



Project participants:

Consortium GARR (IT), CNR (IT), Consorzio COMETA (IT), Fatebenefratelli (IT), University San Raffaele (IT), University of Genoa (IT), University of Foggia (IT), Fondazione SDN (IT), MAAT France (FR), King's College (UK), Uniwersytet Warszawski (PL), Centre Hospitalier Universitaire de Toulouse (FR), Alzheimer Europe (LU)

EC Call: FP7-INFRA-2010-2 – VRC

Contract n: RI-261593

Project type: CP-CSA

Duration: 30 months

Total budget: 3.004.531 €

EC Funding: 2.399.998 €

*Fulvio Galeazzi, fulvio.galeazzi@garr.it
on behalf of DECIDE Consortium*

DECIDE:

a user friendly web-based service for early diagnosis and research on Alzheimer's disease



Why Alzheimer's disease?

Why “early diagnosis”?

Why Grid?

...before we get to the “what” and “how”



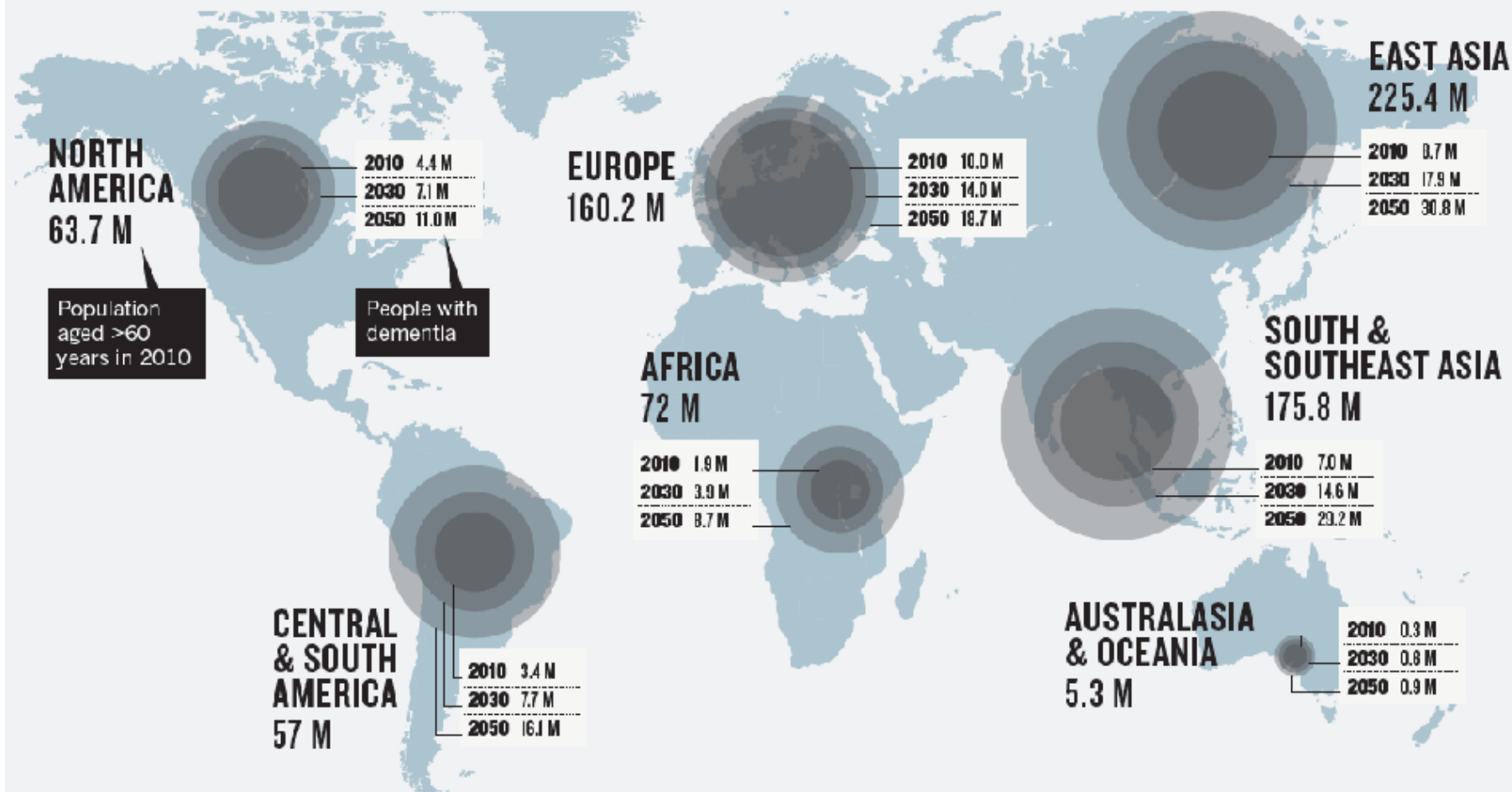
A problem for our age

BY ALISON ABBOTT

NATURE | VOL 475 | 14 JULY 2011

ESTIMATED GROWTH OF DEMENTIA

The number of people with dementia will roughly double every 20 years, with the biggest increases in developing countries.



Early diagnosis of Alzheimer's disease

New diagnostic criteria were issued in 2010-2011 by European Federation of Neurological Societies and National Institute on Aging.

Major step forward: moving away from clinical symptoms, to the real underpinning of the disease.

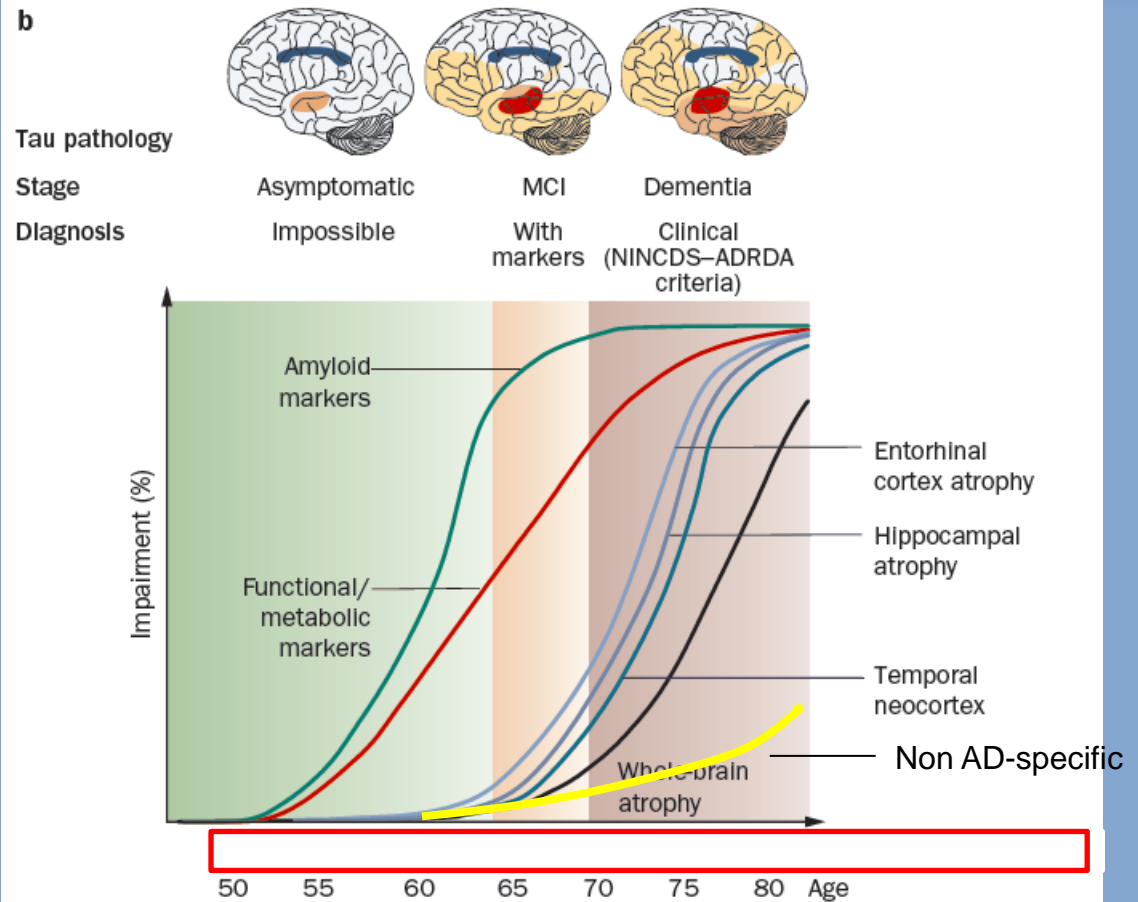
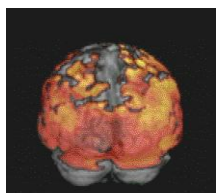


Figure 1 | Natural progression of cognitive and biological markers of Alzheimer

Markers of the disease

BRAIN AMYLOIDOSIS



Amyloid deposits:
amyloid PET

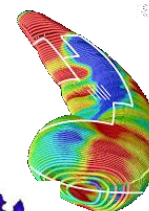


Biochemistry:
CSF Abeta42

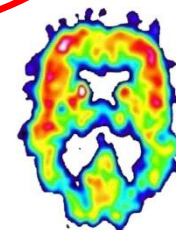
----- *Offered by DECIDE*

NEURODEGENERATION

Structure:
MR hippo volumetry



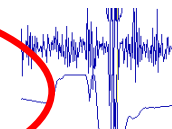
Function:
FDG PET



Biochemistry:
CSF tau



Neurophysiology:
EEG



The Project Consortium

A **vertical approach** to e-Health, targeting the needs of neuroscientists community through the provisioning of an e-Infrastructure aimed at supporting them in the daily execution of the diagnosis

CONSORTIUM GARR - Italy
CONSORZIO COMETA - Italy

Network & GRID Layer
Infrastructure Partners



CNR - Italy
UNIVERSITY OF GENOA - UNIGE Italy
UNIVERSITY OF FOGGIA - UNIFG Italy
MAAT FRANCE - maat G - France
KING'S COLLEGE - United Kingdom
UNIwersytet Warszawski - Poland

Application Layer
Partners



IRCCS Fatebenefratelli - Italy
UNIVERSITY SAN RAFFAELE - Italy
FONDAZIONE SDN - Italy
CENTRE HOSPITALIER UNIVERSITAIRE
DE TOULOUSE - France
ALZHEIMER EUROPE - Luxembourg

Research & Healthcare
Layer
Partners

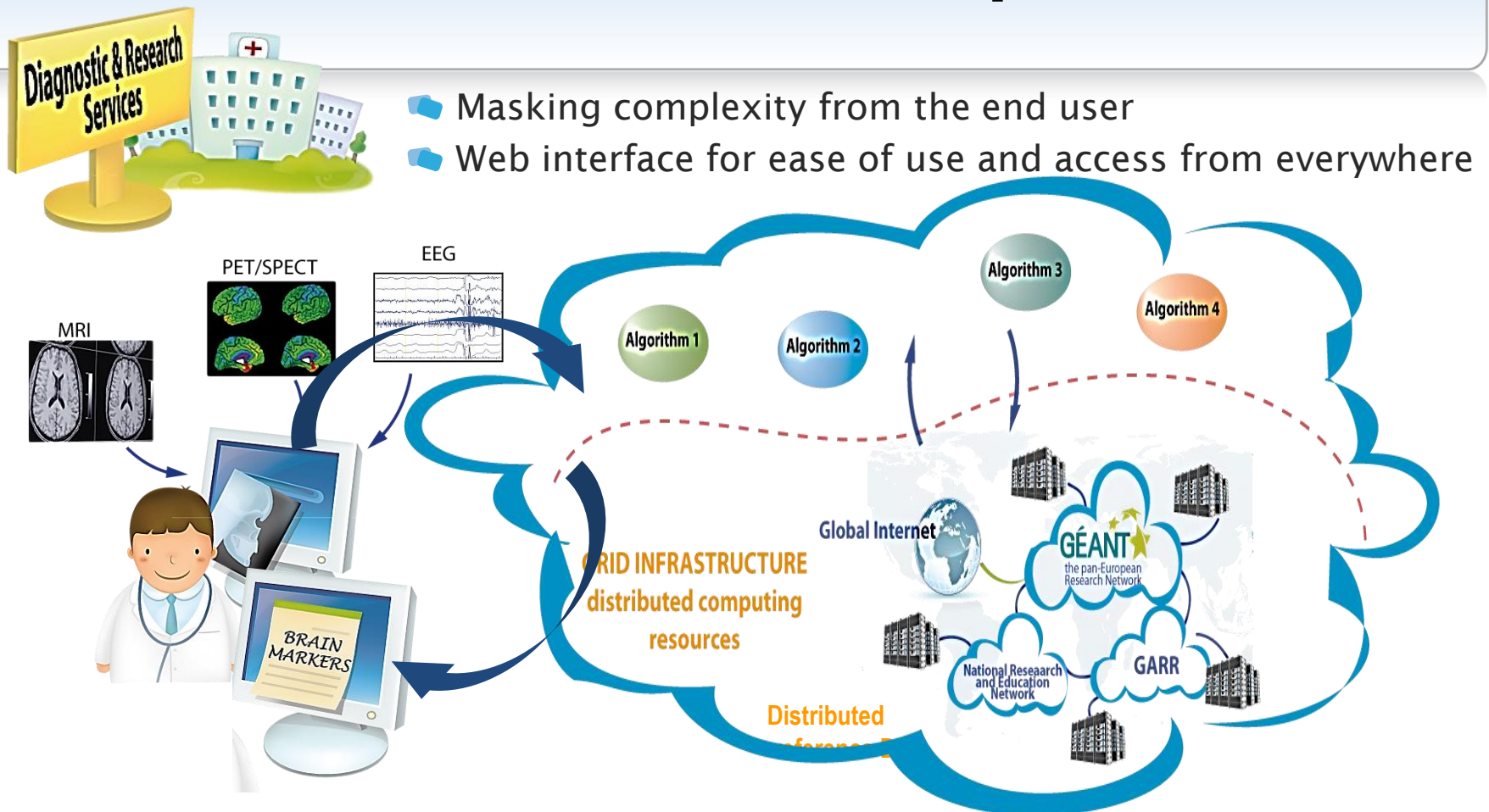


DECIDE Objectives

- Bring to the physicians' fingertips a dedicated, powerful e-Infrastructure
 - relying on GÉANT (network), EGI (computing) and NeuGrid (inspiring idea)
- Deploy a secure and user-friendly **service for helping making early diagnosis**
 - Linking large distributed DBs of multi-modal neuro-images
 - Providing **accurate, quantitative** information
 - Assisting users all along the way
- To **validate** the e-Infrastructure and the service with real patient cases



The DECIDE Service Concept



- Multiple **quantitative** algorithms for research and diagnosis
- Secure exploitation of large multimodal reference databases of normal subjects and patients

Grid technology and Science Gateway

- Grid technology is used behind the scenes:
 - Fine-grained authorization control
 - Sharing of reference datasets while preserving ownership
 - “Normal” data does not leave hospital
- Grid components in use:
 - AMGA: to describe uploaded data files
 - gLibrary: for manipulation of metadata catalogue
 - SecureStorage: providing encrypted storage capabilities, with authorization control on decryption key retrieval

Question: what are EGI support plans for the above?



DECIDE Science Gateway

- The DECIDE Science Gateway makes the Grid usable by non-ICT users
 - Standards based, modular approach
 - Supporting identity federations, for authentication: authorization handled separately
 - Based on robot certificates, no personal certificates involved
 - Simplifies job handling (no .jdl, minimized interactions) for users



DECIDE Applications

- ❏ **GridSPM:** specifically designed for SPECT and PET neurological clinical images provides an SPM analysis for the early diagnosis of Alzheimer Disease
- ❏ **GridEEG:** implements EEG processing algorithms with the aim of detecting early symptoms of Alzheimer Disease and distinguishing different forms of degenerative impairment
- ❏ **GridANN4AD:** concerns the analysis of PET biomarkers in Neurological and Psychiatric Disorders and provides a classification of suspected patients through an Artificial Neural Network
- ❏ ...two more applications being made available soon!
GridMRISeg and **GridGDI**, both for the analysis (volumetry) of MRI images.

diagnostic
application

research
application

research
application

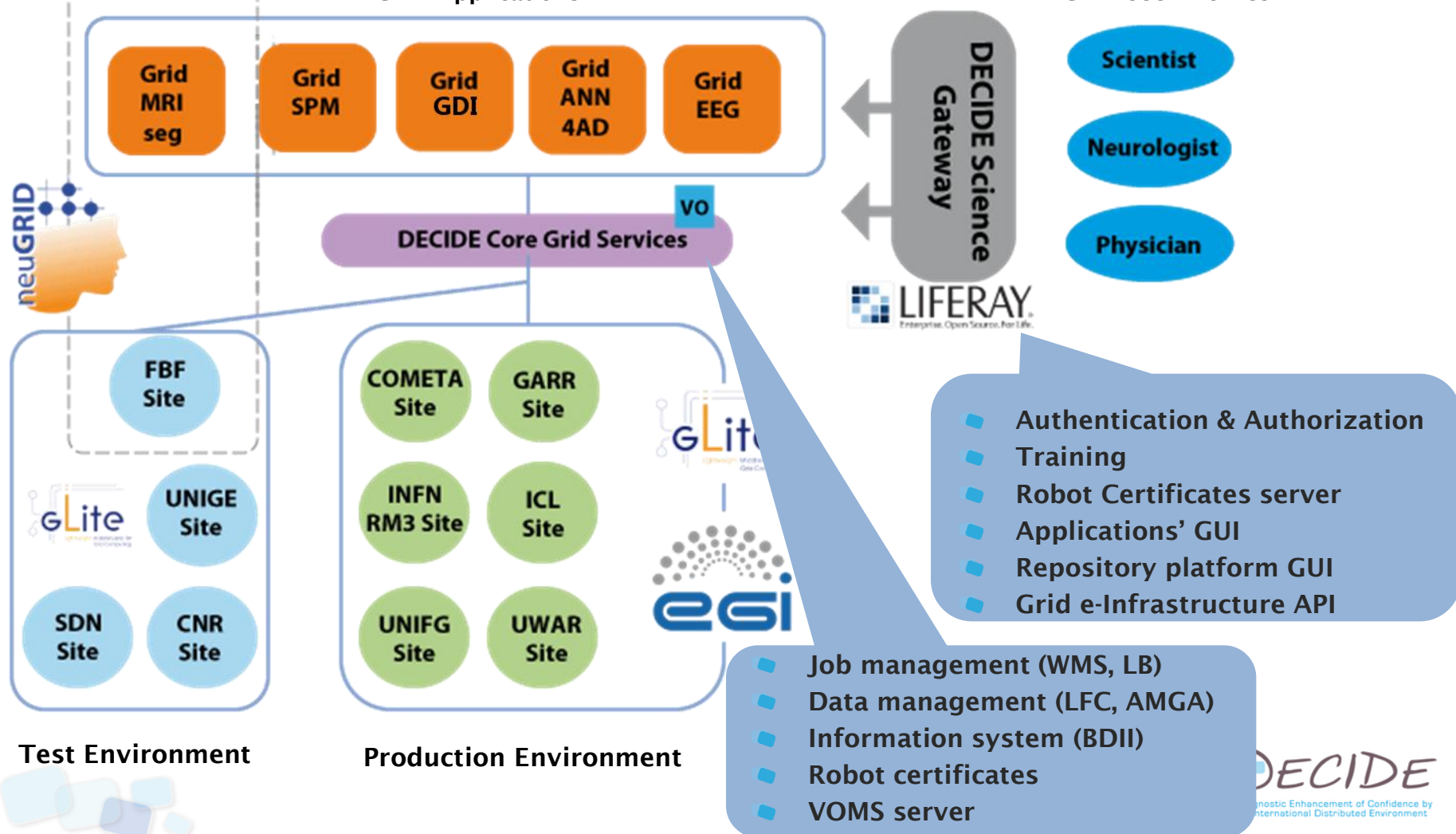
diagnostic
application



DECIDE e-Infrastructure Architecture

DECIDE Applications

DECIDE User Profiles



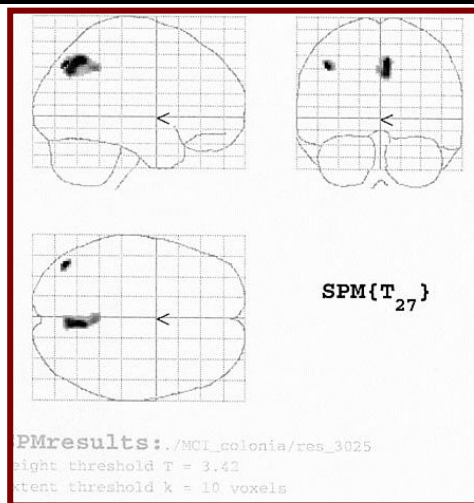
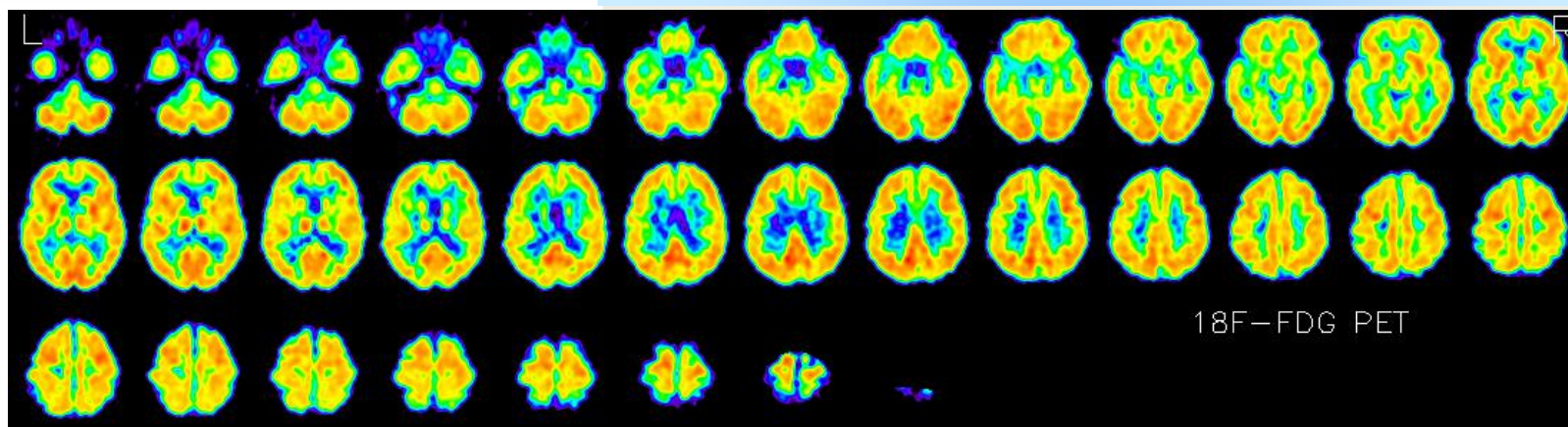
What DECIDE **IS NOT** and what it **IS**

- ❏ **NOT** a tool for automated diagnoses
 - ❏ It is just providing some more information to help a clinician draw a diagnosis
- ❏ **NOT** a tool for masses
 - ❏ Patients, as indirect beneficiaries, may be numerous, though
 - ❏ A single user may represent the nuclear imaging department of a hospital
- ❏ **IS** a tool for supporting clinicians during diagnostic process
 - ❏ Providing additional information to draw diagnosis: see examples in next slides

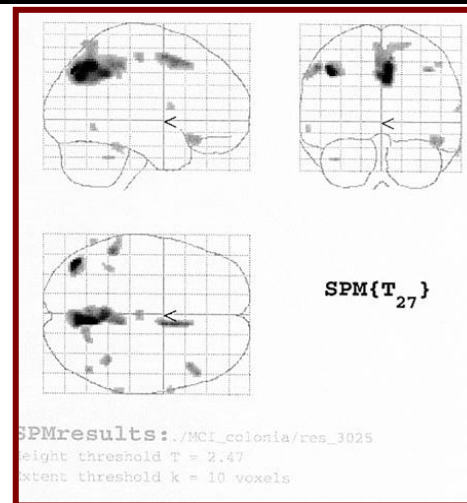


GridSPM application

aMCI ID: C03025 | Age: 82 | MMSE: 25 | CVLT: 4



p = 0.001



p = 0.01

GridSPM: statistical analysis of PET scans

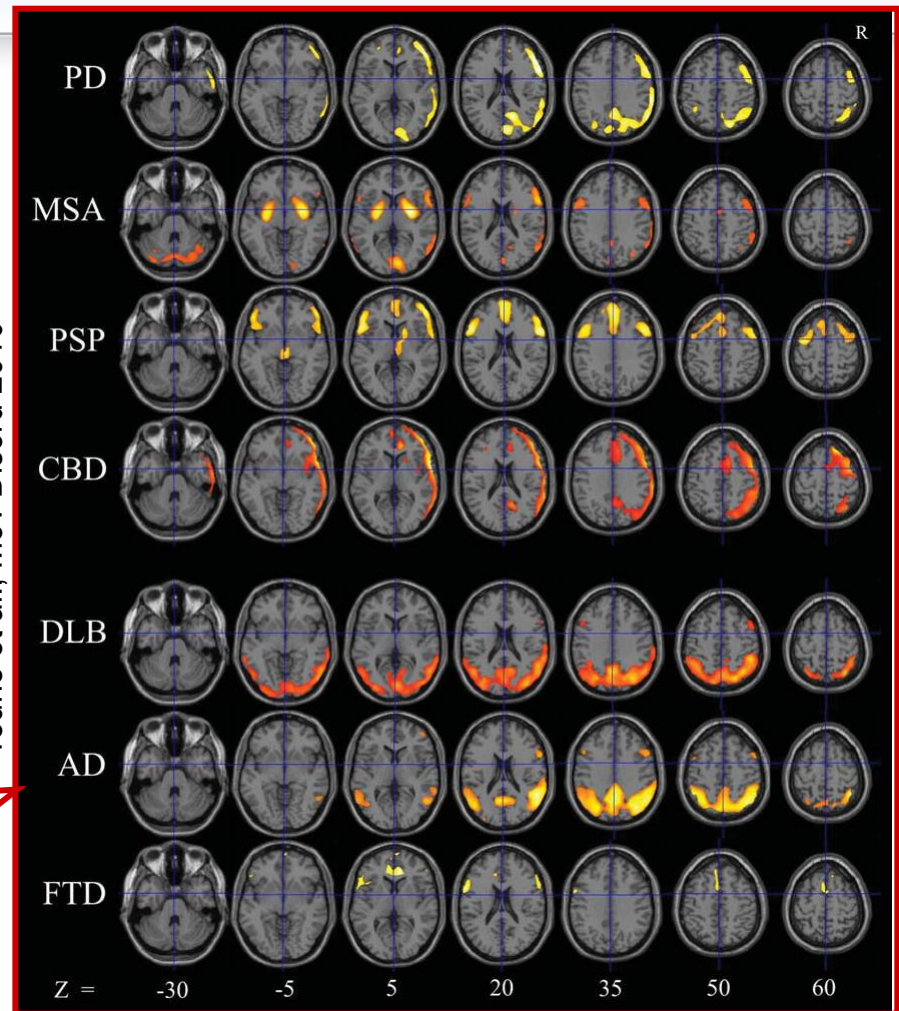
Voxel-based analysis (SPM5)

$p < 0.001$ corrected with cluster cut-off of 20 voxels

**Typical Cerebral
Metabolic Patterns
in Neurodegenerative
Disorders**

96 patients
each group vs. 18 HC
two sample *t*-test

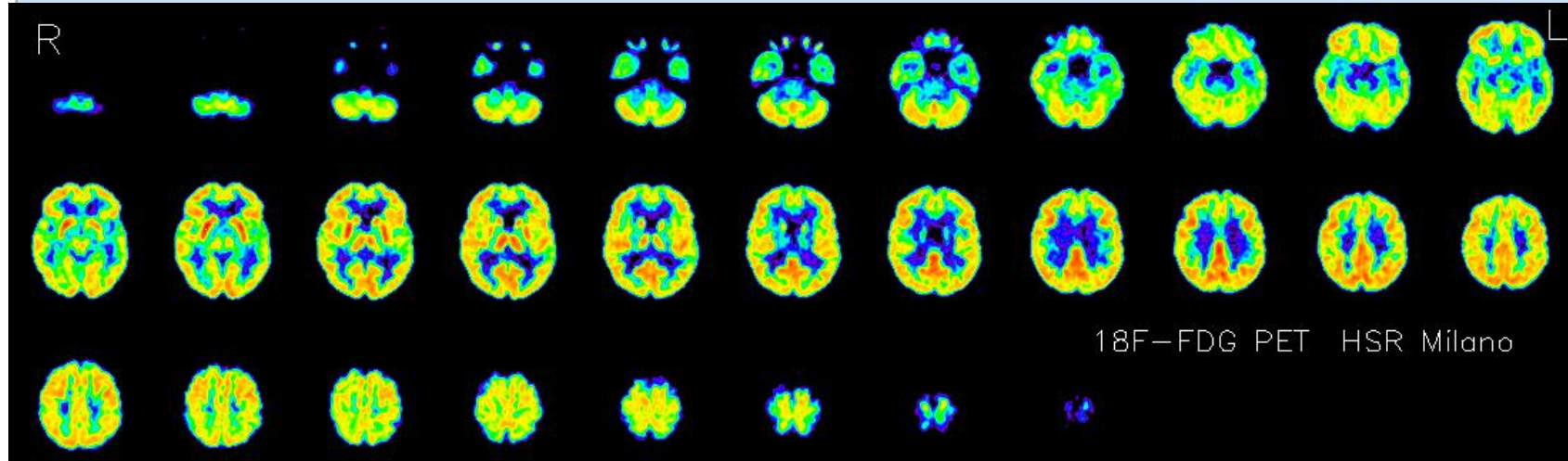
Teune et al., Mov Disord 2010



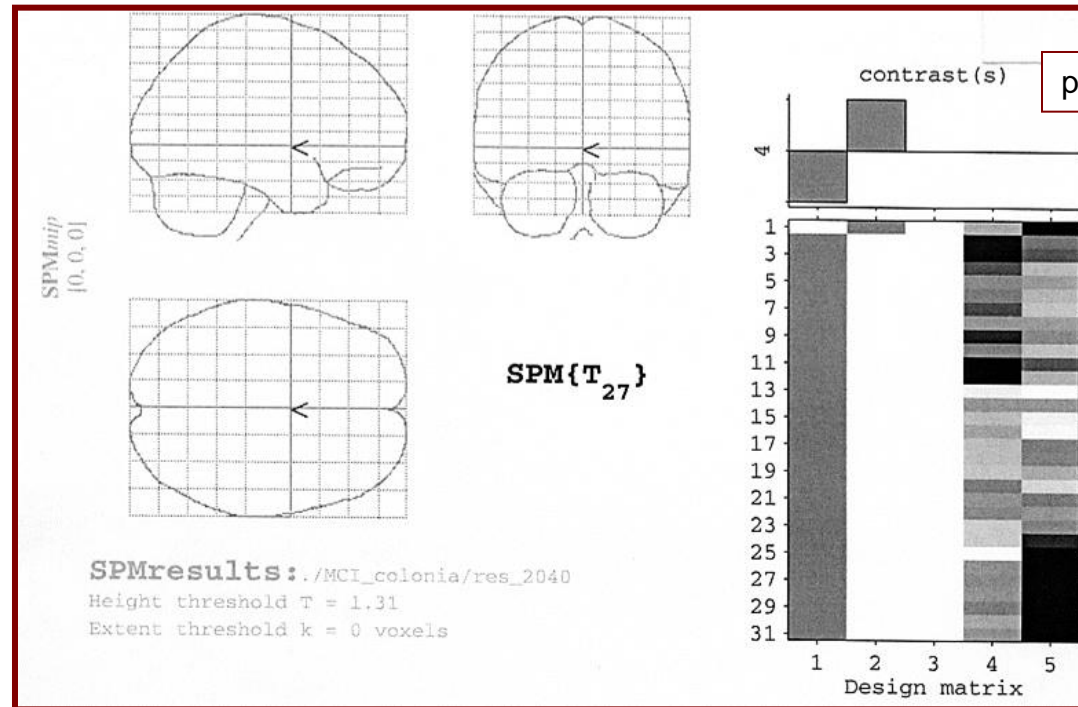
D. Perani, Università Vita-Salute S. Raffaele, Milano

aMCI

ID: C02040 | Age: 72 | MMSE: 27 | CVLT: 5

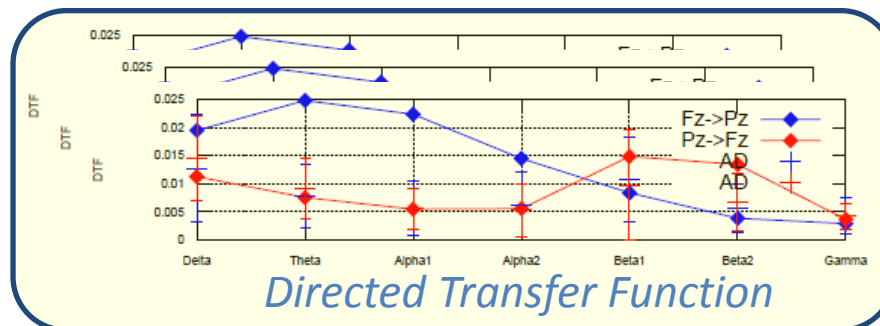
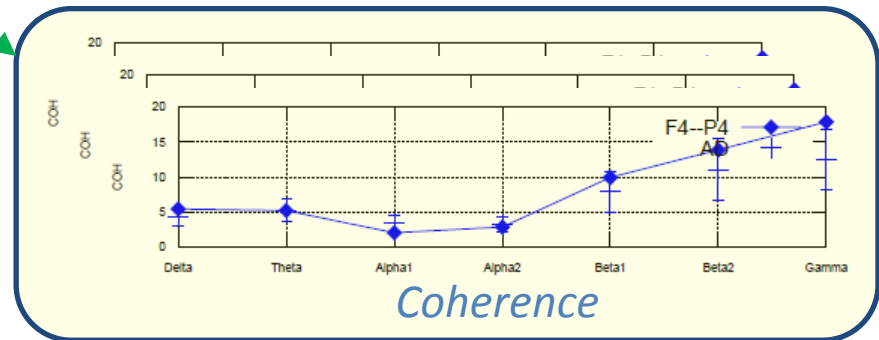
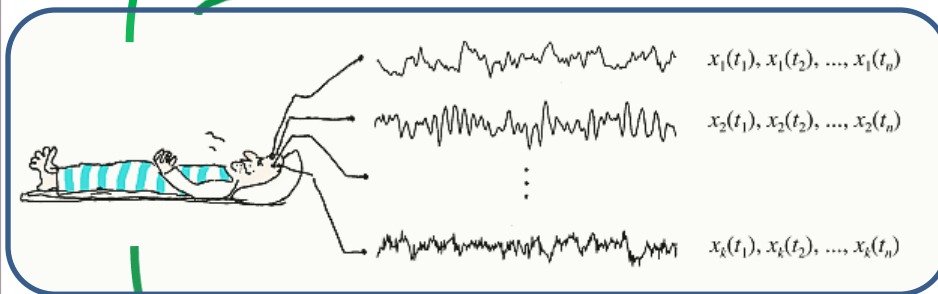
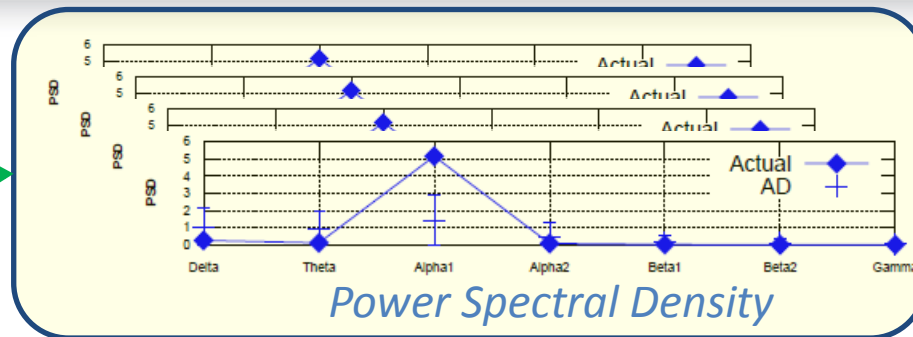


GridSPM report (negative)



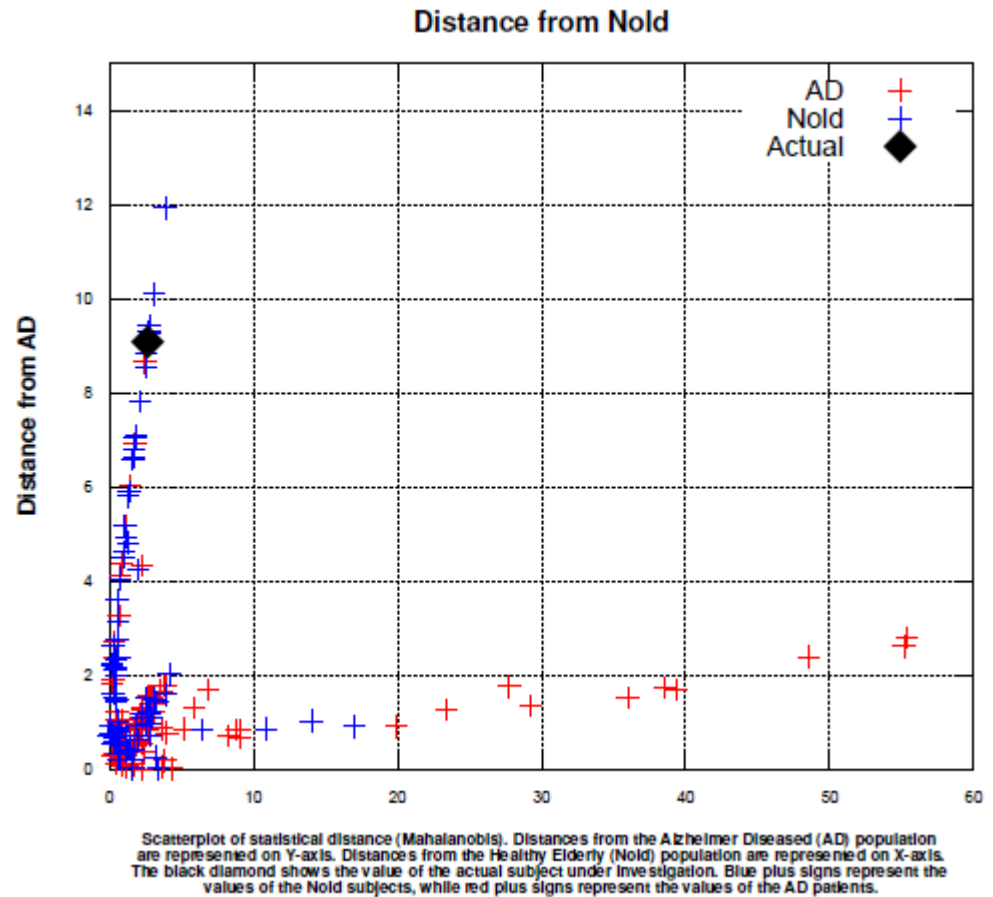
Statistics & send report

GridEEG application (2/3)



GridEEG application (3/3)

Information is combined into a “distance” from populations of normal elderly subjects and Alzheimer subjects




Methodology

- General philosophy: do something WITH users
 - Applications selected based on scientific relevance
 - Users involved since early phase to ensure acceptance
 - Keep clinical practice in mind: accuracy, robustness, simplicity
 - Science Gateway to make GRID usable
 - Identity Federations to avoid certificate burden, yet keeping the service secure
 - Applications carefully tuned to make them suitable to run unattended
- Hospital horizon is several years: service should be sustainable
 - Design should easily cope with technology changes



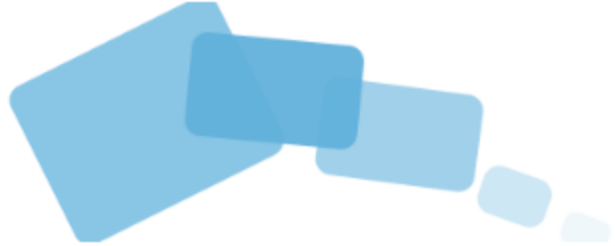
Science Gateway: login

[DECIDE Science Gateway](#) | [DECIDE Home](#) | [Project](#) | [Documents](#) | [Technical Wiki](#)



DECIDE

Diagnostic Enhancement of Confidence by
an International Distributed Environment



DECIDE Science Gateway

- [Home](#)
- [Applications](#)
- [Grid Services](#)
- [User Support](#)

Welcome

Welcome to the DECIDE Science Gateway. If you do not yet have an account, find below the instructions to register and sign in.

1) Register

(If you have already registered an account on the DECIDE Science Gateway go directly to step 2)


In order to create an account on the DECIDE Science Gateway you have to click on the "Register" link which appears on the top right of this page.

Once you are in the registration page, fill the form with all the required information. If you already belong to any of the Identity Federations supported, please select it in the list which appears in the form. Otherwise, leave it blank and choose & confirm a password in the relative box; you will be enrolled in the IDPCT Identity Provider of the GridP Identity Federation. Please, do not forget to specify the application you would like to use and the role you would like to have. When complete, submit the web form and confirm your request of registration following the link which appears in the email that you will receive by the portal at the address you have indicated in the web form.

2) Sign In

(If you do not have yet an account on the DECIDE Science Gateway go back to step 1).

Once you receive the email informing you that your request of registration to the DECIDE Science Gateway




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Science Gateway: applications

DECIDE Science Gateway

DECIDE Home | Project | Documents | Technical Wiki



Diagnostic Enhancement of Confidence by an International Distributed Environment

DECIDE Science Gateway

- Home
- Applications
 - GridANN4ND
 - GridEEG
 - GridMRISeg
 - GridSPM
 - Run
 - Manage Repository
- Grid Services
- User Support

My Workspace

- Jobs
- JobsMap
- Data
- Help

GridSPM - Set Parameters

Grid SPM

Welcome to the Grid SPM DECIDE service. You are running the service in physician mode.

Purpose

This service allows the statistical analysis of SPECT and PET cerebral images through the Statistical Parameter Mapping (SPM) system. The use of the service is allowed to certified and authorized users.

The workflow of the service consists into:

1. Data upload step: your PET/SPECT images have to be submitted to the system via the upload form.
2. The system automatically performs a pre-processing/QC step: submitted PET/SPECT images underwent a process of spatial normalization to a template, in order to be co-registered in the same stereotaxic space, as the normal subject images. Normalized PET/SPECT images have to be convolved with a Gaussian kernel in order to reduce artefacts due to noise dependency and to improve spatial normalization.
3. Statistical procedures (statistical test using Generalized Linear Model) are applied on normalized and smoothed PET/SPECT images in order to obtain a statistical parametric map for the effect of interest. A report in PDF format is generated, consisting of maps showing the effect of interest overlapped and co-registered on a standard anatomical template. You will be allowed to download this report.

How to run the analysis

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How to run the analysis

Please upload your patient's data, choosing the appropriate file. Images have to be submitted both in DICOM and Interfile format. DICOM and Interfile format have to be archived together in .tgz format.



Follow the information on [this page](#) to follow up your analysis and retrieve results.

Normal subjects filter selection
Please select:


Please, note that currently filters are not applied due to the reduced number of normal subjects. Controls are shown for training purpose.

Upload here your SPM data archive
Select your SPM data archive in .zip or .tgz format:

SPM-PHY Matlab Release 1.0 (2015-03/28 19:48)

This is an   service

Minimal user interaction


Diagnostic Enhancement of Confidence by an International Distributed Environment

Science Gateway: job submit



The screenshot shows the DECIDE Science Gateway interface. At the top, a navigation bar includes links for DECIDE Science Gateway, DECIDE Home, Project, Documents, and Technical Wiki. The main header features the DECIDE logo, which consists of a stylized head profile with a brain-like pattern, and the text "DECIDE Diagnostic Enhancement of Confidence by an International Distributed Environment".

On the left side, there is a sidebar menu titled "DECIDE Science Gateway" with the following options:

- > Home
- > Applications
 - > GridANN4ND
 - > GridEEG
 - > GridMRISeg
 - > GridSPM
- > Run
 - > Manage Repository
- > Grid Services
- > User Support

Below the sidebar menu is a section titled "My Workspace" with icons and labels for Jobs, JobsMap, Data, and Help.


The main content area displays a message titled "GridSPM - GRID Job submitted". Below this, it states: "Your request has been recorded". A paragraph follows: "Your GridSPM analysis has been successfully sent to the DECIDE computing infrastructure. Check the status of your analysis at this link".

Below this message is a section titled "Behind the scene". It contains the text: "Those information are reported only for Demo purpose." and "Uploaded archive: /tmp/upload_00000304.zip Session id: 4k24ptnjojn29eh7gr1es5mbbu Job id: n.a. (async)".

At the bottom of the page, there is a small status bar that reads "This is an ... serving" and a row of logos, including the European Union flag.


Science Gateway: job list

DECIDE Science Gateway DECIDE Home Project Documents Technical Wiki



DECIDE

Diagnostic Enhancement of Confidence by
an International Distributed Environment



Menu

- > Home
- > Applications
- > Grid Services
- > User Support

MyWorkspace

- Jobs
- JobsMap
- Data
- Help


MyJobs

Active Jobs List Done Jobs List

The table below shows the status of your jobs.
Statuses are automatically updated every 5 minutes so there is no need to reload this page more frequently.



Copy Print Save Search:



Show entries

Application Name	User Description	Started on (UTC)	Status
GridSPM	GridSPM Matlab Job 2012-05-21-002909	2012-05-20 22:29:19.0	SUBMITTED
GridSPM	GridSPM Matlab Job 2012-05-21-002816	2012-05-20 22:28:19.0	SUBMITTED
GridSPM	GridSPM Matlab Job 2012-05-21-002732	2012-05-20 22:27:19.0	RUNNING
GridANN4ND	GridANN4ND Job 2012-03-29-162350	2012-03-29 14:23:51.0	

Showing 1 to 4 of 4 entries

First Previous 1 Next Last

This is an   service



User Training (1/2)

- At different levels:
 - Grid site administrators,
 - Application developers
 - “Data managers”: the “owner” of the data of a research center/hospital/clinic
 - “Neurologists”: professionals in charge of a patient, requiring a clinical test
 - “Physicians”: professionals executing the test and signing the report
 - “Scientists”: mainly researchers (can also be physicists, mathematicians, statisticians,...), who can tune some parameters for the relevant application



User Training (2/2)

- Specific for each application and for each profile
 - Science Gateway respects this and offers tailored view
- Offered as in-person training and webinar
 - Alternating, every other month
- Science Gateway users:
 - ~80 registered users
 - ~65 service users
 - 17 ANN
 - 45 EEG
 - 12 MRI
 - 15 SPM



Summarizing...

- ❏ DECIDE applications portfolio is perfectly in line with recent diagnostic guidelines on Alzheimer's disease
- ❏ DECIDE has the potential to dramatically change clinicians' daily practice, providing **secure, accurate, easy-to-use service**
 - ❏ Applications carefully tuned so they can run unattended, with minimal user interaction
 - ❏ Training programme is available,
 - ❏ Technical and clinical helpdesk are available
 - ❏ User community growing: very positive feedback
- ❏ Now dealing with sustainability and business model





Thank you for your kind attention!

Find more about DECIDE at www.eu-decide.eu
or contact us for questions and collaboration opportunities at
info@eu-decide.eu

