National Institute of Advanced Industrial Science and Technology
AIST

京都大学防災研究所一般研究集会（課題番号：27K-08）
新世代SARがもたらす災害・環境モニタリングの進展
3 December, 2015

ISCE

InSAR **S**cientific **C**omputing **E**nvironment
- an open source, modular software framework capable of supporting the geophysical research communities' needs.

Akiko TANAKA (Geological Survey of Japan, AIST)

http://pixel.eri.u-tokyo.ac.jp/

Pixel
PALSAR Interferometry Consortium
to Study our Evolving Land surface

設立趣意

干渉SAR (InterferometricSAR;InSAR)を用いて，フランスのMassonnetらが， Landers地震に伴う地殻変動を検出し，ネイチャー誌の表紙を飾ったのは 1993 年でした．以来，多くの地震火山現象に伴う地殻変動の研究にInSARが用いら れ，日本でもL-bandのSARを搭載した国産のJERS-1衛星の活躍により，兵庫県 南部地震や岩手山の活動に伴う地殻変動が検出され，地殻変動研究に威力を発 揮しました．JERS-1の運用が1998年に停止されて以降は，ESA(欧州宇宙機構)と CSA(カナダ宇宙機構)によるC-bandのSAR衛星が運用されていましたが，C-band の波長が植生に覆われた日本の国土の地殻変動研究には適用条件が限られたた め，日本の地殻変動研究においては，InSARの潜在能力が十分に発揮されると はいえない状況が続いてきました．さらに，InSARに必要であるSARデータと解 析ソフトウェアへのアクセスに関する問題もあり，日本におけるInSAR研究は 欧米と比べて大きな遅れを取っているのが実状です．

一方，宇宙航空研究開発機構(JAXA)によってまもなく打ち上げ予定の地球観測 衛星ALOSには，JERS-1と同じ波長であるL-bandの合成開口レーダーセンサー PALSARが搭載されています．植生を透過するL-bandマイクロ波の有用性/優位 性は国際的にも周知の事実です．さらに，ALOS/PALSARはInSARの適用を考慮に 入れて設計されていることから，より簡単かつ高精度に地殻変動の検出が可能 になると期待されています．PALSARデータによるInSARは，地殻変動研究者に とっては，文字通り待望のデータとして全世界的規模で注目されています． いま，地殻変動を検出する道具としてInSARを使うための基盤である，SARデータ へのアクセス，解析ソフトウェアの問題が解決されれば，より多くの研究者が 簡単にInSARを用いて地殻変動データを利用できるようになります．GPSを用い た研究が進んでいる日本において，InSARも合わせて利用可能になれば，地殻 変動の研究が，さらに活発に，より先進的なものになっていくことが期待でき ます．このような背景を踏まえ，地殻変動研究のためのInSARの解析者の育成，利用者の拡大を狙いとして，InSARのユーザグループを立ち上げたいと考え ています．

本グループでは，以下のような活動を行う予定です． なお，具体的な活動内容については，変更の可能性もあります．

1．主として火山・活断層領域のPALSARデータ（level 1（生データ））を本グループ内で共有する．
2．共有データに関しては，本グループにおいて解析を行い，地殻変動に変換したものを公表する．
3．JAXAで開発された国産の解析ソフトSIGMASAR を共同利用し，そのソフトウェア講習会を年 1 度程度行う．
4．メーリングリストによる情報交換
5．年 1 回程度のワークショップの開催

1 に関するPALSARデータは，JAXAと国内共同利用研究契約である東京大学地震研究所（ERI）を通じて共同研究契約を通して提供を受けグループ内で共有します． これらのデータは，担当機関が解析し，随時公開していきます．また，JAXAで 開発された解析ソフトSIGMASARを共同利用し，解析者の育成や，利用者の拡大 を図ります．

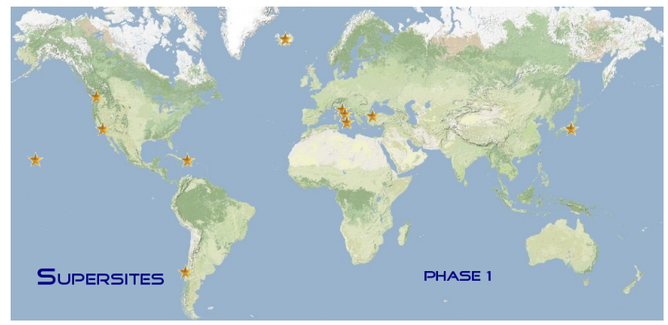
Review: How to set up InSAR capability?

1) Establish access to data

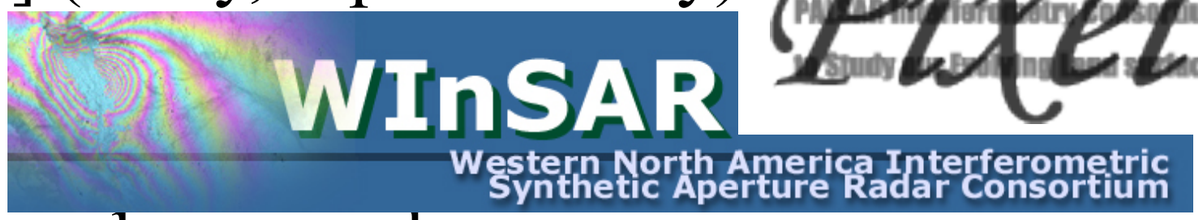
Can useful interferograms be made with available data?
Worry about ground conditions, radar wavelength, frequency of observations, perpendicular baseline, availability of advanced processing techniques

How to Access Data

Overview of available data sources: See http://www.roipac.org/AccessToData



- No Cost data
  - -"Supersites" available for small areas of interest
    [http://supersites.earthobservations.org/]
  - -"WInSAR" Western North America InSAR Consortium
    [http://winsar.unavco.org/] Your institution must be a member.
  - - "PIXEL" PALSAR Interferometry Consortium to Study our Evolving Land surface
    [http://pixel.eri.u-tokyo.ac.jp/] (Sorry, Japanese only)



  - - European Space Agency Category 1 proposals:
    http://eopi.esa.int/esa/esa;jsessionid=1EE3B9CA6753CD0BE236A443EB396A73?e=XDXuWvAzMdf1mrTn3WnRXFv9y0BTUHQ1UHHZnY4oZ3qmCPAMz
- For purchase
  - - Commercial Companies

[As of Oct. 2010]

http://pixel.eri.u-tokyo.ac.jp/

PIXEL 共有データ

PIXEL共有データから得られた結果を公表する場合には、以下のような謝辞をつけてください。

(和文例)
本研究で用いたPALSARデータはPIXEL (PALSAR Interferometry Consortium to Study our Evolving Land surface）において共有しているものであり、 宇宙航空研究開発機構（JAXA）と東京大学地震研究所との共同研究契約によ りJAXAから提供されたものである。PALSARデータの所有権は経済産業省およ びJAXAにある。本研究（の一部）は、東京大学地震研究所特定共同研究（B） 「衛星リモートセンシングによる地震・火山活動の解析」で行われた。

(英文例)
PALSAR level 1.0 data are shared among PIXEL (PALSAR Interferometry Consortium to Study our Evolving Land surface), and provided from JAXA under a cooperative research contract with ERI, Univ, Tokyo The ownership of PALSAR data belongs toMETI (Ministry of Economy, Trade and Industry) and JAXA

北 海 道	ALOS	ALOS2
東北地方	ALOS	ALOS2

http://www.eorc.jaxa.jp/ALOS/top/ra_jtop.htm

画像ギャラリー

ALOS-2プロジェクト

校 正・検 証

基本観測計画

データを使う

データセット

会議・ワークショップ

京都・炭素観測計画

研 究 公 募

研究公募

ALOSデータを用いた研究提案の募集について

- スケジュール
- 第6回研究公募
- 第5回研究公募 (Pi-SAR-L2研究公募) (参考)
- 第4回研究公募 (参考)
- 第3回研究公募 (参考)
- 第2回研究公募 (参考)
- 第1回研究公募 (参考)
- PIメンバーリスト
  - 第5回PIメンバーリスト
  - 第4回PIメンバーリスト
  - 第3回PIメンバーリスト
  - 第2回PIメンバーリスト
  - 第1回PIメンバーリスト

UAF ALASKA SATELLITE FACILITY

Making remote-sensing data accessible since 1991

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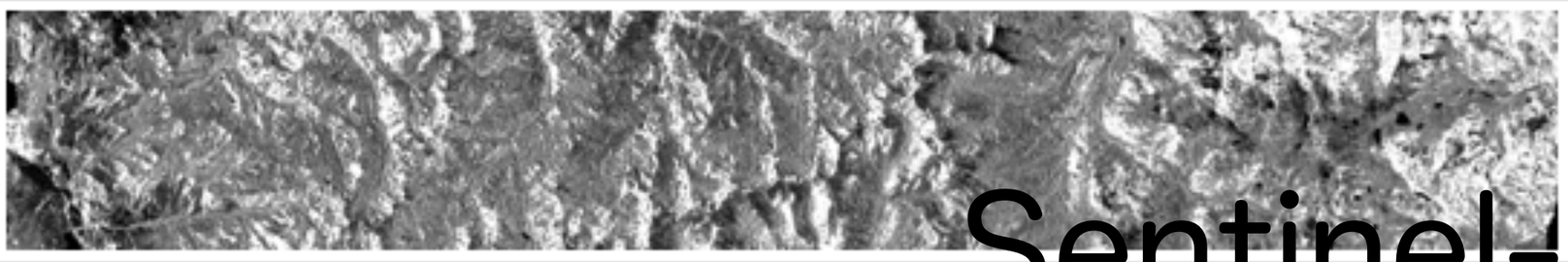
esa Sentinels Scientific Data Hub

European Commission

Welcome to the Sentinels Scientific/Other use Data Hub

The Sentinels Scientific Data Hub provides free and open access to a rolling repository of Sentinel-1 and Sentinel-2 user products, starting from the In-Orbit Commissioning Review (IOCR).
Start of rolling activity will be announced to users before activation.

- Terrestrial Ecology
- InSAR
- ALOS-1 PALSAR
  - About ALOS PALSAR
  - Terrain Corrected (RTC)



Sentinel-1

A radiometrically terrain-corrected PALSAR image shows part of Yellowstone National Park. ASF DAAC 2014; Includes Material © JAXA/METI 2007.

About PALSAR	Download Data	Documents & Tools	RTC Products
Learn about the	ALOS-1 PALSAR	Find product	New

Review: How to set up InSAR capability?

1) Establish access to data
   Can useful interferograms be made with available data?
   Worry about ground conditions, radar wavelength, frequency of observations, perpendicular baseline, availability of advanced processing techniques

2) Purchase/Install software to process data

RINC

Radar Interferometry Calculation Tools

+ rinc_gui

RINC講習会資料（2015/12/1）

小澤拓（防災科研），青木陽介（東大震研），奥山哲（JAEA）

Summary of

InSARProc 2008
July 28-31, 2008
Stanford University
Sponsored by NASA

Howard Zebker, Eric Fielding, Paul Lundgren

Howard Zebker, Eric Fielding, Paul Lundgren

Packages and methods assessed

- DORIS – Andy Hooper and Rob Mellors
- Stanford InSAR – Howard Zebker
- SIOSAR – David Sandwell
- GMTSAR – Rob Mellors
- ROI_PAC – Eric Fielding and Paul Rosen
- Stacking interferograms – Yuri Fialko
- Persistent scattering – Piyush Agram
- SBAS – Riccardo Lanari
- Atmospheric effects – Matt Pritchard and Mark Simons
- ScanSAR – Sean Buckley
- Polarimetry – Howard Zebker

Howard Zebker, Eric Fielding, Paul Lundgren

Primary Recommendations

- Precise and well-characterized products
- Flexible and extensible modular code to encourage modification and improvement by the user community (open-source)
- Comprehensive set of user documentation.

InSAR software:

ROI_PAC (The **R**epeat **O**rbit **I**nterferometry **PAC**kage)

- developed at JPL and Caltech
- a collection of fortran and C programs bound together with perl
- the most widely used for InSAR processing in the peer-reviewed scientific literature (over 3000 unique downloads since 2003 and 150 peer-reviewed publications, roipac.org/BiblioList)

InSAR software:

ISCE (**I**nSAR **S**cientific **C**omputing **E**nvironment)

- a new Stanford/Caltech/JPL software package
- builds on some of the FORTRAN and C programs in ROI_PAC but is faster, more accurate, and provides better geolocation.
- ISCE uses python
- Licensing for ISCE is available to WInSAR members through UNAVCO. (since July 12, 2012)

ISCE

(InSAR Scientific Computing Environment)

https://winsar.unavco.org/isce.html

Caltech/JPL & Stanford (*UNAVCO manages licensing and distribution on behalf of WInSAR*)

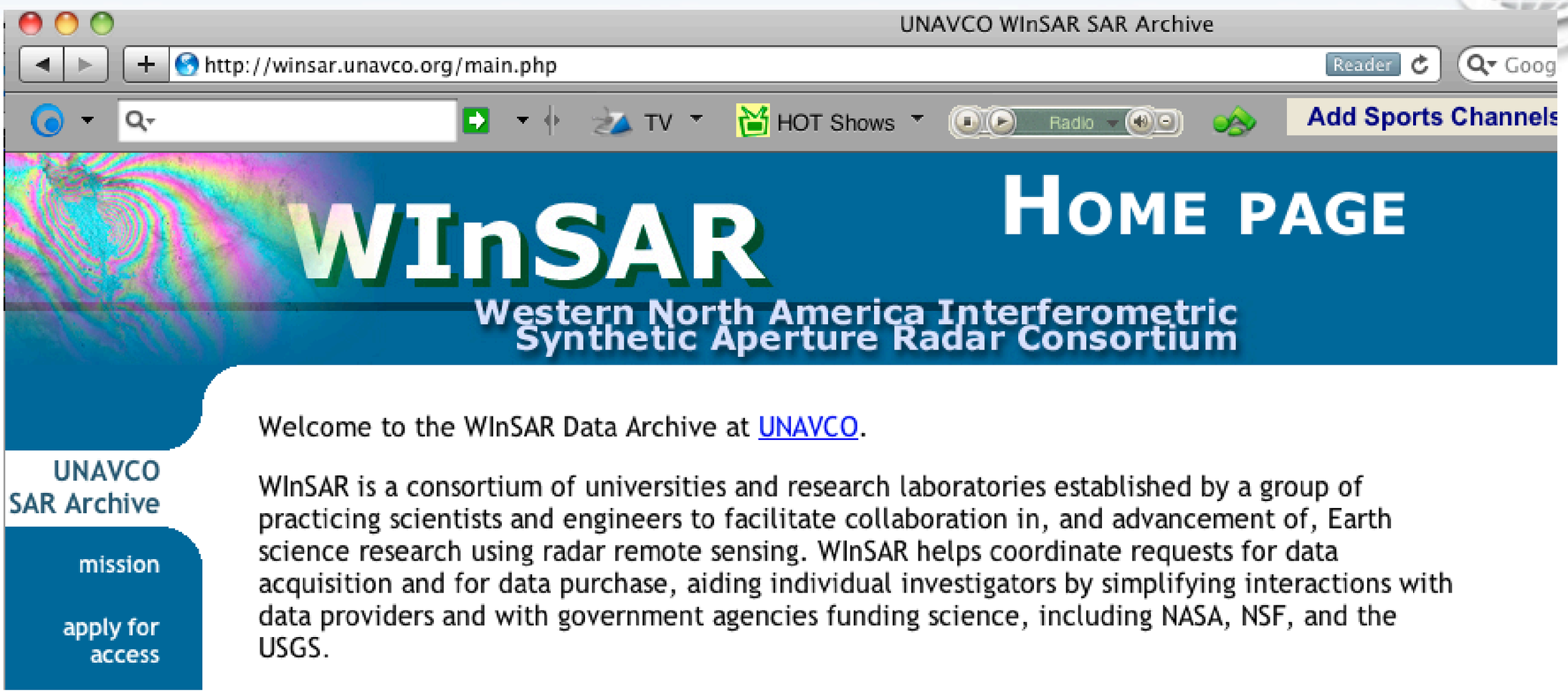
WInSAR
Western North America Interferometric Synthetic Aperture Radar Consortium

Software: ISCE

WInSAR will be distributing the InSAR SCE (InSAR Scientific Computing Environment) software for SAR processing from this page. In order to download the software, institutional representatives of WInSAR Member institutions must sign and return this license agreement. Please print out and sign the cover sheet, and then either scan and email to winsar@unavco.org or fax to 303-381-7501. Once the agreement is received, users from your institution will have access to the software with their normal WInSAR archive credentials.

Date	Version	Comments
		This release, isce-2.0.0, is the first Python3 version of ISCE. Users should switch to the version. We plan to release a final Python2 version soon that will include much, but not all, of the functionality of this version, but future developments and bug fixes will be to the Python3 version. We plan more frequent formal releases in the future and will also release monthly snapshots of the development version of the code.

What is WInSAR ?



- **Consortium of more than 160 Universities & Research Institutions**
- **Executive Committee (elected, 2-year terms)**
- **Hosted by UNAVCO in Boulder, Colorado. UNAVCO provides organizational and operational support for WInSAR activities, including membership administration, financial management, data management and archiving, and software tools for data exploration and access.**

Funding:

http://seom.esa.int/fringe2015/files/presentation129.pdf

Why join WInSAR?

(#1 and #2 apply to US scientists only, for now)

#1) Access to SAR (ERS-1, ERS-2, Envisat, Radarsat-1, ALOS-1 data at UNAVCO (>20 Tb) after signed agreements.

#2) Facilitate co-principal investigators to share data (e.g.TSX) via UNAVCAO facility.

#3) Access to free open-source software: Once a license agreement is signed, WInSAR members can download the ISCE software for InSAR data processing that includes the mdx visualization software: http://winsar.unavco.org/isce.html

#4) Membership in a self-governing community:
News from WInSAR mailing list
Annual SAR/InSAR trainings
Annual WInSAR meeting/lunch at AGU
Input into use of resources for data purchase and access

The Western North America InSAR (WInSAR) Consortium

WInSAR
Western North America Interferometric
Synthetic Aperture Radar Consortium

Home
Charter
▶ Membership
Executive Committee Representatives
Authorized Data Users
Apply to become a Member Institution
Apply to become an Authorized WInSAR User
Reset Your Password
Documents
Mission Tasking
Envisat Tasking
TerraSAR-X Tas
Software & DI
ISCE
InSAR Publica
External Linl

Membership: Institutional Representation

There are three classes of WInSAR Institutional Members: **Full Member** — U.S. institutions; **Adjunct I Member** — institutions in Canada and Mexico; **Adjunct II Member** — all other institutions.

There are 186 WInSAR Institutional Members. The representatives names and emails are shown.

Institution	First Name	Last Name	Email	Category	ISCE
AGH University	Katarzyna	Mirek	Email	Adjunct II	Y
Addis Ababa University	Dagnachew	Legesse	Email	Adjunct II	
Aligarh Muslim University	Mohammad	Suhail	Email	Adjunct II	
Appalachian State University	Scott	Marshall	Email	Full	Y
Arizona Department of Water Resources	unknown	unknown	Email	Full	
California State University, Fresno	Clement	Ogaja	Email	Full	

There are three classes of WInSAR Institutional Members:
102 Full Member — U.S. institutions;
12 Adjunct I Member — institutions in Canada and Mexico;
72 Adjunct II Member — all other institutions.

Related Content

ISCE Prerequisites: What do I need to build?

In the README…

- gcc >= 4.3.5 (C, C++, and Fortran compiler collection)
- fftw 3.2.2 (Fourier transform routines)
- Python >= 2.6 (Interpreted programming language)
- scons >= 2.0.1 (Software build system)
- For COSMO-SkyMed support
  - hdf5 >= 1.8.5 (Library for the HDF5 scientific data file format)
  - h5py >= 1.3.1 (Python interface to the HDF5 library)

[ISCE Documentation, Release 0.3, February 12, 2013, JPL]

How do I run ISCE?

- “insarApp.py” runs all the steps in ISCE

  % insarApp.py insarApp.xml

- “insarApp.xml” file in interferogram directory specifies two input scenes and other processing parameters for the interferogram

- The full list of the ISCE steps is: ['startup', 'preprocess’, 'verifyDEM’, 'pulsetiming', 'estimateHeights’, 'mocompath', 'orbit2sch', 'updatepreprocinfo', 'formslc’, 'offsetprf', 'outliers1', 'prepareresamps', 'resamp’, 'resamp_image', 'mocompbaseline', 'settopoint1', 'topo’, 'shadecpx2rg', 'rgoffset', 'rg_outliers2', 'resamp_only’, 'settopoint2', 'correct', 'coherence', 'filter', 'unwrap’, 'geocode', 'endup’]

% cat insarApp.xml

```
<?xml version="1.0" encoding="UTF-8"?>

<!-- NOTE: property names are not case sensitive -->

<insarApp>
   <constant name="dir">/Users/akiko/work/fusion/20150104_20150816</constant>
   <constant name="date1">20150816</constant>
   <constant name="date2">20150104</constant>
   <constant name="dir1">$dir$/$date1$</constant>
   <constant name="dir2">$dir$/$date2$</constant>
   <component name="insar">
      <property name="Sensor Name">        ALOS2          </property>
      <property name="posting">            15             </property>
      <property name="Culling error limit"> 50            </property>
      <property name="unwrap">             True           </property>
      <property name="unwrapper name">     snaphu_mcf     </property>
      <property name="filter strength">    0.5            </property>
      <property name="doppler method">     useDEFAULT     </property>
      <component name="Master">
               <property name="IMAGEFILE">$dir1$/IMG-HH-ALOS2066460660-150816-UBSL1.1__A</property>
               <property name="LEADERFILE">$dir1$/LED-ALOS2066460660-150816-UBSL1.1__A</property>
               <property name="OUTPUT">$date1$.raw</property>
      </component>
      <component name="Slave">
               <property name="IMAGEFILE">$dir2$/IMG-HH-ALOS2033340660-150104-UBSL1.1__A</property>
               <property name="LEADERFILE">$dir2$/LED-ALOS2033340660-150104-UBSL1.1__A</property>
               <property name="OUTPUT">$date2$.raw</property>
      </component>
      <property name="geocode list">
          filt_topophase.unw, topophase.cor, phsig.cor, los.rdr, topophase.flat
      </property>
</component>
</insarApp>
```

% cat insarApp.xml [DEM]

```
<?xml version="1.0" encoding="UTF-8"?>

<!-- NOTE: property names are not case sensitive -->

<insarApp>
   <constant name="dir">/Users/akiko/work/fusion/20150104_20150816</constant>
   <constant name="date1">20150816</constant>
   <constant name="date2">20150104</constant>
   <constant name="dir1">$dir$/$date1$</constant>
   <constant name="dir2">$dir$/$date2$</constant>
   <component name="insar">
      <property name="Sensor Name">        ALOS2          </property>
      <property name="posting">            15             </property>
      <property name="Culling error limit"> 50            </property>
      <property name="unwrap">             True           </property>
      <property name="unwrapper name">     snaphu_mcf     </property>
      <property name="filter strength">    0.5            </property>
      <property name="doppler method">     useDEFAULT     </property>
      <component name="Master">
               <property name="IMAGEFILE">$dir1$/IMG-HH-ALOS2066460660-150816-UBSL1.1__A</property>
               <property name="LEADERFILE">$dir1$/LED-ALOS2066460660-150816-UBSL1.1__A</property>
               <property name="OUTPUT">$date1$.raw</property>
      </component>
      <component name="Slave">
               <property name="IMAGEFILE">$dir2$/IMG-HH-ALOS2033340660-150104-UBSL1.1__A</property>
               <property name="LEADERFILE">$dir2$/LED-ALOS2033340660-150104-UBSL1.1__A</property>
               <property name="OUTPUT">$date2$.raw</property>
      </component>
      <property name="geocode list">
          filt_topophase.unw, topophase.cor, phsig.cor, los.rdr, topophase.flat
      </property>
      <component name="Dem">
         <catalog>/Users/akiko/work/Sakura/h5/DEM/KYUSHU_SRTM_30m.dem.xml</catalog>
      </component>
   </component>
</insarApp>
```

指定しないと SRTM3

% cat insarApp.xml [matching method]

```
<?xml version="1.0" encoding="UTF-8"?>

<!-- NOTE: property names are not case sensitive -->

<insarApp>
   <constant name="dir">/Users/akiko/work/fusion/20150104_20150816</constant>
   <constant name="date1">20150816</constant>
   <constant name="date2">20150104</constant>
   <constant name="dir1">$dir$/$date1$</constant>
   <constant name="dir2">$dir$/$date2$</constant>
   <component name="insar">
      <property name="Sensor Name">        ALOS2          </property>
      <property name="posting">            15             </property>
      <property name="Culling error limit"> 50            </property>
      <property name="unwrap">             True           </property>
      <property name="unwrapper name">     snaphu_mcf     </property>
      <property name="filter strength">    0.5            </property>
      <property name="doppler method">     useDEFAULT  </property>
<!-- change matching method from default OffsetPRF to ampcor
-->
<property name="SLC Offset Method">
<value>denseoffsets</value>
</property>
<component name="Master">
            <property name="IMAGEFILE">$dir1$/IMG-HH-ALOS2066460660-150816-UBSL1.1__A</property>
            <property name="LEADERFILE">$dir1$/LED-ALOS2066460660-150816-UBSL1.1__A</property>
            <property name="OUTPUT">$date1$.raw</property>
</component>
<component name="Slave">
            <property name="IMAGEFILE">$dir2$/IMG-HH-ALOS2033340660-150104-UBSL1.1__A</property>
            <property name="LEADERFILE">$dir2$/LED-ALOS2033340660-150104-UBSL1.1__A</property>
            <property name="OUTPUT">$date2$.raw</property>
</component>
<property name="geocode list">
   filt_topophase.unw, topophase.cor, phsig.cor, los.rdr, topophase.flat
```

%insarApp.py insarApp.xml

2015-11-27 08:09:16,283 - isce.insar - INFO - ISCE VERSION = 2.0.0_201410,
RELEASE_SVN_REVISION = 1651,RELEASE_DATE = 20141103,
CURRENT_SVN_REVISION = Unversioned directory
ISCE VERSION = 2.0.0_201410,
RELEASE_SVN_REVISION = 1651,RELEASE_DATE = 20141103,
CURRENT_SVN_REVISION = Unversioned directory

Insar Application:

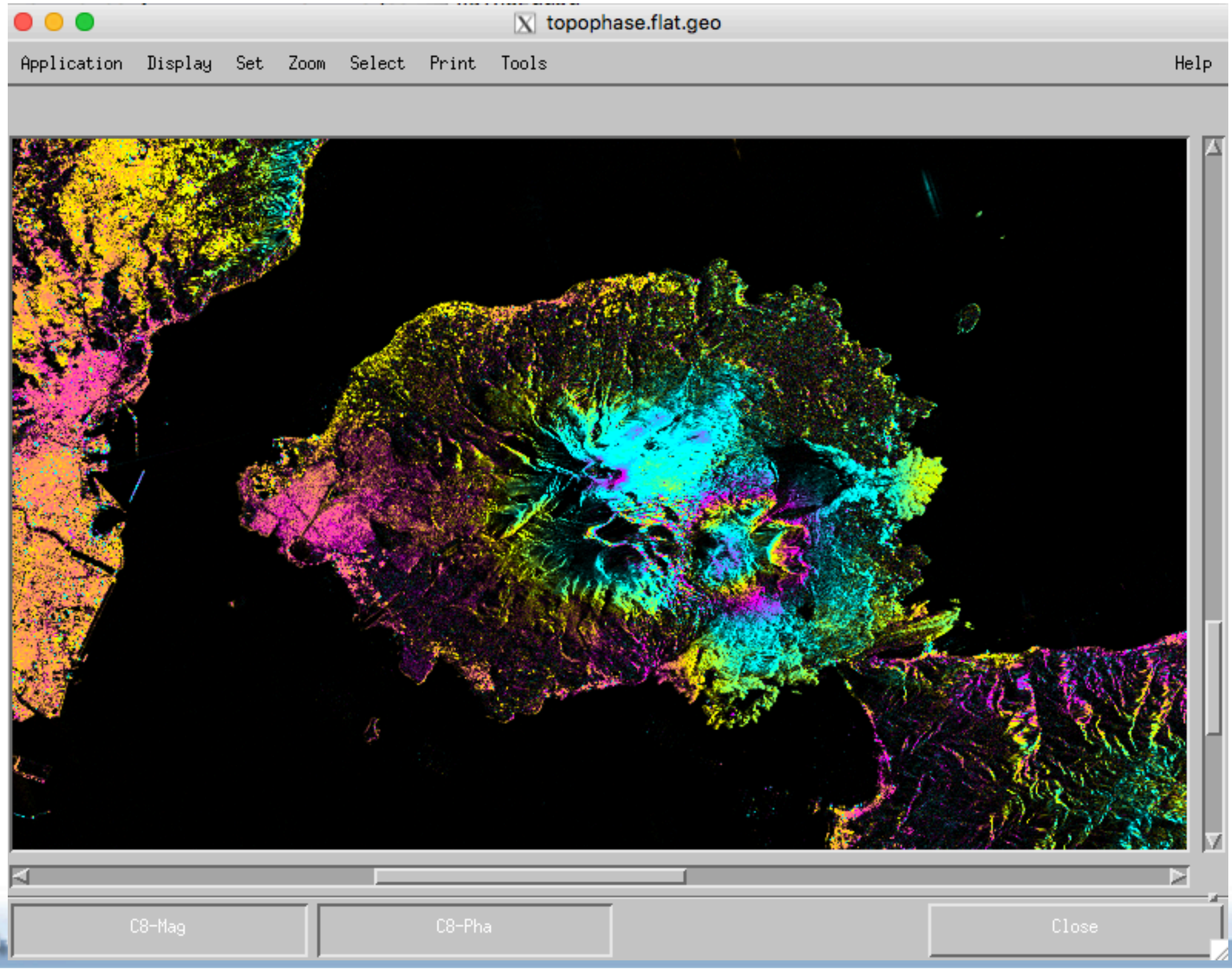
Implements InSAR processing flow for a pair of scenes from sensor raw data to geocoded, flattened interferograms.

The currently supported sensors are: ['ALOS', 'ALOS2', 'COSMO_SKYMED', 'COSMO_SKYMED_SLC', 'ENVISAT', 'ERS', 'KOMPSAT5', 'RADARSAT1', 'RADARSAT2', 'RISAT1', 'ROI_PAC', 'SENTINEL1A', 'TERRASARX', 'UAVSAR_RPI', 'UAVSAR_STACK']

…

% mdx.py

Usage: mdx.py filename [-wrap wrap] ... [-z zoom -kml output.kml]



ISCE Documentation

Release 0.3

JPL

February 12, 2013

Geological Survey of Japan, AIST