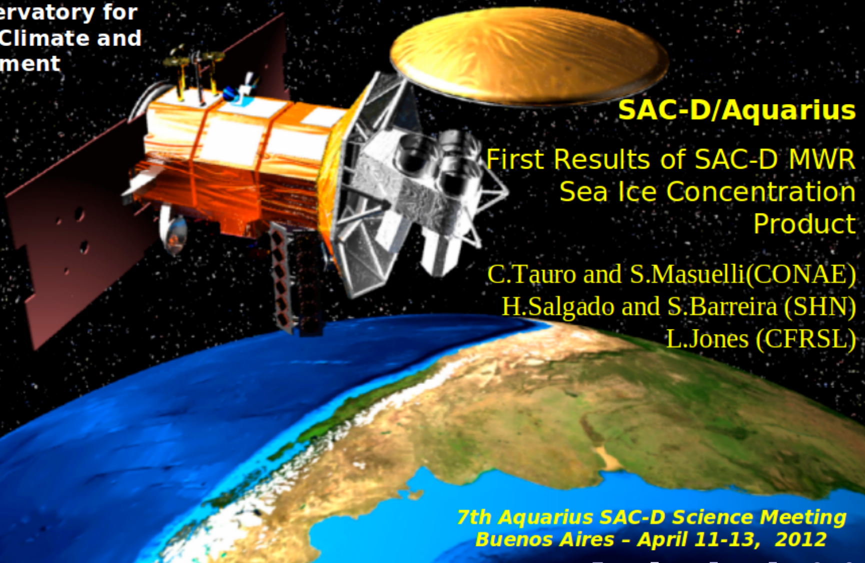
SAC-D/Aquarius

An Observatory for Ocean, Climate and Environment



SAC-D/Aquarius

First Results of SAC-D MWR Sea Ice Concentration Product

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Buenos Aires – April 11-13, 2012

Overview

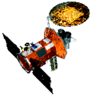
Introduction
- Feasibility of determine Sea Ice Concentration from MWR
- NASA Team algorithm

The MWR sea ice algorithm
- The Model
- Sea ice concentration function for CONAE algorithm

Prototype
- Prototype steps

Validation: preliminary results
- NSIDC and MWR Comparisons

Remarks



Outline

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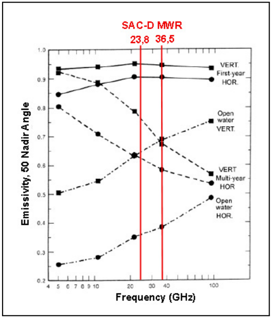
Remarks

Feasibility of determine Sea Ice Concentration from MWR

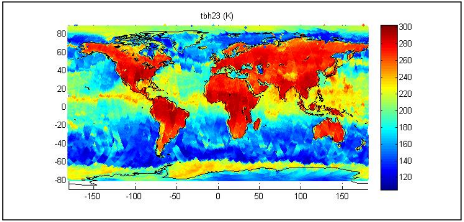
Models for determine sea ice concentration and age are based on differences in the polarizing qualities of sea ice and ocean water, and greater spectral dependence of ocean water than sea ice.

Electromagnetic properties of sea ice and ocean water



[Comiso, Cavalieri, Parkinson, Gloersen, Remote Sens. Environ. ,60:357-384, (1997).]

Brightness temperature of MWR can identify the presence of sea ice



[CONAE]

Outline

NASA Team (NT) algorithm

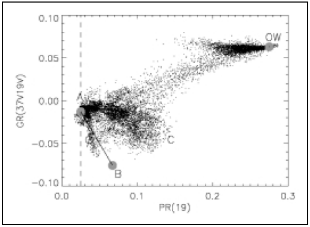
The algorithm was designed for deriving sea ice products from three SSM/I channels (19.4GHz H and V and the 37GHz V). It supose that the brightness temperature measured is comming from Open Water (O), First Year Sea Ice (F) and Multi Year Sea Ice (M).

$$T_B = T_{BO}(1 - C_F - C_M) + T_{BF}(C_F) + T_{BM}(C_M)$$

$$PR = \frac{T_B^V(19) - T_B^H(19)}{T_B^V(19) + T_B^H(19)}$$

$$GR = \frac{T_B^V(37) - T_B^V(19)}{T_B^V(37) + T_B^V(19)}$$

$$C_i = f(GR, PR)$$



A, *B* and *OW* are tie points, which depends on poles.
[Markus, Cavalieri, IEEE Trans. Geosci. Remote Sens., 38, 3, 1387-1398 (2000).]

Where *PR* and *GR* are the ***Polarization and Gradient Ratios.***

[http://nsidc.org/data/docs/daac/nasateam/]

Outline

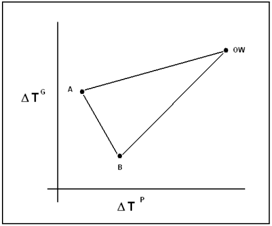
The MWR sea ice model

We assume that the brightness temperature received by the radiometer comes from open ocean (T_{BO}) with concentration C_O, and from sea ice (T_{BI}) with concentration C_I.

$$T_B = T_{BO}C_O + T_{BI}C_I$$

$$1 = C_O + C_I \quad C_I = C_F + C_M$$

Inspired in NT model, we define the next quantities using the MWR bands (23.8 GHz H, 36.5 GHz V and H):



$$\Delta T^P = T_B^V(36.5) - T_B^H(36.5) = PR(T_B^V(36.5) + T_B^H(36.5))$$

$$\Delta T^G = T_B^H(36.5) - T_B^H(23.8) = GR(T_B^V(36.5) + T_B^H(36.5))$$

Where ΔT^P and ΔT^G are the ***Polarization and Gradient differences***.

Outline

Sea ice concentration function for CONAE algorithm

We can find the Sea Ice Concentration as a function of gradient and polarization differences, ie, $C_I = f(\Delta T^G, \Delta T^P)$:

$$C_I = \frac{\Delta T^G - \Delta T_O^G (\Delta T^P - \Delta T_O^P)\alpha}{\Delta T_M^G - \Delta T_O^G (\Delta T_M^P - \Delta T_O^P)\alpha}$$

$$\alpha = \frac{\Delta T_F^G - \Delta T_M^G}{\Delta T_F^P - \Delta T_M^P}$$

where:
C_I is the ice concentration,
ΔT^G and ΔT^P come from data measured by MWR,
$\Delta T_O^{G,P}$, $\Delta T_F^{G,P}$ and $\Delta T_F^{G,P}$ are reference points that must be determinated.

Outline

Prototype steps

Step 1: Brightness temperatures gradient and polarization differences calculation.

Step 2: Scatter plots construction.

Step 3: Reference points obtention.

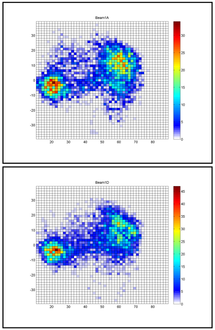
Step 4: Sea Ice Concentration calculation.

Step 5: Sea Ice Concentration representation in a map.

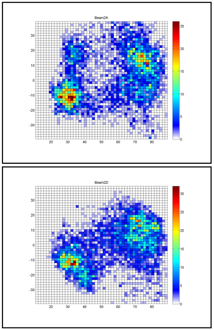
Prototype: Step 2

The scatter plots are constructed separately for each beam, ascending (top) and descending passes (bottom). For example, for beams 1 to 3 we obtain:

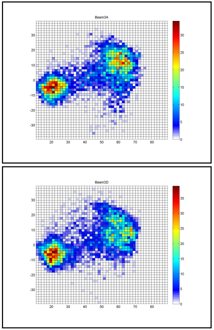
Beam 1



Beam 2

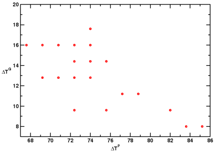


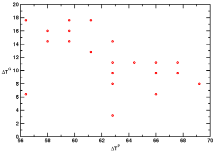
Beam 3



Prototype: Step 3

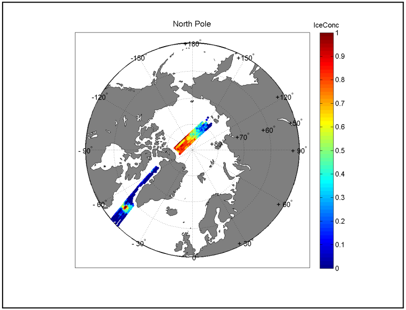
Point	ΔT^P (K)	ΔT^G (K)
Odd Open Water	62.73	12.36
Even Open Water	73.31	13.87
Odd First Year Ice	27.35	-5.66
Even First Year Ice	21.60	-4.40
Odd Multi Year Ice	25.04	-10.24
Even Multi Year Ice	20.51	-11.20

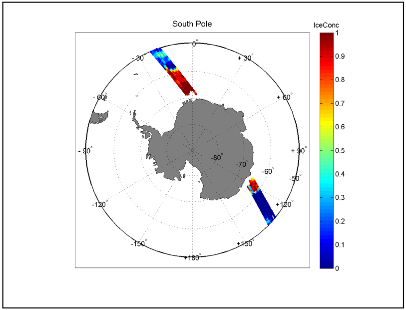




Points used for obtaining Open Water and Sea Ice reference points (odd beams).

Prototype: Steps 4 and 5

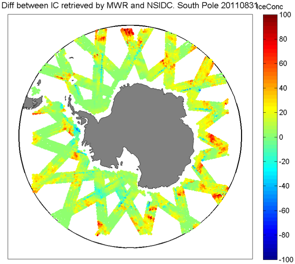


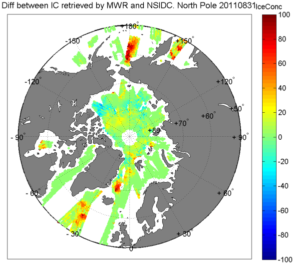


Outline

NSIDC and MWR Comparisons

We calculate the differences of both data embedded in a common grid. Here we show the results corresponding to one day (08/31/2011).



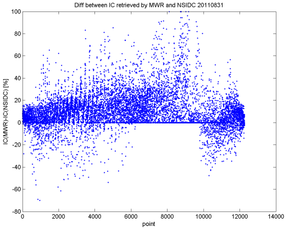


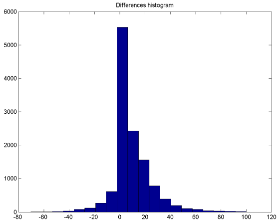
NSIDC data are provieded by SHN.

Differences between MWR and NSIDC (08/31/2011)

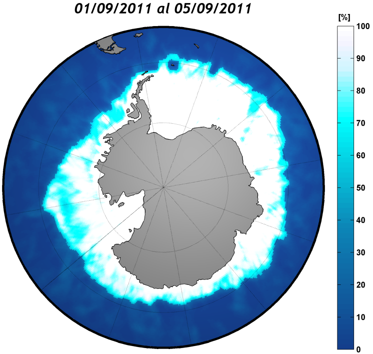
We plot those differences in a histogram, obtaining an error of:

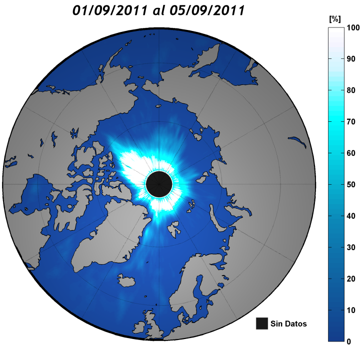
$$E_{IC} \approx 15\%$$





A five days MWR product





Remarks

- The presented algorithm is a self calibrated one.
- The **IC error** is about **15 %**, in comparison with NSIDC results.
- An improved land mask, global grid and climate filters will be applied in further products.
- The validation of the Sea Ice estimation continue with colaboration of the Hidrography Naval Service of Argentina.
- The algorithm presented is implemented in CUSS and it is producing data.
- An ATBD with the details is available.
- A poster with more details is available in poster session.