Reprocessing Facilities for NWP Re-Analysis

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Data Processing Systems

Maintenance and Engineering

EUMETSAT

EUMETSAT Overview

- **EUMETSAT is currently operating 5 operational spacecraft**
  - **Meteosat 6, 8 and 9 over Europe and Africa**
  - **Meteosat 5 and 7 over the Indian Ocean**
- **The data, products and services from the EUMETSAT satellites make a significant contribution to weather forecasting and to the monitoring of the global climate**

EUMETSAT Overview

- EUMETSAT maintains an archive of data from 3 Meteosat Programmes
  - Meteosat Operational Programme
  - Meteosat Transition Programme
  - Meteosat Second Generation
- EUMETSAT archive is important component of climate research
  - 30 years of operations
  - 78 years combined imagery

EUMETSAT Satellites

- Meteosat-1 1977 – 1985
- Meteosat-2 1981 – 1991
- Meteosat-3 1988 – 1995
- Meteosat-4 1989 – 1995
- Meteosat-5 1991 – 2007
- Meteosat-6 1993 – 2006 (…)
- Meteosat-7 1997 – 2008 (…)

Unified Meteosat Archive (UMARF)

- All first generation data transcribed from tape
- Image data live on disk:
  - 300 Terabytes
  - Approximately 1 millions Images
  - Approximately 3 millions Met. Products

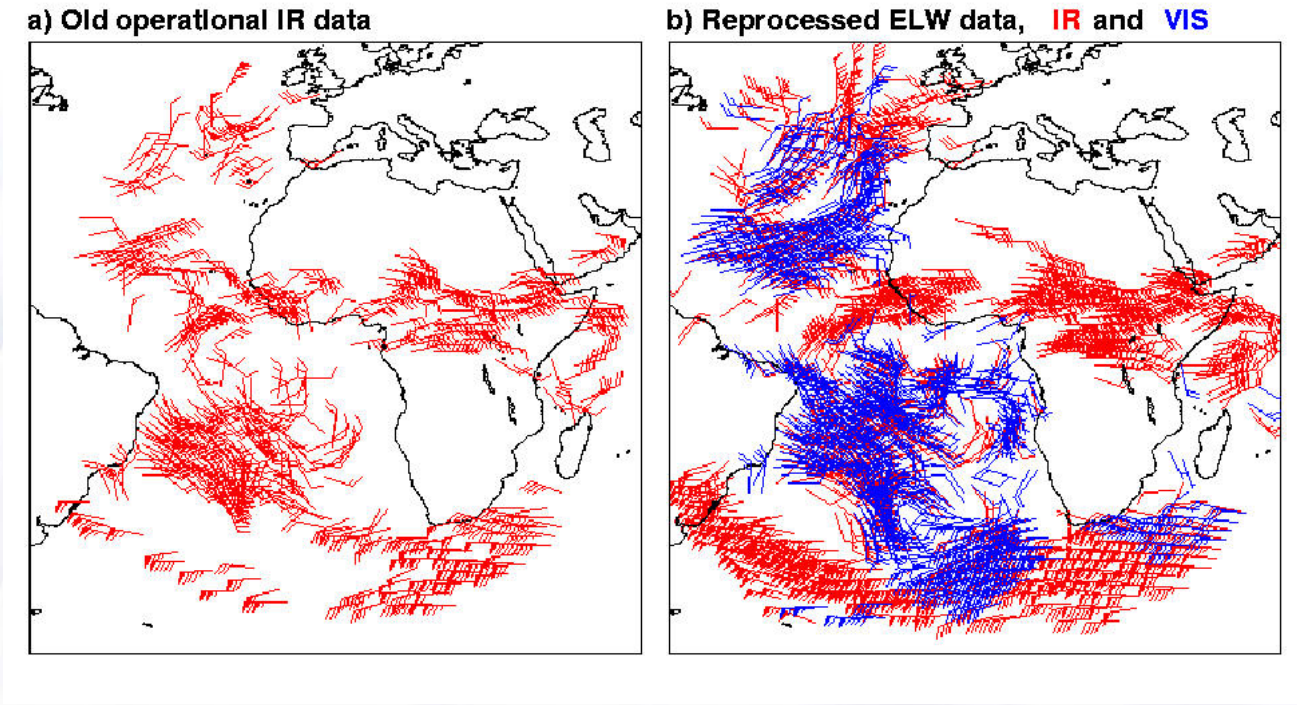
Current Reprocessing Facilities

- **Meteorological Products Extraction Facility (RMPEF)**
  - **Reprocessing of historical Meteosat images for climatological purposes**
  - **System developed from operational platform**
    - **Enhanced “Real Time” system**

RMPEF Aims and Customers

- Reprocess historical images using “best” algorithms
- Customers
  - NWP centres (e.g. ECMWF, JMA)
  - The “Calibration Community”
  - Max Planck Institute / Joint Research Centre for Meteosat Surface Albedo

Improved products from reprocessing



- Larger geographical area (spatial)
- More products per day (temporal)
- Additional channel information (physical)

EUMETSAT

Limitations of current system

- RMPEF “Real Time” system not appropriate solution
  - Unstable
  - High level of user interaction
  - Very old code base
- Unable to overcome performance limitations
  - HP PA-RISC hardware
  - Operational features not required for reprocessing

Limitations of current processing

- Analysis of image data requires improvement
- WV calibration requires improvement
- Extraction of image data too slow (bottle neck)
  - Solved through use of SNI

Re-Engineer RMPEF

- Re-design of the process control infrastructure
  - New system framework
- Re-implement algorithms inside new framework
- Remove wasteful operational features
  - Error, event and parameter logging
- Re-design product generation scheduling system

Re-Engineer RMPEF

- New framework
  - “Platform independent” C++
  - Scalable to fit available hardware
  - Capable of grid computing
  - High level of monitoring and control
  - Interface to legacy FORTRAN4/77 code

Re-Engineer RMPEF

- Initial requirement for 12x performance increase
  - We now process 12 days in 24 hours per machine
  - That is 1 year in 2 weeks with 3 machines
  - Aim for 1 year per 24 hours one 1 machine
- Developed for a 8 processor server
- Can later be used on reclaimed hardware
- Improved performance remains limited by:
  - Single process algorithm, each with single thread
  - Algorithm feedback

Re-Engineer RMPEF

- Framework ready for implementation
- Algorithm modification in 3 stages
  - Implement non-image related processing
    - Calibration
  - Implement simple algorithms
    - Scenes analysis and segment processing
    - Meteosat Surface Albedo
  - Implement complex algorithms
    - Atmospheric Motion Vectors

Future Application of Reprocessing Framework

- Use of MTP RMPEF in Routine Operations
  - Scheduled for 2008
- Use of RMPEF framework for MSG MPEF
  - Scheduled for 2009/2010

Future Application of Reprocessing Framework

- Use in Meteosat Second Generation:
  - Operational processing of real-time image feed
  - Use as development and test platform
    - Replaces stubbed test harness
    - Identical to operational platform
  - Reprocessing of archived level 1.5 data
- Framework identical for all MPEF processing

From User Requirements to Final Product

- Use of framework based system for development
- Process new algorithm in reprocessing mode
- Validate output against long-term statistics
- Release new algorithm to operations in shorter time

Externally Developed Algorithms

- Possible to integrate 3rd party algorithms
  - Release RMPEF API to external agencies
  - Provided for scientifically validated algorithms
    - No ad-hoc tests
  - Allows external users processing access to UMARF
    - For example Satellite Application Facilities

Other Reprocessing Systems

- Reprocessing MSG Image Processing Facility (RIMPF)
  - Designed as part of operational IMPF
  - Migration from Tru64 to Sun AMD64 in 2006/2007
  - Target of 8 processor machine
  - Possible application to all archived images
    - MSG images
    - MOP and MTP images

Reprocessing IMPF

- Application of latest MSG algorithms to all images
- Consistent image set across all spacecraft
- Could initiate re-run of MTP RMPEF reprocessing

Reprocessing Facilities in EUMETSAT

- Limited to small systems
  - Physical space
  - Power availability
  - Financial budget
- Limited by algorithm feedback
- Hence design of flexible framework for algorithms
  - Use small systems and reclaimed systems

Further information

- **http://www.eumetsat.int/**
- **http://en.wikipedia.org/wiki/EUMETSAT**
- **http://en.wikipedia.org/wiki/Meteosat**

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