Geoscience and Remote Sensing Society

'Earth Observation and Deriving Spatial Information for Disasters and Hazards".

Past President, IEEE Geoscience and Remote Sensing Society,
Cooperative Research Centre for Spatial Information (CRC-SI) and
School of Biological, Earth and Environmental Sciences, University of New South Wales, Sydney, NSW 2052,

UNITED NATIONS
Office for Outer Space Affairs

THE UNIVERSITY OF NEW SOUTH WALES

**United Nations International Conference on Space-based Technologies for Disaster Risk Management "Best Practices for Risk Reduction and Rapid Response Mapping"
Beijing, China, 22-25 November 2011**

crc•si

Presentation

- Earth Observation(EO)
- Australian Examples
- EO Issues
- EO Challenges
- GRSS

Case for Satellite Derived Data

- spatially extensive mapping
- localised event detection
- access difficult or dangerous sites
- near real time response
- geo-referenced and calibrated

More than 40 nations with imaging satellites -160 sensors

Systematic Observation Strategy

Semi-continental wall-to-wall coverage
Spatial consistency over regional scales
Temporal consistency over regional scales
Acquisitions within a short time window
Accurate timing
Regional seasonality drives window selection
Consistent sensor configuration
"Long-term" repetition continuity

EO Can Assist

Emergency Response

- **Specific event**
- **Rapid provision**
- **Map information**
- **Support crisis management**

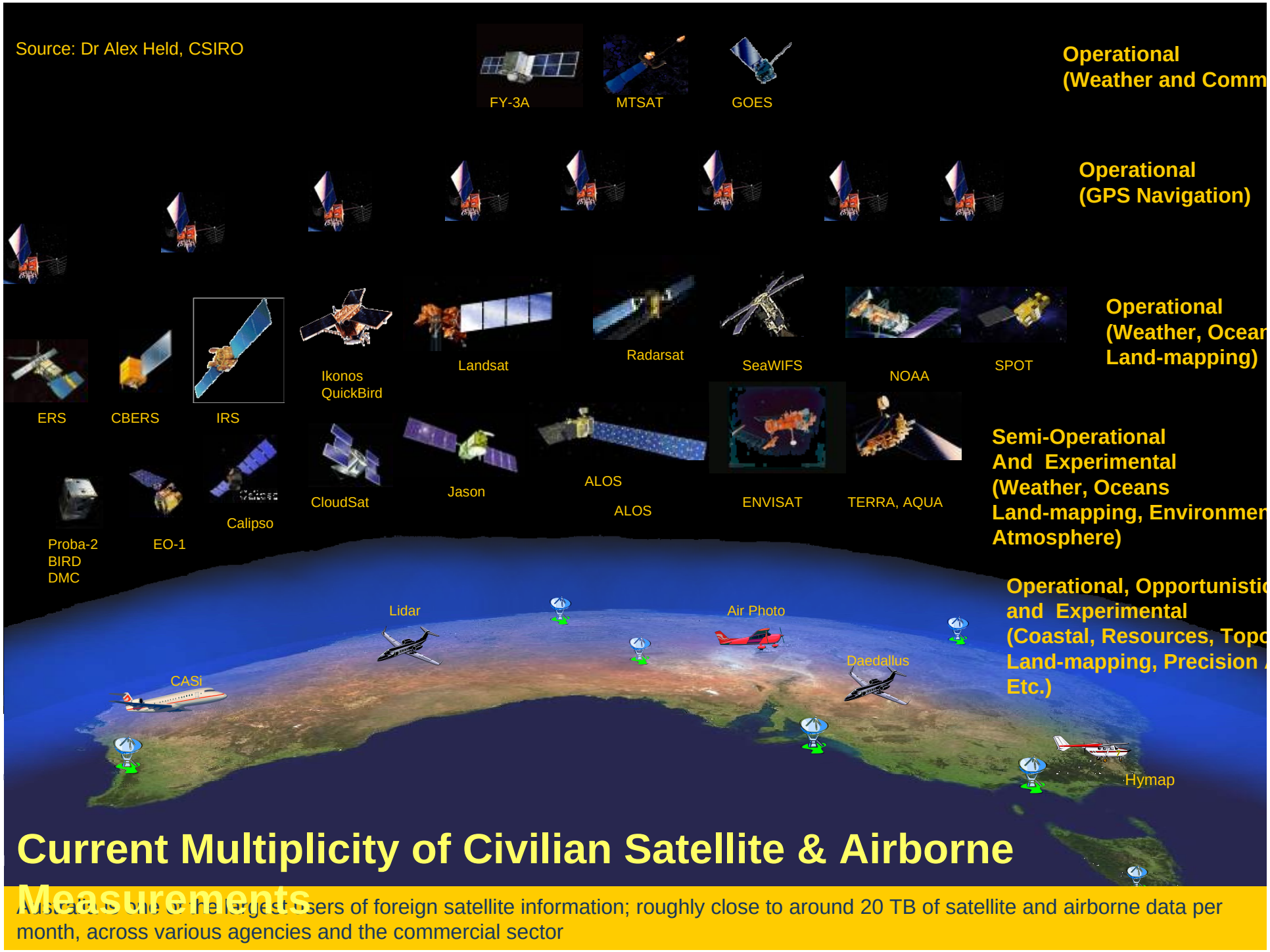
Recovery & Rehabilitation

- Situation maps
- Time series
- Monitoring

Mitigation & Preparedness Planning

- Vulnerability and risk assessment
- Modelling impact
- Early warning

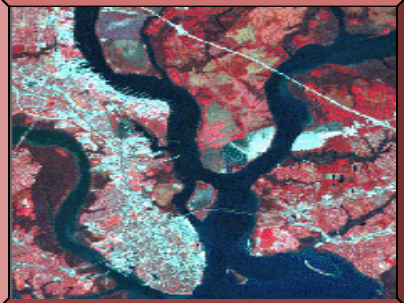
Creates different demands on satellite imagery



Current Multiplicity of Civilian Satellite & Airborne Measurements

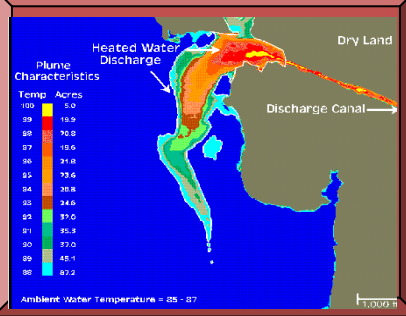
Australia is one of the largest users of foreign satellite information; roughly close to around 20 TB of satellite and airborne data per month, across various agencies and the commercial sector

Sensor Systems

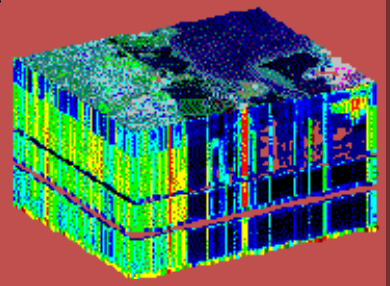


Multispectral

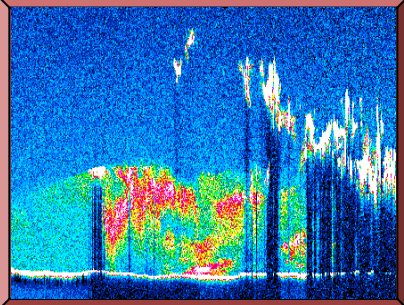
Radar/ SAR



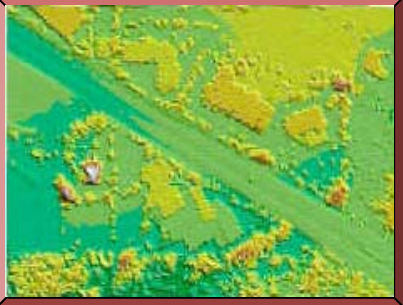
Thermal



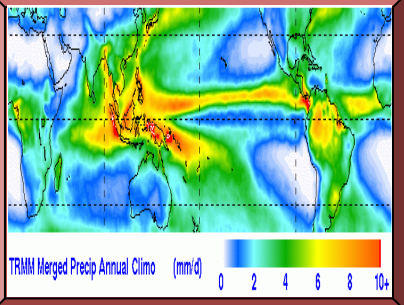
Hyperspectral



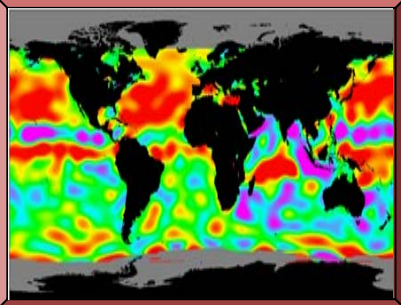
Atmospheric LIDAR



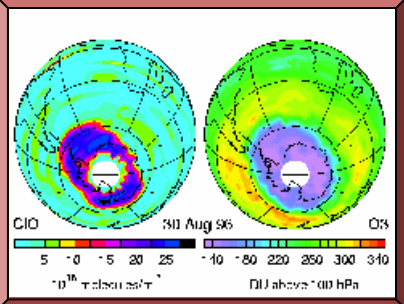
Surface LIDAR



Passive Microwave

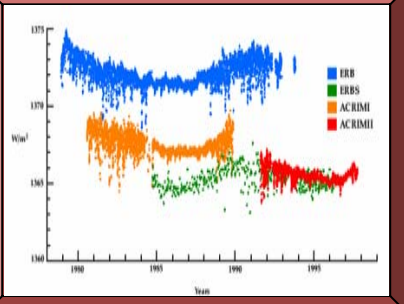


RADAR Altimetry

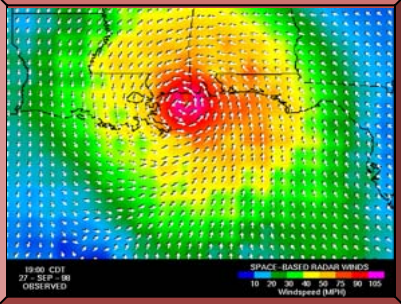


Limb Sounding

Gravitational Fields

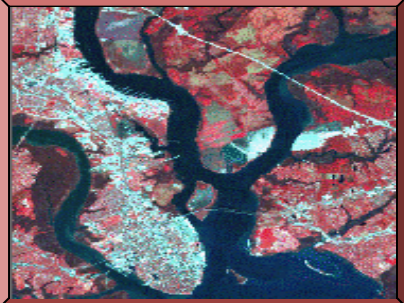


Irradiance/Photometry



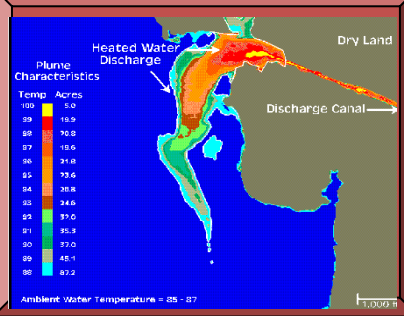
Scatterometry

Sensor Systems

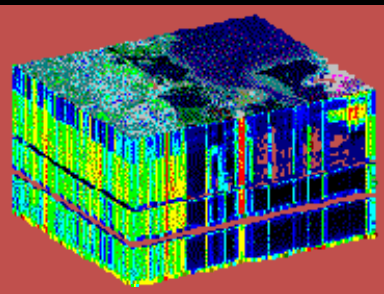


Multispectral

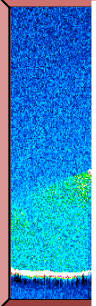
RADAR / SAR



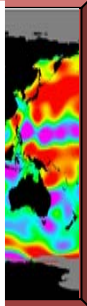
Thermal



Hyperspectral

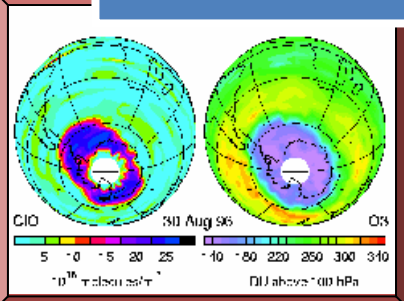


Atm



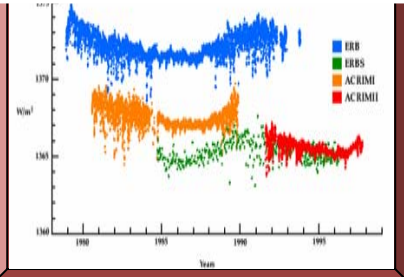
try

Evaluate satellite systems and sensors on their suitability for providing disaster event information

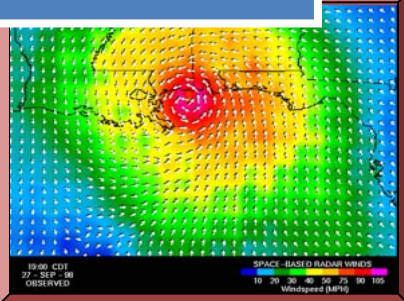


Limb Sounding

Gravitational Fields

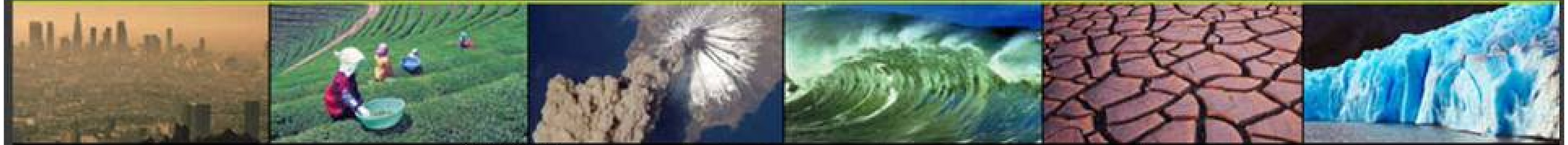


Irradiance/Photometry

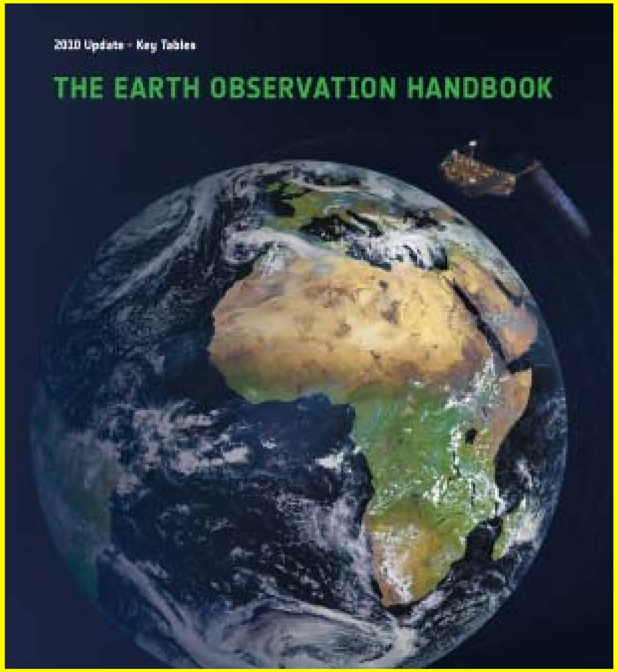


Scatterometry

CEOS Committee on Earth Observation Satellites



Calendar | GEO | Actions | MIM Database | Systems Database | COVE



7 missions have been launched by CEOS agencies since the start of 2010 through to publication on 1st October 2010:

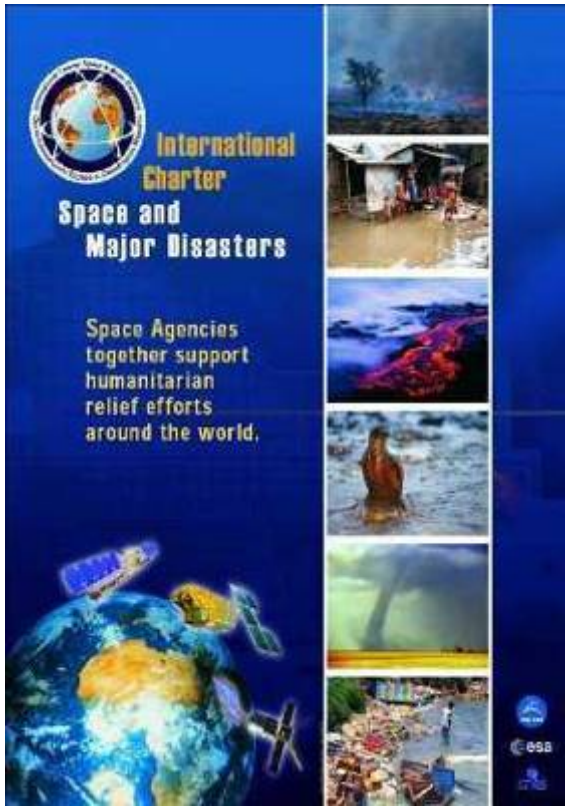
Mission	Agency	Launch
GOES-15 (Geostationary Operational Environmental Satellite - 15)	NOAA	Mar 2010
CryoSat-2 (CryoSat-2 (Earth Explorer Opportunity Mission))	ESA	Apr 2010
PICARD	CNES	Jun 2010
TanDEM-X (TerraSAR-X Add-on for Digital Elevation Measurements)	DLR	Jun 2010
COMS (Communication, Oceanographic, Meteorological Satellite)	KARI / ASTRIUM / KMA / KORDI	Jun 2010
AISSat-1 (Automatic Identification System Satellite-1)	NRC	Jul 2010
CARTOSAT-2B (Cartography Satellite - 2B)	ISRO	Jul 2010

A further 29 missions are scheduled for launch between 1st October 2010 and the end of 2011:

Mission	Agency	Launch
Sich-2	NSAU	Oct 2010
Nigeriasat-2	NASRDA	Oct 2010
NigeriaSat-X	NASRDA	Oct 2010
COSMO-SkyMed 4 (COnstellation of small Satellites for Mediterranean basin Observation - 4)	ASI / MiD (Italy)	Oct 2010
RASAT (RASAT Remote Sensing Satellite)	TUBITAK	Oct 2010
Glory	NASA	Nov 2010
HY-1C (Ocean color and temperature satellite C)	NSOAS / CAST	Dec 2010
RESOURCESAT-2 (Resourcesat Satellite-2)	ISRO	Dec 2010
KOMPSAT-5 (Korea Multi-Purpose Satellite 5)	KARI / [illegible]	Dec 2010
FY-3B (FY-3B Polar-orbiting Meteorological Satellite)	NRSCC / CMA	Dec 2010
Kanopus-V N1 (Kanopus-V Environmental Satellite N1)	ROSKOSMOS / ROSHYDROMET	Dec 2010
MEGHA-TROPIQUES	CNES / ISRO	Jan 2011
HY-2A (Ocean dynamics satellite A)	NSOAS / CAST	Jan 2011
RISAT-1 (Radar Imaging Satellite)	ISRO	Mar 2011
LARES (Laser RElativity Satellite)	ASI	Mar 2011
Pleiades 1	CNES	Mar 2011
SAC-D/Aquarius	CONAE / NASA	Apr 2011
HY-1C (Ocean color and temperature satellite C)	NSOAS / CAST	Jun 2011
Meteor-M N2 (Meteor-M Meteorological Satellite N2)	ROSHYDROMET / ROSKOSMOS	Jul 2011
INSAT-3D (Indian National Satellite - 3D)	ISRO	Aug 2011
NPP (NPOESS (National Polar-orbiting Operational Environmental Satellite System) Preparatory Project)	NASA / NOAA / DoD (USA)	Sep 2011
SARAL (Satellite with ARgos and ALtiKa)	CNES / ISRO	Oct 2011
CBERS-3 (China Brazil Earth Resources Satellite - 3)	INPE / CRESDA	Oct 2011
Elektro-L N1 (Geostationary Operational Meteorological Satellite - 1)	ROSHYDROMET / ROSKOSMOS	Dec 2011
KOMPSAT-3 (Korea Multi-Purpose Satellite 3)	KARI / ASTRIUM	Dec 2011
HJ-1C (Disaster and Environment Monitoring and Forecast Small Satellite Constellation C)	CRESDA / CAST / NRSCC	Dec 2011
FY-2F (FY-2F Geostationary Meteorological Satellite)	NRSCC	Dec 2011
Resurs-P N1 (Resurs-P Environmental Satellite N1)	ROSKOSMOS / ROSHYDROMET	Dec 2011
PAZ	CDTI	Dec 2011

www.ceos.org

INTERNATIONAL CHART “Unified system of rapid space data acquisition and delivery’



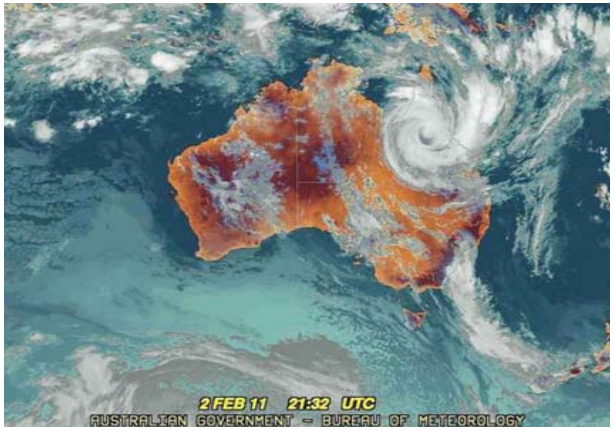
Members

European Space Agency (ESA): ERS, ENVISAT
Centre national d'étudesspatiales(CNES):SPOT
Canadian Space Agency (CSA):RADARSAT
Indian Space Research Organisation (ISRO):IRS
National Oceanic and Atmospheric Administration (NOAA)
POES, GOES
Argentina's ComisiónNacionalde ActividadesEspaciales(CONAE): SAC -C
Japan Aerospace Exploration Agency (JAXA):ALOS
United States Geological Survey (USGS):LANDSAT
Disaster Monitoring Constellation (DMC): UK, Nigeria, Algeria, Turkey
China National Space Agency (CNSA): FY, SJ, ZY satellite series
Since Oct. 2010:German Aerospace Center(DLR)

Collaboration with other organisations.... UNOOSA/ UNITAR/UNOSAT/ GEO/EUSC/ ARDC and Sentinel Asia/GMES.....

Australian Natural Disasters: Examples

Floods

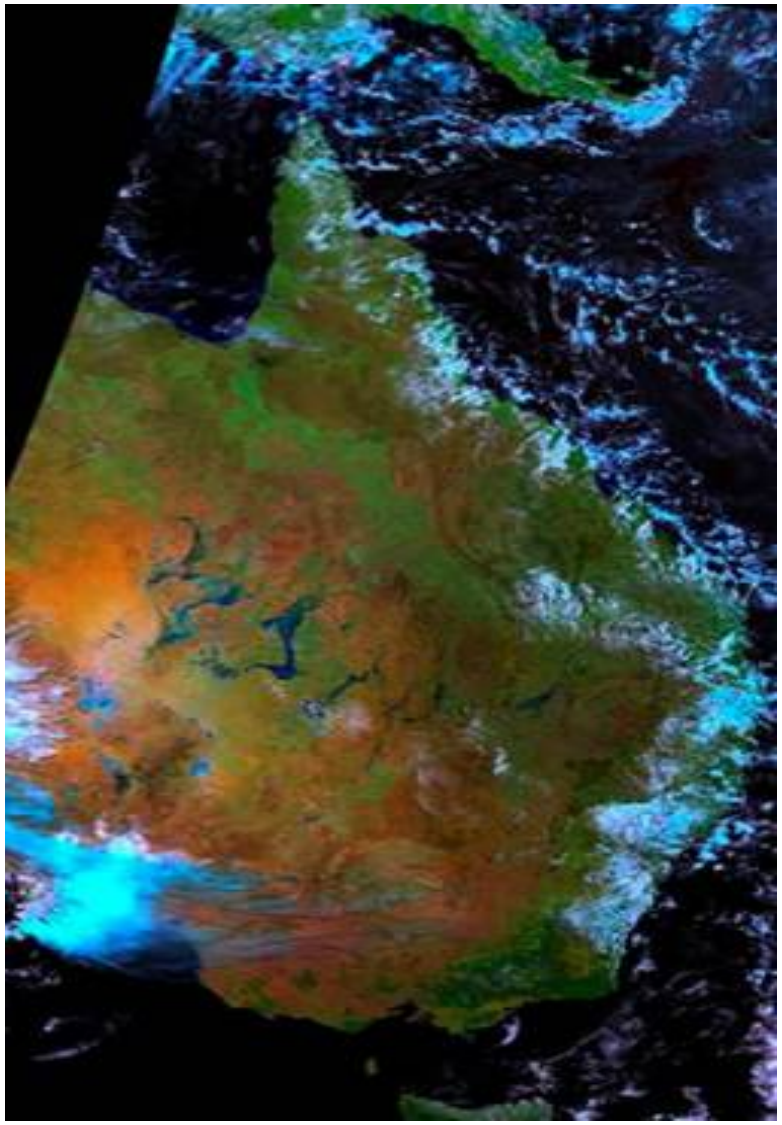


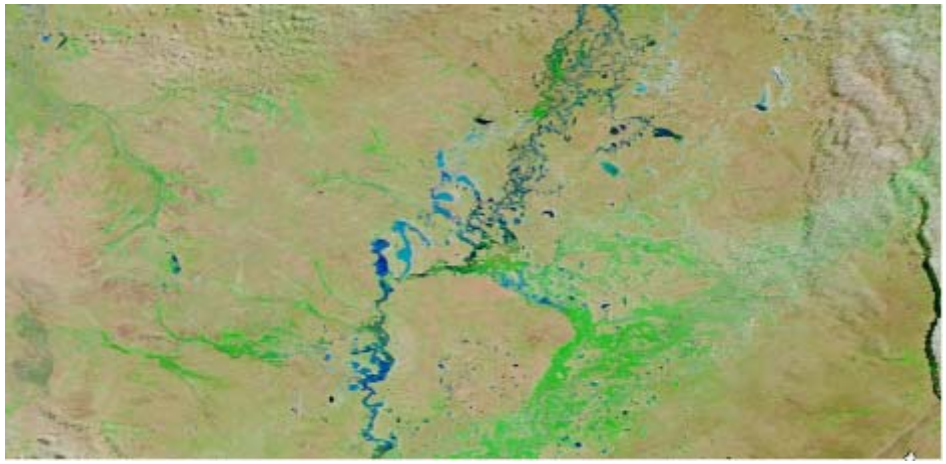
Cyclones

Bushfires

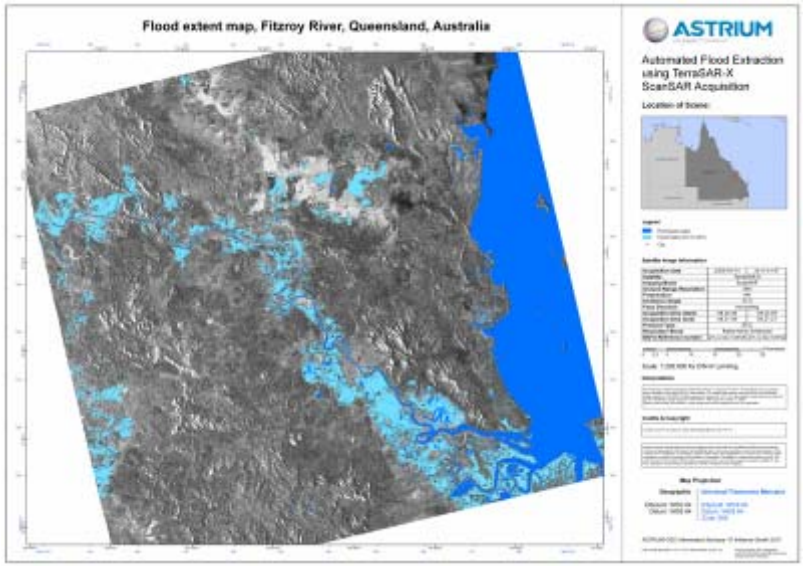
Flooding

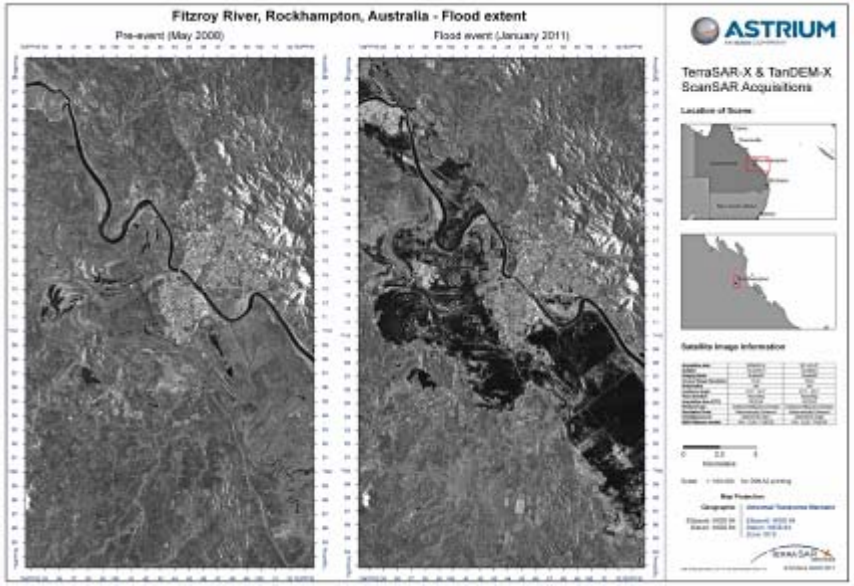
MODIS Channel Country and
Paroo River Catchment March 14,2

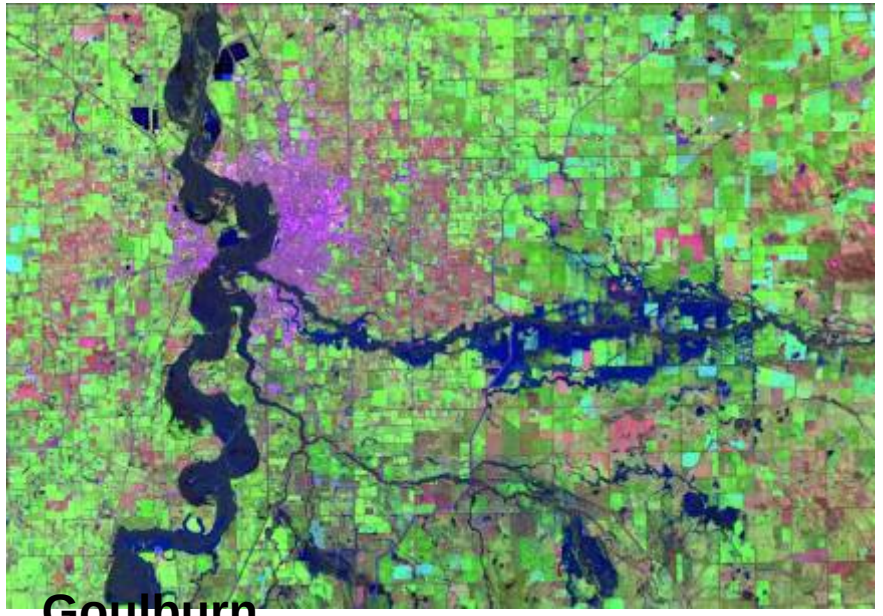




Rural Flooding, Queensland and Victoria , 2011



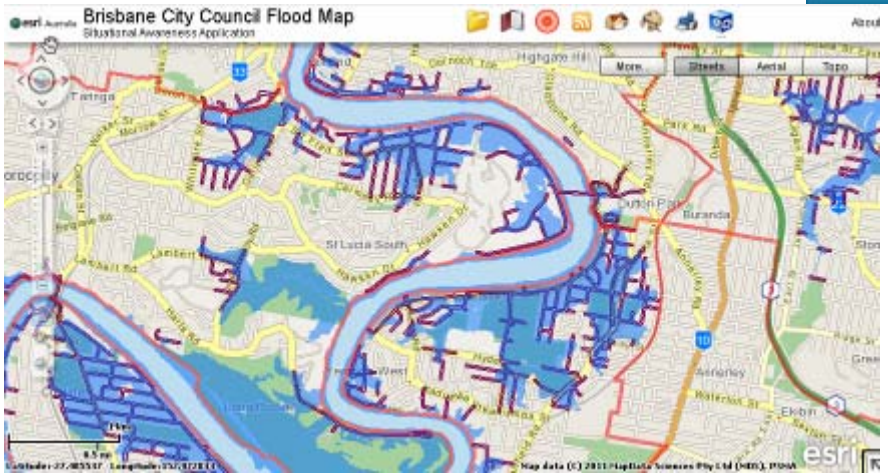




Goulburn River

Brisbane Floods, January 2011

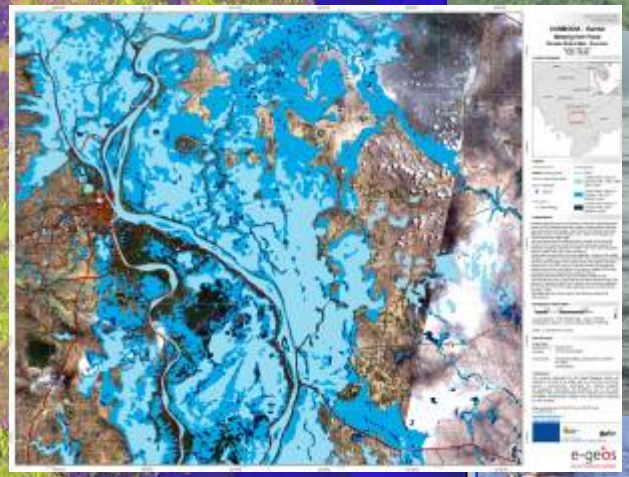
Image



Satellite Map

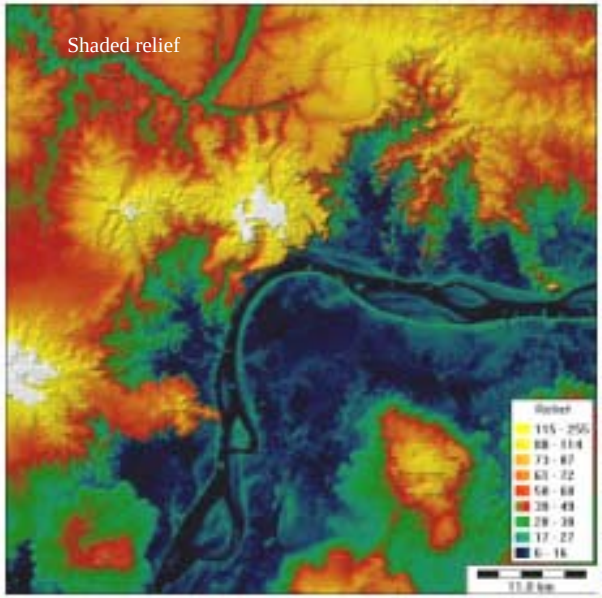
Flood Model simulates a 5.5-metre flood in Brisbane - the level the river was expected to peak at during floods - to help authorities plan their response

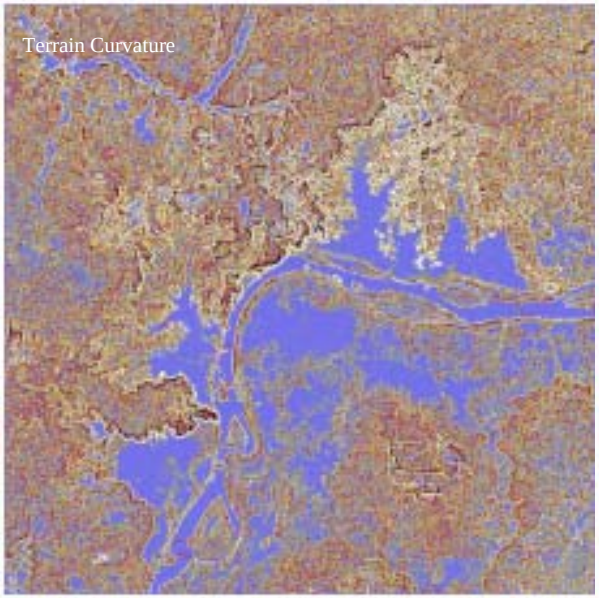
Assessment of Flooding in Cambodia Using PALSAR Data



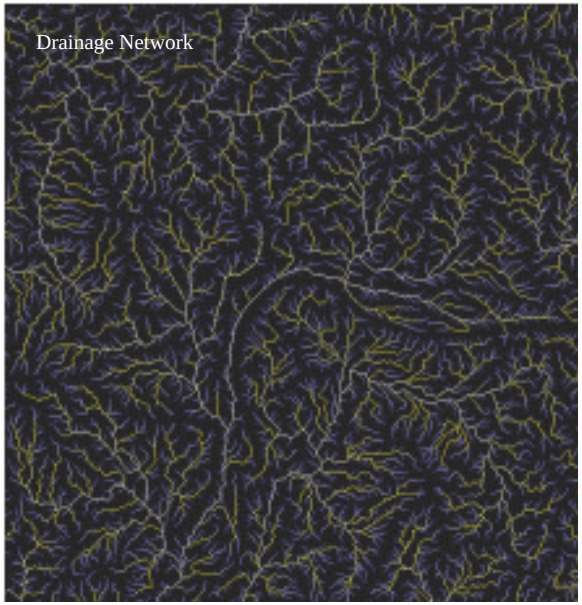
The central and western Mekong Basin Cambodia supports one of the most productive and diverse freshwater ecosystems in the world

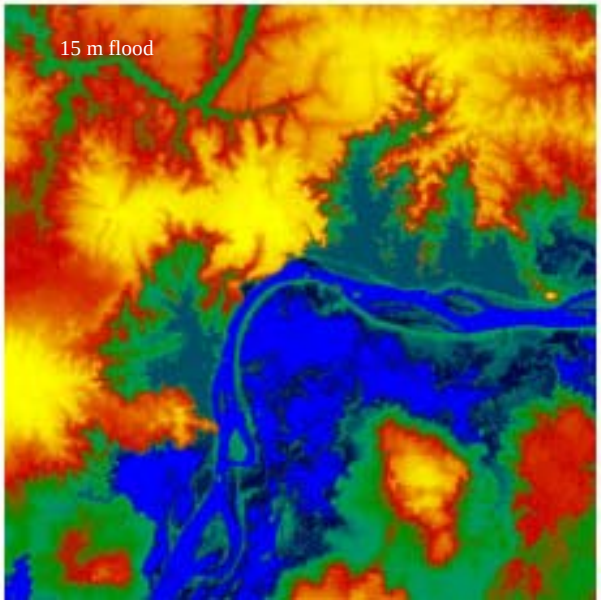
PALSAR 2008 Mosaic
Lower Mekong Basin
(HH,HV,HH-HV)

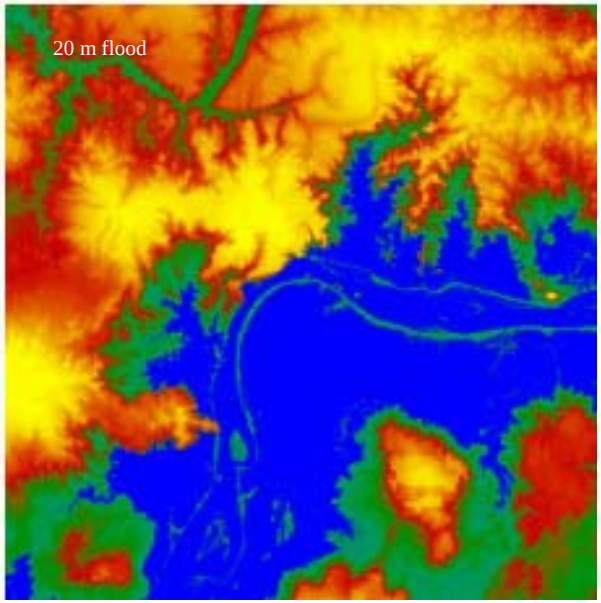




Modelling River Catchments using SRTM 90 DEM

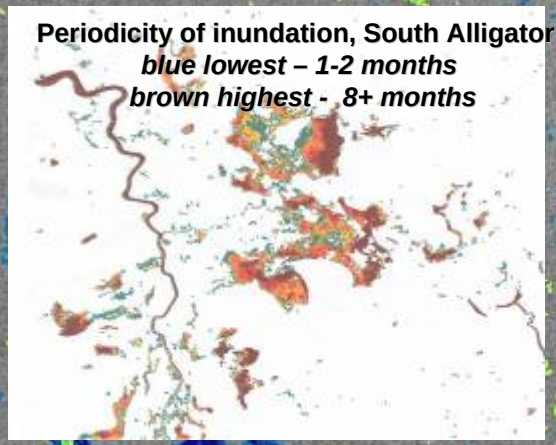




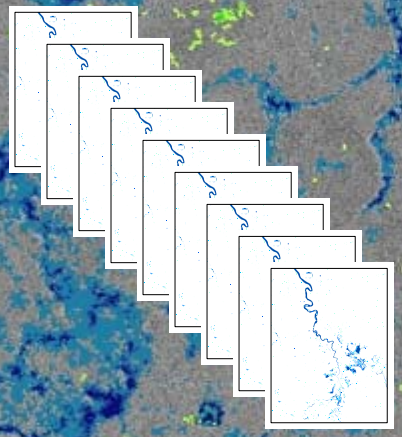


Flood Recession Mapping

South Alligator River, NT

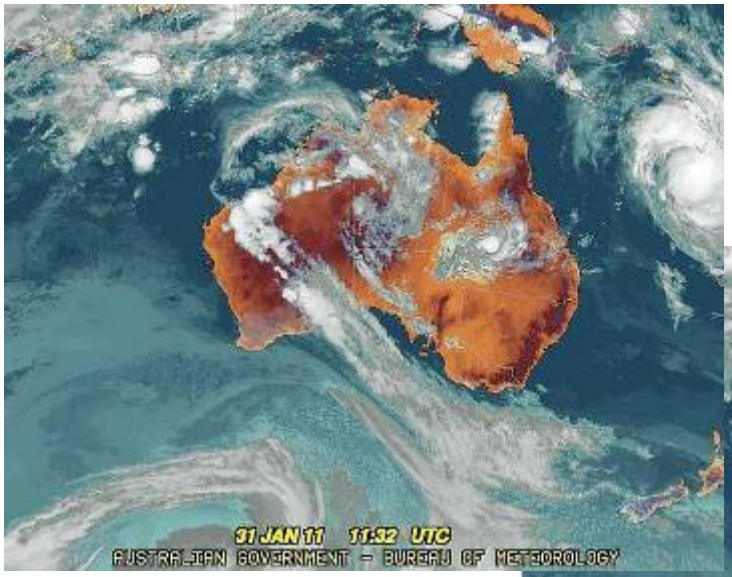


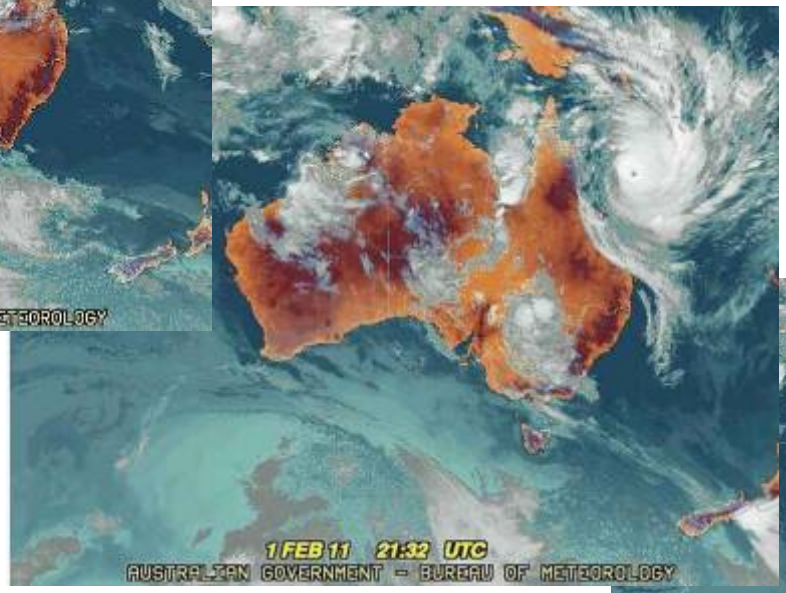
Shows all areas subject to period or permanent water cover



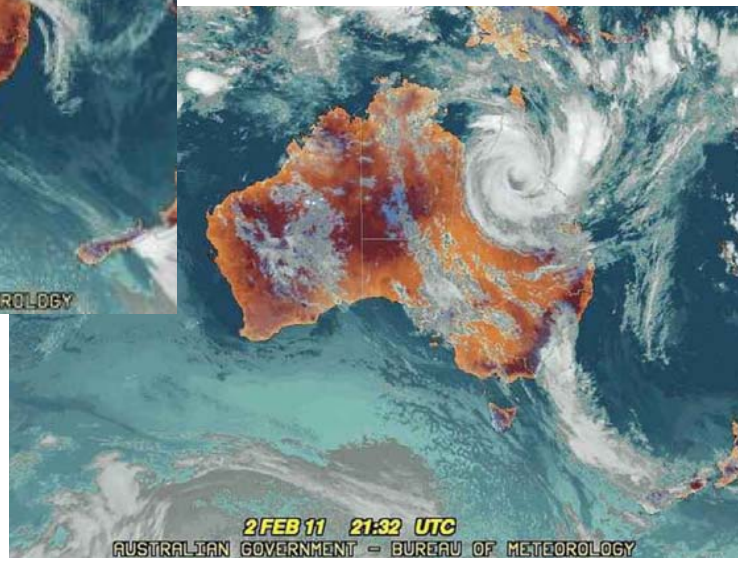
2001Radarsat Time Series

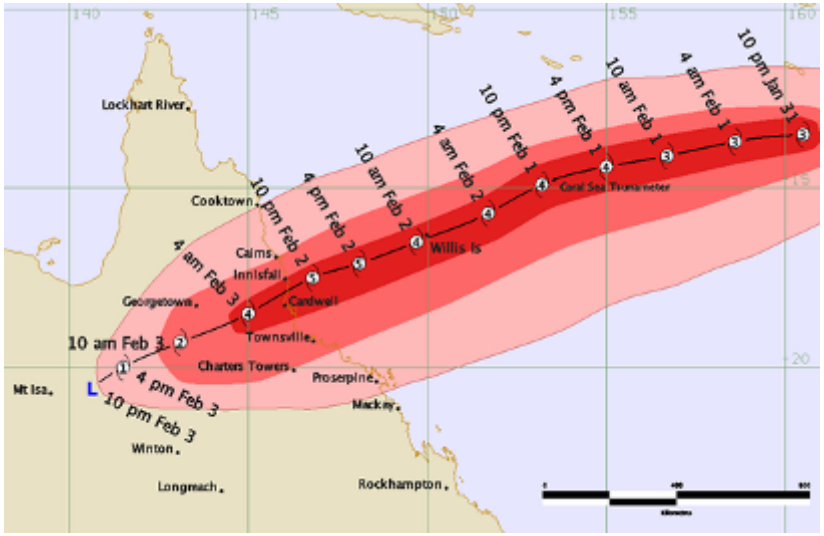
Tropical Cyclones





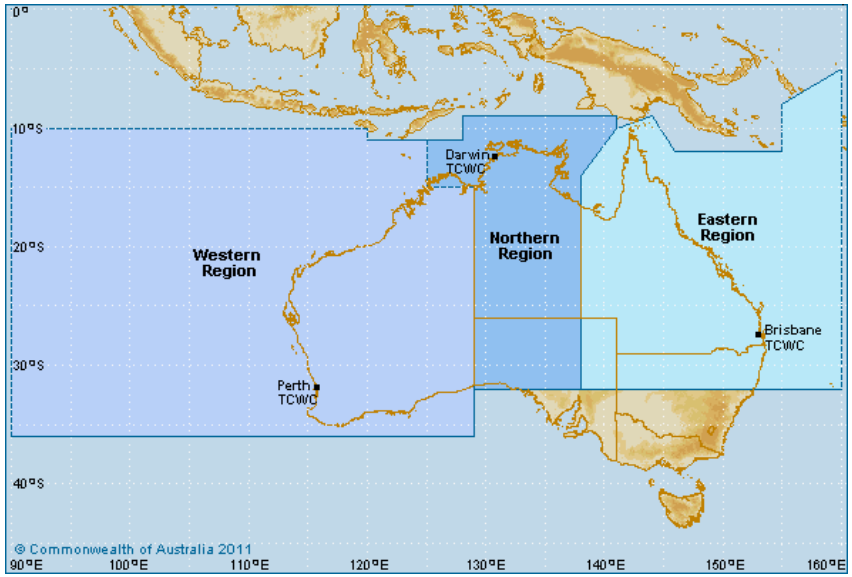
Australian Government
Bureau of Meteorology





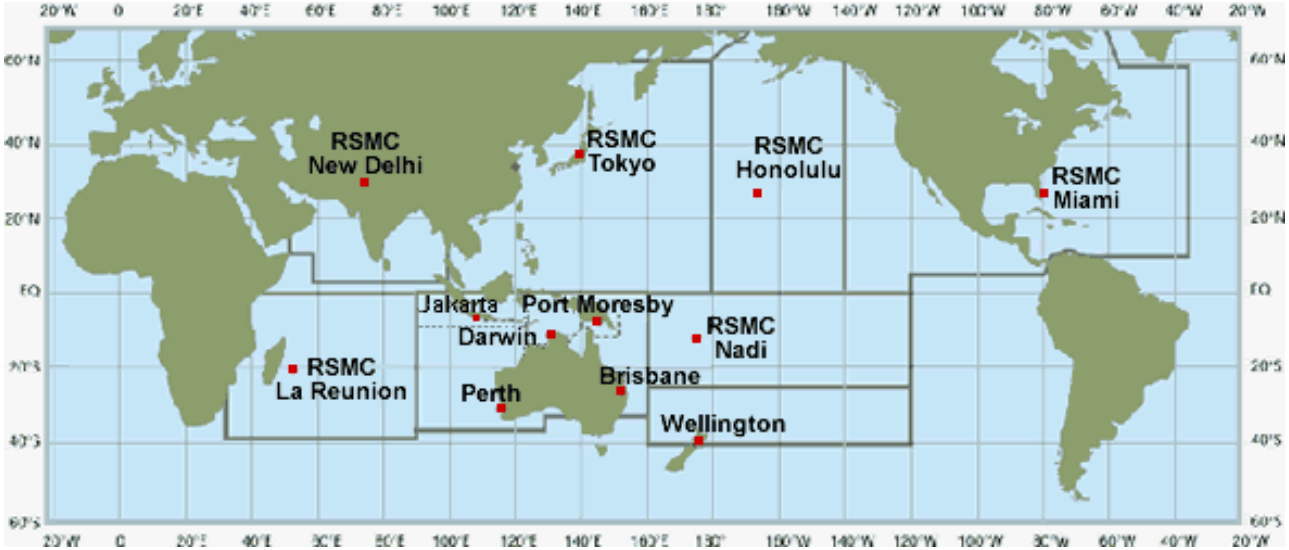
Cyclone Yasi **is one of the most powerful cyclones to have affected Queensland since records commenced. On 2nd Feb 2011 it was upgraded to a marginal Category 5 system.**
http://www.bom.gov.au/cyclone/history/yasi.shtml

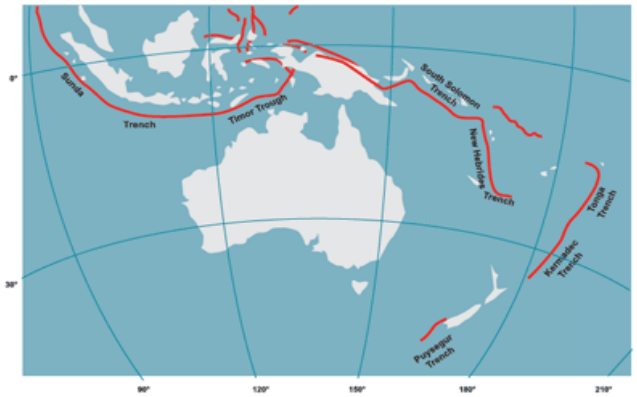
Australian Regional Cyclone Network



- The Australian region tropical cyclone season runs from
  1 November to 30 April
- Cyclones sometimes occur outside this period, mainly in the Central Indian Ocean southwest of Sumatra.
- Seasonal outlooks are issued in October and may be updated during the season.
- Three-day outlooks are issued during the cyclone season for most areas.
- They are issued throughout the year for the Indian Ocean area.

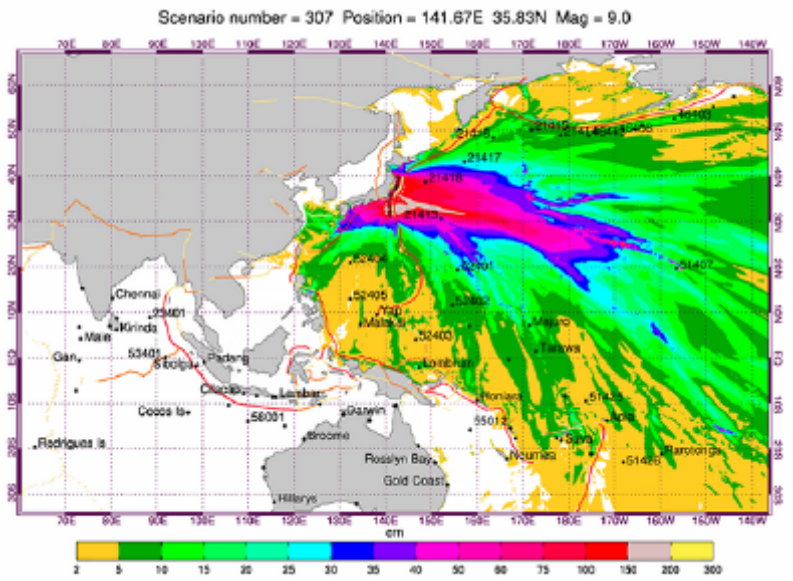
Linked to International Network

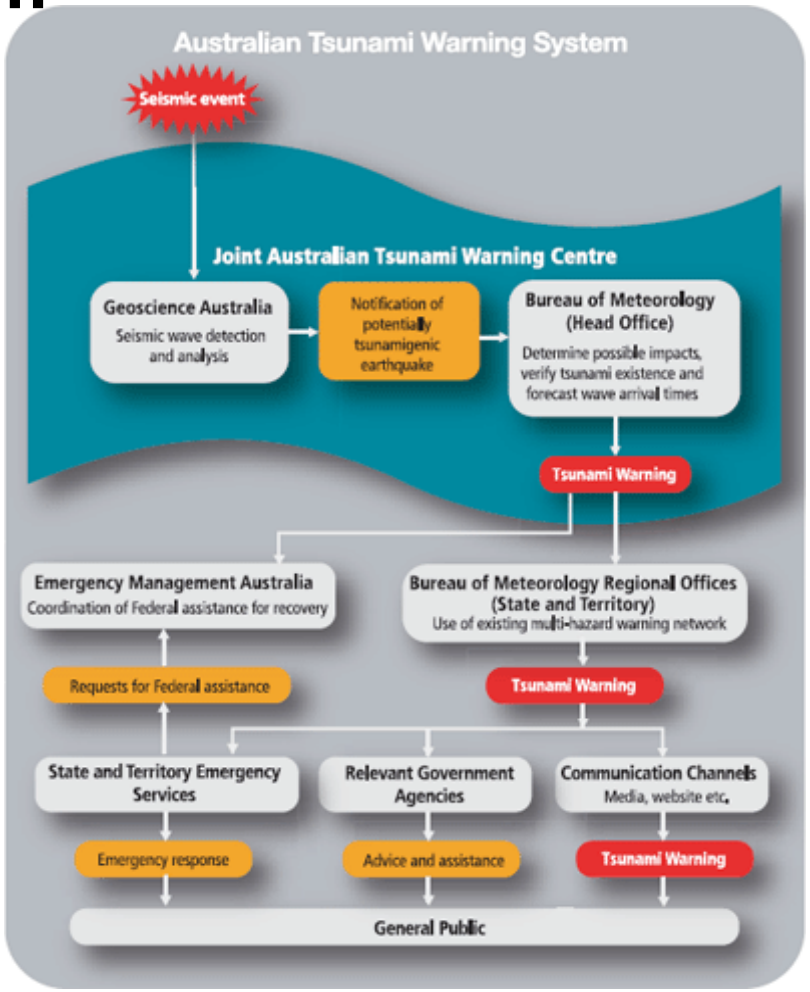




Australian Tsunami Warning System

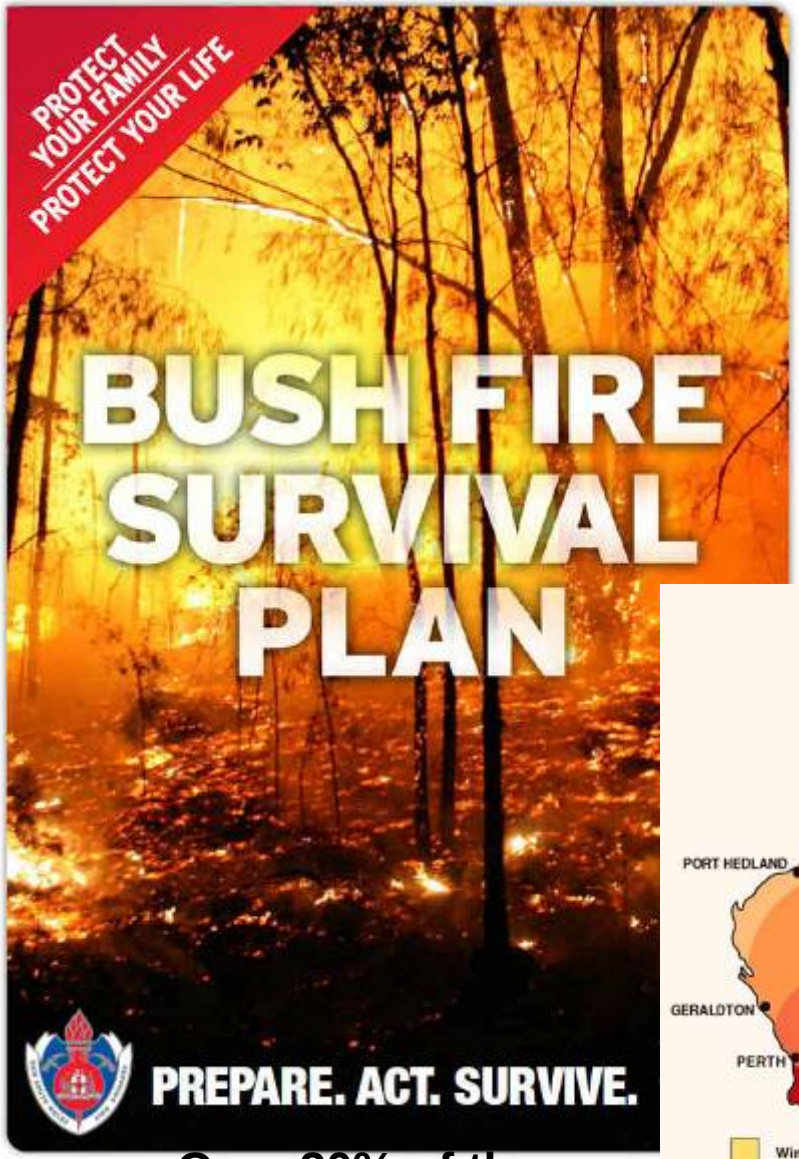
Australia is bounded on the northwest, northeast and east by some 8,000 km of active tectonic plate boundary capable of generating tsunami, which could reach our coastline within two to four hours. One-third of all earthquakes worldwide occur along these boundaries. The impact of a tsunami hitting vulnerable low-lying areas of the Australian coast could be significant.





Geoscience Australia receives real-time data from over 50 seismic stations in Australia, and more than 120 international seismic stations.

Australian Bushfires



Over 20% of the continental surface is burnt in any 12 month period

Live coverage: WA's bushfire emergency

Staff Reporters

November 24, 2011 - 7:25AM

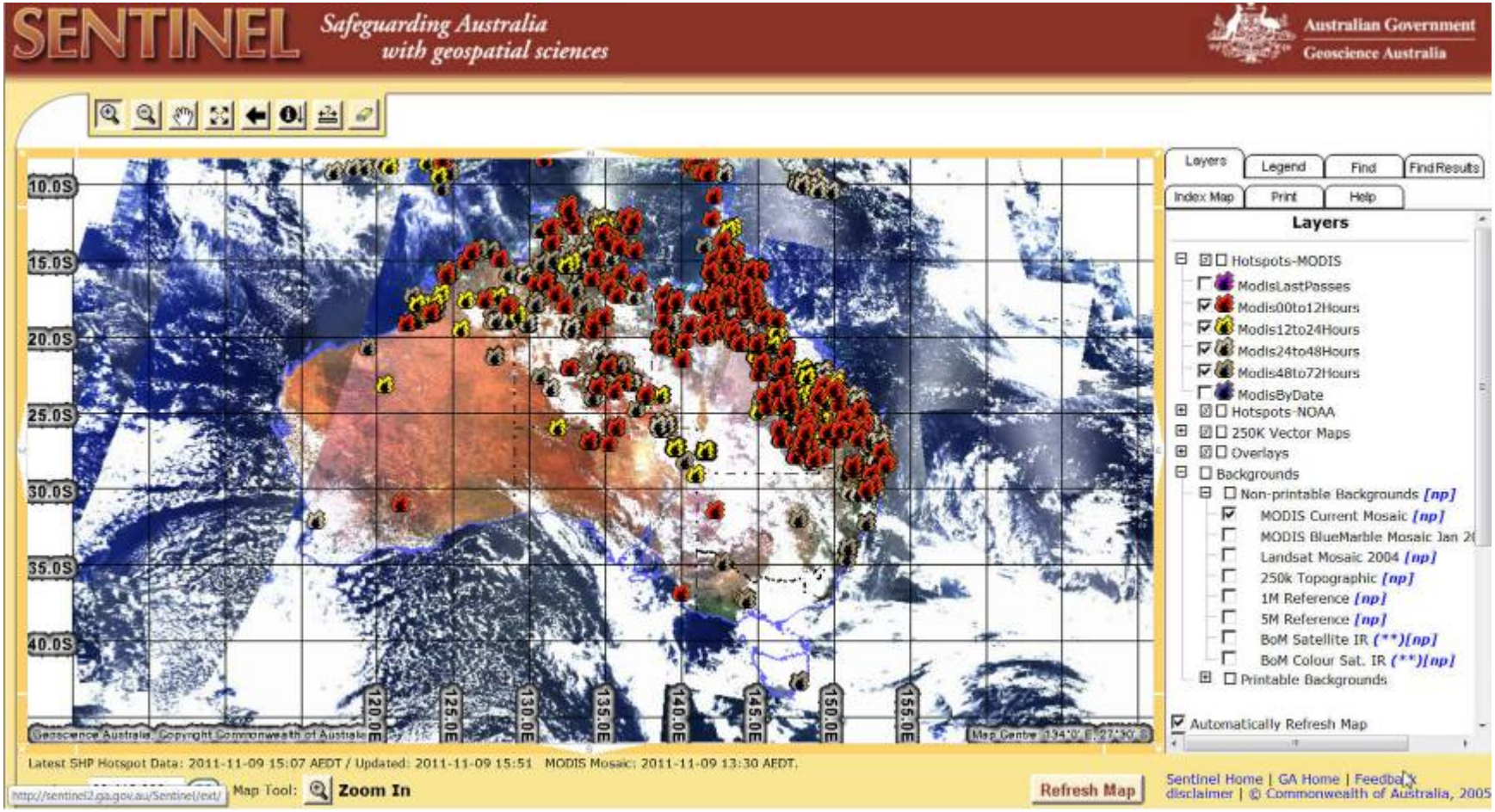
A fire that has razed up to 20 properties in the Margaret River region is today contained but still not under control.

A bushfire emergency warning has been issued for people in the Kilcarnup, Prevelly and wilderness subdivisions and the area north of Wallcliffe Road and east of Caves Road in the Shire of Augusta-Margaret River

Read more:

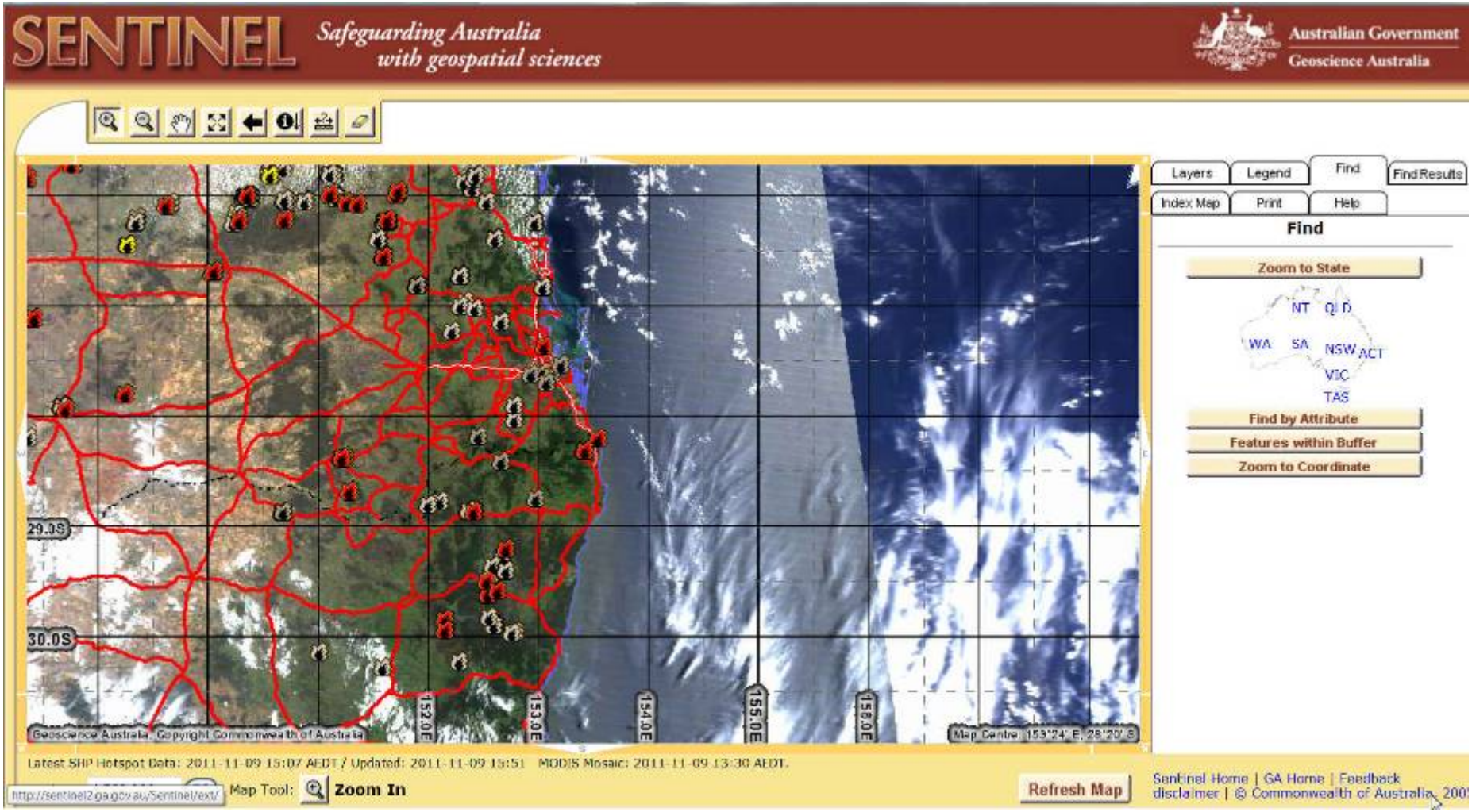
http://www.watoday.com.au/wa-news/bushfire-burns-homes-too-late-for-e

Australian Bushfires

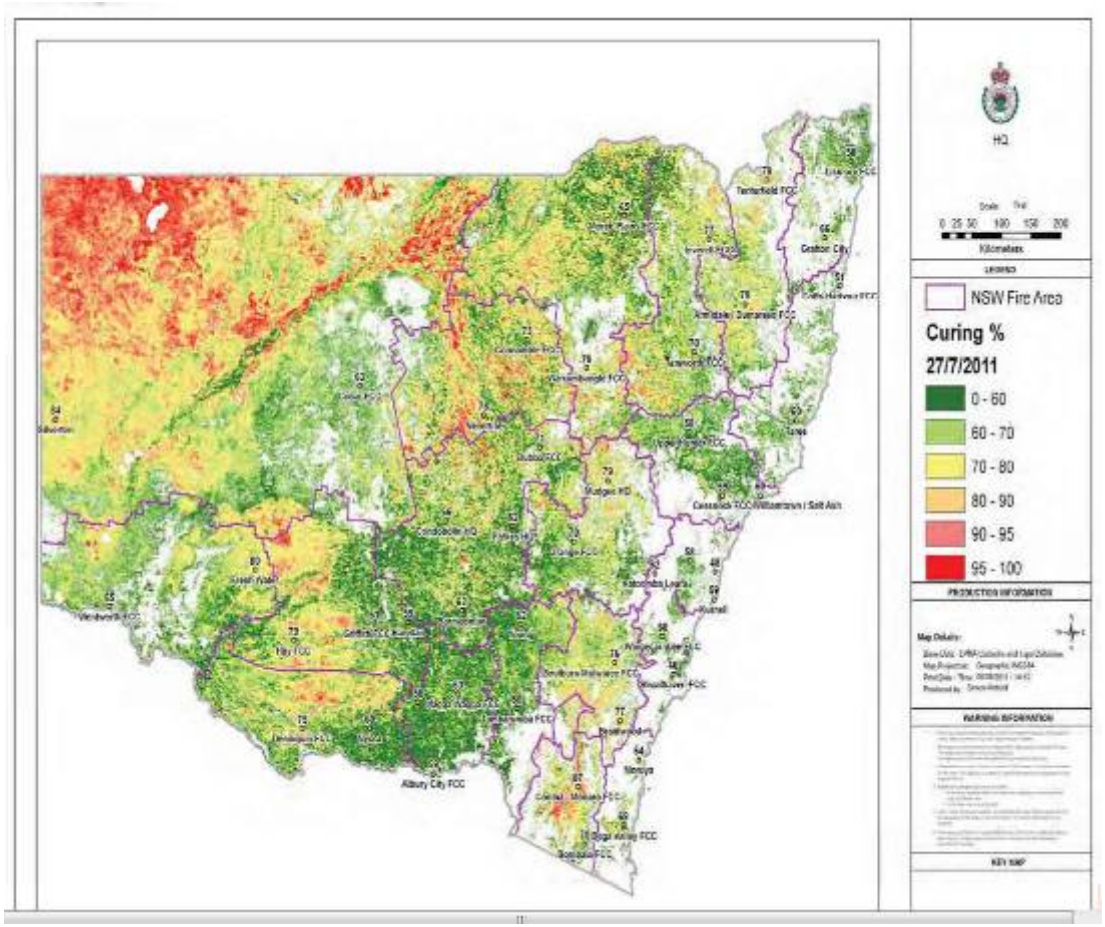


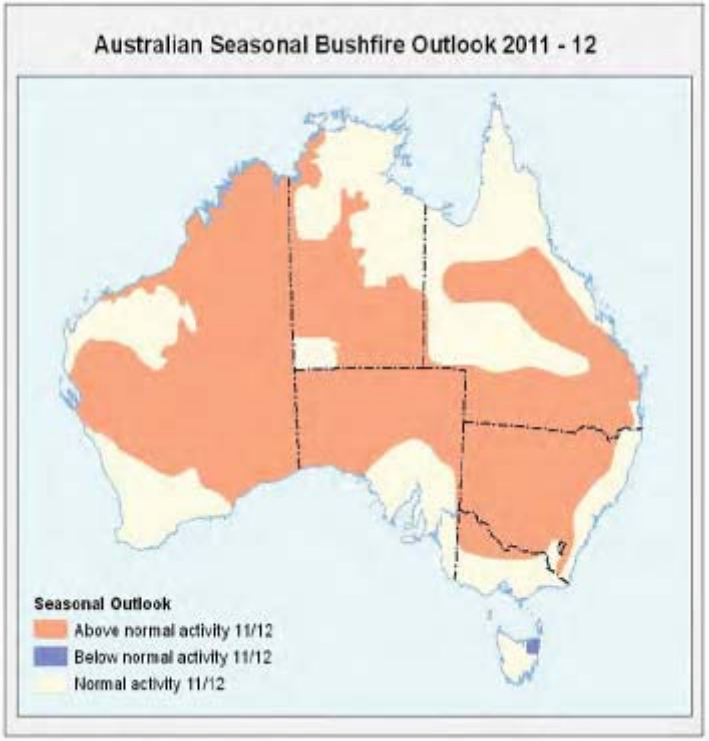
Sentinel is a national bushfire monitoring system that provides timely information about hotspots to emergency service managers across Australia. The mapping system allows users to identify fire locations
with a potential risk to communities and property.

Australian Bushfires

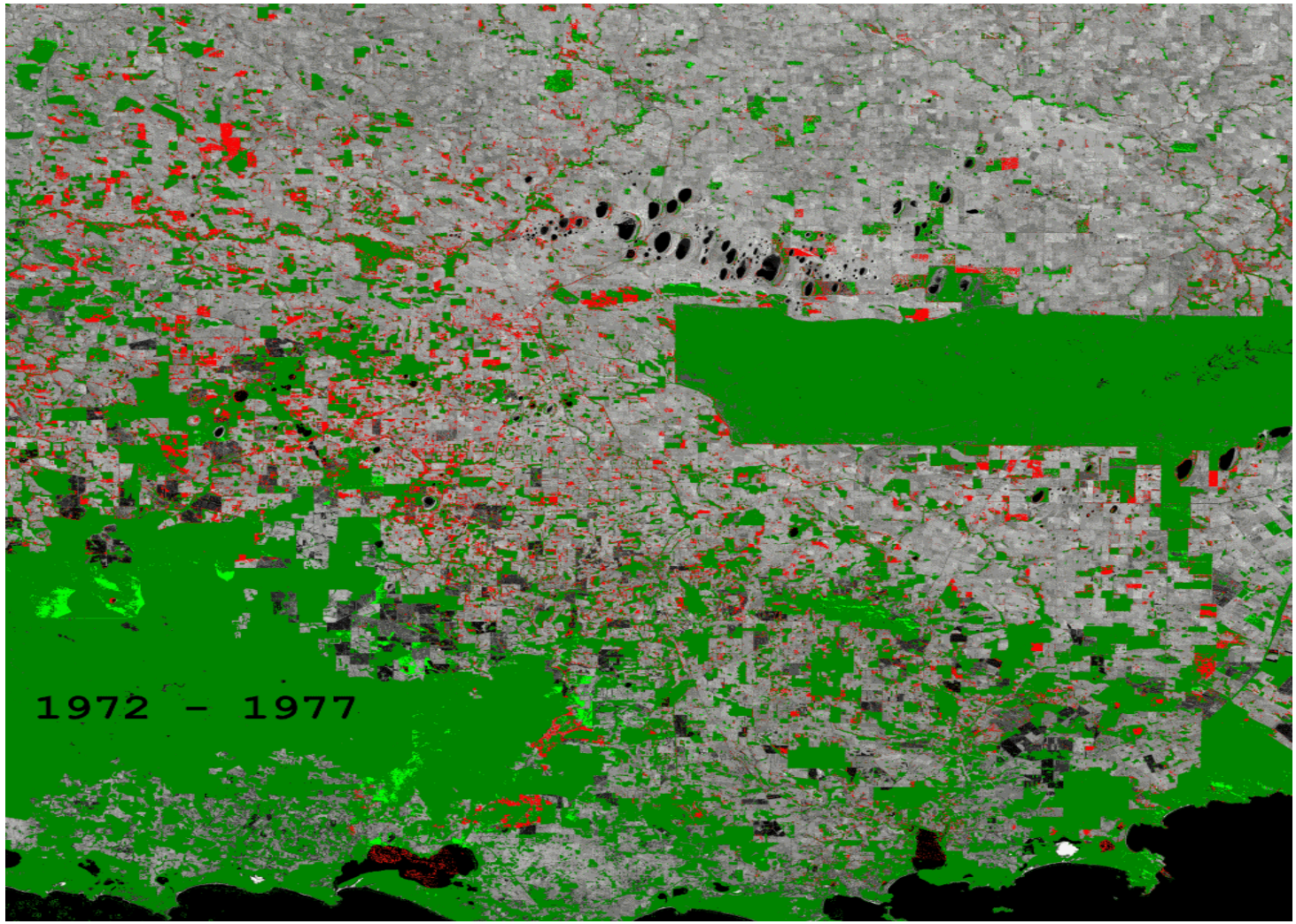


Australian Bushfires





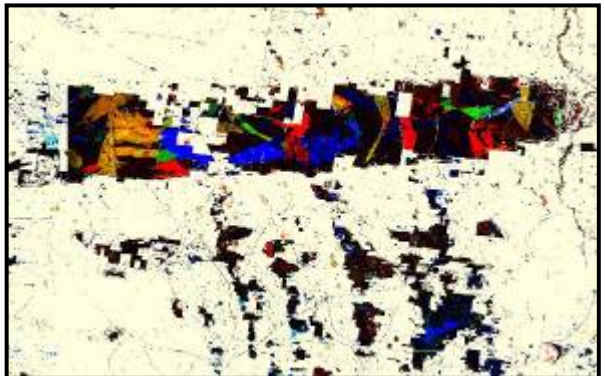
Grassland Curing at 27 July, 201



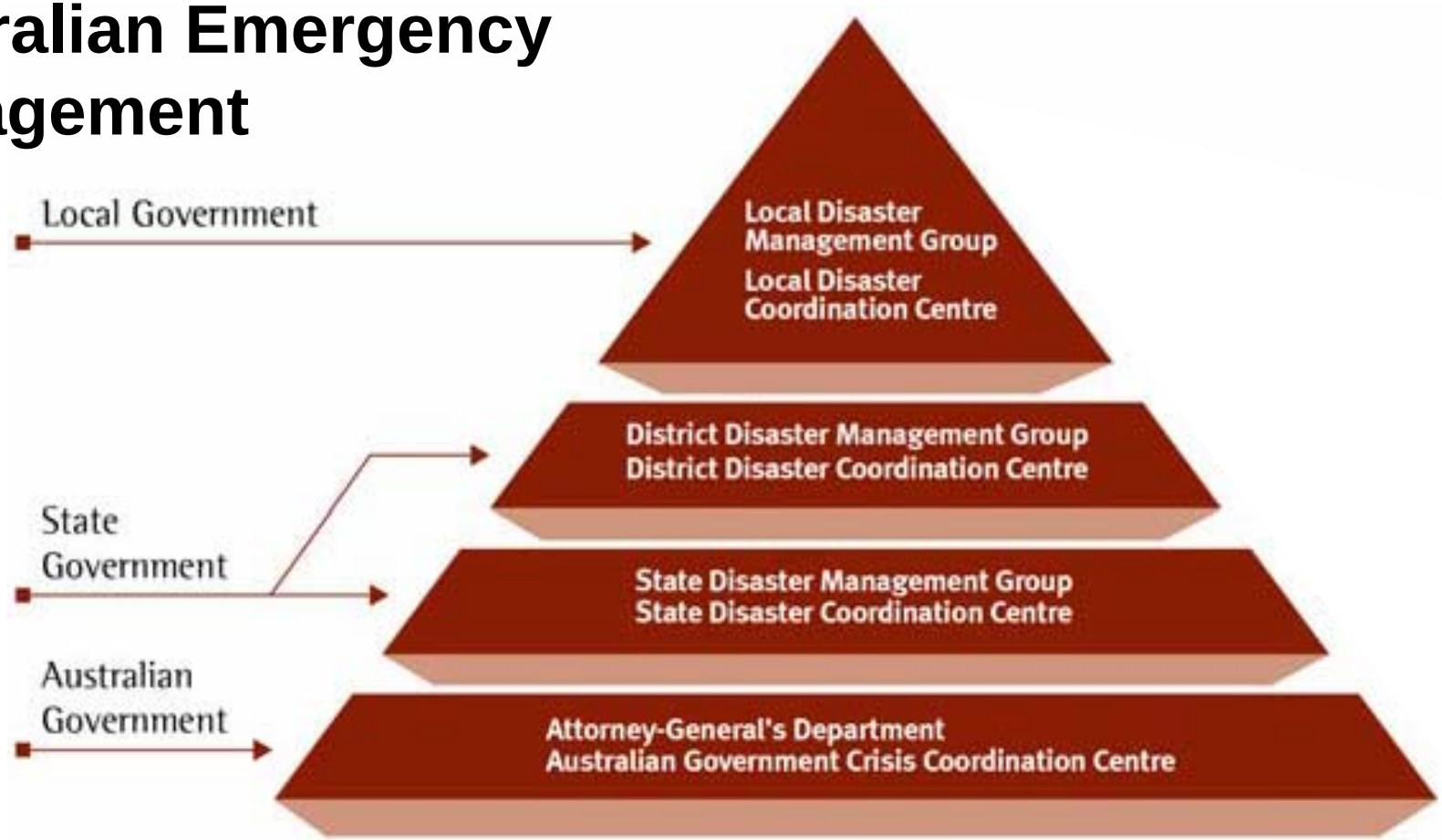
Change Mapping

Trends 1996-2006

Black: stable over time
Colours: fire history and recovery by date*(Wallace et al.)*



Australian Emergency Management



Disaster management groups are established at local, district and State levels and supported by disaster coordination centres. The Australian Government is committed to supporting States and Territories in developing their capacity for dealing with emergencies and disasters, and provides physical assistance to requesting States or Territories when they cannot reasonably cope during an emergency. Australian Government agencies include :

Department of Finance and Deregulation **Geoscience Australia** **Bureau of Meteorology**

EO System Issues

- Timeliness
- Delivery mode - internet capacity and connectivity
- Duplication/redundancy of products-amount of data
- Communication and networking of providers – greater coordination
- Data policy and licence issues
- Da

No single sensor source for all crisis events
Multi-sourced data requirement
Question of interoperability

IT System Issues

- Clear understanding of information products needed for emergency situations - “rapid mapping ”?
- Analysis, interpretation - who does it??
- Products and service delivery – how ?
- Access to and incorporation of local baseline geospatial datasets - fusion
- Dissemination to disaster management community
- Degree of familiarisation with spatial products

Where should this processing take place
Question of repository

Capacity building Issues

- Must include financial, programmatic, institutional, personnel and community commitment
- Technology transfer – hardware/software
- Involve specialised technical training
- Include advisory services – best practice
- Integrate across emergency response, recovery and mitigation phase management

Empowering and strengthening local and regional disaster management communities
Question of organisation

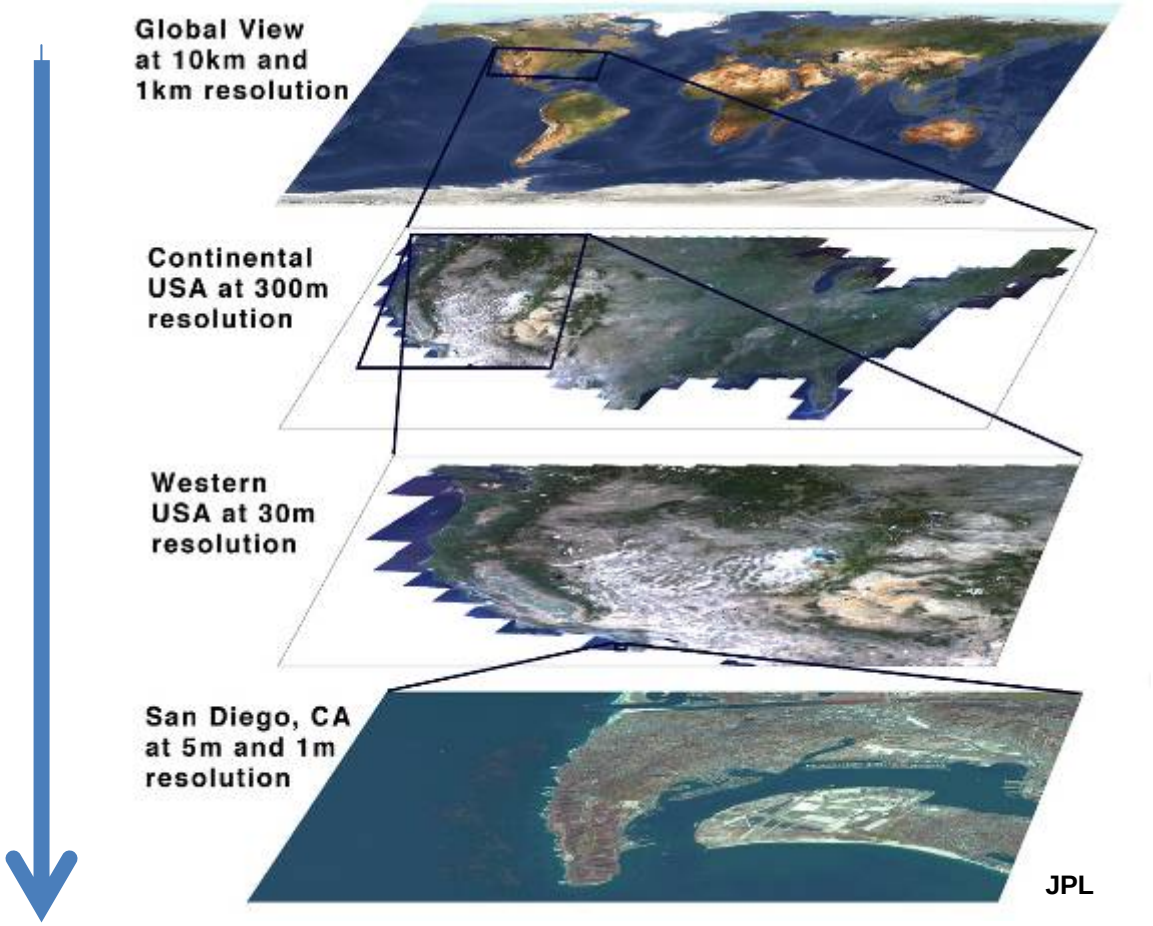
No single sensor source for all crisis events
Multi-sourced data requirement
Question of interoperability

Where should this processing take place
Question of repository

Empowering and strengthening local and regional disaster management communities
Question of organisation

Need for local knowledge, skills and the fusion of EO with other geospatial data is the most persuasive argument for equipping Country Disaster Co-ordination Centres.

Challenge – Greater Spatial Literacy



attributes addressed as on a globe

Digital Earth

Geospatial is a term widely used to describe the combination of spatial software and analytical methods with terrestrial or geographic datasets

Convergence of Information Technologies

User generated content in a virtual community

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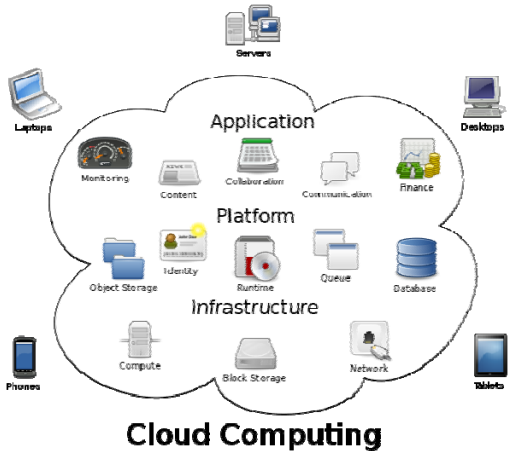


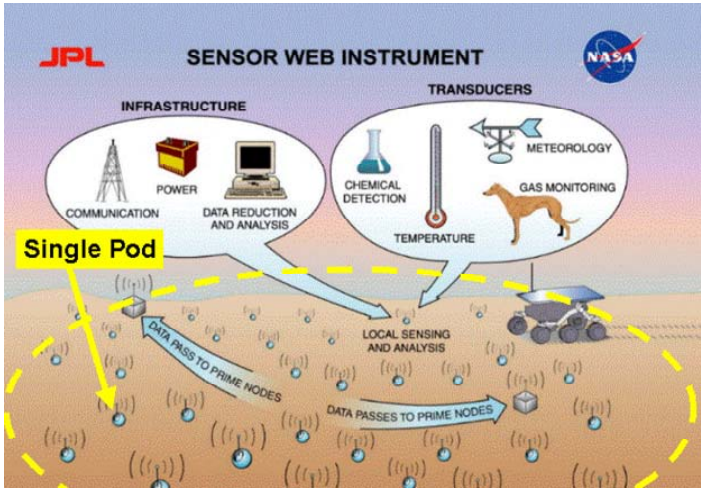
Cloud Computing

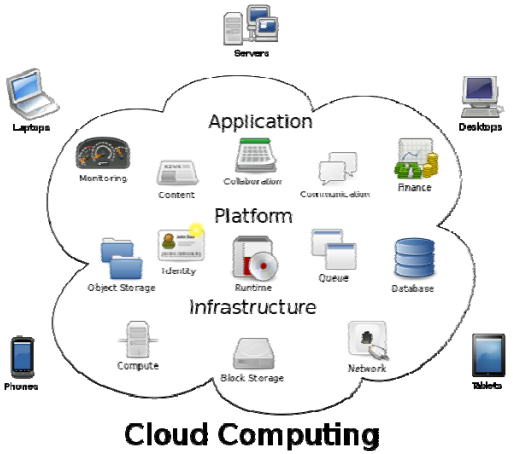
Delivery of shared resources, software, and information to computers and other devices

Convergence of Information Technologies

User generated content in a virtual community

Data gathering devices coupled with computational intelligence and communication





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IEEE SMARTGRID

To predict and intelligently respond to the behaviour and actions

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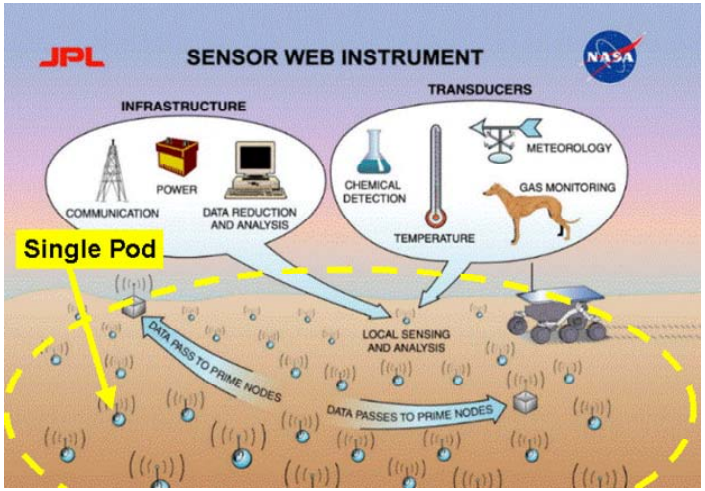

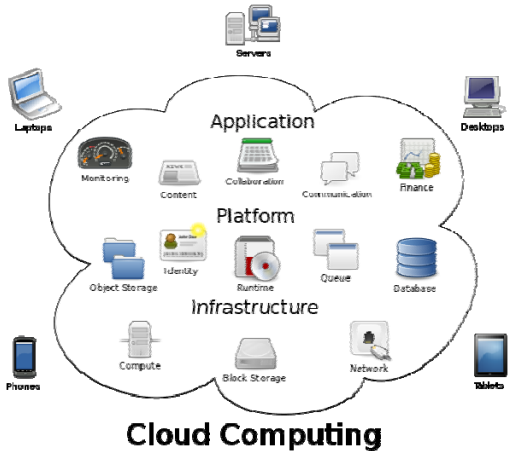

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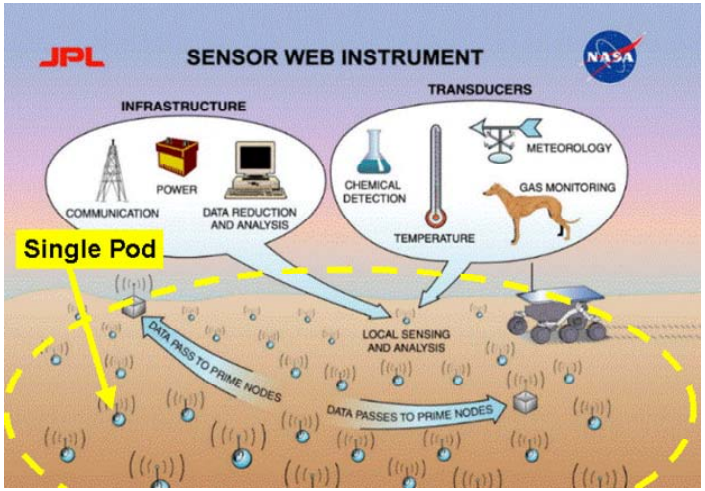

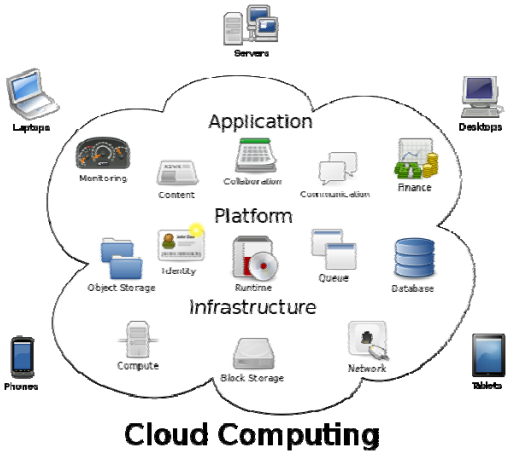

Cloud Computing

Use of web-based and mobile technologies to turn communication into an interactive **dialogue**

Delivery of shared resources, software, and information to computers and other devices

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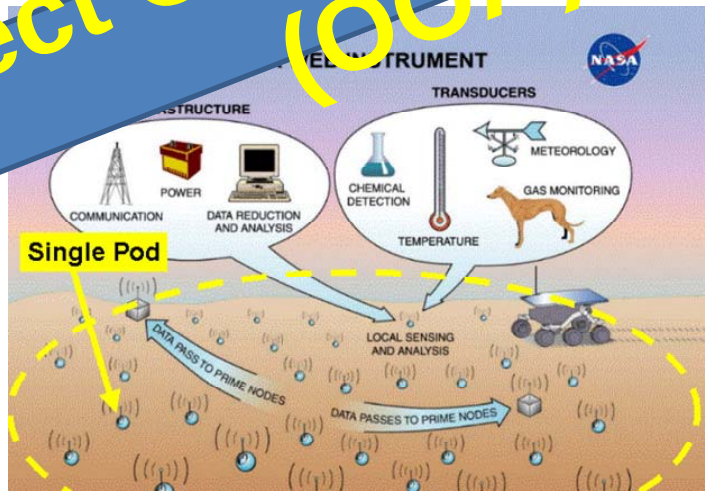
User generated content in a virtual communit

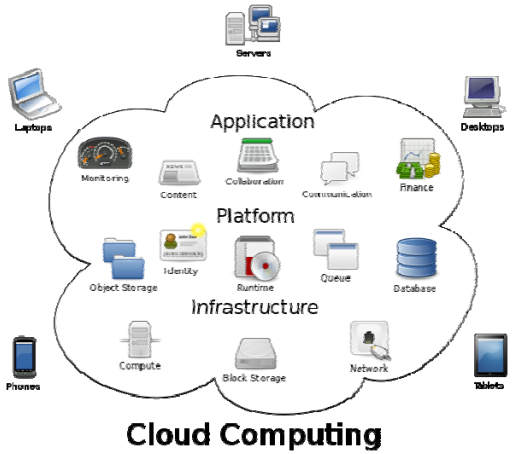
Object Oriented Analysis (OOA)

To predict and intelligently respond to the behaviour and actions

Data gath
devices co
computation
intelligence and communication



Use of web-based and mobile technologies to turn communication into an interactive dialogue



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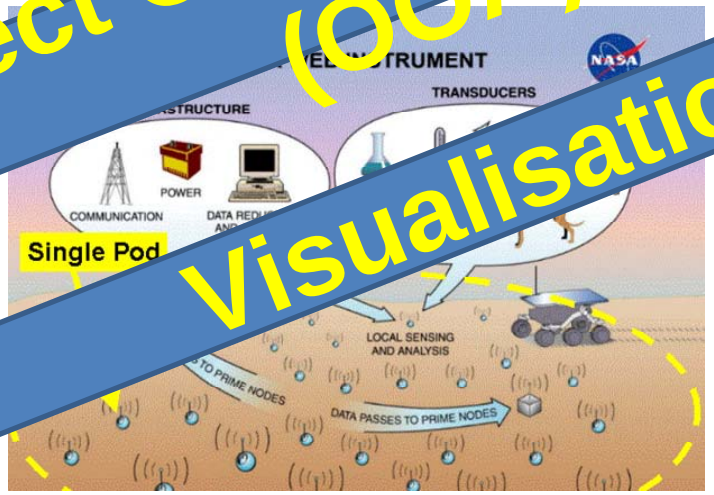
User generated content in a virtual communit

To predi… intelli… …nd to …aviour and actions

Data gath… devices co… computation… intelligence and communication

Object Oriented Analysis (OOA) Visualisation



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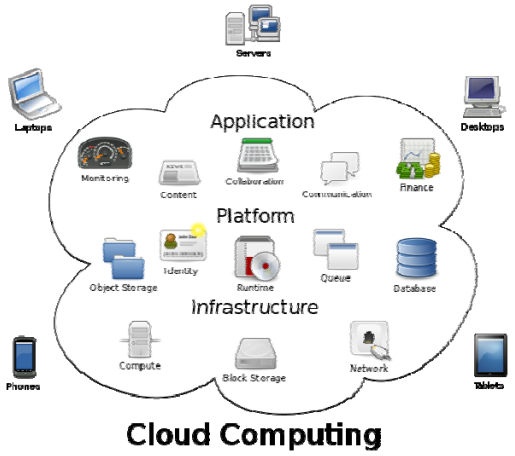

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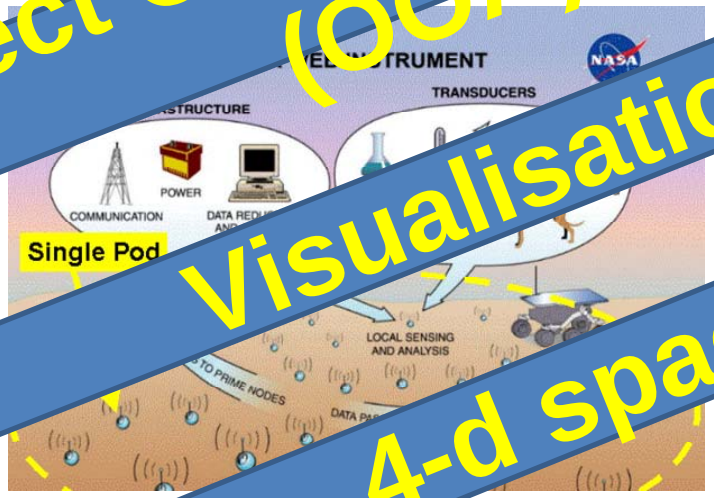

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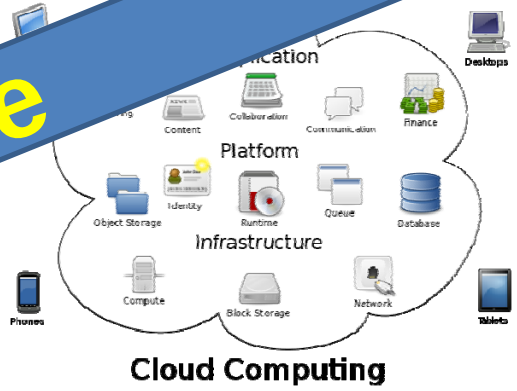

Delivery of shared resources, software, and information to computers and other devices

Object Oriented Analysis (OOA)

Visualisation

4-d space

[Bushfire Connect](#) is a free, community driven service that combines fire information from multiple sources: official and crowdsourced, through multiple media such as the web, mobile devices and SMS.

Bushfire Connect allows local communities to complement official emergency information with grassroots fire reporting.

BushfireConnect

Institute of Electrical and Electronics Engineers

GRSS

Geoscience and Remote Sensing Society

…… to work with other agencies to share GRSS's scientific, technical,educational and professional services more effectively with developing countries as well as contribute to societal benefits……

IEEE-GRSS Support to UN-SPIDER - On Going Dialogue

Major Points of Interest:

- UN-SPIDER Regional Support Offices (RSO)
  - infrastructure and facility program development
  - specialist consultations
- Technical Advisory Missions
  - providing suitable expert personnel
  - offering specialist workshops to interested countries and networks.
- Capacity Building and Development
  - technical training programs and curricula development
- UN-SPIDER Knowledge Portal
  - providing Space Application Guides content (introductory overviews case-studies and specific application examples)
  - providing Technology Guides content (introductory overviews)
  - providing free of charge access to selected eXPLORE papers dealing with Disaster Management and Emergency Response.

GRSS Preparatory Steps:

- Identifying Disaster Management experts within the GRSS membership.
- Initiating a GRSS Working group on Disaster Management and Emergency Response.
- Establishing suitable GRSS/ UN-SPIDER communication and feedback mechanisms


Thankyou!