

Vertical Earth: Integrating Earth Science Data Vertically to Traverse Across Spheres

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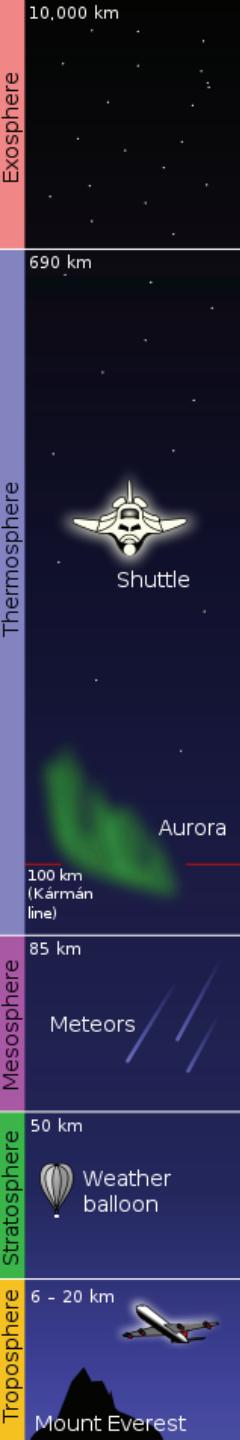
A Computer Scientist in Earth Science – I'm an alien ♪

- Earth scientists focus on creating useful tools for their own research community (or maybe for himself/herself?)
- For computer scientists, or maybe in my opinion, a tool useful across research communities is more interesting.
- They also focus more on the human and society aspects (social application).



Across Communities

- The “**sphere**” analogy plays an important role in earth science.
- A **sphere roughly corresponds to a research community**.
- Each **sphere represents the different range of height, or different targets**.
- A **sphere is conceptually a layer in the onion model of the earth system**.





Spheres (comprehensive?)

		Noosphere
Anthroposphere	Heliosphere	Oceanosphere
Asthenosphere	Heterosphere	Pedosphere
Atmosphere	Humanosphere	Photosphere
Biosphere	Hydrosphere	Plasmasphere
Cosmosphere	Ionosphere	Stratosphere
Cryosphere	Lithosphere	Terrasphere
Ecosphere	Magnetosphere	Thermosphere
Exosphere	Mesosphere	Troposphere
Geosphere		



“Vertical Earth” Project

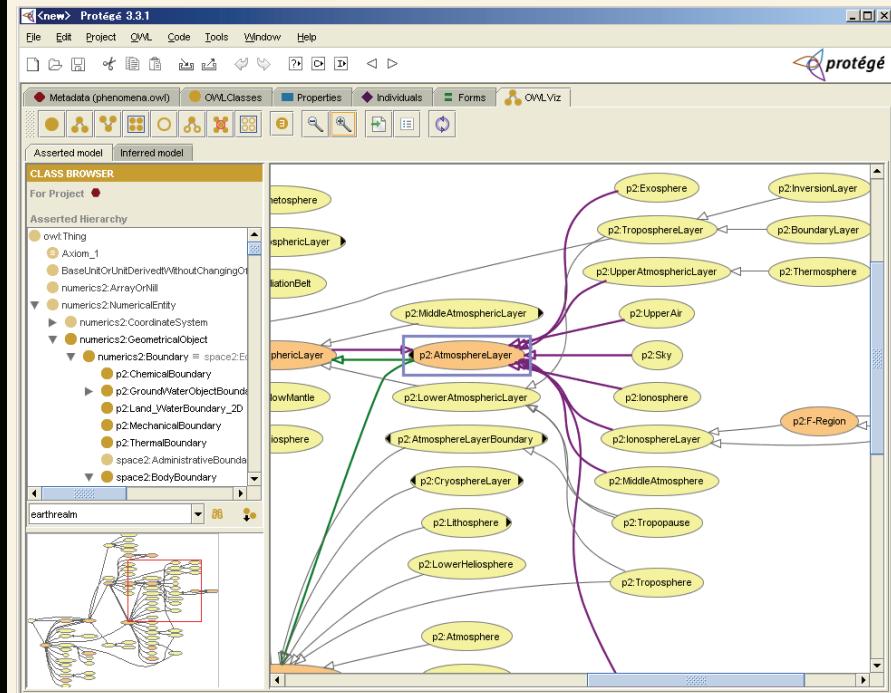
- Earth science data can be modeled as 2D (x, y) for a sphere, and 1D (z) across spheres. They are not dense 3D data.
- “Vertical” symbolically represents data integration across research communities.
- Collaborative work with National Institute of Polar Research and The Institute of Statistical Mathematics.



Previous Work

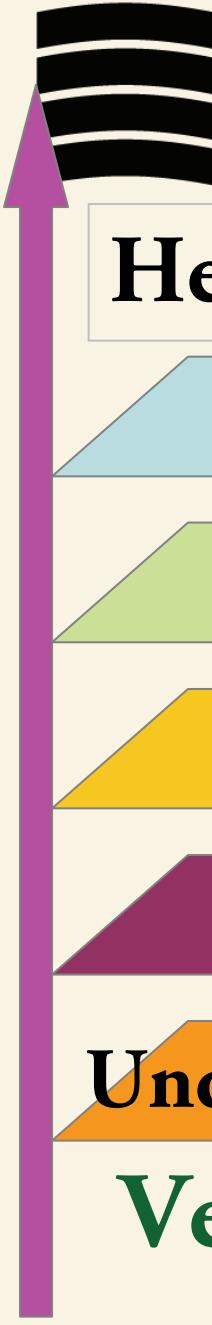
The screenshot shows the homepage of the NASA Global Change Master Directory (GCMD). The header includes the NASA logo and the text "GODDARD SPACE FLIGHT CENTER". Below the header is a banner with the text "Global Change Master Directory" and "Discover Earth science data and services", accompanied by images of a globe, clouds, a river, and a dry landscape. The main navigation menu includes links for Home, Data Sets, Data Services, Portals, Add to GCMD, What's New, Participate, Conferences, and About GCMD. A "Find Data" section on the left lists categories such as Agriculture, Land Surface, Atmosphere, Oceans, Biosphere, Paleoclimate, Biological Classification, Solid Earth, Climate Indicators, Spectral / Engineering, Cryosphere, Sun-Earth Interactions, Human Dimensions, and Terrestrial Hydrosphere. On the right, there is a "Find Data Services" section with links to Data Analysis and Visualization, Data Management / Data Handling, Education / Outreach, Environmental Advisories, Hazards Management, Metadata Handling, Models, Reference and Information Services, and a Data Services Text Search bar. At the bottom, there is a "Data Set Text Search" bar, a "Search tips" link, and links for Data Centers, Projects, Instruments / Sensors, and Platforms / Sources. The footer includes the USA.gov logo, a Privacy Policy and Important Notices link, and the NASA logo. It also contains information about the webmaster (Monica Holland), responsible NASA official (Lola Olsen), and the last update date (November 2008).

GCMD -> Coverage is good, but it is not designed for machines.



NASA GCMD

SWEET Ontology



Vertical / Horizontal Integration

Height

Space

Horizontal

Web services
across
organizations

Underground

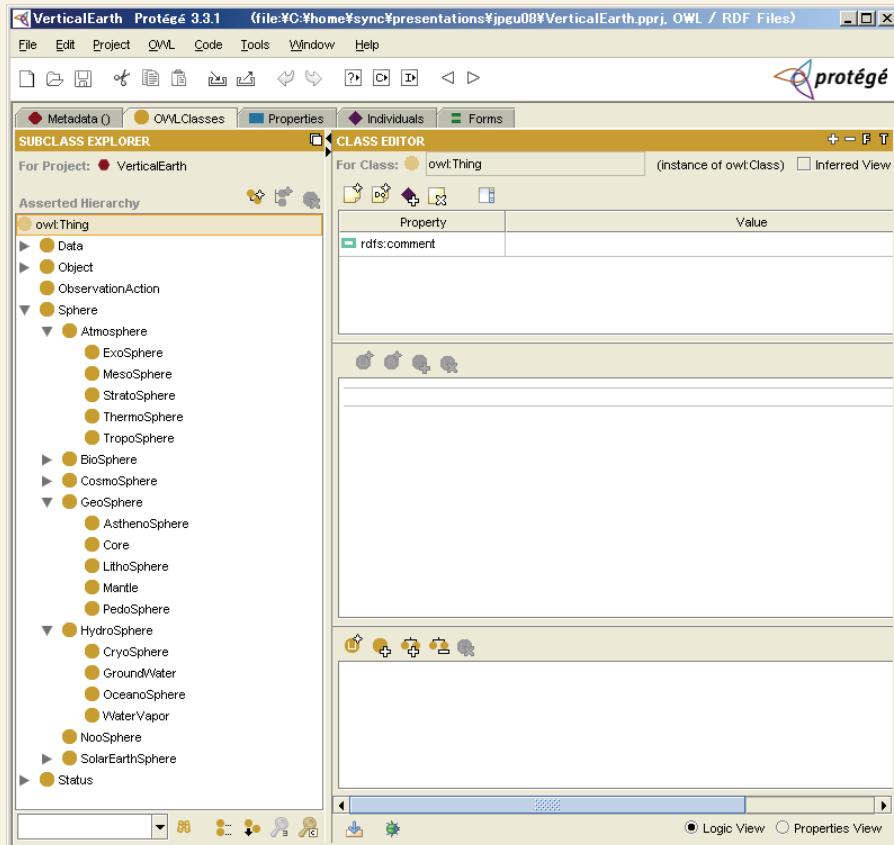
Vertical

Overlay of layers
across communities





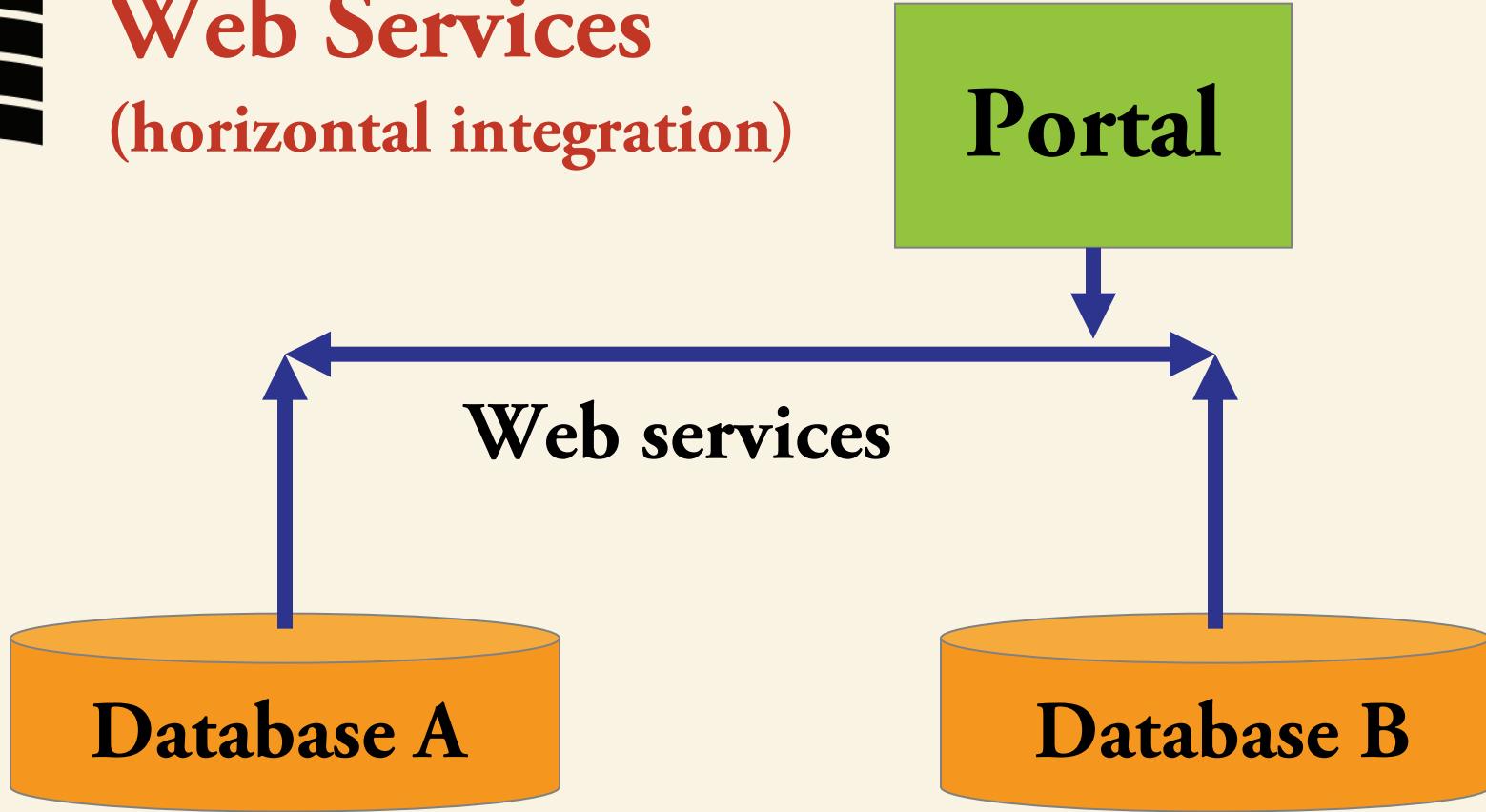
Ontology (vertical integration)



- Use OWL (Web Ontology Language) for specifying concepts.
- Define vocabulary such as superjacent, subjacent for vertical relationship.
- Design for practical usefulness.



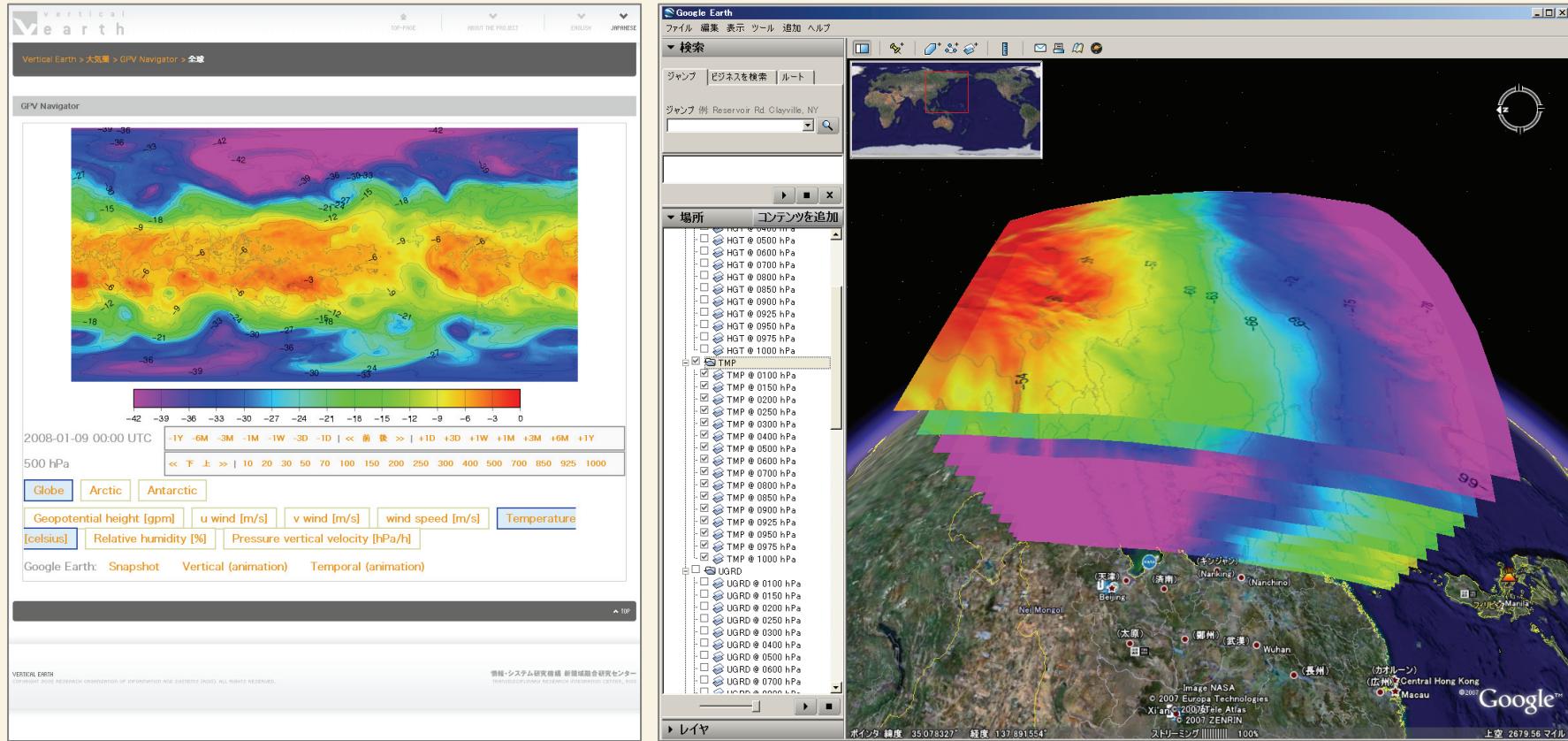
Web Services (horizontal integration)



- OGC (Open Geospatial Consortium) Web services (WMS/WFS/WPS) for integrating data across organizations.



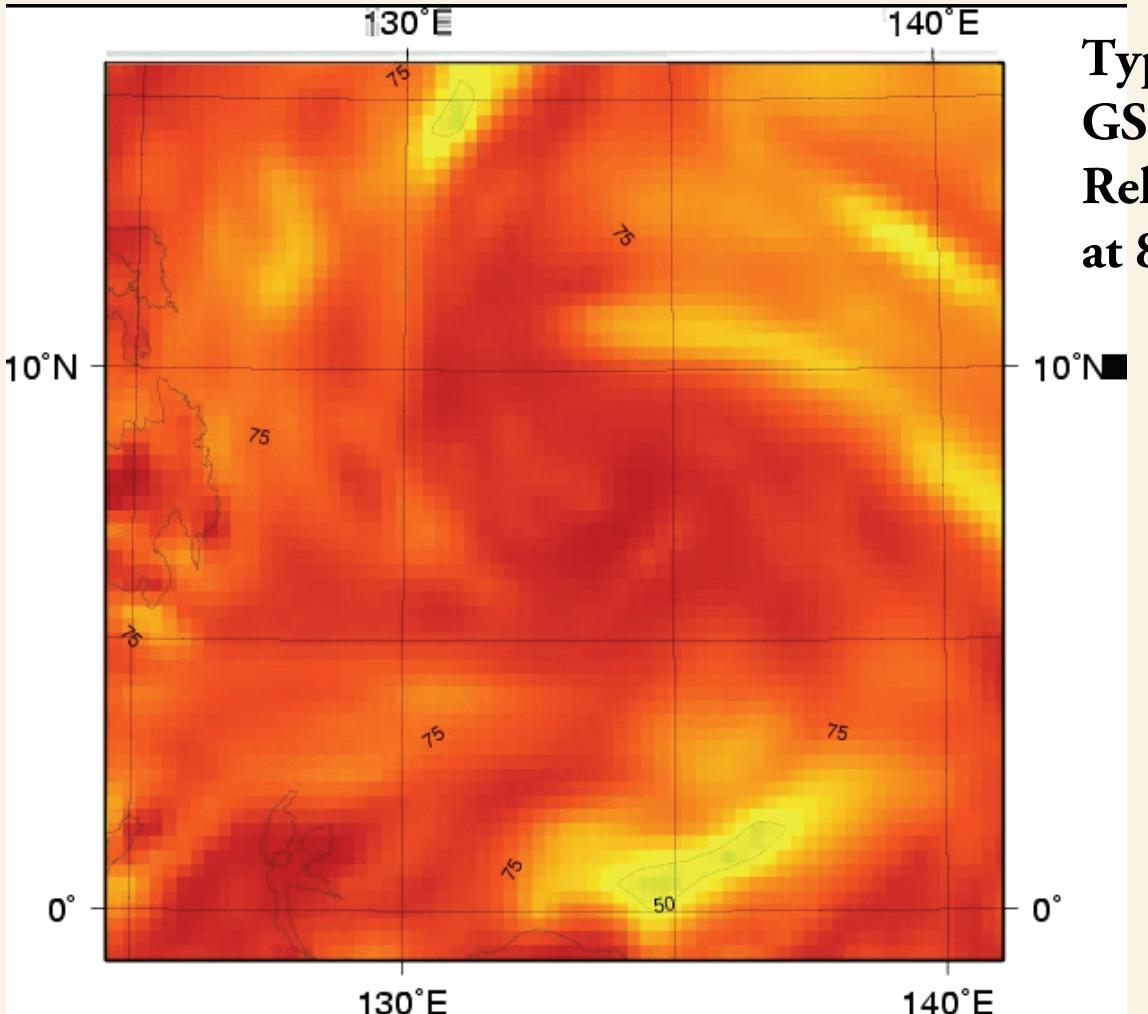
GPV Navigator



- GPV (Grid Point Value) is a good example to show the vertical structure of atmosphere.

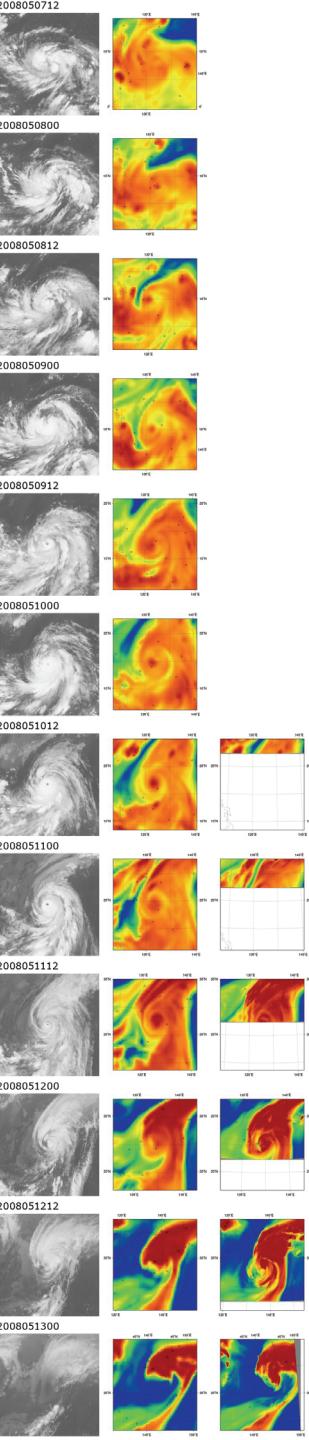


Vertical Typhoon



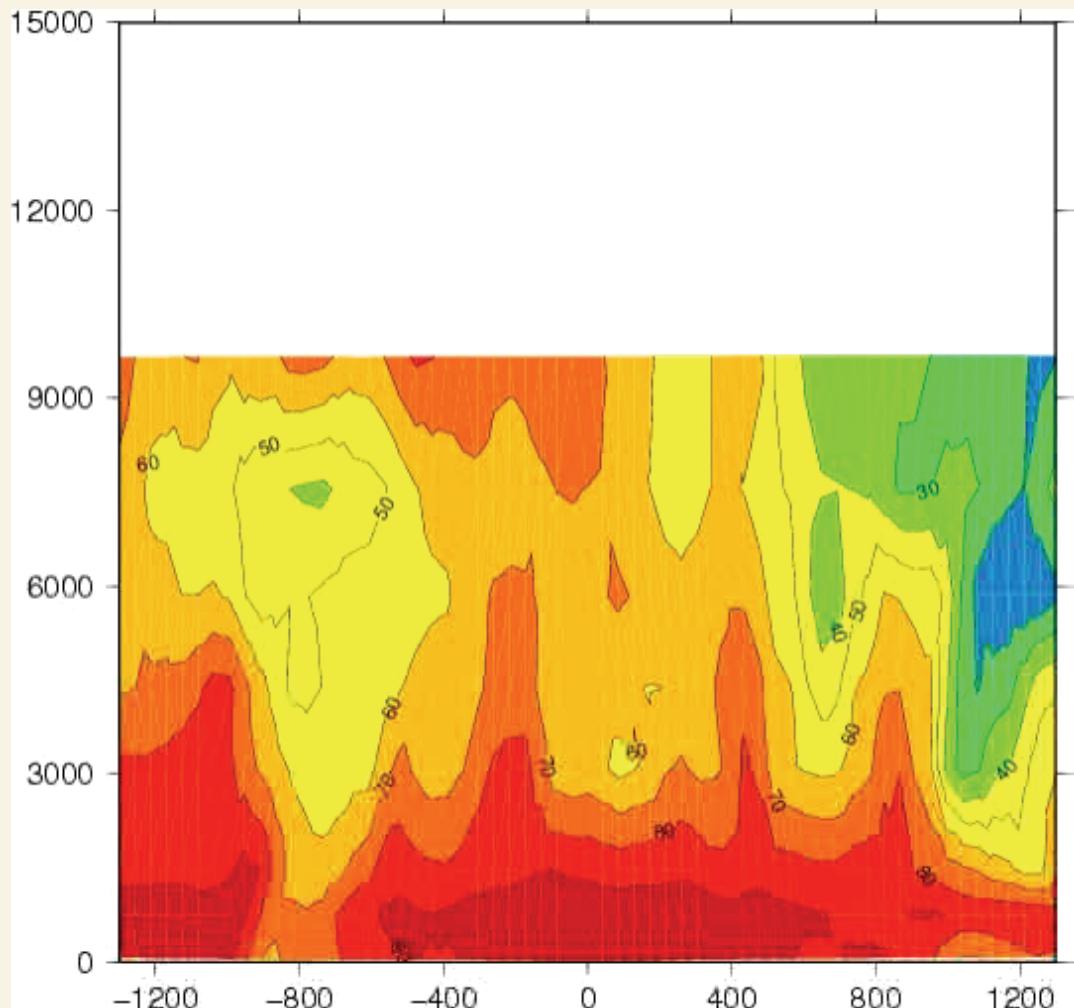
Horizontal View

Typhoon 200802
GSM (JMA)
Relative humidity
at 850hPa



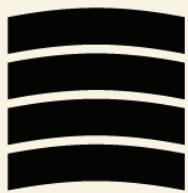


Vertical Typhoon



**Typhoon 200802
GSM (JMA)
Relative humidity
vertical profile for
north (right) –
south (left)**

Vertical View



Digital Typhoon (Poster P-56 of this symposium)

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Digital Typhoon: Typhoon Images and Information

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RSS / Atom / OpenSearch :: [Kids](#) :: [Eyes on the Typhoon](#) :: [Typhoon Front](#) :: [Widget](#)

Real-time Typhoon Information

No typhoon information received at this time.

Number of Typhoons
This year = 19 (Best Track)
Average = 24.0 (1951-2005)

Latest Typhoon Information

- [Typhoon News Weblog](#)
 [Typhoon 200819 \(MAYSAK\)](#) (2008-11-07)
- [Typhoon News Topics](#)
- [Local Information Portal](#)
- [AMeRAS \(AMeDAS Ranking\)](#)
 [on Google Maps](#)
 [AMeDAS Event Detection](#)
- [Disaster Information and Databases](#)
- [Other News](#)
 A widget [Typhoon Visual Report](#) released (2008-07-11)

Typhoon Database Meteorological Satellite Images

1. Search by Metadata

1. [Search by Date / Season](#)
2. [Search by Name / Number](#)
3. [Search by Map](#)
4. [Search by Place \(Lat / Lon\)](#)
5. [Search by Pressure](#)
6. [Search by Wind](#)
7. [Search by Day](#)
8. [Typhoon Calendar](#)
: [N. Pacific](#) : : [S. Pacific](#) :
9. [List by Track Information](#)
: [N. Pacific](#) : : [S. Pacific](#) :

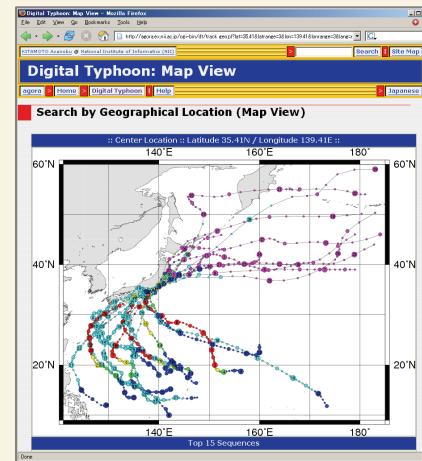
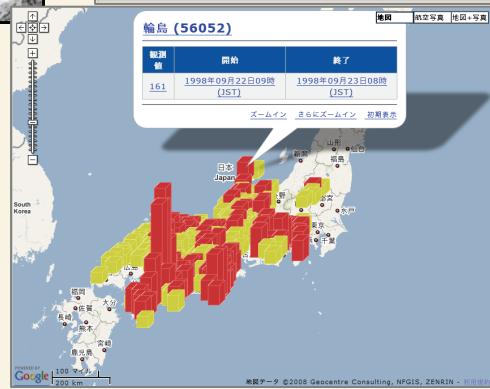
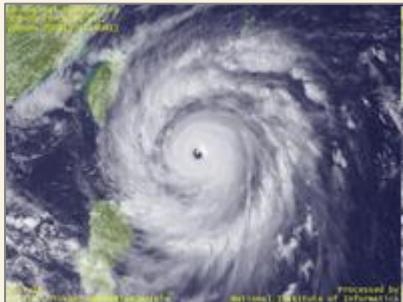
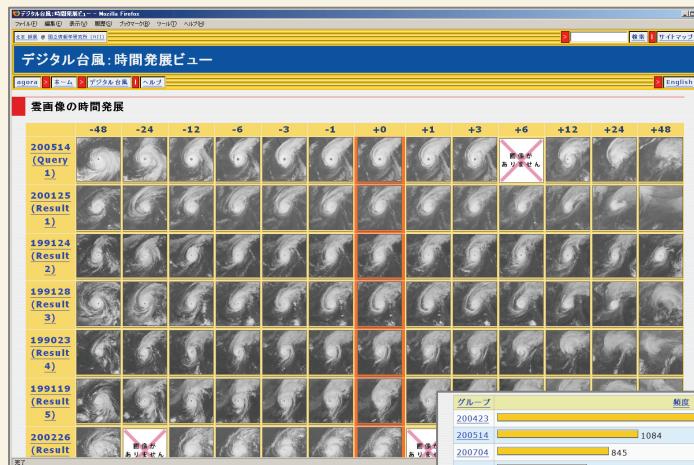
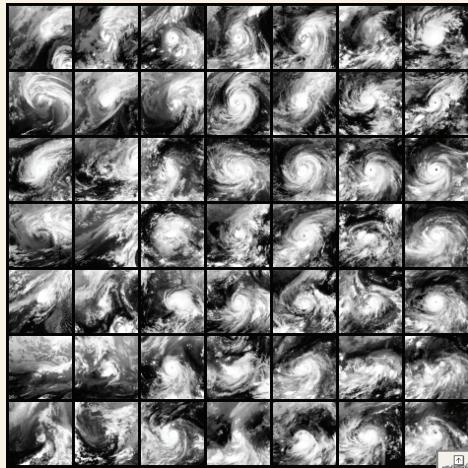
2008-11-11 19:00 (UTC)

www.digital-typhoon.org
2008-11-11 19:00 UTC

- The mission is to organize world's typhoon-related information.
- “Atmosphere” and “Anthroposphere” applications in Vertical Earth.



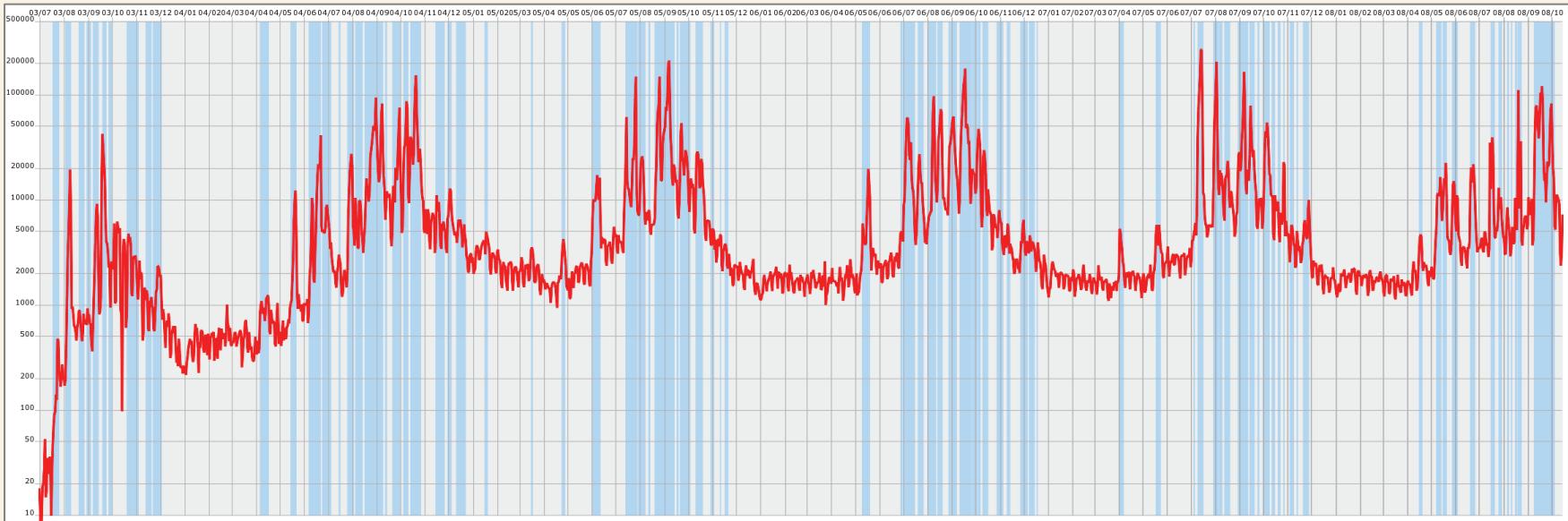
Search and Share



- **Searching data** is an important challenge.
- **Sharing data** in the society is another goal.



Not Only for Earth Scientists..



- Total 80 million PV (or 850,000 PV per day) achieved in 6 seasons.
- Earth science data is useful for people!
Why not share them with the society?



Typhoon Front





Summary

- Computer scientists and earth scientists **stimulate each other** – happy ending ☺
- This is a computer scientists' idea on earth science data - **across-community data integration and social applications.**
- Relationship between “remote” spheres has been relatively unexplored, so we will start from what we can do.



Pointers

- **Vertical Earth**
 - <http://earth.nii.ac.jp/> (will be re-designed soon)
- **GPV Navigator**
 - <http://earth.nii.ac.jp/atmosphere/GPV/globe/>
 - <http://earth.nii.ac.jp/atmosphere/GPV/meso/>
- **Digital Typhoon**
 - <http://www.digital-typhoon.org/>
- **Typhoon Front**
 - <http://front.eye.tc/>
- **My page**
 - <http://agora.ex.nii.ac.jp/~kitamoto/>