New perspectives of combined data sets for environmental information





Barbara Koch

FeLis

University of Freiburg

www.felis.uni-freiburg.de

E-mail:Barbara.koch@felis.uni-Freiburg.de

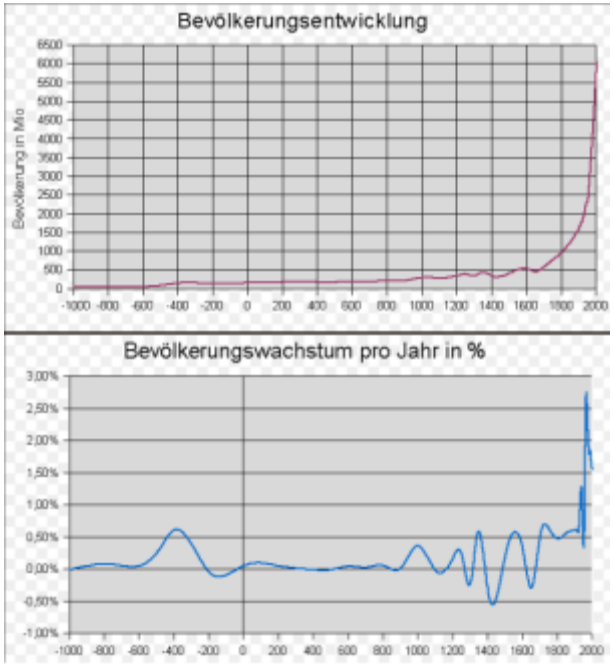


ALBERT-LUDWIGS-
UNIVERSITÄT FREIBURG

felis

Challenges





ALBERT-LUDWIGS-
UNIVERSITÄT FREIBURG

felis

Challenges

















ALBERT-LUDWIGS-
UNIVERSITÄT FREIBURG

felis

Sustainability Development Goals



ALBERT-LUDWIGS-
UNIVERSITÄT FREIBURG

felis

Data need

To manage the challenges and to advance the process
towards the sustainability development goals



Data and spatial information technology
will be of vital importance in this process

Role of data

Data will have an important role

1. monitor changes
2. prevention of environmental destruction
3. manage risks and hazards
4. drive economical and technical innovations

One important source for data is remote sensing

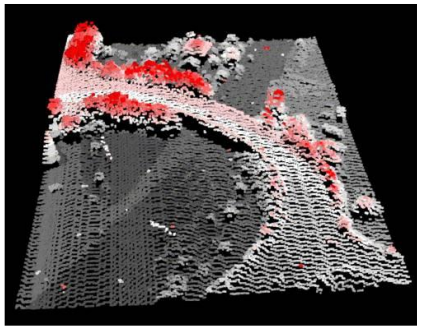
Main sensors

Sensors

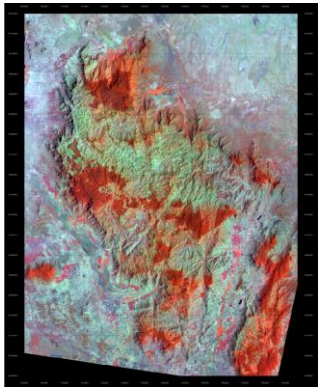
Digital photography



Laserscanner



Opto-electronic sensor



Radar



Sensor plattforms



Huge amount of remote sensing data are available today!

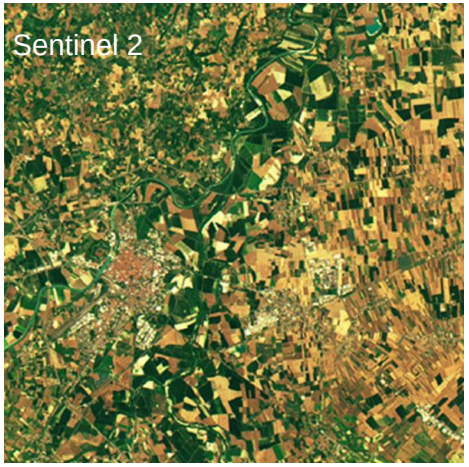
Earth observation satellites

Since 2000 around 100 new satellites have been launched

Imaging passive systems
Multispectral imaging systems
Hyperspectral imaging systems
Imaging active systems
RADAR SAR
LIDAR
Non imaging active systems
Microwave altimeter
Laser altimeter
Scatterometer

Data quality





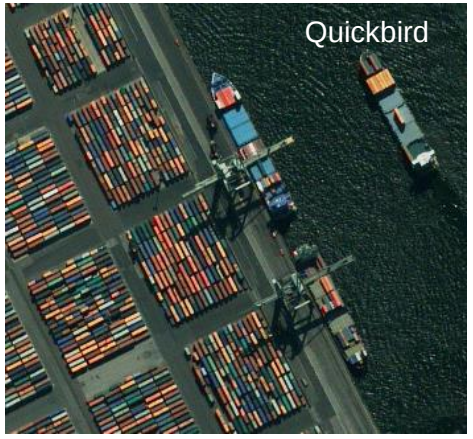
Airbus Defense and Space 2016



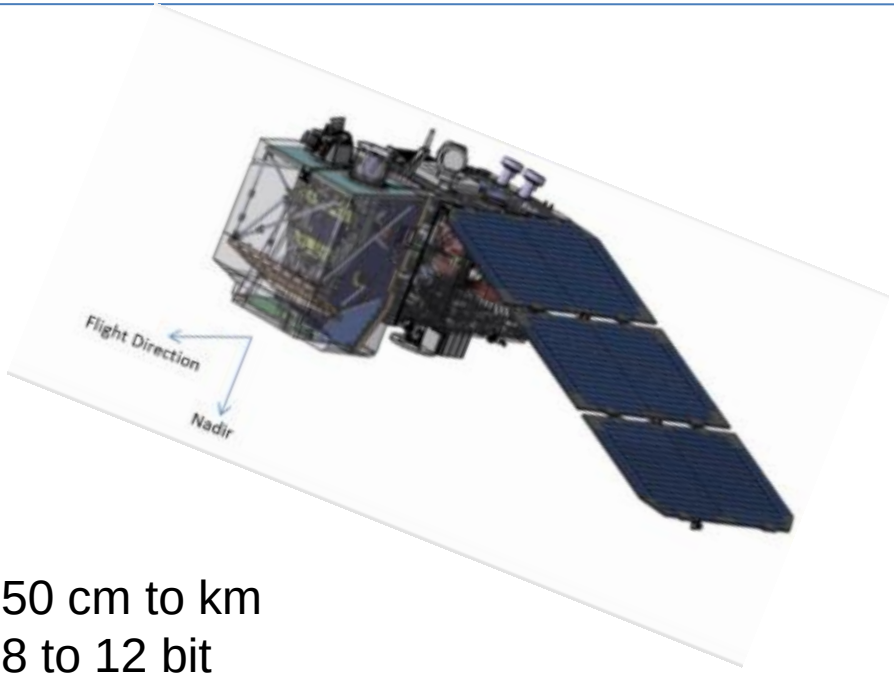








Data portfolio



Today

Spatial resolution	50 cm to km
Radiometric resolution	8 to 12 bit
Temporal resolution	daily to few days
Spectral resolution	few to many bands

ALBERT-LUDWIGS-
UNIVERSITÄT FREIBURG

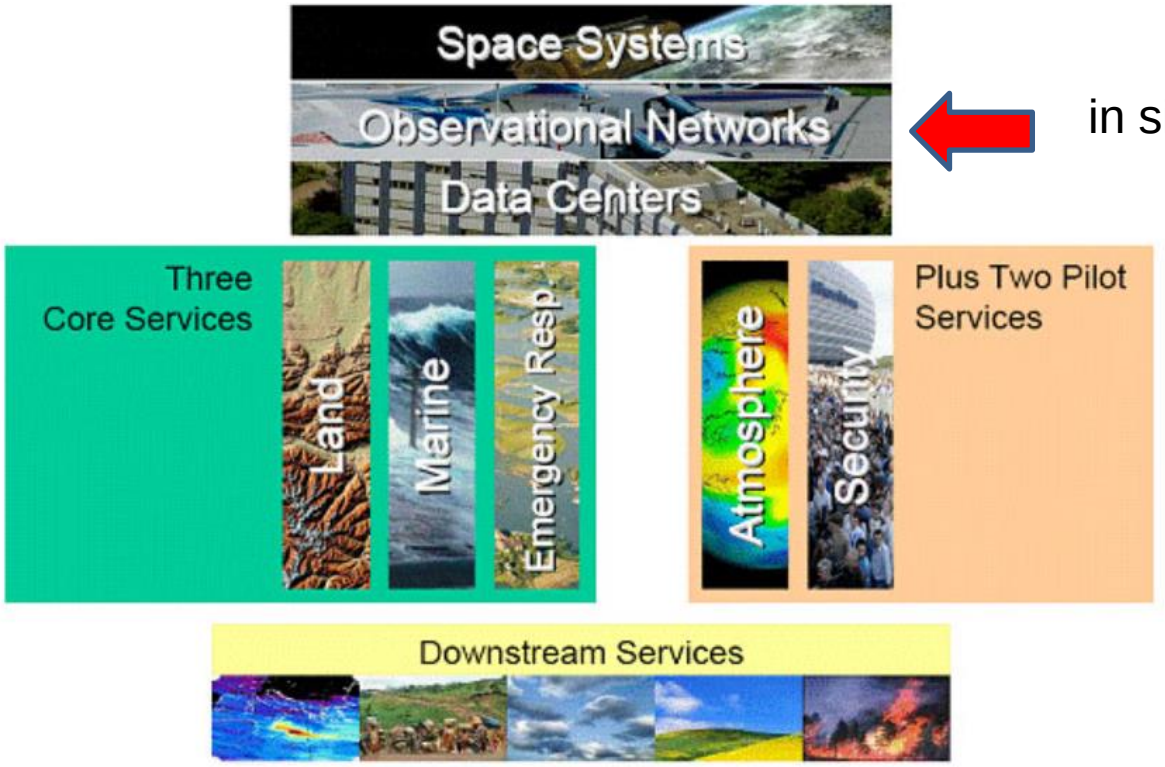
felis

New Perspectives of Combined Data Sets for Environmental Information



Satellite 2016

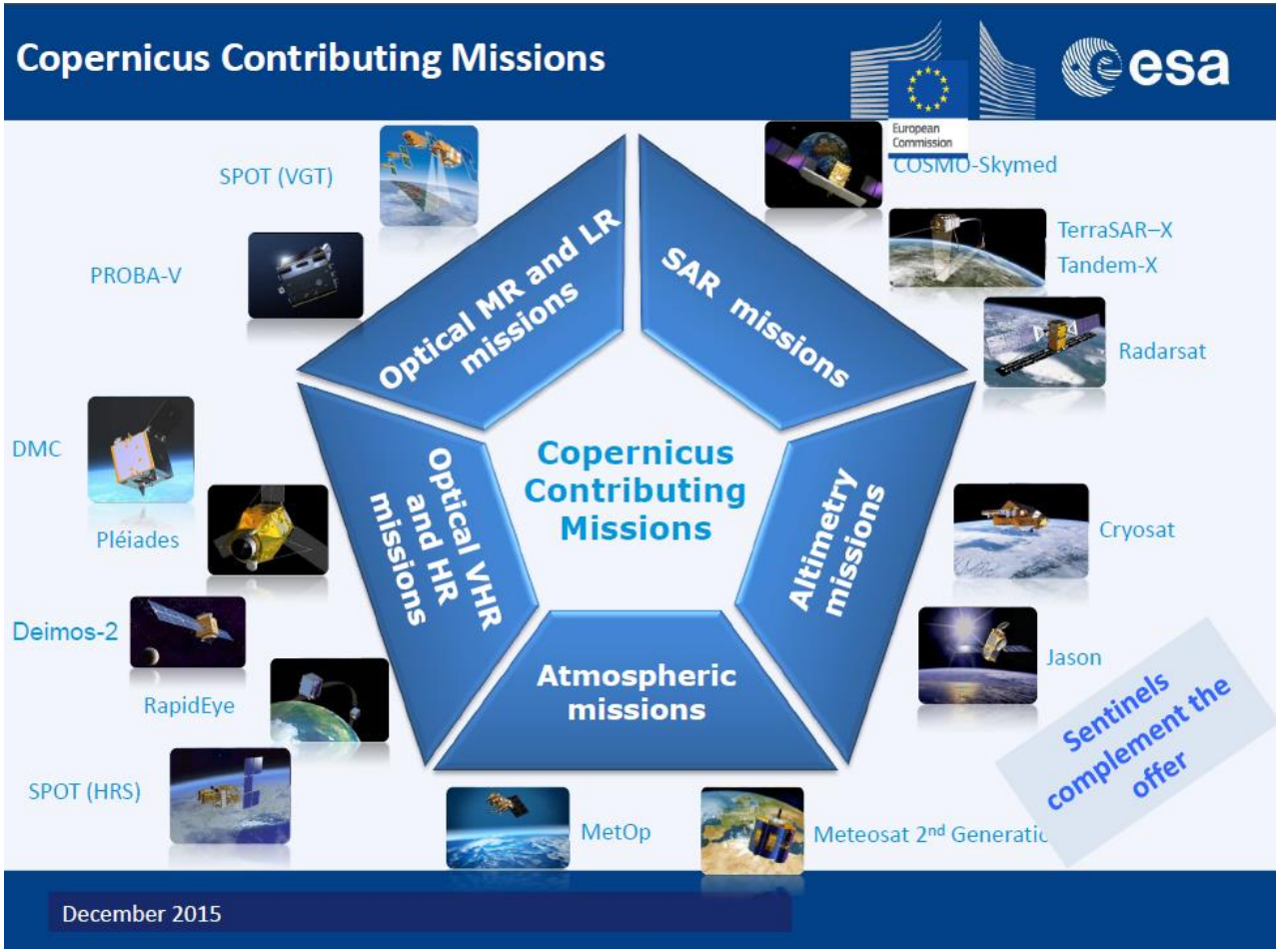
Copernicus System



Sentinel


Copernicus Space Component: Dedicated Missions
European Commission
esa
S1: Radar Mission
S2: High Resolution Optical Mission
S3: Medium Resolution Imaging and Altimetry Mission
S4: Geostationary Atmospheric Chemistry Mission
S5P: Low Earth Orbit Atmospheric Chemistry Precursor Mission
S5: Low Earth Orbit Atmospheric Chemistry Mission
S6 (Jason-CS): Altimetry Mission
FIRST LAUNCH 3.04.2014
FIRST LAUNCH 23.06.2015
FIRST LAUNCH 16.02.2016
December 2015

Copernicus


Copernicus Contributing Missions
esa
European Commission
SPOT (VGT)
PROBA-V
DMC
Pléiades
Deimos-2
RapidEye
SPOT (HRS)
Optical MR and LR missions
SAR missions
Optical VHR and HR missions
Copernicus Contributing Missions
Altimetry missions
Atmospheric missions
COSMO-Skymed
TerraSAR–X
Tandem-X
Radarsat
Cryosat
Jason
MetOp
Meteosat 2nd Generatic
Sentinels complement the offer
December 2015

ALBERT-LUDWIGS-
UNIVERSITÄT FREIBURG

Value of satellite data has increased



High spatial resolution
High time resolution
High spectral resolution
High radiometric resolution

3-D data
Operational availability
Higher time sequences
Long term perspective
Software for processing
Better storage capacity

ALBERT-LUDWIGS-
UNIVERSITÄT FREIBURG

felis

Major future challenges

Carbon sequestration modelling

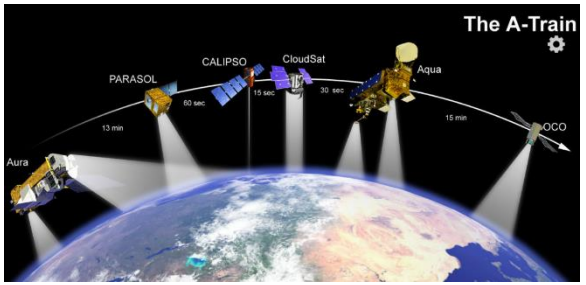
Bio-economy transformation

Biodiversity changes

Tipping point of eco-systems

Energy and Transport

Risks and hazards



?

ALBERT-LUDWIGS-
UNIVERSITÄT FREIBURG

felis

Bio-economy

Bio-economy?

Biomass production and
conversion into value added products

Food
Feed
Bio-energy
Bio-based products ⬆

bio-based plastics 2010 to 2020
35 000 tons ➡ 2 810 000 tons

Busch und Wittmeyer
access: July 2016

ALBERT-LUDWIGS-
UNIVERSITÄT FREIBURG

felis

New sensors

Satellite-based LiDARsystems

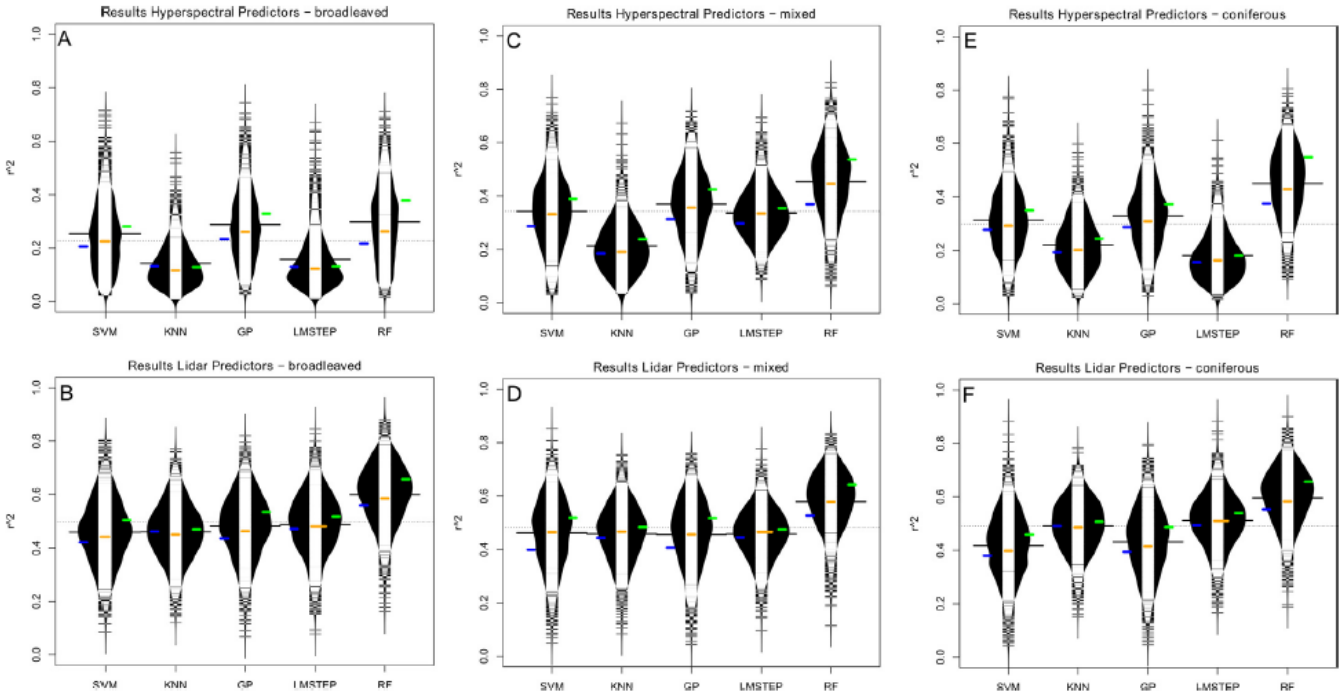
Radarsystems PolInSAR and P-Band

Satellite-based systems for chlorophyll fluorescence

ALBERT-LUDWIGS-
UNIVERSITÄT FREIBURG

felis

New sensors



Biomass estimation of forest areas

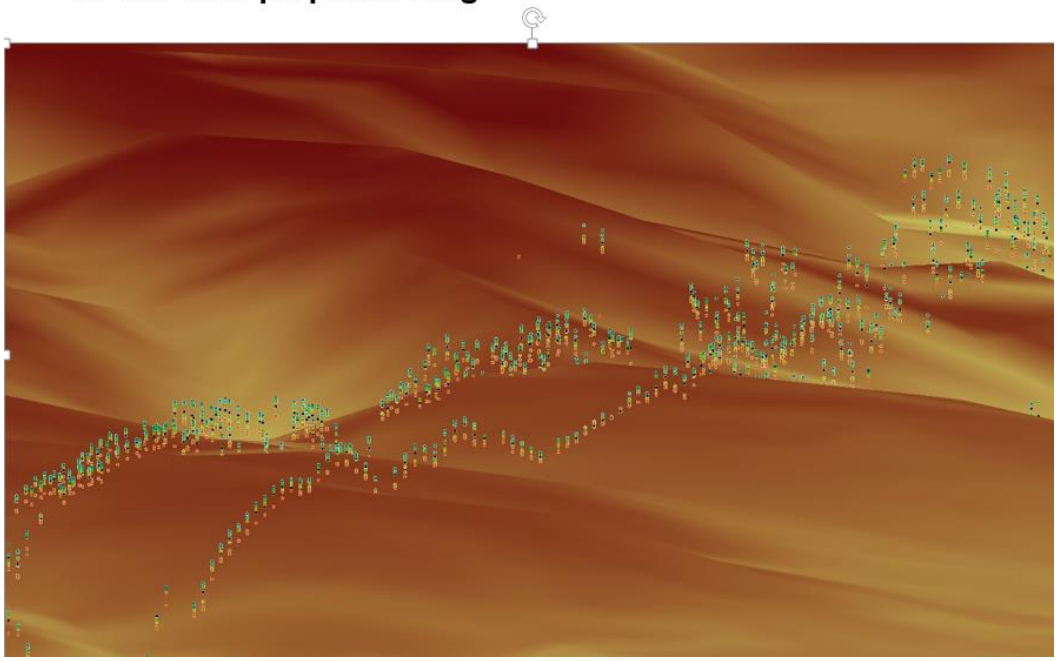
Latifi et al. 2015

ALBERT-LUDWIGS-
UNIVERSITÄT FREIBURG

felis

New sensors

ICESat-data preprocessing



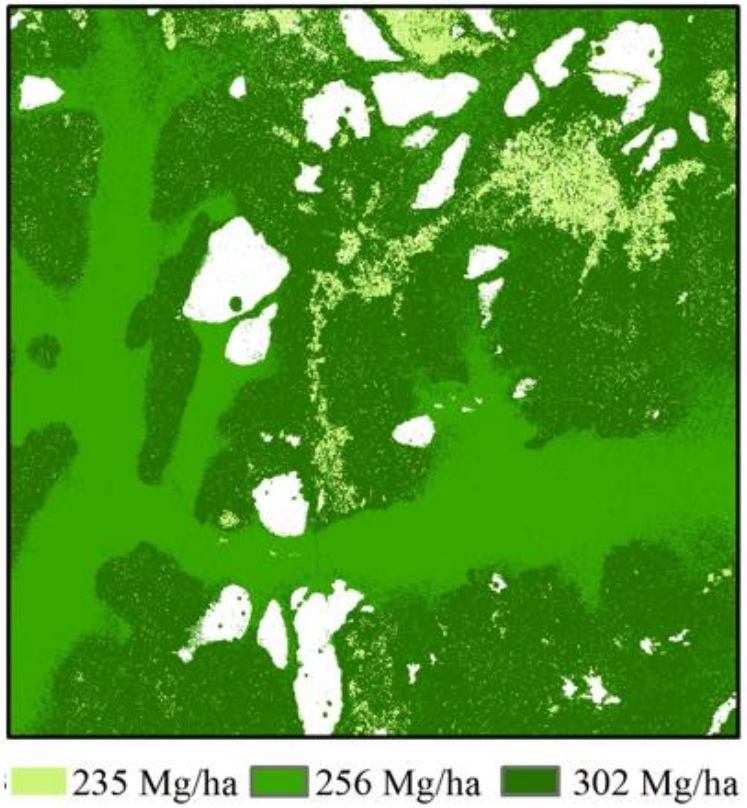
Topograhy and Biomass estimation of forest areas

Enssle et al. 2013

New Sensors

Mean heights:

Secondary forest	24m
Swamp forest	25m
Dense forest	27m

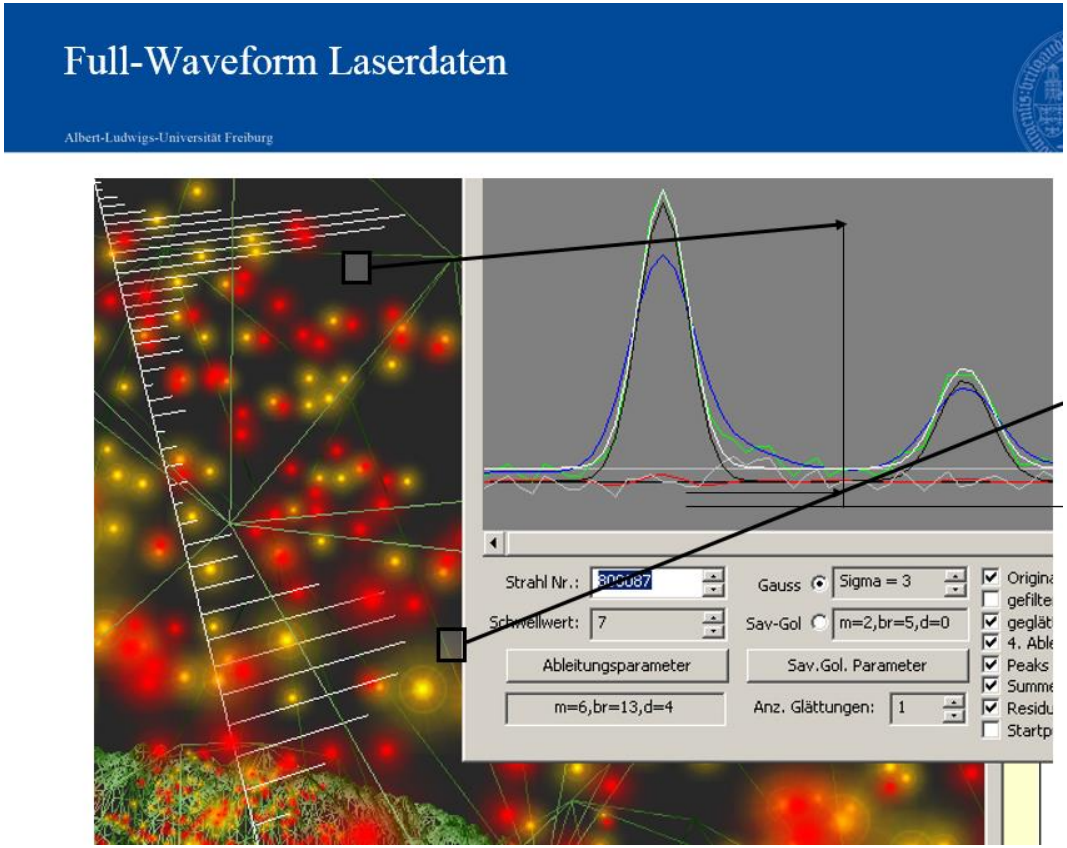


Enssle et al. 2013

ALBERT-LUDWIGS-
UNIVERSITÄT FREIBURG

felis

New sensors



ALBERT-LUDWIGS-
UNIVERSITÄT FREIBURG

felis

New Missions for LIDAR



ICESAT 2 for ice and terrain detection launch NASA 2017

GEDI for forest mapping to model carbon sequestration NASA launch 2018 (ISS) footprint 25 m fullwave



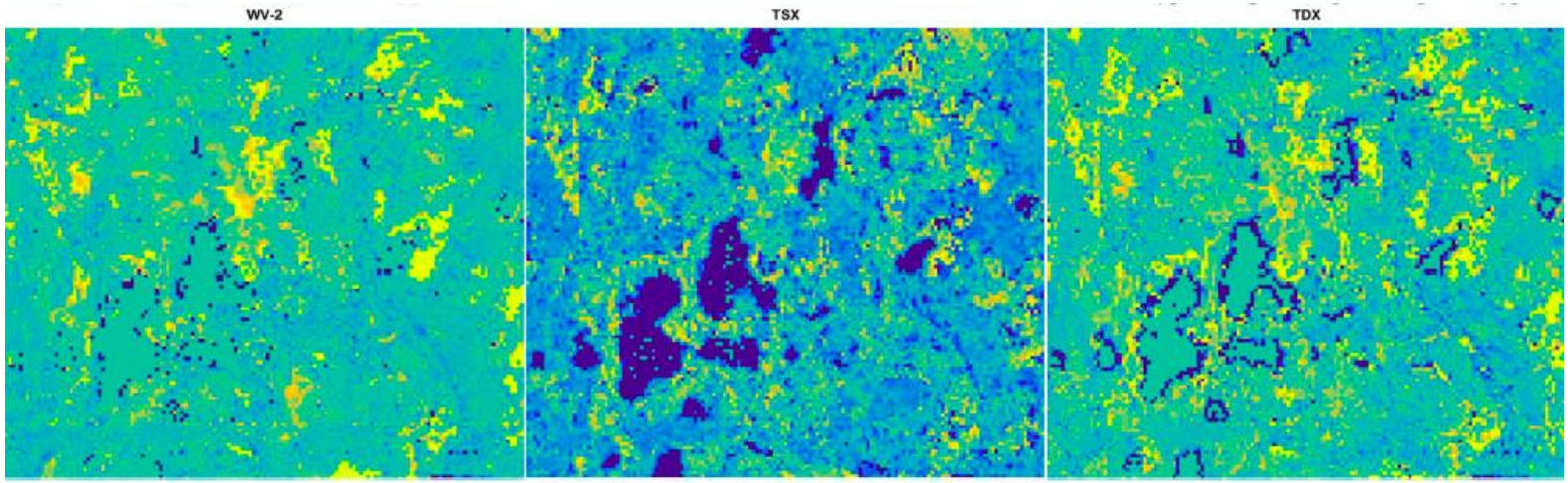
ALBERT-LUDWIGS-
UNIVERSITÄT FREIBURG

felis

New sensors

TanDEM-X missions

simultanous data take is important for vegetation height



Height above ground compared to airborne laser measurments above ground

Xiaowei Yu et al. 2015

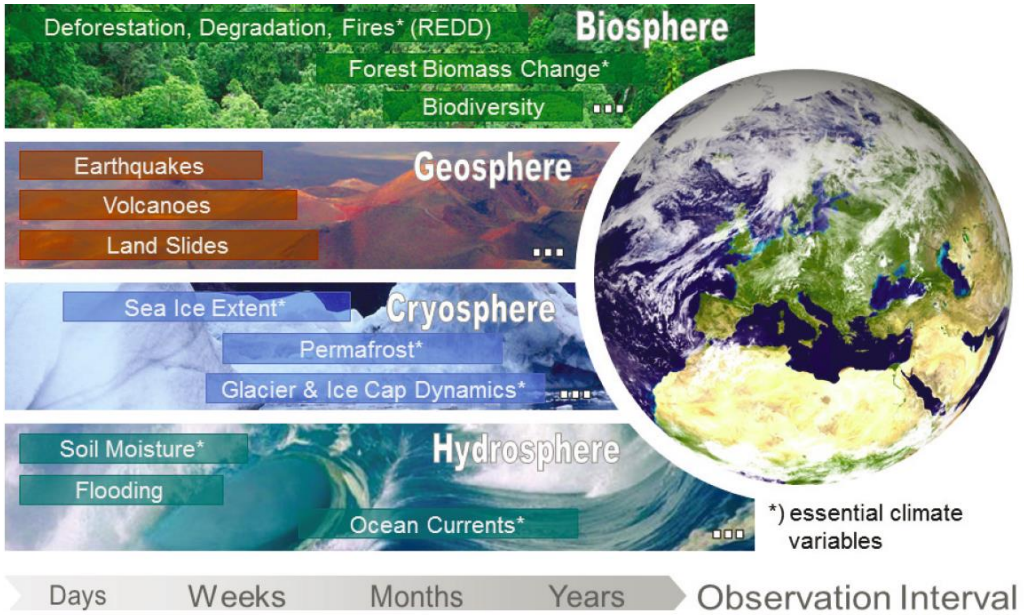
ALBERT-LUDWIGS-
UNIVERSITÄT FREIBURG

felis

New sensors

L-Band TanDEM SAR
proposed by DLR

saturation 100-200 Mg/ha



www.esa.int access July 2016

ALBERT-LUDWIGS-
UNIVERSITÄT FREIBURG

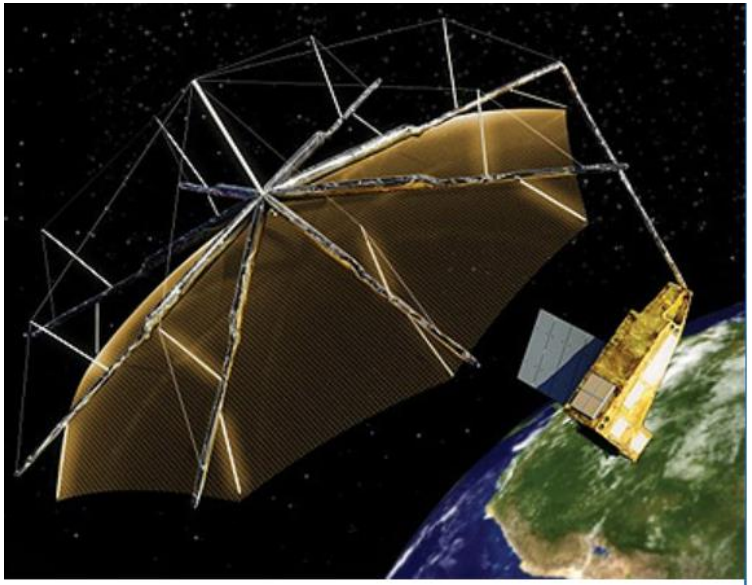
felis

New sensors

Biomass explorer mission for 2021

Mapping of global biomass for carbon sequestration

Saturation AGB ~300 Mg/ha



Biomass *[ESA]*

www.esa.int access July 2016

ALBERT-LUDWIGS-
UNIVERSITÄT FREIBURG

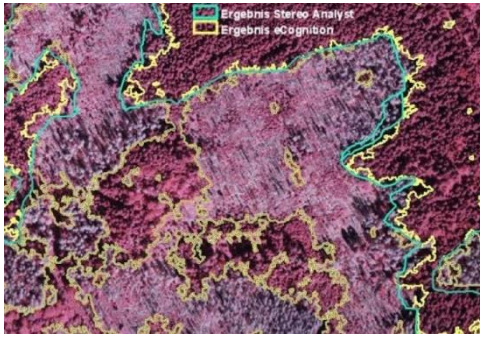
felis

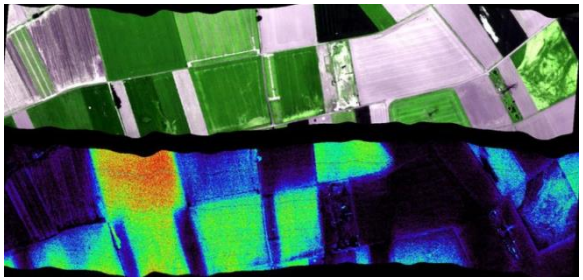
New sensors

Measurement of laser fluorescence

Photosynthetic activity





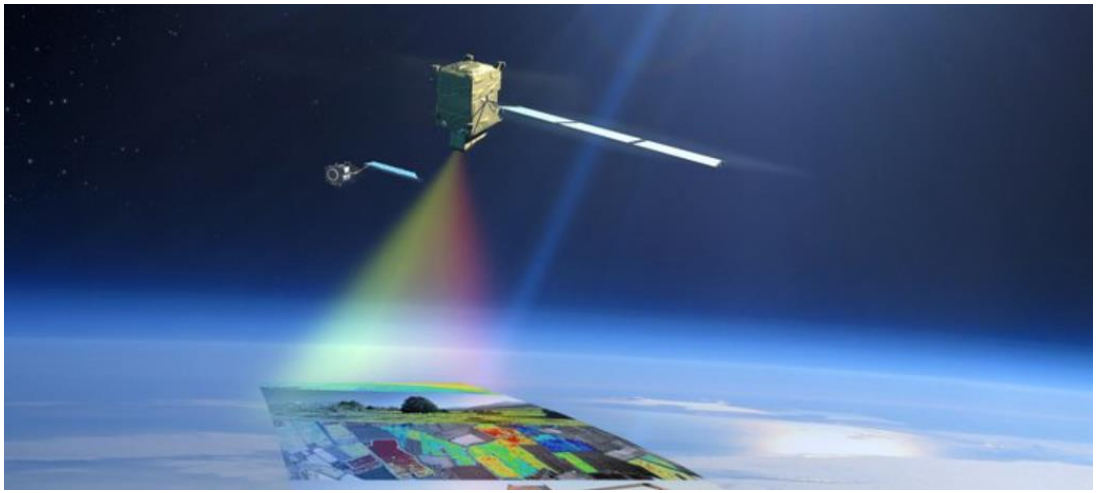


www.esa.int access July 2016

ALBERT-LUDWIGS-
UNIVERSITÄT FREIBURG

felis

New sensors

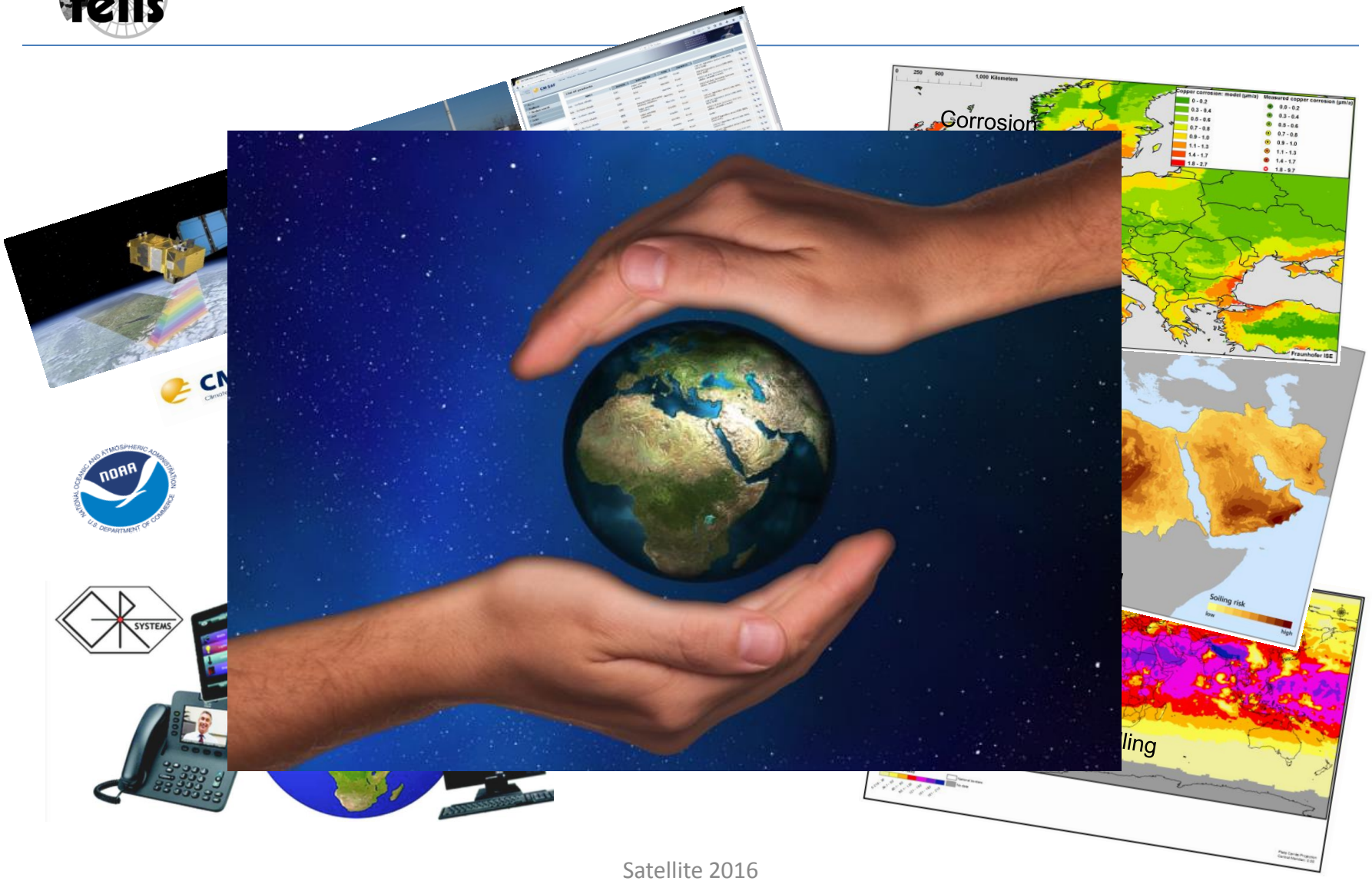


FLEX Flouresence Explorer start in 2022

ALBERT-LUDWIGS-
UNIVERSITÄT FREIBURG

felis

Data networks



Satellite 2016