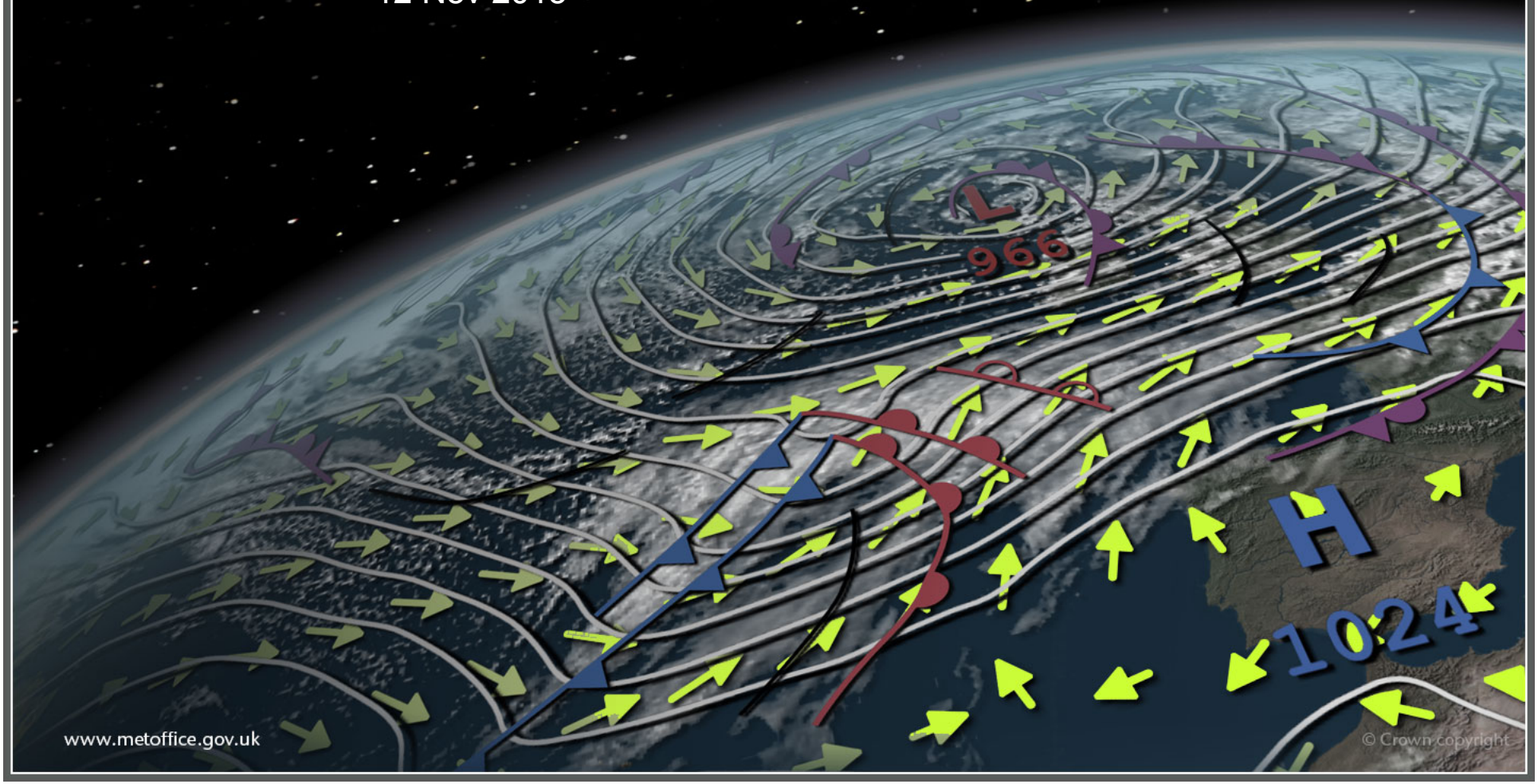
The use of satellite data in the Met Office for NWP and other forecasting applications

Crispian Batstone

12 Nov 2015



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Acknowledgements & Partners

Met office

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Partners

- Europe: ESA, EUMETSAT members, ECMWF, UK Space, Universities
- USA: NASA, NOAA
- Asia: BoM, CMA, JAXA, JMA, KMA
- Unified Model development: KMA, CAWCR, BoM, NIWA

Outline

- Operational NWP models
- Satellite observations assimilated
- Experiments with AMSR-2
- Plans for Himawari-8
- Other activities (FY-2 / FY-3 / Meteor-M N2)
- Future challenges

2015 NWP Models Seamless Suite

UKV and MOGREPS-UK

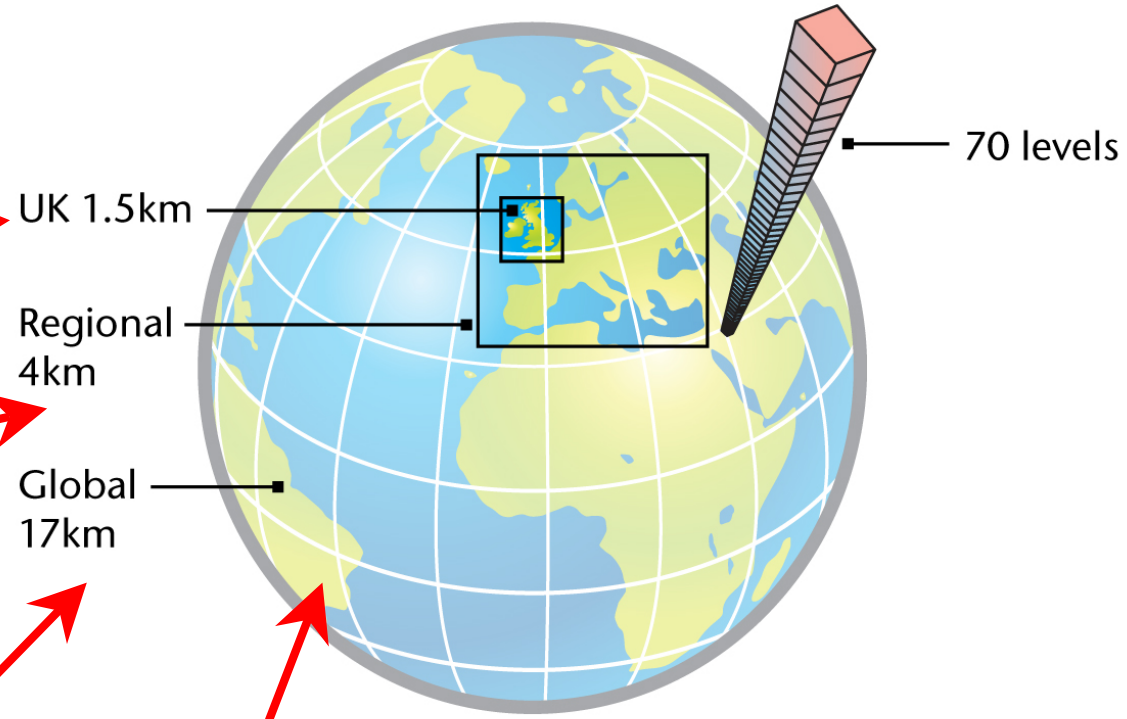
- 1.5km 70L (40km model top)
- 36hr forecast
- 8 times per day
- 12-member Ensemble - 2.2km 4x/day 36h

Euro4

- 4km 70L (40km model top)
- 66hr forecast twice/day
- 144hr forecast twice/day

Global and MOGREPS-G

- 17km 70L (80km model top)
- 66hr forecast twice/day
- 144hr forecast twice/day
- 12-member Ensemble - 33km 4x/day 7d
- 24-member Ensemble - 60km 2x/day 15d



Seasonal: GloSea5

- 60km 85L (80km model top)
- ¼ degree Ocean
- 14-member Ensemble
- 7month forecast once/week

Satellite data used in NWP (1)

Observation type	Satellites	NWP models *
AMSU/MHS radiances	4 NOAA + 2 Metop	G, R
HIRS clear radiances	2 Metop	G, R
IASI and AIRS clear+cloudy radiances	Metop + Aqua	G, R
ATMS & CrIS radiances	Suomi NPP	G
SSMIS radiances	F16 used before failure, preparing F17/18	G, R
Geo imager clear IR radiances	MSG, MFG, GOES, MTSAT2	G, R, UK
GPS RO bending angles	5 COSMIC, Metop/GRAS, GRACE-A, TerraSAR-X, CNOFS	G, R
GPS ZTDs	~350 European stations	G, R, UK

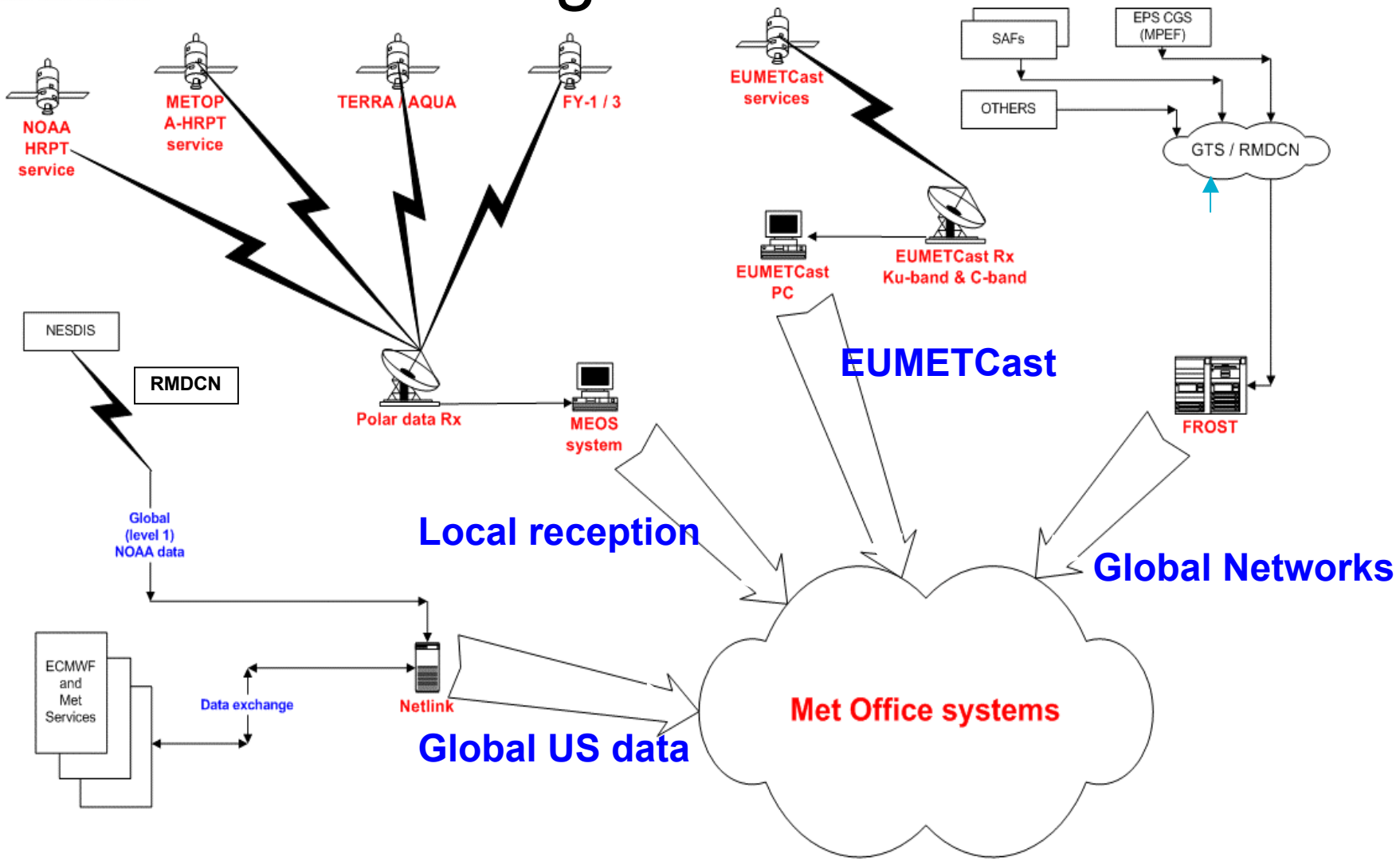
* G = Global, R = Regional = Europe, UK = UK area

Satellite data used in NWP (2)

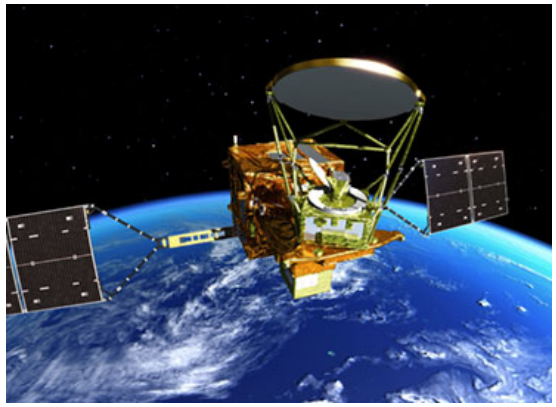
Observation type	Satellites	NWP models *
AMVs - Geo	5 geo satellites	G, R, UK
AMVs – MODIS and AVHRR	Aqua, Terra, NOAA, Metop	G, R
Scatterometers: sea-surface winds	Metop/ASCAT	G, R, UK
MW imager sea-surface winds	Windsat/Coriolis	G
SEVIRI cloud height/amount	MSG	R, UK
SSTs: AVHRR, AMSR-E…	NOAA, Metop, Aqua	G, R, UK
Soil moisture: ASCAT	Metop	G, R, UK
Sea ice: SSM/I, SSMIS	DMSP	G, R
Snow cover	various	G, R

* G = Global, R = Regional = Europe, UK = UK area

How we get the data



AMSR-2 in DA for Global Model



Assimilation of radiances for atmospheric global model

VISION:

“To utilize a constellation of AM and PM orbit microwave imagers in our satellite DA system”

GOALS:

- To utilize AMSR-2 as the primary PM orbit imager

- To utilize SSMIS as the primary AM orbit imager

AMSR-2 in DA for Global Model

May 2012: Launch of GCOM-W1 satellite

May 2013: L1B Test Data Available

Feb 2014: Trial service available on EUMETCast

Mar 2014: Met Office begins receipt and storage of data

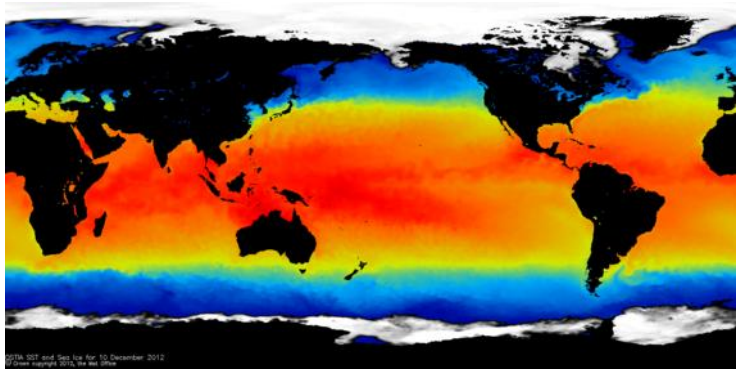
May 2014: Data storage and retrieval fully operational

Jun 2015: Global NWP assimilation trials of AMSR-2 data

Nov 2015: Expected pre-operations parallel suite 37 start date

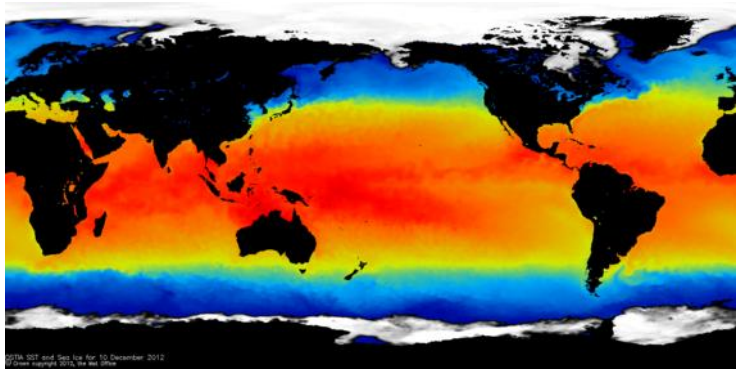
Feb 2016: Expected “go live” of AMSR-2 in NWP operations

AMSR-2 in OSTIA



- Operational Sea Surface Temperature and Sea Ice Analysis
- Daily analysis, 1/20^{o} grid resolution
- Globally complete, gridded
- Validates well compared to other analyses using independent near-surface Argo observations

AMSR-2 in OSTIA



Data types currently assimilated in OSTIA:

- NOAA-18 & 19 & MetOp-A AVHRR
- SEVIRI
- GOES
- In situ (ships, drifters, moored buoys)

Trial JAXA AMSR2 L2P v2.1:

For a test month of March 2015, a control run and a run assimilating AMSR2 SST observations was conducted.

AMSR-2 in OSTIA: Results

- Biases and RMS errors in the high latitudes are large.
- Likely related to microwave insensitivity at low SSTs for certain channels.
- Comparison run using AMSR2 SST observations produced by RSS (Remote Sensing Systems)
- RSS and JAXA AMSR2 biases compared to OSTIA are quite similar. Both have large RMS errors in the high latitudes, but RSS is smaller.
- Ideally use JAXA AMSR2: RSS do not provide an operational service
- AMSR-2 SST trial in Forecast Ocean Assimilation Model (FOAM)

Himawari 8 plans

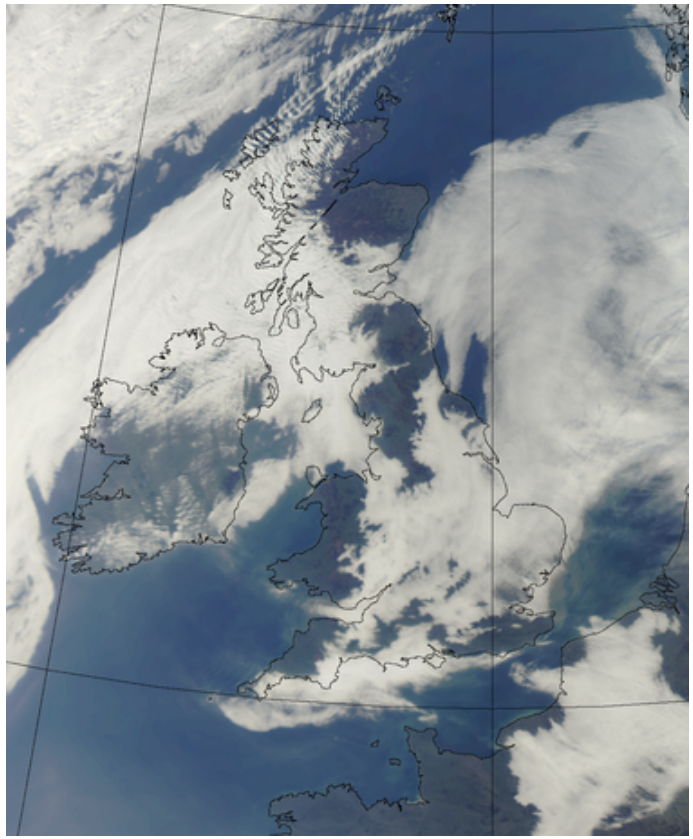
11 channels @ 2km, every 30 minutes via EUMETCast (MSG SEVIRI-like)

AHI channel number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Central wavelength (microns)	0.46	0.51	0.65	0.86	1.61	2.3	3.85	6.25	7.0	7.35	8.6	9.6	10.45	11.2	12.35	13.3

- October 2015: switch operational imagery from MTSAT2 (single channel / Volcanic Ash), new imagery (e.g. dust RGB)
- Working on cloud mask + products
- CSRs / AMVs soon in global model
- High resolution locally processed CSRs / AMVs in SingV model
- Enhanced VA products
- AOD JAXA product

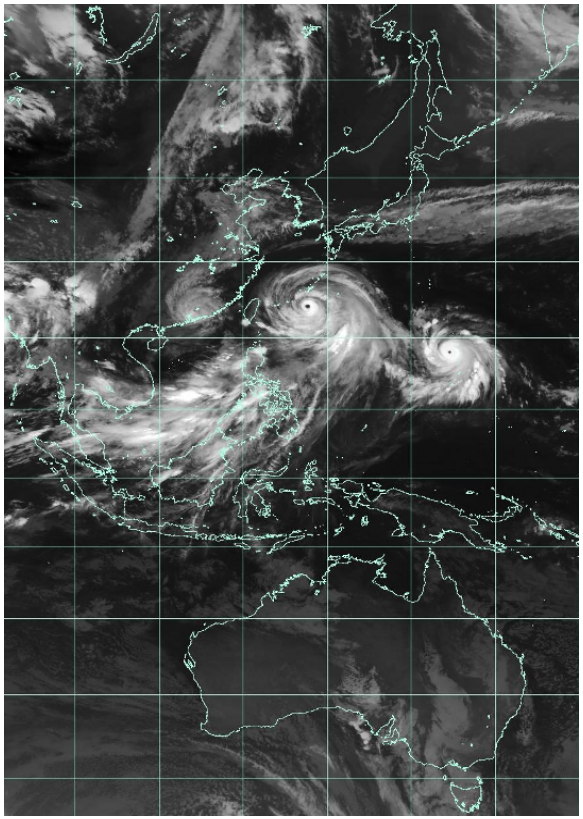
Other activities

- FY-2 imagery
- FY-3 direct broadcast imagery
- Meteor-M N2 MTVZA-GY

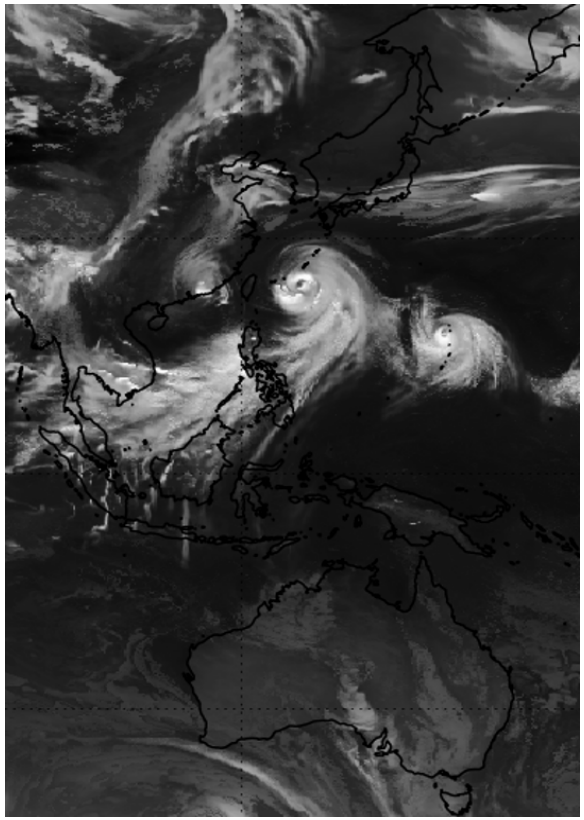


Simulated satellite imagery

9 July 2015 12:00 UTC



MTSAT2



Simulated

Future challenges

GEO

- GOES-R + GLM
- MTG FCI, LI, IRS

LEO

- Sentinel 3
- EPS-SG
- JPSS 1
- GPM GMI
- ADM-Aeolus

Met Office

Thank you for listening!