

SPOT4 (Take 5) time series over 45 sites to get ready for Sentinel-2

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October 2nd, 2013



Sentinel-2 : a revolution for satellite vegetation monitoring

Main Sentinel-2 image features

- ▶ High **resolution** : 10m-20m
- ▶ Large **coverage** : all lands, 290 km swath
- ▶ Frequent **revisit** with constant view angles : 5 days with 2 sat.
- ▶ 13 **spectral** bands

Other revolutionary aspects

- ▶ Mission duration : 7 years for the first generation
 - Plans to replace satellites to extend mission to > 20 years
- ▶ Systematic acquisitions with high repetitivity
 - The user can rely on data availability once a month
 - => operational use (ex : Annual Land Cover)
- ▶ Free and open data (*TBC)
- ▶ “Ready to use” products
 - Level 1C : ortho rectified TOA reflectance product
- ▶ Constant viewing angles :=> No directional effects
 - high quality time series

Sentinel-2 : A revolution for methods

Time

- ▶ SPOT, RapidEye : 1 to 4 images per year
- ▶ Sentinel-2 : 1 to 2 images per month

Surface

- ▶ SPOT, R-E : 60*60 km. Landscape and climate are homogeneous
- ▶ Sentinel-2 : 300*300 km² : Landscape and climate are heterogeneous

Clouds

- ▶ SPOT, R-E : the user orders for (almost) cloud free images
- ▶ SPOT, R-E : the user detects the clouds manually
- ▶ Sentinel-2 : all images are cloudy

Use

- ▶ SPOT, R-E : Very supervised processing of an image, once in a while
- ▶ Sentinel-2 : Automatic processing of large regions

Need for Sentinel-2 simulated data sets

Available simulation data sets in 2012

- ▶ ESA aerial acquisitions
 - High **resolution**, all S-2 **spectral** bands but no **revisit** and small **coverage**
- ▶ Other satellites
 - Formosat-2 : **revisit** and **resolution**
 - Landsat 5,7,8 : **coverage** and **spectral** bands
 - SPOT, R-E, DMC, **resolution coverage** and **revisit** but with changing angles

SPOT4 (Take5)

- ▶ SPOT4 (Take5) provides 3 out of 4 main S2 features
 - **revisit** : every 5 days, during 5 months, 28 acquisitions
 - **resolution** : 20m
 - **coverage** : large sites 60*60 km², 120*120, 300*200
 - **spectral** : Only 4 bands, but with a SWIR band

SPOT4 (Take5) sites

Site selection

- ▶ For French labs
 - call for site proposals
 - => 20 proposals, 80 laboratories, 17 sites selected, 60 images/cycle
- ▶ For international collaboration
 - no time to set up an international consultation and committee
 - => with cost sharing regarding data provision at Astrium Services
 - several space agencies contacted : ESA, NASA, JRC, CCRS participated
 - ESA : 14 sites, 14 sites/cycle
 - JRC : 9 sites, 9 images/cycle
 - NASA : 2 sites, 8 images/cycle, one observed from 2 angles
 - CCRS : 1 site, 1 image/cycle

SPOT4 (Take5) sites

Large Sites

- ▶ 3 very large sites in France, 5 large sites (110*110 km²)
- ▶ Midi-Pyrénées (160*300), BretagneLoire(160*180), ProvenceLanguedoc(220*160)
- ▶ Possibility to test robustness and efficiency of algorithms

Sites observed from different angles

- ▶ 4 sites are observed twice/cycle from 2 different orbits
- ▶ View angle difference a little larger than that of Sentinel-2
- ▶ Possibility to test directional corrections, L3 composite products

Agriculture, Land Cover, Biomass, Irrigation, JECAM

- ▶ Temperate : France, Ukraine, Belgium ; Argentina, China, USA(Oklahoma)
- ▶ Arid : Morocco, Tunisia, USA (New mexico), Egypt, South Africa
- ▶ Tropical : Madagascar, Paraguay

SPOT4 (Take5) sites



SPOT4 (Take5) sites

Meadows, rangelands, habitats, biodiversiy, Natura 2000

- ▶ Temperate : France (Several sites), China
- ▶ Arid : Tunisia, Morocco
- ▶ Tropical : Tanzania, Zambia, Botswana, Angola, Ethiopia

Forests

- ▶ Temperate : France, Boreal : Canada
- ▶ Tropical : Gabon (2), Congo, Borneo, Sumatra, Thailand, Honduras

Water

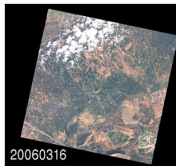
- ▶ Inland : Provence, Languedoc, Aquitaine, Loire, Paraguay, China, Egypt, Jordania
- ▶ Sea : Korea, France, USA (Chesapeake)

Snow

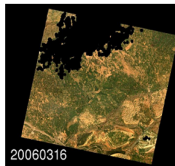
- ▶ Mountains : Pyrenees, Alps, Atlas
- ▶ Plains : Ukraine, USA (Oklahoma), Canada

Products

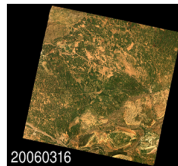
- ▶ Level 1C product :
 - Ortho-rectified images in TOA reflectance
- ▶ Level 2A Product :
 - As Level 1C, but surface reflectance
 - Cloud and Cloud shadows mask
 - Snow and Water masks
- ▶ Level 3A Product :
 - Weighted average of surface reflectance of cloudfree pixels over 1 month
 - Not available yet



Level 1C:



Level 2A:



Level 3A:

Data Access 1

Data Production

- ▶ L1C and L2A Images produced at the French Land Data Center THEIA
- ▶ SPOT4 (Take5) is the first production at THEIA
 - Relatively low number of bugs encountered...

Data policy

- ▶ Free data download submitted to acceptance of a license ("I accept" button)
 - Please **read** it once !
 - Data cannot be sold
 - Services with the data may be sold to prepare for S2 services,
 - Any publication done with the data must be sent to CNES
 - => sylvia.sylvander@cnes.fr, olivier.hagolle@cnes.fr

Data Access - 2

- ▶ from THEIA web site : <http://www.ptsc.fr/en/take5>



PTSC

PTSC **PRODUITS** ACCES PRODUITS **SPOT4 (TAKES)**

SPOT4 (TAKE5)

Lors de la fin de vie de chaque satellite, le CNES fait un appel à idées pour des expériences de courte durée se déroulant avant la désorbitation du satellite. Le CESBIO a saisi l'occasion de la fin de vie du satellite **SPOT4** pour proposer l'expérience Take 5, qui a consisté à faire de SPOT4, pendant 5 mois, un simulateur des séries temporelles que fournira la mission Sentinel-2 de l'ESA. Les premières images de l'expérience sont maintenant disponibles gratuitement à tout utilisateur, sous condition de signer une licence d'utilisation très peu restrictive. Des détails sur l'expérience et sur les caractéristiques de produits sont disponibles [ici](#).

[ACCEDER AUX PRODUITS TAKE 5](#)

Le premier satellite de la mission **Sentinel-2** devrait être lancé d'ici deux ans, le deuxième satellite devrait le suivre 18 mois plus tard. A eux deux, ces satellites nous fourniront tous les 5 jours des images à haute résolution de toutes les terres émergées... ou des nuages qui les recouvrent. Malgré ces nuages, les utilisateurs seront assurés d'avoir accès à des données sans nuages au moins une fois par mois. L'arrivée de ces données devrait donc provoquer une révolution dans l'utilisation des données de télédétection.

Pour ne pas perdre de temps à l'arrivée des Sentinel-2, il est nécessaire de nous préparer dès aujourd'hui à l'utilisation de ces données. Or, il n'existe pas, à l'heure actuelle, de données permettant de simuler parfaitement les caractéristiques de Sentinel-2 :

TAKE FIVE

Musique pour 5 voix (5 voix) (5 voix)

Les données de Sentinel-2 sont disponibles gratuitement à tout utilisateur sous condition de signer une licence d'utilisation très peu restrictive. Des détails sur l'expérience et sur les caractéristiques de produits sont disponibles [ici](#).

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ESA, CNES, CESBIO, IGN, INRA, IFREMER, Météo France, Océan, OSN, PIRENE, SUD, TOS, VITO, ZENITH

Data Access - 3

- ▶ SPOT4(Take5) distribution tool : <http://spirit.cnes.fr/take5/>
- ▶ Necessity to type email address before each download
- ▶ click on L1C or L2A to download the whole time series for one site

cnes
Space for Earth

SPOT4 (TAKE 5)

A PROPOS

+ -

bing

mapshup

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Sélectionner un site

France : Versailles

Porteur
INRA/AgroParisTech

Utilisateurs
AgroParisTech, IRSTEA Montpellier, Arvalis, INRA-Grignon, Université Paris Diderot, CNRS-LSCE, INRA-Orléans

Objectifs scientifiques
Etat des sols (prédiction de la teneur en carbone, rugosité des surfaces, lien avec les systèmes de culture), Phénologie des forêts (lien avec la température), Validation de produits à basse résolution

Cliquez sur les icônes 2A et 1C pour télécharger tous les produits

2A

1C

Télécharger :

2013-06-16

Theia
Land data centre

CESIO

cnes

Data Access - 4

- ▶ Data format : <http://www.cesbio.ups-tlse.fr/multitemp/>
- ▶ Find "Product Format" in SPOT4(Take5) menu
- ▶ Or see "FAQ" page.
- ▶ "How it works" explains the processing methods

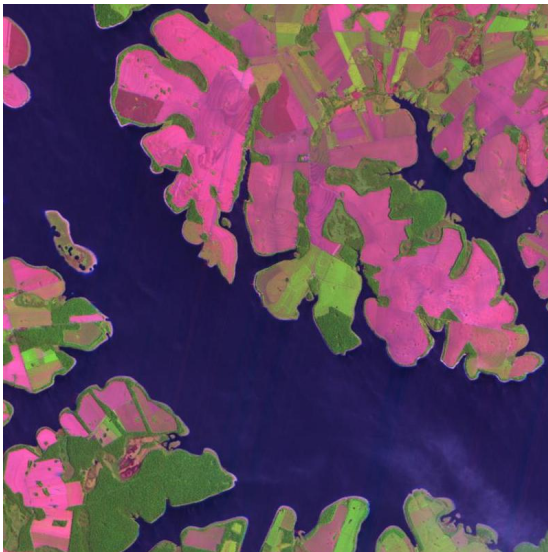


Data use and Audience

Download statistics

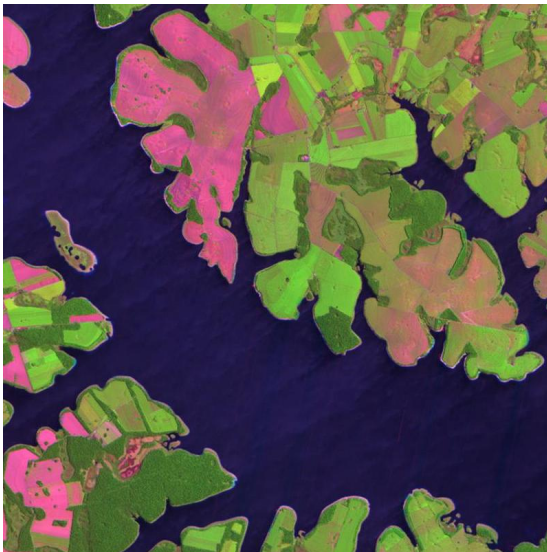
- ▶ Data released on July 16th, Statistics obtained on September 24th
- ▶ A bug prevented to save email addresses until 1st of August
- ▶ Statistics :
 - 1045 downloads until September 24th
 - 367 downloads of whole time series
 - Average : 8 per site (some due to failed downloads)
 - 97 different email addresses (starting from 1st of August)
 - including titi.tata@tutu.fr
 - 70% of downloads are Level 2A.

- ▶ A lot of work...
- ▶ ...to watch the plants grow



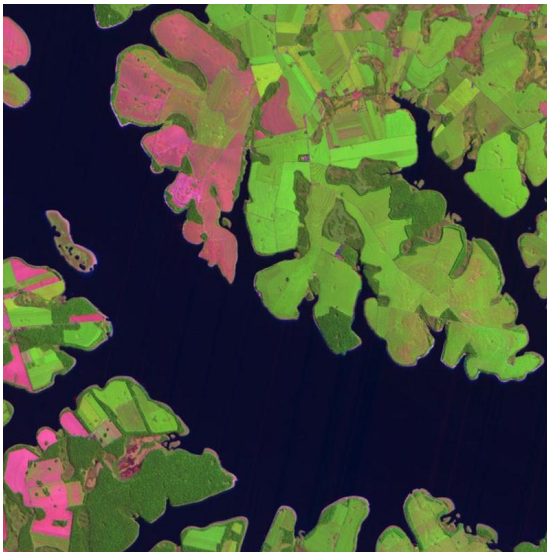
Paraguay 2013/03/10

- ▶ A lot of work...
- ▶ ...to watch the plants grow



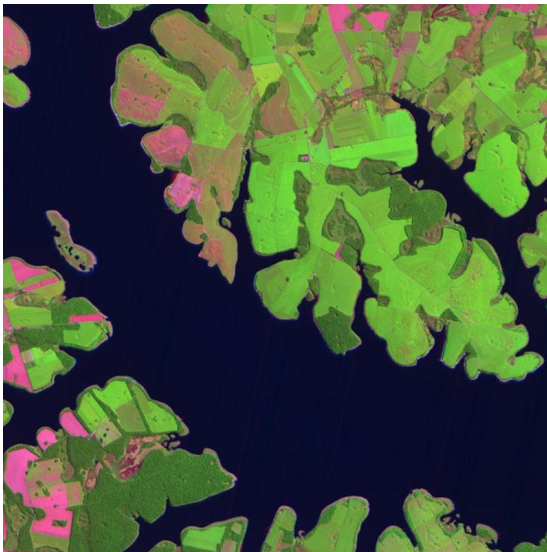
Paraguay 2013/03/30

- ▶ A lot of work...
- ▶ ...to watch the plants grow



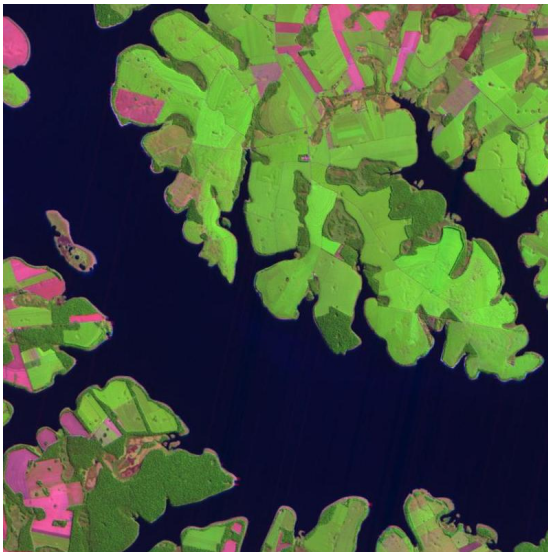
Paraguay 2013/04/09

- ▶ A lot of work...
- ▶ ...to watch the plants grow



Paraguay 2013/04/19

- ▶ A lot of work...
- ▶ ...to watch the plants grow



Paraguay 2013/05/09

Conclusions

A successful experiment

- ▶ Everything worked well in a short time frame : satellite, processors
- ▶ New THEIA prototype Ground Segment processes 2800 images in a week
- ▶ Experiment just begins :
 - Real challenge : use the data to prepare for Sentinel-2
 - Data available free of charge
- ▶ A Spot4 (Take5) meeting will be organised next year
 - Presentation of user results
- ▶ Usefull links :
 - > News : <http://www.cesbio.ups-tlse.fr/multitemp/>
 - > Download : <http://spirit.cnes.fr/take5>
 - > THEIA web site : <http://www.ptsc.fr/>

Conclusions

- ▶ Ready to start again with SPOT5 ?
- ▶ Beginning of 2015 ?