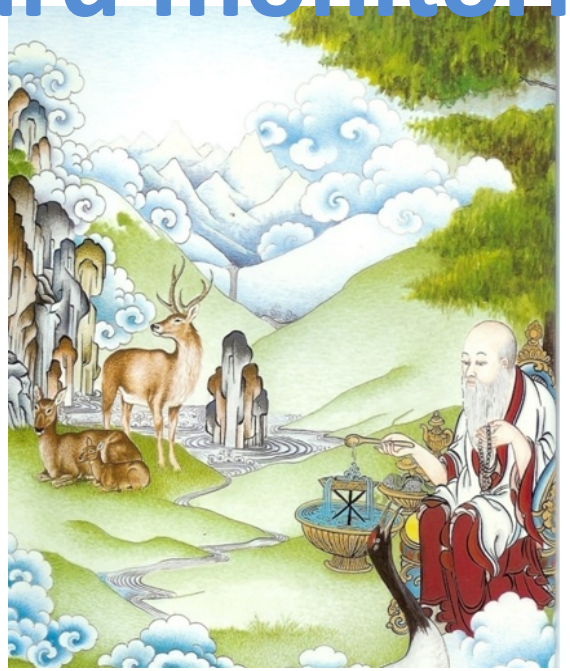
Bhutan - DHMS's expectations of new-generation satellites for hazard monitoring



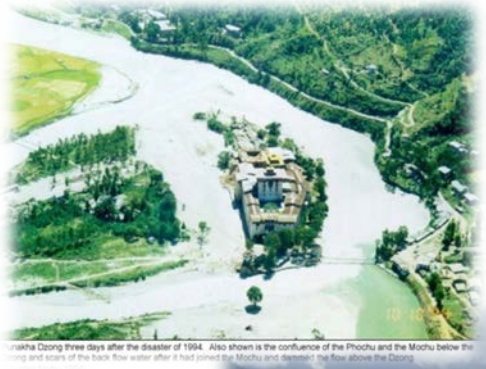
6th Asia/Oceania Meteorological Satellite User Conference

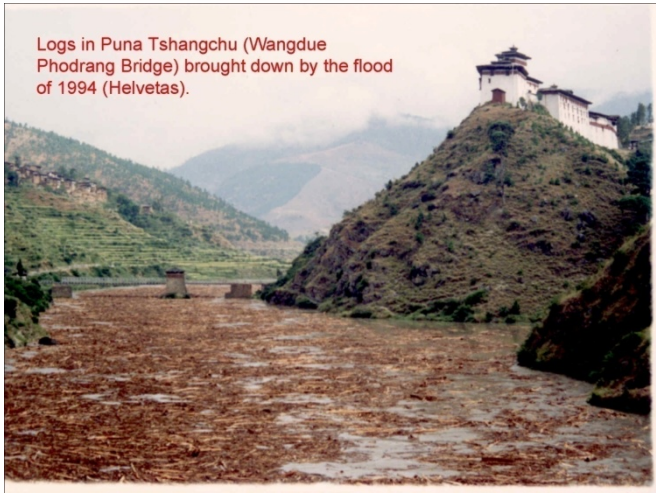
Tokyo, Japan, 9 November 2015

Tokyo International Exchange Center/Plaza Heisei Meeting Facilities

DHMS's top three hazards
that can be monitored by satellite
(Q 1 of the JMA questionnaire)

- Hazard 1: Monsoon activity (e.g., cloud formation, rainfall)





DHMS's top three hazards
that can be monitored by satellite
(Q 1 of the JMA questionnaire)

- Hazard 2: Severe thunder storm
  - Samtse (Southern Bhutan) – there is event every year.
  - Eastern Bhutan
  - Electricity cut-off (for weeks)

DHMS's top three hazards
that can be monitored by satellite
(Q 1 of the JMA questionnaire)

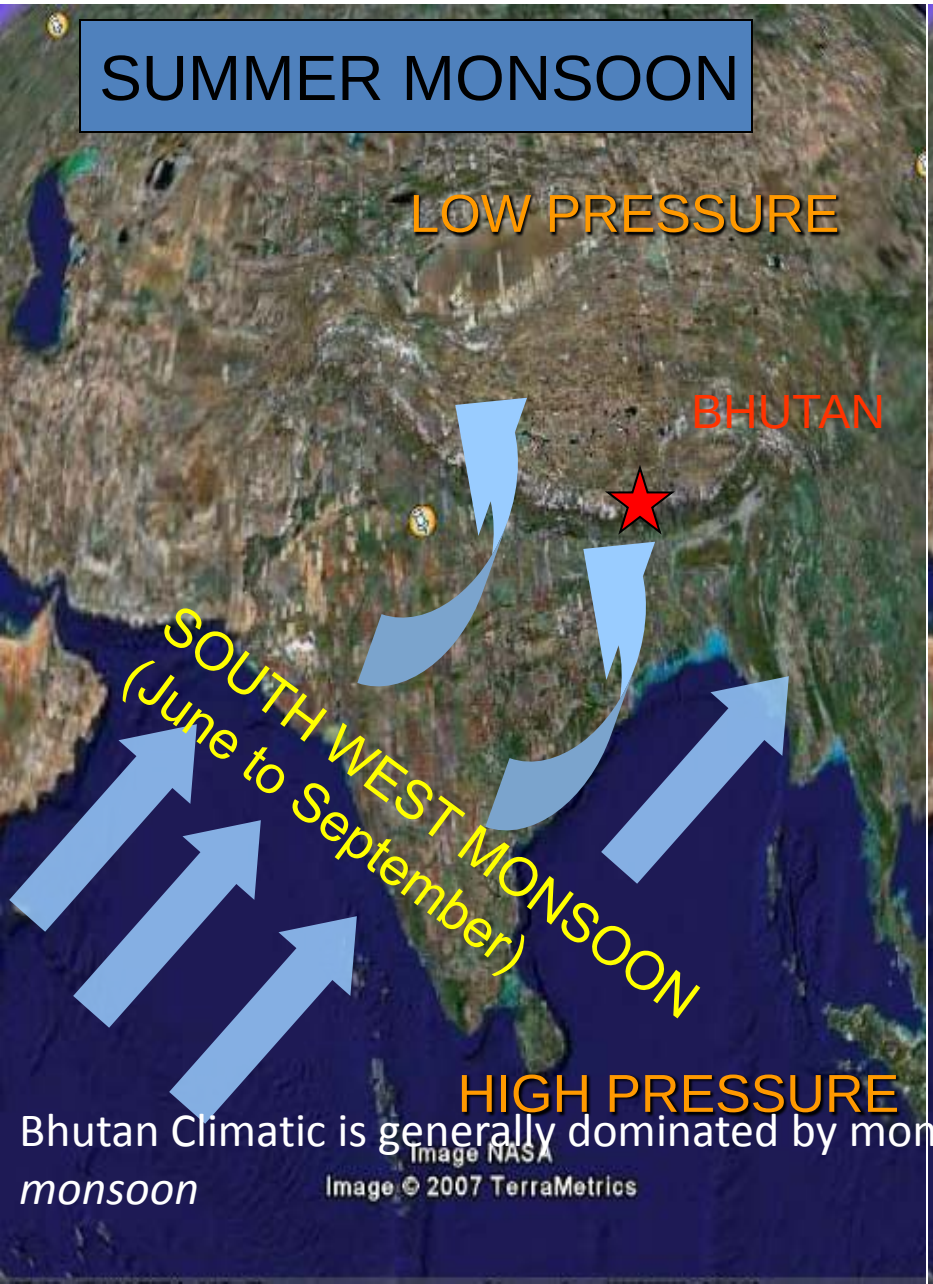
- Hazard 3: Tropical Cyclone
  - Affects from cyclones felt – e.g Aila (destruction – USD 17 million).

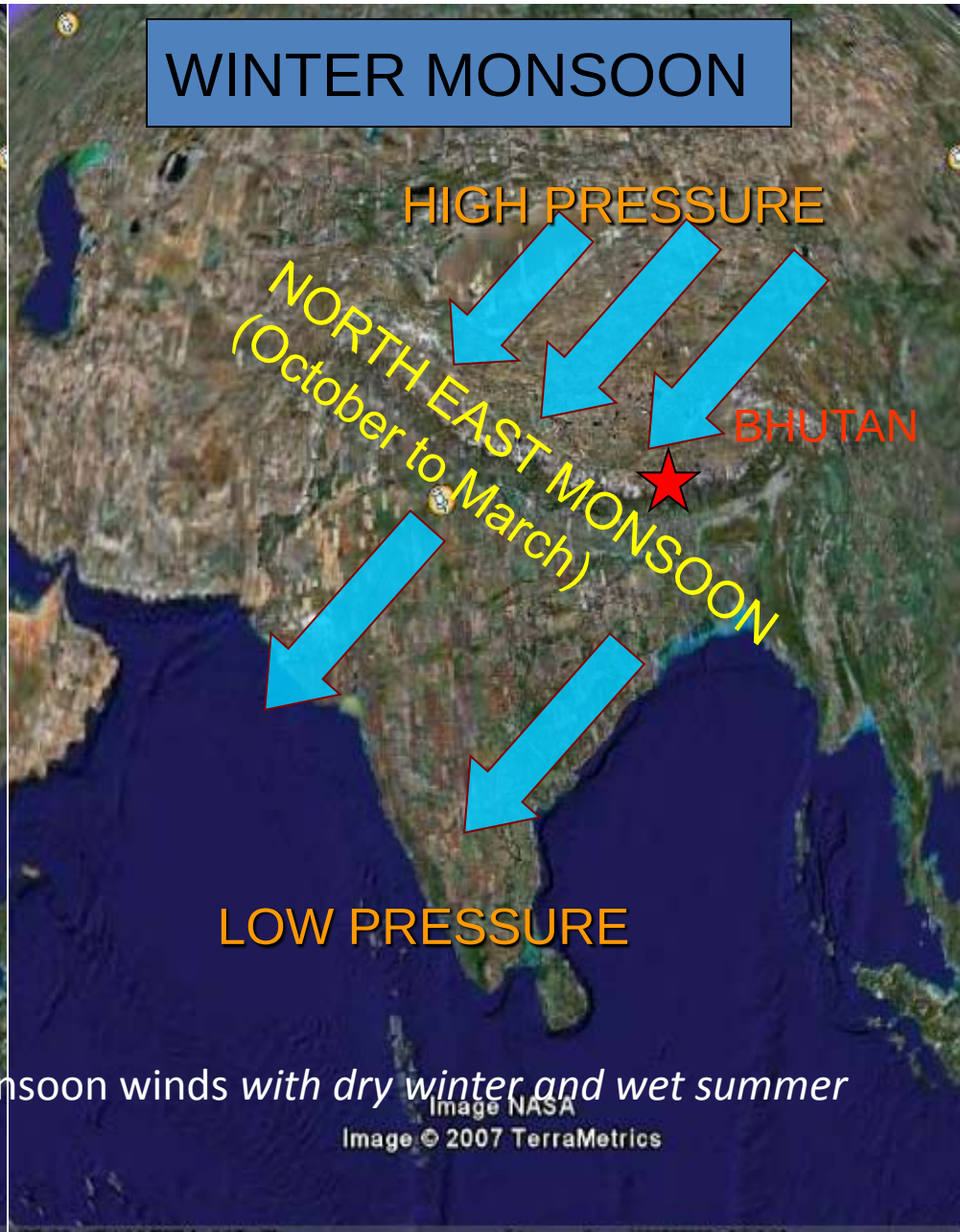
- Incessant rainfall
  in May 2009 – Cyclone Aila
- 1994 GLOF
- June 2015 GLOF
- Flash Flood and every monsoon
- Roads cut-off every monsoon
- Wind storms

Table below lists recent climate-related natural hazards.

Year	Climate hazard Events	Reported damages	Affected areas
2004	Flashfloods	9 lives; damages to 162 houses, 664 acres of farmland and 39 irrigation channels; loss of 350 million tonnes of maize, 126 million tonnes of paddy and 2000 citrus trees. Transportation remained disrupted for days in the affected Dzongkhags (SNC)	Six eastern Dzongkhags
2008	Windstorm	Damages to 249 households, eight school buildings, religious structures and one government office	Trashigang Dzongkhag
2008	Windstorm	More than 80 acres of maize crops affecting 96 households	Mongar Dzongkhag
2009	Windstorm	114 households affected	Trashigang Dzongkhag
2009	Cyclone Aila	12 lives; damages to farmland, infrastructure, etc. amounting to US$17million	Across the country
2010	Flashfloods and landslides	Damages to 2000 acres of farmland and irrigation channels affecting nearly 4800 households; 40 acres of pastureland and a thousand livestock	20 Dzongkhags
2010	Windstorm	Damaged more than 5000 acres of farmland affecting 432 households	Across the country
2011	Windstorms	Damages to 2424 houses, 81 religious structures, 57 schools, 21 health centers, and 13 government buildings	16 Dzongkhags
2011	Flashfloods and landslides	Loss of properties for 200 households (Revised-NAPA).	Industrial estates and residential areas in Phuentsholing and Pasakha
2012	Gasa flashflood and land slides.	Loss of infrastructures –roads, bridges	Gasa Dzongkhag and downstream dzongkhags Punakha, Wangdue etc.

Climatic Condition





Bhutan Climatic is generally dominated by monsoon winds *with dry winter and wet summer monsoon*

Vulnerability

Paro Airport

Monuments

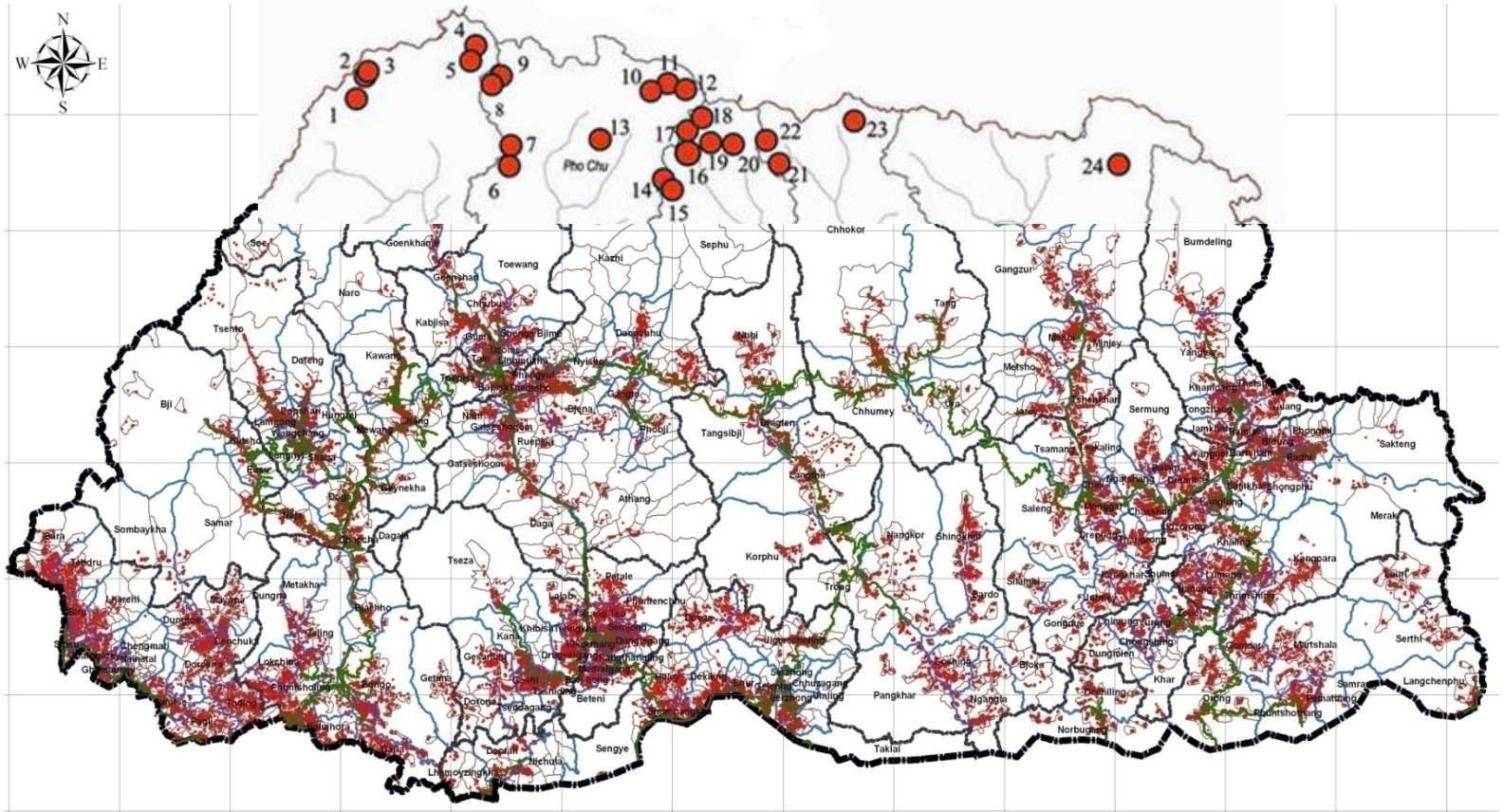
Bumthang Domestic Airport

Agriculture land

Hydropower Plants

Why flood matters for Bhutan??

Point data showing the settlement pattern of Bhutan



Source: NSB, 2005

Over 70% of the settlements are located along the drainage basins.

DHMS's expectations of new series of satellites for hazard monitoring

(Q 2 of the JMA questionnaire)

Major hazard	Features of new generation GEO met. satellite
Hazard 1: Monsoon Activity	**Multi-spectral bands:** New signals derived from multi-spectral-band observations will support issuance of more effective warnings.
Hazard 2: Severe thunderstorms	**Multi-spectral bands:** New quantitative products will be derived from multi-spectral band observation data. New instruments *(e.g., Some of the new generation of geostationary meteorological satellites will have lightning mappers or hyper spectral infrared sounders.)*
Hazard 3: Tropical Cyclones	**Multi spectral bands:** New signals derived from multi-spectral band observation before extremely heavy rainfall are expected to be useful.

DHMS's requirements to get desired benefits from the new generation of satellites

(Q 3 of the JMA questionnaire)

Major hazard	Features of new generation GEO met. satellite
Hazard 1: Monsoon Activity	**Training in imagery analysis:** Training would support the retrieval of new signals from multi-spectral band observation.
Hazard 2: Severe Thunderstorms	**Training in basics of multi-spectral observation**
Hazard 3: Tropical Cyclone	**Easy-to-understand product:** DHMS would be interested in using a product made with multi-spectral band data that indicates new signals prior to extremely heavy rain.

DHMS's plans/expectations for utilization of new-generation geostationary meteorological satellite data

- Develop weather monitoring system using enhanced features of new-generation satellites such as high spatial resolution and multi-spectral bands (the focus would be monsoonal activity combined with wind storms if possible – we are also looking forward to focus on some alert system for flash floods)
- Would like to engage and learn from scientific meetings with focus on the utilization of new-generation satellite imagery.

Thank you

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