ORFEO Preparatory Program

WG-5 "**Hydrology**"

Toulouse - Spot Image

10th of june, 2008

Hydrology group composition

- Hydrologists : Research, Public managers, Engineering

Anne-Véronique AUZET	Strasbourg University - IMFS
Florence BAILLARIN	SPOT Image
Nicolas BAGHDADI	Cemagref
Jean-Stéphane BAILLY	ENGREF-AgroParisTech Montpellier
Catherine FREISSINET	SOGREAH
Patrick LACHASSAGNE	BRGM
Catherine OTTLE	CETP/CNRS
Thomas NAGLER	ENVEO IT GmbH
Sylvain PAYRAUDEAU	ENGEES Strasbourg
Thierry PELLARIN	LTHE Grenoble
Thierry PERCIE DU SERT	ARPE Midi-Pyrénées
Christian PUECH	Cemagref Montpellier
Aziz SERRADJ	LIV Strasbourg
Philippe VERVIER	ECOBAG

- CNES :

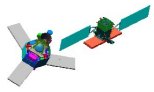
Selma CHERCHALI	Moderator - DCT/SI/AP
Hervé JEANJEAN	Superisor - DSP/OT

Hydrology group : domains of interest

- Hydrological elementary processes
- Water cycle and budget
- Fluvial systems : river-beds, wetlands monitoring
- Surface and groundwater : resources management
- Floods and related risks : modeling and monitoring

at local and regional scales

Relevance of VHR satellite imagery ?

VHR Images and 3D products  , an expected **benefit** for :

- Small, thin (i.e. linear) objects detection-characterization
- Land-use cartography with detailed legend
- Hydrological fields monitoring at VHR
  - To build indicators for catchment, fluvial system, wetlands or flood plain diagnosis
  - For spatially distributed hydrological models parametrization

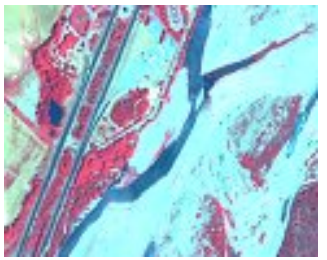
The usual questions :

- Feasibility of information extraction ?
- Accuracies ?
- Is there an "optimum" spatial resolution ?

Target Applications

Hydrological requirements from ORFEO products :

- Quantities : water supply, floods, erosion...
  - Infrastructures and buildings mapping : Flood stakes inventory, artificial cover estimation, artificial networks detection (ditches), urban pollution sources detection
  - Soil properties estimation : moisture, roughness
  - Precise topography and water surface pathes
  - Waterbodies delineation and evolution
  - Vegetation detection : hedges, vegetation cover indices
- Quality : pesticides, nutrients
  - Water turbidity estimation
  - Eutrophication detection
  - Agricultural (on plots and stubbles) practices detection
- Water Eco-systems : Monitoring of aquatic habitats
  - Riverbed geomorphology mapping : delineation, bathymetry
  - Riparian vegetation mapping



Target Applications

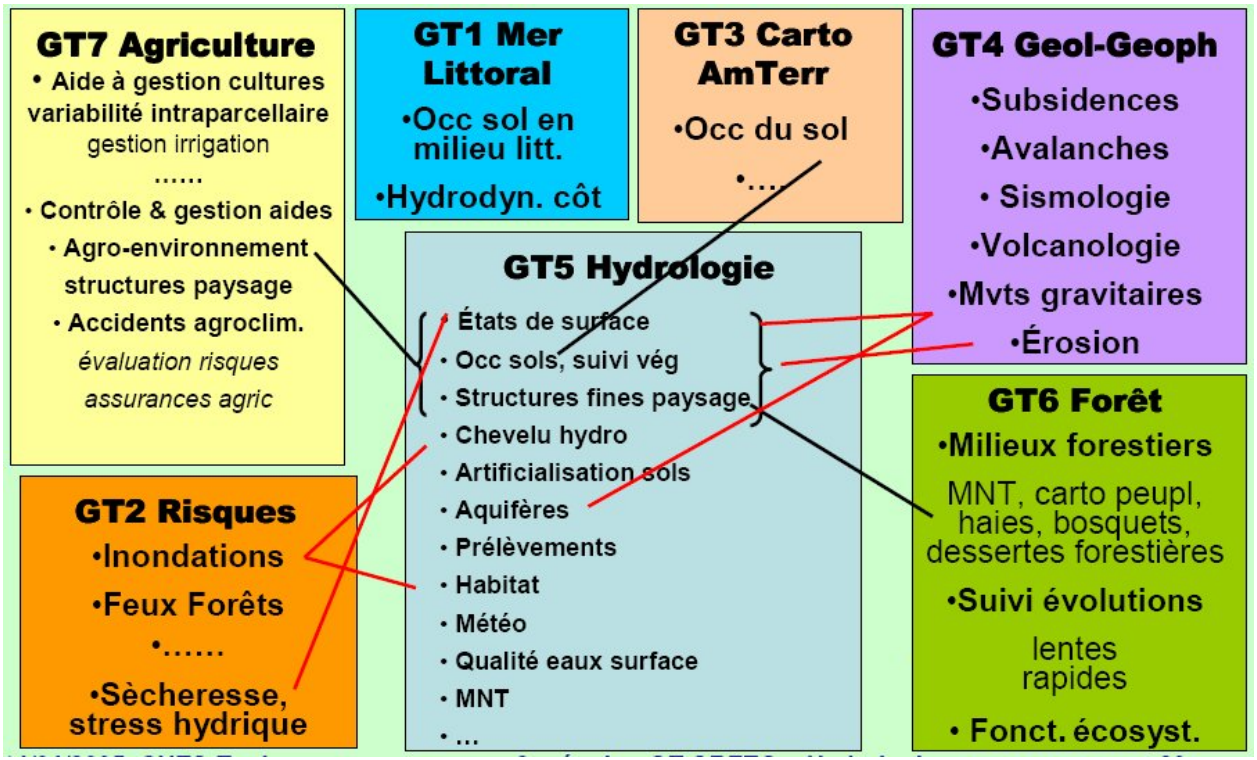
Interactions with other themes :

Agriculture : Agricultural practices detection

Cartography : Land use

Risks : Floods modeling

Geology : Geomorphology (DEM)



Phase 1 : What is useful for hydrology

From "products files" inquiry : 12 files

http://smsc.cnes.fr/PLEIADES/Fr/GT5/fiches/fiches.htm

Fiche 1A	CETP	Etats de surface du sol : états hydriques
Fiche 1B	IMFS	Caractérisation des états de surface du sol : rugosité
Fiche 2	CETP	Occupation des sols et suivi de la végétation
Fiche 3	CEMAGREF	Caractérisation et suivi temporel des plans d'eau
Fiche 4	CEMAGREF	MNT, topographie fine
Fiche 5	CEMAGREF/IMFS	Reconnaissance des structures fines (fossés, canaux, digues)
Fiche 6	CEMAGREF/IMFS	Chevelu hydrographique, chemins de l'eau sur les versants
Fiche 7	Fac Géo/Amén.	Structures urbaines et péri-urbaines
Fiche 8	BRGM	Aquifères
Fiche 9	BRGM/ECOBAG	Interface eaux de surface/eaux souterraines
Fiche 10	BRGM/ECOBAG	Prélèvements/rejets
Fiche 11	IMFS/BRGM	Habitat vulnérabilité - Ressources/Usages
Fiche 12	CETP	Paramètres météorologiques

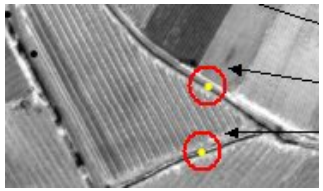
Phase 1 : What is useful for hydrology

Common mapping requirements :

Object or variable

Buildings and roads

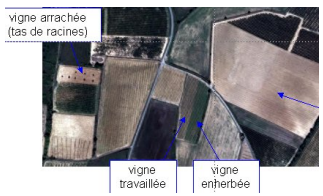
Dams, canals, ditches



Waterbodies delineation

Hedges, plot vegetation cover

Agricultural practices

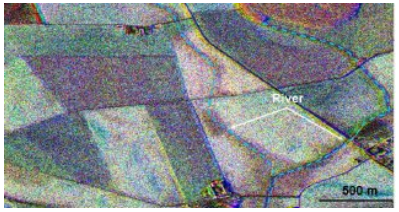


Phase 1 : What is useful for hydrology

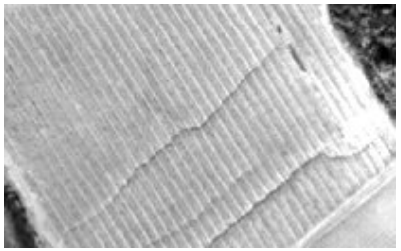
More specific information extraction :

Object or variable

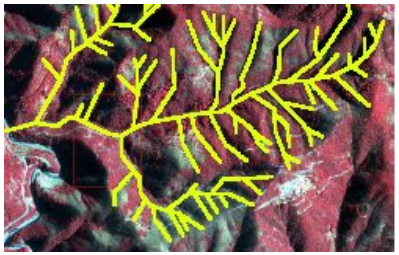
Soil surface moisture and roughness



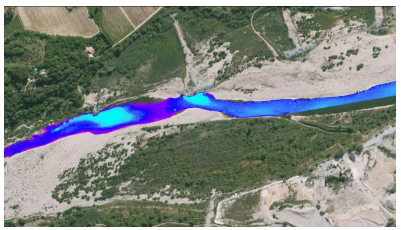
Gullies, tillage practices



Geomorphology (DTM), water pathes

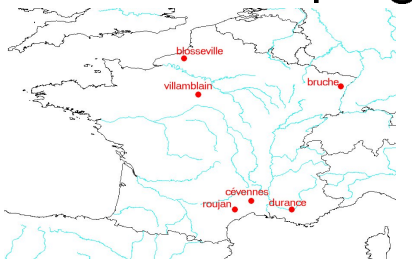


Bathymetry and riverbed geomorphology



Phase 2 : Thematic Studies and Sites

6 studies in progress : cultivated and natural landscapes



Studied objects-variables	**Investigator**	**Sites**	**Data**
rivers morphology bathymetry	Cemagref	Durance	QB
terrain morphology gullies	Cemagref-EMA	Cevennes	QB
surface roughness tillage practices	CETP	Blosseville	Ikonos
surface roughness soil moisture	Cemagref- CETP	Villamblain, Orgeval	TerraSAR
ditches weed control practices	INRA	Roujan	QB, Pe- lican, TerraSAR
terrain morphology hydrographic networks	ENGEES-IMFS	Bruche	-

Some first results : (1) River bed geomorphology monitoring

Morphologic segmentation of shallow rivers from Quickbird images : case study of the Durance river

J.S. Bailly, C. Puech , Y. Le-Coarer, S. Reyes-Castillo, J. Damis, C. Delenne ;
Cemagref, HSM/CNRS

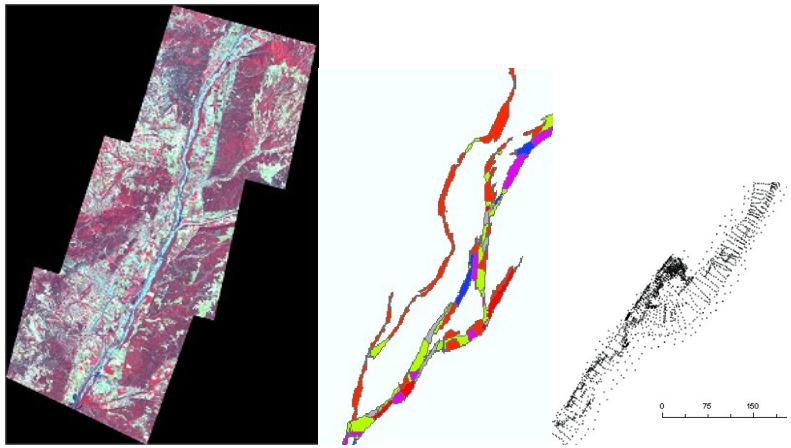
Objectives :

Context of the European water framework,
To map shallow rivers (< 2m depth) geomorphology :

- water depth
- river-bed delineation and width
- functioning segments : riffles, pools

Data :

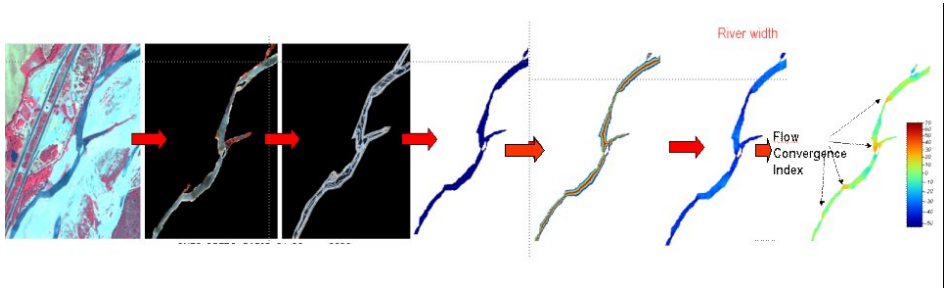
- QB images : P, XS, P+XS
- Ground-truth measurements (depth, functioning segments)



Some first results : (1) River bed geomorphology monitoring

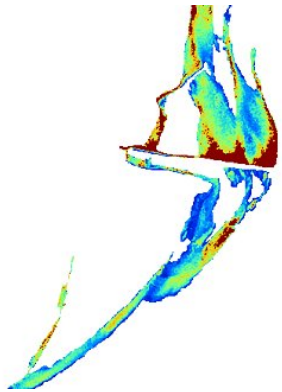
Results (1) :

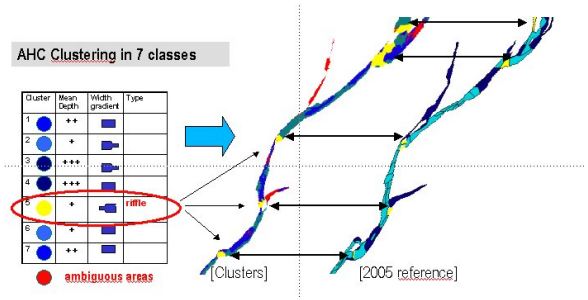
- riverbed delineation using image segmentation + classification : 95% of accuracy
- methods to produce derivative information : width and flow convergence along river



Results (2) :

- depth : regression on band ratios [Legleiter 2005] based on beer-lambert laws
- depth : 9 cm RMSE.
  XS 2.4 m : better results.
  Bathymetry along 45 km of river
- clustering on flow convergence + depth grids along river : riffles and pools detection





Some first results : (2) Soil surface characterization

Potential of TerraSAR-X SAR data for the characterization of soil surface parameters

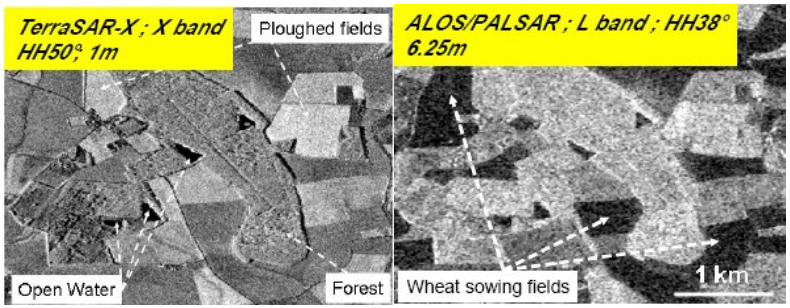
N. Baghdadi, M. Zribi, C. Loumagne, P. Ansart, T.P. Anguela ;
BRGM, CETP/CNRS, Cemagref

Objectives :

To assess the potential of spatial SAR in X-band for the characterization of soil moisture and surface roughness

Data :

- TerraSAR-X images : HH, 26°-28°and 50°-52°...

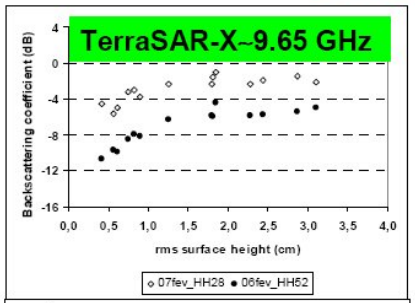


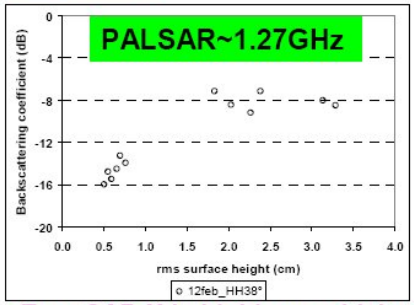
- Ground-truth measurements :
  - roughness
  - soil moisture

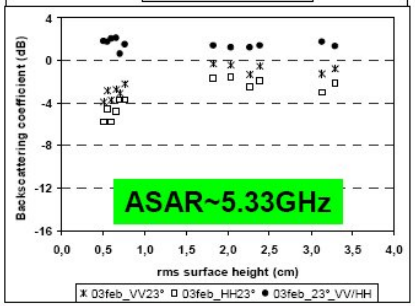
Some first results : (2) Soil surface characterization

Results (1) :

Sensitivity of radar signals to surface roughness - previous results







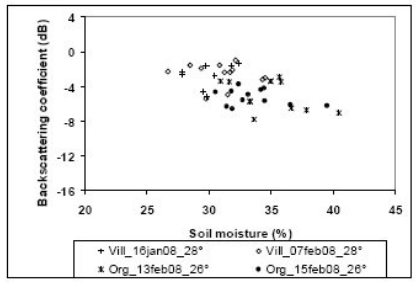
-TerraSAR-X is highly sensitivity to *rms* at high incidence angles.
- σ° increases with *rms* according to a logarithmic function.
- Signal is more sensitive to *rms* under conditions of lower roughness.
- Difference between smooth and rough areas reaches 6dB at 52°, and 3dB at 28°.

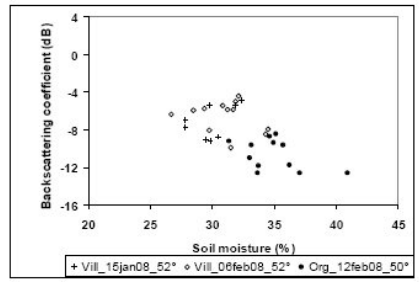
Results (2) :

Sensitivity of radar signals to surface soil moisture

➢ Radar signals decrease with increasing soil moisture, under very wet soil conditions. This decrease is of the same order at high and low incidence angles.

➢ Our database, acquired under conditions of high moisture (*mv* between 27% and 41%), shows that σ° is stable when *mv* is less than about 32%, and that it decreases beyond this threshold.





Next steps and milestones

- Validation of thematic studies still going on :
  - Masters for 2008-2009
  - PhD ending in 2010 with risks thematic group
  - Data delivery for "Bruche" study

- Identifying generic methodological requirements (OTB) :
  - Landscapes linear element detection ?
  - Surface waters delineation ?
  - High resolution DTM generation in natural areas