NCOF

The National Centre for Ocean Forecasting

Development of spatial intercomparison within the operational wave forecast verification exchange

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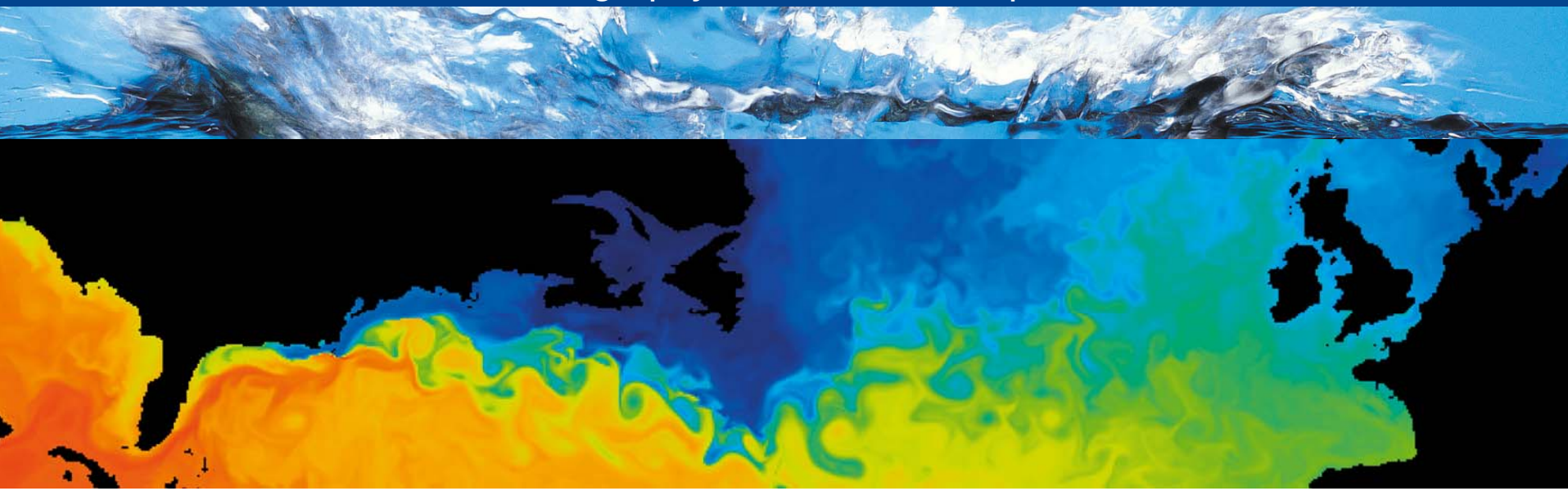
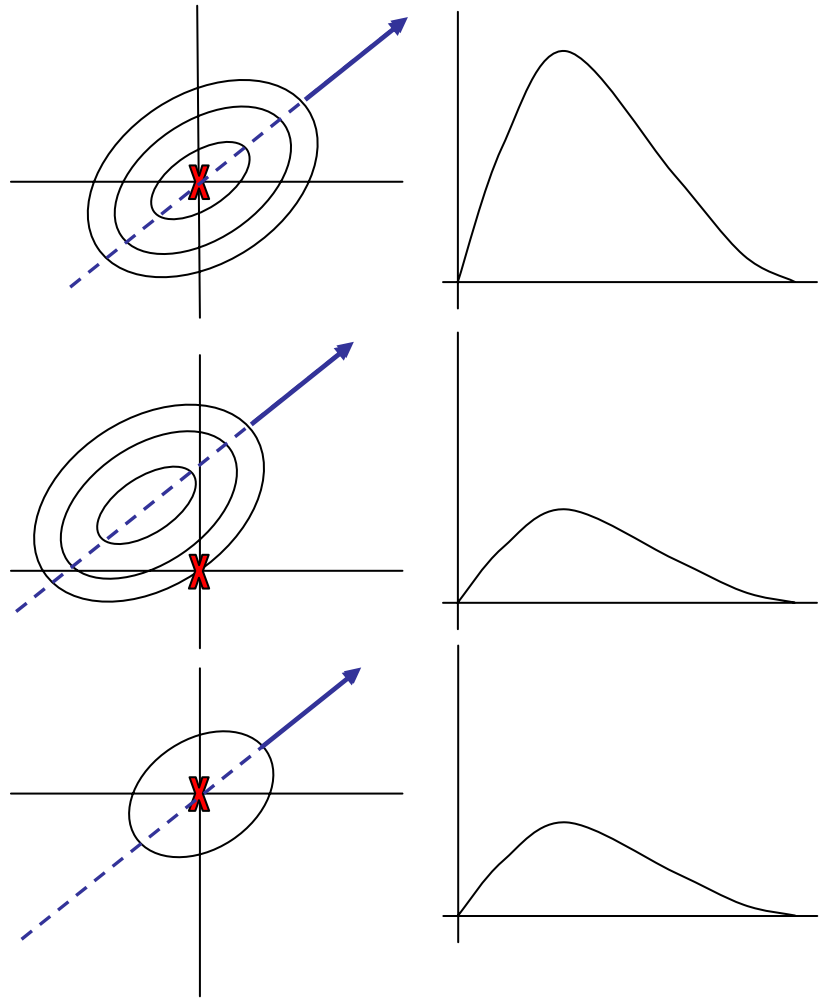


Met Office

www.ncof.gov.uk

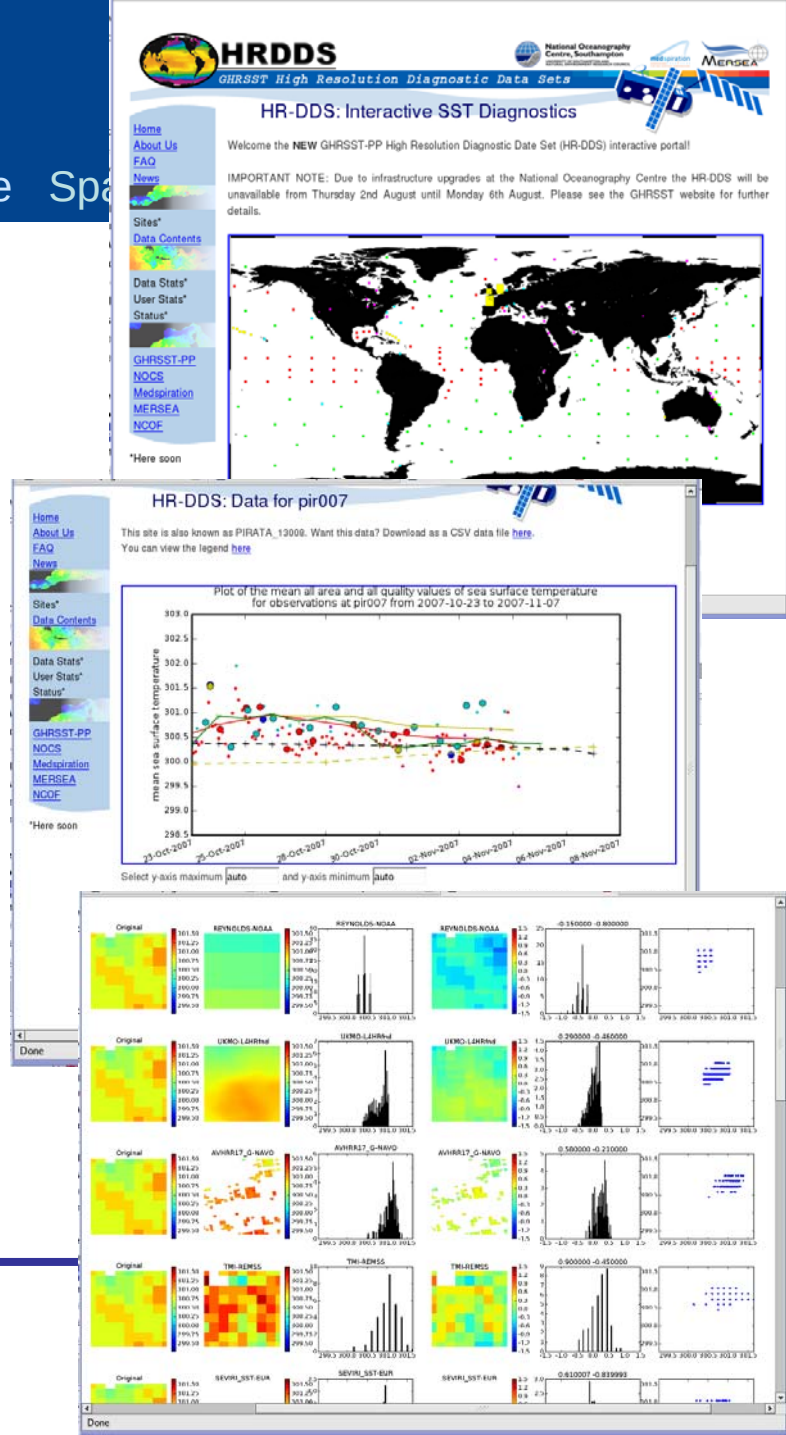
Motivation

- Operational wave forecast verification exchange is very successful
  - Statistical measures of performance
  - Does not provide spatial context
- Aim to develop spatial intercomparisons to provide additional insight
  - Endorsed by JCOMM ETWS
- Spatial intercomparison done routinely for SST and ocean forecast models
  - Aim to apply existing techniques to wave models



Methodology

- Build on intercomparison experience in other projects (MERSEA, GHRSST)
  - Identified that standardisation is key
- Use existing technology
  - “High Resolution Diagnostic Data Set” (HRDDS) developed for SST data
    - Linked databases with web-based visualisation and processing
    - Comparisons over small areas
    - Can include model, satellite and in situ data
- Development of Waves HRDDS underway at NOCS



- Spatial intercomparison can provide complementary information to performance statistics
  - Extension of operational exchange endorsed by JCOMM ETWS
- Technology already in place to facilitate intercomparisons
- Waves HRDDS to be developed to include
  - Wave model outputs
  - Altimeter and SAR data
  - In situ data
- Initial development of the system is underway

JCOMM and the ETWS

World Meteorological Organization

Intergovernmental Oceanographic Commission of UNESCO

jcomm

- JCOMM is the Joint WMO / IOC Technical Commission for Oceanography and Marine Meteorology
- Responsible for coordinating, regulating and managing the marine observing, data management and services system
- Services Programme Area includes Expert Team on Wind Waves and Storm Surges (ETWS)
- 13 members representing the international wave forecasting community
- Terms of reference include:
  - **Monitor and assist in projects for verification of operational wind wave and storm surge model outputs**

Operational wave forecast verification exchange

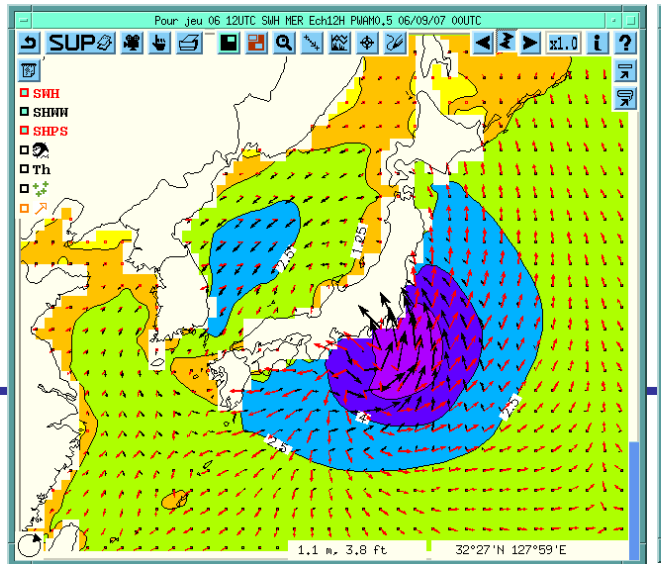
- Routine intercomparison of global wave model forecast verification data
  - Established in 1995 to provide quality assurance for wave forecast model products
  - Continued under the auspices of JCOMM ETWS
- The ETWS-II meeting in Geneva, March 2007, recommended the expansion of the wave forecast verification exchange to include:
  - Validation against altimeter wave height data
    - To be led by Hendrik Tolman and Jean-Michel Lefèvre
  - Validation against spectral buoy data
    - To be led by Jean Bidlot and Hendrik Tolman
  - **Validation of spatial data**
    - **To be led by Adrian Hines and Jean-Michel Lefèvre**
- Validation of spatial data
  - A proposal to use the “High Resolution Diagnostic Data Set” (HR-DDS) concept developed within GHRSST-PP was accepted

Spatial intercomparisons

- Spatial intercomparisons provide complementary information to statistics
  - Can provide insight into differences in performance
- Experience in other projects (MERSEA, GHRSST) shows that practicalities are not straightforward
- Aim will be to:
  - Allow comparison of model fields over small areas
  - Include available satellite and in situ observations

Significant wave height - Typhoon FITOW approaching Japan

ECMWF WAM



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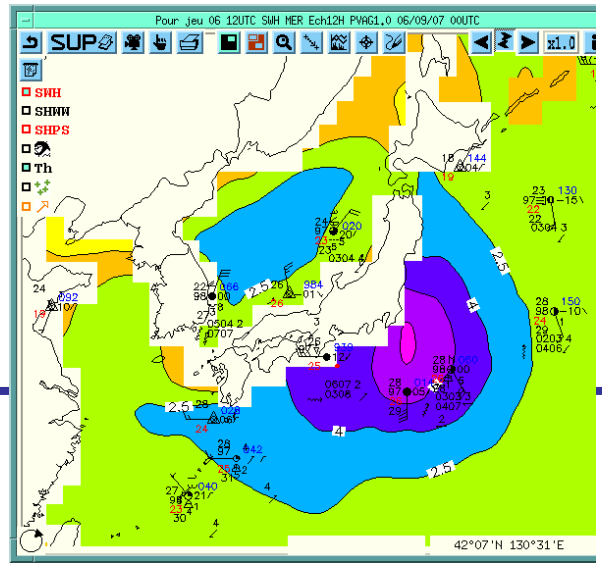

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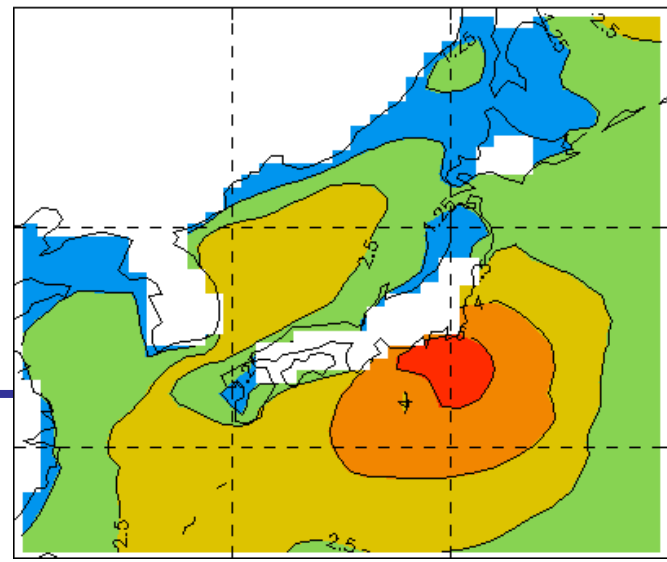


High Resolution Diagnostic Data Set concept

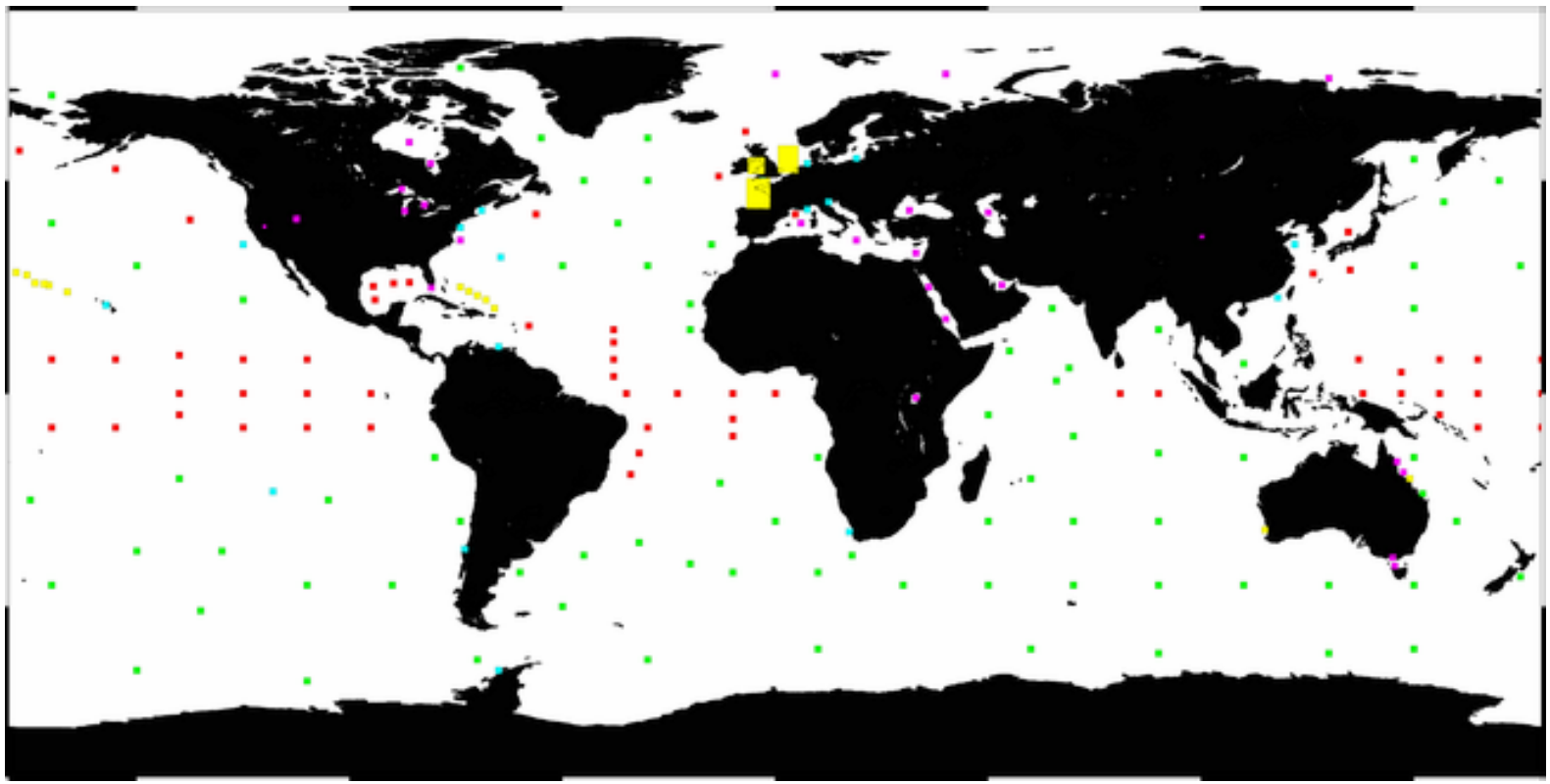
- HR-DDS approach developed in the GODAE High Resolution Sea Surface Temperature Pilot Project (GHRSST-PP)
  - www.hrdds.net
  - Provides a facility for comparison of multiple satellite and model-based SST products
  - Based a number of small areas over which data are provided for comparison
    - Making comparison of multiple products more tractable than when dealing with full global fields
  - A flexible verification and intercomparison tool
- The data used can be delivered from multiple sources
  - Can include observations and model data
  - Collated at a single centre
  - Accessible via a web interface

- HR-DDS architecture
  - Based around two linked databases and a number of components

- Databases
  - Registration database
    - MySQL relational database that stores data and meta-data for each HRDDS granule
  - Statistical database
    - MySQL relational database that stores statistical results for each HRDDS granule
      - Mean, median, RMS, std, max, min, kurtosis, skew

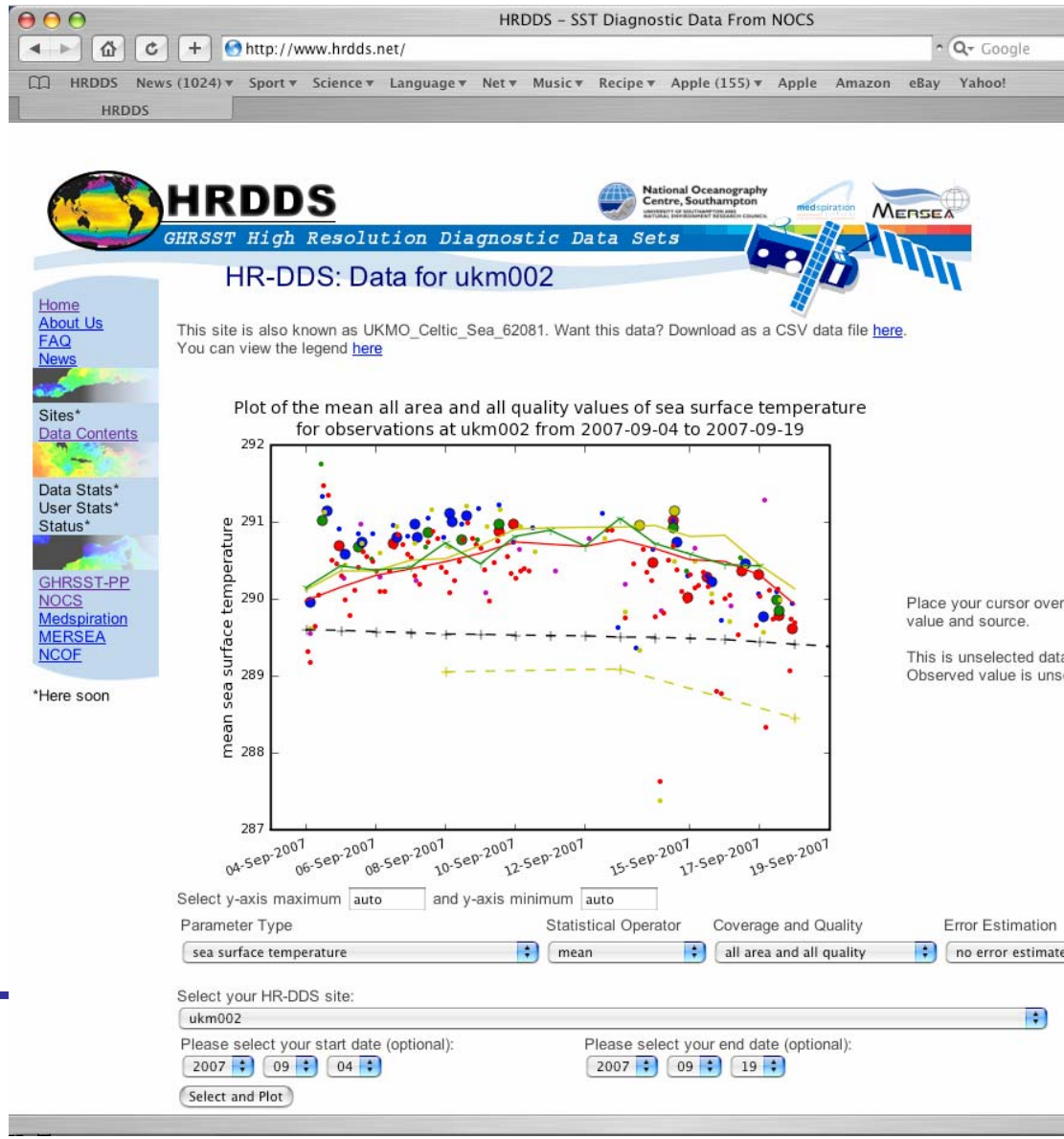
- System components
  - Ingestion system
    - Pulls data via FTP and ingests netCDF
      - Other formats provided interface routine is developed
  - Processing system
    - Produces HRDDS granules from the ingested files
  - Archive system
    - Provides web access to a limited period archive
  - Dissemination system
    - All HRDDS granules are also made available via OPeNDAP

- Top level map of the HR-DDS areas
  - Clicking on an area within the map links to a data access page for the data valid in that area



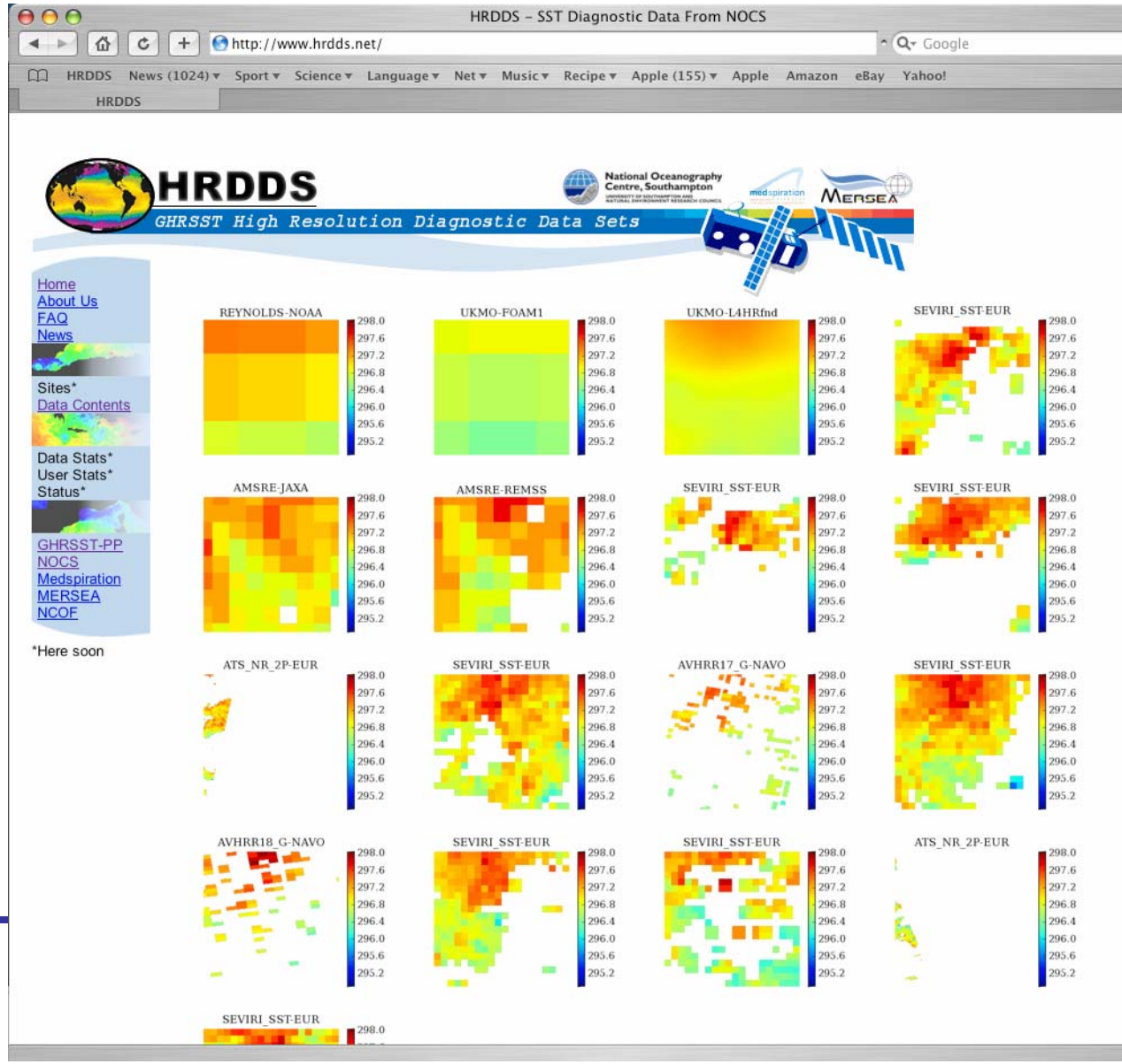
GHRSST HR-DDS Web Interface

- Data access page
  - Basic plot of a recent time series of the mean of the data sets over the area
  - Functionality to generate plots
    - Additional parameters
    - Different statistics
    - Different time series dates
- Each point within plots is clickable
  - Leads to the spatial observations for the HR-DDS area



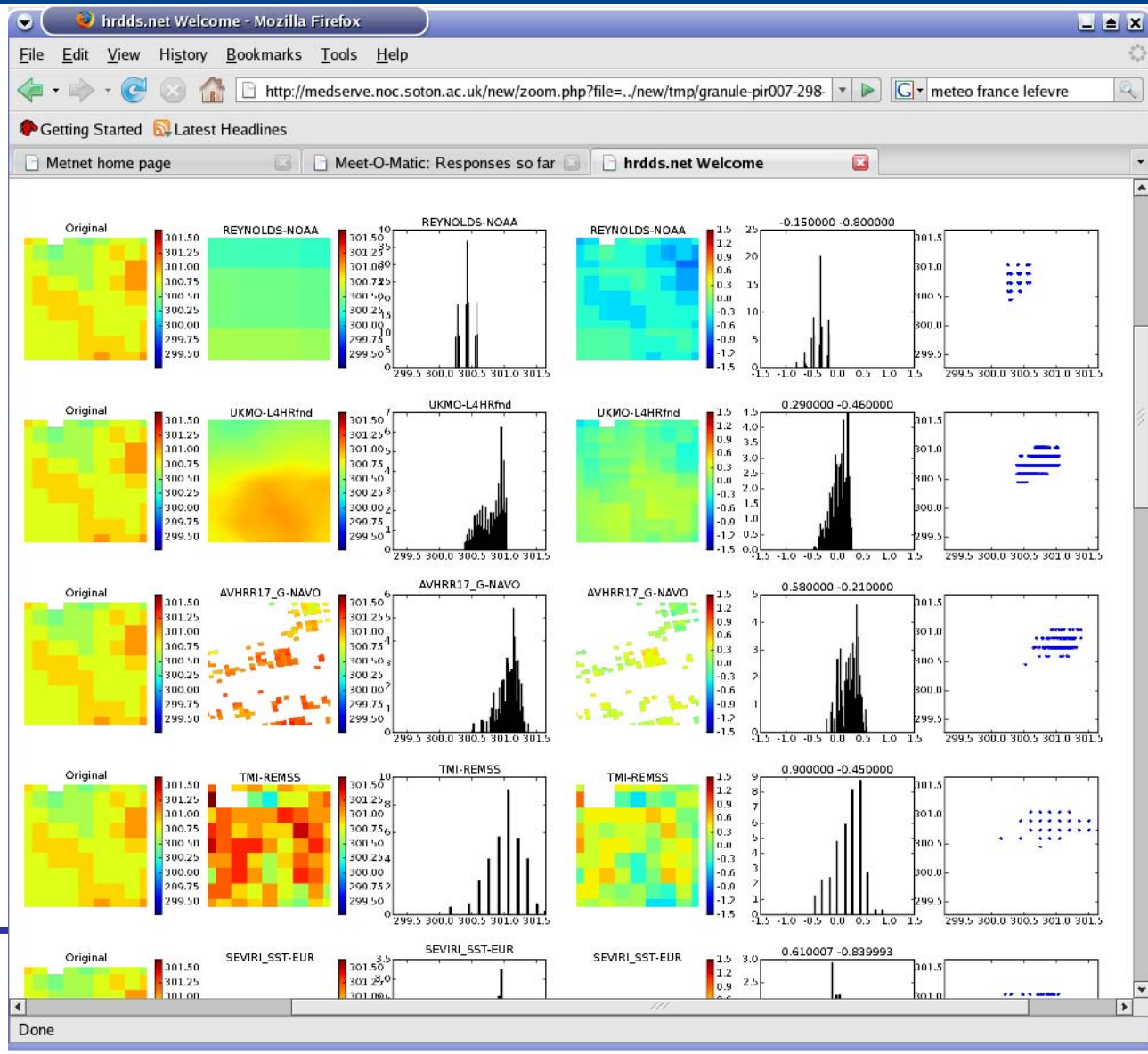
GHRSST HR-DDS Web Interface

- Spatial data comparison page
  - All observations received within that day for all available platforms are presented



GHRSST HR-DDS Web Interface

- Spatial data analysis page
  - Further analysis of selected data granule
  - Comparison of distribution with other data
  - Scatterplots against other data



HR-DDS: potential use in wave verification exchange

- HR-DDS suitable for intercomparison & verification of wave model output
  - Observations from altimetry to be used for comparison
- Draw upon expertise gained in development of the GHRSST HR-DDS
- Met Office have funded NOCS to develop a Waves HR-DDS demonstration for the wave forecast verification exchange
- Extensions could include access to in situ and spectral data
- Areas should include a representative range of physical regimes
- Some issues to be addressed for future application:
  - Data policy?
  - Use of real-time data?
  - Access restricted to participants only?

Summary

- The operational global wave forecast verification exchange has operated successfully for over a decade
  - The majority of the operational wave forecasting centres contribute
- Exchange adopted by JCOMM ETWS
  - Now a key part of international coordination of wave forecasting activities
- ETWS endorsed expansion to include altimeter data, spectral buoy data, and spatial intercomparison
  - Support for application of HR-DDS, originally developed for SST
  - Provides web-based access to data from multiple sources
  - Allows visualisation and manipulation of the data
- Initial demonstration of Waves HR-DDS being developed at NOCS