Climate Change Challenges and Earth Observation Business Opportunities

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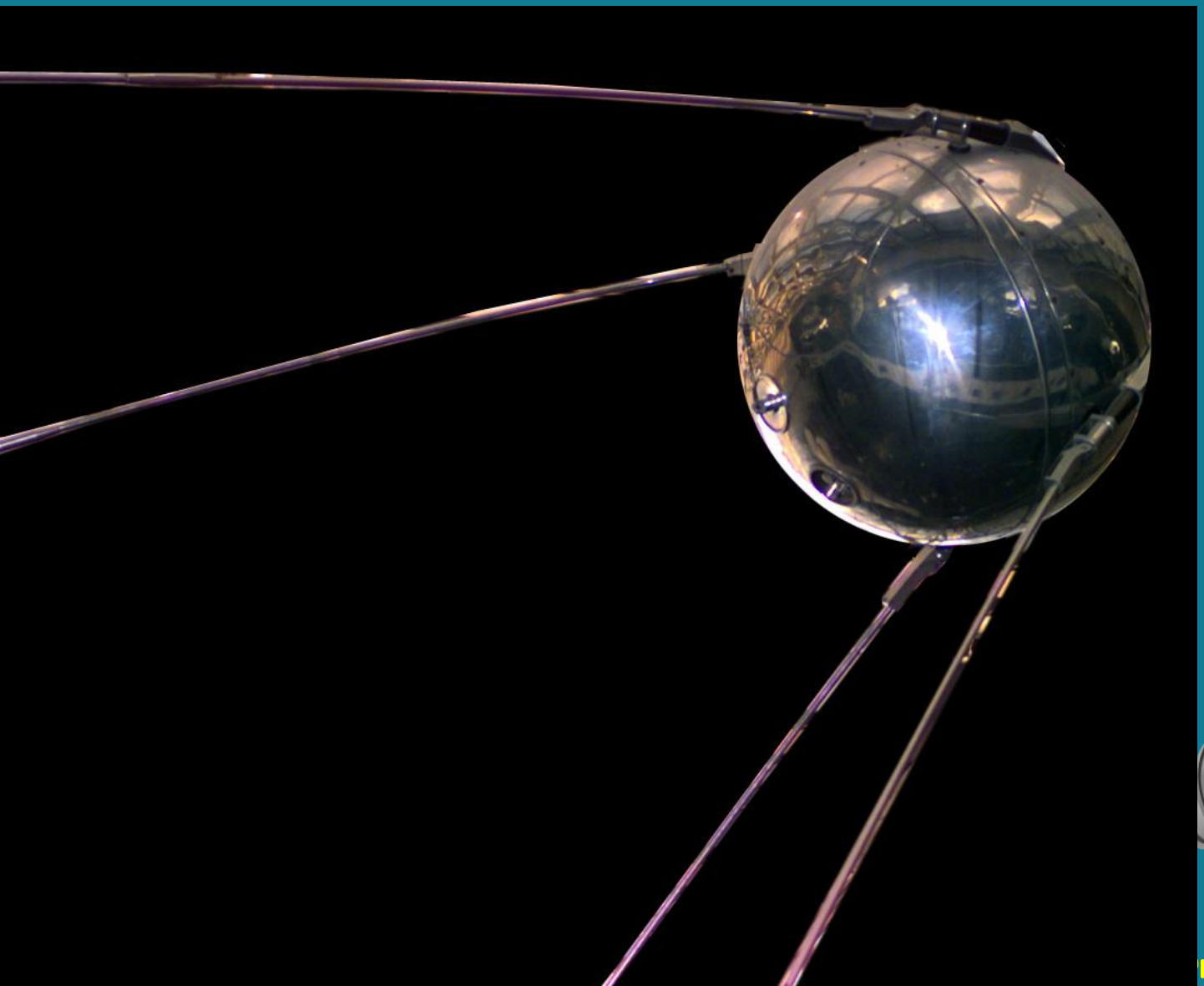
Frascati, Italy

http://www.youtube.com/watch?v=r-bQEiklsK8



SPUTNIK-1

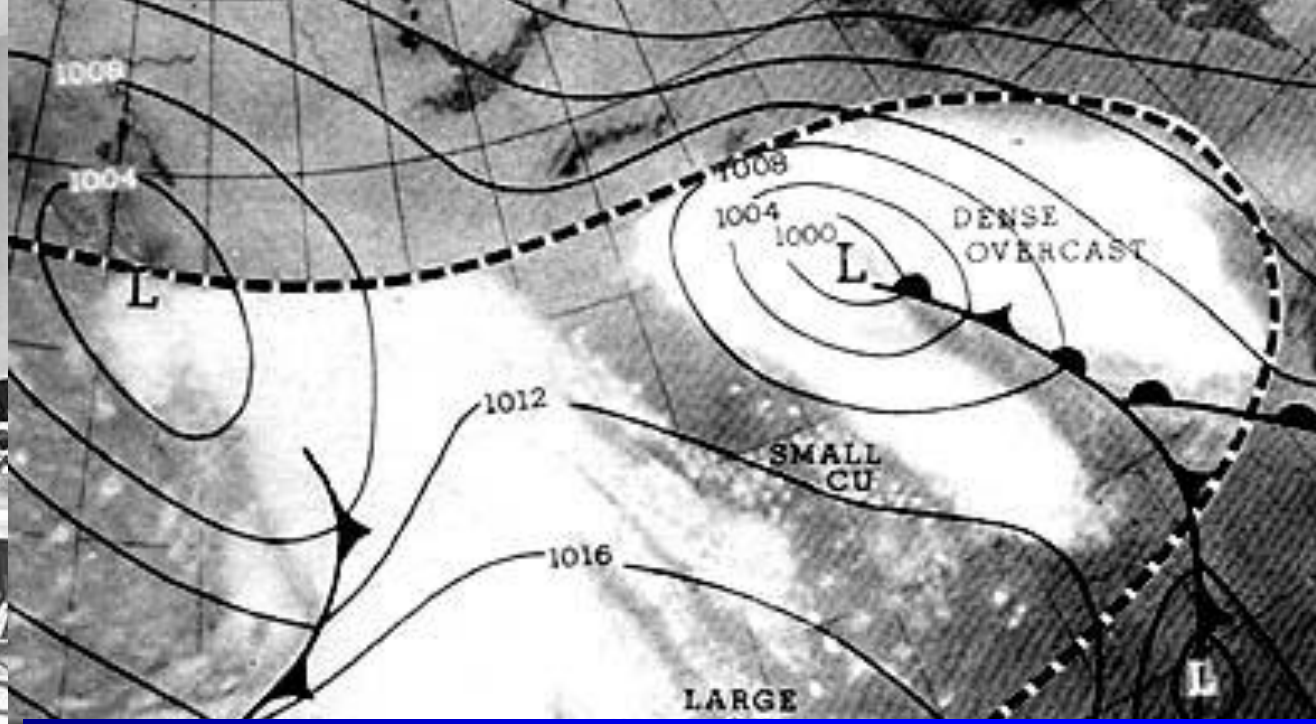
"Спутник-1"

1st Scientific Satellite

Origin of the Space Age

4th October 1957

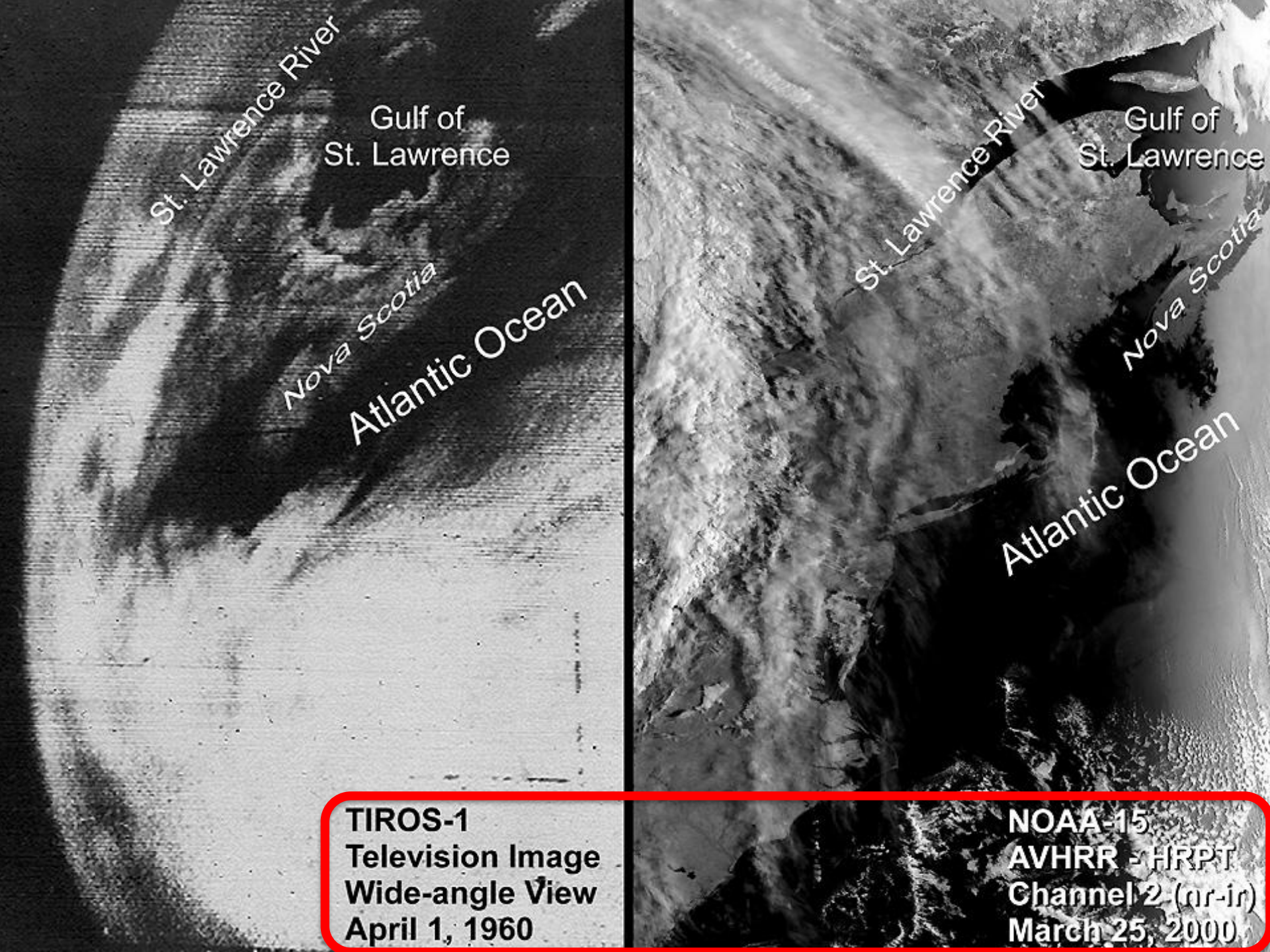
56 years ago



FIRST TELEVISION PICTURE FROM SPACE
TIROS I SATELLITE APRIL 1, 1960

FIRST COMPLETE VIEW OF THE WORLD'S WEATHER

TIROS IX mosaic, February 13, 1965


St. Lawrence River
Gulf of
St. Lawrence
Nova Scotia
Atlantic Ocean
St. Lawrence River
Gulf of
St. Lawrence
Nova Scotia
Atlantic Ocean
TIROS-1
Television Image
Wide-angle View
April 1, 1960
NOAA-15
AVHRR - HRPT
Channel 2 (nr-ir)
March 25, 2000

Space missions face the probably largest scientific and industrial challenges of humanity

Space drives innovation in the major breakthrough and cutting edge technological advances of mankind

- techniques
- processes
- new products
- …
- as well as in markets and business models

An added challenge of paramount importance in this context is

capacity building

that is now included in the programs of most international organizations that work in development.

- Technology and innovation are the basis of all space activities
- Space agencies offer an entire range of space-related activities
  - from space science and environmental monitoring to
  - industrial competitiveness and
  - end-user services

More specifically …

Earth Observation satellites have
a unique global view of planet Earth
providing us
-with better data-
with consistent and frequent information on
the state of our environment
at the regional and
global scale
also in important but remote areas

Greatest challenges facing the world today

- how to stop / adapt to human-induced climate change
- make the leap into a low-carbon society

New innovations is the answer

Making the Most of Satellite Data

Again …

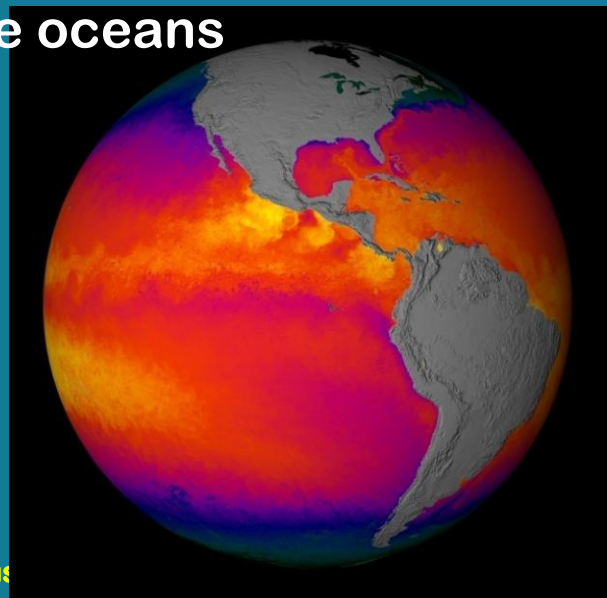
Space / Earth Observation

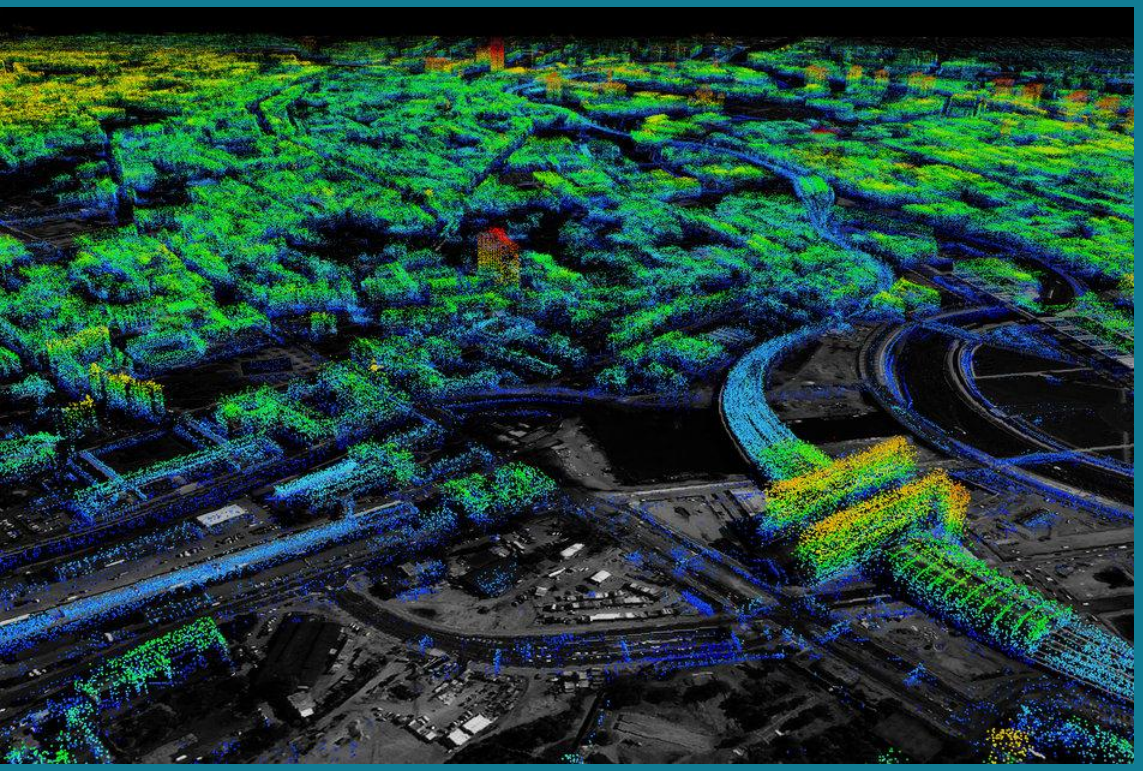
drives innovation in the major breakthrough and cutting edge technological advances of mankind

and …

what (how) does remote sensing / Earth Observation have to do with climate change?

- uncertainties in climate models
  - clouds
  - soil moisture
  - ocean salinity
  - …
  - about the timing, pace, and severity of possible impacts, as well as the options for managing and avoiding them
  - sensitivity of the climate to increases in CO_2 concentrations
  - roles played by major parts of the Earth's systems such as the absorption of carbon and heat by the oceans
- mapping & visualisation
- monitoring and assessment
- security … of unmanaged climate change
  - risks
  - extreme events
  - disasters





Visualising satellite data

Data visualisation is key to understanding and communicating the complex content of scientific data. While many of these issues are of major importance to governments, industry or the general public, they cannot be properly addressed if not understood by the target audiences.

This image illustrates uplift and subsidence in Berlin, Germany, as detected by satellite radars. Different colours represent different rates of deformation. This type of information can be used by urban planning officials to ensure what areas are safe to develop, or if any structures may pose a safety risk.

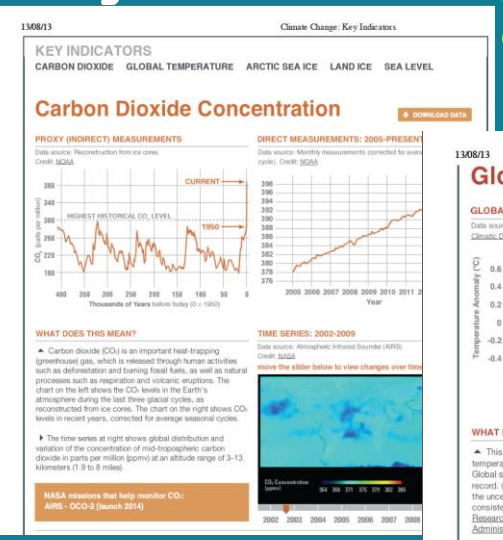
Credits: DLR

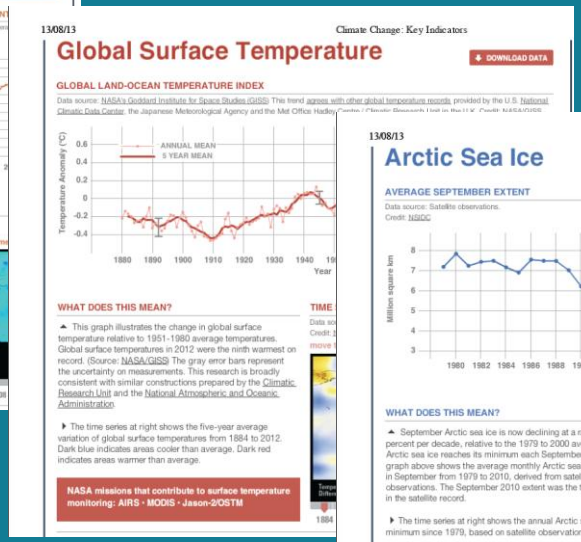
GLOBAL CLIMATE CHANGE

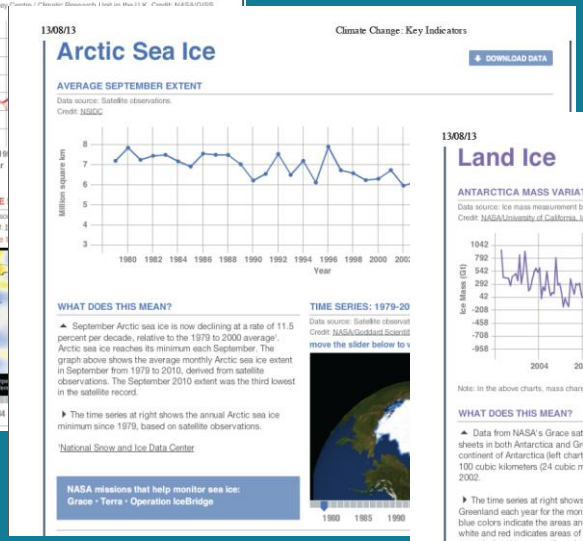
Vital Signs of the Planet

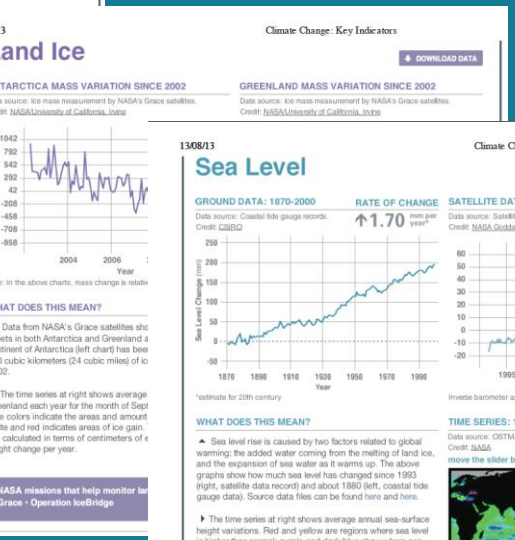
Key Indicators: http://climate.nasa.gov/key_indicators

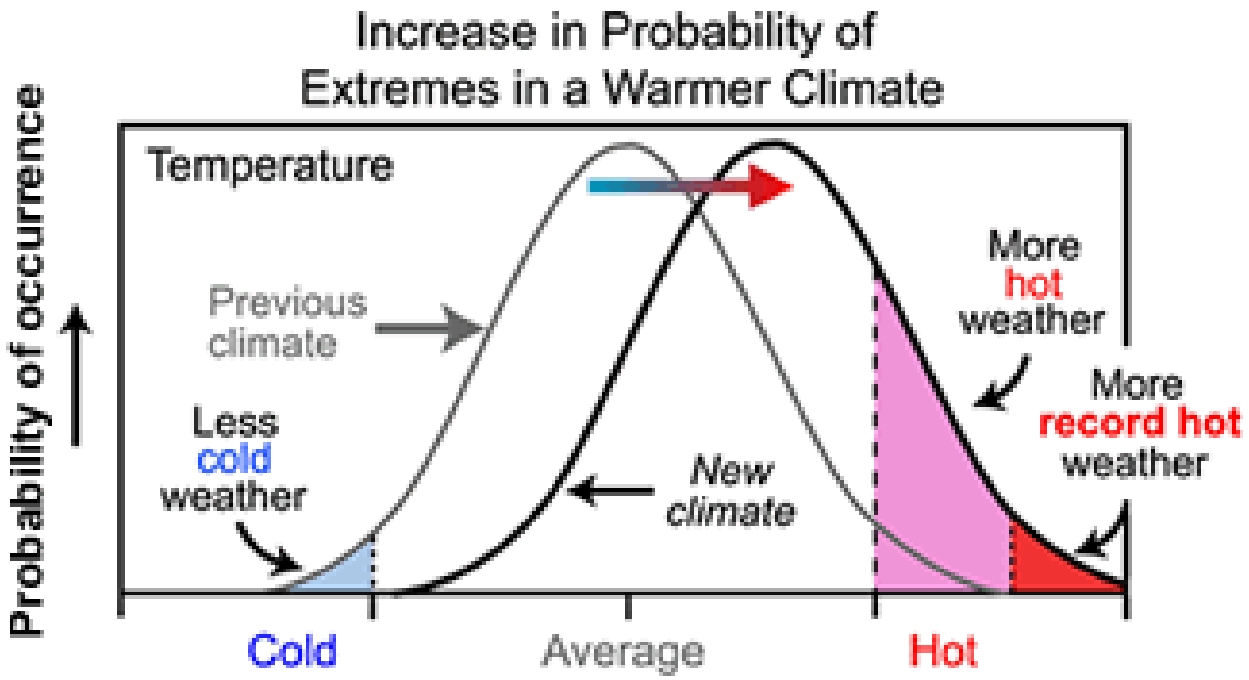
- long data sets vs spatial/global variabilitry

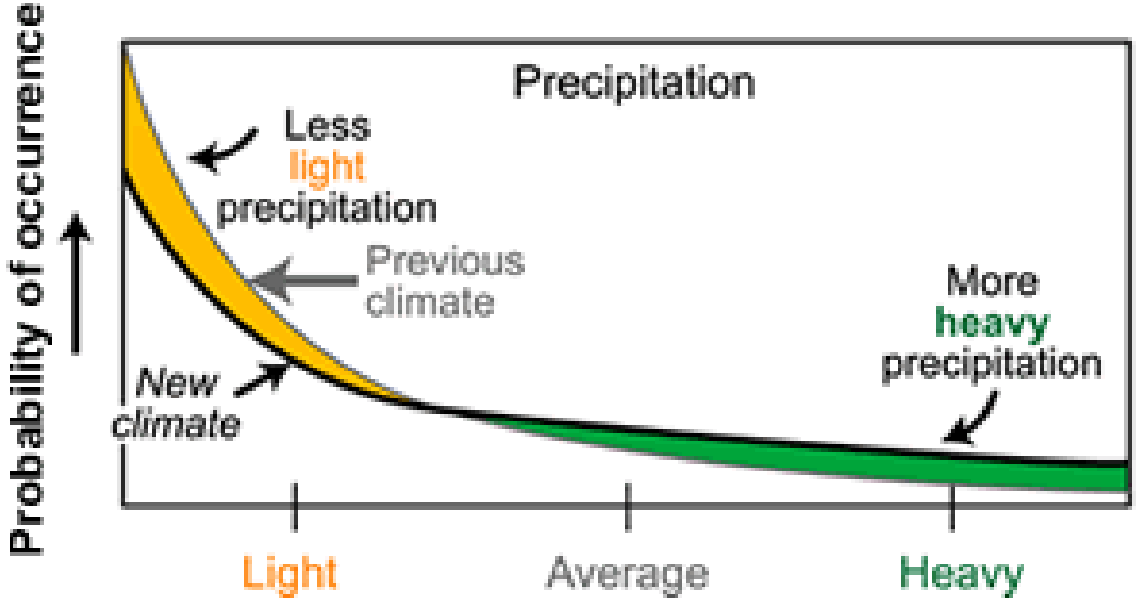












NOAA

extreme events & climate change. Understanding the link & managing the risks

1980-2010 Billion Dollar U.S. Weather Disasters

(Damage Amounts in Billions of Dollars and Costs Normalized to 2007 Dollars Using GNP Inflation / Wealth Index)

1980	Drought / Heat Wave e $55.4 ~10,000 Deaths					
1983	Hurricane Alicia $6.3 21 Deaths	Florida Freeze ~ $4.2 No Deaths	Gulf Storms / Flooding ~ $2.3 ~ 50 Deaths	W Storms / Flooding ~ $2.3 ~ 45 Deaths		
1985	Florida Freeze ~ $2.3 No Deaths	Hurricane Elena $2.5 4 Deaths	Hurricane Juan $2.9 63 Deaths			
1986	Drought / Heat Wave $2.4 ~100 Deaths					
1988	Drought / Heat Wave e $71.2 ~7,500 Deaths					
1989	Hurricane Hugo > $15.3 86 Deaths	N Plains Drought > $1.7 No Deaths				
1990	S Plains Flooding > $1.6 13 Deaths	California Freeze > $5.5 No Deaths				
1991	Hurricane Bob $2.3 18 Deaths	Oakland CA Firestorm ~ $3.9 25 Deaths				
1992	Hurricane Andrew ~ $40.0 61 Deaths	Hurricane Iniki ~ $2.7 7 Deaths	Nor'easter $2.3 19 Deaths			
1993	E Storm / Blizzard $7.9 ~ 270 Deaths	SE Drought / Heat Wave ~ $1.4 > 16 Deaths	Midwest Flooding ~ $30.2 48 Deaths	CA Wildfires ~ $1.4 4 Deaths		
1994	SE Ice Storm ~ $4.2 9 Deaths	Tropical Storm Alberto ~ $1.4 32 Deaths	Texas Flooding ~ $1.4 19 Deaths	W Fire Season ~ $1.4 No Deaths		
1995	CA Flooding > $4.1 27 Deaths	SE / SW Severe Wx $7.5 32 Deaths	Hurricane Marilyn e $2.9 13 Deaths	Hurricane Opal > $4.1 27 Deaths		
1996	Blizzard / Flooding ~ $4.0 187 Deaths	Pacific NW Flooding ~ $1.3 9 Deaths	S Plains Drought ~ $6.8 No Deaths	Hurricane Fran > $6.6 37 Deaths		
1997	Midwest Flood / Tornadoes e $1.3 67 Deaths	N Plains Flooding ~ $4.8 11 Deaths	W Coast Flooding ~ $3.9 36 Deaths			
1998	New England Ice Storm > $1.8 16 Deaths	SE Severe Wx > $1.3 132 Deaths	MN Severe Storms / Hail > $1.9 1 Death	S Drought / Heat Wave $9.5 > 200 Deaths	Hurricane Bonnie ~ $1.3 3 Deaths	
	Hurricane Georges e $7.4 16 Deaths	Texas Flooding ~ $1.3 31 Deaths	California Freeze $3.2 No Deaths			
1999	AR - TN Tornadoes ~ $1.6 17 Deaths	OK - KS Tornadoes > $2.0 55 Deaths	E Drought / Heat Wave > $1.2 e 502 Deaths	Hurricane Floyd e > $7.4 77 Deaths		
2000	Drought / Heat Wave e > $4.8 ~ 140 Deaths	Western Fires > $2.4 No Deaths				
2001	Tropical Storm Allison e ~ $5.6 > 43 Deaths	Midwest / OH Valley Hail / Tornadoes > $2.2 > 3 Deaths				
2002	30-State Drought e > $11.4 No Deaths	Western Fires > $2.3 ~21 Deaths	Severe Wx / Tornadoes > $1.9 7 Deaths			
2003	Severe Wx / Hail > $1.8 3 Deaths	Severe Wx / Tornadoes > $3.8 51 Deaths	Hurricane Isabel ~ $5.6 55 Deaths	S California Wildfires > $2.8 22 Deaths		
2004	Hurricane Charley e ~ $16.5 35 Deaths	Hurricane Frances e ~ $9.9 48 Deaths	Hurricane Ivan e > $15.4 57 Deaths	Hurricane Jeanne e > $7.7 28 Deaths		
2005	Hurricane Dennis e > $2.2 > 15 Deaths	Hurricane Katrina e ~ $133.8 > 1833 Deaths	Hurricane Rita e ~ $17.1 119 Deaths	Midwest Drought e > $1.1 No Deaths	Hurricne Wilma e ~ $17.1 35 Deaths	
2006	Numerous Wildfires > $1.0 28 Deaths	Widespread Drought e > $6.2 * Deaths	Severe Storms Tornadoes e > $1.0 10 Deaths	Northeast Flooding > $1.0 20 Deaths	MW / SE Tornadoes > $1.5 10 Deaths	MW / Ohio Valley Tornadoes ~ $1.1 27 Deaths
2007	Great Plains East Drought > $5.0 * Deaths	Western Wildfires > $1.0 12 Deaths	Spring Freeze > $2.0 No Deaths	East / South Severe Weather > $1.5 9 Deaths	California Freeze > $1.4 1 Deaths	
2008	Southeast / Midwest Tornadoes > $1.0 57 Deaths	MW / Ohio Valley Svr Wx / Tornadoes > $2.4 13 Deaths	MW / Mid-Atl. Svr Wx / Tornadoes > $1.1 18 Deaths	Midwest Flooding e > $15.0 24 Deaths	U.S. Wild Fires > $2.0 16 Deaths	
	Hurricane Dolly > $1.2 3 Deaths	Hurricane Gustav > $5.0 53 Deaths	Hurricane Ike > $27.0 > 112 Deaths	Widespread Drought > $2.0 No Deaths		
2009	Southeast / Ohio Valley Severe Weather > $1.4 10 Deaths	Midwest / Southeast Tornadoes > $1.0 No Deaths	South / Southeast Tornadoes & Severe Weather > $1.2 6 Deaths	Midwest, South, East Severe Weather > $1.1 No Deaths	Western Wild Fires > $1.0 10 Deaths	Southwest / G. Plains Drought e > $5.0 No Deaths
2010	Northeast Flooding > $1.5 11 Deaths	East / South Flooding / Severe Weather > $2.3 32 Deaths	Midwest Tornadoes & Severe Weather > $3.0 3 Deaths			

e = estimated **>** = greater than/at least **~** = approximately/about
* = undetermined

< 5	5-20	20-30	30-40	> 40

Amounts in Billions of Dollars

Source: NOAA's National Climatic Data Center Asheville, NC 28801-5001
www.ncdc.noaa.gov/oa/reports/billionz.html

http://www.ncdc.noaa.gov/oa/reports/billionz.html#chron

lite Remote Sensing and Climate Change
July, 2014

- **The Cost of Extreme Events**

Economic Cost of Weather may total $485 billion in U.S.

Observation Bu

Business Opportunities … in Earth Observation

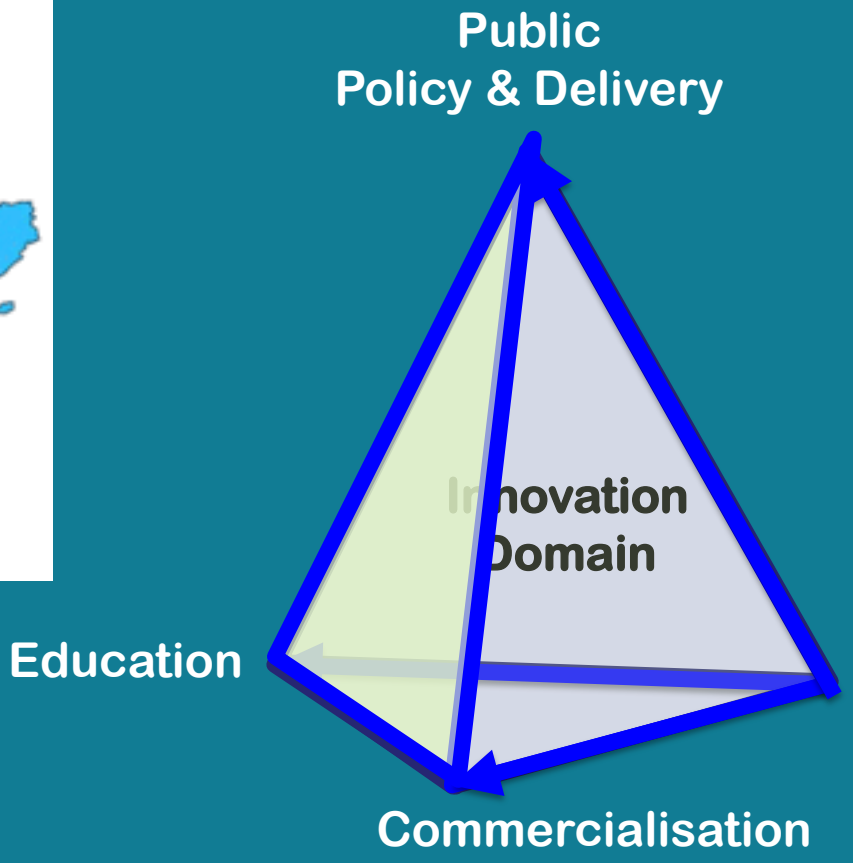
What is Climate-KIC?

www.climate-kic.org

We are Europe's largest public-private innovation partnership focused on climate change, consisting of dynamic companies, the best academic institutions and the public sector.

Driving innovation in climate change

What is Climate-KIC?



Our Activity in Climate-KIC

- **Valencia RIC Education Group**
  - theJourney 2013 #5
  - theJourney 2014 #2
  - Professional Education Conference on "*Climate Change Challenges and Business Opportunities*"
  - Course for Entrepreneurial Scientists & University Professors (2013, 2014)
- **Pioneers in Action**
  - 2013. Pioneer from Emilia Romagna RIC. *Estimation of water vapour and CO_2 Fluxes at the Valencia Anchor Station*
  - 2014. Pioneer from Emilia Romagna RIC. *Study of the energy content (consumption) associated with the different uses of water in a perspective of Life Cycle Assessment (LCA)*
- **Pathfinder Projects**
  - ATLA *(Adaptation Toolbox for Local Authorities)*
  - Blue Revolution
- **Masters & PhDs Internships**

Conference:

Climate Change & Business Opportunities

http://www.climate-kic.org/events/conference-climate-change-business-opportunities/

Conference Conceptua

Dr Ana Iglesias. Polytechnic Univ. Madrid. IPCC WG-II
The Economics of Climate Change Adaptation

09:00 09:15 Opening Session

09:15 10:15 Introductory Session

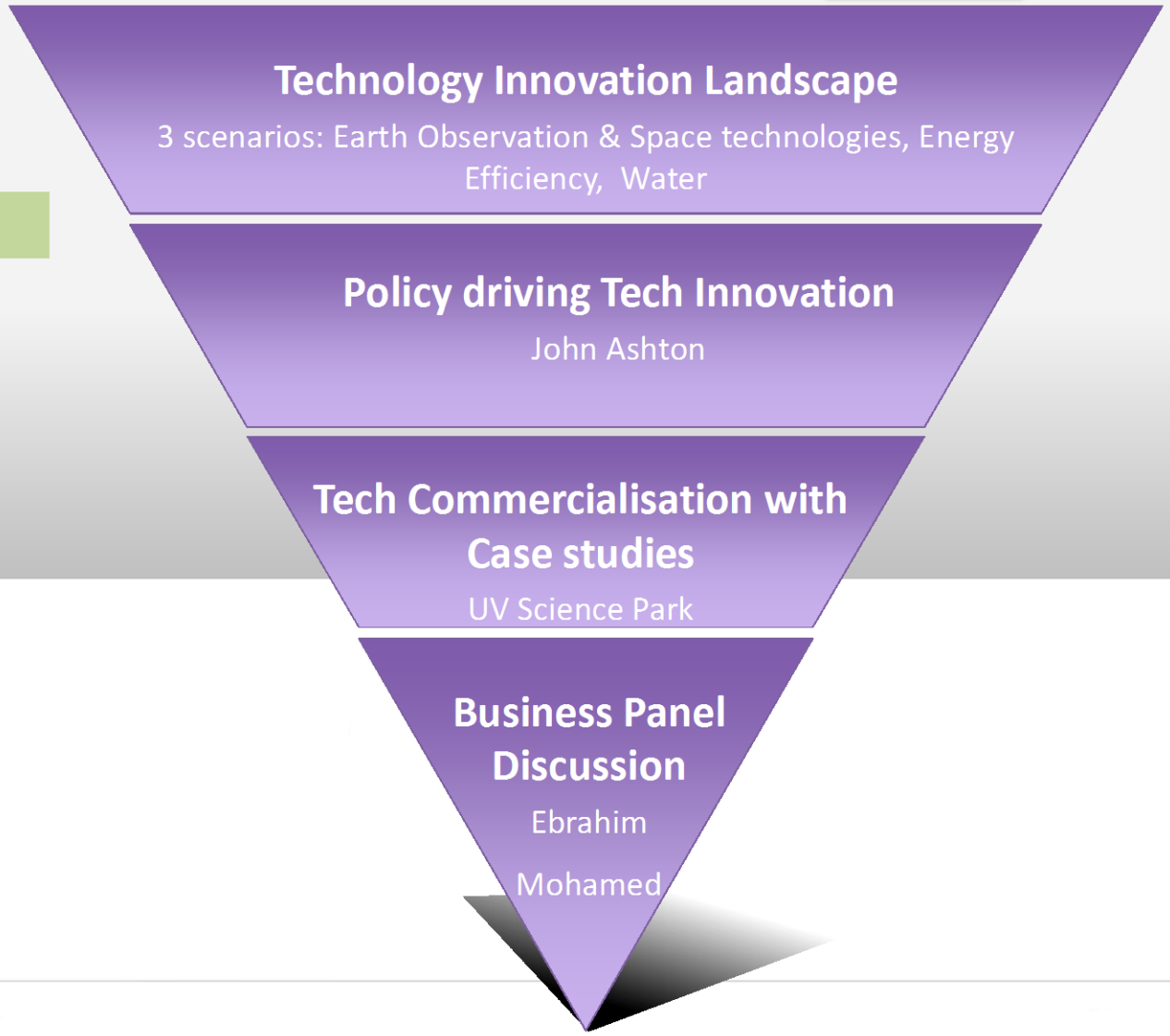
10:45 13:00

13:00 14:00 LUNCH

14:00 15:00

15:00 16:00

16:30 17:30



Three paralel sessions "Technology Innovation Landscape"

Earth Observation and Space Technologies: The session will show developments in this field that can be applied in other industries. Invited speakers are: Pierre-Philippe Mathieu (ESA,Italy), Raul Polit-Castilla (NASA, USA), Ana Sebastian (innovation solutions GMV, Spain), Antonio Falcao (Uninova, Portugal), Emilio Simeone (founder and CEO of Flyby srl, Italy), Ravi Kapur (Imperativespace, UK).

Energy efficiency: Smart Grids: Showcase of the deployment of Smart Grids provides an opportunity to enable traditional energy companies and new market entrants to develop new innovative energy services. Invited entities are: Iberdrola, Energy Technological Institute-ITE..

Efficiency and Economic Feasibility for the Treatment and Regeneration of Water: Showcase of the development and promotion of economically viable wastewater management systems. Entities invited are: Veolia Water, Aqualogy (AGBAR Group), University of Girona (Spain), University of Valencia (Spain).

Policy driving Tech Innovation

John Ashton, former UK climate change diplomat, special representative for Climate Change for three successive foreign secretaries, he is a distinguished Policy Fellow at the Grantham Institute for Climate Change at Imperial College London, a visiting professor at the London University School of Oriental and African Studies; and a Trustee of the UK Youth Climate Coalition and Tipping Point.

Tech Commercialisation with Case studies

Practical examples and showcases of the Science Park of the University Valencia (SPUV) will provide valuable lessons on how to transform new ideas into practical commercially viable products and services. These case studies include, to varying degrees, essential elements of successful technology transfer that explain how innovation moves from the laboratory into the marketplace (Director of the SPUV, Business Innovation, and start-ups and spin-offs based in the SPUV).

Business Panel Discussion – Climate Change: An entrepreneurial Perspective

The panel discussion will be chaired by Ebrahim Mohamed, Director of Education, Climate-KIC. Ebrahim, was awarded this year's Graduate School Director's Award for Professional Skills Training by Imperial College London where he was until recently the Director of the Executive MBA programme. He is an expert in the field of entrepreneurship and is responsible for Climate-KIC's drive in technology entrepreneurship and innovation education in Europe. He will be representing European interests in the EU-Brazil initiative to co-operate in innovation and entrepreneurship in higher education.

theJourney 2013 #5
Climate-KIC Summer School

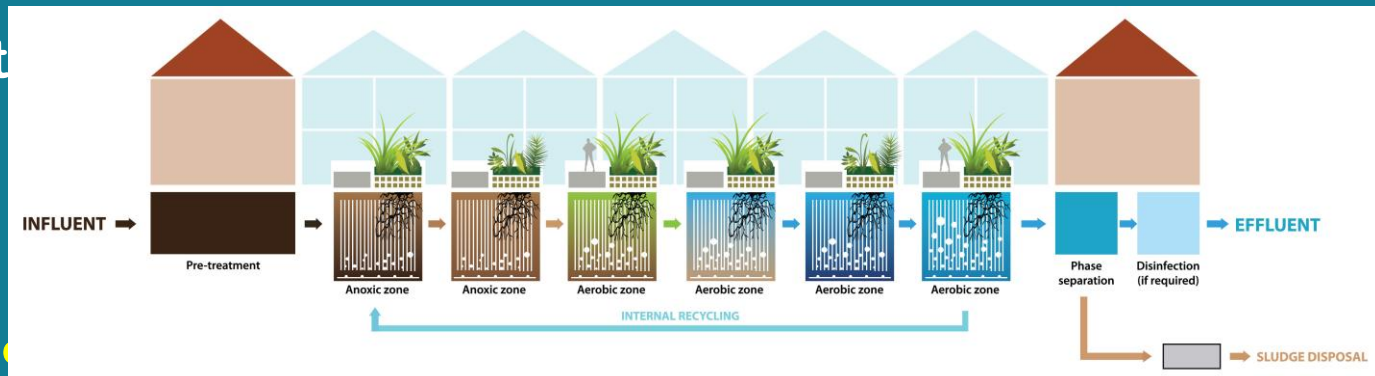
theJourney 2013 #5

Utrecht

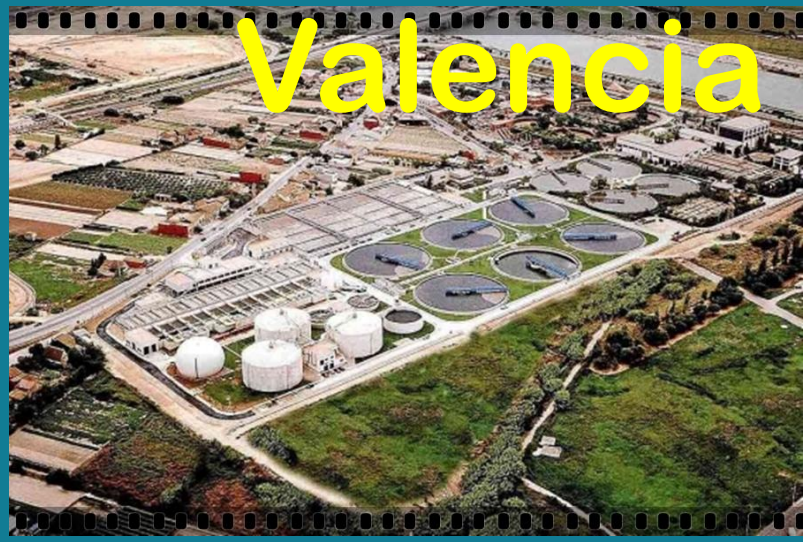
- Climate Change Policy (overview and discussion)
- Introduction climate change science (overview and discussion)
- Soft skill training
- Lecture on Dutch Water Management in the Netherlands
- Lecture: sustainable urban transformation
- Introduction to cases and ideation
- Earth Observation from Space: Quantifying Natural Resources to Better Manage Them
- Visit to ESA-ESTEC
- ESA Business Incubation Centre
- Business Canvas Model. Introduction
- …

theJourney 2013 #5 Budapest

- Regional Aspects of Climate Change
- City Council Ongoing Climate Change Projects
- Business Model Canvas Workshop
- Project Management
- Design Thinking Lecture
- Case Study by Siemens H, CEO
- Cost Structure & Revenue streams
- Finance Workshop
- Introduction to Business Plans
- : Partners and Competitiors
- Pitch Training
- Risk management

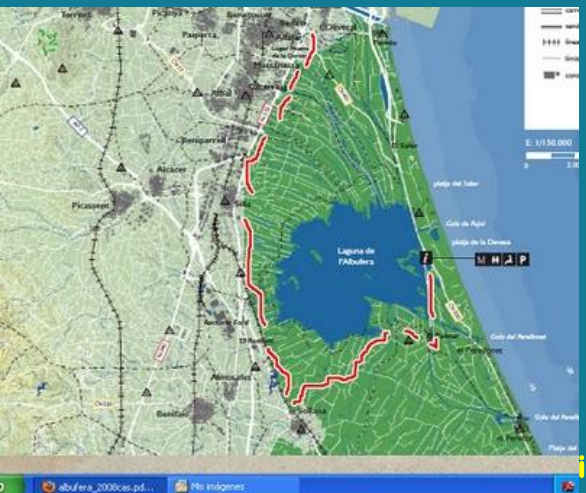


theJourney 2013 #5



Welcome to the City

- Scientific Visit
  - Visit water treatment plant
  - Visit the Albufera Lagoon



theJourney 2013 #5 Valencia

Preparing their Business Plans

http://eit.europa.eu/newsroom/climate-kic-summer-school-concludes-start-pitches-london-and-valencia

ALLICAHU	• thin film solar cell patterns to restaurants and bars
City Cycles	• ArtCycle, online platform to create personalised art
Da Birdy	• fast EV charging infrastructure by redesigning existing public transport infrastructure
Daft-KIC	• Energaze. Energy efficiency solution with remote sensing
justBright	• Green Delivery & Pick-up Service of goods from shops to households
Soliter	• selling walkable solar panels
Sustania	• smart real time remote sensing based irrigation controlling system
TangerAction	• affordable, sustainable and self-sufficient bath and hygienic amenities for regions with water scarcity
The Green Machine	• Everon, power generator from solar and wind energy

theJourney 2013 #5 Valencia

Business Pitch Competition

- Formal Presentations
- Oral Jury
- Reading Jury
- Networking Lunch

Share Your Business with a Selective Audience

you have 3 min sharp to say it all

theJourney 2013 #5 Valencia

releasing the tension and the stress after the big effort

- Scientific Visit to Valencia Anchor Station & MELBEX Site
- Wine Testing – Bodegas Iranzo & Bodegas de Utiel
- Cultural Visit to Requena Cuevas de la Villa
- Networking Dinner

Cañada Honda
Bodegas Iranzo

(Left): "Finca El Renegado", Caudete de las Fuentes, Valencia, Spain (the location of the MELEBEX site is shown with coordinates: 39°31'18.18"N, 1°17'29.64"W, altitude = 800 m a.s.l.). (Right): View of the ELBARA-II 3 footprint from the top of the platform (15 m)

Cultural Visit to the Town of Requena & Cuevas de La Villa

http://www.independentrip.com/39-espana/quever/117-requena/1/465-cuevas-de-la-villa-de-requena/

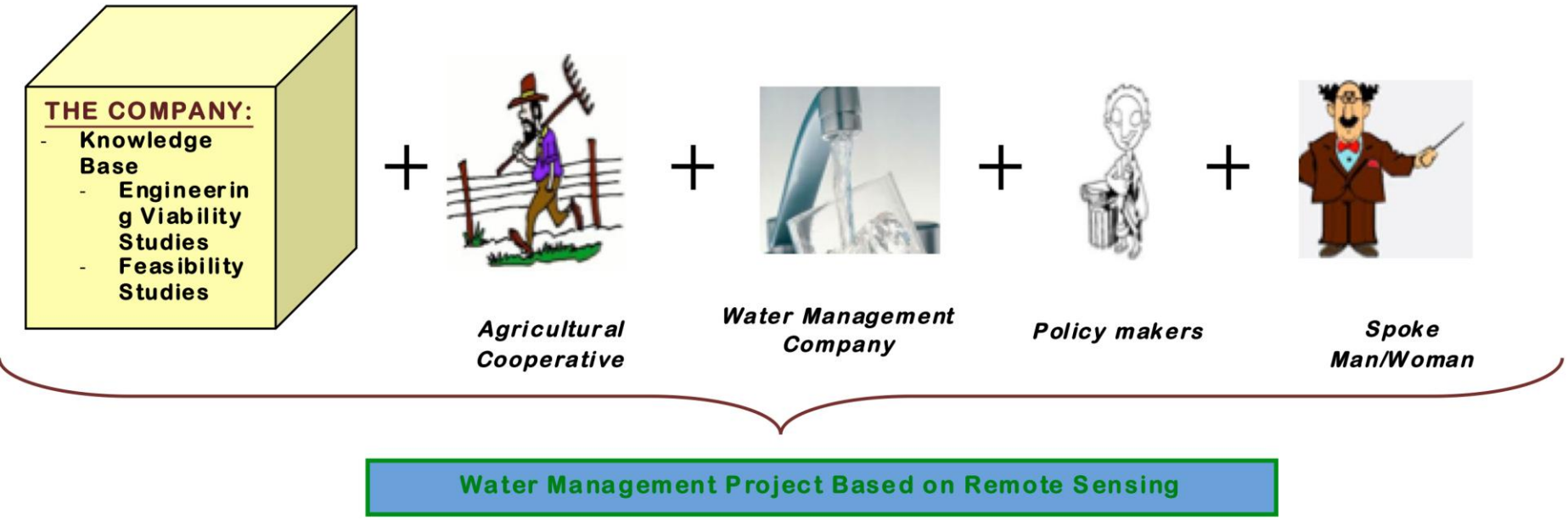
Joint COSPAR – WMO Capacity Building Workshop on Satellite Remote Sensing and Climate Change
Tver University, Russia, 20-31 July, 2014

theJourney #2 2014 – Paris → Valencia → Bologne
25th July 2014

Innovation on Water Management Based on Remote Sensing

Ernesto Lopez-Baeza, Francesc Hernandez & Ana Pavia

University of Valencia



EIP Water Action Group
Pooling resources – Innovating water

RESEWAM-O - REmote SEnsing for WAter Management Optimization (AG132)

Remote Sensing for Water Management Optimization

E. Lopez-Baeza[1], F. Hernandez-Sancho[1], A. Pavia[1], E. Loarte[1], M. Albacete[2], F. Bornez[3], C. Castañeda[4], L. Chacon[5], J. Comas[6], C. Corticelli[7], K. Cross[8], T. Estrela[9], J. Herrero[4], D. Iglesias[10], D. Intrigliolo[11], S. Khodayar[12], J.L. Martinez[13], P.-P. Mathieu[14], R. Monjo i Agut[15], M.A. Rodenas[16], A. Sebastian[17], J. Tamayo[18], I. Vassura[7], T. Baur[19]

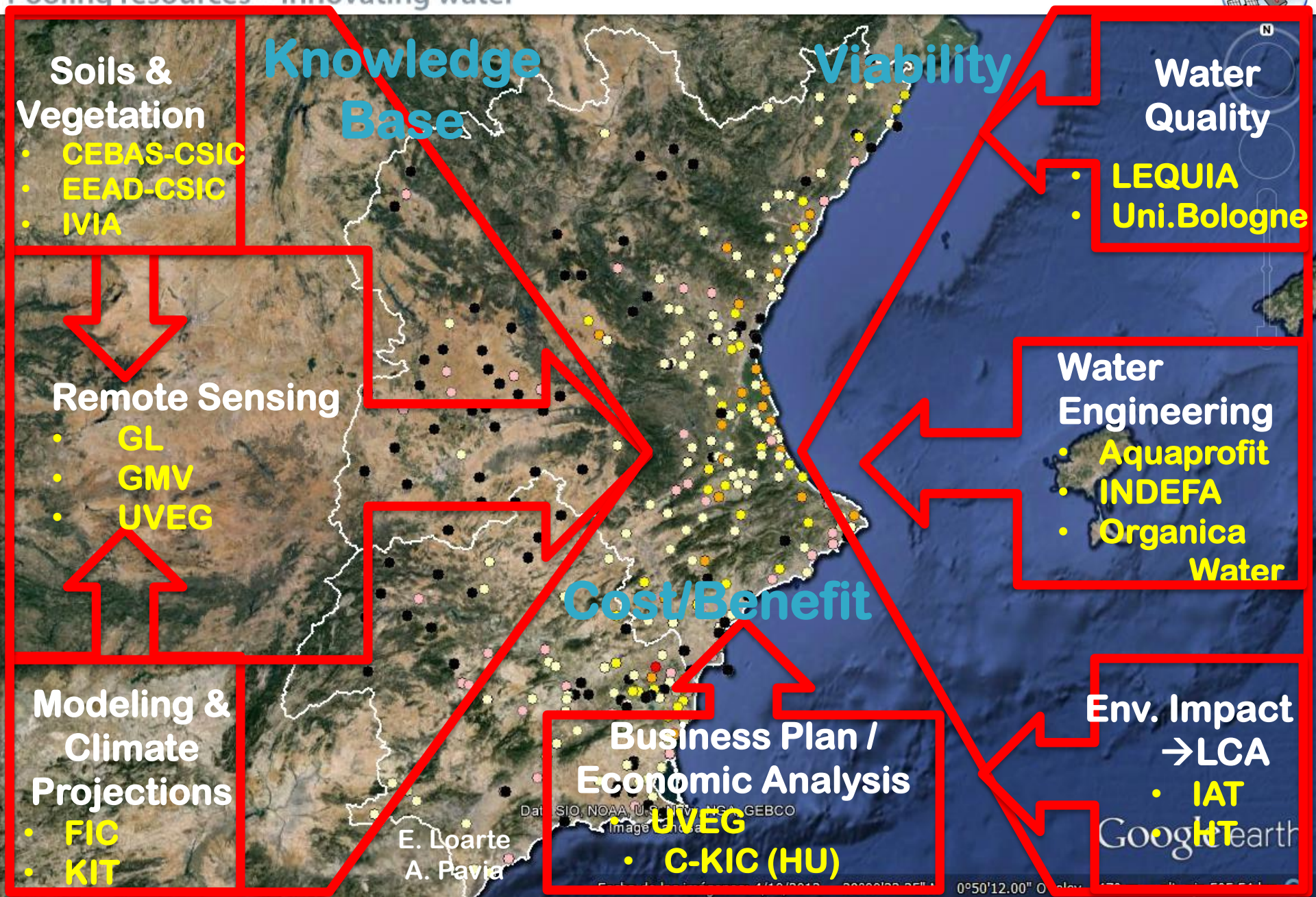
Contact:
Ernesto Lopez-Baeza <Ernesto.Lopez@uv.es>. University of Valencia. Faculty of Physics. Dept Earth Physics & Thermodynamics. Climatology from Satellites Group

http://www.eip-water.eu/working-groups/resewam-o-remote-

EIP Water Action Group

Pooling resources – Innovating water

RESEWAM-O - REmote SEnsing for WAter Management Optimization (AG132)

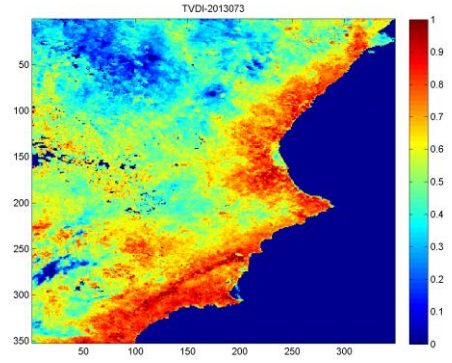


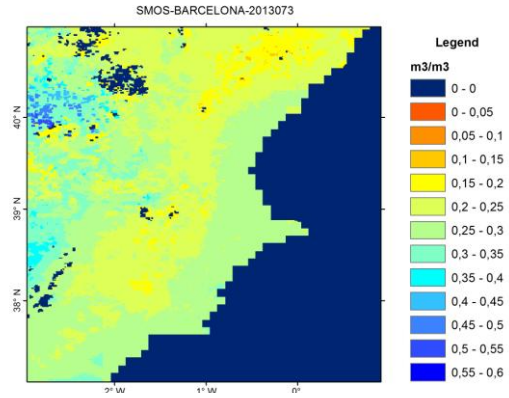
EIP Water Action Group

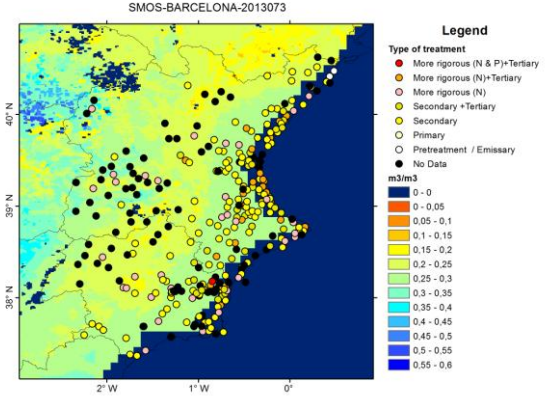
Pooling resources – Innovating water

RESEWAM-O - REmote SEnsing for WAter Management Optimization (AG132)

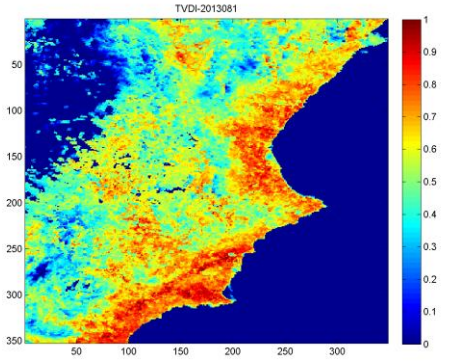
14th Mar 2013

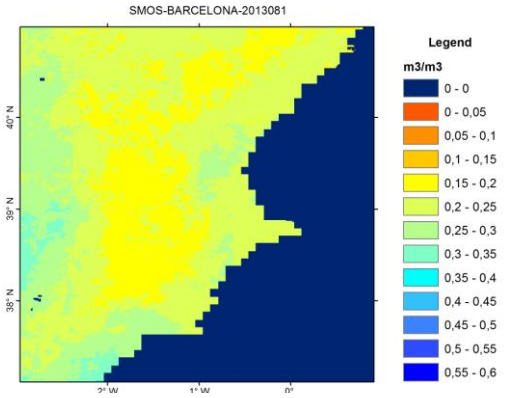


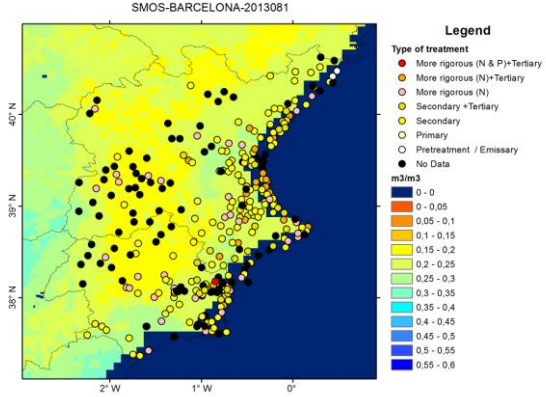




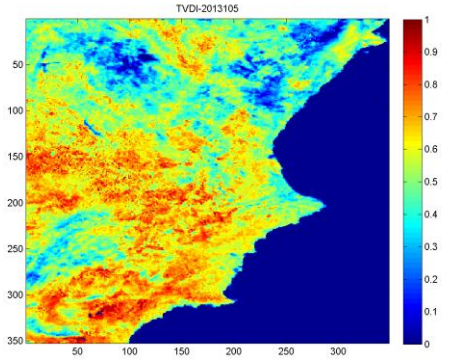
22nd Mar 2013

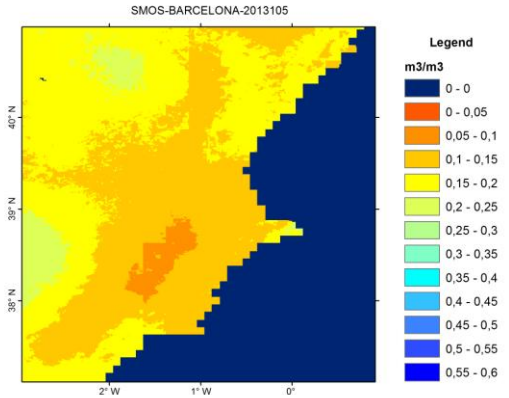


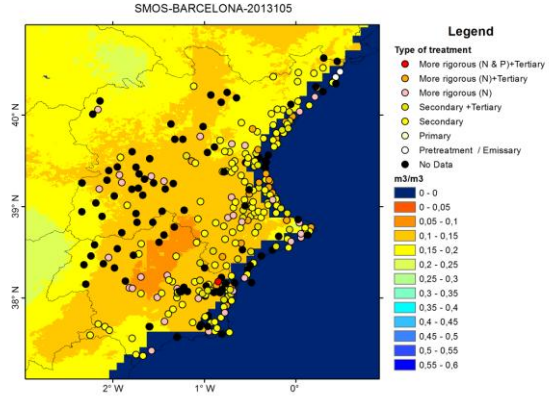




15th Apr 2013





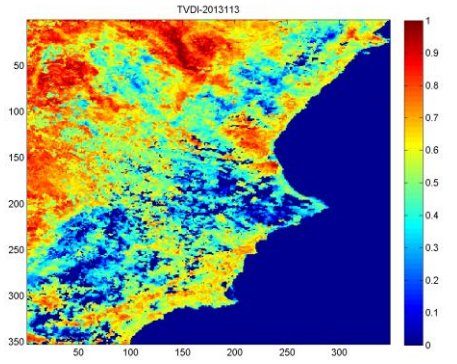


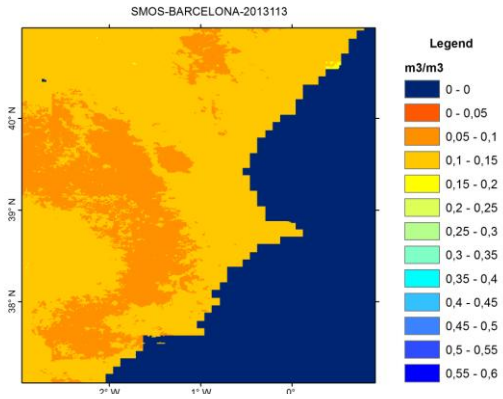
EIP Water Action Group

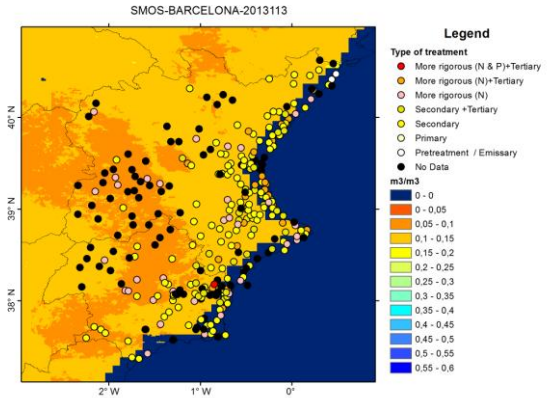
Pooling resources – Innovating water

RESEWAM-O - REmote SEnsing for WAter Management Optimization (AG132)

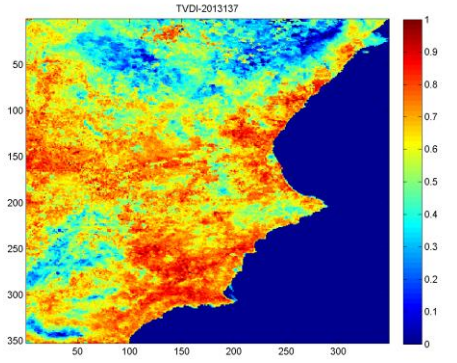
23rd Apr 2013

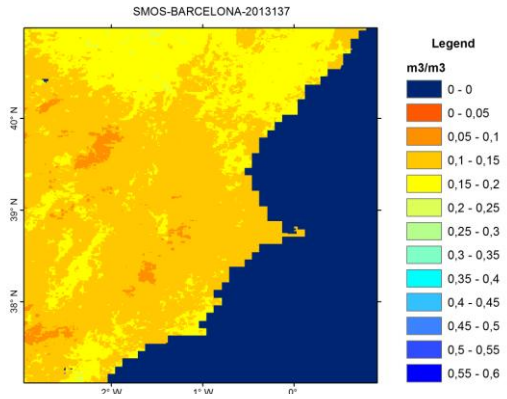


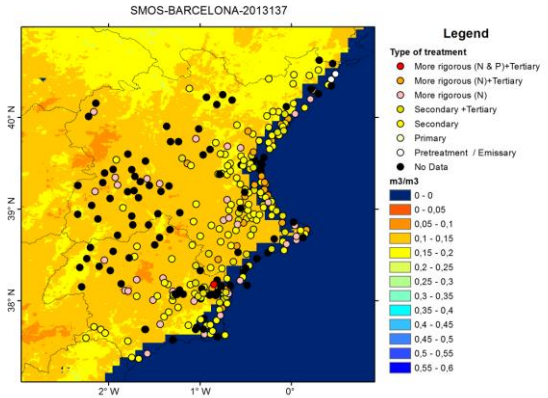




17th May 2013

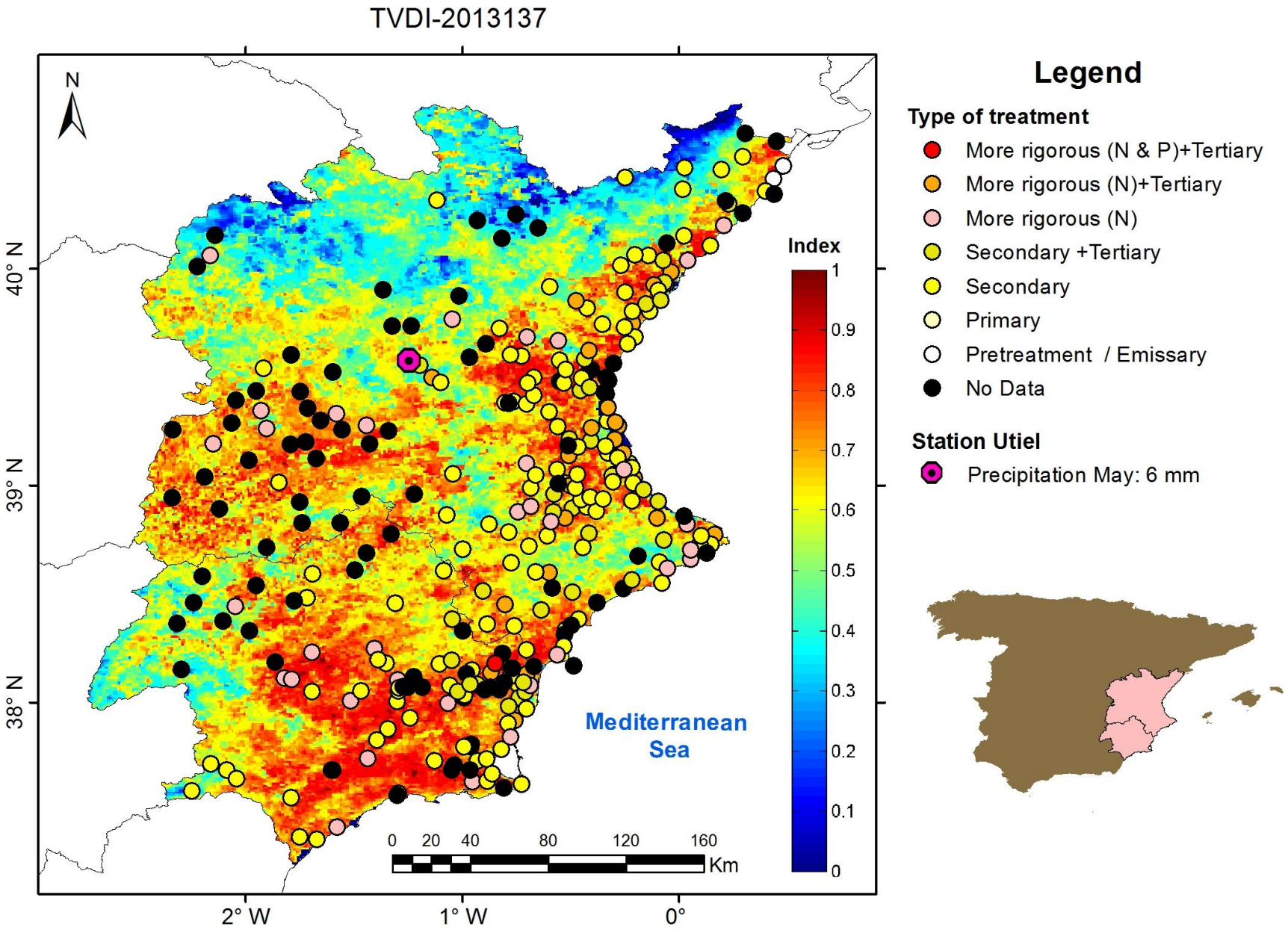






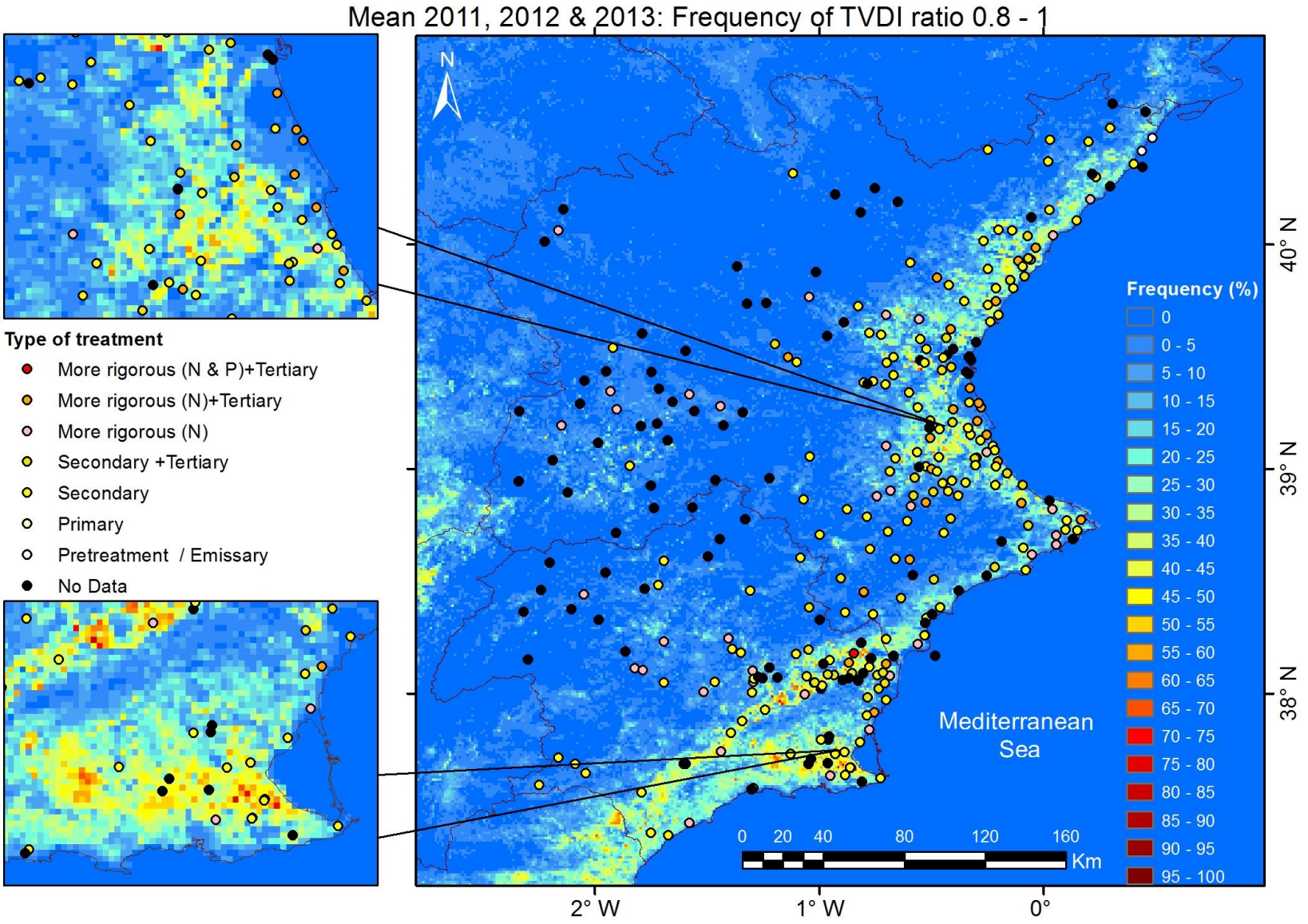
please note: soil moisture resampled at 1 km resolution

high resolution L4 product


TVDI-2013137
N
40° N
39° N
38° N
2° W
1° W
0°
Index
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Mediterranean Sea
0 20 40 80 120 160
Km
Legend
Type of treatment
More rigorous (N & P)+Tertiary
More rigorous (N)+Tertiary
More rigorous (N)
Secondary +Tertiary
Secondary
Primary
Pretreatment / Emissary
No Data
Station Utiel
Precipitation May: 6 mm

EIP Water Action Group
Pooling resources – Innovating water

RESEWAM-O - REmote SEnsing for WAter Management Optimization (AG132)



Space and Innovation …

- Aren't they synonyms?

- Space creates business opportunities and wealth
  - Every invested € is worth
  - Satellite navigation
  - Operational meteorology
  - ESA incubators, start-ups, spin-offs
- Aeronautics
- Robotics and human exploration
  - Operation with no failure and no maintenance
  - Complex transportation. Long travel
  - Extremely hostile environments
  - Far from Earth. No ground support

Space and Innovation …

- Space instrumentation
  - Radars and lidars
  - Passive microwaves
  - Optical sensors
  - Surface and subsurface
  - Light in mass
  - Efficient in energy
  - …
- Transportation
- Power and thermal
- Telecommunications
- Automation

Space and Innovation …

- New materials and components
- Electronics
- Software
- Health, wellness and bio-hazard control
- Sustainable habitats
- …
- …

Space and Innovation … and Climate Change

- Global
- Themes (Climate-KIC)
  - Greenhouse gas monitoring
  - Adaptation services
  - Making transitions happen
  - Sustainable city systems
  - The built environment
  - Land and water
  - Industrial symbiosis
  - Developing a bio-economy

The role of Earth Observation satellites in climate change studies

Conclusions

- Understanding the business perspective of climate change
- Maybe we also have to be a little "**Entrepreneurial Scientists**"
- We are all on the "innovation boat" but maybe we still need to learn innovative techniques or strategies for education
  - Climate-KIC for "advanced students"
  - Space Agencies
    - http://www.esa.int/SPECIALS/Eduspace_EN/
    - www.learn-eo.org
    -
  - Concern for Capacity Building activities

www.learn-eo.org

http://www.esa.int/SPECIALS/Eduspace_EN/