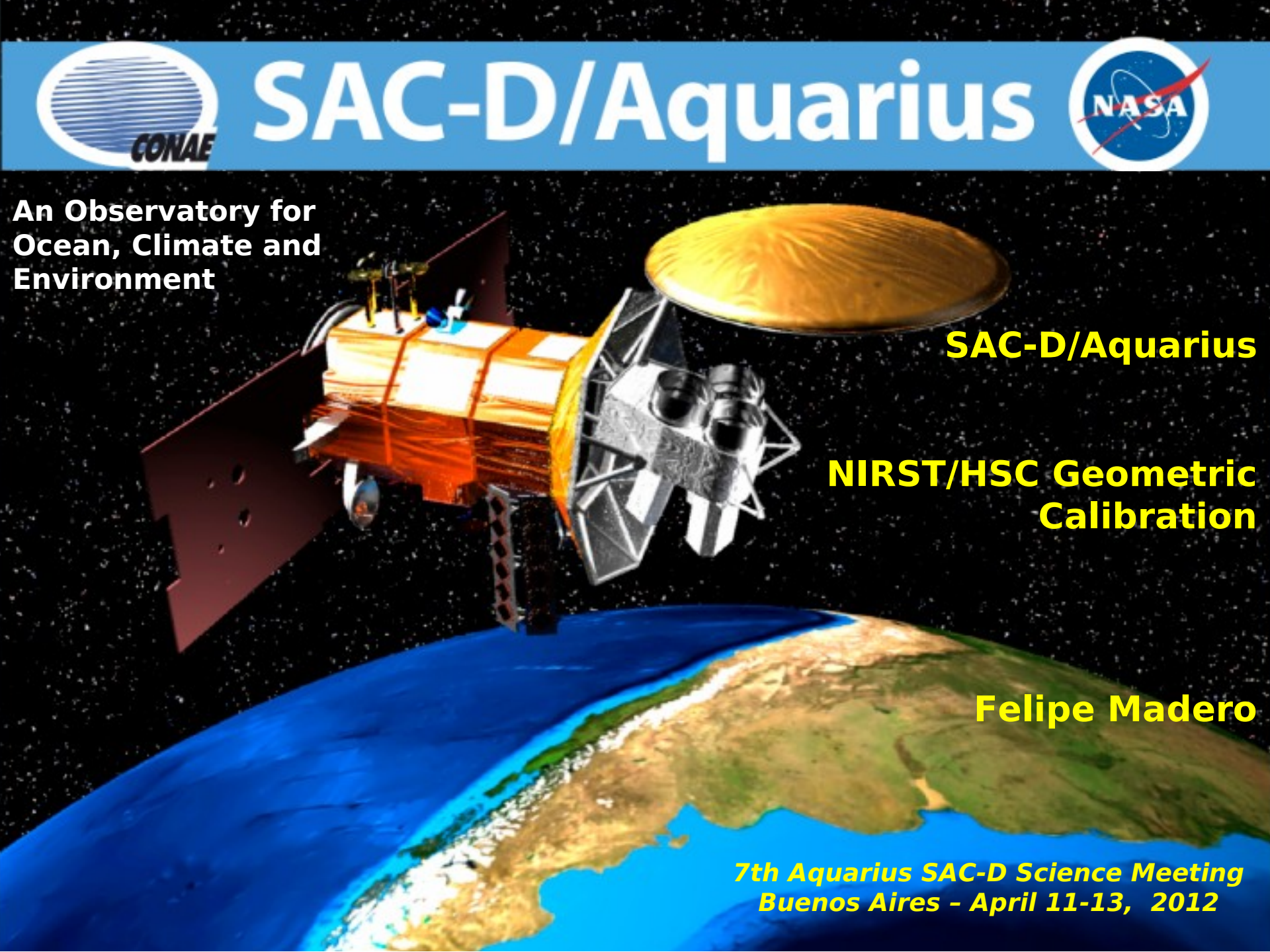
SAC-D/Aquarius

An Observatory for Ocean, Climate and Environment

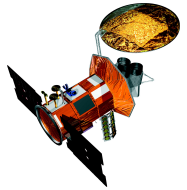


SAC-D/Aquarius

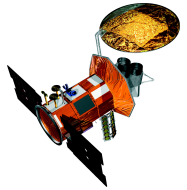
NIRST/HSC Geometric Calibration

Felipe Madero

7th Aquarius SAC-D Science Meeting
Buenos Aires – April 11-13, 2012



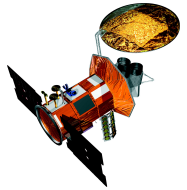
Nirst Geolocation Errors



Geolocation error from pointing knowledge requirement

- Pointing knowledge error: 0.03 degrees (max 915 mts)

- Bias plus random



Bias geolocation error

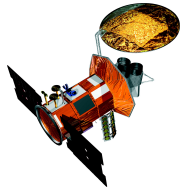
- Error in alignment measurement from ST cube to ref cube: 0.005 degrees (max 180 mts)

- Cyclic (orbital) Thermoelastic deformation errors between ref cube and NIRST reference system: 0.015 degrees (max 529 mts)

- Other cyclic (seasonal) thermoelastic deformation errors between ref cube and NIRST reference system: not estimated

- Error in alignment between NIRST reference system and ref cube: 0.5 degrees (max 10 km)

- Goal to reduce it to 0 by post launch geometric calibration. Cyclic Thermoelastic deformation most difficult to correct.

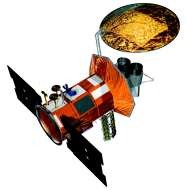


Random geolocation error

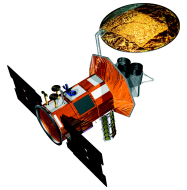
- Error in attitude measurement: 0.011 degrees (max 388 mts)

- Error in mirror pointing knowledge: 0.25 degrees (max 5 km)

- Goal is to have it as the final random error, after post launch geometric calibration.



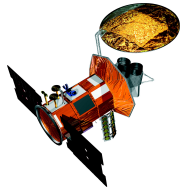
Hsc Geolocation Errors



Geolocation error from pointing knowledge requirement

- Pointing knowledge error: 0.03 degrees (max 3.1 km)

- Bias plus random



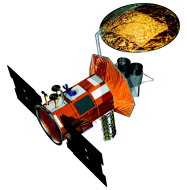
Bias geolocation error

- Error in alignment measurement from ST cube to ref cube: 0.005 degrees (max 530 mts)

- Cyclic (orbital) Thermoelastic deformation errors between ref cube and HSC reference system: 0.015 degrees (max 1.5 km)

- Other cyclic (seasonal) thermoelastic deformation errors between ref cube and HSC reference system: not estimated

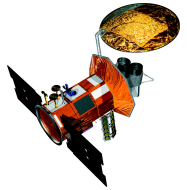
- Goal to reduce it to 0 by post launch geometric calibration. Cyclic Thermoelastic deformation most difficult to correct.



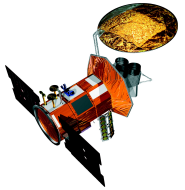
Random geolocation error

- Error in attitude measurement: 0.011 degrees (max 1.1 km)

- Goal is to have it as the final random error, after post launch geometric calibration.

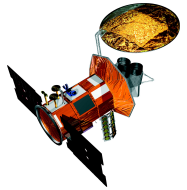


Post Launch Geometric Calibration



Objetive

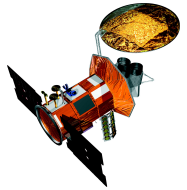
- Increased improvement in geolocation accuracy, by eliminating the different errors



Test cases selection

- Selection of test cases with coasts

- **Nirst: 43; 2011/12/23 to 2012/02/27; 13 Asc, 30 Desc; Aprox. pointing angles: -30, -17, -14, -9, 0, 10, 37 (enough for first assestment)**
- **Hsc: 0**
- **Only coasts, no in-land features (no DEM based processing yet)**
- **Desire: automatic recognition of cases (seems difficult due to current radiometric calibration status). Automatic recognition most interesting for continuous calibration (mid and long term)**



Comparison with true data

- True data:

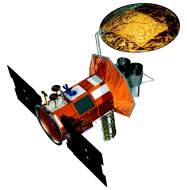
- **GSHHS high res world vector coast (yet to assess its accuracy)**
- **Modis based blue marble 500 mt for december season. Useful for (seasonal?) features not well covered by coast vector. Yet to access if full four blue marble seasons are needed to be used.**

- Sensor data:

- **L1A product: only geolocation, no corregistration correction (partial Nirst L1A product). With blue marble "band" added with interpolating it from geolocation info.**

- Application:

- **geolcal_gui: developed at conae, enables point control selection, saving in database all relevant info. Most important: image coordinates of point in sensor data, and true geodetic coordinates for the point.**



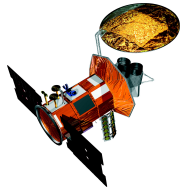
Generation of new geometric calibration paramters

- Application:

- **geocal_generator: developed at CONAE, by now enables to automatically determine best pointing angle for NIRST, to determine estimated time correction, and estimate by least squares the global sensor alignment matrix that gives minimum residual error-**
- **Alignment matrix estimated from the transformation from current line of sight to desired line of sight based in geodetic coordinates.**

- Current calibration most used to try to determine overall alignment matrix:

- **Useful for HSC, first calibration, minimizing error, but not covering periodic (orbital and seasonal) misalignments**
- **Seems not useful for NIRST**
- **Currently considering error in meters, but possibly to consider in the future error in pixels (more uniform along line)**
- **Some criteria to be applied in point control selection in order to avoid giving heavy weight to certain points (Nirst example: cover all pointing angles with equal number of points)**



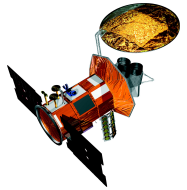
Nirst geometric calibration needs

- Currently every test case is first processed to assess best pointing angle, then used to obtain control points

- Alignment matrix calculation might be biased by anticipated pointing Angle calculation

- New process needed, which find minimum error roll/pitch/yaw angles based alignment matrix, considering variations in pointing angle. Possibly an iteration mechanism over 4 variables.

- Analysis needed to check if there is some correlation between pointing angle and alignment matrix (change in alignment matrix with pointing angle?).

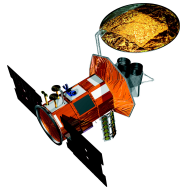


Line of sight first estimation

- Inter band correlation calculations seems to be more validated when using a different focal length. A revision of focal plane parameters is needed to have a good starting point (distance between lines, position of focal point, focal point distance from array, distance between detectors)

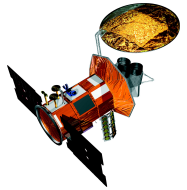
- Certain cuadratic difference observed between calculated line of sight for hsc, and mesured ones. Need to improve model?

- Same thing may be happening with Nirst. More check in needed, but In certain cases there is a cuadratic difference between calculated corregistration offsets and image based corregistration offsets.

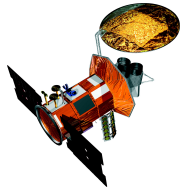


Main Steps

- Obtain better starting point line of sights
- Obtain first global alignment matrix for each camera. Maybe a further Check to be done with nirst.
- Periodically maintaing global alignment matrix
- Get orbital variation model to correct such errors
- Get seasonal variation model to correct such errors
- Assess if it is possible to uses previous (periodic) models and error Corrections with MWR data (more difficult to correct such errors with This sensor)



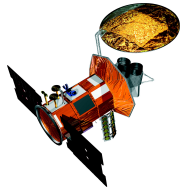
Nirst Pointing angle estimation



Current estimation

- Current estimation is good, and a huge effort. It is needed to validate Its accuracy by using tests cases, and last alignment matrices and models.

- It is needed a mechanism to periodically get such estimations from Sensor engineering



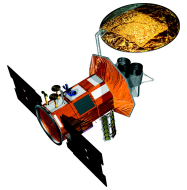
Automatic estimation objetive

- The idea is to enlarge the number of cases from which the pointing angle can be estimated, and to enable the sensor to more frequently change configuration (by now, in order to estimate pointing angle, a configuration change must be done and maintained until a suitable coast in found, once done that, a period of validity of the estimated pointing Angle is obtained, which can be applied in processing)

- Only non homogeneous images are needed, of suitable length, and with two LWIR lines configuration.

- Possibly automatic estimation can be combined wich pointing angle Validity period (info from engineering), to best improve pointing angle Calculation.

- No change in pointing angle was observer yet, during validity period



Automatic estimation needs

- Improvement in automatic corregistration offset calculation from images

- **Idea to maintain pearson coefficient calculations**
- **Possibly needed to consider and check if there is a better correlation not along track (some yaw problem?)**
- **Obtain and validate the most possible number of offsets, from all detectors, and all acquisition lines, in order to further improve the results. Some test cases with problems. Filtering of bad correlations.**
- **Analysis of limitations in the subline accuracy of the method**

- Need to improve alignment matrix, and line of sights

- Analysis of accuracy of the method (given subline accuracy of the calculations)

- Improvement in automatic corregistration offset calculation from geolocation

- **Need to consider not along track better correlation, and pixel area overlapping (?)**