Satellite for Air-Sea Interaction (SASI)

JPL-NASDA Bilateral Discussion
January 26, 1999

Tim Liu / JPL

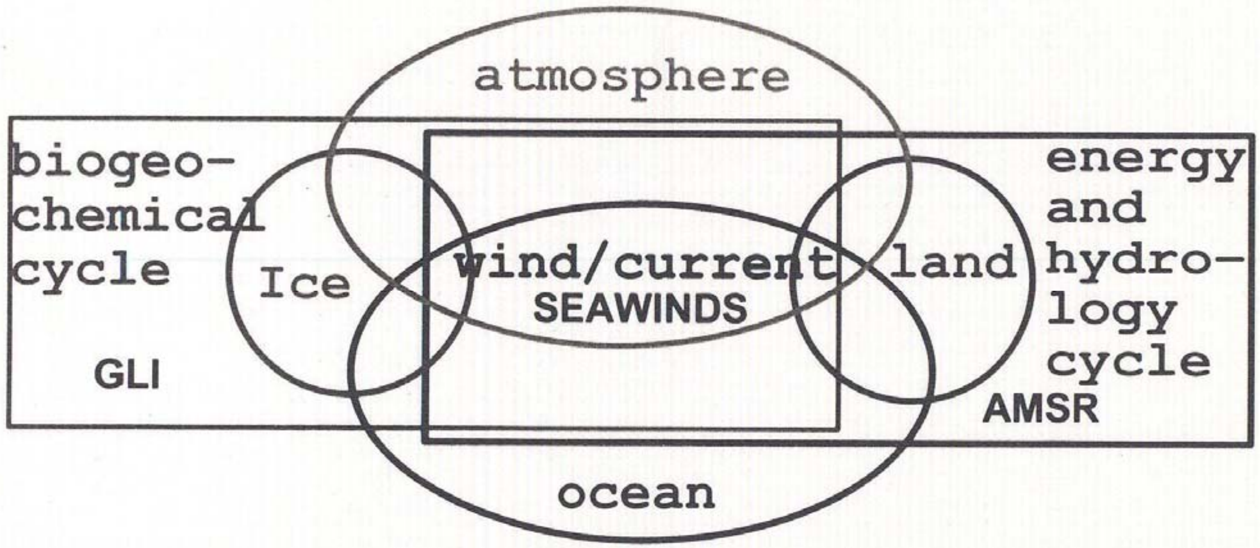
SASI is ADEOS-3B with Enhancements

- Add L-Bands to AMSR and αscat
- Improve spatial resolution with new antenna technology (IIP)

Inspiration for SASI

- ADEOS-2 will be the premier spacecraft to study ocean-atmosphere interaction
- Adding salinity measurement completes science synergism and meets the remaining challenge
- High spatial resolution opens new science frontiers: coastal ecology, natural hazard, and high wave-number forcing of the ocean
- Leadership requires novel application and vanguard technology with inherent risks. By enhancing, but not upsetting measurement continuity, we seize leadership but reduce the risk
- It may set a new model of an operational spacebased ocean observing system

Earth System Science Synergism in ADEOS-2



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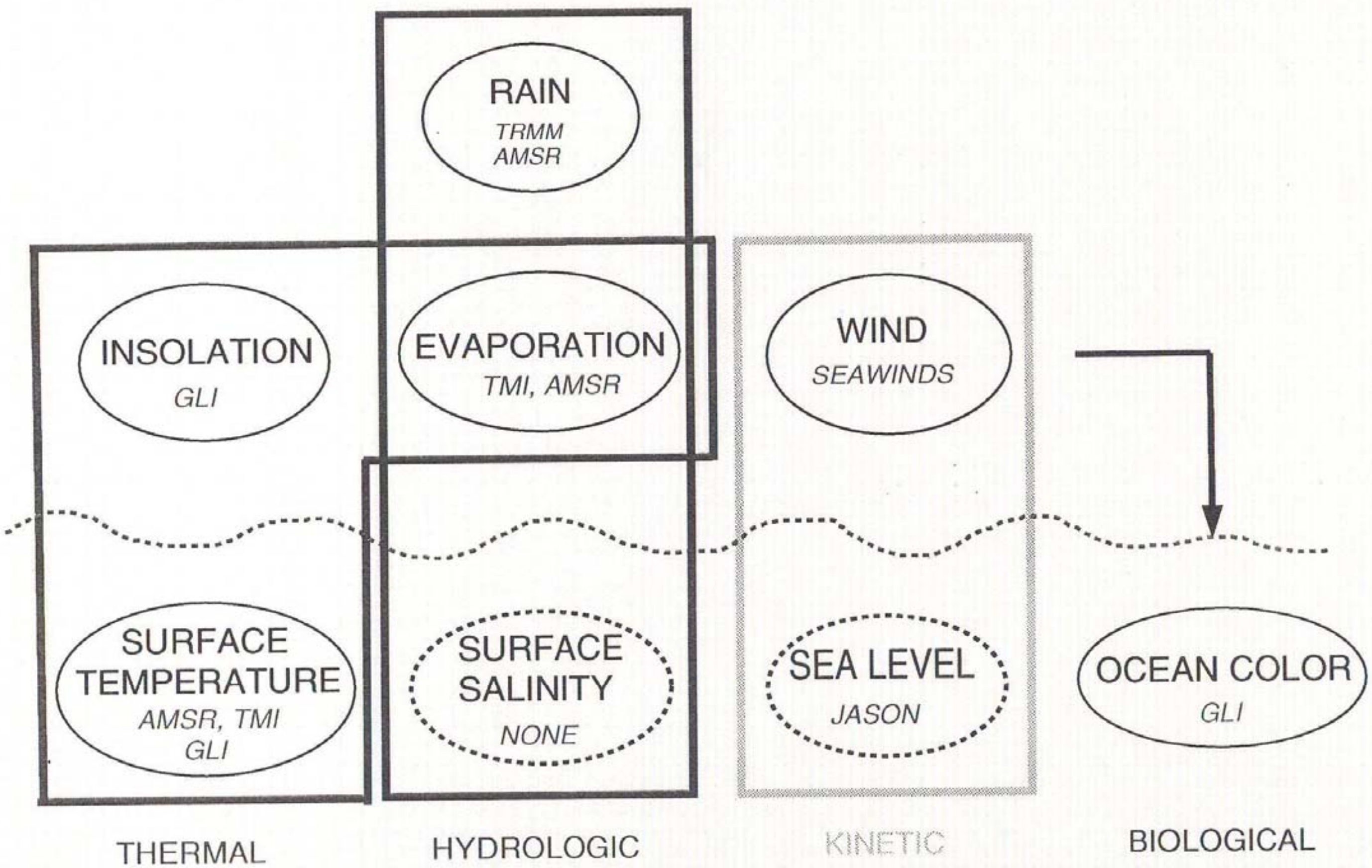
JOINT U.S. - JAPANESE MONITORING OF OCEAN SURFACE FORCINGS AND RESPONSES IN THE 21st CENTURY



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SASI Mission
Instrument Mechanical Performance

- Spin Rate: 5 rpm
- Spun Mass: 200 kg (including bearing and platform)
- Spun Inertia (Izz): 281 Kg-m^2
- Momentum: 147 N•m•s
  - add 40 N•m•s for cross-product ballast mass
- Deployed structure:
  - 1st mode: 1.7 Hz, torsional
  - 2nd mode: 2.8 Hz, bending

THE FUTURE OF EOS ACCORDING TO JIM O'BRIEN

_____The future for Observing the Earth from Space Climate Nowcasting. The Planet is 70 percent ocean. It is now becoming clear that the ocean and cryosphere control the evolution of interannual and interdecadal climate variability on our Planet. The success in understanding and forecasting El Niño is a notable example. Nowcasting Climate means interpretations of the current state of the climate system; i.e., how does this season differ from the normal seasonal climate.

Twenty years ago, the paradigm was that the atmosphere was chaotic. One could only predict the weather 7 - 10 days in advance. We now understand that if we can predict the surface boundary conditions; i.e., ocean sea-surface temperature, soil moisture and ice cover, we can anticipate major swings of climate variability such as the enormous impacts of El Niño.

The current paradigm is we can observe the equatorial sea surface temperature and shape from space and anticipate its future for a few months based on sound physical understanding and therefore, we can expect coming warm or cold winters, floods, shifts of tornado and hurricane frequencies and their impacts on various sectors of our life or economy.

This new paradigm has been proven by Space measurements of wind (NSCAT) and sea level (TOPEX-POSEIDON). The question is what can we do in the future?

The future paradigm is the identification of interdecadel climate shifts or oscillation, both in the South Pacific and North Atlantic. There are well identified, but poorly documented oscillations on 15 - 25 year time scales. These seem to effect the ocean surface conditions and subsequently the atmosphere.

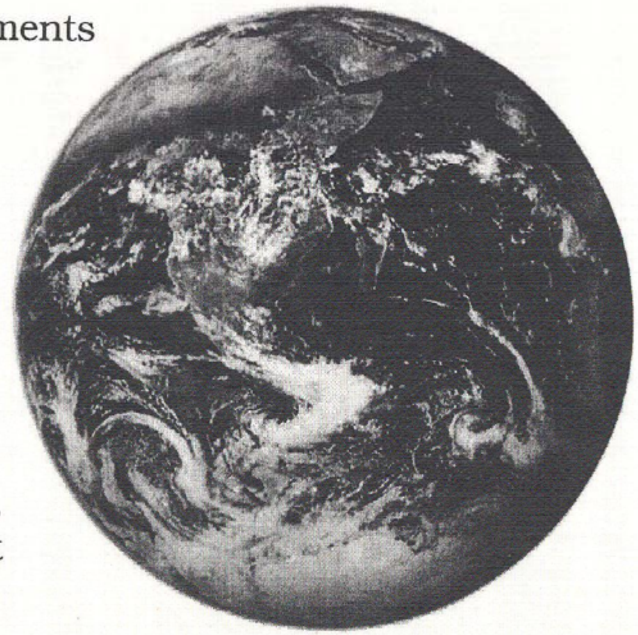
The new paradigm requires long term, global measurements of the state of the ocean, ice and soil conditions. These can only be accomplished by satellites. A series of satellites that provide 15 - 20 years of surface winds over the ocean, sea level slope, ground wetness, ice thickness, age and extent will be fodder for complex Earth System Models which will NOWCAST the correct state of the variability in the climate state.

SASI Mission
Surface-Air Interaction & Hydrology Mission

Objective: **Monitor global air-sea fluxes & corresponding oceanic responses**

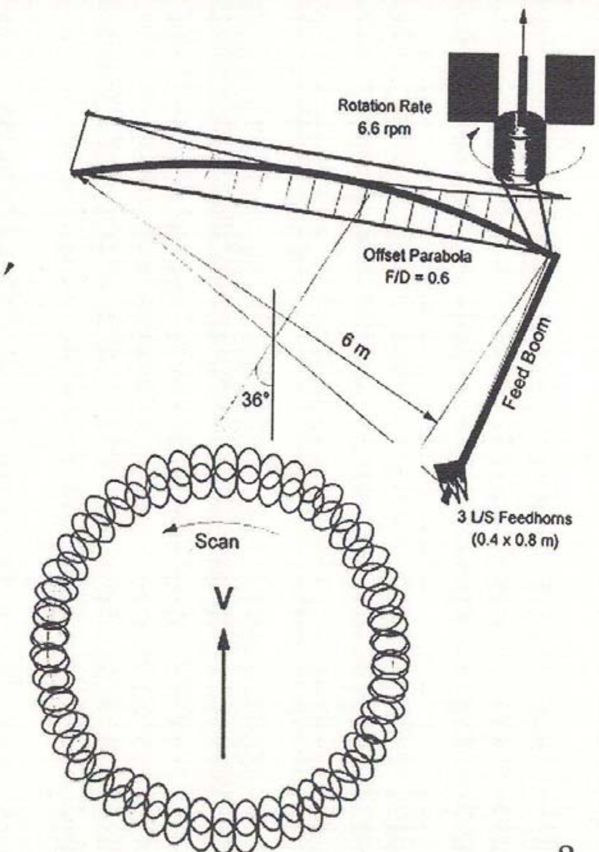
Description:

- Ocean-related science measurements
  - Sea Surface Temperature
  - Sea Surface Salinity
  - Ocean Wind Vectors
- Secondary land & cyrosphere measurements
  - Sea-Ice cover & motion
  - Surface soil moisture
- Vegetation biomass, snow cover, land surface temperature, latent heat fluxes data also provided

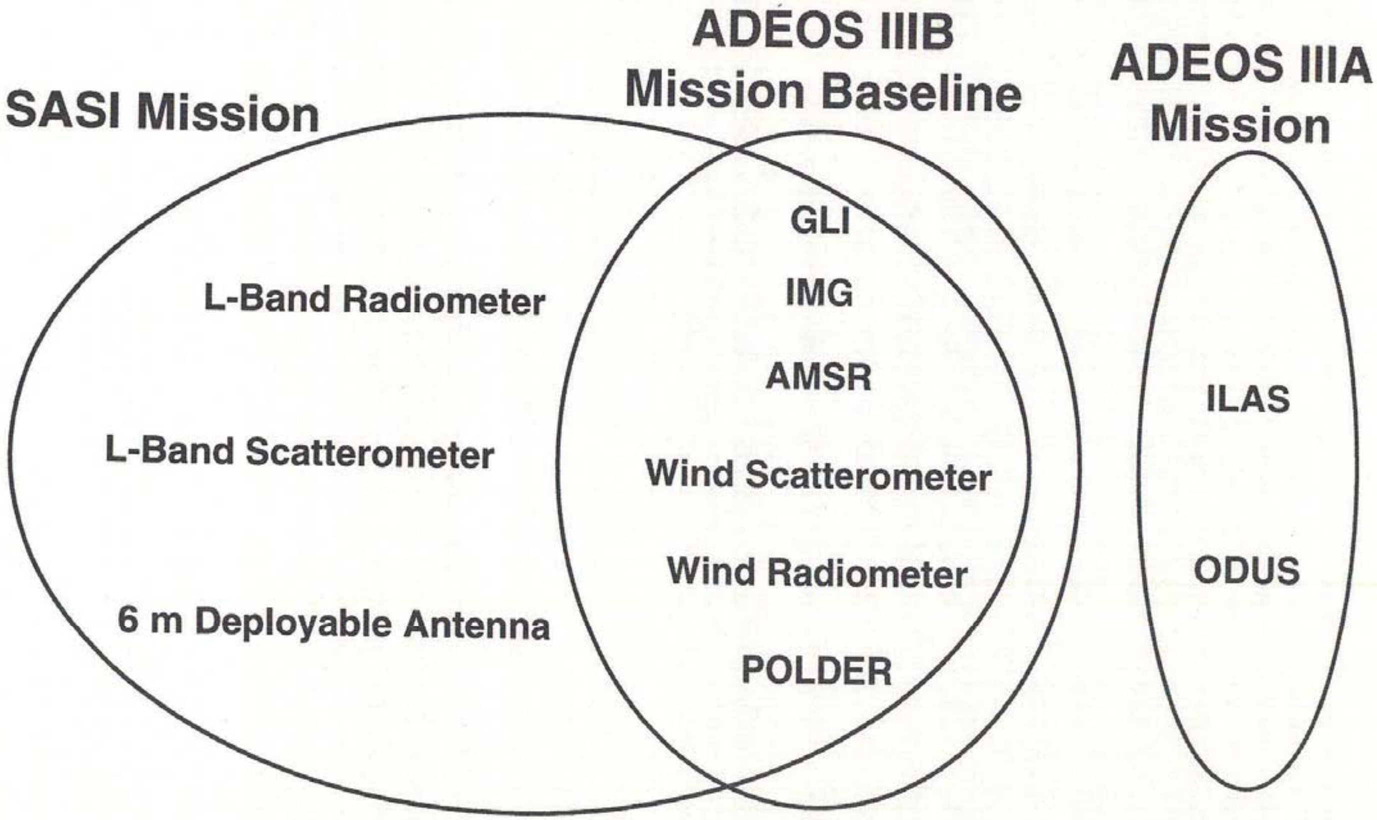


Flux Mission Concept

- 6 m spinning reflector provides common aperture for
  - 1.2 GHz scatterometer
  - 1.4 GHz radiometer
  - 6.9 GHz radiometer
  - 10.6 GHz radiometer
  - 13.4 GHz scatterometer (2 beams)
- Separate spinning 0.8 m reflector provides common aperture for
  - 18.7 GHz radiometer
  - 23.8 GHz radiometer
  - 36.5 GHz radiometer
  - 89 GHz radiometer



SASI Mission
Instrument Grouping



SASI Mission
Benefits

- Ocean salinity and soil moisture will be unique; no currently approved spaceborne capability exists for measuring these parameters
- Single integrated mission package is advantageous for geophysical retrievals and model assimilation
- Provides higher spatial resolution and accuracy for proposed measurements than are attainable using existing sensors
- Logical follow-on to SMMR, SSM/I, SeaWinds and AMSR
- Addresses significant subset of NASA Earth Science & NOAA measurement requirements
- International collaboration mode reduces mission costs for individual partners, increases programmatic feasibility

SASI Mission
Measurement Objectives*

Parameter	Accuracy	Swath	Global Coverage	Resolution
Wind Vectors	2 m/s, 20 deg	1300 km	92% ice free ocean in 2 days	5 km
SST	0.5°C	900 km	2 days	50 km
Ocean Salinity	0.2 - 0.3 psu weekly	900 km	2 days	170 km
Soil Moisture	0.04 g/cm3	900 km	2 days	50 km
Rain	0.8 m/s (vert) 15% rain rate	900 km	2 days	50 km
Sea Ice Motion	3 km tracking accuracy	900 km	Daily	5 km

* estimated for 720 km orbit

SASI Mission
Microwave Instrument Characteristics
(GLI, IMG POLDER not included)

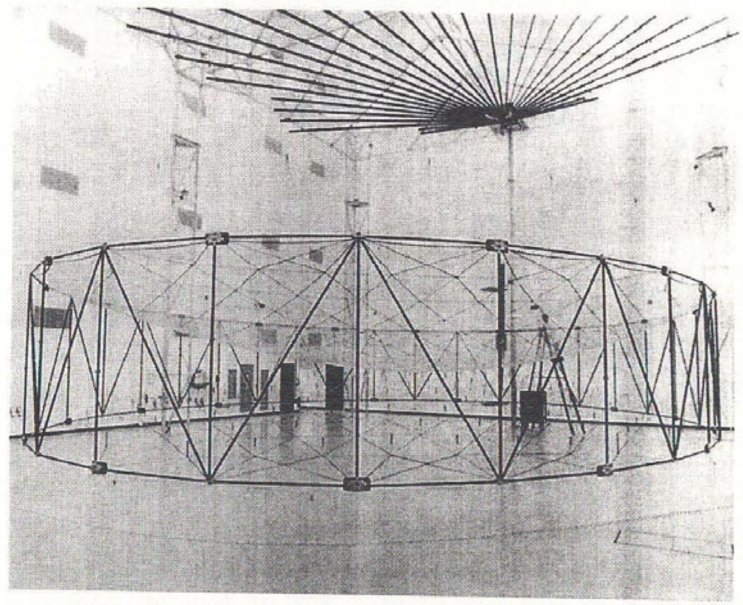
Parameter	Wind/Ice/Snow		SST	Hydrology	
Instrument	Scatterometer (1)	Radiometer (2)	Radiometer (1)	Radiometer (1)	Scatterometer (1)
Frequency	13.4 GHz	18.7 GHz 23.8 GHz 36.5 GHz 89 GHz	6.9 GHz 10.6 GHz	1.4 GHz 2.7 GHz	1.2 GHz
Transmit Power	60 W	n/a	n/a	n/a	20 W
Incidence Angle	46° & 54°	45° to 65°	45°	50°	50°
Footprint	8 km	8 km	50 km	200 km	200 km
Mass	60 kg	40 kg	30 kg	40 kg	30 kg
Data Rate	250 kbps	100 kbps	20 kbps	50 kbps	10 kbps
DC Power (nom)	120 W	60 W	25 W	25 W	50 W

(1) 6 m reflector
(2) 80 cm reflector
(3) Includes allocation for antenna, feeds and instrument platform

[shaded] = **functions added to ADEOS IIIB to create SASI mission**

SASI Mission
6 m Antenna Reflector

- Multi-function reflector antenna
- 6 m deployable reflector antenna assembly
  - stable under rotation, temperature
  - reflector surface suitable for Ka-band frequencies
  - compact stowed volume
- Multi-function feed assembly accommodates diverse radar and radiometer frequencies



Astro 10 m mesh deployable antenna

SASI Mission
Orbit Definition

- Nominal Baseline Orbit:
  - Sun synchronous, 720 km altitude.
  - 98.27° inclination
  - 6 PM ascending node crossing.
  - Allows 90% coverage every 48 hrs.
- Primary alternate altitude: 803 km sun synchronous
- Acceptable orbit range:
  - Altitude: 600 - 803 km
  - Inclination: 81.4 - 98.6 deg (Inclination driven by Sun-Synchronous orbit)
- Orbit achieved by direct injection