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Monitoring of flood-extent, inundation patterns and vegetation; Mekong River Basin, Southeast Asia.

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Objective 1

Development of a flood mapping system using time sequences of PALSAR data in FBD and SCANSAR mode to map flood extent and capable of depicting the extent and changes in the pattern of inundation over time within the Mekong River Basin.

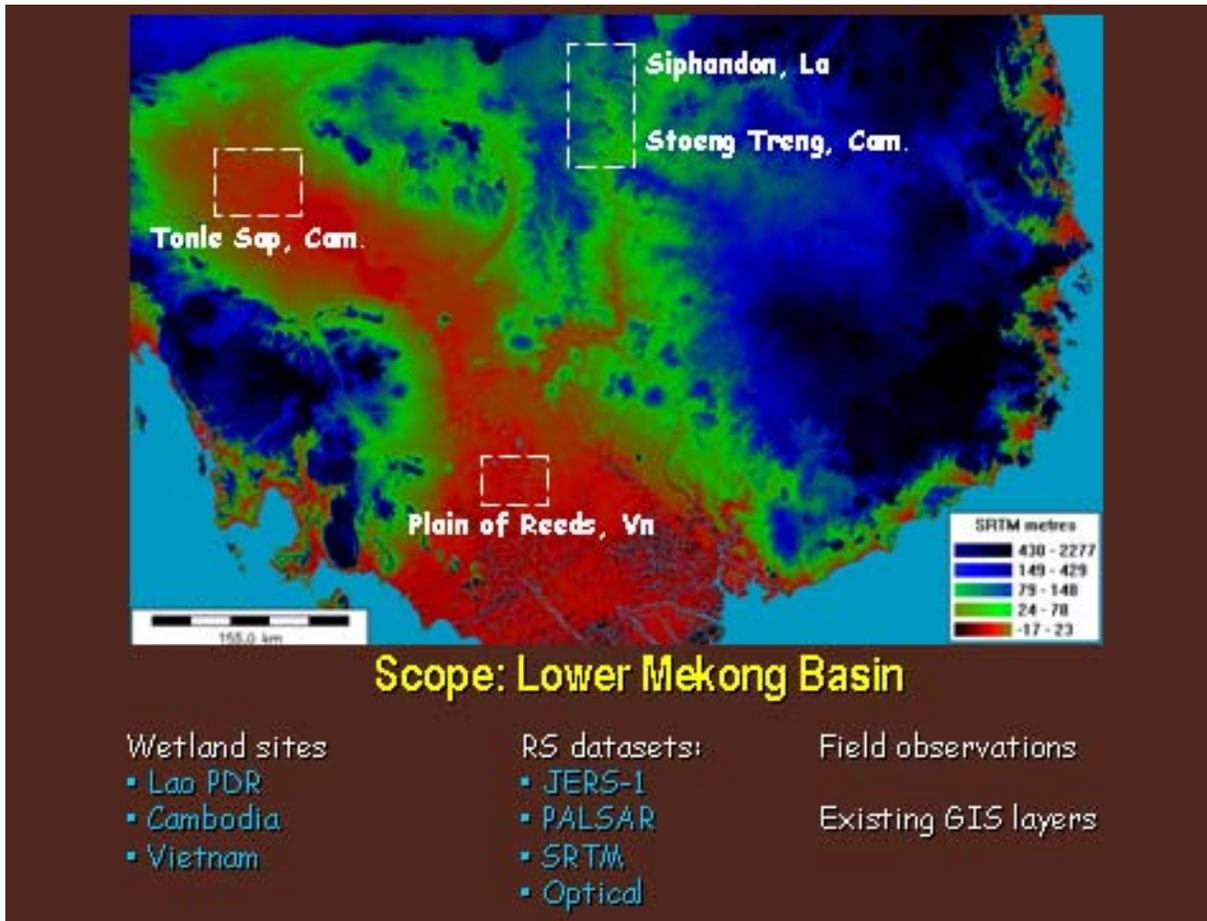
Product Deliverables

Individual maps of flood extent, duration and inundation patterns over a twelve month period in the Mekong River Basin.

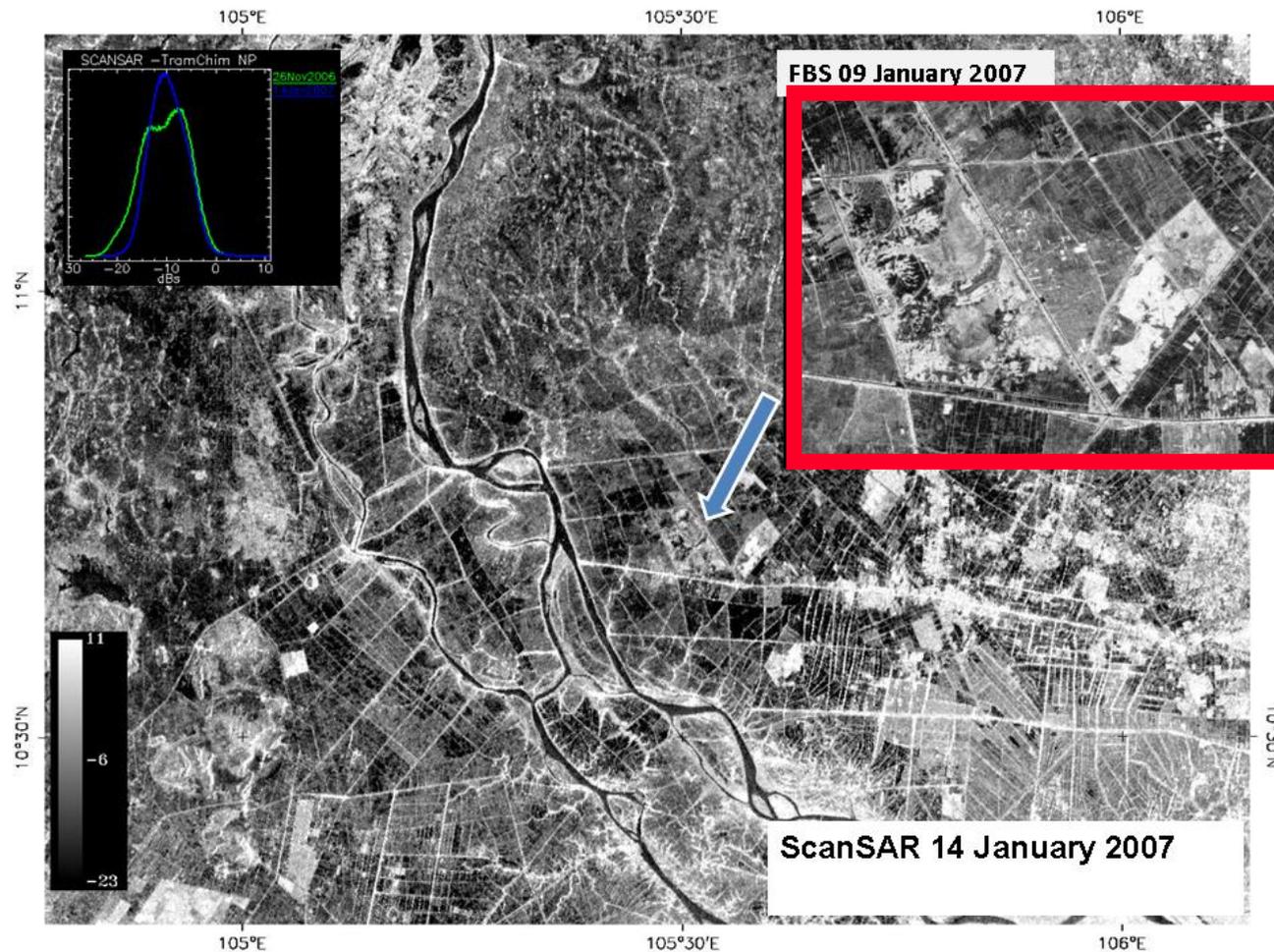
Objective1 - Status

- (i) This task has been completed for FB imagery over a number of test sites in the Lower Mekong Basin. These include; *Stoeng Treng* and *Tonle Sap* in Cambodia, *Siphandon in Laos* and the *Plain of Reeds* in Vietnam

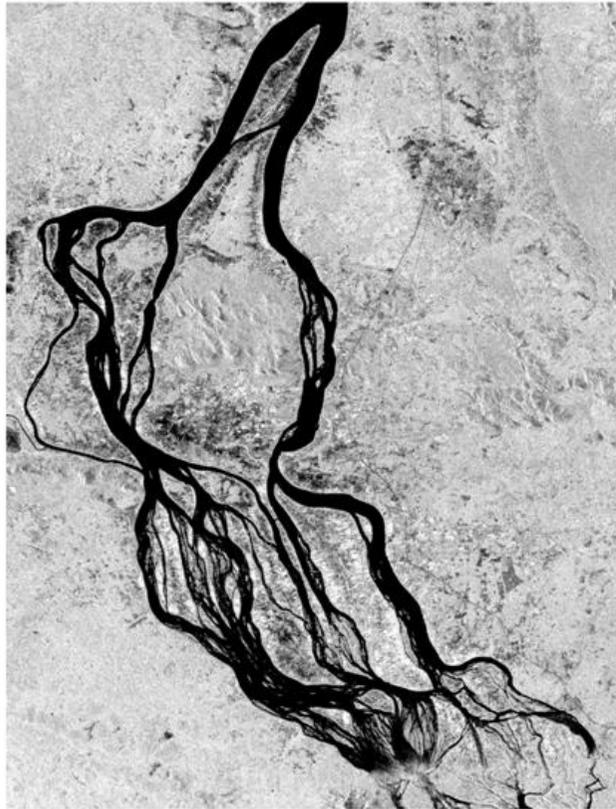
- (ii) The task has not been completed yet using SCANSAR data. Yet to apply processing on mosaic data that has only recently become available.



SRTM background image showing the location of study sites in the Lower Mekong Basin used for evaluating the geometric co-registration, radiometric consistency of PALSAR data and for analysing flood patterns and changes in wetland environments.



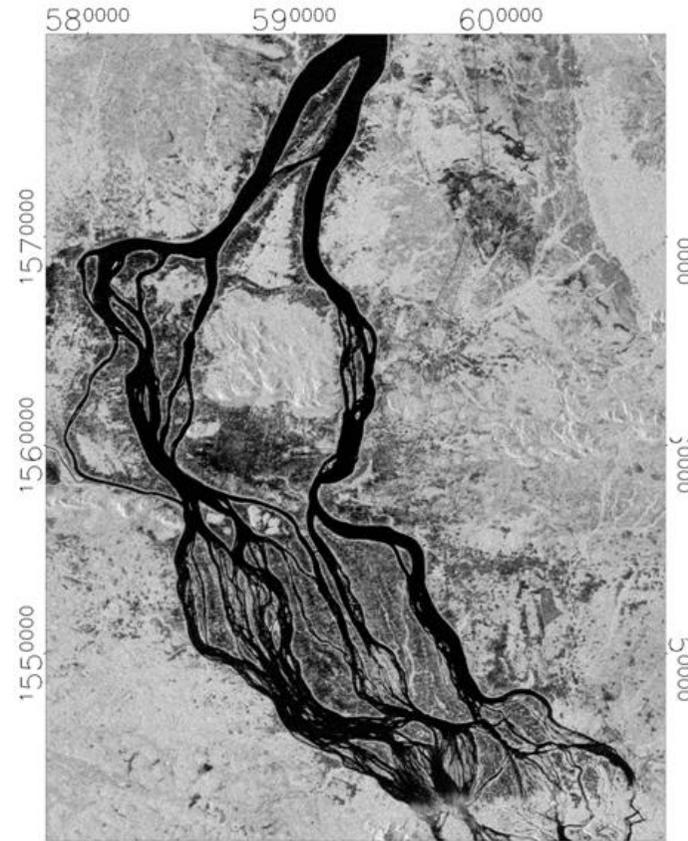
ScanSAR image 14 January 2007 of the Tram Chim Nature Reserve in the Plain of Reeds, Vietnam. The insert shows FBS image of the 9 January 2007 of a portion of the Nature Reserve. Flood mapping analysis has progressed using FBS imagery with methodology to be applied to ScanSAR mosaic data as it becomes available.



PALSAR HH-polarization

Acquired date: 08 Sep 2007

Channel definition – Siphandon site



PALSAR HV-polarization

FBD image of the Mekong River in the Siphandon region of northern Cambodia showing land feature changes in backscatter appearance as a result of polarisation

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PALSAR

Geocoded mosaic: 08Sep 2007

Red: HH-pol

Green: HV-pol

Blue: HH-pol

Green hues: Forest canopy, remnant and regenerated native vegetation

Magenta hues: Ricefields, cleared native shrubland/forest vegetation, typically supporting grasslands

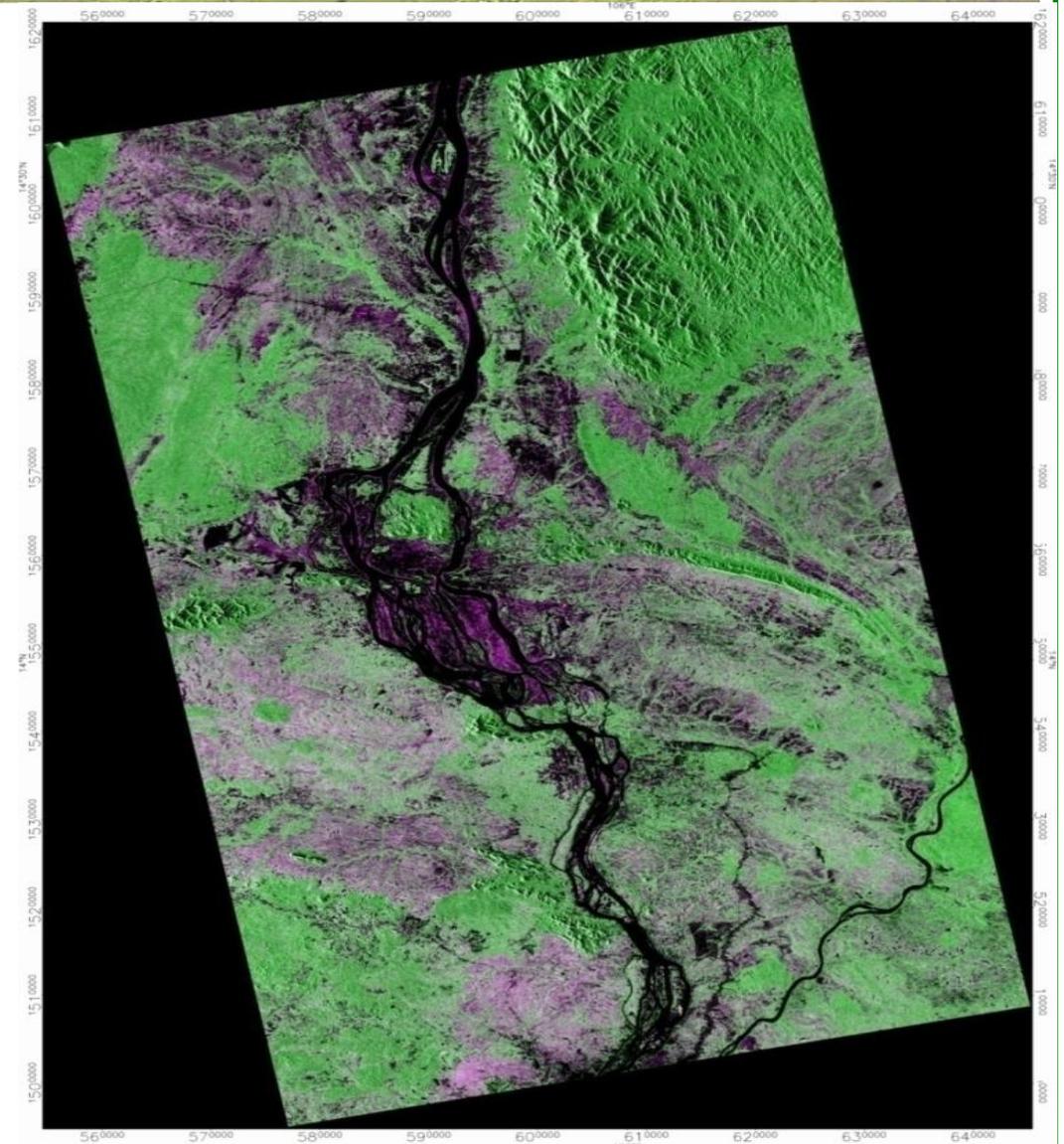
Ratio HH / HV

White: water-filled channels

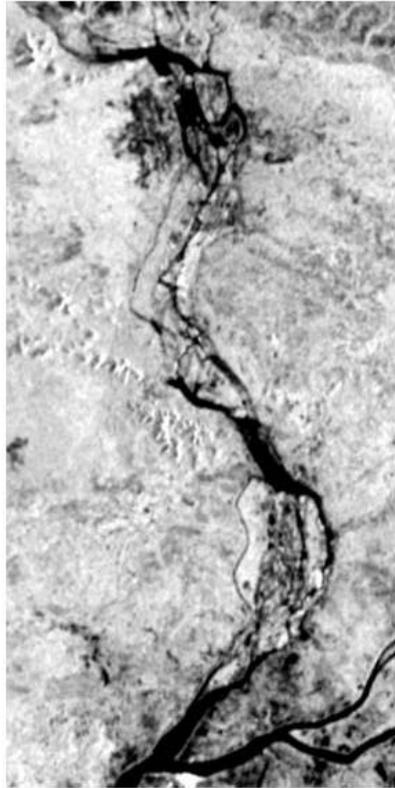
Black: ricefields

Dark grey: cleared forest

Light grey: remnant forest



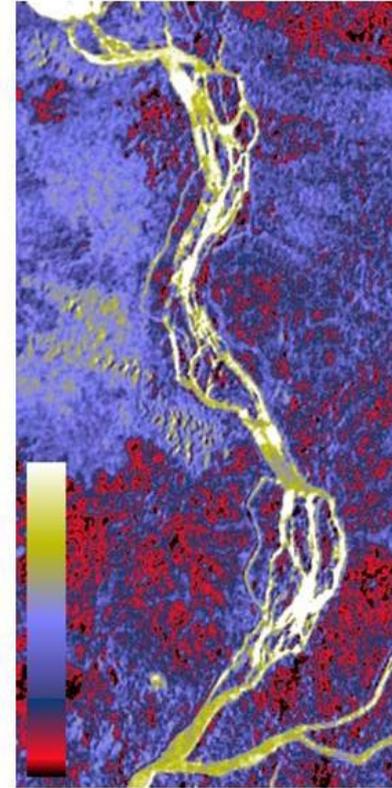
Siphandon, Lao PDR



Dry (Jan-Feb 1997)



Wet (August 1998)

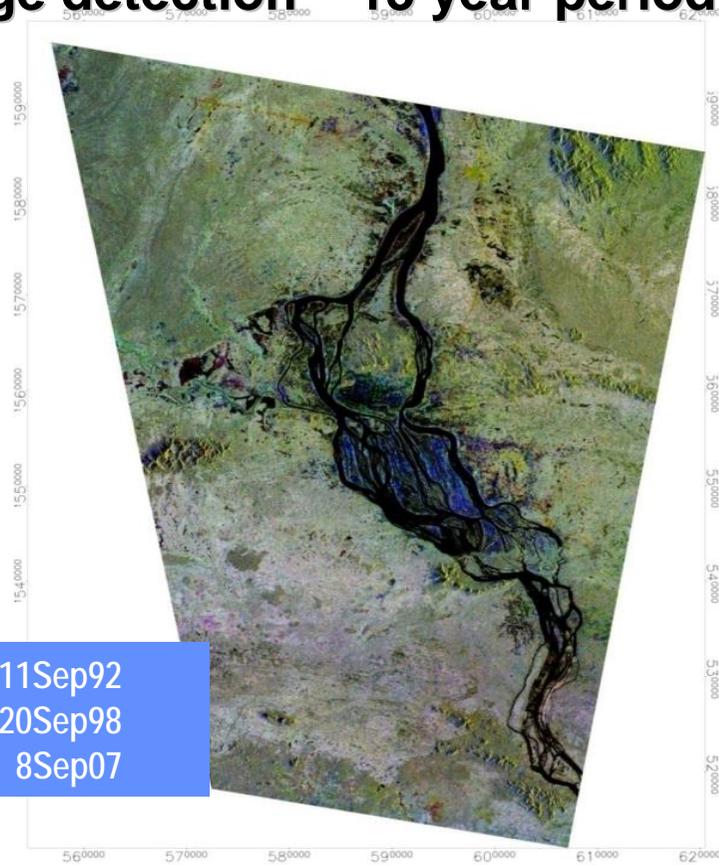


Difference

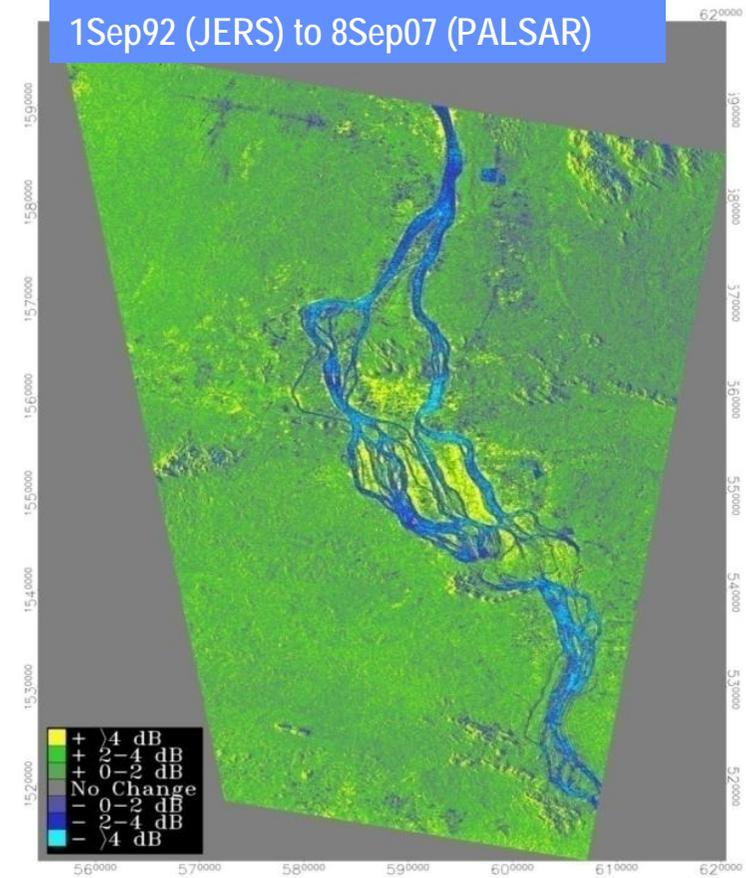
JERS-1 difference image showing scene- and channel-changes between a dry season date (Feb 1997) and a wet season date (August 1998).

White areas show channel inundation between the two dates. Blue areas are relatively unchanged in backscatter while red areas have increased in backscatter due to enhanced vegetation and crop growth with water availability. The same techniques are being applied to PALSAR imagery.

Change detection – 15 year period



R: JERS 11Sep92
G: JERS 20Sep98
B: PALSAR 8Sep07

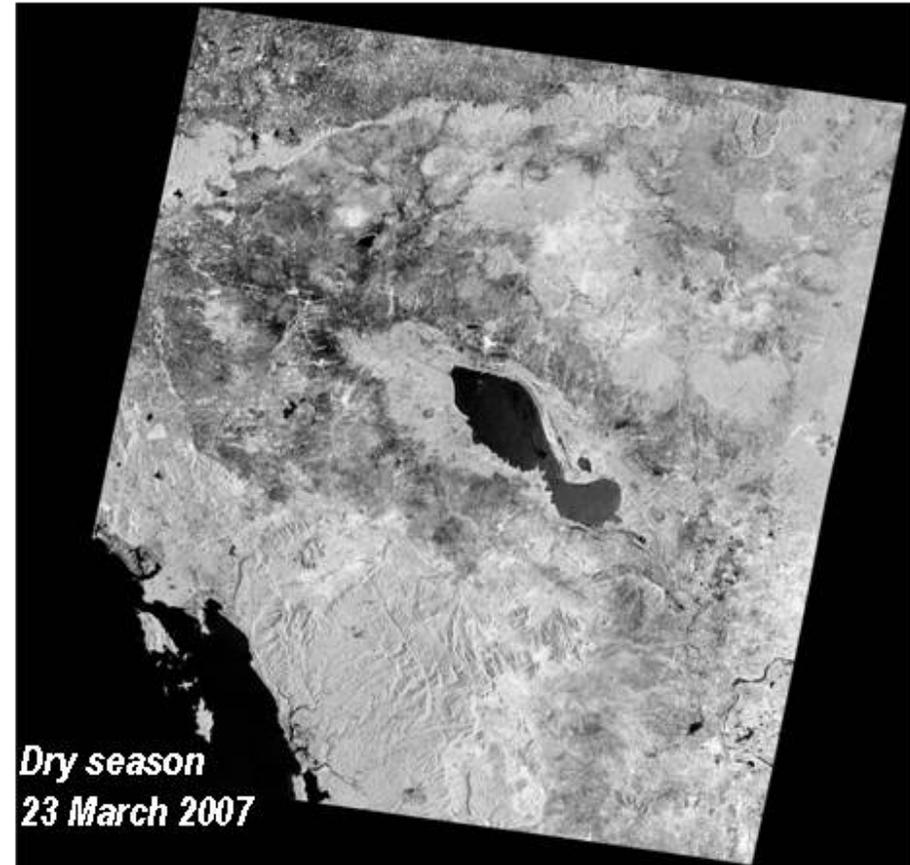
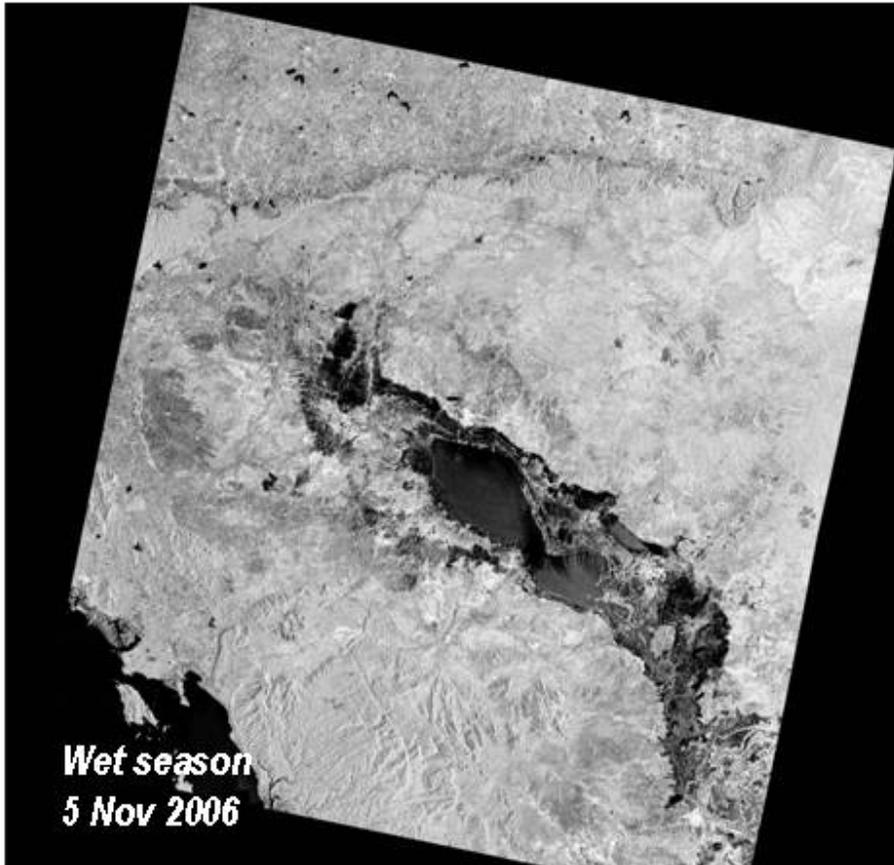


Siphandon, Lao PDR

- + Yellow : increase in biomass, maturation of rice-crops, soil moisture
- + Green : general increase in the level of foliage cover and green biomass
- Cyan-blue : water surface, rough (Sep1992), smooth (Sep07)
- Blue : transport routes

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ScanSAR images of Tonle Sap Great Lake in Cambodia showing seasonal flood extent, wetlands and permanent surface water.

Comparison indicates the extent of flooding during the wet season and open surface water bodies in the dry season.



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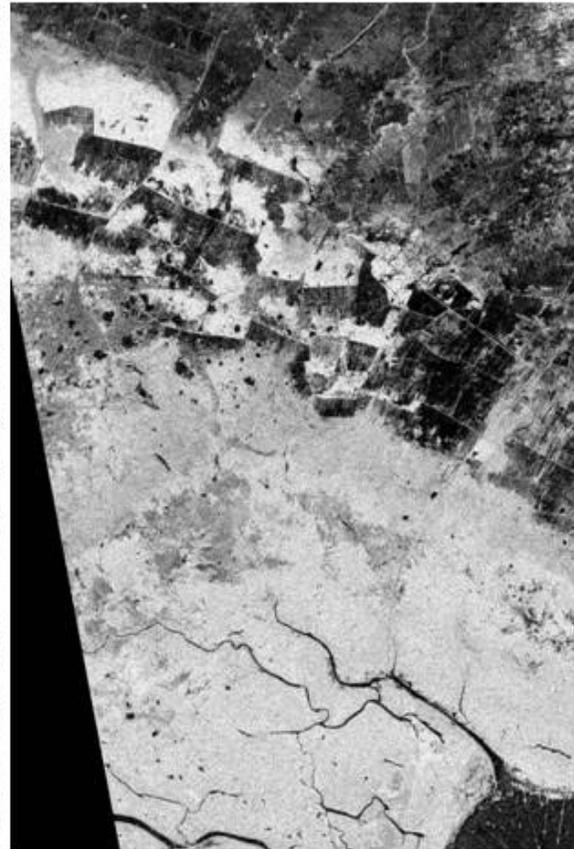


Northern end of Tonle Sap Great Lake. ScanSAR images acquired during the wet and dry show clearly the seasonal differences in the level of water in the lake and also highlight flooding under tree canopies, especially apparent in the wet season.

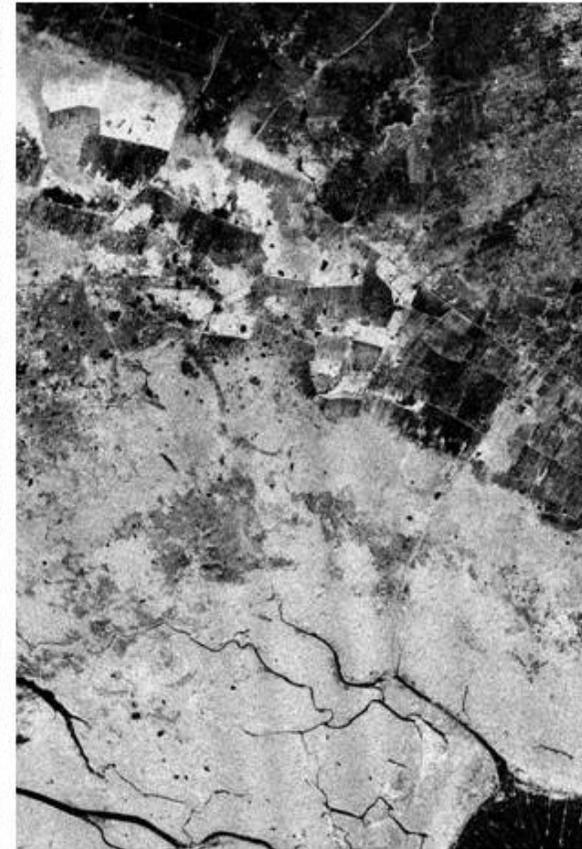




28 December 2006



12 February 2007



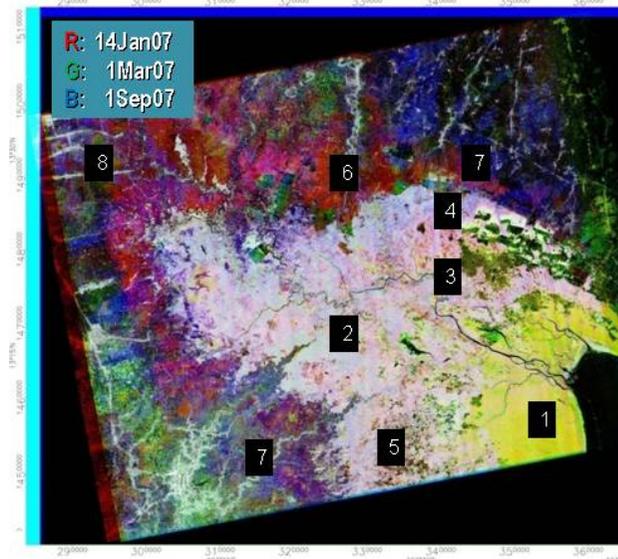
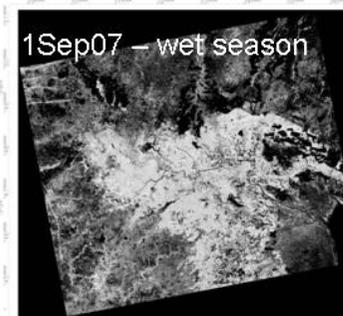
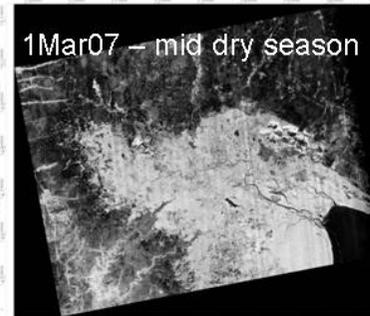
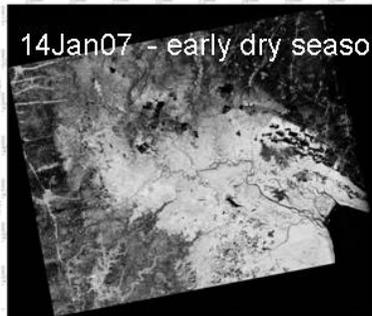
07 March 2007

Sequence of PALSAR FBS images showing changes in backscatter over a three month period as the water level in the Tonle Sap Great Lake falls.

The dark or open water areas in the December image diminish in the February and March images with falling water level

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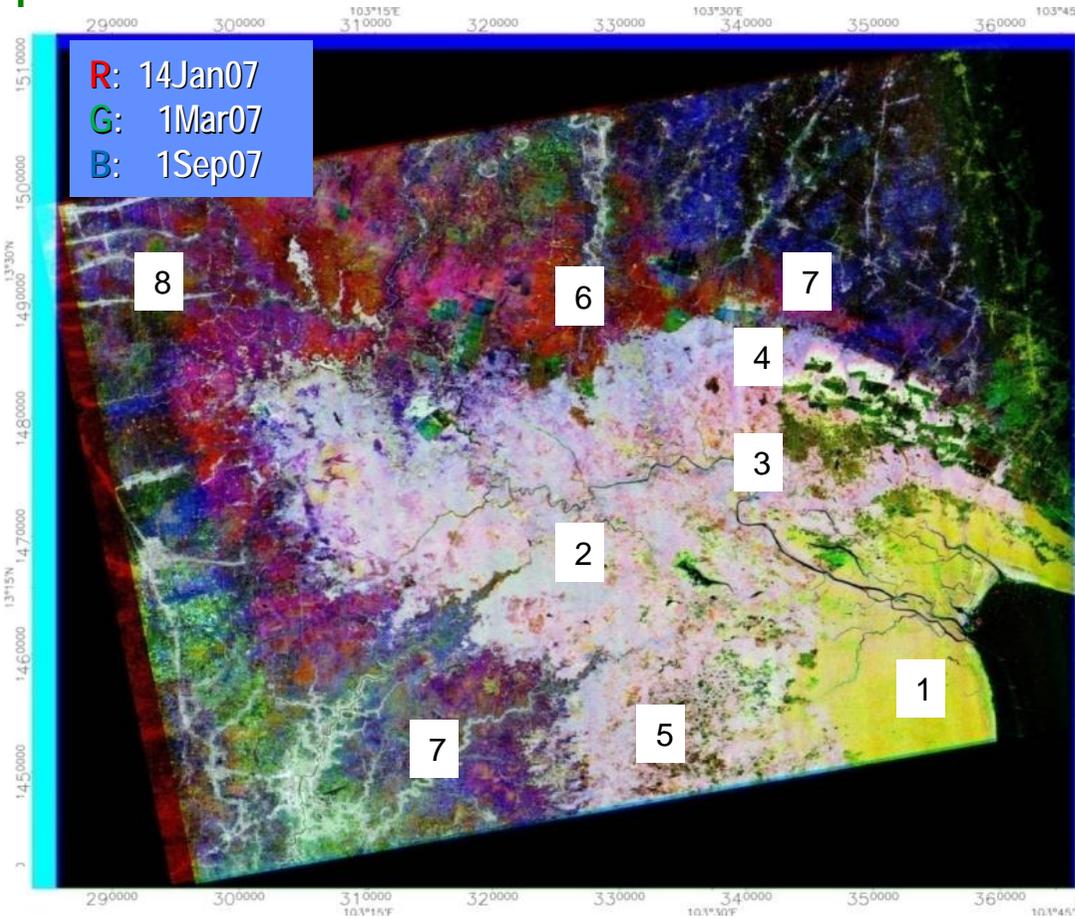
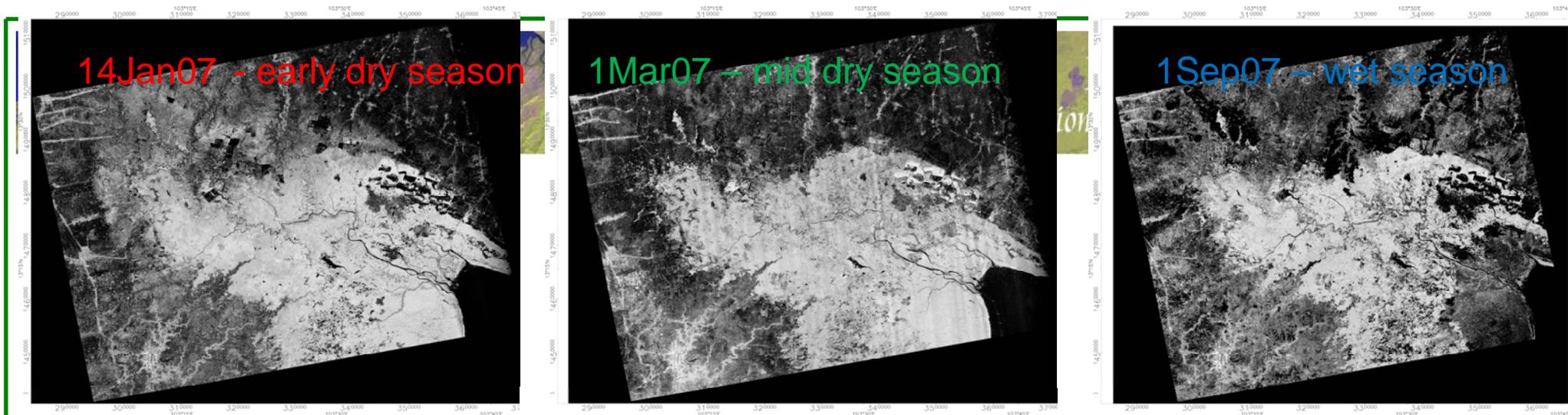


1. Submerged forest within Prek Toal Biosphere Reserve
2. Flooded forest-shrubland
3. Macrophytes
4. Constrained surface water beneath shrublands, upslope of recessional rice-fields
5. Permanent areas of open water, grasslands
6. Surface water drainage
7. Irrigated rice-fields
8. Villages aligned along access routes

Three-date colour composite image of the Prek Toal Nature Reserve, Cambodia.

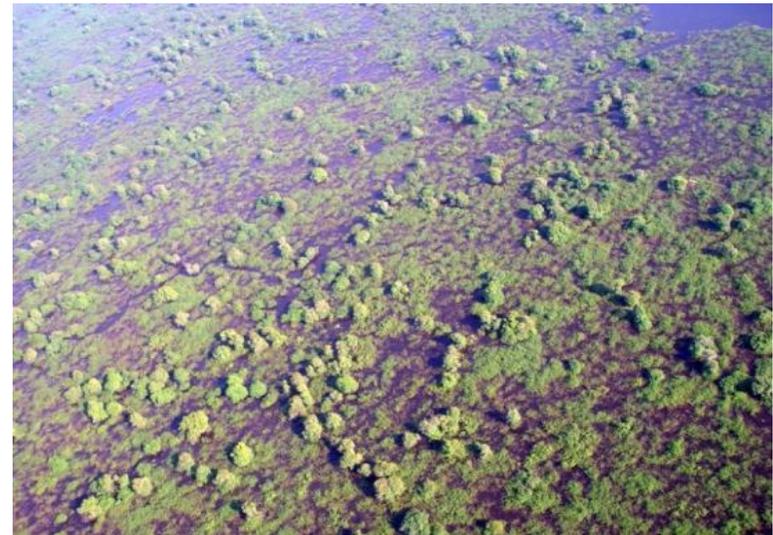
The colour and hues are in response to changing backscatter conditions that occur as a result of falling water levels and crop phenology.



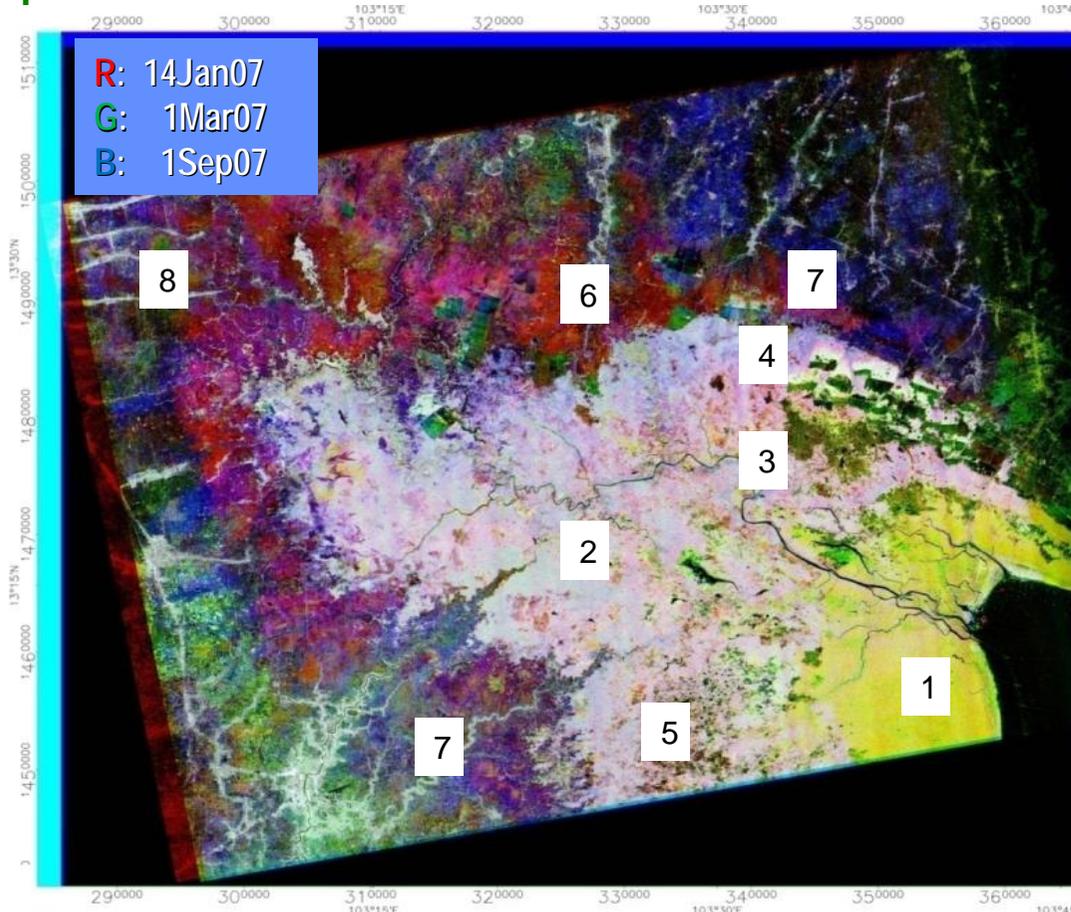
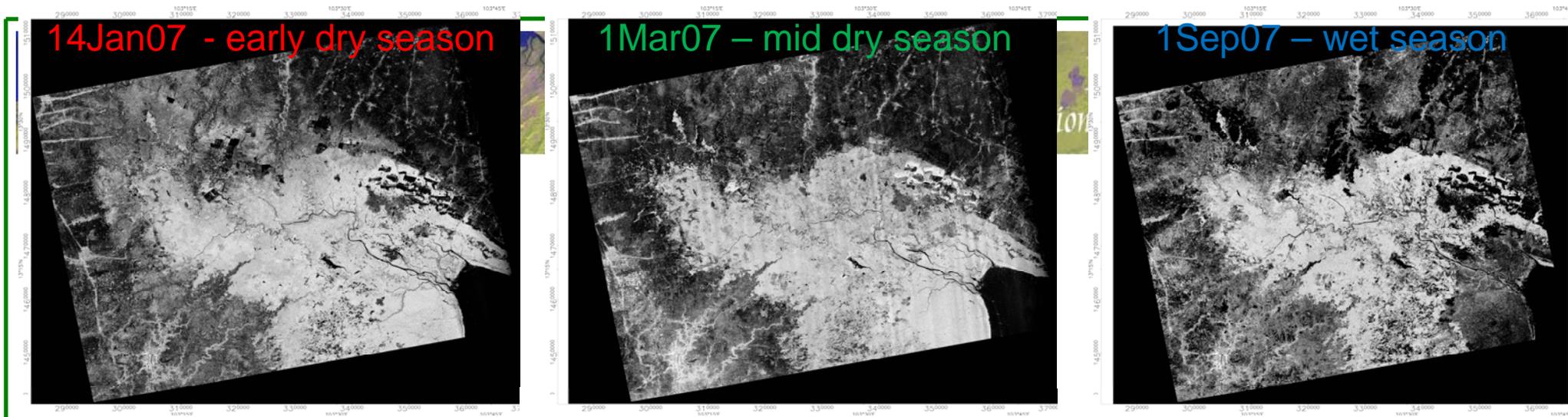


PALSAR HH

1. Submerged forest within Prek Toal Biosphere Reserve



Tonle Sap, Cambodia

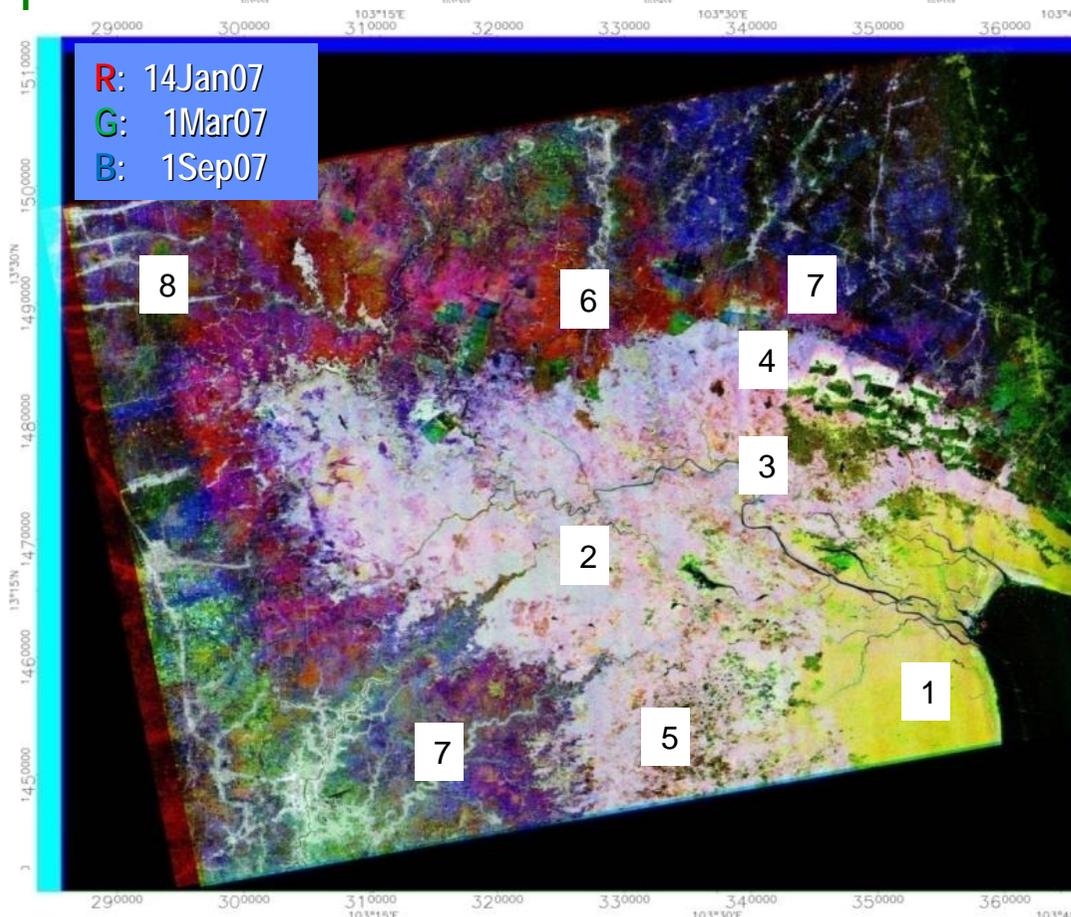
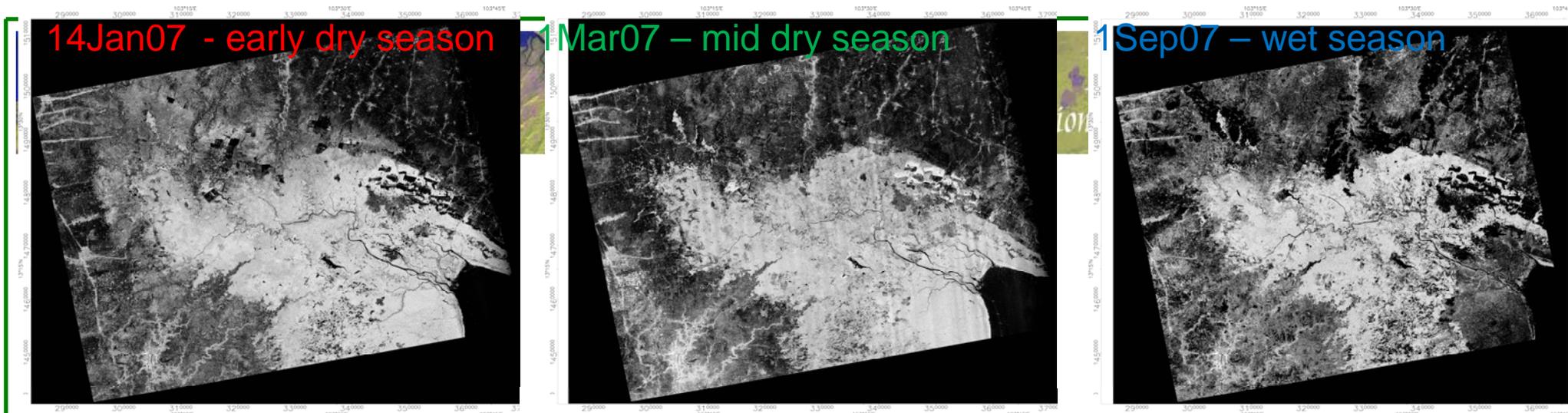


PALSAR HH

2. Flooded forest-shrubland



Tonle Sap, Cambodia



PALSAR HH

3. Macrophytes

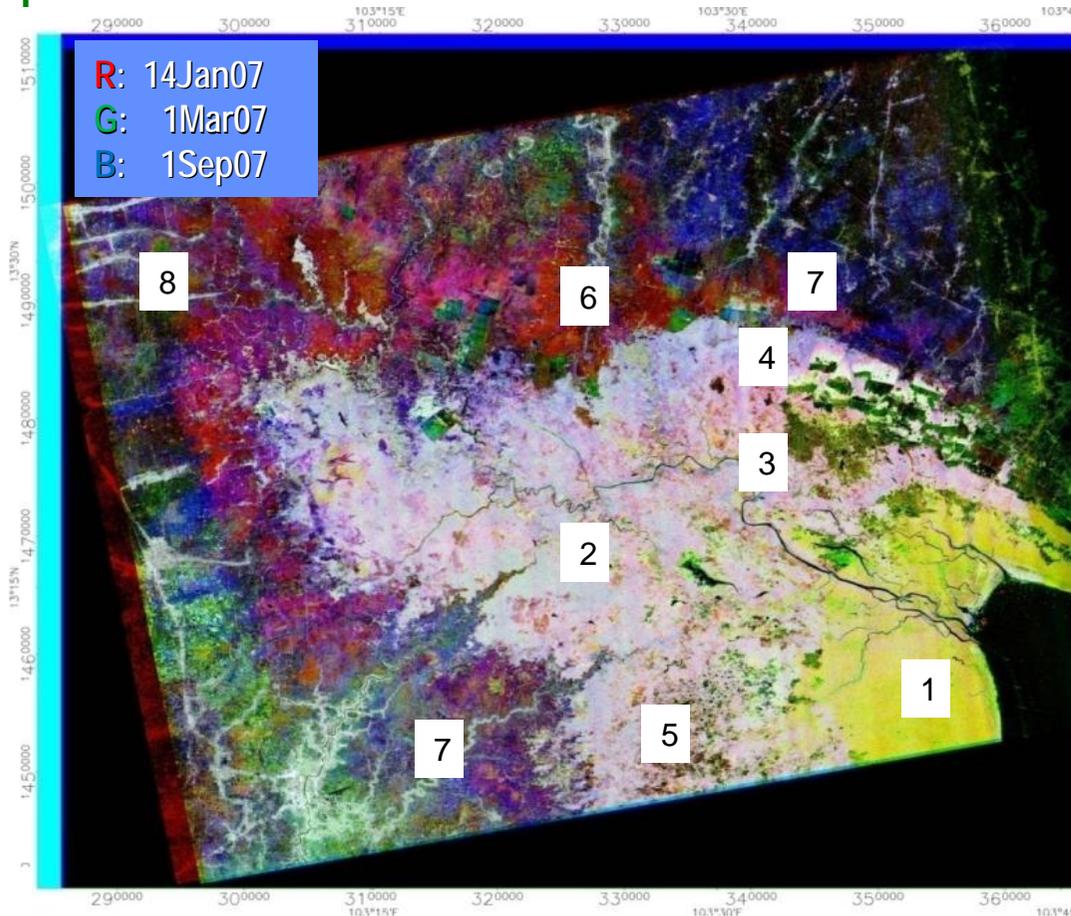
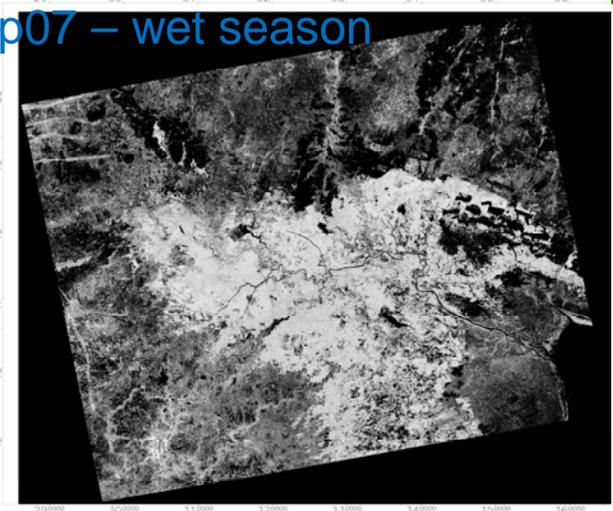
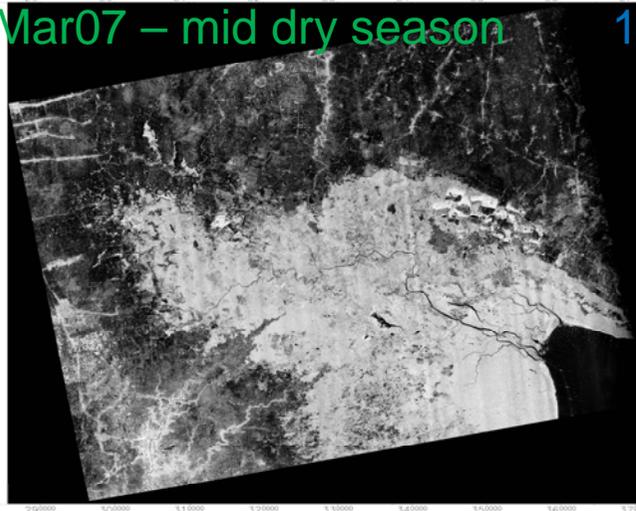
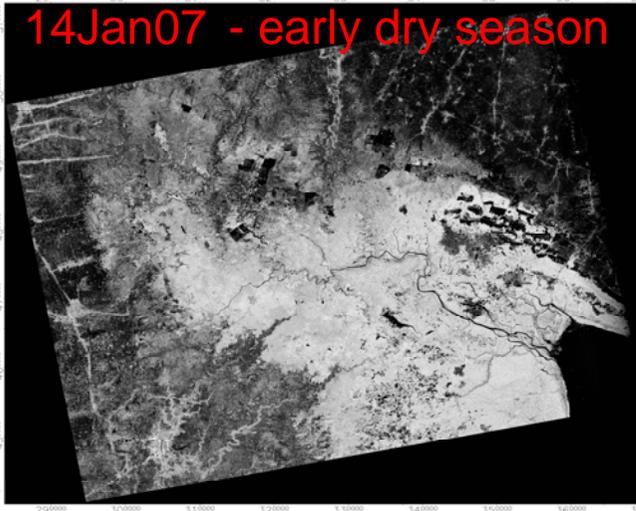


Tonle Sap, Cambodia

14Jan07 - early dry season

1Mar07 - mid dry season

1Sep07 - wet season



PALSAR HH

4. Constrained water beneath shrublands, upslope of recessional rice-fields

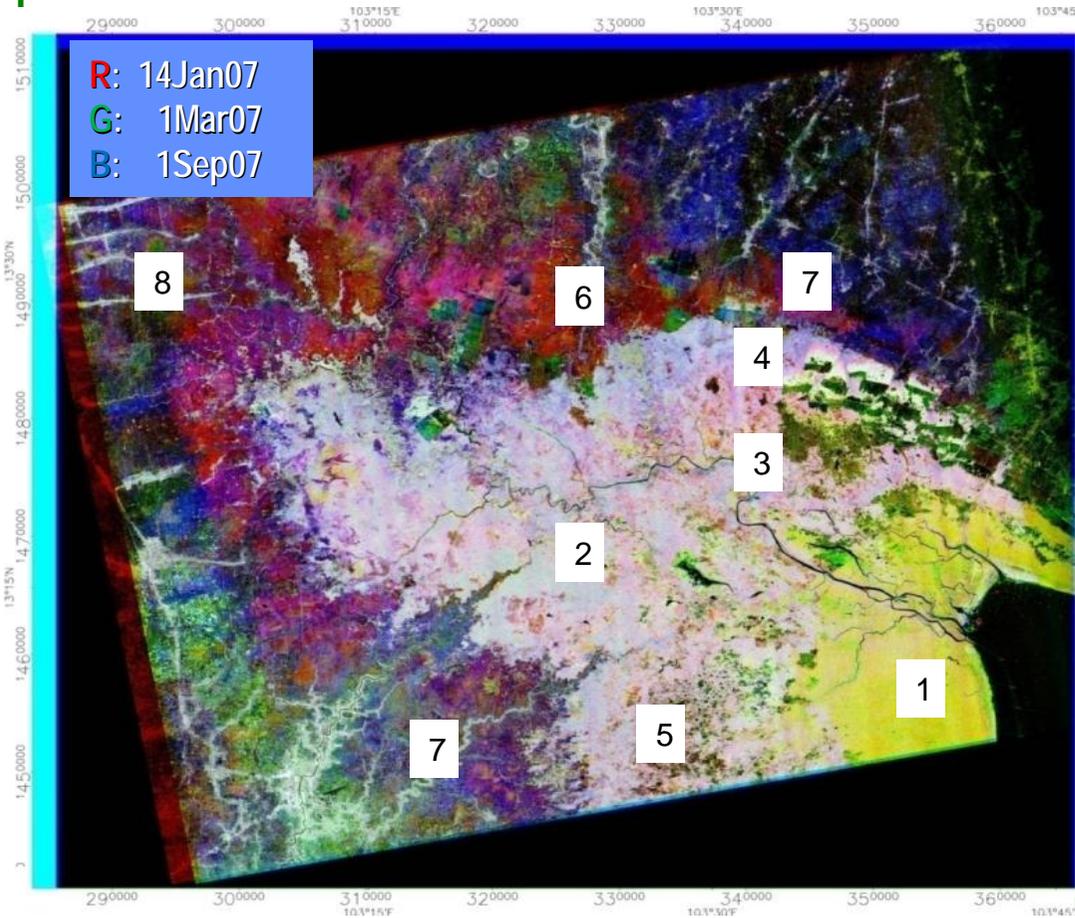
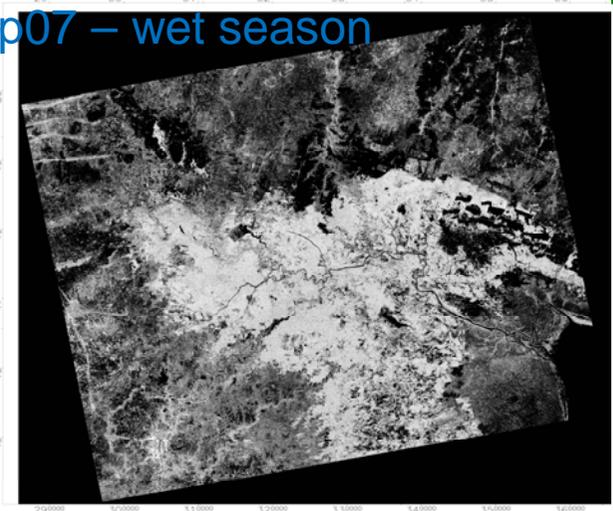
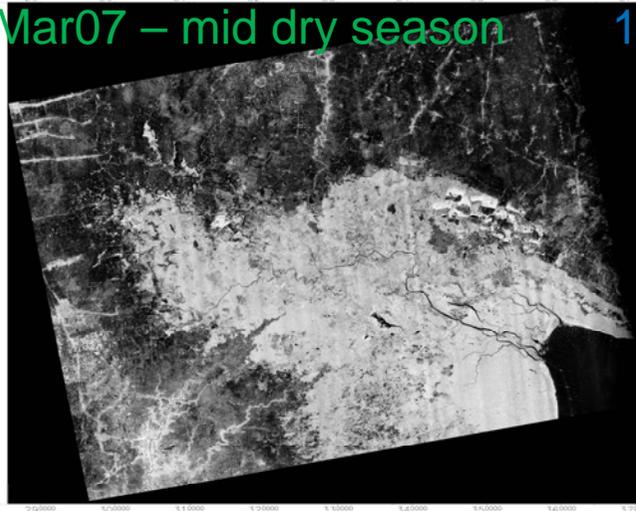
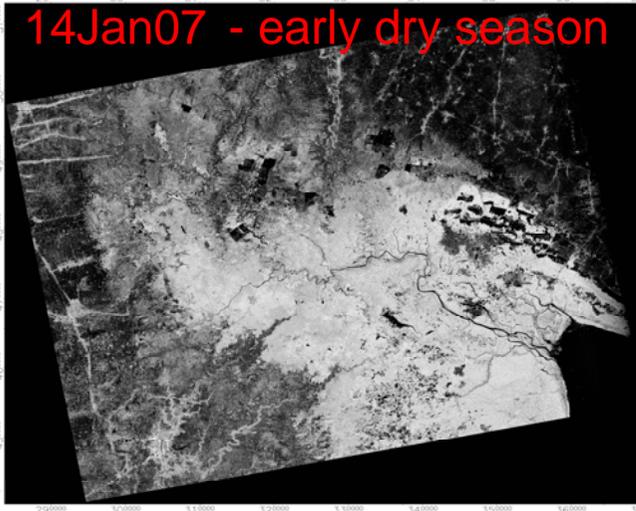


Tonle Sap, Cambodia

14Jan07 - early dry season

1Mar07 - mid dry season

1Sep07 - wet season



PALSAR HH

5. Permanent areas of open water, grasslands

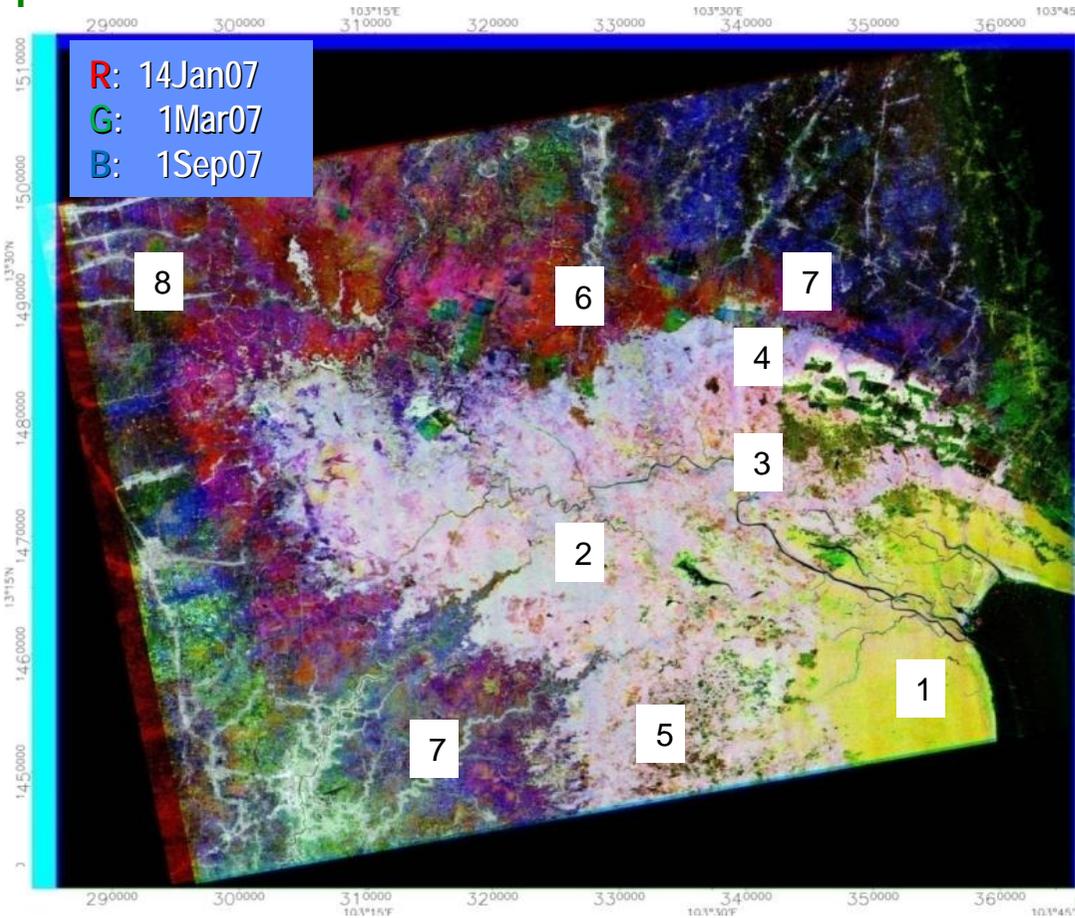
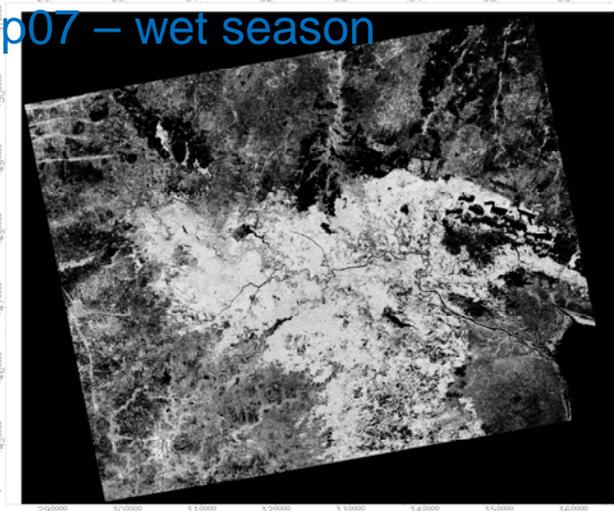
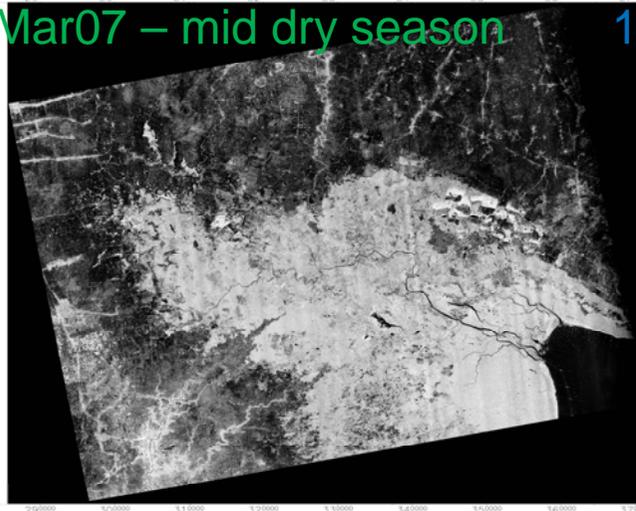
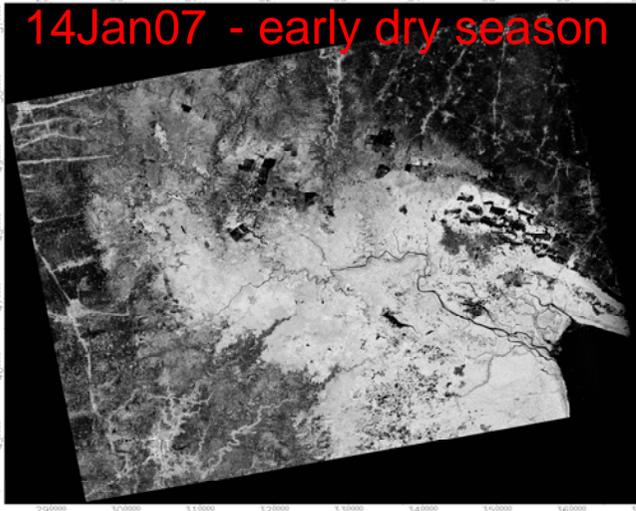


Tonle Sap, Cambodia

14Jan07 - early dry season

1Mar07 - mid dry season

1Sep07 - wet season

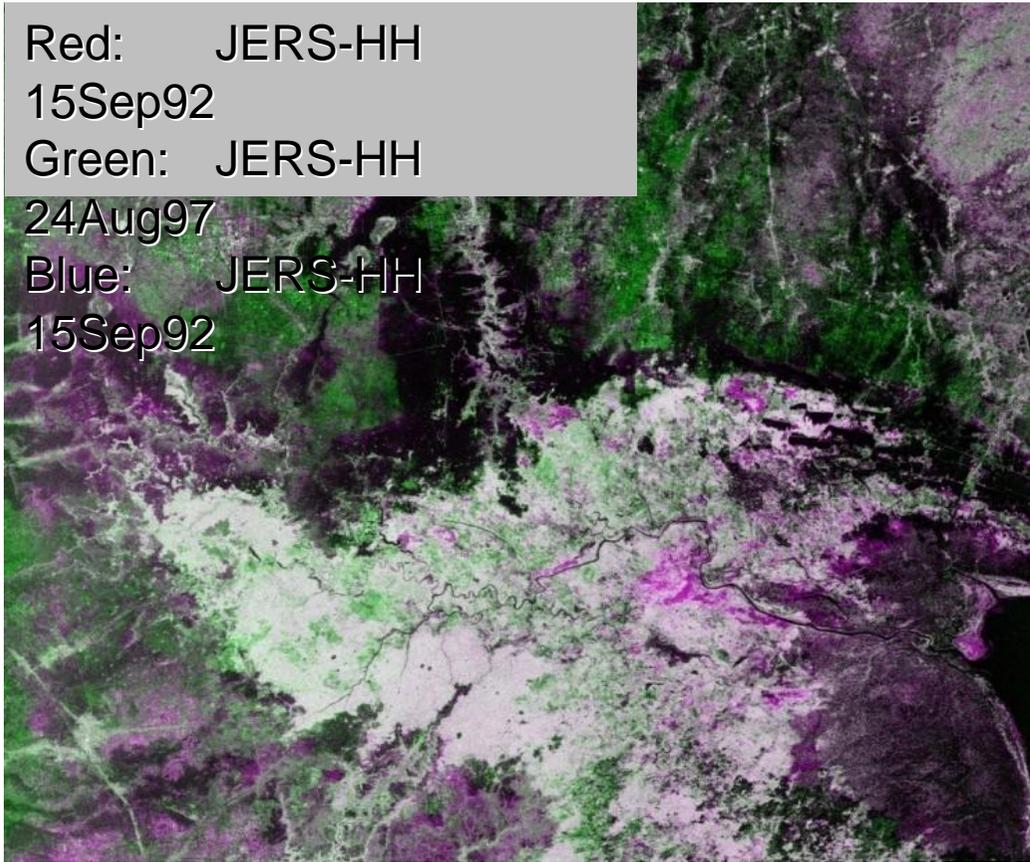


PALSAR HH

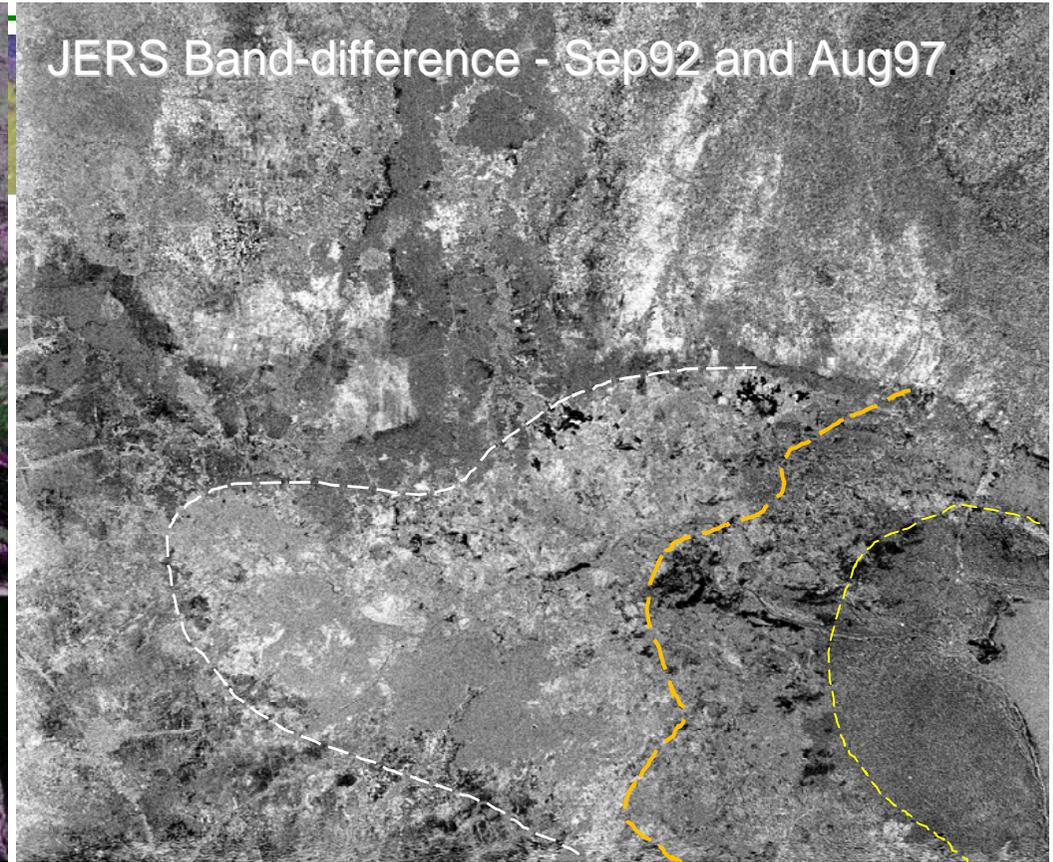
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Tonle Sap, Cambodia

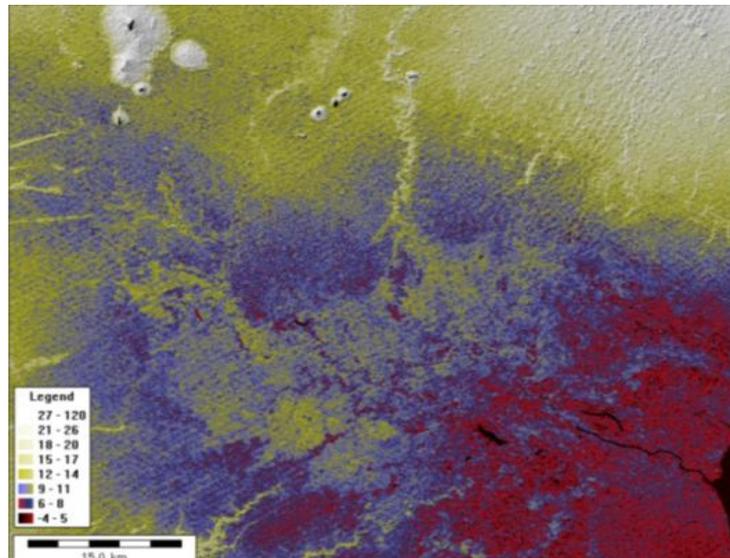
Red: JERS-HH
15Sep92
Green: JERS-HH
24Aug97
Blue: JERS-HH
15Sep92



JERS Band-difference - Sep92 and Aug97



Highlights land-cover changes in a 5-year interval, and a seasonal difference of 3 weeks (Aug to Sep) in dynamic events such as flooding levels and surface flow patterns.



3 arc-shaped textural regions within the wetlands.

3 intermediary stages or patterns of flooding and flood recession within the floodplain?

Tonle Sap, Cambodia

Objective 2

Integrate flood maps derived from PALSAR SCANSAR imagery with SRTM topographic data to produce flood height maps for use in identifying flood prone areas and for predicting the magnitude of flood inundation events within the Mekong River Basin.

Product Deliverables

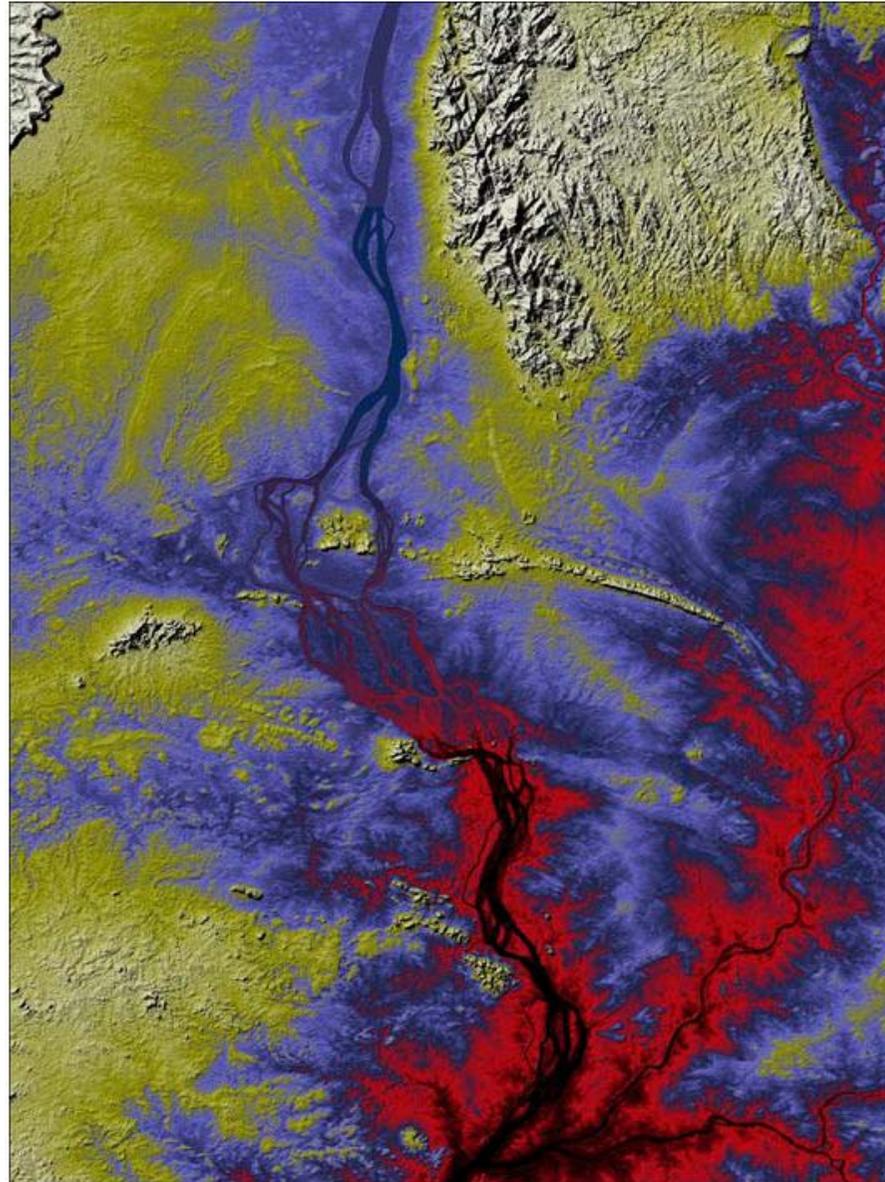
SRTM DEMs showing flood height and flood prone areas along with a flood severity index suitable for use in land use planning for selected river catchments in the Mekong Basin.

Objective 2 - Status

- (i) Processing and validation of STRM DEM of the Mekong River Basin - completed.
Integration of SRTM and PALSAR flood data and developing modeling capability for flood prediction height mapping - continuing.
- (ii) Flood height modeling has been demonstrated but not yet completed.

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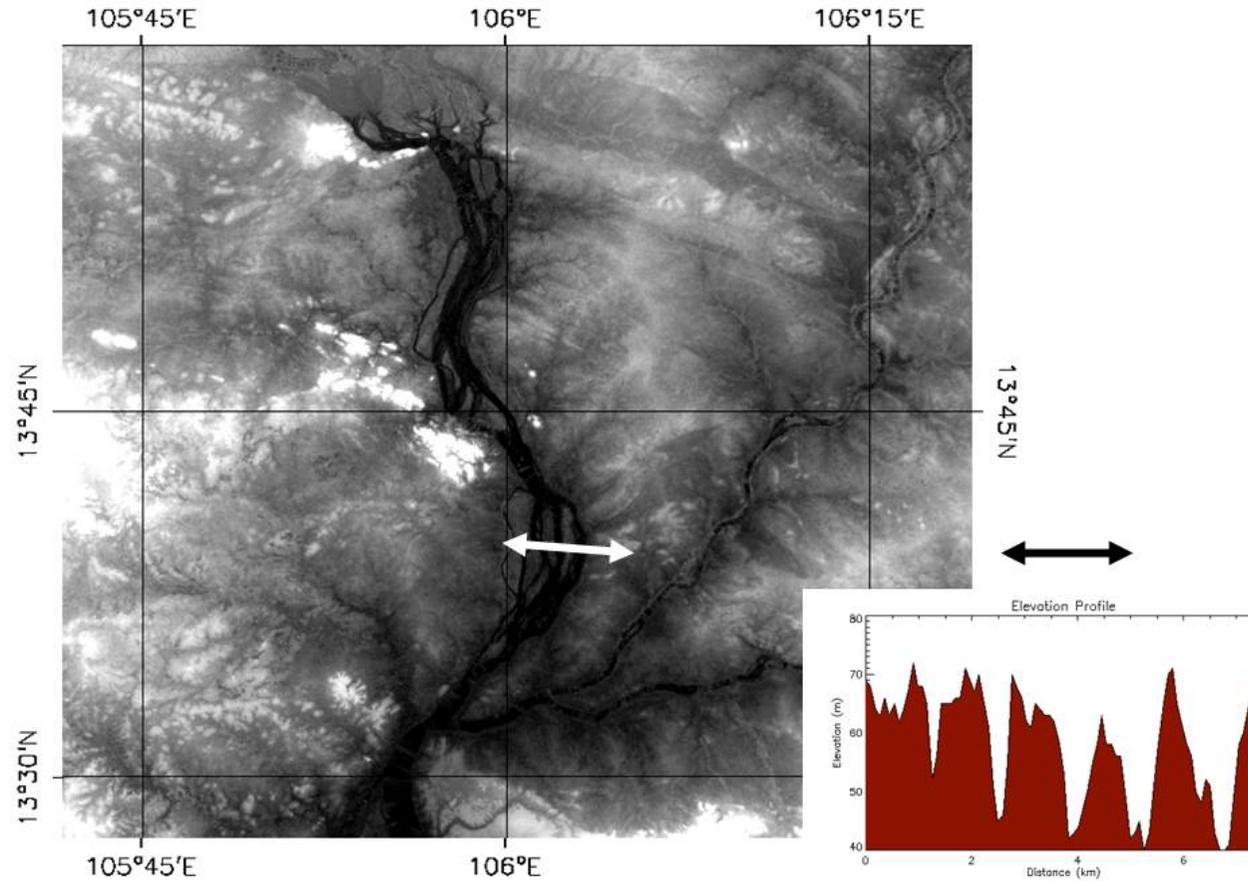
Shaded relief enhancement of SRTM digital elevation data for the Stoeng Treng region in Cambodia.

Mekong River is depicted in centre of image.



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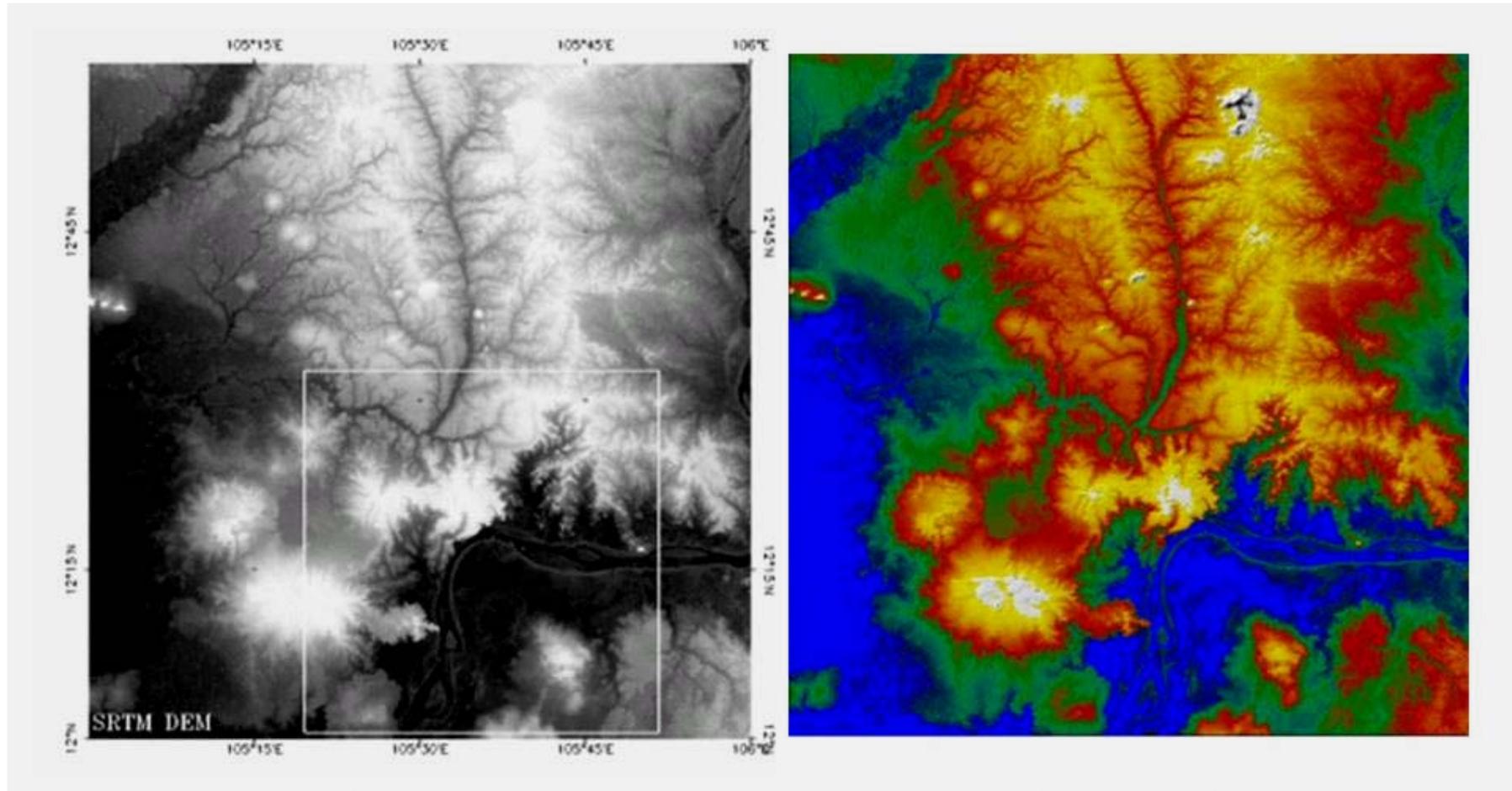
SRTM 1-degree DEM tile for Stoeng Treng.

Insert shows cross section and bank heights of the braided channels of the Mekong River.



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SRTM 1-degree tile image showing DEM (left image) and modelled 20 metre flood height shown in blue (right image).

shaded relief
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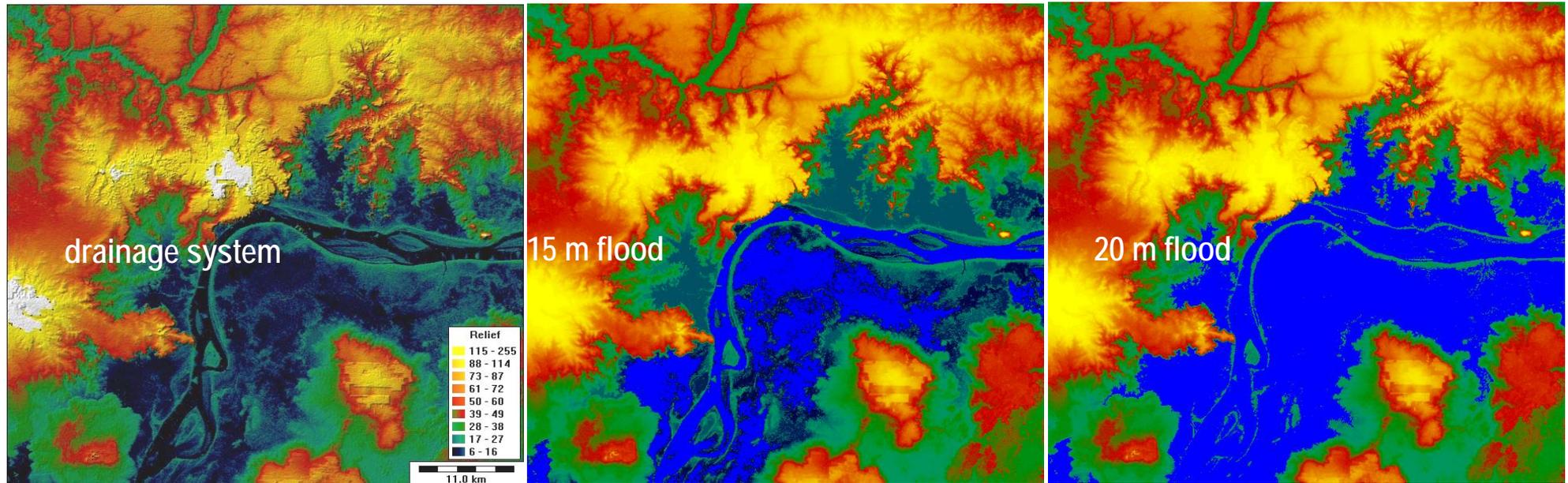
Terrain curvature

Major drainage basins

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SRTM Flood Modeling- Lower Mekong Basin.



Macquarie Marshes – Murray-Darling Basin

- one of largest & most significant wetland systems in Australia
- a non-terminal fresh-water wetland , 200,000 Ha, comprising a series of braided channels and swamps that receive floods from the Macquarie River in the MDB.
- a Nature Reserve within MM is the core wetland – 18,000 Ha in size

Importance:

1. Expansive reed swamps filter water to prevent blue-green algae blooms as it moves into MDR system
2. internationally recognized waterbird breeding area and bird migratory site



Water Availability in the Macquarie-Castlereagh

A report to the Australian Government from the
CSIRO Murray-Darling Basin Sustainable Yields Project

In reality: a wetland in ruin

“Highlights a critical breakdown in habitat management across vested interests and the price of prioritizing water extraction for commercial use above environmental allocations ” ... ECOS 138 Aug-Sept2007



River red gum forest



Floodplain grasses, Black roly poly and



Lagoon and dead stumps



Surrounding wetland veg



Dryland plants – Black roly poly, buck bush
(50 m out from edge of floodplain)



Occasional Red gum



Dense Phragmites reed, <2 m high



Primrose along edge of lagoon



Bora creek. 1 – 1.5 m deep, smooth bank



Erosion channel



Floodplain vegetation near Macquarie River

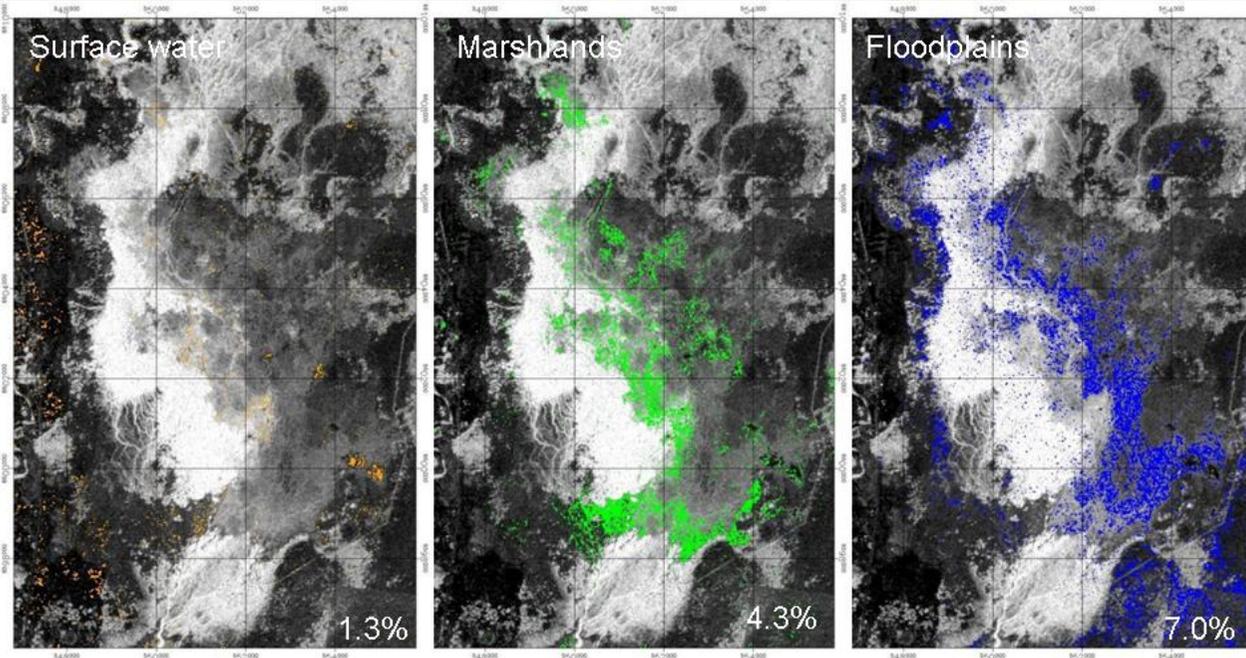


Macquarie Marshes Field Sites



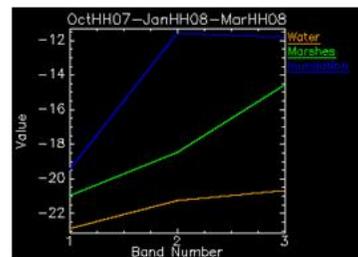
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Spectral Angle Mapper (SAM) image- based on PALSAR OctHH07:JanHH08:MarHH08 data of the Macquarie Marshes.

End-member spectra



Shows separation of 4 cover types, surface water (**orange**), marshlands (**green**) adjacent to the red-river gums (white) and floodplains subject to inundation (**blue**) A median filter has been applied to suppress spuriously classified pixels. Classes are overlain on MNF#1 image derived from the 3 dates.



Conclusions

- **Products to be derived from this study include image-maps of wetland cover and of annual changes in wetland cover, along with flood maps showing flood extent and seasonal floodwater recession patterns. *Yet to be completed on a regional scale.***
- **Complex seasonal cycling involved in the change from wet to dry conditions, especially in the tropical Mekong, is not captured in a single date image. This problem is being resolved using *multi-date imagery* resulting in the likelihood of a much improved classification and monitoring scheme.**
- ***Both the Mekong and the Murray-Darling basins are under threat in terms of water availability and landscape degradation resulting from overuse and land clearing.***

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Acknowledgements

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ALOS Kyoto & Carbon Initiative**

and

**to all members of the K&C Science Team for their continued
collaborations and support.**

