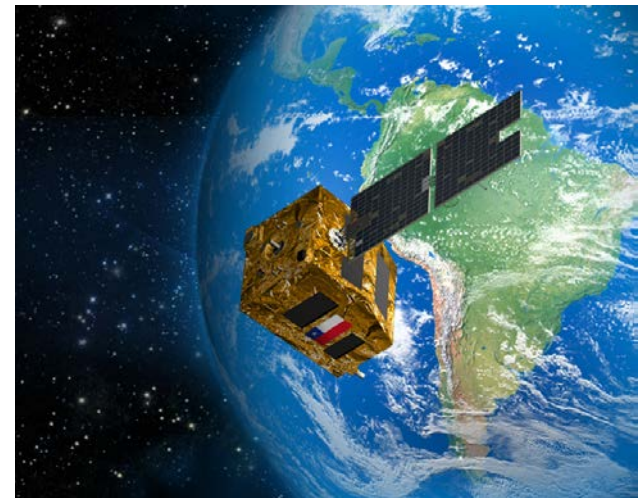


Water Monitoring from Space: a Chilean perspective



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Agenda

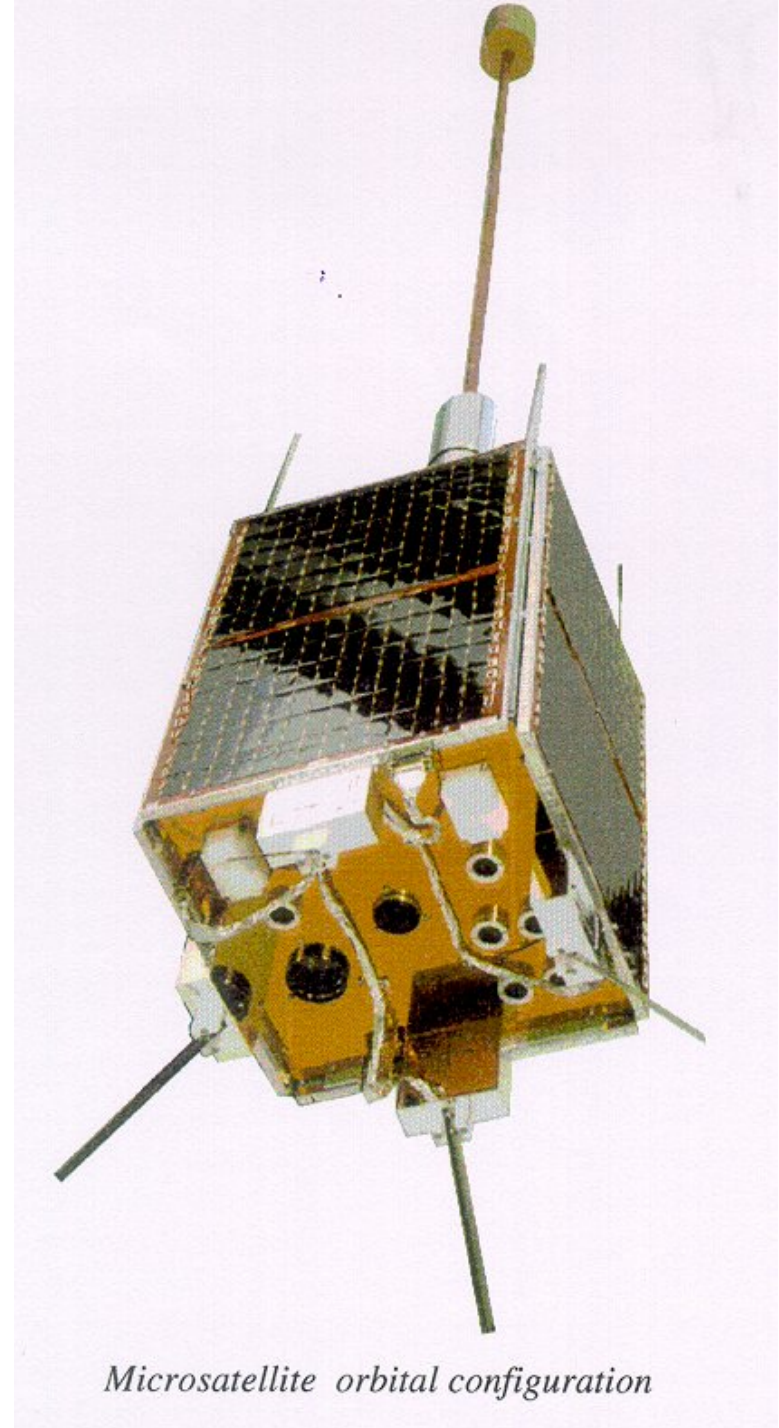
- Policy framework
- Chilean satellites:
 - FASat Alfa and FASat Bravo
 - FASat Charlie
- Examples of monitoring water bodies from space with images captured by FASat Charlie satellite:
 - Water as a diminishing resource
 - Water as a threat to human settlements
 - Water as a fragile resource
 - Water as a hydrological phenomena
 - Water and climate change
- Looking Ahead:
 - FASat Delta

Policy framework

- National Space Policy (2014)
 - Vision: Space to the service of citizens, productive sector and state management
 - Strategic axes:
 - Human resources
 - Innovation and business promotion
 - Space development environment
 - New space institutionalism
 - » Replace current Ministers Council for Space Development
 - Access to information
 - » Promote use of current Chilean remote sensing satellite
 - Infrastructure and Space applications
 - » Continuity of Chilean remote sensing satellite program

FASat Alfa and FASat Bravo

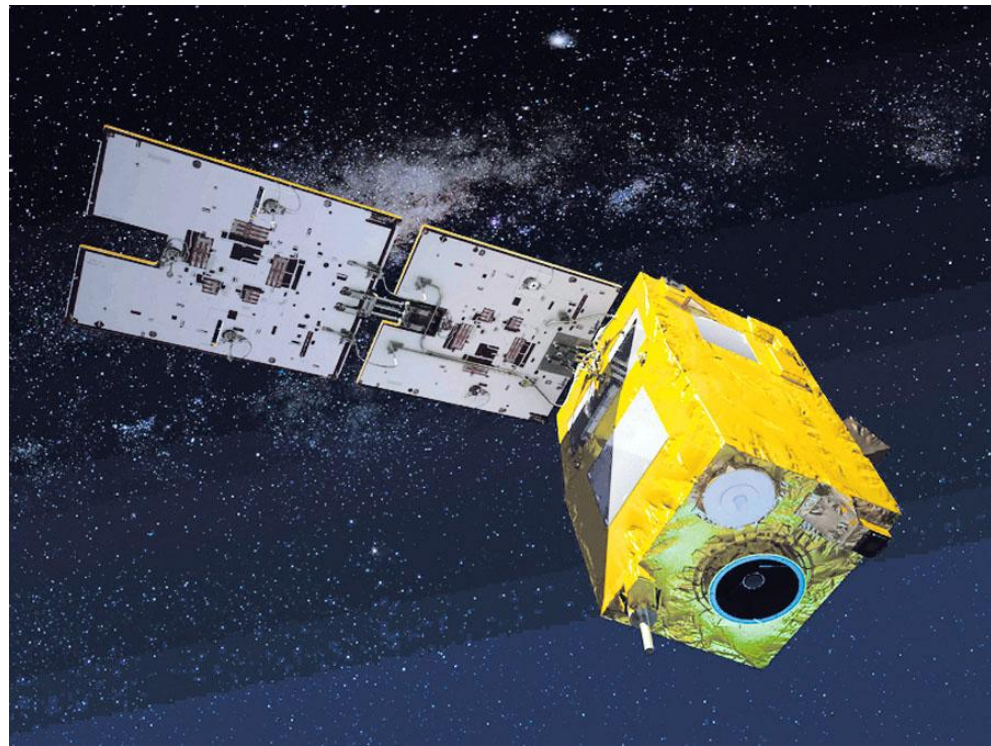
- FASat Alfa microsatellite (50 kg):
 - Cooperation program between Surrey Satellite Technology Limited and Chilean Air Force
 - Main remote sensing payload:
 - Ozone layer monitoring experiment
 - Capture ultraviolet images at two wavelengths
 - Image processing to measure the thickness of the ozone layer
 - Launched from Plesetsk on August 1995
 - Piggy back ride on Sich 1 satellite
 - Failed to decouple from Sich 1
- FASat Bravo microsatellite:
 - Replica of FASat Alfa
 - Ultraviolet sensors calibrated at NASA Goddard Space Center
 - Launched from Baikonur on July 1998
 - Operated by Chilean Air Force for three years lifetime



Microsatellite orbital configuration

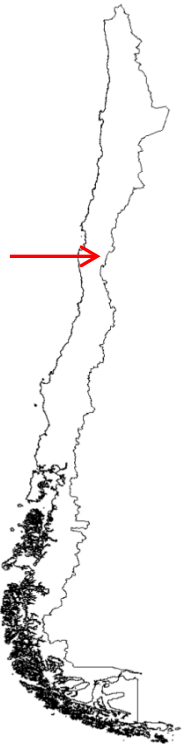
FASat Charlie

- FASat Charlie satellite:
 - Initiative of the Government of Chile
 - Developed by Astrium (now Airbus Space) with participation of Chilean engineers
 - Main payload is a remote sensing sensor:
 - Panchromatic imager with 1.45 meter ground sample distance
 - Multispectral imager with 5.8 meter ground sample distance
 - Launched from Kourou on December 2011
 - Government assigned its operation to Chilean Air Force
 - Has exceeded by 1.5 years its 5 year nominal lifetime
 - Has captured 192.000 images all over the world
 - Captured the images presented in the following slides



Water as a Diminishing Resource

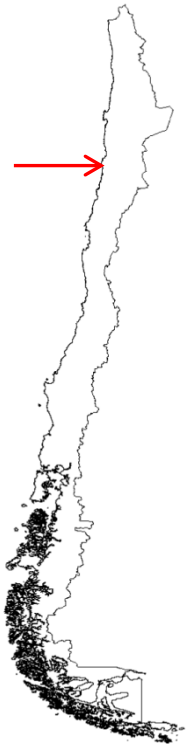
- The desertification of the northern part of Chile has forced agricultural workers to emigrate
- Satellite images are used to assess the level of water in dams and reservoirs
 - An example of “La Paloma” reservoir in the north of Chile (Ovalle region) is presented for 2013 and 2015



Water as a Threat:

Flood damage and change assessment

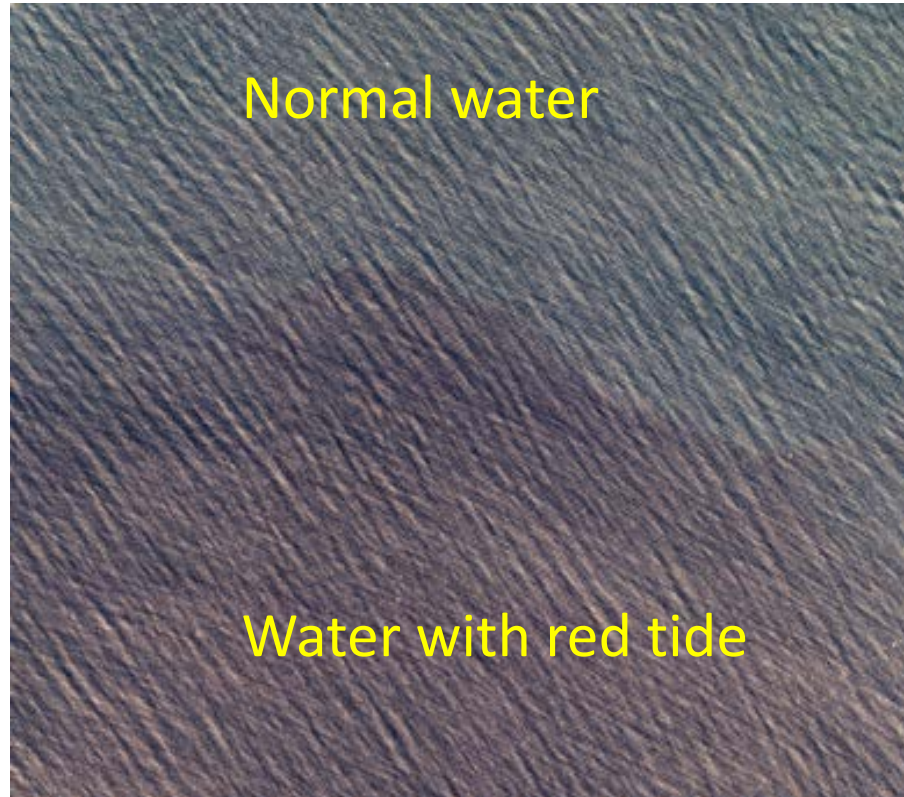
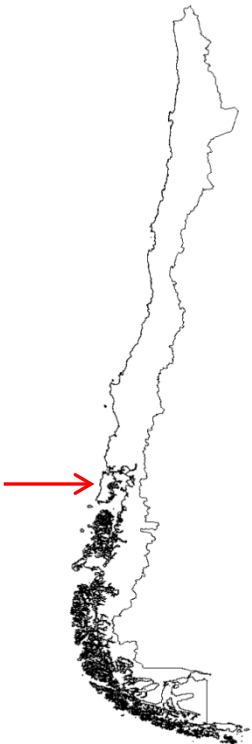
- Unusually heavy downpours in the mountains creates havoc at coastal settlements
- Satellite images are used to assess the level of damage at urban level and to map the changes in the digital terrain model
 - An example of the damage and changes caused by the March 2015 flood occurred in Chañaral is presented



Water as a Fragile Resource:

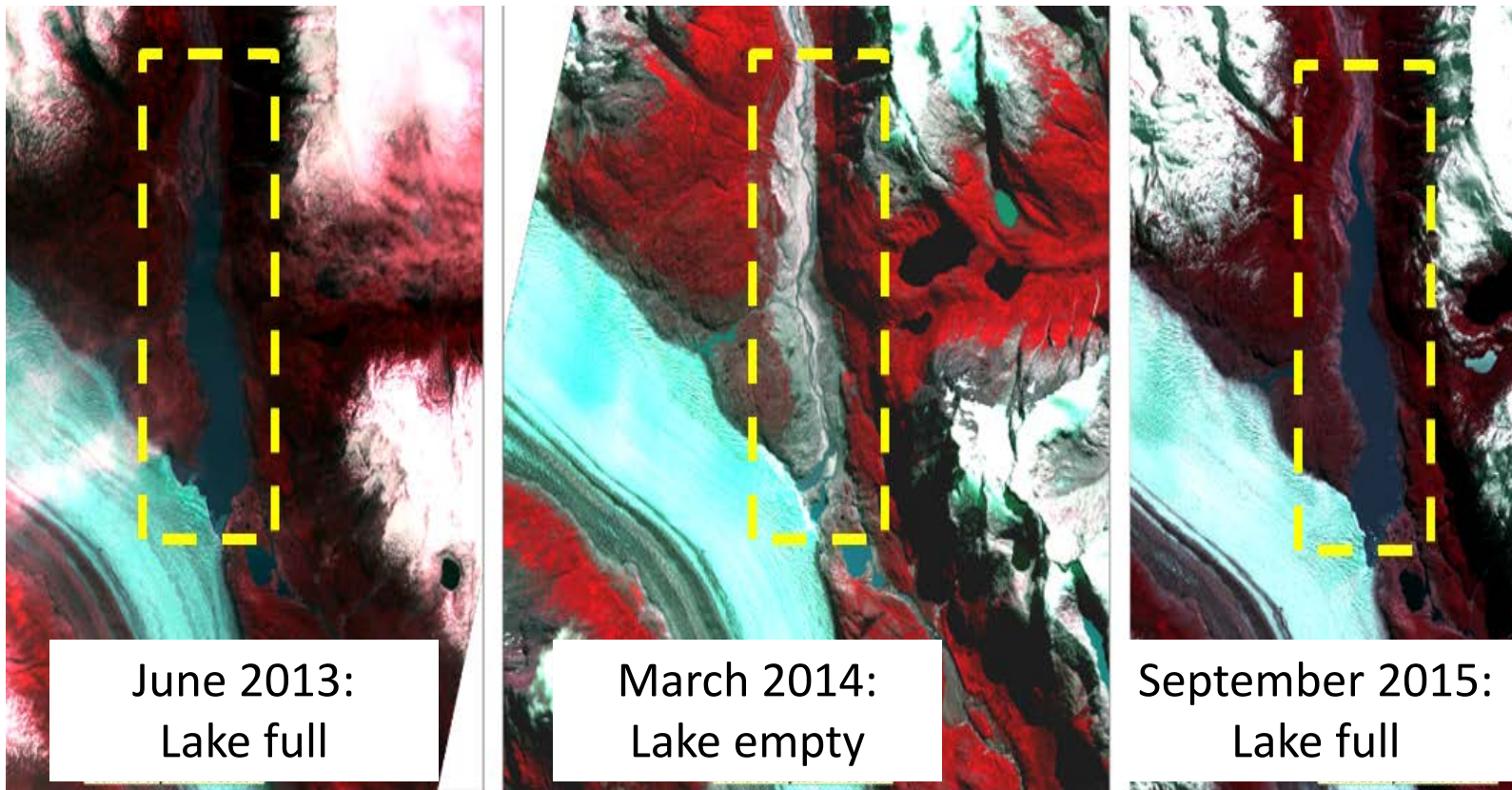
Red tide contamination

- Some red tides in Chile have been associated to anthropogenic sources
- Satellite images are used to detect the presence of red tides
 - An example of the red tide produced in the south of Chile (Chiloe region) in June 2016 is presented



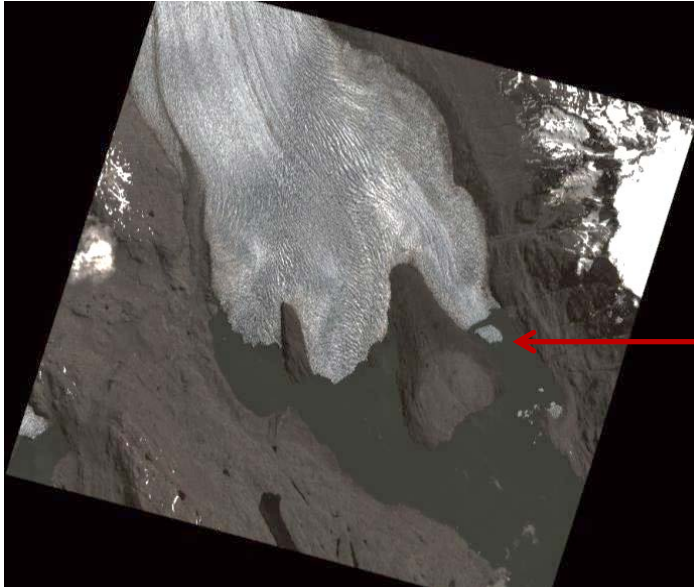
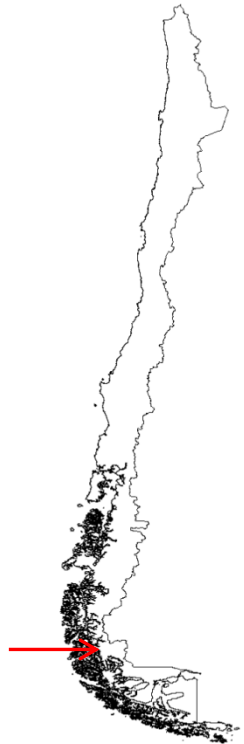
Water as Hydrological Phenomena

- Satellite observations are used to study unusual hydrological phenomena
 - An example of lake Cachet II that appears and disappears is presented (Glacial lake outburst flood)



Water and climate change

- The melting and breakage of huge ice masses are associated to climate change
 - As an example the breakage of the Grey glacier in November 2017 is presented



Continuity of Chilean Remote Sensing Satellite Program

- FASat Delta project:
 - Initiative of the Chilean government
 - High performance remote sensing satellite in the optical range
 - Requirements approved by the Chilean Council of Ministers for Space Development
 - Development assigned to the Ministry of Defense
 - High resolution wide area mosaic mode capability to monitor the Economic Exclusive Zone (EEZ):
 - The mosaic width must be of the order of the EEZ; 370 km
 - To detect illegal fisher boats with a length of 8 meters the effective spatial resolution must be better than 2 meters
 - Up to 8 spectral bands will increase the possibilities to characterize water bodies from space, for example:
 - Detection of a greater variety of red tides
 - Water pollution and water quality assessment

Conclusion

- The Chilean government has developed an autonomous remote sensing space capability based on the FASat Charlie satellite
- The monitoring of water bodies and water related events with FASat Charlie has allowed a variety of applications in different domains
 - Some examples of these applications have been presented
- It is expected that the future Chilean satellite will increase the number of applications related to water, in particular:
 - Monitoring of Economic Exclusive Zone to detect illegal fishers
 - Higher spectral resolution to detect subtler phenomena