

# Delivering sea ice and oceanographic information over low bandwidth connections

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**British  
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NATURAL ENVIRONMENT RESEARCH COUNCIL

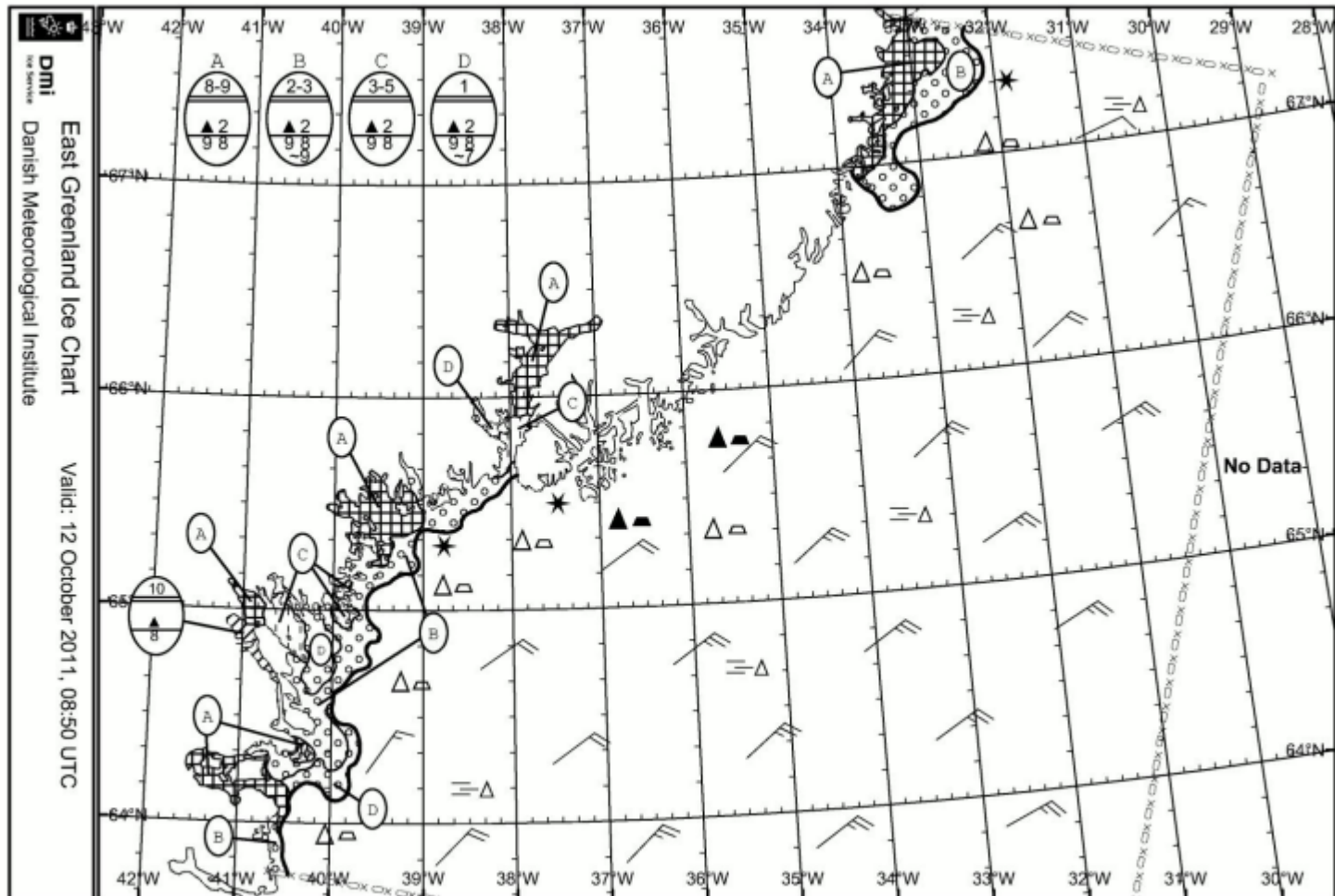


**Polar View**

# RRS James Clarke Ross & RRS Ernest Shackleton

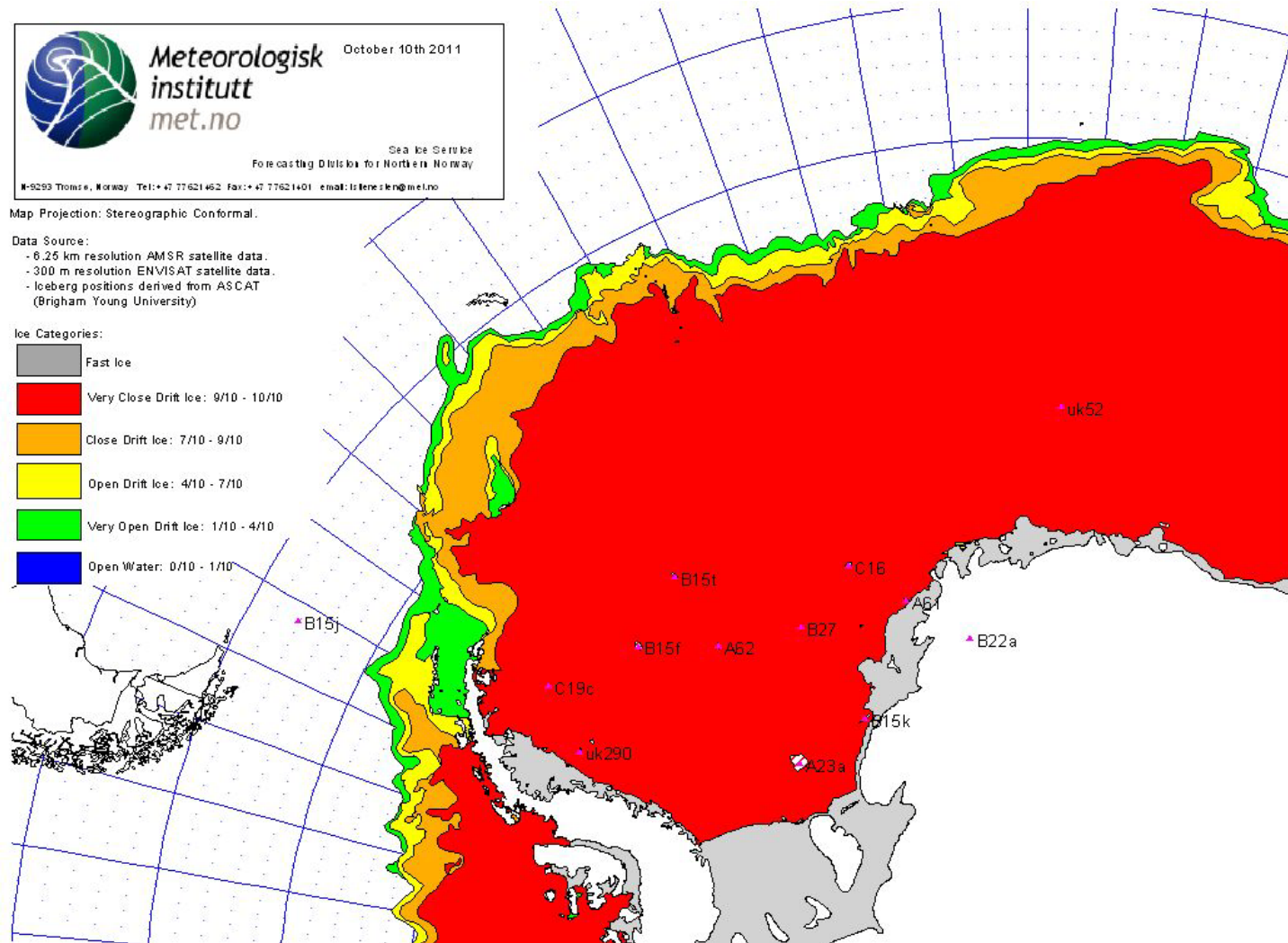


# Low volume



Black and white ice chart (courtesy DMI) – ~300Kb pdf

# Low volume



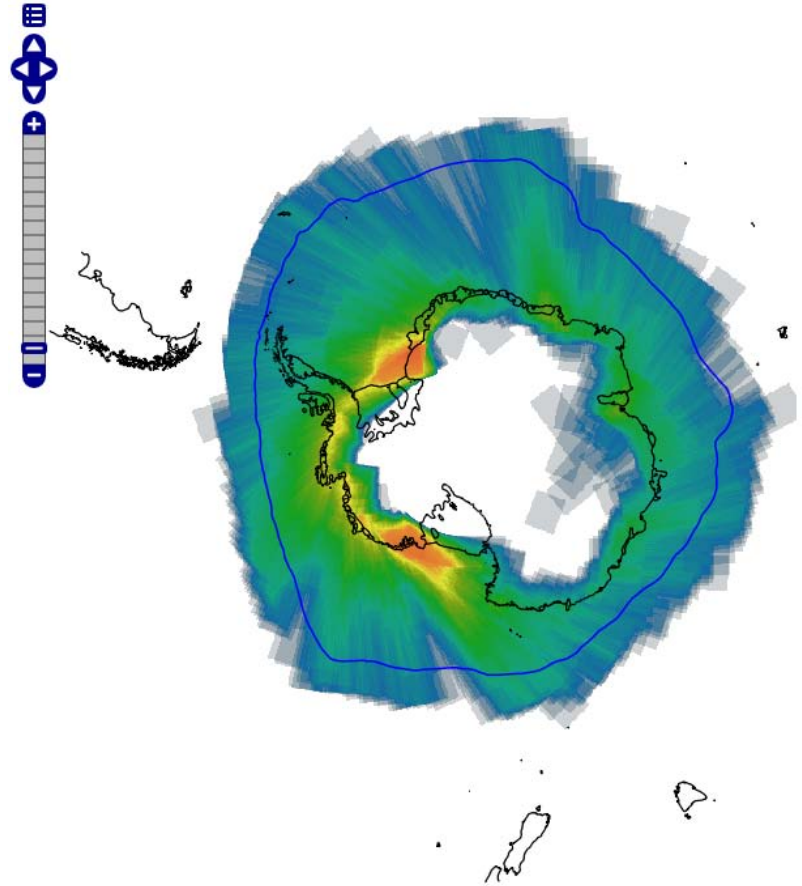
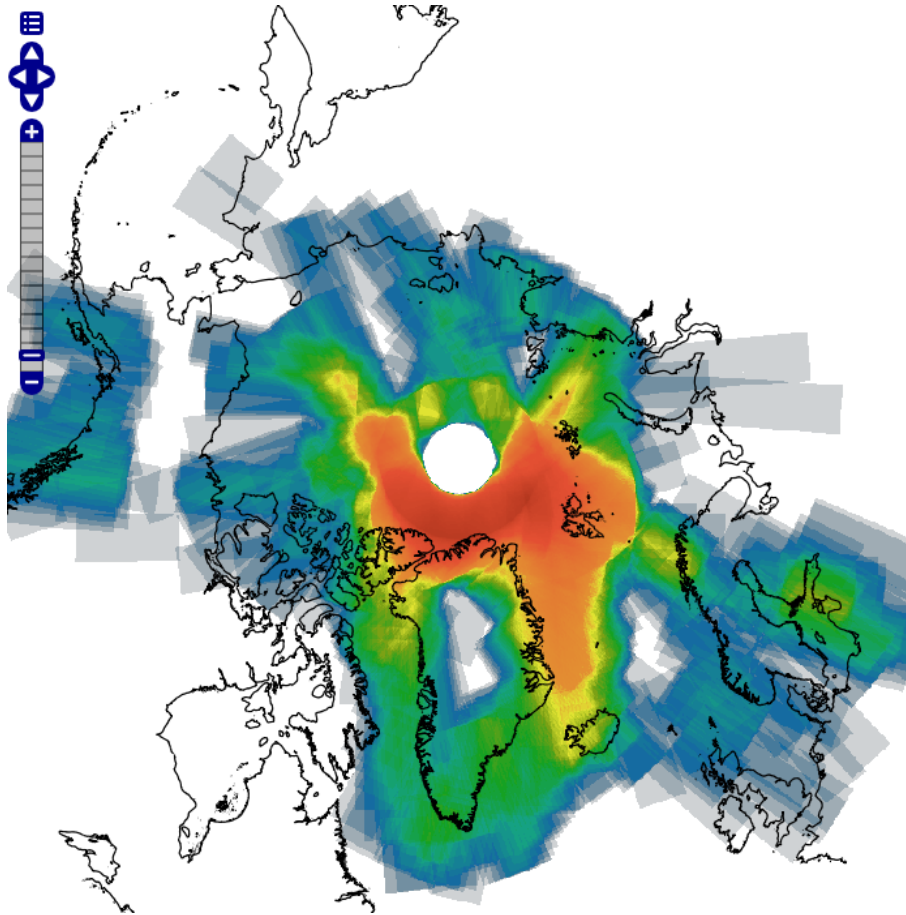
Colour ice chart (courtesy Met.no) – ~150Kb jpg, ~60Kb shp



PolarView High Resolution Sea Ice Monitoring Service  
 Original ASAR WDM image subset  
 Original product ASD\_WDM\_1PRVCE20111012\_05002\_0000WGP67\_0200\_0700\_000N1  
 Image acquisition date/time: 2011-10-12 05:33:40 UTC  
 Projection: Antarctic Polar Stereographic (EPSG:3031)  
 Spheroid: WGS84  
 Latitude of true scale: 71.0

PolarView High Resolution Sea Ice Monitoring Service  
 Universal ASAR WDM image subset  
 Original product: ASAR\_WDM\_1FNAC20111012\_020003\_03000021607\_0200\_0000\_000001  
 Image acquisition date/time: 2011-10-12 00:33:46 UTC  
 Projection: Antartic Polar Stereographic (EPSG 3031)  
 Spheroid: WGS84  
 Latitude of true scale: 71.0

# Information fire hose

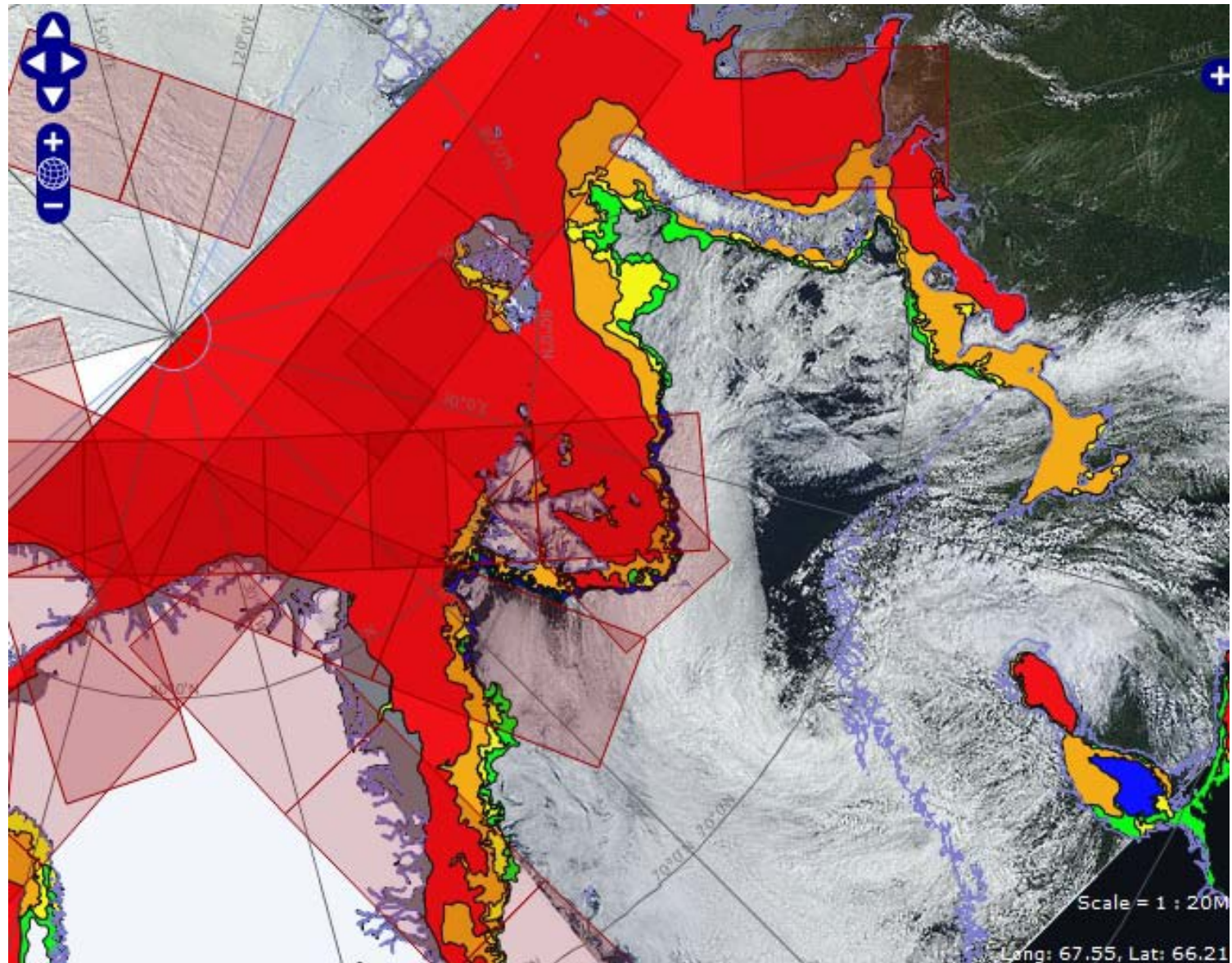


Envisat ASAR coverage every 1 – 3 days

Plus other instruments, higher resolution, polarimetric



# Information fire hose



# Satcoms connection options

Connection type	Bandwidth	1 Mb	5 Mb	50 Mb
Iridium	2.4 Kbps	~ 1 hour	~5 hours	Eternity
Iridium Openport	128 Kbps	~ 1 minute	~ 5 minutes	~55 mins
Standard IP	432 Kbps	~ 20 seconds	~ 1.5 minutes	15 minutes
Inmarsat GlobalXpress	50 Mbps	Lightning	~ 1 second	~ 8 seconds

Remember - these are generally shared connections – and do not consider other problems such as overheads, latency, dropped connections etc



# Connection options



Polar regions have limited coverage from geostationary systems

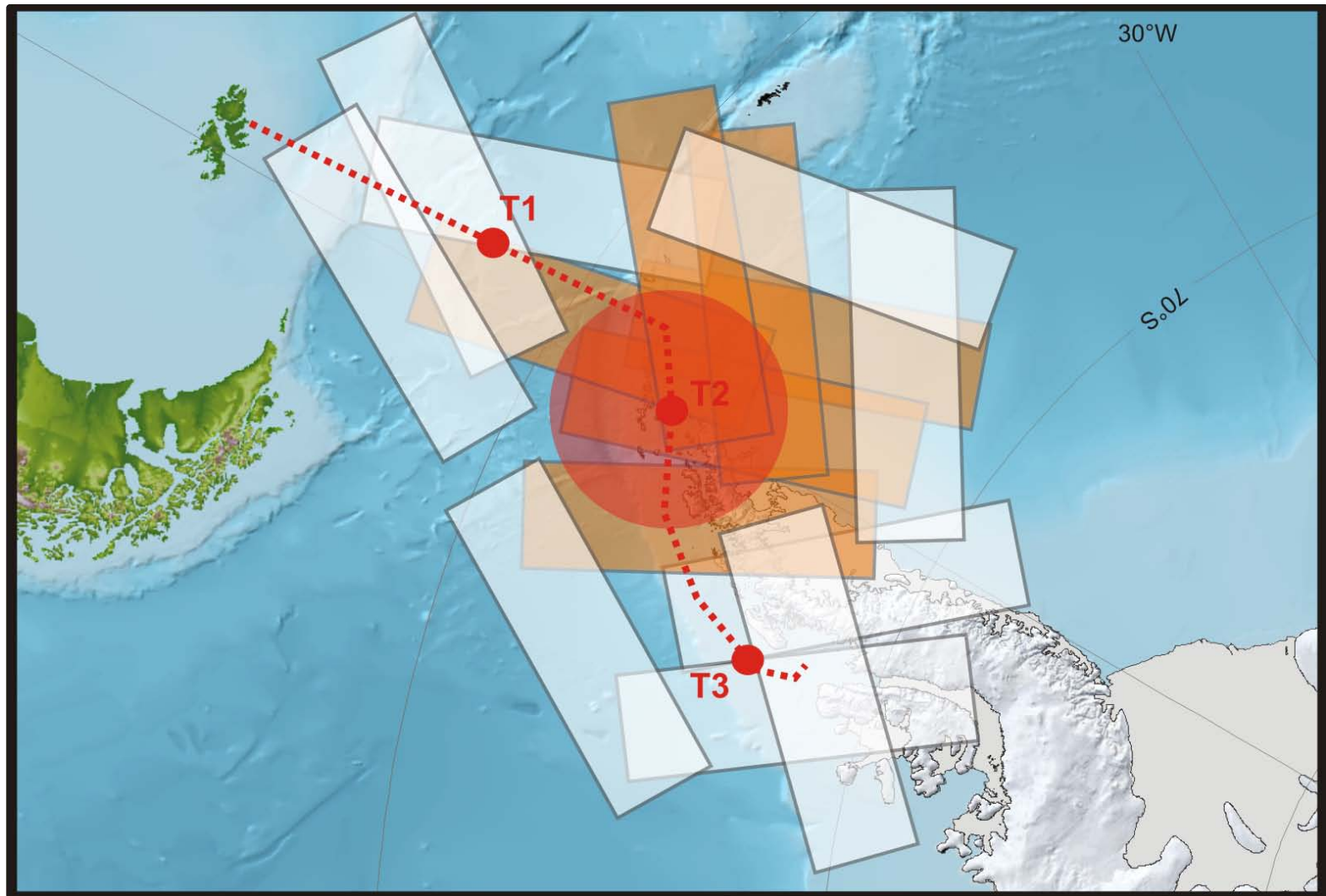
At higher latitudes LEO systems such as Iridium are required

Trend to higher capacity and lower costs in the future

# Reducing the noise

- Choose wisely – not everything that is available
- Make sure information is relevant – within your area of operation
- Avoid heavy websites – use automatic notifications
- Proprietary solutions – e.g. Dialog, BAS customised email & file syncing
- By integrating ship position, available information products and use preferences

# Automatic selection



Full resolution images with maximum dynamic range = large files

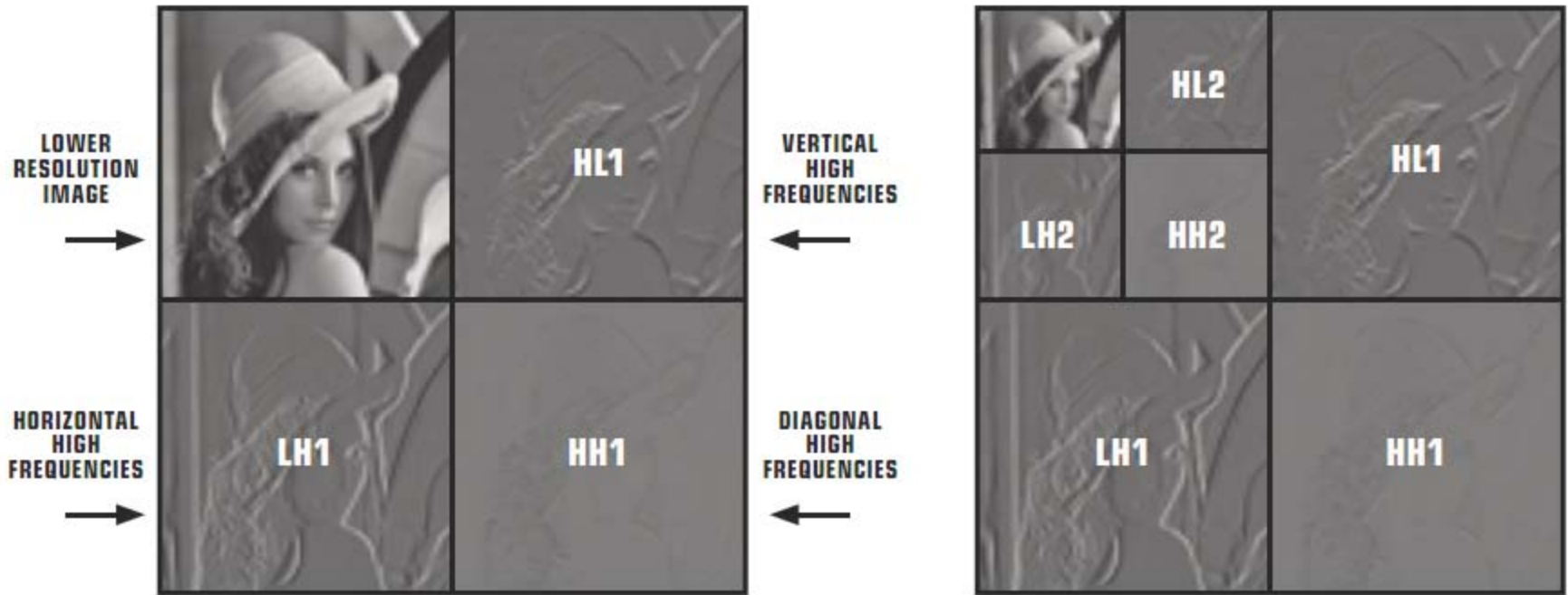
# New digital file formats

- Better image compression using wavelet transformations
- Images split into numerous frequency bands (subbands)
- This covers formats such as JPEG2000, ECW and MrSID
- 2:1 compression for lossless compression
- Up to 10:1/20:1 for lossy compression
- JPEG2000 published as an open standard (ISO/IEC 15444) – main focus



# Wavelet transformations

- Image components are passed recursively through low pass and high pass wavelet filters
- Results in subbands with the upper left one containing all low frequencies,



- Successive decompositions are applied on the low frequencies
- By itself the wavelet transform does not compress image data - it restructures the image information so that it is easier to compress

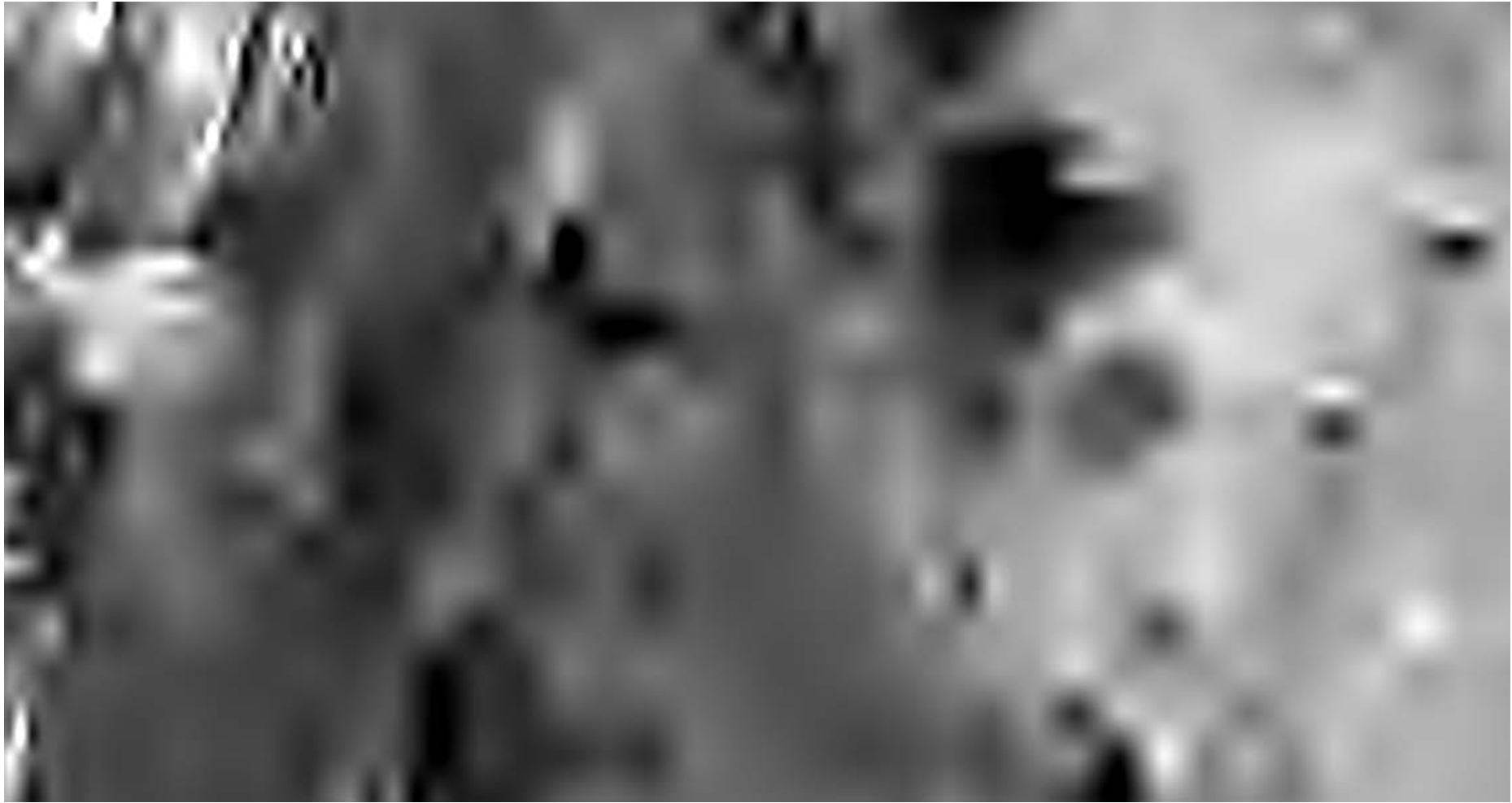
# JPEG2000 capabilities

- JPEG2000 enables the extraction of subsets of image data in three ways:
  1. spatial – i.e. a particular region of the image
  2. resolution level – i.e. a large or small version of the image
  3. quality level – i.e. a high or low quality version of the image
- Multiple resolutions & quality layers in a single file – no separate bands or pyramids
- Random code-stream access allows fast extraction of sub-regions and quality layers
- Progressive transmission - stream information so that image quality improves progressively as the downloading proceeds
- Support for embedding XML metadata in file

# Combining JPEG2000 & JPIP protocol

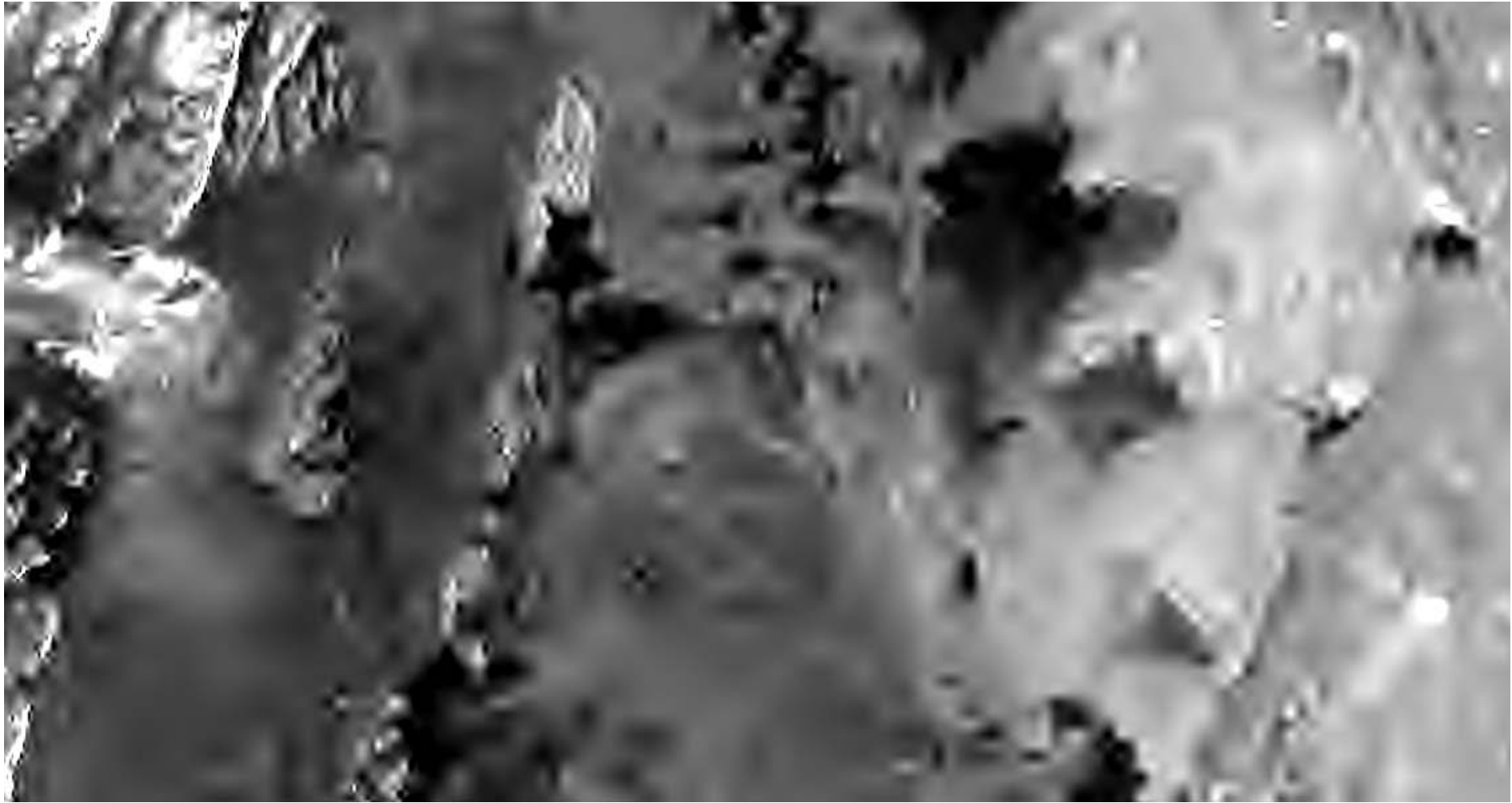
- JPIP (JPEG 2000 Interactive Protocol) is a client/server communication protocol defined in the JPEG2000 (ISO/IEC 15444:9) standard
- Exploit the multi-resolution and spatially random access properties of JPEG2000 for client-server based applications
- JPIP protocol - allows a client to formulate requests using a simple descriptive syntax which identifies the required ROI, resolution etc = more efficient server response
- JPIP enables a server to transmit only those portions of a JPEG2000 image that are applicable to the client needs
- JPIP allows progressively forward images of increasing quality; giving the viewer at the client a view of the image as quickly as possible
- JPIP client can decode these databins and generate a partial image for display at any point while still receiving data from the server
- Overall vast improvement in bandwidth efficiency and speed for image viewing tasks in a client/server environment

# JPEG2000 quality levels – progressive transmission





## JPEG2000 quality levels – progressive transmission



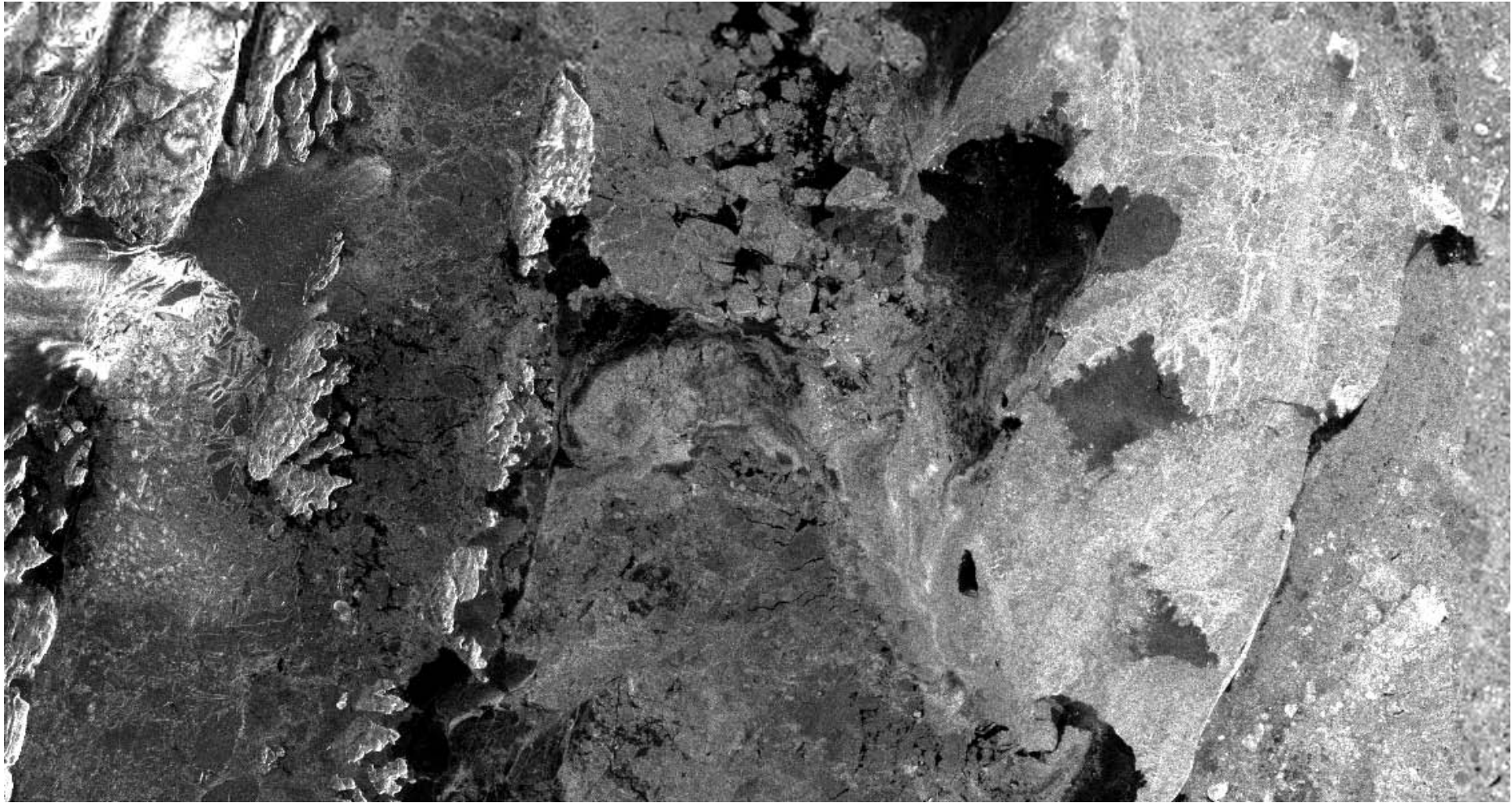
# JPEG2000 quality levels – progressive transmission



# JPEG2000 quality levels – progressive transmission



# JPEG2000 quality levels – progressive transmission





# Practical implementation

- Newer formats not widely supported by existing web browsers - lack of support means this image display and enhanced capability requires complex encoder/decoders
- Need a paired server-client suite in order to support the compression/visualisation of JPEG2000 format data and the use of the JPIP protocol
- Needs 'live' connection to work – not an offline solution
- Some proprietary solutions already exist – e.g. ITT IAS, Lizardtech, ERDAS Apollo, Kakadu – but all have severe limitations in supporting polar geospatial information that our use requires – experience of using these at BAS, KSAT and others
- 2012 season of use in Antarctic
- Closed nature of these systems mean it is difficult to modify and improve – but we are working on it

# Summary

- Increasing volumes and sizes cause transmission problems to remote platforms
- New file formats and streaming protocols offer significant advantages to reducing transfer times and costs
- Adoption and implementation are at early stages and significant problems exist
- Development appropriate to these applications is required

Thank you



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