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COMMISSION FOR BASIC SYSTEMS
OPEN PROGRAMME AREA GROUP ON INTEGRATED OBSERVING SYSTEMS

EXPERT TEAM ON SATELLITE UTILIZATION AND PRODUCTS

ITEM: 9.2

SEVENTH SESSION

GENEVA, SWITZERLAND, 27-30 MAY 2013

Original: ENGLISH

STATUS OF SCOPE-NOWCASTING

(Submitted by Anthony Rea)

Summary and Purpose of Document

This document provides an update on the SCOPE-Nowcasting initiative.

ACTION PROPOSED

The seventh session is invited to:

(a) Note this information; and
(b) Consider revisions to the list of pilot projects.

Appendices: A. SCOPE-Nowcasting Concept Draft (v1.1, 28 Mar 2013)

STATUS OF SCOPE-NOWCASTING

Introduction

1. The aim of the Sustained, Co-Ordinated Processing of Environmental Satellite Data for Nowcasting (SCOPE-NWC) initiative is ensuring continuous and sustained provision of consistent, well-characterized satellite products for nowcasting and severe weather risk reduction.

2. The concept for SCOPE-NWC arose from discussions at ET-SUP-5 in 2010 after consideration of the benefits of the SCOPE for Climate Monitoring (SCOPE-CM) initiative, where the value of different models of cooperation among satellite operators in generating satellite datasets for climate has been demonstrated through theme-driven pilot projects.

3. Four broad areas for projects under SCOPE-NWC have been identified. These are:

a) Basic (Atmospheric) Nowcasting Products;
b) Advanced (Atmospheric) Nowcasting Products;
c) Realtime Ocean Products; and
d) Realtime Atmospheric Composition Products.

4. Under these four areas, five pilot projects have been identified (see Appendix A for details).

5. At ET-SUP-6 it was agreed to set up a SCOPE-NWC working group and a kick-off teleconference was held on 25 April 2013, with participation from a number of ET-SUP members. The teleconference refreshed the SCOPE-NWC concept and sought updates on the pilot projects from participants.

6. The most progressed Pilot Project is Pilot Project 3, a web-based global integrated accumulated satellite-based precipitation estimator, for the past 24, 48 or 72 hours (http://sigma.cptec.inpe.br/scope/ has a prototype). The product is updated 3-hourly and is based on the NOAA/NASA Hydro-Estimator and NASA TRMM 3B42 products (IR). Delay of the NASA TRMM products (8h) and computational power to process globally are current limitations.

7. Agreed actions from the teleconference were:

a) Update the status of pilot projects by 13 May 2013;
b) Include interested parties not on the call (NESDIS), with invitation to contribute a pilot project description on volcanic ash products, by 13 May 2013;
c) Produce an initial inventory of required products, based on catalogues of available products;
d) Focus on a few clients first (e.g., Australia and 1-2 other RA-V Members for Pilot Projects 1 and 2; such a matching should be informed later by RA-V TT-SUR)

8. The teleconference participants also agreed that best use should be made of upcoming opportunities to meet, including:

a) ET-SUP-7 (Geneva, Switzerland, 27-30 May 2013) – with time for a break-out session on SCOPE-Nowcasting;
b) CGMS-41 (Tsukuba, Japan, 8-12 Jul 2013) – with a briefing by Rea to satellite agency Heads of delegations, on SCOPE-Nowcasting; and
c) 4th Asia/Oceania Meteorological Satellites Users' Conference (Melbourne, Australia, 9-11 Oct 2013) – with the opportunity to report on progress in SCOPE-Nowcasting, and of a side meeting with users from RA II and RA V focusing on nowcasting requirements.

9. The teleconference participants also agreed on a first meeting of the ad-hoc SCOPE-Nowcasting Working Group (Geneva, Switzerland, tentatively week 25-29 Nov 2013)

SUSTAINED COORDINATED PROCESSING OF ENVIRONMENTAL SATELLITE DATA FOR NOWCASTING (SCOPE-NWC)

CONCEPT
(DRAFT v1.1 28 MAR 2013)

Review History:

Date	Reviewer	Comment
30-11-2011	A. Rea, P. Zhang	Concept of Operations Outline: to ET-SUP-6
30-05-2012	L. Machado, S. Bojinski	PP Structure added; Consolidation of PP Outlines; Addition of Precip/SWRiskReduction Pilot
01-06-2012	P. Chen (SWFDP)	Comments on Concept; Feedback on PPs
04-06-2012	CMA, IMD, EUM, JMA	Input and Comments on PPs
11-06-2012	A.Rea (BoM)	Input and Comments on PP
22-06-2012	L. Machado, S. Bojinski	Consolidation of Input
30-07-2012	Paul Joe (WWRP Nowcasting Research WG)	Seeking comments
28-03-2013	S. Bojinski	Copy editing, with minor updates

Introduction

1. The aim of the Sustained, Co-Ordinated Processing of Environmental Satellite Data for Nowcasting (SCOPE-NWC) initiative is ensuring continuous and sustained provision of consistent, well-characterized satellite products for nowcasting and severe weather risk reduction. This is to be demonstrated by pilot projects, and to be achieved through establishing a collaborative network among experts, user institutions and satellite operators, that can help sustain product dissemination and facilitated user uptake. The initiative will be supported by WMO.

Background

2. The concept for SCOPE-NWC arose from discussions in 2010 (in the WMO Expert Team on Satellite Utilization and Products – ET-SUP) after consideration of the benefits of the SCOPE for Climate Monitoring (SCOPE-CM) initiative, where the value of different models of cooperation among satellite operators in generating satellite datasets for climate has been demonstrated through theme-driven pilot projects. It was felt by ET-SUP-5 that the concept could be usefully applied to the nowcasting domain, given that:

- The related science is reasonably mature;
- An organized user community is available;
- An established description of the needs of this community exists;
- There are opportunities and synergy with other initiatives.

3. SCOPE-NWC is aligned with a number of WMO initiatives, in particular SCOPE-CM and the Severe Weather Forecasting Demonstration Project (SWFDP). SWFDP is focused primarily on numerical weather prediction output; the observational focus of SCOPE-NWC has the high potential to complement and enhance SWFDP final output and thus lead to improved warning services. Linkages with other relevant programmes, initiatives and groups will be sought, as

appropriate (see below).

4. Should it move after proof-of-concept and pilot phase to an implementation phase, SCOPE-NWC will need to operate as far as possible within the WMO Information System (WIS) framework, in particular in regard to delivery mechanisms for products. Better data integration, standardization and quality control as foreseen within SCOPE-NWC are all key objectives in the WMO Integrated Global Observing System (WIGOS).

Objectives

6. The key objective of SCOPE-NWC is to provide a mechanism through which satellite data can be made available simply and quickly, primarily for users in the NMHSs of smaller or developing nations, where expertise and facilities for processing and utilizing satellite data may be limited or non-existent, but also for more advanced nations where there may be efficiencies possible through combining resources, expertise, and efforts.

7. To achieve this goal, SCOPE-NWC must facilitate the provision of sustained (or at least sustainable) products. That is, the satellite products must:

   a) have a long-term stable status, beyond individual satellite missions;
   b) be generated operationally in a routine and repeatable manner; and
   c) include provisions for smooth transition between different satellite sources, in order to minimize the impact on users' processing and forecasting systems, and reduce training needs.

8. The products must also be coordinated. That is:

a) products need to be consistent across platforms using equivalent algorithms; and
b) products should be generated in consistent, standard formats [be interoperable].

Concept and Scope of Operations

9. The concept for SCOPE-NWC builds on the WIS framework as concerns the metadata definition, data discovery and operational data flow. In addition, it shall include user interaction for consultation on needs, gathering feedback and ensuring outreach, and an expert component for defining standard products and formats, for validation of the products and their documentation, and for scientific feedback. A governing body will define a finite number of areas of interest, and agree upon a finite number of standard products to be pursued.

10. The scope of SCOPE-NWC is limited to satellite-based nowcasting products, that is, products that are useful in the forecasting range <u>zero to six hours where, in the case of NWP, current model forecasting capability is limited.</u> On land, the value of nowcasting products is particularly apparent in regions without weather radar coverage. The products to be considered by SCOPE-NWC fall into four broad categories:

   a) Basic (Atmospheric) Nowcasting Products: these are primarily products used qualitatively, such as visible and infrared imagery, RGB composites and enhancements, fog detection and cloud products;

   b) Advanced (Atmospheric) Nowcasting Products: these include quantitative products requiring the application of algorithms for their generation; products such as precipitation, atmospheric motion vectors, stability indices, total precipitable water, convective initiation and sounding products, and other products to support aviation such as turbulence or aircraft icing potential;

c) Realtime Ocean Products: these include scatterometer data for sea surface winds and sea state data from altimetry; and

d) Realtime Atmospheric Composition Products: these include fire detection, smoke, sand and dust, aerosols and volcanic ash.

11. Products may be generated from geostationary or low-Earth orbit data and, where possible, the higher resolution afforded by low-Earth orbiters should be used to improve interpretation of geostationary data. For example, the interpretation of a lower resolution geostationary fog detection product may be aided if used in conjunction with an interoperable product derived from a polar orbiting satellite.

12. Products will be generated in real time over the defined areas of interest by the Data Providers and sent to the Host Agencies. Alternatively, Data Providers may distribute processing software which the Host Agencies can use to themselves generate products, using raw satellite data distributed by the Providers. There may be multiple Data Providers for any one area of interest. The host agencies will act as a repository for the products and provide online access, and will push products to specific Client Agencies as required. The concept of operations is depicted in Figure 1.

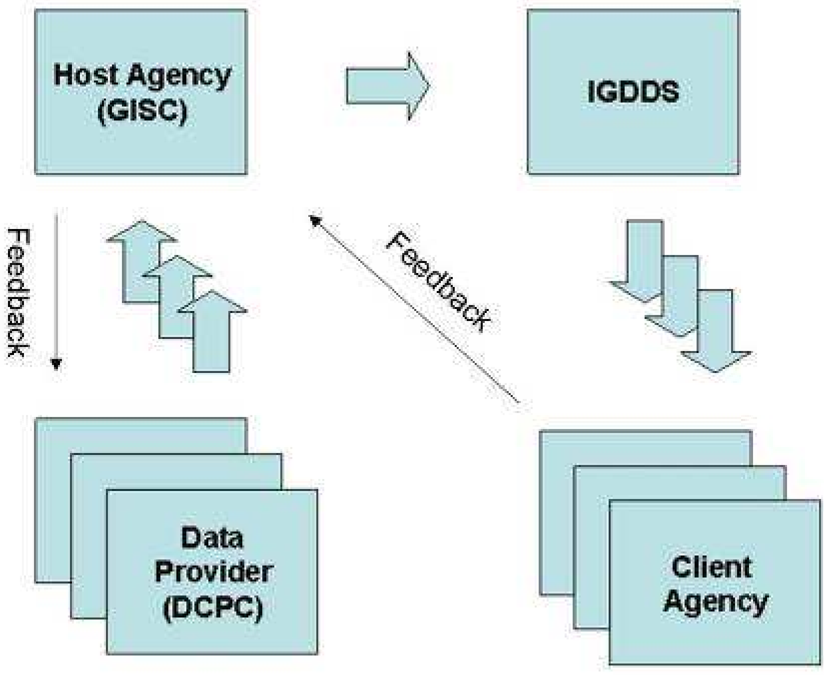


Figure 1 – SCOPE-NWC Concept of Operations

Roles

13. The SCOPE-NWC concept requires a number of different roles to be filled, these are:

a) Client agency;
b) Host agency;

c) Data provider;
d) Steering Committee.

Each of these roles is described in detail below.

Client Agency

14. The *Client Agency* is the primary user of the products provided through SCOPE-NWC. The primary roles of the Client agency are:

a) to define their requirements and make a formal request for products to be generated over their area of interest; and
b) to make appropriate use of the products to serve their end-users and to provide feedback to the Host Agency on issues or errors.

Host Agency

15. The *Host Agency* operates the repository for products to be delivered to Client Agencies. In this sense, the Host Agency functions as a Global Information System Centre (GISC) under the WIS framework. The primary roles of the Host agency within SCOPE-NWC are:

a) to gather data from the various Data Providers;
b) to make data available to Client Agencies in a timely and effective manner;
c) to provide a contact point for Client Agencies to raise issues or report problems; and
d) to compile feedback to Data Providers based on reports by Client Agencies.

Data Provider

16. The *Data Provider* is responsible for generating SCOPE-NWC products and providing these to the Host Agency. In this sense, the Data provider functions as a Data Collection or Production Centre (DCPC) within the WIS. A data provider can be a satellite operator, or another organisation with real-time access to satellite data. The primary roles of the Data Provider within SCOPE-NWC are:

a) to generate products covering areas of interest;
b) to provide products to the Host Agency in a timely and reliable manner; and
c) to provide a point of contact for data problems, issues, and feedback.

Steering Committee

17. The SCOPE-NWC *Steering Committee* is responsible for overseeing all SCOPE-NWC activities and ensuring that activities are coordinated appropriately. The Steering Committee will fulfil the following roles:

a) to agree on standard products, formats and areas of interest;
b) to respond to requests for new products from Client Agencies;
c) to designate Data Providers and Host Agencies and identify what products will be generated and disseminated by each;
d) to provide a central coordination point for SCOPE-NWC activities and point of contact for all external enquiries; and
e) to liaise with the user community, data providers and other WMO groups and

initiatives as required to ensure efficient and effective operation with no duplication of effort.

Until formal establishment of the Steering Committee, SCOPE-NWC is being led by an ad-hoc Working Group (see below)

Links to Underlying Science and Related Initiatives

18. The SCOPE-NWC will need to build on product development in the scientific community, where such products are mature and have demonstrated benefits. For specific product areas, there will be links to both related scientific communities and governance arrangements within WMO, such as with the World Weather Research Project (WWRP) and the Severe Weather Forecasting Demonstration Project (SWFDP). For example, for precipitation products there would be a clear link to the International Precipitation Working Group.

Benefits

19. Benefits of this approach will be:

a) Improved access to satellite data by member states;
b) Improved confidence in products generated through SCOPE-NWC;
c) Reduced operating costs associated with technological change and software upgrades;
d) Reduced training overheads;
e) Improved cooperation between NMHSs through access to shared products.

Pilot Projects

20. To progress the SCOPE-NWC concept, it is proposed that a number of specific pilot projects be initiated. These pilot projects should fit into the four application areas identified. For all areas, a global need has been recognized which will initially be demonstrated on a regional basis. Scaling up to the global level shall be pursued at a later stage and where appropriate. The Pilot Project identified to date are outlined in Annex I.

ANNEX I: SCOPE-NWC PILOT PROJECT OUTLINES

There are currently five proposed pilot projects:

1. Basic Nowcasting

Theme:	Visible and infrared imagery, RGB composites and enhancements, fog detection and cloud products
Lead:	Anthony Rea (BoM) and satellite operator representatives
Region of Coverage:	WMO Region II (Asia) and Region V (South-West Pacific) (area of coverage of MTSAT-2, FY-2)
Providers:	JMA, CMA, KMA (TBD)
Host:	JMA, CMA, KMA (TBD), BoM Australia
Users/Clients:	NMSs in Region II and V
Expected benefits:	• Uniform low-volume products available to NMHSs in Asia-Pacific Region • Consistency of products across different satellite coverages facilitates information sharing and cooperation • Implement recommendations from RGB Satellite Products Workshop Sep 2012
Technical details of planned product/service	• Product content & format: Graphics images, GeoTIFF, netCDF • Access and dissemination: ftp, Mapserver • Quality control: Intercalibration and cross-validation • Provisions for integration and sustainability: Through use of simple, standard data formats
Current needs & gaps	• No standard products available for region; • Low volume products are inconsistent and limited.
Facility for user feedback	To be maintained by the Data Providers; existing user feedback fora in RA II and V
Current status	Draft concept available (9 June 2012)

2. Advanced Nowcasting: "Aviation"

Theme:	Ice cloud detection and turbulence to support aviation; potentially adding precipitation, fog
Lead:	Anthony Rea (BoM) and CMA/JMA representatives
Region of Coverage:	Australia and adjacent Region II (Asia) and V (South-West Pacific)
Providers:	CMA, JMA, KMA (TBD), NASA (for precip), NOAA (for precip)
Host:	Satellite operators and BoM (TBC)
Users/Clients:	NMHSs in RA II and RA V
Expected benefits:	• Improved confidence in products generated through SCOPE-NWC; • Reduced operating costs associated with technological change and software upgrades; • Reduced training overheads;

	• Improved cooperation between NMHSs through access to shared products
Current needs & gaps	No products currently available (except for precipitation)
Technical details of planned product/service	• Product content & format: Cloud properties, Icing potential (both from GEO), Fog (from GEO and LEO) • Access and dissemination: TBD (web, ftp, Mapserver) • Quality control: Through intercalibration and cross-validation • Provisions for integration and sustainability: Through use of simple, standard data formats
Facility for user feedback	To be maintained by the Data Providers; existing user feedback fora in RA II and V
Current status (date)	Draft concept available (9 Jun 2012)

3. Advanced Nowcasting: "Precipitation / Severe Rainfall Risk Reduction"

Theme:	Blended satellite global precipitation product (GEO+LEO)
Lead:	Luiz Machado, Daniel Vila (INPE CPTEC)
Region of Coverage:	Global coverage
Providers:	NOAA/NASA HydroEstimator, NASA TRMM (3B42), NOAA (real-time MW)
Host:	INPE CPTEC
Users/Clients:	Civil authorities, NMHSs, Flash flood guidance systems, general users
Expected benefits:	• Improved confidence in products generated through SCOPE-NWC; • Reduced operating costs associated with technological change and software upgrades; • Fast delivery of severe rainfall information to decision-makers and disaster response authorities (2h extrapolation forecast and ex-post 24h/48h/72h QPEs)
Current needs & gaps	Rapid, facilitated access to quantitative precipitation estimates
Technical details of planned product/service	• Product content & format: Precipitation intensity (real-time and nowcasting), Cumulated precipitation • Access and dissemination: WebGIS • Quality control: Adherence to code standards • Provisions for integration and sustainability: TBD • Facility for user feedback: TBD
Facility for user feedback	TBD
Current status (date)	Draft Concept Paper available

4. Real-time Ocean Products

Theme:	Near-Real-Time (3-hourly) Ocean surface winds for NWP
Lead:	Suman Goyal (IMD) and Volker Gärtner (EUMETSAT); M Mahapatra

	(IMD)
Region of Coverage:	Initially Indian Ocean
Providers:	IMD/ISRO (Oceansat-2) and EUMETSAT OSI-SAF
Host:	TBD
Users/Clients:	NWP Centres, Marine Forecasters
Expected benefits:	• Availability of validated OSVWs for NWP • Improved nowcasting of timing, positioning and wind distribution associated with severe weather. • Validation of model results and more accurate initial conditions for meso-scale models. • Improved confidence in products generated through SCOPE-NWC; • Improved cooperation between NMHSs through access to shared products
Current needs & gaps	OSVW not fully exploited in marine severe weather warnings, and in NWP initialization and assimilation in tropical ocean areas
Technical details of planned product/service	• Product content & format: TBD • Access and dissemination: TBD • Quality control: TBD • Provisions for integration and sustainability: TBD
Facility for user feedback	TBD
Current status (date)	Draft Concept Paper available (20 Apr 2012)

<u>5. Real-time Atmospheric Composition Products: Sand and Dust Forecasting</u>

Theme:	Dust Monitoring and Prediction Products
Lead:	Fang Xiang (CMA) and Hiroshi Kunimatsu (JMA)
Region of Coverage:	WMO Region II (Asia) and V (South-West Pacific)
Providers:	CMA, JMA
Host:	CMA, JMA
Users/Clients:	SDS-WDCs, NMSs (to issue results and warnings) in RA II and RA V
Expected benefits:	• More consistent products across satellite platforms and providers, e.g. through shared use of validation data and techniques • Product providers can create synergies and sustain their activities while avoiding duplication of effort through facilitating themselves to share information of product development and validation • Better dialogue between users and providers • Improved confidence in products generated through SCOPE-NWC; • Improved cooperation between NMHSs through access to shared products
Current needs & gaps	Regional diversity of aerosol-related products that are mostly not harmonized, and not always sustained
Technical details of	• Product content & format: Aerosol optical thickness, effective particle

planned product/service	radius, column density, over land and ocean • Access and dissemination: TBD • Quality control: Through sharing of validation data and techniques • Provisions for integration and sustainability: TBD
Facility for user feedback	TBD
Current status (date)	Draft concept available (8 Jun 2012)

ANNEX II – DETAILED DESCRIPTION OF PILOT PROJECTS

1. Basic Nowcasting

Theme: Visible and infrared imagery, RGB composites and enhancements, precipitation potential products and cloud products

Region of Coverage: Global. Pilot in RA-II and RA-V

Providers: All CGMS Members (initially CMA, JMA, KMA (TBD))

Host: Satellite operators and the Bureau of Meteorology (TBC)

Users/Clients: NMHSs globally (initially RA-II and RA-V)

Current status/gaps: current real-time products generated by satellite operators are mission-specific and non-interoperable.

Technical details:

Products:
Visible and Infrared imagery (10 minute latency)
RGB standard colour composites (10 minute latency)
Cloud detection and characterisation (15 minute latency)

The aim of this pilot is to produce identical, or as close to identical as possible, nowcasting products from adjacent geostationary satellites. Initially the project will focus on MTSAT-2, Fengyun-2 and COMS. In addition, polar products at higher spatial resolution would also be generated over the same coverage areas to improve interpretation of geostationary products.

Some good examples already exist from single providers, including the image subsets produced by JMA, covering a number of different regions in the Asia-Pacific (http://mscweb.kishou.go.jp/sat_dat/index.htm). These images are available in the visible, window channel infrared (11 µm), water vapour (6.7 µm) and 3.8 µm channels from MTSAT-2.

JMA also produce a 'heavy rainfall potential' image, generated specifically for SWFDP in RA-II (south-east Asia) and RA-V (south Pacific islands), as shown in Figure A-II-1.

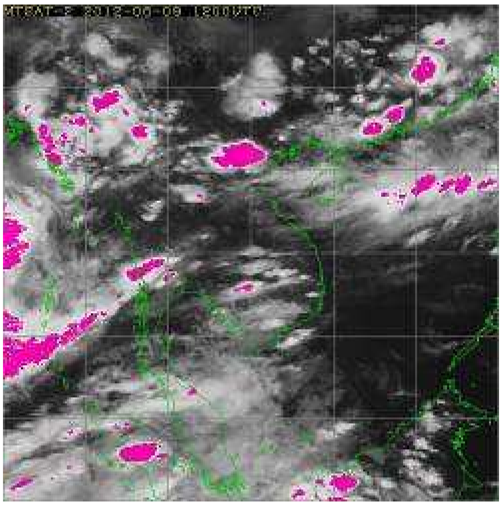


Figure A-II-1 - Imagery with Heavy Rainfall Potential Areas

The initiative is also aligned with an action arising from the 2nd Asia-Oceania Meteorological Satellite Conference. During the conference it was noted that the region has a significant number of satellite observations and satellite-based products being provided for user exploitation. The conference indicated there is a need to optimize use of these observational data, and to optimize the exploitation of these satellite products for user/societal benefits: that need could be met by a more formal arrangement for collaboration.

Access and dissemination:

To be determined but would include web access as a minimum, other options include ftp pull/push and ADDE or GIS mapserver-type applications. The key drivers and constraints will be ease of access, timeliness and minimising the volume of products disseminated.

Quality control:

A key aspect of quality control for these products, which are largely qualitative in nature, will be inter-calibration and cross-validation to improve consistency across platforms. Discontinuities in calibration and/or navigation between satellites are distracting for users and will discourage uptake of these products.

Host agency:

Products would be hosted by local GISCs including satellite operators (CMA, JMA, KMA (TBD)) and the BoM.

Provisions for integration and sustainability:

The choice of simple, standard formats will drive integration of products across platforms and will lead to long-term sustainability for operators and users.

Facility for user feedback:

User feedback could be provided directly to the operators, to the data providers and via a number of existing fora within RA-II and RA-V.

2. Advanced Nowcasting: "Aviation"

Theme: Ice cloud detection and turbulence to support aviation; potentially adding precipitation, fog

Region of Coverage: Pilot in RA-II and RA-V

Providers: CMA. JMA, KMA (TBD); if precipitation added: NASA, NOAA

Host: Satellite operators and the Bureau of Meteorology (TBC)

Users/Clients: NMHSs in RA-II and RA-V

Current status/gaps: no products currently available.

Technical details:

Products:

Cloud characterisation from geostationary imagery (10 minute latency)
Icing potential from geostationary inmagery (10 minute latency)
Fog detection from geostationary and polar imagery (10 minute latency)

The aim of this pilot is to produce identical, or as close to identical as possible, nowcasting products from adjacent geostationary satellites. In addition, polar products at higher spatial resolution would also be generated over the same coverage areas to improve interpretation of geostationary products. As distinct from Pilot Project 1, this pilot would focus on product for aviation support. It is envisaged that products would assist both with route planning and assessing landing conditions.

There are currently no products available from the satellite operators to meet this need. The pilot proposes interoperable products from MTSAT-2, Fengyun-2 and COMS.

Access and dissemination:

To be determined but would include web access as a minimum, other options include ftp pull/push and ADDE or GIS mapserver-type applications. The key drivers and constraints will be ease of access, timeliness and minimising the volume of products disseminated.

Polar products produced in parallel would have longer latency times (up to 2-3 hours for global datasets). However, these products would still be of benefit in aiding interpretation of geostationary products, even if made available later.

Quality control:

A key aspect of quality control for these products, which are largely qualitative in nature, will be inter-calibration and cross-validation to improve consistency across platforms. Discontinuities in calibration and/or navigation between satellites are distracting for users and will discourage uptake of these products.

Host agency:

Products would be hosted by local GISCs including satellite operators (CMA, JMA, KMA (TBD)) and the BoM.

Provisions for integration and sustainability:

The choice of simple, standard formats will drive integration of products across platforms and will lead to long-term sustainability for operators and users.

Facility for user feedback:

User feedback could be provided directly to the operators, to the data providers and via a number of existing fora within RA-II and RA-V.

3. Advanced Nowcasting: "Precipitation / Severe Rainfall Risk Reduction"

Theme: Blended satellite global precipitation product

Region: Global Coverage

Providers: NOAA/NASA HydroEstimator, NASA TRMM (3B42), NOAA (real-time MW)

Host: INPE CPTEC

Users/Clients: Civil authorities, Flash flood guidance systems

Current needs and gaps: Rapid, facilitated access to quantitative precipitation estimates

Technical details:

Products:
Real Time Precipitation Intensity (2 to 4 hours latency)
Nowcasting of precipitation Intensity (3 hours in Advance)
Cumulated Precipitation in the last 24, 48 and 72 hours

The Pilot Project will work with two datasets:

1) The 3B42RT dataset is provided by Nasa GEO DIS and will be uploaded, computed and integrated by INPE. The 3B42RT 3-hourly binary data files can be uploaded at the following webpage: ftp://disc2.nascom.nasa.gov/data/TRMM/Gridded/3B42RT/. The data has horizontal/time resolution of 0.25° x 0.25° each 3 hours. This is a calibrated IR merged with TRMM and other satellite data. Specific information about this dataset can be accessed thought the following URL: http://disc.sci.gsfc.nasa.gov/precipitation/documentation/TRMM_README/TRMM_3B42_readme.shtml

2) The Global Hydro-Estimator (GHE) Products Declared Operational: On April 30, 2012, the global Hydro-Estimator was implemented into the OSPO operation and declared its operational status. The products are now under 24/7 support, and provided to users through the OSPO Data Distribution Server (DDS) and McIDAS ADDE servers. The imagery products are also available on the Internet through: http://www.ospo.noaa.gov/Products/atmosphere/ghe.

The GHE extends the current operational GOES rainfall estimate capability from only over the continental U.S. to the entire globe equator-ward of 60 degrees to meet the NWS users' need in supporting the global flash flood guidance. The GHE also upgrades the current operational system to meet the SPSRB code standards with enhanced error handling, quality monitoring and validation capability. The operational GHE products include: *Instantaneous rain rate, 1 hour, 3 hour, 6 hour, 24 hour and also multi-day precipitation accumulation* over both global Land and Ocean, and are made available in GRIB, McIDAS and netCDF4 formats.

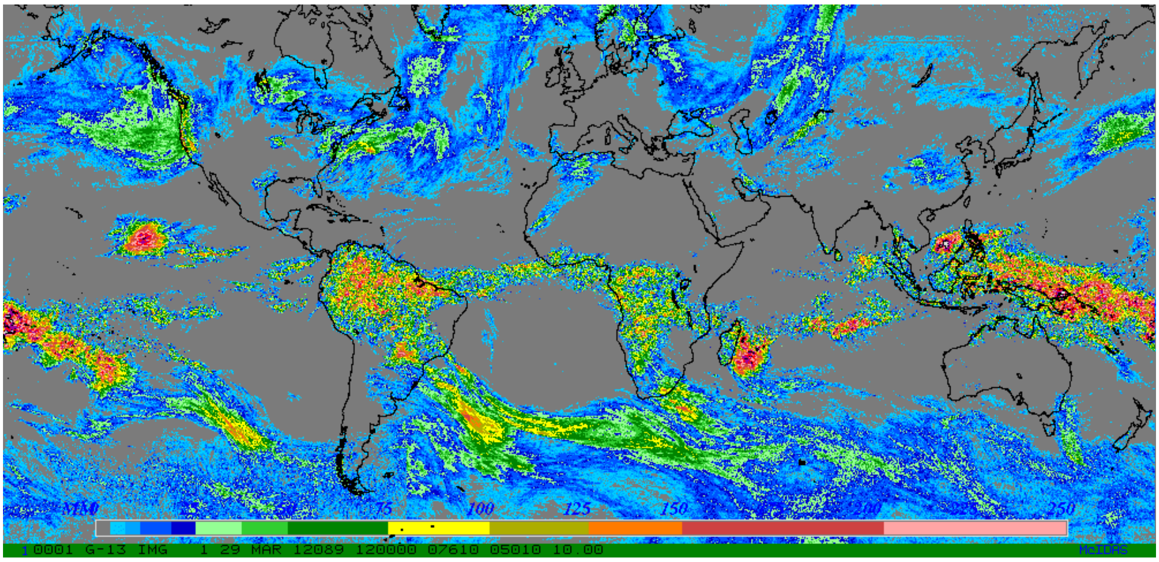


Fig. A-I-2: Example for rain rate estimate

Access to the information:
The system is a Web based Geographic Information System (SIGMA geographic visualization tool based on GEarth). This system is a useful tool to interpret, summarize and integrate the environmental information and display or sends warning for emergency management groups. This is an open access system to also serve the population giving real time information to reduce citizen vulnerability, the information are presented using the GEarth tool.

Users/Clients:
Civil Defence, NMHSs, Flash flood guidance systems, and general users.
All regions without a developed rainfall network or without an integrated system to make rainfall information available in real time can use this system as a first approach of rainfall systems reaching the region or the accumulated rainfall in the last days. The latter is key information for Civil Defence, because it is associated with the potential of landslides and flooding.

Pilot Products and Expected Benefits:
The products available are all based on precipitation estimation from satellite and the extrapolation out to 3 hours to make the information close to the real time (global satellite product has a delay of 3 hours). The main product will be the integration of rainfall in the last 3 days and in the last hours of any particular day. The product is global but can be accessed local due to the tools available by the GIS. The basic resolution is 0.25x0.25 degrees.

4. Real-time Ocean Products

Theme: Near-Real Time (3-hourly) Ocean surface winds for NWP

Region: Initially Indian Ocean

Provider: IMD/ISRO (Oceansat-2) and EUMETSAT OSI-SAF

Host: TBD

Users/Clients: NWP Centres, Marine Forecasters

Current needs & gaps:
OSVW not fully exploited in marine severe weather warnings, and in NWP initialization and assimilation in tropical ocean areas

Technical Details:

Objective:
We are undertaking work to provide a three-hourly product generated by combining the ocean sea surface winds from Oceansat-2 twice-daily swaths (from ascending and descending orbits). The similar work has already been done for ASCAT by EUMETSAT. It can support the SCOPE-Nowcasting initiative. These 3-hourly interpolated winds can be used for nowcasting of timing, positioning and wind distribution associated with severe weather. It can also help to verify the model results. Further, the impact of Oceansat-2 sea surface winds on the short term forecast of high resolution meso-scale models to simulate high impact weather events can also be assessed. Attempts will be made to incorporate these winds in the nowcasting models also.

Utilities of Oceansat-2 winds for nowcasting:

Oceansat-2 winds are useful to see the genesis and intensification of tropical disturbances over the Ocean, especially over the north Indian Ocean, which is a data sparse region. For example in the case of very severe cyclonic storm (VSCS), Thane it was declared vortex with intensity T1.0 on 25th Dec 2011. However, Oceansat-2 pass of 06:34 and 17:25 UTC of 24th Dec 2011 shows clear indication of genesis of the system having the circulation with wind speed about 15 knots as shown in Figure A-II-3. Similarly, as shown in Figure A-II-4, the intensification of VSCS, Giri was observed at 17:28 UTC of 20th Oct 2010 (wind speed 30-35 Kts.) 9 hours earlier as compared to official declaration by India Meteorological Department (IMD).

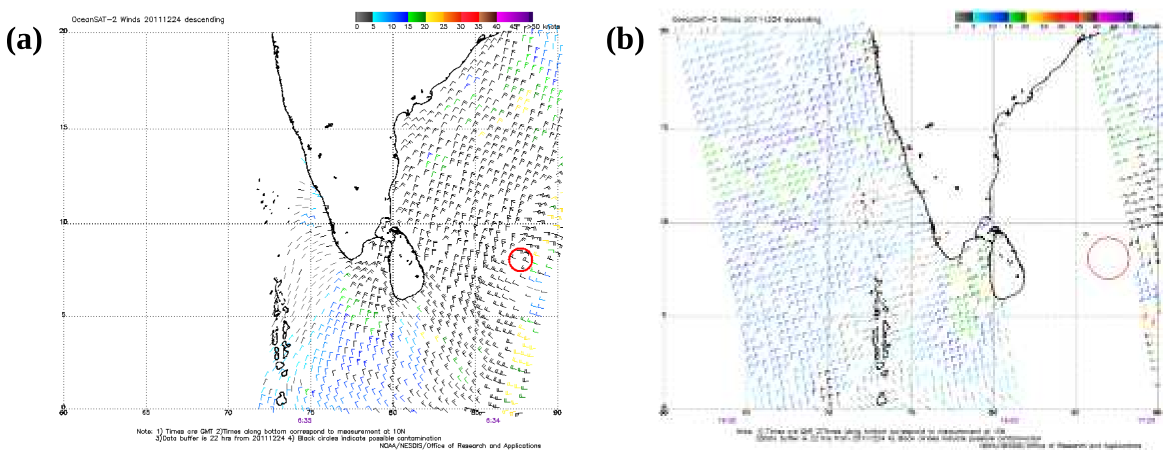


Figure A-II-3: Indication of genesis of VSCS Thane on (a) 06 UTC and (b) 17 UTC of 24 Dec 2011

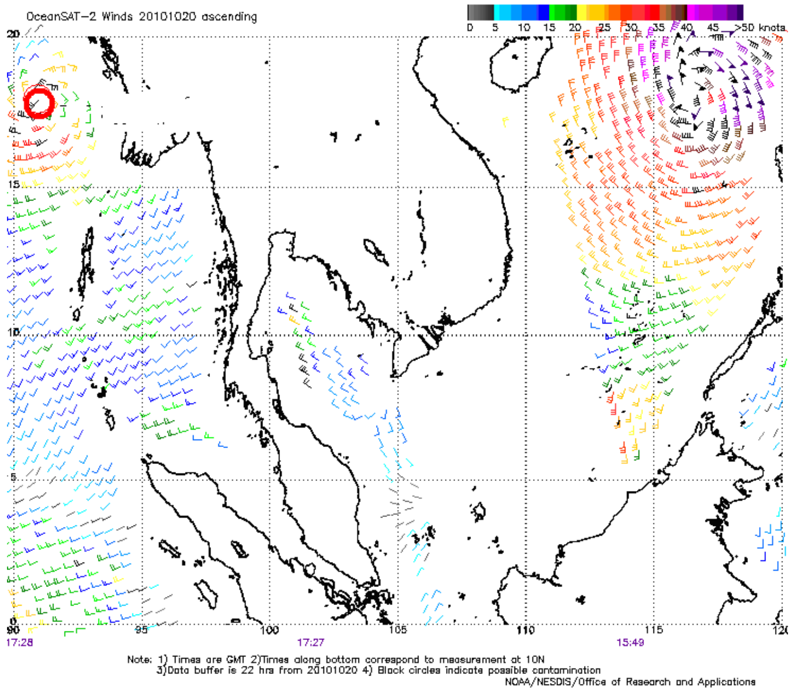


Figure A-II-4: Indication of intensification of VSCS Giri on 17 UTC 20 October 2010

Application of Oceansat-2 winds in NWP:

The track and intensity prediction of tropical cyclones requires accurate representation of the vortex in the model initial conditions. With this aim, an attempt is made to quantify the impact of derived sea surface wind fields from Oceansat-2 on initial position, track movement, evolution of intensity and structure changes of tropical cyclones over the Bay of Bengal (BoB). It is well known fact that assimilation of conventional and non-conventional observations can improve the initial condition significantly. The scarcity of observations in and around the vortex causes either undetected in standard global analyses or poorly represented with ill defined centers and structure. In last two decades, there have been significant improvements in numerical prediction of tropical cyclones that is attributed mainly to the improved network of observations over the open seas and costal regions, improved data assimilation techniques along with increased model resolutions and advanced model physics.

To evaluate the utilities of Oceansat-2 data, the WRF-ARW model with 9 km horizontal resolution and 51 vertical levels (13 levels below 850 hPa, 23 levels below 500 hPa) is used to simulate a VSCS, Laila formed over BoB during 17 – 21 May 2010. The NCEP FNL data is used to simulate the cyclone at five different times starting from 18 UTC 17 May to 18 UTC 19 May 2010 (case-1 to case-5 respectively) which referred as CNTL experiments. Oceansat-2 sea surface winds are assimilated into FNL initial condition for all 5 cases and the data distribution is shown in Figure A-II-5. Oceansat-2 provided a good coverage of winds over the sea in and around the cyclone vortex.

With assimilation of Oceansat-2 winds, the initial structure of the cyclonic vortex improved significantly. The vortex became stronger compared to CNTL experiments. The mean initial vortex position error is also reduced from 88 km to 57 km (about 35% of improvement). This positive impact in initial position and structure of the system contributes for improvement in track forecast/prediction. Track simulations, from the initial conditions of 06 UTC and 18 UTC of 19 May 2010, in 6-hr interval are given in Figure A-II-6a and A-II-6b. The impact of Oceansat winds is significant up to 48 hour forecast which can be clearly demonstrated by Figure A-II-6(c). The CNTL experiment fails to predict the landfall in all the five cases. In first three cases (i.e the runs with the initial conditions 18 UTC 17 May, 06 UTC and 18 UTC of 18 May 2010), even after the assimilation of Oceansat-2 data, the model could not predict the landfall. However, in case-4 (initial condition, 06 UTC 19 May 2010) and case-5 (18 UTC 19 May 2010), Oceansat-2 wind data assimilation helped for better landfall prediction. The position and time errors are given in table-2 which shows the positive impact of Oceansat-2 winds in simulating the landfall of the cyclone.

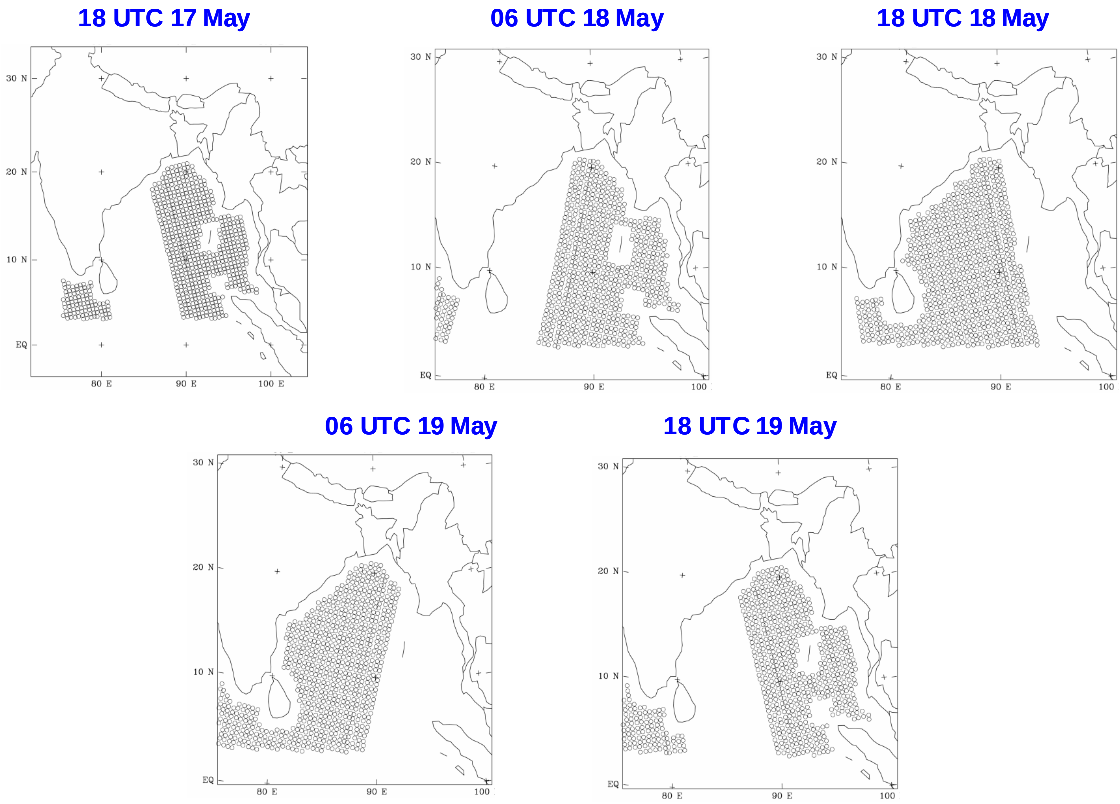


Figure A-II-5: Distribution of derived sea surface winds from Oceansat-2 during 17 – 19 May 2010

Table-2: Landfall errors with Oceansat-2 data assimilated experiment.

Different Initial conditions	OBS lat	OBS lat	Model lat	Model lat	Position error	Time error
IC: 18 UTC 17 May 2010			No Landfall			
IC: 06 UTC 18 May 2010			No Landfall			
IC: 18 UTC 18 May 2010			No Landfall			
IC: 06 UTC 19 May 2010	16	80.5	15.5	80.2	64.2	-6
IC: 18 UTC 19 May 2010	16	80.5	16.17	81.12	34.33	-12

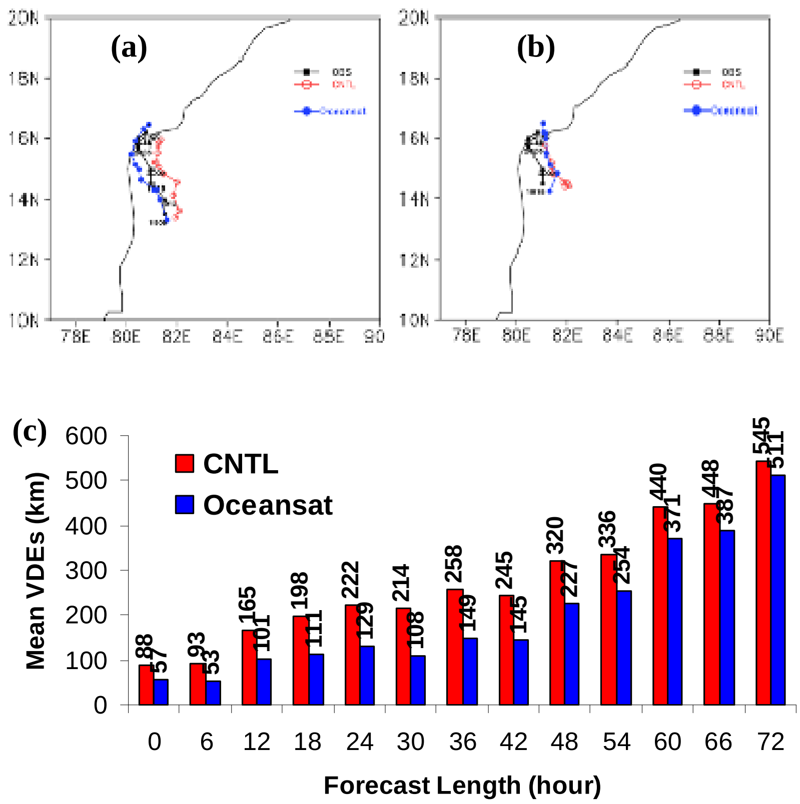


Figure A-II-6: 6-hr interval track simulations from the initial condition (a) 06 UTC 19 and (b)18 UTC 19 May 2010 and (c) mean track error (in km) for all the five cases shown in Table-2

Methodology:-

Ocean surface winds from the Oceansat-2 are available in 25 x 25 km resolution, twice a day. However, as per the requirement of nowcasting, actual (conventional) observations are very essential. Further, the actual observations are very rare which are based on meteorological buoys and ships. Hence, for validation of ocean surface winds based on Oceansat-2, an appropriate interpolation method will be used. Further, after the validation based on the available data of buoys and ships in subsequent 3-hourly period, the ocean surface winds will be extrapolated to create the surface wind fields in the sub-sequent 3-hourly period.

To carry out the above work, a literature survey will be carried out for the objective formulation of the problem. The methodology utilized in case of ASCAT winds will be studied in detail and its application in the study will be explored.

After the development of initial wind fields, their utilities in synoptic applications will be evaluated for recent cyclonic disturbances. Also, these initial fields will be utilized to simulate severe weather events with the help of high-resolution meso-scale models.

In the absence of aircraft reconnaissance, this study will be helpful.

Expected outcome/benefits:

The expected outcome of the study is given below.

- Three-hourly sea surface wind product generated by validating the ocean sea surface winds from Oceansat-2 with available buoy and ship observations, so that the every three hourly Ocean surface wind will be available for synoptic and NWP applications.

- These 3-hourly interpolated winds can be used for nowcasting of timing, positioning and wind distribution associated with severe weather. It can also help to validate the model results and can provide the more accurate initial conditions for meso-scale models.

5. Real-time Atmospheric Composition Products: Sand and Dust Forecasting

Theme: Dust monitoring and prediction

Region: WMO Region II (Asia) and V (South-West Pacific)

Providers: CMA/NSMC (FY-3 & FY-2), JMA (MTSAT, NOAA/AVHRR, Himawari-8/9)

Host: CMA, JMA

Users/Clients: Sand and Dust Storm Warning Centres (SDS-WDC), NMSs in RA II and V

Current gaps: Regional diversity of aerosol-related products that are mostly not harmonized, and not always sustained

Technical Details:

Products:
- Sand and Dust monitoring imagery
- Aerosol optical thickness, effective particle radius, and column density, over land and ocean

1. CMA/NSMC

The Identification Algorithm:

The thresholds of dust in satellite image were investigated by the probability dense function (PDF) and cumulative distribution function (CDF). The sampled targets include clouds, clear sky over land, clear sky over ocean, dust. 11 thresholds were used in visible and infrared band.

The optical thickness, particle radius, and density of dust can be retrieved from this algorithm. Aerosol physical parameters (complex refraction index and particle size distribution) were pre-selected for the dust retrieval in the algorithm. Radiances of 8.7 um, 11um and 12 um in IR window spectral bands are calculated with a radiative transfer model that includes Mie scattering and the Discrete Ordinates Radiative Transfer (DISORT). Aerosol microphysical parameters (complex refraction index and particle size distribution), surface temperature, and dust layer top temperature are a priori inputs. The background land surface temperature is derived from previous day clear sky 11 μm BT observation in the same area and the same UTC time. Only two layers (surface and dust) are assumed in the forward model. Therefore, temperature profile is not necessary, only surface temperature and effective dust layer temperature is required. Infrared window brightness temperatures (BT) at 11 μm show a quasi-linear relationship with dust optical thicknesses and the split window BT difference (BTD) between 11 and 12 μm shows a quasi-linear relationship with the particle radius. The 8.7 μm band is very useful to infer the dust property over desert. However, it is not used in retrieval yet because the variation and uncertainty of surface emissivity is large over desert. Look-up tables (LUT) have been generated with the radiative transfer model to create a relationship between the dust microphysical properties and BT as well as BTD. Retrieval uses two spectral bands to derive two parameters (optical thickness and particle radius). The dust density is derived from the two parameters.

Product example:

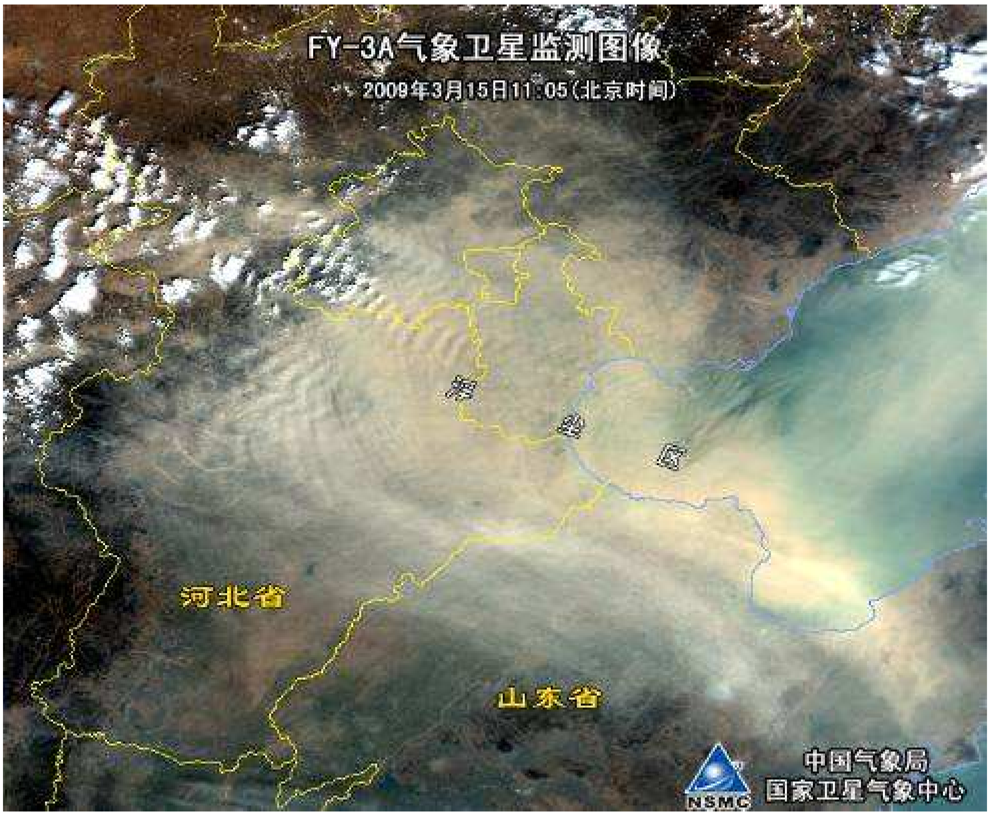
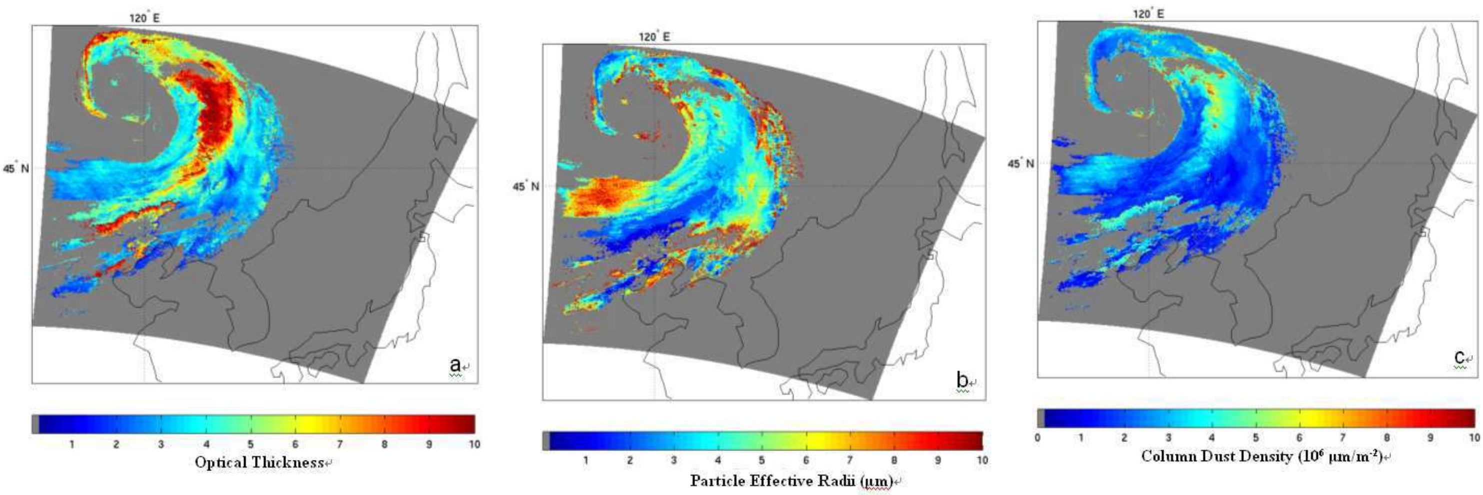


Figure A-II-7 Dust monitoring image (yellow area is the dust area)



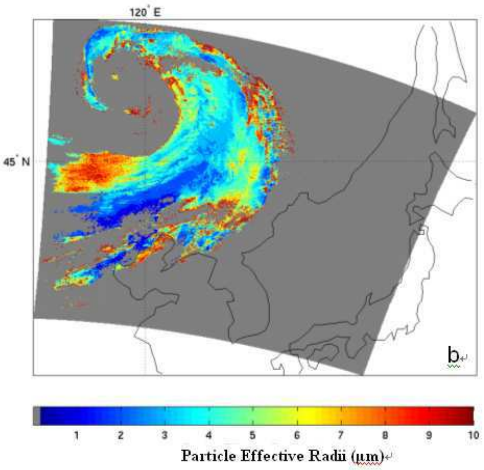


Figure A-II-8 Dust retrieval results in optical thickness, particle effective radius and column dust density

2) JMA/MSC

Current Products:

JMA has produced Aerosol Optical Thickness (AOT) in the vicinity of Japan over cloud-free sea in daytime using visible channel data of MTSAT since December 2002 for internal use. AOT is defined at 500 nm wavelength and retrieved using visible channel referring to Look Up Tables generated by radiative transfer calculations at fixed Ångström exponents. AOT is calculated in 0.25 degree(longitude) x 0.20 degree(latitude) grid seven times a day, from 00 UTC to 06 UTC, hourly. JMA also retrieves AOT and Ångström exponent by a similar method from visible and near infrared data of NOAA/AVHRR 1-3 times a day. Figure A-II-9 (a) shows calculation example; Yellow Sand Dust in the vicinity of Japan was detected, and Figure A-II-9 (b) shows the comparison of AOT between ground observations and the nearest grid values of satellite products.

In addition, JMA uses difference between MTSAT infrared 11 micron and 12 micron data as qualitative information for monitoring the spread of dust events at cloud free pixels even over the land and in the night time (Figure A-II-10).

JMA uses these results to early grasp and monitor the distribution and the density of dust (Yellow sand) in Japan, and to issue dust information.

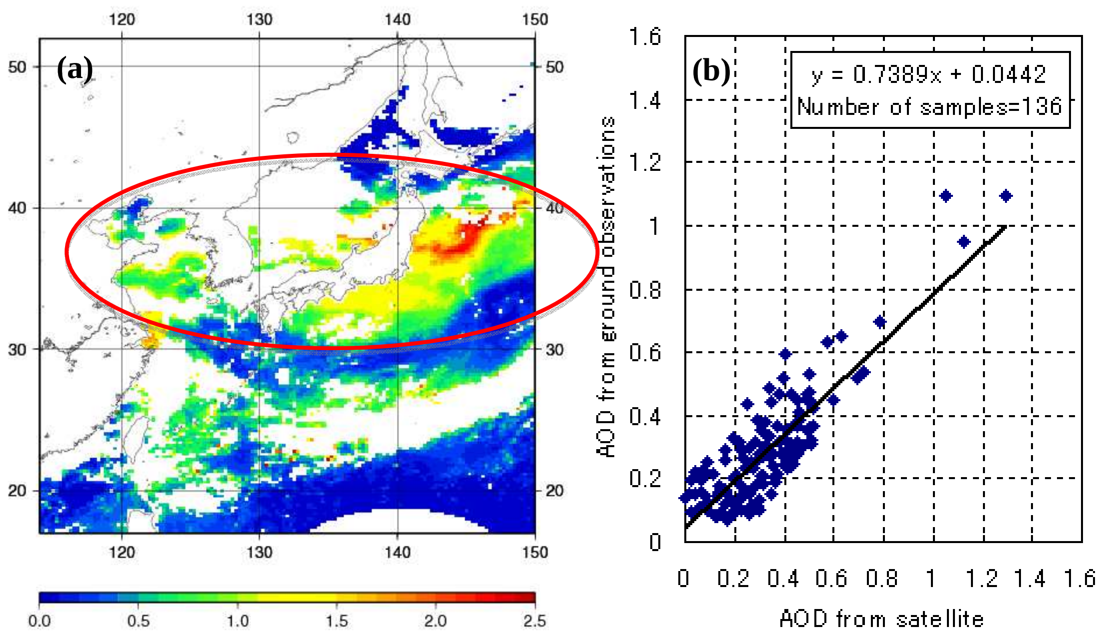


Figure A-II-9: (a) Aerosol Optical Thickness (AOT) distribution retrieved from MTSAT-1R (03 UTC on 18 April 2006). (b) Comparison of AOT data between sun photometer observations conducted in surface stations of JMA and MTSAT-1R (from March to May 2006).

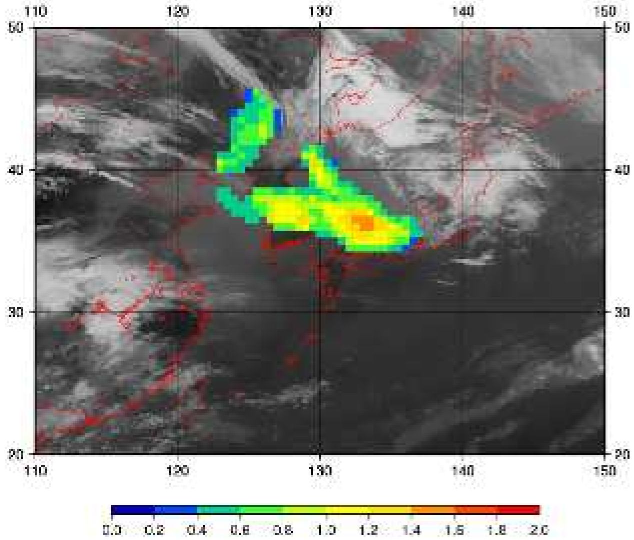


Figure A-II-10: Example of dust monitoring product (03 UTC on 8 April 2006, composite infrared image).

Planned Products:

JMA's follow-on satellites to MTSAT-2 (called Himawari-8 and Himawari-9) will each carry an imager with a capability comparable to that of GOES-R/ABI, and have a higher level of observing capability. JMA is developing new products from Himawari-8/9 observations such as aerosol products for detecting and monitoring dust based on a NOAA/NESDIS GOES-R algorithm, and quantitative data such as dust density and height are expected to be retrieved.

Validation:

It is expected that product providers would share ground observation data set and have common method for validation of the satellite products.

ANNEX III: SCOPE-NWC IMPLEMENTATION

Timeframe and Phasing

Phase I (2012-2014): Inception and Demonstration

- Establish ad-hoc Working Group (ET-SUP Chair, Rea, Mostek, Gärtner; WWRP rep; SWFDP rep; others (TBD); WMO Space Programme)
- Agree on concept and pilot project criteria
- Agree on pilot projects and individual providers, hosts, clients, schedules
- First meeting of all SCOPE-NWC initial partners
- Establishment of initial network and structure, including governance and terms and conditions of all partners
- Each pilot: Demonstration of impact; identify areas of synergy, collaboration, harmonization

Phase II (2015-2016 and onwards): Operations and Continuous Development

- Transition demonstrated capabilities into routine operations
- Identify possibilities for pilot scale-up
- Establish pilot projects in new areas (regions, domains)
- Consolidate governance structure
- Transition governance into existing CBS mechanisms

Detailed Timetable 2012-2013

Pilot Project Concept Papers Ready and Approved by ET-SUP Chair	15 July 2012
Feedback by WWRP WGNR	20 August 2012
Inform CBS-XV about progress	1 September 2012
Inform CGMS-40 about progress	5 November 2012
Teleconference of ad-hoc WG and PP Leads	15 April 2013
Break-out Meeting at next ET-SUP	May 2013
First SCOPE-NWC Meeting	Q4/2013