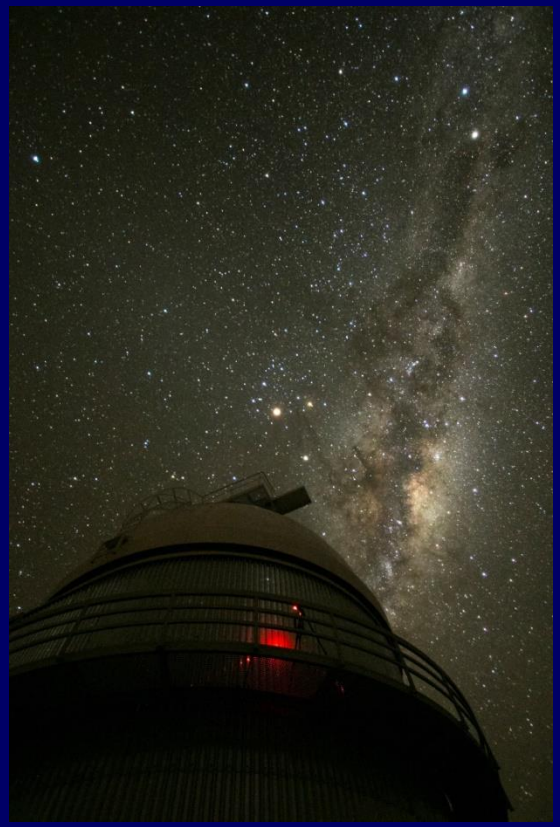
Recent development in astronomical research at Universidad Católica del Norte

Keiichi Ohnaka (Instituto de Astronomía, UCN)



UNIVERSIDAD CATOLICA DEL NORTE CHILE

INSTITUTO DE ASTRONOMÍA ucn chile

http://www.iaucn.cl

Universidad Católica del Norte
Instituto de Astronomía

- ✓ 5 faculty members
  +1 arriving soon
- ✓ 3 post-docs
  +1 arriving soon,
  +1 to be advertised soon
- ✓ PhD program in Physics + Astronomy starts in March 2017

Research areas

- ✓ Galactic archaelogy
- ✓ Spectroscopic studies of ISM
- ✓ Exoplanets
- ✓ Planetary nebulae
- ✓ Atmospheric science
- ✓ Optical / IR interferometry
  High angular resolution observation

Consortium member of

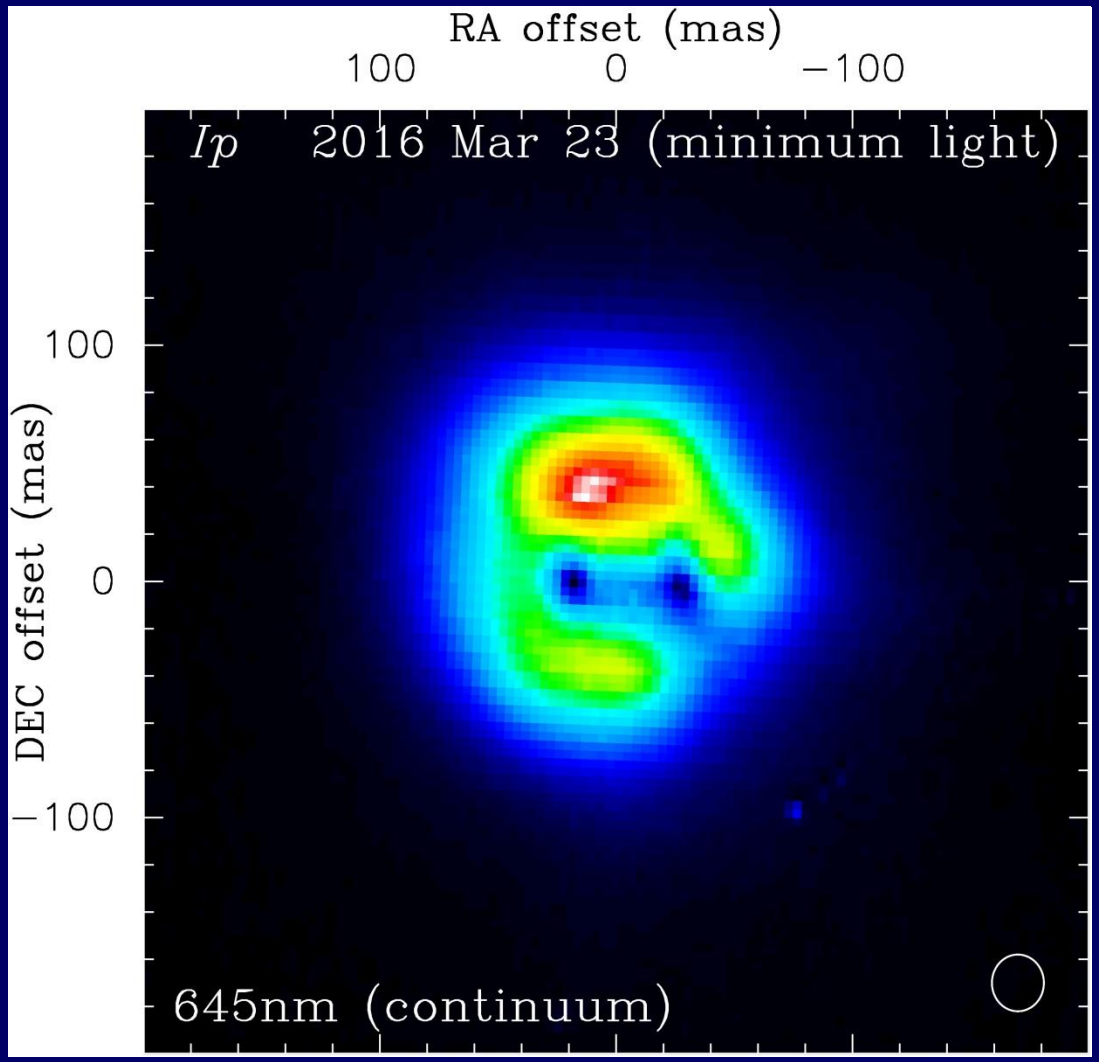
- ✓ ESO Public Survey VISTA Variables in the Via Lactea (VVV)
- ✓ Cherenkov Telescope Array (CTA)

Collaboration with Tokyo Atacama Observatory (TAO) project

- ✓ Visit of TAO members to UCN in 2015 and 2016
- ✓ Possibility for a student exchange
- ✓ Scientific collaboration on,
  e.g., Mass loss from stars in late evolutionary stages
  Synergy between high angular resolution observations and TAO

VLT/SPHERE-ZIMPOL visible polarimetric imaging of the Mira star W Hydrae

- ✓ Unpolarized direct starlight suppressed
  → Clumpy dust clouds detected at ~50 mas (~ 2 Rstar)
- ✓ Significant change between pre-maximum and minimum light
- ✓ Constraining grain size by Monte-Carlo radiative transfer modeling
  → 0.5 μm (pre-maximum)
  → 0.1 μm (minimum light)
- ✓ Contemporaneous TAO mid-IR observation



Ohnaka et al. (2016a, 2016b)

Velocity-resolved IR aperture-synthesis imaging of the surface of stars

Red supergiant Antares

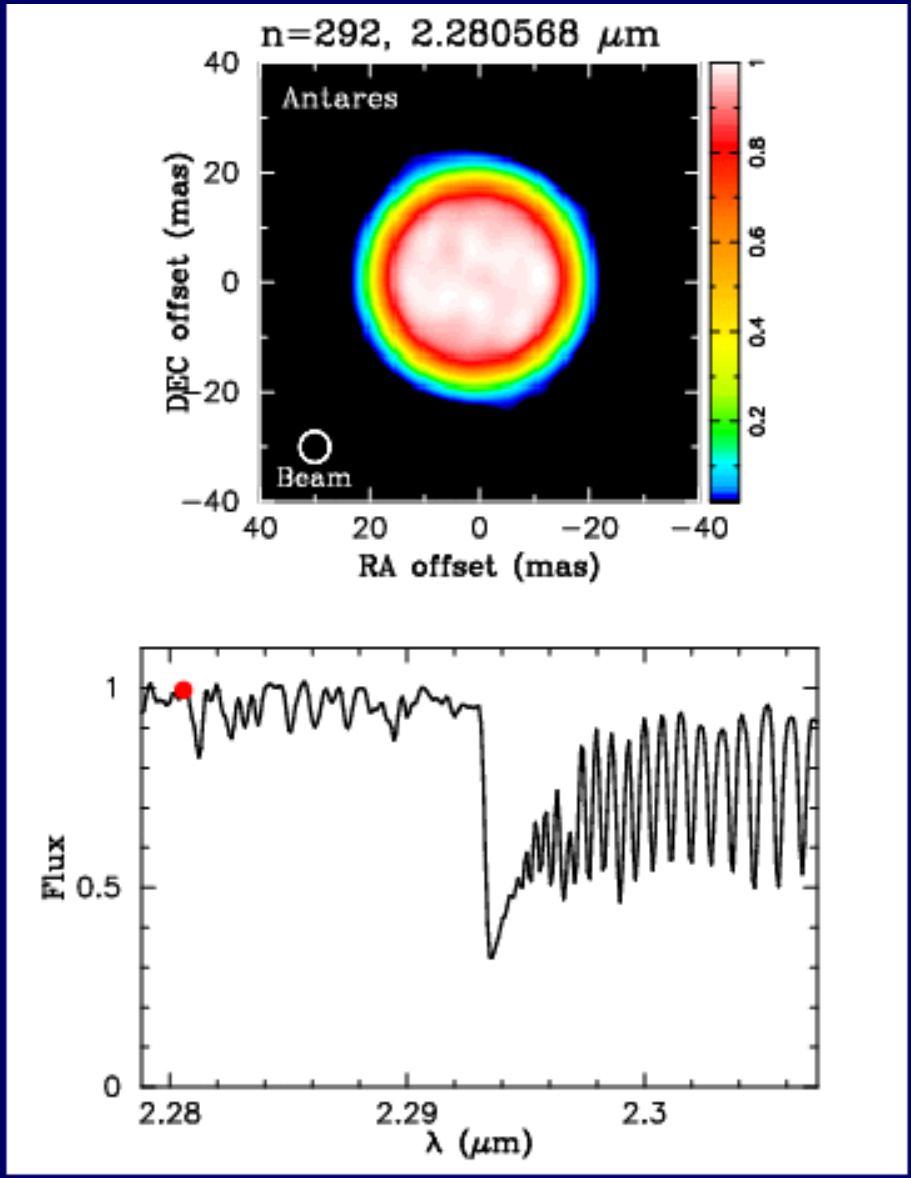
- ✓ VLTI / AMBER instrument
  Spectral resolution up to 12000
  → Individual CO lines resolved

- ✓ Baseline = 4.6 – 82 m
  → Spatial resolution = 5 mas
  → Beam size = 1/7 × stellar size

- ✓ Within 1.5 stellar radii, the gas is moving in clumps in an inhomogeneous manner.

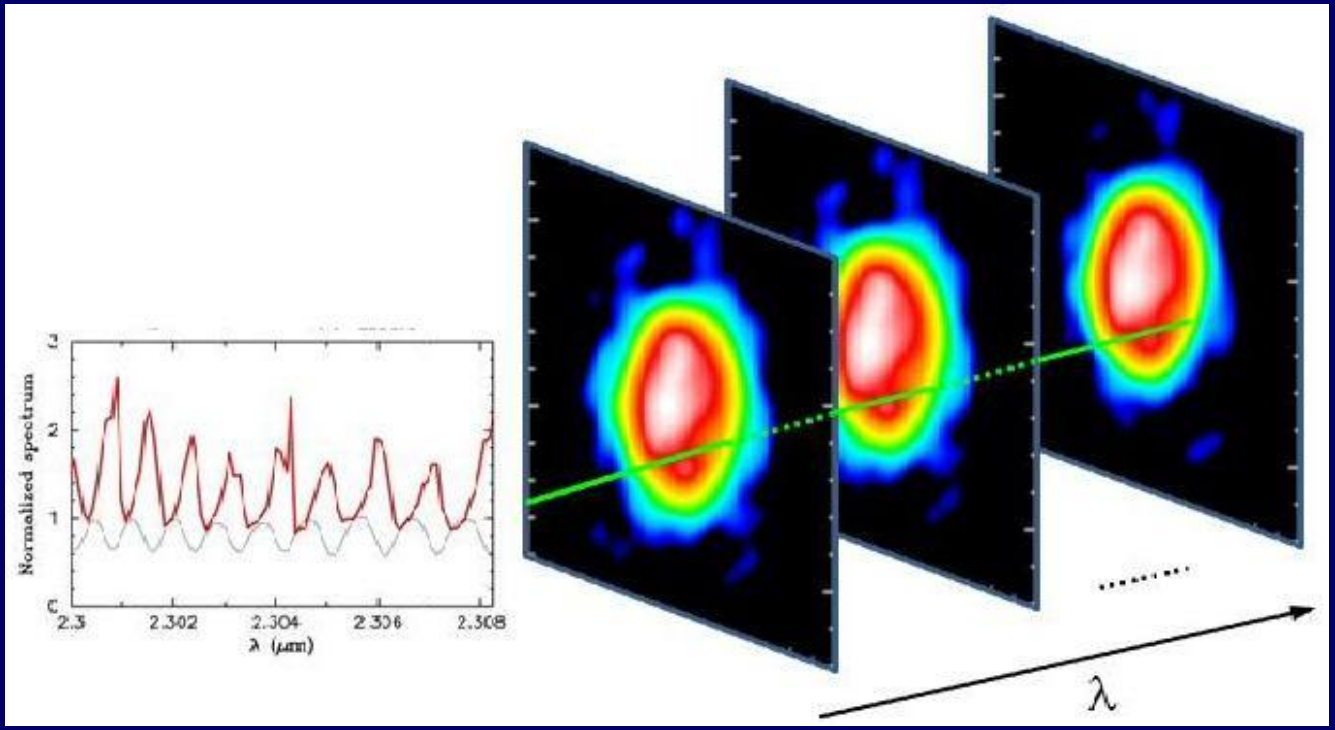
- ✓ TAO mid-IR imaging to trace the clumps on larger spatial scales

Preliminary results:
Ohnaka et al. (2016, in prep)



Milliarcsecond-resolution spatially resolved IR spectroscopy

- ✓ Image at each wavelength is normalized with the observed flux
- → Extract the spatially resolved spectrum at each position



La Silla 1 m telescope (LSOM)

- ✓ Exclusive use for UCN

- ✓ Telescope control and dome refurbished by PUC and UCN. Remote-controled operations

- ✓ FIDEOS (Fiber Dual Echelle Optical Spectrograph) (PI: L. Vanci, PUC)

  400 — 750 nm, spectral resolution = 40,000

  3 months/year reserved for FIDEOS team
  9 months/year for UCN

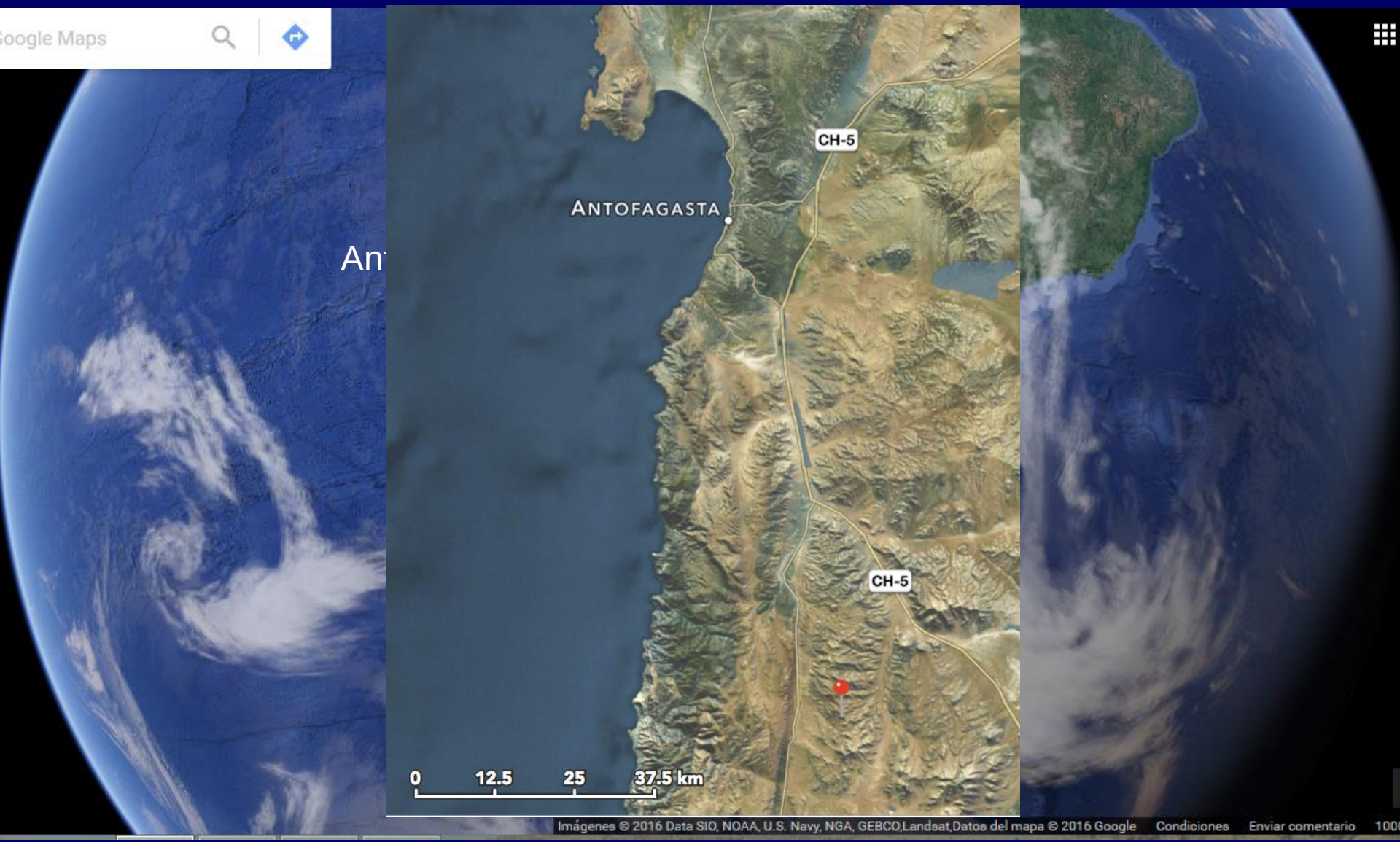
La Silla 1 m telescope (LSOM)

✓ Adaptive optics experiment in the visible
(PI: T. Minezaki, Univ. of Tokyo)

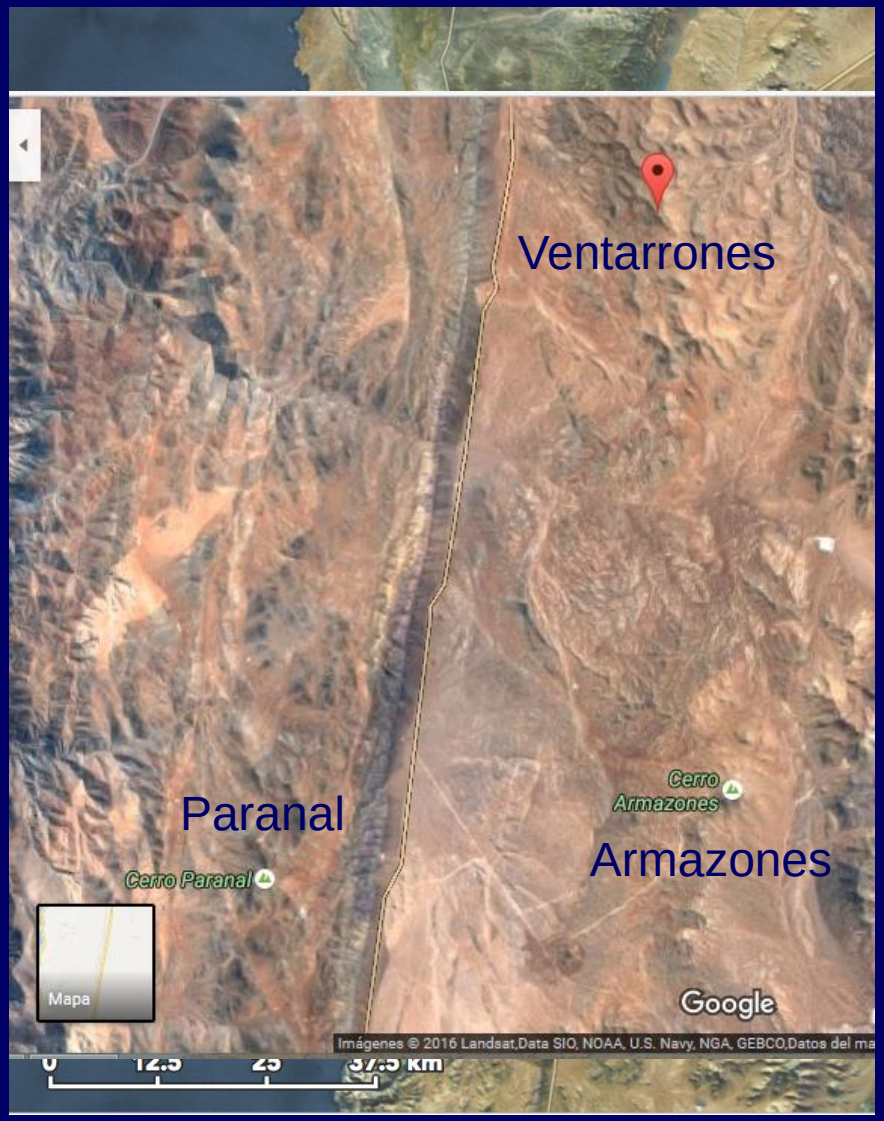
- Developing a compact, (relatively) cheap AO system in the visible for small telescopes (1–2 m)
- Test observations done in Japan (bad seeing)
- Plan: good seeing at La Silla
  → diffraction limit = 0.1 arcsec
- Next step: Laser guide star

✓ Interface to a CCD camera available

Ventarrones Observatory



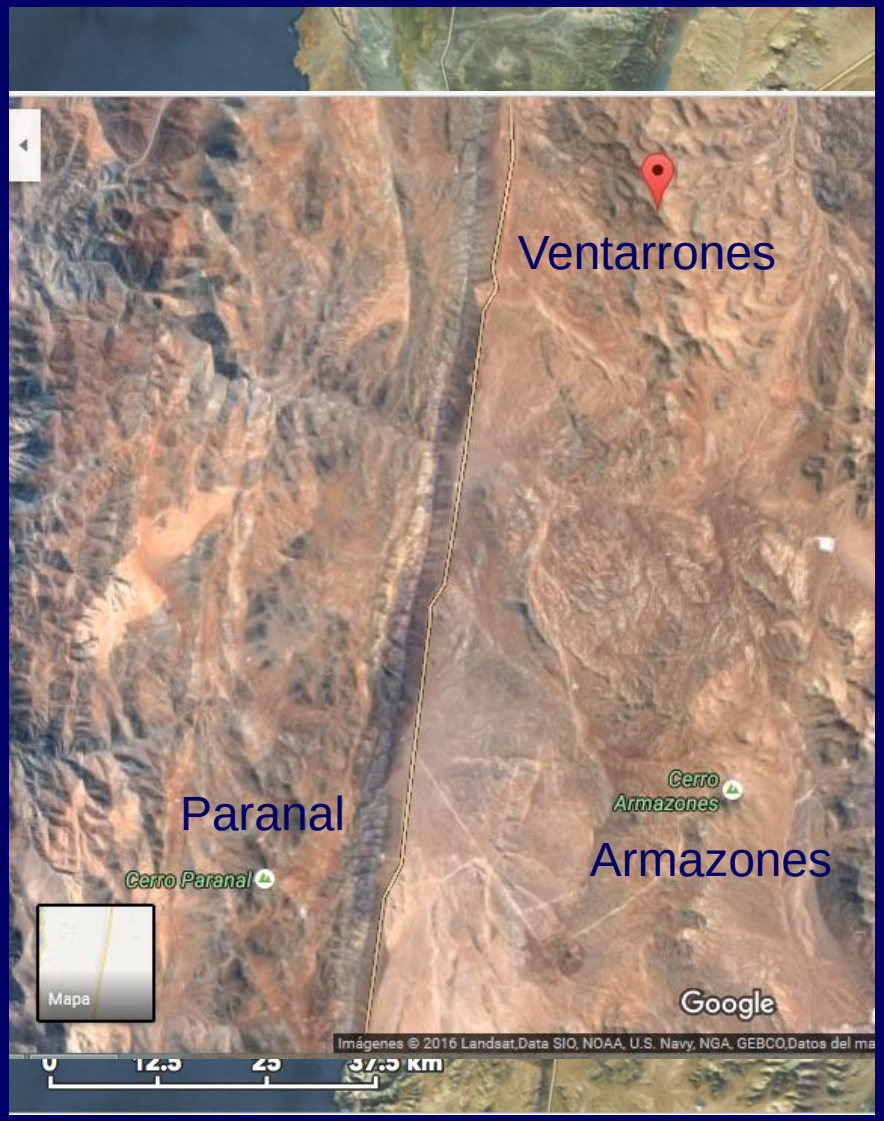
Ventarrones Observatory



- ✓ 90 km south of Antofagasta
  35 km northeast of Paranal
  20 km north of Armazones
- ✓ 20-year concession to UCN
- ✓ Altitude 2800 m
- ✓ 5 km × 5 km area on the summit
- ✓ E-ELT candidate site

Cerro Armazones
Paranal

Ventarrones Observatory



Site characteristics

(Vernin et al. 2012;
Vázquez Ramió et al. 2012)

- ✓ 85% clear nights

	Median	Best 1/4
✓ Seeing (″)	0.91	0.76
✓ Coherence time (ms)	4.90	7.13
✓ Isoplanatic angle (″)	1.96	2.56

Our goals:

- ✓ Develop an astronomical observatory
- ✓ Develop renewable energy sources and efficient use of water
- ✓ Develop an educational & astro-tourism center

Ventarrones Observatory

- ✓ Negociation on partnership agreement with the Chinese (National Astronomical Observatory of China) is ongoing.
- ✓ For energy and water, Texas Tech Univ. is interested in collaboration.
- ✓ Road to the summit will be constructed by Ministerio de Obras Públicas (MOP)
- ✓ There is still a lot of space in 5 km x 5 km!
  Interest in collaboration is welcome!