation</td>
<td>Fall 2008</td>
</tr>
<tr>
<td>12.820</td>
<td>Turbulence in the Ocean and Atmosphere</td>
<td>Spring 2006</td>
</tr>
<tr>
<td>12.820</td>
<td>Turbulence in the Ocean and Atmosphere</td>
<td>Spring 2007</td>
</tr>
<tr>
<td>12.822</td>
<td>Turbulence in the Ocean and Atmosphere</td>
<td>Spring 2006</td>
</tr>
<tr>
<td>12.842</td>
<td>Past and Present Climate</td>
<td>Fall 2008</td>
</tr>
<tr>
<td>12.864</td>
<td>Inference from Data and Models</td>
<td>Spring 2005</td>
</tr>
<tr>
<td>12.950</td>
<td>Atmospheric and Oceanic Modeling</td>
<td>Spring 2004</td>
</tr>
</tbody>
</table>
The document provides links to various educational resources for meteorology, oceanography, climate change, and geophysics. The SERC (Science Education Resource Center) offers a 4-year course that is not online. They also provide a site-wide search for meteorology materials. Web-based resources from Cutting Edge include ocean systems, climate change, and data, simulations, and tools. Cutting Edge also offers hurricane-climate connection and geophysics resources. Pedagogy in Action Teaching Methods includes links to GIS, Google Earth, models, data simulations, and visualizations. The Earth Labs Project and Earth Exploration Toolbook Chapters provide additional resources with teaching activities and materials.
Eyes in the Sky GIT Web Course:
http://serc.carleton.edu/eyesinthesky/GITcourse/index.html (for high school and middle school teachers, but may have useful and applicable info for teaching higher educational level audience)

Teaching with Hurricane Katrina (part of Integrating Research and Education):
http://serc.carleton.edu/research_education/katrina/index.html

Climate Change Collection:
http://serc.carleton.edu/climatechange/summary.html (peer-reviewed, classroom tested resources sorted by topic)

Other Useful Websites for Teaching:
http://serc.carleton.edu/NAGTWorkshops/coursedesign/index.html (Course Design)
http://serc.carleton.edu/NAGTWorkshops/webdesign/Assessment/index.html (Assessment of Student Learning via Web-Based Materials)
http://serc.carleton.edu/NAGTWorkshops/affective/index.html (Affective domain)
http://serc.carleton.edu/NAGTWorkshops/metacognition/index.html (Metacognition)

College of St Rose in Albany, NY

It is also taught at over 300 other colleges and universities around the world. The website is organized and run by AMS and has multiple links associated to weather and hydrology instruction. They also maintain several other websites "Datastreme" for teacher education programs in weather, oceanography and hydrology. The course I teach is basic meteorology, an introduction to meteorological and climatological concepts, that utilizes both textbook work and online/real time weather data and information.

Datastreme

http://www.ametsoc.org/amsedu/DataStremeFrames.html

DataStreme has an excellent online course in meteorology, oceanography and climate going. Go to the AMS website and you can read about the courses under educational outreach.

What is DataStreme Atmosphere?

DataStreme Atmosphere is a major precollege teacher enhancement initiative of the American Meteorological Society with the main goal of training of Weather Education Resource Teachers who will promote the teaching of science, mathematics and technology using weather as a vehicle, across the K-12 curriculum in their home school districts.

The initial step in the training of Resource Teachers is their participation in the DataStreme Atmosphere distance-learning course. The 13-week course is offered twice a year to selected participants. It focuses on the study of the atmospheric environment through the use of electronically transmitted weather data and learning materials combined with Study Guide readings and investigations.

DataStreme Atmosphere is currently funded via the AMS/NOAA Cooperative Program for Earth System Education (CPESE) with assistance from the U.S. National Weather Service and the State University of New York College at Brockport. Initial DataStreme Atmosphere operations were funded by the National Science Foundation.

Louisiana State University

Differential equations and calculus based physics courses on line.

National University
National University has a lot of standard math and physics classes: [http://www.nu.edu/assets/resources/pageResources/catalog73.pdf](http://www.nu.edu/assets/resources/pageResources/catalog73.pdf)

**Pennsylvania State University**

This university has the largest meteorology program in the US, Dr. David Babb is the head of the distance learning programs and is interested in engaging in distance learning in Meteorology. Penn State has an Online Certificate in Weather Forecasting.

[http://www.worldcampus.psu.edu/WeatherForecastingCertificate.shtml](http://www.worldcampus.psu.edu/WeatherForecastingCertificate.shtml)

**University of Illinois**

*Don Wuebbles* has been organizing a distance learning major in environmental sustainability for the University of Illinois. While it does have atmospheric sciences courses in it, it is not a traditional meteorology major.

**University of Kansas**

The University of Kansas has traditionally just offered two introductory courses. One is 3 semester hours and oriented towards non majors. The other is 5 credit hour non-calculus based course with laboratory exercises. The 2nd semester 2009 we have just begun offering an online course in aviation meteorology (also non-calculus based) which has the 5 credit introductory course as a prerequisite. Information about the two introductory courses is available at [http://www.continuinged.ku.edu/is/atmo.shtml](http://www.continuinged.ku.edu/is/atmo.shtml)

There is also a two semester calculus sequence but it is oriented towards business majors and is not the best choice for meteorology students. The University of Kansas is expanding their online courses and more courses may be available in the future.

Overall, I think dynamic and physical meteorology are more difficult to do via distance education. Most students in their late teens and early 20s do not have the maturity to tackle these courses without a fair amount of help. It is easy for such students to fall behind and not realize it as they do not know what it is they do not understand until they try to take a test. Such courses will take considerably more effort to develop a high quality course and this reduces the incentive for universities to create them.
Annex 6 Future work programme

The TT-DOL noted the importance of continuing their work over the next four months to support further discussions on this topic during the EC Panel meeting in Boulder in March 2010. The agreed work program is:

Continuing to identify appropriate distance and online courses

Explore Dept of Agriculture course – Tim Spangler
Identify any other universities that offer BIP-M courses or close to it – all within their Region
Identify further universities that offer online degrees – all within their Region
Ian to talk to UK OU re other distance universities particularly any offering Meteorology
Tim to talk to AMS as a long shot as AMS has relationships with SUNY at Brockport
Jeff to talk to ITC in Netherlands
Ian Mills to talk to Met Office College regarding opportunities for the Met Office, UK, College to work with UK universities in this area.
Get Hamza and Youefi to see what they have in Africa and China

Furthering the proposed demonstration project with CIMH
Create infrastructure for online dynamics and tropical meteorology – COMET and CIMH
David to talk to UWI as well as get them here for the meeting
Vilma to talk to Argentina, Costa Rica and Spain to identify appropriate Spanish speaking institutions to observe/participate in the CIMH demonstration project
Encouraging RTCs to establish the BIP-M equivalency to this programme
Contact the RTCs etc re their aviation met course syllabi

Fostering partnership opportunities

Spanish university – would they be interested in license mode Peru – Vilma Castro
Eduard to explore ideas with RSHU and AAU on how to leverage the correspondence course to online in Russian and other languages
Eduard to find out about availability of Associate Degrees or similar in Russia