# World Meteorological Organization
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**WMO**

## User preparation for new generation satellites including SATURN, VLab and critical transition issues

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# Introduction

- Online portal SATURN (SATellite User Readiness Navigator) launched for public access in June 2014

    - It provides up-to-date information supporting user readiness activities for Himawari-8 and GOES-R.

    - Preliminary content is available for MTG, Elektro-L and FY-4.

    - Continued support from the task team of CGMS focal points to develop the SATURN content remains vital to ensure its currency.

- Initial scope of SATURN: new generation of GEO satellites

    - It is planned for 2015 to extend the scope of the portal to the core meteorological satellites in LEO:

        - NPP/JPSS from NOAA,
        - Metop from EUMETSAT,
        - FY-3 from CMA and
        - Meteor-M from Roshydromet.

# Introduction

- To support and guide satellite operators and users in their respective preparation activities, a <u>Reference User Readiness Project</u> has been developed
    - The Project provides a <u>typical breakdown of user readiness activities and a timeline of deliverables</u> that are needed from satellite development programmes to support user readiness activities
    - The Reference User Readiness Project is presented in detail
- <u>Online training material</u> on aspects of Himawari-8 and GOES-R has been made available through SATURN in English and Spanish (where available), in collaboration with the VLab and the COMET/MetEd programme
    - The VLab strategy 2015-2019 places high emphasis on building capacity in understanding and exploiting data from the new generation satellites (see WMO WP-12 under item I.1).

# Space-Based GOS 2015 - > 2020
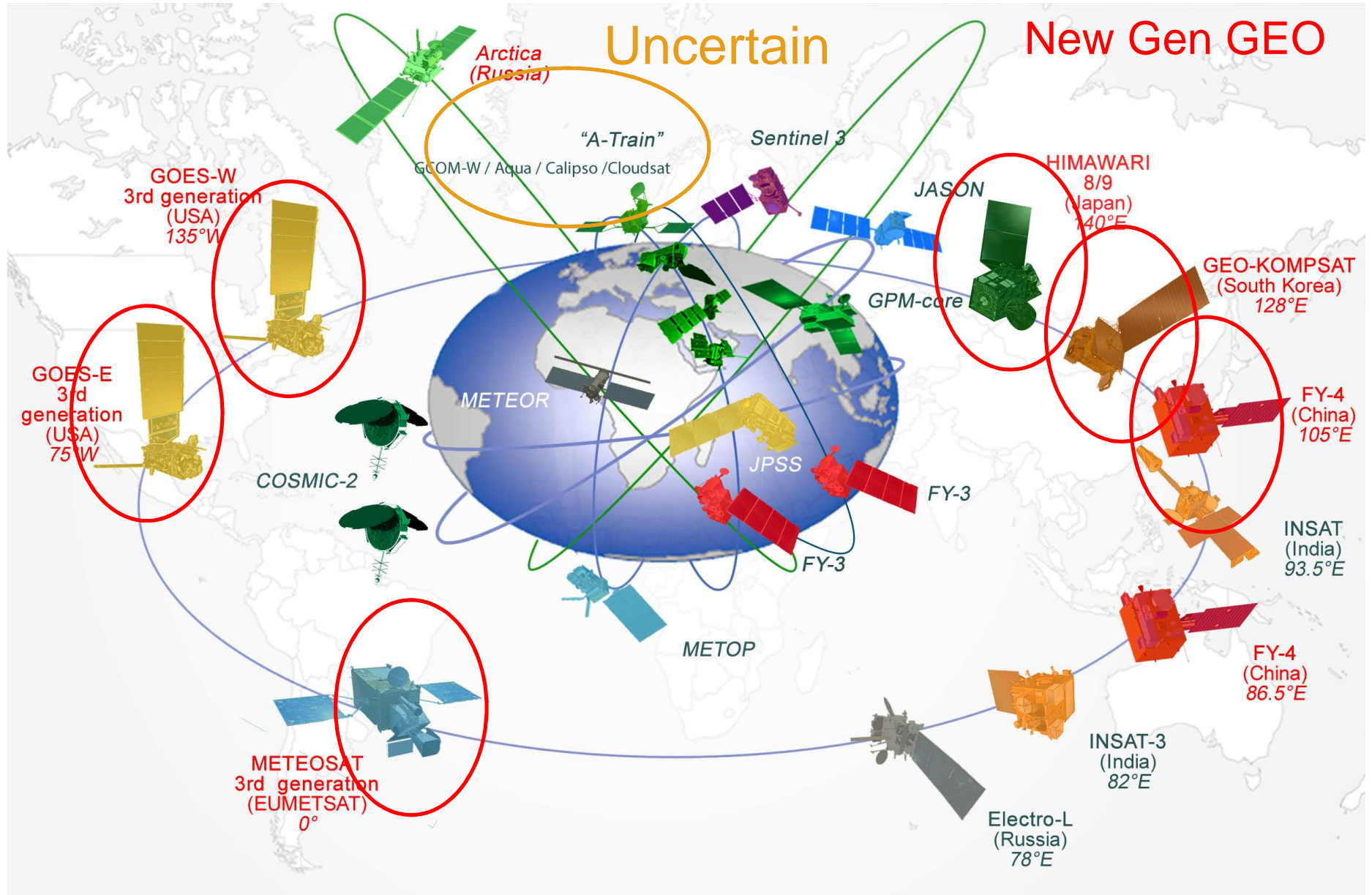
# Reference User Readiness Project

# User Readiness Activities

## Budgeting and planning

- Protect investment made into existing operational programmes
- Understand early where additional investments are necessary or unavoidable

## Research and Development

- Development of NWP data assimilation methods using the new generation satellite data
- Development of new or specially tailored products for specific application areas

## Data handling development and testing

- Design and procurement of reception systems
- Upgrades to terrestrial network access (Internet and RMDCN)
- Internal networks and IT capacity for archiving, visualization, monitoring and processing

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# User Readiness Activities

**Data processing development and testing**

- Processing of direct broadcast data into L0 and L1 products
- Data monitoring and NWP assimilation
- Generation of higher-level products for specific applications
- Integration into the operational user environment, i.e. visualization (with radar and other observations and model outputs) for forecasters.

**Training and Capacity Building**

- Equipment operation and maintenance
- Utilization and interpretation of L1 data and L2 products
- Use of software tools (for processing, analysis, and assimilation)
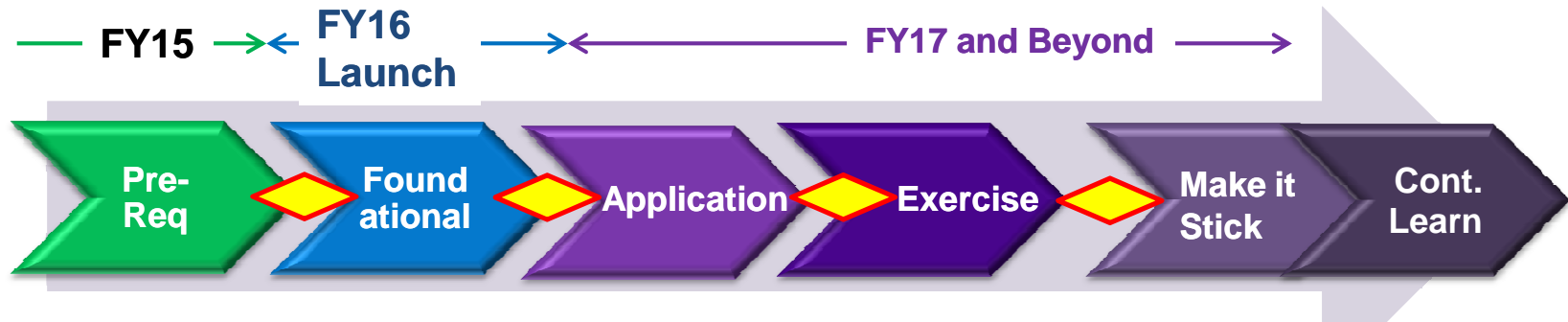- Capacity Building projects with NMHSs of lesser capabilities

**Contributions to Calibration/Validation**

- Participation of NWP centres in instrument Cal/Val activities have become standard practice both for LEO and GEO satellites.
- Monitoring of first-guess minus observation (FG-OBS) departures for L1 products are an important contribution to the Cal/Val activities of satellite operators.

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# Satellite Training Timeline

**FY15** → ← **FY16 Launch** → ← **FY17 and Beyond** →

**Pre-Req** → **Foundational** → **Application** → **Exercise** → **Make it Stick** → **Cont. Learn**

| Pre-Req | Foundational | Application | Exercise | Make it Stick / Cont. Learn |
|---|---|---|---|---|
| • Basic Remote Sensing<br>• Characteristics of Satellites<br>• Pull together from COMET, VISIT, CIMSS, CIRA, SPoRT, WMO Vlab, etc. | • NWS Specific development<br>• GOES vs GOES-R<br>• Use Himawari, MSG & SNPP as examples<br>• Geo vs Polar<br>• Strengths & Weaknesses | • Forecast/warning process<br>• Phenomena based<br>• Baseline products<br>• Service areas (severe, winter, hydro, tropical, fire, aviation, etc.)<br>• 10-15 minute modules<br>• Techniques<br>• QuickGuides | • Simulations<br>• Local training initiatives<br>• "As it occurs" training<br>• Evolve initial satellite concept of operations | • Reference materials in AWIPS<br>• Repeat…practice<br>• Blogs<br>• Seasonal readiness<br>• Peer-to-peer sharing<br>• Storm-of-the month webinars<br>• Demonstrated performance<br>• Continuous Learning<br>• Operations to Research<br>• Optimize implementations for operations<br>• Update for evolving science<br>• Put in IDSS and WRN context |

Training planned until at least 1.5 years after launch!

# Satellite System Development (ECSS)
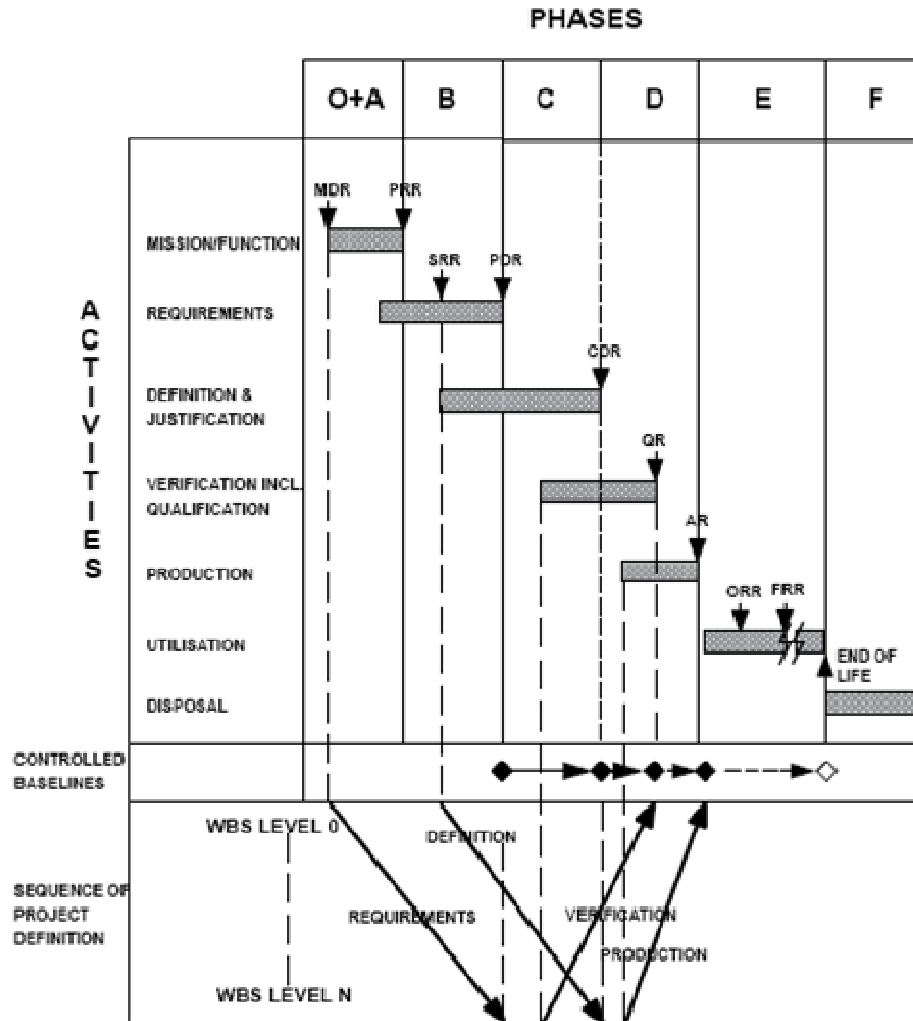


V-shaped development approach

- Minimizes overall schedule and technical risk
- System is accepted as a whole, not optimal from a user point of view

Possible mitigation

- Engagement of users in acceptance of system
- Intermediate deliverables to user community

# Deliverables to Users

**Instrument characterization**
- Spectral Response Functions as measured during on ground instrument testing
- Challenges for advanced instruments, employing complex focal planes and multiple detectors

**Product specifications**
- Scientific specifications of the product algorithms
- Detailed specification of formats for dissemination as well as on-demand requests
- Information on timeliness and expected data volumes, all for both L1 and L2 products.

**Data access mechanism specifications**
- Both Direct Broadcast and DVB-based dissemination.
- Direct Broadcast reception systems (antennas, front-end and computers) are long-lead items and specs are needed 3 years before launch.
- The processing systems requirements are becoming increasingly demanding with the complex DB processing for the new generation of satellites; the impact on users systems is significant.

**Software tools and test data**
- L1 pre-processing software for Direct Broadcast data
- Synthetic data: No scientific value. Used for user dataflow testing
- Proxy data: Data simulated by forward Radiative Transfer Model (RTM) calculations.
- Heritage data: Data sets from relevant precursors
- Pre-operational data

# Deliverables to Users

**Operations plans and schedules**

- Long-term fly-out plan for overall satellite programme,
- Routine operations schedule, including areas of scanning, planning for spacecraft activities, manoeuvres, seasonal yaw-flip, decontamination
- Schedules for activation of LEO direct broadcast where applicable
- Schedules for routine dissemination

**User Notification and Feedback**

- 2-way communications channels, information, user enquiries and feedback (Early!)
- Use of regional user fora (e.g. Group on Satellite Data Requirements for Region III and IV; RAIDEG), Users Conferences and training events (such as the GOES-R Event Week or AOMSUC)

**Training resources**

- For new satellite systems the provision of training material from satellite operators is crucial.
- The WMO-CGMS VLab plays a key role in developing and delivering online training material to users worldwide in several languages.

# Timeline of user activities and deliverables (before L – 3y)

## L-5y -> L-4y

- Initiation of user (e.g., NMHS) readiness project.
- Initiation of cooperative projects addressing needs of less developed WMO members.
- Overall specifications of user segment, including high-level definition of migration path from existing user segment. Preliminary schedule for deliverables to users

## L-4 y -> L- 3y

- Identification of drivers for investment and running cost.
- Planning and allocation of human resources and budgets for investments and running costs.
- Establishment of prioritized data requirements, as clear priorities for current and future products allow the best preparations to be made for establishing data access and delivery capabilities.
- Initial training on capabilities for trainers and decision makers.
- General description of instruments. General description of NRT dissemination mechanisms. Detailed specifications of L2 and L1 products to be available at start of operations (Day-1 products). Heritage test data. Plans for evolution of products after start of operations (Day-2 products).

# Timeline of user activities and deliverables (before L – 1y)

## L-3y -> L- 2y

- Design of new reception system.
- Design of communications network changes, including GTS/RMDCN capacity.
- Design of new data handling and processing functions.
- Training on specific application areas, based on proxy data.
- Specifications of instruments and their performance, including planned SRFs, noise, FOV size.
- Proxy test data.
- Detailed specifications of NRT dissemination mechanisms.
- Detailed specifications of Direct Broadcast (DB), including frequency and signal characteristics and hardware specifications for antennas, front-end components and computer systems for acquisition and processing of DB data.
- General description of offline data access.
- Data/product volume estimates and format definitions.
- Data access conditions (e.g. licensing, key units, etc.).
- L1 pre-processing software for DB (preliminary version).

## L-2y -> L- 1y

- Procurement, installation and acceptance testing of systems.
- Software design for data processing, including NWP ingest.
- Full pre-flight instrument characterization information (including SRFs, noise).
- Information on radiative transfer models (e.g., RTTOV) that support instruments.
- Synthetic test data (including L1B data format details, Sat ID, navigation information).
- Continuous periods of test dissemination of synthetic test data.
- Long-term operations plan.
- Planning for data exchange to serve global community
- Establish two-way communication channels with users

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# Timeline of user activities and <span style="color:red">deliverables</span> (before Launch)

## L-1y -> L- 6m

- End-user training (forecasters)
- <span style="color:red">Start of regular updating of plans for launch and commissioning.</span>

## L-6m -> Launch

- Data processing software testing (using proxy data).
- Technical training on reception systems and other system elements.
- Data acquisition system testing (using synthetic data).
- <span style="color:red">Proxy data based on on-ground instrument characterization.</span>
- <span style="color:red">L2 data format.</span>
- <span style="color:red">Direct Broadcast software package (if DB available).</span>
- <span style="color:red">User documentation for dissemination mechanisms and delivered software tools.</span>
- <span style="color:red">Routine operations schedules.</span>

# Timeline of user activities and <span style="color:red">deliverables</span> (after Launch)

## Launch -> L + 6m

- Full system and software testing (using pre-operational data).
- Support to operators CAL/VAL activities, in particular through NWP assimilation.
- Early dissemination of un-validated L1 data.
- Early switch-on of Direct Broadcast.
- Pre-operational L1 data dissemination.
- In flight characterization of instrument performance.
- L1 pre-processing software for DB (operational version).
- Start of routine User Support

## L+ 6m -> L + 2y

- Scientific data exploitation (iterative based on increased understanding of real data).
- Post-launch training based on real data.
- Declaration of user operational readiness
- Operational L1 data dissemination, from both old and new satellites (as long as possible, but minimum until L+1y).

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# To be considered by CGMS

- CGMS members operating the new generation of GEO satellites to continue and strengthen the support to the SATURN portal

- CGMS members to review and provide comments to the Reference User Readiness Project (as presented in CGMS-43-WMO-WP-09), noting that a further revision will be presented to CGMS-44 for endorsement as CGMS best practice

- NOAA, EUMETSAT, CMA and ROSHYDROMET to appoint/confirm points of contact for including LEO satellites in the SATURN

# Thank you for your attention

www.wmo-sat.info/satellite-user-readiness/

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