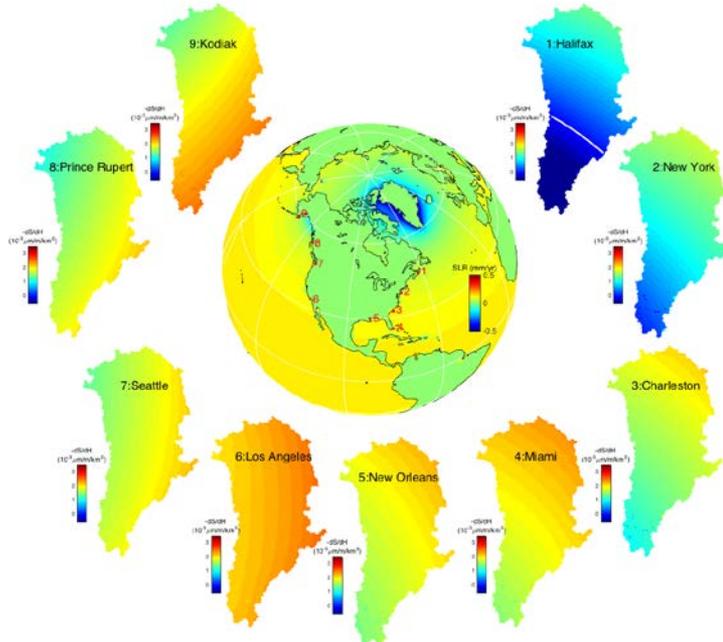


# Should coastal planners worry about where the ice is melting?

Eric Larour, Erik Ivins and Surendra Adhikari



**Gradient fingerprint  $dS/dH$  of local sea-level rise (S) in 9 cities along the US coastline, to changes in ice thickness (H) in Greenland.** The forward sea-level fingerprint used to compute the gradient is shown in the middle frame (in mm/yr), calibrated using thickness changes from GRACE from 2003-2015. For example, glaciers in SW Greenland do not effect sea-level rise in NY or Halifax ( $dS/dH \sim 0$ ) while all of Greenland significantly affects Los Angeles. The fingerprints capture perturbations to the gravity field, bedrock rebound, and rotational feedback caused by ice melt.

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**Science Question:** what is the sensitivity of local sea level rise in coastal cities to changes in ice mass transport in every single glaciated area of the world. **Are cities vulnerable to specific glaciers/ice streams across the Cryosphere?** To answer the question, we implemented a breakthrough adjoint model of our ISSM-SESAW **sea-level rise solver**, and reverse computed the desired sensitivities ( $dS/dH$  for every city, see Fig 1) also called "**Gradient Fingerprints**".

**Data & Results:** We relied on GRACE data to compute forward sea-level fingerprints and their gradient (reverse direction) for **293 locations** around the world. The gradient fingerprints revealed strong spatial variations in the sensitivity of sea-level rise in coastal cities of Northern Europe, Arctic and North-America to thickness changes in Greenland. Similarly, ice melt in specific areas of Antarctica causes significant sea level change in South-America, South of Africa and Australia. The results are hosted on the [vesl.jpl.nasa.gov](http://vesl.jpl.nasa.gov) website and the NASA Sea-level Change Science Team portal.

**Significance and Impact:** First time a high resolution gradient fingerprint has been computed for a comprehensive number of coastal cities. Can be used directly by coastal planners to **understand and quantify the risk posed by far-away glaciated areas to their specific coastal city, even as our understanding of the cryosphere evolves.** The portal has seen a traffic of **~100,000 users** in 4 days. The study has generated articles from **41 news outlets.**