

Landsat 8 and a changing international framework for global land imaging

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Dallas Fort Worth International Airport, 25th July 1972 and 31st August 2013
Images Landsat 1 and Landsat 8, courtesy USGS and NASA

Land Surface Processes condition
Earth's climate system

Land cover change is the key driver of
global biodiversity loss

Land take is increasing; in the EU over
1,000 km² / year of soil are lost

Land grabbing is spreading; Eurasia, Africa,
Caribbean and Latin America all affected

Land is degrading; around 14% of the
global land surface is affected

Land Uses are competing; for food,
fuel, fiber/ carbon sink/ protected areas

Land is non-renewable; 100 years to
form 1-2 cm of soil in temperate climates

**Global Land Resource
monitoring is a scientific,
economic, strategic and
moral imperative**

*44% of the world's food production systems
and 50% of world livestock are vulnerable to
land degradation*

*50% of the global soil carbon pool is in the
northern circumpolar region - the largest
single terrestrial carbon pool (1672 Pg)*

*99% of the world's calories come from the
land*

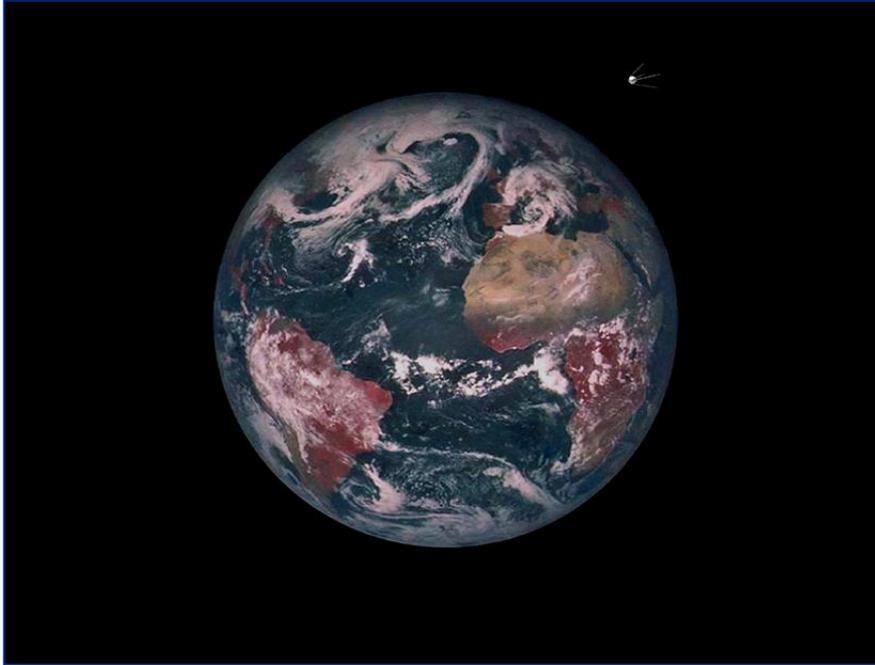
*95% of the people are concentrated on 10%
of the land*

6983 artificial satellites launched from

4th October 1957

to

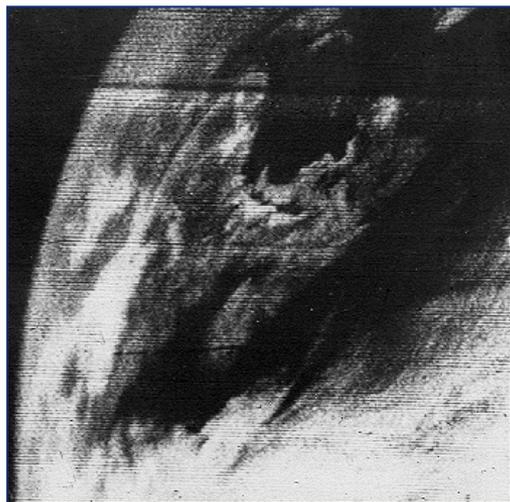
30th June 2013



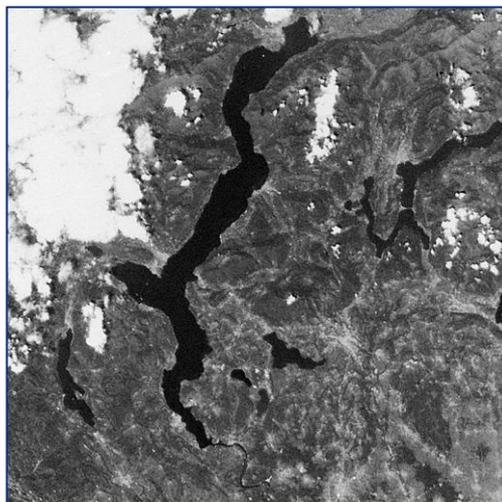
861 Earth Science missions...



TIROS 1, 01-APR-60 X
New Brunswick



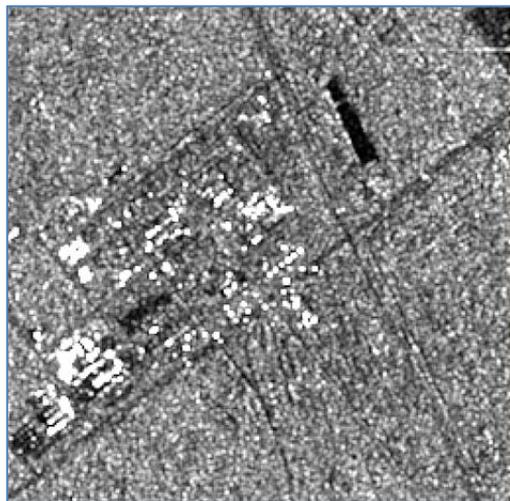
KH, 18-AUG-63 X
JRC Ispra



METEOSAT 1, 09-DEC-77 X
Earth Disk



SIR-C / X 07-OCT-94 X
Kennedy Space Center



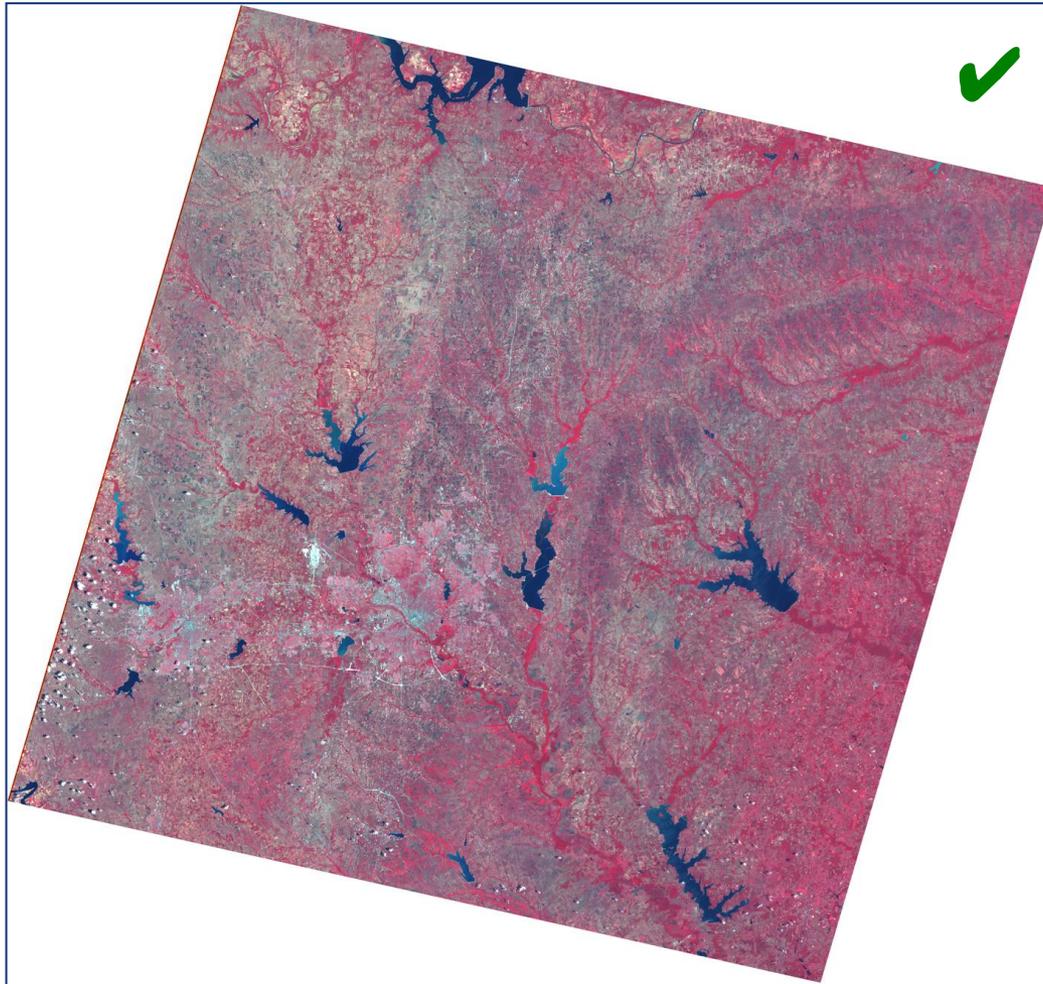
Astronaut Photo 21-JAN-06 X
Turin



RazakSAT 1, ca 14-JUL-09 X
Kuala Lumpur

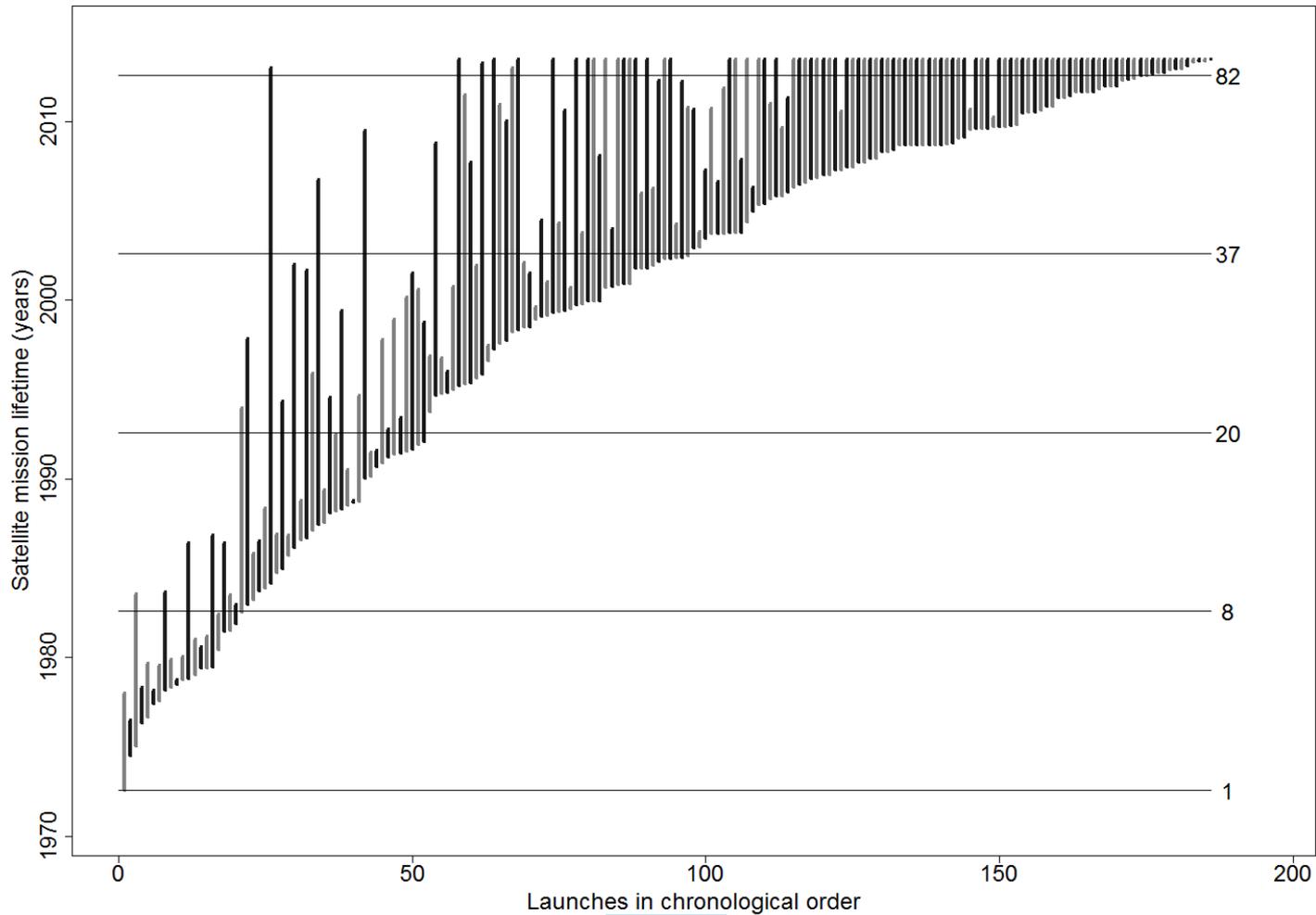


186 have (or had) global land-cover imaging capability

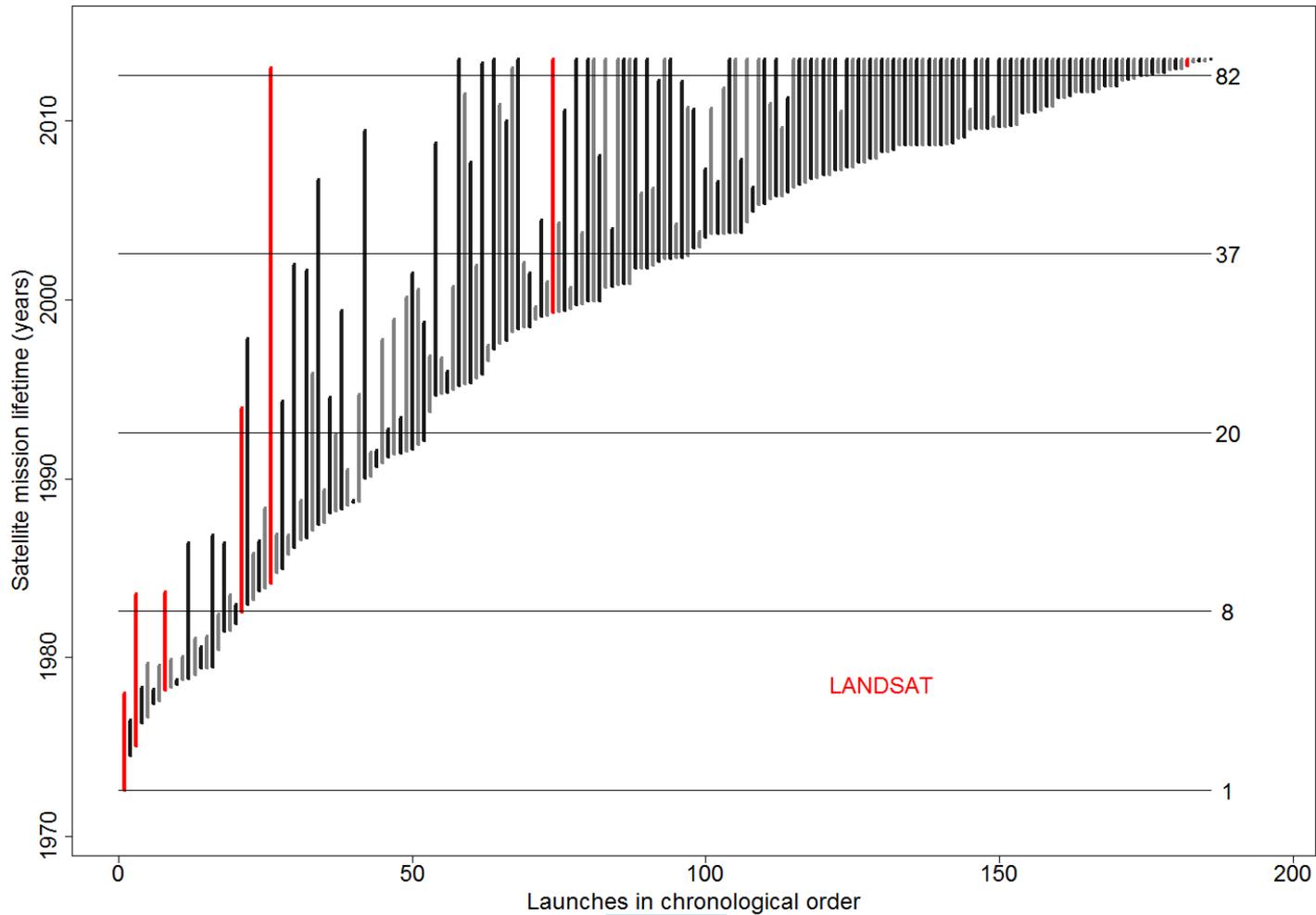


ERTS 1
25-JUL-72
Dallas

The lifespan of all near-polar orbiting, land imaging, civilian satellites shown in chronological order

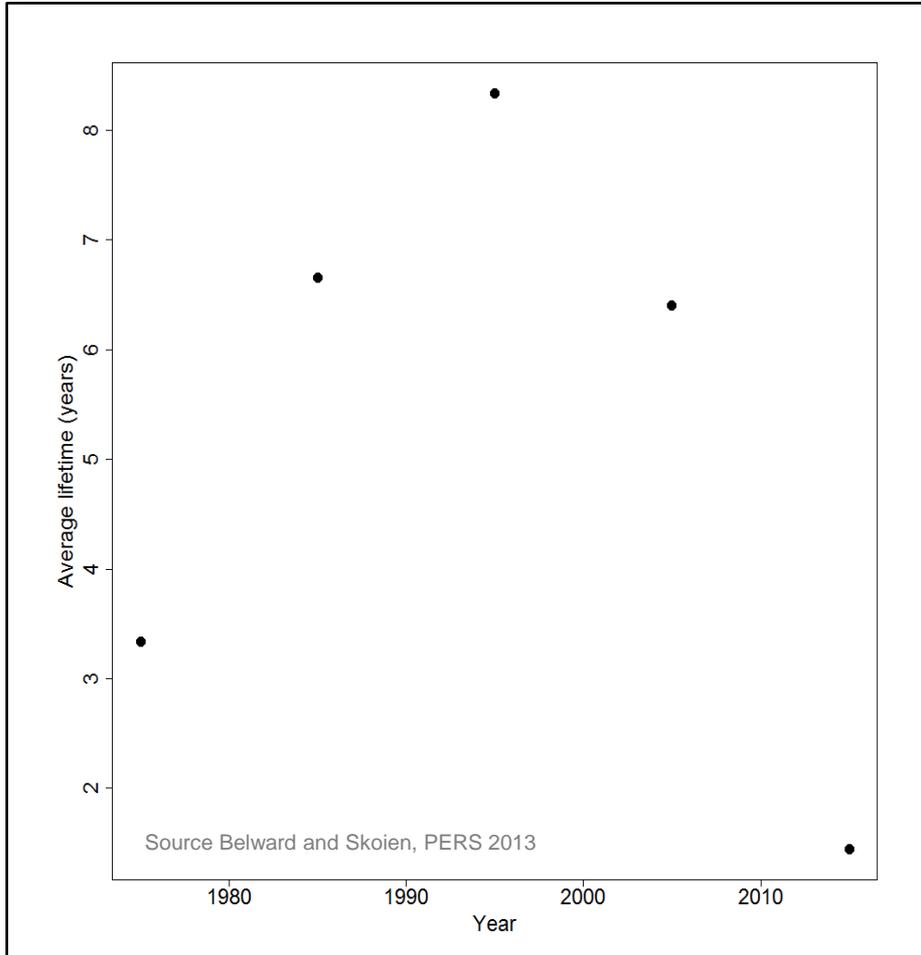


The lifespan of all near-polar orbiting, land imaging, civilian satellites shown in chronological order

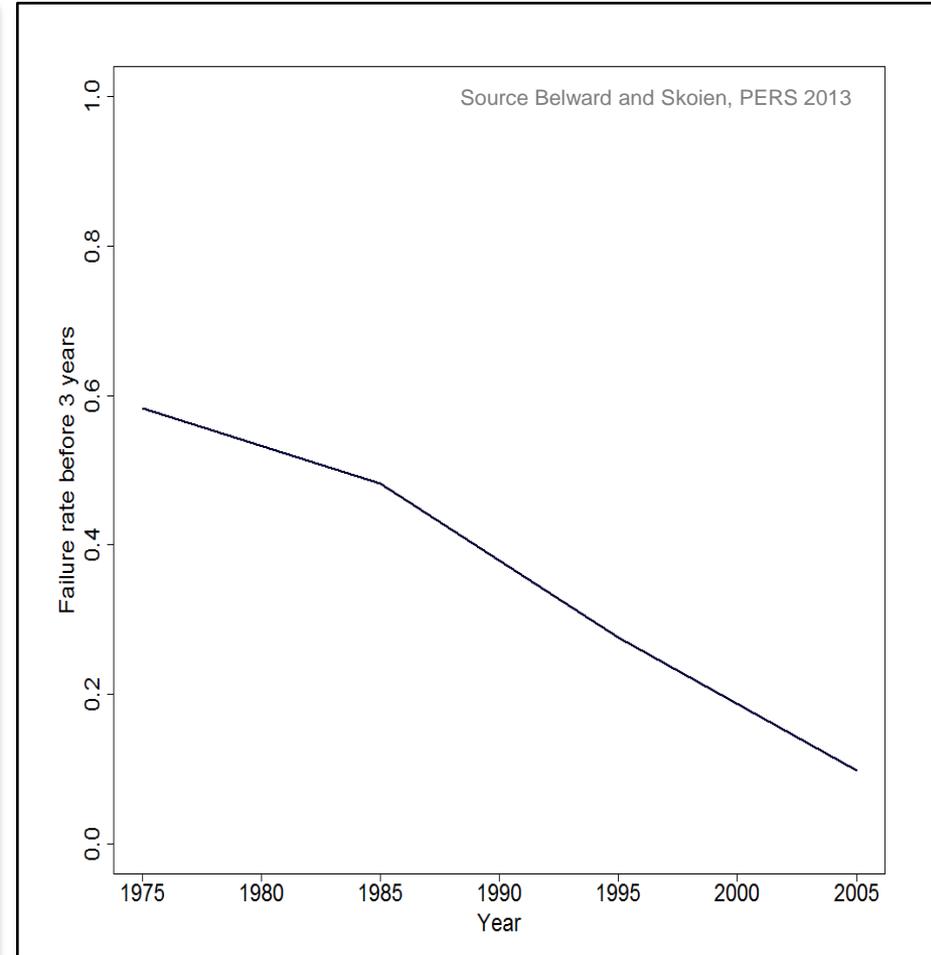


Average mission lifetime for all near-polar orbiting, land imaging, civilian satellites launched per decade, nb average lifetime for 1990s and 2000s will continue to lengthen

The percentage of all near-polar orbiting, land imaging, civilian satellites failing in less than three years of operation per decade (1970 to 2010), nb at-launch failures are excluded

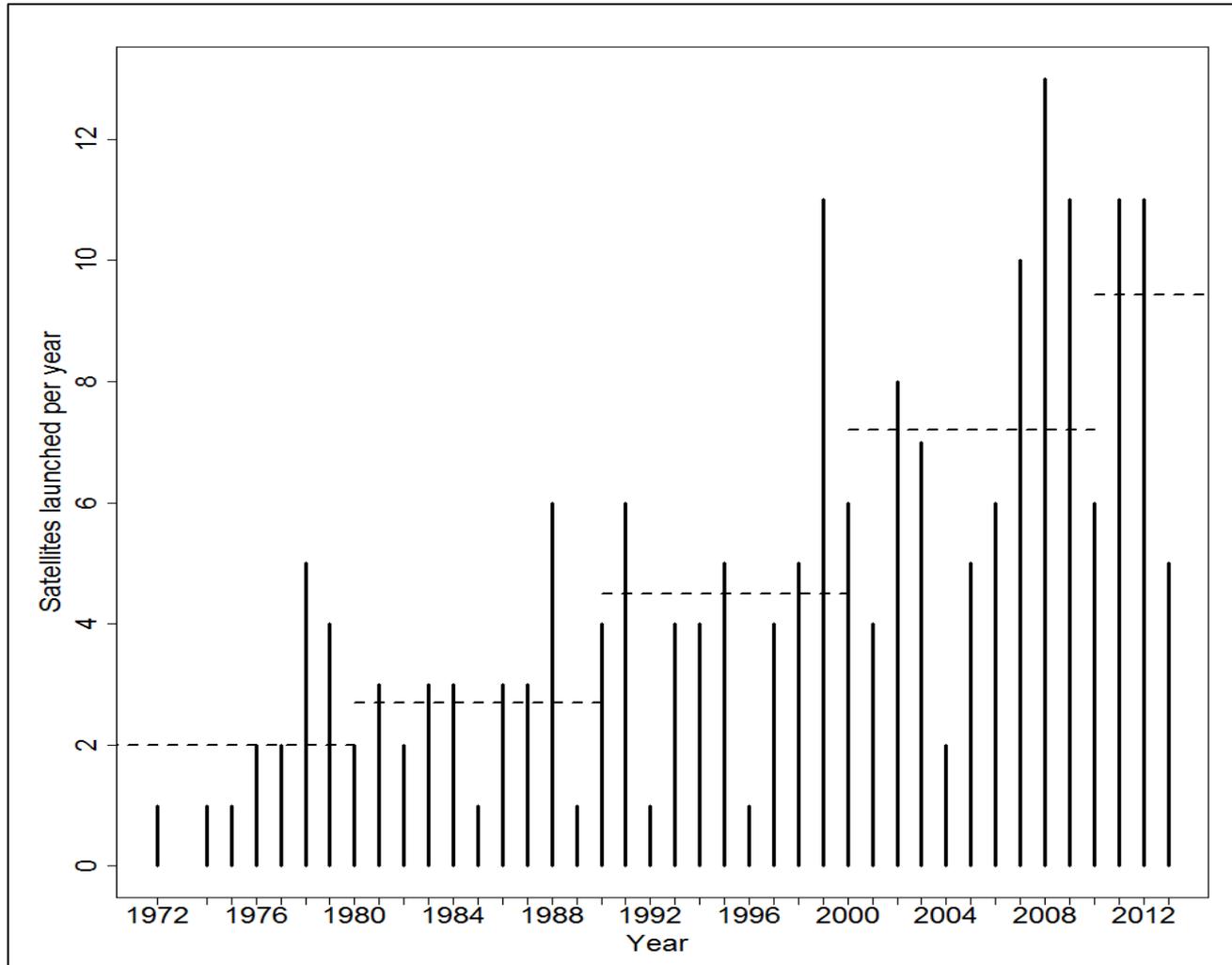


‘Life expectancy’



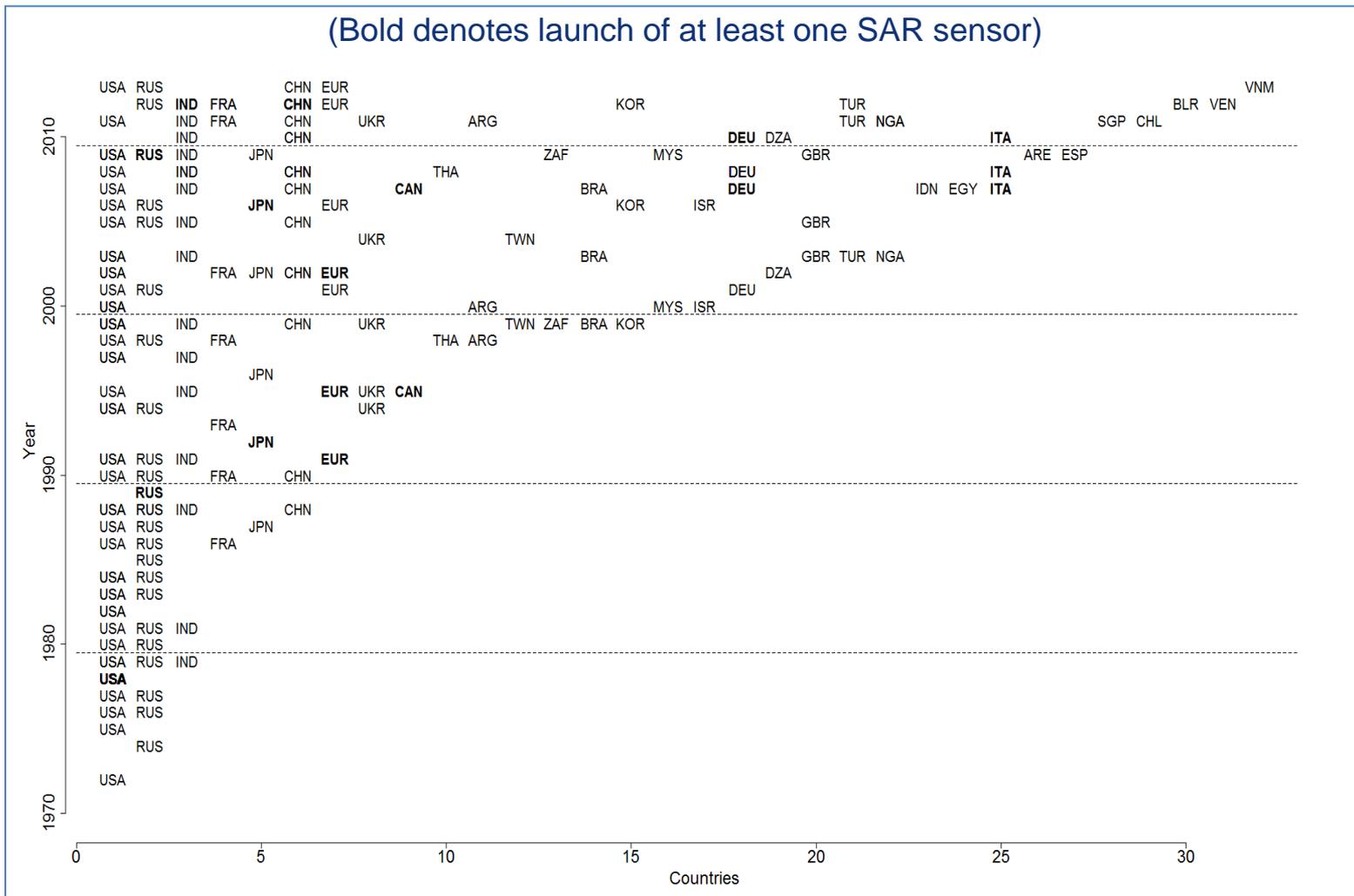
‘Death rate’

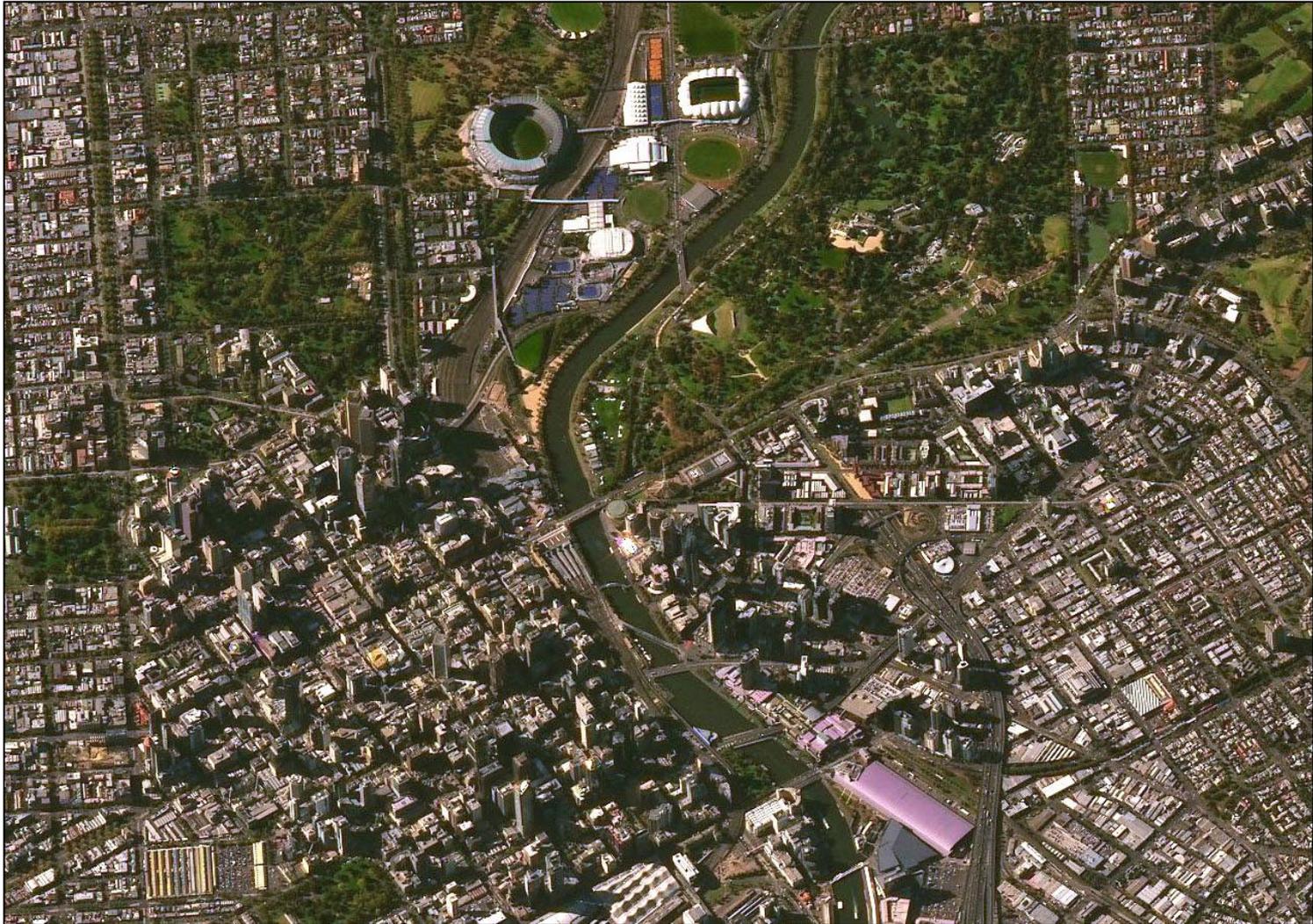
Number of near-polar orbiting, land imaging, civilian satellites launched per year



Years in which sovereign states launched one or more near-polar orbiting, land imaging civilian satellites

(Bold denotes launch of at least one SAR sensor)

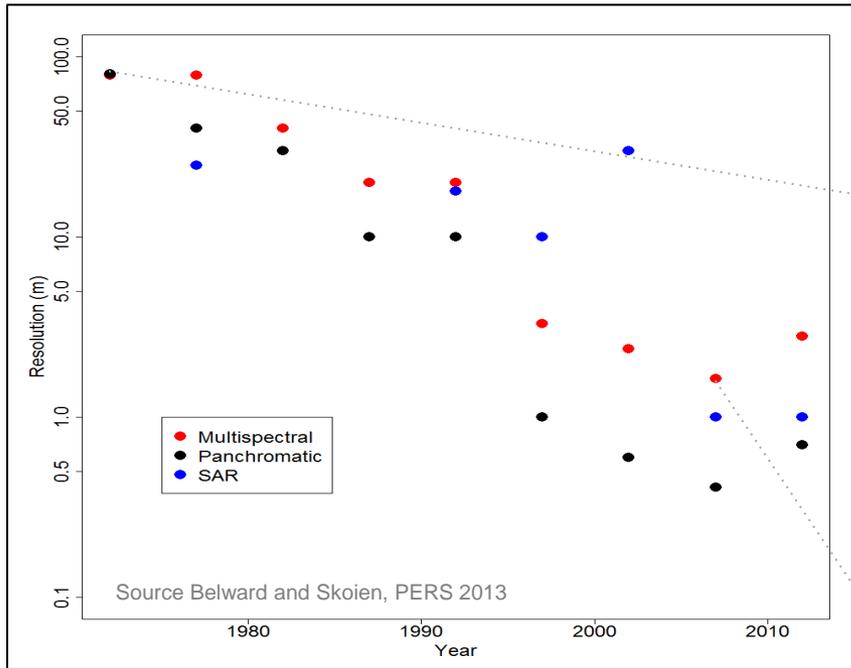




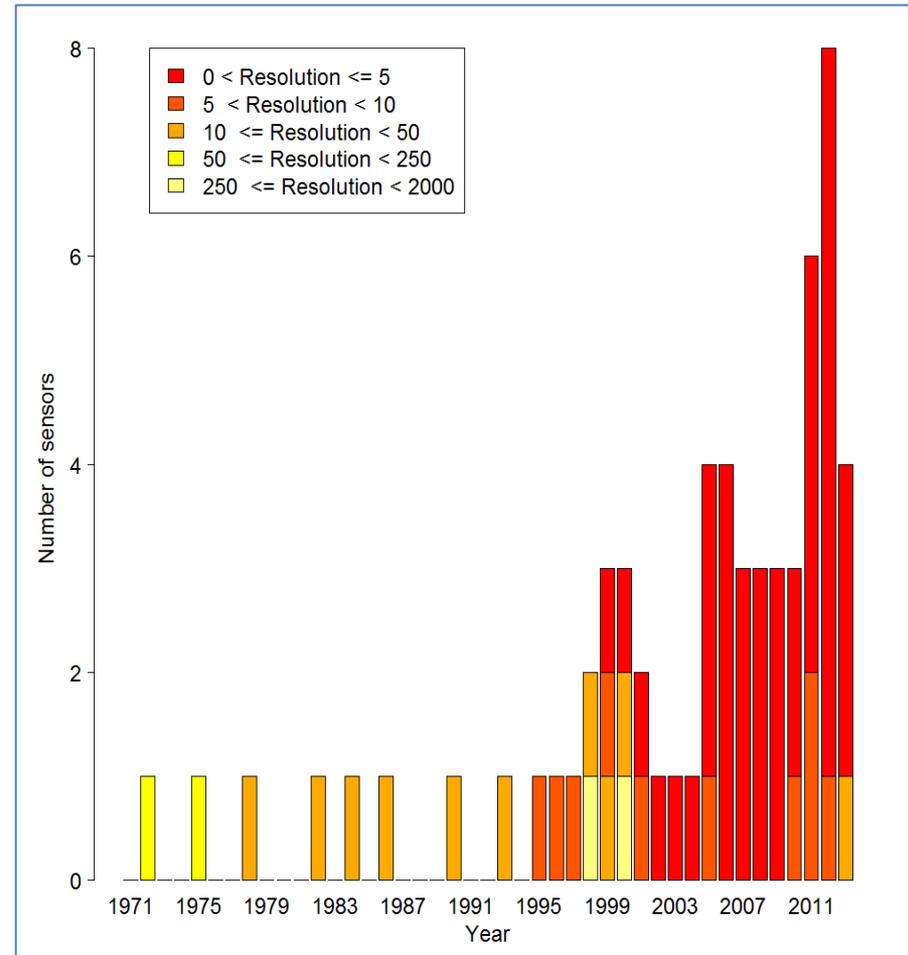
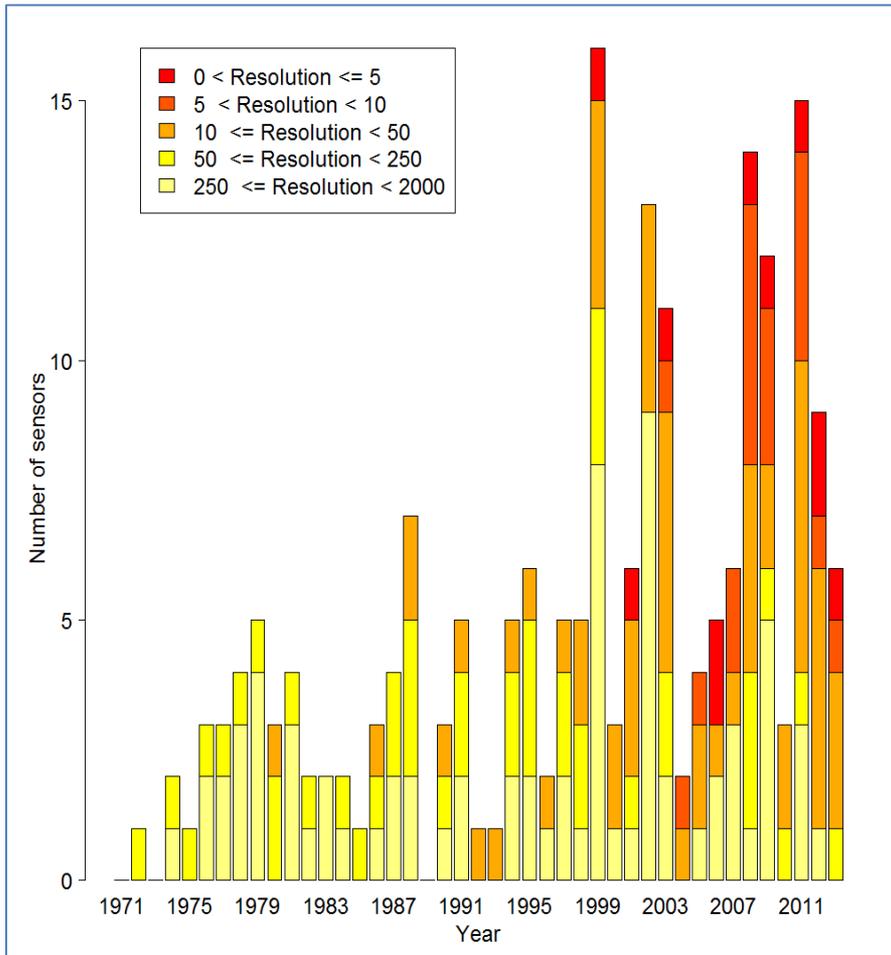


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Changing spatial resolution



Number of multispectral (left) and panchromatic (right) sensors at different spatial resolutions flying on near-polar orbiting, land imaging, civilian satellites per year



International context

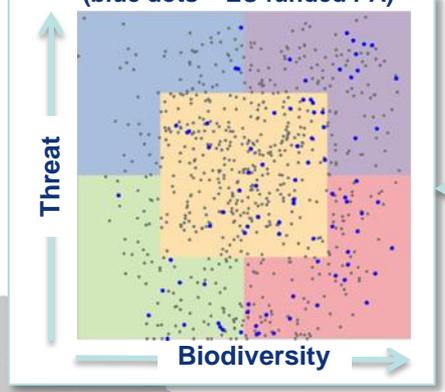
- 186 satellites with some global land imaging capability successfully launched by (or for) 31 countries/geopolitical groups
- Missions failing within three years of launch dropped from 60% to 20%
- Mission operational life increased from 3.3 years to 8.6 years (and increasing)
- Average number of satellites launched yr/decade has increased from 2 to 9
- 90 operating at the end of the first semester of 2013
- Spatial resolution increased from 80 m to 2 m multispectral and 0.41 m pan



Scopus entries found when searching for 'mission name'
and 'land cover'

Group 1 0	Group 2 1 - 5	Group 3 5 - 50	Group 4 50 - 500	Group 5 500 - 5000
Meteor Okean Orbview TMSat SUNSAT TiungSat HaiYang Monitor Topsat Lapan Egyptsat IMS Dubaisat TianHui X-Sat Sich RASAT SSOT Zi Yuan Kanopus Vulkan BelKa VRSS Gocturk Gaofen VNREDSAT	Alsat Suomi NPP RISAT Bhaskrara Almaz BIRD RazakSat SumbandilaSat Oceansat Pleiades EROS Metop GOSAT Resurs Feng-Yun	MOS SAC THEOS Cartosat Nimbus KOMPSAT Resourcesat Seasat Formosat RapidEye ADEOS DMC Cosmo-SkyMed Proba Huan-Jing DMSP CBERS	TerraSAR JERS NMP Radarsat ALOS ERS Envisat IRS WorldView GeoEye	NOAA (731) SPOT (889) EOS (1323) Landsat (3670)

Risk/value for African Protected Areas
(blue dots = EU funded PA)

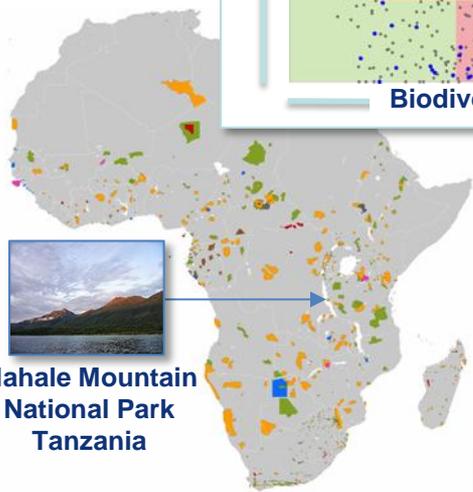


Monitoring Scenarios Forecasts



Provide Web Processing Services

Integrate datasets



Mahale Mountain National Park
Tanzania

Protected Areas (PA)




Ecosystems



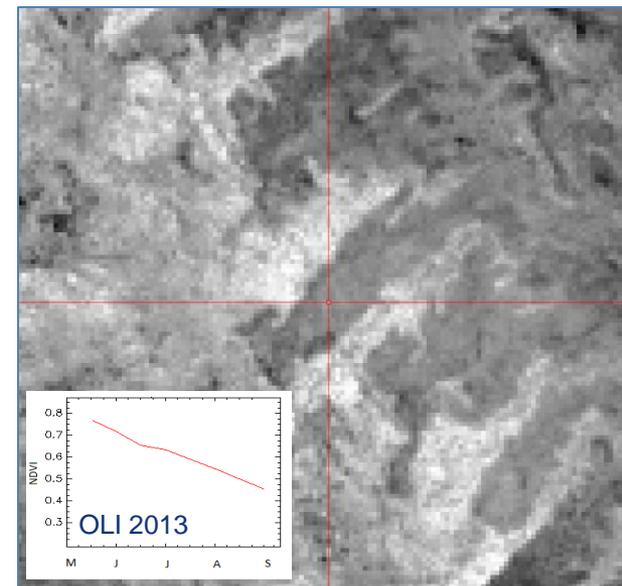
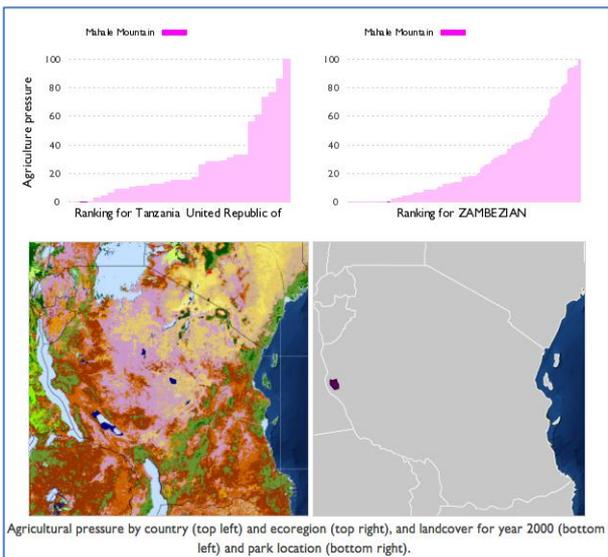
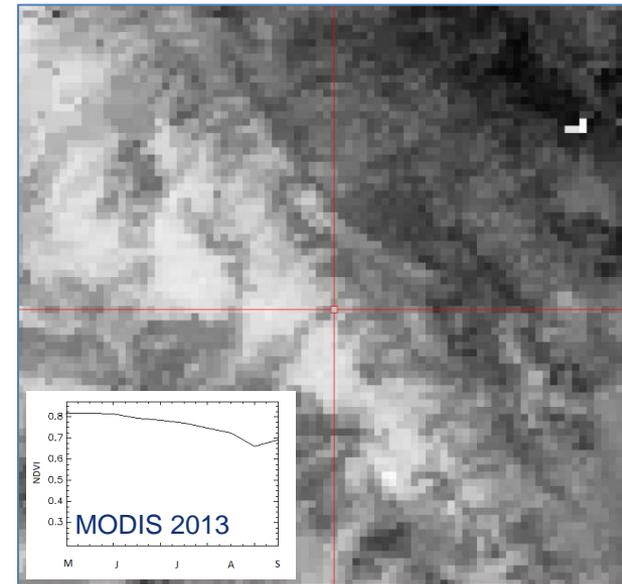
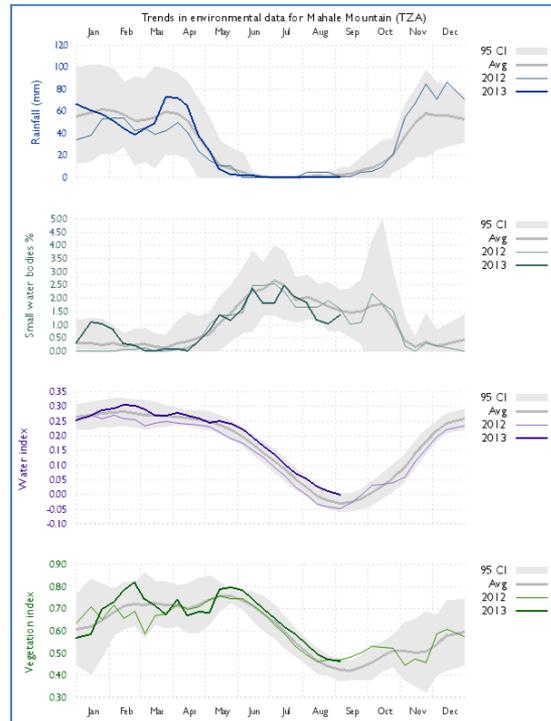
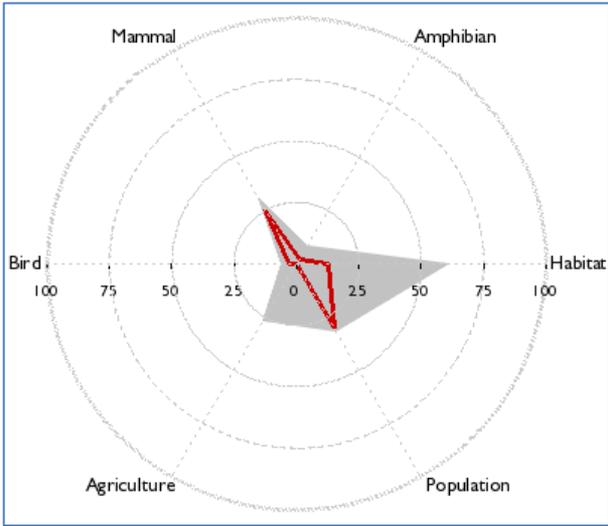

Species







European Commission

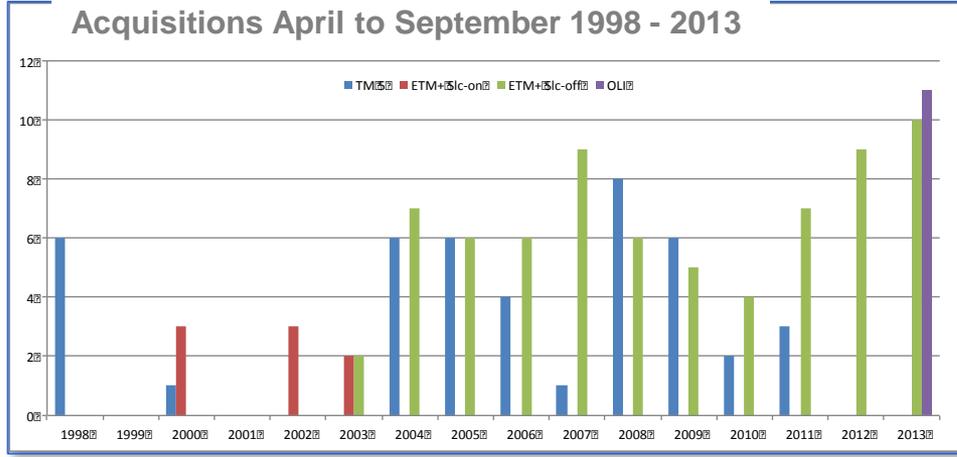


Joint Research Centre

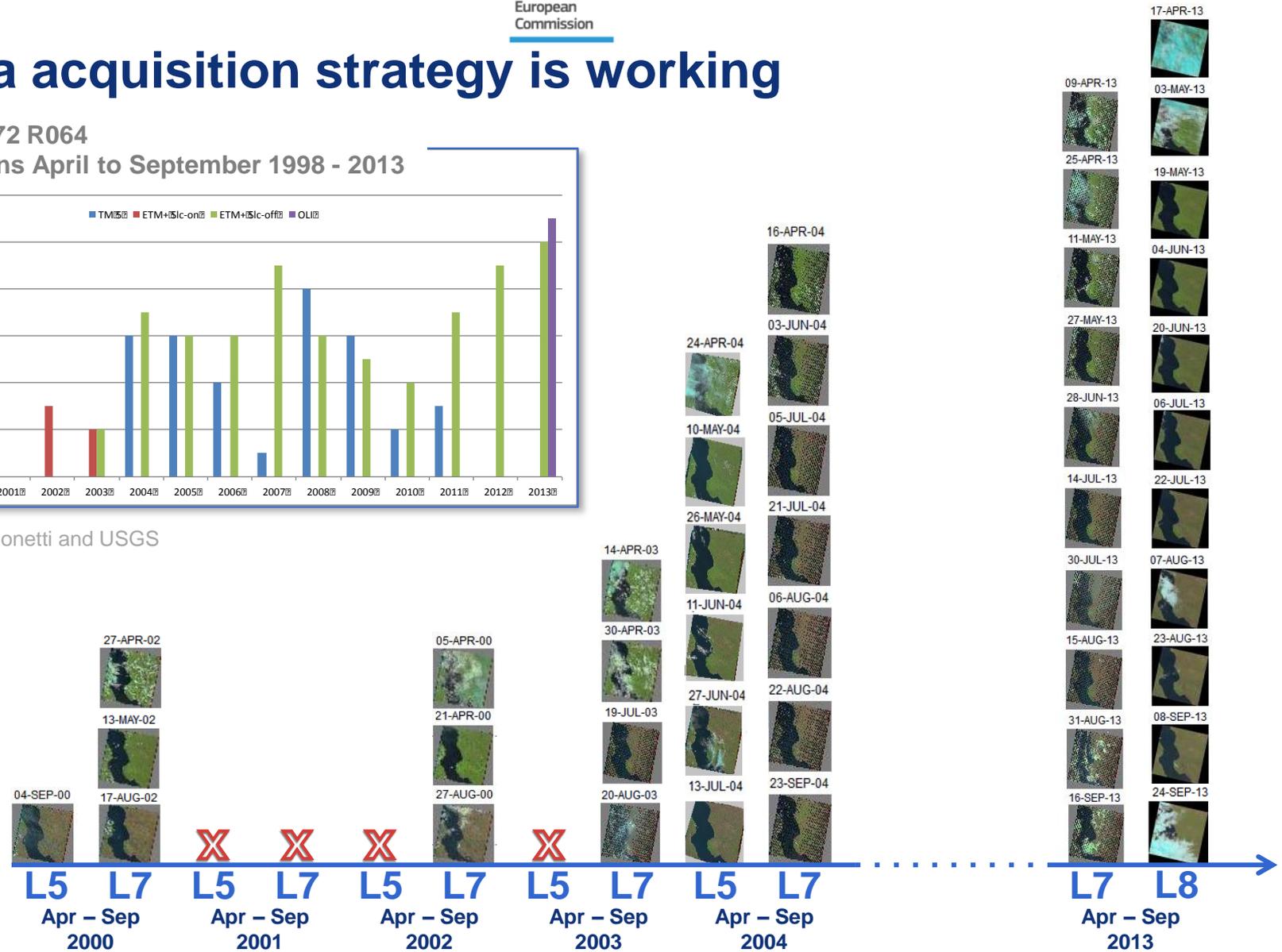
4 km

L8 data acquisition strategy is working

WRS 2 P172 R064
Acquisitions April to September 1998 - 2013



Source Dario Simonetti and USGS



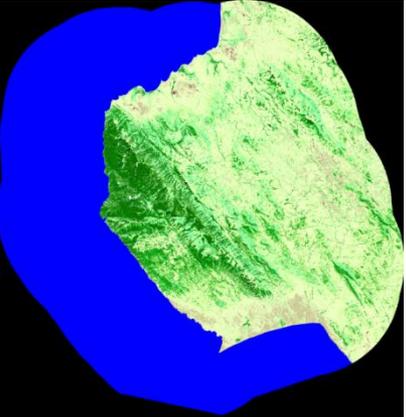
82 km



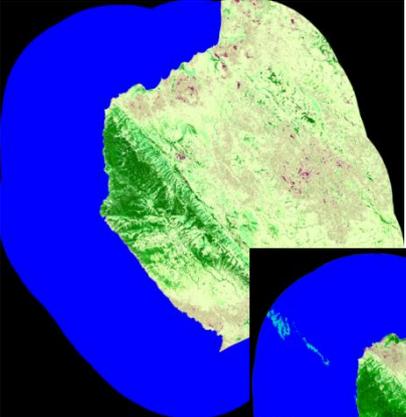
19th May



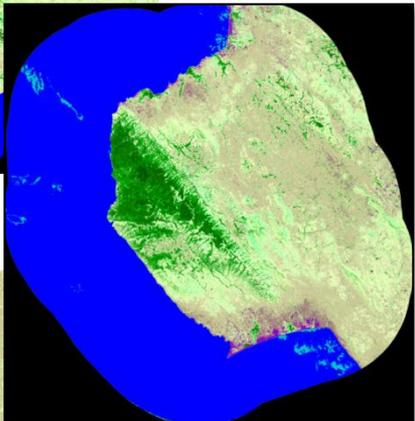
4th June



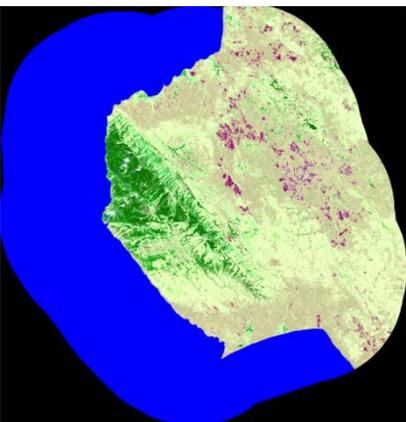
20th June



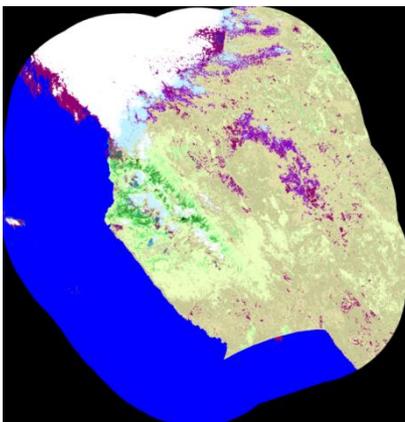
7th July



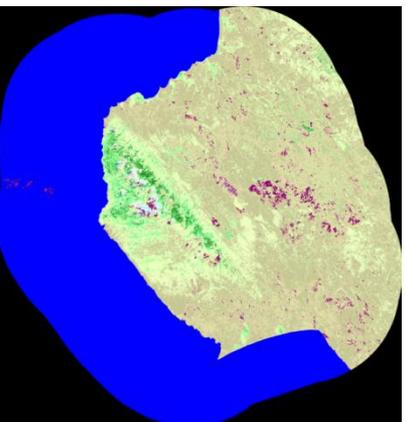
Seasonal composite



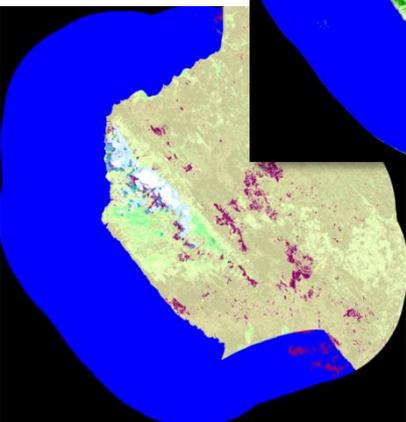
22th July



7th August



23rd August

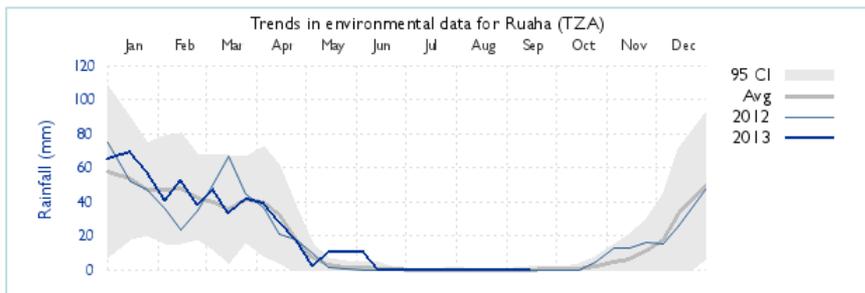


8th September

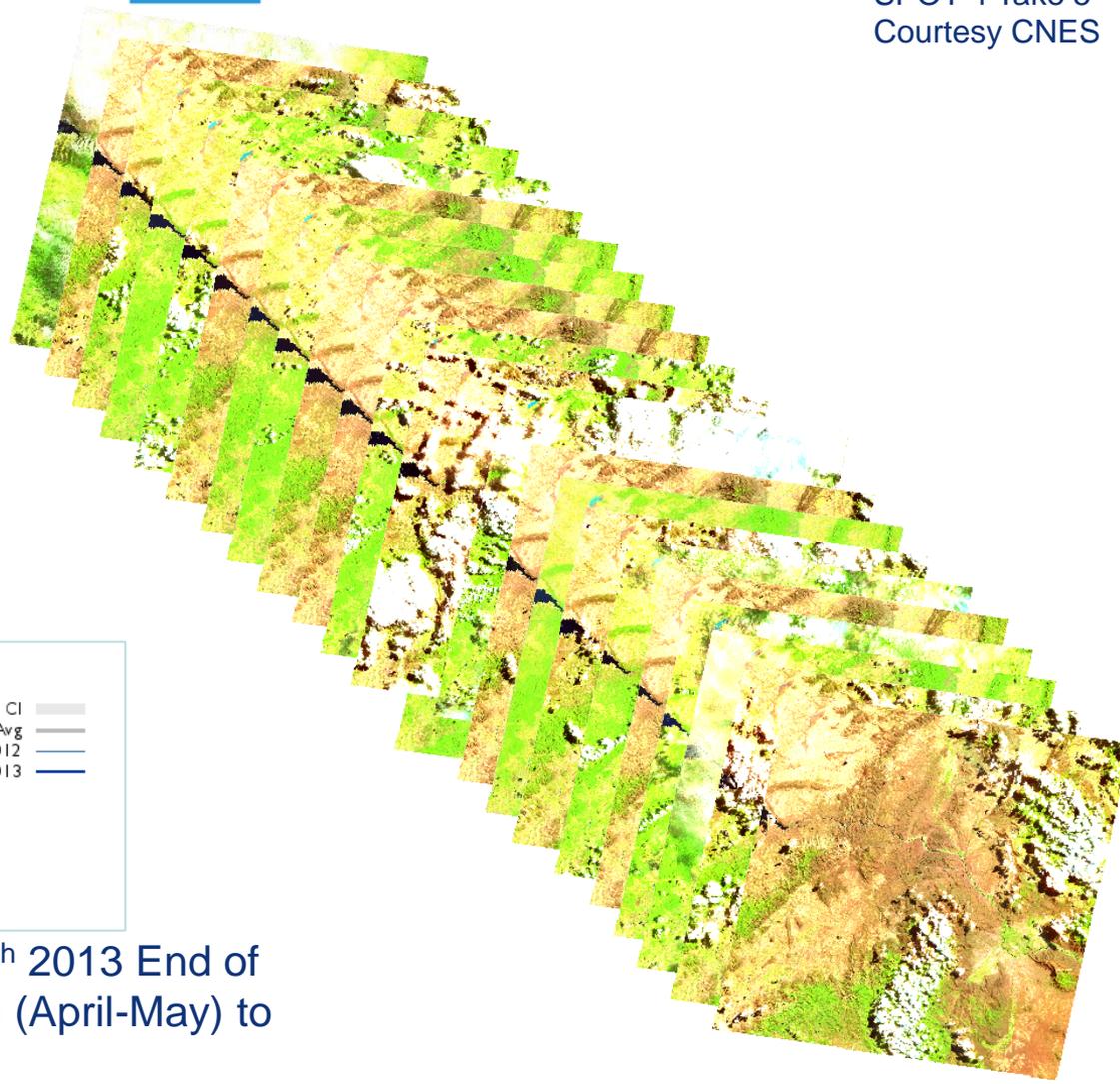
Mahale Mountain National Park, plus 20 km buffer
Single date and seasonal land cover classifications

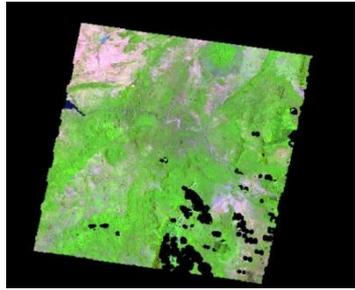


Mtera, Tanzania 7S 36E

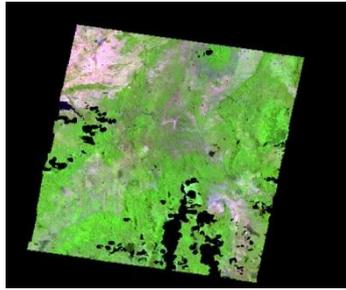


23 acquisitions; February 6th - June 16th 2013 End of wet season (Feb.), to short wet season (April-May) to dry season (June)

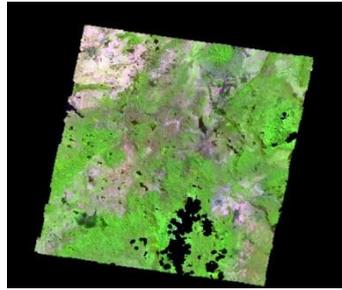




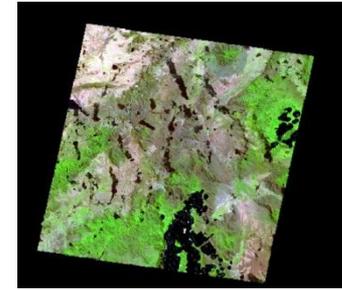
Feb



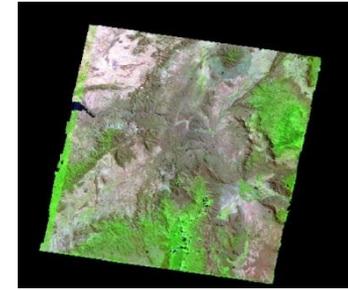
March



April

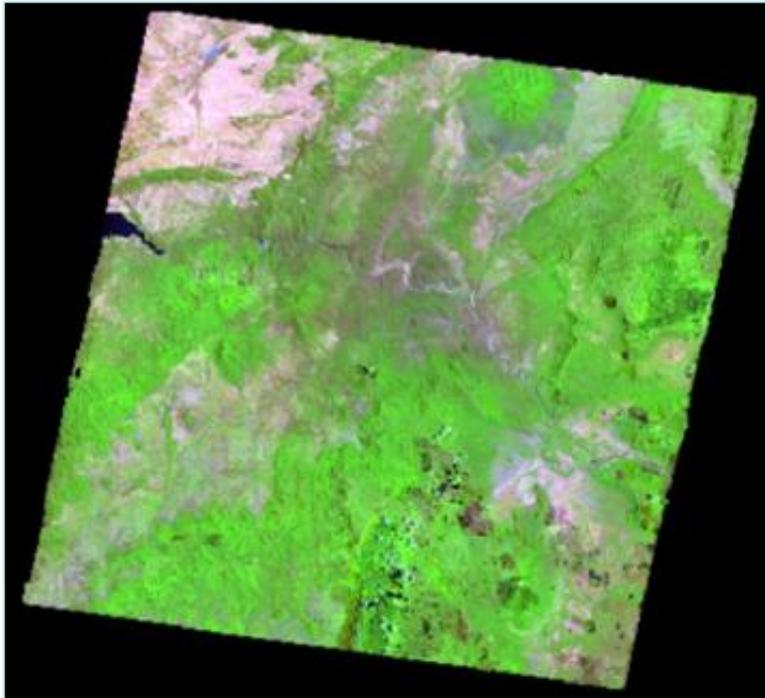


May

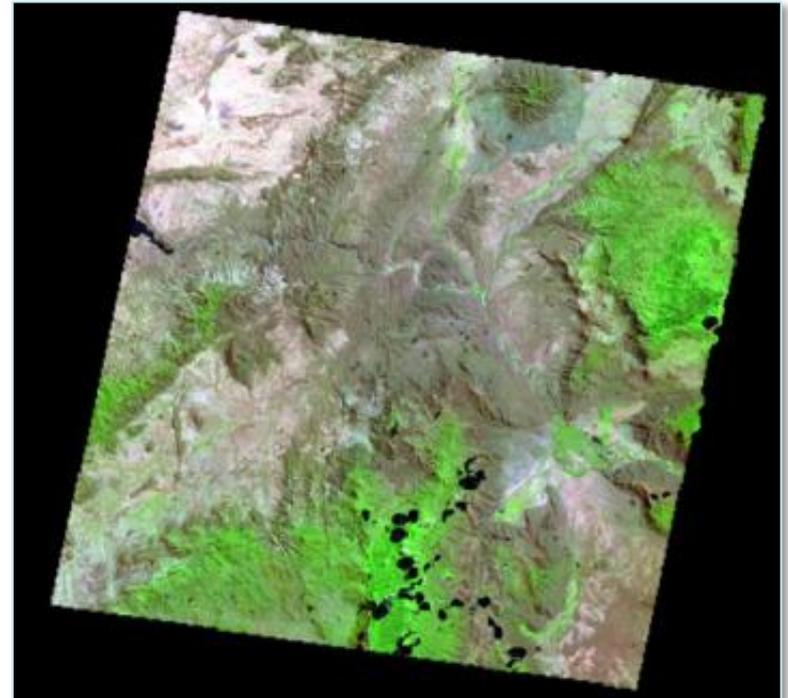


June

Monthly composites based on median after cloud masking



Based on wet season (Feb) image



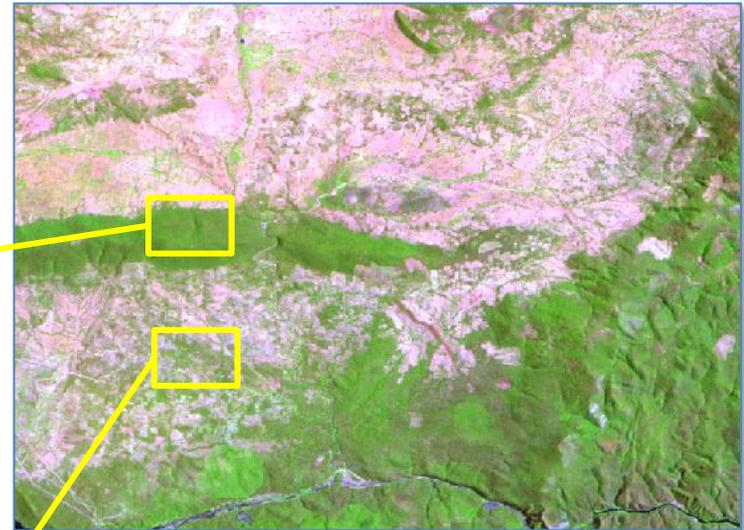
Based dry season (June) image



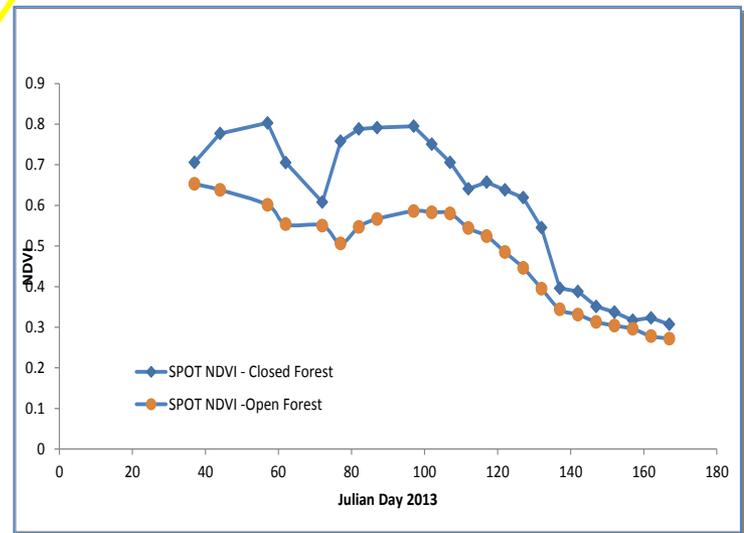
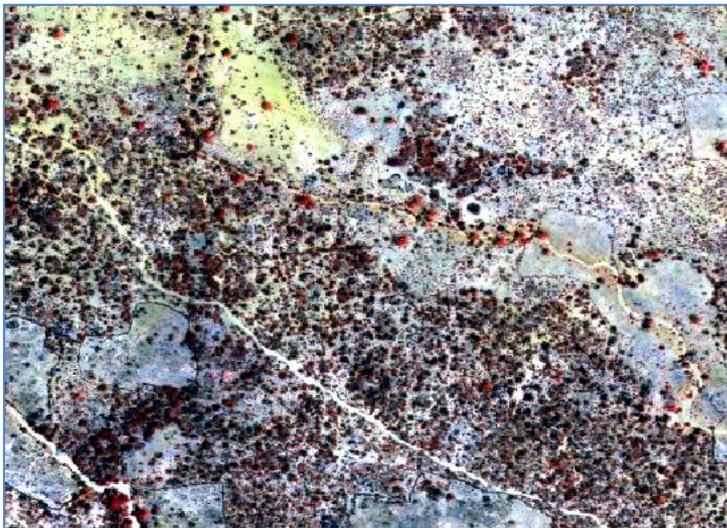
European Commission

Closed dry forest World View 2

S2 simulation



12 km

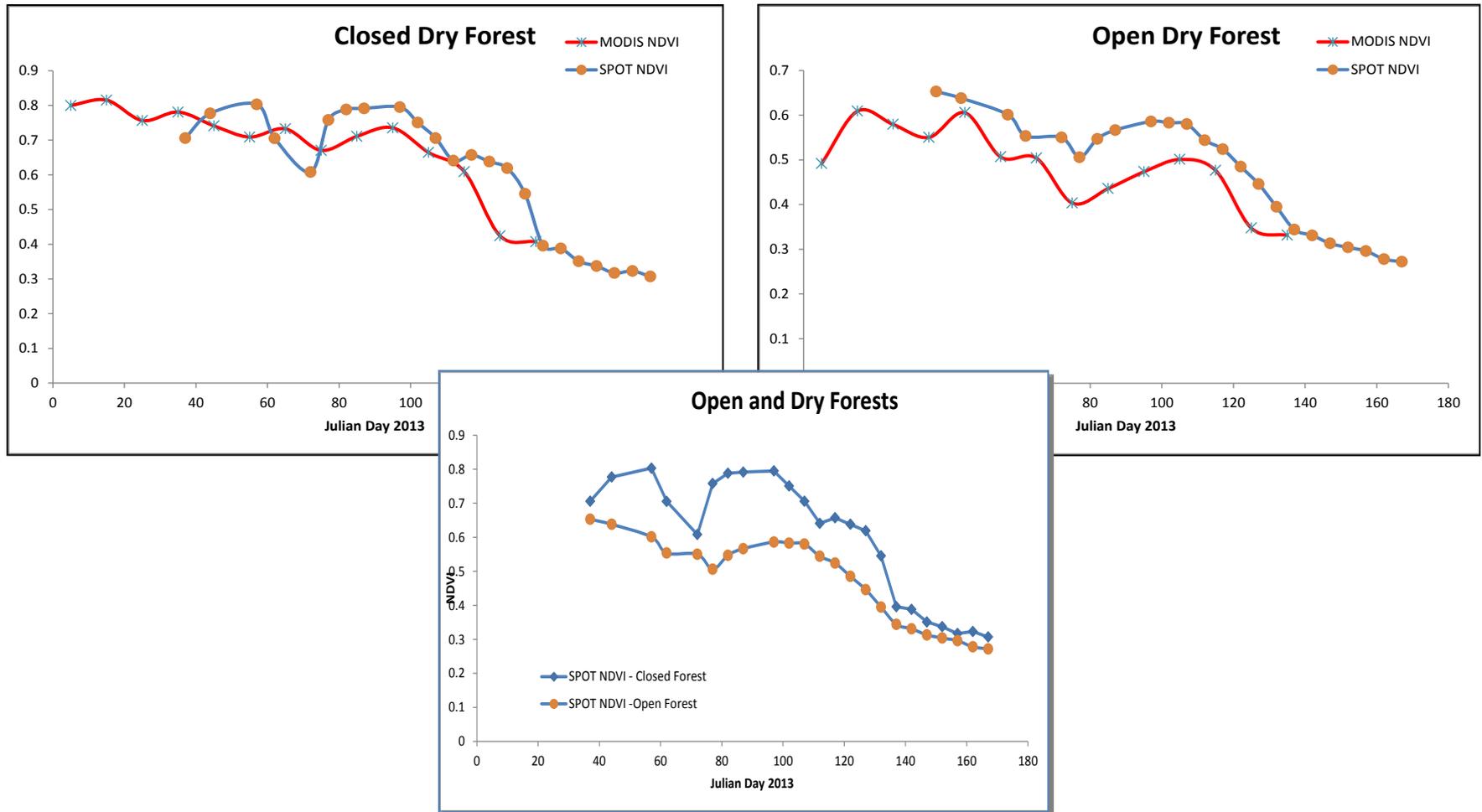


Open dry forest World View 2

Joint Research Centre

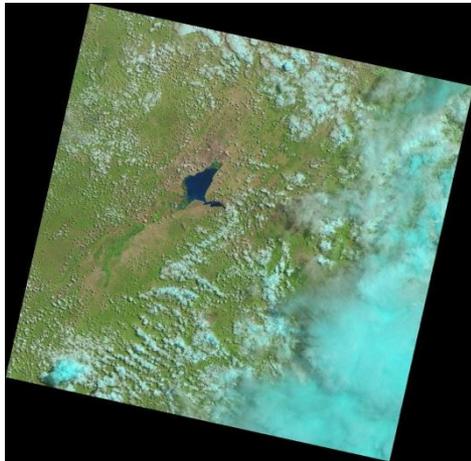
Source Hugh Eva, Lorena Hojas Gascon

S2 simulation Comparison with MODIS Terra NDVI profiles – 250m

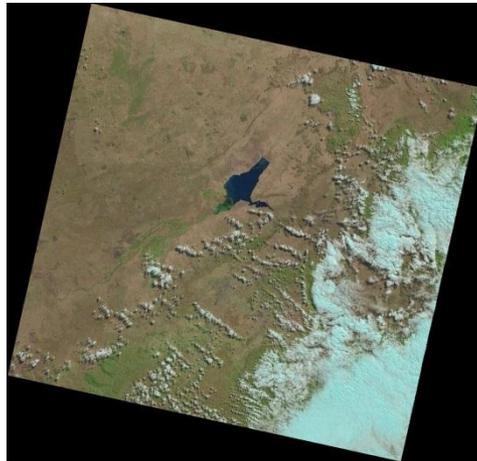




European
Commission



2013/4/7



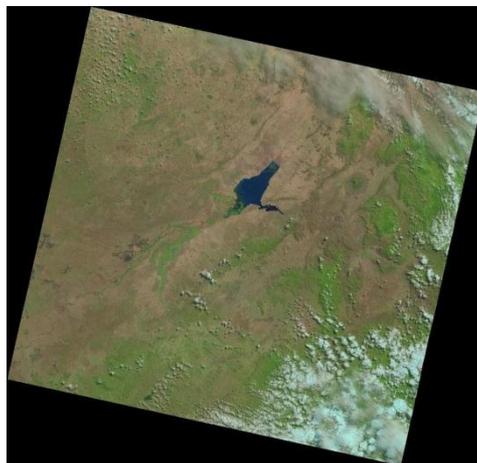
2013/4/21



2013/5/23



2013/6/8



2013/6/24



(2013/7/10)

Joint
Research
Centre

Source L8 USGS NASA

Conclusion

- ① The Landsat program is the gold – standard for land cover observing systems
- ② Finer temporal sampling from the Landsat 7 and 8 data acquisition strategy is improving land cover characterization (land cover mapping and seasonality)
- ③ Better services/applications are emerging as a result
- ④ Expectations for L8 / S2 synergy are high... but L8 (and S2) are not the only platforms to consider... at least 20 other platforms may be relevant
- ⑤ Landsat data policy continues to be the benchmark... others should follow

Satellite	Country	Launch	Resolution
Alsat 2A	Algeria	12.07.2010	10
BelKa 2	Belarus	22.07.2012	12
BJ-1	China	27.10.2005	32
CBERS 2B	China, Brazil	19.09.2007	20
Deimos 1	Spain	29.07.2009	22
EO 1	USA	05.12.2000	30
Gocturk 2	Turkey	18.12.2012	10
HJ-1A	China	06.09.2008	30
HJ-1B	China	06.09.2008	30
IMS-1	India	28.04.2008	36
Kanopus VulKan	Russia	22.07.2012	12
Landsat 7	USA	15.04.1999	30
Landsat 8	USA	11.02.2013	30
NigeriaSat-X	Nigeria	17.08.2011	22
Proba 1	ESA	22.10.2001	17
RASAT	Turkey	17.08.2011	15
Resourcesat 2	India	20.04.2011	23.5
SPOT 5	France	04.05.2002	10
Terra	USA	18.12.1999	15
TH-1A	China	24.08.2010	10
TH-1B	China	06.05.2012	10
THEOS	Thailand	01.10.2008	15
UK-DMC-2	UK	29.07.2009	22
VNREDSat-1A	Vietnam	07.05.2013	10
VRSS-1	Venezuela	29.09.2012	10
X-Sat	Singapore	20.04.2011	10