EnVision: Phase 0 Developments. R. C. Ghail[1] and the EnVision team, [1]Imperial College London, London, SW7 2AZ.

Introduction: EnVision [1] was selected for Phase 0/A study in the ESA M5 round of Medium-class missions. A key factor in this decision was the allocation of NASA funds to ensure affordability. Preparations for ESA's baseline (CDF) study are nearly complete and that study will be reporting its conclusions immediately after the 16th VEXAG meeting, on 9 November 2018. We will report on its conclusions as far as possible and detail any opportunities for community involvement and collaboration.

Fortuitously, NovaSAR-1 [2], the UK's S-band radar satellite that is the direct precursor for VenSAR [3], was successfully launched on 16 September 2018 and we anticipate being able to show the first directly comparable terrestrial imagery from NovaSAR at the meeting.

Baseline Issues: The primary issues arising from the Phase 0 baseline study relate to orbit selection and delivery. Aerobraking modelling and experience indicate that the 'minimum fuel' approach in the proposal will requires an unacceptable 12-18 months; potentially more than two Venus cycles. Since the new Ariane 6 launcher provides far greater lift capability than Soyuz, options are being explored for conventional orbit insertion. Orbital altitude is constrained quite tightly to ~260 km by the competing requirements of gravity field resolution and SAR swath coverage. Hence orbital insertion and maintenance remain a significant challenge.

EnVision's unprecedented data storage and return volume, particularly when Venus is farthest from Earth, is technically challenging. Our proposed approach is to reduce data collection as distance increases, to just the essential InSAR swaths, sounder and IR emission mapping. Because only six orbits are then required for science operations in every 24-hour period, the remaining nine orbits are available for communications, of which only three are used in the proposal, requiring significant storage. Downlinking data during all nine available orbits effectively triples the data return volume and reduces storage requirement to below 10 Tbits.

Community Involvement: Our proposed approach is to select mapping areas representative of the variety of Venus terrains, obtaining a complete suite of data and 'drilling down' to higher resolutions (up to 1 m) to aid in a full understanding of their origin, history and current activity. There may be cases where InSAR and StereoPolSAR coverage need not overlap (which is essential for stereo views), e.g. at extended crater parabolas, thereby potentially extending surface area coverage. In addition, should specific targets or representative areas (as proposed) be preferred? Are there optimal locations for 'drilling down' to the highest resolution 1 m spotlight images?

Trades: Within the constraints of capability and contiguity, early community involvement at this stage is encouraged to identify features of interest, to assist in the inevitable trades and compromises, e.g. Artemis vs Thetis, or Ishtar vs Alpha and Lada, and to ensure broad community support through the next stages. What should be the balance between InSAR coverage, which drives data rate and storage requirements, and polarimetric and high resolution data, which require higher data rates but without the repeat pass constraints? How much total surface coverage is sufficient to meet the science goals of surface change detection and geological history?

Future Developments: The Phase 0/A study is based on the as-proposed mission, but there may be a possibility for contributed experiments; currently a USO is under consideration. As noted in the proposal, in principle such a contribution might include a separate smallsat probe that could undertake complementary science. Assuming final selection, EnVision is likely to spark a similar level of public and scientific interest in Venus as currently enjoyed by Mars. What complementary or follow-on missions might be proposed to explore Venus in a similarly systematic way?

References: [1] EnVision M5 proposal (2016), available from http://arxiv.org/abs/1703.09010

[2] For a detailed description of NovaSAR see https://directory.eoportal.org/web/eoportal/satellite-missions/n/novasar-s

[3] Ghail R. C. et al. (2018) *IJAEOG, 64*, 365-376, http://dx.doi.org/10.1016/j.jag.2017.02.008.