World Meteorological Organization
Organisation météorologique mondiale

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Weather • Climate • Water
Temps • Climat • Eau

Nuestra ref.: WDS/DPFS/GDPFS-NWP/2013 GINEBRA, 1 de mayo de 2014

Anexos: 3 (disponibles solamente en inglés)

Asunto: Informe anual de la OMM sobre los progresos técnicos del Sistema Mundial de Proceso de Datos y de Predicción (SMPDP) y las actividades de investigación conexas en predicción numérica del tiempo (PNT) de 2013, y cuestionario del Programa de Servicios Meteorológicos para el Público.

Finalidad: Presentar su contribución al Informe anual de la OMM sobre los progresos técnicos del Sistema Mundial de Proceso de Datos y de Predicción y las actividades de investigación conexas en predicción numérica del tiempo, a más tardar el **25 de junio de 2014**, y el cuestionario del Programa de Servicios Meteorológicos para el Público a la mayor brevedad posible.

Estimado señor/Estimada señora:

El Informe anual de la OMM sobre los progresos técnicos del Sistema Mundial de Proceso de Datos y de Predicción (SMPDP), combinado con el informe sobre las actividades conexas de investigación en predicción numérica del tiempo (PNT), en adelante "el Informe", permite mantener informados a los Miembros sobre las nuevas instalaciones y la rápida evolución de las instalaciones existentes, las investigaciones y los servicios que se incorporan en los centros SMPDP para responder a las necesidades y los avances de la tecnología.

A: los Representantes Permanentes (o Directores de los Servicios Meteorológicos o Hidrometeorológicos) de los Miembros de la OMM (PR-6766)
Director del Centro europeo de predicción meteorológica a medio plazo (CEPMMP)
Director del Centro Africano de Aplicaciones Meteorológicas para el Desarrollo (ACMAD)

copias: Presidentes y vicepresidentes de la Comisión de Ciencias Atmosféricas (CCA) y de la Comisión de Sistemas Básicos (CSB)
Miembros del Grupo de gestión de la CCA
Miembros del Comité Científico Mixto del Grupo abierto de área de programa sobre el Programa Mundial de Investigación Meteorológica de la CCA
Grupos de trabajo del GAAP sobre el Programa Mundial de Investigación Meteorológica
Miembros del Grupo de gestión y del Grupo abierto de área de programa sobre el Sistema de proceso de datos y de predicción (SPDP) de la CSB
Puntos de contacto de los Centros Meteorológicos Regionales Especializados (CMRE) para la respuesta en casos de emergencia ambiental y/o el procedimiento de búsqueda retrospectivo
(para información)

El Informe tiene por objeto informar a los expertos operacionales y a los investigadores sobre las últimas novedades que se han producido en los centros del SMPDP en relación con: 1) la instalación y actualización de equipo operacional e instalaciones conexas, y en particular de los sistemas de análisis-predicción y de PNT, y de sus sistemas especializados para aplicaciones específicas; y 2) las actividades de investigación y desarrollo en el ámbito de la comprensión de los procesos meteorológicos, y la constante evolución de los modelos numéricos y de las técnicas para facilitar la predicción operativa. Además, este examen exhaustivo basado en todos los informes recibidos desempeña una función esencial para garantizar la comprensión y el seguimiento por parte de la OMM del estado de las actividades del SMPDP a escala mundial, regional y nacional.

En este contexto, me complace informarle de que los informes correspondientes a 2012 remitidos por los Miembros se han compilado y puesto a disposición, junto con los de años anteriores (anexo I), en el sitio web de la OMM:

http://www.wmo.int/pages/prog/www/DPFS/ProgressReports/2012/GDPFS-NWP-2012.html

Se invita a los Miembros a preparar y presentar a la Secretaría de la OMM sus contribuciones al Informe del año 2013. A fin de facilitar la presentación de información relevante sobre las actividades de su centro del SMPDP y/o sobre su colaboración en un consorcio, que abarque desde la predicción inmediata hasta la previsión a largo y a más largo plazo, así como aplicaciones especializadas de PNT y de procesamiento posterior (por ejemplo, para olas oceánicas, mareas de tempestad, hielos marinos, transporte y deterioro natural de la polución, ciclones tropicales, transporte y dispersión de contaminación atmosférica, radiación ultravioleta (UV), predicción de la calidad del aire, humo, arena y polvo, etc.), se ha preparado una nueva plantilla siguiendo el índice del Informe (anexo II), que está disponible en el sitio web de la OMM:

http://www.wmo.int/pages/prog/www/DPS/documents/TEMPLATE_2013.doc

Mucho le agradecería que tomase las disposiciones necesarias para realizar su contribución al Informe de 2013, **únicamente en formato electrónico**, y enviarla a la Secretaría de la OMM a la mayor brevedad posible, y **a más tardar el 25 de junio de 2014**, por correo electrónico (dpfsmail@wmo.int), de preferencia en MS Word u otros formatos compatibles, a la atención de la señora Pascale Gómez.

Quisiera expresarle mi agradecimiento por su continuo apoyo y contribución a este Informe e insto encarecidamente a los Miembros que no hayan contribuido aún o no hayan actualizado sus informes desde hace varios años, a que lo hagan, en beneficio de todos los Miembros de la Organización.

Además, la Comisión de Sistemas Básicos, a través del Programa de Servicios Meteorológicos para el Público, ha elaborado un cuestionario para obtener información específica de los Miembros sobre sus sistemas de "predicción inmediata", además de la información que se solicita para el Informe con arreglo a la sección 4.4.1. El cuestionario, y la información explicativa, figuran en el anexo III. Una vez completado, sírvase enviar el anexo III directamente a la señora Haleh Kootval, jefa del Programa de Servicios Meteorológicos para el Público, por correo electrónico (hkootval@wmo.int).

Le saluda atentamente.

(J. Lengoasa)
por el Secretario General

Annex I
Annual WMO Technical Progress Reports on the GDPFS and related Research Activities on NWP (for 2012, or latest report year)

ECMWF (2012)

Algeria (2009)

Argentina (2010)

Armenia (2011)

Australia (2010)

Austria (2010)

Belarus (2012)

Belgium (2008)

Bolivia (2010)

Bosnia and Herzegovina (2008)

Botswana (2010)

Brazil (2010)

Bulgaria (2006)

Canada (2012) (EN) (FR)

Chile (2008)

China (2012)

Côte d'Ivoire (2004)

Croatia (2011)

Cyprus (2011)

Czech Republic (2010)

Kyrgyzstan (2004)

Latvia (2011)

Lithuania (2012)

Madagascar (2008)

Malaysia (2011)

Montenegro (2008)

Morocco (2006)

Mozambique (2010)

Netherlands (2010)

New Zealand (2011)

Oman (2011)

Pakistan (2012)

Panama (2005)

Peru (2007)

Poland (2012)

Portugal (2011)

Qatar (2012)

Republic of Korea (2012)

Romania (2012)

Russian Federation - English (2011)

Denmark (2010)

Ecuador (2008)

Egypt (2012)

Estonia (2008)

Fiji (2010)

Finland (2012)

France (2012)

Georgia (2004)

Germany (2012)

Greece (2011)

Hong Kong, China (2012)

Hungary (2012)

India (2011)

Indonesia (2009)

Iran, Islamic Republic of (2006)

Ireland (2012)

Israel (2012)

Italy (2011)

Japan (2012)

Kazakhstan (2012)

Kenya (2012)

Russian Federation - Russian (2011)

Saudi Arabia (2008)

Serbia (2008)

Singapore (2012)

Slovakia (2012)

Slovenia (2012)

Spain (2012)

Sri Lanka (2010)

Sweden (2012)

Switzerland (2012)

Tanzania (2012)

Thailand (2012)

The former Yugoslav Republic of Macedonia (2010)

Tunisia (2003)

Turkey (2009)

United Kingdom of Great Britain and Northern Ireland (2011)

United Republic of Tanzania (2009)

United States of America (2007)

Uruguay (2008)

Uzbekistan (2012)

WORLD METEOROLOGICAL ORGANIZATION

ANNUAL JOINT WMO TECHNICAL PROGRESS REPORT ON THE GLOBAL DATA-PROCESSING AND FORECASTING SYSTEM (GDPFS) INCLUDING NUMERICAL WEATHER PREDICTION (NWP) RESEARCH ACTIVITIES FOR 2013

TABLE OF CONTENTS

4.3.2 Model

4.3.2.1 In operation
4.3.2.2 Research performed in this field

4.3.3 Operationally available NWP products

4.3.4 Operational techniques for application of NWP products (MOS, PPM, KF, Expert Systems, etc..)

4.3.4.1 In operation
4.3.4.2 Research performed in this field

4.3.5 Ensemble Prediction System (Number of members, initial state, perturbation method, model(s) and number of models used, perturbation of physics, post-processing: calculation of indices, clustering)

4.3.5.1 In operation
4.3.5.2 Research performed in this field
4.3.5.3 Operationally available EPS products

4.4 Nowcasting and Very Short-range Forecasting Systems (0-12 hrs)

4.4.1 Nowcasting system

4.4.1.1 In operation
4.4.1.2 Research performed in this field

Note: please also complete the CBS/PWS questionnaire on Nowcasting Systems and Services, 2013)

4.4.2 Models for Very Short-range Forecasting Systems

4.4.2.1 In operation
4.4.2.2 Research performed in this field

4.5 Specialized numerical predictions (on sea waves, storm surge, sea ice, marine pollution transport and weathering, tropical cyclones, air pollution transport and dispersion, solar ultraviolet (UV) radiation, air quality forecasting, smoke, sand and dust, etc.)

4.5.1 Assimilation of specific data, analysis and initialization (where applicable)

4.5.1.1 In operation
4.5.1.2 Research performed in this field

4.5.2 Specific models (as appropriate related to 4.5)

4.5.2.1 In operation
4.5.2.2 Research performed in this field

4.5.3 Specific products operationally available

4.5.4 Operational techniques for application of specialized numerical prediction products (MOS, PPM, KF, Expert Systems, etc.) (as appropriate related to 4.5)

4.2.4.1 In operation
4.2.4.2 Research performed in this field

4.5.5 Probabilistic predictions (where applicable)

4.5.5.1 In operation
4.5.5.2 Research performed in this field
4.5.5.3 Operationally available probabilistic prediction products

4.6 Extended range forecasts (10 days to 30 days) (Models, Ensemble, Methodology)

4.6.1 In operation

4.6.2 Research performed in this field

4.6.3 Operationally available EPS products

4.7 Long range forecasts (30 days up to two years) (Models, Ensemble, Methodology)

4.7.1 In operation

4.7.2 Research performed in this field

4.7.3 Operationally available products

5. Verification of prognostic products

5.1 Annual verification summary

5.2 Research performed in this field

6. Plans for the future (next 4 years)

6.1 Development of the GDPFS

6.1.1 Major changes in the operational DPFS which are expected in the next year

6.1.2 Major changes in the operational DPFS which are envisaged within the next 4 years

6.2 Planned Research Activities in NWP, Nowcasting, Long-range Forecasting and Specialized Numerical Predictions

6.2.1 Planned Research Activities in NWP

6.2.2 Planned Research Activities in Nowcasting

6.2.3 Planned Research Activities in Long-range Forecasting

6.2.4 Planned Research Activities in Specialized Numerical Predictions

7. Consortium *(if appropriate)*

7.1 System and/or Model

7.1.1 In operation

7.1.2 Research performed in this field

7.2 System run schedule and forecast ranges

7.3 List of countries participating in the Consortium

7.4 Data assimilation, objective analysis and initialization

7.4.1 In operation

7.4.2 Research performed in this field

7.5 Operationally available Numerical Weather Prediction (NWP) Products

7.6 Verification of prognostic products

7.7 Plans for the future (next 4 years)

7.7.1 Major changes in operations

7.7.2 Planned Research Activities

8. References

EXPLANATORY NOTES

to the suggested contents of Annual Joint WMO Technical Progress Report on the Global Data-Processing and Forecasting System (GDPFS) and Numerical Weather Prediction (NWP) Research Activities

The WMO progress report will be jointly compiled annually by the WDS and AREP Departments of the WMO Secretariat on the basis of contributions from WMO Members and/or GDPFS centres.

The publication will begin with an introduction prepared by the WMO Secretariat explaining the major purposes of the publication with the appropriate references.

Each individual contribution should contain appropriate parts of the following items.

1. Summary of highlights. This should reflect the major changes in the data-processing and forecasting system during the last year.

2. Equipment in use at the centre. This paragraph should contain information on the major data-processing units, especially in the large centres. Here and in the following paragraphs the information for the first national contribution to the Progress Report should be given in a complete form to avoid too many references. In the next contribution, the information can be restricted to the indication of major changes during the year being reported on.

3. Data and products from GTS in use. It is suggested that only the bulletin headings with the basic information (SYNOP, SHIP, TEMP, SATEM etc.) and the types of products (GRID, GRIB, facsimile charts etc.) received through the GTS or other means and used at the centre will be indicated in this paragraph. The daily statistics for each type of bulletin and the product should be included, if such statistics are available. For example, SYNOP-500, TEM-600, GRID-20.

4. Forecasting system. There are several aspects of this system since some centres run several models which have different approaches to the data assimilation, use different numerical techniques and so on. Consequently, this paragraph is divided into several sub paragraphs.

4.1 ***System run schedule***. It is suggested that the general structure of a prognostic system should be described in the paragraph with an indication of models in operational use, including those for specialized applications, the run schedule and the forecast ranges.

4.2-4.6 These sub-paragraphs are a series of similarly structured texts describing different operational sub-systems of a numerical weather forecasting system: Medium-range forecasting (section 4.2); Short-range forecasting (section 4.3); Nowcasting and very-short-range forecasting (section 4.4), Specialized numerical predictions for various sector specific applications, including sea waves, storm surge, sea ice, marine pollution transport and weathering, tropical cyclones, air pollution transport and dispersion, solar ultraviolet (UV) radiation, air quality forecasting, smoke, sand and dust, etc. (section 4.5), extended-range forecasting (section 4.6) and long-range forecasting (section 4.7). Each sub-paragraph contains the same components starting with data assimilation and objective analysis, description of the model, of operational techniques for application of NWP products, and a section on Ensemble Prediction Systems if used for that range. List of products available for WMO members should be indicated. All sub-paragraphs should include information regarding any performed research activities in the related field.

The list of suggested items in each sub-paragraph is given for 4.2 (it is assumed that for 4.3-4.7 they will be similar).

4.2 *Medium range forecasting system (4-10 days).*

4.2.1 *Data assimilation objective analysis and initialization*

4.2.1.1 In operation

- Assimilated data,
- Assimilation cycles, including cut-off time,
- Method of analysis (e.g. 3 D-VAR, 4D-VAR)
- Analysed variables
- First guess
- Coverage
- Horizontal resolution
- Vertical resolution (levels)
- Initialization (non linear normal mode, diabatic etc.)

4.2.1.2 Research performed in this field

4.2.2 *Model*
(If no model is operationally runs for this time range, indicate, if any, the other GDPFS centre and its model from which you use products)

4.2.2.1 In operation

- Basic equations
- Independent variables
- Dependent variables
- Numerical technique (in horizontal, vertical and in time), hydrostatic or non hydrostatic
- Integration domain (in horizontal and vertical)
- Horizontal and vertical resolution
- Time step
- Orography, gravity wave drag, bathymetry (ocean models)
- Horizontal diffusion
- Vertical diffusion
- Planetary boundary layer
- Treatment of sea surface earth surface and soil
- Radiation
- Convection (deep and shallow)
- Atmospheric moisture
- Boundaries
- Type of ocean model (deep and shallow waters)
- Source of input (e.g. wind etc.) data (ocean models).

4.2.2.2 Research performed in this field

4.2.3 Operationally available *Numerical weather prediction products.* This item should contain a brief description of variables which are outputs from the model integration and the list of products available for WMO Members on Internet and on GTS. *(If no model is operationally runs for this time range, indicate the list of products, if any, you use from another GDPFS centre)*

4.2.4 *Operational techniques for application of NWP products.* This item should include only a brief description of automated (formalized) procedures in use for interpretation of NWP output (MOS, PPM, Kalman filter, Expert System, etc.) for example, "the MOS from ECMWF NWP is used to derive extreme temperatures and daily precipitation".

4.2.4.1 In operation

4.2.4.2 Research performed in this field

4.2.5 *Ensemble Prediction System (Number of members, initial state perturbation method, number and different models used, perturbation of physics, post-processing: calculation of indices, clustering).* This item should be a brief but clearer description of the techniques used for the ensemble prediction system, including the main post-processing techniques applied.

4.2.5.1 In operation
4.2.5.2 Research performed in this field
4.2.5.3 Operationally available EPS products. This item should contain a brief description of variables which are outputs from the EPS integration and the list of products available for WMO Members on Internet and on GTS.

5. Verification of prognostic products. Centres producing standard scores are requested to produce an annual summary for insertion in the WMO Progress Report on the GDPFS. The recommended content of this summary is given below:

VERIFICATION SUMMARY FOR INCLUSION IN THE ANNUAL WMO PROGRESS REPORT ON THE GDPFS

RSMC error	Z 500	NH, SH: against analysis 4 extra tropical standard area: against observations
RMS vector wind error	W 250	Same areas
RMS vector wind error	W 250	Tropics: against analysis
RMS vector wind error	W 850	Tropical standard area: against observations

Forecast range: 1, 3 and 5 days

All values to be the average of the monthly values over the year.

For ensemble system, provide annual and seasonal averages of the Brier Skill Score at 24, 72, 120, 168 and 240 hours for Z500 and T850.

6. Plans for the future *(next 4 years)*

6.1 Development of GDPFS.

6.1.1 Indicate major changes in the data processing and forecasting system which are expected in the next year.
6.1.2 Indicate major changes in the data processing and forecasting system which are envisaged within the next 4 years.

6.2 Planned Research activities in NWP, Nowcasting, Long-range Forecasting and Specialized Numerical Predictions. Indicate your planned research and development efforts in the area of understanding of physical processes, models, EPS and other techniques for the next 4 years.

6.2.1 Planned Research Activities in NWP
6.2.2 Planned Research Activities in Nowcasting
6.2.3 Planned Research Activities in Long-range Forecasting
6.2.4 Planned Research Activities in Specialized Numerical Predictions

7. Consortium *(if appropriate)*

There are a number of GDPFS Centres participating in Consortia. Those Centres participating in and/or responsible for a Consortium should indicate it in this item. Details on the system and/or model developed and/or operated by a Consortium, including approaches to the data assimilation, use of different numerical techniques and so on, should be reported in sub-paragraphs 7.1-7.7, using a similar approach as described in item 4.

7.1 *System and/or Model*
7.1.1 In operation
7.1.2 Research performed in this field

7.2 *System run schedule and forecast ranges*

7.3 *List of countries participating in the Consortium*

7.4 *Data assimilation, objective analysis and initialization*
7.4.1 In operation
7.4.2 Research performed in this field

7.5 *Operationally available Numerical Weather Prediction (NWP) Products*

7.6 *Verification of prognostic products*

7.7 *Plans for the future (next 4 years)*
7.7.1 Major changes in operations
7.7.2 Planned Research Activities

8. References: Give references to the sources where more detailed descriptions of different components of the data processing and forecasting system can be found, including WEB sites addresses.

Annex III

The WMO Survey on Nowcasting Systems and Services (2013)

The CBS OPAG/PWS Expert Team on Services and Products Improvement and Innovation (ET/SPII)

Please return to Ms Haleh Kootval : hkootval@wmo.int

Introduction and Background
At its Fourteenth Session, the WMO Commission for Basic Systems (CBS-XIV, Dubrovnik, Croatia, 2009), requested the WMO Public Weather Services (PWS) Programme to continue assisting Members to improve their national PWS programmes by providing guidance on the application of new technology and scientific research in data acquisition and use, especially for nowcasting and multi-hazard warnings.

The development of early warning systems is seen as part of the operational responsibility of NMHSs. The primary objective of a warning system is to empower individuals and communities to respond timely and appropriately to the hazards in order to reduce the risk of death, injury, property loss and damage[1]. The prerequisite to effective warnings and response is timely, accurate forecasts and "nowcasts". These forecasts generally are based on four components: Observational Data and Monitoring Systems; Numerical Weather Prediction; Conceptual Models; and, Situational Awareness.

The Goal of the Survey
As part of the mandate of the PWS Programme, the CBS Open Programme Area Group (OPAG) on PWS Expert Team on Services and Products Innovation and Improvement (ET-SPII) was tasked to survey Members on existing Nowcasting Systems. The results of this survey, are intended to provide information on the variety, strengths and weaknesses of nowcasting systems used in the WMO community. This will allow those Members who are contemplating the development of nowcasting systems to benefit from the experience of others.

Nowcasting Systems: Nowcasting generally refers to weather forecasting for the following 6 hours[1] via the analysis and extrapolation of the weather systems as observed in radar, satellites, and other observational data, and via the application of short-range numerical weather prediction. The technique is often applied to the near-term forecast of smaller scale weather systems such as thunderstorms, which cause tornadoes, flash floods, lighting strikes, and destructive winds. During the last two decades, the ability has been developed to digitalize and

[1] From the Manual on GDPFS (WMO No.485) - Nowcasting is defined as description of current weather parameters and 0-2 hours, description of forecasted weather parameters.

merge the remote sensing observational data with *in situ* observational data such as rain gauge data, and with NWP forecasts. Despite the usefulness of these techniques, nowcasting is still a science being actively researched. More information on nowcasting research may be found on the WMO WWRP Website at the following weblink:
http://www.wmo.int/pages/prog/arep/wwrp/new/nowcasting_research.html

Nowcasting Services: based on the output of nowcast systems, useful products and services may be developed to enable the public and users undertaking weather- sensitive operations, to take mitigation measures to reduce risk of damage and loss caused by approaching high-impact weather. With Internet technology, quantitative nowcast products may now be presented to the users in graphical 3-D format.

The wealth of new forecasting and nowcasting solutions now available makes it increasingly important for WMO Members to have access to scientifically proven and correct, and timely information. This will enable them to make informed decisions to invest their resources wisely when deploying new technologies in servicing user needs.

You are kindly invited to complete this questionnaire in conjunction with your annual Joint WMO Technical Progress Report on the GDPFS including NWP Research Activities for 2013, and return the report with your relies to this questionnaire to WMO.

Questions

NAME OF THE ORGANISATION

Q1. Do you provide forecasts for nowcasting (0 to 6 hours) timescales (Y/N)?

Q2. If you produce forecasts in the 0-6hours range, which of the following do you use?

a. rain gauge (capable of transmitting hourly observations)
b. Automatic/manual stations
c. Upper air stations
d. Lightning detection network
e. Numerical Weather Prediction models (specify type, e.g, deterministic, ensemble, high resolution global model. Local model, etc)

f. Satellite imagery
g. Radar (specify type, e.g., c-band, s-band, Doppler, dual polarization)
h. 'Crowdsourced' reports from the general public (eg via social media)
i. Others (please specify)

Q3. Are any of the data and information from the entities in Q2 integrated into a Nowcasting System (as defined above?)

a. Yes
b. No

1. Guidelines on Early Warning Systems and Application of Nowcasting and Warning Operations (PWS-21, WMO/TD No. 1559)

Q4. If "Yes", is the system fully operational?

a. Yes
b. No

Q5. If yes to Q. 4, What Nowcasting System(s) do you have? Please list:

Name of system	Brief description	When did you start using it?	Which weather events does this system help you forecast?

Please continue on a separate sheet if necessary.

Q6. If no to Q4, are you planning to develop such a system? (Yes/no)

a. Yes
b. No

Q7. For each of the systems described in Q5, please also answer the following questions:

Name of system	What actual data and forecasting products does the system use and what equipment was installed and/or developed?[2]	How effective is this system?				How does this system benefit end users?	How might the system be improved?
		Lead Time provided by the	Accuracy (Choose from *Usually*, *sometimes*, or	Increase in Lead Time[2]	Are verification results available?[3]		

2

		system	***rarely* gives good guidance)**				

Components might include radar, satellite data, synoptic and upper air/boundary layer observations, GPS water vapour data, lightning detection systems, servers/computers, numerical models, data visualisation applications etc.

[2] Compared to forecasting without using the system

[3] Verification results showing the improvement due to the use of the system

Q8. What challenges, if any, do you have in operating and/or maintaining your Nowcasting System(s)?

a. Trained staff for operation and application of outputs
b. Trained technicians for maintenance
c. Financial resource for operation, maintenance and upgrade
d. Other (please specify)

Q9. How are the needs of users and customers reflected during the development of your Nowcasting systems?

Q10. Do you have any plans for updating/improving your Nowcasting system(s) to better forecast other weather phenomena?

a. Yes (please specify)
b. No

Q11. Would you be willing to share your knowledge and experience in the use of nowcasting system (s) with others within the WMO community?

c. Yes
d. No
e. other (specify any conditions that apply for sharing information)