

Airborne Imagery – Potential Role in Monitoring Climate Change

US Department of State

5 October 2009

Briefing Topics

- **Introduction**
- **Climate Change Threats to National Security**
- **Role for Airborne Monitoring**
- **Open Skies Treaty -- Co-operative Observation Regime**
- **Examples of Remote Sensing to Monitor Climate Change**

Airborne Imaging of Climate Change That Threaten National Security

- **Monitoring climate change consequences easier for airborne sensors than monitoring climate change causes**
- **Some consequences that may impact national stability**
 - Severe weather (hurricanes, cyclones)
 - Heavy precipitation & flooding (coastal, interior)
 - Ice melt and water supply
 - Deforestation, desertification, wildfires
 - Environmental contamination
 - Human migration

Role for Airborne Monitoring

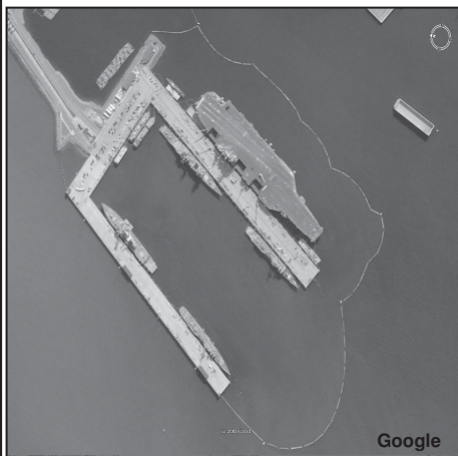
- **Aircraft imaging role in monitoring climate change**
 - Aircraft can complement satellite and on-site observations
- **Advantages of co-operative observation missions**
 - Transparency and confidence building
 - Access to national territories
- **Open Skies Treaty as a model airborne observation regime**
 - Over 600 missions flown since 2002
 - Treaty preamble provides for possible extension to protection of the environment

Advantages of Airborne Imaging over Satellite Collection

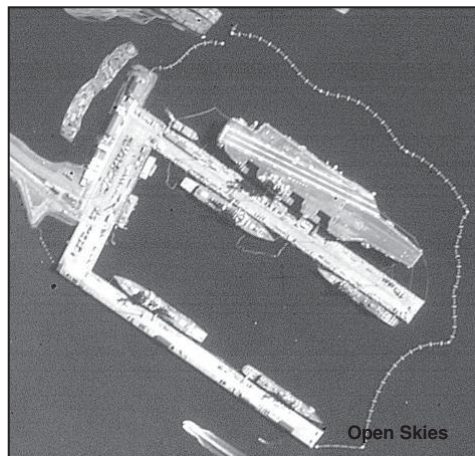
- **Versatility**
 - Aircraft can often fly when and where needed
 - Day-night, all-weather
- **Revisit Capability**
 - Less than satellites
- **Tailored Collection**
 - Non-linear coverage, more adjustable
- **Cost**
 - Sometimes less expensive
- **Resolution**
 - Can exceed commercial imaging satellites

Commercial Satellite Compared to Open Skies Imagery

Not better than 45 CM resolution



Not better than 30 CM Resolution



Open Skies Treaty

-- A Cooperative Airborne Observation Regime

- **Primary purposes**
 - Unarmed aerial observation flights over entire territory of Signatories
 - Promote openness
 - Enhances confidence and security
 - Increases transparency of national intent
 - Help monitor existing and future arms control agreements
- **Open to OSCE States**
 - 8 new members since entry into force



34 countries ratified the Treaty

Belarus	Italy
Belgium	Latvia
Bosnia-Herz	Lithuania
Bulgaria	Luxembourg
Canada	Netherlands
Croatia	Norway
Czech Rep	Poland
Denmark	Portugal
Estonia	Romania
Finland	Russia
France	Slovakia
Georgia	Slovenia
Germany	Spain
Greece	Sweden
Great Brit	Turkey
Hungary	Ukraine
Iceland	US

Treaty Provisions

- **Sensors allowed under the Treaty**
 - 30 cm Optical - panchromatic, color, near IR
 - 50 cm Infrared (IR) - heat detecting
 - 3 m Synthetic Aperture Radar (SAR)
- **Entire country accessible**
 - Restrictions for safety only
- **Data is available to all States Parties**

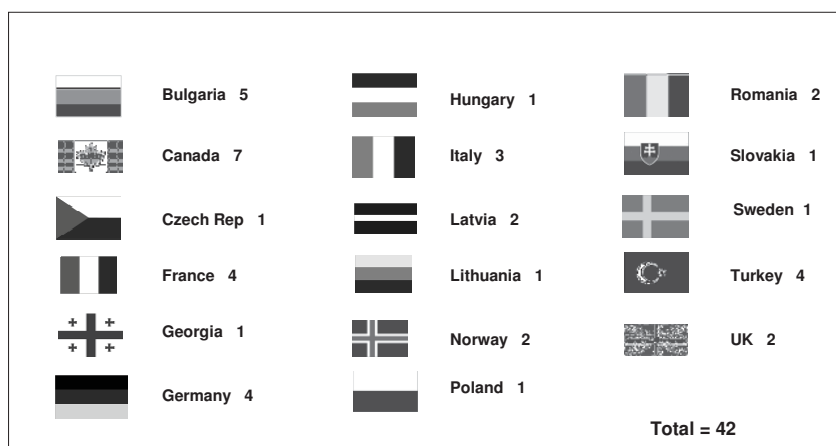
Open Skies Treaty Aircraft

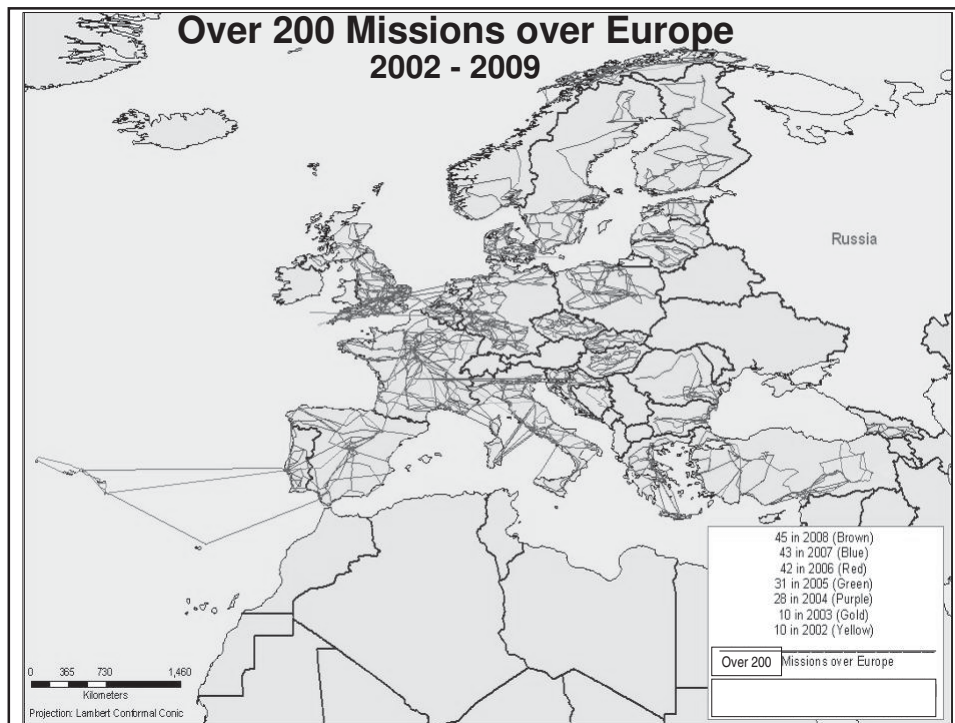
- 17 States Parties have Treaty certified aircraft
- Subject to inspections prior to flight
- Allows observed country to be on-board flights
- Leasing aircraft permitted



Example of International Cooperation

- 71 Total US missions flown through June 2009
- 42 Shared with 17 Treaty Partners





Unique Imaging Capabilities for Open Skies Airborne Sensors

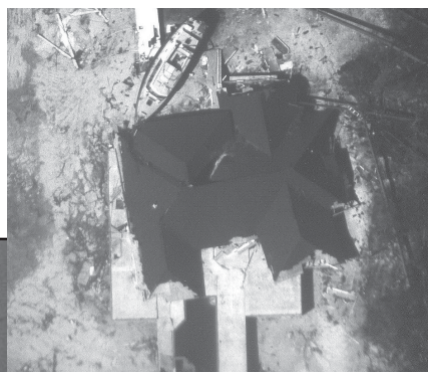
- Imaging anywhere in observed country
- Missions can image
 - Long distance, broad areas, and same-day coverage
 - East-West & North-South imaging
 - (e.g. rivers, coast lines, borders, etc)
- Imaging below-the-clouds
- Medium-resolution stereo imagery
- Future -- Integrated, multi-sensor capability
 - Optical (30 cm), IR (50 cm) and SAR (3 m) imaging at the same time

Use of Open Skies Aircraft for Non-Treaty Missions



Example of OC-135 Hurricane Imagery

- Imaging not constrained by Treaty imagery resolution limitations



< 10 cm resolution

Imagery Product

- **Current**
Hard-copy roll film
 - Difficult to disseminate
 - Limits access by customers
- **Future**
Digital imagery
 - Enhances analysis
 - Improves access and dissemination of imagery



Remote Sensing Examples of Monitoring Climate Change Consequences

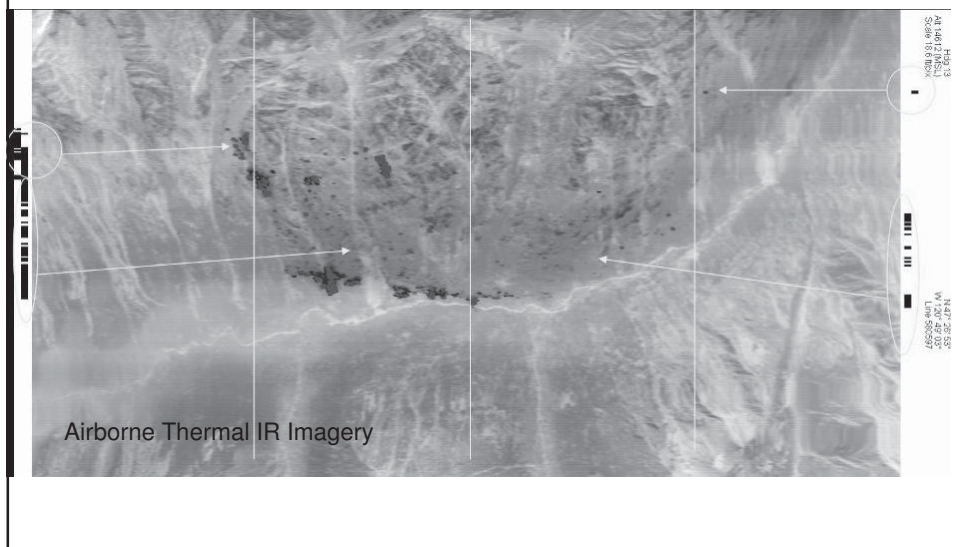
Wildfires

- **Problem:** Climate change drought conditions may encourage wildfires
- **Sensor Application:** Use of airborne thermal infrared sensors can be used to locate/map fire areas both day and night



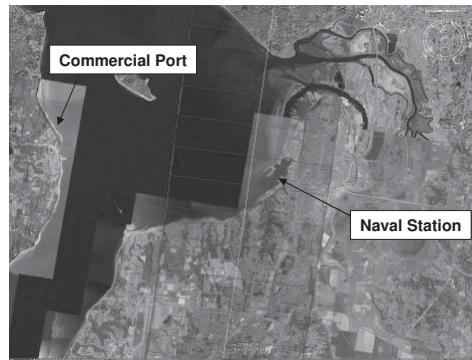
Aircraft with IR Sensor

Fire Detection Example



Water Levels

- **Problem:** Coastal erosion, erosion of shorelines, threats to levies and canals, and ice-shelf fracturing
- **Sensor Application:** Imagery can be used to inform civil defense, disaster response, and economic development



Storm Surge Damage



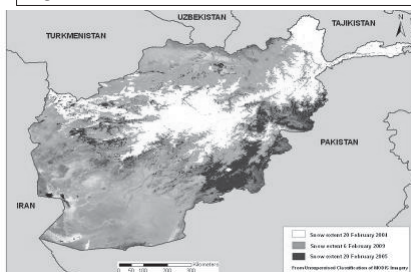
New Orleans, Louisiana

Reduced Access to Fresh Water

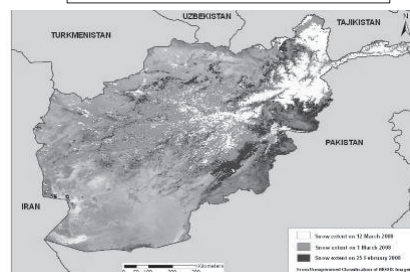
- **Problem:** Reduced natural and man-made water supplies caused by weather phenomena and man-made actions
- **Sensor Application:** Imagery can monitor activity such as --
 - Snow and ice melting
 - Waterway flows and diversion

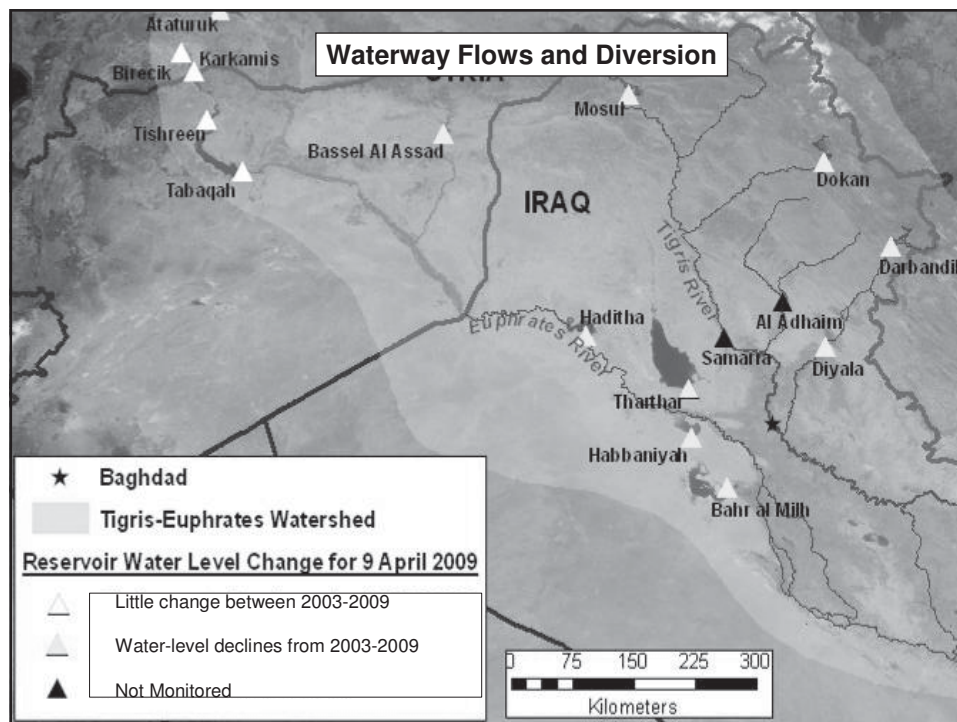
Satellite Monitoring of Snow Melt

**Interannual Variability: Feb 2004, 2005, 2009
Afghanistan**



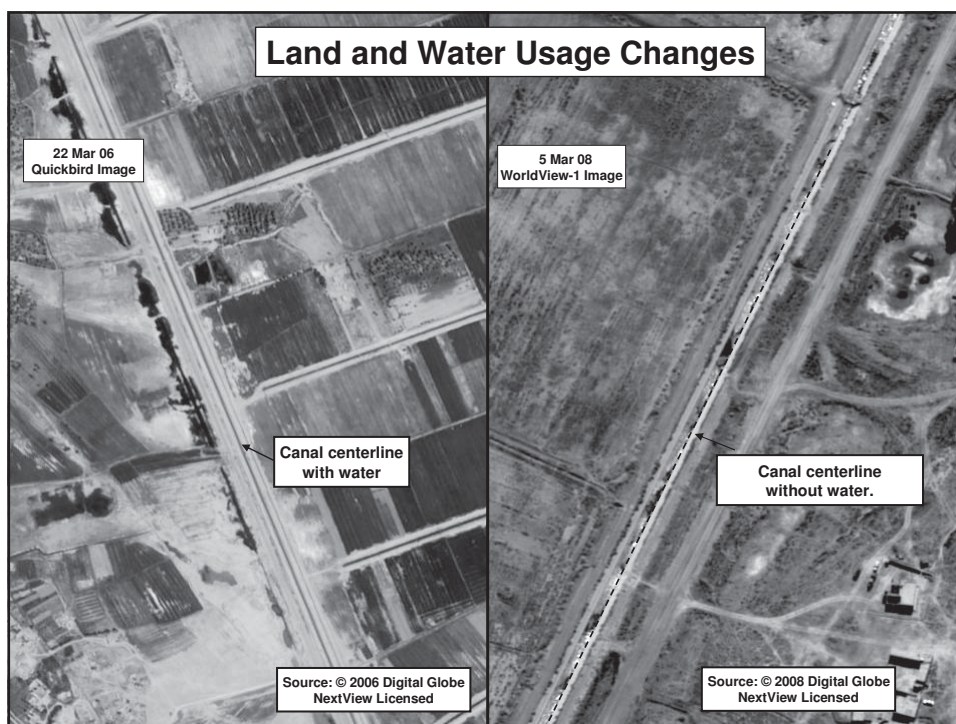
**Rapid Snowmelt: 1 thru 12 Mar 08
Afghanistan**






Human Migration

- **Problem:** Climate change factors can cause the displacement of large numbers of people
- **Sensor Application:** Airborne sensors can monitor evidence of human displacement and such causative factors as
 - Changes in land cover and land use (e.g., deforestation, reforestation)
 - Agricultural declines
 - Flooding, reduced water supply




Environmental Contamination?

Industrial Facility



Smokestack

Airborne Imagery
Color




Smokestack

Airborne Imagery
Thermal IR

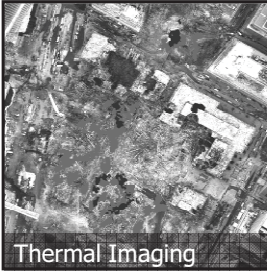
Multi-sensor Imaging

Commercial Airborne Imagery Capabilities




3" Resolution MSI


- MSI
- Thermal
- SAR
- LIDAR
- HSI
- Other



Thermal Imaging



LIDAR



Imagery courtesy of 3001, Inc., Fugro EarthData, & Sanborn

Questions ?

OSCE Open Skies Web Site:
<http://www.osce.org/about/13516.html>