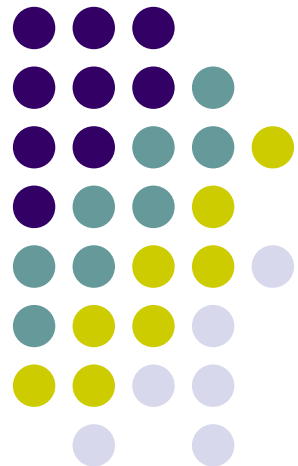
Implementation of distributed oceanographic data management and data processing technologies in FEB RAS



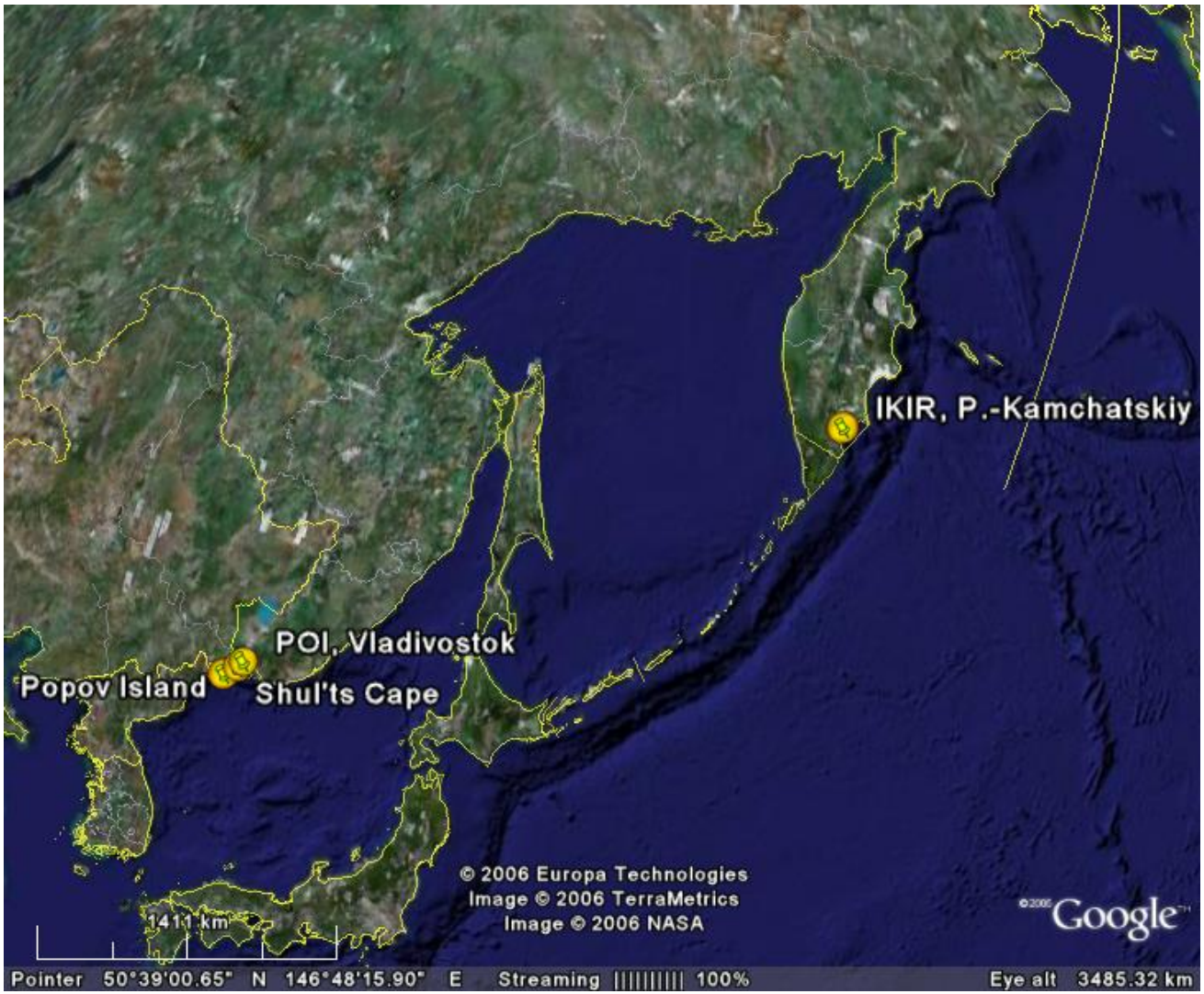
Stepan G. Antushev, Vitaly K. Fischenko and Andrey V. Golik

2006

Background

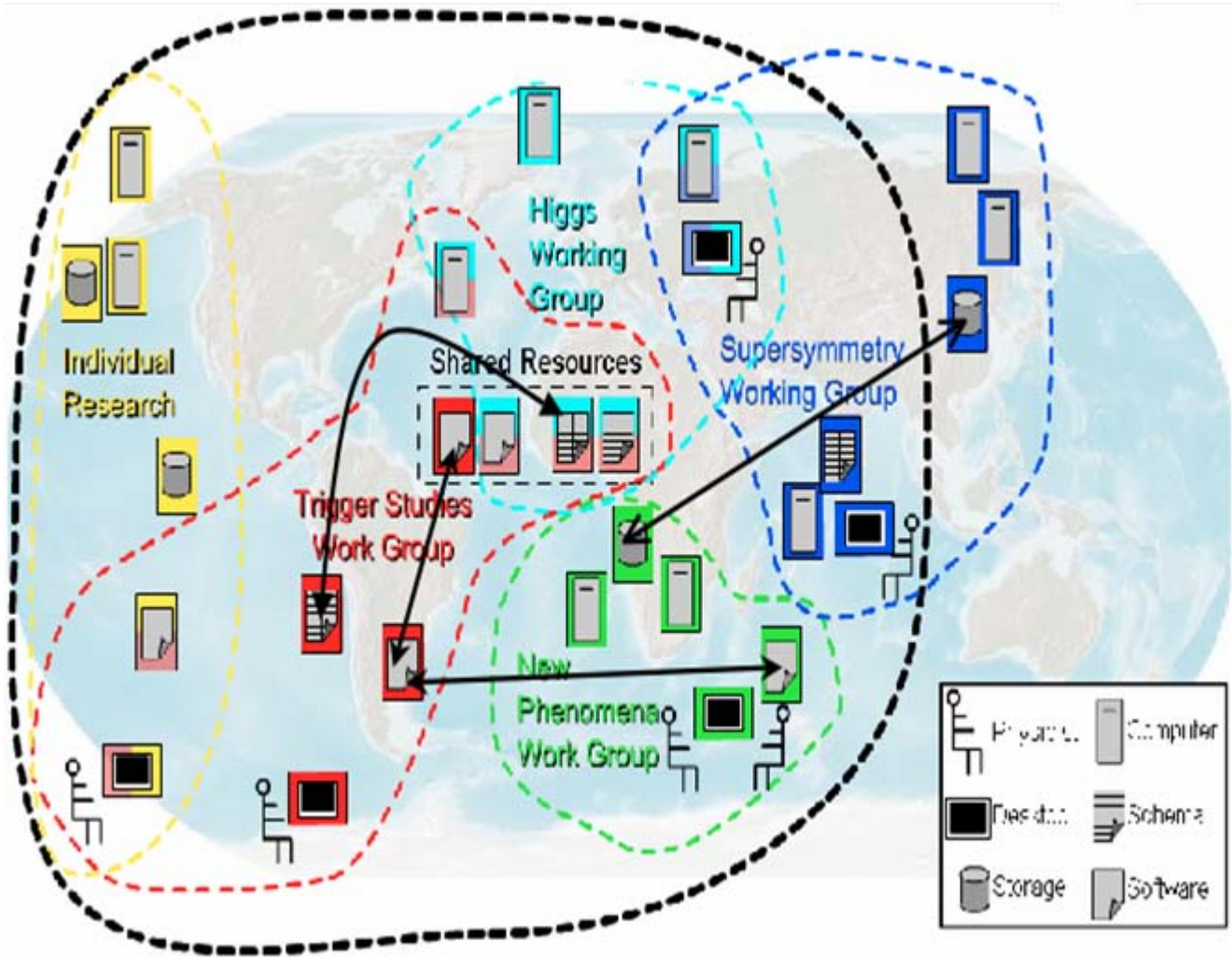
- FEB RAS
  - 6 scientific centers
  - 32 institutes
  - 40 research stations
- Many institutes work on similar or same problems
- Scientific collaboration
- Data/resources needs to be shared someway

POI and IKIR - example of data sharing in FEB RAS



- Data on geomagnetic and electrical fields variation obtained on Popov Island and Kamchatka Pen. stations
- Seismo-acoustic data obtained with laser interferometers on Shul’ts Cape and in P.-Kamchatsky

Grid – technology to facilitate integration of distributed resources

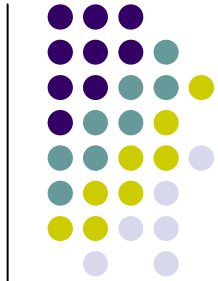


VO-B

Virtual Organizations:

- Distributed resources and people
- Linked by networks, crossing admin domains
- Sharing resources, common goals
- Dynamic

Globus Toolkit

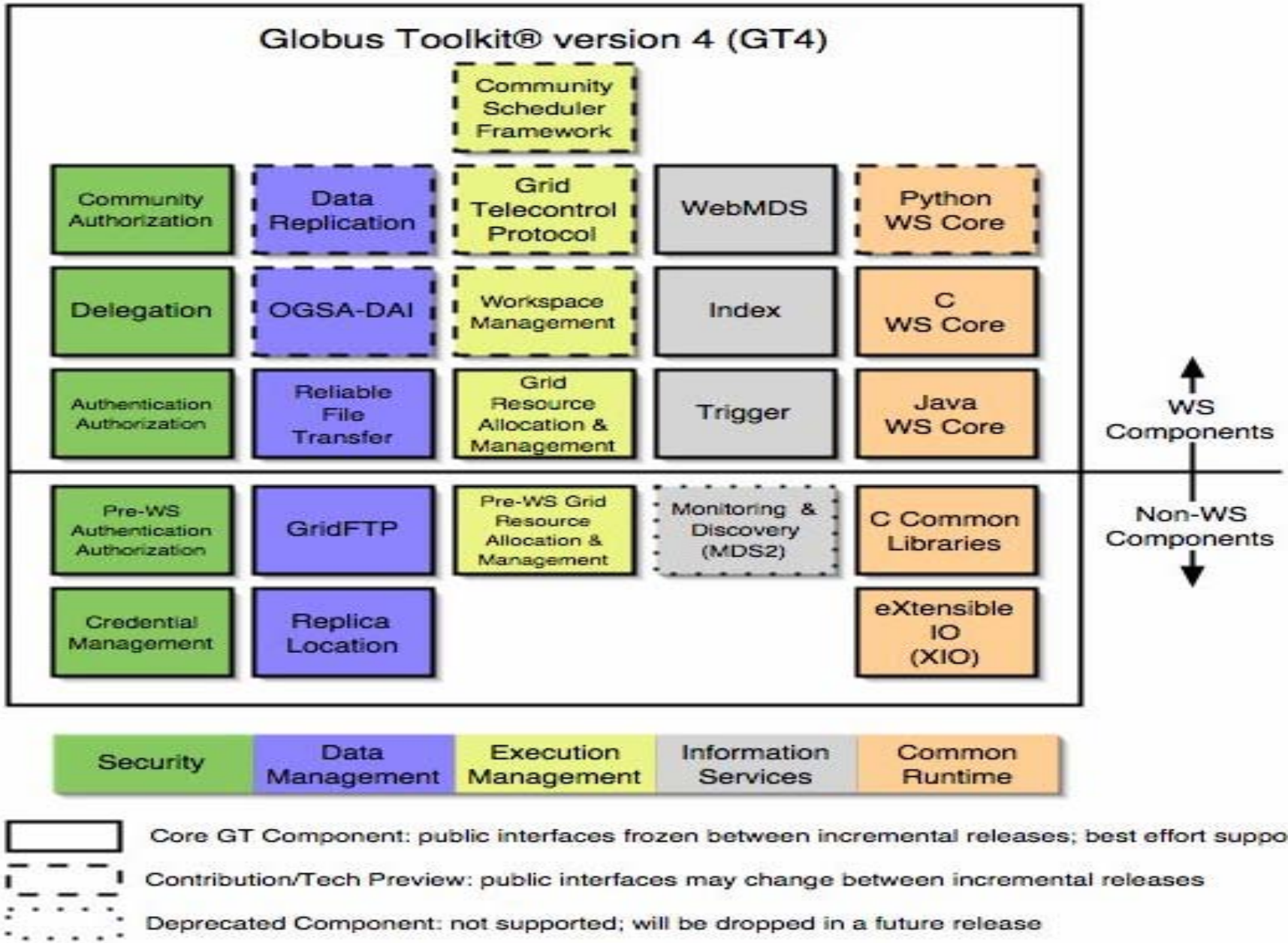


- Environment for Grid-applications development
  - Develop new OGSA-compliant Web Services
  - Develop applications using Java, C/C++, Python Grid APIs
- A set of basic Grid services
  - Job submission/management (GRAM)
  - File transfer (GridFTP, RFT)
  - Database access (OGSA-DAI)
  - Data management: replication, metadata (RLS, DRS, OGSA-DAI)
  - Monitoring/Indexing system information (MDS)

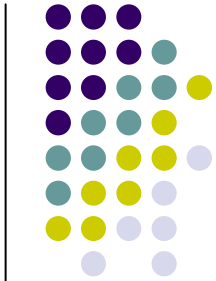
http://globus.org

Ian Foster
Globus Alliance (Argonne National Laboratory, University of Chicago, University of Edinburgh, NCSA, Univa Corporation, University of Southern California, …)
1996-2006

Globus Toolkit: Open Source Grid Infrastructure



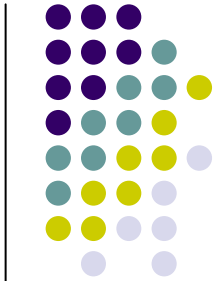
Main GT components



- GRAM – uniform service interface for remote job submission and control
- GridFTP –high-performance, secure, reliable data transfer service optimized for high-bandwidth wide-area networks
- MDS – allows users to discover what resources are considered part of a *Virtual Organization (VO)* and to monitor those resources
- GSI – standard mechanism for bridging disparate security mechanisms; SSL/TLS, PKI, X.509, proxy certificates
- CAS – community authorization service, way to outsource fine-grained access policy administration

Detailed components description: **http://globus.org/toolkit/docs/**

Data management in GT

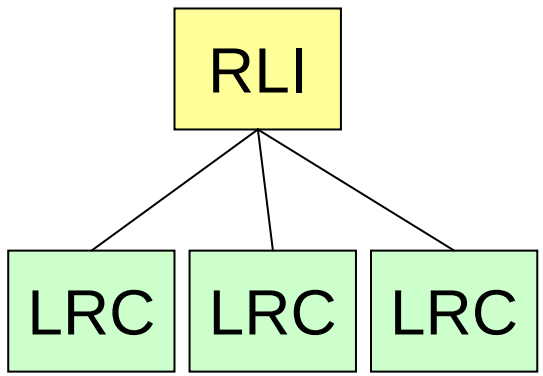


- **Stage/move** large data to/from nodes
  - GridFTP, Reliable File Transfer (RFT)
- **Locate** data of interest
  - Replica Location Service (RLS)
- **Replicate** data for performance/reliability
  - Data Replication Service (DRS)
- Provide **access** to diverse data sources
  - File systems: GridFTP
  - Databases: DAIS (Data Access and Integration)

RLS (Replica Location Service)

- Distributed registry that records the locations of data copies and allows replica discovery
  - Maintains mappings between logical identifiers and target names
  - Must perform and scale well: support hundreds of millions of objects, hundreds of clients

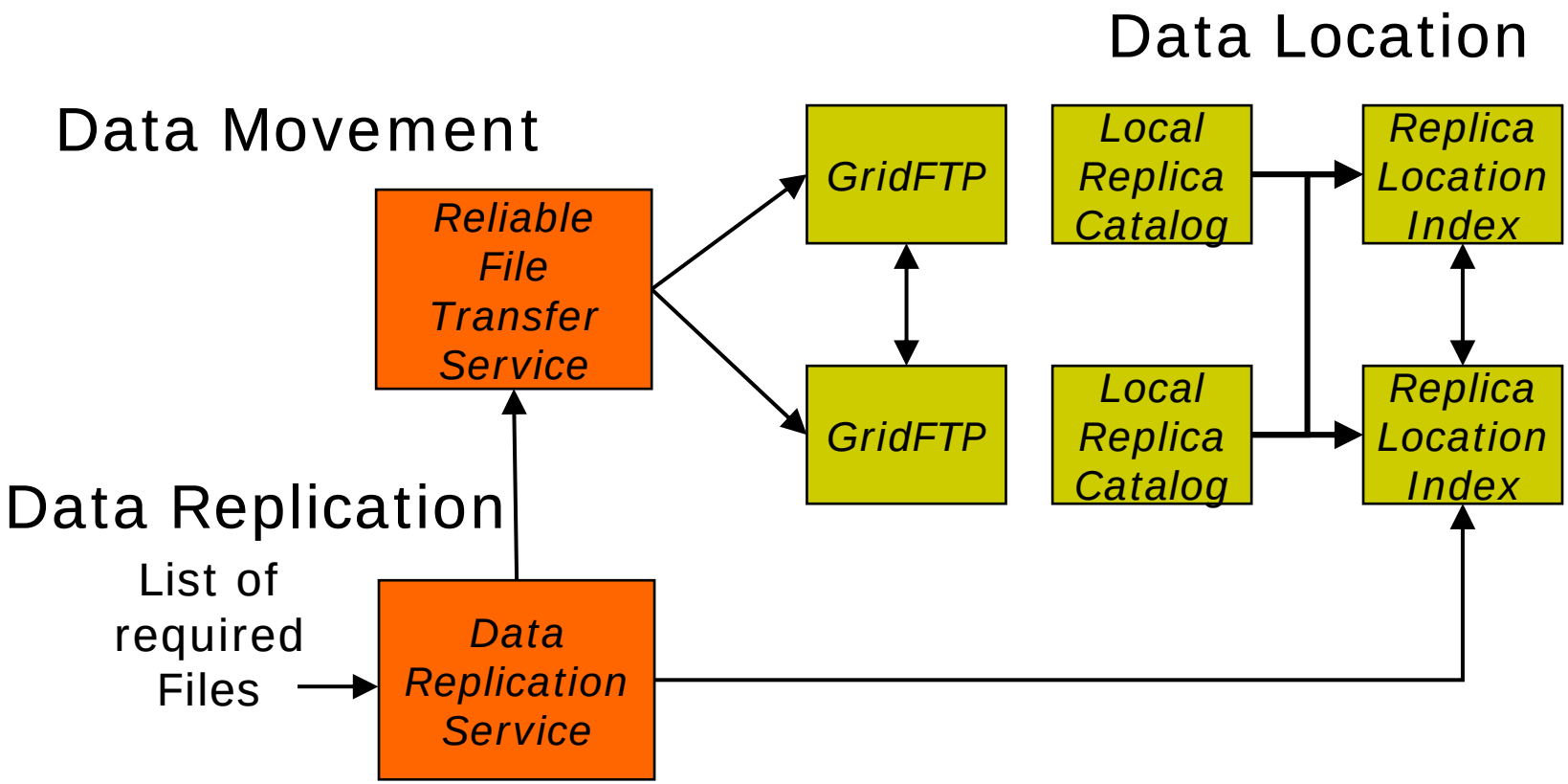
- Local Replica Catalogs (LRCs) maintain logical-to-target mappings
- Replica Location Index (RLI) node(s) aggregate information from LRC(s)



Ian Foster, "**Global Data Services**", Tutorial at 14th NASA Goddard - 23rd IEEE Conference on Mass Storage Systems and Technologies, May 15, College Park, Maryland

DRS (Data Replication Service)

- Replicate data files to specified locations

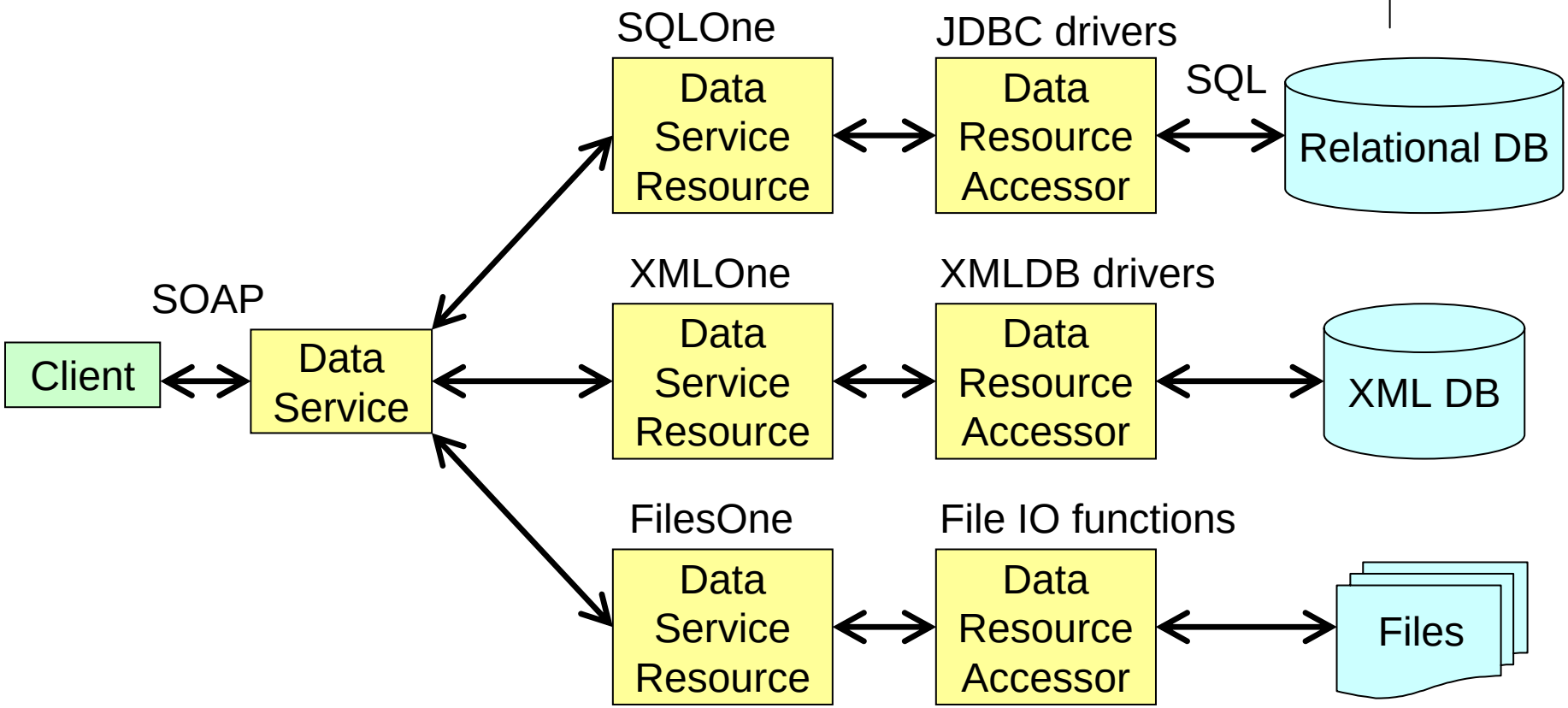


"Design and Implementation of a Data Replication Service Based on the Lightweight Data Replicator System",Ann Chervenak et al., 2005

OGSA-DAI (Data Access and Integration)

- Extensible framework for data access and integration
- Expose heterogenous data resources to a Grid through web services
- Interact with data resources
  - Queries and updates (relational DBs, XMLDB, files)
  - Data transformation/compression (XSLT, ZIP, GZIP)
  - Data delivery (SOAP, GridFTP/FTP, e-mail)
  - Application-specific functionality
- Activities – mechanism for custom data processing

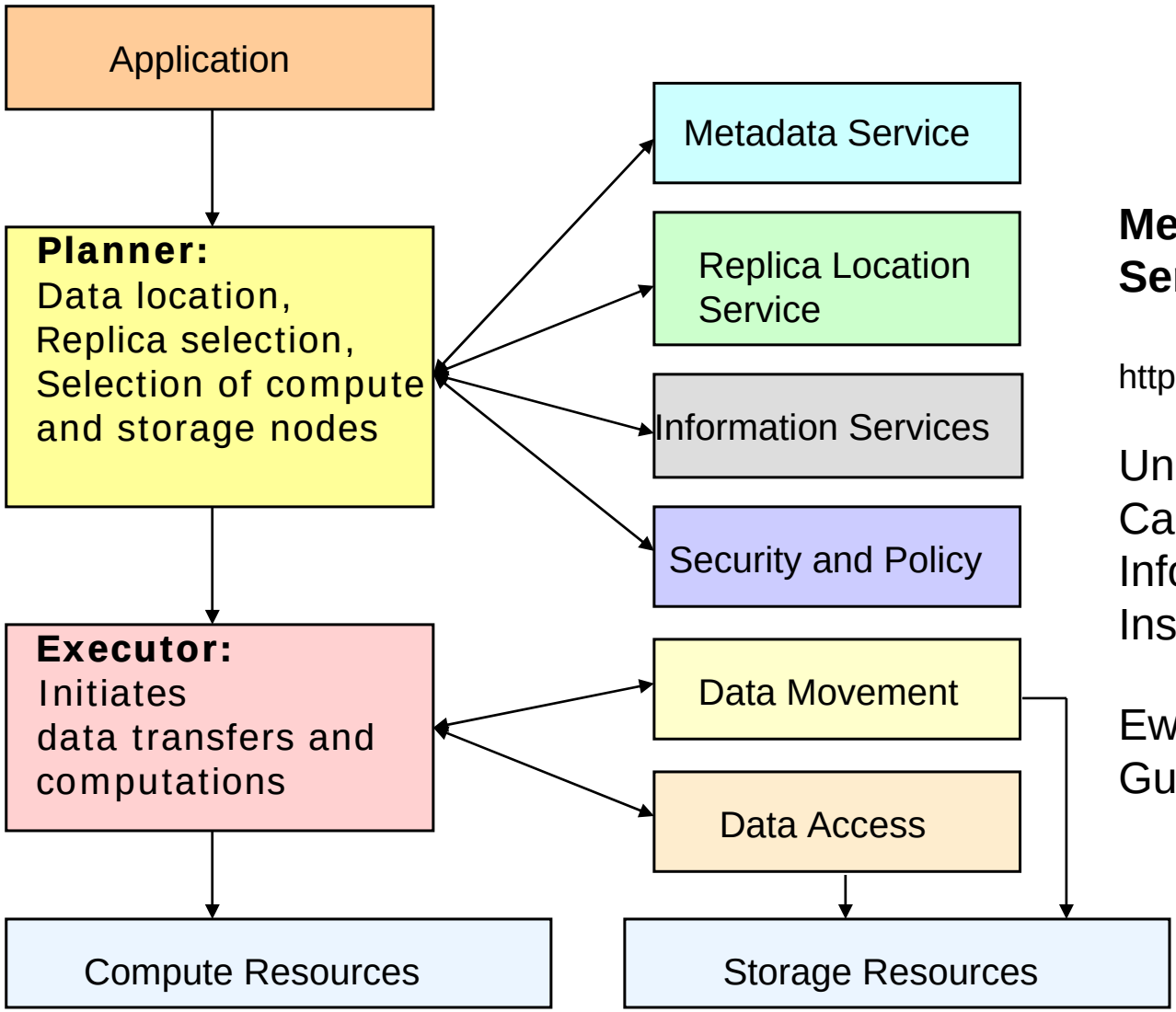
OGSA-DAI (Data Access and Integration)



- Relational DB: MySQL, Oracle, DB2, SQL Server, Postgres
- XML: Xindice, eXist
- Files: CSV, BinX, EMBL, OMIM, SWISSPROT, …

Mike Jackson, Amy Krause, EPCC, The University of Edinburgh, “OGSA-DAI Today”, GridWorld 2006

Functional View of Grid Data Management



Metadata Catalog Service

http://www.isi.edu/~deelman/MCS/

University of Southern California,
Information Sciences Institute

Ewa Deelman
Gurmeet Singh

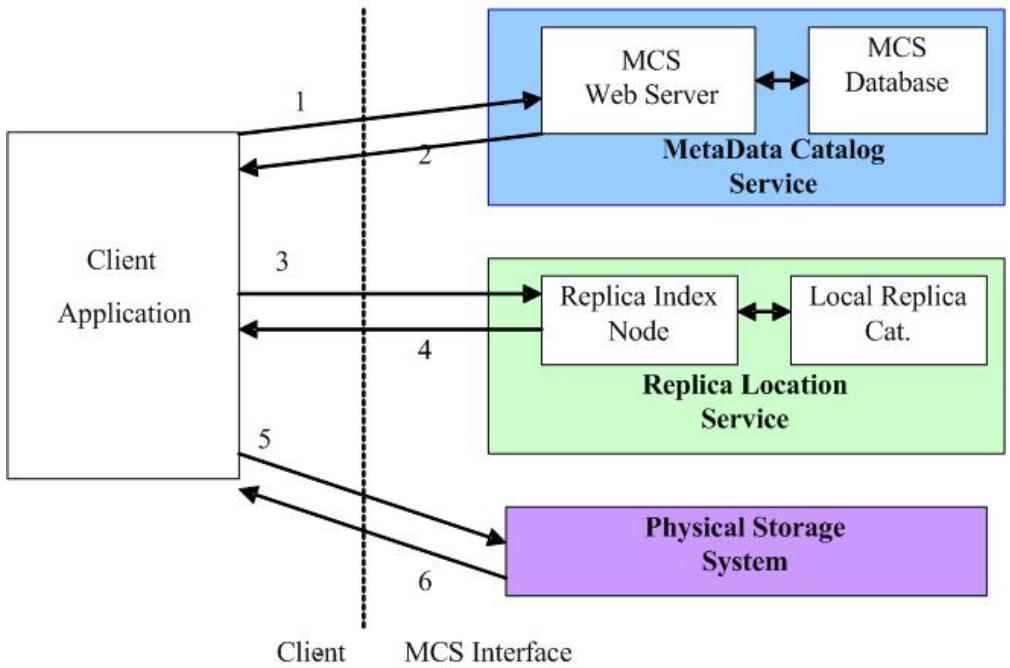
MCS (Metadata Catalog Service)

- Data item – set of attributes and values
- Collection – set of data items or other collections
  - item may belong max to 1 collection
- View – set of data items/collections/views
  - Item may belong to any number of views

- Flexible schema – data items/collections/views can have custom attributes
- Authorization can be imposed on data items or collections

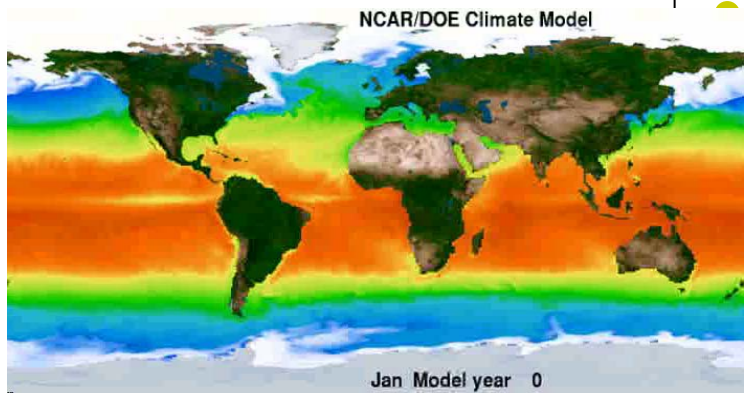
Limitations:

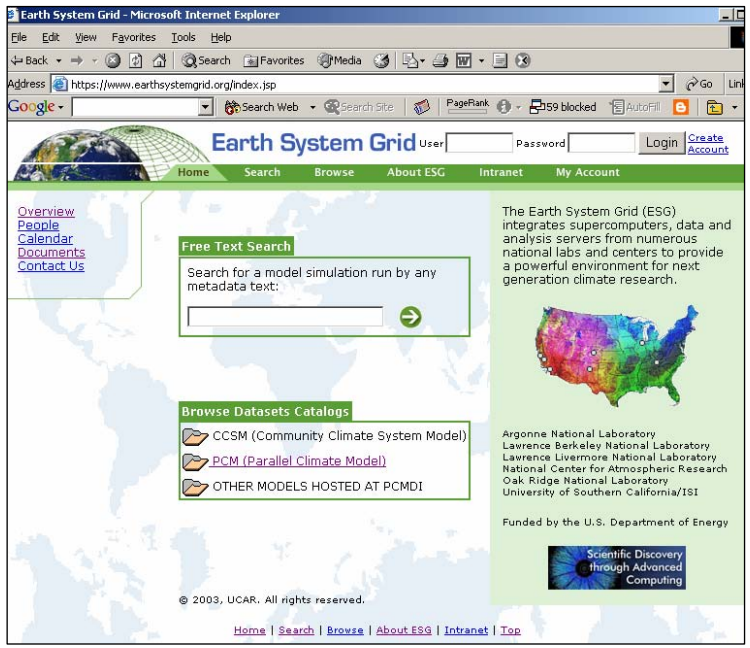
- Described metadata scheme
- No support for complex attribute structuring schemes



GT data services in production use

- Earth System Grid: Climate modeling data (CCSM, PCM, IPCC)
- RLS at 4 sites
- Data management coordinated by ESG portal
- Datasets stored at NCAR
  - 64.41 TB in 397253 total files
  - 1230 portal users
- IPCC Data at LLNL
  - 26.50 TB in 59,300 files
  - 400 registered users
  - Data downloaded: 56.80 TB in 263,800 files
  - Avg. 300GB downloaded/day
- (These data are fall 2005)

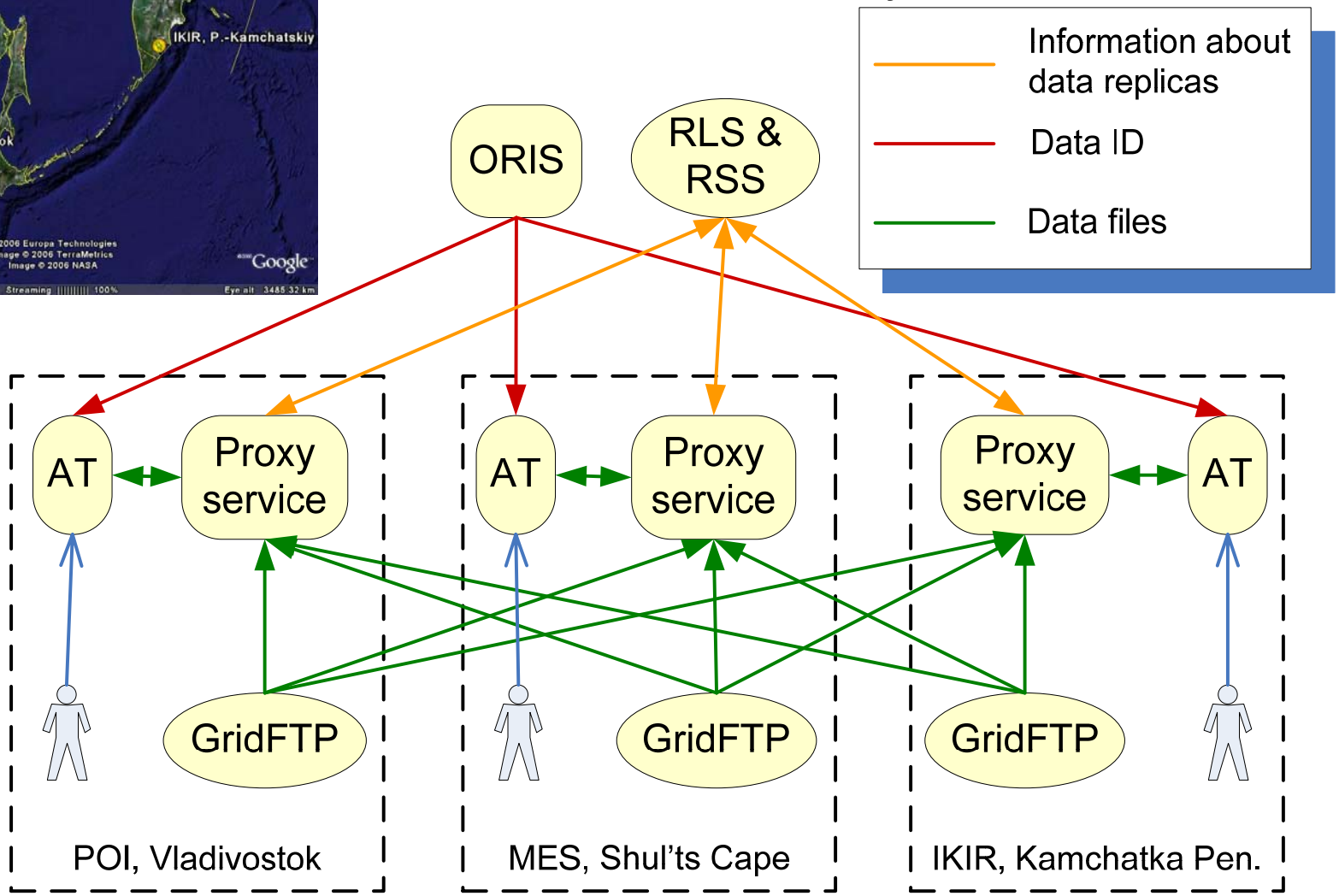




Ian Foster, "**Global Data Services**", Tutorial at 14th NASA Goddard - 23rd IEEE Conference on Mass Storage Systems and Technologies, May 15, College Park, Maryland

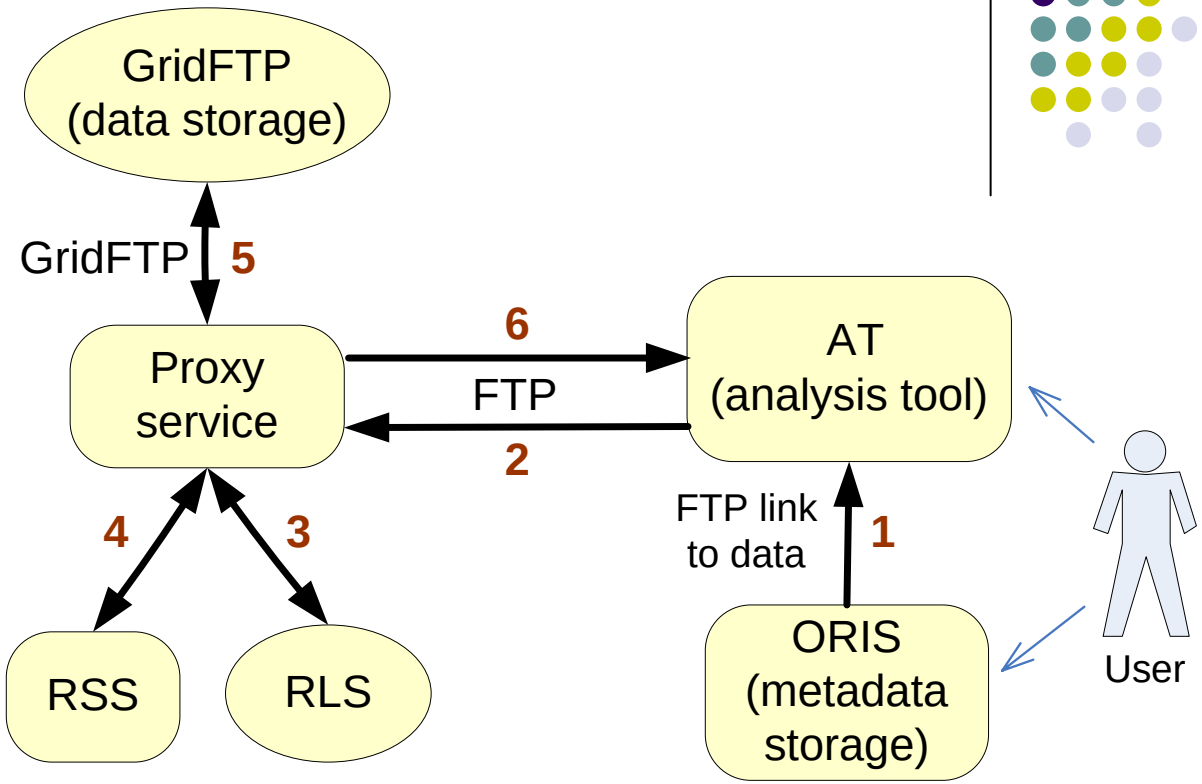
Accessing distributed data

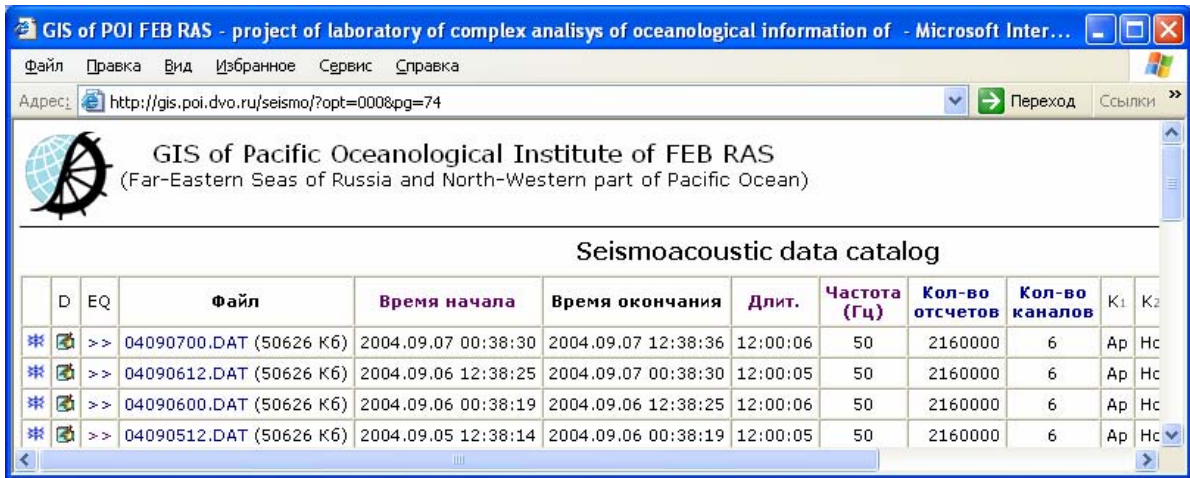
ORIS – Oceanographic Research and Information System
AT – data visualization/analysis tool



Accessing distributed data

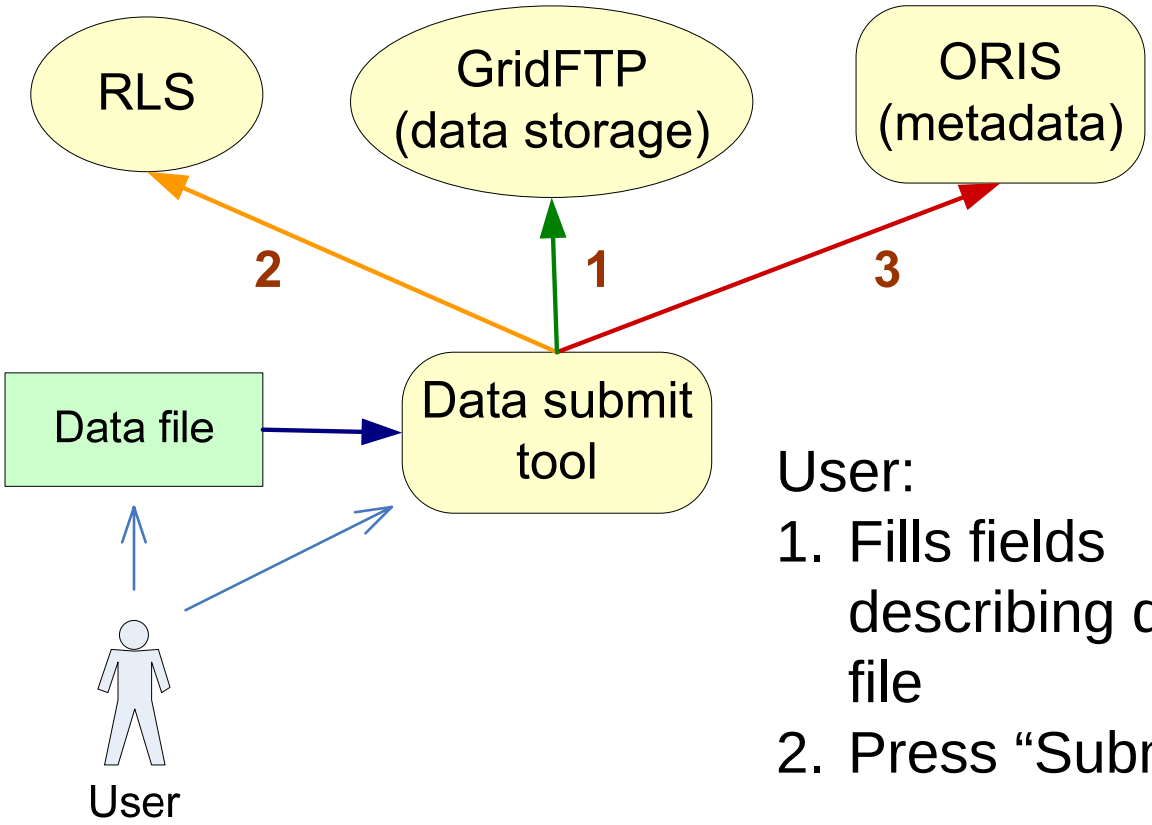
1. Use ORIS to find interesting data and start analysis tool
2. AT requests data using FTP
3. Proxy queries RLS for available replicas
4. Proxy uses RSS to select optimal replica
5. Proxy fetches data file using GridFTP
6. Proxy sends data to analysis tool





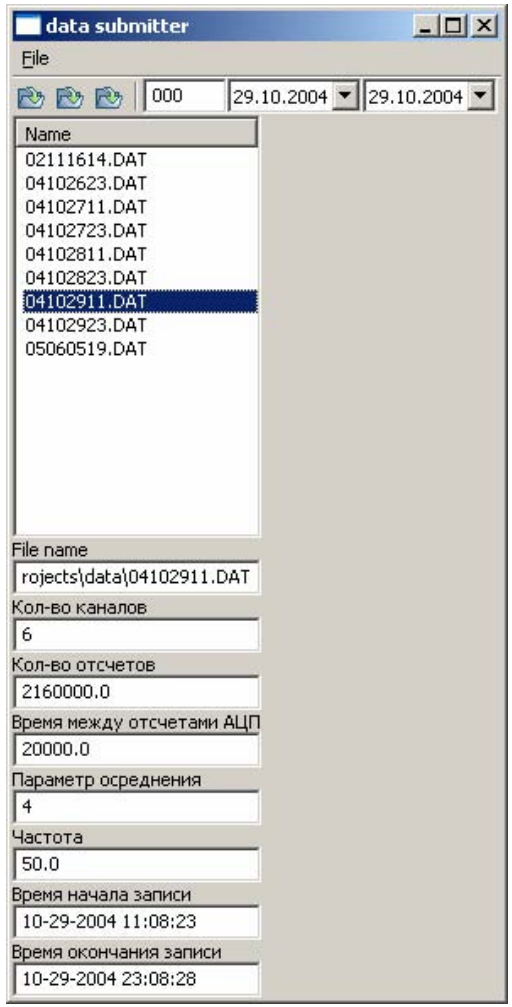
	D	EQ	Файл	Время начала	Время окончания	Длит.	Частота (Гц)	Кол-во отсчетов	Кол-во каналов	K1	K2
		>>	04090700.DAT (50626 Кб)	2004.09.07 00:38:30	2004.09.07 12:38:36	12:00:06	50	2160000	6	Ap	Hc
		>>	04090612.DAT (50626 Кб)	2004.09.06 12:38:25	2004.09.07 00:38:30	12:00:05	50	2160000	6	Ap	Hc
		>>	04090600.DAT (50626 Кб)	2004.09.06 00:38:19	2004.09.06 12:38:25	12:00:06	50	2160000	6	Ap	Hc
		>>	04090512.DAT (50626 Кб)	2004.09.05 12:38:14	2004.09.06 00:38:19	12:00:05	50	2160000	6	Ap	Hc

Submitting new data



User:

1. Fills fields describing data file
2. Press “Submit”



Data submit tool:

- Uploads data file to local GridFTP server
- Updates RLS with replica location info
- Updates ORIS with information about new data

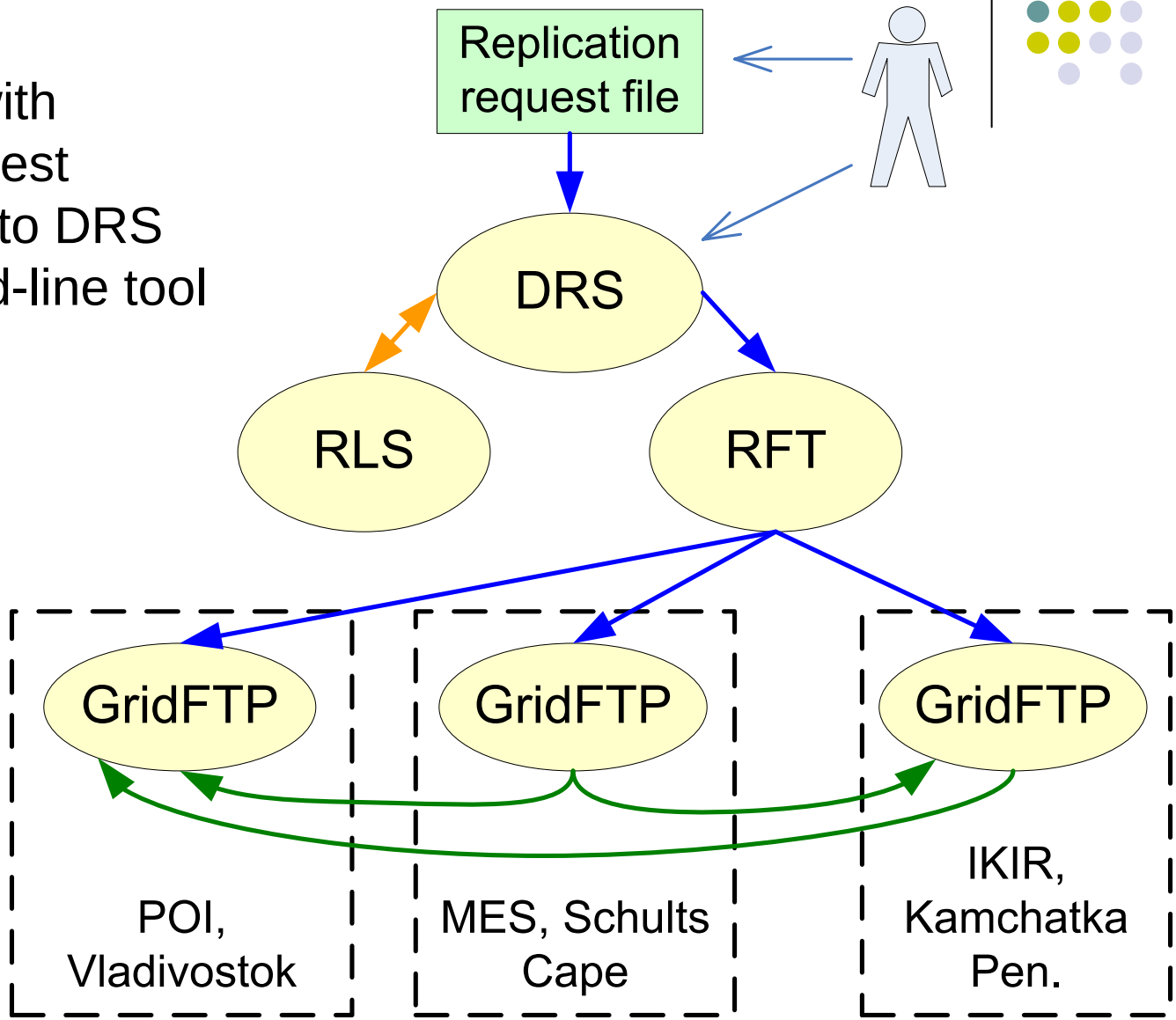
Data replication

User (admin):

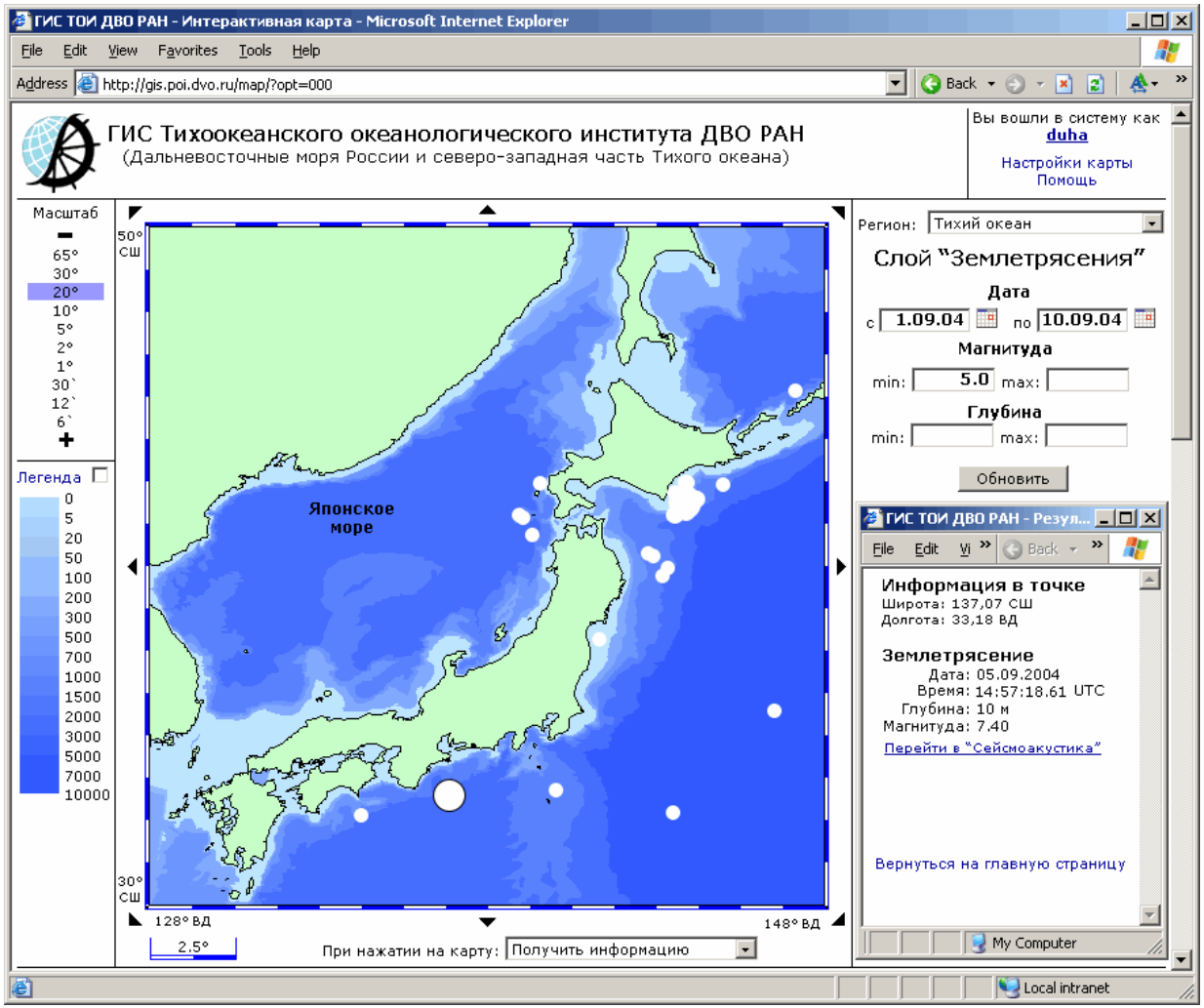
- Make text file with replication request
- Submit this file to DRS using command-line tool

DRS:

- Query RLS for current location of source file
- Submit file copy job to RFT
- Update RLS

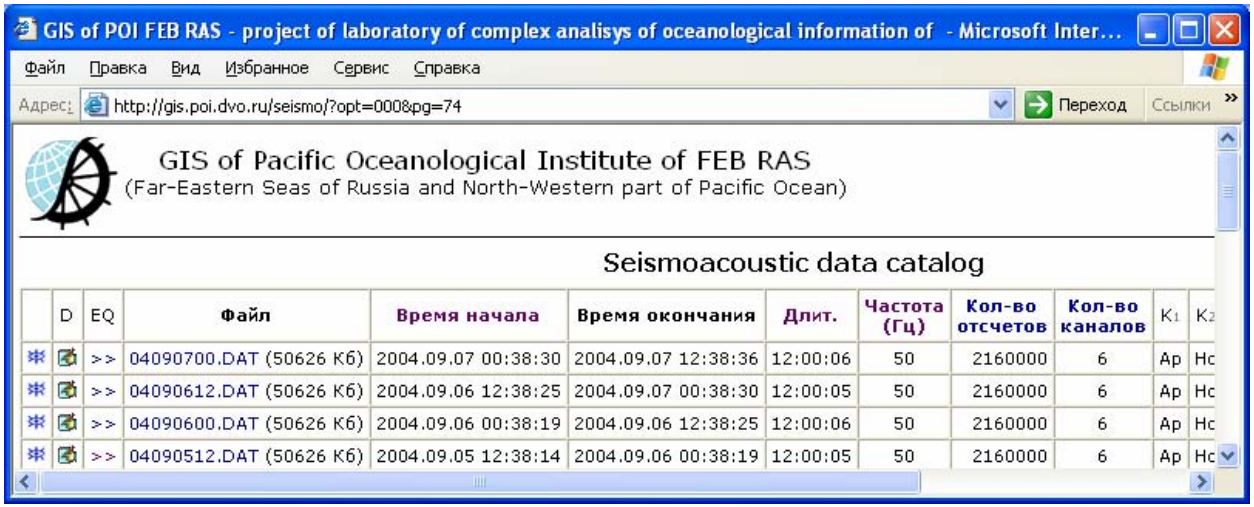


Example – working in ORIS with seismo-acoustic data



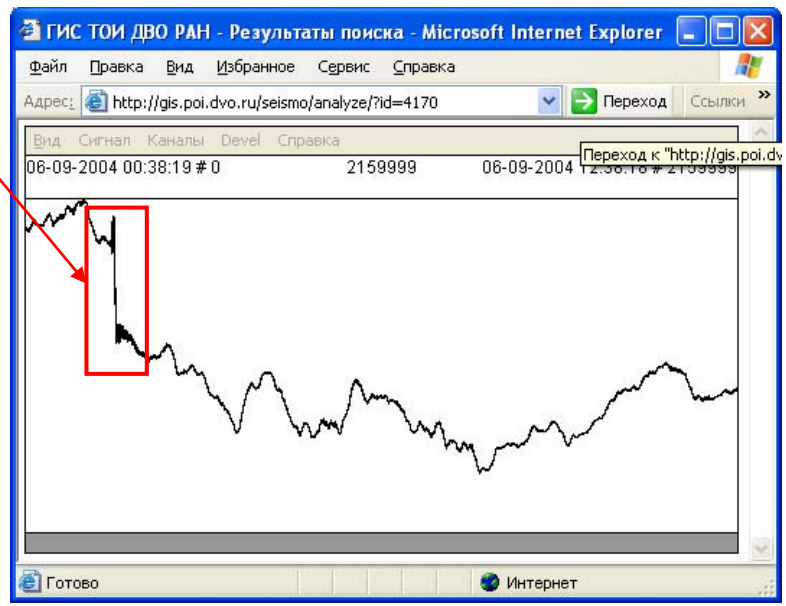
Querying ORIS for earthquakes on 01.09.2006 – 10.09.2006 with magnitude >5

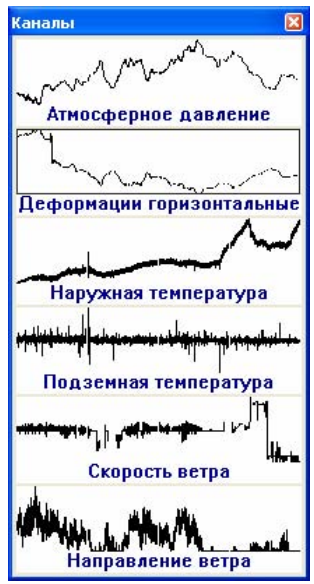
Example – working in ORIS with seismo-acoustic data



Seismo-acoustic data files which were found for selected earthquake's

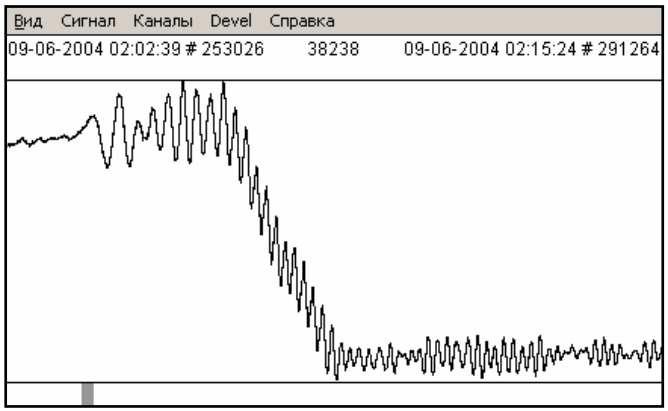
Earthquake

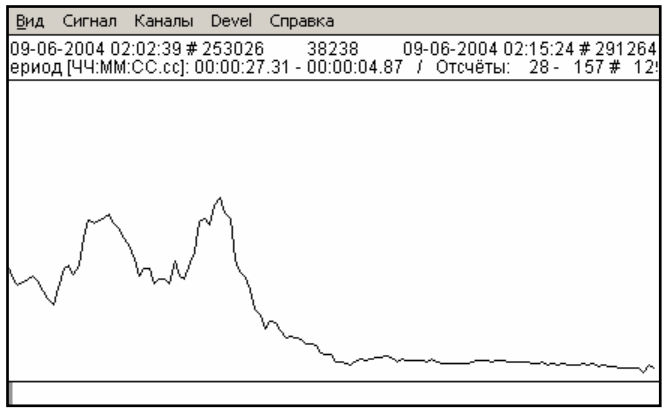




Seismo-acoustic data file opened in analysis tool

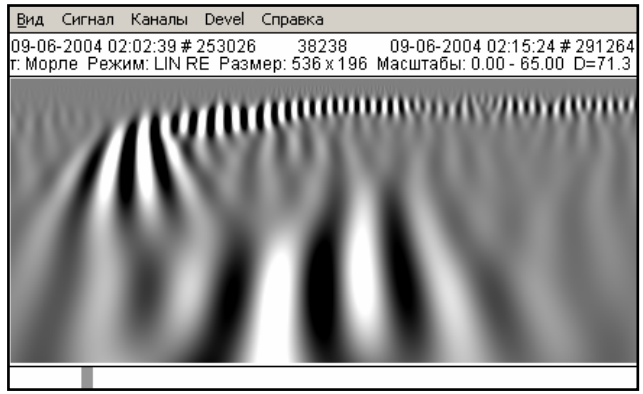
Example – working in ORIS with seismo-acoustic data

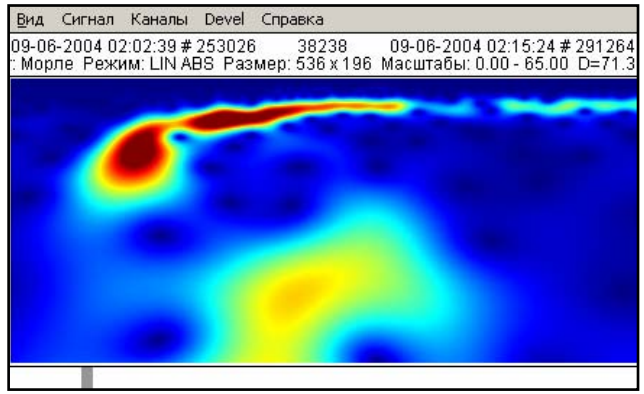


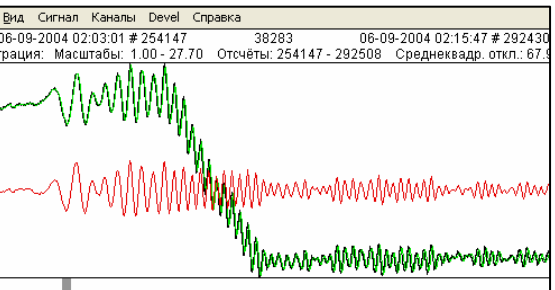


Zoomed oscillogram and part of spectrum with 2 peaks specific to earthquakes

Scalegrams of selected fragment







Filtration

Conclusion

- Grid is very promising technology in general and in data management in particular
- We use OGSA-compliant services to implement data management subsystem of ORIS (GIS) in POI FEB RAS
- We believe Grid technology might be useful for PICES too

Thank you!