Space Based Geodesy Using InSAR

Chuck Wicks

USGS
science for a changing world
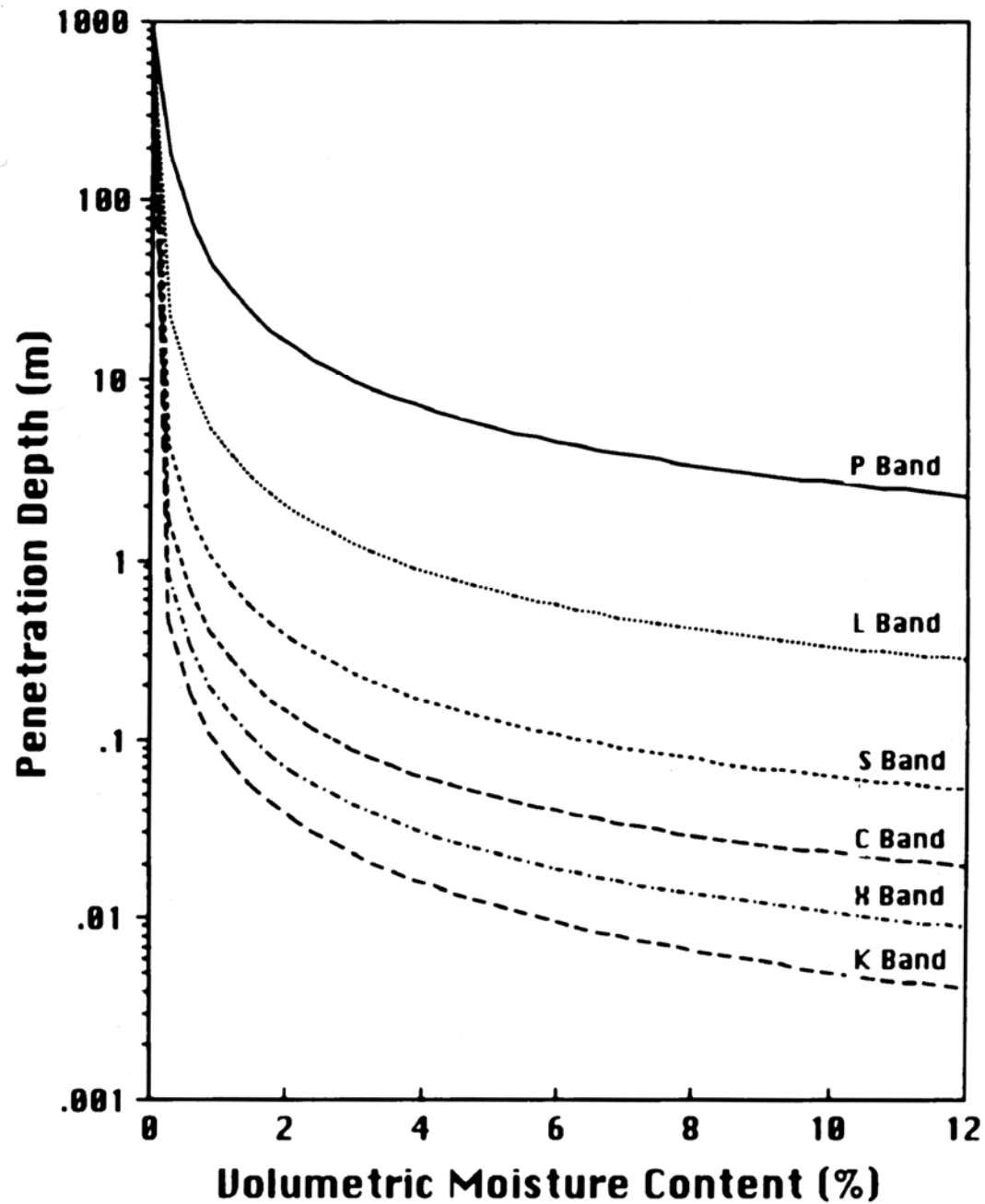
Transmission of Radar Through Atmosphere
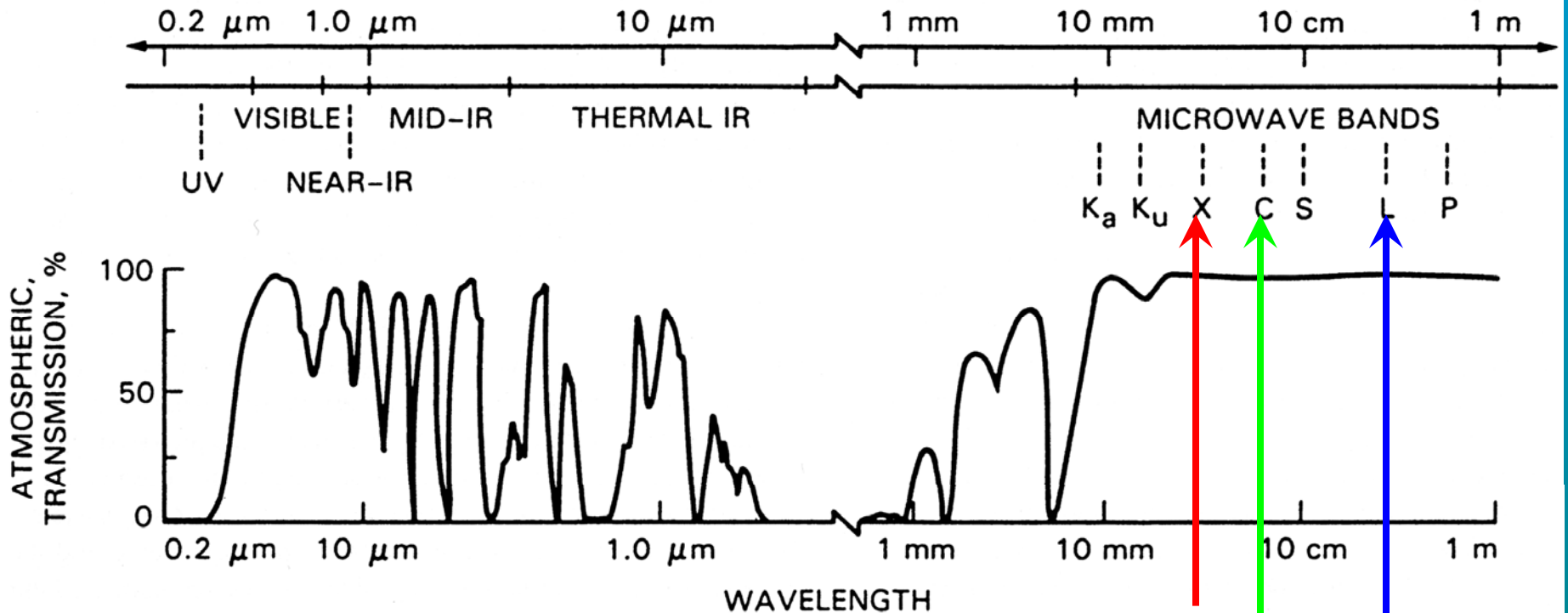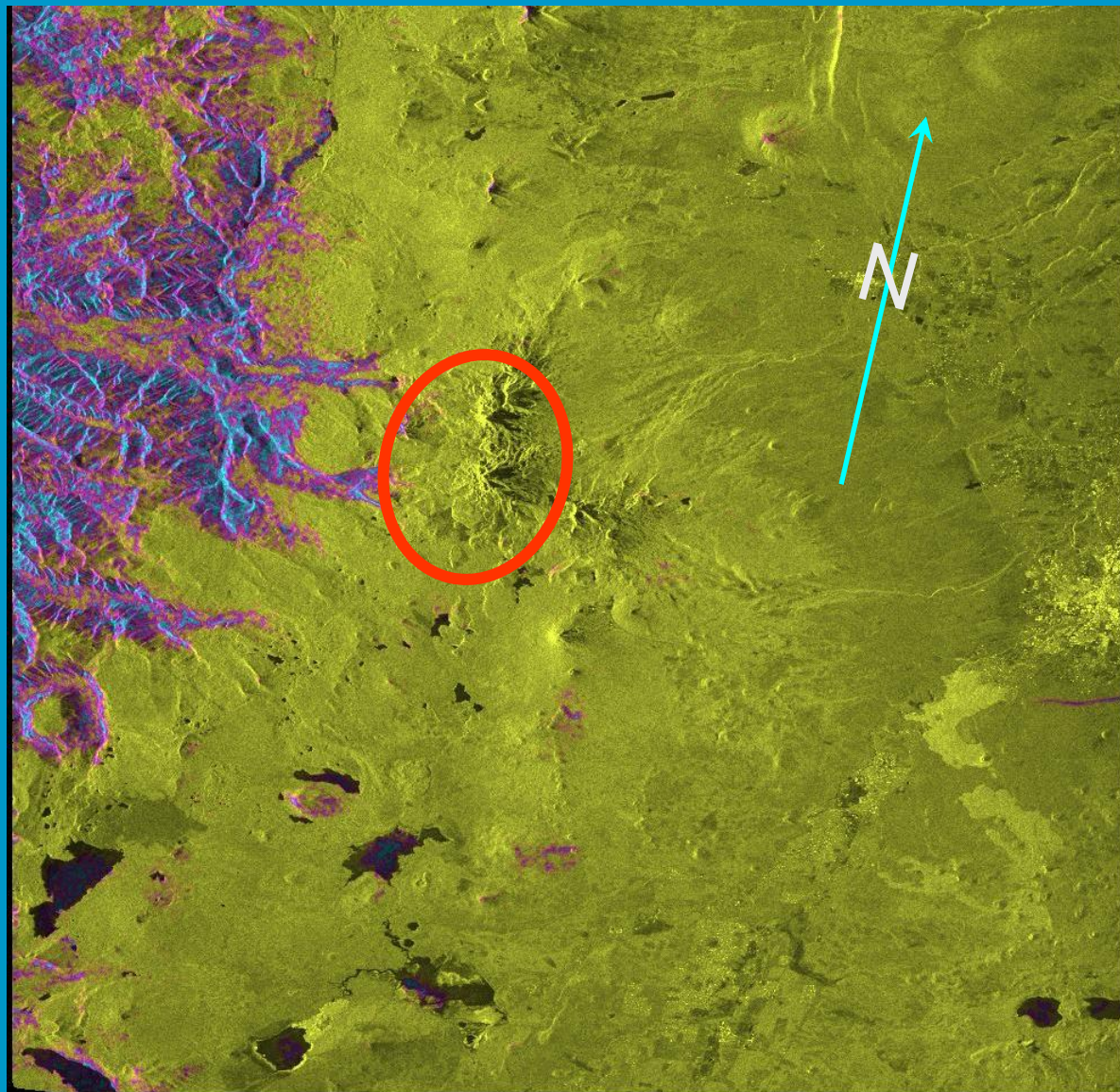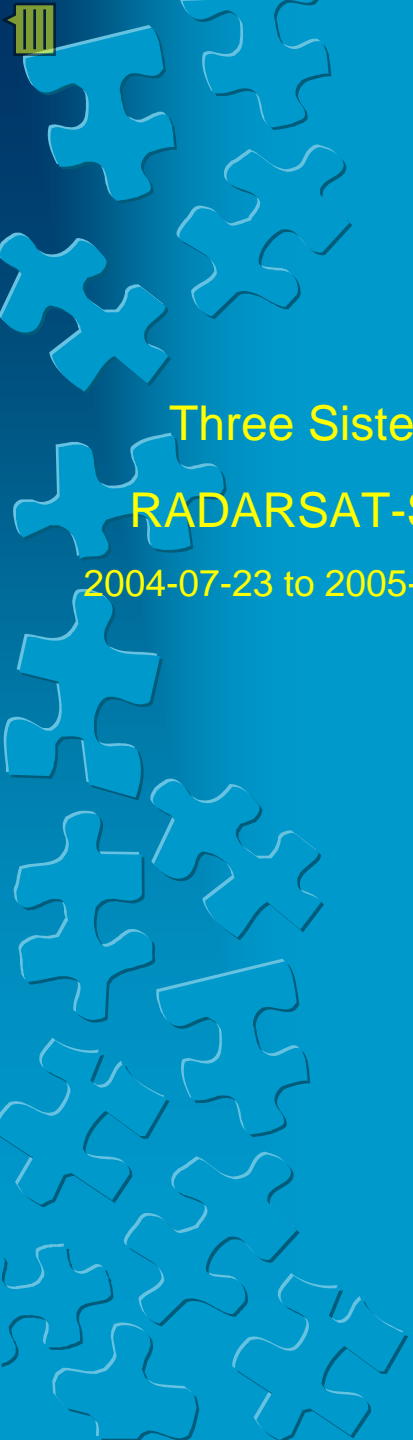

TerraSARX

ENVISAT, RADARSAT, ERS1-2

ALOS, JERS1

A Little Wet Snow Attenuates C-Band Radar… L-Band Does Better

Three Sisters

RADARSAT-ST5
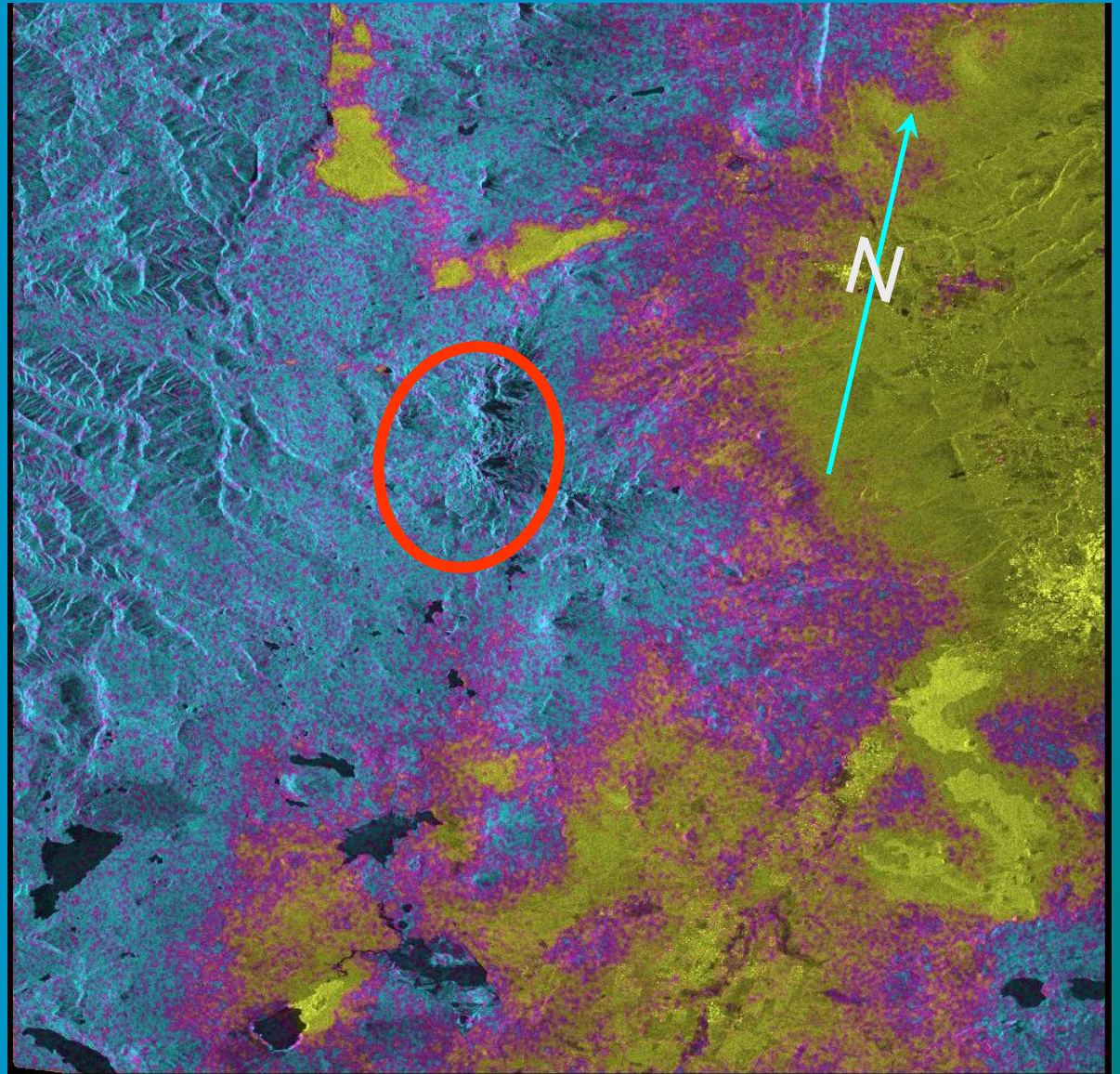
2004-07-23 to 2004-08-16
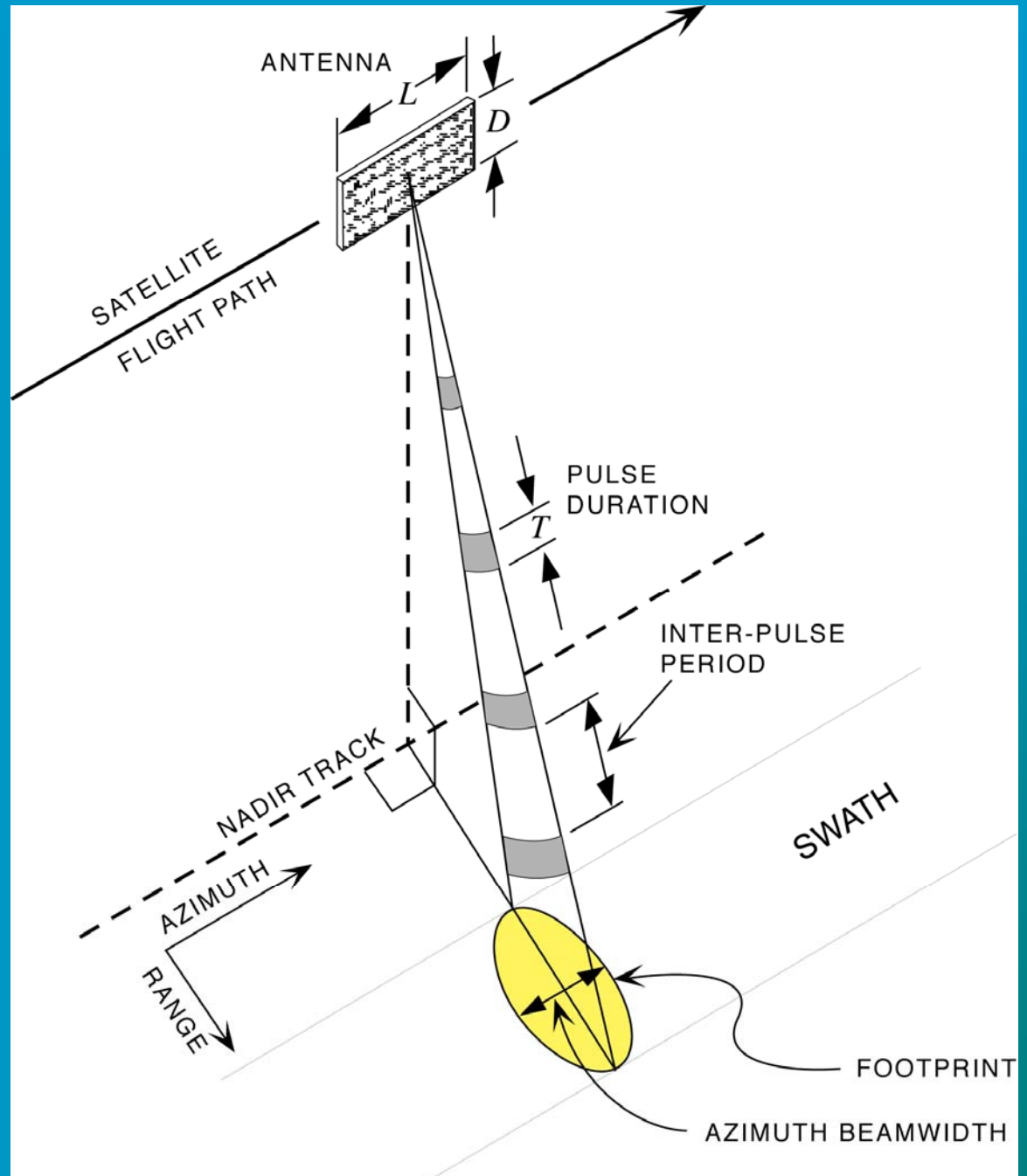
Three Sisters

RADARSAT-ST5
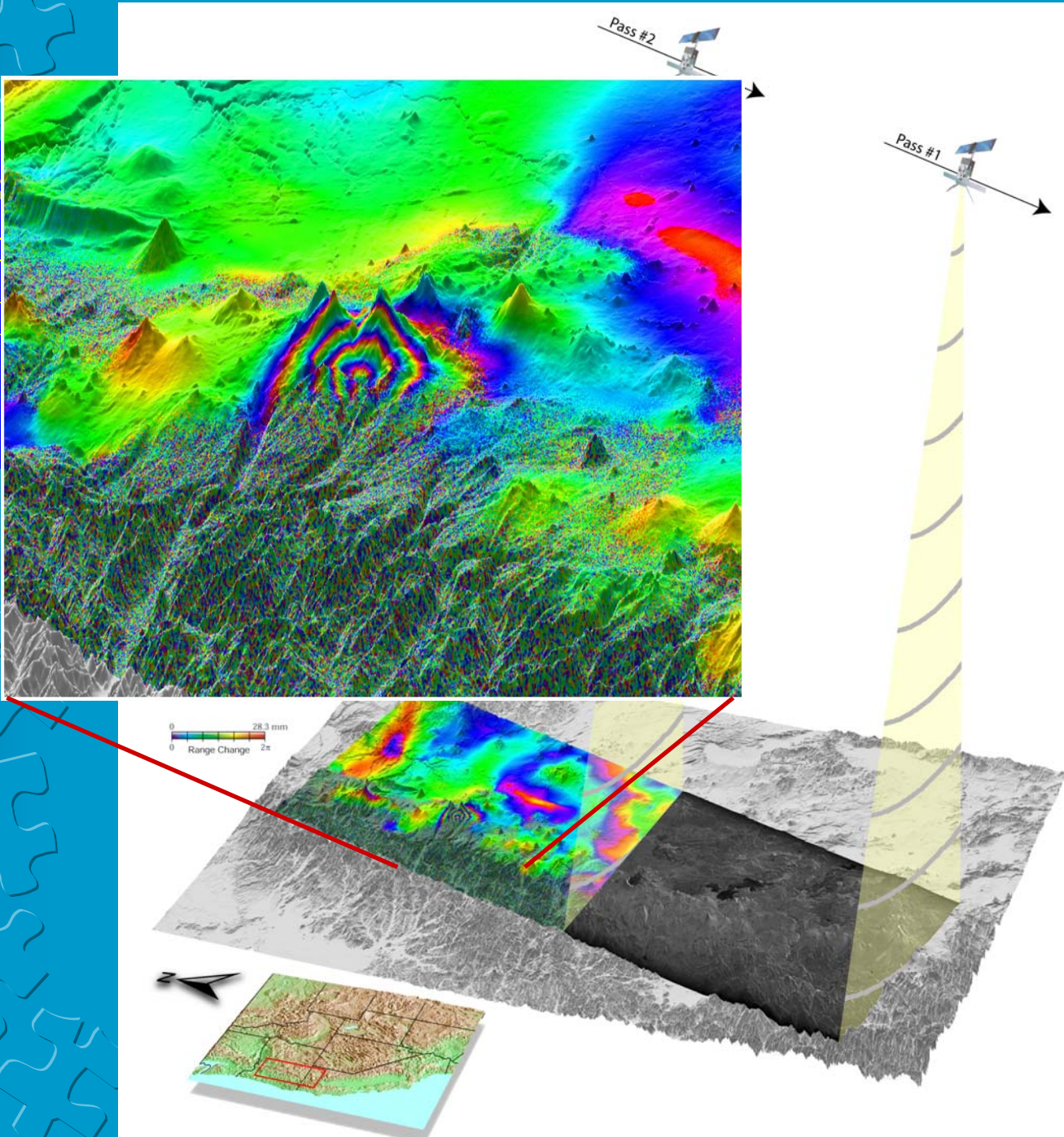
2004-07-23 to 2005-04-13

The azimuth resolution of a stationary antenna is: $R\lambda/L$

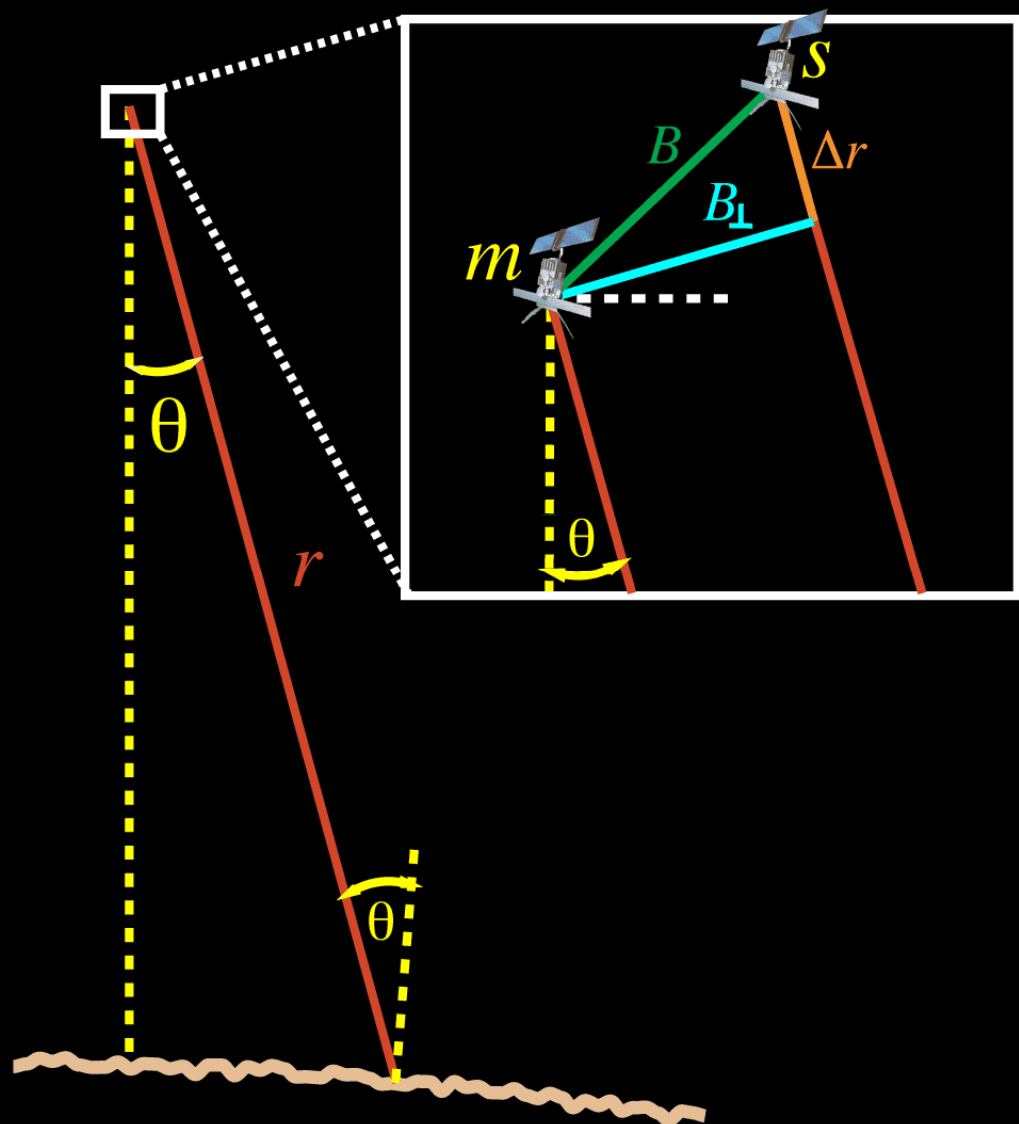In limit, the azimuth resolution of a SAR system is: $L/2$

For an ERS antenna, resolution goes from ~4.5 km to ~5 m using the doppler effect from the moving satellite.
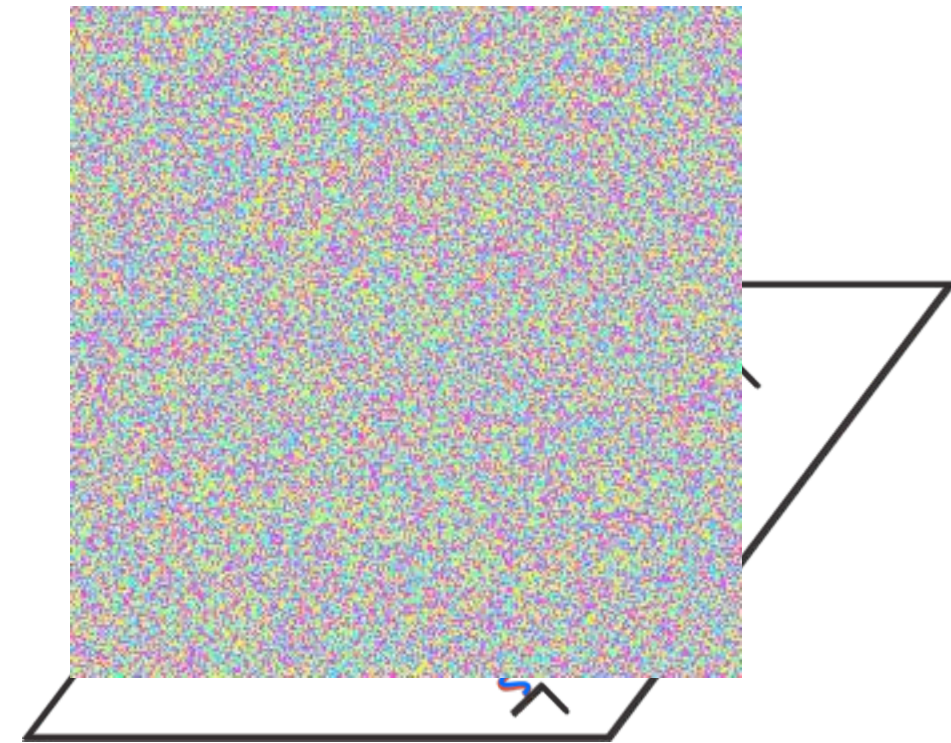
We u
metho
exam
1996
2000.

The perpendicular component of the baseline is important for estimating chances of an interferable pair of SAR images

The phase of the signal (the perpendicular baseline)
between the two radar acquisitions of the phase of
the scattered radar wave interferometric phase will
be incoherent

Scatterers in one pixel

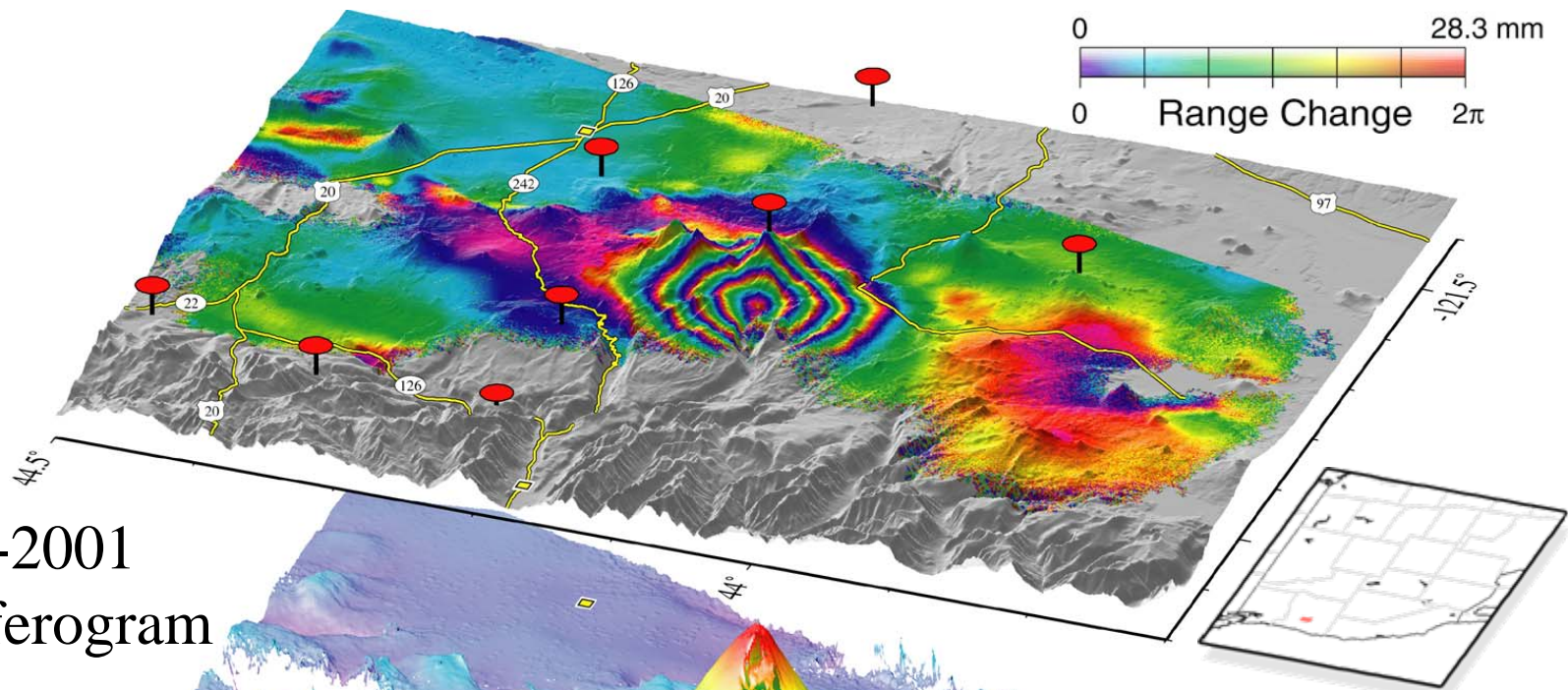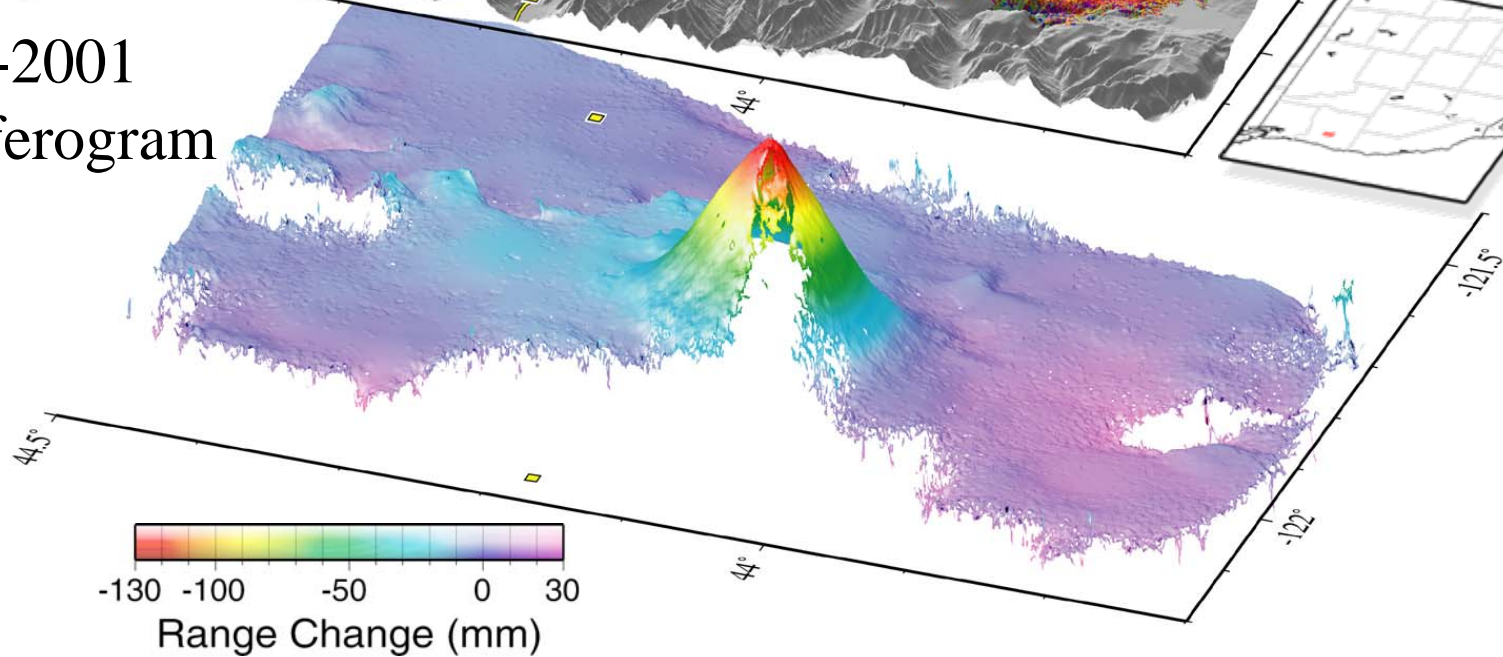The interferogram has an ambiguity related to the wavelength of the RADAR source.
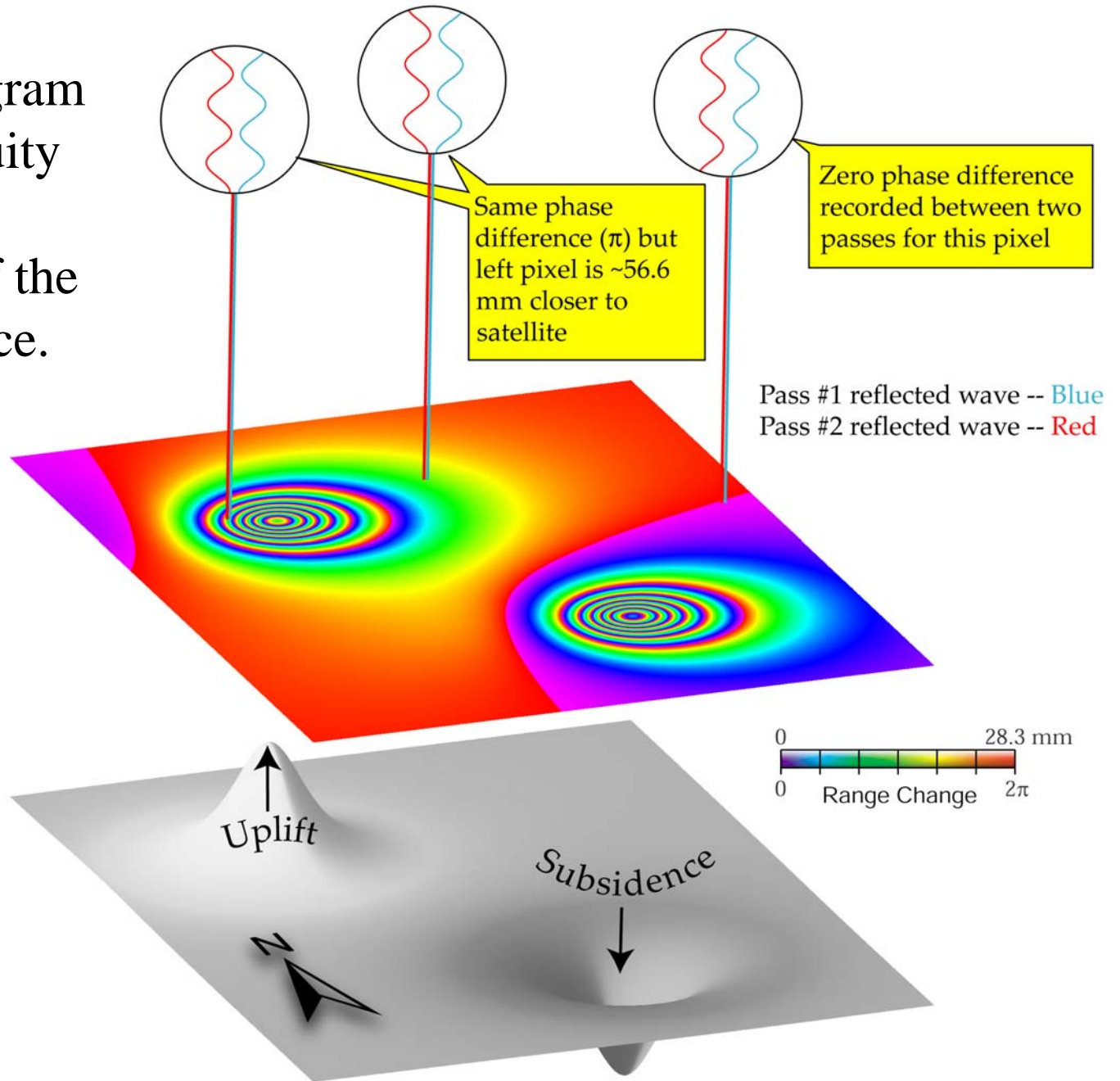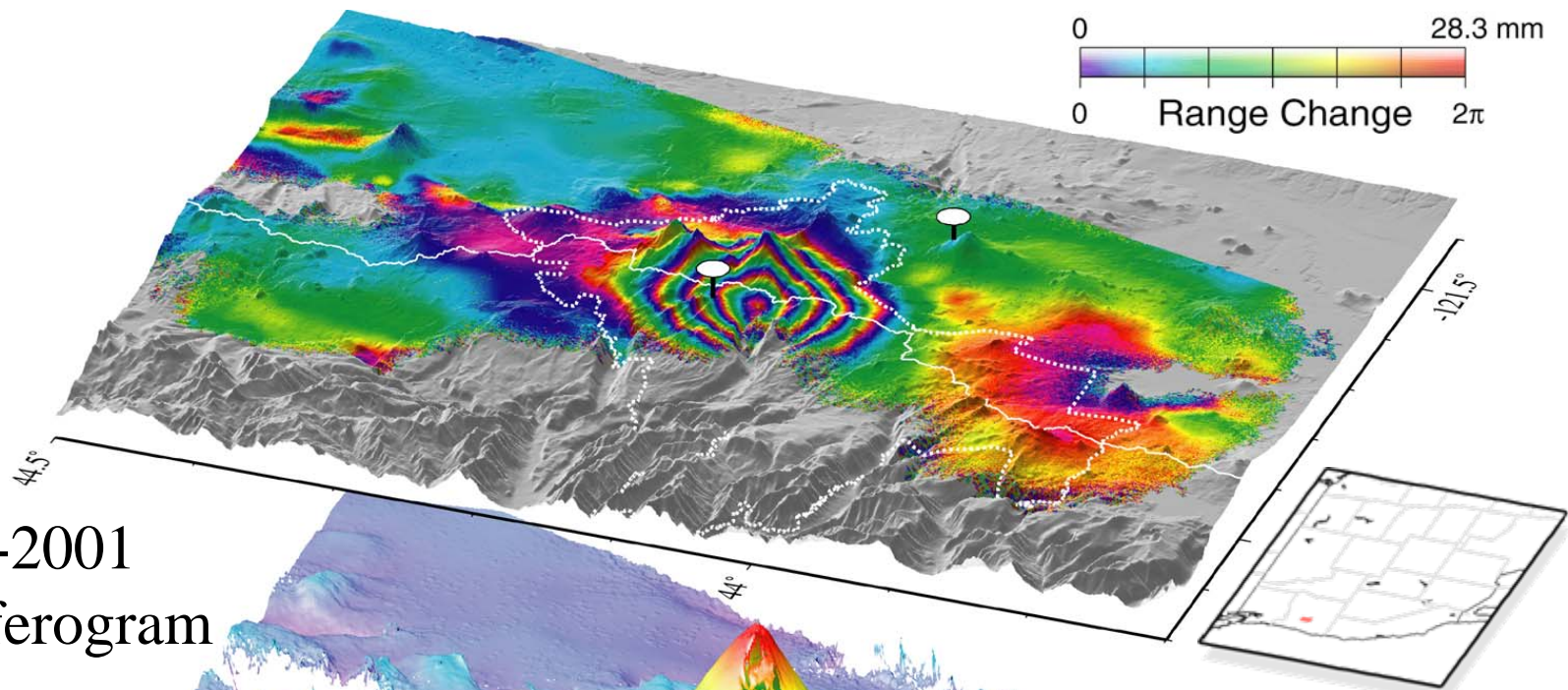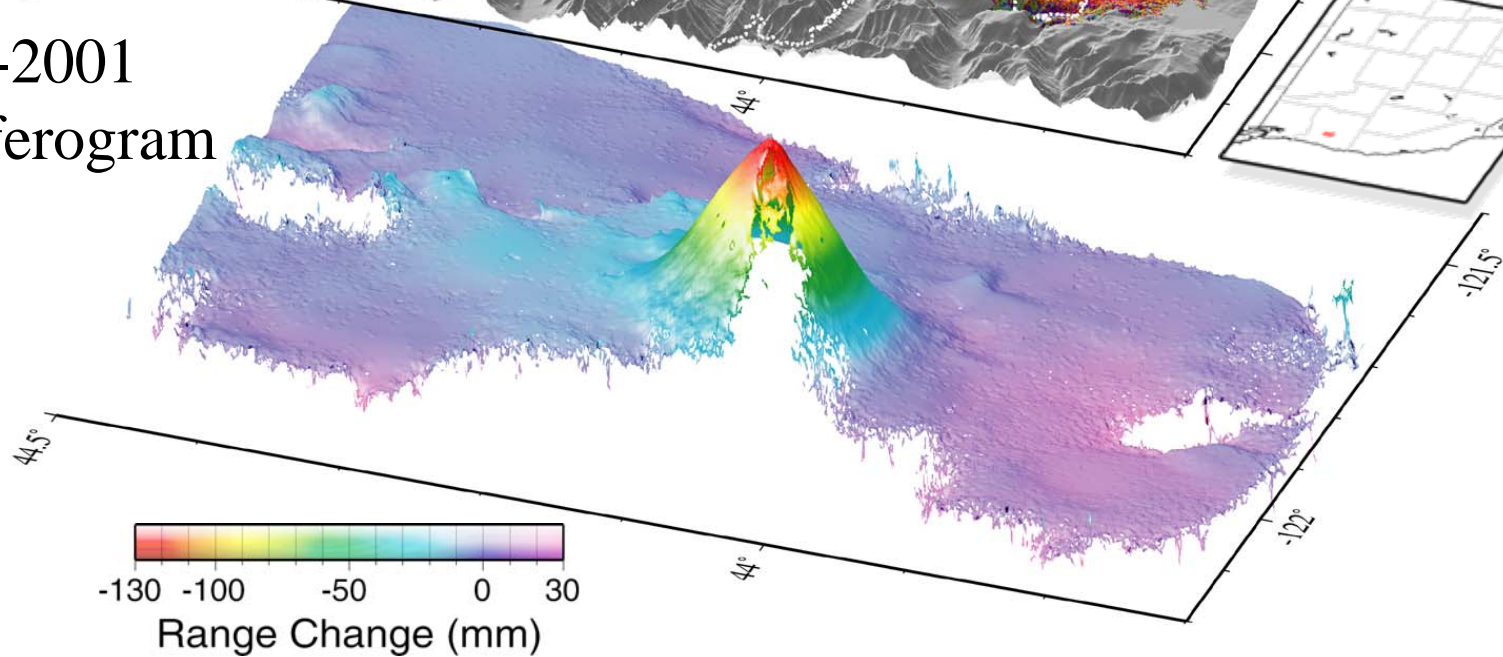
THREE
SISTERS ↗

2002.10.30

1995-2001
Interferogram

1995-2001
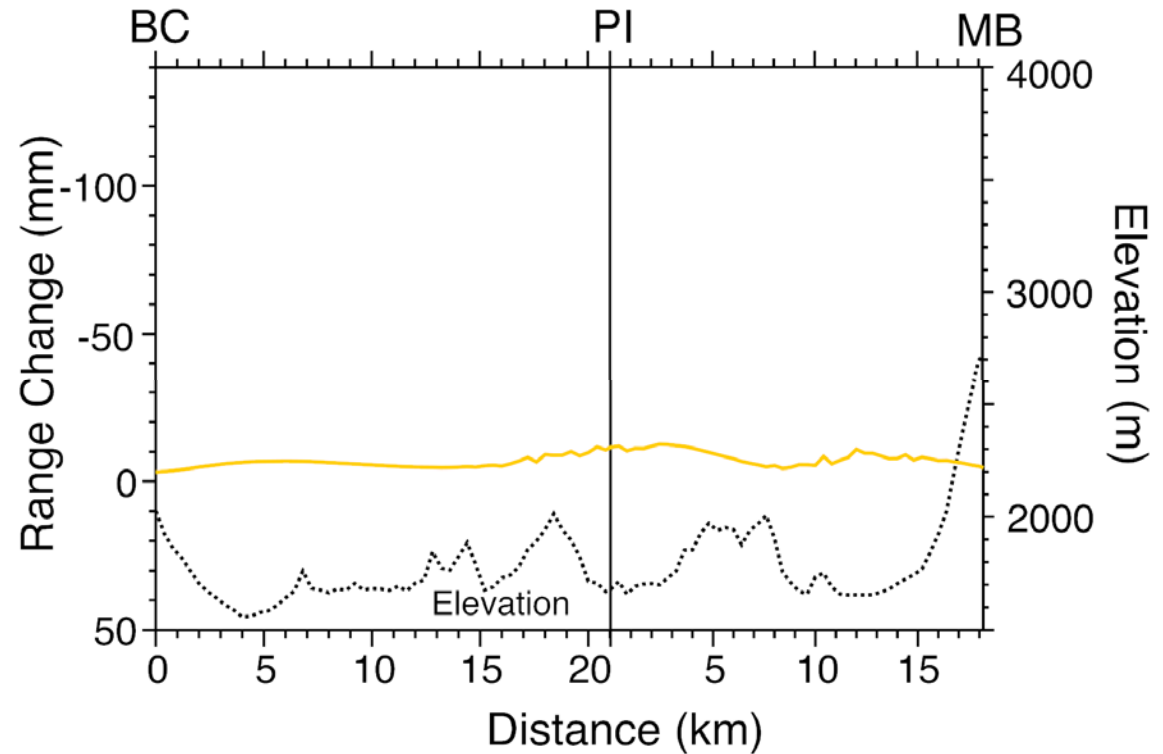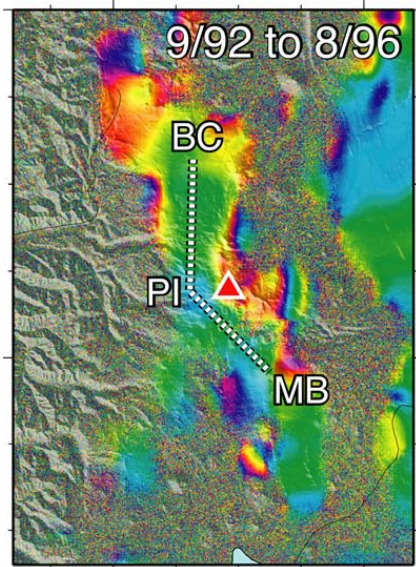Interferogram

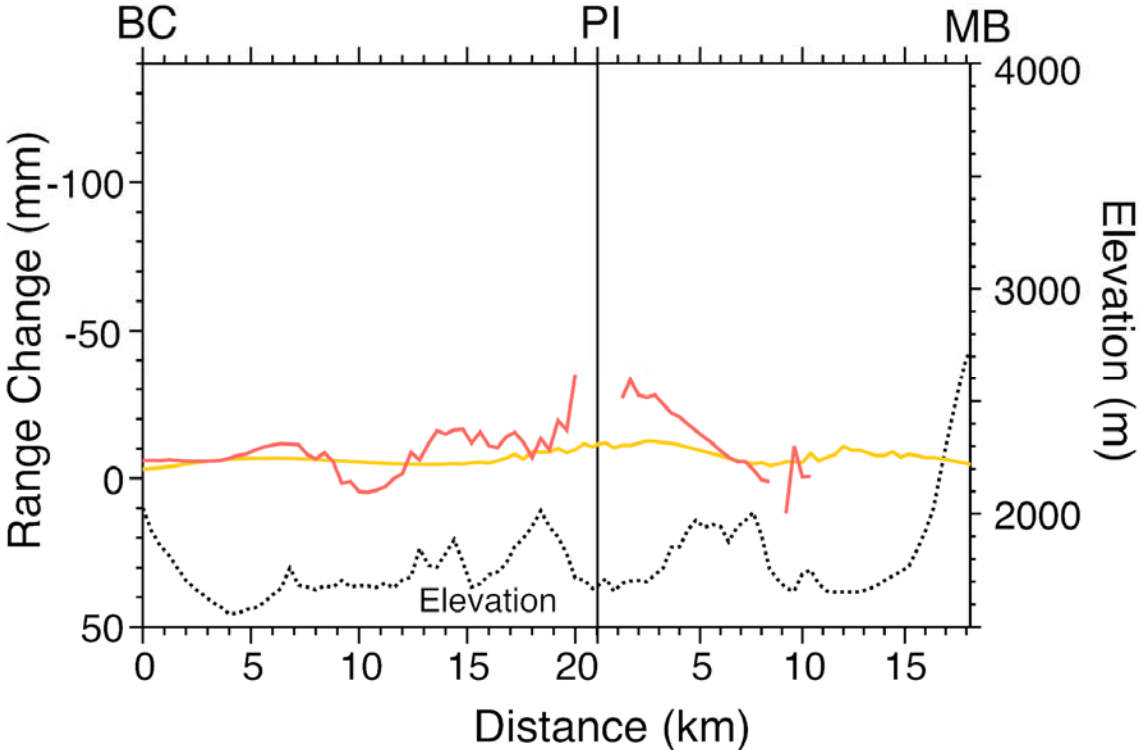0   28.3 mm

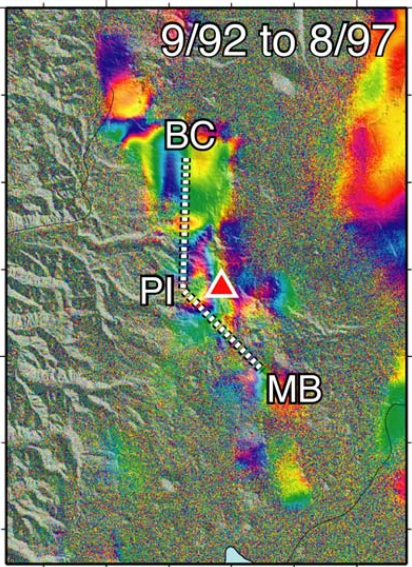0   Range Change 2π
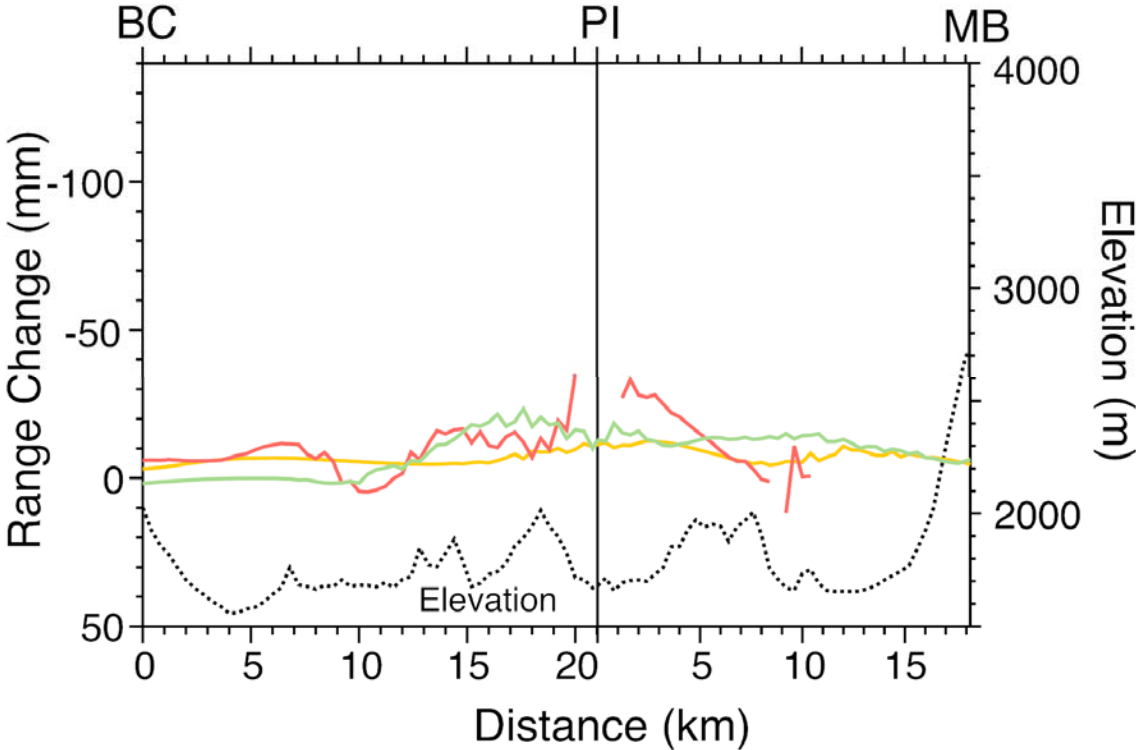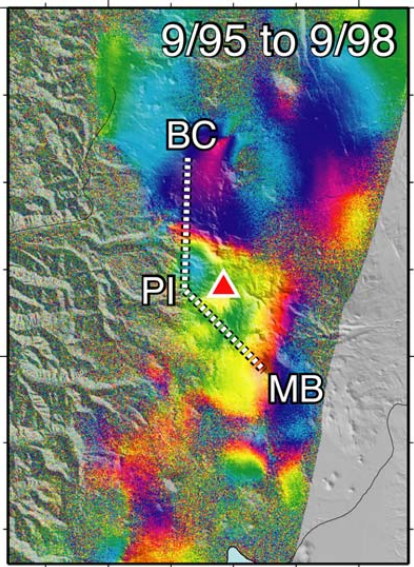
-130   -100   -50   0   30

Range Change (mm)

Profile of Uplift 1992-1996

Profile of Uplift
1992-1997

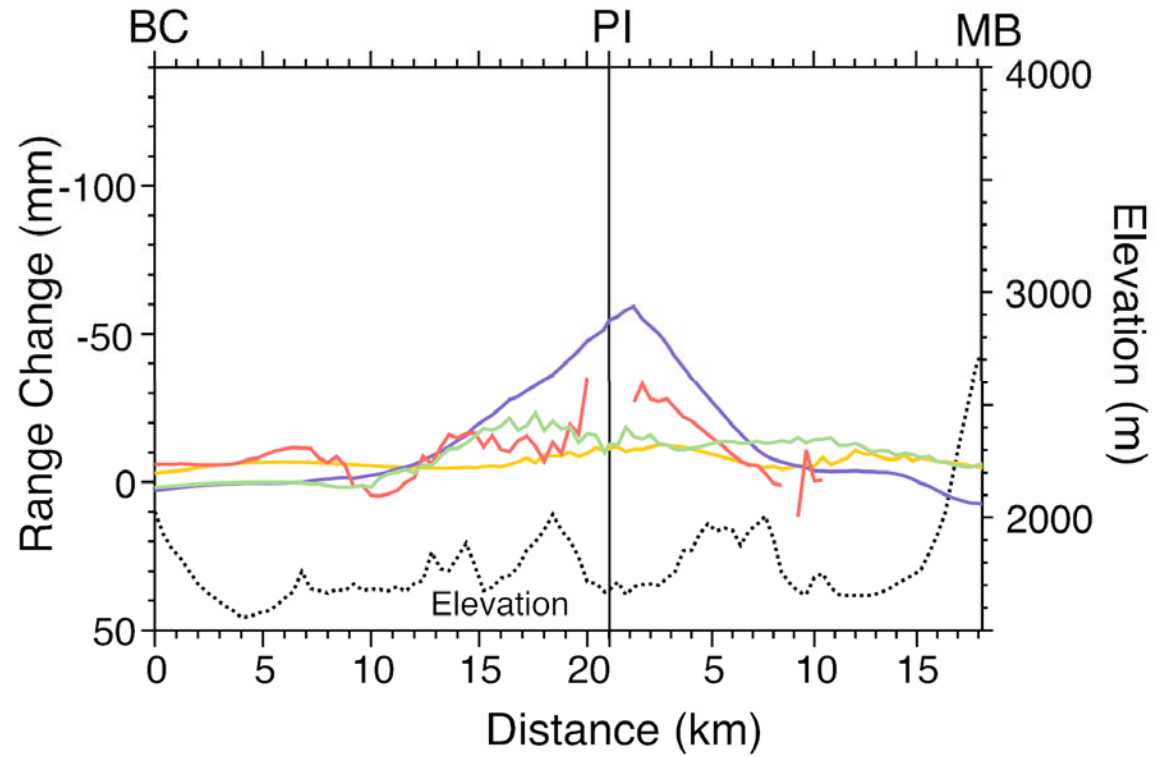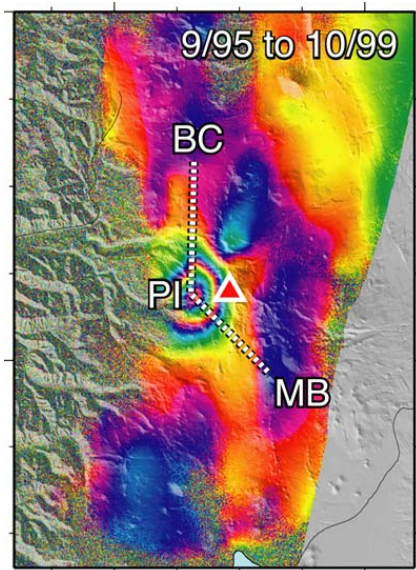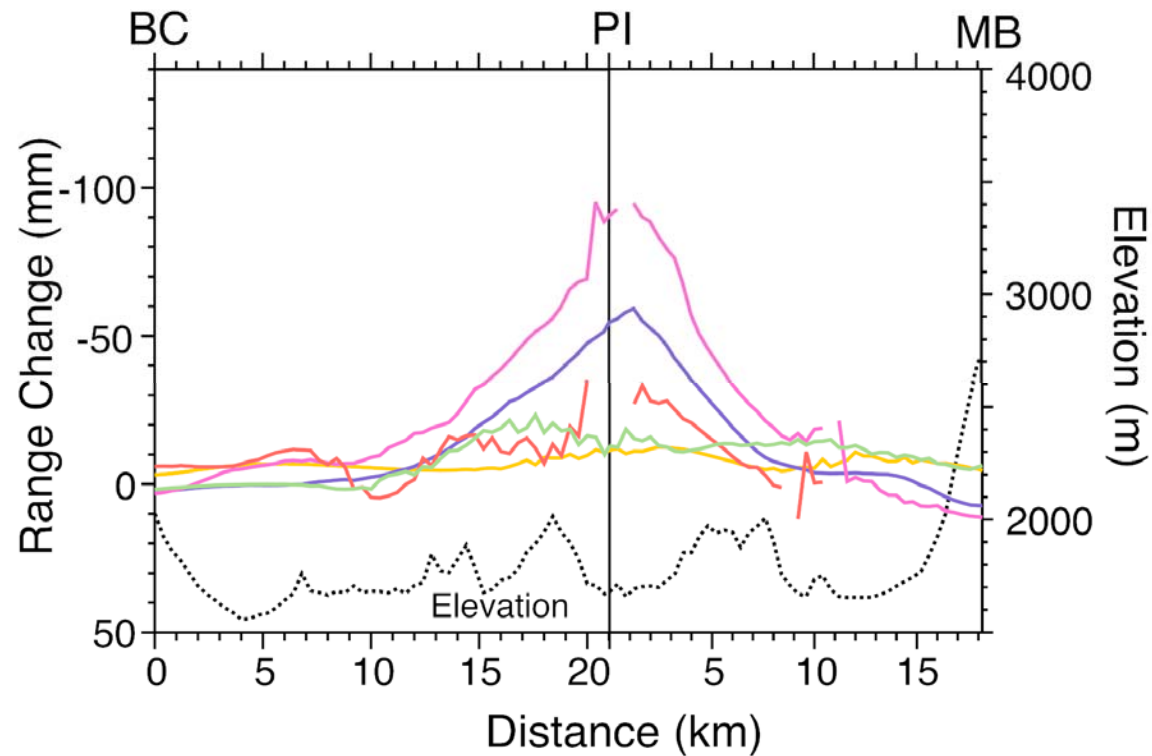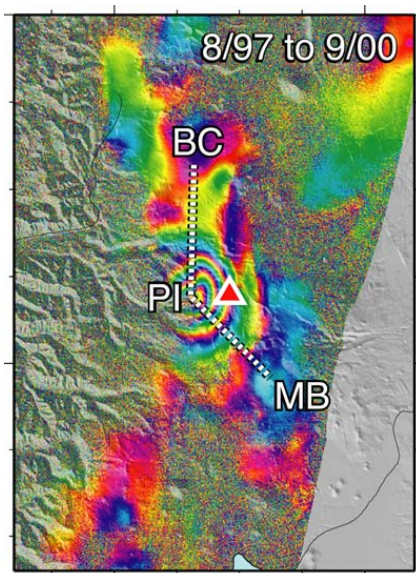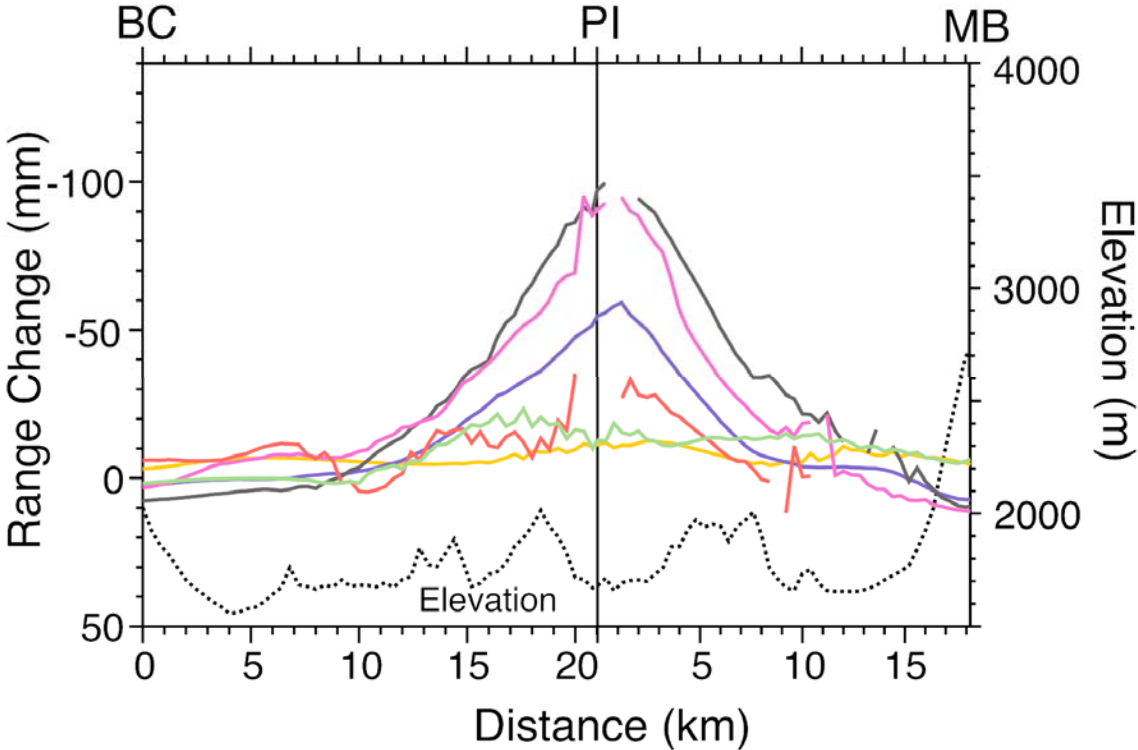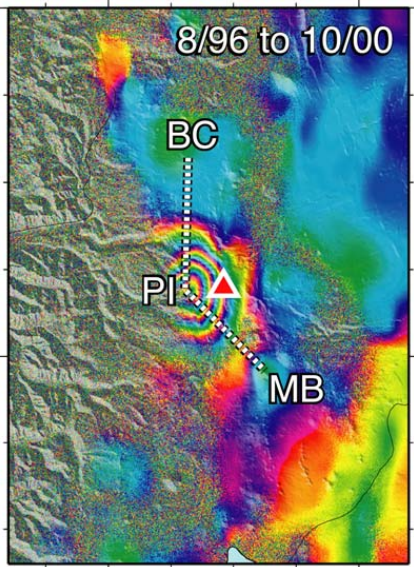# Profile of Uplift
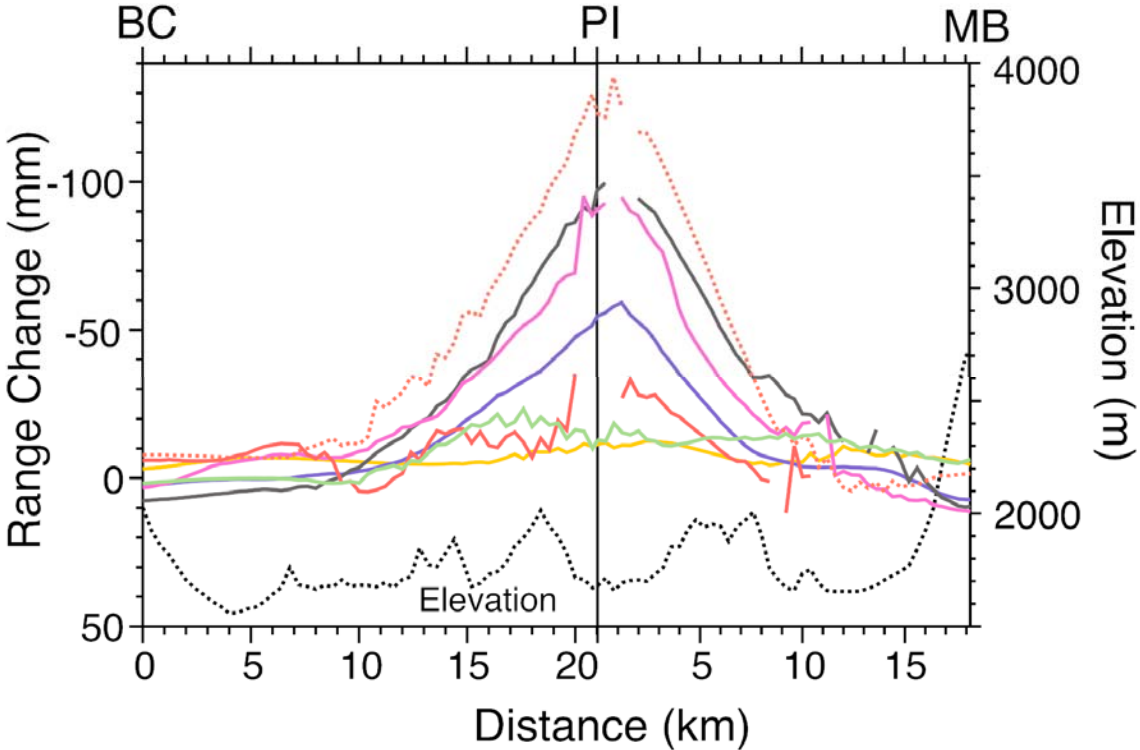## 1995-1998

Profile of Uplift
1995-1999
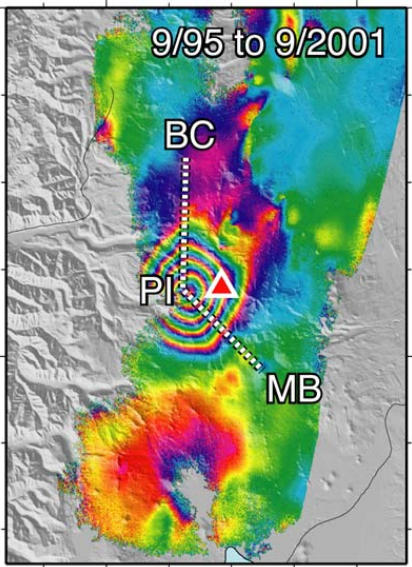
Profile of Uplift
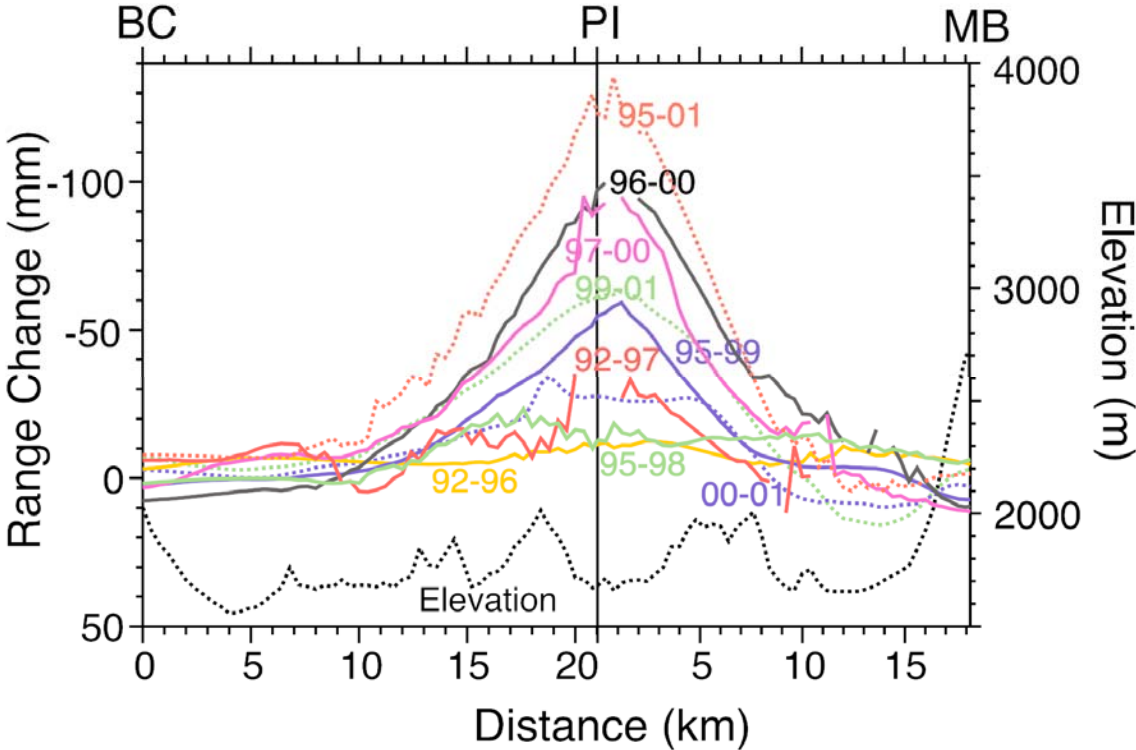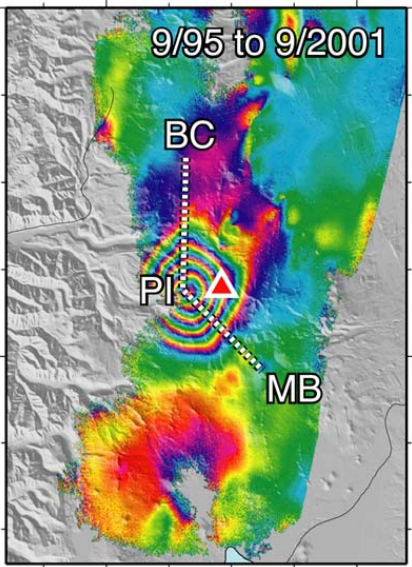## 1997-2000

Profile of Uplift
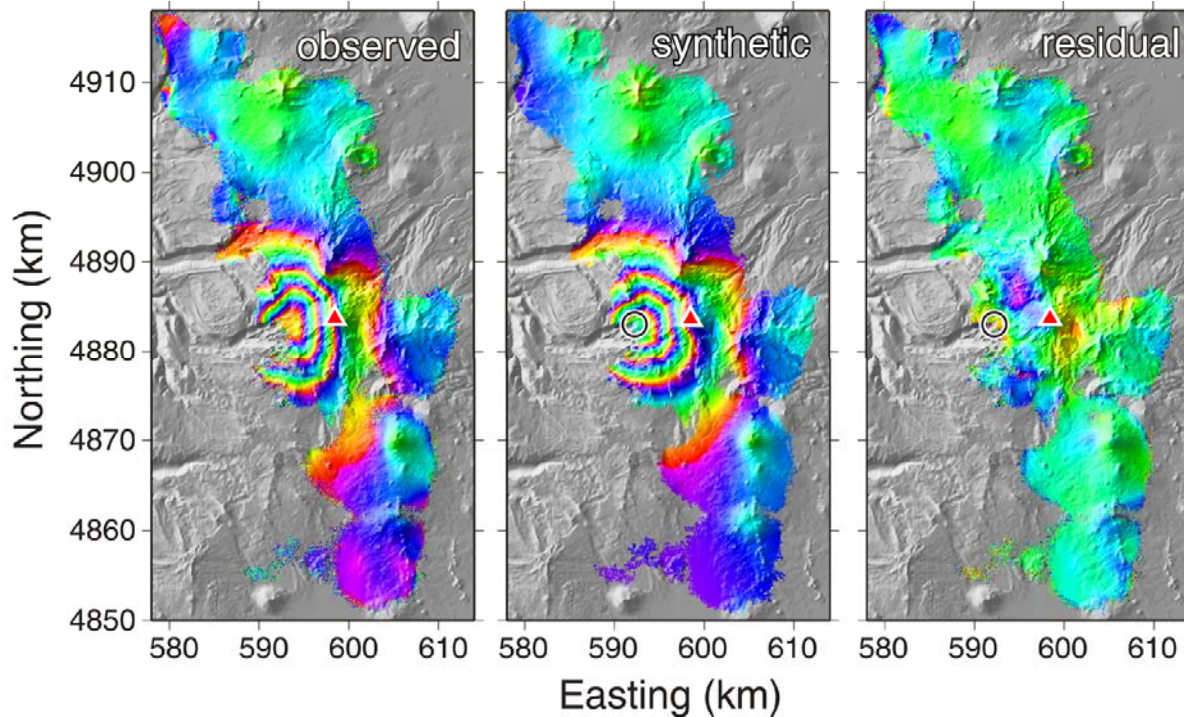# 1996-2000

Profile of Uplift
1995-2001

Profile of Uplift
1995-2001

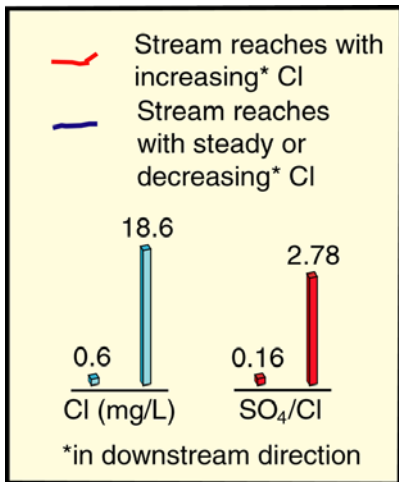# Modeling the Uplift
(or forming an idea what it means)

Assumptions
- Point Source of Inflation
- Elastic Half-space
- Simple correction for topography

Results
- Source Depth is 5-7 km
- Total volume of material injected is 0.02 - 0.03 km^3

Geochemical Anomaly is Coincident with area of Uplift

Stream reaches with increasing* Cl

Stream reaches with steady or decreasing* Cl

18.6

2.78

0.6

0.16

Cl (mg/L)

SO$_4$/Cl

*in downstream direction

Northing (km)

4890

4880

4870

Easting (km)

590

600

610

0

28.3 mm

0

Range Change

2π
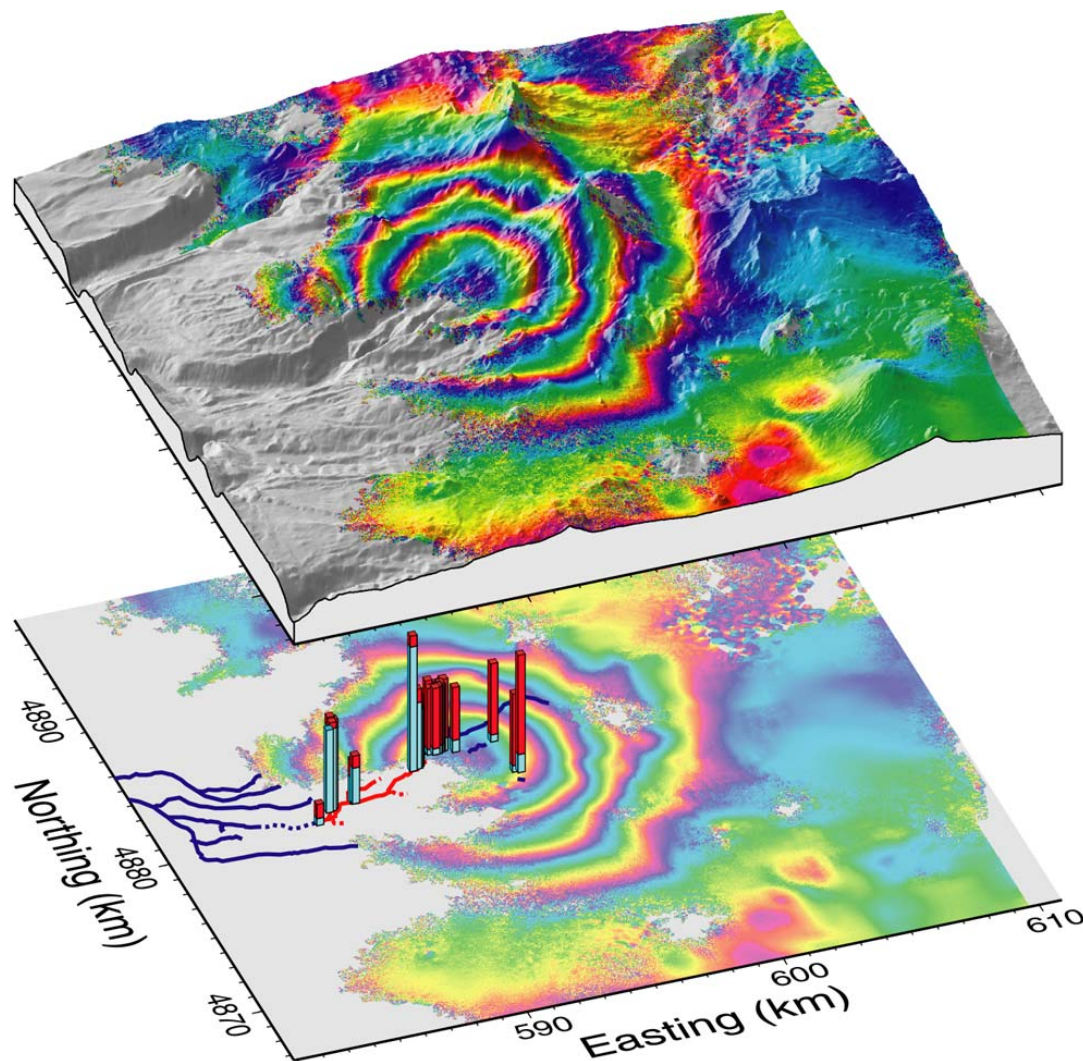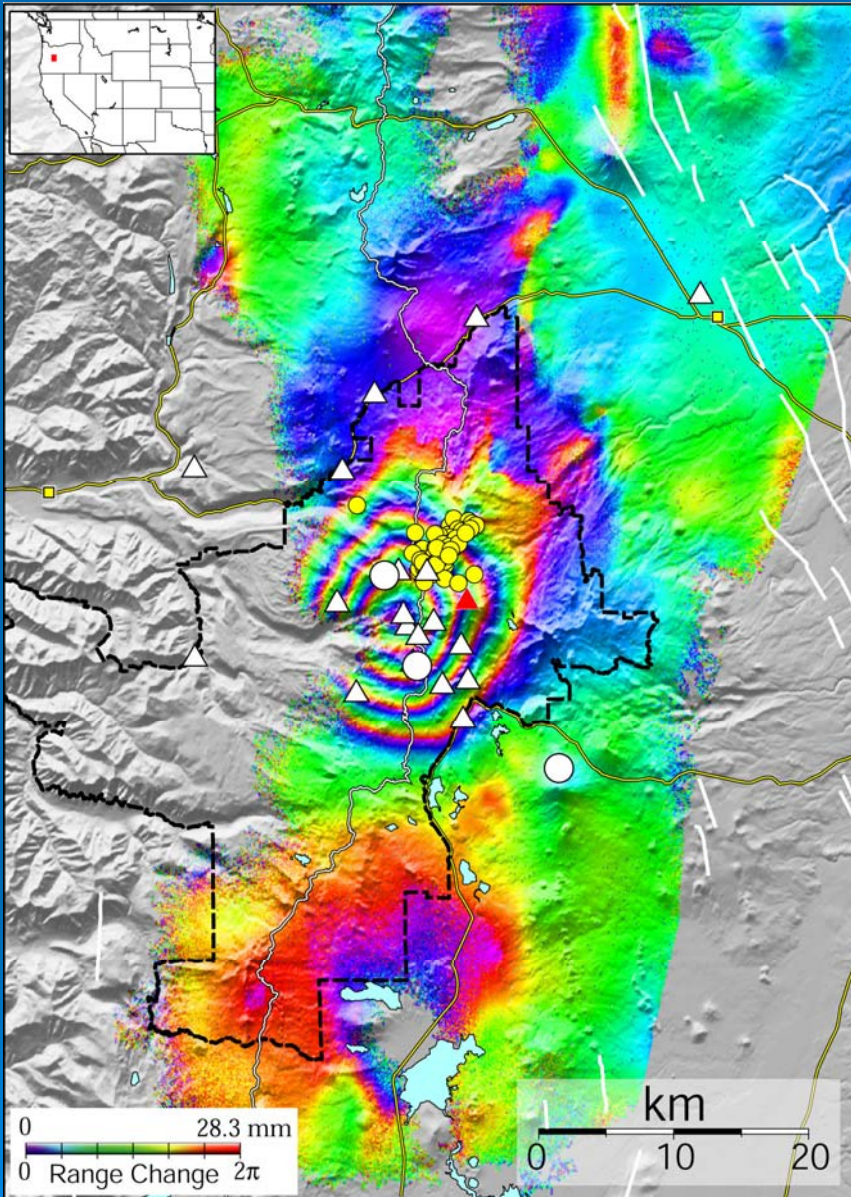
Continuous GPS station HUSB shows steady northward movement from May 2001 until the present (~14 mm/year).

In the Three Sisters volcanic center heavy vegetation limits coherence to the west, and snow limits coherence through the winter and spring.
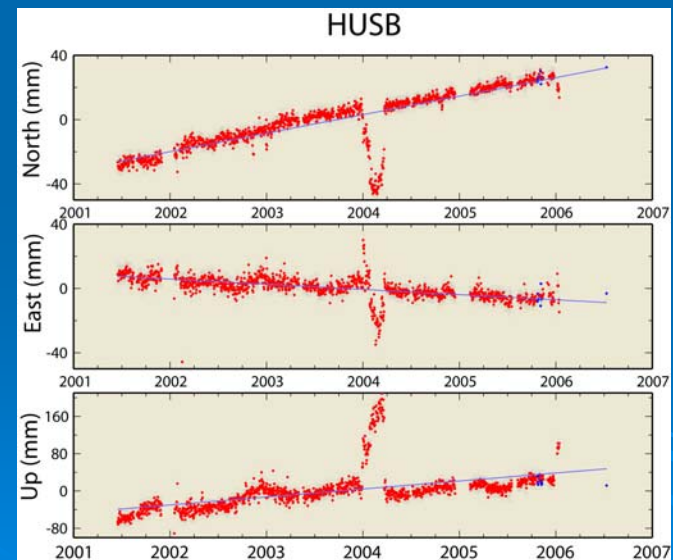
Snow Near South Sister on June 30, 2006

Peulik volcano, Alaska
1996-1997 Interferogram
Lu, et al., JGR 2002