Dynamics of effusive volcanic eruptions during caldera collapse

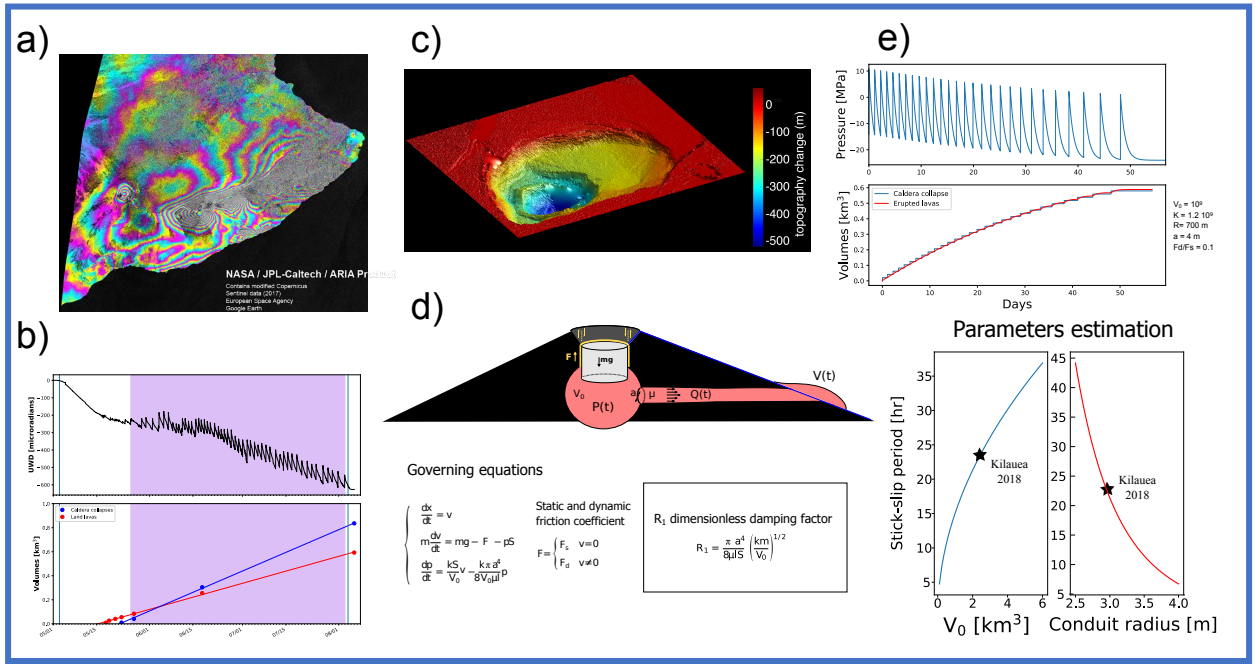
Roman, A., Jet Propulsion Laboratory, California Institute of Technology

Background:

- Large volcanic eruptions are linked with summit caldera collapses
- The relevant physical mechanisms are currently poorly understood. Dynamical models are essential to predict how an eruption will evolve (e.g. how long the eruption will last? How much magma will be erupted?).
- The 2018 Kilauea eruption was the largest event in 200 years: ~1 km^3 of erupted lavas and ~ 1 km^3 caldera collapse. It provides a unique opportunity to study these exceptional eruptions

Analysis:

- Geodetic data from ground-based instruments (tiltmeters and GNSS), airborne and space borne SAR are used to measure deformations and magma flux rates, which in turn are used to constrain the models



a) Sentinel-1 interferogram (2.8 cm per cycle) covering the 2018-05-05 / 2018-04-11 period (eruption starts on May 3rd)

b) Top: Tiltmeters time-series showing inflation/ deflation cycles during caldera collapses. Bottom: volumes of the caldera and of the erupted lavas measured by UAVSAR GLISTEN-A

c) Final net topographic change on the caldera measured by GLISTEN-A

d) Model set-up and governing equations

e) Model time-series for an illustrative calculation and parameters estimation

Significance:

- Large effusive eruptions enter in a particular regime which is governed by caldera collapse
- The dynamics of the collapses shows a stick-slip behavior with well-defined periodicities
- Simple physical models can be used to constrain the parameters of the plumbing system of the volcano which can be in turn used for risk assessment of future eruptions