

Science Diplomacy Through Cities: Applying NASA Earth Observations at the Urban Scale

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The NASA-Rio de Janeiro Partnership

In December 2015, NASA's Earth Science Division and the Rio de Janeiro Mayor's Office signed a five-year agreement to support innovative efforts to better understand, anticipate, and monitor natural hazards and climate change impacts around the city.



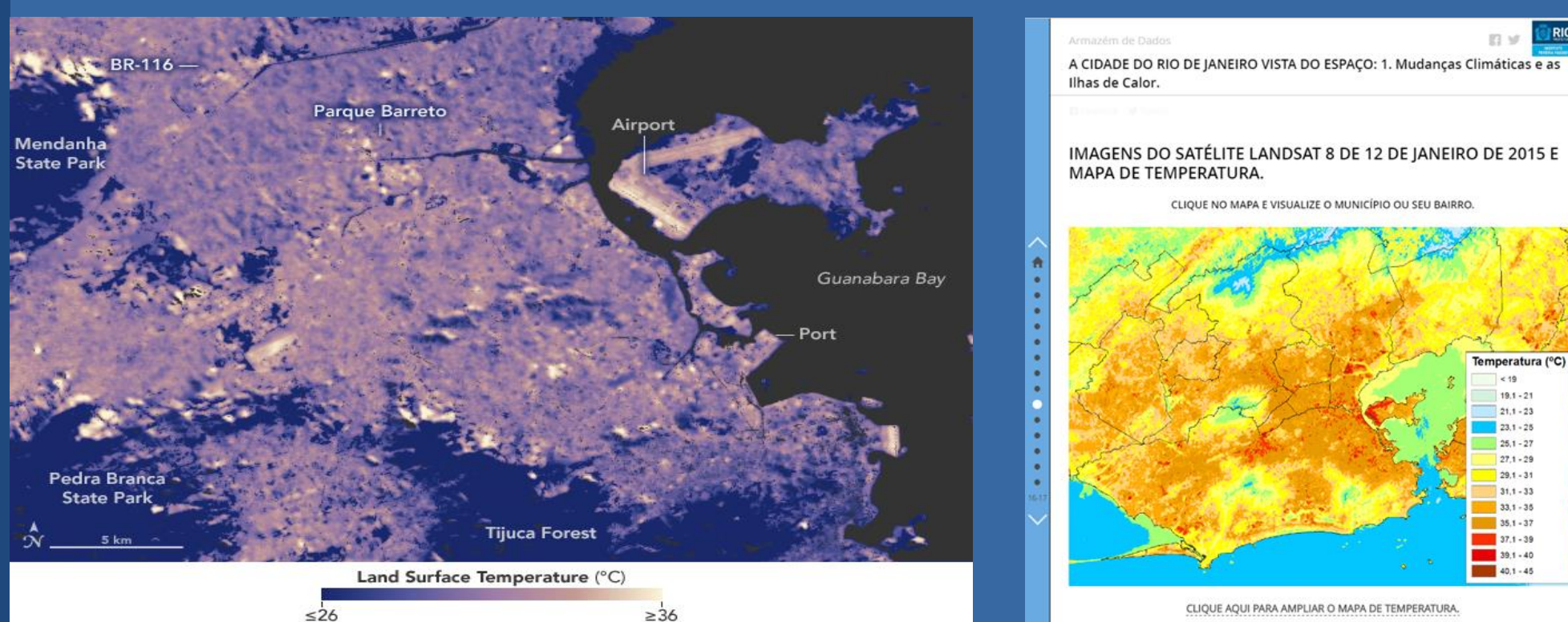
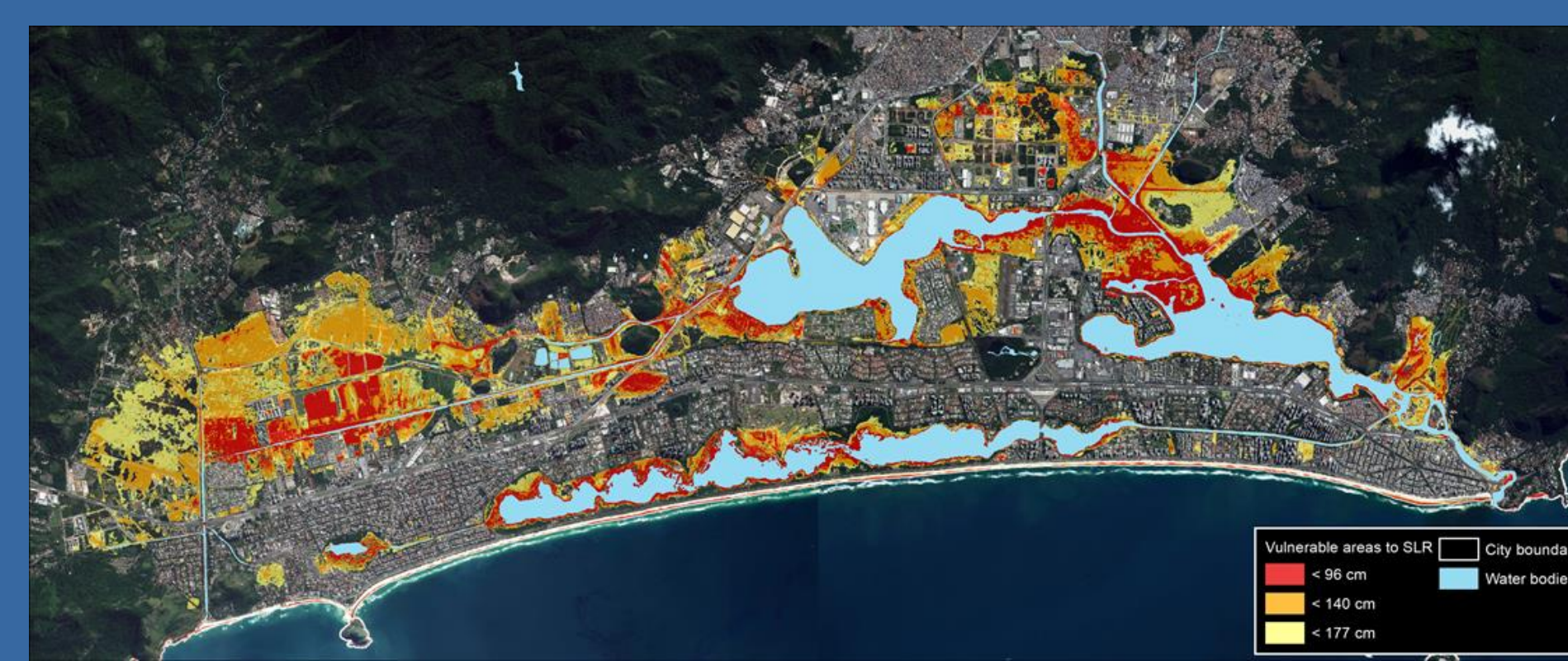
In November 2016, NASA hosted ten delegates from Rio de Janeiro's city government for a **workshop** in New York City. The workshop included training sessions on sea level rise, urban heat islands, water quality and extreme events, as well as a demonstration of the Rio Operations Center and policy discussion with representatives from New York City and the C40 Cities Climate Leadership Group. The workshop helped define the processes for data- and knowledge-sharing and initiated joint research activities.

NASA conducted two series of **educational webinars** in partnership with Rio de Janeiro's Education Secretariat. The first series provided a broad introduction to NASA's Earth science satellite missions and ongoing activities related to climate change impacts, extreme weather, and water and air quality. The second series provided examples of integrating NASA Earth Observations and resources into Rio de Janeiro's educational programs.



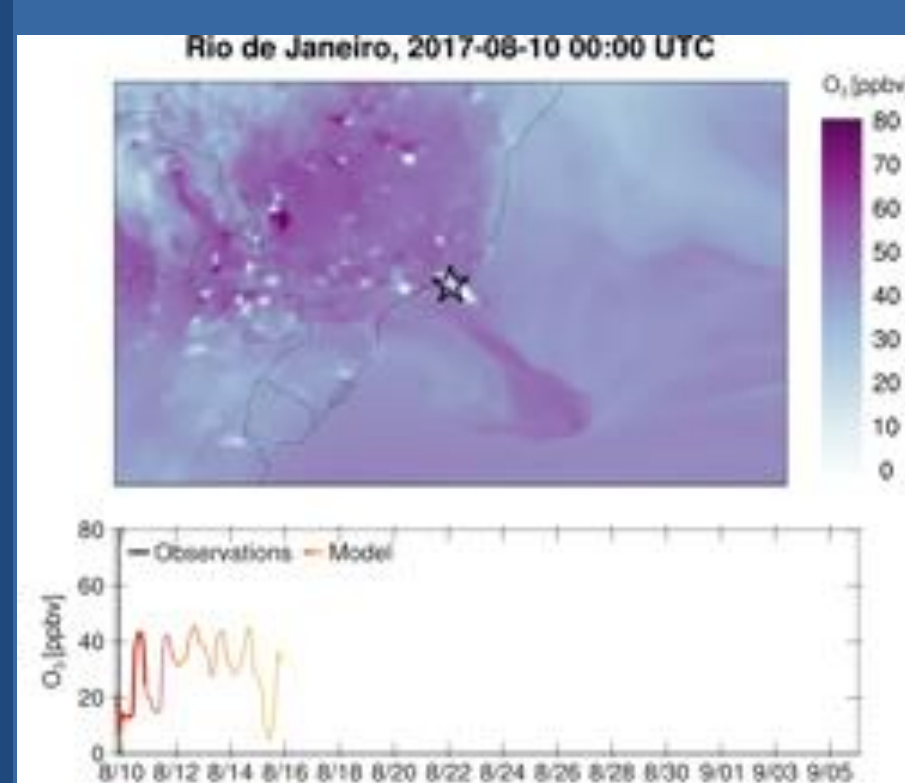
Rio de Janeiro is highly vulnerable to **extreme rainfall and landslides**. The city monitors rainfall continuously: 33 automatic weather stations report at 15-minute intervals. The city is integrating a customized version of NASA's Landslide Hazard System for Situational Awareness (LHASA-Rio) into AlertaRio, the city's warning system, to identify potential landslide activity and issue targeted warnings.

A joint NASA-Rio de Janeiro study used a combination of local measurements, a Lidar survey of city topography, satellite altimetry data from TOPEX/Poseidon and the Jason missions, and CMIP5 climate projections to identify the areas of the city most vulnerable to **sea level rise**.



Landsat-based land surface temperature was used to identify Rio de Janeiro's **urban heat island** and propose climate adaptation actions. The city used this map to identify a priority area for heat mitigation.

Landsat-Sentinel maps of **water quality** indicators such as chlorophyll and total suspended solids provide a much broader view of water quality in the Rio de Janeiro area, as compared with the single monitoring site at **Rodrigo de Freitas Lagoon**. An experimental water quality anomaly tool could soon provide Rio de Janeiro with early indications of potentially hazardous conditions.



Rio de Janeiro is enhancing its understanding of spatial variability and trends in **air quality**, by comparing measurements at eight ground-based stations with estimates from remote sensing. Further, Rio de Janeiro's local air quality measurements are being compared with output from NASA's GEOS-CF forecast system. Discrepancies related to the city's complex topography are expected to lessen with time as the model's horizontal resolution increases. After further testing, NASA's forecast system could be used to warn city officials of hazardous air quality.

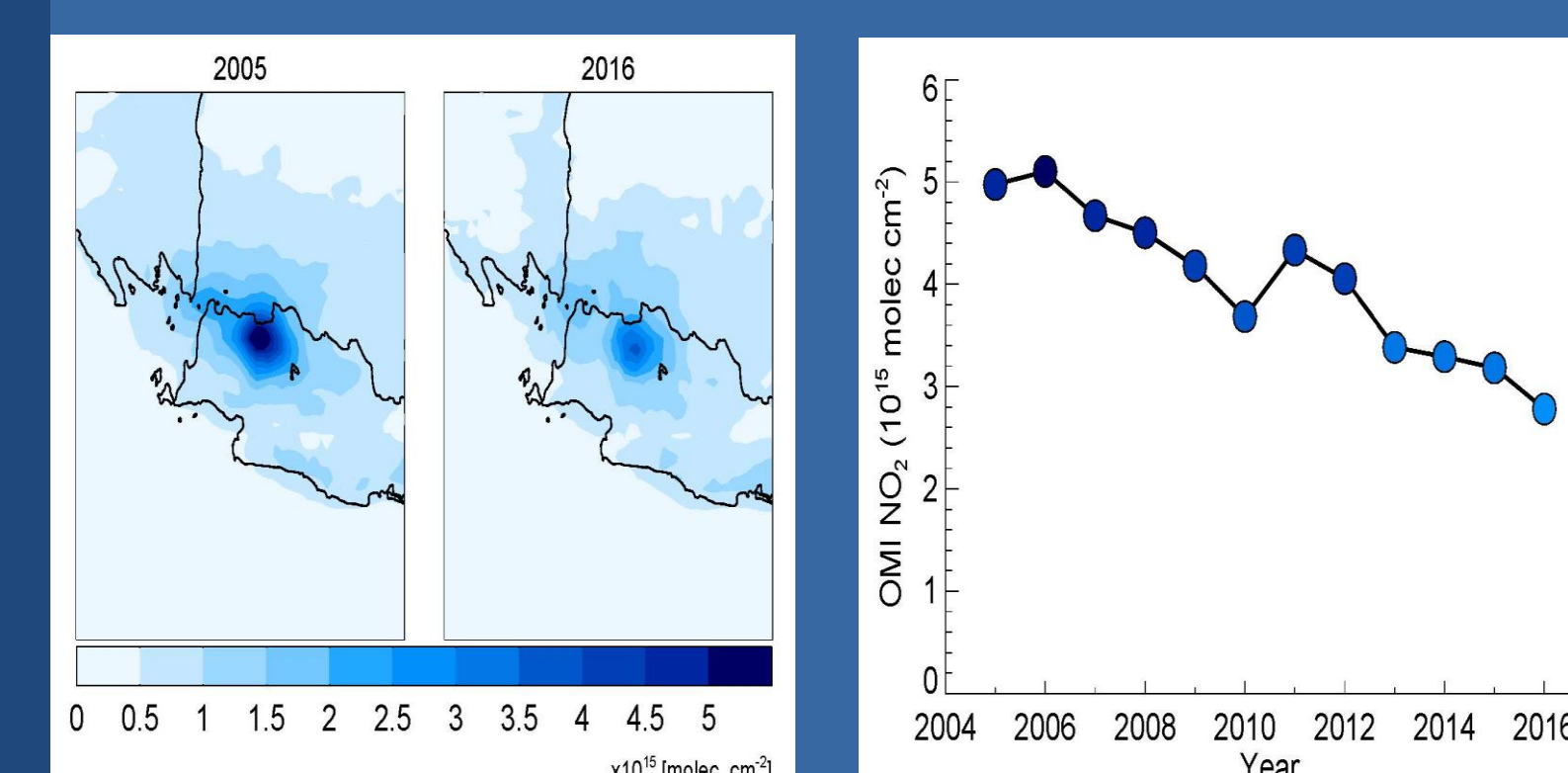
Monitoring & Forecasting Air Quality in Jakarta

Jakarta faces significant environmental challenges, including flooding related to both land subsidence and sea level rise. As with the NASA-Rio de Janeiro partnership, a formalized collaboration between NASA and Jakarta might involve joint work in monitoring and forecasting the city's environmental conditions and risk of natural hazards.



Jakarta's business district [Photo credit: Wikipedia]

Thus far, NASA's work with Jakarta has focused on air quality, leveraging NASA scientists' expertise and existing contacts in Indonesia. The GEOS-CF forecast system is being tested for Jakarta, as compared with the US Embassy's air quality monitor. Continued work with Jakarta might encourage open access to local air quality measurements and enable the adoption of GEOS-CF for operational fire danger and hazardous air quality warnings.



Aura Ozone Monitoring Instrument (OMI) NO₂, a proxy for ground-level NO_x, shows that pollution levels decreased by ~40% in the last decade. While changing fuel sources and more fuel-efficient vehicles may explain this decrease, working directly with Jakarta will help clarify connections between the city's policies and environmental conditions.

Lessons Learned in Collaborating with Cities

NASA's scientific expertise and data products are enhancing cities' environmental monitoring activities by pioneering applications of remote sensing and model-based Earth Observations at the urban scale. The above activities have greatly benefitted from engaging stakeholders and city practitioners from the start. Further, NASA's collaborations with cities have:

- Advanced NASA science, in testing new products and validating of satellite datasets, while meeting the needs of city governments
- Broadened Rio de Janeiro's regional viewpoint and strengthened its relationships with neighboring cities

Scientific collaborations with cities benefit from:

- Selecting city partners with a high level of technical capacity and willing to make strong investments in joint projects
- Sustained communication and face-to-face interactions
- Well-defined deliverables, with dedicated resources and personnel
- Pairing global datasets and projections with in situ measurements and local knowledge
- Sensitivity to local working culture and politics

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