Release of SOCAT Version 4 - First annual release using automated data upload

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Abstract - The Surface Ocean CO_2 Atlas (SOCAT, **www.socat.info**) is a synthesis activity by the international marine carbon research community (>100 contributors). SOCAT version 4 has 18.5 million quality-controlled, surface ocean fCO_2 (fugacity of carbon dioxide) observations with an accuracy of better than 5 µatm from 1957 to 2015 for the global oceans and coastal seas. Automation of data upload and initial data checks speeds up data submission and allows annual releases of SOCAT from version 4 onwards. SOCAT enables quantification of the ocean carbon sink and ocean acidification and evaluation of ocean biogeochemical models. SOCAT represents a milestone in research coordination, data access, biogeochemical and climate research and in informing policy.
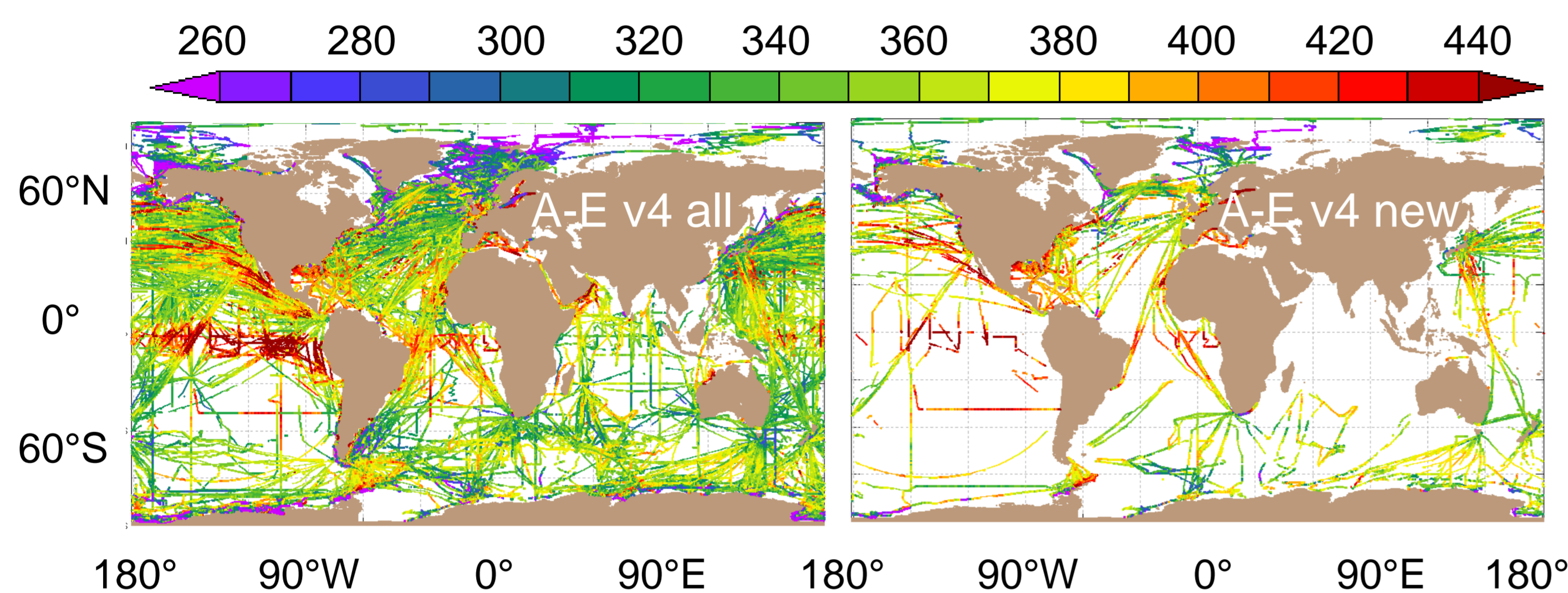
Fig. 1. a) All and b) newly added quality controlled, surface water fCO_2 observations (µatm) in version 4.
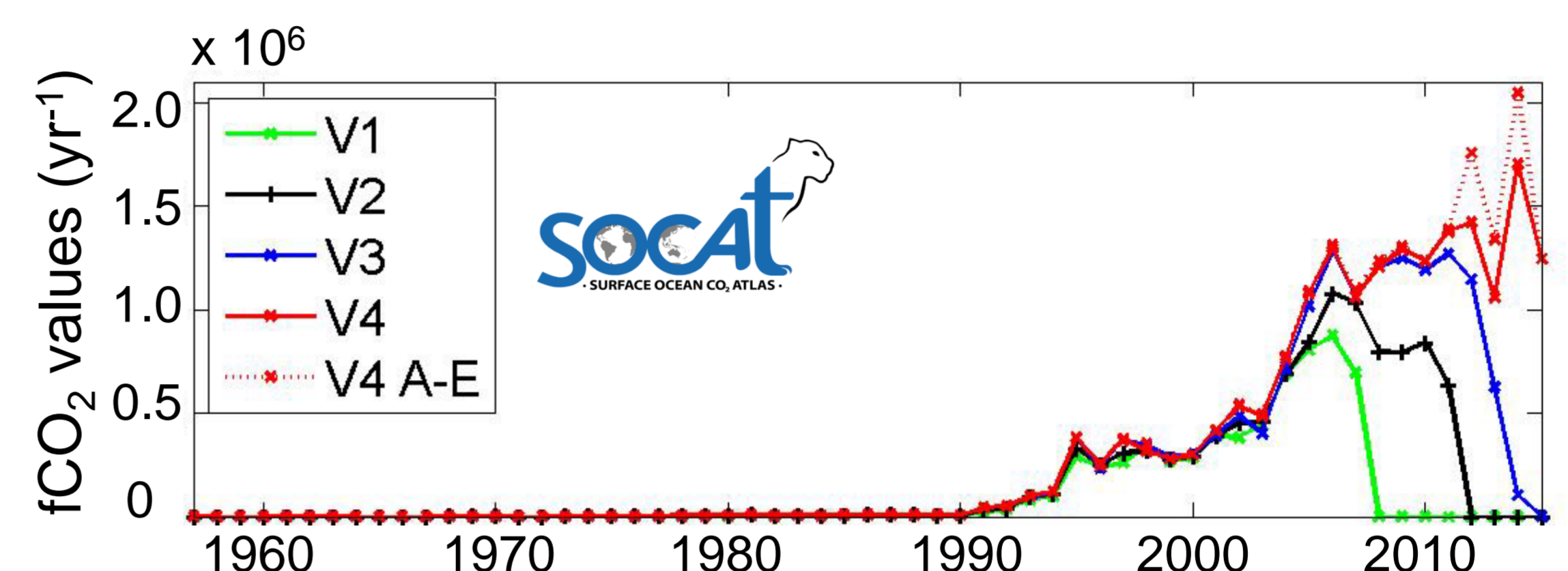

Fig. 2. Number of surface water fCO_2 values per year with flags of A–D in versions 1 to 4 and with flags of A-E in version 4.
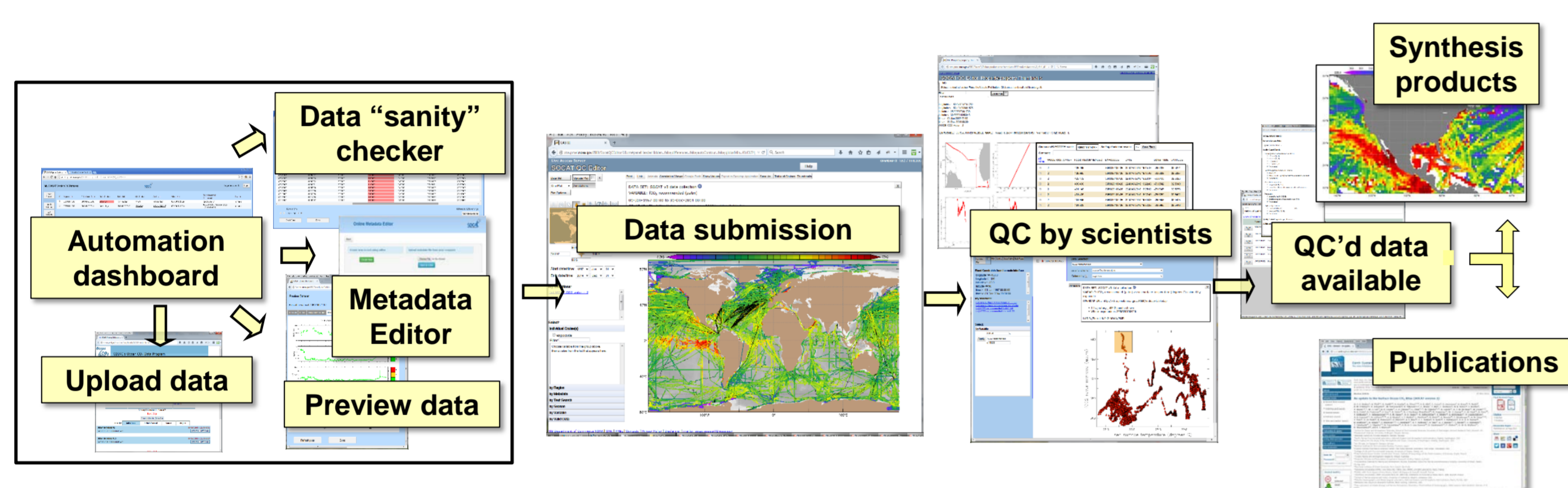

Fig. 3. Data flow upon SOCAT automation from data upload, via submission to quality control and release of synthesis products.

Table 1. Data set quality control flags in versions 3 and 4. All criteria need to be met for assigning a flag of A to E. A flag of E is mainly for alternative sensor data with adequate calibration. Other data set flags are S (suspend) and X (exclude).

	A	B	C	D	E
Accuracy of fCO_2 values (µatm)	<2	<2	<5	<5	<10
High-quality cross-over	yes	no	(no)	(no)	no
Followed approved methods / Standard Operation Procedures	yes	yes	yes/no	yes/no	no
Metadata complete	yes	yes	yes	no	yes
Data quality control acceptable	yes	yes	yes	yes	yes

Key features:
- Synthesis and gridded, quality controlled, observational products of surface ocean fCO_2 for the global oceans and coastal seas,
  V4 (2016): 18.5 million fCO_2, 1957 - 2015,
  V3 (2015): 14.5 million fCO_2, 1957 - 2014,
  V2 (2013): 10.1 million fCO_2, 1968 - 2011,
  V1 (2011): 6.3 million fCO_2, 1968 - 2007,
  with an accuracy for fCO_2 < 5 µatm (flags of A-D, WOCE 2),
- Calibrated sensor data also available (<10 µatm, flag of E),
- During quality control (QC), scientists assign a flag to each data set (see Table 1) and WOCE flags of 2 (good), 3 (questionable) and 4 (bad) to fCO_2 values.
- QC criteria in version 4 are similar to version 3.
- Sea surface temperature and salinity not QC-ed.
- Atmospheric CO_2 measurements accepted (no QC yet);
- Additional surface water parameters accepted (no QC),
- No sustained funding for SOCAT,
- **V5 submission ends 15/01/2017, QC ends 31/03/2017**.

Automation (NEW) and data access:
- Automation of data upload, initial data checks speeds up data submission and enables annual, public releases of SOCAT.
- Online viewers and downloadable.
- SOCAT data is discoverable, accessible and citable.
- Future: Automation of metadata upload.

Scientific findings and impact of SOCAT:
- Large year-to-year variation in the global ocean carbon sink[b,e,f],
- Models underestimate global ocean carbon sink variability[f],
  >140 peer-reviewed scientific publications and high-impact reports cite or name SOCAT,
- SOCAT informs >10 mapping products[b,e,f], the Surface Ocean pCO$_2$ Mapping Intercomparison (SOCOM)[f] and the Global Carbon Budget[d],
- SOCAT informs on ocean acidification[c],
- SOCAT enables quantification of the land carbon sink[d,e,f],
- SOCAT is used for model evaluation[d], including CMIP[a].