

1 FRINGE 2011 WORKSHOP – SORTED RECOMMENDATIONS

This document contains the recommendations from the Session Summaries of the Fringe 2011 Workshop, “*Advances in the Science and Applications of SAR Interferometry and Sentinel-1 Preparatory Workshop*” that was organised between 19.9 and 23.9.2011 in ESA-ESRIN, Frascati, Italy. The recommendations have been sorted into eight categories listed below and the session(s) where the recommendation was given is indicated.

1.1 List of Acronyms

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|------|--|
| EWS | Interferometric Wide Swath |
| IWS | Interferometric Wide Swath |
| NEST | Next ESA SAR Toolbox |
| PIG | Pine Island Glacier |
| PSI | Persistent Scatterer Interferometry |
| SM | StripMap |
| S-1 | Sentinel-1 |
| TOPS | Terrain Observation by Progressive Scans |

1.2 Categories of Recommendations

The recommendations have been sorted into the following categories:

- Sentinel-1 Preparatory Work
- Sentinel-1 Operations
- Sentinel-1 Observation Scenario
- Sentinel-1 Data Processing and Dissemination
- Envisat and the ESA SAR Archive
- User Toolboxes
- Future Studies
- 3rd Party Mission Coordination

1.3 Recommendations related to: Sentinel-1 Preparatory Work

| No | Recommendation | From Session |
|----|---|--|
| 1 | ESA should place more of its existing SAR archive easily accessible online. This will help the community to prepare for the large data volumes of S-1. | Earthquakes & Tectonics |
| 2 | ESA should make simulated S-1 products available in order to familiarize the user community with the new formats. | Earthquakes & Tectonics |
| 3 | ESA should disseminate detailed information about the new TOPS imaging modes including the processing recommendations and requirements for azimuth coregistration accuracy. | Methods General, DInSAR & PSI |
| 4 | ESA should provide the community with TOPS SAR data, either simulated data or preferably actual TOPS SAR acquisitions from TerraSAR-X and/or Radarsat-2. This will help the community to prepare for the new type of SAR data and to solve possible issues related to required TOPS azimuth-coregistration over moving terrain. | Earthquakes & Tectonics, Ice & Snow, Volcanoes, Methods General, DInSAR & PSI, InSAR Methods |
| 5 | S-1 TOPS coregistration issues over moving terrain should be studied. | Ice & Snow, Volcanoes, Summary Session |
| 6 | Additional studies are needed to assess how the 6/12 day repeat-cycle of S-1 affects Ice Velocity tracking, and what is the trade-off between IWS and SM modes. | Ice & Snow |
| 7 | The potential of S-1 for absolute positioning techniques should be studied. | InSAR Methods |

1.4 Recommendations related to: S-1 Operations

| No | Recommendation | From Session |
|----|--|--------------------------------|
| 8 | There is a need for an increased orbital tube to allow for better relative height estimation of Persistent Scatterers (The current 50 m tube will not allow for this, and as a result the achievable PS height precision will be limited). It should be investigated whether an increased orbital tube should be used for only a limited period of the mission (say, during commissioning) or continuously. In other words, the width of the orbital tube needs to be revisited. | DInSAR & PSI |
| 9 | For S-1 operations it is recommended to collect large baselines by periodically shifting the platform trajectory off the nominal 50m orbital tube to tomographically staggered baselines. This could be done during dedicated mission phases, for example the Commissioning Phase. This modality would allow collecting packs of small baselines for DInSAR while allowing few larger baselines for InSAR and Tomography. | Methods General, InSAR Methods |
| 10 | Investigate the possibilities of allotting part of the S-1 observation time to experimenting with new modes, for example the concept of squinted or split beam antenna operations. | InSAR Methods |

1.5 Recommendations related to: S-1 Observation Scenario

| No | Recommendation | From Session |
|----|---|---|
| 11 | Over critical areas requiring frequent observations (tectonic, subsidence, landslides, volcanoes), the capability of the short repeat-cycle of S-1 should be fully exploited, and acquisitions in both ascending and descending orbits should be performed regularly. | Sentinel-1, Earthquakes & Tectonics, Terrain Subsidence & Landslides, Volcanoes |
| 12 | If a choice between single or dual polarization needs to be taken due to mission resources limitations, the mapping extent in single polarization should be prioritized vs. the use of dual polarization. | Sentinel-1 |
| 13 | The S-1 observation strategy should consist of one main mode with as frequent acquisitions over tectonically active areas as possible (with regular acquisitions in other areas), with a priority on two look directions, small baselines, single polarization and long data-takes. | Earthquakes & Tectonics |
| 14 | Consider using higher resolution modes over active tectonic regions to enable along-track deformation measurements with multiple-aperture interferometry or sub-pixel correlation techniques | Earthquakes & Tectonics |
| 15 | Ideally operate at HH-polarization and IWS-mode with ascending/descending passes for full coverage of ice every cycle. <ul style="list-style-type: none"> For ice sheet wide mapping, once a year is probably sufficient because large changes in the interior regions are not expected. Yet you need sufficient data stacking to tackle motion of less than 1 m/yr (e.g. a couple of months of data). Do not forget the smaller glaciated areas: Sentinel-1 systematic mapping of ALL ice sheets and glaciers (Patagonia, Alaska, Himalaya, Alps, Svalbard, Canadian ice caps, etc.) decided a-priori, every cycle if possible, at the minimum by series of 4 consecutive cycles (3 for grounding line mapping, 4 in case of gaps), with coast-to-coast tracks. Be careful about assuming too much a priori which area matters and which does not --> focus on all coastal regions as a threshold mission with a set of predefined tracks. | Ice & Snow |
| 16 | Select “supersites” for systematic acquisitions - maybe following the TanDEM-X supersites definition (5 main outlet glaciers in Greenland; PIG, Thwaites, Totten and the Peninsula in Antarctica + Mountain glaciers in Himalaya, Patagonia, Alaska). | Ice & Snow |
| 17 | ESA should set up a web-based system to collect, in a transparent way, the priorities of the potential S-1 users. The users should clearly identify the ‘minimum requirements’ for their proposed application. | Terrain Subsidence & Landslides, DInSAR & PSI |
| 18 | High revisit frequency with homogeneous acquisitions is desired over volcanic regions (e.g. the whole volcanic arcs). Both ascending and descending acquisitions are needed due to steep slopes (layover etc.) and the nature of volcanic deformation (unknown source type, & geometry). When signs of a possible future eruption, such as an increase in seismicity, are detected (users are partly responsible for this), the planned acquisitions should be acquired with the highest priority and acquisitions additional to the standard mission are desired. | Volcanoes |

1.6 Recommendations related to: S-1 Data Processing and Data Dissemination

| No | Recommendation | From Session |
|----|--|--|
| 19 | ESA should investigate adding Atmospheric Phase Screens routinely to S-1 products to benefit geo-location and interferometry. This information could be produced from global weather & ionospheric models and/or data from future sensors. | Earthquakes & Tectonics, DInSAR & PSI, InSAR Methods |
| 20 | ESA should provide estimates of fine offsets between TOPS SAR scenes to avoid phase ramps from small mis-registration in TOPS interferograms. | Earthquakes & Tectonics |
| 21 | ESA should make RAW auxiliary data for S-1 available once the mission starts, e.g. raw GPS data for orbit determination. | Earthquakes & Tectonics |
| 22 | ESA should seriously consider S-1 data-delivery in Level-0 format as this would entail enormous savings in bandwidth (factor of ~5) for both the users and ESA. | Summary Session |
| 23 | ESA should ensure timeliness of S-1 data availability and ease of downloading as these are of vital importance for successful global monitoring. | Volcanoes |
| 24 | ESA should consider delivering geocoded interferograms, perhaps using a “processing on demand” approach. | Earthquakes & Tectonics |

1.7 Recommendations related to: Envisat and the ESA SAR Archive

| No | Recommendation | From Session |
|----|---|-------------------------|
| 25 | ESA should provide easy online access to large parts of its existing SAR archive – this would be a huge help to scientists and data exploitation. It would also be helpful if the ESA EOLi catalogue was cleaned up | Earthquakes & Tectonics |
| 26 | ESA should maintain the ERS-1/2 and Envisat SAR archives. | Ice & Snow |
| 27 | ESA should acquire as much Envisat ASAR data around 38°N as possible, also in areas that are not tectonically very active to ensure that data are available for future earthquakes. | Earthquakes & Tectonics |
| 28 | ESA should provide rapid preliminary orbit data for Envisat to help rapid response to earthquakes | Earthquakes & Tectonics |

1.8 Recommendations related to: User Toolboxes

| No | Recommendation | From Session |
|----|--|--|
| 29 | ESA should extend the functionality of the ESA NEST Toolbox to include offset-tracking and time-series analysis. | Earthquakes & Tectonics |
| 30 | ESA should deliver an open source SAR processor (e.g. NEST SAR processor) to the community. | Earthquakes and Tectonics, Summary Session |
| 31 | An open source toolbox or package for doing earthquake source inversions should be developed. | Earthquakes & Tectonics |

1.9 Recommendations related to: Future Studies

| No | Recommendation | From Session |
|----|---|----------------------------------|
| 32 | More emphasis should be put on using the InSAR results quantitatively, e.g. for modeling the sources of deformation, risk assessment, forecasting, etc. | Terrain Subsidence & Landslides, |
| 33 | For Very High Resolution X-band data the models should be extended to include the contribution of thermal expansion. | Methods Unwrapping |
| 34 | For Differential Tomography, theoretical studies need to be performed in order to address the ambiguity and performance associated with the estimation of non-uniform motions of multiple targets. These studies should consider not only theoretical bounds, but also performance achievable in practical cases. | Pol-InSAR & Tomography |
| 35 | Further studies are needed to address the radiometric accuracy of super-resolution algorithms. | Pol-InSAR & Tomography |
| 36 | Investigate the quality of Atmospheric Phase Screen estimates produced by PSI. | Atmosphere |

1.10 Recommendations related to: 3rd Party Mission Coordination

| No | Recommendation | From Session |
|----|---|-------------------------|
| 37 | Better access to data for scientific use from TerraSAR-X, Cosmo-SkyMed and Radarsat-2 satellites is desired by the community. | Earthquakes & Tectonics |
| 38 | Coordinate with Radarsat-2 and Radarsat Constellation Mission for coverage of the South Pole. | Ice & Snow |
| 39 | Coordinate with other space agencies for continuity measurements on specific “supersites” (rapidly changing areas), now that three InSAR missions are being phased out in 2011. | Ice & Snow |
| 40 | Space agencies should coordinate and guarantee acquisitions over active volcanoes. | Volcanoes |