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# **REGIONAL ASPECTS OF HOMS**

**by**

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## **SUMMARY**

*The development of the **Hydrological Operational Multipurpose System (HOMS)** in RA VI was significantly affected in the past years by changes resulting from upgrading the system at the worldwide scale. The majority of European HOMS National Reference Centres (HNRCs) collaborated with the WMO Office for HOMS on HOMS Reference Manual (HRM) updating initiated in 1998 and finished in 2001. The total number of hydrological technology components was reduced from 452 to 180. The selection was guided by an attempt for higher usefulness of individual components in the HRM than before. The components contributed by RA VI Members represent about 30 % of the total scope of HRM. A new form of HRM is now available on CD-ROM and on Internet and also in other WMO languages.*

*The representatives of European HNRCs took an active part in preparation of the „Plan for HOMS in the 21<sup>st</sup> Century“. The document modifies and defines the status of the whole system and uses state-of-the-art information and computer technologies, such as Internet, e-mail and CD-ROM. For the purpose of the application of the Plan for specific conditions of RA VI a session of the Directors of European HNRCs was convened from 9 to 10 September 1999 in Geneva. Strategy for the „Implementation and Co-ordination of HOMS in RA VI for the 21<sup>st</sup> Century“ was formulated. Topical needs of Region Europe arising from implementation of principles for sustainable development and damages reduction from flooding and drought were taken in consideration. A proposal of measures for the extension of HNRCs number within RA VI was also considered*

## **1. TERMS OF REFERENCE AND FULFILMENT OF TASKS**

### **General suggestions for development of HOMS in RA VI between 1998 - 2002**

**1.1** Regional Association VI (Europe) considered in its Twelfth Session, which took place in Tel Aviv in Israel from 18 to 27 May 1998, among other activities also the importance of exchanging operational technology in hydrology and water resources. The basic background material for this purpose was the report on development of **H**ydrological **O**perational **M**ultipurpose System (HOMS) in the period between 1994 and 1998, which was prepared by the Working Group on Hydrology RA VI (WGH RA VI).

**1.2** The report noted that the European HOMS activities affect significantly the global development of HOMS. Contribution of new components in the HOMS Reference Manual (HMR) and the number of transfers taking part within RA VI composed around 50% of the global numbers. Therefore, there was an important reason for the directors of the HOMS National Reference Centres (HNRC<sub>S</sub>), mainly the biggest suppliers from RA VI, to meet for considering how best to aim the components in view of the current and future development of situation with water resources both in the Region and globally.

**1.3** Water related global and regional aspects of further development of the socio-economic sphere in the individual parts of the world were previously considered by participants of the „International Conference on Water and the Environment – ICWE“ (Dublin, 26 – 31 January 1992) and subsequently by the „United Nations Conference on Environment and Development – UNCED“ (3 – 14 June 1992). Representatives of the participating countries agreed upon a set of principles for strategy of sustainable development to be followed by the mankind so that ecological disasters, economical and other crises are avoided in future. Knowledge on the water cycle and on man-induced impacts on the hydrosphere plays one of the key roles in reaching the aims of this policy. The RA VI countries also joined, through their agreement, the effort in applying the adopted principles.

**1.4** Collection and application of hydrological information for sustainable development cannot be carried out without appropriate methodological and technological procedures. One of the means helping in or accelerating decision-making processes in these circumstances is therefore also HOMS. Its application and continuous improvement within the whole RA VI should therefore, in this view, be included among the continuing interests for development of the Region.

**1.5** Particularly urgent measures are requested due to current dramatic increase of vulnerability of the environment and increased sensitivity of budgetary resources in RA VI countries resulting from hydrological disasters such as floods and droughts. Therefore transfers and development of such HOMS components, which could help in application of conclusions from ICWE and UNCED concerning protection against impacts of these extreme events, should be supported with increased efforts.

**1.6** Although 49 countries belong into RA VI according to the WMO grouping, not all of these have established HNRC. Fifteen countries have not, so far, set up this systematic unit for international transfer of hydrological technologies. With the aim to reduce the differences between procedures of operational hydrology, mainly where development of regional co-operation could be negatively affected, there should therefore be continuous effort in RA VI to create conditions for increasing the number of HNRCs.

## **Terms of references for the HOMS expert**

- 1.7** Considering all of these regional aspects the Association approved the following tasks for the next period:
- (a) *To promote HOMS activities on the basis of implementation plans for HOMS 1997 – 2000 with respect to the relevant specific conditions and new possibilities to disseminate HOMS technologies (Internet for example)*
  - (b) *To prepare, in collaboration with the WMO HOMS Office, a meeting of Directors of European HNRCs, to consider trends for preparation of integrated component systems, possible international resources and capacities for developments of new components and conditions for indicating regional projects.*
  - (c) *To initiate and support development of HOMS technologies, enabling training of personnel involved in forecasting in a hydrological training facility.*
  - (d) *To assist in establishing new HNRCs in those countries of the Region where they have not yet been established.*

To fulfil the above tasks the expert analysed all documents, which were made available in relation to development of HOMS in Europe, he maintained contact and co-operated with the WMO Office for HOMS (WMO OH) in Geneva, led discussions with directors of European HNRCs in a meeting convened for this purpose and applied appropriate results from meetings of other important institutions and agencies.

### **Fulfilment of tasks under item (a)**

**1.7.1** HOMS activities within RA VI were carried out always in close link with global development of this system. By a decision of the Advisory Working Group (AWG) of Commission for Hydrology (CHy) at the end of 1997, which is also the Steering Committee for HOMS, innovative initiative was given for the HOMS and mainly for revision of numbers and applicability of the components in HRM. The process was divided into three phases beginning in 1999 and ending in 2001. HNRCs of RA VI also co-operated in the process, mainly by exchange of letters. The original number of 451 components in HRM was reduced to 150 with about one third of components contributed by RA VI. All European HNRCs are currently equipped with electronic HRM in an innovative form on a CD-ROM and have also a possibility to maintain changes in individual sections through Internet.

**1.7.2** The expert took part in discussions on development of HOMS during the 5<sup>th</sup> UNESCO/WMO International Conference on Hydrology (Geneva, February 1999) and prepared, on a basis of experience from RA VI, a position paper on implementation of HOMS in 21<sup>st</sup> Century. The report discussed mainly the following problems: Identification of gaps in HRM; Commercialisation of the components and application within HOMS; Revision of criteria for accepting new components; Role of Internet in distribution of components, Development of software sequences; Role of WMO OH. The topics in the report were used in preparing the document on *Implementation Plan for HOMS in the 21<sup>st</sup> Century* (IPH 21 C).

### **Fulfilment of tasks under item (b)**

**1.7.3** Due to personal changes in WMO OH, preparation of the „Meeting on Implementation and Co-ordination of HOMS in RA VI“ could only start in 1999 after Mr. Claudio Caponi was appointed to his function. In parallel, background documents were being prepared for the „International Workshop on HOMS in the 21<sup>st</sup> Century“, which preceded. The actions took place subsequently from 6 to 10 September 2000 in Geneva. The results of discussions were presented in reports given to all HNRCs in RA VI. Both of the meetings allowed rapporteur to get acquainted with positions and proposals for procedures in relation to IPH 21 C directly from present representatives of the main European HNRCs and therefore it was not necessary to distribute a questionnaire for preparation of strategy and further development of HOMS. The concluding formulation of perspective plan for implementation and co-ordination of HOMS in RA VI, resulting from the Geneva discussions, is presented in Chapter 4.

### **Fulfilment of tasks under item (c)**

**1.7.4** All the HNRCs in RA VI received a CD *HOMS in the Twenty-first Century* for presentation HOMS in Power Point, both as a set of slides with related script and as an automatically running slide show. Also printable pdf versions of brochure on HOMS in English, French, Russian and Spanish are available on CD-ROM and Internet too. This publicity means is formulated so that it can serve also as instruction in the use of HOMS itself or as an introduction for training in the use of the individual components and sequences.

**1.7.5** Representatives of European HNRCs present in the Geneva RA VI workshop (see paragraph 1.7.3) together with the HOMS expert identified topics, which can be regarded, in view of situation with water in the Region, as priority. These topics should also serve as the basis for formulation of regional projects including plans for necessary training of interested NMHSs personnel and representatives of the HOMS user community (see Chapter 4).

**1.7.6** The Czech Republic prepared the software package for training on *Technology for Detecting Trends and Changes in Time Series of Hydrological and Meteorological Variables (Change and Trend Problem Analysis – CTPA)*. The CD-ROM contains description of the methodological tools of the software and relevant case studies. The software package was offered through CHy-XI to developing countries and also to RA VI countries and other WMO Members (see Annex to the report).

### **Fulfilment of tasks under item (d)**

**1.7.7** In relation to creating conditions for establishment of new HNRCs in RA VI problems were analysed why some countries did not join the network of the HOMS centres. On the basis of the analysis measures were proposed, which could be subsequently implemented according to the specific conditions in the respective countries (see Chapter 4).

## **2. REVIEW OF IMPORTANT ACTIVITIES RELEVANT TO THE HOMS DEVELOPMENT IN RA VI**

**2.1** During the past period a number of technical events, workshops and training courses were convened aiming to demonstration and consultation of the HOMS components produced within RA VI. Its full review is not available with WMO OH in view of innovative changes, which, mainly between 1999 and 2001, took place within the whole system (selection of components in HRM, facilitation of direct contact between the country-producer and the country-user etc.). Therefore these data are not included in the HOMS monitoring in RA VI given below (see Chapter 3).

**2.2** The important turning point in the HOMS development was introduced by conclusions of the CHy AWG from 1997. The need formulated to revitalise the system was based on experience that:

- HRM includes a number of components not generating interest or being scientifically or technically outdated,
- hydrological needs of the user sphere and specific requirements stemming from changing situation with water resources in relevant WMO RAs have changed,
- technological advances in operational hydrology took place,
- development in information and computer technology advanced rapidly and offers more effective forms for HOMS operation.

CHy AWG responded to this situation by specifying the following measures:

- Revise criteria for acceptance of new components and their maintenance in HRM.
- Allow direct transfer between producer and user of the component or sequence.
- Review the role of structural participants of HOMS (CHy AWG, WMO OH, WMO RAs, HNRCs).
- Develop a training package from HOMS.
- Transform WMO OH into clearinghouse for hydrological technology.

**2.3** At its session in February 1999 in Geneva the UNESCO/WMO International Conference on Hydrology discussed development of HOMS between scientific community of hydrologists and representatives of NHSs. Common discussions led to the following conclusions:

- Proposal for removal of components or sequences in HRM with no or little frequency of requests for application.
- Inclusion of commercial components into HRM on a subsidiary list.
- HNRCs should become by their activities a supporting basis for hydrological development.
- Launch of electronic bulletin as information means between HNRCs and other partners within HOMS.
- Multilingual descriptors of components or sequences should be published on Internet.

**2.4** The international workshop on „HOMS in the 21<sup>st</sup> Century“ (6 – 8 September 1999, Geneva) summarised and considered all existing proposals for innovation of HOMS and with the help of ad-hoc working groups the *Implementation Plan for HOMS in the 21<sup>st</sup> Century* was formulated. Subsequently, CHy AWG recommended the resulting document as guiding general background material for strategy and co-

ordination of current and future HOMS activities at all levels of its development, i.e. at national, regional and global level. In the context with existing history, IPH 21 C represents by adopting innovative philosophy the next stage of development of HOMS:

- defines HOMS functions and aims in new conditions at the beginning of 21<sup>st</sup> Century
- adjusts the status of activities and responsibilities of all structural elements of HOMS and their interrelationship using systematic approach,
- sets clearer criteria for adopting new technologies in view of structure and needs of user community (see Fig. 1),
- specifies improved principles for descriptors of components on a basis of existing experience,
- gives rules for maintenance and transfer of commercial components within HOMS,
- extends accessibility of information in HRM and accelerates transfer using new tools of computer and information technologies such as Internet, e-mail, CD-ROM etc.
- clarifies possible procedures to identify gaps in HOMS and considers these as permanent element of activities within the infrastructure of the system,
- considers the training strategy as non-negligible part of transfer of a component and summarises all possibilities of these approaches,
- lists suggestions for possible activities and means supporting development of HOMS and its use both in NHMSs and in scientific community.

**2.5** WMO CHy-11 Session (6 – 16 November 2000, Abuja) took into consideration and adopted all stages of revitalisation process of HOMS. It also entrusted AWG to monitor continuously results of all these new approaches for development of HOMS at the beginning of 21<sup>st</sup> Century. The Chy-11 participants were also informed of WMO Commission for Instruments and Methods of Observation (CIMO) intention to publish in the framework of HOMS information on all instruments having relation to hydrology.

### **3. HOMS REGIONAL MANAGEMENT AND MONITORING AFTER THE HRM MODIFICATION 2001**

#### **Effectiveness of HOMS**

**3.1** IPH 21C proves that HOMS is and has to be operated as dynamic system. Technology for updating HRM is necessary to adapt continuously to new scientific and technological knowledge and needs of user community. In practice this requires periodic reviews in certain intervals, complementation and removal of components. A question arises on how to monitor these changes.

**3.2** Traditional statistical evaluation of transfer of components used from the beginning of HOMS operation in 1981 and continuing until 1997 with central registration at WMO OH has changed considerably. Experience shows that the number of transfers is indeed measure of the use of HOMS, but is not a measure of effectiveness of the system. Such a measure is the number of applications facilitated by the transferred component, length of the period for which the component is repeatedly requested, spreading of use of the component at the national level, etc. The best demonstration at all, however, is the improvement of knowledge and operational abilities of user community or its subjects.

**3.3** These indicators of effectiveness of HOMS cannot be monitored from top, from the level of WMO OH, as it is possible to do only from bottom, from the level of producer or at the level of HNRCs. Usually the information should be provided by feedback between user and HOMS producer.

**3.4** At the level of RA a simple monitoring should be maintained based on updated HRM first for identification of gaps in hydrological technologies, which are available in HRM, and secondly for identification of subject similarities of components. These activities are according to status of HOMS as defined in IPH 21 C part of roles of RHA and directors of HNRCs.

#### **Need for continuing identification of gaps in HRM**

**3.5** HOMS remains to be based mainly on voluntary provision or offer of technological procedures. Targeted production of components is ensured usually to lesser extent (regional projects, requests by WMO OH, etc.), as it depends on financial support. In result, for certain hydrological topics there can be surplus of components in HRM and for other needs there might be gaps in availability of components.

**3.6** However, not always the adequate cumulative appearance of alternative technologies in HRM must be considered as shortcoming and removed (earlier usually without necessary comparative evaluation). These cases can be easily identified and solved in HRM. Identification of gaps presents much larger problem.

**3.7** What is a gap in HRM? In principle it is a lack of certain hydrological technology for a given practical purpose. It follows that for identification of gaps it is necessary to recognise and use knowledge of user needs at one side and have available definitions of possible uses of a given technology on the other. In practice this calls for a condition requiring that this information makes a part of the component descriptor, which was not always provided by the authors. The directors of HNRCs and RHA WGH should require fulfilment of this condition when accepting a component (see Fig. 1).

**3.8** So far the needs of users are based rather on estimates, which is not necessarily sufficient in comparison with real possible scope of applications of a component. More exact possibility was already suggested by RA VI WGH in its previous period (see the report of the expert on *Regional Aspects of HOMS* during 8<sup>th</sup> Session of RA VI WGH in Helsinki). The principle is based on comparison of results of exact analysis of hydrological needs of individual fields of water management and protection of the environment (classified by using the UN catalogue) with a review of available technologies in HRM. This approach for selection of appropriate component on a basis of user needs, if available through Internet as supplement of HRM, could accelerate and better open information and technological potential of HOMS to user community. So far it is prepared in a form of outline. For its implementation it is necessary to assign a project, best from the level of WMO OH, which could among other aims accelerate links to computer systems used officially by HOMS.

### **Commercial components and how to treat them**

**3.9** It is known that HRM not always included all the most up-to-date technologies immediately after their development. Some were included after producers gained through commercial distribution the expected return. It was natural mainly with those producers that invested their means into development of the technology and were dependent on relevant profit. Under these conditions it was good that HRM included these components somewhat later but widely tested, but HRM could not provide updated review of hydrological technology at the global scale at the best level. Therefore wider inclusion of commercial components or sequences in HRM is improvement of this situation and may increase effectiveness of HOMS.

**3.10** Relation always directly and through contracts. Inclusion of commercial components into HRM does not in any case create legal responsibility in relation to WMO or between producer and user of the technology should be regulated HNRCs. HOMS can only play in such cases dissemination and information roles.

**3.11** HNRCs therefore will not deal with cases when technology or other product will be provided to one user for a given price and then to other possible users for the same price. The centres will not make any actions against further dissemination of transferred commercial technology from the user to other users free of charge against wish of producer.

**3.12** Concerning the opposite commonly known problem of non-authorized commercial use of technology received free of charge through HOMS, it is the problem of conditions of the transfer. HNRC in receiving country should be informed that such transfer is taking place and the producer should clearly define his limiting conditions and request confirmation of their fulfilment.

**3.13** Commercial components and sequences must comply with criteria, which are given for inclusion of non-commercial components into HRM. Special situation can arise in observing international standards. In such cases it is now necessary that WHO OH consult with AWG.

**3.14** Commercial components will be included in the next edition of HRM.

## **Regional monitoring of components in RA VI after updating HRM**

**3.15** Review of RA VI Member States the components or sequences of which, after selection of technologies in HRM, remained or were included on request by WMO OH after 2000 according to new criteria are shown in Tab. 1. It is obvious that by reduction of components the number of countries-producers from RA VI decreased. According to the last traditional statistics made in December 1996 and information by WMO OH on current status of HRM the countries-producers reached 14 before revision, now there are only six such countries. Also the number of included European components or sequences were reduced from 91 to 43. In view of initial stage of revised procedures for inclusion of new components in HRM, these indicators cannot be, so far, analysed. This information is given as a basic measure for further evaluation of development of HOMS.

**3.16** Also ratio of contribution from RA VI in specific sections of revised HRM offers only temporary picture. As a number of countries of the Region belonged to one of the main suppliers of hydrological technologies of HOMS, it can be assumed that the quantitative proportion of European components in sections would increase in coming years. Traditionally, majority of contributions would belong to Sections I, J and K.

**3.17** The total number of contributions from other RAs and their proportion in HRM is shown in Tab. 2. Distribution of components in the sections suggests continuous increase of needs and also offer of modelling technologies (Sections J, K). Next in the list are technologies oriented at collection of data, represented by summary of components in Sections B, C, D, E, F. This trend for RA VI is not parallel with other RAs. European Region shows relatively smaller share on this trend. Similarly other large group is composed of components and sequences in the Sections G, H, I, oriented at assessment of hydrological data. Also here the RA VI share is statistically lower. It could be partially explained by the fact that the European Region has already developed networks of observing stations and systems for assessment of data and therefore the effort for development of new technologies is oriented towards another needs. It is, however, only impression as proved by analysis of components in HRM. Specifically some of the European countries developed large software sequences, which, although monitored individually, cover large part of the spectrum of the needs for collection and assessment of hydrological data (Netherlands - HYMOS, UK - HYDATA, Belgium - MICROPROJECT, etc). It is again a proof that the statistics alone cannot objectively show effectiveness of HOMS.

**3.18** Much lesser extent of available HOMS technologies are included in Sections B, D, X. In the Section L, which includes technologies in relation to groundwater, the number of components from RA VI is relatively bigger than from other RAs together.

**3.19** Tab. 1 also shows that number of countries and also of HNRC in RA VI did not significantly changed in comparison to previous period. Only separation of the Focal Point of northern countries to individual HNRCs took place.

#### **4. IMPLEMENTATION STRATEGY AND CO-ORDINATION OF HOMS IN RA VI**

**4.1** Background documents for analysis of development of HOMS until 2015 (which are the periods of two WMO long-term plans) were among other:

- (A) documents for development of Region Europe
- *Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for Community action in the field of water policy.*
  - *Environment in the European Union at the turn of the century – Appendix to the summary. Facts and findings per environmental issues.*
  - *Science for the twenty-first century. A new Commitment. Declaration on Science and the Use of Scientific Knowledge.*
- (B) WMO documents on development of HOMS
- *Implementation Plan for HOMS in the 21<sup>st</sup> Century. Report*
  - *Report from “Meeting on Implementation and Coordination of HOMS in RA VI”*
  - *Fifth WMO Long-term Plan (5LTP).*

On the basis of these documents and results of discussions with directors of HNRCs in Geneva in September 1999 three strategic directions for implementation of HOMS in relation to Region Europe were proposed.

##### **(1) Water demand projections relevant under “sustainable water resources development”**

**4.2** One of the greatest challenges facing the community of RA VI Member states in the 21<sup>st</sup> century will be the attainment of sustainable development, calling for balanced interrelated policies aimed at economic growth, poverty reduction, human well-being, social equity and the protection of the natural resources, commons and life-support systems (see item 1.3). To fulfil these general objectives in full extent one of the inseparable components must be also the principle of sustainable water policy in the Region Europe.

**4.3** What is to be understood in practice under the objective “to apply principles of sustainable water policy”? In short, it incorporates implementation of the following five specific activities:

- (a) To have available information on capacity, quality and regime of water resources in a given territory.
- (b) To learn about principles and scale of impacts on regime of these water resources if affected by man-induced activities.
- (c) To be able to simulate behaviour of water processes in landscape by means of modelling.
- (d) Recognise the limits of water component in the landscape after surpassing of which harm to quality of the environment or collapse of water ecosystems may take place.

- (e) Decide on adoption or rejection of proposed requirements on the basis of analysis made using steps under (a) to (d).

Such defined objectives of sustainable water policy require, among other, also that development of HOMS in RA VI is guided so that it supports by appropriate technologies, computer software, methodological means etc. activities under items (a) to (e).

**4.4** In the framework of implementation of UNCED conclusions it was decided that already during the first decade of the 21<sup>st</sup> Century majority of countries should adopt principles of sustainable development. In this context the stage of development of HOMS in RA VI to fulfil hydrological needs according to items under (a) to (e) in paragraph 4.3 was set with the corresponding date until 2010.

**(2) Expert systems for flood and drought risks assessment and mapping relevant under „disaster reduction“**

**4.5** Systematic registry available in Europe from 1980 demonstrates that natural disasters of hydrometeorological origin have great impact on the environment. It is roughly estimated that its proportion reaches up to 80% of the total damage. Economic losses due to mainly floods and strong precipitation, which subsequently provoked landslides in the countries of European Union (EU) between 1990 and 1996 were four times higher than during the whole previous decade (see Fig. 2).

**4.6** Flooding is the most common and costly form of natural disaster in the Mediterranean region and in Central Europe. It is also more frequent in recent years in the Rhine basin area. There is a need for management of water resources to be closely integrated with flood protection and maintaining biodiversity.

**4.7** So far there is not any common European policy for reduction of natural disasters established, although some of the programmes, such as EPOCH (European Programme for Climatology and Natural Hazards) are already oriented at regional evaluation of risks. The main reason is given by differing conditions and needs of individual countries requiring different specific measures. This applies not only for Europe, but also to the whole territory of RA VI. In these circumstances the strategy for development of HOMS is in relation to the needs of protection against harmful effects of hydrological disasters, i.e. floods and droughts oriented particularly at initialisation of such technologies, which could help all or at least majority of countries in RA VI.

**4.8** One of such ideas was proposal for a project on *Training of the personnel on a hydrometeorological and water management training simulator*. Its aim is testing of accuracy in decision-making during events of hydrological extremes by personnel responsible for management in such situations (usually meteorologist, hydrologist, water manager, representative of responsible state authority or supervision decision-making authorities). The extreme meteorological, hydrological, water management or other situation is simulated in reduced time scale on distributed, but linked computers, while all other means (models, HOMS components, rules for management of water schemes, status of landscape etc.) are available as in reality. The whole process is controlled and evaluated by independent jury on a central computer (see detailed report of the expert on *Regional Aspects of HOMS for 8<sup>th</sup> Session of WGH RA VI in Helsinki*). The proposal was not, so far, implemented in a

form of the project. It is therefore considered as an appropriate element for inclusion into some of the regional HOMS projects under preparation.

**4.9** During the past decade it can be observed that in activities concerning hydrological extremes there is a tendency to pay more attention to floods, although their counterpart – droughts can create nearly the same damage in some of the RA VI countries. The strategy for HOMS development for the next period therefore assumes increased interest for components helping in balancing this irregularity.

### **(3) Eco-hydrological approaches relevant under „environmental studies“**

**4.10** Pressure on water resources affects habitats, particularly wetlands and can lead to contamination and depletion of surface and groundwater, causing soil degradation excessive salinity and desertification. Therefore in regions of countries with strained water balance interest can be assumed for components dealing with balance of groundwater resources and balance models operating in the system “atmosphere-soil-vegetation-water”. From this point of view it will be necessary to support development of the Section L.

**4.11** Agriculture consumes more water than other uses (approximately 80% versus 20% for urban and industrial use and 5% for cooling water). The Mediterranean countries are the major water consumers – mainly for agricultural purposes, though development pressures in comparatively dry areas are also a factor. Estimations for future total abstractions show very small increases. Implementation strategy of HOMS in relation to this situation is considered under paragraph 4.9.

**4.12** The *Water Framework Directive* mentioned earlier (see paragraph 4.1) would promote in the European part of RA VI integrated water management within river basins, set an overall ecological objective and deal with other pressures not covered in existing legislation. Its implementation requires increased demands on monitoring quality of water component of the landscape and protection of groundwater. To respond to these specific needs, RA VI should contribute appropriate HOMS technologies.

### **RA VI proposals for new components**

**4.13** In relation to formulated strategic aims of HOMS, views of directors of European NRCs and after revision of HRM the following proposals appear important in view of the needs of RA VI:

- Water quality protection procedures.
- Models producing QPF for flash flood forecasting and warning.
- Models using statistical approaches in flood forecasting and warning.
- Modelling of ice phenomena with special emphasis on ice jam induced flooding.
- Standardised profiles indicating hydrometeorological data availability for the country of each HNRC as well as its administrative structures.

## **Strategies for strengthening existing HNRCs**

**4.14** Position of HNRCs is not in all RA VI countries equivalent. HOMS should be recognised as a major information and technology resource. Therefore it is necessary widespread advertising at the national level. Very useful may be for these purposes, among other means, promotive WMO CD-ROM, *HOMS in the Twenty – first Century*, Hydrological Operational Multipurpose System: HOMS is the WMO system for technology transfer in hydrology and water resources, which was received by all HNRCs in RA VI.

**4.15** Effectiveness of HOMS will certainly be increased by elaboration of feedback system between producers and users of components and sequences.

**4.16** As a raising resources for activities of HNRCs are recommended these proposals:

- „Project type“ personnel resources can be allocated within NHSs (if it is possible).
- Receiving of raising funds through scientific foundation/bodies.
- Co-operative agreements with suppliers of commercial components.

## **Regional projects**

**4.17** Experience from the first phases of HOMS development in RA VI clearly demonstrated that regional projects lead to the development of many new components, which cover certain range of users needs and the development of which can be guided and can be provided by common effort relatively more rapidly. Therefore the efforts for obtaining funding for regional projects must be permanent part of the strategy for development of HOMS in RA VI.

**4.18** Funding sources may be a problem. In the case of RA VI the assistance regarding regional needs could be sought from: (1) European Union (2) Government financing (3) Involved Institutions (4) World Bank, in cases of technologies with general application also HWRP – WMO or IHP – UNESCO.

**4.19** It may be also possible to find existing related large projects, which could act as source of new components.

**4.20** The following proposals for regional projects were formulated in view of the needs of RA VI for the first decade of 21<sup>st</sup> Century in line with strategy of development of HOMS:

- (1) Transboundary flood mitigation.  
Monitoring Unified modelling of floods. Dissemination system for flood warnings. Estimation and rectifying damage.
- (2) Management of water scarcity conditions.  
Low flow estimation and regionalization. Drought risk mapping.  
Management techniques for drought assessment.
- (3) Hydrology and ecological aspects of inland waters.  
Monitoring of the hydrological part of the environmental system.  
Management of wetlands and delta areas. Transport of pollutants. Shore erosion and sediment transport.

## **Measures to promote the creation of new HNRCs**

**4.21** The list of 15 countries not having established HNRC in the Region Europe is given in Tab. 1

**4.22** Formally WMO OH and RHAs should approach Hydrological Advisors and/or Permanent Representatives of the countries concerned. The best opportunity for personal discussions are sessions of official bodies of WMO (RA VI, CHy, Cg).

**4.23** Informally, personal contacts are recommended from the position of HNRCs of neighbouring countries offering components free of charge, international co-operation, invitation for training etc.

## **5 CONCLUSIONS AND RECOMMENDED FUTURE ACTIVITIES OF HOMS**

**5.21** Based on the results of activities by WGH RA VI in co-operation with other relevant bodies of WMO in the past period from 1998 and 2001 regarding development of HOMS in Region Europe it can be stated:

- At the level of WGH RA VI incentives for adaptation of new approaches were developed for use, dissemination and changes of hydrological technologies in HRM
- All HNRCs have available revised HRM on CD-ROM and have an opportunity to maintain current changes through Internet. Using up-to-date media (CD-ROM, e-mail, floppy disks, Internet etc.) the Centres can better inform technical public on possibilities of HOMS and co-operate effectively with producers and users of components and sequences of HOMS. Through target analysis of current and future needs as well as by creating feedback links with user sphere they can increase effectiveness of this system of operational hydrology in relation to local, national and regional interests.
- RA VI has developed principles of strategy for implementation and development of HOMS based on development aspects of the Region until 2015 including proposals for regional projects, increasing effectiveness of operation of HNRCs and increase of their number.
- Securing the funding for implementation of regional projects was so far not successful similarly to efforts for increase of number of HNRCs in RA VI.

**5.22** It was demonstrated that for further development of HOMS in the Region Europe, the countries of which still belong to major suppliers and producers components and sequences of HOMS meetings of directors of HNRCs are important means for development. Therefore the plan of regional activities for the next period should take into account the need for such a meeting.

**5.23** As HOMS is a permanent process, it is necessary to include the topic of its further development again into the programme of activities of WGH RA VI for the next period. For this purpose it is recommended to entrust the expert appointed to deal with regional aspects of HOMS with the following tasks:

- (a) To support further development of HOMS in line with the document of AWG CHy *Implementation plan for HOMS in the 21<sup>st</sup> Century* and the document of RA VI *Strategy for implementation and co-ordination of HOMS in RA VI*.

(b) In co-operation with WMO Office for HOMS to aim at implementation of regional projects on „Transboundary flood mitigation systems“, „Management of water scarcity conditions“ and „Hydrology and ecological aspects of inland water“.

(c) In co-operation with WMO Office for HOMS to organize 2<sup>nd</sup> meeting of Directors of European HNRCs for dissemination of available technologies aimed at support of sustainable water policy in RA VI.

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*WMO:* **Fifth Long-term Plan.** WMO, Geneva.

*EU:* **Directive 2000/60/EC of the European Parliament and of the Council** of the 23 October 2000 establishing a framework for Community action in the field of water policy. EU, Brussel, 2000.

**ANNEXES:** Fig. 1

Fig. 2

Tab. 1

Tab. 2

Tab.

2a

**TABLE 1 NUMBER OF HOMS COMPONENT CONTRIBUTED BY RA VI COUNTRIES**

BY DECEMBER 2001

No	RA VI Members	HMRC Habitual yes/no	Section of HRM													Total		
			A	B	C	D	E	F	G	H	I	J	K	L	X		Y	
1	ALBANIA	no																
2	ARMENIA	no																
3	AUSTRIA	yes																
4	AZERBAIJAN	no																
5	BELARUS	no																
6	BELGIUM	yes																
7	BOSNIA AND HERZEGOVINA	no																
8	BULGARIA	yes																
9	CROATIA	yes																
10	CYPRUS	yes																
11	CZECH REPUBLIC	yes																
12	DENMARK	no																
13	ESTONIA	yes																
14	FINLAND	yes																
15	FRANCE	yes																
16	GEORGIA	yes																
17	GERMANY	yes						3	1								2	6
18	GREECE	yes											2					2
19	HUNGARY	yes																
20	ICELAND	no																
21	IRELAND	yes																
22	ISRAEL	yes																
23	ITALY	yes																
24	JORDAN	yes																
25	KAZAKHSTAN	no																
26	LATVIA	yes																
27	LEBANON	no																
28	LITHUANIA	yes																
29	LUXEMBOURG	no																
30	MALTA	yes																
31	MONACO	no																
32	NETHERLANDS	yes								1		2	4					7
33	NORWAY	yes						1			1							2
34	POLAND	yes																
35	PORTUGAL	yes																
36	REPUBLIC OF MOLDOVA	no																
37	ROMANIA	yes																
38	RUSSIAN FEDERATION	yes																
39	SLOVAKIA	yes																
40	SLOVENIA	yes																
41	SPAIN	yes																
42	SWEDEN	yes										1						1
43	SWITZERLAND	yes																
44	SYRIAN ARAB REPUBLIC	yes																
45	THE FORMER YUGOSLAV REPUBLIC OF MACEDONIA	no																
46	TURKEY	yes																
47	UKRAINE	no																
48	UNITED KINGDOM OF GREAT BRITAIN AND NORTHERN IRELAND	yes	1	1	2		3		2		2	2	12					25
49	YUGOSLAVIA	no																
<b>Total for RA VI</b>		<b>34/15</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>0</b>	<b>7</b>	<b>1</b>	<b>3</b>	<b>0</b>	<b>3</b>	<b>5</b>	<b>14</b>	<b>4</b>	<b>0</b>	<b>2</b>		<b>43</b>

TABLE 2

NUMBER OF HOMS COMPONENT FROM OTHER COUNTRIES

BY DECEMBER 2001

No.	RA/VI Members established by SMO	HNRC	Section of HRM													Total		
			A	B	C	D	E	F	G	H	I	J	K	L	X		Y	
1	ARGENTINA	III									1							1
2	AUSTRALIA	V	1							1	3	2		1				9
3	BRAZIL	III								1								1
4	CANADA	IV						5			5	5						15
5	CHINA	II	1		4		1			1	1	2	4					15
6	INDIA	II											1					1
7	JAPAN	II			20		1	5				1	1					28
8	MALAYSIA	V			4													4
9	NEW ZEALAND	V	1							1								3
10	THAILAND	II			3													3
11	USA	IV			2		9	1		3	3	6	21	1			3	49
<b>Total RA I-V</b>			<b>3</b>		<b>33</b>		<b>16</b>	<b>6</b>		<b>4</b>	<b>13</b>	<b>9</b>	<b>34</b>	<b>1</b>			<b>3</b>	<b>129</b>

TABLE 2a

NUMBER OF HOMS COMPONENT CONTRIBUTED FROM INDIVIDUAL RAs

BY DECEMBER 2001

No.	Regional Association	Section of HRM													Total			
		A	B	C	D	E	F	G	H	I	J	K	L	X		Y		
I	Africa																	
II	Asia	1		27		2	5		1	1	3	6						46
III	South America								1	1								2
IV	Nord and Central America			2		14	1		3	8	6	26	1			3		64
V	South-West Pacific	2		4				2	3		2			1				14
<b>Total RA I-V</b>		<b>3</b>		<b>33</b>		<b>16</b>	<b>6</b>	<b>3</b>	<b>4</b>	<b>13</b>	<b>9</b>	<b>34</b>	<b>1</b>			<b>3</b>		<b>126</b>
VI	Europa	1	1	2		7	1	3	3	5	14	4				2		43
<b>Total RA I-VI</b>		<b>4</b>	<b>1</b>	<b>35</b>	<b>0</b>	<b>23</b>	<b>7</b>	<b>6</b>	<b>4</b>	<b>16</b>	<b>14</b>	<b>48</b>	<b>5</b>			<b>5</b>		<b>169</b>

## WORLD'S TOP 10 CONTRIBUTORS

No.	Country	Regional Association	Number of components in HRM
1	USA	RA IV	49
2	Japan	RA II	26
3	UK	RA VI	25
4-5	Canada	RA IV	15
4-5	China	RA II	15
6	Australia	RA V	9
7	Netherlands	RA VI	7
8	Germany	RA VI	6
9	Thailand	RA II	4
10	New Zealand	RA V	3

SECTIONS OF HOMS REFERENCE MANUAL HRM	
A	Policy, planning and organisation
B	Network design
C	Instruments and equipment
D	Remote sensing
E	Methods of observation
F	Data transmission
G	Data storage, retrieval and dissemination
H	Primary data processing
I	Secondary data processing
J	Hydrological forecasting models
K	Hydrological analysis for planning and design of engineering structures and water resources systems
L	Groundwater
X	Mathematical and statistical computations
Y	Training aids in operational hydrology

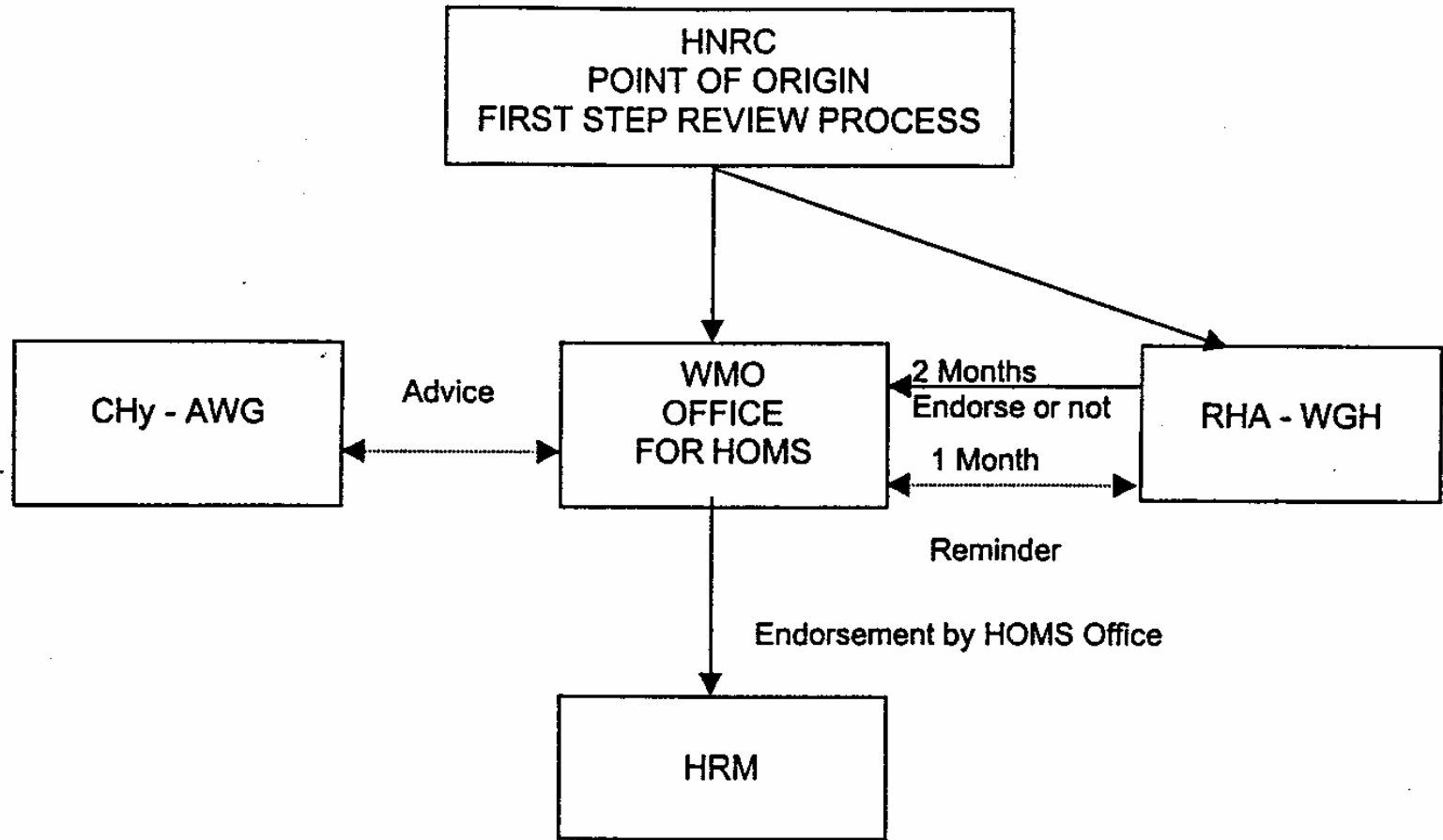


Fig. 1

**ACCEPTANCE PROCEDURE FOR NEW HOMS COMPONENTS**

