GNSS Evolutionary Architecture Study (GEAS)

CGSIC
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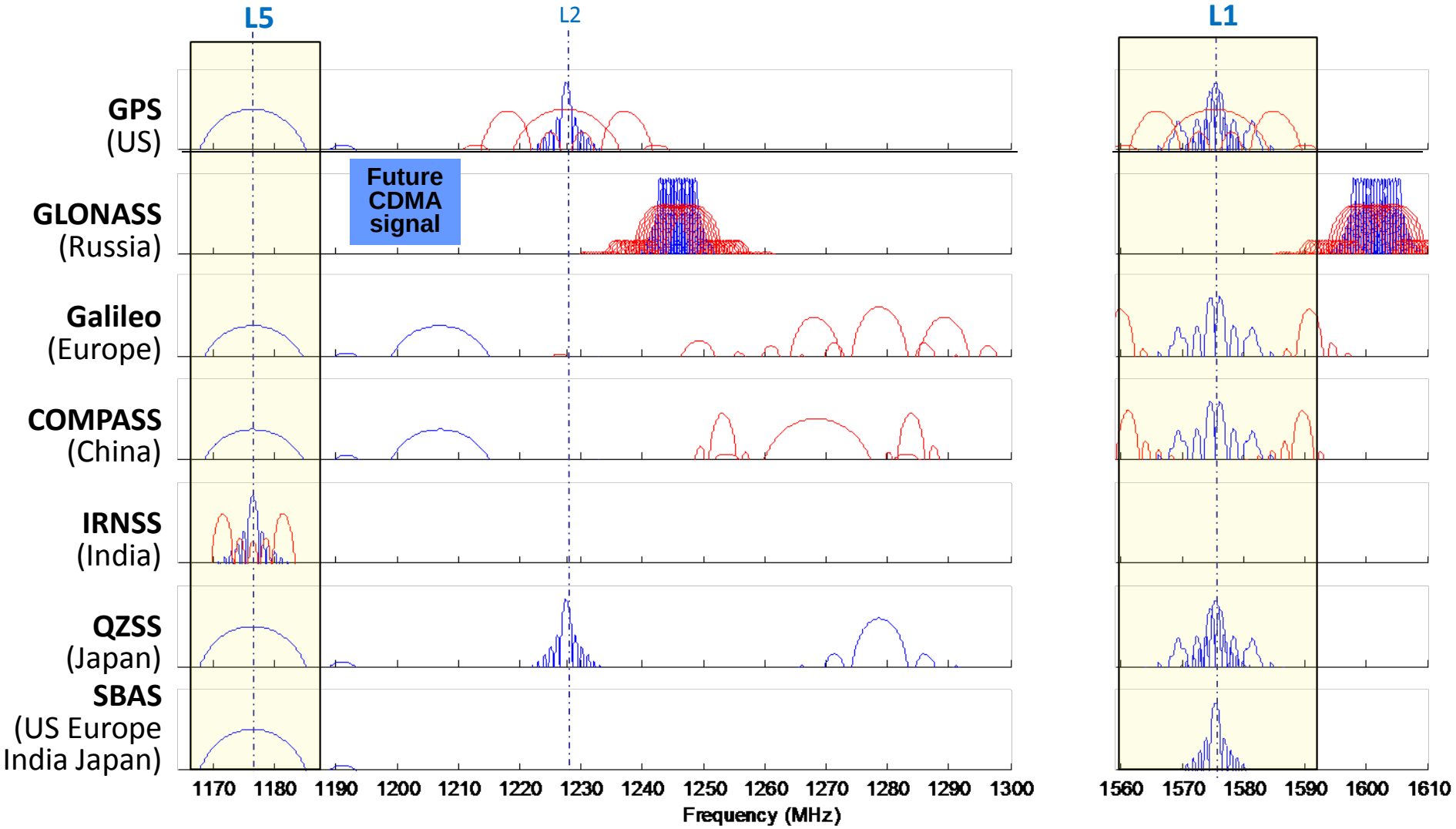
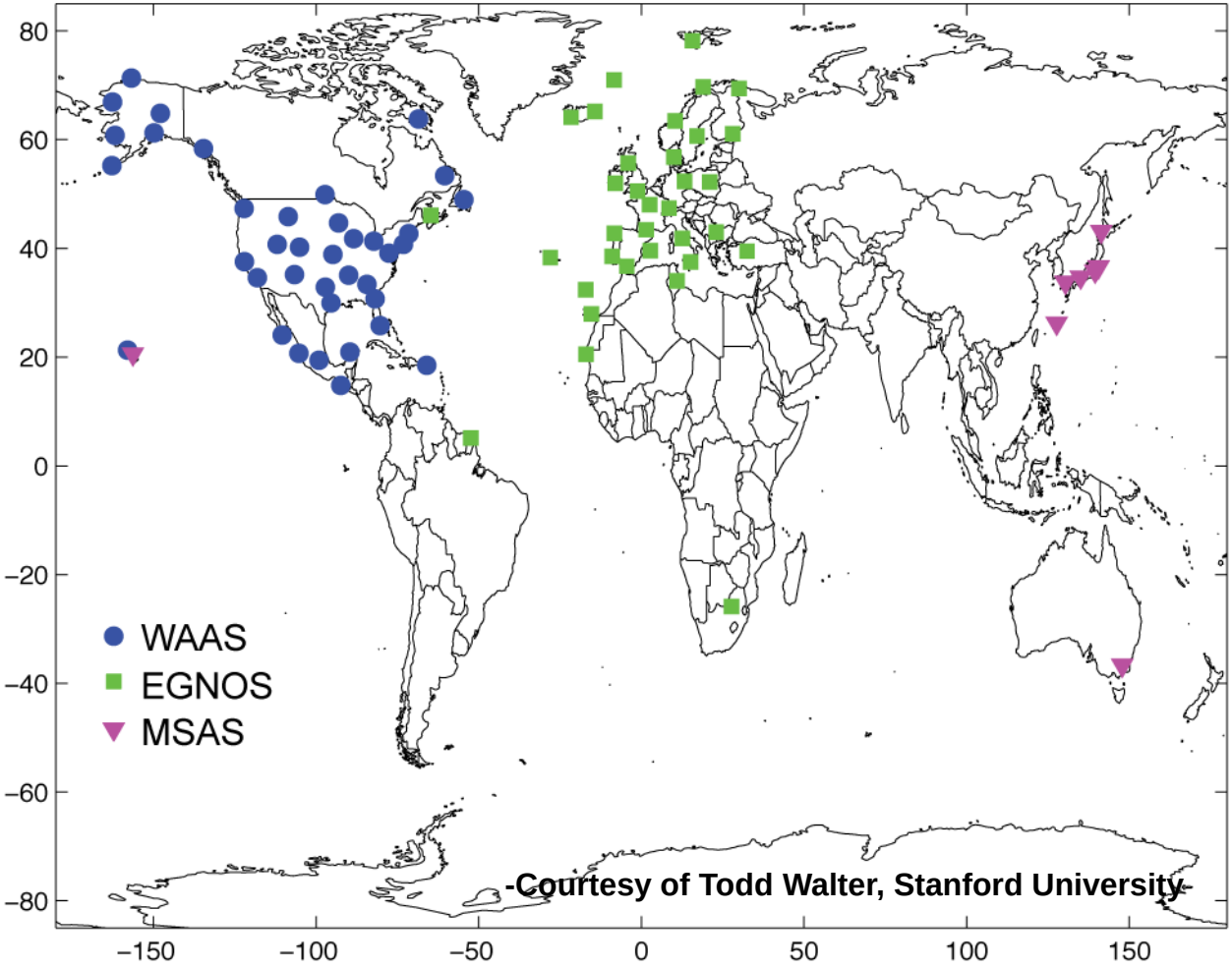
GEAS Objectives

- **Evaluate GNSS-based architectures to provide robust LPV-200 service worldwide circa 2020**
  - Multiple dual frequency GNSS constellations in protected aeronautical bands
  - Direct estimation and removal ionospheric delay errors
  - Opportunity to consider advanced RAIM (ARAIM) techniques
- **Enable a smooth integration of future GNSS in the user equipment**
- **Near term implications for WAAS (SBAS)**
  - India and Russia are developing SBAS systems
  - Investigate potential to expand SBAS to provide global LPV coverage
  - Multiple-constellation SBAS

Current International Signal Plans



Current Reference Networks



-Courtesy of Todd Walter, Stanford University-

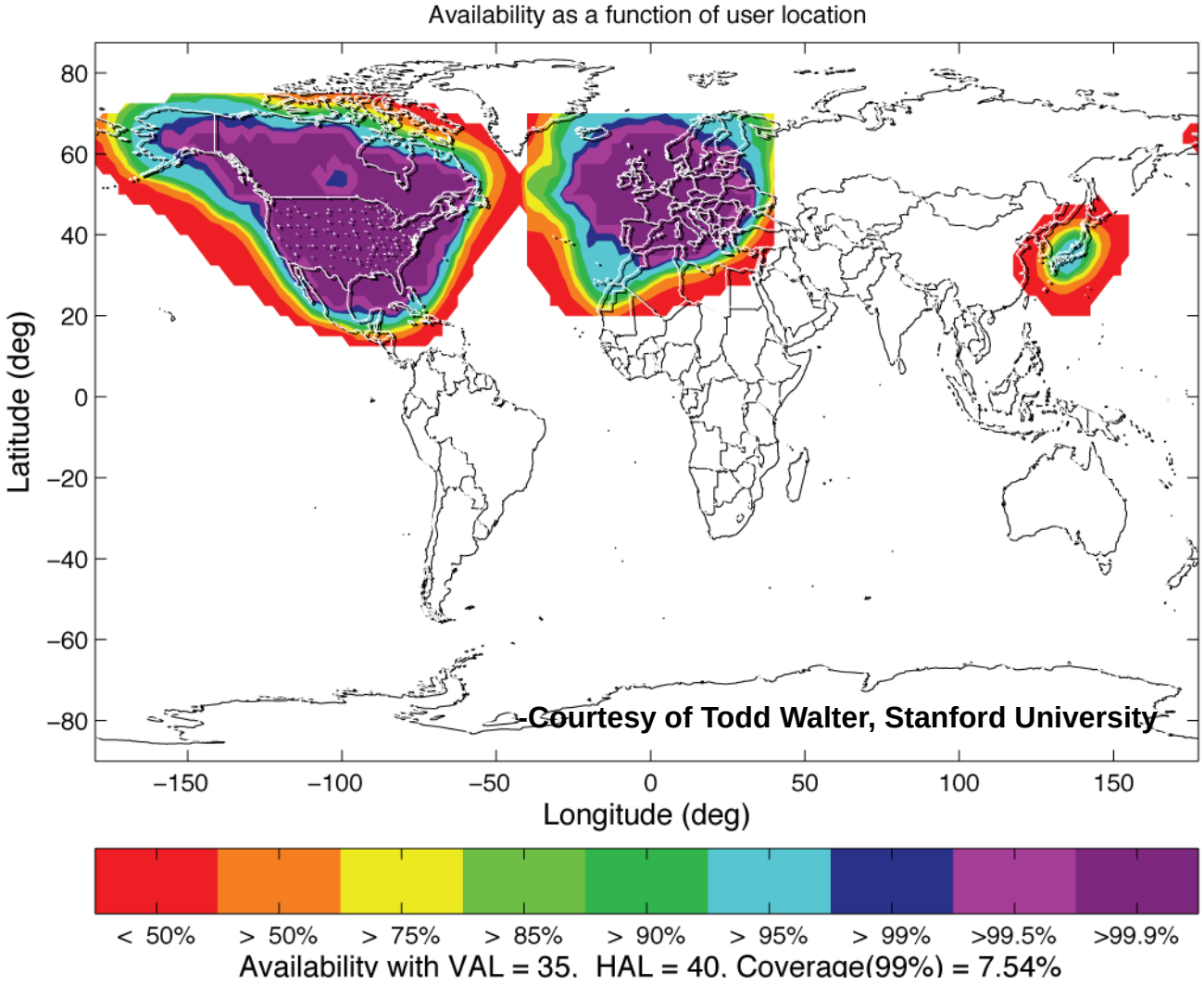
Current LPV-200 Coverage

(Single Frequency GPS)

WAAS

EGNOS

MSAS

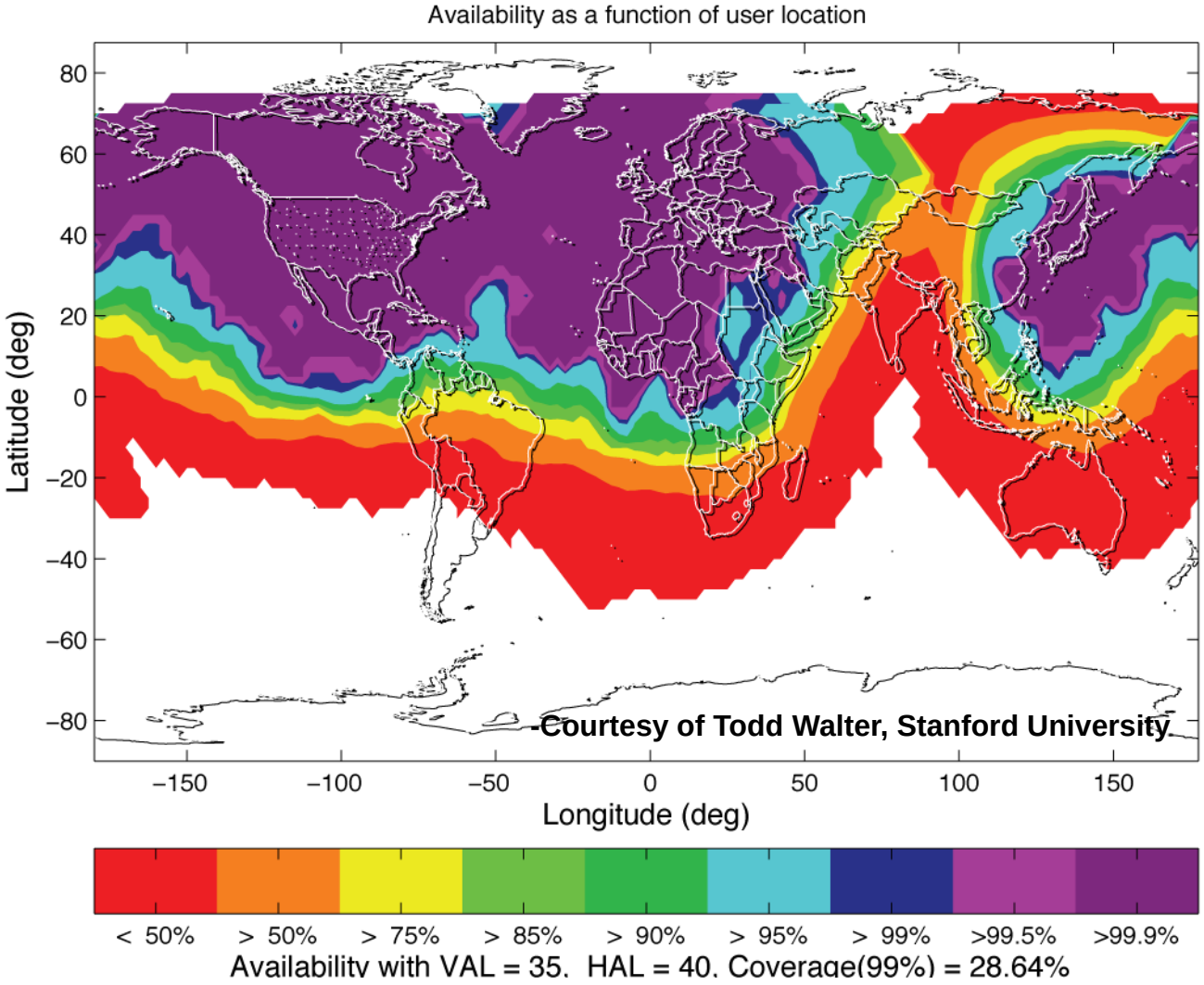


Future LPV-200 Coverage
(Dual Frequency GPS)

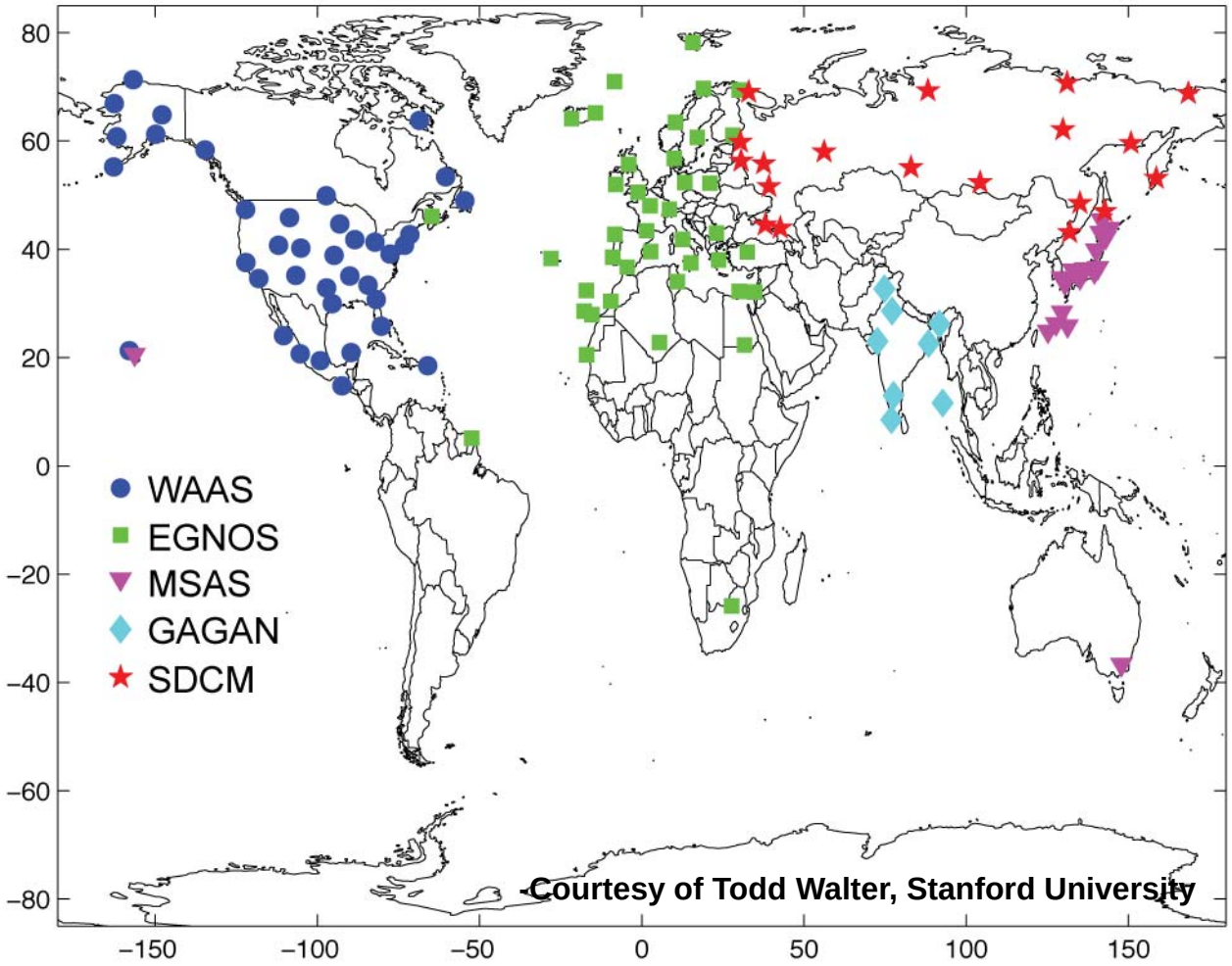
WAAS

EGNOS

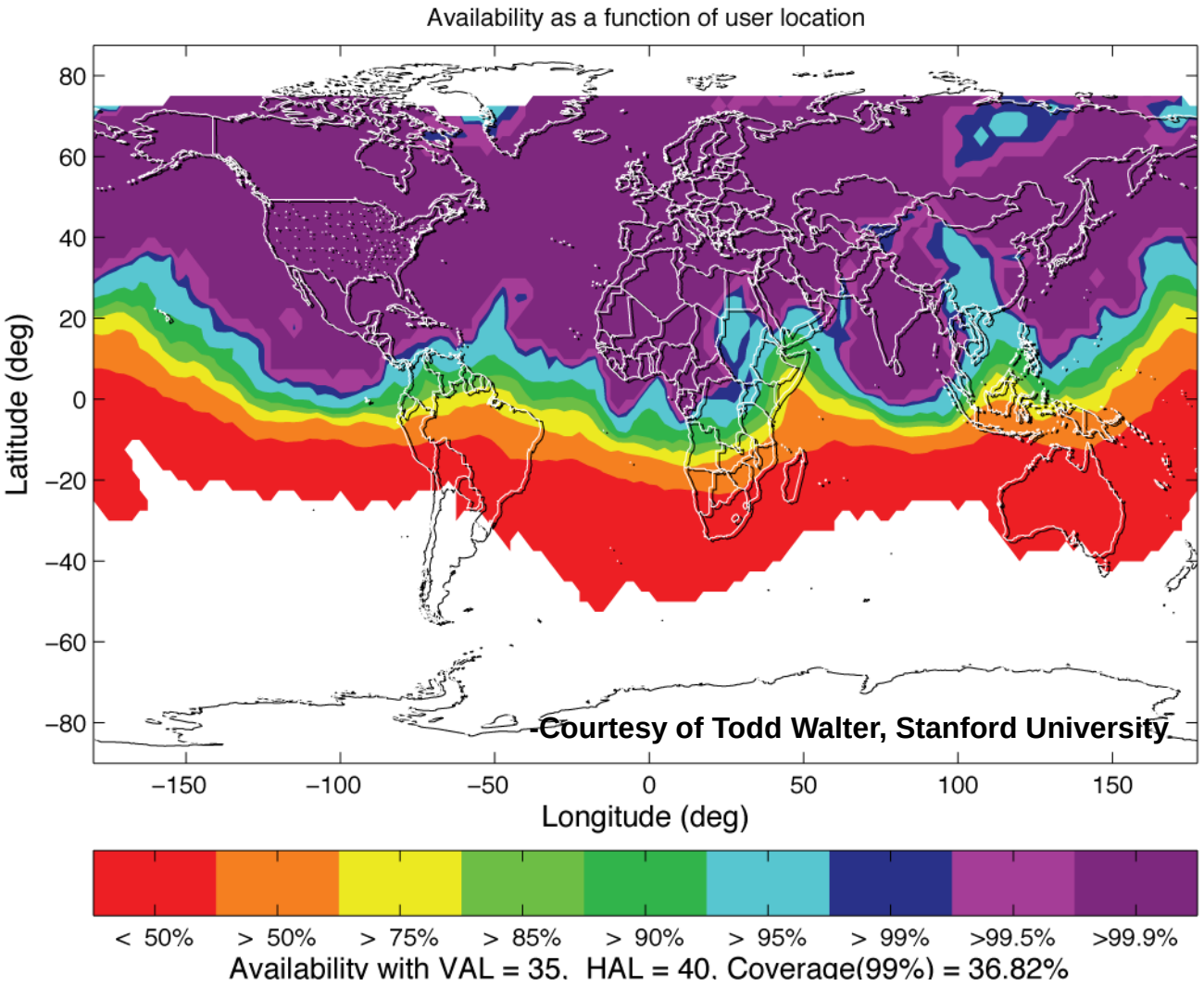
MSAS



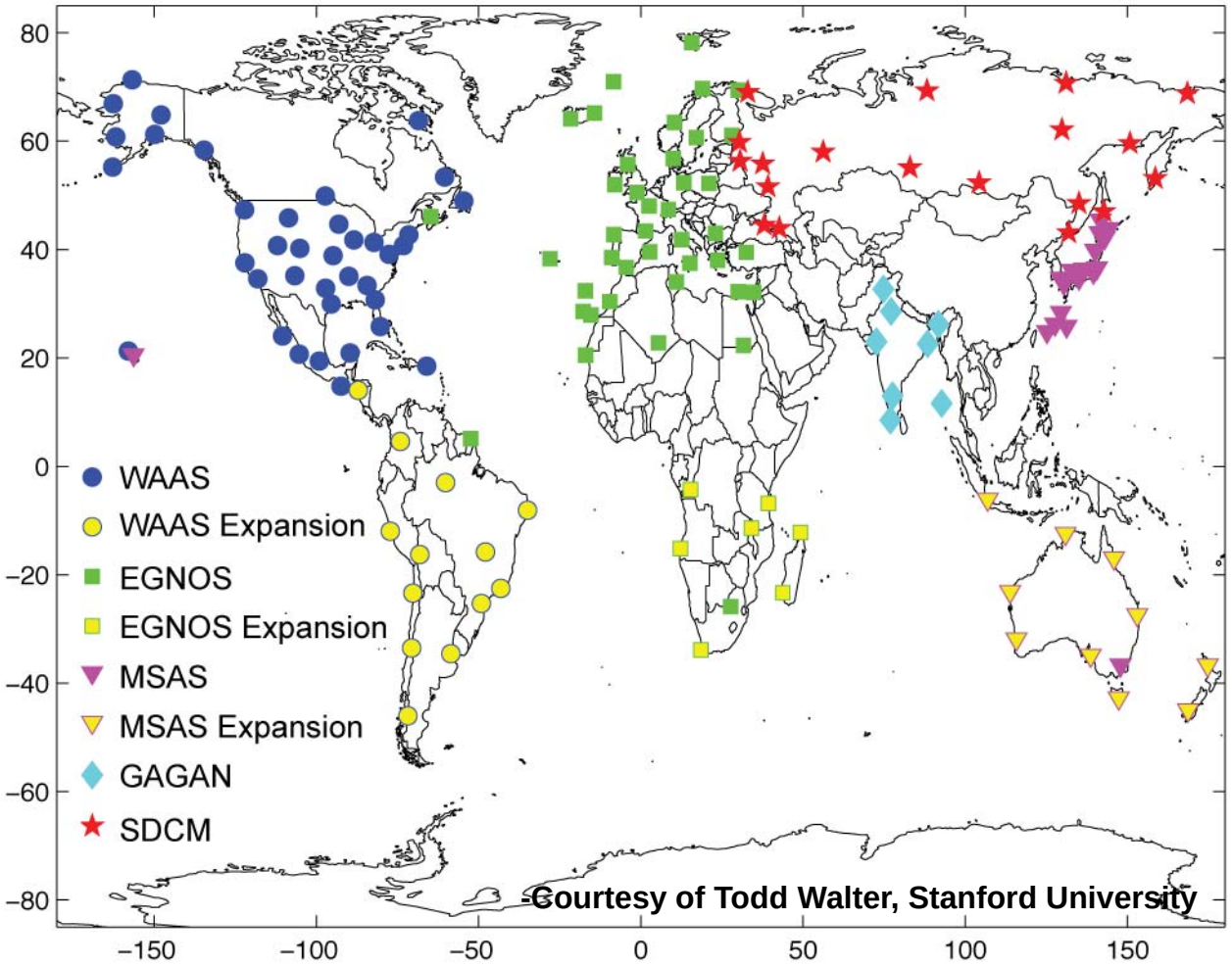
WAAS, MSAS, EGNOS, GAGAN and SDCM Reference Networks



WAAS, MSAS, EGNOS, GAGAN & SDCM
(Dual Frequency GPS)



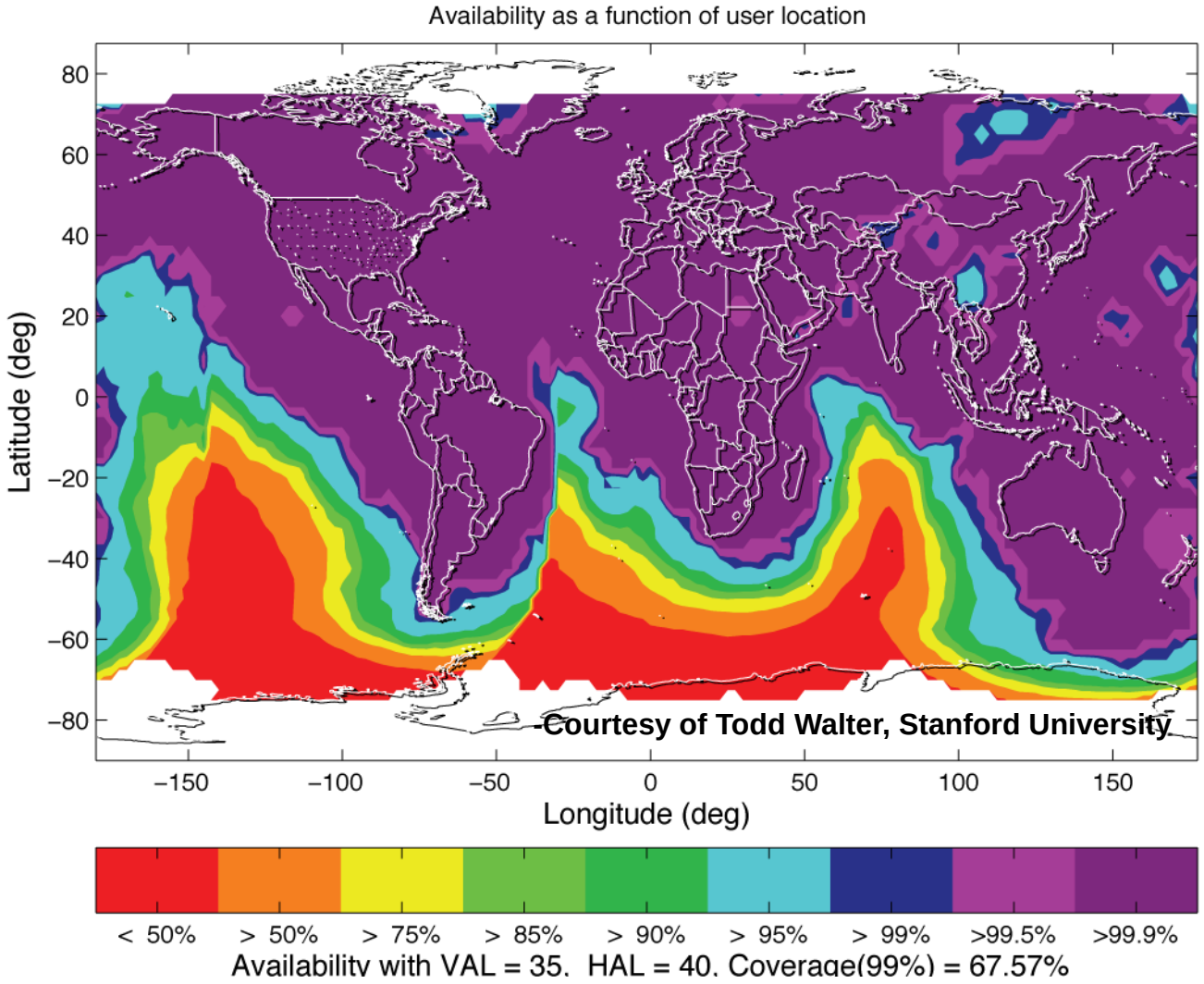
Expanded Networks



-Courtesy of Todd Walter, Stanford University

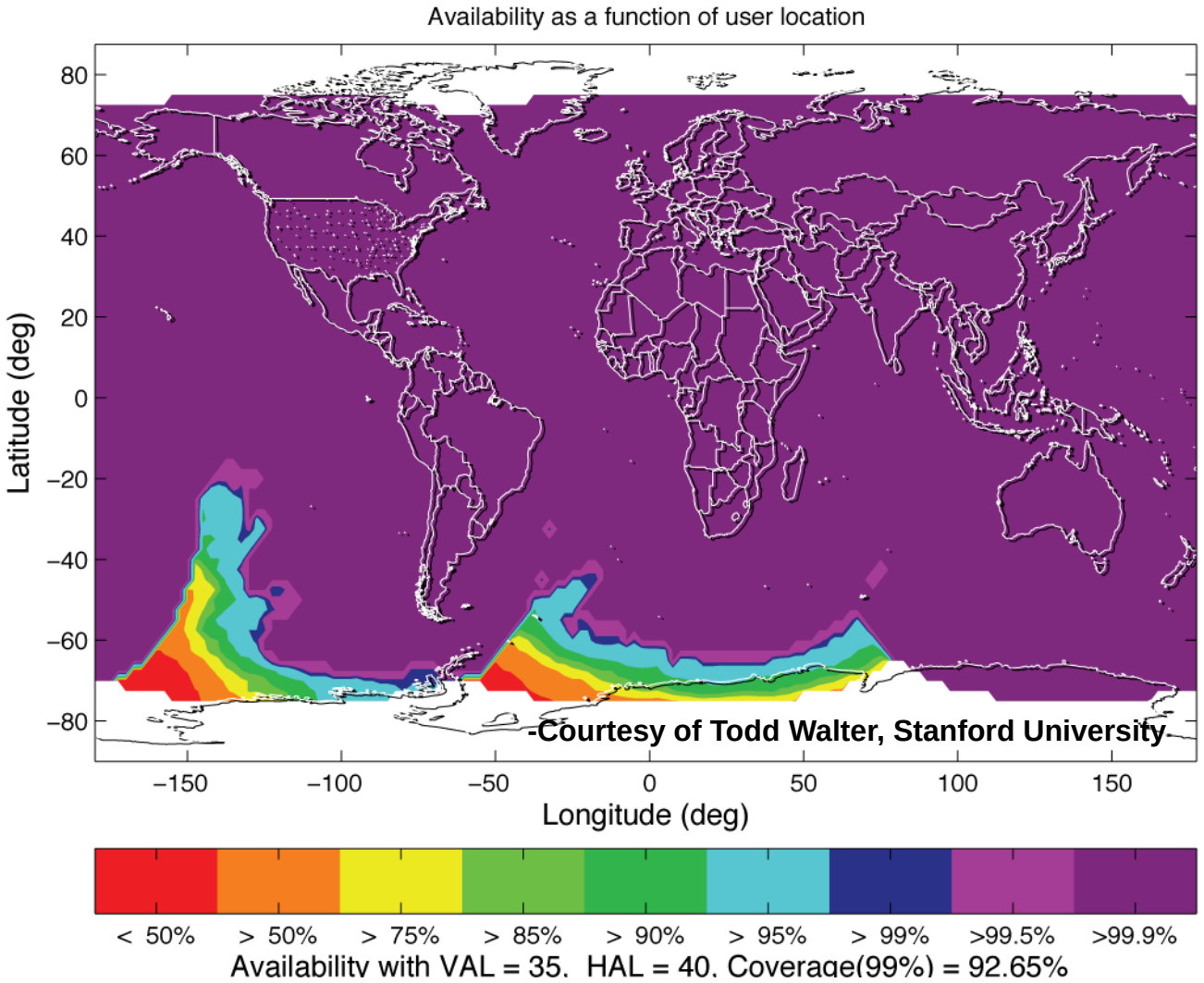
WAAS, MSAS, EGNOS, GAGAN & SDCM

(Dual Frequency GPS + Expanded Networks)



WAAS, MSAS, EGNOS, GAGAN & SDCM

(Dual Frequency GPS + Expanded Networks + Two GNSS Constellations)



Conclusions

- **Single frequency coverage is good within the countries fielding SBAS**
- **Dual frequency extends LPV coverage outside reference networks**
- **Expanding networks into southern hemisphere could allow global coverage of land masses**
- **Multi-Constellation SBAS allows even greater coverage with fewer stations**
  - Compatible Geodesy and Time Standards are Important