CGMS

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STATUS OF THE IGEOLAB INITIATIVE FOR GEO-MICROWAVE

The IGeoLab initiative for a demonstration mission of microwave imaging/sounding in geostationary orbit (GEO-Microwave) is being discussed since CGMS-32 (Sochi, Russia, 17-20 May 2004) and has been pursued in practice since the first meeting of the GEO-Microwave Focus Group (Washington DC, 7 June 2005) approximately 3.5 years ago.

At CGMS-35 (Cocoa Beach, USA, 5-9 November 2007) possibility of convergence was found between GEO-Microwave and the FY-4 programme of Chinese geostationary meteorological satellites of the next generation. WMO and CMA were tasked to write a proposal for the China National Space Agency to take leadership in implementing GEO-Microwave in the framework of the FY-4 programme, and to CGMS members to contribute to the implementation of GEO-Microwave in the framework of the IGeoLab initiative.

The proposal has been duly written and is provided as a background to this document. An advanced presentation took place as the 5th meeting of the Focus Group, structured as a parallel session at the 4th Workshop of IPWG (Beijing, 13-17 October 2008). However, meanwhile the Chinese space meteorology plan has been restructured, and as the FY-4 component intended to embark a MW payload is now on stand, China cannot currently commit to serve as Leading Agency for GEO-Microwave.

Consequently, CGMS-36 will need to re-assess the situation of GEO-Microwave. It is noted that, at present, microwave payloads in geostationary orbit are being studied by:

NASA with GeoSTAR on the PATH mission concept, considered in the framework of the Earth Observation Decadal Survey;

ESA with the GAS instrument concept, in the framework of the ESA Technology Development Programme.

However, it should also be mentioned that:

In the initial phases of the Focus Group, India declared interest in the GEO-Microwave initiative;

China continues to be interested, and some technological studies are being carried out.

Furthermore, IPWG reaffirms a strong interest in the materialization of a GEO-Microwave demonstration mission.

Action/recommendation proposed:

CGMS-36 is invited to:

Take note of the IGeoLab GEO-Microwave situation and instruct the Focus Group on whether to further continue its effort.

Consider the "Proposal for the Implementation of a Microwave Mission in Geostationary Orbit (*GEO-Microwave*) in the framework of the Second-Generation *Feng-Yun* Geostationary Satellite Series (*FY-4*)" provided separately as a background document.

STATUS OF THE IGEOLAB INITIATIVE FOR GEO-MICROWAVE

1 BACKGROUND

The concept of the International Geostationary Laboratory (IGeoLab) was introduced at CGMS-32 (Sochi, Russian Federation, 17-20 May 2004) as a means to implement demonstration missions in geostationary orbit in preparation for future operational systems that would be part of the space-based component of the Global Observing System. The demonstration mission should be implemented through international cooperation amongst space agencies each of them contributing to one, or more, system element(s) (instrument, platform, launch service, ground segment, etc).

GEO-Microwave was selected as one of the first two test cases (the other one was GIFTS, Geostationary Imaging Fourier Transform Spectrometer). A preparatory Task Team meeting (Geneva, 13-14 December 2004) collected information on CGMS members' interest for the two proposals, and the fifth session of the WMO Consultative Meetings on High-level Policy on Satellite Matters (CM-5, Geneva, 24-25 January 2005) established two Focus Groups to progress with the GIFTS and the GEO-Microwave projects, respectively.

The GEO-Microwave Focus Group held the first four meetings as follows:

FG-1 in Washington DC, 7 June 2005: requirements for frequent sampling of precipitation, possible sensing principles to be exploited, technological possibilities, and scientific aspects were reviewed; and a roadmap for implementing GEO-Microwave in the IGeoLab context was outlined.

FG-2 in Rome, 24-25 October 2005: entirely devoted to scientific issues (requirements, basic modelling, retrieval aspects, assimilation, calibration/validation).

FG-3 in Geneva, 29 August 2006: entirely devoted to the search for a leading space agency. The CMA representative introduced the Chinese plans for FY-4, including its MW component.

FG-4 in Beijing, 12-13 April 2007): in-depth review of 1) requirements for frequent precipitation observation, 2) mission concepts and basic technology, 3) data handling, basic modelling, retrieval algorithms, and 4) role of GEO-Microwave in Numerical Weather Prediction.

A key technological aspect was identified at FG-4: the option of a classical filled-aperture antenna or of advanced concepts based on synthetic aperture antennas. The choice between these two options would have a strong impact on the development plan and possible cooperation arrangements. It was therefore found necessary to make progress before submitting a proposal to potential participants. A study was performed by certain FG members to show advantages, disadvantages, development risk/cost and readiness of the two approaches.

CGMS-35 in Cocoa Beach, USA, 5-9 November 2007, agreed the following action:

"*Action 35.03: CMA/CNSA and WMO will cooperate in finalising the work of the GEO-Microwave Focus Group that, according to its Terms of Reference and taking into account the work already done, should:*

- *define a mission scenario attempting to converge with results of feasibility studies in China as they become progressively available;*
- *identify mission components suitable for international partnerships and preliminary assess the realism of collecting the interest of prospective partners;*
- *draft a proposal to the group of prospective partners, including work plan and schedule; and present it to CGMS-36, that implies that CMA/CNSA commit to act as Leading Agency.*

Deadline: CGMS-36, preceded by a presentation at a last meeting of the Focus Group possibly to be held tentatively with the next IPWG meeting in Beijing in autumn 2008."

2 ACTIVITY SINCE CGMS-35

The "Proposal for the implementation of a microwave mission in Geostationary Orbit (GEO-Microwave) in the framework of the Second-Generation Feng-Yun Geostationary Satellite Series (FY-4)" has been written in the course of 2008 with the direct contribution of eight FG members and input from another 12 members (presentations given at FG meetings). The Proposal includes the following chapters:

1. Introduction - IGeoLab and FY-4M
2. Requirements for frequent observation of precipitating clouds
3. Background on satellite microwave radiometry
4. Mission requirements for the geostationary orbit
5. Scientific aspects
6. Mission concepts
7. Work to follow

The last chapter includes programmatic aspects appropriate to serve as "Phase-Ø" or "pre-Phase-A" of the GEO-Microwave development programme, i.e.:

7.1 Establishment of system requirements;

7.2 Identification of mission elements for IGeoLab purposes;

7.3 Outline of the scientific programme to be shared in the IGeoLab partnership:

7.4 Outline Statement of Work for the Phase A study.

Unfortunately, results from feasibility studies in China did not materialize, since the Chinese space programme was heavily restructured during 2008. CNSA moved to the Ministry of Industry and Information and CMA had to review all its commitments towards meteorological satellites. The FY-4M budget is not confirmed for the current five-year plan, and the next plan will be presented in 2010. In the absence of technical elements to constrain the wideness of the options, chapter 7 of the Proposal, though formally compiled, is too generic to be used for entering a Phase A: too many options would lead to long duration and high costs.

As mandated by CGMS-35, the Proposal was prepared with the view to be presented at FG-5 in Beijing, which was convened on 16 October 2008 as a two-hour session covering three items only:

- Presentation of the Proposal;
- Review of technical studies in China (four recorded from FG-4, one of which updated at FG-5);
- Report to CGMS-36.

About 40 IPWG members attended the FG-5 session. The IPWG Plenary considered that, although the current situation seems to be inconclusive, the initiative should continue to be pursued since microwave in GEO represent a basic innovation for the progress of precipitation observation.

3 DISCUSSION

Based on FG-5 results and discussions with NSMC management, it seems unlikely that China can commit to take the leadership of GEO-Microwave at CGMS-36. CGMS-36 therefore has to make a decision, i.e. to close the initiative or to redirect it towards a revised objective.

It has to be noted that continuing the effort is rather problematic. In fact, the Focus Group has already:

Established and consolidated the requirements;

Identified suitable remote sensing principles;
Collected evidence of relationships between precipitation and mm-submm radiation;
Experimented several retrieval schemes;
Conducted experiments of mm-submm radiance data assimilation in NWP models;
Analyzed alternative mission concepts;
Compared different technologies in respect of compliance with user requirements;
Provided (though rather generic) itemization of activities to be conducted in Phase-A.

The Focus Group cannot add much unless a space agency undertakes to move towards finalizing a mission definition. It is recalled, as pointed out in previous CGMS sessions, that even pursuing the scientific work is problematic due to lack of funding for scientific institutes and difficulty to attend meetings due to travel costs. Some of the missions for FG-4 were financially supported by WMO (which cannot be repeated), and attendance to FG-5 by FG members has been limited to the few who were in Beijing to attend IPWG.

On the other hand, it is felt that there would be benefit in pursuing the activity at least for some more time. The following background still holds:

NASA has included GeoSTAR in the mission PATH (Precipitation and All-weather Temperature-Humidity) listed in the Earth Observation Decadal Survey;

ESA is studying GAS (Geostationary Atmospheric Sounder) in the framework of its technological programme.

In addition, it should be recorded that:

In the initial phases of the Focus Group, India declared interest in the GEO-Microwave initiative;

China continues to be interested, and some technological studies are being carried out.

It also should be recorded that IPWG maintains strong interest for the materialization of a GEO-Microwave demonstration mission.

4 CONCLUSION

CGMS-36 should consider the GEO-Microwave situation and:

Investigate whether any CGMS member is interested in becoming Lead Agency.

In the affirmative, CGMS-36 could:

Task the Focus Group to transfer all results so far achieved to the potentially interested Agency.

In the negative, CGMS-36 could:

Close the Focus Group activity and the IGeoLab GEO-Microwave initiative.

The “Proposal for the Implementation of a Microwave Mission in Geostationary Orbit (*GEO-Microwave*) in the framework of the Second-Generation *Feng-Yun* Geostationary Satellite Series (*FY-4*)” is provided separately as a background document.