XV WORLD FORESTRY CONGRESS

Remote sensing to monitor forest areas

Can ongoing developments and methods help monitor, report and verify changes in forest areas ?

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Why remote sensing?

- **Tropical forests:**
  - Huge areas of poor accessibility, insufficient manpower, funding, …
  - Often no national forest inventory with sufficient field sampling and revisit
- **Need to ensure:**
  - Objective and reliable monitoring of key forest structure variables (cover, height, …), representative in space and time
  - as to implement consistent forest definition frameworks
  - And track and quantify changes in forest areas

Remote sensing, a vast, burgeoning technical field

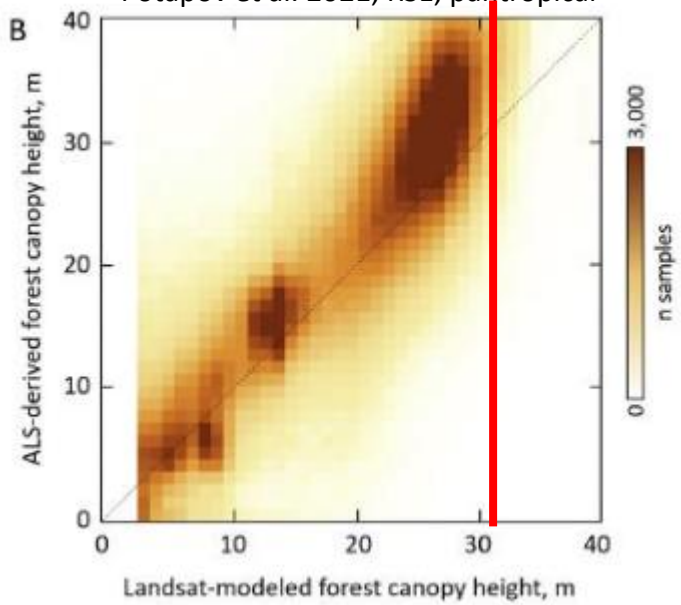
- **Variety and complementarity of data sources**
  - Spaceborne active (radar, i.e. cloud immune) and passive (optical) images
  - space- air-borne active (lidar) for local-truthing
- **Recent game-changers**
  - Online cloud-computing applied to historical images series (NASA Landsat archive ~ 45 years)
  - Free images series of increased temporal frequency (5 days revisit), and enhanced spatial (10 m pixels) and spectral (red-edge) resolution: notably ESA Copernicus system
- **Enduring limitations**
  - Limited interpretability of radar signal
  - Saturation at intermediate canopy cover and biomass levels (for most signals)

Illustrations of some limitations

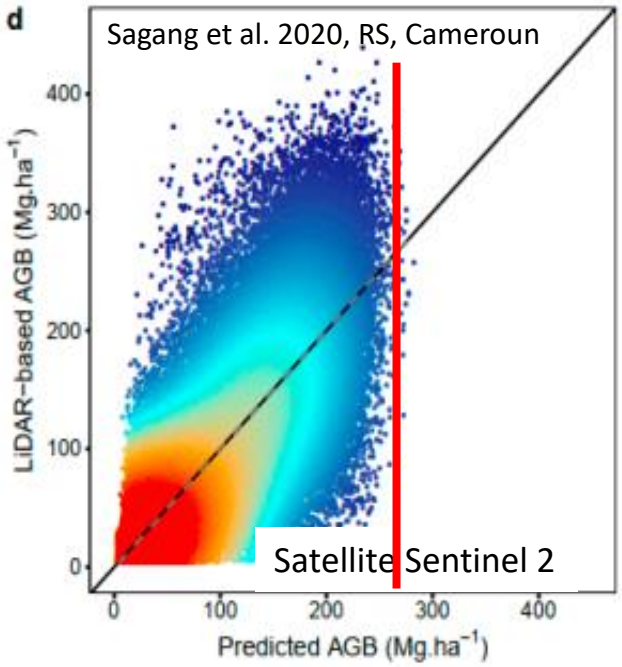
- **Signal saturation**

Airborne Measurement (lidar)

Potapov et al. 2021, RSE, pantropical



Sagang et al. 2020, RS, Cameroun

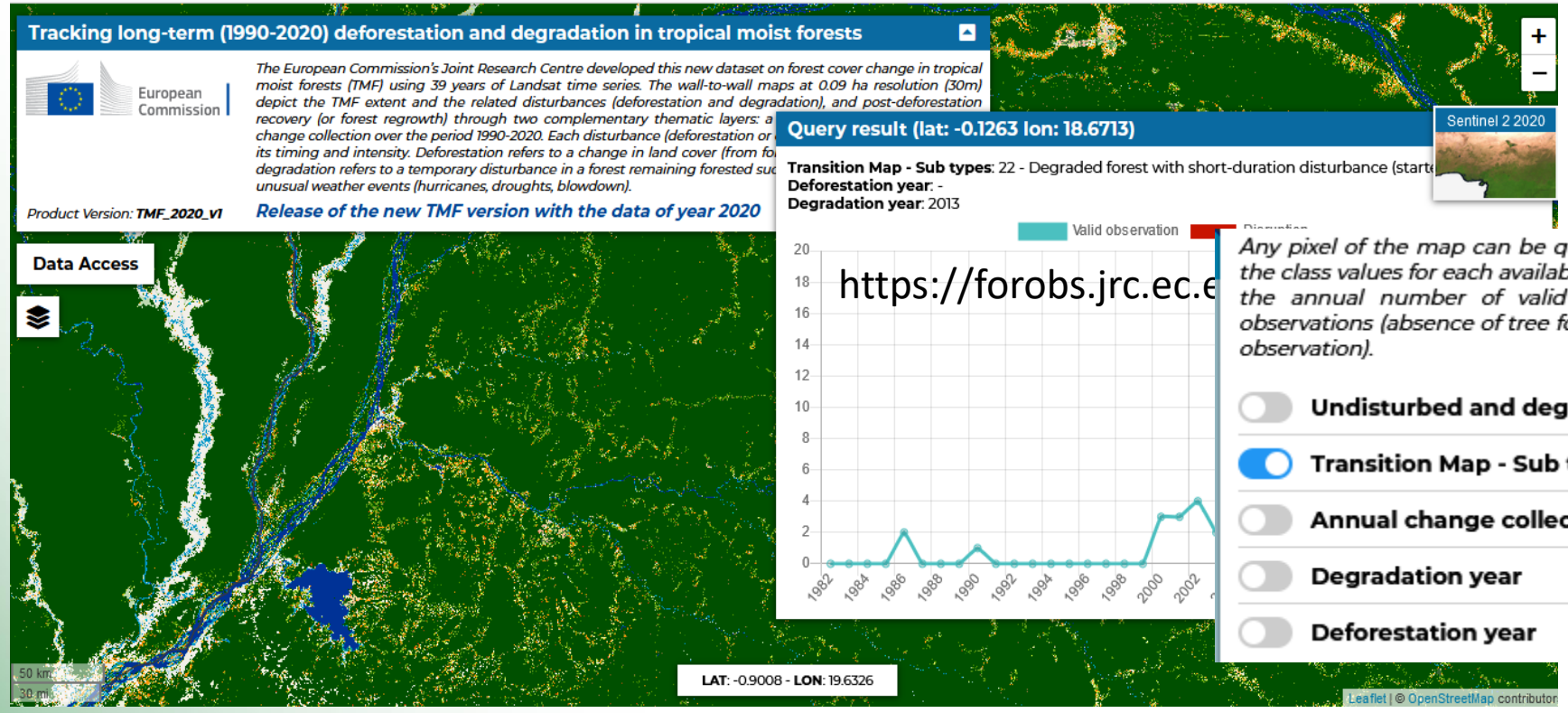


- Predicted from spaceborne signal

- Canopy height (left): saturates at ~30 m
- Above-ground biomass (right), saturates at ~ 200 t/ha
- Yet useful: depicting low to intermediate parts of the degradation gradient

Global (pantropical) scale achievements

- **Based on historical Landsat series**
  - Global Forest Watch (% cover): http://globalforestwatch.org
  - EU – JRC Deforestation & degradation: https://forobs.jrc.ec.europa.eu/TMF/



Limited to tropical moist forests

Conclusion: what is possible or not?

- **Global, broad-scale, “routine”,**
  - detect contrasted changes: e.g. from intermediate cover (>~30%-50%) towards open crops or pastures
  - distinguish “natural” forest from artificial plantations (rubber, oil palm, eucalypts, …)
  - detect severe degradation

- **More difficult, context-dependent**

  - Quantify local gradients of forest degradation (and « classical field structure variables »)
  - Map complex agroforest systems retaining forest intermediate canopy cover (e.g. Cocoa, …)

  This call for: local calibration/validation, fusion of data types, skilled operators

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In summary:

- remote sensing is and will be a critical tool
- Reliable implementation of forest/degradation definitions is tightly dependent on technical possibilities development
- robust, broad-scale techniques as well as locally refined ones are needed

Thank you!

Pierre COUTERON