

### **IGEO LAB OVERALL STATUS**

In response to CGMS Recommendation 34.01,  
Recommendation 34.02, Action 34.01 and Action 34.02

The background to the IGeoLab concept is described with reference to discussions at CGMS-34 and CM-7. At CGMS-34 two test cases had been identified (GIFTS and GOMAS). CM-7 decided to address these two cases in a more general way as “IR Hyperspectral” and “Microwave” and identified a further candidate test case, namely the exploitation of a Highly Elliptical Orbit (HEO) for observing the polar regions.

The potential candidate missions/test cases are described and their latest status is described. No progress was recorded in setting up a demonstration mission for a hyperspectral sounder, although the interest of such a mission was reaffirmed in the light of current geostationary plans for the 2014-2015 timeframe.

The latest status of the GEO-Microwave test case is covered in a separate paper (WMO-WP-04).

The third test case, HEO, has received high attention since CM-7 through the establishment of a Task Group to take the concept forward. The outcomes of the first meeting of the Task Group are outlined and those of the second meeting (where the group was renamed the “IGeoLab for HEO Focus Group”), which took place shortly before CGMS-35, are briefly described.

In conclusion the document invites CGMS members to actively focus on the next steps necessary in the process of bringing the concept of IGeoLab to a reality by considering firm implementation proposals.

## IGEOLAB OVERALL STATUS

### 1 BACKGROUND AND INTRODUCTION

IGeoLab is a concept of international partnerships to prepare and implement demonstration missions of innovative instruments in geostationary orbit. The status of the development of the IGeoLab concept was addressed at CGMS-34 and in January 2007 at the seventh session of the Consultative Meetings on High-level Policy on Satellite Matters (CM-7).

At the time of CGMS-34, two test cases had been selected:

- GIFTS (Geostationary Imaging Fourier Transform Spectrometer), for frequent profiling of atmospheric temperature, humidity, and wind through infrared spectroscopy;
- GOMAS (Geostationary Observatory for Microwave Atmospheric Sounding), for frequent observation of precipitation by sounding in the millimetre and sub-millimetre wavelength ranges.

With regard to the GIFTS test case, now named in a more generic way "IR Hyperspectral", several discussions have been held since the first Focus Group meeting on GIFTS (Washington, DC, USA, June 2005) and it was concluded that the NASA developed instrument existed as an Engineering and Development Unit (EDU), it would have the potential to meet WMO requirements, there would be a potential flight opportunity on the Russian Federation Elektro-L 2 and the instrument could be accommodated on board this spacecraft. However, a considerable amount of funding would be required to upgrade the EDU to a flight model. Although high-level exchange of correspondence had taken place among the United States and the Russian Federation, with the support of ROSCOSMOS, NASA/NOAA and WMO, and in spite of great interest manifested at CM-6 in Buenos Aires, the situation of financial resources to upgrade the EDU to a flight model had not been solved.

With regard to the initial GOMAS proposal (now called "GEO-Microwave"), several meetings have taken place and scientific and technical work has made considerable progress. Since GOMAS has not been selected by ESA as a core Earth Explorer mission, the fundamental issue of identifying a 'lead space agency' has not been solved. The latest status of the GEO-Microwave test case is covered in a separate WP.

CM-7 reaffirmed the value of the IGeoLab concept and confirmed the importance of pursuing demonstration missions for advanced geostationary sounders, both hyperspectral infrared and microwave. CM-7 also discussed the possibility to investigate a third test case that would be dedicated to Highly Elliptical Orbit (HEO) missions in Molniya orbit.

## 2 LATEST STATUS OF THE IR HYPERSPECTRAL TEST CASE

CGMS-34 recommended that relevant satellite operators indicate activities that could be undertaken to unblock the situation enabling upgrading the GIFTS EDU to flight model and thus also unblocking the potential contribution to the project of several CGMS members who had expressed a willingness once the core space segment issue is resolved.

It can be noted that several agencies have now indicated plans for interferometric hyperspectral sounders, and that an early demonstration mission in the IGeoLab framework would be helpful to optimize such plans and prepare operational applications. In China, CMA indicated plans for an Interferometric Infrared Sounder (IIS) for the FY-4 Optical series in 2014 and beyond. In Japan, JMA indicated its intention to explore with JAXA the possibility of cooperation on the development of a geostationary hyperspectral sounder for MTSAT Follow-On (MTSAT-FO) as of 2014. In Europe, EUMETSAT has agreed to include the Infrared Sounding (IRS) mission in the baseline for the Meteosat Third Generation (MTG) preparatory programme, with a tentative launch date in 2017 for this particular mission.

In the USA, the National Research Council issued in January 2007 a major report entitled "Earth Science and Applications from Space: National Imperatives for the next Decade and Beyond" (widely referred to as the "Decadal Survey"). Recognizing the technical challenges and accompanying risk of cost increase of the GOES-R Hyperspectral Environmental Sensor (HES), the report recommends considering the following approaches:

- To complete the GIFTS instrument, deliver it to orbit via a cost-effective launch and spacecraft opportunity and evaluate its potential to be a prototype for the HES instrument; and/or
- To extend the HES study contracts focusing on cost-effective approach to achieving essential sounding capabilities to be flown in the GOES-R timeframe.

## 3 LATEST STATUS OF THE HEO TEST CASE

CM-7 also noted that CGMS-34 had considered potential new test cases to be introduced, following GIFTS and GEO-Microwave. In noting document CGMS-34 ROSC-WP-04 ("Space monitoring of earth high-altitude regions by Electro-L type satellites in Molniya orbit"), CGMS-34 had recalled a proposal aimed at utilizing an IR imager with water vapour channels for the determination of winds in high-latitudes along the lines of what has been achieved with MODIS. The discussion that followed recorded that at least ROSCOMOS, ROSHYDROMET and EUMETSAT were interested in investigating the possible applications of Molniya orbits.

CM-7 was informed of ROSCOMOS and ROSHYDROMET preliminary plans for the Arctica project that would involve two satellites on highly elliptical orbit with an inclination of 63° and an orbital period of 12 hours. This configuration would allow a quasi-permanent coverage of high latitude areas for weather, ice and snow monitoring as well as for telecommunications and data collection. Based on its own experience, ROSCOMOS and ROSHYDROMET were convinced of the interest of

this concept which could be implemented in a cost-effective way if sufficient support could be mobilized through international cooperation. ROSCOSMOS / ROSHYDROMET then confirmed their intention to convene a Task Group to determine the interest of CM space agencies for an IGeoLab mission based on Molniya orbits.

CM-7 expressed a strong support to the idea of expanding the scope of IGeoLab in order to use the IGeoLab framework for a demonstration mission based on Molniya orbit. Initiating such a project seemed particularly appropriate in the context of the International Polar Year (IPY) as it would pave the way for possible long-term sustained missions providing quasi-permanent coverage of the polar regions. The Russian Federation and the WMO Space Programme were thus urged to rapidly convene a Task Group to review the possible scope of a cooperative undertaking around this concept. CM-7 noted that Canadian Space Agency (CSA), EUMETSAT and NOAA expressed preliminary interest to participate.

In response to CGMS-34 and CM-7 the Russian Federation and the WMO Space Programme established an IGeoLab HEO Task Group (re: CGMS Action 34.02) and the first meeting of the group was held in Moscow on 24 April 2007. The participants were the Canadian Space Agency, the Nansen Centre (Norway), NOAA, Roscosmos, Roshydromet, the Russian Academy of Sciences, several Russian Federation technical and scientific institutions and WMO. The Task Group recommended the Russian "Arctica" project as a basis for further discussions as a matter of urgency, in the framework of IGeoLab. The meeting reviewed proposals by Roscosmos and Roshydromet to use modules for orbital platform, payload, spacecraft control and ground processing. It was acknowledged that the use of these modules, subject to successful testing in 2008 in the Elektro and Spectr programmes, would allow the implementation of Arctica at minimum cost and risk. The Task Group considered that the Arctica project had the potential to allow further progress in NWP, with better forecasting of dangerous weather and climatic anomalies for northern countries and worldwide. The Task Group recommended further discussions on possible international cooperation in joint production and use of the hardware and software resources of the Arctica space system. The Task Group noted a Finnish proposal to complement the Arctica payload by means of the UV Auroral Imager and to take advantage of a ground station in Finland. The Task Group nominated Dr Georgy Polischuk (Director General of Lavochkin Association, Russian Federation) and Dr Vasily Asmus (Director of Science Research Centre, Roshydromet, Russian Federation) as Chair and Co-chair of the project respectively. It recommended convening a second meeting in Geneva to discuss:

- Geophysical user requirements and possible technical solutions;
- A description of the user segment of the project plan and its evaluation mechanism.

The Fifteenth WMO Congress supported the initiative to address, in the IGeoLab framework, the cooperation on a possible mission in HEO based on the Russian Federation Arctica project, taking into account the outcome of the Task Group.

The second meeting of the HEO Task Group (renamed “IGeoLab for HEO Focus Group”) took place in Geneva on 9 and 10 October. The main points to come out of that meeting were as follows:

- The session was informed about:
  - The latest status of the Russian Federation’s Arctica Project;
  - The Canadian Space Agency (CSA) planning towards its Polar Communications and Weather (PCW) mission;
  - The NOAA long term vision for a national USA MEO mission.
- The session noted that the space systems described in presentations provided by NOAA and CSA on their national vision/initiative would be valuable for MEO/HEO missions and required further elaboration. The session also noted that the Russian Federation Project is based on mature technologies and extensive heritage in use of Molniya type orbit.
- Following discussion, the members recommended both the “Arctica” Project and CSA’s PCW mission for further consideration in the framework of the IGeoLab international concept.
- Focus Group members reviewed the proposal by Roshydromet and Roscosmos to use Russian high-end modules of space hydrometeorological equipment and base orbital platform, launching facilities as well as ground infrastructure modules for SC control and data reception and processing for the “Arctica” project implementation. In particular, Focus Group members noted the Russian Federation’s intention to use base modules being tested on Russian “Electro” and “Spektr” space systems that would reduce risk and cost of the “Arctica” Project and shorten its implementation. The session also noted that there is a reserve available for other instruments up to 500 kg.
- Focus Group members agreed to recommend to their respective space agencies and meteorological services to consider international cooperation including joint manufacturing and use of equipment, software and information resources of the “Arctica” space system.
- The Russian Federation analyzed the Finnish proposal to provide an instrument to supplement already manifested instruments on the “Arctica” SC with a UV Auroral Imager for aurora studies, as well as a proposal to use a Finnish ground station. The Russian Federation agreed to review and discuss specific technical issues with Finland on a bilateral basis.
- For the CSA project, the session noted that it was following traditional satellite system development phases and was presently in Phase 0 to identify user and science needs and system feasibilities. CSA anticipates completion of Phase 0 in mid 2008 and to move into Phase A by the end of 2008.
- The session noted the strong willingness on the parts of the Russian Space Agency and the Canadian Space Agency to consider higher-level cooperation in HEO missions and suggested that harmonization between the respective

initiatives for HEO would offer advantages for the realization of a HEO mission and should be further explored.

- Focus Group members recommend the following:
  - To hold a third IGeoLab HEO FG session in March 2008, tentatively in Canada [TBC], to examine a consolidated set of user requirements, identify potential mission architectures and explore possible models of collaboration;
  - Canada and the Russian Federation were encouraged to start bilateral technical meetings as soon as possible, preferably prior to the March 2008 meeting;
  - To carry out further work on international cooperation on bilateral and multi-lateral basis taking advantage of WMO's considerable expertise to facilitate international science teams for spacecraft instruments, ground processing algorithms and validation mechanisms, and involvement in the user and ground segments.

#### **4 CONCLUSIONS**

A lot of interest has been expressed for each of the three test cases, and their feasibility is not questioned, however no decisive step has been taken yet to implement them and to initiate project proposals. Given the need to optimize financial investments and to best exploit the available expertise, CGMS satellite operators are invited to take steps towards implementation proposals.