

Progress in sea surface temperature retrieval and future directions

Chris Merchant and Pierre Le Borgne

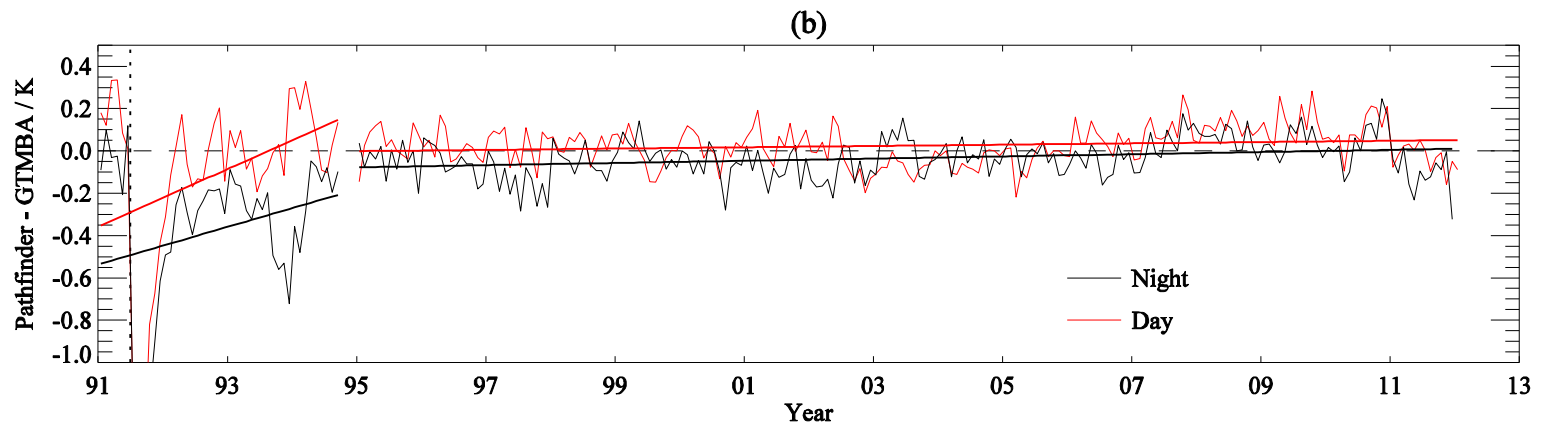
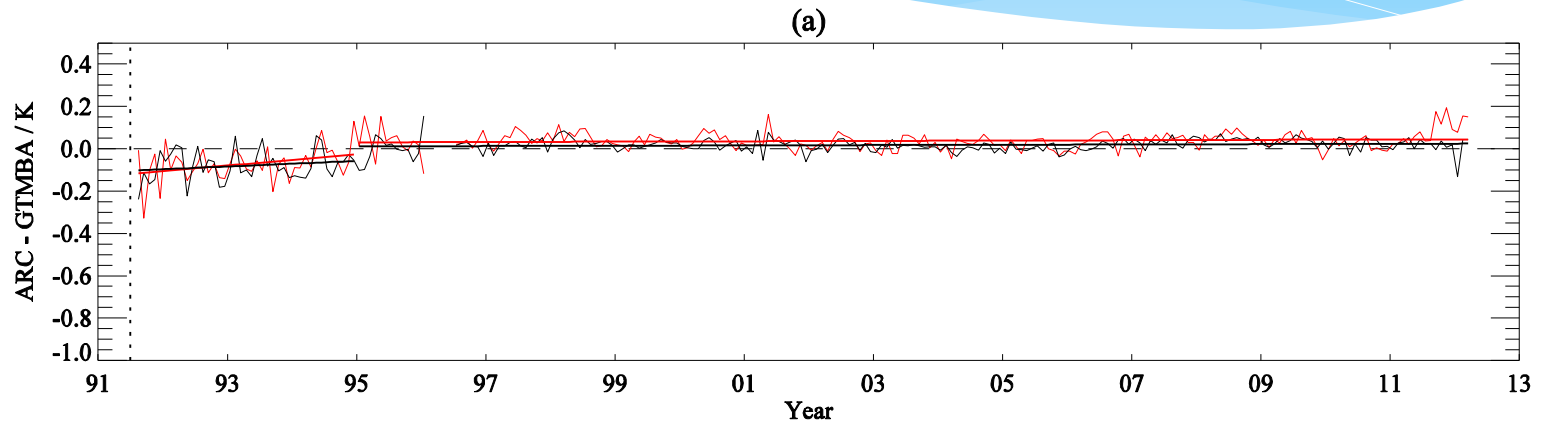
Projects and what I learned from them

- * ATSR Reprocessing for Climate (ARC)



- * ATSR-only, accuracy, harmonised, stability, independent
- * Coefficient-based retrieval based on radiative transfer

Stability of ARC <5mK/yr since 1993



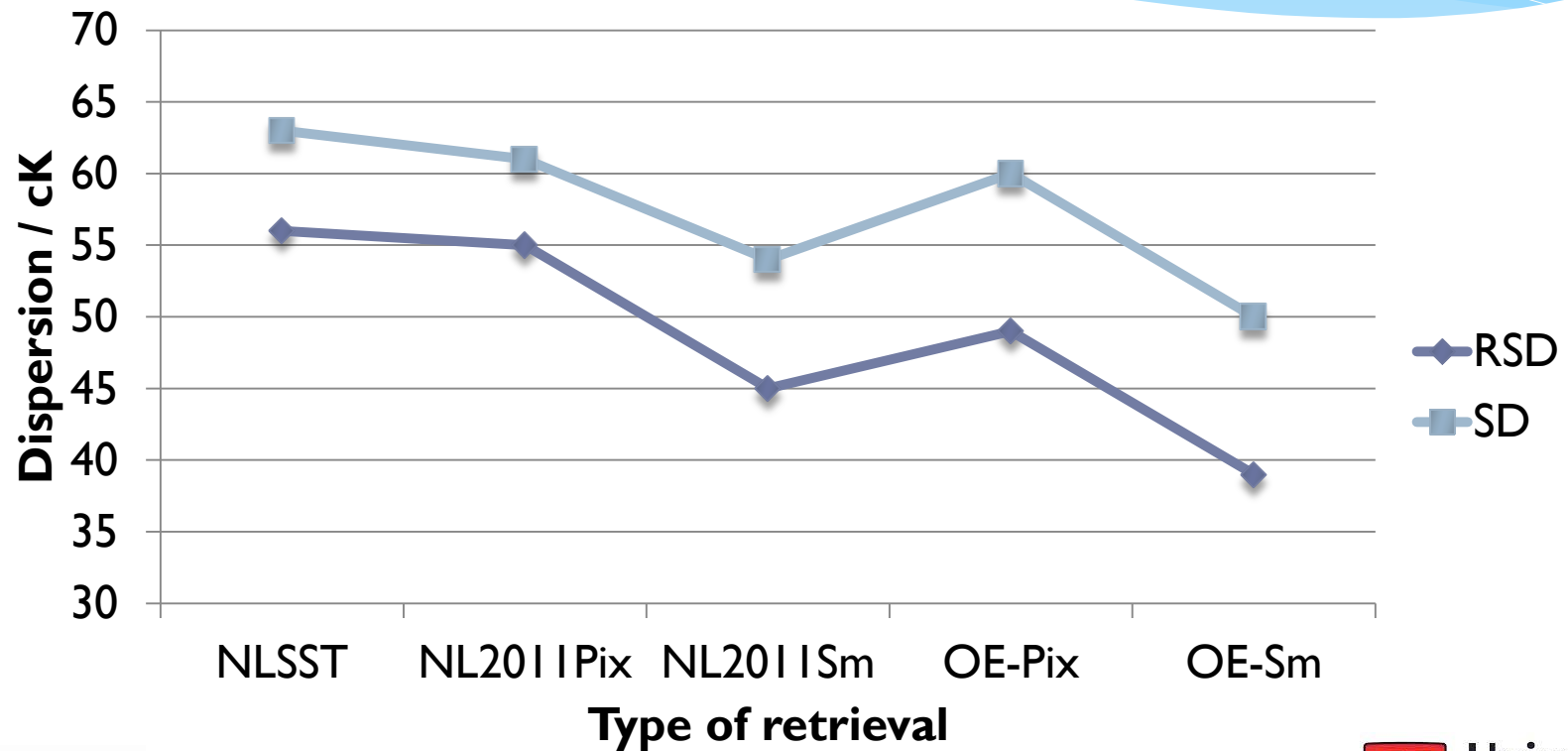
Projects and what I learned from them

- * ATSR Reprocessing for Climate (ARC)
 - * ATSR-only, accuracy, harmonised, stability, independent
 - * Coefficient-based retrieval based on radiative transfer
- * OSI-SAF / EUMETSAT visiting scientist
 - * Mainly SEVIRI focussed
 - * Optimal Estimation (OE) and smooth-atmosphere OE



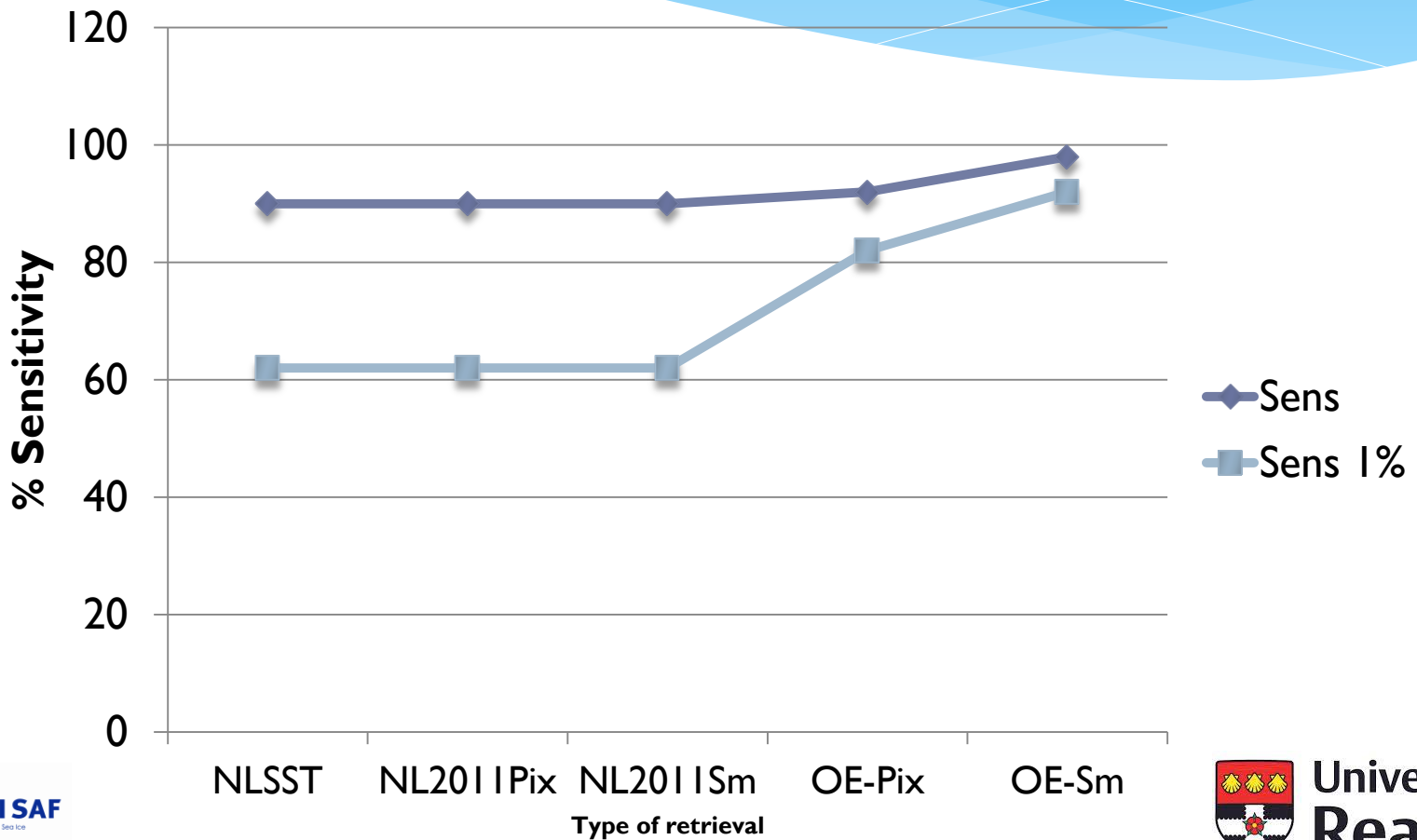
Use of radiative transfer can improve SST retrievals and gives insight

SD and RSD of buoys

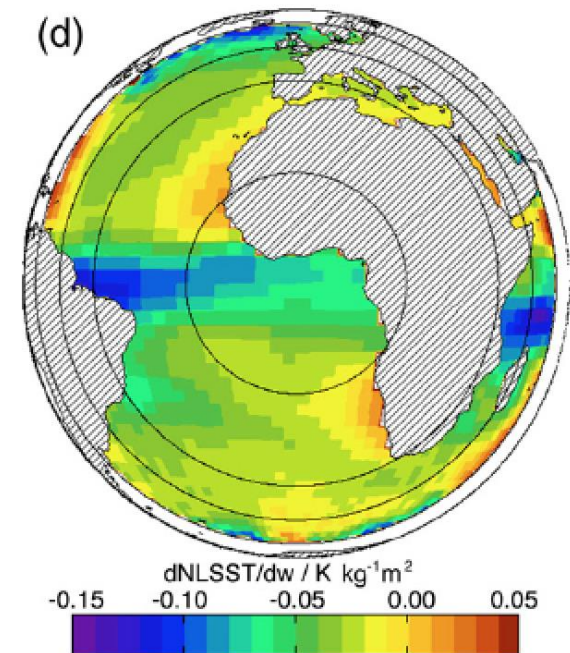
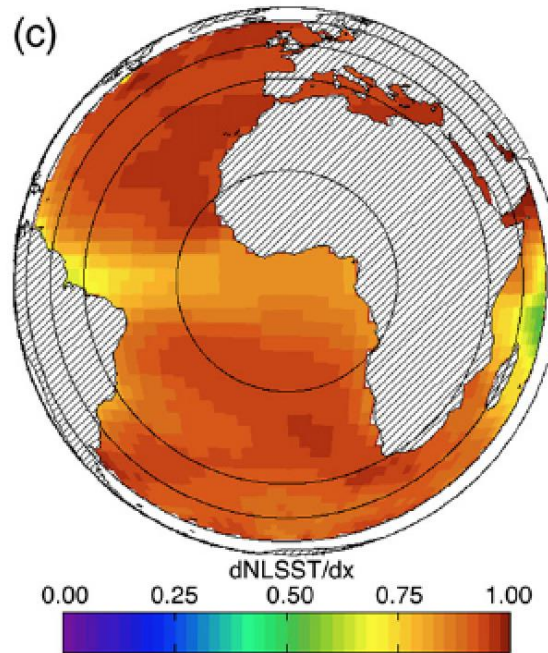
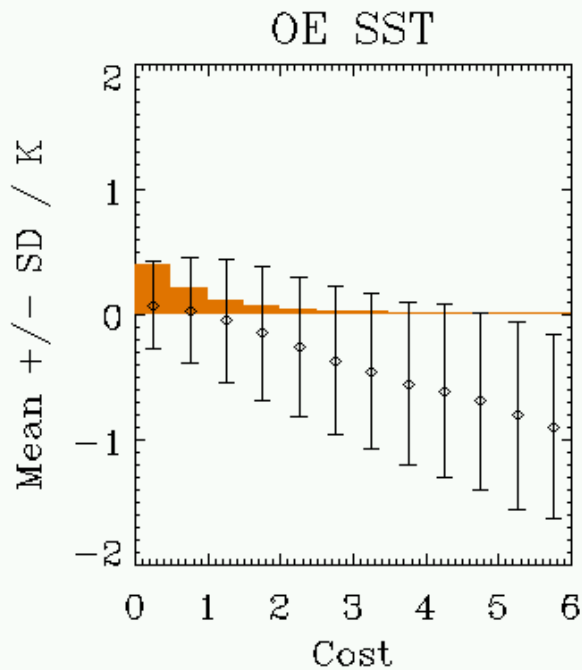


Use of radiative transfer can improve SST retrievals and gives insight

Mean and 1 centile sensitivity



OE doesn't just give an SST



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- * ESA Climate Change Initiative SST

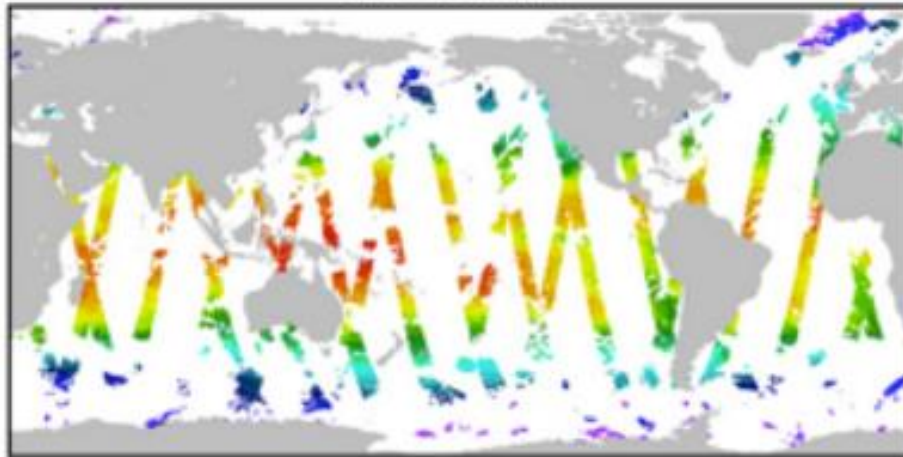


- * AVHRRs x-calibrated to ATSRs
- * Power of multi-sensor match-up approaches
- * Model components of uncertainty

Multi-sensor matches in SST CCI

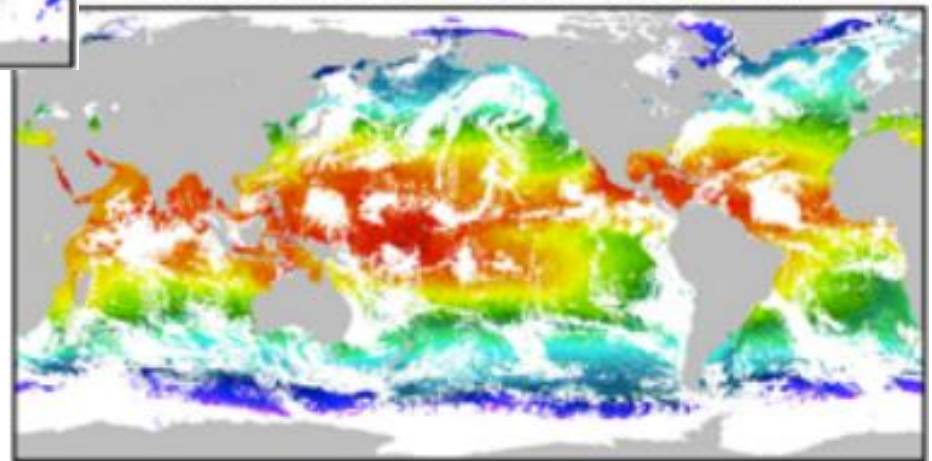


AATSR (1 km)



To get AVHRR coverage tied to ATSR accuracy & stability, exploit ATSR-AVHRR matches

AVHRR GAC from NOAA 17/18 (9km)



Figs from Robinson et al., 2012,
Rem Sens Env, 116

Interim conclusions

- * Over past ~5 years, a range of projects have demonstrated significant SST benefits from RT based approaches
 - * Pierre, Boris, Andy ...
- * Need to get recognition of this built into future mission planning
 - * SLSTR level 1 definition has embedded NWP profiles

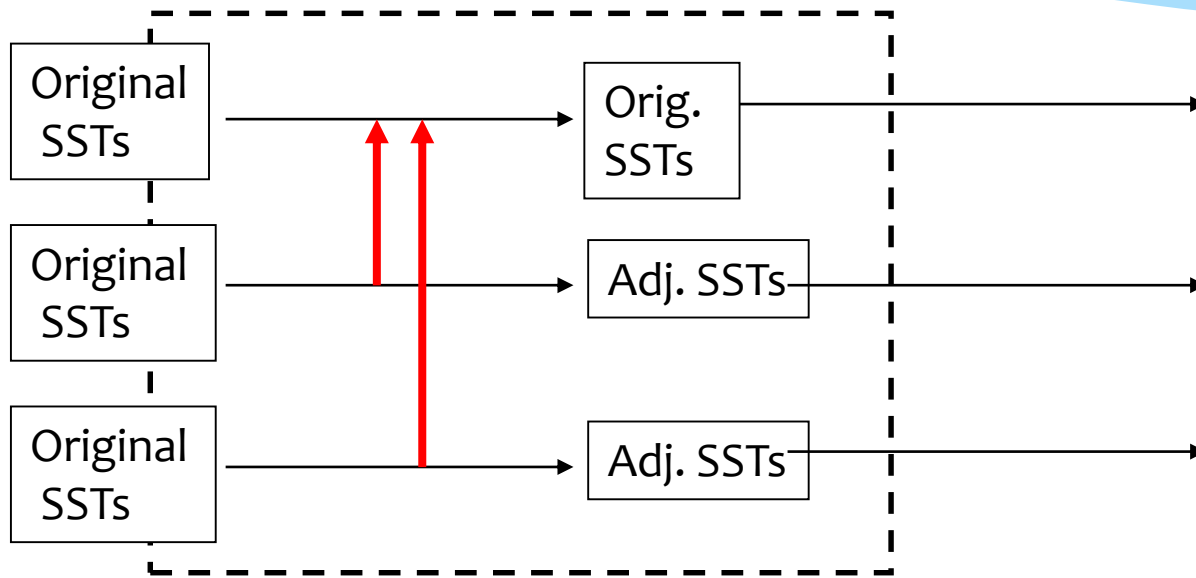


SST CCI 2 retrieval

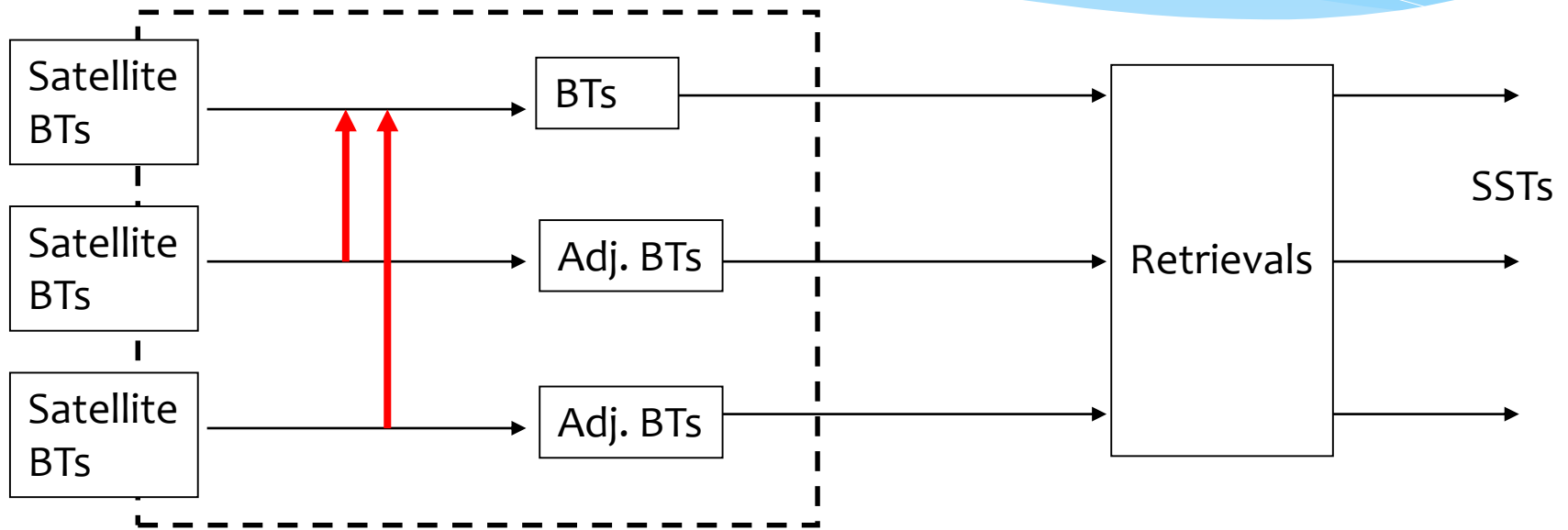
- * Smooth-atmosphere OE for ATSR and AVHRR
 - * ~100% SST sensitivity**
 - * Full variability of SST
 - * Low SST noise
- * Radiative transfer bias correction – 1991 to 2012
 - * BTs consistent with full radiative transfer in ARC SST
- * ** Except for AVHRR in the tropics in day-time
 - * Use of 8.7 um may help here on newer sensors
- * But what about pre-1991? No “reference sensor”
 - * Exploit the system of sensors



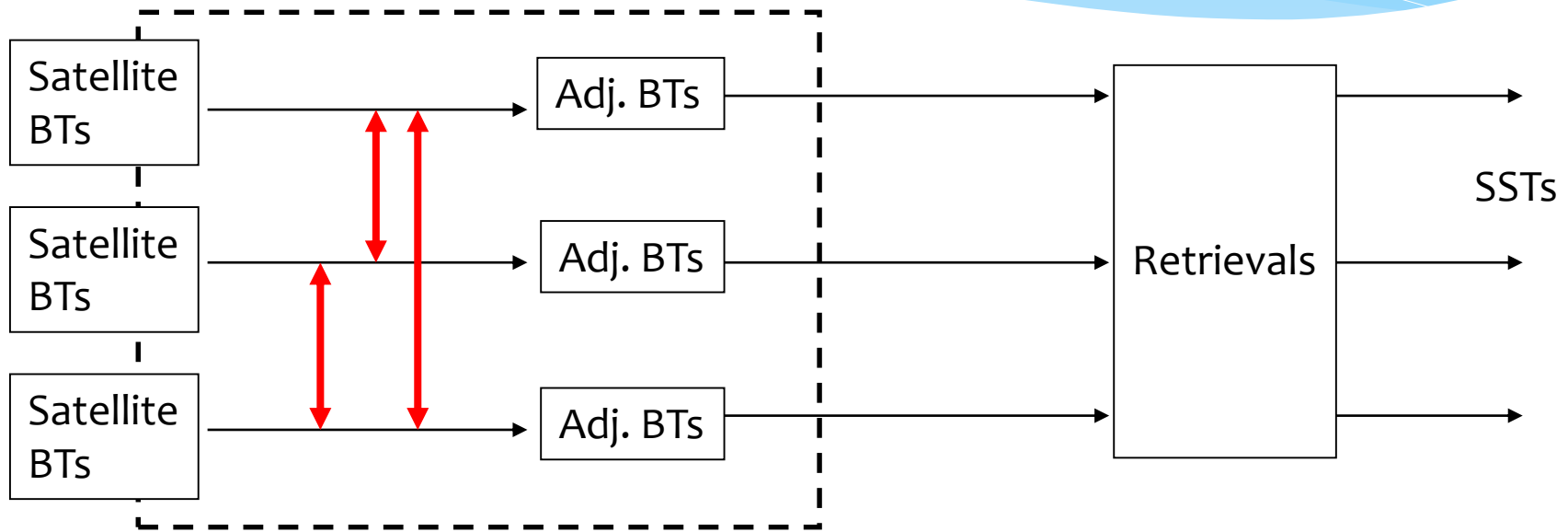
Exploiting system of sensors: reference sensor & SST adjustment



Exploiting system of sensors: reference sensor & BT adjustment



Exploiting system of sensors: mutual BT adjustment



Need multi-sensor matches over multiple overlapping sensors (MMS technology) AND knowledge of the main factors related to BT biases for each sensor & channel (embody sensor-specific expertise)

Other challenges for RT-based retrievals

Other challenges for RT-based retrievals



Other challenges for RT-based retrievals

- * Stratospheric aerosol periods (Pinatubo and El Chichon)
 - * Dual-view or multi-channel with orthogonality constraint on retrieval?
 - * Exploit aerosol information from HIRS?
 - * Include stratospheric aerosol in retrieved vector?
- * But what about the next one?

Other challenges for RT-based retrievals

- * Tropospheric aerosol, mainly desert dust
 - * Again, should this be in retrieved vector?
- * Associated uncertainty estimation
 - * Decomposed by degree of error correlation
- * Bringing MW SST into consistency with IR
- * Achieving and then demonstrating high stability

Conclusions

- * Recent progress in optimal estimation, taking advantage of the longer spatial scales of the atmosphere
- * Expect smooth-atmosphere OE to be widely applicable in IR SST – preserves precision (Cornillon sense), low noise
- * Better SSTs, but OE and similar techniques require BT bias correction (observations relative to RT)
- * Bias correction sometimes requires deep insight into the behaviour of the sensor
- * Without a reference sensor, we need mutual bias correction across multiple sensors – how exactly?
- * Are we ready for the next big volcano?