

ACFJ Services for Aviation

ACFJ Consortium

- ▶ **Australia:** Bureau of Meteorology (BOM)
- ▶ **Canada:** Natural Resources Canada (NRCan)
- ▶ **France:** SPECTRA (Collecte Localisation Satellite (CLS), European Satellite Services Provider (ESSP), Météo-France)
- ▶ **Japan:** National Institute of Information and Communications Technology (NICT)

ACFJ Experience: Australia

- Operational space weather service (RWC Australia)
- Established in 1947 as the "Ionospheric Prediction Service" (IPS)
- Supporting industry, government, aviation, defence and the general public with space weather advice and forecast service.
- Specialists in HF communications, ionospheric physics, geomagnetism and all aspects of space weather



ACFJ Experience: Australia

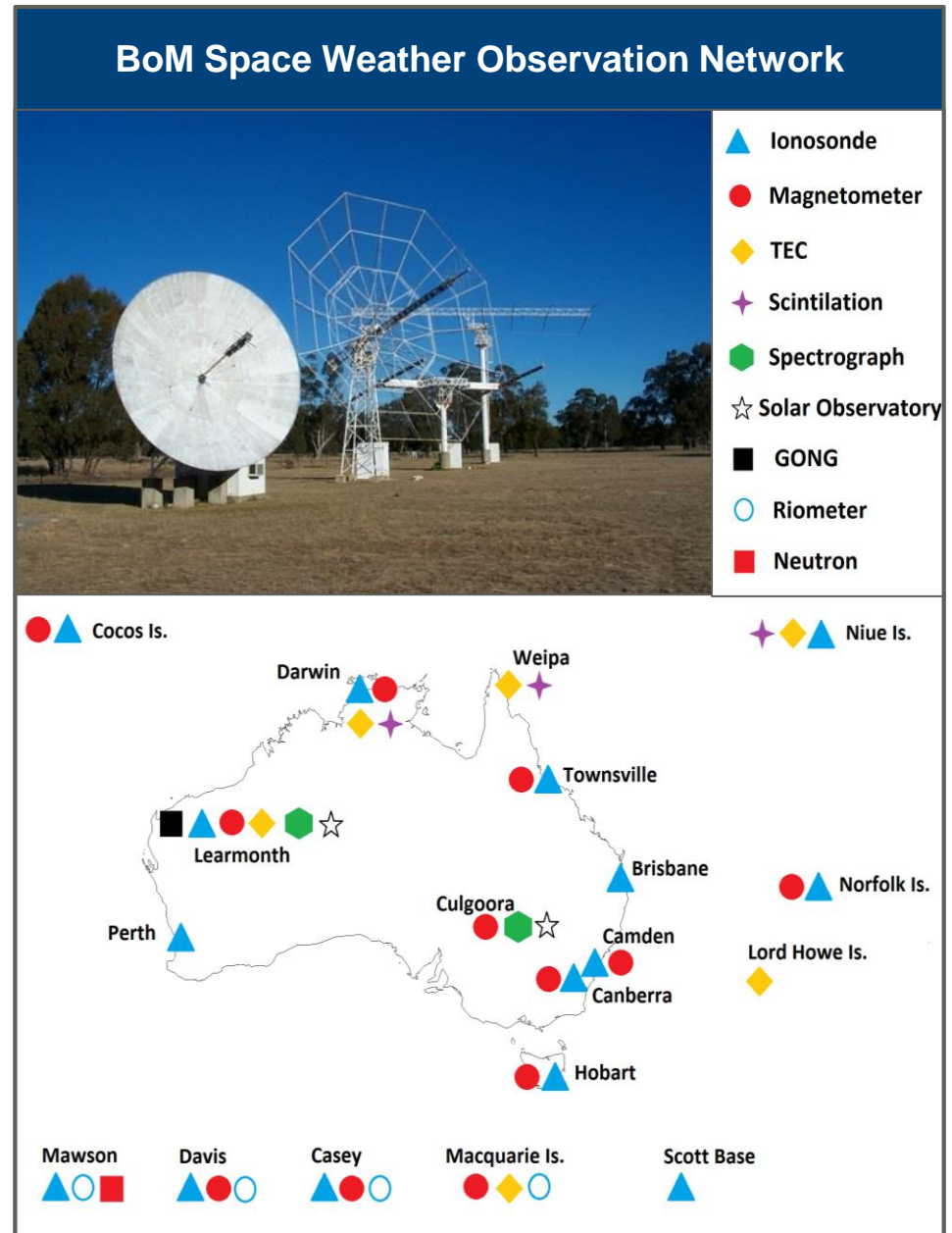
Space weather
observation network:

across Australia,

the Southern Pacific

the Antarctic region

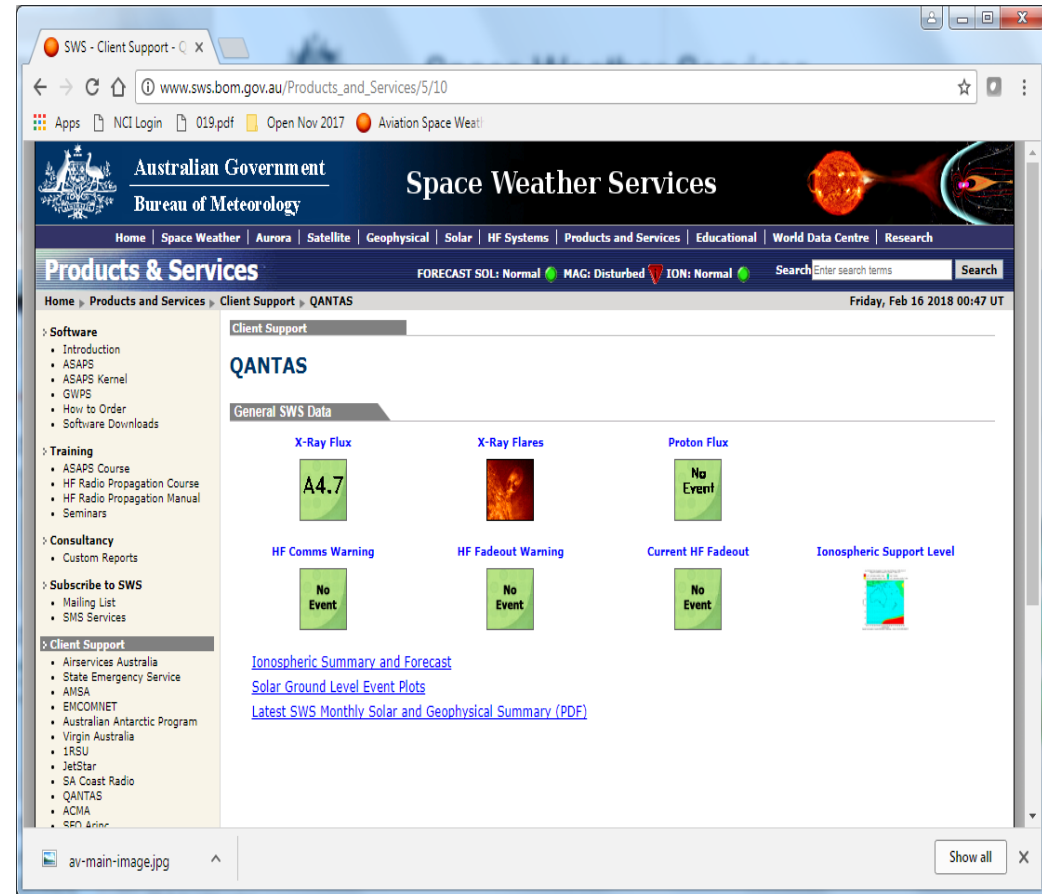
ACFJ



ACFJ Experience: Australia

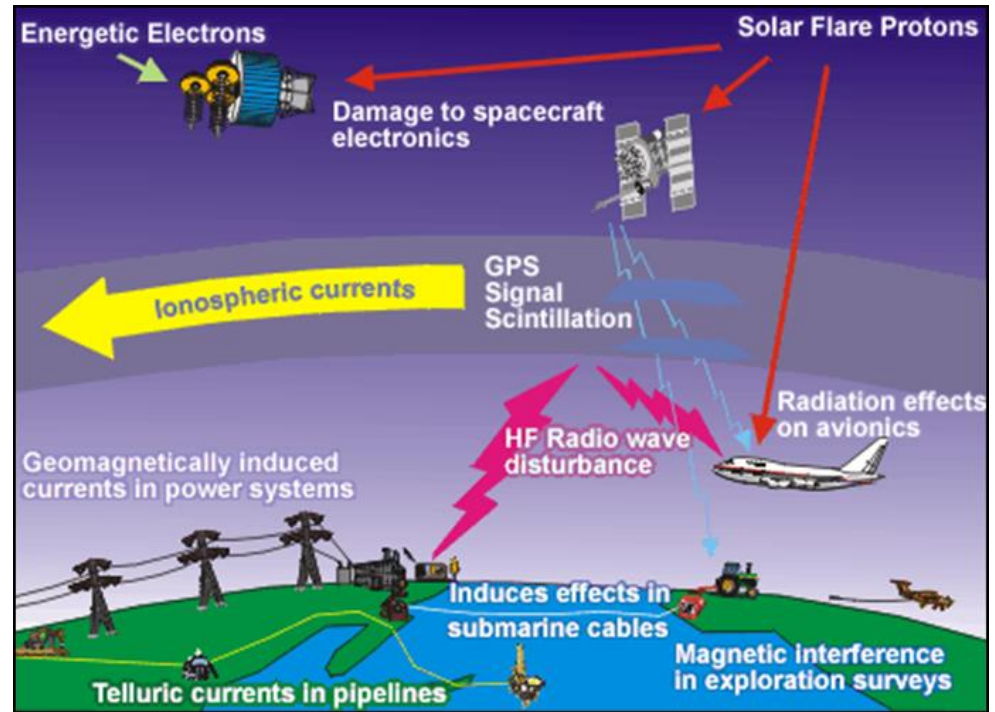
Space Weather Forecast Team consists of

- 3 Senior Space Weather Forecasters
- 7 Space Weather Forecasters
- MET/aviation forecasters with space weather competencies operating out of the 24/7 National Operations Centre (NOC)



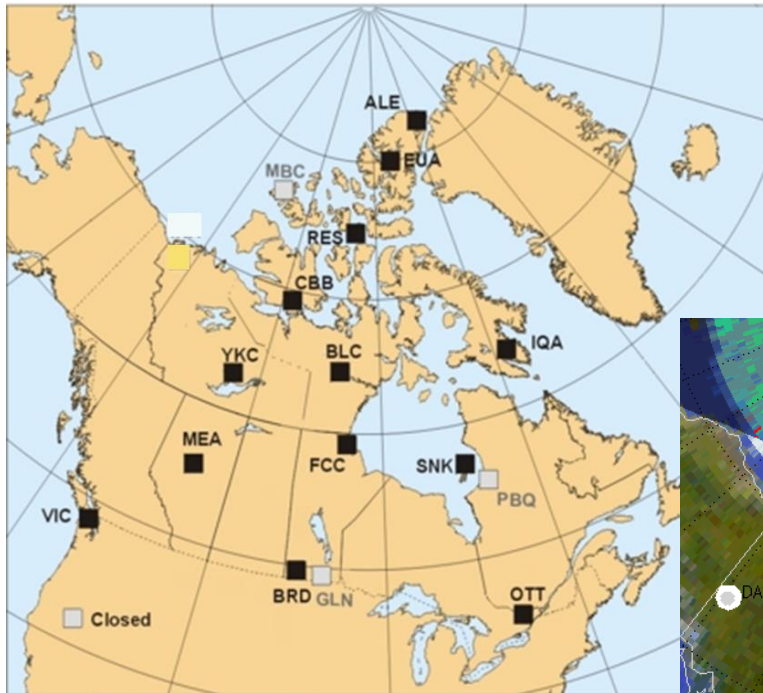
ACFJ Experience: Canada

- Operational space weather service (RWC Canada)
- Established in 1976 to provide forecasts of magnetic activity
- Initial focus on forecasts for aeromagnetic surveys and electric power systems, expanded to include satellites.
- 2000s: expand work to include space weather effects on aviation – active in the Cross-Polar Working Group

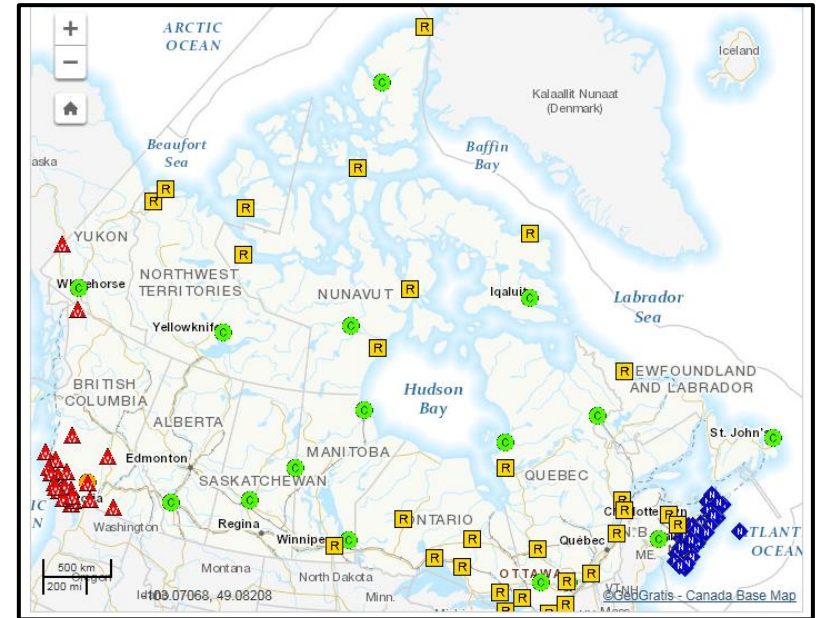


ACFJ Experience: Canada

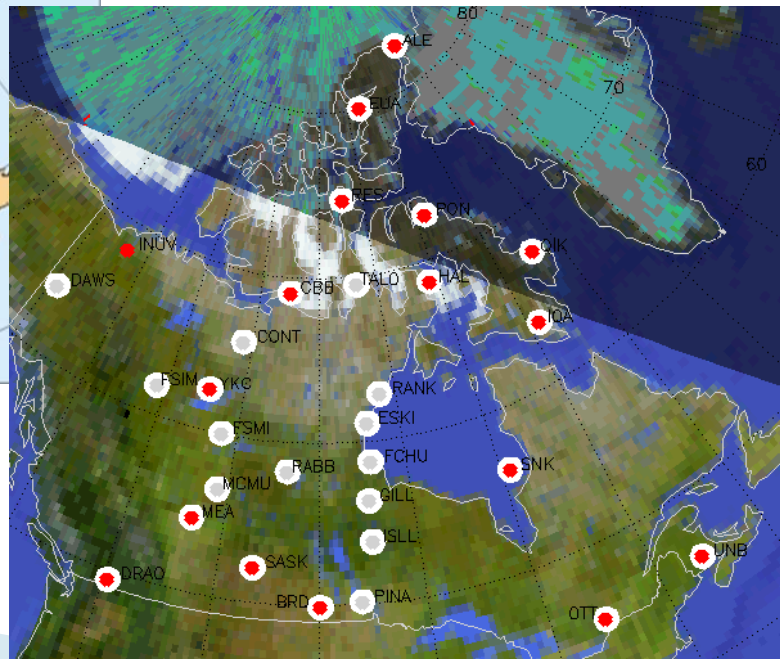
Magnetic Observatories



Riometers



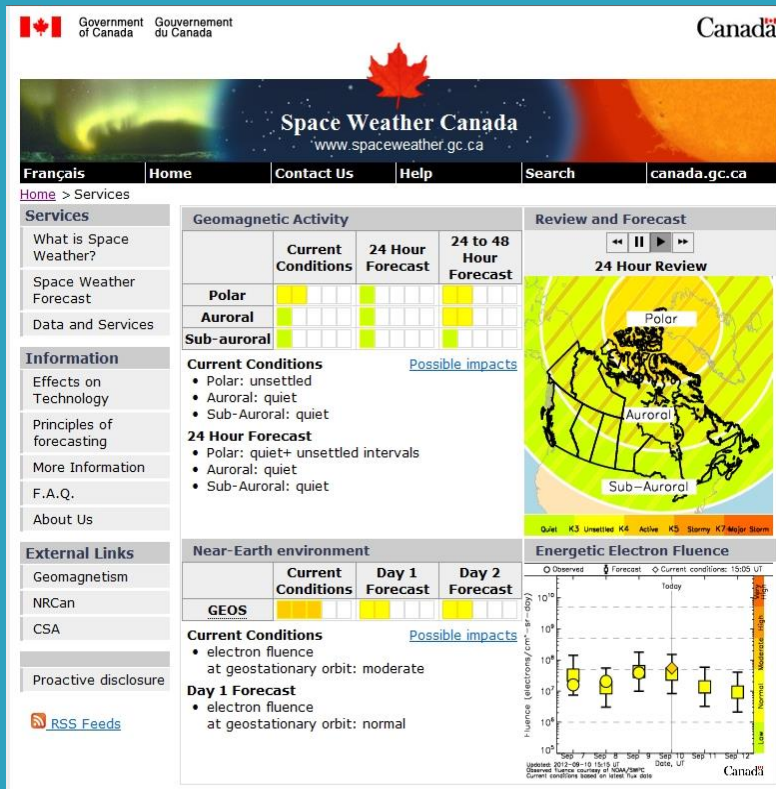
GNSS
Receivers



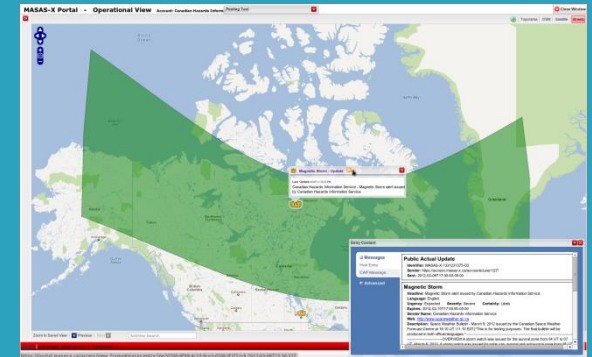
ACFJ Experience: Canada

Canadian Space Weather Forecast Centre

NRCan Canadian Hazards Information Service



Government Operations Centre



Critical Infrastructure Operators



ACFJ

www.spaceweather.gc.ca

ACFJ Experience: France



We certify you're there.

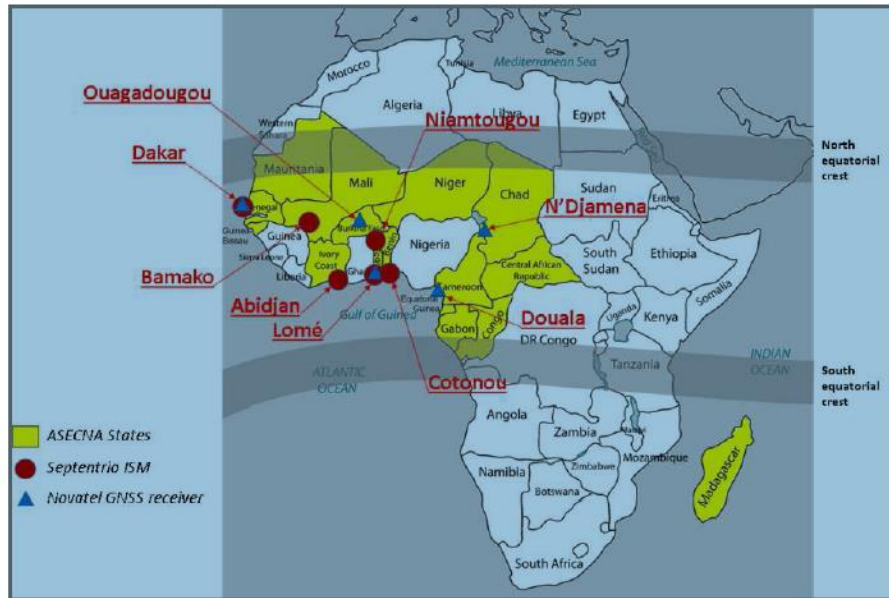


- Involved in space weather since 2000,
- operational SW forecasting services since 2006
- Expertise in radiation & ionospheric scintillations
- Operation of GPS augmentation system (EGNOS)
- Network of 40 RIMs stations (>80 receivers)
- Long experience of space weather effects on EGNOS and impacts on Air Navigation services
- 24/7 Aviation Met Service Provider
- - Operates one of 9 ICAO Volcanic Ash Advisory Centres

All three members located in Toulouse/France
in an integrated space weather network

ACFJ Experience: France

EGNOS RIMS (Ranging and Integrity Monitoring Stations) network



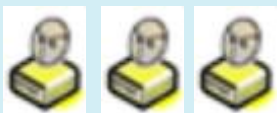
Ionosphere scintillation monitoring stations operated by France in West Africa (in cooperation with ASECNA)



*External and
internal (ESSP, CLS)
sources*

Data Provision

GNSS Network
Magnetic indexes
data
X-ray fluxes
Protons fluxes
Solar wind data
Neutron
Monitors



Data and
Product
Archive

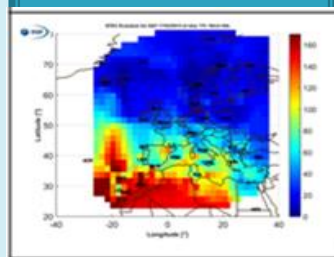
ESSP, CLS

Data processing and Alert generation

GNSS Products

Radiation
Products

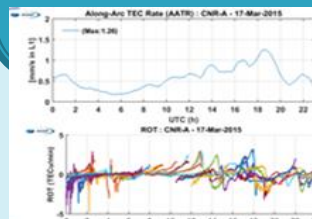
(Satcom
Products)



Data/Product
Analysis

Advisory
Generation

Verification



Variety of
Information for
Users

Météo-France

Information Management and Dissemination SWx Advisories

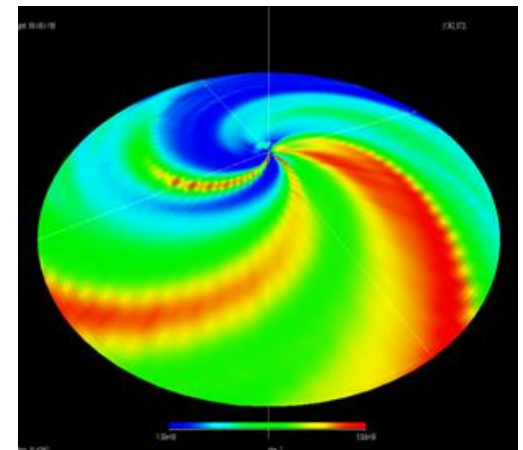
```
SWX001 LFW 061132
SWX ADVISORY
DTG: 20170906/1100Z
SWIC: TOULOUSE
ADVISORY NR: 2017/2
NR WPLC: 2017/1
SWX EFFECT: HF COM MOD
OBS SWX: 20170906/1100Z DAYLIGHT SIDE
FCST SWX +00HR: 20170906/1700Z DAYLIGHT SIDE
FCST SWX +12HR: 20170906/1700Z DAYLIGHT SIDE
FCST SWX +18HR: 20170906/2300Z NO SWX EXP
FCST SWX +24HR: 20170907/0500Z NO SWX EXP
RMK: PERIODIC HF COM ABSORPTION OBS AND LIKELY TO CONTINUE IN THE NEAR TERM.
CYCL AND PERIODIC LOSS OF HF ON THE SUNKY SIDE OF THE EARTH EXP.
END HF COM DEGRADATION LIKELY OVER THE NIT 2 DAYS. SEE WWW.SPECTRA-TOULOUSE.FR
NAT ADVISORY: 20170906/1700Z
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Data Storage
Quality Control
Transmission
Message
Switching
AMHS connection
(SADIS, WIFS)

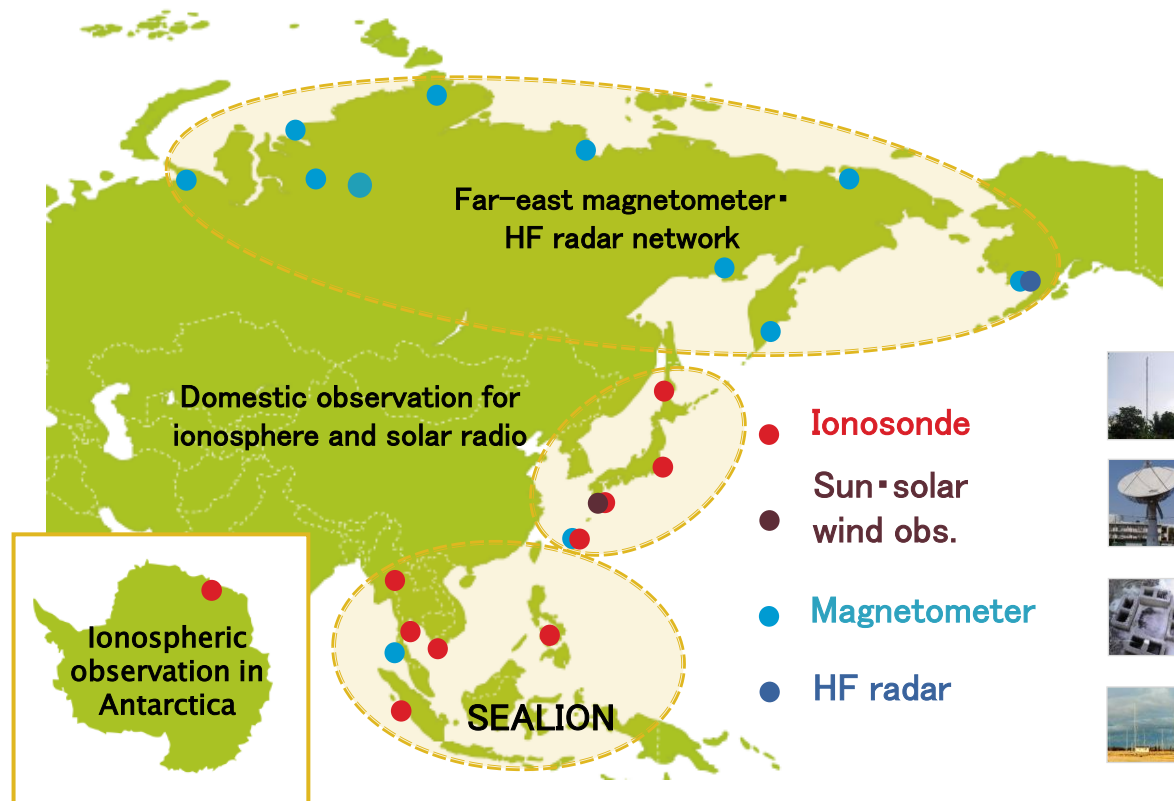
Nowcast and
Forecast
service

ACFJ Experience: Japan

- Since 1952, measured solar radio spectrum,
- 1957: started operational alert service for radio propagation
- 1978, NICT provided foF2 global map first in the world using satellite observation.
- NICT is in charge of space weather forecast services in Japan as a regional warning center of ISES
- Extensive experience in space weather model development and space weather monitoring



ACFJ Experience: Japan

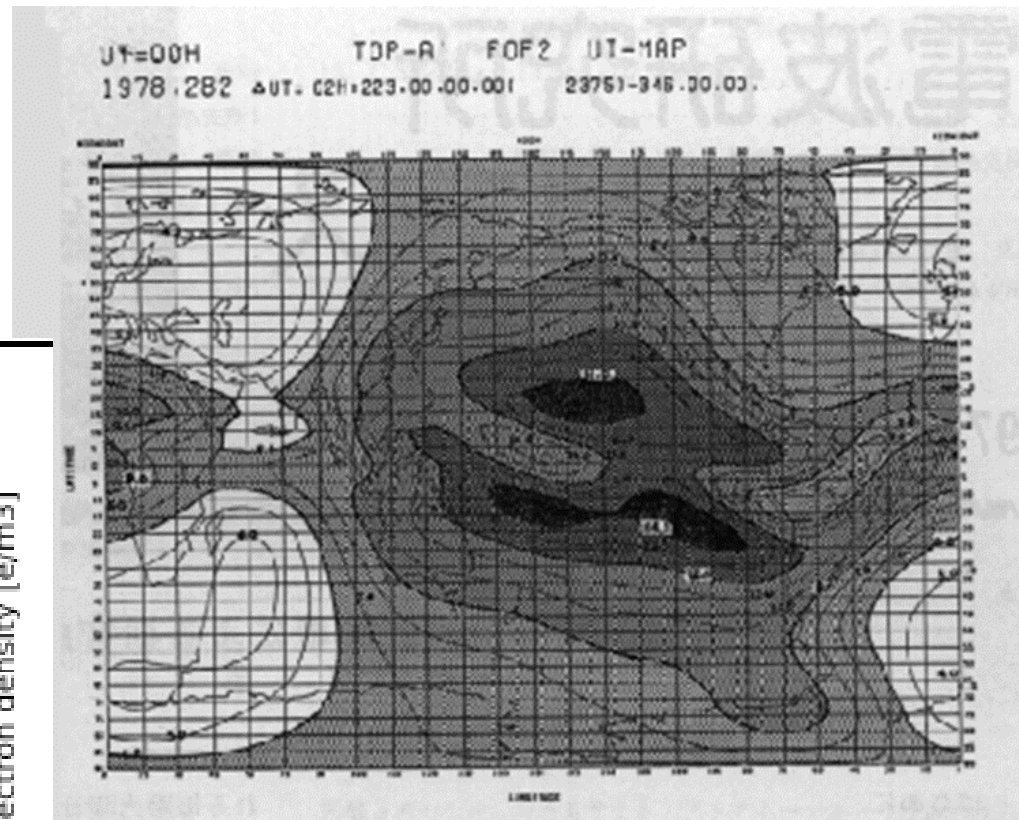
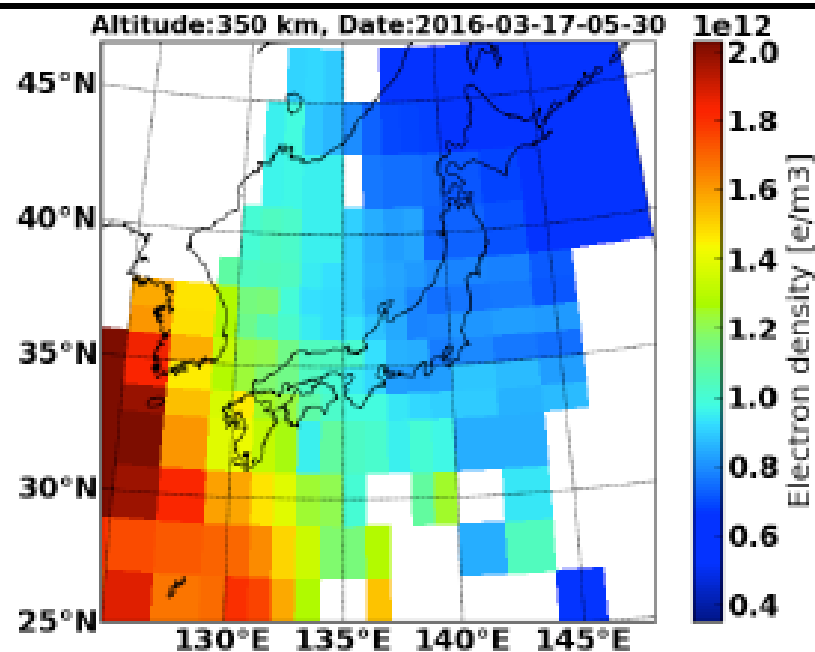


SWx observing network

- Observation network: one of the largest networks in Asia & West Pacific region

ACFJ Experience: Japan

3D distribution of ionospheric
electron density

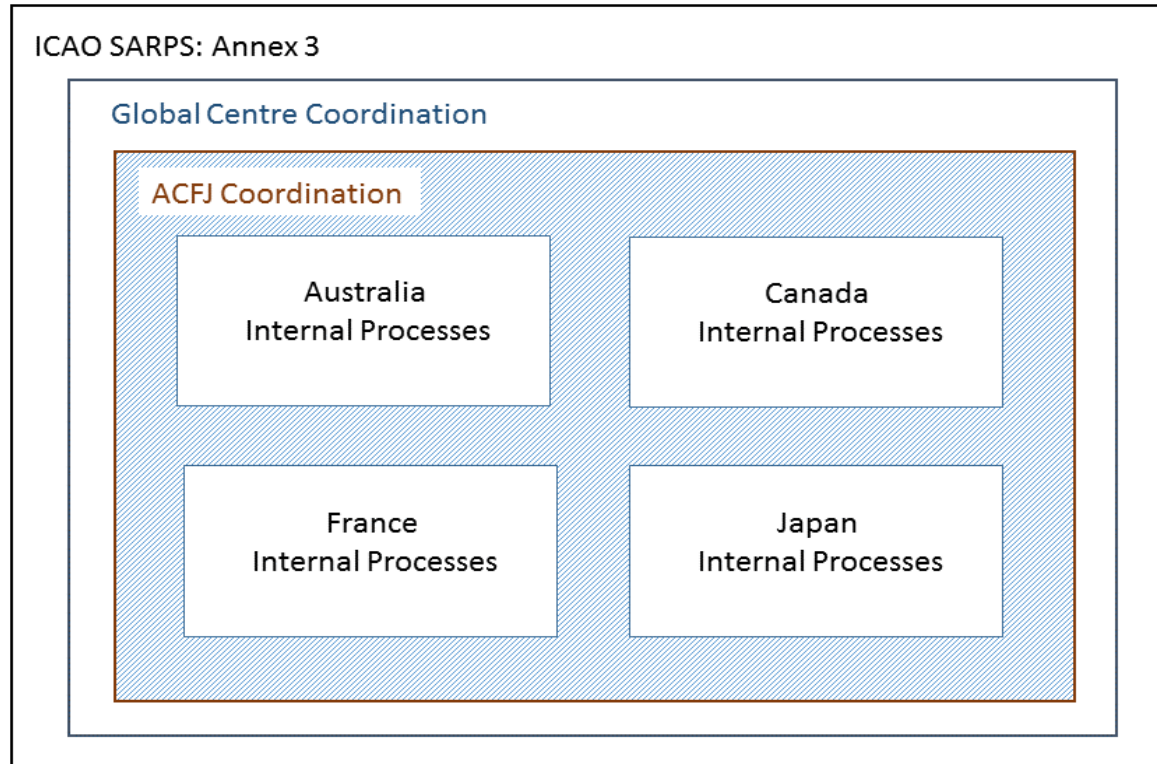


Global foF2 map

ACFJ

+ Radiation Modelling

Delivery of ICAO Services



Active in Global Centre Coordination group

Sub group on advisory led by Stephanie Desbios

Sub group on consistency led by Larisa Trichtchenko

Delivery of ICAO Services

ICAO Annex 3 Services		Advisory issuance (nominal/routine)	Advisory dissemination (nominal/routine)	Back-up for dissemination
Radiation	Dose rate	SPECTRA (with NICT inputs)	SPECTRA	BoM
HF COM	Absorption due to X-rays	BoM (with NICT, NRCAN inputs)	BoM	SPECTRA
	Polar Cap Absorption (PCA)			
	Auroral Absorption (Kp)			
	Maximum Useable Frequency (MUF) depression			
GNSS	Total Electron Content (TEC) & Scintillations	SPECTRA (with BoM, NICT, NRCAN inputs)	SPECTRA	BoM
SATCOM	TBD			

Delivery of ICAO Services: Radiation

ACFJ/CLS operates the **SiGLE-RT** model from LESIA/Paris Observatory developed by N. Fuller & K.L. Klein.

Data: neutron monitors (NMDB, <http://nmdb.eu>)

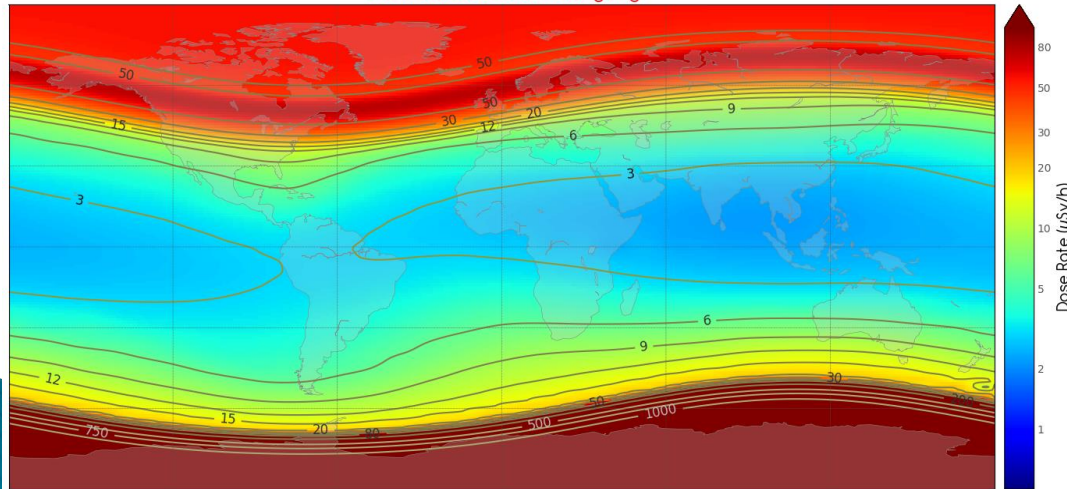


Models :

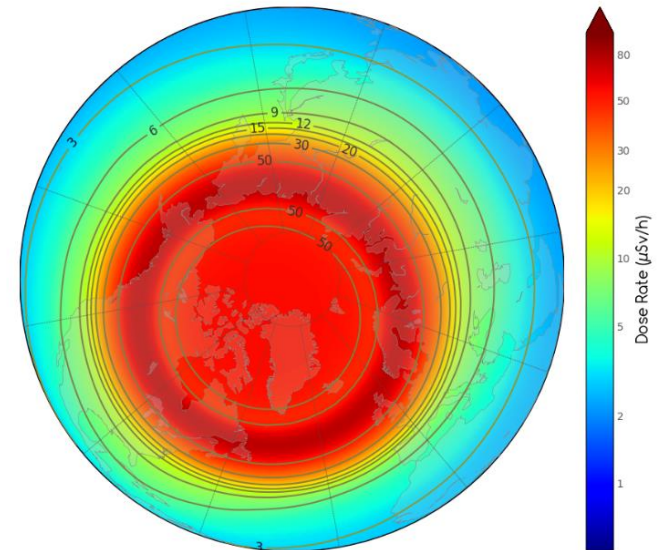
- EPCARD (GCR if no solar activity)
- SiGLE (in case of GLE) : unique model, calibrated by measurements on-board the Concorde aircraft. RT version includes automated event detection and dose computation.

Radiation dose map at 44000 feet (13.4 km) for 2005-01-20T06:55:00 (max 1488.8 $\mu\text{Sv/h}$)

A Ground Level Event is ongoing

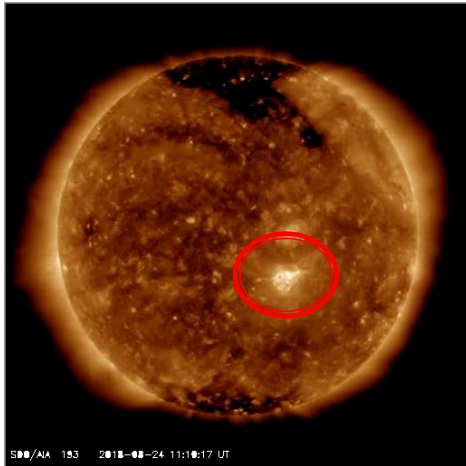


Radiation dose map at 44000 feet (13.4 km) for 2005-01-20T06:55:00 (max 76.6 $\mu\text{Sv/h}$)

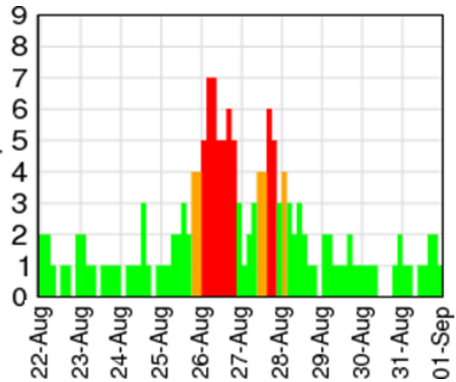
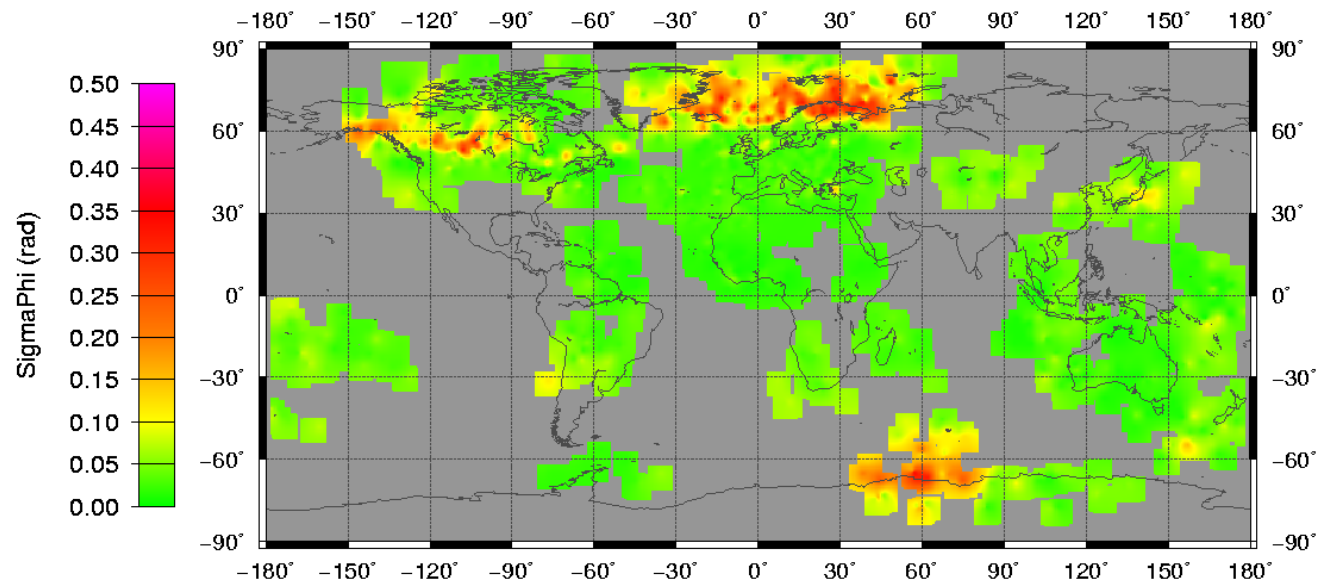


Delivery of ICAO Services: GNSS

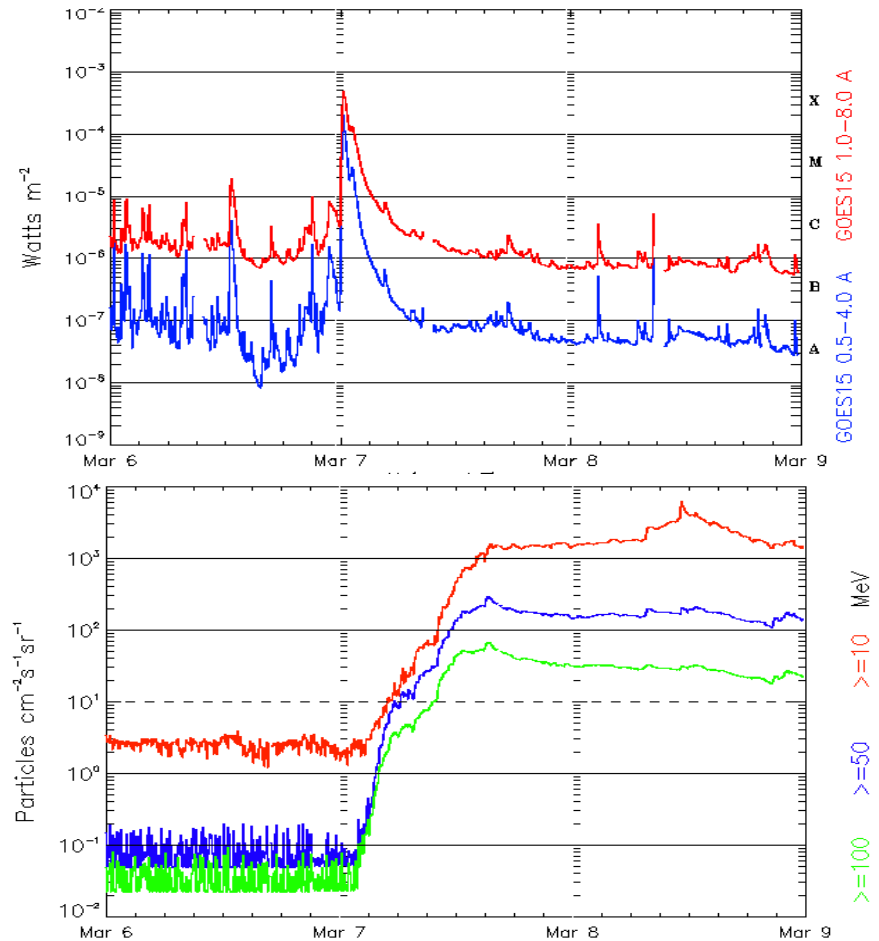
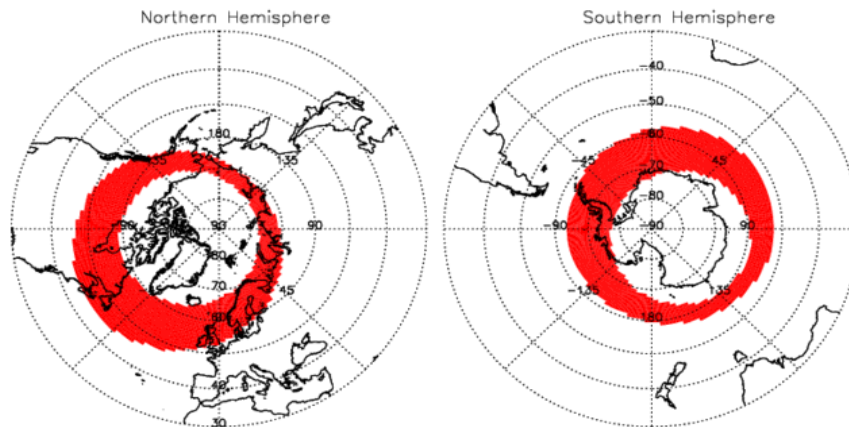
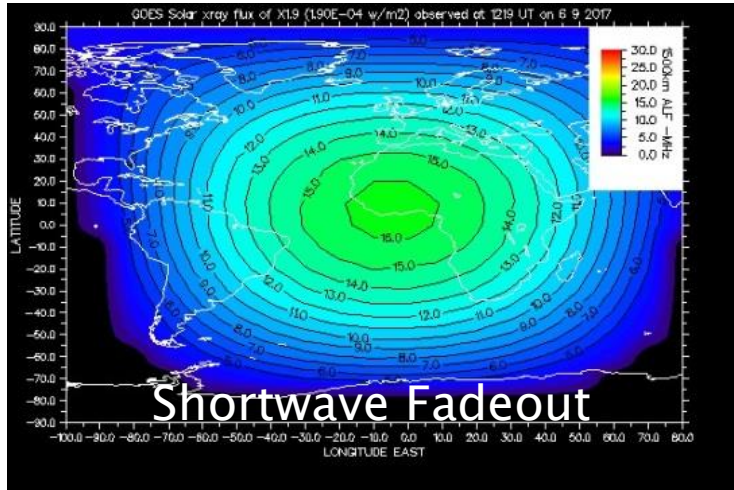
August 2018 event due to a CME



26/08/2018 – 03:00
Phase Scintillation

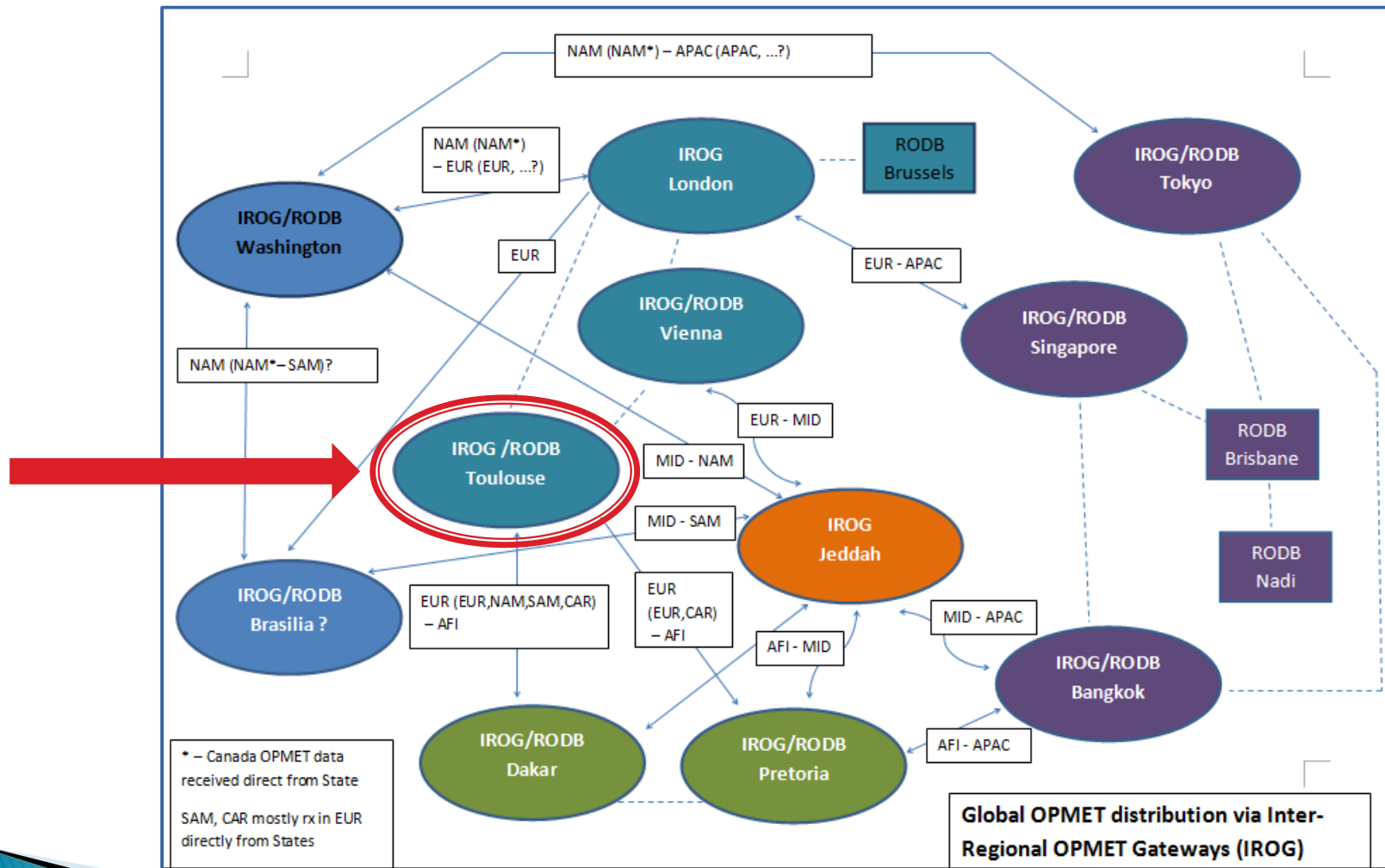


Delivery of ICAO Services: HF Radio

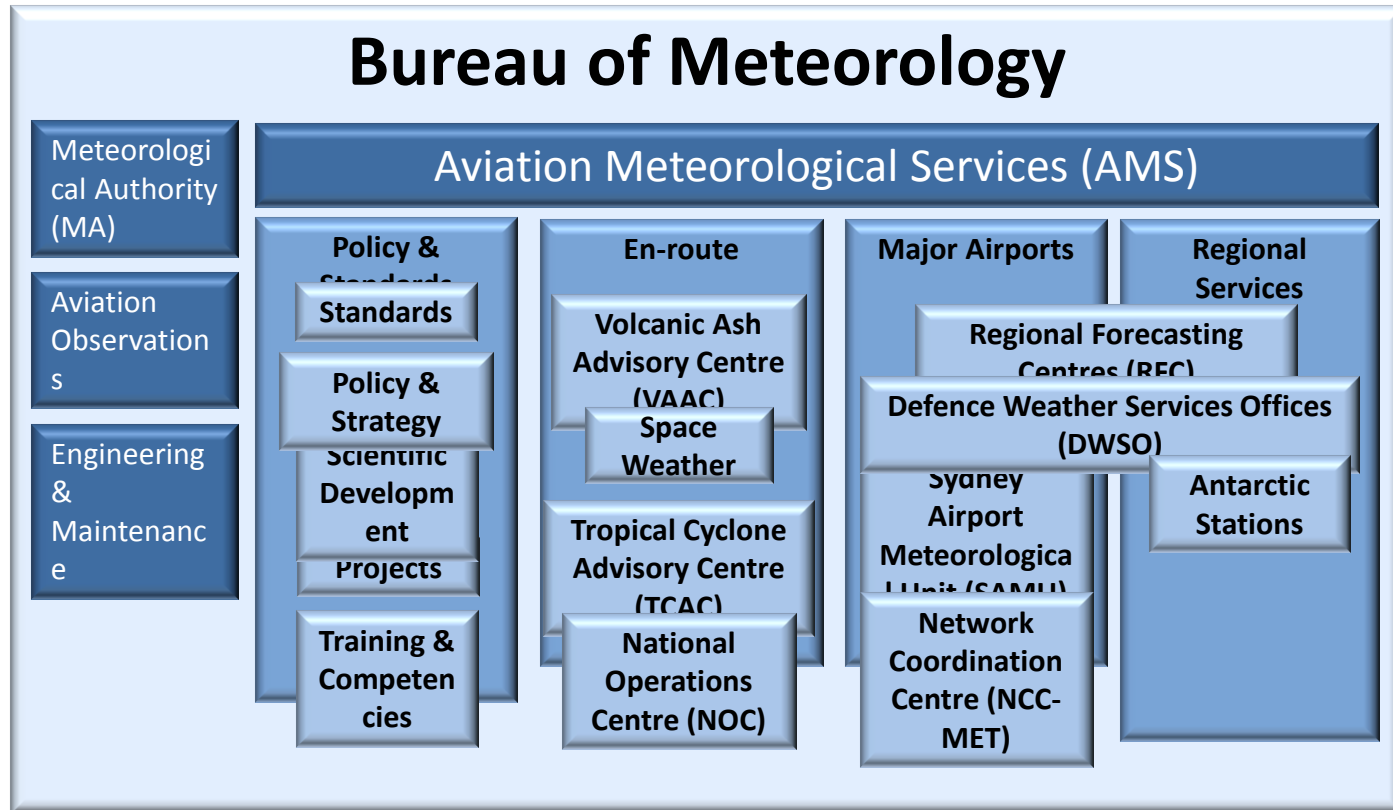


Polar Cap Absorption

Dissemination of ICAO Services: France



Dissemination of ICAO Services: Australia



<http://web.bom.gov.au/spb/adpo/aviation/offices.shtml>

Summary of ACFJ

- ▶ Long experience in SW forecasting
- ▶ Monitoring networks around the world
- ▶ Experience in radiation modelling
- ▶ Experience in GNSS TEC and scintillation
- ▶ Experience in HF radio (SWF, PCA, AA)
- ▶ France is point of dissemination of radiation and GNSS services
- ▶ Australia is point of dissemination of HF radio services

Future Steps

- ▶ Working to resolve issues with advisories
 - – mapping affected regions
 - – number of advisories
- ▶ Coordinate with other Global Centres
- ▶ Incorporate feedback from aviation users
- ▶ Ongoing research to improve services