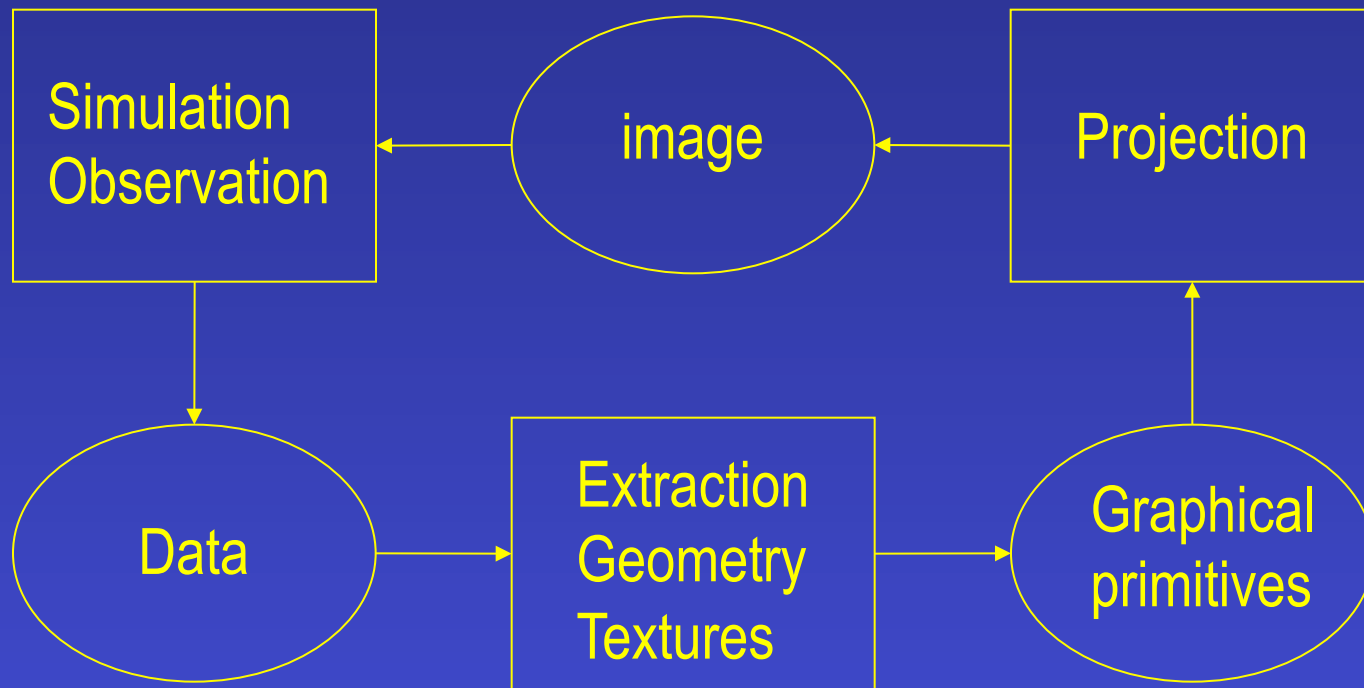


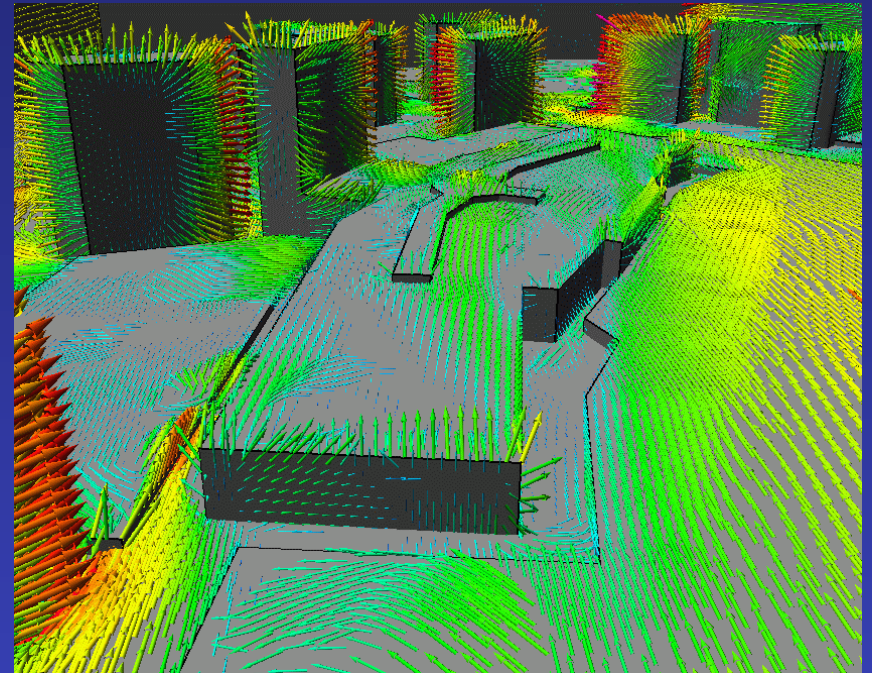
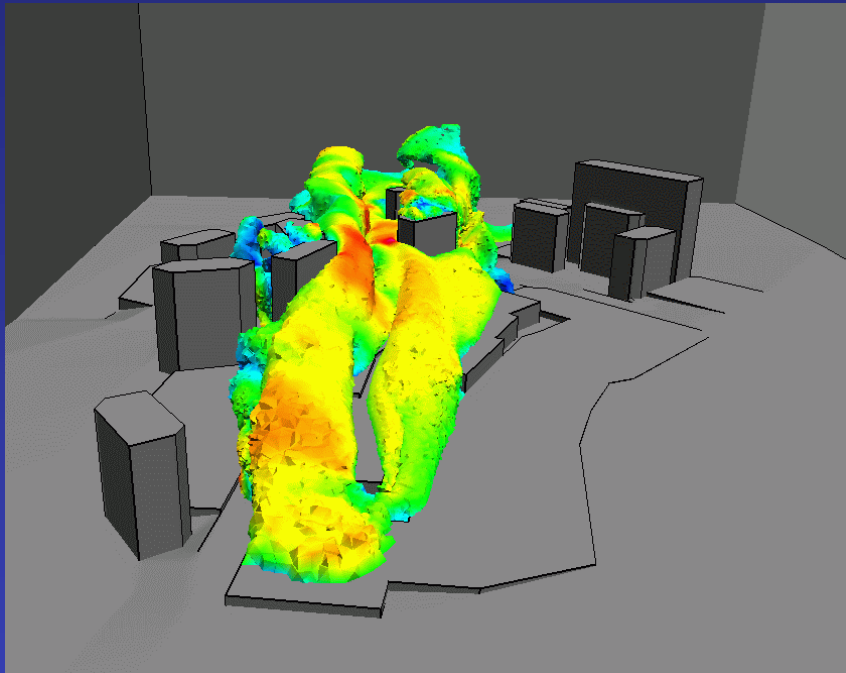


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# Simulation - Visualisation Loop

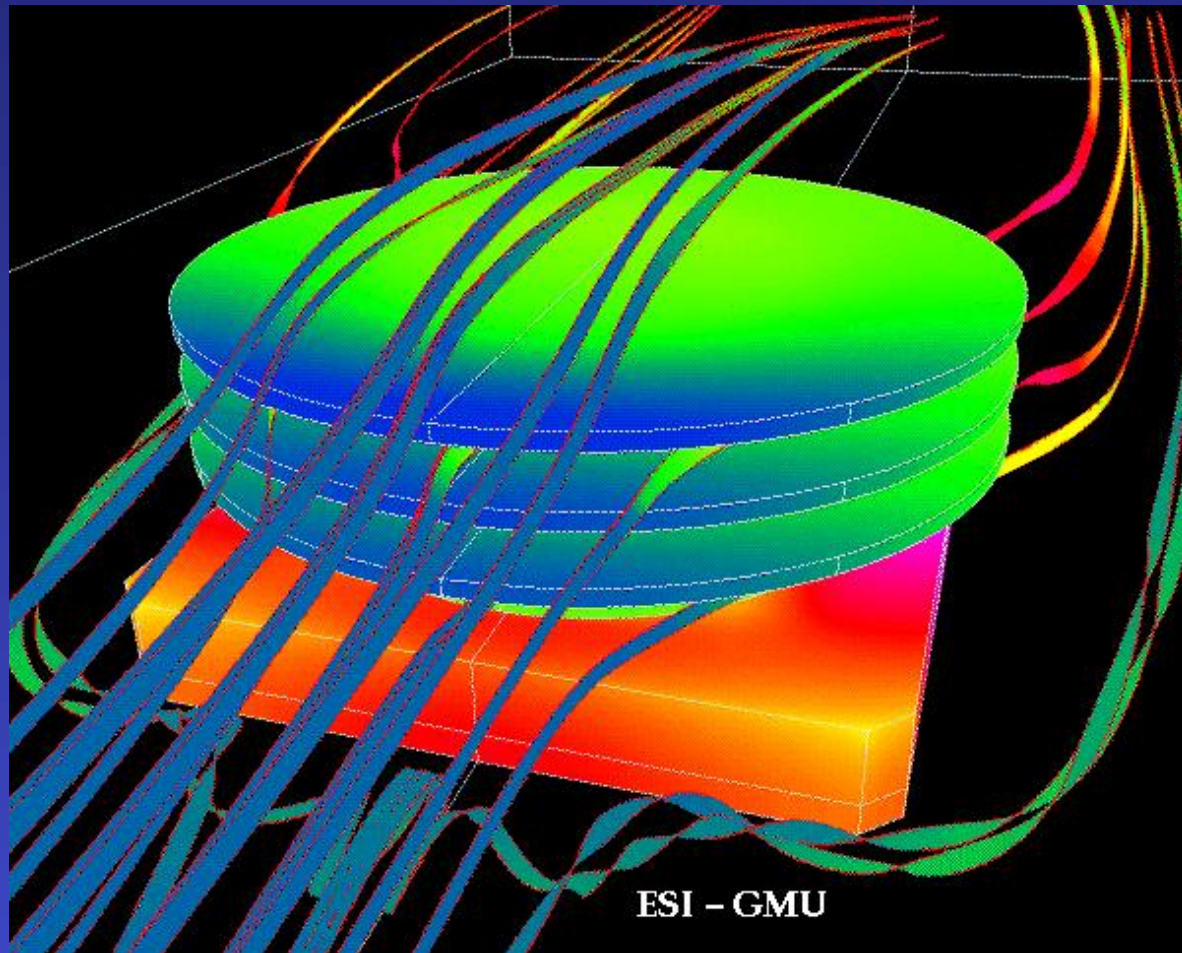


## Visualization Examples

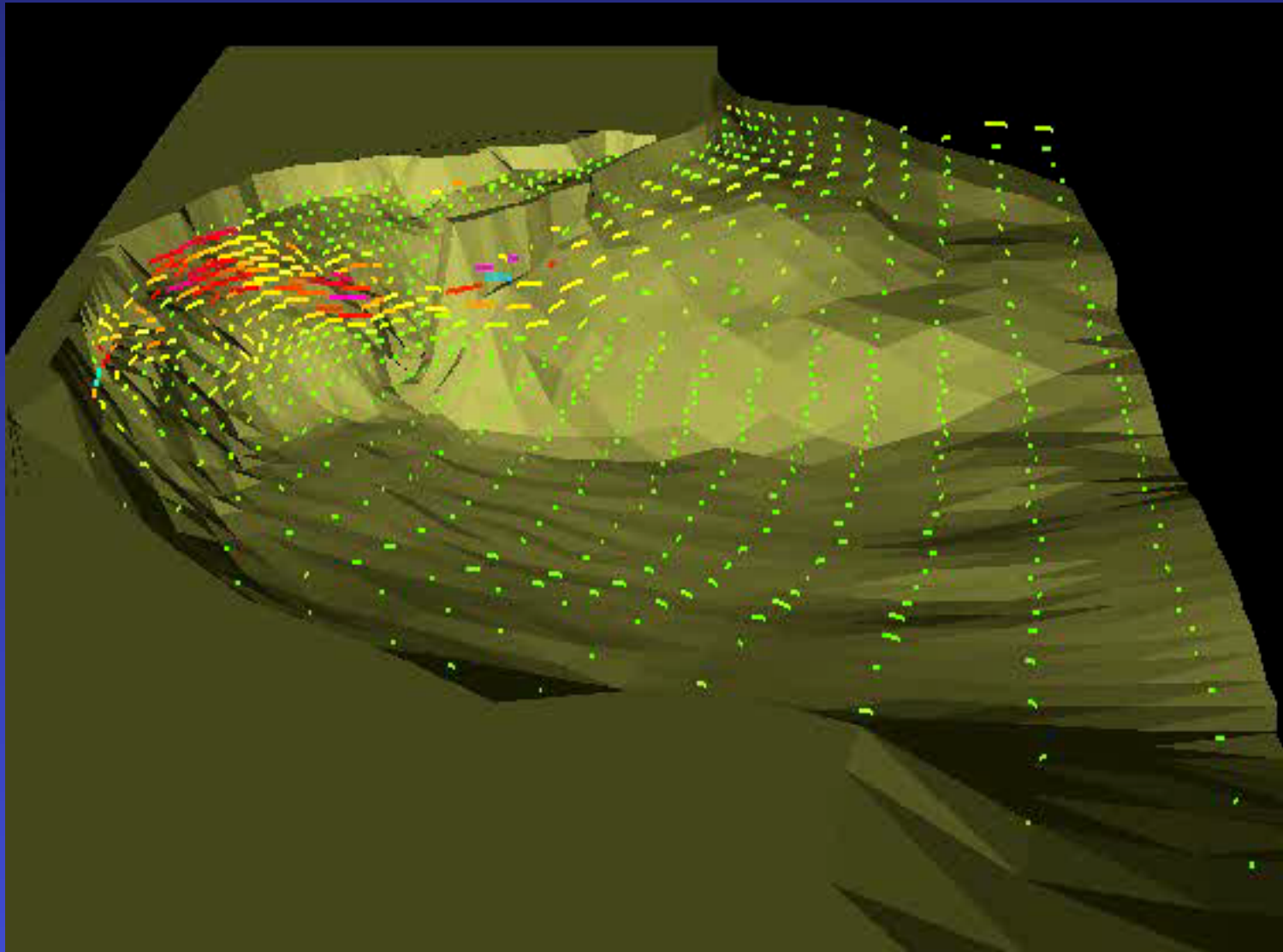


Data: concentration : 1 scalar defined in the volume  
velocity: 1 3D vector defined in the volume

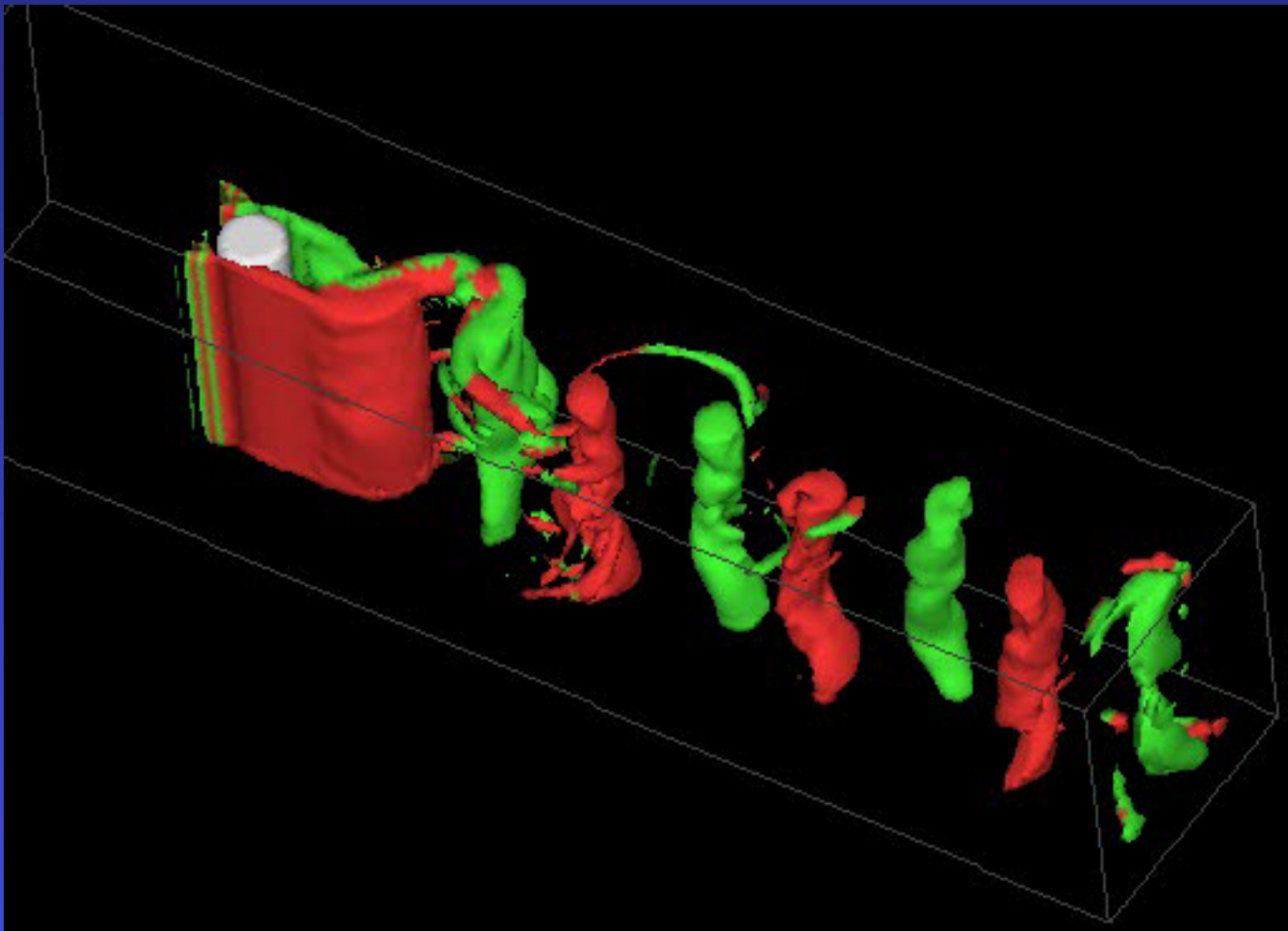
Techniques: Colored Isosurfaces, Colored Arrows



## Visualization Examples

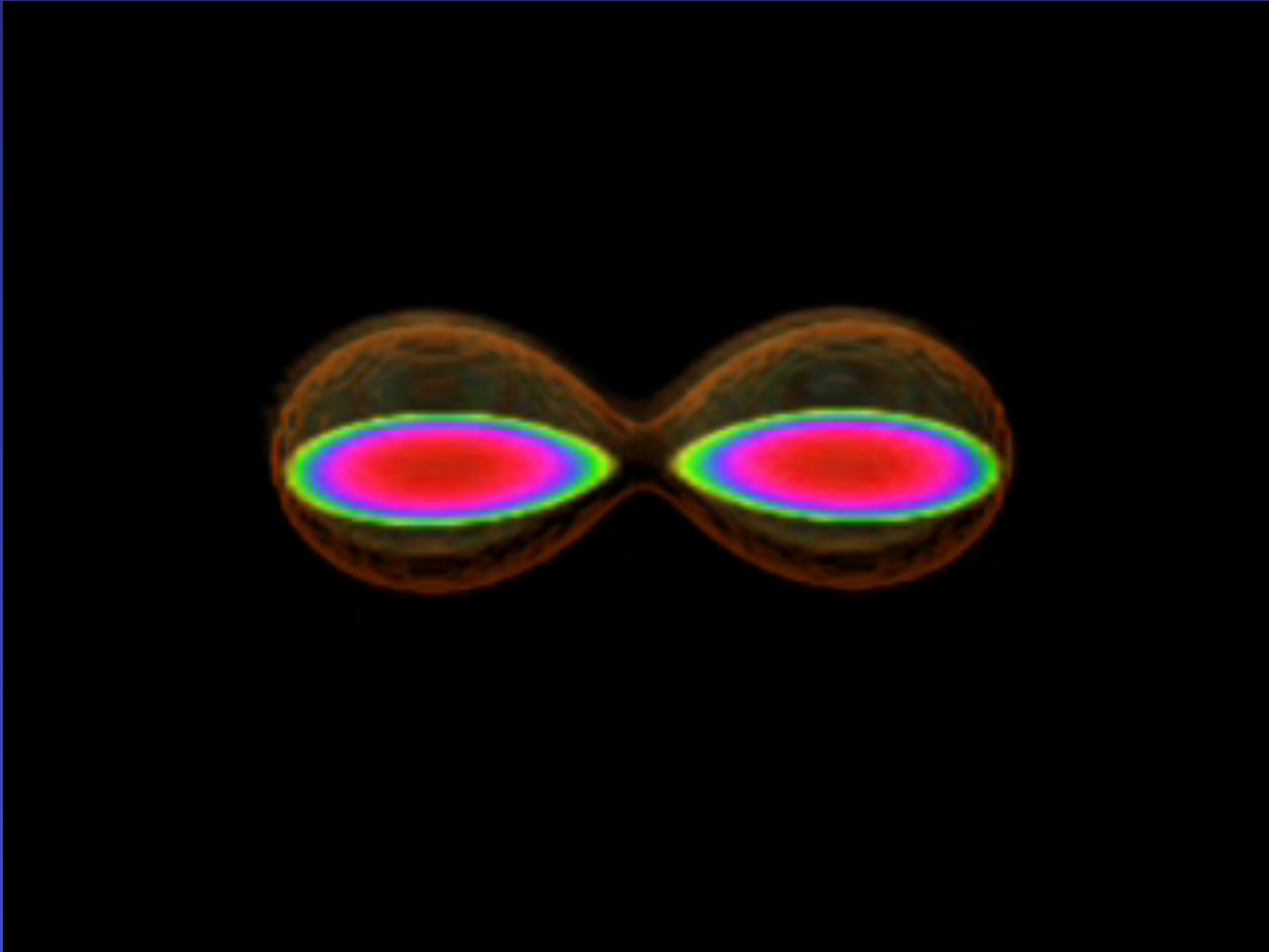


## Visualization Examples



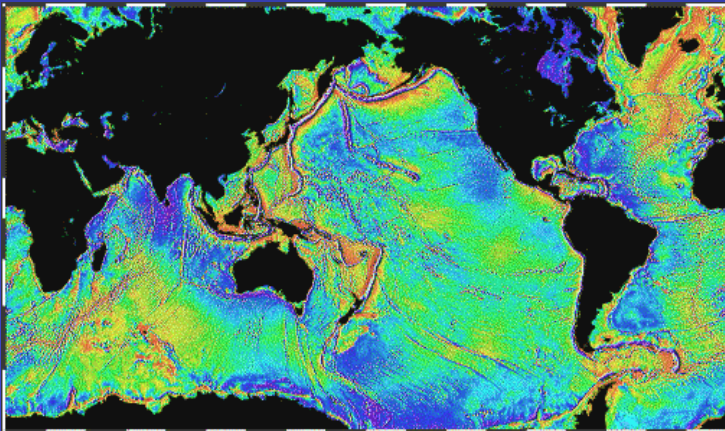
---

# Visualization Examples



# Large Datasets in Scientific Visualization

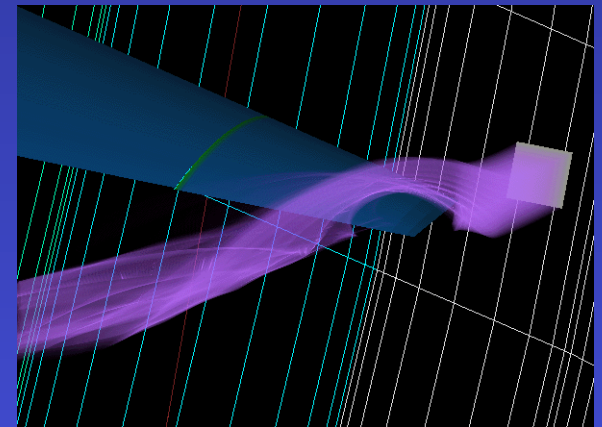
- Satellite Observation
- Volumetric medical data (scanner MRI/CT)
- Numerical simulation: static, dynamic



ERS-1/GeoSat



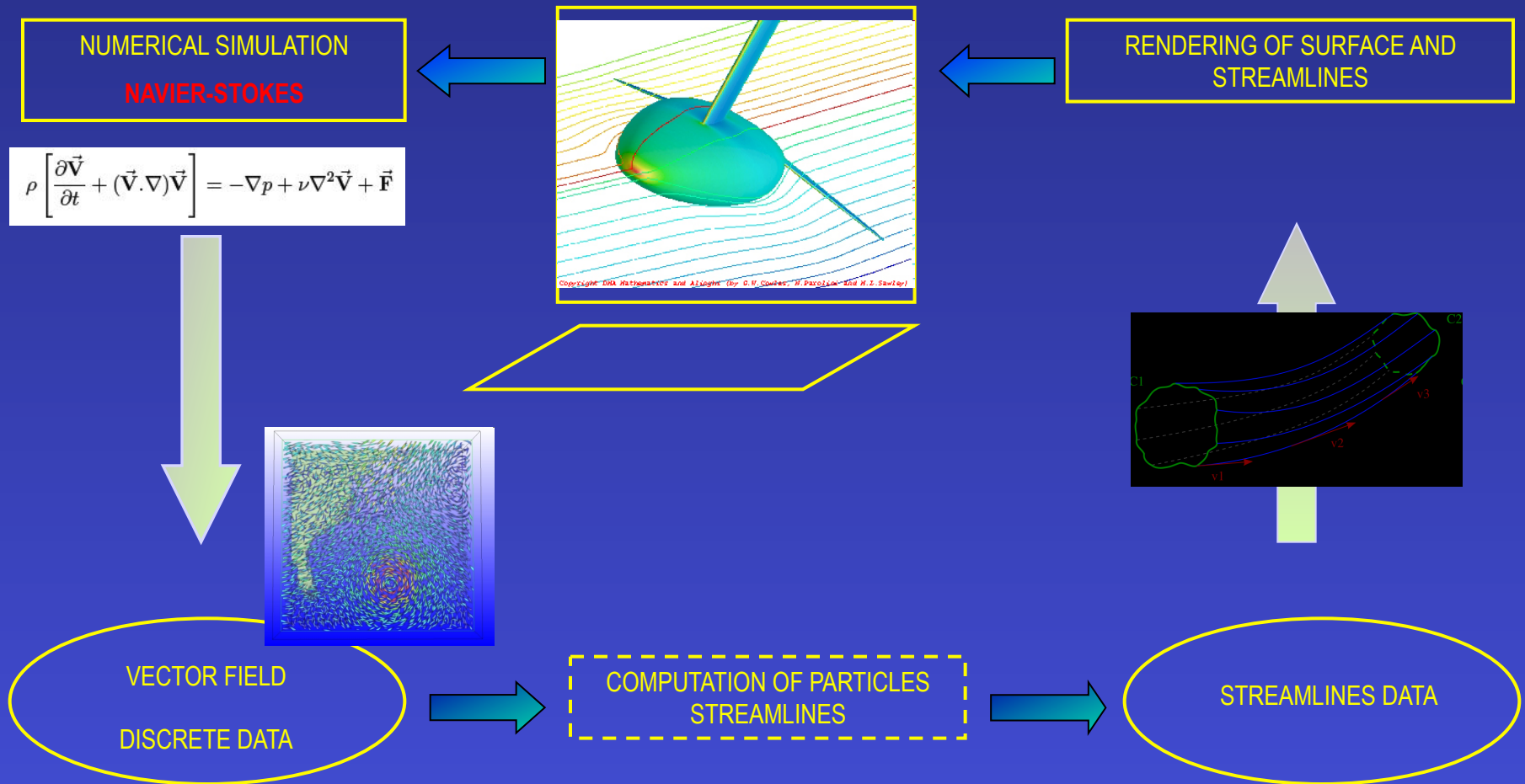
Stanford



LLNL

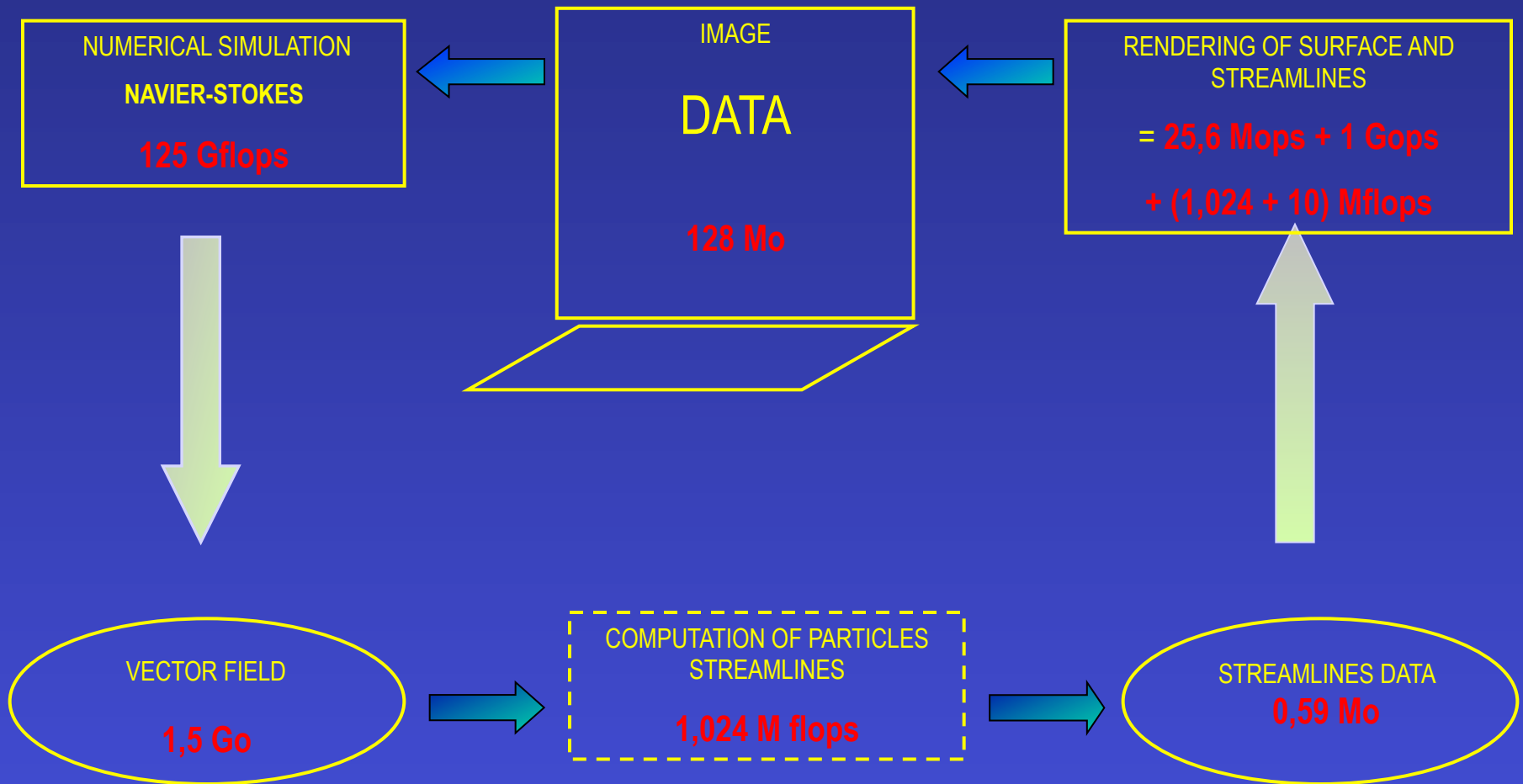


# Loop Simulation-Visualization in fluid dynamics



# Time complexity

## Bandwidth complexity



- NASA's Turbo Pump > 100 Go
- Oak Ridge Supernova > 1 To
- Richtmyer-Meshkov Turbulent > 207 To

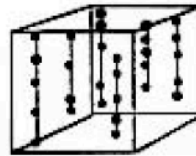
Kilo-octet (Ko)	$10^3$ octets	Page dactylographiée
Mega-octet (Mo)	$10^6$ octets	Petit roman
Giga-octet (Go)	$10^9$ octets	Camionnette remplies de romans
Tera-octet (To)	$10^{12}$ octets	$2To$ : bibliothèque académique
Peta-octet (Po)	$10^{15}$ octets	$200Po$ : tout ce qui a été déjà imprimé
Exa-octet (Eo)	$10^{18}$ octets	$5Eo$ : tous les paroles depuis le début de l'humanité

TAB. 7.1 – du Ko à l'Eo - curtesy of Kasik

# Recherche de gisements pétrolières



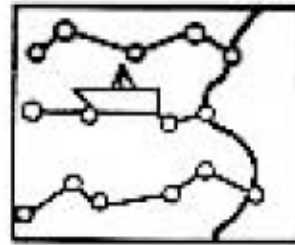
## • WELL LOG DATA (Courtesy D.Lane & D.Krinsel)



Location			Mineral
5.50	1.00	0.00	11.0
5.50	1.00	10.00	10.0
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.

**Données:**  $(x_i, y_i, z_{i_j}; M_{i_j})$   $i = 1, \dots, N$ ,  $i_j = 1, \dots, N_i$ .

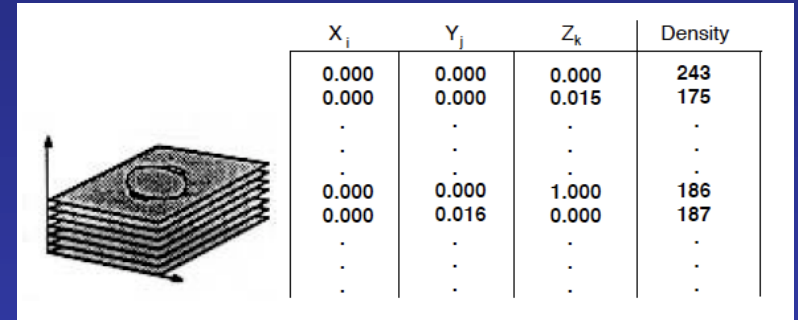
# Mesures océanographiques



Location		Temperature
23.56	37.80	27.3
49.29	54.78	69.2
67.24	43.42	10.2
.	.	.
.	.	.
.	.	.
.	.	.

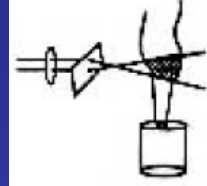
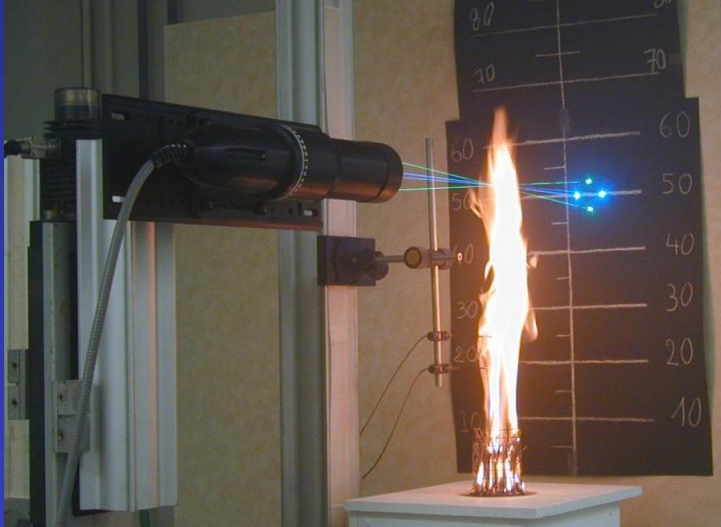
$$(x_{ij}, y_{ij}; T_{ij}) \quad i, j = 1, \dots, N, M.$$

# Scanneurs médicaux



**Données:**  $F_{ijk} = F(x_i, y_j, z_k)$   $i, j, k = 1, \dots, N$ .

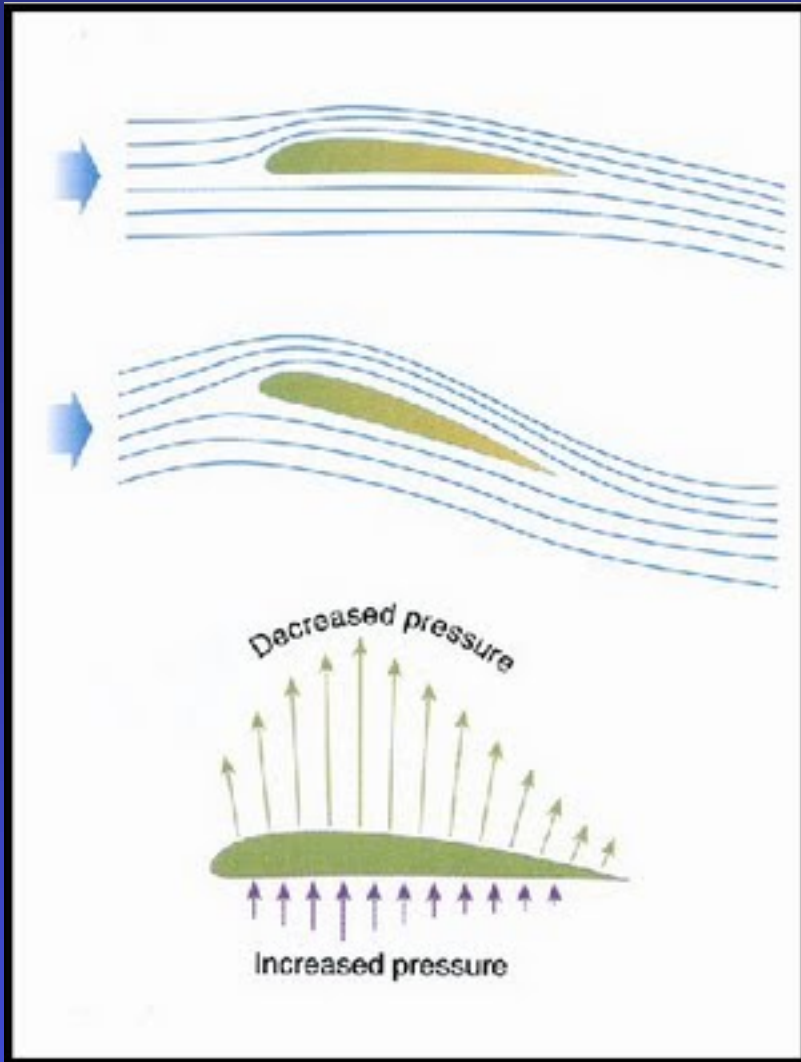
# Mesures optiques de combustion

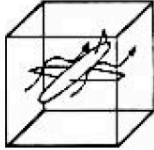


	Location			Concentration
0.00	0.00	0.02	001	
0.00	0.00	0.04	007	
0.00	0.00	0.06	003	
.	.	.	.	
.	.	.	.	
.	.	.	.	
.	.	.	.	

$$(r_i \cos(\Phi_j), r_i \sin(\Phi_j), z_k; C_{ijk})$$

# Mesure de pression aérodynamique



	Location			Pressure
		-132.1	38.5	6.1
	-128.3	38.5	6.6	0.119
	-116.8	38.5	7.5	0.067
	.	.	.	.
	.	.	.	.
	.	.	.	.
	.	.	.	.

$$(x_{ij}, y_{ij}, z_{ij}; P_{ij}), \quad i = 1, \dots, N_u, \\ j = 1, \dots, N_v,$$

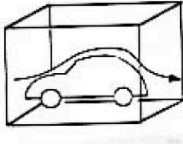
$$(x_{ij}, y_{ij}, z_{ij}) = W(u_i, v_j),$$

$W(u, v)$  surface paramétrique de l'aile.



# Aérodynamique



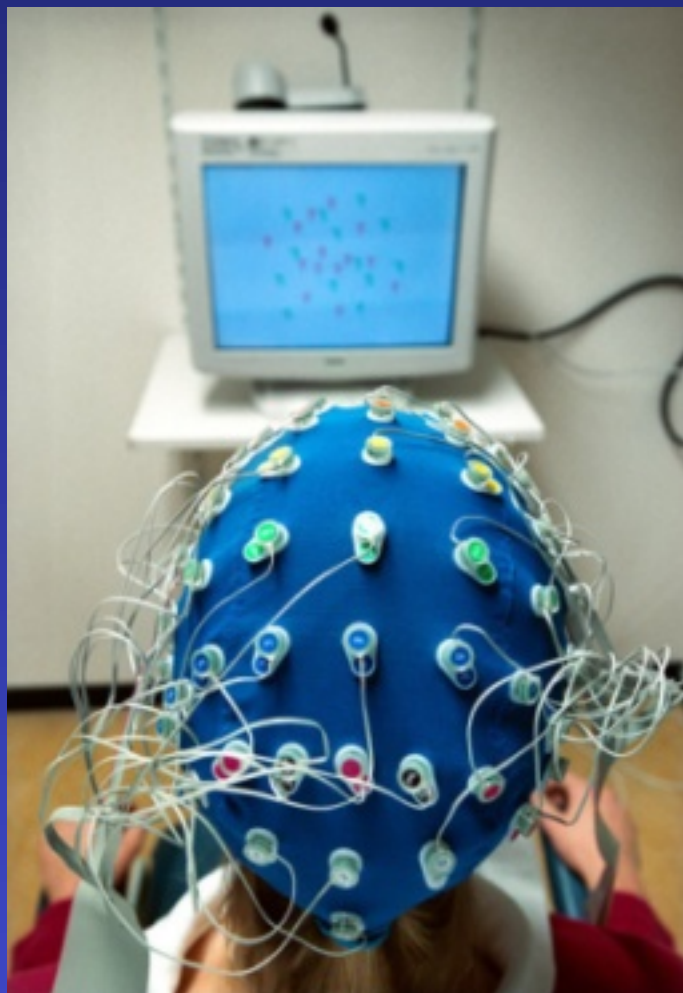
	Location			Velocity		
	7.77	9.45	3.85	(1.33	2.34	0.45)
	4.14	-2.78	2.68	(1.86	3.56	1.25)
	.	.	.	.	.	.
	.	.	.	.	.	.
	.	.	.	.	.	.
	.	.	.	.	.	.
	.	.	.	.	.	.

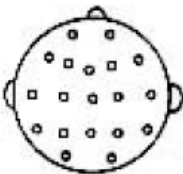
$$(x_{ijk}, y_{ijk}, z_{ijk}; (u_{ijk}, v_{ijk}, w_{ijk}))$$

$$i = 1, \dots, N_x,$$


$$j = 1, \dots, N_y,$$

$$k = 1, \dots, N_z.$$



	Location			Voltage
	6.54	4.56	5.64	0.033
	9.14	-3.14	1.38	0.086
	9.45	2.12	1.19	0.310
	.	.	.	.
	.	.	.	.
	.	.	.	.

**Données:**  $(x_i, y_i, z_i; V_{ij}), \quad i = 1, \dots, N,$   
 $j = 1, \dots, 6.$   
 $(x_i, y_i, z_i) \in \text{crâne}.$

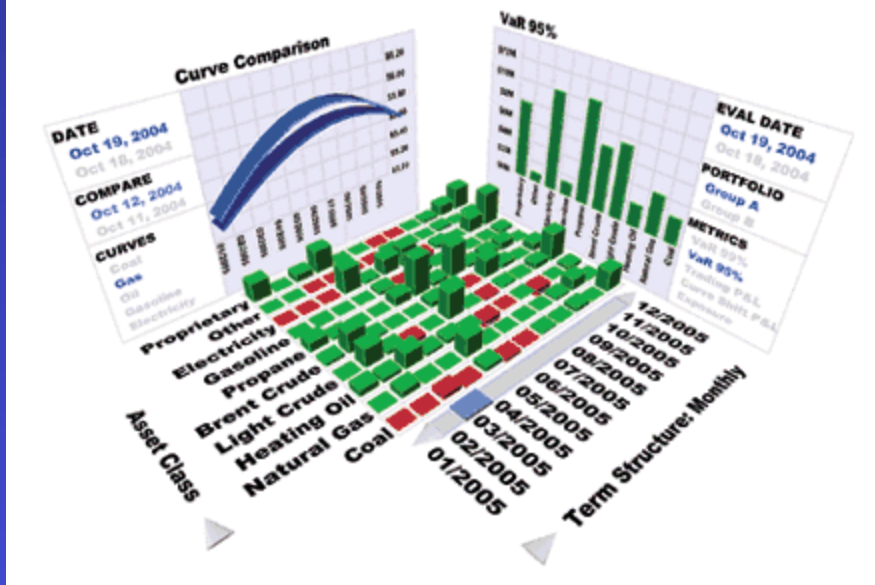
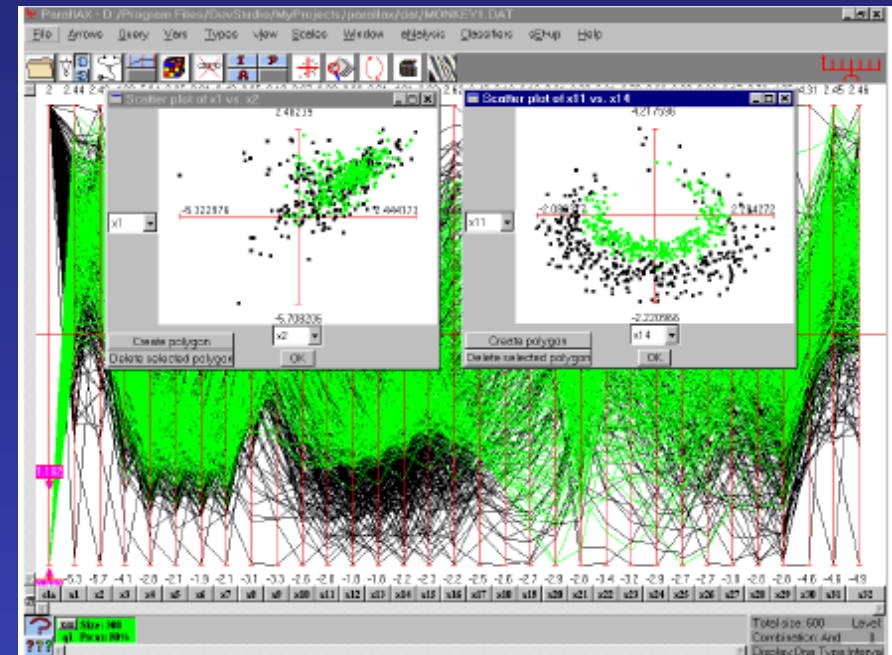
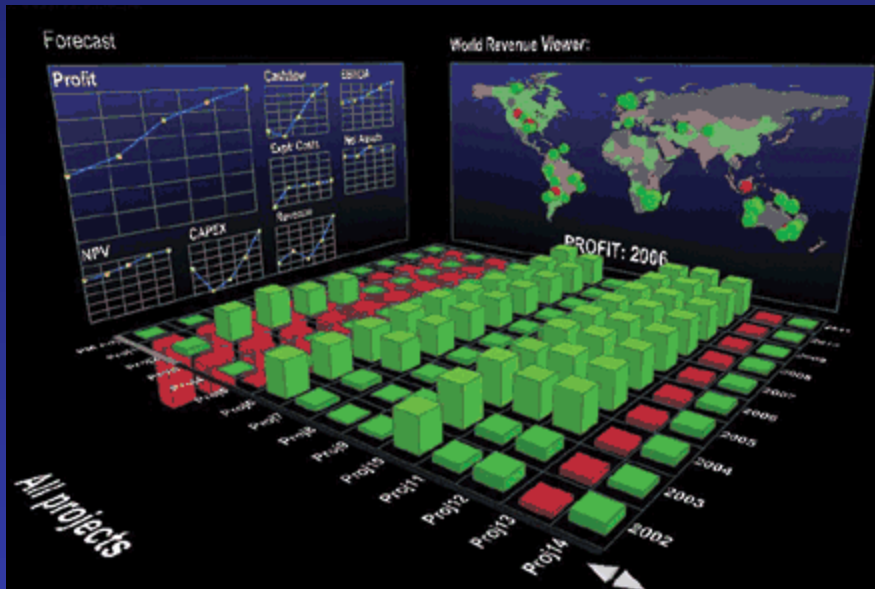
Longitude	Latitude	Rainfall
43 19' 34"	23 36' 13"	14.6
21 35' 59"	45 09' 36"	23.6
43 19' 34"	23 36' 13"	14.6
.	.	.
.	.	.
.	.	.
.	.	.

$$(x_i, y_i, z_i; R_i), \quad i = 1, \dots, N.$$

avec la restriction  $x_i^2 + y_i^2 + z_i^2 = 1$ .

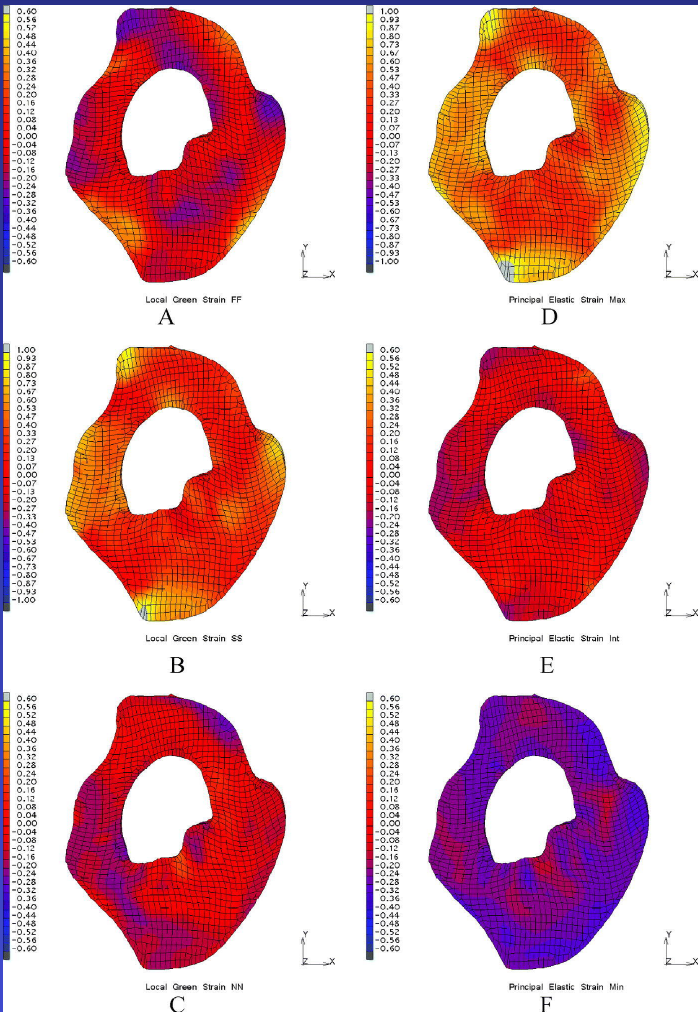

$$(x_i, y_i, z_i) = (\sin\Phi_i \cos\Psi_i, \sin\Phi_i \sin\Psi_i, \cos\Phi_i)$$

# Marchés financiers



Données dimension N

# Simulation Elements Finis

	Location			Temperature
	21.9	69.2	23.1	88.7
	95.3	11.9	99.7	78.9
	-	-	-	-
	-	-	-	-
	-	-	-	-
	-	-	-	-
	-	-	-	-
	-	-	-	-

Données:  $(x_i, y_i, z_i; T_i), \quad i = 1, \dots, N,$   
 Faces:  $F_k = P_1, \dots, P_N,$   
 Cellules:  $C_j = F_1, \dots, F_M.$

- **ORIGIN**
  - Simulation or Observation
- **DOMAIN**
  - 1D, 2D, 3D, nD
- **TYPE**
  - Scalar, Vector, Tensor
- **REGULARITY OF DATA SITES**
  - Cartesian, Curvilinear, Unstructured, Scattered